AN ANALYSIS OF THE COORDINATING BOARD, TEXAS COLLEGE AND UNIVERSITY SYSTEM'S CAMPUS SECURITY FORMULA

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TO CATHY, CASEY, AND CAMERON

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TABLE OF CONTENTS

TABLES

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

FIGURES

CHAPTER THREE

APPENDICES

CHAPTER ONE

INTRODUCTION AND STATEMENT OF PURPOSE

INTRODUCTION

The competition among Texas' colleges and universities to attract top quality high school students has forced most institutions to market the advantages of joining their ranks. Past efforts to entice incoming freshman have touted the traditional aspects of campus life: housing, meal plan options, recreational activities, and quality of education. Unfortunately, when recruiting, university presidents have had to shift their focus to another aspect of campus life -- campus crime. This new concern was just an afterthought on most Texas campuses in the 1960's and 1970's.

While crime is a grim fact of American life today, most parents assumed that, by its nature, the college campus was inherently safer than the outside world. This, unfortunately, is no longer true. According to a *USA TODAY* poll one of every four college students has been the victim of a crime (Swisher, 1989:5). While most crimes are only petty theft, violent crime is also on the rise. In the preliminary findings of their most recent national survey, Maryland's Towson State University Campus Violence Prevention Center, "reported 22 murders, 215 rapes, 429 other sexual assaults, and 3007 physical assaults on college campuses in the 1989-90 school year" (Shoop 1991:82). The 437 schools responding to the survey also reported 139 muggings (Shoop 1991:82). These attest to the problem now facing colleges and universities.

Many colleges and universities have been reporting crime statistics for inclusion in the Uniform Crime Report for many years. Yet, federal legislators feared that the rising crime rate on campuses, and the competition for students, had lead institutions to "gloss over" the crime picture on campus. This lead to the enactment of the Crime Awareness and Campus Security Act of 1990 (Shoop 1991:81). The act requires colleges and universities to issue an annual campus security report to students, employees and parents.

The growing awareness of the crime problem on college and university campuses has generated the need for increased funding for campus security. Texas college and universities, support by the Texas College and University System Coordinating Board's Campus Security Formula, join institutions across the nation in the search for increased funding for security.

RESEARCH PURPOSE

The purpose of this research is to examine the effectiveness of the Texas College and University System Coordinating Board's (Coordinating Board) Campus Security Formula. The research is explanatory. Three hypothesis are tested.

Hypothesis 1: Per capita funding generated by the Security Formula is positively related to crime rates of the Texas colleges and universities funded through Texas Higher Education Coordinating Board Formula.

Justification: Effectiveness of funding recommendations of the Coordinating Board Security Formula should be measured by the relationship between funding levels and crime rates.

Hypothesis 2: All factors used in generation of the Security Formula have a positive relationship to crime rates of Texas colleges and universities.

Justification: If the factors are not positively related to crime rates then funding recommendations have little impact on reducing crime.

Hypothesis 3: The location of a college or university within 5 miles of IH 35 show a positive relationship with crimes rates.

Justification: The effect of IH 35 on campus crime has been a point of discussion in the Security Formula Committee.

The Coordinating Board's Campus Security Formula was designed to produce effective funding levels for all Texas institutions governed by the Coordinating Board. The Security Formula is as follows:

$$\text{Total Dollars} = \$28.6(HC+E) \times C \times V$$

Where $28.6 = Cost per Capita Multiplier
HC = Student enrollment
E = Number of employees
C = Local population multiplier
V = Campus property value multiplier

The multipliers C and V were included to provide additional funding to institutions with the greatest probability of having higher crime. These multipliers are supported in the literature concerning the ecology of crime (Harries 1974). Hypothesis one states that if these theories are correct then a positive correlation should exist between the total dollars generated by the formula and the crime rates on the campuses. The correlation between total dollars and crime rates is therefore an appropriate test.

Hypothesis two also has it basis in the same population and property crime theories. If the formula is to be totally effective then there should be a positive correlation between each of the elements of the formula and crime rates on campus. Therefore, it is appropriate to test these relationships.

Hypothesis three was generated by concern of several of the Texas colleges and universities, that do not benefit from the population and property value multipliers. They maintain that Interstate Highway 35, which is not addressed in the formula, is contributing to crime on their campuses. Although limited, there is research supporting this contention. Therefore, testing this proposition, by adding another element, is appropriate.

While some literature addresses the basic construction and use of formulas, no previous research examines the relationship between formula dollars generated, or elements of the formula, and actual crime rates. The Campus Security Formula Study Committee (Formula Study Committee) with the assistance of Coordinating Board staff have issued reports as part of the biennial review, but have not addressed the correlations hypothesized in this study. These reports are reviewed in the next chapter.

The project is a quasi-experimental design examining existing data. Coordinating Board formula data supplied by the Coordinating Board staff and crime rates supplied by the Texas Department of Public Safety for the 36 Texas public colleges and universities is used. The study encompasses the last two complete Texas Legislative Bienniums including Fiscal Years 88, 89, 90, and 91. Regression analysis is used to examine the relationship between crime rates and the formula, both in the aggregate, and in its components. A detailed description of the formula, research methodology and research results is in the chapters that follow. In addition, an overview of each chapter is presented below.

CHAPTER SUMMARIES

The organizational setting of the Applied Research Project is discussed in Chapter Two. A brief history of formula funding is discussed first, emphasizing the strengths and weakness of the linearity of the formula. The Coordinating Board's role in formula funding and the committee process in formula review is then presented. This section also reviews previous work of the Campus Security Formula Study Committee and the Coordinating Board staff in testing the formula.

Chapter Three reviews, in detail, previous criminological research as it relates to the Coordinating Board's rationale for use of the elements chosen for the formula. It also examines the justification for examination of Interstate Highway 35 as possible influence on crime rates on campus. The literature is divided into two broad categories:

A. Ecological indices of crime

B. Geography of Criminal Mobility

No research directly relating to campus security formulas was found.

The methodology used in this study is presented in Chapter Four. Previous precedent for the use of regression analysis in criminological research is briefly discussed. The relationship between regression analysis as a methodology and the linearity of funding formulas is also used to justify the research design. The methodology used to test each hypothesis is examined.

In Chapter Five the results of the statistical tests used to analyze the hypotheses are presented. Correlation, and regression are discussed.

Findings of the research are summarized in Chapter Six focusing on the evidence that supports or refutes the three hypotheses. Strengths and weaknesses of the research design are presented. In addition, opportunities for further study are developed. Finally, recommendations to the Formula Study Committee are also included.

CHAPTER TWO

ORGANIZATIONAL SETTING

FORMULA BUDGETING

The State of Texas takes credit for the innovation of formula funding that is now used by over thirty U.S. states (Webb 1989). The formula system in Texas was mandated when the Fifty-sixth Legislature created the Texas Commission on Higher Education in 1955 (Webb 1989). The Commission was directed to develop a method of formula funding for higher education. The Commission on Higher Education was replaced by the Coordinating Board, Texas College and University System, in 1965, by the Fifty-ninth Legislature (Webb 1989).

Miller (Moss and Gaither 1976:543) defined budget formulas as

> an objective procedure whereby quantitative data dealing with the relationships between programs and costs are manipulated in such a manner as to arrive at an estimate of future budgetary requirements.

The term "formula funding" is frequently used in describing the process. However, "formula budgeting" is a more accurate description, since most formulas generate an appropriations request and not the actual funding (Gross 1979:2) The Texas Coordinating Board's formula system would be classified as formula budgeting. Recommendations of the Board are forwarded to the Legislative Budget Board for review and then sent to the Legislature for action.

Authors that have reviewed development of formula budgeting list a number of reasons for their creation:

(1) political complexities;
(2) the need for a more equitable distribution of resources;
(3) inadequate revenues;
(4) increased demands for accountability;
(Moss and Gaither 1976:546)

For the purpose of this project, only one reason need be addressed: the equitable distribution of resources (Moss and Gaither 1976:546, and Gross 1979:2). Equitable distribution meant that formulas prevented legislatures from arbitrarily reducing funding of one institution in favor of another institution. Imbedded in the formula were reasons an institution received larger appropriations than another institution. The Coordinating Board's Campus Security Formula was designed with equitable distribution of funds in mind. The inclusion of the multipliers for population and property value were intended to provide equitable distribution based on the probability of higher crime rates.

Formulas are also noted for their linear nature. This property promotes automatic increases in funding as institutions grow (Moss and Gaither 1976:553 and Gross 1979:4). Unfortunately, this phenomenon also operates during periods of decline forcing institutions to absorb reductions in funding. The linearity of the Security Formula provides the basis for the use of regression analysis as the primary statistical technique. Regression examines the linear nature of different elements that can be described by a straight line.

TEXAS FORMULA PROCESS

The Coordinating Board was given "broader powers, increased responsibilities, and greater financial support" when it replaced the Commission on Higher Education in 1965 (Webb 1989:2). The Board was

> charged with the responsibility to 'devise, establish, periodically review and may revise formulas for the use of the Governor and The Legislative Budget Board (LBB) in making appropriations recommendations to the Legislature'. (Webb 1989:2)

In 1988, the formula process produced recommendations from fifteen formulas to serve the 37 public senior universities, these formulas have evolved from the five used in the 1960 appropriations request.

The formula process in Texas revolves around the States' biennium. The process begins with the review of the formulas by the formula study committees in odd numbered years. The study committees prepare recommendations, based on their findings, to present to the Formula Advisory Committee in November. The Formula Advisory Committees' reviews the Study Committee recommendations and then prepares its own recommendations for the Commissioner of Education (Webb 1989:3). The Coordinating Board requires the Commissioner to present both his recommendations and those of the Formual Advisory Committee if they differ (Nance 1991).

After adoption by the Coordinating Board, the formulas are then forwarded to the Legislative Budget Board (LBB) and

Governor for use in developing their instructions to the universities for the appropriations process. The process culminates with the submission of the universities' budgets to the LBB, and the LBB's review and recommendation to the Legislature. This project addresses the need of Campus Security Formula Study Committee for new information during the 1993 review cycle.

CAMPUS SECURITY FORMULA

Formula Elements

The Campus Security Formula was first used during the 1982-83 biennium (Analysis 1986:91). After the initial design, the Formula Study Committee has reviewed the formula each biennium since 1985. This section describes the elements of the formula and discusses the study Formula Study Committee reports as related to each element. The Campus Security Formula (Appendix I) consists of five elements as described in Chapter One:

$$\text{Total Dollars} = \$28.6(HC+E) \times C \times V$$

Where $28.6 = Cost per capita multiplier
HC = Student headcount
E = Number of employees
C = Local population multiplier
V = Campus property value multiplier

Cost per Capita Multiplier

The cost per capita multiplier is based on a study by Dr. Ralph Steen. Dr. Steen referenced the Kansas formula system for campus security that allocated $22 and $23.91, respectively for FY 82-83, per student, faculty, and staff member per year (Committee, 1985:6). The Texas per capita multiplier is based on the Kansas formula figures and supported by a U.S. Department of Justice and U.S. Department of Commerce Special Study that reported, "the annual per capita direct expenditures by city and county governments in the State of Texas for police protection amounted to $25.60" (Committee, 1985:6). For FY 87 Texas the dollar multiplier was $23.86, just slightly less the dollar amount in the Special Study (Committee, 1985:6).

The Formula Study Committee's (1985) analysis of this element involved surveys of the funded universities to determine their actual expenditures on campus security. The 1985 survey found that many institutions rely heavily on auxiliary funds to meet their needs (Committee 1985:2). Most formula recommendations have been confined to increases in the multiplier to more adequately reflect the true cost of campus security and keep pace with inflation.

Student Headcount and Employee Headcount

Student headcount is the number of students enrolled for the even numbered year of the previous biennium. Employee headcount is the number of active employees (both faculty and staff), as of October 31, of the same year that contribute to the retirement fund, under Article 3.50 of the Texas Insurance Code (Webb, 1989:38).

