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Predicting Attrition Among Human Anatomy and Physiology I Students in Community Colleges

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PREDICTING ATTRITION AMONG HUMAN ANATOMY AND PHYSIOLOGY I STUDENTS IN COMMUNITY COLLEGES

by

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ABSTRACT

Anatomy and Physiology (A&P) courses are offered at almost every postsecondary educational institution in the United States enrolling over 450,000 students each year across the United States with an overall attrition rate between 30-40%. Approximately 150,000 of these students will not be successful the first time they attempt A&P. This constitutes one of the highest attrition rates of all undergraduate degree courses with this size of yearly enrollment.

A&P courses often serve as gateway course required for the continuation and completion of several biological degree fields. Many health-related professional programs such as nursing, paramedicine, and other allied health vocations require students to complete human A&P before being allowed to either apply or graduate from their curriculum of study. Therefore, the success or failure of A&P coursework within our postsecondary educational system is essential to institutional achievements and the national public health communities.

Community colleges in the United States enroll over 6 million students per year and train approximately 60% of healthcare workers nationwide. Increased emphasis is being placed on these two-year institutions to improve student outcomes and increased graduation and workforce credentialling rates. Significant research has been conducted to discover the best methods to achieve the desired student results, but one set of courses that has been deficient in studies is A&P.

This research expands the body of knowledge by combing an argument-based validity theory and phenomenological interpretive lens into an analysis of academic variables that could improve the advisement process for A&P students at the community college level. The sample for this study was taken from one community college within MS which demonstrates a comparable demographic distribution in age, race, and gender as national community college census. Jones College in Ellisville, MS provided such a data set and therefore was used for the research.

A sequence of statistical analysis was conducted on the proposed independent variables to determine any significant relationships between the predictor variables and A&P course outcomes. These variables were placed into a regression formula to identify the most sensitive and specific prediction model which could be used by academic counsellors in the advisement of students seeking enrollment in A&P I courses.

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Finally, thank you to all my friends, colleagues, and family who have supported me through the process. Some people live their entire life never experiencing the kindness and love that I have felt and received from all of you, and I thank my Lord for each of you each day. May God bless each of you and your family.

DEDICATION

I have learned over the years that the journeys and paths we take are not what our existence is truly about, but instead, it is about the people that impact the people we can influence and us. God has blessed me to have had many people be part of my voyage of life. One of the things I love to collect is lighthouses because that is what each of us is supposed to be. We are to be a lighthouse that guides others on their journey, who may not know or see the dangers ahead or need to be reminded that the shore is closer than they think right when they're willing to give up. So I have had people like that, and I would like to dedicate my Ph.D. to three people.

First, my wife Jessica has been one of the most supportive women I could have ever asked. She stood beside me when I was absent due to graduate class at night. She had sacrificed for me when I needed to spend our money to pay for graduate classes. She tolerated me when I was grumpy or tired from staying late to work on projects. Most importantly, she never let me quit, no matter how often I thought about stopping. She has been amazing; this degree is as much hers as mine.

Secondly, to my two boys, Brannan and Christopher, I have always wanted to set an example to them of what it means to be a man, a husband, a father, and a Christian. I wanted them to value education and believe they could achieve anything they set their minds on. So I wanted them to be proud of their father and one day to demonstrate the same example to their kids. So, boys, thank you for loving me through this process. This is your degree also.

Lastly, to my late Aunt Winnie D. Sessums, you and John-John raised me as much as anyone else ever did. Both of you poured love into me and supported me through school. Without you, my family would have never been able to afford the education that propelled me into college and into the man I am. All you ever wanted was to see me be the first Sessums with a Ph.D. I'm sorry it took so long, and you're not here to see me walk across the stage. I know you would be proud of me, and I want this Ph.D. to honor you and your love for me. Thank you, Wee-Wee, for all you did. I love and miss you greatly.

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LIST OF ABBREVIATIONS

ACT	American College Test
A&P	Anatomy and Physiology
BIO	Biology
CTE	Career and Technical Education
DE	Dual Enrollment
FTE	Full-Time Equivalent Student
JC	Jones College
MCCB	Mississippi Community College Board
NCES	National Center for Education Statistics
PBF	Performance Based Funding
SAT	Scholastic Aptitude Test
USM	The University of Southern Mississippi

CHAPTER I-INTRODUCTION

Overview

Over the last two decades, there has been an increased interest in students' learning and success in higher education. Much of this research echoes already commonly accepted beliefs about the complexity of human learning and the inadequacies of analytical models to conceptualize the educational process. Significant public and political attention have been focused on post-secondary institutions' attrition and student completion rates. McCoy and Mejia (2012) describe the current higher educational system as being at a "tipping point" or "crossroads." They suggest that due to population growth, technological advancement, and a shift towards a more automated society, the current requirements for higher education have outpaced the educational machinery that powers these changes. The academic trends suggest that new and innovative partnerships and cooperation across the entire spectrum of educational stakeholders will be required to meet the future national needs.

The healthcare worker crisis during the COVID pandemic signified just one area of concern involving students' success in their academic and career training at the college and university level. Our country needs educated doctors, nurses, paramedics, and other patient care providers to combat the growing size of the nation's sick and diseased demographic. Workforce studies predict that by the year 2034 the nation could face a shortage of up to 124,000 physicians, including 48,000 primary care physicians (Association of American Medical Colleges, 2021). These students cannot enter the workforce until they are successful in the post-secondary educational arena. Educational stakeholders must take a new look at the high attrition courses that prevent student's degree plan completion. In the area of healthcare and other biological sciences, one such

course limiting student success is Anatomy and Physiology (A&P). Prior research has suggested that students' performance in their A&P courses is a robust predictor of failure or success in their current health-related courses (Vedartham, 2018). Using data from over 2,600 students, this study investigated ways we might predict students' success in A&P to help shape college advisement and help alleviate the high attrition rates in this gateway course.

Philanthropists and world investors such as Bill Gates recognize the critical state of higher education. In an interview with *The Chronicle of Higher Education,* Gates voiced concerns involving the yearly graduation and retention reports coming from most universities around the nation. Wasted financial resources for students who are not successful, historical shortages in our national workforce, and the devastating impact on students' self-confidence and persistence have become the center of educational and political concern. Gates explains his foundation's sizable donations to higher education by saying: "*…And so that failing student is a disaster to everyone. And yet there has been surprisingly little put into finding out who does well."* (Young, 2012, "Conversations with Bill Gates," [response to question 6]).

With the growing financial pressure and ever-increasing global competition for a highly educated and innovative workforce, administrators and educators across the globe are looking for ways to ensure that students can complete the educational pathways they begin as quickly and efficiently as possible. A large majority of academic researchers and educational reformers across the nation believe that these "crossroads" lead to the doorsteps of the local community and junior colleges (McCoy & Mejia, 2012). The community and junior college systems across the country provide a potential avenue for

students of all backgrounds, demographics, and abilities to achieve academic success due to their admissions policies, locations, costs, and resources.

Community College Impact

Community colleges and other two-year educational institutions perform a vital role in stabilizing the national labor force and economy. A report commissioned by the American Association of Community Colleges (2022) states that during 2019-2020, over $110 billion dollar were invested into the American community college system. From that investment, students will contribute an estimated $1.3 trillion into the national economy during their working lives. Additionally, this educational venture will create $35 billion in social savings involving crime reduction, lower social services such as welfare, decreased unemployment, and an improvement in overall national health and well-being. Current projections report that for every dollar invested into the community college system generates an average of $11.60 back into the U.S. economy, not accounting for inflation (American Association of Community Colleges, 2022).

According to federal data, over 7 million students attended two-year educational institutions during the 2020-2021 academic year. Registration numbers have seen a steady decrease in enrollment over the last seven years across all levels of postsecondary education. The downward trend in enrollment was amplified during the COVID pandemic but did not statistically alter the overall downward trend in college numbers (Community College Research Center, 2022). Reports estimate that only 62% of students at the community college level are classified as full-time status. Of the other 38% of students who are classified as part-time status, 72% these individuals are employed by outside entities while attending school (American Association of Community Colleges, 2022).

With the rise in financial pressure and obligations, these institutions face increasing scrutiny concerning retention and graduation rates (Blumenstyk, Sander, Schmidt, & Wasley, 2008). Community colleges receive approximately 18% of their revenue from federal sources, 33% from state, 20% from local sources, and only an average of 17% from student tuition and fees (US Department of Education, 2022). Over 83% of community college students receive some form of federal or state financial aid in the forms of grants, loans, or scholarships (National Center for Edcuational Statistics, 2021). Over 55% of students in the community college system are in job-field studies (Weissman, 2021). The growth in workforce demands combined with increasing financial restraints places an elevated burden on community college leaders to demonstrate an efficient and successful educational system. As an example of this heightened attention, President Obama, in the American Graduation Initiative (2009), intensified the expectations when he exalted community colleges: *"So community colleges are an undervalued asset in our country. Not only is that not right, but it's also not smart (paragraph 30)."* His comments brought attention to the importance of community colleges being valued and supported across the country, but with that increased support, comes increased expectations. The president's initiative sought to assist an estimated 5 million Americans in obtaining a degree or workforce certification (paragraph 25). However, even with the increased federal and public attention, community colleges still need help with student persistence and readiness.

Community colleges in the country typically use an open admissions policy, denoting that anyone with a GED or high school diploma can attend. According to Cohen and Kelly (2018), even though community colleges, under an open-door policy, usually

accept students despite their backgrounds, there are often cases of more strict acceptance guidelines or academic conditions required for specific courses or professional programs. The study focused on A&P courses is an example of such criteria. Most health-related professional fields, such as nursing, radiology, emergency medical services (EMS), and both DO and MD medical programs require A&P completion. Therefore, high attrition rates in A&P may directly impact these medical programs and the resulting workforce. Nevertheless, the retention and attrition rates reported from community colleges across the nation continue to present disturbing trends. Data from the Community College Research Center reveals that approximately 40% of students nationwide in the fall 2020 academic semester were not enrolled in any institution one year later. Full-time students suffered an attrition rate of 31%, and part-time students almost 51% (Community College Research Center, 2022). Additionally, only approximately 43% of students enrolled in all secondary-education institutions earned a degree or certificate credential over six years between 2014-2020.

Another role community colleges serve is to offer remedial coursework for incoming students. Each community college varies in its student placement policies. Most use some form of standardized testing such as an ACCUPLACER, ACT, or SAT. Other institutions might use an incoming student's grade point average (GPA) or other prior academic grading to determine which students may require remedial coursework (Community College Research Center, 2022). Sample research done at multiple nationwide two-year and four-year institutions revealed that over 50% of students initially enrolled were placed in developmental or remedial coursework regardless of the type of postsecondary institution. (Pruett & Absher, 2015).

Federal data reveal that an estimated 68% of students enrolled in two-year colleges completed remedial coursework, with approximately 59% taking a remedial math course and 28% taking a developmental English course (Roberts, Craft, & Gatliff, 2022). However, more research is needed on the number of students enrolled in fundamental Biology courses or the potential impact these classes may have on more complex biology courses such as Anatomy and Physiology (A&P). A&P courses consistently have higher attrition rates compared to core academic courses for healthcare students, such as human growth and development, psychology, and nutrition. According to Fontaine (2014) and Brown et al. (2018), this high rate negatively affects students' pursuit of allied-health career paths. Fontaine (2014) confirmed that students often perceive A&P coursework as considerably more difficult compared to other required courses of most community colleges, making it challenging to succeed in their health-related programs. Since A&P courses are often required for these medicine related programs, a low performance and or success rate in A&P courses decreases the number of health-related graduates. Some of the previous research suggests that these discouraging results may be primarily the result of inadequately advised students during placement and after taking the courses (Brown et al., 2018).

This study explores A&P course persistence at the community college level by examining the quantitative factors associated with A&P attrition rates. Several studies have attempted to create correlations between students' academic success and individualized independent variables such as age, gender, learning styles, and prior experiences (Alyahyan, & Düştegör, 2020; Burke, 2019; Fike, 2008). Nevertheless, more research is needed to explore the inter-relationship of these multiple variables that post-

secondary students may have experienced. A combination of these variables may one possible way to help alleviate high attrition rates many colleges courses experience (Zeegers, 2004).

Dynamics of the Problem

As denoted by employment projection from the Bureau of Labor Statistics (2022), the demand for skilled allied healthcare workers in the country is projected to surge almost 13% by 2030 due to the high demand for healthcare services. However, as demand for quality healthcare professionals increases, there are constant shortages across the health industry. Healthcare workforce planning is a complex challenge for the whole society and is not just isolated to the United States (Dzakali, Relic, & Michelutti, 2022). The proposed causes of the healthcare worker crisis cover a wide range of topics including lack of education support, worker burnout, and an overall aging population with greater needs. The American Association of Medical Colleges (AAMC) (2019) echoes these concerns by predicting more than 122,000 physician shortages in the country by 2032. This report hypothesizes that the deficit is due in part to the increased populations of people susceptible to various diseases (AAMC, 2019). For example, the AAMC (2019) reports that the population of those over 65, an age at which a need for healthcare increases exponentially, is likely to grow by 48% in the upcoming decade. Unfortunately, copious numbers of working physicians will be attaining the age of retirement together with baby boomers, making the shortage and the need for more healthcare professionals a pressing issue in the country.

These influences are anticipated to lead to more than 2 million new employment opportunities over the upcoming decades within the healthcare sector (Bureau of Labor Statistics, 2022). According to Drennan and Ross (2019), by 2025, it is projected that

there will be a deficit of over 400,000 home health aides and about 30,000 nurse practitioners in the country. Likewise, according to Vedartham (2018), this shortage is likely to be reflected across all healthcare-related fields if solutions for the wide array of workforce shortages are not discovered.

As suggested above, apart from the creation of additional jobs from this growth, employment opportunities in this sector arise from the necessity of replacing employees who permanently leave their occupations upon retiring. Gultice et al. (2015) asserted that more than 1.9 million jobs opening in the healthcare sector alone will occur annually from replacement and growth needs. Similarly, Pilleron, et al. (2019), established that the demand is also because of the general public's susceptibility to different diseases, as seen from the outbreak of the coronavirus. These findings affirm the need for more well-prepared healthcare workers to fill the gap, given the increasing shortage within the industry.

Hull et al. (2016) established that in preparing future qualified healthcare workers, emphasis on health-related education is paramount. Prior research has suggested that students' performance in their A&P courses is a robust predictor of failure or success in their current health-related courses (Vedartham, 2018). (This is a really important sentence and idea I think should try and weave into page 1) Accordingly, Vedartham (2018) found that courses in A&P are vital in healthcare because they help students develop active learning, problem-solving, and inquiry techniques needed to perform well in health-related programs. Reinke (2019) indicated that A&P course success is associated directly with degree completion and graduation in health-related fields.

Therefore, A&P course success determines degree completion and graduation because it forms the basis for most college healthcare courses.

A&P courses offer the groundwork for further education in nursing and allied health programs, and these courses substantially influence the student's admission into such programs (Cline et al., 2022). The content of A&P coursework constitutes the most significant educational content integrated into the curriculum of most health-related programs in the US (Cline et al., 2022). A&P courses help lead to effective clinical care and contribute positively to multidisciplinary team efforts for successful healthcare workers (Hull et al., 2016). For example, in most community colleges, A&P programs use evidence-based teaching to foster educational growth, and this same type of transformational thinking helps develop strong and versatile healthcare workers (Human Anatomy and Physiology Society, 2020).

Problem Statement

Limited research exists involving which specific variables, or combinations of variables, provide a better prediction model for students' academic success in initial enrollment for A&P I courses at the community college level. While community college enrollment continues to decline, growing political and public focus places heightened pressure on concerns over the retention and success rates of these institutions, and the healthcare and biological science workforce shortages threaten our nation’s public health and technological advancement. Nevertheless, the success and persistence rates of students taking A&P continue to be low regardless of the best efforts of teachers, students, and relevant student services for improvement. Despite these concerning performance results, community colleges are still responsible for training approximately 60% of all healthcare professionals in the country (Vedartham, 2018). However, the

students become the unfortunate victims of reaching a college classroom and realizing they are unprepared for the journey. Might a better advisement and placement model be able to predict and support students' academic success in A&P 1 courses? Few studies have deeply studied the quantitative factors and their interactions, such as GPA, ACT scores, and prior college courses, which form the basis for A&P student persistence versus attrition. This study investigated the roles, and potential interactions, of such variables looking for a possible answer for this question.

The Rationale for the Study

Students primarily enroll in A&P courses with the intention of moving into either a biological science degree path or a healthcare program in the future. The main reason is that A&P courses exist as corequisite or prerequisite coursework for most healthcare and biology degrees, although these requirements vary based on colleges and programs (Drennan & Ross, 2019). Drennan and Ross (2019) found that the outcomes of students' A&P courses significantly impact college attrition rates and secondary program success, making their effectiveness essential in healthcare education and biological degree plans. The outcome of A&P coursework has been demonstrated as a contributing factor towards student success in secondary health programs such as nursing. Some researchers have claimed many core concepts in A&P help students to make evidence-based decisions through practical laboratory lessons, which is a continuing model in most health care education, and hence supports success in nursing school (Schmidt & MacWilliams, 2011).

However, given the importance of A&P in healthcare and associated science pathways, high attrition rates indicate that most colleges, particularly community colleges, need help retaining learners through to the finish of their programs. For these

reasons, the lack of student persistence, mainly those in community college A&P courses, is a significant concern to campus administrators, nurse educators, biology instructors, and other related stakeholders (Pilleron et al., 2019). Due to the importance of A&P courses in science education and the need to prepare professionals in healthcare, there is always a need to examine different strategies which hinder higher retention and success rates by developing a robust and reliable predictor model (Hull et al., 2016). From these findings, this study intended to find a suitable solution for the greater attrition rate in community colleges among students in A&P courses. This study investigates the relationship between students' academic performance in their initial enrollment in an A&P course and a variety of prior academic measures, including GPA, composite ACT score, ACT science subscore, number of prior completed college credits, and completion of introductory biology coursework.

Significance of the Study

The findings of this study could offer valuable help for school administrators, academic advisors, healthcare professionals, and strategists in multiple career paths. School administrators can use the results of this research to examine students' progress in A&P courses. In addition, the findings and potential tools could provide insights into the factors influencing success and attrition rates among A&P students. Likewise, the study is essential to policymakers in education because they can utilize the results to develop and implement effective policies to reduce the high attrition rate in A&P courses in community colleges.

These findings can be imperative for improving the number of future healthcare workers by ensuring students' success in A&P courses. The success of learners in A & P courses, in turn, will decrease the number of various unfilled positions in health-related

fields in the country. Furthermore, the developed strategies will have the potential to be applied nationwide in solving the problem of increasing student success in A&P (Drennan & Ross, 2019). Because this research will evaluate the use of academic factors such as ACT scores and GPA, the results may also be used to guide high school counsellors in their students' college preparation. Lastly, researchers in related fields such as education and healthcare can also use the findings to expand their knowledge on the issue. Therefore, to find more solutions, they can conduct improved future studies based on the attrition results among A&P students within community colleges.

Justification: Need for a Strong Advisement Model

Different studies revealed that student advisors often encourage students interested in A&P courses to complete one or more prerequisite courses (Drennan & Ross, 2019; Clarke et al., 2014). These studies have demonstrated a positive correlation between the successful completion of prerequisite science-related classes such as general biology or principles of biology and success in A&P courses. However, despite the efforts of student advisors, there still remains a high attrition rate in A&P courses. This continuing struggle with predicting student outcomes in A&P provides the rational for a more robust advisement model to be developed.

A growing amount of recent research questions the effectiveness of these tests and scoring systems used by student advisement to place students in different college courses such as A&P. Brecht and Burnett (2019), in their study, contrasted and compared the more familiar national tests administered to high school students concerning their alleged efficacy. The findings showed that the SAT, as initially administered in 1926, was mainly developed to test inborn or aptitude ability. In addition to these SAT findings, Cline et al.

(2022) states that ACT was used in testing prior learning or achievement and may no longer adequately demonstrate postsecondary preparedness.

Therefore, based on these findings, given the high attrition rate, current student advisement and placement are ineffective, especially in community colleges. The hypothesized reason for this ongoing attrition problem is that most current advisement models use isolated placement guidelines that only require a single clearance component for enrollment. Therefore, unless the advisement process accurately depicts the students' full capability in courses such as A&P, they will continue to lead to wrong placements and a high attrition rate. For these reasons, there is a need for strong advisement models for college students needing A&P courses that combine different academic factors and are also capable of identifying at-risk students. In this respect, this study attempted to develop a robust, strong advisement model for college students which considers multiple prior academic achievements instead of relying upon an isolated entry requirement for A&P.

Definition of Terms

The definitions of pertinent terms used in this research are included in this section. However, only terms that are viewed as not to be readily known by the target audience are presented. Apart from that, terms that can be used differently in various contexts are also defined based on how they are utilized in this study. Therefore, all key definitions mainly draw from the current study context for these reasons.

1. Attrition – in education, attrition is the number of students who leave a given program for any known reason without completion.

2. Attrition Rate – This rate measures the number of learners who leave a program before the expected completion date, expressed as a percentage of the total number of students initially in the program.
3. The predictor model – a mathematical framework that can predict future events or outcomes.
4. Contributory factor – a component impacting the students' failures, especially those taking anatomy and physiology as used in this study.
5. Retention – the number of students who completed a given course based on the passing grade.
6. Student success – in this study, student success denoted the passing of a student in a given course ascertained by the education outcomes as assessed by the appropriate methods. In this case, success in A&P courses was considered a grade of C and above as a final course grade.
7. Community college – a community college in this study referred to any educational institution accredited to award the Associate in Science degree, or a comparable degree, as one of its highest degrees.
8. Allied health – this term is used to entail all medical support professionals, and for convenience, it also encompassed the nursing profession in this study.
9. Active learning – an instructional approach involving active engagement of learners with course materials through problem-solving, discussion, and role plays. Active learning puts more learning responsibilities on the students than passive strategies such as lectures.

10. Socioeconomic factors – as used in this study, these are factors that are either connected with or related to the interaction of economic and social factors impacting the education of a student.
11. Stopping-out – This is used to denote a situation in which a student halts class attendance but fails to officially withdraw from the course.
12. Accuracy – as used in this study, is the potential of any predictor model to accurately predict students' outcomes in each field.

Dynamics of the Study

Aims and Objectives

This research will examine the variables contributing to high attrition among A&P students in community colleges. This aim will be fulfilled using the following objectives:

1. To determine if, within the practical limitations of available information, a model exists that increases the researcher's ability to accurately predict student success in A&P I courses, as defined by a final grade of "C" or better using any sole academic variable or combination of variables.
2. To design a regression model utilizing independent variables which can increase the success rate of predictions for students enrolling in an A&P I course.
3. To critically interpret the advisement process utilized with college students enrolling in A&P I courses.

Research Questions

This research seeks to answer the below research questions:

1. Does the cumulative amount of college credit hours successfully completed, as defined by a grade of "C" or higher, predict a student's success in an A&P I course?
2. Does a student's GPA prior to A&P I enrollment predict a student's success in an A&P I course?
3. How effective is the composite ACT score in predicting a student's success in an A&P I course?
4. How effective is the ACT science subscore in predicting a student's success in an A&P I course?
5. How does the successful completion of General Biology courses predict a student's success in an A&P I course?
6. How effective is cross-variable or self-multiplicative combinations of the studied independent variables in predicting a student's success in an A&P I course?

Hypotheses

The current study examines the following hypotheses:

Null hypothesis 1: The cumulative college credit hours successfully completed prior to A&P I enrollment do not predict a student's success in an A&P I course.

Null hypothesis 2: A student's GPA prior to enrollment in an A&P I course does not predict a student's success in an A&P I course.

Null hypothesis 3: A student's composite ACT score does not predict a student's success in an A&P I course.

Null hypothesis 4: A student's science subscore on the ACT does not predict a student's success in an A&P I course.

Null hypothesis 5: A student's successful completion of a General Biology course before A&P I enrollment does not predict a student's success in an A&P I course.

Null hypothesis 6: Cross-variable or self-multiplicative combinations of the studied independent variables do not predict a student's success in an A&P I course.

Method Summary

Sample Description

The sample population for this analysis came from Jones College in Ellisville, MS. Jones college has a mean annual enrollment of over 4,500 students with a gender representation of approximately 58% female versus 41% male and a racial profile of 62% white, 33% black, and 5% other during (Mississippi Community College Board, January). Jones College offers approximately five A&P I course each academic semester at differently sectioning and times (Jones College, 2022). The isolated A&P I data for this analysis was generated as the accumulation of all students enrolled in an A&P I course during the academic years of 2015-2021 which totalled 2,858 students.

Analysis Design

This study used a research correlation design to develop a predictor model for the high student attrition among those taking A&P courses in different community colleges across the country. The research design was chosen because it effectively examines the connection between many variables by applying statistical methods. Furthermore, the quantitative research method provides the best format for data acquisition because the researcher is only concerned with the analysis of numerical data. Therefore, it is the best research method for determining the link between different variables. As such, social and

cultural factors are outside the scope of this research as it will concentrate only on the quantitative factors impacting the A&P courses' attrition rate.

Using secondary quantitative data, the researcher evaluated the extent of the relationship by identifying patterns and trends in the relevant dataset. In addition, a postpositivist paradigm was deployed to help answer this study's research questions. Postpositivism involves research designs that attempt to create and discover dynamic solutions to research problems while recognizing the possible biases created by the researcher (Phillips & Burbules, 2000). This philosophy was used because it allowed the researcher to freely use the methods best suited for the topic selected. As a result, because of the freedom provided by this philosophy, it is often suitable in quantitative research, as adopted in this study. Moreover, the postpositivist philosophy in this research focused mainly on the outcomes or consequences of the study. In the process, the researcher accepted that copious interpretations and realities exist within the study outcomes, and that the background and values of the researcher could influence the interpretation of the results (Racher & Robinson, 2003).

A deductive approach was also used to complement the chosen philosophy to increase its credibility and validity. When using a deductive research approach, the researcher attempts to make inferences concerning the data by moving from the general premises of the study to specific conclusions. In this approach, the researcher tests the study's hypothesis by gathering data and examining observations that assist in confirming or rejecting the hypothesis. A deductive approach was used to examine the main factors contributing to the high withdrawal rate among learners pursuing A&P, with a focus on

community colleges. The approach was used because it effectively explores a general theory to examine whether it is valid based on the research area's chosen condition.

This study used 2,858 students who were enrolled in A&P I courses at Jones College from 2014-2021. Student records were obtained through the admissions office at Jones College under The University of Southern Mississippi and Jones College's IRB protocol. As such, any personally identifiable information was removed from the collected data to protect the privacy and confidentiality of the students. The data requested included students' A&P I course outcomes, college-credit hours completed, ACT composite scores and science subscores, and other variables deemed relevant for the study as previously listed. The selection of Jones College as the study site was grounded on three main criteria, which considered if the school is representative of the community college population in the state of Mississippi. The criteria used were size, location, and the college's commitment to students' equality. It is also worth noting that the characteristics of demographics in the school were present across the spectrum of different programs available at community colleges, and most of the programs at Jones College require A&P courses. Apart from that, the college was best suited as the location of the study because its size falls in the upper middle range of the state's 15 community colleges. It is also of importance to note that the researcher is currently an A&P instructor and the EMS program director at Jones College, and therefore has a vested interest in the results and possible implications of this research study. Thus, all these factors justified the choice of the college for collecting relevant student data.

Data were analyzed using SPSS version 28 as it can analyze many variables simultaneously, making it the best choice. SPSS also offers a detailed output for every analysis that can be useful for interpreting and understanding results from each technique's underlying assumption. The independent variable assigned was course type (traditional or online), past college hours, GPA and ACT scores, and the prerequisite entry criteria. An ANOVA was also conducted with SPSS on the multiple independent variables and their varied combinations. Multiple regression analyses were then used to address every question, in which descriptive and inferential statistics, such as mean, median, standard deviation (SD), frequency, and median, were used. Lastly, all ethical considerations were accounted for in the collection and analysis of data to prevent ethical issues that would have interfered with the study's credibility.

Assumptions of the Study

The following assumptions constitute the study's supporting structure.

1. A valid interpretational basis exists to give meaning to the test scores to enhance the general research's validity.
2. A valid statistical basis exists to ensure an accurate interpretation of the findings.
3. The obtained information in this study will only be utilized for other purposes that are believed to be within the study's scope if the university ethics committee approves. The main reason is to avoid ethical concerns that might impact the study's validity.
4. Data security will be maintained the whole time in an encrypted data storage device to maintain the confidentiality of the collected data from the study participants.

5. Data and the results will be returned to all participating institutions, and a data purge will occur after data analysis is complete for security.
6. A&P course success will be considered a final letter grade of "C" or higher.

Delimitations of the Study

The findings of this research are subject to multiple delimitations, as discussed below. All delimitations in this study are considered mainly in numerical progression.

1.) The research sample for this study was restricted to the students enrolled in A&P 1 at Jones College in Ellisville, MS, during the academic years of 2014-2021. This expansive time frame attempted to prevent unforeseen skewing of the data due to curriculum or content changes within the A&P course design across the community college of Mississippi. One example of possible skewing in the data involves the use of student enrollment data in the 2020-2021 years during the COVID pandemic. It is possible that the impacts of the pandemic upon student college enrollment could skew the data results. The researcher will analyze any significant changes of data during these sample years. This timeframe also provided an extensive enough sample to account for any outliers within the data.

2.) This study was limited to one single-community college within Mississippi. Despite the selected community having a robust demographic comparison to the overall population of MS, caution was used in generalizing the research conclusions to other institutions. However, the researcher acknowledged that using a convenient sample population makes it possible to create biased general conclusions and aims for local generalizations in discussing the results.

3.) Only four college instructors delivered the instructional material to the sample students. Due to the smaller enrollment size of community colleges, only five individual instructors taught A&P during the data range. The primary researcher was one of those instructors but only served as an adjunct instructor teaching one A&P I course per year during the 2017-2021 academic years. These instructional years only constituted approximately 150 students. To prevent any data or interpretational bias, these students' data were removed prior to the analysis and not used for data reporting.

4.) The A&P I course curriculum, including content chapters, for this study was set up by the Mississippi Community College Board. This content was selected by a curriculum committee comprised of A&P instructors across the state from all post-secondary institutions, Mississippi community College Board curriculum experts, and community and workforce stakeholders. The state curriculum is adopted every five years, utilized by all community colleges, and articulated to universities as approved transfer credit. Despite most of the researched course curriculums conforming to national standards for all A&P courses, it is worth noting that a limited degree of content variation exists as a form of delimitation.

5.) The data to be collected is based on secondary reporting of data by Jones College. For this reason, data accuracy is restricted to the accuracy of the records from the college. In data collection, it will be noted that the student records used in the research may have yet to have available scores that are complete. However, when this happens, students' incomplete data will not be encompassed in this analysis.

Theoretical Framework and Interpretative Lens

To better understand the interactions between A&P course success and the independent variables of this study, two different theoretical frameworks were used as interpretive lenses for the analysis results. First, theoretical frameworks and interpretative lenses are considered valuable to understand research results and allow the researcher to focus on which variables and constructs they are attempting to explain (Bean, 1982). The goal of these perspectives was to help better understand the variables' relationships and create a more effective and precise advisement model for educational institutions.

