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Optimizing Allocation of U.S. Humanitarian Civic Assistance Projects in Support of Developing Foreign Democracy

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OPTIMIZING ALLOCATION OF U.S. HUMANITARIAN CIVIC ASSISTANCE PROJECTS IN SUPPORT OF DEVELOPING FOREIGN DEMOCRACY

THESIS

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Abstract

Humanitarian projects in foreign countries are funded by the U.S. government to foster peace, prosperity, and the spread of democratic ideals around the globe. The type and scope of projects are restricted by current doctrine and funding regulations. Specifically in 2014, USAF personnel supported medical and educational construction projects/programs in the country of Belize. Within Belize, medical and educational projects were funded under the Humanitarian and Civic Assistance (HCA) program through the NEW HORIZONS exercise. Fiscal constraints, including shrinking budgets due to sequestration, have placed greater emphasis in the responsible distribution of resources and foreign assistance. The purpose of this thesis is to analyze public opinion survey data collected by the Latin American Public Opinion Project (LAPOP) and analyze predictors in satisfaction in democracy organized at the village and district level. The research findings represent suggestions, based on the population, that predict optimal placement of HCA projects.

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Christopher E Wittman

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OPTIMIZING ALLOCATION OF U.S. HUMANITARIAN CIVIC ASSISTANCE PROJECTS IN SUPPORT OF DEVELOPING FOREIGN DEMOCRACY

1. Introduction

1.1 Chapter Overview

The United States (U.S.) government contributes resources and funding in foreign assistance and aid programs across the globe. The aid programs consist of a plethora of programs, all with the primary purpose of saving lives, alleviating suffering, and maintaining human dignity ("Global Humanitarian Assistance," 2015). The mission of such aid programs is clear; however there is a deficiency in program selection process. Specifically, no method that systematically identifies the most desirable type and location, within a defined region in foreign countries, to place aid programs exists. While the Department of Defense Instruction 2205.02 clearly defines what constitutes a Humanitarian and Civic Assistance (HCA) project, the instruction lacks defining criterion or factors to identify and evaluate for HCA project selection. In a fiscally-constrained environment, procedures selecting program type and location would greatly benefit the humanitarian project selection process and the intended local citizen population. This goal of this research is to introduce a method to evaluate criterion and factors to investigate for project selection and the basic framework for how to choose the optimal type and location of future humanitarian projects.

1.2 Background

The U.S. government provides humanitarian programs globally with the primary purpose of "support[ing] global peace, security, and developing efforts" in order to protect our economy, social status, and U.S. national security on a global scale ("Foreign Assistance," 2015). As early as World War II, the U.S. invested considerable time and money into rebuilding foreign countries' infrastructures and economies with the objective of stabilizing regions across the globe. In 1961, President Kennedy identified the need for a U.S. government organization to provide oversight for all foreign assistance efforts. This organization was dubbed the United States Agency for International Development (USAID). This agency's primary focus "was long-term global development to include economic and social progress" ("Foreign Assistance," 2015). To augment this agency's efforts, an additional directive, recently enforced by the President of The United States (POTUS), provides clearer guidance to all U.S. government agencies on how to direct and implement assistance abroad ("Foreign Assistance," 2015). POTUS's directive highlights the additional need for justification of fund allocation within government foreign assistance funding.

Our thesis will discuss two key humanitarian assistance programs the DOD controls. First, this research introduces the Overseas Humanitarian, Disaster, and Civic Aid (OHDACA) Humanitarian Assistance (HA) program guidance and protocols. Second, this research presents the OHDACA Humanitarian and Civic Assistance (HCA) program by providing an example program and describing in detail the purpose, constraints, and guidance provided by the DOD. This provides an indepth review of the HCA and offers improvement recommendations to the specific projects conducted under

the HCA program. The HA and HCA programs listed above consist of two types of assistance programs under the OHDACA appropriation. Chapter 2 describes the two programs in greater detail.

This thesis presents Operation NEW HORIZONS as a recurring example HCA program the U.S. government currently manages. Operation NEW HORIZONS is an HCA exercise assembled from several individual projects in multiple locations. NEW HORIZONS executes yearly (pending sequestration) by the U.S. military in select South American countries. The U.S. performs this exercise in a joint environment with local national military forces. The operation provides personnel the opportunity to obtain training in construction and medical fields within a pseudo-deployed environment. Staff personnel, provided by the 12th Air Force under Southern Command (SOUTHCOM), plan humanitarian exercises such as NEW HORIZONS by Air Force units. Local governments in conjunction with U.S. Embassy officials assist SOUTHCOM in selecting future project locations. A list of "pre-approved" locations and projects provided by the host nation equips COCOMs, such as SOUTHCOM, with a list of possible project sites. Assuming the typical project satisfies basic military objectives, a procedure to provide decision support to commanders in site selection is critical, specifically in identifying geographical area with the greatest need. A decision support process would equip the planners to choose a project location based on the greatest need and susceptibility of the local area to our projects. Our research will provide improvements over the current process, and demonstrate how the U.S. can benefit using a model to help identify "prime" locations for HCA projects globally.

1.3 Problem Statement

A method does not currently exist that statistically evaluates potential humanitarian project locations. The procedure by which U.S. global humanitarian assistance projects are chosen would vastly benefit from a method that identifies prime project locations with the greatest need and relates that need to the overarching objective of U.S. foreign policy. Our research defines this need as a location with relatively low satisfaction in government services. The intent of this research is to create a method that ranks geographical regions in Latin America utilizing passively collected data that evaluates regions for their expected receptiveness regarding humanitarian projects in their respective locations. The HCA projects typically itendify proect locations using broad scope. Our identified regions represent locations identified under a narrower scope compared with the original process. This narrows the placement of HCA projects to areas which represent the greatest likelihood to benifit from an HCA project. The ability to examine satisfaction in government services from the citizens in the high at-risk locations is paramount, and susceptible populations are subject to local crime/corruption, organized drug rings, and low trust in the local/national justice system. Identifiying these locations provides AFSOUTH the tools necessary to make more informed decisions regarding future HCA project site selections. The OHDACA HA program, for example, funds projects responsible for "building and/or reinforcing security and stability in a host nation" (Pendleton, Czyz, Mak, & Michels, 2012, p. 5) and would best combat at-risk and susceptible populations in the direct vicinity of these groups.

1.4 Research Questions

In order to investigate the scenario described in the problem statement, this research will use survey data generated from the AmericasBarometer survey from the Latin American Public Opinion Project (LAPOP) institution. We will use data from the survey and create multiple models which test a series of questions generated from the overarching problem statement. The research questions stated below in Table 1 will address our problem statement and provide the foundation for investigating the relationship between key inputs and outputs:

Table 1: Research questions

Number	Research question
1	How does personal satisfaction in various local government services in a respondent's region effect the personal view of satisfaction in democracy?
2	How do views towards government legitimacy in a respondent's region at the local/national level influence an individual's satisfaction in democracy?
3	What characteristics, if any, of individuals that, when grouped at the local town/village/province, level can accurately predict satisfaction in democracy?
4	How can the current method of choosing U.S. Humanitarian projects overseas improve with the addition of publically available information?

The "characteristics" and the "publically available information" the previous questions address inquiries about any factors or traits derived from the AmericasBarometer survey respondents that, when compiled, can help predict personal satisfaction in democracy. Various survey questions address items such as hometown, religious beliefs, political ideology, and trust in elections.

1.5 Methodology

This research lends itself to the data from surveys created by LAPOP and humanitarian assistance data provided by SOUTHCOM. Vanderbilt University sponsors the AmericaBarometers surveys in several Latin America countries. U.S. humanitarian data is available online for projects from 2008 to the present, along with the type of humanitarian project conducted within SOUTHCOM's area of responsibility (AOR). To address the research questions, we require georeferencing for each LAPOP survey respondent and U.S. humanitarian project data with useable spatial data. The spatial data enabled us to conduct spatial statistical tests to address our research questions. We used aggregation techniques with the LAPOP survey data at various geographical levels such as the village/town/city, constituency, and district levels. The locational data used assumes the different surveyed groups properly represent the local national population. Additional tests check for errors due to aggregation and verify the accuracy of each aggregation unit.

1.6 Significance of study

This research can provide significant contributions to the humanitarian project selection process. If publically known variables such as basic demographic factors, satisfaction in local public schools, and trust in the government exist concerning individual towns and regions in a country of interest, spatial tools can offer the ability to bolster estimation methods in regions that could benefit the most from the presence of a humanitarian project.

1.7 Summary

The thesis follows the traditional five-chapter format. Chapter 2 explores a literature review of topics relating to the subjects and processes applicable in this research. Chapter 3 outlines the methodology utilized in this research in order to explain how spatial statistics applications apply in exploring the proposed research objectives. Chapter 4 explains the analysis and results from various spatial statistic investigative techniques. Finally, Chapter 5 addresses the results and findings of Chapter 4 and provides recommendations for future research opportunities. This thesis concludes with suggestions for follow-on research and a summary of this research effort.

2. Literature Review

2.1 Chapter Overview

This chapter introduces the literature reviewed during this research. First, this chapter lays the foundation of this thesis by detailing the vision of the U.S. government's foreign aid programs and the executing agent of HCA projects in South America. Next, this chapter introduces the area of study, applicable previous research regarding and the public opinion surveys used in this research. This chapter concludes with describing unique analysis methods used in geospatial studies, and details the scope of this thesis's investigative topics in regards to assessing the satisfaction of democracy.

2.2 National Security Strategy of the United States

To understand the current U.S. vision of providing humanitarian assistance in developing countries across the globe, we investigated the document that provides the vector for government's foreign policies and programs. This document, The National Security Strategy, provides an annual report generated by the President of the United States and submitted to the members of Congress. The purpose of this report details the current American foreign policy and reaffirms the commitment of the U.S. in continuing to provide national security for both the American public and allied partners across the globe (Obama, 2015, pgs. 3-29).

With the wars in Afghanistan and Iraq dwindling as they near their closing years, the 2015 National Security Strategy addresses the tools (specifically for our military) to combat terrorism and strengthen countries seeking democracy. These tools must be changed to address the U.S. combats threatening actions to safeguard our interests in a

changing environment. Our warfighting strategy has shifted fundamentally by moving "away from a model of fighting costly, large-scale ground wars in Iraq and Afghanistan" (Obama, 2015, p. 9). We now champion a model that "prioritizes targeted counterterrorism operations, collective action with responsible partners, and increased efforts to prevent the growth of violent extremism and radicalization that drives increased threats" (Obama, 2015, p. 9). The U.S. strategy to combat the growth of extremism has integrated with providing additional training funds for equipping our partners to defeat terrorists and extremists locally. A variety of programs led by organizations such as the U.S. military, USAID, and other DOD entities, the U.S. is taking the lead in assisting emerging democratic nations across the globe.

Funding amounts for nearly all government programs have seen fluctuations due to budget constraints. Exemptions for foreign assistance programs simply do not exist, as these programs have also seen their yearly budget fluctuate. Additionally, in recent years the DOD budget has experienced drastic reductions and budget fallouts due to sequestration. Ensuring the U.S. government's foreign aid funding contributes to the overall objective as stated by the POTUS holds even an even greater importance given the presence of shrinking budgets.

Despite the reductions in DOD budgets, funding for HCA programs continue to sponsor humanitarian projects in foreign countries. As seen below in Figure 1, the DOD obligated over $50 million in funds for HCA projects spanning over five major COCOMs (GAO, 2012).

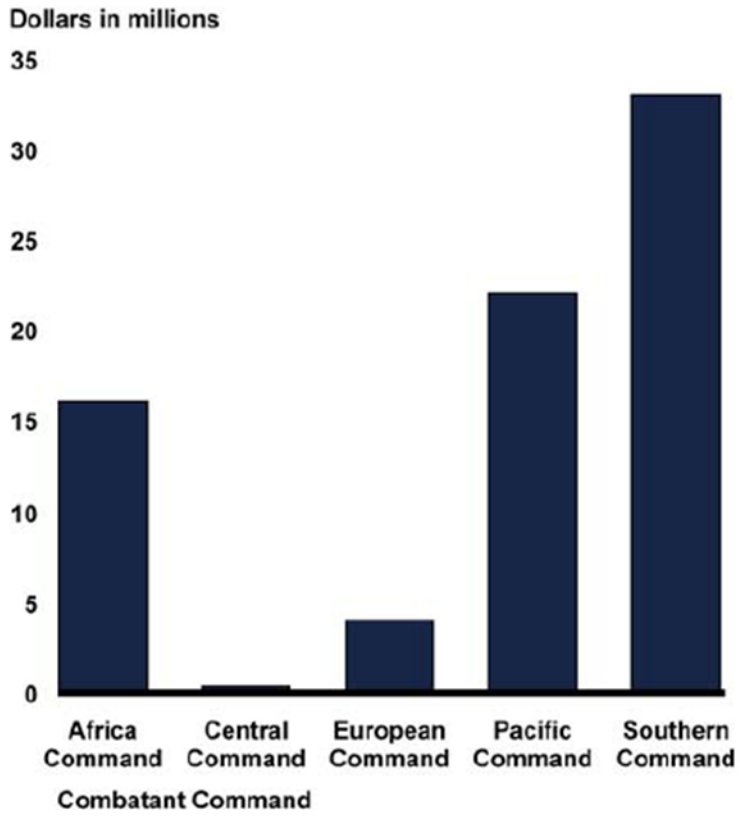

Figure 1: HCA Obligations from 2005-2010 per COCOM (GAO, 2012)

2.3 COCOM Posture Statements

Every year, COCOMs are required to brief the Senate Armed Service Committee concerning the year's accomplishments, problems, and future anticipated challenges. As seen specifically in SOUTHCOM, the brief by General John Kelly highlights the security environment, command priorities, and critical needs and concerns concerning operations in South America (Kelly, 2015, p. 2). General Kelly passionately describes the countries in South America the U.S. partners with as "committed to winning back their streets… from criminal gangs and drug traffickers, and doing so while protecting human rights" (Kelly, 2015, p. 3). To help combat this egregious force, U.S. SOUTHCOM, with the assistance of USAID, funded the construction of 172 humanitarian projects and exercises

providing free medical and dental services to more than 42,000 patients in the South America region in 2014 alone. These projects demonstrate the commitment from the U.S. to the citizens of Latin America where services are either poor or non-existent (Kelly, 2015, p. 22).

2.4 Previous research regarding humanitarian effectiveness in Belize

In 2015, Air Force Institute of Technology (AFIT) graduate Capt. Sam Logan investigated citizen satisfaction in the local populace of Belize. Logan conducted this research using a time series survey distributed throughout the different regions of Belize. The survey metrics focused on local citizen satisfaction in projects conducted as part of the recent humanitarian exercise, NEW HORIZONS 2014. As previously mentioned in this thesis, U.S. military executed Operation NEW HORIZONS in Belize at multiple locations. Unfortunately, the previous research could not account for factors that determined how the survey respondents were selected/questioned, and lacked enforcement over "random sampling" of the survey respondents (Logan, 2015, p. 67). After performing multiple regression techniques on the collected survey data, Logan confirmed that his models could not produce statistically significant results in the determination of citizen satisfaction (Logan, 2015, p. 69). Through more stringent data collection techniques and with ties to spatial data, a much greater chance of identifying a potential relationship between citizen satisfaction and the presence of U.S. military-led humanitarian missions could exist.

2.5 Latin American Public Opinion Project

For over 30 years, the LAPOP Institution has conducted public opinion surveys within Latin America and delivered valuable research data. One surveys in particular, AmericasBarometer, represents one of "the only scientifically rigorous comparative survey that covers 28 nations including all of North, Central, and South America, as well as a significant number of countries in the Caribbean" (Vanderbilt, n.d.). The questions in this survey undergo testing in the countries of interest to assure compliance and quality. The data collected from the surveys in Latin American countries represent a variety of topics, to include multiple research institutions and covering topics such as investigating local police trustworthiness, marriage/infidelity rates, the effects of poverty, and assessing the presence of democracy. These survey questionnaires ask approximately 240 questions and allow a wide variety of research options regarding multiple topics in Latin American. The survey provides a foundation for the proposed research presented in this thesis.

2.6 Belize

Belize represents just one of the countries surveyed by the LAPOP institution. Recognized as the newest country in Latin America, Belize has suffered from colonialism, slavery, and exploitation from the dominating world powers. Its involvement in the American drug trade, political corruption in recent history, and close proximity to Cuba during the Cold War as a developing nation triggered U.S. action in the form of humanitarian assistance, counter-drug operations, and economic support (Bolland, 1986, pgs. 136-137). The full independence of Belize from British rule in 1981

(Peedle, 1999, p. 6) enabled the continued pursuit of self-governing by the overwhelming majority of Belizians and welcomed U.S. support in HA and HCA funding in the country.

Belize represents an excellent candidate for this research due to the relative small size, high density of HCA projects in 2014, and high density of LAPOP survey respondents. Occupying nearly 8800 square miles (Peedle, 1999, p. 4), Belize compares with the size of the U.S. state of New Jersey. As shown below in Figure 2, Belize shares a coastline with the Atlantic Ocean and borders countries Guatemala and Mexico.

Figure 2: Map of Belize

As published by the Statistical Institute of Belize, the 2010 Belize Census reports an estimated population of 322,453 residents ("Statistical Institute of Belize," 2015). Table 2 shown below documents the populations and percentages for each District in Belize.

Table 2: 2010 Census Population of Belize ("Statistical Institute of Belize," 2015)

District	Population	Overall % of Total Population
Belize	95,291	29.5%
Cayo	75,046	23.2%
Corozal	41,061	12.7%
Orange Walk	45,946	14.2%
Stann Creek	34,324	10.6%
Toledo	30,785	9.5%
Total	322,453	100%

LAPOP's AmericasBarometer original sample size of 1,512 respondents from Belize captures 1:214 ratio of the citizens to respondents when compared with the 2010 Census data. This ratio represents a strong representative sample of the citizen of Belize.

2.7 Evaluation of medical effectiveness in DOD Humanitarian Assistance

As previously stated, U.S. led humanitarian exercises usually consist of medical related projects and programs. Military and civilian medical programs have been the most frequent form of overseas humanitarian assistance across the world (Drifmeyer & Llewellyn, 2003, p. 6). The report "Measuring the Effectiveness of Department of Defense Humanitarian Assistance" created by members of the Center for Disaster and Humanitarian Assistance Medicine (CDHAM) identifies how two different major commands in the U.S. military differ in planning and evaluating humanitarian projects.

While both commands have programs that fund assistance projects in countries of dire need, Drifmeyer and Llewellyn highlight the differences between the commands. These differences highlight the performance metrics used to measure the effectiveness of their respective projects (Drifmeyer & Llewellyn, 2003, p. 6). The differences highlight the lack of a systematic process or model by the government to predict a more effective means of allocating foreign aid assistance. The article then identifies metrics that provide goals in the medical community for identifying 'effectiveness'.

Defining the completion of medical assistance projects proves difficult to determine, especially if the end state not centered on the construction/renovation of a medical facility or the exhaustion of all medical equipment. CDHAM identifies the need for "establishing criteria, measuring effectiveness over time, and making decisions based on feedback of information" (Drifmeyer & Llewellyn, 2003, p. 21), in order to determine when the true "completion" of a project occurs. If a process or model existed, the government could utilize this method to reliably assess the effectiveness of its humanitarian projects, and justify the funds spent supporting overseas projects.

2.8 Geographic Information System

Since the 1960s, computers have been able to capture and process geospatial data (Chang, 2008, p.3). As the advancement of technology and computer computing power rapidly developed over the following decades, the abilities of computing programs also evolved. The Geographical Information System (GIS) computing system offers a method of capturing, storing, manipulating, analyzing, managing, and presenting spatial and geographical types of data. The ability to handle and process geospatial data helps

distinguish GIS from other computer systems (Chang, 2008, p.1). This computing system answered the growing desires of in public, private, and government needs by providing a system to document, track, effectively and efficiently provide geographical database information in a dynamic, interactive environment. GIS itself presents a multidisciplinary tool utilized by a variety of academic disciplines and applications (Davis, 1996, p. 53) that enables the use of spatial data and database non-locational data (or non-spatial data) to solving unique problems using untraditional methods.

2.8.1 OHASIS

To help the COCOM planners and representatives store records of humanitarian exercises on a single unified system, the DOD enforced use of the OHASIS (Overseas Humanitarian Assistance Health and Safety Information System) database by Defense Security Cooperation Agency (DSCA), COCOMs, and other government units and personnel (ARMY, n.d.). The OHASIS system specifically manages the worldwide humanitarian efforts performed or funded by the U.S. government. This web-based GIS system collects and displays humanitarian project information such as year performed, funding, manning requirements, global positioning coordinates, and individual after-action reports.

2.9 Linear regression and assumptions

Traditional research seeks to assess relationships between a defined set of variables. Models created by a researcher represent both these relationships, typically in the form of a single outcome variable and one or more predictor variable(s), and a chosen

analysis technique. The analysis technique chosen by the researcher tests for interactions between the outcome and predictor(s). This section will briefly introduce the linear regression model, state assumptions necessary in order to show support for linear regression model results, and list reasons for introducing spatial analysis tools into this research.

The most basic form of regression is straight-line, or linear, regression analysis (Kleinbaum, 1998, p.11). This type of analysis tests one outcome variable against one or more predictor variable(s). Linear regression serves as the default regression technique. Additional simple alternate methods of regression exist for implementation if the linear model does not provide a best fit. The strategy of first performing the linear regression model serves as the default test.

