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IDENTIFYING MIDSHIPMEN FOR ACADEMIC ASSISTANCE USING ENTRY VARIABLES

by

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13. ABSTRACT Each graduating class from the United States Naval Academy experiences an attrition rate of approximately 24 percent. A significant portion of that attrition is attributed to academic difficulties. The Academy provides various programs such as the Plebe Intervention Program (PIP) to assist midshipmen experiencing academic difficulty. The purpose of this study was to develop an empirical approach to selecting first-year Naval Academy Midshipmen for academic intervention based upon objective initial entry data. Categorical values from the Learning and Study Strategies Inventory (LASSI), SAT scores and high school rank were incorporated as independent variables in a linear regression model with dependent variable Cumulative Quality Point Rating (CQPR). Two regression analyses were conducted to develop the final equation. Results of the 2nd regression indicate class standing, individualized SAT Math and SAT Verbal scores were highly significant at the 0.01 level relative to academic performance. Several LASSI variables also proved valuable in the model. Motivation, Attitude, Time Management, Select Main Ideas, Study Aids and Test Strategies were also significant at the 0.05 level. While these results were encouraging, the low R^2 value of 3.27 indicated that the model could not predict CQPR for a specific case with accuracy. However, utilizing this equation empirically enhances current intervention program selection processes significantly improving the identification of academically challenged midshipmen.

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IDENTIFYING MIDSHIPMEN FOR ACADEMIC ASSISTANCE USING ENTRY VARIABLES

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ABSTRACT

Each graduating class from the United States Naval Academy experiences an attrition rate of approximately 24 percent. A significant portion of that attrition is attributed to academic difficulties. The Academy provides various programs such as the Plebe Intervention Program (PIP) to assist midshipmen experiencing academic difficulty. The purpose of this study was to develop an empirical approach to selecting first-year Naval Academy Midshipmen for academic intervention based upon objective initial entry data. Categorical values from the Learning and Study Strategies Inventory (LASSI), SAT scores and high school rank were incorporated as independent variables in a linear regression model with dependent variable Cumulative Quality Point Rating (CQPR). Two regression analyses were conducted to develop the final equation. Results of the 2nd regression indicate class standing, individualized SAT Math and SAT Verbal scores were highly significant at the 0.01 level relative to academic performance. Several LASSI variables also proved valuable in the model. Motivation, Attitude, Time Management, Select Main Ideas, Study Aids and Test Strategies were also significant at the 0.05 level. While these results were encouraging, the low R^2 value of 3.27 indicated that the model could not predict CQPR for a specific case with accuracy. However, utilizing this equation empirically enhances current intervention program selection processes significantly improving the identification of academically challenged midshipmen.

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I. INTRODUCTION

A. BACKGROUND

Academic attrition has been a subject of concern for years in both civilian and military institutions of learning. (Lavin, 1965; Marcus, 1989; Schreiner, 1988; Congos, 1997) In order to stay viable, colleges, universities and military academies alike, must be able to recruit and retain enough students to meet the operating goals of the institution. While the academic and operational goals for civilian and military institutions may differ, the underlying requirement of maintaining a sufficient student body remains. At highly selective institutions, the challenge is even more daunting.

Student attrition can have significant effects throughout an institution. In civilian schools, the student body brings with it major sources of funding in the form of tuition, grants, scholarships, dormitory fees, and support of various other services provided by the institution. These sources of funding help to pay for faculty, service and support staff, facility maintenance and development costs, utilities and many other administrative and operational costs associated with the institution. Therefore, if the school is not attracting and retaining enough students (i.e. sources of income) to help balance its operating costs, then the institution will not remain viable and could become the subject of unsolicited attention. Military institutions must deal with similar social and financial issues as well as political considerations. This topic will be addressed further in later discussion.

Another factor of student attrition is its effect on the reputation of an institution. Most institutions pride themselves on providing an academically challenging environment for their students. The problems of adjusting to this challenging

environment while coping with the reality of being away from home can be significant impediments to student retention. If the challenges provided by the institution are not tempered with sound judgment and realistic goals, then one measure of institutional reputation may be a high attrition rate for the school or a particular program. In civilian and military institutions this is a double-edged sword because a reputation of disproportionately high attrition, may turn away prospective students who would otherwise be interested in applying for admission. It is important for an institution to monitor student attrition and make every attempt to understand its root causes.

Military institutions must also focus on student attrition but for different reasons. The primary sources of funding for military institutions such as the United States Naval Academy originate not from individual students but from government resources. The U.S. Naval Academy serves as a major source of officers for the Navy and Marine Corps and its sole purpose is to produce officers who will lead the men and women of our armed forces to support and defend the United States against all enemies foreign and domestic.

Every taxpaying United States citizen is a stakeholder in the final product of the Naval Academy. Therefore, the Academy must ensure that it is doing everything possible to prepare midshipmen to be effective and successful in military service. The public nature of the Academy requires that close attention be paid to maintaining the quality and necessary quantity of its products. Similar to civilian institutions, attrition at the Naval Academy directly affects public perception. For example, imagine that the Naval Academy's Class of 2030 inducted twelve hundred midshipmen for plebe summer, but only graduated 600 midshipmen four years later. An attrition rate of this magnitude

would indicate inefficiency and ineffectiveness within the organization. While this is an extreme example, it illustrates the importance of managing attrition effectively. A certain degree of attrition is appropriate and natural. Not every individual admitted to the Naval Academy possesses the basic but elusive building blocks from which military leaders are developed. The current attrition rate, released by the Naval Academy Institutional Research Department is approximately twenty-four percent. This means that of the twelve hundred midshipmen admitted to the academy each year, approximately three hundred do not make it to graduation. The Office of the Superintendent, US Naval Academy estimates the cost of educating and training a midshipman at over two hundred thousand dollars. Therefore, it is important that administrators seek to minimize attrition where possible. Is it possible and practical for the Naval Academy to reduce the current attrition rate? This study focuses on one aspect of this question.

One of several reasons for the current attrition rate is academic deficiency. Organizations such as the Naval Academy Academic Center have been established in an attempt to assist those midshipmen who encounter academic difficulties in order to provide them with the basic tools they need to succeed academically. There are several other contributors to the attrition rate. Some of them include: conduct and honor offenses, physical deficiencies or injury, and professional performance. All of these forms of attrition affect the academy, however this study focuses on the prediction of academic performance in the hopes of developing an empirical approach to assist in the selection of midshipmen for academic assistance programs.

Academic performance is extremely important at the Naval Academy. A college education is a prerequisite for most officers with very few exceptions. While the Naval

Academy provides the opportunity for midshipmen to pursue very diverse fields of study, the core required courses provide every graduate with a rigorous background in engineering. Regardless of major selection, every midshipman maintains a very busy and rigorous academic schedule. Academics can also affect various aspects of midshipman life. Privileges such as liberty and weekends, leadership opportunity within the brigade of midshipmen, overall class standing and, most importantly, service assignment are dependent, in varying degrees, upon academic performance. Academic standing also plays into lineal number generation. An individual's lineal number determines where a class member falls out with respect to peers from all accession sources within a particular year group. This number follows an academy graduate throughout their naval career and is a seniority factor that can affect promotion and command opportunities. Obviously, academic performance weighs heavily on every midshipman as they progress through the Naval Academy.

The Naval Academy requires that every graduate maintain a 2.0 overall Cumulative Quality Point Rating (CQPR) in order to graduate from the Naval Academy. Midshipmen failing to meet the academic criteria can be subject to review by an academic board and subsequently separated from the Naval Academy. As previously stated, the Naval Academy loses approximately 24 percent of each entering class before graduation. While some attrition is expected and planned for each year and the academy traditionally supplies the Navy with a sufficient corps of officers, it is important to minimize unnecessary losses simply because the costs involved are too high. It costs over $200,000 to produce one officer for the Navy or Marine Corps. To lose a midshipman in their third or forth year for any reason is somewhat recouped by either a

partial monetary repayment or enlisted service obligation, but the tradeoff is significant. By the time a midshipman has reached their Second Class (junior) year, a significant amount of funding has already been lost to summer training, food, housing, travel, pay and educational expenses. If a midshipman is lost prior to the third academic year, then all funds consumed are lost because there is no obligation or payback from the midshipman. They simply leave with two years of fully funded military training and college education under their belt. Therefore by attempting to understand and assess academic potential, administrators could focus on midshipman who may otherwise struggle academically. It is reasonable to say that most midshipmen want to succeed academically. Given the right tools and motivation, those who may struggle could benefit from assistance programs and theoretically successfully graduate given that they encounter no other problems associated with attrition.

Since academic performance can influence attrition, it is incumbent upon Naval Academy administrators to provide services that "at-risk" midshipmen may utilize to improve their academic skills and subsequently reduce chances of academic attrition. Some may argue that we should simply screen out those who may be academically "at-risk". In response, the argument could also be made that for any class of midshipmen entering the Academy; there will always be midshipmen who exhibit a lower academic performance level than their peers. However, the purpose of the Naval Academy is to provide good officers and there is no historical evidence to suggest that a poor student cannot be an excellent officer.

Identification of "at-risk" midshipmen requires study of historical data to estimate significant factors affecting academic performance. The United States Naval Academy

Academic Center was created to deal specifically with midshipmen having academic difficulties. Voluntary referral to the Academic Center is welcomed, however resources are limited so it is important to identify and attempt to provide services to those midshipmen most in need of assistance.

Generally, high school rank, SAT scores and other objective measurable criteria are used to determine one's academic potential. Studies show that these performance characteristics are indeed significant in relation to academic performance. (Astin, 1968; Congos, 1997; Lavin, 1965) However, there are other subjective factors that may also significantly affect academic performance. Lee 1970 discusses specific interest factors that influence different areas of study such as biology, chemistry and mathematics. It was found that interest characteristics and personality traits could either positively or negatively affect academic performance for specific areas of study. At the Naval Academy, Plebe Midshipmen are administered the Learning and Study Strategies Inventory (LASSI) prior to starting academic studies. This inventory consists of 77 questions relating to 10 areas of learning and study ability. Some or all of these areas may significantly affect academic performance. This study attempts to assess whether these 10 variables along with other objective criteria can be used to develop a relationship that effectively predicts academic performance.

B. PURPOSE

The overall objective of this thesis is to research and develop a relationship that can be used by the Academic Center to select midshipmen for academic intervention. By identifying independent variables that significantly affect academic performance, the

USNA Academic Center could identify and predict academic performance for incoming midshipmen. The predicted performance characteristics could be implemented as a measure for selecting midshipmen in need of assistance.

C. RESEARCH QUESTIONS

1. What entry-level independent variables significantly affect Cumulative Quality Point Rating (CQPR)?
2. Is the Learning and Study Strategy Inventory (LASSI) an indicator of academic performance?
3. Can an empirical model be developed to select midshipmen for academic intervention?
4. Should the LASSI be administered to all incoming midshipmen?
5. When should the LASSI be administered?
6. Can a prediction model be implemented to assist in the selection of midshipmen for academic assistance?

D. BENEFITS OF STUDY

This study will provide an empirical process for selecting midshipmen for academic intervention based upon historical data. Since academic grades directly affect attrition as well as class standing, it is hoped that by defining academic performance based upon collected entry level data the selection process can be improved to identify midshipmen genuinely in need of assistance.

E. SCOPE, LIMITATIONS AND ASSUMPTIONS

1. Scope

The main focus of this study was to determine whether it is possible to predict academic performance during plebe year. Data for seven successive Naval Academy classes from year groups 1996 through 2003 was collected. Specific content and discussion of data is included in the literature review section of this study.

Every midshipman graduates from the Naval Academy with a Bachelor of Science degree and most take the same or similar classes their plebe year. However, once midshipmen select an academic major, departmental curriculum differences preclude academic comparisons for this particular study. Lavin, 1965 addresses this specific problem noting that uncontrolled sources of variation in grades obtained from students taking different courses of instruction introduces a fundamental error into the prediction of overall grade point average. Therefore, only plebe year performance characteristics were analyzed for each class year in order to provide a more uniform academic profile from which to make comparisons and base predictions.

The remaining scope of the thesis consists of statistical analysis of data collected for each class using linear regression and finally a discussion of results observed with recommendations for future research.

2. Limitations and Assumptions

There are some inherent limitations to conducting a quantitative analysis within this field of study. First, this study attempts to implement objective and subjective criteria to determine a measurable quantity. Factors such as motivation and desire are

difficult to quantify and usually take the form of simple estimations based upon observer or interviewer perception of an individual. This type of analysis is fundamentally flawed because one interviewer's perception of "motivation" could be very different from another interviewer's perception and result in a large degree of error. Other social or external influences will be difficult to take into account. One example of social influence is family pressure. While the results of this pressure may be evident in some areas, the full effects on specific performance areas may be elusive.

