DEFENSE EQUAL OPPORTUNITY MANAGEMENT INSTITUTE

DIRECTORATE OF RESEARCH

DISPARITIES IN MINORITY PROMOTION RATES: A TOTAL QUALITY APPROACH

Fiscal Years 1987-1991

by

Dr. Carol A. Robinson

and

LT Steven S. Prevette, USN

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PREFACE

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SUMMARY

Problem

Promotion rates by race and gender are not equal in the military services. However, which differences represent "true" equal opportunity problems and which are due to random variability in small populations? This question must be answered in order for affirmative action programs to be effectively implemented and their usefulness measured.

Purpose

The primary purpose of this report is to analyze the promotion data in the 1987 to 1991 Military Equal Opportunity Assessments. In addition, an attempt was made to identify factors that relate to these problem areas.

Approach

The promotion board results were analyzed using a Total Quality approach. Control charts were utilized to aid in distinguishing random variation in promotion results from significant differences in underlying promotion opportunities.

Promotion board data were investigated for statistically significant promotion rate differences among races and gender. Observed differences in rate were compared against the likely differences that could result from random variation in a baseline model where each individual has an equal probability of promotion. If the observed promotion differences were significantly greater than that which the random baseline model might create, then these promotion results are flagged as significantly different. The significance level used in this report was 3 standard deviations (3-sigma), in accordance with current standards for control charts.

Related background information was gathered and cognizant points of contact were identified. In addition, a model to identify reasons for promotion disparities was initiated.

Results

1. The Navy E-7 board produces the most significant differences between males of different races. Black males have been promoted at 3 standard deviations less than the board average in every year from 1987 to 1991. In 1990 and 1991, every minority male group was promoted at less than the board average. White males were promoted at 3 standard deviations above the board average in four of the five years.

2. Black males are the most under-promoted race/gender group. The specific boards with the most negative results from 1987 to 1991 were the Air Force E-8, E-9, O-4, and O-5 boards; the Army E-7, E-8, and E-9 boards; the Navy E-7 board; and the Marine Corps E-7, E-8, and E-9 boards. Black males were promoted at below the board average in 52 of the 55 promotion boards held in these categories. Black males were promoted at 3 standard deviations below the board average in 18 of these boards.

3. The Army officer boards have been repeatedly (eight out of eight officer boards from 1989 through 1991) promoting White males at slightly below the board overall average rate. In every board, females were promoted at greater than the board average, and non-White males were promoted at greater then the board average in seven of the eight boards. Although no individual board result was in itself significant, this pattern over eight boards is sufficient to warrant further investigation.

Conclusions

Promotion board results vary significantly with race and gender. The most racially biased results are from enlisted E-7 and E-8 boards.

1. The current Military Equal Opportunity Assessments are not effective at presenting promotion result differences.

2. The control chart is an effective method of analyzing and displaying promotion board results.

3. The development of a model to help in the identification of reasons for promotion disparities is feasible and would be a valuable tool to target areas for research and development.

Recommendations

1. Conduct further investigations into the source of these significant differences in promotion rates, utilizing control chart analysis for other demographic and personnel data as it relates to promotion opportunity.

2. Utilize Total Quality methods (including control charts) to analyze all equal opportunity data. Use Total Quality methods to identify problem areas, and to plan, implement, and check the results of affirmative action programs.

3. If differences in promotion rates from race to race are due to differing qualification levels in the individuals in each race, utilize a Total Quality approach to identify specific weaknesses which are barriers to promotion. Implement corrective action programs which will raise every person's qualifications for promotion. This will serve to increase the quality of all individual service members, and tend to decrease the difference in qualification levels between the races.

4. Continue the effort to analyze the E-7 promotion board processes in order to identify barriers to promotion for minority males and develop strategies to overcome these barriers.

INTRODUCTION

Problem

The Department of Defense desires to ensure equal opportunity for promotions and advancement for all personnel. In cases where opportunity for promotion are not equal, then corrective and affirmative actions need to be implemented to create equal promotion opportunities.

An accurate assessment of the existence or non-existence of differences in promotion opportunities between races and genders is vitally important in order to apply affirmative action initiatives. It is therefore necessary to analyze the question:

> Are promotion rates for each race and gender combination within each Department of Defense promotion board the same as the overall promotion rate for the respective board?

In addition, a model needs to be developed that will enable military leaders to identify possible reasons for promotion disparities and initiate possible corrective actions.

Purpose

One purpose of this project is to provide a statistical analysis of the hypothesis that promotion rates are equal for each race and gender. It will identify the promotion boards and the races and gender where the promotion rates are statistically significantly different. This report will also provide a methodology to identify statistical significance through the use of control charts and Total Quality Management. Through the use of these methods, true equal opportunity problem areas may be detected, analyzed for potential corrective actions, and the impact of implemented corrective actions verified. This follows the "Plan, Do, Act, and Check" cycle used in Total Quality Management.

This report provides an across-the-board look at promotion rates in the Department of Defense from 1987 to 1991. Although the annual assessments by each service have listed promotion data, no attempt has been made to statistically test the data. Each service has analyzed only its own promotion data, and minimal analysis of trends from year to year has been performed.

A second purpose of this project is to gather preliminary background information, identify data sources, and establish cognizant points of contact. These types of information will serve as a resource data base for future equal opportunity related research.

Background

Department of Defense Instruction 1350.3 states:

> It is DoD policy for the Military Services to monitor and report on selected dimensions of their personnel programs to ensure equal opportunity and fair treatment for all Service members through affirmative actions and other initiatives. It is the prerogative of the Services to establish requirements for affirmative action plans and assessments at organizational levels below Service headquarters.

This instruction further specifies that each Service will provide an annual Military Equal Opportunity Assessment (MEOA). Specifically, promotion data is to be reported using DD Form 2509 (Appendix C).

The annual Military Equal Opportunity Assessments include the number of personnel considered and the number of personnel promoted, broken down by the following categories (per DODI 1350.3):

1. Service. The Army, Navy, Air Force, and Marine Corps each generate an assessment of their respective data.

2. Fiscal Year. These assessments are published annually. Each report contains the current year data and the previous three years. Data for fiscal year 1987, 1988, 1989, 1990, and 1991 were analyzed for this report.

3. Rank. At a minimum, the assessments contain data for senior enlisted advancement (to E-7, E-8, and E-9) and data for middle grade officer promotions (to O-4, O-5, and O-6).

4. Race. Data are to be provided for the following categories:
   - American Indian and Alaskan Native
   - Asian American and Pacific Islander
   - Black (Non-Hispanic)
   - Hispanic
   - White (Non-Hispanic)
   - Other or Unknown

5. Gender. Each of the races is to be further sub-divided by gender (Male or Female).

The personnel considered are the number of personnel that were "in-zone" for the respective promotion.

The MEOA is also to include a numerical and narrative comparison of the data over time for evidence of change or relative fluctuations. Currently, the MEOA contains no analysis of whether the observed promotion differences signify equal opportunity problems, or are simply due to random chance.

The sources for the data in this report were the Fiscal Year 1990 Military Equal Opportunity Assessment for each Service, and advance copies of the promotion data for the 1991 assessments. These advance copies were provided by the individual Service Equal Opportunity organizations.

Method

The primary graphical analysis tool used in this report is the control chart. Control charts have been used in industry for analysis of repetitive processes. The control chart is used to investigate individual outputs and to perform rudimentary trend analysis. Control charts display each individual result versus the overall average result. Control limits are also established which are three standard deviations (3-sigma) from the average result. If an individual result is outside the 3-sigma limit, then the process is "out of control." Results outside of the 3-sigma limits represent points that are highly unlikely to occur simply due to random variation, and are statistically significant.

The concept of statistical significance is extremely important. Without it, affirmative action initiatives may be applied to observed differences in promotion rates which may have occurred due to chance variation. The small populations in some minority categories may lead to apparent differences which are false alarms and do not require action. On the other hand, an apparently slight difference in promotion rates between two reasonably large groups may be overlooked when the difference is actually highly significant and may affect hundreds of persons.

In order to assess the observed differences in the promotion rates, one may use a random promotion process as a baseline model to compare with the actual observed results. In the random model, one assumes that every individual in the population has an equal probability of being promoted. Each individual's promotion or non-promotion is decided purely randomly and is independent of any other individual. Any differences in results between individuals or groups of individuals is due to random variation.

An observed difference in promotion rates between two actual groups in a population can be expressed in terms of the probability that the random process model (with an equal promotion probability for each individual) could generate such a result. This probability that the random process could produce the observed result is the statistical significance level. The statistical significance level may also be thought of as a "false alarm" rate. If the random model should only produce as severe a result as was actually observed in one of one thousand like promotion boards, then the significance level is 0.001. In terms of the "false alarm" analogy, if one were to declare these two groups' promotion rates are "different," there would be a 0.001 chance that the declaration is in error--that instead these differing promotion results were simply generated by random chance and the baseline probability for each person's promotion was equal.

Statistical significance levels may be used to assist in differentiating between differences in promotion rates due to random variation and due to "true" equal opportunity problems. The statistical thresholds or control limits between probable random variation and "true" problems may be plotted on a control chart. The control chart is an effective graphical tool for finding significant differences in promotion rates between races and gender.

A literature search was conducted with the assistance of the Defense Equal Opportunity Management Institute library. Literature was obtained through this library and through inter-library loans. Primary researchers in the field and representatives at various Department of Defense organizations were contacted to acquire information and serve as points of contact for future efforts.

An additional task, although not a part of the formal tasking, was an attempt to develop a model to aid in the identification of the causes of differences in promotion rates. Such a model would also be useful for initiating affirmative actions. The approach taken was to define and analyze the promotion board process for a specific rank and service. The rank or Service chosen would be based on the promotion board data analysis results. Several events in the promotion board process that might retard the advancement of a population sub-group were identified. The defining of the board process was accomplished by review of Department of Defense directives, and telephone interviews to cognizant individuals.

The use of control charts and statistical significance are important factors in Total Quality methods. The application of Total Quality includes separating random variation from variation with underlying causes. In this manner, apparent equal opportunity problems may be identified, prioritized, and corrective actions implemented. Following up of corrective actions with further data analysis is also required. Total Quality and Equal Opportunity share many common goals, and the tools of Total Quality are applicable to Equal Opportunity affirmative actions.

CURRENT MEASUREMENT TECHNIQUES

The purpose of discrimination measures is to provide means to assess the need for affirmative action, and the impact of affirmative actions taken. Such methods should aid in comparing actual results achieved with affirmative action goals, illustrate trends, and highlight the magnitude of differences.

The first step toward affirmative action progress assessment is the collection of data relating to the group(s) considered for each category. Department of Defense Directive 1350.2 provides guidance for the collection and reporting of equal opportunity assessment data.

The Military Equal Opportunity Assessments

The promotion data section of these reports includes the number of personnel considered and the number of personnel promoted by year, rank, race, and gender. These data are presented in a tabular format, as described in Appendix C, DD form 2509. The respective promotion rates are calculated and rounded to the nearest 0.01. In some reports, graphs of promotion rates versus the overall average are presented.

No specific statistical tests are specified to be performed, nor are any performed. There is no indication if the promotion rates presented are significantly different from group to group. The reader is left to determine if a difference between two groups is an item that requires an action. Some hesitation over the small population sizes of certain minorities is expressed, but is not explained in a manner that clearly states whether the differences in promotion rates in such cases are important or not. In large populations where small changes in promotion rate are important, the rounding of the promotion rate to the nearest 0.01 hides significant differences between groups.

The graphs which are provided in some MEOA's do not show the significance of differences, and the data in the graphs are also shown rounded to the nearest 0.01.

The Representation Index

On occasion, a number referred to as a "Representation Index" or "Difference Indicator" is presented. However, the Representation Index (R.I.) provides little new information. It is basically a ratio of the promotion rates for two different groups. The statistical significance of the Representation Index varies greatly with the sizes of the two populations.

The R.I. is defined in the Department of the Army Pamphlet 600-26, and is intended to create a standard by which to measure the degree by which two rates are different. It can be used to compare the actual number of minority members promoted versus the expected number of minority members promoted. The formula utilized is

R.I. = ((Actual number promoted/Expected Number) x 100) - 100.

The "expected number" promoted is the number of minority members considered times the overall rate of that minority in the Service population. The R.I. is usually expressed as a percentage. If the actual number promoted occurred exactly at the rate for the entire population, then the R.I. will equal zero. If the minority promotion rate is greater than the overall rate, then the R.I. will be greater than zero. If the minority promotion rate is less, then the R.I. will be less than zero.

Unfortunately, little is accomplished by this calculation. The basic problem is determining what value of the R.I. implies a significant difference in the minority promotion rate versus the overall rate. The original report that created the R.I. formula provides a graph to convert R.I. values to statistical significance level. A copy of this graph is provided in Appendix D. Use of such a conversion gives the R.I. more usefulness as a statistical tool. However, the R.I. is not as useful as directly calculating the statistical significance levels. This report recommends calculating the statistical significance levels of differences in promotion rates directly.

Chi-Square Test

The chi-square contingency table test is the only method in use in current equal opportunity studies which expresses the statistical significance of the observed differences between race and gender categories. The chi-square is generally a good test for detecting differences in proportion from one group to the next. Each group is assumed to be a random sample from some overall population.

The chi-square contingency table test is used to test the hypothesis that the mean (or average) frequencies of occurrence are distributed in the same proportions from category to category. Specifically, the appropriate hypothesis for this report is that the overall promotion rates for each race/gender category are equal, with observed differences being due to random variation.

The disadvantages of the chi-square test include:

1. It gives only a Yes or No answer to "are the rates different?" It does not show which group is the "different" group, nor does it give the direction of the difference.

2. It is difficult to include within a graph presenting promotion rates.

3. It is difficult to compute.

4. It is not accurate for small sample sizes (See reference to Yate's correction below).

The mechanics of the chi-square test include calculating the expected number of people who would be promoted and not promoted for each category. The expected number promoted (or not promoted) are the number of people considered for promotion in each category, times the overall promotion (or non-promotion) rate. This number is the number of people who would be promoted (or not promoted) if the promotion rates were exactly equal among the categories. The differences between the expected and observed number promoted and the expected and observed number not promoted in each category are calculated. These differences are squared and then divided by the expected number of promotions (or non-promotions) in each category. Finally, all these squared differences are summed together and the final value compared against the value of the chi-square from a chi-square table. If the value from the table is exceeded, then the promotion rates are different.

The chi-square could be used to test any number of categories, for example, all twelve combinations of race and gender in a given promotion board could be compared to see if the board results are distributed evenly. One limitation of using the chi-square in this manner is that it only gives a yes or no answer. If the chi-square was used in this manner, and gave a result that stated that the promotions were not distributed evenly, further analysis would be required to determine which races and gender were the source of the "unevenness," and in which direction the unevenness occurs. The chi-square test results are also difficult to graph and display in a readily apparent manner.

A 2 x 2 chi-square test is useful to use when comparing one group against all other groups. The 2 x 2 chi-square sums the squared differences of four values:

1. The difference between the number of minority members promoted and the expected number of minority members promoted is squared and divided by the expected number of minority members promoted.

2. The difference between the number of minority members not promoted and the expected number minority members not promoted is squared and divided by the expected number of minority members not promoted

3. The difference between the number of non-minority members promoted and the expected number of non-minority members promoted is squared and divided by the expected number of non-minority members promoted

4. The difference between the number of non-minority members not promoted and the expected number of non-minority members not promoted is squared and divided by the expected number of non-minority members not promoted

These four values are summed and compared against the chi-square value from a chi-square table with one degree of freedom. For example, if the sum exceeds 10.8, then the minority and non-minority promotion rates are statistically different at a significance level of 0.001.

The 2 x 2 chi-square is not accurate when the expected number of occurrences in any category is less than 6. The chi-square tends to exaggerate the significance of differences in these cases. Several schemes, including "Yate's adjustment" are available in statistical texts for correction of this inaccuracy.

PROPOSED METHODOLOGY: THE USE OF CONTROL CHARTS

The promotion data presented in the Services' Military Equal Opportunity Assessments were analyzed for statistically significant differences in promotion rates between race and gender categories. The method of control charts was used to display the differences between promotion rates. Like the graphs used currently in the MEOA, these control charts display the promotion rate for each race/gender group and the overall promotion rate for the board. The important new item added is the 3-Sigma control limit for these group promotion rates. If the promotion rate for a given race and gender falls less than the control limit, then the group promotion rate is less than the overall board promotion rate at a significance level of 0.00127. Since one can also be interested in significantly high promotion rates, the significance level for values outside (in either direction) the control limits is two times 0.00127 (0.00254). Points outside of the control limits highlight areas of concern where further investigation should occur and affirmative action taken. Control charts also are a basis of Total Quality.

Total Quality Management

Much of the Department of Defense is implementing Dr. Deming's Total Quality ideas. These methods have been referred to as Total Quality Management or as Total Quality Leadership. Total Quality focuses on process improvement. The process of interest for this report is the military promotion system. Total Quality methods may be used to attain equal opportunity. The goal of Equal Opportunity is to provide equal opportunity for promotion. The corresponding goal for Total Quality process improvement should be to improve all persons' opportunity for promotion and, as a side effect, equalize all persons' opportunity for promotion.

Differences in promotion opportunity will exist between groups in a military population even with a completely "fair" promotion system due to the differences in individuals' strengths and weaknesses. An effort undertaken to improve the strengths desired for promotion in any weak individual groups will result in an increase in quality for the entire organization. Many times an organization is only as strong as the weakest link in its chain.

One of the basic principles espoused by Dr. Deming is the use of data to support management decisions. A recommended tool is presentation and analysis of data through the use of control charts.

> A control chart is a statistical device principally used for the study and control of repetitive processes [here, promotion boards]. Dr. Walter A. Shewhart, its originator, suggests that the control chart may serve, first, to define the goal or standard for a process that the management might strive to attain; second, it may be used as an instrument for attaining that goal; and, third, it may serve as a means of judging whether the goal has been reached.

Statement of the Goal

The goal of Equal Opportunity is that each race/gender group should have the same opportunity for promotion as any other group. Promotions should be granted on the basis of an individual's professional merits, and not be influenced by the individual's race or gender. A control chart can be utilized to detect significant differences in promotion rates between the races and gender in the military population that are not likely to have been caused by random variation.

The Control Chart as an Instrument for Attaining the Goal

If significantly different rates between groups are found through use of the control chart or other statistical tools, then further evaluation of the disparate group should be made to determine the source of the difference in promotions. The control chart may be utilized on other personnel data attributes in order to discover which strengths or weaknesses dominate the decision of whether or not to promote an individual. Distribution of these strengths and weaknesses may be coincidentally distributed with race and gender.

A process that identifies and corrects professional weaknesses that impede promotion should result in better individual quality and performance. If the promotion process is based upon valid merits needed by the military, then such an effort to increase the merits for promotion in all personnel will result in a higher quality military force. Unequal promotion rates among certain groups (by race, gender, education, training, etc.) should be taken as an opportunity to identify weaknesses in the group and correct the weaknesses. The purpose of the control chart is to identify such weaknesses so that affirmative actions may be implemented.

Use of Control Charts to Evaluate Achievement of the Goal

Ensuring that all groups of the military population have promotion opportunities that do not vary according to race or gender will require many long-term programs. The use of control charts to evaluate progress towards equalization is important, and is crucial to applying Total Quality to the promotion process. This report will primarily evaluate if the military is currently at the goal of equal promotion opportunity for all groups regardless of gender or race. The primary tool for this evaluation will be the analysis of promotion data using control charts and Total Quality methods.

The control chart has important advantages in evaluating promotion data. First, it is a visual representation of promotion rates, and condenses pages of numbers into a one page graph. More importantly, the control chart can display individual datum points which exceed the variation that might be expected if the promotion probability was equal for each individual. The worst case variation which might be expected from a random process with equal promotion probabilities are plotted as the "control limits." If no points are outside of the control limits, and no non-random trends or patterns are apparent, the process being graphed is said to be "in control." Variations in data in an "in control" process appear to be random. Indications of an "out of control" process are points outside the control limits or other indications that the variations in the process do not appear random. While an individual datum may not in itself be significantly out of specification, several data points in a row slightly out of specification may indicate an "out of control" process.

The utilization of control charts in this report varies slightly from the standard industrial use of control charts for quality assurance. Standard control charts assume that a constant proportion rate occurs over time. Promotion rates will vary and are expected to vary by service, year, and rank. This variation is not of concern in this application, but it means that a single overall promotion rate may not be utilized from board to board. Only variation by race and/or gender within a given service, year, and rank combination is of concern. Trends from board to board may still be visually detected, but instead of a single, overall promotion rate for all boards being displayed on the control chart, the overall promotion rate for the individual board will be displayed.