When undergoing linear regression analysis, the researcher must verify assumptions concerning the data. As listed in Kleinbaum (1998), assumptions the data must hold true when performing linear regression include:

- *Existence*: For any fixed value of an input variable, a measurable outcome variable must exist, exhibiting a probability distribution with a finite mean and variance.
- *Independence*: The outcome variable must be statistically independent of one another.
- *Linearity*: The mean value of the outcome variable must be expressed as a straight-line function of the input variable(s).
- *Homoscedasticity*: The variable o the outcome variable must be the same for any value of the input variable(s)
- *Normal Distribution*: Residuals from the chosen analysis tool must be present a normal distributed fashion. If the normality assumption is not "badly" violated, the conclusions will generally still be reliable and accurate

In order to evaluate the data for violations of any of the listed assumption, scholars have created tests that evaluate the data and tested relationships for each of the listed assumption areas (explained in Chapter 3, tested in Chapter 4). In areas of research such as surveys conducted over time and geographical studies (such as the spatially bound data in this thesis), violations regarding assumptions of independence in the outcome variable often fail and require additional tests/transformations.

2.10 Unique characteristics of the independence assumption violation

Due to the geographical component of the research, this thesis briefly describes additional analysis techniques necessary for linear regression violations. If the selected outcome variable exhibits a clustering affect in the measured value, the outcome variable requires testing to measure the strength of dependence.

2.10.1 Moran's I

A well-known test in the spatial analysis field called Moran's I tests a variable for dependency. In this research, dependency measures the relationship of a community's influence by its neighbors. Dependency in spatial-bound data results from the networks present in the community due to relative geographical location. The inputs to evaluate dependency using the Moran's I statistic include:

- Locations of measurements
- the measured variable value
- the spatial connectivity matrix.

2.10.2 Spatial connectivity matrix overview

The Moran's I calculation depends on the creation of a spatial connectivity matrix. The spatial connectivity matrix represents a mathematical description for how all the data points relate to each other. For simplicity and applicability to this thesis, this literature review will focus on the geographical unit of point data (villages) and Euclidean distance. A connectivity matrix for point data derives from the raw distances between each of the cities in a dataset. These distances derive from point to point measurements, or commonly known as the "how as a crow flies" distance. The GeoDa® program created by Luc Anselin conducts spatial data analysis, geovisualizaion, spatial autocorrelation and spatial modeling (Anselin & Rey, 2014, pgs. 1-6). This thesis uses GeoDa® software to test the proposed models in Chapter 3 for autocorrelation via the Moran's I statistic. This statistic outputs a value between 1 and -1; negative values indicate dispersed patterns, and positive values indicate clustered patterns.

The GeoDa® software outputs a graphical representation and calculation for Moran's I by displaying a plot of the actual and predicted values of the spatial data frame. Figure 3 depicted below shows an example of this output.

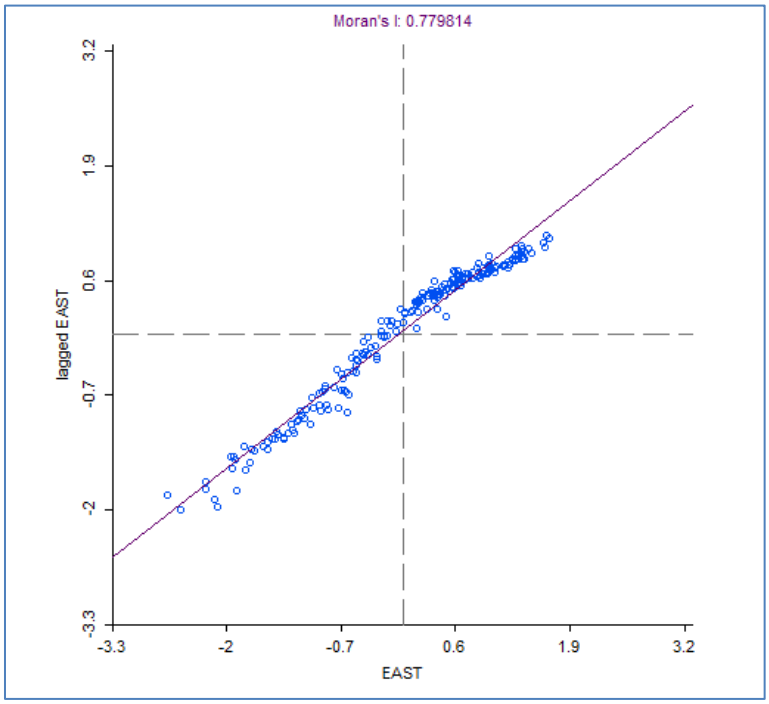

Figure 3: Example Moran's I output

The value of the Moran's I statistic (displayed in the middle near the top of Figure 3) indicates the clustering level. Research also regards this as the slope of the line created from plotting the lagged dependent variable value against the original dependent variable value.

2.11 Democracy and higher education

In order for the U.S. government to be successful in its goal of assisting countries with adopting stronger democratic principles, this researcher must stress the importance of characteristic behaviors typically present in citizens that supporting democracies. Existing literature supports the relationship between higher education and the presence of democratic politics (Lipset, 1959, p. 83). This typically produces a weak (but measureable) positive relationship between personal education and satisfaction in

democracy. This research will assess the satisfaction in schools at an individual and grouped level and determine any relationship to satisfaction in democracy. The U.S. government's foreign aid programs will benefit by enabling higher education in foreign countries based on the criteria established in OHDACA. Democratic forming countries represent prime candidates for public education projects and would also benefit from the population receiving higher education. A perfect example of an exercise that aims to bolster higher education in these countries is the construction of a school in an overpopulated or underfunded location. A recent humanitarian operation held in 2014 in the country of Belize created five schools at four different sites, with the intent of fostering learning environment for children in the surrounding area.

2.12 The quality of democracy vs. evaluation of government performance

The idea of democracy is a very large, dynamic topic that is difficult to summarize and define due to many intricate factors and relationships that affect policies, parties, and issues with providing rights, liberties, and opportunities to citizens (Dahl, 2003, p. 137). Citizens rely on their government to provide basic rights and liberties to live a comfortable life. There is agreement by many scholars that "the current cycle of democracy has been more durable and has more depth and better prospects for survival than other [types of governments] in recent [history]" (Levine, Daniel H./ Molina, 2011, p.1). Due to the widespread acceptance and success of democracy in the world today, measuring the quality of democracy at the country level based on policy and actions would prove beneficial for comparing democracies around the world. Rather than

extensively define the quality of democracy between nations, this thesis focuses on the evaluation of the government's performance and to the criteria for measuring this topic.

This research stresses the importance of discussing the differences between the quality of democracy (as determined by the actions of a country's political system) and the evaluation of government performance in countries identified as democratic. The quality of democracy as defined by scholars Levine and Molina is first broken up into dimensions for basic elements for the procedural definition of democracy (Levine, Daniel H./ Molina, 2011). Table 3 below shows the elements identified that define the basics of democracy as noted by Dahl (2003). These principals form the backbone of a government that provides the necessary rights, liberties, and opportunities demanded from a country's citizens (Dahl, 2003, p. 137).

Table 3: Basic elements for procedural definition of democracy (Dahl, 2003, p. 8)

Principles of established democracy
Free, fair and frequent elections
Untrammeled equal access to voting and to institutions
Information that is accessible and sufficient for citizens to make reasonable judgement
Elected officials empowered to govern and be held accountable and responsible to their constituents
An inclusive definition of citizenship

The quality of democracy measures the degree to which these elements exist in a country's diplomatic policy. The measurements for each of these elements is determined using a scale with defining criteria for each for low and high measures. The evaluation of a Democratic government's performance, or satisfaction in democracy, is an individual

measure of how well the government implements its own policy. Every individual has a unique view and perception of the government performance of his or her country.

A depth of literature describes predictors for both the quality of democracy and assessing the satisfaction in democracy. This thesis focuses on three main predictors made available from questions asked in the AmericasBaramoters survey. The predictors this thesis focuses in include satisfaction in public services, measures of government legitimacy, and measures of social capital.

2.12.1 Government services

Citizens depend on the government to provide an array of services. Through a variety of taxes imposed on citizens, the government assumes the responsibility and burden of financing public infrastructure projects such as roads, schools, hospitals, and communication networks. Citizens demand these public services, or referred to in this thesis as public services, and often high expectations overwhelm actual performance (Van Ryzin, 2006, p. 601) in satisfaction of these services. Additional investment by citizens in the community can influence service evaluations. Involvement in the community by citizens is hypothesized to influence satisfaction in public services and with their city governments (DeHoog, Lowery, & Lyons, 1990, p. 809). Primary services investigated in this thesis revolve around the purpose of the HCA projects executed in Belize during 2014 that bolster the local education and medical services. An additional question present in the AmericasBarometer survey inquiring the satisfaction in public roads enabled additional research on the relationship between quality of public roads and satisfaction in democracy.

2.12.2 National government legitimacy

As described by Scholar Charlton, countries that identify as democratic have a responsibility to its' citizens to govern responsibly and in abiding by basic democratic principals in governing and providing for its people (Charlton, 1986, p. 23). Rather than attempt to explain the intricate details involved with defining democracy, this thesis intends to define a nation's democratic legitimacy. The survey questions asked in the AmericasBaromter survey limit the scope of defining "national government legitimacy" to just three categories presented by Charlton and other literature. These categories represent various paradigms within a democracy that a citizen expects the political institution to uphold and control responsibly.

2.11.2.1 Basic rights

Protection of basic human rights for all citizens regardless of race, sex, or social class provides the basic freedom and citizenship demanded from citizens. The ability of citizens to enjoy freedom, receive information unrestricted, and participate in the decision making progress is a fundamental definition of democracy. Protection of these basic rights is a core concept of government legitimacy.

2.11.2.2 Trust in elections

Successful democracies must foster trust in the implemented election mechanisms as seen by the public. The trust generated by these mechanisms increases voter confidence and supports free and fair elections. Any form of corruption, involving the incumbent or challenging political party, must be guarded against, lest voter confidence be reduced to a point that damages the satisfaction in the country's democratic process.

2.11.2.3 Trust in justice system

Trust in the justice system refers the amount of assurance present citizens have in the effectiveness and ability of the execution of the justice system. Positive trust typically exists when the leaders in position of power execute their actions and punishments consistently for criminals among the entire population.

2.12.3 Social Capital

The interactions between citizens and the cooperative effort of contributing to a common goal often form tight-knit communities. The strong relationships created and the collective action taken to address community issues form one's social capital (Cruz, 2008, p. 1). The measure of an individual's social capital illuminates the collective effort seen in individuals who contribute to problem solving in the community. Based on data generated from 2008 from LAPOP, Cruz (2008) examined what typical socioeconomic and demographic characteristics influence citizen involvement in solving problems around the community.

Table 4 below shows the factors found to be significant from data collected from 21 countries in Central and South America.

Table 4: Social capital construct

Subject	Findings
Perception of economic situation	Citizens more concerned with their personal economic situation tend to participate more in solving community problems
Political interest	The more people are interested in politics, the more participation in community problem solving
Ideology	People on the left tend to be more involved in solving problems in the community
Size of city	The smaller the city in which people live, the more they are involved in solving community problems
Age	Older people tend to be more involved than younger people
Gender	Women tend to be less involved
Education	The more years of education, the greater the involvement in community solving problems

The findings generated by Cruz influence this research to investigate any interaction/relationship in government services in Chapter 3.

2.13 Summary

Chapter 2 concludes with presenting background information regarding the underlying problem presented from AFSOUTH and key principles described in the literature that apply to the scope of this research. This basic knowledge creates the baseline for the research and the topics of investigation in respects to assessing the satisfaction in democracy in Latin America. The next chapter describes the methodology behind the proposed models in this research in order to answer the questions from Chapter 1.

3. Methodology

3.1 Chapter Overview

Chapter 3 discusses the methodology used in this research. First, this section presents a summary of the AmericasBarometer survey data and its application in this research. Second, this research presents the hypotheses chosen to represent the framework of the proposed research questions from Chapter 1. Next, aggregation and compilation techniques describe the organization of the AmericasBarometer and OHASIS data. Following this step, a presentation of the geographical comparisons, statistical regression and spatial regression techniques used in this research concludes Chapter 3. This chapter presents the methodology used to identify potential relationships that exist between defined independent variables (IVs) and dependent variables (DVs) in a series of models and regression techniques.

3.2 AmericasBarometer and HCA Dataset

This thesis presents research on AmericasBarometer survey data collected by the LAPOP institute in Belize during 2012. LAPOP originally created the survey for studying democratic public opinions as local repressive regimes ended their rule and democratization expanded in Latin America (LAPOP, n.d.). To collect the survey data presented in this research, LAPOP hired local nationals. While the majority of Belizeans speak English, Spanish speakers represent an overwhelming minority in the country. As a response to this secondary presence in Belize, LAPOP personnel administered the AmericasBarometer survey in both English and Spanish.

Research utilizes data available from the 2012 AmericasBarometer survey and locational project data from U.S. HCA projects conducted in 2014. The OHASIS database contains the project name, year of completion and geographical coordinates necessary for this research. This thesis compares 2012 survey data with actual 2014 HCA project locations to account for time necessary to plan these projects. In order to plan for a mid-2014 exercise, planning must begin at least 12 months in advance. If data from the AmericasBarometer survey influenced the planning process for the 2014 NEW HORIZONS exercise, the most recent LAPOP data at that time (from 2012) would apply.

After reviewing the questions in the AmericasBarometer, we identified items of particular interest to this research. In order to address the problem statement and research questions presented in Chapter 1, we organized and recoded the questions to create the necessary IVs and DVs for testing. Appendix A can be referenced for instructions on how to download the AmericasBarometer survey and the instructions to organize and generate the tested variables in this research. Table 5 below shows the survey key and original AmericasBarometer this researcher found applicable to this research.

Table 5: 2012 Interested AmericasBarometer questions

Survey Key	Original AmericasBarometer survey questions
pn4	In general, would you say that you are very satisfied, satisfied, dissatisfied or very dissatisfied with the way democracy works in Belize?
b10a	To what extent do you trust the justice system?
b47a	To what extent do you trust elections in this country?
l1	According to the meaning that the terms "left" and "right" … own political leanings, where would you place yourself on this scale?
pol1	Interest in politics
q2	Age
ed	Education level
idio	View on economic situation
sd2new2	Satisfaction with conditions of streets, roads, and highways?
sd3new2	Satisfaction with quality of public schools?
sd6new2	Satisfaction with quality of public medical and health services?
pol1	Interest in politics
l1	Political ideology
q2y	Age
idio1	View on personal economic situation
ed	Education level
tamano	Size of city

3.3 Proposed models

This section presents the models that were tested to answer research questions presented in Chapter 1. We identify each research question in this section and document the methods used. All IVs and DVs originate at the individual survey level. Aggregated IV and DV measures to the village/town/city level for the proposed models provide a layer of detail used to compare between the village/town/cities. First, three single models are presented, with the addition of a fourth model which tested for any interactions.
Reference

Table 6 below displays each research question and associated model.

Table 6: Model # and associated research question

Model #	Research question
1	How does personal satisfaction in various local government services in a respondent's region effect the personal view of satisfaction in democracy?
2	How do views towards government legitimacy in a respondent's region at the local/national level influence an individual's satisfaction in democracy?
3	What characteristics, if any, of individuals that, when grouped at the local town/village/province, level can accurately predict satisfaction in democracy?
4	*
Decision method proposal	How can the current method of choosing U.S. Humanitarian projects overseas improve with the addition of publically available information?

* (Researcher curious to interactions between previously defined IVs)

In addition to Models 1-3, this research can benefit from identifying any relationship between previously defined IVs and their interactions on each other against the DV "satisfaction in democracy". The addition of Model 4 tests this proposed relationship. We concluded by introducing a method to assist with future project selections in the "decision method proposal" model. The final proposed model is meant to address the fourth research question.

All presented models and the final method were tested against the DV representing "satisfaction in democracy." Our research uses the question "pn4" in the AmericasBarometer survey to represent the DV. This question originates on the 1-4 Likert scale and required recoding to ensure a high value correlated with a "very

satisfied" metric. Coding procedures utilized for data collection and aggregation in SPSS® can be found in Appendix A.

3.3.1 Model 1: Satisfaction in government services

The first model tests the relationship between "satisfaction in government services" and "satisfaction in democracy". To generate the "satisfaction in government services" independent variable, this research requires combining specific questions from the original survey. The literature provided in Chapter 2 justifies the generation of the "satisfaction in government services" IV from identified questions. As shown below in Figure 4, the generated variable representing "satisfaction in government services" (IV1) represents the average of satisfaction with public roads, satisfaction with public schools, and satisfaction with public health services.

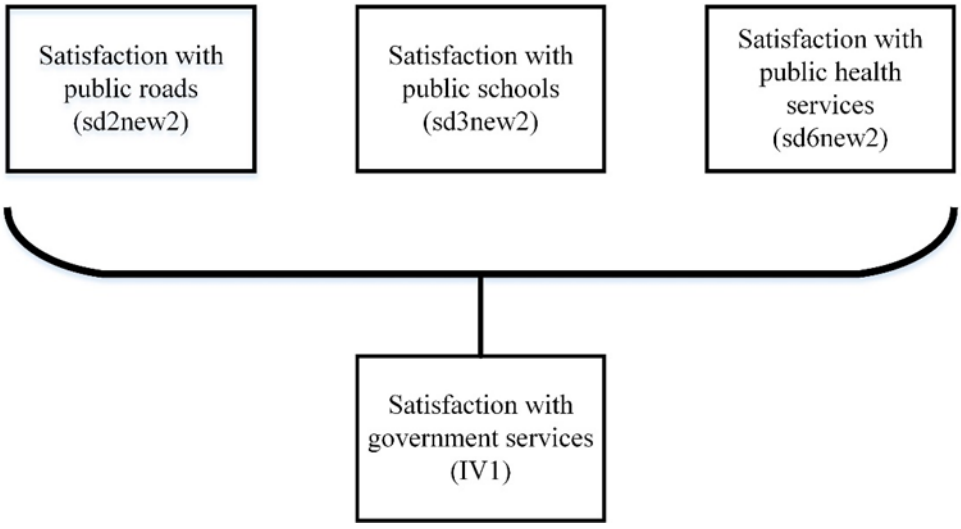

Figure 4: Satisfaction with government services variable generation

Figure 5 shown below represents the null hypothesis for Model 1. Model 1 tests the generated "satisfaction with government services" IV described above against the DV "satisfaction in democracy".

H_1 : The composite village/town/city grouping measure of satisfaction in government exhibits neither a positive nor negative relationship on local citizen's satisfaction in democracy.

Figure 5: Model 1 null hypothesis

3.3.2 Model 2: Rating of national government legitimacy

The second model in this thesis tests the relationship between an individual respondent's personal view on "national government legitimacy" and "satisfaction in democracy". To generate the "national government legitimacy" variable, this research requires combining specific questions from the original survey as documented within the literature review in Chapter 2. As shown below in Figure 6, the generated variable representing "national government legitimacy" (IV2) represents the cumulative average of "basic rights are protected by political system", "trust in elections", and "trust in justice system".

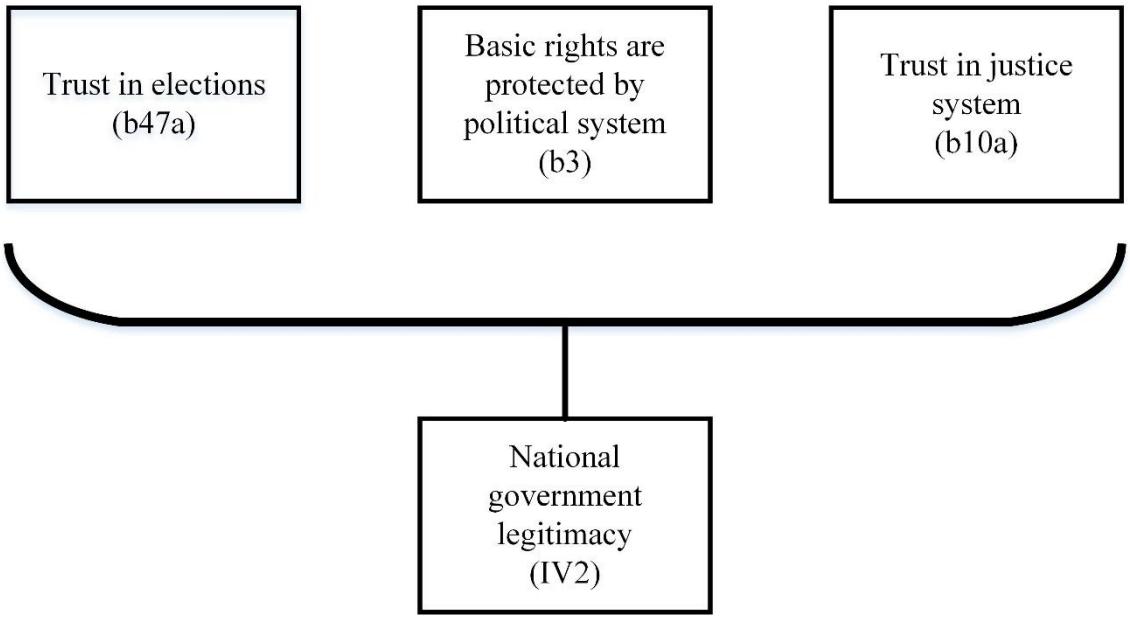

Figure 6: National government legitimacy variable generation

Figure 7 shown below represents the null hypothesis for Model 2. Model 2 tests the generated "national government legitimacy" IV described above against the "satisfaction in democracy" DV as defined previously in Chapter 3.

H_2: The composite village/town/city grouping measure of government exhibits neither a positive nor negative relationship on local citizen's satisfaction in democracy.

