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Evidence-Based Approaches to Law Enforcement Recruitment and Hiring

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ABSTRACT

Recruiting diverse, qualified candidates is a continual challenge for law enforcement. Around the turn of the millennium many metropolitan agencies reported a shortage of eligible individuals interested in police work. With the downturn in the economy came a flood of applicants, but also, eventually, slashed funding for recruitment and hiring. The Los Angeles Police Department (LAPD) has felt the recession keenly: its advertising budget was cut by 60 percent in fiscal year 2009, city personnel involved in applicant processing have been furloughed regular, and last March the City Council approved a three-month hiring freeze. The LAPD, and law enforcement in general, can clearly benefit from evidence-based approaches to evaluating recruitment programs and streamlining the application process. Using LAPD and city administrative data from fiscal years 2007 and 2008, I estimate impacts- in terms of applicant numbers- for LAPD's recruitment efforts, and I revise a model for prioritizing applicants developed by Lim et al. (2009).

Over the course of the study period, I find overall positive returns to print advertising and recruitment event expenditures, which exhibited elasticities of 0.15 percent and 0.12 percent, respectively. The local impact estimates for intensive recruitment programs vary by site and by how controls are defined, from negligible to significantly positive. With regard to the new prioritization model, I find that military service is not a significant predictor of passing the background investigation but it is predictive of success in the academy and passing probation,

conditional on having passed the background investigation. Certain applicant signals, such as missing a preliminary investigative interview and deferring a polygraph examination, are significant predictors of a negative background investigation outcome. The overall predictive power of the revised priority score system is comparable to the original system, though with applicant signals the new model is better at predicting failure.

While the results of these analyses may be of particular interest to LAPD, the methods employed, as well as those recommended for future studies, are applicable to any law enforcement agency interested in attracting and identifying high-quality applicants more efficiently.

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Thanks to my "Bureaukamerad" Ben Bryant for his good humor, his help with countless issues great and small, and for putting up with my peccadillos.

Last on this list but first in my heart, I thank my family- my mother Susan, my father Fritz, my brother Si, my wife Learden, and my son Wolfgang- for all their love and support throughout this sometimes arduous endeavor.

Recruitment and retention are perennial concerns for large metropolitan law enforcement agencies. Over much of the last decade, police departments from New York City to San Diego experienced substantial difficulty in finding and keeping officers (e.g. Morway, 2007; Pomfret, 2006). Although the number of law enforcement officers nationwide grew by 3.4 percent from 2000 to 2004, hiring did not keep pace with population growth and was well below the rate of law enforcement growth during the 1990s (Reaves, 2007).[1] Moreover, 20 of the 50 largest local police agencies in the nation actually shrank in size from 2000 to 2004, in some cases by as much as 10 to 15 percent.

Experts commonly attribute problems in police recruiting to several causes: retirements of officers from the baby-boom generation; a smaller, better-educated generation of young workers with less interest in law enforcement specifically, and civil service generally, and less tolerance for the lengthy law-enforcement hiring process; higher rates of drug use, obesity, and debt among young people, which disqualifies many of them for police work (Raymond et al., 2005); low starting salaries relative to the private sector, at least when the economy is strong; negative perceptions about policing, particularly among underrepresented populations; and greater competition from the military, federal law-enforcement agencies, and private security firms in the wake 9/11.

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[1] U.S. population grew an estimated 4.3 percent between 2000 and 2004 (U.S. Census Bureau).

The nation's largest police agencies were among the most heavily impacted by recruitment difficulties. From 1989 to 2002, the average number of applicants to agencies with 500 or more officers decreased by 37 percent, while the percentage of applicants who were successful declined 43 percent (Taylor et al., 2005). In 2002, sixteen percent of large agencies were operating at less than 90 percent of their authorized strength.

Persistent difficulty in recruiting women and racial and ethnic minorities to law enforcement exacerbated the problem.[2] Taylor et al. (2005) found that in large police agencies, women were hired at a rate 71 percent below their representation in the population, while racial and ethnic minorities were underrepresented by about 15 percent. Obviously, when substantial segments of the labor pool are disinclined toward (or discouraged from) law enforcement as a career, it is that much harder for agencies to meet work force requirement. Further, there is widespread agreement that improving racial and gender diversity in police agencies will promote better communication and collaboration between police and the communities they serve, which will in turn enhance police accountability and legitimacy (see, e.g., National Research Council, 2004).

The nationwide economic downturn which began late in 2007 has proved to be a double-edged sword for law enforcement recruiting: more candidates are applying, but the budgets for recruiting and hiring have been slashed. Police and Sheriff's Departments around the country have reported sharp increases in the number of applicants, as is the Federal Bureau of Investigation (Gordon and Robinson, 2009). And yet, fiscal woes brought on by the recession are preventing agencies from capitalizing on the larger applicant pools. Several have even

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[2] Women rose from 8 percent of local police officers in 1987 to 11 percent in 2003. Over the same period, racial minority representation rose from 15 percent of police officers to over 24 percent (Hickman and Reaves, 2003).

cancelled academies for lack of available funds to pay the cadets' salaries (e.g. Parascandola, 2009; Avila, 2009).

Nowhere are these recruitment and hiring challenges more evident than in the city of Los Angeles.   Per capita, the Los Angeles Police Department (LAPD) is one of the smallest big-city police departments in the country. Despite reaching an historically high force strength of 9895 officers in early 2009, or about one officer for every 388 residents, Los Angeles is still substantially under-policed compared to other major cities like New York, which has one officer per 233 residents, and Chicago, with one officer for every 213 residents (Atlanta Police Foundation, 2009). Because the city of Los Angeles sprawls over more than 450 square miles, LAPD is also relatively small in terms of the geographic area of its jurisdiction, with 21 officers per square mile, compared to 59 officers per square mile in Chicago and 118 officers per square mile in New York City.

Since 1981, the LAPD has also been under consent decrees (*Blake v. City of Los Angeles*, 595 F.2d 1367; *United States v. City of Los Angeles*, 595 F.2d 1386) which stipulate greater diversity in hiring its officers. Twenty percent of the department's officers must be female, and the department must have black and Hispanic officers in proportion to their representation in the labor population of the five counties surrounding the Los Angeles metropolitan area.[3]   The current police force strength disparity between Los Angeles and other big cities actually represents a significant improvement over the status a few years ago, when Los Angeles had one officer for every 426 residents (McGreevy, 2006; Los Angeles Police Department, 2006). The

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[3] In 2005, the labor force in the five-county region was 7 percent black, 41 percent Hispanic, and 12 percent Asian

change stems from a concerted campaign, launched in 2006 by Mayor Antonio Villaraigosa and then-Police Chief William Bratton, to increase the size of the LAPD by 1000 officers (City of Los Angeles, 2006). Effective use of the Department's recruiting apparatus was seen as a key to the success of the campaign (Kleinbaum, 2005).

LAPD also typifies the new paradigm in law enforcement recruiting. The Department is no longer having difficulty attracting applicants, and has in fact been inundated with applications since early 2009. Where in 2008 the department averaged about 700 applicants in a month, in early 2009 it received upwards of 1500 in a month (Sosa, personal communication, May 4, 2009). At the same time, LAPD's marketing budget for the 2009 fiscal year was cut by 60%, and increasing the number of background investigators and personnel analysts to handle the flood of applicants is not an option in the near term. That year the city's chief legislative analyst recommended cutting the police academy class by 45 recruits to save money. This reduction in the number of new hires in 2009 was projected to save $1 million, money that could prevent proposed cuts to library-book purchases and graffiti-removal programs (Cavanaugh, 2008; Helfand, 2008). In February 2009, the city's budget deficit was projected at $427 million for the 2009–2010 fiscal year, and Mayor Villaraigosa began considering widespread city layoffs and deep cuts to services (Willon, 2009). Los Angeles, along with most of California, has yet to recover from the recession, and in March of 2011 the City Council approved a three-month hiring freeze for LAPD (Linthicum, 2011).

To assist the LAPD in its effort to grow and achieve consent decree compliance, Lim et al (2009) conducted a rudimentary analysis of its marketing campaign and developed a priority score system as a tool for influencing the quantity and quality of recruits. The marketing analysis summarized productivity across generic recruiting event types (e.g. job fairs,

recruitment seminars, sporting events) and advertising media, as well as identifying relatively untapped areas of Los Angeles County that merit more attention from recruiters. Under the priority score system, each candidate is assigned a priority score to streamline the hiring process for those with the highest probability of success. At present, the components of the score are educational attainment, residency, and Preliminary Background Assessment outcome.

Important empirical questions related to LAPD's recruiting and hiring remained in the wake Lim et al. (2009). This dissertation builds on their work with a more in-depth analysis of marketing data and an updated applicant processing tool. In the chapters that follow I describe empirical work which provides evidence, if not definitive answers, pertaining to some important recruitment research questions. Through time series regression I evaluate which, if any, of LAPD's advertising sources, aggregated at the level of advertising medium, had positive returns in terms of overall applicants and/or applicants within the female, black, and Asian target applicant groups. Using weighted regression and instrumental variables, I test whether LAPD's more intensive recruitment tools- the LAPD Cadet and Police Academy Magnet School programs- have measurable localized impacts on recruitment at the zip code level. Lastly, I expand on the priority score model using elastic net regression to determine if military service or early applicant signals are valuable predictors not only of passing the background investigation phase, but of early job performance.

Although the descriptive statistics and results of the analysis are likely to be of particular interest to LAPD and the Los Angeles Personnel Department, and in fact *should not* be generalized to other agencies, the analytical methods described herein are readily applicable to any law enforcement agency looking for evidence-based solutions to recruitment and hiring

issues. The implications for public safety policy are clear. Especially in a troubled economic climate, law enforcement agencies can ill-afford to squander money on recruiting events and advertising that do not contribute to the quantity and/or diversity of recruits. An evidence-based marketing strategy can help them avoid this pitfall. Because the basic stages of the application process for city and county peace officer positions are quite consistent across jurisdictions (Wilson et al., 2010a), the prioritization point system is potentially applicable to law enforcement agencies throughout the United States. To the extent that the system increases retention and decreases the amount of resources required to process applicants, its widespread adoption could generate substantial efficiency gains for law enforcement recruiting. Similarly, adopting data-driven approaches to evaluate marketing strategies has the potential to attract a higher number of worthy applicants for the same amount of money.

As is often the case in social science research, data availability and other considerations limited the analysis to methods that were feasible but less than ideal, to a degree that the final results are somewhat disappointing in their ambiguity. More important than the results of these analyses are the descriptions of superior methods that could be employed to answer the research questions posed in future studies.

The remainder of the dissertation is organized as follows: Chapter 2 presents a review of literature related to law enforcement recruitment; Chapter 3 covers the analysis of LAPD advertising efficacy for the fiscal years 2007 and 2008; Chapter 4 deals with estimating the localized impacts of LAPD's more intensive recruitment programs; Chapter 5 describes the updated model for an applicant priority score system, and Chapter 6 summarizes key findings and lessons for improved recruitment and hiring practices.

This dissertation draws on research both directly and indirectly related to law enforcement recruitment and hiring. Primarily this study is informed by a collection of law enforcement agency surveys and other largely qualitative research generally seeking to define a set of best practices in police recruiting. However, its conceptual framework is derived from military manpower and is motivated by a perceived need to bring evidence-based practices to police recruitment and hiring.

POLICE RECRUITMENT STUDIES

Given the obvious societal import of having law enforcement agencies adequately staffed with quality personnel, it comes as no surprise that a considerable amount of research has been devoted to the topic of police recruitment. Nor is it surprising that the volume of police recruitment research has steadily increased over the last 10-15 years, as it has become more apparent that numerous agencies large and small are experiencing difficulties hiring enough people (Scandlen, 2000; Butterfield, 2001; Koper et al., 2001a; Pomfret, 2006; Morway, 2007; Reaves, 2007), hiring the right people (Kirk, 2001; Maggi and McCarthy, 2010), and retaining the right people (Manolatos, 2006; Spielman, 2009).

Wilson et al. (2010a) have aptly used the metaphor of a bucket to describe the workforce issues facing law enforcement. The volume of the bucket represents the absolute demand for police officers, and the water volume is the current force strength. The difference between the volume of the bucket and the volume of water represents the unmet demand for police officers,

which is impacted in three ways. First, the metaphorical spigot from which the supply of police flows may "tighten", signifying a smaller stream of qualified applicants as a result of higher rates of obesity and illicit drug use, a shift in preferences away from police work, whether caused or exacerbated by the availability of relatively attractive alternatives to law enforcement. Second, the bucket (demand) has increased with the additional duties law enforcement has taken on in the areas of homeland security and immigration (Scrivner, 2006; Rubin, 2010b; Schmidt, 2011), and also due to a gathering consensus that investing in police is a cost-effective crime-prevention strategy (Heaton, 2010). Third, in this analogy, attrition is a hole in the bucket. Factors that widen the hole include malfeasance (corruption), low job satisfaction, few promotional opportunities, availability of relatively attractive employment, and incentives for early retirement (Freeman and Yearwood, 2004; Wilson et al., 2010a). The literature on police recruiting has shed light on various strategies for dealing with these challenges.

Getting enough water from the spigot, that is attracting sufficient numbers of qualified applicants- has been the focus of considerable research. Several independent efforts have been made to understand the hearts and minds of potential police recruits and successful police recruits in order to help law enforcement refine its recruitment practices (Lester, 1983; Kaminski, 1993; Stone and Tuffin, 2000; Switzer, 2006; Foley et al., 2008; Ridgeway et al., 2008; Castaneda and Ridgeway, 2010). The more recent of these studies confirm the assessment of Hubbard et al. (2004) that young adults are seeking meaningful work. The opportunity to make a difference in the community consistently ranked above novelty and excitement as a reason for pursuing a law enforcement career. Like their predecessors, today's police were also attracted to the job security and benefits associated with a career in law enforcement (Lester, 1983; Slater and Reiser, 1988; Raganella and White, 2004; Switzer, 2006; Castaneda and

Ridgway, 2010).   Recent surveys have also underscored the enduring importance of friends and family and the increasing importance of the internet as sources of information about law enforcement careers.

Program evaluation, focus groups, recruiter and managerial surveys have also been utilized to hone law enforcement recruiting. A study involving five demonstration sites for recruitment campaigns tailored to hiring service-oriented personnel concluded that community members should participate in the recruitment and selections processes, as well as in the creation of a department's "brand" (Scrivner, 2006). Based on the finding that many cadets profess an interest in law enforcement years before they are eligible to apply, business and recruiter focus groups have argued for long-range recruitment programs and partnerships with schools (Taylor et al, 2006; Switzer, 2006; Scrivner, 2006;).

To meet hiring quotas, law enforcement agencies have been "loosening the tap", relaxing standards or modifying the selection process, whether voluntarily or as a result of legal action (Wilson, 2010a). Over the last ten years, a number of big-city departments have lifted long-standing age, educational, and residency requirements, made their fitness tests easier, and adopted less stringent drug use and credit problem policies (Taylor et al., 2005; Lee, 2005; Raymond et al., 2005). Amazingly, the effects of these policy changes on recruitment, let alone officer performance, have not been researched. The tension inherent in this strategy is that some maintain it will adversely affect police legitimacy (Katz, 2000; Decker and Huckabee, 1999), yet the changes are intended to help boost female and minority representation in these agencies (Ridgeway et al., 2008) as a means to increase police legitimacy (Walker, 1985). Revamping the selection process from the traditional hurdle approach has likewise been proposed (DeCicco,

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2000), though at many agencies there are strong bureaucratic impediments to such change (Bradley, 2005).

Many of the recruitment practices used in law enforcement agencies are borrowed from military manpower research, which makes a good deal of sense: both are government organizations with a chain of command, both have security/peace-keeping functions requiring some of the same skills, and both are service-orientated professions. As a result, there is substantial overlap in their potential recruit populations. Many veterans go on to careers in law enforcement, and many law enforcement officers are also military reservists (Webster, 2008). Furthermore, the military's large data sets and research budgets have facilitated more rigorous empirical studies.

RAND military-manpower researchers, for example, have estimated "how much extra must be expended on each of several recruiting resources to gain an additional high-quality recruit— the marginal cost of each of the recruiting resources" (Asch and Orvis, 1994). They found that the marginal costs for providing educational benefits, adding more recruiters, and increasing advertising expenditures are similar, while increasing enlistment bonuses and increasing entry-level pay cost significantly more. The effectiveness of advertising varies by level of expenditure and across different media. There are "threshold levels of advertising below which advertising has essentially no impact, and saturation levels of advertising activity above which additional advertising has essentially no impact" (Dertouzos and Garber, 2003). Thus the plot of advertising versus the change in return on investment takes the shape of an elongate S-curve. Figure 2.1 illustrates this relationship for the U.S. Army. First of all, it shows that the U.S. Army gains a higher return for its advertising expenditure as the level of the expenditure increases. Second, regardless of the level of advertising budget, for the Army, television advertising is relatively

cost-effective compared to other media. Therefore, the relative marginal cost of advertising

compared to other recruiting resources must be evaluated depending on where the advertising

intensity is on the S-curve. If the advertising intensity is below a critical threshold to have some

impact on the number of recruits, the department will be better off investing in alternative

recruiting resources to increase that number.

FIGURE 2.1: DIFFERENTIAL IMPACT OF ADVERTISING RESOURCES ON NUMBERS OF U.S. ARMY RECRUITS
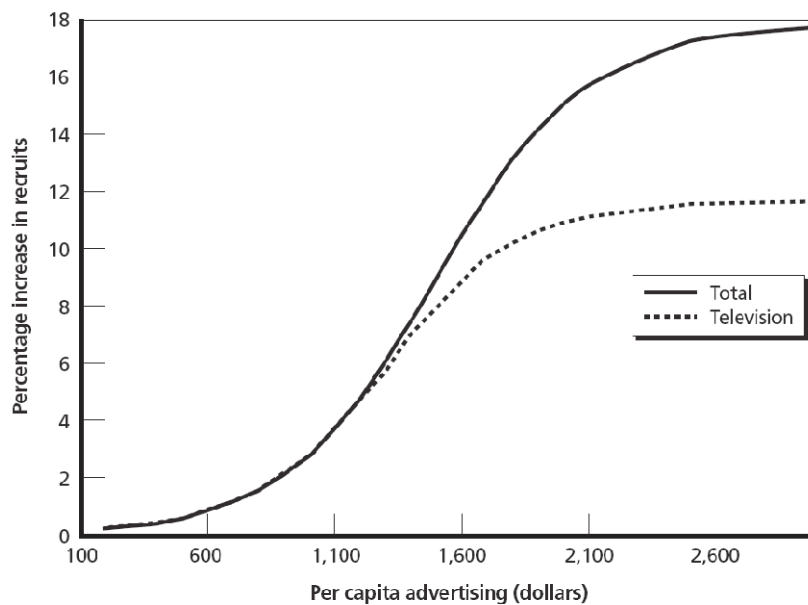
SOURCE: Dertouzos and Garber (2003, Table 8.3)

The lessons from RAND's research on military recruiting are certainly instructive for law

enforcement, yet there are enough differences between the recruiting realities- such as applicant

qualifications, terms of employment, recruiter incentive options, and marketing budgets- that it is

perilous to assume that what works for military recruiting will work for law enforcement

recruiting. To underscore this point, a recent analysis of 70 agencies found no relationship

between the number of applicants and recruitment budget, recruitment incentives, or advertising

expenditures, apart from a positive correlation for television ads (Wilson et al, 2010b). Their findings may be an artifact of non-response bias (i.e., agencies with effective recruitment programs were less inclined to participate in the study) or mostly ineffective recruitment and advertising programs masking a small number of effective ones. However, Jordan et al. (2009), one of the only other studies using law enforcement agency and regional data to identify factors that impact recruitment, found that recruitment budget was a statistically significant predictor of applicant and hiring numbers among females and minorities. Moreover, Swope (1999) reported that television commercials were ineffective at recruiting police in New York and New Orleans. There is an obvious shortage of empirical work on the efficacy of law enforcement recruiting and advertising campaigns specifically, a gap this dissertation helps fill.

The expanding role of law enforcement in the 21st century has put added pressure on recruitment. In terms of the analogy, it is harder to keep the bucket full when it keeps getting bigger. As city populations grow, the law enforcement agencies that serve them tend to grow as well (Koper et al., 2001b), but commensurate growth in viable applicants is not a given. Former LAPD chief William Bratton, among others, has argued that increasing force strength is vital to both public safety and officer safety (McCarthy, 2004; Rubin and Winton, 2009), and several studies support his claim (Levitt, 2002; DiTella and Schargrodsky, 2004; Klick and Tabarrok, 2005; Evans and Owens, 2007; Heaton, 2010). The rise in community policing, with its emphases on forging partnerships, data analysis, and proactive problem-solving, implies changes in the quantity and quality of recruits (Trojanowicz and Bucqueroux, 1990; Garciano and Heaton, 2008; Wilson et al., 2010a). At the same time law enforcement has taken on a host of new responsibilities, most notably counterterrorism functions, but also immigration enforcement

and disruption of human trafficking and identity theft rings (Riley et al., 2005; Switzer, 2006; Scrivner, 2006; Schaefer et al., 2009; Wilson et al., 2010a).

Retention- plugging or shrinking the hole in the bucket- is related to recruitment in two important ways: retention can be reduced by recruiting people who are interested in law enforcement for the right reasons and thus more likely to remain on the job, and; to the extent the retention is less of a problem, future recruiting needs will be diminished. Several studies have examined the attributes and attitudes of successful law enforcement recruits and their relationship to job satisfaction. In terms of demographic variables, an officer's age, gender, race, education, and years on the force have been shown to impact job satisfaction, though in what way and to what extent have varied over time, by department, and according to how job satisfaction is defined and measured (Buzawa, 1994). Tenure, up to career midpoint, has been found to be inversely related to job satisfaction (Griffin et al, 1978; Buzawa, 1984), and generally this is likewise the case with the highly correlated variable of age (Hunt and McCadden, 1985; Dantzker, 1994). The effect of education on job satisfaction is highly inconsistent. Lefkowitz, 1974 found educated officers were more likely to report negative attitudes toward their work, but Cascio (1977) found more educated officers were more motivated. Mixed findings were also reported by Griffin (1978), Buzawa (1984), and Dantzker (1992). In particular, the survey by Dantzker (1992) showed college-educated patrol officers had higher job satisfaction up to five years on the job, but that it fell below their less-educated co-workers beyond that point, thus raising the specter of mid-career "brain-drain" posited by Sherman (1978). And yet, in other studies education has not been an important factor in predicting job satisfaction (Dantzker, 1994; Buzawa et al., 1994; Zhao et al, 1999). As one

might expect, the interactions between race, gender and job satisfaction also tend to be time and place-dependent. In a survey of 1202 officers in six U.S. police departments, black and female officers exhibited lower scores on several measures of job satisfaction (Hunt and McCadden, 1985). However, other investigators have found no significant gender or ethnic effects on job satisfaction measures (Dantzker, 1994; Zhao et al. 1999), while still others found white males were the group least satisfied with police work (Buzawa, 1984; Buzawa et al., 1994; White et al., 2010).

Some studies on police job satisfaction have looked beyond basic demographics to assess how motivations and organization features affect job satisfaction. In their survey of Spokane police officers, Zhao et al. (1999) found that the variety of skills, the degree to which officers felt their work affected others' lives, and their level of autonomy were all positively correlated with job satisfaction and more important than any demographic variables in predicting job satisfaction. Officers more directly engaged in problem-solving and community-oriented policing report enhanced job satisfaction (Trojanowicz and Bucqueroux, 1990; Wycoff and Skogan, 1993; Skogan and Hartnett, 1997). Six years into the job, New York City police officers who expressed altruistic motivations for joining the force (e.g. to help people in the community) were significantly more satisfied with their jobs than officers with less enthusiastic motivations (e.g. lack of better alternatives; to use as a stepping stone to a better career).

CONCEPTUAL FRAMEWORK

This dissertation is based on a guiding conceptual framework derived from decades of RAND military manpower research (Asch and Orvis, 1994) and recent police-recruiting studies (Ridgeway et al., 2008). There are clear parallels between military and law enforcement employment, and military manpower research is also useful because the research budgets allow

for large-scale studies with robust quasi-experimental analyses. The framework identifies key factors that influence the number of recruits and their demographic diversity. Figure 2.2 depicts these factors and their role in the law enforcement recruiting process. There are two categories of key factors:

- Environmental factors that are beyond the direct control of law enforcement agencies

- Policy factors that law enforcement agencies can alter to increase the number of recruits.[4]

In this framework, the key environmental factor influencing the number of applicants and recruits is job seekers' propensity for a career in law enforcement. The propensity is, in turn, influenced by the community's and influencers' views and opinions of law enforcement, individual tastes toward the profession, and local labor market conditions. A weak local economy with a high level of unemployment raises job seekers' propensity for a career in law enforcement, simply because there are fewer alternatives.

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[4] Economic literature on recruiting generally categorizes the environmental factors as issues relating to labor supply and the employer's policies as issues relating to the demand for labor.

FIGURE 2.2: ENVIRONMENTAL AND POLICY FACTORS INFLUENCING NUMBERS OF RECRUITS
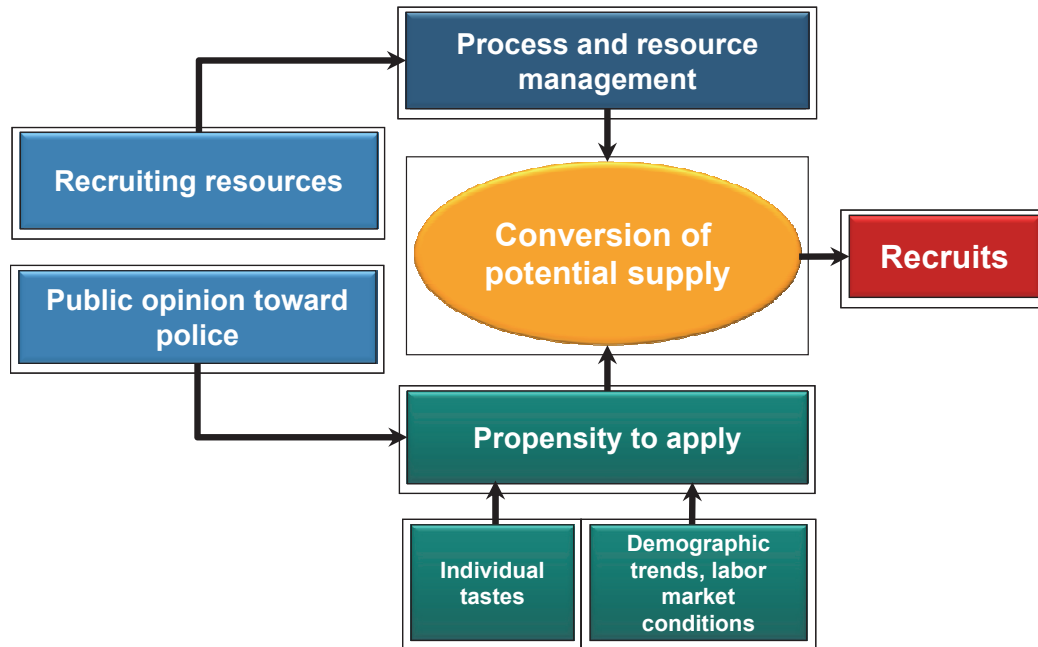
SOURCES: Adapted from Asch and Orvis (1994); Ridgeway, Lim, et al. (2008).

While environmental factors are beyond the direct control of law enforcement agencies, the agencies can directly influence the level of propensity by maintaining positive relationships with the communities they serve and by increasing recruiting resources, such as the number of recruiters, advertisement, outreach efforts, and recruiting bonuses.

As resources may be suboptimal for the near term, reflecting weaker conditions in the local economy, law enforcement agencies will need to rely on two other policy factors: recruiter and resource management, and the conversion process of potential supply. Recruiter and resource management concerns how the agencies task recruiters to attract potential applicants and manage marketing resources. The *conversion process* refers to the department's recruiting policies, screening and hiring standards, and practices and procedures that each applicant must face to become a recruit. Major steps in the conversion process for most law enforcement

agencies include written and physical tests and background investigations. Obviously it behooves agencies to minimize unnecessary losses in the conversion process, which can be incurred by excessive delays. The applicant prioritization system created by Lim et al (2009), and refined in Chapter 5, is designed to assist law enforcement agencies in reducing these delays.

EVIDENCE-BASED DECISION-MAKING

Evidence-based practices are becoming increasingly common in the criminal justice realm as well. The Comparative Statistics (CompStat) program implemented by William Bratton, first as police chief in New York and then in Los Angeles, has ushered in an era of evidence-based policing (Weisburd et al, 2003). Predictive policing is mathematic modeling of calls for service and neighborhood characteristics, such as code violations, to identify "hot spots"- locations and/or times at which crimes are likely to occur. By allowing commanders to direct resources to the areas of highest risk, predictive policing offers the potential for disrupting crime before it occurs. Memphis PD has been using an IBM predictive algorithm since 2006, and department leaders credit the technology with helping them cut crime by 30 percent (Rubin, 2010a).

Predictive modeling is also being applied at the other end of the criminal justice system to focus supervision on the highest-risk probationers. UC Irvine's Center for Evidence-Based Corrections has developed a Parole Violation Decision-Making Instrument (PVDM) which utilizes demographic and criminal history information to estimate the likelihood of recidivism. A validation sample of parolees categorized by the model as low risk were 21 percentage points less likely to commit any felony while on parole than those classified as moderate risk (Turner et al., 2009) .

Human resources is one area which, judging from the literature, has not seen a similar gravitation toward more data-driven decision-making. The world of professional sports, where statistics play a key role in hiring, salary, and coaching decisions, is a notable exception (Lewis, 2003). Generally, however, the field has been dominated by more qualitative methods, such as "whole person assessment" and personality tests (e.g. Hogan et al, 1996; Hough and Oswald, 2000). Without discounting these methods, law enforcement agencies, given the volume of applicants and the numerous stages in the application process, can benefit from a decision-making tool that prioritizes candidates according to readily observable characteristics revealed early in the application process.

INTRODUCTION

The Los Angeles Police Department markets itself through recruiting events, supplemented by advertisements placed on radio, television, newspapers, magazines, mailers, and the internet. In 2007, the Personnel Department's Public Safety Bureau (PSB), which oversees LAPD's marketing campaign, spent a total of $1 million on advertisements and venue rental and registration fees for recruiting events. This amount is several times what most law enforcement agencies spent on recruiting in 2007, but only a miniscule fraction of LAPD's $3.3 billion budget (Wilson et al., 2010a; Helfand and Hymon, 2007). Recently, the city's economic woes have prompted drastic cuts in PSB's budget. This drastic funding constraint makes it imperative that PSB have an evidence base upon which to make advertising decisions.

PSB assesses advertising effectiveness through a pair of surveys. Every seventh visitor to the JoinLAPD.com recruiting website is prompted to take a marketing survey, and all applicants, when they sit for the written exam, take a brief marketing survey appended to the application, asking how they learned about LAPD. While this feedback can provide useful direction about allocation of advertising resources, the PSB staff concedes that the approach has limitations. Responses of some applicants suggest they view the survey as a test, with right and wrong answers. Other applicants may not recall, or may recall incorrectly, the information sources that impacted their decision to apply. If all applicants indicate a particular source was influential, should more be spent on it, or less? The answer depends on whether the spending level is below the saturation threshold.

