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MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF FACTORS PREDICTING GRADUATION OF STUDENTS AT DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER

by

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December 2004

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This thesis analyzes factors related to academic, military and personal backgrounds that affect graduation of students enrolled at the Defense Language Institute Foreign Language Center (DLIFLC). The data in this thesis were taken from DLIFLC and only students from the four principal services with valid DLAB scores were considered for this study. Also, as DLI is concerned with students who do not make the grade academically, entries having administrative attritions were not considered. Four logistic regression models were analyzed for the purposes of this study: Graduation of students across all four categories of languages taught at DLIFLC, graduation of students in Category I languages, graduation of students in Category III languages and graduation of students in Category IV languages. The results of this study can assist DLIFLC in investing its resources in students with the best chances of success and assist the staff in identifying the weaker students from the onset of the course.

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AN ANALYSIS OF FACTORS PREDICTING GRADUATION OF STUDENTS AT DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER

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ABSTRACT

This thesis analyzes factors related to academic, military and personal backgrounds that affect graduation of students enrolled at the Defense Language Institute Foreign Language Center (DLIFLC). The data in this thesis was taken from DLIFLC and only students from the four principal services with valid DLAB scores were considered for this study. Also, as DLI is concerned with students who do not make the grade academically, entries having administrative attritions were not considered. Four logistic regression models were analyzed for the purposes of this study: Graduation of students across all four categories of languages taught at DLIFLC, graduation of students in Category I languages, graduation of students in Category III languages and graduation of students in Category IV languages. The results of this study can assist DLIFLC in investing its resources in students with the best chances of success and assist the staff in identifying the weaker students from the onset of the course.

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EXECUTIVE SUMMARY

The primary purpose of this thesis is to analyze factors related to the academic, military and personnel background factors of a student that might affect the graduation of students enrolled in the basic programs in Defense Language Institute Foreign Language Center (DLIFLC).

Four different models were developed in the study: A model predicting probability of graduation across all four categories of languages; a model predicting probability of graduation for Category I languages; a model predicting probability of graduation for Category III languages; and a model predicting probability of graduation for Categories IV languages.

The model involving 12,302 entries across all four categories of languages showed all the main effects to be significant but more importantly, the second order interactions of category of language with gender, with DLAB scores and with service to be significant. Thus, this model has suggested that there are peculiarities brought about by the category of language. Furthermore, because of the relative complexity of this model, it would not be easy for the results to be interpreted and hence, the model was not practical for the purposes at hand. Consequently, separate models based on the different categories of languages were used instead.

The model predicting the probability of graduation in Category I languages analyzed 2,319 entries and the results indicated an effect by the DLAB scores, whether a student has been recycled at least once and whether a student has been relanguaged at least once. The results suggested that higher DLAB scores, and not having been recycled and relanguaged are associated with a higher probability of graduation. The results also suggest that the predicted decrease in probability of graduation associated with recycling and relanguaging is larger when DLAB scores are small. The variables Gender and Service were not found to have any significant effect.

The model predicting the probability of graduation in Category III languages analyzed 3,867 entries. The results indicated that females in the Marines having DLAB scores of 95 or higher have the highest probability of graduation. Similarly, males in the Army having DLAB scores of less than 95 have the lowest probability of graduation. Among those who have not been recycled before, the Marines have the highest predicted probability of graduation, followed by the Navy, Air Force and the Army. However, for those who have recycled at least once before, the Air Force has the highest predicted probability, followed by the Army, Marines and the Navy. Furthermore, for the Air Force, the predicted probability of graduation actually increases if a person has been recycled at least once. However, for the Marines and the Navy, the predicted probability of graduation decreases if a person has been recycled at least once, with the Navy showing a larger decrease than the Marines.

The model predicting the probability of graduation in Category IV languages, based on 5,925 entries, indicated that being in the Navy, female, having DLAB scores of 120 or higher, and who had not been recycled or relanguaged would have the highest probability of graduation. Males in the Army with DLAB scores of less than 120 and who had been recycled or relanguaged at least once have the lowest probability of graduation. The model also suggested that among those who have a DLAB score of lower than 120, the Navy have the highest predicted probability of graduation, followed by the Marines, the Air Force and the Army. For those who have a DLAB score of 120 or higher, the Navy also has the highest predicted probability, followed by the Army, the Air Force and the Marines. Furthermore, the increase in predicted probability of graduation for students with a DLAB score of 120 or higher, compared to those with a DLAB score less than 120, was greater for the Air Force and Army students than for the Marines and the Navy.

The results of this study can assist DLIFLC in investing its resources in students with the best chances of success and assist the staff in identifying the weaker students from the onset of the course. This information, plus data on the progress of these students in the course itself, might help DLIFLC reduce the failure rates of these students through directing the staff's attention to where it is needed most.

I. INTRODUCTION

The Defense Language Institute Foreign Language Center (DLIFLC) is located at the United States Army Presidio of Monterey, California. It is responsible for the foreign language training of enlisted and officer personnel from the four armed services and a small number of federal civilians and foreign military. The Defense Language Proficiency Test (DLPT) is administered at the end of the course and serves as the main instrument used to assess a student's proficiency in the core skills of listening, reading and speaking. Successful graduation from DLIFLC entails meeting the minimum scores required in the DLPT.

The main purpose of this study is to analyze factors related to the academic, military and personal background factors of a student that might affect the graduation of student. If the variables related to success in learning a foreign language can be identified, the selection process can be further refined. This would assist DLIFLC in investing its resources in students with the best chances for success. This would in turn reap savings and produce long-term gains for the Armed Services in the recruitment and training of soldiers into competent linguists. The results of this study will also assist the deans and the teaching staff to identify the weaker students from the onset of the course. This information, plus data on the progress of these students in the course itself, might help DLIFLC reduce the failure rates of these students through directing the teaching staff's attention to where it is needed most.

A. BACKGROUND

1. DLI and its Mission

The mission of DLIFLC is to educate, sustain, evaluate and support foreign language specialists under the guidelines of the Defense Foreign Language Program (DFLP). The DFLP provides the Department of Defense and other Federal agencies with linguists capable of supporting United States national interests worldwide (DLIFLC General Catalog, 2003).

Approximately 25 languages, classified into four categories of languages based on the level of difficulty, are taught in DLIFLC throughout the year. The categories are numbered from I to IV, with a higher number signifying a more difficult language to master. Category I languages include French, Italian, Portuguese and Spanish, with the initial length of training at DLIFLC being 25 weeks. Category II language consists of only the German language with an initial training of 34 weeks. Category III languages consist of Croatian, Czech, Georgian, Greek, Hebrew, Kurdish, Persian, Polish, Pushtu, Russian, Tagalog, Thai, Turkish, Uzebek and Vietnamese with an initial training of 47 weeks. Category IV languages consist of Arabic, Chinese, Korean and Japanese, and involve an initial training of 63 weeks.

Training can be carried out in either the basic, intermediate, advanced or specialized levels. The majority of students enroll at the basic level courses and these students are mainly from the four principal services and have less than one year of military service.

2. Tests Conducted on Students

The tests carried out on students include the Defense Language Aptitude Battery (DLAB) test, administered prior to the student's entry at DLI. It serves as a means to gauge a student's aptitude for foreign language training. It has been shown that a higher DLAB score increases the chances of success (Lett and O'Meara, 1990). For languages that have a higher level of difficulty, a higher DLAB score is needed as a pre-requisite for entry into these languages. The minimum required scores are, for Category I, 85; for Category II, 90; for Category III, 95; and for Category IV, 100. However, there have been exceptions to this rule as there have been students enrolled in languages even though they did not meet the minimum cut-off for that language.

The Defense Language Proficiency Test (DLPT) is the main instrument used to assess a student's proficiency in the core skills of listening, reading and speaking. It is designed to assess how competent an individual is in using the foreign language in both their professional and social capacities. Department of Defense (DoD) DLPT proficiency standards, known as Interagency Language Roundtable (ILR) Descriptions, are outlined in Table 1.1.

Table 1.1. DoD Proficiency Standards (ILR Descriptions)

Level	Function/Tasks	Context/Topics	Accuracy
3	Support Opinions Hypothesize Explain Deal with Unfamiliar topics	Practical Abstract Special Interests	Errors never interfere with communication and rarely disturb the native speaker
2	Narrate Describe Give Directions	Concrete Real-World Factual	Intelligible even if not used to dealing with non-native speaker
1	Q and A Create with the Language	Everyday Survival	Intelligible with effort and practice
0	Memorized	Random	Unintelligible

The DLPT is administered after the student has completed all the necessary modules in the language training program. Students who do not show satisfactory progress in the course are not allowed to take the DLPT. Those students can then be either relanguaged into a different language course at his/her next enrollment, usually into an easier language category, or be recycled. Recycling of students occurs when a student is allowed another attempt at the same language at his/her next enrollment if he/she fails to successfully complete the course.

To successfully graduate from a language course, the student must meet the minimum scores or proficiency of 2/2/1+ required in a DLPT. This indicates the student has a proficiency level of 2 in listening and reading and a proficiency level of 1+ in speaking for the foreign language he/she is trained in.

The level of proficiency is measured from a base level of 0, 1, 2 or 3 as indicated in the table and an associated ‘plus’ level with the base level. This is to denote students who have a proficiency in one skill that exceeds the base level but is not good enough to be classified as the next level up.

Other tests that are carried out by DLIFLC include the major program tests developed within the respective language departments to evaluate a student's progress in course work. Specific skills such as translation are tested by the Performance Final Learning Objectives (FLOs) while the Proficiency FLOs, which encompasses the traditional language skills of listening, reading and speaking are tested by DLPT. This thesis focuses on using the DLPT scores as the measurement of success of a student.

B. THE PROBLEM

Unsuccessful students enrolled in DLIFLC are costly. This is both from the organizational perspective and from that of an individual, since that person could have furthered his or her career elsewhere in the services. Thus, to identify the factors that might explain a likely reason for success in a course and how they could be used to identify a weaker student would be beneficial for both parties. The study will attempt to point out any relationship among the variables using data from fiscal years 1998 to 2003.

In order to achieve this, this study will look into any relationship from factors related to the academic, military and personal background of the student. These factors include the branch of military service, gender, aptitude for a foreign language, the effect of recycling and relanguaging of students to the successful graduation of a student.

To gather insight into each language category and any particularities as a result of the level of difficulty of the language, a separate analysis will be carried out on each of the three different categories of languages considered in this thesis: Category I, Category III and Category IV.

The analysis will result in graduation models, which will yield useful information on factors that might determine the successful graduation of students and will also be beneficial to understanding the differences in factors affecting graduation in the different language categories.

C. ORGANIZATION OF THE THESIS

This thesis is comprised of five chapters. Chapter II is a review of past studies done on the attrition of students enrolled in courses conducted at DLIFLC. Chapter III is description of the population, data set and the variables considered. Chapter IV consists

of the results of the analysis and the multivariate analyses of the graduation models. Chapter V provides conclusions from the analyses and presents future research recommendations.

