NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

DEFENSE ANALYSIS CAPSTONE PROJECT REPORT

IMPROVING RECRUITING OF THE 6TH RECRUITING BRIGADE THROUGH STATISTICAL ANALYSIS AND EFFICIENCY MEASURES

by

Samuel E. Figueroa

December 2014

Project Advisor: William P. Fox
Second Reader: Jeffrey B. House

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704–0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** December 2014	**3. REPORT TYPE AND DATES COVERED** Capstone Project Report	
4. TITLE AND SUBTITLE IMPROVING RECRUITING OF THE 6TH RECRUITING BRIGADE THROUGH STATISTICAL ANALYSIS AND EFFICIENCY MEASURES			**5. FUNDING NUMBERS**
6. AUTHOR(S) Samuel E. Figueroa			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this research are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ____N/A____.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT

For the first time since the inception of the all-volunteer force in 1973, the percentage of minorities within the U.S. Army has reached a record high as presented by University of Syracuse's Amy Lutz. In her journal in 2008, *Who Joins the Military?: A Look at Race, Class, and Immigration Status*, Lutz examines socio-economic status as an important predictor to military service. However, budget cuts and the downsizing of military personnel make the recruiting selection more competitive than ever before while the Army needs qualified individuals from all social classes and ethnic backgrounds. The U.S. Army's 6th Recruiting Brigade (6th REC BDE) has the largest recruiting mission in the western United States. Data from the U.S. Census Bureau shows that minority population growth concentrates throughout counties in this region. The fact that those minority groups predominate poses a unique challenge for the 6th REC BDE. This research explores statistically the effect that recruiters with additional language ability have on improving recruiting. Also, it examines how significant it would be to allocate recruiters with secondary languages in areas where those languages prevail. The statistical procedures used in this research have proved that language is a significant factor, and that those recruiters who have secondary language skills contribute significantly to the recruiting mission.

14. SUBJECT TERMS U.S. Army recruiting, data envelopment, anova, military diversity			**15. NUMBER OF PAGES** 105
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540–01-280-5500

Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

IMPROVING RECRUITING OF THE 6TH RECRUITING BRIGADE THROUGH STATISTICAL ANALYSIS AND EFFICIENCY MEASURES

Samuel E. Figueroa,
Major, United States Army Reserve
1999, BSCE, University of Puerto Rico

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN DEFENSE ANALYSIS

from the

NAVAL POSTGRADUATE SCHOOL
December 2014

Author: Samuel E. Figueroa

Reviewed by:
William P. Fox — Project Advisor
Jeffrey B. House — Second Reader

Accepted by:
John J. Arquilla
Chair, Department of Defense Analysis

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

For the first time since the inception of the all-volunteer force in 1973, the percentage of minorities within the U.S. Army has reached a record high as presented by University of Syracuse's Amy Lutz. In her journal in 2008, *Who Joins the Military?: A Look at Race, Class, and Immigration Status*, Lutz examines socio-economic status as an important predictor to military service. However, budget cuts and the downsizing of military personnel make the recruiting selection more competitive than ever before while the Army needs qualified individuals from all social classes and ethnic backgrounds. The U.S. Army's 6th Recruiting Brigade (6th REC BDE) has the largest recruiting mission in the western United States. Data from the U.S. Census Bureau shows that minority population growth concentrates throughout counties in this region. The fact that those minority groups predominate poses a unique challenge for the 6th REC BDE. This research explores statistically the effect that recruiters with additional language ability have on improving recruiting. Also, it examines how significant it would be to allocate recruiters with secondary languages in areas where those languages prevail. The statistical procedures used in this research have proved that language is a significant factor, and that those recruiters who have secondary language skills contribute significantly to the recruiting mission.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

6th REC BDE	6th Recruiting Brigade
ACS	American Community Survey
ANOVA	analysis of variances
API	Asians and Pacific Islanders
ASVAB	Armed Services Vocational Aptitude Battery
AVF	all-volunteer force
BN	Recruiting Battalion
BRAC	base realignment and closure
CONUS	continental United States
DEA	data envelopment analysis
DMU	decision-making unit
DOD	Department of Defense
FY	fiscal year
GEN	general
MG	major general
P2P	personnel-to-population ratio
POI	population of interest
RA	regular Army
ROI	return on investment
RSID	recruiting station identification
SOF	Special Operations Forces
USAR	United States Army Reserve

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

I am grateful to my wife, Brenda, and my children who are my inspiration, and my advisor, Dr. William Fox, whose knowledge and guidance pointed me in the right direction. I am also grateful to LTC Jeffrey B. House, who made himself available many times and in many ways, not only for this research, but throughout my tenure at NPS. I thank the commander of the 6th Recruiting Brigade, COL Collin J. Fortier and his great staff: Mr. Wilfred Oguma, Ms. Kelly Wakefield, and Mr. Edward Jarvis, who welcomed me at the brigade, and provided me the recruiting data and how to make sense of it. I am indebted to Ms. Noel Yucuis and Ms. Jean Vengua from the NPS Graduate Writing Center for their utmost dedication and professionalism. Thanks to COL Ian Rice for originally envisioning and shaping the need to research this topic. Last, but not least, I thank my friend, CPT Horacio Brambila, for being available to work with me on the extensive datasets.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND AND NEED

The U.S. Department of Defense (DOD) announced in February 2014 its goal to shrink the Army to its smallest size since the WWII era. Collective budget cuts and the downsizing of military personnel make the U.S. Army's recruiting selection more competitive than ever before. Eligibility for recruitment is primarily based on identification of recruiting prospects who are primarily intellectually proficient, physically and morally fit, but also culturally aware, and ethnically diverse. Former Secretary of the Army John M. McHugh highlights the importance of creating a sustainable, diverse force in which the cultural background, perspective, and attributes of culturally diverse peoples are the pivot on which military service is enriched.[1] The current Chairman of the Joint Chief of Staff General (GEN) Martin E. Dempsey projects that by 2020 "we're going to need as much diversity and as much talent as we can possibly attract, if that's going to be the case, then what are we waiting for?"[2] Therefore, the recruiting strategists confront a new challenge to improve the productivity of the recruiting mission of minorities.

This research examines whether recruiters who speak more than one language are more successful recruiters. We also examine the population demographics to verify whether the recruits' ethnic distribution matches the population from which they are recruited.

The U.S. Army already distributes its recruiting stations near public high schools that historically rank highest academically, in order to track populations with higher academic qualifications. It is desirable to continue tracking those educationally

---

[1] Department of the Army, *United States Diversity Roadmap*, (Washington, DC: Assistant Secretary of the Army [Manpower & Reserve Affairs] Diversity and Leadership Directorate, 2010), i, https://www.deomi.org/DiversityMgmt/documents/Army_Diversity_Roadmap_December_2010.pdf.

[2] Weekend Edition Sunday, "'Time and Casualties': Gen. Dempsey on Cost of Sequester," *NPR.org*, February 17, 2013, http://www.npr.org/2013/02/17/172227744/obamas-top-military-adviser-says-cuts-would-cost-time-and-casualties.

advantaged populations, by also continually analyzing how to attract the human capital of the minorities. It is important to show soldiers and the U.S. population how the military thrives with ethnic and racial diversity. Strategically, the perception that the United States projects to the world—that it respects the rights of people—can dissipate before reaching its objectives when the armed forces do not incorporate diverse people in that fight.

The U.S. Army's 6th Recruiting Brigade (6th REC BDE), headquartered in Las Vegas, Nevada, has the largest recruiting mission in the country. The 6th REC BDE's recruiting area of responsibility covers ten states: Washington, Oregon, California, Utah, Nevada, Idaho, Montana, Wyoming, Alaska and Hawaii. The demographics for these states are rich in diversity as they have larger ethnically diverse populations than the rest of the country.[3] The 6th REC BDE consists of seven battalions located in the cities of Seattle, Portland, Salt Lake City, Sacramento, Fresno, Los Angeles, and Southern California. The seven battalions have 42 companies composed of approximately 181 recruiting stations. The 6th REC BDE accomplishes its mission with an authorization of 1,554 recruiters. This research found that 209 of these recruiters, or 13.45%, have a secondary language. The 6th REC BDE assigns each recruiting battalion the number of recruits it needs to generate every year from its assigned areas. Table 1 shows the recruiting mission goals assigned to each battalion for fiscal year (FY) 2014. The 6th REC BDE had to recruit at least 16,179 service members for FY14.

[3] United States Census Bureau, "2010 Census Shows America's Diversity" (CB11-CN.125), March 24, 2011, http://www.census.gov/newsroom/releases/archives/2010_census/cb11-cn125 html.

Table 1. 6th REC BDE Required Mission Demands per Battalion

6th REC BDE *BN (Codes)*	Regular Army (RA) *Mission*	Army Reserve (AR) *Mission*	*BN Total*
LA (6F)	1,729	371	1,729
PTLD (6H)	1,633	333	1,633
SAC (6I)	1,827	389	1,827
SLC (6J)	1,472	734	1,472
SOC (6K)	2,497	534	2,497
SEA (6L)	1,479	635	1,479
FRES (6N)	2,000	546	2,000
Total	12,637	3,542	16,179

There are two measures to describe the success of each battalion in its recruiting mission. The first one is how recruiting "mission success" is defined. This success is based upon maximizing the fill-to-demand ratio. Every recruiting center should reach or surpass 100% of its demand, for as many months as possible. Another metric that yields success is defined as how the ethnic distribution of recruits matches the population demographics. This metric is known as the personnel-to-population ratio (P2P). The P2P metric identifies whether the ethnicity proportion of the recruits mirrors their own populations. This is relevant regarding the diversity of the U.S. military. A broad representation of the population is imperative for quality national defense, cultural understanding, and to show American principles to the world.[4]

The achieved fill-to-demand ratios are an intuitive way to understand how effective a recruiting center is in a given month. Table 2 displays examples of the fill-to-demand ratios—the filled recruits divided by the demand, or the assigned recruiting mission, for each month.

[4] Department of the Army, *United States Diversity Roadmap*, 2.

Table 2. Examples of Fill-to-Demand Ratio Values by Recruiting Center from Los Angeles BN

Month	Company	Center	Overall Demand	Overall Filled	Fill-to-Demand Ratio
Apr10	6F2 - SAN GABRIEL VL	6F2D - AZUSA CENTER	8	2	0.25
Aug10	6F7 - COASTAL	6F7F - TORRANCE CENTER	4	1	0.25
Aug11	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	6	1	0.17
Feb13	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	9	0	0.00
Jan10	6F8 - LOS ANGELES	6F8D - HOLLYWOOD CENTER	4	1	0.25
Jan12	6F7 - COASTAL	6F7F - TORRANCE CENTER	8	2	0.25
Jan12	6F5 - SN FERNANDO VL	6F5N - SAN FERNANDO VALLEY CENTER	10	3	0.30
Jan13	6F2 - SAN GABRIEL VL	6F2D - AZUSA CENTER	14	3	0.21
Jan13	6F3 - LONG BEACH	6F3H - LONG BEACH CENTER	12	3	0.25
Jan13	6F3 - LONG BEACH	6F3V - HUNTINGTON PARK CENTER	12	3	0.25
Jan13	6F5 - SN FERNANDO VL	6F5N - SAN FERNANDO VALLEY CENTER	14	4	0.29
Jul11	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	7	0	0.00
Jul12	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	10	0	0.00
Jun11	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	6	0	0.00
Jun13	6F7 - COASTAL	6F7F - TORRANCE CENTER	11	0	0.00
Jun13	6F2 - SAN GABRIEL VL	6F2D - AZUSA CENTER	14	3	0.21
Jun13	6F3 - LONG BEACH	6F3R - NORWALK CENTER	12	3	0.25
Mar11	6F2 - SAN GABRIEL VL	6F2A - POMONA	5	0	0.00
Mar13	6F5 - SN FERNANDO VL	6F5N - SAN FERNANDO VALLEY CENTER	16	3	0.19
May10	6F7 - COASTAL	6F7F - TORRANCE CENTER	7	1	0.14
May12	6F2 - SAN GABRIEL VL	6F2F - EL MONTE CENTER	9	2	0.22
May13	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	11	1	0.09
Nov10	6F2 - SAN GABRIEL VL	6F2F - EL MONTE CENTER	8	2	0.25
Oct09	6F7 - COASTAL	6F7V - CULVER CITY CENTER	3	0	0.00
Oct11	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	9	2	0.22
Sep11	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	6	1	0.17
Sep11	6F7 - COASTAL	6F7V - CULVER CITY CENTER	6	1	0.17
Sep11	6F7 - COASTAL	6F7F - TORRANCE CENTER	5	1	0.20
Sep11	6F2 - SAN GABRIEL VL	6F2F - EL MONTE CENTER	8	2	0.25
Sep12	6F3 - LONG BEACH	6F3H - LONG BEACH CENTER	8	1	0.13
Sep12	6F7 - COASTAL	6F7T - INGLEWOOD CENTER	8	1	0.13
Sep12	6F2 - SAN GABRIEL VL	6F2F - EL MONTE CENTER	8	2	0.25
Sep13	6F7 - COASTAL	6F7F - TORRANCE CENTER	11	3	0.27
Sep13	6F5 - SN FERNANDO VL	6F5V - SIMI VALLEY CENTER	10	3	0.30
Oct12	6F2 - SAN GABRIEL VL	6F2F - EL MONTE CENTER	12	4	0.33
Feb10	6F2 - SAN GABRIEL VL	6F2V - ROWLAND HEIGHTS CENTER	3	1	0.33
Sep10	6F2 - SAN GABRIEL VL	6F2V - ROWLAND HEIGHTS CENTER	6	2	0.33

Table 3 indicates the population of interest (POI) available for recruiting and the number of recruits per battalion. Tables 4 and 5 show the P2P data for FY14. The red status identifies the battalions that fail to recruit at least 75% of the demographics of their recruiting areas. Concurrently, the yellow status shows the amount of recruits generated between 75 and 99%, and the green status the P2P the ones above 100%. Also, as seen in the tables, the only ethnicities that do not match their demographics populations are the Hispanics and the Native-Americans. The Hispanic numbers have two battalions that do not conform to the P2P criteria resulting, in average, with less Hispanic recruits in proportion with their recruiting POIs. The Seattle Recruiting Battalion (BN) generates less Native recruits than they should. In other words, all the battalions having metrics of green status are matching their P2P metrics.

Table 3. 6th REC BDE Population of Interest and Number of Recruits per Battalion

6th Recruiting Brigade - All Battalions		TOTAL POPULATION OF INTEREST	TOTAL NUMBER ENL
CODE	BN NAME		
6F	LOS ANGELES	1,829,134	2,115
6H	PORTLAND	875,464	1,629
6I	SACRAMENTO	1,179,720	2,136
6J	SALT LK CITY	1,236,234	1,850
6K	SOUTHERN CAL	2,037,937	2,782
6L	SEATTLE	1,231,081	1,936
6N	FRESNO	1,866,489	2,122

Table 4. Personnel-to-population African-American, Hispanics, and White Populations for the 6th REC BDE

6th Recruiting Brigade - All Battalions		AFRICAN_AMERICAN					HISPANIC					WHITE				
CODE	BN NAME	AA POP	ENL	% POP	% ENL	P2P	H POP	ENL	% POP	% ENL	P2P	W POP	ENL	% POP	% ENL	P2P
6F	LOS ANGELES	149,839	227	8.19%	10.73%	1.31	989,411	1,007	54.09%	47.61%	0.88	438,464	419	23.97%	19.81%	0.83
6H	PORTLAND	17,824	72	2.04%	4.42%	2.17	119,363	89	13.63%	5.46%	0.40	539,900	763	61.67%	46.84%	0.76
6I	SACRAMENTO	65,592	173	5.56%	8.10%	1.46	351,065	399	29.76%	18.68%	0.63	624,376	1,278	52.93%	59.83%	1.13
6J	SALT LK CITY	48,679	152	3.94%	8.22%	2.09	241,802	261	19.56%	14.11%	0.72	859,890	1,268	69.56%	68.54%	0.99
6K	SOUTHERN CAL	104 754	294	5.14%	10.57%	2.06	985 624	1 153	48.36%	41.45%	0.86	703 806	1 004	34.54%	36.09%	1.04
6L	SEATTLE	46,769	193	3.80%	9.97%	2.62	159,746	181	12.98%	9.35%	0.72	866,280	1,259	70.37%	65.03%	0.92
6N	FRESNO	104,294	205	5.59%	9.66%	1.73	789,770	706	42.31%	33.27%	0.79	635,385	842	34.04%	39.68%	1.17

Table 5. Personnel-to-population for Asians and Pacific Islanders and Native-Americans for the 6th REC BDE

6th Recruiting Brigade - All Battalions		ASIAN PACIFIC ISLANDER					NATIVE AMERICAN				
CODE	BN NAME	API POP	ENL	% POP	% ENL	P2P	NA POP	ENL	% POP	% ENL	P2P
6F	LOS ANGELES	248,628	459	13.59%	21.70%	1.60	2,792	3	0.15%	0.14%	0.93
6H	PORTLAND	191,349	693	21.86%	42.54%	1.95	7,028	12	0.80%	0.74%	0.92
6I	SACRAMENTO	126,722	257	10.74%	12.03%	1.12	11,965	29	1.01%	1.36%	1.34
6J	SALT LK CITY	65,403	132	5.29%	7.14%	1.35	20,460	37	1.66%	2.00%	1.21
6K	SOUTHERN CAL	236,618	321	11.61%	11.54%	0.99	7,135	10	0.35%	0.36%	1.03
6L	SEATTLE	118,935	271	9.66%	14.00%	1.45	39,351	32	3.20%	1.65%	0.52
6N	FRESNO	330,664	352	17.72%	16.59%	0.94	6,376	17	0.34%	0.80%	2.35

B. INFERENTIAL STATISTICS METHODS

Chapter III explains the method used to test the hypothesis claiming that "additional language qualifications of recruiters improve the overall mean of the fill-to-demand ratios." The fill-to-demand ratio is the metric under observation in that chapter. The hypothesis-test process begins, first, identifying two set of samples to compare *the mean of the fill-to-demand ratios* in order to determine whether the language-to-recruiter ratios, throughout the 6th REC BDE's companies, increase the fill-to-demand metric. The methodology uses a statistical model to show whether recruiting centers that have recruiters with secondary languages meet their fill-to-demand ratios at a higher rate of mission success than those recruiting centers with less recruiters with additional languages.

Second, if this statistical analysis is successful, showing that recruiters with secondary language skills succeed in recruiting at a higher rate, a *data envelopment analysis* will be used in Chapter IV to determine the efficiency of the current recruiting companies based upon a predetermined set of inputs and outputs.

Third, this research also implements analysis of variances (ANOVA) to examine whether specific recruiter languages improve recruitment. The purpose of the ANOVA is to additionally assist the 6th REC BDE in the decision-making process by comparing multiple fill-to-demand ratios and by determining the effectiveness of recruiters who possess Spanish, Tagalog, Chinese, and Korean as second languages to maximize recruiting throughout its companies. The identification of the recruiting company locations where the different recruiters' languages are present provide a statistically significant advantage or disadvantage toward the effectiveness of the fill-to-demand ratios, and help to maximize recruitment for Hispanics, Asians and Pacific Islanders (API) in all of the regions where those languages prevail.

The last test performed in the analysis is a test of hypothesis *for comparing large-sample mean proportion*s, which analyzes whether the number of recruiters matching a particular population language play a role that can be statistically tested and proven. This hypothesis test analyzes how the recruiters within each language type contribute in increasing or decreasing the overall efficiency represented as the mean of the fill-to-demand ratios.

These four methods use measures such as the available demographic populations in a given region, the type of the recruiter languages, the fill-to-demand ratio, and the P2P metrics in ways to measure their correlation in drawing mission success. Such measures and the implementation of statistical inferences allows us to make better conclusions on whether the specific type of languages yields a different correlation; to know that recruiters with a given language also tend to produce higher fill-to-demand ratios in specific company regions.

C. RESEARCH IMPORTANCE

This research addresses three important questions to enable the 6th REC BDE to improve its recruiting mission throughout. Does the recruiters' additional language have a statistically significant effect on the recruiting mission? If the effect is significant, where are those recruiters needed, and in which locations are the recruiting missions maximized by this phenomenon? How significant would it be to allocate recruiters with Spanish, Tagalog, Chinese, and Korean as second-language capabilities in areas where those languages prevail? The current drawdown plan requires a force reduction in active Army personnel from 513,800 soldiers down to 510,000 this year. The projections are to gradually continue decreasing the active force by an additional 70,000 soldiers by 2019.[5] Therefore, it is reasonable to ask whether the loss of recruits will bring greater or less diversity and whether more stringent intellectual requirements will benefit one ethnic group more than another.

The repeal of the Don't Ask Don't Tell policy, in 2011, paved the way for the DOD to holistically embrace diversity. As evidence, the DOD released the Human Goals Charter, signed in April 28, 2014, reaffirming the DOD's commitment to diversity, inclusion, and fairness as a goal that is essential to the DOD's mission success.[6] While a diverse force is needed, government reports also say that only 25 percent of the POI qualifies to serve due to academic, health, or legal standards for applications.[7] This latent statistic makes the recruiting mission more complex. The DOD's leaders favor the AVF as the effective model to maintain a diverse force for decades to come;[8] nevertheless, the declining pool of eligible candidates makes imperative the need to adapt these conditions to more comprehensive initiatives.

The U.S. Army's Recruiting Command thoroughly tracks the ethnicity ratio to identify whether existing ethnic groups are equally, under-, or over-represented. Army recruiters are challenged with enlisting qualified prospects coming from minority communities where the prevailing languages are other than English. However, the 6th REC BDE lacks a study that enables it to determine where to maximize the recruiting mission based on the recruiter language skillsets. The analysis will ultimately benefit the U.S. Army as well as the 6th REC BDE with the largest recruiting mission in the country.

---

[5] David Vergun, "Senior Leaders Explain Army's Drawdown Plan," *Army News Service*, July 24, 2014, http://www.army.mil/article/130534/Senior_leaders_explain_Army_s_drawdown_plan.

[6] Department of Defense (DOD), *2014 Human Goals Charter* (Washington, DC: DOD, 2014), http://www.defense.gov/documents/DOD-HumanGoals_4-28-14.pdf.

[7] Donna Miles, "Officials Urge Congress to Protect Recruiting, Retention Incentives," *American Force Press*, March 3, 2009, http://www.defense.gov/news/newsarticle.aspx?id=53310.

[8] Bernard Rostker, *I Want You!: The Evolution of the All-Volunteer Force* (Santa Monica, CA: RAND Corporation, 2006), 756.