Argument-Based Validity Theory

First, a conventional, argument-based validity framework was used to interpret the study's results. A significant amount of prior research supports the validity of traditional student advisement based on placement tests or standardized testing scores (Belfield & Crosta, 2012; Ngo & Kwon, 2014). Using an argument-based interpretive lens, the researcher relied on the test score versus analysing the design or merit of the test itself (Kane, 2013). This approach allowed the researcher to analyse how different placement tests and associated scores are utilized. Then the researcher looked for collaborative evidence to support the placement methodology and advisement validity. This study lends itself to this framework in that students' GPA, composite ACT score,

and science sub-score are all utilized as placement criteria for A&P I courses. Since advisement and placement based on these tests are considered to be without personal bias, this study sought to explore the plausibility of these assumptions.

Phenomenological Framework

The second and more challenging framework used for this study was a phenomenological approach. Phenomenology is a common philosophical approach that concentrates on an individual's subjective experiences (Vors et al., 2019). When used as an interpretive lens, it can be imperative to understand the significance and meaning of a quantitative study from the participants' experience. Therefore, phenomenology was used to provide a meaningful rationale as to the difference between the existing advisement models and the reality of the continued course attrition problems. This lens will help to establish why the current traditionally accepted advisement models for students are not successful, specifically in placing students in A&P and higher science courses due to the high attrition rate.

One way to use phenomenological reduction, also called *epoche*, is in interpreting the findings. This approach involved suspending preconceived biases and notions to extract the student's subjective experiences solely through quantitative analysis. Based on this viewpoint, the aim of this interpretive lens is for the data to be viewed in a manner that is objective and unbiased (Flynn & Korcuska, 2018). The quantitative data of prior academic experience prior to enrollment in the A&P course provided a foundation to interpret whether the current advisement models are faulty in design or if the student's affective and social experiences disrupt the predictive expectations. As a result, the

findings should not be impacted by the researcher's perspectives but are used in the interpretation post-analysis in chapter five.

Another way in which the phenomenological viewpoint was applied is to utilize hermeneutic interpretation that encompasses examining the interpretations and meaning of the collected data using the quantitative academic experiences of the students as the phenomena, therefore using this interpretive lens in a purely quantitative fashion. This aspect involved seeking issues such as how the findings relate to the participants' experiences and how these findings can assist in shedding light on the participants' experiences based on the gathered data. Likewise, this lens applied a reflexive perspective in which the researcher will reflect on their biases, preconceived notions, and assumptions. The researcher then considered how these factors influenced the study to establish objective findings.

A phenomenological viewpoint as an interpretive research lens, primarily in a quantitative study, helped offer a more contextualized and nuanced understanding of the collected data and findings. The main reason is that by assessing the participant's subjective experiences and considering the significance and meaning of the data in the context of such experiences, researchers can attain a deeper comprehension of the research questions and the findings' implications (Flynn & Korcuska, 2018). Another benefit of using this lens is that it assists the researcher in identifying patterns in the collected data, which may only be apparent after using other interpretive lenses (Vors et al., 2019). These patterns offered insight into the underlying issues regarding the topic being studied and highlight future research areas.

However, it is worth noting that there are critical challenges in applying a phenomenological viewpoint as an interpretational lens in a quantitative study. One of the challenges is that it can take much work to accurately capture and represent the research participants' subjective experiences, especially in measuring attrition of students in A&P courses using test scores and other quantitative measures. Quantitative studies typically rely on standardized instruments and measures in collecting data that may only partially capture the complexity and richness of the participants' experiences. To overcome this challenge, the researcher must take a broader perspective when evaluating the individual quantitative results of this study. The results of this data-driven study may not clearly present the complexity of the multiple variable interactions or the possible affective and social changes that the students may be exposed to while enrolled in A&P I courses.

For this reason, the researcher was open to and receptive to the subjective participant's experiences when using a phenomenological viewpoint as an interpretational lens. This approach was challenging because the researcher may have preconceived biases and notions which could influence their data interpretation, even in a quantitative study. Thus, in overcoming this challenge, the researcher could utilize reflexivity in examining their assumptions and biases and considered how they may have influenced the research. Researchers infrequently utilize phenomenological frameworks when analysing purely quantitative data, but linked with an argumentative-based interpretive lens, the researcher believed that diverse combinations would best serve the goals and research questions. This study did not statistically address the social and more broad qualitative experiences of students. The study also did not directly examine the individual

participants in A&P courses but viewed the quantitative results through this phenomenological perspective.

Expected Outcomes

The result of this study was anticipated to offer a predictor model for the high attrition rate among students taking A&P in different community colleges across the country. These findings would help fill the research gap on the issue of A&P attrition in community colleges using an efficient predictive model for student acceptance and placement. In doing this, the study's findings are expected to outline the key factors impacting the success rate of students taking A&P in community colleges. These results are also expected to detail the factors influencing the acceptance of community colleges and the placement of learners for various A&P courses using the model. Subsequently, the expected outcomes from this research will help improve the learning and teaching of A&P courses by making them seamless for students and school administrators based on the current variables of student attrition. As a result, the improvements based on this research's findings will help decrease the high attrition rate among students taking A&P courses in community colleges, therefore potentially improving graduation rates, professional degree obtainment, and workforce potential.

Dissertation Outline

This dissertation entails five chapters and attempts to provide post-secondary institutions with data that can better predict a student's outcome in college A&P courses.

Chapter Two consists of a review of the relevant literature associated with the study. This chapter presents a historical overview of the challenges with higher education and specific advisement within the biological degree fields. The role of community colleges within the educational system is highlighted along with the struggles concerning retention and overall post-secondary resource management. Placement policies and remedial coursework of college courses are discussed about the goals of this research project. Special attention is given to A&P courses and college advisement models or placement policies for these courses.

Chapter Three presents the methodology used in data collection and analysis, backed with relevant justification for their selection. This chapter also contains a discussion of the research population along with a justification of the research sample.

Chapter Four describes the results of the statistical analysis of the data. The descriptive data of the sample is provided with a brief discussion and comparison to the larger comparative population. The results from the proposed analytical tests, including correlation, ANOVA, and multiple regression, are presented with a discussion concerning any variations or statistical validity relevant to the interpretations.

Chapter Five contains the researcher's interpretation of the findings. This chapter discusses a more extensive summary of results in reference to the proposed research questions and hypotheses. Any revelations or unexpected results are evaluated along with potential implications for future research. Finally, the chapter concludes with a summary of the findings and recommendations based on the researcher’s analysis.

Summary

Given the academically diverse student population, community college's placement and advisement policies for students enrolling in advanced-level courses such as A&P requires attention and research. There remains a significant amount of data that may provide answers to the specific questions concerning student prediction and success. In addition, a literature gap remains concerning A&P and other higher biological science attrition rates. This study was designed to add to the continual growth of research concerning community colleges' advisement and placement policies. It is the researcher's belief that the results from this study concerning A&P courses could be generalized for similar science courses across all levels of higher education. The study examines the variables of GPA, ACT score, fundamental biology courses, and overall college hours to generate a predictor model that could be implemented in the college setting. Currently, such a model either does not exist or presents as non-feasible for implementation. In that case, the researcher hopes that the data collected and analysed will provide a conversational foundation for the next step in advisement research.

CHAPTER II LITERATURE REVIEW

Introduction

This chapter intends to review the relevant research associated with successful course prediction and completion of community college students in Anatomy and Physiology (A&P) courses. Additionally, this chapter will examine the literature related to current advisement models for A&P courses, including the relationship between independent variables such as GPA, ACT scores, preparatory coursework, and college hours and the dependent variable of student success, defined as a final grade of "C" or higher. Multiple types of literature, including completed dissertations, educational journals, books, state and federal publications, periodicals, local institution publications, and public internet sources, were reviewed for this chapter.

Postsecondary institutions across the United States continue to battle an ever-growing problem of academically underprepared students enrolling across their campuses. This expanding population of struggling individuals has pushed administrators, policymakers, and instructors to critically analyze many long-standing college and university admittance and advisement programs in an effort to provide more beneficial resources and advisement to academically weaker students. In contemporary times, a plethora of research exists on the prediction and advisement practices used with students for a variety of specific college course advisement. These research studies seek to understand, enhance, and support student learning at the earliest stage of their educational journey, preventing failure and withdrawal (Hu et al., 2014; Márquez-Vera et al., 2016). Nevertheless, many of the historical and contemporary analyses conducted on student advisement fail to provide a straightforward solution to rising college attrition rates and student failure. The variables contributing to a student's success or failure in

higher education are complex in their inter-relationship and make a straightforward model of conceptualizing the advisement challenges difficulty (Ilgan, 2013). Due to the complex intertwining of student factors, more focused research on specific academic factors that predict student success is essential to turning the attrition trend in our colleges and universities.

National Education Accountability

With the rising cost of postsecondary education, the increasing demand for a credentialed workforce, and a surge in college withdrawal rates, institution administrators and advisors must consider exploring factors that impact students during the early stages of their education journey. For this reason, significant changes have occurred concerning higher education regulation over the last two decades. Historically, universities and colleges across the United States were highly esteemed and mostly allowed to self-govern in terms of student admittance, advisement, and reportable outcomes. In addition, funding for public institutions was generally free flowing with few limits or disruptions. However, times and responsibilities have changed.

Policy leaders and funding allocators from the local, state, and federal levels of government hold postsecondary institutions to a significantly higher level of transparency and accountability (Whitt, 2005). In 2002 President George Bush signed the No Child Left Behind (NCLB), a federal mandate attempting to increase the educational achievements of all students across the nation. However, with the higher expectations for primary and secondary schools also came many challenges with testing and accountability problems in many state school boards. Several educational researchers describe a shift from innovative classroom teaching towards a more rigorous and

sometimes unachievable testing performance (Betebenner, 2002). The impact of this instructional shift created drastic consequences for postsecondary education.

Despite little research being conducted on the preparation of high school students in the specific areas of A&P or similar higher level biology courses, significant focus has been placed on other academic areas of student proficiency such as mathematics and reading skills. By comparing the trends in other subject areas such as mathematics, reading, and English a similar pattern can be deduced for A&P courses. In 2006 the National Assessment of Educational Progress Report (NAEP) commissioned by the Secretary of Education, Margaret Spelling, reported that over 80% of high school seniors planning on attending college needed to be proficient in fundamental mathematics. Yet, in the same report, 64% of seniors lacked the necessary reading competencies. Similar studies during that time revealed that 41% of community college students and 29% of all postsecondary students were "developmentally deficient" in reading or math skills (Byrd & Macdonald, 2005, page number).

These accountability trends continued, and in 2008 the commissioned report Diploma to Nowhere was issued by Strong American School. This report stated that approximately 43% of community college students and 29% of students enrolled in four-year institutions required remediation coursework in English, reading, math, or a combination of all three subjects (Strong American Schools, 2008). This same report calculated that the average cost of remedial coursework per student ranged from $1,607 to $2,008 each year. With approximately 1.7 million college students taking remedial or preparatory coursework for their assigned degree plans during this period, the national cost of remedial education was estimated at over $3 billion per year (Huffington, College

Preparedness Lacking," para.5). Since 2010 the national high school graduation rate or GED equivalent has increased to approximately 93%. In addition, college enrollment has increased to nearly 41% (de Brey et al., 2019).

These reports provide an optimistic trend to academic researchers who fear the decline in postsecondary education will worsen, yet despite initiatives instituted by Federal, state, and local entities, a decreased in the needed remedial course work for enrolling college students has not declined. In fact, some of the most recent studies estimate that 75% of newly enrolled students are not prepared for direct placement into core degree requirement classes, and therefore need remedial coursework. The more alarming statistics of this report reveal that 50% of students taking remedial courses will not continue enrollment for a second year (Fordaym, "Tipping the College Remediation Scales," par. 2).

National data in 2020 indicates that 32% of postsecondary enrolled students will not complete a degree program (Education Data Initiative, 2023). This attrition data accounts for almost 38 million students who begin a degree or certificate program and withdraw from college. Two-year institutions comprise approximately 39% of the overall non-completers, and four-year universities 18% (National Center for Educational Statistics, 2021). For this study, one of the most significant data points reveals that over 73% of the students who withdraw from higher education nationwide do so within the first twelve months after initial enrollment (Education Data Initiative, 2023). So why do students in the first year of their postsecondary career fail to persist in their educational journey? Is this a preparation challenge; a resource issue; or, as this paper postulates for A&P courses, an advisement dilemma? These disturbing studies emphasize the

continuing need for colleges and universities to evaluate their institutions' acceptance and advisement policies to help students improve their educational achievements at the earliest stages of advisement, primarily when related to specific capstone-based courses such as A&P.

Community College Education

The community college system began at Joliet Junior College in Illinois in 1901 (AACC, Community Colleges Past to Present section, para. 2). As the nation began to overcome mobility challenges, social issues, and financial burdens, more of the public began to pursue higher education. Traditional universities and four-year universities were not able to meet the increase in student population. Many of these conventional educational institutions were considered privileged and were only available to the elite of the growing society. In addition, the location and cost of attending most universities made it impossible for most families. The community college system developed to offer a more localized, financially achievable, and practical solution for the national public.

When World War II ended and the GI Bill became available to many of our returning soldiers, the community college system filled the void created by the war in educating this new generation of the American workforce. A vast majority of the soldiers that were drafted or enlisted into our armed services, had not received any formal postsecondary education. Additionally, most of their tradecraft was focused on military specific job fields. This gap in traditional college education created challenges in the integration of these returning soldiers into the national labor force. Over 450 community and junior college opened their doors during the 1960 thanks in part to the baby boomer generation reaching adulthood (AACC, Community Colleges Past to Present section,

para. 2). Presently, over 1,400 community or other equivalent two-year institutions enroll students across the United States and serve over 12 million students annually (Community College Research Center, 2022).

Most public two-year institutions, such as community, operate under an open-admission policy. Under this policy, students who meet the minimum requirements for college registration, such as age, residency, and financial ability, can enroll in college courses. While many universities and four-year institutions use minimum national test scores and GPA, class rankings, competitive interviews, or other necessary checkpoints to select the most perceived capable candidates for their programs, these academic checkpoints are not required in community colleges, and a competitive entry process does not exist (American Association of Community Colleges, 2022).

Nevertheless, open-access policies at these two-year colleges pose challenges and unique issues that administrators, instructors, and other educational stakeholders must attempt to solve. For example, most four-year institutions have selective admissions policies that grant the ability to limit the enrollment numbers of underprepared students (Fike & Fike, 2008). Community colleges across the nation do not typically utilize such enrollment restrictive measures. For this reason, community colleges tend to enroll more underprepared students than many universities or other four-year institutions (Fordham, "Tipping the College Remediation Scales," para.2). Community colleges also have a higher enrollment of students that come from economically or socially depressed backgrounds. Many of these students' local school systems have failed to provide them with a strong academic background due often to the lack of financial and physical resources within the local school systems. Community colleges are often the only

academic and financial option for many of these students. Community colleges seldom decline students who wish to register, making them a huge asset to the national education infrastructure, but also often placing upon them a huge burden of academic deficient learners.

In addition to the ease of entry, many public figures and political leaders have boosted awareness and enrollment for community colleges, adding to their appeal for those pursuing higher education. In October 2010 at the first-ever White House Summit on Community Colleges, Dr. Jill Biden declared "the work of community colleges are one of America's best-kept secrets and the fastest growing segment of higher education in America," (Biden, {Letter}, par. 2). Other factors, such as lower tuition costs, greater accessibility, and greater schedule flexibility for non-traditional students, have also been shown to drive higher community college admittance numbers (Romano, 2011). With increasing student enrollment also often comes increased student attrition rates. Community college freshmen dropout rates have averaged 38% over the last five years (Education Data Initiative, 2023). These concerning student trends have drawn the attention of governmental leaders. Among them, programs such as the American Graduation Initiative initiated by President Obama have led to increased discussion about student success rates at the community college level and the extent to which the federal government should be involved in regulation (Ewell, 2011, p. 26). A report by the American Institute of Research in 2011 calculated that federal, state, and local entities spend close to $4 billion on first-time, full-time students who dropped out of community college after their first year. These staggering statistics on the financial impact of student attrition continues to place growing pressure on community colleges administrators,

researchers, and classroom instructors in the pursuit for meaningful analysis of their incoming students' admittance and advisement policies.

Mississippi Community Colleges

Mississippi is an excellent example of the role of community colleges in more rural states across the nation. The Mississippi community college system comprises fifteen main college campuses with over 500 satellite locations and covers all eighty-two counties of the state. Over two-thirds of the high school graduates of MS will enroll in a minimum of one credited or non-credited course through the MS community college system, totalling over 200,000 student engagements each year. Approximately 96% of all MS community college enrolled students are residents of MS, and three-quarters of the graduates of the community colleges will continue to work in MS after their course or degree completion (Mississippi Association of Community and Junior, 2020). Economically, projections show a financial impact for the state of over $2.1 billion in wages and salaries, $3.9 billion in GDP, and over $277 million in state and local tax revenues.

Reports on previously cited data concerning student withdrawal reveal that 10.7% of Mississippians are college dropouts. This accounts for approximately 316,000 students, of which 45% are under the age of 35. Encouragingly, residents of MS are 2.7% less likely to withdraw from college and 4.4% more likely to become college students when compared to national averages (Mississippi Community College Board, 2020). In addition, students enrolled in MS community colleges have a 1.5x greater likelihood of enrolling in a four-year university if enrolled at some point in a local community college

and have a 58% projection of completing a degree at the transferred institutions (Mississippi Community College Board, 2020).

However, one concerning data point shows that MS has around twice the number of college dropouts than undergraduates (Education Data Initiative, 2023). In an attempt to improve student retention, the MS Community College Board has committed significant resources to lower the state withdrawal rate by 2025 through curriculum redesign and an increase in institutional support (Mississippi Community College Board, 2020). Curriculum writing teams made up of subject area instructors, college administrators, and state curriculum experts meet regularly to evaluate and adjust degree plans for community college majors. These adjustments many times include changes in prerequisite requirements, course descriptions, or learning objectives. The overarching goal is to find instructional and institutional methods that best improve the student's outcomes in the associated courses.

College Placement Policies for Courses in MS Community Colleges

Across Mississippi, each of the fifteen community colleges maintains various placement policies to ensure the quality of education (Lawrence, 2017). While all the community colleges in Mississippi practice an "open admission" policy, college placement is not usually the same as admission to a particular program, particularly those with competitive enrollment. Despite the open admission policy of the community colleges, some course programs, such as A&P, have additional admission requirements. Therefore, prospective students applying for competitive programs or enrolling in more advanced academic courses based on curriculum expectations may be required to demonstrate some form of course preparation. Each community college in Mississippi

has the autonomy to designate its specific set of prerequisites for enrolling in certain courses. This means that entrance into specific courses like A&P differs depending on which institution the student chooses to attend. Since no universal placement criteria exist, the role of proper student advisement for the more challenging courses falls upon the academic advisors (Tran, 2022). To attempt to alleviate the stresses that advisors and institutions face with student attrition, new early warning systems and drop-out detection software are becoming more widely used.

Student Early Warning and Drop Detection

New early warning intelligent systems monitor and activate alerts for the student's academic advisors when risks exist or arise that threaten students' academic success. These early warning systems are typically built into institutions' enrollment and advisement programs. The systems utilize self-declared data from the students and previous academic performance data. The systems compile information such as student GPA, national testing scores, previous course grades, enrollment status, financial assistance, and a variety of other social and academic measurements to classify students into risk categories or assign risk scores for each student (Broos, Pinxten, Delporte, Verbert, & & De Laet, 2020). These scores or risk classifications attempt to predict the student's potential success in college courses, providing academic advisors with much-needed perspective for student guidance. These monitoring programs were developed to help advisors and academic counsellors better understand and support the student's learning process and course guidance (Hu et al., 2014). In addition to the early warning systems in place at the advisory level, educational software developers and universities have created 'systems of early warning' that monitor students' performance during a

semester as a means of remedying poor student achievement problems in specific courses. These systems provide alerts mainly to instructors and students to address any real-time difficulties and improve students' performances through proper advice (Choi et al., 2018). Most of these students' alerts rely on some form of a statistical model to inform their predictions (Polyzou & Karypis, 2019).

Data from learning management systems (LMS) are also being exploited to predict and advise students for specific courses, particularly for student performance in STEM courses (Elbadrway et al., 2016; Bernacki et al., 2020). These evolving methods are particularly important as multiple studies have revealed through the collection of in-depth data from secondary sources the challenges of finding reliable predictor models for college-level student success (Collins, 2008; Fike & Fike, 2008). However, some of the data collected in previous studies demonstrate that a correlation may exists between student's past performance through online LMS systems and a prediction of how well the student will perform in specific college courses (Elbadrawy et al., 2016; Hu et al., 2014; Márquez-Vera et al., 2016). Despite this study not being focused on specific LMS systems involved in A&P delivery, the data collected for the current research will include students who utilized LMS resources during the course completion.

College Advisory Challenges

College faculty and staff responsible for evaluating and advising course selection for potential students can undergo significant stress during the student guidance process (Zeidenberg, Community Colleges Under Stress, 2008). First, college leadership and financial stakeholders continue to pressure advisers to improve student retention and persistence due to the financial and political expectations placed on the institution.

Secondly, new definitions and measures are constantly being implemented to find more effective and efficient ways to assess incoming students. As an additional stressor, a study conducted by Hodara, Jaggars, and Karp (2012) found significant discrepancies concerning the overall strategies and goals of college leaders and advisors when evaluating student course placement. Their study concluded that advisors were often placed in dilemmas due to poor advisement models, and they emphasized the need for a comprehensive redesign of course placement strategies (Hodara et al., 2012.)

Third, advisers often must choose between efficiency and effectiveness when placing students in courses. For example, when interviewed, many college advisors admitted that using traditional placement tests such as the ACT, ACCUPLACER, and SAT was imprecise but outweighs the monumental endeavour of moving towards a more holistic entered advisement model (Hodara et al., 2012). Advisors find themselves pressured by the large number of students needing academic guidance and the limited amount of time and resources to provide efficient and effective educational guidance. Many advisers struggle with the balance of placing students into the right courses based on their academic history versus following school policies that will move students through the fastest pathway possible. For many in this situation, the path of least resistance is to continue using a framework that they know is many times detrimental to the student's future career path.

In addition to advisors facing challenges, more frequently, underprepared students entering the community college system need to be made aware of their academic deficiencies. This can create added tension when an advisor attempts to place the student in remedial or preparatory coursework. A student in need of this additional support would

be classified by Tinto as the "disadvantaged student" (1987, p.160). In Tinto's Theoretical Dropout Model, he suggested that college advisors and faculty should be prepared to assume the role of mentors and social support systems for students who are either first-generation college students or lack the necessary support structure to be academically successful (Nicoletti, 2019). More recent educational researchers echo Tinto's initial impressions that students require more than just academic guidance to be successful, and faculty must use a more holistic approach in course placement and advisement (Boggs, 2010). An academically deficient student often needs to understand their limitations or the academic path most beneficial for accomplishing their goals. These students require a strong, well-informed educational guide, which naturally becomes the student's academic advisor.

Finally, advisors often need consistent and data-driven advisement guidelines to correctly predict student success in courses. Colleges and advisors across the nation implore various course placement models ranging from single placement criteria to considerably more complex multifaceted conditions (Xia, 2017). Most adopted advisement processes at postsecondary institutions believe the best way to predict students' performance before advising them is through stored data in the university information system that entails grades, study field, gender, age, and other relevant demographics (Helal et al., 2018).

Despite still suffering from research gaps, the data related to college course advisement has expanded exponentially over the last ten years. Many specific programs or courses, such as A&P, within the educational setting still need more research to make accurate predictions on student success, but research such as this project stride to fill

those disparities with meaningful analytical results. Contemporary theories suggest that the traditional advisement model no longer best predicts the courses in which students can be successful. Despite being limited and incomplete, the newer and more innovative advisement methods focus on a greater holistic view of student's academic needs, considering the student's environmental, social, and behavioural development combined with their prior academic history (Bailey, Jeong, & Cho, 2010). To accomplish the expectation set before them, college advisors must attempt to utilize a combination of cognitive and non-cognitive measurements to best predict which courses students can be most successful (Ngo & Kwon, 2015). These considerations require advisors to be deliberate in their recommendations to students and comprehensively informed on as many student factors as possible.

Cognitive Factors Associated with A&P Courses

Introductory science courses such as A&P can be found in almost all undergraduate degree plans and professional program requirements, particularly in health sciences, at the community college and university levels (Harris et al., 2004). Most college-level A&P courses are taught over two semesters, but the specific requirements often vary from the institution. The number of course hours, laboratory requirements, necessary final grades, and completion time depends on the program or end goals of which the student is pursuing. Most students taking A&P courses plan to attend some health science program. However, many other science and biological degree plan either require A&P or allow it to be an elective for graduation (Wehrwein, VanRyn, & Kelly, 2020).

Medical profession programs such as dental school or medical school typically do not require A&P as a prerequisite to enrollment in their programs, because these types of programs have A&P built into their internal course teachings. However, many students still enroll in A&P either for preparation for entrance exams or for self-development (Human Anatomy & Physiology Society, 2020). The Human Anatomy and Physiology Society estimate the number of students enrolled in A&P yearly across the US and Canada at 450,000. Approximately two-thirds of these students are enrolled in A&P at the community college, with the remaining one-third in the university or four-year institutions.

Courses such as A&P are complex and entail numerous interconnected cognitive concepts necessary to be successful in both biological fields and health-related professions (Hull, Wilson, Hopp, Schaefer, & Jackson, 2016). Cognitive factors refer to characteristics of the person that affect performance and learning. These factors serve to modulate performance such that it may improve or decline. These factors involve cognitive functions like attention, memory, and reasoning (Danili & Reid, 2006). As an example, students cannot only memorize the components of a particular body system, such as the cardiovascular system, instead, they must be able to manipulate the information from the cardiovascular system and integrate that knowledge into other systems, such as the respiratory or renal system. In addition, the students must understand each system's pathophysiology and how diseases or injury causes multiple organ or body system failures. This type of learning complexity makes biology courses such as A&P challenging for first-time students, making accurate advisement essential for the student's success (Human Anatomy and Physiology Society, 2020).

Many of the same academic skills needed to produce high scores on the GED, SAT, and ACT are also necessary for courses like A&P. These skills include critical reading comprehension skills, information manipulation, strong study habits, and test taking techniques. Vedartham (2018) has demonstrated that comprehensive standardized assessment tests like these assisted students in preparing for the A&P course rigors when taken before enrollment in many of these higher-level science courses. Regarding cognitive factors, standardized test such as the ACT and SAT, offer students an opportunity to assess their knowledge of the foundational biological processes and the time management skills needed to succeed in this course. College advisors evaluate these multiple academic factors by comparing previous students' results along with current institutional policies. These academic mentors attempt to determine if a student is adequately prepared to succeed in high-intensity courses such as A&P. Yet, with the continuing national attrition rate for first-time A&P enrollment between 45-50%, using cognitive methods alone in advisement may not be sufficient to improve retention and overall success (Hughes & Scott Clayton, 2011).

Non-Cognitive Factors

Research on improving student success in more complex academic courses like higher level mathematics has more recently begun to concentrate on the influences of factors beyond cognitive skills that may impact a student's success (Semeraro et al., 2020; Castor, 2005). Though overall cognitive abilities have been regarded consistently as one of the predictor patterns for success in college courses, non-cognitive factors, such as academic behaviours, also appear to play a substantial role in course success (Cvencek et al., 2018).

In more challenging science courses such as A&P, microbiology, chemistry, and physics, the research indicates that students must not only have the cognitive abilities to study, memorize, and regurgitate information but also must demonstrate non-cognitive skills such as interpersonal engagement, self-motivation, and active communication techniques to be successful (Sturges & Mauner, 2013). As a non-cognitive attribute, student commitment, even though impacted by different factors, is also a determinant of success or failure (Semeraro et al., 2020). Specifically, the commitment-making process effectively promotes pro-environmental behaviors such as active classroom engagement, mentor relationships, constructive peer dialogue, and personal health management (Karp & Bork, 2012). When students commit to this positive learning behavior, they are likely to adhere to their course commitment, and this action leads to long-term change in behavior associated with success (Runharr, Wagenaar, Wesselink, & and Runhaar, 2019).

Apart from completing assignments, an individual must be physically present in the classroom to learn content, knowledge, and skills to succeed (Cvencek et al., 2018). Studies utilizing student surveys concerning non-cognitive behaviors and attitudes have demonstrated that academic behaviors have extreme statistical significance for academic success and performance in courses such as A&P. For example, one such study administered questionnaires to students before and after specific science courses. The questionnaire assessed students' attitudes and academic behaviors, such as study habits and overall class commitment (Runharr, Wagenaar, Wesselink, & and Runhaar, 2019). At the end of the courses, the students were given similar assessments but included questions about the student's perception of how their behaviors or attitudes impacted their cognitive

skills. The results revealed a strong correlation between the student's non-cognitive characteristics and academic performance.

Other studies have focused on counterproductive academic behaviors (CAB) that students may demonstrate and the impact of such behaviors on student course outcomes. CABs include actions such as academic dishonesty, absenteeism, or instructional apathy (Salgado, Moscoso, & Cuadrado, 2022). Additionally, a student's academic attitude toward the learning environment can affect the frequency of a student's class attendance, schoolwork effort, and commitment to the course material, therefore altering the likelihood of failure or success (Roth, 2016). Empirical evidence suggests that CAB can result in significant consequences that affect students who engage in these behaviors, their peers, faculty, academic administration, and the educational system overall (Cuadrado, Salgado, & Moscoso, 2021).

Another non-cognitive skill that has been connected to positive academic performance is social skills. The definition attributed to social skills includes positive decision-making, improved behavior, interpersonal interactions, personal reflection, and self-awareness (Jovarini et al., 2018). Jovarini et al.'s (2018) study showed that students with highly advanced interpersonal skills have higher chances of having a distraction-free and positive experience in the classroom. Therefore, more attention can be given to achievements and learning. In another example, Harmon et al. (2018) determined that social skills such as prosociality and leadership can improve learning, especially in more collaborative classroom styles, due to a greater likelihood of collaborative studying or course preparation.

Social ties and relationships established by the student in the collegiate environment also have been identified as a possible non-cognitive impact on student performance (Samaha & Hawi, 2016). In this study, Samaha and Hawi (2016) used questionnaires to collect data about students' friendships and found that this data could also help enhance the prediction of student failures. Another similar study identified correlation between student's social support and friendships and overall academic success. Thus, advisors could potentially offer course direction to students based on their friendships and the interest of their social groups or professional organizations (Coffman & Gilligan, 2003). Though not widely used currently by college-level advisors, the underlying hypothesis of this study implies that for an advisement model to be successful, a more inclusive profile is needed of a student, which includes more data points outside of their academic performance. Non-cognitive factors are beyond the scope of the current research project, but the researcher still acknowledges that these variables are potentially influential to student A&P outcomes.

One major challenge of studies that demonstrate a connection between academic performance and social skills is that many reveal a correlational tendency, which means that being confident in the impact of particular social relationships is impossible (Wladis et al., 2015). The literature in this review reveals a need for more and improved research on successful course prediction in A&P classes. However, attempting to study both cognitive and non-cognitive variables in one analysis is an overwhelming task. For this reason, the current study and associated literature will only focus on the cognitive variables of the A&P students.