Figure 7: Model 2 null hypothesis

3.3.3 Model 3: Rating of social capital

The third model tests the relationship between the measurement of an individual's "social capital" and "satisfaction in democracy". To generate the measurement of an individual's "social capital", this research requires combining specific questions from the original survey justified from literature review in Chapter 2. As shown below in Figure 8, the generated variable representing "social capital" (IV3) represents the z-score

average of “size of city”, “interest in politics”, “political ideology”, “age”, “view on personal economic situation”, and education level (tomano, pol1, l1, q2y, idio1, and ed, respectively). This data required z-score calculations due to inconsistent ranges between the individual questions. Refer to Appendix A regarding how to code/recode the individual questions for IV3 generation.

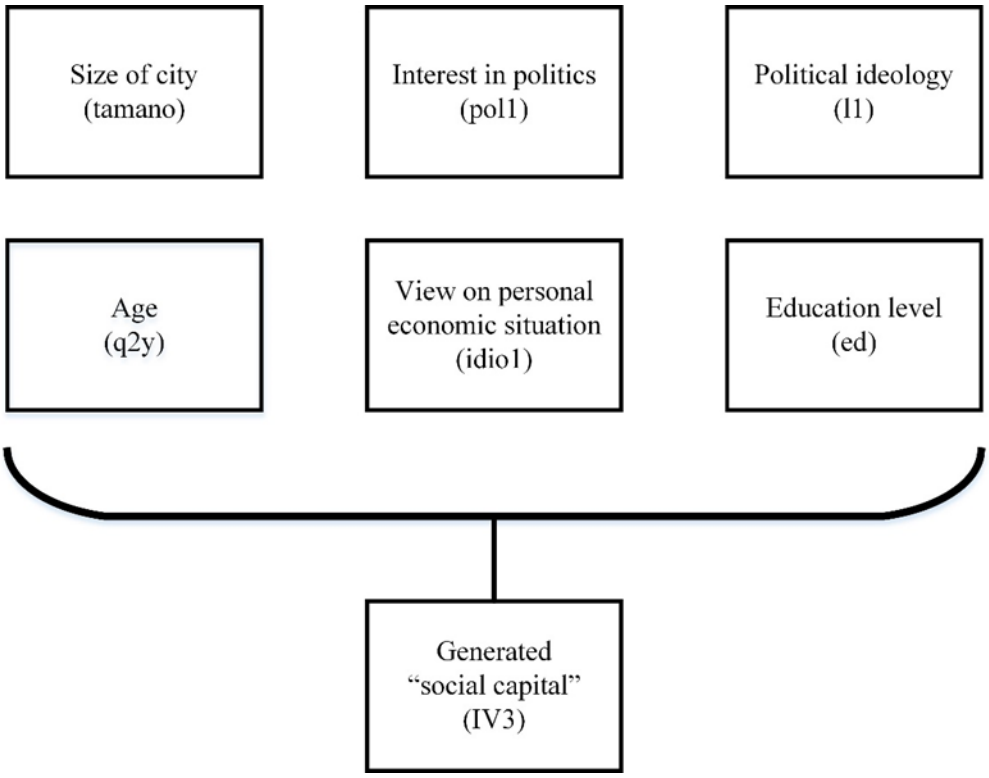

Figure 8: Social capital variable generation

Figure 9 shown below represents the null hypothesis for model 3. Model 3 tests the generated “social capital” IV described above against the “satisfaction in democracy” DV.

H_0 : The composite village/town/city grouping measure of social capital exhibits neither a positive nor negative relationship on local citizen’s satisfaction in democracy.

Figure 9: Model 3 null hypothesis

3.3.4 Model 4: Combined model

A fourth, final model will test the interactions between the previously defined IVs and the DV "satisfaction in democracy". Rather than test the generated "satisfaction in government services" IV, this fourth model tests individual components from the "satisfaction in government services" IV to evaluate the significance of the individual influences between different measured satisfaction (roads, schools, and health services) variables. This provides insight into the casual effects created because of combining the listed IVs. Figure 10 details the visual representation of the proposed relationship in Model 4, and Figure 11 shows the fourth hypothesized model.

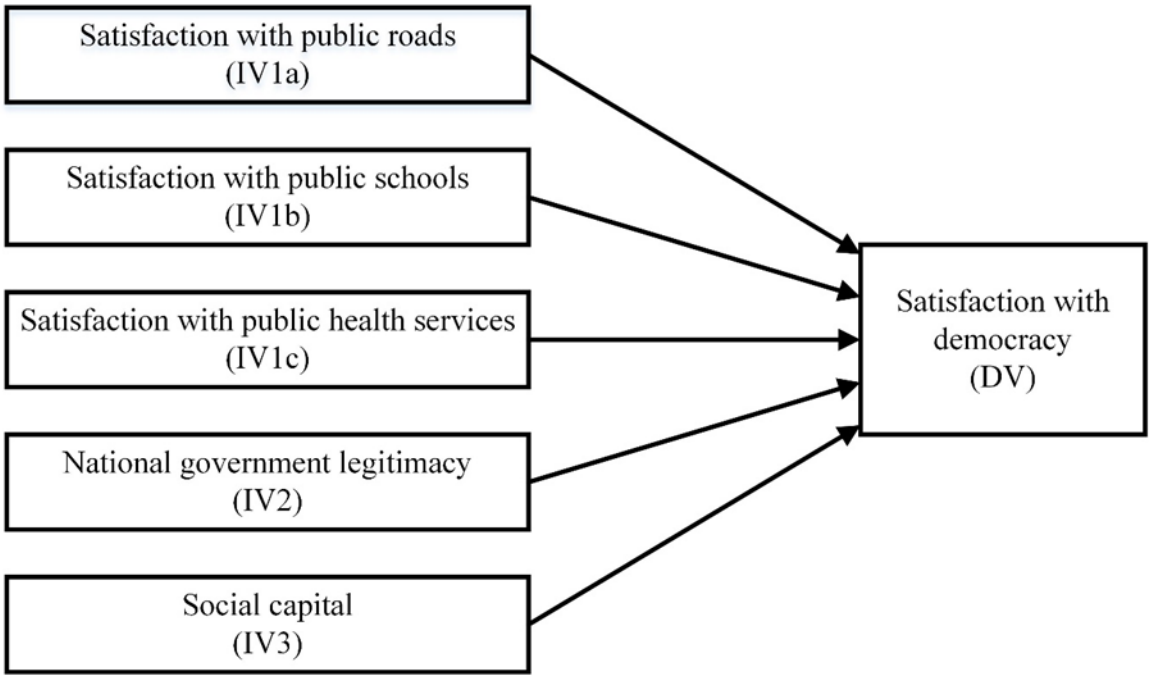

Figure 10: Proposed relationship to Model 4

H_4 : The composite village/town/city grouping of multiple selected IVs exhibits neither a positive nor negative relationship on local citizens satisfaction in democracy.

Figure 11: Model 4 null hypothesis

3.4 ANOVA

The models presented in this chapter will identify any relationship between the defined IVs and DV. In order to do this in a linear fashion, a statistically significant difference between the grouping levels of DVs should exist. The analysis of variance (ANOVA) statistical test compares the means between several populations (in this case, grouping levels such as districts, constituencies, and village/town/cities). If the test shows significance, then this researcher can reject the null hypothesis. Figure 12 below shows the null hypothesis for this individual test.

H_o: $\sigma^2_1 = \sigma^2_2 = \sigma^2_3 = ... = \sigma^2_n$
H_a : Not all variances are equal (i.e. $\sigma^2_i = \sigma^2_j$ for some i,j)

Figure 12: Hypothesized ANOVA test

3.5 Proposed statistical regression techniques

Models presented in the previous section test data aggregated at the village/town/city level to offer a maximum number of groups available to test. This research utilizes the simple linear regression statistic and multiple linear regression statistic as the first method of testing the relationships presented in Models 1 – 4. In order to accept these results, the assumptions stated in Chapter 2 must prove valid. This section presents an additional test called spatially lagged linear regression if the residuals or selected DV exhibits any clustering. First, this research tests for independence in the DV "satisfaction in democracy" via the Moran's I test. This test is valid for every model due to the repeated DV across the models. The Moran's I statistic requires a spatial

weights matrix in order to test for clustering and significance. The "Spatial Weights Matrix" section in Chapter 2 shows the method of calculating various spatial weights matrices used in this research, and Table 7 shown below documents the intended tested thresholds.

Table 7: Moran's I spatial weight thresholds

Distances
54.7 KM
75 KM
100 KM
125 KM
150 KM

3.5.1 Simple Linear Regression

If the Moran's I test results indicate no spatial clustering in the DV, then the proposed may be subject to a linear regression analysis. Equation 1 depicted below shows the general linear regression formula.

$$y_i = \beta_0 + \beta_1 x_1 + \varepsilon_i \quad (1)$$

y_i = dependent variable term

β_0 = x-intercept (constant)

β_1 = regression coefficient (Beta) vector

x_1 = independent variable vector

ε_i = model error term

3.5.2 Multiple Linear Regression

If the Moran's I test shows no spatial clustering in the DV, then model four can endure multiple linear regression (MLR) testing. MLR, shown below in

, tests the relationship presented in this research for any significant relationships between multiple IVs and crossed IVs against a single DV. This model is important to test for any relationship that exists between the IVs and the selected DV.

$$y_i = \beta_0 + \beta_1 x_{1a} + \beta_2 x_{1b} + \beta_3 x_{1c} + \beta_4 x_2 + \beta_5 x_3 + \beta_k x_j x_k + \varepsilon_i \quad (2)$$

y_i = dependent variable term

β_0 = x-intercept (constant)

β_k = regression coefficients (Beta) vector

x_{1a} = independent variable $IV1_a$ vector

x_{1b} = independent variable $IV1_b$ vector

x_{1c} = independent variable $IV1_c$ vector

x_2 = independent variable $IV1_2$ vector

x_3 = independent variable $IV1_3$ vector

$x_{k,j}$ = independent variable vectors

ε_i = model error term

3.5.3 Spatially Lagged Linear Regression

If the Moran's I test results signify spatial clustering in the DV, then each proposed model cannot undergo standard linear regression or MLR. Instead, our regression formula must include an additional variable to account for this clustering. When the observed DV in a location is dependent on the DV values observed at neighboring locations, spatial dependence exists. Spatially lagged linear regression accounts for this dependency by adding a lagged dependent variable. To spatially lag the

dependent variable, the researcher must redefine the ε_i error term. As seen below in Equation 3, the altered ε_i error includes a spatially lagged dependent variable.

$$\varepsilon_i = \rho w_i * y_i + \in_i \quad (3)$$

ε_i = error term from linear regression equation

ρ = parameter measures spatial autocorrelation

w_i = spatial weights matrix

y_i = dependent variable vector

$\in_i$ = unaccounted error from spatially lagged model

If the measured DV presents spatial lag as a significant measure in the model, this research requires spatially lagged linear regression and the addition of the spatially lagged error term described above in .

Each "fit model" created as a result of the correct regression technique endures testing of the residuals to ensure passing of all tests and identifying of the results for significant models.

3.5.4 OLS with Dummy Variables

This research tests statistical model Ordinary Lease Squares (OLS) model with dummy variables in the final model. This final model tests a variation of the spatially lagged linear regression model by accounting for the geographical district regions in the

data. Rather than assign a value based on distance between districts (or other geographical features), this regression technique utilizes creating dummy variables to account for the regional geographical features. OLS with dummy variables represents a method to address spatial heterogeneity for varying geographical regions (Ward & Gleditsch, 2008, p. 51). This research presents this introductory model and associated calculations as a method to compare between districts (or any other geographical unit of choice). This research makes the assumption the districts are homogeneous fix issues regarding heterogeneity to accept the model results.

3.6 Decision method proposal for HCA Selection

The final problem statement in Chapter 1 proposes investigating any revisions regarding HA/HCA project placement for the 2014 calendar year. Our research will investigate the actual HA/HCA project locations in 2014 and "areas of interest" generated from the 2012 AmericasBarometer survey data. This research defines these "areas of interest" as geographical units that have a high "utility value." This section describes the method, creation of the Utility Value variable, and accompanying decision tree proposed in this research.

The decision method in this research retrieves data from AmericasBarometer survey and groups the individuals per the geographical units explained previously in this chapter. The retrieved data allows us to make inferences for each individual geographical category based on the respondents that live in a particular area. For example, all respondents categorized into their respective districts will allow the researcher to make inferences regarding the populations residing in each district.

This “utility value” variable calculated in this research represents the relationship of accounted variance of a particular variable over the inverse of the "Growth Potential.” below shows this equation and the proposed relationship.

$$Utility Value = \left(Partial\ R^2 \right) * GP \tag{4}$$

Utility Value = Raw value (scaled if necessary)

Partial R^2 = value of accounted variance from a single IV

GP = Growth Potential = (Maximum IV mean – unit IV mean)

The partial R2, or also known as sequential r-squared, is derived from the multiple linear regression statistic between all of the previously defined IVs and DV. Rather than make inferences regarding the total r-squared value for the regression model, this research uses the individual partial r-squared values from each IV for analysis.

This research uses the created Utility Value to assemble a decision tree. This decision tree categorizes two decisions: where to build a school and where to perform medical projects. The two categories derive from the limited types of projects performed under the HCA program, and the types of projects that actually took place in Belize during the 2014 calendar year. Figure 13 below shows the decision tree described in this section.

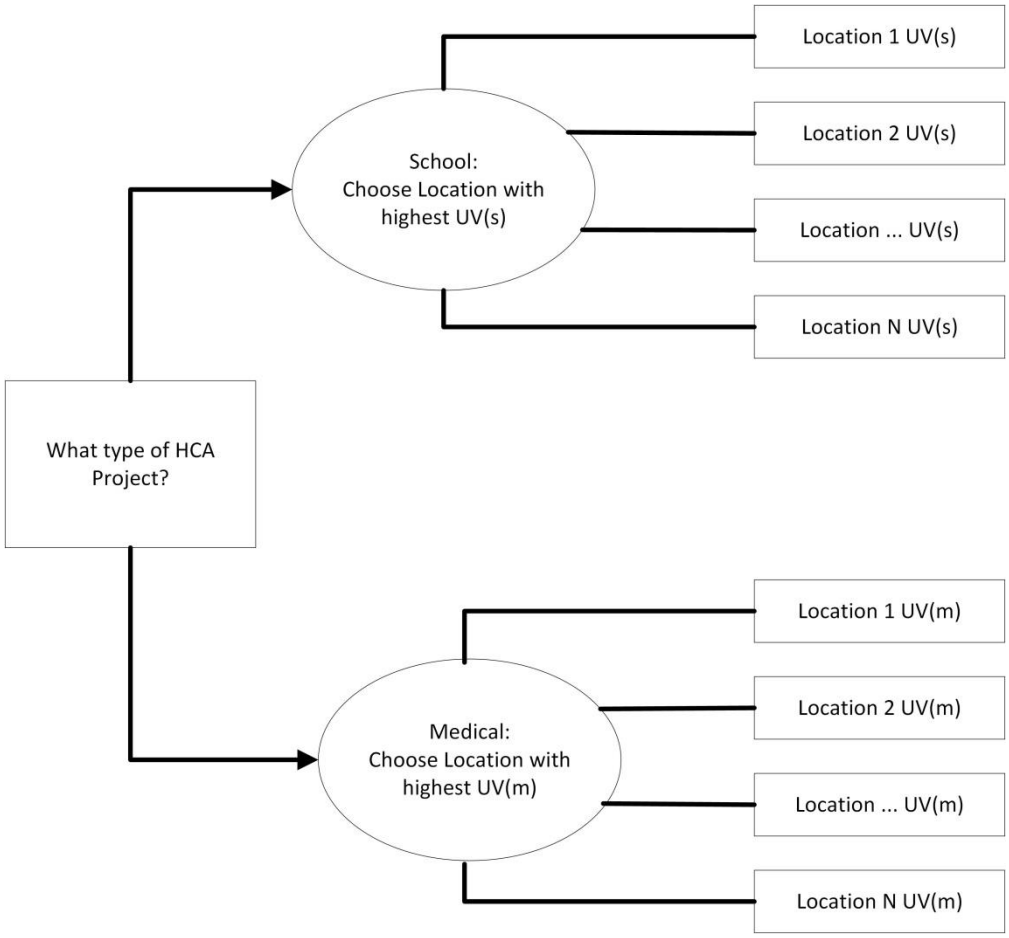

Figure 13: Decision tree

This decision method of evaluating what type of project to perform in specific regions can apply to varying data sets. This thesis will attempt to answer the question at the district, constituency, and village/town/city level. As shown below in Table 8, the survey categorized each respondent into these grouping levels. The presented Utility Value equation evaluates regions in the country that show the lowest measure for satisfaction in certain government provided services and the highest growth potential associated with that region. As documented previously in this thesis, HA/HCA projects have very specific funding requirements and can only support specific objectives. The

projects carried out in 2014 consisted of construction projects, medical projects, and a medical exercise.

Table 8: Aggregation grouping levels

Group
Districts
Constituency
Village/Town/City

3.7 Georeferencing

In order utilize the spatial analysis tools discussed in Chapter 2, each individual AmericasBarometer survey must contain a georeferencing coordinate. The georeferencing coordinates, or spatial component, refer each survey to a home village/town/city. Each AmericasBarometer survey collects the hometown of the participant and then matched by this researcher with a corresponding table of latitude and longitude coordinates. The other geographical groupings derive from the original hometown. An example of this for a resident in the United States is the city of Dayton is located in Kent County, within Ohio. Table 9 below shows the geographical groupings for Belize and the matching key in the AmericasBarometer survey.

Table 9: 2012 AmericasBarometer Geographical feature questions

Key	Georeferenced LAPOP Questions
Prov	What province do you live in?
Municipio	What municipality do you belong to?
Belvillage	What is your home village?

The presence of other geographical features in the survey data collected enables the comparison between geographical groupings in this research. While the maximum

resolution for this data exists at the comparisons among cities, the small sample sizes in some cities limits the depth of this research. On the contrary, while the largest sample sizes at the district level provide the greatest power for statistical tests, the district level lacks the ability to pinpoint a specific region to execute a humanitarian project. The Google Maps® software provided longitude/latitude coordinates for the center of each city/town/village location, and ArcGIS®, via the online database, provided corresponding representations of the country's constituencies and districts. The files obtained by the online ArcGIS® database originate in the .SHP file format and represent these geographical groups as polygons.

3.7.1 Connectivity Matrix Generation

There are two major types of connectivity matrices introduced in this research: binary and row standardized. In order to create connectivity matrices, the researcher must first create a raw weights matrix. The raw weights matrix depicting Euclidian distance displays the distances of each possible straight line. For example, use cities A, B, C, and D. The Euclidean distance, or point-to-point measures, measures the distances between each city. See Table 10 below for an example of a raw weights matrix using Cities A, B, C and D.

Table 10: Raw weights matrix

	City A	City B	City C	City D
City A	0 KM	8 KM	2 KM	5 KM
City B	8 KM	0 KM	4 KM	2 KM
City C	2 KM	4 KM	0 KM	3 KM
City D	5 KM	2 KM	3 KM	0 KM

After generation of the raw weights matrix representing the distances between each city, this research uses the threshold binary spatial weights matrix. As shown below in Table 11, this type of matrix signifies the distances between cities under the chosen threshold, in this case 5 kilometers, as a "1". Distances outside of the threshold receive a "0".

Table 11: Connectivity matrix within 5KM

	City A	City B	City C	City D
City A	0	0	1	1
City B	0	0	1	1
City C	1	1	0	1
City D	0	1	1	0

With all neighbors under a certain threshold receiving a "1", this gives equal weight to each of the neighbors within the chosen threshold. This research will test several distances to evaluate the strength of the networks from varying neighbor distances and the resulting influence on the DV.

3.8 Prepare Data for Analysis

In order to prepare the AmericasBarometer data for analysis, the researcher must create various tables/matrixes to represent the value of the selected characteristics for this research. This research categorizes approximately 58 villages/towns/cities and six districts represented in Belize with this data source.

Table 12 below shows an example matrix used to compile the data for regression.

Table 12: Data preparation for IV, DV village level

Location	IV1	IV1a	IV1b	IV1c	IV2	IV3	DV
Village 1							
Village …							
Village 58							

3.9 Assumptions/Limitations

In order to apply reliable statistical methods with usable data, the researcher must make assumptions concerning the data and state limitations encountered during research. First, the research in this thesis is solely dependent on the AmericasBarometer survey data collected by LAPOP. We assumed the surveys given did not contain misleading or confusing questions in the eyes of the respondent. Conducting the interviews face-to-face in the native language with the assistance of locals employed by Borge y Asociados, the data is assumed to be clear and accurate (LAPOP, 2015). Should the respondent have felt uncomfortable regarding any question or section of the survey, "N/A" or "did not respond" options were available and documented as necessary.

Second, the statistical techniques used in this research depended on a DV with significant limitations. The DV measured on a Likert scale from 1-4. This presents the problems of having only four choices, skewed results, and does not offer an option for a neutral answer (such as a 5 or 7 point Likert). In addition to the small Likert value, only half of the surveys given contained the "satisfaction in democracy" DV question. This significantly trimmed down the number of eligible surveys from over 1500 to under 750 used in this research.

The georeferencing capabilities of Google Maps® and ArcGIS® in this research present another assumption. The village/city/town coordinates, constituency and district diagrams, and records of humanitarian assistance projects in the Occupational Health And Safety Information System (OHASIS) assume to properly represent their actual locations.

All IVs and DVs generated from the AmericasBarometer survey assume to represent the population of geographical area. Research conducted in this thesis assumes the survey respondents from i.e. a village/town/city accurately reflect the population of the respective region. The variance between the aggregations varies, spanning from zero to very large (1.1 Likert scale) variances for some groups. This is typically a result of a low sample size for small villages.

3.10 Summary

This chapter presented the methodology and proposed models to test each research question and problem statement. The chapter also identified the aggregation methods, proposed linear regression, and the additional regression techniques tested for each model. Next, Chapter 4 details the results of the models and maps detailing the results of the presented decision method.

