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A Demonstration Well-being Index for the City of Los Angeles

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I would like to thank all my professors and the administrative staff at Fletcher who work every day to create a conducive environment for learning. It has been a real privilege to work with you.

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“We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.”

U.S. Declaration of Independence, 1776

“Everyone has the right to life, liberty and security of person.”

Article 3, Universal Declaration of Human Rights
United Nations, 1948

“We, the OECD Members, will work together with each of them to develop new forms of partnership and collaboration with the aim of improving the well-being of all our citizens.”

OECD 50th Anniversary Vision Statement, 2011

“...the time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people’s well-being.”

Joseph E. Stiglitz and Amartya Sen, Report by the Commission
on the Measurement of Economic Performance and Social Progress

1. Purpose

The catalyst for this capstone was a conversation with the chief data officer of Los Angeles about what well-being might look like for the city. That conversation transformed into a short-term consultancy to define well-being, research methodology and demonstrate a well-being index. As a graduate student, I am to advise their office on an operational approach and the benefits and limitation of such an index for policy making.

The motivation for cities to start to consider well-being as a key performance indicator is part of a larger trend to towards data-driven government processes and best practices. Well-being and happiness indices are well-known at the national and international levels. As we will see, there are also domain-specific, hyper-localized well-being and satisfaction research. Well-being for a city is relatively new. Well-being to inform municipal policymaking is even more unproven. Thus, a larger justification may be to investigate whether the truism we hold for data-driven decision making in the public space still make sense given a complex index. I wish to specify a methodology, test it and assess whether the results are relevant and usable from a data integrity lens.

Lastly, the neighboring City of Santa Monica is one of the first cities to implement a well-being framework to define its relationship with the populace. If well-being is to take off, there needs to be a larger discussion on whether government should and can effectively intervene in citizens' well-being. I believe that discussion needs to take place at the definition, methodology and implementation levels. Specifically, what exactly is well-being, what is the appropriate methodology to measure it and what does the data distort? At a higher perspective, what is the appropriate level of utilization of a well-being index for policymaking? Where are the pitfalls? This capstone tries to answer these questions through a literature review of theory and a demonstration construction of a well-being index for the City of Los Angeles.

THEORY

2. Santa Monica, Well-being and Happiness

In 2017, the city of Santa Monica in California published the Wellbeing Project, a new initiative to define, measure and improve the well-being¹ of their residents. The city outlines six categories that have been determined to drive well-being at the individual level. These categories include outlook, community, place & planet, learning, health and economic opportunity¹. The project is notable for being one of the first cities to undertake such an effort. The city government uses the metric to measure service gaps and performances by zip code. At first glance, well-being is a far departure from other objective key performance indicators that cities have been keener to utilize. If city governments are to take to well-being with the same enthusiasm, then the definition, methodology and operationalization of such an index need to be flushed out.

Well-being is not a new concept. There is a growing body of literature on psychological and subjective well-beings. For example, the impact of urban environmental factors on specific population's subjective well-being is increasingly being teased out through studies in which subjects self-report on their satisfaction level in relation to specific domains. The researchers then try to identify specific drivers and pathways that may enhance or diminish self-reported well-being. Their research questions concern the impact of, for example, a marginal increase in interior housing quality on an elder's self-reported well-beingⁱⁱ? These studies tend to be one-dimensional and suffer from limitations in data and existing confounders.

Another more well-known approach is the country of Bhutan's Gross National Happiness (GNH) Index. The GNH Index draws from nine domains of happiness, over 33 indicators to construct a sufficiency² metric. The nine domains include both social and economic elementsⁱⁱⁱ and add up to a state of well-being. The methodology behind Bhutan's GNH index builds on the Oxford Poverty & Human Development Initiative's research on measuring multi-dimensional poverty^{iv}. The underlying assumption defines well-being as meeting a series of objective thresholds. If basic needs and poverty indicators are met, then an individual is marked as in a state of well-being. The GNH chooses objective indicators over subjective preferences. This is a diametrically opposite approach to subjective well-being. It too may contain weaknesses in the methodology that limit the relevance and usability of the index. For a city to adopt a well-being instrument, it needs to an instrument that fits its priorities and scale. It needs something in between the microeconomic studies and the nationwide assessment.

Well-being is inherently difficult to define and measure. A larger discussion about whether city "should" be informed by a well-being metric is important itself. The Santa Monica example provides a few constructive learning opportunities. First, the city engages its residents in arriving at the six categorical drivers of well-being. Second, the city gains insights from implementing the project, both internally and externally. Third, the project allows for the institutionalization of data practices. Lastly, the index represents an opportunity for targeted policy intervention and re-orientation of city services towards a defined goal. Defining and

¹ There are variations on the spelling of the word. This capstone will utilize well-being.

² Sufficiency is defined as meeting the predetermined threshold for each category of happiness.

measuring well-being seems to be part of a larger vocabulary of city-led learning. As the city operating system rapidly changes, cities are collaborating and sharing best practices. Digitalization, data analytics, and process improvement are at the center of an effort to modernize city governments. In one sense, well-being measurement is one more iteration in a data-driven policymaking trend.

3. Well-being for the City of Los Angeles

How might well-being look like for the city of Los Angeles? In one sense, Santa Monica's index is specific to their confluence of place, people and circumstances. For any cities looking in, Santa Monica's effort is only demonstrative³. The findings are not comparable across cities and the methodology may not be transferable. For Los Angeles to measure well-being, they would have to arrive at a definition that is relevant to its residents, locales and circumstances. That is to say, well-being in Los Angeles will inevitably be different from that of Santa Monica. This presents certain challenges from a policy making perspective, namely, one city cannot compare performance and share best practices across sites. However, policymaking can still gain from an index because the index helps establish a baseline within a geographical boundary. It allows for comparison between different areas of the city. In some cases, it may confirm what we know anecdotally about certain neighborhoods and identify what specific variables drive their well-being deprivation. In others, we may be surprised by what we find. If the measurement is taken over time on an annual basis with consistent methodology, then we can monitor for trends and changes. Policies can then be tailored to these findings. Thus, these uses reinforce the importance of a consistent, defined methodology that explicitly states the assumptions of the index. The first step towards that methodology is the city defining what well-being is.

One can also learn a lot from the process of constructing a well-being index. Defining well-being and deciding on the methodology are both intentional policy choices on what is important to the city. It is important that these assumptions arise from a transparent and perhaps, engaging, process. Likewise, this index will build on existing datasets from various open data portals. The researcher may be able to assess the ease of use of these resources. Furthermore, in a world where data is increasingly put on pedestal, a deep dive into a thematic index will also highlight the limitations of such a metric. It seems reasonable to suggest that policymaking should be informed by a well-rounded approach that includes both insights and limitations.

³ It is not clear what policy interventions came out of the project nor if the city continues to measure well-being on an annual basis.

4. Definition of Well-being

a. *Intuitions*

In a standard dictionary, well-being is defined as a state characterized by health, happiness, and prosperity⁴. This definition implies that well-being encompasses one's physical and mental health, emotional and social happiness, and economic prosperity. At the same time, we intuitively understand well-being to be subjective. Given the same objective baselines, different individuals may still have varying levels of well-being. To a certain extent, this can be attributed to the gap between one's reality and one's expectations, needs and desires. People who are well-off economically can be more dissatisfied than their relatively impoverished peers. They value different things and may apply different weight to each domain⁵ of well-being. For some, material well-being outweighs health; while for others, work is far more important than intimacy. A person's individual characteristics can impact their definition state of well-being. In this case, a female may experience well-being differently from a male; a youth may be happier than a senior. A definition of well-being must allow for heterogeneous, interactive effects of a wide range of driving characteristics. In other words, our intuitions suggest that any definition of well-being must be multidimensional, allows for objective and subjective elements, and encompass weighting among different domains and across fixed individual characteristics.

b. *Literature Review of Well-Being Definition*

A review of the literature on the definition of well-being supports these intuitions. One such definition is the resource-based approach, which only includes objective measures such as income and basic needs that add up to a state of well-being. This recalls Bhutan's GNH index meeting pre-determined thresholds. However, the pitfall is that even objective indicators can be biased because they embed the researcher or society's values^v of what are important for well-being. Regardless, the takeaway may be that having a core layer of basic needs can be a good starting point.

Another approach is utilitarian, which allows for more complexities by taking into account people's actual values, personalities, knowledge and evaluation of future improvement. This recalls the subjective well-being studies referenced above where well-being is self-reported. The measure is treated like a utility and researchers focus on identifying specific variables that enhance or diminish this utility^{vi}. For our purpose, the inclusion of a subjective varying mechanism suggests a complexity that is more consistent with our intuitions above.

The differences between resource-based (objective) and utilitarian (subjective) well-beings play out in the survey instrument one would deploy. For example, in a subjective study, an individual may be asked to rate their overall well-being and then their satisfaction over a certain domain, such as daily commute. In an objective study, an individual may be asked to indicate the length of their daily commute. In the former, one would try to identify the

⁴ Dictionary Definition

⁵ Domain is a variable that may drive well-being. It can be one's income level, housing security, transportation option, and any number of other characteristics. They're typically conceived as columns in a dataset (individuals are the rows).

relationship between commute and overall well-being. It may be a strong, weak, positive or negative impact. In the latter, if one's commute is longer than a predetermined threshold, such as one hour, then, the individual would be marked as deprived of well-being. As we can see, both perspectives are limited in how they do not approximate the complexity of well-being. At the same time, we are also saying that they're both important.

c. Aligning Objective and Subjective Elements of Well-being

Maria Amerigo and Juan Ignacio Aragonés (1997) propose a theoretical and methodological approach to residential satisfaction^{vii} that may help us align objective and subjective lenses on well-being. In their model, the pathway for well-being starts at the level of the personal characteristics of the individual. These personal characteristics shape how one perceives the objective and subjective attributes of their residential environment. Both objective and subjective domains then inform residential satisfaction. Amerigo and Aragonés also included physical and social domains. Thus, in a grid, one can define attributes as objective-physical, objective-social, subjective-physical and subjective-social^{viii}. Each attribute enhances or diminishes residential satisfaction. For an example of their grid and the range of multidimensionality of well-being, please see Appendix 1.

Their approach allows for a wider range of domains than those that are strictly objective or subjective. By necessity, measuring some of these attributes will require self-reporting. Their framework also allows for the mix of personal characteristics, with the interplay of objective and subjective lens. In addition, the idea that well-being can be moderated by human agency is a consistent theme in other papers. Human beings will act, thus changing their expectation and their perception of their surroundings^{ix}. This last point is in further support of the inclusion of subjective, perception-based measurements.

Valerie Brown (1995) presents a similar urban ecological model of aging that utilizes the same combination of objective environmental characteristics, perceived environmental characteristics and personal characteristics to walk through a well-being pathway. In her model, objective characteristics are filtered through a perception lens first before combining with personal characteristics to arrive at residential satisfaction. Residential satisfaction, personal characteristics and perception combine to determine one's subjective well-being^x. The lesson here may be that while researchers are aware of the many domains that drive well-being—including both subjective and objective indicators—the order and weights of these domains are less clear. In building an index for the city, we too must take care to include these elements.

d. Capability Approach

Lastly, the capability approach articulates well-being as the “freedom people have to enjoy valuable activities and states.” There are two vectors, functioning and capability. Functioning is defined as “beings and doings that people value and have reason to value.” Capability is the “real opportunity that we have to accomplish what we value.”^{xi} While certainly very abstract, the approach suggests that well-being is dependent on the extent to which we are able to do what we believe is important, without constraining how values are defined. On one hand, well-being is tied to one's ability and the characteristics of the surrounding environment.

On the other hand, the approach allows for the diversity of human needs and the inclusion of moral considerations and ethical principles^{xii}. How one defines well-being matters for the methodology of the index. In this case, well-being cannot be generalized and must be flexible to the specificity of an individual's values. There are many domains that enhance or diminish well-being. Therefore, the methodology must allow for the accumulation of these domains. At the same time, one can include both general weights and individual weights to the domains to mimic the differences in how each individual defines well-being.

e. Aligning Intuitions with Literature

Overall, these approaches offer useful insights about the role and importance of subjective and objective attributes, expectation and weights. They all collectively say that well-being is difficult to define while subtly hinting that the definition affects the methodology. But if we were to define it as we need to for this project, *well-being must surely be multidimensional with many objective attributes but flexible across the many ways that subjective differences in values play a role*. We need a methodology that is equally flexible to be able to effectively measure well-being.

f. Limitations

At the same time, there are challenges that have not been explicitly referenced yet. Well-being data are inconsistent and largely incomplete as we move from objective to subjective to psychological indicators. Researcher's judgment in what to collect leads to biased datasets. On the other hand, there can be too much data and too many domains. Furthermore, when data is self-reported, as is the norm with subjective well-being, the quality is likely compromised. Likewise, as a composite index, well-being risks becoming a black-box that no one truly understands. Lastly, well-being must be relevant and understandable to individuals it presumes to represent. The index must also be relevant and usable to policy makers. Sometimes, these goals are contradictory. Any methodology would also need to address these data concerns directly.

5. The Alkire-Foster Method

A promising methodology that has been deployed for measuring human development is the Alkire-Foster Method⁶. In the case of human development, the primary index measures poverty level, which, at its core, is a set of objective indicators. The method has also been deployed for Bhutan's Gross National Happiness Index. In reviewing Bhutan's utilization, their framework is essentially consistent with the Alkire-Foster's; however, they inverted the measure to arrive at happiness instead of poverty. Lastly, Emma Samman in her paper^{xiii} suggests how to build a framework for indexing well-being with the Alkire-Foster Method. All three examples demonstrate the relevance and usability of the method and its potential use to measure well-being

⁶ The Alkire-Foster Method is a copy-righted methodology. It is cited here for academic purpose and as reference. To deploy it in the field as part of an official program, the programmer must reach out to the copyright owner for a license. On the other hand, this means that the methodology is proven and deployed previously with success.

in Los Angeles. Most importantly, it appears to be consistent with our intuition and literature definition.

The Alkire-Foster Method for Human Development takes an individual as a unit of analysis through a multi-dimensional matrix. Dimensions on which individuals will be measured are chosen. These dimensions may include housing, food security, income level, and more, depending on the researcher’s goals, the relevance of the dimension for the index and data availability. Within each dimension, an indicator is chosen and objectively measured. For the range of value within each indicator, a deprivation cut-off mark is determined. An example of a deprivation cut-off mark would be the poverty line for income level. The deprivation cut-off marks allow for each individual to be rated as deprived or not deprived for each dimension across the data row. The number of deprivation across all dimensions of each individual is summarized. A second cut-off is introduced to identify individuals with enough cumulative deprivations to be considered multi-dimensionally poor. In a matrix with 10 dimensions, six and above number of deprivations may be one such benchmark. Determination of threshold for each dimension and for overall deprivation cut-off are both exogenous policy decisions. In Table 1 below, we see how an Alkire-Foster Deprivation Matrix might work.

Table 1: Alkire-Foster Deprivation Matrix using sample dataset⁷

Objective Domains:	Food	Housing	Income	Transit
Indicators:	# of meals per day	Rent as % of monthly income	Monthly salary	Commuting time
Indicator Cut-off Threshold:	>3	<30%	>3X above Federal Poverty Line	<1 hour
Multi-dimensional Cut-off:	>2			

ID	Food	Food Threshold	Housing	Housing Threshold	Income	Income Threshold	Transit	Transit Threshold	Sum of Well-being	Multi-dimensional Well-being
1	2.5	0	31%	0	3	0	1.25	0	0	0
2	4	1	25%	1	7	1	2	0	3	1
3	1.75	0	55%	0	1	0	1.75	0	1	0

Indexation runs across the rows. [1, 0] is used to score each domain relative to the predetermined cut-off threshold. Sum of Well-being is the more nuanced score with greater variation while Multidimensional Well-being [1, 0] reflects the score against the multidimensional cut-off.

The method allows for the calculation of three summary statistics. Using well-being instead of deprivation in this example, the headcount, H, is the number of satisfied individuals over the number of total individuals. In our example above, 1 out of 3 individuals are considered objectively in a state of well-being. This figure is an overview and may miss the fact that deprived individuals may become increasingly more deprived within a specific domain. The

⁷ This dataset is created for demonstration. See ophi.org.uk/research/multidimensional-poverty/how-to-apply-alkire-foster/ as previously cited for better example of the Alkire-Foster Method.

Average Well-being Gap, A, is the average number of satisfaction over the number of total satisfaction and non-satisfaction count per individual. In our example above, average number of well-being domains is 1.33 per individual, over a possible total of 4 per individual. The multidimensional cut-off is 2 in our example. Thus, A is a good comparison of the average individual against the second cut-off threshold for multidimensional well-being. Lastly, the Adjusted Headcount, M_0 , is the product of the Headcount, H, and the Average Well-being Gap, A. In our example above, this figure would be 1.33. This metric indicates the average number of dimensions of a satisfied individual and reflects the breadth of well-being. The basic framework allows for weights at the individual-, dimensional- and cutoff-levels during summation calculation. The weights themselves would have to be surfaced through other methods.

Table 2: Three Summary Statistics of Alkire-Foster Method

$M_0 = H \times A$	
Headcount, H	number of satisfied individuals over the number of total individuals
Average Well-being Gap, A	average number of satisfaction over the number of total satisfaction and non-satisfaction count per individual
Adjusted Headcount, M_0	product of the Headcount and the Average Well-being Gap

a. Advantages of the Alkire-Foster Method

While the Alkire-Foster Method was designed for measuring poverty and deprivation, it could very well be adapted for well-being, as Bhutan has demonstrated in their Gross National Happiness Index. The method is easy to understand in that researchers can clearly state the dimensions that they believe enhance or diminish well-being. Weights can be included in both linear and nonlinear forms. Weights allow for the inclusion of fixed-individual effects, different levels of dimensional importance, and for dimensions to interact amongst themselves and with fixed-individual effects. This characteristic is consistent with our intuition that while well-being is different for everyone, it does build off meeting some fundamental basic needs.