The effectiveness of recruiting events is assessed by the recruiters who attend them, in written summaries on the quality and quantity of people with whom they had contact in After Action Reports. Recruiters' evaluations are likewise valuable for gauging the viability of events, but they have the same subjectivity problem as the surveys. Recruiters may overstate the success of events in which they had contact with numerous, ostensibly qualified individuals if few of them ultimately apply or are hired, and understate the success of events in which they had contact with fewer individuals, a larger portion of whom eventually become LAPD officers. Additionally, recruiters' assessments are confined to approximating the overall turnout and on impressions of the quality of the event attendees with whom they had contact. They can only speculate about whether the event may have enhanced LAPD's brand among quality prospects who, for whatever reason, did not stop to talk with them, or among influencers who may relay positive messages about LAPD to friends and family. Regression analysis offers a way to objectively measure the return on investment of both the advertising and recruiting event aspects of LAPD's marketing.

RESEARCH QUESTIONS

The research questions addressed in this chapter are fairly straightforward:

- *Which aspects of LAPD's marketing campaign offer the highest rate of return (i.e. have the most influence) in terms of overall applicants as well as by target group applicants?*

- *Which aspects of LAPD's marketing campaign offer the highest rate of return (i.e. have the most influence) in terms of overall **successful** applicants as well as successful applicants by target group?*

ANALYTICAL APPROACH

Time-Series Regression

To answer the first question, a time-series regression model of recruiting event data, advertising expenditure data, and administrative data for fiscal years 2007-2009 is estimated to measure the impact of components of the marketing campaign on LAPD recruitment on the number of online PBA test takers and the number of applicants.

Substantively, this marketing analysis is similar to the work of Dertouzos and Garber (2003) analyzing the impact of military advertising on recruitment, though here it is necessarily to utilize a simpler time-series model more like one used by Levitt and Venkatesh (2000) because the Los Angeles Police Department is the only unit of observation, in contrast to a panel data set with 66 Military Entrance Processing Stations which can exploit both cross-sectional and time series variation. The present study also differs from Dertouzos and Garber (2003) in that no distinction is made between low and high quality recruits.

The marginal effect for each aspect of LAPD's marketing campaign, which includes both recruiting and advertising, is estimated on two outcomes: the number of people completing online Preliminary Background Assessments and the number of people taking the Personal Qualifications Essay exam. The online PBA is a useful metric because all of LAPD's marketing directs interested parties to the recruiting web page for detailed information. Although online PBA tests provide little information about caliber of the individuals LAPD's advertising is luring[5], the response represents a level of interest in the job beyond mere website browsing. Furthermore, advertising that induces applicants to take the online PBA may be more efficient if

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[5] Many who take the test do not apply, and of those who do, some will face disqualification for being untruthful about PBA responses or found otherwise deficient.

PBA disqualifications dissuade unworthy applicants from taking the PQE exam. PQE numbers are more indicative of the strength of the advertising influence and a slightly better index of quality, if indeed online PBA takers are forthright and the worst among them deterred by feedback indicating virtually certain disqualification. Although it would be of interest to use appointed hires as an outcome, the primary goal is to understand the impact of recruitment expenditures on the supply of potential hires, whereas actual hires are a function of both supply and demand. In addition, the length of the application process would severely limit the observation period, processing delays beyond the applicants' control would greatly reduce the reliability of such estimates.

The marketing arm of the personnel department has provided two years' worth of recruiting event data (including the date, hours, registration fees, and approximate number attendees at each event) from FY 2008 and FY 2009. Summing event registration fees will give the weekly recruiting expenditure. The model makes two key simplifying assumptions. One is equal and constant effort and ability across recruiters. Another is exogeneity in the timing of events and advertising, which is only somewhat mitigated by controlling for season. This assumption is violated if, for example, military events are planned to coincide with the return of troops from Iraq and Afghanistan, or advertising is stepped up to counteract negative publicity.

The personnel department has also tracked weekly advertising expenditures, broken down by specific source within each of four advertising media- television, radio, print, and online- over the same period. Note that online advertising does not refer to the recruiting web page, which is permanent, but to periodic ad placement on other websites. Advertising expenditures are aggregated by medium. The dependent variables are counts of the number of online PBAs taken and counts of the number of people sitting for the written exam, which is administered several

times a week. Links between advertising expenditures and applicant numbers are tested using the Koyck distributed lag regression, which has been applied in studies of advertising and sales for years (Rao, 1972; Frances and van Oest, 2004). The Koyck method has the advantages of minimizing loss of information and multicollinearity, both of which become more problematic as the number of lags increases, and of not imposing an arbitrary structure on the lag structure but instead allowing for a gradual decay consistent with the erosion of consumer memory. The Koyck specification strategy consists of first lagging predictor and response variables one period as shown in equation 1,

$$(1) \quad Y_{t-1} = \alpha_0 + \beta_1 X_{1t-1} + ... \beta_n X_{nt-1} + \varepsilon_{t-1}$$

and then inserting the fitted lagged response values into a second regression as shown in equation 2.

$$(2) \quad Y_t = \alpha_0 + \alpha_1 \hat{Y}_{t-1} + \beta_0 X_{1t} + ... + \beta_n X_{nt} + \varepsilon_t$$

The total effect of X_t on Y is $\dfrac{\hat{\beta}_j}{1-\hat{\alpha}_1}$. Using this formulation also permits estimation of the proportion of the effect that occurs in the first lag period, second lag period, etc. Using weeks as the unit of analysis gives 103 observations. Aside from the advertising media regressors the model includes:

- *Season*, four indicator variables for time of year to control for seasonal fluctuations in job-seeking;

- *Unemployment*, the moving average monthly unemployment rate in Los Angeles County, which will also be lagged;

- *Difference between Average Weekly Wage for Law Enforcement in Los Angeles County and Other Forms of Local Government Employment,* from the Bureau of Labor Statistics Quarterly Census of Employment and Wages.

Logistic Regression Using Applicant Survey Responses

To answer the second research question, I rely on applicant marketing survey responses contained in the administrative data for the period from October 2007 to July 2009. Logistic regression is used to estimate the relationship between reported marketing influences and the probability of applicant success. In this chapter as in chapters 3 and 4, the benchmark for success is not hiring but clearing the background investigation stage. Using background clearance as the outcome makes sense because the background investigation is the bottleneck step of the hiring process, although making this the endpoint still substantially reduces right censoring issues in the data caused by additional hiring delays downstream of the background. The subsequent physical abilities tests and the oral interview can be attempted as many times as needed to pass (i.e. they are not elimination stages), and elimination on medical/psychological grounds is essentially stochastic. The drawback to using this outcome is that applicant attrition beyond the background stage, at 8%, is still considerable. Furthermore, the overall Academy graduation rate for the study period was 66 percent.

Figure 3.1 shows the application survey, commonly known as the Blue Card Survey. Question 5 of the survey lists information sources about LAPD hiring. A minor but important detail about the hiring process is that PQE test takers also include individuals applying for the Los Angeles International Airport (LAX) Police and the Los Angeles Unified School District (LAUSD) Police. Note also that the regression does not (and cannot) measure fixed cost

advertising such as a billboard or the Department's own recruitment page, which are constant over the entire study period and thus exhibit no variation.

FIGURE 3.1: LAPD APPLICANT MARKETING SURVEY

To assist us in our recruitment efforts, we request that you complete this questionnaire. The information that you provide will be used only for evaluation and enhancement of our recruitment efforts. Please read each question carefully and mark one response to each question that applies by darkening the circle completely.

1. Where are you taking this test? (mark only one)

- Personnel Building ○
- San Pedro Municipal Building ○
- Marvin Braude Constituent Center ○
- Constituent Services Center ○
- Hollywood Community Center ○
- Crenshaw Plaza ○
- Personnel Building - Expedited ○
- Pocket Test _____ ○

2. What is your highest level of education? (mark only one)

- High School/GED, or CHSPE ○
- Some College ○
- Associate's Degree ○
- Bachelor's Degree ○
- Graduate Degree ○

3. If you have attended college, what was your major course of study? (mark only one)

- Criminal Justice ○
- Business/Economics ○
- General Ed/Undecided ○
- Engineering/Computer ○
- Communications ○
- Psychology/Sociology ○
- Liberal Arts ○
- Education ○
- Science ○
- Other ○

4. How did you learn about a career in public safety with the City of Los Angeles? (mark all that apply)

- PennySaver/ShopWise ○
- Career Expo/Job Fair ○
- Recruiter ○
- Flyer or Brochure ○
- Television - specify station below ○
- Radio - specify station below ○
- College ○
- Street Banner ○
- Movie Theater ○
- Billboard ○
- Newspaper or Magazine ○
- Internet - specify website below ○
- Police Officer, Current or Retired City Employee, or Reserve Officer, Name _____ ○
- LA Avenger Game ○
- Neighborhood Council, Non-Profit Organization or Religious Organization Name _____ ○

5. If you chose Radio or Television in question 4 above, please list the station below.

6. If you chose Newspaper or Magazine in question 4 above, please list the publication below.

7. If you served in the military, please indicate which branch. (mark only one)

- Army ○
- Navy ○
- Air Force ○
- Marines ○
- Coast Guard ○
- National Guard/Reserves ○

8. If you chose Internet in question 4 above, please indicate if it was one of the following.

- On-line job listing (Careerbuilder.com, Hotjobs.com, monster.com) ○
- JoinLAPD.com ○
- LA Personnel Dept. Website (www.lacity.org/per/safety.htm) ○
- LA Police Department Website (www.lapdonline.org) ○
- LA Police Reserves Website (www.joinlapdreserves.com) ○
- www.lawa.org/police/ ○
- www.portofla.org ○
- www.lacity.org/GSD/security.htm ○
- Other Website _____ ○
- (example: google.com, yahoo.com, ask.com)

I certify that all statements on this application are true and complete to the best of my knowledge. I understand false or incomplete statements shall be sufficient cause for disqualification or dismissal.

SIGNATURE _____ DATE _____

FORM PDR-3 (rev.06/07)   AN EQUAL EMPLOYMENT OPPORTUNITY EMPLOYER   PLEASE TURN PAGE OVER AND CONTINUE

The online surveys pose two limitations in that they are anonymous and voluntary. The respondents cannot be linked to applicant data, and there may well be systematic differences between respondents and non-respondents, so the online contain useful feedback for PSB, they are not suitable for answering this particular research question. The application survey has neither of these shortcomings. Because the blue card survey responses are part of each applicant's administrative data, it is possible to test for differences in the reported marketing influences between those who are unsuccessful in the application process and those who are

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successful through the background stage. Equation 3, a logistic regression similar to the one

used for priority score analysis, can be used for this purpose:

$$(3) \quad \frac{P_i(hired)}{1-P_i(hired)} = \beta_0 + \beta_1 education + \beta_2 residence + \beta_3 sex + \beta_4 race + \beta_5 TV + \beta_6 Radio + \beta_7 Internet$$
$$+ \beta_8 \operatorname{Print} + \beta_9 Mailer + \beta_{10} \operatorname{Re}cruiter + \varepsilon_i$$

The regression will relate changes in the likelihood of clearing background to a series of

binary variables each representing one of the information/advertising sources listed under

applicant survey item #13. For each generic advertising source (Radio, Recruiter, etc.), the value

is 1 if the respondent indicated the source was influential, and 0 if the respondent did not check

the box. A finding of significant differences in marketing influences across gender and race and

between successful and unsuccessful applicants can inform decisions about reallocating the

marketing budget and may reveal another predictor for use in the priority score (see Chapter 4).

DATA

Over the two fiscal years studied, July 2007 through June 2009, PSB bought advertising in a

wide array of media outlets. Table 3.1 provides a partial listing of the outlets PSB used to inform

residents of Los Angeles and surrounding counties that LAPD was hiring, with the target

demographic or format in parenthesis, where applicable. A drawback of the analytical approach

is that aggregating by medium treats all spending within that medium as equivalent, when that is

neither the reality nor the intent- much of PSB's marketing is geared toward increasing the

diversity of LAPD applicants rather than the sheer number of applicants. In addition, one or two

very effective advertising sources in a given medium may be obscured by others in the same

medium that are ineffective, though this would not apply to television, which consists of only one source, and probably not to direct mail either, for which all three sources are shown.

TABLE 3.1: EXAMPLES OF LAPD MARKETING OUTLETS

Print	*Flight Jacket* (Military)	*L.A. Watts Times* (African American)	*Hoy* (Hispanic)	*Asian Journal* (Filipino)	*Gorgeous Magazine* (Gay and Lesbian)
Radio	*KIIS* (Top 40)	*KPWR* (Rap and Hip Hop Music)	*KROQ* (Popular)	*KJLH* (Gospel)	*KFRG* (Country)
Television	*KSCI LA 18* (the largest Asian language television station in the country, with programming in Chinese, Korean, Tagalog, and Vietnamese)				
Internet	*Google Ad Words*	*Jobing.com*	*hireveterans.com* (Military)	*WOAR Weekly Newsletter* (Lesbian)	*Spot Runner Online Ads* Los Angeles and San Diego
Direct Mail	*Pennysaver*	*ShopWise*	*Long Beach Press Telegram- Red Plum Mailer*		
Recruitment Events	Cal State Northridge Job Fair	*Hirequest* Job Fair	*Bill Picket Rodeo* (African American)	*Women For Hire* Job Fair	*Hire Patriots* Job Fair (Military)

Box plots of the weekly spending on advertising for the study period are depicted in Figure 3.2. The length of the box defines the 25th and 75th percentiles, the median is in the line bisecting the box, the ends of the "whiskers" are the 5th and 95th percentiles, and dots represent outliers. Normally distributed data will have a median in the middle of the box, whiskers of equal length, and few outliers. Spending on most media is clearly not normally distributed. The 75th percentile for weekly expenditure on television and direct mail advertising is $0/week, so positive expenditures all appear as outliers. In fact, print is the only medium with a minimum expenditure above zero. Radio, print, and recruiting expenditures exhibit varying degrees of positive skew, while online spending most nearly resembles normally distributed data: its mean ($1288) and median ($1201) are close in value, and the 95th percentile is a little over two

standard deviations from the mean. Box plots of the dependent variables, online PBA takers and

PQE takers (applicants), are shown in Figure 2.3.

FIGURE 3.2: Box plots of Weekly Advertising Expenditures for Fiscal Years 2008 and 2009
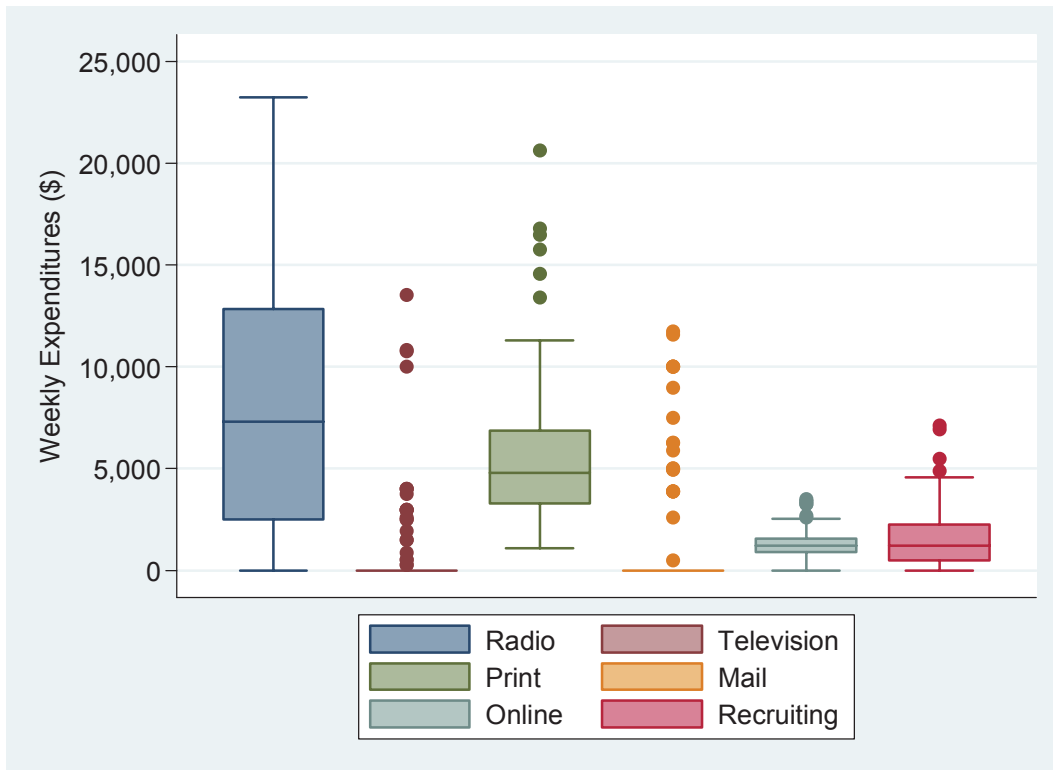
DIAGNOSTIC TESTS

One of the main concerns with time series regression is the distinct possibility of first order

serial correlation in the residuals. If autocorrelation is present, a key Ordinary Least Squares

assumption- that the coefficient $\hat{\beta}$ is an efficient estimator- does not hold. In the case of

positively correlated error terms, the standard errors will be underestimated and the t-statistics

overestimated, leading to spurious rejection of the null hypothesis (Type I error).

Initial diagnostic test results are summarized in Table 3.2A. For the regression of PQE test takers on advertising expenditures, autocorrelated errors do not appear to pose a problem. Both the Breusch-Godfrey test and Durbin's h test for autocorrelation fail to reject the null hypothesis of serial independence. Regressing the residual on the two-period lag residual is significant at the 95% level, but of greater concern is the finding of heteroskedastic residuals, suggesting a need for log transformation of the variables and robust standard errors.

The regression of Online PBA Test Takers on advertising expenditures is another matter. Both the Breusch-Godfrey test statistic and the Durbin's h test statistic are highly significant for one and two-period lags. In a regression of the error term on a one-period lag residual, the coefficients is estimated at 0.30 and is highly significant. As with the PQE outcome, the Bruesh-Pagan test likewise strongly rejects the null hypothesis of homoskedastic residuals.

Log transformation ameliorates the issues with the PQE outcome but exacerbates problems with the PBA Outcome, as Table 3.2B shows. As a remedy the for the PBA outcome, I'll use the Prais-Winsten estimator, which reweights the standard errors to correct for autocorrelation. Specifically, all terms in the regression are multiplied by $\sqrt{1-\rho^2}$ where rho is the coefficient on the lag of the error term, with $|\rho| < 1$, in the decomposition $\varepsilon_t = \rho\varepsilon_{t-1} + e_t$, and e_t is a random perturbation.[6]

As a falsification test, current Online PBA and PQE Test Taker numbers were also regressed against the fitted values of time period $t+1$. The idea behind this falsification test is that applicant numbers and online activity in the present should not be influenced by future

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[6] Note that Durbin's h test, the Breusch-Godfrey test, and the Breusch-Pagan test cannot be computed following a Prais-Winsten transformation or after use of robust (Huber-Eicker-White) standard errors. The Durbin-Watson d statistic is 1.54 following Prais-Winsten transformation, which is squarely in the zone of indecision for positive autocorrelation.

advertising expenditures. A finding to the contrary indicates lingering autoregressivity and specification problems. When distributed leads were created by regressing the fitted values of time *t+1* back on time *t*, the coefficient on the fitted values, α , was not significant for either outcome (data not shown).

TABLE 3.2A: DIAGNOSTIC TEST RESULTS FOR UNTRANSFORMED, OLS TIME SERIES REGRESSIONS

	Outcome	Lag	F/t-statistic	Prob > F/t
Breusch-Godfrey	PQE	1	0.27	0.60
		2	1.20	0.31
	PBA	1	10.71*	0.00
		2	11.41**	0.00
Durbin's H	PQE	1	0.24	0.63
		2	1.07	0.35
	PBA	1	10.44*	0.00
		2	11.09**	0.00
Breusch-Pagan test	PQE	NA	13.13*	0.00
For Heteroskedasticity	PBA	NA	7.26**	0.01
			Coefficient	
Residual regressed on	PQE	1	-0.0002	0.99
Lagged Residual		2	-0.20*	0.04
	PBA	1	0.30**	0.00
		2	-0.0222	0.50

* significant at 5%; ** significant at 1%

	Outcome	Lag	F/t-statistic	Prob > F/t
Breusch-Godfrey	PQE	1	0.22	0.58
		2	2.50	0.27
	PBA	1	31.63**	0.00
		2	38.87**	0.00
Durbin's H	PQE	1	0.27	0.60
		2	2.31	0.32
	PBA	1	39.76**	0.00
		2	53.75**	0.00
Breusch-Pagan test for	PQE	NA	1.12	0.29
Heteroskedasticity	PBA	NA	31.75**	0.00
			Coefficient	
Residual regressed	PQE	1	0.05	-0.54
on Lagged Residual		2	-0.14	-1.44
	PBA	1	0.08**	0.00
		2	0.08**	0.00

* significant at 5%; ** significant at 1%

RESULTS AND DISCUSSION

Table 3.3 lists the regression results for the outcomes of overall Online PBA Takers and PQE Test Takers (i.e. applicants). Logarithmic coefficients are interpreted as the percentage increase in Online PBAs and Applicants resulting from of a one percent increase in advertising expenditure.[7] Print advertising has no discernible impact on the number of Online PBAs, but a one percent increase in print advertising expenditures yields a 0.15 percent increase in applicants. Conversely, radio advertising has no effect on applicant numbers, but a one percent increase in spending on radio ads increase Online PBA takers by 0.01 percent. The finding that radio advertising modestly boosts online PBAs but does not increase applicant numbers suggests one of two processes: 1) radio ads have a slight tendency to induce people to take the online PBA who are subsequently disqualified or 2) radio ads refer applicants to the online PBA who were

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[7] Zero-expenditure observations were changed to $1 to enable logarithmic regression.

planning to apply anyway but hadn't planned to take the PBA online. According to my models, television, direct mail, and online advertising expenditures (i.e. those not associated with LAPD's own websites) had no impact on either Online PBAs or PQEs over the range of PSB expenditures during this period. A one percent increase in registration and venue leasing fees for recruitment events is associated with a 0.04 percent increase in Online PBA Takers and a 0.12 percent increase in applicants. Seasonal effects in applicant volume are evident, with spring (the exclusion category) being the most fruitful time of the year for applicants. Unemployment has significant and positive impacts on PBAs and PQEs, but overall the wage differential between law enforcement employment and the mean wage does not.

The coefficients α represent the decay rates for advertising with respect to PBAs and PQEs. Its value is relatively large and significant for the PBA outcome, indicating that the cumulative effect of advertising is more important for PBA test taking, but this is most likely because the effects are so small to begin with. For PBAs this cumulative effect, $\frac{\hat{\beta}_j}{1-\hat{\alpha}_1}$, is $\frac{0.04}{0.41} = 0.10$ for recruiting and 0.02 for radio. For PQEs the cumulative effect of is only slightly larger than the initial estimate, $\frac{0.15}{0.98} \approx 0.15$ for print advertising and ~0.12 for recruiting events. The alpha values imply that the consumer memory for advertising is much longer with respect to the PBA: 90 percent of the advertising effect on PBAs is felt in a month, but 90 percent of the effect of advertising on PQEs is felt in less than a week. Although some of the difference in the alpha estimates might be explained by the contingent of people taking the PBA online and not subsequently applying, much of the difference is undoubtedly due to the autocorrelation issue

with the online PBA model, as alpha is determined from the fitted values of the lagged regression.

TABLE 3.3: ESTIMATED ELASTICITIES FOR OVERALL ONLINE PBA TAKERS AND PQE TEST TAKERS WITH RESPECT TO ADVERTISING EXPENDITURES

	% Increase Online PBA Takers	% Increase PQE Test Takers (Applicants)
Print	0.03	0.15*
Mail	0.01	0.00
Radio	0.01*	0.01
Online	0.00	0.02
Television	0.00	0.00
Recruitment	0.04**	0.12**
Summer	-0.36**	-0.19
Fall	-0.01	-0.15
Winter	0.11	-0.21
LA Co. Unemployment Rate	1.34**	0.61**
LA Co. Law Enforcement-Mean Wage Differential	0.04	-0.28
Alpha	0.59**	0.02

* significant at 5%; ** significant at 1%

In terms of the boosting the sheer number of applicants, print advertising and recruitment expenditures are the investments found to have positive returns over the range of ad spending in the study period. Estimating the costs of bold advertising expenditure increases, such as doubling the weekly number of PQE test takers through increased print advertising alone, is ill-advised because such estimates require extrapolation well outside the fairly restricted range of the data and would assume constant elasticity. The risk in extrapolation is the estimates may lie past the point of diminishing returns and even exceed the advertising saturation threshold demonstrated by Dertouzos and Garber (2006). However, estimation of more modest effects is feasible. These results also suggest, for example, that increasing the number of PQE test takers by 15 percent might be achieved by increasing print advertising expenditures from the mean of

$5540 to $11400, which is within the city's budget and just over half of the maximum amount ($20640) allocated to print ads in a given week over the study period.

Similarly, Table 3.2 indicates that a 15 percent increase in applicants could be achieved by increasing the outlay on recruitment fees by about $400 above the mean to $1980, holding all else equal. Thus, although the elasticity of applicants with respect to print media is higher than the elasticity of applicants with respect to recruitment event fees, it is less expensive to achieve the same increase in applicants through recruitment event expenditures. It is interesting to note that survey respondents indicate they were influenced by radio more frequently than newspaper/magazines, contradicting the empirical results. This inconsistency may be related to persuasive communication literature distinguishing cognitive and emotional responses to messages (e.g. Petty and Cacioppo, 1981): print media may do more to promote action, even though radio broadcast ads are more memorable.

Table 3.3 also shows that the unemployment rate in Los Angeles County has a huge impact on LAPD applicant numbers. A one percent (not one percentage point) increase in the moving average unemployment rate increased online PBA test taking by 1.3 percent and applicants by 0.6 percent, far exceeding the impact of any advertising. According to the NBER Business Cycle Dating Committee, the country was in a recession from December 2007 to June 2009 (National Bureau of Economic Research, 2010), which covers about 3/4ths of the study period. Over the two years captured in the data, the county's unemployment rate more than doubled, from a low of 4.9 percent in July of 2007 to a high of 11.4 percent in June of 2009. The median moving average of the unemployment rate over the study period was 7.3 percent, which coincided with the midpoint of the time series at the end of June 2008. As stated in the

introduction, the recession triggered an avalanche of applicants to LAPD, one of a very few

employers actively hiring. Rising unemployment would have allowed PSB to substantially

reduce LAPD advertising expenditures and maintained the same number of applicants well

before budget woes deemed such cuts necessary.

Figure 3.3 depicts the difference in online PBAs, applicant numbers, and total advertising

expenditures on either side of the median moving average unemployment rate of 7.3 percent.

Rather than offsetting rising unemployment with reduced marketing, advertising expenditures

were actually about 9% ($82000) higher when the unemployment rate was at or above 7.3

percent, over which time the number of online PBAs increased nearly 80 percent to 8771 and the

number of applicants jumped 35 percent to 12152.
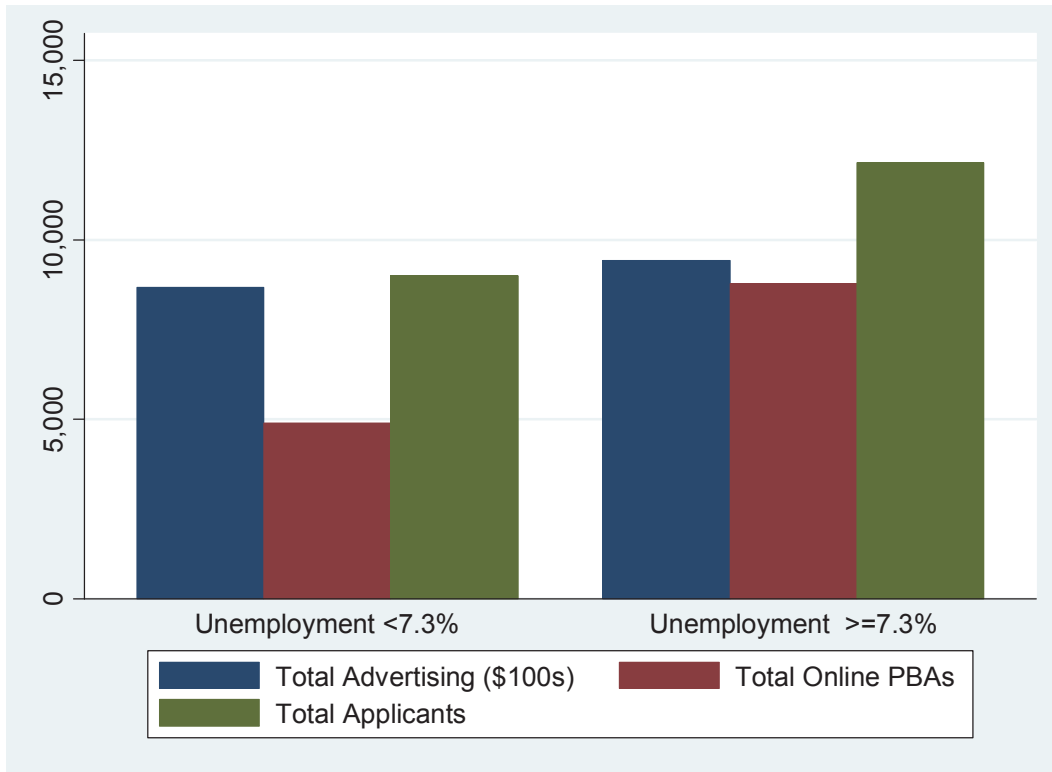
The impact of unemployment rate, which peaked during the busiest applicant time for the

LAPD, far outweighed the impact of advertising. A breakdown of advertising expenditures by

medium, shown in Figure 3.4, further illustrates that the increase in advertising expenditures was

mostly in radio (16.7 percent, $65000 increase), online advertising (25 percent, $15000

increase), and direct mail (9.4 percent, $6130 increase), none of which is shown to significantly

increase applicant numbers over the range spent. The combination of heightened unemployment

and the seasonal effect of springtime were the driving forces behind the increase in applicants in

fiscal year 2009.
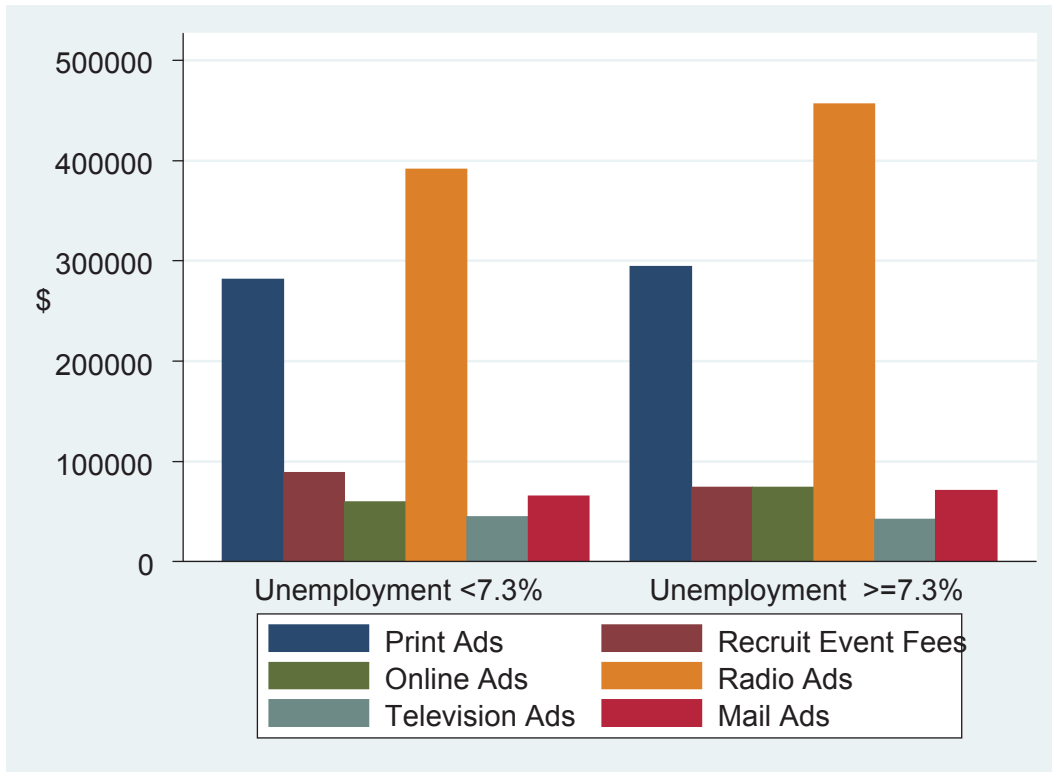
Judgment on advertising effectiveness should not be rendered without considering its benefits in terms of diversifying LAPD. In view of LAPD's mandate for increasing the diversity as well as the size of its force, I estimated separate regressions for each of the target applicant groups to test for differential impacts of marketing on applicant numbers (it is not possible to estimate separate regressions for Online PBA takers because race and gender are only known for those individuals who subsequently apply). Because weekly counts for some groups were occasionally zero, 0.5 was added to each group's weekly tally to generate continuity-corrected logarithms.