4. Results

4.1 Chapter Overview

Chapter 4 documents the results found using the proposed techniques and models explained in Chapter 3. Our study first aggregates the data from the AmericasBarometer public opinion surveys and organizes the HCA project locations from Belize in 2014. Second, this research investigates each presented model for relationships present between the selected IVs and DV. Finally, this research presents the results of a utility model showing where to concentrate our foreign assistance projects under the HCA program. A brief conclusion summarizes Chapter 4 paves the way for discussions in Chapter 5.

4.2 AmericasBarometer data aggregation

This section shows the output of the aggregation techniques used in this research. The different aggregation outputs in this research display: the country, district, constituency, and city aggregation groupings. Table 13 below contains the aggregation groups and associated sample sizes.

Table 13: Aggregating grouping level sample sizes

Group	Group sample size
Districts	6
Constituency	31
Village/Town/City	58

We first aggregate the IVs/DV at the country level. Table 14 below displays this metric. Descriptive statistics conducted at the country level show the sample size, mean, and standard deviation for each IV/DV and provides a reference point for the entire research.

Table 14: IVs, DV aggregated at country level of Belize

Descriptive	IV1	IV1a	IV1b	IV1c	IV2	IV3	DV
Sample Size	648	648	648	648	648	648	648
mean	2.521	2.40	2.70	2.46	4.652	-.0009	2.71
Standard deviation	0.532	0.747	0.638	0.707	1.272	.38535	0.596

The research intended to aggregate the IVs/DV at the district, constituency, and village/town/city level and provide tight geographical units most in need of humanitarian projects. The different aggregation levels allowed the researcher to identify characteristics of the IVs and DV between the different grouping levels at the district, and later at the village/city/town level. Complications regarding obtaining the data at the constituency level from LAPOP and Vanderbilt University prevented aggregation to the constituency level in this study. In addition, the village/town/city aggregation method proved to be problematic for the utility value statistical test when comparing within the village/town/city groups due to small sample sizes (as low as 3). These unforeseen events, led the researchers focus on data aggregated at the village/city/town level for the first four models and utilizes district level data for the exploratory utility value model presentation.

Table 15 below shows the data aggregated to the district level. Reference Appendix B for this data aggregated to the village/town/city level.

Table 15: IVs, DV aggregated at the district level

District	Sample Size	IV1 mean	IV1a mean	IV1b mean	IV1c mean	IV2 mean	IV3 mean	DV mean
Belize	79	2.700	2.610	2.810	2.670	5.000	0.180	2.770
Cayo	85	2.550	2.530	2.810	2.290	4.440	0.030	2.750
Corozal	189	2.510	2.380	2.610	2.520	4.470	-0.240	2.490
Orange Walk	147	2.400	2.140	2.730	2.330	4.430	0.020	2.820
Stann Creek	80	2.580	2.400	2.750	2.600	4.960	0.200	2.780
Toledo	68	2.510	2.560	2.570	2.410	5.140	0.130	2.870

4.3 Spatial descriptive statistics

As previously mentioned in Chapter 2, a nation-wide census in 2010 provided the population breakdown of the six districts in Belize. To support our claim that LAPOP accurately represents the breakdown of these districts in their survey, Table 16 below compares the population groups between the districts.

Table 16: Census population vs LAPOP survey representation

District	Overall total population %*	LAPOP surveyed population	LAPOP surveyed population %
Belize	29.5%	190	29.0%
Cayo	23.2%	148	22.6%
Corozal	12.7%	79	12.1%
Orange Walk	14.2%	88	13.4%
Stann Creek	10.6%	81	12.4%
Toledo	9.5%	69	10.5%
Total	100%	655	100%

* These % values per district originate from the 2010 Census ("Statistical Institute of Belize," 2015)

We conclude that the data collected at the district level by LAPOP accurately represents the population of Belize for the Utility Value model presented in this Chapter.

4.4 2014 HCA Data

This section details how we classified each individual project site executed during 2014 in Belize into the district groupings. First, we plotted each project site's coordinates on various maps showing each geographical grouping. This original latitudinal/longitudinal coordinate, measured in degrees, are housed by the OHASIS database and required transformation to meters. The ArcGIS® software converted a set of original global latitudinal/longitudinal points to a projected coordinate system in meters specific to the country of Belize. The output allowed the researchers to create distances and spatial weights in meters, rather than degrees of latitude/longitude units.

This research represents each village/town/city level as a point in ArcGIS®. In order to capture which individual village/town/city(s) had a project conducted in their vicinity, a threshold representing the village/town/city "boundary" is required. Reference Appendix C for the geospatial coordinates obtained from Google Maps® and the projected coordinates created from ArcGIS® used in this research.

4.5 ANOVA

To test the models for a relationship between the defined IVs and DV, we used an ANOVA between the DV and each grouping method.

Table 17 below displays the results of this test.

Table 17: ANOVA for each aggregation level

Level of Aggregation		Sum of Squares	df	Mean Square	F	Sig.
District	Between Groups	11.195	5	2.239	6.612	.000
	Within Groups	250.246	739	.339		
	Total	261.442	744			
Constituency	data not	available	at	time	of	submission
Village/ Town/ City	Between Groups	43.731	57	.767	2.421	.000
	Within Groups	217.711	687	.317		
	Total	261.442	744			

The ".000" significant levels for both the district and village/town/city demonstrates that we can reject the null hypothesis which states the means between the groups are the same. In conclusion, the test above shows the selected DV exhibits a significant difference between the means when aggregated at the district and village/town/city level. Before this research can endure linear regression on the proposed models, the next section describes the steps used to test for autocorrelation in the DV.

4.6 Spatial Tests

As described in chapter II, survey data with a spatial component must be tested for spatial dependence in the selected DV of "satisfaction in democracy". If correlation, or spatial dependency exists, in the residuals, then a spatially lagged error term must accompany the standard linear regression formula to account for this dependence.

4.6.1 Connectivity matrix

To test the Moran's I statistic, this research created various spatial weights matrices to test for autocorrelation in the DV. One type of spatial weight matrix, the binary threshold connectivity method, represents the spatial weights matrices chosen for this research. Refer to Appendix D for the raw distance weight matrix and Appendix E for an example connectivity threshold weights matrix.

4.6.2 Moran's I

As described in Chapter 2, the Moran's I statistic outputs a value between -1 and 1, with increasing positive values representing autocorrelation. A range of thresholds were tested and confirmed that no large positive values describe the data and no spatial autocorrelation exists in the DV. Figure 14 below displays the Moran's I plot of the smallest threshold in order for every village to have a neighbor. Reference Appendix F for the remaining Moran's I plots at the tested thresholds.

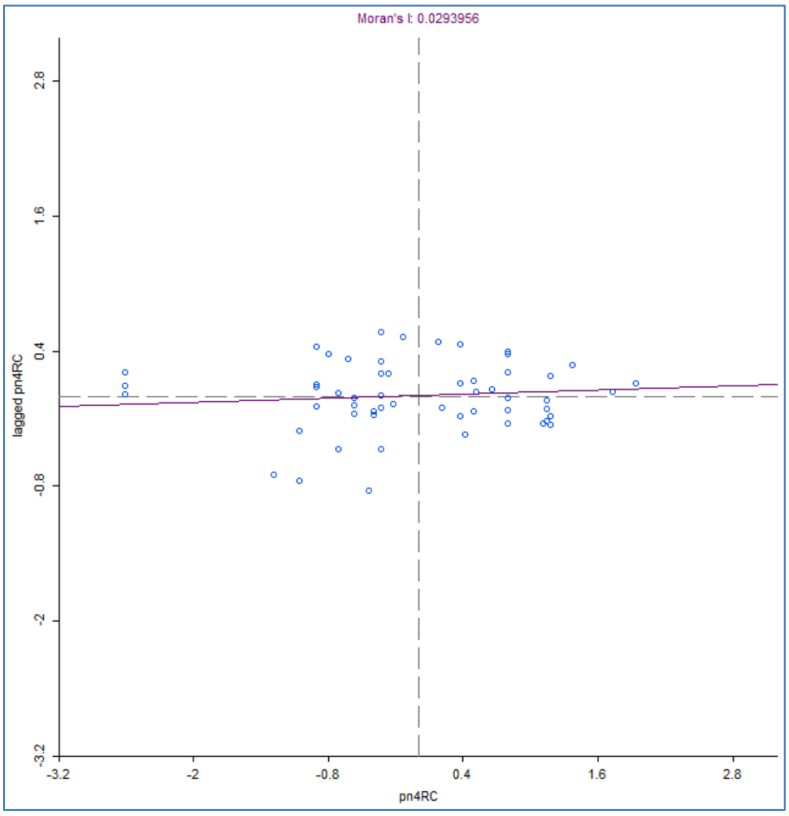

Figure 14: Moran's I calculation of DV (<54.6KM)

Because the Moran's I statistic indicating no spatial clustering in the DV of "satisfaction of democracy", both single and multiple linear regression techniques can apply to this research.

4.7 Models 1, 2, 3, 4

This section summarizes models 1-4 and the linear regression statistic used to test the proposed relationships in Chapter 3.

Table 18 shown below introduces the models with their tested IVs and results for tests of normality and variance necessary to validate the linear regression technique.

Table 18: Models 1-4 Tests of Assumptions

Model	IV	Shapiro-Wilk test of normality	Breusch–Pagan test of constant variance
1	IV1	p = .3176, reject null	p = .038 , cannot reject[a]
2 part 1	IV2	n/a	n/a
2 part 2	IV2	p = .0241, cannot reject[b]	n/a
2 part 3	IV2	p = .1752, reject null	p = .349, reject null
3	IV3	p = .1507, reject null	p = .280, reject null
4	IV1b,IV3	p = .0348, cannot reject	p = .196, reject null

a. Upon further testing, model presented a "soft fail" in constant variance. This researcher accepts this soft fail and continues with the linear model.
b. Further analysis of the residuals warrants no skewed data. This researcher accepts fail and continues with model.

4.7.1 Model 1

Model 1 tests the relationship between satisfaction in government services and satisfaction in democracy. The government services IV will be referenced as IV1. After performing OLS regression in SPSS® software, this research produces a statistically significant model showing a positive relationship between IV1 and the selected DV. Table 19 shown below shows this linear regression output.

Table 19: Model 1 Linear Regression Output

Model	R	R Square	Std. Error of the Estimate
1	.535	.287	.24924

The residuals produced from Model 1 pass both the Shapiro-Wilk's goodness of fit and Breusch-Pagan tests. Model 1 can statistically predict 28.7% of the variance associated with the DV, and the regression plot in Figure 15 shown below displays the scatterplot representing IV1 and the DV.

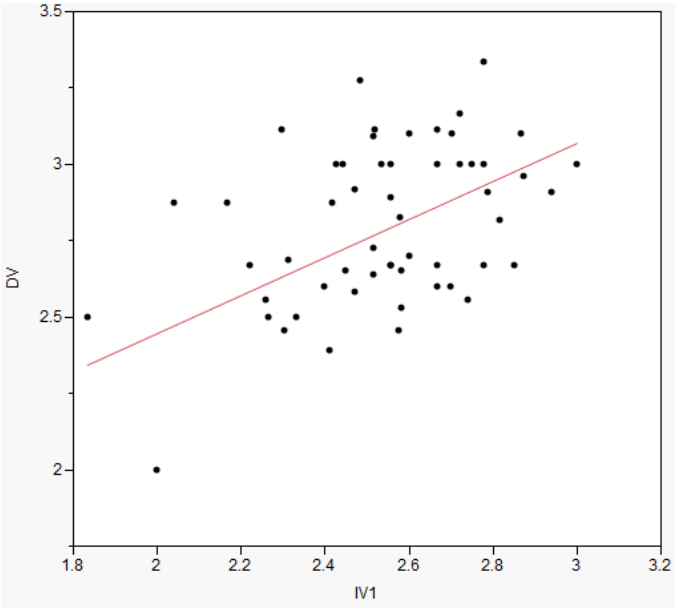

Figure 15: Model 1 regression plot

Table 20 listed below shows the output of the unstandardized and the standardized coefficients of IV1 for model 1. Note the significance of the model of .000 suggests the model is significant in predicting satisfaction in democracy.

Table 20: Model 1 Coefficient Output[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.201	.333		3.605	.001
	IV1	.623	.131	.535	4.743	.000

a. Dependent variable: satisfaction in democracy

4.7.2 Model 2

Model 2 tests the relationship between satisfaction in government legitimacy and satisfaction in democracy. The government legitimacy IV will be referenced as IV2.

After performing OLS regression in SPSS® software, the test first shows no statistically significant model using a p-value of .05 between IV2 and the selected DV. Table 21 shown below displays this regression model output. Additional iterations of model 2 with the removal of outliers yields significant results and introduces a limitation concerning the surveys.

Table 18 shown at the beginning of this chapter lists the associated Shapiro-Wilk goodness of fit and Breusch-Pagan statistic results for each iteration, if applicable.

Table 21: Model 2 Linear Regression Summary

Model	R	R Square	Std. Error of the Estimate
2	.239	.057	.28652

IV2 accounts for just under 6% of the variance of the DV when using linear regression. This researcher attributes this low variance to the insignificance in the model. Table 22 shown below shows the coefficient output for the model failing significance.

Table 22: Model 2 Coefficient Output[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	2.201	.313		7.035	.000
	IV2	.122	.066	.239	1.843	.071

a. Dependent variable: satisfaction in democracy

Further investigation of the residuals requires using the Cook's D test to identify any outlier within the residuals. Figure 16 below displays an outlier in the model using the Cook's D plot.

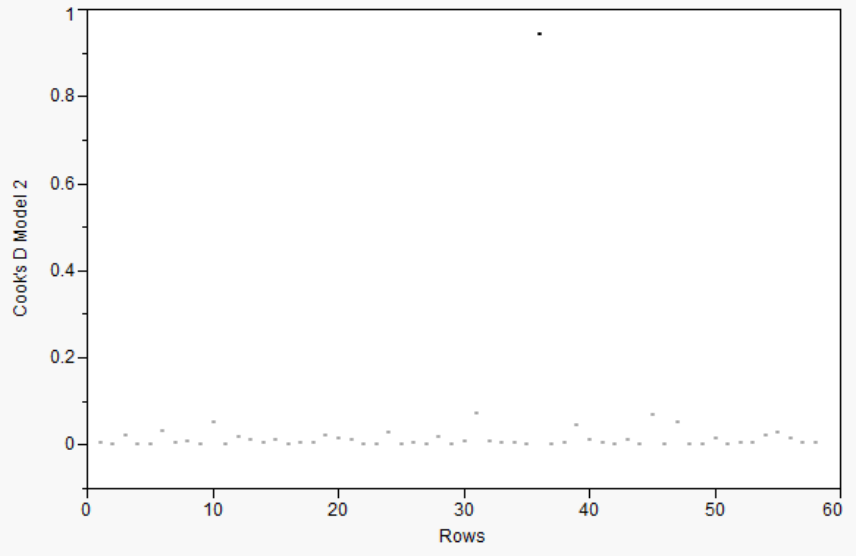

Figure 16: Model 2, Cook's D plot

After removing outlier "Pueblo Viejo" item number 36 and re-running the model, the model tests significant. Further analysis of the residuals uncovers a non-normal distribution, and the test of normality using the shapiro-wilks test fails. Figure 17 below shows a plot of the failed normality.

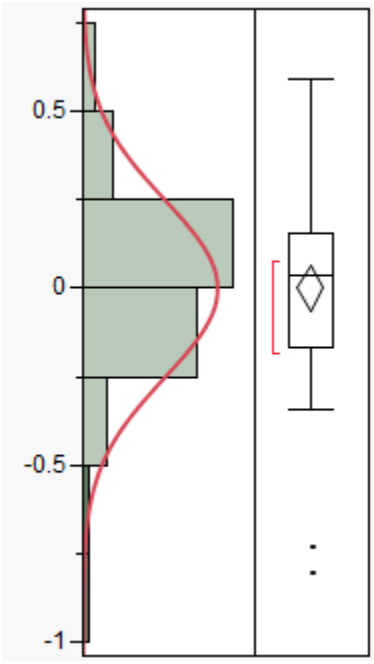

Figure 17: Model 2 plot of residuals (minus 36)

This researcher notices that two additional cities in particular, points 31 and 45 (Maya Mopan and San Pablo, respectively) represent outliers. The next step of this research shown below in Table 23 removes these cities and conducting the final retest of model 2.

Table 23: Model 2 Linear Regression Summary (minus 36, 31, 45)

Model	R	R Square	Std. Error of the Estimate
2	.471	.222	.20915

As shown above, the removal of points 36, 31, and 45 create a significant model, accounting for 22.2% of the adjusted variance describing the relationship between IV2 and the selected DV.

Table 24 shown below depicts the coefficient table output.

Table 24: Coefficient table output (minus outliers 36, 31, and 45) [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	1.881	.242		7.775	.000
	IV2	.200	.051	.471	3.892	.000

a. Dependent variable: Satisfaction in democracy

4.7.3 Model 3

Model 3 tests the relationship between the measurement of social capital and Satisfaction in Democracy. The generated social capital IV will be referenced as IV3. After performing OLS regression in SPSS® software, this research produces a statistically significant model showing a positive relationship between IV3 and the selected DV. Table 25 shown below displays this SPSS® output. The residuals produced from model 3 pass both the Shapiro-Wilk goodness of fit test checking for normality and the Breusch-Pagan test of constant variance. Reference Appendix G for a breakdown of these calculations. Model 3 accounts for 15.7% of the variance within the DV.

Table 25: Model 3 Linear Regression Summary

Model	R	R Square	Std. Error of the Estimate
3	.396[a]	.157	.27100

The IV3 measure of social capital model shows to have a slightly higher slope in the regression plot. Refer below to Figure 18 for this plot. Upon identification of three visual outliers on the value of two on the DV axis, a check on the Cook's D plot confirms this model can keep the results in the model.

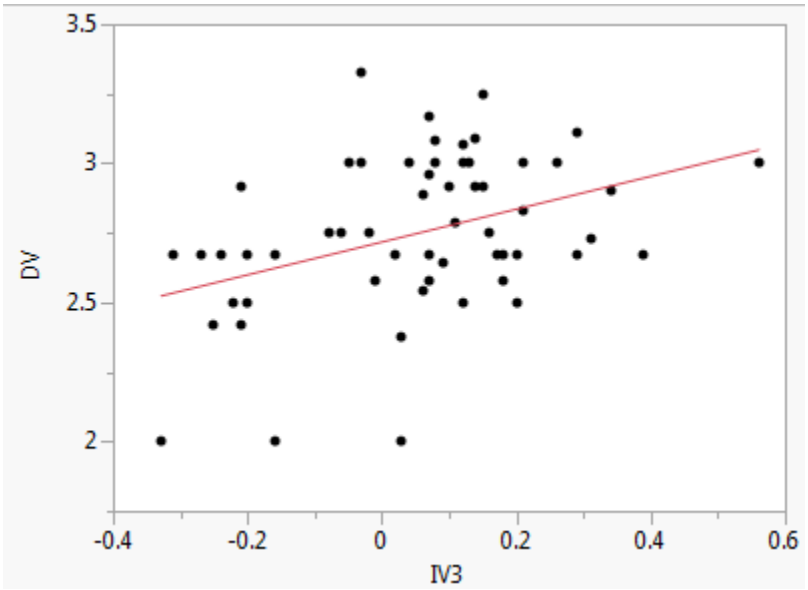

Figure 18: Model 3 regression plot

Table 26 listed below shows the output of the coefficients for model 3. The model results indicate a significant model when using IV3 to predict the selected DV of "satisfaction in democracy."

Table 26: Model 3 Coefficient Output[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
3	(Constant)	2.744	.037		74.555	.000
	IV3	.511	.158	.396	3.224	.002

a. Dependent Variable: Satisfaction in democracy

4.7.4 Model 4

Model 4 tests the relationship and interactions between the previously defined IVs and the DV Satisfaction in Democracy. As described in Chapter 3, this study tests the

individual terms within IV1 for any interaction and associated significance. These additional terms, satisfaction in roads, schools, and health services, will be referred to as IV1a, IV1b, and IV1c, respectively in represented models. This researcher utilized JMP software to identify any interactions present between the identified IVs. After discovering two significant IVs (satisfaction in schools and social capital) using an alpha value of .05, this researcher tested the interaction of these IVs. Results of this tests warrants no significant interaction between satisfaction in schools and social capital. See Appendix G for these two stepwise models.

After performing multiple OLS regression in SPSS® software, the first iteration of Model 4 produces significant results, however further analysis discovers non-normal residuals as shown below in Figure 19.

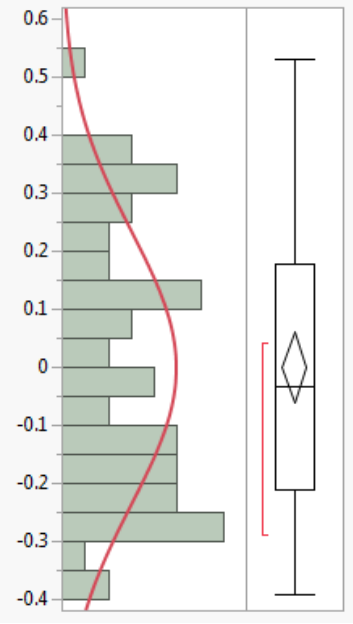

Figure 19: Model 4 plot of residuals

Because regression guards against deviations of non-normality, this researcher chooses to accept the model. Model 4 warrants a significant result, and Table 27 below shows the linear regression summary. This summary shows the importance of the "satisfaction with schools" IV, as this variable alone captures 27.8% of the variance when regressed against the DV "satisfaction in democracy."

Table 27: Model 4 Linear Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
4[a]	.528	.278	.265	.251138	.278
4[b]	.599	.359	.336	.238826	.081

a. Predictors: (Constant), "Satisfaction in schools"

b. Predictors: (Constant), "Satisfaction in schools", social capital

Figure 20 below shows the plot of the actual DV against the predicted DV for Model 4.