Dimensions can include only a few objective indicators or a more expansive set of domains, including subjective ones. The multidimensionality allows for incidence and intensity of well-being. That is, there could be many dimensions that enhance or diminish one's well-being. At the same time, one individual may experience a higher intensity of deprivation of well-being through accumulation of more negative dimensions relative to others also considered below the well-being cut-off. Recalling our intuitions, well-being is different for everyone. Multidimensionality allows for that expansiveness of dimension and customization at the individual-level. In addition, the method is scalable to different levels, offering researchers the ability to make the index as simple or as complicated as they see fit. Based on our criteria for the index, the methodology here conveys relevance, usability and flexibility. Lastly, the methodology has been used in other indices and has proven to be customizable. These are all attributes that would lead one to utilize the basic idea behind Alkire-Foster to construct a well-being index for Los Angeles.

b. Adapting Alkire-Foster to Los Angeles

If a city is to adapt the Alkire-Foster Method to construct a well-being index, it might be do in the following sequence. The first layer of data would be the objective dimensions, accompanied by pre-determined thresholds, for well-being at an individual level. These objective dimensions, as chosen by the city, is the basis for a predicted well-being score⁸. In short, based on our assumptions around basic needs, one can arrive at a score that in theory should predict one's well-being, holding all other subjective variables constant. However, this score would be of limited relevance to the individuals as it excludes all subjective differences. It may offer usability to the city in surfacing incidence and intensity of deprivation along objective dimensions.

Subjective data on well-being can be included through the deliberate addition of weights. One limitation is that there is inherently a lot missing data on subjective well-being and its drivers. As we know, subjective well-being relies on self-reported data. A strategic deployment of a subjective well-being instrument may be able to resolve both obstacles. An instrument may be able to surface which objective dimensions should be given more importance. It may also highlight which fixed-individual characteristics are the strongest predictors of subjective well-being. These data points inform how weights might be constructed. To further model the interaction between dimensions and fixed-individual characteristics, one would need to employ social science reasoning. We need to include weights because we have defined well-being to be interactive mix of both objective and subjective factors.

There are existing instruments that can collect subjective well-being in our scenario. For example, the World Health Organization's Quality of Life Survey⁹ is one source from which question types, formats and content can be referenced. The Cantril Ladder has been used in a few of the works cited here and more prominently in the Gallup Poll's well-being indices¹⁰. The instrument asks participants to self-assess on a 10-point ladder their present and future conditions. Responses are grouped into the three categories of thriving, struggling and suffering. From this subjective y-outcome, one can assess correlations with measures of poverty and other variables^{xiv}. Another instrument is the Rosenberg Self-Esteem Scale, from which one can derive a score to be used as the y-outcome of interest in place of subjective well-being^{xv}. Both instruments are tested and proven in their effectiveness. Lastly, Emma Samman's proposed subjective instrument is copied below in Appendix 2 as an example. Samman cited and collected components from existing, published instruments to construct a new, short tool that solicits responses for meaning of life, self-determination, domain-specific life satisfaction and happiness¹¹.

It stands to reason that these proven instruments can requisition the necessary subjective data. The city can choose to deploy one contemporaneously as the predicted well-being score is

⁸ Score refers to the sum of all domains. An index is the score, marked against the cut-off threshold, in binary assignment.

⁹ A WHO study about young people and adolescent is cited in this capstone.

¹⁰ These are mostly national and international surveys.

¹¹ How she utilizes these different responses will be discussed in the following sections.

being developed. One possible avenue is through random survey of online site visitors. Overall, these instruments are good complements to existing objective indicators-based data. We are assuming that the objective indicators are derived from pre-existing datasets. While objective questions may be inserted into the subjective survey instrument, the inclusion risks deteriorating the user-friendliness of a quick set of questions. The benefit of this two-pronged data collection approach is that it can be done without greater investment in resources. The Alkire-Foster Method allows for both datasets to be incorporated.

Likewise, the city can choose to utilize participatory, qualitative interviews to estimate weights. Residents' engagement in defining well-being for the city is a possible way forward. It speaks to the relevance criterion that city residents should be able to play an active role in defining well-being for themselves. One can certainly deploy both options. However, the argument for the subjective instrument is the calculation of the weights in a statistically significant manner. It allows the data will tell the story.

c. Weighting Strategies

Like the thresholds, setting weights is more art than science and has policy implication for the whole index. There are several approaches. The default is no weight, which in effect, provides equal weight to all dimensions while excluding subjective variation. While this is the status quo of the predicted well-being score, it is most certainly wrong. Another approach is to utilize a frequency-based criterion derived from the proportion of the population suffering deprivation in a specific dimension. Frequency-based gives a larger weight to dimensions with larger proportion; therefore, surfacing the most distributed dimensions. A similar approach is to favor dimensions for which you have the best quality of data. In effect, the tradeoff is a higher level of reliability of the well-being index for a smaller range of dimensions. Statistical weights can also be deployed but the drawback may be that it is too normative. In terms of participatory techniques, one can utilize budget allocation and analytic hierarchy process to surface the most important dimensions of well-being for the participants. The one challenge in this latter branch of methods is that selection of participants must be sufficiently representative of the population.^{xvi}

Each weighting strategy conveys a tradeoff. Each choice is done by an individual with a policy preference. In the end, these choices will have reverberation downstream to the final index. Given these limitations, the best cure is absolute transparency in the assumptions that drive your choices.

d. Regression-based Weighting Strategy

Taking into consideration the subjective instrument in the preceding sections, the weighting strategy that is most valid may be a regression-based approach using subjective well-being as the binary y-outcome of interest. The independent variables would be fixed-individual variables and dimensions in a linear functional form^{xvii} such as the one below.

$$[\text{Well-being}_{\text{binary}} = B_0 + B_1 * (\text{Subj Domain Satisfaction}) + B_2 * (\text{Fixed-Individual Variables}) + U_i]$$

In effect, this multivariate linear regression would surface the variables that most predict subjective well-being, a measure that is similar to a p-score. Weights can then be assigned by estimators or the estimators can inform the weights that are deployed. What is elegant about this weighting strategy is that it allows the data to tell the story based on empirical analysis.

To be clear, there are weakness to this strategy as well. Regression-based weights are only as valid as the choice of the functional form. That choice is informed by social science reasoning and should include a larger range of options than the strictly linear form above. The specification of the functional form—whether you have included all the variables, the inclusion of nonlinear parameters, and the interaction of variables—is open to social science debate. Likewise, the threat of multicollinearity among the dimensions exists. One may include independent variables that are correlated or omit important variables, which can bias the estimators in both cases. In all likelihood, the availability of data is going to be a constraint. Furthermore, should the subjective well-being instrument be deployed each year, then it is likely that in a time series, the driver of subjective well-being will change over time. This adds another layer of complexity to the index, for better or for worse.

e. Argument against deploying only Subjective Well-being Data

One could imagine measuring well-being through a strictly subjective instrument, asking individuals to self-report on their state and what causes them to report higher or lower state of well-being. Such studies do exist and there are weaknesses to a purely subjective dataset. Self-reporting of well-being is unreliable and subject to misattribution and noise^{xviii}. In various studies with self-reported well-being, one indicates that people have a preference for warmer temperature and that actual temperature day of may influence how people respond in a survey^{xix}. In another, the age of the respondent is a strong predictor of subjective well-being^{xx}. Likewise, whether the respondent has experienced a recent negative event will influence the response. Negative life events are not only better predictor of well-being^{xxi}, they are more strongly correlated than positive ones^{xxii}.

These studies highlight an aspect of the subjective instrument that may prove to be useful. One can derive the best predictors of well-being through a subjective well-being instrument. These are correlational relationships. In existing studies on subjective well-being, they are called confounders. In one study on the effect of natural space on emotional well-being among young people in Canada, individual socio-economic status, neighborhood safety and family affluence were confounders; age, gender and ethnicity were some of the effect modifiers^{xxiii}. In another study on subjective well-being and residential traffic noise, the more powerful predictors are age, gender, socioeconomic status, and satisfaction with one's personal relationship and one's financial situation^{xxiv}. In a study on subjective well-being among children and adolescents in Europe, girls were found to be more stressed than boys^{xxv}. These studies confirm that fixed individual effects are important to include in the index. They also highlight certain objective measures, such as socioeconomic level, that are strong precursors to and predictors of well-being. This would seem to support the weighting strategy, which utilizes impact estimates from similar subjective instruments.

Lastly, more than a few of these studies define subjective well-being as partially effected by perceptions and expectations. Our perception and expectation are shaped by one's objective circumstances. In one unique study, one's self-reported happiness is defined by two objective measures, one's salary and that of the neighbor. Your happiness goes down as your neighbor's salary increases. The increase in your neighbor's salary is perceived as an equivalent decrease in one's own salary^{xxvi}. The objective measures here provide context to interpret self-report well-being. Thus, subjective and objective lens of well-being are complementary attempts to measure a complex thing. A subjective-only, self-reporting instrument on well-being would only lead to one, limited perspective.

f. Aligning Regression Weighting Strategy with Subjective-Objective Definition

Our effort at alignment is informed by our intuitions on well-being and the working definition from the literature review. For one, we understand that subjective and objective well-being alone do not tell the full story. In much the same way we choose the Alkire-Foster Method to include many objective dimensions of well-being, we also want to include subjective weights on each objective dimensions of well-being. The regression-based weighting strategy is one approach to highlight subjective forces, and to include them within the Alkire-Foster steps. Recalling the two theoretical approaches that model filtering objective attributes through subjective expectations, the inclusion of weights parallel those models on a technical level. It makes sense that our personal preferences should effect how we perceive our objective surroundings. We would be giving more weight to objective dimensions for which we perceive a greater need. Therefore, well-being is determined by a greater share of the extent to which we're fulfilling those needs. This strategy mimics the gap between needs and expectation that enhances or diminishes well-being. Ultimately, the predicted well-being index will transform into a composite score that is multidimensional with an objective core and a subjective filter.

In practice, this means deploying a subjective instrument¹² that collects satisfaction level on the same domains as those used in the objective scores. After determining which domains are stronger predictors of well-being, the estimators of those variables from a linear regression are used as weights. In our example above, if we determine that food and income should out-weight the other two domains, than their respective scores would be augmented in the summation for the multidimensional cut-off. If you indicate your income is important to your well-being, then it should count more when you're above the threshold for income-derived well-being. If your income is below the threshold, then you're not satisfied and it does not contribute to your well-being.

g. Aligning Psychological, Subjective and Objective Well-beings

Weights allow differences to be embedded in the well-being score. They do not account for how psychology and subjectivity may play larger roles in state of well-being. Emma Samman's working paper on psychological and subjective well-being provides a larger

¹² This instrument could also conceivably ask about satisfaction related to income and actual income. However, the survey would become unwieldy. The author is looking for a quick deployment of a subjective instrument (ten questions) and work with existing objective datasets. In practice, it would be easier to do one instrument overall.

framework for aligning psychological, subjective and objective well-beings. Her instrument is one of the proposed instruments listed above to requisition self-reported data. Samman provides four components in the definition of well-being. First, wellbeing is based on one’s psychological wellbeing. Does an individual perceive meaning in her life based on her unique potential? Does she perceive the ability to define and progress towards said meaning? This is a eudemonic¹³ measure. Second, are one’s basic psychological needs being met? The self-determination theory lists these core concerns as autonomy, competency and relatedness. The third component is happiness. Is the individual currently happy? Part two and three constitute the hedonic¹⁴ measure. Fourth, there are seven domain-specific life satisfaction determinants. These include material well-being, health, productivity, security, intimacy, community and spirituality. Each domain is broken into sub-domains. For example, material well-being is composed of food, housing and income.

Samman’s proposed instrument asks individual to report on all four supra-elements using a Likert scale. In the case of the domains within the fourth element, she employs a similarly ranged scale for each domain. A composite life satisfaction score of all the domains is calculated without the use of weights. That score, representing the fourth element of domain-specific life satisfaction, is added to the scores for psychological wellbeing, psychological needs and happiness to create an overall well-being score. This last calculus is completed without weights^{xxvii} as well. See Table 3 below for breakdown.

Table 3: Psychological, Subjective and Objective Components of a Well-being Score

Well-being_{composite}		= Psychological Well-being + Life Satisfaction + Happiness			+ Objective Criteria	
	Self-reported	Self-reported		Self-reported	Existing, objective data	
		Domain-specific		Weights →	Domain-specific	
		Material Well-being			Material Well-being	
		Health			Health	
		Productivity			Productivity	
		Security			Security	
		Intimacy			Intimacy	
		Community			Community	
		Religion			Religion	
Correlation between self-reported, domain-specific satisfaction and overall life satisfaction can inform weights for the domains in the objective data-driven criteria of well-being.						

What is interesting is that her section for domain-specific life satisfaction is effectively the subjective well-being dimensions that we discussed earlier. Her instrument can provide the self-reported data for a regression-based weighting strategy. The extent in which each domain predicts self-reported subjective well-being can inform the weights in the calculation of the objective, predicted well-being score. The domains and the dimensions can be designed in such a way that they coincide thematically. In this way, we are filtering the objective predicted well-

¹³ Definition is conducive to happiness.

¹⁴ Relating to or considered in terms of pleasant (or unpleasant) sensations.

being score through subjective, self-reported data on the importance of each dimension. Samman's instrument is a good complement to the technical and definitional criteria laid out earlier.

Likewise, her definition of well-being, as multidimensional overall and multidimensional within each element, recalls the scaling flexibility of the Alkire-Foster Method. Her instrument takes into account psychological wellbeing, domain-specific life satisfaction and happiness as equal parts in a composite well-being score. Her overall framework also includes the fourth "objective" criteria for well-being based on national survey data. In summary, well-being is a summation of one's psychological wellbeing, subjective domain-specific life satisfaction, happiness and objective criteria^{xxviii}. It is important to note that objective dimensions of well-being here are less prominent to overall well-being at this point than where we started earlier.

At the end of the day, the above is an idealized, comprehensive framework that tries to anticipate all the nuances of a complex subject. As the complexity increases, you do risk becoming incomprehensive and irrelevant. It is also unrealistic in practice, as the demonstration well-being will show. Nonetheless, it is important to flush out a comprehensive model, against which we can reflect on the limitation of the implemented model.

6. Variations of the Well-being Score

If we recall the discussion about the Alkire-Foster Method, it is builds upon smaller dimensions. Multidimensionality applies in the dimensions-driven, objective, predicted well-being score, and in the domains-driven life satisfaction score. Regression-based weights can be drawn from the self-reported domains-driven life satisfaction score. These weights can inform the dimensions-drive objective predicted well-being score. Multidimensionality also applies as we add self-reported supra-psychological and happiness scores. Thus, overall well-being can be formulated as summary of the dimensions-driven objective, predicted well-being score, the introduction of a regression-based weighting strategy, and supra-psychological, -happiness and – subjective self-reported well-being data. This appears to be consistent with our intuitions and our definition of well-being. The well-being index would exist in the four following iterative forms:

Wellbeing =

- i. Multidimensional, predicted well-being score based on objective dimensions**
- ii. Multidimensional, predicted well-being score with weights from life satisfaction survey**
- iii. Multidimensional, predicted well-being score with weights from life satisfaction survey and fixed-individual effects¹⁵**

¹⁵ At this point, we are excluding interaction between life satisfaction domains and fixed-individual effects.

- iv. Multidimensional, predicted wellbeing score with weights, embedded with a multidimensional framework that includes psychological well-being, life satisfaction and happiness scores. The overall composite score will be unweighted.**

For a graphical interpretation of the components of well-being, see Appendix 3.

PRACTICE

7. Well-being for the City of Los Angeles

How does well-being look like in practice for the city of Los Angeles? It is possible to utilize the definition and methodology outlined above to begin to answer the question. However, given the time limitation, I am unable to design and deploy an instrument that gathers both objective and subjective data about the basic dimensions of well-being. In essence, a weights discovery process for each dimension is unavailable. What is available is a set of existing objective dimensional data that may help take the first step towards constructing a multidimensional, predicted well-being score for Los Angeles. The many iterations of the well-being score listed above also present well-being as a process. Thus, while I cannot follow through on the comprehensive framework, the construction of the index in the first iteration, is still worthwhile because I may be able to learn about the relevance and usability of the proposed methodology. The final outcomes will be a domain-specific visualization of well-being across a geospatial administrative unit in Los Angeles, a visualization of the multidimensional score of well-being across Los Angeles and a final multidimensional index map of Los Angeles. I also hope to surface the areas suffering from lack of well-being and the specific domains, sub-domains and indicators that afflict these neighborhoods. Lastly, I would like to learn whether the results are relevant for policy discovery. The following is detailed description of the demonstration well-being index I constructed for Los Angeles.

a. Available Data

Data are procured from various sources. LA Data, the city's data office, maintains an open data portal called GeoHub. It is a repository of existing geospatial analysis, research, and past maps as well as a clearinghouse for agency-specific records. It also offers shape files for city boundaries and infrastructure, such as medical centers, parks and churches. The 2016 American Community Survey (ACS) is another resource that provides block group by block group records of household income, employment, commute, housing, etc. I use both the 2016 American Community Survey by all block groups in Los Angeles and the Tiger administrative block group boundaries. The data from this source constitute a majority of the information visualized. The California Environmental Screen 3.0 portal offers data on the intersection of the environment and public health. As an index, it offers a clear organizing framework for tracking methodology and assumptions. Lastly, there are agency-specific data portals, such as LA Metro and LAPD that help fill in data gap. Overall, I find the availability of objective data to be substantial. I imagine those looking for data for other cities would be similarly surprised.

Among these existing datasets, the 2016 ACS offers the most granular unit of analysis at the Census block group level. The California Environmental Screen 3.0 and the GeoHub have data at the Census tract level. Unfortunately, there are no individual-level survey data. The values for the tract level can be transferred to block group since the latter combines to create the former. This limitation of data by administrative border means that for analysis, we can only make statements about the block groups. Thus, in the following demonstration, the indicators are often described as a percentage of the total households, under or over certain threshold¹⁶, in a

¹⁶ Usually described as a percentage of the households in a block group too.

block group. These are not statements about the households themselves. They are about the collective profile in a block group. Obviously, block group shapes are imperfect, not normalized and could lead to distortion. However, with 2,505 total block groups in Los Angeles, it might not matter. GIS is chosen as the software for visualization because it brings out geospatial patterns very easily for policy makers. At a later point, the block groups can be aggregated into zip code and other groupings. These geospatial administrative units are the ones that policymakers and civil servants are most familiar with.

b. Choosing the Domains

The domains¹⁷ form the basic core of the well-being index. I synthesize the domains¹⁸ used by Santa Monica and those included¹⁹ in the sample subjective instrument^{xxix} to arrive at a comprehensive list for Los Angeles. Under other circumstance, it would be more dynamic to host pre-index engagement with city residents to surface the domains that drive their well-being. By determining them on my own, I am making a big assumption²⁰ that all the domains are important to the residents. As the data will bear out later, this is not necessarily true.