Use of the LASSI within the analysis attempts to quantify some subjective factors that may affect academic performance. However, it is possible that some unknown or undetermined subjective factors will be neglected and will consequently fall out as error in the analysis. The key is to minimize this error term to provide the most accurate relationship possible. For the purposes of this study, it was assumed that every midshipman entering the academy desired and put forth the effort to succeed at the academy where success is defined as graduation from the institution. It was also assumed that midshipmen entering the PIP were motivated to apply program techniques and guidance to their studies. These assumptions are critical in allowing for clear interpretation of collected data but should be kept in mind for error considerations.

Second, there is bound to be a degree of correlation among some of the independent variables such as high school grades and SAT scores. Simply put, this means that some independent variables may have similar effects on academic performance because they are directly or indirectly related to each other as well as the dependent variable. For example, high school grades may be a positive indicator of SAT scores as well as an indicator of academic performance. Therefore high school grades

and SAT scores are related to each other and any effects on a third dependent variable will have to take this into account. It is important to understand, define, and account for these relationships to provide the best possible prediction. While it may be fairly simple to determine correlations among variables that are closely related, it may be more difficult to identify subtle relationships among variables. Neglecting these subtle relationships may decrease the effectiveness of the model equation in predicting the dependent variable. It was assumed that, by definition, the hypothesized model will not ultimately define academic performance and that there will be an error term involved.

One final limitation is that some of the raw LASSI data for certain classes is missing and will prevent use of those midshipmen in the data analysis regarding LASSI influence. Specifically, LASSI data for the classes of 1998 – 2000 is unavailable due to technical difficulties in the transfer of data during shutdown of the Naval Academy Timesharing System (NATS). This system held all LASSI information and when it was disabled, some of that data was lost. Since there is still a significant amount of data available to complete the study this will not affect the overall analysis, but subtleties among classes may be missed due to this omission. As part of the data analysis section, a comparison will be made between data collected before this three-year gap and data obtained afterward.

F. ORGANIZATION OF STUDY

This study consists of six chapters: introduction, literature review, data description and methodology, hypothesis, results, and conclusions and recommendations. The literature review includes a brief introduction, an overview of all materials

referenced, discussion of the LASSI, discussion of the Supplemental Instruction (SI) program, model justification and discussion, and a final chapter summary. The data description and methodology section includes a brief introduction, discussion of the variables to be analyzed, visual representation and discussion of the model equation, cross-tabulations, descriptive statistics and a chapter summary. The hypothesis chapter consists of a basic introduction, model discussion and representations and a chapter summary. The results section consists of all regression data including charts, models, regression tables, coefficients and discussion. Finally, the last chapter consists of all conclusions and recommendations for further research.

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II. LITERATURE REVIEW

A. INTRODUCTION

The body of literature reviewed for this study covers various aspects of academic performance and assistance. Personality characteristics, objective measurable achievement, and past performance levels have been the subject of studies for decades. The purpose of this chapter is to review some of the existing research and develop the baseline from which this study was launched.

B. NAVAL ACADEMY ACADEMIC CENTER

"The Academic Center exists to support the mission of the Naval academy by providing the highest quality academic support programs for midshipmen seeking to improve their academic performance." (Bowman, 1998) The Naval Academy Academic Center was established in 1989 and strives to achieve this mission each academic year by providing various services to midshipmen primarily on a voluntary basis. These services include plebe programs, academic counseling, learning skills and tutoring. The goals of these programs are twofold: "To provide excellent academic support services to enable midshipmen to work to their full potential in a rigorous educational environment and to teach basic learning skills necessary for effective academic performance." (Bowman, 1998) This study focuses on the Plebe Programs area of the Academic Center.

1. Plebe Programs

There are two primary services provided within Plebe Programs. The Plebe Intervention and Plebe Advising programs are both designed to help incoming

midshipmen adjust to the rigorous academic environment of the Naval Academy by providing various forms of instruction and counseling. The purpose of this intervention is to develop or improve existing academic skills in the hopes of providing a skill set the learner can implement successfully in and out of the classroom. This study focuses primarily on the Plebe Intervention Program.

The Plebe Intervention Program (PIP) provides proactive support to midshipmen identified as "at-risk" by the program director, athletic coaches, company officers, academic boards and other sources. Midshipmen identified as program participants are paired with an academic advisor and provided counseling and learning skills instruction as well as weekly advising meetings with the program administrators throughout the academic year. Participation is primarily voluntary although some midshipmen may receive directives to participate from the academic board or their company officers. Plebe Intervention is designed to maximize the potential of midshipmen who may otherwise have significant difficulties performing academically.

2. Selection Process

Approximately 100 midshipmen per year are offered the opportunity to participate in the Plebe Intervention Program. Typically, the bulk of these midshipmen are identified and notified during plebe summer based upon initial entry information such as admissions data and board feedback, Naval Academy Athletic Association (NAAA) recommendations, and Naval Academy Preparatory School (NAPS) data. These sources are utilized to prepare a watch list of 200 midshipmen. Subsequently, placement exams for all of the midshipmen on the watch list are reviewed and approximately 60 are

selected for enrollment in the PIP. The remaining 140 are monitored for the first six weeks of the academic semester. At the time of this study, this program had the capacity to service approximately 100 midshipmen. Therefore, in the weeks following the first six-week grading period, the remaining 40 midshipmen are selected from the watch list for inclusion in the program.

3. Intervention

Midshipmen who are selected or volunteer to participate in the Plebe Intervention Program are counseled on a weekly basis and are provided with individualized and group study skills instruction. The purpose of this instruction is to give each midshipman the tools required to build effective study habits and assist them in preparing for the rigorous academic environment of the United States Naval Academy. Some midshipmen may even be placed in basic-level courses designed to teach the fundamentals of a subject who exhibits a below average level of understanding of the course material. This program is not designed to exist in lieu of extra instruction with professors and students are expected to interact with their individual instructors as well as the Academic Center when problems are encountered.

C. LASSI

The Learning and Study Strategies Inventory (LASSI) was developed at the University of Texas at Austin as part of a cognitive learning strategies project in 1978. The primary purpose of this cognitive study was to address growing concerns about under prepared students entering post-secondary educational environments. It was hoped that findings could be developed into an assessment tool to identify students' academic

strengths and weaknesses. This would prove extremely useful in developing databases for trend analysis and designing ability specific training programs for those in need of academic assistance. (Weinstein, 1987).

The LASSI was developed over several years through data gathering, expert consultation and statistical analysis. A panel of experts utilized all available data to assemble 645 items that were determined could possibly relate to learning. This pool was then reduced to 291 by eliminating items that were related to personality characteristics, were poorly worded or duplicated, and those that did not directly relate to study practices. Next a series of pilot tests were conducted over several years with results being compared to similar proven test procedures, standardized test correlations and academic achievement results. After adjusting to these criteria, various items were added to and deleted from the survey in its final form. The resulting LASSI consists of a 77-item questionnaire in Likert format. It has been tested and validated in its current form by over 30 colleges and universities. In all cases few difficulties were reported and all reported a high degree of usefulness.

LASSI results are computed by each student following administration of the survey and are presented in percentile format. There are a total of ten categories assessed; attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self testing, and test strategies. Each student can then compare their performance with national norms provided within the survey packet. Average performance for each category was determined to be between the 50^{th} and 75^{th} percentiles. This information has proved useful to administrators in identifying students who may need additional assistance in specific areas.

At the United States Naval Academy, the LASSI is administered prior to commencement of academic studies during plebe year. The survey is then scored, reviewed and stored at the Naval Academy Academic Center for future reference. It is currently considered as a minor factor in selecting midshipmen for the Plebe Intervention Program. This study seeks to identify whether individual categories of the LASSI, along with other objective criteria, may be used to specifically identify midshipmen for the Plebe Intervention Program. A review of each category and further discussion of the LASSI survey is included in subsequent chapters.

D. SUPPLEMENTAL INSTRUCTION

Over the years, there have been many approaches to academic assistance in college. One of the most prominent and researched has been a voluntary assistance program called Supplemental Instruction (SI) was founded at the University of Missouri-Kansas City. It was in founded in 1973 by Deanna C. Martin for voluntary use of students enrolled in various professional studies including medicine, dentistry and pharmacy. Its purpose was to provide a non-threatening learning environment outside of normal class hours for specific high-risk courses of instruction. Discussion of the Supplemental Instruction program is valid for the purposes of this thesis because the volume of research detailing positive results observed by students participating in Supplemental Instruction provides a basic premise that assistance programs can work if properly implemented.

As previously stated, this program focuses on high-risk courses. For a course to be identified as high-risk, 30 percent of all final grades for the semester had to be D's, F's

or withdrawals. The fact that specific classes were identified as high-risk is interesting in itself because the term "high-risk" is typically associated with student potential not course difficulty. Martin (1993) quotes Laura Rendon from the May 1989 edition of the American Association of Higher Education Bulletin:

> Our educational institutions, particularly higher education, like to perceive themselves as pillars of perfection. When something goes wrong with the system, it is easier to blame the victim for contaminating the system. In so doing, institutions practice scapegoating and focus on the needs or deficiencies of students instead of facing up to the institutions own imperfections. (page i.)

At the time, this was a fundamental shift in learning theory. In the traditional sense, student academic potential is assessed using measures such as SAT and ACT scores, prior academic performance, and certain subjective factors such as essays, interviews and recommendations. Supplemental Instruction focuses on the courses, not the students and establishes a forum through which students enable themselves to learn. This idea was formulated because of rising concerns about college attrition in recent years. "Tinto (1987) predicted in 1986 that, of the nearly 2.8 million students who entered higher education for the first time, over 1.8 million would leave without receiving a degree." (Martin, 1993) Tinto went on to identify four significant elements of student attrition: social isolation, difficulty adjusting, linking class material to prior knowledge and difficulty in the college environment. Supplemental Instruction was developed as an institutional response to these four obstacles to learning. There are several benefits to the Supplemental Instruction program. First, it is proactive rather than reactive. Students sign up for the program before classes begin and are recommended for classes with Supplemental Instruction sessions based upon objective entry criteria. Supplemental

Instruction is implemented in courses that students have the most difficulty with, but it is course specific. A Supplemental Instruction session in history will be very different from a Supplemental Instruction session in Chemistry. They are geared toward the course material, not specific study skills. Supplemental Instruction leaders attend every class session so as to better facilitate discussion of difficult material. Supplemental Instruction is not considered a remedial program even though it is designed to improve student performance. Students who participate represent the entire range of academic performance levels. One last benefit is that Supplemental Instruction sessions are designed to promote interaction and cooperation whereby students work in groups to mutually support each other.

There are three key personnel categories that oversee the implementation and administration of Supplemental Instruction sessions. The Supplemental Instruction Leader is a student who acts as a learning facilitator. Typically, the leader has taken the subject course or a comparable course previously, attends all classes, takes notes and reads all course assignments. In essence, the leader is a model student who guides the group in mutual learning. The Supplemental Instruction Supervisor oversees the entire Supplemental Instruction program, identifying high-risk courses, supervising Supplemental Instruction Leaders and gaining faculty support. Faculty members make up the remaining group. They screen Supplemental Instruction Leaders for competency and must be willing to participate in the program for it to be effective. In essence, Supplemental Instruction is a very simple concept relying on only a few dedicated key personnel to be effective.

While the academic assistance programs provided by the Naval Academy Academic Center are not Supplemental Instruction programs; there are several similarities between the two that lend to comparison. Naval Academy programs and Supplemental Instruction both focus on early intervention. While the Naval Academy gears toward study skill development, counseling and some peer assisted tutoring, Supplemental Instruction is strictly peer facilitated, but both primarily assemble prior to class convening. Supplemental Instruction is not a remedial program and neither is the Naval Academy Plebe Intervention Program. The Plebe Intervention Program does target midshipmen having potential for academic difficulty, however this does not mean that the program is a remedial tool. It simply means that midshipmen are targeted in the hopes of preventing the need for remedial measures once poor performance has been established. A similar selection process is performed by academic advisors promoting use of Supplemental Instruction programs. Students are screened prior to commencement of classes and recommended to sign up for classes with Supplemental Instruction sessions attached. As with the Naval Academy program, students are not required to participate in Supplemental Instruction sessions. One final similarity is that Supplemental Instruction sessions are designed to enable students through mutual support, cooperation and interaction. The Naval Academy programs are designed to enable students by developing tools they can use to enhance their educational atmosphere. These tools include study skills, group interaction, academic counseling, and, if needed, individual and group tutoring in specific courses. It is important to realize that these two programs are not parallel in scope and operation, but the fact that both primarily seek to enhance and improve the learning environment through outside intervention leads to comparison.

Extensive research has shown Supplemental Instruction to be valid and successful. Martin, (1993) found that students participating in Supplemental Instruction earned a significantly larger percentage of A and B course grades and earned significantly less D, F, and withdrawal values. It is important to note here that Martin's study controlled for the academic potential of students enrolling in Supplemental Instruction programs and that comparisons were made to motivated non-Supplemental Instruction students as well as all non-Supplemental Instruction students. Motivation levels were established via survey data taken prior to commencement of academic classes. In all cases, students who participated in Supplemental Instruction programs outperformed those who did not participate. Specifically, 44.5 percent of all Supplemental Instruction students received final grades of A or B and 16.7 percent received grades of D, F, or W. In the motivational control group, only 34.5 percent received an A or B and 34.5 percent received a D, F or W. The difference was even more pronounced in the non-Supplemental Instruction-non-motivational group where 26.3 percent received an A or B and 51.1 percent received grades of D, F or W.