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II. LITERATURE REVIEW

A. LANGUAGE SKILL CHANGE PROJECT

The Language Skill Change Project (LSCP) was conducted by the Research and Analysis Division of DLIFLC. The objectives of the study were manifold and included identifying factors related to changes in proficiency and understanding predictors of language learning at DLIFLC. Spanish, German, Russian and Korean were chosen as the representative languages from each of the four categories. (O'Mara, et al., 1994)

1. The Prediction of Language Learning Process at DLIFLC

LSCP Report II, titled "The Prediction of Language Learning Success at DLIFLC", considered factors related to the successful completion of training and achieved scores on the DLPT in listening, reading and speaking. The factors considered in this study were factors related to general ability, language aptitude, cognitive ability, and attitudinal/motivational variables at the start of and during training at DLIFLC, as well as language learning strategies and personality and demographic variables. This study found that measures of cognitive ability like the Armed Services Vocational Aptitude Battery (ASVAB) and DLAB consistently predicted success in foreign language learning while non-cognitive measures like student attitudes, motivation and applied learning strategies also offered significant potential in predicting success in acquiring foreign language learning. (O'Mara, et al., 1994)

2. Training Approaches for Reducing Student Attrition from Foreign Language Training

Report III of the LSCP, titled "Training Approaches for Reducing Student Attrition from Foreign Language Training", used the data gathered from the LSCP. Its purpose is to devise approaches to better accommodate students' abilities and shortcomings within the training program. It evaluated academic attrition based on potentially modifiable abilities and attributes, which included knowledge of grammar, verbal memory skills and motivation. DLAB score was also considered. The study confirmed the general trend that students with higher DLAB scores performed better. The study also found that a DLAB score of 100 is pivotal in determining attrition. Students with scores of 100 or below are not only more likely to attrite but the probability of

attrition is also more susceptible to the influence of other factors, namely the difficulty of the language or their level of military experience. The study further recommended a possible increase in the minimum DLAB scores as a pre-requisite for the more difficult languages in Category III and IV. (O'Mara, et al., 1994)

B. THE EFFECTS OF LENGTH OF SERVICE AND PRIOR LANGUAGE STUDY AT DLI ON DLPT ATTAINMENT

The Research and Analysis Division of DLIFLC conducted this study to compare the DLPT performance of enlisted military personnel who had been in service for four years or more with the performance of initial entry trainees in basic language courses. The study also compared those who had four years or more of service with those who did not, as well as comparing those who had studied a language at DLIFLC previously with those who had not. Language learning aptitude was controlled in both these comparisons. The study showed that length of service is not a significant factor in DLPT performance, while prior study in a foreign language is a useful predictor of subsequent language learning success. The effect of prior language study was approximately twice as strong for students of Spanish as for students in the more difficult languages of Russian, Arabic and German. (Shaw, et al., 1993)

C. OTHER DLIFLC STUDIES

The Research and Analysis Division of DLIFLC conducted a study entitled "Relationships of Language Aptitude and Age to DLPT Results among Senior Officers Students in DLIFLC Basic Language Courses." The results of the study showed that advanced age, as represented by senior officers in Paygrades O5 and O6, is not a significant factor in learning a language. Instead, the study found that language aptitude, as measured by the DLAB score, was a significant factor and recommended that candidates with a DLAB score of 120 or more should be sought to maximize success and minimize risk of training failure. (Shaw, et al., 1993) Another study entitled "Language Choice and Performance" was conducted to determine if the language of proficiency attained by students in Basic Courses at DLIFLC is in part a function of whether the language to which they are assigned is one that they would elect to study if given a choice. The study found that performance is by and large independent of language choice. (Jackson, et al., 1994)

D. EFFECT OF GENDER ON DLIFLC ATTRITION

A thesis titled "The Effect of Gender on Attrition at the Defense Language Institute Foreign Language Center" was completed in 1996. The study tried to determine whether the higher rate of attrition of females than males at DLIFLC were due to gender bias. The results showed that gender is a significant main effect for the model run on Air Force subjects only. However, the study indicates that Air Force females do not attrite more frequently than their male counterparts due to their gender. In fact, Air Force females have similar attrition rates compared to their male counterparts having identical attributes (e.g., the same paygrade group). The higher overall attrition rate for Air Force females is mostly due to their relatively high proportion in lower paygrades and more difficult language categories.

When considering all the data from the four main services, gender is not significant as a main effect, but the interaction with the service was a significant effect. That is, the gender effect has different magnitudes in the different services. Further analysis into the model that is run on all the data, excluding Air Force subjects, supported the conclusion that the Air Force subjects caused the interaction term between gender and service to be significant. In conclusion, the study found no effect of gender on attrition at DLIFLC. (Arthur, et al., 1996)

E. PREDICTING THE PROFICIENCY OF ARABIC AND PERSIAN LINGUISTS TRAINED AT THE DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER

The purpose of this study was to determine how major program tests, semester GPAs and cumulative skills GPAs in the Arabic and Persian language departments relate to success on the DLPT. The study helped the school deans within these language departments in interpreting the meaning of program tests, semester GPAs and cumulative skills GPAs when making decisions about attrition and academic performance.

In the analysis, the results indicated that the semester GPAs were the most predictive variables of overall DLPT performance for both Arabic and Persian Language. For Persian, semester GPAs one and two were good indicators while for Arabic, semester GPAs two and three were good indicators of DLPT performance. (DeRamus, et al, 1999)

F. CHAPTER SUMMARY

Previous studies on foreign language learning have drawn different conclusions on the factors that can be used to predict attrition. However, several studies have conclusively shown that the measurement of language aptitude, as found in the DLAB score, was a significant factor. Past studies have also shown that prior language study in a foreign language was consistently associated with higher language proficiency while gender, advanced age, the length of service and language choice were not significant factors. Chapter III discusses the data set used in the analysis.

III. DATA, MODELS AND PRELIMINARY ANALYSIS

A. DATA

The data in this thesis were taken from DLIFLC and consisted of students from the four armed services and a small number of federal civilians and foreign military from fiscal years 1998 through 2003. The students were all involved in the basic programs taught in DLIFLC and consisted mainly of students who have less than one year of service in the military.

The database contains a record for each time an individual is enrolled in a language. If an individual was enrolled in a course in Arabic in FY98 and a decision to drop him back to a later class was made, he would then have two entries in the database. The first entry would classify him as initial (new) entry and give the reason for not completing the course. The second entry would then classify his entry as a recycle if he is still enrolled in the same language, and provide his final status for this course. Assuming he graduated the second time, he would not count as an attrition even though he failed to graduate from the course in his first attempt. However, if he failed his Arabic course and got relanguaged to a lower category language like Spanish, he would have been considered as an attrition in the Arabic Language. If he subsequently failed from the Spanish course and was suspended from DLIFLC altogether, this individual would have been counted as having 2 attritions, one for each of the two languages he was enrolled in. Thus, to determine the graduation rates, the middle records where the students recycle within the same language without graduating were removed. The final outcome of the student of having either graduated or failed from the language he is currently enrolled in and left DLI or has moved on to a different language, was considered for the analysis.

There were a total of 14,869 initial entries enrolled in a total of 25 foreign languages conducted at DLIFLC. However, 202 entries did not have valid DLAB scores and another 201 entries did not come from the 4 main armed services. Excluding these left 14,416 entries in our data set.

Furthermore, attritions in the language courses fall generally into either the academic or administrative categories. Administrative attritions include reasons related to medical discharge/injuries, failure to pass physical tests, being overweight, security

clearance issues and disciplinary reasons. Thus, the entries pertaining to administrative attritions would thus include students not completing the language course and thus, not being able to take the DLPT due to reasons unrelated to their competency in learning a foreign language. As DLI is concerned with students who do not make the grade academically, entries having administrative attritions are not considered. Therefore, the focus is on the entries who have either successfully graduated or undergo attrition for either not taking or failing the DLPT. In considering only these entries, a total of 12,302 entries were used for this study.

B. VARIABLE DEFINITIONS

The models used in this study have dependent variables referring to whether the students have met the graduation requirements and a number of independent variables that represented his or her academic performance, military and personal background information.

1. Dependent Variables

The dependent variable used in the retention model is a binary variable taking a value of 1 if the student met the DLPT requirements and thus graduated, and a value of 0 if the student did not pass the DLPT or failed to take the test.

Table 3.1. Dependent Variables and Descriptions

RESPONSE VARIABLES	
GRADUATED	0 - IF THE STUDENT DOES NOT MEET THE MINIMUM REQUIREMENTS OF THE DLPT OR HAS NOT TAKEN THE TEST
	1 - IF THE STUDENT HAS MET THE MINIMUM REQUIREMENTS OF THE DLPT

2. Independent Variables

The independent variables used in this study include gender, the service he or she is from, DLAB scores, whether the student has been relanguaged at least once, whether the student has been recycled at least once, and the category of language the student is enrolled in.

Each of the independent variables is treated categorically. Table 3.2 presents the independent variables and their descriptions. In the graduation model across all four categories of languages, all six of the above independent variables are used in the

analysis. In the graduation model for any individual category of language, of course, the category of language variable is omitted. Also, different cut-offs for the DLAB scores are used for the models involving just the Category III languages and Category IV languages.

Table 3.2. Independent Variables and Descriptions

DEMOGRAPHICS	
GENDER	0 IF FEMALE
	1 IF MALE
DLAB SCORE	0 IF DLAB SCORE IS LESS THAN 85
(Used in model across all languages and model involving Category I language only)	1 IF DLAB SCORE IS BETWEEN 85 AND LESS THAN 90
	2 IF DLAB SCORE IS BETWEEN 90 AND LESS THAN 95
	3 IF DLAB SCORE IS BETWEEN 95 AND LESS THAN 100
	4 IF DLAB SCORE IS 100 AND HIGHER
DLAB SCORE >= 95	0 IF DLAB SCORE IS LESS THAN 95
(Used in model involving Category III languages only)	1 IF DLAB SCORE IS 95 OR HIGHER
DLAB SCORE >=120	0 IF DLAB SCORE IS LESS THAN 120
(Used in model involving Category IV languages only)	1 IF DLAB SCORE IS 120 OR HIGHER
SERVICE	0 IF STUDENT IS FROM US AIR FORCE
	1 IF STUDENT IS FROM US ARMY
	2 IF STUDENT IS FROM US MARINE CORPS
	3 IF STUDENT IS FROM US NAVY
CAT	0 IF STUDENT IS ENROLLED IN CATEGORY 1 LANGUAGE
(used in model across all languages only)	1 IF STUDENT IS ENROLLED IN CATEGORY 2 LANGUAGE
	2 IF STUDENT IS ENROLLED IN CATEGORY 3 LANGUAGE
	3 IF STUDENT IS ENROLLED IN CATEGORY 4 LANGUAGE
RECYCLE	0 IF STUDENT HAS NOT BEEN RECYCLED BEFORE
	1 IF STUDENT HAS ONE OR MORE RECYCLES
RELANGUAGE	0 IF STUDENT HAS NOT BEEN RELANGUAGED BEFORE
	1 IF STUDENT HAS ONE OR MORE RELANGUAGES

C. SAMPLES USED IN ANALYSIS

Students from the four armed services with valid DLAB scores who either successfully graduated from a language course or underwent attrition for academic reasons from the FY 1998 through 2003 were used in the analysis. A total of four regression models were used in the analysis: Graduation of students across all four categories of languages taught at DLIFLC, and Graduation of students in each of the language Categories I, III, and IV.