Comparing promotion rates solely within a given board does have a statistical impact. The standard control chart compares current data against past data. The current data are not used in the calculation of the overall performance rate. However, on these promotion control charts, the promotions occurring to each race/gender group are included in the overall promotion rate that the group is being compared to. This will cause the control chart to be slightly less sensitive to detecting a difference between the promotion rate of the majority (or a sizable minority) versus the rest of the population for the board.

Control Charts and the Chi-Square Test

The 2 x 2 chi-square procedure is very similar to the 3 Sigma comparison in a control chart. The chi-square is slightly more accurate for large population cases in that it compares the promotion rate of the group to the promotion rate of people not in the group. If the size of the group is sufficiently large to affect the overall promotion rate of the population, then the control chart used in this report will be less sensitive to changes than the chi-square test. The control chart could be made to be mathematically equivalent to the chi-square procedure if instead of plotting the overall population promotion rate one plotted the promotion rate of the personnel not in the group.

It was decided not to use this modification on the control charts for this report due to:

1. The increase in the number of calculations required (two rates need to be calculated for each group instead of just the group rate and one overall rate).

2. The increase in complexity in the control chart as there is no convenient method to plot chi-square values with the promotion rates.

3. The binomial confidence interval for small sample sizes could not be as readily used (although Yate's correction could be used for the chi-square).

4. For the most part, promotion rates for minorities are of concern. Minority group results will cause less shifts in the overall promotion results.

For comparison purposes, the respective chi-square values were tabulated with the listing of the "out of control" (outside 3-sigma) promotion board results in Appendix E.

Control Chart Mechanics

A control chart is constructed by plotting the variable of concern for the process on the y-axis. In this case, the promotion rate for each group is the variable of concern. Repeated output values from the process proceed along the x-axis. If one is looking at a single promotion board, then one might plot race and gender categories on the x-axis. For an example, see Figure 8 which plots the results from the Navy E-7 board in 1991. Control charts of this format would be extremely useful in the Service Military Equal Opportunity Assessments.

The next step is to determine the overall promotion rate for all persons considered by that promotion board. This is plotted as a horizontal line on the control chart. In all figures in this report, the overall average promotion rate for each board is plotted as a dashed line.

Control Limits

The final step to creating a control chart is crucial--the setting of the control limits. If a datum point is plotted outside of the control limits, a Total Quality manager concludes that the process is "out of control." An out of control process is one in which the variation observed in the output of the process is probably due to some specific factor other than random variability. In this report it is a group promotion result that indicates that the variation in the promotion process is not simply random variation. The race/gender group corresponding to this point has a significantly different promotion rate than the overall average.

Most statistical texts recommend setting the control chart control limits at three standard deviations from the mean (or average) of the process output value. A standard deviation is generally signified by the Greek letter sigma (σ), so these control limits are often referred to as "3-Sigma Limits."

In some cases, the standard deviation of the process output must be estimated from past data. For example, if one were concerned with the weight of roofing nails produced by a factory as an indication of the quality of the nail, one would need to calculate the average weight and the standard deviation for these weights from past data. If the data were normally distributed (that is, it follows the "bell" shaped curve), then the probability that a given nail's weight would be farther than 3 standard deviations to one side of the average is 0.00127. Thus the probability of receiving a process output value outside of the 3 sigma limits is approximately 2 in 1000 (there are two sides available totalling 0.00254 probability). Therefore, if one measured the weight of a given nail and received a value outside of the 3 sigma limits, it is very unlikely that random variability is the cause. Note however, that if one measured 1000 nails, one would expect to find 2 or 3 of these nails to be outside of the 3 sigma limits simply due to random variation.

It is because that occasionally one might find a nail (or process output) outside of the control limits simply due to random chance that the control limits are also referred to as the significance level for a statistical test. For a 3 sigma control chart, one could say that an out of control (outside 3 standard deviations from the process average) point is statistically significant at a 0.00254 level. The significance level may also be thought of as a false alarm rate. That is, when using 3 Sigma limits, one would expect to receive 2 or 3 false alarms (falsely indicating an out of control process) out of every thousand data values generated in a strictly random process.

In this report, there were 1172 promotion data points to consider. Thirty-two of these 1172 points were below the 3 Sigma level of the promotion rate for their respective promotion boards. This far exceeds the expected "false alarm" rate of approximately two (0.00127 times 1172). Therefore, the hypothesis that promotion rates are equal for all minority groups in the Department of Defense SHOULD BE REJECTED at a statistical significance level of 0.001.

Binomial Data

In the previous example of roofing nails, the process output (weight of the nail) could be any value from zero to infinity. However, the output of the promotion process is more discrete. The number of persons promoted must be an integer (each person is either promoted or not promoted, with no fractional results possible) and can be no more than the number of persons in that group considered for promotion. If the number of persons considered is very large, then the possible outcomes are nearly continuous and may be represented by the Normal (or bell-shaped) distribution. However, if the number of persons considered is small, the possible outcomes are limited and the process must be represented by the binomial distribution.

The standard deviation of a binomial distribution is always

$$\sqrt{p(1-p)/n}$$

In this case, "p" equals the overall promotion rate observed for the entire promotion board, and "n" equals the number of individuals in the category (race, gender combination) being examined. The process improvement goal is then to reduce the variability between races and gender to the variability that would be expected by the binomial distribution.

The binomial distribution is generated from repeated, independent go-no go trials. Such individual trials are called Bernoulli trials. The statistical characteristics of a binomial process is:

1. There are only two possible outcomes for each individual (Smith is either promoted or not promoted).

2. The outcome of one trial does not affect the outcome of another trial (Jones being promoted does not affect Smith's chance at promotion).

3. The probability of each outcome does not depend on any non-random factor (Smith's promotion does not depend on his race or gender).

It appears that this last characteristic also implies that Smith's promotion does not depend upon his ability or performance! In fact, a completely (statistically) fair promotion process would be to promote or not promote an individual solely as a result of a coin flip. If the same coin were tossed to determine everyone's promotion, then race and gender would have no impact on promotion rate.

A promotion process where each person considered for promotion is judged solely on his or her "merit" for promotion, and where these "merit" factors are randomly and evenly distributed among all races and gender, the results by race and gender will display the characteristics of the binomial process. That is, the only variation between races and gender will appear to be random.

> If chance variations ["merit" factors] are ordered in time or possibly on some other basis [race and gender], they will behave in a random manner. They will show no cycles or runs or any other defined pattern. No specific variation to come can be predicted from knowledge of past variations.

On the other hand, variation produced by chance causes follows statistical laws. For example, if 10 pennies are tossed in a random manner, the relative frequencies with which 0, 1, 2, . . . , 10 heads occur will tend, as the tossing is continued, to approach the frequencies of a binomial distribution. Likewise, in random samples of n units [persons] each from a [promotion] process that is affected only by chance causes, the probabilities of getting 0, 1, 2, . . . , n nonconforming [or personnel promoted from a minority] will also be given by the binomial distribution. The variation produced by a system of chance causes can thus be predicted for mass phenomena.

Knowledge of the behavior of chance variations is the foundation on which control chart analysis rests. If a group of data is studied and it is found that their variation conforms to statistical pattern that might reasonably be produced by chance causes, then it is assumed that no special assignable causes are present. The conditions which produced this variation are, accordingly, said to be under control. They are under control in the sense that, if chance causes are alone at work, then the amount and character of the variation may be predicted for large numbers, and it is not possible to trace the variation of a specific instance to a particular cause [i.e. bias for or against a minority]. On the other hand, if the variations in the data do not conform to a pattern that might reasonably be produced by chance causes, then it is concluded that one or more assignable causes are at work. In this case the conditions producing the variation are said to be out of control.

If the promotion control charts display that the process is out of control, then, following the Total Quality ideas, one should examine the out of control data points to try to determine the assignable causes, and work to correct the assignable causes. Appendix E lists all of the points outside of the control limits found in the 1987 to 1991 promotion data.

Calculation of 3-Sigma Limits for Promotion Data

The following equations may be used to generate the 3-sigma upper control limit (UCL) and lower control limit (LCL) for each race and gender category:

$$UCL = p + 3 \times \sqrt{\{p(1-p)/n}$$

$$LCL = p - 3 \times \sqrt{\{p(1-p)/n}$$

As in the previous equation for binomial standard deviations, "p" equals the overall promotion rate for the promotion board, and "n" equals the number of persons in the race/gender category. Use of these limits approximates the binomial distribution as a Normal distribution. This approximation is fine for large groups. As group sizes decrease, this approximation becomes less accurate. It tends to produce larger control limits than would be accurate--lower control limits less than zero or upper control limits greater than one could result. No promotion rate could actually be less than zero or greater than one. One would tend to not be able to detect significant proportion differences in small minorities.

A more accurate method of determining the control limits for small groups (generally where the expected number of persons to be promoted is less than ten) is to utilize the binomial distribution itself. Confidence intervals for the binomial distribution are printed in several statistical texts. The 0.00254 (corresponding to 3 Sigma) control limits for this report were generated by a computer algorithm which generated the binomial probabilities for all groups whose expected number of promotions was less than 100. This program was written in dBase III PLUS. See appendix F for a listing of the program. Similar programs could be written in any computer language.

The Normal approximation upper and lower control limit should be sufficient for most control charts. Use of the approximation will tend to not detect differences in promotion rates that the binomial control limits would detect as statistically significant. Generally, small populations require large shifts in proportions to be determined to be statistically significant. In this report, only three of the 32 groups that have a significantly low promotion rate were of a size less than 100. The use of binomial limits is a refinement, but not an absolute necessity.

Trend Analysis

The use of upper and lower control limits on a control chart identifies individual points that are "out of control" and should be investigated. There may also be statistically significant differences in promotion rates that occur over several promotion boards, but no individual promotion rate is severe enough to go outside of the 3-sigma significance level. There are several additional statistical tests that may be applied to control charts. Some of these schemes are listed in *Quality Control and Industrial Statistics*, Chapter 7. These schemes involve identifying "runs" on the control chart. For example, seven points in a row all above or all below the average promotion rate is considered statistically significant in this reference. This reference also recommends that a run of 2 or 3 points in a row outside of 2-sigma (two standard deviations) be investigated, and that a run of 4 or 5 outside of 1-sigma limits be investigated.

Another trend analysis tool for binomial data is logistic regression. It is a special regression tool (similar to linear regression) that is especially useful with binomial data. The statistical theory of logistic regression is beyond the scope of this report. Several computer statistical software packages support logistic regression, including BMDP and SAS.

The Role of the Control Chart

Overall, the control chart is vital to attaining equal opportunity.

> A control chart may thus be used to specify the goal of management. It is also an instrument for attaining that goal. To see whether a process is in control, past data pertaining to the process are plotted on a control chart. If the data conform to a pattern of random variation within the control limits, the process will be judged as being in control at a level equal to the mean line on the chart. If the data do not conform to this pattern, as is almost always the case in the beginning, then departures from the pattern are investigated and assignable causes tracked down. If an exceptional cause of variation is on the unfavorable side, the effort is made to eliminate the special cause of this variation. If the exceptional variation is on the favorable side, an effort may be made to extend and perpetuate the cause producing it. In this way the process may eventually be brought close to a state of statistical control at a desirable level. After a condition of control has been satisfactorily approximated, departure from the condition may be quickly detected by maintaining a control chart on current output.

Although a high promotion rate for a given group is not favorable, an effort should still be made to determine why this group was promoted at a higher rate than the other groups. If the cause of the high promotion rate is a direct result of racial and/or gender bias, then efforts can be taken to reduce that bias. If the cause of the high promotion rate is some indirect positive characteristic that one group happens to hold more than others, then effort could be directed to increase the desirable characteristic in the other groups.

> The reader should also note the following: If no points fall outside the control limits and if there is no evidence of nonrandom variation within the limits, it does not mean that assignable causes are not present. It simply means that the hypothesis that chance causes are alone at work is a tenable hypothesis and that it is likely to be unprofitable to look for special assignable causes. . . . If chance can reasonably explain our results, we look no further. Thus, if a control chart shows a process is "in control," it means that the hypothesis of random variation is a reasonable one to adopt for managerial purposes. When the chart fails to show control, then other action is reasonable.

Ideally, the qualities that are desired of a person in order to be promoted are apparently randomly distributed throughout the entire population. Efforts to artificially increase the promotion rates of certain groups will generally be detected as non-random patterns. The existence of such promotion "quotas" would be detectable by control chart.

This report assumes that a "fair" promotion process, with equal opportunity of promotion for all individuals, can best be modelled as a random binomial process. The binomial process assumes that each individual has an equal probability of promotion. Thus, for the actual promotion board process, if all promotion data for each race and gender category fall within the 3-sigma control limits for a random process, and no other trends are apparent, one may assume that a "fair" promotion process is in effect, and little may be gained by further investigation and actions. If, however, data falls outside the control limits, or other non-random patterns exist, then action should be taken to create a more "fair" promotion process.

ANALYSIS OF PROMOTION BOARD RESULTS

Overall, there are significant, non-random differences in promotion rates between races and gender. The actual promotion data does not fit the "fair" model of random promotions based on a binomial distribution with each individual's probability for promotion being equal. The most apparent problems occur with minority males in the Navy E-7 boards, and Black males in many enlisted promotion boards.

The results of the promotion rate analysis are presented here using control charts. The purpose of the control chart is to determine if the variation in promotion results from race to race and gender to gender is greater than the variation a random promotion process would create. Areas of high variation (outside of 3-sigma limits, for example) are areas where differences in promotion rates between race/gender groups probably occur.

These control charts are displayed in the following manner. The overall promotion rate for each promotion board (by service, year, and rank) is shown as a horizontal dashed line. The promotion rate for the specific race and gender in that board is shown as a solid horizontal line. The 3 sigma upper and lower control points are shown as the ends of a vertical line. Note that because each sample size (number of people in each race/gender category) is different, the upper and lower control limits are different for each category.

Any promotion rates that are above or below the 3-Sigma control limits are circled. These are promotion board results that would be highly unlikely (significant at 0.00254) if the promotion rate was equal for all race/gender categories.

This chapter also demonstrates several uses of control charts in trend analysis. Control charts have been organized by race and year (e.g. displaying results for Black males in each 1991 board), by rank and year (e.g. displaying results for all races in the Navy E-7 board), and by service and race (e.g. displaying the results for all Air Force Black males in 1987 - 1991 enlisted boards). This should provide the reader with varied methods of organizing data for future control charts.

Appendix E contains a complete list of all promotion boards that were outside of the 3-sigma limits for their respective control charts. A total of 34 promotion results below the lower 3 sigma limit are listed. A total of 52 promotion results above the upper 3 sigma limit are listed. Distribution of these out of control points are shown in Table 1.

Table 1
Distribution of Out of Control Promotion Results by Service and Rank

Numbers of Out of Control points by Service:

US ARMY	US AIR FORCE	US NAVY	US MARINES
29	25	22	10

Numbers of Out of Control points by Rank:

E-7	E-8	E-9	O-4	O-5	O-6
40	28	8	7	1	2

The numbers of out of control (outside of 3-sigma limits) are evenly distributed throughout the Army, Air Force, and the Navy. The Marines have less out of control points than the other Services. This might be influenced by the smaller populations in the Marines causing their 3-sigma limits to be farther apart. The great majority of out of control results are in the enlisted E-7 and E-8 boards (68 out of 86).

1991 Promotion Board Results and Discussion

Figures 1 through 7 show the results of all fiscal year 1991 promotion boards by race and gender using control charts. This chapter has included a complete display for all of the 1991 data since it is the most recent data results, and to provide an example of the use of control charts for presenting and evaluating Equal Opportunity data. The most troublesome (from an Equal Opportunity point of view) boards were the enlisted boards. The Army E-7, E-8, E-9; the Navy E-7; and the Air Force E-8 boards contained promotion rates outside of the 3-sigma control limits. In general, the 1991 officer boards have more even (in control) promotion rates, with all rates within the 3-sigma control limits. Historically, the results of enlisted boards have contained more statistically significant differences between race/gender categories than the officer boards.

The Navy MEOA separates officer promotions by Line and Staff categories. The figure 1 through 7 control charts combine the Navy Line and Staff officers together for ease of comparison with the other Services' officer data.

Black males were the most poorly promoted group in 1991, as shown in figure 1. The Army E-7 and E-8, the Navy E-7, and the Air Force E-8 boards all gave results below the 3-sigma lower control limit. Black males were promoted at rates below the board average in 11 of the 12 enlisted boards and 8 of the 11 officer boards in 1991. Historic results for Black males are also below average, as further explained later in this report.

Females of all races were consolidated into one control chart (figure 2), in order to give an overall look at females. This also raised the sample sizes for each board (as compared to looking at females by individual races), giving tighter control limits. The Military Equal Opportunity Assessments also typically graph all females together. The differences between the races for females appeared to be minimal in 1991. Overall, females were promoted at rates exceeding the upper 3-sigma control limits in four boards. These boards were the Army enlisted E-7, E-8, and E-9 boards and the USAF E-8 board. Note that these boards had significantly low results for Black males in figure 1. None of the individual female race groups were below their lower 3-sigma control limits in 1991.

Figure 3 shows the results for Asian-American and Pacific Island males. The result for the Navy E-7 board was below the lower 3-sigma limit. The result for the Navy E-8 board was nearly below this limit also (it was low at the 2-Sigma significance level).

The results for American Indian and Alaskan Native males, Hispanic males, and "Other" males were all within the 3-sigma control limits. These results are shown in figures 4, 5, and 6. Generally, the "Other" males represent a very small portion of the military population, and their control limits are far apart due to the small sample sizes. Overall, their board results appear to display random variation.

Results for White males are shown in figure 7. White males were promoted at rates exceeding the upper 3-sigma control limits in the Army E-7 and the Navy E-7 boards. White males were promoted at above the average board rate in eight of the nine enlisted promotion boards held in 1991. Although the difference in promotion rates between White males and the average promotion rate differed by less than 0.01, these small differences are significant for these large enlisted populations. Also, since White males are the majority of the overall population and thus their promotion results strongly influence the overall promotion rate, there must be major differences between their promotion rates and the minorities in order for White males to be outside 3 standard deviations from the overall average. Note that because the MEOA's round promotion rates to the nearest 0.01, these statistically significant differences in promotion rates are not detectable in the MEOA.

Overall, the 1991 Army E-7 board had Black males "out of control" low and females and White males "out of control" high. The Navy E-7 board results are discussed in figure 8.

The 1991 officer promotion board results did not show as strong favoritism towards White males. In fact, the Army officer boards have been promoting White males consistently slightly below the average promotion rates, as discussed in figure 16.

The Navy E-7 Board

The U. S. Navy E-7 board has been the most significantly unequal board for minority promotion rates. Figures 8 and 9 show the results for 1991 and 1990. In both years, all minority males were promoted at below the board average. Black males were below the lower 3-sigma control limit in both years. White males were above the upper 3-sigma control limit in both years.

Data for the years 1987, 1988, and 1989 are presented in the Navy Military Equal Opportunity Assessment, however, the 1990 Navy MEOA states that the data for these three years are "inaccurate." The authors of this report were unable to determine which of the data was inaccurate. For this reason, control charts for these years are not presented in this report. Analysis of the available data (which may be inaccurate) showed nine promotion rates outside of the 3-sigma control limits over these three years. White males were above the upper 3-sigma control limit in four of the five years (1987-1991). Black males were below the lower 3-sigma control limit in all five years. The Navy E-7 board appears to be generating three out of control results per year (out of the 12 race and gender combinations). The MEOA-reported promotion results demonstrate a consistent pattern over five years of significantly lower promotion rates for minority males, and especially so for Black males.

In comparison, the Navy E-8 and E-9 boards show "in control" results for minority (including Black) males. This pattern is apparent over the five years. This may be an indication that those Black males that are promoted to E-7 prove to be successful in the "downstream" E-8 and E-9 boards. However, the E-7 board is the initial board for becoming a Chief Petty Officer. The low rate of E-7 promotion for minority males may be causing underrepresentation of minorities in the Navy Chief ranks.