It would not be appropriate to parallel this program directly with the Naval Academy's program due to significant differences in implementation. However, the fact that Supplemental Instruction has been validated through extensive research (Martin, 1993; Koechner, 1997) and exists as a student intervention program leads to the conclusion that intervention programs can and do improve student performance if properly implemented. One major goal of this study is to assist in the identification of midshipmen for participation in the Naval Academy Plebe Intervention Program in the

hopes of exercising early intervention for those who may experience academic difficulties.

E. SIGNIFICANT VARIABLES

Increasing interest in collegiate attrition rates has led the academic community to study factors that contribute to academic achievement. A wealth of research exists on the subject covering various objective and subjective variables. Most studies use some form of cumulative grade point average as a measure of overall student achievement. (Astin, 1968; Blanc, 1983; Collins, 1982; Congos, 1997; Crawford, 1948; Koechner, 1997; Lavin, 1965; Lee, 1970; Weitzman, 1981) Using this measure as a dependent variable, many studies then develop a hypothesis as to what variables may help predict the dependent variable. These independent variables may be objective or subjective in nature and include items such as student survey data, entry variables such as SATs, ACTs, and high school rank, personality characteristics, intellectual factors, demographical data and participation in intervention programs. While there are differences in every study ranging from the data set utilized to variations in the type of independent variable and formatting used, similarities and trends have become apparent over the years. For example, several studies have noted that the Scholastic Aptitude Test and high school rank are fairly strong predictors of academic performance. (Collins, 1982; Weitzman, 1981)

Collins, (1982) studied the affects of high school rank, supplemental instruction and individualized math and verbal SAT scores upon overall grade point average and individual course grade. Results indicated that SAT math and high school rank were

powerful indicators of academic performance in math and science based courses such as biology and chemistry. SAT verbal scores were little use in predicting grades in technical classes, but were not evaluated relative to other non-science courses of instruction. Collins did note "utilization of the supplemental instruction program can make a significant contribution to the academic achievement of students." (Collins, 1982) This infers the basic assumption that there is a positive correlation between academic intervention and academic performance. In Lavin, (1965) problems associated with the prediction of academic performance were discussed along with the idea that personality characteristics may have a significant impact upon academic potential. Specifically, several problems with prediction were noted. Students do not take the same courses with the same instructors. Not only are there very great differences in course material, there are certainly great differences in grading criteria from instructor to instructor. Therefore, Lavin observed that any study attempting to predict academic performance must take this into account by isolating certain aspects of academic study or discussing error statistics during the research process. This creates a significant boundary to research by restricting when and how much data can be utilized at any given point in time. The current study attempts to control for a good deal of inconsistency by focusing primarily upon the first academic year when the majority of the Naval Academy Plebe class takes the same, if not very similar courses. The first academic year for each incoming class provides the optimum time for researching academic performance across the brigade of midshipmen. After plebe year, selection of different majors and elective courses makes accurate study much more difficult. Lavin also discusses the potential for personality characteristics to affect academic performance. Motivation, attitude toward academic endeavors and

measures of independence were some of the characteristics that were observed to positively correlate with academic performance. Lavin summarizes several inventory-like studies that focus on these subjective factors with some interesting specific correlations. Anxiety was found to be a negative predictor of academic performance in a test-taking environment. Specifically, individuals that were highly permeable, or influenced by internal and external stimuli, and low on stability, or susceptible to nervous tension, would perform negatively in a high stress environment. This may seem to be an obvious assessment within the civilian academic environment. However, at the Naval Academy stress is an important element of the training process and midshipmen are forced to learn coping mechanisms and perform under stress to a much higher degree than is realized in civilian institutions. Therefore, anxiety may not play as critical a role in predicting academic performance as in other academic environments. In summary, Lavin's study provides more fuel to support the idea that subjective personality factors can influence performance in the classroom. The key is to accurately identify which characteristics are most influential and then try to isolate ways to measure these characteristics for an individual.

Conclusions summarized in Weitzman's 1981 study support the view that high school record and SAT scores combined provide a very strong indicator of performance with no discussion of personality characteristics. "The predictive validity of 0.72 indicates that the HSR-SAT (high school record-scholastic aptitude test) combination is a powerful predictor of first-year academic achievement in college." (Weitzman, 1981) Weitzman also evaluated opposing positions of several studies conducted regarding the importance of SAT scores and high school record relative to college academic

performance. Weitzman observed that there were several biases included in the chosen studies, but that overall the combined SAT may have a predictive validity of 0.62, an incremental validity 0.17 above and beyond that of high school record alone. This seems to lend credence to the argument that discrepancies in grade determination among different high schools introduces a certain amount of error when compared to the use of SATs relative to the college academic environment. Conclusions also indicate that the SAT is a valid instrument of selection for college applicants further strengthening the argument to utilize some form of SAT score in any model that attempts to predict college academic performance.

Astin, (1968) supports the idea that the high school record is the single most effective predictor of academic performance, but aptitude tests, college selectivity and personality characteristics add significantly to the correlation with academic performance.

Weinstein, (1987) observed that self-testing characteristics, or at least the idea that an individual performs some form of self-check prior to demonstrating required knowledge is a positive correlate for academic performance. Factors like discipline, focus and desire could also speak to academic performance in a similar manner.

In summary, several studies have observed positive correlations between subjective and objective measures with academic performance. Since the LASSI focuses primarily upon subjective factors of performance, is currently implemented during the Naval Academy indoctrination process and archived in a database, it makes perfect sense to study this inventory as it pertains to academic performance along with all other objective criteria utilized by the Naval Academy Academic Center. Existing research

strongly suggests that objective criteria such as SAT and High School Record also be included in any model predicting academic performance.

F. MODEL JUSTIFICATION

In reviewing several of the studies summarized above, a general model for predicting academic achievement was developed. This model, presented below, included both subjective and objective variables in basic linear regression format.

$$\begin{aligned} GPA = \beta_0 + \beta_1(SATM) + \beta_2(SATV) + \beta_3(ClassStanding) + \\ \beta_{4-13}(LASSI\ Variables) + \in_0 \end{aligned} \quad (1)$$

In total, thirteen independent variables were included in the model designed to predict academic GPA, or CQPR. It was expected that not every variable would prove to be predictive of academic performance and that some would prove to be negative predictors. It was also expected that there would be a certain amount of interaction among some of the more closely related variables. However, this model is a logical starting point based upon the goals of this study and collection of previous studies reviewed.

G. CHAPTER SUMMARY

It is clear that there are numerous opinions as to what factors actually influence academic performance during the first year college. The United States Naval Academy

environment offers a unique opportunity to study a strictly regimented population where class attendance is mandatory and the amount of after school distractions during the first year is somewhat limited for underclassmen by a regimented study period. Couple this environment with very similar first-year course loads and you have a relatively good population for academic observation. The model proposed above will not, in all likelihood, provide the researcher with the ability to predict the CQPR for an individual, but it is hoped that those interested in identifying students who may experience academic difficulty may find a refined version of this model useful in assigning students to assistance programs.

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III. DATA DESCRIPTION AND METHODOLOGY

A. INTRODUCTION

The purpose of this study is to empirically identify variables that significantly affect plebe year academic performance. By collecting historical case data representing individual midshipmen as they progressed through the Naval Academy in past years, this study attempts to quantify specific variables, both objective and subjective, that may affect academic performance. It is hoped that by quantitatively identifying these variables, a model can be developed that sufficiently predicts academic performance. As a result, the Naval Academy Academic Center could utilize this model to assist in the identification of midshipmen who may require academic assistance.

B. DATA

The data utilized in this study are primarily objective in nature. Initial entry data such as high school rank and size, high school GPA, SAT scores and other objective data were combined with subjective variables from the Learning and Study Strategies Inventory (LASSI) to form a main database catalogued by case using the midshipmen identification code, or alpha code. Descriptions of specific data characteristics are included below.

The Institutional Research department of the United States Naval Academy provided a majority of case data obtained. Demographics, standard test scores, high school ranking information, academy academic performance as well as a variety of other variables are collected and maintained within this department's databases. Data was collected on approximately 9800 midshipmen from the classes of 1996 through 2003.

This data was obtained in text format and transferred into the SPSS 9.0 statistical analysis program for manipulation and analysis.

Another major source of information was the Naval Academy Academic Center. LASSI information was obtained in hardcopy and computer based formats for the classes of 1996, 1997 and 2001 through 2003. No data was available for the classes of 1998 through 2000 due to technical difficulties realized upon retiring the Naval Academy Timesharing System that housed some of the LASSI data. LASSI computer based information was read directly from scan able test answer sheets, catalogued by alpha code and maintained on floppy disks for each class. The raw form of this data contained numerical values for each question answered resulting in a total of 77 fields of numerical data, one field for each question. This data was read into SPSS 9.0 for each class with variables created for each of the 77 questions on the test. Once common variables were established for each grouping of class data, the classes were merged to form a database of LASSI information. This database included over 6000 cases from the classes of 1996, 1997 and 2001 through 2003. By itself, this form of information would not be valuable because the LASSI test requires that this raw information be manipulated according to instructions contained in the LASSI user's manual. Only when these procedures are followed does the information become useful. Simply put, 77 questions were manipulated into 10 categories of the LASSI; attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self testing and test strategies. Following the included instructions, these categorical scores were computed and then converted into percentile format for comparison with nationally developed norms provided by the LASSI. This percentile form was then merged using

midshipmen alpha codes as a common variable between the original database and the LASSI database. Essentially, ten new variables based upon the subjective criteria of the LASSI were added to the objective data obtained from institutional research.

Finally, alpha codes for all midshipmen having participated in the PIP were obtained, transferred into a spreadsheet format and then merged into SPSS 9.0 with the rest of the database. Plebes participating in the PIP were separated into three groups. The first group consisted of midshipmen who were originally selected for participation in the program prior to induction day. The second group, or add-on group one, consisted of those midshipmen selected for the program based upon their six-week grades. The third group, or add-on group two, consisted of those midshipmen selected for participation based upon their first semester QPR. It is important to distinguish between these three groups to assess the impact of timely intervention by the Academic Center. Once these variables were assembled, the database was considered complete and the analysis phase of study could proceed. Further discussion of individual variable format, description and use is included as part of the data analysis chapter.

C. VARIABLES

Several groups of data were collected and grouped into variables to assess their potential as predictors of academic performance. All of the data collected was combined into a master database catalogued into cases by Midshipmen alpha code. The following variables were assembled: ALPHA, HSRANK, HSSIZE, STANDING, SATV, SATM, WMMLT, ATTRITIO, S1QPR, S2QPR, CQPR, ATT, MOT, TMT, ANX, CON, INP,

SMI, STA, SFT, TST, RESTBRIG, INITIAL, ADDON1, and ADDON2. Each of these variables is discussed in detail below.

1. Independent Variables

Independent, or explanatory variables are those variables that help predict a given dependent variable. It is critical to understand the process and format of each independent variable so that any interaction or lack thereof can be established with reliability. Basic descriptions of each candidate variable are summarized below.

Variable ALPHA is the six digit string variable used to catalogue and link all other data sources to the master file. All data added to the master file was first catalogued by case using the midshipmen alpha code, organized in ascending order and then merged into the master file using ALPHA as the case identifier. This variable was used solely for cataloguing purposes and was not a candidate for prediction models.

HSRANK and HSSIZE both relate to midshipmen high school academic performance and are numerically formatted. Neither variable is useful in itself due to the significant variations in relative class sizes. A number one ranking in a class of 10 is significantly different than a number one ranking in a class of 200. In order to make these variables meaningful, a third variable, STAND, was computed using equation 2.

$$\text{STAND} = (\text{HSRANK} / \text{HSSIZE}) * 100 \qquad (2)$$

This variable has relevance in that it determines relative position within a given high school class regardless of size. STAND is a numerical variable presented in percentage format. A lower value for this variable indicates higher academic performance relative to

classmates. This variable was considered as a candidate for prediction models due to its universal applicability and direct relationship to previous academic performance.

SATV and SATM are both numerical variables representing the highest score earned on the Scholastic Aptitude Test prior to entering the Naval Academy. These variables are widely believed useful in determining potential academic success and are highly weighted by the Naval Academy Admissions Board. Therefore, the Naval Academy Admissions Office seeks applicants with scores of at least 1200 for the combined SAT. Since the Academy curriculum is highly math-based, the board also seeks an even split between math and verbal or a slightly higher math score. While there are no strict cut-offs for acceptance to the Naval Academy, a wealth of research summarized in literature review, points to the use of these two variables as predictors of academic success potential. Both variables were considered as candidates for the prediction model.