College and Workforce Impact of Anatomy and Physiology Courses

An in-depth comprehension of attrition rates, particularly in programs encompassing A&P coursework, can be complicated because A&P courses and many medically focused science courses, such as microbiology, biochemistry, and nutrition, are present in non-STEM and STEM degree plans (Chen et al., 2013). This crossover of A&P requirements between STEM and non-STEM-based majors can cause the outcome data to be skewed. For many national and institutional research organizations, these two educational tracks are analysed separately, leading to an incomplete picture of the impacts of unsuccessful A&P students.

Biomedical sciences are categorized as STEM disciplines and include diverse educational majors including mathematics, engineering, and computer science (Li, Wang, Xiao, & Froyd, 2020). However, many health science programs are grouped as non-STEM due to the professional certifications and licensures accompanying these courses. A&P attrition rates are often similar across institutions in Biological Sciences and other disciplines of STEM. However, attrition rates of health sciences, grouped as non-STEM, are significantly higher in bachelor's degree programs (Hull et al., 2016). The differences can be seen in the results of a study by Freeman et al. (2011), who denoted that nursing, pre-physical therapy, and pre-occupational therapy students have substantially more difficulties with A&P than those taking other academic-based STEM programs, such as those pursuing a bachelor's degree in biology. Therefore, the inability to pass A&P courses often forces students to change their major or degree plan, demonstrating the adverse effects of unsuccessful A&P courses.

A college education is expensive and can feel especially so for low-income students. However, a college education can be more expensive if students are admitted without a solid plan and eventually change their majors (Altonji et al., 2014). When students are unprepared or find A&P courses difficult, they are more likely to withdraw or take courses that do not contribute to their planned major. Studies estimate that about 81% of college students typically change their major at least once within the first three years of enrollment (Major et al., 2016). These changes can lead to high costs for the students and the institution.

A&P course success is associated directly with degree completion and graduation, as evidenced in a study by Farkas et al. (2016), in which learners who completed this course had and higher degree completion than those who did not. The researchers contributed this to the fact that most students taking A&P were seeking a specialized program of study or profession. Students who were successful in the complexity of A&P were also more likely to manage the complicated coursework of their chosen area of study (Farkas, Mazurek, & Marone, 2016). Similar studies suggested that success in A&P motivated students in their education, especially those who took additional science courses (Hull et al., 2016). As a result, students feel well-prepared for other courses upon taking and succeeding in the A&P course. Hopp (2009), who administered a survey regarding the students' perspectives and experience in their A&P courses at the community college level, recorded a statistically relevant connection between students' success in other science courses and their successful passing of the A&P. Based on many of these referenced studies, success in the A&P course has a potentially significant role in reducing college attrition rates and program changes.

While many studies, such as Farkas et al. (2016) and Hopp (2009), focused on college course completion and graduation, Chen and Voyles (2013) focused on the connection between A&P and health-related professional success. Chen and Voyles (2013) demonstrated that taking an A&P course is critical for long-term success because it offers the foundation of knowledge necessary for a medical career. Additionally, A&P offers intimate human development knowledge and how the body changes and grows throughout an individual's life (Wehrwein et al., 2020). Thus, a background in A&P helps healthcare professionals better comprehend their patients' needs. Clarke et al. (2014) further posit that A&P is integral for healthcare professionals' success, particularly in emergency conditions. This study found that human anatomy assisted in emergency cases by making healthcare workers cope well in such situations due to their in-depth understanding of the concepts of A&P. These findings imply that the concepts of A&P assist healthcare workers in examining the health of a patient quickly and making a precise decision at the right time, ultimately leading to high career success rates.

Literature Gap for Placement Criteria for Anatomy and Physiology Courses

As an example of the discrepancy in research literature concerning advisement models, an overview of the predictor studies for academic disciplines such as Mathematics should be reviewed. Significant exploration has been conducted on what variables or factors best predict student success in college degree plans involving mathematics, such as college algebra and higher math-related courses. Studies concerning mathematics advisement exist on specific topics such as the effectiveness of remedial coursework, the sensitivity and specificity of national placement exams, instructional methodology, and even the social interactions of college students (Boyce, 1964; Wilson,

2011; Kwon, 2015; Long, 2003; McEwen, 2019). Many of these research projects have produced credible guidance towards student advisement for colleges and universities for their mathematic advisors.

Similar studies exist for similar academic degree plans across the humanities and arts. However, more research needs to be explicitly focused on Biology-related courses like A&P. Dedicated organizations or associations such as the Human Anatomy and Physiology Society (HAPS) perform significant research on almost all aspects of improving student performance of A&P courses (Human Anatomy and Physiology Society, 2023). In addition, the Human Anatomy and Physiology Society (HAPS) has also researched prerequisite courses and teaching methodologies that best influence student performance (Shaffer, Schriner, Loudon, & Dacanay, 2018). However, no clear predictability studies or advisement models have been developed from their efforts for college advisors to use for A&P-specific guidance. This study will attempt to fill portions of the literature gap concerning specific academic variables' predictability, specificity, and sensitivity in predicting A&P I success.

Variables Predicting A&P Success

Course Loads and Prior Completed College Credit as A&P Predictor

Although not linked directly to A&P delivery methods, one study demonstrated that heavier course loads in college-level science programs correlate to higher chances of students' success (Huntington & Gill, 2021). For full-time students at most postsecondary institutions this would require five to eight hours of coursework, at least four days per week. Optimal A&P success would most likely be achieved if most of the academic material had some foundational basis associated with A&P concepts. The researcher suggests that this correlation may be related to an increased time requirement towards

academic pursuits, therefore, decreased subsequent time given to non-academic distractions (Gultice et al., 2015). Students likely to succeed based on higher course loads must focus, manage time well, and have increased engagement with like-minded individuals such as professors, support services, and other students (Brugiavini, Carraro, & Kovacic, 2020).

Students who are registered as full-time status or take higher amounts of course credits per academic term are less likely to have external employment or other high-demand responsibilities. In addition, many of these students are enrolled in professional degree programs, which limit the non-academic obligations they can assume. This required increase in academic focus likely contributes to higher success in courses such as A&P (Vitali et al., 2020). However, a heavier course load is only sometimes beneficial because, in some cases, an increase in academic responsibilities correlates negatively with the student's academic performance. If a student is not academically and socially prepared, the likelihood of failure or withdrawal increases significantly (Poldin et al., 2016).

Prerequisites for A&P Courses and Prior College Hours

Most colleges and universities require or strongly recommend some prerequisite coursework before enrolling in higher-level science courses such as A&P. Some research has demonstrated that academic background influences the type and quantity of new learning needed to attain the high degree of mastery needed for academic success (Hopp, 2009). For A&P, general biology or principles of biology classes are typically recommended as preparatory work. These introductory biology courses often provide foundational science understanding and concepts that are built upon later in a more complex A&P class offering (Shaffer, Schriner, Loudon, & Dacanay, 2018).

A student needing help identifying with a particular subject might not see the value of learning the subject, which may lead to a higher likelihood of academic failure (Hauser, 2013). In a study by Roth (2016), academic preparation led to positive mindsets, including value for academic work, growth mindset, belongingness to the academic community, and self-efficacy. This study showed a positive pathway from academic mindsets to academic performance and behaviors based on students' academic preparation and mastery of content leading to persistence. This can be particularly important considering that in one study, the majority of science majors and students in health-related professions studies who completed their intended course or degree plan described A&P as one of their most challenging courses (Hopp, 2009). It can be inferred from these findings that academic background, including preparation, and mastery of foundational content, directly impacts the students' success because of increased motivation and confidence. However, no research in the literature precisely describes how many credit hours or which specific science courses have the most significant impact on overall outcomes in specific courses like A&P.

This study will analyze the individual developmental or prerequisite courses students typically take to enroll in A&P. The objective is to identify any statistical connection between a single prerequisite course or combination of courses that can be used to predict successful completion of A&P. In addition, an analysis of prior college hours concerning A&P success will be studied to detect any significant prediction factors.

Standardized Test Scores (ACT and SAT) for A&P I Predictors

College entrance examinations have undergone numerous revisions since their enactment in the United States more than a century ago (Evans, 2015). Early forms of the ACT and SAT were essay-based. These essay-based college entrance examinations initially focused on a handful of preparatory college curricula such as fundamental mathematics and reading. These forms of assessments became problematic when the population of high school graduates almost quadrupled within two decades. The amount of time and resources necessary to adequately grade the writing portions of these assessments became overwhelming. In addition, a more standardized and objective measurement system became necessary to create a fair measurement scale (Saunders-Scott et al., 2018). These complications with the essay-based assessments. contributed to the formation of the multiple-choice structure commonly used today. Most colleges and universities in the United States utilize some form of the SAT or the ACT as either institution admission or specific course placement. Community colleges in MS primarily utilize the ACT and its subject sub-scores for advisement (Mississippi Institutions of Higher Learning, 2022), thus it is the primary standardized test considered in this study.

According to McEwen's research (2019a), the present-day ACT measures students' knowledge based on the high school curriculum and is mainly used in the Southern and Midwest states. In the ACT, mathematics, science, reading, and English have sub-scores ranging from one to thirty-six points and a composite score, primarily the average of the sub-subject scores (Evans, 2015). In an attempt to predict academic success in college courses, the SAT and ACT have undergone significant transformations since their initiation. The significance of college entrance examinations such as SAT and ACT increased substantially during the 1950s to make college admissions efficient and

accurately predict students' success in college courses. However, despite these tests being in existence for more than a century, there are still mixed views concerning their effectiveness in predicting students' success in college courses based on these findings (McEwen, Mohn, Herron, & Shelley, 2018).

With the ACT playing an imperative role in college admission, the predictive potential of the test has been assessed in detail. However, these tests no longer serve their intended purpose because the test results are presently branding the students after taking them (Allensworth & Clark, 2020). Instead, students are taught how to take the national placement test at the secondary educational levels. Once the student receives their scores, this becomes their academic "brand." They are directed toward the programs, institutions, and careers that best fit their test score. Because of this, student biases are created by high school counselors and then transferred later to college advisors (Stiggins & Griswold, 1989). These preconceptions can often lead to poor advisement and the misplacement of students in ill-prepared coursework (Gilmore, 2008).

The ACT was initially designed to test prior learning or achievement. Therefore, it is ostensible that in some situations, the importance of these test scores cannot be ascertained because of the bragging rights and entering students' publication of test scores by secondary school systems (Brecht & Burnett, 2019). The pressure that postsecondary schools are under to graduate students is a continuation of the expectations placed on primary and secondary institutions to improve high school graduation and national testing results.

Because primary and secondary education funding is directly related to state and national testing, many schools spend extensive time teaching students how to prepare for national testing such as the ACT and less time developing fundamental academic skills such as reading comprehension and critical concept analysis. In an attempt to overcome these demerits, Varga et al. (2019) showed that most institutions regarded as semi-selective are presently leaning towards a combination formula including both the high school GPA and test scores. Many educational stakeholders' beliefs concerning using tests such as the ACT and SAT as an isolated student predictor are evolving. Many educational experts believe these tests no longer serve their intended purposes and are beginning to be viewed differently by students and colleges (Allensworth & Clark, 2020).

Another challenge with using tests like the ACT as a student predictor is a large amount of conflicting data concerning the usage and validity of the scores. Much of the research conducted on the ACT comes from an internal analysis by the test designers and organizations behind test development. Critics voiced their concerns about possible bias toward the evaluation and analysis of the testing design by the same entities benefiting financially from these tests. As a result, much of the research concerning the ACT focuses on the validity and equality of the test model instead of the validity of the test score predictability, which is discussed later in the theoretical framework of this study. Of the limited existing research, Woods et al. (2018) found that the composite ACT score is often a weak predictor of course success, especially in problem-based mathematics and science courses. However, Allensworth and Clark (2020) claimed that ACT sub-scores of Mathematics, Science, and English are more credible success predictors than the composite scores of the ACT.

In 2019 the national ACT report stated that over 1.8 million graduates took the ACT, representing approximately 50% of the US high school graduating population (National ACT Development, 2019). The current ACT is divided into five sections or sub-scores. These include English composition, reading, math, science, and a combined STEM section covering mathematics and science specialties. According to the condition of college and career readiness of 2019, the national average ACT score was 20.7 with an English average sub score of 20.1, a reading subscore of 21.2, a mathematics subscore of 20.4, and a biology sub score of 20.6. The same report also outlines ACT college readiness benchmarks. The ACT college readiness benchmarks are the minimum subsection scores that the ACT research department states that students need to obtain to have a high probability of success in credit-bearing college courses such as English composition, social sciences courses, college algebra, and biology (ACT, 2023). These benchmarks, described by the ACT committee, state that a student who meets the benchmark will have a 50% chance of obtaining a "B" or higher in associated college courses or a 75% chance of obtaining a "C" or higher in related credit-based first-year college courses.

The 2019 career readiness report revealed that except for the reading subscore section of the ACT nationally, students did not achieve the ACT's readiness benchmarks (National ACT Development (b), 2019). Additionally, students who took the ACT in 2019 identified what areas or careers they were interested in pursuing at the college level. The top three selected topics were nursing, medicine, and general biology. The ACT estimates a "percentage of fit," which gives a perspective on whether a student's interest aligns with their benchmark score capability (ACT, 2023).

The basis behind these ACT benchmark recommendations is that any student who does not meet the benchmark scores for interested subject areas may not have the foundational knowledge needed to be successful in the ACT aligned courses. For example, in the nursing category, only 32% of the interested students fit the major based on their ACT subscores. There was a 49% fit for both the major classified as medicine or pre-medicine and that of biology (National ACT Development, 2019). Considering these three topics were also listed as three of the top 10 enrollment programs in the Community College system across the nation, these testing benchmarks coupled with student capability create concerns about the validity of the ACT student predictability (American Association of Community Colleges, 2022).

The results are even more discouraging when the ACT composition and subscores are analysed specifically in Mississippi. In 2019 the average ACT composite score from Mississippi was an 18.4, with approximately 100% of high school students completing the ACT (Mississippi Community College Board, 2020). Students in Mississippi scored an average of 18.1 in English, 18.9 in reading, 17.9 in mathematics, and 18.4 in the science subsection. Based on the ACT benchmarks, the highest competency and "fit" area was in the English section at 46%. The reading and mathematics benchmarks were 29% and 20%, respectively. However, the most concerning and relevant data for the current study were that of the students who showed interest in a science or medical-related major; the ACT benchmark fit, which supposedly predicts whether these students would do well in those study areas, was only 19% (National ACT Development (b), 2019).

The data concerning ACT scores and their benefit and implications for advisement for college students is conflicting. Yet, one fact remains concerning the use of these scores for college advisement: whether beneficial or not, there has been little focus placed on the predictability of the composite ACT score and, more importantly, the science subscore in its relationship to science-based courses such as A&P. This study will attempt to provide data looking at the relationship between the ACT and the outcomes of anatomy and physiology students, therefore, adding some data to the literature gap for future researchers to build upon.

GPA as an A&P Predictor

Traditionally, student GPA has served as a commonly used predictor of course success at the postsecondary education level. Many administrators and advisors use a student's high school GPA as initial guidance for what courses a student should take during their first year of college. At the university or four-year institution level, GPA is often the determining factor in student admission into the institution or specialized professional program (Weinstein, 2023) Nevertheless, there is little significant literature showing how a student's GPA after admission and the first semester of college courses predicts future course success.

Students' GPAs during their first year of college should significantly increase or decrease depending on the level of courses that the advisor places them in. For example, if a student is enrolled in remedial or fundamental coursework, their GPA would likely increase as they advance in their college career. In contrast, a student who enters college with a higher GPA may be placed in more advanced coursework resulting in a decrease in their grade point average after the first semester of courses (Brookhart, Guskey,

Bowers, McMillan, & Smith, 2016). Given the potential implications of initial course placements based on GPA, there is a growing demand for educational researchers to adequately track student course placement associated with GPA after initial college enrollment.

Another factor that may distort the accuracy of using a student's GPA for advisement centers around the problem of evaluating the academic rigor of the student's primary and secondary education. In other words, primary and secondary school systems that have higher expectations or standards in coursework may create an inaccurate correlation with the student's GPA. This discrepancy may cause students to be placed in college coursework based on their GPA, for which they need to be adequately prepared. Lastly, students' cumulative GPA may not accurately predict a student's specific strengths or weaknesses in major degree studies. For example, a student's GPA may be lowered because they are not academically strong in mathematics or English, yet their competency level in science or laboratory courses may be more positive. It is generally accepted that not all students will be proficient in all levels of courses. This may be due to the intensity of the coursework, the critical thinking components of a particular topic, or simply the student's excitement and engagement level depending on their interest. Again, most studies on GPA predictability fail to consider the complexity of how GPA is impacted once the student enters the college setting.

The most contemporary studies on GPA usage demonstrate conflicting interpretations of the value of a student's GPA for advisement (Buckley, Letukas, & Wildavsky, 2019; Koretz, et al., 2016; Allensworth & Clark, 2020). Some studies suggest that utilizing a student's high school grade point average (GPA) to determine college-

level course enrollment is a more accurate predictor than national placement tests such as the ACT or SAT (Buckley, Letukas, & Wildavsky, 2019). However, other data suggest that there may exist a correlation between the college's GPA and standardized testing, such as the ACT, which college advisors could use in combination for student advisement (Herrmann, 2020). Therefore, it can be inferred from these findings that colleges should implement a more open-minded or subjective interpretation of the student's GPA to predict their success in a given course.

This study will analyze the sample students' GPA at the time of enrollment in their A&P course against their outcomes in the A&P I course. This portion of the analysis aims to identify any significant correlation or statistical significance demonstrating predictability between a student's GPA at the time of enrollment and their outcome in the course. Currently, there is no research literature demonstrating a benefit to using a student's high school GPA versus their college GPA for course prediction. This study will analyze the students' GPA at time of A&P I enrollment due to the fact that many students do not take this course until later in their college academic career. Additionally, if any significance is revealed, further analysis will attempt to identify the specificity or sensitivity of GPA as a single predictor of student success. If such a relationship exists, then corroborating evidence of GPA usage in Anatomy and Physiology advisement can be proposed.

Theoretical Framework and Interpretative Lens

When performing a predictive analysis, the researcher can use many different theoretical frameworks or interpretive lenses to interpret the data. The perspective chosen by the researcher guides the discussion, interpretation, and eventual recommendations

from any given project. Similar studies on predictability models for college students have used frameworks such as chaos theory or social justice theory in their interpretation (McEwen, Mohn, Herron, & Shelley, 2018). However, the researcher of this study did not believe that either of these perspectives would best accomplish the project's goals. Because chaos theory and social justice are two of the more common frameworks used for this type of analysis, it is worthwhile addressing why they were not selected for this particular study.

Chaos theory is the perspective that in any given system, there are unpredictable factors that can cause a stable environment to become unstable or chaotic (Levy, 1994). In the case of college student advisement, few researchers argue that students exist in a completely stable, predictable pattern while enrolled in courses (Skinner et., 1992). Therefore, a chaos theoretical framework is often used to look for random factors that can change student outcomes. The chaos theory was not utilized in this study because this research examines isolated stable independent variables and their relationship with a bimodal outcome such as excess or non-success. Using a chaos theory framework could possibly introduce more uncertainty concerning the independent variable specificity and sensitivity in prediction, making any interpretation of this data less confirmational.

Another commonly used interpretive lens for this form of analysis would be to use a social justice framework. This perspective views outcome data and associated variables from a question of causality based on demographics such as gender, race, sexual orientation, or environmental upbringing (Morris, 2018). An example of a social justice viewpoint would be to ask if the student's outcomes were connected to instructor bias, primary and secondary educational access, or inadequate support measures at the

college level. However, given the difficulty of categorizing and identifying these factors for college advisors, using a social justice framework did not accomplish this study's overall objectives and goals. This project attempts to identify specific qualifying variables from an academic perspective that can help predict success in Anatomy and Physiology students; therefore, using argument-based validity theory and a phenomenological interpretive lens is more appropriate for analysing the results.

Argument-Based Validity Theory

Much of the previous research on the validity of placement scores during advisement utilizes an argument-based approach to data interpretation. An argument-based approach focuses on a variable's test score or numerical outcome instead of analysing the qualitative design or delivery of the test (Scott-Clayton, 2012). This method is not concerned with the testing environment, learning styles of the students, or instructional methodology of the instructors but instead only considers the testing score or outcome of an academic assessment. This interpretive lens attempts to evaluate how a test score, or evaluation outcome is used for future placement decisions. Once a relationship or correlation is identified involving the assumption of an assessment, the researcher then attempts to find supporting evidence that collaborates and gives plausible validity to a placement test or score (Kane, 2013).

Michael Kane was the primary architect of argument-based validity theory and has co-authored multiple research projects on testing validity and educational measurements. Kane proposes (1992) that the interpretation of a test score or educational measurement's validity must be based on the assumptions preassigned to the testing outcomes. The term validity in educational measurements is defined as: "the degree to

which evidence, in theory, supports the interpretations of a test score for proposed uses of those test scores (AERA et al., 2014, p.1.)." To simplify Kane's theory, a researcher should not attempt to discover the validity of a test but instead determine the validity of the test result or outcomes usage. Kaine focused primarily on the use of argument-based validity theory in mathematics. His original article established numerous assumptions demonstrating the fairness and equality of tests given to mathematics students (Kane, 2013). After establishing the assumptions, he used an argument-based validity lens to evaluate whether the usage of that mathematics test adequately predicted the student's capability of being enrolled in college algebra. His methods stated that once certain assumptions have been established, a researcher must look past the test itself and evaluate the usage of the test outcomes (Kane, 1992).

This study examines multiple independent variables and their relationship to a student's A&P course outcome. The argument-based validity framework provides a solid foundation to interpret the success predictability of Anatomy and Physiology students based on composite ACT scores, science subscores, student GPA, and even possibly final grade outcomes of prerequisite courses. Since the sample data for this project comes from an isolated Community College with a limited number of faculty, teaching, and an identical curriculum with similar outcome assessments, the assumptions of equality, preparation, and test validity can be established assumptions. Therefore, through an argument-based validity lens, the outcome analysis can be used not to assess the testing material's delivery or the course's instructional methodology but can be viewed and discussed in terms of the validity of advisement placement in future courses.

Phenomenological Framework

The second interpretive framework for the discussion of this project provides a more complicated viewpoint and possible challenge. Typically, a phenomenological methodology is used to explore an individual's experience within a particular phenomenon or experience. Phenomenology includes a broad spectrum of philosophies and theories, such as transcendentalism, existentialism, and hermeneutics (Cilesiz, 2009). Most research projects that use this framework are qualitative in design and focus more on the student's perspective or interpretation of their educational experiences. Phenomenology is a constructivist design and educational philosophy that proposes that phenomena or experiences from an individual past construct the reality of current happenings. Researchers using this framework attempt to connect the reality of an outcome to the experiences of the individual being studied. If a phenomenological lens is primarily qualitative, how does this interpretive framework apply to the current quantitative study?

This study analyses a combination of independent quantitative variables to better identify and design more effective collegiate advisement models for A&P students. One of the challenges that advisors have when making decisions and recommendations for students for their college course selection is gathering and interpreting all of the quantitative data in a way that allows them to make the best predictions for student success. Individual variables such as ACT scores, GPA ranges, or courses completed provide advisors with a checklist to evaluate. However, the combined multifaceted component of student advisement can be the most significant obstacle for these academic guides. The current researcher's goal is to view these individual academic variables together as a single quantitative phenomenon instead of qualitative experiences. In a

simplified form, this interpretive lens will attempt to connect the phenomena of a student's academic background to the reality of the current advisement models. These prior educational experiences can be considered from a phenomenological perspective to create a comprehensive and more inclusive advisement model for educational instructors, which can be used for student prediction in A&P courses.

Conclusion

Community colleges across the nation are experiencing unprecedented pressure to improve student retention, graduation, and workforce placement. Healthcare-related professions and biology majors rank in the top five-degree fields at the Community College level, and these areas of study place a high emphasis or requirement on completing A&P courses. Healthcare professions need qualified and knowledgeable individuals entering medical studies who have a solid grasp of the human body and the pathologies that lead to diseases and injury patterns. Biology and science degrees, whether health care related or not, require students to have a solid grasp of the fundamental knowledge of chemistry, cellular mechanics, and environmental life functions that the anatomy and Physiology courses provide. In addition to these professional fields, almost all higher-level degree plans implore the critical thinking and complex information integration that AP courses utilize. These are some of the reasons why Anatomy and Physiology courses are considered gateway courses in many educational decree plans, yet A&P classes continue to be one of the highest attrition-based courses of the Community College and four-year institution catalog.

The literature review described in this chapter outlines the research gap for high-level science courses and, more specifically, for A&P courses. Much of the research on

predictability models for course placement has revolved around mathematics, English, and other humanities courses. More research needs to be conducted on science-based courses and the specific prediction variables that demonstrate student success as an outcome. As stated earlier, even national tests such as the ACT and SAT focus less on the validity of the science components of these tests to judge students' competency level in postsecondary courses. Moreover, little study has been conducted on the multifaceted relationship between student scores, such as GPA and the ACT, in combination with prerequisite courses leading into enrollment of Anatomy and Physiology. The goals and objectives of this study are to help fill the research gap concerning Anatomy and Physiology advisement and pre-existing student academic variables. The data obtained from this study has the potential to guide future research on higher education science advisement and can provide valuable insight for faculty and administrators whose role it is to improve student outcomes, and subsequently, improving institutional effectiveness.

CHAPTER III- METHODOLOGY

Introduction

Anatomy and Physiology I (A&P I) courses suffer from an above average attrition rate compared to most undergraduate postsecondary courses. Community colleges across the nation are responsible for the majority enrollment of A&P I students. Studies have been conducted on the multifaceted cognitive and non-cognitive factors that influence the overall success of college students, but minimum research exist on the specific academic variables or combination of variable that offer a strong predictive value for student outcomes in A&P I. Due to the importance of A&P I for healthcare-related degree fields and other biological science programs, college advisors need a more robust and sensitive advisement model for guiding students course decisions. This study is intended to quantitatively determine whether a specific independent variable or combination of variables can predict the successful completion of Anatomy and Physiology (A&P) I for undergraduate students at two-year colleges. This chapter details the statistical basis used to generate the research models used in the study, the satisfaction of procedural assumptions, compares representative demographics of the population and sample, describes the data collection methods, and outlines the data analysis procedures.

Research Design

This study is a retrospective quantitatively designed analysis utilizing secondary archival data from 2,858 students as both the dependent and independent variables. Altering the study's independent variables would make the study nonexperimental in design (Tabachnick & Fidell, Using Multivariate Statistics, 2019); thus, they remained the same throughout. The descriptive study examines the correlation between student success in an A&P I course and prior academic accomplishments. This statistical

technique attempts to find correlations between isolated variables and allows the researcher to develop prediction models for desired outcomes. A correlational design does not explicitly attempt to demonstrate cause and effect but instead determines if some form of correlation exists (Nassaji, 2015). Using this statistical design, the researcher can study the presented independent variables, possible relationships between these variables, and the possible roles of the variables in predicting the successful completion of A&P I courses by community college students in Mississippi.

Multiple regression analyses were conducted to determine what combination of studied independent variables best predicts student success in A&P I. Discriminant analysis was used to classify the sample participants and identify any significant characteristics that could alter the statistical results and interpretation. Discriminant analysis is the statistical process that utilizes predictor variables to classify subjects into two or more groups (Ary, 1996). Discriminant analysis is also used in developing prediction models, assessing consistency, and describing variable relationships.

The research methods utilized in this study allowed the researcher to evaluate the suggested hypotheses and answer the proposed research questions. An Analysis of variance (ANOVA) was used to identify if any statistically significant relationships existed between the independent variables and outcome variable. The researcher hypothesized that significance would be identified among the predictor variables including cumulative completed college hours, Composite ACT score, ACT science subscore, GPA at time of A&P I enrollment, and completion of individual biology prerequisite courses. If a statistically significant finding was present with the ANOVA analysis, a series of binary linear regression tests were performed to identify the specific

relationship between the isolated independent variable and A&P I outcome. The researcher also hypothesized that combinations of the proposed variables could provide a predictive measure to A&P I outcomes. Specificity and sensitivity analysis was performed on multiple variable combinations to assess for strong predictive parings. The research questions concerning the effect or degree of using the proposed academic variables to predict student outcomes in A&P were then answered based of the hypothesis results.

Data Acquisition

After the dissertation committee and Institutional Review Board (IRB) approval, the archival data was acquired from the Office of Institutional Research at Jones College. This archival data included: date of college admission, sex, race, age, and state residency status. Demographic information was obtained from students' enrollment and registrar information. Primary data collection was not required since the predictor variables included test scores, GPA, and college hour credit counts, along with the outcome variable being the end-of-course grade. The Office of Institutional Research and Information Technology (IT) compiled this data and delivered it in a secure excel spreadsheet without any identifiable data markers. Data was screened for any absent or flawed data points. To be considered “flawed,” any data point was missing such as demographic or academic required information; and that student was removed from the data set. Next, any data points presenting with severe outliers, such as excessive college hours of any amount above 200 total attempted credits were removed due to the concern of skewing the analysis. Since all of the variables in question have defined upper and lower limits, all values within these limits were considered possible and expected within a standard distribution.

The study sample population included 2,858 students enrolled in an A&P I class at Jones College between 2015 through the 2021 academic year. Participants were limited to students taking the course for the first time to prevent contamination of internal validity caused by previous exposure to the course material. A total of 2,858 students enrolled and received an outcome posted on the academic transcript. All data were collected by the Information Technology (IT) department using the student management system PeopleSoft. The non-demographic information collected for each student included: composite ACT score, ACT science sub-score, date of A&P I enrollment, number of completed college hours at the time of A&P I enrollment, number of completed BIO college hours at the time of A&P I enrollment, specific BIO courses completed prior to A&P I enrollment (i.e., Principles of Biology and General Biology), section (days and times of class offerings), and instructional types (hybrid, online, traditional), GPA at time of A&P I enrollment, final A&P I grade, gender, ethnicity, and age.

Co-Variant Removal

The researcher was also served as an adjunct faculty member for A&P I during the data sampling years. Due to the potential confounding of results, all data from courses taught by the researcher were excluded from the data set by the Institutional Research Office of Jones College prior to data delivery. The researcher is not a primary or full-time faculty of the A&P I course, resulting in a lower relative proportion of students in the allotted timeframe. Cleaning removals were guided by removing factors that were not targets of the listed research questions. These factors are listed below.

1.) Individuals who repeated the A&P course created an undefinable element due to preexposure to course material, study topics, and testing analytics. Since the

study's goal is to generate a model that will mitigate or eliminate the repetition of the course in question, these cases need not be considered. Those students who had previously enrolled in A&P I were excluded from the analysis.

2.) Students whose files were incomplete were also removed from this study. Several students were missing ACT scores or other demographic factors in the college information system. The number of incomplete student files constituted less than 3% of demographic or completion cases in the total sample size, so the impact of their removal was minimal on the data set. The lack of ACT scores constitutes approximately 6% of the available cases. It is safe to consider the distribution and variation of the actual data to reflect the distribution and variation of the population. Based on the current standard of computerized reporting of standardized scores, these cases were considered errors of advisement, contributing to a lower overall model variation accounting in all statistical models.

