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Wright-Patterson Air Force Base, Ohio

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AN ANALYSIS OF THE EFFECTS OF THE RIVET SAVE MODIFICATION ON THE PERFORMANCE OF MINUTEMAN CREWMEMBERS IN THE MINUTEMAN EDUCATION PROGRAM

Jack L. Anderson, Captain, USAF
Larry W. Barnett, Captain, USAF

LSSR 31-81

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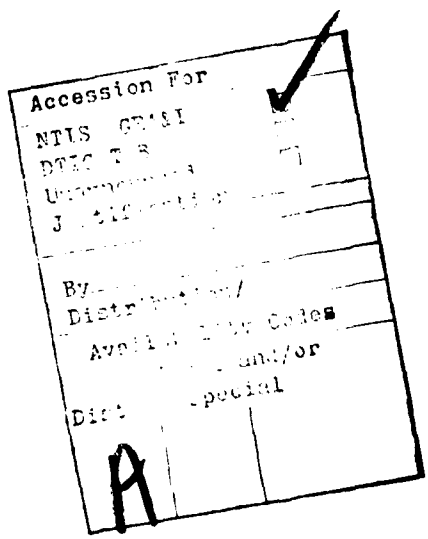

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The Minuteman Education Program (MMEP), which is SAC funded and administered by the Air Force Institute of Technology (AFIT), provides graduate level education programs at each of the six Minuteman bases. The program has been the subject of many past research efforts aimed at establishing its worth as a positive inducement of qualified officers into the missile career field. Little attention has been given to general policies or programs that may detract from the overall attractiveness of the MMEP. The purpose of this study was to evaluate one such program, the Rivet Save modification, and determine its effects, if any, on the performance of Minuteman crewmembers in the MMEP. It was assumed that declining performance would indicate negative effects that detract from the value of the MMEP. The authors concluded that the Rivet Save modification did not produce any significant effects on crewmember quarterly grade point averages (GPA), graduating GPA, or on the time required to complete the degree requirements. There was some evidence produced that demonstrated declining enrollment figures prior to implementation of the modification. Statistical testing yielded results which indicated no significant increases in enrollment following implementation, but did indicate stabilization with a gradual increase in total enrollment.

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AN ANALYSIS OF THE EFFECTS OF THE RIVET SAVE MODIFICATION ON THE PERFORMANCE OF MINUTEMAN CREWMEMBERS IN THE MINUTEMAN EDUCATION PROGRAM

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

Jack L. Anderson, BS
Captain, USAF

Larry W. Barnett, BA
Captain, USAF

June 1981

This thesis, written by

Captain Jack L. Anderson

and

Captain Larry W. Barnett

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Chapter 1

INTRODUCTION

Background

In many remote areas of several midwestern states, Strategic Air Command (SAC) Minuteman missile combat crews are on constant alert, always ready to take action should the unthinkable become reality. The unthinkable is the possibility of a nuclear exchange between the nations possessing offensive nuclear capability. This is an awesome responsibility placed upon the shoulders of these young officers. Recruitment of launch control officers continues to be a problem. Alert duty is normally a very boring activity. Two officers are barricaded behind thick concrete and steel doors in an area no larger than one room in an average house. These long periods underground can have less than desirable effects on motivation, retention, and self-improvement efforts.

Early in the life of the Minuteman weapon system only non-electronic means of occupying crewmember idle time were allowed below ground. These restrictions were necessary due to the sensitive nature of the electronic equipment present in the capsule. Because of these restrictions activities were limited to reading, games,

and so forth. In the mid 1970's electronically shielded televisions and radios were installed in the capsules.

One program which satisfied the need for useful activity during alert, while providing a means for self improvement, was the Minuteman Education Program (MMEP). Funded by SAC and administered by the Air Force Institute of Technology (AFIT), the program offered graduate level education programs at each of the six Minuteman bases. Programs were sponsored by local universities and courses were taught by resident professors.

When crewmembers elected to enter the MMEP program it was virtually guaranteed they would be able to attend classes. Their alert duty schedule was built around their class schedule. Even though MMEP participants had no scheduling problems, classes were considered duty commitments and they were expected to attend.

Prior to July 1977, requirements for two-man control of critical components in the alert capsule required two awake, responsive crewmembers present. Crews were typically on alert for twelve hours, after which time they were relieved by another crew. The crew being relieved then proceeded above ground to spend twelve hours in rest status. After resting, they relieved the on-duty crew and spent the last twelve hours of a thirty-six hour tour on alert. Crews were normally scheduled for five tours of duty per month.

In July 1977 the Rivet Save modification was placed into

effect. The modification included a system of tamperproof seals which allowed detection of unauthorized access to the two-man control components. This modification had a dramatic effect on crew life. It was then possible for one member of the alert crew to sleep in the capsule. This made the requirement for above-ground rest periods unnecessary. Another change that resulted was the restructure of the alert schedule. Crews were scheduled for up to eight twenty-four hour alerts per month. The most significant benefit of this change was the reduction of the number of personnel assigned to crew duty by one-third.

Problem Statement

The reduction of assigned crew personnel reduced the population of potential MMEP participants. Classes were made available to other educationally qualified personnel on a tuition basis. This provided classes of sufficient size to continue the program in a cost effective manner. What was not known was whether the proportion of crewmember participants declined in equal proportion to the Rivet Save reduction of personnel. Also unknown was the comparative success rates in terms of time to complete, quarterly grade point averages, and cumulative grade point averages for crewmember graduates.

Research Questions

1. Since the implementation of the Rivet Save modification has there been a significant proportional change in crewmember MMEP enrollment (Minot AFB only)?

2. Since the implementation of the Rivet Save modification has there been a significant change in the mean time required for crewmembers to complete the MMEP program?

3. Since the implementation of the Rivet Save modification has there been a significant change in the mean quarterly grade point average of crewmember MMEP graduates?

4. Since the implementation of the Rivet Save modification has there been a significant change in the mean cumulative grade point average of crewmember MMEP graduates?

Literature Review

The literature review for this study encompassed two primary areas of concentration: (1) previous AFIT theses concerning the Minuteman Education Program and the missile operations career field and (2) past studies of the MMEP originating from other sources.

Previous AFIT Studies of the Minuteman Education Program

Since the first missile combat crew sat through the first Minuteman alert duty tour, a potentially serious problem has

developed and persisted with little or no relief. The problem of attracting and retaining qualified officers is made very difficult because of the inherent unattractiveness associated with such crew duty. Responses by missile crewmembers to questionnaires used in past studies of the Minuteman Education Program (MMEP), and the missile operations career field in general, have consistently demonstrated at least two very important conclusions. First, the characteristics of the missile operations career field have led to duty which is isolated, monotonous, and rigid, permitting no creativity, and providing little intrinsic satisfaction (8:7). Considering these dour prospects it is easy to envision the difficulties to be encountered during attempts to recruit likely candidates for these tedious positions. Second, the results of past studies have indicated that the MMEP is a key incentive in attracting officers to the missile operations career field (9:168). The MMEP has been identified as the prime motivating factor that has induced qualified officers into the missile field (8:18). In essence, the MMEP was to serve as a reward to be made available to those enduring the hardships associated with missile crew duty.

To date, the MMEP is the only program identified as a successful enticement of officers into the missile operations career field. If events have occurred that deter from the overall appeal of the MMEP, they must be identified and evaluated so that corrective

measures may be implemented in such a way as to preserve the attractiveness and effectiveness of the program. The introduction of the Rivet Save modification in 1977 created dramatic changes for the day to day life style of the crewmember. The magnitude of this modification warrants evaluation as to its effect on the Missile Combat Crew Member (MCCM) and the MMEP. This evaluation should determine if the Rivet Save modification had a detrimental effect on the MMEP and, if so, has it affected the performance of the crewmember in the MMEP.

