ADMISSION FACTORS USED TO DETERMINE ENTRY INTO A NURSING PROGRAM BASED ON STUDENT SUCCESS INDICATORS AT A PUBLIC UNIVERSITY

by

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ABSTRACT

This study compared application data for an undergraduate nursing program at a public health science center university in the southeast. The study covered five years of application cohorts from 2009 to 2014 from admission through graduation. The application data analyzed two dependent variables to predict students likely to achieve success in the nursing program. These two variables to measures success were: the ability of the admitted student to successfully achieve graduation requirements; and those graduates that were able to pass the national nursing certification exam on the first attempt. The application data was assessed to determine if a relationship existed between the data used to select students for admission and the success outcomes from an undergraduate nursing program.

The application data was analyzed using a logistic regression and decision tree model to explore the relationship between the variables. The scores provided by the faculty members' overall assessment of the entire application file was significant in three of the four logistic regression models and race was significant in the national certification logistic regression model. A similar finding resulted with scores provided by the faculty members' overall assessment of the entire application file placed as the first node in three of the four decision tree models, and race placed as the first node in the national certification exam decision tree model. The study found that the data provided by faculty members in the admission process yielded results with the highest predictability related to student success in a nursing program.

DEDICATION

This dissertation is dedicated to my wife, Jodi. Her support and words of encouragement provided me with the inspiration and motivation to complete this journey. She continues to impress me with her compassion and commitment that she shows towards the students she teaches.

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CHAPTER I:

INTRODUCTION

The projected population of the United States of America expects to grow to over twenty-five million citizens in the next ten years, with 73% of that increase in the population over sixty-five years old. In forty years, that projection grows to exceed 88 million, and 64% of those citizens are expected to be over the age of sixty-five (United States Census Bureau, 2013). This migration of the United States population towards an aging population places increased demands on the health care system through a predicted growth from 7 million to 14 million in the number of older adults requiring care in health care facilities by 2020, and a corresponding increase from 5 million to 7.7 million older adults needing care for Alzheimer's disease (Beverly, Burger, Maas, & Specht, 2010). The requirement for a larger nursing workforce, as part of the health care system, has been one of the foci of attention to address this growing health care shortage (Buerhaus, Auerbach, Staiger, & Muench, 2013; The National Academies Press, 2011).

The nursing workforce, as a subset of society, has seen the same trend towards an aging workforce (Janiszewski-Goodin, 2003). As part of an older workforce, the population of nursing faculty can also be categorized as a demographic of older nurses. This workforce faces the challenge of recruiting younger nurses with a longer time to serve as both care providers and as faculty members (Nardi & Gyurko, 2013). The current national nursing faculty shortage of 1,328 full-time positions, which represents 7.1% of the faculty needed in higher education, makes this professionally qualified population of faculty a valued resource, and subsequently the allocation of faculty members' time becomes a limited commodity (Li, Stauffer, & Fang, 2015).

As nursing education explores ways to expand the methods to increase the nursing workforce, limited numbers of faculty becomes a constraint. There have been several approaches to resolving the nurse shortage through two different growth proposals. One approach addresses the training of more existing nurses into the role of nursing instructors (Palmer & Paterson, 2010; Reid, Hinderer, Jarosinski, Mister, & Seldomridge, 2013). Another approach attempts to improve the production of current nursing programs within faculty constrained environments (Scott & Zerwic, 2015; Yucha, Smyer, & Strano-Perry, 2014).

While working with limited faculty, the efforts intended to increase the number of nursing faculty or increase the production of current nurses becomes a significant factor for the use of faculty in undergraduate nursing programs. Specifically, the use of faculty time becomes a valuable resource. The review of an applicant's file requires time spent by faculty members as part of the application review process. The allocation of faculty members' time to increase the accuracy of the admissions process may be considered essential if the time invested improves the selection process increases graduation and certification outcomes, and grows the number of qualified nurses (McNelis et al., 2010; Scott & Zerwic, 2015; Sinha, Oswald, Imus, & Schmitt, 2011). Application review processes have considered academic performance by reviewing application data and application supporting information, like essays and interviews, to improve the likelihood of selecting students with similar characteristics to previously selected students that have a historical record of demonstrated success in a nursing program (Jeffreys, 2007; McCarey, Barr, & Rattray, 2007). Therefore, this study attempted to explore the data available in an application process to evaluate the effectiveness in the faculty members' subjective assessment of an application file along with the use of available data in application files into a nursing school's admission decisions was an effective use of faculty time.

Background

In order to determine if faculty members' subjective evaluation of an application file aligns with the success of an admitted student, a nursing program utilization of faculty members' input was assessed in this study. The undergraduate nursing program was selected based on the admission process used by the school, which meets this requirement and several other considerations necessary to add validity to this study. The selection process for this study had to identify a nursing program that received more applications than available seats during the period of the study. The undergraduate nursing program has received more applications than available seats for over ten years, which covered the intended period of the study. The academic environment and curriculum have remained constant to allow for the study to consider all application data as equivalent and in a stable academic curriculum when analyzing the application data as part of a specific admission year. The undergraduate nursing program has maintained a constant academic environment, which includes a consistent admissions process and academic course outcomes. The use of a public institution with an open admission system provides consistent admission process and standards to establish a foundation to evaluate the effects of the faculty members' subjective input into admissions decisions.

Nursing programs have explored methods to grow the size and efficiency of the undergraduate Bachelors of Science in nursing program (Aiken, Cheung, & Olds, 2009; Reinhard & Hassmiller, 2009). The constraints of an aging nursing faculty, limitations on the number of clinical sites, constraints on the faculty to student ratio in clinical settings, reduced patient stays, and patients admitted to hospitals with a greater percentage requiring a higher level of acute care has limited the growth in adding additional students into existing nursing programs, and places a strain on the current state of the health care environment (Kc & Terwiesch, 2009).

Efforts to first identify the applicants with the highest probability of successfully progression and completion of a nursing program thus becomes a potential strategy to increase graduates. The ability to identify the best-qualified applicants during the admissions process attempts to minimize student attrition. By admitting students with a higher probability of success, the likelihood of preventing the loss of students increases the likelihood of success for students gaining admission into the limited seats in a nursing program. There are many reasons for student attrition and efforts designed to address methods or interventions to decrease attrition (Johnson, Johnson, Kim, & McKee, 2009). The ability to identify and predict those students that have a higher likelihood of succeeding in this constrained environment is an approach that attempts to increase successful students. The selection process is the first point in a nursing education program that determines the students gaining entry into a limited admission academic program, which then leads to a commitment between the education program and that student. Thus, the students allowed into a nursing program can be screened to identify the best-qualified students.

The admission selection process follows a variety of methods to select students for admissions. These admission processes follow institution guidelines under the protection of case law (Kaplin & Lee, 2014). Institutions of higher education attempt to operate within these rules and still meet their enrollment management objectives. The goal during an admissions process attempts to select a cohorts of students for admission that possess the characteristics and achievements that best represent that institution and at sufficient levels to maintain the operation and selectivity of that institution (Hoxby, 2009). Ideal admissions processes accomplish both of these goals.

The admissions process can evaluate previous academic performance, achievements, writing samples, interviews, and a number of other quantifiable or subjective measures. This selection process may involve faculty members as integral components in this process. With a shortage of faculty in healthcare and an associated value attached to the use of faculty time, this study intends to determine if the application review by faculty members indicates a higher prediction than the demographic and academic performance measures in a nursing applicants file. Additionally, this work also intends to determine the factors that provide the highest probability of students to reach the point of graduation and the ability to pass the national certification exam.

The underlying need to increase the number of nurses working in a health care setting provides a rationale for this study. In a nursing program, similar to other professional programs, a nursing student can earn a bachelor of science degree in nursing, but cannot practice as a registered nurse until the graduate passes the national certification exam. The certification requirement creates the necessity for admissions processes to select applicants with the highest probability of graduating and adding to the nursing workforce, as an intended outcome of this study to inform admission's practices. The admission process should consider both the ability of a student to successfully complete both the academic degree requirements and pass the national certification exam (Alabama Board of Nursing, 2016b). The results of this study will ideally add to the work previously completed in admissions and specifically nursing program admissions, with the goal to increase the number of nurses needed to address the current and projected nursing shortage.

Purpose of the Study

The efforts for increased accountability at institutions of higher education have placed more emphasis for universities to improve graduation and retention rates (Alexander, 2000; Alexander, Harnisch, Hurley, & Moran, 2010). Along with the university pressure to produce improved performance in graduation and retention rates, the health system places demands to produce increases in the nursing workforce (The National Academies Press, 2011). These overlapping pressures provide a similar focus for educational systems to maximize the time, and funding spent on each student's education. This study intends to determine the means to define an efficient admission process that uses the institutions resources as effectively as possible, and specifically if faculty members' time assessing application files results in the identification of successful students.

This research attempted to determine the application variables relationship to success measures in an undergraduate nursing program. Specific emphasis concerned the use of faculty members' time as part of the admission decision review, and if the probability of successful students can be identified at the point of application to help improve the number of qualified nurses entering the workforce. The use of existing data and processes used at the point of application can be researched to determine if those factors provide an ability to predict the probability of success through the completion of an existing academic program. If improvements are possible in improving the success rates of identifying the students with the highest possibility of attaining a nursing degree, that result has a positive effect on the individual student and the health care system.

Significance of the Study

The efforts on increased accountability on institutions of higher education have placed more emphasis for universities to improve graduation and retention rates (Alexander, 2000; Alexander et al., 2010). Along with the university pressure to produce improved performance in graduation and retention rates, the health system is placing demands on an increased nursing workforce (The National Academies Press, 2011). These overlapping pressures have a similar focus to educational systems that maximize the time, and funding spent on each student's education. This study intended to determine if students can be identified at the point of application to help improve the success of students and the number of qualified nurses entering the workforce through the use of faculty time in reviewing applications into an undergraduate nursing program. If improvements are possible in improving the success rates of nursing students, those modifications effect the individual student's outcomes and the resultant impact on the health care system.

Research Questions

The following questions where included in the research study. They included

1. Which application metrics relate to a student's success in meeting graduation standards in a nursing program; and
2. Which application metrics relate to a student's success on the professional certification exam after graduating from a nursing program?

Organization of the Dissertation

This dissertation consists of five chapters. The first chapter provides the background and rationale for conducting this study. The second chapter describes the theoretical framework and the review of the literature addressing this study's topic. The third chapter defines the design of

the study and the method the data was analyzed. The fourth chapter summarizes the results of the data analysis. The fifth chapter provides the interpretation of the results of the data analysis.

CHAPTER II:

REVIEW OF LITERATURE

This chapter provides the literature review and a subsequent theoretical framework designed to provide the rationale for this study given a relevant description of research into academic admission processes. College admission processes provide the set of steps or procedures intended to admit applicants into an institution of higher education. Some institutions attempt to identify applicants that meet defined admission criteria or add to the overall diversity in an admission class (Hoxby, 2009; Pascarella, Cruce, & Umbach, 2006; Scott & Zerwic, 2015). In assessing the qualities of prospective applicants into a specific institution or academic discipline, the peculiarities of the educational processes and a specific university environment provide the context used in those admissions decisions (Timer & Clauson, 2011; Tinto, 1982). The admission's process intends to match the qualities of the applicants to the institution. A successful admissions process selects students able to progress towards degree completion at an institution (Mattern, Shaw, & Kobrin, 2010).

The review of literature begins with an explanation of educational environment and requirements critical for success in a nursing curriculum, and then expands to describe the admission systems. The educational environment necessary to prepare a student for the nursing career requires classrooms, labs, simulation facilities, and actual clinical sites combined with qualified nursing faculty and adjunct clinical instructors at all of these sites (Potter, Perry, Stockert, & Hall, 2013). Since nursing is a professional program requiring an alignment of theoretical concepts to application in a health care setting, nursing educational programs require

assistance from the health care system. As nursing programs rely on local hospitals and clinics, undergraduate nursing programs depend on several environmental factors to provide the education processes necessary to educate future nurses (Alabama Board of Nursing, 2016a). The health care environment requires students to demonstrate interaction with patients and other health care professionals, as part of health care team (Cooper et al., 2010; Liou, Chang, Tsai, & Cheng, 2013; Murray, Schappe, Kreienkamp, Loyd, & Buck, 2010). The clinical skills require addition competencies built upon communication, decision making, and compassion which comprise a portion of the application skills necessary for high quality patient care (Cronenwett et al., 2007; Edgecombe & Bowden, 2009). As a component of an education system, nursing schools follow steps similar to any education process that start with student admissions, but vary once the nursing student begins the linked classroom and clinical education. The additional health care related clinical skills add to the complexity in determining the application characteristics of a nursing school applicant.

Undergraduate Nursing Education

Understanding the process required to educate a new nurse and the environment that higher education operates within the health care setting is vital in understanding the restrictions that prevent simply expanding enrollment in existing programs. Nursing students at the undergraduate level can be referred to as pre-licensure students, since they have not qualified to take the National Council Licensure Examination for Registered Nurses (NCLEX-RN) (Alabama Board of Nursing, 2016a). The NCLEX-RN requires students to demonstrate a minimum level of knowledge prior to gaining certification to work with patients as a registered nurse. The curriculum design implements a skills based approach to learning and validation of competencies prior to the application of those skills in a patient care setting (Cooper et al., 2010; Liou et al.,

2013). The development of nursing curriculum identifies essential skills and the associated means to ensure those skills can be adhered to in a dynamic health care setting (Iwasiw, Goldenberg, & Andrusyszyn, 2014). The advances in medicines, technical devices, and health care procedures additionally requires continuous updates to the nursing curriculum (Mundt, Clark, & Klemczak, 2013; Nielsen, Noone, Voss, & Mathews, 2013). If a student leaves the program mid-curriculum, no method typically exists to insert a student in that vacant seat, because of a lack of the validated foundational skills instruction completed at the beginning of the program. The education steps involved in nursing education identify nursing concepts, and develop methods to educate the health care components and nursing skills associated with each concept that set the expectation for successful progression in an undergraduate nursing program (Axley, 2008; Tanicala, Scheffer, & Roberts, 2011).

An undergraduate nursing student who does not persist in course work results in a permanent loss to a cohort of admitted students and thus reduces the number of potential graduates. The clinical setting would seem a likely place to ask for more student placements to grow a nursing program; however, current regulatory restrictions limit expansion in order to protect patient safety and limits the number of students in a clinical setting (Alabama Board of Nursing, 2016a). Thus, schools of nursing cannot increase admission at the beginning of the program to account for initial losses, since the students begin with a limited number of available seats in clinical coursework in the first semester. Alternative approaches have been implemented to increase the number of graduating students. When considering alternatives, nursing education regulations also limit the number of clinical groups by allowing only one clinical group in any nursing unit at a time. Even including three potential shifts of nursing unit rotation in a typical day, the available clinical slots remains relatively constant. This fixed clinical site availability

limits the total number of students an undergraduate nursing program can educate, assuming no growth in clinical units.

The clinical sites dictate the number of faculty that can supervise nursing students in a direct patient care setting at a typically ratio of 1:8 in clinical settings, with slight variation between state boards of nursing (Alabama Board of Nursing, 2016a). The relatively low faculty to student ratio required in clinical courses adds to the pressure for effective use of nursing faculty time. For a cohort of 104 students that requires three faculty members to maintain a 1:35 ration in the classroom, the 1:8 ratio requires 13 clinical instructors for the semester. A common requirement for nursing curriculum involves a didactic course to have a matching clinical course that facilitates the application of the theory into health care practice, which matches a three-hour didactic course to a clinical course requiring 90 clinical hours. For a faculty member to accomplish 90 clinical hours with eight students in that clinical group, the faculty member must spend one full day at a clinical site for 8 to 15 days out of a semester depending on the ability to schedule 12 to 6 hour clinical rotations. In either situation, the faculty member teaches off site for a full day throughout the semester and is unavailable to teach other didactic course on that clinical day (Alabama Board of Nursing, 2016a; Jackson, 2008). This faculty oversight ratio determines the number of nursing faculty needed to produce new nurses. Many schools of nursing operate with unfilled nursing instructor positions, thus further limiting the number of students that can enter clinical courses (Murray et al., 2010). The limited number of potential students that can be admitted into an undergraduate nursing program has been the focus of research.

Higgs, Milde, and Hasse (1984) created a model that assessed the key segments of a nursing student's academic progression. From a longitudinal perspective, the three key times to

effect student success: at the point of admission; progression through the program; and at graduation as the student prepares for the national certification exam (Higgs, Milde, & Haase, 1984). At the beginning of the process, the admission decisions attempt to identify students to grant entry into an academic program with a potential limitation on the total number of available seats, which Higgs classified as the pre-major variables. For the students granted admission, the progression decisions and policies for evaluating and preparing current nursing students establish criteria for continuation in the program.

During the progression through an academic program, academic support systems exist to provide intervention or services as needed to increase student success (Higgs et al., 1984). The variables selected by Higgs and colleagues were those values that could be quantified and compared. Jeffrey's model included the qualitative aspects of professional interaction and psychological outcomes (Jeffreys, 2015). The professional interactions include both activities tied to career developmental and academic interventions based on demonstrated risk factors or predictable reasons for student attrition (Johnson et al., 2009). The process of education ideally creates a qualified graduate able to operate safely in a health care setting.

The last step in an undergraduate academic program to provide educational assistance in preparation for post-graduation requirements occurs when a nursing student prepares and takes the national professional certification exam. Higgs and colleagues defined these measures to include attaining the degree, meeting certification standards, and career performance (Higgs et al., 1984). The success of the individual student impacts both the student and the reputation of the program. This paper focuses on the analysis applied to the application decision to attempt to predict student success in a nursing program as the student progress through the curriculum and reach a point of graduation and the professional certification exam.

As the student transitions into the nursing curriculum, the preparatory education, the expectations of the classroom and clinical experience, and the adjustment to 12 hour clinical experiences have the potential to establish a foundation for the indicators of safe conduct in an increasingly complex health care system for a nursing program (Boxer & Kluge, 2000; Cronenwett et al., 2007). Students without the capability to either understand or apply complex health care protocols safely or lack the proper academic preparation represent a student with a higher risk of failure to meet academic or clinical skills requirements. The application process attempts to develop a method to screen and evaluate potential applicants for admission into an academic program, with the intention to admit students with the highest potential of succeeding in the program based on known performance standards. With the availability of course grades, research ties academic performance to success in nursing programs (Kowitlawakul, Brenkus, & Dugan, 2013; McCarey et al., 2007; Wolkowitz & Kelley, 2010). The subjective assessment of essay and interviews also comprises an area of research that indicates characteristics of successful nursing students (Eddy & Epeneter, 2002; Pitt, Powis, Levett-Jones, & Hunter, 2014). The identification of highly qualified applicants requires a rigorous review of limited data supplied in an application process. The criteria created for university admissions processes varies from one university to another, and have operated with internal discretion based on the legal precedent that defers expertise to educators and the decisions made within institution of higher education (Kaplin & Lee, 2014).

The essential skills in the students' preparation to work safely with patients link directly to the certification competency standards (Hsu & Hsieh, 2009). The listing in Table 1 describe required outcomes expected of the academic programs, nursing faculty, and students participating in a nursing program (American Association of Colleges of Nursing, 2008).

Table 1

Expected Graduate Outcomes from a Baccalaureate Nursing Program

Essential	Description
I	Liberal Education for Baccalaureate Generalist Nursing Practice
II	Basic Organizational and Systems Leadership for Quality Care and Patient Safety
III	Scholarship for Evidence Based Practice
IV	Information Management and Application of Patient Care Technology
V	Healthcare Policy, Finance, and Regulatory Environments
VI	Interprofessional Communication and Collaboration for Improving Patient Health Outcomes
VII	Clinical Prevention and Population Health
VIII	Professionalism and Professional Values
IX	Baccalaureate Generalist Nursing Practice

Source: Summarized from The essentials of baccalaureate education for professional nursing practice. (2008). *American Association of Colleges of Nursing*. October 20, 2008. Retrieved from http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf

The essential skills outline the expectation of the knowledge and skills for an undergraduate nursing student to achieve at the conclusion of the academic program. These skills provide the framework for the theoretical and clinical competencies for nursing programs to meet certification standards. The Commission on Collegiate Nursing Education (CCNE) represents the autonomous component of the American Association of Colleges of Nursing (AACN) that conducts the accreditation of nursing programs. The accredited baccalaureate nursing programs expect graduates to be able to safely perform generalist care across the human lifespan, manage increasingly complex health care teams, and advocate for and educate the patient (American Association of Colleges of Nursing, 2008).

Nursing Curriculum

The essentials outline the skills a nursing student must be able to demonstrate based on the curriculum at the end of an academic program, but the order in which a program covers these skills varies across individual institutions. The variation allows nursing programs to either integrate or separate course content. This variance manifests itself when comparing nursing programs that teach the content by combining or separating the patient population, disease process and medications and these potential differences becomes apparent at the beginning of the academic program. Courses like pathophysiology and pharmacology can cover the course material completely as distinct courses, or combined into nursing curriculum allowing these courses to be taught in conjunction with specific patient populations. Examples of these patient populations include pediatric, adult, or psychiatric patients' health concerns that can be integrated with the intention to associate the disease process taught in pathophysiology, with the medicinal approaches provided by pharmacology within that specific patient grouping (Potter et al., 2013). Over three semesters, the pathophysiology and pharmacology content are completely covered, but the process prevents students from being able to transfer course work due to the differences in where and when the course content and patient population are covered in the curriculum. Since nursing program faculty members verify at the completion of the academic program, that a nursing graduate has met all the essential skills as part of the student's education prior to attempting the certification examination, the summation of the total education is critical. However, the course flow may vary between academic institutions, while still achieving the same outcome of at the conclusion of the program (Alabama Board of Nursing, 2016a). Since an undergraduate pre-licensure nursing program must guarantee students meet the essential skill necessary and be verified prior to attempting the national certification exam, students start at the

beginning of the curriculum to first master these essential basis skills, and complete a university ‘s specific pathway through an academic undergraduate nursing program. These variations in the educational processes at various universities allows institutions to achieve similar results through modifications in the academic curriculum.

Clinical Sites

Adding to the shortage of nursing faculty is the availability of the clinical sites due to economic factors. As health care costs have risen, the United States has reduced the number of beds to treat critical care patients by 4.2%, and the occupancy in these units rose by 13.7% (Halpern, Pastores, Thaler, & Greenstein, 2006). While care remains a concern for hospitals, the need to be efficient with limited resources has caused hospital administrators to implement processes to maximize each bed and placing patients in lower acuity units to fully utilize each unit’s bed capacity (Green & Nguyen, 2001; Thompson, Nunez, Garfinkel, & Dean, 2009). These reports show a need to better maximize facility usage from levels averaging 65% to reach levels above 80% bed utilization (Litvak & Bisognano, 2011). As patient occupancy increases, these facilities strive to maintain high levels of care without increasing risk to patient safety (Kc & Terwiesch, 2009). Economic factors limit clinical site availability by retaining patients with acute conditions that qualify for in-patient care, and nursing staff working at increasing levels of full patient loads.

A restriction on the clinical site availability restricts the production of nursing students, and indirectly results from the rising cost of health care. With the changes in health maintenance organization reimbursements, the implementation of the Affordable Care Act, and ever advancing health care procedures, hospitals experience shorter patients stays and involve a higher percentage of acute health conditions (U.S. Department of Health & Human Services,

2014). The reduced time patients stay in the hospital lowers the number of potential patients available for clinical opportunities for students (Bueno et al., 2010; Kaboli et al., 2012). Patient stay for conditions involving surgery or trauma care have been reduced from 2% to 15% percent, which equates to an approximate six-day average stay lowered to a four-and-a-half-day stay. The higher acuity conditions of the patients, and patients with more severe illnesses that require advanced health care skills, establishes expectations for student's qualifications at a higher level of skills training upon entry into the clinical setting.

University admissions processes report limited data on prospective applicants, but include the number of applications, the corresponding number of students offered admission and the final count of enrolled students from the matching applicant list. The details of specific admission processes remain closed due to the sensitive nature of the applicants' data and the legal right for higher education institutions to select the students for their campus. This study intends to determine if five years of applicant files in one competitive university nursing program provides quantifiable results to justify the use of faculty application assessment in the admissions process. This intent to determine approaches to reduce the current shortage of health care workers has resulted in schools of nursing attempting to maximize the success in the nursing educational programs. The review provides the context to the admission processes and the specific factors that influence the selection of nursing students based on the progression, graduation, and post-graduation certification exam requirements.

Previous Undergraduate Nursing Program Research

The admission selection process attempts to use the characteristics of an applicant's application packet as indicators of success in a nursing program. This review attempts to determine if the input resource meets the quality necessary to produce the product, a successful

nursing graduate. Since this inputted resource depends on the application qualities of the student, the ability to select the best qualified applicants describes the research efforts of Higgs and colleagues (Higgs et al., 1984). The Higgs model considered the application of a pre-nursing students, the performance of those student in nursing course work, and the performance of those nursing student after graduation. The factors considered under each of these three areas are listed in Table 2.

Table 2

Higgs Model of Prediction of Success in Nursing Education and Nursing Practice

Pre-Major Variables	Nursing Major Variables	Post-Graduation
Intellectual Ability/Aptitude	Progression:	Career
Scholastic Performance	Completion/Attrition	Aptitude Tests
Demographics	Level of Achievement	Scholastic
Personal/Personality	Performance Criteria	State Board Test Scores
Sociological -	NLN Exams	Organizational Variables
Situational/Interactional	Organizational Variables	

Note: Adapted from Higgs, Milde, & Haase's (1984). Predicting success in nursing: From prototype to pragmatics. *Western Journal of Nursing Research, 6*(1), 77-95.

The nursing application submission in an admission process represents a point in time where a typical student has been involved in college courses and the college environment for typically two years. Each applicant has entry qualities that involve the personal and academic characteristics for that student at that point in time. These inputs provide a means to compare students against a known set of academic and experiential expectations using Higgs' research model as a baseline. Each applicant completes a college admission process to have been admitted as a freshman to the university, and begins a second application iteration to be able to apply to the upper division academic program, often at the end of the sophomore year. Since, each student completes the same set of pre-requisite courses that meets regional accreditation

standards, the application components are consistent for each applicant. The entirety of the entry inputs, demographic data, college academic and extracurricular performance, and the targeted application components provide a pool of data for comparison between applicants. Using the concepts of the Higgs model, a comparison of those characteristics can be used in assessing student performance. Since the production of graduates occurs within a closed educational nursing system that is unable to admit additional students after the first semester, the selection criteria for the inputs of nursing school applicants becomes a critical step in this resource dependent environment (Schrum, 2015).

Nursing Student Educational Requirements

Prior to starting in the first nursing course, a nursing student must complete a prescribed set of prerequisite course work ("Chapter 610-X-3 Nursing education programs," 2014). This prerequisite course work meets two objectives: core degree standards; and degree specific content preparation. The core degree standards for a bachelor's degree align with the United States educational model to include a foundation of liberal arts course work. The degree specific courses are comprised of the content necessary before beginning nursing courses. The State of Alabama articulation agreement (Alabama Commission on Higher Education) has directed these courses: anatomy; physiology; microbiology; statistics; developmental psychology; and university course work as assessed by each institution. These additional courses are comprised of courses like nutrition or computer skills course work. The intent is to lay a standardized foundation as an entry point into an academic program (Alabama Board of Nursing, 2016a).