D. LITERATURE REVIEW

Besides accounting for cultural diversity there are several arguments about who, in general, is likely to enlist in the military. The sustainability of manpower is based on how the U.S. military provides competitive salaries, bonuses, and huge educational benefits.[9] Some military leaders, such as retired Major General (MG) Dennis Laich, with decades of experience in managing human capital, criticizes the actual AVF policy and believes the compulsory draft is the best option to establish a proportional demographic in the shortest time. In the article "Why Ending Volunteer Service Is the Next Fight for Military Equality," Laich argues that the draft option will maximize the likelihood to project long-term financial stability.[10] Laich, in his book *Skin in the Game: Poor Kids and Patriots*, illustrates how the cost of a large army, created by the AVF, is financially unsustainable and provides evidence that by 2039, personnel costs will consume the entire defense budget.[11] Laich asserts that the compulsory draft maintains an optimal social representation, which sends a message to those who feel that wealthy citizens—the ones who benefit the most from the democracy—are less likely to serve. Laich also argues that those who benefit the most from society should volunteer more in its defense.[12] This economic argument can be one of the intervening variables to study more in depth in a future work along with the minority group trends.

The subject of redefining recruiting missions in terms of recruiter language capabilities has not been addressed in many scholarly sources. However, there are many sources that address the impact of ethnic diversity on the military. The following sources are useful as they provide case studies dealing with optimization models, government planning and implementation, recruiting market comparisons, and U.S. military education

---

[9] Rostker, *I Want You!*, 754.

[10] Zeke Stokes, "Op-ed: Why Ending Volunteer Service Is the Next Fight for Military Equality." *Advocate.com*, October 16, 2013, http://www.advocate.com/commentary/2013/10/16/op-ed-why-ending-volunteer-service-next-fight-military-equalityPost.

[11] Ibid.

[12] Kathy Roth-Douquet and Frank Schaefer, *AWOL* (New York: HarperCollins, 2006), 11.

on foreign language and cultures. Other sources that relate to POI include demographic reports and population studies.

Michael J. Teague provides a method for recruiting station allocation. Although it neither addresses ethnic diversity nor the language of recruiters, this study shows a valuable case for determining the optimal number of recruiting stations in order to maximize the annual number of recruits for the regular Army (RA) and the United States Army Reserve (USAR).[13] Teague addresses the improvement of the recruiting mission in the Albany BN with the intent of applying its findings to the rest of the continental United States (CONUS). One of Teague's main assumptions was that potential recruiting locations had already been chosen and a drawdown was in effect, which might lead to a base realignment and closure (BRAC) in which recruiting stations could be closed. The data from the zip codes within the Albany region provided propensity variables for calculating the expected number of recruits. The objective functions have three variables: the propensity according to demographic and economic factors in each of the zip codes, the distance of each zip code to its assigned stations and historical data that provided the amount of time the recruiters spent in each zip code. The model was formulated as a non-linear integer programming problem to iterate through all the possible alternatives. Other binary variables within the objective function were assigned to allow the program to select whether the potential stations remained open or closed. After running all the possible alternatives, the program identified the maximum amount of recruits for the RA and the USAR and the suggested stations that needed to remain open to achieve that maximum amount of recruits. Although economic and historical data was used in this study, it lacked an account of language skills as a key variable in improving the fill-to-demand ratio.

Major George F. McGrath's thesis, "Email marketing for U.S. Army and Special Operations Forces (SOF) Recruiting" analyzed four prospecting strategies to recruit soldiers: telephone, referral, face-to-face, and Internet or email prospecting. The main

[13] Michael J. Teague, "An Optimal Allocation of Army Recruiting Stations with Active and Reserve Recruiters" (master's thesis, Naval Postgraduate School, 1994), 13.

purpose of McGrath's study focuses on demonstrating the efficiency of email prospecting in comparison to phone prospecting. Drawing on data as a former company commander, McGrath's mathematical models deploy from the time spent to call or email prospects during FY06, included associated costs and productivity estimates. McGrath calculates an estimated return on investment (ROI) in case the U.S. Army decides to use an email marketing service for recruiting. The equations in the model were graphed to layout the domains and identify the points in which the decision variables yield. McGrath's study was very useful for this research because it demonstrates mathematically and graphically how to set up objective and constraint functions, as an example of maximizing or minimizing decision variables within a model.

Carol Stoker and Stephen Mehay present a comparative analysis of marketing and advertising strategies that have been developed in four AVF nations in response to recruiting, advertising and marketing challenges.[14] Among the challenges, the specific issues that relate to the main topic of this research are the trend in language impediments for recruiters in recruiting native aborigines—who are some of the fastest-growing minorities—in Canada, Australia, the United Kingdom, and the United States. It also provides information from the minorities' perception toward their military organizations, the minorities' representation in each nation's military and the impact in military recruiting from significant population changes within minorities. The study centers around four major areas that indirectly relate to this study: Assessing social, demographic, and economic factors in each nation; discussing the structure of each nation's recruiting organization and its strategy development process; documenting various recruiting, marketing, and advertising initiatives in each nation; and examining efforts to evaluate the effectiveness of specific marketing initiatives.

Sterilla A. Smith's article, "Army Culture and the Foreign Language Program" emphasizes the continuous need of the Army for culturally aware personnel who have foreign language proficiency to conduct full-spectrum operations and meet current and

[14] Carol Stoker and Stephen Mehay, *Recruiting, Advertising, and Marketing Strategies in All-Volunteer Force Nations: Case Studies of Canada, Australia, the Unites Kingdom, and the United States* (NPS-GSBPP-12-005) (Monterey, CA: Naval Postgraduate School, 2011), 65.

future challenges throughout the world.[15] Smith discusses the Army's holistic strategy to sustain the education of culture and foreign languages at all levels, from new entry soldiers up to career soldiers, officers, trainers and advisors. It is important to provide Army recruiters these kinds of opportunities to improve their abilities to identify and recruit prospects from other cultures.

Historically, data has shown how ethnic trends provide insight into the balance of diversity. According to Richard L. Fernandez, in his 1987 congressional article, 60% of soldiers were volunteers who came from disadvantaged economic classes. They came from the bottom half of the income distribution of the median family incomes.[16] Fernandez states, in a following book, that in 1996 the numbers of African-American recruits reflected a historical representation of the overall propensity of the general youth to join the Army during the first 20 years of the AVF policy. More importantly, analyzing the percent of African-American recruits versus the family income in 1987 showed that the active-duty African-American male recruits followed an inverted U-shape, or a normal distribution pattern. The percentage of recruits versus income was distributed in six categories ranging within zero to $27,400 per year.[17] It is reasonable to say that in 1987 the probability of African-Americans joining the Army continually increased to approximately $16,000 family income per year and then continually decreased as the median of family income increased.

The recruiting trends of African-American youth helped predict the recruitment propensity in relation to existing family income and the probability to join the Army for high-qualified high school graduates in 2007.[18] That information was valuable to identify

[15] Sterilla A. Smith, "Army Culture and Foreign Language Program," *Military Intelligence Professional Bulletin* 38, no. 1 (January-March 2012), 3.

[16] Richard L. Fernandez, *Social Representation in the U.S. Military* (CBO Publication #499) (Washington, DC: Congressional Budget Office, 1989), http://www.cbo.gov/sites/default/files/89-cbo-044.pdf.

[17] Richard L. Fernandez, "Social Representation in the Military: A Reassessment," in *Professionals On the Front Line: Two Decades of the All-Volunteer Force*, ed. J. Eric Fredland et al. (Washington, DC: Brassey's), 228.

[18] Beth J. Asch, Paul Heaton, and Bogdan Savych, *Recruiting Minorities: What Explains Recent Trends in the Army and Navy?* (Santa Monica, CA: RAND), 26.

future trends and anticipate problems in manpower. Asch, Heaton, and Savych mention an important fact that, by analyzing the over-representation projection, even when the Hispanic recruits compensated for black recruits, the real problem of attracting more whites and population from the higher-income strata was still unresolved.[19] The scores of the Armed Services Vocational Aptitude Battery (ASVAB) for high school graduates in 1987 showed that the African-American recruits out-enlisted whites by 2:1, even when the whites passed the ASVAB in numbers that tripled those of African-Americans eligible to join the Army.

Fernandez asserts the importance of following recruiting trends for African-Americans more closely. The propensity to join was dependent upon the economic resources and race, because for every 10 recruits, approximately seven were African-American, and three were white.[20] The African-American over-representation decreased during 1987 to 1992, but Hispanic recruits filled that void after showing a marked increase in recruits. The trends during the decade of 2000 to 2010 showed the same trend as the 1980s. Today, African-Americans are still over-represented, but it continues to gradually decrease.

The fact that the recruiting trends during the last decade, still maintained by Hispanics, other minorities and non-citizens, result in a positive tendency for recruiting. However, here are scholars arguing that the increased recruiting rate of change, shown by minorities, is decreasing due to the negative impact of long wars during the past decade. Evidence shows that the higher numbers of soldiers deploying are reasonably starting to take its toll.[21] Nevertheless, these arguments suggest that minorities are still a recruiting multiplier—to be highly considered—when analyzing recruiting propensity.

---

[19] Fernandez, "Social Representation in the Military," 239.

[20] Ibid., 230.

[21] Asch, Heaton, and Savych, *Recruiting Minorities*, 84.

E. THE USE OF CURRENT DEMOGRAPHIC DATA

The 2010 Census was used to complement the data production numbers provided by the 6th REC BDE. The U.S. Census Bureau data shows that minority population growth is concentrated in counties in the Pacific Northwest, Pacific Southwest, western Arizona, southern Nevada, and areas of the interior West, which are precisely the areas where the 6th REC BDE operates.[22] The success of identifying qualified potential recruits in these states is directly related to the variety of languages spoken by recruiters and their understanding of the cultural backgrounds that predominate in the most populated minority areas. For this project, the POI has been categorized as the youth population between 17 to 29 years old. Army recruiters have access to pertinent information about the qualifications of high school students and frequently use market research analysis from private companies to identify the zip codes where higher qualified prospects are found. Language is an additional variable to reach those qualified prospects. The U.S. Census showed that the spoken languages at home other than English have a percentage increased from 1980 to 2010 by 232.8% for Spanish, by 345.3% for Chinese, by 327.1% for Korean, and by 231.9% for Tagalog.[23] These facts reasonably suggest that a higher density of these types of families can be located by zip code, using the data from the census, and the recruiters can potentially use a secondary language to help them better influence and bond with prospects from these populations that predominately speak other languages. It also suggests that in those cases when recruits come from non-English speaking families whose parents do not speak or are not fluent in English, recruiters create favorable conditions by communicating with parents and establishing ties of communication.

---

[22] Karen R. Humes, Nicholas A. Jones, and Roberto R. Ramirez, *Overview of Race and Hispanic Origin: 2010* (Washington, DC: United States Census Bureau, 2011), 22, http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf.

[23] Camille Ryan, *Language Use in the United States: 2011* (Washington, DC: United States Census Bureau, 2013), 7, http://www.census.gov/prod/2013pubs/acs-22.pdf.

F. RESEARCH HYPOTHESIS

Inferential statistics often use hypothesis statements to test whether there is a difference between samples from a data set. The first step of this study is to validate the expectation that recruiters with at least one additional language increase the fill-to-demand ratio. This important step pursues a more in-depth analysis in conjunction with the other subsequent methods of data envelopment analysis (DEA), and additional optimization models.

A null hypothesis is a debatable statement that claims whether samples from a given data-set are or are not equal. In this research, two samples are categorized by their corresponding percentages of recruiters with an additional language—called languages-to-recruiter ratio. The recruiting centers that have a percentage of recruiters greater or equal than the battalion’s language-to-recruiters average ratio comprise one sample set. The centers with lower than the average languages-to-recruiter ratio comprise the second sample set. The null hypothesis claims that the fill-to-demand ratio is the same or lower for centers with higher language-to-recruiter ratios while the alternative hypothesis is that the sample with the higher language-to-recruiter ratios will have the greater fill-to-demand ratios than the sample with lower language-to-recruiter ratios.

THIS PAGE INTENTIONALLY LEFT BLANK

II. METHODOLOGY AND MODELS

This research employs inferential statistics through hypothesis-testing criteria. To analyze the data statistically we begin by computing the fill-to-demand ratio for all the recruiting centers. Are recruiting centers with above average language-to-recruiter ratios more effective than those with below average? The data for the hypothesis-testing encompasses the fill-to-demand ratios generated during the last five fiscal years in which more than 55,000 recruits have joined the U.S. Army and the USAR through battalions of the 6th REC BDE. The demand is the number of recruits required on a monthly basis by each battalion from its subordinate recruiting centers to accomplish the overall recruiting mission.

The 6th REC BDE has seven battalions and 50 companies in which each has five to eight recruiting centers. Appendix A displays the lists and maps of all the recruiting centers in each battalion. In statistics, hypothesis-testing is a method used to make inferences in order to compare two sample means. In this case, hypothesis-testing involves the comparison of the productivity of two samples of recruiting centers. First, the average of recruiters who have an additional language is computed as the battalion's average language-to-recruiters ratio. The second step assigns membership of each recruiting center to either Sample 1 or 2. That battalion's average is used to identify the recruiting centers that are above or below the average language-to-recruiters ratio when compared to the resulting battalion average. Therefore, Sample 1 comprises all recruiting centers whose number of recruiters with secondary language skill is less than the overall battalion average, and Sample 2 comprises all recruiting elements whose number of recruiters with secondary skill is greater than or equal to the battalion's average.

A. STATISTICAL ANALYSIS AND HYPOTHESIS-TESTING

The two samples mean hypothesis-testing uses the fill-to-demand ratios of Sample 1 and Sample 2 to calculate two sets of means and standard deviations.

The formulas to test the hypotheses are defined by these basic assumptions for the two samples.[24] We define the sample means $\overline{x}$ and $\overline{y}$ with their respective standard deviations $S_x{}^2$ and $S_y{}^2$ as follows:

1. $x_1, x_2, x_3 \ldots x_m$ represent the fill-to-demand ratios of each center in Sample 1 with mean $\overline{x}$, and variance $S_x{}^2$.
2. $y_1, y_2, y_3 \ldots y_n$ represent the fill-to-demand ratios of each center in Sample 2 with mean $\overline{y}$, and variance $S_y{}^2$.
3. The fill-to-demand ratios for Sample 1, represented by x, and Sample 2, represented by y, are independent.

For our hypothesis test, the null hypothesis (H_O) claims that the means are the same, or higher language-to-recruiter ratios actually makes things worse, which is commonly represented using the formula $\mu_x - \mu_y \leq 0$. The alternative hypothesis ($\mathrm{H}a$) is significant as it establishes the rejection region in the lower and higher tail of a normal type distribution. The rejection regions formulas for the lower and higher tail are $\mu_x < \mu_y$ for the lower, and the higher tail formula is $\mu_x > \mu_y$. The formulation of the null and alternative hypothesis test is as follows:

[24] Jay L. Devore, *Probability and Statistics: For Engineering and the Sciences*, 6th ed. (Belmont, CA: Brook/Cole, 2004), 317.

H_O: Are the means of Sample 1 and Sample 2 the same, or Sample 1 worst?
In other words, does μ_x-μ_y ≤ 0?

Ha: The options for alternative hypotheses contradict the null with either claiming that:

1) The samples are different, formulated as μ_x-μ_y $\neq 0$.
2) The fill-to-demand ratio $\overline{x}$ of Sample 1 is higher than $\overline{y}$ of Sample 2, formulated as $\mu_x > \mu_y$.
3) The fill-to-demand ratio $\overline{y}$ of Sample 2 is higher than $\overline{x}$ of Sample 1, formulated as $\mu_x < \mu_y$.

The respective rejection regions to use when alternative hypotheses claim
to reject the null hypothesis are shown in Figure 1:

1) The formulation t < $|t_\alpha|$ for a level α test represents the rejection regions when samples are different.
2) The t < t_α represents rejection region in the lower tail test $\mu_x > \mu_y$.
3) The t > t_α represents rejection region in the higher tail test $\mu_x < \mu_y$.

Test Statistic :

$$t = \frac{\overline{x} - \overline{y}}{\sqrt{\frac{S_x^2}{m} + \frac{S_y^2}{n}}}$$

The hypothesis-testing has two decision variables: the rejection region α and the test statistic t. The rejection regions are identified where the calculated t_α falls along the t-axis as displayed in Figure 1. The test statistic computation decides whether the decision to reject the H_O. The means, $\overline{x}$ & $\overline{y}$, with their respective standard deviations, ${S_x}^2$ & ${S_y}^2$, are used to compute the test statistic t for each battalion. Therefore, the rejection of the H_O occurs if, and only if, the computed t falls within the rejection region. The rejection region α has a total shaded area of 0.01 or 0.05.

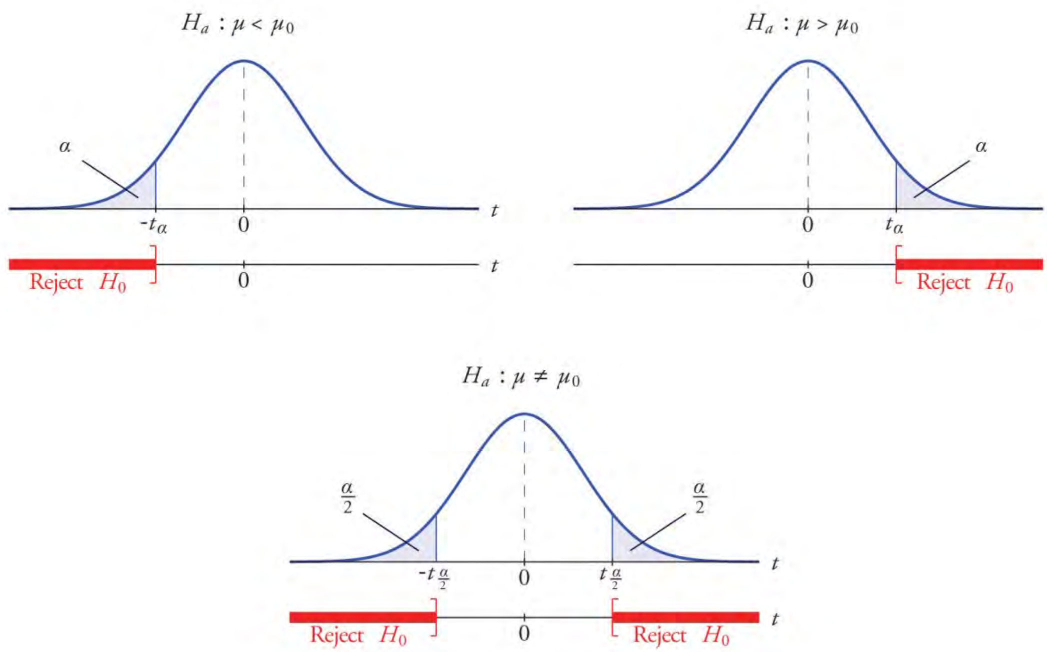


Figure 1. α, t_α, and rejection areas illustrated when $\mu_x < \mu_y$, $\mu_x > \mu_y$, and $\mu_x - \mu_y \leq 0$[25]

An important aspect of the test is the level of significance α. The α value is defined as the smallest level of significance at which the H_O would be rejected when a specified test procedure is used on a given data set. The p-value which is the respective shaded area associated with the location of t within its axis. The upper right diagram in Figure 1 uses an upper tail test. In other words, the only way for the shaded area—the α-value—to be 0.05 is when t lies at 1.664. The upper left diagram uses the lower tail test approach with a value of $-t_{0.05}$ equals to -1.664. When computing the test statistic t using the lower tail test, if the value is lower than –1.664, then the rejection of the H_O occurs. The H_O is rejected when the α-value is less than 0.05, and otherwise the decision is to reject the H_O in favor of the Ha claim. A rejection of the H_O provides grounds to suggest that the Ha is statistically significant.

[25] University of California, Davis StatWiki, "8.4 Small Sample Tests for a Population Mean," http://statwiki.ucdavis.edu/Under_Construction/Testing_Hypotheses/8.4_Small_Sample_Tests_for_a_Population_Mean.

B. DATA ENVELOPMENT ANALYSIS AND BACKGROUND

Data envelopment is a method for comparing the relative efficiency of competing organizational units or producers. In other words, the efficiency approach evaluates each producer or decision-making unit (DMU) relative to the average producer. Efficiency is calculated by analyzing a set of inputs that produces a set of outputs, in this case in a scale from zero to one. The data envelopment's results compare each DMU in efficiency order assigning 1.00 to the most efficient DMU among the others.[26] In contrast, it is inefficient if the total value of its outputs is less than the total values of its inputs. For example, a producer A is capable of attaining *Y(A)* outputs with *X(A)* inputs. Therefore, the branch is efficient if the total value of its outputs is greater than or equal to the total value of its inputs.

In the broadest sense, the intent of using dependent and independent variables in both inputs and outputs, adjusts the model to the reality of the recruiting operation. In general, the recruiting leadership can control the number and the languages of the recruiters they assign to any station, but not their performances and whether the different demographic populations decide to enlist in the Army.

Demographics play an important role for the DEA method. Demographics in the western U.S. are unique compared to the rest of the country. The ethnic distribution throughout the United States for the Army since 2003 shows that, on average, about two-thirds (64.3%) of recruits come from whites followed by African Americans, Hispanics and API, in that order.[27] The fact that the ethnic pattern varies greatly in the western of the United States makes these differences a unique challenge for the 6th REC BDE; the majority of its POI comes from a variety of minority groups.[28] Therefore, the marked demographic differences among all the ten states under the 6th REC BDE's area of

---

[26] Cliff T. Ragsdale, *Spreadsheet Modeling & Decision Analysis*, 4th ed. (Mason, OH: Thomson South-Western, 2004), 107.

[27] U.S. Army Recruiting Command, G7/9 - Marketing, Education and Outreach, "U.S. Army Recruiting Command Goals," last modified December 4, 2013, http://www.usarec.army mil/hq/apa/goals.htm.

[28] Humes, Jones, and Ramirez, *Overview of Race*, 22.

responsibility prevent it from adopting a monolithic approach as it should if the demographics are to be as homogeneous as it reflects throughout the United States.

The analytic approach to improving recruiting needs to consider the propensity of the minorities, as well as the diverse economic, cultural, and social constraints that each state has. Figure 2 shows the vast majority of Hispanics (55%), a considerably high API population (20%), and less dense white and African-American populations throughout the 6th REC BDE. Therefore, the reason to select the ethnic ratios as an important input variable in the data envelopment method is based on the marked ethnic differences that prevail in most parts of the western region.