Table 3.4 lists the elasticities for advertising media expenditures broken down by race and gender. These regressions indicate print media is most effective at attracting Hispanic male and Asian applicants, though the coefficient borders on significant for all applicant categories.

Recruitment event expenditures are effective within every group, especially black females and white males. Online advertising is found to have a significant positive effect on the number of white females who apply to LAPD, but otherwise the estimated impacts of online, radio, and television ad expenditures are negligible. Perhaps most striking is the result that white females appear to be the most sensitive to unemployment rate and to changes in the wage differential between law enforcement and the average wage. A one percent increase in the wage differential increases the number of white female applicants by more than 3 percent, all else equal. This result accords with one of the earliest studies on females in law enforcement (Milton, 1972) as well as more recent research. Castaneda and Ridgeway (2010), which found that good salary was a more important factor for both pursuing and accepting a job in law enforcement for new female officers than for their male counterparts. The finding is undermined somewhat by the significant inverse relationship between wage differential and Asian female applicant numbers, though the magnitude if not the sign of this elasticity estimate is suspect given that the median number of female Asian applicants is 1/week. The path of least resistance to achieving the consent decree goal of 25 percent female officers is through continued recruitment of Hispanic females, who apply at higher rates than white, black, and Asian women and who appear insensitive to the relative pecuniary benefits of working for LAPD. However, while LAPD has no control over the mean government wage in Los Angeles County, this result suggests that maintaining a competitive salary is another strategy for increasing female representation in the force. White females are also a distinct group in their responsiveness to online advertising, which implies that PSB would do well to emphasize the competitiveness of its starting salary in online ads.

TABLE 3.4: ESTIMATED ELASTICITIES FOR PQE TEST TAKERS WITH RESPECT TO ADVERTISING EXPENDITURES

	Males (n=16857)	Females (n=4287)	White Males (n=4807)	White Females (n=867)	Black Males (n=1906)	Black Females (n=773)	Hispanic Males (n=8244)	Hispanic Females (n=2438)	Asian Males (n=1440)	Asian Females (n=209)
Print	0.13	0.23	0.01	0.10	0.18	0.35	0.15*	0.23	0.19*	0.40**
Mail	0.00	-0.02	0.00	-0.02	0.00	-0.02	0.00	-0.02	0.01	-0.01
Radio	0.01	0.00	0.01	-0.01	0.01	0.01	0.00	0.00	0.01	0.00
Online	0.01	0.03	0.01	0.10**	0.04	0.09	0.01	0.03	-0.01	-0.06
Television	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.01	0.01	0.01
Recruitment	0.11**	0.13**	0.14**	0.10*	0.13**	0.16**	0.10**	0.12**	0.11**	0.11**
Summer	-0.10	-0.12	-0.04	-0.75**	0.06	0.07	-0.17*	-0.06	-0.04	-0.05
Fall	-0.19	-0.26	-0.08	-0.49**	-0.27	-0.43	-0.27*	-0.20	-0.12	-0.17
Winter	-0.20	-0.39	-0.18	-0.55*	-0.20	-0.24	-0.22	-0.42	-0.22	-0.29
LA Co. Unemp. Rate	0.56*	0.75**	0.75**	0.89**	0.68*	0.55	0.47*	0.72*	0.33	0.85*
LA Co. Law Enforcement- Mean Wage Differential	-0.42	0.36	-0.83	3.45**	-0.16	0.89	-0.05	-0.12	-0.81	-2.27

* significant at 5%; ** significant at 1%

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Table 3.5 lists the baseline rates for passing the background investigation across gender and ethnic lines. With estimated elasticities of advertising media for these groups, calculating the returns to increased ad expenditures on background clearing applicants of a particular race and gender would be straightforward, but the danger of extrapolation outside the range of the data looms even larger. Increasing the number of female applicants/week by 15 percent over the mean of 41- six additional female applicants- would cost about $3800 and would produce on average only one additional female clear through the background stage. The same calculation for Asian females, however, would require extrapolation well outside the range of data, producing a wholly unreliable estimate. Although the sensitivity of white females to changes in the relative- not absolute- financial compensation of law enforcement suggest that an additional female applicant could be gained by increasing the wage differential from the mean of $656 to $821, over the course of a career this monthly salary difference is hardly less expensive.

TABLE 3.5: BASELINE RATES OF BACKGROUND INVESTIGATION CLEARANCE BY GENDER AND ETHNIC GROUP

	Male	Female
Black	11.4%	10.5%
Hispanic	16.6%	16.2%
Asian	16.5%	18.8
White	15.1%	16.4%
Overall	15.4%	15.4%

Apart from inducing people to apply for employment, a good recruitment campaign will attract the right kind of applicants to the job, qualified individuals with an aptitude for the work

who will find it rewarding for a number of years. The importance of attracting properly motivated candidates to law enforcement was underscored by White et al. (2010), who found that NYPD officers with altruistic motivations reported higher job satisfaction six years into the job, and officers with motivations implying a lower commitment to the profession (e.g. *lack of other alternatives, stepping stone to a better career*) reported lower job satisfaction.[8] The second piece of the marketing analysis looks at whether any systematic differences exist between self-reported information sources/media influences and candidate rates of success in the application process.

The first column of Table 3.6 lists logistic regression coefficients, which are the natural logarithms of the odd ratios. Exponentiation of the coefficients gives the more easily interpreted odds ratios, listed in the second column. Cursory inspection reveals that individually, none of the advertising media have any significant effect on the probability of successful completion of the application process through background investigation. Referrals to LAPD through the Police Officer Recruitment Incentive Program (PORIP), and those who cite the influence of friends and family in law enforcement, enjoy odds of success through background investigation roughly one-and-a-half to two times that of those who do not, controlling for military service, county of residence (Los Angeles vs. other), education, race, and gender. When PORIP and friends and family are removed, as in Column 3, the advertising source variables remain insignificant.

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[8] The same survey was administered twice- first to new recruits and then six years on- to examine motivational stability. The significant decrease in overall ranking for some of the less noble motivations, in particular "to use this job as a stepping stone to a better career," may in part be due to the 30 percent attrition for this Academy class. This could not be demonstrated, however because the surveys were not linked to the respondents.

TABLE 3.6: LOGISTIC REGRESSION RESULTS FOR BACKGROUND CLEARANCE BY APPLICANTS' REPORTED LAPD INFORMATION SOURCE

Self-Reported Source of Information	Coefficient	Odds Ratio	Coefficient
Internet	0.0002	1.0002	-0.1634
Radio	0.0774	1.0805	0.0505
Newspaper/Magazine	0.2122	1.2364	0.1377
Television	-0.0580	0.9436	-0.0677
Recruiter	0.0240	1.0243	-0.0178
Movie	-0.4456	0.6404	-0.4652
Direct Mail	-0.4133	0.6615	-0.4266
Outdoor	-0.0828	0.9205	-0.0843
PORIP	0.4207**	1.5230**	----
Police Officer Friend/Family Member	0.7460*	2.1085**	----

* significant at 5%; ** significant at 1%

The regression results have a few important implications. First, it should gratify the city that the recruitment incentive program, which pays $500 to an active or retired city employee, a neighborhood council, or non-profit organization for referring a candidate upon appointment to LAPD and another $500 if and when the candidate graduates from the Academy, does in fact identify applicants of higher caliber and may pay for itself even when applicants abound. Second, the self-reported influence of friends and family in law enforcement is an even stronger predictor of candidate quality. Intuitively, it seems reasonable that candidates who consulted with peers and trusted advisors who work in law enforcement before applying would be more invested in the decision than those who apply in response to a radio ad, especially if the friends/family members were consulted by or advised the candidate to apply because of their ability to discern whether the candidate would be well-suited to the job. Moreover, these results illustrate that spending more on a particular advertising medium only increases the number of potential hires insofar as it increases the quantity of applicants. Referrals and friend/family consults are not masking advertising effects either, as the third column shows that advertising

variables remain insignificant when these variables are omitted from the regression. At the aggregate level of medium, the current mix of advertising has no discernible impact on the quality of applicants, and the assumption from the previous section, concerning a linear increase in the number of hires from advertising expenditure increases, holds.

CONCLUSION

The preceding analysis provides empirical evidence that print advertising and recruitment event expenditures PSB made over the study period had positive returns in terms of attracting applicants to LAPD. A very slight positive impact was detected for radio ads on internet traffic, as evidenced by numbers taking the initial online PBA, but it did not translate into increased applicants. Spending on other advertising media, *in the aggregate*, was either below the threshold at which increased spending would yield detectable increases in applicants, the range of measurable positive returns does not exist (unlikely), or the model was not properly specified to detect positive returns. Considering PSB's budget, and the observation that PSB spent nothing on radio, television, online, and direct mail advertising in some periods, spending levels above the saturation threshold can be ruled out as an explanation for lack of any detectable impact.

Unemployment rate had several times the positive impact on applicant numbers of the effective advertising media. Given the relative insignificance of radio, television, online, and direct mail advertising, spending on these media could have been reduced without consequence to recruitment, and they certainly did not need to be increased in fiscal year 2009. PSB would do well to monitor the unemployment rate and, depending on the departmental needs and applicant processing capability, adjust its advertising expenditures accordingly. Based on elasticity estimates, the 56% increase in unemployment rate between the end of fiscal year 2008 and the end of fiscal year 2009 was responsible for 96% of the increase in applicants.

All race and ethnic groups are responsive to recruitment events, and to roughly the same degree. White females are a distinct group in being the most sensitive to unemployment rate and the only group exhibiting positive responsiveness to online advertising and relative increases in the pecuniary rewards of being a police officer. LAPD's outreach to white females should emphasize the competitive starting salary and opportunities for raises. Asian females were especially responsive to print advertisements and not motivated by the financial compensation offered by the job. For both of these groups, there may be a targeted advertising source that is working well. Though beyond the scope of this study, it obviously behooves PSB to determine which advertising accounts these might be.

Using self-reported information sources from applicants, no advertising sources were found to significantly improve the odds of success for applicants *in the aggregate*. In other words, there were no significant differences in the quality of applicants who responded to print advertisement as opposed to radio advertisements, direct mail advertisements, et cetera.

Fitting regressions to advertising data has yielded some useful insights, perhaps most useful of all the recognition of its shortcomings, which underscore the need and possibilities for a more rigorous process for tracking the performance of LAPD's marketing. There are several limitations with the data that could be rectified in future studies. The most glaring limitation is the number of data points, which encompass just two years, and two especially volatile years for the labor market. Another issue, already alluded to, is the problem of aggregation by source and location. As data accumulate, PSB will have enough time periods to include individual advertising sources as regressors, and though the internet is removing geography as a limiting factor in the potential audience of advertising (to wit, more and more newspapers, magazines,

radio, and television are available online), it still might improve the granularity of the analysis to classify some advertising sources, such as local radio stations and newspapers, according to the area of dominant influence (ADI) or designated marketing area (DMA). These data could be coupled with applicant zip codes to test for localized effects of particular advertising sources.

Finally, though the Koyck time series regression simulates human memory by incorporating a decay rate for the impact of advertising media, it is unrealistic to model the same decay rate for all media. PSB staff may have a better sense of the lag structure of individual advertising media because they know more precisely the amount of time that elapses between when an aid is paid for and when it runs. In addition, they might further define the lag time by including a question in the applicant survey asking when candidates saw the advertisement that prompted them to apply.

INTRODUCTION

The essence of LAPD recruiting is community outreach. Through their presence at hundreds of job fairs, cultural festivals, and sporting events each year, LAPD recruiters share their stories with thousands of prospective recruits. Dispensing advice and encouragement, they represent the friendly face of the Department for countless individuals. Beyond the standard meet-and-greet events, LAPD recruiters have been certified by the city personnel office to administer the Personal Qualifications Essay Exams (PQEs), which they do on a semi-regular basis in a number of neighborhoods both inside and outside Los Angeles city limits. These "pocket tests", as they are called, are meant to reap recruits from within the local population by reducing the inconvenience (i.e. test takers' time and transportation costs) of taking the initial step in the application process.

LAPD has two other prominent recruitment tools that are long-term feeder programs designed to generally prepare participants for the future by emphasizing physical fitness, self-discipline, and the value of public service while specifically providing training and promoting careers with the LAPD. One might therefore expect these programs would influence both the quantity and quality of applicants drawn from the local environs.

The first of these, LAPD Cadets, is volunteer program for adolescents and young adults that has been in existence for nearly half a century, albeit under the name LAPD Explorers for much

of that time. At any given time close to 2000 area youths are enrolled in the program. The LAPD Cadet Program mission statement, which is posted on its website[9], reads:

> *The purpose of the LAPD Cadet Program is to help instill discipline, leadership, academic excellence and life-skills in all youth participants. The LAPD Cadet Program also seeks to empower students to maximize their personal, scholastic and their life potential. It has four principle goals:*
>
> - *To recruit young men and women who are interested in building positive relationships between police and the youth of our communities*
> - *To provide a forum in which young people can provide community service while working with law enforcement*
> - *To provide character-training, public-speaking and academic instruction that prepares young people for their future*
> - *To offer physical training that will result in improved physical fitness for all who participate in the program*

Youth Services Officers oversee a Cadets program in each of LAPD's Divisional Stations, as mandated in the Department manual. Additionally, there are LAPD Cadet Programs at the Metropolitan (Metro) Division, which has the same address as Central Division, and in each of the Communications Divisions. Participation is not evenly distributed among the 23 locations. According to one of the program coordinators, divisions can have as few as fifteen and as many as 80 Cadets.

In order to participate in LAPD Cadets applicants must meet the following eligibility requirements:

- *Be 14-20 years old*
- *Have a passing grade point average (1.0 and above)*
- *Have no record of serious arrest or criminal convictions*

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[9] http://www.lapdcadets.com/about/mission, accessed October 10, 2010.

- *Provide a letter of recommendation from a teacher, pastor, or other responsible adult who is not a relative*
- *Receive a medical examination and doctor's approval to participate (for insurance purposes)*

Simulating the process for actual LAPD hires, "recruit cadets", once accepted, must also attend and graduate from the 18-week Cadet Academy to continue the program. It is important to stress that LAPD does not require any commitment from Cadet Program participants to apply to LAPD once they are old enough. The Department does not formally track the number of participants who apply, program leaders estimate only about 10 percent pursue careers in law enforcement with any agency. The website's Frequently Asked Questions page states: "Even though a lot of classes teach Cadets [skills] related to being a police officer, the Cadet Program is designed to provide building blocks to becoming a better student and adult, regardless of [career] ambition." Indeed, U.S. citizenship is also not a requirement for participation, nor is LAPD using income or willingness-to-pay as a criterion for involvement. The program is completely free. After graduating from the Cadet Academy, program participants are typically posted at the LAPD Division nearest where they live, though this is not a requirement, for a midweek afternoon and possibly a weekend activity. Some of the duties include manning the front desk, fielding calls, and directing traffic at Dodger games.

The second of these intensive recruitment tools are the Los Angeles Police Academy Magnet Schools (LAPAMS), which consist of five high schools and two Middle Schools within the Los Angeles Unified School District. Conceived in the early 1990s by Los Angeles Unified School District Board Member Roberta Weintraub, the LAPAMS program was seen as a means of recruiting and training "homegrown" LAPD officers (Vanderkam, 2009). However, as with

LAPD Cadets, the program's broader objective is to imbue students with the values of self-discipline, health and fitness, reverence for the law, and community service to foster their development into responsible adults and their success in whatever career path they choose. Where LAPAMS differs from LAPD Cadets is that law enforcement concepts and training are more thoroughly integrated into the standard high school curriculum. The PAMS program is five days a week contrasted with one or two days a week as in the Cadet Program. Dorsey High School's Police Academy Magnet webpage includes the following description:

> *The Police Academy Magnet School Program curriculum goes beyond the basic high school course requirements, providing students with specialized coursework, training, mentoring, work and volunteer opportunities. The program includes:*

- *Communication skills, with emphasis on listening, reading, speaking, writing and thinking as it relates to law enforcement.*
- *Basic concepts of criminal law, principles of law enforcement, constitutional law, the criminal justice system and other law related topics.*
- *Health training, including mental and physical health.*
- *The role of science and technology in solving crimes.*
- *A Police Academy COMPUTER LAB using programs which relate to law enforcement.*
- *Community service, to develop good citizenship and ongoing community development*

Students are free to apply to magnet schools distant from their neighborhoods, and in fact students are eligible for subsidized busing if they reside outside a three-mile radius from the school. The Reseda High School Police Academy Magnet lists the following as requirements on its webpage, though most of the criteria are somewhat subjective:

- *At least a 2.0 Grade Point Average*
- *No unsatisfactory marks in cooperation or work habits*
- *Respect for adults, peers, and community*
- *Exceptional conduct, in and out of school*
- *An interest in physical training*
- *Pride in his or her/uniform*
- *A desire to pursue a career in law enforcement*

If the Cadet Program and LAPAMS programs are effective at attracting participants from the immediate neighborhood and motivating them to apply, a localized impact on recruitment may be detectable. If the programs are effective at preparing students to apply to LAPD, a localized impact on the number of successful recruits might be detectable.

RESEARCH QUESTIONS

Is there a statistically significant localized (i.e. at the zip code level) impact of LAPD recruiting tools- testing sites, magnet schools, and divisional stations- on the number of applicants a zip code produces, as compared to what would be predicted based on zip code demographics alone?

Is there a statistically significant localized impact of LAPD recruiting tools and the number of successful applicants (through background stage) a zip code produces, as compared to what would be predicted based on zip code demographics alone?

ANALYTICAL APPROACH

Lim et al. (2009) used Poisson regression of the number of applicants by Southern California zip code as a function of relevant demographic variables such as age, race, and gender composition, median household income, and unemployment rate. The regression was used to create a map of expected versus actual applicant yield. Areas coded green were performing better than predicted, yellow were close to predicted, and red were worse than predicted. When locations of recruiting events were superimposed on this map, red zip codes with no recent recruiting events nearby were identified as potentially worthy of greater attention. Figure 4.1 depicts this map for overall applicants in Los Angeles County.
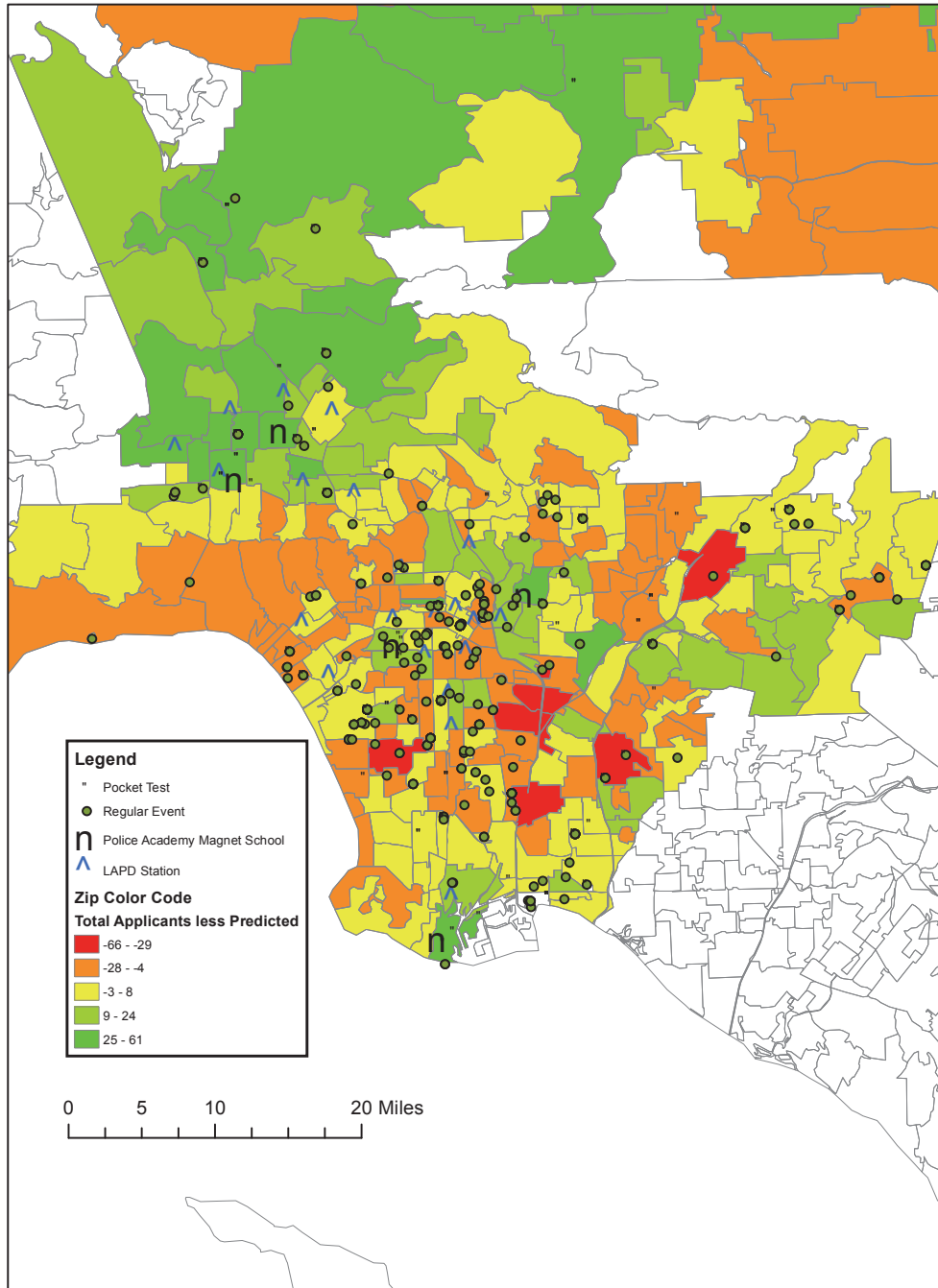
Inspecting the color-coded map, Police Academy Magnet School (PAMS) coordinators

noticed an association between green zip codes (i.e. those performing above expectation) and the

locations of police magnet schools. The schools and the cadet program had not been

incorporated into the analysis, nor had recruitment events been differentiated according to whether they featured pocket tests or not. Adding binary variables for LAPD stations, PAMS, and pocket tests to the regression confirms that the presence of a PAMS is correlated with locally elevated numbers of applicants overall and among females within LA County zip codes. The presence of LAPD Divisional stations, Pocket Tests, and the number of non-Pocket Test events is not (See Table 4.1).

TABLE 4.1: ESTIMATED GAIN IN APPLICANTS FROM RECRUITMENT TOOLS FOR LOS ANGELES COUNTY ZIP CODES

Variable	Overall	Black	Asian	Female
Police Academy Magnet School	12**	0	0	8*
Police Station	0	0	0	0
Pocket Test	0	0	0	0
Number of Non-PT Events	0	0	0	0

* significant at 5%; ** significant at 1%

Table 4.1 should not be interpreted as evidence that the LAPD Cadets, Pocket Tests events, and other recruitment events had no impact on applicant numbers over the study period. On the contrary, the analysis in the previous chapter demonstrated that recruitment events were the most productive aspect of LAPD's marketing campaign for fiscal years 2008 and 2009. Rather, Table 4.1 casts doubt on the notion that programs other than PAMS exert a significant measurable *localized* effect on recruitment. Stated another way, within Los Angeles County, distance does not appear to pose a significant barrier to access to either the Cadet Program or to recruitment tests and events. The PAMS program imposes a geographic barrier to access because only youth residing in the city of Los Angeles (LA Unified School District) have access to the program, but

because of the four-year, five-days-a-week commitment it involves, distance may also pose a barrier for students within LAUSD (and/or their parents) who face commuting costs. Recognition of those costs is implicit in the provision of a busing subsidy for students who live more than three miles from the magnet school campus.

As with other program evaluations, the main challenge in evaluating the effectiveness of recruiting is overcoming the fundamental problem of causal inference. In the case of LAPD recruitment specifically, the challenge is in differentiating between programs that successfully "proselytize", reaching individuals who would otherwise have sought employment with another law enforcement agency or chosen a different career path entirely, as opposed to programs that merely "preach to the choir", attracting people who were intent on applying to LAPD anyway. The straightforward Poisson regression lacks a convincing counterfactual. It's possible that the zip codes containing PAMS have always yielded more applicants and the phenomenon has nothing to do with these recruiting programs, although founder Roberta Weintraub was adamant that the schools were established wherever she could get administration support, which is possibly, but unlikely, correlated with prevailing attitudes toward LAPD or law enforcement in general within the zip code. Conversely, police stations were undoubtedly not positioned so as to optimize recruitment of officers from the surrounding communities. The lack of localized Cadet Program recruiting effects shown in Table 4.1 may indicate police station locations are correlated with characteristics anathema to recruitment. To overcome the causal inference problem it is necessary to devise a more plausible counterfactual. Data available permit me to use two methods to estimate the impact of the Police Academy Magnets, but only one to re-estimate the impact of LAPD Cadets Program. Because pocket tests were held within 9 miles of the zip code centroid for 95 percent of Los Angeles County zip codes, and because no zip code

effect for recruitment events was detected for LA County in the preliminary Poisson regression, access to Pocket Tests and event will be built into the model but not evaluated separately.

BALANCED COVARIATES METHOD

Ideally, Personnel Division applicant data would span a period of time preceding, as well as following, the inception of these programs, in which case the impact of the programs could be measured using a panel data difference-in-differences approach.

$$\text{Applicants}_{it} = \beta\text{PAMS}_{it} + \theta\text{Cadets}_{it} + \gamma X_{it} + \varepsilon_{it}$$

This model measures the relative change in the number of applicants between treated and untreated zip codes in the pre-treatment and post-treatment time periods. In a simple two-period version of the model examining the Magnet Schools, for example, the overall impact is: $\left(\beta_{PAMS=1,t=1} - \beta_{PAMS=1,t=0}\right) - \left(\beta_{PAMS=0,t=1} - \beta_{PAMS=0,t=0}\right).$ The difference-in-differences approach has intuitive appeal and has the structural advantage of controlling for or "differencing out" arbitrary spatial-temporal changes such as different rates of population growth.

One of the latest variations on the difference-in-differences approach is the use of synthetic control groups, a method developed by Abadie and Gardeazabal (2003) and further demonstrated in Abadie, Diamond, and Hainmueller (2010). The advantage of synthetic controls over standard difference-in-differences is that instead of treating all control areas as equally informative, synthetic controls, as the name implies, create a composite comparison group by weighting potential control units. Optimal weights are created by minimizing the distance between the pre-treatment outcomes and pre- and post-treatment covariates. Regrettably, the difference-in-

differences approach is infeasible here because applicant data are not available for both pre- and post periods for either the LAPAMS or the LAPD Cadet Program.

While it is an empirically weaker design because it is less likely to control for unobserved differences, an artificial control group can still be created by weighting zip codes on the basis of similarity in predictors only. Perhaps the most desirable feature of this estimation strategy is that unlike the instrumental variables approach, weighted regression permits measurement of the impact of the schools and stations individually, as opposed to making the implicit instrumental variable assumption that all the schools are equally effective at producing future LAPD applicants and hires. Likewise, though the initial regression found no local effect for the police stations collectively, with balanced covariates exceptions to the rule might be revealed.

For each Police Academy Magnet School, a different set of weights is assigned to Los Angeles zip codes without a PAMS to produce an artificial control group. Let the weights be a vector $\mathbf{W}$ of non-negative values summing to one, generated by minimizing the quantity $\|\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}\|$ in which $\mathbf{X}_1$ are treatment zip code values and $\mathbf{X}_0$ are untreated zip code values. The weighted Poisson regression becomes essentially a simple t-test between each treated zip code and its synthetic control zip code composed of weighted untreated zip codes. The advantages of using this distance function are simplicity and the fact that it usually results in a synthetic control that closely resembles the treatment group on all observables. The drawback of this function is that it treats all covariates as equally important in creating the control, and I already know otherwise from the initial Poisson regression.

For the PAMS analysis, control zip codes were created two ways: 1) using only the non-PAMS zip codes within the city of Los Angeles, and 2) using only Los Angeles County zip codes outside the city of Los Angeles. The first controls provide a truer estimate of the localized

effect, because they include only zip codes eligible for the treatment and potentially include zip codes abutting the PAMS zip codes, which may have numerous treatment takers. The second controls compare PAMS zip codes to populations that are completely ineligible for the treatment and under different local governance, providing upper bound estimates of a sort. For the Cadet Program analysis I include all LA County zip codes because the program is not limited to city residents.

INSTRUMENTAL VARIABLE METHOD

When this dissertation was initially proposed, I anticipated acquiring applicant home addresses approximated to the nearest cross-street. With this information, distance from an LAPAMS and LAPD stations could be used as an instrumental variable (IV) in a two-stage regression to measure the impact of the magnet schools and the Cadets program on recruitment. Unfortunately, approximate addresses for LAPD applicants were ultimately not forthcoming from the Personnel Department. It is possible, however, to estimate the impact of the PAMS as a whole using the less precise instrumental variables of distance from the zip code centroid to the schools and stations.

The model takes the following form:

$$(1)\ Y_i = \theta S_i + \sum_{j=1}^{n} \psi_{ij} X_{ij} + \varepsilon_i$$

$$(2)\ S_i = \pi Z_i + \sum_{j=1}^{n} \beta_{ij} X_{ij} + v_i$$

Z_i is the instrumental variable, which in this case is either distance from each zip code centroid to nearest LAPAMS or an indicator for whether the zip code centroid is within three miles of a

PAMS, and $\sum_{j=1}^{n} \psi_{ij} X_{ij}$ and $\sum_{j=1}^{n} \beta_{ij} X_{ij}$ are the remaining control covariates their respective

equations. The instrumental variable shifts the regressor of interest, S_i, in this case counts of

students enrolled in LAPAMS, by some factor $\pi \neq 0$. Counts of students enrolled in LAPAMS

are then used as a predictor of Y_i, which are counts of LAPD applicants or hires for a zip code.