WMMLT refers to the Admissions Office Whole Person Multiple. This number is in numerical format and is generated each year by the Admissions Board using a formula developed through an outside statistical analysis firm. The formula takes various objective entry criteria and gives each variable its own weight according to a historical database. There are several subjective factors that can affect this number such as teacher recommendations, military tradition within the family, and interviews results. This variable was not considered for use in developing prediction models due to continuous variations in the formula used to generate the WMMLT and the use of subjective factors that may vary from midshipman to midshipman. Since SAT's, high school academic

performance, and many other entry variables are used to generate the WMMLT, this variable could also cause correlation problems among the other variables.

ATTRITIO refers to the attrition code assigned to midshipmen leaving the academy. This code was originally received from institutional research consisting of a two-digit code for any midshipman leaving the Naval Academy for any reason. There are a multitude of reason for leaving the academy, but they can all be grouped into seven general categories: plebe summer voluntary resignation, academic year resignation, qualified resignation, academic discharge, discharge (conduct or performance), medical discharge, and deceased. This variable was not considered a candidate for prediction models because it deals solely with midshipmen attrition once it has happened and has no direct effect on academic performance. This variable was however useful as a filter for the descriptive analysis section.

The next ten variables represent the ten results obtained from the LASSI test given during Plebe Summer. Each of these variables is numeric and significant to one decimal place. The variables are reported as percentiles representing midshipmen performance in each of the ten categories relative to historically tracked national norms. For ease of analysis, scores were compiled into ten equal percentile ranges between 10 percent and 100 percent. A midshipman earning a score of 90 on any of the categories would have scored higher than 90 percent of those who had taken the test. Therefore, a higher score represents a higher level of potential in that specific area. All of these variables were considered for prediction models because they attempt to quantify subjective personality traits ignored by other objective criteria. A brief description of each LASSI variable is included below.

ATT, or LASSI attitude percentile measures an individual's attitude toward school. "If the relationships between school and their life goals are not clear, then it is difficult to maintain a mind-set that promotes good work and its related tasks." (Weinstein, 1987) Students scoring lower on this measure may have problems with scholastic identity. In other words, they may not understand why they are attending school or have a clear idea of how education fits into their lives.

MOT assesses a student's motivation to perform specific tasks related to achievement. Tasks such as completing assigned readings and homework, studying diligently, and accepting responsibility for performance relate directly to motivation and are key factors for this variable. If students learn to hold themselves responsible for their own study habits and performance, then they are less likely to assign performance outcomes to outside factors such as bad teachers, books or luck. This increased sense of responsibility and diligence would be accompanied by increased motivation toward school and a higher percentile score for MOT.

TMT refers to student time management abilities. "Most students have various demands on their time and only by creating realistic schedules and sticking to them can they fit in everything." (Weinstein, 1987) This statement holds especially true for plebe midshipmen who are under more stringent time constraints and pressures than the rest of the brigade. A midshipman scoring in the low range on this measure could be expected to fall short in academic or professional performance, experience a high degree of stress and earn a reputation for disorganization.

ANX measures a student's anxiety level toward academic tasks. Anxiety may be a determining factor in academic performance. "Cognitive worry, a major component of

anxiety, is manifested in negative self-referent statements." (Weinstein, 1987) This negativity can be self-fulfilling and cause major problems with performance. If students believe they will perform badly on a test they may increase the likelihood of a negative outcome. Time consumed by anxiety is time taken from concentrated study efforts further complicating academic tasks.

CON deals with a student's level of concentration. People have different levels of focus, or concentration, whereby they are able to block outside interferences or internal thoughts and emotions in order to deal with a given situation or learning environment. A person who scores high in this area is able to concentrate on the subject without losing focus or allowing other interferences to corrupt the learning environment. A person scoring in the lower percentiles may be easily distracted, emotional, and otherwise unable to maintain focus on a given subject. Obviously, a person scoring in the lower percentiles may have difficulty learning course materials if they cannot maintain an appropriate level of concentration.

INP deals with how a person processes information. It deals with information organization and retrieval. This can take the form of both internal and external organization such as note taking and outlining, making lists, paraphrasing or creating internal pneumonics to remember important facts or figures. The degree of focus upon certain aspects of information can affect how much or how long that information is retained and this has specific implications with respect to academic achievement. For instance, if a student regularly "crams" for exams by memorizing large quantities of information in a short period before the exam, then the chances of truly learning the material are far more remote. This can be especially detrimental when students are

required to maintain a base level of knowledge for future courses. There are various ways to process information, but it is hoped that by comparing these differences against a historical database, that this variable may help predict academic performance.

SMI refers to a student's ability to identify main ideas from a given media source. This ability is particularly important to effective learning in a time-constrained environment such as the Naval Academy. "If a student cannot select out the critical information then the learning task becomes complicated by the huge amount of material the individual is trying to acquire." (Weinstein, 1987) Identifying key study points and excluding redundant material promotes effective and efficient study and can be expected to positively affect academic performance.

STA measures a student's ability to effectively organize main ideas into useable study aids. It also measures ability to utilize existing materials to further enhance study. Students experiencing problems with timely and effective study habits may not be using tools such as study sessions, outlining, study guides, charts, diagrams and other such media to enhance their efforts. These students would be expected to earn low scores in the study aids variable.

SFT is a self-testing and reviewing measure. This variable assesses a student's ability to track their progress during the learning process through self-administered performance assessments. This ability to review personal retention and performance characteristics is useful in determining whether current study habits and strategies are sufficient for student goals or need to be revised for effectiveness. A student scoring highly for this characteristic uses mental reviews, problem solving, and question and answer techniques to consolidate new knowledge and perceive potential difficulties with

specific material or study strategies. This ability may have significant implications for academic performance.

The last of the LASSI variables, TST, deals with test taking strategies. A student who takes the time to prepare not only for the material covered by a test but also for the type of test may score highly on this percentile. Methods of study, memory drills, and mental attitude toward tests all play a significant part in the test strategy variable. Test format can also be very important because effective study techniques can be very different based upon the format of the test. Memorization of small snippets of information may not be sufficient for the depth of knowledge required for an essay exam. Similarly, broad sweeping knowledge of a particular study area may not be necessary for a multiple-choice exam and may only serve to overwhelm the student. Test taking strategies may affect academic performance.

INITIAL, ADDON1, ADDON2, and RESTBRIG are categorical variables created to identify variations in academic performance between midshipmen participating in the Plebe Intervention Program at three different time periods, and those not participating in an intervention program. It is expected that entering such intervention programs would be beneficial to those participating. However, comparing these midshipmen to the rest of the brigade provides a control variable by which the intervention midshipmen can be compared and the effectiveness of the intervention program can be simply analyzed. These variables are numerical and binary. For each case a value of "1" indicates that the midshipman was a member of one of the groups. A value of "0" indicates that the midshipman was not a member of that particular group. RESTBRIG carries a value of "1" for all midshipmen who had no intervention. INITIAL

carries a value of "1" for all midshipmen who were initially selected for participation in the intervention program prior to academic year. ADDON1 carries a value of "1" for all midshipmen who were added to the program after the first six-week grading period. Lastly, ADDON2 carries a value of "1" for all midshipmen added to the intervention group following the first semester grading period. For each case only one of these four variables could carry a value of "1" thereby establishing four distinct groups of midshipmen and allowing for comparisons among each group.

2. Dependent Variable

S1QPR, S2QPR and CQPR all refer to midshipman Quality Point Rating. This is effectively a midshipman's academic grade point average. S1QPR, S2QPR, and CQPR reflect a midshipman's 1st semester, 2nd semester and cumulative grade point average during plebe year respectively. These variables are numerical in format and significant to two decimal places. S1QPR and S2QPR were useful for descriptive analysis and possibly for prediction models. CQPR was considered for prediction models as the dependent variable because it encompasses grades for both 1st and 2nd semester grading periods. CQPR is numeric, significant to two decimal places and provides the most basic measure of academic performance consistent throughout the Naval Academy and the nation as a standard measure of performance. While there are subtle difference in grading criteria and calculation among educational institutions, the basic premise of study and performance assessment are similar so that comparisons may be accomplished and studies sited with little fear of conflict. If nothing else, CQPR provides a relatively stable

variable, within the walls of the Naval Academy, on which to base this statistical prediction model.

D. GENERAL DATA OBSERVATIONS

Over 9800 data cases were collected for possible use in developing academic prediction models. In order for a case to be useful, however, it would have to contain valid data for each variable included in statistical calculation. Any cases missing data entries for the included variables would automatically be excluded from the calculations. Therefore, it is very important to identify and attempt to explain any significant discrepancies or variations among the collected data.

The most significant discrepancy noted in the collection of data for this study was that no LASSI information was available for midshipmen in the classes of 1998 through 2000. Since these midshipmen represent approximately one third of all data collected and are located midway through the 1996 to 2003 population of useable data, it is important to address any data variations between the 96-97 group and the 01-03 group. This analysis is important because any inconsistencies between these groups can affect regression results and consequently affect the prediction model. In order to address these issues, a comparison of mean values was constructed for all variables considered as prediction model candidates. Cases were separated into three case-groups based upon year so that mean value comparisons could be conducted. Each case-group was compared to the other case groups as well as all cases combined. The results of this comparison are presented in Table 1.

A significance level of 5.0% was chosen to represent areas of concern between case-group values. Class standing showed a significant increase of 7.4% between the 1996-1997 and 2001-2003 groups although the maximum deviation between any of the case-groups and the overall mean was no greater than 4.1%. Too many variables exist among educational programs throughout the country to adequately assess this variation. One possible explanation for the increase could be more stringent high school class standing requirements at the academy admissions level. SAT Verbal scores also reflected an increase on the order of 12.4% between the 1996-1997 and 2001-2003 case-groups. This variation is easily explained by the renorming of the Scholastic Aptitude Test (SAT). This process, initiated several years ago renormalized the verbal portion of the SAT resulting in higher scores on the verbal portion only. The SAT verbal score mean values reported for case-group 1996-1997 reflect norms before this change was implemented. Mean values reported in case-group 1998-2000 reflect the interim period during the change and case-group 2001-2003 reflects mean values after the change was fully implemented. The fact that the SAT verbal values collected were based upon different test criteria should have minimal effect upon the overall prediction model. Studies have shown that SAT verbal is a much weaker indicator of academic performance than other variables such as SAT math or high school rank. (Collins, 1982)

There was no significant variation in academic performance between the case-groups. As table 1 illustrates, there was only a 1.5% and 0.75% maximum differential between case-groups for the second semester and cumulative academic reporting periods respectively. The largest differential, 3.7%, occurred during the first academic reporting period. This larger differential, while still insignificant is somewhat expected due to the

variability in a student's initial adjustment to both the military and academic environment of the Naval Academy.

Three of the ten LASSI variables showed significant variations between case-groups. Information Processing, Study Aids, and Self Testing categories varied 8%, 10% and 11% respectively between case-groups 1996-1997 and 2001-2003. Since no LASSI information was available for case-group 1998-2000, a trend analysis from 1996 to 2003 could not be conducted. However, since there were no significant variations in CQPR throughout the period of study; the highest variation was 3.7%, it can be assumed that the degree of variation among these three variables over time had little affect upon overall CQPR and will have minimal, if any, negative effect on the accuracy of prediction models. The following text includes some general data observations.

Midshipmen are required to maintain a 2.00 CQPR in order to successfully graduate from the Naval Academy. During the first semester of Plebe Year, 83.9% of all midshipmen studied earned a CQPR of 2.00 or above. 80.7% earned above a 2.00 for the second semester and by then end of Plebe Year, 86.1% of all midshipmen studied had earned at least a 2.00 cumulative CQPR. Of note is the fact that case-groups 1998-2000 and 2001-2003 indicated a decrease in second semester performance relative to first semester performance. This is interesting because one would think that with the shock of both the military and academic environments facing new midshipmen, there would be a natural adjustment period during which any compromise in academic performance would appear. This should appear in the first semester grades if at all. However, this trend shows just the opposite effect except in case-group 1996-1997. In this case-group, second semester grades were higher than first semester grades. It is also important to

understand that this assessment is made using mean values, not individual values for each midshipmen and the variance between first and second semester grades is minimal.

Another interesting point of observation is the fact that mean values for the LASSI variables fell high within normal ranges of 50 to 75. This means that on average, midshipmen scored higher than roughly 65% of the population in all categories with some variation depending upon the variable in question. In particular, midshipmen scored an overall average of 73.43% on the concentration category. Very simply stated, midshipmen generally score higher on the LASSI survey than the rest of the population. For any given LASSI category only 25% to 35% of midshipmen studied earned lower than average scores.