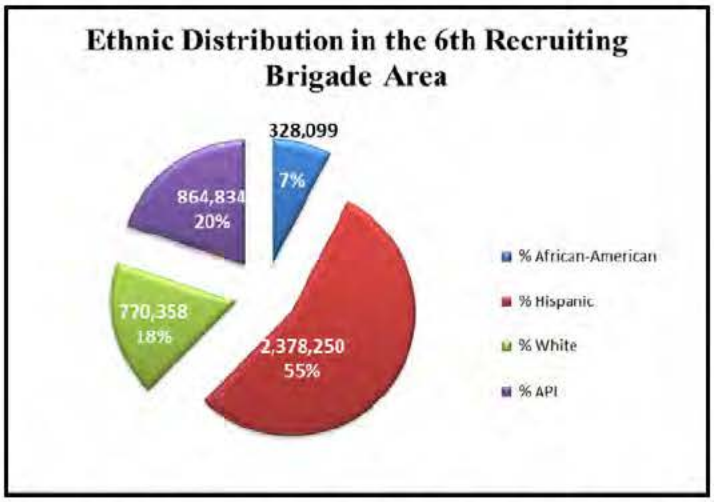


Figure 2. 6th REC BDE Ethnic Distribution within its Population, as of February 2014. (Provided by U.S. Army's 6th Recruiting Brigade)[29]

The U.S. Army Recruiting Command reports that during FY13 in the United States 49.2% of the recruits were whites, 24.9% African-Americans, 19.1% Hispanics, 6.2% and 0.6% were APIs and Native-Americans, respectively. A significant difference when compared with the demographics of the 6th REC BDE's region.

[29] 6th Recruiting Brigade, "P2P Combined thru February 2014," (Worksheet), 2014.

The data envelopment method uses the following linear programming formulation to calculate its efficiencies. The description of the DEA parameters, the *X (A)* inputs, and the *Y (A)* outputs are explained as:

Indices:

c assigns a number to each company c

i assigns non-negative inputs *i*, where *i* represents the population of interest available for recruiting, and the total number of recruiters within each company region during FY14.

o assigns non-negative outputs *o*, where *o* represents fill-to-demand ratios accrued by each company *c* during FY14 and the percentage of recruiters out of the #Recruiters with an additional language per company.

The coefficient inputs are defined as follows:

$X_{c,\,input\ 1}$ = %*API* represents the population percentage of the available Asians and Pacific Islanders (API) for each company *c*.

$X_{c,\,input\ 2}$ = %*AA* represents the population percentage of the available African-Americans (AA) for each company *c*.

$X_{c,\,input\ 3}$ = %H represents the population percentage of the available Hispanics (H) for each company *c*.

$X_{c,\,input\ 4}$ = % Native represents the population percentage of the available Native Americans for each company *c*.

$X_{c,\,input\ 5}$ = % W represents the population percentage of the available whites (W) for each company *c*.

The coefficient weights of input 6 use integer values and it is defined as follows:

$X_{c,\,input\ 6}$ = #Recruiters represents the total number of recruiters assigned to each company *c*.

For example, $X_{1,\ input\ 1}$ represents the percentage of the available Asians and Pacific Islanders for Company #1.

The description of the $Y(A)$ outputs are as follows:

$Y_{c,\ output\ 1}$ = %Filled represents the fill-to-demand ratios accrued for each company *c* during the last five FYs.

$Y_{c,\ output\ 2}$ = %Language represents the language-to-recruiters ratio per company *c* during the last five FYs.

The data sets have six inputs described with variable *i*=6, and two outputs described by variable *o*=2, and the 42 companies in which its efficiencies will be analized can be described as $DMU_1,\ DMU_2,\ ...,\ DMU_c,$ where $c = 42$.

$X(A)$ Inputs Matrix

$$\begin{bmatrix} X_{1,\ input\ 1} & X_{1,\ input\ 2} & \cdots & X_{1,\ input\ i} \\ X_{2,\ input\ 1} & X_{2,\ input\ 2} & \cdots & X_{2,\ input\ i} \\ \vdots & \vdots & & \vdots \\ X_{c,\ input\ 1} & X_{c,\ input\ 2} & \cdots & X_{c,\ input\ i} \end{bmatrix}$$

$Y(A)$ Ouputs Matrix

$$\begin{bmatrix} Y_{1,\ output\ 1} & Y_{1,\ output\ o} \\ Y_{2,\ output\ 1} & Y_{2,\ output\ o} \\ \vdots & \vdots \\ Y_{c,\ output\ 1} & Y_{c,\ output\ o} \end{bmatrix}$$

The indices to determine the efficiency for each DMU_c are as follows:

Let $w_1,\ w_2,\ \dots\ ,w_i$ be the set of decision variables of inputs into each $DMU_1,\ DMU_2,\ \dots\ ,DMU_c$ and $t_1,\ t_2$ the corresponding decision variables of the outputs.

Let $W_{1,1},\ \dots\ ,W_{c,i}$ be the set of coefficient vectors for each input $X_{1,1},\ \dots\ ,X_{c,i}$ and let $T_{1,1},\ \dots\ ,T_{c,o}$ be the set of coefficient vectors for each set of of outputs $Y_{1,1},\ \dots\ ,Y_{c,\text{o}}$.

The value of each constraint for the set of inputs $W_1,\ W_2,\ \dots\ ,W_c$ is as follows:

$$\begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_c \end{bmatrix} = \begin{bmatrix} W_{1,1} & W_{1,2} & \cdots & W_{1,i} \\ W_{2,1} & W_{2,2} & \cdots & W_{2,i} \\ \vdots & \vdots & & \vdots \\ W_{c,1} & W_{c,2} & \cdots & W_{c,i} \end{bmatrix} \times \begin{bmatrix} w_{1,1} \\ w_{2,1} \\ \vdots \\ w_{c,i} \end{bmatrix}$$

The value of each constraint for the set of outputs $T_1,\ T_2$ is as follows:

$$\begin{bmatrix} T_1 \\ T_2 \\ \vdots \\ T_c \end{bmatrix} = \begin{bmatrix} T_{1,1} & T_{1,2} & \cdots & T_{1,i} \\ T_{2,1} & T_{2,2} & \cdots & T_{2,i} \\ \vdots & \vdots & & \vdots \\ T_{c,1} & T_{c,2} & \cdots & T_{c,i} \end{bmatrix} \times \begin{bmatrix} t_{1,1} \\ t_{2,1} \\ \vdots \\ t_{c,i} \end{bmatrix}$$

The data envelopment will calculate which of the companies, in this case $DMU_1,\ DMU_2,\ \dots\ ,DMU_c$, are more efficient when compared to the others.

The linear formulation to implement the solutions of the *DMUs* is as follows:

Objective Function:

$$\text{Max} \quad DMU_1, DMU_2, \ldots, DMU_c$$

Subject to:

Constraint 1: $\begin{bmatrix} W_1 \\ \vdots \\ W_c \end{bmatrix} - \begin{bmatrix} T_1 \\ \vdots \\ T_c \end{bmatrix} >= 0$; limits the resource of outputs to that of inputs

Constraint 2: $\begin{bmatrix} DMU_1 \\ \vdots \\ DMU_c \end{bmatrix} - \begin{bmatrix} T_1 \\ \vdots \\ T_c \end{bmatrix} = 0$; the efficiencies cannot be more than the output values

Constraint 3: $\begin{bmatrix} DMU_1 \\ \vdots \\ DMU_c \end{bmatrix} <= 1$; limits the efficiency to values less than or equal to 1

Constraint 4: $\begin{bmatrix} w_1 \\ \vdots \\ w_i \end{bmatrix} \geq 0.001$; limits the input decision variables to values greater than zero

Constraint 5: $\begin{bmatrix} t_1 \\ t_2 \end{bmatrix} > 0.001$; limits the output decision variables to values greater than zero

Constraint 6: $\begin{bmatrix} X_{1,\,input\ 1} & X_{1,\,input\ 2} & X_{1,\,input\ 3} & \cdots & X_{1,\,input\ i} \\ X_{2,\,input\ 1} & X_{2,\,input\ 2} & X_{2,\,input\ 3} & \cdots & X_{2,\,input\ i} \\ \vdots & \vdots & \vdots & & \vdots \\ X_{c,\,input\ 1} & X_{c,\,input\ 2} & X_{c,\,input\ 3} & \cdots & X_{c,\,input\ i} \end{bmatrix} \times \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_i \end{bmatrix} = 1$;

the multiplication of the input coefficients and decision variables must equal 1

Using the notation above, the data envelopment maximizes the efficiency of a single vector $\text{DMU}_1, \ldots, \text{DMU}_c$ as a ratio of weighted inputs to outputs. In other words, the DMU values indicate how efficiently a company has transformed the inputs—the available populations and recruiters—into higher fill-to-demand and language-to-recruiter ratios when compared to other companies. Having a result of 1.00 represents a

100% efficiency within the used criteria. All the sets of constraints work to limit the DMU's objective function for competing companies to values greater than or equal to zero and less than or equal to 1.00. By using the matrix of weighted inputs $[W_1, ..., W_c]^T - [T_1, ..., T_c]^T$ constraint 1 ensures the results are greater or equal to zero. Similarly, constraint 2 forces matrix vectors $[DMU_1, DMU_2, \dots, DMU_c]^T - [T_1, T_2 ..., T_c]^T$ equal to zero. The set of decision variables $w_1, w_2, \dots, w_c$ and the set t_1, t_2, are embedded in the input and output formulas, and allow the decision variables to be part of the objective and constraint formulations. $DMU_1, DMU_2, \dots, DMU_c$ is another decision variable that is embedded in constraints 2 and 3. Constraints 4 and 5 also limit the values of the DMU_c to range between zero and 1.00.

C. ANALYSIS OF VARIANCE TEST

The ANOVA test examines the relationship between one or more numerical and categorical variables. In general, ANOVA is used to test the null hypothesis that several means are the same, against an alternative hypothesis that at least one mean is different. In this case, the ANOVA analyzes the significance between the different ethnical population distributions and the fill-to-demand ratios as numerical values to that of recruiter languages, which are categorical variables.

From the 6th REC BDE we received the POI data broken down by ethnicities in population and recruit percentages of Hispanics, APIs, whites, African-Americans, and Native Americans. The API data comprises such a great amount of different ethnicities that by not breaking it down would make it impossible to analyze the language-to-recruiter ratio relations. Therefore, the API data was complemented with data from the 2010 Census by identifying the zip code language distributions within all the ten states involved in this study. Language data from more than 4,000 zip codes was merged with the API data to identify the most prevalent language presence per zip code for the API populations. The concept of knowing the locations and the proportion of language indicators allows us to match the recruiters with an additional language and set the field for an ANOVA test.

III. STATISTICAL ANALYSIS OF 6TH RECRUITING BRIGADE DATA

A. DISCUSSION

The data used for hypothesis-testing was organized by battalion. The data accounts for all recruiting mission production for the last five fiscal years, from October 2009 to September 2014. The first step was to calculate the language-to-recruiter ratios for the battalions. One of the main assumptions was that the total recruiters and their language qualifications remained constant in every center throughout the five years. This assumption was made because the specific data of the number of recruiters and their language qualifications were not available from previous years. In other words, the language-to-recruiters ratio and the total number of recruiters assigned to the centers was maintained even when the normal inflow and outflow of recruiters normally happens during a five years span. Another assumption proved critical to the hypothesis-testing: Since the number of recruiters with an additional language was given only at the company level, we used the percentage deviation of the demographics by zip code to assign the recruiters with secondary languages to each center.

The assignment of recruiters with secondary languages uses the percentage deviation. The percentage deviation computes the proportion of the demographics in a zip code to the brigade demographic average. On one hand, the brigade demographic average was based on the assumption that the English-only speakers are usually white or African-American. As shown in Figure 2, the combined percentages of white and African-American populations came to approximately 27%. Hispanics have an average of 55% and the API, 20%. On the other hand, we did another computation strictly based on zip codes. Each recruiting center has zip codes assigned from which the recruiting mission takes its POI. The data from the 2010 Census provides the prevailing language per zip code. This allowed determining the percentage of the more common API languages such as Chinese, Japanese, Korean, Vietnamese, and Indian, by zip code; and consolidating the data to each center. Therefore, the percentage deviation is the division of the demographic of English only speakers, determined by the census, by the 27% of English only speakers from the brigade demographic average. In this way we see how the center demographics compare to the brigade average to determine where to allocate the available recruiters by language qualifications as shown in Table 6.

B. EXPLANATION OF DATA

The goal is to extract the samples from the data and to calculate the sample's test statistics t for each battalion in order to use in hypothesis-test described in the methodology. Our goal is to determine whether a rejection of the H_O applies, providing grounds to suggest that the Ha is statistically significant at an α equal to 0.05 level of significance. If this is true, then the existence of recruiters with an additional language generates higher fill-to-demand ratios than the recruiters that only speak English. The language-to-recruiter ratios are shown in Table 6.

Table 6. 6th REC BDE's Number of Recruiters with Secondary Languages by Type

Company/ Center	English Only	Spanish	Chinese	Tagalog	Thai	Vietnamese	Korean	Portuguese	Recruiters w/ Secondary Language	TOTAL	Ratio	BN	Regions
6F2- SAN GABRIEL VL	30	5	1	1	0	0	1	0	8	38	0.211	LA	AZUSA
6F3- LONG BEACH	30	7	0	1	1	0	2	0	11	41	0.268	LA	LONG BEACH
6F5- SN FERNANDO VL	37	3	0	0	0	0	1	0	4	41	0.098	LA	VAN NUYS
6F7- COASTAL	19	5	0	1	0	1	1	0	8	27	0.296	LA	ELSEGUNDO
6F8- LOS ANGELES	28	6	1	2	0	0	3	0	12	40	0.3	LA	GLENDALE
6F8- LOS ANGELES	10	1	0	0	0	0	0	0	1	11	0.091	LA	LOS ANGELES
6H5- HONOLULU 6H7- GUAM	38	0	0	5	0	0	5	0	10	48	0.208	PTLD	HONOLULU
6H2- VANCOUVER	36	3	0	1	0	0	0	0	4	40	0.1	PTLD	VANCOUVER
6H3 - WILSONVILLE	23	1	0	1	0	0	0	0	2	25	0.08	PTLD	WILSONVILLE
6H1 - EUGENE	28	0	0	0	0	0	0	0	0	28	0	PTLD	EUGENE
6H2 - VANCOUVER	9	0	0	0	0	0	0	0	0	9	0	PTLD	PORTLAND
6J6N- NELLIS CTR	63	4	1	1	0	0	0	0	6	69	0.087	SLC	NELLIS AFB
6J1- OGDEN	27	0	0	0	0	0	0	0	0	27	0	SLC	OGDEN
6J2- SALT LAKE	29	0	0	0	0	0	0	0	0	29	0	SLC	SALT LAKE CITY
6J3- BUTTE	25	0	0	0	0	0	0	0	0	25	0	SLC	BUTTE
6J4- BOISE	28	0	0	0	0	0	0	0	0	28	0	SLC	BOISE
6J6- LAS VEGAS	36	2	0	2	0	0	0	0	4	40	0.1	SLC	LAS VEGAS
6J9- BIG HORN	17	0	0	0	0	0	0	0	0	17	0	SLC	BILLINGS
6J2- SALT LAKE	10	0	0	0	0	0	0	0	0	10	0	SLC	SALT LAKE CITY
6L6- ALASKA	24	0	0	0	0	0	0	0	0	24	0	SEA	EAGLE RIVER
6L2- SEATTLE	18	2	0	3	0	0	0	0	5	23	0.217	SEA	TUKWILA
6L3- SPOKANE	22	1	0	0	0	0	0	0	1	23	0.043	SEA	SPOKANE
6L4- TACOMA	24	2	0	1	0	0	0	0	3	27	0.111	SEA	TAKOMA
6L5- YAKIMA	19	3	0	0	0	0	0	0	3	22	0.136	SEA	YAKIMA
6L7- OLYMPIA	27	1	0	0	0	0	1	0	2	29	0.069	SEA	TUMWATER
6L1- EVERETT	23	1	0	1	0	0	0	0	2	25	0.08	SEA	MARYSVILLE
6L2- SEATTLE	9	0	0	0	0	0	0	0	0	9	0	SEA	SEATTLE
6K1- REDLANDS	38	5	0	0	0	0	0	0	5	43	0.116	SOC	REDLANDS
6K2- FULLERTON	26	7	1	2	0	2	2	0	14	40	0.35	SOC	FULLERTON
6K4- LA MESA	24	12	0	3	0	0	0	0	15	39	0.385	SOC	LA MESA
6K5- NEWPORT BEACH	19	1	0	1	0	1	0	0	3	22	0.136	SOC	IRVINE
6K6- SAN MARCOS	44	6	0	0	0	0	0	0	6	50	0.12	SOC	VISTA
6K7- RIVERSIDE	45	8	0	1	0	1	0	0	10	55	0.182	SOC	RIVERSIDE
6K8- SAN DIEGO	24	7	0	3	0	0	0	1	11	35	0.314	SOC	SAN DIEGO
6K5G- MISSION VIEJO CTR	8	1	0	0	1	0	0	0	2	10	0.2	SOC	MISSION VIEJO
6I0- SIERRA NEVADA	26	3	0	0	0	0	0	0	3	29	0.103	SAC	RENO
6I1- REDDING	41	1	0	0	0	0	0	0	1	42	0.024	SAC	REDDING
6I3- SACRAMENTO VL	36	3	0	0	0	0	0	0	3	39	0.077	SAC	FAIR OAKS
6I4- SAN JOAQUIN	32	4	0	0	0	0	0	0	4	36	0.111	SAC	FRENCH CP
6I5A- ARDEN CTR	36	2	1	0	0	1	1	0	5	41	0.122	SAC	SACRAMENTO
6I6- NORTH BAY	27	1	0	3	0	0	0	0	4	31	0.129	SAC	SANTA ROSA
6I5S- FOLSOM CTR	10	1	0	0	0	0	0	0	1	11	0.091	SAC	RANCHO CORDOVA
6N1- FRESNO	54	6	0	1	0	0	0	0	7	61	0.111	FRES	FRESNO
6N2- BAKERSFIELD	34	6	0	0	0	0	0	0	6	40	0.15	FRES	BAKERSVILLE
6N6- GOLD COAST	27	6	0	1	0	0	0	0	7	34	0.206	FRES	VENTURA
6N7- SOUTH BAY	33	0	1	3	0	0	0	0	4	37	0.108	FRES	PALO ALTO
6N8- EAST BAY	50	4	0	1	0	0	0	0	5	55	0.091	FRES	WALNUT CREEK
6N9- MONTEREY BAY	22	5	0	0	0	0	2	0	7	29	0.241	FRES	GILROY
Total	**1345**	**136**	**6**	**39**	**2**	**6**	**19**	**1**	**209**	**1554**			

Table 7 shows an extraction of the data as it is used to set up to test the hypothesis on two samples. The whole data set encompasses production numbers from the last five fiscal years. The first column represents the recruiting station identification codes (RSID). The center column refers to four centers—Azusa, El Monte, West Covina, and Montebello. Note that each center has the production numbers from FY10 and FY11.

Also note that there are months in which there is not any production, in West Covina and Montebello during the last half of FY11. The assumptions made are that West Covina and Montebello centers seem to be closed since then. Nevertheless, their production numbers were part of the hypothesis-testing for FY10 and FY11. For instance, based on location it is assumed that El Monte Center is covering the area for Montebello and the Azusa Center has taken the place for the ones from West Covina. The productions of other centers that appeared during previous fiscal years and show to be closed are part of the study using similar assumptions regarding its locations. The next columns display the FY and its respective months from October (M-1) to September (M-12). The production numbers are shown in the Demand and Filled columns as the required recruiting mission and the respective joining recruits per month. The fill-to-demand ratio column denotes the effectiveness that each center achieved throughout every month.

The language-to-recruiter ratio column assigns a 0, or otherwise a 1, to those centers with fewer recruiters with a secondary language than the Los Angeles BN average of 0.22. This procedure is similar for every center. The language-to-recruiter ratio for each center is compared to their respective overall battalion averages. The language-to-recruiter ratio averages for each battalion are shown later in Table 9.

Table 7. Setting-up the Data for Hypothesis-Testing

RSID	Center	FY	Month	Demand	Filled	Fill-to-Demand Ratio	Language-to-Recruiter Ratio (LTR)	Language: = 0 if LTR < 0.22 = 1 if LTR >= 0.22	Total Recruiters per Center	Total Recruiters w/ Secondary Language per Center
6F2D	AZUSA CENTER	2010	M-1	6	6	1.00	0.09	**0**	11	1
6F2D	AZUSA CENTER	2010	M-2	7	9	1.29	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-3	6	6	1.00	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-4	9	8	0.89	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-5	8	7	0.88	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-6	8	7	0.88	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-7	8	2	0.25	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-8	6	9	1.50	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-9	6	5	0.83	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-10	6	9	1.50	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-11	7	7	1.00	0.18	**0**	11	1
6F2D	AZUSA CENTER	2010	M-12	6	4	0.67	0.18	**0**	11	1
6F2F	EL MONTE CENTER	2010	M-1	5	6	1.20	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-2	7	5	0.71	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-3	5	4	0.80	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-4	8	3	0.38	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-5	7	7	1.00	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-6	7	4	0.57	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-7	5	5	1.00	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-8	4	7	1.75	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-9	3	6	2.00	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-10	6	7	1.17	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-11	6	4	0.67	0.21	**0**	14	2
6F2F	EL MONTE CENTER	2010	M-12	4	4	1.00	0.21	**0**	14	2
6F2K	WEST COVINA CENTER	2011	M-1	7	8	1.14	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-2	6	7	1.17	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-3	5	5	1.00	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-4	5	5	1.00	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-5	6	7	1.17	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-6	4	5	1.25	0.18	**0**	11	1
6F2K	WEST COVINA CENTER	2011	M-7	0	0	0.00	0.00	**0**	0	0
6F2K	WEST COVINA CENTER	2011	M-8	0	0	0.00	0.00	**0**	0	0
6F2K	WEST COVINA CENTER	2011	M-9	0	0	0.00	0.00	**0**	0	0
6F2K	WEST COVINA CENTER	2011	M-10	0	0	0.00	0.00	**0**	0	0
6F2K	WEST COVINA CENTER	2011	M-11	0	0	0.00	0.00	**0**	0	0
6F2K	WEST COVINA CENTER	2011	M-12	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-1	1	1	1.00	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-2	2	3	1.50	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-3	3	0	0.00	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-4	3	2	0.67	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-5	3	4	1.33	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-6	3	2	0.67	0.29	**1**	7	2
6F2M	MONTEBELLO	2011	M-7	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-8	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-9	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-10	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-11	0	0	0.00	0.00	**0**	0	0
6F2M	MONTEBELLO	2011	M-12	0	0	0.00	0.00	**0**	0	0

The percentage deviations play an important role in assigning the recruiters with secondary languages as displayed in the last column of Table 7. The San Gabriel Valley Company (Co.) has eight out of 30 recruiters with at least an additional language capability, composed of five Spanish-speakers, one Chinese-speaker, one Tagalog-speaker, and one Korean speaker. For example, the five recruiters who speak Spanish from the company of San Gabriel Valley where distributed throughout all the centers every fiscal year, and their allocation went to the centers with larger deviation percentages. The assignment assumptions of those Spanish speaking recruiters went to those centers in which their zip codes had a population of more than 55% Hispanics. San Gabriel Valley has not had more than five recruiters who speak Spanish, and no more than one Chinese, Tagalog, or Korean-speaker for every FY. As shown in Table 7, in FY10, out of the eight recruiters with secondary languages, one recruiter went to Azusa Center and two to El Monte Center. In FY11, one of those eight was assigned to West Covina, and two other recruiters with secondary language to Montebello Center during the first six months of FY11, as assumed that Montebello closed operations after that. The same assignment assumptions apply to every center in order to maintain the language-to-recruiter ratios constant to the actual assignment in order to observe the fill-to-demand ratios tendencies.