The Navy Fiscal Year 1990 Military Equal Opportunity Assessment states:

> Advancement opportunities to E-7 for Blacks (10%) was below the overall opportunity of 13% for advancement to E-7. In both [E-6's also show similar behavior] enlisted advancement cases, the difficulty is caused by overcrowding of certain ratings by minorities and women. . . A concerted effort is being made across the rating spectrum to encourage initial entry and cross-rating into undermanned ratings which offer substantial upward mobility. Trends indicate progress is being made in these endeavors.[1]

The Navy assessment provides a graph of representation of minorities in Department of Defense occupational areas. This graph demonstrates an overrepresentation of minorities in health care, support/admin, service/supply, and non-occupational. Minorities are underrepresented in electronics repair, "other technical," electrical/mechanical, and craftsmen. Thus, a higher proportion of minorities in the Navy appear to be in non-technical fields than the majority (White males). The non-technical fields have less promotion opportunities than technical fields, according to the 1990 Navy MEOA.[2]

Black Males

As a group, Black males are the most under-promoted racial category. The specific boards with the most negative results over the five years analyzed are:

Air Force	E-8, E-9, O-4, and O-5
Army	E-7, E-8, and E-9
Navy	E-7
Marine Corps	E-7, E-8, and E-9

There were a total of 55 promotion boards held in the above categories from 1987 to 1991. Black males were promoted at below the board average in 52 of the 55. Black male promotions were below the lower 3-Sigma control limit in 18 of these boards.

Figures 10 through 13 show the results for Black males in Air Force officer, Air Force enlisted, Army enlisted, and Marine Corps enlisted promotion boards respectively. Figures 8 and 9 show the results of the Navy E-7 boards, which were previously discussed in this report.

Black males were promoted at below the board average in every Air Force O-4 and O-5 board since 1987. Three of the four O-4 and one of the five O-5 boards gave results below the lower 3-sigma control limit. The 1991 Air Force O-4 board did demonstrate improvement in Black male promotions, although their rate was still below average. The Air Force O-6 board appears to be more "in control," but three of the four results were slightly below average for Black males.

Black males were promoted at below the board average in every Air Force E-8 and E-9 board since 1987. Two of the E-8 board results were below the lower 3-sigma control limit. Interestingly, Black males were promoted at above average rates in the 1987, 1988, 1989, and 1990 Air Force E-7 boards (1988 and 1990 were above the upper 3-sigma control limit). The 1991 E-7 board result was slightly below average (probably not statistically significant). These E-7 above average results may lead to increased Black male promotions in future E-8 and E-9 boards as these E-7's reach consideration for E-8 and E-9. The 1990 Air Force MEOA noted that "for E-8 and E-9 Black promotion rates were somewhat lower."[3] No like statement was made for Black officer promotion rates.

Black males were promoted at below the board average in 14 of the 15 Army enlisted promotion boards from 1987 to 1991. Six of the enlisted board results were below the lower 3-sigma control limit. The 1990 U.S. Army MEOA states, "Guidance provided selection boards has resulted in the achievement of equitable representation across the board."[4] Also, "promotion rates for all tracked groups were equitable."[5] These statements are not supported by the trends and patterns evident in figure 12 for Black male enlisted promotions.

Black males were promoted at below the board average in 13 of the 14 Marine Corps enlisted promotion boards reported from 1987 to 1991. One board (E-8, 1989) was below the lower 3-sigma control limit. The 1990 Marine Corps MEOA notes "for the fourth consecutive year, the overall selection rate for minorities is below that for Whites."[6]

The Marine Corps 1990 MEOA also noted that promotions to O-4 for Blacks was "substantially" below the Whites for four consecutive years. From 1987 to 1990 the Black male promotion rates were within the 3-sigma control limits, but consistently below average. The Black male promotion rate to O-4 did improve in 1991 to slightly below the overall average (see figure 1 for the 1991 results). As previously noted, Black males were below the promotion board average in all of the analyzed 1991 Marine Corps boards (E-7, E-8, E-9, O-4, O-5, O-6). Black promotion rates were highlighted as an overall "concern" in the 1990 MEOA executive summary, and several Equal Opportunity Task Force actions were listed as in progress to improve Black promotions.

Other Minority Promotion Trouble Areas

Figures 14 and 15 show the promotion board results for Air Force enlisted Hispanic males and officer Black Females (specifically O-4). Hispanic males were promoted at below the board average in all Air Force enlisted boards, with two boards below the lower 3-sigma control limit. Black Females were promoted at below the board average in all four O-4 boards held from 1987 to 1991. Black females were promoted at above the promotion board average for all O-5 boards, but this may not be statistically significant due to the small population of Black female Air Force O-4's available for promotion to O-5 (note the large size of the control limits on the control chart).

U. S. Army Officer Boards, 1989 - 1991

The Fiscal Year 1990 Military Equal Opportunity Assessment for the Army states "selection rates for all categories should not be less than the overall selection rate for the total population considered."[7] The Army officer promotion boards have been achieving this goal, at least for minority categories. Forty-four of 63 minority categories were promoted at above the overall promotion board rate from 1989 to 1991. However, it is impossible for all race and gender categories to be "not less than the overall selection rate" if any one of the categories is promoted at above the overall average. Some category must fall below average. In the case of the Army officer boards, that category is White males. The behavior demonstrated on the control charts is highly suggestive of a "quota" system for minorities being in effect.

Figure 16 shows the Army officer promotion board results from 1989 to 1991 organized into White male, non-White male, and female (all races) categories. In all eight boards, White males are slightly below the promotion board average for all boards. This lower rate is from 0.1 percent to 1 percent below the average. Only two board results are statistically significant at a 1-sigma (.15) significance level. However, the fact that eight of eight officer boards have below average promotion rates for White males is potentially significant. This pattern should be investigated, as it is a run of control chart data exceeding seven points in a row.[8]

No Army officer race/gender category has fallen outside the 3-sigma control limits. Data are only available since 1989 because the Army assessment reported results by race only and by gender only previous to 1989. The graphs offered in the current Army assessments also perform the same consolidation. Since White females have tended to be promoted at above the board average, combining White females and White males together mitigates the lower promotion rate for White males. Also the rounding of promotion rates to the nearest 0.01 makes the difference in White male promotions harder to detect in the MEOA presentation.

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[1]. Department of the Navy. United States Navy and United States Naval Reserve Fiscal Year 1990 Military Equal Opportunity Assessment, p. vii.

[2]. Ibid, p. 9-5.

[3]. Department of the Air Force. United States Air Force 1990 Military Equal Opportunity Assessment.

[4]. Department of the Army. Military Equal Opportunity Assessment Fiscal Year 1990.

[5]. Ibid, p.3.

[6]. Department of the Navy, United States Marine Corps. Military Equal Opportunity Assessment, 1990, pp.3-13 through 3-17.

[7]. Department of the Army. Military Equal Opportunity Assessment Fiscal Year 1990, section 3A.

[8]. Duncan, 1986, p.435, provides this criteria in the "Summary of out-of-control criteria."

RESULTS AND DISCUSSION - Selection Board Procedures (E-7)

Differences in promotion rates can best be explained within the concept of institutional racial discrimination. Institutional racism, which as a term has entered the language only recently (Department of the Army-Pam 600-43, 1977), can best be conceptualized as any negative impact upon a specific race of people resulting from routine operations or procedures of an organization (Goehring, 1979).

Feagin (1978) further breaks institutional discrimination into two types: direct and indirect. Direct is when an intent to harm the minority group in question exists, and indirect is when no intent exists. The indirect variety can occur independently of the attitudes and motivations of individuals who may unknowingly perpetrate it (Department of the Army-Pam 600-43, 1977). Since the armed services have been at the forefront of a movement to establish equal opportunity for racial minorities and have taken aggressive measures toward equality of treatment for all personnel, the indirect form of institutional discrimination is of particular interest for this effort.

Feagin notes that indirect institutional discrimination has two forms: side-effect and past-in-present discrimination. Side-effect discrimination refers to the use of some selection variable, either correlated with performance or not, which differentially rejects disproportionately large numbers of minority individuals (Goehring, 1979). Past-in-present discrimination covers inequities that occurred in the past and that place minority members at a disadvantage in an established circumstance.

In affirmative action programs to eliminate institutional discrimination, the first step is to identify the dimensions on which it may occur and how significantly it occurs. When disparities are found, appropriate measures should be taken to target where past-in-present and side-effect forms of discrimination are occurring in a system and make timely modifications to the system.

Butler and Holmes (1981) divided studies focused on egalitarian policies in the military into two categories: (1) those concerned with examining attitudinal responses to military practices, and (2) those devoted to measuring inequality in structural terms. Studies related to examining attitudinal responses indicate that minorities perceive less Equal Opportunity than Whites (Arceneaus et al., 1974) and that Black personnel perceive more discrimination than do their White counterparts (Brown and Norolie, 1975; Brink and Harris, 1967; Borus et al., 1972; Hiett et al. 1974; Konigsberg et al., 1976). Studies related to measuring inequality in structural terms show that Blacks do not receive the same treatment (DOD,1972), location in rank structure (Moskos, 1970), occupational assignments (Butler, 1976), and promotions (Miller and Ransford, 1978; Segal and Nordie, 1979; Butler, 1976a) as Whites.

Navy Chief Petty Officer Board

The results reported in this section fall under the category of structural issues. We are focusing our effort on the Navy Enlisted Selection Board for advancement to Chief Petty Officer (E-7). Our group under study is the Black male. Specifically, we are interested in how the Promotion Board relates to the promotion of Black males at the E-7 level. This choice was based on the results reported in the last section.

This was an initial attempt to define and analyze the E-7 Selection Board processes to identify those factors inherent to the process that might interfere with the advancement or promotion of a racial sub-group.

The results of a board's decision are a function of two interrelated set of events: most importantly the experiences and knowledge that the enlistee acquires prior to satisfying the promotion criterion (external) and the processes that occur during the Selection Board proceedings (internal). Thus, factors external to the promotion board process, and factors internal to the board's selection procedures, will be investigated. This effort brings together factors that determine if someone is selected or not selected.

Only portions of the overall process are targeted for discussion due to time limitations and the easy availability of supporting literature. It is however hoped that what is reported will serve as a model for the continuation of this effort. The following information pertaining to the E-7 selection board was obtained through: (1) telephone calls to cognizant individuals; (2) reviews of ongoing research or articles concerned with selection board issues; and, (3) reviews of directives BUPERSINST 1430.16 and BUPERSINT 1616.9. Appendix A lists the points of contact. Appendix B lists literature relevant to the issues under study that are not referenced in the body of the report.

The following sections provide general information on the composition of the selection board processes in terms of composition, duties, selection criterion, and procedures. In addition, the identification of potential external and internal deterrents to an unbiased evaluation and resulting selection are supplemented by relevant literature.

Promotion Board Composition.

Each selection board is composed of the following members: (1) a captain who serves as the President; (2) A junior officer, usually from the Bureau of Naval Personnel (BUPERS) advancement section, who serves as the recorder; (3) officers, usually from the Washington, DC, area who serve as board members; (4) Master Chief Petty Officers, who are mostly from out of town; and, (5) assistant recorders who are E-7s or E-8s. BUPERS 262 (Enlisted Advancement) select the board members from a pool of potential board members nominated by their respective command's Commanding Officer.

Although no legal requirement exists, the Bureau of Naval Personnel attempts to ensure minority representation on all Boards. A BUPERS reprsentative indicated during a phone conversation that the representation of minorities and women on the panel is taken very seriously. They are constantly queried by outside sources on this issue. BUPERS tries, as a minimum, to make the representation on the board reflect the representation of the number of minorities and women going up for promotion. However, Lawson (1976), reports that, due to limited funds, fleet requirements, and scarcity of senior minority officers, this goal is not often achieved.

The exact size of the board varies with the availability of temporary duty funds, number of records reviewed, and time available. The average number is about 80 members. The board meets for six weeks.

The recorder, assistant recorders, OPNAV Enlisted Advancement Planner, and the Master Chief Petty Officer of the Navy (MCPON) may provide consultative services to the entire board in any matter concerning selections that may be referred to them. The MCPON is the senior enlisted person in the Navy and while holding this honorary position represents all of enlisted Navy personnel.

The board members are divided into approximately 13 panels by the recorder. Each panel, comprised of individuals in the same general field, is responsible for reviewing the records of individuals in the same rating. The presidents are not normally assigned to any panel but may reorganize the panels if they think it is necessary.

Quota

OP-132F3 establishes a maximum selection quota for each rating. Quotas are to be filled by the "best qualified" candidates competing for advancement. If an insufficient number of "best qualified" candidates are available, it is within the discretion of the panel to leave part of the quota unfilled. At any given time approximately 25,000 candidates will be considered for promotion.

Although advancement across the Navy is driven by vacancies, several factors are taken into consideration when establishing quotas. These are: current inventory; total projected losses; and gain, growth, and funding authorized.

Pre-convening Procedures.

The selection board is convened by the Chief of Naval Personnel. The Secretary of the Navy, CNO, BUPERS, and the OPNAV Enlisted Community Managers (ECM) all make input to the boards.

Each year a precept is prepared for board use. This precept contains the following information: (1) the oath to be administered to the board members and recorders when they convene; (2) an outline of the conduct and expected performance of the individuals serving on the board; (3) an outline of the selection process; and, (4) guidance and general information (i.e., selection criteria, equal opportunity).

During its first day the board establishes, within the guidelines of the precept, its internal ground rules and the minimum selection criteria used for screening the records of candidates. Application of the ground rules may vary from rating to rating for many reasons such as sea duty or lack of it, supervisory opportunities, availability of schooling opportunities. As selection boards cannot divulge how they completed their task, it is impossible to state precisely how a board operates.

During the first two days, the panel members acquaint themselves with the various materials they will be using and practice evaluating test records to establish grading standards.

Records Under Consideration.

Records for each rating are brought to the respective panel by the board assistant recorders. For each candidate, there is a folder that contains microfiche records 1E and 2E, correspondence received by the board, and an Enlisted Summary Record (ESR).

Microfiche record 1E contains each candidate's professional service history including: (1) Procurement; (2) Classification and Assignment; (3) Administrative Remarks; (4) Separation, Retirement, Casualty, and Death; and, (5) Miscellaneous Professional Service History. Also, the race of an individual can be found in this microfiche.

Microfiche record 2E contains each candidate's performance evaluation and training data. Also included are awards, medals, and citations, and adverse information.

The panel obtains the candidate's test score, rate, and unit identification code (UIC) from the ESR.

Selection Procedure:

The following selection procedure is employed to select the "best qualified" candidate.

1. Each candidate (record) is then reviewed and scored by two panel members. At least 3 years are reviewed, with 5 years as the norm. Panel members may go farther back to establish trends and break ties.

2. The two scores are summed. If there is a significant difference between the two panel members' assessments, a third member reviews the record.

3. Next, based on the scores, the panel arranges all the candidates from top to bottom. At that time, the panel indicates where the cut-off mark is for promotable candidates and recommended selectees. A phone interview indicated that the panel may reevaluate marginal cases.

4. The entire board is then briefed by each panel on the rating's structure, its job and peculiarities, the number of candidates, and the similar characteristics of those recommended for advancement.

5. Finally, the entire board votes on the slate, which must be accepted by a board majority. A written report of the board's recommendations for selectees is signed by all members, including the president, and submitted to the Chief of Naval Personnel for approval.

Germane to the overall E-7 board selection process (just described) are those factors considered by the board members in the selection of "qualified candidates." An investigation of these factors provides an opportunity to assess the events that an enlistee must have prior to being considered for promotion and that might be considered external to the board selection process. The factors presented below are not the only ones influencing selection.

1. Performance Evaluations.

The marks and narratives in evaluation reports are reviewed. Peer group ranking also indicates how the candidate compares with members of the same paygrade within the same command. Personal decorations, letters of commendation/community involvement also reflect a well-rounded individual.

Navy Regulations require keeping records for enlisted persons that reflect their fitness for the service and performance of duties. Enlisted performance evaluation reports are used in many personnel actions, including advancement in grade, selection for responsible assignments and specialized training, awarding of the Good Conduct Medal, qualifying for retention and reenlistment, and characterization of service upon discharge. Performance reports are also used to improve enlistees performance by coupling the evaluation with a counseling session. During these sessions, areas in which an enlistee must improve in order to qualify for promotion are indicated. BUPERSINST 1616.9, "Navy Enlisted Performance Evaluation (Eval) Manual," sets the policies and procedure for enlisted performance evaluation.

Form NAVPERS 1616/24 is used for reporting. See Appendix C for an example of the form. Blocks 1-26 pertain to background information, such as name, rate, members UIC, etc. Blocks 27-38 cover the evaluation section of the performance evaluation report. In these sections enlistees are graded on several performance elements.

1. Professional Factors–Military knowledge/Performance and rating knowledge/performance.

2. Personal Traits--Initiative, Reliability, Military Bearing, Personal Behavior, Human Relations including EO.

3. Self Expression–Speaking Ability, Writing Ability.

4. Leadership–Directing and Counseling.

The assignment of grades are based on the following criteria.

4.0 - Always meets or exceeds standards. Invariably a strong performer, even when the greatest demands are placed on this trait.

3.8 - Meets high standards, lacking only some element of strength or consistency needed for a 4.0 at this time.

3.6/3.4 - Meets standards, but has some weaknesses which can be a handicap when the highest demands are placed on this trait.

3.2/3.0 - Meets minimum standards, but weaknesses significantly limit the responsibilities which the member can be assigned.

2.8/2.6 - Below minimum standards. Performance is a continuing problem.

2.0 - Performance is unsatisfactory for current grade level.

1.0 - Performance is unacceptable and member shows no capability of improvement.

Block 39 reports the member's overall performance (rank), contribution to the command's mission and potential for further service. This score is not an average of the other grades. The top 50% of E-7 personnel who are graded 4.0 must be ranked.

Block 40 is a summary of block 39 grades for all members in the comparison group and blocks 41-43 indicates the recommendation for promotion.

The back of the performance report (blocks 50-56) summarizes the following types of information: (1) primary responsibilities and deployments; (2) completed achievements; and, (3) comments regarding accomplishments during the reporting period, how well the member has done these accomplishments, strengths, and potential for responsibility and advancement.

From the first day that an enlistee reports for duty his or her performance is being evaluated. This performance is reported in the performance report. (Note: Officer performance reports are referred to as FITREPs). Since a major criterion for an enlistee's success in the Navy is the performance reflected in these reports, a number of researchers have reported research pertaining to this issue. These reports have attempted to investigate reporting systems for various services on a number of related issues. Issues include, but are not limited to: (1) philosophy, importance, and uses of performance evaluations (Lawson, 1976; Acosta, 1965); (2) identification of problem areas (Lawson, 1976; Desselle et al., 1965; Murphy, 1980; McKenna, 1963); (3) history of reporting systems (Desselle et al, 1965; Theberge, 1979); and, (4) attitudes regarding fitness report systems (Theberge, 1979). Dessele et. al. (1965), proposes the application of the computer in standard-score evaluation of fitness reports.

Important criteria for any reporting mechanism are built-in properties that enable reporting officials to evaluate their subordinates objectively and fairly--to successfully divorce opinion from fact. The failure of a reporting senior to objectively appraise the performance of any subordinate is a grave failure to meet public trust and could constitute an injustice not only to the member reported on but to other members as well. Performance reports that provide a realistic and objective evaluation of a subordinate's past performance and future potential will ensure that the members of the board have the correct input needed.

Hamner et al. (1974) examined how the gender and race of the rater and the gender and race of the ratee influence assessments of ratee performance. They found that gender-race stereotypes do influence behavior on a work-sampling task even when objective measures are defined.

Lawson (1976) believes that the ability to evaluate others skillfully is a critical skill and is not currently a criterion for judging performance. He proposes relevant tools and techniques that would enable reporting seniors to prepare FITREPs that are more objective and fairer to the person being evaluated.

In a task very similar to this present effort, Acosta (1965), analyzed the methodology of the promotion system with special emphasis on the FITREPs. The historical development of the reports, with particular attention to the rating scales employed, and the problems involved in the preparation of the reports, was also explored. Of special interest is her attempt to identify problems involved in the biases of the evaluator.

Casual interviews with Navy personnel indicate an inflation in performance marks in Blocks 27-38. These indications are backed by a study (Herold et al, 1984) that surveyed a sample of Pacific Fleet officers to identify methods for improving the Navy officer performance evaluation system. One major weakness that they identified was the inflation in performance ratings. They claim that this weakness diminishes the usefulness of evaluation as input to decisions concerning promotion and assignment. Olsen (1979) also refers to the inflation problem. It would be of interest to investigate to what extent the objective ratings for Black males deviate from the inflated norm. Do their scores fall into this inflated norm? Keep in mind that Hamner et al. research indicated that even when objective measures are defined, bias occurs on the part of the rater.