Since past studies have shown the importance of DLAB scores in predicting success and since part of the focus of this analysis is to identify the effect of DLAB scores on the successful graduation of students, entries with invalid DLAB scores were not considered. Students who were federal civilians and from the foreign military were also not included in the model as they did not constitute the area of interest of our study. Table 3.3 lists the sample sizes and the graduation rates for the models used in the analysis.

Table 3.3. Samples Used in the Analysis

MODEL	NUMBER OF ENTRIES	GRADUATION RATES
GRADUATION MODEL ACROSS ALL 4 CATEGORIES	12,302	0.7196
GRADUATION MODEL IN CATEGORY I	2,319	0.7960
GRADUATION MODEL IN CATEGORY III	3,867	0.7336
GRADUATION MODEL IN CATEGORY IV	5,925	0.6815

D. DESCRIPTIVE STATISTICS

1. Graduation Across All Four Categories of Languages

The model included 12,302 entries. Table 3.4 contains the number of entries, proportion in sample, number of graduations and graduation rate for each level of variable used in the model.

The overall graduation rate across all four categories of languages was 71.96%. The graduation rate decreased as the language category became more difficult. This is shown by the steadily decreasing graduation rate of 79.60% for Category I language to 68.15% for Category IV language. While Category I languages had the highest graduation rate, they also have fewer entries than Categories III and IV languages. Category IV languages had the most entries. Category II language, which consisted of only the German language, had only 191 entries with a graduation rate of 69.11%. Between the services, there is a difference of 11% in the graduation rate between the Navy entries and the Army entries. However, there are more than three times the entries

in the latter group as in the former. The majority of the entries are male but the graduation rates for females are higher than the males by 5%. For the DLAB scores, the best performing group is from those who have DLAB scores of between 90 and 95. The graduation rate for those with DLAB scores of less than 85, hence not meeting the pre-requisite for the Category I languages, is also the lowest at only 55%.

The graduation rate for students with no recycles was nearly 11% higher than the rate for those having at least one recycle. The graduation rate for those with no relanguages was 14% higher than for those having at least one relanguage.

Thus, preliminary analysis suggests that each of the independent factors may have an effect on the graduation of a student.

Table 3.4. Descriptive Statistics for Graduation Rates Across All Four Categories of Languages

VARIABLE	LEVEL	NUMBER OF OBSERVATIONS	PROPORTION	NUMBER GRADUATED	GRADUATION RATE
CATEGORY	1	2319	0.189	1846	0.7960
	2	191	0.016	132	0.6911
	3	3867	0.314	2837	0.7336
	4	5925	0.482	4038	0.6815
SERVICE	US Air Force	3261	0.265	2406	0.7378
	US Army	6160	0.501	4218	0.6847
	US Marines	1060	0.086	786	0.7415
	US Navy	1821	0.148	1443	0.7924
GENDER	Female	3664	0.298	2764	0.7544
	Male	8638	0.702	6089	0.7049
DLAB SCORES	<85	40	0.003	22	0.5500
	>=85 And <90	254	0.021	171	0.6732
	>=90 And <95	545	0.044	396	0.7266
	>=95 and <100	1828	0.149	1279	0.6997
	>=100	9635	0.783	6985	0.6146
RECYCLE	0	10539	0.857	7745	0.7349
	1 or more	1763	0.143	1108	0.6285
RELANGUAGE	0	11747	0.955	8529	0.7261
	1 or more	555	0.045	324	0.5838
Total Entries	-	12302	-	8853	0.7196

2. Graduation in Category I Language

This model analyzed 2,319 entries. Table 3.5 provides the number of entries and proportions in the sample for each variable used in the model. The overall graduation rate

in this category of language was 79.60%. Between the services, there is a difference of 8% in the graduation rate between the Marine entries, the best performing group of the four, and the Army entries, the lowest group. However, there were nearly four times as many entries in the latter group than the former. The majority of the entries were male but the graduation rate for females was 3% higher then the males. For the DLAB scores, the best performing group was from those who have DLAB scores of 100 or higher and they had a graduation rate of 85.57%. This also formed the biggest group of entries. The graduation rates also increased steadily as the DLAB scores increased. The graduation rate for those with no recycles was nearly 8% higher than for those who were recycled at least once. The graduation rate for those with no relanguages was nearly 25% higher than for those were relanguaged at least once. However, there were only 11 entries that were relanguaged at least once. This is partly due to the fact that the languages in Category I are the easiest languages to master, and students having difficulty in their language would be less likely to be relanguaged than recycled.

Thus, preliminary analysis suggests that each of the independent factors may have an effect on the graduation of a student in a Category I language.

Table 3.5. Descriptive Statistics for Graduation Rates in Category I Languages

VARIABLE	LEVEL	NUMBER OF OBSERVATIONS	PROPORTION	NUMBER GRADUATED	GRADUATION RATE
SERVICE	US Air Force	606	0.261	507	0.8366
	US Army	1064	0.459	809	0.7603
	US Marines	234	0.101	198	0.8462
	US Navy	415	0.179	332	0.8000
GENDER	Female	583	0.251	478	0.8199
	Male	1736	0.749	1368	0.7880
DLAB SCORES	<85	27	0.012	14	0.5185
	>=85 And <90	231	0.100	163	0.6623
	>=90 And <95	388	0.167	293	0.7552
	>=95 and <100	592	0.255	461	0.7787
	>=100	1081	0.466	925	0.8557
RECYCLE	0	2088	0.900	1679	0.8041
	1 or more	231	0.100	167	0.7229
RELANGUAGE	0	2308	0.995	1840	0.7972
	1 or more	11	0.005	6	0.5455
Total Entries	-	2319	-	1846	0.7960

3. Graduation in Category III Language

3,867 entries were analyzed in the model for graduation from Category III languages. The overall graduation rate in this category of language was 73.36%. Between the services, there was a difference of 10% in the graduation rate between the Marines entries, the best performing group of the four, and the Army entries, which formed the group with the lowest rate. However, there were more than seven times as many entries in the latter group than the former. The majority of the entries were male, while the graduation rate for females was 4% higher than the males. There was a 4% improvement in the graduation rate for those having DLAB scores of 95 or higher than for those who did not. The graduation rate for students with no recycles was 2% higher than for those who were recycled at least once. The graduation rate for students with no relanguages was 10% higher than for those who were relanguaged at least once. Thus, the service, DLAB score, and whether a student has been relanguaged may have an effect on the graduation rate of students in Category III languages. Table 3.6 presents the descriptive statistics for graduation in Category III languages.

Table 3.6. Descriptive Statistics for Graduation Rates in Category III Languages

VARIABLE	LEVEL	NUMBER OF OBSERVATIONS	PROPORTION	NUMBER GRADUATED	GRADUATION RATE
SERVICE	US Air Force	1283	0.332	967	0.7537
	US Army	1709	0.442	1188	0.6951
	US Marines	279	0.072	221	0.7921
	US Navy	596	0.154	461	0.7735
GENDER	Female	1296	0.335	985	0.7600
	Male	2571	0.665	1852	0.7203
DLAB SCORES	<95	128	0.033	88	0.6875
	>=95	3739	0.967	2749	0.7352
RECYCLE	0	3387	0.876	2494	0.7363
	1 or more	480	0.124	343	0.7146
RELANGUAGE	0	3710	0.959	2738	0.7380
	1 or more	157	0.041	99	0.6306
Total Entries	-	3867	-	2837	0.7336

4 Graduation in Category IV Language

A total of 5,925 entries were analyzed in the model for graduation from Category IV languages. The overall graduation rate in this category of language was 68.15%, which was also the lowest among the four categories of languages. Between the services,

there was a difference of 16% in the graduation rate between the Navy entries, the best performing group of the four, and the Army entries, which formed the group with the lowest rate. However, there were more than four times as many entries in the latter group than the former. The majority of the entries were male but the graduation rates for females were 6% higher than the males. There was a 14% improvement in the graduation rate for those who have DLAB scores of 120 or higher than for those who did not. The graduation rate for those who have no recycles was nearly 14% higher than for those were recycled at least once. The graduation rate for those who have no relanguages was 12% higher than those were relanguaged at least once. Thus, the service, the DLAB score, gender, whether a student has been recycled and whether a student has been relanguaged, may have an effect on the graduation rate of students in Category IV languages. Table 3.7 presents the descriptive statistics for graduation in Category IV languages.

Table 3.7. Descriptive Statistics for Graduation in Category IV Languages

VARIABLE	LEVEL	NUMBER OF OBSERVATIONS	PROPORTION	NUMBER GRADUATED	GRADUATION RATE
SERVICE	US Air Force	1342	0.226	908	0.6766
	US Army	3289	0.555	2153	0.6546
	US Marines	545	0.092	366	0.6716
	US Navy	749	0.126	611	0.8158
GENDER	Female	1767	0.298	1288	0.7289
	Male	4158	0.702	2750	0.6614
DLAB SCORES	<120	3992	0.674	2541	0.6365
	>=120	1933	0.326	1497	0.7744
RECYCLE	0	4887	0.825	3447	0.7053
	1 or more	1038	0.175	591	0.5694
RELANGUAGE	0	5540	0.935	3820	0.6895
	1 or more	385	0.065	218	0.5662
Total Entries	-	5925	-	4038	0.6815

E. CHAPTER SUMMARY

The purpose of this study was to analyze the factors that affect the graduation of students enrolled in foreign language courses in Defense Language Institute Foreign Language Center (DLIFLC). The data in this thesis were taken from DLIFLC and

consists of students from the four armed services with valid DLAB scores. These students had either successfully graduated or had underwent attrition for academic reasons in the languages courses between FY1998 through 2003.

Entries across all four categories of languages were analyzed first. Furthermore, entries in each category of language (minus Category II) were analyzed separately to determine if there were any peculiarities due to the level of difficulty of the language.

Preliminary analysis involving entries across all four categories of languages has shown that there may be an effect on the graduation rate by each of the independent variables of category of language, service, DLAB scores, whether a student has been recycled at least once and whether the student has been relanguaged at least once. For entries from Category I language only, there seems to be a strong effect by the DLAB scores and a possible effect by the service, whether the student has been recycled and whether the student has been relanguaged. For entries from Category III languages only, there may be an effect by the service, DLAB score, whether the student has been recycled and whether the student has been relanguaged. For entries from Category IV languages only, there may be an effect by the service, DLAB score, whether the student has been recycled and whether the student has been relanguaged. Chapter IV discusses the multivariate analysis for the graduation models.

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IV. MULTIVARIATE ANALYSIS

This chapter contains the results of logistic regression analyses for estimating the probability of graduation in DLIFLC. The different steps required in a logistic regression analysis are shown here. Evaluation and interpretation of the results for each model are also in the sections that follow. The chapter concludes with a summary of the results found in the different logistic regression models.