For the purpose of the exercise, the domains are material well-being, health, productivity, security, intimacy, community, and environment. Each domain breaks down into sub-domains. I develop guiding questions to help focus the sub-domain and then identify indicators that can approximate the relationship that each sub-domain plays in facilitating or diminishing well-being.

Please see Table 4 below for domains, sub-domains, threshold questions and the indicators. The following section will review the logic and assumption for including each sub-domain.

Table 4: Domains and Sub-domains for Well-being in Los Angeles

Domain	Sub-domain	Threshold Question	Proxy/Indicators
Material Well-being	Food	Do you have adequate access to quality and affordable food?	Food Stamp
	Housing	Do you have access to affordable and secure housing?	Cost of Rent
			Crowding in Occupancy
	Income	Is your income level above a widely-recognized indicator of poverty?	Income Level, Federal Poverty Level
Transit	Do you have access to public transit? Is public transit a reasonable option in terms of commute time?	Time to Work	

¹⁷ Also known as dimensions previously.

¹⁸ Outlook, community, place & planet, learning, health and economic opportunity

¹⁹ Material well-being, health, productivity, security, intimacy and community

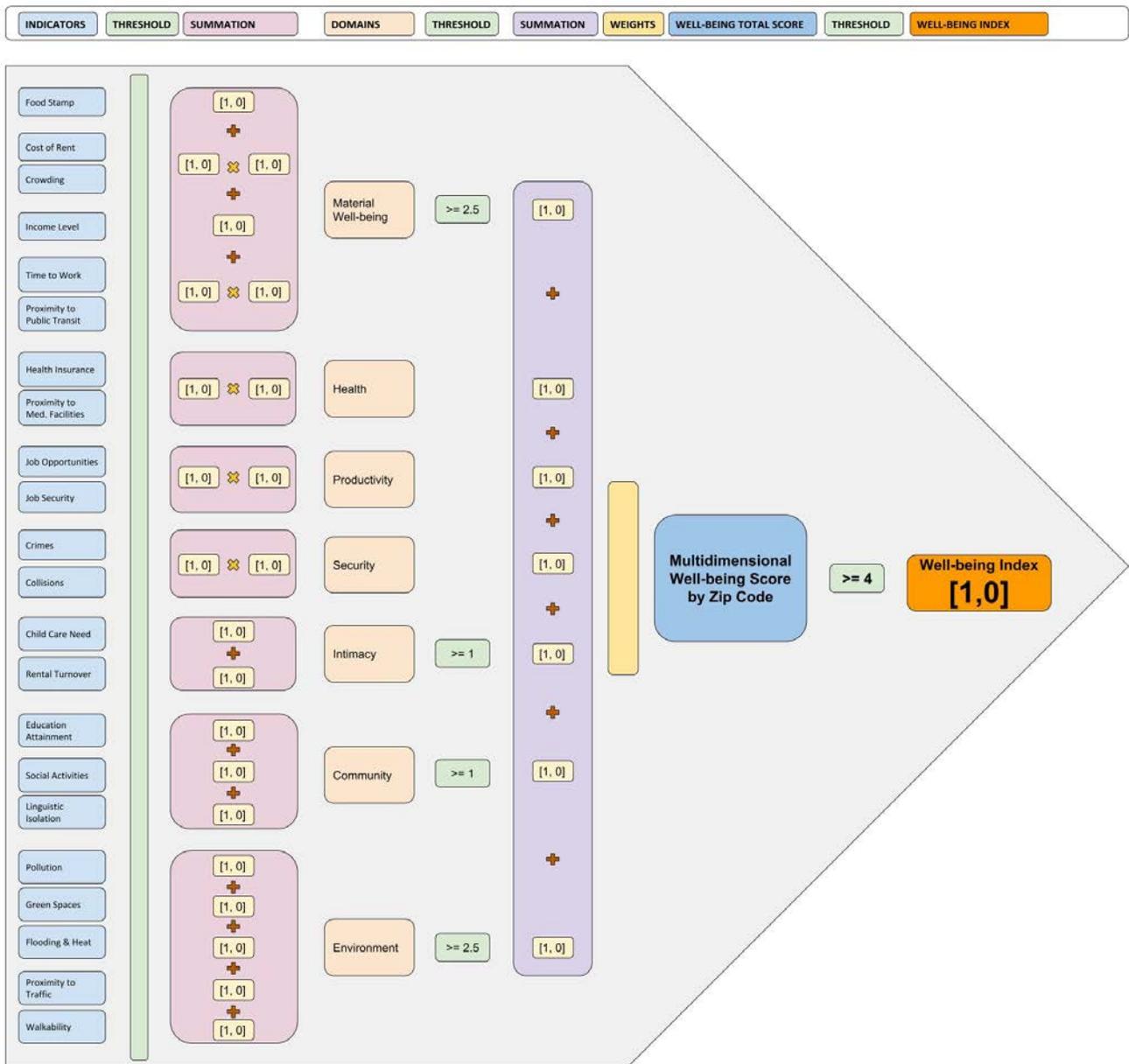
²⁰ It is my intention to list all assumptions in the body of the description and for each domain, and not in a separate paragraph on limitations. This is in line with my transparency argument.

			Proximity to Public Transit Access Points
Health	Health	Do you have access to health insurance and health facilities?	Health Insurance
			Proximity to Medical Facilities
Productivity	Work	Have you been employed in the past 12 months (opportunities)? Have you been employed fully or partially in the past 12 months (job security)?	Job Opportunities
			Job Security
Security	Physical Safety	What is your proximity to crimes and fatalities from car crashes?	Proximity to 2016 reported crimes
			Proximity to 2016 collisions
Intimacy	Friends and Family	What is your tenure of residence? To what extent do you have unfulfilled child care/support needs?	Child Care Need
			Rental Turnover
Community	Neighborhoods and Education	What is your level of education attainment?	Education Attainment
	Social	What is your proximity to places of social, cultural and volunteer activities? What is your level of linguistic isolation?	Proximity to Social, Cultural and Volunteer Activities Linguistic Isolation vis-à-vis English
Environment	Pollution	What is the level of air pollution and water contamination in your neighborhood?	Level of Air and Water Pollution
	Green Space	What is your proximity to neighborhood green spaces?	Proximity to Green Spaces
	Climate Vulnerability	What is the level of heat and flooding threats in your neighborhood?	Risks of Flooding and Extreme Heat
	Urban Stress	What is your level of urban stress related to proximity to high traffic area and the level of walkability in your neighborhood?	Proximity to High Traffic Points Walkability

c. Logic and Assumptions of Domains, Sub-domains and Indicators

Overall, I select 22 indicators based on existing data to inform seven domains that constitute the multidimensional score for well-being. Each indicator is subject to a threshold that determines whether said indicator is well-being enhancing or well-being diminishing. They are then assigned [1, 0] and summarized in their specific domain grouping for a domain score. The domain scores are then subjected to a threshold rule as well before being assigned [1, 0] for the final summation under the multidimensional score for well-being. The unit of indexation is by the 2010 Census block group. For a visualization of the data pathway and index construction, see Figure 2 below.

Figure 2: Multidimensional Well-being Index Construction

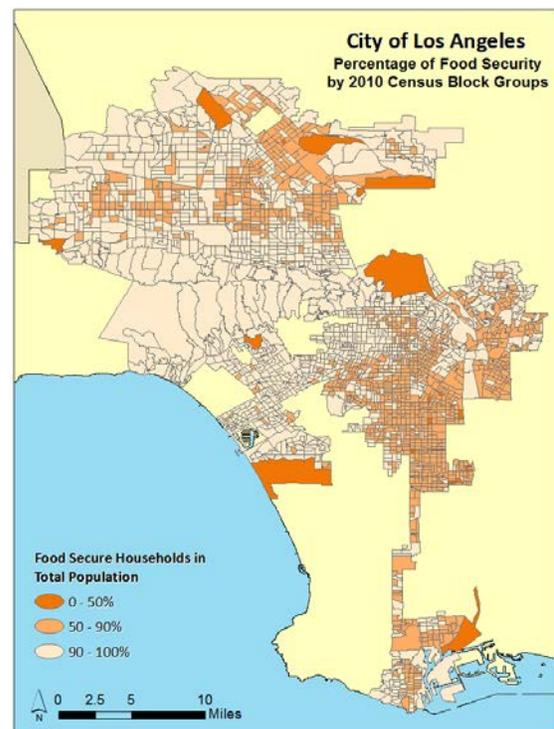


In the following sections, all sub-domains and indicators will be visualized in maps that utilize similar cues. Darker hues convey areas deficient in well-being because they have not surpassed the pre-determined thresholds. Each map will have a legend, including the proposed threshold for specific sub-domain well-being. The maps visualize the depth and distribution of each indicator measure over Los Angeles block groups. While the threshold is included in the legend, the maps do not visualize the final well-being assignment [1, 0]. The purpose is to provide the reader with a sense of the patterns that arise among the 22 indicators. The well-being assignment [1, 0] for the seven domains are visualized in a separate section that follows.

i. Material Well-being Domain

Material well-being is a composite domain of four sub-domains for urban dwellers. They are food security, housing security, income and transit. For the **food sub-domain**, I want to identify access to affordable food as the indicator. I use the 2016 American Community Survey (ACS) to ascertain the number of households with **food stamps** in a block group. The figure is divided by the total population of the block group to arrive at a percentage. Block groups in which greater than 90% of the households do not receive food stamps are considered to be food secure. These block groups are coded 1 for well-being enhancing.

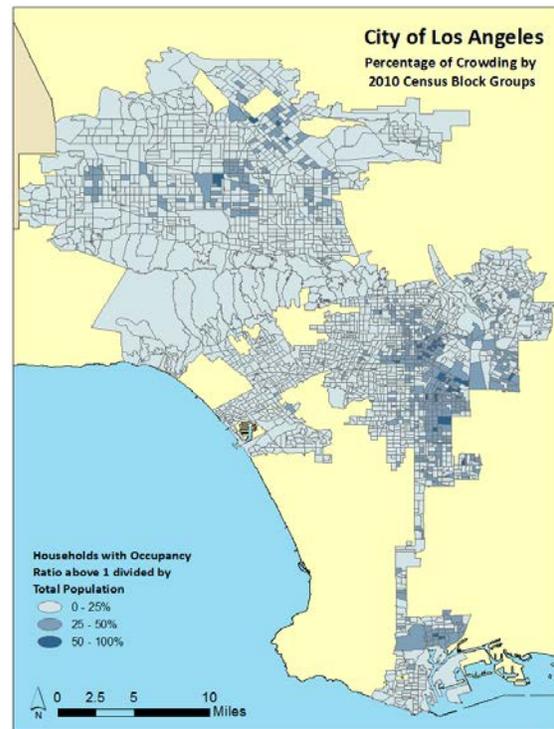
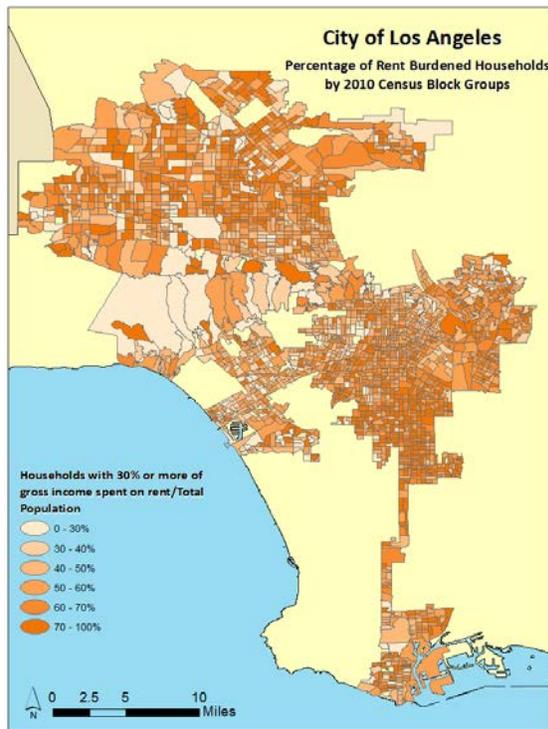
In the food security map here, lighter hue indicates block groups in which 90% or greater of the households do not require food stamps. My assumption is that food stamp is a strong indicator of food insecurity.



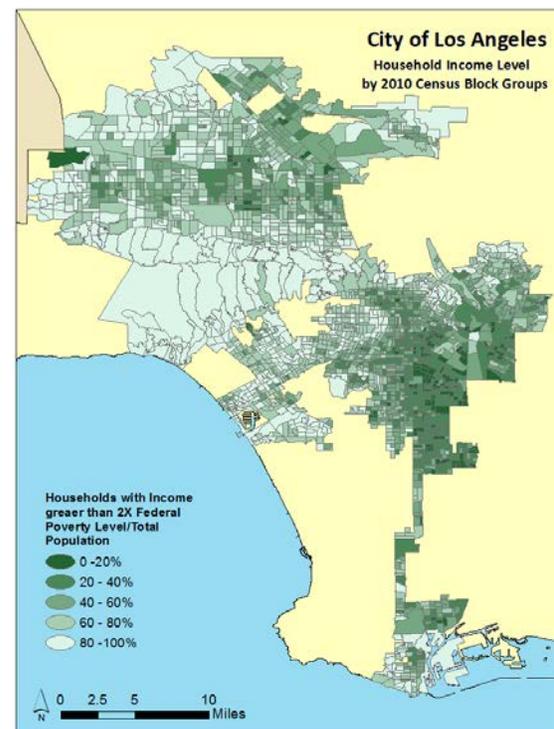
For the **housing security** sub-domain, I use percentage of gross income towards **rent cost** as a measure of housing security. Households who spent more than 30% of their gross income on rent are considered insecure. Block groups in which less than 30% of the households are rent-burdened are considered rent secure area. A second indicator that I utilize is the **occupancy ratio** (number of persons per room) to approximate residential crowding. I calculate the number of households with occupancy ratio equal or greater than 1 over the total number of households to arrive at the percentage of households who suffer from crowding in a block group. Block groups in which 25% or more of the households are suffering from crowding are coded as 0 for well-being diminishing.

Both cost of rent and crowding are required to score 1 for housing security to be well-being enhancing. In the two maps below, they suggest that most households in block groups suffer from rent burden, while crowding affects a considerably smaller swath of block groups.

Overall housing insecurity should then reflect a distribution that is greater than what we see in the rent burden map.



For the **income level** sub-domain, I use the federal poverty level as a reference point. Income level and cost are higher in an urban area. The federal poverty level (FPL) includes rural poverty. Thus, the US Department of Housing and Urban Development provides a useful bridge definition of low-income in the County of Los Angeles in 2017 relative to the FPL. For a family of three, the low-income level is \$64,900, which is roughly 3 times that of the federal poverty level of \$20,420^{xxx}. The 2016 ACS data only tally households with reported income two times above the FPL. For the index, I use two times or greater than the FPL as the threshold for income level as well-being enhancing. This situates the average income threshold, disregarding family size, at slightly above \$40,000 per year. Block groups in which more than 75% of the reported household incomes are twice the FPL or more are coded as 1 for well-being enhancing.

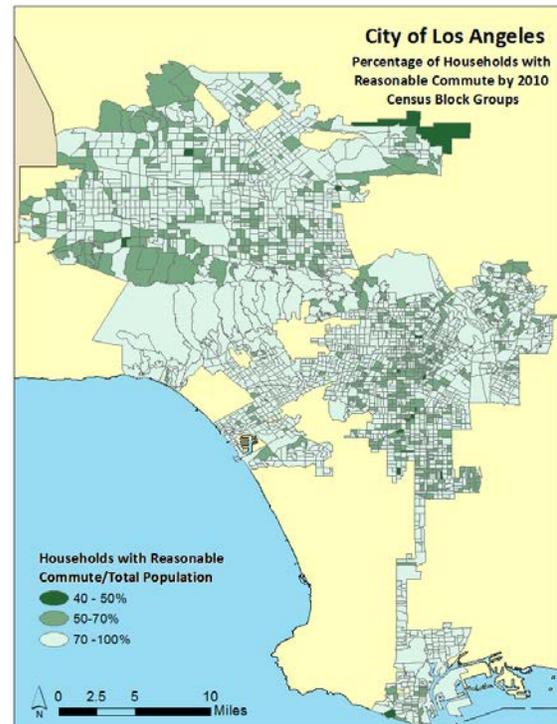


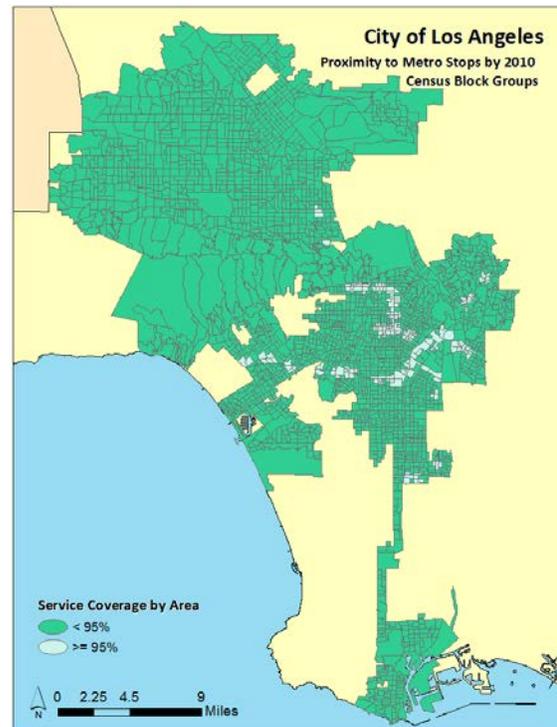
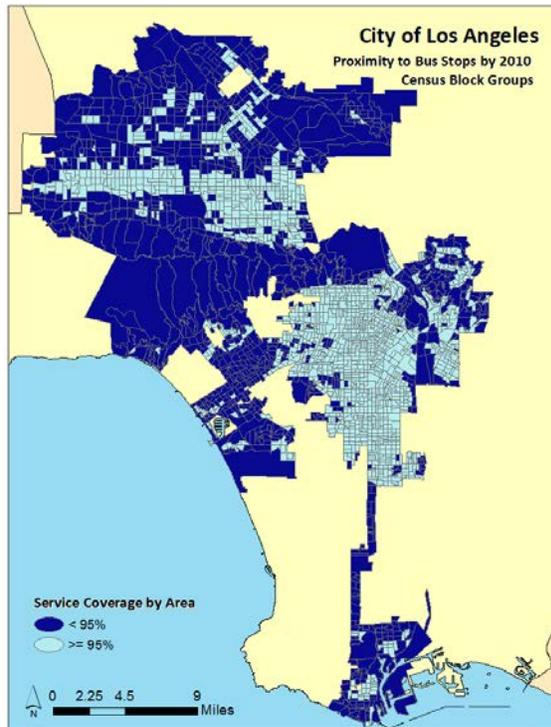
It is important to note that for income level, one could have utilized data with the average income per block group from other sources. That would have been valid as well. However, the 2016 ACS only tally the number of households within income ranges. The methodology is open to other descriptive statistics and thresholds. It is only at the last step that one must assign a 1 or a 0 for being above or below the predetermined threshold. In the map, there is once again a huge swath of block groups with majority households that do not make two times more than the FPL.