The presence of inflation in marks results in reliance during board proceedings on the more subjective narrative section of performance ratings. Therefore, while race is not, per se, a factor in selection, information on minority candidate behavior, appearance, and personality in the narrative may be presented differently by the rater or interpreted differently by the board with consequent effects on selection. Officers in the Herold et al. (1984) study, felt that the narrative portion of FITREPS is too subjective and is influenced by the writer's literary ability.

Nieva et al. (1981) examined performance evaluation narratives of Navy women and men in relation to an examination for bias in promotion. In their study, narrative sections of performance ratings for men and women eligible for promotion to chief petty officer were analyzed to determine whether statements in the narrative section or the manner in which the statements were interpreted by the selection board were subject to gender bias. Results indicated that the type of statements made in a report determined whether or not a person was selected for promotion.

A related study (Thomas et al., 1983) investigated the possibility that gender bias was written into the narrative section of officer fitness reports. The narrative portion of the FITREPS for a sample of women and men who were being considered for promotion to lieutenant commander in April 1981 were content analyzed. The results showed that FITREP narratives for males were significantly longer and contained more references to leadership qualities than did those for females. Also, the actual descriptors used in the narratives were different. Those for men seemed to cluster around the competency characteristics described by Broverman et al. (1972); and those for women, the warmth-expressive characteristics.

A follow-on study (Spishock and Scheifers, 1983) investigated whether or not *a priori* knowledge of an individual's gender influences an evaluator's decision in choosing an officer for promotion based on the FITREP narrative. In this research two forms (masculine and feminine) of male and female archetype FITREP narratives were developed by inserting masculine and feminine pronouns as appropriate. The descriptors in the narratives remained the same. Half of a group of officers were given the male-archetype narrative with masculine pronouns and the female-archetype narrative with feminine pronouns; and the other half, the male-archetype narrative with feminine pronouns and the female-archetype narrative with masculine pronouns. The officers were asked to evaluate the narratives and select one of the two officers described for promotion. The results indicated that the evaluators overwhelmingly selected the officer described by the male archetype narrative regardless of whether the pronouns used were masculine or feminine. "Competence" descriptors are positive factors in the selection of the officer for promotion for both male and female officers.

2. Professional Performance at Sea.

Significant emphasis is placed on professional performance at sea. The assignment of sea duty is an outcome of the detailer's decision to recommend to the placement officer that a particular billet should be filled by a particular person. The individual's preference is also taken into consideration in this decision. A *Navy Times* article (25 July, 1988) referred to an address delivered by Vice Admiral Leon A. Edney at the National Naval Officers Association convention. Edney commented that the Navy has done extremely well in providing increased opportunities for minorities in the officer and enlisted ranks, but can do much better. He went on to say that minority officers are detailed differently: They spend more time in recruiting and equal opportunity billets than do majority officers. The overall processes regarding detailing need to be defined and analyzed.

3. Assignment in a Technical Job Rate.

An additional indicator of indirect institutional discrimination is the assignment of Black enlisted personnel to military occupational specialities when they enter the service. In an ideal and fair environment, opportunities for assignment to occupations are no different for Black personnel than for anyone else.

Technical military occupational specialities are defined as those that require extensive specialized training. Nontechnical military occupations are defined as those that do not require extensive specialized training. Nontechnical ratings are thought to have slower advancement rates and slower advancement results in a loss of earnings (Chief of Naval Operations report, 1988).

That Black males are underrepresented in technical specialities is supported by the Semi-Annual Occupational Profile report (Research Division, 1991). The Chief of Naval Operations report (1988) also made reference to this situation. However, statistical analyses need to be conducted within each occupational area to see if the differences between the representation of Black and White males is significant. The 1990 Navy Military Equal Opportunity Assessment report states that the specialities in which Blacks are concentrated seem to have lower promotion rates. But they do not present data showing if the specialties are technical or nontechnical.

A view often presented is that Blacks are not assigned to technical occupations because they do not do well on the Armed Forces Qualification Test (AFQT). This fact has been attributed to educational deprivations. In many cases, this reasoning cannot be denied. However, when Butler (1976), assessed Black enlistment participation in the Army through a presentation of trend data showing the distribution of Blacks by military occupational specialities, Blacks were still underrepresented in technical occupations even when mental group level was controlled.

In line with the fact that advancement quotas across the Navy are vacancy driven, an investigation should be conducted to verify which rates are commonly undermanned and highlight those that are underrepresented by minorities. The Selected Reenlistment Bonus data files should provide input regarding the undermanned rates.

4. Improving Educational Level.

The panel gives consideration to improving educational level. This includes both academic and occupational training, whether such education is gained as a result of the individual's initiative during off-duty hours or as a participant in a Navy-sponsored program. Data need to be collected to determine if Blacks are participating in various educational opportunities. If they are not, then possible reasons for their nonparticipation should be identified. Possible reasons for nonparticipation might include: (1) lack of mentors to point out the advantages of participating in such programs; (2) members of a peer group also not participating in such programs; (3) lack of role model such as a supervisor who does take advantage of various educational programs; and, (4) a duty assignment which leaves no time to participate in such programs.

Other areas of consideration.

Below are additional areas of consideration that will not be discussed at this time due to time limitations.

5. Board Competition Within Rate. Candidates presented to the board should compete within their rates.

6. Weight and PRT Standards. Failure to meet Navy's weight/PRT standards may render candidates ineligible.

7. Test Scores. Specialty test results are also taken into account since they give an individual's relative standing compared to other candidates.

This was an initial attempt to define the E-7 Selection Board processes and to highlight various factors, external and internal to the process that might act as deterrents to the promotion of Black males. It is hoped that this effort will be continued so that eventually strategies to overcome barriers to promotion will be developed and applied.

CONCLUSION

Equal Opportunity for promotion is not demonstrated by the promotion board results. There are statistically significant differences in the promotion rates by race and gender. The enlisted E-7 and E-8 promotion boards for all the Services show severe differences among minority males.

The Navy E-7 promotion board has produced the most racially biased results of all of the promotion boards examined.

As a group, Black males have significantly lower promotion rates than any other group, across all of the Services. This is apparent in many enlisted promotion boards, and the Air Force officer boards.

The individual Service Military Equal Opportunity Assessments are not effective at detecting, quantifying, and displaying differences in promotion rates. They are not effective at presenting whether or not differences are significant differences which deserve action. Promotion rates are rounded to the nearest 0.01 which can hide significant differences between large population size groups. A mass quantity of raw data is provided without an effective graphical presentation or any interpretation. When graphs are provided, raw differences in promotion rates are shown, without regard to population size or the statistical significance of the differences.

The use of statistical tests of significance is vitally important. Control charts provide a relatively easy method of detecting statistically significant differences in promotion rates which are unlikely to be due to random variation. Control charts can also be used to visually display promotion rate data upon which to base affirmative actions.

The development of a model to help in the identification of reasons for promotion disparities is feasible and would be a valuable tool to target areas for research and development.

RECOMMENDATIONS

1. Black male promotions and the Navy E-7 promotion process should be priority candidates for further study. Specific affirmative actions may be required for these groups.

2. The use of quotas to artificially ensure that all minority promotion rates are equal to or greater than the board average will ensure that the majority is always promoted at below average rates. This method may be in effect in the Army officer promotion boards. A better method to achieve equal promotion opportunity is to apply Total Quality and strive to improve each person's opportunity for promotion. In time, the promotion qualifications for all persons (regardless of race and gender) may be improved to an equitable and higher level.

3. Implement the use of control charts to present and analyze Equal Opportunity data. This effort may be started as part of the larger effort of implementation of Total Quality in the Services. Preferably, the Military Equal Opportunity Assessments should utilize control charts in presenting Equal Opportunity data.

4. Department of Defense Instruction 1350.3 should be reviewed for the method it prescribes for presentation of promotion data. It is recommended that promotion rates be calculated to four significant digits, rather than to the nearest 0.01. Consideration of the use of control charts and statistical tests of significance should be made. The control charts could be generated by the individual Services or by a Department of Defense researcher.

5. Continue analysis of Equal Opportunity data with statistical tools. Promotion board results may be further analyzed for trends using logistic regression models in order to build a promotion model. Analysis of the model may result in identifying the underlying causes of differences in racial promotion rates. The cause of differences between the races in promotion achievement may be due to underlying differences between the races, rather than direct racism. Identification of underlying causes (such as background, education, duty assignments) will be necessary in order to build effective affirmative action programs.

6. Continue the effort to analyze the E-7 promotion board processes in order to identify barriers to promotion for minority males and develop strategies to overcome these barriers.

7. Investigate a comparison of time to promotion for Black and White enlisted personnel in all Services. Butler (1976) investigated time to promotion for Black and White enlisted persons in the Army. Even when the two groups were matched on a civilian education and AFQT score basis, Blacks consistently took more time than Whites to be advanced in grade. Miller and Ransford (1978) reanalyzed Butler's data for additional differences between the two groups. They demonstrated that inequities for Black promotions were greatest for those that should have been highly competitive for promotion. There was also lower promotion of those Blacks into those ranks that would involve supervision of Whites.

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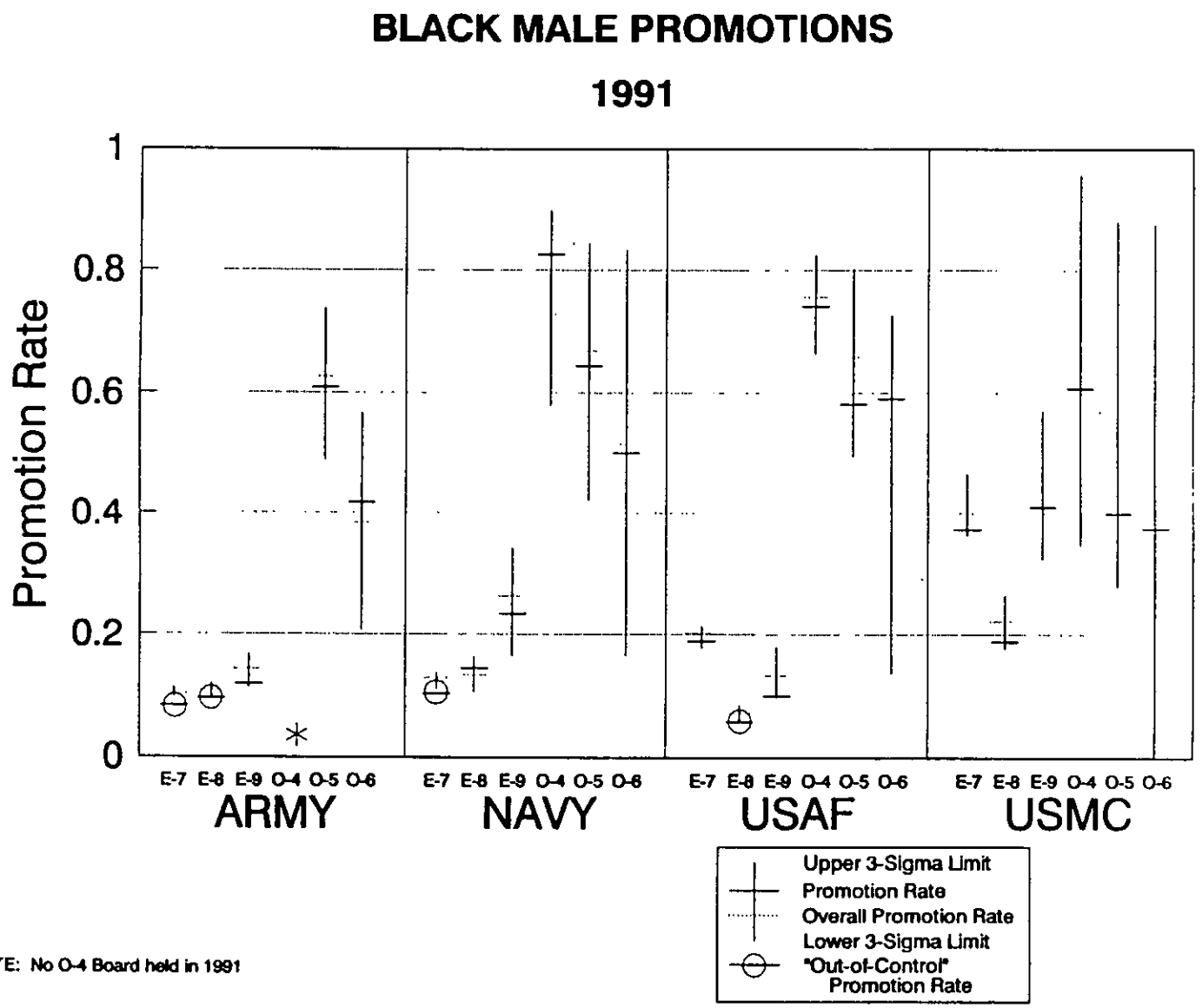
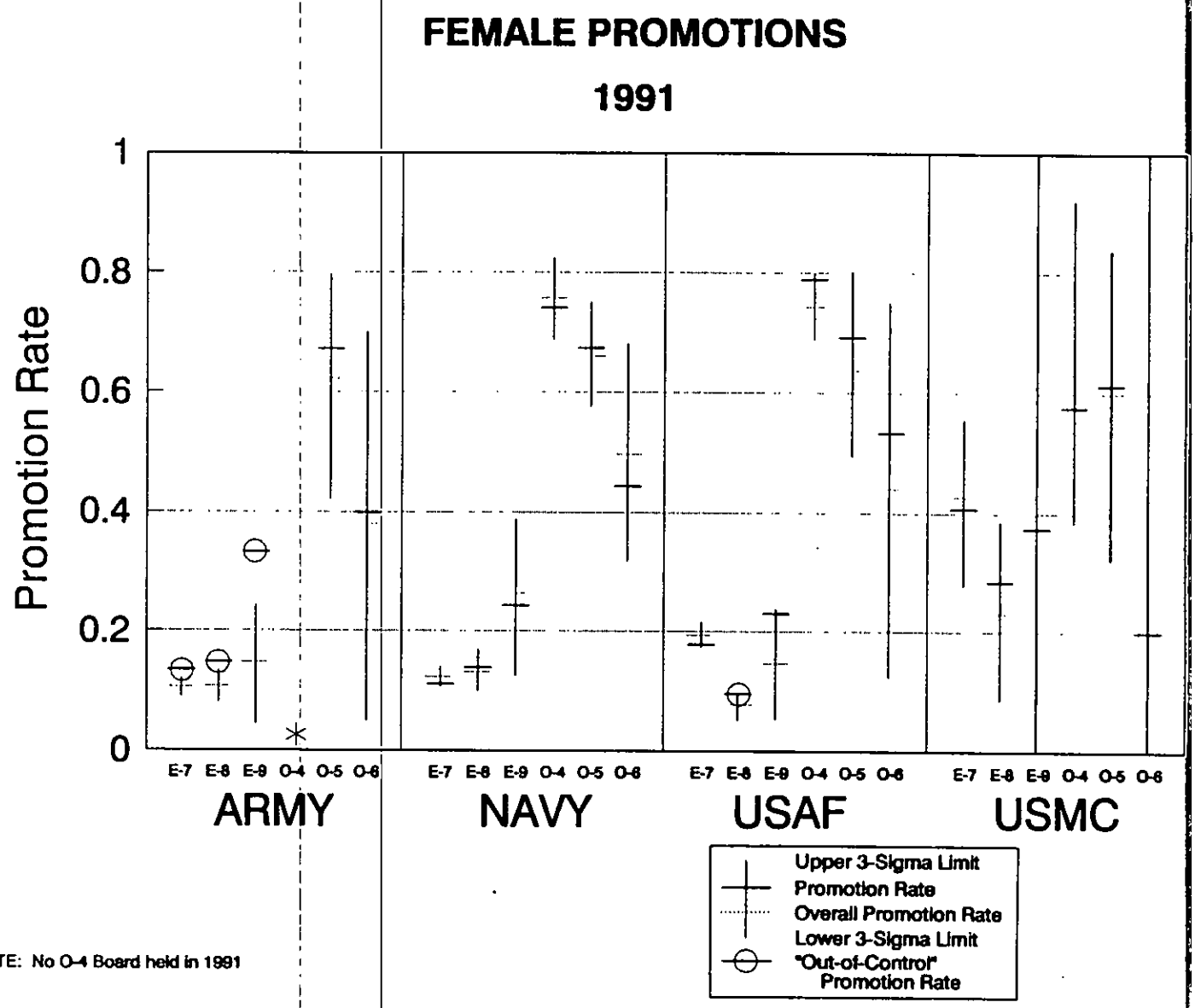
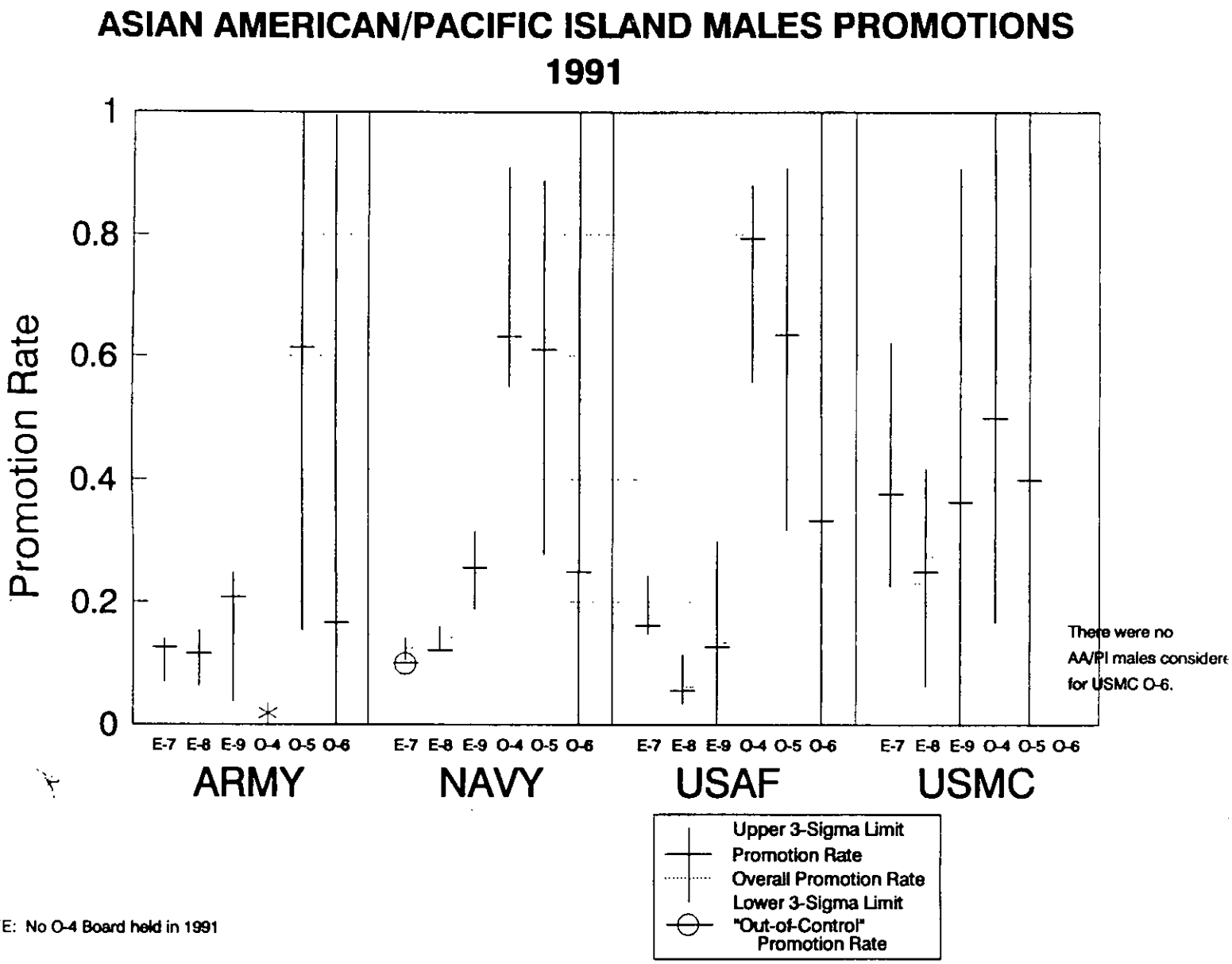