The test statistic t is finally computed with the sample means $\overline{x}$ & $\overline{y}$, and their respective standard deviations $S_x^{\,2}$, $S_y^{\,2}$ from Samples 1 and 2, respectively. The Language column uses two indicators, 0 and 1, to identify if the language-to-recruiter during that month was greater than the Los Angeles Battalion recruiter average. Those indicators create Sample 1, which has 598 observations, and otherwise Sample 2 has 720 observations.

C. INFERENTIAL STATISTICS

As the H_O claims that the sample mean $\overline{x}$ of the fill-to-demand ratios of Sample 1 is greater than or equal to $\overline{y}$ for Sample 2. $\mathrm{H}a$ is used to contradict the H_O and its rejection is determined using the alternative hypothesis, $\mathrm{H}a$ with $\mu_x < \mu_y$ rejection region as shown in Figure 1. The complete formulation for the hypothesis-test for the Los Angeles Battalion is as follows:

Lower tail sample test:

H_O: Null hyphothesis, are the means for Sample 1 the same or greater than Sample 2 in the recruiting centers from Los Angeles Battallion? In other words, does $\mu_x - \mu_y \geq 0$?

μ_x = mean of the filled-to-demand ratios from the observations within Sample 1

μ_y = mean for the filled-to-demand ratios from the observations within Sample 2

H*a*: Alternative hypothesis, $\mu_x < \mu_y$, represents that the means of the fill-to-demand ratios are greater for Sample 2.

Therefore, the null hypothesis is rejected because the test statistic t is less than $t < t_{0.5}$ gor a level $\alpha = 0.05$.

For a lower tail level test, and $\alpha = 0.05$, $t_{0.5} = -1.664$, and the test statistic falls within the rejection region if $t < t_{0.5}$.

Test Statistic : $$t = \frac{\overline{x} - \overline{y}}{\sqrt{\frac{S_x^2}{m} + \frac{S_y^2}{n}}} = \frac{0.92 - 0.996}{\sqrt{\frac{0.438^2}{598} + \frac{0.576^2}{720}}} = -2.7116,$$

therefore, t falls within the rejection region as $t < t_{0.5}$, or $-2.7116 < -1.664$.

The p-value is less than 0.05, resulting in 0.0033 < 0.05, therefore we can reject the null hypothesis that says that $\mu_x - \mu_y \leq 0$.

The resulting values the for the test statistic t of Los Angeles BN using both samples within Sample 1 and Sample 2 are as follows:

Sample 1	Sample 2
Fill-to-demand mean, $\overline{x} = 0.9197$	Fill-to-demand mean, $\overline{y} = 0.9955$
Standard deviation, $S_x = 0.4382$	Standard deviation, $S_y = 0.5757$
Number of observations, $m = 598$	Number of observations, $n = 720$

The same lower tail hypothesis-tests where calculated for all the rest of the battalions. The null hypothesis statement is:

H_O: Are the means the same in the recruiting centers for each of the battalions?

The following t results were compared with the lower tail level test $t_\alpha = -1.664$ using α = 0.05. Table 8 illustrates the sample mean hypotheses test for each batallion:

$t_{Portland} = -6.5772 < -1.664$, with a p-value = 2.4 x 10^{-11}, therefore reject the null hypothesis

$t_{Sacramento} = -0.056 > -1.664$, with a p-value = 0.47767, therefore, fail to reject the null hypothesis.

$t_{Salt\ \text{Lake City}} = -5.835 < -1.664$, with a p-value = 2.7 x 10^{-9}, therefore reject the null hypothesis

$t_{Southern\ California} = -1.5921 > -1.664$, with a p-value = 0.00568, therefore Fail to reject the null hypothesis

$t_{Seattle} = 6.66921 > -1.664$, with a p-value = 1.3 x 10^{-11}, therefore fail to reject the null hypothesis

$t_{Fresno} = -4.4336 < -1.664$, with a p-value = 0.00000463, therefore reject the null hypothesis

Table 8. Two Sample Means Hypothesis-Testing Results

Two Sample Mean Hypothesis Testing Results by Battalion									
6th REC BDE	***Sample 1***			***Sample 2***			***t-statistic***	**Reject the H_O? YES, if t <= -1.664**	**p-value**
Battalion	$\overline{x}$	S_x^2	m	$\overline{y}$	S_y^2	n			
Los Angeles	0.9197	0.4382	598	0.9955	0.5757	720	-2.7116	YES	0.0033
Portland	0.9347	0.59196	1,210	1.1232	0.6706	846	-6.5772	YES	2.40E-11
Sacramento	0.9213	0.52399	657	0.9227	0.5345	1,399	-0.0560	NO	0.47767
Salt Lake City	0.9077	0.61328	1,741	1.1854	0.8963	392	-5.8350	YES	2.70E-09
Southern California	1.0434	0.71344	1,302	1.1082	1.0522	875	-1.5921	NO	0.00568
Seattle	0.9885	0.64921	1,280	0.8246	0.4926	884	6.6692	NO	1.30E-11
Fresno	0.8477	0.4764	1,030	0.9656	0.6778	944	-4.4336	YES	4.63E-06

D. INTERPRETATIONS

The hypothesis tests suggest that, for four of the battalions, including Los Angeles, Portland, Salt Lake City, and Fresno BN, having more recruiters with a secondary language makes recruiting better on average. The small p-values suggest that, based on the distribution of the data, there is a strong language effect suggesting that, 19 out 20 times, having recruiters with secondary language yields higher fill-to-demand ratios. Also, less variation provides more confidence in the results. When comparing the standard deviations of we can relate that higher standard deviations lead to higher p-values. It is interesting to see that, of the three battalions failing to reject the null hypothesis—Seattle, Sacramento, and Southern California—two of them, Seattle and Sacramento, are in the fifth and sixth position, respectively, based on the number of recruiters with secondary language, as shown in Table 9.

Even when in the Southern California BN has the highest number of recruiters with secondary languages with 66, the data does not show statistical evidence to conclude that the fill-to-demand ratio increases. However, the Southern California and Sacramento BNs have t-statistic results that are very close to fall within the rejection region. The t-statistics values are both negative. Southern California has a t-statistic of -1.5921 and Sacramento, -0.56. By looking both $\overline{x}$, $\overline{y}$ results we can see that both sample means for Sample 2, the $\overline{y}$ means, are greater than the $\overline{x}$ means, which suggest the fill-to-demand ratios are higher. Although the fill-to-demand performance are at a higher rate for Southern California and Sacramento BNs, where the presence of recruiters with secondary languages is greater than their averages, we cannot draw conclusions that these occurrences will happen with a certainty of at least 19 times out of any 20 observations taken at random. Nevertheless, there are statistical evidences that the lack of recruiters with an additional language generates lower fill-to-demand ratios in the majority of the battalions than the recruiters that only speaks English-only.

Table 9. Language-to-Recruiter Ratios by Battalion

6th REC BDE's Recruiters *Secondary Language Data*			
Battalion	***English Only***	***Number of Recruiters w/ Secondary Language***	***Language-to-Recruiter Ratio***
Salt Lake City	245	10	0.04
Seattle	182	11	**0.06**
Sacramento	229	21	**0.09**
Portland	150	16	0.11
Fresno	256	36	0.14
Los Angeles	198	44	0.22
Southern California	294	66	0.22

The key idea from a statistical point of view is that even when we have failed to reject the null hypothesis for three battalions, it does not mean that the null hypothesis is accepted as true. It means that there is not statistical evidence to reject the claim that recruiters with an additional language improve the effectiveness of the fill-to-demand ratios in those battalions. It is reasonable to say that the larger amount of English-only recruiters in Seattle, Sacramento, and Southern California could mask the effectiveness effect that the recruiters with second languages might have due to the higher volumes of English-only recruiters.

Table 10 shows the P2P for all the main ethnic populations excluding African-American and whites for FY14. The green status represents that the recruiting missions successfully match their ethnic population's distributions. The yellow represents the recruit numbers are at least 75%, but less than 100%. The red status comprises the center that that have P2P ratios less than 75%.

The hypothesis - test results allow drawing conclusions by knowing the battalions in which the recruiters with a second languages yield better fill-to-demand ratios. By looking at Table 10 we can suggest to allocate more Spanish speaking recruiters in Los Angeles, Portland, Salt Lake City, and Fresno—to the battalions in which the null hypothesis "recruiters with secondary languages yield the same fill-to-demand ratios" was rejected. However, the same allocation suggestions regarding Seattle, Sacramento, and Southern California BNs are not statistically proven, because the null hypothesis was rejected and do not yield a statistically significant p-values.

Moreover, the battalions improving their effectiveness with recruiters with secondary language have the higher P2P ratios. As displayed in the minority roll-up column in Table 10, we can see that, overall, the Los Angeles and Portland BNs have the highest P2P ratios and Sacramento and Fresno BN the lowest. These P2P ratios conform to the hypothesis-testing results. The battalions that failed the hypothesis test are among the lowest P2P ratios. The Seattle BN has the lowest P2P ratio of Native-American recruits, Southern California BN is among the lowest P2P ratios on API, and Sacramento BN is the lowest for the Hispanic ethnicity. Overall, the battalions in which the null hypothesis was rejected have better P2P. This reasonably demonstrates that adding more recruiters with additional language capabilities will balance the proportions and help to improve the recruiting mission.

Table 10. 6th REC BDE's Minority Personnel-to-Population (P2P) for FY14

6th Recruiting Brigade All Battalions		HISPANIC					ASIAN PACIFIC ISLANDER					NATIVE AMERICAN					MINORITIES ROLL-UP				
CODE	BN NAME	H POP	ENL	% POP	% ENL	P2P	API POP	ENL	% POP	% ENL	P2P	NA POP	ENL	% POP	% ENL	P2P	H, API & NA POP	ENL	% POP	% ENL	P2P
6F	LOS ANGELES	989,411	1,007	54.17%	47.68%	0.88	248,628	459	13.61%	21.73%	1.60	2,792	3	0.23%	0.14%	0.63	1,240,831	1,469	67.84%	69.46%	1.02
6H	PORTLAND	119,363	89	13.74%	5.50%	0.40	191,349	693	22.03%	42.86%	1.95	7,028	12	2.21%	0.74%	0.33	317,740	794	36.29%	48.74%	1.34
6I	SACRAMENTO	351,065	399	30.06%	18.94%	0.63	126,722	257	10.85%	12.20%	1.12	11,965	29	2.44%	1.36%	0.56	489,752	685	41.51%	32.07%	0.77
6J	SALT LK CITY	241,802	261	19.89%	14.40%	0.72	65,403	132	5.38%	7.28%	1.35	20,460	37	6.24%	2.00%	0.32	327,665	430	26.51%	23.24%	0.88
6K	SOUTHERN CAL	985,624	1,153	48.53%	41.59%	0.86	236,618	321	11.65%	11.58%	0.99	7,135	10	0.58%	0.36%	0.62	1,229,377	1,484	60.32%	53.34%	0.88
6L	SEATTLE	159,746	181	13.40%	9.51%	0.71	118,935	271	9.98%	14.23%	1.43	39,351	32	12.37%	1.65%	0.13	318,032	484	25.83%	25.00%	0.97
6N	FRESNO	789,770	706	42.46%	33.54%	0.79	330,664	352	17.78%	16.72%	0.94	6,376	17	0.57%	0.80%	1.42	1,126,810	1,075	60.37%	50.66%	0.84

THIS PAGE INTENTIONALLY LEFT BLANK

IV. APPLICATION OF DATA ENVELOPMENT ANALYSIS TO DETERMINE EFFICIENCY

A. DEFINING THE SETS OF INPUTS AND OUTPUTS

The application of data envelopment determines, in ranking order, how efficiently individual recruiting companies operate as compared to the others. The first six columns in Table 11 show the *X(A)* input coefficients used to compute the competing companies', or DMUs', efficiencies. The efficiency inputs chosen include five population distributions for the most common ethnicities—Hispanics, Asians and Pacific Islanders, whites, African-American, and Native-Americans—and the total number of recruiters available in each company. The *Y(A)* outputs are represented by the fill-to-demand and language-to-recruiter ratios.

The DEA goal is to arrange the *X(A)* inputs and the *Y(A)* outputs in a way to test whether the DMU efficiency responses reflect any correlations between the demographic, descriptive data of the recruiters, and the achieved fill-to-demand ratios. We might characterize the recruiting resources by the available population as an independent variable and the total number of recruiters as a dependent variable. The challenge is to find a variable to measure the language effect since even though we know the recruiters' languages, data on recruits' languages is not available. We will show later that there is a correlation between the *Y(A)* outputs used and the specific language outputs desired. Nevertheless, the DEA method proves valid using the language-to-recruiter and the fill-to-demand ratios as *Y(A)* outputs. The DMU's efficiency, resulting from maximizing this arrangement, measures the strength of the interaction of the input and output values for each company. Then, the efficiency values can be used to determine the company ranking.

B. IMPLEMENTING THE DEA MODEL

The following are needed for evaluating efficiency of the companies in Table 11:

Requirement 1: The weighted sum of the company's populations, or the first five columns in the following table, must be equal to 1.00. It does not account for other ethnicities.

Table 11. Input and Output Coefficients for the DEA Approach (Array named matrix (A))

6th REC BDE	Input Coefficients						Output Coefficients	
Company	**%PopAPI**	**%PopAA**	**%PopH**	**%PopW**	**%PopNative**	**#Recruiters**	**Fill-to-Demand Ratio**	**Language-to-Recruiter Ratio**
6F2 - SAN GABRIEL VL	**0.263722**	**0.031573**	**0.517156**	0.185787	0.001763	**38**	**0.872152**	**0.2105**
6F3 - LONG BEACH	**0.087205**	**0.105755**	**0.672485**	0.133068	0.001486	**41**	**0.959648**	**0.2683**
6F5 - SN FERNANDO VL	0.080011	0.035218	0.533119	0.350004	0.001648	41	0.763623	0.0976
6F7 - COASTAL	0.157075	0.199102	0.295339	0.347086	0.001397	27	0.840470	0.2963
6F8 - LOS ANGELES	0.136177	0.055508	0.546700	0.260140	0.001474	51	0.896214	0.3000
6H1 - EUGENE	0.036067	0.007294	0.093672	0.846818	0.016149	28	0.798541	0.0909
6H2 - VANCOUVER	0.074656	0.038769	0.133544	0.745682	0.007349	49	0.888734	0.2083
6H3 - WILSONVILLE	0.035723	0.010366	0.173345	0.769427	0.011140	25	0.763134	0.1000
6H5 - HONOLULU	0.600513	0.014254	0.122297	0.260485	0.002450	24	1.014687	0.0800
6H7 - GUAM	0.926119	0.010042	0.000000	0.063839	0.000000	24	1.016260	0.0000
6I0 - SIERRA NEVADA	0.047907	0.019145	0.250423	0.664284	0.018241	29	0.910788	0.0000
6I1 - REDDING	0.040783	0.010726	0.151065	0.772217	0.025210	42	0.808599	0.0870
6I3 - SACRAMENTO VL	0.081499	0.036714	0.216618	0.657542	0.007626	39	0.920515	0.0000
6I4 - SAN JOAQUIN	0.113513	0.053919	0.445580	0.381530	0.005457	36	0.931590	0.0000
6I5 - CAPITOL	0.202628	0.107138	0.257041	0.427997	0.005197	52	0.888965	0.0000
6I6 - NORTH BAY	0.086219	0.066036	0.319470	0.519875	0.008401	31	0.656557	0.0000
6J1 - OGDEN	0.018162	0.008748	0.129949	0.833434	0.009707	27	0.797701	0.1000
6J2 - SALT LAKE	0.043967	0.010922	0.149390	0.784530	0.011190	29	0.752606	0.0000
6J3 - BUTTE	0.010439	0.002670	0.039882	0.885437	0.061573	25	0.714416	0.0000
6J4 - BOISE	0.017945	0.006657	0.165861	0.800868	0.008668	28	0.860633	0.0000
6J6 - LAS VEGAS	0.102264	0.107663	0.309920	0.474534	0.005620	109	0.890533	0.2174
6J9 - BIG HORN	0.006928	0.003742	0.067161	0.844465	0.077704	17	0.754591	0.0435
6K1 - REDLANDS	0.046855	0.080681	0.566912	0.300264	0.005287	43	0.969034	0.1111
6K2 - FULLERTON	0.201510	0.019564	0.492608	0.284349	0.001969	40	0.857143	0.1364
6K4 - LA MESA	0.117789	0.053590	0.506028	0.317863	0.004730	39	0.715259	0.0690
6K5 - NEWPORT BEACH	0.139674	0.013223	0.270650	0.574473	0.001979	32	0.743743	0.0800
6K6 - SAN MARCOS	0.044696	0.032839	0.508044	0.408251	0.006170	50	0.876591	0.0000
6K7 - RIVERSIDE	0.086515	0.090924	0.563245	0.256525	0.002791	55	0.855292	0.1163
6K8 - SAN DIEGO	0.173149	0.050862	0.249331	0.523374	0.003284	35	0.757979	0.3500
6L1 - EVERETT	0.086824	0.018779	0.109900	0.768680	0.015817	25	0.837500	0.3846
6L2 - SEATTLE	0.201467	0.073000	0.102603	0.616732	0.006198	32	0.766444	0.1364
6L3 - SPOKANE	0.023348	0.012660	0.055685	0.891007	0.017300	23	0.796624	0.1200
6L4 - TACOMA	0.092312	0.068854	0.121083	0.704523	0.013227	27	0.990457	0.1818
6L5 - YAKIMA	0.016830	0.008463	0.338310	0.614801	0.021596	22	0.775581	0.3143
6L6 - ALASKA	0.074101	0.028043	0.061478	0.655457	0.180921	24	0.855114	0.2000
6L7 - OLYMPIA	0.048443	0.018887	0.094673	0.814933	0.023064	29	0.901454	0.1034
6N1 - FRESNO	0.081141	0.043657	0.577334	0.292158	0.005710	54	0.792119	0.0238
6N2 - BAKERSFIELD	0.036745	0.072447	0.546160	0.338127	0.006521	40	0.836003	0.0769
6N6 - GOLD COAST	0.055439	0.015520	0.471056	0.454545	0.003440	34	0.721532	0.1111
6N7 - SOUTH BAY	0.321473	0.038378	0.254535	0.383649	0.001965	37	0.638575	0.1220
6N8 - EAST BAY	0.225293	0.125870	0.299244	0.346959	0.002633	55	0.692921	0.1290
6N9 - MONTEREY BAY	**0.213740**	**0.023038**	**0.451766**	0.309182	0.002274	**29**	**0.726957**	**0.0909**

Requirement 2: Extract the input and output coefficient arrays to be used as matrix formulations. The values of Matrix ***A*** in Table 11 encompass two arrays, the input, and the output coefficients. The input matrix shown follows the set of coefficient vectors for the input variables with a sample of the first two rows and the last row of the input coefficient values from Table 11:

$$\begin{bmatrix} X_{1,\ input\ 1} & X_{1,\ input\ 2} & X_{1,\ input\ 3} & \cdots & X_{1,\ input\ i} \\ X_{2,\ input\ 1} & X_{2,\ input\ 2} & X_{2,\ input\ 3} & \cdots & X_{2,\ input\ i} \\ \vdots & \vdots & \vdots & & \vdots \\ X_{c,\ input\ 1} & X_{c,\ input\ 2} & X_{c,\ input\ 3} & \cdots & X_{c,\ input\ i} \end{bmatrix} = \begin{bmatrix} 0.263722 & 0.031573 & 0.517156 & \cdots & 38 \\ 0.087207 & 0.105755 & 0.672485 & \cdots & 41 \\ \vdots & \vdots & \vdots & & \vdots \\ 0.213740 & 0.023038 & 0.451766 & \cdots & 29 \end{bmatrix}$$

The output matrix array is the set of coefficient vectors for the fill-to-demand and language-to-recruiter output variables. It also includes a portion of its output coefficients:

$$\begin{bmatrix} Y_{1,\ output\ 1} & Y_{1,\ output\ 2} \\ Y_{2,\ output\ 1} & Y_{2,\ output\ 2} \\ \vdots & \vdots \\ Y_{c,\ output\ 1} & Y_{c,\ output\ o} \end{bmatrix} = \begin{bmatrix} 0.872152 & 0.2105 \\ 0.959648 & 0.2683 \\ \vdots & \vdots \\ 0.726957 & 0.0909 \end{bmatrix}$$

Requirement 3: In order to maximize the efficiency of the companies, or DMUs, the model formulation uses three set of decision variables. Excel Solver identifies the optimal values for the decision variables by solving a linear program, as shown in Figure 3, of which the objective is to maximize the efficiency of the companies.

As indicated in Chapter II, the efficiency decision variables comprise the set of decision-making units DMU_1, DMU_2, … ,DMU_c; the set of decision variables of inputs w_1, w_2, … ,w_i; and the corresponding decision variables of the outputs t_1, t_2.