The curriculum design prepares students for direct patient care. This process requires the student to gain both theoretical and application knowledge simultaneously (American Association of Colleges of Nursing, 2008). The educational process associated with nursing

involves initially understanding of the theory behind the health care process, which typically begins with simpler skills and health assessments that continually build throughout the curriculum onto complex skills and involve in depth knowledge of both the disease processes and pharmaceutical implications. As the students start their course work, the hands on skills associated with the theory taught in the classroom is presented a second time and practiced in the labs through training devices, functional body models, and patient simulations. The standards to demonstrate proficiency in these skills is upheld through the instruction and validation phases of the education. Once a student has demonstrated proficiency on a skill, the nursing student qualifies to perform that skill with actual patients with faculty supervision (Alabama Board of Nursing, 2016a). The live patient interactions require the student to perform these tasks consistently and safely (Cronenwett et al., 2007).

Health care professions degrees add another level of performance onto an undergraduate student's expectations. The safety concern demands a level of proficiency at the onset of the academic experience and requires constant monitoring. An error in a patient's medication dosage has the potential to adversely affect the patient's health or even be fatal (Cronenwett et al., 2007; Kc & Terwiesch, 2009). This level of performance is one of the factors that differentiate a health care professions student from a major based solely on theory. Once an applicant demonstrates an understanding of these requirements and gains admission into a nursing program, and has been selected based upon previous students' performance with similar characteristics to potentially possess the qualities of the student able to adapt in the nursing curriculum (Higgs et al., 1984; Jeffreys, 2015).

The demand for higher levels of preparation removes the inability to insert students into the curriculum. The fundamental level of skill for a pre-licensure nurse are highlighted in the

efforts by the committee tasked to oversee the standards required for these students called Quality and Safety Education for Nurses (QSEN). The standards directed by QSEN address: patient centered care; teamwork and collaboration; evidence based practice; quality improvement; safety; and informatics (Cronenwett et al., 2007). Along with these standards, the process of educating these nursing students through integrated clinical instructor teaching approaches and dedicated clinical sites allows for higher levels of student content synthesis and application (Edgecombe & Bowden, 2009). The requirements for these undergraduate nursing students address the skills most commonly associated with patient care with an increasing utilization of computers and advanced health care monitoring systems, which require additional training and specialized skills (Boxer & Kluge, 2000). This heightened training level requires weeks of education and hands-on practice before the nursing student's initial interaction with patients.

These two factors, nursing faculty shortage and limited clinical site availability, have limited the maximum number of students in a cohort in the initial admissions offerings. Depending on a school of nursing's situation in regards to their resources, the more restrictive factor involving the number of faculty instructors or the number of clinical sites sets the maximum number of admitted students. Using this constrained environment to define the state of nursing education, the approaches taken in an effort to educate nurses involves the aspects of innovation of the education process, efficiency in the current process of nursing student education, or for progress in both of these areas. Federal government and state legislatures have addressed the shortage through incentive funding to promote growth in the nursing workforce or more specifically nurse educators.

Alternative Approaches to Increase Nurses

The federal government has taken several approaches to increase nurse workforce growth. One effort provides funds to hospital and clinics that train nurses through Title VIII funding through the Medicare system. These funds are designed to educate health care professionals in training hospitals and clinics. In 2009, $152 million dollars was allocated towards nursing education (Aiken et al., 2009). In collaboration with the Robert Wood Johnson Foundation and the American Association of Retired Persons, the U.S. Department of Labor and the Division of Nursing at the Health Resources and Services Administration held two national summits (Reinhard & Hassmiller, 2009). These summits discussed efforts to provide detailed data to account for the nursing workforce shortages intended to influence future health care funding decisions. Reinhard and Hasmiller described the allocation of $600 million to support health care worker education, $300 million to support the National Health Service Corps to pay educational loans for health care workers to service in underserved counties, and $45 million from the national Institute for Nursing Research designed to support nursing research efforts. The federal government efforts and outside organizations have effected national funding and worked to influence state support towards increasing the nursing and health care providers.

The American Association of Colleges of Nursing (AACN) tracks the efforts by states to support the increases needed in the nursing workforce (American Association of College of Nursing, 2006). This AACN state legislative address listed multiple states' efforts to increase the nursing workforce within their state. Maryland's efforts to provide $6 million to create more graduate prepared nurses and retain the faculty teaching at nursing schools. Kansas established funding in 2006 to provide equipment, salary bonuses, and student scholarships to grow the number in the state. Illinois provided $5000 towards nursing student loan repayment. Nebraska

and Pennsylvania both have versions of graduate loan repayment for nurses who serve as nursing instructors after completing their graduate education. These financial incentives at the state level demonstrate the efforts to support an increase in the number of qualified health care professionals to meet predicted nursing and nursing faculty shortages.

The aspect of innovation requires changes to the curriculum or to the methods students gain the required qualifications to meet the certification standards as a registered nurse. The current focus of research into methods to innovate or modify the credentialing of nursing programs is underway (Cramer et al., 2014; Harrison, 2014). One approach looked at providing a more comprehensive curriculum that provides a broader connection of nursing skills and concepts across each course (Lewis, 2014). This curriculum design changes the method and grouping of the course material, and initial research showed a 1% to 4% improved content retention, but does not increase the number of graduates or reduce the time to graduation. Other approaches look at allowing simulation to replace clinical experiences. These changes are under review by leaders in the nursing field, and are being addressed by these national organizations: National Council of State Boards of Nursing; the Pew Health Professions Commission; the American Association of Colleges of Nursing; and the Committee on Quality of Health care in America from the Institute of Medicine (Nehring, 2008). These efforts to use simulations to replace clinical hours intends to make substantive change to the current educational model to positively affect the number and quality of nurses entering the workforce (The National Academies Press, 2011). This ongoing process currently progresses without consensus; however, simulation has been adopted by 22 states to replace clinical hours with simulation hours (Hayden et al., 2014). This simulation initiative replaces and does not lessen the time to graduation for a nursing student. The financial incentives and simulation efforts improve the

quality of the nursing education without directly affecting the production throughput, thus these initiatives were not be the focus of the work described in this paper.

Improvements to Existing Nursing Production

In the current model of nursing programs, the approach to address the efficiency of the current education model is defined as an attempt to maximize the existing educational system in order to successfully educate and license new nurses into the workforce. When analyzing the process of producing a graduate from a nursing program, multiple factors influence the success of nursing students and encompasses the student's characteristics and environmental factors. Jeffreys originally developed a model in 2004 and published the revised model in 2012 and in subsequent publications, which addresses the relationships between the student and those environmental factors (Jeffreys, 2012, 2015). This model explains the diverse backgrounds of nursing students, the characteristics and academic preparation the student arrives at the start of a nursing program, and then explores the environment that facilitates the opportunities that promote or deter student success. Jeffrey also discusses the complexity in this environment and that faculty members gain a better insight when considering the student holistically, as students develop strengths and weakness that can be factored into student engagement and success. The combination of entry characteristics and environment influence a student's outcomes.

Although multiple factors contribute to a student's success, this study limits the environment to academic performance. The course grades and time of progression of the student through the course work creates a set of measurable variables that describes the student's performance in the nursing academic environment. The characteristics that determine a student's academic major requirements influence the success a student faces in the pursuit of a degree, when completing those courses. The performance standards for an academic program

derive those expectations from the demands of the degree, and thus the quality of the product, the nursing graduate. This study considers the qualities of the student and the environmental factors that influence the student's ability to meet both program and certification standards.

Theoretical Framework

As nursing shortages impacts the health care system and the ability of schools of nursing to use of all available resources as one strategy to maximize the successful education of each student admitted into a nursing program, effective use of nursing faculty time becomes essential (American Association of Colleges of Nursing, 2014; Li et al., 2015). The conceptualization of this work describes the key phases in a student's progression through an undergraduate nursing curriculum, and the characteristics those students possess at the point of application, and in the interaction of the education environment those students encounter through the lens of the resource dependency theory. This approach follows the framework originally described by Pfeffer and Salanick (1978) in their Resource Dependency Theory. In the theory, the reliance of an organization within the environment relates to the stability of the entire system. The organizations that supply resources impact the organizations that consume those resources. The resource dependency theory provides rationale to describe the efforts of organizations to expand the suppliers and consumers within the system, with the intent to create more stability in the event of a change in the supplier or consumers' ability to meet the system's needs (Bess & Dee, 2008b). The organizations that cannot expand their suppliers can attempt to create linages for more stability due to the reliance between the supplier and the consumer ("Theoretical contexts," 2013). The health care system provides an example of an environment with limited opportunities for expanding suppliers, and relies on interdependent relationships to create stability.

When the organization is a school of nursing operating in the health care system, the relationship with those outside entities determines the ability of the school to place students into a limited number of clinical sites and produce nursing graduates. The interaction occurs at the entrance of applicant through the admissions process, and continues through the student's entire career. The assessment of the resources involves two steps, with the first step determining if the school receives sufficient resources followed by the second step of evaluating the resource utilization (Bess & Dee, 2008a). The current supply of students from the higher education institutions produces more applicants that available seats in nursing programs. The American Association of Colleges of Nursing indicated that although there has been an increase in overall enrollment, 68,936 qualified applicants were turned away from nursing programs during the 2014-2015 academic year (American Association of Colleges of Nursing, 2015). The report indicates the limitation in expanding further enrollments based upon limited clinical sites, faculty, classrooms, adjunct clinical instructors, and funding. The restrictions placed on the health care system rely on effective use of the resources and partnerships between the nursing school's students and faculty members, and the clinical facilities and nurses within the health care system.

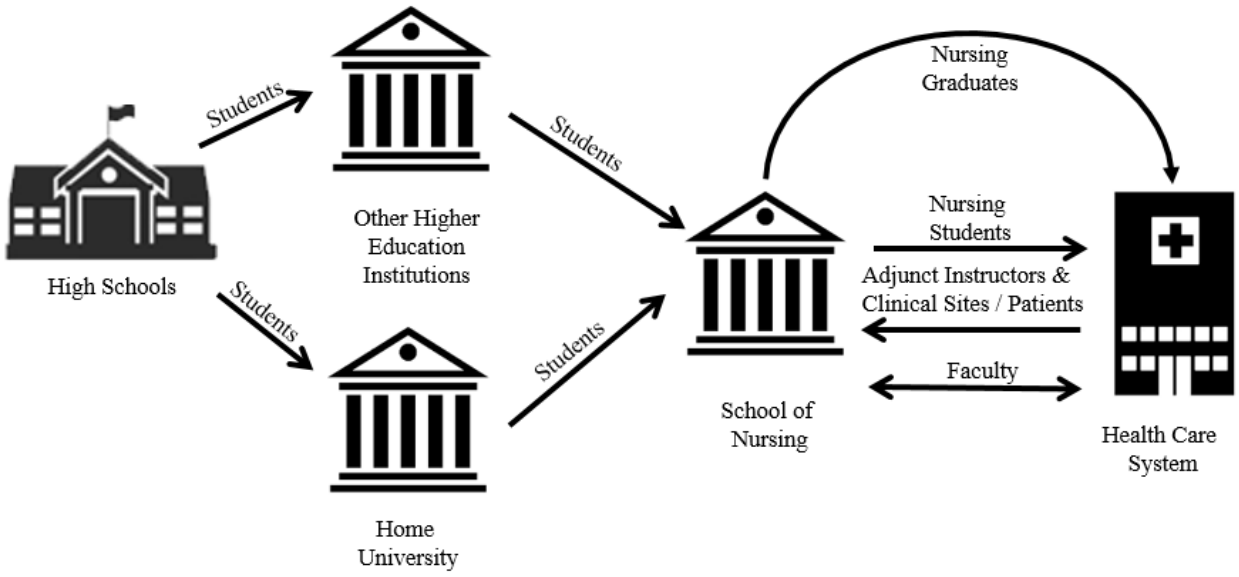

Figure 1. Resource dependency for a school of nursing. Derived from Nienhüser, W. (2008). Resource dependence theory-How well does it explain behavior of organizations?. *Management Revue*, 9-32.

In considering this theory, a typical school of nursing depicted in Figure 1 relies upon several external organizations for resources (Nienhüser, 2008). The applicants to the program apply from its home university and as transfer students from other higher education institutions to provide qualified applicants. The applicants from the home university and other institutions of higher education supply the input of qualified applicants necessary to meet the admissions capacity of the nursing school. As discussed, the current application numbers exceed the admission capacity into a number of schools of nursing (American Association of Colleges of Nursing, 2015). In the context of the resource dependency theory, schools of nursing with stability in the number of universities and number of applicants being supplied, shifts the focus to the interaction with the health care system and determining the quality of the applicants.

The school of nursing's product is a qualified graduate nursing student. At the beginning of the education process, these students complete pre-requisite course work and can apply to any school of nursing at which the applicant meets the application standards. These pre-requisite

courses follow national and state guidelines that allow for consistency and accreditation standards (American Association of Colleges of Nursing, 2008). Since students can apply to a school of nursing of their choosing, both the student and the school have a symbiotic relationship that encourages students to meet or exceed application standards, while the school provides a high quality education in an attempt to attract applying students. Students select nursing for multiple reasons, including cost, the reputation of the program, and the applicant's belief of qualifying for admission (Krawczyk, 1997). Schools of nursing want to encourage qualified applicant to choose their program to ensure sufficient enrollment of students to make the academic program viable, and to admit applicants with higher levels of preparation to increase the likelihood of applicant's completion of the academic program (Jeffreys, 2007; Jones-White, Radcliffe, Huesmann, & Kellogg, 2010).

Schools of nursing receiving applications that exceed the educational admission capacity of the school can apply selective admissions processes in order to increase the likely success of the students. Since these students will provide care to patients in the health care system and interact with the nurses in those hospitals and clinics, those students become representatives of the school. The nursing students are expected to uphold the standard of the profession (Potter et al., 2013). To ensure continued linkage between the school of nursing and the health care facilities, the quality of the nursing student's performance influences the desire of the health care system to support nursing student education. Since the nursing faculty members have progressed through a school of nursing and provide the linkage between the school of nursing and the health care sites, the nursing faculty possess first-hand experience of student's performance in the classroom and clinical settings (Pitt et al., 2014; Scott & Zerwic, 2015). In determining the

students best qualified for admission, nursing faculty members provide professional experience to an admissions process.

The health care system needs a steady supply of newly graduated nurses to work in the hospitals and clinics. The resource dependency theory lists this interdependent relationship as a benefit to both the school of nursing and the health care system. Schools of nursing able to place students in a necessary resource in a clinical setting, that the school could not create, provides the hospital or clinic with unpaid nursing care through the students' and the faculty clinical instructors' efforts ("Theoretical contexts," 2013). The hospital and clinics also want to recruit the nursing student after graduation, so they have an added incentive to create a conductive learning environment designed to provide incentives for the student to return as an employee after graduation (Murray et al., 2010). The health care system prefers the highest quality nursing students able to provide patient care as a student and enter the workforce as a qualified nurse. The admission process has the potential to increase the selection of applicants that meets the needs of both the school of nursing and the health care system.

Once admitted, schools of nursing rely on the health care system to provide access to clinical sites and to augment a shortage of nursing faculty members with clinical instructors(Ganley & Sheets, 2009). Hospitals and clinics receive funding from the federal government to educate nursing students, and those students provide a source of labor that the health care facility receives without paying salary for the students' work compete for a limited number of clinical sites (Aiken et al., 2009). The environment provides incentive for the health care system to assist in the education of nursing students and for the schools of nursing to develop partnerships with these health care facilities. The environment contains competition between the different schools of nursing over access to the limited number of clinical sites. The

number of clinical sites determines the number of students the school can enroll and the perception of the benefit of nursing administration to allow students access to clinical sites (Murray et al., 2010).

The interdependencies between the schools of nursing, the nursing applicants, and the healthcare system creates an environment with several critical points between these inputs to outputs. While maintaining an adequate supply of qualified applicants, sites to train nursing students, and a supply of clinical adjunct instructors to augment faculty shortages remains important aspects of the nursing educational environment. This study focused on the characteristics of the school of nursing's primary input of the nursing school applicant. The characteristics of the applicants encompasses a point in which an improved admission decision can impact the likelihood of increasing the number of undergraduate nursing graduates.

Admission Processes

The admission process operates under a strict set of federal and state regulations intended to allow equal access to all applicants. As specific university's published admission standards indicate minimum expectations for an applicant to qualify for admission review. Competitive academic programs may employ objective and subjective processes to stratify candidates in the application process to provide an ordered list to select students. Since the application possesses a level of concern in terms of litigation against the institution of higher education utilizing a specific admissions process, the research into admissions lacks detailed explanation of entire admission processes, but highlights specific aspects of institutional processes (Tinto, 1982).

The point of graduation represents the outputs from the resource dependency theory. In professional schools, the expectations by the academic environment and the post-graduation requirements often entail the completion of a certifying exam to demonstrate a level of

proficiency in the discipline associated with that degree (Buerhaus et al., 2013). Teachers, engineers, and nurses represent examples of undergraduate degrees that have certification exams tied to career field qualifications that must be achieved prior to employment. Each student must first meet degree requirements for the awarding of the degree, and to demonstrate professional knowledge on the certification exam. Using Higgs model as the concept of a longitudinal study to assess student progression in a nursing program, the depiction of the tailored model used in this study is listed in the Figure 2.

Nursing Progression Model

Both Higgs and Jeffreys built models to depict the progression of nursing students (Higgs et al., 1984; Jeffreys, 2015). The Higgs' model covered five broad categories of pre-admission variables, with variables inside those categories that cover over 30 areas to include items not used for public university admission: religion, marital status, and age (Kaplin & Lee, 2014). The Jeffreys' model used demographic characteristics comprised of gender, age, and ethnicity, and academic characteristics comprised of pre-nursing grade point average, anatomy and physiology grades, local credits, and transfer credits. Aspects from these models led to the development of the progression model listed in Figure 2.

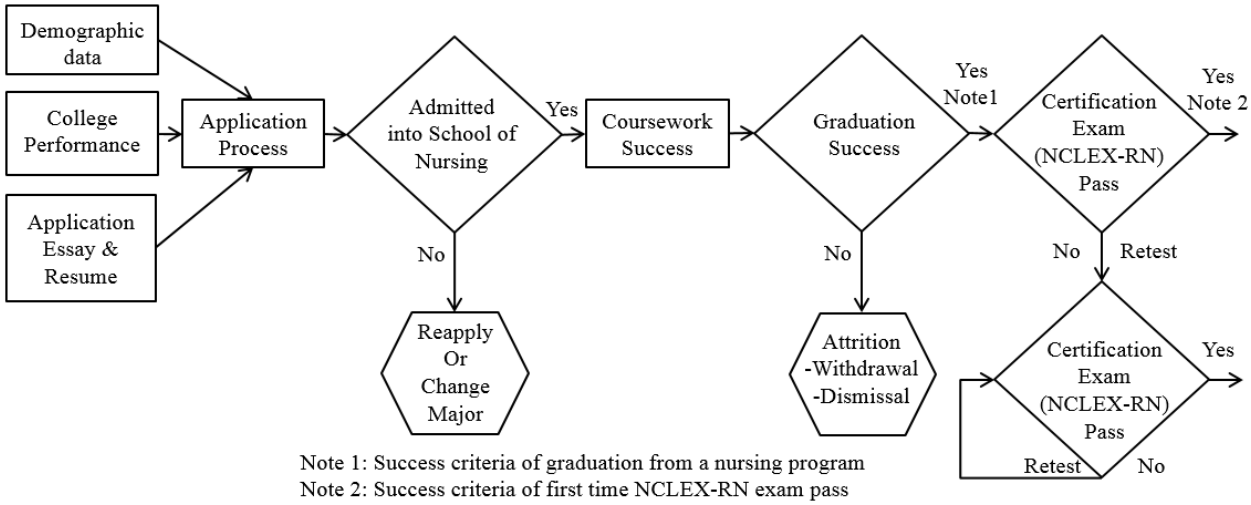

Figure 2. Depiction of the framework for undergraduate nursing progression. Derived from Higgs, Z. R., Milde, F. K., & Haase, P. (1984). Predicting success in nursing: From prototype to pragmatics. *Western journal of nursing research*, 6(1), 77-95. and Jeffreys, M. R. (2015). Jeffreys's Nursing Universal Retention and Success model: Overview and action ideas for optimizing outcomes A–Z. *Nurse Education Today*, 35(3), 425-431.

The product of a nursing program becomes an input for the healthcare system. The shortage of nurses makes this output from the education system a valued resource for hospitals and clinics (American Association of Colleges of Nursing, 2014; Janiszewski-Goodin, 2003). These nurses become members of the health care system, and once these nurses complete their master of science in nursing degree, these nurses become potential clinical instructors or can transition into nursing faculty positions (Alabama Board of Nursing, 2016a). Schools of nursing create another symbiotic relationship with the health care system through the need for training sites to complete the clinical education. A nursing student's preparation and experiences provide the educational foundation to meet graduation and national certification exam performance measures.

The research into progression and nursing certification exam indicators was far more extensive. The search through the literature used a combination of database searches, which were followed by finding related articles once appropriate articles were found. Using these

relevant articles, the works cited within the relevant articles and the articles cited by these articles led to a historical and progressive exploration of the research completed in each theme of nursing student success.

Nursing Professional Standards

The nursing profession follows an established set of standards developed by the American Nurses Association ("Professional Standards," 2016). These standards outline the scope of practice, ethical standards, and performance expectations for the various nursing roles. These standards define the educational requirements necessary before working as a nurse. For students pursuing a registered nursing certification (RN) at the undergraduate level of nursing, students can complete an associates or a bachelor's degree. For both the associate and bachelors programs, a defined set of pre-requisite course work is required before enrolling in upper division nursing courses (Alabama Board of Nursing, 2016a).

Once complete with pre-requisite courses, nursing course work involves the application of theory work in the classroom, followed by skills validation in the skills lab prior to working with patients. Many nursing programs incorporate simulations training to augment the students learning and allow the students to experience high acuity health care cases (Gordon, 2009; Merriman, Stayt, & Ricketts, 2014; White, Brannan, Long, & Kruszka, 2013). Students apply health care theory while assigned to clinical experiences to demonstrate proficiency in the nursing field. At the completion of the nursing program, the students take a national certification exam after earning the undergraduate degree. The National Council Licensure Examination - Registered Nurse (NCLEX-RN) is a nationally administered exam that qualified graduates of undergraduate nursing programs to earn the RN certification and work as a nurse (National Council of State Boards of Nursing, 2016).

Once a nurse passes the NCLEX-RN, the nurse begins working as a novice nurse. A novice nurse has no previous experience and progresses to higher levels of proficiency over time (Potter et al., 2013). Nurses can attain a masters or doctorate in nursing through continued education. These advanced degrees allow for additional expansion in the scope of practice and levels of responsibility. If a nurse earns a master of science in nursing, the nurses can serve as preceptors or adjunct nursing faculty in the clinical setting (Alabama Board of Nursing, 2016a). The adjunct clinical instructors fill a necessary shortage that would be unmet using only full-time nursing faculty members (Ganley & Sheets, 2009; Nardi & Gyurko, 2013).

Whether an individual works in the health care system as a nursing student, bedside nurse, or nursing faculty member, professional standards follow strict safety and performance expectations (Alabama Board of Nursing, 2016b). Failure to follow those standards results in disciplinary actions ranging from minor fines to the loss of the nursing license. Additionally, nurses must complete continuing education training to maintain their nursing license. This renewal process occurs every two years for registered nurses (Alabama Board of Nursing, 2016b). These performance expectations require a specific level of performance on undergraduate nursing students, and puts implications onto schools of nursing admissions processes.

Undergraduate Admission Process

The admission processes at institutions of higher education operates based on several competing factors. These factors influence the processes implemented to determine the qualities and methods of selection enacted by each individual institution to establish the characteristics of the applicants gaining an offer of admission (Holley & Harris, 2010). The research from Holley identified universities listing revenue from students as a crucial component to maintain the

economic viability of the institution. This economic focus in higher education pushes to the forefront of concerns during times of economic hardship, and a greater dependency on tuition revenue. These institution's faculty and staff attempt to enroll a cohort of students that meets the institutional needs, with an increasing reliance on students able to absorb increasing tuition costs (Engberg & Wolniak, 2010). The indicators show that there exists a point which a potential student selects a university regardless of the tuition cost, and as the socioeconomic status of that potential student drops, certain tuition costs become a factor in the decision making process of that student.

Enrollment management attempts to determine the extent tuition can be raised without decreasing the number of qualified students to admit. As the selection process continues to develop, the amount of selectivity has increased in more prestigious institutions as these institutions have implemented a variety of strategies to enroll students ("Collegiality or strategic compromise? A new era in admission consortia," 2012). This heightened competition due to economic concerns over the past decade has reduced the collaborative nature of collegiate admissions, as universities fear the economic effect of lower than expected enrollments. As the selectivity in colleges has increased, the number of highly qualified students has remained effectively flat and not matched the slight population growth. This relatively unchanged population of students has resulted in a change in the tactics used to recruit students that fit into a specific university's traits.

The identification of the students with the potential to succeed on a campus builds the reputation and provides economic stability for the university. By demonstrating a history of high student success, universities attract talented students, providing those students with an environment for academic engagement with comparable peers, and those same students'

continued attendance provides four full years of tuition income. A same increase in the percentage of retained students provides additional resource revenue to strengthen a university's operations. This best match philosophy recruits and enrolls students more likely to persevere at a specific university, and the alignment of the student to a specific university produces higher levels of student satisfaction and richer academic accomplishments (Mattern et al., 2010). As universities look to attract students to their institution, the desired outcome looks at factors at the point of admission to determine the students most likely to accept an offer of admission and then to remain enrolled (Bean & Metzner, 1985; Tinto, 1975). Bean builds on Tinto's work and indicates that each institution has traits and characteristics that make their institution better able to accommodate certain types of students, and that the institution should determine those students that best fit the environment provided on their campus.

The efforts to attract students that have a first preference for that particular institution are ideal when both the student and the institution match. Universities that can identify their unique characteristics are able to offer early admission to highly qualified students that meet the university's highest admission criteria (Avery & Levin, 2010). For these highly qualified students, this match removes the anticipation of the admission decision. The study identifies several of the most selective universities ceasing their early admission programs to ensure the process selects the highest quality students, and the students in the early admission process may take a seat from a student that achieves higher admission standards than the early-admitted student. Since these elite universities represent a minority of the universities nationally, early admission has continued to be a common practice.

Universities also use financial incentives to attract higher caliber students. The used of merit based scholarships attempts to attract students with higher high school grade point

averages and standardized tests scores to improve the status of the university and compete with the universities vying for the same student populations (Stanley & French, 2009). The selection process attempts to determine the point where merit scholarships can be awarded to attract these high caliber students, and still operate due to the lost revenue in the form of lost tuition revenue.

As universities attempt to predict which applicants will succeed on their campus, various admission criteria are used. The most common criteria include high school performance and standardized testing. The two most prevalent tests are the American College Test, ACT, and the Scholastic Assessment Test, SAT. The literature indicates mixed results in the predictive accuracy of these tests. Research in support of these standardized tests state that a significant percentage of the students potential reflects in these scores (Marsh, Vandehey, & Diekoff, 2008). Marsh highlights that this prediction applies to the entry of college work and college performance is a better predictor of overall a student's success in college. Conversely, research has shown that the standardized test scores have little effect on a student's success in college (Pascarella et al., 2006). Since colleges look at multiple factors, the composite make-up of a student could be determined based upon numerous other factors than just the standardized test scores.