3.) A student who received a "W (withdrawal)," "FA (failure due to attendance)," or "I (incomplete)" were excluded from the analysis. No precise method currently exists to identify which of the multiple withdrawal factors impacted each student. For example, some students may have received a "W" due to financial obligations, an "FA" due to sickness or unforeseen medical conditions, or an "I" due to a missed assignment or course obligations. However, since all the mentioned classifications cannot be converted into an actual course grade, they cannot be calculated in the grade point average.

Therefore, this data was removed from the sample set as the study aims to predict student outcomes.

Cleaning processes removed 253 cases from the acquired data set, resulting in a total sample of 2,605 cases. An adequate sample size is required to perform multiple regression analysis with five independent variables (college hours, composite ACT, science ACT subscore, GPA, and prior Biology hours). One method of determining the necessary sample size is to use N>50+8m, where m is the number of independent variables for multiple correlations and N>104+m for individual predictors (Tabachnick & Fidell, Using Multivariate Statistics: Pearson New International Edition, 2013). Utilizing these calculations, a sample size of 90 (N>50+(8)(5) is needed for the regression and 109 (N>104+ 5) to test individual predictors. The sample size was deemed adequate for analysis based on these statistical educational standards. Using the larger sample size of this study helped increase the power of the study and reduce the likelihood of a Type II error (Slavin & Smith, 2009).

Sample Range

The sample selection for the 2015-2021 academic years was chosen due to three rationales. First, using a broader scale of years would help prevent any state or institutional curriculum changes from impacting the overall analysis of this study. Changes in curriculum, textbooks, schedules, and learning outcomes vary over the academic years. However, using this sample range limited any of these expected changes. Second, the selected sample period provided an adequate number of students for which statistical testing, interpretation, and inferences could be established. Lastly, the worldwide COVID pandemic occurred during the latter portion of the selected sample dates. The impacts of the pandemic on higher education are generally considered from

the academic fall term of 2019 through the 2021 fall term (Howell, et al., 2022). During this timeframe postsecondary enrollment dropped approximately 6.6% nationwide, impacting an estimated one million students (Krishnan, Law, & Roundsaville, 2020) The sample for this research includes data within the pandemic academic period. Based off the provided data, enrollment at Jones College during the COVID pandemic interval decreased approximately 2.1%. The overall impact of these enrollment changes in A&P I course enrollment are negligible. The potential impact of the pandemic on student success will be discussed in the concluding sections of this paper but is beyond the primary research goals of this study and does not pose a statistical risk in the data analysis.

Sample Justification

Currently, fifteen community colleges exist in Mississippi. These institutions enroll approximately 100,000 students annually in more than 250 unique programs of study. All of Mississippi's community colleges are open-enrollment institutions that recruit students throughout the state and region (Mississippi Association of Community and Junior, 2020). The college is situated in a geographical location that grants the institution a diverse student population and therefore provides an optimal sample student population for this study. The college recruits and enrolls students from across MS. Based off the demographic data provided by students at time of registration, 80 of the 82 MS counties had students enrolled at Jones college. During the research interval, 75 of the 82 counties in MS were represented by A&P I students. Jones College's credible academic results, vision and institutional goals, student enrollment size, and mirroring of the intended parent population of the state of Mississippi further support its ability to provide a suitable sample of study for the parent population.

Jones College is positioned in the southeastern, central portion of Mississippi. The college is centered between Meridian and Hattiesburg, Mississippi, which comprise the largest non-rural populations in this region. In addition to general academic courses, Jones College supports various career technical programs in health care, industrial manufacturing, and technological development. Due to the location, class offerings, and overall academic reputation (i.e., high job placement, graduation, and university transfer rates), Jones College recruits diverse students from across MS and southern regions. For example, over 70 of the 82 MS counties were accounted for in the sample data during the years researched in this study.

During the sample range of this study, Jones College consistently ranked between the sixth to eighth largest community college in Mississippi out of the fifteen community colleges institutions. The college's average enrollment during the years was 4,700 students annually. These enrollment numbers place Jones College in the middle to upper range of the community colleges in MS, therefore aiding in providing a balanced, consistent sample of students for this research. Jones College reported that during the research period, the average demographic profile was 62% white, 33% black, and 5% from other ethnic groups. Females comprised most of the student body at 58% compared to 41% of males and less than 1% not reporting (Jones College, 2021).

The Mississippi Community College Board reports for the same research period revealed an overall community college student population of 57.2% white, 41.3% black, 62.4% female, and 36.8% male (MCCB, 2021). The MS state census reveals a similar demographic breakdown during the research sampling timeframe with a reporting population of approximately 58% white, 38% black, 2% Asian, and 2% other racial

descriptions. The state demographic reports demonstrated a less than 1% change from 2010 to 2020 (United States Census Bureau, 2023), indicating that the population demographics remained consistent throughout the sampling period. Jones College provides a comparable demographic breakdown to the state of MS and the fifteen community colleges based on these comparisons. Like the other community colleges, Jones College has an open enrollment policy that grants acceptance into the college and professional programs to students from various academic backgrounds. This varied academic makeup provides a data set that encompasses a broader demographic, providing more accurate data to reflect the larger MS student population. Such a varied range of students allowed for broader applicability of the research conclusions.

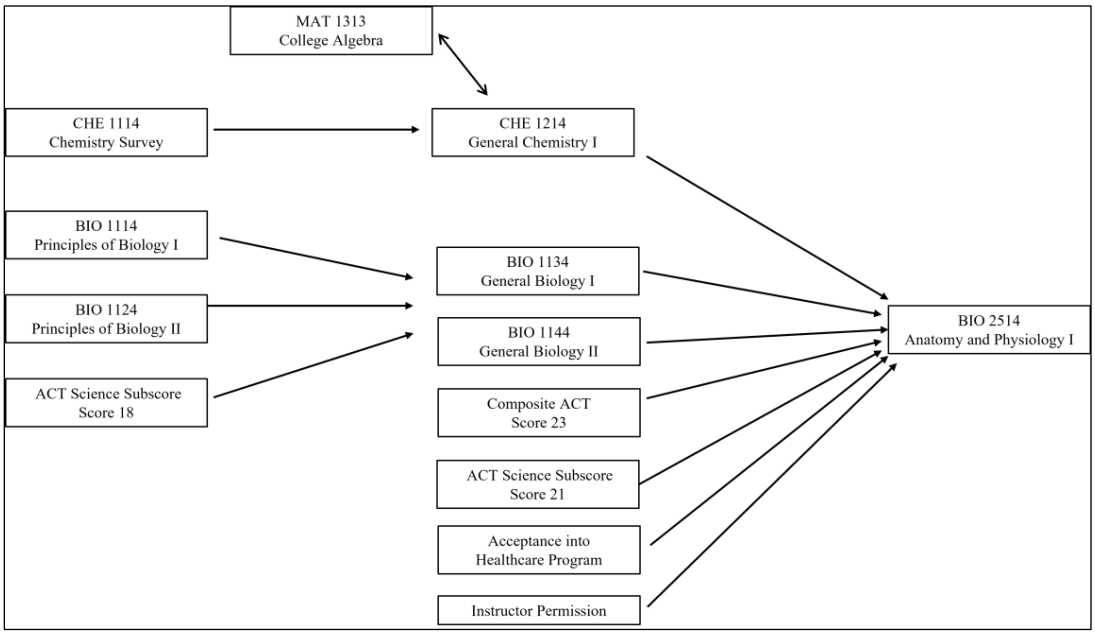
Jones College provided approximately five A&P I courses each academic semester for student enrollment. These classes were offered during different time periods and in various section formats. The researcher of this project taught one section of A&P I each semester during the studied sample period. The student data from the researcher's A&P I courses was not included in the analysis to eliminate any researcher bios or skewing of data. The remaining A&P I courses offered at Jones provided comparative data for an analysis. Several benefits existed for the use of the Jones sample data. First, the remaining A&P I courses were taught by only three individual instructors. These instructors worked in close partnership with each other to develop consistent course designs and curriculum delivery. Secondly, all instructors utilized the same schedule format, assessments rubrics, exams, and subject learning objectives. Lastly, all the A&P I instructors used the same online learning platform, Canvas, as the supplemental delivery method for instructional material. Since the majority of the A&P I instructional material

is delivered in a similar format, the researcher concluded that course design and evaluation bios was minimized.

Course Sequence and Placement

This project was designed to evaluate potential placement criteria that could be used to predict success for students placed in college A&P I courses. To better conceptualize the methodology of this research, a visual description of course sequence and placement criteria for students into A&P I courses at Jones College is provided. According to the 2019-2021 and previous 2015-2018 versions of the Jones College course catalog, a student can be admitted into an A&P I course through various prerequisites (Jones College, 2022). Enrollment into A&P I at Jones College only requires students to meet any one of the entry requirements listed in the college catalog (Jones College, 2022). Figure 1 illustrates the varied criteria that allow students to gain admittance into an A&P I class at Jones College if any of the following criteria are met: "*BIO 2514 – Anatomy and Physiology I – Prerequisite: Minimum ACT score of 21 on the Science component, or BIO 1134, 1144, or CHE 1214, or admission to a health-related program at JC, or permission of instructor"* (Jones College, 2022). Most other community colleges and universities use similar placement criteria for A&P I. Some institutions have fewer "gateways" into the course, yet other programs have either more options or a combination of criteria. Unfortunately, no definitive research literature can justify or support these criteria as effective placement methods.

Figure 1: Jones College A&P I Course Sequencing



Note: Jones College course sequence for students enrolling in Anatomy and Physiology I course. This figure shows the developmental courses and other optional admission criteria for A&P admittance.

Statistical Analysis

The predictor variables were then coded into manageable data fields using SPSS. Categorical variables that required coding were the individual prerequisite biology course codes as completed or non-completed. The outcome analysis required a continuous dependent variable, so the final letter grade outcome was recoded into either a successful (code=1) or a non-successful category (code=0).

Operation Variable Description

Independent Variables

Grade Point Average (GPA)

In this study, GPA was a continuous variable calculated based off the student's GPA at the time of enrollment into their A&P I course. The formula for calculating GPA

used by post-secondary educational institutions is to divide the total points earned in the student's credited academic career by the total number of college credits attempted. The resulting figure is the GPA for that program.

Composite ACT Score

This study used the student's composite ACT score as a continuous variable. A student's composite score is the average of the student's English, Math, Reading, and Science subscores. The scores are then rounded to the nearest whole number. The composite ACT score's range consists of 1–36.

ACT Science Subscore

The student's Science Subscore on the ACT was used as a continuous variable for this study. The science section has 40 questions administered in total. It is the only ACT section that does not have subscores, though it still has three distinct question types: data representation, research summaries, and conflicting viewpoints (ACT, 2023).

Prior College Credit Completion

This study used the prior college credits completion variable as a continuous variable. This is the total credit hours completed prior to the student's enrollment into the A&P I course. These hours include transfer credits the student provides by transcripts to student enrollment. Only course completion with credit hours granted is included in the calculation; therefore, final grades of "F, I, W, of FA" are not used in this calculation.

Biology Prerequisite Courses

The biological prerequisite course completion was a categorical variable. The individual courses analysed in this study include Principles of Biology I (BIO 1114), Principles of Biology II (BIO 1124), General Biology I (BIO 1134), and General Biology II (BIO 1144). For the analysis, codes were given based on the student's completion of each course. The data was coded as completion (code=1) or not-completed (code=1).

Dependent Variable

The dependent variable for this study was the final letter grade assigned for the student's initial A&P I course. The dependent variable was a categorical variable for this study. This data field was classified and recoded as successful completion (code=1) or unsuccessful (code=0). For a successful code, the student's final grade was an assigned "A, B, or C." All other grades or classifications were coded as unsuccessful.

Address of Assumptions for Statistical Tests

Analysis of Variance (ANOVA) and Multiple Regression (MR) require certain statistical assumptions to be used in the outcome analysis interpretation. Depending on the test being utilized, the violation of the assumptions can be minor or severe. As part of an ANOVA, multiple regression is considered robust to most assumption violations (Field, 2009). Each assumption was verified before testing, as henceforth described. Multiple regression was used to generate predictions in the evaluation of the research hypotheses. The goal of this study was to identify which of the independent variables had a stronger correlation with the dependent variable of A&P I success, and therefore a hierarchical or sequential regression was chosen over a standard regression (Tabachnick & Fidell, Using Multivariate Statistics: Pearson New International Edition, 2013). Hierarchical regression allows the researcher to run several regressions while still controlling a different variable (Warner, 2020).

Assumptions of Correlation.

The outcome variable was recoded to a quasi-continuous variable via coding to a four-point grading scale. This method allows for continuous data analysis via reporting transcript grades (McEwen, Mohn, Shelley, & Herron, 2019). The Pearson correlation coefficient measures the linear association between variables. Four main assumptions

listed below exist for correlation. All regression assumptions were tested for violations before analysis. No violations existed.

1.) The two variables of interest must be in a continuous data form. Therefore, except for the outcome variable and the requested demographics, the variables used in this research were continuous in nature when reported.
2.) The two variables of interest should have a linear relationship, demonstrated with a scatterplot. Scatterplots were used to determine the linearity of the relationship between the variables. No observations of non-linear relationships were discovered.
3.) Extreme outliers must be absent. The data were pre-screened to evaluate and adjust for any extreme outlier data points. After screening, all data points were within acceptable ranges as defined by the upper and lower limits of the data means within a standard deviation.
4.) The distribution of variables should be near-to normal or normal. Distribution plots, skewness, kurtosis figures, and variable means were used to test for normality. No gross deviations from the expected results were observed.

Assumptions of ANOVA.

All ANOVA assumptions were tested for violations before analysis.

1.) The responses for each factor level should demonstrate a normal population distribution. Each continuous predictor variable was examined for normality by creating histograms in combination with calculations of skewness and kurtosis. The sample size limited the impact of skewness due to the adjustment factor of 1.00 for sample sizes greater than 100. The skewness value for each predictor variable was evaluated compared to the normal skew

of zero, and the kurtosis figures were compared to a normal kurtosis of 3.00. The resulting analysis reveals the data to be within acceptable ranges. Considerations of the sample versus population impact concerning skewness and kurtosis will be addressed in chapter V.

2.) The distribution within the variables should have the same variance. Given the sample size and the specifics of data acquisition, homogeneity of variance violation was not expected. Furthermore, as the sample is reflective of the population, and elimination procedures were not based on sub-group identification, the variances represented in the groups must be accepted as found. Therefore, accounting for potential issues will be addressed in chapter V.

3.) The dependent variable is categorical. Each student was awarded a categorical code of successful completion if they completed the course with a final letter grade of "C" or higher. For example, suppose the student completed the course with a final letter grade of "D" or “F," they were given a categorical code for unsuccessful. In order to achieve a continuous dependent variable, the variable was recoded to a continuous scale via the method previously described.

Random Independent Samples

This study was conducted with a single sample of participants. The students had 14 available predictor variables in the data set. Except for the ACT science sub-scores and the ACT composite score, all variables are independent. While the ACT science sub-score is a component of the ACT composite score, it constitutes 25% of the contribution. Three other independent sub-scores constitute the remaining components of the overall

score, which mitigate the degree of dependence between these two variables. Furthermore, these variables have been used in numerous previous analyses (McEwen, Mohn, Herron, & Shelley, 2018).

Assumptions of Regression.

All regression test assumptions were tested for violations before analysis.

Variable Types.

The ACT scores, amount of college hours, GPA, and BIO hours are continuous. Any variables that were not categorically binary in nature were binary coded.

Non-zero Variance.

All predictor variables have a non-zero variance.

Multicollinearity.

There is an expectation that some degree of multicollinearity will exist due to the nature of the relationship between the utilized continuous independent variables. However, the degree is limited due to the contributions of numerous other factors. This was previously described with the ACT science sub-score and ACT composite score. However, the raw data was used directly for analysis due to the need for a practical application model, to which centering could be more conducive, and the limited impact of the previously described relationships.

Homoscedasticity.

This study examines practical use models that must also follow legally established placement protocols. As such, it is illegal to place students in courses based on demographic parameters. Furthermore, the comparisons utilize the whole sample without respect to breakdowns in the variable sub-groups for similar reasons. Thus, the variables must be taken as is, with an accounting reserved for interpretation in chapter V.

Independence of Errors

Due to the sample size, no violations or data problems were expected.

Normality of Distributed Errors

Skewness and kurtosis of the residuals for the independent variables were obtained and analysed through standard acceptability criteria.

Independence

Each value of the outcome variable is based on student outcomes in the class. Since this study examined the predictive characteristics of other variables unrelated to this, independence is not considered an issue. Therefore, the study is further limited to one dependent variable, reducing the concern.

Linearity

Plots for each independent variable versus the dependent variable were obtained and examined for linearity. Non-linear relationships were not noted.

ANOVA

The fourteen independent variables were analysed and compared to the outcome variable using a univariant ANOVA analysis. The outcome variable of course completion was compared with the independent variables. Any variables demonstrating a statistical significance of ($P<0.05$) were used for regression analysis. The ANOVA analysis was used to answer the research question regarding variables that are statistically significant predictors of outcomes in the course.

Regression

A series of binary logistic and linear regressions were used as a predominant analysis to address the research questions of this study. The series of regression analyses were utilized in this study in order to determine the combination of independent variables that best predict success in A&P I courses. First, a linear regression analysis was

performed to generate a mathematical predictor model compared to currently used and readily available predictor models. A regression equation was generated to compare the models. Finally, sensitivity and specificity tables were generated and used to examine the accuracy of regression models compared to the baseline and commonly available information models.

Conclusion

This study was designed as an exploratory research project to determine if a specific set of student variables can be used to predict whether a student will be successful with a final letter grade of "C" or higher in an A&P I course at the community college level. By determining the relevant variables which contrast the successful versus non-successful students, a more accurate advisement model can be developed and implemented by the student's academic advisor. Although historically more accurate as more parameters are introduced, predictor equations also contain a noted difficulty in implementation. Therefore, the analysis of effort versus benefit is reserved for chapter V.

CHAPTER IV--RESULTS

This retrospective, nonexperimental quantitative study aimed to evaluate whether student outcomes in Anatomy and Physiology (A&P) I could be predicted by individual placement criteria or a combination of these criteria. This chapter describes the results from the data analyses performed for this study. The study utilized data from Jones College, a community college in southern MS, for the academic years 2015-2021. The sample data was comprised of first-time enrollment students of A&P I. The outcome variable for this study was student success in the A&P I course, where a final grade of "C" or higher was coded as successful, and a grade of "D" or "F" was classified as unsuccessful. The independent variables examined included: GPA at the time of A&P enrollment, Composite ACT score, ACT science subscore, prior completed college credits, and completion of prerequisite and developmental biology courses as credit hours. A regression model was used to evaluate and compare the currently utilized placement criteria with the model indicated by the study.

This chapter will provide an analysis of the descriptive statistics as they relate to the independent and dependent variables previously described. The study used descriptive measures, correlation, and an Analysis of Variance for the primary analyses. A hierarchical logistical regression was utilized if any correlations existed between the independent and dependent variables. The significance between the variables, including categorical and continuous predictor variables, and a hierarchical logistical regression will be discussed. In conclusion, answers to the proposed hypotheses will be presented, ending with a brief chapter summary.

Assumption of ANOVA Analysis

The quantitative research consisted of an ANOVA model to measure the relationship of the dependent variable of A&P final grade with the following five independent variables: total credited college hours, completed biology course hours, GPA at time of enrollment, composite ACT score, and ACT science subscore. To conduct an ANOVA analysis, the dependent variable must be continuous in nature. Therefore, the student's final grade was converted to a college grade point scale, where a grade of an "A" =4, "B" =3. "C" =2, "D" =1, and "F" =0. The result of the ANOVA formula, the F statistic (also called the F-ratio), allowed a comparison of multiple independent variables of more than two groups at the same time to determine if there was a statistically significant association among the variables and A&P outcome. These outcomes could indicate what combination of variables may be more important in focusing advisement policies and A&P prediction models at the community college level.

Before performing the ANOVAs, the sample was assessed to verify that the assumptions of ANOVA (i.e., independent observations, normally distributed populations, and homogeneous variances) were satisfied. In all cases, the data categories were independent because of the design of the data collection, in which each predictor variable was collected and recorded as a separate data point of one sample group. As a result, no one category had a bearing on another category. Skewness and kurtosis calculations were performed to detect violations of the normality assumption. For the five independent variables, skewness ranged from -1.0 to 1.0, and kurtosis ranged from 0 to 2.0. These skewness and kurtosis values are within the expected range of chance fluctuations, so the normality assumption is satisfied.

Assumption of Regression Analysis

The study used a binary linar regression (BLR) for secondary data analysis and a multiple linear regression to generate the overall model used in the sensitivity and specificity of placement comparisons. Before addressing the research questions, all assumptions associated with binomial linear regression were evaluated. Linear regression analyses demonstrate if variables can explain a statistically significant amount of variance in a dependent variable after accounting for other variables. A traditional linear regression analysis presumes that all cases are independent.

Before the data analysis phase, the investigator examined several assumptions regarding the binary linear regression test and how they were addressed by the analyst statistically. Fox (2016) notes that the seven primary assumptions of the linear regression are as follows:

1) The classification of the dependent variable is binary.

2) One or more independent variables are either continuous or categorical.

3) The dichotomous dependent variable's categories are mutually exclusive and exhaustive.

4) A minimum of 30 cases exists for each predictor variable.

5) There is a linear relationship between the continuous independent variables and the logit transformation of the target.

6) The predictor variables do not highly correlate with one another, and multicollinearity is absent.

7) There are no significant outliers or any extreme leverage points.

Descriptive assumptions

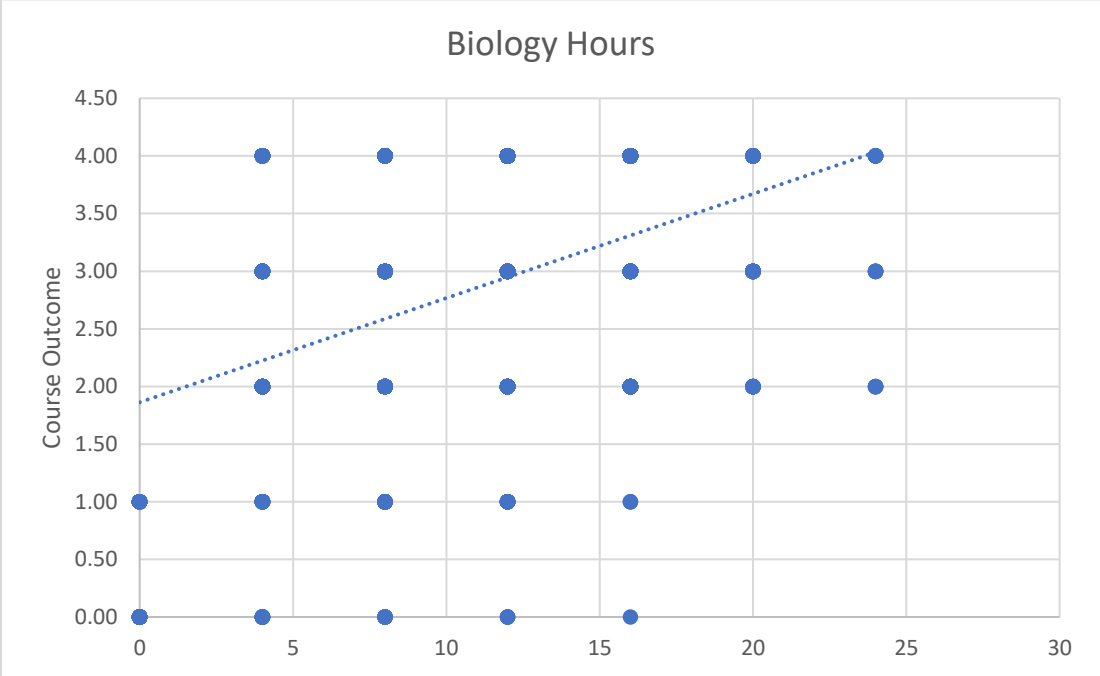
The researcher answered the first four assumptions of the BLR through a visual inspection of the secondary data and the use of scatterplots. Between 2015 to 2021, 2,605 students completed their A&P I course. The single categorical independent variable was the prior, completed biology (BIO) courses. The individual biology courses were isolated and assessed for A&P predictability later in the analysis, but for this regression portion, the researcher accounted for the binary nature of the biology courses by combining the total number of biology courses completed before A&P enrollment. The study also described the dichotomous dependent variable within the context of the sample population. The dependent variable of A&P course outcome GPA averaged at 2.82 (*SD* = 1.01, Variance =1.02, Skewness = -1, Kurtosis = 0) (See Table 1). The Kurtosis of this predictor variable was within normal limits, and the study judged it as not prone to generating statistical outliers.

Table 1: Continuous Variable Analysis

	BIO Hours Before A&P I	Cumulative College Hours total before A&P I	GPA Prior to A&P I	ACT Science Subscore	ACT Composite Score	Course Outcome GPA
Mean	10.58	55.61	3.07	21.37	20.82	2.82
S.D.	4.84	29.02	0.63	3.12	3.34	1.01
Variance	23.41	841.93	0.39	9.74	11.13	1.02
Skew	0	0	-1	0	1	-1
Kurt	0	0	2	1	0	0

Analysis for BIO hours completed prior to A&P enrollment noted a mean of 10.58 (*SD* = 4.84, Variance=23.41, Skewness = 0, Kurtosis = 0). A visual scatterplot was used to examine the predictive or correlational relationship between the number of BIO hours and the dependent variable of A&P course outcome GPA. A trend line was added to the plot showing the mathematical best fit to the data. This can provide an additional signal as to how strong the relationship between the two variables is and if any unusual points are affecting the computation of the trend line. This scatterplot (Figure 2) showed that a loose, linear relationship exists between the variables. While the relationship is not a strong correlation, the assumptions of regression only require that it not exhibit a non-linear relationship pattern.

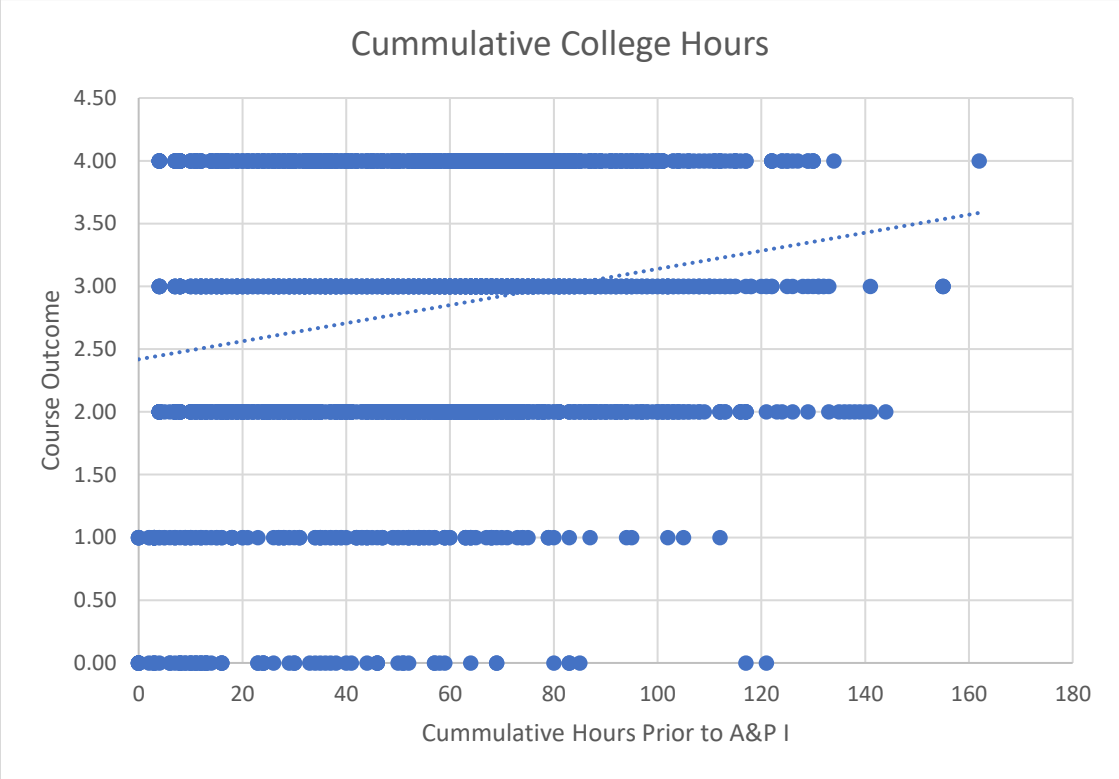
Figure 2: Total Biology Hours Prior to A&P Enrollment and Outcome A&P I GPA



Note: The dotted line identifies the mathematical best fit for the data

The total amount of college credit completed prior to A&P enrollment averaged 55.61 (*SD* = 29.02, Variance=841.93, Skewness = 0, Kurtosis = 0). The visual scatterplot in Figure 3 provides a summary of this correlation. The Kurtosis of this predictor variable was within normal limits, and it was judged as not prone to the generation of extreme spread and outliers. Like Figure 2, Figure 3 shows a loose, linear relationship between the variables that also meet the assumption of not exhibiting a non-linear relationship pattern.

Figure 3: Cumulative College Hours Prior to A&P Enrollment and Outcome A&P I GPA

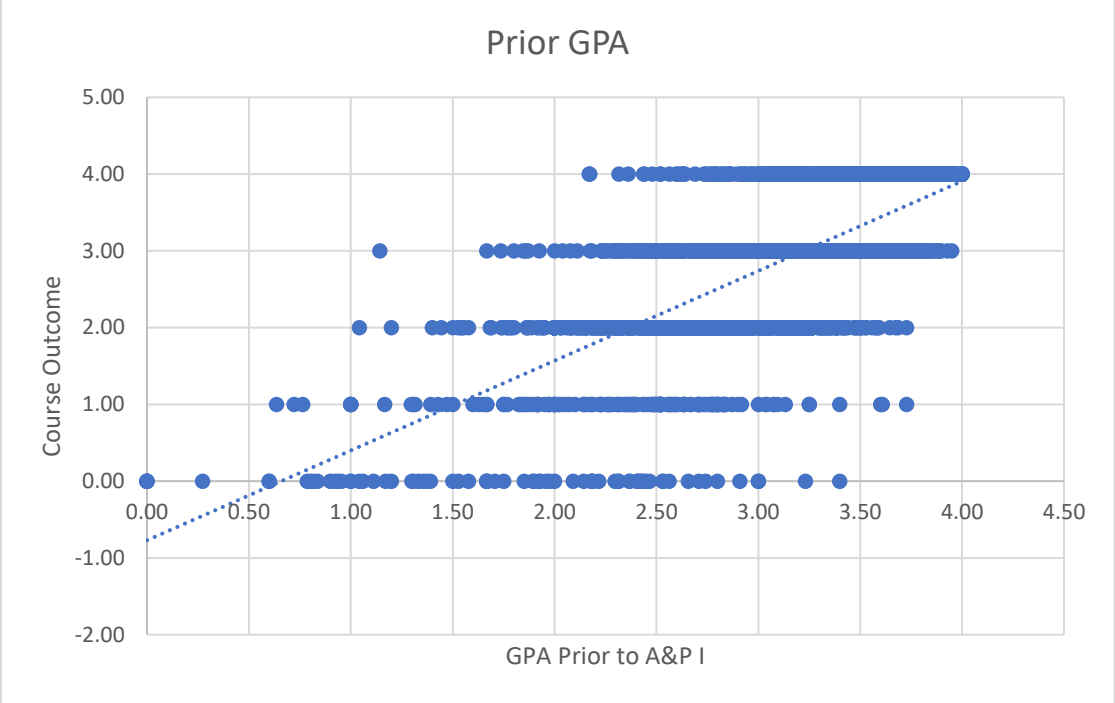


Note: The dotted line identifies the mathematical best fit for the data

The mean for student GPA prior to A&P enrollment was 3.07 (*SD* = 0.63, Variance=9.74, Skewness = 0, Kurtosis = 1). A visual scatterplot was used to look at the predictive or correlational relationship between the student's GPAs prior to enrollment and the dependent variable of A&P course outcome GPA. A trend line was added to the

plot showing the mathematical best fit to the data. The Kurtosis of this predictor variable was within normal limits, and it was judged as not prone to the generation of statistical outliers. Figure 4 demonstrates a loose, linear relationship between the variables. The assumption of regression only requires a non-linear relationship; therefore, the loose linear relationship is acceptable for this variable.