A. METHODOLOGY

Regression models are used to determine the relationship between a dependent (response) variable and one or more independent (predictor) variables. A linear model is the most frequently used of all regression models but it is not appropriate in modeling probabilities. This is because any linear model with nonzero slope may result in the predicted probability having values less than 0 or greater than 1, which is clearly not possible. Therefore, to model probability realistically, we would have to use a function that approaches, but never exceeds, the [0,1]boundaries. (Hamilton, 2000) Since the dependent variables used in this study are also binary, taking the values of either '0' or '1,' logistic regression was applied in this analysis. (Hosmer and Lemeshow, 2000) The independent variables were treated as categorical variables. A categorical variable with k levels was replaced with $k - 1$ dummy (0-1) variables, with one category being chosen as the "baseline" or the default level for each of the independent variables. Categories chosen as the "baseline" for each of the independent variables are shown below:

SERVICE	Air Force
CATEGORY OF LANGUAGE	1 (used only for analysis across all four categories of languages)
RELANGUAGE	0 (Never been relangauged)
RECYCLED	0 (Never been recycled)
GENDER	Female
DLAB Score	Depending on the analysis done

The categorical variable, DLAB Score, had a different baseline for the different models that were fitted in this study. For both the models involving entries across all four categories of languages and involving just the Category I language, the DLAB score of below 85 was chosen as the baseline. For the model involving just the Category III language, the DLAB score of below 95 was chosen as the baseline. Finally, for the model involving just the Category IV language, the DLAB score of below 120 was chosen as the baseline.

The next step was to fit the model using the main effects of the independent variables, up to and including the second order interactions. The software package S-Plus® 6.2 was used to assist in the analysis for this study. An analysis of deviance test (McCullagh and Nelder, 1989) was used to determine whether the variables were significant in explaining the dependent variable. Insignificant terms were deleted one at a time using backwards elimination implemented with the `dropterm()` function from S-Plus's MASS library. At each step of the backward elimination process, the most non-significant term in the fitted model was deleted. The model was then fitted again and the above process repeated. When all remaining terms in the model were found to be significant at the 5% level of significance, thus allowing no further terms to be deleted, the process was stopped by yielding the final model.

Evaluation of the model was then carried out before the results were interpreted. Overall adequacy of the model was first determined through first calculating the predictive efficiency of the model and carrying out the goodness-of-fit test (Menard, 2002, p. 17). The Goodness-of-fit test is done through an analysis of deviance (McCullagh and Nelder, 1989) and the Hosmer-Lemeshow test (Hosmer and Lemshow, 2000) while predictive efficiency of the model was measured by comparing the misclassification rates of the models with the naïve estimation error rates to determine if there were any improvements in the misclassification rate over the naïve rate. In the Hosmer-Lemeshow test, predictions are sorted and divided into groups of equal size and in each group, the actual proportion of "good" responses and the average of the predicted probabilities are computed. These should be close for a good model. The Hosmer and Lemeshow test also provides a goodness-of-fit statistic, $\hat{C}$, which is obtained by

calculating the Pearson Chi-square statistic from observed and estimated expected frequencies. The $\hat{C}$ test statistic, which approximately follows a Chi-square distribution with $m - 2$ (number of groups minus 2) degrees of freedom, is used to test the null hypothesis that states that the model fits well (Hosmer and Lemeshow, 2000, p. 148).

Another part of the evaluation is focused on the diagnostics. A plot of change in deviance versus the predicted probability was used to detect poorly fitted observations and a plot of influence statistics *(ΔB)* was used to detect influential observations (Hamilton, 1992, p. 238). The last part of the evaluation dealt with the contribution of each independent variable or interaction between the independent variables

After completing the evaluation of the fitted models, interpretation of the models was performed as a final step. As the model used categorical independent variables, odds ratios were also used in the interpretation due to the ease of calculation and interpretation. In a logistic regression model without any interactions, odds ratios are calculated simply by exponentiation of the estimated coefficients. Confidence intervals for coefficients are calculated by the expression $\exp[\hat{\beta}_i \pm Z_{(1-\alpha/2)} * \hat{SE}(\hat{\beta}_i)]$ (Hosmer and Lemeshow, 2000).

In the logistic regression models developed in this study, confidence intervals for odds ratios were calculated only for the main effects of the explanatory variables that are not involved in interactions with any other variable.

B. MODEL FOR PROBABILITY OF GRADUATION ACROSS ALL FOUR CATEGORIES OF LANGUAGES

The graduation model involving 12,302 entries across all four categories of languages analyzed the effect of independent variable on the probability of graduation.. Table A.1 contains the estimated coefficients, standard errors, t-values for each independent variables and the interactions.

Table 4.1. Results of Graduation Model Across all Four Categories of Languages

Coefficients	Value	Std.Error	t.value
(Intercept)	0.376	0.406	0.924
ServiceArmy	-0.242	0.145	-1.660
ServiceMarines	-0.048	0.223	-0.216
ServiceNavy	-0.052	0.173	-0.299
Cat2	-9.550	66.880	-0.142
Cat3	0.706	0.937	0.754
Cat4	1.380	1.330	1.040
Dlab 85 to 90-	0.819	0.423	1.930
Dlab 90 to 95-	1.170	0.416	2.810
Dlab 95 to 100-	1.140	0.405	2.820
Dlab 100 and higher	1.710	0.402	4.260
Gender	-0.214	0.048	-4.470
Recycle	-0.696	1.620	-0.430
Relanguage	-0.218	0.048	-1.180
ServiceArmy: Cat2	0.065	0.550	0.117
ServiceMarines: Cat2	-1.580	1.510	-1.040
ServiceNavy: Cat2	-0.560	0.571	-0.974
ServiceArmy: Cat3	0.054	0.168	0.323
ServiceMarines: Cat3	0.213	0.275	0.774
ServiceNavy: Cat3	0.294	0.210	1.403
ServiceArmy: Cat4	0.212	0.161	1.320
ServiceMarines: Cat4	0.129	0.246	0.523
ServiceNavy: Cat4	0.910	0.206	4.422
Dlab85 to 90-: Recycle	-0.064	1.670	-0.038
Dlab90 to 95-: Recycle	0.677	1.640	0.412
Dlab95 to 100-: Recycle	1.080	1.630	0.664
Dlab100 and higher-: Recycle	0.432	1.620	0.267
ServiceArmy: Recycle	-0.286	0.136	-2.100
ServiceMarines: Recycle	-0.232	0.232	-1.000
ServiceNavy: Recycle	-0.639	0.198	-3.230
Cat2 : Dlab85 to 90-	8.380	66.900	0.125
Cat3 : Dlab85 to 90-	0.297	1.230	-0.242
Cat4 : Dlab85 to 90-	7.710	40.40	0.191
Cat2 : Dlab90 to 95-	8.850	66.90	0.132
Cat3 : Dlab90 to 95-	-1.260	0.959	-1.320
Cat4 : Dlab90 to 95-	-1.830	1.460	-1.250
Cat2 : Dlab95 to 100-	8.840	66.900	0.132
Cat3 : Dlab95 to 100-	-1.350	0.936	-1.440
Cat4 : Dlab95 to 100-	-2.070	1.360	-1.520
Cat2 : Dlab100 and above	9.290	66.870	0.139
Cat3: Dlab100 and above	-1.340	0.934	-1.440
Cat4 : Dlab 100 and above	-2.510	1.330	-1.880
Gender:Relanguage	-0.452	0.212	-2.130

The results showed the all the main effects to be significant but more importantly, that the second order interactions of category of language with gender, with DLAB scores and with service are significant. Thus, this model has suggested that there are peculiarities brought about by the category of language. This is not surprising given the many and varied languages present in the various categories. Furthermore, given the relative complexity of this model, it would not be easy for the results to be interpreted and hence, this model is not practical for the purposes at hand. As a result, separate models based on the different categories of languages would be more appropriate and these were analyzed below.

C. MODEL FOR THE PROBABILITY OF GRADUATION IN CATEGORY I LANGUAGES

This model analyzed 2,319 entries and the model as suggested by the logistic regression is included in Appendix A.

The classification table for graduation in Category I language is presented in Table 4.2. Entries, which have predicted probabilities greater than 0.764 were predicted as graduated. Table 4.2 shows that the misclassification rate of predictions is 26.09 percent. The naïve misclassification error rate is 20.39 percent, which is less than the predicted misclassification rate. Thus, it is determined that it is not possible to predict individual student's success in graduating any better than the naïve model. Instead, the more direct and useful application for this model would be to apply it in the context of predicting the probability of graduation for groups of students who share similar attributes. As a result, using the misclassification rates as a measure of predictive efficiency would not be relevant. Instead, the goodness-of-fit tests would be more appropriate and should be used instead.

Table 4.2. Misclassification Rates for the Model Predicting Graduation in Category I Languages

OBSERVED VALUES	PREDICTION VALUES	
	FALSE	TRUE
0	126	258
1	347	1588
Naïve Misclassification Rate	473/ 2319= 0.2039	
Prediction Misclassification Rate	(258+347) / 2319 = 0.2609	

Hosmer-Lemeshow test results are presented in Table A.1. The null hypothesis that states that the model fits well cannot be rejected at the 38% confidence level. Figure 4.1 shows the comparison of the expected percentages of graduations versus observed percentages of graduations.

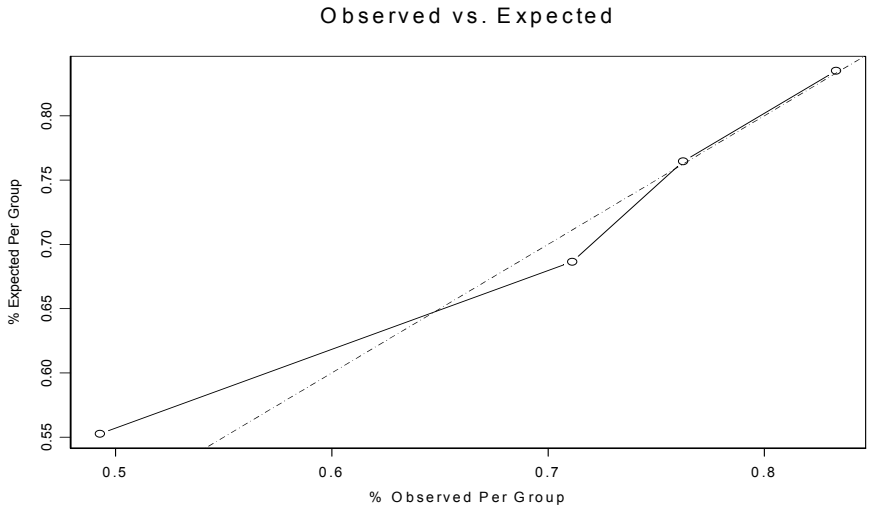

Figure 4.1. Comparison of Observed and Predicted Probabilities for Graduation in Category I Language

Plots of influence statistics ΔB versus observations and deviance versus predicted probability are included in Appendix A. Figure A.1 graphs the influence statistic values for the observations in the data set. None of the observations were influential, as shown by all observations having Cook's distance less than 1. Logistic regression results for the probability of graduation in Category I languages are presented in Table 4.3 and Table A.1. No interaction term was found to be significant. The main effects of DLAB scores, recycling and relanguaging were all found to be statistically significant at the 95% confidence level.

