An Analysis of Navy Recruiting Goal Allocation Models

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Background and tasking

The Navy continually aims to have the right combination of personnel to meet its dynamic needs. Achieving the desired overall force composition requires accessing the right mix of recruits—enlisted and officer, active and reserve. To do this, the Navy must have details about the available recruitable population, including where specific types of people are located.

The Navy desires to improve the way it allocates recruiting goals. The Navy Recruiting Command (NRC) uses econometric models to guide how it geographically allocates goals for recruiting enlisted personnel, and employs a less rigorous method for officers. These models consider a variety of factors, but they have limitations. There has not been a review of the enlisted model since the late 1990s, and the current model does not consider all the components of the recruiting market that the Navy may want to examine. The Navy's method for allocating recruiting goals for officers has been developed in even less detail, and has not been evaluated recently. Also, the perception among recruiters is that there might be too much emphasis on past production when setting goals, especially in officer recruiting models. A broader issue is that recruiting goals are tied to Navy Recruiting Districts (NRDs), which are quite large, thus preventing the precise allocation of manpower and advertising funds for recruiting purposes because such allocation was not an original goal model objective. In the future, more precise goaling models can facilitate NRC's ability to restructure recruiting.

In light of these issues, the Commander of NRC (CNRC) asked CNA to suggest how to improve the existing models and methods. To address this tasking, we offer suggestions for advancing the methodology underlying their current ways of setting goals.

Approach

We began by talking to the winners of the Recruiter of the Year (ROY) awards to understand what they think is lacking in the current goaling process. Next, we reviewed the literature on recruiting practices and modeling methods. Then, after reviewing how the other services allocate their recruiting missions, we examined existing databases to see what data are available as model inputs. Finally, we created a model for active enlisted personnel and identified what data are necessary to create a similar model for the reserve enlisted and active and reserve officers. Using information we collected about officer data, we developed recommendations on how to improve the current approach to officer recruit goaling.

Findings and recommendations

Our study findings, results, and recommendations relate to the five personnel types under review: active enlisted, reserve enlisted, active officer, reserve officer, and officers in the medical field.

Enlisted active

The current NRC model for goaling enlisted recruits for the active component (AC) was rigorously developed. It uses much of the publicly available data, but these data lack detail and specificity, particularly with regard to location. The goals are distributed to the NRDs, which are fairly large. To provide NRC with the capability to account for location in goaling, we develop a model for forecasting the number of recruits of different types from each zip code. We verify our model's predictive capability and recommend adopting the zip-code level model to make better use of available market data. This more highly detailed goaling method will be helpful as the NRC considers reorganizing and redistributing its goals both geographically and demographically.

Enlisted reserve

As for reserve enlisted, NRC is using available data, but the data have some of the same issues. For non-prior-service personnel, we

recommend using our active enlisted model with some minor changes to data inputs.

Officer active

We learned of significant data problems on the officer side. Current accession data do not have enough detail about where potential Officer Candidate School attendees live and from which college or university the officer was recruited. We recommend that NRC continue its effort to fill its data gaps, as well as support efforts to create an all-service officer database. An easy modification to the current method would be to use more publicly available market data, such as propensity-to-enlist and medical data from the Centers for Disease Control and Prevention. Once the relevant data are in place, the existing officer goaling method can be evaluated quantitatively for its performance before resources are spent on improving it.

Officer Reserve

Data about the prior-service and non-prior-service populations reveal similar issues to those of the active officer population. On the non-prior-service side, we recommend that NRC add the market considerations we recommended for the AC officer goaling, and continue its efforts on accurately recording home-of-record and college data. We also recommend that NRC focus on collecting and updating accurate, timely, and specific data about officers who leave the active duty force, so they may be contacted later for the reserves.

Medical

The small number of officers in the medical field makes it difficult to apply statistical techniques to the goaling process. The current process is based, in large part, on past production, which can discourage recruiters from producing as many contracts as they can. If NRC is to keep the current medical goaling model, we propose improvements through incentives and additional market information sources, such as data on medical students. However, we also recommend that NRC consider alternative ways of doing recruiter goaling, including using incentives and competition to motivate

recruiters. One of our suggestions is to consider the "fantasy draft" model for goaling medical recruiters, as is done in the Air Force.

Introduction

Background and tasking

Navy Recruiting Command (NRC) is responsible for recruiting four main types of personnel, each of which constitutes a separate recruiting market: officers and enlisted for the Active Component (AC) and officers and enlisted for the Reserve Component (RC). In addition, NRC has responsibility for recruiting all the Navy's medical officers, an important submarket of AC and RC officers. An effective goaling process is a key factor in ensuring that all the Navy's accession goals are met and that recruiting resources are used efficiently. In particular, the geographic allocation of the Navy's recruiting goals has a major impact on resource productivity, as well as on the quantity, quality, and demographic mix of recruits. The goaling processes for the five types of personnel listed above have not, however, been updated or critically examined for some time. This is significant because, over the last decade, several important changes have occurred, including the following:

- NRC has increased its emphasis on meeting detailed goals, especially for demographic diversity.
- Data about key market characteristics are, increasingly, publicly available via the internet.
- Budget constraints have tightened, highlighting the need for effective use of recruiting resources.

In light of these changes, the Commander, Navy Recruiting Command (CNRC) asked CNA to examine NRC's goaling processes with an eye toward making maximum use of available market information and efficient use of recruiting resources.

Issues

In general, the purpose of a goaling process is to distribute a total service accession goal to recruiters in the field in a way that maximizes the probability that the aggregate mission is met. Depending on its design, a goaling model may also be used to signal changes in the recruiting environment that call for changes in the overall level of recruiting resources or changes in their distribution across the country.

An important consideration in the allocation process is equity: all recruiters should have the same opportunity to succeed. To equitably distribute recruiting goals across geographic markets, a goaling model must control for the underlying productivity of a particular area. For example, a full model might take into account the size of the target population; economic and labor market variables that capture alternative employment opportunities; indicators of the relevant population's propensity to join the military; and measures of Navy and other military recruiting resources applied to the area. In practice, some of these variables are related to each other in the way that they affect an area's productivity, so data may show that only a subset of these variables is required for an adequate goaling model. Equity concerns are not entirely about fairness; they are also related to productivity. Goals that are perceived to be too difficult for the market can harm recruiter morale and, therefore, productivity.

Navy Recruiting Command (NRC) uses econometric models to geographically allocate recruiting goals for AC and RC enlisted personnel, and employs less formal methods to allocate goals for AC, RC, and medical officers. All the models consider some important factors, but they have limitations. Although the enlisted goaling model is statistically rigorous, it may not include all the components of the recruiting market that the Navy may want to examine. The methods for allocating recruiting goals for officers are not statistically rigorous, largely due to quality and quantity of available data, and may place too much emphasis on past production, while not taking advantage of available market data. An issue that affects all five goal allocation models is that they are defined at the National Recruiting District (NRD) level, which prevents the use of poten-

tially valuable market information and the precise geographic allocation of resources, including recruiters, advertising, and stations.

To inform improvements to NRC's current goaling methods, this study addresses the following questions for each of the five personnel types and their associated markets:

- What is the most effective goaling level or unit of analysis?
- What market, demographic, and resource factors should be included in each model?
- What method should be used to allocate recruiting goals?

Approach

This study was done in two phases. We began with exploratory activities, then, based on results from these activities, we moved to model assessment and development.

The exploratory phase of the study focused on understanding the goaling methods currently used for each market by the Navy, as well as the other services, and on identifying market-specific issues associated with each approach. Information on the Navy came from relevant literature as well as from discussions with CNRC personnel at various levels; selected 2010 Recruiters of the Year (ROY);[1] and participants in the 2011 Officer Goaling Conference. Information on other services was provided to us by the staff of the U.S. Army Recruiting Command (USAREC), Marine Corps Recruiting Command (MCRC), and the Air Force Recruiting Service (AFRS). We also examined existing Navy and market data to explore the market-specific potential for statistical modeling and to inform model inputs and structure. We reviewed the following data sources:

- Navy data
  - — Enlisted Master File (EMF)
  - — Officer Master File (OMF)

[1] We summarize what we learned from ROY winners in appendix A.

  - — Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE)
  - — Reserve Component Common Personnel Data System (RCCPDS)
- Market data
  - — The U.S. Census
    - – General population statistics
    - – Woods & Poole and Qualified Military Available (QMA) subsets
  - — Public Use Microdata Sample (PUMS), which is part of the American Community Survey (ACS)
  - — Integrated Postsecondary Educational Data System (IPEDS)
  - — National Center for Education Statistics (NCES)
  - — National Center for Veterans Analysis and Statistics (NCVAS)
  - — Center for Disease Control (CDC)
  - — Association of American Medical Colleges (AAMC)
  - — American Association of Colleges of Osteopathic Medicine (AACOM)

Based on the results of these exploratory activities, for the enlisted AC market, we developed a zip-code level goaling model that takes into account key market factors, including information related to gender and race/ethnicity. We then evaluated the model against real data from outside the estimating sample to assess its predictive accuracy. For the other four markets, data issues and resource constraints dictated that we take a more qualitative approach. For these markets, we identified appropriate modeling techniques and the data required to support such models. We also considered non-modeling approaches to improve the goaling process.

Organization of this report

The paper is divided into five main sections, one for each market segment (enlisted AC, enlisted RC, officer AC, and officer RC). The final section looks at recruiting medical professionals. Within each section, we describe the Navy's current goaling method and identify the issues we believe need to be addressed. This set up is followed by a brief summary of the other Services' goaling methods and lessons learned from them. With all the necessary information in hand, we then analyze the goaling issues and make recommendations.

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Enlisted active component (AC)

Introduction

The enlisted AC mission is by far the Navy's largest recruiting mission and the goaling model for enlisted AC personnel is the Navy's most sophisticated. It uses a combination of statistical methods to forecast high-quality male contract production. The model includes historical production, recruiting resources, and economic and population factors, as well as seasonality, pay, and other variables. The Enlisted Goaling Model (EGM) is used to provide goals for each of the two Regions (East and West). It also is also configured to provide estimates of the recruiting potential for each of the 26 NRDs. The Regions may use the goaling model recommendations for their NRDs, but they are free to modify these allocations. Each NRD further redistributes its goals down to recruiting stations and individual recruiters, using whatever approach they deem most relevant.

The EGM has remained largely unchanged for at least two decades, over which time the recruiting environment has changed substantially. Two changes have particular relevance for enlisted AC goaling. First, an increased emphasis on demographic diversity suggests a need to include new factors in the model. Second, tighter budget constraints, and the concomitant need to use the goaling model to support efficient resource allocation, suggest a need to model employing a smaller unit of analysis.

Therefore, in this section, we develop a new enlisted goaling model that uses the zip code as its level of analysis and that allows for more refined modeling of contracts for the demographic sub-groups of interest. We begin by defining the enlisted AC market to provide context for the modeling discussion and to elucidate how the goaling and modeling concerns for enlisted AC personnel differ

from the goaling and modeling concerns of the other four types of personnel addressed in this report.

Market definition

Geography

For the Navy, enlisted AC recruiting markets are defined geographically by recruiting stations and the areas surrounding them: together, the recruiters assigned to each station are responsible for covering a surrounding geographic territory that is roughly defined by zip codes [1]. The stations are nested within the 26 NRDs, and NRDs aggregate to the two Regions.

Eligibility

Within geographic areas, eligibility requirements for enlisted personnel further define the enlisted AC market in terms of education level and age. The primary target population for enlisted AC recruiting is high school students and high schools graduates ages 17 to 22. This is the primary market because members of this age group are both "at the stage of life that career decisions are natural" and at the "optimum training age" [1]. A secondary target market consists of men in the 22- to 29-year-old age group, with or without a high school diploma [1]. Although the secondary market officially includes non-high-school-degree graduates (NHSDGs), the Navy only enlists a limited number of these each year because this group has been shown to have high first-term attrition relative to high-school-degree graduates (HSDGs) [2].[2]

The enlisted AC market is further defined in terms of recruit quality based on scores on the Armed Forces Qualifying Test (AFQT). Recruits who attain a percentile of 50 or above and have a high school diploma are called A-cell recruits, those with the same AFQT scores but without a high school diploma are B-cells, and those who score below 50 but have a high school diploma are considered Cu-cells [3]. These cells are shown in figure 1. In general, recruiters

[2] The DOD restricts NHSDGs to 10 percent of total accessions, and the Navy currently places a 5 percent cap on NHSDG accessions [30].

seek to enlist A- and Cu-cell recruits; the Navy does not enlist anyone with an AFQT score below 35 and does not enlist NHSDGs with AFQT scores below 50 [1].

Figure 1. Recruit Quality Cell Matrix

AFQT Percentile	HSDG	NHSDG
50 - 99	A	B
31 - 50	Cu	D

Finally, additional eligibility requirements related to health status, citizenship, and criminal behavior further narrow the market.

Size

Between FY2007 and FY2011, the average size of the enlisted AC recruiting mission was just under 36,000 accessions.[3] With a mission this large, it is feasible to use a statistical goaling model to allocate the recruiting goals at a low level of geographic detail.

Enlisted AC goaling—the enlisted goaling model

Description

The model used for enlisted AC goaling is known as the enlisted goaling model (EGM). It is a sophisticated econometric model[4] that is designed to determine the supply of eligible recruits and to allocate the recruiting mission to each NRD. The dependent variable in the EGM is the number of net new contracts from each NRD in a given quarter. The explanatory variables are:

- A series of variables to capture the sizes of the male A- and Cu-cell populations in each NRD

[3] This data came from the Facts and Statistics tab on the CNRC website: http://www.cnrc.navy.mil/PAO/facts_stats.htm .

[4] To account for the possibility of a strong relationship between recruiting in a particular quarter and recruiting in past quarters, the model is estimated as an autoregressive form.

- The number of production recruiters in each NRD[5]
- The seasonally unadjusted national employment rate
- The ratio of military pay to civilian youth earnings
- The Youth Attitude Tracking Study (YATS) propensity to enlist
- The combined amount of money spent by the Army and Navy on advertising
- The number of A-school seats available
- The total veteran population in each NRD and
- Controls for season, government shutdown in 1995, and individual NRD effects

However, because the model was developed in the late 1980s and early 1990s, the supply of "eligible recruits" refers to the supply of male recruits only. Also, the model includes no information about race and ethnicity.

Performance

The EGM was last evaluated in the late 1990s by CNA, which reported its results in *An Econometric Analysis of the Enlisted Goaling Model* by Goldhaber [4]. In general, Goldhaber found that the model was reasonably accurate at predicting the number of A-cell male enlistments on the NRD level, but that different models

[5] The number of recruiters is determined using a different model. Each year, planning staff at NRC determine the desired number of recruiters using a constrained optimization model that calculates the cost-minimizing number of recruiters for a given beginning-of- year contract objective or the maximum number of contracts for a given number of recruiters. The model includes as parameters the programmed levels of other recruiting resources (e.g., advertising and enlistment incentives), forecasts of the national unemployment rate and of military pay relative to civilian pay, as well as the supply response to increases in the number of recruiters, which comes from the EGM. [29]

should be used for subgroups of the population, such as workforce recruits vs. high school seniors.

Goldhaber also explored adding new variables to the model, such as average tuition in four-year public and private colleges and universities (by state), average wages of those with at least an associate degree and those with at least a bachelor's degree, and average unemployment rates for those with some college but less than a bachelor's, and those with at least a bachelor's degree. However, Goldhaber concluded that the modeling complications introduced by these additional variables were too large compared with the increase in model precision. As a result, with one the exception identified below, he recommended keeping the existing mix of variables for A-cell recruits. [4]

Goldhaber recommended taking the advertising variables out of the model because of their endogeneity to the outcome: the Navy spends more money on advertising where and when it is less successful in its recruiting efforts, so in the model there was a negative correlation between advertising and recruit production, which is counterintuitive. Because assessing the effect of advertising is important, he recommended estimating it in a separate study and connecting it to changes in propensity to enlist rather than to the number of contracts. [4]

New goaling issues

Although the EGM has performed well over the years, CNRC has raised two concerns regarding its overall design.

Unit of analysis

Based on our initial tasking and on additional conversations with NRC staff, CNRC's primary concern regarding the EGM is the unit of analysis. Because NRDs are large—spanning multiple labor markets and even multiple states—modeling at the NRD level does not allow the Navy to precisely allocate the recruiting goal based on market-specific conditions and needs. While recruiting goals are eventually distributed down to the station level, this is done without the help of a model or rigorous methodology. A goaling model with

more geographical detail could make both goal and resource allocation more structured and potentially more efficient.