The HC and E factors are based on the criminological theory that crime increases as population increases. The theory is discussed in more detail in Chapter Three.

Furthermore, the 1985 Formula Study Committee recognized this fact when it stated that, "The total number of persons for whom police services are provided is the most meaningful and important factor in the formulas" (Committee, 1985:7).

These two factors did not receive much attention until 1991. The Formula Study Committee (1991) noted that approximately 80% of the dollars generated by the formula are produced by HC and E. The Formula Study Committee (1991) attempted to assess the validity of these factors by reviewing the Uniform Crime Reports (UCR). Members felt that the UCR suggested that factors other than those currently used in the formula also impacted campus security (Committee 1991). Socioeconomic characteristics of the surrounding area, number and type of campus events, students housed on campus, the "density" of physical facilities, campus topography, access to interstate highways, etc. were discussed.

Nevertheless, the Formula Study Committee viewed HC and E as the primary drivers of the formula and believed that an institution with twice as many students and employees would have twice the need for security. Therefore, no change was recommended (Committee 1991).

Local Population Multiplier

The local population multiplier (C) gives an institution credit for the total population of incorporated communities having boundaries that either enclose the central campus or are within 5 air miles of the central campus boundary. Population estimates are taken from the 1980 U.S. Census, and boundaries are determined using the official county map of the Texas State Highway Department (Webb 1989:38). The population estimate is then used to determine a multiplier in the formula (Appendix I).

The population multiplier is again based on the criminological literature indicating that crime rates increase as population increase. This is also discussed in more detail in Chapter Three. The 1985 Formula Study Committee (7) state that:

> Institutions located in the larger cities of the state find that their campuses are the focal point of the less desirable element of the population. The population factor recognizes this problem and gives appropriate weight to it

In 1989, the Formula Study Committee (6) recommended a change in the air mile radius from 5 miles to 35 miles. The Formula Study Committee (1989:6) reached the conclusion that increased mobility of criminals was resulting in increased security problems for campuses located within one hour's drive of a metropolitan area. In spite of this recommendation, the Formula Advisory Committee refused to adopt this change.

The 1991 Formula Study Committee noted that while the adjacent city's crime rates increase with population increases, the crime rates on university campuses did not necessarily correlate to the crime rate of the city. In an attempt to better understand this phenomenon, the Formula Study Committee undertook a more detailed analysis of the "C" factor. Using the 1990 Uniform Crime Report (UCR), the Formula Study Committee established ratios for violent, property, and total crime for the population breakdowns shown in Appendix I.

The Formula Study Committee (1991) found that there was a greater disparity between the crime rate of smaller cities and larger cities than was reflected in the formula. The disparity was even greater when violent crime was used. The Formula Study Committee (1991) also found that a crime "bubble" exist for cities with populations between 250,000 and 499,999 and that "bubble" had persisted since the inception of the formula.

The Formula Study Committee also noted that there are anomalies in the crime statistics. The crime statistics reported by Southwest Texas State University (SWT) were one of these anomalies. "SWT reports one of the highest rates of campus crime per 1,000 students in the State" (Committee 1991). This is in contrast to the City of San Marcos that reported a crime rate below average. The Formula Study Committee (1991) also mentioned that similar situations exist at Stephen F. Austin and Prairie View A&M. These anomalies prevented the Formula Study Committee from recommending that crime statistics be used verbatim in the formula.

The Formula Study Committee (1991) again discussed the need to change the air miles from 5 to 35. The Formula Study Committee (1991) felt that both the University of North Texas, due to its proximity to Dallas; and SWT due to its proximity to Austin, needed help from the formula. In spite of this conclusion, the Formula Study Committee (1991) decided that more study was needed and deferred making a recommendation until the next biennium.

Property Value Factor

The property value factor provides additional funding to institutions with high value campuses. The factor is a ratio of the replacement cost of buildings to the gross square footage of the institution. This ratio is then divided by the ratio of the total replacement cost of buildings and total gross square footage for all the universities (Webb 1989:39) (Appendix I).

The literature, discussed in Chapter Three, confirms the relationship between higher crime rates and property values. The 1985 Formula Study Committee (7) stated its belief in this principal, "The Property Value Factor in the formula recognizes the increased security requirements for institutions which have a high value campus." This is in sharp contrast to the 1989 report that stated "the factor no longer accomplishes its intended purpose since the value of most facilities is not significant in determining the level of security required" (Committee 1989:6). The Formula Study

Committee (1989) then recommended removal of the property value factor. This change was also turned down by the Formula Advisory Committee.

The 1991 Formula Study Committee again voted to eliminate this factor from the formula. The report stated that the property being protected had no relation to the physical plant of the institution. "The 'property' being protected is more in the line of money, appliances, electronic equipment, or vehicles as opposed to buildings" (Committee 1991). Despite its vote, the Formula Study Committee later decided to defer another recommendation to the Formula Advisory Committee to eliminate the property value factor. The Formula Study Committee felt it more consistent to wait until further study would allow revision of the entire formula (Committee 1991).

SUMMARY

The Campus Security Formula Study Committee has made two attempts to modify the Security Formula during the past four bienniums. The difficulty of the task lies in the large number of factors that influence crime, lack of confidence in the data available and the Formula Study Committee's limited resources to perform the needed analysis. The Coordinating Board Staff has provided support to the Formula Study Committee by generating basic descriptive statistics for their analysis. The use of regression analysis to test the factors in the formula should provide better data to assist the Formula Study Committee in its recommendations for formula change.

As has been shown, the Population Multiplier and the Property Value Multiplier have been controversial for a number of years. Yet, both of these factors have a sound base in the literature, explaining there inclusion in the Campus Security Formula. In the next chapter the literature concerning the ecology of crime and criminal mobility is reviewed to develop the foundation for the hypotheses presented in Chapter One.

CHAPTER THREE

REVIEW OF THE LITERATURE

INTRODUCTION

This Chapter reviews the literature which examines two apparently unrelated bodies of criminal research; 1) mobility of criminals and 2) the socioeconomic influences affecting crime. Yet, researchers integrate these two topics throughout the literature. This body of work forms the basis for the use of the population multiplier and property value multiplier in the Campus Security Formula. The need for new research concerning Interstate Highway 35 and its incorporation into the analysis of the Campus Security Formula is be discussed.

Twenty-four studies were reviewed for the purposes of this paper. Twelve of these sources dealt with factors influencing criminal mobility, the journey to crime, and provided data on absolute travel distances. The other twelve sources provided data on social influences that affect crime rates and indirectly the journey to crime. An integrated approach is used to review the literature.

An examination of specific topic areas in the literature relating to socioeconomic factors, and to criminal mobility, provides an understanding of the work published in each topic area. In addition, the complexity of criminal research and the difficulty in drawing conclusions about the causes of crime is apparent.

GENERAL DISCUSSION

Literature addressing the phenomenon of criminal mobility comprises two main schools of study, criminal geography and the ecology of crime (Harries, 1974; Harries, 1980; and Davidson, 1981). The geographer studies crime from a spatial perspective, describing criminal activity through the use of maps to illustrate crime patterns (Harries, 1974:117). The spatial perspective of the geographer, as it relates to this literature review, revolves around the relationship of the residence of the criminal and the location of the offense. The geographer may examine factors such as travel distance, characteristics of the criminals neighborhood, and characteristics of the location or person victimized. The role of the geographer cannot "explain why crime occurs or how to control it," but rather through spatial interrelationships the geographer attempts to assist in both (Harries, 1974:116).

Ecological crime research attempts to test theories of causality, an area not entered by the geographer. Ecological theories include: opportunity theories, social disorganization theories, and sub-culture theories (Davidson, 1981). Population factors serve as a central theme in most ecological crime research, with population density, total population, and percent population change appearing as the primary population variables used in ecological studies.[1] Population variables, relating to increases in crime rates, are continually referenced in the literature.

References to crime as an urban phenomenon are found throughout the literature, yet, the extent to which cities import or export crime is still the subject of considerable controversy (Davidson, 1980). An understanding of both the ecology and geography of crime are critical to the discussion of importing and exporting crime. This chapter is divided into three sections, a discussion of the ecological indices of crime, the geography of crime mobility, and a summary of the literature as it relates to the Campus Security Formula and Interstate Highway 35.

ECOLOGICAL INDICES

Harries (1974:43-47), in *The Geography of Crime and Justice*, analyzes 134 Standard Metropolitan Statistical Areas (SMSA)in the United States, and identifies nine socioeconomic indices that constitute a "general crime" factor. The relationship between these nine indices and crime is so important that it remains the central theme for much of the research conducted on this topic. While most authors do not refer to casual links, all factors have demonstrated a strong correlation to higher crime rates. Davidson (1980:25) condenses Harries' list stating

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[1]Crutchfield, Georken, and Gove, 1982; Davidson, 1981; Harries, 1974; Harries, 1980, and Jarrell and Howsen, 1990.

cities with a high crime rate tend to have (1) larger populations; (2) fewer jobs in manufacturing (3) higher per capita incomes; (4) greater social disorganization (e.g. divorce); (5) higher rates of population change; (6) more unemployment; (7) and larger black population.

These seven indices of the ecology of crime provide a basis for a discussion of ecological factors influencing the journey to crime. Population factors are discussed as a single topic, followed by, manufacturing jobs, social disorganization, high per capita income, and unemployment.

Population

Discussion of the correlation between crime rates and population occurs more often in the literature than any other indices. Population research has taken many forms. Some authors oversimplify, as Davidson (1980) did, by referring to crime as an urban phenomenon or that crime increases as city size increases. More in depth studies, however, have addressed the demographics of population, and that relationship to crime. Richer measures of population employed in this research include analysis of crime rate in relation to the percent black or percent hispanic population, population density, and percent population change.[2]

Harries' (1974) expands on the use of these richer measures in his nine General Crime Factors. His study grouped 32 common variables based on their "patterns of

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[2]Brantingham and Brantingham, 1980; Crutchfield, Georken, and Gove, 1982; Harries, 1974; Harries, 1980; and Worden, 1980.

intercorrelation" (Harries 1974:46). Five of the nine factors, SMSA Size, Population Change, Black Population, Suburban Population Density, and Social Disorganization used population variables in their description (Harries, 1974:47). Harries' (1974) model provides a typical view of how important population factors are through out the literature.

The relationship between crime rates and population continues to be addressed in research, and supported by results. Crutchfield, et al. (1982:471) analysis of "Crime Rate and Social Integration" found a positive correlation between population, and assault and robbery. Harries (1974:35) in a review of literature covering population studies found a positive relationship between population density, and violent and property crimes. In their study of crime and occupations Brantingham and Brantingham (1980:102) found that robbery was the only crime index that rose in relation to the size of the city.

Regardless, evidence in the literature indicates that as modern society evolves these population factors are also affected. While city size shows a general relationship to crime rates, the oldest continuous finding in crime research is that crime rates vary from city to city (Brantingham and Brantingham 1980:93). Variations in crime rates have been documented back to 1820's (Brantingham and Brantingham, 1980:93). Worden (1980:117), in a study of crime rates in a

120 SMSA's from 1960 to 1970, found that in 1960 the best predictors of total crime were population growth, crowding, and population rank. In 1970, however, the concentration of youthful minorities and the size of the Spanish-speaking population in the SMSA's were better predictors (Worden, 1980:117).

Jarrell and Howsen (1980) also addressed several population variables in their economic model of criminal behavior, finding that other variables in the model appeared to have greater impact on the crime variables. They also present a new finding, that urbanization produces a U-shaped relationship with crime rates of burglary, larceny, and assault, rather that a positive linear effect (Jarrell and Howsen, 1980:491). While population remains an important predictor of crime rates, changing demographics have changed the composition of the population predictors.

Manufacturing Jobs

Few references to journey to crime and the crime index, manufacturing jobs, were found in the literature. While other indices are associated with rising crime rates communities supporting a primarily manufacturing environment show instead a lower incidence of certain crimes. In one study, examining occupations and employment mixes of cities, it was found that cities of a primarily manufacturing makeup produced an environment contributing to a low rate of burglary and larceny (Brantingham and Brantingham 1980:102).