Table 4.3. Model for Probability of Graduation in Category I Language

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.089	0.385	0.230	
Dlab 85 to 90-	0.647	0.410	1.580	0.85 – 4.26
Dlab 90 to 95-	1.090	0.404	2.700	1.35 – 6.55
Dlab 95 to 100-	1.230	0.398	3.090	1.57 – 7.48
Dlab 100 and higher	1.740	0.395	4.390	2.62 – 12.32
Recycle	-0.390	0.160	-2.460	0.49 – 0.92
Relanguage	-1.320	0.617	-2.140	0.08 -- 0.89

Confidence intervals for odds ratios were calculated for each of the independent variables not included in any interactions. Since the confidence interval of the odds ratio for DLAB scores of between 85 and 90 included 1, having a DLAB score of between 85 and 90 does not seem to help in improving the probability of graduation when compared to those who had a DLAB score lower than 85. However, the confidence interval of the odds ratios for DLAB score of between 90 and 95 is 1.35-6.55. Therefore, this group was found to have between 1.35 and 6.55 times greater predicted odds of graduation than those who had a DLAB score lower than 85. Similarly, those with DLAB scores between 95 and 100 were found to have a 1.57 to 7.48 times greater predicted odds of graduation and those with DLAB scores of 100 and higher, a 2.62 to 12.32 times higher predicted odds in graduation. Those who have been recycled at least once were found to have between 0.49 to 0.92 times odds of graduation compared to those who have not been recycled before. As for those who have been relanguaged at least once, they were found to have between 0.08 to 0.89 times odds of graduation compared to those who have not been relanguaged before.

D. MODEL FOR THE PROBABILITY OF GRADUATION IN CATEGORY III LANGUAGES

The model analyzed 3,867 entries. The logistic regression results and diagnostic plots are included in Appendix B.

The result of the Hosmer-Lemeshow test is shown in Table B.1. The p-value of 0.95 indicated that the null hypothesis, which states that the model fits well, cannot be rejected at the 95 percent confidence level. Comparison of the expected percentages of

graduations versus observed percentages of graduations is shown in Figure 4.2. Figure 4.2 indicates that it is possible to use the model to predict probabilities of graduation in Category III languages accurately.

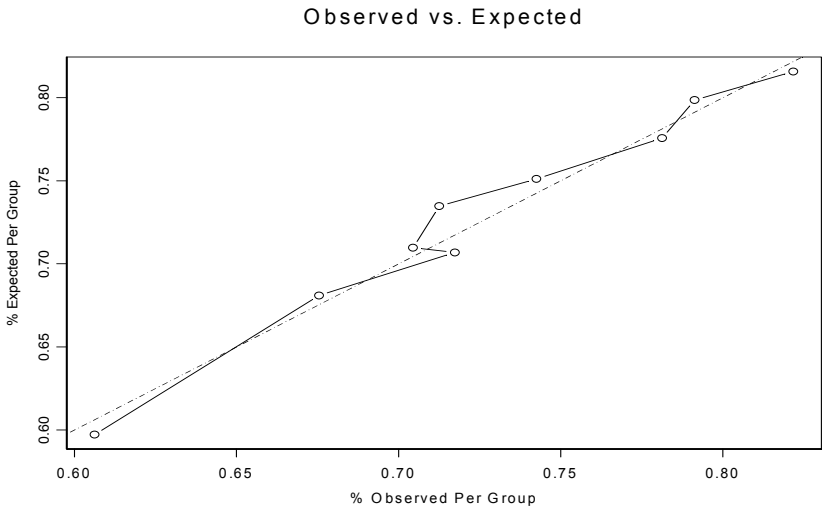

Figure 4.2. Comparison of Observed and Predicted Probability for Graduation in Category III Languages

Plots of influence statistics ΔB versus observations and deviance versus predicted probability are included in Appendix C. Figure B.1 graphs the influence statistic values. All the observations have ΔB values less than 1, which indicate that there are no influential observations. Figure B.2 graphs the change in deviance versus predicted probability of graduation. Logistic regression results for the probability of graduation for Category III languages are presented in Table 4.4 and Table B.1. The results show that the main effects of all the independent variables that were being considered to be significant.

Table 4.4. Model for Graduation in Category III Languages

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.758	0.130	5.820	
ServiceArmy	-0.224	0.091	-2.480	
ServiceMarines	0.323	0.175	1.840	
ServiceNavy	0.293	0.128	2.280	
Dlab 95 or higher	0.482	0.108	4.440	1.31 – 2.00
Gender	-0.135	0.083	-1.640	
Recycle	0.174	0.208	0.839	
Relanguage	0.021	0.328	0.634	
ServiceArmy: Recycle	-0.174	0.259	-0.672	
ServiceMarines: Recycle	-0.798	0.480	-1.660	
ServiceNavy: Recycle	-0.979	0.352	-2.780	
Gender:Relanguage	-0.753	0.387	-1.950	

Confidence intervals for odds ratios were calculated for the DLAB scores only as it was the only independent variable that did not appear among the interactions. The confidence interval of the odds ratios for DLAB scores was found to be 1.31-2.00. Thus, entries having DLAB scores of 95 or higher were found to have predicted odds of graduation of between 1.31 and 2.00 times greater than those who have DLAB scores lower than 95.

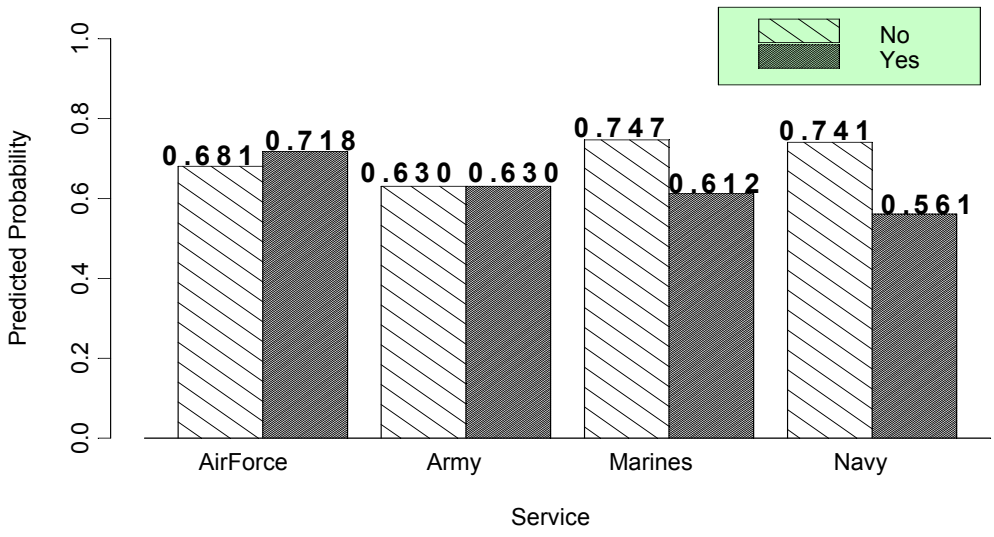

Figure 4.3. Effect of Service and Recycling on the Predicted Probability of Graduation in Category III Languages

The model suggested an interaction between the service and whether a person has been recycled at least once. Figure 4.3 shows a plot of predicted probabilities of graduation versus the Service and whether a person has been recycled at least once (shown by Yes or No in the plot). As before, all other variables are set to baseline values. Among those who have not been recycled before, the Marines have the highest predicted probability of graduation, followed by the Navy, Air Force and the Army. However, for those who have recycled at least once, the Air Force has the highest predicted probability, followed by the Army, Marines and the Navy. Furthermore, for the Air Force, the predicted probability of graduation actually increases if a person has been recycled at least once. However, for the Marines and the Navy, the predicted probability of graduation decreases if a person has been recycled at least once, with the Navy showing a larger decrease than the Marines.

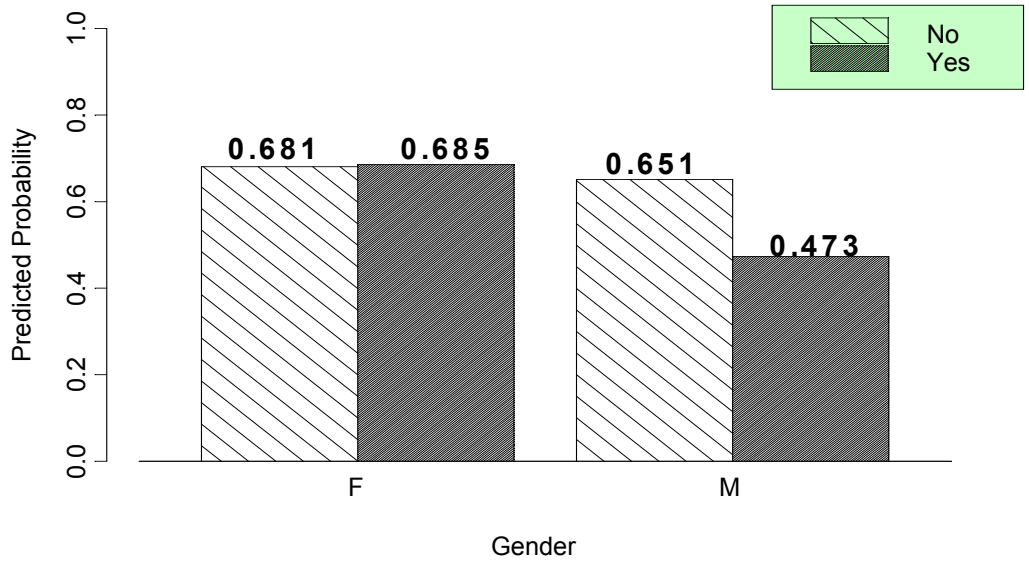

Figure 4.4 Effect of Gender and Relanguaging on the Predicted Probability of Graduation for Category III Languages

The model also suggested an interaction between the gender and whether a person has been relanguaged at least once. Figure 4.4 shows a plot of predicted probabilities of graduation versus the gender and whether a person has been relanguaged at least once (shown by Yes or No in the above plot). All other variables are set to their baseline

values. For both cases of whether a person has been relanguaged at least once or not relanguaged, the females have the higher probability of graduation than the males. In fact, the females showed a slight increase in the predicted probability of graduation when relanguaged compared to when she has not. However, the males showed a marked decrease in the predicted probability of graduation of 18% when he has been relanguaged at least once as compared to when he has not.

E. MODEL FOR THE PROBABILITY OF GRADUATION OF STUDENTS IN CATEGORY IV LANGUAGES

The model analyzed 5,925 entries. Logistic regression results and diagnostic plots are included in Appendix C.

The result of the Hosmer-Lemeshow test is shown in Table C.1. The p-value of 0.60 indicates that the null hypothesis, which states that the model fits well, cannot be rejected at the 60 percent confidence level. Comparison of the expected percentages of graduations versus observed percentages of graduations is shown in Figure 4.5. Figure 4.5 indicates that it is possible to use the model to predict probabilities of graduation in Category IV languages accurately.