Figure 4: Student GPA Prior to A&P Enrollment and Outcome A&P I GPA

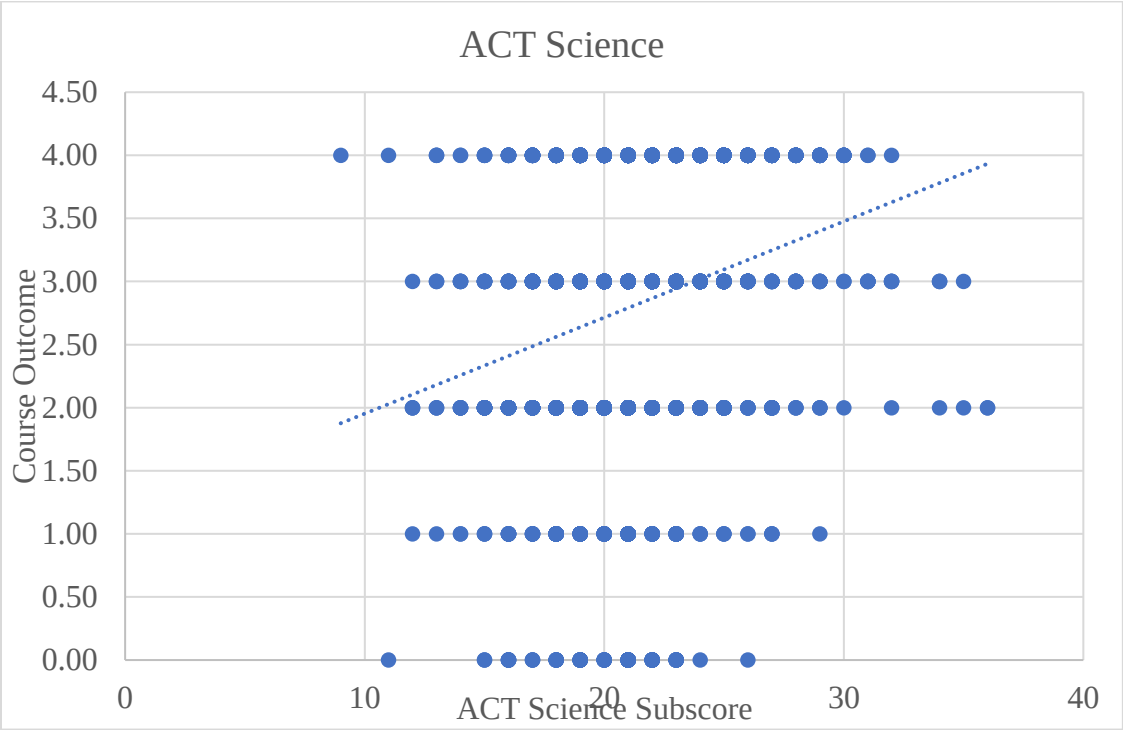


Note: The dotted line identifies the mathematical best fit for the data

The ACT Science subscore for A&P students calculated a mean of 21.37 (*SD* = 3.12, Variance=9.74, Skewness = 0, Kurtosis = 1). A visual scatterplot was used to look at the predictive or correlational relationship between the student's ACT science subscore and the dependent variable of A&P course outcome GPA, and a best fit trend line was added to the plot. The Kurtosis of this predictor variable was within normal limits, and it was determined as not prone to the generation of statistical outliers. Figure 5

demonstrates a linear relationship between the variables that still meets the assumptions of regression.

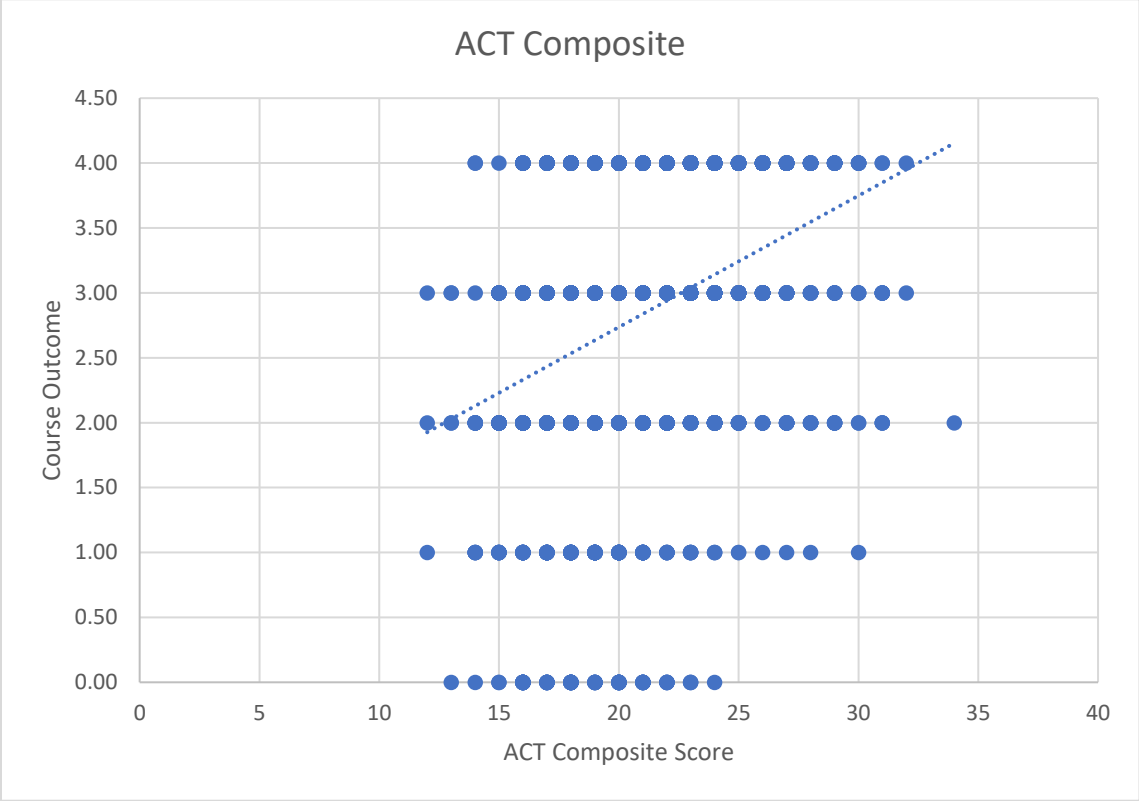
Figure 5: Student ACT Science Subscore Prior to A&P Enrollment and Outcome A&P I GPA



Note: The dotted line identifies the mathematical best fit for the data

The calculated mean of the Composite ACT score for A&P students was 20.82 (*SD* = 3.34, Variance=11.13, Skewness = 1, Kurtosis = 0). Figure YY shows the visual scatterplot with best fit line used to look at the predictive or correlational relationship between the student's ACT science subscore and the dependent variable of A&P course outcome GPA. The Kurtosis of this predictor variable was within normal limits, and it was judged as not prone to the generation of statistical outliers. Figure 6 follows the previous independent variables pattern indicating a loose, linear relationship between the variables that maintains the assumptions of the regression.

Figure 6: Student Composite ACT score prior to A&P Enrollment and Outcome A&P GPA



Note: The dotted line identifies the mathematical best fit for the data

Linearity assumptions.

The Box-Tidwell (1962) statistical testing procedure was used to assess the linearity of the continuous variables with regards to the logit of the dependent variable. The researcher calculated a Bonferroni correction to the six interaction terms within the model. From this, a new statistical significance was generated with $p < 0.00834$. The Bonferroni correction value was less than all significance levels found during the Box-Tidwell (1962) test. Therefore, the continuous variables of age and experience demonstrated linearity to the logit of the dependent variable.

Multicollinearity assumptions.

The researcher examined the next assumption, a lack of multicollinearity, using Variance Inflation Factors (VIFs) calculations. The target VIFs is < 10 (Fox, 2016). All independent variables met this threshold and met the requirements of no multicollinearity.

Outlier assumptions

The investigator examined the significant outliers as the final assumption of the binary linear regression. Of the 2,605 cases, none exhibited universal extremes which were ±2 standard deviations from the mean. Inspection of most cases revealed that many were not extremes of all examined variables, but rather a combination of slight changes and likely due to factors beyond the students' control. Their location in the upper and lower boundaries of two or more independent variables caused a cumulative standard deviation outside of the threshold within the prediction regression model. As such, while their variable values are extreme, the cases are not unusual. Therefore, the cases exhibiting these traits were determined to be practical extremes and not statistical outliers.

Demographic Descriptions

The sample population for this study was comprised of all students who enrolled in A&P I course at Jones College during the research timeframe of the 2015-2021academic years and totaled 2,605 students. The descriptive data, shown in Table 2, as reported by the college's reporting system, reveals a population primarily comprised of white females between the ages of 20–24-year-old. The mean age was 26.33 (*SD* = 5.89, Variance=34.76, Skewness = 2, Kurtosis = 6).

Table 2: Sample Age, Race, and Gender

Age	Total
<20	8
20-24	1173
25-29	993
>29	431
Race	
White	1878
Black	654
American Indian	22
Asian	23
Hispanic	19
Pacific Islander	1
Not Specified	8
Sex	
Male	552
Female	2051
Undisclosed	2
	n = 2605

Over 64% of students enrolled in A&P during this research period completed a minimum of one prerequisite course. The optional prerequisite courses that a student may complete to meet A&P I entry requirements at Jones College include General Biology I, General Biology II, or General Chemistry I. Most of these students (Figure 7) enrolled in

General Biology I. Students enrolled in A&P class nearly equally during the Spring and Fall semesters with fewer enrollments during the summer semester of the academic year, which was to be anticipated (Figure 8.) More students enroll in A&P in the Fall semester due to the normal offering and sequence of A&P course during the academic year. A&P I is typically taken during the fall semester, and A&P II completed in the Spring semester. Since the COVID pandemic is of interest in academic research currently, it is also worth noting that 77% of students in this study were not impacted academically by the COVID pandemic (Figure 9).

Figure 7: Student Preparatory Biology Course Enrollment Prior to A&P O I Enrollment

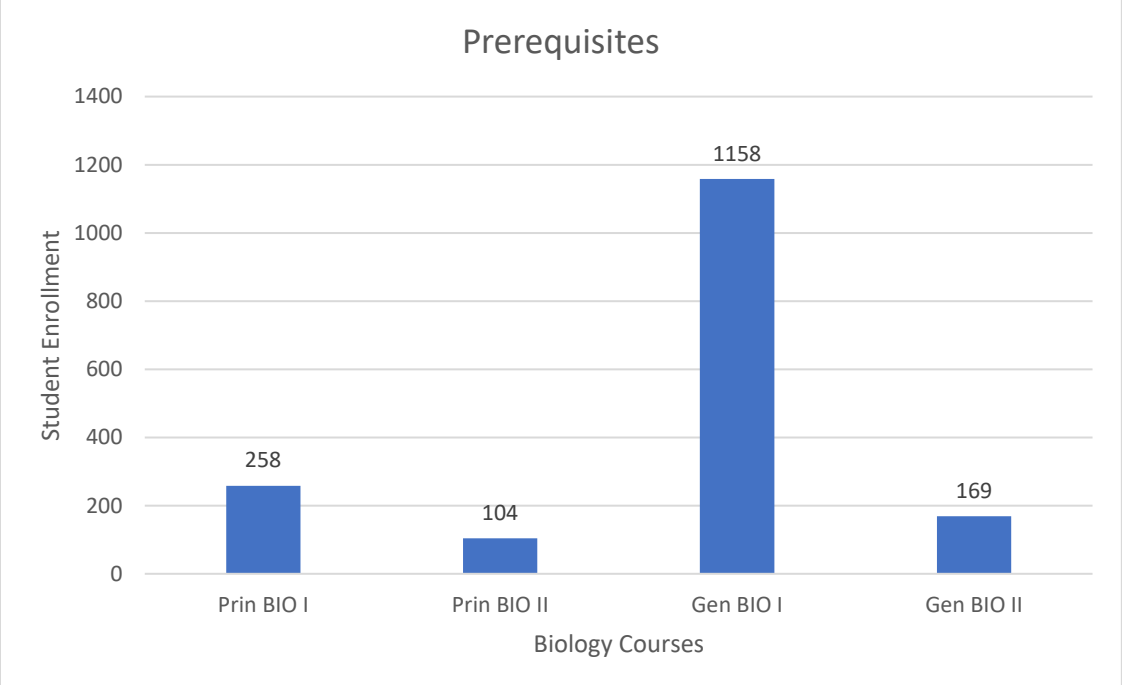


Figure 8: Semester of A&P I Enrollment

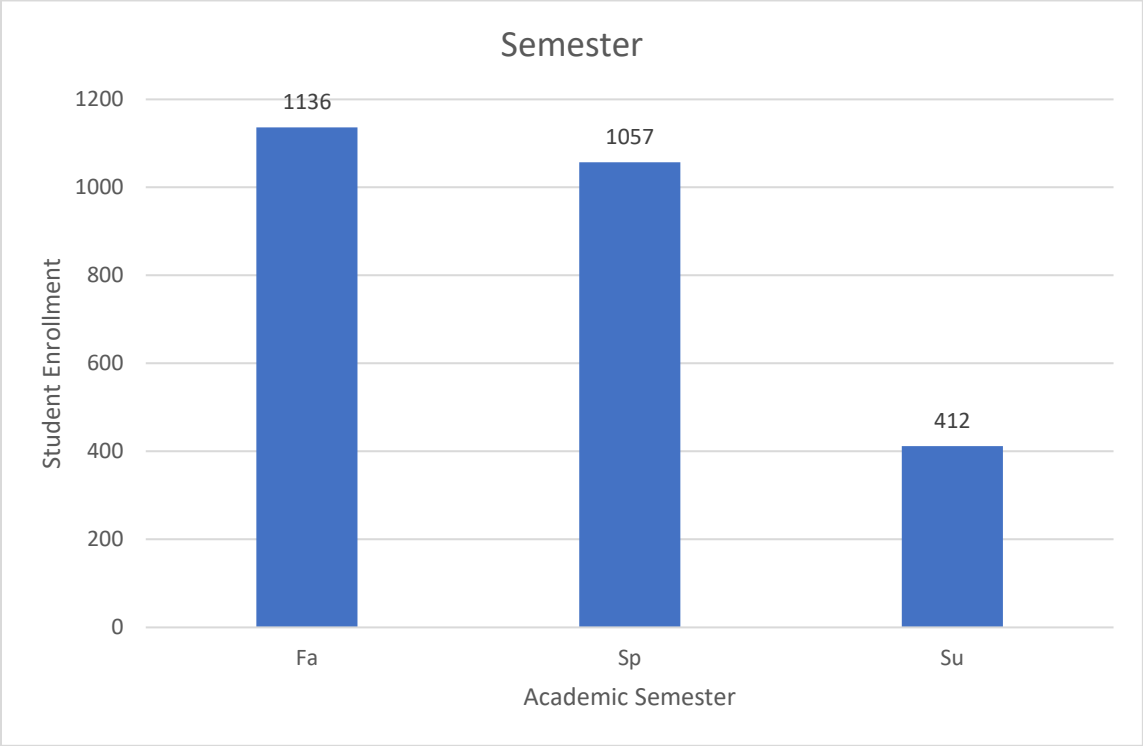
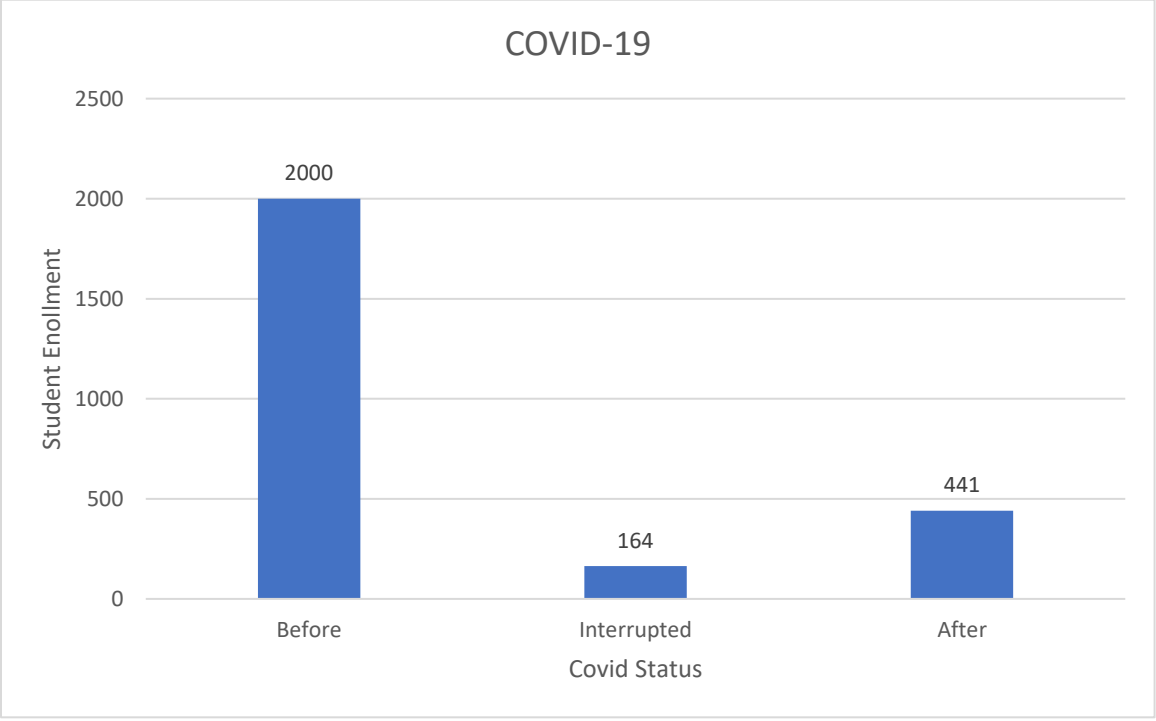


Figure 9: Semester of A&P I Enrollment



ANOVA Results

An ANOVA was conducted to compare the effect of the academic independent variables on the final A&P I grade point average of completing students. Comparisons were made among prior Biology course hours, total prior college credits, ACT science subscore, composite ACT score, and student GPA. There was a significant difference in A&P I GPA among the academic factors at the $p < .05$ level for the three groups $F(2,20832) =[6937.357]$, $p =0.001$. Since a statistical significance is reported between the independent and dependent variables, the individual research questions and hypotheses were further analysed using linear regression to discover the relationship between each predictor variable and the output variable.

Table 3: ANOVA Results

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between	5850955.70	7	835850.81	6937.36	0.00	2.02
Within	2509953.60	20832	120.49			
Total	8360909.30	20839				

$p < .05$

Research Question One

The first research question focused on the cumulative amount of completed college hours prior to the students' first-time enrollment in an A&P I course at Jones College in Ellisville, MS. No advisement process currently exists at Jones College for predicting student success in A&P based on the completed total college credits at time of

enrollment in A&P I. The reported college hours used for this analysis portion is comprised of all preceding credit courses completed with a final grade of “C” or higher. This portion of the analysis aims to identify any correlation or predictive relationship between the prior completed college credits and A&P I outcomes. This independent variable will be studied as a continuous variable using descriptive and inferential analysis with a binary linear regression model.

1. Does the cumulative amount of college credit hours successfully completed, defined by a grade of "C" or higher, predict a student's success in an A&P I course?

H_1: The cumulative college credit hours completed prior to A&P I enrollment predict student success in an A&P I course.

H_0: The cumulative college credit hours successfully completed prior to A&P I enrollment are not predictive of student success in an A&P I course.

Descriptive and inferential statistics were used to investigate the research hypothesis. First, the frequencies and percentages were used to describe the student's cumulative college credit hours completed before A&P I enrollment. Table 4 shows that the number of female students who reported cumulative college credit hours completed successfully was higher than their male counterparts.

Table 4: Cumulative College Credit Hours Completed by Gender and Ethnicity

Variable	N	M	SD
Gender			
Female	2209	54.95	28.21
Male	579	54.63	29.49
Ethnicity			
White	2006	55.75	28.959
Black	703	51.4	29.988
Asian	25	58.04	30.44
Amind	23	51.74	25.088
Hispanic	22	59.64	24.112
Pacif	8	69.38	25.696

The female students also had higher scores in cumulative college credit hours completed successfully (M = 54.95, SD = 28.21) than male students (M = 54.63, SD = 29.49) (see Table 4). The majority of students were also white, followed by black student. The mean cumulative amount of college credit hours completed successfully among white student was higher than other races when the sample size is considered (M = 55.75, SD = 28.959).

Under inferential statistics, a binary linear regression was used to analyse the data, with cumulative college credit hours completed successfully before A&P I as the independent variable and student success in A&P I being the dependent variable. The binary linear regression indicated that cumulative college credit hours completed

successfully before A&P I was a significant predictor of a student's success in an A&P I course, $\chi^2(1) = 98.497$, $p < .001$. In addition, the model explained 7.9% (Nagelkerke R^2) of the variance in student success in an A&P I course (see Table 5). However, Hosmer and Lemeshow test showed that the model exhibits a limited fit for the data, $\chi^2(8) = 19.573$, $p = .012$ (<.05). The odds ratio (OR) for student total college credit was 1.026 (95% CI 1.020 – 1.031) (see Table 5).

Table 5: Regression Output

							95% C.I. (EXP(B))	
		B	S.E.	Wald	Df	Sig.	Exp(B)	Lower	Upper
Step 1	College credit hours	.025	.003	86.487	1	<.001	1.026	1.020	1.031
	Constant	1.234	.126	95.234	1	<.001	3.436		

Log likelihood =1517.22 ; *Cox & Snell* R^2 = .034; *Nagelkerke* R^2 = .079; $\chi^2(1) = 98.497$, $p < .001$

Table 5 shows that increasing cumulative college credit hours completed successfully before A&P I was associated with an increased likelihood of success in an A&P I course, Wald =86.487, $p < .001$. The regression model also correctly predicted 100% of cases of success and 0% of failure cases, giving an overall percentage correct prediction rate of 91.7% (see Appendix 1). Thus, the null hypothesis was rejected in favour of the research hypothesis. Based on the result, there is sufficient evidence to suggest that cumulative college credit hours completed successfully before A&P I predict student success in an A&P I course.

Research Question Two

The second research question analysed the GPA at time of enrollment of first-time A&P students at Jones College in Ellisville, MS. Despite GPA being identified in literature as a strong predictor for overall college success (Allensworth & Clark, 2020), no specific advisement policy currently exists at Jones College for placement or prediction of student success for A&P course based off GPA. The GPA utilized for this portion of the analysis was calculated based on the student's course transcript of completed courses at the time of A&P enrollment. The objective of this portion of the analysis was to identify any correlation or predictive relationship between student GPA and A&P I outcomes. This independent variable was studied as a continuous variable using descriptive and inferential analysis with a binary linear regression model.

2. Does a student's GPA prior to A&P I enrollment predict a student's success in an A&P I course?

H_1: A student's GPA prior to enrollment in an A&P I course is predictive of student success in an A&P I course.

H_0: A student's GPA prior to enrollment in an A&P I course is not predictive of student success in an A&P I course.

Descriptive and inferential statistics were used to investigate the research hypothesis. The descriptive statics in Table 6 showed frequencies and percentages that describe the student's GPA before enrollment in an A&P I course. The female students reported higher mean GPA before enrollment in an A&P I course (M = 3.07, S.D. = .64) than their male counterparts (M = 2.98, S.D. = .67) (See Table 6).

Table 6: Student's GPA Before Enrollment in an A&P I Course by Gender and Ethnicity

Variable	N	M	SD
Gender			
Male	2223	2.98	.67
Female	587	3.07	.64
Ethnicity			
White	2017	3.14	.62
Black	714	2.79	.66
Asian	25	3.48	.53
Amind	23	3.05	.55
Hispanic	22	2.95	.55
Pacif	8	3.17	.60

The result also showed that Asian students had the highest GPA before enrollment in an A&P I course of all the races (M = 3.48, S.D. =.53). Thus, it may be argued that female students and Asian students had higher GPAs before enrollment in an A&P I course than other students.

The inferential statistic employed to investigate the research hypothesis was linear regression. Binary linear regression was the most appropriate regression analysis because the outcome variable (student success in an A&P I course) is a binary variable categorized into success and failure. The regression analysis results indicated that a student's GPA before enrollment significantly predicts a student's success in an A&P I course, $\chi^2(1) = 552.723$, $p < .001$. The result also showed that the model explained 39% (Nagelkerke R^2) of the changes in student success in an A&P I course, and the Hosmer

and Lemeshow test indicates that the regression model was a good fit for the data, $\chi^2(8) = 9.1321$ $p = .331$ (>.05). The odds ratio (OR) for students' GPA before enrollment in an A&P I course was 13.178 (95% CI 9.931– 17.487) (see Table 7).

Table 7: Regression Output

							95% C.I. (EXP(B))	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1	GPA before	2.279	.144	319.206	1	<.001	13.178	9.931	17.487
	Constant	-4.594	.364	159.525	1	<.001	.010		

Log likelihood =1161.64 ; *Cox & Snell* $R^2 = .02$; *Nagelkerke* $R^2 = .39$; $\chi^2 = 552.723$, $p < .001$

As illustrated in Table 7, students with a higher GPA at the time of A&P I demonstrated an increased likelihood of success in an A&P I course, Wald =319.21, $p < .001$ (<.05). The regression model also correctly predicted 99% of cases of success and 27% of failure cases, giving an overall percentage correct prediction rate of 92.7% (see Appendix 2). Thus, the null hypothesis was rejected in favour of the research hypothesis. Based on the findings, it was reasonable to conclude that sufficient evidence exists to suggest that a student's GPA before enrollment in an A&P I course predicts student success in an A&P I course.

Research Question Three

The third research question explored the student's composite ACT score at the time of enrollment of first-time A&P students at Jones College in Ellisville, MS. According to the college catalog, advisors at Jones College are encouraged to place students directly into A&P courses if they have a composite ACT score of 23 or higher. This allows students with acceptable composite score to bypass prerequisite or fundamental biology courses, such as Principles of Biology or General Biology. The objective of this portion of the analysis was to identify any correlation or predictive relationship between composite ACT scores and A&P I outcomes. This independent variable was studied as a continuous variable using descriptive and inferential analysis with a binary linear regression model.

3. Does the composite ACT score predict a student's success in an A&P I course?

H_1: A student's composite ACT score is predictive of student success in an A&P I course.

H_0: A student's composite ACT score is not predictive of student success in an A&P I course.

Descriptive and inferential (regression) statistics were used to investigate the hypothesis. The study employed frequencies and percentages to describe a student's composite ACT score based on gender and ethnicity (see Table 8).

Table 8: Descriptive Statistics for ACT Composition Score

Variable	N	M	SD
Gender			
Female	2150	20.54	3.194
Male	569	21.62	3.707
Ethnicity			
White	1957	21.49	3.220
Black	685	18.79	2.750
Asian	24	21.50	3.683
Amind	23	19.70	2.566
Hispanic	21	18.05	3.154
Pacif	8	19.88	3.271

The majority of A&P I students were females. However, male students reported higher ACT composite scores than females. Even though most of the students were white, Asian students reported the highest mean ACT composition score. However, the high mean score could be attributed to a small number of Asian students (N =24). Thus, overall, white students performed better than other races in the ACT composite when the sample size is considered. Hispanic students had the lowest score on the ACT composition scores.

The study employed a binary linear regression as an inferential statistic to investigate whether a student's composite ACT scores affect their success in A&P I course. The dependent variable was A&P I grade, while the independent variable was student composite ACT scores. The result indicates that student composite ACT scores

are a significant predictor of a student's success in an A&P I course, $\chi^2(1) = 104.73$, $p < .001$ (see Table 9).

Table 9: Regression Output

								95% C.I. (EXP(B))	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition	.237	.025	87.659	1	<.001	1.268	1.206	1.332
	Constant	-2.371	.486	23.793	1	<.001	.093		

Log likelihood =1555.453; *Cox & Snell* R^2 = .04; *Nagelkerke* R^2 = .082; χ^2 = 104.73, $p < .001$

The regression model explained 8.2% (Nagelkerke R^2) of the variance in student success in an A&P I course, with the Hosmer and Lemeshow test showing that the model was fit for the data, $\chi^2(8) = 6.564$, p =.584 (>.05). The OR for student composite ACT scores was 1.268 (95% CI 1.206 – 1.332). The result showed that increasing student composite ACT scores were associated with an increased likelihood of success in an A&P I course, Wald =87.659, $p < .001$. The model correctly predicted 100% of cases of success and 0% of cases of failure, giving an overall percentage correct prediction rate of 91.1% (see Appendix 3). Thus, the null hypothesis is rejected. Thus, sufficient evidence suggests that student composite ACT scores predict student success in an A&P I course.

Research Question Four

The fourth research question explored the student's ACT Science subscore at the time of enrollment of first-time A&P students at Jones College in Ellisville, MS. According to the college catalog, advisors at Jones College are encouraged to place students directly into A&P courses if they have an ACT Science subscore of 21 or higher. This allows students with acceptable science subscores to bypass prerequisite or fundamental biology courses, such as Principles of Biology or General Biology. The assumption is that students who reach the science benchmark score on the science portion of the ACT should be adequately prepared for an A&P I course. The objective of this portion of the analysis was to identify any correlation or predictive relationship between ACT science subscores and A&P I outcomes. This independent variable was studied as a continuous variable using descriptive and inferential analysis with a binary linear regression model.

4. Does the science subscore on the ACT predict a student's success in an A&P I course?

H_1: A student's science subscore on the ACT does is predictive of student success in an A&P I course.

H_0: A student's science subscore on the ACT does is not predictive of student success in an A&P I course.

Descriptive and inferential statistics (logistic regression) were used to investigate the research hypothesis. The frequencies and percentages of the student's science subscore based on gender (Male, female) and race (White, Black, Asian, Hispanic, Amind, Pacif) are shown in Table 10. As illustrated in Table 9, Male students reported a higher mean student science sub-score (M = 22.38, SD = 3.638) than female students (M

= 21.06, SD = 2.909). However, the number of females (N = 2136) who reported the student's science sub-score was more than the number of males who reported the same score (N= 586).