Figure 1.
1991 Black Male Promotions



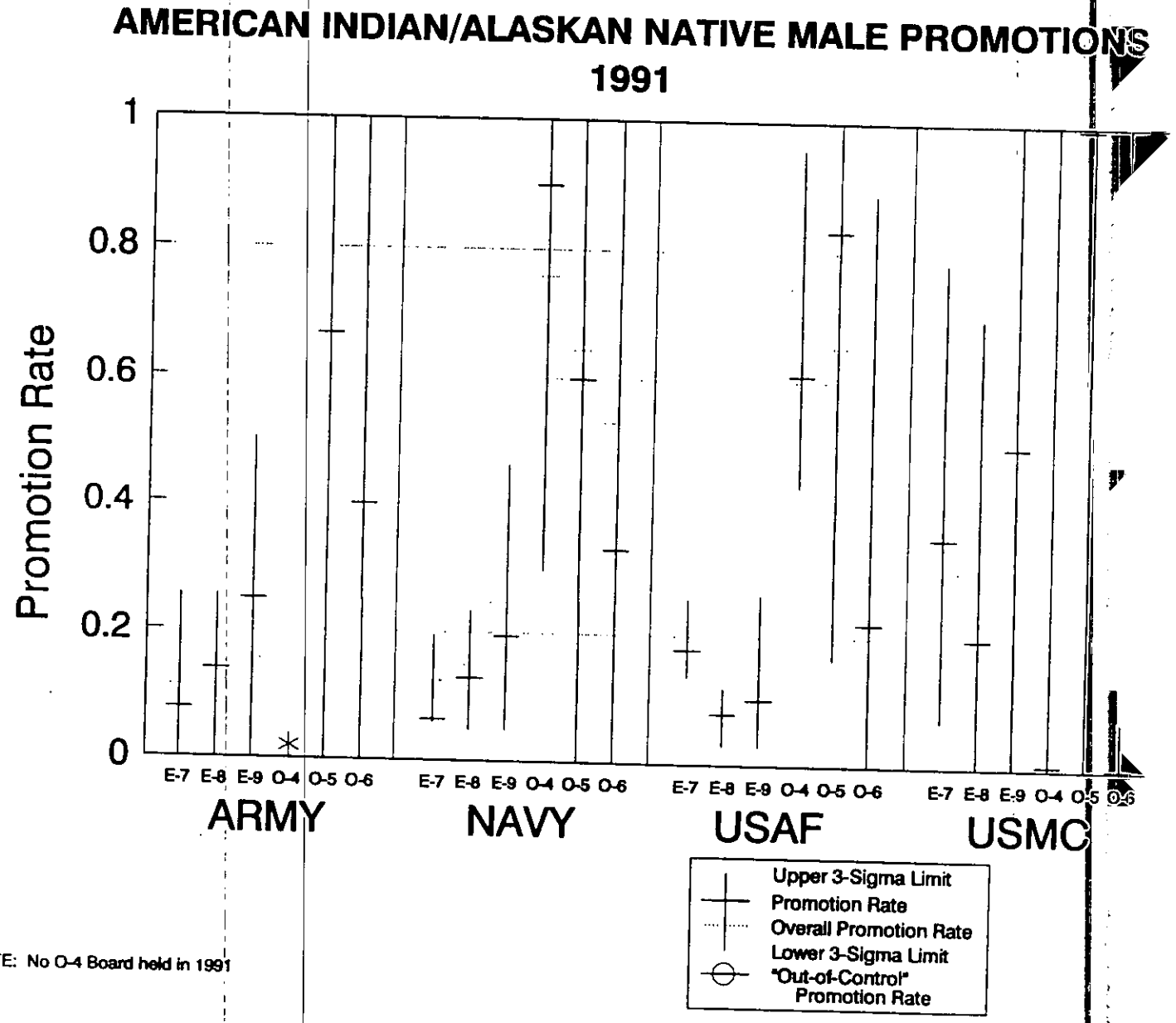
NOTE: No O-4 Board held in 1991

Figure 2.
1991 Female Promotions



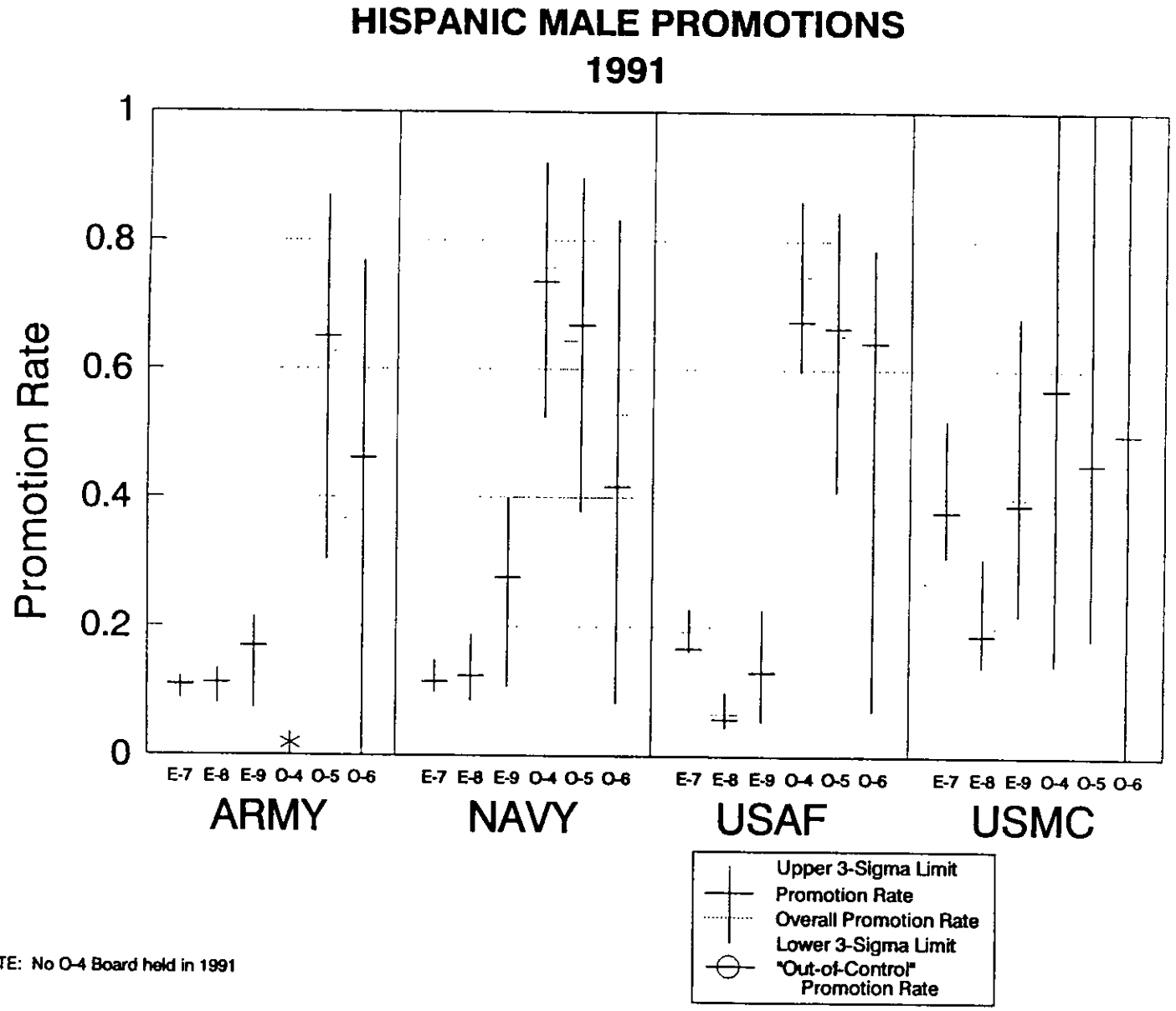
NOTE: No O-4 Board held in 1991

Figure 3.
1991 Asian American / Pacific Island Males Promotions



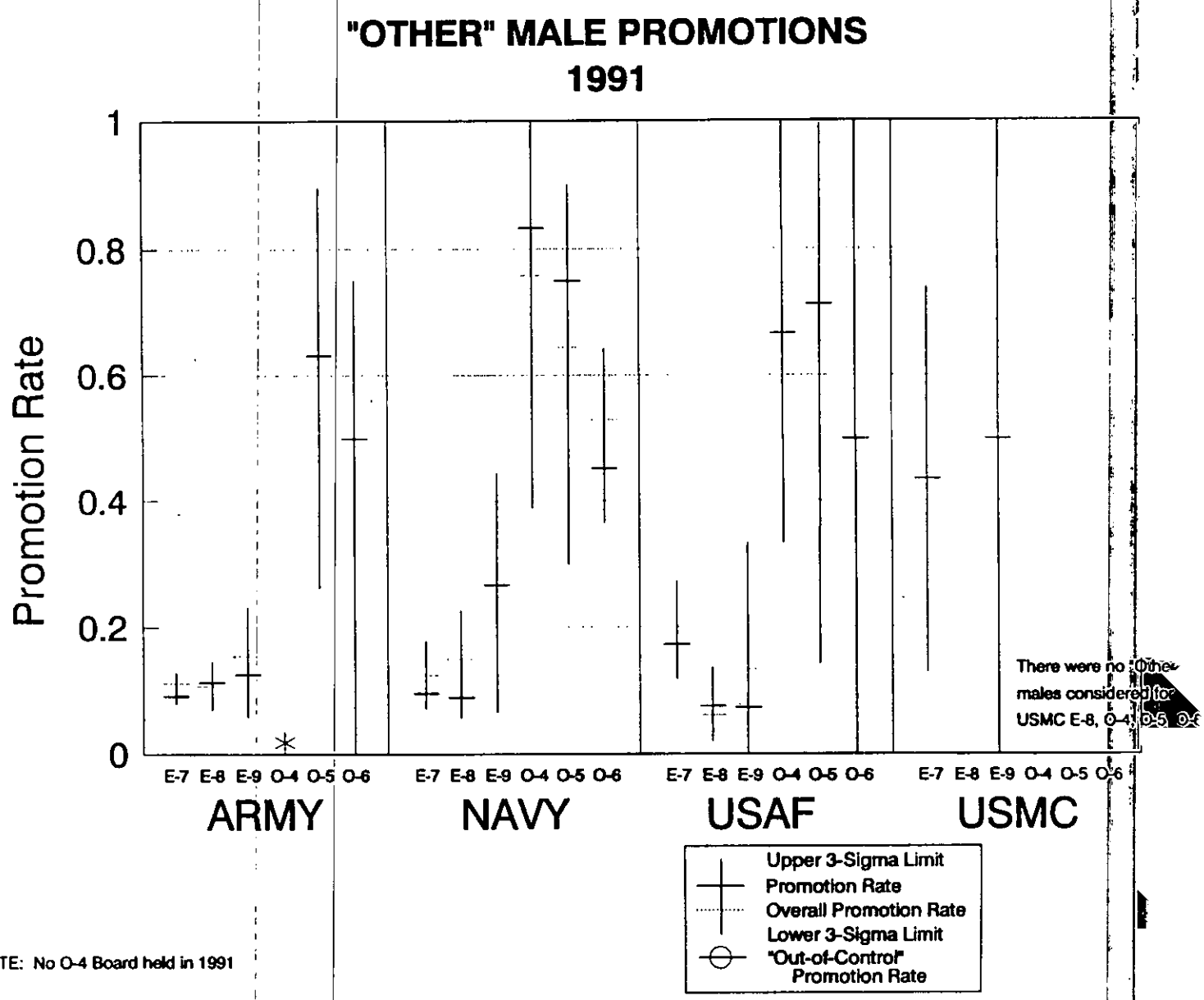
NOTE: No O-4 Board held in 1991

Figure 4.
1991 American Indian / Alaskan Male Promotions



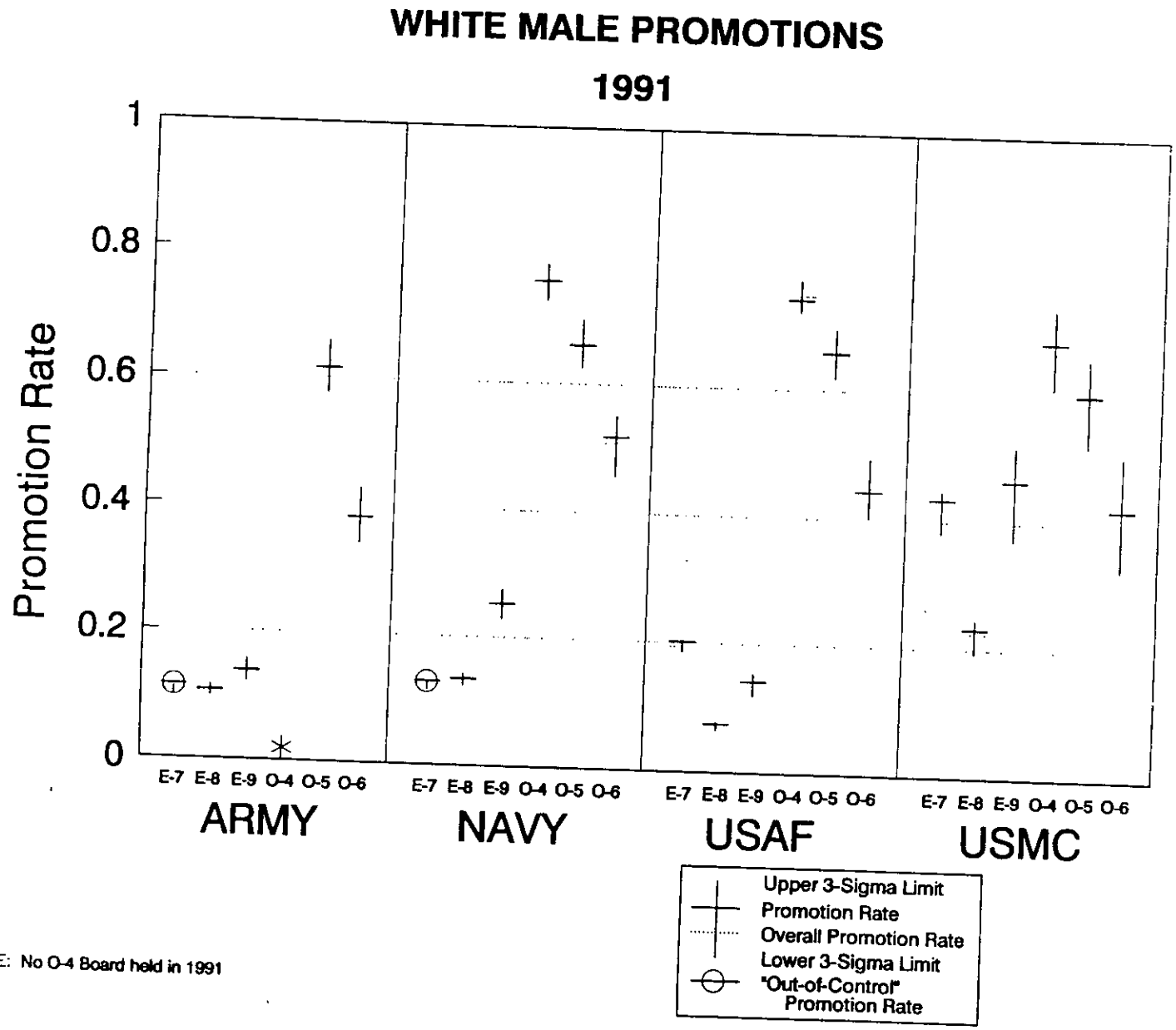
NOTE: No O-4 Board held in 1991

Figure 5.
1991 Hispanic Male Promotions



NOTE: No O-4 Board held in 1991

Figure 6.
1991 "Other" Male Promotions



NOTE: No O-4 Board held in 1991

Figure 7.
1991 White Male Promotions

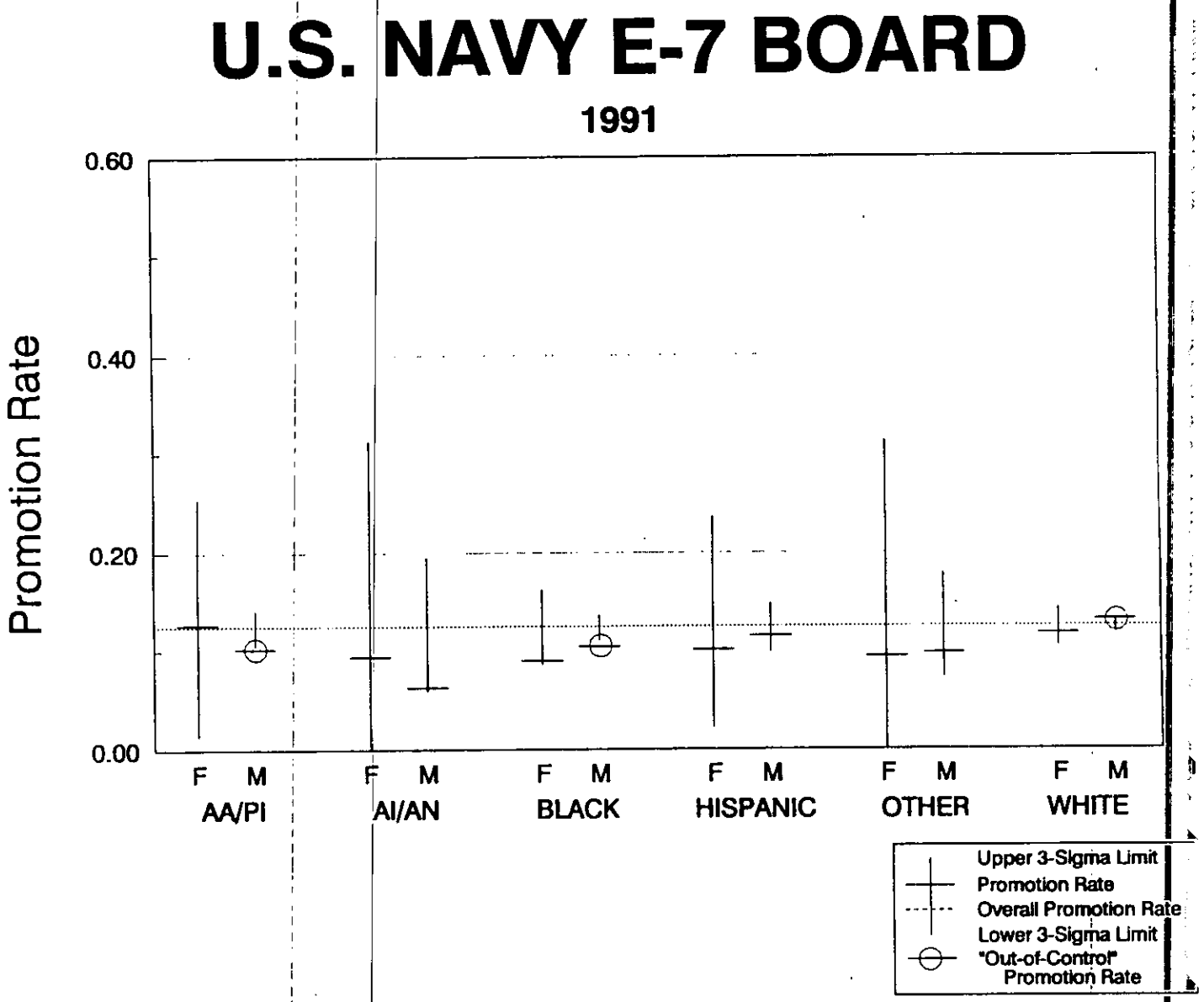


Figure 8.
1991 U.S. Navy E-7 Board

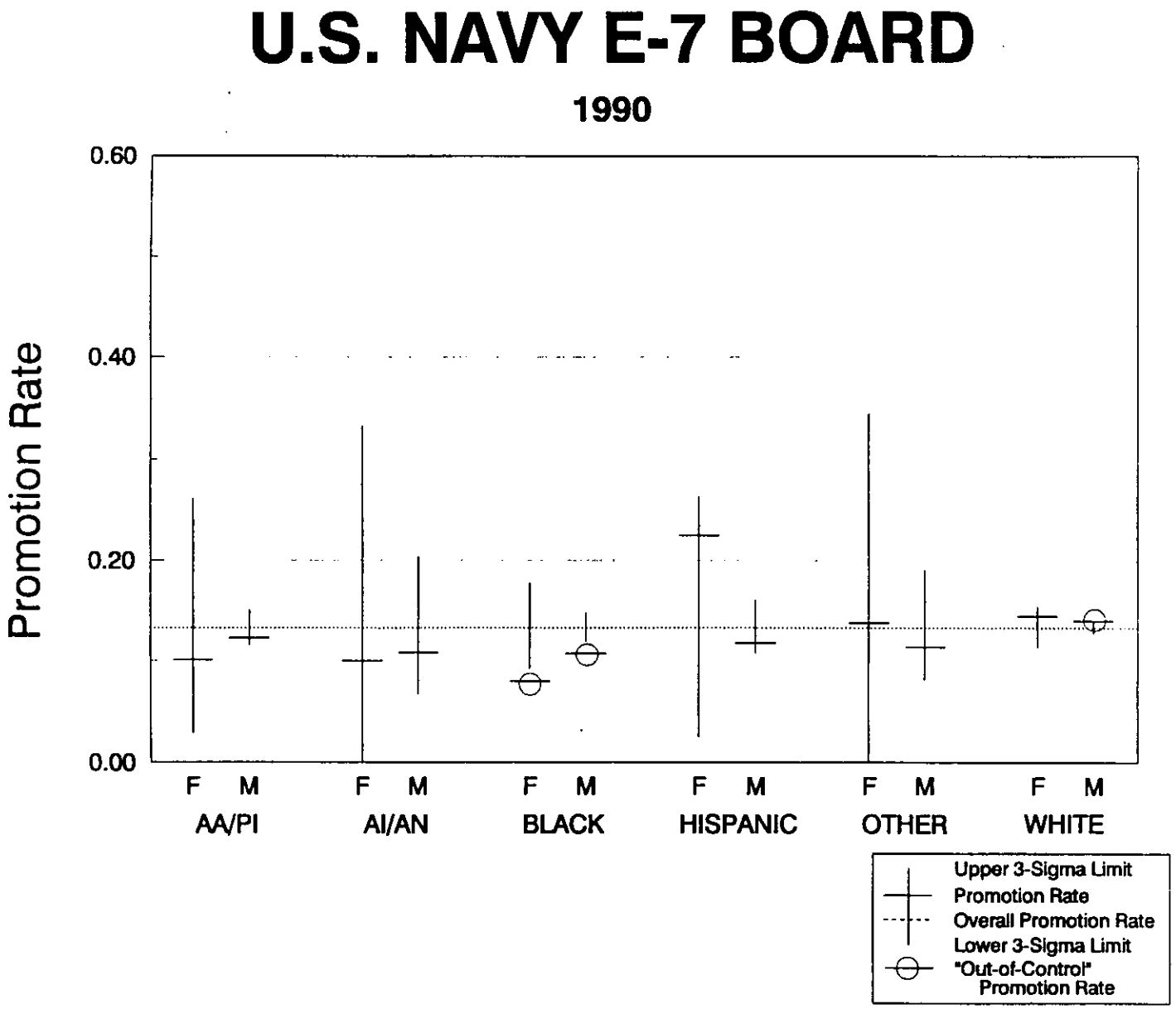
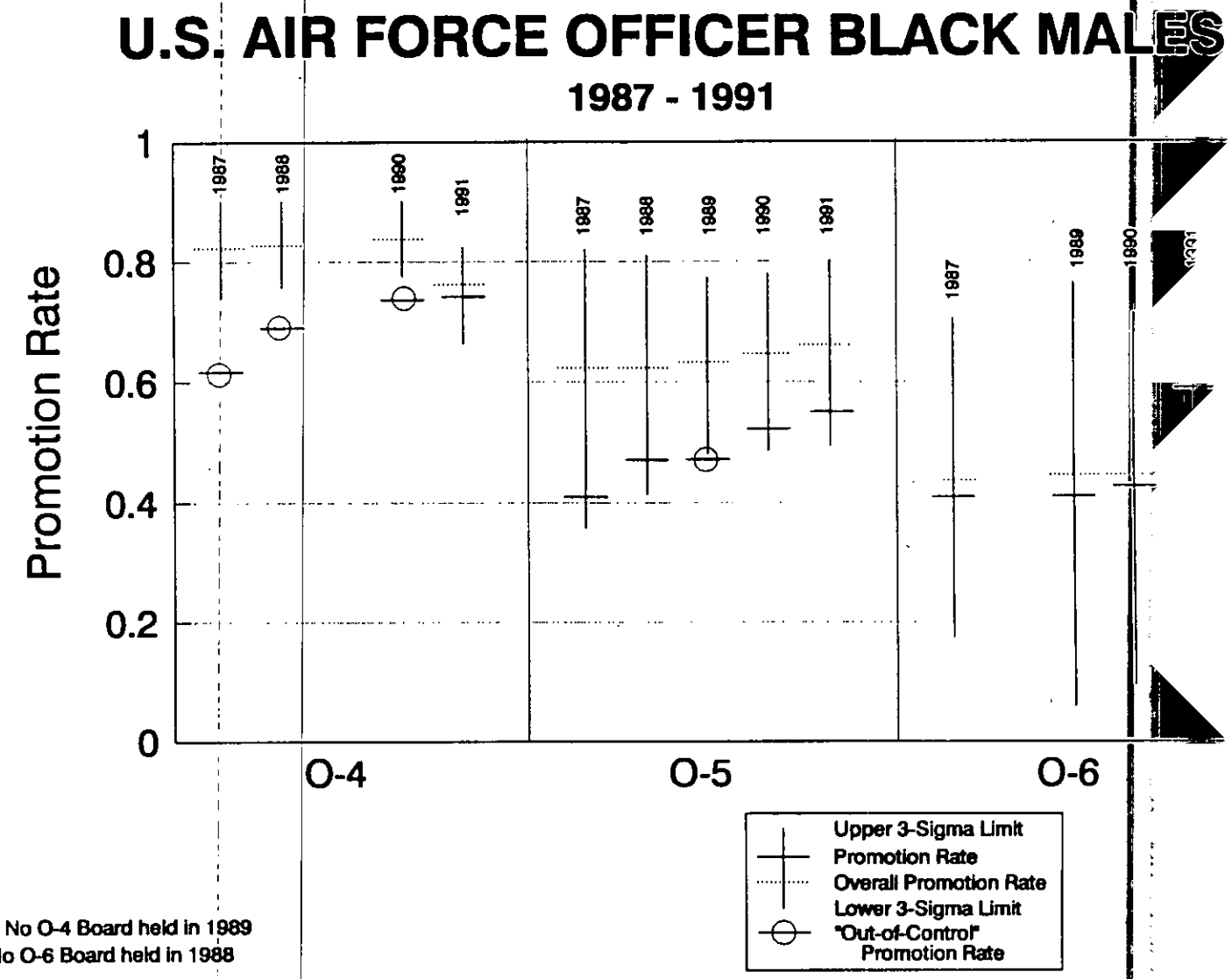