Demographic diversity

The Navy has become increasingly focused on demographic diversity, with the goal of growing a force that is representative of the nation in terms of race, ethnicity, and gender. And, compared to the other Services, the Navy has been relatively successful at recruiting racial/ethnic minorities and women into its enlisted ranks. For example, the Military Leadership Diversity Commission (MLDC) reported that, for 2007 and 2008, the Navy was the only Service whose enlisted AC accessions were not disproportionately white relative to the eligible recruiting pool. And, only the Air Force had a higher share of women among its accessions for the same years: 23 percent for Air Force accessions compared to just below 19 percent for Navy accessions. The female accession shares for the Army and the Marine Corps were 16 and 7 percent, respectively. [5]

To ensure that its accessions continue to be representative, the Navy sets diversity targets for each NRD. Since the EGM cannot be used to generate these targets, they are created using a combination of past production and the demographic mix of the NRD population. And, like the overall goal, diversity targets are distributed to the station level without the use of a formal model. Having more geographically precise information on which geographic markets have larger shares of women and minorities who are in the right age group and meet the Navy's eligibility requirements would help achieve the representation goal.

In addition, from talking with the recruiters of the year, we learned that they rarely go out to specifically recruit minority candidates. The recruiters' trust in their NRC regional assignments emphasizes the need to learn in detail about the location of minority recruits and the need to continue placing recruiters in areas with racially and ethnically diverse populations.

Lessons from other Services[6]

Before addressing these issues, we looked to the other Services for ideas. Our review of the other Services' goaling methods for the enlisted AC market showed that none has a model that is as detailed or statistically rigorous as the EGM. Instead, all three other Services allocate their national goals to lower geographic levels using measures of market size or past production, or combinations of the two.

The Army goals at the station level (there are 1,400 Army recruiting stations across the country) use a weighted average of just two factors. The first is a measure of historical past production[7] that captures the overall Department of Defense (DOD) production of high-quality contracts. The second is a projection of the qualified military available (QMA)[8] population between 17 and 29 years of age. The weights the Army assigns to these two factors can change over time. In the past, the Army has assigned a 90 percent weight to past production and a 10 percent weight to the QMA population. Recently, however, the weights changed to 60 percent and 40 percent, respectively. The Air Force allocates national recruiting goals at the group level[9] based solely on a 5-year average of past production, with the most recent three years weighted more than the other two.[10]

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[6] We are grateful to Mr. Mike Nelson at USAREC, Col T.J. Kenney at AFRS, and Captain Joseph Wydeven at MCRC for providing CNA with the following information on goaling in their respective services.

[7] The past production measure is a weighted average of the last four years of production, with the weights declining from 40 percent for the most recent year to 30, 20, and 10 percent for the next three years.

[8] QMA is the total 17- to 24-year-old population, excluding institutionalized and those in military service, unauthorized immigrants, and non-HSDG not enrolled in high school or an equivalency program.

[9] The Air Force Recruiting Service (AFRS) is organized into 3 groups, 24 squadrons, and 1,215 recruiting offices.

[10] In the past, the model included manning and population data in addition to past production. In recent years, however, evaluations of the model have shown the contribution of manning and population to be small in comparison with past production; as a result, the Air Force has been using the simplified model.

Finally, the Marine Corps goals at the zip-code level use two population measures and a past production measure. It begins with estimates of the 17- to 24-year-old civilian non-institutionalized population (CNIP) provided by an outside agency called Woods and Poole (W&P). Then, it determines what percentage of enlistees should score 50 or above on the AFQT using five years' worth of results from ASVAB (Armed Services Vocational Aptitude Battery) test takers (regardless of whether the test taker subsequently enlisted). The population estimates are then combined with five years' worth of zip-code level DOD production data. Based on this information, the Marine Corps determines what each station's mission share should be. Furthermore, this population distribution is used to determine the allocation of recruiting resources. If there is a shift in population, recruiters are moved between the regions, but the total remains the same.

We drew two conclusions from our review of the other Services' methods. Our first conclusion was to minimize using a measure of past production in our model. This conclusion was based on evidence that methods that rely too much on past production can provide the wrong incentive for recruiters who may perceive that producing a lot a contracts this year, will only make their jobs that much harder next year. In their 2006 evaluation of the Army's goaling method, Dertouzos and Garber emphasize the importance of latest past production numbers on setting fair goals and caution against their potential negative effect on recruiter motivation. [6] In our conversations with 2010 Recruiters of the Year, we heard the same message with regard to the Navy's goaling method for officers; as such, this issue will be addressed again in the AC and RC officer sections. Our second conclusion was to model at the zip code level. The zip-code level model used by the Marine Corps appears to provide a good level of detail to use for resource allocation.

Addressing the issues: A zip-code level goaling model with diversity data

To address the issues raised by CNRC, we created a zip-code-level model. Zip-code data are the most granular and detailed information available about potential recruits. Including such data is beneficial for several reasons. First, tracking specific population information by zip code will allow the Navy to be more responsive to changing demographic needs and to target specific subpopulations as necessary. Like the Marine Corps, the Navy could begin allocating resources and recruiters to those areas that are most likely to produce particular types of contracts. Second, understanding which areas are likely to be most and least productive could lead to the closing or consolidation of recruiting stations. Similarly, the Navy could place recruiting stations strategically to minimize the distance between them and promising populations.

Research suggests that this final point on distance and travel time between recruiting stations and potential recruits merits additional attention. In 1992, Bohn and Schmitz looked at the effect that distance has on enlistment rates. They hypothesized that an increase in distance would have a negative effect on the rate of recruitment and found this to be true. [7] A later study by the same authors used a different modeling technique but reached a similar conclusion: The greater the distance from the recruiting station to a recruit's location, the more production rates fell. [8] Evaluating production on a zip-code level can inform the NRC about where most of the recruitable population resides. This, in turn, can inform station placement in an effort to decrease the distance and travel time between the station and as many potential recruits as possible.

Estimation technique—the Zero-inflated Poisson Model

In this subsection, we describe our model for recruiting on the zip-code level. Because each zip code produces a positive whole number of contracts, an ordinary least squares model would not be appropriate because it places no restrictions on the sign of the outcome and is primarily designed for continuous outcomes. Rather, a count model using the Poisson distribution is appropriate. In practice, however, many zip codes are expected to produce no

contracts at all, so we use a zero-inflated Poisson (ZIP) model. The ZIP model provides a way of modeling the excess zeros[11] in addition to the counts of recruits we expect from each zip code.

To accommodate the extra zeros, the modeling process is divided into two stages. In the first, we estimate whether the zip code is expected to produce any contracts at all. In the second, we estimate how many contracts the zip code will produce conditional on this number being greater than zero [9].

Recent studies have shown the variables that go into our model as predictors to be important for enlistments (see [10]). These variables are primarily socioeconomic in nature (e.g., population, education, and crime data). Therefore, multicollinearity is a potential modeling concern.[12] Although this may not affect the model's predictive ability, the estimated coefficients in the model can become unstable and sensitive to model specification. The coefficients can take signs that are counterintuitive, but, because the purpose of this model is prediction rather than estimate coefficients, we consider multicollinearity a secondary concern and caution against interpreting the coefficients in isolation.

Our model is different from EGM in three ways: the estimation technique, the unit of analysis, and the input independent variables. Because we are using a zip-code level zero-inflated Poisson model, we refer, for its components, to literature which has considered similar modeling techniques (see [10] in addition to EGM).

Model inputs—the any-contracts model

The first step in the modeling process is estimating the likelihood that a zip code will yield any contracts at all. The inputs to this model are listed below. Notably missing from this list are economic inputs such as the unemployment rate. During our model selection

[11] We consider these zeros "excess" because they would not be expected under an ordinary Poisson model. A formal statistical procedure called the Vuong test will be used to verify that the zero-inflated model is appropriate for the data.

[12] This phenomenon occurs when multiple predictors in the model are related to each other and therefore explain the outcome in related ways.

process over several years of data, the unemployment rate was not shown to have a significant relationship with total enlistments, so we did not include it in the model presented below, but it does come up as significant in other models included in appendix B. Additionally, we use market awareness measures as a substitute for propensity to enlist and advertising.

Distance to nearest college or university

We included data from IPEDS (Integrated Postsecondary Educational Data System) on the distance "as the crow flies" from the zip-code centroid to the nearest centroid of a zip code that contains a degree-granting college or university. We also included the square of this distance and a dummy variable for situations in which there is a college or university in the zip code under consideration. We hypothesize that the nearby presence of a college or university might affect a youth's future goals, steering him or her away from the military and toward higher education.

Size of the nearest college or university

IPEDS also provides the size of the nearest college or university. The variable is divided into ordinal groups of under 1,000, 1,000–4,999, 5,000–9,999, 10,000–19,999, and 20,000 and over. We recoded these as one though five, respectively, for our analysis. We hypothesize that there might be a relationship between the size of the nearest college or university and the academic atmosphere around the zip code, and thus, the zip code's likelihood of producing enlistees.

Interaction of size and distance

We also include the interaction of size and distance of the nearest college or university in our model. This will help determine whether the effect of distance to nearest college on recruit production varies with the size of that college.

Multiple schools flag

We flag zip codes that have multiple colleges or universities in them.

Historically Black College or University (HBCU)

We flag zip codes that contain an HBCU. We hypothesize that this may be particularly important for our minority models, but we left it in all models to check for effects.

Model inputs—the count model

In the second stage "count model," we model the predicted number of enlisted AC contracts for each fiscal year. Below, we list the explanatory variables.

Distance to the responsible Navy Recruiting Station

Each zip code is assigned as an area of responsibility to a recruiting station. We got the list of these assignments from CNRC and computed the distance "as the crow flies" between the two zip code centroids: the zip code in question and the station's zip code. We also added the square of this variable to the model because it has been shown to be significant [10].

Demographic data

We included population data in our model. We alternated between several specifications, using the QMA dataset and the W&P data, but ultimately, the detail provided by W&P provided a more accurate model for prediction of total inventory, so we present our findings based on that dataset. We included population counts, by zip code, of 17- to 19-year-olds and 20- to 21-year-olds, by race and education group. We included the racial/ethnic categories of black, Hispanic, and white, as well as the following education categories: currently in college, currently in years 1 through 3 of high school, currently a high school senior, and high school graduate. For some subpopulations of the total inventory, QMA data were better predictors, and in some cases we had to use a combination of the QMA and W&P data. These data came from the Recruit Market Information System (RMIS), which was provided to us by the staff at Joint Advertising Market Research & Studies (JAMRS).

Navy Awareness Index

CNRC provided us with the Navy Awareness Index (AI). This variable measures each location's awareness of the Navy by summarizing information on Navy leads. More specifically, AI estimates the likelihood that consumers recognize the Navy's "product" (i.e., employment/career opportunities available through naval service). These data were measured by the Designated Market Area (DMA), and the mapping between DMAs and zip codes was provided by CNRC.

Recruiters

We include the number of recruiters from each service that are recruiting in each zip code. Because a recruiter is often responsible for more than one zip code, this number is sometimes a decimal. These data are from RMIS.

Crime data

Because crime data has been shown to be an important variable for predicting enlistments [10], we include data on property and violent crime, which we obtained from the Census Bureau. The data are on the state level, so all zip codes in the state get the same number for these variables. They measure the number of property and violent crimes per 100,000 people in the state.

Veteran population

We obtained veteran population statistics from the National Center for Veterans Analysis and Statistics (NCVAS). The data are by county and age group (17–44, 45–64, 65–84, and 85 and older).

Model results

We ran our model for 2006 to 2010, with each model's inputs predicting the following year's recruiting results. Previous models have been run using within-year data [10], but because our interest is

specifically in forecasting enlistments, we created a model that mirrors NRC's work in this way.[13]

The resulting model coefficients differed slightly every year, but we present only the most recent results in this paper, i.e., results using 2009 data to predict 2010 recruits by zip code. Table 1 shows the results for the any-contracts model. As hypothesized, the greater the distance to the nearest college, the higher the probability of a zip code producing recruits. The squared distance was also significant, but the coefficient looks practically unimportant due to its size. The largest negative effect on the probability of a productive zip code was the existence of multiple colleges or universities in the zip code. We interpret this as follows: the presence of multiple schools likely takes students directly away from military services, and it might also indirectly create an academic atmosphere encouraging college, rather than the military, after high school. We also estimate a negative relationship between the size of the school and the probability of a productive zip code.

Table 1. Results from the Any Contracts Model: Coefficients for modeling productive zip codes

Variable	Coefficient	Standard error	p-value
Distance to closest college/ university	0.1638	0.0117	0.0000
Distance squared	-0.0021	0.0002	0.0000
College or university in zip	-0.3313	0.1877	0.0770
Size of the college / university	-0.1455	0.0415	0.0000
Multiple school flag	-1.8673	0.9131	0.0410
Constant	-1.8077	0.1811	0.0000

Table 2 presents the results from the counts model. Of particular interest are the variables with p-value less than 0.05, because those variables were deemed statistically significant, meaning that they correlate well with our response variables, so for ease of reading, we have removed those variables which were highly insignificant. Similar models

[13] The Navy's WEBSTEAM database, which is used by recruiters to identify and analyze markets, could easily incorporate predictions from our model.

for subpopulations of the total inventory by race/ethnicity, A-cell, and gender are presented in tables 7 through 13 in appendix B.

Table 2. Results from the Counts Model: Coefficients for modeling inventory on a zip-code level

Variable	Coefficient	Standard Error	p-value
Distance to responsible Navy Recruiting Station	-0.0141	0.0005	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
W & P 17-19 currently in college Hispanic	0.0103	0.0057	0.0680
W & P 17-19 currently in college white	-0.0152	0.0020	0.0000
W & P 17-19 currently in HS, year 1-3 black	0.0030	0.0012	0.0120
W & P 17-19 currently in HS, year 1-3 Hispanic	0.0141	0.0025	0.0000
W & P 17-19 currently in HS, year 1-3 white	0.0025	0.0013	0.0650
W & P 17-19 HSDG black	0.0011	0.0003	0.0000
W & P 17-19 HSDG Hispanic	0.0025	0.0004	0.0000
W & P 17-19 HSDG white	0.0003	0.0001	0.0040
W & P 17-19 senior in HS Hispanic	-0.0113	0.0014	0.0000
W & P 17-19 senior in HS white	0.0017	0.0006	0.0040
W & P 20-21 college grad White	0.0075	0.0015	0.0000
W & P 20-21 currently in HS, year 1-3 black	-0.0203	0.0060	0.0010
W & P 20-21 currently in HS, year 1-3 white	-0.0292	0.0060	0.0000
W & P 20-21 HSDG black	-0.0012	0.0003	0.0000
W & P 20-21 HSDG Hispanic	-0.0015	0.0004	0.0000
W & P 20-21 HSDG white	0.0006	0.0001	0.0000
W & P 20-21 senior in HS black	0.0088	0.0023	0.0000
W & P 20-21 senior in HS Hispanic	0.0193	0.0029	0.0000
W & P 20-21 senior in HS white	0.0080	0.0016	0.0000
Navy Awareness Index in 2009	0.5996	0.0512	0.0000
USAF recruiters in 2009	0.0855	0.0182	0.0000
USMC recruiters	0.0325	0.0095	0.0010
USN recruiters	0.0677	0.0040	0.0000
Violent crime	0.0002	0.0001	0.0050
Property crime	0.0003	0.0000	0.0000
Veteran population 17-44	0.3459	0.0274	0.0000
Veteran population 65-84	-0.2061	0.0321	0.0000
Veteran population 85 and up	0.5167	0.0973	0.0000
Constant	-1.6927	0.0637	0.0000

Distance to the nearest recruiting station, as well as its square, were statistically significant in predicting total recruits in a zip code. As expected, the distance to the nearest recruiting station has a negative relationship with enlistments. The farther the station is from a given zip code, the less Navy presence is in that zip code, and the more effort is required for the recruiter and the potential recruit to make the contact. The square of the distance is also statistically significant, but the coefficient is quite small, nearly zero, so it does not carry practical importance because the coefficient has nearly no impact on the predicted count of recruits.