For the **transit** sub-domain, the selected indicators are **commuting time** among households and **proximity to public transit** options such as bus and metro. For the commuting time indicator, households that require 45 minutes or less to arrive to work are considered to be well-being facilitating. In the 2016 ACS, I calculate the percentage of households with reasonable commute out of the total households per block group. Within a block group, 70% or greater of the households would need to enjoy a commute of 45 minutes or less for the block group to be coded as 1 for well-being enhancing.

For the proximity to public transit options indicator, I access geospatial point data for all bus and metro stops within Los Angeles from LA Metro's GIS portal. I calculate the distance away from bus stops and metro stations for all 100-square-foot pixel cells within a block group boundary. These pixels are coded 1 or 0, depending on their distance value. The threshold for proximity to bus stops is a quarter mile, while the threshold for proximity to metro stations is half a mile. Pixels within a block group under the proximity thresholds are coded as 1. The number of 1s within a block group is counted. The overall number of pixels are counted as well. When I calculate the percentage of 1s out of the total number of pixels, I have determined the percentage of the area of the block group that is in close proximity to any public transit options. Block groups in which 95% or greater of the area are near any transit option are coded as 1 for well-being facilitating.

Both reasonable commuting time and proximity to public transit options are required for a block group to be coded as 1 for well-being facilitating. One could drive and achieve shorter commute time, however, my assumption deems car ownership as well-being diminishing for the city. One could also be physical near a public transit option and still suffer from long commute or misaligned lines. Thus, neither indicator alone would do this sub-domain justice. In addition, access to metro lines is more prized than proximity to bus stops. The differential definition in distance thresholds and the conditionality of commuting time help to correct this discrepancy.





Lastly, it is important to note in the visualization that there is, in fact, a high baseline of households who suffer from long commutes. In block groups where only 40% to 50% of households have reasonable commute, 60% to 50% still do not. Even in block groups where over 70% of the households have reasonable commute, 30% may still fall short. These nuances are important for the city's transit policy makers.

Overall, the maps below suggest that access to metro lines is largely restricted to the immediate vicinity of the physical infrastructure. Even within areas with a metro stop, the last mile may still pose a challenge for access. While there is a preponderance of bus stops in the city, they seem to mainly serve a centralized swath with a higher density of stops. These visualizations, of course, do not take into account the destination, route optimization and possibility of connections that proximity to a bus stop may or may not offer²¹. Those analysis can be done through network mapping using more sophisticated GIS techniques.

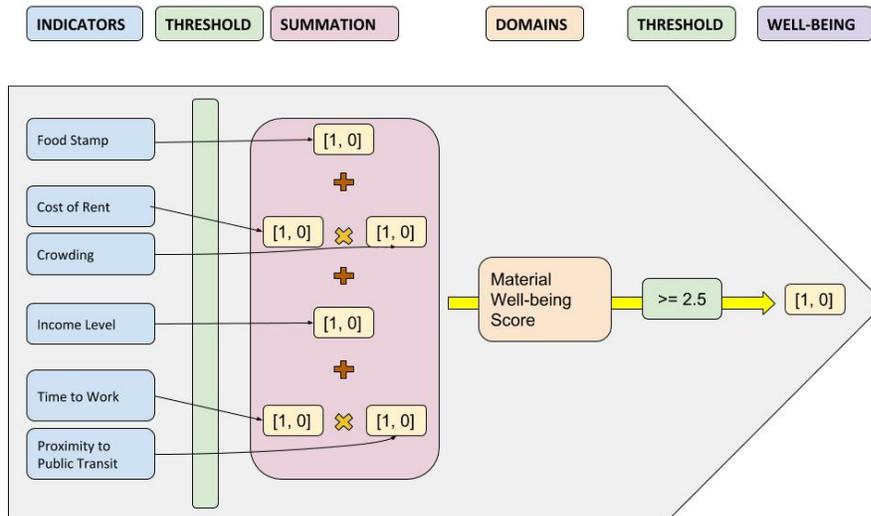
To calculate whether the material well-being domain, as a summation of the four sub-domains, facilitates or diminishes well-being, I utilize a 2.5 threshold, out of a possible total score of 4. A block group would need to amass a score greater than 2.5 to be coded as 1 for well-being enhancing for the domain of material well-being. I assume that city residents will have to make trade-offs and all four sub-domains are, in practice, out of reach. In achieving

²¹ Another methodology may be to ask residents to trace their daily commutes. This may surface where the transit system is serving residents in the most efficient and timely manner.

2.5²² out of the four, they would have adjusted their expectation and be content with what they have.

The indexation chart below demonstrates how indicators are folded into sub-domains and the well-being score for each domain. For the material well-being domain, the measure for each of the indicators (usually a percentage measure of the households out of a total population figure in a block group) passes through a predetermined threshold. A code of 1 is assigned for passing, and 0 is assigned for failing. The binary scores are then added up per indicated rule. For example, food stamp stands alone as an indicator and is added to the overall score. Cost of rent and crowding are mutually indispensable to housing and are therefore multiplied to arrive at a unitary score that is added to the overall score. Material well-being has an overall score for each block group. The score is then subjected to a predetermined threshold and assigned 1 or 0 afterward for domain well-being. Each subsequent domain will have an indexation chart for clarification.

Chart 1: Indexation for Material Well-being Domain



ii. Health Domain

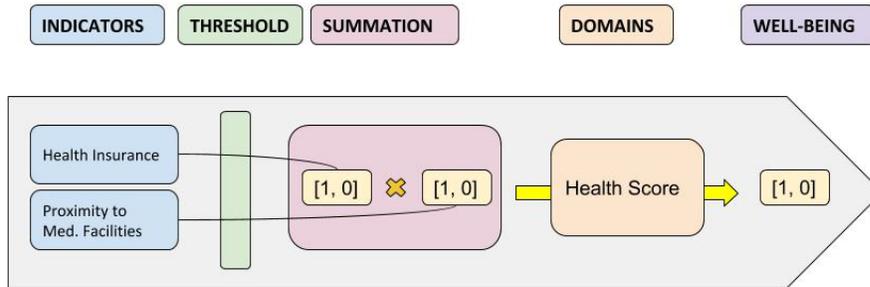
The **health** domain is a composite of two indicators, **access to health insurance** and **proximity to medical facilities**. The 2016 ACS tallies households per block group with health insurance²³. A block group in which over 90% of the households out of the total population have health insurance is coded as 1 for well-being enhancing. For proximity to medical facilities, LA Data’s GeoHub provides spatial coordinates of health centers, health clinics, mental health centers and hospitals. I use a proximity analysis technique similar to that of the bus stop and metro station indicators to arrive at a percentage of the area of a block group near a medical facility. The threshold of proximity is 1 mile or less. Thus, if 50% or greater of all possible

²² The current calculation of the sub-domains into the domain does not allow for 2.5. However, with the introduction of weights, the final domain score could change.

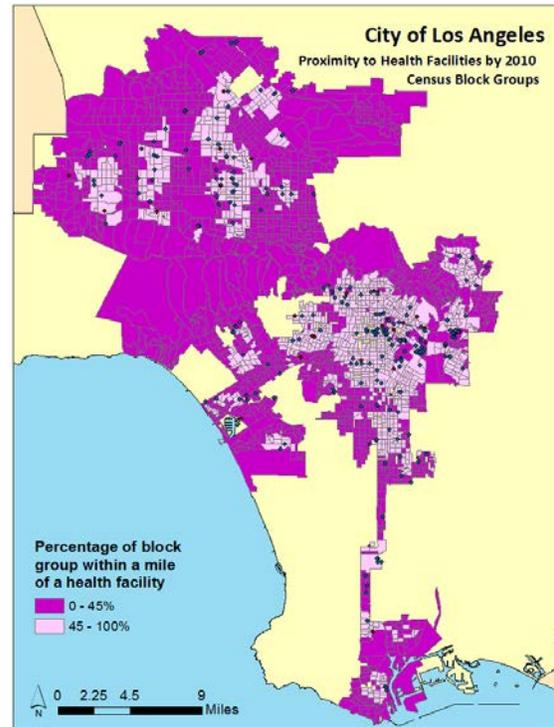
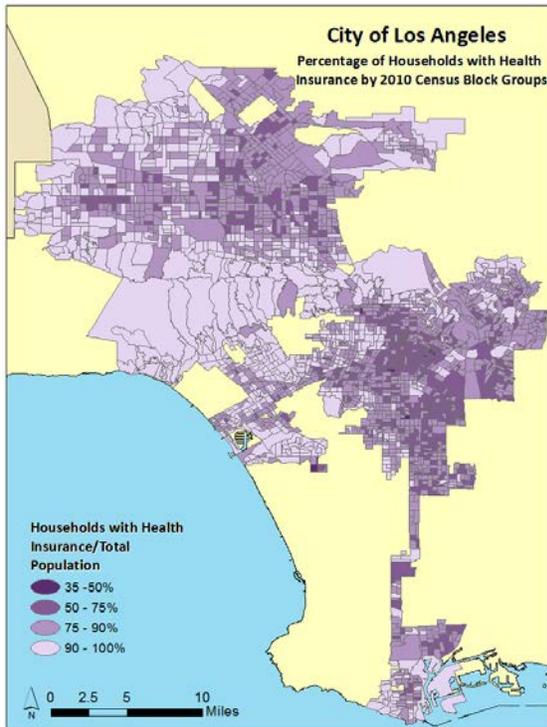
²³ Includes employer-financed, private and public options.

points in a block group are 1 mile or less from any medical facilities²⁴, then that block group is coded as 1 for well-being enhancing. The block groups, taken together, approximate a hot spot of medical facilities concentration. My assumption is that both access to health insurance and medical facilities are required for health to facilitate well-being.

Chart 2: Indexation for Health Domain [1*1 = 1]



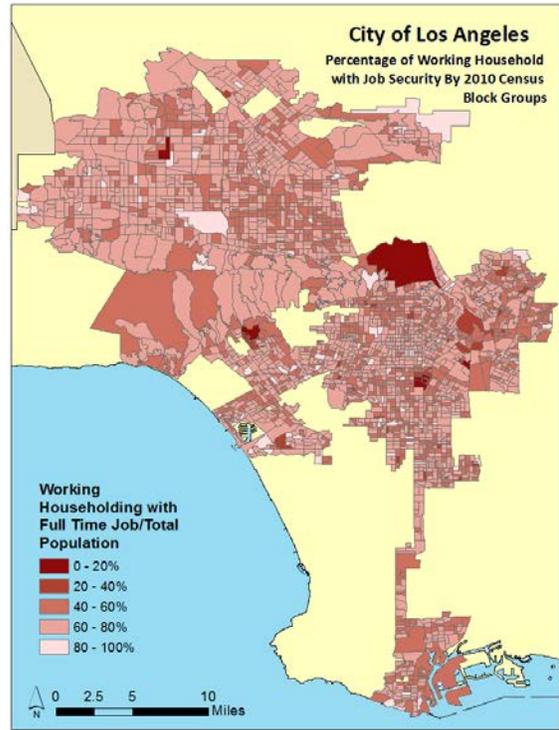
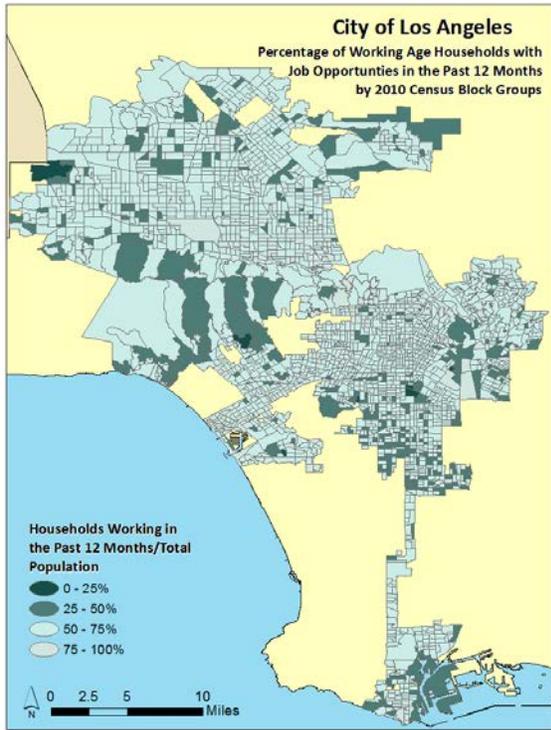
The access to health insurance visualization belies a similarly high baseline that appears in transit previously. Almost all block groups seem to sustain high level of households with no health insurance, with the heaviest hit groups suffering from almost 65% of the households in deficit. As a public policy matter, it appears that the health insurance indicator should be given more attention.



²⁴ The limitation of this assumption is that it discounts the range of ambulatory services. Larger facilities have greater catchment area. In my definition here, I basically reduce health services to walk-in. One way to correct for this in the future is to increase the proximity threshold to one mile. Another might be to use a different metric, such as medical facilities per capita per square feet.

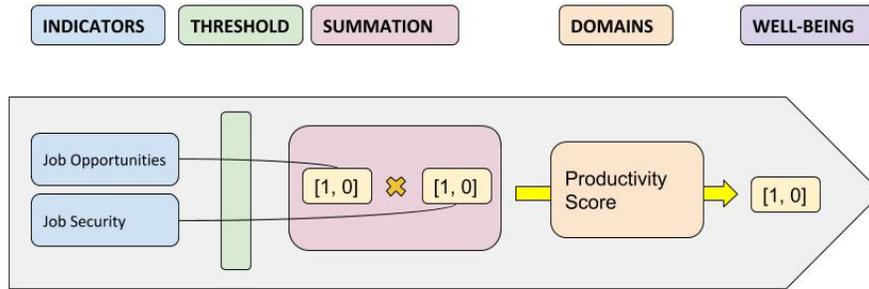
iii. Productivity Domain

The **productivity** domain is a composite of two imperfect indicators, **job opportunities** and **job security**. For the former, I use the 2016 ACS to calculate the percentage of 20 to 64 year-old-led households reporting employment in the past 12 months. The threshold for job opportunities is that 50% or more of the total households in a block group are working. For the latter, I calculate the percentage of working households in the past 12 months with employment who reported working full time. The threshold for this indicator is 60% or greater of the full-time composition of working households. The thresholds are relatively unanchored and can be adjusted if there are standard desired employment rates at the city level. My underlying assumption is when a high percentage of the population is working²⁵ and of those who report working, a high percentage reports working full time, then job opportunities and job security are both present. The two indicators are the necessary ingredients for one to feel productive. Both job opportunities and security need to exist for the productivity domain to be coded as 1 for well-being enhancing.



²⁵ Taking into consideration children, stay-at-home partners and elderlies, 50% appears high to me.

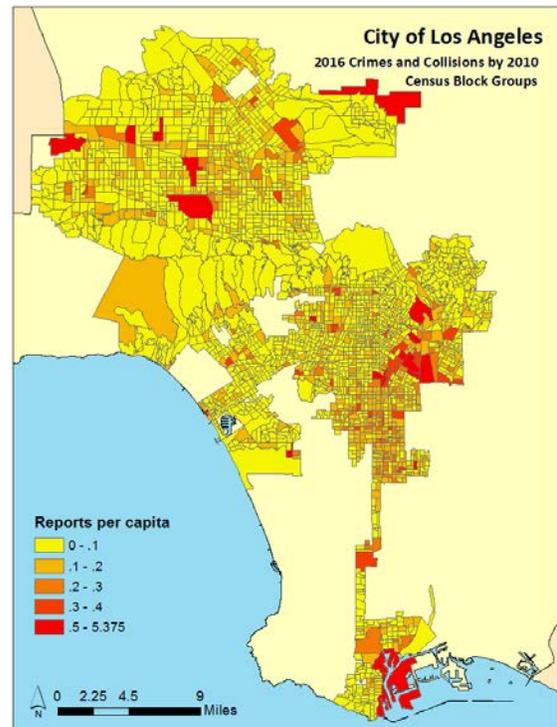
Chart 3: Indexation for Productivity Domain ($1 \times 1 = 1$)



It appears that the job opportunities that are reported are well-distributed among block groups. However, full-time opportunities among those who are working are still lacking. This would require more in-depth look at the economic data of the city to assess the situation²⁶.

iv. Security Domain

The **security** domain assumes that one needs to feel physically safe in order to thrive. The domain is a composite of two indicators, incidence of **reported crimes** and tally of **traffic collisions**. The 2016 crime reports are sourced from Data LA’s main website with XY coordinates to convert into points on a map. I tally the number of crimes within each block group²⁷. For traffic collisions, I use Geohub’s 2016 reports of all collisions in the city. They are also tallied per block group. Thus, each block group is assigned a combined tally of reported crimes and collisions from 2016.