Past AFIT students have conducted five very pertinent studies that will be expanded on for further evaluation. This research effort identified only those portions of the studies which deal with the MMEP and the overall performance of the crewmembers. The studies of Anarde and Bell, Ashbaugh and Godfrey, Cancellieri and Willoughby, Engel and O'Neill, and Kemp and Rybacki will be discussed separately.

Anarde and Bell. This 1979 study was performed in an effort to identify any possible correlation of MCCM attitudes with Minuteman wing operations performance. In addition, the study explored MCCM attitudes at each different Minuteman wing in order to determine whether or not there were significant attitude differences associated with wing location. Past studies conducted on the MMEP

combined with the results of a revised questionnaire from the Cancellieri and Willoughby study were the basis of this research effort. The authors concluded that while MCCM attitudes differed from one wing to another, MCCM attitudes within each wing had not significantly changed since 1976, and that operations performance did not significantly differ from one Minuteman wing to another. Further, the authors concluded that no basis existed in this study for supporting a relationship between MCCM attitude and Minuteman wing operations performance (1:103).

Ashbaugh and Godfrey. The primary purpose of this 1976 thesis was to determine whether or not MCCM's attitudes, job satisfaction, and retention rates had improved since the formation of the Minuteman Working Group at HQ SAC (2:2-3). The authors collected data through the use of a questionnaire that was essentially a revision of an older research questionnaire designed by Brooksher and Scott during a 1975 research project. Their evaluation of the resulting data produced the conclusions that: (1) the MCCMs did not have favorable attitudes toward either their job or the missile career field; and, (2) MCCM attitudes had not changed significantly from the attitudes observed in prior surveys (2:112-114). Although the research did not produce data to prove it, Ashbaugh and Godfrey suggested that increases in the requests for crew duty extensions

between 1971 and 1975 may have been spawned by the MMEP (2:114-115).

Cancellieri and Willoughby. This 1977 research effort was based on the data obtained from the Ashbaugh and Godfrey questionnaire, and explored potential MCCM attitude difference among the six Minuteman wings (7:7-38). The research proved inconclusive and the evidence was unable to support the hypotheses that: (1) demographic composition of the crew force differed from one wing to another or that (2) any relationship existed between that composition and MCCM attitude at each wing (7:109-112).

Among the questions asked, there were ten which referred directly to the MMEP and its value as perceived by the respondents. Throughout the six Minuteman wings, there was general agreement among the crew members that the MMEP was a distinct advantage of the missile career field. These value perceptions were indicative of sentiments existing prior to the implementation of the Rivet Save modification.

Engel and O'Neill. This questionnaire-based study in 1978 concluded that: (1) MCCMs do not have a favorable attitude toward their job, (2) MCCMs do not wish to remain in the missile career field, (3) the majority of MCCMs who volunteered for crew duty did so because of the opportunity to earn a master's degree through the MMEP, and

(4) MCCMs favor the MMEP because of its academic strength (8:102-108). The results of this research effort indicate that MCCMs do view the MMEP as a valuable inducement for participation in the missile career field. Further, Engel and O'Neill concluded that the MMEP was a definite retention factor worthy of prime consideration (8:107).

Kemp and Rybacki. This research effort further used the Ashbaugh and Godfrey questionnaire, combined with the refinements of the Engel and O'Neill questionnaire, in a 1980 attempt to further define the attitudes of the MCCMs with respect to the MMEP. The dramatic conclusions of this team demonstrated a significant decline in attitudes of MCCMs toward their work schedule and their physical working environment (9:166). They further concluded that while MCCMs still considered the MMEP to be one of the most positive aspects of crew duty, their overall attitudes toward their job and their career field were in a state of decline (9:168).

Other Sources of Studies

Brooksher and Scott. This 1973 study provided a comprehensive review of literature on motivation, morale, effectiveness, and retention of MCCMs (6:12-20). The data base for the study was compiled from the results of three separate surveys designed to produce

three perspectives of the same situation. The first two surveys were sent to 550 senior missile commanders, staff officers, recently retired senior personnel, and middle level staff officers at the 3901st Strategic Missile Evaluation Squadron (SAC). The third and final survey was sent to 479 current and former MCCMs. The data was collected and analyzed under three assumptions: (1) the missile force would be active for the foreseeable future, (2) the missile systems would continue to be manned, and (3) the size of the missile force would be relatively stable (6:8-10).

In a very lengthy statement, Brooksher and Scott concluded that there needed to be an increase in career field motivators like the MMEP, more visible career opportunity, and greater prestige for the MCCM.

Kieklak. The primary purpose of this 1972 research effort was to determine those attributes of missile crew duty that serve to motivate MCCMs. Major Kieklak indicated that the one motivator evident throughout his research was the MMEP. He concluded the MMEP played a significant role in the crewmember's decision to enter the missile career field and to remain in the field if they were so inclined (10:18-19).

Bickerstaff. This very interesting report reviewed the studies of the missile operations career field that were conducted from 1965

through 1973.

The 1973 findings and conclusions of Mr. Bickerstaff indicated that significant numbers of MCCMs were dissatisfied with their jobs (5:67). He went on to say there were a wide variety of reasons for the overall dissatisfaction but they could all be lumped into one category entitled creature comforts (5:79-82). Among the many negative responses Bickerstaff evaluated, there was some positive evidence concerning the value of the MMEP. He found the MMEP to be one of the very few successful motivators common to a majority of the MCCMs in the studies he reviewed (5:82).

Summation of Relevant Findings

The literature reviewed for this research effort focused on the attitudes of the personnel assigned to the various Minuteman units. A common conclusion of each of these studies was that further investigations were needed to ascertain why MCCM attitudes appear to remain stable when efforts to improve their career prospects are an on-going concern.

The thesis by Ashbaugh and Bell in 1976 studied the effect of the SAC Missile Management Working Group on the crewmembers' attitudes. They found that although attitudes in general were poor, the addition of the Minuteman Education Program (MMEP) had stimulated interest in the missile career field and attracted many

volunteers.

These positive effects of the MMEP were confirmed by the Engel and O'Neill study in 1978. Their research effort revealed that although MCCMs do not wish to remain in the missile career field, they do view the MMEP as a valuable asset. Kemp and Rybacki however, using a similar study in 1980, demonstrated that although the MCCM viewed the MMEP as one of the more positive aspects of missile crew duty, there had been a significant decline in their attitudes toward their work schedule and their physical working environment.

The studies conducted by Cancellieri and Willoughby in 1977 and Anarde and Bell in 1979 attempted to link MCCM attitudes to the location of the missile wing and neither could reveal significant statistical data to support this hypothesis. Anarde and Bell also concluded that MCCM attitudes were definitely poor but there was no evidence supporting a relationship between MCCM attitudes and wing operations performance.

The remainder of the studies reviewed for this research effort reveal that during the years the Minuteman program has been in existence there have always been poor MCCM attitudes associated with it. The MMEP proved to be one of the positive factors but it has apparently not helped to increase the level of MCCM job or career satisfaction.

Research Justification

Previous studies in the missile operations career field have served to identify at least one major problem area and at least one major benefit area. The problem area stems from job dissatisfaction that appears to be prevalent throughout the history of the Minuteman weapon system. The off-setting benefit is the ability to complete a master's degree within the MMEP. The combined analysis of these studies tends to indicate that the attitudes of MCCMs have not improved over the years and, in fact, have declined. A further implication is that career dissatisfaction has remained stable in spite of changes in operating policies which may not have influenced the perceptions of MCCMs.