To evaluate the maximization of the efficiency of DMU_1, DMU_2, … ,DMU_c, we solve the following problem sets of vectors concurrently. The sets W_1, W_2, … , W_c for the inputs and T_1, T_2 for the outputs are used as sets of constraints to solve the maximization problem :

$$\begin{bmatrix} X_{1,\,input\ 1} & X_{1,\,input\ 2} & \cdots & X_{1,\,input\ i} \\ X_{2,\,input\ 1} & X_{2,\,input\ 2} & \cdots & X_{2,\,input\ i} \\ \vdots & \vdots & & \vdots \\ X_{c,\,input\ 1} & X_{c,\,input\ 2} & \cdots & X_{c,\,input\ i} \end{bmatrix} \times \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_i \end{bmatrix} = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_c \end{bmatrix}$$

$$\begin{bmatrix} Y_{1,\,output\ 1} & Y_{1,\,output\ 2} \\ Y_{2,\,output\ 1} & Y_{2,\,output\ 2} \\ \vdots & \vdots \\ Y_{c,\,output\ 1} & Y_{c,\,output\ o} \end{bmatrix} \times \begin{bmatrix} t_1 \\ t_2 \end{bmatrix} = \begin{bmatrix} T_1 \\ T_2 \\ \vdots \\ T_c \end{bmatrix}$$

A set of zero vectors initializes all the decision variables DMU_1, DMU_2 … ,DMU_c; w_1, w_2, … ,w_c; and the t_1, t_2.

changing variables (initialized as zero)

↓

$$\begin{bmatrix} X_{1,\,input\ 1} & X_{1,\,input\ 2} & \cdots & X_{1,\,input\ i} \\ X_{2,\,input\ 1} & X_{2,\,input\ 2} & \cdots & X_{2,\,input\ i} \\ \vdots & \vdots & & \vdots \\ X_{c,\,input\ 1} & X_{c,\,input\ 2} & \cdots & X_{c,\,input\ i} \end{bmatrix} \times \begin{bmatrix} w_1 = 0 \\ w_2 = 0 \\ \vdots \\ w_i = 0 \end{bmatrix} = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_c \end{bmatrix}$$

changing variables (initialized as zero)

↓

$$\begin{bmatrix} Y_{1,\,output\ 1} & Y_{1,\,output\ 2} \\ Y_{2,\,output\ 1} & Y_{2,\,output\ 2} \\ \vdots & \vdots \\ Y_{c,\,output\ 1} & Y_{c,\,output\ o} \end{bmatrix} \times \begin{bmatrix} t_1 = 0 \\ t_2 = 0 \end{bmatrix} = \begin{bmatrix} T_1 \\ T_2 \\ \vdots \\ T_c \end{bmatrix}$$

Requirement 4: The preceding set of vectors form the constraints in the linear program formulation. The highest efficiency value for the companies is restricted to 100%. The solver iterates until it finds the best DMU efficiency that meets all the constraint criteria. The remaining companies fall in decreasing order based upon the one, or ones, achieving exactly 100%. Therefore, after solving the maximization, these decision variables—initialized as zero—will become a percentage that identifies those companies that produce better outputs.

This zero vector is a set of changing variables that becomes the DMU's efficiency percentages resulting out of Excel Solver's computations.

changing variables (initialized as zero)

$$\begin{bmatrix} DMU_1 \\ DMU_2 \\ \vdots \\ DMU_c \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

The linear program formulation for implementing the DEA model is as follows:

Objective Function:

Max $DMU_1,\ DMU_2,\ \dots\ ,DMU_c$ Maximizes the DMU's efficiencies as decision variables.

Subject to:

Constraint 1: $\begin{bmatrix} W_1 \\ \vdots \\ W_c \end{bmatrix} - \begin{bmatrix} T_1 \\ \vdots \\ T_c \end{bmatrix} >= 0$ To limit the resource of outputs to that of inputs.

Constraint 2: $\begin{bmatrix} DMU_1 \\ \vdots \\ DMU_c \end{bmatrix} - \begin{bmatrix} T_1 \\ \vdots \\ T_c \end{bmatrix} = 0$ To limit the difference of the set of vectors to be no more than zero.

Constraint 3: $\begin{bmatrix} DMU_1 \\ \vdots \\ DMU_c \end{bmatrix} <= 1$ To limit the DMU's efficiencies to values less than or equal to one.

Constraint 4: $\begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_i \end{bmatrix} \geq 0.001$ To limit the input decision variables to values greater than zero.

Constraint 5: $\begin{bmatrix} t_1 \\ t_2 \end{bmatrix} > 0.001$ To limit the output decision variables to values greater than zero.

Constraint 6: $$\begin{bmatrix} X_{1,\ input\ 1} & X_{1,\ input\ 2} & X_{1,\ input\ 3} & \cdots & X_{1,\ input\ i} \\ X_{2,\ input\ 1} & X_{2,\ input\ 2} & X_{2,\ input\ 3} & \cdots & X_{2,\ input\ i} \\ \vdots & \vdots & \vdots & & \vdots \\ X_{c,\ input\ 1} & X_{c,\ input\ 2} & X_{c,\ input\ 3} & \cdots & X_{c,\ input\ i} \end{bmatrix} \times \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_i \end{bmatrix} = 1$$

To limit the multiplication of the input coefficients and the input decision variables to be equal to one.

Figure 3 shows how to implement the preceding DEA linear formulation using Excel Solver. The naming conventions in the following Excel Solver screen represent the array of cells in which the data is found. For example, the naming convention

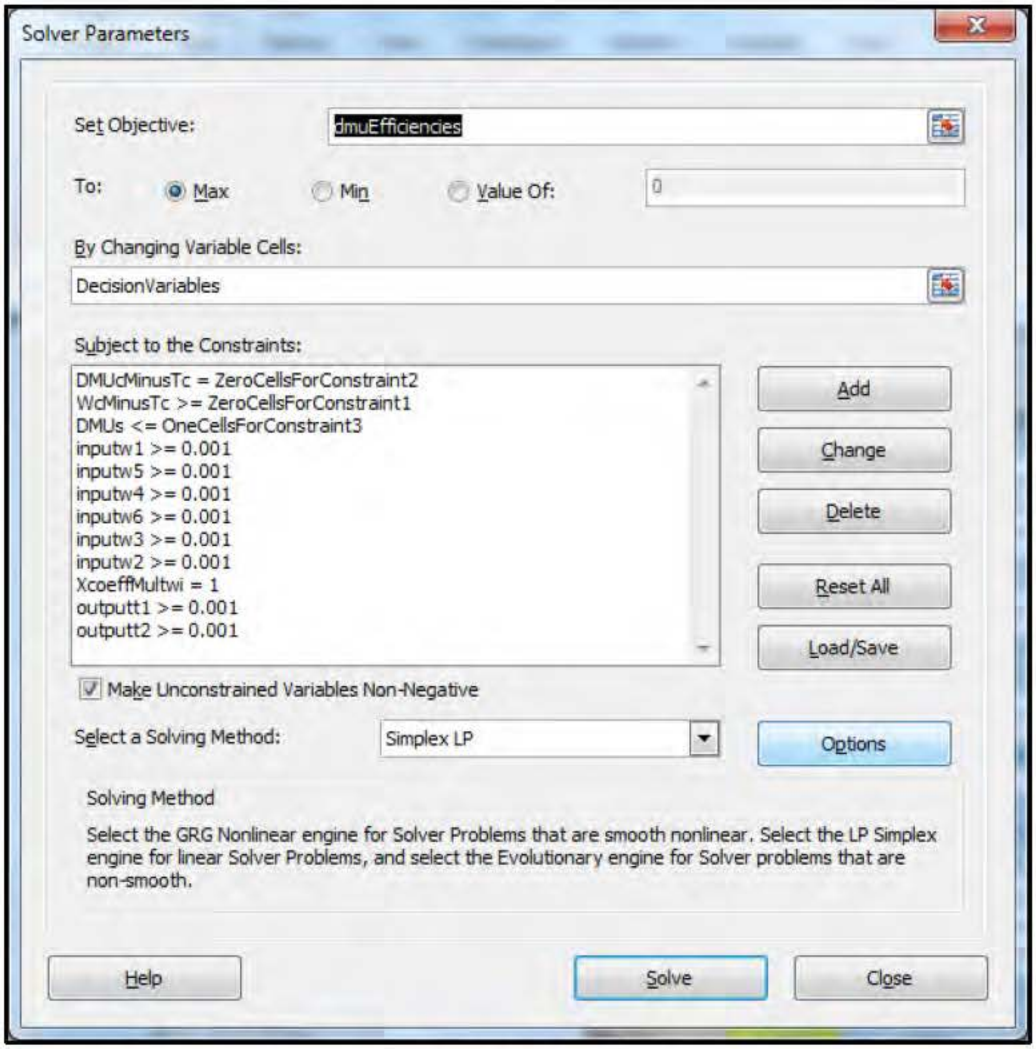


Figure 3. Linear Program for the DEA Problem Using Excel Solver

Decision Variables contains an array of cells in an Excel column that has all 42 decision variables assigned as $DMU_1, DMU_2, \dots, DMU_c$; six values for the $w_1, w_2, \dots, w_i$; and two values for the outputs t_1 & t_2. Each formulation, in the S*ubject to the Constraints* block has similar naming conventions in order to simplify the location of the data in the Excel spreadsheet.

C. DATA ENVELOPMENT ANALYSIS RESULTS

The efficiency results in Table 11 provide an opportunity to determine whether the data envelopment method for ethnic populations correlates with the actual recruiting numbers by ethnicity. Note that the data envelopment analysis only uses the ethnic population distributions and the total number of recruiters; similarly, the outputs use the fill-to-demand and language-to-recruiter ratios. However, the actual recruiting data—the number of recruits by ethnicity—is neither part of the inputs nor the outputs of the DEA method. Due to the fact that the collected data that include the number of recruits by ethnicity does not match the overall number of the fill-to-demand ratios

The DEA method accounts for the company's performance in the form of the fill-to-demand ratio and indirectly, the P2P metrics. We will also show that the correlation between the recruiting efficiencies of the DEA and the P2P metrics suggests that the DEA model can be used to allocate recruiters with secondary languages. The decision-making criteria for allocating recruiters would be a bottom-up approach. In other words, the units at the bottom of the DEA ranking in Table 12 would be the ones to first receive new assignments of recruiters with secondary languages. Recommendations for the specific languages are given in Chapter V.

Table 12. Optimal DEAs Efficiencies for the 6th REC BDE's Companies

DMU Ranking*	DEA Efficiencies	Company
DMU- 2	1.0000	6F3 - LONG BEACH
DMU- 33	1.0000	6L4 - TACOMA
DMU- 9	0.9886	6H5 - HONOLULU
DMU- 10	0.9631	6H7 - GUAM
DMU- 23	0.9558	6K1 - REDLANDS
DMU- 5	0.9506	6F8 - LOS ANGELES
DMU- 30	0.9235	6L1 - EVERETT
DMU- 21	0.9173	6J6 - LAS VEGAS
DMU- 7	0.9126	6H2 - VANCOUVER
DMU- 1	0.8976	6F2 - SAN GABRIEL VALLEY
DMU- 4	0.8965	6F7 - COASTAL
DMU- 36	0.8892	6L7 - OLYMPIA
DMU- 14	0.8828	6I4 - SAN JOAQUIN
DMU- 35	0.8779	6L6 - ALASKA
DMU- 13	0.8723	6I3 - SACRAMENTO VALLEY
DMU- 11	0.8631	6I0 - SIERRA NEVADA
DMU- 24	0.8583	6K2 - FULLERTON
DMU- 28	0.8498	6K7 - RIVERSIDE
DMU- 15	0.8424	6I5 - CAPITOL
DMU- 34	0.8411	6L5 - YAKIMA
DMU- 29	0.8365	6K8 - SAN DIEGO
DMU- 27	0.8307	6K6 - SAN MARCOS
DMU- 38	0.8182	6N2 - BAKERSFIELD
DMU- 20	0.8156	6J4 - BOISE
DMU- 12	0.7956	6I1 - REDDING
DMU- 32	0.7954	6L3 - SPOKANE
DMU- 17	0.7897	6J1 - OGDEN
DMU- 6	0.7874	6H1 - EUGENE
DMU- 31	0.7724	6L2 - SEATTLE
DMU- 37	0.7587	6N1 - FRESNO
DMU- 8	0.757	6H3 - WILSONVILLE
DMU- 3	0.7566	6F5 - SN FERNANDO VL
DMU- 26	0.7318	6K5 - NEWPORT BEACH
DMU- 22	0.7298	6J9 - BIG HORN
DMU- 39	0.7213	6N6 - GOLD COAST
DMU- 42	0.7196	6N9 - MONTEREY BAY
DMU- 18	0.7132	6J2 - SALT LAKE
DMU- 25	0.7011	6K4 - LA MESA
DMU- 41	0.7002	6N8 - EAST BAY
DMU- 19	0.677	6J3 - BUTTE
DMU- 40	0.6463	6N7 - SOUTH BAY
DMU- 16	0.6222	6I6 - NORTH BAY

(* DMUs rank from Highest to Lowest)

The most efficient companies, those achieving a DEA score of 100%, are Long Beach, within the Los Angeles BN and Tacoma from the Seattle BN. The least efficient companies include North Bay from the Sacramento BN, achieving 62.2%, and South Bay from the Fresno BN, achieving 64.6%.

Long Beach Company has 41 recruiters assigned to its recruiting centers, of which seven speak Spanish, one speaks Tagalog, one speaks Thai, and two speak Korean, with a total of 11 secondary language recruiters. There are two ways to compute the overall minority percentages: by company or by ethnicity. From FY10 to FY14, the Long Beach Co. recruited 2,041, or 27%, of the 7,400 recruits that the Los Angeles BN produced. Also, Long Beach significantly contributes to Los Angeles BN's overall production numbers by ethnicity. Comparing the total recruits by ethnicity, Long Beach produces 397 whites, or 21% of 1,864 white recruits, 265 African-Americans (32%), 1,064 Hispanics (34%), 306 APIs (20%), and nine Native-Americans (24%).

Table 13. Company Breakdown of Enlisted Recruits by Minorities within the Los Angeles BN

LOS ANGELES BN		NUMBER OF ENLISTED OF MINORITIES FROM FY10 to FY14					
CODE	CO NAME	WHITE	AFRICAN_AMERICAN	HISPANIC	API	NATIVE_AMERICAN	TOTAL ENL BY COMPANY
6F2	SAN GABRIEL VL	290	57	689	459	6	1,501
6F3	LONG BEACH	397	265	1,064	306	9	2,041
6F5	SN FERNANDO VL	561	83	391	155	8	1,198
6F7	COASTAL	270	312	380	168	7	1,137
6F8	LOS ANGELES	346	118	603	449	7	1,523
TOTAL BY ETHNICITY		1,864	835	3,127	1,537	37	7,400

Long Beach Company's production is significant compared to the second largest company producer from Los Angeles BN, Los Angeles Company (code 6F8). The higher number of recruits comes mostly from the 1,064 Hispanic recruits. Los Angeles Co. ranked fifth in the DEA order in Table 12, with 1,523 recruits, as shown in the preceding table. This is 518 less recruits than Long Beach Co. with 2,041. Some might associate that the significant difference with the advantage of having more recruiters, but this is not the case; Los Angeles has 51 recruiters, and Long Beach has only 41. Of those, 13 and 11 have secondary languages, respectively. The data in Table 13, also shows that Los Angeles Co. has a greater population than the Long Beach, 473,578 versus 437,908; yet Long Beach produces more. This evidence validates the DEA results: 100% efficiency falls intuitively to the "best" producer from Los Angeles BN, not only achieving higher recruiting numbers with fewer recruiters and a smaller population but also showing acceptable ratios when analyzing the P2P metric. None of the P2P metrics for Long Beach Co. fall below the 0.75 limit, but Los Angeles scores 0.75 in Hispanic recruits. The overall P2P metrics for the minorities of Long Beach, consolidated at company level, are 1.23 for African-Americans, 0.78 for Hispanics, 1.46 for APIs, and 1.72 for Native-Americans. Table 14 shows the comparison of minority recruits within all Los Angeles BN's companies.

Table 14. Comparison of the Minority Recruit Numbers and Their Populations from Companies within the Los Angeles Battalion

LOS ANGELES BN		AFRICAN_AMERICAN				HISPANIC				ASIAN PACIFIC ISLANDER				NATIVE_AMERICAN				TOTAL POP	TOTAL RACE ENL
CODE	BN NAME	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P		
6F2	SAN GABRIEL VY	57	3.16%	3.80%	1.20	689	51.72%	45.90%	0.89	290	18.58%	19.32%	1.04	459	26.37%	30.58%	1.16	285,538	1,495
6F3	LONG BEACH	265	10.58%	12.98%	1.23	1,064	67.25%	52.13%	0.78	397	13.31%	19.45%	1.46	306	8.72%	14.99%	1.72	437,908	2,032
6F5	SN FERNANDO VL	83	3.52%	6.93%	1.97	391	53.31%	32.64%	0.61	561	35.00%	46.83%	1.34	155	8.00%	12.94%	1.62	336,089	1,190
6F7	COASTAL	312	19.91%	27.44%	1.38	380	29.53%	33.42%	1.13	270	34.71%	23.75%	0.68	168	15.71%	14.78%	0.94	296,021	1,130
6F8	LOS ANGELES	118	5.55%	7.75%	1.40	603	54.67%	39.59%	0.72	346	26.01%	22.72%	0.87	449	13.62%	29.48%	2.16	473,578	1,516

Table 15 illustrates only the P2P break-down for the minorities of all recruiting centers within Long Beach and Los Angeles Companies. This table shows that the centers within Long Beach Co. have better P2P numbers than the recruiting centers within Los Angeles Co. The socio-economic factor is assumed to be negligible. The overall

Table 15. Comparison of the Minority Recruit Numbers and Their Populations from the Recruiting Centers of Long Beach and Los Angeles Companies

LO NG BEACH, LOS ANGELES			AFRICAN_AMERICAN		HISPANIC		WHITE		ASIAN PACIFIC ISLANDER		TOTAL ENL BY CENTER	TOTAL ENL BY COMPANY
Company	RSID	Name	ENL	P2P	ENL	P2P	ENL	P2P	ENL	P2P		
Long Beach	6F3B	LAKEWOOD CENTER	46	60.61	158	0.76	175	1.30	141	1.26	520	2,032
	6F3H	LONG BEACH CENTER	144	97.57	202	0.85	108	0.81	108	1.07	562	
	6F3R	NORWALK CENTER	38	27.39	370	0.85	97	1.32	50	1.63	555	
	6F3V	HUNTINGTON PARK CENTER	37	207.65	334	1.02	17	2.47	7	2.01	395	
Los Angeles	6F8D	HOLLYWOOD CENTER	33	74.64	82	0.49	75	0.48	240	3.00	430	1,516
	6F8E	LA CENTRAL CENTER	42	101.23	234	0.88	23	0.82	54	1.42	353	
	6F8H	BURBANK CENTER	18	38.32	144	0.72	158	1.18	62	1.60	382	
	6F8T	PASADENA CENTER	25	63.24	143	0.85	90	0.97	93	1.53	351	

economic characteristics are similar for Long Beach and Los Angeles populations.[30]

The other company to achieve 100% is Tacoma Co. within the Seattle BN. Tacoma Co. has only 3 recruiters with secondary languages, two who speak Spanish and one who speaks Thai. Its recruiting production for the last five fiscal years is 1,611, or 22%, of 7,281 service members recruited by the Seattle BN. The battalion production by ethnicity yields 219 APIs (24.6%), 241 African-Americans (40%), 113 Hispanics (20%), 1,026 whites (20%), and 12 Native-Americans (10%).

Tacoma Co. also had the highest company recruiting numbers within Seattle BN, which has seven companies total. The company with the second largest recruiting numbers within the Seattle BN was Olympia (code 6L7)—ranked twelfth in DEA order—with 1,236 recruits. Tacoma Co. recruited 375 more recruits than Olympia Co., whose production yielded 30% more recruits. However, note that this marked difference occurs with relatively the same number of total recruiters. Tacoma and Olympia have approximately the same total number of recruiters with 27 and 29, respectively. Tacoma has three recruiters with secondary languages and Olympia two. Therefore, based on DEA criteria, Tacoma is more effective. The economic characteristics are also assumed as a negligible factor due to similar household incomes percentages.[31]

The actual P2P metrics for African-Americans and whites in the Seattle BN are favorable. During the last five years, all companies of the Seattle BN have consistently achieved P2P metrics of more than 0.80 for whites. The P2P metrics for Hispanics, APIs, African-Americans and Native-Americans clearly show the marked effectiveness of Tacoma over the other companies. Table 16 illustrates that Tacoma has 423 recruits from an available minority population of 52,356, achieving its recruits with less than half of the population of Seattle Co., which has 313 recruits from a population of 118,957.

---

[30] United States Census Bureau, "Selected Economic Characteristics," accessed December 18, 2014, http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table

[31] United States Census Bureau, "Selected Economic Characteristics," accessed December 18, 2014, http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?fpt=table

Table 16. Comparison of Minority Recruits Numbers and Their Populations from Companies within the Seattle Battalion

SEATTLE BN		AFRICAN_AMERICAN				HISPANIC				ASIAN PACIFIC ISLANDER				NATIVE_AMERICAN				TOTAL POP	TOTAL RACE ENL
CODE	BN NAME	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P	ENL	% POP	% ENL	P2P		
6L1	EVERETT	16	1.80%	7.96%	4.42	60	52.76%	29.85%	0.57	116	40.36%	57.71%	1.43	9	6.88%	4.48%	0.65	47,428	201
6L2	SEATTLE	27	7.38%	8.63%	1.17	47	34.06%	15.02%	0.44	232	64.05%	74.12%	1.16	7	1.89%	2.24%	1.18	118,957	313
6L3	SPOKANE	13	1.25%	11.61%	9.29	37	59.04%	33.04%	0.56	47	24.05%	41.96%	1.75	15	16.91%	13.39%	0.79	17,838	112
6L4	TACOMA	79	6.88%	18.68%	2.72	113	55.04%	26.71%	0.49	219	39.50%	51.77%	1.31	12	5.46%	2.84%	0.52	52,356	423
6L5	YAKIMA	2	0.82%	0.92%	1.12	189	90.24%	86.70%	0.96	21	4.40%	9.63%	2.19	6	5.36%	2.75%	0.51	57,275	218
6L6	ALASKA	32	2.78%	15.61%	5.60	43	19.67%	20.98%	1.07	81	24.79%	39.51%	1.59	49	55.54%	23.90%	0.43	46,303	205
6L7	OLYMPIA	24	1.83%	8.08%	4.41	78	58.12%	26.26%	0.45	174	28.76%	58.59%	2.04	21	13.12%	7.07%	0.54	24,644	297

There are many other factors for improving recruitment numbers, nevertheless, DEA can be used as a tool to assess changes in conditions such as evolving demographic data, to reallocate recruiting center areas of operation, to update rankings based on new recruiting production and fill-to-demand ratios, or to assess changes in the recruiter's manning, or language-to-recruiter ratios.