Figure 9.
1990 U. S. Navy E-7 Board



Note: No O-4 Board held in 1989
No O-6 Board held in 1988

Figure 10.
U.S. Air Force Officer Black Males

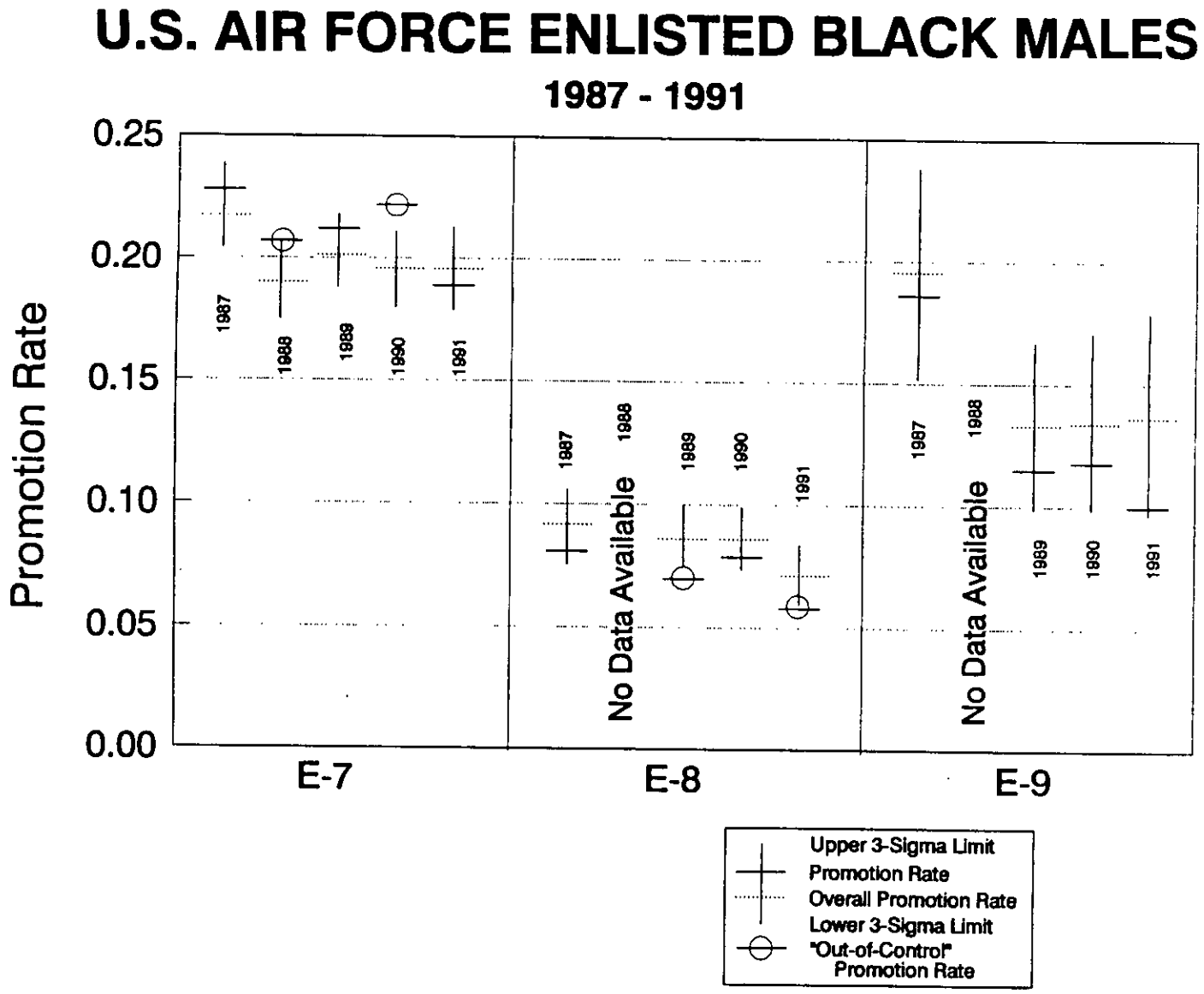


Figure 11.
U.S. Air Force Enlisted Black Males

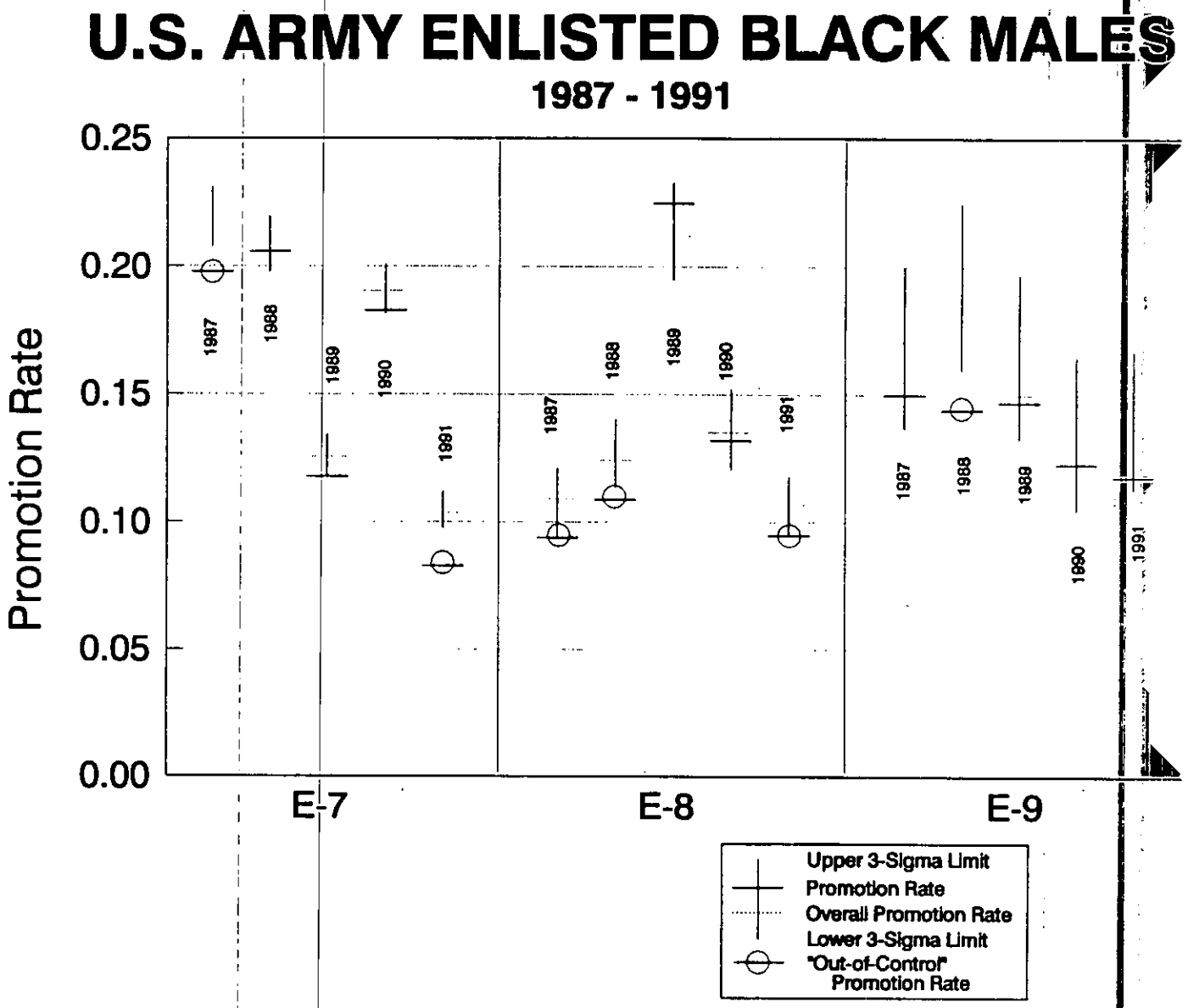


Figure 12.
U.S. Army Enlisted Black Males

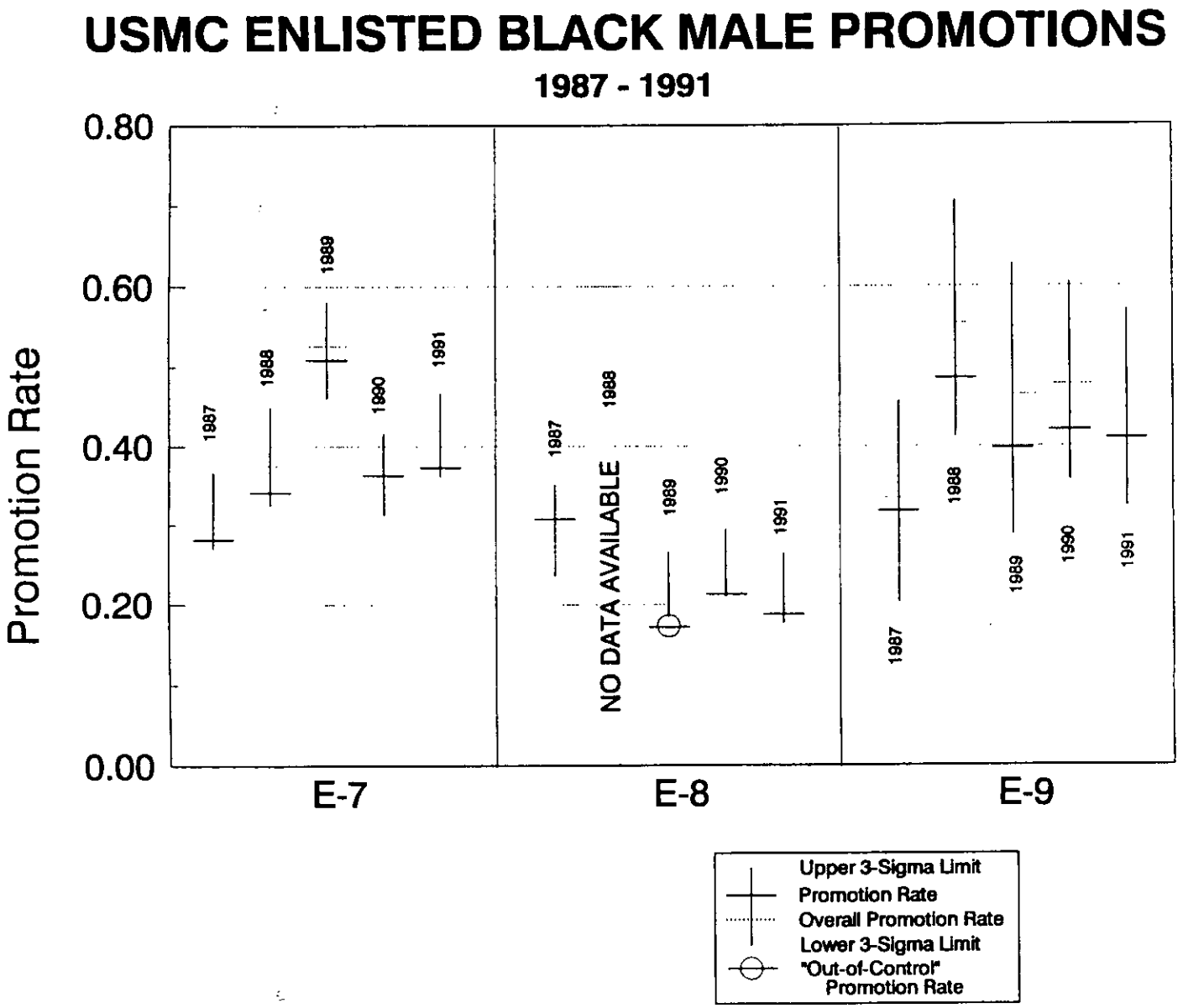


Figure 13.
U.S.M.C. Enlisted Black Males

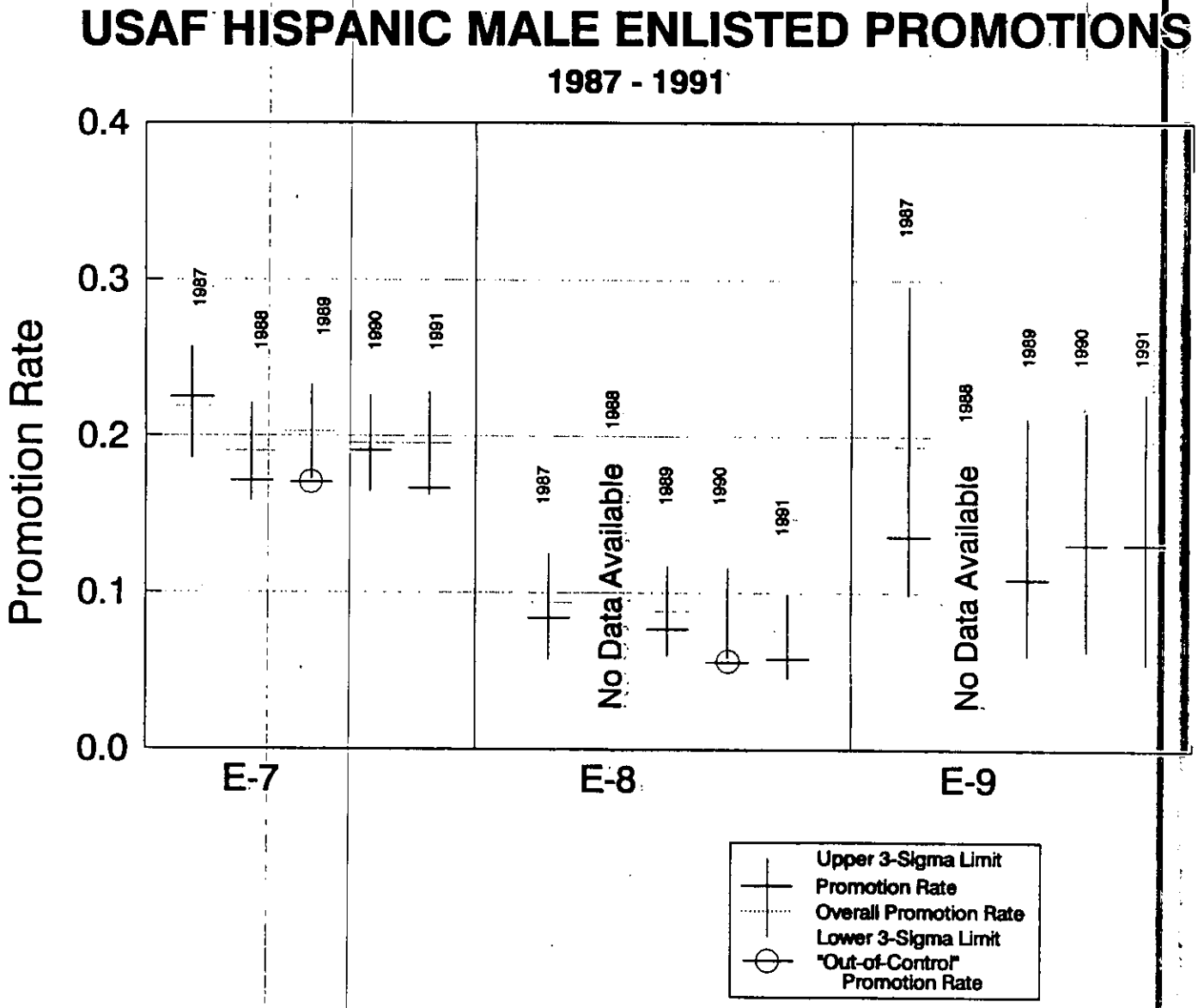


Figure 14.
U.S. Air Force Enlisted Hispanic Males

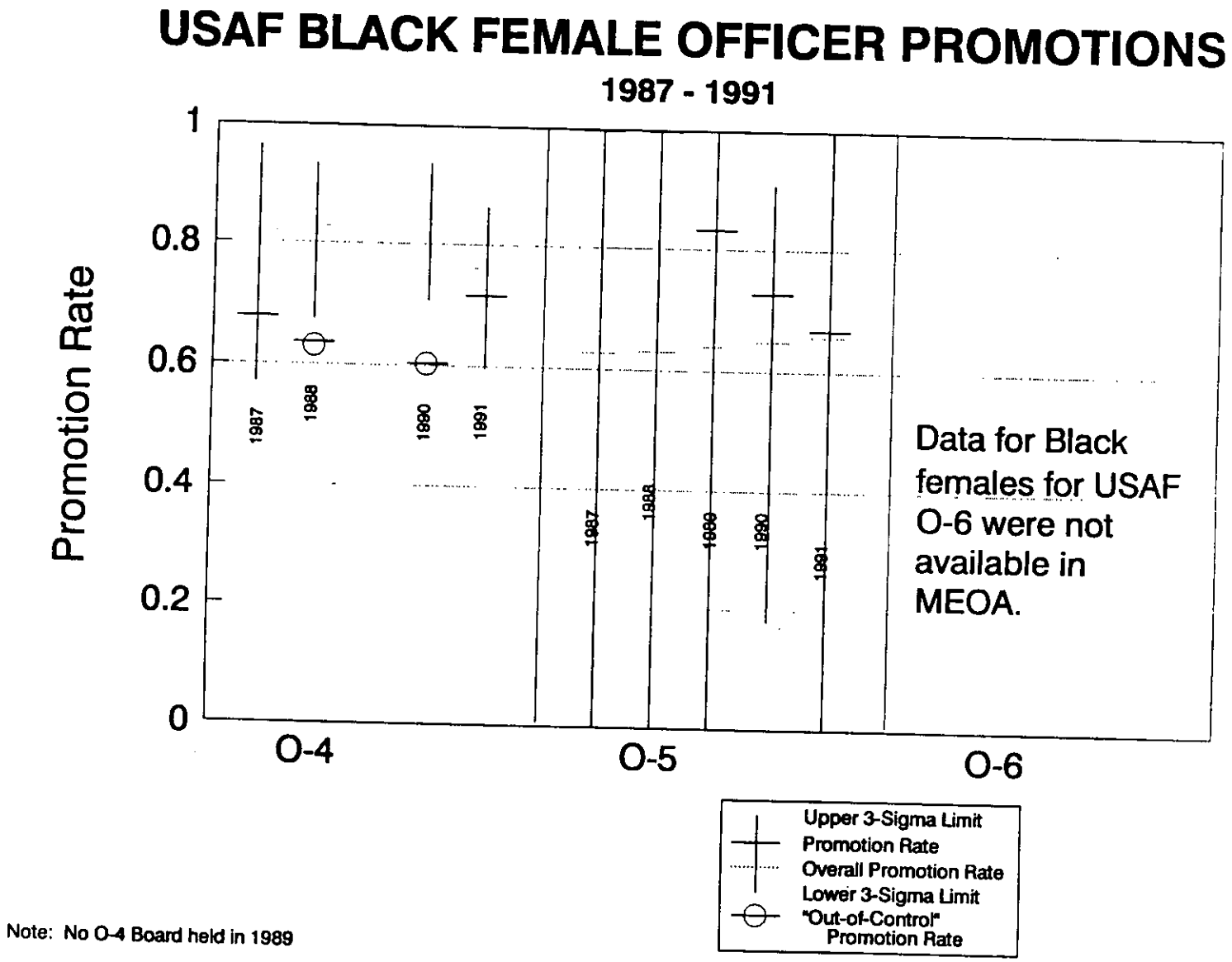
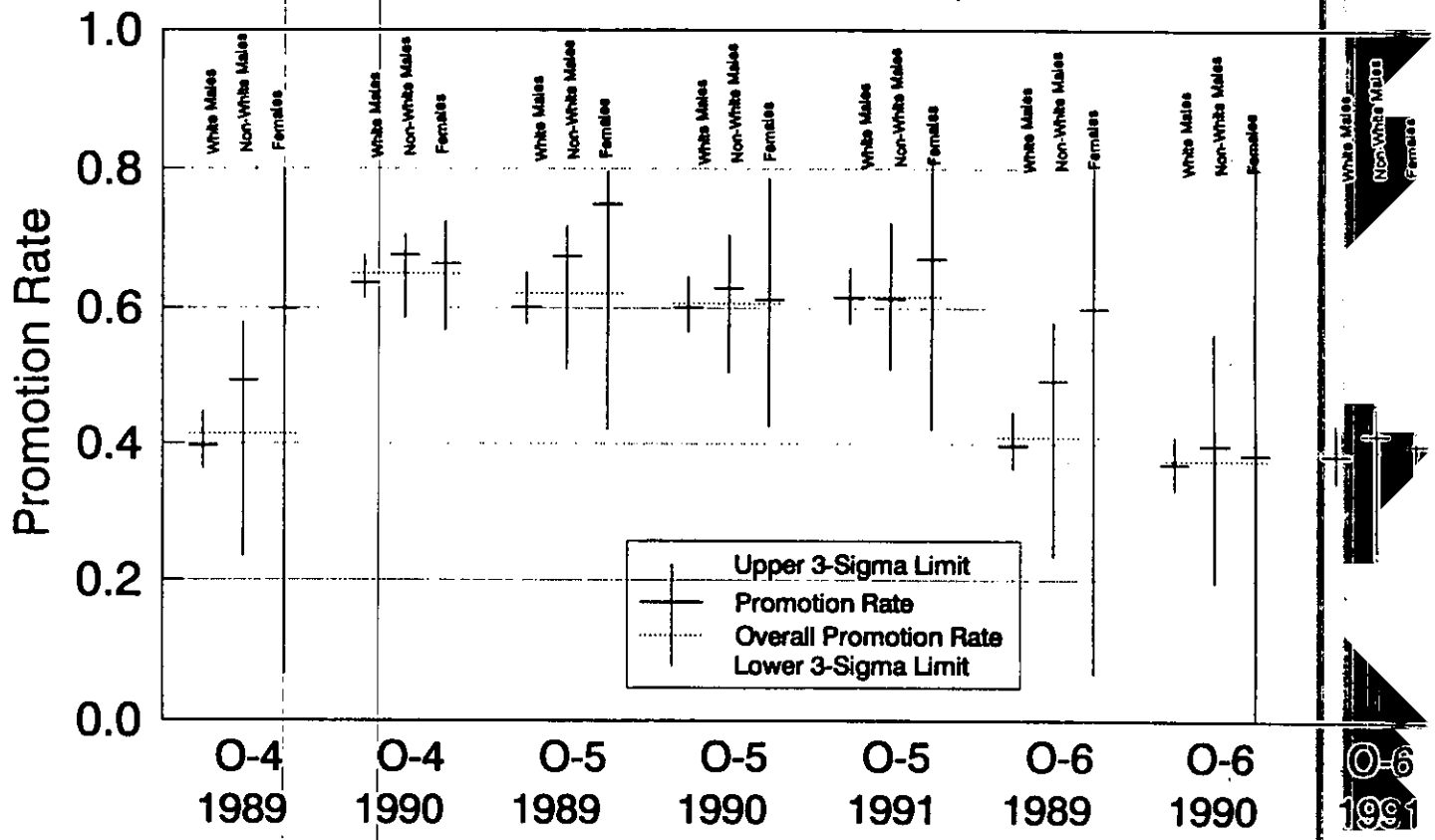


Figure 15.
U.S. Air Force Black Female Officers

U.S. ARMY OFFICER PROMOTION BOARDS

1989-1991



Note: No O-4 Board was held in 1991.

Figure 16.
U.S. Army Officer Promotion Boards 1989 - 1991

APPENDIX A
POINTS OF CONTACT

Research Related

Dr. Brenda Moore University of Maryland	Women Issues in the Navy
Dr. Paul Rosenfeld Navy Personnel Research and Development Center (NRPDC) San Diego CA DSN: 553-7658 Fax: 553-9973 / (619) 553-9973	Current Equal Opportunity Issues - emphasis on attitudes and perceptions
Ms. Amy Culbertson NRPDC, San Diego CA DSN: 553-7654 Fax: 553-9973 / (619) 553-9973	Women in the Navy
MAJ Jose Picart U.S. Military Academy West Point, NY DSN: 688-5015	Promotion issues related to Blacks. Behavioral Science
Dr. Robert Morrison NPRDC, San Diego CA DSN: 553-9256 Fax: 553-9973 / (619) 553-9973	Selection and Promotion of Officers

Defense Equal Opportunity Management Institute staff

SSG Robert B. Shephard DSN: 854-5214	U.S. Army Administrative Representative
YN2 Darren L. Gibson DSN: 854-5214	U.S. Navy Admin. Representative
MSgt Carolyn S. Semiglasow DSN: 854-7542	U.S. Air Force Admin. Representative
MAJ Eugene Hall DSN: 854-2968	U.S. Marine Corps Research

Promotion Board Contacts

Mr. Chapman Office of Promotions & Appointments DSN: 224-2725	U.S. Navy Officer Boards
LT Kelly Henry Enlisted Advancement Board BUPERS 262 DSN: 224-3428/2763	U.S. Navy Enlisted Boards
SSgt Mendes Secretary for Dept of Air Force Selection Board DSN: 487-2362	U.S. Air Force Enlisted Boards
LtCol Smith DSN: 487-5785/5601	U.S. Air Force Officer Boards
BMCM David L. Pender Cruiser-Destroyer GROUP TWO DSN: 563-5354/5	Served on a Navy E-7 Board

Military Training

Mr. Gale Hamblin
Department Head, Academic/Education Enhancement
Commander, Navy Education and Training (CNET)
DSN: 922-4984

Ms. Barbara Taylor
NPRDC liaison to CNET
DSN: 922-2376

Demographic Data

Ms. Valerie Hall Navy Personnel Research and Development Center San Diego, CA DSN: 553-7763	"Train Track" Database - source of Navy Enlisted longitudinal personnel data.

APPENDIX B

RELATED ARTICLES

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APPENDIX C

FORMS

Page

DD Form 2509 (From DODI 1350.3) C-3

Enlisted Performance Evaluation Report (U. S. Navy) C-5

SAMPLE

MILITARY EQUAL OPPORTUNITY ASSESSMENT

REPORT CONTROL SYMBOL
DD-FM&P(A)1760

PART I - DATA FROM CURRENT FISCAL YEAR

1. FY 88 ASSESSMENT

2. DOD COMPONENT/SUBCOMPONENT
Element rendering the report (e.g., Active Army, ANG, etc.)

3. SOURCE AGENCY
a. OFFICE: Directorate of Human Resources (EO)
b. TELEPHONE NUMBER: AV XXX-XXXX/XXXX

4.a SUBJECT: Promotions to Grade 0-6

b. CATEGORY: Promotions

TRACKED GROUPS	5. MALE A	5. MALE B	5. MALE C (A + B)	5. MALE D (OSD Use only)	6. FEMALE A	6. FEMALE B	6. FEMALE C (A + B)	6. FEMALE D (OSD Use only)	7. TOTAL A	7. TOTAL B	7. TOTAL C (A + B)	7. TOTAL D (OSD Use only)	8. FOR OSD USE
(1) American Indian/ Alaskan Native													
(2) Asian American/ Pacific Islander													
(3) Black (Non-Hispanic)													
(4) Hispanic													
(5) White (Non Hispanic)													
(6) Other/Unknown													
(7) TOTAL													

9.a THE NUMBERS IN COLUMN A ARE:
Actual numbers selected for promotion during rptg period

b. THE NUMBERS IN COLUMN B ARE:
Numbers from each group considered for promotion in period

10. STATEMENT OF SERVICE/COMPONENT AFFIRMATIVE ACTION(S)
The Service/Component submitting this report has established its own affirmative action(s) and/or initiative(s) in this category. These may be found in its Affirmative Action Plan (AAP). This block is provided so that one may reel in a concise form the objective(s) or aims of the Service/Component in the category and subject shown in block 4 above. Remarks in block 10 should relate directly to the reporting element's pre-stated intent or plan of action.