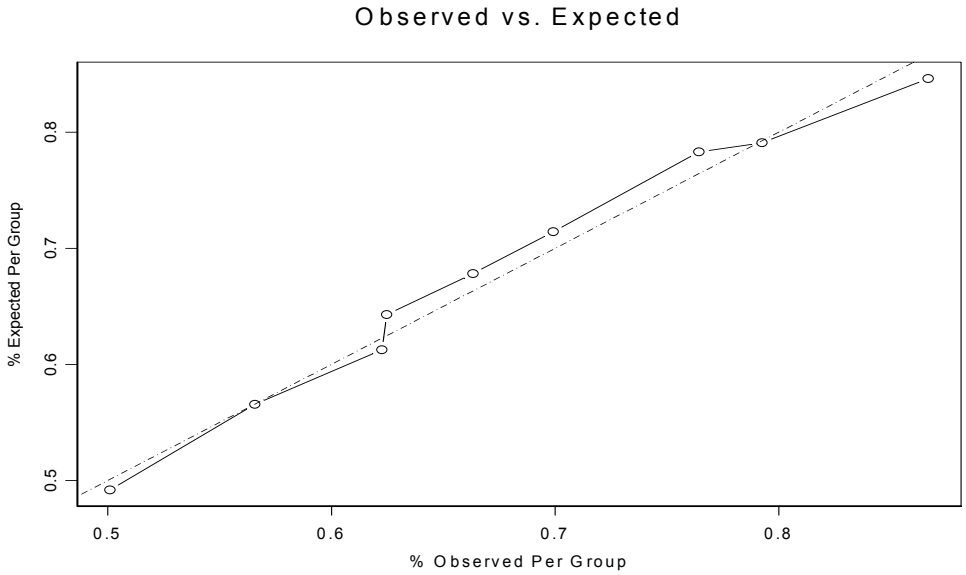

Figure 4.5. Comparison of Observed and Predicted Rates for Graduation in Category IV Languages

Plots of influence statistics ΔB versus observations and deviance versus predicted probability are included in Appendix C. Figure C.1 graphs the influence statistic values. All the observations have ΔB values less than 1, which indicated there were no influential observations. Figure C.2 graphs the change in deviance versus predicted probability of graduation. Logistic regression results for the probability of graduation in Category IV languages are presented in Table 4.5 and Table C.1. The results showed that the main effects of all the independent variables that were being considered were found to be significant.

Table 4.5. Model for Predicting Probability of Graduation in Category IV Languages

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.849	0.083	10.200	
ServiceArmy	-0.129	0.082	-1.580	
ServiceMarines	0.202	0.130	1.550	
ServiceNavy	0.779	0.130	5.970	
Dlab 120 or higher	0.697	0.140	4.990	
Gender	-0.263	0.065	-4.050	0.68 – 0.87
Recycle	-0.453	0.082	-5.530	
Relanguage	-0.493	0.110	-4.480	0.49 – 0.76
ServiceArmy: Dlab 120 and above	0.131	0.160	0.815	
ServiceMarines: Dlab120 and above	-0.595	0.244	-2.440	
ServiceNavy: Dlab120 and above	-0.180	0.257	-0.700	
Dlab120 and above: Recycle	-0.367	0.166	-2.210	

Confidence intervals for odds ratios are only calculated for the two independent variables that do not appear in the interactions (Gender and Relanguage). The confidence interval of the odds ratios for Gender is 0.68 – 0.87. Thus, males are found to have only between 0.68 and 0.87 times the predicted odds in graduation of the females. Also, having been relanguaged at least once seems to reduce the odds of graduation by a factor of between 0.49 and 0.76.

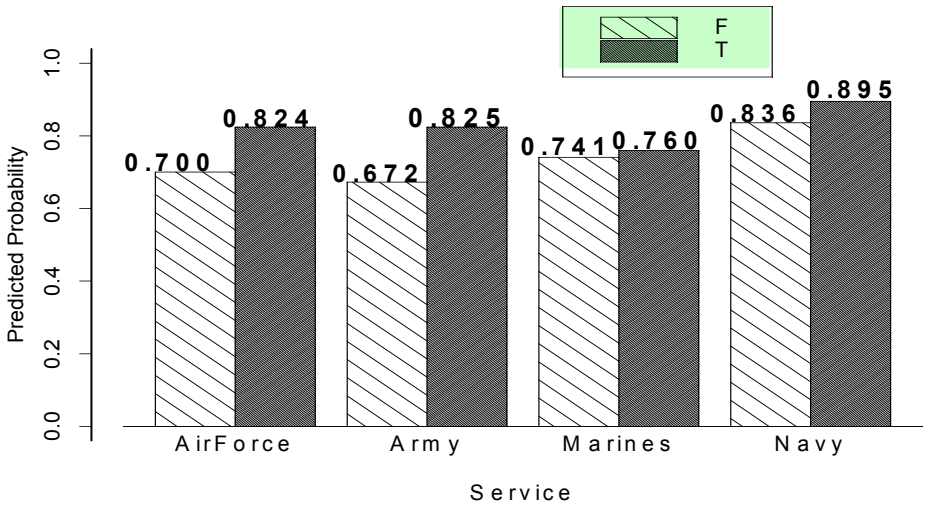

Figure 4.6. Effect of Service and DLAB Scores on the Predicted Probability of Graduation in Category IV Languages

The model suggested an interaction between the service and whether the DLAB score is 120 or higher. Figure 4.6 shows a plot of the predicted probabilities of graduation versus the Service and whether the DLAB score is 120 or higher (shown as False or True in the above plot). All other variables are set to their baseline values. Among those who have a DLAB score of lower than 120, the Navy students have the highest predicted probability of graduation, followed by those in the Marines, the Air Force and the Army. For those who have a DLAB score of 120 or higher, the Navy students also have the highest predicted probability, followed by the students from the Army, the Air Force and the Marines. Furthermore, for those who have a DLAB score of 120 or higher, the predicted probability of graduation of the Air Force and the Army increased more than the improvement seen in the Marines and the Navy than the students from their corresponding services that have DLAB score of less than 120.

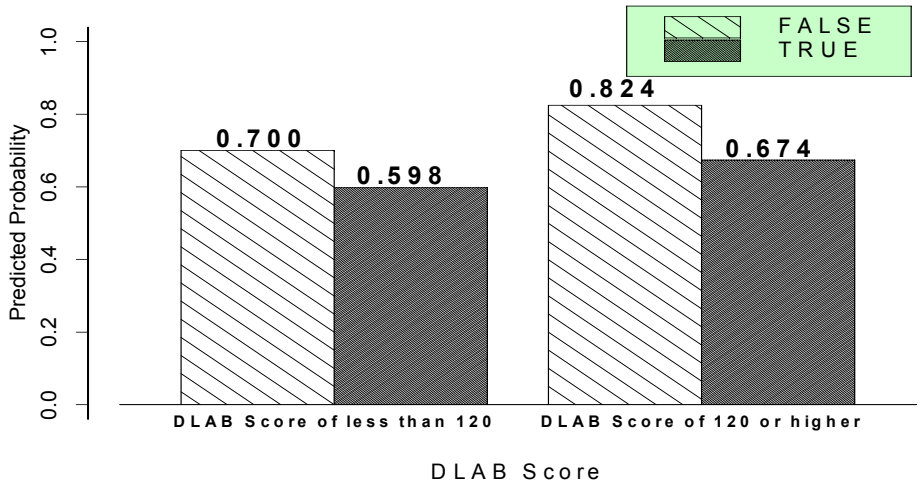

Figure 4.7 Effect of DLAB Scores and Recycling on the Predicted Probability of Graduation in Category IV Languages

The model also suggested an interaction between the DLAB score and whether a person has been recycled at least once. Figure 4.7 shows a plot of the predicted probabilities of graduation versus the DLAB score and whether a person has been recycled at least once (shown as True or False in the plot). All other variables are set to their baseline values. Among those who have been recycled at least once, for those that have a DLAB score of 120 and higher, the predicted probability of graduation decreases (15%) more than those with a DLAB score that is below 120 (10%). However, the predicted probability of graduation is still higher for those who have a DLAB score of 120 or higher (67.4%) than those who do not (59.8%) among those who have been recycled at least once.

F. CHAPTER SUMMARY

This chapter covered the analysis for the probability of graduation across all four categories of languages and the probability of graduation in each of the four language categories, excluding category II.

The model involving 12,302 entries across all four categories of languages showed all the main effects to be significant but more importantly, the second order interactions of category of language with gender, with DLAB scores and with service to be significant. Thus, this model has suggested that there are peculiarities brought about

by the category of language. Furthermore, because of the relative complexity of this model, it would not be easy for the results to be interpreted and hence, the model was not practical for the purposes at hand. Consequently, separate models based on the different categories of languages were used instead.

The model predicting the probability of graduation in Category I languages analyzed 2,319 entries and the results indicated an effect by the DLAB scores, whether a student has been recycled at least once and whether a student has been relanguaged at least once. The results suggested that higher DLAB scores, and not having been recycled and relanguaged are associated with a higher probability of graduation. The results also suggest that the predicted decrease in probability of graduation associated with recycling and relanguaging is larger when DLAB scores are small. The variables Gender and Service were not found to have any significant effect.

The model predicting the probability of graduation in Category III languages analyzed 3,867 entries. The results indicated that females in the Marines having DLAB scores of 95 or higher have the highest probability of graduation. Similarly, males in the Army having DLAB scores of less than 95 have the lowest probability of graduation. Among those who have not been recycled before, the Marines have the highest predicted probability of graduation, followed by the Navy, Air Force and the Army. However, for those who have recycled at least once before, the Air Force has the highest predicted probability, followed by the Army, Marines and the Navy. Furthermore, for the Air Force, the predicted probability of graduation actually increases if a person has been recycled at least once. However, for the Marines and the Navy, the predicted probability of graduation decreases if a person has been recycled at least once, with the Navy showing a larger decrease than the Marines.

The model predicting the probability of graduation in Category IV languages, based on 5,925 entries, indicated that being in the Navy, female, having DLAB scores of 120 or higher, and who had not been recycled or relanguaged would have the highest probability of graduation. Males in the Army with DLAB scores of less than 120 and who had been recycled or relanguaged at least once have the lowest probability of graduation. The model also suggested that among those who have a DLAB score of lower than 120,

the Navy have the highest predicted probability of graduation, followed by the Marines, the Air Force and the Army. For those who have a DLAB score of 120 or higher, the Navy also has the highest predicted probability, followed by the Army, the Air Force and the Marines. Furthermore, the increase in predicted probability of graduation for students with a DLAB score of 120 or higher, compared to those with a DLAB score less than 120, was greater for the Air Force and Army students than for the Marines and the Navy.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSIONS

The primary purpose of this thesis is to analyze factors related to the academic, military and personnel background factors of a student enrolled in the basic program in DLIFLC that might affect graduation. Chapter I provides the background to DLI. Chapter II gives an overview of prior related studies. Chapter III describes the data sets and the models used in the study, and present the preliminary data analysis results. Chapter IV includes the logistic regression results for the models developed in the study.

The data in this thesis were taken from DLIFLC and consisted of students from the four armed services and a small number of federal civilians and foreign military from fiscal years 1998 through 2003. The majority of these students have less than one year of service in the military. Only students from the four principal services and with valid DLAB scores were considered for this study. Also, as DLI is concerned with students who do not make the grade academically, entries having administrative attritions were not considered. Therefore, the focus is on the entries which have either successfully graduated or undergo attrition for either not taking or failing the DLPT. In considering only these entries, a total of 12,302 entries were used for this study.

Four different models were developed in the study: A model predicting probability of graduation across all four categories of languages; a model predicting probability of graduation for Category I languages; a model predicting probability of graduation for Category III languages; and a model predicting probability of graduation for Categories IV languages. To be considered as having graduated from the basic program, a student must meet the minimum scores or proficiency required in a DLPT, which is a level of 2/2/1+ of having attained a proficiency level of 2 in listening and reading and a proficiency level of 1+ for speaking.