Counts of LAPD Cadets by zip code were not available, precluding the use of IV for estimating

its impact on recruitment.

There is precedent for using distance as an instrumental variable. Patient proximity to

hospitals was used to obtain an unbiased estimate for the impact of intensive treatment on acute

myocardial infarction outcomes (McClellan, McNeil, and Newhouse, 1994). Closer to the

subject matter at hand, Card (1993) and Kling (2001) used proximity to schools as an

instrumental variable to estimate returns to schooling. Where this analysis differs from previous

studies is in having zip code as the unit of analysis, due to the fact that PAMS graduates are not

linked to LAPD applicants through any official record keeping. The PAMS status of individual

applicants is unknown, so the estimation of the treatment effect is at the zip code level. In fact,

the zip code distribution of PAMS students is generalized from six years of data 2004-2010,

which only partially overlap with the CAPS applicant data.

DATA

The outcome data are from the same Candidate Processing System (CAPS) database used for

gauging advertising in the previous chapter and for development of an applicant prioritization

system in the next chapter. As in Chapter 3 the outcomes of interest are overall applicants, target

group applicants, overall hires, and target group hires by zip code for the period from mid-2007

to mid-2009. Demographic variables are virtually identical to those utilized by (Lim et al.,

2009), and consist of the following United States Census Bureau 2000 Census data by Zip Code

Tabulation Area[10]:

> *Population Aged 18-44*
> *Percent Black*
> *Percent Latino*
> *Percent Aged 18-44*
> *Percent Foreign Born*
> *Percent Below Poverty*
> *Percent College Graduates*
> *Percent Unemployed*
> *Percent Veterans*
> *Median Household Income*

These variables were merged with recruitment tool access variables obtained from the Public

Safety Bureau of the Personnel Department. The weights, which were computed using the

"synth" package in R (version 2.11.1) and designating the vector of pre- and post- outcomes

equal to one, in order to remove the dependent variable from the weighting process. Weights

incorporated the following recruitment variables:

> *Nearest Station (for PAMS analysis)*
> *Nearest PAMS (for LAPD Cadets analysis)*
> *Nearest Pocket Test*
> *Number of non-Pocket Test Recruiting Events in zip code*

Distances were computed by geo-coding school, station, and event addresses in ArcGIS

version 10, obtaining the x and y coordinates of each zip code centroid, and calculating the

---

[10] Census Zip Code Tabulation Areas (ZCTAs) do not perfectly correspond to postal zip codes. Occasionally zip codes are merged in ZCTAs, and in other cases the boundaries are not exactly the same. ZCTAs and postal zip codes were compared by overlaying them in ArcGIS. ZCTAs representing roughly merged postal zip codes had applicant data accordingly combined, recognizing that this was sometimes an imperfect solution to the incongruity of these two data sources. Furthermore, not every zip code is entirely within or outside Los Angeles city limits. I chose to err on the side of inclusiveness and count any zip code partially within the city as a city zip code.

Euclidean distances between each zip code centroid and each recruitment tool. The minimum distances for each zip code to each recruitment tool were retained as variables for the analysis. Middle schools were not included in LAPAMS analysis, based on the assumption that their effects would most likely be mediated by LAPAMS high school attendance. The Cadet program's Metro Division, which occupies the same building as Central Division, was not separately coded. Mission, Topanga, and Olympic Divisions were included as placebos because they opened too recently for the data to capture.

It is desirable for the balanced covariates estimation, and necessary for the instrumental variables estimation, to know something about the underlying distribution of program participants. As mentioned previously, by definition magnet schools allow students to attend from anywhere within the Los Angeles Unified School District, which is contiguous with Los Angeles City boundaries. For the PAMS analysis, it's worthwhile to document the extent to which heavily weighted control zip codes are taking the treatment (i.e. sending a lot of kids to the PAMS), as this will tend to diminish the estimated local impact. Similarly, in order for the instrument to be valid the schools need to draw significantly more students from nearby.

Four of the five PAMS draw half of their students from the 22 zip codes that are within 3 miles of a PAMS and less than 25 percent from greater than 10 miles away. San Pedro High School Police Academy Magnet is anomalous in that less than a quarter of graduates over the past seven years have come from within an estimated three miles of the school, and over 60 percent hail from neighborhoods that are an estimated ten miles or more from the school. This observation may be related the fact that San Pedro is at the southwestern edge of the City of Los Angeles and is largely surrounded by county municipalities. San Pedro and Wilmington are connected to the rest of the city via an impressive feat of gerrymandering: a two-mile wide strip

bracketing State Route 110 known as the Harbor Gateway, from whence many of San Pedro High's recent graduates came. Figures A.2-A.6 show the geographic distribution of PAMS students from the 2004-2010 graduating classes for the schools individually, while Figure 4.2 validates the premise that most PAMS students live in the neighborhood of a PAMS- even if they don't attend the PAMS closest to them.

FIGURE 4.2: GEOGRAPHIC DISTRIBUTION OF POLICE ACADEMY MAGNET GRADS 2004-2010 (N=783)
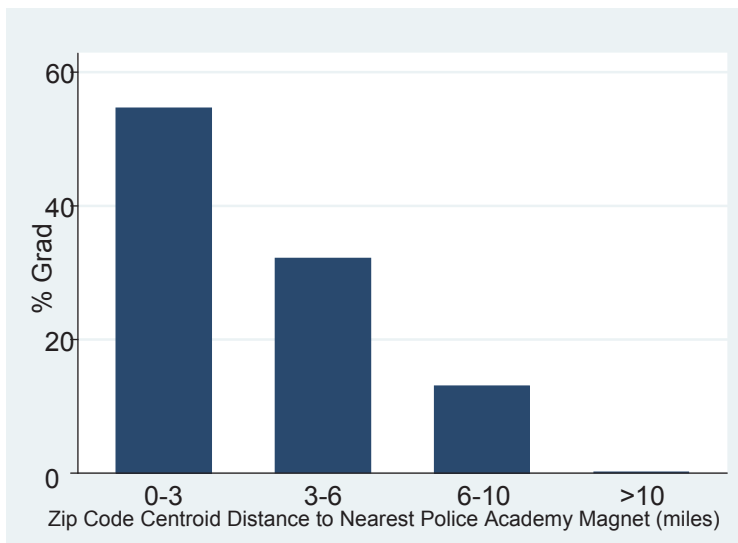
Roughly 55 percent of all PAMS graduates lived within 3 miles of a PAMS campus, and only one student out of 783 (.13 percent) lived greater than 10 miles from the nearest PAMS campus. Quite a few students are attending a Magnet School other than the one that is geographically most convenient to them. As mentioned above, the curricula at the schools are not identical (e.g. Reseda has the strongest forensic science instruction), which might draw students from further away. The instrument is undermined if distance proves to be less of an access barrier to the treatment, but with the exception of San Pedro High, the effect of distance on attendance at the Police Academy Magnets is still quite pronounced: only 23 percent of Los

Angeles zip code centroids are within three miles of a PAMS, whereas the 47 percent of Los Angeles zip code centroids 3-6 miles from the nearest PAMS and the 29 percent of zip codes 6-10 miles away accounted for only 32 percent and 13 percent of PAMS graduates, respectively.

Table 4.2 lists the covariate values for the PAMS zip codes and their respective synthetic control groups. Although the weighting generally results in similar values between the treatment and control, covariate balance seems to have been particularly problematic for zip code 90731, San Pedro High School's zip code. Perhaps this is a reflection of the area's marked socio-economic heterogeneity. The sixteen percent difference in the population aged 18-44 between 90731 and its control may bias in favor of finding a PAMS effect. The synthetic zip code for 90731 also has substantially higher proportion of blacks and a lower proportion of Hispanics, both of which would bias against finding a PAMS effect. The 12 percent difference in unemployment rate and the 16 percent difference in median household income, though sizeable, ought not to bias the result one way or another.

TABLE 4.2: COVARIATE BALANCE FOR PAMS ZIP CODES AND LOS ANGELES CITY SYNTHETIC CONTROL ZIP CODES

Variable	90016	90016 Control	90032	90032 Control	90731	90731 Control	91335	91335 Control	91343	91343 Control
% Black	48.2	47.4	2.0	3.3	7.3	11.8	4.4	6.5	5.0	5.2
% Latino	43.6	42.2	80.6	77.4	47.8	41.2	41.8	48.9	53.1	52.9
% Foreign Born	30.8	30.6	42.1	44.0	27.0	29.4	42.9	41.6	43.5	43.3
Population 18-44	18995	19063	20102	20640	25657	22117	29658	28306	24437	23744
% Age 18-44	40.4	40.3	42.9	43.0	43.8	42.2	43.5	43.7	42.8	42.7
Med HH Inc	29079	31375	33445	34980	35910	41774	40792	42126	41786	40763
% Below Poverty	24.5	25.3	21.2	23.5	20.5	18.3	14.7	17.1	22.4	21.6
% College Grad	12.8	13.0	10.2	10.2	17.5	18.8	19.6	22.9	19.1	19.8
% Unemployed	11.2	12.1	10.5	10.0	8.1	9.1	7.8	8.4	8.3	8.6
% Vets	7.3	7.5	4.9	5.1	10.0	8.4	7.0	6.7	7.5	7.2
Nearest Station	1.4	1.4	2.8	2.7	3.2	3.1	1.0	1.3	2.2	2.2
Nearest PT	1.0	1.0	1.4	1.5	0.0	0.5	1.0	1.3	1.4	1.5
Event Count	6	6	2	2	4	4	4	4	0	1

Figures A.6-A.10 depict maps of Los Angeles County with the each PAMS highlighted royal blue and control zip codes with weights equal to or greater than 0.1 highlighted in sky blue. Because the synthetic controls comprised exclusively of city zip codes are created without regard to proximity to the PAMS zip codes, some of the more heavily weighted control zip codes have treatment takers. This may bias the analysis against finding program effects, but it makes for a better test of the proposition that the schools have localized recruitment impacts and means that any detected impacts are that much more likely to be genuine.

When synthetic controls are comprised exclusively of Los Angeles County zip codes outside of the city, there are no treatment takers among the control zip codes, and the controls are known to differ on potentially key variables like local governance and law enforcement agency. This weighted regression measures the local PAMS recruitment impact using a potentially more generous counterfactual of similar zip codes with no exposure to the treatment and limited

exposure to LAPD. Table 4.3 shows the covariate balance between the PAMS zip codes and the county-based synthetic controls.

TABLE 4.3: COVARIATE BALANCE FOR PAMS ZIP CODES AND LOS ANGELES COUNTY SYNTHETIC CONTROL ZIP CODES

Variable	90016	90016 Control	90032	90032 Control	90731	90731 Control	91335	91335 Control	91343	91343 Control
% Black	48.2	46.1	2.0	2.5	7.3	11.0	4.4	5.6	5.0	5.7
% Latino	43.6	44.3	80.6	80.1	47.8	44.5	41.8	45.8	53.1	52.3
% Foreign Born	30.8	28.6	42.1	42.7	27.0	31.0	42.9	41.9	43.5	43.6
Population 18-44	18995	18170	20102	20173	25657	24281	29658	28644	24437	24005
% Age 18-44	40.4	40.6	42.9	43.0	43.8	43.4	43.5	43.4	42.8	42.8
Med HH Income	29079	34715	33445	35352	35910	42617	40792	43152	41786	41298
% Below Poverty	24.5	24.3	21.2	21.6	20.5	18.3	14.7	15.6	22.4	21.9
% College Grad	12.8	12.0	10.2	10.3	17.5	16.9	19.6	21.3	19.1	19.0
% Unemployed	11.2	11.3	10.5	10.5	8.1	8.7	7.8	7.8	8.3	8.5
% Vets	7.3	7.7	4.9	4.9	10.0	9.0	7.0	6.6	7.5	7.3
Nearest Station	1.4	4.2	2.8	3.2	3.2	4.9	1.0	2.5	3.2	3.6
Nearest PT	1.0	1.0	1.4	1.6	0.0	1.0	1.0	1.4	1.4	1.6
Event Count	6	6	2	2	4	4	4	4	0	0

BALANCED COVARIATE RESULTS

Table 4.4 below summarizes the estimated impact of the Police Academy Magnet Schools on the number of applicants and hires, overall and by target group, in comparing PAMS zip codes to city zip code synthetic counterparts. For most comparisons, the differences between the PAMS zip codes and the controls are not statistically significant, though it is encouraging that the "overall" difference is positive in nearly every case. In a few comparisons, the difference is statistically significant but may not be practically significant. For example, the number of successful Asian applicants produced by the Dorsey High and Wilson High zip codes is one more than would be expected from their comparable zip codes over a three-year period. While the differences are statistically significant, they are not terribly compelling evidence that the PAMS program should be expanded to increase the number of Asian recruits. The Wilson High School zip code exhibits both statistically and practically significant differences in the number of

applicants, yielding 25 more applicants overall, but only one additional successful applicant. The Reseda High School zip code distinguishes itself for yielding seven more Asian applicants and three more successful applicants. The individual PAMS appear to have had only a slight net positive effect on LAPD recruiting, but recall that heavily weighted zip codes in these synthetic controls had treatment takers. This downward bias was expected because proximal zip codes tend to be more demographically similar than distal zip codes, and the PAMS were still conveniently located for youths in these neighboring zip codes. The impact of PAMS on recruitment within their zip codes is being measured against zip codes which the PAMS may also be impacting, so the finding of a net positive effect is meaningful.

TABLE 4.4: DIFFERENCES IN APPLICANT/SUCCESSFUL APPLICANT COUNTS BETWEEN PAMS AND L.A. CITY SYNTHETIC CONTROL ZIP CODES

Applicants	Overall	Black	Asian	Female
Dorsey High School/Synthetic Control	65/57	21/22	3/1 *	13/15
Wilson High School /Synthetic Control	77/52*	5/2	5/3**	15/15
San Pedro High School /Synthetic Control	69/49	9/9	2/5*	9/13
Reseda High School /Synthetic Control	86/64	5/6	10/3**	20/16
Monroe High School /Synthetic Control	58/43	3/4	5/7	12/9
Successful Applicants				
Dorsey High School /Synthetic Control	11/12	1/5**	1/0**	2/2
Wilson High School 90032/Synthetic Control	16/11	1/0	1/0 **	2/2
San Pedro High School 90731/Synthetic Control	11/6	0/1 **	0/0	1/1
Reseda High School 91335/Synthetic Control	19/11	0/1 **	3/0**	4/2*
Monroe High School 91343/Synthetic Control	13/10	2/1	0/0	2/2

* significant at 5%; ** significant at 1%

The local impact of the PAMS Program on recruiting was considerably larger when controls were fashioned from county zip codes outside the city. PAMS zip codes yielded on average nineteen more applicants and three more background clearing applicants than their respective synthetic controls. It is not surprising that the estimates would be higher because I am no longer

measuring a local recruitment impact so much as measuring the difference between zip codes with prime access to the PAMS program to demographically similar zip codes with no access, which may overstate the true zip code-level impact. In the next section I revisit the PAMS program using instrumental variables, looking at the collective rather than individual impact of the schools. But first I'll discuss the localized impacts of the LAPD stations themselves, which if present are assumed to be mainly due to the Cadets Program.

TABLE 4.5: DIFFERENCES IN APPLICANT/SUCCESSFUL APPLICANT COUNTS BETWEEN PAMS AND L.A. COUNTY SYNTHETIC CONTROL ZIP CODES

Applicants	Overall	Black	Asian	Female
Dorsey High School/Synthetic Control	65/36*	21/14	3/1	13/11
Wilson High School /Synthetic Control	77/45*	5/1**	5/0**	15/12
San Pedro High School/Synthetic Control	69/47	9/6	2/2	9/13
Reseda High School/Synthetic Control	86/50*	5/5	10/6	20/8**
Monroe High School/Synthetic Control	58/38	3/3	7/4	12/10
Successful Applicants				
Dorsey High School/Synthetic Control	11/4	1/1	1/0**	2/1
Wilson High School/Synthetic Control	16/8**	1/0**	1/0**	2/1
San Pedro High School/Synthetic Control	11/9	0/1**	0/0	1/2
Reseda High School/Synthetic Control	19/15	0/2**	3/2	4/2**
Monroe High School/Synthetic Control	13/7**	2/1	0/1	2/1

* significant at 5%; ** significant at 1%

The same weighting of observations was carried out for each zip code containing an LAPD Divisional Station, using non-Station zip codes throughout Los Angeles County as controls. Covariate balance was generally superior to what was obtained for the PAMS analysis because there were more observations on which to perform the weighting- 285 zip codes in the county, compared to just 106 in the city- and though no data on Cadet program participant distribution were available, fewer of the control zip codes were adjacent to treatment zip codes and were therefore less likely to be "partially treated" (see Appendix Table A.1 and Figures A.1-A.18). An exception is the zip code for Central (and Metropolitan) Division. Los Angeles' notorious

"Skid Row" is located in zip code 90014. A synthetic control with such grinding poverty and low official resident population could not be constructed from among non-Station zip codes in Los Angeles County. Table 4.4 summarizes the differences in applicants and successful applicants overall and within target groups. There is considerable variation in the estimated impact of Stations on recruitment numbers. A few stations- Newton, Devonshire, West Valley and Foothill- appear to markedly boost recruitment numbers within their respective zip codes. Of particular interest is significant positive impact these stations appear to have on recruitment of female candidates. Other zip codes with LAPD Stations- Rampart and Central- yield significantly fewer applicants and successes than their synthetic non-Station counterparts. When the significant results are tallied, over the course of the study period, zip codes with LAPD Stations yielded 94 more applicants and 27 more background clearing applicants than predicted for comparable zip codes.

The balanced covariate model does not remedy the problem of selection on unobservables; there may well be factors unrelated to the LAPD Stations that account for significantly elevated or depressed recruitment numbers locally. Of these, the most conspicuously absent is local crime rate, which is known to be positively correlated with police recruitment but which I was unable to obtain at the zip code level. It should also be borne in mind, as I have no data to show otherwise, that participation in the Police Cadet Program is more geographically diffuse than that of the Police Academy Magnet Schools. Additionally, the impact of a station on recruitment, whether positive or negative, may be the product of more than just its Cadet Program. LAPD has a greater presence in the areas immediately surrounding the stations, which serve as the hub from which patrol vehicles fan out across the Division each day. The extent to which LAPD's

presence makes a positive or negative impression may matter as much for local recruitment as the Cadet Program. The placebo stations should be indistinguishable from their control groups. Significant results could be due to Cadet Program participation at nearby divisional stations (e.g. the centroid of the current Mission Station zip code, 91345 is only three miles from Foothill Division Station, 91331) or other unobserved features of these zip codes. Mission Station opened in 2005, two years before the beginning of the study period, sufficient time for the station to have made an impression on the neighborhood, but insufficient time for its Cadet Program to have a local impact on applicant numbers. Whatever biases may affect the Cadet Program estimates, from the placebo results it does not appear stations sites have been chosen for their recruitment potential.

TABLE 4.6: DIFFERENCES IN APPLICANT/BACKGROUND CLEARING APPLICANT COUNTS BETWEEN CADET PROGRAM AND SYNTHETIC CONTROL ZIP CODES

	Overall Apps — BI / Pass	Black Apps — BI / Pass	Asian Apps — BI / Pass	Female Apps — BI / Pass
77th /Control	61/47 ; 10/8	11/13 ; 1/1	0/1** ; 0/0	20/15 ; 2/2
Newton /Control	85/61** ; 18/10**	13/6 ; 2/1	0/2** ; 0/0	21/18 ; 7/2**
Central /Control	7/11** ; 2/2	0/2** ; 0/0	0/0 ; 0/0	2/3 ; 1/0
Rampart/Control	17/22* ; 2/4**	3/4 ; 0/0	4/6** ; 0/1**	0/3** ; 0/0
Wilshire/Control	63/58 ; 9/11	19/22 ; 0/4**	6/6 ; 0/0	13/16 ; 2/3**
West LA/Control	21/27 ; 8/4**	2/3 ; 0/0	5/4 ; 3/1*	3/6** ; 0/1**
Hollywood/Control	25/29 ; 2/4**	3/4 ; 0/0	1/5** ; 0/0	5/5 ; 1/1
Hollenbeck/Control	41/42 ; 9/10	0/1** ; 0/0	0/2** ; 0/0	9/12 ; 2/2
Southeast /Control	20/22 ; 1/4**	11/13 ; ½	0/0 ; 0/0	8/7 ; 1/1
Southwest /Control	47/34 ; 12/4**	17/18 ; 4/2**	0/0 ; 0/0	10/11 ; 3/2
Northeast /Control	59/42 ; 20/10*	3/2 ; 0/0	5/3 ; 2/1	12/10 ; 4/2
Pacific /Control	39/42 ; 9/9	4/3 ; 1/1	4/3 ; 1/1	4/9** ; 0/2**
Harbor /Control	69/53* ; 11/11	9/7 ; 0/2**	1/2** ; 0/0	9/11 ; 1/2**
Devonshire/Control	51/27 ; 10/6	4/3 ; 0/0	5/3**; 1/1	6/4 ; 0/1**
Van Nuys /Control	32/33 ; 6/7	2/3* ; 0/1**	2/3; 0/0	2/7** ; 0/2**
N. Hollywd /Control	35/37 ; 8/6	6/3 ; 1/0*	2/2; 0/2*	5/9 ; 1/1
W. Valley /Control	86/61**; 19/15**	5/5 ; 0/2**	9/7; 3/2	20/13** ; 4/3
Foothill /Control	108/70**; 19/13	9/3* ; 2/0**	1/4** ; 0/1**	30/17** ; 3/3
"Placebo" Stations				
Mission /Control	34/24 ; 10/6	0/1** ; 0/0	0/1**; 0/0	4/4 ; 0/1**
Topanga /Control	51/47 ; 11/10	5/4 ; 1/1	3/5 ; 0/1**	10/10 ; 4/2**
Olympic /Control	33/40 ; 10/7*	3/4 ; 2/0**	6/6 ; 0/3**	7/13** ; 2/1**

* significant at 5%; ** significant at 1%

INSTRUMENTAL VARIABLE RESULTS

The first test of instrument validity is instrument relevance. An instrument is relevant when one can emphatically reject the null hypothesis that the shifter π, in this case distance (in miles) to the nearest PAMS, is not significantly different from zero. In practice, t-statistics of ± 3.2 or higher are recommended (Staiger and Stock, 1997). The instrumental variable "distance to nearest PAMS" has a t-value of -4.41 and a corresponding p-value of 0.00001, while the binary instrument of PAM ≤ 3 miles has a t-value of 5.50 and a corresponding p-value of less than 0.00001.

The second important condition a valid instrument must satisfy is the exclusion restriction. The exclusion restriction holds if the only way the instrumental variable impacts the outcome is through its effect on the number of people receiving the treatment, in this case PAMS attendance. Otherwise the estimate will be inconsistent. Mathematically this is written $Cov(Z_i, \varepsilon_i) = 0$. While there is no way to test the exclusion restriction directly, the exogeneity of the instrument can be evaluated indirectly by assessing how closely the exogenous variables approximate experimental conditions (i.e. randomized control and treatment groups) with respect to the instrumental variable. As mentioned previously, PAMS founder Roberta Weintraub claims the schools were established wherever there was support for the program, but it's doubtful the school distribution is purely random. Surely some effort was made to spread the schools out within LAUSD to maximize student accessibility. Table 4.7 below compares the mean covariate values between PAMS-proximal zip codes (i.e. those whose centroids are 3 miles or less from a PAMS, consistent with the LAUSD threshold distance for subsidized busing) to those greater than three miles from a PAMS.

TABLE 4.7: MEANS (STANDARD ERRORS) FOR ZIP CODES PROXIMAL AND DISTAL TO A PAMS

Variable	Zip Codes ≤3 miles from a PAMS (n=24)	Zip Codes > 3 miles from a PAMS (n=82)
Pop 18-44	18910 (7587)	16271 (9920)
% 18-44	42.4 (4.9)	44.7 (8.3)
% Black	19.7** (26.1)	9.4 (13.1)
% Latino	46.2 (26.2)	37.1 (26.7)
% Foreign Born	35.8 (13.1)	38.4 (14.1)
Med HH Income	38906 (12448)	43940 (25743)
% Below Poverty	19.8 (8.4)	21.0 (13.7)
% College Graduate	21.4* (14.4)	29.5 (20.0)
% Unemployed	9.6 (3.2)	9.7 (7.0)
% Vets	7.1 (2.8)	7.1 (3.3)
Nearest LAPD Station	1.9 (1.1)	2.4 (1.7)
Nearest PT (miles)	1.5** (1.0)	2.5 (1.8)
Event Count	1.6 (1.8)	2.2 (5.4)

* significant at 5%; ** significant at 1%

For all but three of the covariates in the model, the differences between the zip codes proximal to PAMS and zip codes more distal to PAMS are not statistically significant. However, a significantly higher proportion of residents in PAMS-proximal zip codes are black, and a significantly lower proportion of residents in PAMS-proximal zip codes are college educated. Black population in a zip code is a borderline significant predictor of higher applicant numbers. The estimated disparity in applicants between zip codes with a black population close to 20 percent and those with a black population near 9.4 percent is 1 applicant (27 vs. 26), holding all else constant at the mean. A higher proportion of college graduates in a zip code is associated with significantly lower applicant numbers. The estimated disparity in applicants between zip codes with a college graduate proportion around 21.4 percent and those with a college graduate proportion around 30 percent is eight applicants (32 vs. 24), holding all else constant at the mean. PAMS-proximal zip codes are on average about one mile further from the nearest Pocket Test offered, a distance which translates into a negligible disparity of less than half an applicant,

holding all else constant at the mean. The real cause for concern, of course, is that because the instrumental variables are correlated with other variables in the model, instrumenting on distance from the treatment does not approximate experimental conditions; significant observable differences between proximal and distal zip codes may be symptomatic of significant differences on unobserved variables. The instrument may thus be present in the error term of the 2nd stage of the regression, biasing the estimate.

Table 4.8 summarizes the regression results for OLS in comparison to the continuous instrument of distance in miles from zip code centroid to PAMS and the binary instrument of 3 miles or less to a PAMS. Along with the population number of people 18-44, the total number of PAMS graduates a zip code has is a significant predictor of the number of applicants that zip code produces after instrumenting for Magnet School access. Somewhat paradoxically, a zip code's poverty rate and college graduation rate are both inversely correlated with applicant numbers.

The interpretation of the coefficients is not the same for OLS and the IV Poisson regressions. According to the OLS estimate, each additional PAMS graduate increases the number of applicants by 0.25. Poisson regression coefficients are incident rate ratios, indicating the number of PAMS graduates increases the number of LAPD applicants by a factor of 1.02-1.04. At the mean of seven PAMS graduates, this translates into 0.7-1.0 additional applicants per additional PAMS graduate.

TABLE 4.8: IMPACT OF PAMS ON APPLICANT NUMBERS

	(1) OLS	(2) nearest PAM	(3) PAM≤3miles
Total Students	0.25*	1.04*	1.02*
Nearest Station	0.72	1.01	1.00
Nearest Pocket Test	0.74	1.06	1.04
Zip Code Event Count	0.09	0.99	0.99
Population 18-44 (1000s)	1.72**	1.02	1.03**
Percent 18-44	-0.24	1.01	1.01
Percent Black	0.16	1.01	1.01
Percent Latino	0.26	1.00	1.00
Percent Foreign Born	0.02	1.00	1.00
Median Household Income ($1000s)	-0.05	0.98*	0.99
Percent Below Poverty	-1.33**	0.95**	0.95**
Percent College Graduates	-0.46	0.98*	0.97**
Percent Unemployed	0.96	1.00	1.00
Percent Veterans	0.37	0.98	0.98

* significant at 5%; ** significant at 1%

Table 4.9 shows that the total number of PAMS graduates in a zip code is also a positive predictor of the number of successful applicants that zip code yields. While the estimated effect is quite small for OLS, the IV Poisson estimates are comparable to the estimated effect of PAMS on sheer applicant numbers. At the mean of 7.4 students, an additional PAMS graduate increases the number of background-clearing applicants by 0.2-0.3. The number of people aged 18-44 is again a significant positive predictor, but interestingly, the percentage black, percentage Latino, and the distance to nearest Pocket Test are also significantly and directly correlated with the number of background clearing applicants. This means that within L.A. County, zip codes that an average distance of about 2 miles from a Pocket Test actually yielded an estimated 0.75-0.9 fewer background-clearing applicants than those between 3 and 4 miles away. Successful applicant counts as a function of Pocket Test distance are highly non-linear, but this result does suggest that LAPD need not expand pocket testing to interstitial neighborhoods in the near term.

TABLE 4.9: IMPACT OF PAMS ON SUCCESSFUL APPLICANT NUMBERS

	(1) OLS	(2) nearest PAM	(3) PAM≤3miles
Total PAMS Graduates	0.06*	1.05*	1.04*
Nearest Station	-0.09	0.94	0.94
Nearest Pocket Test	0.78*	1.18*	1.15*
Zip Code Event Count	0.05	0.99	1.00
Population 18-44 (1000s)	0.34**	1.01*	1.02
Percent 18-44	-0.03	1.02	1.02
Percent Black	0.07*	1.01*	1.01*
Percent Latino	0.11**	1.00	1.00
Percent Foreign Born	0.02	1.01	1.01
Median Household Income ($1000s)	-0.03	0.98	0.99
Percent Below Poverty	-0.40**	0.94**	0.94**
Percent College Graduates	-0.04	0.99	0.98
Percent Unemployed	0.31**	1.00	1.00
Percent Veterans	0.33	1.02	1.02

* significant at 5%; ** significant at 1%

CONCLUSION

Significant localized recruitment effects were detected for the Police Academy Magnet Schools as a whole and for specific Police Cadet Program sites, though the methods used were not free of bias. The balanced covariate method for estimating the recruitment impact of each individual PAMS assumed, when the controls were other city zip codes, that distance would be a greater barrier for anyone outside the PAMS zip code, which did not necessarily depict reality. In fact, the centroids for some of these neighboring zip codes were actually closer to the PAMS than the centroids of the PAMS zip codes (e.g. 90008 with respect to Dorsey High and 90732 with respect to San Pedro High). Furthermore, when the demographic variables were factored in to create the weights, the most heavily weighted zip codes were usually close to the PAMS zip code, where the distance barrier would be smallest. The balanced covariate method for estimating the recruitment impact of each individual PAMS assumed, when the controls were L.A. County zip codes outside the city, that the only important difference was access to the schools, which also did not necessarily depict reality. For example, county zip codes outside the

city are under different local governance, and LAPD may face greater competition for recruits from the law enforcement agencies that serve these communities.

Statistically significant differences in a few covariates as a function of distance to PAMS undermine the credibility of the instrumental variables method as approximation of natural experimental conditions. Because the instruments were correlated with observed and unobserved variables, upwardly biased estimates are a distinct possibility. In defense of the IV estimates, endogeneity concerns are somewhat mitigated by the PAMS creator's contention that the Magnets were established without regard to local recruitment prospects.