On the other hand, the rate of burglary and larceny were high in cities specializing in entertainment and finance, and insurance and real estate. Research conducted by Jarrell and Howsen (1990) which reported findings for the degree of industrialization supported Brantingham and Brantingham's (1980) conclusions on burglary and larceny. Jarrell and Howsen (1990:489) reported that industrialization had no correlation with robbery, while assault, murder, and rape demonstrated some significance.

<u>High Per Capita Income</u>

High per capita income and related economic factors are supported in literature as being a crime indicator. Boggs (1966:907) stated that "the social structural variables found here suggest that the most intensively exploited business crime targets are those in high-rank neighborhoods adjacent to offender areas". Hakim (1980) hypothesized that the relative wealth of the community would have a direct impact on the importation of property crime. He stated that "property crimes are imported to wealthy, developed, and commercially enriched communities which are located in close proximity to the major urban areas and are easily accessible to highways" (Hakim 1980:275). Importation of crime in relation to the relative wealth of the community is discussed in more detail with criminal mobility.

Greater Social Disorganization

With exception of population, social disorganization provides the broadest range of definitions of any of Harries' (1974) social indices. Harries' (1974) study of SMSA's used net population change, marriage rate and divorce rate as variables best describing this phenomenon. Crutchfield, et al.(1982:468) argued that previous research has failed to tie formal deterrence to the concept of social integration. Their approach was to first define what they referred to as an integrated social system:

1) a High degree of consensus in norms, values, and goals;
2) cohesiveness, or social solidarity; and
3) A sense of belonging or we feeling among persons living in the community in question.

The authors then used population size and total mobility, rather than the traditional measures used by Harries, as measures of social disorganization. Mobility was subdivided into 3 components; a mover rate, immigration rate, and total mobility (the sum of mover rate and immigration rate) (Cruthchfield et al. 1982:469-70). The theory stated that geographic mobility contributed to the social disintegration. Crutchfield, et.al. (1982) findings suggests population mobility accounts for social disorganization more completely than population changes alone.

Numerous studies address variables reflecting different attributes of the concept of social disorganization. Baker (1986) used the concept of "defended neighborhoods" in his research. He defined a "defended neighborhood" as the smallest unit possessing a corporate identity that was known to both insiders and outsiders. All individuals would be aware of the symbolic boundaries that marked the beginning and end of the community and that this would serve to "regulate spatial movement" (Baker, 1986:60).

While Baker's (1986:60) concept of a defended neighborhood referred primarily to physical boundaries, it also implied, "that members shared something in common with each other." This corresponds to the cohesive unit used by Crutchfield, et al (1982) in defining an integrated society. Baker maintained that strong defended neighborhood would deter crime by non-residents of the neighborhood. He found that the cohesiveness of the community does in fact impede intrusion by outsiders, in that only 31 percent of the crime was committed by outsiders of the communities studied (61).

Baker's (1986) findings are supported by Brantingham and Brantingham's (1980) research concerning economic specialization. Brantingham and Brantingham (1980:103) found that manufacturing environments, exhibiting a low migration rate, have lower rates of property crime.

Jarrell and Howsen's (1990) economic model of criminal behavior also demonstrates the relationship between social disorganization and crime. The authors found a positive correlation between social disintegration variables and property crime.

Katzman's (1980:121) hypothesis suggested that as mobility increased, defined as movement of the poor to the suburbs, that the safety of neighborhoods from crime was compromised. In addition, Katzman's (1980:132) results suggest that as potential criminals gain access, and begin to relocate to higher income neighborhoods, the cohesiveness is lost and crime rates rise. Baker's (1986:61) finding that 70 percent of the crime in neighborhoods is committed by neighborhood residents supports Katzman's research.

The literature illustrates the difficulty researchers have defining social disorganization. The complexity of the social disorganization issue also suggests that the dynamics of societal change constantly redefines which indicators best correlate to higher crime rates.

Unemployment

Unemployment is one of the more straightforward of Harries' (1974) indices. He used only two variables in his model, percent unemployed and local expenditures for welfare, to define unemployment. In reviewing the lack of social integration, Crutchfield, et al. (1982) also used unemployment as a control variable representing blocked opportunity. Unemployment produced a mild positive correlation only to burglary and larceny, and a fairly negative correlation to murder (Crutchfield, et al. 1982:471).

Brantingham and Brantingham (1980:102) found that unemployment contributes to larceny rates and black unemployment correlates with robbery. Nonetheless, their discussion made no mention of a correlation between violent crimes and unemployment. Hence, they were unable to replicate findings of the Crutchfield, et al. (1982) study. Jarrell and Howsen (1990:485) used a factor referred to as "legal return" which includes a measure of unemployment. Jarrell and Howsen's (1990:489) results suggest a mild correlation with all six crime factors, burglary, larceny, robbery, assault, murder, and rape. As shown, the literature does support theories relating increases in certain types of crime to unemployment indices.

GEOGRAPHY OF CRIMINAL MOBILITY

Review of the criminal mobility literature reveals two key objectives. First, studies are descriptive in that they provide numerical data on travel distances of offenders. This is also referred to as the journey to crime. Second, studies examine the factors that describe and explain the phenomenon. The twelve articles in Table 3.1 present studies concerning the journey to crime, which were representative of the literature and relevant to the purpose of this paper.

The preponderance of the literature on the journey to crime was published in the 1970's and early 1980's, with all of the research data dating back to the 1970's or earlier.

The earliest article quoted liberally in the literature was White's (1932) study of felonies committed in Indianapolis in 1930. I found it strange that no published work in the area of criminal mobility and travel distances could be found during the late 1980's or 1990's.

Several observations that can be made concerning the journey to crime, based on the literature, are:

1) Crime in metropolitan areas exhibits a central tendency.
2) Travel distance exhibits a distance decay phenomenon.
3) Offenders committing property crimes tend to travel longer distances than offenders committing crimes against the person.
4) Adult offenders tend to travel longer distances than juvenile offenders.
5) Distance traveled is related to the value of the property taken.
6) Criminals prefer to stay close to home.

The discussion of the journey to crime encompasses these six phenomenon, which form the foundation of much of the research on criminal mobility.

<u>Central Tendency</u>

Davidson (1981:68) provides the base from which to begin this discussion, he states that studies of the journey to crime cannot be restricted purely to distance, that consideration must be given to the direction of travel, and the origin and destination of the offender. Two observations about the journey to crime as an urban phenomenon are; first, crime concentrates nearest the center of city and diminishes outward, and second, crime exhibits radial tendencies.[3] Of this center city tendency Davidson (1981:68) also noted that, "An analysis of the connections between locus and residence will almost certainly reveal an intensely radial pattern with a high correlation between distance traveled and distance of residence from the centre." White's (1932:501) research in Indianapolis supports Davidson's (1981) conclusions with an observation that "crime of all kinds is peculiarly characteristic of the central business district."

Distance Decay Phenomenon

In Figure 3.1 the relationship between robberies and distance from home is presented graphically. The graph demonstrates the finding, which is consistent through out the literature -- criminals prefer to stay close to home.[4] Capone and Nichols (1975:47), using research based on travel tendencies of shoppers, hypothesized that criminals would exhibit similar behavior as distance from their residence increased. Capone and Nichols (1975:47) demonstrated that when the number of robbery offenses committed in Dade County were graphed against the distance the offender traveled from his residence, the line dropped sharply to the five mile point and then gradually leveled off out to approximately fifteen miles. In a study, conducted in Miami, of unarmed

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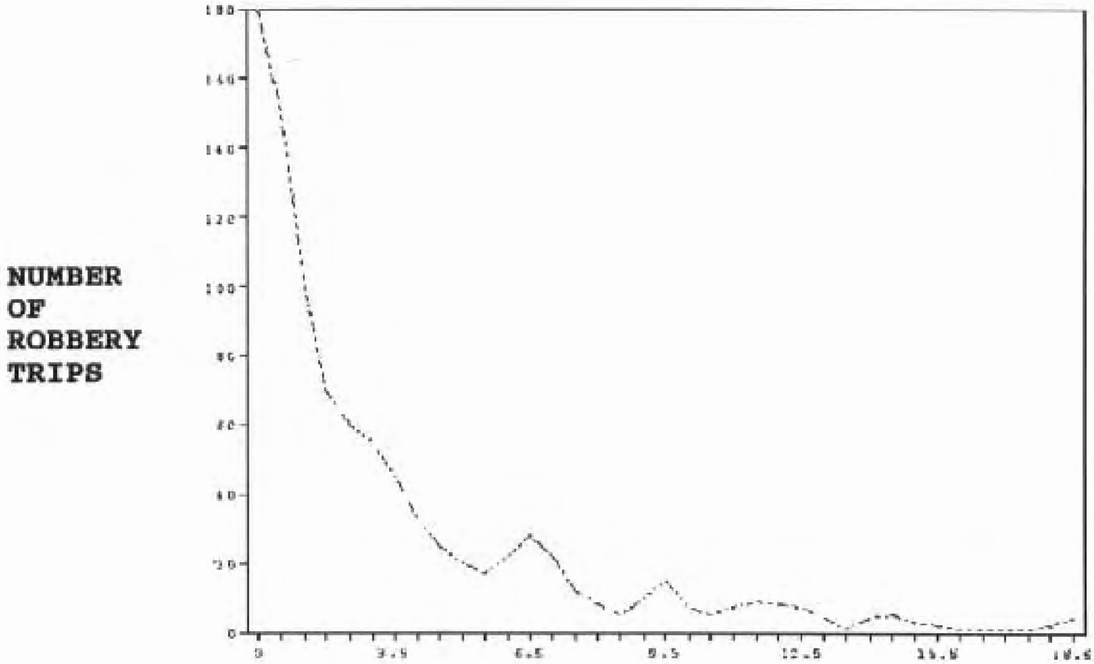
[3]Davidson 1981; Pyle, et al. 1974; and Stephenson 1974.

[4]Capone and Nichols, 1975; Capone and Nichols, 1976; Pyle, 1974; Rhodes and Conly, 1981; White, 1932.

and armed robbery, Capone and Nichols (1976) reached similar conclusions.

ROBBERY TRIPS AND DISTANCE
UNINCORPORATED DADE COUNTY, 1971



DISTANCE IN MILES
(Capone and Nichols 1975:47)

<u>Property Crimes vs. Violent Crimes</u>

Crimes against persons involves an area of study not found in crimes against property, the relationship of the offender and the victim. Offenders committing violent crime have been shown to travel shorter distances than property offenders[5] Davidson (1981:67) in *Crime and Environment* states that

> The distance traveled is indeed the expression of a complex interaction between the offender (his background, predispositions, knowledge, perceptions, etc.) and the target or victim (the risks, rewards, opportunities, attractions, etc.)

Bullock (1955:570) in analyzing urban homicides found that 32.8 percent of the assailants lived at the same address or within the same block as the victim. This lead him to conclude that conflicts were not only between members of the same race but also neighbors.

Le Beau (1987) in *Journey to Rape* addressed the issue of complex interaction of offender/target variables in analyzing the behavior of rapists in their approach to their victim. Le Beau (1987:135) found a distinct difference in the preferences of serial offenders and single offenders. The study concluded that the method of approach, rather than type of offender was more significant in predicting travel distance.

White's (1932) study of Indianapolis homicides clearly illustrates that property offenders travel longer distances to commit crimes than do violent crime offenders. Pyle et al.'s (1974) findings in Summit County address the longer travel distances in commission of property crimes. His research supported White's (1932) original travel distance

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[5]Capone and Nichols, 1975; Pope, 1980; and Pyle, et al., 1974. 1974.

findings. Phillips (1980:178) also reported supportive findings in Lexington-Fayette county stating that "Crimes against persons involve shorter journeys than crimes against property." Rhodes and Conly (1981:179) found that while 50 percent of rapes occurred within .5 miles, only 30 percent of burglaries and 25 percent of the robberies occurred within that distance.