The MMEP has been identified time and time again as the prime motivator for officers to enter the missile operations career field. It is assumed that policies affecting the MMEP could, in turn, affect the attitude of participating MCCMs. This assumption provided the basis for the need to fully evaluate all possible effects of policy changes on the MMEP.

One such major policy change occurred when the Rivet Save modification was implemented. This program drastically altered the daily patterns and schedule structures for all MCCMs. These alterations may or may not have altered the ability of the MMEP to adequately meet the needs of the MCCM. It is assumed that an

adverse effect on the MMEP would lead to increasing dissatisfaction, decreased MMEP enrollment, and a decrease in MCCM performance in the MMEP.

The MMEP has proven itself a valuable program in the past and there is no reason to believe it cannot continue to perform in this valuable role. If this is to be the case, we must insure that associated factors and policies are not causing inadvertent and detrimental effects on the program. An analysis of past research efforts combined with current data on MCCM classroom performance should reveal conclusive insights into the current value of the MMEP.

Chapter 2

METHODOLOGY

The Population

The population consisted of 480 officers graduating from the MMEP between January 1975 and December 1979 who remained on active duty as of November 1980. A computer printout of these individuals allowed determination of those who possessed either 1825 or 1823 Air Force Specialty Codes (AFSCs). This identified the individual as having been either a Minuteman crew commander or deputy crew commander. Graduates not possessing one of these two AFSCs were excluded from the survey. Due to the fact that the MMEP program at Ellsworth AFB, South Dakota, is administered on a semester basis, graduates of that program were also excluded. This left 254 active duty graduates of the remaining five MMEP programs. The programs at Malmstrom AFB, Montana; F.E. Warren AFB, Wyoming; Whiteman AFB, Missouri; Grand Forks AFB, North Dakota; and Minot AFB, North Dakota were all administered on an academic quarter basis.

Data Collection

The major source of data for the project was individual officer education records held by the AFIT Records Repository (RR) at Wright-Patterson AFB, Ohio. This facility maintained education records for all active duty Air Force officers. Individual records were pulled and the data collected included the quarter first enrolled in graduate school, last quarter enrolled prior to graduation, grade point average for each quarter enrolled, and cumulative grade point average at graduation.

Because of the ready accessibility of the data, the researchers were able to survey the entire population. The relatively small population justified this decision in the interest of improved accuracy of results.

The listings of data were arranged into classes by quarter and computerized for storage and evaluation. The classes were numbered from one to twenty with number one representing the first quarter of 1975 and number twenty representing the last quarter of 1979. Each class then contained all of the selected data for the quarter represented.

In order to facilitate the evaluation of the classes of data, a computer program was selected to determine the number of cases within each class and the mean of each class. The Statistical

Package for the Social Sciences (SPSS) is a complete system of computer programs designed for the analysis of social science data (14:1). The Condescriptive subprogram in SPSS was chosen because of its ability to calculate descriptive statistics for continuous data. The outputs of this program provided the inputs to the time series analysis portion of this research.

Time Series Analysis

The output from the SPSS program was then separated into two divisions with the lower division containing classes one through ten and the upper division containing classes eleven through twenty. The lower division included results produced prior to the introduction of the Rivet Save modification while the upper division included results produced after the Rivet Save modification. A time series analysis was applied separately to each division of data and to each variable (time to complete MMEP, total enrollment, quarterly GPA, and graduating GPA).

Time series analysis refers to the study of the movement of a series of data through time (11:358). This type of analysis allowed compensation for additional factors that could have had significant but short-term effects on any one of the four variables being analyzed. The time series analysis was selected because of its ability to either identify the existence of a trend or to demonstrate the absence of a

trend. Trend is defined as the influence of long-term factors whose effects on the situation tend to change gradually (13:611). The assumption was made that whether a trend existed or not, the condition could be most accurately modeled by use of the linear trend function.

The linear trend function is used to predict T_t when the $Y_{t's}$ are known:

$$T_t = b_0 + b_1 X_t$$

where:

T_t = the trend value

t = the period ($t = 1, \ldots, n$)

X_t = a numerical code denoting period t

b_0 = the Y intercept of the trend line

b_1 = the slope of the trend line

Y_t = observed value during period (13:615)

By substituting Y_t into the model, b_0 and b_1 could be computed using the method of least squares (13:439). The criterion of least squares states that the best fitting curve of a given type is the one from which the sum of the squared deviations of the data is least (15:593). Using this method of least squares, the trend line was fitted by finding the values of b_0 and b_1 that minimize the sum of the squared deviations

from the trend line. To accomplish this a computer program for regression analysis was used.

After obtaining a trend value for each of the stated variables, hypothesis tests were conducted to determine if significant changes had taken place since implementation of the Rivet Save modification. Using an alpha level of .10, tests were conducted to determine if each trend line (slope) was significantly different from zero. For the purposes of this research it was postulated that no trend should be identified before or after Rivet Save. Using alternatives:

$$H_0: \beta_1 = 0$$

$$H_1: \beta_1 \neq 0$$

the decision rule was:

if $F^* \leq F(1-\alpha; 1, n-2)$, conclude H_0

if $F^* > F(1-\alpha; 1, n-2)$, conclude H_1 (13:480)

The computation of F* was:

$$F^* = \frac{MSR}{MSE}$$

where:

MSR = regression mean square

MSE = error mean square (13:455)

The F* value is a computed value generated by the regression analysis program. The critical value of F is a value obtained by consulting a published table. In this case, with an alpha level of $\alpha = .10$, one degree of freedom in the numerator of F, and a sample size of n = 10, the table indicates that $F(.90;1,8) = 3.46$ (4:97). Since the alpha level, degrees of freedom, and sample size are equal for each variable, the critical value of F was the same for each statistical test.

A fitted trend line is the line which minimizes the squared differences between plotted points (13:615). Comparing the fitted trend line for each variable before and after the modification was expected to indicate any change in trends. Interpretation of the results of the hypothesis tests indicated that if the null hypothesis had been accepted for any variable in both the upper and the lower divisions, no significant change had occurred. If, however, the null hypothesis had been rejected for one division and accepted for the other division of the same variable, a significant change would have occurred. If the null hypothesis had been rejected in both divisions and the sign of the slopes were the same, no significant change had occurred. The fourth and final alternative would have occurred if the null hypothesis had been rejected for a variable in both divisions and the signs of the slopes were not alike. This would have indicated that a very significant change had occurred.

Summary

It was the intent of this research effort to determine if the implementation of the Rivet Save modification had any effects on the performance of crewmember participants in the Minuteman Education Program. Data was collected for individual graduates and assembled by academic term. A time series analysis was used in an attempt to determine if a significant trend had developed during the period before or after the Rivet Save modification. Then, any identified trends for a given variable were compared to the trend for the same variable for the opposite period. By comparing the two periods the possibility of a causal effect of the Rivet Save modification could be identified.

Chapter 3

DATA ANALYSIS

Introduction

This chapter describes the analysis of the data collected for this research and provides the results of data analysis conducted to answer the research questions in Chapter 1. Discussion of the results of hypothesis testing will be presented along with any relevant findings.