To obtain better estimates of the localized impact of PAMS on recruiting, LAPD is advised to conduct the difference-in-differences analysis described above and to control for local crime rate, a key variable missing from the present study. The results of the LAPD Cadets program, the results should likewise be cautiously interpreted, not only for the risk of selection on unobservables but because there is less theoretical and empirical basis for asserting that the impact of Cadets would be felt at the zip code level. There is less reason to worry about selection on observables, however, as neighborhood recruitment potential is not a factor in station placement. The magnitude of the positive impact at a few stations is large enough to recommend that LAPD conduct a review of its Cadet Programs in an effort to learn what distinguishes the most popular sites and to see if those qualities can be duplicated at less popular sites. Cadet Programs at the newer stations- Mission, Olympic, and Topanga- can also be evaluated using the difference-in-differences approach.

An added caveat regarding inferences with both methods is that the final outcome is not truly the hiring outcome, but the passage of the background investigation. It may be that the benefits

of attending a Police Academy Magnet School or participating in the LAPD Cadets Program are more apparent downstream of the background investigation, as in successful completion of the LAPD Academy and distinguished performance as an officer.

It is essential to bear in mind that the preceding analysis says absolutely nothing about the effectiveness of LAPD Cadets and LAPAMS in terms of achieving their primary goal of molding adolescents into disciplined, lawful, healthy, civic-minded young adults, a goal which may have a variety of far-reaching positive effects, ranging from crime reduction to increased GDP. Both programs may well be spectacularly successful in these regards. Similarly, this analysis obviously says nothing about performance of the LAPAMS as academic institutions, about how students fare on standardized tests, their graduation rates, or the rates at which they pursue higher education. Finally, this analysis does not identify the number of LAPAMS graduates who may be pursuing employment at other law enforcement agencies, though this should be of interest to the LAPD. For if LAPAMS and Cadets program alumni are becoming deputies and officers in other jurisdictions in large numbers, it is wonderful validation for the training these programs provide, but from the narrow perspective of LAPD recruiting, such a finding would have to be viewed as problematic. The LAPD application form should include a space to indicate LAPAMS attendance and participation in the Cadet program, which should be shared with the Department. For their part, the magnet schools should try to maintain contact with program graduates not only for the sake of developing an experientially and financially valuable alumni network, but also (for those students who do not apply to LAPD) to report back what fraction of responding graduates who have taken employment at another law enforcement agency.

As a prelude to the next chapter, a note of caution is in order regarding the use of applicant numbers as a benchmark of success *per se*, for applicants of inferior quality are a problem not a

boon for the City and the Department. Unqualified applicants can waste City employment

resources in testing administration and costly background investigations, can dissuade qualified

candidates from applying by clogging the applicant pipeline, and can cost the City even more

through incompetence or corruption if mistakenly hired.

INTRODUCTION

STAGES IN POLICE RECRUITING

Although the content of the exams and the exact hiring standards may differ from one agency to the next, the stages in the law enforcement application process are remarkably consistent across agencies. This is partly a result of convergence in policies among the various state commissions on Peace Officer Standards and Training (POST) and similar law enforcement accreditation bodies. Most large, urban law enforcement agencies are either voluntarily or statutorily subject to standards established by the state POST Commission (or equivalent body) and as such are typically required to screen applicants with some sort of written exam, a background investigation (usually featuring a polygraph test), and medical and psychological evaluations. Interestingly, fitness tests are not typically codified by POST but are instead left to the agencies to devise.

The hiring process for law enforcement is typically time-consuming and labor-intensive. A sampling of police and sheriff's department recruiting web pages indicates that the hiring process is seldom less than three months, is often six months, and can take up to a year.[11] Here again LAPD is no exception. For half of all applicants who make it to the background investigation stage and receive a final recommendation, the process takes up to 127 days; 75 percent complete the process in less than 193 days, while 25 percent are finished in less than 92 days.

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[11] Information was obtained on May 10, 2009, from Frequently Asked Question responses on recruiting web pages for Phoenix, AZ Police Department; Junction City, KS PD; Mesa, AZ PD; Mountain View, CA PD; Portland, OR PD; Mesa County, AZ Sheriff's Department; Montgomery County, MD PD; San Diego County, CA SD; Dane County, WI SD; Washington County, OR SD; Fairfax County, VA SD; and King County, WA SD.

DEVELOPMENT OF A PRIORITIZATION MODEL

During the recruiting process, a police department faces external factors that are beyond its control. However, the department does have control over how it manages recruiting process and resource management. In particular, the agency's capability to focus on the most promising applicants during the recruiting process is an internal factor which, when properly leveraged, improves efficiency in the hiring process and accelerates the process of getting new officers in to the academy and on the payroll. With the right scheme for prioritizing applicants at the various stages of the recruiting process, a department can influence the quantity and quality of recruits, in a cost-neutral manner, with limited influence from the external factors. This is especially critical in the current economic climate, as local governments are under extreme pressure to freeze or reduce spending on recruiting and hiring resources.

To realize this capability, an agency needs a system designed to assign high scores to those candidates most likely to complete the process. The system must also be flexible enough to assign higher scores to applicants with special skills (e.g. language or technology skills) or to meet diversity requirements.

PRELIMINARY MODEL OF PRIORITIZATION

Lim et al. (2009) describes the development of a preliminary model of prioritization for the LAPD, which in early 2009 was handling 1,500 applications per month. The applications arrive with minimal information but do include educational attainment, place of residence, and the results of a short preliminary background questionnaire on debt, driving proficiency, criminal history, and drug history. These few factors turned out to be highly predictive of completing the process and enrolling in the academy. Those with no issues on the background questionnaire,

residing in Los Angeles County, and having some college experience were hired 43% of the time. By contrast, those with some issues on the questionnaire, residing in Los Angeles County, and possessing a high school degree were hired 21% of the time.

Rather than treat all applicants on a first come-first serve basis, LAPD began to triage applicants based on a priority score. The scores were computed by fitting logistic regression equation 1:

$$(1) \quad \frac{P_i(\text{hired})}{1 - P_i(\text{hired})} = \beta_0 + \beta_1 \text{background}_i + \beta_2 \text{education}_i + \beta_3 \text{residence}_i + \beta_4 \text{sex}_i + \beta_5 \text{race}_i$$

The outcome, $P_i(\text{hired})$, is the probability an applicant i of being hired, and predictors are characteristics of the applicant. (The inclusion of sex and race in the logistic regression prevents the score from being a proxy for sex and race; comparisons of the priority scores across sex and race found that no group would be disadvantaged.) Then each applicant received a priority score equal to: $\text{score}_i = (\beta_1 \text{background}_i + \beta_2 \text{education}_i + \beta_3 \text{residence}) \cdot 10$

Table 5.1 summarizes the priority score points awarded under the basic model of Lim et al. (2009).

TABLE 5.1: PRELIMINARY PRIORITY SCORE FOR APPLICANTS WHO PASS THE PQE

Characteristic	Logistic Regression Coefficient	Priority Score Points
PBA		
PBA DQ	(ref)	0
PBA issues	1.28	13
PBA OK	2.18	22
Location		
Other U.S.	(ref)	0
Other Southern California	0.17	2
L.A. County	0.49	5
Education		
< H.S. diploma	(ref)	0
H.S. diploma	0.43	4
Some college	0.81	8
Bachelor's or higher	0.81	8
Priority score summary		
Minimum		0
Maximum		35
Mean		24.1
Median		22
Standard deviation		6.0

REGULARIZED REGRESSION

Ordinary Least Squares Regression (OLS) is a monumentally important analytical tool for estimating effect sizes and developing predictive models. Researchers in fields as varied as epidemiology and economic development have relied on the technique to identify critical variables, to debunk popular misconceptions about cause-and-effect, and ultimately to promote better decision-making. However, OLS is widely acknowledged to have inherent limitations as a tool for making accurate predictions. Foremost among them is a tendency to produce estimates which though relatively unbiased can have high variance. Second is the problem posed by multicollinearity. That is, OLS estimates become more unreliable when highly correlated predictors are included in the model. A third shortcoming of OLS in terms of predictive

modeling is that it cannot be used to generate models from data for which there are more predictors than observations.

Dissatisfaction with the predictive performance of OLS regression has motivated statisticians to develop regression regularization techniques. These techniques impose constraints or penalties on independent variable coefficients to improve variable selection and model prediction properties. Ridge regression, for example, imposes an upper bound on the sum of squares of the coefficients (Hoerl and Kennard, 1970). The least absolute shrinkage and selection operator or "LASSO" method proposed by Tibshirani (1996) is an OLS regression with a penalty on the sum of the absolute value of the regression coefficients. However, ridge regression is not designed to de-select any variables, so the solutions are not parsimonious. In addition, the ridge regression penalty has a tendency to shrink the coefficients of correlated variables toward each other. LASSO excludes variables by continuously shrinking coefficients toward zero, but the method indiscriminately selects one variable from groups of highly correlated variables. When such predictors exist, the predictive performance of LASSO is inferior to ridge regression. Zou and Hastie (2005) devised a remedy these shortcomings which they affectionately dubbed "elastic net" regression. The name derives from the structure of the penalty, which enables parsimonious model construction but is also capable of selecting groups of correlated variables, as they put it, stretching to accommodate "all the big fish."

The general formula for regularized regressions is shown in equation 2:

$$\hat{\beta}(\text{elastic net}) = \arg_\beta \min |y - X\beta|^2 \text{ s.t. } \lambda_1 \sum_{j=1}^{p} \alpha |\beta_j| + (\lambda_2) \sum_{j=1}^{p} (1-\alpha)\beta_j^2 \leq t \qquad (1)$$

where λ_1 and λ_2 are termed the "shrinkage parameters"- limiting the size of the coefficients- and t is a constant which has the approximate effect of setting a subset regression retaining t

regressors. When $\alpha = 1$, equation (1) is a LASSO regression, and when $\alpha = 0$ equation (1) is a ridge regression, so the elastic net is the combined penalty in which $0 < \alpha < 1$. Both penalties tend to shrink coefficients, but acting in concert, the ridge regression constraint on $\sum_{j=1}^{p} \beta_j^2$ copes with collinear predictors while the LASSO constraint on $\sum_{j=1}^{p} |\beta_j|$ promotes zeroing of uninformative variables. Because the model is designed to be implemented to prioritize applicants, predictive performance is more important than proving any hypotheses about what factors drive candidate success, so the use of biased regression is not problematic.

RESEARCH QUESTIONS

- *Is military service a significant predictor of successful completion of the application process?*

- *Are there other applicant information or signals revealed during the application process can be used to update the prioritization score?*

- *Are priority score variables also predictive of success downstream of the hiring process (i.e. graduation from the Academy, passage of probation)?*

ANALYTICAL APPROACH

The City of Los Angeles Candidate Processing System (CAPS) records the progress of each applicant for police officer in the City of Los Angeles. The analysis was performed on CAPS data from October 2007, when the Personnel Department began noting military service in CAPS to July of 2009. When only CAPS data are used, candidate success is defined as satisfactorily completing all stages of the application process and receiving an offer of employment from the Los Angeles Police Department. CAPS data were subsequently merged with LAPD

administrative data so that the model could be re-estimated on the early job performance outcomes of graduating from the Academy and passing the probationary period of employment.

Covariate coefficients on the background investigation outcome are translated into points for a priority score system for triaging candidates through simple multiplication by ten and rounding to the nearest integer. The model coefficients on the gender and ethnicity control variables are not included in the computation of the score. Rather, allocation of points to target groups is calculated after the fact by making assumptions about how much prioritization matters (e.g. 1% increase in the probability (joining LAPD) while taking into account consent decree diversity goals, which as of 2005 were 25 percent female, 10 percent black, and 12 percent Asian. Hispanics must also be hired in proportion to their composition in the Los Angeles labor force, but this has not been a difficult quota to meet. In fact, Lim et al (2009) found that the best chance of meeting the quota for female officers was through recruitment of Hispanic women.

VARIABLES INCLUDED IN THE MODELS

The study by Lim et al. (2009) on LAPD recruitment resulted in a simple prioritization model with three predictors based on logistic regression coefficients. These were:

Preliminary Background Application (PBA) Result- The PBA is the initial stage of the application process, and it asks questions about candidates' personal histories that are grouped into four topical categories: 1) respect for the law, 2) financial record, 3) driving proficiency, and 4) drug and alcohol use. The PBA can be taken online at http://www.joinlapd.com/index2.html, in which case applicants are instructed to print out their test result to hand in at the time of the proctored essay exam, or in person just prior to the essay exam. Candidates who take the PBA online receive an instant assessment of their chances of successfully making it through the police-officer selection process. Some applicants are

essentially disqualified, informed that they have insurmountable issues in their background and strongly discouraged from applying. Others are advised that their backgrounds have potentially problematic issues. They are encouraged to resolve the issues prior to continuing the application process or to be prepared to explain these issues to background investigation personnel during the preliminary background interview. Not surprisingly, those with "PBA OK" had a higher likelihood of passing the background investigation stage than those with "PBA Issues", and both groups outperformed the reference group of "PBA DQ."

Residence- Candidates from "LA County" had a higher likelihood of passing the background investigation than candidates from elsewhere in "Southern California" (defined as San Diego, Orange, San Bernardino, Riverside, and Ventura counties), and both groups outperformed the reference group of "Other U.S."

Education- Candidates with a "4-year degree or higher" had roughly the same likelihood of passing the background investigation as candidates with "Some College, both groups had a higher likelihood of passing background than candidates with a High School Diploma, and all those groups outperformed the reference group of High School General Equivalency Degree.

Officials in the City Personnel Department and the Los Angeles Police Department Personnel Group agreed that, though this basic model was useful, a model which took into account new information acquired as the candidate progressed through the application process would add value. For example, a candidate might have an unblemished PBA but later show signs of deception on background questions during the polygraph exam. On a subtler level, and mindful of the work of White et al. (2010), a candidate's commitment to the career choice might be

signaled in his or her failure to keep hiring process appointments. To better serve the needs of the Personnel Department, variables were added to the model so that candidate priority scores could be updated. The additional variables, and the rationale behind their inclusion, are described below.

Military Service- Intuitively, military service would seem to be excellent preparation for law enforcement because both careers require physical fitness, firearm proficiency and other combat skills, and respect for the chain of command. Candidates with military service are thus among the most highly coveted by law enforcement agencies.

Online vs. Onsite PBA- It is conceivable that there could be systematic differences between candidates who take the PBA online and the candidates who do not take it until they arrive at the testing site to Personal Qualifications Essay (PQE) exam. Hypothetically, taking the PBA online could be a signal of a more organized and earnest candidate who has researched the LAPD on the internet and heeded instructions to take the PBA online and print , as opposed to one who may be applying on a lark. On the other hand, candidates who attend the LAPD Expos, which conclude with a PQE exam, tend to be very strong candidates.

No Show/Cancel Preliminary Investigative Questionnaire Interview- *A priori*, missing a scheduled appointment in the application process seems a strong signal a candidate is worried about the interview, not committed to becoming an LAPD officer, or generally undependable.

No Show/Cancel Polygraph Examination- A second "flake factor" variable, as Personnel dubbed it, indicative of a candidate worried about revealing damaging information to the polygraph examiner or otherwise reluctant to continue with the application process.

Polygraph Deception- Candidates whose polygraph responses are interpreted by the examiner as deceptive, but who make no admission of lying or other wrongdoing, may be hiding

something that is later uncovered by background investigators. If background investigators determine that a candidate was untruthful about something in their personal history- even if it is something that would not be grounds for disqualification *per se* - the lying itself is grounds for disqualification.

Polygraph Interrupted- Polygraph examiners may halt a polygraph test if the subject is suspected of using countermeasures, such as sedatives or surreptitiously self-inflicted pain during baseline questions (to induce physiological distress). If the examiners are correct in their assessments, these are candidates attempting to game the system, presumably to conceal background issues.

Polygraph Pass- To the degree that background investigators trust the polygraph results, passing the polygraph should send a positive signal about a candidate's viability. The background investigator may be able to complete his or her investigation more quickly if there is no nagging concern that the candidate is hiding something. Note that if passing the polygraph were a prerequisite for continuing in the process, it could not be used in the model because not passing would perfectly predict failure. However, candidates are permitted to continue when the examiner renders "No Opinion", and in fact quite a number of candidates in this category ultimately pass the background investigation.

Background Investigation Outcome- As with most of the predictors, the outcome is binary pass/fail. However, to reduce the number of censored observations, we counted as a failure anyone who spent over a year in the application pipeline with the background investigation result pending. This definition results in 12 misclassified failures, some of whom

had drawn out the application process by appealing an initial failed background investigation result.

Academy Graduation Outcome- A subset of those who pass the background investigation are eventually offered employment, which begins with six-months of training at the Academy. Attrition continues at the Academy, as cadets are eliminated or quit due to the intense fitness regimen, distaste for the paramilitary structure, or inadequate performance on classroom or field examinations. Academy graduation rates for the monthly classes between July 2008 and October 2009 ranged from 80% down to a low of 38%.

Probationary Employment Outcome- After the Academy, rookie officers are assigned to one of LAPD's 21 Patrol Divisions, where they begin a yearlong probationary period under the supervision of a training officer. For various reasons (e.g. loafing), some officers are terminated during this probationary period. One third of the 363 Academy Graduates from July 2008 to December 2008 did not pass probation.

The following predictors are available for the Academy Graduation Outcome and Probation Period Outcomes only:

Oral Interview Score- Candidates can pass the Oral Interview with a grade of A, B, or C. B and C grades were compared to the exclusion category of As to test whether lower scores might be associated with lower success rates in the Academy or on Probation.

Candidate Assistance Program (CAP) Participation- The LAPD offers the CAP fitness training sessions to applicants to prepare them for the rigor of the Academy and the job. Sessions are held weeknights (except Friday) and Saturday mornings. In theory CAP participation can benefit hires not only by increasing their fitness levels, but by acclimating them to LAPD culture and the training facilities, and introducing them to officers and their

fellow cadets who can serve as a support system. On the other hand, CAP participation may be superfluous for the most physically fit and self-motivated candidates, and indeed CAP is recommended to candidates who fail the Physical Abilities Tests, which are considered much easier than Academy fitness tests. CAP participation could not be used as a predictor of background investigation outcome because candidates may start to attend after passing background. CAP participation could not be used as a predictor of hiring outcome because, while LAPD tracks attendance in CAP, many who participate are not candidates for LAPD, which makes matching to Personnel Data prohibitively difficult.

Alternative Training Protocol- The Alternative Training Protocol (ATP) is a remedial exercise program for cadets who fail the first fitness test at the Academy. Given the fitness demands of the Academy (the applicant Physical Abilities Test is much easier than the Academy fitness test, according to recruiters) one would expect   lower success rates at the Academy for individuals who arrived physically less prepared.

All analysis was carried out using R version 2.9.1. Regularized regression models were programmed using the elastic net (glmnet) package, generalized boosted models using the gbm package. Ridge and LASSO regression models were created by setting α from equation (1) equal to zero and one, respectively, and doing ten-fold cross validation to find the value of λ at which the log likelihood of the models is maximized. Elastic net models were compared by varying the value of α between 0 and 1 in 0.1 increments. As a further basis for comparison, the results and predictive performance were compared to the generalized linear model (glm) package - essentially a standard logistic regression- and the generalized boosted model (gbm) package.

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The generalized boosted model took the functional form of an "ANOVA decomposition", which can be written:

$$(3) \quad f(x) = \sum_{j} f_j(x_j) + \sum_{jk} f_{jk}(x_j, x_k) + \sum_{jkl} f_{jkl}(x_j, x_k, x_l) + \cdots.$$

In this case, the GBM was programmed to include 2- and 3-way interaction terms, 3000 iterations and a shrinkage parameter of 0.005. Because of the number of terms in the GBM model, and the impracticality of reporting, much less interpreting, the interaction term coefficients, a statistic called relative influence is reported for each variable in a gbm model. The estimated relative influence of a variable x_j is $I_j = \left(E_X \left[\frac{\partial \hat{f}(x)}{\partial x_j} \right] \mathrm{var}_x[x_j] \right)^{1/2}$ where the larger the quantity I_j, the larger the empirical gain from including x_j in the model (Friedman, 2001).

Log likelihood values for each regression were likewise generated through ten-fold cross validation simulated out-of-sample predictions. Predicted values from these cross validations were used to create Receiver Operating Characteristic (ROC) curves.

RESULTS AND DISCUSSION

PREDICTIVE POWER

Table 5.2 compares the coefficients and out-of sample prediction log likelihoods of the models for the background investigation outcome. Each time a new variable would be observed to update the priority score, the sample was sub-setted to exclude individuals in the data who had already been eliminated by that stage. Otherwise the model would count candidates who never got to the polygraph stage as having failed the polygraph, for example. This process was repeated with academy graduation and probation passage as the outcomes, as shown in Tables

4.3 and 4.4, respectively. Recall that raw scores derive from rounding significant (for GLM) and non-zero (for regularized regression) coefficients to the nearest tenth and then multiplying by 10.

Table 5.2 GLM coefficients are statistically significant for the original three variables in the model: residency, education, and PBA result. Other significant predictors were failure to appear for a Preliminary Investigative Questionnaire interview (PIQ No Show), cancelling or missing a polygraph examination (Polygraph Defer), and passing the polygraph examination. Military service was not predictive of the background investigation outcome, but curiously, polygraph examinations that were interrupted or ruled as "deception with no admission" were associated with increased likelihood of success through the background investigation stage.

Regularized regression is biased, which complicates the process for generating reliable confidence intervals, especially since the shrinkage parameters were estimated through 10-fold cross validation. Thus, regularized regression coefficients do not bear asterisks indicating statistical significance, but are "significant" for the purposes of priority score development if they are of sufficient magnitude to count for at least ± 1 point. Any non-zero coefficient can be included in the computation of the score, again with the exception of the target group controls. Coefficients for the regularized regressions are the same sign but smaller than the GLM, and the penalty results in several coefficients shrinking to zero (e.g. Military Service, Onsite PBA).

The log likelihood values in Table 5.2 indicate that the LASSO (alpha=1) out-of-sample prediction for the background investigation outcome is ever so slightly superior to the GLM, to any of the elastic net regressions, and, surprisingly, to the much more computationally intensive GBM as well (it is also superior to the other regularized regressions with alpha = 0 to alpha= 0.9, though these results are not shown). But the differences in prediction performance on the

background investigation outcome, it turns out, are trivial. Figures 5.1, 5.2, and 5.3 show the Reciever Operating Characteristic (ROC) curves for the GLM, LASSO, and GBM, respectively. The area under the ROC curve, also known as the c-statistic, measures the model's ability to correctly classify successes and failures, and is right around 0.675 for all three GLM, LASSO, and GBM.

When the outcome variable is Academy graduation, some of the significant predictors change, as shown in Table 5.3. Law enforcement's high regard for applicants with military backgrounds is validated by this analysis, which would award two points to candidates with military service. The remedial exercise program (ATP) is even more strongly correlated with failure in the Police Academy than expected (-23 points), which implies that either the Physical Abilities Test is too easy or the academy fitness test is too difficult. If neither can be altered, LAPD needs to examine this issue more closely to determine whether it makes financial sense to continue training cadets who fail the fitness test.

Relative to cadets who aced the Oral Interview, cadets who received passing grades of C were less likely to graduate from the Academy (-2 points). On the basis of the log likelihood of ten-fold cross validation, the LASSO again was better than the Ridge Regression or GLM but is inferior to the GBM and no better than elastic net regression with alpha=0.8 and alpha=0.9 (not shown). More importantly, the c-statistic for the LASSO, at 0.708, is lower than either the GBM (0.737) and the GLM (0.713). The LASSO yields some classification accuracy to the other models, but performance is comparable despite the LASSO's relative simplicity, with coefficients on thirteen of the twenty-two variables reduced to zero.

As Table 5.4 shows, the models are far less adept at predicting who will pass probation. The estimates for the GLM model become unstable because the ratio of observations to variables has

decreased considerably (n= 304 observations, p= 20). The probation outcome is of course conditional on having graduated from the Academy, so the amount of variation in the predictors of the Academy graduation outcome is greatly diminished. Most of the remaining variation in outcome is due to unobserved characteristics, and as a result passing the polygraph is the only significant GLM predictor, but it is negative and quite large in magnitude. From Table 4 it can also be seen that the LASSO is no longer the best regularized regression. This distinction now belongs to the elastic net model with alpha=0.4, which even outdoes the GBM. The areas under the ROC curve for the probation passage outcome (not shown), are 0.535 for GLM, 0.607 for Elastic Net with alpha=0.4, and 0.627 for GBM. These values, particularly for the GLM, are getting dangerously close to 0.5, the point at which the model is essentially useless, predicting with the same accuracy as a coin toss. The low c-statistics indicate none of these models is very useful for predicting which rookie officers will successfully complete the probationary employment period.

Variable	GLM	Ridge Regression alpha=0	LASSO alpha=1	GBM Relative Influence
LA County	0.59**	0.56	0.56	4.66
Southern California	0.36*	0.33	0.33	2.34
Military Service	0.01	0.00	0.00	2.19
High School Grad	0.32	0.26	0.25	2.39
Some College	0.70*	0.63	0.62	3.50
Bachelors or Higher	0.72**	0.65	0.64	4.66
PBA Issues	2.07**	1.52	1.48	12.60
PBA OK	2.57**	2.02	1.98	9.00
Onsite PBA	0.00	0.00	0.00	3.15
PIQ No Show	-0.42**	-0.41	-0.41	2.65
Polygraph Pass	1.06**	1.05	1.05	21.82
Polygraph Defer	-0.12	-0.12	-0.11	2.77
Polygraph Interrupted	0.25	0.24	0.24	2.66
Polygraph Deception	0.79**	0.78	0.78	16.4
Female	0.06	0.06	0.06	2.00
Asian	-0.42**	-0.41	-0.40	2.33
Black	-0.54**	-0.52	-0.52	4.95
Hispanic	-0.09	-0.08	-0.11	3.45
Log Likelihood	-2146.97	-2146.45	-2146.32	-2152.77

* significant at .05 level; ** significant at .01 level

TABLE 5.3: REGRESSION RESULTS FOR ACADEMY GRADUATION OUTCOME (N=800)

Variable	GLM	Ridge Reg. alpha=0	LASSO Reg. alpha=1	GBM Relative Influence
CAP Participation	0.00	0.00	0.00	10.30
ATP Participation	-2.59**	-2.02	-2.28	55.21
Oral Grade B	-0.07	0.03	0.00	0.68
Oral Grade C	-0.31	-0.17	-0.18	2.38
LA County	0.22	0.17	0.04	1.37
Southern California	-0.19	-0.13	-0.09	1.45
Military Service	0.36	0.34	0.18	2.59
High School Grad	-0.09	0.15	0.10	2.37
Some College	-0.72	-0.32	-0.17	2.29
Bachelors or Higher	-0.41	-0.06	0.00	0.88
PBA Issues	16.31	0.14	0.00	4.87
PBA OK	16.19	0.07	0.00	0.25
Onsite PBA	-0.23	-0.17	0.00	1.44
PIQ No Show	-0.09	-0.08	0.10	1.40
Polygraph Pass	0.03	-0.02	0.00	1.23
Polygraph Defer	-0.17**	-0.14	0.00	0.59
Polygraph Interrupted	0.06	0.00	0.00	0.08
Polygraph Deception	0.14	0.14	0.00	0.99
Female	-0.68	-0.51	-0.47	1.91
Asian	0.35	0.27	0.00	1.21
Black	0.08	0.36	0.00	0.19
Hispanic	0.02	-0.07	0.00	3.28
Log Likelihood	-349.21	-345.99	-342.74	-338.44

* significant at .05 level; ** significant at .01 level

TABLE 5.4: REGRESSION RESULTS FOR PROBATION PASSAGE OUTCOME (N=304)

Variable	GLM	Ridge Reg. alpha=0	Elastic Net alpha=0.4	LASSO Reg. alpha=1	GBM Relative Influence
CAP Participation	-0.01	0.00	0.00	0.00	13.86
ATP Participation	-0.26	-0.04	0.00	0.00	48.69
Oral Grade B	-0.03	0.05	0.00	0.14	1.29
Oral Grade C	-0.62	-0.09	-0.26	-0.30	2.63
LA County	-0.60	-0.06	-0.06	-0.04	2.13
Southern California	-0.19	0.06	0.00	0.00	1.43
Military Service	0.43	0.10	0.12	0.10	3.16
High School Grad	-0.36	0.02	0.00	0.00	1.76
Some College	-0.42	-0.02	0.00	0.00	2.67
Bachelors or Higher	-0.47	-0.01	0.00	0.00	1.26
PBA Issues	-0.38	-0.03	0.00	0.00	2.52
PBA OK	15.98	-0.01	0.00	0.00	1.96
Onsite PBA	16.06	0.01	0.00	0.00	1.95
PIQ No Show	-0.66	-0.09	0.00	0.00	1.59
Polygraph Pass	-0.83*	-0.13	-0.37	-0.42	1.88
Polygraph Defer	-0.23	-0.02	0.00	0.00	0.71
Polygraph Interrupted	-0.10	-0.04	0.00	0.00	0.40
Polygraph Deception	-0.46	-0.03	0.00	0.00	0.92
Female	-0.74	-0.15	-0.44	-0.50	6.27
Asian	0.29	0.02	0.00	0.00	1.99
Black	0.16	-0.03	0.00	0.00	0.35
Hispanic	0.33	0.01	0.00	0.00	3.28
Log Likelihood	-179.12	-148.89	-147.12	-149.31	-179.88

* significant at .05 level; ** significant at .01 level

FIGURE 5.1: GLM RECEIVER OPERATING CHARACTERISTIC CURVE FOR BIPASS OUTCOME
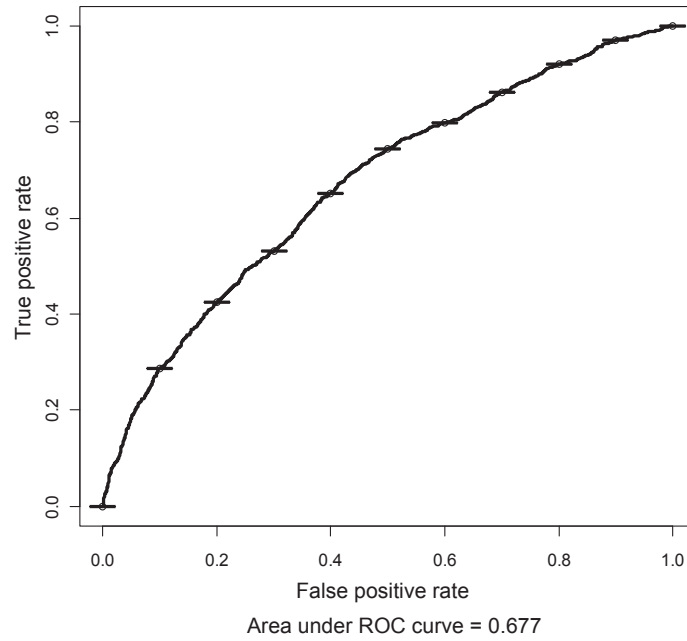
FIGURE 5.2: LASSO RECEIVER OPERATING CHARACTERISTIC CURVE FOR BIPASS OUTCOME
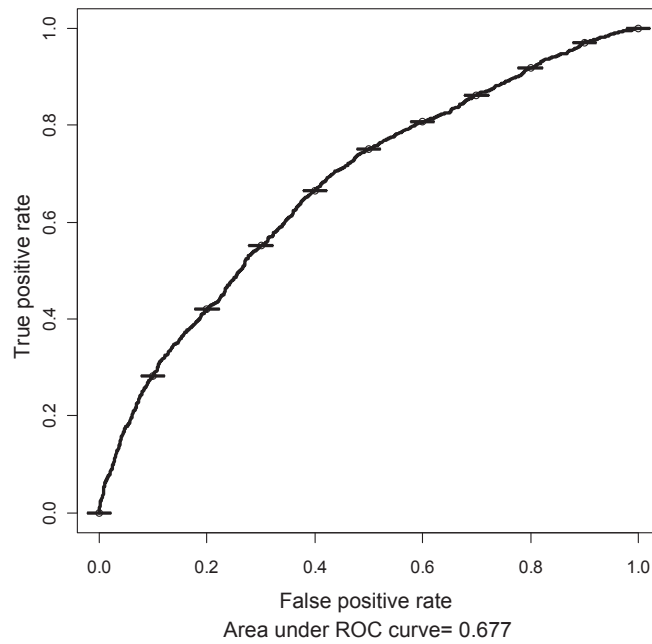
Area under ROC curve= 0.674
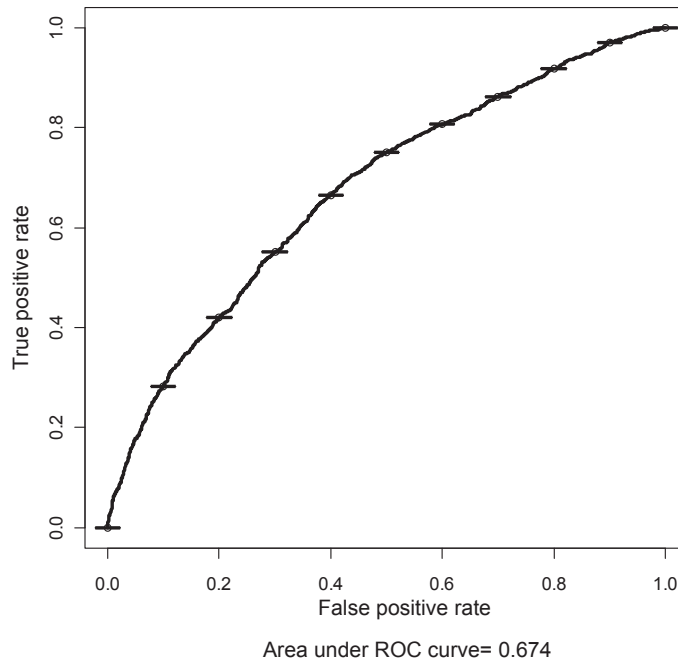
TARGET GROUP POINT ESTIMATION

As discussed in Lim et al. (2009), applying priority scores without taking race and gender into account could undermine LAPD's diversity hiring goals. The final phase of the analysis is to formulate adjustments to the priority scores to help the LAPD achieve these goals. As of 2005, the LAPD was aiming to have 25% female officers, 10% black officers, and 12% Asian officers on its force (the goal for Hispanics is 35%, but this has not been difficult to achieve historically).