This selection of applicants fundamentally begins by first determining the number of students the institution can accommodate. Next, the number of applicants desiring entry into a specific institution influences the decision of the institution. The capacity of the university to accept students when compared to the number and quality of the students wishing to apply to that institution determines the level of competiveness of an institution, and how the institution's faculty members and staff make admission decisions.

The number of applicants the university can accommodate derives from the established admission standards and the level of competition associated with that institution. These admission standards align with the population of students and the academic performance those students achieve through the secondary education process. Institutions without a limitation on seats and a focus on access admit all students. These admission processes can be conducted in a batch decision-making process after a deadline or on a rolling basis. These non-selective admission processes have resulted in higher levels of students requiring academic interventions and higher levels of student attrition.

The institutions with more qualified applicants than available capacity to admit students use varying levels of selection processes. These selection processes increase in complexity and resources as the applicant to available admission numbers increase, which allows institutions to place greater demands on the applicants (Lillis, 2008). The admission standards have focused on demographic and standardized testing data for each applicant. The measures use demographic data and standardized test results. The primary demographic measure cited lists the high school grade point average as the most predictive measure of student retention and success (Mills, Sampel, Pohlman, & Becker, 1992). The high school grade point average has conversely been indicative of potential, but unable to identify unsuccessful students. The grade point average has been cited as a factor in selection and student potential and is recognized as not identifying post-secondary failure, has been able to identify a high percentage of successful students (Sinha et al., 2011).

For institution of higher education use the simplest level of admission selection process resulted in an established historical admission criterion that determines the minimum requirements for admission into the university. The applicant's offers of admission based against

measurable criteria. Universities with more qualified applicants than available admissions can use this method of established admission standards for the first reduction in applicants, and then sort the applicants into an order or merit list based on that admissions criterion. Order of merit lists represent one common technique utilized by competitive universities attempt to admit students more likely to reach graduation.

Along with the institution's faculty and staff attempting to select the best students, students also attempt to select the institutions that will best fit their educational aspirations. This assessment of the institutional characteristics involves aspects of student preference, the ability of the student to understand and complete the application and financial aid processes, and prestige and social influences on the student's choice (Martin, Wilson, Liem, & Ginns, 2013). The study found that the students' high school preparation and expectation of continued education increased the number of students that attended college and an increased academic performance of those students in their college courses. This study stated that attendance at a high quality high school was not a guarantee of success, but students with attending secondary education systems of higher quality and possessing a personal level of commitment for academic success were able to succeed at a higher rate than their peers without this preparation. Preparation also impacts performance in higher education institutions.

Undergraduate Pre-nursing Preparation

The characteristics necessary to prepare students for an undergraduate nursing program require a combination of both a theoretical understanding of the science of health care and the application of that knowledge in a clinical setting. Research conducted to determine the attributes of a successful nurse highlighted a combination of technical skill and interpersonal emotional intelligence (Rochester, Kilstoff, & Scott, 2005). This clinical competency requires

nursing students to be able to function in complex environments and apply critical thinking. The faculty and adjunct instructors have to develop the student's clinical skills through application of knowledge with live patients (Rogan, 2009). The nursing students face a dynamic clinical learning experience that does not follow a schedule, since patients do not always need care during a particular student's shift. The expectation for clinical education involves taking advantage of learning opportunities as patient needs arise. Research into understanding clinical expectations and learning finds that successful students are active participants in this process (Melender, Sandvik, JonsÉN, Hilli, & Salmu, 2012).

A component of a nursing care pertains to the ability of the nurse to attend to the needs of the patient. The larger needs of the patient require clinical skills involving multiple levels of care. The study conducted by Hudacek found seven areas involved in caring for a patient: caring; compassion; spirituality; providing comfort; going the extra distance; and community outreach (Hudacek, 2008). These qualities require nursing students to assess a patient's physical and emotional needs as part of the healing process. Additional efforts have explored the development of nursing students to understand the balance between feeling compassion for a patient and the real world limitations in the health care system (Curtis, Horton, & Smith, 2012). The nursing students gain experience in providing care while dealing with the stress and emotions when functioning in a field confronting patients encountering pain and trauma. A portion of a nursing student's education involves techniques to understand and cope with the stresses associated with health care (Hodges, Keeley, & Grier, 2005).

Nursing faculty members have years of experience in health care and understand the emotional maturity required to work in a health care setting. As these faculty members understand that nurses can succeed with varying degrees of caring skills, but need a foundation

of health care theory and interpersonal skills (Johnson & Cowin, 2013). Johnson's research confirmed the difficulty in identifying a single set of traits for successful nurses. The nursing faculty members that participate on an application review process attempt to select students that exhibit the traits associated with successful nurses. The research by Wilkes confirms the caring aspect of nursing combined with a strong work ethic and good communications skills (Wilkes, Cowin, Johnson, & Zheng, 2014). Additionally, applicants with work or volunteer experience in a health care setting have been shown to have greater resiliency to progress in nursing programs (Wilson, Chur-Hansen, Marshall, & Air, 2011). When faculty members review a student's application, the experience and understanding of successful nursing traits and experiences influences the assessment on an applicant's file. Nursing experience and practice requirements provide nursing faculty members with unique perspectives to assess nursing school application files.

Undergraduate Nursing School Admission Processes

The admission into undergraduate schools of nursing remains limited by a finite number of student's placements in clinical nursing course experience. The clinical restrictions coupled with a larger applicant pool than can be accommodated in the admissions process results in a resource limited environment. The restriction on the seats creates a competitive admission process at many nursing schools. The selection of the students may vary from each institution, but several admissions processes are in use to attempt to select the most qualified students for admission.

The first admission process attempts to determine if high school demographics, grade point average and standardized testing results from the American College Test, ACT, and the Scholastic Assessment Test, SAT, identify highly qualified applicants. The research by

Wolkowitz showed the ACT provided predictive data for the first semester course work in the nursing program (Wolkowitz & Kelley, 2010). The data showed the ACT science component as a more predictive component of the ACT exam related to early nursing course work success as compared to the other components of the ACT. The admission into schools of nursing often happens in the junior year of college course work and use measures and academic factors completed in the students first two years in college.

Several studies attempted to determine a correlation between course work performance before and after admission into a school of nursing as a measure of successful completion of the pre-requisite course work. Jeffreys analyzed the prerequisite course work completed prior to the application for admission into the school of nursing and specifically the performance in the anatomy and physiology courses (Jeffreys, 2007). The study showed a positive correlation between both the prerequisite course work and the anatomy and physiology courses. This correlation only held for the first semester of nursing course work, and this correlation did not exist past the first semester. This lack of continued correlation after the first semester results from a large number of dismissals in the first semester of the nursing curriculum. The nature of nursing course work results in the elimination of academically unsuccessful students early in the academic program. With the loss of the students that aligned to weaker academic records upon entry, the group eliminated from further comparison, thus removes this potential correlation.

Jeffreys continue her research to discover the components that influence the success of students selected into an undergraduate nursing program. Her work further defined her retention and success model (NURS), which expanded upon the environmental factors that contributed to nursing student success (Jeffreys, 2015). The model describes several areas where research and practice models aimed at positively influencing students' educational performance and

progression. This model and other research efforts have been used to identify reasons for student attrition. Several studies describe the reason for attrition linked to personal reasons, academic failure, or external factors like financial issues (Johnson et al., 2009; McGann & Thompson, 2008). These studies found that personal reasons provided the rationale for groups of students that failed to progress, and often contained no identifiable characteristics. These students covered the entire range of academic and experience of the successful admitted students. The implication is a certain percentage of the unsuccessful students will comprise outliers due to the personal withdrawal factors.

Similar research cited the results of college prerequisite course work's correlation to academically successful student's performance. The research by Swain resulted in a correlation between the students prerequisite course work grades, the cumulative grade point average and the specific performance in anatomy and physiology correlated to the students' performance in the first semester of the students nursing course work (Swain, 2012). The pre-requisite course work accessed the number of courses that a student achieved a letter grade of an 'A' (van Rooyen, Dixon, Dixon, & Wells, 2006). The students that received more 'A's in the pre-requisites had higher academic performance in their nursing course work, as compared to the student's performance on the written assignments in the nursing curriculum. Van Rooyen additional listed the number of 'A's in the science courses had an even higher correlation to nursing course work performance than the overall 'A's in the student's course work.

McCarey also analyzed prerequisite course work by tracking the performance of nursing students through the two year in the nursing curriculum (McCarey et al., 2007). The study showed the prerequisite course work indicating performance in the nursing program. This performance matched the first year closer than the second year of nursing course work

performance. The study presented by Kowitlawakul found the prerequisites correlating to the entire nursing program academic performance, and the study found several other indicators for increased study academic success (Kowitlawakul et al., 2013). As with similar studies, the performance in anatomy and physiology identified predictors of success in the nursing course work. The other component of previous academic success Kowitlawakul identified aligned with students who had successfully completed a bachelor's degree also performed at a higher level than the students completing their first bachelor's degree. Kowitlawakul cited a relationship between nursing standardized testing based on nursing skills completed by potential applicants prior to submitting their application to the nursing school in order to show specific academic competencies prior to admission. These admission tests showed correlation to higher test scores aligned with nursing school performance.

Two different companies that have developed test to predict success in the first semester courses of an undergraduate nursing program, as a measure of pre-admission potential success designed specifically for nursing students. The two tests are the Nurse Entrance Exam, NET, and the Test of Essential Academic Skills, TEAS. Both tests explicitly state that the standardized testing provided by their exams provide prediction of success in the first semester of nursing school. This first semester theme described in the research does not track correlation over time or include the attrition into the data.

The TEAS was the standardized test utilized in the study conducted by Wolkowitz to identify students with a higher probability of success in the first semester of academic course work (Wolkowitz & Kelley, 2010). The data indicated that the standardized test predicted the performance in the nursing science content and a loose correlation between the reading skills of the nursing students. The NET employed by Ellis also indicated first semester success (Ellis,

2006). The results of Ellis' research determined scores that would best predict an acceptable progression rate through the first semester in a nursing program. The study found that the students' test scores rose on subsequent test attempts. Wolkowitz conducted research into this phenomenon to determine the effect on admission decisions (Wolkowitz, 2011). The study indicated that the scores were higher on subsequent test attempts, but at a rate that did not impact the admission decisions.

The competitive nature of nursing school admission has generated research that attempt to determine the factors that increase the likelihood that the students selected for admission into a school of nursing. The relationship of previous academic performance relating to nursing school performance combined with exposure to the health care environment indicates the highest levels of predicting nursing student success (Shulruf, Wang, Zhao, & Baker, 2011; Timer & Clauson, 2011). The research shows data that improve the selection of student, but does not eliminate student attrition.

Subjective Admission Processes

The admission into nursing schools can use both objective and subjective criteria to evaluate potential applicants. The objective measures described earlier include the demographic data and application academic performance data. The subjective measures include application essays, letter of recommendation, and interviews. These subjective measures are designed to measure the applicant qualities that extend beyond mere academic performance and attempt to identify applicant personality traits, levels of discipline, and motivation. Subsequent discussion describes these subjective measures individually.

The application essay answers university specific questions and evaluate the writing, reading, and critical thinking skills of potential students. The ability of a nursing student to read

effectively has been identified as a related factor for those students to be retained and graduate from their nursing program (Symes, Tart, & Travis, 2005). In this study, the reading comprehension rate exhibited a positive correlation with both the retention and graduation rates. The application essay used in other studies determined the quality and communication skills conveyed through written work as a predictor of student success. The course work in a nursing program requires a significant amount of reading that covers both content and application of the material relating to the care of patients. The pace of the readings combined with the detailed science component of the material dictates the level of academic performance a student should possess, which includes a strong reading comprehension rate in order to stay maintain proficiency in the course work. This study identifies students that read and retain at a slower rate struggle without the assistance from academic interventions. Symes discusses ways to increase the reading comprehension of the students entering the nursing program, once a student is identified as having weaker reading skills.

As a student applies to the nursing program faculty members at schools of nursing attempt to identify students with weaker reading and writing skills through the assessment of the application essay, any additional written application documents, and grades earned in course associated with written assignments. A detailed method employed by one nursing program in the Midwest defined specific evaluation criteria to assess the application essay and assign a score to the evaluation (Sadler, 2003). The criterion consisted of , "…focused heavily on writing criteria: organization, focus, development of ideas, standard English usage, and congruency of the ideas with values, norms and behaviors of the nursing profession" (Sadler, 2003). Sadler discussed the attempt in this step in the admissions process as ideally accomplishing several tasks. The first task was determining the ability of the applicant to write clearly and concisely.

A nursing student performs this task daily when writing daily patient care plans. This type of writing has to be concise, and yet include all of the important information in a cohesive, easily understood format. The second component assessed on the essay involves determining an applicant understands the role and the rationale for entering this career field. The understanding of the role was intended to reduce students who voluntarily left the program during the initial term of nursing course work based on the student's inability to cope with the clinical sights, smells, and patient interactions. The assessment of the essays failed to identify the specific students that left the program, but the essays described several common themes associated with the character traits of the students that left the program.

The results from writing sample comparison also shared the finding in other research. The work by McNelis used application essays to determine the cognitive ability of the students and the applicant's experience in the field (McNelis et al., 2010). The applicant with more time spent in clinical or health care settings provided detailed descriptions of those experiences. The applicants that sought out experiences described personality traits in students that matched the nursing professional expectations and those students had higher chances of succeeding in a nursing school environment. The results found that the process out and participating in the health care setting prior to entrance into nursing school increased the likelihood of selecting students that were less likely to voluntarily leave the nursing program. This finding describes a subjective measure that matches the expectations in the nursing students.

The attributes of a nursing student align to several areas that indicate success traits tied to nursing student performance. The research conducted at one institution's nursing program found a correlation with both the student's grade point average and specific components of the student's cognitive rating (Beauvais, Stewart, DeNisco, & Beauvais, 2014). The author

highlights the additional stresses nursing students place themselves under in a nursing program and their ability to adapt to those stresses. The additional stress listed for nursing students accounted for from the nursing academic content and application of that content within short time periods. The study was on a small population, but found a correlation between success students and their cognitive rating. The cognitive was based on the several tests completed by the nursing students and comprised four areas of emotional intelligence, psychological empowerment, resilience, and spiritual well-being. The correlation between the academic success measures of these students was significant in all four items, with higher correlations in emotional intelligence and resilience. These personality traits exist in other research.

The work by Eddy found that the cognitive abilities of students indicated their success in the academic program and the student's likelihood of passing the national certification exam (Eddy & Epeneter, 2002). This qualitative study interviewed recent nursing school graduates and found a relationship between several factors, which included the student's ability to deal with stress and cope with academic challenges. The ability to measure the academic capacity of a potential student studied previously in the field through the Watson-Glaser Critical Thinking Appraisal. The work by Bauwens showed that both the grade point average and the critical thinking appraisal correlated to success in nursing course work (Bauwens & Gerhard, 1987). This research is dated and uses an appraisal that has been replaced by exams to determine the overall success of nursing students, which incorporates critical thinking within the questions within the exam, but the Watson-Glaser Critical Thinking Appraisal assessed critical thinking in general, and was not built specifically for the exclusive evaluation of nursing students. Critical thinking and behavioral assessment are also concerns for the admissions process.

The interview process often involves trained teams of professionals asking scripted questions in order to ascertain specific cognitive and behavioral characteristics of a potential candidate. The interview process has been concerned with consistency and fairness as a critical component of this process. The work by Clayton showed a bias in interviewer based on gender (Clayton, Baird, & Levinson, 1984). The interview teams and the majority of the applicants were predominantly male and scoring for students with similar academic records showed consistently lower scores for female applicants. The discrepancy was slight and did not have an impact on the overall admission decision, but placed these candidates at a slight disadvantage based on the rating by the interview teams.

Bias has been reported in other areas of research connected to admission interviews. The study by Zidmars indicated that interviews were given and rated higher based on the reputation of the secondary school the applicant attended (Zimdars, 2010). This bias allowed college applicants to gain an advantage based upon the reputation of the school they attended and not based on their personal academic record. The author cites the perspective of the administrative official at the university concerned that not all students were provided equal access, but that previous performance from the students from the schools were indicative of the preparation and thus the potential for future success at their university.

The interview process has not always yielded results that are more predictive than other admission measures. The research by Timer found that the interview process was no more predictive than just using a student's grade point average (Timer & Clauson, 2011). The results put in question the need for this step in an admission process, and the best use of faculty time.

Registered Nursing Certification Exam

Academic disciplines leading to roles with professional organizations that require national certification exams receive evaluation feedback based on the percentage of the graduating students that pass the certification exam. This evaluation feedback determines the quality of the academic program and for the graduate, based on competency exams as a process to measure the knowledge to safely practice in their field. An inability to pass a certification exam, and thus fail to qualify for employment in positions requiring the certification, defeats the fundamental reason for the attaining the education. The nursing profession requires graduates to successfully achieve a passing score on the National Council Licensure Examination for Registered Nurses, NCLEX-RN. With specific emphasis on the first testing attempt, this certification exam has been the focus of nursing schools research to determine the methods and reasons that predict student success on this national certification exam.

Students gain admission into the nursing program based on the assessment of individual performance after completing the prerequisite course work prior to starting into their nursing courses. The study of students completing nursing curriculum prerequisites with higher grades on this course work showed a positive relationship with the NCLEX-RN exam (Simon, McGinniss, & Krauss, 2013). The performance by these students in the natural science courses, specifically biology and chemistry, were better indicators for identifying students that were more likely to pass the national certification exam on the first attempt. This finding was also an outcome of the research conducted by Higgins, when determining if the admission data and prerequisite course performance met established standards (Higgins, 2005). The finding also found that natural sciences like anatomy were stronger predictors of student success.

The same data that schools of nursing use to admit students can be tracked over multiple years to determine if that data can predict NCLEX-RN first time passage. Alameida found that student demographic data in a diverse population did not indicate any significance based on the demographic data alone (Alameida et al., 2011). These results are contradicted in the research conducted by Haas, where the male and African-American student populations demonstrated a significantly higher failure rate on the exam (Haas, Nugent, & Rule, 2004). These two populations represent less than twelve percent of the total student population. Alameida additionally used standardized testing to predict certification exam success. Since this research involved distinct institutions, the supposition from Tinto's research asserts that universities have distinct environments and changes or phenomena are specific to that campus (Tinto, 1982). Although the specifics may be campus specific, the national completion of these exams can apply to a larger population of students.

Two exit exams designed to predict NCLEX-RN passage rates have been the focus of the research concerning nursing school application process. The Assessment Technologies Institute (ATI) and the Health Educational Systems Incorporated (HESI) exams are the dominant exams used in the United States, and are designed to provide students with exposure to comparable content and questions the students answer on the national certification exam. Alameida found that the ATI exam predicted success on the NCLEX-RN exam (Alameida et al., 2011). These results aligned with the finding from Spurlock, who studied the results from universities that used either the ATI or the HESI as a standardized exit exam, found that success could be predicted by the scores achieved on these tests (Spurlock & Hunt, 2008). These results showed a positive correlation as score increased on the preparatory standardized tests, the likelihood that the student would pass the exam on the first attempt increased.

Harding's (2010) research found no correlation between the standardized testing results and the ability to identify the students that failed their first attempt on the certification exam. The literature identifies the correlation between the standardized test was positive for higher scores to predicting first time pass results, and that there was no correlation between the standardized test scores and the first time failures. The number of first time failures traced back to multiple factors not captured in standardized testing. These factors included reasons representing random individual events, medical or personal tragedies, that could not be predicted to a particular student's academic progression, but were represented in each group of unsuccessful students. These instances represent outliers in the data and standardized testing is unable to address those students. Harding points out that these standardized exams were not designed to identify failures.

The results from Harding's research also linked the standardized test results positive correlation to predicting first time NCLEX-RN pass rates with university progression policies (Harding, 2010). Progression policies intend to provide an environment for students to meet defined benchmarks linked to content mastery. Universities link the scores on the standardized exams by the specific matched nursing course work content throughout the nursing program. Students failing to meet established testing benchmarks may be required to follow progression policies that require students to complete additional testing or to retake an entire semester's worth of nursing content.

The research by Rogers linked several components of a student's preparation that correlated to nursing student's first time success on the NCLEX-RN exam (Rogers, 2010). These characteristics included developing students that felt confident about taking the exam, possessed critical thinking skills, displayed maturity and had sufficient preparation for this

specific exam. The preparation prior to the exam also reduced the student's stress during the exam.

Further research expanded the connection between successful test takers. Students who were responsible for their own learning outcomes felt prepared for the exam (Eddy & Epeneter, 2002). Eddy also found that the students that failed their first time on the exam felt unprepared for the exam and did not feel personally responsible for their lack of preparation. This lack of preparation also increased the student's perception of stress while waiting to complete and during the actual exam.

The multiple factors identified by Roger's includes the student's personal characteristics, curriculum design, and the learning environment (Rogers, 2010). When students possessed psychological confidence, applied rigor in class preparation, spent adequate time studying, and were provided a supportive academic environment that addressed the student's needs resulted in increased graduation and certification pass rates. Academic courses design based on a quality curriculum, operating with engaged students, while receiving academic support services were able to achieve higher rates of success. The implementation of these varied factors providing an opportunity to increase a student potential success. Thus, differences in these three areas impact student success when sitting for the certification exam. The prediction of a first time failure requires assessments in each of these areas, and partially explains the complexity in the problem of predicting a student's ability to pass or fail an exam on the first attempt when looking at different university's academic systems.

Higgins further uses the admission data and prerequisite course performance to identify groups of students that are at a higher risk of not completing the nursing program and failing their first attempt on the NCLEX-RN exam (Higgins, 2005). The prediction cannot identify

specific students, but identifies groups of students that meet certain criteria and are categorized according to academic risk factors. The students identified at a higher risk can be remediated to further increase the likelihood of first time pass rates (Pennington & Spurlock, 2010). The development of individual study plans and active participation by the student increased the likelihood of student success. The investment of time and effort combined with academic capability by the individual student correlates to higher success rates.

Preparation in prerequisite course work has been an indicator of success in the early part of the nursing program. A similar effect occurs in the success on the NCLEX-RN success when comparing pre-requisite to nursing course work performance. Romeo's research showed that the nursing grade point average, which ties to nursing course work competency, predicts NCLEX-RN pass rates (Romeo, 2013). This connection between pre-requisite and nursing course performance aligns with student's ability to demonstrate content mastery and testing performance. The nursing curriculum indicators predict students, on average, performance at a higher level on the nursing national certification exam, after demonstrating academic performance during the preceding nursing course work.

Summary

Admissions utilizes application information to make a decision that allows entry into academic programs. Research indicates that effective assessment of information provides admission decisions with increased predicted success in the selection of nursing program applicants; further inquiry of those factors into a multi-year study of the student success may allow for higher levels of predictability. Since faculty shortages exist and admissions processes use a portion of that faculty members' time, the determination whether that faculty members' evaluation provides improved prediction in student progression and success requires analysis.

CHAPTER III:

METHODOLOGY

The shortage of nursing faculty members limits the number of hours available to educate nursing students. Expending faculty members' time in the administrative activity of an admissions selection process reduces time available in the didactic and clinical education of undergraduate nursing students. Utilizing nursing faculty members' time in the role of application review has been the impetus for research studies (Cleary, McBride, McClure, & Reinhard, 2009). Specifically, this study intended to determine if the use of faculty members' time providing a subjective assessment of application files along with other application variables provides data better able to predict the selection of undergraduate nursing applicants.

As part of the objective of an admissions process, there is a premium on finding the applicants with the greatest likelihood of achieving success at a specific institution (Jeffreys, 2007; Kowitlawakul et al., 2013; Wharrad, Chapple, & Price, 2003). This study builds upon the previous models from Higgs and Jeffreys in addressing efforts to identify nursing student progression and success indicators (Higgs et al., 1984; Jeffreys, 2015). The model determines if historical factors, characteristics, and academic performance of previously successful students comprise similar elements of current applicants. The factors and characteristics associated with previous academic performance are intended to be predictive of future performance, which lends the study to a quantitative approach. The admissions process listed in Appendix B uses established quantifiable academic performance data and the subjective data converted to numerical data from an established rubric based on the evaluation from the nursing faculty

members. This study adds data analysis to the importance of faculty members' input to accurately gauge future student performance based on previous performance and application documents. The result of this student may assist future admission development and processes, and determine if faculty members' time provides valuable insight into the selection of students applying to an academic undergraduate nursing program.

As discussed in the development of nursing education through the lens of the resource dependency theory, the nursing admissions process faces an environment that relies on a symbiotic relationship between the health care facilities and the nursing programs at higher education institutions. This environment's resources limits the number of students offered admission, and requires extensive preparation as a means to insert additional students once the educational process starts (Potter et al., 2013; Pryjmachuk, Easton, & Littlewood, 2009). This limitation in admissions without the ability to add additional students after the start of the first semester of course work assumes that initial selection comprises the highest possible number of graduates, thus becoming an essential element in the production of graduates (Higgins, 2005; Jeffreys, 2007; Jones-White et al., 2010). The data selected for this study permits the use of quantitative methods to analyze the relationship and process used during an application review to predict applicant success characteristics. The applicant's file contains quantifiable demographic data and quantified subjective portions of the applications based on a rubric that assigned numerical values to the subjective portions of the applicant's file. With the availability of numerical assessments as outlined in the literature review, schools of nursing attempt to make predictions during the admissions process in selecting the most qualified applicants.

The prediction depends on the likelihood of a student succeeding in the academic program. As Creswell (2012) describes a quantitative research to be predictive in the

relationship between one variable and determining if that one variable has the predicted outcome based on the researcher's hypothesis. If the academic and surrounding environment involved in an admission process remain relatively constant and a sufficient sample size describes the phenomenon, the likelihood of the relationship existing in future events increases. Since the admissions process attempts to select applicants in a timely manner with limited information, quantitative analysis provides a method to assist to inform admission decisions (Marsh et al., 2008; Pascarella et al., 2006; Sinha et al., 2011). This study analyzed the factors that predict student success in a nursing program, and describe the model of admission using the collected research data.

Measures of Success

This study defines success by analyzing two outcomes that an undergraduate nursing student achieves at the completion of an academic program. The first outcome metric defines success when an undergraduate nursing student meets graduation requirements. The student must pass all required didactic and clinical competencies and be awarded a bachelors of science in nursing degree from the university. This degree indicates that a graduate has demonstrated mastery of health care content and the ability to perform the role of a novice nurse. The academic programs send a list of graduates approved to attempt the national certification exam and apply for a nursing license through a state board of nursing.

The second outcome metric defines success when the recent undergraduate nursing graduate passes the national certification exam on the first attempt. Since undergraduate nursing programs maintain accreditation standards based on the program's national certification exam first attempt pass rate and student records record the first attempt pass rates, the outcome measure did not include subsequent exam attempts. Alabama's State Board of Nursing requires

all undergraduate nursing programs to maintain an 80% first time national certification exam passage rate (Alabama Board of Nursing, 2016a). A recent undergraduate nursing graduate may retake the national certification exam multiple times after the first attempt; however, these subsequent attempts do not add to a nursing program's performance statistics. Additionally, nursing programs may not receive the first attempt information for recent graduates that take the national certification exam outside of the nursing program's home state. Since subsequent passage of the certification exam and out-of-state recent graduate performance are not reported as performance standards, this data was not used in the analysis. Further, students that do not meet graduation requirements were not qualified to take the national certification exam, and therefore not included in the study. The ability of an undergraduate nursing student to meet these success outcomes provides additional rationale for defined application metrics.