The DEA method also validates the low production of those companies attaining the lowest efficiencies. The North Bay and South Bay achieved the bottom positions in the DEA raking order as shown in Table 11. To show this, an additional approach compares the DEA results, which already accounts for the fill-to-demand ratios, to determine the recruit production of North Bay and South Bay within the companies of their respective battalions. The North Bay and South Bay need more recruiters with secondary languages to improve their DEA ranking. Table 17 shows that neither North Bay nor South Bay is within those companies with lesser population, but their recruit production is among the lowest.

Table 17. Sacramento and Fresno BN's Recruits Production

FRESNO BN		TOTAL POP	TOTAL ENL	SACRAMENTO BN		TOTAL POP	TOTAL ENL
CODE	BN NAME			CODE	BN NAME		
6N1	FRESNO	334,049	513	6I0	SIERRA NEVADA	135,159	255
6N2	BAKERSFIELD	207,123	464	6I1	REDDING	166,533	362
6N6	GOLD COAST	240,329	231	6I3	SACRAMENTO VALLEY	164,683	329
6N7	SOUTH BAY	384,573	232	6I4	SAN JOAQUIN	236,186	436
6N8	EAST BAY	421,035	470	6I5	CAPITOL	263,253	511
6N9	MONTEREY BAY	279,380	212	6I6	NORTH BAY	213,906	243

THIS PAGE INTENTIONALLY LEFT BLANK

V. APPLICATION OF THE ANOVA TEST

A. THE ANOVA TEST APPLICATION

The analysis of variance test is a method for comparing the means of multiple factors in a data set simultaneously.[32] In Chapter 3 we tested the hypothesis that the means of two samples of fill-to-demand ratios, are the same for all recruiters despite their language capabilities, using the sample means $\overline{x}$ and $\overline{y}$. The ANOVA test also uses hypothesis-testing to investigate mean effectiveness, but simultaneously compares multiple factors associated with each specific language, and its mean effect on the fill-to-demand ratio.

We have already statistically shown through hypothesis-testing that in four of the battalions, additional recruiter language skill is a recruiting multiplier. The ANOVA combines the effect of the population and recruiters, as new factors, by assigning the observed languages as their levels. The results of the ANOVA test are expressed in terms of the quantitative effect on those assigned language levels. This chapter answers whether recruiters who speak secondary languages are more effective in those companies that reflect predominant languages that match the recruiter's secondary languages. There are three primary factors under investigation:

1. The factors pertaining to the fill-to-demand ratios are represented by the variable F for each company population c.

2. The demographic factor represented as P assigns the predominant languages within all the zip codes among the recruiting companies c. This factor is indexed with languages x for levels of English, Spanish, Chinese, Korean, and Tagalog, having variable X as the total number of languages in the population. These x levels are assigned to the recruiting company populations of which different languages are predominant.

3. The factor of the recruiter languages, R, is indexed with y language levels similar to those that factor P assigns but with a different classification criterion. Factor R assigns its y language levels— English, Spanish, Chinese, Korean, and Tagalog — when more than 5 percent of a

[32] Devore, *Probability and Statistics*, 410.

company's recruiters *r* speak any of those languages. The variable Y represents the total number of recruiters' languages throughout the 6th REC BDE.

B. SOME NOTATION FOR ANOVA

The fill-to-demand factor $F_{x,y}$ represents the consolidation of the fill-to-demand ratios of the *x*th population language level drawn from the *y*th recruiter's language. This consolidation computes the demographic language mean $\overline{P}_{x}\cdot$, which reflects the effect of the language on the company's populations. The mean factor $\overline{P}_{x}\cdot$ is computed as follows:

$$\overline{P}_{x}\cdot = \frac{P_{x,1} + \cdots + P_{x,r}}{r} \text{ for } 1 \leq x \leq c$$

Similarly, the $\overline{R}\cdot_{y}$ formula is:

$$\overline{R}\cdot_{y} = \frac{R_{1,y} + \cdots + F_{c,y}}{c} \text{ for } 1 \leq y \leq r$$

The grand mean $\overline{F}_{x,y}$ is then:

$$\overline{F}_{x,y} = \frac{\sum_{x=1}^{X}\sum_{y=1}^{Y} \overline{P}_{x}\cdot \, \overline{R}\cdot_{y}}{XY}$$

In other words, $\overline{F}_{x,y}$ simultaneously computes the variations of the fill-to-demand ratios corresponding with the population and recruiter languages.[33]

C. CLASSIFICATION OF THE POPULATION LANGUAGE FACTOR

The classification of factor *P* highlights the actual *y* language level effects latent in every recruiting company region as reported by the U.S. Census Bureau. The Census Bureau conducts the American Community Survey (ACS) annually to show the estimated

[33] Devore, *Probability and Statistics*, 443.

population who speaks languages other than English.[34] Table 18 shows that in California, among those who speak a foreign language at home, an estimated 70.4% of this population is 18 to 64 years old. Within this population, 20 to 24% have high school or college degrees.[35] The presence of this pool of prospects, who speak foreign languages and are qualified academically, suggests the value of outreach.

Table 18. Characteristics of People by Language Spoken at Home in California

	Percent distribution of people who speak a language other than English at home			
	Total		Spanish or Spanish	
California	Estimate	Margin of Error	Estimate	Margin of Error
Total population 5 years and over	15,581,992	+/-30,935	10,226,305	+/-25,764
AGE				
5 to 17 years	19.4%	+/-0.1	23.1%	+/-0.1
18 to 64 years	70.4%	+/-0.1	69.8%	+/-0.1
65 years and over	10.2%	+/-0.1	7.1%	+/-0.1
NATIVITY AND CITIZENSHIP STATUS				
Native population 5 years and over	40.8%	+/-0.1	49.5%	+/-0.1
Foreign-born population 5 years and	59.2%	+/-0.1	50.5%	+/-0.1
Naturalized U.S. citizen	27.3%	+/-0.1	16.1%	+/-0.1
Not a U.S. citizen	31.9%	+/-0.1	34.3%	+/-0.2
POVERTY STATUS IN THE PAST 12 MONTHS				
Population 5 years and over for whom poverty status is determined	15,337,914	+/-31,857	10,059,614	+/-26,234
Below poverty level	20.5%	+/-0.2	24.0%	+/-0.2
At or above poverty level	79.5%	+/-0.2	76.0%	+/-0.2
EDUCATIONAL ATTAINMENT				
Population 25 years and over	10,697,208	+/-18,121	6,487,780	+/-14,047
Less than high school graduate	33.4%	+/-0.2	45.6%	+/-0.2
High school graduate (includes	20.7%	+/-0.1	23.5%	+/-0.2
Some college or associate's degree	21.6%	+/-0.1	20.7%	+/-0.2
Bachelor's degree or higher	24.3%	+/-0.1	10.2%	+/-0.1

[34] United States Census Bureau, "American Community Survey," accessed November 20, 2014, http://factfinder2.census.gov/faces/nav/jsf/pages/programs.xhtml?program=acs.

[35] United States Census Bureau, "Characteristics of People by Language Spoken at Home," accessed November 20, 2014, http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?fpt=table.

The presence of foreign languages is also significant throughout all ten states that compose the 6th REC BDE area. Table 19 shows the 2013 estimated distributions of people who speak a second language for these ten states, as collected by the U.S. Census Bureau from the American Fact Finder of the 2013 3-year ACS estimates. The data shows that such populations are even more significant; the academic projection of the people who graduate from high school or earn college degrees range from 20 to 37%. This data seems to be even more significant than the data from California due to the fact that California has the highest percentage of the population that does not graduate from high school.

Table 19. Characteristics of People by Language Spoken at Homes within Ten States

	Percent distribution of people who speak a language other than English at home									
	California	**Washington**	**Oregon**	**Utah**	**Nevada**	**Idaho**	**Montana**	**Wyoming**	**Alaska**	**Hawaii**
6th Recruiting Brigade State Footprint	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Total population 5 years and over	15,581,992	6,452,439	3,667,247	2,599,481	2,573,728	1,481,887	945,877	537,057	674,772	1,300,144
AGE										
5 to 17 years	19 4%	0 178	0 171	0 243	0 186	0 21	0 172	0 184	0 198	0 166
18 to 64 years	70 4%	68 20%	67 10%	65 30%	67 30%	64 60%	66 10%	67 70%	71 00%	67 20%
65 years and over	10 2%	0 14	0 158	0 104	0 14	0 143	0 167	0 139	0 093	0 162
NATIVITY AND CITIZENSHIP STATUS										
Native population 5 years and over	40 8%	85 80%	89 60%	90 80%	79 60%	93 70%	97 90%	96 30%	92 30%	81 00%
Foreign-born population 5 years	59 2%	14 20%	10 40%	9 20%	20 40%	6 30%	2 10%	3 70%	7 70%	19 00%
Naturalized U S citizen	27 3%	6 60%	4 10%	3 30%	9 00%	2 30%	1 10%	1 30%	4 10%	10 70%
Not a U S citizen	31 9%	7 60%	6 30%	5 90%	11 50%	4 00%	0 90%	2 40%	3 50%	8 30%
POVERTY STATUS IN THE PAST 12 MONTHS										
Population 5 years and over for whom poverty status is determined	15,337,914	6,326,750	3,596,272	2,553,350	2,536,682	1,451,890	922,667	523,488	659,266	1,265,013
Below poverty level	20 5%	0 134	0 165	0 126	0 154	0 154	0 153	0 114	0 096	0 112
At or above poverty level	79 5%	0 866	0 835	0 874	0 846	0 846	0 847	0 886	0 904	0 888
EDUCATIONAL ATTAINMENT										
Population 25 years and over	10,697,208	4,640,203	2,673,399	1,641,750	1,840,605	1,014,097	683,938	380,967	461,441	948,912
Less than high school graduate	33 4%	9 80%	10 40%	9 00%	15 30%	10 90%	7 50%	7 70%	8 20%	9 40%
High school graduate (includes	20 7%	23 60%	24 70%	23 10%	28 70%	27 50%	29 70%	30 10%	28 00%	27 90%
Some college or associate's	21 6%	34 50%	34 90%	37 10%	33 40%	36 00%	33 90%	36 90%	36 30%	32 50%
Bachelor's degree or higher	24 3%	32 10%	30 00%	30 80%	22 50%	25 60%	28 90%	25 30%	27 40%	30 30%

The population factor P assigns its x languages levels using the highest percentage deviation δ for each company region c. The percent deviation is calculated using the observed percentages of the population demographics by zip code, and the true values as the demographics provided by the 6th REC BDE for the POI distributions of the population ages from 17 to 29 years old. The true percentage values are 55% of Hispanics, 20% of API, 18% of whites, and 7% of African-Americans. The API population was broken down into the estimated distributions of the Asians and Pacific Islanders as collected from the U.S. Census. The equation to compute the company's deviation percentages is as follows:

$$\delta_x = \frac{\textit{Observed}\ \%\ \text{population} - \textit{True}\ \%\ \text{population}}{\textit{True}\ \%\ \text{population}}$$

Therefore, the categorization of the *x* language level for each company *c* is based on the highest δ_x found among the existing languages. The population for each company is a collection, or the sum, of all the zip codes describing the languages estimates within those. The *x* language level is the one with the highest observed population deviation in population above the brigade's average.

D. CLASSIFICATION OF THE RECRUITER'S LANGUAGE FACTOR

The recruiter language factor *R* targets the different languages levels using the actual 6th REC BDE assignment of recruiters with secondary languages within its companies. The categorization of *y* language level for factor *R* is based on whether the *y* level matches the selected *x* language, for the given company under investigation, and also that same company has at least 5% of the recruiters of the same language. When both levels match the match number equals to 1, otherwise equals 0. For example, if a company is coded to have a predominantly Hispanic population, the recruiter languages— the factor R_y—are coded to be zero unless the company has recruiters with Spanish language skills, and, these recruiters make up is at least 5% of the total in the company.

E. DATA COLLECTION

Using both the population and the recruiter language factors, recruiting companies are classified according to the respective levels. The factor P_x categorizes each company with the highest δ_x—the highest observed population—and the R_y is either 0 (the default value) or 1 if it complies with the following criteria: First, the secondary languages of the recruiters assigned to any given company need to match the selected language in factor P_x. Second, the amount of the recruiters with that specific language needs to be more than 5% of the overall total of recruiters in each company. The data collected is shown in the following Table 19.

Table 20. 6th REC BDE's Company Data with Assigned Languages Levels for the Population Factor P and the Recruiting Factor R

Company	Factor P_x Demographic Language	Factor R_y R_y=1, if Recruiter's Language match Factor P_x; and if more than 5% of those Recruiters are assigned to the Company R_y=0, otherwise	Demand	Filled
6F2 - SAN GABRIEL VL	Hispanic	1	425	434
6F3 - LONG BEACH	Hispanic	1	557	526
6F5 - SN FERNANDO VL	Hispanic	1	392	323
6F7 - COASTAL	English	1	330	276
6F8 - LOS ANGELES	Hispanic	1	395	407
6H1 - EUGENE	English	1	283	177
6H2 - VANCOUVER	English	1	462	363
6H3 - WILSONVILLE	Hispanic	0	307	194
6H5 - HONOLULU	Tagalog	1	637	596
6H7 - GUAM	Tagalog	1	170	147
6I0 - SIERRA NEVADA	Hispanic	1	250	222
6I1 - REDDING	English	1	372	307
6I3 - SACRAMENTO VL	English	1	360	304
6I4 - SAN JOAQUIN	Hispanic	1	415	393
6I5 - CAPITOL	English	1	472	478
6I6 - NORTH BAY	Hispanic	0	347	220
6J1 - OGDEN	English	1	373	247
6J2 - SALT LAKE	English	1	489	310
6J3 - BUTTE	English	1	217	168
6J4 - BOISE	English	1	315	232
6J6 - LAS VEGAS	Tagalog	0	653	595
6J9 - BIG HORN	English	1	146	109
6K1 - REDLANDS	Tagalog	0	537	463
6K2 - FULLERTON	Korean	0	417	358
6K4 - LA MESA	Tagalog	1	393	324
6K5 - NEWPORT BEACH	Chinese	0	241	175
6K6 - SAN MARCOS	Tagalog	0	498	465
6K7 - RIVERSIDE	Hispanic	1	634	583
6K8 - SAN DIEGO	English	1	311	222
6L1 - EVERETT	Korean	0	282	234
6L2 - SEATTLE	Chinese	0	271	221
6L3 - SPOKANE	English	1	286	228
6L4 - TACOMA	Tagalog	0	452	387
6L5 - YAKIMA	Hispanic	1	220	177
6L6 - ALASKA	English	1	226	217
6L7 - OLYMPIA	English	1	376	287
6N1 - FRESNO	Hispanic	1	571	484
6N2 - BAKERSFIELD	English	1	452	418
6N6 - GOLD COAST	Chinese	0	317	203
6N7 - SOUTH BAY	Chinese	1	318	212
6N8 - EAST BAY	English	1	551	426
6N9 - MONTEREY BAY	Korean	1	330	200

F. THE ANOVA TEST IMPLEMENTATION

Similar to the initial hypothesis-test the null hypothesis claims that the fill-to-demand mean factor, $\overline{F}_{x,y}$, are "the same everywhere," as it disregards the effects of the population and the recruiters languages on the mean disregarding the different regions where ethnic distributions and languages fluctuates." To do this the ANOVA model defines the following hypothesis parameters:[36]

The null hypothesis for the ANOVA model has the following formulation settings and assumptions:

1) We model the fill-to-demand mean as $\bar{F}_{x,y} = \mu_{x,y} + \varepsilon_{x,y}$, where the $\mu_{x,y}$ is the true average response and the errors $\varepsilon_{x,y} \sim N(0,\sigma^2)$ are assumed to be normally distributed, with mean =0 and common variance σ^2.

2) The model for the factors under study factors are represented in the true average response as $\mu_{x,y} = \mu + P_x + R_y$, where the the true average response include the factors effects.

3) The null hypotheses H_O are:

$$H_{OP}: P_1 = \cdots = P_r = 0$$

$$H_{OR}: R_1 = \cdots = R_c = 0 \quad where \sum_{x=1}^{X} P_x = 0 \; and \; \sum_{y=1}^{Y} R_y = 0.$$

4) The alternative hypotheses Ha contradict the Ho as:

Ha_P : At least one $P_x \neq 0$

Ha_R : At least one $R_y \neq 0$

To reject the Ho at an α level of significance of 0.10 the p-value must be equal or less than 0.10 for any of the factors P and R. For P_x the rejection means that either language have a different effect on recruiting, for the R_y, a rejection means that having a langauge has a different effect.

G. THE ANOVA RESULTS AND MODEL INTERPRETATION

The ANOVA test uses the following ten consolidated fill-to-demand ratio, factored by the values in Table 19, to compute if these factors have a statistical effect on

[36] Devore, *Probability and Statistics*, 443.

the grand mean $\overline{F}_{x,y}$. Table 20 shows the consolidated fill-to-demand ratios as assigned to the factors P_x and R_y.

Table 21. Consolidated Fill-to-Demand Ratios (or Means) Based on Population and Recruiter Languages

Factor P_x

Factor R_y	Chinese	English	Hispanic	Korean	Tagalog
0	0.722557	0.658346	0.78265	0.829787	0.892523
1	0.666667	0.796322	0.907044	0.858513	0.889167

As seen in Table 21, the mean values fluctuate in two ways, as the language levels of P_x and R_y change. The p-value results— for both factors— of the Two-way ANOVA test make possible to reject the null hypothesis that says none of these means are different. It can be seen that these means in Table 21 are different, but are these mean differences statistically significant?

Figure 4 shows the results of each level of factor P_x, represented as the Demog. Language variable in the x-axis. The diamond-shaped symbols illustrate the effect that the language has to recruiting. The Spanish, Korean and Tagalog languages reflect to have higher means values than the grand mean $\overline{F}_{x,y}$, which it is 0.800335. The Chinese and English languages lie below the grand mean.

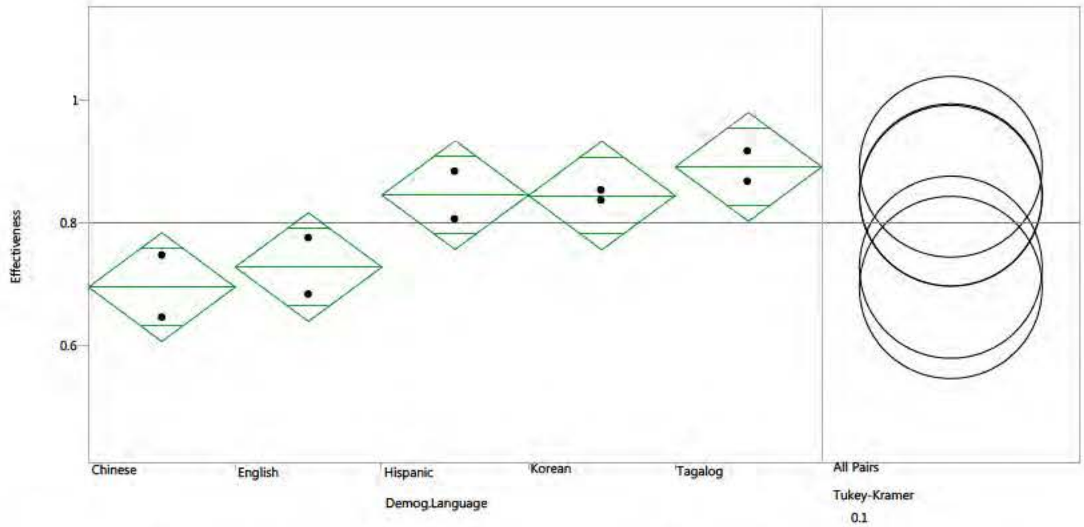


Figure 4. Two-way Analysis of Effectiveness By Population's and Recruiter's Language Factors

The corresponding level means are summarized in Table 21. Graphically, the majority of the confidence intervals cross the grand mean, therefore in those cases the factor P_x could result in occurrences in the null hypothesis, $H_{OP}: P_1 = \cdots = P_r = 0$, not being rejected.

Table 22. Language Level Means for the Results of the Two-way ANOVA

Level	Number	Mean	Std Error	Lower 90%	Upper 90%
Chinese	2	0.69461	0.04162	0.60588	0.7833
English	2	0.72733	0.04162	0.6386	0.8161
Hispanic	2	0.84485	0.04162	0.75611	0.9336
Korean	2	0.84415	0.04162	0.75541	0.9329
Tagalog	2	0.89085	0.04162	0.80211	0.9796

This case applies to the English, Spanish, and Korean levels.[37] However, the interpretation of the p-value of 0.0993 shown in Table 22 provides statistical evidence

[37] Devore, *Probability and Statistics*, 422.

that the null hypothesis $H_{OP}: P_1 = \cdots = P_r = 0$ is rejected for the P_x factor, giving grounds to conclude that at least one of the language levels appear to be different. Based on this model, the language of the population is a factor that drives the effectiveness of the fill-to-demand ratio and, more generally, the recruiting mission. On the other hand, the p-value of the recruiter's language factor shows that the null is not rejected. In other words, having at least 5% of the recruiter's matching the population factor P_x is not statistically significant to changes in the fill-to-demand ratio.

Table 23. The P-value Results

Two-way Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	P-Value
Factor P_x (Demog.Language)	4	0.0572	0.0143	4.1268	0.0993
Factor R_y (Match5%)	1	0.00538	0.00538	1.5513	0.2809

The data for the factor P_x seem to suggest in regions where Spanish, Korean, and Tagalog are spoken recruiting is more attainable than the areas where English and Chinese languages predominates. This suggests that it is more effective to allocate recruiters with Spanish, Korean, and Tagalog secondary languages to areas demographically matching their skills, and these be the first ones to select for assignment.

These results can be complemented with the DEA ranking method to prioritize the assignment of Spanish, Koreans, and Tagalog speakers to those companies at the bottom of the DEA order. New assignments will benefit more in those areas where Spanish, Korean, and Tagalog prevail. Another tool for interpretation, to choose whether any of these languages would bring more recruits, is the confidence intervals shown inside the diamond-shaped objects in in Figure 4. The closer the confidence intervals the less chance of variability for the mean to raise or drop. Therefore, recruiters who speak Korean language pose a better overall option for assignment, followed by the Tagalog and then the recruiter Spanish speakers, regardless of whether they match the predominant language of the population.