Table 10: Descriptive Statistics for Student's Science Sub-score

Variable	N	M	SD
Gender			
Male	2136	22.38	3.638
Female	565	21.06	2.909
Ethnicity			
White	1942	21.86	3.119
Black	682	19.87	2.640
Asian	24	20.75	3.854
Amind	23	21.04	2.306
Hispanic	21	19.57	1.912
Pacif	8	18.69	3.059

Table 10 also shows that white students reported higher mean student science sub score (M = 21.86, SD = 2.119) than other races, followed closely by Asian students (M = 20.75, SD = 3.854). The number of white students who reported their ACT science subscore was also higher than other races (N = 1942). However, regression analysis is necessary to investigate the influence of students' science subscores on their success in the A&P I course.

The main inferential statistic used to investigate the research hypothesis was linear regression. The independent variable in the regression analysis was the student's science subscore, while the dependent variable was student success in an A&P I course, categorized as success and failure. The result of the regression analysis shows that a student's science subscore was a significant predictor of student success in an A&P I course, $\chi^2(1) = 48.063$, $p < .001$ (see Table 11).

Table 11: Regression Model Output

								95% C.I	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Science subscore	.155	.023	46.030	1	<.001	1.168	1.117	1.222
	Constant	-.890	.467	3.638	1	.056	.411		

Log likelihood =1599.27; *Cox & Snell* R^2 = .02; *Nagelkerke* R^2 = .038; χ^2 = 48.063, $p < .001$

The regression model explained 3.8% (Nagelkerke R^2) of the variance in student success in an A&P I course. However, the Hosmer and Lemeshow test shows that the model is not fit for the data, $\chi^2(7) = 30.732$, $p < .001$ (<.05). The odds ratio for student ACT science subscores was 1.168 (95% CI 1.117 – 1.222). The result shows that higher student ACT science subscores were associated with an increased likelihood of success in an A&P I course, Wald = 46.030, $p < .001$ (see Table 11). The model correctly predicted 100% of cases of student success in the A&P I course and 0% of student failure in the A&P I course, giving an overall percentage correct prediction rate of 91.1% (Appendix 4). Thus, the null hypothesis is rejected in favour of the research hypothesis. Therefore, sufficient evidence suggests that a student's science subscores predict student success in an A&P I course.

Research Question Five

The fifth research question explored the relationship and impact of previous completed Biology courses for first-time A&P students at Jones College in Ellisville, MS. According to the college catalog at Jones College, students who do not achieve the minimum required composite ACT score or ACT science subsection must successfully complete, with a final grade of "C" or higher, at least three credit hours of fundamental biology coursework prior to enrolling in A&P I. The assumption is that students that successfully complete either portions of Principles of Biology or General Biology should be adequately prepared for an A&P I course. The objective of this portion of the analysis is to identify any correlation or predictive relationship between the amount of biology course credit and A&P I outcomes. This independent variable will be studied as a continuous variable using descriptive and inferential analysis with a binary linear regression model. The regression model will present the cumulative or combination effect of multiple Biology courses.

5. Does successful completion of General Biology courses predict a student's success in an A&P I course?

H_1: A student's successful completion of a General Biology course before A&P I enrollment is predictive of student success in an A&P I course.

H_0: A student's successful completion of a General Biology course before A&P I enrollment is not predictive of student success in an A&P I course.

Descriptive and inferential statistics (regression) were used to investigate the research hypothesis. The frequencies and percentages description of the student's general Biology I and II scores. The frequencies and percentages are shown in Table 12.

Table 12: Frequencies and percentages for General Biology I and II

		Biology I		Biology II	
		N	%	N	%
Valid	Not taken	1620	56.7	2682	93.8
	Taken	1238	43.3	176	6.2
	Total	2858	100.0	28.58	100

As illustrated in Table 12, a total of 2858 are Biology students. However, most students had not taken Biology I and II classes.

The study employed logistic regression to conduct an inferential analysis of the research hypothesis. The independent variables, Biology I, Biology II, Principles of Biology I, and Principle of Biology II, were categorized as taken and not taken, while the dependent variable, a student's success in A&P I course, was categorized as success and failure. The regression result is shown in Tables 13, 14, and 15.

Table 13: Regression output with Biology I as a predictor variable

					95% C.I.for EXP(B)	
		B	S.E.	Sig.	Lower	Upper
Step 1[a]	General Biology I(1)	.419	.138	.002	1.160	1.993
	Constant	2.163	.082	.000		

Log likelihood =1704.839; *Cox & Snell* R^2 = .003; *Nagelkerke* R^2 = .007; χ^2 = 9.523, *p* =.002

As shown in Table 13, successful completion of Biology I before A&P I enrollment significantly predicted student success in an A&P I course, $\chi^2(2) = 9.523$, $p = .002$. Completing Biology, I significantly increased student success in A&P I course, Wald =9.225, p = .002. The model explains .7% of changes in student success in the A&P I course. It also correctly predicted 100% of cases of student success in the A&P I course and 0% of student failure in the A&P I course, giving an overall percentage correct prediction rate of 91.1%.

Table 14: Regression output with Biology II as a predictor variable

						95% C.I.(EXP(B))	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	General Biology II(1)	1.253	.459	.006	3.500	1.425	8.598
	Constant	2.279	.067	.000	9.771		

Log likelihood =1703.278; *Cox & Snell* R^2 = .004; *Nagelkerke* R^2 = .009; χ^2 = 11.084, $p < .001$

Successful completion of Biology II before A&P I enrollment significantly predicted student success in an A&P I course, $\chi^2(1) = 11.084$, $p < .001$ (Table 14). Completing Biology II significantly increases student success in A&P I course, Wald = 7.464, p = .006. The model explains .9% of changes in student success in the A&P I course. It also correctly predicted 100% of cases of student success in the A&P I course and 0% of student failure in the A&P I course, giving an overall percentage correct prediction rate of 91.1%.

Table 15: Regression Output with Biology I and II as predictor variables

						95% C.I. (EXP(B))	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	General Biology I(1)	.334	.140	.017	2.944	1.184	7.320
	General Biology II(1)	1.080	.465	.020	1.396	1.061	1.837
	Constant	2.186	.082	<.001	8.636		

Log likelihood =1697.444; *Cox & Snell* R^2 = .03; *Nagelkerke* R^2 = .013; χ^2 = 16.918, p < .001

Successful completion of Biology I and II before A&P I enrollment significantly predicted student success in the A&P I course, $\chi^2(1) = 16.918$, p <.001 (<.05) (Table 15). The model explains 1.3% (Nagelkerke R^2) of the changes in student success in an A&P I course, with the Hosmer and Lemeshow test indicating that the model is a good fit for the data, $\chi^2(1) = .003$, p =.960 (<.05). Students who completed Biology I course before an A&P I enrollment were 2.944 times more likely to experience an increase in their success in an A&P I course than those who failed to complete the biology course successfully before A&P I enrollment. Also, students who completed Biology II courses successfully before A&P I enrollment were 1.396 times more likely to experience an increase in success in an A&P I course than those who failed to complete the course before A&P I enrollment.

The result also indicates that completing the Biology I course would increase a student's likelihood of success in an A&P I course, Wald = 5.679, p =.017 (see Table 13). At the same time, failure of a student to take a biology II course would decrease the student's success in an A&P I course, Wald = 5.400, p =.020. The model correctly

predicted 100% of cases of student success in the A&P I course and 0% of student failure in the A&P I course, giving an overall percentage correct prediction rate of 91.1%.

These results also show that the successful completion of each of the biology courses (Biology I and Biology II) improve student success in A&P I. Thus, the null hypothesis is rejected. Even though the specificity and sensitivity of prediction do not vary with the number of Biology courses taken, doing both Biology I and Biology II have more impact on the success of the A&P I course. The regression model with Biology I and II as predictors has higher explanatory power than individual models. Though Principles of Biology I and Principle of Biology II are predictor variables, Table 16 shows that alone they have no significant effect on student success in A&P I course ($p > .05$). Including Principle of Biology, I and II does not alter the specificity and sensitivity of prediction (correct prediction remained at 91.1%). Table 16 confirms that only Biology I and Biology II taken together prior to A&P I enrolment significantly affect student success in A&P I course ($p > .05$).

Table 16: Multiple Regression output

						95% C.I.for	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	General Biology II(1)	1.042	.466	.025	2.835	1.138	7.059
	Principles of Biology I(1)	-.373	.227	.101	.689	.441	1.075
	Principles of Biology II(1)	.261	.375	.485	1.299	.623	2.707
	General Biology I(1)	.369	.142	.010	1.446	1.094	1.912
	Constant	2.174	.084	.000	8.796		

Log likelihood =1697.444; *Cox & Snell* R^2 = .03; *Nagelkerke* R^2 = .013; χ^2 = 16.918, $p < .001$

A two-way analysis was conducted to verify whether the impact of successful completion of general Biology courses before A&P I enrollment on student success in the A&P I course was statistically significant, as shown by the binary logistic regression. The main effect of successful completion of the Biology II course before A&P I enrollment yielded an F ratio of $F(1, 2600) = 6.450$, $p = .011$,$\eta^2p = .002$, indicating that the mean student success in A&P I course was significantly greater for students who completed Biology II course successfully before A&P I enrollment (M = 3.20, S.D. = .782) than students who fail to complete Biology II course successfully before A&P I enrollment (M = 3.02, S.D. = .782). The effect of completing the Biology I course successfully before A&P I enrollment yielded an F ratio of $F(1, 2600) = .658$, $p = .417$,$\eta^2p = .000$, indicating that the effect of completing the Biology I course successfully before A&P I enrollment was not significant, with successful completion of the course (M = 3.05, S.D. = .782) and failure to complete the course (M =3.01, S.D. = .782) (see Appendices 6 and 7). The interaction effect was non-significant, $F(1, 2600) = .997$, $p = .318$ ($p > .05$). The finding that successful completion of the biology II course before A&P I enrollment supported the binary logistic regression analysis that showed that such completion exhibited a positive effect of student success on A&P course. However, contrary to the logistic regression, successful completion of Biology I and the interaction with successful completion of Biology I and II before A&P I enrollment have no significant effect on student success in A&P I course.

Research Question Six

The sixth research question explored cross-variable or self-multiplicative combinations of the independent variables and the possible predictive value for A&P I success for first-time A&P students at Jones College in Ellisville, MS. For this portion of

the study, a binary logistical regression model was employed to identify any statistically significant combinations of variables that improved the specificity and sensitivity predication of A&P I outcomes. A “best fit” regression formula concludes this chapter.

6. Does any cross-variable or self-multiplicative combinations of the studied independent variables predict a student's success in an A&P I course?

H_1: Cross-variable or self-multiplicative combinations of the studied independent variables are predictive of student success in an A&P I course.

H_0: Cross-variable or self-multiplicative combinations of the studied independent variables are not predictive of student success in an A&P I course.

Binary logistical regression analysis was conducted to investigate whether self-multiplicative combinations of the studied independent variables predict a student’s success in an A&P I course. The regression employed ACT composition Score, ACT Science Subscore, Principles of Biology I &II, General Biology I& II, GPA before A&P, and Cumulative Hours before A&P I as independent variables and success in the A&P I course as the dependent variable. The resulting output is shown in Table 17.

Table 17: Binary logistic regression output

						95% C.I EXP(B)	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition Score	.132	.047	**.005**	1.141	1.041	1.251
	ACT Science Subscore	-.039	.046	.395	.962	.879	1.052
	Principles of Bio I(1)	-.204	.263	.438	.815	.487	1.365
	Principles of Bio II(1)	-.071	.400	.860	.932	.425	2.042
	General Bio I(1)	.028	.186	.879	1.029	.714	1.482
	General Bio II(1)	.513	.491	.295	1.671	.639	4.371
	GPA Before A&P I	2.481	.175	**<.001**	11.949	8.474	16.849
	Cumulative Hours Prior	.005	.004	.187	1.005	.998	1.012
	Constant	-6.340	.724	.000	.002		

Log likelihood =1076.171; *Cox & Snell* R^2 = .165; *Nagelkerke* R^2 = .378; χ^2 = 492.351, $p < .001$

The regression analysis results in Table 17 showed that student ACT composition scores and GPA before A& P I significantly predicted student success in an A&P I course, $\chi^2(2) = 492.351$, $p < .001$. All other predictors were not significant ($p > .05$). All eight predictors in the model explained 37.8% (Nagelkerke R^2) of the variation in student success in an A&P I course, with the Hosmer and Lemeshow test, indicating that the model is a good fit for the data, $\chi^2(1) = 6.749$, p =.564 (<.05). Student ACT composition scores and GPA before A&P I or significant at 5% level, ACT composition score (Wald = 7.957, p = .005), and GPA before A&P I (Wald = 200.164, $p < .001$). The OR for ACT scores was 1.141 (95% CI 1.041 – 1.251), and for GPA before A& P I, the corresponding figures were 11.949 (95% CI: 8.474 – 16.849) (see Appendices 7). The model correctly

predicted 99% of cases of student success in the A&P I course and 25.4% of students failing an A&P I course, giving an overall percentage correct prediction rate of 92.8%. Since more than one independent variable predicts student success in the A&P I course, the null hypothesis is rejected. Thus, sufficient evidence suggests that self-multiplicative combinations of the studied independent variables predict a student's success in an A&P I course.

The multiple regression model provides a better sensitivity prediction than the individual regression models because it explains a larger variation in a student's success in A&P I course (37.8%). However, an appropriate model for predicting student success in A&P I would require the removal of non-significant predictors from the model. A regression model generated after removing the six insignificant predictors is shown in Table 18.

Table 18: Regression output of the most appropriate model

						95%	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition Score	.116	.029	<.001	1.123	1.061	1.189
	GPA Before A&P I	2.579	.154	<.001	13.189	9.753	17.836
	Constant	-6.868	.643	<.001	.001		

Log likelihood =1106.357; *Cox & Snell* R^2 = .181; *Nagelkerke* R^2 = .402; χ^2 = 553.826, $p < .001$

The regression analysis shows that ACT composition score and GPA before A& P I significantly predicted student success in an A&P I course, $\chi^2(2) = 553.826$, $p < .001$. The model explains 40.2% (Nagelkerke R^2) of the variation in student success in an A&P

I course, which is larger than all prior models. The Hosmer and Lemeshow test also indicate that the model is a good fit for the data, $\chi^2(8) = 4.396$, $p = .820$ (>.05). As shown in Table 18, ACT composition score and GPA before A&P I was significant at 5% level, ACT composition score (Wald = 116.065, $p < .001$), and GPA before A&P I (Wald = 280.559, $p < .001$). The OR for ACT scores was 1.123 (95% CI 1.061 – 1.189), and for GPA before A& P I, the corresponding figures were 13.189 (95% CI: 9.753 – 16.849). The model correctly predicted 99% of cases of student success in the A&P I course and 28.5% of students failing an A&P I course, giving an overall percentage correct prediction rate of 92.7%.

Hypothesis Result Summary

A summary of the six proposed hypotheses of this study reveals that each independent variable has some degree of statistical significance in relation to the outcome variable of A&P I, therefore the null hypothesis was rejected for each of these postulates. Despite all variables showing a significant statistical result, only student GPA of hypothesis two, and combinations of prerequisite biology courses from hypothesis six were able to explain greater than 10% of the data variance. Hypotheses one, three, four, and five were able to predict over 95% of the student success but could not predict student failure. Based on these results, a more practical discussion of the individual merits of each academic variable in their use as predictors in A&P I is necessary.

The purpose of this research was to evaluate the individual academic variables that could be used to better predict the success or failure of first-time enrollment A&P I students. If the studied academic variables demonstrated a significant relationship with the final course outcome, the researcher desired to create a regression formula and model

that could best predict A&P results. As previously stated, all of the studied variables demonstrated a statistical significance, but may have failed to explain variance or perform a comprehensive prediction of both success and failure, therefore the variables may not have been a good fit for the data. The current advisement models at Jones College focuses on biology prerequisites, composite ACT scores, and ACT science subscores as acceptable placement criteria for A&P I, yet the data results indicate that these variables may not be reliable factors as isolated predictors. Variables such as the ACT science subscore or the completion of courses such as the Principles of Biology are still being used in student advisement despite questionable validity. Institutions and faculty most likely continue this practice due to the availability and simplicity of acquiring these data points from student files. In contrast, cumulative hours, GPA, and prerequisite course combinations have a greater variance in ranges, therefore creating a more complex and cumbersome set of factors for advisors to implement

The new regression model being proposed considers the significant factors from the individual binary logistic regressions, including overall prediction rate, model fit, odds ratio, and variance explanation. This data (Table 19) was used to create the proposed regression formula.

Table 19: ANOVA SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.766
R Square	0.587
Adjusted R Square	0.586
Standard Error	0.651
Observations	2605.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	1565.2045	173.9116	409.798776	0.0000
Residual	2595	1101.2738	0.4244		
Total	2604	2666.4783			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.947	0.0931	-10.1673	0.000	-1.1292	-0.7641	-1.1292	-0.7641
Spring Semester Attempt - Coded	0.198	0.0271	7.3008	0.000	0.1445	0.2506	0.1445	0.2506
Class Type - WWW Coded	-0.231	0.0646	-3.5686	0.000	-0.3574	-0.1039	-0.3574	-0.1039
Class Type - Coded	0.106	0.0337	3.1393	0.002	0.0397	0.1720	0.0397	0.1720
Prin BIO I Coded	-0.192	0.0460	-4.1790	0.000	-0.2825	-0.1020	-0.2825	-0.1020
Gen BIO I Coded	-0.111	0.0309	-3.5852	0.000	-0.1715	-0.0502	-0.1715	-0.0502
Cummulative BIO Hours	0.058	0.0038	15.2367	0.000	0.0510	0.0660	0.0510	0.0660
Cumulative College hours	-0.006	0.0006	-10.6762	0.000	-0.0070	-0.0048	-0.0070	-0.0048
GPA Prior to A&P I	1.033	0.0248	41.6069	0.000	0.9845	1.0819	0.9845	1.0819
ACT Composite Score	0.014	0.0043	3.1352	0.002	0.0051	0.0221	0.0051	0.0221

A comprehensive regression formula was created, with all statistically significant predictor variables, for examination and discussion of potential use in advisement. This formula is a more comprehensive model than is currently used by advisors for student placement into A&P I courses. The current advisement focuses on individual variables to qualify students for A&P I enrollment, but the proposed formula incorporates all significant factors from this study to create one all-inclusive prediction model. The complexity of this proposal and the difficulty of obtaining and implementing the necessary data may create significant challenges for advisors, therefore the practicality of this formula will be discussed in greater detail in chapter five.

The proposed formula below provides the highest simultaneous sensitivity and specificity prediction for students enrolling in A&P I with the academic variables provided at Jones College. The formula incorporates a considerable number of variables pertaining to different class attributes and academic measures of the student. These include: Spring as the semester of enrollment, WWW as the online variable, Halfterm as the length of course in weeks, PrinBIO1 as the principles of biology course, GenBio1 as the general biology I course, BioHrs as the total amount of prior completed biology course credit hours, CollegeHrs as the cumulative completed college credits, PriorGPA as the cumulative GPA at time of A&P I enrollment, and ACTComp as the composite ACT score (Table 19).

$\hat{Y}$ = - 0.947 + 0.198*Spring - 0.231*WWW + 0.106*HalfTerm - 0.192*PrinBIO1 - 0.111*GenBio1 + 0.058*BioHrs - 0.006*CollegeHrs + 1.033*PriorGPA + 0.014*ACTComp

The proposed regression formula had an overall prediction success rate of 90.6% with a 97% sensitivity and 48% specificity capability (Table 20). This is to be anticipated since student course failures are often connected to non-academic factors beyond the recognition ability of the student's advisors. Using the data from this formula and global regression model, the isolated independent variables can be assessed for individual advisement usage.

Table 20: Regression Model Accuracy

Success		Failure	
2361		244	
		Actual	
		Pass	Fail
Predicted	Pass	2192	58
	Fail	186	169
	Sensitivity	97%	
	Sensitivity	48%	

Comparing the regression model to currently used placement parameters, a student's GPA>2.5 demonstrated a predictive sensitivity of 96% and specificity of 36% (Table 21). GPA had an overall predictability rate of 86.7%. GPA had a positive coefficient of 1.033 indicating, a positive relationship with outcomes. Based on this portion of the regression, GPA has a comparable capability of predicting the student's outcome, with an easier effort of implementation for the advisor.

Table 21: GPA Only: Regression Model Accuracy

		GPA Only	
		Actual	
		Pass	Fail
Predicted	Pass	2109	77
	Fail	269	150
	Sensitivity	96%	
	Sensitivity	36%	

Comparing the second most common A&P I prerequisite to the regression model, students who have completed the Biology I course demonstrated a predictive sensitivity of 93% and specificity of 10% (Table 22). Biology I completion had an overall predictability rate of 46.9%. Biology I completion had a negative coefficient of -0.192, indicating a negative relationship with outcomes. Completion of Biology I had a comparable capability of predicting the successful student's outcome when compared to the regression model. However, the specificity of the Biology I prerequisite suffered a prominent fall off in the accuracy of the predictions, rendering the use of the prerequisite suspect in widespread application. It should be considered that these students typically have sub-threshold ACT science subscores resulting in their placement in Biology I.

Table 22: BIO I Only: Regression Model Accuracy

		Bio I Only	
		Actual	
		Pass	Fail
Predicted	Pass	1077	81
	Fail	1301	146
	Sensitivity	93%	
	Sensitivity	10%	

As the most common placement prerequisite, the ACT Science subscores demonstrated a predictive sensitivity of 93% and specificity of 11% (Table 23). This is comparable to the Biology I placement parameter. Science subscores had an overall predictability rate of 61.2%. Based off this portion of the regression, ACT Science subscores has some capability of predicting the student's outcome but is not effective in the context of other variables. Additionally, its utility is readily exceeded by other variables such as GPA. In the original global regression analysis, the ACT science subscore failed to exhibit statistical significance in conjunction with other variables (β=-0.007, $p = 0.356$) despite the goodness of fit results in the hypothesis. This suggests that the ACT science subscore suffers from some interactions with other variables or is better accounted for in other combination variables such as the ACT composite score.

Table 23: ACT Science Only: Regression Model Accuracy

		ACT Science Only	
		Actual	
		Pass	Fail
Predicted	Pass	1483	115
	Fail	895	112
	Sensitivity	93%	
	Sensitivity	11%	

To improve the prediction capacity of placement parameters while limiting the degree of implementation difficulty, a combination model was evaluated. Students who have a GPA>+2.5 and have completed between twenty-four to eighty-four hours of college credit prior to A&P I enrollment demonstrated a predictive sensitivity of 97% and specificity of 17% (Table 24). The combination of GPA and cumulative college hours had an overall predictability rate of 64.9%. This combination may exhibit some utility in evaluating the potential of student success who do not otherwise meet placement criteria but are deemed to exhibit a non-typical indicator of success such as age and experience in the college setting.

Table 24: GPA and Cumulative College Hours: Regression Model Accuracy

		GPA and College Hours	
		Actual	
		Pass	Fail
Predicted	Pass	1483	115
	Fail	895	112
	Sensitivity	93%	
	Sensitivity	11%	

Conclusion

The primary goal of this study was to analyze the independent academic variables that could be used to predict student success in A&P I courses at the community college level. To accomplish this, the sample populations demographic data was discussed and evaluated for assumptions of normality, linearity, and correlation. An ANOVA was conducted that revealed a statistically significant relationship between the independent variables and the students' overall outcome for the A&P I course. The independent variables were then placed in a linear regression to identify specific statistically significant variables and develop a regression formula that could improve advisement predictability of student success in Anatomy and Physiology courses. The regression formula that was the best fit was able to predict 97% sensitivity and 48% specificity on student outcomes. In addition, the proposed hypotheses were examined for acceptance or rejection.

The overall outcome of the research created a complex regression formula. Despite this formula having a high sensitivity and prediction rate, exceeding all commonly used models of course placement, it is often found that the complexity and cumbersomeness of this formula hinder advisement implementation. In chapter five, the results previously delineated will be reviewed in greater detail. The limitations of the study and recommendations for future analyses will be discussed. Finally, the overall impact that the results may have on advisement policies for Anatomy and Physiology I course at the Community College level will be examined.

CHAPTER V--DISCUSSION

Introduction

First time enrolled students in A&P I classes at community colleges have a lower retention and success rate compared to similar courses offered at the postsecondary level (Human Anatomy & Physiology Society, 2020). This high failure rate of A&P I leads to additional challenges for students and educational institutions. Students who are not initially successful in A&P often decide to complete remedial coursework, retake the A&P course, choose a different degree path, or withdraw from the formal educational journey completely. All of this post-failure A&P I options are costly to the student and instructional entities' financial status, but also potentially diminishes the students, instructors, and advisors academic moral due to the perception of failure (Zeidenberg, 2011). Both consequences can be lessened if A&P I success can be enhanced through more precise and predictive advisement.

The existing literature concerning A&P advisement and outcome prediction does not provide enough data to accurately predict success or failure for students. The purpose of this study was to add to the increasing literature considering potential advisement and placement policies for students enrolling in postsecondary A&P I courses at Jones College by examining the proposed independent variables individually and combined in their relation to course outcomes. This study investigated the relationship between the student's academic variables and successful completion, as defined by a final letter grade of "C" or higher, during their first attempt at taking an A&P I class.

The predictor variables that were studied included: student GPA, composite ACT score, ACT science subscore, cumulative college hours prior to enrollment, and prior

biology prerequisite coursework. A regression analysis was chosen to study the individual variables with the outcome variable because the goal of the research was to create a successful prediction model for A&P I. Regression test demonstrate statistical relationships between independent and dependent variables. Two separate forms of regression analysis were chosen for this study. A binary logistic regression was chosen initially to study the dependent variable as a dualistic outcome of either success or non-success. This binary regression can identify significant relationships but is not able to quantify the specific significance of the variable. The researcher applied a linear regression so that the significance of the outcome could be identified. For the researcher to utilize a linear regression analysis, the A&P I final grade outcome was translated into a continuous variable compared to continuous independent variables, such as GPA and ACT scores. As an example, a final grade was translated as follows: “A” =4.0, “B” =3.0, “C” =2.0, “D” =1.0, and “F” =0. The researcher considered A&P I success to be a final grade of “C” or higher and non-success as a grade of “D” or “F.”

The researcher evaluated six hypotheses using an argument-based validity theory and a phenomenological interpretive lens. The study's objective was to discover if a student's success in A&P I could be predicted with an isolated or combination of academic variables. The overall goal of this study was to create a successful prediction formula that all postsecondary student advisors could implement within their institutions, therefore improving the retention and success rate of A&P I students nationwide. This chapter presents a discussion of the findings and connections to the literature, an evaluation of the proposed interpretive lens and theoretical frameworks, the implications for practitioners and policymakers, and recommendation for future research.

Summary and Discussion of Main Findings

This study examined archival data focused on student success in A&P I courses at Jones College in Ellisville, MS. The current placement model used by advisors at Jones College grants student access to A&P I who have achieved an ACT science subscore of twenty-one or higher or has completed General Biology I or General Biology II courses with a final grade of "C" or higher (Jones College, 2023). Therefore, one component of this research was to evaluate the current placement criteria used by advisors at Jones College for statistical significance concerning student A&P I outcomes. In addition, secondary academic variables not currently being utilized were assessed for potential advisement model implementation. This chapter also outlines the positive statistical relationships between course outcomes and the studied independent variables, emphasizing the combination of variables that may generate the most robust prediction ratio. Finally, acceptance or rejection of the research hypothesis was determined based on the results presented in chapter four.

Research Question One: Cumulative College Hours Prediction

The first research question for this study focused on whether the placement rates of students using cumulative prior, completed college credits could predict a student's success in an A&P I course. Hypothesis one predicted that students who had completed more college credits before enrollment in A&P I would have a higher success rate in the first-time course enrollment. The literature reviewed in chapter two concerning A&P I advisement among postsecondary institutions across the nation revealed very little literature on institutions that currently utilize completed college credits as criteria for A&P I placement. Similarly, the current student placement model used by the advisors of Jones College does not consider cumulative college credits when advising the placement

of students into A&P I. This portion of the study sought to identify any statistical relationships between total prior college hours and final A&P I course grades.

The sample population's cumulative credit hours were examined against course outcomes for A&P I, controlling for covariates, to identify if a relationship occurred. Results indicated a statistically significant relationship between the two variables; therefore, it can be concluded through this research that the number of college hours completed prior to enrollment in A&P can significantly influence the overall outcome. In addition, the data suggest that a direct relationship exists between completed college hours and A&P I final scores, in that as a student's cumulative college hours increase, so does the students success outcome in A&P I.

The cumulative hour calculation was not based on any specific college-level coursework. Instead, this data variable included courses across all disciplines, including preparatory coursework required for other degree fields. The average college hours taken by students in the sample population was 55.6 hours. If it is to be assumed that the average student takes a full-time credit load of twelve college hours per semester, then this equates to the average student completing between two to three semesters of college coursework before enrollment in A&P I.

The visible scatterplot concerning cumulative hours demonstrated a loose linear relationship between prior cumulative hours and A&P I course outcome . Despite being considered a weaker correlation, it is essential to note that the relationship does demonstrate a linear association. The researcher accepts that while the variables can be used in a predictive capacity, the resulting predictions will only be somewhat accurate in one or more aspects. The sensitivity and specificity results of this variable indicate this

predictability weakness involving the prediction of student failures in A&P I. This loose correlation can be explained due to a sample population of over 2,000 general enrollment community college students with a significant variance in the amount of completed college hours. As previously discussed, community colleges are open-enrollment institutions that accept a wide variety of academically prepared and ill-prepared students. Many of these students pursue multiple degree fields before deciding on A&P I-related pathways, therefore taking higher than average amounts of college credit. Another factor that can explain the wide variance of college hours taken before A&P I enrollment is that many students are taking prerequisites to prepare for entry into healthcare professions. For this reason, students may enroll in multiple academic semesters to prepare for those programs. Despite the significant variance of cumulative hours, the relationship was linear. Therefore, the researcher considered the results applicable and potentially extendable to the general population based on a linear mathematical model.

The binary regression used to analyze the cumulative hour's relationship with A&P I explained 7.9% of the variance in student success of the studied course. The regression model could predict 100% of the cases of student success based on prior college hours but was unable to predict any of the student failure cases. The overall model using college hours could predict 91.7% of all student outcomes. The current study did not attempt to discover the optimal number of college hours that contributed to successful prediction. Instead, it only analysed the data to determine if a positive correlation existed between increasing the number of college hours prior to enrollment and the final A&P I result. The researcher concludes that a positive correlation does exist

between these two variables. Because of the difficulty of finding and qualifying the specific range of college hours needed for success, the benefit and usefulness of these results are debatable.

One additional challenge exists from the results of testing this hypothesis: while cumulative hours demonstrate an ability to predict student success efficiently, the same variable does not accurately predict student failure. The weaker ability to predict student failure is common among predictive studies. Primarily, this is due to the reality that success or failure prediction is a complex interaction of several variables which are unrelated to academic parameters. Experienced students can often compensate, which explains the direct relationship. At the low end, unmeasured personal variables have a more profound impact. Because the specific threshold of college hours needed for optimal prediction has yet to be identified, the researcher concludes that this isolated academic variable does not provide a reliable tool for A&P I placement. With additional research on this variable, a more precise usage of cumulative college hours can be designed.