Demographics were also significantly correlated with enlistments. Of the many W&P variables included in the model, the largest positive coefficient was obtained for the number of 17- to 19-year-old Hispanics currently in the first three years of high school. Some coefficients for the population data are actually negative. This could be because the relationship with enlistments is actually negative (with college degrees, for example), or it could be the result of the inevitable multicollinearity of all the population variables. The coefficients seem to suggest that it is easier to recruit in areas with many Hispanic high school students. Spending time interpreting the coefficients in this case, however, is not efficient because it is likely that collinearity has made the estimates unstable. The purpose of this model is to predict the final number of enlistees expected from each zip code; the model coefficients can be used to do so despite the caution with respect to their interpretation. Model results meant to identify high-producing diversity markets are presented in appendix B.

The largest positive coefficient in the count portion of the model is for the Navy AI. This means that the AI, which measures the ratio of the number of responses from all advertising sources (leads) in a DMA to the average number of leads across DMAs is very strongly correlated with enlistments. This speaks to the effectiveness of Navy advertising.

The coefficients on the numbers of recruiters from other services are all positive. This is an indication that military presence in general contributes to the recruiting environment and overshadows whatever competition there is between services for recruits.

The data on veterans is also significant. We note that the presence of very young and very old veterans, who likely participated in the Iraq War and World War II, respectively, has a positive relationship with enlistments. The presence of those in the age group between 65 and 84 is negatively related, likely because of the controversial war in Vietnam. The group of 45- to 64-year-olds is not significant, possibly because both younger and older veterans are in that group. On average, then, there is no effect. Unfortunately, these are the only breakdowns provided by the dataset so we cannot investigate this further.

Model diagnostics

After performing a test to confirm that the zero-inflated model was appropriate,[14] we evaluated our model based on its predictive abilities. First, we computed the predicted number of enlistments for every zip code in our analysis. Then, we instituted the following checks. We computed the average difference between actual 2010 contracts from the zip codes and the predictions the model made. We expect the average difference between actual and predicted values to be close to zero. Anything other than zero would indicate that our model is biased. In this model, the average difference between actual and predicted numbers of enlistments was 0.076. This means that on average, our model is accurate.

Our next step was to compute the mean absolute deviation (MAD). In the analysis described above, when we averaged the differences between predicted and actual enlistments, negative and positive differences canceled each other out, giving an optimistic estimate of how accurate our model can be. We now know that it's right on average, but we want to know by how many people we are wrong on average. To do this, we first rounded the model predictions to the

[14] Specifically, we used the Vuong test to check whether a regular Poisson model could have been used rather than the zero-inflated one. The test gave a p-value of 0, confirming that the zero-inflated model was appropriate.

nearest integer.[15] We did so because this is how the NRC would use the model: NRC would round the predictions to see how many whole people it expects from each zip code. Then, we computed the difference between actual enlistments and the predictions, but we took the absolute value of the difference before averaging so that all differences contribute to our MAD. We estimate the MAD to be about 0.943. That is to say, our model is off by just less than one person, on average, per zip code.

Finally, we checked whether we were correctly predicting nonproductive zip codes. Of all the zip codes that really produced zero recruits, our model correctly identified just over 55 percent, which is not great performance—only marginally better than guessing. This is a part of the model that could be improved in future research. Because this clearly contributed to our overall error rate, we recomputed our MAD for only those zip codes that produced recruits. In that case, our model was only off by about 0.533, as opposed to 0.943. So it is fair to say that the performance of this model would greatly improve (the prediction errors would be cut in half) if we could correctly identify the nonproductive zip codes.

Recommendations

We developed this zip-code level model to help NRC distribute goal in more geographical detail. After verifying the model's predictive capability in the previous section, we recommend adopting the zip-code level model to make better use of available market data. The improvement in the detail of this goaling method should prove helpful as the NRC considers reorganizing, consolidating or closing stations, and redistributing its goals both geographically and demographically. Although the coefficients of the models should not be interpreted in isolation, the models are valid for predictions, and their forecasts can be used to determine the proportions and feasibility of recruiting goals at each station.

[15] In the zero-inflated Poisson model, the observed value is typically a count, but a predicted value is a conditional mean (the average number of events given the predictors) so it need not be an integer.

Specifically, we recommend the use of this detailed model in tandem with the EGM, i.e. to use the EGM to come up with a total NRD goal, and then use the zip-code model to allocate the EGM goal to stations proportionately to the model predictions. On one hand, this approach allows NRC to maintain their EGM which includes variables they deem important for enlistment, and which was built on their substantial subject matter expertise. On the other hand, the combination of the two models will allow a more detailed adjustment for the recruiting markets and thus may improve the efficiency of resource use and equity among recruiter assignments.

Furthermore, we suggest an evaluation of travel time in addition to distance to the responsible Navy Recruiting Station as a variable which might have an effect on contract production in a zip code. It is possible that travel time will be a more effective predictor because distance does not take into account whether a given area is rural or urban and therefore harder to travel to or likely to have traffic congestion.

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Enlisted reserve component (RC)

Introduction

There are two elements to RC recruiting: prior-service (PS) and non-prior-service (NPS) recruiting. Recruiting for enlisted NPS reserves is similar to the AC because the target populations are the same. In fact, recruiters can now recruit for both components, although there are some major differences between the two. For instance, because a much smaller number of people enlist in the reserves, modeling and geographical allocation of resources are more complex from a statistical perspective. In addition, because reservists usually live at home and train on base at regular intervals, recruiting for the RC depends on the location of drilling units, as well as vacancies and authorizations— three restrictions that do not come into play in modeling the AC. Because of the similarities in target population for NPS recruits and AC recruits, the goaling model is currently similar between the two, as are the concerns, identified in the previous section.

For PS recruiting, because enlistees come in with specific skill sets, vacancies and authorizations at a specific drilling unit are particularly important. An ongoing issue with PS recruiting is the ability to locate and contact sailors after they leave active duty.

Enlisted RC goaling – the current models

In the enlisted RC, as in the AC, each service uses different methods to define recruiting goals and to allocate resources. After describing the current Navy models, we discuss related issues in the Army and the Marine Corps (similar information for the Air Force was not available to us at this time). In each case, we look for practices that may help the Navy refine its current RC goaling methodology.

Non-prior Service (NPS)

For NPS recruiting, NCR uses the New Accession Training goal model, which is based on the same methodology as the goaling model in the enlisted AC. (Please see the previous section for details.) The only difference is that populations that go into the reserve model are constrained to residing within 50 miles of Navy Operational Support Centers (NOSCs), where the recruits undergo training. This is a logical restriction, given that recruits have to travel regularly to train. The model predicts enlistments of A-cell men on the NRD level and assumes that AC production recruiters recruit NPS enlistees. The model has not been evaluated against production.

Prior Service (PS)

RC prior-service goals are constructed using a weighted combination of one-third reserve recruiters, one-third historical reserve PS past production, and one-third USN NAVET (U.S. Navy Veteran) losses for the past five fiscal years. Although the weights are currently the same for each of the three components, they have moved around in the past. It makes sense that QMA is not part of this calculation, since general population distribution has little to do with where Navy veterans usually end up. One issue we identified in the PS goaling method is that it does not explicitly take into account authorizations and vacancies at the units for which it goals. Another issue is that, like the NPS model, its ability to accurately predict production has not been evaluated.

Lessons from other Services[16]

U.S. Army

Non-prior Service (NPS)

The first step in the Army goaling process is to allocate all recruiters geographically, regardless of their component (i.e., active, Army

[16] We are grateful to Mr. Mike Nelson at USAREC, Colonel T.J. Kenney at AFRS, and Captain Joseph Wydeven at MCRC for providing CNA with the following information on goaling in their respective services.

National Guard, or Army reserve). This distribution is based on an equal weighting of QMA and DOD past production. Subsequently, recruiters are allocated by component. Active Guard Reserve (AGR) recruiters are allocated separately from the rest of the recruiting force, based on the following four weighted factors: 30 percent past production, 20 percent vacancies, 40 percent TPU (troop program or drilling unit) authorizations, and 10 percent QMA. The Army, however, is currently considering a model that relies completely on distributed authorizations and TPU structure as a fixed basis for locating AGR recruiters.

The second step in the goaling process is distributing the mission, which is also done with a model. The Army Reserve (AR) model for distributing the enlistment contract mission is also based on four factors: past DOD-wide production, QMA, vacancies, and authorizations for the TPUs in the geographical area. As for all services, vacancies are of particular concern in Army reserve recruiting: recruiting is dependent on specific vacancies in local Army reserve TPUs. These vacancies have to be available, be within 50 miles of the applicant's residence, and have open training seats.

More precisely, the goal allocation model for recruiting NPS enlistees is structured as follows:

- 10 percent AR Past Production (PP): a measure of market potential, based on a weighted average of the last four years, with more recent years weighed more heavily.[17]
- 20 percent QMA: projected 17- to 29-year-old population
- 45 percent vacancies (limited by training seats)
- 25 percent authorizations

This year, current vacancies and authorizations are modified by G-2 (Deputy Chief of Staff) to reflect the changes due to ARFORGEN (Army Force Generation) and mobilization sourcing that will occur on October 1st. The AR weights vacancies heavily because they are

[17] For current year y_t, the weights are as follows: y_{t-1} = 40 percent y_{t-2} = 30 percent; y_{t-3} = 30 percent, and y_{1-4} = 10 percent.

currently over endstrength and require a precision mission. Authorizations are weighted much lower than vacancies because attrition is currently very low. The weight given to past production is low because past vacancy availability is likely to be different from future vacancy availability. And, finally, because QMA is considered to be a good measure of the NPS market, it remains in the model.

Prior Service (PS)

The PS enlisted model is built in the following way (the same units are filtered out in the PS model as in the NPS model):

- 35 percent AR PS past production (PP): a measure of market potential based on the last four years, weighted 40 percent, 30 percent, 20 percent, and 10 percent
- 5 percent QMA: projected 17- to 29-year-old population
- 40 percent vacancies (limited by training seats): where the accessions must be made
- 20 percent authorizations: measure of vacancy growth due to attrition

Past production is weighted more heavily in the PS model because, historically, PS vacancies have always been open to accessions regardless of the unit ARFORGEN cycle (i.e., regardless of current billet availability and the unit's capacity to train). QMA has little weight because it does not measure the PS market accurately enough. Vacancies do not need to be limited by training seats and are weighted heavily because the AR is currently over endstrength.

One of the struggles with PS recruiting is accurately recording and maintaining the records of veterans' addresses. The DMDC provides a list of individuals leaving the service to USAREC, and the Army has contractors contact credit rating agencies to update that address information.

U.S. Marine Corps

The Marine Corps recruits enlisted reservists based on their proximity to 1 of about 500 SMCR units, detachments, and individual

mobilization augmentee (IMA) billet locations in the continental United States, Hawaii, and Puerto Rico. A 2001 CNA study by Dolfini-Reed looks at how recruitable populations support the current Selected Marine Corps Reserve (SMCR) force laydown [11]. The motivation for this work is that certain geographical areas have difficulty supporting the manning requirements of some reserve units. PS IMA billets have paygrade and skill requirements, particularly because there is no training funding for IMA positions. This makes recruiting for these billets more challenging than on the active duty side, since location and skill matches limit who can become a reservist. Furthermore, the travel policy states that a reservist must live within 100 miles of the unit, or within three hours' travel time, whichever is less. In this sense, the USMC's ability to man a reserve unit depends on its geographic location

Dolfini-Reed presents three main problems that follow from the current process of recruiting Marine reservists. First, if a unit is in either a remote or a highly populated area, it could face significant issues with recruiting. Rural locations have fewer people from which to draw, and urban areas may have more people with security clearance and driver's license restrictions. In addition, urban areas often do not have the training space for some military occupations. Second, high population areas may have more diverse and skilled people, but those same people may want to have a military occupation that is substantially different from their civilian job (i.e., a civilian computer programmer wanting to do artillery). Finally, it is challenging to move the location of reserve units because Congress often selects their locations for political rather than demographic or military reasons.

The study makes two primary recommendations. First, the Marine Corps should consider moving some reserve units from the northeast and north central regions of the United States to areas in the west and south where there are larger markets. Second, the Marine Corps should think about consolidating some units that are consistently undermanned or short on certain skill sets. One example is the intelligence units in Washington, D.C. These units are typically undermanned even though most intelligence professionals live in that area. It could be useful to combine these units.

Next, we consider the allocation of recruiters rather than reserve units. CNA researchers Malone and Hattiangadi consider different ways that the Marine Corps could allocate PS recruiters across districts [12]. In the same document, CNA also offers two other methods for deciding where to place recruiters based on additional variables. One of these variables is the "ease" of actually filling billets, which is defined as the number of leads divided by the number of billets. A second variable that could be used in conjunction with the first is the vacancy rate, which is defined as the number of leads divided by the fill rate.

By accounting for both variables, CNA's approach identifies districts that could need more PS recruiters if either leads or vacancies increased in a particular area. More recruiters would be useful if leads grow, because the added recruiters could help secure the extra placements. Malone and Hattiangadi acknowledge that the current method is acceptable, but also suggest that the service consider using CNA's expanded approach.

Recommendations

In considering the goaling methods laid out in this section, as well as the enlisted model described in the previous section of this paper, we provide some general recommendations for how the Navy might improve its RC goaling process.

Because NPS recruiting is similar to AC enlisted recruiting in terms of the target population, and because AC recruiters currently perform this function in the Navy, it makes sense to use the zip-code-level model we suggest for the AC as a starting point for NPS recruiting. However, the population data that go into the model should be narrowed to within 50 miles of the NOSCs, as is done in the current Navy model. Following the Army model, we recommend that vacancy and authorization data be added.

Although we do not evaluate such a model in this paper, we recommend that an evaluation similar to the one we used for the AC model be performed on this detailed NPS recruiting model. Then, provided that the model performs well, or based on an improved

model, CNRC could address the issues discussed in the Marine Corps section, such as merging and moving reserve units.

For PS recruiting, because the available population is defined quite differently, we agree with NRC's decision to leave QMA out of its model and to incorporate market information through NAVET losses. It seems sensible, however, to evaluate adding vacancies and authorizations to the model, as they are in the Army's model. We also recommend that the model's predictive capabilities be evaluated in the manner we discussed in the section on the enlisted AC. The weights of different model components can be adjusted accordingly.

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Officer active component (AC)

Introduction

Compared with enlisted goaling, creating an officer goaling model presents several additional challenges. First, the number of officer accessions is smaller than the number of enlisted accessions, so statistical modeling is less reliable. Second, the geographic units of analysis are more difficult to characterize. Typically, the services consider colleges and universities their units of analysis rather than zip codes or states. However, the Census and similar data sources, which are readily available in fine geographic detail, may not apply, since potential recruits may attend college far from home. When officers are recruited, their home of record is recorded inconsistently: sometimes the services record the permanent residence and sometimes the college address. In addition, all-service officer data are not as readily available as their enlisted counterpart. Instead, each service has to use its own past production data.

In addition, diversity is a different issue for officer recruiting than for enlisted. First, the target population of college graduates presents a different diversity picture from high school graduates, with fewer eligible candidates, so it is harder to recruit a racially and ethnically diverse force. MLDC reports that each service had several problems with representation of race/ethnicity groups in various officer commissioning sources. The report noted the underrepresentation of (a) Hispanics and non-Hispanic Asians for Navy officer accession; (b) Hispanics, non-Hispanic Asians, and non-Hispanic others in Army officer accessions; and (c) Hispanics, non-Hispanic blacks, and non-Hispanic Asians in Air Force accessions. Similarly, women were underrepresented despite making up more than 50 percent of the recruiting pool [13].

As a result of data challenges which we detail below, building a statistical model is, at present, not plausible. Therefore, in this section,

we examine current methodology for officer recruiting, considering the issues described above and discussing ways to improve goaling methods. Given the noted data constraints, our analysis in this section is necessarily qualitative—we rely on information gathered during the Officer Goaling Conference, on discussions with recruiters and recruiting leadership from the Navy and other services, and on relevant literature. We also report on how the issue of officer diversity in recruiting is approached in each service, and we make suggestions for the Navy.

Current officer AC goaling method

The primary market for active duty officers is the college market, which is made up of people who are currently enrolled in four-year colleges and universities. If prospective applicants are not in school, they are part of the work force market, which consists of employed and unemployed non-affiliated civilians and Navy veterans. The NAVET market is a primary market for reserve officer recruiting.[18]

Description

The current Navy AC officer goaling method aggregates school-level data to the NRD level, placing equal weight on measures of market (college and workforce), on manning, and on historical production; each is weighted at one-third.