Admission Process

The admissions process identified for this study used a committee system to review application files for admission. The committee members' goal involved an assessment of the applicant's propensity to meet the academic program's graduation and national professional certification exam standards. Since objective measure and metrics were applied to the subjective components of the application process, an analytical approach to determining if the scores provide a degree of predictability into student success based on those admission measures. In this work, the intention was to determine if the faculty members' subjective scores on writing skills, understanding the nursing profession, and a summative assessment of the entire applicant's file predicted student success as compared to the demographic and academic measures also available in an applicant's application packet.

Application Review Process

The following provides a description of the steps taken during the undergraduate nursing student application process utilized to produce the data for this study.

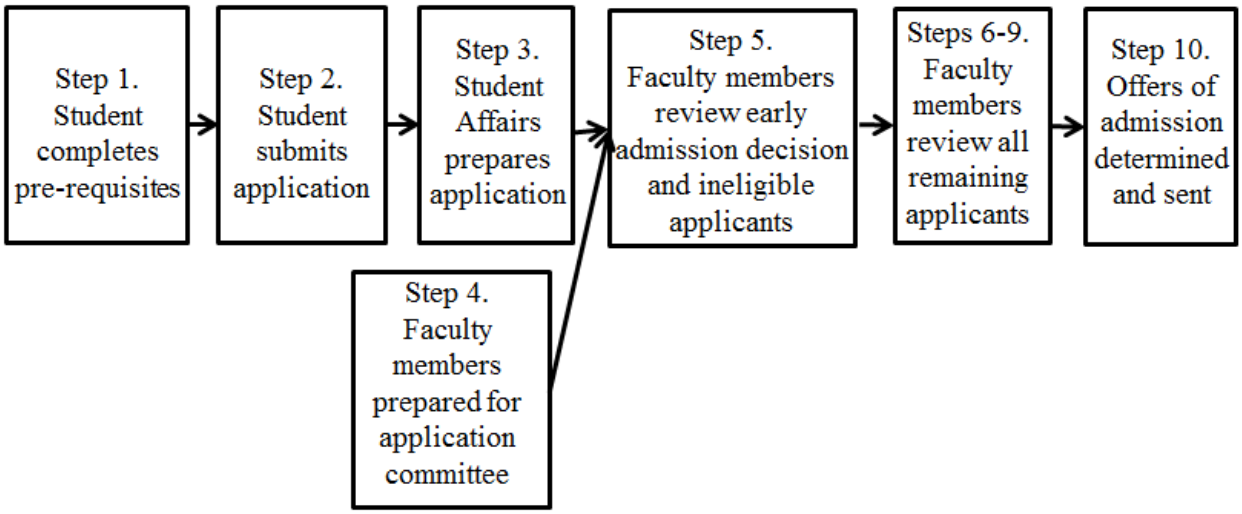

Figure 3. Depiction of the steps for an undergraduate nursing application review

The more detailed explanation of the undergraduate nursing application review process is described in the following steps. They include the following:

1. Applicants complete or will have all pre-requisite courses completed before the projected start of nursing course work. The list of pre-requisite requirements is listed in Appendix B;
2. Undergraduate students submit application, which includes the application form, a personal essay, a resume, and any supporting documentation of volunteer or paid work in a health care setting;
3. Student affairs administrative personnel include the student's transcripts to the application file, calculate the student's undergraduate grade point average and academic performance, and make a second copy of the personal essay after removing all identifying information except the student identification number.

The application review process consists of a file review committee that meets twice;

4. The faculty members serving on the admissions review committee participate in a class designed to provide consistency in file scoring. The class provides an overview of all of the information presented in a student's application file, a description of the academic performance measures, difference in pre-requisite course, and the opportunity to review previously scored resumes and essays. The rubric for the faculty members' assessment is presented (see Appendix C). The academic performance measures cover grade point averages, credit hours completed, and the number of times a student failed or withdrew from course work. The pre-requisite courses differences include a discussion on the range of courses that can be used to meet a pre-requisite requirement, and the setting of those courses. Examples of course settings include the use of live or virtual labs in co-requisite science courses and anatomy courses using human cadavers as opposed to other mammalian cadavers;

5. The faculty members on the committee first review files that qualify for early admission decisions and applications falling below admission standards. The early admission students attended the university directly from high school, completed all pre-requisite courses at the university while maintaining a 3.2 grade point average. If the early admission decision students qualify for admission, and the applicants below admission standards meet the respective criteria, an admission offer or denial results. If the early admission students fail to maintain early admission decision criteria or if applicants identified as not

meeting application were misidentified, the application qualifies for a review during the second session of the application review committee;

6. Files are distributed among faculty members ensuring each application file receives two reviews and that each faculty member is evenly distributed to all of the other members on the committee;
7. The two faculty members' subjective application assessments scores are compared and when a difference in these scores exceed the established threshold, the file receives a third faculty members' review. The entire committee discusses and determine which two of the three scores to average together to score the file. This step intends to limit extremes in application file scores;
8. The faculty member reviews each file by first reading the personal essay. An assessment score for writing proficiency and concept of nursing are recorded. The faculty member then reviews the entire application file and completes an overall assessment of the file;
9. The faculty members' review the averaged faculty members' results and submit a proposed ranking of all applicants in order of merit based on academic performance measures and the faculty members' file assessment scores; and
10. Offers of admission begin with the early admission decision list and progresses sequentially through the order of merit list making offers on an incoming new undergraduate nursing cohort.

Research Questions

Research questions for the study included the following:

1. Which application metrics relate to a student's success in meeting graduation standards in a nursing program; and
2. Which application metrics relate to a student's success on the professional certification exam after graduating from a nursing program?

The first research question addresses the relationship between application metrics and the ability of a student to meet graduation standards. The approach to question one attempted to determine if the logistic regression or decision tree models shows any relationship between the application variables and the students that are able to successfully reach graduation standards (Raju & Schumacker, 2015). The logistic regression and decision tree models outcomes indicated if the probability of identifying previous performance has significance in identifying successful graduates. Two different models were used to explore the effect of each modeling approach to determine if an application metrics were significant in both models. The two models used a randomized sample of 80% of the application data to build a model from a logistic regression, and a model from a decision tree. The remaining 20% of the application data was used to evaluate the model's success, by correctly predicting success in the students' graduation outcomes (Lipovetsky, 2009).

The second research question follows a similar process as research question one, except the success outcome changes to students that pass the national certification exam on the first attempt. The approach to question two attempts to determine if the model output indicates any trends in the descriptive statistics or a correlation between the application metrics and the students that are able to pass the national certification exam on the first attempt. The data was

applied to two models to determine if the probability of identifying previous performance has significance in identifying successful graduates. The two models used a randomized sample of 80% of the application data to build a model from a logistic regression, and a model from a decision tree. The remaining 20% of the application data was used to evaluate the model's success, by correctly predicting success in the first attempt on the national certification exam (Lipovetsky, 2009).

Data Collection

The data obtained for this research was requested from a public university with a nursing program on an urban campus with an academic health science center. Using the Higgs model, the data falls into one of the three categories of variables: pre-nursing; nursing major; or post-graduation (Higgs et al., 1984). The data selected aligns with course work and predictors that have been indicative of academic success in nursing coursework (Higgins, 2005; Kowitlawakul et al., 2013; McCarey et al., 2007; Rogers, 2010). The application file review data consists of the demographic data and archived numerical assessment scores completed on undergraduate nursing applicants. The study completed data analysis on these recorded values and scores.

The data includes application data to the nursing program and academic performance data for students at the equivalent of a college sophomore applying for admission into the traditional Bachelor of Science in nursing degree program starting college junior level nursing courses with cohorts of admission classes entering from the fall 2009 through spring 2014 academic years. The undergraduate nursing program consists of 66 semester credit hours over five consecutive semesters. The undergraduate nursing program operates during all 12 months of the year, and students attend classes consecutively during the fall, spring, and summer semesters. The curriculum creates blocks of course work designed to progress admitted cohorts of students

through as groups of full-time students. The courses cannot be taken separately, nor can a student progress through as a part-time student. The progression policy allows for students to fail or withdraw from one course in the entire nursing course work, with dismissal resulting after any combination the second course failure or withdrawal ("UAB School of Nursing 2015-2016 Student Handbook ", 2015). This progression policy constrains the length of time a student can remain in the nursing program to six semesters or less, thus the spring 2014 cohort and earlier cohorts will have achieved graduation or been dismissed from the program.

The nursing program admits students twice a year in the fall and spring semesters. The timeframe of fall 2009 through spring 2014 academic years creates 10 admission cohorts, with 5 cohorts admitted in the fall semester and 5 cohorts admitted in the spring semester. Each cohort admitted a range from 96 to 120 students, with admission being granted to first-time students being reduced by students with course failures in the first semester retaking first semester course work. Using the estimate of 100 potential newly admitted students, the maximum sample size for the study was estimated to be 1,000 potential students. The actual number in the sample was lower due to an early admission decision process. The early admission decision students' results were tallied and removed from the student data that went through a faculty member committee review and received an assessment. The early admission decision students comprise approximately 30% of and admission cohort, and reduced the number of applicant files to 722 files.

The early admission decision allows students a guaranteed admission by meeting eligibility criteria. The early admission decision students receive no additional funding due to this specific admission program, but the student receives a guarantee of admission into the undergraduate nursing program if specific academic performance standards are met. The entry

criteria as a first time college freshman includes a high school grade point average of 3.2 or higher and an ACT composite test score of 24 or higher. The admission criteria stipulate that a prospective student achieve a 3.2 grade point average in the student's college pre-requisite course work to maintain eligibility. These early admission decision students are reviewed by a committee, but do not receive subjective faculty evaluation scores. These students were not considered in the study, nor added in the model to test the decision tree. The models both incorporated subjective faculty members' assessment scores, and since these early admission students did not receive these scores a separate model would need to be developed. The study's intention is to determine if the faculty members' time is best spent on an admission committee as a factor to predict student success, thus the early admission study did not receive this portion of faculty members' time and was not be used in the study.

The demographic data includes: race; gender; cumulative grade point average; and pre-requisite grade point average (Haas et al., 2004; Newton, Smith, & Moore, 2007; van Rooyen et al., 2006). The data includes the subjective evaluation of an applicant's data consisting of volunteer hours, an essay evaluation, an understanding of the major nursing discipline, and a faculty members' overall assessment of all components of an applicant's file (Pitt, Powis, Levett-Jones, & Hunter, 2014b; Schmidt & MacWilliams, 2011). The faculty members' subjective portions of the applicant's evaluation comprises the personal essay evaluation through an assessment of writing proficiency and an understanding of the nursing role, and a faculty member overall impression of the applicant's file (Hendricks & Krothe, 2014; Sadler, 2003). Academic performance data includes all pre-requisite course grades, and national certification exam first time pass completion (Higgins, 2005; Rogers, 2010; Romeo, 2013). The pre-requisite courses were converted from a letter grade to a numerical equivalent using a 0-4 point scale. The

pre-requisites were reordered in the various models to determine the course with higher correlation, as previous studies have indicated that subsets of course like anatomy, physiology, and microbiology are highly predictive of nursing student success (Griffiths, Bevil, O'Connor, & Wieland, 1995). The other subsets of courses that have been studied that have indicated a relation with nursing student's success are inorganic chemistry and the second science course the student completed as part of the pre-requisite course work requirements (Potolsky, Cohen, & Saylor, 2003). The three faculty member assessment scores were also compared to determine the relationship with the success measures and the placement of those variables when developing the models. Both success outcomes were modeled with the intent to determine the application factors that indicate the greatest relationship to the ability of an applicant to meet graduation requirements and pass the nation certification exam on the first attempt.

Table 3

Research Variables

Variable Name	Variable	Type	Description
	Demographic		
Gender	Gender *Independent Variable*	Binary	Student's gender: 1=Male 2=Female
Race	Race *Independent Variable*	Categorical	Student's Race: 1=Asian 2=Black 3=Hispanic 4=Multicultural 5=Native American 6=White 7=Unknown
	Academic Performance (Pre-admission)		
English_1_Course	Grade in English Composition I course *Independent Variable*	Continuous	Grade achieved in course Range: 0 - 4
English_2_Course	Grade in English Composition II course *Independent Variable*	Continuous	Grade achieved in course Range: 0 - 4
Inorganic_Chem_Course	Grade in inorganic chemistry course *Independent Variable*	Continuous	Grade achieved in inorganic chemistry course Range: 0 - 4
Science_Course	Grade in natural science course *Independent Variable*		Grade achieved in natural science course Range: 0 - 4
Math_Course	Grade in finite math or pre-calculus course *Independent Variable*	Continuous	Grade achieved in finite math or pre-calculus course Range: 0 - 4
Statistics_Course	Grade in statistics course *Independent Variable*	Continuous	Grade achieved in statistics course Range: 0 - 4
Anatomy_Course	Grade in anatomy course *Independent Variable*	Continuous	Grade achieved in anatomy course Range: 0 - 4
Microbiology_Course	Grade in microbiology course *Independent Variable*	Continuous	Grade achieved in microbiology course Range: 0 - 4
Nutrition_Course	Grade in nutrition course *Independent Variable*	Continuous	Grade achieved in nutrition course Range: 0 - 4
Physiology_Course	Grade in physiology course *Independent Variable*	Continuous	Grade achieved in physiology course Range: 0 - 4

Variable Name	Variable	Type	Description
	Demographic		
Dev_Psych_Course	Grade in developmental psychology course *Independent Variable* Extracurricular Activities (Pre-admission)	Continuous	Grade achieved in developmental psychology course Range: 0 - 4
Health_Care_Exp	Health care experience *Independent Variable* Faculty Subjective Evaluations	Binary	Participated in 40 or more hours of health care volunteer or paid work 1=Yes 2=No
English_fac	English subjective faculty evaluation *Independent Variable*	Continuous	Assessment of writing skills on the application essay Range: 0-10
Nursing_fac	Nursing profession understanding *Independent Variable*	Continuous	Understanding of nursing role on the application essay Range: 0-5
Overall_fac	Overall faculty application assessment *Independent Variable* Success Measures	Continuous	Overall evaluation of all components of the application Range 0-20
Graduation	Graduation achieved *Dependent Variable*	Binary	Student met graduation requirements 1=Yes 2=No
NCLEX	NCLEX passed *Dependent Variable*	Binary	Student passed first attempt on certification exam 1=Yes 2=No

Site Access

Prior to analyzing the data, approval was requested and received from both the University of Alabama Institutional Review Board, and the undergraduate nursing program's Institutional Review Board. The student course grades for the pre-requisite and nursing courses were stored in university's student record system, Banner. The admission information listed on the application data collected and was stored in the nursing program's student data records. Once approval was obtained, a research technician, with Institutional Review Board training and access to the data assigned randomized identifiers to the information and removed any identifying information. The data was processed as aggregate data to ensure student anonymity.

Sample

The data represents five years of admissions data from a public research university in the southeast. The university's enrollment corresponds to the state's demographics with one-third of the enrollment comprised of minority students and two-thirds white students ("UAB Undergraduate student demographics," 2015; United States Census Bureau, 2016; Unites States Census Bureau, 2015). The sample includes all applicants that were offered admission, at a minimum enrolled in five-year period, and tracked over multiple years of graduation.

Table 4

Student Enrollment Compared to Census Data - 2014

Organization	White	Black or African-American	Asian	Hispanic	Other/ Unknown	Non-Resident Alien
U.S.	63.7%	12.2%	4.7%	16.3%	3.1%	na
Alabama	67.0%	26.2%	1.1%	3.9%	1.8%	na
UAB	63.3%	21.1%	5.0%	2.6%	4.4%	3.6%
School of Nursing	71.0%	19.1%	2.5%	3.1%	3.7%	0.5%

Source: Summarized from the UAB Undergraduate student demographics. (2015). September 14, 2015. Retrieved from http://www.uab.edu/institutionaleffectiveness/images/enrollment/total-demographics.pdf and United States Census Bureau. (2016). *Race*. Retrieved from http://www.census.gov/topics/population/race.html

Research Design

The application data compared two outcomes from the undergraduate nursing education. The groups of independent variables were separately compared to one dependent variable at a time to determine if one of the two potential success outcomes from the nursing program shows a relationship: the graduation from the program; and the passage of the national certification exam. The two outcomes were modeled using a logistic regression and a decision tree to determine the ability to predict graduation national certification exam success outcomes. The research intended to use the student's application data: gender, race, admission cohort year and semester, each pre-requisite course grade, volunteer or work hours spent in a health care setting, and the three archived assessment scores from the faculty members' application review. The application data derives from the Higgs model, which addresses the three key progression points in a nursing student's education (Higgs et al., 1984). The work by Jeffreys addresses the subjective components necessary to provide the holistic understanding of an applicant's background and capabilities to succeed in a nursing program (Jeffreys, 2015).

This application data and academic pre-requisite performance data were independently compared to two separate dependent variables: graduation; and national certification exam first attempt passage. The three assessment scores from the faculty members' application review comprise the variables of: writing proficiency; an understanding of the nursing discipline; and a faculty members' overall assessment of an applicant's file, were analyzed to determine if the archived data indicates that the faculty members' assessment provides significant results. These variables were chosen that represent aspects of success for the student and the academic program. These independent variables quantify each student's level of content mastery and the number of new nurses entering the workforce.

The intent of this research was to determine the relationship between the admission data and the ability of the nursing student to graduate and pass the certification exam utilized a statistical approach that accomplishes that specific task. In an initial review of comparable studies, approaches included the t-test when using a population with an expected standard distribution (Higgs et al., 1984). The studies that have used correlation were attempting to determine the cause and effect between variables. In this work, two types of regression were applied to determine if the faculty's assessment of an applicant's application file is predictive of student success. Regression assumes variables can be used to predict the relationship between variables based on the relation between those variable (Witte & Witte, 2009).

Data Analysis

The proposed approach completed descriptive statistics and an association between the independent variables groupings of demographic data, academic pre-nursing, extracurricular activities, nursing academic performance and faculty subjective evaluations (Raju & Schumacker, 2016). Research questions 1and 2 utilized SPSS Version 23® for the descriptive

statistics, association between variables, and logistic regression. The decision tree model was computed using R Statistical Software® to analyze the variables listed in research questions 1 and 2.

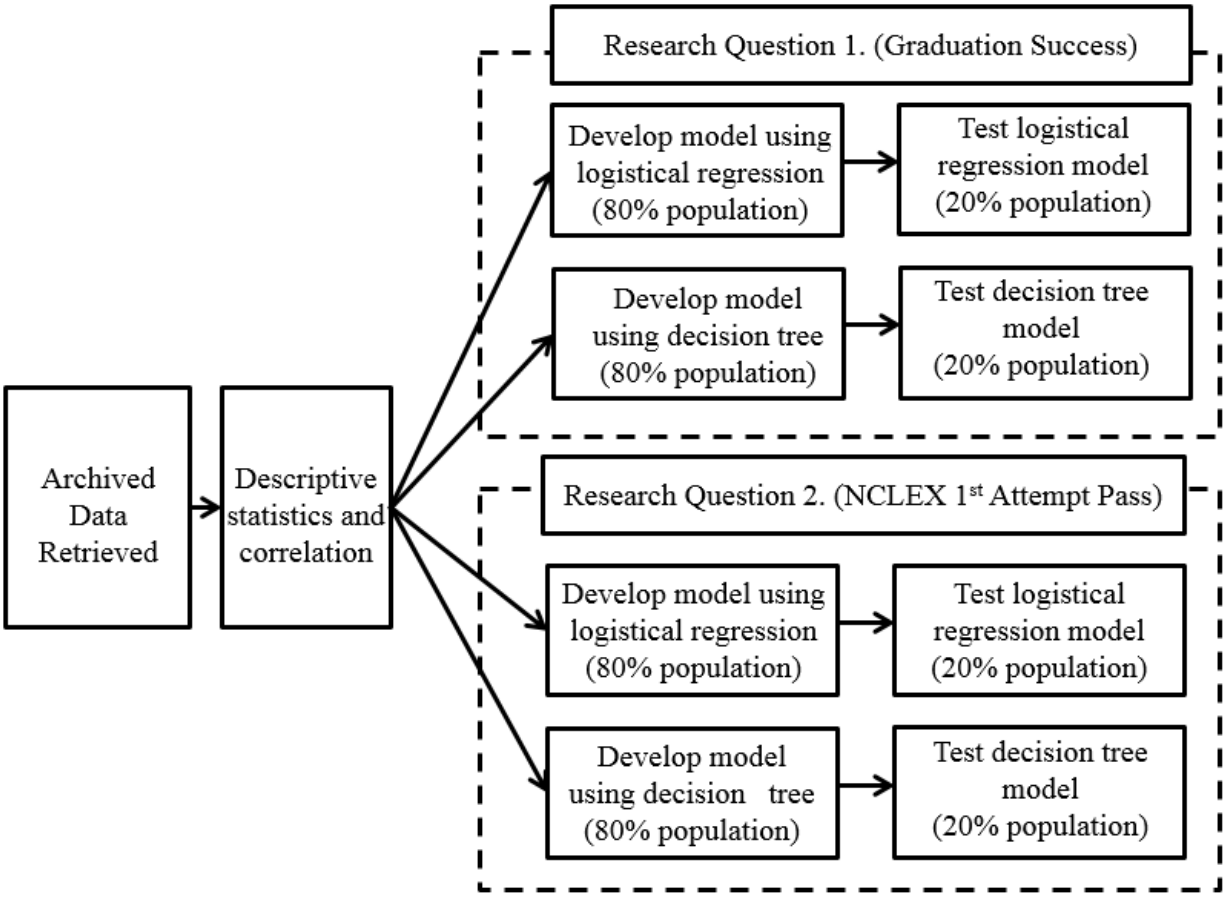

Figure 4. Depiction of data analysis steps

Research questions 1 and 2 followed similar data analysis steps. After collecting the archived application data, the step involved completing the descriptive statistics on each independent and dependent variable. The descriptive statistics were used to determine overall model fit. The next step completed an assessment of the association between variables for all of the independent and dependent variables. A correlation was initially used to determine if any relation exists between the variables, and comprised the initial analysis of the variables and the relationship between all of the variables.

A separate logistic regression model was developed to determine if the graduation success and national certification exam first time passage could be created using the dependent application variables to predict the success measures represented by the independent variables. A generalized logistic regression, which accounted for binary criteria and can be used to predict future outcomes, was selected for this study. The formula uses the probability (*P*) of the independent variable (*Y*) to equal create the calculated probability. The formula calculates the odds to probability relationship (Predicted_logit) of the event occurring through the summation of the regression coefficients (β), which SPSS® calculates, and the dependent variable value (*X*) (Hanneman, Kposowa, & Riddle, 2012; Montgomery, Peck, & Vining, 2015).

$$Predicted\_logit = \sum(\beta 1X1 + \beta 2X2 + \cdots + \beta nXn)$$

The predicted probability was calculated with the dependent variables (*X*) based on the predicted probability divided by one plus Euler's constant raised to the negative summation of the regression coefficients (β) and the dependent variables (*X*) (Dvorak & Roessger, 2012; Montgomery et al., 2015). The success metric has a binary outcome, with the first metric of a student meeting graduation standards or not achieving those standards *(graduated | not graduated)*. This relationship can be represented as a conditional mean of *Y* given *X*, *E(Y | X)*, where the expected value of graduation can be represented by $\pi(X)$.

Logit Transformation

$$P(X) = ln\frac{\pi(X)}{1-\pi(X)} = \sum(\beta 1X1 + \beta 2X2 + \cdots + \beta nXn)$$

If ln (odds) = Y

odds = eY

$$\frac{\pi(X)}{1-\pi(X)} = e^{\sum(\beta 1X1+\beta 2X2+\cdots+\beta nXn)}$$

$$\pi(x) = \frac{odds}{1+odds}$$

$$= \frac{e^{\sum(\beta 1X1+\beta 2X2+\cdots+\beta nXn)}}{1+e^{\sum(\beta 1X1+\beta 2X2+\cdots+\beta nXn)}}$$

$$\pi(X) = \frac{e^{-(Predicted\_logit)}}{(1 + e^{-(Predicted\_logit)})}$$

The SPSS® software factored in all of the variables to determine the relationship between the independent variable and the dependent variables. The *B* values are the logistic odds for the dependent variables in a data set used to calculate the independent variable on a logit scale (Witte & Witte, 2009). The predicted logit value is placed into a predicted probability formula to produce the predicted probability to create the logistic regression predicted outcome (Witte & Witte, 2009). The logistic regression formulas are listed below with the dependent variable names inserted into the formula, and the predicted logit represents the respective independent variable (Hanneman et al., 2012; Montgomery et al., 2015).

Predicted_logit = (English Comp I *B* Value*English Comp I) + (English Comp II *B* Value *English Comp II) + (Inorganic chemistry *B* Value *Inorganic chemistry) + (Inorganic chemistry lab *B* Value *Inorganic chemistry lab) + (Natural science *B* Value *Natural science) + (Natural science lab *B* Value *Natural science lab) + (Math *B* Value *Math) + (Statistics *B* Value *Statistics) + (Anatomy *B* Value *Anatomy) + (Physiology *B* Value

*Physiology) + (Microbiology *B* Value *Microbiology) + (Nutrition *B* Value *Nutrition) + (Intro psychology *B* Value *Intro psychology) + (Developmental psychology *B* Value *Developmental psychology) + (Gender *B* Value *Gender) + (Race *B* Value *Race) + (-Health care experience *B* Value *Health care experience) + (English_fac *B* Value *English_fac) + (Nursing_fac *B* Value *Nursing_fac) + (Overall_fac *B* Value *Overall_fac) + (constant)

Predicted_Probability = 2.718281828459**Predicted_logit / (1+2.718281828459**Predicted_logit)

Note: Euler's number e = 2.718281828459

Since the graduation and certification exam outcomes are binary, the use of a logistic regression was utilized to predict the outcomes of these categorical independent variables (Witte & Witte, 2009). A student either successfully graduates or not and passes the national certification exam on the student's first attempt or not. The logistic regression accounts for this relationship by creating a non-linear line equation that allows the prediction model to avoid results that are not feasible. In the case of predicting a student's graduation possibility, a straight line would result in large error in students' data that did not fall at the linear intersection points on the line. Significance levels of 0.05 were set, as the threshold for significance was used for the separate analysis for these two dependent variables.

In the creation of the logistic regression model, a variable selection method was used with 80% of the collected archived application data. The model's output allows for multiple approaches to the individual variables to be considered when developing the model, and thus can

be used to predict the outcome based upon the probability of an outcome based on the regression function. The logistic regression model factors in the variables to create the probability of one of two possible outcomes. The success of the model was compared to the accuracy in the remaining 20% of the data.

Research question 1 and 2 also developed a model through the use of a decision tree. A decision tree was used to determine the selection process that yields the highest probability of success of the student reaching graduation requirements and success in passing the national certification exam on the first attempt. The decision tree allowed for predictive variables to identify points in a decision making process that allow for selection with a high degree of probability and a minimum amount of additional comparison. The admission process presents an ideal environment for this analysis (Schumacher, Olinsky, Quinn, & Smith, 2010). The construction of the decision tree was devised to allow specific nodal probabilities to be set to satisfy an acceptable range of students' admission decisions. These decision points allow for adjustments in the decision, in order to arrive at an acceptable solution without excessive computations.

The decision tree evaluates all of the dependent variables in relation to an independent variable. The decision tree model was selected based on the models process of binary outcomes through a parsing process that results in yes or no, or pass or fail sort that fits the intent of this study (Raju & Schumacker, 2015). The R Statistical Software® splits the data at points when a dependent variable can separate the data using the constraints of the tree. The first constraint was selecting a probability of 95% for the terminal nodes of the tree. The terminal nodes indicate an endpoint where the calculations end and the results are presented. The second constraint selected sets the pruning value for the tree. The software can produce dozens of

terminal nodes, which may not yield results significantly different depending on the size and variation in the data.