The results of this hypothesis seem insignificant. However, the researcher proposes that these results are evidence of the need for students to have academic exposure before enrolling in more challenging science courses such as A&P I. A recommendation not to enroll students who lack prior college course exposure could be supported based on this study's results. However, this variable alone may not provide clear evidence of prediction, but combined with other potential academic variables, the researcher believes more decisive advisement criteria may be shown.

The researcher attempted to view the results and associated hypotheses through the theoretical framework of argument-based validity theory and a phenomenological interpretative lens. Since the use of cumulative hours is a continuous scale and not an isolated assessment outcome, argument-based validity does not fit well with this research question. An argument-based validity interpretation requires a more isolated assessment to justify the outcomes. The researcher suggests that the overall cumulative hours could be viewed as a combined assessment outcome if a predetermined threshold of completed credits was established. The current research methodology needs to fit a theoretical framework interpretation correctly.

The phenomenological lens that the researcher used to view this hypothesis provides a more significant discussion involving future research. Phenomenology focuses on the significance of an experience and attempts to provide a meaningful rationale between a specified phenomenon and the associated reality of the outcomes. Despite this usually being a qualitative tool, the researcher believes it is possible to form conclusions about increasing college credits as a predictor of success in later coursework. One theory that could be postulated from this study states that students' experience taking preparatory academic courses constitutes a phenomenon of self-development, academic preparation, and social acclamation. These student developments provide a meaningful rationale that can potentially explain the reality of improved A&P I success from more experienced students. Finally, the researcher admits that postsecondary education is a complex process involving academic and non-academic development but also suggests that students' academic experiences are as valuable of phenomena as the more qualitative affective elements.

The researcher's recommendation considering this hypothesis would be that future investigators, combined with college administration and advisors, attempt to analyze their institutions, observing for the threshold number of college hours that can predict the success in more complex, upper-level science courses. Suppose that threshold number is not feasible due to the structure of their institution and degree plans. In that case, the researcher proposes combining cumulative college hours with other academic factors as advisement criteria.

Research Question Two: GPA at the time of A&P I Enrollment

The second research question involved analysing the relationship between students' GPAs prior to enrolling in A&P I and the associated outcomes. Chapter two states that student GPA has long been utilized for postsecondary admission and course placement. Many universities and colleges use students' high school GPAs as an admission criterion. In addition, several professional programs such as medical school, nursing, and other specialized degree fields have minimum GPA requirements. However, no literature on college GPA as a success predictor in A&P I courses could be identified. Students’ high school GPA is most often used during the initial enrollment at an academic institution or during the first semester of coursework. After this initial phase, the student's GPA is primarily used as a benchmark for continued enrollment, financial aid, or extracurricular permission. The researcher could find no literature or current examples where a college student's continuous GPA was used as placement criteria for higher science courses such as A&P I. Jones College, where the sample data was obtained, does not currently have an advisement policy using the students GPA for

placement into A&P I courses. Therefore, this study's second hypothesis and research question examined if a student's GPA at the point of A&P I enrollment could be statistically correlated to course outcome.

The results from chapter four provided a mean student GPA before A&P I admission of 3.07, which is slightly lower than the national average GPA at time of college admission. (National Center for Educational Statistics, 2021). Similar to the first hypothesis concerning cumulative college hours, students' GPAs in the sample population demonstrated a loose linear relationship when associated with A&P I outcomes. This weak correlation was not of concern to the researcher due to the linear relationship. The researcher understands that this weak correlation may decrease the variable's predictability power. However, it can be considered during the interpretation and discussion of the results. After utilizing a binary linear regression, the results demonstrated that GPA significantly predicted ($p<.001$) a student outcome in A&P I . GPA was able to predict student success at 99% accuracy and predicted student failure at 27% accuracy. This gives the overall prediction rate using a GPA of 92.7%. Based on these results, the researcher concludes that students' college GPA at the time of A&P I enrollment could be utilized as a primary predictor and an advisement tool; therefore, the null hypothesis is rejected, and the proposed hypothesis is accepted.

A multitude of factors could influence a student's high school GPA. First, if a student comes from a weaker secondary school system in which the teachers or the instructional methodology did not prepare the student appropriately for the intensity of college academic courses, the student's GPA may be lower. Likewise, it can be argued that the student support structure at their home could be vital in providing them with

academic encouragement or guidance, which could affect their high school course performance. Third, the student could have a learning disability or challenge that was not addressed or could have lacked proper accommodations in their school district. Any one or a combination of these factors could result in a lower GPA for initial enrollment at a postsecondary institution. Many of the same academic challenges exist at the college or university level, including new social factors that may have yet to be present in their secondary education. However, most community colleges and higher education institutions provide a more significant support structure, innovative early warning systems, more course pathways, and a personalized advisement system. These tools offer students who may have had a lower GPA at high school graduation an opportunity to reset their academic scoreboard and achieve their most significant potential. The researcher believes that GPA combined with a predetermined amount of college credits may be a more efficient and predictive variable for A&P I course placement. This possibility is reviewed below in a separate discussion.

Students' GPAs should be a straightforward academic variable to access during student advisement, making it an advisor-friendly data point. Secondly, institutions can more easily identify a specific threshold or range for GPA criteria. This research project aimed to identify statistically significant variables and combinations of variables that could better predict course outcomes. It is important to note that while the analysis did not identify specific GPAs or a range of GPAs that marked students' success or failure threshold, this is a significant recommendation for future research concerning A&P I courses.

The theoretical framework and interpretive lens used for this hypothesis have similar challenges and descriptions as the previous hypothesis dealing with cumulative college hours. The argument-based validity theory needs to fit this research question better due to the need for a specific assessment tool. Since college GPA is calculated by a wide range of course structures, assessment types, and methodology, no one assessment tool could be used by an argument-based validity viewpoint. Additionally, the phenomenological perspective considers the wide range of courses the students may have taken to achieve the current GPA. Without performing a qualitative survey, the researcher realizes that the phenomena of college course preparation through initial academic credits help bridge the students' experiences and the reality of their current ability.

One last outcome mentioned previously concerning student GPA from the project results should be addressed. A regression predictability analysis was conducted using a student's GPA combined with cumulative college hours as multifaceted independent variables. The researcher chose these two variables due to two main rationales. First, cumulative college hours and GPA indicated statistical significance in their relationships to A&P I outcomes. Secondly, GPA and prior credit are independent variables that advisors or institutions do not currently use as placement criteria. Using a multiple regression model, the results of combining these two independent variables demonstrated a high probability of success in predicting A&P I. This regression formula had a sensitivity of 97% and a specificity of 17%. In addition, these variables were able to predict more student successes cases than failures, which is frequently the case when using prediction models. The researcher believes that a model using students' GPAs combined with a range of prior, completed college hours can provide advisors with a

more effective pathway for student guidance. This model has the potential to prevent underprepared students from being admitted into A&P I, therefore improving retention and decreasing course attrition rates.

Research Question Three: Composite ACT score for A&P I Predication

The third research question scrutinized the relationship between students' Composite ACT scores and A&P I outcomes. Like GPA, postsecondary institutions have traditionally used composite ACT scores as admission criteria, financial aid, scholarship eligibility, or course placement by advisors. The literature of chapter two, combined with additional prior ACT research, demonstrates conflicting opinions on the usefulness of composite ACT scores as a predictor of students' postsecondary readiness (Allensworth & Clark, 2020; U.S. Department of Education, 2019; Lotkowski, 2004; Belfield, 2012). Despite the conflicting beliefs by academic professionals, there is little significant research explicitly linking composite ACT scores to A&P I course results. Jones College does not list composite ACT scores as an advisement checkpoint for A&P I advisement (Jones College, 2023). The hypothesis of this research question states that composite ACT scores will demonstrate statistical significance in predicting A&P I outcomes.

The results of the variable analysis revealed a mean composite ACT score of 20.8 with a standard deviation of 3.34. The visual scatter plot demonstrated a loose linear relationship that coincides with the other independent variables of this study. The regression outcome indicated a statistically significant relationship between composite ACT scores and A&P I outcomes with a $p<.001$. Composite ACT explained approximately 8.2% of the variance within the model and predicted 100% of student success but zero percent of student failure. This calculated an overall prediction rate of

91.1%. Based on these results, the null hypothesis was rejected, and the hypothesis was supported, saying that composite ACT scores could be used as a successful predictor of student outcomes.

The ACT research committee does not specify a benchmark composite score that predicts student readiness, despite setting subscore benchmarks that we will discuss in the following hypothesis. The national composite ACT score average fluctuates between 19 and 20, putting the sample data at Jones College slightly above the national average (U.S. Department of Education, 2019). The purpose of this study was not to identify the specific threshold score that produces the highest prediction for A&P I but to determine the existence of a statistical relationship and if that composite ACT score could be implemented into an effective advisement model. Therefore, the evidence suggests that student composite ACT scores can predict success in A&P I but may have difficulty predicting student failures. For this reason, the researcher does not believe that an isolated composite ACT score should be used as the sole determinant factor for student advisement.

One recommendation for future research would be to focus on the specific composite ACT score that has the highest predictive power. More specifically, researchers and institutions can identify a score that predicts success and a separate score with a higher predictive value for student failure. Finally, future studies should examine the trends in composite ACT score reliability over the last ten years. A casual overview of ACT research combined with the national statistics concerning student readiness at the college level brings into question whether the usefulness of the ACT scores has declined (Allensworth, E., & Clark, K. 2020). One concern of many academic stakeholders is that

high school students are being prepared to produce high ACT scores but need more time to prepare for the academic core concepts needed for postsecondary education (Belfield, C., & Crosta, P. M., 2012). This study does show a relationship between ACT composite scoring and A&P I readiness, but further research could help identify the actual use of these scores. Currently, Jones College does not use the composite ACT score as an advisement tool for A&P I enrollment, but with a more detailed analysis, a potential predictive range for composite ACT scores could be identified.

A phenomenological interpretive lens and an argument-based validity theory can provide a unique perspective to composite ACT score values. Taking the ACT is an important phenomenon in the secondary educational journey of students. Many schools spend significant time, personnel, and other resources to prepare students for this examination. In this quantitative study, the researcher believes that the student's experience in the preparation and execution of the ACT provides a rationale for the significance of this test in postsecondary preparation. However, the researcher also admits that this lens would provide greater insight with a qualitative survey included on the student's ACT perspective and experience before college.

In contrast, using composite ACT scores and subscores fits appropriately with an argument-based validity framework. This interpretive approach focuses on the test score instead of the test validity. This study examines the use of the composite ACT score and not the merit that the test indicates, and therefore can be utilized as a potential framework for assessing this independent variable's usefulness. After examining the results of all of the independent variables used in this study, the researcher is not convinced that an argument-based validity theory produces the most efficient outcomes for an advisement

model. Instead, the researcher believes that the merit and validity of an exam or outcome score must be calculated into an advisor's recommendations for students seeking admission into A&P I. In other words, the test score may be able to predict success but does not necessarily predict student readiness.

Research Question Four: ACT Science Subscore for A&P I Predication

ACT science subscores formed the fourth hypothesis of this study, in which the researcher sought to determine if the ACT science subscore could predict the outcome of A&P I. Jones College uses an ACT science score of 21 or higher as an entry criterion for A&P I courses (Jones College, 2023). Suppose students can score above a 21 in the ACT science section. In that case, advisors conclude that students have enough knowledge of science readiness to succeed in higher-level science courses such as A&P I, microbiology, and chemistry. Students are not required to take prerequisite biology courses or meet any other admission requirement if they can score above 21 on the science portion of the ACT. Because Jones College is an open enrollment institution, students are also not required to achieve a specific composite ACT score or a benchmark score in any of the other subsections of the ACT for general enrollment into the college (Jones College, 2023). However, no obtainable rationale could be discovered on how Jones College reached this advisement policy.

The analysis of the ACT science subscore within the regression model was able to explain 3.8% of the variance of the data. It correctly predicted 100% of student success cases but zero percent of student failures in the A&P I course. This resulted in an overall prediction rate of 91.1%. Science subscores on the sample population revealed a mean score of 21.37, which is significantly higher than the national average of 19.9. The visible

correlation relationship for this variable followed the trend of the other independent variables for this study, showing a loose linear relationship between the dependent variable and predictor variable. The linear regression revealed a statistically significant relationship between ACT science subscores and overall A&P I course outcomes with $p<.001$ (Table 10). The results cause the null hypothesis involving science subscores to be rejected and the fourth hypothesis to be accepted, supporting the use of science ACT subscores as a statistical predictor for A&P I final results.

The ACT Research Institute indicated that the national average on the science subscore is 19.9 (U.S. Department of Education, 2019). The ACT organization also sets benchmark scores for each subsection topic. The benchmark score for the science section is a score of 23 or higher. According to the ACT organization, the benchmark score states that a student scoring 23 or higher in the science section has a reasonable chance of success in postsecondary educational institutions. The student is predicted to have a 50% or higher chance of scoring a "B" or in associated postsecondary coursework and a 75-80% chance of scoring a "C" or higher. The ACT classifies associated coursework with the science subscore simply as "biology" (ACT, 2023).

The researcher finds it perplexing that the organization that develops and validates the ACT exams sets the benchmark for student success at the postsecondary level at 23, despite the national average on that subsection being approximately 20. One suggestion for future research concerning the science subsection would be to explore the disconnect between postsecondary science expectations and the benchmarks on the ACT section scores. The researcher suggests that one possibility is that an inconsistency has developed between the type of material being scored on the ACT science section and the

core knowledge necessary for success in postsecondary education science courses. Therefore, despite the results showing statistical significance in this study, the researcher cannot confidently recommend that science ACT subscores be utilized as an efficient sole predictor for student placement into A&P I courses.

The theoretical framework and interpretive lens proposed for this hypothesis have the same challenges as previously with ACT composite scores. A phenomenological look at the science portion of this assessment may result from the phenomena of science preparation at the secondary level. However, a more qualitative assessment would be necessary to demonstrate whether an academic or non-academic background is more significant to the scoring. An argument-based validity framework could examine how the science score predicts student preparedness. However, the researcher also realizes that the validity of the science objectives on the ACT constitutes a critical interpretation of the value of this variable in student advisement. As previously observed, the researcher believes that the best advisement model must have a combination of academic variables if student A&P I attrition is to be decreased.

Research Question Five: Prior Biology Courses for A&P I Predication

The fifth research question analysed the relationship between prerequisite and fundamental biology courses taken prior to enrollment in A&P I one course. The advisement policies at Jones College allow students to be admitted into A&P I if they have completed General Biology I or General Biology II with a “C” or higher. General Biology provides fundamental concepts of life functions across both animal and plant systems. The placement criteria assume that students who have demonstrated success in General Biology courses have obtained the necessary structural knowledge to be

successful in A&P I. Both General Biology I and General Biology II are required for science majors at Jones College. Non-science majors are allowed to take Principles of Biology I or Principles of Biology II to meet non-science major degree requirements. This hypothesis examined how each biology course impacted A&P I outcomes. The overall goal of the researcher was to establish which course or combination of courses has the most substantial predictability for A&P I outcomes. For example, General Biology I, General Biology II, Principles of Biology I, and Principles of Biology II was placed into a logistic regression to evaluate for statistical significance. These results could be implemented in the advisement process of colleges nationwide to improve course completion.

The initial frequency analysis showed that out of the sample population, 43.3% of students enrolled in A&P I completed General Biology I. In contrast, only 6.2% of A&P I students completed General biology II. These results reveal that approximately 50% of students taking A&P I completed either General Biology I or II before enrollment, which gives the researcher a robust analysis for predictive power as combined variables.

For this analysis, the outcome-dependent variable was classified as success or failure, determined by a final grade of "C" or higher. General Biology I demonstrated a significant relationship in predicting student success with $p=.002$. General Biology II also demonstrated a statistical significance in A&P I outcomes with a $p<.001$. Students who completed Biology I and Biology II before A&P I enrollment also demonstrated a statistically significant relationship in the course outcomes with a $p<.001$. Based on these

results, the null hypothesis for the fifth research question is rejected. Finally, the hypothesis predicting that Biology I and Biology II courses could statistically impact A&P I outcomes was accepted.

The results also indicated that Principles of Biology I and Principles Biology II courses did not significantly affect student success in A&P I with a $p>.05$. Therefore, the researcher proposes that Principles of Biology courses should be excluded from the advisement model for A&P I placement. In addition to the linear regression, a two-way interaction test was conducted to evaluate the impact of the successful completion of General Biology I and II. To accomplish this two-way analysis, the outcome grade of A&P I was converted into a continuous grade point average. This part of the analysis revealed that General Biology I is a statistically significant course. Finally, the researcher proposes that the impact of General Biology I on A&P I outcomes is a mental training issue for lab-based science courses, not necessarily a content issue. A&P I requires students to demonstrate discipline in their study habits, class engagement and attendance, testing techniques, and critical thinking skills with complex material. The researcher proposes that the benefits of prerequisite courses such as Biology I, Biology II, and Fundamentals of Biology for A&P I students are imbedded in these essential academic skills more than the content competencies.

The results of this hypothesis create a series of challenging questions for the researcher. First, a statistical relationship exists between General Biology I & II and A&P I outcomes. The researcher concludes that the explanation for the conflicting results involving these prerequisite and fundamental courses can be found not necessarily in the individual course completions but in the total science preparation developed from overall

college course completion. In other words, students who have completed General Biology I and II have contributed to the overall cumulative college hours finished prior to A&P I enrollment. As stated in hypothesis one, the amount of college credits completed by students prior to A&P I enrollment does have a statistically significant relationship with A&P I outcomes. Therefore, students who have completed biology coursework have a higher probability of being successful in their A&P I course.

One recommendation for future research would be to analyze a combination of commonly completed college courses in the first academic semester of student enrollment. The goal would be to find a combination of college hours and coursework that best prepared the student for the academic rigors and fundamental knowledge needed for success in A&P I. The research objectives of this project were to identify if a statistical significance existed between the pre-requisite courses the student took prior to A&P I enrollment and the A&P I outcomes. Despite the evidence of a statistical relationship, the researcher is hesitant to recommend that any individual course be used as an entry criterion for A&P I.

Research Question Six: Cross-Variable or Self-Multiplicative for A&P I Predication

This study's sixth and final research question explored the cross-variable and self-multiplicative combinations of all of the independent variables and their relationship with A&P I success. ACT composite score and student GPA were the only two independent variables from the multiple regression, which had a statistical significance with the outcome result. In addition, a multiple regression analysis was conducted to identify any combinations of these independent variables that could be used to create a “best fit” regression model for advisement use.

The regression analysis of this research question resulted in a model that could predict 92.8% of all sample cases, including 99% of students' success and 25.4% of students' failure in A&P I courses. Because of the prediction power of the proposed regression formula for this research question, enough evidence exists that the researcher rejected the null hypothesis and accepted that there were combinations of independent variables that could predict A&P I outcomes. The researcher also concluded that the multiple regression model involving all independent variables was more substantial than the individual regression models. This strengthened prediction ability is likely explained because a more significant percentage of the variation in the data was able to be explained.

The proposed regression model had an overall prediction success of 90.6 with a 97% sensitivity and 48% specificity. When comparing that to the most commonly used advisement tools, the researcher concluded that the proposed new formula demonstrated superior results than the individual variables. For example, utilizing a student's GPA as an isolated variable only produced an overall prediction rate of only 86.7%. However, General Biology I completion only was able to predict 46.9% of the sample results, and isolated ACT science subscores only had a 61.2% overall prediction.

The researcher attempted to improve the prediction rate by combining GPA and cumulative college hours. A range of 24 to 84 hours of college credit was used for this formula based on the average amount of college hours completed by the sample population. Combining a GPA greater than 2.5 with cumulative college hours prior to A&P I enrollment reached a 64.9% predictability rate. The inefficiency of any variable combination can summarize the overall weakness of the individual variable prediction

models to achieve a predictability success of greater than 70%. The researcher concludes that the regression formula that produced the most significant overall prediction required a combination of all the statistically significant independent variables.

Appropriateness of the Theoretical Framework and Interpretive Lenses

This study was based on two theoretical frameworks: argument-based validity theory and phenomenological interpretation. Several researchers have studied the validity of traditional placement tests using an argument-based validity theory (Ngo & Kwon, 2014). This framework examines how test outcomes or scores are used for future academic decisions. The ACT and other course outcomes may not be as strong predictors for college coursework as previously assumed. The statistical tests in this study suggest that the ACT composite score and the ACT science subscore demonstrate statistical significance with A&P I outcomes. Suppose the goal of a placement model is to place more students in A&P I only based on one independent variable. In that case, using an argument-based validity theory, the use of student GPA, science subscores on the ACT, composite ACT scores, and prerequisite course outcomes are supported by this study. However, the researcher is concerned that these findings may not represent other higher education institutions due to the sample population size and above-average scores. As a result, the researcher suggests that future research consider a more significant and diverse sample, which may provide a different perspective on using these test scores and course outcomes as a predictor. Therefore, using an argument-based validity framework may not be the most beneficial lens for this study's wide variety of variable types.

Using a phenomenological interpretive lens to evaluate the independent variables of this study is also challenging. The results revealed a disconnect between the statistical significance of these variables and the reality of high attrition and low success rates in A&P I courses. This inconsistency is apparent due to the high A&P I attrition rates with independent variables that all demonstrate some statistically relevant predictive power. As mentioned, a phenomenological interpretation is typically reserved for a more qualitative study where students' experiences are evaluated, not just the course outcomes. However, the researcher asserts that a certain degree of interpretation can be gathered using a phenomenological perspective. If academic stakeholders look at the students' academic journeys and accomplishments as a phenomenon, then phenomenological interpretation can be inferred. The researcher believes that the connection between the actual statistical outcomes and the student's academic progress exists because of the overall academic preparation and not any one individual academic variable. Therefore, the appropriateness of these two theoretical frameworks and interpretive lenses depends on how future readers and researchers interpret the student's academic experiences.

Interpretations

The results of this study do provide a more effective and statistically predictive model for anticipating student A&P I success compared to the current utilized college advisement policies. However, the proposed regression formula and prediction model requires a complex and comprehensive amount of student data to be an appropriate advisement tool. Advisors often need more time and information to guide student course decisions correctly. The currently used advisement models at most postsecondary institutions represent a more concise and data-friendly tool for advisors, despite needing

to be more efficient in improving student retention. College success depends on so many factors for students, primarily that the students taking A&P I may not be science majors but instead are attempting this course for acceptance into healthcare-related professions. Several other non-academic factors beyond the scope of this research influence student outcomes, therefore creating fluctuations in the prediction algorithm that can drastically change the outcome. Finally, the researcher highly recommends that college administrators and other educational stakeholders view the student advisement process from a holistic view that does not use a single measure or variable as a cut score or entry criteria but instead attempts to connect the student's academic background with identifiable non-academic experiences.

Prediction Ability

The models presented in this study demonstrate, in terms of sensitivity, a superior ability to predict student success compared to the current methods for A&P I advisement. This improved accuracy of predicting a student's pass ability greatly benefits the proposed model. However, when predicting a failure, the proposed models demonstrate less success than predicting passes. This makes the overall prediction rate less efficient but still improved compared to the current advisement policies.

Implications

The researcher recommends that educational institutions explore the relationship between individual program placement policies and success based on their student academic and non-academic demographics. Data should be acquired to help identify policy changes that will improve student success and decrease attrition of high-risk courses. This study indicates that it is possible to identify common academic

characteristics among students concerning core success or failure. Although using isolated variables such as GPA may be simpler and more time efficient in increasing student enrollment numbers, advisement personnel should consider the success rate of students completing A&P I courses in considering a more sophisticated advisement model.

Designing an advisement system that gathers and calculates multiple academic variables, such as ACT scores and prerequisite courses, may require additional resources and time. However, the results of this study indicate a more effective method of calculating student success. With stronger and more data driven advisement processes, student preparedness for courses such as A&P I can be identified, therefore potentially decreasing the number of unprepared students entering these courses. The students that require remedial or preparatory coursework can be directed towards the most appropriate classes until they are better prepared for the more complex academic offerings. These changes will potentially increase student retention, therefore decreasing the academic burdens placed on students and schools and improving the overall academic offerings of both two-year and four-year institutions.

Limitations

This study helps identify the limitations of isolated academic factors in predicting A&P I course success. Despite the statistically significant results that were demonstrated with many variables, community colleges should use the results from this study with caution. Institutions can control multiple factors, but a complex combination of other life experiences can influence student success. These experiences need to provide trackable data for advisement policies to incorporate. Therefore, advisors have the challenging role

of incorporating these student occurrences into the academic regression model. The acquisition of this data will likely occur either in advisement one-on-one interviews or with comprehensive advisement surveys that the students will fill out before making course selections.

The sample population for this study creates a second research limitation. The sample was isolated to a single regional Community College in Mississippi. Despite the researched college having comparable demographics to the national and Mississippi student population, the researcher recognizes that this sample population does not necessarily provide the variance needed to produce a universal interpretation. Therefore, it is advised that the educational institutions wanting to implement this study's recommendations first analyze their student population for the same identified predictable patterns.

Implications for Future Research

The current research project needed to be more comprehensive in comparing certain placement information. Therefore, future studies are required to compare other variables such as transfer credits, financial support, enrollment status, and other common early warning predictor factors that may describe the students. In addition, student extracurricular involvement, such as clubs, sports, or other organizations, should be studied to see the quantifiable social impact on student A&P I outcomes. To accomplish many of these goals, a student survey would need to be developed and implemented prior to the student being advised for A&P I, making this a challenging future research project.

The qualitative impacts of the students' experiences before and after A & P I course completion provide unique and clarifying data which could be implemented into the proposed academic prediction formula.

Another area of research involves finding the specific threshold for each independent variable studied in this project. For example, a significant value could be identified if the specific GPA or range of GPAs with the highest correlation and prediction to coerce outcome could be identified. For example, comparing institutional results with national ACT benchmarks could provide a more specific advisement threshold for enrollment into A&P I. Researchers should also attempt to identify the specific number of credit hours within certain periods that offer a more accurate measurement of potential student success. All of this proposed research would help design a comprehensive, holistic advisement model that could be adopted by any postsecondary institution wishing to implement.

Conclusion

The purpose of this non-experimental quantitative study was to compare student outcomes for first-time enrollment in A&P I course with potential academic variables, which could be used to improve advisement prediction and placement. Student attrition in A&P I course is a leading topic of discussion in higher education, with a specific focus on community college student attrition. Since community colleges are typically open-door institutions, they are challenged with improving student success in an environment where a large majority of their enrolled students are academically disadvantaged (Juszkiewicz, 2015). The findings from this study emphasize the importance of

institutions engaging in an analysis of their advisement and placement criteria for higher-level science courses such as A&P I.

Using a phenomenological interpretive lens, this study attempted to explain the phenomena of student academic experience with the reality of A&P I outcomes. An argument-based validity framework also examined the appropriate use of GPA, composite ACT score, and ACT science subscore for placement criteria in college A&P I. While all the academic factors studied in this project demonstrated some form of statistical relationship with final A&P I outcomes, the study also indicates that using single-entry criteria does not efficiently and confidently predict student failure and success. The researcher concludes that a more holistic advisement process derived from a combination of academic and non-academic student variables would best serve the students, institutions, and health-related professions. Based on the results of this study, the researcher believes in the use of multiple measures and their ability to identify which students need added support. Furthermore, colleges and universities across the country should continue searching for optimal advisement tools to help all students achieve their academic goals.

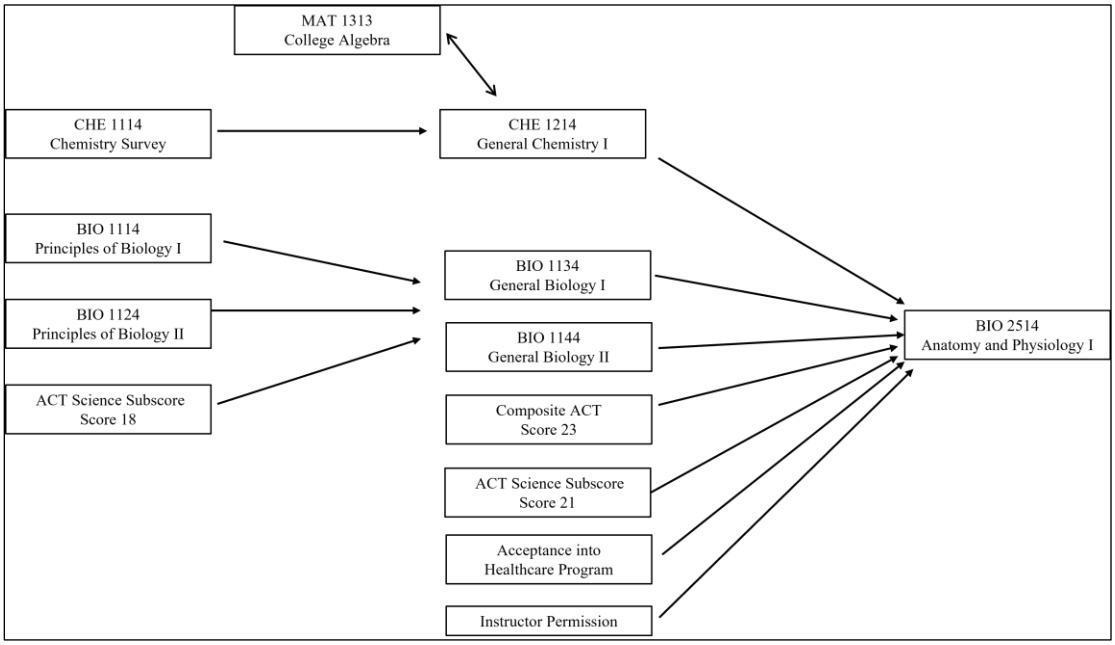
This study sought to provide research that could fill the literature gap concerning best practices for A&P I course student advisement and success probability. Jones College in Ellisville, MS, provided a consistent and reliable data sample to study the academic factors potentially associated with A&P I outcomes. The researcher chose cumulative college hours, composite ACT score, science ACT score, GPA, and fundamental biology courses as the independent variables for study, with overall student A&P I outcome as the outcome variable. After analysis, all studied variables

demonstrated some significant relationship with student success or failure during their first attempt at an A&P I course at the post-secondary educational level. After interpreting the results from the analysis, the researcher concluded that no single academic variable or combination of variables could provide an efficient probability model for advising A&P students. The variables studied demonstrated an ability to forecast a student's success in A&P I. However, the same variables or combination could not provide the same confidence in foretelling student failure in these courses. Furthermore, the researcher recognizes that continued research on A&P attrition rates, including qualitative and mix-method studies, would add valuable data to the identified literature gaps. Finally, the researcher summarizes the results of this study by recommending that student advisement policies for A&P courses be evaluated to take a more holistic view of the prerequisites and other academic factors that could improve the probability of student A&P I outcome prediction.