Table 5.5 shows the raw score components and Figure 5.4 shows the breakdown of raw scores by applicant groups. The point allocations for polygraph deception (without admission) and polygraph interrupted are shaded because, though they have predicted value, I recommend they not be included in the scoring. The City already re-tests in these situations, a policy which acknowledges that deceptions sans admissions and interruptions for suspected countermeasures

are tentative results in need of clarification. At the same time, the finding clearly shows that applicants should not be penalized for these polygraph findings by moving them to the back of the line.

TABLE 5.5: RAW PRIORITY SCORE COMPONENTS FOR BACKGROUND CLEARANCE

Variable	Priority Score Points
LA County Residency	6
Southern California Residency	3
Military Service	0
High School Graduation	3
Some College	6
Bachelors or Higher Degree	6
PBA OK	20
PBA Issues	15
Onsite PBA	0
PIQ No Show	-4
Polygraph Pass	11
Polygraph Defer	-1
Polygraph Interrupted	2
Polygraph Deception	8
Min	-5
Max	43

Without knowing the real impact of prioritization on a candidate's likelihood of joining the LAPD, I calculate score adjustments under different assumptions about its true impact. The basic assumption is that the probability of joining LAPD is given by:

$$\frac{P(join \mid score, race, sex)}{1 - P(join \mid score, race, sex)} = f(race, sex)\exp(score/10)K^{score - meanscore}$$

That is, the probability of joining is a function of score, race, gender, and a quantity K representing the degree to which prioritization, in the form of expeditious applicant processing and proactive mentoring, influences joining. When $K = 1$, LAPD either does not prioritize or prioritization has no effect, while a value of $K = 1.01$ means that for each point above the mean priority score, the probability of joining LAPD increases by 1 percent. Conversely, so long as applicant processing resources are fixed, applicants with scores less than the average would receive lower priority and have probabilities of joining reduced by a factor of $\frac{1}{K}$. Suppose a candidate with a priority score of 13, five points above the mean raw score of 8, has a 30 percent probability of joining in the absence of prioritization (K=1.00). If $K = 1.01$ prioritization would increase that probability to only 31 percent, but if each point above the mean increased probability of joining by 10 percent, the probability of joining would increase to 41 percent.[12]

Table 5.6 shows the projected hiring rates for target groups for different values of K. The projected target group hiring rates reach the court-mandated quotas for $K \geq 1.05$, without ever threatening the Hispanic quota. At first blush, this appeared to represent a considerable predictive improvement over the original priority score system, which did not shift projected demographics to consent decree levels even at $K = 1.20$. However, when the original system is applied to the more current applicants it achieves the targets just as readily (i.e. at K=1.05).

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[12] Solving for P is straightforward. When K=1.01 and the score is 13, the new odds ratio $(P/1-P)=(0.3/0.7)(1.01)^{13-5}$. When K=1.10, the new odds ratio is $(P/1-P)=(0.3/0.7)(1.10)^{8}$.

TABLE 5.6: PROJECTED DEMOGRAPHICS BY RACE/ETHNICITY AND SEX UNDER VARIOUS HYPOTHESIZED VALUES FOR INFLUENCE OF PRIORITIZATION ON ODDS OF JOINING LAPD (%)

K	FEMALE	BLACK	HISPANIC	ASIAN
1.00	19	8	52	11
1.01	23	8	52	10
1.05	25	10	51	12
1.10	25	10	50	12
1.20	25	10	50	12
1.50	25	10	50	12

The difference is that the new system penalizes some of the target groups in updating the scores. For example, black candidates have a no-show rate of 12.3 percent for the preliminary investigative questionnaire and a polygraph exam deferral rate of 10.9 percent, compared to rates of 9 percent and 9.6 percent, respectively, for all other candidates. In fact, as Table 5.7 illustrates, when the top 20 percent of priority scores for both systems are compared, the old system is better at predicting success and the new system is better at predicting failure. The City might consider alternating between the more forgiving original priority score system and the more stringent new priority score system depending on whether applicants are in short supply or superabundant.

TABLE 5.7: CORRECTLY CLASSIFIED CASES FOR PASSING BACKGROUND WITH TOP 20 PERCENT OF PRIORITY SCORES AS THE CUTOFF

Old Model		Female	Black	Hispanic	Asian
Passed	Predicted to Pass	128	43	299	68
Failed	Predicted to Fail	238	208	724	173
New Model					
Passed	Predicted to Pass	91	28	186	58
Failed	Predicted to Fail	288	226	887	211

Different values of K entail different target group priority score adjustments. Recall that if

$K = 1$ then no amount of priority score adjustment will make any difference in target group

percentages. Table 4.7 contains the point adjustments for hypothesized values of $K > 1$. Notice

that the gap between current and projected Department composition and disparities in the male-

female ratio of candidates across ethnicities cause the point allocation to favor female candidates

over black and Asian candidates of either gender in part because a relatively high proportion of

black and Hispanic candidates are female (24 percent and 20 percent, respectively, versus 10

percent for Asians and 12 percent for whites).

TABLE 5.8: POINT ADJUSTMENTS NEEDED TO MEET SHORT-TERM TARGETS UNDER VARIOUS ASSUMED VALUES OF K
(THE AFFECT OF PRIORITIZATION ON THE PROBABILITY OF JOINING)

K	FEMALE	BLACK	ASIAN
1.01	43	0	3
1.05	12	5	7
1.10	7	3	3
1.20	4	1	2
1.50	2	0	0

While the number of qualified applicants who withdrawal because of the wait and the cost of

this attrition are unknown, there is evidence that application processing time is an important

factor in a person's choice of employers. Anecdotally, the LAPD has lost candidates to the Los

Angeles County Sheriff because of the length of time it takes the Personnel Department to

conduct background investigations (McGreevy, 2006). In a survey of 850 new law enforcement

cadets, the time required to complete the hiring process was cited as the most difficult aspect of

applying (Switzer, 2006). In more recent survey of new hires at 44 metropolitan law

enforcement agencies, length of application process was rated a "somewhat important" factor in

the decision to accept employment at a particular agency, and several respondents expressed

frustration and bewilderment at the duration of the process (Castaneda and Ridgeway, 2010). For the moment it seems reasonable to make neither too weak nor too strong an assumption about the impact of prioritization. Setting $K = 1.10$, the priority point score distribution after target group adjustments is as shown in Figure 5.5.

FIGURE 5.5: DISTRIBUTION OF PRIORITY SCORES WITH TARGET GROUP ADJUSTMENTS (K=1.10)
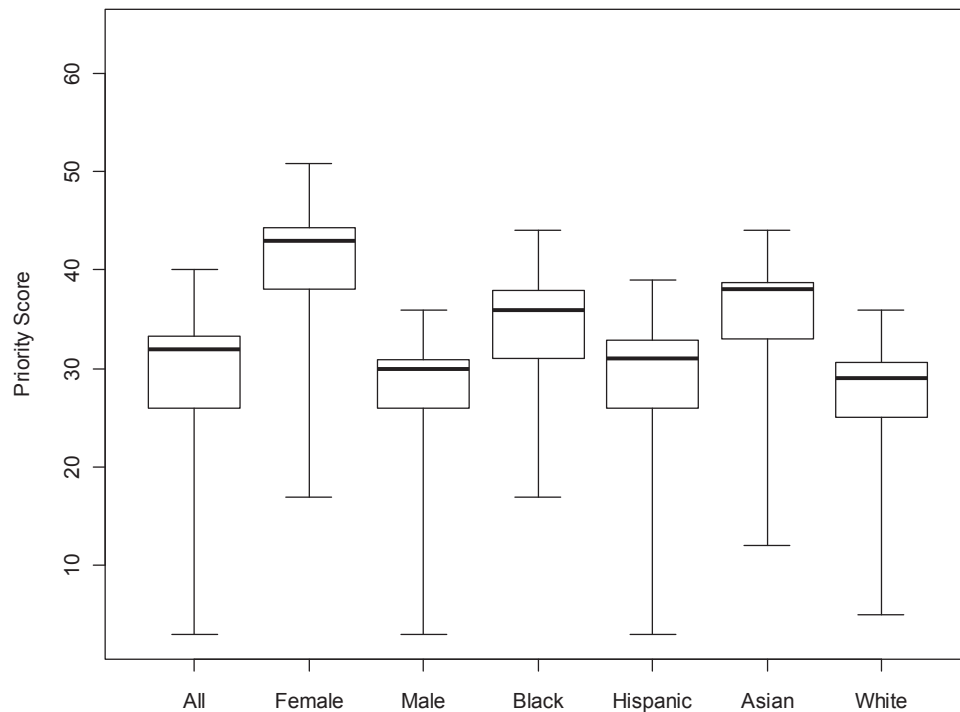
CONCLUSION

The foregoing analysis, comparing regularized regression (LASSO and elastic net) to generalized linear models (GLM) and generalized boosted models (GBM), makes a compelling case for parsimony in modeling. The LASSO's predictive performance on the background outcome equaled that of the more complex GBM, with all of its permutations to boost predictive performance, and updating did not substantially improve predictive power over the original,

three-variable priority score system. Despite the inclusion of numerous variables, none of the regression models was especially good at predicting the probationary outcome.

The updated score system does offer a couple of advantages over the previous priority score, however. First, the new model is dynamic, incorporating events that transpire between the initial application and the background investigation process which serve as signals, albeit noisy signals, of applicants quality. The Personnel Department may increase processing efficiency, even if net predictive performance is roughly equivalent, by downgrading applicants who miss PIQ and polygraph appointments. Importantly, the new model suggest that polygraph exams in which countermeasures or deception are suspected, but not corroborated, should *not* be used as criteria for downgrading applicants Conceivably, both priority score systems could prove useful for sorting applicants, the original in times of scarcity and the updated version in times of surplus. Second, the LAPD can also use the updated model to inform decisions about new cadets, including, for example, how much to invest in cadets who fail the initial academy fitness test and require remedial physical training.

The extent to which prioritization system will improve efficiency and help LAPD achieve diversity objectives can't be estimated because the actual impact of prioritization on the candidates' probability of joining the Department remains unknown. Another drawback of the analysis is the dubious assumption that the impact of prioritization follows a linear probability model, if only because the Personnel Department cannot reasonably be expected to take slightly more time to process a candidate with a score of 23 over one with a 24, and incrementally more time to process a 22. There is also a limit to how much prioritization any candidate can receive. No candidate is going to be offered a job the day they apply, no matter how high the raw score and how coveted the demographic. The true impact of prioritization is not likely to become clear

anytime soon, absent a randomized controlled trial in which priority scores are modified by a random disturbance term. Such an experiment raises legitimate human subject protection concerns, but is the only way to disentangle the effect of being a qualified candidate and the effect of expedited applicant processing on the probability of joining LAPD. The model does, however, give LAPD an improved, cost-neutral mechanism for helping to achieve and maintain its diversity goals while more efficiently processing candidates, which should in theory also reduce attrition of qualified candidates.

The evidence-based or data-driven approaches described in this dissertation are perhaps best appreciated as a primer on the potential for empirical evaluations to inform law enforcement recruitment and hiring programs and practices. While it is something of a disappointment that the methods employed here provided few definitive answers, the analyses reveals weakness that could be rectified in future studies. And although one must be careful not to generalize or extrapolate from the results, they do yield some immediately useful insights for law enforcement. Below I summarize some of the lessons derived from findings in the preceding chapters.

Returns to advertising should be tracked and adjusted according to the unemployment rate. As the unemployment rate for Los Angeles County rose precipitously in the fiscal year 2008, more than doubling from the low of 4.9 to 11.4, the number of monthly applicants to LAPD also more than doubled from 700 to 1500. The intent may have been to attract qualified applicants who suddenly found themselves out of work, but the wisdom of this strategy is called into question by research indicating people who "drift" into law enforcement tend to report lower job satisfaction (White et al., 2010). After the difficulty police agencies had finding quality recruits over most of the last decade, it is unlikely the advertising attracted a large contingent of people who had always wanted to be police officers but had to experience the shock of losing the jobs they'd settled for to realize it. The city can verify whether the proportion of quality applicants rose or stayed constant as the unemployment rate increased- either of which would tend to vindicate maintaining the level of advertising spending, but administrative data show the PQE pass rate declined by 2 percent between 2007 and 2008, and dropped another 2 percent in 2009. Moreover, the proportion of applicants who passed the background investigation fell from nearly

5% between 2007 and 2008. In the absence of a reliable prioritization system, an applicant pipeline that is clogged with poor candidates wastes resources and increases the risk of good candidates balking from the queue.

Agile, responsive budgeting is not something governments are especially well known for. Often there are stipulations that a budget cannot carry over from one fiscal year to the next, and spending under-budget may result in reduced funding in subsequent years. With governments at every level in severe fiscal crisis, frugality and flexibility are sorely needed to stretch budgets.

Long-range recruitment programs are worth trying. The Explorer/Cadet recruitment programs are not uncommon among large law enforcement agencies, whereas LA Unified's police magnet schools are novel, yet neither has been previously evaluated in terms of recruitment impact. When he first came to Los Angeles, Former Chief William Bratton marveled at the existence of the Police Academy Magnet Schools, delighted that an idea he was unable to implement in New York City had taken root in his new bailiwick (Vanderkam, 2009). While none of the methods available for the present study gave definitive proof that the Police Academy Magnet Schools and the Cadets programs turn young people on to policing or improve their chances of getting hired by LAPD, they provide the best evidence to date that both programs are contributing to the supply of future police officers.

Even barring any recruitment benefit, these programs can be a prudent investment. For LAPD these programs are not even primarily about recruiting, but a much broader vision consistent with the philosophy of community policing: forging partnerships with community institutions and molding youth into successful, civic-minded young adults as a means of improving public safety proactively. This is a model for other law enforcement agencies to

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emulate. As the youth programs coordinator explained to me, "Some of the kids in the programs come from neighborhoods or even families where the prevailing attitude is that all police officers are [jerks]. But if these kids go back home and report that they had an awesome time hanging out with Officer So-and-so, it becomes a lot harder for that negative stereotype to persist." The community-wide public safety impacts of these programs are even more difficult to measure than the recruitment impact, yet they are potentially very significant.

In this dissertation an effort was made to estimate the localized recruitment effects of these intensive programs because 1) only a localized effect could be detected with the data at hand, and 2) demonstrating a localized effect would imply that recruitment could be increased by expanding the programs to other parts of the city. With the wide availability of mapping software (e.g. CrimeStat III), law enforcement agencies can and ought to be tracking recruitment with the same zeal and sophistication they apply to tracking crime, monitoring how it changes spatially and temporally in response to their concerted efforts. Agencies wishing to initiate a long-range program will have an advantage in assessing the recruitment impact, and perhaps the public safety impact as well, if they have already been meticulously geo-coding applicant addresses.

Create applicant viability rankings. Prioritizing applicants is at least cost-neutral and at best a cost-saving way to streamline the hiring process. Whether or not it is ultimately implemented, the mere exercise of developing a priority score system has yielded useful insights about the application process, confirming anecdotal evidence regarding the value of military experience and the problematic gap between applicant fitness standards and academy fitness standards. In theory, prioritization should also positively impact hiring and retention, the former by decreasing the length of time spent in the pipeline and the latter by capitalizing on applicant signals

associated with lower viability. Determining the existence and magnitude of these effects entails experimentation in which applicants are either randomly assigned to the priority score system or the native priority score of each applicant is shifted by a random amount. Such manipulation could not be incorporated into the methodology of this dissertation without notifying applicants of the experiment and allowing them to opt out, which would likely have defeated the purpose, and because not every target group would be equally impacted by study participation. However, for agencies that do not privilege any applicant group (women, minorities) in accordance with law or policy, such concerns should be mitigated by the fact that on balance, the outcome for every applicant is the same as it would otherwise have been. By virtue of randomization, any differences in the number of applicants processed (average processing time), the number of applicants offered positions who accept, and the number of hired applicants who are still with the agency at some future point in time, are all effects of the prioritization system.

Law enforcement officials may worry that a randomized trial will lead to processing mistakes, that the "diamond in the rough" will be overlooked while the red carpet is rolled out for someone who looks good according to the numbers but is lacking in qualities not captured by the model. First of all, it is up to agency to decide how rigorously to apply the priority score, whether it will dominate existing heuristics or be used merely a guideline. Just as it was emphasized in Lim et al. (2009), I recommend here that the priority score should not supersede the judgment of personnel when new information surfaces which objectively or subjectively alters an applicant's chances for success. Where it could prove very valuable is in confirming the impressions of personnel involved in applicant processing and deciding who should get preference within a group of otherwise equally matched candidates.

REFERENCES

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller, "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program," *Journal of the American Statistical Association,* Vol. 105, No. 490, 2010, pp. 493-505.

Abadie, Alberto and Javier Gardeazabal, "The Economic Costs of Conflict: A Case Study of the Basque Country," *American Economic Review,* Vol. 93, No. 1, 2003, pp. 113-132.

Atlanta Police Foundation, *Police Force Strength: A Major City Comparison*, Atlanta, Georgia, February 2009.

Avila, Celina, "2009 Police Academy Cancelled," *KVIA ABC-7 News*, November 25, 2008. As of May 10, 2009: http://www.kvia.com/global/story.asp?s=9411253

Blake v. City of Los Angeles, 595 F.2d 1367, 9th Cir., May 2, 1979.

Bradley, Patrick L., "21st Century Issues Related to Police Training and Standards," *Police Chief*, Vol. 72, No. 10, October, 2005, pp. 32-39.

Butterfield, Fox, "Urban Police Jobs Are Losing Their Appeal," *New York Times*, July 30, 2001. As of May 23, 2011:
http:www.nytimes.com/2001/07/30/national/30POLI.html

Buzawa, Eve, "Determining Police Officer Job Satisfaction: The Role of Selected Demographic and Job-Specific Attitudes," *Criminology*, Vol. 22, No. 1, 1984, pp.61-81.

Buzawa, Eve, Thomas Austin, and James Bannon, "The Role of Selected Socio-Demographic and Job-Specific Variables in Predicting Patrol Officer Job Satisfaction: A Re-examination Ten Years Later," *American Journal of Police*, Vol.13, No.2, 1994, pp. 51-75.

Cansler, James, Commander of LAPD Personnel Division, personal communication with authors, May 4, 2009.

Card, David, "Using Geographic Variation in College Proximity to Estimate the Return to Schooling," *National Bureau of Economic Research*, Cambridge, Mass., USA, 1993.

Cascio, W.F., "Formal Education and Police Officer Performance," *Journal of Police Science & Administration*, 1977.

Castaneda, Laura and Greg Ridgeway, *Today's Police and Sheriff Recruits: Insights from the Newest Members of America's Law Enforcement Community*, Santa Monica, Calif: RAND Corporation, MG-992-DOJ, 2010.

Cavanaugh, Kerry, "LAPD Recruits in the Middle of a Budget Fight," *Daily News(Los Angeles), Valley edition*, February 26, 2008, p. A3.

City of Los Angeles, Office of the Mayor, "Mayor Villaraigosa and Chief Bratton Unveil Plan to Expand LAPD by 1,000 Officers," Los Angeles, Calif., April 12, 2006.

Dantzker, M.L., "An Issue for Policing-Educational Level and Job Satisfacation: A Research Note," *American Journal of Police,* Vol. 12, No. 2, 1992, p. 101-118.

Dantzker, M.L., "Measuring Job Satisfaction in Police Departments and Policy Implications: An Examination of a Mid-Size, Southern Police Department," *American Journal of Police*, Vol. 13, No. 2, pp. 77-101.

Decicco, D.A., "Police Officer Candidate Assessment and Selection," *FBI Law Enforcement Bulletin,* Vol. 69, No. 12, 2000, pp. 1-6.

Decker, Lisa K. and Robert G. Huckabee, "Law Enforcement Practices and Narrowing the Applicant Pool: A Case Study," *Journal of Offender Rehabilitation*, Vol. 29, No. 3&4, 1999, pp. 57-70.

Dertouzos, James N., Steven Garber, National Defense Research Institute (U.S.), RAND Corporation., and United States. Dept. of Defense, *Is Military Advertising Effective? : An Estimation Methodology and Applications to Recruiting in the 1980s and 1990s*, Santa Monica, Calif.: RAND Corporation, MR-1591-OSD, 2003.

Dertouzos, JN and S Garber, "Effectiveness of Advertising in Different Media. The Case of Us Army Recruiting," *Journal of Advertising,* Vol. 35, No. 2, 2006, pp. 111-122.

Di Tella, Rafael, and Ernesto Schargrodsky, "Do Police Reduce Crime? Estimates Using the Allocation of Police Forces After a Terrorist Attack," *American Economic Review*, Vol. 94, No. 1, March 2004, pp. 115-133.

Evans, William N., and Emily G. Owens, "COPS and Crime," *Journal of Public Economics*, Vol. 91, No.2, February 2007, pp.181-201.

Foley, P.F., C. Guarneri, and M.E. Kelly, "Reasons for Choosing a Police Career: Changes over Two Decades," *International Journal of Police Science and Management,* Vol. 10, No. 1, 2008, pp. 2-8.

Garciano, Luis and Paul Heaton, "Information Technology, Organization, and Productivity in the Public Sector: Evidence from Police Departments," *Journal of Labor Economics*, Vol. 28, 2010, pp. 167-201.

Gordon, Robert K. and Carol Robinson, "Birmingham Law Enforcement Recruits on the Rise," *Birmingham News*, April 14, 2009. As of May 24, 2011:
http://blog.al.com/spotnews/2009/04/birmingham_law_enforcement_rec.html

Griffin, G.R., R.L.M. Dunbar, and M.E. McGill, "Factors Associated with Job Satisfaction among Police Personnel," *Journal of Police Science and Administration,* Vol. 6, No. 1, 1978, pp. 77-85.

Friedman, Jerome, 2001. "Greedy Function Approximation: A Gradient Boosting Machine," *Annals of Statistics*, Vol. 29, No. 5, pp.1189-1232.

Helfand, Duke, and Steve Hyman, "Mayor Unveils Budget Kind to LAPD," *Los Angeles Times*, April 20, 2007.

Helfand, Duke, "Budget Ax to Spare LAPD," *Los Angeles Times*, February 27, 2008, p.B4.

Hickman, Matthew, Brian Reaves, and United States. Bureau of Justice Statistics, *Local Police Departments, 2003*: Washington, D.C.: US Dept. of Justice, Office of Justice Programs, Bureau of Justice Statistics, 2003.

Hoerl, Arthur, and Robert Kennard, "Ridge Regression: Applications to Nonorthogonal Problems," *Technometrics*, Vol. 12, No. 1, pp.69-82.

Hogan, Robert, Joyce Hogan, and Brent Roberts, "Personality Measurement and Employment Decisions: Questions and Answers," *American Psychologist*, May 1996, pp. 1-21.

Hough, Leaetta M. and Frederick L. Oswald, "Personnel Selection: Looking Toward the Future- Remembering the Past," *Annual Review of Psychology*, Vol. 51, 2000, pp. 631-664.

Hubbard, Gwendolyn, Robert Cromwell, Tony Sgro, "Mission Possible: Creating a New Face for the FBI," *Police Chief*, Vol. 71, No. 10, 2004, pp. 37-44.

Hunt, R.G., and K.S. McCadden, "A Survey of Work Attitudes of Police Officers: Commitment and Satisfaction," *Police Studies*, Vol. 8, No. 1, 1985, pp. 17-25

Jordan, W.T., L. Fridell, D. Faggiani, and B. Kubu, "Attracting Females and Racial/Ethnic Minorities to Law Enforcement," *Journal of Criminal Justice,* Vol. 37, No. 4, 2009, pp. 333-341.

Kaminski, Robert J., "Police Minority Recruitment: Predicting Who Will Say Yes to an Offer for a Job as a Cop," *Journal of Criminal Justice*, Vol. 21, No. 4, 1993, pp. 395-409.

Kirk, Michael, "L.A.P.D. Blues," *Frontline*, May 15, 2001.

Kleinbaum, Josh, "LAPD Launches Massive Recruiting Campaign on TV, the Web," *Los Angeles Daily News*, August 2, 2005.

Klick, Jonathan, and Alexander Tabarrok, "Using Terror Alert Levels to Estimate the Effect of Police on Crime," *Journal of Law and Economics*, Vol. 48, No. 1, April 2005, pp. 267-279.

Kling, J.R., "Interpreting Instrumental Variables Estimates of the Returns to Schooling," *Journal of Business and Economic Statistics,* Vol. 19, No. 3, 2001, pp. 358-364.

Koper, Christopher S., and Gretchen E. Moore, "Hiring, Training, and Retention of Police Officers: A National Examination of Patterns and Emerging Trends," in Christopher S. Koper, Edward R. Maguire, and Gretchen E. Moore, eds., *Hiring and Retention Issues in Police Agencies: Readings on the Determinants of Police Strength, Hiring and Retention of Officers, and the Federal COPS Program*,

Washington, D.C.: Urban Institute, 2001a, pp. 41–53.

Koper, Christopher S., and Gretchen E. Moore, "A Survey-Based Assessment of Factors Causing Changes in Sworn Force Size: Examining the Perceptions of Police," in Christopher H. Koper, Edward R. Maguire, and Gretchen E. Moore, eds., *Hiring and Retention Issues in Police Agencies: Readings on the Determinants of Police Strength, Hiring and Retention of Officers, and the Federal COPS Program*, Washington, D.C.: Urban Institute, 2001b, pp. 27–40.

Lee, Wendy, "LAPD May Relax Its Hiring Rules, *Los Angeles Times*, August 29, 2005.

Lefkowitz, J., "Job Attitudes of Police: Overall Description and Demographic Correlates," *Journal of Vocational Behavior*, Vol. 5, 1974, pp. 221-230.

Lester, David, "Why Do People Become Police Officers? A Study of Reasons and Their Predictions of Success," *Journal of Police Science and Administration*, Vol. 11, No. 2, 1983, pp. 170-174.

Levitt, Steven D., and Sudhir Alladi Venkatesh, "An Economic Analysis of Drug-Selling Gang's Finances," *Quarterly Journal of Economics*, Vol. 115, No. 3, 2000, pp. 755-789.

Levitt, Steven D., "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review*, Vol. 87, No. 3, June 1997, pp. 270-290.

Lewis, Michael, *Moneyball: The Art of Winning an Unfair Game*, New York, New York: W.W. Norton & Co., 2004.

Lim, Nelson, Carl Matthies, Greg Ridgeway, and Brian Gifford, *To Protect and to Serve: Enhancing the Efficiency of the LAPD Recruiting*, Santa Monica, Calif.: RAND Corporation, MG-881-RMPF, 2009.

Linthicum, Kate, 2011. "L.A. City Council OKs LAPD Hiring Freeze," *Los Angeles Times*, March 23, 2011.

Los Angeles Police Department, "LAPD Announces Crime Down Again in 2005," press release, Los Angeles, Calif., January 5, 2006. As of May 10, 2011:
http://www.lapdonline.org/january_2006/news_view/3729

Maggi, Laura and Brendan McCarthy, "Former Police Officer Pleads Guilty to Danziger Bridge Shooting, Cover-up of Stunning Breadth," *New Orleans Times-Picayune*, February 25, 2010.

Manolatos, Tony, "S.D. Cops Flee City's Fiscal Mess, Seek Jobs at Other Departments," *San Diego Union-Tribune*, July 5, 2006.

McCarthy, Terry, "The Gang Buster," *Time*, January 14, 2004.

McClellan, Mark, Barbara J. McNeil, and Joseph P. Newhouse, "Does More Intensive Treatment of Acute Myocardial Infarction in the Elderly Reduce Mortality? Analysis Using Instrumental Variables," *JAMA,* Vol. 272, No. 11, 1994, p. 859.

McGreevy, Patrick, 2006. "LAPD Recruits May Get Civilian Jobs First," Los Angeles Times, March 29, 2006.

Milton, C., *Women in Policing*: Police Foundation, 1972.

Morway, Renee, "Where Would NYC Be Without the NYPD?," Associated Content, May 22, 2007, As of May 10, 2009: http://www.associatedcontent.com/article/254129/nypd_recruitment_down.html?cat=17

National Bureau of Economic Research, Business Cycle Dating Committee, untitled press release dated September 20, 2010. As of March 10, 2011: http://www.nber.org/cycles/sept2010.html

Petty, R.E., J.T. Cacioppo, and D. Schumann, "Central and Peripheral Routes to Advertising Effectiveness: The Moderating Role of Involvement," *The Journal of Consumer Research,* Vol. 10, No. 2, 1983, pp. 135-146.