The pruning values were set to stop when the terminal nodes reached a result that listed an outcome with a total of less than ten applicants in the terminal node. Since the pruning value also stops further calculation and the data may not be able to predict a probability of 95%, the terminal nodes may list probabilities lower than the goal probability of 95%. Since the decision tree can be set to select and sort every case, a decision tree may result in hundreds of nodes depending on the size and variance in the dataset. By selecting a threshold that applies to a larger portion of the data, the model is more likely to be able to be generalized and not specific to one sample of data (Raju & Schumacker, 2016).

The graphical representation of the decision tree uses a combination of symbols and text to depict the outcomes from the analysis. The R Statistical Software® uses circles to represent a node and a bar graph to represent a terminal node. The node number is listed above the node and the node lists the dependent variable in the circle, with the values used to split the data listed on the two lines extending from the circular node. The terminal node's number is listed at the top of the respective bar graph along with the number of data points terminating at this node. The terminal node also graphically depicts the probabilities of the independent variable on the bar graph.

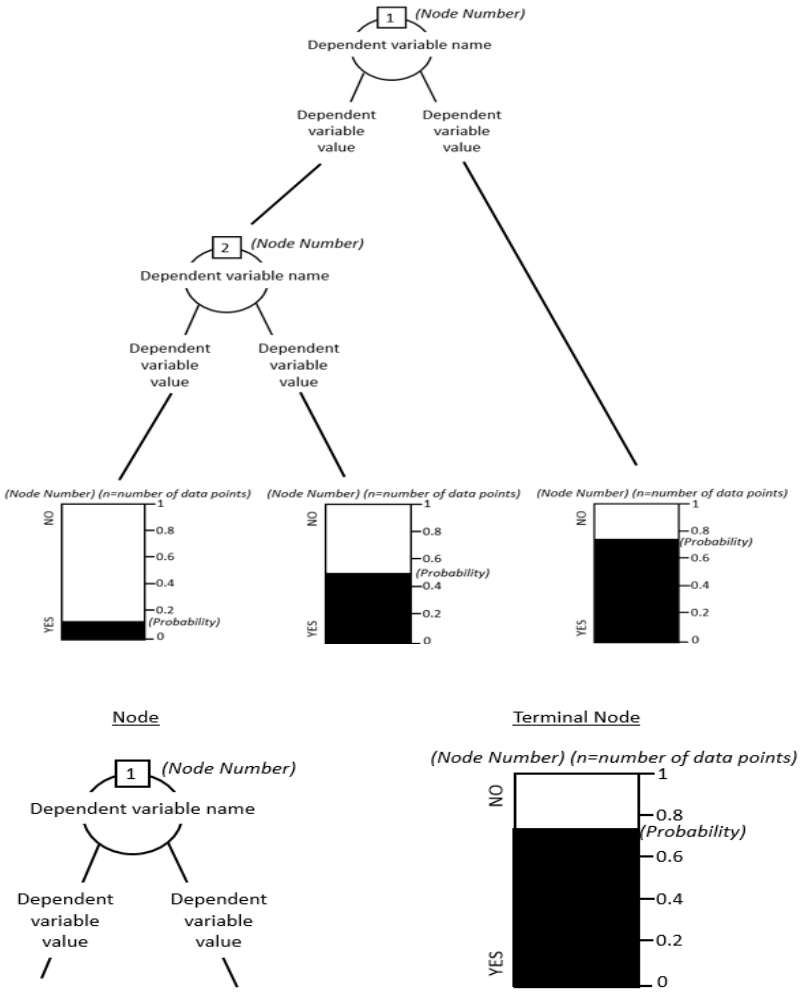

Figure 5. Decision tree nodes design

Table 5

Research Analysis

Research Question	Variable Name	Independent Variables	Statistical Analysis
	Gender	Gender	Descriptive statistics and variable associations
	Race	Race	
	English_1_Course	Grade in English Composition I course	
	English_2_Course	Grade in English Composition II course	
	Inorganic_Chem_Course	Grade in inorganic chemistry course	
	Science_Course	Grade in natural science course	
	Math_Course	Grade in finite math or pre-calculus course	
	Statistics_Course	Grade in statistics course	
	Anatomy_Course	Grade in anatomy course	
	Microbiology_Course	Grade in microbiology course	
	Nutrition_Course	Grade in nutrition course	
	Physiology_Course	Grade in physiology course	
	Dev_Psych_Course	Grade in developmental psychology course	
	Health_Care_Exp	Health care experience	
	English_fac	English subjective faculty evaluation	
	Nursing_fac	Nursing profession understanding	
	Overall_fac	Overall faculty application assessment	
1. Which application metrics relate to a student's success in meeting graduation standards in a nursing program?	Graduation - dependent variable		Logistic Regression and Decision Tree
2. Which application metrics relate to a student's success on the professional certification exam after graduating from a nursing program?	NCLEX - dependent variable		Logistic Regression and Decision Tree

The intent of this study is to determine the application variables associated with graduation and national certification in order to improve the application review process (Pitt et al., 2014; Schmidt & MacWilliams, 2011). An increase in the efficiency in the progression of students in an existing undergraduate nursing program, while advancing the state of the science in approaches that further research can follow in this area of higher education operation.

Reliability

The data collection depends on the admission process as a consistently conducted operation. The admissions guidelines remained unchanged during this period, and the program leadership positions were filled by the same faculty members. The preparation for the faculty members followed a standardized orientation of the application file review process prior to each application cycle. The files were reviewed by two faculty members, and the subjective scores were averaged together. Files with the two subjective scores greater than seven points apart were discussed by the entire faculty application review committee to adjust the score to within seven points prior to averaging the scores.

Positionality and Potential Bias

The review process follows a design that complies with legal precedent, educational and institutional guidelines, and has been approved through the faculty curriculum committee. Although the office where I work collects the application components, builds the application files, and collects the application assessment data, I do not provide any scores applied to an application review. Since the study analyzed archived application data and archived success outcomes data, the analysis involved the statistical and modeling results of static data. Since the data are static and represents the faculty members' scores, the quantitative approach to the analysis of the individual metrics available in the application file limits the potential bias in the

data analysis approach taken for this study. Personal bias was considered in the decision to analyze or discuss specific variables regardless of the variable's significance. Conscious efforts were taken to review the findings in a consistent manner to intentionally ensure the outcomes match the data from the statistical analysis and models. As a member of the school in an office that facilitates the admission process, the goal of admitting students with the likelihood of meeting graduation and national certification standards. This goal aligns with the intent of an admission committee for a school attempting to work within a constrained environment with the ability to offer limited admissions.

Limitations

This study applies to a southeastern public institution that operates as part of an academic health science center and the finding cannot be applied to other higher education institutions. The data covered a five-year period in an academic nursing program that admits twice a year in the fall and spring semesters. The data resulted in the comparison of ten cohorts of students from the point of application through graduation and the national professional certification exam. The students are in an undergraduate nursing program, designed for full-time enrolled students, following a prescriptive cohort approach with blocks of co-requisite course, in a school located in an urban setting.

The data analysis ignores the students denied admission or granted an early admission decision. Neither the denied or early admission decision students receive subjective faculty members' assessment scores, which is the focus of this study. The study considers students' success as meeting graduation standards and passage of the first attempt on the national certification exam. The study did not consider students that changed majors into another academic discipline and achieved an undergraduate degree at the home or at a transfer

institution, due to availability of data, potential for extended graduation timeline, and these data did not align with the focus of a specific admissions process for a specific academic discipline. The study did not assess students that take the national certification exam more than once. The study intended to define the first time attempt as a success measure on the national certification exam. The number of times a student retook the national certification exam after failing the first attempt was not recorded. The subsequent passage after any number of retakes was not recorded. The first attempt pass rate published by the Boards of Nursing determines the quality of each program, which adds to the importance of assessing the initial attempt on this exam.

The archived data from faculty members' assessment scores collected in the study includes scores from faculty members' that all taught in the undergraduate program. These faculty members varied between application review cycles based on the faculty members' availability on the date of the application review. Faculty members' archived data quantify the results submitted from faculty members who could serve on multiple committees, either sequentially or with gaps between committee participation. The faculty members' data were collected after all received training on the method to score the application files before the committee review.

Delimitations

The data selected for this study represents a convenience sample due to the lack of access to application data for undergraduate nursing programs. These data provided the demographic data information used at the time the application that was reviewed and the multi-year results of the students' progression and graduation results over a consecutive five-year period. The data utilized nursing students' application information only. This decision to exclude other undergraduate student data was based on the competitive admission process and specific

indicators that relate to student performance and graduation in a specific academic program. The data were drawn from one university based on the diversity of the nursing program, which follows a similar percentage of the potential college applicant pool and state's demographics. These two factors allowed for the analysis of this data to represent the state's population with a more significant emphasis on the faculty assessment as a basis in the selection of the data for this study.

Summary

This analysis intended to determine the optimal admissions process that identifies students with the highest probability to earn the degree and meet national certification exam standards. The assessment of the subjective portions of the admissions process provided data to indicate if faculty members' time spent evaluating application files is effective use of faculty members' effort. The access to five years of admission data that covers the admitted students through graduation provided an opportunity to evaluate if admissions data associated with student performance after each student completed two years of college pre-requisite course work. The decision tree's output has the potential to outline a process for future admissions decisions, and allow research to influence practice.

CHAPTER IV:

RESULTS

This research intended to determine if faculty members' time spent on reviewing nursing school application files accurately identified students with higher probabilities of successfully completing the graduation standards and subsequently passing the first attempt on the national certification exam. The study reviewed data from the faculty members' subjective scores on the writing skills, understanding of the nursing profession, and a summative assessment of the entire applicant's file to predict a student's success along with demographic and academic performance measures available as part of an application packet. The research questions considered these scores as a part of application metrics associated with the two success outcomes of meeting graduation standards and first time passage of the national certification exam.

A logistic regression model and a decision tree model were computed using 80% of the data to create respective models, and used the remaining 20% of the data to test the models. The two models output additionally computed all demographic factors during the first round of analysis, and a second round of analysis removed race and gender to create an admissions model. The analysis and models output was comprised from the archived data, which was obtained from one southern, public, undergraduate nursing program in a university within an academic health science center covering a five-year period, from fall semester of 2009 through the spring semester of 2014.

The three sections of this chapter allow for the analysis of the application metrics and the development and testing of the models with the two different outcomes. Section one of this

chapter lists the descriptive statistics for each of the variables and an assessment of the association of all of the variables with the two outcomes. Sections two and three used a logistic regression model and a decision tree model to model the two success outcomes of meeting graduation standards and first time passage of the national certification examination respectively.

Data

The data analyzed for this study consists of archived data collected from the application review process from students applying to an undergraduate nursing program after completing the 60 semester credit hours of pre-requisite course work. These pre-requisites qualify the applicant as a college junior, with necessary pre-requisite courses completed that satisfied the application requirements. The demographic and academic performance data are described as aggregated information for the undergraduate nursing student cohorts admitted from fall 2009 to spring 2014 that underwent a faculty member review as part of the admission process. The total admission cohort includes students granted early admission that did not require a faculty application review and are not included in this study. These additional students were admitted into these cohorts by meeting established admission standards that qualified for early admission. These early admission decision students did not receive a faculty member subjective assessment score, and therefore are not considered in this study.

The approximate admission cohort admitted between 96 to 120 new students per cohort during this period. Early admission decision students did not receive a score based on application review, and thus lowered the number of applicant data for this study. The data for this study comprised 722 admitted students that received scores during the application review process from faculty members. The potential number of students that could achieve the first

success outcome and be evaluated for meeting graduation standards resulted in a total potential student population with an N=722.

The second success outcome, first time passage of the national certification exam, relies on a student to meet graduation requirements before being verified to sit for the national certification exam. The data provided 627 students that graduated and 95 students that did not graduate of the original 722 students that were admitted through the application review process. Additionally, students that take the exam out-of-state do not provide first-time attempt information, and were eliminated from the total number of potential of first-time exam performance measures. The data included 54 students that either took the exam in a state other than the host university, or failed to have their first attempt on the certification exam recorded. A combination of 95 students that did not graduate and 54 students without first attempt information reduced the number of potential certification exam measures to N=573 first time national certification exam scores. The descriptive statistics include tables for the population data with N=722 for the admitted students at the point of graduation, and with N=573 for the students that met graduation standards and were able to report national certification exam results.

Gender

The gender of the undergraduate nursing student data listed in Table 6 lists both the number of students and the percentage of students in the respective cohort. The average percentage of female students admitted that received a faculty assessment review was 82.1% and ranged from 71.4% to 90.1%, which mirrors the male student that ranged from 9.9% to 28.6%.

Table 6

Student Gender for Graduation

Cohort	Female				Male				Total
			Graduated				Graduated		
			Yes	No			Yes	No	
	N	*%*	*N*	*N*	*N*	*%*	*N*	*N*	*N*
Fall 2009	46	80.7	42	4	11	19.3	9	2	57
Spring 2010	82	79.6	76	6	21	20.4	21	0	103
Fall 2010	57	81.4	52	5	13	18.6	11	2	70
Spring 2011	68	78.2	62	6	19	21.8	16	3	87
Fall 2011	49	83.1	45	4	10	16.9	9	1	59
Spring 2012	68	87.2	59	9	10	12.8	7	3	78
Fall 2012	42	82.4	37	5	9	17.6	9	0	51
Spring 2013	68	85.0	48	20	12	15.0	8	4	80
Fall 2013	40	71.4	36	4	16	28.6	13	3	56
Spring 2014	73	90.1	59	14	8	9.9	8	0	81
Total	593	82.1	516	77	129	17.9	111	18	722

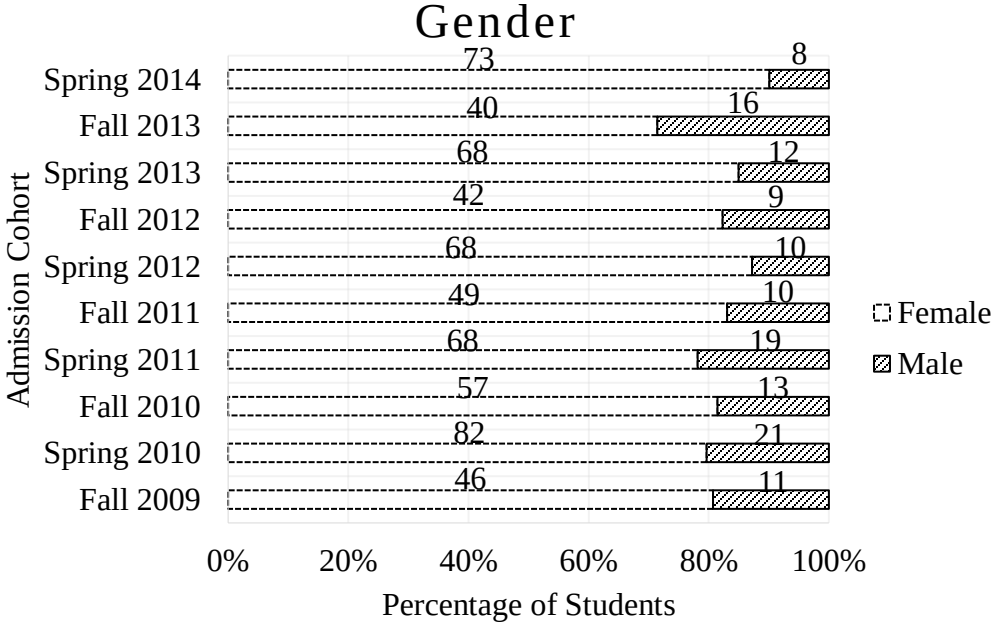

Figure 6. Gender

The gender of the undergraduate nursing student population listed in Table 7 lists both the number of students and the percentage of students in the respective cohort. The average percentage of female students admitted that received a faculty assessment review was 81.5% and ranged from 70.5% to 90.6%, which mirrors the male student that ranged from 9.4% to 29.5%.

Table 7

Student Gender for the National Certification Exam

Cohort	Female				Male				Total
			NCLEX				NCLEX		
			Pass	Fail			Pass	Fail	
	N	*%*	*N*	*N*	*N*	*%*	*N*	*N*	*N*
Fall 2009	40	83.3	37	3	8	16.7	8	0	48
Spring 2010	68	77.3	60	8	20	22.7	18	2	88
Fall 2010	47	81	42	5	11	19	11	0	58
Spring 2011	56	77.8	53	3	16	22.2	15	1	72
Fall 2011	39	81.3	33	6	9	18.7	8	1	48
Spring 2012	58	90.6	51	7	6	9.4	6	0	64
Fall 2012	35	79.5	32	3	9	20.5	8	1	44
Spring 2013	45	86.5	43	2	7	13.5	7	0	52
Fall 2013	31	70.5	29	2	13	29.5	13	0	44
Spring 2014	48	87.3	46	2	7	12.7	7	0	55
Total	467	81.5	426	41	106	18.5	101	5	573

Race

The race of the undergraduate nursing student population is listed in Table 8, and lists both the number and percentage of students. The average percentage of non-white students was 24.8% and ranged from 15.3% to 35.0%. The enrollment data listed in Table 4 contains the cumulative enrollment from the census report collected for the fall semester of 2104. The census data counted all undergraduate students in the nursing program, which included early admission

decision students along with the regular admissions students that underwent a faculty member subjective assessment that is covered in this study. The non-white percentage from Table 4 was 29%, which falls within the range of this subset of the population, the applicant's receiving a score based on a faculty members' subjective assessment, as listed in Table 8.

Table 8

Student Race for Graduation

Cohort	African-American		Asian		Hispanic		Multicultural		Native American		White		Total
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*
Fall 2009	10	17.5	2	3.5	2	3.5	0	0.0	0	0.0	43	75.4	57
Spring 2010	20	19.4	3	2.9	1	1.0	1	1.0	1	1.0	77	74.8	103
Fall 2010	11	15.7	1	1.4	2	2.9	1	1.4	0	0.0	55	78.6	70
Spring 2011	14	16.1	2	2.3	1	1.1	3	3.4	0	0.0	67	77.0	87
Fall 2011	4	6.8	2	3.4	1	1.7	1	1.7	1	1.7	50	84.7	59
Spring 2012	19	24.4	2	2.6	0	0.0	0	0.0	1	1.3	56	71.8	78
Fall 2012	7	13.7	0	0.0	1	2.0	0	0.0	1	2.0	42	82.4	51
Spring 2013	22	27.5	4	5.0	2	2.5	0	0.0	0	0.0	52	65.0	80
Fall 2013	9	16.1	2	3.6	3	5.4	0	0.0	0	0.0	42	75.0	56
Spring 2014	15	18.5	4	4.9	3	3.7	0	0.0	0	0.0	59	72.8	81
Total	131	18.1	22	3.0	16	2.2	6	0.8	4	0.6	543	75.2	722

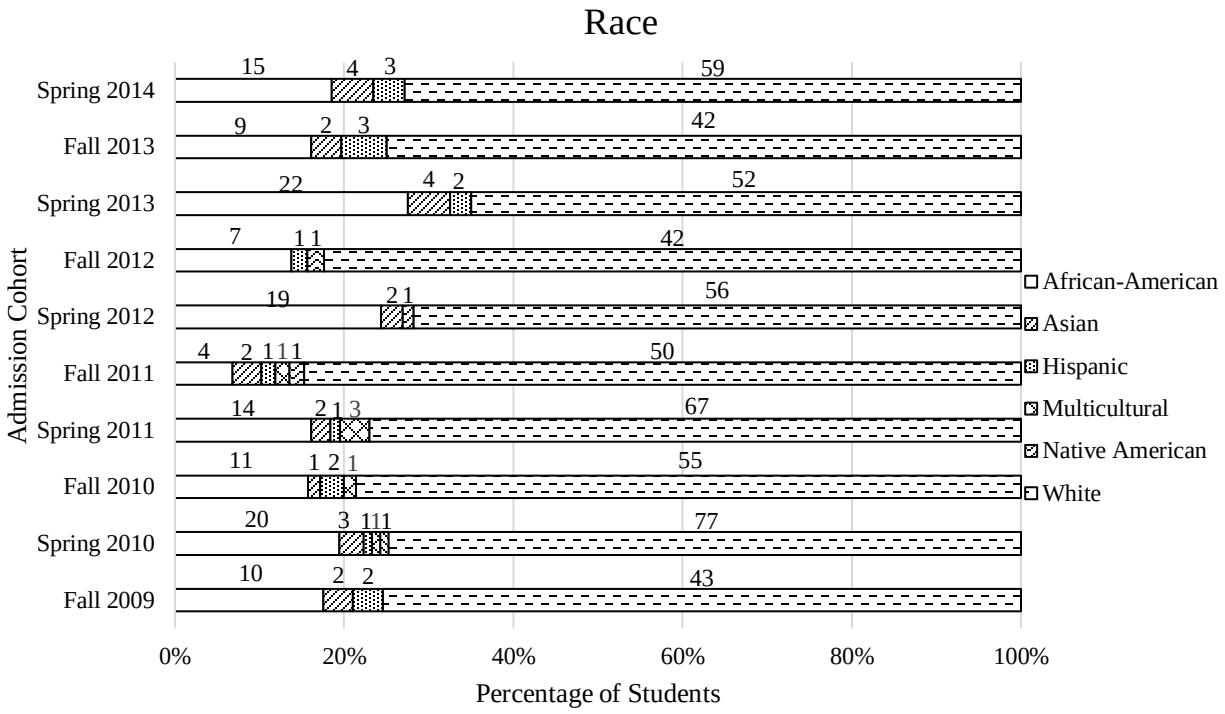

Figure 7. Race

The race of the undergraduate nursing student population is listed in Table 9, and lists both the number and percentage of students. The average percentage of non-white students was 23.0% and ranged from 15.3% to 27.3%. The enrollment data listed in Table 4 contains the cumulative enrollment from the census report collected for the fall semester of 2104. The census data counted all undergraduate students in the nursing program, which included early admission decision students along with the regular admissions students that underwent a faculty member subjective assessment that is covered in this study. The non-white percentage from Table 4 was 29%, which falls outside the range of this subset of the population, the applicant's receiving a score based on a faculty members' subjective assessment, as listed in Table 8.

Table 9

Student Race for the National Certification Exam

Cohort	African-American		Asian		Hispanic		Multicultural		Native American		White		Total
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*
Fall 2009	9	18.8	2	4.2	2	4.2	0	0.0	0	0.0	35	72.9	48
Spring 2010	16	18.2	2	2.3	0	0.0	1	1.1	1	1.1	68	77.3	88
Fall 2010	9	15.5	0	0.0	2	3.4	1	1.7	0	0.0	46	79.3	58
Spring 2011	13	18.1	1	1.4	1	1.4	1	1.4	0	0.0	56	77.8	72
Fall 2011	4	8.3	2	4.2	1	2.1	0	0.0	1	2.1	40	84.7	48
Spring 2012	13	18.1	1	1.6	0	0.0	0	0.0	1	1.6	49	76.6	64
Fall 2012	7	15.9	0	0.0	1	2.3	0	0.0	1	2.3	35	79.5	44
Spring 2013	10	19.2	3	5.8	1	1.9	0	0.0	0	0.0	38	73.1	52
Fall 2013	5	11.4	2	4.5	3	6.8	0	0.0	0	0.0	34	77.3	44
Spring 2014	11	20.0	3	5.5	1	1.8	0	0.0	0	0.0	40	72.7	55
Total	97	16.9	16	2.8	12	2.1	3	0.5	4	0.7	441	77.0	573

Pre-requisite Course Performance

The academic performance of the population by course is listed in Table 10. A student applying to the undergraduate nursing program must have a passing grade in these courses in order to gain admission. The resulting data therefore consists of the following grades: 'A'; 'B'; 'C'; and 'P'. Unsuccessful grade attempts do not qualify an applicant for admission and thus are not represented in this data, which are comprised of the following grades: 'D'; 'F'; and 'W'. A successful grade of 'P' can be achieved by completing the course in high school as an advanced placement course, or a student can earn the grade by a credit-by-exam process. The pre-requisite courses were completed at either the host university, as transfer course work completed at a regionally accredited institution of higher education, or by a combination of host and transfer course work. The transfer pre-requisite courses were evaluated to ensure the course met the same standards as the host institution's course work.

The number and percentage of course grades are listed in Table 10. The highest percentage of a grade of 'A' reached 69.3% in the inorganic chemistry lab course, and the lowest percentage was 34.2% in microbiology. The highest percentage of a grade of 'B' reached 46.0% in physiology, and the lowest percentage was 25.9% in inorganic chemistry lab. The highest percentage of a grade of 'C' reached 20.2% in microbiology, and the lowest percentage was 4.3% in developmental psychology.

Table 10

Pre-requisite Course Grades

Cohort	Grade								
	A		B		C		P		
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*
English Composition I	337	46.7	290	40.2	66	9.1	29	4.0	722
English Composition II	371	51.4	275	38.1	65	9.0	11	1.5	722
Inorganic Chemistry	299	41.4	291	40.3	132	18.3	0	0.0	722
Inorganic Chemistry Lab	500	69.3	187	25.9	35	4.8	0	0.0	722
2nd Natural Science	309	42.8	301	41.7	112	15.5	0	0.0	722
2nd Natural Science Lab	383	53.0	274	38.0	64	8.9	1	0.1	722
Finite Math	379	52.5	257	35.6	81	11.2	5	0.7	722
Statistics	345	47.8	292	40.4	83	11.5	2	0.3	722
Anatomy	314	43.5	319	44.2	89	12.3	0	0.0	722
Physiology	249	34.5	332	46.0	141	19.5	0	0.0	722
Microbiology	247	34.2	329	45.6	146	20.2	0	0.0	722
Nutrition	322	44.6	305	42.2	95	13.2	0	0.0	722
Introductory Psychology	351	48.6	287	39.8	74	10.2	10	1.4	722
Developmental Psychology	434	60.1	256	35.5	31	4.3	1	0.1	722
Total	4,840	47.9	3,995	39.5	1,214	12.0	59	0.6	10,108

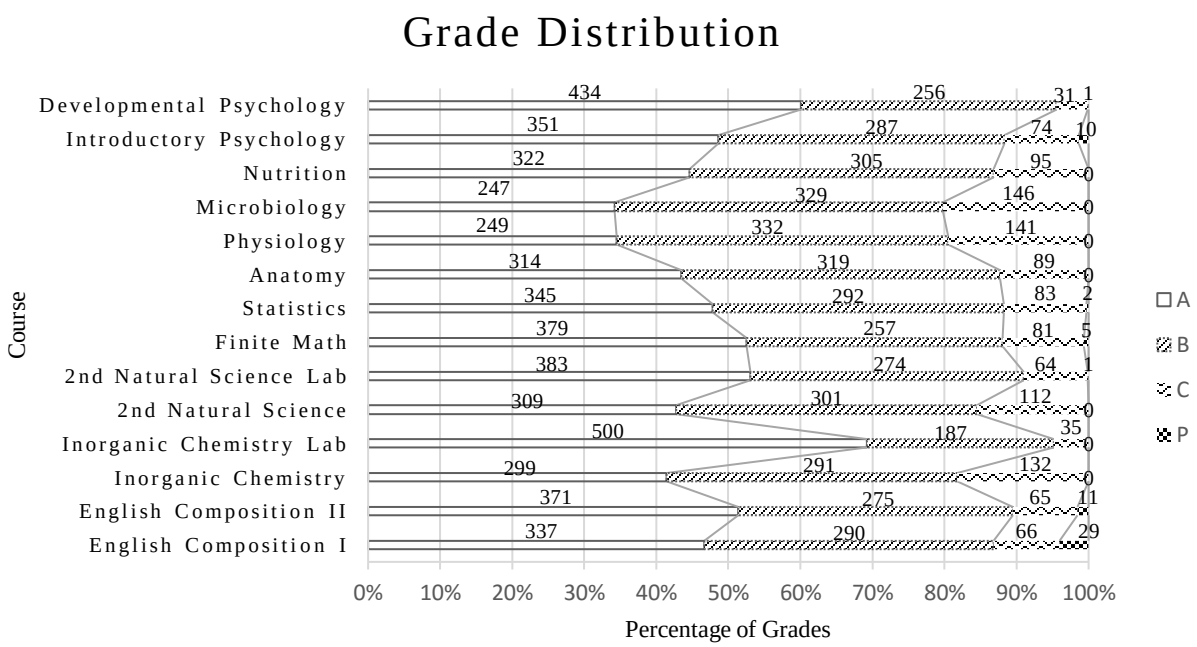

Figure 8. Pre-requisite grade distribution

Extracurricular Activities

The extracurricular component of the application data consists of health care experience. Students met this metric by volunteering or working in a health care setting for 60 hours or more while in college. This component of the application is voluntary and does not disqualify an applicant in the review process. The health care experience is listed in Table 11, and represents both number and percentage of students that have completed the required number of hours of health care experience. An average of 38.6% of the applicants participated in a health care experience and the application cohorts ranged from 24.3% to 48.5% participation.