11. ASSESSMENT
A narrative assessment of the Service/Component's accomplishment of its AAP objective(s) in this subject is begun in this block and continued on additional blank sheets as needed. In those instances where established objectives were not achieved, it may be valuable to examine why accomplishment was not possible. While this is principally a subjective self-analysis, it is appropriate to link comments to the statistical data display above. This becomes even more valuable as the reverse side of this form is filled in and trends begin to become available for analysis. Further, it often will be appropriate to cross-reference assessments to other categories and/or subjects, especially category 2 (Composition).

THIS FORM MAY BE TYPEWRITTEN, FILLED IN BY HAND, OR A COMBINATION OF BOTH METHODS.

DD Form 2509, DEC 87

SAMPLE

SAMPLE

PART II - DATA FROM PREVIOUS FISCAL YEARS

FY 87 ASSESSMENT | 4.a SUBJECT: Promotions to Grade 0-6 | b CATEGORY: Promotions

TRACKED GROUPS	5. MALE A	5. MALE B	5. MALE C (A + B)	5. MALE D (OSD use)	6. FEMALE A	6. FEMALE B	6. FEMALE C (A + B)	6. FEMALE D (OSD use)	7. TOTAL A	7. TOTAL B	7. TOTAL C (A + B)	7. TOTAL D (OSD use)	8. FOR OSD USE
(1) American Indian/ Alaskan Native													
(2) Asian American/ Pacific Islander													
(3) Black (Non-Hispanic)													
(4) Hispanic													
(5) White (Non-Hispanic)													
(6) Other/Unknown													
(7) TOTAL													

FY 86 ASSESSMENT | 4.a. SUBJECT: Promotions to Grade 0-6 | b CATEGORY: Promotions

TRACKED GROUPS	5. MALE A	5. MALE B	5. MALE C (A + B)	5. MALE D (OSD use)	6. FEMALE A	6. FEMALE B	6. FEMALE C (A + B)	6. FEMALE D (OSD use)	7. TOTAL A	7. TOTAL B	7. TOTAL C (A + B)	7. TOTAL D (OSD use)	8. FOR OSD USE
(1) American Indian/ Alaskan Native													
(2) Asian American/ Pacific Islander													
(3) Black (Non-Hispanic)													
(4) Hispanic													
(5) White (Non-Hispanic)													
(6) Other/Unknown													
(7) TOTAL													

FY 85 ASSESSMENT | 4.a. SUBJECT: Promotions to Grade 0-6 | b CATEGORY: Promotions

TRACKED GROUPS	5. MALE A	5. MALE B	5. MALE C (A + B)	5. MALE D (OSD use)	6. FEMALE A	6. FEMALE B	6. FEMALE C (A + B)	6. FEMALE D (OSD use)	7. TOTAL A	7. TOTAL B	7. TOTAL C (A + B)	7. TOTAL D (OSD use)	8. FOR OSD USE
(1) American Indian/ Alaskan Native													
(2) Asian American/ Pacific Islander													
(3) Black (Non-Hispanic)													
(4) Hispanic													
(5) White (Non Hispanic)													
(6) Other/Unknown													
(7) TOTAL													

DD Form 2509 Reverse, DEC 87

SAMPLE

1616-1

ENLISTED PERFORMANCE EVALUATION REPORT

1 NAME *(Last, First, Middle or Middle Initial)*	2 RATE/RATING	3 SSN

BRANCH/CLASS: 4 ☐ USN | 5 ☐ USNR

STATUS: 6 ☐ ACTIVE | 7 ☐ INACTIVE | 8 ☐ TEMAC | 9 ☐ ACDUTRA

10 MEMBER'S SHIP OR STATION	11 MEMBER'S UIC	12 DATE REPORTED

OCCASION FOR REPORT: 13 ☐ Periodic | 14 ☐ Transfer | 15 Other

PERIOD OF REPORT: 16 From | 17 To

TYPE OF REPORT: 18 ☐ Regular | 19 ☐ Con-Current

20 HEIGHT & WEIGHT/PHYS. QUAL.	21 RESERVE PART	22 EFF DATE OF RATE

23 REPORTING SENIOR'S NAME *(Last and Initials)*	24 RANK	25 TITLE	26 SSN

	EVALUATION SECTION **Requires Comment*	NOT OBS	4.0	3.8	3.6	3.4	3.2	3.0	2.8*	2.6*	2.0*	1.0*
PROFESSIONAL FACTORS	27 MILITARY KNOWLEDGE/ PERFORMANCE											
	28 RATING KNOWLEDGE/ PERFORMANCE											
PERSONAL TRAITS	29 INITIATIVE											
	30 RELIABILITY											
	31 MILITARY BEARING											
	32 PERSONAL BEHAVIOR											
	33 HUMAN RELATIONS INCL EQUAL OPPORTUNITY											
SELF EXPRESSION	34 SPEAKING ABILITY											
	35 WRITING ABILITY											
LEADERSHIP	36 DIRECTING											
	37 COUNSELING											
38 MANAGEMENT *(E-7/8/9 Only)*												
39 OVERALL EVALUATION												
40 SUMMARY *(Required for E-4 & Above)*												

ADVANCEMENT RECOMMENDATION: 41 ☐ Recommended | 42 ☐ Progress Toward | 43 ☐ Not Recom *

45 SIGNATURE OF REPORTING SENIOR

44 SIGNATURE OF MEMBER

I acknowledge that I have seen this evaluation report and understand my rights under Article 1110, U.S. Navy Regulations (1973) to submit a statement.