The market measures consist of college degree data from the National Center for Education Statistics (NCES). From this dataset, the Navy focuses solely on Science, Technology, Engineering, or Mathematics (STEM) degrees. The data are analyzed by the number of degrees by degree type, race/ethnicity of the degree recipient, gender of the degree recipient, and school quality. NRC excludes nonresident aliens from these data and uses this as a proxy for citizenship since no better citizenship data are available. CNRC maps college majors to specific Navy officer designators, and goals can be

[18] See: http://www.cnrc.navy.mil/publications/Directives/1131%202E_CHATER%206_CH1.pdf

computed at this very detailed level. Overall, the Navy recruits into 67 broad officer categories, with a total of over 260 detailed goals.

Performance

Although NRC has not formally quantitatively evaluated the officer goaling method, they are looking to improve their current model. We first discuss the performance of the goaling method in general. Then, we describe the problems associated with the Navy data. The lack of data defines the limitations on our analysis.

Methodological issues

As noted earlier, NRC's current goal allocation methodology relies on market information, the number of recruiters, and past production. We address each of these components below.

Market. Currently, NRC focuses on STEM degree graduates in their market analysis. Their method is quite detailed and includes a mapping from college degrees to officer designators. Educational data are used to estimate the numbers of college graduates with relevant degrees, and thus provide a proxy for officer goals. Although very carefully thought out, this method does not take into account propensity to enlist by geographic area.

Recruiters. As referenced above in the Enlisted AC section, the number of recruiters has a clear impact on how many contracts one might expect to obtain from an area. In the Enlisted AC model, the marginal effect of a recruiter, or the number of contracts that each recruiter is expected to produce, is estimated using a model. Here, however, that number is implied by the weight placed on the number of recruiters, which is not necessarily estimated correctly, and has not been empirically verified.

Past production. Currently, one-third of the weight of the goal is attributed to past production. Five years' worth of past production is included in the methodology because it is often seen as a reliable measure of the market and propensity to enlist. However, there are three main problems with measuring the market in this way. First, past production provides a backward incentive system for recruiters

[6]. ROY awardees told us that, if a recruiter does an exceptional job one year and recruits above and beyond her goal, she is tasked with a higher number the following year. If she underrecruits, her job next year will be easier. Past production is perceived as punishing those who work harder and rewarding those who work less hard[19]. Second, in the case of officer recruiting, when the numbers are small (e.g., one recruiter might recruit three or four people for a given community), there are large chance variations in recruiting outcomes. It is possible for someone to recruit four people for a community one year, and nine people the next, without large changes in the surrounding environment. The part of past production that is due to chance alone can then affect future goals and set up an expectation of eight people a year, which may not be a reasonable expectation. Changes based on past production can be very irregular and unsystematic. Third, relying on past production means that, to some extent, the goaling expectations are always lagging behind the changing recruiting environment.

Data issues

Deficiencies in past data collection, and current struggles with producing a reliable IT system that facilitates data integrity, make the task of officer goaling especially difficult. Navy officer goaling suffers from small-sample problems, making statistical modeling less reliable. In addition, the Navy accession data that we obtained from the Officer Master Files were missing nearly one-third of college and university data for Officer Candidate School accessions over the last six years. Of the remaining schools, many university names were misspelled, so we could not trust the accuracy of the existing counts of recruits from these schools. In addition, campus information was missing for many universities that belong to larger university systems, such as the University of California, so we were unable to tell

[19] The caveat to this assessment is that, because the model smoothes over the last five years of past production, the most recent year should not have a strong effect on the change in goal. However, the model predicts on the NRD level, and a district CO can use the most recent past production numbers to alter a particular recruiter's goal. Thus, although this large effect of recent production is not explicitly part of the goaling model, it is part of the process, and is perceived negatively by recruiters.

which city produced the officer candidate. Finally, DOD-wide officer accession data are not currently available. Obtaining DOD-wide records will greatly increase the sample sizes for subsequent analysis, making it more robust.

New goaling issues

Demographic diversity

Diversity presents different issues for officer recruiting than for enlisted. Because of the differences in the demographics in target population, it is harder to recruit a racially and ethnically diverse force. There are many benchmarks to choose from when it comes to racial and ethnic diversity. The Army, for example, uses the general population composition, others have used the composition of college graduates, or the composition of employees in management positions. Ultimately, the Navy picked a benchmark that is based on the predictions of the 2037 population composition. During the Officer Goaling Conference, recruiters expressed concern about the fact that diversity is goaled differently from overall goals. There was a popular proposition that would move the process from goaling applications to goaling a combination of applications and selections within legal constraints, or at least incentivizing selections while goaling applications only. Another suggestion, and the one that is likely to be pursued by the Navy in the near future, is goaling all officers based on applications.

Lessons from other Services[20]

In this section, we look to the other services to determine how they goal for officers and for ways to address the issues described above.

[20] We are grateful to Mr. Mike Nelson at USAREC, Col T.J. Kenney at AFRS, and Captain Joseph Wydeven at MCRC for providing CNA with the following information on goaling in their respective services.

U.S. Army

In the Army, enlisted recruiters recruit for Officer Candidate School (OCS), West Point, and Reserve Officers' Training Corps (ROTC). Only medical officers and chaplains are recruited by officers. Recruiting for special programs in the Army officer corps is usually handled by enlisted recruiters in grades E6 and above.

The USAREC portion of the officer mission has decreased from 1,000 in FY 2011 to 600 in FY 2012. When this already small mission is allocated to 250 recruiting companies, the apportioned recruiting goals get very small, making a rigorous statistical model not feasible. Instead, this distribution is based on population statistics, such as the number of people attending college and similar metrics. This goal then gets passed from the recruiting company to individual recruiting stations and recruiters. This distribution, which uses colleges and universities as its analysis units, is based on past production as the main contributor. Recently, the Army has started focusing on recruiting from STEM degrees, making their task more complex.

In the Army, diversity is set as a target on a station level, but there are neither rewards for overexecuting the diversity goal nor penalties for not meeting the target.

U.S. Air Force

The Air Force Recruiting Service (AFRS) recruits general duty officers who do not come from ROTC or the Air Force Academy. These usually represent between 10 and 20 percent of the general duty officers who go to Officer Training School (OTS). Senior enlisted personnel with past recruiting experience recruit all officers in the Air Force, with the exception of chaplains and lawyers, who are recruited by volunteer recruiters in their ratings.

The Air Force officer recruiting goals are assigned based on propensity to enlist (as measured by past production) and manning. This suggests that market factors are taken into account, albeit indirectly. The Air Force places importance on recruit quality: all candidates are required to take the Air Force Officer Qualifying Test

(AFOQT). This test, like the Graduate Record Examination (GRE), covers academics, analytical thinking, and mathematics. It contains five composites: pilot, navigator, academic, verbal, and quantitative. The test measures aptitudes, and scores are later used to select candidates for commissioning programs, such as OTS or Air Force Reserve Officer Training Corps (AFROTC). It is also used for selection into specific training programs, such as pilot and navigator training. In addition to the AFOQT, an officer applicant needs at least a 3.0 grade-point average (GPA) to be competitive.

In the Air Force, officer diversity is handled in a similar fashion to enlisted diversity. Recruiters earn points for recruiting women, Hispanics, and African-American applicants. There are additional points for applicants who apply for flying jobs, or to become electrical engineers, computer engineers, and meteorologists. Competitions based on these points within and between squadrons incentivize recruiters to earn these points. A top squadron can't win overall unless its diversity target has been met. Squadrons are encouraged to have internal reward systems that motivate recruiters and keep them oriented toward general Air Force needs.

U.S. Marine Corps

Each year, CNA produces the Qualified Candidate Population (QCP) report for the Marine Corps [14]. This report pulls data on schools from the Integrated Postsecondary Education Data System (IPEDS), which has enrollment and graduation rate information, as well as SAT scores. CNA merges this dataset with Barron's data on school quality. The Barron's score is based on the percentage of applicants admitted, as well as on the average incoming SAT scores and high school GPA among those admitted. Top-tier colleges take students who ranked in the top 20 percent of their high school classes, earned GPAs between A and B+, and received SAT scores in reading and math of 655 to 800. These schools admit fewer than a third of applicants. After the schools are ranked on a combination of quantity and competitiveness using Barron's scores, the total mission is allocated to recruiting districts in proportion to the numbers associated with these schools.

The Marine Corps uses the QCP report to determine where Officer Selection Officers (OSOs) should focus their attention for recruiting on college campuses [15]. Given that there are only about 70 OSOs at 60 or so Officer Selection Stations (OSSs), the Marine Corps must identify where the QCP is concentrated, and assign OSOs accordingly, in order to optimize the use of their recruiting resources. The market of potential Marine Corps officer candidates includes people who are test-score qualified and either have a bachelor's degree or are in the process of earning one. This makes schools a good area to focus on when deciding where to assign recruiters.

A recent study by CNA analyzes the composition of potential Marine Corps officer candidates, with a focus on the size, location, and racial/ethnic attributes of the population. The study also provides a list of the schools with the highest concentration of QCP, as well as maps showing the distribution of certain kinds of college graduates by county. The paper concludes that the QCP tends to be in large, competitive, mostly public educational institutions [14]. Qualified black and Hispanic men are highly concentrated in large, productive schools—a fact that should inform diversity-based recruiting efforts. These results align with an earlier CNA study that examined whether the QCP can predict which schools are most likely to produce many officer accessions [15]. While that study did not focus on diversity within the QCP, it claims that the QCP estimates are "strong, positive predictors of which schools 'produce' large number of Marine Corps officers."

Finally, the QCP paper [14] also presents an analysis that augments the traditional QCP data with propensity to enlist and medical data collected by the Centers for Disease Control and Prevention (CDC). This analysis results in more precise estimates of the QCP population, and generates a refined list of the schools with the most officer candidates. This kind of additional market information could help the Navy better evaluate its officer recruiting market.

Although officer racial and ethnic diversity is a concern for the Marine Corps, recruiting at Historically Black Colleges and Universities (HBCUs) hasn't been very successful. In addition, these colleges do not usually show up high on the ranked QCP list. Rather, there is a

separate list of QCP schools for minority officers [14]. In the Marine Corps, each OSO must submit a certain number of diversity applications based on feasibility, as computed by QCP estimates. Anecdotally, however, because only applications are currently goaled, recruiters tend to submit candidates that they know will not get in simply to accomplish that goal.

The Navy appears to have the most detailed approach to recruiting officers for active duty. The fact that the Navy recruits into over 260 officer categories makes it difficult to appropriate methods from other services, who have less detailed goals, and thus, to whom recruits appear more uniform. Additionally, the Navy, more so than other services, focuses on recruiting STEM graduates, which decreases the number of potential candidates and eliminates certain schools from consideration altogether.

Additionally, we did not find that other services had a significantly different approach to recruiting a demographically diverse officer force.

Addressing goaling issues in the officer AC

We found the Navy's method for recruiting AC officers to be more detailed than its equivalents in the other services. Because the Navy, more so than the other services, focuses on recruiting STEM graduates, CNRC maintains and regularly updates a dataset with numbers of technical college degrees from most schools, and a mapping from those degrees to officer designators. In this section, we attempt to create a list of QCP schools the way the Marine Corps analyzes them to check whether this methodology would be helpful to the Navy.

In table 3, we present a rough estimate of what the QCP schools would look like for the Navy[21] before the adjustments for propensity

[21] The Navy's minimum SAT score requirement is 1050, whereas it is 1000 for the USMC, so the list is slightly different for the Navy. In addition, we did not use Barron's data to identify how competitive the schools are; we used the default measurement provided by IPEDS.

and medical data. To construct this table, we used data from easily accessible online sources. We used the IPEDS dataset to obtain the list of schools, their competitive attributes, and enrollment data.

Table 3. Estimated list of QCP Schools

Institution name	% admitted 2009	% undergraduates		Full-time undergraduate enrollment	Black	Hispanic
		Black	Hispanic			
Arizona State University	90	5	16	45,597	2,280	7,296
Ohio State University–Main Campus	65	7	3	37,864	2,650	1,136
Pennsylvania State University–Main Campus	51	4	4	37,485	1,499	1,499
Texas A&M University	67	3	14	35,400	1,062	4,956
The University of Texas at Austin	45	5	18	35,364	1,768	6,366
University of Central Florida	47	9	15	34,197	3,078	5,130
Michigan State University	72	8	3	33,429	2,674	1,003
University of Florida	43	10	15	31,316	3,132	4,697
Indiana University–Bloomington	73	5	3	31,061	1,553	932
University of Illinois at Urbana–Champaign	65	7	7	30,639	2,145	2,145
Purdue University–Main Campus	73	3	3	30,334	910	910
University of Minnesota–Twin Cities	50	5	2	28,539	1,427	571
University of Washington–Seattle Campus	61	3	6	28,094	843	1,686
Brigham Young University	69	0	4	28,048	0	1,122
Florida State University	61	10	13	27,705	2,771	3,602
Rutgers University–New Brunswick	61	8	10	27,588	2,207	2,759
University of Wisconsin–Madison	59	3	4	27,386	822	1,095
University of Arizona	78	3	18	27,103	813	4,879
University of California–Los Angeles	23	4	15	25,772	1,031	3,866
University of Michigan–Ann Arbor	50	6	4	25,342	1,521	1,014
University of Colorado at Boulder	84	2	6	24,916	498	1,495

In the first column of the table, we give the percentage of applicants admitted. The next two columns indicate the proportions of minor-

ity enrollment. The fourth column is the total number of full-time undergraduate students, and the two columns that follow are the numbers of black and Hispanic students. These numbers are obtained by multiplying the respective proportions in columns 2 and 3 by the total enrollment number. Table 4 is the QCP table created for the Marine Corps, with adjustments made for medical data and propensity to enlist. There are many similarities between the quick data pull and the original QCP school list, indicating that this is an inexpensive way to get at roughly correct data. Note that this list does not focus on any specific kind of degree, but rather on the total number of students. As we will see later, this method is less useful when only STEM degrees are of interest.

Table 4. QCP for the Marine Corps

QCP		Medical-adjusted QCP		Medical- and propensity-adjusted QCP	
Pennsylvania State University–Main Campus	4,161	Pennsylvania State University–Main Campus	3,324	Pennsylvania State University–Main Campus	148
University of Florida	3,662	University of Florida	2,976	University of Florida	147
Ohio State University–Main Campus	3,660	Ohio State University–Main Campus	2,883	Brigham Young University	139
Texas A&M University	3,371	Texas A&M University	2,661	University of Central Florida	131
University of Illinois at Urbana–Champaign	3,294	University of Illinois at Urbana–Champaign	2,656	Texas A&M University	131
University of Central Florida	3,267	University of Central Florida	2,655	Arizona State University	129
The University of Texas at Austin	3,222	Brigham Young University	2,613	Ohio State University–Main Campus	129
Brigham Young University	3,148	The University of Texas at Austin	2,543	The University of Texas at Austin	125
Arizona State University	2,985	Arizona State University	2,426	University of California–Berkeley	119
University of California–Berkeley	2,861	University of California–Berkeley	2,336	University of Illinois at Urbana–Champaign	118
University of Michigan–Ann Arbor	2,793	University of Maryland–College Park	2,236	University of Maryland–College Park	111
University of Maryland–College Park	2,772	Florida State University	2,202	University of California–Los Angeles	109
University of Wisconsin–Madison	2,751	University of Michigan–Ann Arbor	2,188	Florida State University	109
Florida State University	2,710	University of Minnesota–Twin Cities	2,181	University of Washington–Seattle Campus	108
University of Minnesota–Twin Cities	2,654	University of Wisconsin–Madison	2,176	University of Colorado at Boulder	107

When we looked at the officer data for the Navy and compared the non-missing school entries with top QCP schools that we identified earlier, there was little correlation between what schools came out as top QCP schools and where most Navy officers came from. This is likely because the QCP analysis that CNA performs for the Marine

Corps does not make adjustments for STEM degrees. We present our comparison in table 5. The third column indicates rank based on total QCP population. The rightmost column indicates where the QCP schools rank when sorted by Navy inventory.