Table 1

Comparison of Variable Mean Values by Class Group

Case Group	All	1996-1997	1998-2000	2001-2003
Class Standing	13.21	12.73	13.02	13.75
SAT Verbal	599	566	585	636
SAT Math	660	661	656	663
1st Semester Grades	2.67	2.61	2.67	2.71
2nd Semester Grades	2.64	2.66	2.64	2.62
Cumulative Grades	2.67	2.66	2.67	2.68
Attitude	67	69	-	66
Motivation	66	66	-	66
Time Management	61	63	-	60
Anxiety	67	68	-	67
Concentration	73	73	-	73
Information Processing	64	67	-	62
Selecting Main Ideas	65	66	-	64
Study Aids	62	66	-	59
Self Testing	65	70	-	62
Test Strategies	67	67	-	67

Note. a. Dashed entries represent missing data.
b. LASSI scores are presented in percentile format

E. CROSS-TABULATIONS

Cross-tabulation analysis allows the researcher to identify simple trends between both dependent and independent variables. In order to assess the viability of each independent variable discussed in previous sections, a cross-tabulation was conducted against cumulative plebe year GPA (CQPR). Variables, SATV, SATM, STAND, and all ten LASSI variables were crossed with CQPR for this preliminary analysis. This simple tool provides correlation statistics, graphical, and tabular data that can help determine whether the subject variable should or should not be used in prediction models.

When cross-tabulation was conducted, some cases were excluded due to missing data. Valid cross-tabulations were obtained for 89% of both SATM and SATV scores, 78% of STAND and approximately 50% of the LASSI variables. The lower percentage of valid LASSI cross-tabulations is due to the inclusion of cases from classes 1998 through 2000 where no LASSI information was available. Two specific statistical values, the chi-square statistic and Pearson simple correlation coefficient (R), are generated from this analysis and can give the researcher some insights into the relationship between the crossed variables. The Pearson correlation coefficient is a measure of the strength and direction of the linear relationship between two variables. Its maximum absolute value is 1.0. This means that variables that are perfectly correlated positively or negatively would have an R-value of 1.0 and –1.0 respectively. Any variations from these extreme values indicate degrees of correlation.

The chi-square statistic indicates the likelihood that the null hypothesis is true that any two given variables are independent of one another. It compares a calculated Chi-Square value against the static Chi-Square distribution in order to assess variance of the error term. A significance level must be chosen to determine what level of variance is acceptable. For the purposes of this study a significance level of 0.05 was used to assess whether or not to accept the null hypothesis. If the significance is greater than 0.05, then the null hypothesis is accepted.

Cross-tabulation of SATV against CQPR yielded a chi-square value of 0.000 and an R-value of 0.286. A categorical review of the cross-tabulation indicated that the bulk of midshipmen (81%) earned an SATV score between 500 and 700 and that the higher a midshipman scored on the SATV, the more likely they were to earn a higher CQPR. This became evident when the observed number of midshipmen earning higher grades increased as SATV score increased. For example, the largest group of midshipmen (35%) scoring between 500 and 550 on the SATV earned a CQPR between 2.00 and 2.50. The largest group of midshipmen (28%) scoring between 650 and 700 on the SATV earned a CQPR between 2.50 and 3.00. This indicates a possible relationship between SATV and CQPR. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that SATV and CQPR are independent of one another. An R-value of 0.286 indicates that while there may be a significant relationship, it is probably fairly weak. See Table #2 for Cross-Tabulation scores.

Table 2

Cross-Tabulation of SATV Against CQPR

	SATV score category			
CQPR	550	600	650	700
4.00	3.8	7.3	9.9	15.3
3.50	15.2	18.8	20.7	26.6
3.00	29.6	[a]30.7	[a]31.6	[a]27.5
2.50	[a]35.1	29.3	25.4	22.6
2.00	13.7	12.4	10.8	7.2
1.50	2.4	1.5	1.3	0.7
1.00	0.2	0.0	0.2	0.0
% of Cases	17.6	24.3	23.2	15.9
		[b]81.0		

Notes. Values represent percent of midshipmen within SATV Category who earned corresponding CQPR.

81.0% of midshipmen earned SATV scores between 500 and 700

[a]indicates the largest percentage of midshipmen within SATV category.

[b]indicates total percentage of all cases

Cross-tabulation of SATM against CQPR yielded a chi-square value of 0.000 and an R-value of 0.419. A categorical review of the cross-tabulation indicated that the bulk of midshipmen (88.8%) earned an SATM score between 550 and 750 and that the higher a midshipman scored on the SATM, the more likely they were to earn a higher CQPR. This became evident when the observed number of midshipmen earning higher grades increased as SATM score increased. For example, the largest group of midshipmen (37%) scoring between 550 and 600 on the SATM earned a CQPR between 2.00 and 2.50. The largest group of midshipmen (31%) scoring between 700 and 750 on the SATM earned a CQPR between 3.00 and 3.50. This clearly indicates a possible relationship between SATM and CQPR. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that SATM and CQPR are independent of one another. The R-value of 0.402 indicates there may be a significant and fairly moderate relationship between the two variables. This observation concurs with expectations based upon previous studies discussed in the literature review. Refer to Table 3 for comparison results.

Table 3

Cross-Tabulation of SATM Against CQPR

	SATM score category			
CQPR	600	650	700	750
4.00	1.1	3.9	9.5	18.2
3.50	7.6	14.6	23.8	[a]30.9
3.00	27.2	30.2	[a]31.3	28.6
2.50	[a]37.4	[a]35.0	26.2	17.1
2.00	23.1	14.6	7.9	4.4
1.50	3.4	1.6	1.1	0.5
1.00	0.1	0.1	0.1	0.2
% of Cases	11.8	27.3	31.3	18.4
		[b]88.8		

Notes. Values represent percent of midshipmen within SATM category who earned corresponding CQPR.

88.8% of midshipmen earned SATM scores between 550 and 750.

[a]indicates the largest percent of midshipmen within each SATM category.

[b]indicates total percentage of all cases

A cross-tabulation was also conducted for STAND against CQPR. This resulted in a chi-square statistic of 0.000 and Pearson correlation coefficient of magnitude -0.376. Results of this analysis revealed that 77.8% of the midshipmen studied were in the top 20% of their high school classes and over half were in the top 10%. Since STAND is organized so that a decrease in percentage value for high school class standing indicates an increase in high school academic performance, one would expect to see a corresponding increase in CQPR associated with a decrease in STAND. Therefore, a negative Pearson coefficient is expected since studies have shown that class standing in high school can be a predictor of college academic performance. (Astin, 1968; Lavin, 1965; Weitzman, 1981)

Analysis was focused upon the top 20% group since they represent the bulk of midshipmen and can be studied to identify major trends in performance. For midshipmen in this group, a decrease in STAND was met with a corresponding increase in academic performance. Specifically, 30% of midshipmen in the top 5% of their class earned a CQPR between 3.00 and 3.50 while 34% of midshipmen in the top 15% to 20% range earned a 2.00 to 2.50 CQPR indicating that there is indeed a relationship between the two variables. Since these four categories contain the bulk of midshipmen in the 1000 case random sample, there is a limited amount of information to be gained by analyzing statistics from the 25^{th} percentile to the 100^{th} percentile for academic standing. It should be noted however, that there does seem to be a downward trend in CQPR for the largest number of midshipmen in these lower categories that concurs with a negative association between STAND, in this format, and CQPR. For example, 41% of midshipmen in the 25^{th} percentile earned between a 2.00 and 2.50 CQPR while 41% of midshipmen in the

70th percentile earned between a 1.50 and 2.00. The negative Pearson Correlation coefficient concurs with these observations and indicates that there may be a valid and moderate association between the two variables in question. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that these two variables are independent of one another. Refer to Table 4 for comparison results.

Table 4

Cross-Tabulation of STANDING Against CQPR

	STANDING (Percentile)			
CQPR	5	10	15	20
4.00	19.7	5.8	4.9	3.6
3.50	[a]29.9	21.3	17.0	14.1
3.00	28.4	[a]33.7	[a]33.8	28.2
2.50	17.1	28.7	30.9	[a]33.5
2.00	4.3	9.9	12.1	17.2
1.50	0.6	0.7	1.4	3.0
1.00	0.0	0.0	0.0	0.4
% of Cases	35.7	19.9	13.1	9.1
		[b]77.8		

Notes. Values represent percent of midshipmen within STANDING category who earned corresponding CQPR.

77.8% of midshipmen attained STANDING percentages in the top 20%.

[a]indicates the largest percentage of midshipmen in STANDING category

[b]indicates total percentage of all cases

Cross-tabulations were also conducted for all ten of the LASSI variables in order to assess possible correlations with CQPR. In all but one category, Time Management, at least 50% of the midshipmen studied scored in the above average percentile range (70-100). For Time Management, 48.1% of midshipmen studied scored in the above average range. Conversely, anywhere from 24% to 40% of all midshipmen studied scored in the below average range for individual LASSI categories. Specific categories of note are the time management (TMT) and study aids (STA) categories of the survey at 40.1% and 38.3% respectively.

A significant portion of this general analysis is based upon observation of CQPR values for the largest grouping of subjects within each crossed variable percentile range. For example, if the largest number of midshipmen scoring in the 10%, 50%, and 100% ranges of the ATT category earn a 1.00, 2.50, and 4.00 CQPR respectively, then it is logical to assume that there is a significant relationship between these two variables given that the other percentile ranges reflect a similar relationship. Individual cross-tabular analysis is discussed in the following text.

A cross-tabulation of LASSI attitude variable (ATT) against CQPR produced a chi-square statistic of 0.000 and R-value of 0.129. Results of the analysis indicate that 59% of the subjects scored in the above average percentile while 32.4% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each ATT category revealed no distinct patterns. However, the chi-square statistic of less than 0.05 suggests rejection of the null hypothesis that ATT and CQPR are independent of one another. An R-value of only 0.129 indicates that while

there may be a significant relationship between the two variables, it is probably very weak at best.

A cross-tabulation of LASSI motivation variable (MOT) against CQPR produced a chi-square statistic of 0.000 and R-value of 0.256. Results of the analysis indicate that 58% of the subjects scored in the above average percentile while 34% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each MOT category revealed fluctuations between CQPR values of 2.50 and 3.00 with a developing consistency toward 3.00 as motivation level increased. The chi-square statistic of less than 0.05 suggests rejection of the null hypothesis that MOT and CQPR are independent of one another. The R-value of 0.256 indicates that there may be a significant relationship between the two variables and it could significantly affect CQPR.

Cross-tabulating the LASSI time management variable (TMT) against CQPR produced a chi-square statistic of 0.000 and an R-value of 0.109. Results indicate that 48.1% of the subjects scored in the above average percentile while 40.1% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each TMT category revealed a relatively constant value of 3.00 across the board showing only minor fluctuations at the 20^{th} and 30^{th} percentile ranges. The chi-square statistic of less than 0.05 suggests rejection of the null hypothesis that TMT and CQPR are independent of one another. However, the low R-value of 0.109 indicates that any relationship between the two variables has minimal if any significant effect on CQPR.

Cross-tabulating the LASSI anxiety variable (ANX) against CQPR produced a chi-square statistic of 0.000 and an R-value of 0.195. Results indicate that 57.3% of the subjects studied scored in the above average percentile while 29.7% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each ANX category revealed a very slight upward trend in CQPR associated with increasing ANX scores. Specifically, a CQPR value of 2.50 was achieved for the largest single percentage of midshipmen scoring in the 10^{th} through 40^{th} ANX percentile ranges. For the remaining ANX percentile ranges, the largest percentage of midshipmen earned a 3.00. The chi-square statistic of less than 0.05 suggests rejection of the null hypothesis that ANX and CQPR are independent of one another. However, the low R-value of 0.195 indicates that any relationship between the two variables has only marginal effect on CQPR.

Cross-tabulation of the LASSI concentration variable (CON) against CQPR produced a chi-square statistic of 0.000 and an R-value of 0.180. Results indicate that 65.1% of the subjects studied scored in the above average percentile while 23.8% scored in the below average percentile for this category. There appears to be a fairly larger proportion of high scores for this variable as compared to other LASSI variables studied. Observation of CQPR values for the largest subject group within each CON category revealed a very slight upward trend in CQPR associated with increasing CON scores. Specifically, CQPR values fluctuated from 2.50 to 3.00 between CON percentile ranges 40 through 70 with a developing consistency toward 3.00 after 70%. This variable seems to somewhat mimic the performance of MOT with respect to CQPR. The chi-square statistic of less than 0.05 suggests rejection of the null hypothesis that CON and CQPR

are independent of one another. However, the low R-value of 0.180 indicates that any relationship between the two variables has only marginal effect on CQPR.

Cross-tabulating the LASSI information-processing variable (INP) against CQPR produced a chi-square statistic of 0.044 and an R-value of 0.053. Results indicate that 51.3% of the subjects studied scored in the above average percentile while 35.4% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each INP category revealed no particular trends. CQPR values for these groups varied between 2.50 and 3.00 with no apparent pattern indicating little correlation. The chi-square statistic bordering significance at the 0.044 level suggests rejection of the null hypothesis that INP and CQPR are independent of one another. The low R-value of 0.053 indicates that any relationship between the two variables might be negligible.