Parascandola, Rocco, "Budget Forces NYPD to Cancel 2010 Academy," *Newsday*, February 11, 2009. As of March 3, 2011: http://www.officer.com/web/online/Top-News-Stories/Budget-Forces-NYPD-to-Cancel-2010-Police-Academy/1$45355

Pomfret, John, "Police Sweeten Package to Fill Shortage," *Boston Globe*, April 2, 2006. As of March 3, 2011: http://www.boston.com/news/nation/articles/2006/04/02/police_sweeten_package_to_fill_shortage/

Raganella, Anthony J., and Michael D. White, "Race, Gender and Motivation for Becoming a Police Officer: Implications for Building a Representative Police Department," *Journal of Criminal Justice*, Vol. 32, No. 6, 2004, pp. 501-513.

Rao, Vithala R., "Alternative Econometric Models of Sales-Advertising Relationships," *Journal of Marketing Research*, Vol. 9, May 1972, pp. 177-181.

Raymond, Barbara, Laura J. Hickman, Laura Miller, and Jennifer S. Wong, *Police Personnel Challenges After September 11: Anticipating Expanded Duties and a Changing Labor Pool*, Santa Monica, Calif.: RAND Corporation, OP-154-RC, 2005. As of May 10, 2009: http://www.rand.org/pubs/occasional_papers/OP154/

Ridgeway, Greg, Nelson Lim, Brian Gifford, Christopher Koper, Carl Matthies, Sara Hajiamiri, and Alexis Huynh, *Strategies for Improving Officer Recruitment in the San Diego Police Department*, Santa Monica, Calif: RAND Corporation, MG-774-SDPD, 2008.

Riley, K. Jack, Gregory F. Treverton, Jeremy M. Wilson, and Lois M. Davis, *State and Local Intelligence in the War on Terrorism*, Santa Monica, Calilf: RAND Corporation, MG-394-RC, 2005.

Rubin, Joel and Richard Winton, "Crime Continues to Fall in Los Angeles Despite Bad Economy," *Los Angeles Times*, January 1, 2009.

Rubin, Joel, "Budget Cuts Prompted LAPD to Eliminate a Counter-Terrorism Task Force," *Los Angeles Times*, May 6, 2010.

Rubin, Joel, "Stopping Crime before It Starts," *Los Angeles Times*, August 21, 2010.

Scandlen, M, "Filling the ranks: Police Seek to Woo Recruits as Applicant Numbers Fall," *Indianapolis Star*, July 30, 2000.

Schaefer, Agnes G., Benjamin Bahney, and K. Jack Riley, *Security in Mexico: Implications for U.S. Policy Options*, Santa Monica, Calif: RAND Corporation, MG-876-RC, 2009.

Schmidt, Brad, "Portland City Council Unanimously Approves 'As-Needed' Involvement with JTTF," *The Oregonian*, April 28, 2011.

Scrivner, Ellen M., Innovations in Police Recruitment and Hiring: Hiring in the Spirit of Service, Washington, D.C.: Office of Community Oriented Policing Services, U.S. Department of Justice, 2006.

Sherman, Lawrence W., *The Quality of Police Education*, Washington, D.C.: Police Foundation, 1978.

Skogan, Wesley G., and Susan M. Hartnett, *Community Policing, Chicago Style*, New York, New York: Oxford University Press, 1997.

Slater, Harold R., and Martin Reiser, "A Comparative Study of Factors Influencing Police Recruitment," *Journal of Police Science and Administration*, Vol. 16, No. 3, 1988, pp. 168-176.

Sosa, Gloria, Assistant General Manager of the City of Los Angeles Personel Department, personal communication with the author, May 4, 2009.

Spielman, Fran, "Early Retirement for Cops Helps Budget, Not Force," *Chicago Sun-Times*, July 23, 2009.

Staiger, D. and J.H. Stock, "Instrumental Variables Regression with Weak Instruments," *Econometrica: Journal of the econometric society,* Vol. 65, No. 3, 1997, pp. 557-586.

Stone, V., R. Tuffin, and G. Britain, *Attitudes of People from Minority Ethnic Communities Towards a Career in the Police Service*: Home Office, Policing and Reducing Crime Unit, Research, Development and Statistics Directorate, 2000.

Switzer, Merlin E., *Recruitment and Retention: Best Practices Update*, Sacramento, Calif.: California Commission on Peace Officer Standards and Training, POST2005TPS-0371A, 2006.

Swope, C., "The Short Blue Line," *Governing*, 1999, pp. 32-34.

Taylor, Bruce, Bruce Kubu, Lorie Fridell, Carter Rees, Tom Jordan, and Jason Cheney, *The Cop Crunch: Identifying Strategies for Dealing with the Recruiting and Hiring Crisis in Law Enforcement*, Washington, D.C.: Police Executive Research Forum, December 30, 2005. As of May 10, 2009: http://www.ncjrs.gov/pdffiles1/nij/grants/213800.pdf

Tibshirani, Robert, "Regression Shrinkage and Selection Via the Lasso," Journal of the Royal Statistical Society, Series B, Vol. 58, 1996, pp. 267-288.

Trojanowicz, R., and B. Bucqueroux, *Community Policing: A Contemporary Perspective*, Cincinnatti, Ohio: Anderson, 1990.

Turner, Susan, James Hess, and Jesse Jannetta, "Development of the California Static Risk Assessment Instrument (CSRA)," Irvine, CA: UC Irvine Center for Evidence-Based Corrections Working Paper, 2009.

United States v. City of Los Angeles, 595 F.2d 1386, 9th Cir., May 2, 1979.

Walker, S., "Racial Minority and Female Employment in Policing: The Implications of "Glacial" Change," *Crime & Delinquency,* Vol. 31, No. 4, 1985, p. 555.

Webster, Barbara, *Combat Deployment and the Returning Police Officer*, Washington, D.C: United States Department of Justices, Office of Community Oriented Policing Services, 2008.

Weisburd, David, Stephen Mastrofski, Ann Marie McNally, Rosann Greenspan, and James Willis, "Reforming to Preserve: COMPSTAT and Strategic Problem Solving in American Policing," *Criminology and Public Policy*, Vol. 2, No.3, 2003, pp. 421-456.

White, Michael D. and Gypsy Escobar, "Making Good Cops in the Twenty-First Century: Emerging Issues for the Effective Recruitment, Selection and Training of Police in the United States and Abroad," *International Review of Law, Computers & Technology,* Vol. 22, No. 1, 2008, pp. 119-134.

White, Michael D., Jonathan A. Cooper, Jessica Saunders, and Anthony Raganella, "Motivations for Becoming a Police Officer: Re-assessing Officer Attitudes and Job Satisfaction after Six Years on the Street," *Journal of Criminal Justice*, Vol. 38, No. 4, 2010, pp. 520-530.

Willon, Phil, "L.A. Budget Gap Could Hit $1 Billion," Los Angeles Times, February 28, 2009. As of March 13, 2009: http://www.latimes.com/news/local/la-me-la-budget28-2009feb28,0,4878373.story

Wilson, Jeremy M., Erin Dalton, Charles Scheer, and Clifford A. Grammich, *Police Recruitment and Retention for the New Millenium: The State of Knowledge*, Santa Monica, Calif.: RAND Corporation, MG-DOJ, 2010a.

Wilson, Jeremy M., Bernard Rotsker and Cha-Chi Fan, *Recruiting and Retaining America's Finest: Evidence-Based Lesson for Police Workforce Planning*, Santa Monica, Calif.: RAND Corporation, MG-960-DOJ, 2010b.

Wycoff, Mary A., and Wesley K. Skogan, *Community Policing in Madison: Quality from the Inside Out*, Washington, D.C.: U.S. Department of Justice, 1993.

Yearwood, D.L. and S. Freeman, "Recruitment and Retention of Police Officers in North Carolina," *Police Chief*, Vol. 72, No. 10, 2004.

Zhao, Jihong, Quint Thurman, and Ni He, "Sources of Job Satisfaction Among Police Officers: A Test of Demographic and Work Environment Models," *Justice Quarterly*, Vol. 16, No. 1, March 1999, pp. 153-172.

Zou, Hui and Trevor Hastie, "Regularization and Variable Selection Via the Elastic Net," *Journal of the Royal Statistical Society*, Series B, Vol. 67, No. 2, 2005, pp. 301-3.

FIGURE A1: GEOGRAPHIC DISTRIBUTION OF DORSEY HIGH GRADS 2004-2010 (N=107)
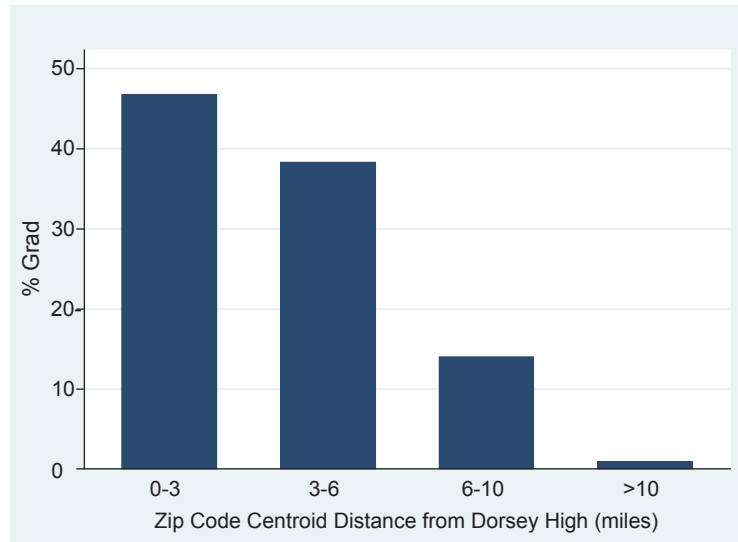
FIGURE A.2: GEOGRAPHIC DISTRIBUTION OF WILSON HIGH GRADS 2004-2010 (N=186)
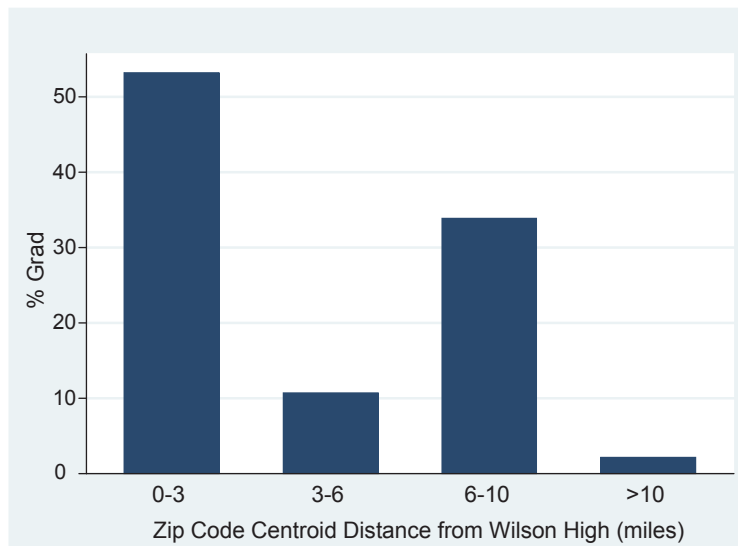
FIGURE A.3: GEOGRAPHIC DISTRIBUTION OF SAN PEDRO HIGH GRADS 2004-2010 (N=113)
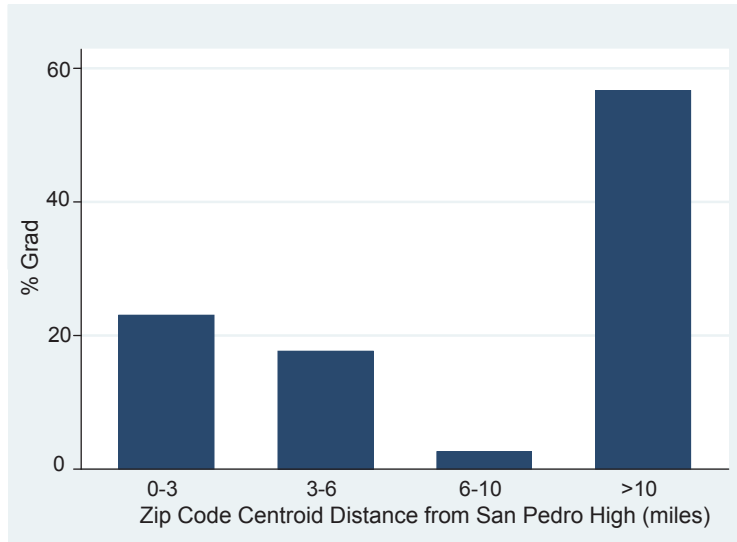
FIGURE A.4: GEOGRAPHIC DISTRIBUTION OF MONROE HIGH GRADS 2004-2010 (N=146)
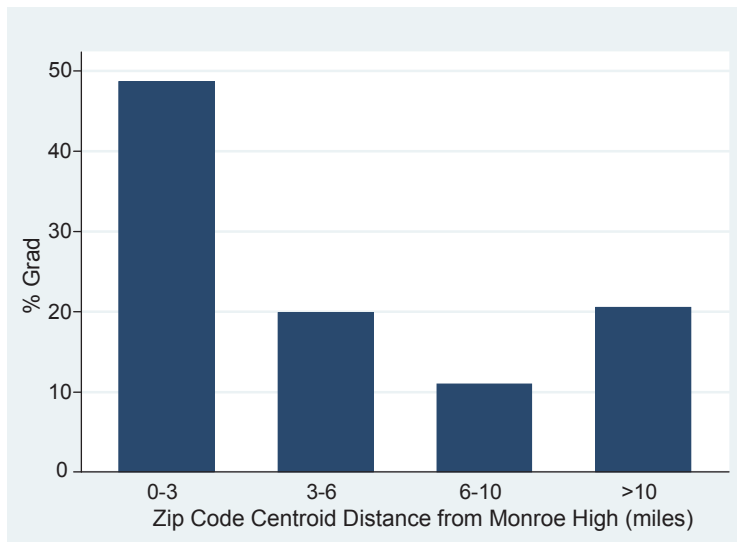
FIGURE A.5: GEOGRAPHIC DISTRIBUTION OF RESEDA HIGH GRADS 2004-2010 (N=231)

FIGURE A.6: MAIN CONTROL ZIP CODES FOR DORSEY HIGH ZIP CODE (90016)

Zip Code	Weight	Miles from DHS	PAMS Grads	Apps	BI Pass
90016	1	1.4	21	65	11
90008	0.24	1.0	9	45	9
90047	0.21	4.5	11	55	13
90062	0.18	2.2	8	47	12
91331	0.18	16.8	20	108	19

Legend

Dorsey High Zipcode

Main Dorsey High Control Zip Codes

City of Los Angeles

0   4.5   9   18 Miles
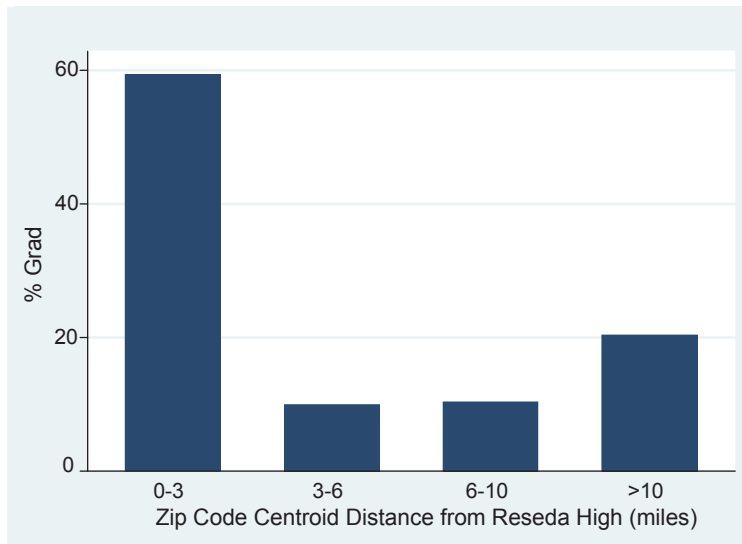
FIGURE A.7: MAIN CONTROL ZIP CODES FOR WILSON HIGH ZIP CODE (90032)

Zip Code	Weight	Miles from WHS	PAMS Grads	Apps	BI Pass
90032	1	0.9	44	77	16
90063	0.70	2.0	28	64	15
90501	0.11	18.4	1	35	2

Legend

■ Wilson High Zipcode

■ Main Wilson High Control Zip Codes

■ City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.8: MAIN CONTROL ZIP CODES FOR SAN PEDRO HIGH ZIP CODE (90731)

Zip Code	Weight	Miles from SPHS	PAMS Grads	Apps	BI Pass
90731	1	2.2 mi	23	69	11
90501	0.51	7.1 mi	1	35	2
90732	0.14	1.4 mi	3	19	2
91331	0.17	36.9 mi	20	108	19

Legend

■ San Pedro High Zipcode

■ Main San Pedro High Control Zip Codes

■ City of Los Angeles

0   4.5   9   18 Miles
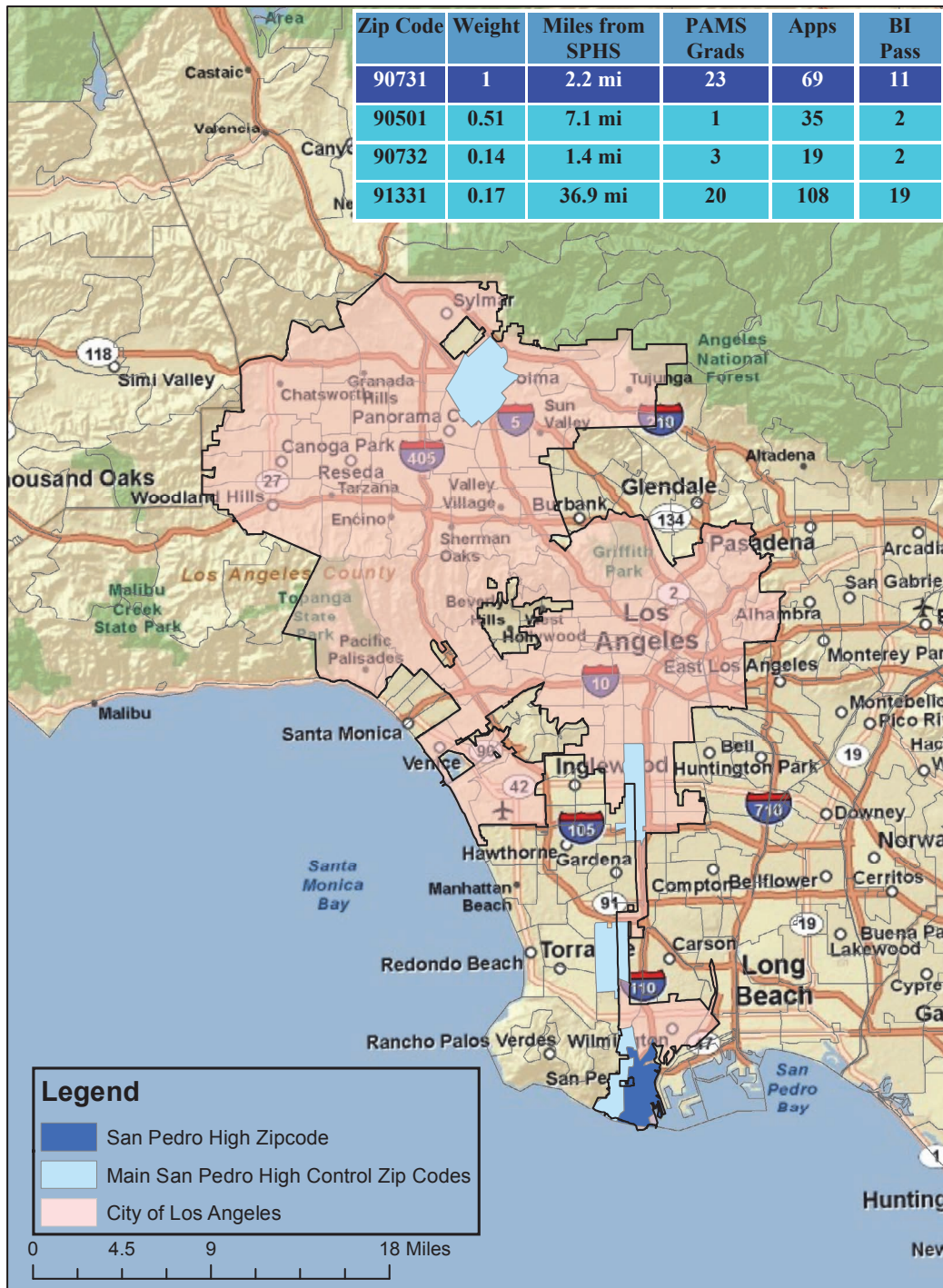
FIGURE A.9: MAIN CONTROL ZIP CODES FOR RESEDA HIGH ZIP CODE (91335)

Zip Code	Weight	Miles from RHS	PAMS Grads	Apps	BI Pass
91335	1	0.9	83	86	19
90046	0.12	11.7	0	27	3
91331	0.43	7.2	20	108	19
91401	0.14	6.1	7	32	7

Legend

- Reseda High Zipcode
- Main Reseda High Control Zip Codes
- City of Los Angeles
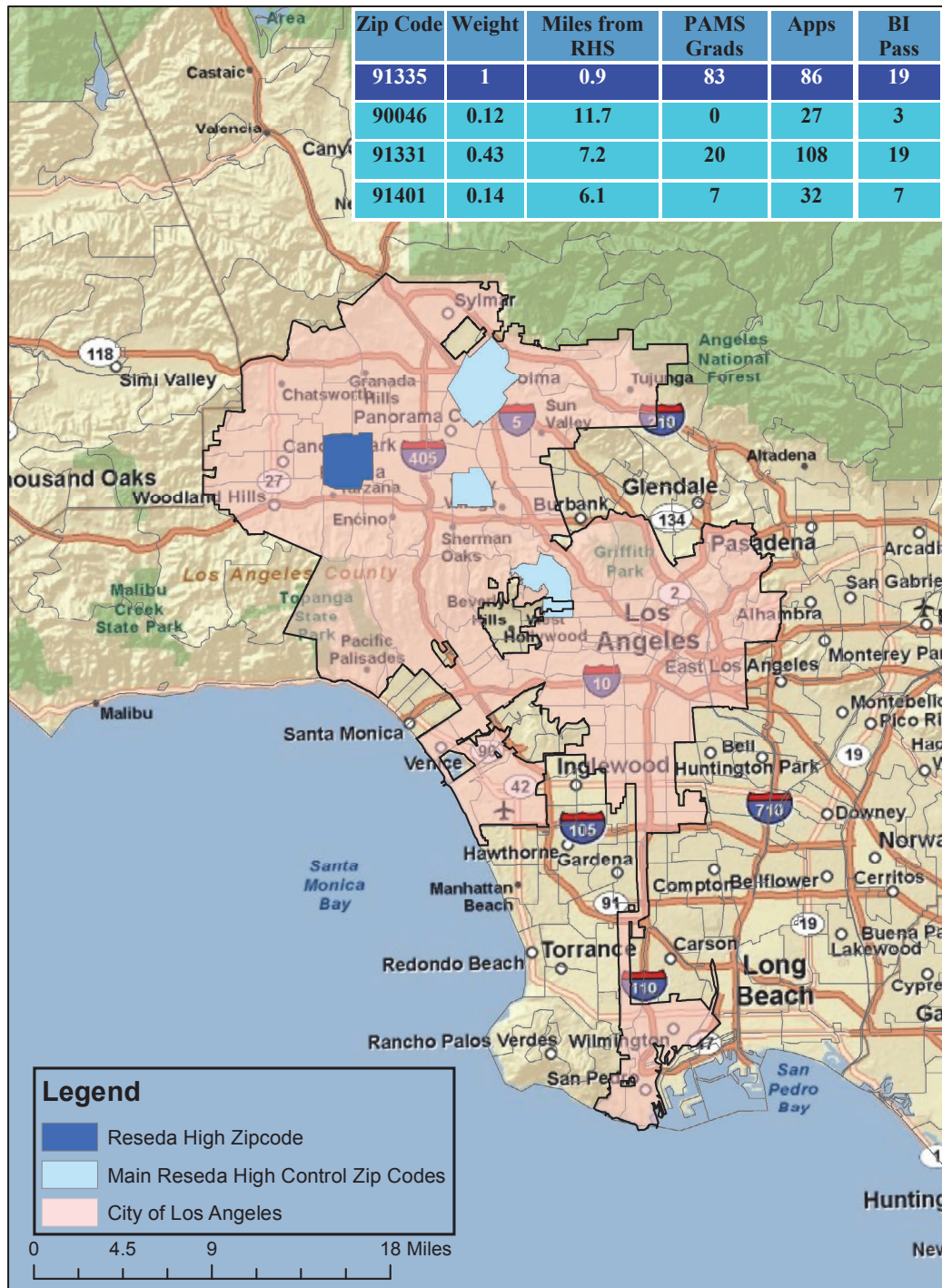
FIGURE A.10: MAIN CONTROL ZIP CODES FOR MONROE HIGH ZIP CODE (91343)

Zip Code	Weight	Miles from MHS	PAMS Grads	Apps	BI Pass
91343	1	0.1	31	58	
90006	0.30	17.0	13	33	10
90732	0.24	35.4	3	19	2
91344	0.11	4.5	2	62	15
91406	0.20	3.2	53	47	11

Legend

- Monroe High Zipcode
- Main Monroe High Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

TABLE A.1: COVARIATE BALANCE BETWEEN LAPD STATION ZIP CODES AND SYNTHETIC CONTROL ZIP CODES

	90003 77th	90003 Control	90011 Newton	90011 Control	90014 Central	90014 Control	90017 Rampart	90017 Control	90019 Wilshire	90019 Control	90025 W. LA	90025 Control
% Black	3.1	2.8	13.5	9.8	25.8	24.1	3.6	6.2	32.3	30.0	3.1	4.5
% Latino	66.9	65.7	85.6	81.4	27.2	37.5	86.3	72.9	44.1	43.6	16.1	13.3
% Foreign Born	40.2	42.0	53.9	50.9	44.9	35.1	69.9	63.3	41.7	41.3	37.2	35.3
Population Aged 18-44	25507	24732	46773	40695	997	6466	10764	16303	30325	28759	24441	23609
Median HH Income	22346	22736	23851	26346	8633	28385	14847	19469	31501	29878	47806	49101
% Below Poverty	4.0	3.8	39.1	31.5	42.3	37.3	50.5	40.1	23.5	24.7	15.1	14.6
% College Grad	3.3	6.6	2.8	5.0	8.7	20.1	3.4	11.3	21.3	20.0	55.5	51.5
% Unemployed	15.6	15.8	13.2	12.9	18.8	21.5	10.1	12.9	10.8	10.6	4.6	6.2
% Vets	3.5	4.4	2.1	3.3	13.0	10.3	2.8	3.4	5.6	6.5	6.9	6.8
Nearest PAMS	5.7	5.7	5.1	6.2	4.5	5.0	4.5	5.1	2.0	3.9	6.3	6.2
Nearest PT	1.0	2.1	3.1	3.7	1.0	1.8	1.0	1.5	0.0	1.2	2.2	2.5
Event Count	2	3	2	2	0	1	0	1	1	1	0	0

TABLE A.1 (CONTINUED)

	90028 Hollywd	90028 Control	90033 Hollenbeck	90033 Control	90061 SE	90061 Control	90062 SW	90062 Control	90065 NE	90065 Control	90066 Pacific	90066 Control
% Black	7.5	8.6	1.3	3.3	45.4	43.4	50.7	46.6	2.1	2.4	3.4	4.7
% Latino	38.6	39.7	92.7	88.2	53.1	52.0	44.4	43.6	65.7	64.3	34.1	32.8
% Foreign Born	51.2	51.9	52.1	53.0	31.4	30.3	32.4	29.2	47.0	46.0	34.6	34.6
Population Aged 18-44	17283	17025	20438	19824	9721	10789	11420	12708	20139	20184	26922	26461
Median HH Income	21893	26611	22429	25238	26449	28413	26901	28877	38271	38918	45089	45780
% Below Poverty	28.5	28.2	37.1	35.0	33.5	33.6	27.7	29.1	20.1	19.8	13.9	14.3
% College Grad	26.0	25.5	4.6	5.6	5.9	8.5	7.0	13.1	21.1	19.8	37.8	36.7
% Unemployed	1.25	1.27	13.3	13.3	15.9	15.9	15.1	14.8	8.4	8.4	6.6	6.7
% Vets	5.8	5.6	2.9	2.8	6.6	6.8	6.7	7.4	5.4	5.3	7.5	7.3
Nearest PAMS	5.1	5.3	2.2	3.5	8.1	7.2	2.2	3.7	2.8	4.0	5.1	5.7
Nearest PT	0.0	0.6	2.0	2.0	2.0	2.4	1.4	1.5	4.1	3.8	2.2	2.3
Event Count	3	3	2	2	2	2	1	1	0	0	1	1

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	90731 Harbor	90731 Control	91325 Devonshire	91325 Control	91331 Foothill	91331 Control	91335 W. Valley	91335 Control	91401 Van Nuys	91401 Control
% Black	7.3	11.4	6.1	9.2	5.6	4.1	4.4	4.6	5.0	5.9
% Latino	47.8	44.7	23.3	25.0	8.3	7.4	41.8	45.9	4.5	4.3
% Foreign Born	27.0	33.5	27.9	29.5	4.7	4.8	42.9	42.5	44.5	43.4
Population Aged 18-44	25657	22804	15855	15104	41757	38736	29658	27465	18528	18289
Median HH Income	35910	43285	48855	47850	39225	35919	40792	42023	35403	36359
% Below Poverty	20.5	19.6	13.7	17.4	19.4	21.1	14.7	17.4	22.4	22.0
% College Grad	17.5	20.8	3.6	3.8	6.0	9.7	19.6	22.0	25.7	24.6
% Unemployed	8.1	8.6	14.5	13.2	9.7	9.7	7.8	8.0	9.8	9.8
% Vets	10.0	8.7	7.7	8.0	4.4	4.8	7.0	6.9	6.8	6.7
Nearest PAMS	0.0	3.6	2.0	3.9	3.2	7.1	0.0	3.6	5.0	5.3
Nearest PT	0.0	1.3	1.0	1.3	1.0	2.4	1.0	1.8	0.0	0.5
Event Count	4	4	0	0	4	3	4	4	5	5

TABLE A.1 (CONTINUED)

	91601 N. Hollywd	91601 Control	90006 Olympic	90006 Control	91304 Topanga	91304 Control	91345 Mission	91345 Control
% Black	8.3	8.3	3.8	5.0	4.8	5.0	5.8	5.0
% Latino	49.0	48.9	79.0	76.3	33.1	34.3	53.1	51.6
% Foreign Born	39.6	39.7	66.4	61.2	33.3	33.3	37.0	32.6
Population Aged 18-44	19015	19012	29835	28374	21405	21142	6836	7838
Median HH Income	31671	32230	20593	22490	48052	47996	52603	49372
% Below Poverty	21.4	21.4	37.2	35.7	14.1	14.1	9.0	12.5
% College Grad	22.8	22.6	9.0	9.5	9.0	9.5	16.0	20.7
% Unemployed	11.1	11.1	13.4	12.4	6.8	6.8	6.9	7.1
% Vets	5.8	5.8	2.3	3.6	8.7	8.6	9.8	9.3
Nearest PAMS	7.8	7.8	3.6	5.3	6.3	6.8	2.2	4.7
Nearest PT	3.2	3.2	1.0	2.0	5.0	4.9	2.2	2.2
Event Count	0	0	0	0	1	1	1	1