Table 5. IPEDS and Navy schools

Institution name	Full-time undergraduate enrollment	IPEDS QCP rank	Navy rank
Arizona State University	45,597	1	27
Ohio State University	37,864	2	27
Pennsylvania State University	37,485	3	15
Texas A&M University	35,400	4	6
The University of Texas at Austin	35,364	5	3
University of Central Florida	34,197	6	541
Michigan State University	33,429	7	32
University of Florida	31,316	8	4
Indiana University–Bloomington	31,061	9	36
University of Illinois at Urbana–Champaign	30,639	10	19
Purdue University–Main Campus	30,334	11	60
University of Minnesota	28,539	12	27
University of Washington–Seattle	28,094	13	16
Brigham Young University	28,048	14	24
Florida State University	27,705	15	11
Rutgers University–New Brunswick	27,588	16	114
University of Wisconsin–Madison	27,386	17	12
University of Arizona	27,103	18	67
University of California, Los Angeles	25,772	19	102
University of Michigan–Ann Arbor	25,342	20	13
University of Colorado at Boulder	24,916	21	24
University of California–Berkeley	24,797	22	2
University of Georgia	24,669	23	38
University of Maryland	24,617	24	5
Temple University	24,114	25	36

As a contrast, in table 6, we provide the schools that most Navy officers came from and their IPEDS ranks based on total QCP (some ranks are tied). Several schools are missing an IPEDS rank because they are not part of the IPEDS system. Again, it is easy to see that there isn't a strong correlation between high-potential QCP schools

and those colleges and universities where the Navy has successfully recruited in the past. Thus, the Marine Corps approach is not likely to work for Navy goaling.

Table 6. All inventory based on Navy rank: Navy most productive schools (2005–2009)

Institution name	Total recruited inventory	Navy rank	IPEDS rank
Embry-Riddle	283	1	313
University of California	170	2	2
University of Texas	163	3	5
University of Florida	179	4	8
University of Maryland	127	5	24
Texas A&M	178	6	4
University of North Carolina	139	7	65
Southern Illinois University	101	8	146
State University of New York	184	9	42
University of Phoenix	94	10	
Florida State University	58	11	15
University of Wisconsin	105	12	17
University of Michigan	127	13	20
Thomas Edison College	69	13	
Pennsylvania State University	216	15	3
University of Washington	145	16	13
St. Leo University	77	16	174
University of South Florida	78	18	29
University of Illinois	117	19	10
University of Pittsburgh	41	19	71
Old Dominion University	90	21	
Louisiana State University	36	21	36
University of Tennessee	34	21	45
University of Colorado	174	24	21
Brigham Young University	32	24	14

Provided that the Navy plans to maintain its focus on recruiting STEM graduates, we conclude that general data pulls used in the Marine Corps do not provide enough detail on college graduates to be useful. That said, Malone et al. recommends two extra data sources to incorporate into the Marine Corps' QCP computations: estimates of propensity to enlist provided by JAMRS, and health-related data from the Center for Disease Control (CDC) [14].

These additional market characteristics could help isolate the most likely candidates for the Navy from within college populations as well.

Suggestions for a way forward

Ideas and suggestions

In considering the issues the Navy faces, in combination with our review of relevant literature and of the goaling methodology used in the other services, we suggest the following ways forward in evaluating and improving the Navy AC officer mission allocation process:

- We suggest that NRC continue its efforts to collect better data on its officer recruits, particularly as it pertains to their home of record and college/university. Current data are often erroneous or missing, making rigorous analysis impossible. We also suggest that the NRC continue its efforts to have DOD develop an all-service officer recruiting database. Obtaining DOD records will greatly increase the sample sizes for subsequent analysis, making it more robust. Once the reliable data are in place, NRC will have enough information to perform a thorough market analysis and use these market data to move away from using past production in its goaling methodology.
- Although the system currently used by the NRC is fairly complete, a potential flaw is that it places an incorrect weight on the number of recruiters in the model. Once the data are in place, we could study how the market responds to variations in recruiter numbers or how the number of recruiters should be changed to obtain the allocated goal.
- As was done in the recent CNA study for the Marine Corps [14], we suggest that Joint Advertising Marketing Research & Studies (JAMRS) estimates of youth propensity to enlist be included in the NRC model. As we showed in table 4, in the case of USMC, including this information changed the school order on the ranked list. Including propensity may also substitute for the current model's reliance on past production.

- Also based on the Malone et al. study, we suggest that NRC estimates be adjusted for data from the CDC [14]. The data available online include diabetes, obesity, and activity information on a county level. Including this information will have an effect on the order of the ranked schools.
- Once the data issues mentioned above are resolved, rigorous analysis of the model will be possible. We think that evaluating the current model and its shortcomings is an important step in the process of improving it. We recommend using measures similar to what we used to evaluate our zip-code-level model in the earlier section, such as looking at the mean absolute deviation of the model predictions and making sure the model is not biased. To perform such an evaluation, however, it is important to collect quality data.

Diversity

In this final subsection, we provide suggestions based on the diversity issues we identified with NRC staff and recruiters at the Officer Goaling Conference, and within the literature (primarily the MLDC report [13]), that could be helpful in thinking through improvements in diversity goaling. In-depth analysis of these issues was outside the scope of this project, so we are unable to make recommendations, but it is important to pursue these issues in future work.

- A useful idea discussed at the Officer Goaling Conference (mentioned in the Navy section on diversity) was that for minority applicants, NRDs could be ranked based on selection rates. This way, rankings take selections and attainments into consideration; applications are goaled, but quality is incentivized.
- Another idea we garnered from the Officer Goaling Conference was that diversity recruiting performance evaluations could be based on whether soft application targets are met *and* on whether selection percentages matched application percentages by NRD. For example, if in a particular NRD, the nonminority selection rate was the same as the selection rate for a particular minority category, then it follows that the NRD's minority applicants were as competitive as their other

applicants. The recruiting region could be recognized for achieving that balance. If the minority selection rate is higher than that for nonminorities, the NRD could be recognized for achieving outstanding quality in minority applications. Both this suggestion and the previous one would fare well with the Navy's recent proposal to goal applications for all officers.

- Per the recommendation in the MLDC report, the Navy could evaluate the effectiveness of current spending on minority marketing and recruiting initiatives to check whether those resources are optimally allocated.
- The Navy could examine untapped recruiting markets. This includes exploring recruiting at two-year colleges and strategically locating ROTC host units. The MLDC report cites National Center for Education Statistics (NCES) 2008 data and posits that close to 50 percent of all students in college attended two-year colleges, and this percentage is slightly higher for blacks and Hispanics. In addition, a report by Kraus from 2004, states that, in the enlisted Navy, those with two-year college degrees have higher test scores and higher continuation and reenlistment rates than those with only high school degrees [16]. The report also says that 17 percent of all students attending a two-year college transfer to a four-year college. The same is true for 19 percent of Hispanics and 8 percent of blacks. MLDC suggests that these students could be targeted for ROTC.
- Furthermore, MLDC recommends an evaluation of ROTC locations relative to diverse qualified population locations.

Officer reserve component (RC)

Introduction

As on the enlisted side, there are two types of recruits who enter the officer reserves: those with prior service (PS) and those without (NPS). Those with prior service enter the reserves with a certain skill set and training and are usually looking for a particular job. They are usually recruited within a short amount of time after completing an active duty obligation. In contrast, NPS officers who don't come in through a Navy program such as ROTC, enter the reserves in a similar way as the active duty in the sense that they are recruited out of the general college-educated population and without prior Navy training. The recruiting process is quite different for NPS and PS officers, so we address the two groups separately in this section.

Officer reserve PS

Current goaling model

In the Navy, the RC officer goal model is a weighted combination of the market (20 percent), recruiters (40 percent), and historical production over the last five years (selects, enlistments, and accessions—40 percent). The IRR market is identified from the eligible Navy officer losses provided by the Chief of Naval Personnel (CNP). The market is composed of officers who have completed MSO, officers who have not yet completed MSO, and officers serving under approved Ready Reserve Agreements.

Addressing Officer Reserve PS goaling issues

One issue we identified with the RC officer goal model is that its heavy reliance on past production makes recruiters distrust it. However, one minor benefit of using the last five years of production is

that one year of increased production has a relatively small impact on the predicted mission. Hence, this system should not be as demotivating as one with a heavier reliance on most recent numbers. Nevertheless, the five-year window for evaluating production could lead to a risk that CNRC can lag behind market changes by several years.

The IRR list, which is given to recruiters, has records for those who left the military in the last three years. It is not clear, however, if this is the optimal time span. Although we could not locate existing studies on how long someone should stay on that list, at the Officer Goaling Conference it was discussed that three years is too long and that, after a year or two, there is little chance of someone from the IRR list joining the reserves.

In addition, anecdotally, and based on our conversations with NRC staff, it's unclear what home of record (HOR) means in the IRR. Our understanding is that it is frequently unreliable because a lot of people put down Florida as HOR for tax reasons. Sometimes, officers give addresses they intend to move to but never actually end up moving there. Many give their current home base address even though they plan to move at the end of their obligation.

Lessons from other Services[22]

The services rely on officers separating from the AC for the majority of the reserve officers that they recruit. These officers have both the training and experience to fill reserve jobs.

In the Air Force, roughly 90 percent of RC officers come in with prior service. In the upcoming fiscal year, the Air Force Reserves plan to recruit a little over 300 PS officers, excluding health professionals. RC officer recruiting is very much tied to the 45 wings used for drilling. In fact, the vacancies and needs of the training units are what dictate the goal distribution, and recruiters are sent to those

[22] We are grateful to Mr. Mike Nelson at USAREC, Col T.J. Kenney at AFRS, and Captain Joseph Wydeven at MCRC for providing CNA with the following information on goaling in their respective services.

areas in accordance with the allotted goal. Like the Navy, the Air Force keeps the Individual Ready Reserve (IRR) list. The IRR list gets populated during the exit interview that each active duty officer must have with a recruiter, and the Air Force sends out quarterly mailings to that address. The Air Force experiences problems with the addresses on the IRR list; they are frequently inaccurate because officers leaving the Air Force either don't go to the location they planned or they move.

To help mitigate similar issues, the Army has a special division responsible for management of the IRR list, under the Chief of Army Reserves.

The Marine Corps Recruiting Command has a system in which enlisted and officers can recruit PS officers. Those assigned to this duty reach out to officers within two years of the end of their military service obligation (MSO) and update their records for MCRC. This way, they have more accurate data on the officers than when they originally filled out their paperwork.

Ideas and suggestions

We have identified some issues that should be addressed to improve RC goaling for officers with prior service. Our priorities for potential improvements follow:

- Increase emphasis on data recording so that the Career Transition Office (CTO) and IRR lists have reliable HOR information. Location is especially critical when recruiting people into the reserves. This may involve following up with officers who are coming up on the end of their minimum service requirement (MSR) and updating records. Some of the weight that the current method places on the IRR could be relocated to the CTO.
- Reconsider the number of years used in past production. This recommendation is based on our participation in the officer goaling conference, where we heard that recruiters thought going back five years was not valuable. A first step to do this would be to see how the model predictions change using various time period lengths and evaluate (using methods similar to those we

presented in the section on enlisted recruiting) which model predicts the outcome the best. There will be inevitable endogeneity in this type of a test since, intuitively, the recruiting goal can affect the recruiter's behavior. However, recruiters have told us that, while they take the goal into account, it is not the main driver of their work, so there might be some validity to a test like this.

Identify the new maximum amount of time someone stays on the IRR list. This number can be studied. A first step would be to look at people who get recruited into the IRR and see what the average time is between when they left active duty and affiliated with a SELRES unit. During the Officer Goaling Conference, we heard that people drop off after about two years.

Officer reserve NPS

Current goaling model

In the Navy, RC non-Medical officer Direct Commission Officer (DCO) goals are weighted combinations of recruiters (50 percent, same recruiters used for RC NAVET Model) and historical production (50 percent), which is a 5-year production average. Aside from placing a large weight on historical production and having the number of recruiters in the computation, which we discussed in the previous section, what stands out about this method is that there is no current market information incorporated in the calculation.

Lessons from other Services

Military recruiting does not exert much effort on recruiting NPS officers into the reserves. The services focus on recruiting NPS into the active forces, and PS officers into the reserves.

The Marine Corps has, however, recruited NPS officers,. Because NPS RC officers are similar to AC officers, the Marine Corps has a similar model in place for reserve NPS officer recruiting.

The Army and the Air Force recruit very few NPS officers into the RC so their recruiting and goaling methods are not systematic. In fact, the Air Force does not goal PS and NPS separately because it has a strong preference for PS officers. Those interested in becoming NPS officers in the Air Force have to interview for the position, and typically there are more leads than billets, so the Air Force does not aggressively recruit NPS officers.

Ideas and Suggestions

To improve the current RC NPS officer goaling model, we have three suggestions. The most important actions should be decreasing reliance on past production and putting increased weight on recruiting market information. This can be done in two ways. First, the NRC already has a fairly detailed model for college degree recipients. This information could serve as a starting point for this model, and it would not come at a large cost because the Navy already uses this model.

Second, we suggest incorporating information on the workforce that is publicly available in the Census. Specifically, occupation data are available by state in the Public Use Microdata Sample (PUMS), which is part of the American Community Survey (ACS). We suggest that the NRC create a mapping between Navy officer designators and Census occupation definitions, and use a combination of those selected with a measure of propensity to join (this could be based on past production) to help geographically allocate the recruiting goal. Similar to the enlisted case, it will make sense to limit this population information to a radius of 50 to 100 miles within a training unit.

Finally, since the reserves are geographically tied to training units so that the recruits can drill regularly, we advise that training unit requirements, vacancies, and authorizations be incorporated in this calculation.

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Medical officer recruiting

Background

Across services, medical recruiting is the most difficult type of recruiting. Doctors frequently have to give up a convenient schedule, a large salary, and sometimes a private practice to join the military. They also spend more time in school in pursuit of their degrees than most other recruits.

Christensen et al. note that recruiting practices in the civilian sector are similar to those used by the services; for example, often these potential employers offer scholarships and loan repayment programs. The study also found that some important factors in the civilian sector were salary, training, and job satisfaction [17]. For recruiting and marketing to medical professionals, this means inclusion of pay, affiliation with academic medical centers, and training opportunities to offset some of the opportunity costs we described above.

The study's authors posit that increasing accessions can only happen as the result of services providing additional resources to enhance and expand current programs, as well as to research the practices of other services [17].

Christensen et al. also discuss a concern regarding the negative effect that the changing gender mix in medical schools can have on physician recruiting. As the proportion of women in medical schools increases, it has a negative effect on medical recruiting because women historically have had a much lower propensity to join the military than men. The authors state that the female proportion of new medical students grew from 7 percent in 1965 to almost 50 percent in 2005. In addition, Riche and Kraus point out that the foreign-trained and non-citizen share of the medical community is

growing, which may also have a negative effect on recruiting medical personnel into the military [18].

A description of goaling issues in medical officer recruiting

The Navy, Army, and Air Force all encounter the foregoing difficulties in recruiting and goaling doctors and health professionals. The Marine Corps does not recruit doctors. We summarize the various services' methodologies below.

U.S. Navy

The Navy recruits the following categories of medical personnel:

- Medical Corps (MC) direct appointments (DA)
- MC students
- Dental Corps (DC) direct appointments
- DC students
- Medical Service Corps (MSC) direct appointments
- MSC students
- Nurse Corps (NC) direct appointments
- NC students

The majority of medical personnel are accessed via various scholarship programs, such as the Health Professions Scholarship Program (HPSP). For example, in FY 2011 the Navy was goaled with 16 physicians from the workforce and 289 to be acquired through the HPSP and similar programs.

The components of the current medical goaling model are recruiters, historical production, and a market factor. In the AC model, each factor receives a weight of one-third. For MC, DC, MSC, NC, and DA, the NRC uses a combination of professional college degree market and workforce data. In the RC Direct Commission Officer model, market (based only on professional workforce data) gets 20 percent of the weight, designated reserve recruiters get 40 percent,

and historical production over the last five years is weighted at 40 percent.

The workforce data are from PUMS, specifically the U.S. Census ACS, which gives the geographic locations, by state, for the medical workforce age 18 to 40. The main potential issue with these data is that they are organized on a state level, which is fairly large and does not always correspond with the NRD assignments. Still, this is the only breakdown available in the ACS. The other two components of the model are recruiter and historical five-year production, each weighted at one-third.

We describe a few data sources below that could provide ready-to-use data on matriculation and graduation of medical students by medical school. Medical students constitute a large part of the recruiting market, so incorporating this information should help inform goal distribution.

The Association of American Medical Colleges provides several useful datasets on its website. These give enrollment and graduation numbers over time for different medical schools. We present one of those datasets in table 14 in appendix C. The association's website (www.aamc.com) presents various breakdowns of these data, including race and ethnicity, Medical College Admission Test scores, GPA, and others. This can be a first step in identifying the market for medical recruiting.