Adult Offenders vs. Juvenile Offenders

The literature suggests younger offenders exhibited shorter travel distances. The authors attributed this behavior to juveniles having fewer criminal skills. Lack of the ability to dispose of certain types of property limited younger offenders to the theft of money or goods easily disposed of through personal contacts.[6] Younger offenders also demonstrated a healthier fear of the police and limited access to transportation (Reppetto, 1976:173). Reppetto (1976:173) concluded that younger burglars tend to work close to home, citing a housing project in which 81 percent of offenders arrested for burglary resided in the project.

Property Value

As noted earlier property crime has shown to relate to higher per capita incomes. The research has also indicated a relationship between the journey to crime and the value of property. Hakim's (1980:267) economic analysis of factors influencing travel distance, assumed the three following

[6]Phillips, 1980; Reppetto, 1976; and Stephenson, 1974.

costs that distance imposes on the criminal, thereby deterring long travel distances:

> (i) the explicit and implicit transportation cost (e.g. gasoline, car amortisation, and the value of the time spent on traveling) (ii) the risk of being identified as a stranger in a cohesive community; and (iii) the costs of becoming acquainted with the unfamiliar place in which the criminal plans to operate.

The literature supports the conclusion that areas with greater economic rewards are more attractive targets, and thus overcome the associated costs to the criminal. Pyle, et al. (1974:184) noted that offenders traveled seven times the average distance to burglarize high-income areas of Akron.

Capone and Nichols (1975, 1976) in two studies of Dade county drew similar conclusions concerning the motivation of income. Capone and Nichols (1975:46) found that "distance traveled by offenders is directly related to the value of property realized in the robbery." The research by Jarrell and Howsen (1990) supports these findings in regard to tourism as a form of economic opportunity. Tourism demonstrated a strong correlation to burglary, larceny and robbery, overcoming the deterrence Hakim (1980) identified (Jarrell and Howsen, 1990:489).

Of the literature reviewed, Pope (1980) presented the only research to dispute the relationship of property value and property crime. Unfortunately, Pope's analysis used a cross-tabulation format, which, did not include chi-square as a test for statistical significance. In addition, the distribution of data produced a number of cells with data sets too small to be significant in the analysis, rendering the research suspect.

Travel Distance

McIver (1980), in reviewing the literature on criminal mobility generalized the current findings on travel distance, noting that most crimes occur within one mile of the criminal's place of residence. While McIver's (1980) observations are in keeping with the distance decay phenomenon discussed previously, he oversimplified the issue with this observation. Table 3.1 provides data summarized from twelve studies on criminal mobility, several of which were not included in McIver's (1980) review. Reppetto (1976), Pope (1980), and Bullock (1955) present findings that generally support McIver's (1980) one mile premise. Nevertheless, findings reported by the other authors listed in Appendix 1 generally have mean averages greater than one mile.[7] Stephenson (1974) reported a mean travel distance of 4.69 miles in Phoenix, significantly greater than any other study.

SUMMARY OF ECOLOGICAL AND GEOGRAPHICAL LITERATURE

Ecological factors are generally referenced as causal factors, while the geographical literature attempts to

[7]From Appendix 1: Capone and Nichols, 1975; Capone and Nichols, 1976; Le Beau, 1987; Phillips, 1980; Pyle et al., 1974; Repetto, 1976, Rhodes and Conly, 1981; Stephenson, 1974; and White, 1932 for property crimes.

provide an understanding of the spatial distribution. It can be concluded that the two approaches cannot be totally separated in analysis of crime rates. Integration of ecological and geographical factors permeates the literature; Bullock (1955), while focusing on travel distances, also addressed population and socioeconomic factors; and Stephenson (1974) used sex, ethnic group, and age in his analysis of travel distances of juveniles.

Several conclusions can be drawn concerning the literature of the ecology and geography of crime. First, the research has been primarily limited to SMSA's, based on theories concerning socioeconomic impacts of crime. Brantingham and Brantingham (1980:93), as noted earlier, stated that the longest lasting and most consistent observation about crime is that recorded crime rates vary from city to city. The concentration on SMSA's has also been primarily in areas other than the Southwest, with the exception of Stephenson's (1974) study of Phoenix and Bullock's (1955) study of Houston.

Second, the research regarding SMSA's has addressed questions of either the central tendency of crime or the effect of crime on contiguous suburbs. The literature on travel distance appears to be biased toward densely populated areas, failing to address the effect SMSA's on non-contiguous incorporated municipalities. The distance decay phenomenon, since the distribution around the mean is

Table 3.1
Summary of Criminal Mobility Literature

AUTHOR	LOCATION	DATE OF STUDY DATA	TYPE OF CRIMINAL ACTIVITY	PRINCIPAL ACTIVITY	FINDINGS	
White (1932)	Indianapolis	1930	Felonies	Regression	CRIME	
					Against Person...........	0.84
					Rape..................	1.52
					Assault and Battery....	0.91
					Manslaughter...........	0.11
					Against Property.........	1.72
					Auto Banditry..........	3.43
					Embezzlement...........	2.79
					Robbery................	2.14
					Vehicle Taking.........	1.77
					Burglary...............	1.76
					Grand Larceny..........	1.53
					Obtaining Money Falsely	1.47
					Petit Larceny..........	1.42
Bullock (1955)	Houston	1945-1949	Homicide	Regression	57% occurred within .04 miles of offender's residence.	
Stephenson (1974)	Phoenix	1968	Juvenile delinquency	Descriptive Statistics	Mean distance traveled....	4.69
Capone & Nichols (1975)	Dade County	1971	Robbery	ANOVA	Robbery Mean..............	3.21
					Range.....................	.05 to 18.7
Pyle et al. (1974)	Summit County	1971	Felonies	Regression	CRIME	AVERAGE DISTANCE TRAVELED
					Homicide.................	1.76
					Rape.....................	1.34
					Aggravated Assault.......	1.29
					Unarmed Robbery..........	2.10
					Armed Robbery............	2.20
					Nonresidential Burglary..	2.34
					Residential Burglary.....	2.48
					Larceny..................	1.84

Table 3.1
Summary of Criminal Mobility Literature

AUTHOR	LOCATION	DATE OF STUDY DATA	TYPE OF CRIMINAL ACTIVITY	PRINCIPAL ACTIVITY	FINDINGS
Capone & Nichols (1976)	Dade County	1971	Armed & Unarmed Robbery	Holmogorous Smirnoff Test	33% Less than one mile 50% Less than two miles 66% Less than three miles 75% Less than five miles
Le Beau (1987)	San Diego, California	1971-1975	Rape	Chi-Square ANOVA	Single offenders mean..... 3.5 Serial offenders residence 1.77
Pope (1980)	6 California Jurisdictions	1972-1973	Burglary	Descriptive Statistics	52% within one mile of burglar's residence
Rhodes & Conly (1981)	District of Columbia	1974	Rape, Robbery, Burglary	Regression	MEAN DISTANCE Robbery.................. 2.10 Burglary................. 1.62 Rape..................... 1.15
Phillips (1980)	Lexington-Fayette Urban County, Kentucky	1974-1975	Felony & Misdemeanors	Descriptive Statistics	Mean for all crimes........ 1.43
Reppetto (1976)	Boston	1976	Robbery Burglary	Descriptive Statistics	Robbery : Mean distance traveled is 6 miles, 90% occur within 1.5 miles. Burglary : Mean distance traveled is 0.5 miles, 93% occurred within 1.5 miles.
Baker (1976)	Dayton	1982	All Crimes	Descriptive Statistics	Most crimes committed by neighborhood residents.

skewed by the preponderance of shorter travel distances, does not provide data on longer travel distances. Only Capone and Nichols (1975) presented a range of travel distances.

Third, as Table 3.1 illustrates, the majority of the research relating to the geography of criminal mobility is nearly twenty years old. The research reviewed concerning the ecology of crime was also found to be quite dated, with most of that research being published in the early 1980's. Worden's (1980) findings concerning the changing explanations of crime from 1960 to 1970 suggest that shifts in the American society cause an evolution in the factors effecting crime rates. Katzman (1980) supports this evolution when he suggested that the changing metropolitan structure contributes to the sub-urbanization of crime.

Fourth, literature concerning the effect of interstate highways on crime rates is limited. Hakim (1980), and Jarrell and Howsen (1990) were the only researchers that addressed the highway factor. Both studies used dummy variables for the interstate highway influence, finding positive correlations between crime rates and the cities location on the highway. Hakim (1980:275) found that

> Property crimes are 'imported' to wealthy, developed and commercially enriched communities which are located inclose proximity to the major urban areas and are easily accessible by highways.

Hakim's (1980) findings would suggest that bedroom communities, not contiguous to SMSA's might be a draw for criminals.

Although the research demonstrates the basis for inclusion of the population multiplier and property value multiplier in the campus security formula, the literature suggests new research is needed. The age of the literature and the limit research on interstate highways leads to the conclusion that the 5 airmiles, used to determine the population multiplier in the Campus Security Formula, needs to be reexamined. Methods of analysis found in the literature are now used to develop a methodology for examination of the three hypotheses stated in Chapter One.

CHAPTER FOUR

METHODOLOGY

This Chapter discusses the methodology used to test the three hypotheses introduced in Chapter One. Particular emphasis is given to the research design, since the statistical techniques used are new to the study of formula funding in Texas. How these statistical techniques were used in other research is reviewed to establish their credibility for this project. As with all statistical analysis, data limitations are addressed emphasizing how potential problems are controlled.

RESEARCH DESIGN

The research conducted in this project is a quasi-experimental design, since statistical controls are used in lieu of a control group. The data used in the study are existing data from the Texas Department of Public Safety Crime Reports. Correlation, simple regression, and multiple regression are used, as the statistical technique, to analyze the Campus Security Formula. Table 4.1 provides an overview of the theories associated with each hypothesis. The independent variables consist of elements of the campus security formula (HC, E, C, V). In addition a variable dealing with a campus' proximity to IH-35 in included. The dependent variables are types of crime rates (violent, property, and total). Table 4.1 also includes level of measurement for both the independent and dependent

TABLE 4.1
RESEARCH DESIGN

Hypothesis	Theory	Independent Variable	Level of Measurement	Dependent Variables (Ratio)	Type of Analysis	Statistical Output
One: Security Formula to Crime Rates	Administrative Question	Per Capita Funding	Ratio	Violent Crime/M Property Crime/M Total Crime/M	Simple Regression	r r^2 t-test F-test
Two: Formula Factors to Crime Rates	Population (Harries 1974) Property Value Boggs 1966, Hakim 1980)	Student Enrollment (HC) Number of Employees (E) Population Multiplier (C) Property Value Multiplier (V)	Ratio Ratio Ordinal Interval	Violent Crime/M Property Crime/M Total Crime/M	Simple and Multiple Regression Correlation Matrix	r r^2 t-test F-test
Three: IH 35 to Crime Rates	Transient Crime (Jarrell and Howsen 1990)	HC, E, C, and V Dummy variable for IH 35	Interval	Violent Crime/M Property Crime/M Total Crime/M	Multiple Regression Correlation Matrix	r r^2 t-test F-test

variables.

Model

The use of regression analysis allows the hypotheses to be tested by determining the correlation or effect of each independent variable on the dependent variables. Table 4.2 shows the expected relationship, as would be predicted from the literature examined in Chapter Three. These expected relationships are illustrated as follows:

CR = f(PCF, PCE, HC, E, C, V, IH35)

The results are then used to determine the appropriateness of each of the elements used in the Campus Security Formula.

Independent Variables

The existing data used includes the entire population of colleges and universities funded through the Campus Security Formula of Coordinating Board, Texas College and University System. The population under study contains a total of thirty institutions, ranging in size from Texas A&M University at Galveston (524 students) to the University of Texas at Austin (46,140) in Fall of 1986. The individual colleges and universities are the unit of analysis (Appendix 1).