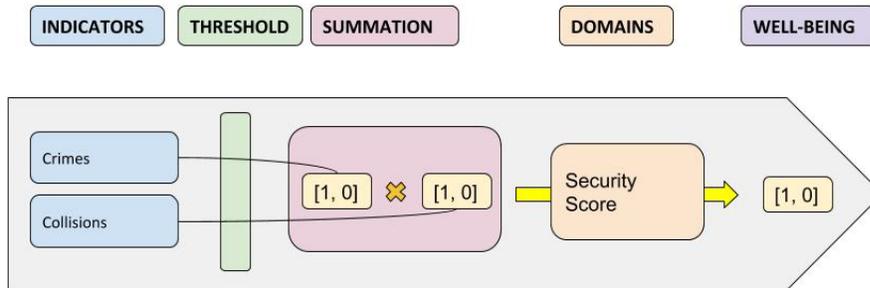
By utilizing a general tally, a lot of nuances is lost with respect to crime types, intensity and the impact on the community. Collisions are also different from crimes since police reporting standards do not always register them as crimes. However, collisions do convey similar level of physical harm. In combining them, I am hoping to approximate the presence of physical harm in a block group. The combined tally figure is normalized by total population within the block group. I use a threshold of .2 crimes and collision per capita to delineate high physical violence area and low physical violence area. Block groups with less than .2 crimes and collisions per capita in 2016 are coded as 1 for well-being enhancing. The threshold may seem high but one must recall that crimes include all police reporting and collisions include all types

²⁶ It would appear that one of the utility of the multidimensional index is to suggest domains that might warrant further investigation.

²⁷ On the choice of GIS spatial analytical technique, it was far easier to tally than employ Euclidean distance to arrive at a proximity metric. There are too many dots, which slowed down the operating system considerably.

of vehicle-related incidences. While the threshold seems high, the tallies are also likely to be inflated. Low incidence rate of both crimes and collisions are needed for the security domain to be well-being facilitating.

Chart 4: Indexation for Security Domain ($1 * 1 = 1$)

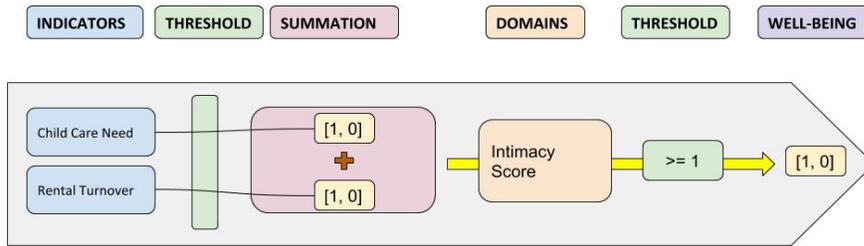


v. Intimacy Domain

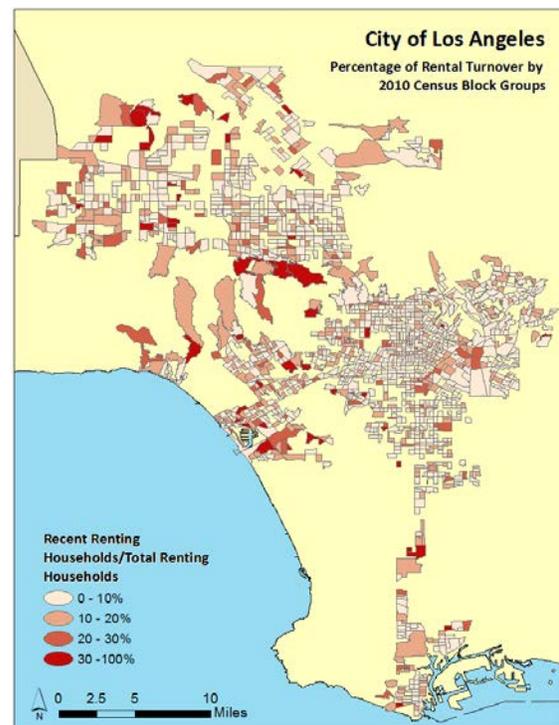
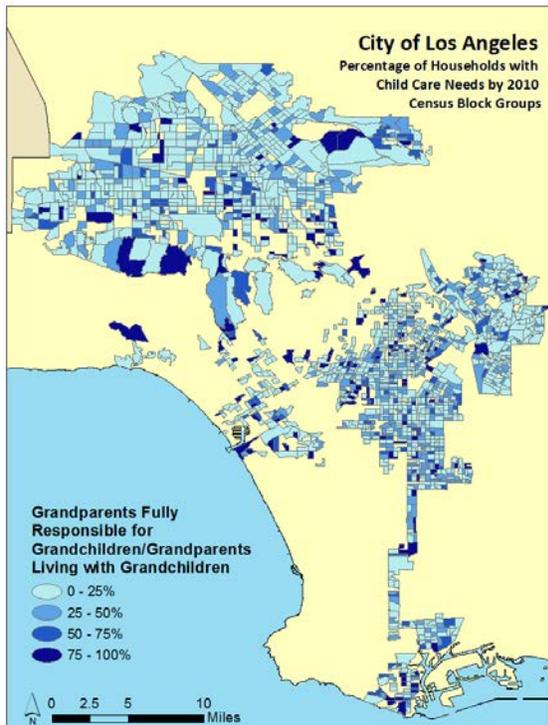
The **intimacy** domain suffers from the same lack of precise data as the productivity domain. Intimacy refers to the size, strength and support of your social network. The 2016 ACS does not provide an estimate in any sense. Measures such as household size may eschew the downside of larger families. Therefore, I try to approximate **child care need** as a proxy indicator of one's social network support. Presumably, households with strong and supportive network may have less need for child support. Grandparents living with grandchildren does not say much about network size. However, out of that population, grandparents who are fully responsible for their grandchildren may highlight more intense child care need and smaller support network for the household unit. Thus, block groups in which 25% or more of the grandparents who are living with their grandchildren are also fully responsible for their grandchildren are coded as 0 for needing child care support.

Another indicator I use to approximate social network size is **rental volatility**. I calculate rental turnover by dividing the total number of recent renters, defined as 3 years or less from the most recent move-in date, over the total renting population in the block group. I assume that households that are moving or constantly moving, are less likely to build a support network. Thus, high percentage of recent renters is bad for intimacy in the present. Block groups would be coded 0 for rental volatility if 10% or greater of the renting households are new. The presence of either indicator could tell us about intimacy. Thus, for indexing, only one indicator would need to score 1, meaning that there is a proxy for support network, for intimacy to be coded as 1 for well-being enhancing.

Chart 5: Indexation for Intimacy Domain ($1 + 1 \geq 1$)



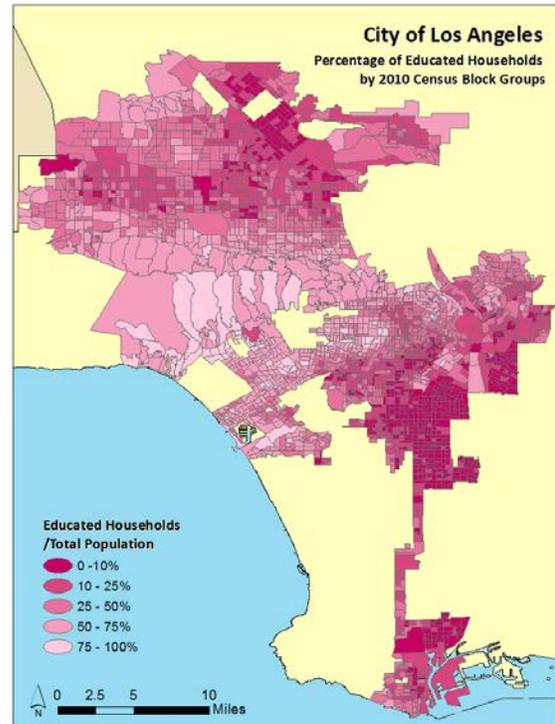
The indicators used for the intimacy domain highlight the problem of imperfect and missing data. It is important to consider whether limited indicators say anything meaningful about the sample population. At the same time, these imperfect indicators are going to be so deeply buried in a multidimensional index, marginal benefits or harm may not even be detected. Where the impact may come into play is for the block groups on the cusp. Thus, it would be prudent to look at the distribution of the multidimensional score by block groups and investigate if there are bunching near the threshold. If well-being-enhanced groups are not clearly identified, then it might suggest more careful calibration of the thresholds as well as the imperfect indicators.



In the maps below, there is no discernable pattern. The issue may be that overall, renting population and grandparents do not show up consistently and in strong enough signal for all the block groups. They may not be a good representative sample²⁸ of the overall population.

vi. Community Domain

In the **community** domain, I use educational attainment, linguistic isolation and social activities to approximate how community might drive well-being. For **education**, the 2016 ACS provides the highest academic degree of a household. Higher education level indicates that on some levels, people have had the opportunities to learn. Learning touches on growth and personal development. I am not arguing that more educated individuals build better community, only that learning and exposure to other ideas are critical to community building. I tally households with four-year degree or higher, and then calculate the percentage of households who achieved higher education out of the total population in the block group. Block groups with 10% or more highly educated households are coded as 1 for well-being enhancing.

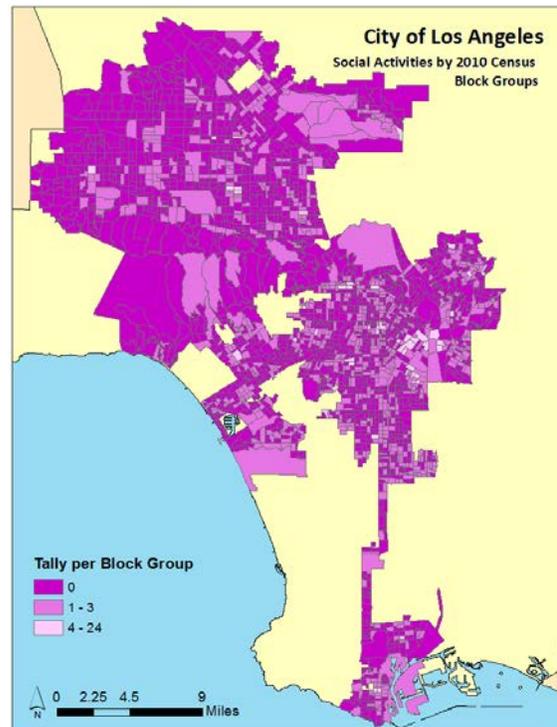
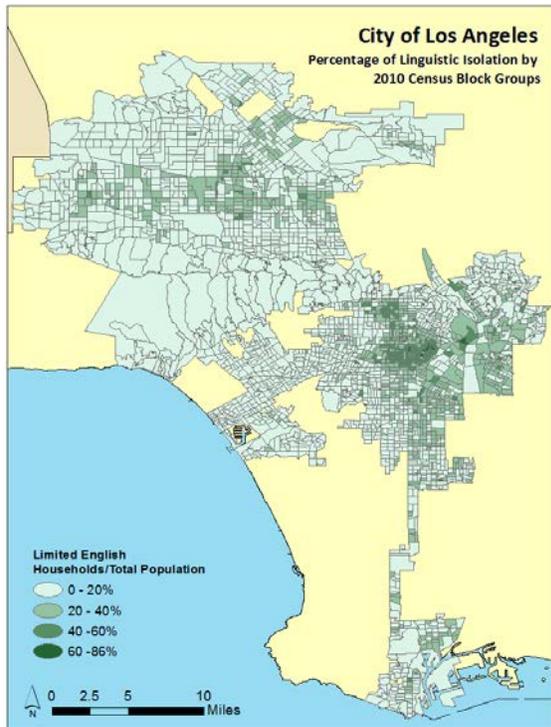


For **linguistic isolation**, I estimate the percentage of households with limited English ability. Linguistic isolation in an English-dominant area is a form of marginalization and diminishes well-being²⁹. Block groups with a cap of 20% or less of households in linguistic isolation are coded as 1 for well-being facilitating.

Lastly, for **social activities**, I use churches, farmers' markets, community organization, volunteering opportunities, community services, Great Street Initiatives and People's St Plazas as signals. Their locations are provided by different datasets on LA's GeoHub. I tally the count of each activity for a total figure per block group. The range of the number of activities extends from 0 to 24. Block groups that have one or more of these activities are coded as 1 for well-

²⁸ One can also detect for the first time, missing block groups. In those cases, the block group does not have any population of grandparents living with grandchildren. The areas were selected out in the course of the scoring.

²⁹ There is the possibility that linguistic isolation leads to stronger group identity among the isolated population, thus, is enhancing well-being. One research paper highlights the trade-off, among new immigrants, of assimilation and retaining national identity. Jean S. Phinney found that well-being is dependent on the interaction between context and the individual. Strong source of ethnic identity enhances well-being. A society friendly to adaptation enhances well-being. Marginalization does not. I am assuming that linguistic isolation in Los Angeles is a form of marginalization.



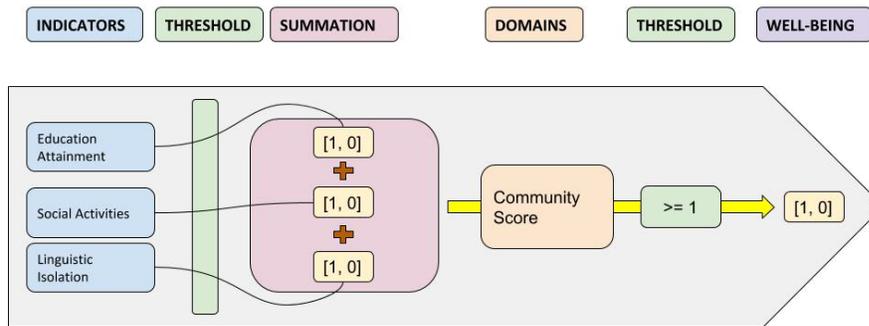
being enhancing. Admittedly, the social life of a neighborhood are going to be severely undercounted. Reading clubs, interest groups, movie nights and sports simply do not show up at all in any datasets. Thus, a low threshold such as one is justified by the idea that even one signal is correlated with a larger set of activities underneath³⁰. I am assuming that the occurrence of these activates or organizations will lead to community building. Conversely, programs such as People’s St Plazas, may exist in certain areas because those neighborhoods are underserved and lacking in social activities. If reverse correlation is the case, then the program logic shares the same logic of how social activities drive community building.

The education attainment and linguistic isolation visualizations exhibit very similar pattern of distribution of deficiency over the block groups. Linguistic isolation covers a smaller but arguably more intense foot print. There are block groups in which up to 86% of the households have limited English speaking ability. There is also a very high baseline of households with limited English ability. At the same time, these block groups are potentially home to households of whom over 90% have not been able to graduate from a 4-year college. Social activities, on the other hand, is relatively well-distributed. It goes to show that linguistic isolation and education may not limit social activities, which bodes well for everyone.

Education attainment, linguistic isolation and social activities are all proxies for community building. They are not mutually indispensable; they complement each other. Thus, for the community domain to facilitate well-being, any of the three indicators in a well-being enhancing role will do the trick.

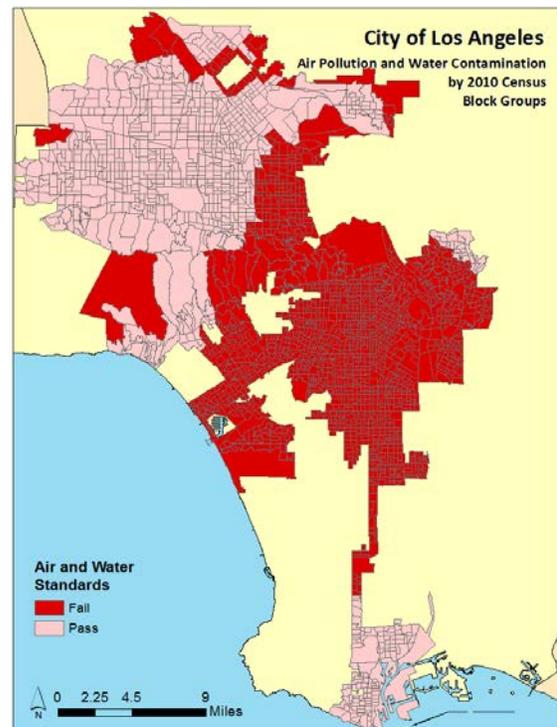
³⁰ Overall, there does not appear to be any other social life measure.

Chart 6: Indexation for Community Domain (1+ 1 +1 >= 1)

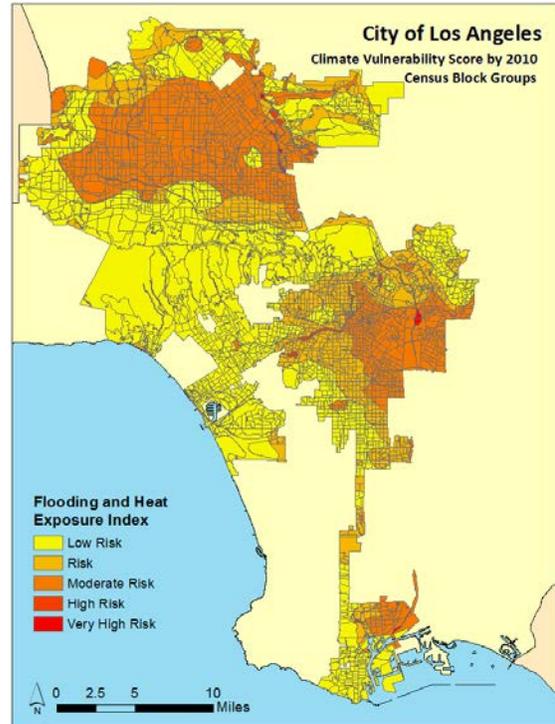
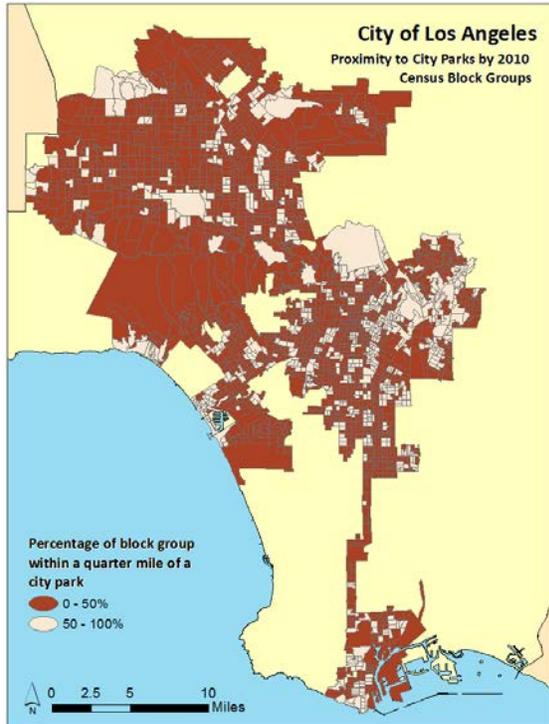


Environment Domain

The **environment** domain is composed of four sub-domains. They are pollution, green space, climate vulnerability and urban stress. For **pollution**, CalEnviroScreen3.0 provides air and water pollution data at the Census tract level. Their values are assigned to the block groups that make up the tract. For air quality, the key measure utilized is the mean concentration of PM2.5 in $\mu\text{g}/\text{m}^3$ over the last three years. The EPA standard for PM2.5 in 2012 is $12 \mu\text{g}/\text{m}^3$. Los Angeles exhibits a pollution range of 9.96 to $12.89 \mu\text{g}/\text{m}^3$. Block groups with PM2.5 concentration greater than or equal to $12 \mu\text{g}/\text{m}^3$ are coded as 0 for well-being diminishing. For drinking water quality, the range of the water contaminant index ranges from 194.73 to 888.47³¹. I borrow the dataset's top 30 percentile division and set the threshold as greater than 629 for well-being diminishing. Block groups with less than $12 \mu\text{g}/\text{m}^3$ for air quality and less than 629 for water contamination are coded as 1 for well-being enhancing. Suffering from either air pollution or water contamination would diminish well-being.