In addition, the American Association of Colleges of Osteopathic Medicine provides tables of their enrollees and graduates, with several breakdowns, and would make a useful addition to the medical recruiting model. Such tables as table 15 in appendix C can be obtained on its website (www.aacom.com).

When recruiting DCOs for the RC, the Navy usually looks for graduate students, as well as individuals in residency programs, Certified Registered Nurse Anesthetist (CRNA) programs, and trade organizations. The goal is 20 percent market (as measured by the medical workforce), 40 percent designated reserve recruiters, and

40 percent historical production. NAVETs are usually recruited directly from active duty or from the IRR lists.

A complicating issue in medical recruiting is that the goals are relatively small. In some medical subspecialties, the number of doctors required is much smaller than the number of NRDs. When these goals are assigned to regions, the assignment is frequently perceived as unfair; it is difficult to recruit doctors. Past production also accounts for a sizable proportion of the goal computation. Because goal allocation is based partially on past production, and small numbers can often depend on chance rather than on the market, recruiters do not trust this model. In fact, the model's reliance on past production was one of the main complaints from the recruiters we interviewed at the ROY awards.

Perhaps the key issue with respect to setting goals is how goals affect the motivation and productivity of recruiters. We heard from several recruiters and from leadership that competition, incentives, and rewards might be the best way to allocate Navy medical recruiting goals. They believe that the interest and motivation generated by a competitive environment will overshadow the unfairness that comes from assigning goals in small numbers.

Lessons from other Services[23]

The Army is organized with medical recruiting prominently placed in USAREC. Medical recruiting is organized with five special medical recruiting battalions under the command of the Medical Recruiting Brigade. The Army relies on senior enlisted recruiters to perform virtually all of the medical recruiting.

For health practitioners, the Army mostly focuses on the relevant school population. The main component of the mission allocation model for medical recruiting is past production and graduation numbers from various medical schools. Collecting information on

[23] We are grateful to Mr. Mike Nelson at USAREC, Colonel T.J. Kenney at AFRS, and Captain Joseph Wydeven at MCRC for providing CNA with the following information on goaling in their respective services.

graduating classes from medical school would be a useful addition to the way the Navy currently goals medical officers.

The Air Force, like the Army, relies on senior enlisted recruiters to recruit medical personnel. For medical goals, the Air Force uses both applications and board success. However, they monitor board results to make sure quality of applicants is competitive. The AFRS is the major recruiter for medical professions. It recruits 90 percent of all health care professionals (medical doctors, nurses, Medical Service Corps, etc.). One of the factors considered in medical goals is feasibility of recruiting numbers given recruiting resources. Goals come from officer endstrength projections of requirements, which are determined independently from recruiting resources. Hence, goals may not be feasible. For example, two years ago the AFRS was tasked with recruiting a large number of fully qualified MDs, but had resources allowing for only a few dozen medical recruiters. This year they had a mission of 25 fully qualified MDs, which was achievable. Next year it will be 55, which is also reasonable. The Air Force's workforce medical doctor goals are by specialty, as are the Navy's.

Until recently, in the Air Force, the allocation of medical goal was done based on past production, without much emphasis on particular medical subspecialties. For example, it recruited surgeons, in general, as opposed to surgeons with particular specializations. Starting in FY 2011, however, the requirements became more detailed. To distribute these newly specific goals, for FY 2012, the allocation of many of the more challenging medical goals (fully qualified MDs) will happen using a "fantasy draft" model. Each group gets to select one of the goals until all the goals have been allocated. The group gets the entire nation to recruit against these goals. For example, if a recruiter is looking for an oral surgeon, he or she can go to conventions and visit places across the country to find the appropriate specialty. If a different group finds an oral surgeon, it has to refer that person to the group tasked with recruiting that specialty.

Potential ways forward

In reviewing the Navy process and considering the other services, we identified two problem areas in the current goaling process: one is market related, and the other is process related. Thus, we present two sets of considerations for a way forward. The first assumes that the current goaling process will continue to be used, but aims to improve it by adding additional market data. The second explores the idea of completely restructuring the medical goaling process by introducing competition and incentives as tools to motivate recruiters. In appendix D, we present an overview of existing literature on recruiter incentives, which can apply to both sets of considerations.

Making medical officer recruiting more market driven. We identified some data sources that will help better define the market or the potential recruitable population. NRC could include these data sources in their goaling calculations. NRC should continue to use the medical workforce data from PUMS, but we believe that the additional sources will improve the precision of the calculations.

Restructuring the medical officer goaling process. As we mentioned above, one consequence of goal distribution is its effect on recruiter motivation. As we heard from recruiters, and also found in literature, competition is one of the most effective recruiter motivators. With that in mind, it makes sense to think about an entirely different mission allocation system, one based on self-selection and ambition.

As discussed earlier, the Air Force has already implemented such a system. We think that the Air Force approach of assigning many of the smaller goals, such as workforce physicians, through an auction system has merit. These goals are literally too small to be allocated through any sort of statistical goaling model. By letting the areas and/or districts self-select, CNRC will be eliminating the problem of placing too much emphasis on past production as well. Also, by allowing areas to choose their specific goals, this approach promotes direct responsibility and autonomy for the recruiters.

A medical “fantasy draft” goaling approach could be considered and evaluated as an alternative by CNRC. Under this model, each region or NRD would be assigned a random number. Then, according to

that order, each participant would choose a medical job category to recruit and would be solely responsible for recruiting into that category regardless of the region of the country. A competition could be introduced based on completing the recruiting task. Alternatively, the medical professions could be ranked based on difficulty to recruit, and an auction draft could be implemented in which the participants could trade their medical recruiting missions. NRC could wait to see whether this model works successfully for the Air Force or, alternately, conduct a study to assess this approach's potential for success.

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Future work

In this section, we briefly describe three potential extensions of the analysis developed in this study.

1. In an immediate follow-on of our work, we could adapt the modeling approach used for the enlisted AC population to the enlisted reserve population; however, we would have to adjust for the geographic dependency on training units. (The available population would have to be restricted to within a 50-mile radius of a training unit.)

2. Likewise, CNA could apply this modeling method to the officer populations (both active and reserve), potentially generating estimates at the university level. (In the officer case, units of analysis are primarily universities, not zip codes.) The success of this effort, however, will depend on data availability. We summarize the data issues in the following bullet points:

3. The active officer (NPS) population needs more accurate home-of-record (HOR) and university data. Currently, the university field in the Officer Master File (OMF) is missing for almost a third of OCS recruits. For many others, the university name is misspelled or campus information is missing. This makes it difficult to validate the existing officer goaling method and to test new ideas. Given that current NRC goaling methods take university degrees into account, it is important to keep accurate records on universities for assessment of existing calculations and for future forecasting capabilities.

4. There is also uncertainty associated with HOR data in the OMF. For some officers, the data reflect their college address, and for others, their permanent residence. In addition, it is not recorded whether the officer was recruited while at college or at his or her permanent address. This

uncertainty prevents improvements to the current goaling model because it limits our knowledge of where the officers are actually being recruited.

5. There is a clear need for a DOD-wide officer accession database. Such a database would provide the necessary additional information that would allow for more robust modeling of the officer corps.

6. The reserve officer (PS) population needs more data on the location of officers who leave active duty. We heard from NRC and recruiters that data on PS officers are frequently unreliable. Although all of the services experience this issue to some extent, some services have concrete efforts in place to update the databases used for PS recruiting, and it seems that a special effort is required from NRC to collect and maintain accurate and up-to-date data on officers who leave active duty. Currently, lack of such data is the main obstacle to PS recruiting.

7. For officers with medical skills, CNA could help restructure the current goaling process by reviewing different ways to use incentives and competition to motivate recruiters. Medical officers are the hardest to recruit, and the process does not lend itself to statistical modeling. It is worth considering an involved qualitative analysis of potential medical goaling alternatives.

Appendix A: Recent goal allocation concerns and ROY winner interviews

Every year, the Navy presents 13 to 15 top enlisted and officer recruiters with the Recruiter of the Year, or ROY, award. At the beginning of the project, we had an opportunity to talk with some of last year's winners about the current recruiting environment. Those discussions helped inform this project. Although it wasn't feasible to study all topics identified during those discussions, we describe the most salient here for reference.

Diversity recruiting

Recruiters who won awards for their diversity numbers mentioned that they are more successful in inner-city areas, and that it helps if the recruiter is of the same gender and racial/ethnic background as the potential recruits. They mentioned having to travel quite a bit to achieve their numbers, and they talked about the use of social media tools to attract recruits. They also said they don't specifically recruit to the recommended diversity targets: they do their job every day and diversity takes care of itself. This emphasizes their reliance on CNRC's ability to geographically allocate diversity goals. Recruiters mentioned a recent emphasis on quality rather than quantity and a push for women, Hispanic, and African American A-cell recruits.

Merging missions

With more extensive use of the reserves in wars in Iraq and Afghanistan, recruiting into the reserve component (RC) has become more critical. Also, in a cost-constrained environment, the Navy is merging missions in its four major markets (i.e., enlisted, officer, AC, and RC), enabling reassignment of recruiters across missions, and, in

some instances, a recruiter to recruit for all four. This could introduce cost savings by closing some of the recruiting stations.

In addition, the Navy has slowly been merging enlisted and officer missions. In our interviews, recruiters did not express concerns about merging active and reserve missions; in fact, they explained that this is already being done to some degree. However, merging enlisted and officer missions seemed to generate more concern. On the positive side, the recruiters thought that merging these missions would enable officer candidates to come into any office and apply without having to go to officer recruiting. Because parts of the recruitable population are similar for enlisted and officer missions, recruiters would also be able to cross-reference high schools and colleges. In fact, the recruiters told us that many candidates are not sure which of the two careers they prefer when they first consider joining the Navy.

Enlisted recruiters we interviewed thought that a qualified recruiter can recruit enlisted and officer candidates, AC, and RC, provided sufficient training and information. However, officer recruiters had more concerns. Officer recruiting is often viewed as more challenging by the recruiting community, and there is a larger startup cost of getting to know the recruiting and processing system, as well as the available market. In addition, they felt that many officer candidates have a strong preference for talking with recruiters who have officer experience; these candidates require a special mentality and approach. For example, officer candidates are likely to be less available to stop by a recruiting station. Instead, a recruiter often needs to travel to them. Some recruiters worried that, given time constraints on recruiter training, it was not possible to inform a recruiter sufficiently on both enlisted and officer processes. One recruiter suggested that an enlisted recruiter who works to recruit officers could do most of the work, but an officer could come in to give a presentation on a regular basis.

Finally, recruiters brought up an additional concern: the time required for processing. Officer recruiters are given individual quarterly goals, and enlisted recruiters are given station monthly goals. They also noted that it can take anywhere from 3 to 6 months for the officer application to go through the NRC system, whereas an

enlisted application takes only a few days. This will make the processes difficult to merge.

Recruiters' geographical range

One of the main objectives of CNRC mission allocation is to assign goals equitably so that all recruiters get the same opportunity to succeed in their jobs. Goals are allocated geographically based on models in the database called Standardized Territorial Evaluation and Analysis for Management (STEAM), which has station-level data and an all-service accession dataset for enlisted recruiters.

Recruiters currently use STEAM to learn about their market and determine how to allocate their time. For additional information, they reach out to recruiters who have worked in the same area, and they investigate their assigned neighborhoods for socioeconomic factors, such as income and political affiliation.

When we asked recruiters about their geographical range, we got a variety of answers. Several recruiters mentioned that they usually travel within 20 miles of their recruiting station and sometimes up to 50 miles. Many said that they would drive 1 to 1.5 hours to meet with potential recruits, and a few said they would be willing to drive to another state for a meeting with a promising and qualified candidate. Officer recruiters mentioned that they find it particularly challenging to establish their market. Because quality of officer applicants affects their probability of selection into the Navy, they placed great emphasis on the equitable assignment of recruiters to areas close to colleges and universities of different quality.

Technology

The technology of recruiting has changed markedly over the last 20 years, with new marketing technologies, social networking, and greater recruiter mobility. Of the many recent technological advances, those making it easier to keep in touch have had the most impact on Navy recruiting.

Recruiters discussed several tools that have enhanced their productivity, as well as technologies they see as necessary for improving their workflow. Several recruiters mentioned that they use Facebook to communicate with potential recruits and those in the Delayed Entry Program (DEP). Many find it easier to contact recruits via Facebook than by phone, and they use the "Friends of Friends" feature in Facebook to find additional candidates and get references. This technique allows them to indentify candidates who are members of swim or other athletic teams. Some also use Facebook to check that potential recruits adhere to the Navy's height and weight standards, and they use this information to determine qualified candidates or to provide mentoring. Recruiters are also finding that texting rather than calling young recruits results in more frequent interaction.

Because social networking sites and text messaging have become the leading ways that young people communicate, inability to text or go on Facebook hurts recruiters. Regular contact with those in the Delayed Entry Program and mentees is important, and both social networking and texting help recruiters stay in touch. Most recruiters expressed dissatisfaction with the amount of paperwork and with the number of computer- and phone-related issues they encounter. Because of frequent travel, they mentioned the need for portable computers and printers.

Past production

Several recruiters told us that they rely on CNRC to give them achievable goals, and they direct their time toward recruiting in general rather than toward the specific number provided by CNRC.[24] Currently, past production (i.e., the number of recruits brought on in a district in the previous several years) makes up a portion of the model that forecasts enlistments for each area. This is not surprising because past production is a good measure of the recruiters' market, and recruiters agree that without past production informing some of the goaling model, the missions would become stagnant.

[24] CNRC actually only goals Regions. NRD COs then goal recruiters.

The problem with this measure, however, is that it does not necessarily incentivize recruiters in the right way. One's hard work one year may result in a harder task the following year, whereas poor production could be "rewarded" with a smaller, more accomplishable goal. One recruiter told us that he was goaled one year with four officers in a particular community, but delivered nine, so the following year, he was goaled with nine, which was quite hard to accomplish. Recruiting models use more than one year of past production (typically three to five), so this sharp increase in required numbers is likely a result of the goaling process (leadership oversight) rather than of the goaling model alone. Nevertheless, recruiters suggested that goals should be raised in a marginal manner and based on the nation's need, rather than on past production.

Medical officer recruiting

Our conversations with recruiters and leadership identified medical officer recruiting as the most difficult of the recruiting tasks. Geographically allocating recruiting goals is particularly complex for the medical field because every year the number of recruits needed for medical programs is small (sometimes smaller than the number of NRDs), and there is an inherent unfairness when these numbers get distributed among NRDs and then further assigned to particular recruiting stations. When these small numbers get further subdivided by diversity requirements, the perceived unfairness is even greater.

Recruiters were unhappy with the way past production affected these requirements because they felt that, with numbers this small, past production was highly affected by chance alone and not by the size of the recruitable population. We heard from several recruiters that, if some form of competition were incorporated in medical officer goaling, the process would be more motivational and perceived as engaging and challenging rather than unfair.

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Appendix B: Enlisted active component (AC) zip-code-level model results

This appendix presents resulting model estimates for modeling recruit production on a zip-code level for various subpopulations of the total inventory. Several models were unstable with respect to model specifications, and some were impossible to estimate. We present, for each subpopulation, the best estimable model.

A-cell recruits

Table 7 presents our model results for predicting A-cell recruits by zip code.