The result of the p-value for the factor R_y was anticipated because it shows the reality of the current situation. In general, there are not many recruiters with secondary languages across the 6th REC BDE. Although recruiters with secondary language improve recruiting—as we have seen previously—the consolidation of the data for the ANOVA test leaves just ten observations. When a researcher does not have a large amount of observations (*large-N*), it is unusual to obtain statistical results that prove to be meaningful. The actual data shows that by taking observations at random the recruiter's languages do not appear to have a significant effect. The p-value of 0.2809 is interpreted as anticipating a statistical effect just once for every three occurrences, and for statistical purposes this is far too low to accept as significant.

An alternate method that takes into account large sample sets is the hypothesis test comparing sample proportions. This method will test the factor R_y using all the consolidated mean observations in Table 20, as well as the individual fill-to-demand ratios as proportions. This method is covered in the next chapter.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. APPLICATION OF THE LARGE-SAMPLE α-LEVEL HYPOTHESIS TEST

A. LARGE-SAMPLE PROPORTION TESTS

The sample proportions test assumes the company's fill and demand observations as independent trials of successes or failures. The amount of observations has to be taken into account completely for the hypothesis tests as compared to the ANOVA test, which compressed all the information into just ten observations.

B. THE SAMPLE PROPORTION MODEL

The null hypothesis for the large-sample mean proportion test has the following formulations and assumptions:

1) We model the large-sample α-level test statistic Z under the assumption that for the null hypothesis H_O:

$H_O: r_{Match,y} \geq r_{NoMatch,y}$,

in which *Match* is 1, *NoMatch* is 0, y represents the five languages as Chinese (ch), English (en), Hispanic (hp), Korean (ko), and Tagalog (ta).

The null hypothesis for factor R_y infers that the effect of having recruiters with language skills that match the population is equal to or greater than $r_{NoMatch,y}$ when the recruiter's language match the language of the population.

2) The alternative hypothesis Ha for each language contradict Ho :

$Ha: r_{1,ch} < r_{0,\, ch}$

$Ha: r_{1,en} < r_{0,\, en}$

$Ha: r_{1,hp} < r_{0,\, hp}$

$Ha: r_{1,ko} < r_{0,\, ko}$

$Ha: r_{1,ta} < r_{0,\, ta}$

Rejecting the null hypothesis will provide strong evidence for the alternatives hypotheses to conclude that recruiters with languages matching the real population does not produce a larger effect on recruiting.

3) The test statistic Z is formulated as follows:

$$Z = \frac{\hat{r}_{1,y} - \hat{r}_{0,y}}{\sqrt{\hat{r}_c(1-\hat{r}_c)\left(\frac{1}{m}+\frac{1}{n}\right)}} \; ; \; \hat{r}_c = \frac{filled_1 + filled_0}{demand_1 + demand_0}.$$

The *filled* variables represent the number of recruited out of the *demand* for each company. Using a α level of 0.05, the corresponding rejection region is $Z_{0.05}$= -1.645. A test statistic Z less than -1.645 rejects the null hypothesis.

C. IMPLEMENTING THE LARGE-SAMPLE PROPORTION TEST

The test statistic Z for the recruiters that speak Chinese and Tagalog fell in the rejection region and the result of their p-values is less than 0.05. This rejects the null hypothesis. Therefore, strong evidence suggests that matching recruiters who speak Korean and Chinese to the population does not necessarily improve recruiting. Nevertheless, Korean recruiters do well overall despite of operating in a population in which the Korean language prevails as shown in Chapter 5.

Table 24. Fill and Demand data for the Recruiter's Languages Levels

	6th REC BDE	*Parameters for Matching R_y*		*Parameters for No Matching R_y*		*Standard Error*	*Test Statistic, Z*	**Reject the HO? YES, if Z <= -1.644**	**P-value**
		Filled	*Demand*	*Filled*	*Demand*	*r_c*			
Factor R_y Levels	Chinese	212	318	599	829	0.7071	-1.8618	YES	0.0313
	Hispanic	3,549	3,859	414	654	0.8781	20.7207	NO	1.0000
	Korean	200	330	592	699	0.7697	-8.5652	YES	5.40E-18
	Tagalog	1,067	1,200	1,910	2,140	0.8913	-0.2990	NO	0.3825

On one hand the effect of targeting the populations who speak Tagalog proves beneficial for recruiting. On the other hand, the effect of matching recruiters who speak

Tagalog is not a statistically significant factor. Conversely, the p-value of 1.00 for the Hispanic level strongly suggests that it completely disagrees with the null hypothesis as originally proposed. In cases like this, when having p-values of 1.00 a new null hypothesis stating the opposite as originally claimed would be the inference to use. In this way, testing the null hypothesis as: $Ho: \ r_{1,hp} \le r_{0,\, hp}$, a claim that supports the recruiters who speak Spanish does not have to match its population languages to have a larger effect. The alternative hypothesis $Ha: \ r_{1,hp} > r_{0,\, hp}$, which claims the opposite, that the Hispanic recruiters matching their population do not produce a significant effect, results in completely rejecting the new null with a p-value of 0.00. Therefore, we find the strongest possible evidence that of all the language levels of the minorities, recruiters who speak Spanish produce the greatest effect when assigned to population where the prevalent language is Spanish.

THIS PAGE INTENTIONALLY LEFT BLANK

VII. DISCUSSION AND CONCLUSIONS

The statistical procedures used in this research have proved that language is a definitive factor that deserves detailed attention, because sampling the performances of different population and recruiter data subsets produces a variability that can be statistically measured. Each method highlights that there are large and small effects associated with language. This research shined light for recruiter language as a source for reaching minorities, and improving recruiting in general.

The first hypothesis test used one of the measures of mission success—the fill-to-demand ratio—to validate each of the battalions in terms of its fill-to-demand performance during the last five fiscal years and the number of recruiters with secondary languages. The average of recruiters per battalion was the threshold to categorize two samples of recruiting centers as above or below those averages. The two samples mean test suggested that four of the seven battalions, including Los Angeles, Portland, Salt Lake City, and Fresno, validated that having more recruiters with secondary languages positively impacts mission success. Two other battalions, Sacramento and Southern California, also showed an increase in their fill-to-demand ratios, as their test statistics fall very close to the rejection region, although the results were not statistically significant. The Data of the Seattle BN did not suggest any distinguishable statistical evidence regarding the presence of recruiters with secondary languages; in fact, it showed the lowest P2P ratios for all minorities among the battalions.

The DEA ranking method corresponded closely with P2P production achievers. As expected, the recruiting production by ethnicity, what the P2P measures, correlated with more efficient companies from the DEA method. Therefore, DEA could help identify the lower efficiency companies, as the ones to be first considered when assigning recruiters with secondary languages.

The ANOVA test provided a way to bring light to the language effect from the data. ANOVA aimed to simultaneously associate a higher or lower effect from the population prevalent languages and the observed occurrences. The population languages proved statistically significant. This research suggests that identified populations whose language effects resulted in means above the brigade's grand mean—Spanish, Korean, and Tagalog—are the populations to prioritized to effectively improve recruiting of minorities. Overall, Chinese and English fell below the grand mean, but this research does not explore the reason behind these findings.

The matching R_y factor proved essential for assignment. It was not possible to simultaneously confirm the validity of the two factors using the ANOVA test was not possible. To confirm the validity of R_y the Large-Sample test was used to determine whether the effect of matching the recruiters suggested statistical significance assuming the filled and demand data as trials of successes or failures. Out of all the languages, the recruiters who spoke Spanish resulted to be the ones to prioritize to populations where Spanish is prevalent.

This research showed statistically that recruiters who have second-language skills contribute to the recruiting mission. Therefore, the U.S. military must continue to advance opportunities for Americans of all backgrounds. By integrating other cultures, the military enables its troops to be more adaptable, flexible, and competent against an array of culturally diverse threats from all over the world. Ethnic diversity in the United States enriches its society with people of all varying backgrounds who have historically contributed to and developed their communities. These groups enrich the U.S. military as well. America's diversity is a source of strength and a competitive advantage that creates the conditions to recruit, develop, and retain the most capable people the nation has to offer.[38]

[38] Department of the Army, *United States Diversity Roadmap*, 8.

VIII. FUTURE WORK

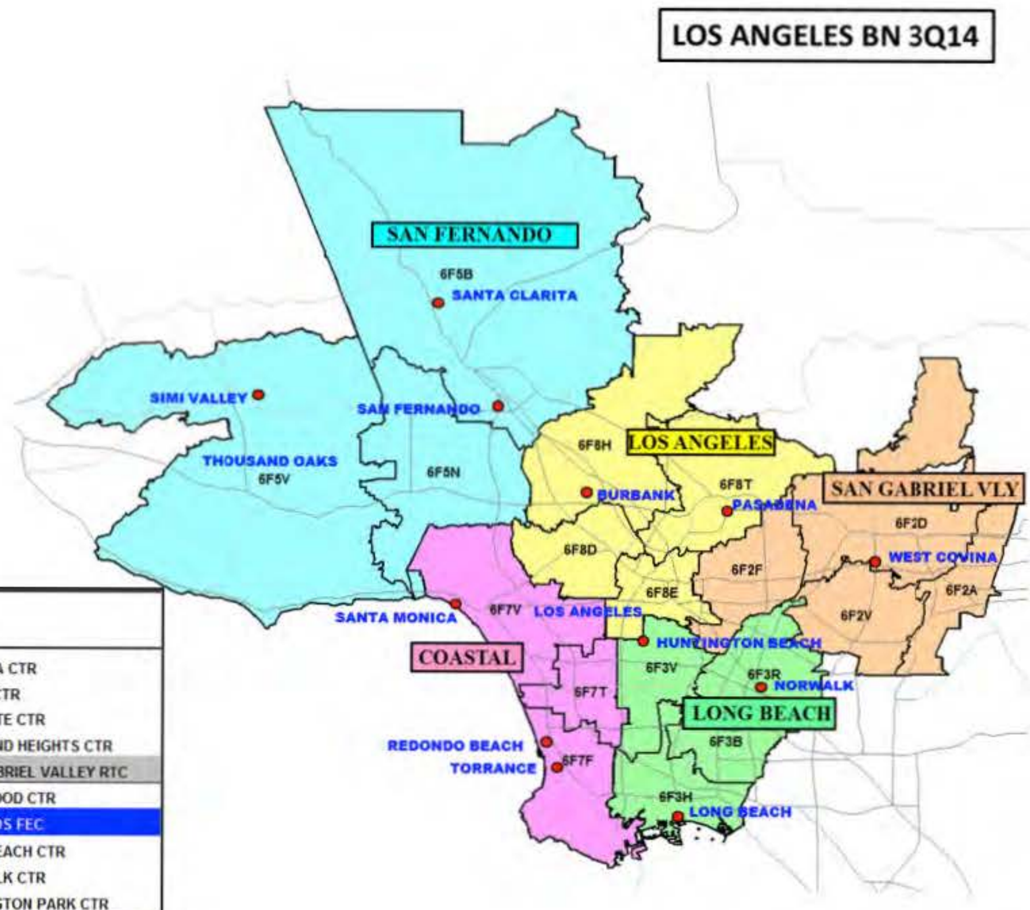
The goal of this research, to analyze the effect of the minority languages, such as Spanish, Tagalog, Chinese, or Korean, to maximize recruiting can be better addressed by collecting the specific types of languages for both the recruits and recruiters down to the recruiting center level. This would help greatly to improve the collection of the recruit languages, whatever that language might be, without limiting to the ones mentioned before.

The 6th REC BDE is continues to track the recruiting rate for Hispanics and Asians and Pacific Islanders, as well as monitoring the whites, African-Americans, and the Native-American communities. The research provides two important recommendations. First, to start tracking all languages spoken by recruits when they first join the Army. The assumptions made using language estimates from the U.S. Census are appropriate, but are not as precise as they could be. The recruit's language data by zip code should be consolidated by recruiting centers. This can lead to better understanding the language tendencies of specific recruiting areas of concern. In this way, the effect of various languages can be matched with the population estimates by zip code, and even the fill-to-demand ratios can be expressed at language level, so the effect of each language can be analyzed separately. Second, the data collected for APIs needs to be broken down into the most common Asian ethnicities, due to the fact that data from the U.S. Census shows that foreign languages are incrementing in households. We cannot rely on ethnicity to infer a spoken language, as there is also a tendency of minorities that do not speak their families' dialect. Therefore, actual foreign languages' tendencies in the 6th REC BDE recruiting footprint are essential, ANOVA can measure how significant those tendencies are for improve recruiting. For the ANOVA test to work, it also needs to have the specific recruiter's language by recruiting center to accurately determine the language effect broadly.

The advantage of having specific language data is that it will bring insight, different for every battalion, which might uncover facts that have not been explored before. As an example, this kind of study can also be effective for facility location planning. The planning assumptions might be to close recruiting centers, or, to determine optimal areas in which recruiting can be maximized by adding more recruiters. The maximization of resources can be better projected in the long term with an analysis of more specific data. The key is to assess indicators to find the right models that optimize recruiting within a given region. Whether the indicators include language or any other measure of interest, the approach will be similar. However, each region will have its own indicators of “key terrain” on which to build different local strategies.

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION

The colored areas represent each 6th REC BDE's company recruiting footprint.



RSID	NAME
6F2A	POMONA CTR
6F2D	AZUSA CTR
6F2F	EL MONTE CTR
6F2V	ROWLAND HEIGHTS CTR
6F2	SAN GABRIEL VALLEY RTC
6F3B	LAKEWOOD CTR
6F3B1	CERRITOS FEC
6F3H	LONG BEACH CTR
6F3R	NORWALK CTR
6F3V	HUNTINGTON PARK CTR
6F3	LONG BEACH RTC
6F5B	SANTA CLARITA CTR
6F5B1	GRANADA HILLS FEC
6F5N	SAN FERNANDO VALLEY CTR
6F5V	SIMI VALLEY CTR
6F5	SAN FERNANDO RTC
6F7F	TORRANCE CTR
6F7T	INGLEWOOD CTR
6F7V	CULVER CITY CTR
6F7	COASTAL RTC
6F8D	HOLLYWOOD CTR
6F8D1	KOREA TOWN FEC
6F8E	LA CENTRAL CTR
6F8H	BURBANK CTR
6F8T	PASADENA CTR
6F8	LOS ANGELES RTC

Figure 5. Los Angeles Battalion Map

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

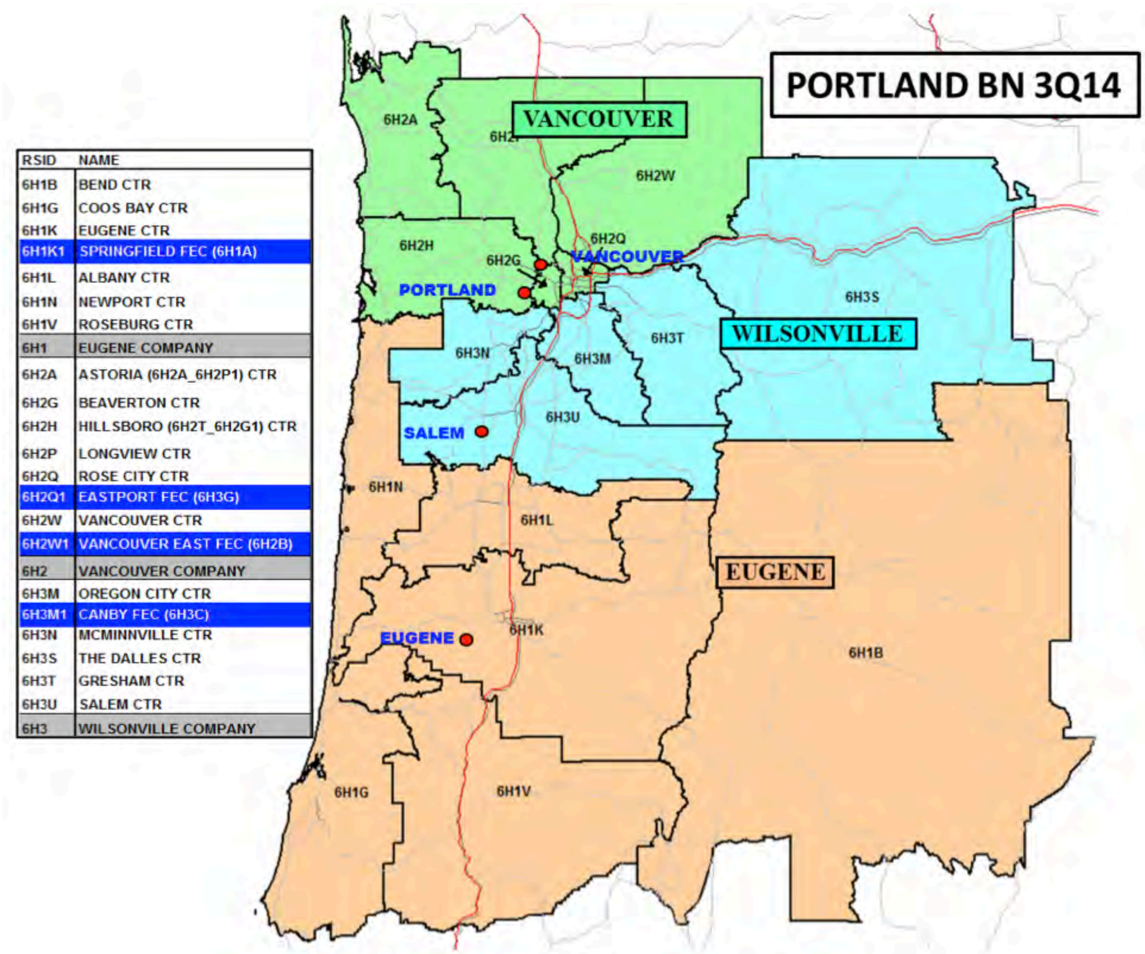


Figure 6. Portland Battalion Map 1

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

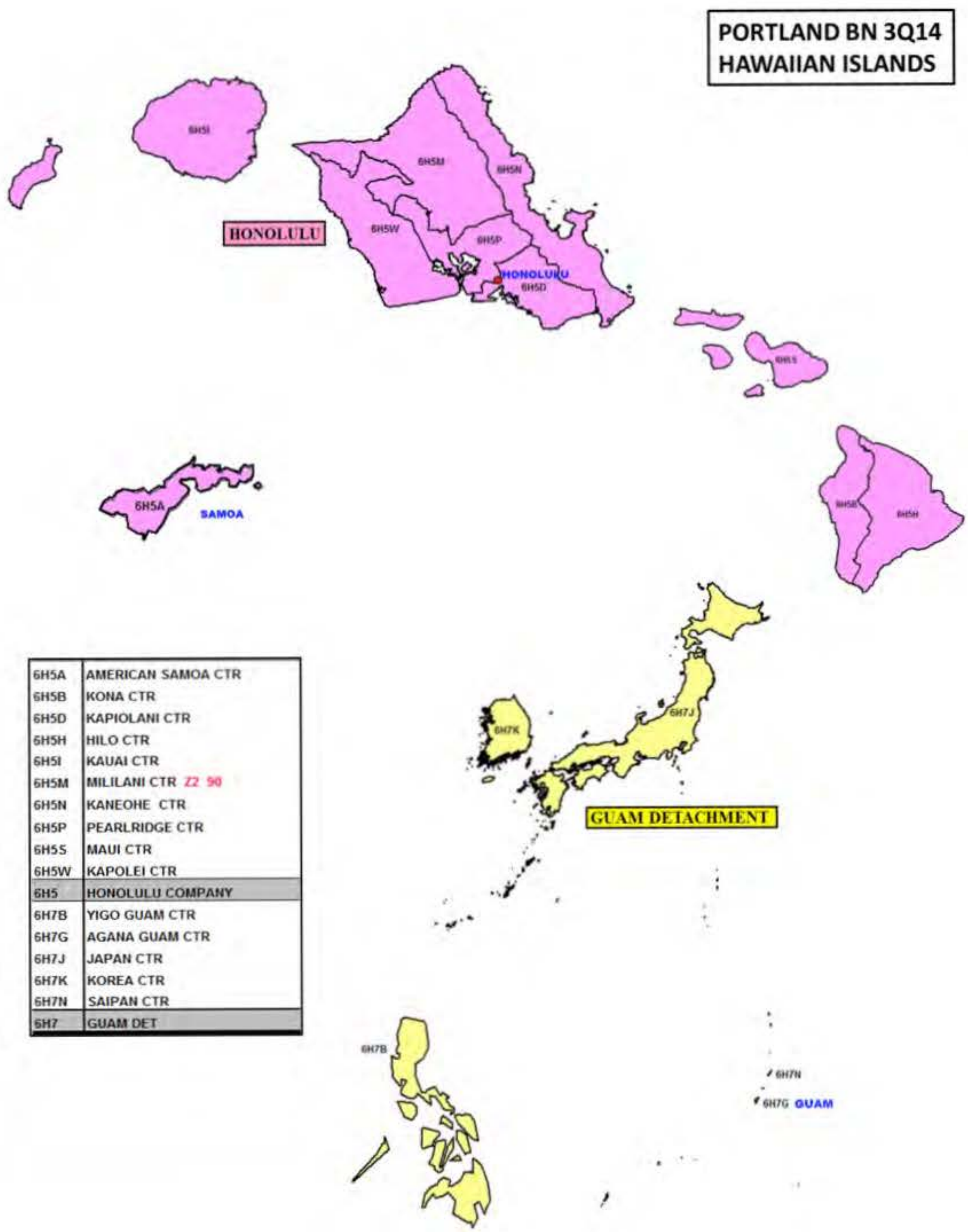
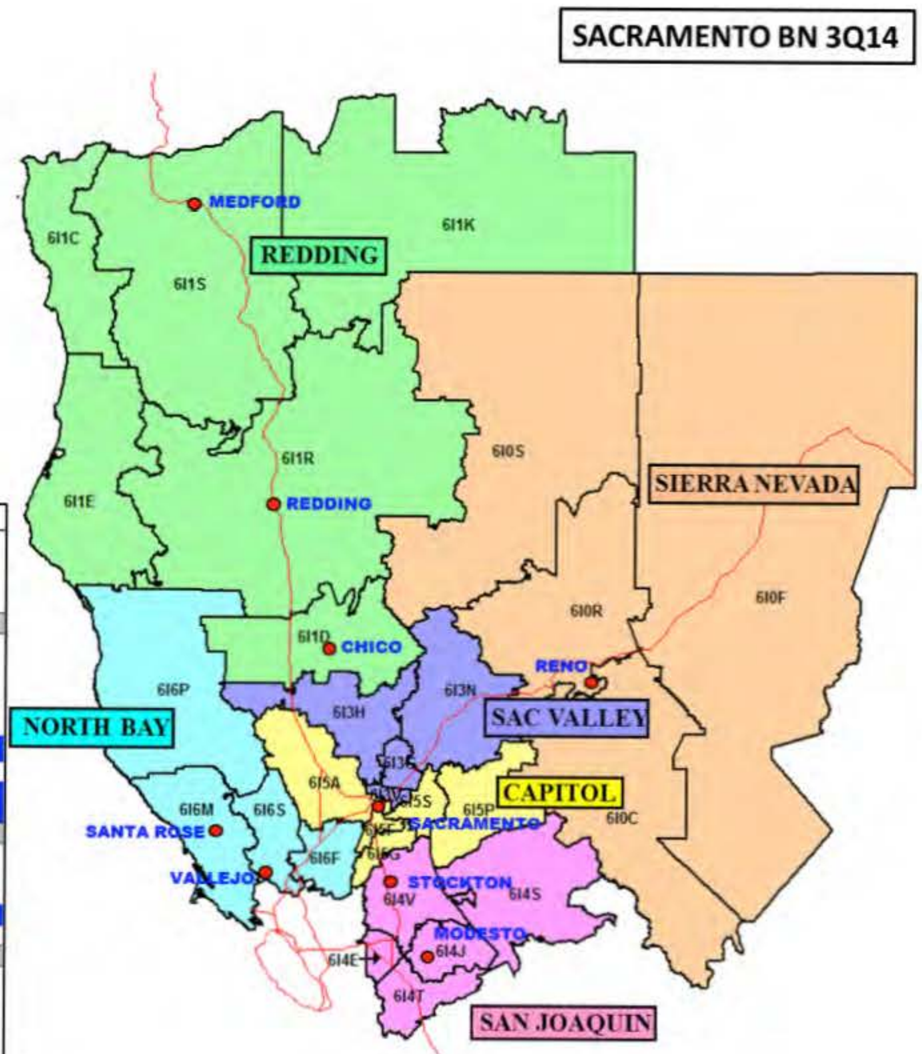