FIGURE A.11: MAIN CONTROL ZIP CODES FOR 77TH DIVISION STATION ZIP CODE (90003)

Zip Code	Weight	Miles from 77th	Apps	BI Pass
90003	1	1.0	61	10
90001	0.29	2.0	54	5
90006	0.22	5.1	33	10
90044	0.21	2.2	73	10
90059	0.19	3.6	28	6

Legend
- 77th Station
- Main 77th Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.12: MAIN CONTROL ZIP CODES FOR NEWTON DIVISION STATION ZIP CODE (90011)

Zip Code	Weight	Miles from Newton	Apps	BI Pass
90011	1	1.0	85	18
90006	0.18	2.8	33	10
90044	0.17	5.4	73	10
90201	0.59	6.7	69	10

Legend
- Newton Station
- Main Newton Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.13: MAIN CONTROL ZIP CODES FOR CENTRAL DIVISION STATION ZIP CODE (90014)

Zip Code	Weight	Miles from Central	Apps	BI	Pass
90014	1	1.0	3	2	
90008	0.13	6.7	45	9	
90013	0.26	0.2	6	0	
90057	0.14	6.7	30	6	
90058	0.23	3.2	2	0	
90067	0.17	10.0	0	0	

Legend

- Central Station
- Main Central Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

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FIGURE A.14: MAIN CONTROL ZIP CODES FOR RAMPART DIVISION STATION ZIP CODE (90017)

Zip Code	Weight	Miles from Rampart	Apps	BI Pass
90017	1	0.6	12	1
90057	0.74	0.6	30	6
90058	0.23	7.2	2	0

Legend
- Rampart Station
- Main Rampart Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles
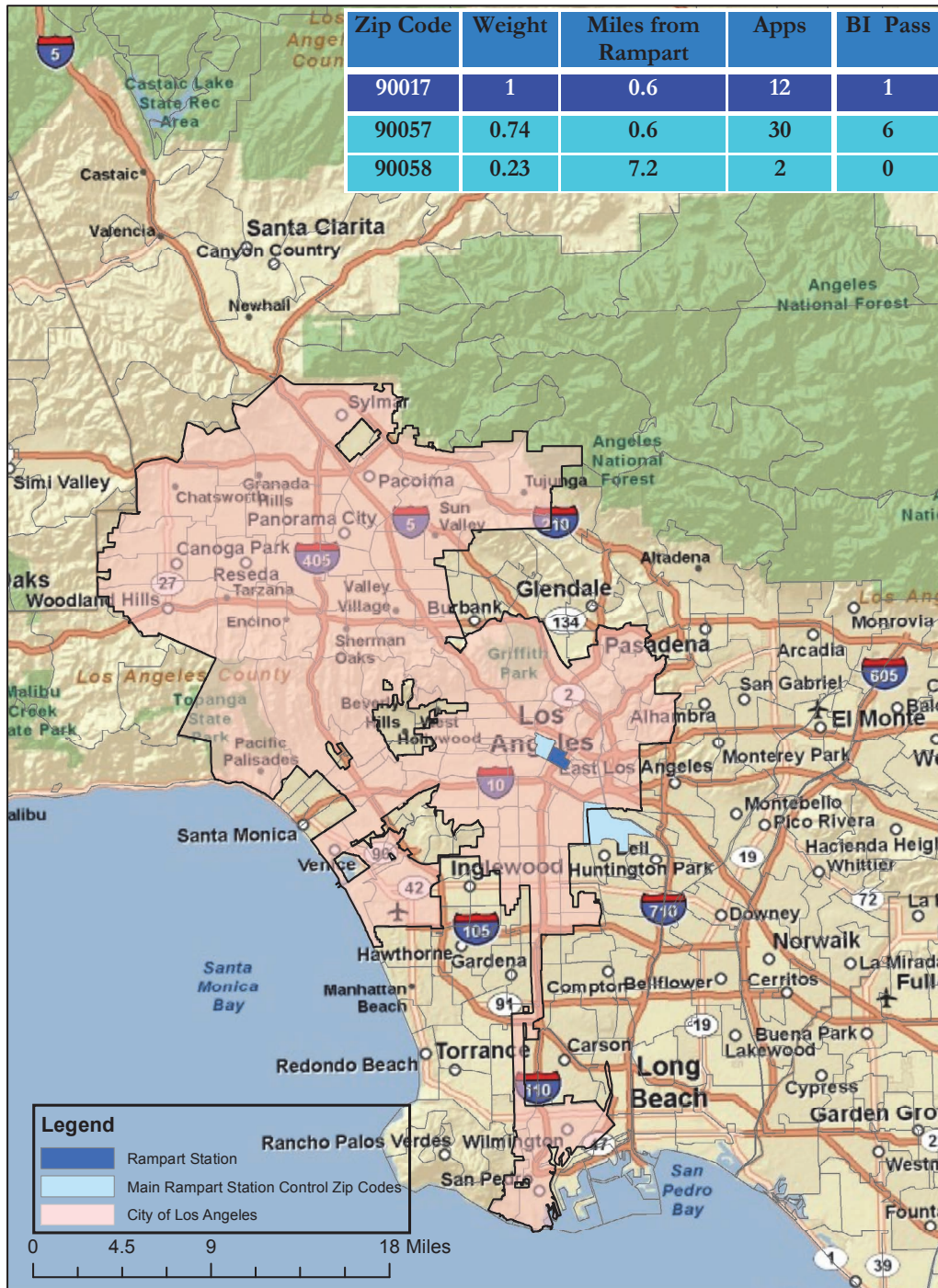
FIGURE A.15: MAIN CONTROL ZIP CODES FOR WILSHIRE DIVISION STATION ZIP CODE (90019)

Zip Code	Weight	Miles from Wilshire	Apps	BI Pass
90017	1	0.6	63	9
90004	0.40	2.8	41	7
90008	0.28	3.0	45	9
90250	0.21	9.0	106	21

Legend
- Wilshire Station
- Main Wilshire Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles
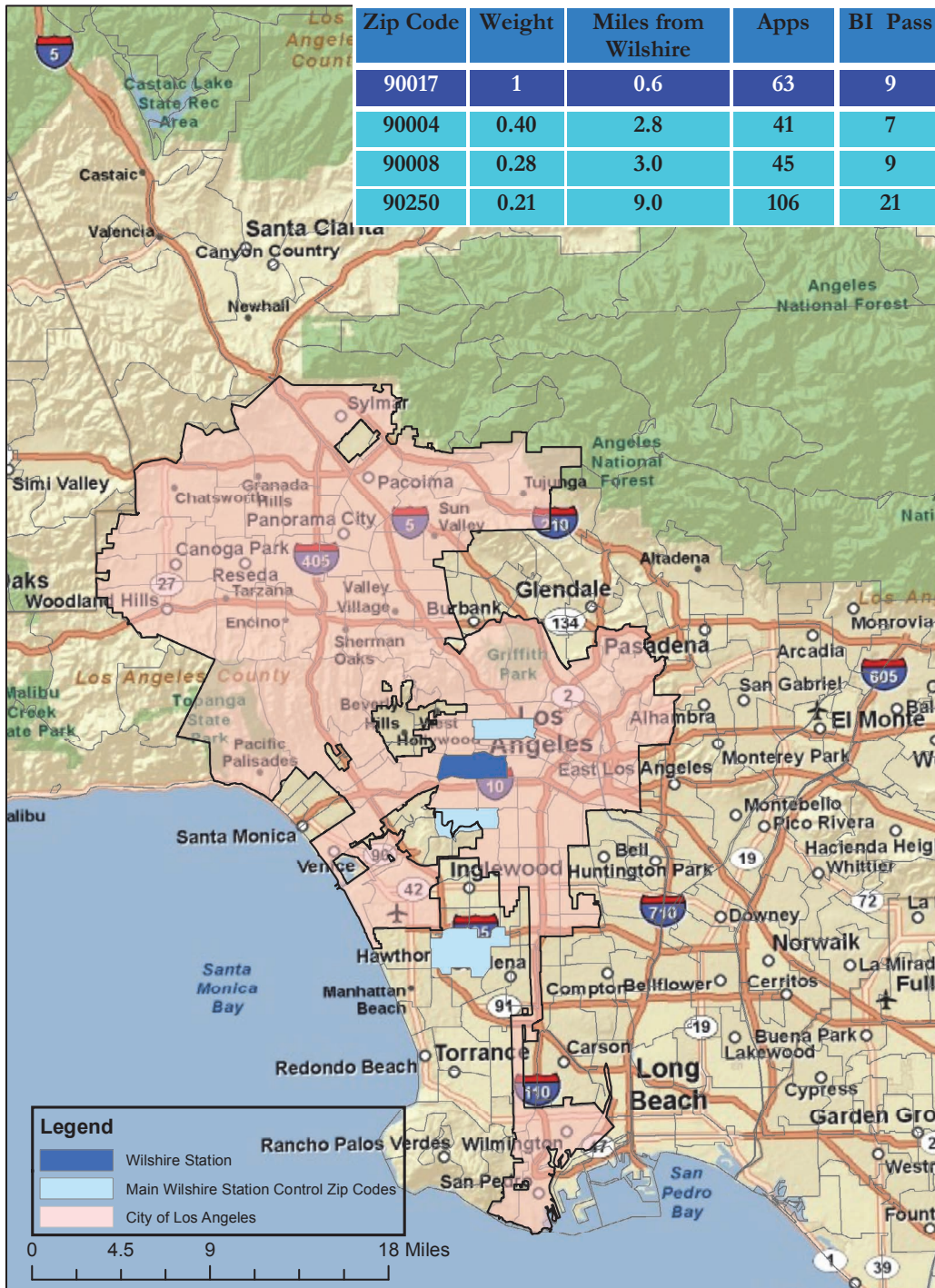
FIGURE A.16: MAIN CONTROL ZIP CODES FOR WEST LA DIVISION STATION ZIP CODE (90025)

Zip Code	Weight	Miles from West LA	Apps	BI Pass
90025	1	0.1	21	8
90024	0.13	1.4	17	3
90034	0.13	3.2	50	10
90046	0.37	6.4	27	3
90803	0.17	29.0	21	5

Legend
- West LA Station
- Main West LA Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.17: MAIN CONTROL ZIP CODES FOR HOLLYWOOD DIVISION STATION ZIP CODE (90028)

Zip Code	Weight	Miles from Hollywood	Apps	BI Pass
90028	1	0.1	25	2
90020	0.29	2.2	50	5
90029	0.31	2.0	28	4
90814	0.12	24.6	13	5

Legend

- Hollywood Station
- Main Hollywood Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.18: MAIN CONTROL ZIP CODES FOR HOLLENBECK DIVISION STATION ZIP CODE (90033)

Zip Code	Weight	Miles from Hollenbeck	Apps	BI Pass
90033	1	1.0	41	9
90006	0.13	4.4	33	10
90058	0.19	2.5	2	0
90063	0.47	1.9	64	15

Legend
- Hollenbeck Station
- Main Hollenbeck Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.19: MAIN CONTROL ZIP CODES FOR SOUTHEAST DIVISION STATION ZIP CODE (90061)

Zip Code	Weight	Miles from Southeast	Apps	BI Pass
90061	1	1.4	20	1
90058	0.10	5.8	2	0
90059	0.19	2.0	28	6
90222	0.35	2.4	20	3
90303	0.11	3.0	27	5

Legend
- Southeast Station
- Main Southeast Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.20: MAIN CONTROL ZIP CODES FOR SOUTHWEST DIVISION STATION ZIP CODE (90062)

Zip Code	Weight	Miles from Southwest	Apps	BI Pass
90062	1	0.6	47	12
90018	0.10	2.8	44	7
90021	0.11	4.5	0	0
90302	0.35	2.4	20	3

Legend
- Southwest Station
- Main Southwest Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.21: MAIN CONTROL ZIP CODES FOR NORTHEAST DIVISION STATION ZIP CODE (90065)

Zip Code	Weight	Miles from Northeast	Apps	BI Pass
90065	1	2.2	59	20
90042	0.34	4.0	76	18
90270	0.27	9.8	11	3
91030	0.12	6.1	13	4
91343	0.10	15.3	58	13

Legend

- Northeast Station
- Main Northeast Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

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FIGURE A.22: MAIN CONTROL ZIP CODES FOR PACIFIC DIVISION STATION ZIP CODE (90066)

Zip Code	Weight	Miles from Pacific	Apps	BI Pass
90066	1	1.4	39	9
90034	0.10	3.2	50	10
90046	0.17	8.5	27	3
90650	0.11	19.9	80	20
90803	0.16	24.8	21	5
91343	0.15	17.5	58	13

Legend
- Pacific Station
- Main Pacific Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.23: MAIN CONTROL ZIP CODES FOR HARBOR DIVISION STATION ZIP CODE (90731)

Zip Code	Weight	Miles from Harbor	Apps	BI Pass
90731	1	3.2	69	11
90044	0.15	12.0	73	10
90815	0.11	11.2	30	7
91343	0.39	34.2	58	13

Legend
- Harbor Station
- Main Harbor Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles
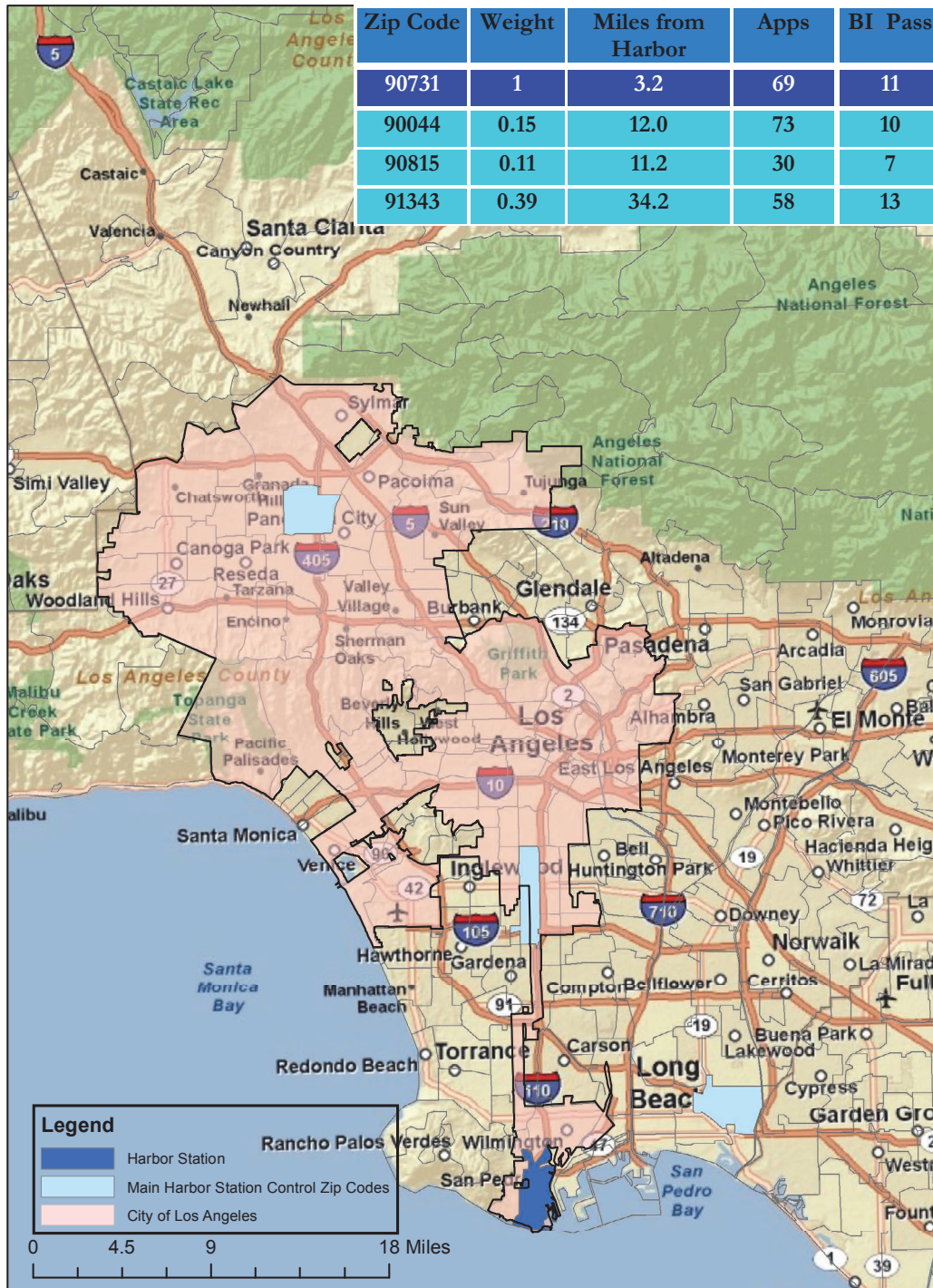
FIGURE A.24: MAIN CONTROL ZIP CODES FOR DEVONSHIRE DIVISION STATION ZIP CODE (91325)

Zip Code	Weight	Miles from Devonshire	Apps	BI Pass
91325	1	1.4	51	10
90013	0.14	22.0	6	0
90036	0.36	17.0	16	4
91306	0.29	3.6	58	13
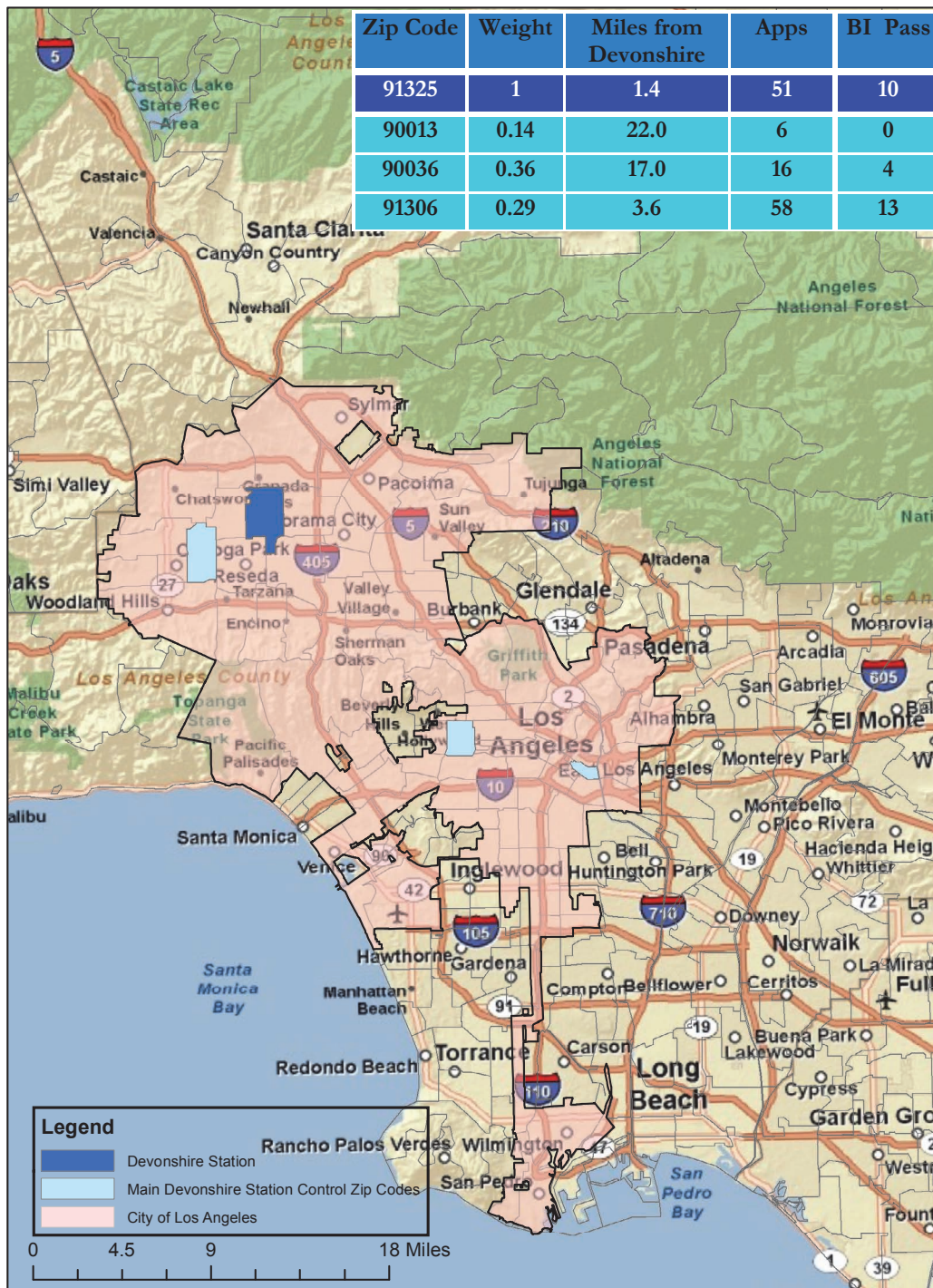
FIGURE A.25: MAIN CONTROL ZIP CODES FOR FOOTHILL DIVISION STATION ZIP CODE (91331)

Zip Code	Weight	Miles from Foothill	Apps	BI Pass
91331	1	0.5	108	19
90201	0.28	24.2	69	10
90650	0.31	30.6	80	20
91402	0.34	2.8	63	9

Legend

Foothill Station

Main Foothill Station Control Zip Codes

City of Los Angeles

0   4.5   9   18 Miles
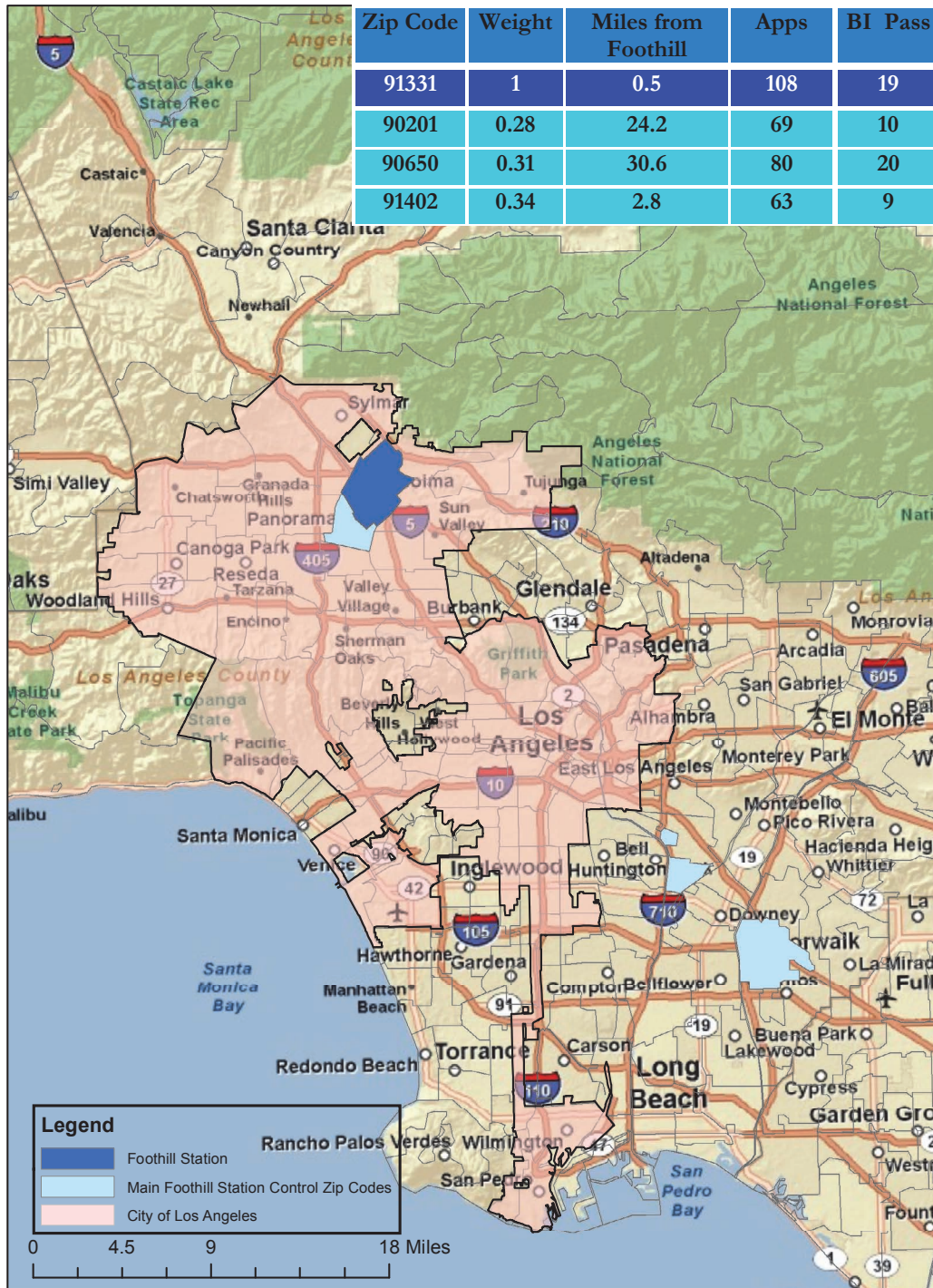
FIGURE A.26 MAIN CONTROL ZIP CODES FOR WEST VALLEY DIVISION STATION ZIP CODE (91335)

Zip Code	Weight	Miles from West Valley	Apps	BI Pass
91335	1	0.6	86	19
90650	0.14	33.6	80	20
91343	0.44	5.0	58	13
91801	0.27	25.0	57	15

Legend
- West Valley Station
- Main West Valley Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.27: MAIN CONTROL ZIP CODES FOR VAN NUYS DIVISION STATION ZIP CODE (91401)

Zip Code	Weight	Miles from Van Nuys	Apps	BI Pass
91401	1	1.1	32	7
90029	0.30	10.8	28	4
90815	0.10	33.4	30	7
91402	0.14	3.0	63	9
91754	0.13	19.2	26	9

Legend
- Van Nuys Station
- Main Van Nuys Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.28: MAIN CONTROL ZIP CODES FOR NORTH HOLLYWOOD DIVISION STATION ZIP CODE (91601)

Zip Code	Weight	Miles from N. Hollywood	Apps	BI Pass
91601	1	0.5	35	8
90022	0.30	10.8	70	9
90036	0.10	33.4	16	4
91502	0.14	3.0	13	2

Legend
- North Hollywood Station
- Main North Hollywood Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.29: MAIN CONTROL ZIP CODES FOR OLYMPIC DIVISION STATION ZIP CODE (90006)

Zip Code	Weight	Miles from Olympic	Apps	BI Pass
90006	1	0.5	33	10
90022	0.30	8.2	70	9
90036	0.14	3.2	16	4
91502	0.14	9.1	13	2

Legend
- Olympic Station
- Olympic Station Main Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles

FIGURE A.30: MAIN CONTROL ZIP CODES FOR TOPANGA DIVISION STATION ZIP CODE (91304)

Zip Code	Weight	Miles from Topanga	Apps	BI Pass
91304	1	2.0	51	11
90201	0.16	31.1	69	10
91040	0.23	16.5	32	8
91311	0.21	4.0	47	11

Legend

Topanga Station

Main Topanga Station Control Zip Codes

City of Los Angeles

0   4.5   9   18 Miles

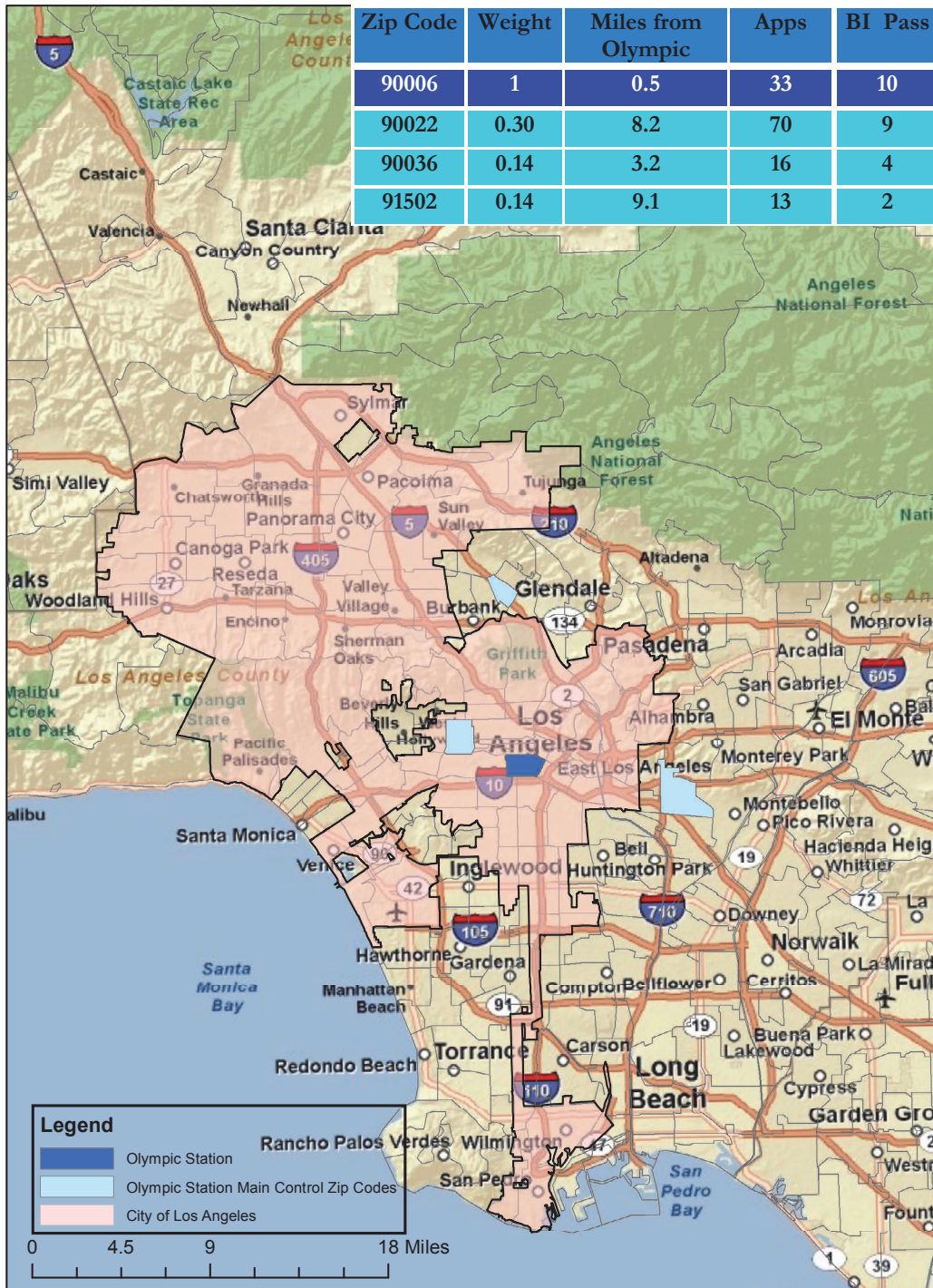FIGURE A.31: MAIN CONTROL ZIP CODES FOR MISSION DIVISION STATION ZIP CODE (91345)

Zip Code	Weight	Miles from Mission	Apps	BI Pass
91304	1	0.4	34	10
90040	0.12	26.2	14	6
90067	0.13	15.3	0	0
90732	0.22	37.1	19	2
91340	0.32	1.4	48	14

Legend
- Mission Station
- Main Mission Station Control Zip Codes
- City of Los Angeles

0   4.5   9   18 Miles