Table 7. Model results for predicting A-cell recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0151	0.0006	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
W & P 17-19 currently in college black	0.0100	0.0065	0.1240
W & P 17-19 currently in college Hispanic	0.0081	0.0065	0.2120
W & P 17-19 currently in college white	-0.0151	0.0022	0.0000
W & P 17-19 currently in HS, year 1-3 black	0.0055	0.0014	0.0000
W & P 17-19 currently in HS, year 1-3 Hispanic	0.0141	0.0028	0.0000
W & P 17-19 currently in HS, year 1-3 white	0.0016	0.0015	0.2660
W & P 17-19 HSDG black	0.0008	0.0003	0.0110
W & P 17-19 HSDG Hispanic	0.0025	0.0004	0.0000
W & P 17-19 HSDG white	0.0003	0.0001	0.0210
W & P 17-19 senior in HS, black	-0.0019	0.0009	0.0280
W & P 17-19 senior in HS, Hispanic	-0.0121	0.0016	0.0000
W & P 17-19 senior in HS, white	0.0024	0.0007	0.0000
W & P 20-21 college grad black	0.0143	0.0068	0.0360
W & P 20-21 college grad Hispanic	0.0029	0.0042	0.4950
W & P 20-21 college grad White	0.0084	0.0016	0.0000
W & P 20-21 currently in HS, year 1-3 black	-0.0074	0.0067	0.2710
W & P 20-21 currently in HS, year 1-3 Hispanic	-0.0113	0.0059	0.0550

W & P 20-21 currently in HS, year 1-3 white	-0.0298	0.0067	0.0000
W & P 20-21 HSDG black	-0.0010	0.0003	0.0030
W & P 20-21 HSDG Hispanic	-0.0014	0.0004	0.0010
W & P 20-21 HSDG white	0.0005	0.0001	0.0000
W & P 20-21 senior in HS, black	0.0041	0.0026	0.1120
W & P 20-21 senior in HS, Hispanic	0.0243	0.0033	0.0000
W & P 20-21 senior in HS, white	0.0073	0.0018	0.0000
Navy Awareness Index in 2009	0.6900	0.0571	0.0000
USAF recruiters in 2009	0.0743	0.0204	0.0000
USA recruiters	0.0071	0.0033	0.0350
USMC recruiters	0.0311	0.0105	0.0030
USN recruiters	0.0699	0.0044	0.0000
Violent crime	0.0002	0.0001	0.0090
Property crime	0.0002	0.0000	0.0000
Veteran population 17-44	0.3288	0.0306	0.0000
Veteran population 45-64	0.0091	0.0314	0.7720
Veteran population 65-84	-0.1408	0.0336	0.0000
Veteran population 85 and up	0.4308	0.1027	0.0000
Constant	-1.9588	0.0706	0.0000
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Non-zero model			
Distance to closest college / university	0.1724	0.0135	0.0000
Distance squared	-0.0023	0.0002	0.0000
College or university in zip	-0.2252	0.2142	0.2930
Size of the college / university	-0.1578	0.0478	0.0010
Size by distance interaction	-0.0008	0.0025	0.7390
Multiple school flag	-2.7610	2.7492	0.3150
Historically black college or university in zip	-0.0158	0.1943	0.9350
Constant	-1.9235	0.2084	0.0000

Black recruits

This model was unstable and not robust to model specifications. In many specifications, our software was unable to estimate the model. We present one of the successful specifications in table 8. For brevity, we omit the statistically insignificant results.

Table 8. Model results for predicting the number of black recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0118	0.0018	0.0000
State unemployment rate	0.0296	0.0117	0.0120
QMA black 17-19	0.0078	0.0021	0.0000
QMA white 17-19	-0.0079	0.0012	0.0000
W & P 20 no high school black	-0.0039	0.0014	0.0060
W & P 20 GED black	0.0671	0.0238	0.0050
W & P 20 GED white	0.0319	0.0107	0.0030
W & P 20 in HS, years 1-3 black	0.0869	0.0313	0.0060
W & P 20 in HS, years 1-3 white	0.0786	0.0401	0.0500
W & P 20 HSDG	-0.0102	0.0024	0.0000
W & P 20 Native American no HS	0.0041	0.0014	0.0030
W & P 20 HS senior black	-0.0263	0.0134	0.0490
W & P 20 HS senior white	0.0645	0.0145	0.0000
W & P 21 college grad black	-0.0929	0.0310	0.0030
W & P 21 no HS black	0.0048	0.0013	0.0000
W & P 21 GED white	-0.0326	0.0126	0.0100
W & P 21 in HS years 1-3 black	-0.0822	0.0297	0.0060
W & P 21 HSDG Hispanic	-0.0100	0.0043	0.0200
W & P 21 no HS black	-0.0056	0.0026	0.0340
W & P 21 AA degree white	0.0194	0.0096	0.0430
W & P 21 senior in HS black	0.0385	0.0138	0.0050
W & P 21 senior in HS Hispanic	0.0696	0.0230	0.0030
W & P 21 senior in HS white	-0.0466	0.0133	0.0000
W & P 22 college grad black	-0.0066	0.0026	0.0120
W & P 22 HSDG black	0.0056	0.0023	0.0140
W & P 22 HSDG Hispanic	-0.0096	0.0052	0.0630
W & P 22 HSDG white	0.0052	0.0021	0.0150
W & P 17-19 GED black	-0.0232	0.0107	0.0300
W & P 17-19 GED Hispanic	-0.0458	0.0261	0.0800
W & P 17-19 HS years 1-3 black	0.0139	0.0084	0.0980
W & P 17-19 years 1-3 Hispanic	0.0028	0.0010	0.0050
W & P 17-19 years 1-3 white	0.0077	0.0019	0.0000
W & P 17-19 in college white	0.0018	0.0005	0.0010
W & P 17-19 senior in HS Hispanic	-0.0103	0.0047	0.0300
W & P 23-24 college grad black	0.0062	0.0012	0.0000
W & P 23-24 AA degree black	-0.0056	0.0030	0.0620
W & P 23-24 AA degree Hispanic	0.0094	0.0055	0.0900
W & P 23-24 senior in HS black	0.0541	0.0194	0.0050
W & P 23-24 senior in HS Hispanic	-0.0999	0.0279	0.0000

Navy Awareness index	0.8029	0.1613	0.0000
USAF recruiters	0.1965	0.0472	0.0000
USA recruiters	-0.0140	0.0084	0.0950
USMC recruiters	0.0872	0.0293	0.0030
USN recruiters	0.0135	0.0112	0.2300
Violent crime	-0.0005	0.0002	0.0070
Property crime	0.0004	0.0000	0.0000
Veteran population 45-64	0.5852	0.0857	0.0000
Veteran population 65-84	-1.0567	0.1151	0.0000
Veteran population 85 and up	1.1917	0.3386	0.0000
Constant	-3.6337	0.2289	0.0000
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Non-zero model			
College or university in zip	-3.2560	0.4215	0.0000
Constant	1.5061	0.5197	0.0040

Black A-cell recruits

Table 9 presents our model results for predicting the number of black A-cell recruits by zip code.

Table 9. Model results for predicting the number of black A-cell recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0183	0.0023	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
W & P 17-19 currently in college black	0.0300	0.0142	0.0350
W & P 17-19 currently in college Hispanic	-0.0556	0.0213	0.0090
W & P 17-19 currently in college white	-0.0285	0.0089	0.0010
W & P 17-19 currently in HS, year 1-3 black	-0.0049	0.0026	0.0570
W & P 17-19 currently in HS, year 1-3 Hispanic	0.0152	0.0096	0.1130
W & P 17-19 currently in HS, year 1-3 white	0.0114	0.0050	0.0220
W & P 17-19 HSDG black	0.0006	0.0006	0.2830
W & P 17-19 HSDG Hispanic	0.0027	0.0015	0.0670
W & P 17-19 HSDG white	-0.0013	0.0004	0.0040
W & P 17-19 senior in HS, black	0.0072	0.0016	0.0000
W & P 17-19 senior in HS, Hispanic	-0.0161	0.0052	0.0020
W & P 17-19 senior in HS, white	-0.0035	0.0023	0.1250
W & P 20-21 college grad black	0.0056	0.0140	0.6880
W & P 20-21 college grad Hispanic	0.0284	0.0089	0.0010

W & P 20-21 college grad white	0.0031	0.0060	0.5990
W & P 20-21 currently in HS, year 1-3 black	-0.0596	0.0187	0.0010
W & P 20-21 currently in HS, year 1-3 Hispanic	-0.0076	0.0179	0.6710
W & P 20-21 currently in HS, year 1-3 white	0.0081	0.0218	0.7090
W & P 20-21 HSDG black	-0.0008	0.0007	0.2030
W & P 20-21 HSDG Hispanic	-0.0017	0.0015	0.2500
W & P 20-21 HSDG white	0.0020	0.0004	0.0000
W & P 20-21 senior in HS, black	0.0231	0.0068	0.0010
W & P 20-21 senior in HS, Hispanic	0.0318	0.0100	0.0010
W & P 20-21 senior in HS, white	0.0052	0.0060	0.3840
Navy Awareness Index in 2009	1.4917	0.1763	0.0000
USAF recruiters in 2009	0.2188	0.0540	0.0000
USA recruiters	0.0080	0.0091	0.3830
USMC recruiters	0.0217	0.0311	0.4860
USN recruiters	0.0268	0.0124	0.0300
Violent crime	0.0002	0.0002	0.2020
Property crime	0.0004	0.0000	0.0000
Veteran population 17-44	0.3167	0.0866	0.0000
Veteran population 45-64	0.4756	0.0967	0.0000
Veteran population 65-84	-1.0550	0.1266	0.0000
Veteran population 85 and up	1.0796	0.3744	0.0040
Constant	-4.9429	0.2238	0.0000
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Non-zero model			
Distance to closest college / university	0.1712	0.0309	0.0000
Distance squared	-0.0016	0.0005	0.0010
College or university in zip	-0.1029	0.2970	0.7290
Size of the college / university	-0.0248	0.0786	0.7520
Size by distance interaction	-0.0038	0.0058	0.5120
Multiple school flag	-1.9223	1.9512	0.3250
Historically black college or university in zip	-2.2667	0.7687	0.0030
Constant	-1.4263	0.3712	0.0000

Hispanic recruits

Table 10 presents our model results for predicting the number of Hispanic recruits by zip code.

Table 10. Model results for predicting the number of Hispanic recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0313	0.0015	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
QMA 17-19 I-IIIA black	0.0022	0.0003	0.0000
QMA 17-19 I-IIIA Hispanic	0.0056	0.0002	0.0000
QMA 17-19 I-IIIA white	0.0006	0.0000	0.0000
Navy Awareness Index in 2009	1.7594	0.1071	0.0000
USAF recruiters in 2009	0.1194	0.0362	0.0010
USA recruiters	0.0317	0.0052	0.0000
USMC recruiters	0.1885	0.0162	0.0000
USN recruiters	0.0764	0.0072	0.0000
Violent crime	0.0010	0.0001	0.0000
Property crime	0.0003	0.0000	0.0000
Veteran population 17-44	0.4855	0.0674	0.0000
Veteran population 45-64	-0.3404	0.0712	0.0000
Veteran population 65-84	-0.1335	0.0770	0.0830
Veteran population 85 and up	0.9779	0.2252	0.0000
Constant	-4.0439	0.1407	0.0000
---	---	---	---
Non-zero model			
Distance to closest college / university	0.2194	0.0189	0.0000
Distance squared	-0.0036	0.0004	0.0000
College or university in zip	0.4802	0.1201	0.0000
Size of the college / university	-0.0059	0.0353	0.8670
Size by distance interaction	-0.0106	0.0031	0.0010
Multiple school flag	-0.1532	0.1733	0.3770
Historically black college or university in zip	0.7875	0.1904	0.0000
Constant	-1.1273	0.1785	0.0000

Hispanic A-cell recruits

Table 11 presents our model results for predicting the number of Hispanic A-cell recruits by zip code.

Table 11. Model results for predicting the number of Hispanic A-cell recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0338	0.0017	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
QMA 17-19 I-IIIA black	0.0021	0.0003	0.0000
QMA 17-19 I-IIIA Hispanic	0.0054	0.0002	0.0000
QMA 17-19 I-IIIA white	0.0007	0.0000	0.0000
Navy Awareness Index in 2009	1.8643	0.1187	0.0000
USAF recruiters in 2009	0.1421	0.0402	0.0000
USA recruiters	0.0366	0.0059	0.0000
USMC recruiters	0.1959	0.0180	0.0000
USN recruiters	0.0747	0.0079	0.0000
Violent crime	0.0009	0.0001	0.0000
Property crime	0.0003	0.0000	0.0000
Veteran population 17-44	0.4212	0.0738	0.0000
Veteran population 45-64	-0.2957	0.0771	0.0000
Veteran population 65-84	-0.1115	0.0809	0.1680
Veteran population 85 and up	0.9464	0.2329	0.0000
Constant	-4.3508	0.1543	0.0000
---	---	---	---
Non-zero model			
Distance to closest college / university	0.2254	0.0213	0.0000
Distance squared	-0.0036	0.0004	0.0000
College or university in zip	0.4886	0.1349	0.0000
Size of the college / university	0.0324	0.0394	0.4100
Size by distance interaction	-0.0123	0.0036	0.0010
Multiple school flag	-0.0299	0.1898	0.8750
Historically black college or university in zip	0.7357	0.2103	0.0000
Constant	-1.3642	0.2047	0.0000

Female recruits

Table 12 presents our model results for predicting the number of female recruits by zip code.

Table 12. Model results for predicting the number of female recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0234	0.0012	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
QMA 17-19 I-IIIA black	0.0062	0.0003	0.0000
QMA 17-19 I-IIIA Hispanic	0.0043	0.0003	0.0000
QMA 17-19 I-IIIA white	0.0006	0.0000	0.0000
Navy Awareness Index in 2009	0.3339	0.1113	0.0030
USAF recruiters in 2009	0.1806	0.0390	0.0000
USA recruiters	0.0139	0.0063	0.0270
USMC recruiters	0.1435	0.0199	0.0000
USN recruiters	0.0545	0.0082	0.0000
Violent crime	0.0003	0.0001	0.0340
Property crime	0.0003	0.0000	0.0000
Veteran population 17-44	0.2730	0.0547	0.0000
Veteran population 45-64	0.2248	0.0584	0.0000
Veteran population 65-84	-0.2158	0.0617	0.0000
Veteran population 85 and up	0.5422	0.1876	0.0040
Constant	-2.5881	0.1348	0.0000
---	---	---	---
Non-zero model			
Distance to closest college / university	0.1672	0.0183	0.0000
Distance squared	-0.0023	0.0003	0.0000
College or university in zip	-0.0297	0.1694	0.8610
Size of the college / university	0.0338	0.0458	0.4610
Size by distance interaction	-0.0053	0.0032	0.0980
Multiple school flag	-0.1497	0.2894	0.6050
Historically black college or university in zip	-0.0822	0.2257	0.7160
Constant	-1.6590	0.2308	0.0000

Female A-cell recruits

Table 13 presents our model results for predicting the number of female A-cell recruits by zip code.

Table 13. Model results for predicting the number of female A-cell recruits by zip code

Variable	Coefficient	Standard Error	p-value
Distance to NRS	-0.0262	0.0014	0.0000
Distance to NRS squared	0.0000	0.0000	0.0000
QMA 17-19 I-IIIA black	0.0062	0.0003	0.0000
QMA 17-19 I-IIIA Hispanic	0.0042	0.0003	0.0000
QMA 17-19 I-IIIA white	0.0007	0.0000	0.0000
Navy Awareness Index in 2009	0.5327	0.1245	0.0000
USAF recruiters in 2009	0.1747	0.0441	0.0000
USA recruiters	0.0156	0.0071	0.0290
USMC recruiters	0.1556	0.0222	0.0000
USN recruiters	0.0570	0.0091	0.0000
Violent crime	0.0004	0.0001	0.0060
Property crime	0.0002	0.0000	0.0000
Veteran population 17-44	0.2659	0.0604	0.0000
Veteran population 45-64	0.2334	0.0645	0.0000
Veteran population 65-84	-0.1608	0.0675	0.0170
Veteran population 85 and up	0.5576	0.2024	0.0060
Constant	-3.0119	0.1519	0.0000
Non-zero model			
Distance to closest college / university	0.1819	0.0229	0.0000
Distance squared	-0.0025	0.0004	0.0000
College or university in zip	0.0856	0.1901	0.6520
Size of the college / university	0.0656	0.0527	0.2130
Size by distance interaction	-0.0079	0.0038	0.0400
Multiple school flag	0.1247	0.2783	0.6540
Historically black college or university in zip	0.0312	0.2533	0.9020
Constant	-1.8709	0.2796	0.0000

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Appendix C: Examples of data sources for medical officer goaling

In table 14, we present the total number of graduates by medical school and gender for 2008 through 2010. Table 15 displays the number of graduates in osteopathic medicine.