APPENDIX A – Listed Figures

Figure: A1

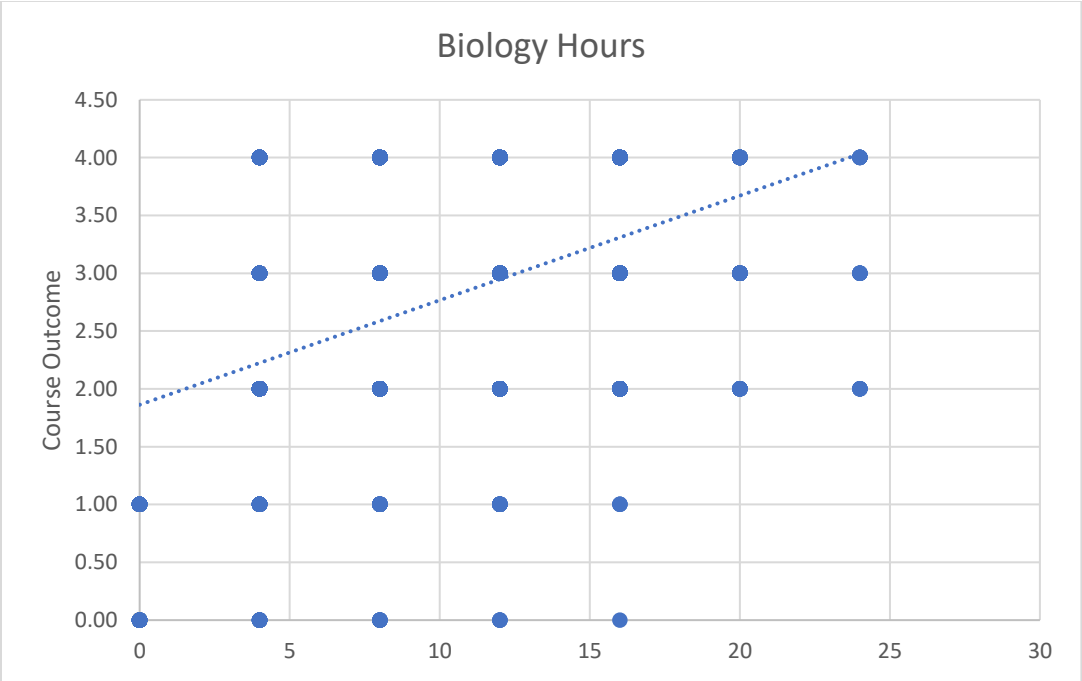
Jones College A&P I Course Sequencing



Note: Jones College course sequence for students enrolling in Anatomy and Physiology I course. This figure shows the developmental courses and other optional admission criteria for A&P admittance.

Figure A2

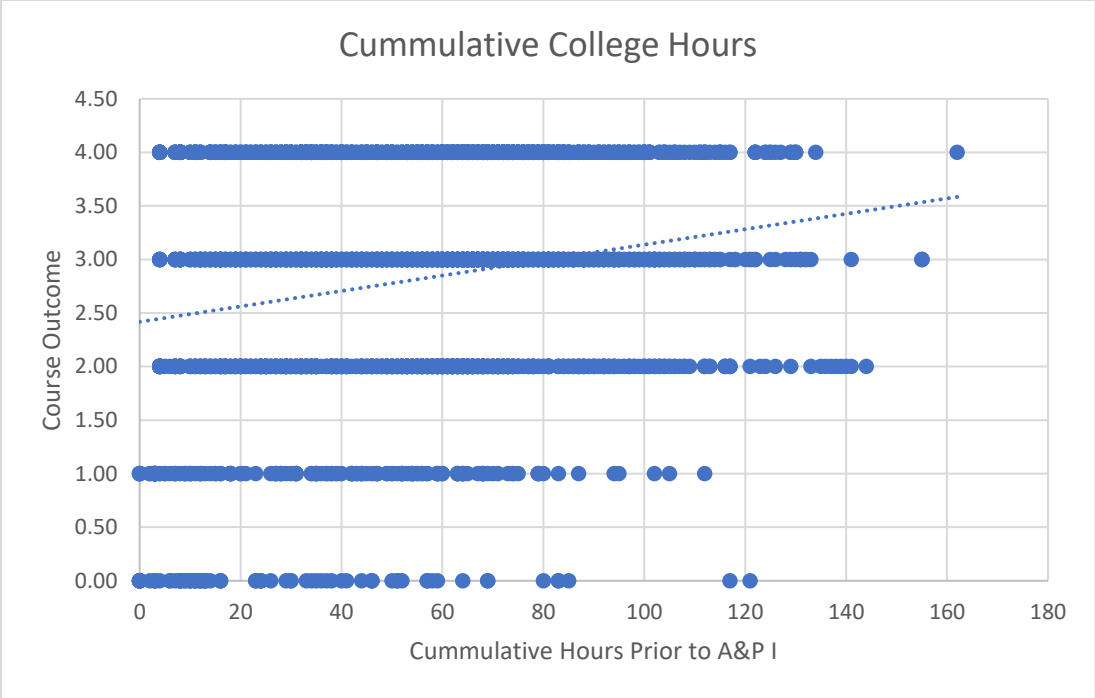
Total Biology Hours Prior to A&P Enrollment and Outcome A&P I GPA



Note: The dotted line identifies the mathematical best fit for the data

Figure A3

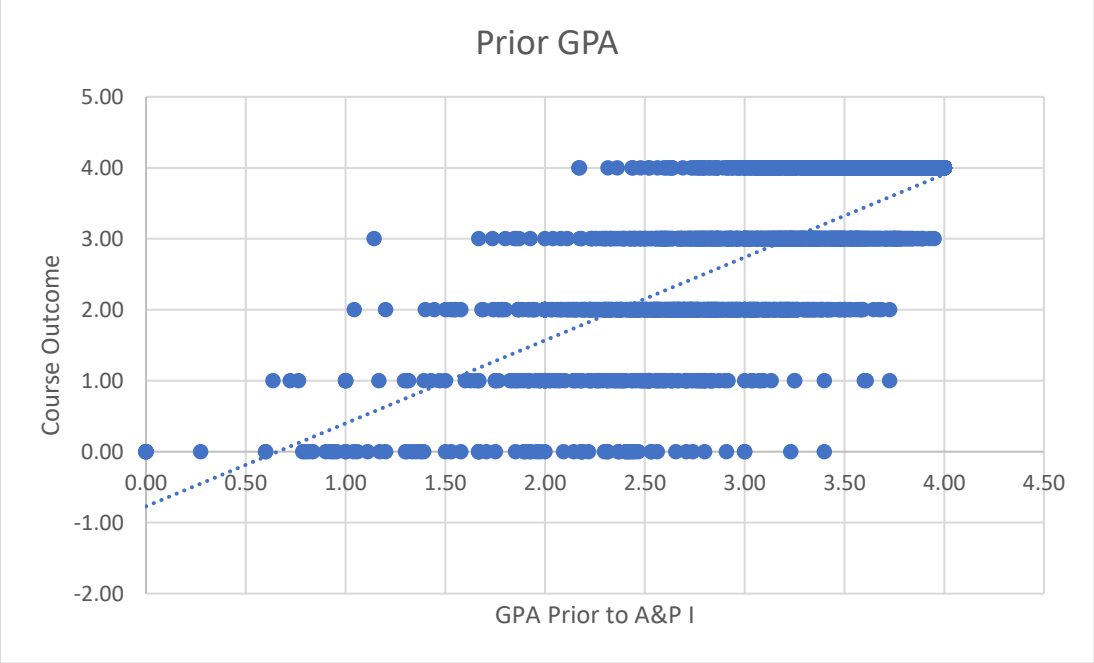
Cumulative College Hours Prior to A&P Enrollment and Outcome A&P I GPA



Note: The dotted line identifies the mathematical best fit for the data

Figure A4

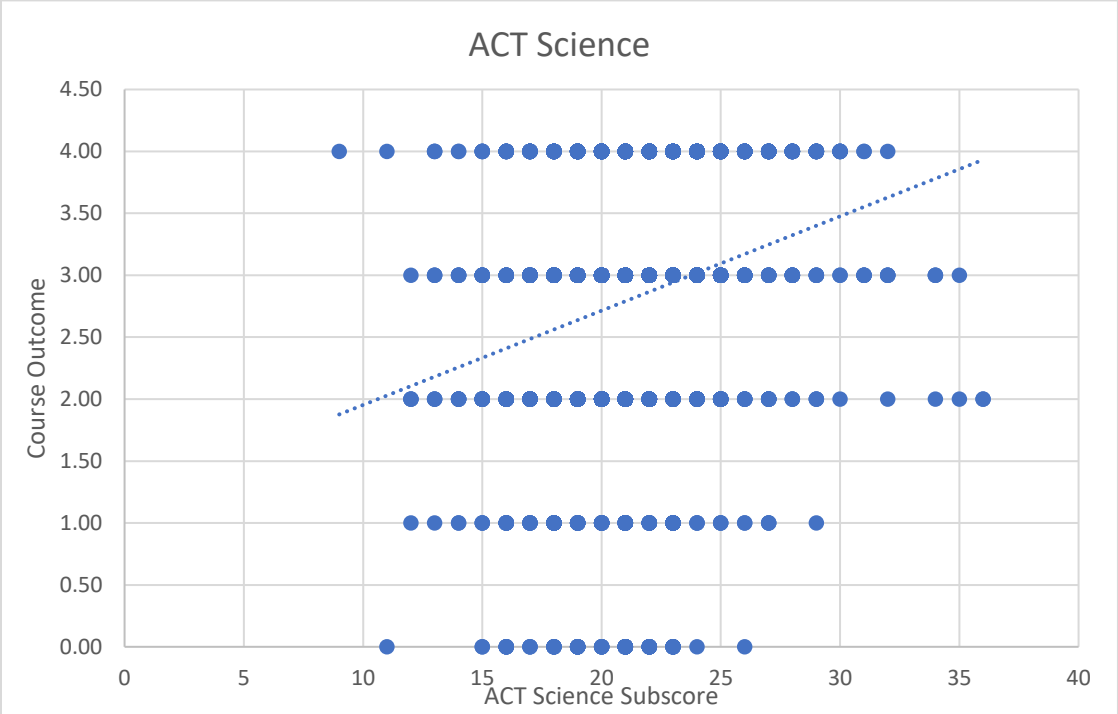
Student GPA Prior to A&P Enrollment and Outcome A&P GPA



Note: The dotted line identifies the mathematical best fit for the data

Figure A5

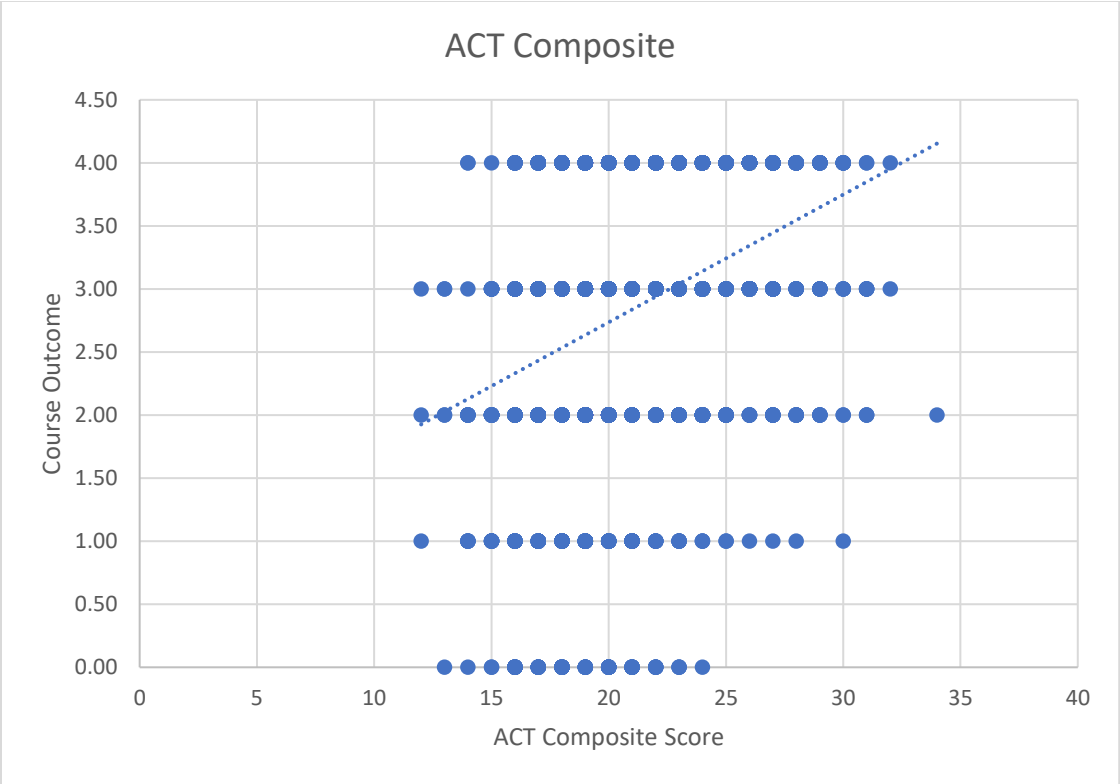
Student ACT Science Subscore Prior to A&P Enrollment and Outcome A&P GPA



Note: The dotted line identifies the mathematical best fit for the data

Figure A6

Student Composite ACT score prior to A&P Enrollment and Outcome A&P GPA



Note: The dotted line identifies the mathematical best fit for the data

Figure A7

Student Preparatory Biology Course Enrollment Prior to A&P O I Enrollment

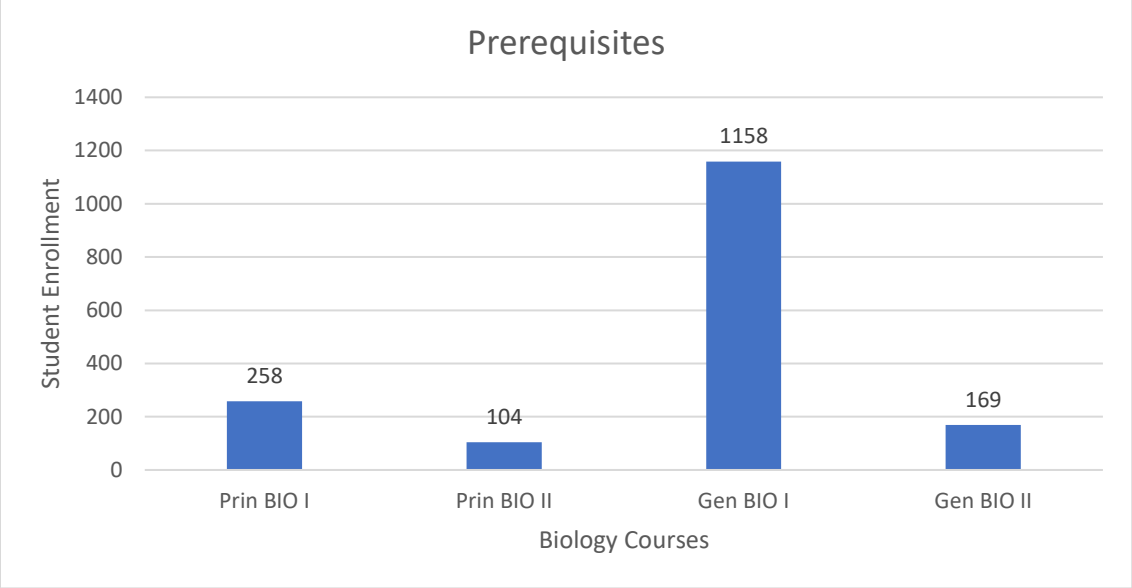


Figure A8

Semester of A&P I Enrollment

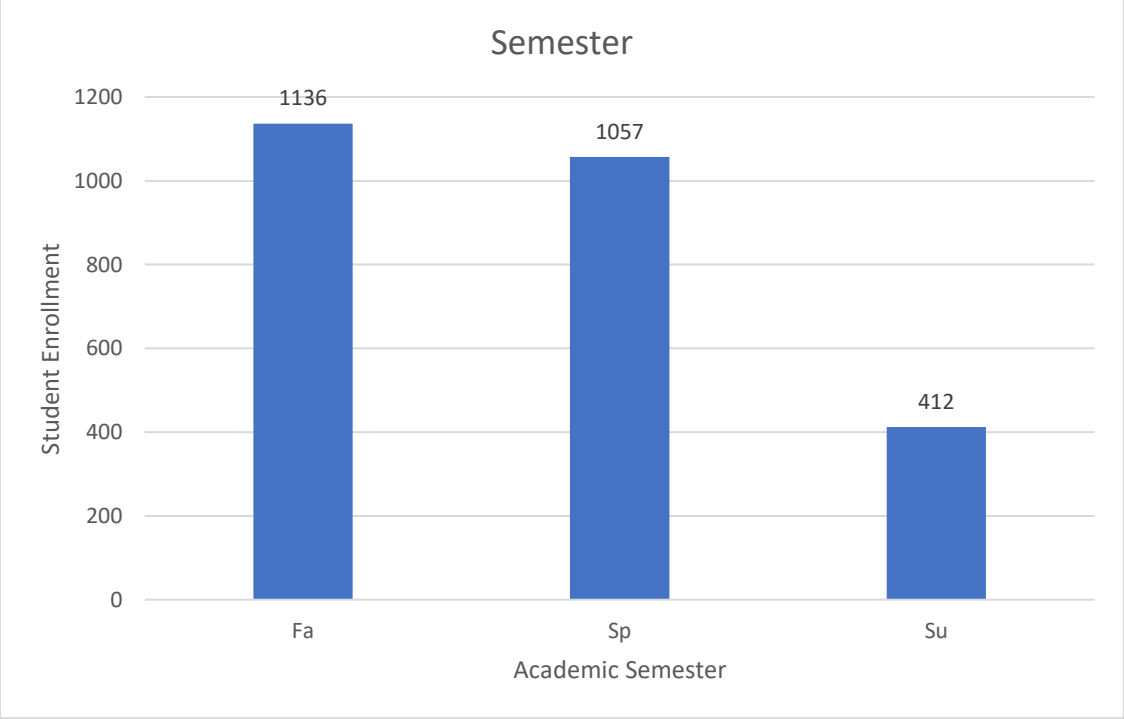
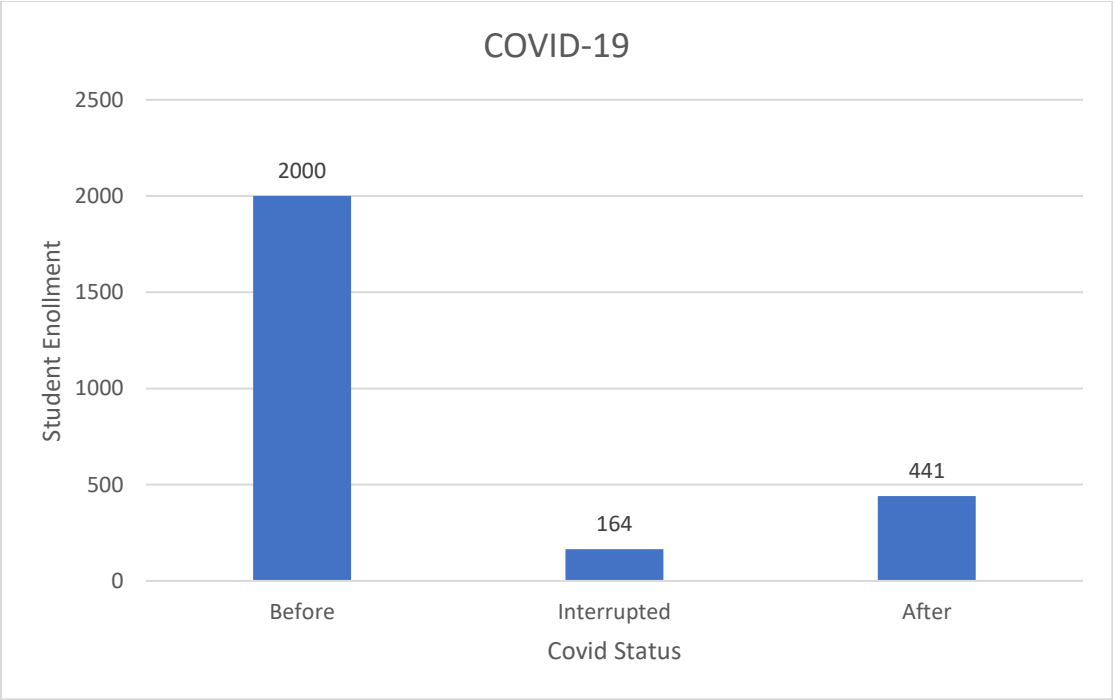


Figure A9

Students Impacted Academically in A&P I by COVID Pandemic



APPENDIX B – Listed Tables

Table B1

Continuous Variable Analysis

	BIO Hours Before A&P I	Cumulative College Hours total before A&P I	GPA Prior to A&P I	ACT Science Subscore	ACT Composite Score	Course Outcome GPA
Mean	10.58	55.61	3.07	21.37	20.82	2.82
S.D.	4.84	29.02	0.63	3.12	3.34	1.01
Variance	23.41	841.93	0.39	9.74	11.13	1.02
Skew	0	0	-1	0	1	-1
Kurt	0	0	2	1	0	0

Table B2

Sample Age, Race, and Gender

Age	Total
<20	8
20-24	1173
25-29	993
>29	431
Race	
White	1878
Black	654
American Indian	22
Asian	23
Hispanic	19
Pacific Islander	1
Not Specified	8
Sex	
Male	552
Female	2051
Undisclosed	2

n = 2605

Table B3
ANOVA
Results

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5850955.70	7	835850.81	6937.36	0.00	2.02
Within Groups	2509953.60	20832	120.49			
Total	8360909.30	20839				

$p < .05$

Table B4

Cumulative College Credit Hours Completed by Gender and Ethnicity

Variable	N	M	SD
Gender			
Female	2209	54.95	28.21
Male	579	54.63	29.49
Ethnicity			
White	2006	55.75	28.959
Black	703	51.4	29.988
Asian	25	58.04	30.44
Amind	23	51.74	25.088
Hispanic	22	59.64	24.112
Pacif	8	69.38	25.696

Table B5

Regression Output

							95% C.I. (EXP(B))	
		B	S.E.	Wald	Df	Sig.	Exp(B)	Lower	Upper
Step 1	College hours	.025	.003	86.487	1	<.001	1.026	1.020	1.031
	Constant	1.234	.126	95.234	1	<.001	3.436		

Log likelihood =1517.22 ; *Cox & Snell* R^2 = .034; *Nagelkerke* R^2 = .079; $\chi^2(1) = 98.497$, $p < .001$

Table B6

Student's GPA Before Enrollment in an A&P I Course by Gender and Ethnicity

Variable	N	M	SD
Gender			
Male	2223	2.98	.67
Female	587	3.07	.64
Ethnicity			
White	2017	3.14	.62
Black	714	2.79	.66
Asian	25	3.48	.53
Amind	23	3.05	.55
Hispanic	22	2.95	.55
Pacif	8	3.17	.60

Table B7

Regression Output

						95% C.I. (EXP(B))	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	GPA	2.279	.144	<.001	13.178	9.931	17.487
	Constant	-4.594	.364	<.001	.010		

Log likelihood =1161.64 ; *Cox & Snell* R^2 = .02; *Nagelkerke* R^2 = .39; χ^2 = 552.723, p < .001

Table B8

Descriptive Statistics for ACT Composition Score

Variable	N	M	SD
Gender			
Female	2150	20.54	3.194
Male	569	21.62	3.707
Ethnicity			
White	1957	21.49	3.220
Black	685	18.79	2.750
Asian	24	21.50	3.683
Amind	23	19.70	2.566
Hispanic	21	18.05	3.154
Pacif	8	19.88	3.271

Table B9

Regression Output

						95% C.I.	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition Score	.237	.025	<.001	1.268	1.206	1.332
	Constant	-2.371	.486	<.001	.093		

Log likelihood =1555.453; *Cox & Snell* R^2 = .04; *Nagelkerke* R^2 = .082; χ^2 = 104.73, p < .001

Table B10

Descriptive Statistics for Student's Science Sub-score

Variable	N	M	SD
Gender			
Male	2136	22.38	3.638
Female	565	21.06	2.909
Ethnicity			
White	1942	21.86	3.119
Black	682	19.87	2.640
Asian	24	20.75	3.854
Amind	23	21.04	2.306
Hispanic	21	19.57	1.912
Pacif	8	18.69	3.059

Table B11

Regression Model Output

						95% C.I	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Science subscore	.155	.023	<.001	1.168	1.117	1.222
	Constant	-.890	.467	.056	.411		

Log likelihood =1599.27; *Cox & Snell* R^2 = .02; *Nagelkerke* R^2 = .038; χ^2 = 48.063, p < .001

Table B12

Frequencies and percentages for General Biology I and II

		Biology I		Biology II	
		N	%	N	%
Valid	Not taken	1620	56.7	2682	93.8
	Taken	1238	43.3	176	6.2
	Total	2858	100.0	28.58	100

Table B13

Regression output with Biology I as a predictor variable

						95% C.I.for EXP(B)	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Biology I(1)	.419	.138	.002	1.521	1.160	1.993
	Constant	2.163	.082	.000	8.701		

Log likelihood =1704.839; *Cox & Snell* R^2 = .003; *Nagelkerke* R^2 = .007; χ^2 = 9.523, p =.002

Table B14

Regression output with Biology II as a predictor variable

						95% C.I	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Biology II(1)	1.253	.459	.006	3.500	1.425	8.598
	Constant	2.279	.067	.000	9.771		

Log likelihood =1703.278; *Cox & Snell* R^2 = .004; *Nagelkerke* R^2 = .009; χ^2 = 11.084, p < .001

Table B15

Regression Output with Biology I and II as predictor variables

						95% C.I. (EXP(B))	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	General Biology I(1)	.334	.140	.017	2.944	1.184	7.320
	General Biology II(1)	1.080	.465	.020	1.396	1.061	1.837
	Constant	2.186	.082	<.001	8.636		

Log likelihood =1697.444; *Cox & Snell* R^2 = .03; *Nagelkerke* R^2 = .013; χ^2 = 16.918, p < .001

Table B16

Multiple Regression output

						95% C.I.for EXP(B)	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1[a]	General Biology II(1)	1.042	.466	.025	2.835	1.138	7.059
	Principles of Biology I(1)	-.373	.227	.101	.689	.441	1.075
	Principles of Biology II(1)	.261	.375	.485	1.299	.623	2.707
	General Biology I(1)	.369	.142	.010	1.446	1.094	1.912
	Constant	2.174	.084	.000	8.796		

Log likelihood =1697.444; *Cox & Snell* R^2 = .03; *Nagelkerke* R^2 = .013; χ^2 = 16.918, p < .001

Table B17

Binary logistic regression output

						95% C.I EXP(B)	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition Score	.132	.047	**.005**	1.141	1.041	1.251
	ACT Science Subscore	-.039	.046	.395	.962	.879	1.052
	Principles of Bio I(1)	-.204	.263	.438	.815	.487	1.365
	Principles of Bio II(1)	-.071	.400	.860	.932	.425	2.042
	General Bio I(1)	.028	.186	.879	1.029	.714	1.482
	General Bio II(1)	.513	.491	.295	1.671	.639	4.371
	GPA Before A&P I	2.481	.175	**<.001**	11.949	8.474	16.849
	Cumulative Hours Prior	.005	.004	.187	1.005	.998	1.012
	Constant	-6.340	.724	.000	.002		

Log likelihood =1076.171; *Cox & Snell* R^2 = .165; *Nagelkerke* R^2 = .378; χ^2 = 492.351, $p < .001$

Table B18

Regression output of the most appropriate model

						95% C.I.(EXP(B))	
		B	S.E.	Sig.	Exp(B)	Lower	Upper
Step 1	ACT composition Score	.116	.029	<.001	1.123	1.061	1.189
	GPA Before A&P I	2.579	.154	<.001	13.189	9.753	17.836
	Constant	-6.868	.643	<.001	.001		

Log likelihood

Table B19

Regression Statistics	
Multiple R	0.766
R Square	0.587
Adjusted R Square	0.586
Standard Error	0.651
Observations	2605.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	1565.2045	173.9116	409.798776	0.0000
Residual	2595	1101.2738	0.4244		
Total	2604	2666.4783			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.947	0.0931	-10.1673	0.000	-1.1292	-0.7641	-1.1292	-0.7641
Spring Semester Attempt - Coded	0.198	0.0271	7.3008	0.000	0.1445	0.2506	0.1445	0.2506
Class Type - WWW Coded	-0.231	0.0646	-3.5686	0.000	-0.3574	-0.1039	-0.3574	-0.1039
Class Type - Coded	0.106	0.0337	3.1393	0.002	0.0397	0.1720	0.0397	0.1720
Prin BIO I Coded	-0.192	0.0460	-4.1790	0.000	-0.2825	-0.1020	-0.2825	-0.1020
Gen BIO I Coded	-0.111	0.0309	-3.5852	0.000	-0.1715	-0.0502	-0.1715	-0.0502
Cummulative BIO Hours	0.058	0.0038	15.2367	0.000	0.0510	0.0660	0.0510	0.0660
Cumulative College hours	-0.006	0.0006	-10.6762	0.000	-0.0070	-0.0048	-0.0070	-0.0048
GPA Prior to A&P I	1.033	0.0248	41.6069	0.000	0.9845	1.0819	0.9845	1.0819
ACT Composite Score	0.014	0.0043	3.1352	0.002	0.0051	0.0221	0.0051	0.0221

Table B20

Regression Model Accuracy

Success	Failure
2361	244

		Actual	
		Pass	Fail
Predicted	Pass	2192	58
	Fail	186	169
	Sensitivity	97%	
	Sensitivity	48%	

Table B21

Regression Model Accuracy

		GPA Only	
		Actual	
		Pass	Fail
Predicted	Pass	2109	77
	Fail	269	150
	Sensitivity	96%	
	Sensitivity	36%	

Table B22

Regression Model Accuracy

		Bio I Only	
		Actual	
		Pass	Fail
Predicted	Pass	1077	81
	Fail	1301	146
	Sensitivity	93%	
	Sensitivity	10%	

Table B23

Regression Model Accuracy

		ACT Science Only	
		Actual	
		Pass	Fail
Predicted	Pass	1483	115
	Fail	895	112
	Sensitivity	93%	
	Sensitivity	11%	

Table B24

Regression Model Accuracy

		GPA and College Hours	
		Actual	
		Pass	Fail
Predicted	Pass	1483	115
	Fail	895	112
	Sensitivity	93%	
	Sensitivity	11%	

APPENDIX C – IRB Approval Letters

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident submission on InfoEd IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER:	22-153
PROJECT TITLE:	Examining the Predictability Models for High Attrition among Human Anatomy and Physiology (A&P) Students in Community Colleges
SCHOOL/PROGRAM	Center for STEM Education
RESEARCHERS:	PI: Benjimen Sessums Investigators: Sessums, Benjimen~Buford, Kendrick~Cwikla, Julie~Svatek, Rachel~
IRB COMMITTEE ACTION:	Approved
CATEGORY:	Expedited Category
PERIOD OF APPROVAL:	31-May-2022 to 30-May-2023

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

s

February 14, 2022

To Whom it May Concern:

Mr. Benjimen Sessums is a student in the process of finalizing his IRB proposal. Once Mr. Sessums receives IRB approval and submits his research request, the Institutional Effectiveness Committee at Jones College will review the request. Mr. Sessums will be permitted to conduct research if the Committee approves his request. Should you need additional information, please feel free to email me (ashley.beard@jcjc.edu).

Sincerely,

Ashley Beard
Dean of eLearning & Institutional Research
Jones College

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