Data Presentation Format

The presentation of data will be in the order of the research questions presented in Chapter 1. The research question will be restated and the analysis will be in a discussion format. Included in the discussion will be an analysis of the hypothesis and the statistical testing procedure used to provide answers to the research questions. The analysis of each research question will be presented in the following format:

1. The research question will be restated.

2. Tables will be cited and used to present the data obtained during the research. Where applicable the table will include the

class size, class mean, and standard deviation.

3. Figures will be cited and used to illustrate the results of the time series analysis. A statement of the findings of the statistical test will be presented.

4. Comments will be made to highlight observations or note key points.

Research Question #1

Since the implementation of the Rivet Save modification has there been a significant proportional change in crewmember MMEP enrollment? The data used to analyze this question was obtained by research conducted at Minot AFB ND. This reduced scope was forced due to data availability and accessibility at that location as opposed to other MMEP locations.

Data contained in Table A-1 was obtained from unofficial records compiled by the secretary to the resident administrator of the MMEP (3). Prior to July 1977, authorized manning at Minot AFB was 257 crewmembers (16). After the reduction for Rivet Save the crewmember manning was reduced to 180 (12). Manning remains at that level to the present time. Using the figures presented in Table A-1 for crewmembers enrolled in classes the proportions of total crewmembers were computed using the authorized levels and are presented in Table A-2.

Figure B-1 illustrates the plots of proportions enrolled prior to July 1977. By using time series analysis the trend was identified and is illustrated by the negative sloping line on the graph. Figure B-2 illustrates the proportions after the July 1977 change. The trend identified for this data had a slight positive slope.

By comparing the F-critical value of 3.46 to the obtained value for the data from Table B-1 the hypothesis that the slope was equal to zero was rejected and it was assumed that the proportion of enrollment prior to the July 1977 change was declining. Using the same F-critical value for comparison to post-July 1977 data the null hypothesis was accepted. It is assumed that for that period although there seems to be a slight proportional increase in enrollment it was not statistically significant. The trend shows no change in enrollment.

Research Question #2

Since the implementation of the Rivet Save modification has there been a significant change in the mean time required for crewmembers to complete the MMEP program? The data used to answer this question was obtained from all MMEP locations with the exception of Ellsworth AFB SD.

Table A-3 contains the mean time in quarters required for completion of the MMEP. These figures are based on the quarter

in which a student graduated. For example, a student graduating in quarter 1 began graduate courses 12.71 quarters prior to the end of that quarter.

Figure B-3 illustrates the plot of means and the obtained trend function prior to July 1977. As with the enrollment data a slight decline in time was noted. Figure B-4 shows the plot and trend function for data after July 1977. Again a negative slope to the trend function was noted.

When testing the hypothesis that the slope was equal to zero in both periods the F value obtained was less than the F-critical value of 3.46. Thus the null hypothesis was accepted in both cases and it was assumed that there were no significant changes in the time required for graduates to complete the MMEP.

Research Question #3

Since the implementation of the Rivet Save modification, has there been a significant change in the mean quarterly grade point average of crewmember MMEP graduates? The data used to answer this question was collected only for graduates of the program. Participants who did not graduate were not included in the research.

Table A-4 reflects the number of observations in each quarter and the mean grade point average. Of interest was the tendency for the mean to be high during summer quarters 3, 7, 15, and 19.

During the eleventh quarter the mean was the second lowest of the entire period. This quarter also was the first after the scheduling change of Rivet Save.

Figure B-5 illustrates the plot of mean quarterly GPAs for the first period. A very slight decline is indicated by the trend function. As shown in Figure B-6 the mean quarterly GPAs after the change showed a positive trend. This was due in large part to the unusually high mean in quarter 19. Due to the small number of observations in this class the results may be misleading.

Comparison of obtained F values with the F-critical value of 3.46 again proved inconclusive. The null hypothesis was accepted in both cases and it was assumed there has been no significant change in graduate quarterly GPAs.

Research Question #4

Since the implementation of the Rivet Save modification has there been a significant change in the mean cumulative grade point average of crewmember MMEP graduates? The data for this analysis included graduating GPAs for 254 MMEP graduates?

Table A-5 contains the mean graduating GPAs. As with previous analysis the small class sizes in quarters 19 and 20 may be significant. Of interest is the exaggerated standard deviations for these two classes when compared to the other classes.

The plot of mean cumulative GPAs for the first half of the study are seen in Figure B-7. There seems to be a slight positive trend. Figure B-8 contains the plot for the last half data and here there is a slight negative slope to the trend line. Once again testing the hypothesis that the slope of the trend is equal to zero it was determined that the obtained F value was less than the F-critical value of 3.46 in both cases. Therefore the null hypothesis was accepted for both periods and it was assumed that there was no significant change in mean cumulative GPA for either period.

Summary

The results of data analysis on the four variables were not conclusive. A negative trend for enrollment figures during the first period was curbed during the second period. Results for completion time, quarterly GPA, and cumulative GPA revealed no significant trends either before or after the change implemented in July 1977.

Chapter 4

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter states the significant findings of this research effort as they pertain to the specific research objectives. We conclude by offering some general recommendations for further research concerning the missile operations career field, the Minuteman Education Program, and the effects of the Rivet Save modification program.

Conclusions

The primary objective of this research was the investigation and evaluation of effects of the Rivet Save modification on the participation and performance of MCCMs in the MMEP. This research effort did not produce any evidence that the Rivet Save modification may have significantly affected the performance of MCCMs in the MMEP. With one exception, the statistical tests resulted in an acceptance of the null hypotheses, proving that the Rivet Save modification had no significant effect on: (1) the time to complete the MMEP program, (2) the mean quarterly grade point averages of

crewmember MMEP graduates, and (3) the mean cumulative grade point averages of crewmember MMEP graduates.

The one exception occurred as a result of the analysis of enrollment data from the Minot AFB MMEP. The time series trend analysis indicated a significant decline in enrollment figures prior to the implementation of the Rivet Save modification. Following implementation, the negative trend was halted and enrollment began a slight increase. Although this increase did not prove to be statistically significant, the evidence suggests a possible benefit associated with the modification. Any conclusion, however, would have been premature at this point because of the small sample size and the lack of a statistically significant increase.

A possible explanation for the declining enrollment prior to the modification may hinge upon the fact that a large personnel reduction was being anticipated by the crew force. Prior to the July 1977 implementation, crewmembers were asked to volunteer to transfer in order to reduce manning. It is plausible that those anticipating early release from crew duty would not start the MMEP knowing that completion possibilities were remote. It is also possible that those notified in early 1977 of pending transfer would drop from the program because of insufficient time remaining to complete the degree requirements.

In conclusion, this research produced no evidence that the

Rivet Save modification produced any ill effects on the MMEP. In fact the only effects evident, appear to either enhance the program or not affect it at all. Future research may prove more definitive in this area.

Recommendations

Suggestions for further study on this subject center around three areas. These include expanded data retrieval, alternative performance factors, and graduate's attitudes toward MMEP policies. Research in these areas may provide insight for future personnel policy changes which may affect the MMEP.

Data for this effort included performance figures for graduates remaining on active duty as of November 1980. Although admittedly difficult to obtain, data on other graduates who have either separated or retired may be useful in revealing some unidentified trend. Researchers may not be able to obtain sufficient data of this type from school authorities. Another source might include graduates who have since left the service. Expansion of the period studied could also yield results. Comparison of performance factors for crewmember versus non-crewmember graduates is an area that could be attempted.

The second category which may be considered for further research would involve study of alternative performance factors.