³¹ The index does not provide a unit. It is dimensionless.



For **green spaces**, I use LA Geohub's feature data sets on parks and recreation facilities. A distance analysis with a proximity threshold of $\frac{1}{4}$ quarter mile is used. I calculate the percentage of a block group that is under a quarter mile away from the nearest park. Block groups in which greater than 50% of the area are within a quarter mile of a park is coded as 1 for well-being enhancing. Thus, a block group may have a park but if it is too far away for most residents, then it does not enhance well-being. In addition, if a park is in a neighboring block group but is within a quarter mile of most residents of a second block group, the latter would be marked as 1 for well-being enhancing. Green space is defined in terms of its reach and coverage. This analysis excludes trails, natural areas and the greater outdoors in Los Angeles County and Southern California, which may be more accessible to those with vehicles. For our purpose, I am assuming that if one is able to walk to their neighborhood park, then that is well-being facilitating³².

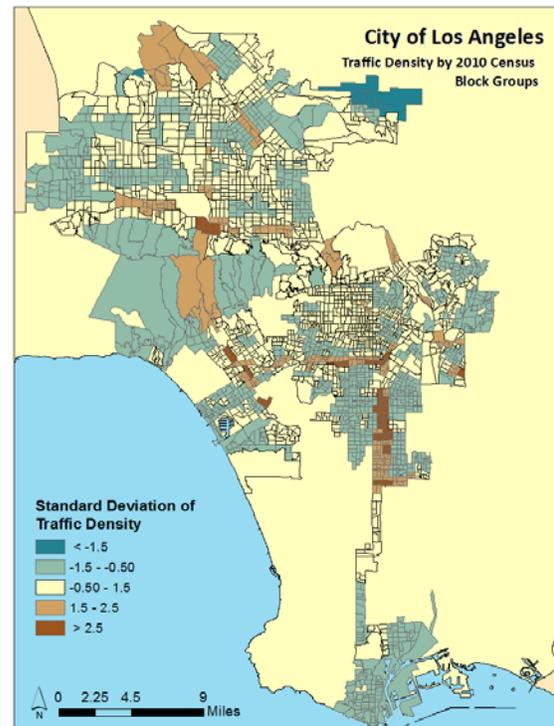
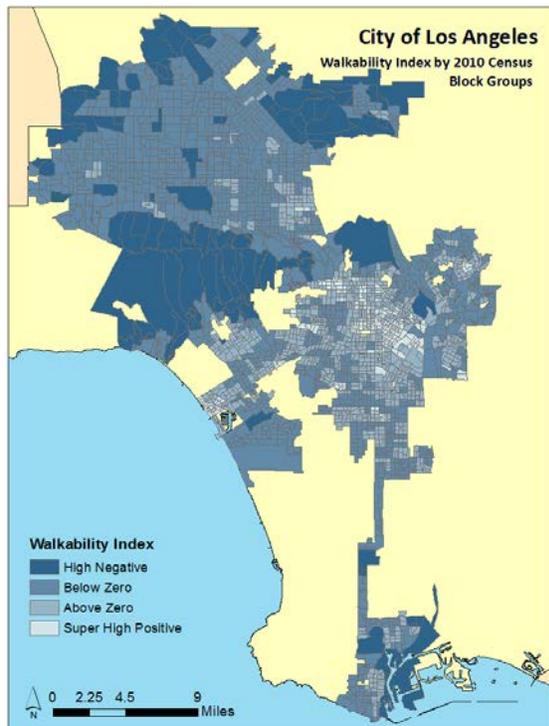
For **climate vulnerability**, I use the GeoHub's existing map of flooding vulnerability and daytime and nighttime hotspots. The range of all three indices extends from 0 to 5, with 5 being the most vulnerable. I tally the scores for each block group, effectively increasing the range from 0 to 15. Block groups with total score between 0 and 5 are coded as 1 for well-being enhancing. This range allows for the area to suffer all three threats at low intensity or only one at high intensity. For block groups with range from 5 to 15, they're coded as 0 for well-being diminishing, meaning they're suffering from multiple combination of flooding and heating

³² Indexation pathway for green space sub-domain: close proximity = 1 for well-being

stresses. While the scoring here is slightly dubious, it suggests prioritization of areas suffering from all three over areas suffering from just one of the indicators³³.

For level of **urban stress**, the two indicators are proximity to high traffic areas and walkability within a block group. CalEnviroScreen3.0 provides an index for proximity to high traffic by Census tract. The value of the index for each Census tract is assigned to the block groups within the tract. Traffic density is defined as traffic volume divided by total road length, with a range of 76.56 to 5104.46 and a mean of 1601³⁴. The distribution is right skewed. I use a relative score to separate well-being facilitating from well-being diminishing. Thus, block groups with standard deviation greater than or equal to 1.5 of traffic density are coded as 0 for well-being diminishing. Block groups with less than 1.5 standard deviation are coded as 1 for well-being enhancing. One justification for using a relative score is to recall the role of neighbors in setting one's expectation. When we perform better than our neighbors—in this case, suffering less traffic density relative to the city as a whole—we are happier.

The GeoHub also provides a walkability index score by census tract from 2012. Assuming that walkability has not varied greatly over time, the score is transferred from Census tract to Census block groups. The range of the score extends from -7.329 to 26.7³⁵, with a mean of -0.0283. The distribution is a normal distribution-shaped curve with a long right tail. This is a qualitative measure at best. However, with the mean score close to zero, I use any score above zero as well-being enhancing (0 to 26.7) while any score below 0 (-7.3 to 0) is coded 0 for well-



³³ Indexation pathway for climate vulnerability: [1,0] + [1,0] + [1,0] = 0 for well-being to equal 1

³⁴ The unit should be cars per mile.

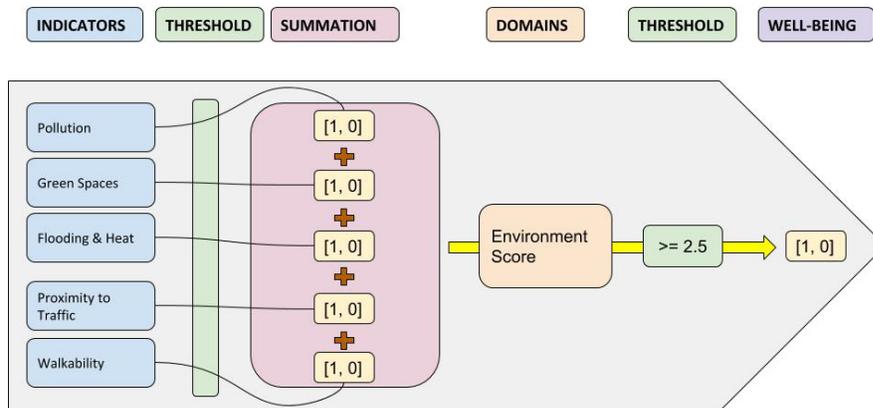
³⁵ Unit is unclear.

being diminishing. If traffic density scores low or walkability scores high, urban stress is coded as 1 for well-being enhancing³⁶.

In general, the assumptions for the relationship between environmental indicators and well-being are grounded in existing studies. Pollution diminishes well-being; green spaces enhance it. Climate vulnerability and urban stress both negatively impact well-being. In the visualization, pollution splits the city into a true north-south divide. Green spaces highlight the general lack of proximity to any parks in the whole city. Climate vulnerability repeats a pattern that is visible in many of the other indicator maps while walkability may have inverted that pattern. Thus, it is possible that the most climate vulnerable areas are also the most walkable. The two are not entirely mutually exclusive as they both build on high population density. Lastly, the challenge with traffic density is the lack of objective baseline for what is normal. Standard deviation compares values within the dataset. Los Angeles may suffer from high level of traffic on average compared to other cities. The visualization for traffic density may only highlight areas where the traffic problem is truly extraordinary and fail to convey the high baseline that residents also suffer every day.

For the **environment** domain overall, having 2.5 of 4 sub-domains of pollution, green space, climate vulnerability and urban stress (with 2 indicators listed) should push the domain into a well-being facilitating role. The total possible score for environment is five. Each of the four sub-domains is currently unweighted.

Chart 7: Indexation of Environment Domain (1 + 1 + 1 + 1 + 1 >= 2.5)



For a table of all indicators and their thresholds, please see Appendix 4.

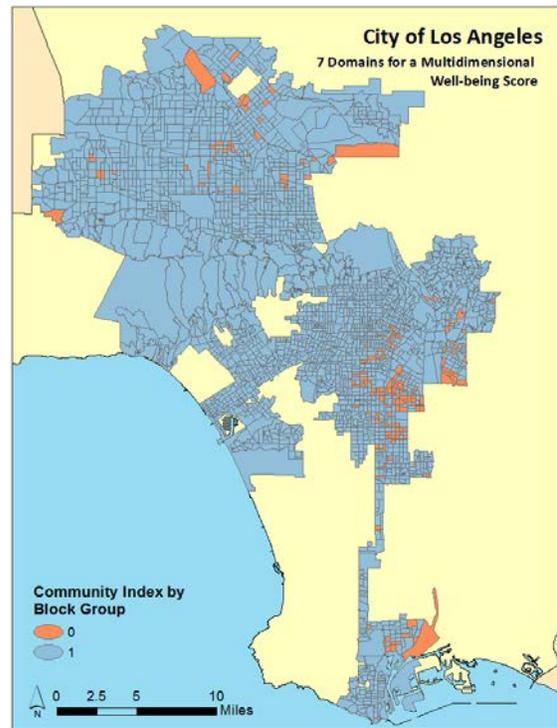
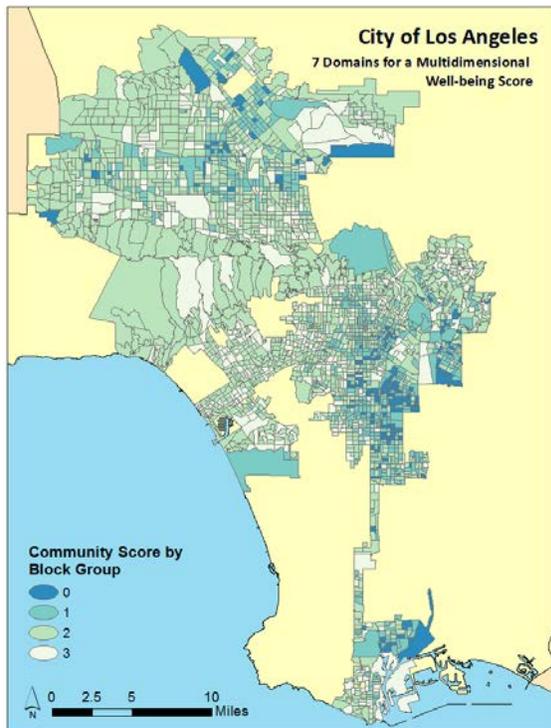
³⁶ Indexation pathway for urban stress: $[1,0] + [1,0] \geq 1$ for wellbeing

d. Seven Domains of a Multidimensional Well-being Index

Once all 22 datasets have been transformed into their appropriate indicator format, I merge them on the unique identifier for Census block group³⁷ to create a master excel³⁸. This allows the predetermined calculation that will code each of the 7 domains as 1 for well-being enhancing or 0 for well-being enhancing. The reader will notice that for some of the domains, there are a score (numerical range) and an index [1, 0]. Both maps are included to account for the nuances that the score metric may convey over the index.

i. Community Domain

For the community domain, a well-being score is generated from adding the indices of education attainment, social activities and linguistic isolation. Block groups that score higher or equal to 1 are coded as 1 for well-being enhancing. The two visualizations below provided a contrast between the distribution of the scores, ranging from 0 to 3, against the distribution of the well-being index of 0 and 1. Community appears to be a domain in which most areas of the city come out ahead but a closer look indicates that many block groups are on the margin of the threshold.

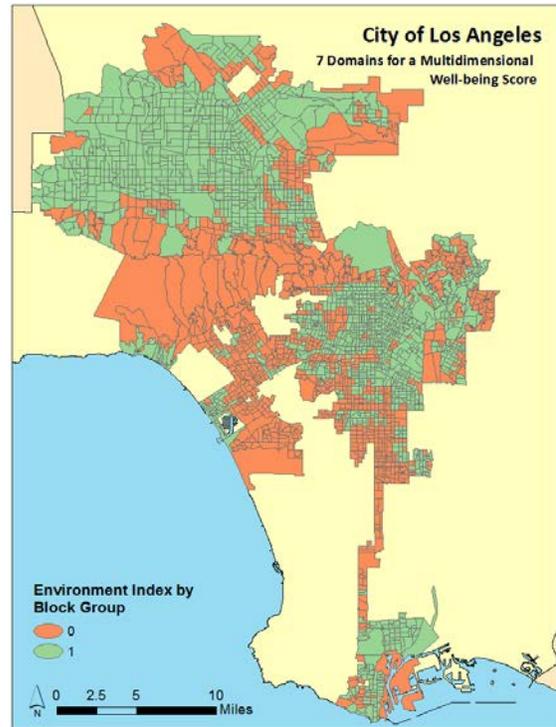
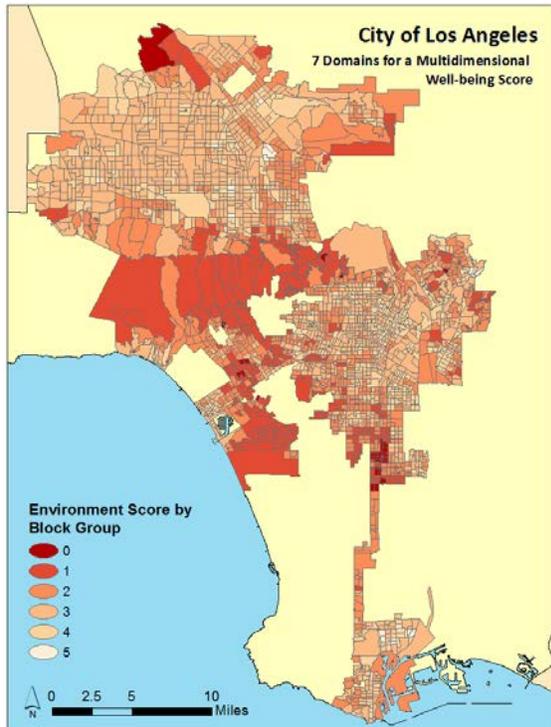


³⁷ Unique identifier for Census block group includes state number, county number, tract number and block assignment. For datasets without a unique identifier, different techniques were employed to generate a merging ID that is identical to the Census block group ID. In other cases, I used spatial joining to assign values from larger polygon onto the smaller block group polygon. In those instances, the data is considered less reliable.

³⁸ Master excel is available in a folder attached to this capstone, for verification and for use by other researchers.

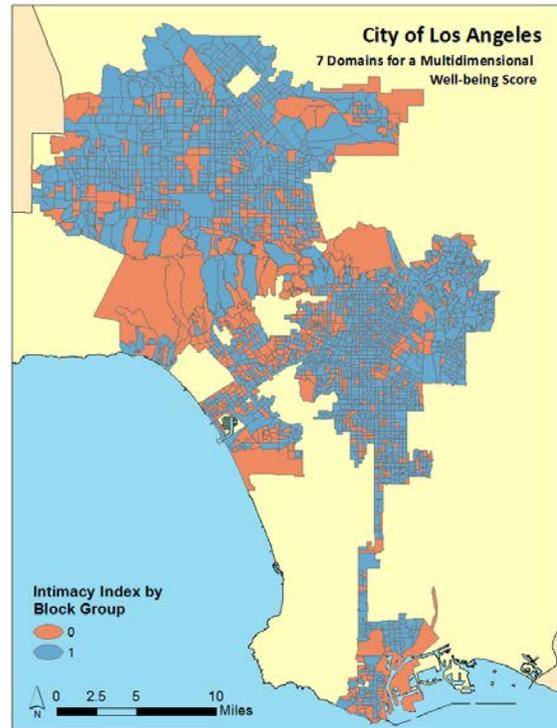
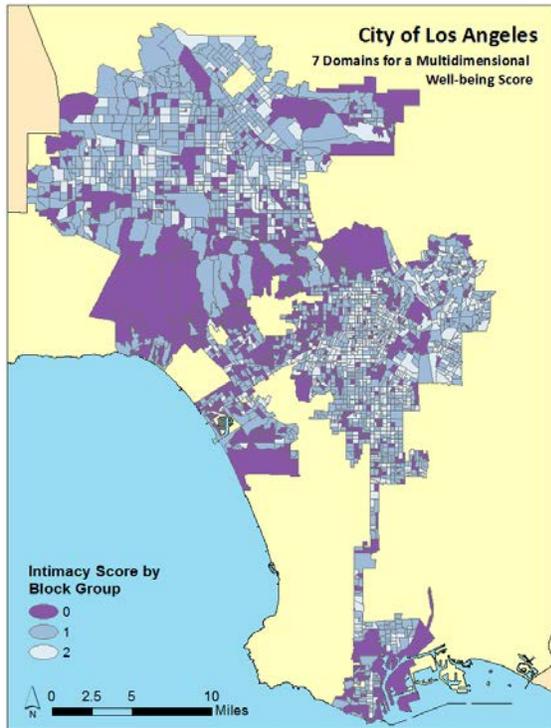
ii. Environment Domain

Indices for pollution, proximity to green spaces, risk of flooding and exposure to heat, proximity to traffic and walkability are combined to create a cumulative score for the environment domain. Block groups with a score greater than or equal to 2.5 are coded as 1 for well-being enhancing. It appears that by index, most block groups do pretty well; however, on closer inspection, we'll see once again that most block groups are within the 2 to 4 scores.