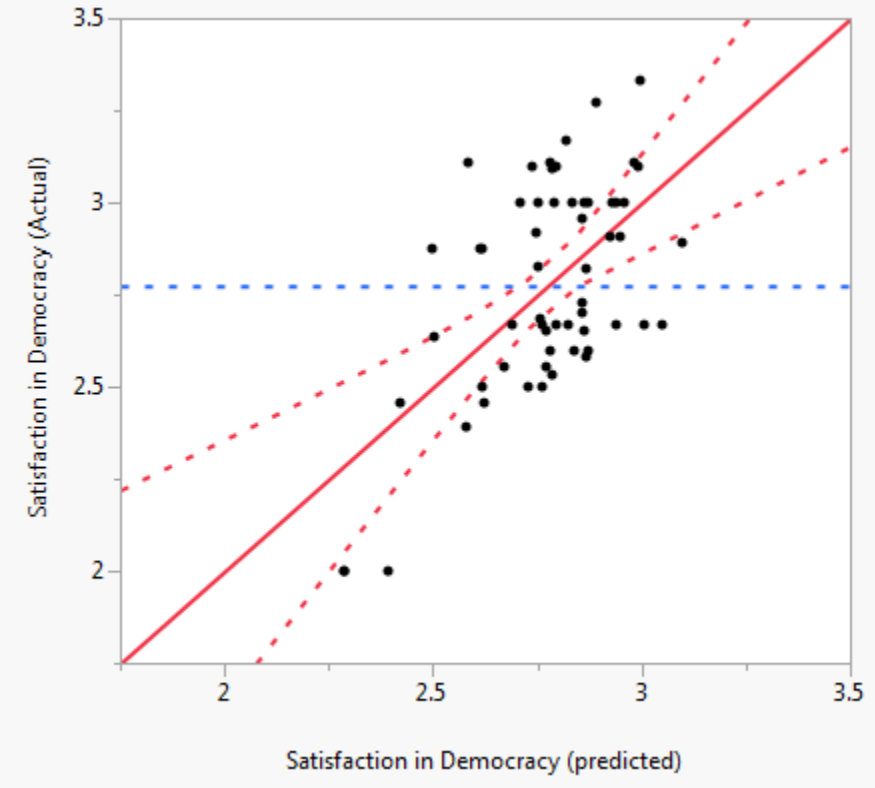

Figure 20: Plot of predicted DV vs actual DV

Table 28 shown below displays the significant IVs present in the model. Note that the only two IVs (IV1b and IV3) contributed to a significant model, and that the interaction of these two variables warrants insignificant results. Reference Appendix H for a summary of this test.

Table 28: Model 4 Coefficient Output[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
4	(Constant)	1.405	0.324		4.339	.000
	IV1b	0.494	0.120	0.458	4.123	.000
	IV3	0.379	0.144	0.292	2.631	.011

a. Dependent variable: satisfaction in democracy

This research concludes that when aggregated at the city level, model 4 captures the largest percent of adjusted accounted variance associated with the DV variable "satisfaction in democracy." Model 4 captures 33.6% of the accounted adjusted variance when "satisfaction in schools" and "social capital" regress against the DV.

4.8 Presentation of Utility Value model and comparison of 2014 HCA sites

The utility model presented in Chapter 3 intends to serve as an exploratory model. This model does not verify assumptions or explore the residuals, and includes all included IVs previously defined regardless of their significance in the model. Instead, this study utilizes the total R-squared values for each geographical unit and compares them with the individual partial R-squared values correlating with each IV term. Before conducting regression between the IVs and DVs, knowing the correlations between the IVs and DV per group (or district in this case) can prove very beneficial. As shown below in Table 29, the chart highlights the correlations and associated significance values. This highlights that the correlations between each of the districts varies, and that a correlation between satisfaction in schools and satisfaction in democracy proves significant based on at least the .05 p-value.

Table 29: Correlation table between IVs/DV per district

District		IV1a (Satisfaction w/ Roads)	IV1b (Satisfaction w/ schools)	IV1c (Satisfaction w/ Public Health Services)	
Toledo	Pearson Correlation	.220	.390	.370	DV (Satisfaction in Democracy)
	Sig. (2-tailed)	.071	.001	.002	
	N	68	68	68	
Stann Creek	Pearson Correlation	.285	.273	.482	
	Sig. (2-tailed)	.009	.013	.000	
	N	82	82	82	
Orange Walk	Pearson Correlation	.122	.302	.141	
	Sig. (2-tailed)	.266	.005	.198	
	N	85	85	85	
Corozal	Pearson Correlation	.185	.227	.085	
	Sig. (2-tailed)	.100	.043	.455	
	N	80	80	80	
Cayo	Pearson Correlation	.256	.202	.141	
	Sig. (2-tailed)	.002	.014	.088	
	N	148	148	148	
Belize	Pearson Correlation	.339	.346	.265	
	Sig. (2-tailed)	.000	.000	.000	
	N	193	193	193	

Coding Key
Correlation is NOT significant
Correlation is significant at the .05 level
Correlation is significant at the .01 level

The created model utilized OLS with dummy variables as described in Chapter 3. The RStudio code to create the output tables shown below can be found in Appendix H. Table 30 shown below contains each district and their associated R-squared tables.

Table 30: R-squared values for IVs per district

District	Sample Size	Total R^2	Partial R-squared				
			IV1a	IV1b	IV1c	IV2	IV3
Corozal	81	.165	.038	.038	.060	.055	.012
Orange Walk	85	.139	.015	.076	.009	.054	.000 [a]
Belize	193	.067	.115	.041	.001	.022	.003
Cayo	148	.122	.066	.018	.000 [a]	.088	.016
Stann Creek	82	.290	.081	.036	.160	.046	.048
Toledo	68	.220	.049	.109	.040	.000 [a]	.071

[a] Non-zero values

This table shows the comparison of the individual partial R2 values with the total R2 value for each district. The district with the highest accounted variance, Stann Creek, can attribute its significant contribution from the IV1c, or "satisfaction in public health services" IV. The district with the lowest accounted variance, Orange Walk, shows significantly low variances from the IVs "satisfaction in public roads" and "satisfaction in public health services." Below, Table 31 shows just the IVs satisfactions in schools and health services compared with the total R-squared value for each district.

Table 31: % of accounted variance from satisfaction in schools and health services

District	Total R^2	% R^2 from school	% R^2 from health services
Corozal	.207	23.03%	36.36%
Orange Walk	.187	54.68%	6.47%
Belize	.213	61.19%	1.49%
Cayo	.220	14.75%	0.00%
Stann Creek	.396	12.41%	55.17%
Toledo	.298	49.55%	18.18%

The next step of the utility value identifies the average values for "satisfaction in schools" and "satisfaction in health services" of each district and subtracts the score from the district with the highest category value. As seen below in

Table 32, no values exist for Corozal due to having the highest satisfaction in schools and health services means.

Table 32: District growth potential calculation

District	Sample Size	Sat in schools	Sat in health services	Growth potential in IV1b	Growth potential in IV1c
Corozal	79	**2.81**	**2.67**	**None**	**None**
Orange Walk	88	2.80	2.30	.01	.37
Belize	190	2.61	2.52	.20	.15
Cayo	148	2.73	2.33	.08	.34
Stann Creek	81	2.74	2.59	.07	.08
Toledo	69	2.57	2.41	.24	.26

As seen in the growth potentials above, the highest range of average values range from only .24 and .34 of a 4-point Likert scale for IV1b and IV1c. This represents a relatively low range between the districts. The utility chart shown below in Table 33 represents the calculated utility value for each district at the "satisfaction in schools" and "satisfaction in health services" categories. The method of scaling utility values helps identify a ranked order of districts. High utility values represent districts that both show potential to improve in the satisfaction score and a high partial R2. This R2 represents the amount of variance accounted from the IV when regressed upon the DV "satisfaction in democracy".

Table 33: Utility Value calculations

District	Satisfaction in schools Utility Value[a]	Satisfaction in medical services Utility Value[a]
Corozal	**None**	**None**
Orange Walk	0.547	2.396
Belize	12.239	0.224
Cayo	1.180	0.000
Stann Creek	0.869	4.414
Toledo	11.891	4.727

a. Utility Values scaled by 100

Based on the utility chart, this researcher concludes that the HCA projects intending to increase satisfaction in schools should occur in the Toledo and Belize Districts. These two districts represent the greatest need of projects based on the R-squared values when regressed on the DV. Table 34 below shows where the 2014 HCA school projects actually took place. A map showing the locations of these school projects can be found in Appendix I.

Table 34: 2014 HCA School Projects in Belize

OHASIS Project ID	District
23791	Belize
23800	Belize
23803	Belize
24049	Belize
25766	Belize
*	Cayo

* Project 25766 took place 2 two locations

The following map presented in Figure 21 shows the ranked order for the districts in Belize with respect to the school Utility Value calculation. The map must be used in

conjunction with assistance of the school Utility Value calculations and to identify potential project sites.

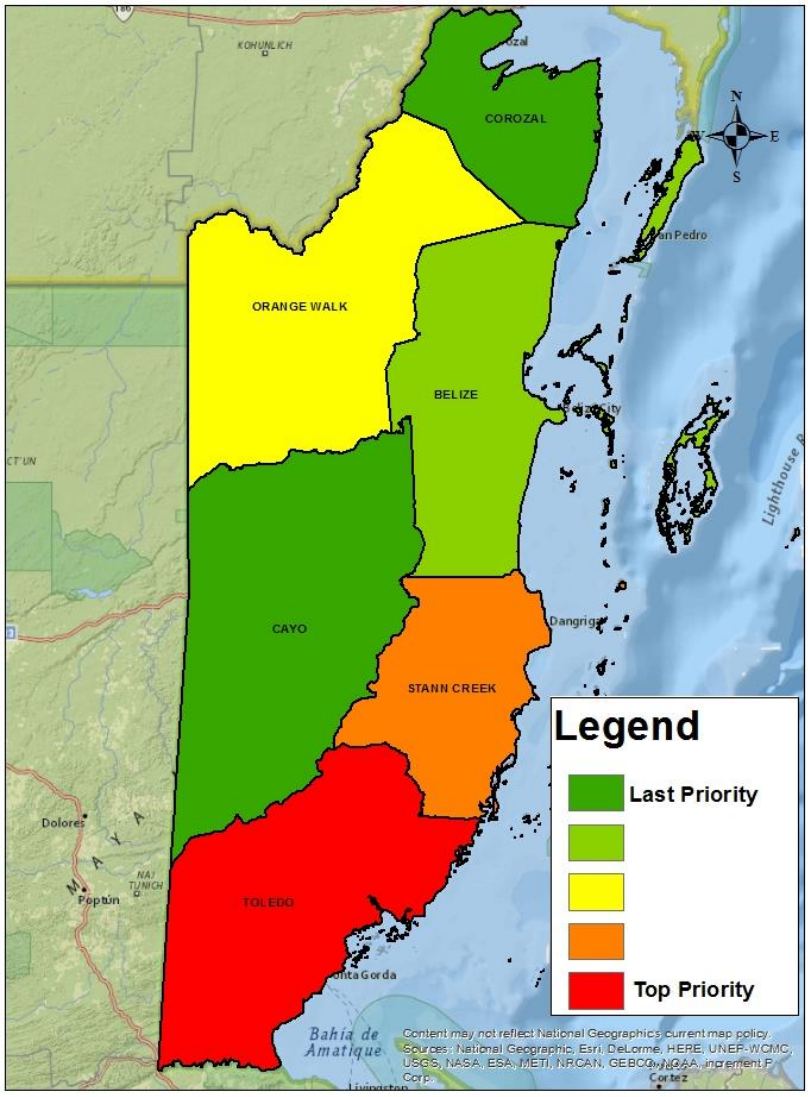

Figure 21: Districts of Belize school UV ranking

Looking again at the utility chart, we concluded that the HCA projects intending to increase satisfaction in medical services should occur in Stann Creek, Toledo, and Orange Walk districts. These three districts represent the greatest need of projects based

on the R-squared values when regressed on the DV. Table 35 below shows where the 2014 HCA projects actually took place.

Table 35: 2014 HCA Medical Projects in Belize

OHASIS Project ID	District
22634	Orange Walk
23804	Belize
23840	Belize
23841	Orange Walk
23844	Belize
23845	Belmopan
23846	Corozal

The utility value metric suggests that the emphasis of medical projects in Belize during 2014 should rather take place in Districts Stann Creek or Toledo when utilizing the medical Utility Value metric. Refer to Figure 22 below to view a map representing the ranking of this medical UV metric.

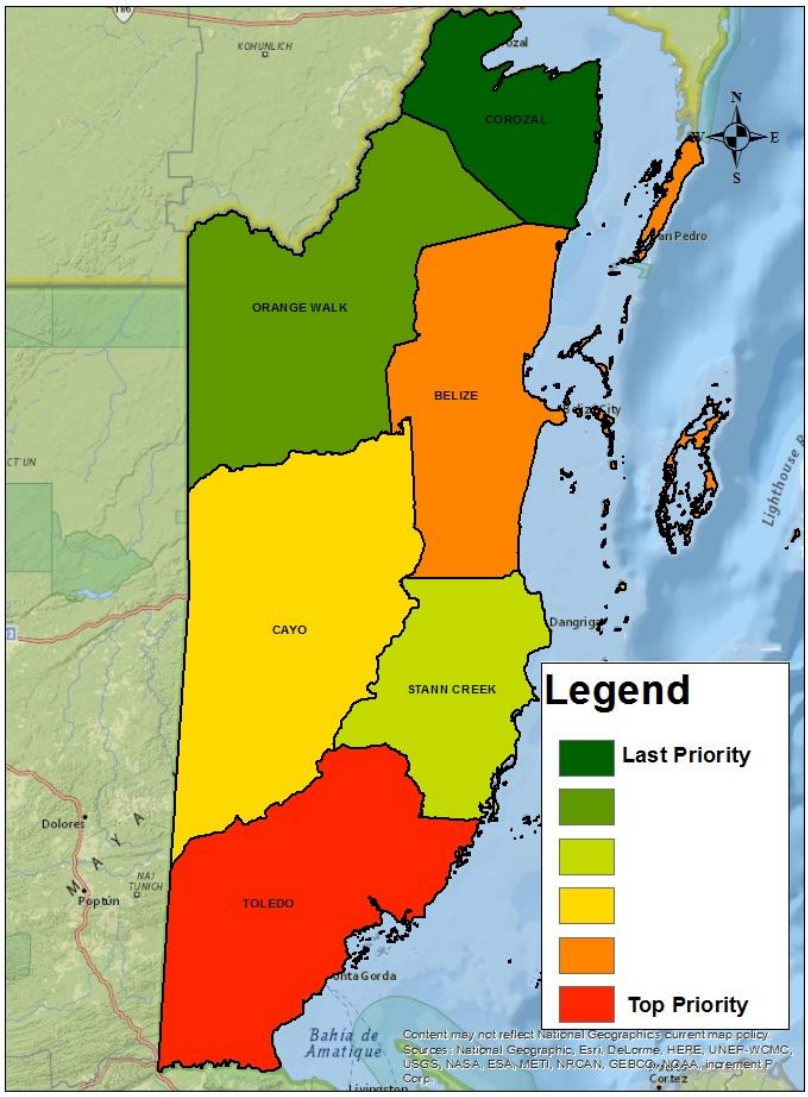

Figure 22: Districts of Belize medical UV ranking

Further analysis of the individual needs within the district will bolster future projects and meet the need of certain medical care in the area.

4.9 Summary

Chapter 4 describes the statistical steps and methods to test the proposed models in Chapter 3. Four of our models resulted in significant findings showing a positive

relationship between satisfaction with government services, ratings of government legitimacy, measure of social capital, and the interaction between these variables. It should be noted the model regarding the ratings of government legitimacy because significant only after the removal of an outlier as detailed in the section. Next, this chapter presented the calculation of a utility model and a comparison against actual project locations performed in 2014 and how this model could influence future decisions in HCA project site selection.

5. Discussion and Conclusion

5.1 Chapter Overview

Chapter 5 provides an overview of the research conducted in this thesis and the answers our research questions. We discuss the relationship of the presented IVs to the overall DV of satisfaction in democracy, stress the importance of the model results Chapter 4, and suggest how to incorporate the findings into future HCA project selections. This chapter concludes with recommendations for future research and a summary of this research effort.

5.2 Review of Research Questions

The research questions presented in Chapter 1 intended to verify the intent of the HCA projects, specifically regarding two types of projects performed in Belize: medical support and educational support. This section reviews each research question and describes the findings.

Question 1: How does personal satisfaction in various local government services in a respondent's region effect the personal view of satisfaction in democracy?

This research can conclude that positive satisfaction in various local government services in a respondents region positively influences the personal satisfaction in democracy. Our finding mirrors the expected result based on literature and helps answer the last research question.

Question 2: How do views towards government legitimacy in a respondent's region at the local/national level influence an individual's satisfaction in democracy?

We concluded that there is significance between the ranking of a government legitimacy rating and an individual's satisfaction in democracy with the removal of outliers in the data. Upon further analysis of the outlier villages, we discovered the outlier villages have only two or three surveys representing the village. We noted this as a limitation of the data and documents applicably in the limitations section. The chosen significance level of .05 conclude there is significance between IV2 and the DV with the outliers removed.

Question 3: What characteristics, if any, of individuals that, when grouped at the local town/village/province, level can accurately predict satisfaction in democracy?

The characteristics mentioned above generate the measured social capital variable in Chapters 3 and 4. Based on the literature and recommendations from Scholar Cruz, this research can conclude there is significance between a positive measure in social capital and satisfaction in democracy.

Question 4: How can the current method of choosing U.S. Humanitarian projects overseas improve with the addition of publically available information?

Model 4 conducted in Chapter 4 highlights a significant finding regarding how to determine satisfaction in democracy when aggregated at the city level. IV variables "satisfaction in schools" and social capital represent significant predictors when regressed against the chosen DV. Chapter 4 concluded with a model showing a Utility Value calculation and decision tree to help assist with future Humanitarian projects. Our model

serves as a starting point for choosing project sites that have the most opportunity to increase their raw satisfaction score by increasing the satisfaction in democracy rating based on choosing projects similar to the types executed in Belize in 2014 under the HCA program.

5.3 Significance of research

The research can aid the process of choosing locations to meet HCA objectives through a systematic approach. The correlation table presented in Chapter 4 highlighted the fact that in some districts there is a correlation between satisfaction in roads and satisfaction in democracy. Although this correlation was relatively weak, it highlights an additional area the U.S. foreign aid can aid that has the potential to impact our diplomacy goals. While the approach of the Utility Model presents an unbiased measure for evaluating locations, this method should accompany other processes. Although areas identified show the highest utility value and meet criteria necessary to qualify for HCA projects, additional measures need to occur to verify the *type* of need in the area. For example, existing medical facilities and the low density of children in rural areas can impact the type and locations of projects conducted under the HCA program.

5.4 Recommendations for future research

Constraints outside the control of the researchers hindered the ability to make inferences at the original desired geographical groupings. Due to the drastic differences in size per village/town/city (ranging from 2 to 118), greater resolution will warrant results with more power and resolution. This researcher also recommends working more

closely with Vanderbilt University regarding future research. Information collected and released at the constituency level would add an additional geographical unit to use in analysis.

5.5 Suggestions for future research

During the span of this research, the researcher identified potential future research topics to continue research this subject. To make an impact on the HCA program, this research needs to work succinctly with research examining effectiveness of our HCA projects. Identifying the effectiveness of our projects will enable us to optimize our projects to the environment and tailor them more to the specific customer. For example, if the model presented in Chapter 3 selects a district to represent a prime candidate for a medical project due to a low satisfaction in medical services and a medical facility is constructed where access to terrain/road conditions warrant hindered travel, meaning a district has room for improvement to the. At the time of publication, fellow researcher Art Dietrich researches the effectiveness of the U.S. HCA projects between 2010 and 2014 in Belize. His initial results show no relationship between satisfaction in schools and the vicinity of a project. If the geographical unit, such as a district, benefited from a new project such as the construction of a new school, identifying any measureable impact over time regarding the satisfaction in schools might prove extremely difficult or non-existent.

5.6 Limitations

In order to conduct research with some unknowns, this researcher made several assumptions regarding the data collected in this research. The selected DV of "satisfaction in democracy" limits this research because of assumptions regarding the comprehension level of the survey participant. If an individual's perspective of satisfaction in democracy, for example, bases solely on the personal feelings regarding the elected officials currently in office and not the process of fair elections, then this answer would incorrectly refer to satisfaction one has in democracy. This is an overall vague term, and can have multiple definitions depending on the class/group of citizens. In addition to the selected DV, the "geographical unit" or village/town/city, constituency, and district properties influenced the results of this research. The bounds of each geographical unit restrict the dummy variables used in this research, and are depending on the geographical features of Belize.

5.7 Summary

This thesis concludes with some parting words regarding this research. The preponderance of information from the models lead this researcher to conclude that when represented at the city level, the proposed models accurately predict satisfaction in democracy by accounting for ~27.8% variance between the defined IVs and DV. This research helps validate the purpose of HCA projects within Belize, and presents a model that can assist in choosing geographical regions presenting the greatest need for HCA projects. While the planners should trust the local governments receiving aid to submit valid project sites proposals, knowledge on the surrounding areas concerning what

influences the satisfaction in democracy proves worthy. Continued research in this field will further develop our HCA programs and spread democratic principles throughout the world.