Two separate sets of data were analyzed for the 1988-89 and 1990-91 Texas Legislative Bienniums. The independent variables used to analyze the Campus Security Formula are shown in Table 4.2. They are Per Capita Funding, Per Capita Expenditures, Student Enrollment, Number of Employees, Population Multiplier, Property Value Multiplier and Interstate Highway 35. All data for the independent variables were supplied by the Coordinating Board Staff, except the location of universities located along IH 35. This information was obtained from the Texas Department of Transportation County Maps.

As was illustrated in Table 4.1 all of the variables are interval/ratio except the population multiplier and IH 35. The population multiplier, although it appears to be interval, does not have continuous intervals. Nevertheless, it is treated as interval for the purposes of this project. IH 35 is represented as a dummy variable. The Per Capita Expenditures variable is actually composed of expenditures for the first Fiscal Year of each study period and budgeted funds for the second year. The Coordinating Board Staff was unable to supply expenditures for both years and felt budget totals provided a close approximation.

Dependent Variables

The dependent variables used for the study were Violent Crime Rate per Thousand, Property Crime Rate per Thousand, and Total Crime Rate per Thousand for each institution. Crime rates were supplied by the Texas Department of Public Safety. Violent Crime is comprised of murder, rape, assault, and robbery. Property Crime consists of larceny, burglary, and auto theft. The original intent of the study was to regress each of the seven crimes against the

TABLE 4.2
INDEPENDENT VARIABLES

VARIABLE	EXPECTED RELATIONSHIP	DESCRIPTION	CODING FORMAT
Per Capita Funding	Negative	Formula $ per total head count (HC+E)	$/(HC+E)
Per Capita Expenditures	Positive	Expenditures per total head count (HC+E)	$/(HC+E)
Student Enrollment (HC)	Positive	Fall Student Enrollment	Actual Head Count
Number of Employees (E)	Positive	Total Faculty and Staff	Actual Number of Employees
Population Multiplier (C)	Positive	Numerical Multiplier determined by Local Population	Actual Formula Factor
Property Value Multiplier (V)	Positive	Numerical Multiplier determined by Property Value Ratio	Actual Formula Factor
Interstate Highway 35	Positive	Schools located within 5 air miles of IH35	0/1

* Relationship to Crime Rates per thousand

independent variables, however, large numbers of zeros in the violent crime categories would have yielded spurious results. Hence, the crime statistics were grouped into violent crime, property crime, and total crime categories. All three categories of crimes were divided by the sum of the Student Enrollment (HC) and Numbers of Employees (E) to yield the count per thousand.

<u>Research Strategy</u>

Correlation Matrix

Prior to performing the simple and multiple regression analysis a correlation matrix of the independent variables was prepared to test for multicollinearity.

Hypothesis One

Correlation of the Per Capita Funding and Per Capita Expenditures to campus crime rates was tested using simple regression. Each of the three dependent variables was independently entered in the regression equation against the two funding variables.

Hypothesis Two

Correlation of the variables representing the elements of the Campus Security Formula to campus crime rates were tested using multiple regression. Each of the three dependent variables was independently entered in the multiple regression equation containing the four independent variables, HC, E, C, and V.

Hypothesis Three

The residual variance explained by IH35 was then tested by adding the IH35 dummy variable to the equation used to test Hypothesis Two. Regressions using the same three dependent variables were performed.

REGRESSION ANALYSIS IN CRIMINOLOGICAL RESEARCH

Regression analysis is used extensively in criminological research. Of the articles reviewed in Chapter Three, eight of the twenty-four researchers employed some form of regression analysis and used existing crime statistics as data. Table 4.3 lists these articles by author with the statistical tests presented to support the authors conclusions. The complexity of these applications varied. Jarrel and Howsen (1990:485) used the

TABLE 4.3

RESEARCH UTILIZING MULTIPLE REGRESSION ANALYSIS

AUTHOR	DATA SOURCE	YEAR	STATISTICAL OUTPUT REPORTED
Brantingham and Brantingham	Crime Statistics	1980	Correlation Coefficient, R, R-squared
Bullock	Crime Statistics	1955	Correlation Coefficient
Crutchfield, et al.	Crime Statistics	1982	Standard Regression Coefficient, R, R-squared
Hakim	Crime Statistics	1980	Correlation Coefficient, Intercept, t-value, F-value, R-squared
Jarrel and Howsen	Crime Statistics	1990	Intercept, t-value, p-values
Katzman	Crime Statistics	1980	Beta Coefficients, F-value, R-squared
Rhodes and Conly	Crime Statistics	1981	Regression Coefficient, Standard Error, Intercept
Worden	Crime Statistics	1980	Intercept, b(slope), R-squared

most complex model containing twenty-eight variables.

Bieber (1988:1) warns that multiple regression may be over utilized by behavioral and social scientist. He points out that over the past 10 years that changes in research methodologies and experimental designs has resulted in the use of more complex models (Bieber 1988:1). This increased complexity has lead to "two undesirable consequences: (1) solutions are more difficult to interpret, and (2) they have a greater likelihood of messy inter-variable relationships, that is multicollinearity" (Bieber 1988:1)

Nonetheless, the use of regression for analysis of the Campus Security Formula is appropriate. First, the research conducted requires analysis of the relationship between multiple predicator and criterion variables. Second, the literature describes formula budgets as linear in nature (Moss 1976:543). Linearity fits one of the primary requirements of multiple regression since the regression formula describes a straight line. Finally, the data used in this research are continuous interval level or can be treated as such. The linearity of regression analysis and the need for continuous interval level data are supported by Bieber (1988:4). This particular study is also relatively simple in comparison to the articles listed in Table 4.3 eliminating Bieber's (1988:1) objections to complexity and interpretation of results.

DATA CONSTRAINTS OF REGRESSION ANALYSIS

DeLeonardi and Curtis (1992:112-113) state that multiple regression analysis must meet five assumptions if use of the technique is to be appropriate. In addition, multicollinearity is also a threat to multiple regression and is discussed (DiLeonardi and Curtis 1992:126). The first of Dileonardi and Curtis' five assumptions is the need for interval-level data.

Interval-level Data

The first assumption is that the level of measurement for the data must be continuous interval/ratio (DiLeonardi and Curtis 1992:113). The robust view of regression analysis allows that ordinal data which can be represented in an interval fashion can be utilized in a regression equation. The use of dummy variables in regression equations (representing the value of a ordinal variable as a 1 or 0) is an example of this technique. As discussed in the Research Design all of the variables meet this criteria or can be used as interval level data effectively.

Linearity

The regression equation is based on the relationship of the criterion and predictor variable approximating a straight line. This second assumption requires that when data is graphed on a scattergram that the data points form a linear relationship. If the data points fail to define a visible linear relationship or have a curvilinear relationship then the technique may not be appropriate (DeLeonardi and Curtis 1992:114). The description, in the literature, of formula funding as linear, suggests regression is an appropriate test. The multiple correlation coefficient (r^2) is used to measure the fit of the line described by the regression equation and is utilized in this study (Hy, et al., 1983:302).

<u>Homoskedasticity</u>

The third assumption, homoskedasticity, requires that when plotted data points have an approximately even distribution along a straight line. If the plot tends to scatter as it nears or moves away from the point of origin then heteroskedasticity exists. This is caused by the variance increasing or decreasing along the line. DeLeonardi and Curtis (1992:118) state that a certain amount of inconsistency is to be expected. This phenomenon can only be detected through the use of scattergrams. Scattergrams were run for all variables individually to examine this effect prior to performing multiple regression.

<u>Correlation with Error</u>

The fourth assumption is that the independent variable must not correlate with the sampling error. This can occur if a weak, but significant result is misinterpreted. Protecting against this is done by setting expected significance levels at a point appropriate for the sample size or increasing the size of the sample. Control of correlation of error has been achieved by examining the F-test at three different significance levels.

Normal Distribution

The normal distribution assumes that all values of all the variables is normally distributed. DiLeonardi and Curtis state that this fifth assumption is the most robust of the factors, if the sample is over 100 cases (1992:119). Unfortunately, the limited population does not provide the size necessary to meet this requirement. Therefore, there is some threat to reliability. Again, as with correlation with error, examining data at three different significance levels reduces the risk from this threat.

Multicollinearity

Another factor that was considered in the research design was multicollinearity. Multicollinearity exists when two or more of the independent variables are strongly correlated. This condition affects the variances and thus the results (DeLeonardi and Curtis 1912:126). Multicollinearity was controlled by running a correlation matrix for independent variables and checking for strong correlations. High correlation between independent variables can be correct by dropping one of the variables from the analysis (Hy, et al. 1983:315)

In Chapter Five findings of the research are discussed. This includes a review of the methods used to interpret the data and presentation of the statistical test results.

CHAPTER FIVE

ANALYSIS OF FINDINGS

This chapter examines the relationship between elements of the Campus Security Formula and crime rates. Statistical results presented in this chapter provide the foundation needed to accept or reject the Hypotheses presented in Chapter One. Interpretation of the statistical output is discussed emphasizing the methods used to interpret the results. The results of the simple regression are presented only as significance levels, while more detailed information is provided for the multiple regression analysis.

INTERPRETATION OF REGRESSION ANALYSIS

Earlier discussions have stated that regression analysis is a linear function. Regression analysis therefore describes a straight line using the following formula:

$$Y = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n$$

where X represents the independent variables and Y represents the predicted values of the dependent variable (Hy, et al. 1983:288). The straight line is identified by the values of b_0 and b_n, b_0 is the intercept and b_n is the regression coefficient or slope of the line (Hy, et al. 1983:288). The significance of regression coefficient is its predictive capabilities. If the regression equation is significant then a change in the regression coefficient can be used to predict the value of the dependent variable *Y*.

The regression coefficient can also be represented by beta (*B*), in multiple regression, which is referred to as the standardized coefficient (Hy, et al. 1983:301). Using beta and the independent variables the following equation is derived for the Campus Security Formula elements:

$$CR = B_0 + B_1HC + B_2E + B_3C + B_4V$$

Since the beta coefficient is standardized through standardization of the variables, beta coefficients in the same formula can be compared directly to "determine the relative importance of the independent variable in terms of their effects on the dependent variable" (Hy, et al. 1983:300-1). The beta coefficient is used in this analysis since comparison of the relative importance of the variables has more value than the ability to predict crime rates, which is not the purpose of the Campus Security Formula. Standardization of beta is achieved through the software used in the analysis.

Significance Levels

Brown (1989:116) warns that the probability of falsely accepting or rejecting a hypothesis is in part a function of sample size. The total number (n) of cases analyzed, based on the crime data available, was 24 for FY 88-89 and 29 for FY 90-91. The size of n for this study falls below the recommended ten cases per variable needed for the multiple regression present in Hypothesis Two and Three (DiLeonardi and Curtis 1992:129). Follow up analysis was performed to satisfy this concern. Brown's concerns are addressed by presenting significance at three levels, $p < .01$, $p < .05$, and $p < .10$.

Significance of the relationships is tested by examining the confidence level (p) and coefficient of determination (r^2) (Hy, et al. 1983:303). The p-value, which is based on the Student's T-test, is easily understood since its values range from .000 to 1.00, $p < .05$ is generally being interpreted as mildly significant. The Student's T-test is used to compare the means of two samples (DiLeonardi and Curtis 1992:70). Interpretation of r^2 is also relatively easy to understand, its values can range from .00 to +1.00 and represents the percentage of the variation explained by each variable (Hy, et al. 1983:302).

The correlation coefficient (r) is used to determine the strength of the relationship between two variables. The range of values for r is -1.00 to +1.00, with the strength of the relationship increasing as it approaches 1.00 (Hy, et al. 1983:284). The sign (-,+) indicates the direction of the relationship, that is, whether the relationship is a positive or negative.