Statement: Desired/Not Desired (cross out as appropriate)

46 ADDRESS OF REPORTING SENIOR

47 TYPED NAME AND SIGNATURE OF REGULAR REPORTING SENIOR ON CONCURRENT REPORT	48 DATE FORWARDED
	49 DATE FWD *(If 47 Used)*

NAVPERS 1616/24 (Rev. 6-83) S/N 0106-LF-016-1721

Report NMPC 1616-1

OCR TYPING FONT NOT REQUIRED FOR COMPLETION OF THIS SIDE

50 MEMBER'S LAST NAME, INITIALS	51 SSN	PERIOD OF REPORT 52 From	53 To

54 DUTIES AND RESPONSIBILITIES

55 SPECIAL ACHIEVEMENTS

56 EVALUATION COMMENTS

☆ U.S. GOVERNMENT PRINTING OFFICE 1983—605-010/8503

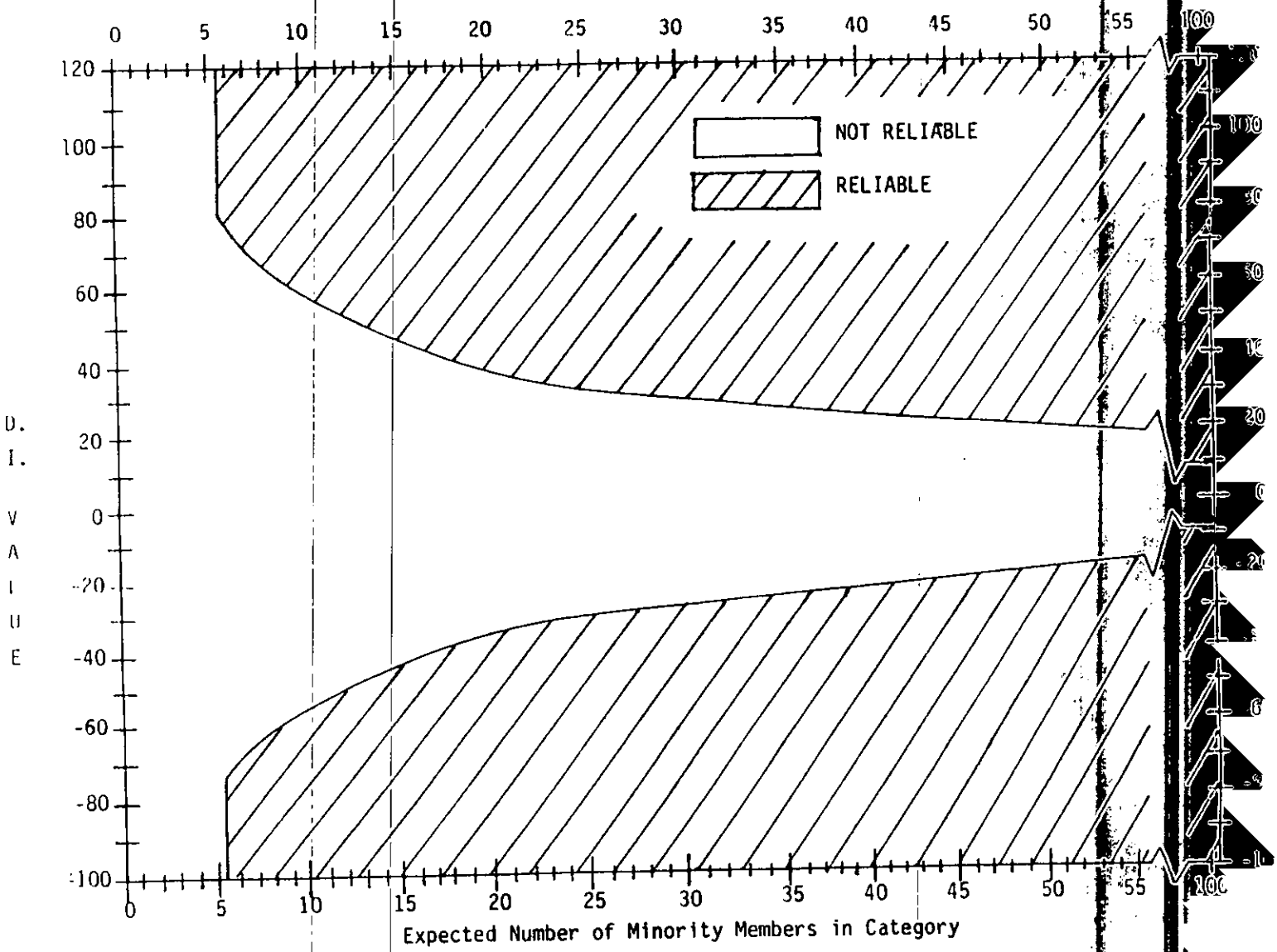
APPENDIX D

Representation Index Significance Levels

The Difference Indicator (later referred to as the Representation Index or R.I.) was proposed in Goehring, 1979. Goehring noted that the Discrimination Index is an "approximation derived from the standard test [Chi-Square] between two independent proportions." Goehring performed a Monte Carlo analysis of the R.I. in order to assess its statistical significance level. The analysis examined more than 20,000 selected 2 x 2 tables and calculated Chi-Square test values for each. The statistical significance of the R.I. does vary greatly versus population size. The figure below is reproduced from this publication. The cross-hatched ("RELIABLE") area appears to be the area where the R.I. result is significant at a 5 percent level. This publication states:

> In the derivation of the function presented in [the] figure, it was necessary to invoke several assumptions of which users should be cognizant. The number of minority individuals in the total eligible population has been assumed to be less than half of the total. Further, the selection ratio has been assumed not to exceed .25. If in a specific case either of these circumstances does not hold, it is recommended that the chi-square test be conducted rather than depending upon the values in the figure.

Note that this figure is not very useful for promotion board results as most selection (promotion) rates exceed 25 percent. Also, the expected number of minority members promoted often exceeds 100. The figure does not present data for number of members less than 6, and Goehring recommends the use of "Fisher's exact test" in such cases.



Reliability of difference indicator values

APPENDIX E

1987 - 1991 PROMOTION BOARD RESULTS
(Promotion Rates outside 3-Sigma Limits Only)

Promotion Rates Less than Lower 3-Sigma Limits

Service	Rank	Line/ Staff (USN)	Fiscal Year	Board Average Promotion Rate	Promotion Rate for this Group	Lower 3-Sigma Limit	R.I.	2X2 Chi-Square Result	Number Selected for Promotion	Number Considered for Promotion
Females (all races considered together)										
US NAVY	E-7		1989	0.14130	0.11189	0.12220	-20.81	21.34	335	2994
USMC	E-7		1988	0.38823	0.24031	0.25581	-38.10	11.88	31	129
Black Females										
US NAVY	E-7		1987	0.15440	0.04959	0.06612	-67.88	10.21	6	121
US NAVY	E-7		1990	0.13384	0.07987	0.09265	-40.3	15.92	50	626
USAF	O-4		1988	0.83012	0.63636	0.67532	-23.34	20.69	49	77
USAF	O-4		1990	0.83901	0.60417	0.70833	-27.99	39.43	58	96
Hispanic Females										
USMC	E-7		1988	0.38823	0.03704	0.11111	-90.46	14.17	1	27
White Females										
US NAVY	E-7		1989	0.14130	0.11569	0.12108	-18.13	14.51	309	2671
Asian-American/Pacific Island Males										
US NAVY	E-7		1991	0.12352	0.10197	0.10645	-17.44	14.49	341	3344

Service	Rank	Line/ Staff (USN)	Fiscal Year	Board Average Promotion Rate	Promotion Rate for this Group	Lower 3-Sigma Limit	R.I.	2X2 Chi-Square Result	Number Selected for Promotion	Number Considered for Promotion
Black Males										
US ARMY	E-7		1987	0.21980	0.19844	0.20822	-9.72	62.86	2285	11515
US ARMY	E-7		1991	0.10482	0.08339	0.09753	-20.45	141.60	1325	15890
US ARMY	E-8		1987	0.10819	0.09465	0.09521	-12.51	12.35	488	5156
US ARMY	E-8		1988	0.12696	0.10914	0.11373	-14.04	20.46	622	5699
US ARMY	E-8		1991	0.10732	0.09554	0.09612	-10.98	19.70	657	6877
US ARMY	E-9		1988	0.19260	0.14373	0.15998	-25.38	32.94	189	1315
US NAVY	E-7		1987	0.15440	0.12339	0.12692	-20.08	11.87	192	1556
US NAVY	E-7		1988	0.12829	0.08383	0.10252	-34.66	26.87	127	1515
US NAVY	E-7		1989	0.14130	0.11549	0.11631	-18.26	9.92	202	1749
US NAVY	E-7		1990	0.13384	0.10719	0.12007	-19.91	37.75	590	5504
US NAVY	E-7		1991	0.12352	0.10367	0.11057	-16.07	22.14	602	5807
USAF	E-8		1989	0.08763	0.07042	0.07483	-19.64	23.77	309	4388
USAF	E-8		1991	0.07229	0.05772	0.06019	-20.15	19.70	238	4123
USAF	O-4		1987	0.82035	0.61809	0.73871	-24.66	55.44	123	199
USAF	O-4		1988	0.83012	0.69136	0.75785	-16.72	34.91	168	243
USAF	O-4		1990	0.83901	0.73139	0.77628	-12.83	27.32	226	309
USAF	O-5		1989	0.63567	0.47273	0.48182	-25.63	13.82	52	110
USMC	E-8		1989	0.22562	0.17197	0.18476	-23.78	19.82	162	942
Hispanic Males										
USAF	E-7		1989	0.20313	0.17127	0.17290	-15.69	10.04	273	1594
USAF	E-8		1990	0.08693	0.05550	0.05946	-36.16	16.01	56	1009
Other Males										
US NAVY	E-7		1987	0.15440	0.12994	0.13820	-15.84	22.83	582	4479
USMC	E-7		1987	0.31907	0.08523	0.21023	-73.29	45.80	15	176
USMC	E-8		1987	0.29393	0.03846	0.17949	-86.91	51.15	6	156
USMC	E-9		1987	0.33065	0.03125	0.20312	-90.55	61.15	4	128
White Males										
US ARMY	E-8		1989	0.21415	0.20118	0.20196	-6.06	34.82	2053	10205

Promotion Rates Greater than Upper 3-Sigma Limits

Service	Rank	Line/ Staff (USN)	Fiscal Year	Board Average Promotion Rate	Promotion Rate for this Group	Lower 3-Sigma Limit	R.I.	2X2 Chi-Square Result	Number Selected for Promotion	Number Considered for Promotion
Females (all races considered together)										
US ARMY	E-7		1987	0.21980	0.29988	0.25073	36.43	60.35	484	1614
US ARMY	E-7		1989	0.12584	0.14921	0.14508	18.57	13.28	399	2674
US ARMY	E-7		1990	0.19147	0.24373	0.21278	27.29	54.13	748	3069
US ARMY	E-7		1991	0.10482	0.13486	0.11975	28.66	36.44	511	3789
US ARMY	E-8		1989	0.21415	0.27318	0.26422	27.57	12.51	165	604
US ARMY	E-8		1990	0.13666	0.20862	0.17803	52.66	31.56	150	719
US ARMY	E-8		1991	0.10732	0.14769	0.13307	37.62	22.12	192	1300
US ARMY	E-9		1991	0.14011	0.33333	0.24324	137.90	34.40	37	111
USAF	E-7		1987	0.22145	0.25500	0.25041	15.15	14.70	472	1851
USAF	E-7		1987	0.22145	0.25500	0.24193	15.15	24.85	944	3702
USAF	E-8		1987	0.09105	0.19012	0.13827	108.82	51.66	77	405
USAF	E-8		1987	0.09105	0.19012	0.12346	108.82	97.00	154	810
USAF	E-8		1989	0.08763	0.12632	0.11579	44.15	19.56	132	1045
USAF	E-8		1990	0.08693	0.12652	0.11020	45.53	26.06	167	1320
USAF	E-8		1991	0.07229	0.09680	0.09236	33.90	13.41	145	1498
USMC	E-7		1989	0.52160	0.65432	0.64198	25.44	11.59	106	162
Black Females										
US ARMY	E-7		1990	0.19147	0.23904	0.22001	24.84	25.94	409	1711
US ARMY	E-8		1990	0.13666	0.20741	0.20370	51.77	11.98	56	270
US ARMY	E-9		1991	0.14011	0.40000	0.36000	185.48	14.33	10	25
Hispanic Females										
US ARMY	E-7		1991	0.10482	0.19847	0.19084	89.34	14.43	26	131

Service	Rank	Line/ Staff (USN)	Fiscal Year	Board Average Promotion Rate	Promotion Rate for this Group	Lower 3-Sigma Limit	R.I.	2X2 Chi-Square Result	Number Selected for Promotion	Number Considered for Promotion
White Females										
US ARMY	E-7		1989	0.12584	0.15901	0.15601	26.35	11.03	173	1088
US ARMY	E-7		1990	0.19147	0.24515	0.22653	28.03	22.57	278	1134
US ARMY	E-7		1991	0.10482	0.14830	0.13070	41.47	26.15	187	1261
US ARMY	E-8		1989	0.21415	0.29129	0.28529	36.02	11.81	97	333
US ARMY	E-8		1990	0.13666	0.21282	0.19231	55.73	19.42	83	390
US ARMY	E-8		1991	0.10732	0.15259	0.14667	42.19	14.64	103	675
US ARMY	E-9		1991	0.14011	0.33333	0.26923	137.90	24.23	26	78
US NAVY	O-6	STAFF	1989	0.48672	1.00000	0.83333	105.46	12.68	12	12
USAF	E-8		1987	0.09105	0.20656	0.14426	126.87	53.23	63	305
USAF	E-8		1989	0.08763	0.13944	0.12085	59.12	25.28	105	753
USAF	E-8		1990	0.08693	0.14132	0.11650	62.56	34.54	131	927
USAF	E-8		1991	0.07229	0.10372	0.09883	43.47	15.06	106	1022
USAF	E-9		1991	0.13769	0.26263	0.25253	90.74	13.02	26	99
Asian American / Pacific Islands Males										
US ARMY	E-7		1987	0.21980	0.27467	0.27019	24.96	12.15	167	608
US ARMY	E-7		1990	0.19147	0.23698	0.23407	23.77	12.57	182	768
US NAVY	E-7		1989	0.14130	0.16263	0.15843	15.10	19.09	605	3720
US NAVY	E-8		1989	0.14826	0.17893	0.17148	20.69	17.57	377	2107
US NAVY	E-9		1989	0.26323	0.35802	0.33951	36.01	16.09	116	324
American Indian/Alaskan Native Males										
US NAVY	E-8		1987	0.14029	0.23037	0.21990	64.21	13.06	44	191
Black Males										
US NAVY	O-6	STAFF	1990	0.47046	1.00000	0.88889	112.56	10.15	9	9
USAF	E-7		1988	0.19022	0.20663	0.20574	8.63	12.30	1190	5759
USAF	E-7		1990	0.19529	0.22168	0.21124	13.51	30.02	1233	5562

Service	Rank	Line/ Staff (USN)	Fiscal Year	Board Average Promotion Rate	Promotion Rate for this Group	Lower 3-Sigma Limit	R.I.	2X2 Chi-Square Result	Number Selected for Promotion	Number Considered for Promotion
Other Males										
US NAVY	O-4	STAFF	1987	0.77043	0.88038	0.85770	14.27	16.07	184	209
USMC	E-7		1988	0.38823	0.73171	0.60976	88.47	22.13	30	41
USMC	E-8		1989	0.22562	0.54545	0.45455	141.76	19.47	18	33
White Males										
US ARMY	E-7		1991	0.10482	0.11476	0.11106	9.49	26.75	2492	21714
US NAVY	E-7		1987	0.15440	0.16066	0.16046	4.06	34.63	5145	32024
US NAVY	E-7		1988	0.12829	0.13405	0.13389	4.49	49.29	4313	32174
US NAVY	E-7		1990	0.13384	0.14038	0.13941	4.89	35.70	4720	33623
US NAVY	E-7		1991	0.12352	0.13136	0.12886	6.34	68.16	4492	34197
USAF	O-4		1987	0.82035	0.84770	0.84528	3.33	55.69	1809	2134
USMC	E-9		1987	0.33065	0.39964	0.39093	20.87	30.19	219	548

NOTES

If the 2 x 2 Chi Square test value exceeds 10.8, then the promotion rates are significantly different at a 0.001 level. (Chi Square 1 degree of freedom)

The Navy 1990 Military Equal Opportunity Assessment states that the promotion data for 1987, 1988, and 1989 are "inaccurate."

The Representation Index (R. I.) values are presented for general information and consideration. The statistical significance of the R. I. varies extremely with sample size (number considered for promotion).

Dependencies within the data:

By consolidating females of all races into one category and also listing the individual races separately, the out of control points relating to females may be double counted. That is, White Females may be outside the 3-sigma limits, and Females (overall) for the board might also be outside of 3-sigma for the same board. Females were not double counted when computing the overall promotion average for the boards.

Another dependency withing the data relates to the majority - minority relationship. If one race/sex combination is outside the 3-sigma limits, it may cause other minorities or the majority to be outside the 3-sigma limit in the opposite direction. For example, if Black males were promoted at a very low rate, they will be outside the lower 3-sigma limit. Their results will lower the overall promotion rate, and as a related issue, White males may be seen as outside the upper 3-sigma limit.

Taking the above two dependencies into account, there are approximately 1049 independent data points in the database. There appear to be approximately 66 independent "out of control" data points.

APPENDIX F

```
* dBase III+ Program to find the upper 3 sigma and lower 3 sigma control limits given the
number of minority considered for promotion and the overall promotion rate for the entire
population

* by LT Steven S Prevette, 13 May 92, at Defense Equal Opportunity Management Institute,
Patrick Air Force Base, FL

* dBase III PLUS is a registered trademark of Ashton-Tate

CLEAR
SET DECIMAL TO 5

* Declare Variables

ngroup = 0
nrate  = 0
conf   = .00127  && The confidence level at 3-Sigma is .00127

* Get data from user

CLEAR
? "Program to calculate the Upper and Lower 3-Sigma Control Limits"
? "for a group within an overall population."
?
?
INPUT "Enter the population size of the group : " to ngroup

INPUT "Enter the overall promotion rate      : " to nrate
?
* COMPUTE CONTROL LIMITS

IF ngroup * nrate < 100

   * Compute limits for small groups using Binomial Distribution
   plow = 0
   Bns  = 0  && Bns is the No. of Successes for the Binomial table

   pn = (1-nrate) ** ngroup  &&   This is the probability that no one is
*                                 promoted
   pLow = pn


   DO WHILE pLow < conf
```

* The following is a recursive routine to build a Binomial table. It continues until the cumulative probability exceeds the lower confidence level.

```
      Bns = Bns + 1
      pn = pn * (ngroup - Bns + 1) * nrate / (Bns * (1 - nrate) )
      pLow = pLow + pn

   ENDDO

   LCL = Bns / ngroup


   pUpper = pLow

   DO WHILE pUpper < 1 - conf

* The binomial table continues to be built until the cumulative
      probability exceed the upper confidence level

      Bns = Bns + 1
      pn = pn * (ngroup - Bns + 1) * nrate / (Bns * ( 1 - nrate ) )
      pUpper = pUpper + pn

   ENDDO

   IF Bns = ngroup .and. nrate ** ngroup > conf

*     Causes UCL to equal 1 if probability of ALL being
*     promoted is within the desired control limits

      UCL = 1.00000


   ELSE

*     Correction to lower the Bns value due to the pUpper
*     loop exceeded the upper confidence level

      UCL = ( Bns - 1 ) / ngroup
```

```
   ENDIF
ELSE
   * Calculate Control Limits using Normal Approximation
   Sigma = SQRT ( nrate * ( 1 - nrate ) / ngroup )
   LCL = nrate - 3 * Sigma
   UCL = nrate + 3 * Sigma
ENDIF
? "The Lower Control Limit is : ", LCL
? "The Upper Control Limit is : ", UCL

RETURN
```

Data on American POWs from the period 1950-1951

93-FOI-0699

СПИСОК

американских военнопленных
(данные 1950-51 гг.)

1. Barter Charles T. _____, 39 лет, майор артиллерии;
2. Iantron Newton W. _____, 36 лет, майор;
3. Hugent Ambrose H. _____, 41 год, капитан артиллерии
4. Anderson Douglas R. _____, 32 года, капитан медицинской слу
5. Green Marin W. _____, 39 лет, капитан артиллерии;
6. Macomber Wayne B. _____, 34 лет, капитан;
7. Minietta Charles _____, 33 лет, I-й лейтенант артиллери
8. Bergman William J. _____, 38 лет, I-й лейтенант;
9. Fox John A. _____, 29 лет, I-й лейтенант;
10. Marlett Herbert E. _____, 30 лет, I-й лейтенант;
11. Rountree Wadie J. _____, 24 лет, I-й лейтенант;
12. Sirman Donald S. _____, 29 лет, летчик, I-й лейтенант;
13. Jester William F. _____, 28 лет, 2-й лейтенант;
14. Maynard Edward W. _____, 37 лет, I-й лейтенант артиллерии;
15. Aroy Thomeson _____, 19 лет, солдат;
16. Kaiser Henry G. _____, 26 лет, сержант;
17. Garbee Melton C. _____, 22 лет, старший солдат;
18. Spinoza Floyed E. _____, 25 лет, старший солдат;
19. Wilson James E. _____, 20 лет, старший солдат;
20. Cooper George A. _____, 18 лет, старший солдат;
21. Rager Fred H. _____, 23 лет, солдат;
22. Sizemore Jessie L. _____, 19 лет, старший солдат;
23. Deekard Ernest L. _____, 21 год, старший солдат;
24. Domenech Jame D. _____, 22 лет, капрал;
25. McComas Charles M. _____, 20 лет, старший солдат;
26. Krenz Dorcil A. _____, 20 лет, старший солдат;
27. Grant Eugene W. _____, 27 лет, старший сержант; #476