Cross-tabulating the LASSI selecting main ideas variable (SMI) against CQPR produced a chi-square statistic of 0.000 and an R-value of 0.129. Results indicate that 54.2% of the subjects studied scored in the above average percentile while 33.2% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each SMI category revealed a very slight upward trend in CQPR associated with increasing SMI value. The largest individual percentage group of midshipmen within the bottom half of the SMI categories generally earned a 2.50 CQPR while midshipmen in the top half generally earned a 3.00. Exceptions to this finding were observed at the 20^{th} and 90^{th} percentiles where the largest individual percentage of midshipmen earned a 3.00 and 2.50 respectively. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that SMI and CQPR are independent of one

another. The R-value of 0.129 indicates that while the two variables are not independent of one another, any relationship that may exist between the two variables is fairly weak.

Cross-tabulation of the LASSI study aids variable (STA) against CQPR produced a chi-square statistic of 0.003 and an R-value of –0.065. Results indicate that 53.5% of the subjects studied scored in the above average percentile while 38.3% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each STA percentile category revealed a very slight downward trend in CQPR associated with increasing STA value. This variable is interesting in the fact that it indicates a negative correlation with CQPR. Taken literally, a midshipman who scores highly on this measure seems to have a very slight academic disadvantage relative to those who have lower scores. There are several ways to interpret this finding. One interpretation is that there is a negative correlation between the two variables. Another could be that there is some other unmeasured characteristic associated with the STA variable that causes a negative interaction between the two. One other explanation could be the time the test is administered. Variations in resources and training prior to the Naval Academy experience could induce response bias and therefore interfere with the accuracy of the STA measure. There appears to be very little pattern to the fluctuations of CQPR for the largest single percentage of subjects across STA percentiles. Fluctuations do not occur until the 60% range and alternate between values of 2.50 and 3.00 from the 60% through 100% ranges. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that these variables are independent of one another. However, the very low R-value of -.065 indicates that any relationship may be negligible.

Cross-tabulation of the LASSI self-testing variable (SFT) against CQPR produced a chi-square statistic of 0.527 and an R-value of 0.038. Results indicate that 55.9% of the subjects studied scored in the above average percentile while 36.6% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each SFT percentile category revealed no significant patterns with respect to CQPR. The chi-square value of 0.527 is greater than 0.05 suggesting that the null hypothesis be accepted that CQPR and SFT are independent of one another. The very low R-value of 0.38 indicates very little if any correlation and concurs with the chi-square observation.

Cross-tabulation of the LASSI test strategies variable (TST) against CQPR produced a chi-square statistic of 0.000 and an R-value of 0.241. Results indicate that 55.7% of the subjects studied scored in the above average percentile while 35.0% scored in the below average percentile for this category. Observation of CQPR values for the largest subject group within each STA percentile category revealed a slight increase in CQPR associated with higher performance on TST. Specifically, the largest single percentage of midshipmen within the 60^{th} percentile range and lower generally received a 2.50 CQPR. The only exception to this observation occurred in the 40^{th} percentile range where the largest group of midshipmen earned a 3.00 CQPR. The largest single percentage of midshipmen within the 70^{th} percentile and above generally earned a 3.00. This indicates a slight, but significant upward trend in CQPR. The chi-square statistic is less than 0.05 suggesting rejection of the null hypothesis that these variables are independent of one another. The R-value of 0.241 indicates that there may be a fairly moderate correlation between TST and CQPR.

F. BASIC ANALYSIS METHOD

This section provides a brief explanation of the analysis methodology and structure implemented in order to obtain results for discussion.

Once the data collection phase was completed as detailed above, preliminary analysis of existing Academic Center selection procedures was conducted using descriptive statistics, frequency analysis and cross-tabulations within the SPSS 9.0 program. This helped to identify basic relationships between observed data and current selection methods. These simple relationships also played a part in developing a hypothesis for future assessment. Once this step was completed, a linear regression model was developed using both the information obtained from previous research and preliminary analysis observed in this study. After running the model through a linear regression in SPSS, results were discussed in terms of overall significance. Certain elements of the first model appeared to have no relevance in the prediction of academic performance, but could not be arbitrarily removed from the equation. Therefore, further analysis and research was conducted leading to the development of a second hypothesized model for academic performance. A description of why certain variables were included or excluded was required in order to ensure this new model could be accepted as a valid modification of the original. Discussion of all variables to be used finalized this section with particular attention given to formatting the final equation for use in the PIP selection process. In addition methods of comparison similar to the first regression were utilized to provide a sound statistical basis for the final model. After model justification was completed, the model was run, results observed and discussed in detail.

Finally, a method for utilizing the hypothesized model to assist the Academic Center in identifying midshipmen who may experience academic difficulty was proposed with discussion and comparison to the existing selection criteria. This analysis method is detailed in the Comparison of Data section of this study.

IV. HYPOTHESIS

A. INTRODUCTION

The Academic Center utilizes several criteria in selecting midshipmen for participation in academic intervention programs. Each year a watch list of approximately 200 names is generated based upon the following initial entry criteria: admissions data, final Naval Academy Prep School (NAPS) grades, admissions board recommendations, Naval Academy Athletic Association input, standardized test results, the Nelson-Denny Reading test administered during Plebe Summer and to some extent, the LASSI survey results. From this watch list, midshipmen are selected based on perceived need. There is no empirical process in place that assists in the selection process. If an equation could be developed that could adequately predict academic performance, it would be a very useful tool for empirically ranking midshipmen academically. The problem with attempting this task is that there are typically many subjective factors involved with academic performance that can hamper the accuracy of a prediction model using only objective criteria. Lavin, 1965 studied the affect of several subjective factors such as study habits, attitude, interest, anxiety, adjustment and aggression in an attempt to understand the intricacies of such intellective factors and their affect upon academic performance. His results indicated that many of these factors did in fact have both positive and negative affects upon academic performance and should be included in any model attempting to predict GPA. Therefore, the attempt must be made to incorporate both subjective and objective criteria into any model that seeks to accurately predict academic performance.

B. MODEL EQUATION

In order to assess the predictive power of specific variables against CQPR, an equation must be developed and analyzed. This equation should be reflective of the goals of the study and be well based from past research in order to be of significant value. Based upon literature review of academic achievement theory and past studies on subjective and objective performance measurement, the following prediction model for CQPR was developed.

$$CQPR = b_0 + b_1 SATM + b_2 SATV + b_3 STAND + b_4 ATT + b_5 MOT + b_6 TMT + b_7 ANX + b_8 CON + b_9 INP + b_{10} SMI + b_{11} STA + b_{12} SFT + b_{13} TST + \in_0 \quad (3)$$

Next a hypothesis was required in order to establish a basis for review of findings. The hypothesis details expected signs, either positive or negative, for each independent variable coefficient. This allows the researcher to express an educated opinion as to what the observed results may reveal. This opinion is then either disputed or reinforced by observed regression results and either supports or negates the null hypothesis for each variable coefficient. Utilizing the information obtained from both the literature review and data description, a hypothesis was developed for each of the variables included in the prediction model. See equation 4. This hypothesis will be compared to the observed regression results for further discussion in the results chapter.

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$$CQPR = f(SATM, SATV, STAND, ATT, MOT, TMT, ANX, CON, INP, SMI, STA, SFT, TST) \quad (4)$$

Three included variables, INP, STA, and SFT are of particular interest. Cross-tabulation data indicated that INP bordered upon significance at the 0.044 level with regard to the chi-square statistic and possessed a very low Pearson (R) correlation coefficient. Since there was relatively little valid information regarding the subject of information processing in both the data description and literature review areas of study, no assumption was made as to the sign of this regression coefficient although it was assumed that this variable would have minimal effect upon CQPR. Data obtained from crossing the STA variable with CQPR revealed a negative correlation coefficient although the R-value was very small and the chi-square statistic was not particularly strong. Most probably, this variable had no real predictive value for CQPR, but was included in the preliminary analysis to be reviewed following regression observations. Literature review indicates that the SFT variable is a positive correlate for academic performance. (Weinstein, 1987) However, cross-tabular analysis against CQPR revealed no such correlation. The chi-square statistic was insignificant and the R-value was very small. This variable is expected to carry little or no weight in the prediction model. SATM, SATV, and STAND were all expected to be positive indicators of academic performance based upon both the literature review findings and data description including cross-tabular analysis of each against CQPR. However, since STAND is formatted so that a lower value indicates higher academic performance the regression coefficient associated with this variable is expected to be negative. Both MOT and TST were expected to be fairly significant and positive variables in predicting academic performance due to their R values each approaching 0.300 and significant chi-square observations. Literature review indicates that there was inconsistency in research

findings on motivation as a predictor of academic performance, but that there was some evidence leading to the belief that a small correlation exists between motivation and academic performance. (Lavin, 1965) The other variables including ATT, TMT, ANX, CON, and SMI produced significant chi-square statistics with low R-values indicating that their involvement in the prediction of academic performance may serve to refine and not define the model.

C. CHAPTER SUMMARY

The model equation developed involves thirteen different variables. There is little doubt that attempting to utilize so many variables for prediction of such a dynamic dependent variable as cumulative grade point average may lead to such complicating factors as probable high correlations among some of the independent variables. This multicollinearity problem can affect the significance of coefficients of the highly correlated variables.

It is important to keep in mind that a key point of this study is to help simplify and provide consistency throughout the selection process for students who may have academic difficulties. Even if the resulting equations developed through regression do not provide an effective means for predicting actual CQPR, they are still very useful if they can be utilized to provide more accurate and efficient identification of those who will otherwise experience difficulty.

V. RESULTS

A. INTRODUCTION

Implementing the model linear regression equation developed in the hypothesis section, linear regression analysis was conducted using the SPSS 9.0 software. In reviewing the results, it was important to establish significance level thresholds with respect to the observed t characteristic and their respective significance values. For the purposes of this study the following criteria was used to determine the level of significance for a particular variable. First, the calculated (t_p) value is observed from regression results provided by SPSS 9.0. This t value is then compared against the critical t value (t_c) in order to determine whether or not to accept the null hypothesis. If t_p has an absolute value larger than t_c, then the null hypothesis is rejected. In the hypothesis section of this study, hypothetical signs for each regression coefficient were developed based upon research data. Therefore, the null hypothesis for a particular variable regression coefficient would indicate a value of the opposite sign as the hypothesis for that coefficient or zero. The t_c value to be used depends upon the level of significance chosen. For this study, the following scale was used to determine variable coefficient significance. Table 5 details coefficient significance figures.

Table 5

Range of Significance for Regression Coefficients

Range of Significance	Prediction Value
0.000 - 0.049	Highly Significant
0.050 - 0.099	Significant
0.100 - 0.149	Marginally Significant
0.150 and higher	Not Significant

Note. Values are determined based upon infinite degrees of freedom.

B. REGRESSION ANALYSIS

Once the initial regression was completed using all ten LASSI variables, SATV, SATM and STAND, the results were compiled and analyzed for statistical significance using significance values in Table 5 as the standard. The following results were obtained.

1. 1st Regression

Of the entire database of information compiled consisting of nearly 10000 cases of data, 3998 held valid entries for all the variables included in this initial regression analysis. This is partially due to system-missing entries for midshipmen with incomplete data, but mostly due to the missing LASSI data from the classes of 1998 through 2000. Therefore, this regression analysis represents the prediction of academic performance primarily for classes 1996, 1997, and 2001 through 2003.

Two of the statistical results obtained from regression analysis are the coefficient of determination (R^2) and the F statistic. R^2 is a goodness of fit statistic that helps describe how well the model equation fits the sample data. In other words, a value of 1.00 for R^2 means that all of the error term is explained by residuals in the equation. This value is always positive and ranges between zero and one. A value of one indicates that the equation perfectly fits the sample data. Conversely, a value of zero indicates that the equation fits the data poorly if at all. The F statistic is a measure of the overall significance of an equation. Unlike R^2 that determines degree of fit, the F statistic provides a formal hypothesis test of the overall fit and can be a powerful indicator of the predictive power of an equation.

For this initial model, the R^2 and F statistic observed were 0.324 and 146.59 respectively. At first glance, the R^2 seems low. However, this may indicate that the model equation may not predict CQPR very well for an individual, but may predict fairly well for the group as a whole. The F statistic observed was also significant indicating that the model does in fact possess a degree of predictive power for CQPR. Each independent variable's performance is described next.

Of the thirteen variables included in the linear regression model above, ten of them reflected some degree of significance with respect to CQPR. Specifically, the regression coefficients for STAND, SATV, SATM, MOT, and STA were all significant at the 0.000 level. Coefficients for ATT, TMT, SMI, and TST were all "highly significant" and varied from 0.003 to 0.019 in significance. Only one variable coefficient was evaluated as "significant" due to a t value of 1.693 and significance level of 0.091. While still significant at the 0.10 level, this coefficient lay on the border of marginal

significance and warranted further discussion and analysis before any decision was made on whether or not to remove it from future equations. ANX, CON, and INP, however, reported t values of 0.331, 0.456, and 0.636 respectively. These variable coefficients were considered "not significant" because of their low t values and associated significance levels. These variables were only significant at the 0.74, 0.65 and 0.52 levels respectively and lie well outside the parameters for even marginal significance. This indicates it is most likely that these variables do not assist in the prediction of CQPR.