The model involving 12,302 entries across all four categories of languages showed all the main effects to be significant but more importantly, the second order interactions of category of language with gender, with DLAB scores and with service to be significant. Thus, this model has suggested that there are peculiarities brought about

by the category of language. Furthermore, because of the relative complexity of this model, it would not be easy for the results to be interpreted and hence, the model was not practical for the purposes at hand. Consequently, separate models based on the different categories of languages were used instead.

The model predicting the probability of graduation in Category I languages analyzed 2,319 entries and the results indicated an effect by the DLAB scores, whether a student has been recycled at least once and whether a student has been relanguaged at least once. The results suggested that higher DLAB scores, and not having been recycled and relanguaged are associated with a higher probability of graduation. The results also suggest that the predicted decrease in probability of graduation associated with recycling and relanguaging is larger when DLAB scores are small. The variables Gender and Service were not found to have any significant effect.

The model predicting the probability of graduation in Category III languages analyzed 3,867 entries. The results indicated that females in the Marines having DLAB scores of 95 or higher have the highest probability of graduation. Similarly, males in the Army having DLAB scores of less than 95 have the lowest probability of graduation. Among those who have not been recycled before, the Marines have the highest predicted probability of graduation, followed by the Navy, Air Force and the Army. However, for those who have recycled at least once before, the Air Force has the highest predicted probability, followed by the Army, Marines and the Navy. Furthermore, for the Air Force, the predicted probability of graduation actually increases if a person has been recycled at least once. However, for the Marines and the Navy, the predicted probability of graduation decreases if a person has been recycled at least once, with the Navy showing a larger decrease than the Marines.

The model predicting the probability of graduation in Category IV languages analyzed 5,925 entries and the results indicated that being in the Navy, female, having DLAB scores of 120 or higher, and who had not been recycled or relanguaged would have the highest probability of graduation. Males in the Army with DLAB scores of less than 120 and who had been recycled or relanguaged at least once have the lowest probability of graduation. The model also suggested that among those who have a DLAB

score of lower than 120, the Navy have the highest predicted probability of graduation, followed by the Marines, the Air Force and the Army. For those who have a DLAB score of 120 or higher, the Navy also has the highest predicted probability, followed by the Army, the Air Force and the Marines. Furthermore, the increase in predicted probability of graduation for students with a DLAB score of 120 or higher, compared to those with a DLAB score less than 120, was greater for the Air Force and Army students than for the Marines and Navy.

B. LIMITATIONS AND RECOMMENDATIONS

The models developed in this study focused on the effect of independent variables of DLAB score, gender, service, the category of language, whether a student has been recycled at least once and whether a student has been relanguaged at least once on the graduation of a student in DLIFLC. One of the major limitations for this study is the lack of independent variables such as the progress scores or the semester GPAs of students that can further reflect the academic performances of the students beyond the DLAB score. Past studies and this study has shown the importance of DLAB scores in determining the prospects of a student in graduating from a language course. By having more academic performance indicators available, it may increase the accuracy of the models by incorporating them into the model described within. Inclusion of these variables in this model may also allow us to ascertain the phases of the courses at which students would most likely drop out from the course. It can also help DLIFLC plan the number of students to take in for a particular language course so that the required number of linguists required by the various services would be met.

Another area for future study would be to expand this study by analyzing each language separately. Just as this study has shown the peculiarities brought about by the category of language, it is conceivable that there will also be peculiarities brought about by the many different and varied languages that are taught in DLI. Thus, it may be worthwhile to analyze each language separately.

A final area would be to establish reasons for the differences in the graduation rates among the services. This is particularly relevant as the Air Force started on an indoctrination program known as SMART (Student Motivation and Retention Training) towards the end of 1996, followed by the Navy in 1998 and the Army in 2002. The goal

of SMART is to provide the students with study skills and an introduction to the culture of their language to better prepare them for their language skills. However, not all students enrolled in DLI have the opportunity to undergo this course due to time and scheduling constraints. Hence, a possible study would be to determine if the SMART program has made a difference in the graduation of students undergoing language learning.

APPENDIX A. LOGISTIC REGRESSION RESULTS AND DIAGNOSTIC PLOTS FOR PROBABILITY OF GRADUATION IN CATEGORY 1 LANGUAGE

Table A.1. Logistic Regression Results for Graduation in Category I Language

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.089	0.385	0.230	
Dlab 85 to 90-	0.647	0.410	1.580	0.85 – 4.26
Dlab 90 to 95-	1.090	0.404	2.700	1.35 – 6.55
Dlab 95 to 100-	1.230	0.398	3.090	1.57 – 7.48
Dlab 100 and higher	1.740	0.395	4.390	2.62 – 12.32
Recycle	-0.390	0.160	-2.460	0.49 – 0.92
Relanguage	-1.320	0.617	-2.140	0.08 -- 0.89

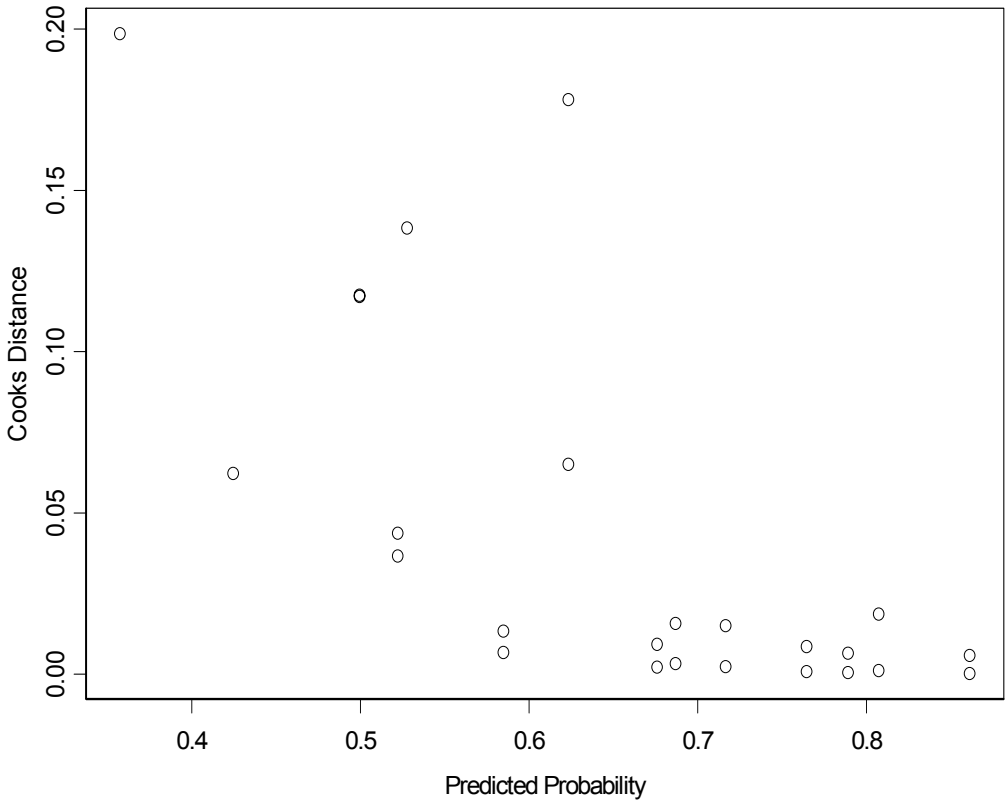

Figure A.1. Cook's Distance Plot for Model Predicting Probability of Graduation in Category I Languages

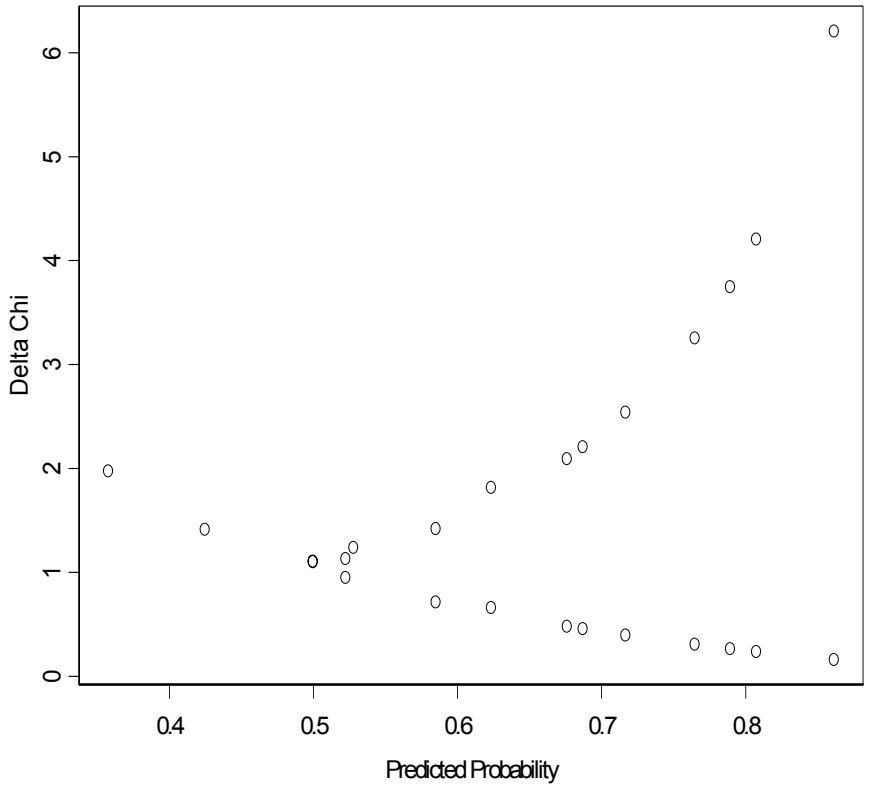

Figure A.2. Deviance Residual (Delta Chi) Plot for Model Predicting Probability of Graduation in Category I Languages

APPENDIX B. LOGISTIC REGRESSION RESULTS AND DIAGNOSTIC PLOTS FOR PROBABILITY OF GRADUATION IN CATEGORY III LANGUAGES

Table B.1. Logistic Regression Results for Graduation in Category III Language

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.758	0.130	5.820	
ServiceArmy	-0.224	0.091	-2.480	
ServiceMarines	0.323	0.175	1.840	
ServiceNavy	0.293	0.128	2.280	
Dlab 95 or higher	0.482	0.108	4.440	1.31 – 2.00
Gender	-0.135	0.083	-1.640	
Recycle	0.174	0.208	0.839	
Relanguage	0.021	0.328	0.634	
ServiceArmy: Recycle	-0.174	0.259	-0.672	
ServiceMarines: Recycle	-0.798	0.480	-1.660	
ServiceNavy: Recycle	-0.979	0.352	-2.780	
Gender:Relanguage	-0.753	0.387	-1.950	
Hosmer- Lemeshow Goodness of fit test: Chi-squared = 2.235, df = 7, p-value =0.9457				