For instance, what was the relationship between job performance of MMEP participants as compared to non-MMEP personnel? Due to the length of time which has elapsed since the Rivet Save change it becomes necessary to expedite any study requiring direct contact with participants due to problems of attrition. Direct contact with graduates might be the only way to obtain data concerning perceived value of the program when applied in a military atmosphere.

The last category for possible future research involves MMEP participant attitudes toward policy changes in the program. For example, scheduling of classes before Rivet Save involved fifteen days for each quarter. After the change, classes were scheduled for ten days per quarter along with an appropriate change in individual class length. This may have had some effect on performance or attitudes of participants. Another possible question that needs to be answered involves the attitudes of the participant's family toward MMEP enrollment. Since time spent in MMEP would otherwise be free time, some dependents may resent giving up scarce family time. Here again, this would suggest use of a direct contact mode of data retrieval which will become increasingly more difficult with the passage of time.

It is imperative that analysis of effects and benefits of the MMEP be continuously evaluated. This is because the program has been used to attract volunteers to the missile operations career

field. If the program begins to disappoint participants it may become desirable to change the program, provide other incentives to volunteers, or find an acceptable replacement. Objective research on these subjects can provide invaluable information to policy makers who will be making decisions effecting the future of the MMEP.

Epilog

While this research effort found no conclusive statistical evidence of a relationship between the implementation of the Rivet Save modification and performance of MCCM in the MMEP, the efforts to study and identify factors that may detract from the missile career field must continue. The list of undesirable facets of monotonous alert duty is long and comprehensive. The role of the MCCMs in this nation's defense is too critical to permit us to allow the degradation of our ability to attract highly motivated candidates into the career field.

APPENDICES

APPENDIX A

RESEARCH DATA

Table A-1

Minot AFB MMEP Participation By Quarter

Quarter	18XX In Class	18XX Out	18XX Independent Study
1	82	12	12
2	81	18	12
3	70	15	21
4	71	13	18
5	78	9	14
6	73	14	15
7	64	17	11
8	75	5	14
9	73	8	13
10	65	4	25
11	40	20	16
12	49	13	13
13	66	5	9
14	61	8	17
15	56	10	14
16	61	10	14
17	59	14	13
18	56	16	18
19	44	23	20
20	53	15	16

Table A-2

Minot AFB Crewmember Enrollment Proportions

Quarter	Proportion Enrolled
1	.32
2	.32
3	.27
4	.28
5	.30
6	.28
7	.25
8	.29
9	.28
10	.25
11	.22
12	.27
13	.37
14	.34
15	.31
16	.34
17	.33
18	.31
19	.24
20	.29

Table A-3

Time to Complete MMEP

Quarter	Class Size	Mean (Qtrs)	Std. Dev.
1	17	12.71	4.83
2	17	10.58	4.17
3	7	12.57	4.72
4	14	9.21	2.36
5	9	10.89	3.30
6	17	11.88	6.25
7	12	10.92	2.27
8	18	10.17	3.60
9	15	10.13	3.40
10	10	12.30	4.37
11	17	9.71	4.06
12	12	11.17	4.80
13	13	11.54	6.21
14	20	13.20	3.89
15	12	10.58	2.75
16	9	9.67	1.94
17	11	11.36	2.58
18	17	10.29	4.79
19	2	8.50	3.54
20	5	9.60	3.29

Table A-4

Mean Quarterly GPAs

Quarter	Class Size	Mean	Std. Dev.
1	128	3.489	.551
2	114	3.431	.509
3	83	3.592	.478
4	115	3.443	.512
5	126	3.481	.480
6	108	3.390	.563
7	103	3.478	.533
8	119	3.383	.512
9	100	3.489	.510
10	96	3.497	.510
11	90	3.363	.514
12	79	3.405	.480
13	62	3.460	.500
14	67	3.532	.526
15	49	3.429	.540
16	41	3.512	.586
17	34	3.331	.556
18	26	3.487	.459
19	8	3.625	.582
20	5	3.500	.548

Table A-5

Mean Cumulative GPAs

Quarter	Class Size	Mean	Std. Dev.
1	17	3.44	0.23
2	17	3.51	0.21
3	7	3.39	0.29
4	14	3.56	0.23
5	9	3.40	0.31
6	17	3.54	0.26
7	12	3.45	0.26
8	18	3.51	0.25
9	15	3.48	0.25
10	10	3.45	0.31
11	17	3.31	0.22
12	12	3.50	0.30
13	13	3.44	0.26
14	20	3.44	0.33
15	12	3.39	0.26
16	9	3.50	0.22
17	11	3.34	0.28
18	17	3.43	0.35
19	2	3.47	0.66
20	5	3.32	0.53