Appendix A: SPSS® Coding from LAPOP to current research IVs/DV

The following coding instructions should be used to pull the original SPSS document made available from Vanderbilt, delete unnecessary questions, and recode the questions necessary for this research. Next, create the latent variables used to measure the DV of "satisfaction in democracy". Then delete all surveys that do not have a value for any IV or DV variable.

```
#pull data set from
http://datasets.americasbarometer.org/datasets/1408769729Belize%20LAPOP%20Amer
#icasBarometer%202012%20Rev1_W.sav
#dataset is 2012 AmericasBarometer survey of Belize
## original SPSS document contains 286 columns; interested in only keys listed below
##keep ID, sd2new2, sd3new2, sd6new2, b3, b10a, b47, q2, ed, tamano, pol1, idio1, l1,
#prov
##delete manually the other survey questions##

##IV/DV Calculation##
# To create DV, recode: pn4
RECODE pn4 (3=2) (4=1) (2=3) (1=4) (ELSE=Copy) INTO DV.
VARIABLE LABELS  DV 'Recoded satisfaction in Democracy'.

# To create IV1a, IV1b, IV1c,  Recode: sd2new2, sd3new2, sd6new2
RECODE sd2new2 (3=2) (4=1) (2=3) (1=4) (ELSE=Copy) INTO IV1a.
VARIABLE LABELS  IV1a 'Recoded sd2new2'.
RECODE sd3new2 (3=2) (4=1) (2=3) (1=4) (ELSE=Copy) INTO IV1b.
VARIABLE LABELS  IV1b 'Recoded sd3new2'.
RECODE sd6new2 (3=2) (4=1) (2=3) (1=4) (ELSE=Copy) INTO IV1c.
VARIABLE LABELS  IV1c 'Recoded sd6new2'.

# To create IV1 (or sat in government services), combine IV1a, IV1b, IV1c and divide
average by 3
COMPUTE IV1=(IV1a + IV1b + IV1c ) / 3.

#To create IV2, (or measure of Government Legitimacy) combine b3, b10a, b47a and
divide average by 3
COMPUTE IV2=(b3 + b10a + b47a) / 3.

# Identify variables in IV3 (or Social Capital): tamano, q2, ed, pol1, idio1, l1
#recode tamano, pol1, I1
RECODE tamano (1=5) (2=4) (4=2) (5=1) RC_tamano.
VARIABLE LABELS  RC_tamano 'Recoded city size for SC'.
RECODE  pol1 (1=4) (2=3) (3=2) (4=1)  RC_pol1.
VARIABLE LABELS  RC_pol1 'Recoded Ideology for SC'.
```

RECODE I1 (1=10) (2=9) (3=8) (4=7) (5=6) (6=5) (7=4) (8=3) (9=2) (10=1) RC_I1.
VARIABLE LABELS RC_I1 'Recoded Ideology for SC'.
##Z-standardize all variables above to create: zRC_I1, zIC_tamano, zRC_pol1, zq2, zed, zidio1

#To create IV3, combine RC_I1, RC_tamano, RC_pol1, q2, ed, idio1 and divide average ##by 6
COMPUTE IV3=(zRC_I1 + zRC_tamano + zRC_pol1 + zq2 + zed + zidio1) / 6.

#Delete individuals with missing, N/A, DK coding measure for DV, IV1, IV1a, IV1b, ##IV1c, IV2, or IV3
Aggregation Methods
#Districts = prov
#Constituencies = not provided by LAPOP, skip
#Village/town/city = take the ‘villages’ from village and remove duplicates

RECODE village (711=1) (96 thru 98=2) (260 thru 380=3) (693-695=4) (704=4) (554 thru 581 = 5) (639 = 6) (533 thru 544 = 7) (428 = 8) (188 = 9) (192 thru 196 = 9) (460 thru 464 = 10) (65 thru 83 = 11) (58 thru 60 = 12) (417 thru 419 red= 13) (633=14) (440 = 15) (635 = 16) (189 thru 191 = 17) (230 thru 231 =17) (625 = 18) (647 = 19) (143 thru 147 = 20) (203 thru 206 = 21) (708 = 22) (610 thru 614 = 23) (653 = 24) (655 = 24) (234 thru 238 = 25) (256 = 25) (25 = 26) (46 thru 48 = 26) (28 thru 31 = 27) (244 thru 254 = 28) (56 thru 57 = 29) (469 = 30) (424 = 31) (150 thru 178 = 32) (385 thru 410 = 33) (606 thru 609 = 34) ((586 = 35) (623 = 35) (629 thru 630 = 35) (652 = 36) (626 thru 627 = 37) (446 thru 449 = 38) (636 = 39) (432 thru 435 = 40) (109 thru 113 = 41) (488 thru 517 = 42) (102 thru 107 = 43) (681= 44) (700 = 45) (18 thru 20 = 46) (654 = 47) (518 thru 526 = 48) (36 thru 38 = 49) (96 = 50) (122 thru 125 = 50) (589 thru 590 = 51) (452 thru 453 =52) (439 =53) (441 = 53) (703 =54) (127 thru 134 =55) (472 thru 474 = 56) (461 = 57) ((674 thru 680 = 58) (716 thru 720 = 58) INTO Village/town/city.
VARIABLE LABELS Village/town/city 're-labeled Villages/towns/cities.

Appendix B: IVs/DV means per village

Village	Sample Size	IV1 mean	IV1a mean	IV1b mean	IV1c mean	IV2 mean	IV3 mean	DV mean
Air Strip Area	3	3.000	3.000	3.000	3.000	5.000	0.116	3.000
August Pine Ridge	5	2.667	2.400	3.000	2.600	3.533	-0.063	2.600
Belize NS Comb.	118	2.412	2.220	2.542	2.475	4.113	-0.238	2.390
Bella Vista	12	2.472	2.500	2.583	2.333	5.111	0.162	2.917
Belmopan	32	2.313	1.813	2.813	2.313	3.865	-0.118	2.688
Benguche	3	2.667	2.667	2.667	2.667	5.778	0.082	2.667
Benque	10	2.533	2.400	2.700	2.500	5.333	-0.105	3.000
Bullet Tree Falls	10	2.267	2.000	2.500	2.300	4.433	0.212	2.500
Burrell Boom	9	2.852	2.889	3.000	2.667	4.630	-0.555	2.667
Camalote	11	2.485	2.455	2.909	2.091	4.303	0.113	3.273
Corozal Town	20	2.583	2.600	2.650	2.500	4.917	0.135	2.650
Cristo Rey	9	2.704	2.778	2.667	2.667	5.259	0.143	3.000
Duck Run	9	2.667	2.444	3.000	2.556	4.852	0.240	3.111
Foreshore	3	2.556	2.000	3.000	2.667	5.333	-0.096	3.000
Frank Eddy	2	1.833	1.000	2.500	2.000	3.833	-0.083	2.500
Front Street	3	2.778	2.333	3.000	3.000	5.000	-0.272	2.667
Gardenia	9	2.741	2.667	2.889	2.667	4.444	-0.193	2.556
Georgetown	3	2.667	2.667	2.667	2.667	5.333	0.379	3.000
Ghans	3	2.667	2.333	3.000	2.667	5.667	0.294	2.667
Guinea Grass	11	2.515	2.455	2.818	2.273	4.485	-0.052	3.091
Hattieville	11	2.576	2.636	2.636	2.455	4.333	-0.246	2.455
Holly Wood Area	3	2.556	2.667	3.000	2.000	4.444	0.416	2.667
Independence	11	2.788	2.364	2.909	3.091	5.000	0.267	2.909
Jalacte	6	2.722	2.500	2.833	2.833	5.444	0.013	3.167
Ladyville	11	2.515	2.636	2.545	2.364	4.030	-0.456	2.636
Libertad	10	2.700	2.400	2.800	2.900	4.667	0.115	2.600
Little Belize	11	2.939	2.909	3.000	2.909	4.848	0.080	2.909
Lords Bank	11	2.303	2.091	2.273	2.545	3.788	-0.314	2.455
Louisville	10	2.600	2.600	2.700	2.500	4.733	0.300	2.700
Mahogany	6	2.333	2.333	2.667	2.000	4.389	0.078	2.500
Maya Mopan	3	2.000	2.000	2.000	2.000	4.444	-0.027	2.000
Orange Walk Town	32	2.583	2.656	2.750	2.344	4.021	0.032	2.531
Pedro Town	24	2.875	2.875	2.875	2.875	5.292	0.060	2.958
Placencia	12	2.722	2.750	2.667	2.750	4.944	0.166	3.000
Pomona	11	2.515	2.455	2.727	2.364	4.879	0.265	2.727

Village	Sample Size	IV1 mean	IV1a mean	IV1b mean	IV1c mean	IV2 mean	IV3 mean	DV mean
Pueblo Viejo	2	2.519	2.556	2.778	2.222	5.037	-0.007	3.111
Red Bank	6	2.472	2.333	2.917	2.167	4.028	0.033	2.583
Roaring Creek	9	2.450	2.150	2.950	2.250	3.833	-0.027	2.650
Sabals Community	3	2.167	2.125	2.375	2.000	4.000	0.091	2.875
San Antonio	9	2.580	2.652	2.609	2.478	4.797	0.137	2.826
San Estevan	12	2.000	2.000	2.000	2.000	4.778	-0.302	2.000
San Ignacio	20	2.818	2.818	2.818	2.818	4.606	0.163	2.818
San Jose	8	2.444	2.667	2.667	2.000	3.778	0.617	3.000
San Marcus	23	2.417	2.375	2.250	2.625	4.958	-0.066	2.875
San Pablo	3	2.556	2.111	3.111	2.444	5.074	0.396	2.889
Santa Clara	11	2.867	2.700	3.100	2.800	5.267	0.132	3.100
Santa Cruz	3	2.556	2.333	2.667	2.667	4.417	0.248	2.667
Santa Elena	8	2.400	1.700	2.700	2.800	4.667	0.092	2.600
Sarteneja	9	2.042	2.000	2.375	1.750	4.333	0.067	2.875
Shipyard	10	2.296	2.444	2.222	2.222	5.519	0.193	3.111
Silk Grass	12	2.429	2.714	2.857	1.714	4.000	0.022	3.000
Spanish Lookout	10	2.600	2.700	2.600	2.500	5.333	0.105	3.100
St. Matthews	8	2.778	2.333	3.000	3.000	5.333	0.092	3.000
Swasey	9	2.750	2.750	2.750	2.750	5.167	-0.051	3.000
Trial Farm	7	2.519	2.556	2.778	2.222	5.037	-0.007	3.111
Unitedville	10	2.472	2.333	2.917	2.167	4.028	0.033	2.583
Wagierale	3	2.450	2.150	2.950	2.250	3.833	-0.027	2.650
Water Supply	4	2.167	2.125	2.375	2.000	4.000	0.091	2.875

Appendix C: 2012 AmericasBarometer Survey village/town/city Georeferencing

Village	Proj. Y*	Proj. X*	X-Coor**	Y-Coor**
Air Strip Area	-9886223	1816583	16.09894	-88.80949
August Pine Ridge	-9877128	2034705	17.9757	-88.72775
Belize NS Comb.	-9817958	1979040	17.50457	-88.19621
Bella Vista	-9855243	1863583	16.50761	-88.53115
Belmopan	-9881497	1950076	17.25111	-88.76705
Benguche	-9821887	1916882	16.96956	-88.23151
Benque	-9922448	1929299	17.07278	-89.13487
Bullet Tree Falls	-9919880	1940466	17.16865	-89.11180
Burrell Boom	-9842171	1987375	17.57082	-88.41373
Camalote	-9887273	1949576	17.24683	-88.81889
Corozal Town	-9838849	2083617	18.39315	-88.38838
Cristo Rey	-9851467	2078447	18.34907	-88.49723
Duck Run	-9910875	1949058	17.24238	-89.03091
Foreshore	-9823887	1917282	16.96956	-88.23151
Frank Eddy	-9866730	1950443	17.25426	-88.63434
Front Street	-9820387	1917982	16.96956	-88.23151
Gardenia	-9842838	1999396	17.67374	-88.41972
Georgetown	-9852550	1880329	16.65179	-88.50697
Ghans	-9820887	1917982	16.96956	-88.23151
Guinea Grass	-9862638	2033907	17.96889	-88.59759
Hattieville	-9839989	1973192	17.44932	-88.39412
Holly Wood Area	-9886227	1816183	16.09894	-88.80949
Independence	-9842441	1866734	16.53476	-88.41615
Jalacte	-9925443	1823465	16.16177	-89.16177
Ladyville	-9828710	1984816	17.54891	-88.29280
Libertad	-9847027	2074058	18.31164	-88.45735
Little Belize	-9844465	2082557	18.38411	-88.43433
Lords Bank	-9831554	1984940	17.54998	-88.31836
Louisville	-9853089	2074977	18.31948	-88.51181
Mahogany	-9821087	1917982	16.96956	-88.23151
Maya Mopan	-9852550	1880329	16.65179	-88.50697
Orange Walk Town	-9858454	2047332	18.08357	-88.56563
Pedro Town	-9791784	2028347	17.92137	-87.96109
Placencia	-9837446	1865156	16.52116	-88.37128
Pomona	-9837561	1920169	16.99437	-88.37231
Pueblo Viejo	-9918831	1831429	16.23048	-89.10238
Red Bank	-9852550	1880329	16.65179	-88.50697
Roaring Creek	-9885157	1951126	17.26012	-88.79988
Sabals Community	-9822687	1917382	16.96956	-88.23151

San Antonio	-9910096	1930100	17.07966	-89.02391
San Estevan	-9853089	2055170	18.15049	-88.51181
San Ignacio	-9916343	1938558	17.15228	-89.08002
San Jose	-9859980	2048041	18.08962	-88.57371
San Marcus	-9897044	1829703	16.21559	-88.90666
San Pablo	-9859187	2061695	18.20618	-88.56659
Santa Clara	-9852803	2072306	18.2967	-88.50924
Santa Cruz	-9916136	1832708	16.24151	-89.07817
Santa Elena	-9913154	1939919	17.16396	-89.05138
Sarteneja	-9811985	2079121	18.35481	-88.14256
Shipyard	-9871548	2024215	17.88605	-88.67762
Silk Grass	-9833392	1907255	16.88339	-88.33486
Spanish Lookout	-9907723	1951751	17.26549	-89.00259
St. Matthews	-9866730	1950443	17.25426	-88.63434
Swasey	-9860690	1875852	16.61326	-88.58008
Trial Farm	-9857081	2047297	18.08326	-88.54766
Unitedville	-9900510	1945534	17.21214	-88.93779
Wagierale	-9822887	1917282	16.96956	-88.23151
Water Supply	-9886827	1816183	16.09894	-88.80949

*Projected coordinates (in meters) are created from ArcGIS® from WGS 84 Web Mercator coordinates

**WGS 84 Web Mercator coordinate system (in degrees of arc) are pulled from Google Maps®

Appendix D: Raw Distance Matrix (58x58 villages) in KM

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	218	176	56	134	119	118	128	176	133	271	264	135	118
2	218	0	81	173	85	130	115	103	59	86	62	51	92	128
3	176	81	0	121	70	62	116	109	26	75	107	105	98	62
4	56	173	121	0	90	63	94	100	124	92	221	215	102	62
5	134	85	70	90	0	68	46	40	54	6	140	132	29	65
6	119	130	62	63	68	0	101	101	73	73	168	164	95	3
7	118	115	116	94	46	101	0	11	99	41	176	165	23	98
8	128	103	109	100	40	101	11	0	91	34	164	154	12	98
9	176	59	26	124	54	73	99	91	0	59	96	92	79	72
10	133	86	75	92	6	73	41	34	59	0	143	134	24	70
11	271	62	107	221	140	168	176	164	96	143	0	14	153	166
12	264	51	105	215	132	164	165	154	92	134	14	0	142	163
13	135	92	98	102	29	95	23	12	79	24	153	142	0	91
14	118	128	62	62	65	3	98	98	72	70	166	163	91	0
15	135	85	58	88	13	58	58	52	45	19	136	129	42	55
16	121	130	61	65	69	2	103	102	73	74	167	163	96	5
17	188	49	32	136	63	85	106	97	12	67	84	80	85	84
18	72	156	104	17	75	48	84	89	107	76	203	198	89	47
19	121	130	61	64	69	1	102	102	73	74	167	163	95	4
20	219	15	71	170	86	124	120	110	51	88	55	46	98	122
21	163	72	23	111	48	59	93	86	14	53	110	106	75	57
22	1	219	177	57	134	119	119	129	177	133	272	265	135	119
23	67	172	115	13	92	54	102	107	121	94	217	212	107	54
24	40	217	189	81	134	139	106	117	184	132	274	265	126	138
25	178	70	12	124	63	68	109	101	14	68	99	96	90	67
26	260	50	99	211	129	159	163	152	87	131	13	6	140	158
27	269	58	107	219	138	167	172	161	95	140	6	8	149	166
28	177	67	15	124	61	69	107	99	11	66	99	96	87	67
29	261	47	102	211	128	161	161	150	88	130	17	4	139	160
30	120	128	61	64	66	2	100	99	71	71	166	162	93	2
31	70	156	106	16	75	50	83	88	108	76	204	198	88	49
32	232	23	79	184	100	135	134	123	62	102	41	32	111	134
33	232	86	56	177	119	115	164	155	65	124	73	78	143	115
34	69	174	116	18	96	54	106	112	122	98	218	214	111	54
35	114	121	62	59	53	16	85	85	67	58	163	159	79	13
36	36	208	179	71	124	129	98	109	174	122	265	256	118	128

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
37	72	156	105	17	76	48	85	90	108	77	204	198	90	47
38	135	84	73	93	4	72	43	36	56	3	140	132	26	69
39	119	129	62	63	67	1	100	100	73	72	167	164	94	2
40	116	110	104	86	35	89	12	14	89	30	169	160	19	86
41	241	32	84	192	109	142	144	133	69	111	32	23	121	140
42	126	104	106	97	37	97	11	4	89	31	164	154	12	94
43	233	22	81	185	100	137	134	123	63	102	41	32	111	135
44	17	206	169	54	121	115	103	113	167	120	260	253	120	114
45	247	32	92	198	114	150	147	136	76	116	30	18	124	148
46	258	45	100	209	126	158	159	148	86	127	18	6	136	157
47	34	206	176	68	122	126	97	108	171	120	263	254	116	125
48	126	101	103	96	33	94	14	7	85	28	162	152	9	91
49	273	79	100	220	147	163	186	176	97	150	27	39	163	162
50	208	12	70	161	75	118	108	97	47	76	68	58	85	116
51	105	135	73	49	64	15	92	93	81	69	176	172	88	14
52	137	88	94	103	26	93	27	17	75	21	149	139	4	90
53	138	83	54	90	17	56	62	57	41	23	133	126	46	53
54	65	160	112	13	77	56	82	88	113	78	209	203	89	55
55	233	24	79	184	100	135	135	124	62	102	41	32	112	133
56	130	92	89	94	20	84	27	20	72	14	151	142	11	81
57	119	129	62	63	67	1	100	100	73	72	167	164	94	2
58	1	219	177	57	134	120	119	129	177	133	272	265	135	119

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	135	121	188	72	121	219	163	1	67	40	178	260	269	177
2	85	130	49	156	130	15	72	219	172	217	70	50	58	67
3	58	61	32	104	61	71	23	177	115	189	12	99	107	15
4	88	65	136	17	64	170	111	57	13	81	124	211	219	124
5	13	69	63	75	69	86	48	134	92	134	63	129	138	61
6	58	2	85	48	1	124	59	119	54	139	68	159	167	69
7	58	103	106	84	102	120	93	119	102	106	109	163	172	107
8	52	102	97	89	102	110	86	129	107	117	101	152	161	99
9	45	73	12	107	73	51	14	177	121	184	14	87	95	11
10	19	74	67	76	74	88	53	133	94	132	68	131	140	66
11	136	167	84	203	167	55	110	272	217	274	99	13	6	99
12	129	163	80	198	163	46	106	265	212	265	96	6	8	96
13	42	96	85	89	95	98	75	135	107	126	90	140	149	87
14	55	5	84	47	4	122	57	119	54	138	67	158	166	67

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
15	0	58	55	71	58	84	37	135	88	139	53	126	134	51
16	58	0	84	50	1	123	59	121	56	141	67	158	166	68
17	55	84	0	119	84	40	26	188	133	194	20	75	83	18
18	71	50	119	0	49	153	93	73	18	92	107	193	202	106
19	58	1	84	49	0	123	58	121	56	141	67	158	166	68
20	84	123	40	153	123	0	65	219	168	220	60	43	52	58
21	37	59	26	93	58	65	0	164	106	172	16	101	109	14
22	135	121	188	73	121	219	164	0	67	40	178	261	270	177
23	88	56	133	18	56	168	106	67	0	94	119	207	216	119
24	139	141	194	92	141	220	172	40	94	0	188	263	271	187
25	53	67	20	107	67	60	16	178	119	188	0	91	99	3
26	126	158	75	193	158	43	101	261	207	263	91	0	9	90
27	134	166	83	202	166	52	109	270	216	271	99	9	0	11
28	51	68	18	106	68	58	14	177	119	187	3	90	11	0
29	126	160	76	194	160	42	103	261	209	262	93	6	165	93
30	56	3	83	48	2	122	57	120	55	140	67	157	203	67
31	72	52	120	2	51	154	94	71	19	90	108	194	38	108
32	97	135	50	166	135	14	76	233	181	234	69	29	76	68
33	109	114	59	160	114	71	73	232	169	245	57	72	218	59
34	91	56	134	23	55	171	108	69	5	97	120	209	163	120
35	43	17	79	42	17	116	53	115	54	131	65	154	262	65
36	129	131	184	82	131	210	162	36	84	10	178	253	202	177
37	72	50	119	1	49	154	94	72	17	92	107	194	138	107
38	16	73	64	77	72	86	50	135	95	134	66	129	167	63
39	57	2	84	48	2	123	58	119	54	139	68	159	166	68
40	46	91	97	75	90	114	82	116	93	108	98	157	29	96
41	106	141	57	174	141	23	83	241	189	243	74	20	161	73
42	49	98	95	85	98	109	84	126	103	115	99	152	38	97
43	98	136	52	167	136	14	77	233	182	234	71	29	258	69
44	124	117	178	67	117	207	154	17	66	29	169	249	26	168
45	112	149	64	181	149	28	91	247	196	247	83	17	13	82
46	123	158	74	191	158	40	100	258	206	259	91	6	260	90
47	127	128	182	79	128	208	160	34	81	13	175	251	158	174
48	46	95	92	84	95	107	80	127	102	117	96	150	33	93
49	141	161	85	203	161	68	110	273	215	280	96	35	64	96
50	74	118	38	144	118	13	60	209	160	208	58	56	176	56
51	56	17	93	33	16	130	66	105	42	124	78	167	145	78
52	39	94	80	89	93	94	71	137	107	130	86	137	131	83
53	5	56	51	73	56	81	32	138	89	143	48	122	207	46
54	75	58	125	9	58	158	100	65	20	83	114	199	37	113