Figure 7. Portland Battalion Map 2

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)



RSID	NAME
6I0C	CARSON CITY CTR
6I0F	FALLON CTR
6I0R	RENO-S CTR
6I0S	SUSANVILLE-S CTR
6I0	SIERRA NEVADA RTC
6I1C	CRESCENT CITY CTR
6I1D	CHICO CTR 22 90
6I1E	EUREKA CTR
6I1K	KLAMATH FALLS CTR
6I1R	REDDING CTR
6I1R1	RED BLUFF FEC (6I1B)
6I1S	MEDFORD CTR
6I1S1	YREKA FEC (6I1V)
6I1S2	GRANTS PASS FEC
6I1	REDDING CO
6I3G	ROSEVILLE CTR
6I3H	YUBA CITY CTR
6I3N	AUBURN CTR
6I3N1	GRASS VALLEY FEC (6I3D)
6I3V	FAIR OAKS CTR
6I3	CTRRAMENTO VALLEY RTC
6I4E	TRACY CTR (6I4E_6I4V2)
6I4J	MODESTO-N CTR
6I4S	SONORA CTR
6I4T	TURLOCK CTR (6I4T_6I4J1)
6I4V	STOCKTON-M CTR
6I4	SAN JOAQUIN RTC
6I5A	ARDEN CTR
6I5F	FLORIN CTR
6I5G	ELK GROVE CTR (6I5E_6I5F1)
6I5P	PLACERVILLE CTR
6I5S	FOLSOM CTR
6I5S1	RANCHO CORDOVA FEC (6I5C)
6I5	CAPITOL RTC
6I6F	FAIRFIELD CTR
6I6M	SANTA ROSA CTR
6I6M1	NOVATO FEC
6I6P	UKIAH-M CTR
6I6S	VALLEJO CTR
6I6S1	NAPA FEC (6I6N)
6I6	NORTH BAY RTC

Figure 8. Sacramento Battalion Map

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

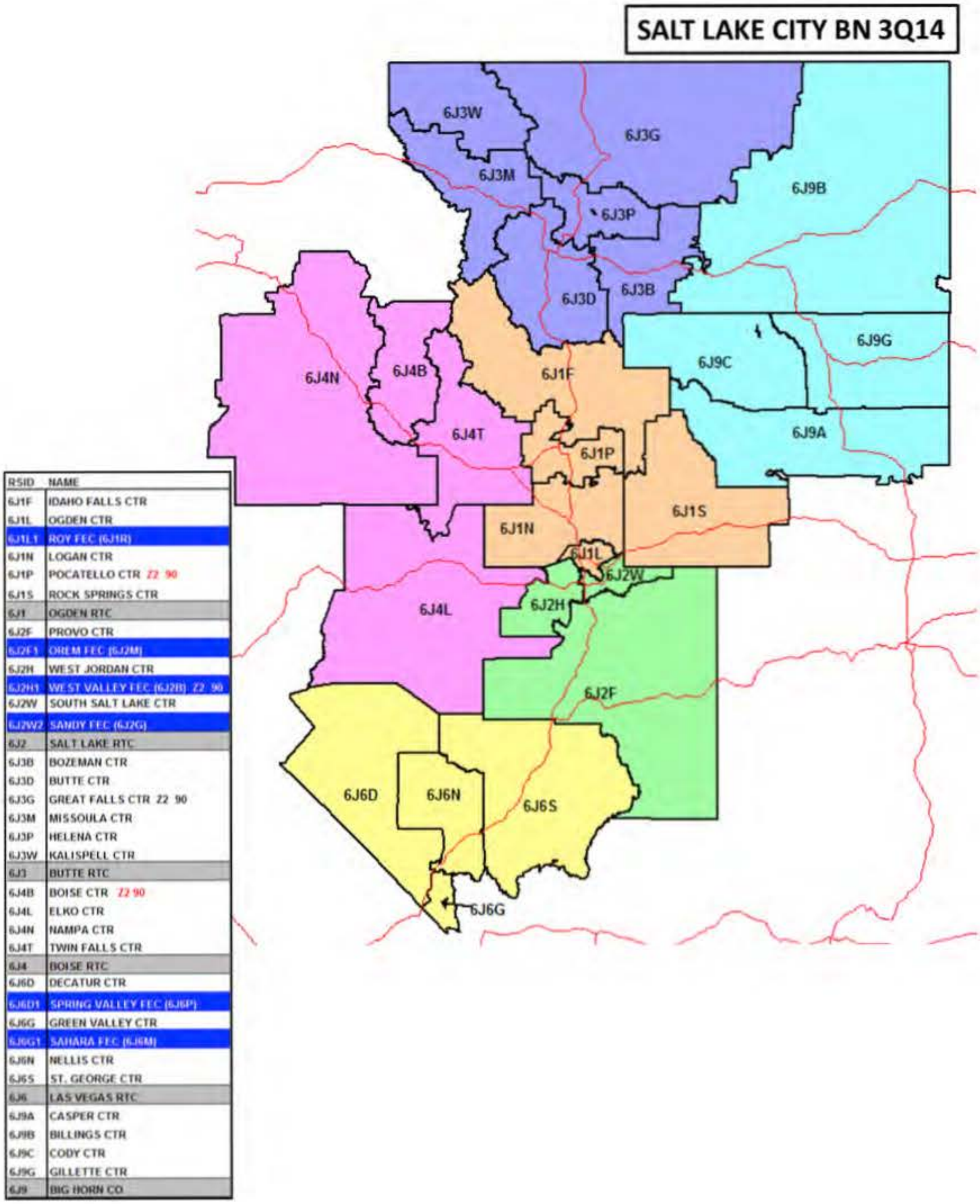


Figure 9. Salt Lake City Battalion Map

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

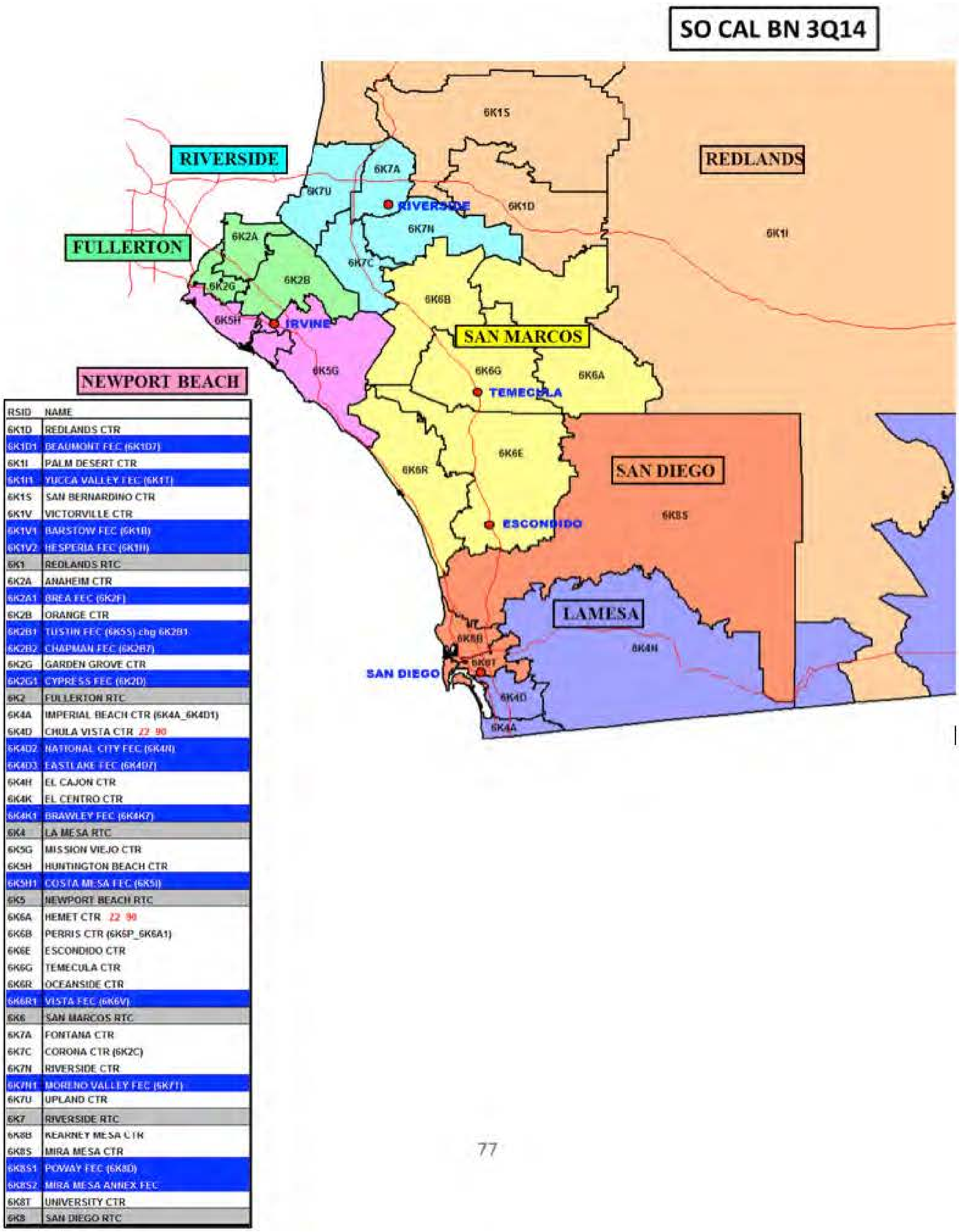


Figure 10. Southern California Battalion Map

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

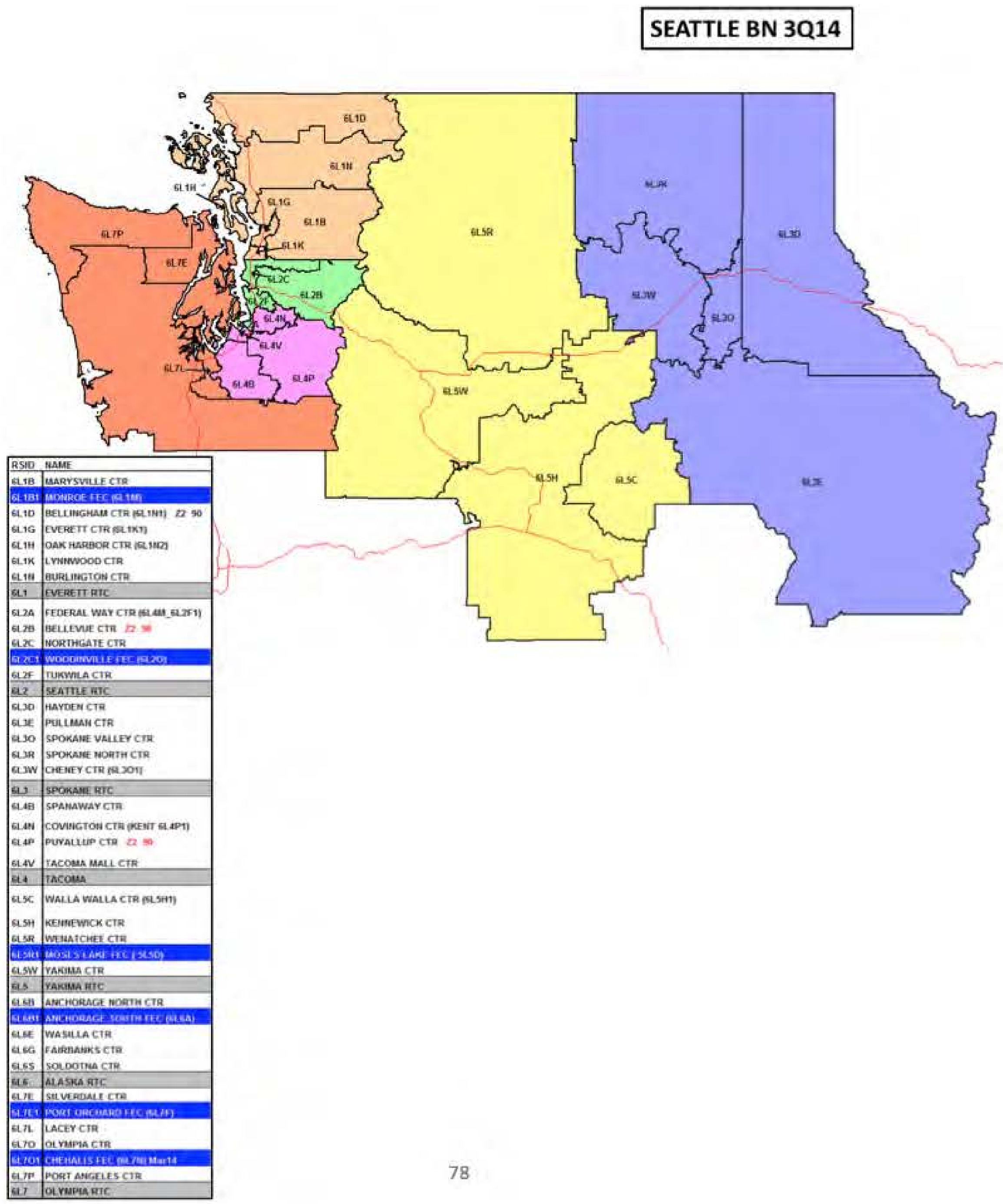


Figure 11. Seattle Battalion Map

APPENDIX: 6TH RECRUITING BRIGADE MAPS PER BATTALION (CONT.)

RSID	NAME
6N1A	CLOVIS CTR
6N1C	MERCED CTR
6N1C1	MADERA FEC (6N1M)
6N1F	FRESNO CTR (6N1A1)
6N1R	VISALIA CTR
6N1R1	HANFORD FEC (6N1H)
6N1R2	PORTERVILLE FEC (6N1P)
6N1	FRESNO RTC
6N2A	BAKERSFIELD CTR (6N2A1; converted to CTR)
6N2A1	BAKERSFIELD EAST FEC (6N2A; converted to TFL)
6N2A2	DELANO FEC (6N2D)
6N2C	RIDGECREST CTR
6N2D	PALMDALE CTR
6N2D1	LANCASTER FEC (6N2E)
6N2	BAKERSFIELD RTC
6N6D	OXNARD CTR
6N6D1	VENTURA FEC(6N6V)
6N6G	SAN LUIS OBISPO CTR
6N6G1	PASO ROBLES FEC (6N6P)
6N6N	SANTA MARIA CTR
6N6N1	LOMPOC FEC (6N6L) CONVERT TO FEC
6N6	GOLD COAST RTC
6N7B	SAN MATEO CTR (6N7F_6N7B1) Z2 90
6N7G	MOUNTAIN VIEW CTR (6N7S_6N7G1)
6N7G1	SANTA CLARA M FEC (6N7G)
6N7M	GOLDEN GATE CTR
6N7	SOUTH BAY RTC
6N8A	ALAMEDA CTR
6N8A1	RICHMOND FEC (6N8P)
6N8D	BRENTWOOD CTR
6N8F	FREMONT CTR
6N8F1	HAYWARD FEC (6N8I)
6N8H	PLEASANT HILL CTR
6N8L	LIVERMORE CTR
6N8	EAST BAY RTC
6N9D	GILROY CTR
6N9D1	CAPITOLA FEC (6N9P)
6N9M	SAN JOSE EAST CTR
6N9M2	ALMADEN FEC (6N9O)
6N9S	SALINAS-S CTR
6N9S1	SEASIDE FEC (6N9A)
6N9	MONTEREY BAY RTC

Figure 12. Fresno Battalion Map

LIST OF REFERENCES

6th Recruiting Brigade. "P2P Combined thru February 2014," (Worksheet). 2014.

Department of the Army. *United States Diversity Roadmap*. Washington, DC: Assistant Secretary of the Army (Manpower & Reserve Affairs) Diversity and Leadership Directorate, 2010. https://www.deomi.org/DiversityMgmt/documents/Army_Diversity_Roadmap_December_2010.pdf.

Asch, Beth J., Paul Heaton, and Bogdan Savych. *Recruiting Minorities: What Explains Recent Trends in the Army and Navy?* Santa Monica, CA: RAND Corporation, 2009.

Department of Defense (DOD). *2014 Human Goals Charter*. Washington, DC: DOD, 2014. http://www.defense.gov/documents/DOD-HumanGoals_4-28-14.pdf.

Devore, Jay L. *Probability and Statistics for Engineering and the Sciences*. 6th ed. Belmont, CA: Brooks/Cole, 2004.

Fernandez, Richard L. *Social Representation in the U.S. Military* (CBO Publication #499). Washington, DC: Congressional Budget Office, 1989. http://www.cbo.gov/sites/default/files/89-cbo-044.pdf.

———. "Social Representation in the Military: A Reassessment." In *Professionals On the Front Line: Two Decades of the All-Volunteer Force*, edited by J. Eric Fredland, Curtis L. Gilroy, Roger D. Little, and W. S. Sellman, 226–245. Washington, DC: Brassey's.

Humes, Karen R., Nicholas A. Jones, and Roberto R. Ramirez. *Overview of Race and Hispanic Origin: 2010*. Washington, DC: United States Census Bureau, 2011. http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf.

Miles, Donna. "Officials Urge Congress to Protect Recruiting, Retention Incentives." *American Forces Press Service*, March 3, 2009. http://www.defense.gov/news/newsarticle.aspx?id=53310.

Ragsdale, Cliff T. *Spreadsheet Modeling & Decision Analysis*. 4th ed. Mason, OH: Thomson South-Western, 2004.

Rostker, Bernard. *I Want You!: The Evolution of the All-Volunteer Force*. Santa Monica, CA: RAND, 2006.

Roth-Douquet, Kathy, and Frank Schaeffer. *AWOL*. New York: HarperCollins, 2006.

Ryan, Camille. *Language Use in the United States: 2011*. Washington, DC: United States Census Bureau, 2013. http://www.census.gov/prod/2013pubs/acs-22.pdf.

Simeone, Nick. “Hagel Outlines Budget Reducing Troop Strength, Force Structure.” *American Forces Press Service*, February 24, 2014. http://www.defense.gov/ news/newsarticle.aspx?id=121703.

Smith, Sterilla A. “Army Culture and Foreign Language Program,” *Military Intelligence Professional Bulletin* 38, no. 1 (January-March 2012): 3–12.

Stoker, Carol and, Stephen Mehay. *Recruiting, Advertising and Marketing Strategies in All-Volunteer Force Nations: Case Studies of Canada, Australia, the United Kingdom, and the United States* (NPS-GSBPP-12-005). Monterey, CA: Naval Postgraduate School, 2011.

Stokes, Zeke. “Op-ed: Why Ending Volunteer Service Is the Next Fight for Military Equality.” *Advocate.com*, October 16, 2013. http://www.advocate.com/ commentary/2013/10/16/op-ed-why-ending-volunteer-service-next-fight-military-equalityPost.

Teague, Michael J. “An Optimal Allocation of Army Recruiting Stations with Active and Reserve Recruiters.” Master’s thesis, Naval Postgraduate School, 1994.

United States Army Recruiting Command. G7/9 - Marketing, Education and Outreach. “U.S. Army Recruiting Command Goals.” Last modified December 4, 2013. http://www.usarec.army.mil/hq/apa/goals.htm.

United States Census Bureau. “2010 Census Shows America’s Diversity” (CB11-CN.125). March 24, 2011. http://www.census.gov/newsroom/releases/archives/ 2010_census/cb11-cn125.html.

———. “American Community Survey.” Accessed November 20, 2014. http://factfinder2.census.gov/faces/nav/jsf/pages/programs.xhtml ?program=acs.

———. “Characteristics of People by Language Spoken at Home.” Accessed November 20, 2014. http://factfinder2.census.gov/faces/tableservices/ jsf/pages/productview.xhtml?fpt=table.

———. “Selected Economic Characteristics.” Accessed December 18, 2014. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview. xhtml?pid=ACS_13_5YR_DP03&prodType=table.

University of California, Davis StatWiki. “8.4 Small Sample Tests for a Population Mean.” http://statwiki.ucdavis.edu/Under_Construction/Testing_Hypotheses/ 8.4_Small_Sample_Tests_for_a_Population_Mean.

Vergun, David. “Senior Leaders Explain Army’s Drawdown Plan.” *Army News Service*, July 24, 2014. http://www.army.mil/article/130534/Senior_leaders_explain_ Army_s_drawdown_plan.

Weekend Edition Sunday. "'Time and Casualties': Gen. Dempsey on Cost of Sequester." *NPR.org*, February 17, 2013. http://www.npr.org/2013/02/17/172227744/obamas-top-military-adviser-says-cuts-would-cost-time-and-casualties.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California