ANALYSIS OF OUTPUT STATISTICS

Correlation Matrix

Analysis of data was conducted with both single and multiple regression analysis. However, as Bieber (1988) suggests the problem of multicollinearity must be dealt with first. Therefore, a correlation matrix (Table 5.1) was run for all independent variables to be used in the analysis, for both study periods. Hy, et al. (1983:314) states that multicollinearity need only be eliminated when variables are strongly correlated (>± .700). Results shown in Table 5.1 indicate only one set of variables which present a problem of the multiple regression analysis, Student Enrollment (HC) and Number of Employees (E) with a correlation of .919. This relationship would be expected since universities strive for predictable student/faculty ratios. More is said about this later in the chapter.

Simple Regression Analysis

The literature suggests that certain variables used in the Campus Security Formula should have a positive relationship to crime rates. Population of the campus, as defined by Student Enrollment and Number of Employees, the Population Multiplier and Property Value Multiplier, would be expected to exhibit a positive correlation to crime rates. It would also be expected that Funding per Capita and Expenditures per Capita would correlate positively if the factors above produced significant results.

DiLeonardi and Curtis (1992:77) suggest beginning with "all-by-all" analysis or testing all independent relationships first. This technique was therefore used to

Table 5.1
Correlation Matrix
Strength of Interrelations of Study Variables

	FY88 THROUGH FY89 n = 24						
	FC	EX	HC	E	C	V	IH35
FC	1.00	.973	-.249	-.139	.074	.568	-.151
EX	.973	1.00	-.270	-.133	.002	.618	-.270
HC	-.249	-.270	1.00	.917	.264	-.138	.141
E	-.139	-.133	.917	1.00	.175	-.023	-.022
C	.074	.002	.264	.175	1.00	.352	-.249
V	.568	.618	-.138	-.023	.352	1.00	-.191
IH35	-.151	-.089	.141	-.022	-.249	-.191	1.00
	FY90 THROUGH FY91 n = 29						
	FC	EX	HC	E	C	V	IH35
FC	1.00	.922 *	-.245	-.148	.129	.727 **	-.174
EX	.922 *	1.00	-.244	-.122	-.009	.760 **	.075
HC	-.245	-.244	1.00	.919	.192	-.121	.157
E	-.148	-.122	.919	1.00	.099	-.031	.003
C	.129	-.009	.192	.099	1.00	.256	-.254
V	.727	.760	-.121	-.031	.256	1.00	-.211
IH35	-.174	-.075	.157	.003	-.254	-.211	1.00

p = based on t-value
Significance * $p < .01$ ** $p < .05$ *** $p < .1$

Table 5.2
Simple Regression Probability That Crime Rates Per Thousand Are Related To Independent Variables

FY88 THROUGH FY89 n = 24			
	VIOLENT CRIME PER THROUSAND	PROPERTY CRIME PER THOUSAND	TOTAL CRIME PER THOUSAND
FUNDING PER CAPITA (FC)	-.120	-.317	-.325
EXPENDITURES PER CAPITA (EX)	-.140	-.333	-.342
STUDENT ENROLLENT (HC)	-.231	.316	.303
NUMBER OF EMPLOYEES (E)	-.193	.001	.001
POPULATION MULTIPLIER (C)	.955	-.345 ***	-.361 ***
PROPERTY VALUE MULTIPLIER (V)	.022	-.239	-.239
INTERSTATE HIGHWAY 35 (IH35)	-.114	.151	.144
FY90 THROUGH FY91 n = 29			
	VIOLENT CRIME PER THOUSAND	PROPERTY CRIME PER THOUSAND	TOTAL CRIME PER THOUSAND
FUNDING PER CAPITA (FC)	-.193	-.388 **	-.389 **
EXPENDITURES PER CAPTIA (FC)	.009	-.246	-.236
STUDET ENROLLMENT (HC)	-.198	.226	.204
NUMBER OF EMPLOYEES (E)	-.190	.002	.002
POPULATION MULTIPLIER (C)	-.150	-.147	-.153
PROPERTY VALUE MULTIPLIER (V)	.256	-.028	-.007
INTERSTATE HIGHWAY 35 (IH35)	-.045	-.005	-.008

p = based on t-value
Significance * $p < .01$ ** $p < .05$ *** $p < .1$

determine relationships of the independent variables to crime rates prior to running multiple regression equations. Table 5.2 contains beta coefficients for each of the simple regressions performed.

This analysis yielded only on two significant relationships. The Population Multiplier demonstrated a slight negative relationship to Property Crime per Thousand and Total Crime per Thousand in FY 88-89. It is important to note that the sign of the beta coefficient is negative, when based on the literature the expected relationship should have been positive. Also the confidence level was only $p < .10$ indicating a weak relationship. The second relationship showing significance was Funding per Capita to Property Crime per Thousand and Total Crime per Thousand in FY 90-91. Hypothesis One predicted a positive relationship between Crime rates and funding. Again note the sign of the beta coefficient, indicating a negative relationship between these variables.

All other independent variables tested showed no significant relationship to the crime rate dependent variables.

Multiple Regression

Campus Security Formula Elements

As discussed in the Chapter Four, the four independent variables representing the Campus Security Formula elements were regressed against the three crime rate variables. The results, however, did not correspond with the simple regression. The combination of elements had better predictive abilities in FY 88-89 than the elements demonstrated individually. Unfortunately, the two study periods did not both yield significant results. Neither the single variable nor the sum of the variables were significant in explaining Violent Crime, Property Crime, and Total Crime in FY 90-91.

Table 5.3 provides the statistical output for both equations. The FY 88-89 equation produce three variables demonstrating some level of significance. Student Enrollment was the most significant with a confidence level of $p < .01$ for both Property Crime per Thousand and Total Crime per Thousand. The beta coefficient predicted a positive increase for property crime and total crime with increasing enrollment.

The other two variables showing significance were the Number of Employees and the Population Multiplier, both with confidence levels in the $p < .05$ range. Surprisingly, the relationship was negative for both of these variables rather than positive as predicted in Chapter Four.

The equations with Property Crime Per Thousand and Total Crime per Thousand for FY 88-89 showed an r^2 of .433 and .436 respectively indicating that 43 per cent of the variance in crime per thousand is explained by the variables in the equation.

Table 5.3
Probability that Campus Crimes Can be Predicted by Head Count, Employees Count, Population Multiplier and Property Value Multiplier

FY88 THROUGH FY89 n = 24								
	Intercept	Student Enrollment (HC)	Number of Employees (E)	Population Multiplier (C)	Property Value Multiplier (V)	F-Value	R-Squared	P(Significance) of equation
Violent Crime per thousand	.684	-.062	-.099	-.326	.135	.736	.134	.5788
Property Crime per thousand	36.851	1.438 *	-1.091 **	-.545 **	-.545	3.630 **	.433	.0233
Total Crime per thousand	38.041	1.431 *	-1.094 **	-.560 **	.611	3.678 **	.436	.0222
FY90 THROUGH FY91 n = 29								
	Intercept	Student Enrollment (HC)	Number of Employees (E)	Population Multiplier (C)	Property Value Multiplier (V)	F-Value	R-Squared	P(Significance) of equation
Violent Crime per thousand	-4.310	.217	-.352	-.242	.333	1.020	.145	.4172
Property Crime per thousand	15.675	.638	-.378	-.259	.111	.756	.112	.5628
Total Crime per thousand	11.365	.632	-.392	-.269	.133	.720	.07	.5865

p - Based on t-value
Significance * p < .01 ** p < .05 *** p < .1

Table 5.4
Probability that Campus Crimes
Can be Predicted by
Head Count, Employees Count, Population Multiplier
and Property Value Multiplier and Interstate Highway

FY89 THROUGH FY89 n = 24									
	Intercept	Student Enrollment (HC)	Number of Employees (E)	Population Multiplier (C)	Property Value Multiplier (V)	IH35	F-Value	R-Squared	P(Significance) of Equation
Violent Crime per thousand	.843	.278	-.411	-.448	.162	-.267	.809	.183	.5584
Property crime per thousand	39.539	1.788 *	-1.413 **	-.670 *	.147	-.275	3.400 **	.486	.0245
Total Crime per thousand	40.856	1.800 *	-1.433 **	-.692 *	.153	-.289	3.522	.495	.0214
FY90 THROUGH FY91 n = 28									
	Intercept	Student Enrollment (HC)	Number of Employees (E)	Population Multiplier (C)	Property Value Multiplier (V)	IH 35	F-Value	R-Squared	P(Significance) of equation
Violent Crime per thousand	-4.092	.334	-.456	-.278	.333	-.095	.822	.152	.5466
Property Crime per thousand	21.584	.887	-.600	-.338	.112	-.203	.758	.142	.5889
Total Crime per thousand	17.491	.882	-.614	-.347	.133	-.203	.728	.137	.6098

p - Based on t-value
Significance * $p < .01$ ** $p < .05$ *** $p < .1$

Table 5.5
Multiple Regression of Crime Rates with Head Count and Population Multiplier

FY88 THROUGH FY89 n = 24						
	Intercept	Student Enrollment (HC)	Population Multiplier (C)	F-Value	R-Squared	P(Significance) of Equation
Violent Crime per thousand	2.552	-.179	-.265	1.444	.121	.2584
Property Crime per thousand	64.769	.400 **	-.425 **	3.949 **	.273	.0350
Total Crime per thousand	67.174	.389 ***	-.438 **	4.001 **	.276	.0337
FY90 THROUGH FY91 n = 29						
	Intercept	Student Enrollment (HC)	Population Multiplier (C)	F-Value	R-Squared	P(Significance) of Equation
Violent Crime per thousand	2.277	-.176	-.117	.718	.052	.4973
Property Crime per thousand	43.191	.264	-.197	1.265	.089	.2992
Total Crime per thousand	45.468	.241	-.199	1.123	.080	.3405

p - Based on t-value
Significance * p < .01 ** p < .05 *** p < .1

The FY 90-91 data yielded no significant results for any of the variables.

Interstate Highway 35

The multiple regression equations run in the above analysis were then recomputed adding the IH 35 variable. The IH 35 variable showed no significance in any of the equations.

SUPPLEMENTARY TEST OF SIGNIFICANCE

Analysis of the Campus Security Formula was undertaken not only to answer the questions in the three hypotheses, but to suggest modifications to the Formula. In order to meet this need, the question of multicollinearity must be addressed. Hy, et al. (1983:313) suggests that when variables are strongly correlated that one variable simply be dropped from the equation. I also felt it logical that an equation be tested without the variables that failed in all tests to show significance.

Therefore another set of equations were computed using only Student Enrollment and the Population Multiplier as the independent variables. Both variables remained significant for the FY 88-89 study period, although the strength of the relationship dropped slightly. Regressed against Property Crime per Thousand, they were both significant at the $p < .05$ confidence level, and against Total Crime per Thousand Student Enrollment was significant at $p < .10$ and the Population Multiplier at $p < .05$. Again it should be noted that the Population Multiplier exhibits a negative direction. Thus, the analysis suggests that Per Capita Crime drops as the Population Multiplier (C) increases, making it suspect as a valid element in the Campus Security Formula. Neither of the variables showed significance during the FY 90-91 study period.

The next chapter draws conclusions concerning the hypotheses and makes recommendations concerning the Campus Security Formula elements to the Formula Study Committee.

CHAPTER SIX

CONCLUSIONS AND SUMMARY

Chapter Six reviews the results presented in Chapter Five drawing conclusions as to whether the three hypotheses were supported. More importantly, this chapter discusses the implications of the findings relating to the Campus Security Formula. It also includes recommendations to the Formula Study Committee on the suitability of the formula elements.

Prior to addressing conclusions drawn from this study the validity of crime statistics as reported in the *Uniform Crime Report* should be addressed. As the Formula Advisory Committee observed there are anomalies in the crime data for the various universities, and not all universities have been reporting crime data (Committee 1991). These issues are also voiced in the literature concerning the validity of the *Uniform Crime Reports* (UCR).

Nevertheless, Skogan's (1974:32) concluded that measurement errors in the UCR do not necessarily lead to false conclusions. UCR also appears to be provide more valid measures of the incident of rape and aggravated assault than do victimization surveys (Menard and Covey 1988:373). This is significant since rape is one of the primary concerns of University administrators. The only way to address the variation in crime rates at Southwest Texas State University, Stephen F. Austin, and Prairie View would be to undertake a comparative analysis of the crime reports on various university campuses, which is beyond the scope of this study.