APPENDIX B

TREND FUNCTIONS

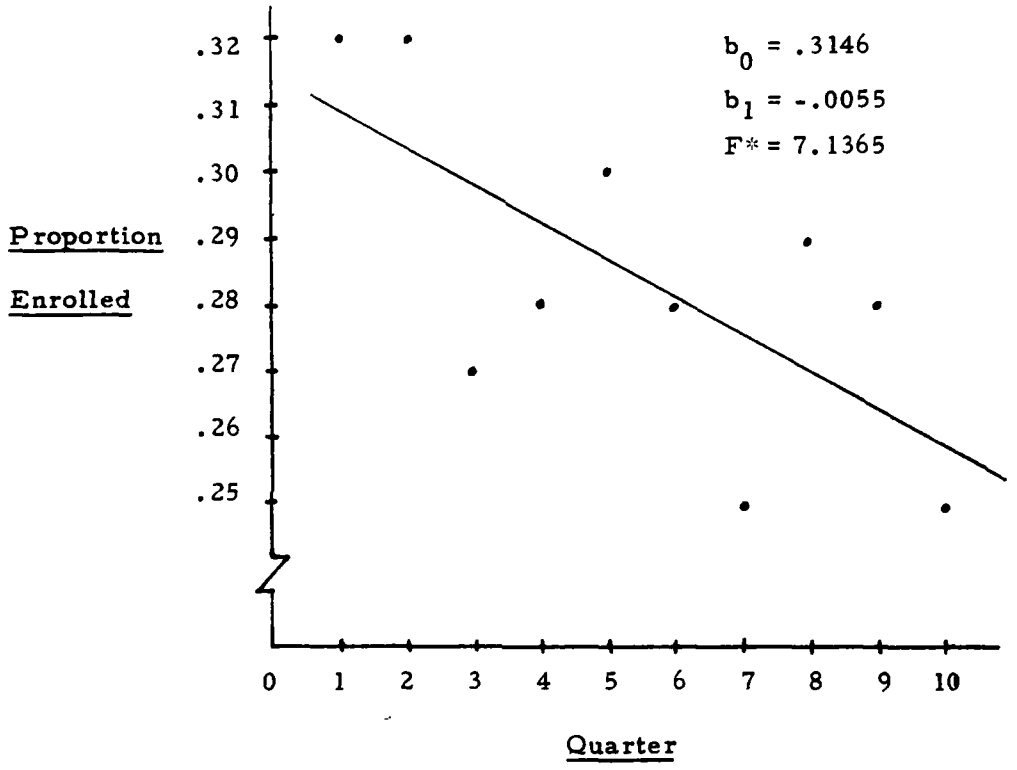

Figure B-1: Lower Division Enrollment Trend Function

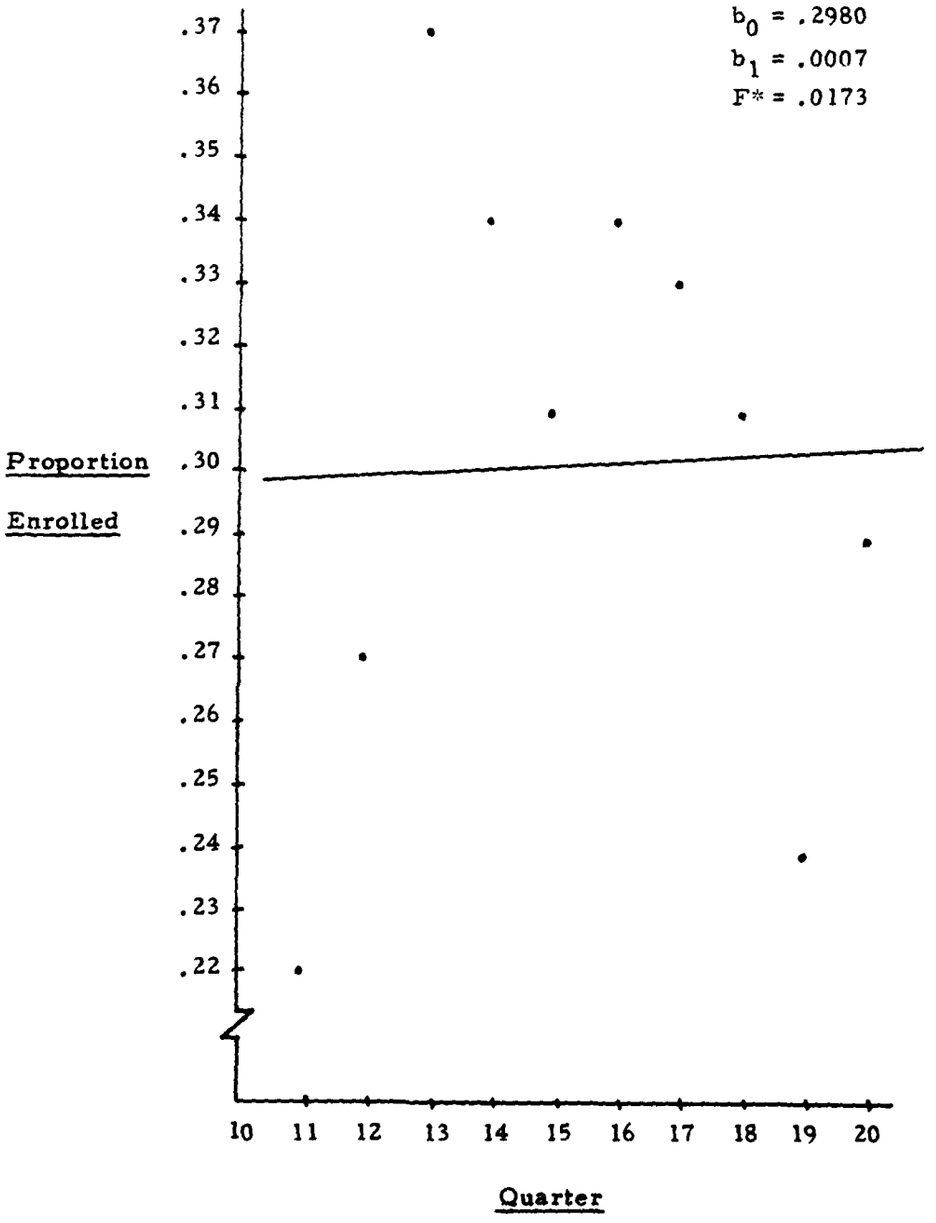

Figure B-2: Upper Division Enrollment Trend Function

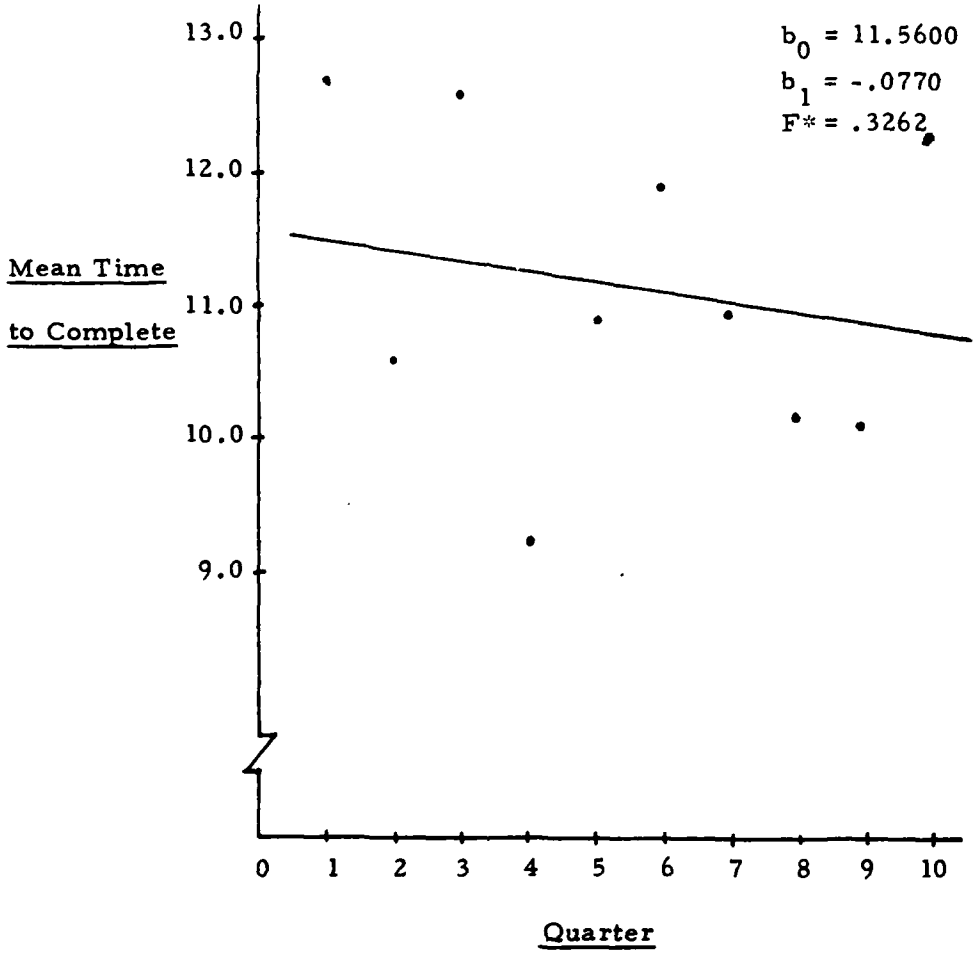

Figure B-3: Lower Division Completion Time Trend Function