Table 14. Total graduates by U.S. medical school and gender

		2008			2009			2010		
State	Medical School	Women	Men	All	Women	Men	All	Women	Men	All
AL	Alabama	61	99	160	71	90	161	59	105	164
	South Alabama	29	36	65	34	29	63	33	34	67
AR	Arkansas	61	79	140	62	78	140	62	86	148
AZ	Arizona	52	52	104	66	57	123	56	52	108
CA	Loma Linda	80	86	166	76	84	160	62	96	158
	Southern Cal-Tech	88	80	168	85	89	174	81	79	160
	Stanford	52	41	93	39	39	78	39	60	99
	UC Davis	51	42	93	43	42	85	53	36	89
	UC Irvine	47	44	91	34	43	77	49	55	104
	UC San Diego	54	72	126	52	58	110	54	65	119
	UC San Francisco	76	73	149	82	63	145	81	76	157
	UCLA Drew	13	11	24	20	9	29	12	5	17
	UCLA-Geffen	74	75	149	77	47	124	72	75	147
CO	Colorado	57	75	132	70	63	133	73	73	146
CT	Connecticut	45	35	80	52	25	77	47	28	75
	Yale	59	36	95	52	45	97	54	56	110
DC	George Washington	92	63	155	87	77	164	102	76	178
	Georgetown	98	82	180	87	102	189	98	95	193
	Howard	52	47	99	58	50	108	48	49	97
FL	Florida	58	56	114	70	54	124	67	63	130
	Florida State	28	29	57	47	27	74	65	29	94
	Miami-Miller	73	77	150	86	85	171	68	87	155
	South Florida	66	49	115	60	53	113	65	55	120
GA	Emory	56	57	113	51	58	109	65	61	126
	MC Georgia	65	104	169	82	98	180	89	90	179

	Mercer	32	21	53	27	36	63	27	33	60
	Morehouse	31	20	51	34	22	56	28	16	44
HI	Hawaii-Burns	37	21	58	35	25	60	28	30	58
IA	Iowa-Carver	58	78	136	66	78	144	69	62	131
IL	Chicago Med-Franklin	85	98	183	89	93	182	78	108	186
	Chicago-Pritzker	59	39	98	51	62	113	55	60	115
	Illinois	153	155	308	143	157	300	160	170	330
	Loyola-Stritch	74	65	139	64	68	132	69	63	132
	Northwestern-Feinberg	75	91	166	75	92	167	77	78	155
	Rush	77	48	125	60	62	122	73	64	137
	Southern Illinois	37	36	73	35	30	65	36	33	69
IN	Indiana	118	142	260	120	147	267	116	148	264
KS	Kansas	69	94	163	79	76	155	79	89	168
KY	Kentucky	36	59	95	46	49	95	41	55	96
	Louisville	57	89	146	52	84	136	54	84	138
LA	LSU New Orleans	76	79	155	72	98	170	64	101	165
	LSU Shreveport	44	53	97	49	61	110	51	61	112
	Tulane	65	90	155	60	72	132	66	98	164
MA	Boston	81	71	152	90	64	154	86	67	153
	Harvard	88	86	174	85	90	175	78	75	153
	Massachusetts	53	49	102	50	49	99	61	40	101
	Tufts	78	96	174	78	91	169	70	99	169
MD	Johns Hopkins	57	44	101	52	73	125	58	60	118
	Maryland	85	61	146	76	64	140	98	62	160
	Uniformed Services-Hebert	49	108	157	45	113	158	40	123	163
MI	Michigan	74	95	169	73	88	161	85	80	165
	Michigan State	51	47	98	52	38	90	65	52	117
	Wayne State	115	131	246	117	135	252	144	129	273
MN	Mayo	17	19	36	20	19	39	22	10	32
	Minnesota	110	98	208	94	110	204	103	103	206
MO	Missouri Columbia	44	45	89	46	39	85	46	54	100
	Missouri Kansas City	58	27	85	51	38	89	50	40	90
	St Louis	71	79	150	61	90	151	65	98	163
	Washington Univ. St Louis	58	61	119	57	57	114	52	63	115
MS	Mississippi	48	50	98	29	65	94	55	60	115
NC	Duke	37	53	90	53	54	107	49	56	105
	East Carolina-Brody	36	36	72	32	35	67	33	34	67
	North Carolina	78	87	165	78	79	157	65	75	140
	Wake Forest	49	55	104	49	57	106	50	65	115
ND	North Dakota	29	31	60	29	30	59	28	28	56
NE	Creighton	55	66	121	62	67	129	59	58	117
	Nebraska	52	63	115	50	65	115	51	69	120

NH	Dartmouth	33	29	62	35	28	63	40	46	86
NJ	UMDNJ New Jersey	70	76	146	84	78	162	78	90	168
	UMDNJ-RW Johnson	85	69	154	80	70	150	84	67	151
NM	New Mexico	43	27	70	34	35	69	42	35	77
NV	Nevada	27	22	49	25	26	51	27	28	55
NY	Albany	77	56	133	87	51	138	67	60	127
	Buffalo	66	66	132	88	61	149	58	71	129
	Columbia	59	75	134	75	83	158	77	91	168
	Cornell-Weill	45	51	96	52	40	92	45	53	98
	Einstein	88	86	174	97	82	179	98	80	178
	Mount Sinai	63	55	118	63	58	121	68	48	116
	New York Medical	96	96	192	101	82	183	104	88	192
	New York University	77	77	154	81	83	164	85	90	175
	Rochester	57	34	91	47	42	89	44	50	94
	SUNY Downstate	107	94	201	93	106	199	80	93	173
	SUNY Upstate	75	68	143	70	84	154	80	70	150
	Stony Brook	62	42	104	57	51	108	49	64	113
OH	Case Western	65	70	135	75	93	168	71	89	160
	Cincinnati	67	89	156	65	78	143	66	96	162
	Northeastern Ohio	58	43	101	56	64	120	58	52	110
	Ohio State	73	129	202	66	130	196	86	115	201
	Toledo	68	72	140	57	78	135	56	85	141
	Wright State-Boonshoft	52	37	89	56	42	98	56	34	90
OK	Oklahoma	60	79	139	52	96	148	60	89	149
OR	Oregon	64	39	103	59	62	121	66	61	127
PA	Drexel	127	117	244	126	107	233	131	129	260
	Jefferson	111	104	215	128	129	257	129	115	244
	Penn State	61	66	127	67	66	133	71	77	148
	Pennsylvania	70	71	141	72	79	151	84	72	156
	Pittsburgh	67	71	138	73	74	147	56	75	131
	Temple	85	96	181	80	83	163	74	87	161
PR	Caribe	25	25	50	31	27	58	33	28	61
	Ponce	38	35	73	32	34	66	29	29	58
	Puerto Rico	53	47	100	42	50	92	47	47	94
	San Juan Bautista	41	11	52	47	29	76	33	26	59
RI	Brown-Alpert	42	28	70	54	36	90	45	52	97
SC	MU South Carolina	64	72	136	60	70	130	66	72	138
	South Carolina	38	38	76	35	33	68	30	48	78
SD	South Dakota-Sanford	22	31	53	22	25	47	21	25	46
TN	East Tennessee-Quillen	26	30	56	35	27	62	28	34	62
	Meharry	51	44	95	35	34	69	59	26	85
	Tennessee	56	96	152	49	89	138	55	90	145

	Vanderbilt	36	58	94	46	57	103	51	67	118
TX	Baylor	81	98	179	74	83	157	71	81	152
	Texas A&M	35	41	76	39	38	77	41	34	75
	Texas Tech	57	79	136	61	66	127	64	79	143
	UT Galveston	103	94	197	103	95	198	108	113	221
	UT HSC San Antonio	128	74	202	108	91	199	122	89	211
	UT Houston	86	102	188	84	105	189	94	128	222
	UT Southwestern	94	127	221	113	120	233	87	117	204
UT	Utah	38	60	98	40	59	99	35	64	99
VA	Eastern Virginia	55	54	109	57	49	106	43	56	99
	Virginia	57	73	130	64	77	141	69	72	141
	Virginia Commonwealth	86	95	181	82	92	174	95	92	187
VT	Vermont	57	24	81	57	48	105	61	47	108
WA	U Washington	95	74	169	89	91	180	89	80	169
WI	MC Wisconsin	87	99	186	89	112	201	99	95	194
	Wisconsin	64	71	135	99	75	174	70	71	141
WV	Marshall-Edwards	15	27	42	21	31	52	23	38	61
	West Virginia	38	50	88	38	60	98	37	66	103

Table 15. Graduates in osteopathic medicine

Academic Year	College	Total Graduates	Male	Female	% Female
2009-10	ATSU-KCOM	165	101	64	39%
2009-10	AZCOM/MWU	137	99	38	28%
2009-10	CCOM/MWU	171	85	86	50%
2009-10	DMU-COM	207	125	82	40%
2009-10	GA-PCOM	66	29	37	56%
2009-10	KCUMB-COM	239	119	120	50%
2009-10	LECOM	215	120	95	44%
2009-10	LECOM Bradenton	142	69	73	51%
2009-10	MSUCOM	187	89	98	52%
2009-10	NSU-COM	215	107	108	50%
2009-10	NYCOM/NYIT	269	118	151	56%
2009-10	OSU-COM	82	43	39	48%
2009-10	OU-COM	110	55	55	50%
2009-10	PCOM	235	103	132	56%
2009-10	PCSOM	66	33	33	50%
2009-10	TUCOM-CA	129	68	61	47%
2009-10	TUNCOM	120	75	45	38%
2009-10	UMDNJ-SOM	100	46	54	54%
2009-10	UNE-COM	112	56	56	50%
2009-10	UNTHSC/TCOM	151	83	68	45%
2009-10	VCOM	149	63	86	58%
2009-10	Western U/COMP	203	104	99	49%
2009-10	WVSOM	161	72	89	55%
2008-09	ATSU-KCOM	166	104	62	37%
2008-09	AZCOM/MWU	149	83	66	44%
2008-09	CCOM/MWU	163	68	95	58%
2008-09	DMU-COM	197	95	102	52%
2008-09	GA-PCOM	73	35	38	52%
2008-09	KCUMB-COM	234	114	120	51%
2008-09	LECOM	217	119	98	45%
2008-09	LECOM Bradenton	159	82	77	48%
2008-09	MSUCOM	198	87	111	56%
2008-09	NSU-COM	218	105	113	52%
2008-09	NYCOM/NYIT	290	138	152	52%
2008-09	OSU-COM	82	41	41	50%
2008-09	OU-COM	103	44	59	57%
2008-09	PCOM	269	126	143	53%
2008-09	PCSOM	74	42	32	43%

2008-09	TUCOM-CA	133	51	82	62%
2008-09	TUNCOM	91	47	44	48%
2008-09	UMDNJ-SOM	92	35	57	62%
2008-09	UNE-COM	116	54	62	53%
2008-09	UNTHSC/TCOM	128	62	66	52%
2008-09	VCOM	139	73	66	47%
2008-09	Western U/COMP	196	98	98	50%
2008-09	WVSOM	101	60	41	41%

Appendix D: Review of incentives literature

Our sponsor asked us to briefly review literature on incentives; we include our review in this appendix. For additional reading, we also suggest the following references: Cooke [19], Cooke [20], Samuelson et al. [21], and Jehn and Shughart [22].

Background

After the draft ended in 1973, each of the services created incentive programs to motivate recruiters. While there are differences among these programs, there are also many commonalities. For example, all the services have Recruiter of the Year, Quarter, and Month awards, as well as awards at different levels of command [23].

In addition, the services often use other kinds of incentives, such as plaques or promotions. These are usually in place for a set period of time and are designed to focus on service-specific needs. The needs themselves change and can include requirements for enlistees to have certain racial/ethnic or professional attributes. For the most part, these incentives are similar across the services, mainly as a result of DOD regulations regarding recruiter awards [23].

Various studies have looked at the effectiveness of certain incentives and at other factors that contribute to recruiter productivity. Common themes in the literature are that recruiting is a high-stress job and that fear of failure is a strong motivator for recruiters. This is particularly relevant for the most difficult types of recruiting, such as medical recruiting.

Recruiter incentives

In a 2001 study, Emerson analyzed factors that influenced Navy recruiter motivations to meet recruiting objectives. Data for the study were collected through an online survey given to the enlisted re-

cruiting force. The survey was meant to identify recruiters' attitudes about certain incentives. Sabbaticals and financial awards ranked highest on the list of extrinsic tangible incentives, but data analysis indicated that recruiters rank intangible incentives even higher. The top two intangible incentives were: (1) wanting to avoid letting down their station and (2) feeling good for meeting the mission [23].

The number one motivator of this incentive type is understandable. According to Loving, failure can lead to poor performance evaluations, which can make a recruiter less competitive for promotion [24]. It can also mean extra training and supervision during an already challenging assignment. Removing a recruiter from his or her position for low productivity, which may seem like a sensible course of action, can actually reflect poorly on the commanding officer of the recruiting station. Doing this is an acknowledgment that the commanding officer was unable to train and lead a subordinate, and it places strain on the remaining recruiters because the station must still meet quotas, but with fewer personnel until a replacement arrives.

Loving also discovered that a good command climate has the largest impact on recruiter motivation [24]. Two other studies reveal that how leaders choose to motivate, set goals for, and discipline recruiters can affect recruiter performance (see [23 and 25]). Incentive preferences differed by paygrade, volunteer status, and membership in the Career Recruiting Force.

In 1993, Barfield examined recruiter productivity by:

- Geographic location
- Racial and ethnic background of the recruiter and recruit
- Incentive program

The study found that recruiters are more productive when recruiting people who are like themselves. For example, women were better at recruiting women [26]. This finding has potential policy implications, particularly when services must target populations with specific attributes. It may be beneficial to increase the number of

recruiters with a certain profile (e.g., male Hispanics) if, and when, a service aims to recruit more male Hispanics. Similarly, one could infer that some involvement of a surgeon might be helpful in recruiting another surgeon. Clearly, this is difficult, in practice, when it comes to recruiting for critical jobs in the medical field. One solution might be to have nonmedical recruiters put forth most of the effort needed to recruit for critical medical jobs, but have some representatives of those fields come in and give seminars on their jobs with some regularity.

This analysis also concluded that two initiatives—the Recruiter Advancement Through Excellence (RATE) program and the Recruiter Meritorious Advancement Program (RMAP)—succeeded in emphasizing recruit quality instead of simply quantity. Both programs seem to be better than the Freeman Plan, which the Navy implemented in 1979 to award recruiters for enlisting quality people rather than focusing on quantity. Despite the perceived success of RATE and RMAP, some in the Navy felt that there was room for improvement regarding recruiter incentives [26]. This would indicate that a similar program that focuses on how to recruit medical professionals could address some of the difficulties in medical recruiting.

Garcia and Sharma judged the performance of the Navy Recruiter Incentive Program of October 1992 to April 1993 for Expansion of Female Representation among recruits [27]. The quality incentive system gave recruiters two more points for every female contract. Recruiters earning the most points received consideration for medals, certificates, and advancement. A policy comparison was made using recruiting data collected from the Navy Recruiting Districts for 1992 and 1993. Although this study looked only at female recruitment efforts, in the past, the Navy has offered similar point awards for recruiting other target populations, such as those qualified to work in the nuclear field. The study concluded that giving recruiters extra points for enlisting members of a target group is a good strategy.

Similar to the target-specific incentives discussed in Garcia and Sharma, the Marine Corps sometimes has seasonal recruiting drives with rewards for enlisting certain types of people (see [24 and 27]). The winter months can be a very difficult time for recruiters, so one

program incentivizes them to sign up high school graduates who can attend recruit training within 30 to 60 days. This kind of campaign is usually highly publicized, with recruiter performance disseminated daily, to spur competition among Marines. One year there was a baseball theme to the program, and awards included baseballs and bats. More substantial rewards, such as meritorious promotions, went to the most productive recruiters. This is further evidence that spurring competition and using awards could make a difference in medical recruiting as well.

- Recent research has questioned the efficacy of traditional measures of performance, which can act as incentives for recruiters. Dertouzos and Garber argue that performance measurements should reward recruiter skill and effort since recruiters who have more skill secure more contracts for a given level of effort when market quality is constant [28]. The issue is that most metrics do not allow the separation of skill and effort, so it is difficult to infer how much production occurs as a result of either factor. Better performance measures would isolate skill and effort and account for the following:
- Adjust for such things as the quality of local markets based on demographics or economic conditions.
- Account for differences in enlistment rates over time within local areas or regions.
- Assess differences in the difficulty of recruiting certain populations, such as high school seniors with high test scores.

These studies have identified that recruiter incentives can affect recruiter performance, but they have produced few results that can be used to guide a service in how to construct a set of incentives. There have not been any controlled experiments on recruiter incentives, although large-scale experiments have been used in the past to test educational benefits, bonuses, and advertising. If the Navy chooses to experiment with alternative ways of setting recruiting targets, as in the case, for example, of medical recruits, it would be an opportune time to set up an experiment that could produce some insights into how such an approach affects recruiter performance.

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