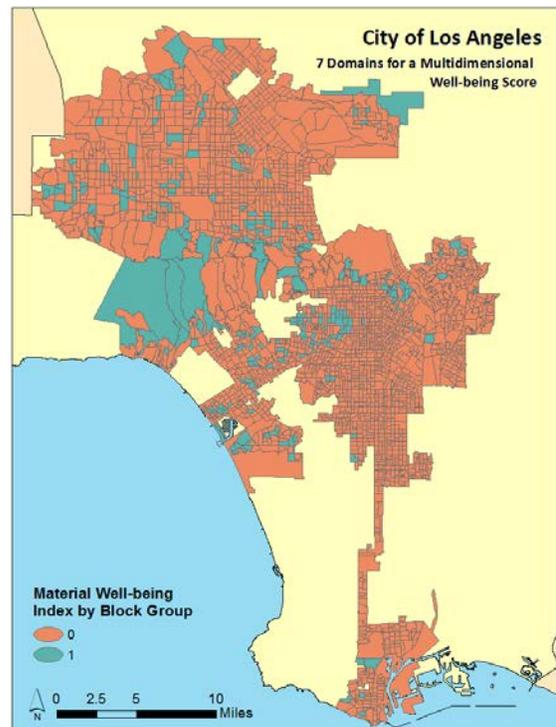
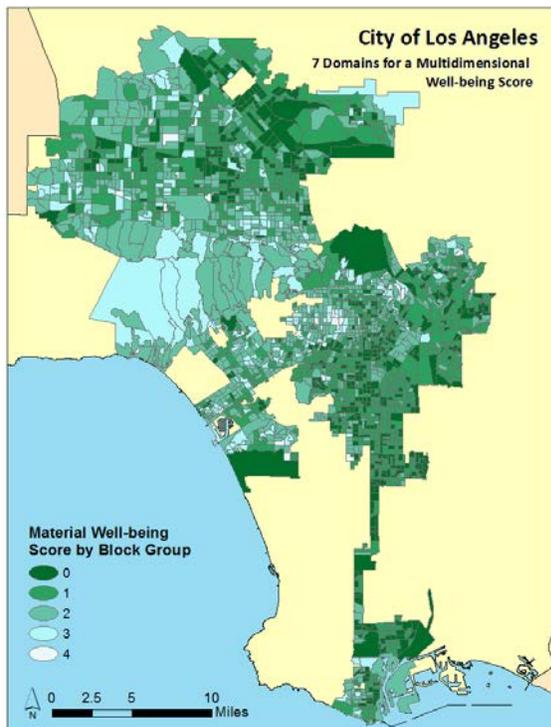
iii. Intimacy Domain

The indices for child care need and rental turnover are added to generate a score for the intimacy domain. Out of a total possible score of 2, any block groups with a score greater than or equal to 1 are coded as 1 for well-being enhancing. In this case, the split in distribution is between block groups with score of 1 against block group with score of 2. In the index, this nuance is washed over as they're both coded as 1.



iv. Material Well-being Domain

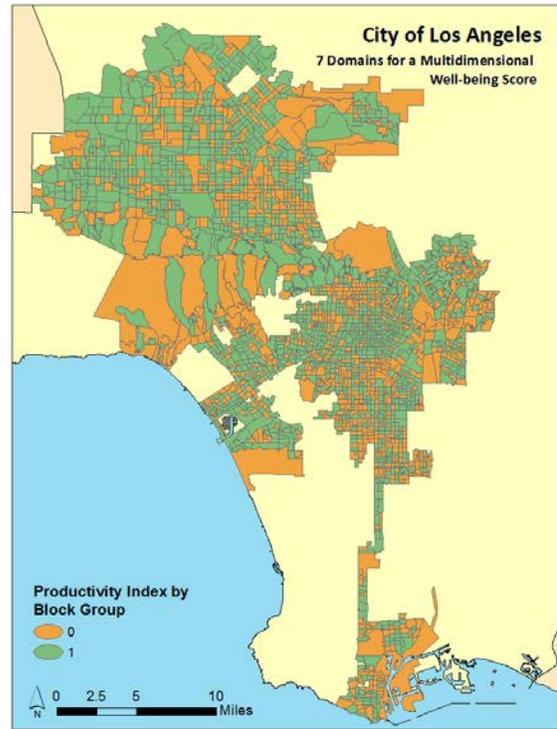
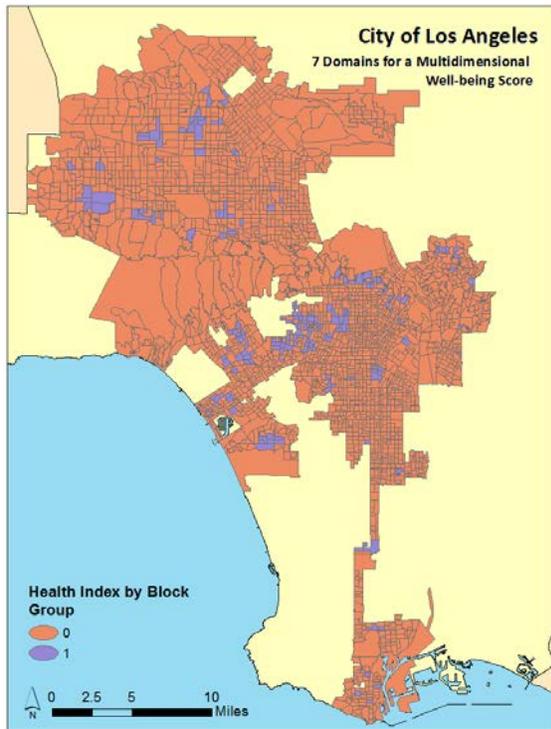
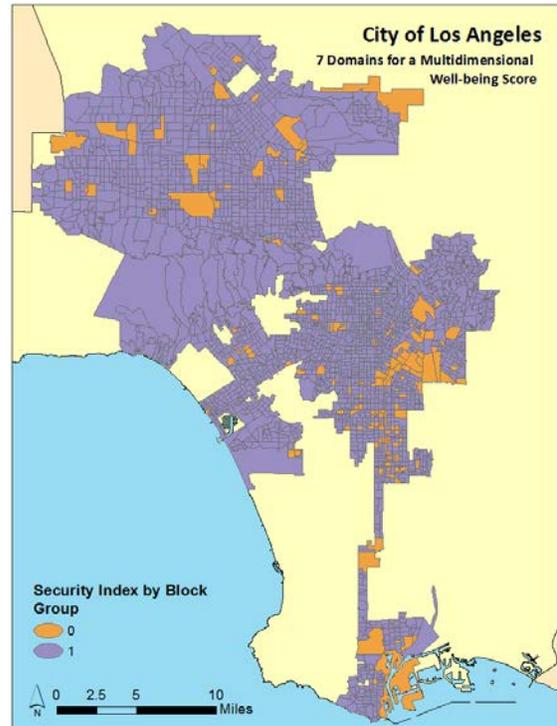
The score for material well-being includes the indices for food security, cost of rent, crowding, income, commute time and proximity to public transit. Cost of rent and crowding are both necessary for housing to be coded as 1 for well-being enhancing. Reasonable commuting time and proximity to public transition are also both necessary for transit to be coded as 1 for well-being enhancing. Both pairs require multiplication to account for the mutual necessity condition. Out of a total possible score of 4, block groups with a score of 2.5 or greater are coded as 1 for well-being enhancing. Material well-being is the most complex domain of the seven. It appears that most block groups failed to achieve a state of well-being in this domain index. In the score's visualization, most block groups reside resoundingly below the thresholds. This indicates an intensity of deprivation not seen in the other domains until now.



v. Health, Productivity and Security Domains

Health, productivity and security domains are all bi-indicator domain with a multiplication condition. Thus, there is no need to generate a score map for each as the multiplied values are transferred directly to the domains. In terms of interpretation, this means looking at the count of each indicator's well-being ones and zeros to get a sense of the impact of each indicator.

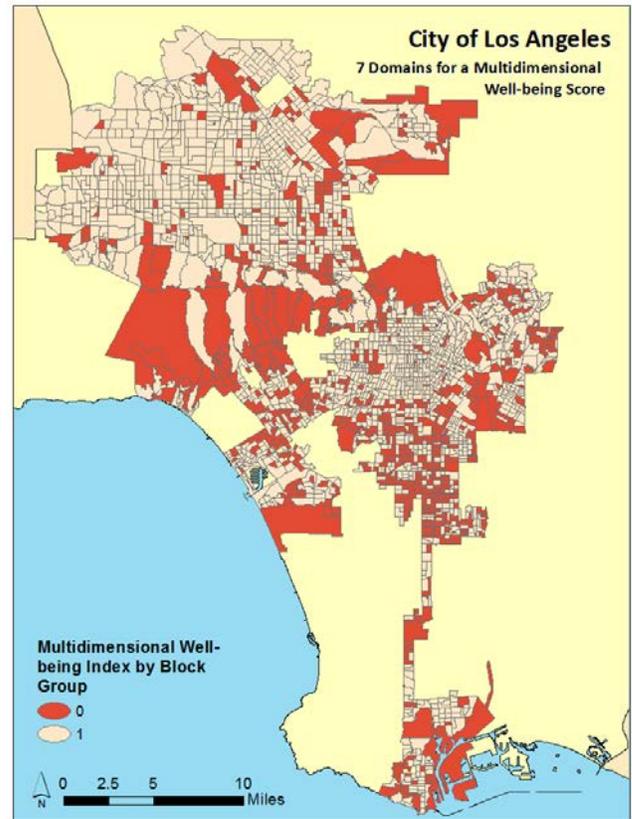
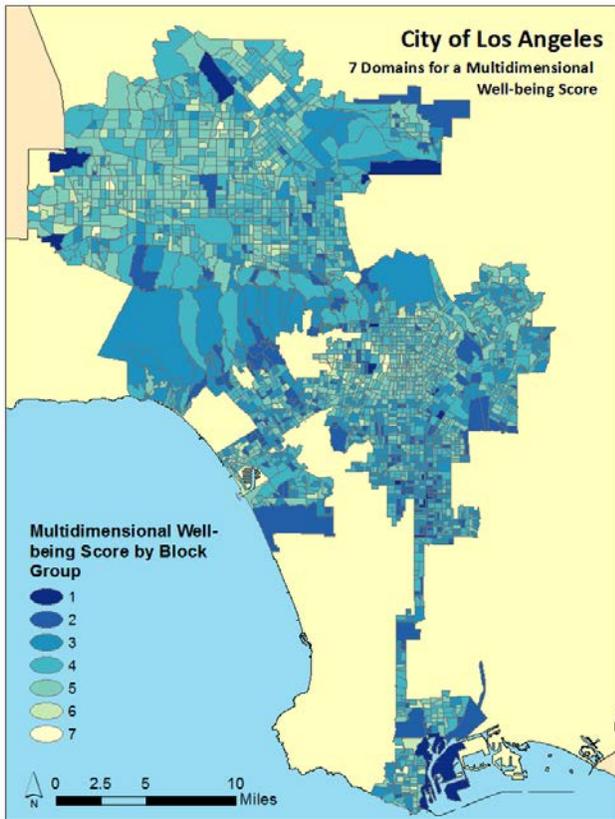
In the visualization here, security performs better than productivity. Health appears to be unsatisfactorily for almost all block groups.



For a list of all maps, see Appendix 5.

8. Multidimensional Well-being Score and Index for the City of Los Angeles

The indices for the seven domains are then added to generate a multidimensional score for each block group. The range of the score extends from 1 to 7, with 7 encompassing all domains for well-being enhancing. Block groups with a score of 4 or greater are coded as 1 for well-being enhancing. The score map below offers a more in-depth view of the distribution of the scores while the index map shows clearly where well-being exists. It does appear that there is a critical mass of block groups within the 3 to 5 range. This highlights once again the issue of threshold determination. In this case, 4 is chosen for no other reason than to pick a figure in the middle. Effectively, it is saying that if a block group is scored 1 for well-being enhancing for close to half of all the indicators, then it is a block group with well-being. In this case, the margin at the threshold does not seem to be impacted greatly if the threshold move left or right. However, for future consideration, the multidimensional threshold and all thresholds before it should warrant more careful consideration.



a. Block Groups with Low Multidimensional Well-being

The multidimensional well-being index highlights the block groups with low multidimensional well-being. Of the 2,505 block groups in Los Angeles, 700 block groups score below the multidimensional threshold for well-being. Collectively, these block groups represent 23.3% of the total population³⁹, meaning almost a quarter of the city suffers from deprivation of well-being. The most depriving domains are health, material well-being, productivity and the environment. The average multidimensional score among the block groups is 2.72, far below the predetermined threshold of 4⁴⁰.

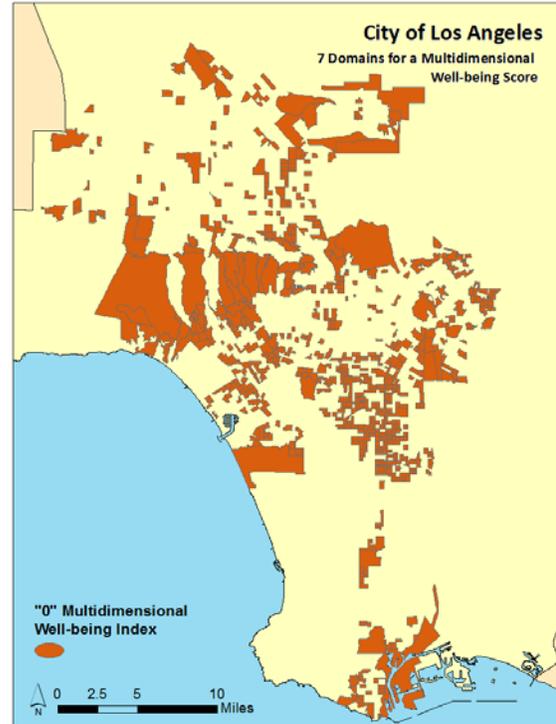


Table 5: Block Groups coded 1 for well-being enhancing in the following domains:

Domains	Tally (out of 700 total) ⁴¹
Health	13
Material Well-being	19
Productivity	163
Environment	176
Intimacy	366
Security	581
Community	587

b. Block Groups at the Extreme Low End of Well-being

The multidimensional well-being score also helps to highlight the block groups at the extreme end of the well-being deprivation. Of the 2,505 total block groups, 181 of them score 1 to 2 on the multidimensional score. This group represents the most intense level of deprivation. The average score among them is 1.92, almost 30% lower than block groups marked as low well-being. The population afflicted is 5.1%⁴² of the city. Overall, health, material well-being and productivity are the most intense drivers of deprivation. A second group, environment and intimacy, follows behind.

³⁹ There are 615,224 total population in the block groups, out of a total ACS survey population of 2,639,818. I am using the percentage here.

⁴⁰ This supports the idea that the threshold, while randomly determined, does not moved the critical mass of deprivation by much.

⁴¹ Low tally means that particular domain has not been coded 1 for well-being enhancing in most of the block groups here.

⁴² There are 136,470 total population within the block groups, taken as a percentage of the total population in the 2016 ACS sample.

Table 6: Block Groups coded 1 for well-being enhancing in the following domains:

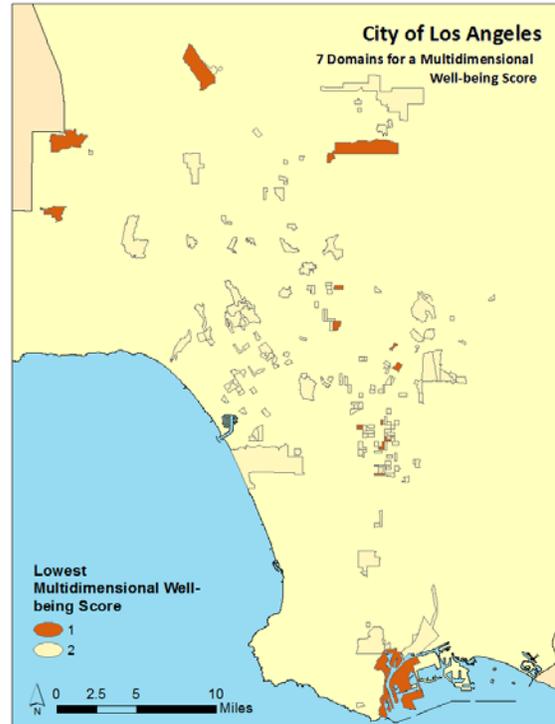
Domains	Tally (out of 181 total)
Health	0
Material Well-being	2
Productivity	11
Environment	26
Intimacy	51
Security	122
Community	136

Digging deeper, only 62 block groups score 1 for well-being enhancing for health insurance and 47 for proximity to medical facilities in the health domain. Recalling that both proximity and health insurance are needed for a block group to be coded 1 for well-being enhancing, the actual deprivation of both indicators and the lack of an intersection among the block groups that have one of them, result in a zero count of the health domain as well-being enhancing.

The material well-being domain faces a similar mathematical problem. Recalling that the threshold is 2.5 out of a total score of 4, there are only 6 block groups that do not suffer from rent burden and 35 block groups that have income level two times above the federal poverty level. There is just no intersection of the few block groups that score 1 for well-being enhancing in either indicator. This removed two of the possible four domains from the score summation. The level of deprivation along those two indicators are too profound for this set of block groups to overcome and achieve a 1 for material well-being.