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
55	98	134	50	166	134	14	76	233	181	234	69	29	148	67
56	32	85	79	80	84	96	67	130	98	125	82	139	167	79
57	57	3	85	48	2	123	58	119	54	139	68	159	270	68
58	135	122	188	73	121	219	164	1	67	39	178	261	1	178

	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	261	120	70	232	232	69	114	36	72	135	119	116	241	126
2	47	128	156	23	86	174	121	208	156	84	129	110	32	104
3	102	61	106	79	56	116	62	179	105	73	62	104	84	106
4	211	64	16	184	177	18	59	71	17	93	63	86	192	97
5	128	66	75	100	119	96	53	124	76	4	67	35	109	37
6	161	2	50	135	115	54	16	129	48	72	1	89	142	97
7	161	100	83	134	164	106	85	98	85	43	100	12	144	11
8	150	99	88	123	155	112	85	109	90	36	100	14	133	4
9	88	71	108	62	65	122	67	174	108	56	73	89	69	89
10	130	71	76	102	124	98	58	122	77	3	72	30	111	31
11	17	166	204	41	73	218	163	265	204	140	167	169	32	164
12	4	162	198	32	78	214	159	256	198	132	164	160	23	154
13	139	93	88	111	143	111	79	118	90	26	94	19	121	12
14	160	2	49	134	115	54	13	128	47	69	2	86	140	94
15	126	56	72	97	109	91	43	129	72	16	57	46	106	49
16	160	3	52	135	114	56	17	131	50	73	2	91	141	98
17	76	83	120	50	59	134	79	184	119	64	84	97	57	95
18	194	48	2	166	160	23	42	82	1	77	48	75	174	85
19	160	2	51	135	114	55	17	131	49	72	2	90	141	98
20	42	122	154	14	71	171	116	210	154	86	123	114	23	109
21	103	57	94	76	73	108	53	162	94	50	58	82	83	84
22	261	120	71	233	232	69	115	36	72	135	119	116	241	126
23	209	55	19	181	169	5	54	84	17	95	54	93	189	103
24	262	140	90	234	245	97	131	10	92	134	139	108	243	115
25	93	67	108	69	57	120	65	178	107	66	68	98	74	99
26	6	157	194	29	72	209	154	253	194	129	159	157	20	152
27	165	203	38	76	218	163	262	202	138	167	166	29	161	38
28	93	67	108	68	59	120	65	177	107	63	68	96	73	97
29	0	159	195	28	77	210	156	252	195	128	161	156	20	150
30	159	0	50	134	114	55	15	129	48	70	1	88	140	95
31	195	50	0	167	161	23	44	80	3	77	50	74	175	84
32	28	134	167	0	69	183	129	224	167	100	135	128	9	123
33	77	114	161	69	0	169	117	234	160	121	115	154	67	154
34	210	55	23	183	169	0	55	88	21	98	54	97	191	108

	29	30	31	32	33	34	35	36	37	38	39	40	41	42
35	156	15	44	129	117	55	0	120	43	57	15	73	136	81
36	252	129	80	224	234	88	120	0	82	124	129	99	233	107
37	195	48	3	167	160	21	43	82	0	78	48	76	175	86
38	128	70	77	100	121	98	57	124	78	0	71	33	109	34
39	161	1	50	135	115	54	15	129	48	71	0	88	141	96
40	156	88	74	128	154	97	73	99	76	33	88	0	137	11
41	20	140	175	9	67	191	136	233	175	109	141	137	0	133
42	150	95	84	123	154	108	81	107	86	34	96	11	133	0
43	28	135	168	2	71	184	130	224	168	100	136	128	10	123
44	249	116	65	221	225	69	108	22	67	122	115	101	230	111
45	15	148	182	14	75	198	143	238	181	114	149	141	9	136
46	3	157	192	26	75	208	153	250	192	125	158	153	17	148
47	250	127	77	222	232	85	118	3	79	122	126	98	231	106
48	148	93	83	121	150	106	78	109	85	30	93	10	130	3
49	41	161	204	56	55	215	161	270	203	147	162	178	48	175
50	54	116	145	27	80	163	109	198	145	74	117	102	36	97
51	169	15	35	142	128	42	14	114	33	68	15	80	149	89
52	135	91	89	108	139	112	77	121	90	23	92	22	117	16
53	123	54	73	95	105	92	43	133	74	21	55	51	103	54
54	199	57	7	171	167	26	50	73	9	79	56	73	179	84
55	28	133	167	1	68	183	129	225	167	100	134	129	9	124
56	138	82	79	110	137	102	68	116	81	16	83	18	119	17
57	161	1	50	135	115	54	15	129	47	71	0	88	141	96
58	261	121	71	233	232	70	115	35	73	135	120	116	241	126

	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
1	233	17	247	258	34	126	273	208	105	137	138	65	233	130	119	1
2	22	206	32	45	206	101	79	12	135	88	83	160	24	92	129	219
3	81	169	92	100	176	103	100	70	73	94	54	112	79	89	62	177
4	185	54	198	209	68	96	220	161	49	103	90	13	184	94	63	57
5	100	121	114	126	122	33	147	75	64	26	17	77	100	20	67	134
6	137	115	150	158	126	94	163	118	15	93	56	56	135	84	1	120
7	134	103	147	159	97	14	186	108	92	27	62	82	135	27	100	119
8	123	113	136	148	108	7	176	97	93	17	57	88	124	20	100	129
9	63	167	76	86	171	85	97	47	81	75	41	113	62	72	73	177
10	102	120	116	127	120	28	150	76	69	21	23	78	102	14	72	133
11	41	260	30	18	263	162	27	68	176	149	133	209	41	151	167	272
12	32	253	18	6	254	152	39	58	172	139	126	203	32	142	164	265
13	111	120	124	136	116	9	163	85	88	4	46	89	112	11	94	135

	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
14	135	114	148	157	125	91	162	116	14	90	53	55	133	81	2	119
15	98	124	112	123	127	46	141	74	56	39	5	75	98	32	57	135
16	136	117	149	158	128	95	161	118	17	94	56	58	134	85	3	122
17	52	178	64	74	182	92	85	38	93	80	51	125	50	79	85	188
18	167	67	181	191	79	84	203	144	33	89	73	9	166	80	48	73
19	136	117	149	158	128	95	161	118	16	93	56	58	134	84	2	121
20	14	207	28	40	208	107	68	13	130	94	81	158	14	96	123	219
21	77	154	91	100	160	80	110	60	66	71	32	100	76	67	58	164
22	233	17	247	258	34	127	273	209	105	137	138	65	233	130	119	1
23	182	66	196	206	81	102	215	160	42	107	89	20	181	98	54	67
24	234	29	247	259	13	117	280	208	124	130	143	83	234	125	139	39
25	71	169	83	91	175	96	96	58	78	86	48	114	69	82	68	178
26	29	249	17	6	251	150	35	56	167	137	122	199	29	139	159	261
27	258	26	13	260	158	33	64	176	145	131	207	37	148	167	270	1
28	69	168	82	90	174	93	96	56	78	83	46	113	67	79	68	178
29	28	249	15	3	250	148	41	54	169	135	123	199	28	138	161	261
30	135	116	148	157	127	93	161	116	15	91	54	57	133	82	1	121
31	168	65	182	192	77	83	204	145	35	89	73	7	167	79	50	71
32	2	221	14	26	222	121	56	27	142	108	95	171	1	110	135	233
33	71	225	75	75	232	150	55	80	128	139	105	167	68	137	115	232
34	184	69	198	208	85	106	215	163	42	112	92	26	183	102	54	70
35	130	108	143	153	118	78	161	109	14	77	43	50	129	68	15	115
36	224	22	238	250	3	109	270	198	114	121	133	73	225	116	129	35
37	168	67	181	192	79	85	203	145	33	90	74	9	167	81	47	73
38	100	122	114	125	122	30	147	74	68	23	21	79	100	16	71	135
39	136	115	149	158	126	93	162	117	15	92	55	56	134	83	1	120
40	128	101	141	153	98	10	178	102	80	22	51	73	129	18	88	116
41	10	230	9	17	231	130	48	36	149	117	103	179	9	119	141	241
42	123	111	136	148	106	3	175	97	89	16	54	84	124	17	96	126
43	0	221	14	25	223	120	57	26	143	107	95	172	3	110	136	233
44	221	0	235	247	19	111	264	196	100	123	127	59	221	116	115	17
45	14	235	0	12	236	133	50	39	157	120	109	186	15	123	149	247
46	25	247	12	0	248	145	41	52	166	132	120	197	25	135	158	258
47	223	19	236	248	0	107	268	197	111	119	131	70	223	114	126	34
48	120	111	133	145	107	0	172	94	86	13	50	83	121	14	93	127
49	57	264	50	41	268	172	0	81	173	159	137	209	55	160	162	273
50	26	196	39	52	197	94	81	0	123	81	72	149	27	84	117	209
51	143	100	157	166	111	86	173	123	0	87	55	42	142	77	15	106
52	107	123	120	132	119	13	159	81	87	0	43	89	108	10	92	137
53	95	127	109	120	131	50	137	72	55	43	0	77	95	37	55	139

54	172	59	186	197	70	83	209	149	42	89	77	0	171	80	56	65
55	3	221	15	25	223	121	55	27	142	108	95	171	0	111	134	233
56	110	116	123	135	114	14	160	84	77	10	37	80	111	0	83	130
57	136	115	149	158	126	93	162	117	15	92	55	56	134	83	0	120
58	233	17	247	258	34	127	273	209	106	137	139	65	233	130	120	0

Appendix E: Example threshold connectivity matrix (<56.4 KM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
5	0	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1
7	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0
8	0	0	0	0	1	0	1	0	0	1	0	0	1	0	1	0	0	0	0
9	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0
10	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
12	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
13	0	0	0	0	1	0	1	1	0	1	0	0	0	0	1	0	0	0	0
14	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	1
15	0	0	0	0	1	0	0	1	1	1	0	0	1	1	0	0	0	0	0
16	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
17	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
18	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1
19	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0
20	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0
21	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0
22	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0
26	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
28	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0
29	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
30	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
31	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
32	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
35	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	0	1	1
36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
38	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
39	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
40	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
41	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
42	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
43	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
44	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
46	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
50	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
51	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
52	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
53	0	0	1	0	1	0	0	0	1	1	0	0	1	1	1	0	1	0	0
54	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
55	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
56	0	0	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	0
57	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
58	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
2	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
3	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
4	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1
5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
6	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0
12	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
15	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0
16	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1
17	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
18	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
19	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1
20	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0
21	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0
22	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
23	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1
24	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
25	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
26	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0
27	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0
28	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
29	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1
31	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	1
32	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1
35	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	1
36	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	0
38	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
40	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
41	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
42	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
43	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
44	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0
45	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0
46	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
47	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
48	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
50	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
51	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0	0
54	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	1	0	1
55	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	1	0	1
58	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0

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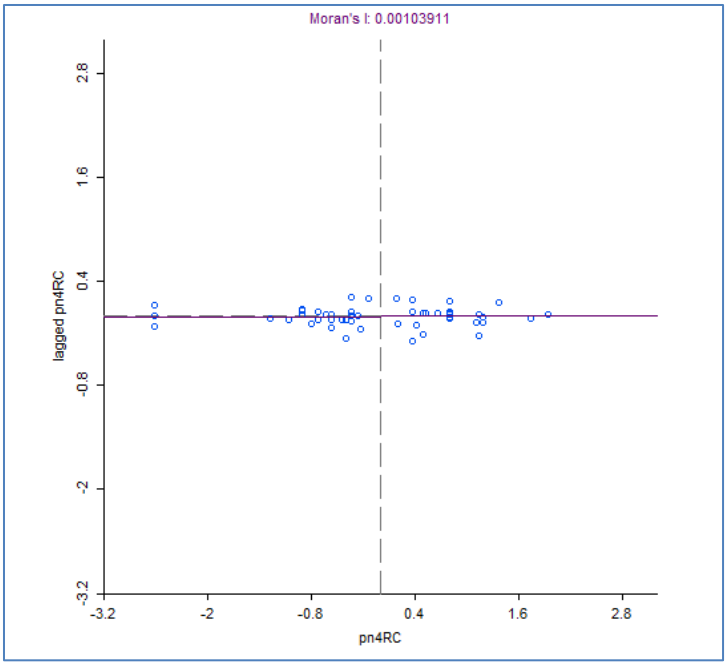
2	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
4	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0
5	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
6	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
7	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0
8	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
10	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
11	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0
12	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0

	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
13	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
14	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
15	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
16	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
17	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0
18	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
19	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
20	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0
21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
22	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
23	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
24	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
26	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0
27	0	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	1
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
29	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	0	0	1	0	0	0
30	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
31	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
32	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
34	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
35	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0
36	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
37	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
38	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
40	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
41	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	1	0	0	0
42	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0
43	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0
44	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
45	0	0	0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0
46	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0
47	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
48	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
49	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0
51	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
52	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
53	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
55	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0

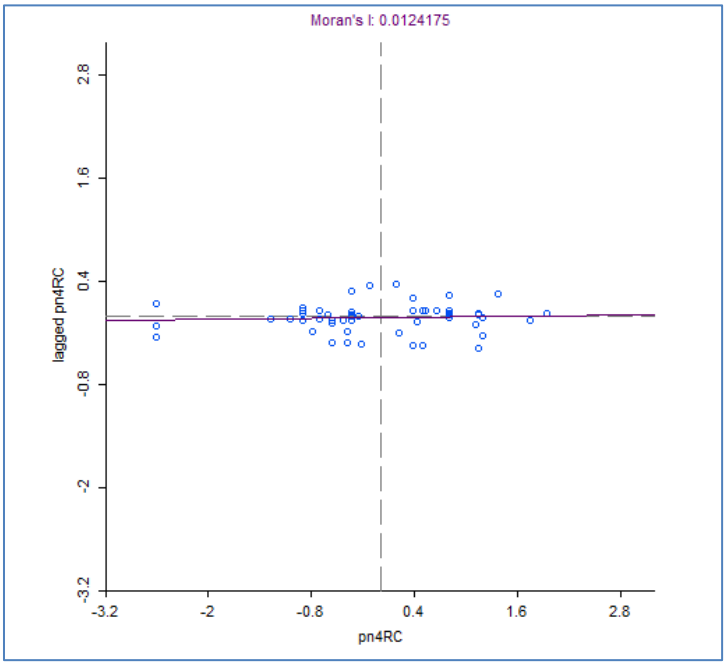
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
56	1	0	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0
57	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
58	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Appendix F: Moran's I Plots

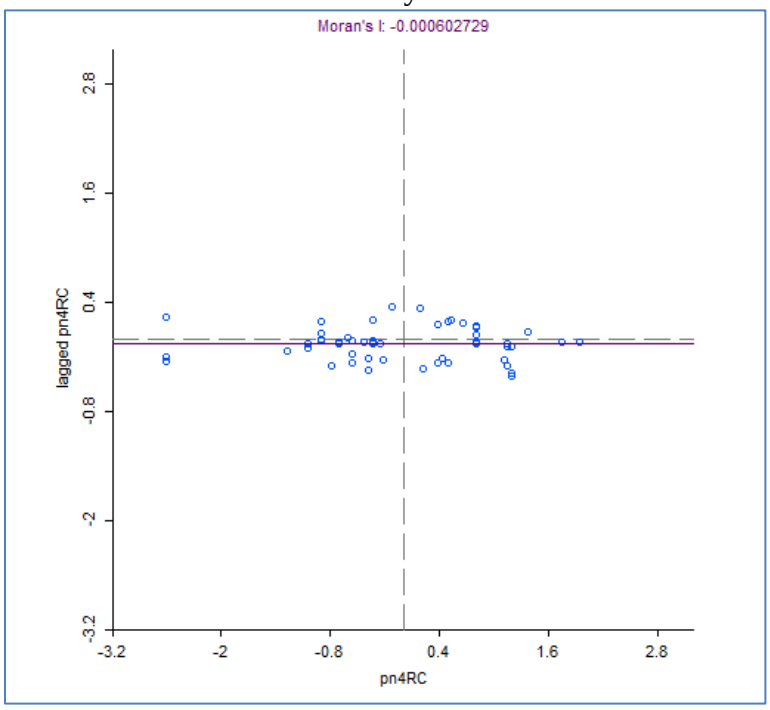
150KM Binary threshold



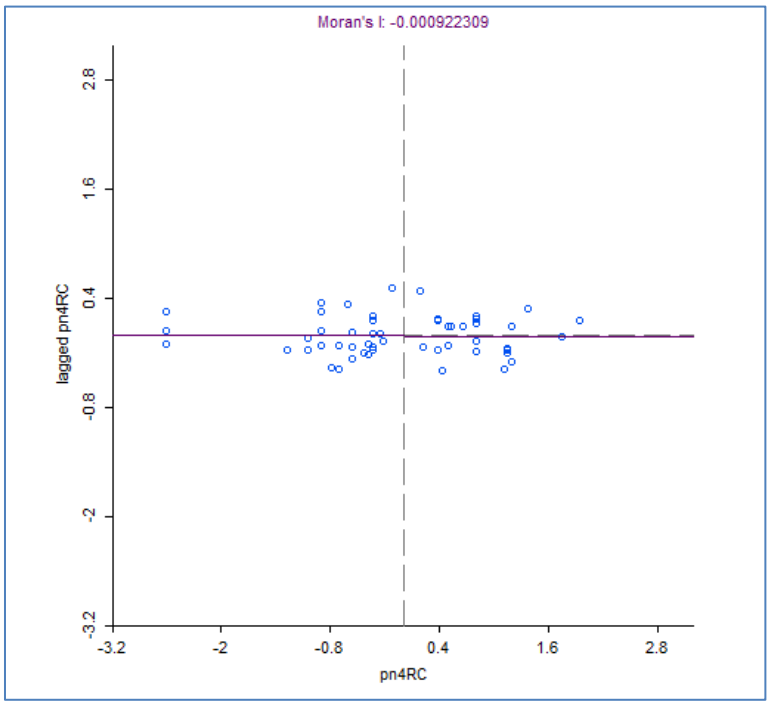
125KM Binary threshold



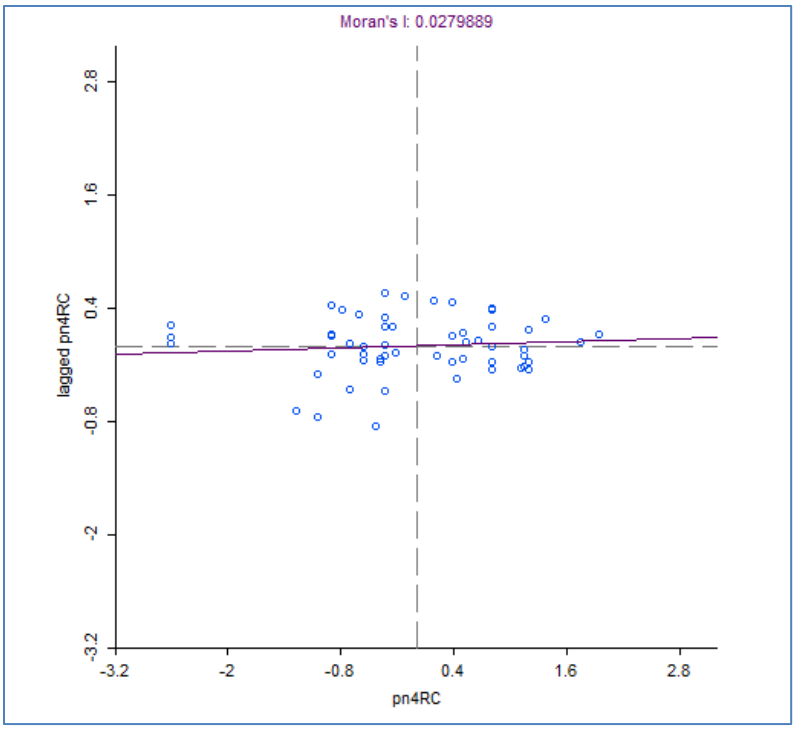
100KM Binary threshold



75KM Binary threshold

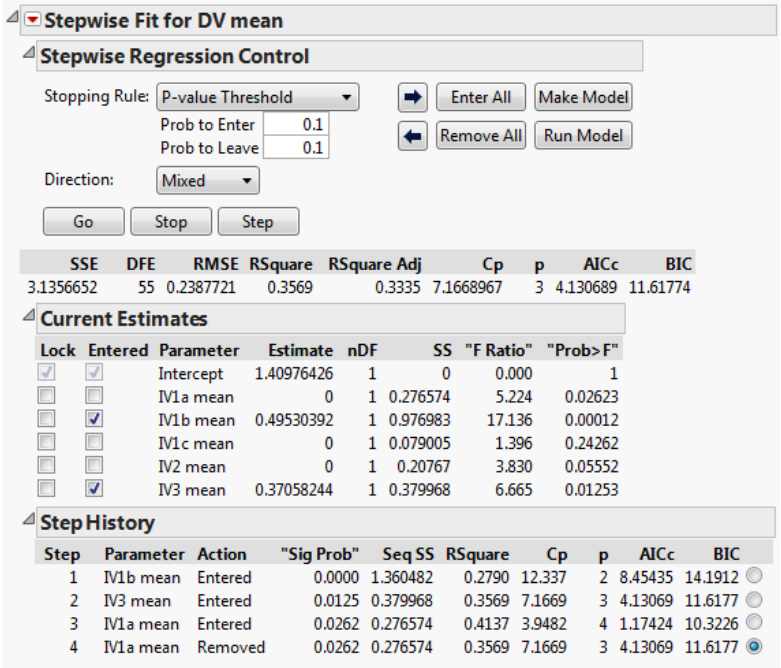


54.7KM Binary threshold



Appendix G: Stepwise function of Model 4

See below for original JMP output testing all IVs



Stepwise Fit for DV mean

Stepwise Regression Control

Stopping Rule: P-value Threshold | Enter All | Make Model | Remove All | Run Model