Table 11

Health Care Experience

Cohort	Participated in Health Care Setting				
	Yes		No		Total
	N	*%*	*N*	*%*	*N*
Fall 2009	27	47.4	30	52.6	57
Spring 2010	50	48.5	53	51.5	103
Fall 2010	17	24.3	53	75.7	70
Spring 2011	35	40.2	52	59.8	87
Fall 2011	20	33.9	39	66.1	59
Spring 2012	28	35.9	50	64.1	78
Fall 2012	21	41.2	30	58.8	51
Spring 2013	28	35.0	52	65.0	80
Fall 2013	19	33.9	37	66.1	56
Spring 2014	34	42.0	47	58.0	81
Total	279	38.6	443	61.4	722

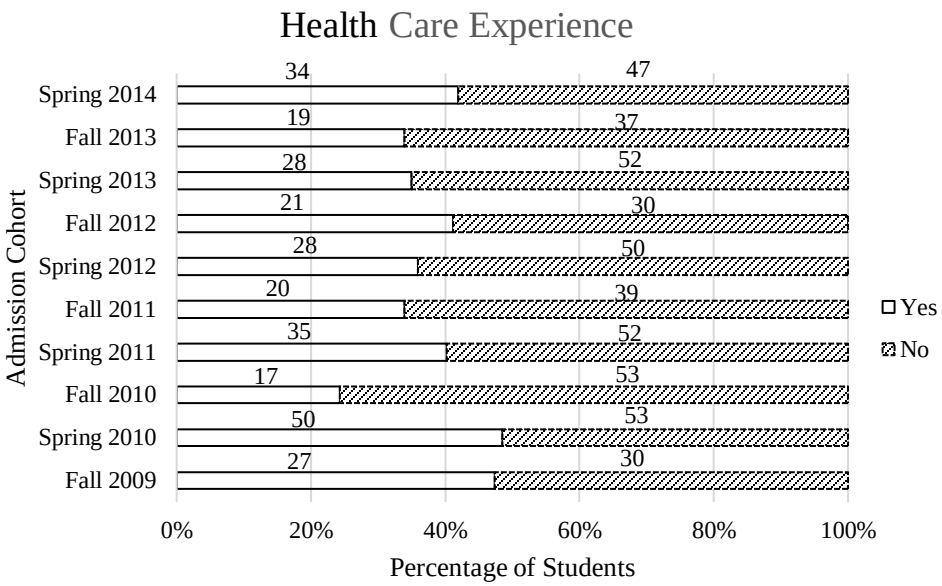

Figure 9. Health care experience

Subjective Assessments Scores

The scores from the faculty members' subjective assessment of an applicant's file are listed in Table 12, which are the mean of two separate faculty members' scores. The entire set of scores covers all of the applicants that received a faculty members' score to qualify for admission into the undergraduate nursing program used in this study. The writing skills assessment, with a variable name of English_fac had a potential range of scores from 0 to 10, covered an actual range from 2 to 10 with a mean of 6.474. The understanding of the nursing profession, with a variable name of Nursing_fac had a potential range of 0 to 5, covered an actual range of 0 to 5 with a mean of 3.01744. The summative assessment of the entire application, with a variable name of Overall_fac had a potential range of 0 to 20, covered an actual range of 3.5 to 20 with a mean of 12.299.

Table 12

Faculty Member Subjective Application Assessments

Variable Name	N	Range	Minimum	Maximum	Mean	Standard Deviation	Variance
English_fac	722	8.0	2.0	10.0	6.474	1.4483	2.097
Nursing_fac	722	5.00	0.00	5.00	3.0177	1.02489	1.050
Overall_fac	722	16.5	3.5	20.0	12.299	3.1744	10.077

Table 13 accounts for the grade distribution for the graduation success measure. The table lists the number and percentage of grades at the point of graduation broken down by the students that successfully achieved graduation standards and those who failed to meet that requirement. The largest percentage difference for a grade of 'A' was evident in the natural science course where the percentages had a range of 8.9%, and a smallest difference in the introductory psychology course of 0.2%. The grade of 'B' had the largest difference in English composition I at 13.2% and the smallest difference in the microbiology course with a 0.3%

difference. The grade of 'C' had the largest difference in the inorganic chemistry course at 8.9% and the smallest difference of 0.5% in the physiology course.

Table 13

Grade Distribution at Graduation

		Met Graduation Standards			
		Yes		No	
Variable Name	Variable	N	%	N	%
English Composition I					
	A	300	47.8%	37	38.9%
	B	241	38.4%	49	51.6%
	C	60	9.6%	6	6.3%
	P	26	4.1%	3	3.2%
English Composition II					
	A	324	51.7%	47	49.5%
	B	238	38.0%	37	38.9%
	C	57	9.1%	8	8.4%
	P	8	1.3%	3	3.2%
Inorganic Chemistry					
	A	254	40.5%	45	47.4%
	B	260	41.5%	31	32.6%
	C	113	18.0%	19	20.0%
Inorganic Chemistry Lab					
	A	429	68.4%	71	74.7%
	B	167	26.6%	20	21.1%
	C	31	4.9%	4	4.2%
Natural Science					
	A	261	41.6%	48	50.5%
	B	265	42.3%	36	37.9%
	C	101	16.1%	11	11.6%
Natural Science Lab					
	A	327	52.2%	56	58.9%
	B	241	38.4%	33	34.7%
	C	58	9.3%	6	6.3%
	P	1	0.2%	0	0.0%
Math					
	A	327	52.2%	52	54.7%
	B	224	35.7%	33	34.7%

		Met Graduation Standards			
		Yes		No	
Variable Name	Variable	N	%	N	%
	C	71	11.3%	10	10.5%
	P	5	0.8%	0	0.0%
Statistics					
	A	299	47.7%	46	48.4%
	B	257	41.0%	35	36.8%
	C	69	11.0%	14	14.7%
	P	2	0.3%	0	0.0%
Anatomy					
	A	272	43.4%	42	44.2%
	B	279	44.5%	40	42.1%
	C	76	12.1%	13	13.7%
Physiology					
	A	211	33.7%	38	40.0%
	B	294	46.9%	38	40.0%
	C	122	19.5%	19	20.0%
Microbiology					
	A	213	34.0%	34	35.8%
	B	286	45.6%	43	45.3%
	C	128	20.4%	18	18.9%
Nutrition					
	A	277	44.2%	45	47.4%
	B	266	42.4%	39	41.1%
	C	84	13.4%	11	11.6%
Introductory Psychology					
	A	305	48.6%	46	48.4%
	B	245	39.1%	42	44.2%
	C	67	10.7%	7	7.4%
	P	10	1.6%	0	0.0%
Developmental Psychology					
	A	376	60.0%	58	61.1%
	B	225	35.9%	31	32.6%
	C	25	4.0%	6	6.3%
	P	1	0.2%	0	0.0%

Table 14 accounts for the grade distribution for the national certification exam success measure. The table lists the number and percentage of grades for the students that qualified to take the national certification exam, which was further broken down by the students' success on the first attempt to pass the exam. The largest percentage difference for a grade of 'A' was in the introductory psychology course where the percentages had a range of 9.9%, and a smallest difference in the introductory physiology course of 0.1%. The grade of 'B' had the largest difference in introductory psychology course at 11.4% and the smallest difference in the math course with a 0.9% difference. The grade of 'C' had the largest difference in the physiology course at 6.3% and the smallest difference of 0.3% in the natural science course.

Table 14

Grade Distribution for National Certification Exam

		Passed First Attempt			
		Yes		No	
Variable Name	Variable	*N*	*%*	*N*	*%*
English Composition I					
	A	252	47.8%	23	50.0%
	B	199	37.8%	19	41.3%
	C	53	10.1%	3	6.5%
	P	23	4.4%	1	2.2%
English Composition II					
	A	275	52.2%	23	50.0%
	B	192	36.4%	19	41.3%
	C	53	10.1%	4	8.7%
	P	7	1.3%	0	0.0%
Inorganic Chemistry					
	A	215	40.8%	18	39.1%
	B	219	41.6%	21	45.7%
	C	93	17.6%	7	15.2%
Inorganic Chemistry Lab					
	A	363	68.9%	28	60.9%
	B	139	26.4%	15	32.6%
	C	25	4.7%	3	6.5%
Natural Science					
	A	215	40.8%	22	47.8%
	B	222	42.1%	16	34.8%

		Passed First Attempt			
		Yes		No	
Variable Name	Variable	*N*	*%*	*N*	*%*
	C	90	17.1%	8	17.4%
Natural Science Lab					
	A	272	51.6%	25	54.3%
	B	200	38.0%	18	39.1%
	C	54	10.2%	3	6.5%
	P	1	0.2%	0	0.0%
Math					
	A	275	52.2%	23	50.0%
	B	190	36.1%	18	39.1%
	C	58	11.0%	5	10.9%
	P	4	0.8%	46	100.0%
Statistics					
	A	255	48.4%	24	52.2%
	B	211	40.0%	17	37.0%
	C	60	11.4%	4	8.7%
	P	1	0.2%	1	2.2%
Anatomy					
	A	230	43.6%	20	43.5%
	B	239	45.4%	20	43.5%
	C	58	11.0%	6	13.0%
Physiology					
	A	181	34.3%	14	30.4%
	B	241	45.7%	26	56.5%
	C	105	19.9%	6	13.0%
Microbiology					
	A	181	34.3%	16	34.8%
	B	240	45.5%	20	43.5%
	C	106	20.1%	10	21.7%
	P				
Nutrition					
	A	233	44.2%	23	50.0%
	B	223	42.3%	17	37.0%
	C	71	13.5%	6	13.0%
Introductory Psychology					
	A	257	48.8%	27	58.7%
	B	209	39.7%	13	28.3%
	C	52	9.9%	5	10.9%
	P	9	1.7%	1	2.2%
Developmental Psychology					
	A	317	60.2%	31	67.4%
	B	192	36.4%	12	26.1%
	C	18	3.4%	2	4.3%
	P	0	0.0%	1	2.2%

Table 15 describes the graduation rates for each admission cohort. The rates range from a low of 70.0% to a high of 94.2%. The average graduation rate from these ten cohorts of students averages 86.8%.

Table 15

Graduation Rates

Cohort	Met Graduation Standards				
	Yes		No		Total
	N	*%*	*N*	*%*	*N*
Fall 2009	51	89.5	6	10.5	57
Spring 2010	97	94.2	6	5.8	103
Fall 2010	63	90.0	7	10.0	70
Spring 2011	78	89.7	9	10.3	87
Fall 2011	54	91.5	5	8.5	59
Spring 2012	66	84.6	12	15.4	78
Fall 2012	46	90.2	5	9.8	51
Spring 2013	56	70.0	24	30.0	80
Fall 2013	49	87.5	7	12.5	56
Spring 2014	67	82.7	14	17.3	81
Total	627	86.8	95	13.2	722

Table 16 describes the national certification exam first time pass rate for each admission cohort. The rates range from a low of 85.4% to a high of 96.4%. The average first time pass rate from these ten cohorts averages 92.0%.

Table 16

Certification Exam Pass Rates

Cohort	First Attempt Passage				
	Yes		No		Total
	N	*%*	*N*	*%*	*N*
Fall 2009	45	93.8	3	6.3	48
Spring 2010	78	88.6	10	11.4	88
Fall 2010	53	91.4	5	8.6	58
Spring 2011	68	94.4	4	5.6	72
Fall 2011	41	85.4	7	14.6	48
Spring 2012	57	89.1	7	10.9	64
Fall 2012	40	90.9	4	9.1	44
Spring 2013	50	96.2	2	3.8	52
Fall 2013	42	95.5	2	4.5	44
Spring 2014	53	96.4	2	3.6	55
Total	527	92.0	46	8.0	573

Tables 17 through 20 list the logistic regression based on a randomized sample of 80% of the application data available in this study. The remaining 20% of the application data was calculated using the predicted probability equations to calculate each of the test data's application scores to determine the overall quality of the model. The accuracy of the model was accessed using the misclassification rates. The logistic regression for all of the calculated probabilities above the 0.5 threshold met the criteria for a successful outcome. This threshold categorized all applications as meeting the graduation requirement or passage of the first time success rates. Table 17 calculated the logistic regression as compared to the success metric of meeting graduation requirements. The only variable that held statistical significance was the summative assessment of the entire application (Overall_fac), with a $p = 0.005$, through a stepwise variable selection method. The stepwise assumes the data contains data with equal

importance, and adds each variable in order to create the model (Montgomery et al., 2015). For every increase by one unit of the overall faculty assessment score, the odds of student graduation increases by 13.4%.

Table 17

Logistic Regression Based on Graduation Outcomes

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
English Composition I	.065	.140	.219	1	.640	1.068	.812	1.404
English Composition II	.071	.171	.171	1	.679	1.073	.768	1.500
Inorganic Chemistry	-.003	.205	.000	1	.988	.997	.667	1.489
Inorganic Chemistry Lab	-.293	.270	1.182	1	.277	.746	.439	1.266
Natural Science	-.115	.222	.270	1	.603	.891	.577	1.376
Natural Science Lab	.095	.245	.151	1	.697	1.100	.680	1.778
Math	-.135	.188	.518	1	.472	.874	.605	1.262
Statistics	.028	.281	.010	1	.920	1.029	.593	1.785
Anatomy	.085	.213	.158	1	.691	1.088	.717	1.652
Physiology	.005	.222	.001	1	.981	1.005	.650	1.554
Microbiology	.072	.206	.121	1	.728	1.074	.717	1.608
Nutrition	-.291	.217	1.797	1	.180	.747	.488	1.144
Introductory Psychology	-.186	.190	.954	1	.329	.831	.572	1.205
Developmental Psychology	.164	.233	.492	1	.483	1.178	.746	1.861
Gender	.145	.341	.180	1	.672	1.156	.592	2.257
Race	.095	.070	1.883	1	.170	1.100	.960	1.261
Health Care Experience	-.268	.275	.949	1	.330	.765	.446	1.312
English_fac	-.018	.106	.030	1	.863	.982	.798	1.209
Nursing_fac	.004	.151	.001	1	.981	1.004	.747	1.348
Overall_fac	.126	.044	8.019	1	.005	1.134	1.039	1.237
Constant	1.514	1.866	.658	1	.417	4.545		

Table 18 factored in all variables available in the application to determine relative weights using logistic regression to compare each of those variables to the success metric of meeting graduation requirements without including the race and gender variables. The only variable that held statistical significance was the summative assessment of the entire application (Overall_fac), with a $p = 0.002$. For every increase by one unit of the overall faculty assessment score, the odds of student graduation increases by 14.5%.

Table 18

Logistic Regression based on Graduation Outcomes (without Race and Gender)

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
English Composition I	.058	.139	.175	1	.676	1.060	.807	1.393
English Composition II	.074	.170	.190	1	.663	1.077	.772	1.501
Inorganic Chemistry	-.026	.204	.016	1	.900	.975	.654	1.453
Inorganic Chemistry Lab	-.282	.268	1.107	1	.293	.754	.446	1.276
Natural Science	-.106	.221	.231	1	.631	.899	.584	1.386
Natural Science Lab	.071	.243	.084	1	.772	1.073	.666	1.728
Math	-.134	.186	.513	1	.474	.875	.607	1.261
Statistics	.052	.280	.034	1	.854	1.053	.608	1.824
Anatomy	.080	.213	.143	1	.706	1.084	.714	1.646
Physiology	.000	.221	.000	1	1.000	1.000	.648	1.543
Microbiology	.072	.205	.125	1	.724	1.075	.719	1.608
Nutrition	-.291	.216	1.822	1	.177	.747	.489	1.141
Introductory Psychology	-.184	.188	.951	1	.329	.832	.575	1.204
Developmental Psychology	.177	.233	.577	1	.448	1.193	.756	1.883
Health Care Experience	-.270	.273	.979	1	.322	.763	.447	1.303
English_fac	-.017	.106	.026	1	.872	.983	.799	1.210
Nursing_fac	.011	.150	.006	1	.939	1.011	.753	1.358
Overall_fac	.135	.043	9.786	1	.002	1.145	1.052	1.246
Constant	2.089	1.735	1.450	1	.228	8.080		

Table 19 factored in all variables available in the application to determine relative weights using the logistic regression to compare to the success metric of passing the national certification exam on the first attempt. The only variable that held statistical significance was race, with a $p = 0.026$. The summative assessment of the entire application (Overall_fac) was not statistically significant, but was the closest variable with a $p = 0.057$. For every increase by one unit in race, the odds of student graduation increases by 23.1%.

Table 19

Logistic Regression Based on National Certification Exam Outcomes

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
English Composition I	-.033	.219	.023	1	.880	.967	.630	1.487
English Composition II	-.257	.279	.848	1	.357	.773	.447	1.336
Inorganic Chemistry	-.068	.288	.056	1	.813	.934	.531	1.643
Inorganic Chemistry Lab	.065	.348	.035	1	.851	1.067	.539	2.112
Natural Science	.056	.296	.036	1	.849	1.058	.592	1.890
Natural Science Lab	.065	.329	.040	1	.842	1.068	.560	2.034
Math	-.005	.265	.000	1	.986	.995	.592	1.674
Statistics	-.282	.401	.495	1	.482	.754	.343	1.656
Anatomy	-.101	.300	.112	1	.737	.904	.502	1.629
Physiology	-.009	.299	.001	1	.975	.991	.551	1.781
Microbiology	.052	.290	.033	1	.857	1.054	.597	1.859
Nutrition	-.050	.286	.030	1	.862	.951	.543	1.667
Introductory Psychology	-.133	.261	.258	1	.611	.876	.525	1.461
Developmental Psychology	.466	.318	2.154	1	.142	1.594	.855	2.972
Race	.208	.093	4.961	1	.026	1.231	1.025	1.478
Gender	-.820	.627	1.711	1	.191	.440	.129	1.505
Health Care Experience	-.565	.406	1.940	1	.164	.568	.257	1.259
English	.035	.148	.056	1	.813	1.036	.774	1.385
Nursing	-.110	.209	.278	1	.598	.896	.594	1.350
Overall	.115	.061	3.614	1	.057	1.122	.996	1.263
Constant	2.870	2.679	1.148	1	.284	17.638		

Table 20 calculated the logistic regression as compared to the success metric of passing the national certification exam on the first attempt without including the race and gender variables. The only variable that held statistical significance was the summative assessment of the entire application (Overall_fac), with a $p = 0.015$. For every increase by one unit of the overall faculty assessment score, the odds of student graduation increases by 15.5%.

Table 20

Logistic Regression Based on National Certification Exam Outcomes (without Race and Gender)

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
English Composition I	-.069	.212	.105	1	.746	.934	.616	1.415
English Composition II	-.224	.268	.701	1	.402	.799	.473	1.351
Inorganic Chemistry	-.128	.282	.207	1	.649	.880	.506	1.528
Inorganic Chemistry Lab	.131	.341	.148	1	.701	1.140	.584	2.226
Natural Science	.043	.290	.022	1	.881	1.044	.592	1.843
Natural Science Lab	.037	.323	.013	1	.909	1.037	.551	1.953
Math	-.026	.262	.010	1	.920	.974	.582	1.629
Statistics	-.197	.398	.245	1	.621	.821	.377	1.792
Anatomy	-.116	.300	.150	1	.699	.890	.495	1.602
Physiology	.004	.299	.000	1	.989	1.004	.559	1.804
Microbiology	.051	.289	.031	1	.861	1.052	.597	1.855
Nutrition	-.047	.287	.026	1	.871	.955	.544	1.676
Introductory Psychology	-.150	.251	.354	1	.552	.861	.526	1.409
Developmental Psychology	.463	.310	2.235	1	.135	1.590	.866	2.918
Health Care Experience	-.680	.403	2.847	1	.092	.506	.230	1.116
English_fac	.047	.146	.105	1	.746	1.048	.788	1.395
Nursing_fac	-.092	.208	.198	1	.657	.912	.607	1.370
Overall_fac	.144	.059	5.880	1	.015	1.155	1.028	1.297
Constant	1.876	2.333	.647	1	.421	6.527		

The logistic regression test data correctly identified 86.1% for the success measure of meeting graduation standards and a 92.2% for the success measure of first time passage of the national certification exam. The model's output did not identify any of the students that were unable to meet graduation standards or pass the certification exam on the first attempt.

Table 21

Logistic Regression Model Classification Results - Met Success Outcome

	Correctly Identified		Incorrectly Identified	
Success Outcome	N	%	N	%
Graduation outcomes	124	86.1	20	13.9
Graduation outcomes (without race and gender)	124	86.1	20	13.9
National certification exam outcomes	106	92.2	9	7.8
National certification exam outcomes (without race and gender)	106	92.2	9	7.8

The decision tree evaluates all of the dependent variable in relation to an independent variable. The R Statistical Software® split the data at points when a dependent variable can separate the data using the constraints of the tree. The first constraint was selecting a probability of 95% for the terminal nodes of the tree. The terminal nodes indicate an endpoint where the calculations end and the results are presented. The second constraint selected sets the pruning value for the tree. The software can produce dozens of terminal nodes. The pruning values were stopped when the terminal nodes reached a result that listed an outcome with a total of less than ten applicants in the terminal node, with the largest tree producing 13 terminal nodes. Since the pruning value also stops further calculation and the data may not be able to predict a probability of 95%, the terminal nodes may list probabilities lower than the goal probability of 95%.

The graphical representation of the decision tree uses a combination of symbols and text to depict the outcomes from the analysis. The R Statistical Software® uses circles to represent a

node and a bar graph to represent a terminal node. The node number is listed above the node and the node lists the dependent variable in the circle, with the values used to split the data listed on the two lines extending from the circular node. The terminal node's number is listed at the top of the respective bar graph along with the number of data points terminating at this node. The terminal node also graphically depicts the probabilities of the independent variable on the bar graph.

The decision tree depicted in Figure 6 modeled the nodes based upon 80% of the application data and tested the model using 20%. The analysis used the success measure of meeting graduation standards with all of the application variables. The tree created a total of 15 nodes through a pruning process, broken down into 7 decision point nodes and 8 terminal nodes. The first node was able to correctly identify 86.8% of the students able to meet graduation standards based solely on the score of the summative assessment of the entire application (Overall_fac), when the application was scored above 11.75. The output from the model incorrectly placed 35 applicants in the first node, which results in an initial 8.9% misclassification. This branch alone sorted 395 of the 722 applications, or 54.7%. Nodes 4 and 10 represent terminal nodes that predicted probabilities of 25.7% and 20.8% respectively. These nodes represent probabilities with much lower likelihood of applicants meeting the success measure of meeting graduation standards. The software and a listing of the detailed percentages are listed in Appendix E.

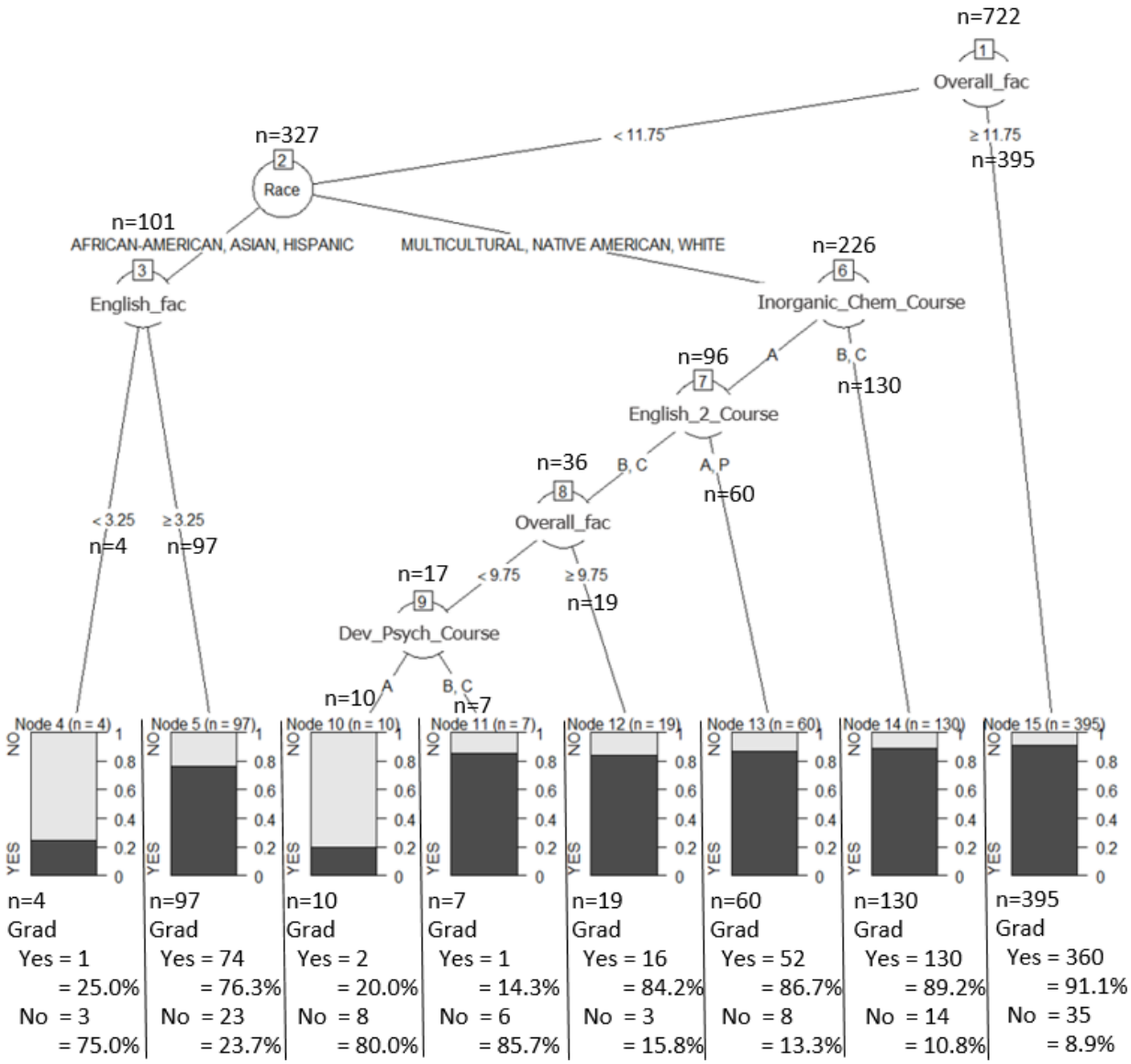

Figure 10. Decision tree for graduation success using all application variables

The analysis used the success measure of meeting graduation standards with all of the application variables except gender and race is depicted in Figure 7. The tree created a total of 25 nodes through a pruning process, broken down into 12 decision point nodes and 13 terminal nodes. This decision tree mimicked the decision tree, which included gender and race, at the first decision point node. The first node was able to correctly identify 86.8% of the students able to meet graduation standards based solely on the score of the summative assessment of the entire

application (Overall_fac), when the application was scored above 11.75. The model's output incorrectly placed 35 applicants in the first node, which results in an initial 8.9% misclassification. This branch alone sorted 395 of the 722 applications, or 54.7% of the total applicants. Three of the nodes predicted probabilities of success below 50% with: Node 9 at 11.1%; Node 13 at 40.0%; and Node 19 at 20.0%.