CONCLUSIONS

Hypothesis One

The analysis of the data leads to the rejection of Hypothesis One, no positive correlation were found between Formula Funding levels and Crime Rates per Thousand. In fact, during the FY 90-91 study period there was a negative relationship between Property Crime per Thousand and Total Crime per Thousand. The variable Expenditures per Capita was examined purely as an administrative question to test if supplemental funding by the universities was a better predictor of crime on campuses and no relationship was found between these variables.

Hypothesis Two

Hypothesis Two supported only one variable, Student Enrollment, and this result occurred only in FY 88-89. The research Hypothesis were rejected for all other variables. Nevertheless, the Number of Employees and the Population Multiplier did show significant relationship to the crime rate dependent variables in FY 88-89, but the relationship was negative rather than positive.

Hypothesis Three

Hypothesis Three was not supported, as no relationship was found between crime rate dependent variables and

Interstate Highway 35.

IMPLICATIONS FOR THE FORMULA STUDY COMMITTEE

Number of Employees

In data from both bienniums a strong correlation existed between Student Enrollment and Number of Employees. Although not significant in both bienniums a negative relationship was exhibited between Number of Employees and crime rates. These two factors combined suggests that the Number of Employees could be dropped from the formula without drastically altering its validity.

Student Enrollment

The Student Enrollment variable is a better predicator of crime rates when used with the Population Multiplier. But, the use of Student Enrollment alone does not appear to be a recommended option since, in the simple regression tests, Student Enrollment showed no relationship to the crime rate dependent variables.

Also, it should be considered that the strong showing of Student Enrollment occurred with data from five schools missing. Statistically this would suggest the FY 90-91 data has more meaning than the significance found in the relationship in FY 88-89. However, from an administrative perspective, and considering no better data exist at this time, the use of the Student Enrollment variables remain the strongest alternative available to the Committee.

Population Multiplier

The Population Multiplier produced the most perplexing results of the four variables. Its relationship to crime rates was almost as strong as Student Enrollment, unfortunately, as stated earlier, the relationship is negative in both biennium. The literature suggests that its relationship should be positive. One explanation might be that the additional funding has actually lowered the crime rate on some campuses. Another explanation is that the crime data anomalies discussed earlier in this chapter are correct. Thus suggesting either improved reporting is needed, or additional funding is required for certain institutions.

The confidence levels for data in FY 88-89 indicate that it may have value as a predicator. However, the Population Multiplier also failed to show significance in FY 90-91. It may be possible that the extension of the radius to 35 miles would produce the desired effect, but this cannot be determined without further research.

Property Value Multiplier

The committee's 1989 and 1991 recommendations to eliminate the Property Value Multiplier are strongly supported by the results of this study. The Property Value Multiplier was not found to be significant in any of the tests.

FUTURE RESEARCH

Several questions remain, that if addressed would provide additional data to assist the Campus Security Formula Study Committee. First, the comparison of crime reporting standards and actual crime reports, for the colleges and Universities under the Coordinating Board, would answer the question posed by the Committee and validate this study. Second, extending this study to the FY 92-93 biennium would again help validate this research. Third, additional research on the relationship of IH 35 to crime rates seems warranted since the number of institutions on IH 35 was so small, it did not provide an adequate sample.

APPENDIX I

Texas Higher Education Coordinating Board

RECOMMENDED FORMULA
FOR
CAMPUS SECURITY

Public Senior Colleges and Universities
1990-91 Biennium

For Fiscal year 1990

$26.93 (HC + E) x C x V

For Fiscal year 1991

$28.06 (HC + E) x C x V

Definitions of terms used in the formula:

1. HC is the Fall Semester 1988 headcount enrollment.

2. E is the number of active employees as of October 31, 1988, for whom the institution is required to make a contribution under Article 3.50 of the Texas Insurance Code.

3. C is a population factor of institutions located in, or adjoining, large metropolitan areas. The value of C is according to the following table:

Population	C Value
0 - 50,000	1.00
50,001 - 100,000	1.04
100,001 - 200,000	1.08
200,001 - 300,000	1.12
300,001 - 600,000	1.30
600,001 - 1,000,000	1.40
1,000,001 - 1,500,000	1.50
1,500,001 - and above	1.60

The appropriate population for each institution shall be based on the 1980 report of the U.S. Bureau of the Census of all incorporated communities (cities and towns) which have a boundary either enclosing the central campus or within five air miles of the central campus boundary (as determined by the official county map of the Texas State Highway Department), including the most reliable data on cities across the Mexican border, where applicable.

4. V is a property value factor for institutions which have a high value campus (i.e., a campus which significantly exceeds the average value per square footage. V is determined by the following table:

RCB ÷ TRCB GSF TGSF	"V" Value
0.00 to 1.05	1.00
1.06 to 1.10	1.05
1.11 to 1.15	1.10
1.16 to 1.20	1.15
1.21 to 1.25	1.20
1.26 and up	1.25

RCB is the August 31, 1989 replacement cost of buildings for the institution as calculated in the Building Maintenance Formula recommended by the Coordinating Board.

GSF is the gross square feet (outside dimensions) of educational, general and service buildings completed and carried on the books of the institution as of August 31, 1989, as calculated in the Custodial Services Formula recommended by the Coordinating Board.

TRCB is the total RCB for all colleges and universities as of August 31, 1989.

TGSF is the total GSF for all colleges and universities as of August 31, 1989.

NOTES:

1. Minimum of $151,600 for fiscal year 1990, and $158,000 for fiscal year 1991.

2. If the appropriated rates of increase for 1990 and 1991 are different than the recommended rates shown above, the minimum amounts recommended should be adjusted proportionately.

3. Prairie View A & M Nursing School at Houston, Texas Woman's University Nursing Schools at Dallas and Houston, Pan American University at Brownsville, East Texas State University at Texarkana, Laredo State University, and the University of Houston-Victoria shall request funding on the basis of need.

APPENDIX II
DEMOGRAPHIC DATA

UNIVERSITY	STUDENT ENROLLMENT (HC) FY 88-89	STUDENT ENROLLMENT (HC) FY 90-91	NUMBER OF EMPLOYEES (E) FY 88-89	NUMBER OF EMPLOYEES (E) FY 90-91
East Tx St Univ	6921	7289	725	716
Lamar Univ	11592	11828	1372	1030
Midwestern St.	4382	5340	341	369
North Tx St Univ	21271	24498	2098	2210
Pan American Univ	8903	11212	739	845
Stephen F Austin	2238	12573	1066	1072
Praire View A&M	4499	5640	844	826
Tarleton St Univ	4636	5667	436	480
Texas A&M Univ	34940	37485	8662	8977
Texas A&M Galveston	524	742	165	191
Tx Southern Univ	6983	8538	912	988
Angelo St Univ	5801	6333	489	471
Sam Houston St Univ	10486	1153	847	874
SWTSU	19775	2050	1442	1522
Sul Ross St Univ	1831	1784	284	271
Texas Tech Univ	23470	24605	3118	3161
Texas Woman's	7950	8816	1078	1019
UT Arlington	23245	23383	2519	2027
UT Austin	46140	50107	11587	9377
UT Dallas	7324	7667	1377	1047
UT El Paso	13753	14971	1521	1421
UT Permian	1822	2132	250	211
UT San Antonio	12413	13134	997	1171
UT Tyler	3642	385	306	333
UH Univ Park	29042	30372	3964	3466
UH Dowtown	7255	7408	305	395
UH Clear Lake	6691	7196	502	651
Corpus Christi	3813	4046	326	324
Tx A&I Univ	5012	5800	615	784
West Tx St Univ	3028	5756	866	712

APPENDIX III-A
FUNDING DATA

UNIVERSITY	CERTIFIED FORMULA FUNDS FY88	FY89	FY90	FY91
East Tx St Univ	189697	197266	215575	224620
Lamar Univ	347367	361228	392666	409142
Midwestern St.	139600	145200	167888	174932
North Tx St Univ	579784	602920	719246	749426
Pan American Univ	258355	268664	350671	365385
Stephen F Austin	327591	340663	367460	382879
Praire View A&M	165699	172311	200249	208651
Tarleton St Univ	139600	145200	165539	172485
Texas A&M Univ	1166861	1213423	1348239	1404812
Texas A&M Galveston	139600	145200	151600	158000
Tx Southern Univ	391749	407382	472025	491831
Angelo St Univ	162297	168773	190561	198557
Sam Houston St Univ	281171	292391	334875	348926
SWTSU	526393	547398	593187	618078
Sul Ross St Univ	139600	145200	151600	158000
Texas Tech Univ	712420	740848	807557	841443
Texas Woman's	223984	232922	264857	275970
UT Arlington	894886	930595	958008	998206
UT Austin	2048055	2129779	2290723	2386843
UT Dallas	302220	314280	352002	366772
UT El Paso	568421	591103	662115	689939
UT Permian	139600	145200	151600	158000
UT San Antonio	465782	484369	539327	561958
UT Tyler	139600	145200	151600	158000
UH Univ Park	1441226	1498736	1603813	1671110
UH Dowtown	360122	374492	386648	402872
UH Clear Lake	314086	326619	355017	369914
Corpus Cristi	139600	145200	151600	158000
Tx A&I Univ	139605	145200	171921	179135
West Tx St Univ	171040	177865	174183	181492

APPENDIX III-B
FUNDING DATA

	EXPENDITURES			
UNIVERSITY	FY88	FY89 *	FY90	FY91 *
East Tx St Univ	242336	267966	266762	280516
Lamar Univ	316466	294246	313819	33868
Midwestern St.	118584	123648	135078	112752
North Tx St Univ	472849	481130	494251	599175
Pan American Univ	230971	269648	305224	354105
Stephen F Austin	340892	340363	352128	359290
Praire View A&M	319638	361422	450090	485445
Tarleton St Univ	129456	141268	158910	166873
Texas A&M Univ	1040327	1126640	157481	1286290
Texas A&M Galveston	166826	173321	169201	173778
Tx Southern Univ	397292	455672	533539	544427
Angelo St Univ	143448	148091	162012	166663
Sam Houston St Univ	256062	257776	276545	282053
SWTSU	499113	489191	509116	541807
Sul Ross St Univ	135859	14427	146721	146817
Texas Tech Univ	579386	619781	685803	702287
Texas Woman's	370494	515886	545710	548421
UT Arlington	125558	776935	803629	850222
UT Austin	2398937	2510345	2671831	2729055
UT Dallas	295747	307069	338283	353518
UT El Paso	550110	464081	488150	551342
UT Permian	142650	137335	142961	146519
UT San Antonio	443392	565343	524228	487098
UT Tyler	136899	111309	116552	118515
UH Univ Park	1487605	1388491	1432372	1468600
UH Dowtown	323080	313034	363499	328717
UH Clear Lake	304794		218382	50000
Corpus Cristi	150585	157578	159917	154680
Tx A&I Univ	147492	152399	161055	166951
West Tx St Univ	121931	142118	143549	151901