Some interesting results were encountered with respect to hypothetical coefficient signs. First, ATT was hypothesized to be a positive indicator of CQPR. However, regression results argue that this variable is a negative indicator of CQPR. At first glance, this result does not seem logical. One would imagine that a student's attitude toward school might have significant influence upon scholastic achievement. The attitude category measures clarity of educational goals and the importance of education to an individual. At the Naval Academy, there are several competing priorities that may affect the prediction polarity of ATT. The end result of graduation from the Naval Academy is an officer commission in the Navy or Marine Corps. A Midshipman's Order of Merit (OOM), comparable to grade point average (GPA) in civilian institutions, is determined by several factors including academics, military and physical performance and conduct. This combination of competitive factors is very different from civilian institutions where academic grade point average alone is the primary measure of performance. At a civilian institution, a person who does not value education and lacks sufficient clarity of educational goals could be considered self-destructive. At the Naval

Academy, such a person may simply place higher value on another source of competitive measure. Midshipmen can often be heard stating that their performance as officers will not be determined by the value of their CQPR. That is not to say that midshipmen do not value education, only that there are other factors that compete with academics for priority.

Another area of surprise was the SMI variable. It was hypothesized that the ability to select main ideas and know what areas of text to study would be a valuable asset and naturally affect CQPR in a positive manner.

The opposite effect was observed in the regression equation. The coefficient of this variable was significant with a t value of –2.77; SMI was shown to be a negative predictor of CQPR. There could be several explanations for this result. Selecting Main Ideas may truly not influence academic performance or even be a detriment due to the focus on only certain material and not on the whole understanding. Another possibility could be that the SMI variable is highly correlated with another variable in the equation. This situation could cause interference in the relationship between SMI and the dependent variable.

After analyzing results from the first regression it was determined that a second regression would be necessary to determine the overall model effect resulting from removal of variables found to be insignificant. Due to reasons summarized above, variables ANX, CON and INP were removed from the model. Although initially insignificant, variable SFT was retained in the equation in order because it bordered on significance. The effects of removing the other three variables could positively or

negatively affect the significance level of the SFT variable. Table 6 summarizes observed results from the first regression.

Table 6

Summary of 1st Regression Analysis for Variables Predicting CQPR

(N = 3998)

Variable	B	SE B	β	t	Sig.
Constant	-0.05333	0.109	–	-0.49	0.624
STAND	-0.00901	0.001	-0.211	-14.72	0.000
SATV	0.00126	0.000	0.155	10.44	0.000
SATM	0.00285	0.000	0.292	19.25	0.000
ATT	-0.00114	0.000	-0.050	-2.95	0.003
MOT	0.00399	0.000	0.169	8.50	0.000
TMT	0.00107	0.000	0.046	2.41	0.016
ANX	0.00014	0.000	0.006	0.33	0.741
CON	0.00024	0.001	0.009	0.46	0.649
INP	0.00023	0.000	0.010	0.64	0.524
SMI	-0.00120	0.000	-0.051	-2.77	0.006
STA	-0.00220	0.000	-0.104	-6.29	0.000
SFT	0.00072	0.000	0.032	1.69	0.091
TST	0.00112	0.000	0.049	2.34	0.019

Note. $R^2 = 0.324$, $F = 146.59$

2. 2nd Regression

A second regression was performed in exactly the same manner as the first regression. Variables hypothesized as predictors of CQPR were once again assembled with three qualified exceptions as discussed previously. The primary difference between these two regression procedures was the removal of variables ANX, CON and INP based upon variable discussion from the first regression results. All other procedures remained constant. SPSS 9.0 was used to perform the regression of the dependent variable against the independent variables with the following results. The R^2 value obtained from this regression was 3.27 with an F statistic value of 196.73. The removal of three insignificant variables did not affect the R^2 squared statistic appreciably although a positive increase of 0.03 was observed. This indicates that the variables removed did not significantly affect the predictive power of the model equation. However, the change in the F statistic was more pronounced at an increase of 50.15. This means that although the predictive power of the equation did not change appreciably, the significance of the values obtained increased by 34%. Therefore, the removal of ANX, CON and INP resulted in a more statistically significant outcome. Table 7 summarizes results from the second regression. More in-depth discussion of regression results follows Table 7.

Table 7

Summary of Linear Regression Analysis for Variables Predicting CQPR

Second Regression: ANX, INP and CON Variables Removed.

(N = 3998)

Variable	B	SE B	ß	t	Sig.
Constant	-0.06114	0.107	-	-0.57	0.568
STAND	-0.00898	0.001	-0.211	-14.89	0.000
SATV	0.00127	0.000	0.157	10.69	0.000
SATM	0.00286	0.000	0.295	19.84	0.000
ATT	-0.00099	0.000	-0.043	-2.64	0.008
MOT	0.00392	0.000	0.166	8.61	0.000
TMT	0.00113	0.000	0.049	2.79	0.005
SMI	-0.00111	0.000	-0.048	-2.64	0.008
STA	-0.00223	0.000	-0.105	-6.61	0.000
SFT	0.00088	0.000	0.039	2.20	0.028
TST	0.00123	0.000	0.054	2.86	0.004

Note. R2 = 0.327, F = 196.73

Additionally, there were appreciable changes in the significance values of several included variables. Specifically, while all of the variables maintained the same coefficient sign as in the previous regression, there were notable differences in the t and significance values. The following text and table summarize changes.

The t values for STAND, SATV, SATM, MOT, and STA varied by –0.17, 0.25, 0.59, 0.11, and –0.32 respectively indicating a strengthening of the relationship between these independent variables to the dependent variable. These variables were all highly significant in the first regression and no appreciable changes in significance were observed for the second regression. ATT and SMI reflected a slight weakening in t value. ATT showed a 0.31 positive change weakening the negative t value from –2.95 to –2.64. This also changed the significance level from 0.003 to 0.008. Although this is a noticeable change, the variable remains highly significant relative to the dependent variable. Similarly, SMI showed a 0.13 positive change weakening the negative t value from –2.77 to –2.64. This changed the significance level noticeably from 0.006 to 0.008. However, the variable remains highly significant relative to the dependent variable. Of particular interest were the changes observed in the significance values associated with variables TMT, SFT, and TST. In each case, the results observed in the second regression reflected increasing t values corresponding to higher significance relative to the dependent variable. TMT and TST reflected moderate t value increases of 0.38 and 0.52 respectively. Both of these variables were highly significant in the first regression. SFT provided the most interesting results between the first and second regression. As noted in the chart below, SFT bordered significance at the 0.09 level in the first regression with a t value of 1.69. Results from the second regression reflected a dramatic

change in t value from 1.69 to 2.20. This resulted in a change in characterization for variable SFT from marginally significant to highly significant at the 0.03 level. Possible explanations for this phenomenon are detailed below.

The removal of ANX, CON, and INP for the second regression served to further strengthen the significance values of TMT, SFT, and TST. One possible explanation of this result is that removing some of the interactive complications associated with three non-significant variables in the same equation allows the highly significant variables to more fully describe observed results. Correlation results from the first regression seem to support this theory. TMT was observed to be highly correlated to CON with a Pearson Correlation of 0.62. SFT was observed to be moderately correlated with both CON and INP with Pearson Correlation values of 0.41 and 0.49 respectively. TST was observed to be highly correlated with both ANX and CON with Pearson Correlation values of 0.59 and 0.57 respectively. Because these variables were highly insignificant relative to the dependent variable and highly correlated to several highly significant variables, their removal could allow for a better overall description of the observed results. Table 8 refers.

Table 8

Summary of Changes in t Values and Significance Observed Between First and Second Regression Analysis. (N = 3998)

Variable	Regression 1		Regression 2		Change	
	t value	Sig	t value	Sig.	Δt	DSig
Constant	-0.49	0.624	-0.57	0.568	-0.08	-0.056
STAND	-14.72	0.000	-14.89	0.000	-0.17	0.000
SATV	10.44	0.000	10.69	0.000	0.25	0.000
SATM	19.25	0.000	19.84	0.000	0.59	0.000
ATT	-2.95	0.003	-2.64	0.008	0.31	0.005
MOT	8.50	0.000	8.61	0.000	0.11	0.000
TMT	2.41	0.016	2.79	0.005	0.38	-0.011
SMI	-2.77	0.006	-2.64	0.008	0.13	0.002
STA	-6.29	0.000	-6.61	0.000	-0.32	0.000
SFT	1.69	0.091	2.20	0.028	0.51	-0.063
TST	2.34	0.019	2.86	0.004	0.52	-0.015

Table 8 details changes in significance for all included variables in the CQPRpred model. Simply stated, Class standing and individualized SAT scores proved to be the most significant variables for predicting relative performance. This is not a surprise since literature review strongly supports these observations. Indicating t-values of -14.72, 10.44, and 19.25 for Class Standing, SAT Verbal and SAT Math respectively; these variables are, by far, the strongest predictors observed. It should also be noted that SAT Math was the most powerful predictor of all independent variables tested. Since Class Standing reflects overall high school performance in all academic fields and SAT scores are individualized to reflect Verbal and Math based performance, the relatively strong emphasis on technical, math, and science based courses at the Naval Academy supports a more significant correlation between SAT Math and academic performance.

Even though SAT Math, SAT Verbal and Class Standing were observed as highly significant variables, several LASSI variables also proved to be highly significant. This is interesting because the LASSI is based upon personality characteristics and SATs and Class Standing are objective and performance-based. Backed by literature review and observations from this study, the inference can be made that, in conjunction with objective measures, subjective variables such as personality characteristics can provide moderately enhanced prediction capability to relative performance models of academic achievement. Specifically, the following LASSI variables were observed to be highly significant at the 0.00 to 0.05 level and are listed in order of precedence from most significant to least significant: Motivation, Study Aids, Attitude, Selecting Main Ideas, Time Management, and Test Strategies. Only Self Testing was observed as significant at the 0.10 level and was considered a moderate predictor for the model equation.

Three LASSI variables, Study Aids, Selecting Main Ideas and Attitude were observed to have a negative impact upon Cumulative Quality Point Rating. While there is no certain answer why above average performance in these areas would be correlated with a downward trend in academic performance, some thoughts are detailed in the following text.

The Study Aids and Selecting Main Ideas variables are centered on the idea of outlining and compartmentalizing study in order to achieve a requisite knowledge level. Academic and military studies at the Naval Academy are more detail oriented and require a thorough understanding of material. Students are taught that attention to details is paramount to their success as Navy and Marine Corps Officers. Therefore, the ability or tendency to compartmentalize or outline material may be a detriment to a student in this environment.

As discussed in previous chapters, the negative coefficient for Attitude could be explained by the dual focus of the Naval Academy. The purpose of the Academy is to provide Navy and Marine Corps Officers to the fleet. This is accomplished through a variety of academic and military classes, practical experience, training and immersion in a complete military environment while attending the Naval Academy. It is not uncommon for a midshipman to look at professional development and military courses as more important than purely academic pursuits. This is somewhat perpetuated by the fact that course of study has little to no bearing on most service options for midshipmen. In other words, a student is not required to study aerospace engineering in order to select Naval Aviation as their service community after graduation. Therefore, a negative

coefficient for Attitude does not mean that midshipmen have a negative perception of academics but may value other aspects of Academy life as more important.

It is important to understand that personality characteristics are very difficult to quantify. The LASSI provides a statistically sound basis for understanding and evaluating personality characteristics, but there are always exceptions to the rule. With continuing efforts to maintain long term, consistent database information and conduct further trend analysis, the intricacies and relationships between each of these variables may be more fully understood.

C. COMPARISON OF DATA

After analyzing results from the second regression, a model was developed for the purpose of comparing the current PIP selection process to a process that includes an empirical equation derived from linear regression. This study focuses upon the prediction of CQPR. Therefore, any model derived from regression results should ultimately provide a value for $CQPR_{PRED}$ (predicted CQPR) for comparison with population data. Since results from regression number two appeared to more fully describe population data as described in previous sections, the variables and associated coefficients from the second regression were utilized to develop the model below for $CQPR_{PRED}$.

$$\begin{aligned} CQPR_{PRED} = {} & (-6.114E-02) + (-8.979E-03)(STAND) + (1.268E-03)(SATV) + \\ & (2.862E-03)(SATM) + (-9.902E-04)(ATT) + (3.918E-03)(MOT) + \\ & (1.132E-03)(TMT) + (-1.108E-03)(SMI) + (-2.227E-03)(STA) + \\ & (8.779E-04)(SFT) + (1.229E-03)(TST) \end{aligned} \tag{5}$$

Once a valid model was established, a process for comparison was devised in order to assess the feasibility of including empirical analysis in the Plebe Intervention Program selection process. Several aspects of the selection process required consideration for this study to have any significant value to the Naval Academy Academy Academic Center. Several questions had to be answered. What are the limitations of the empirical formula developed? Can the formula be implemented as stand-alone selection criteria, or should other factors play a role in the selection process? Does the empirical formula provide a more accurate assessment of academic performance than the current selection process? Answers to these questions are critical to determining whether to utilize this model, in part or as a whole, for practical use in the Academic Center's selection process.