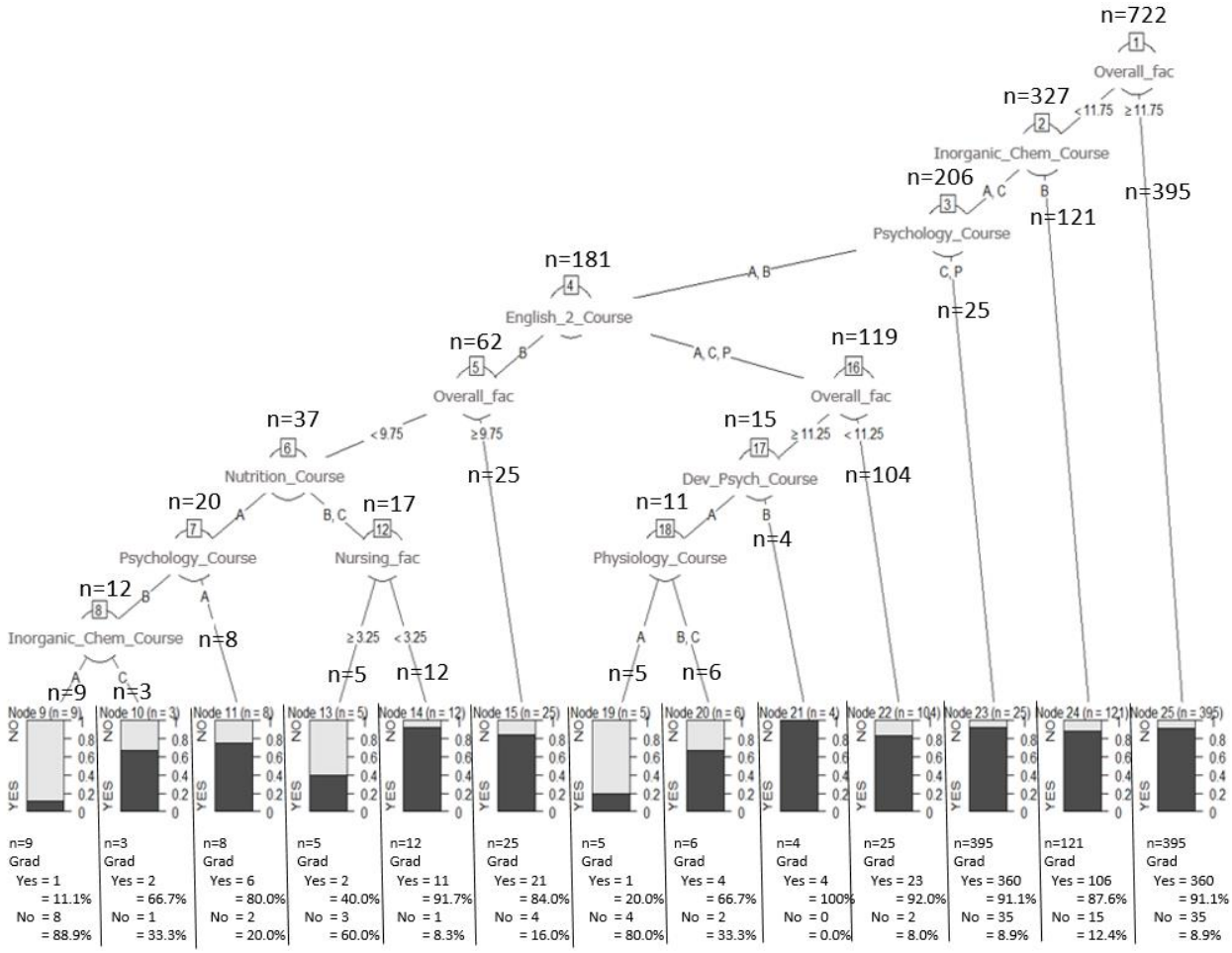

Figure 11. Decision tree for graduation success using all application variables except gender and race

The analysis used the success measure of passing the first attempt on the national certification exam with all of the application variables is depicted in Figure 8. The tree created a

total of 11 nodes through a pruning process, broken down into 5 decision point nodes and 6 terminal nodes. The first node was able to correctly identify 92.0% of the students able to pass the first attempt on the national certification exam based solely on race, when the application was multicultural or white. The model's output incorrectly placed 27 applicants in the first node, which results in an initial 5.9% misclassification. This branch alone sorted 456 of the 573 applications, or 79.6%. Node 6 identified 5 students that resulted in a predicted 0.0 % probability of passing the national certification exam on the first attempt.

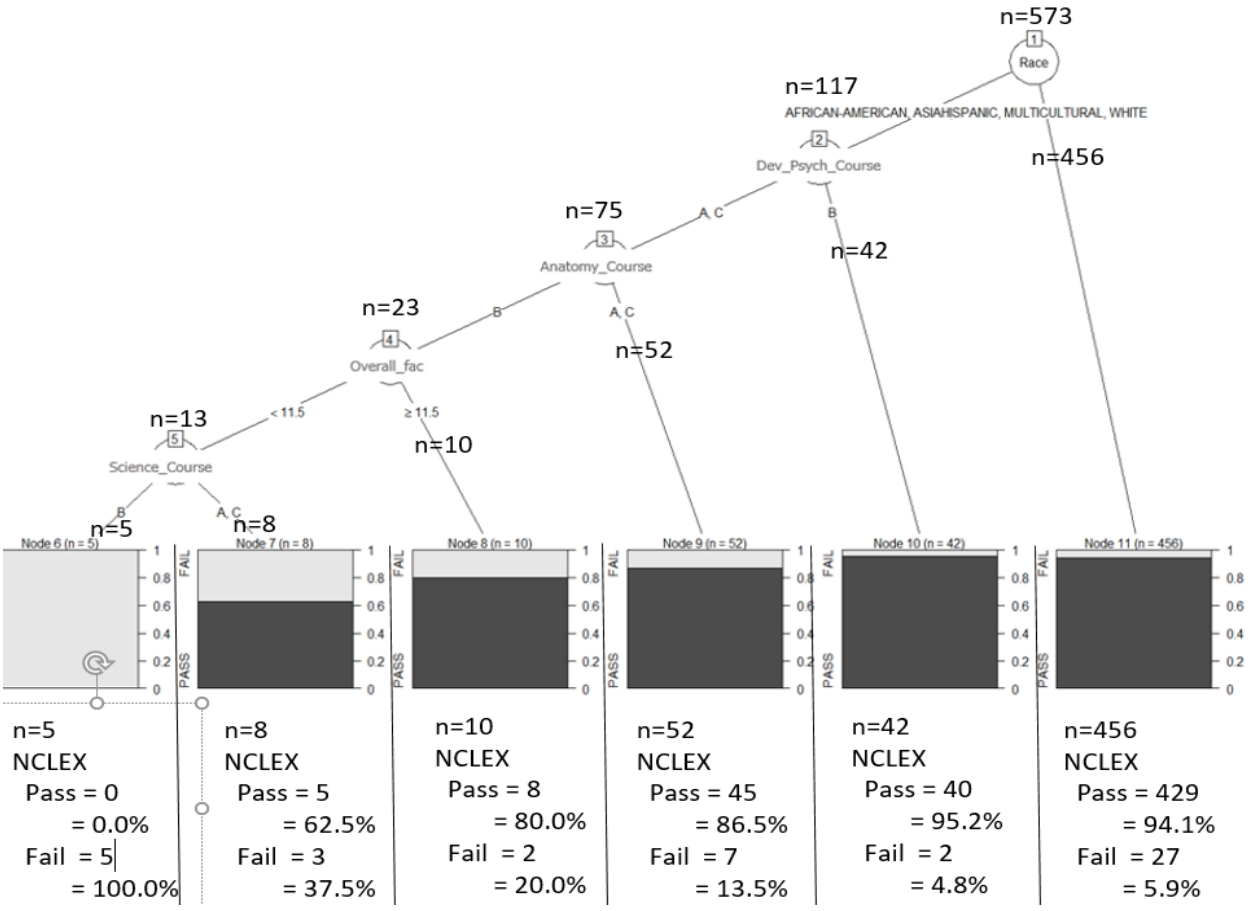

Figure 12. Decision tree for National Certification Exam success using all application variables

The analysis used the success measure of passing the first attempt on the national certification exam with all of the application variables except gender and race is depicted in

Figure 9. The tree created a total of 15 nodes through a pruning process, broken down into 7 decision point nodes and 8 terminal nodes. The first node was able to correctly identify 92.0% of the students able to pass the first attempt on the national certification exam based solely on the score of the summative assessment of the entire application (Overall_fac), when the application received a score above 11.25. The model's output incorrectly placed 18 applicants in the first node, which results in an initial 5.1% misclassification. This branch alone sorted 354 of the 573 applications, or 61.8%. Node 10 identified 3 students that resulted in a predicted 0.0 % probability of passing the national certification exam on the first attempt.

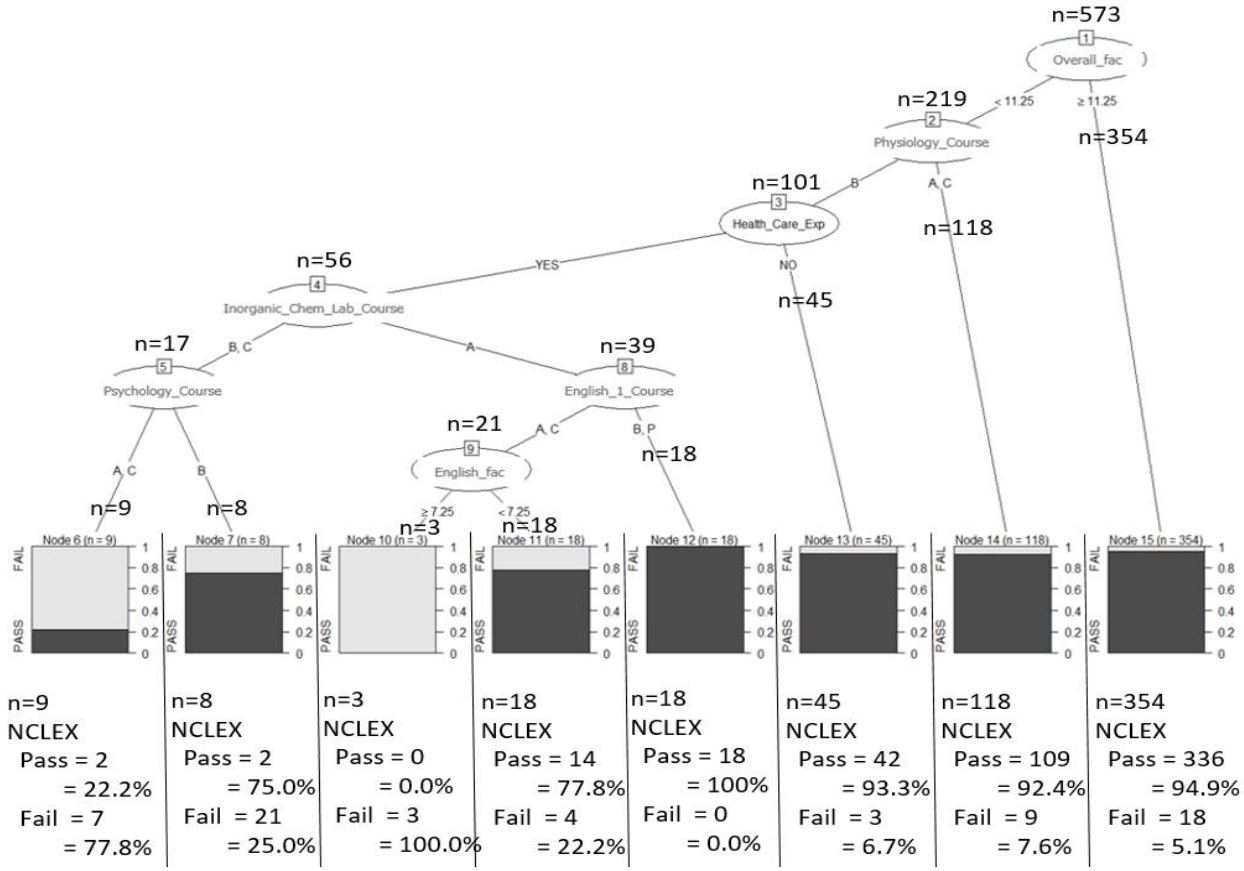

Figure 13. Decision tree for National Certification Exam success using all application variables except gender and race

Summary

This study analyzed the application process data from 10 admission cohorts over a five-year period to determine if faculty members' assessment scores in the application review process are an effective use of limited faculty members' time. The analysis used a logistic regression and a decision tree model to assess the application metrics as dependent variables compared to two different success measures. The success measures of meeting graduation requirements and passing the first attempt on the national certification exam were modeled separately as the independent variables in the two models. The two models were further broken down with race and gender data being removed in the second iteration of the model in order to create a model that met admission decision criteria.

The logistic regression model used 80% of the data to create the model and 20% of the data to test the model. Using the results from Table 21, the model's output correctly identified 86.1% of the students able to meet graduation standards in the iteration with and without race and gender; however, the model's output failed to identify the students unable to meet graduation requirements. The only independent variable compared to the success measure of meeting graduation standards identified to have statistical significance in both iterations of the model was the dependent variable of faculty members' overall assessment of the application file. This variable was one of three subjective assessment scores used in this analysis. From Table 21, the model's output correctly identified 92.2% of the students able to pass the first attempt on the national certification exam in the iterations with and without race and gender; however, the model's output again failed to identify the students unable to pass the first attempt on the national certification exam. Race and faculty members' overall application assessment were statistically significant in predicting passage on the first attempt of the national certification

exam. The decision tree model that excluded race and gender listed the faculty members' overall assessment of the application file as the only statistically significant dependent variable.

The decision tree model also used 80% of the data to create the model and 20% of the data to test the model. The model, which included race and gender, resulted in eight terminal nodes. The first node was able to split the 722 application files into a terminal node that consisted of 395 of the applicant's files and resulted in a 91.1% correctly identification rate with the meeting graduation standards success measure. The model excluding race and gender resulted in a tree with 13 terminal nodes. The first node was able to split the 722 application files into a terminal node that consisted of 395 of the applicant's files and resulted in a 91.9% correctly identification rate with the meeting graduation standards success measure. The decision tree model's results from the passage of the first attempt on the national certification exam success measure, when including race and gender, produced a tree with six terminal nodes. The first node on the tree was able to split 573 application files into a terminal node that consisted of 456 of the application files and a 94.1% predicted probability of passage of the first attempt of the national certification exam. The model's results from the passage of the first attempt on the national certification exam, excluding race and gender, created a tree with eight terminal nodes. The first node on the tree was able to split 573 application files into a terminal node that consisted of 354 of the application files and a 94.9% predicted probability of passage of the first attempt of the national certification exam.

CHAPTER V:

SUMMARY, FINDINGS, AND RECOMMENDATIONS

This study attempted to explore the association between application variables to a student's success in a nursing program. Additionally, the study evaluated the effectiveness in the faculty members' subjective assessment of an application file in order to model the application data utilizing the metrics most predictive in the admission decisions into an undergraduate nursing program. The data used in the model creation and testing applies to only one specific public university that is associated with an academic health science center; however, the process used to generate the model and testing can be applied to other universities and other academic programs. The generalizability of this study may assist future admission's process decisions.

Overview

The analysis of the archived application data covering a five-year period modeled the process to determine if the scores provided in the application files with faculty members' subjective application assessment as part of the file was an effective use of the faculty members' time. This evaluation of the process attempted to create models that could inform future admission decisions. The models were built upon existing research and current admission protocols to evaluate the effectiveness in predicting student success. The availability of the subjective assessment scores provides access to information with limited coverage in research literature.

Population Data

The gender distribution in an undergraduate nursing program has a greater percentage of women. The university's percentage of enrolled undergraduate female for fall 2014 was 58.2% ("UAB Undergraduate student demographics," 2015). The nursing field has been predominantly female in the United States, but has been increasing in male employment. In 2013, the national average of male nurses was 7% (American Association of College of Nursing, 2015). The population used in this study had a male population that averaged 17.9%, which is twice the number of male nurses in the workforce and 23.9% lower than the university's male population.

This study utilized a logistic regression model and a decision tree model to analyze the application metrics for an undergraduate nursing program. The logistic regression model and the decision tree model were computed using 80% of the data to create the model and 20% of the data to test the model. The SPSS® software factored in all of the variables to determine the relationship between the independent variable and the dependent variables and produced the *B* values. The *B* values are the logistic odds for the dependent variables in a data set used to calculate the independent variable on a logit scale (Witte & Witte, 2009). Once the logistic regression calculated the *B* values from 80% of the data, those *B* values were placed in a formula to calculate the predicted logit. The predicted logit results from the sum of the multiplication of the *B* values with the corresponding dependent variable value. The predicted logit value is placed into a predicted probability formula to produce the predicted probability to create the logistic regression predicted outcome (Witte & Witte, 2009).

The decision tree evaluates all of the dependent variable in relation to an independent variable. The R Statistical Software® split the data at points when a dependent variable can separate the data using the constraints of the tree. The terminal nodes indicate an endpoint where

the calculations end and the results are presented, based on the goal predictability of 95% and the pruning level of the tree, which stopped when terminal nodes reached a result that listed an outcome with a total of less than ten applicants. The results of these two models' output provided a means to evaluate the application review process to determine if any of the applications metrics were predictive of success to achieve graduation or national certification exam success.

Gender did not have statistical significance in the logistic regression models, with a p = 0.672 for graduation and p = 0.191 for national certification success measures. The decision trees for the two success measures did not select gender as a decision node using testing model pruning levels. This analysis resulted in gender providing no impact on predicting student success in the nursing program.

The race of the population of applicants used in this study consisted of a minority population of 24.8%. The university student population consists of a minority population of 36.7% ("UAB Undergraduate student demographics," 2015). The national average on minority nurse in the United States in 2008 was 16.8% (American Association of College of Nursing, 2015). In the logistic regression model for graduation success, race was not statistically significant, with a p = 0.170. The logistic regression model for the national certification exam was statistically significant at the 0.05 level for race, with a p = 0.026. The decision tree model for graduation success used race to sort the remaining 327 applicants at the second node. The decision tree model for national certification exam success was used in the first node and placed 456 of the 573 applicants at the first node, which equates to 79.6% of the applicants. Race is one of two application metrics that held statistical significance in this study.

Pre-requisite Course Performance

Pre-requisite course performance covered the mandatory courses necessary to meet application requirements into the undergraduate nursing program. Research has compared individual courses and groups of courses to undergraduate nursing student success (Griffiths et al., 1995; Kowitlawakul et al., 2013; McCarey et al., 2007). These studies limit the definition of success to the early semester in the nursing program. Although these studies found course performance to be predictive, this study did not find a statistical significance by any course based on the success criteria of graduation and national certification exam outcomes.

The grade of 'A' averaged 47.9% and ranged from 34.2% to 69.3%. The grade of 'B' averaged 39.5% and ranged from 25.9% to 46.0%. The grade of 'C' averaged 12.0% and ranged from 4.8% to 20.2%. The grade of 'P' averaged 0.6% with a range of 0% to 4.0%. The grades were skewed to the higher end of the grading spectrum, with a grade of 'A' approaching half of the grades. The logistic regression model's output resulted in no statistical significance from any course in either the graduation or national certification exam success measures. The decision tree for graduation success used course work to start the selection process at node 6 to sort 226 of the 772 applicants, which equated to 29.2% of the applicants. The decision tree for graduation success without gender and race started sorting applicants at node 2 placing 48.8% into subsequent nodes. The decision tree for the national certification exam started sorting applicants at node 2 and accounted for 20.4% of the remaining applicants. The decision tree for the national certification exam without gender and race started sorting at node 2 and accounted for 38.2% of the remaining applicants.

Extracurricular Activities

Health care experience indicated which applicants worked or volunteered in a health care setting for more than sixty hours. This component was the only optional activity for an applicant to complete and still meet application requirements. The exposure to health care has been linked to clinical performance as a measure of student satisfaction and expectations (Curtis et al., 2012; Hudacek, 2008). The applicant's average 38.6% participating in a health care setting when applying to the program. The logistic regression models output resulted in no statistical significance in health care experience when compared to the two success measures. Health care experience was only used in one of the four decision trees, national certification exam without gender and race. Health care experience sorted 101 of the applicants at node 3, which equates to 17.6% of the applicants.

Subjective Assessment Scores

The scores from the faculty members' subjective assessment of the application files were further analyzed using descriptive statistics for the students based upon the ability of the student to meet graduation requirements. The faculty member's subjective assessment scores are a mean of two faculty members' scores. The mean and standard deviation were similar between the writing skills assessment (English_fac) and the understanding of the nursing profession (Nursing_fac). The difference between the means was 0.158 and 0.0142, and a difference between the standard deviations was 0.0438 and 0.00075 respectively, as listed in Table 22. The summative evaluation of the entire application (Overall_fac) had a larger difference with the mean being 1.411 apart and the standard deviation difference of 0.2151. The t-test resulted in a significance in the relationship between the three variables and graduation success, with Overall_fac with a $p = 0.000$. The results from a ranked approach using the Wilcoxon test

provided parallel results, except the Overall_fac component showed a significance above the 0.05 level with $p = 0.006$. Also, the effect size was low for writing skills assessment (English_fac) and the understanding of the nursing profession (Nursing_fac), but the summative evaluation of the entire application (Overall_fac) had a medium effect size of 0.42.

Table 22

Data from Faculty Members' Subject Assessment at Graduation

Variable Name	Yes		No		T-test	Wilcoxon	Effect Size
	Mean	SD	Mean	SD	p value	p value	
English_fac	6.495	1.4438	6.337	1.4776	0.671	0.443	0.05
Nursing_fac	3.0195	1.02569	3.0053	1.02494	0.843	0.871	0.18
Overall_fac	12.485	3.1677	11.074	2.9526	0.000	0.006	0.42

The scores from the faculty members' subjective assessment of application files were also analyzed using the descriptive statistics for a student based upon the success measure of passing the national certification exam on the first attempt in Table 23. The writing skills assessment (English_fac) were 6.495 and 6.283 with a standard deviation of 1.4438 and 1.3402; the understanding of the nursing profession (Nursing_fac) were 3.0195 and 3.0109 with a standard deviation of 1.4438 and 1.3402; and the summative evaluation of the entire application (Overall_fac) were 12.564 and 11.152 with a standard deviation of 3.1616 and 2.683. The t-test identified a statistical significance in these scores as compared to the national certification exam first time pass rate with a $p = .001$. The Wilcoxon test calculated an Overall_fac scores with a $p = 0.003$. The value met the 0.005 threshold for statistical significance. The ranked approached used by the Wilcoxon test indicated that the distribution may not be normal, and the Wilcoxon test can be applied to distributions regardless if the distribution is normal. The Overall_fac score resulted in a medium effect size of 0.44.

Table 23

Data from Faculty Members' Subject Assessment for National Certification Exam

Variable Name	Yes		No		t-test	Wilcoxon	Effect Size
	Mean	SD	Mean	SD	p value	p value	
English_fac	6.516	1.4403	6.283	1.3402	0.674	0.14	0.04
Nursing_fac	3.018	1.0337	3.0109	0.94569	0.567	0.996	0.15
Overall_fac	12.564	3.1616	11.152	2.683	0.001	0.003	0.44

The scores provided by faculty members' subjective assessment of applicant files resulted from faculty members' receiving instruction on the application evaluation system and utilizing an established rubric to record the scores. The analysis of the score from the faculty members' subjective assessment of applicant files were tested using a t-test and Wilcoxon test. The success measures for graduation and national certification exam were found to have no statistical significance using the t-test for the writing skills assessment (English_fac) and the understanding of the nursing profession (Nursing_fac). The t-test was significant for both success measures for the summative evaluation of the entire application (Overall_fac), with graduation success of .000 and national certification passage of .001. The subjective assessment by faculty member resulted in one variables that showed an association with application data and the two success outcomes. Statistical significance was shown in both success measures in one of the variables when the Wilcoxon test was completed. The subjective assessment score from the faculty members' evaluation of the entire application (Overall_fac) was statistically significant at the 0.05 level for meeting graduation with a $p = 0.006$, and at the 0.005 level for national certification exam with $p = 0.003$. The Wilcoxon ranked approach identified a relationship between these application measures. The Overall_fac score resulted in a medium effect size of 0.42 for graduation success and 0.44 for national certification exam success.

The variable of writing proficiency (English_fac) and understanding the nursing profession (Nursing_fac) were found to have no statistical significance in either the logistic regression or decision tree models. The logistic regression models' output resulted in statistical significant for the Overall_fac variable in three of the four models. The success measure of graduation had a $p = 0.005$, graduation without gender and race had a $p = 0.002$, and the national certification exam without gender and race had a $p = 0.015$. The success measure of national certification exam had the variable Overall_fac with a $p = 0.057$. The decision tree models' output resulted in a similar set of results with Overall_fac sorting the applicant in node 1 in three of the four models. The only model without Overall_fac as node 1 was the national certification exam success measure, and Overall_fac was placed at node 4 sorting 4.0% of the applicants.

The results of using the two models with only the subjective assessment score from the faculty members' evaluation of the entire application (Overall_fac) are listed in Table 24. Table 5.3. The results of this variable alone as compared to the models using all of the application variables produced similar results to the logistical regression and decision tree models. This study indicates that the Overall_fac variable as an important component in the application review process. By using the overall faculty assessment score of 12 to separate the data, the graduation data results in 395 applicant files with a score of greater or equal to 12, which is 51.2% of the total 772 applicant files in the sample. The success metric of meeting graduation was 360, which is a 91.1% correctly classified percentage. The national certification data results in 330 applicant files with a score greater than or equal to 12, which is 57.6% of the 573 applicant files in the sample. The success metric of passing the certification exam on the first attempt was 312, which is a 94.5% correctly classified percentage.