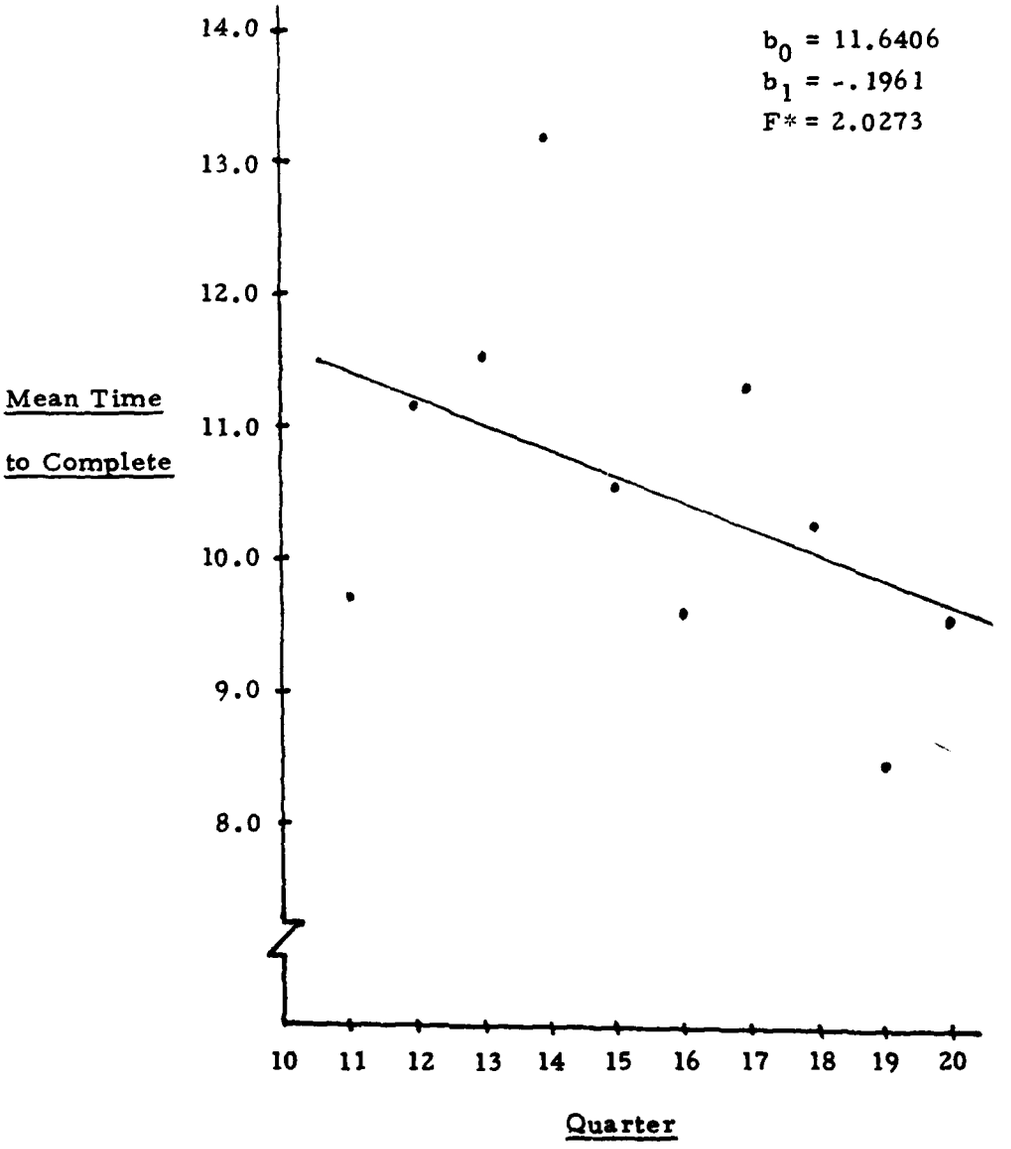

Figure B-4: Upper Division Completion Time Trend Function

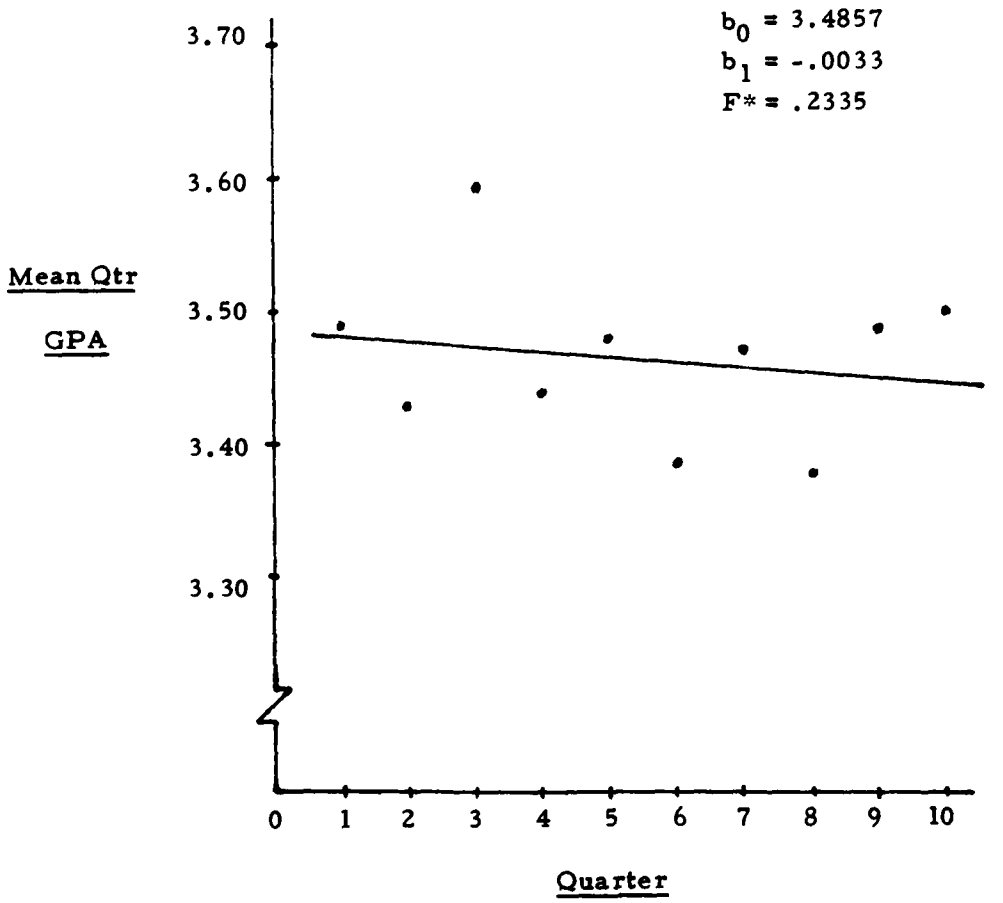

Figure B-5: Lower Division Mean Quarterly GPA Trend Function

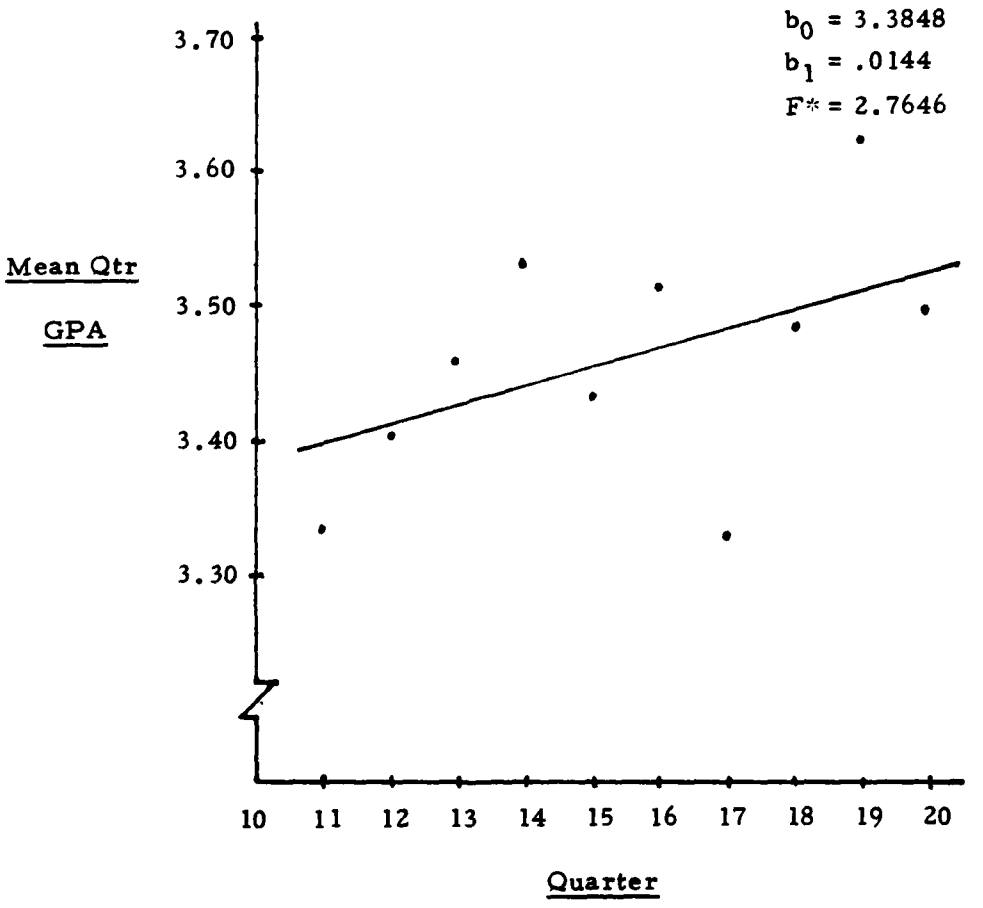