Prob to Enter 0.1

Prob to Leave 0.1

Direction: Mixed

Go | Stop | Step

SSE	DFE	RMSE	RSquare	RSquare Adj	Cp	p	AICc	BIC
3.1356652	55	0.2387721	0.3569	0.3335	7.1668967	3	4.130689	11.61774

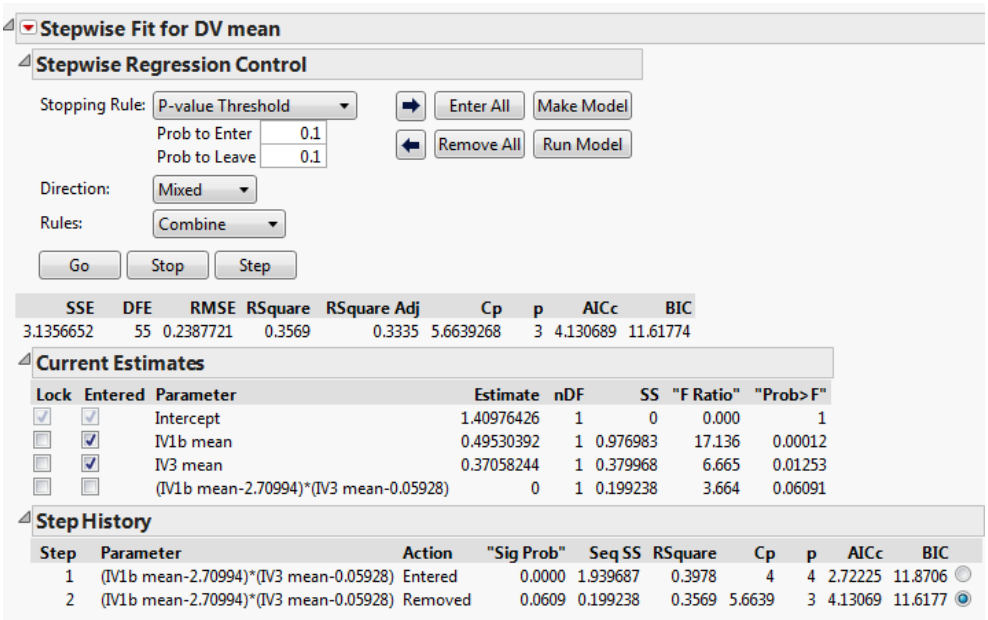
Current Estimates

Lock	Entered	Parameter	Estimate	nDF	SS	"F Ratio"	"Prob>F"
☑	☑	Intercept	1.40976426	1	0	0.000	1
☐	☐	IV1a mean	0	1	0.276574	5.224	0.02623
☐	☑	IV1b mean	0.49530392	1	0.976983	17.136	0.00012
☐	☐	IV1c mean	0	1	0.079005	1.396	0.24262
☐	☐	IV2 mean	0	1	0.20767	3.830	0.05552
☐	☑	IV3 mean	0.37058244	1	0.379968	6.665	0.01253

Step History

Step	Parameter	Action	"Sig Prob"	Seq SS	RSquare	Cp	p	AICc	BIC
1	IV1b mean	Entered	0.0000	1.360482	0.2790	12.337	2	8.45435	14.1912
2	IV3 mean	Entered	0.0125	0.379968	0.3569	7.1669	3	4.13069	11.6177
3	IV1a mean	Entered	0.0262	0.276574	0.4137	3.9482	4	1.17424	10.3226
4	IV1a mean	Removed	0.0262	0.276574	0.3569	7.1669	3	4.13069	11.6177

See below for JMP output testing the additional IV1b*IV3 term (insignificant)



Stepwise Fit for DV mean

Stepwise Regression Control

Stopping Rule: P-value Threshold | Enter All | Make Model | Remove All | Run Model

Prob to Enter 0.1

Prob to Leave 0.1

Direction: Mixed

Rules: Combine

Go | Stop | Step

SSE	DFE	RMSE	RSquare	RSquare Adj	Cp	p	AICc	BIC
3.1356652	55	0.2387721	0.3569	0.3335	5.6639268	3	4.130689	11.61774

Current Estimates

Lock	Entered	Parameter	Estimate	nDF	SS	"F Ratio"	"Prob>F"
☑	☑	Intercept	1.40976426	1	0	0.000	1
☐	☑	IV1b mean	0.49530392	1	0.976983	17.136	0.00012
☐	☑	IV3 mean	0.37058244	1	0.379968	6.665	0.01253
☐	☐	(IV1b mean-2.70994)*(IV3 mean-0.05928)	0	1	0.199238	3.664	0.06091

Step History

Step	Parameter	Action	"Sig Prob"	Seq SS	RSquare	Cp	p	AICc	BIC
1	(IV1b mean-2.70994)*(IV3 mean-0.05928)	Entered	0.0000	1.939687	0.3978	4	4	2.72225	11.8706
2	(IV1b mean-2.70994)*(IV3 mean-0.05928)	Removed	0.0609	0.199238	0.3569	5.6639	3	4.13069	11.6177

Appendix H: R-Studio Coding for presented model

```
Capstone <- read.csv("G:/2GB Stick/Elshaw update/R Work/Final_Model_Dist.csv")

district.mat <- NULL
district.MAT <- c(district.mat)
district.vec <- Capstone[,"Dist"]
district.uniq <- unique(district.vec)

district.len <- as.numeric(length(district.uniq))
district.count <- 1
while(district.count <= district.len){
  Model.spec <- Capstone[Capstone[,"Dist"]==district.uniq[district.count],]

  Y<-Model.spec[,"DV"]
  X1<-Model.spec[,"IV1"]
  X1a<-Model.spec[,"IV1a"]
  X1b<-Model.spec[,"IV1b"]
  X1c<-Model.spec[,"IV1c"]
  X2<-Model.spec[,"IV2"]
  X3<-Model.spec[,"IV3"]
  spec.lm <- lm(Y~X1a+X1b+X1c+X2+X3)
  y.len <- length(Y)
    sequential <- anova(spec.lm)
  test <- as.matrix(sequential[2])
  test.len <- as.numeric(length(test[,1]))
  SSE <- test[test.len,1]
  SST <- sum(test[,1])
  R2 <- (SST-SSE)/SST
  part.x1a <- test["X1a",]/SST
  part.x1b <- test["X1b",]/SST
  part.x1c <- test["X1c",]/SST
  part.x2 <- test["X2",]/SST
  part.x3 <- test["X3",]/SST
  district.mat <-
c(district.uniq[district.count],R2,y.len,part.x1a,part.x1b,part.x1c,part.x2,part.x3)
  district.MAT <- rbind(district.MAT,district.mat)

  district.count <- district.count + 1
}

colnames(district.MAT)<- c("District","R^2","n","x1a","x1b","x1c","x2","x3 ")
```

Appendix F: 2014 Belize HA/HCA Georeferencing

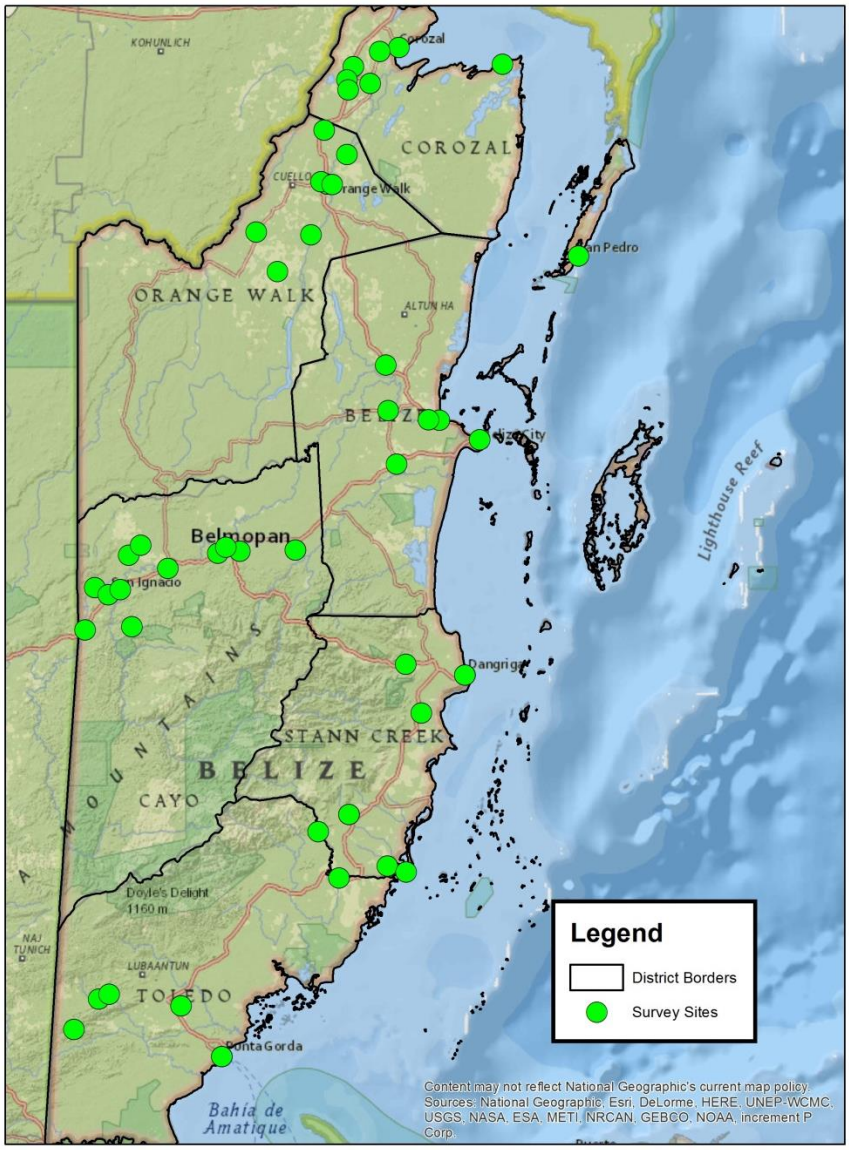
OHASIS Project ID	Proj. Type	Proj. Y*	Proj. X*	X-Coor**	Y-Coor**
22634	Medical	-9859104	2047670	18.08645	-88.5658
23791	School	-9839993	1973058	17.44817	-88.3942
23800	School	-9817894	1979738	17.50541	-88.1956
23803	School	-9818461	1979254	17.50127	-88.2007
23804	Medical	-9882349	1950547	17.25516	-88.7746
23840	Medical	-9819466	1979863	17.50648	-88.2098
23841	Medical	-9859104	2047670	18.08645	-88.5658
23844	Medical	-9817824	1979905	17.50684	-88.1952
23845	Medical	-9817824	1979905	17.50684	-88.1953
23846	Medical	-9839549	2083762	18.39438	-88.3902
24049	School	-9818358	1980131	17.50877	-88.1998
25766	School	-9840042	1974047	17.45742	-88.3934
***	School	-9881774	1948341	17.23237	-88.7692

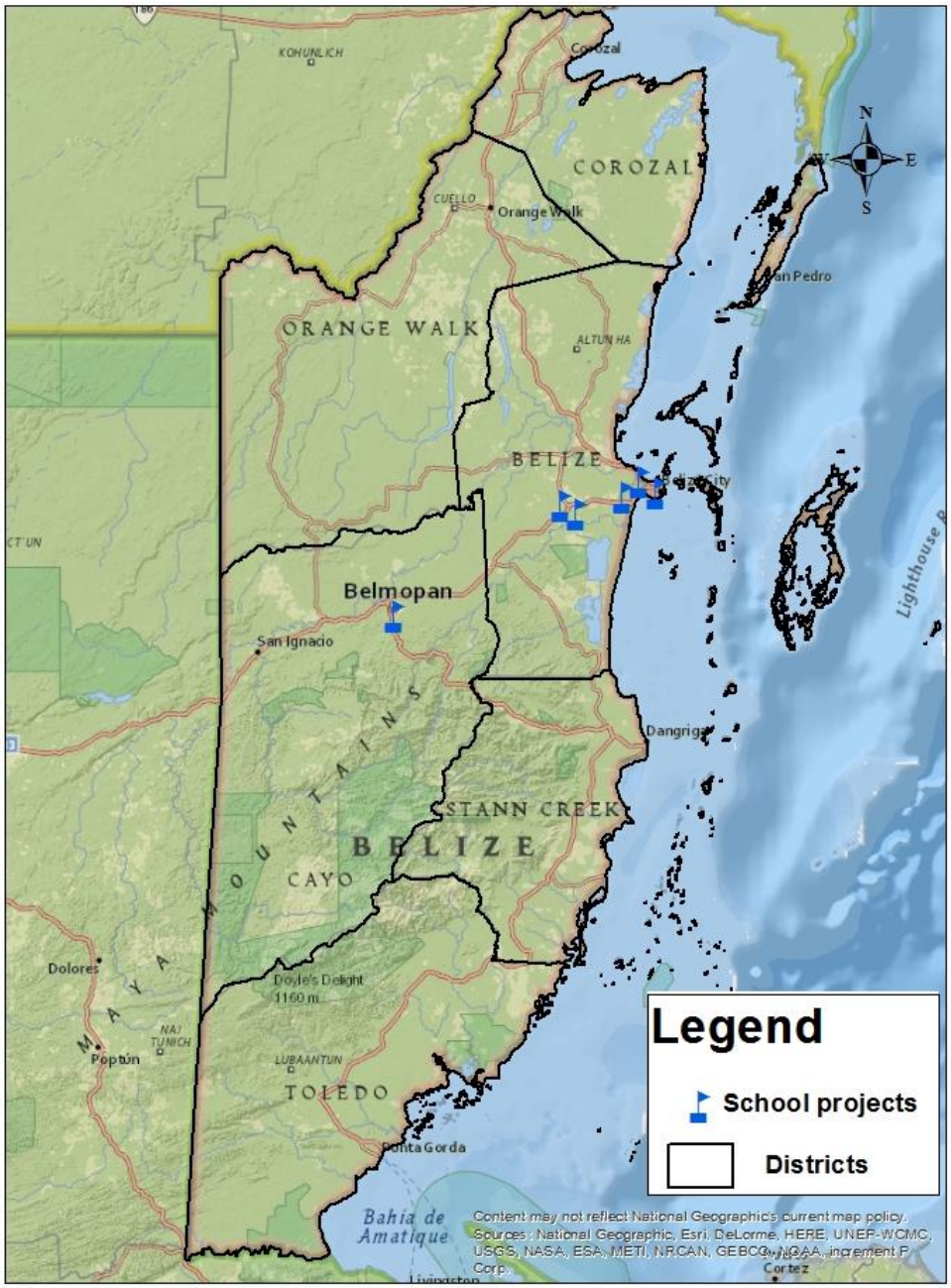
*Projected coordinates (in meters)

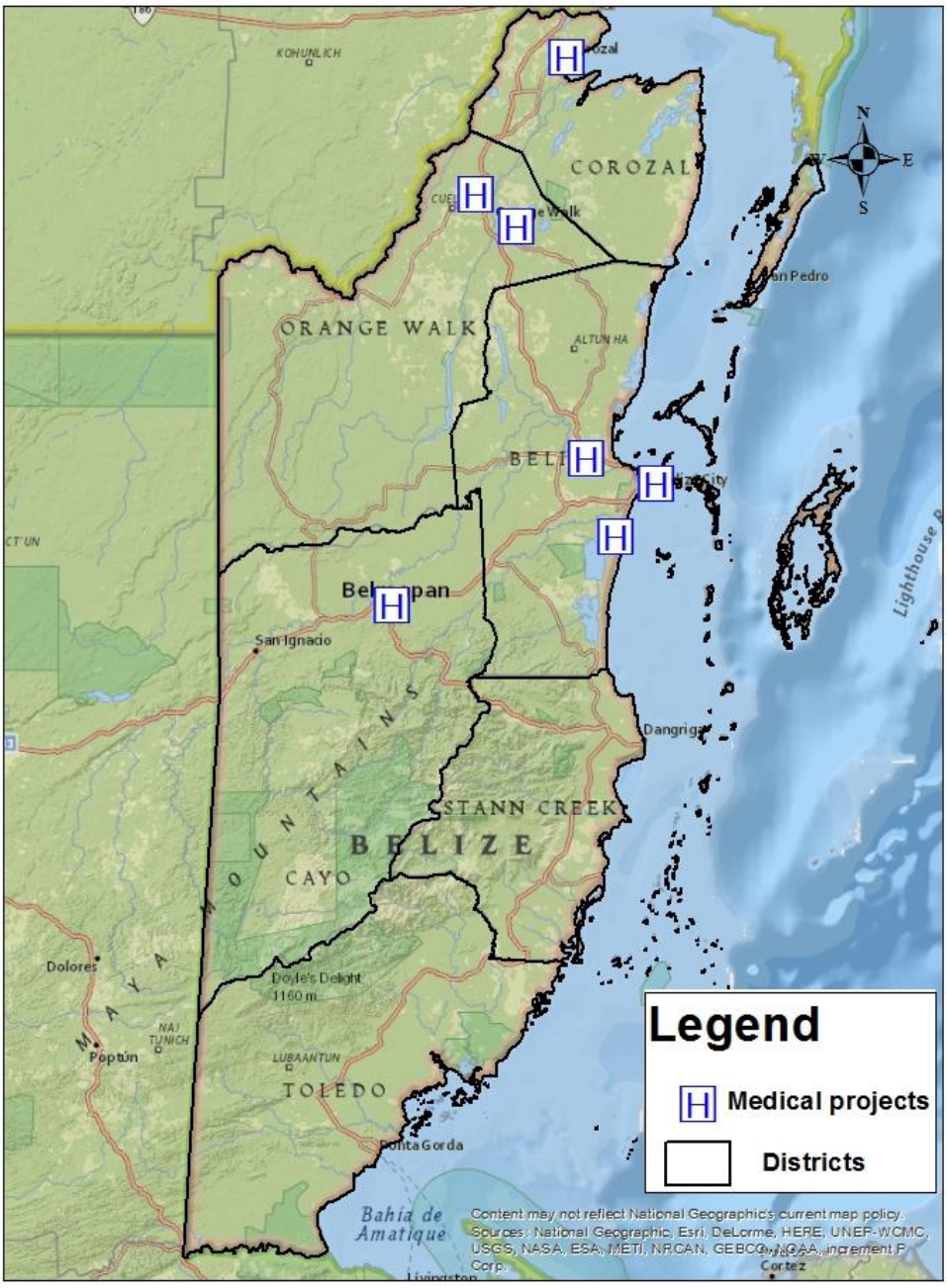
**WGS 84 Web Mercator coordinate system (in degrees of arc)

***OHASIS Project 25766 took place in 2 locations

Appendix I: Associated Maps of Belize




KOHUNLICH
Corozal
COROZAL
CUELLO
Orange Walk
ORANGE WALK
ALTUN HA
BELIZE
Belmopan
San Ignacio
MAYA MOUNTAINS
STANN CREEK
BELIZE
CAYO
Dangriga
Dolores
Doyle's Delight
1160 m
NAJ TUNICH
Poptún
LUBAANTUN
TOLEDO
Punta Gorda
Bahia de Amatique
Cortez
Lighthouse
N
E
S
Legend
School projects
Districts
Content may not reflect National Geographic's current map policy.
Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.


KOHUNLICH
COROZAL
ORANGE WALK
ALTUN HA
BELIZE
San Ignacio
Dangriga
STANN CREEK
CAYO
TOLEDO
MAYA MOUNTAINS
Dolores
Doyle's Delight
1160 m
Poptún
NAJ TUNICH
LUBAANTUN
Punta Gorda
Bahia de Amatique
Cortez
Lighthouse
N
S
E
W
Legend
Medical projects
Districts
Content may not reflect National Geographics current map policy.
Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

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14. ABSTRACT

Humanitarian projects in foreign countries are funded by the U.S. government to foster peace, prosperity, and the spread of democratic ideals around the globe. The type and scope of projects are restricted by current doctrine and funding regulations. Specifically in 2014, USAF personnel supported medical and educational construction projects/programs in the country of Belize. Within Belize, medical and educational projects were funded under the Humanitarian and Civic Assistance (HCA) program through the NEW HORIZONS exercise. Fiscal constraints, including shrinking budgets due to sequestration, have placed greater emphasis in the responsible distribution of resources and foreign assistance. The purpose of this thesis is to analyze public opinion survey data collected by the Latin American Public Opinion Project (LAPOP) and analyze predictors in satisfaction in democracy organized at the village and district level. The research findings represent suggestions, based on the population, that predict optimal placement of HCA programs.

15. SUBJECT TERMS
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