Table 24

Model Classification Results Using Only Overall Faculty Members' Assessment Scores

		Overall Assessment Score	
Success Metric	Success Outcome	>=12	<12
Graduation	Yes	360	267
	No	35	60
National certification exam	Pass	312	215
	Fail	18	28

Research Question Results

The analysis of the application variables attempted to determine if these data could predict student success after two years in an undergraduate nursing program. The research by Higgs identified multiple reasons for attrition that resulted in student losses (Higgs et al., 1984). These student losses effected students without any clearly indicative trends to specifically identify individual students. Jeffreys' research, which addresses similar concerns, also noted that specific students could not be identified, but that groups of students at a higher risk of attrition could be identified (Jeffreys, 2015). Through a modeling approach, this study showed similar outcomes in an admission process, which cannot identify individual student losses, but comprises a process that results in successful outcomes. Tables 15 and 16 list an average graduation rate of 86.8%, and a first time national certification exam passage rate of 92.0%. The university's six-year graduation rate was 55.5% in 2008 ("UAB Undergraduate student demographics," 2015).

Previous studies have focused on the undergraduate nursing student's performance either at the beginning or at the completion of the nursing program. The initial or first two semesters of the program has been studied to determine if a student's academic performance can be predicted based upon previous academic performance or by achieving a specified score on a tailored

application exam (Alameida et al., 2011; Potolsky et al., 2003; Wharrad et al., 2003). The completion of an undergraduate nursing program followed by a first attempt at the national certification exam has been studied based upon nursing course work performance and specialized exam preparation prior to taking the national certification exam (Higgins, 2005; Mills et al., 1992; Spurlock & Hunt, 2008). This study analyzed an existing admission system to determine whether application metrics could predict success in an undergraduate nursing program. The resulting models were able to predict successful students; however, the models' output did not identify the students that were unsuccessful in attaining graduation or passing the certification exam on the first attempt.

This multi-year study tracked five years of undergraduate nursing students from application through graduation from a school of nursing, and found that faculty overall subjective assessment of application file to be highly predictive in forecasting students with a highly likelihood of successfully achieving graduation standards and passing the national certification exam on the first attempt. Previous studies considered subjective assessments of application essays and interviews as predictors for the first semester or first two semesters in a nursing program (Rosenberg, Perraud, & Willis, 2007; Sadler, 2003). The scores assigned by faculty members' complete assessment of an undergraduate nursing school application represent an area of research that has not represented in a review of the literature.

For the first research question, which application metrics, specifically the faculty members' subjective application review scores, relate to a student's success in meeting graduation standards in a nursing program, the summative evaluation of the entire application file (Overall_fac) was the only statistically significant predictive variable in determining graduation success. The t-test was significant with a $p = 0.000$, and Wilcoxon test result with a

statistical significance with a $p = 0.006$. The logistic regression models' output was computed with a statistical significance in both the assessment of graduation success using Overall_fac with and without the variables of gender and race with a $p = 0.005$ and $p = 0.002$, respectively. The decision tree model was computed with an Overall_fac as node 1 in both models, which sorted 395 of the 722 applications files, which equates to 51.2% of the population.

For the second research question, which application metrics, specifically the faculty members' subjective application review scores, relate to a student's success on the professional certification exam after graduating from a nursing program, the summative evaluation of the entire application file (Overall_fac) was one of two statistically significant variables used to determine the success measure of passing the national certification exam on the first attempt. The t-test was significant with a $p = 0.001$, and Wilcoxon test resulted in a statistical significance with a $p = 0.003$. The logistic regression model output was computed with a statistical significance in the assessment of passing the national certification exam using Overall_fac without the variables of gender and race with a $p = 0.015$. The decision tree model's output resulted in Overall_fac as node 1 in the assessment of passing the national certification exam without the variables of gender and race model, which sorted 354 of the 573 applications files, which equates to 61.8% of the population.

The variable of race was the second statistically significant variable used to determine the success measure of passing the certification exam on the first attempt. The logistic regression model identified a statistical significance in the assessment of passing the national certification exam using race with a $p = 0.015$. The decision tree model's output resulted in race as node 1 in the assessment of passing the national certification exam model, and was able to sort 456 of the 573 applications files, which equates to 79.6% of the population.

Implications

Undergraduate nursing programs face the challenge of identifying students with the highest probability of completing the nursing program and passing a national certification exam when selecting students through an admissions process. The data available in a student's application provides a consistent set of data and application specific documents utilized to compare, rank, and select students for admissions. The selection process attempts to determine if admitted student will perform both in theory work in the classroom, and can demonstrate health care skills in a clinical setting. The study indicated several areas that have implications for undergraduate nursing admission processes, and potentially general admission processes.

The use of faculty members' time spent on a selection committee resulted in the best measure in predicting success through the data resulting from the overall assessment of an applicant's file. This result implies that the faculty members' ability to weigh all of the information in totality provides the best prediction of a student's ability to succeed in an undergraduate nursing program. The effect on a nursing student's retention results from all of the characteristics the student possesses and environment factors (Jeffreys, 2007; Robertson, Canary, Orr, Herberg, & Rutledge, 2010). The scores from the faculty members' overall assessment, which considered the student in total and the student's environment met a level of statistical significance on the Wilcoxon Test and the logistic regression model for both the graduation and national certification success measures, and qualified as the first node on the decision in three of the four models.

The faculty members' overall assessment provides additional implications for admission processes. Since the quantifiable data were also analyzed in the study, and with the exception of race qualifying as the first node in the national certification pass rate model, no other metric

achieved statistical significance. The faculty members provide both experience and the ability to assess performance over time. As a nurse, the role requires faculty members to have accounted for multiple sets and think critically about the health care data to determine a patient's future needs (Zurmehly, 2008). The admissions process follows a similar pattern of analyzing existing data in order to make a prediction for future performance.

The ability to forecast future performance requires both a sense of time and to associate that data with trends in performance. The model selected for this study lacked the sophistication to discern the data relative to time and to aggregate the data to compare performance in subsequent semesters. The data were analyzed as discrete events and not associated with the progression of the student over a student's life to develop a pattern or trend. The faculty members' assessment can take into account a specific student's performance, with the example of a student that struggled in their first year of college course work, but transitioned and performed at a high level in their subsequent course work. The evaluation of individual grades and other application data does not take time into account and thus fails to identify upward or downward trends in academic performance.

The academic performance measures also assume that failure to meet graduation standards and pass the first attempt on the national certification exam rely on academic performance. Since the application consists of a resume, a personal essay, and optional volunteer work, the faculty members are able to factor in life situations and patterns of behavior into the overall assessment that may have impacted academic performance. Since student departure often stems from multiple reasons, a student's success may be impacted by factors not identifiable in an application file (Bean & Metzner, 1985; McGann & Thompson, 2008; Pryjmachuk et al., 2009).

With a selective admissions process comprised of a qualified applicant pool of students, students offered admission have previously demonstrated a certain level of academic performance in previous college coursework. Since academic capability has been identified, the reason for success or failure may not be based on academic measures alone. With the students completing the same prerequisite courses and meeting a minimum application grade point average in order to apply to the undergraduate nursing program, the group of students offered admission consist of a homogeneous population.

In the pre-requisite courses, grade distributions when analyzing the graduation requirement and the national certification exam success measures never exceeded 21.7% for a grade of 'C', as listed in Tables 13 and 14. The two tables list the distribution of grade of 'A' and 'B' without identifying a trend or pattern in the data. The tables also describe some courses with a higher percentage of students receiving a grade of 'A' in a course that failed to meet one of the success criteria. These pre-requisites provide the foundation of the content needed to succeed in upper level course work (Potter et al., 2013). The lack of individual course performance being predictive in either success measure implies that the grades are important in predicting success, and are not directly related to student retention. The ability to predict individual student attrition involves other factor or relationship that are not apparent exclusively in the application data.

Recommendations for Future Research

Based upon the results of this study, several areas of future research were identified. These areas directly relate to the two success measures selected for this study, which involved achieving graduation standards and passing the national certification exam on the first attempt.

These suggestions for research involve variables that may be unique to a specific institution of higher education, but may be applied to similar institutions.

The analysis of academic grade performance was applied to the two long-term success measures in this study. This study provided no significance associated with specific pre-requisite grade performance when compared to graduation and national certification exam outcomes. Several research articles identified specific pre-requisite courses to be predictive of first semester undergraduate nursing performance (Kowitlawakul et al., 2013; McCarey et al., 2007; Swain, 2012). With the availability of pre-requisite course grades, an iterative approach could be used to evaluate the performance of the nursing students through each semester of the nursing program. This analysis may determine if the pre-requisite course work has a relationship to student performance in the initial semesters of nursing course work leading to graduation, or determine the point in an academic program where pre-requisite course work may still provide insight into student success. Along with academic performance, other application information may be able to evaluate student performance.

The use of standardized college entrance exams and nursing application tests to predict nursing student success provides another performance measure that has been the focus of previous research (Pascarella et al., 2006; Wolkowitz & Kelley, 2010). These studies evaluated the use of standardized tests from the ACT and SAT to cover both college admission tests and specialized undergraduate nursing admissions tests. The analysis of both the composite test score and the separate sub-scores of these tests provides another source of data that could be analyzed to determine the relationship between standardized test scores at the point of application in predicting success for graduation and national certification exam outcomes. As dominant college admission exams become increasingly more prevalent, these scores may

become a component of application requirements. With academic performance, admissions can include subjective components to the application review process.

The scores provided from the summative assessment of the entire application created by the faculty members' assessment created the information with the highest likelihood of identifying students' success in this study. Previous research has utilized subjective evaluations to determine success in admissions processes (Clayton et al., 1984; Sadler, 2003). The scores provided in this study relied on current nursing faculty members. The faculty members received classes intended to add consistency to standardize the application scoring and scored application files based upon a rubric in the application assessment process. The background and professional experiences of the nursing faculty along with the importance the faculty members' places on specific aspects of a student's application information provides an area of research to explore. Research can evaluate if the summative assessment of the entire application relies on a holistic approach of multiple factors or specific components of an applicant's data influences the faculty members' assessment.

The entire process of subjective evaluations components in admission decisions provides another area for research. This study saw no statistical significance in the scores associated with writing proficiency and understanding of the nursing profession. Conceptually, the ability to communicate and alignment with health care attributes has been indicative of nursing professional success (Jeffreys, 2012; Pitt et al., 2014). The data analyzed in this study either failed to create a means to submit this information or to score these areas in a way to relate to student performance. The submission of on-site interviews and writing samples may provide alternative methods to better assess student performance in a standardized environment.

These models could be used on future admissions to test the validity of the outcomes on current and future application cohorts of students. The continued collection and assessment of ongoing application data provides additional data to verify the findings in from this sample. Future cohorts of applications files will provide support to the finding of this study if the model provides matching results from the models to actual student success outcomes.

Recommendations for Practice

Based on this study's finding of faculty members' overall assessment of an application file being the variable with significance for predicting the likelihood of a student achieving success for graduation and passage of the national certification exam on the first attempt, the faculty members' input into the admission process provides effective data in the identification of quality applicants. Jeffreys (2015) similarly identified multiple factors when selecting applicants, including the university environment, as potential influencers in student success in a nursing program. The work by van Rooyen et al. (2006) compared the total number of 'A' grades in pre-requisite course work related to student performance in nursing courses provided an additional study of a summative approach in the evaluation of students' academic performance. These studies support a holistic approach to application reviews to provide increased likelihood when making admission decisions.

The use of pre-requisite course work alone has provided predictability through the initial semesters of undergraduate nursing performance (Kowitlawakul et al., 2013; Swain, 2012). The use of standardized college entrance exams, the American College Test, ACT, and the Scholastic Assessment Test, SAT, have also limited the association with student success in the study to first semester of nursing performance (Wolkowitz & Kelley, 2010). The undergraduate nursing entrance exams, the Test of Essential Academic Skill, TEAS, and the Nurse Entrance Exam,

NET, provided predictability for first semester undergraduate nursing student performance (Ellis, 2006; Wolkowitz & Kelley, 2010). In these studies, the predictability through graduation and national certification exam after graduation fails to provide the predictability for an admission decision to impact these two student success outcomes. Application review committees intending to select the most qualified students to meet these success measures need information that provides increased predictability for success using all of the data available. Thus, limited faculty members' time is effectively used through the review and assessment of all of the data provided in an application files, and should continue to be part of the file application review process.

The administrative preparation may be reduced if the calculation of overall and pre-requisite grade point averages is replaced by the overall faculty members' application file assessment. This study may be applicable to other academic disciplines to prioritize or select applicants. The use of a decision tree model, as a method to sort applicants with the application metrics provided by the selection scores, can be designed to identify students with a high probability of meeting graduation requirements and reduced administrative workload. Application review preparation that includes analysis of previous data and the association of that application data to success outcomes allows for adjustments in the application scoring rubric, and inform the application committee when selecting students for admission.

Conclusion

This study provides additional research into the previous studies conducted in admission decision making and application review processes. The models selected for this study identified a significant variable that provided the most predictability in measuring student success in an undergraduate nursing program. By assessing the effectiveness in the faculty members'

subjective assessment of an application file, and modeled the application data to determine the metrics most predictive in the admission decisions into an undergraduate nursing program, the study provides results that inform this admission process and provides a case to study the factors used to determine the factors and process used by faculty to make a subjective evaluation, and to replicate the results at other higher education institutions to determine if the results are more universal.

The results identified the scores provided by the summative evaluation by faculty members' assessment of an entire application packet and race to be the only two application variables to be statistically significant in predicting student success to meet graduation standards and pass the national certification exam on the first attempt. The use of faculty members' time provides the only component variable that can be used in admission decisions, and the variable of race can be used to identify the potential for success or attrition from an undergraduate nursing program. This study indicates that the use of faculty members' time in assessing application files provides more accurate admission decisions, and should be continued in the admission process in this environment.

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APPENDIX A:

IRB CONSENT

THE UNIVERSITY OF ALABAMA | Office of the Vice President for Research & Economic Development
Institutional Review Board for the Protection of Human Subjects

May 5, 2016

Peter Tofani, MS, LTC(R)
Assistant Dean for Student Affairs
University of Alabama at Birmingham
School of Nursing - NB 1003
1720 2nd Avenue South
Birmingham, AL 35294-1210

Re: IRB # EX-16-CM-044 "Admission Factors Used to Determine Entry Into a Nursing Program Based on Student Success Indicators At a Public University"

Dear Mr. Tofani:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your protocol has been given exempt approval according to 45 CFR part 46.101(b)(4) as outlined below:

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Your application will expire on May 4, 2017. If your research will continue beyond this date, complete the relevant portions of Continuing Review and Closure From. If you wish to modify the application, complete the Modification of an Approved Protocol Form. When the study closes, complete the appropriate portions of FORM: Continuing Review and Closure.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number.

Good luck with your research.

Sincerely,

Director & Research Compliance Officer
Office for Research Compliance

358 Rose Administration Building | Box 870127 | Tuscaloosa, AL 35487-0127
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066

APPENDIX B:

PRE-NURSING COURSE REQUIREMENTS

Area I: Written Composition	6 hours total
English Composition I	3
English Composition II	3
Area II: Humanities and Fine Arts	12 hours total
Literature*	3
Arts	3
Humanities	3
Elective	3 (or 6)*
Area III: Natural Sciences and Mathematics	11 hours total
Inorganic Chemistry	4
Organic Chemistry**	4
Pre-Calculus or Finite Math	3
Area IV: History, Social, and Behavioral Sciences	12 hours
Psychology	3
Developmental Psychology	3
History*	3 (or 6)*
Area IV Elective	3
Area V: Additional Pre-Nursing Requirements	18 hours total
Human Anatomy	4
Human Physiology	4
Microbiology	4
Nutrition	3
Descriptive Statistics	3
Additional Pre-Nursing Requirements	
Approved FYE course	2 hours total
TOTAL:	61 hours

* Student needs either a 6 hour sequence of literature or history.
** Students may otherwise take any additional science with lab (excluding Geology and Astronomy).

APPENDIX C:

BSN APPLICATION REVIEWER ANALYSIS

Application Semester:
Applicant's Full Name:

Academic Performance Data:

Volunteer or Work Experience
- Volunteer
  - Number of Hours:
  - Agency:
- Work
  - Number of Hours:
  - Organization:

Quality of Written Essay:
- 10 = Exceptional mastery of English language (neatly written or typed, excellent: grammar; spelling; flow of ideas; etc.)
- 8 = Very Good usage and thought flow
- 6 = Good usage, with a few grammar mistakes
- 4 = Fair usage
- 2 = Weak usage
- 0 = Unintelligible

Concept of Nursing:
- 5 = Displays exceptional concept of nursing
- 4 = Displays good concept of nursing
- 3 = Displays realistic concept of nursing
- 2 = Understands basic roles of nurses
- 1 = Weak description of nurses' role
- 0 = No understand of the nursing profession

Overall impression of applicant from all materials presented:
(Indicate your overall impression of the applicant by taking into account all the factors.)
- 20 = Stellar – possesses all of the characteristics to succeed in the nursing program;
- 15 = Above average – possesses most of the characteristics to succeed in the program
- 10 = Average – solid performer across the board; no significant weak areas
- 5 = Below average – one major weak area
- **0** = Unacceptable – Several weak areas or one or more significant issues

APPENDIX D:

SPSS® PROGRAMMING SYNTAX CODE

```
 COMPUTE pred_logit = (-.060*EH101T) + (-.097*EH102T) + (-.168*CH105T) + (.416*CH106T) + (-
 .056*CH107T) + (-.098*CH108T) + (.043*MA105T) + (.014*MA180T) + (.161*BY115T) + (-
.098*BY116T) + (.076*BY261T) + (-.107*NTR222T) + (-.141*PY101T) + (.075*PY212T) + (-
.512*GENDERTT) + (.199*RACET) + (-.795*VOLT) + (.065*English) + (-.063*Nursing) +
(.123*Overall) + (1.291).
EXECUTE.

COMPUTE pre_group = 2.718281828459**pred_logit/(1+2.718281828459**pred_logit).
EXECUTE.

COMPUTE pred_logit2 = (.058*EH101T) + (.074*EH102T) + (-.026*CH105T) +
(-.282*CH106T) + (-.106*CH107T) + (.071*CH108T) + (-.134*MA105T) + (.052*MA180T) +
(.080*BY115T) + (.000*BY116T) + (.072*BY261T) + (-.291*NTR222T) + (-.184*PY101T) +
(.177*PY212T) + (-.270*VOLT) + (-.017*English) + (.011*Nursing) + (.135*Overall) + (2.089).
EXECUTE.
COMPUTE pre_group2 = 2.718281828459**pred_logit2/(1+2.718281828459**pred_logit2).
EXECUTE.

COMPUTE pred_logit3 = (-.033*EH101T) + (-.257*EH102T) + (-.068*CH105T) + (.065*CH106T) +
(.056*CH107T) + (.065*CH108T) + (-.005*MA105T) + (-.282*MA180T) + (-.101*BY115T) + (-
.009*BY116T) + (.052*BY261T) + (-.050*NTR222T) + (-.133*PY101T) + (.466*PY212T) + (-
.820*GENDERTT) + (.208*RACET) + (-.565*VOLT) + (.035*English) +
(-.110*Nursing) + (.115*Overall) + (2.870).
EXECUTE.

COMPUTE pre_group3 = 2.718281828459**pred_logit3/(1+2.718281828459**pred_logit3).
EXECUTE.

COMPUTE pred_logit4 = (-.069*EH101T) + (-.224*EH102T) + (-.128*CH105T) + (.131*CH106T) +
(.043*CH107T) + (.037*CH108T) + (-.026*MA105T) + (-.197*MA180T) + (-.116*BY115T) +
(.004*BY116T) + (.051*BY261T) + (-.047*NTR222T) + (-.150*PY101T) + (.463*PY212T) + (-
.680*VOLT) + (.047*English) + (-.092*Nursing) + (.144*Overall) + (1.876).
EXECUTE.

COMPUTE pre_group4 = 2.718281828459**pred_logit4/(1+2.718281828459**pred_logit4).
EXECUTE.
```

APPENDIX E:

R STATISTICAL SOFTWARE® PROGRAMMING CODE

```
 getwd()
 rm(list=ls(all=TRUE))
dat <- read.csv("data_set_admission.csv")     # reading the data file
dim(dat)     # outputs the number of observations and number of variables
colnames(dat)     # gives all the column names
names(dat)
install.packages("rpart")     # loads decision tree statistics software package
install.packages("partykit")
library(rpart)     # connects R to statistics package commands
library(partykit)
set.seed(1982)
# Fitting Graduation model after admission
tree.fit1=rpart(Graduation ~ Gender + Race + English_1_Course + English_2_Course +
          Inorganic_Chem_Course + Science_Course + Math Course + Statistics_Course +
          Anatomy_Course + Physiology_Course + Microbiology_Course + Nutrition_Course +
          Psychology_Course + Dev_Psych_Course + Health_Care_Exp + English_fac + Nursing_fac +
          Overall_fac, data=dat,
            method="class",
            control=rpart.control(minsplit=10, minbucket=3, maxdepth=15, cp=0, maxcompete=4,
                                  maxsurrogate=5, usesurrogate=2, surrogatestyle=0, xval=10))
                                   # surrogate splits for missing data
printcp(tree.fit1)     # creates nodes for the decision tree
plotcp(tree.fit1)     # plots decision tree notes
pruned.fit1<-prune(tree.fit1,cp=0.0097)     #creates decision tree
pruned.fit1     # prunes the decision tree
plot(pruned.fit1)     #plots the branches of the decision tree
plot(as.party(pruned.fit1))  #plots the entire decision tree
```

APPENDIX F:

R STATISTICAL SOFTWARE® DECISION TREE RESULTS

Graduation (Post-Admission)

n= 722 node), split, n, loss, yval, (yprob) * denotes terminal node

1) root 722 95 YES (0.13157895 0.86842105)

2) Overall_fac< 11.75 327 60 YES (0.18348624 0.81651376)

4) Race=African-American,Asian,Hispanic 101 26 YES (0.25742574 0.74257426)

8) English_fac< 3.25 4 1 NO (0.75000000 0.25000000) *

9) English_fac>=3.25 97 23 YES (0.23711340 0.76288660) *

5) Race=Multicultural, Native American,White 226 34 YES (0.15044248 0.84955752)

10) Inorganic_Chem_Course=A 96 20 YES (0.20833333 0.79166667)

20) English_2_Course=B,C 36 12 YES (0.33333333 0.66666667)

40) Overall_fac< 9.75 17 8 NO (0.52941176 0.47058824)

80) Dev_Psych_Course=A 10 2 NO (0.80000000 0.20000000) *

81) Dev_Psych_Course =B,C 7 1 YES (0.14285714 0.85714286) *

41) Overall_fac>=9.75 19 3 YES (0.15789474 0.84210526) *

21) English_2_Course =A,P 60 8 YES (0.13333333 0.86666667) *

11) Inorganic_Chem_Course =B,C 130 14 YES (0.10769231 0.89230769) *

3) Overall_fac>=11.75 395 35 YES (0.08860759 0.91139241) *

Graduation (Admission)

n= 722 node), split, n, loss, yval, (yprob) * denotes terminal node

1) root 722 95 YES (0.13157895 0.86842105)

2) Overall_fac< 11.75 327 60 YES (0.18348624 0.81651376)

4) Inorganic_Chem_Course =A,C 206 45 YES (0.21844660 0.78155340)

8) Psychology_Course =A,B 181 43 YES (0.23756906 0.76243094)

16) English_2_Course =B 62 19 YES (0.30645161 0.69354839)

32) Overall_fac < 9.75 37 15 YES (0.40540541 0.59459459)

64) Nutrition_Course=A 20 9 NO (0.55000000 0.45000000)

128) Psychology_Course =B 12 3 NO (0.75000000 0.25000000)

256) Inorganic_Chem_Course =A 9 1 NO (0.88888889 0.11111111) *

257) Inorganic_Chem_Course =C 3 1 YES (0.33333333 0.66666667) *

129) Psychology_Course =A 8 2 YES (0.25000000 0.75000000) *

65) Nutrition_Course =B,C 17 4 YES (0.23529412 0.76470588)

130) Nursing>=3.25 5 2 NO (0.60000000 0.40000000) *

131) Nursing< 3.25 12 1 YES (0.08333333 0.91666667) *

33) Overall_fac >=9.75 25 4 YES (0.16000000 0.84000000) *

17) English_2_Course =A,C,P 119 24 YES (0.20168067 0.79831933)

34) Overall_fac >=11.25 15 6 YES (0.40000000 0.60000000)

68) Dev_Psych_Course =A 11 5 NO (0.54545455 0.45454545)

136) Physiology_Course =A 5 1 NO (0.80000000 0.20000000) *

137) Physiology_Course =B,C 6 2 YES (0.33333333 0.66666667) *

69) Dev_Psych_Course =B 4 0 YES (0.00000000 1.00000000) *

35) Overall_fac < 11.25 104 18 YES (0.17307692 0.82692308) *

9) Psychology_Course =C,P 25 2 YES (0.08000000 0.92000000) *

5) Inorganic_Chem_Course =B 121 15 YES (0.12396694 0.87603306) *

3) Overall_fac >=11.75 395 35 YES (0.08860759 0.91139241) *

NCLEX (Post-Admission)

n= 573 node), split, n, loss, yval, (yprob) * denotes terminal node

1) root 573 46 PASS (0.08027923 0.91972077)

2) Race=African-American, Asian, Native American 117 19 PASS (0.16239316 0.8376 0684)

4) Dev_Psych_Course =A,C 75 17 PASS (0.22666667 0.77333333)

8) Anatomy_Course =B 23 10 PASS (0.43478261 0.56521739)

16) Overall_fac< 11.5 13 5 FAIL (0.61538462 0.38461538)

32) Inorganic_Chem_Course =B 5 0 FAIL (1.00000000 0.00000000) *

33) Inorganic_Chem_Course =A,C 8 3 PASS (0.37500000 0.62500000) *

17) Overall_fac>=11.5 10 2 PASS (0.20000000 0.80000000) *

9) Anatomy_Course =A,C 52 7 PASS (0.13461538 0.86538462) *

5) Dev_Psych_Course =B 42 2 PASS (0.04761905 0.95238095) *

3) Race=Hispanic, Multicultural, White 456 27 PASS (0.05921053 0.94078947) *

NCLEX (Admission)

n= 573 node), split, n, loss, yval, (yprob) * denotes terminal node

1) root 573 46 PASS (0.08027923 0.91972077)

2) Overall_fac< 11.25 219 28 PASS (0.12785388 0.87214612)

4) Physiology_Course =B 101 19 PASS (0.18811881 0.81188119)

8) Health_Care_Exp=YES 56 16 PASS (0.28571429 0.71428571)

16) Inorganic_Chem_Lab_Course =B,C 17 8 FAIL (0.52941176 0.47058824)

32) Psychology_Course =A,C 9 2 FAIL (0.77777778 0.22222222) *

33) Psychology_Course =B 8 2 PASS (0.25000000 0.75000000) *

17) Inorganic_Chem_Lab_Course =A 39 7 PASS (0.17948718 0.82051282)

34) English_1_Course =A,C 21 7 PASS (0.33333333 0.66666667)

68) English_fac>=7.25 3 0 FAIL (1.00000000 0.00000000) *

69) English_fac< 7.25 18 4 PASS (0.22222222 0.77777778) *

35) English_1_Course =B,P 18 0 PASS (0.00000000 1.00000000) *

9) Health_Care_Exp=NO 45 3 PASS (0.06666667 0.93333333) *

5) Physiology_Course =A,C 118 9 PASS (0.07627119 0.92372881) *

3) Overall_fac>=11.25 354 18 PASS (0.05084746 0.94915254) *