As previously covered, the Naval Academy Academic Center places approximately 200 midshipmen on an academic watch list. This list is generated from a variety of sources including, but not limited to, SAT scores, reading comprehension tests, NAAA recommendations and other sources. Typically these individuals are ranked in order of concern although there is currently no empirical process in place to assist in their identification. During the period of study, the Academic Center had the capacity to accept approximately 100 midshipmen into the Plebe Intervention Program. This constitutes approximately half of those placed on the watch list. For the purposes of this study, it was critical to determine whether the incorporation of an empirical process provided an enhanced ability to select midshipmen who experienced significant academic difficulty. In order to determine the validity of the empirical process, the prediction

model was used to develop a predicted first semester Quality Point Rating or $CQPR_{PRED}$ for each individual included in the study.

To calculate a valid $CQPR_{PRED}$, the collected data had to be filtered for invalid entries. This was accomplished by using the SPSS 9.0 filter function to remove all cases with invalid entries for the included variables and actual CQPR. After filtering, a total of 4065 valid cases were assembled for comparison analysis. Using the model for $CQPR_{PRED}$ developed from results obtained in the second regression, predicted Quality Point Ratings were calculated for each case. The next step was to determine how to compare the predicted CQPR to both actual CQPR and the PIP selection process.

The object of both the Plebe Intervention Program and this study is to ensure that midshipmen most in need of academic assistance are identified. The measure of academic success utilized for this purpose is CQPR. Therefore, in order to satisfy both of these objectives, actual CQPR was used as a reference point. Those midshipmen with the weakest actual CQPR were identified as individuals most in need of academic assistance. Since the Naval Academy Academic Center possesses limited resources and provides services to approximately 100 midshipmen via the Plebe Intervention Program each year, it is logical that they would desire to intervene with those midshipmen projected to earn the weakest actual CQPR. Each year approximately 1100 midshipmen are inducted into the Naval Academy. If approximately 100, or 9.10 percent of these midshipmen participate in the Plebe Intervention Program at some point in time, then this percentage is valuable as a comparison point.

Next, the variable ACINTERV was created for all included cases to represent participation in the Plebe Intervention Program. This variable is categorical indicating a

value of one (1) if the midshipman participated in the PIP and zero (0) if not. Once variables ACINTERV and $CQPR_{PRED}$ were created, the final comparison was conducted.

Assuming that 9.10 percent of the total cases participated in the PIP, a simple comparison was performed using the lowest 9.10 percent of values for both CQPR and $CQPR_{PRED}$. This was completed utilizing the SORT CASES function of SPSS to sort each variable in ascending order and filter out all but the lowest 9.10 percent of each. The result was a collection of 370 cases with the lowest predicted or actual CQPR respectively. Descriptives for CQPR and $CQPR_{PRED}$ are included in Table 9.

Table 9

Comparative Analysis of CQPR, CQPRpred, and

PIP Selection Process (N=370)

Descriptive Statistics within Actual CQPR					
Variable	Valid (N)	Minimum	Maximum	Mean	Deviation
CQPR	370	0.50	1.88	1.64	0.22
CQPRpred	370	1.28	3.22	2.33	0.34

Note. Table represents lowest 9.10 percent (370) within

Actual CQPR.

Isolating the lowest 9.10 percent of all observed values for CQPR and $CQPR_{PRED,}$ provides a basis for simultaneously comparing the individuals included in the Plebe Intervention Program and the accuracy of the prediction model developed.

Ideally individuals included in the assistance program reflect individuals actually experiencing academic difficulty. Of the 370 cases identified, 154 participated in the Plebe Intervention Program. This reflects a positive identification rate of approximately 41.6 percent. By comparison, 121 cases included in the lowest CQPR group were also included in the lowest $CQPR_{PRED}$ group indicating a positive identification rate of approximately 32.7 percent. This simple comparison indicates that the current selection

process provides more accurate identification of individuals who experience academic difficulty. Specifically, the current process identifies those who have academic difficulty approximately 8.90 percent more effectively than the CQPR prediction model. Table 10 details frequency of identification for academic assistance based upon the current Academic Center selection process and use of the CQPR prediction model.

Table 10

Comparative Analysis of CQPR, CQPRpred, and

PIP Selection Process (N=370)

Frequencies of Subject Variables Within CQPR			
Variable	Valid (N)	Frequency	Percent
ACINTERV	370	154	41.6
CQPRpred	370	121	32.7

Note. Table represents lowest 9.10 percent (370) within Actual CQPR.

Does this mean there is no value added by utilizing the model equation? More in-depth analysis was able to shed some light on this question.

It is important to realize that the positive identification rate of 41.6 percent reflects the total number of participants in the Plebe Intervention Program for the entire year. In other words, many of the individuals who participated in the program were identified after the first six-week grading period. Since previous research indicates earlier identification and intervention can provide more beneficial results toward academic success, it is of value to identify and utilize a selection process that focuses upon accuracy and timeliness. In order to assess the timeliness of the current selection process, the ACINTERV variable was then broken down further to indicate whether an individual was identified prior to or after the first six-week grading period. When developing the ACINTERV variable, several records of data obtained from the academic center archives were utilized. These records indicated when a midshipman entered the PIP. Midshipmen entered the PIP in one of three groups during the semester, the initial group, the first add-on group or the second add-on group. The initial group was identified prior to the start of the academic year. The first add-on group was identified after the first six-week grading period and the second add-on group was identified after the second six-week grading period. All three groups were developed into categorical variables INITIAL, ADDON1 and ADDON2 and combined to develop the ACINTERV variable. For the purpose of further comparison to the prediction model, a descriptive analysis was conducted using SPSS 9.0 to identify how frequently midshipmen were identified to participate in the PIP prior to starting academic classes. The same group of 370 midshipmen with the lowest CQPRs was utilized for this comparison.

A total of only 69 midshipmen, or 18.6 percent within the CQPR group were identified prior to the start of academic year, while 32.7 percent were identified within the $CQPR_{PRED}$ group. While this low identification rate is partially due to the Academic Center's policy of using the first six-week grading period as a secondary feedback identification process, there is a significant amount of intervention time lost due to the lag in identification. Since the prediction model more accurately identifies midshipmen with academic difficulty, (by 14.1 percent) there is significant value-added to the intervention program in utilizing this model as a subjective supplement to the objective criteria currently in use. This would allow for a higher percentage of intervention early in the academic year, thereby providing the individual student more time to implement skills learned during intervention to positively affect CQPR. Table 11 details the frequency of identification for academic assistance based upon both the prediction model and the current Academic Center selection process including only those midshipmen who participated in the program during the first six-week grading period. It is important to recognize that there is a six-week delay in follow-on identification with the current Academic Center selection process and no delay in utilization of the CQPR prediction model. The current process requires this delay in order to obtain six-week academic performance feedback prior to selecting additional PIP participants. Utilizing the CQPR prediction model may alleviate some of this need and allow for most intervention participants to be identified prior to commencement of academic classes.

Table 11

Comparative Analysis of CQPR, CQPRpred, and

PIP Selection Process (N=370)

Frequencies of Subject Variables Within CQPR			
Variable	Valid (N)	Frequency	Percent
INITIAL	370	69	18.6
CQPRpred	370	121	32.7

Note. Table represents lowest 9.10 percent (370) within Actual CQPR.

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

It is abundantly clear that exclusive use of the prediction model developed within this study for identification of all students who participate in the PIP is inappropriate. There are many subjective elements affecting CQPR that cannot be fully addressed by a simple equation. It is also clear that this equation cannot be used to accurately predict actual CQPR for an individual with any significant degree of accuracy. This is evidenced by the low R^2 square value of 0.327. However, there is sufficient evidence to support implementing the CQPR model developed above for the purpose of establishing potential relative performance characteristics among incoming fourth class midshipmen. In other words, this model can be used as a preliminary means of identifying midshipmen for academic assistance with the understanding that it will not provide accurate CQPR prediction, but will provide an educator with a relative performance rating based upon initial entry variables correlated with academic performance. This process could be implemented simply by following a few basic steps.

First, ensure that all initial entry data is collected and formatted correctly in accordance with details provided for each variable in the description section of this study. Second, filter out any invalid entries. Be aware that if there are missing or invalid entries for any included variables of a particular case, the midshipman associated with that case would be excluded from the calculation process. In order to avoid the potential problem of overlooking a midshipman who may need assistance, it would be valuable to perform a

frequency evaluation for each included variable to identify any cases with missing or invalid entries. Once these cases are identified, missing or invalid entries can be obtained or corrected if possible. Third, compute $CQPR_{PRED}$ for each case using Equation (5). In the SPSS 9.0 program, this can be performed using the compute function to create new variable "$CQPR_{PRED}$". Fourth, sort the resulting values in ascending order. The resulting column of data provides a baseline for relative performance. In this case, $CQPR_{PRED}$ could be better described as a predicted class ranking rather than a predicted quality point rating. The fifth step in the identification process would be to review the calculated data implementing subjective criteria such as interviews, recommendations and any other desired input to either strengthen or weaken cases for academic assistance consideration. Finally, assemble the desired number of midshipmen for academic assistance counseling and implement the appropriate program.

The process described above is by no means perfect. It's strength lies in its flexibility. It would be unrealistic to assume that Equation (5), modeled above, could be permanently utilized as a means for identifying midshipmen for academic assistance. Changes in culture, academics, and time may alter the relationships between certain independent variables and the dependent variable $CQPR_{PRED}$. Therefore it is important to maintain a consistent database of information so that historical data may be periodically reviewed to develop new equations for modeling $CQPR_{PRED}$. As additional historical data is gathered, the relationships between each independent variable and the dependent variable may further define themselves and provide a more accurate description of academic performance.

B. LESSONS LEARNED

There have been many lessons learned in conducting this research project. Most have been encountered during the data collection and analysis process. In attempting to establish a valid database of information to include academic grades, LASSI test scores and objective entry-level information, it is imperative that organizations keep some form of standardization in data storage. In discontinuing the use of the NATS system, the Naval Academy was unable to maintain certain pertinent information relative to the academic performance of its students. This loss of data prevented a more thorough analytical process creating a time gap in valid data obtained. Upon realization of this loss of data, the Naval Academy Academic Center has taken steps to ensure that a consistent record is being maintained so that further analysis may be conducted if necessary.

During the cross-tabulation phase of this study, it became readily apparent that accurate prediction of academic performance for an individual would be very difficult to achieve. By introducing such a large number of objective and subjective variables into the prediction equation, the study also introduced a great deal of error into the equation. This error could have been attributed to missing variables and/or relationships between the variables utilized. The key is to realize that perfect or near-perfect prediction is not a realistic goal to achieve. Instead of narrowing goals to achieve perfect prediction and actual performance, researchers may find more benefit in broadening goals to achieve relative performance.

Collection and organization of data for the time period observed consumed a great deal of time partially due to inconsistencies in valid entries. In order to obtain

statistically significant results, it is crucial to spend as much time as necessary during this step in order to ensure that research is conducted using valid data.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

This study has focused upon the prediction of academic performance using objective and subjective criteria for the purpose of assisting the Naval Academy Academic Center in targeting midshipmen who would most greatly benefit from their services. Another avenue of research could involve assessing the differential in academic performance between those midshipmen who participate in the PIP and those of the same relative characteristics who did not. Along those same lines, is there a greater benefit to intervening early in the academic year (initial identification) or waiting to identify those who are already having problems (add-on groups)?

Still another avenue of this same general topic would be to determine whether there is a significant differential in academic performance based upon the time of intervention. In other words, is there a significant difference in the level of improvement for a student who enters the program at the initial level and one who enters as part of the second add on group?

In a follow-on to this study, a researcher could follow the same steps detailed in this thesis to maintain and update the model equation so that any cultural, systemic or database refinement changes would be accounted for in future selection processes. Maintaining the database may also help refine and possibly improve the prediction capability of the model equation.

One last research topic could be to break down the candidate multiple (WMMLT) into it specific components and attempt to determine whether there are specific subjective and objective components of this variable that could be used to predict academic performance. Some of these components, such as high school rank, and SAT's, have been researched for this study. However, there are other aspects that could lend to further research such as the point system used to grade teacher recommendations, blue and gold officer interviews as well as other subjective areas.

The bottom line is that there is a great deal of research still to be conducted in the area of education and educational assistance. Subjective factors may prevent researchers from ever fully describing academic performance, but continued review, insight and statistical research may provide even more evidence to help educators to identify those who require additional assistance to be successful.

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