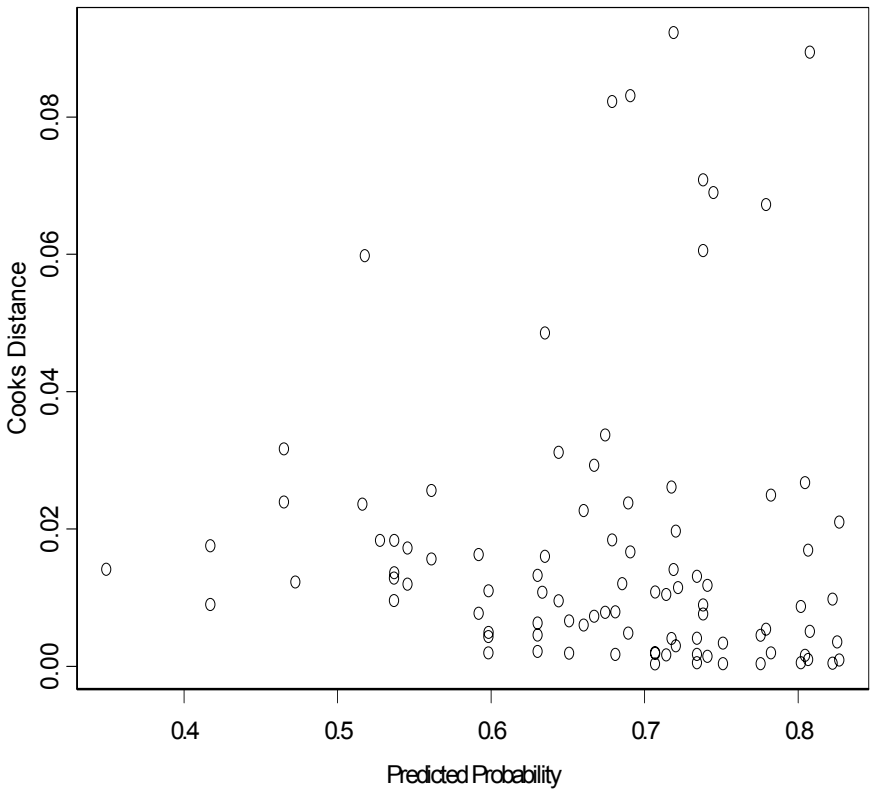

Figure B.1. Cook's Distance Plot for Model Predicting Probability of Graduation in Category III Languages

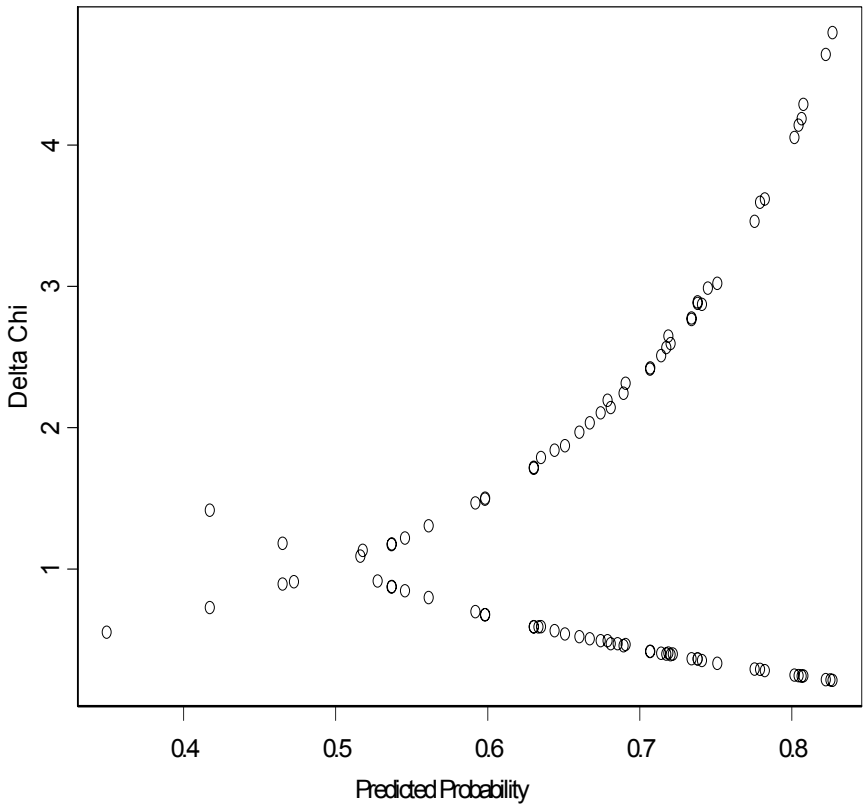

Figure B.2. Deviance Residual (Delta Chi) Plot for Model Predicting Probability of Graduation in Category III Languages

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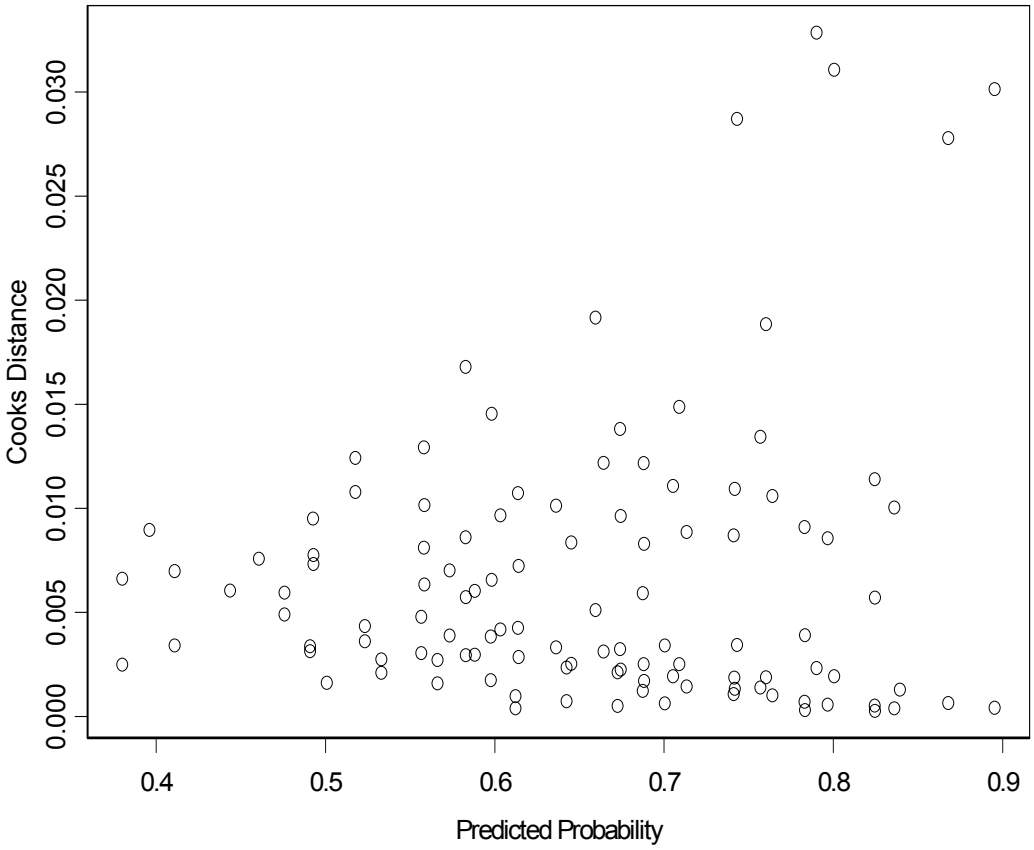
APPENDIX C. LOGISTIC REGRESSION RESULTS AND DIAGNOSTIC PLOTS FOR PROBABILITY OF GRADUATION IN CATEGORY IV LANGUAGE

Table C.1. Logistic Regression Results for Graduation in Category IV Language

Coefficients	Value	Std.Error	t.value	95 % CI of Odds Ratio
(Intercept)	0.849	0.083	10.200	
ServiceArmy	-0.129	0.082	-1.580	
ServiceMarines	0.202	0.130	1.550	
ServiceNavy	0.779	0.130	5.970	
Dlab 120 or higher	0.697	0.140	4.990	
Gender	-0.263	0.065	-4.050	0.68 – 0.87
Recycle	-0.453	0.082	-5.530	
Relanguage	-0.493	0.110	-4.480	0.49 – 0.76
ServiceArmy: Dlab 120 and above	0.131	0.160	0.815	
ServiceMarines: Dlab120 and above	-0.595	0.244	-2.440	
ServiceNavy: Dlab120 and above	-0.180	0.257	-0.700	
Dlab120 and above: Recycle	-0.367	0.166	-2.210	



FigureC.1. Cook's Distance Plot for Model Predicting Probability of Graduation in Category IV Languages

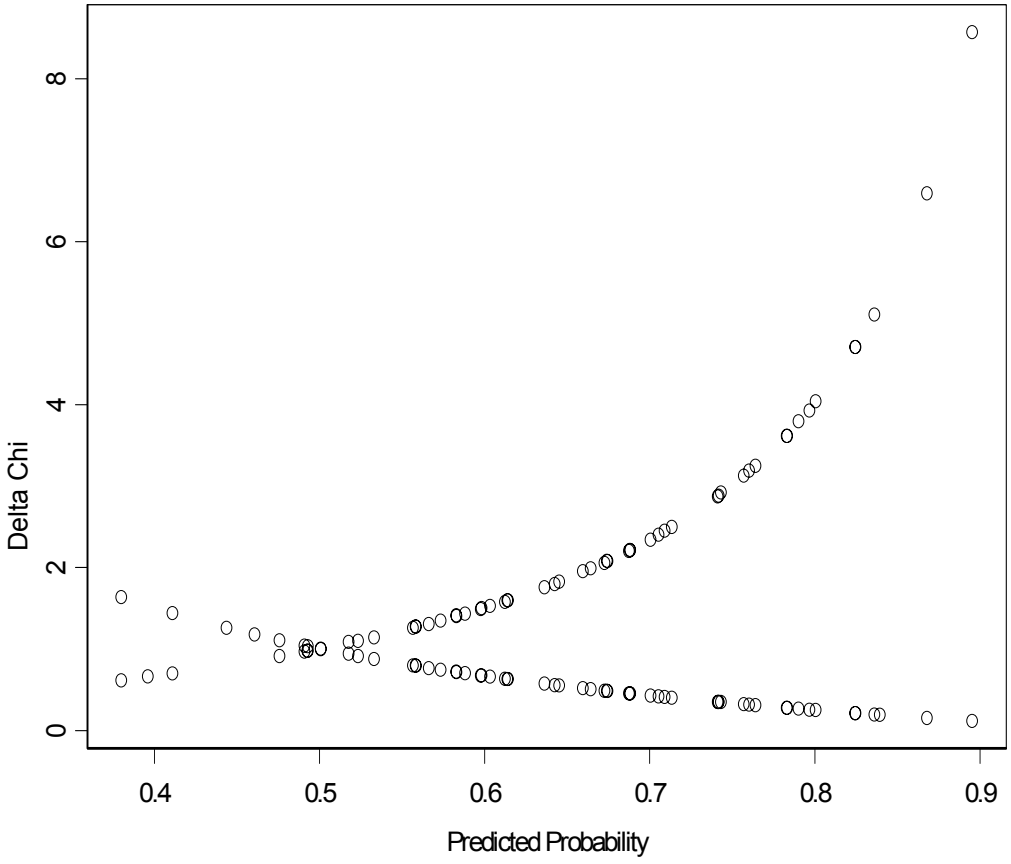


Figure C.2. Deviance Residual (Delta Chi) Plot for Model Predicting Probability of Graduation in Category IV Languages

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