*Actual expenditures unavailable, budget figures used

APPENDIX IV
V & C

UNIVERSITY	POPULATION MULTIPLIER (C)		PROPERTY VALUE MULTIPLIER (V)	
	FY 88-89	FY 90-91	FY 88-89	FY 90-91
East Tx St Univ	1.00	1.00	1.00	1.00
Lamar Univ	1.08	1.08	1.00	1.05
Midwestern St.	1.04	1.04	1.05	1.05
North Tx St Univ	1.00	1.00	1.00	1.00
Pan American Univ	1.08	1.08	1.00	1.00
Stephen F Austin	1.00	1.00	1.00	1.00
Praire View A&M	1.00	1.00	1.25	1.15
Tarleton St Univ	1.00	1.00	1.00	1.00
Texas A&M Univ	1.04	1.04	1.00	1.00
Texas A&M Galveston	1.08	1.08	1.25	1.25
Tx Southern Univ	1.60	1.60	1.25	1.15
Angelo St Univ	1.04	1.04	1.00	1.00
Sam Houston St Univ	1.00	1.00	1.00	1.00
SWTSU	1.00	1.00	1.00	1.00
Sul Ross St Univ	1.00	1.00	1.10	1.15
Texas Tech Univ	1.08	1.08	1.00	1.00
Texas Woman's	1.00	1.00	1.00	1.00
UT Arlington	1.40	1.40	1.00	1.00
UT Austin	1.30	1.30	1.10	1.10
UT Dallas	1.40	1.50	1.00	1.00
UT El Paso	1.50	1.50	1.00	1.00
UT Permian	1.04	1.04	1.00	1.0
UT San Antonio	1.40	1.40	1.00	1.00
UT Tyler	1.04	1.04	1.05	1.05
UH Univ Park	1.60	1.60	1.10	1.10
UH Dowtown	1.60	1.60	1.20	1.15
UH Clear Lake	1.60	1.60	1.10	1.05
Corpus Cristi	1.12	1.12	1.00	1.00
Tx A&I Univ	1.00	1.00	1.00	1.00
West Tx St Univ	1.00	1.00	1.00	1.00

APPENDIX V-A
CRIME DATA

UNIVERSITY	VIOLENT CRIME		PROPERTY CRIME		TOTAL CRIME	
	FY 88	FY 89	FY 88	FY 89	FY 88	FY 89
East Tx St Univ	5	9	172	180	179	189
Lamar Univ	2	3	381	260	383	263
Midwestern St.	4	8	64	95	68	103
North Tx St Univ	13	3	510	548	523	552
Pan American Univ	3	7	208	155	21	162
Stephen F Austin	1	1	385	422	386	423
Praire View A&M						
Tarleton St Univ		4		151		155
Texas A&M Univ	10	14	955	936	965	950
Texas A&M Galveston	0	0	9	4	9	4
Tx Southern Univ		22		215		237
Angelo St Univ	0	2	102	100	102	100
Sam Houston St Univ	17 *	23 *	64 *	79 *	81 *	102 *
SWTSU	14	4	808	638	822	642
Sul Ross St Univ	4	4	42	29	46	31
Texas Tech Univ	2	6	741	756	743	762
Texas Woman's	0	1	40	55	40	56
UT Arlington	3	5	339	400	342	405
UT Austin	15	7	978	953	993	960
UT Dallas	0	2	64	53	64	55
UT El Paso	6	4	194	217	200	221
UT Permian	0	0	11	13	11	13
UT San Antonio	0	2	124	136	124	138
UT Tyler						
UH Univ Park	17	6	748	732	765	738
UH Dowtown	6	1	128	89	134	90
UH Clear Lake	1	0	45	36	46	36
Corpus Cristi						
Tx A&I Univ	6	2	185	164	191	166
West Tx St Univ						

APPENDIX V-B
CRIME DATA

	VIOLENT CRIME		PROPERTY CRIME		TOTAL CRIME	
UNIVERSITY	FY 90	FY 91	FY 90	FY 91	FY 90	FY 91
East Tx St Univ	7	8	129	144	136	152
Lamar Univ	12	8	364	242	376	250
Midwestern St.	6	84	53	73	59	77
North Tx St Univ	6	18	502	415	508	433
Pan American Univ	4	13	132	111	36	124
Stephen F Austin	1	4	385	389	386	393
Praire View A&M	16	22	214	211	230	233
Tarleton St Univ	5	5	92	135	97	140
Texas A&M Univ	10	6	944	881	954	887
Texas A&M Galveston	0	0	3	1	3	1
Tx Southern Univ	28	15	213	238	241	253
Angelo St Univ	0	0	68	65	68	65
Sam Houston St Univ	23 *	23 *	86 *	75 *	109 *	98 *
SWTSU	30	11	531	508	561	519
Sul Ross St Univ	1	2	22	26	23	28
Texas Tech Univ	13	3	630	669	643	672
Texas Woman's	0	2	52	48	52	50
UT Arlington	7	6	366	553	373	559
UT Austin	11	9	922	981	933	990
UT Dallas	0	1	58	65	58	66
UT El Paso	4	3	183	186	187	189
UT Permian	0	0	12	8	12	8
UT San Antonio	1	2	133	117	134	119
UT Tyler	0	1	28	14	28	15
UH Univ Park	5	7	595	640	600	647
UH Dowtown	4	2	111	139	115	141
UH Clear Lake	1	0	28	42	29	42
Corpus Cristi						
Tx A&I Univ	5	1	256	222	263	223
West Tx St Univ	6	6	83	127	89	133

* Data supplied by University, not Department of Public Safety

BIBLIOGRAPHY

An Analysis of the Texas Higher Education Formula System: A Report to the Select Committee on Higher Education. Texas Research League. Austin, TX. November, 1986.

Baker, Daniel and Connely, Patrick G. "Neighborhood Criminals and Outsiders in Two Communities: Indications that Criminal Localism Varies." *Sociology and Social Research* 71 (October 1986): 59-63.

Beiber, Stephen L. "Multiple Regression and Its Alternatives." *The Social Science Journal* 25 (1988): 1-19.

Boggs, Sarah L. "Urban Crime Patterns." *American Sociological Review* 30 (1966): 899-908.

Brantingham, Paul J. and Brantingham, Patricia L. "Crime, Occupation, and Economic Specialization: A Consideration Of Inter-Metropolitan Patterns." In *Crime: A Spatial Perspective*, edited by Keith D. Harries and Daniel E. Georges-Abeyie, New York: Columbia University Press, 1980.

Brown, Stephen E. "Statistical Power and Criminal Justice Research." *Journal of Criminal Justice* 17 (1989): 115-22.

Bullock, Henry Allen. "Urban Homicide in Theory and Fact." *Journal of Criminal Law, Criminology, and Police Science* 45 (January-February, 1955): 565-76.

Campus Security Formula Recommendations 1988-1989 Biennium. Campus Security Formula Study Committee. Texas Higher Education Coordinating Board. November 13, 1985.

Campus Security Formula Recommendations 1990-1991 Biennium. Campus Security Formula Study Committee. Texas Higher Education Coordinating Board. November 18, 1987.

Campus Security Formula Recommendations 1992-1993 Biennium. Campus Security Formula Study Committee. Texas Higher Education Coordinating Board. November 15, 1989.

Capone, Donald L. and Nichols, Woodrow W., Jr. "Urban Structure and Mobility." *American Behavioral Scientist* 20 (November/December 1976): 199-213.

Capone, Donald L. and Nichols, Woodrow W., Jr. "Crime and Distance: An Analysis of Offender Behavior is Space." *Proceedings of the Association of American Geographers*. Washington: Association of American Geographers, 1975.

Cohen, Lawrence E. and Land, Kenneth C. "Discrepancies Between Crime Reports and Crime Surveys." *Criminology* 22 (November, 1984): 299-530.

Crutchfield, Robert D., Georken, Michael R. and Gove, Walter R. "Crime Rate and Social Integration." *Criminology* 20 (November, 1982): 467-78.

Davidson, R.N. *Crime and Environment*. New York, N.Y.: St. Martin's Press, Inc., 1981.

DiLeonardi, Joan W. and Curtis, Patrick Almond. *When the Number Are In*. Chicago, Ill.: Nelson Hall Inc., 1992.

Gross, Francis M. "Formula Budgeting for Higher Education: Panacea or Nemesis for the 1980's?" *The AIR Professional File No. 3* (Fall 1979).

Hakim, Simon. "The Attraction of Property Crime to Suburban Localities: A revised Economic Model." *Urban Studies* 17 (1980): 265-76.

Harries, K.D. *The Geography of Crime and Justice*. New York, N.Y.: McGraw-Hill Book Company, 1974.

Harries, K.D. *Crime and The Environment*. Springfield, Ill.: Charles C. Thomas Publisher, 1980.

Henderson, Douglas A. and Denison, Daniel R. "Stepwise Regression in Social Psychological Research." *Psychological Reports* 64 (1989): 251-57.

Hy, Ronald J.; Feig, Douglas G.; and Regoli, Robert M. *Research Methods and Statistics: A Primer for Criminal Justice and Related Sciences*. Cincinnati, Ohio: Anderson Publishing Co., 1983.

Jarrell, Stephen and Howsen, Roy M. "Transient Crowding and Crime: The More 'Strangers' in an Area, the More Crime except for Murder, Assault and Rape." *American Journal of Economics and Sociology* 49 (October, 1990): 483-93.

Katzman, Martin T. "The Supply of Criminals: A Geo-economic Examination." In *Crime Spillover*, edited by Simon Hakim and George F. Rengert. Beverly Hills: Sage Publications, 1980.

Le Beau, James L. "The Journey to Rape: Geographic Distance and the Rapists Method of Approaching the Victim." *Journal of Police Science and Administration* 15 (1987): 129-36.

Menard, Scott and Covey, Herbert C. "UCR and NCS: Comparison Over Space and Time." *Journal of Criminal Justice* 16 (1988): 371-84.

McIver, John P. "Criminal Mobility; A Review of Empirical Studies." In *Crime Spillover*, edited by Simon Hakim and George F. Rengert. Beverly Hills: Sage Publications, 1980.

Moss, Charles E., and Gaither, Gerald H. "Formula Budgeting." *Journal Of Higher Education* Vol. XLVII No. 5 (1976): 543-62.

Nance, Bill. Associate Vice-president for Budgeting and Administrative Services. Southwest Texas State University. (Formally Director, Formula Division, Coordinating Board, Texas College and University System). Personal Interview, 27 September 1991.

Pettiway, Leon E. "Mobility of Robbery and Burglary Offenders: Ghetto and Nonghetto Spaces." *Urban Affairs Quarterly* 18 (December 1982): 225-70.

Phillips, Phillip D. "The Journey to Crime." In *Crime: A Spatial Perspective*, edited by Keith D. Harries and Daniel E. Georges-Abeyie, New York: Columbia University Press, 1980.

Pope, Carl E. "Patterns in Burglary: an Empirical Examination of Offense and Offender Characteristics." *Journal of Criminal Justice* 8 (1980):39-51.

Pyle, Gerald F., et. al. *Spatial Dynamics of Crime*. University of Chicago, Department of Geography, Research Paper No. 159 (1974).

Report of the Campus Security Study Committee to the Formula Advisory Committee 1994-1995 Biennium. Campus Security Formula Study Committee. Texas Higher Education Coordinating Board. November 18, 1991.

Reppetto, Thomas A. "Crime Prevention and the Displacement Phenomenon." *Crime and Delinquency* 22 (April, 1976):166-77.

Rhodes, William M and Conly, Catherine. "Crime and Mobility: An Empirical Study." In *Environmental Criminology*, edited by Paul J. Brantingham and Paula L. Brantingham. Beverly Hills: Sage Publications, 1981.

Shoop, Julie Gannon. "Fighting Crime on Campus: New Law Alerts Students." *Trial* 7 (April, 1991):81-2.

Skogan, W.G. "The Validity of Official Crime Statistics: an Empirical Investigation." *Social Science Quarterly* 55 (July, 1974): 25-28.

Stephenson, Larry K. "Spatial Dispersion of Intra-urban Juvenile Delinquency." *The Journal of Geography* 73 (March, 1974):20-26.

Swisher, Kara. "Campus Crime." *Washington Post*. October, 19, 1989, Sec. C, p. 5.

Webb, Bill. Background Information for Committee Work. Texas College and University Coordinating Board Memorandum to Formula Advisory Committee and Formula Study Committees. 25 September 1989.

White, Clyde R. "The Relation of Felonies to Environmental Factors in Indianapolis." *Social Forces* 10, 4:498-509.

Worden, Marshall A. "Criminogenic Correlates of Intermetropolitan Crime Rates, 1960 and 1970." In *Crime: A Spatial Perspective*, edited by Keith D. Harries and Daniel E. Georges-Abeyie, New York: Columbia University Press, 1980.