Figure B-6: Upper Division Mean Quarterly GPA Trend Function

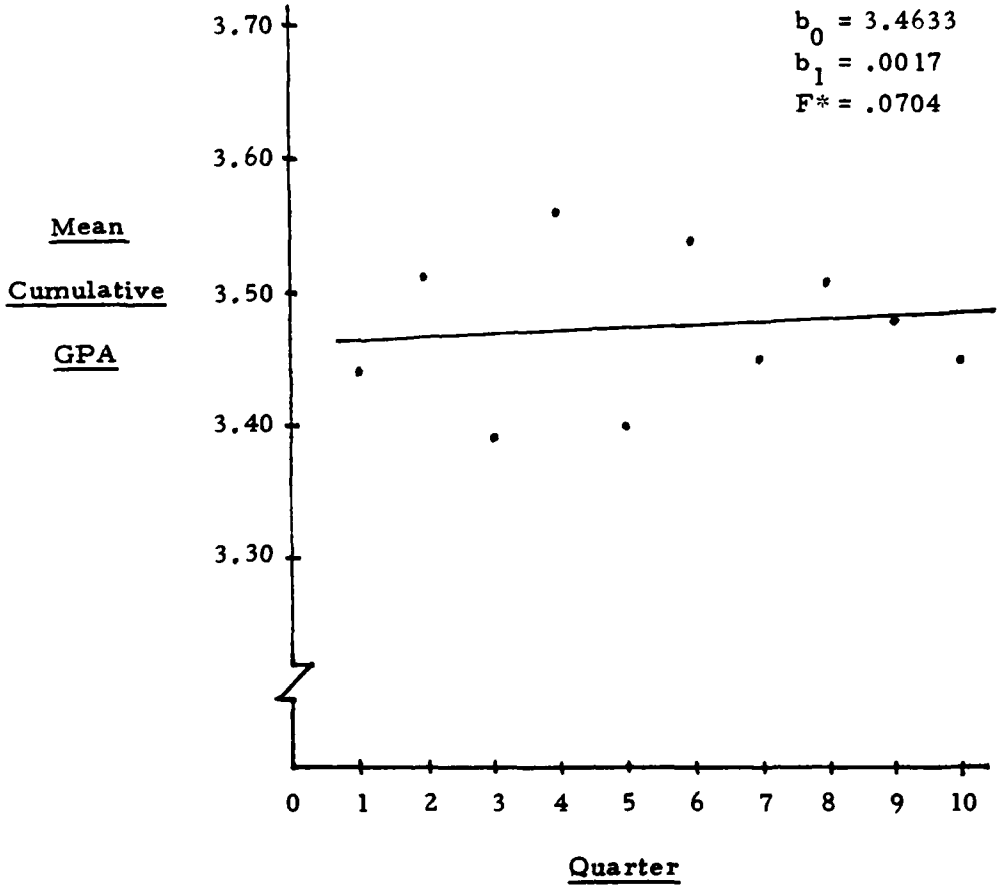

Figure B-7: Lower Division Mean Cumulative GPA Trend Function

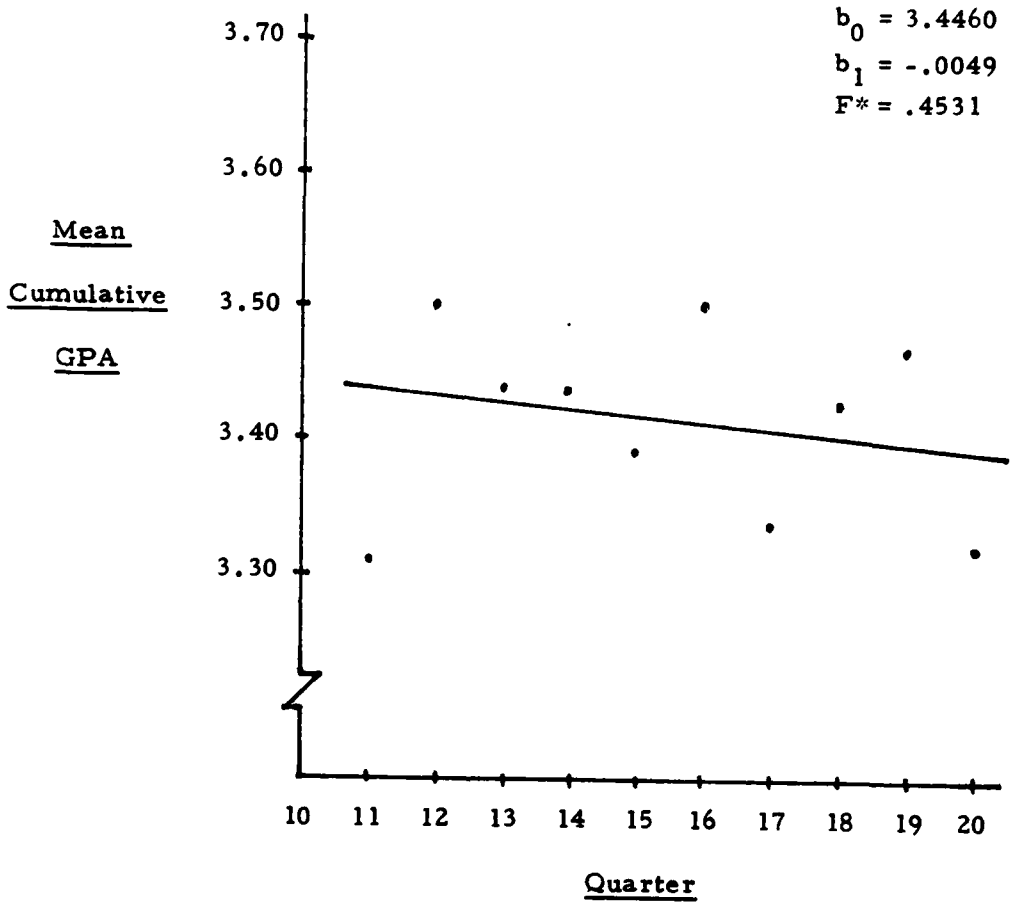

Figure B-8: Upper Division Mean Cumulative GPA Trend Function

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