For the productivity domain at only 11 count of block groups, recall that both job opportunities and job security must exist for productivity to be well-being enhancing. Only 46 block groups perform well in the job security indicator. The lack of full time work among population who reported working in the past 12 months in this set of block groups keep the domain in a well-being diminishing state.

The environment domain is slightly more complicated to unpack. The threshold is 2.5 or greater out of 5 total score. There are only 25 block groups that perform well in air pollution and water contamination, 25 for proximity to green spaces, and 51 for walkability. These three doom the domain overall for the 181 block groups. At the very least, they suggest that the city should prioritize improving these metrics in these neighborhoods.



Lastly, for intimacy, the domain may have been prejudiced by a limited sampling population⁴³ and imperfect indicators. There are only 25 block groups that achieve some level of rental stability and only 46 block groups in which more child care support is not needed. It could very well be that there are not enough renters and nor grandparents for this domain to leave a mark on these block groups. However, intimacy is only the 5th domain at this point. These block groups need only perform terribly in the first four to land here among the most deprived set. Intimacy, even if the tally is to magically improve, would not move many of the block groups out of this category.

c. Location of Most Needs

These 181 block groups extend over 54 zip codes in Los Angeles City. Obviously, the distribution is scattered in such way that evades particular policy focus. The top six zip codes, by count of block groups within its boundary are:

Common Name	Zip Code	Count of Block Groups
South Park, Green Meadows, South Vermont	90003	20
Westwood	90024	10
South Vermont	90044	9
Crenshaw, Adams/La Brea	90008	8
South Vermont, Vermont Square	90047	8
Mar Vista, Barnes City	90066	8

The top six zip codes, by total population affected, are:

Common Name	Zip Code	Total Population in Block Groups
South Park, Green Meadows, South Vermont	90003	15,293
Wholesale, Silverlake, Downtown	90012	8,592
Mar Vista, Barnes City	90066	7,456
Mar Vista, Palms	90034	6,718
South Vermont	90044	5,818
Westwood	90024	5,735

The count of block groups is an imperfect measure because block groups vary greatly in size and population density. However, when a zip code contains many block groups, it provides a central geographic focus. With total population, the ranking may be skewed by one or two block groups that just happen to have a higher density⁴⁴. Intersecting the two measures provides a rough measure of the neighborhoods that warrant attention for well-being policy and programs. These neighborhoods appear to be South Vermont, South Park and Green Meadows.

⁴³ Recall that the indicators are specific to the renter population for rental turnover, and to the grandparents' population, for those fully responsible for their grandchildren.

⁴⁴ The figure may also be representative of the larger population there, in which it would be better to normalize the figure first before comparing.

Furthermore, it would be interesting to look at the individual well-being profile of each neighborhood as well as verifying the findings against ground truth and anecdotal evidence. Certain areas may make sense; however, there may be others that are unexpected and therefore, worthwhile investigating.

9. Discussing Lessons

The construction of the multidimensional well-being score and index for Los Angeles provides certain lessons and an opportunity to discuss the drawbacks of such an approach.

a. Lack of Subjective Weights

Despite a thorough discussion about subjective weights, no weights were used in the construction of the multidimensional well-being index. Part of the issue is the lack of data on appropriate weights. Another is time limitation. However, there are a number of interjection points where weights could be applied. The most obvious is in the summation of the 7 domains. The importance of certain domains could have been inflated or deflated. Weights could also be applied at the indicator level in the aggregation and multiplication steps. This is not limited to weights related to domains but also fixed individual effects. For example, I could apply a discount for males in the community domain by drawing on the ratio of male population to total population per block group. All in all, while weights were not used in this index exercise, I have realized that they could be introduced in many ways. The inclusion of weights warrant the same level of transparency that has been attempted here in the assumptions because they are inherently about biases.

b. Ground-truthing

It is important to point out that as a researcher, I have minimal general knowledge about Los Angeles. While this may be helpful in terms of objectively setting indicators, thresholds and working with the data without any preconceived notions of the city, it also precludes me from asking common sense questions and drawing from qualitative sources to guide me. At the end, I cannot tell or do not know if the areas that have been highlighted as low well-being make sense. I do believe that a significant pre-assessment or follow-up period to assess the ground truth would greatly support the research findings. One such manner would be to individually research each of the zip codes and neighborhoods that surface for low multidimensional score. Certainly, the neighborhoods that appear in our list include some surprising ones as well. Thus, it would be interesting to understand specifically what domains drive them. The beauty of the index is that once you acquire a bird's eye view of the conditions, you can be more decisive in investing your research time in specific areas.

c. Fussy Thresholds, Thresholds' Impact on the Margin

Over the course of the construction of the index, it is striking how many thresholds are used. Each threshold is in fact a simplification. You are losing data when you use threshold to codify ones and zeros from a higher range of values. Thus, an index constitutes a tremendous

loss of information. At the same time, each threshold is subject to a decision by the researcher. I consult with sources as best as I can; however, I would confess that most of the thresholds and aggregation rules are decided randomly. I also take the approach that I would be able to change them if they do not make sense. In practice, once a threshold has been written down, it is hard to modify. Furthermore, these thresholds also reflect my biases. In the index, we identify certain indicators and thresholds that may have impacted block groups on the margin. The maps could all look very different based on slight adjustments in the assumption. This weakness strikes at the relevance of the index, and at the veracity of any conclusion. I found this to be very polemical.

At the same time, thresholds, as a movable object, may offer an opportunity. As researchers, we can invite residents to tell us what an acceptable threshold of the indicators would be. Recalling our literature review, well-being is an interaction between our reality and our expectation. Inviting residents to recommend thresholds is an active way of incorporating their expectation and what makes them happy into the index. This also resolves the issue with subjective weights because we have learned that thresholds can be calibrated subjectively. In this case, it may be a more feasible way of combining subjective preferences with objective data.

d. Ability to do Sensitivity Analysis

As I try to identify the main drivers of a low multidimensional score, I realize how useful it would be to incorporate sensitivity analysis into the index model. The ability to adjust thresholds quickly, to imagine improving one domain quickly and reflect on the overall effect for the city may in fact better inform policy choices. Thus, a possible modeling technique to incorporate into this exercise is systems dynamic. This insight also highlights the fact that our domains are independent of each other. That is most likely not the case in real life. An improvement in one may impact several other domains. There could be positive as well as negative feedback loops that are worth investigating. In addition, the index is a strictly summation exercise. At the end of the day, well-being depends on whether you have an adequate number of indicators, sub-domains and domains. This seems like a limitation.

e. Push for Simplicity

I did not set out to create 22 indicators. I wanted seven domains and the 22 indicators spawn from them. Even in their pre-nascent form, the 22 indicators are not equal. Depending on the mathematical rule—whether one is aggregated or multiplied—an indicator could determine a domain or be part of the domain. Overall, there are too many indicators. Tracking them was difficult. Furthermore, tracing them back from the index was difficult. I do believe that more simplicity is the way to go. Thus, a short hybrid subjective-objective instrument may be an effective way to simplify the process and retrieve only the data that are needed. The instrument questions, while fewer, would only target specific information that are needed. Any index is a guide. It should not tell you everything about the neighborhood. That comes in the deeper dive investigation afterward.

Another issue with the preponderance of indicators is the relevance. At the end of the day, each indicator may constitute only 1/22 of the index. At that sliver of impact, what is the

relevance of that indicator? This is the metaphorical drop in a bucket. Taking the logic further, if relevance is missing, then what is the usability? I would argue for a deterrent question to limit the number of data-induced indicators⁴⁵—is this one absolutely necessary? Such a question would enforce data discipline and help us eliminate imperfect indicators driven by missing data.

Lastly, I have made an effort to be really transparent about the assumptions that go into the construction of the index. This reflects a discomfort with black box indices. I think this is related to the idea of simplicity. If you do not understand how an index is constructed, you should not rely on it for policy making.

f. Citizens Engagement Opportunities in all Stages

There are numerous opportunities for citizens' engagement in the course of the construction of the index. This demonstration exercise is conducted by a researcher in the Northeast. Thus, I never had the opportunity to speak with residents. However, I do think it is important to highlight some ideas here.

A good framework to consider for this type of exercise is the assess, design, monitor, evaluate, and learn (ADMEL) cycle. Each point of this cycle is an opportunity for citizen engagement. Researchers can invite citizens to surface the domains that drive their well-being. Citizens can provide the weights which should govern the domains. They can even inform on what indicators would be the most appropriate to measure for the domains. They can suggest the causal pathway to well-being. This is an active process in which we understand what is important to the population we're measuring, why is it important and by how much. We also need to go back to them, through formal and informal communication processes, to keep the index on track. It seems obvious that people should have a say in what is happiness and what makes them happy in a well-being index. Such an engagement would augment relevance and encourage ownership of the index.

g. Correlation versus Attribution

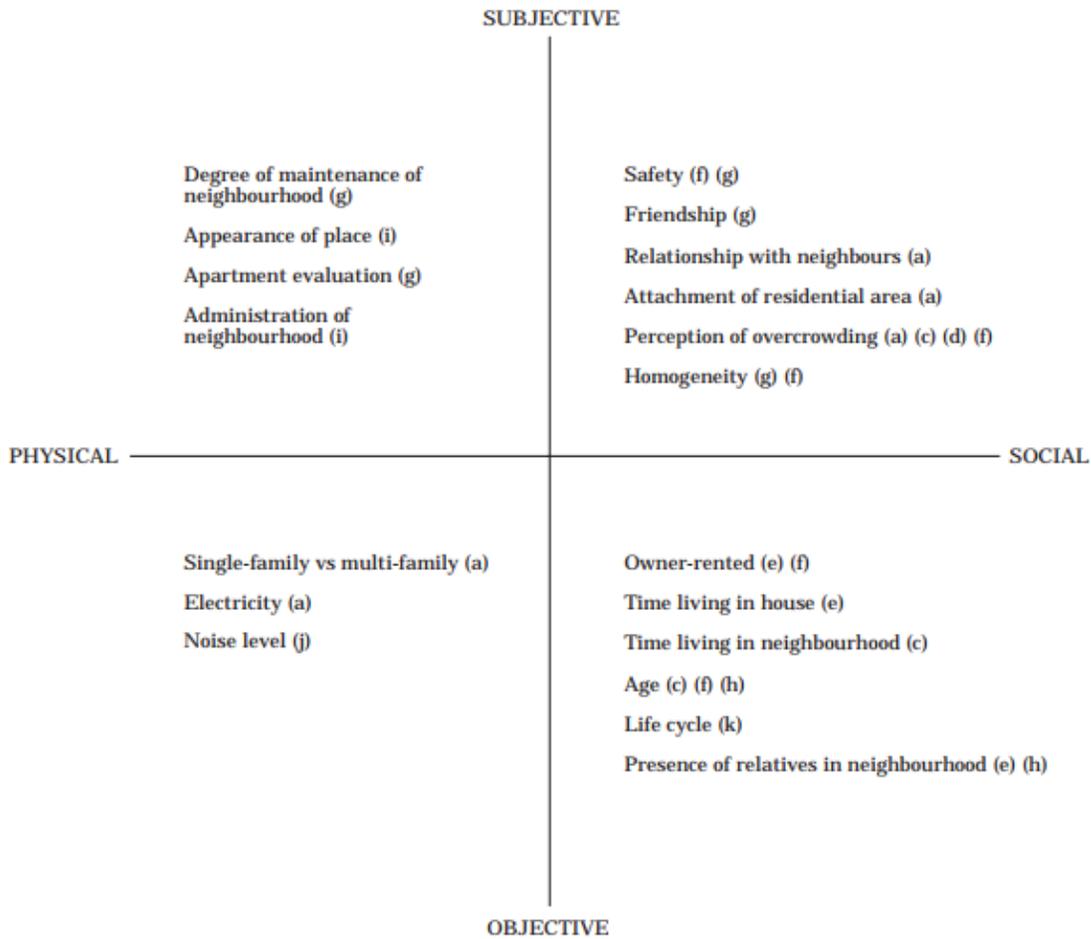
There were many indicators that exhibit similar distribution patterns across the maps. These indicators could be correlated. They facilitate or diminish well-being together. Under such circumstance, some of these indicators would be superfluous. We could choose a better indicator or a stronger correlation and disregard the rest. However, it may not be so simple. An index is the summation of various domains. The indicators may interact with each other in unexpected ways (effectively, we would be introducing omitted variable bias). Lastly, we should not assume that correlation is attribution. If an indicator is found to be strongly correlated with well-being, no research design exists to suggest that the relationship is causal. A summation index is not designed to surface main drivers. In fact, it is the complete opposite of that. As a policy matter, then, we should be aware that interventions based on the index is not the same type of evidence-based and rigorously tested design that we associate with impact evaluation.

⁴⁵ Data-induced data is the idea that you can always create more indicators out of your data. The potential is unlimited.

h. Addressing Relevance and Usability for Policy Makers

There are enough concerns in the above section to cause one to hesitate in the deployment of a well-being index for policymaking. Ultimately, the utility of a well-being index depends on the design of the tool. In the first place, to what extent can the number of assumptions and biases be minimized? Where are the opportunities to anchor in ground truths? Second, to account for the complexity in the idea of well-being, both subjective and objective variables need to be incorporated in the index. This is not a barrier to implementation. Instead, consider it an opportunity for proximity, dialogue and engagement with the populace. It helps to break down the firewall of data that can build up between civil servants and population. Third, the index needs to be transparent. Is there a general understanding of what is being measured and how the city judge success? When the rules are clear, it strengthens accountability on both side of the index and grows ownership. Fourth, the index is useful for identifying areas with a critical mass of deprivation. If it is measured on an annual basis, then it may even act as an early warning system. However, there are no programs or policies that are designed strictly as countering low well-being. Interventions are more likely to be domain-specific. Thus, on one hand, the index only gives general signal for further attention; on the other, it allows for tailored response upon closer inspection. There should never be a one-size-fits-all policy response. Lastly, the index, in the end, is just a data point. It should not displace the larger emphasis on people, process and technology that inform all policymaking. With great power comes great responsibility. In this case, I believe that humility should be an equal complement.

Appendix 1: Amerigo and Aragonés (1997)'s Grid of Predictors of Residential Satisfaction



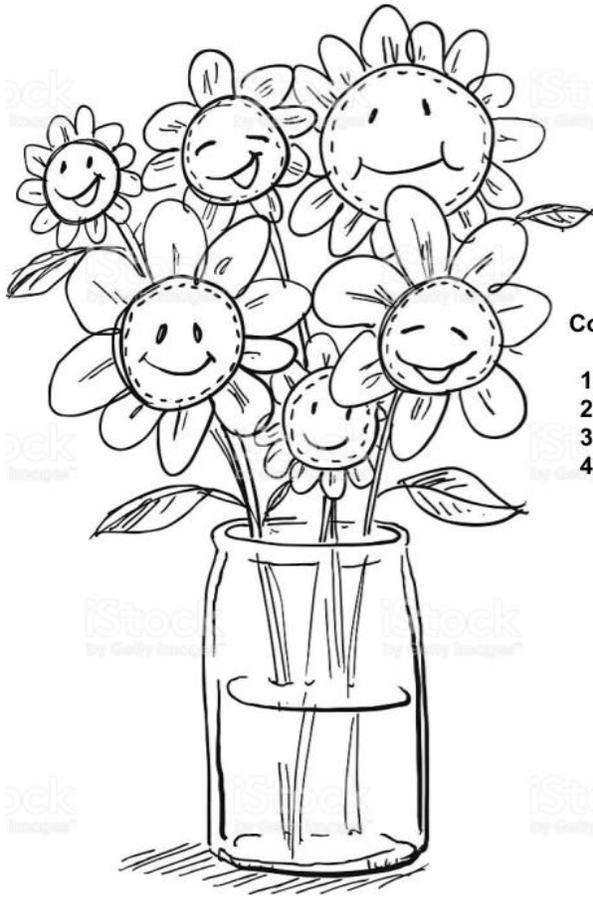
Appendix 2: Sample Subjective Well-being Survey Instrument⁴⁶

1. Meaning of Life				
How often, if at all, do you think about the meaning and purpose of life?				
1 Often	2 Sometimes	3 Rarely	4 Never	
2. Meaning in Life				
1 Not at all true	2 Not very true	3 Somewhat true	4 Completely true	
Statement				Score
My life has a clear sense of purpose				
I have a good sense of what makes my life meaningful				
I have discovered a satisfying life purpose				

⁴⁶ This sample subjective well-being survey instrument comes from Emma Samman's "Psychological and Subjective Wellbeing: A Proposal for Internationally Comparable Indicators." Her paper has been cited in other parts of this capstone. The instrument is being cited here as an example of a short and user-friendly tool to solicit self-reported, domain-specific data from participants. It is open to modification. In her paper, Samman cited and collected well-known sources of survey to develop one set that may be used for subjective well-being measurement.

3. Questions on Self-Determination			
1 Not at all true	2 Not very true	3 Somewhat true	4 Completely true
Autonomy			
Statement			Score
I feel like I am free to decide for myself how to live my life.			
I generally feel free to express my ideas and opinions			
I feel like I can pretty much by myself in daily situations			
Competence			
Statement			Score
People I know tell me I am competent at what I do.			
Most days I feel a sense of accomplishment from what I do.			
I often feel very capable.			
Relatedness			
Statement			Score
I get along well with people I come into contact with.			
I consider the people I regularly interact with to be my friends.			
People in my life care about me.			
4. Overall Life Satisfaction			
In general, would you say that you are satisfied with your life? Would you say that you are:			
1 Very satisfied	2 Fairly satisfied	3 Not very satisfied	4 Not at all satisfied
5. Domain-specific Satisfaction			
Overall, how satisfied are you with (domain)? Are you....			
1 Very satisfied	2 Fairly satisfied	3 Not very satisfied	4 Not at all satisfied
Domain	Specific Item(s)		Satisfaction Level
Material Well-being	Food		
	Housing		
	Income		
Health	Health		
Productivity	Work		
Security	Physical safety		
Intimacy	Friends & Family		
Community	Education		
	Neighborhood		
	Ability to help others		
Religion/spiritual wellbeing	Wellbeing from spiritual, religious or philosophical beliefs		
6. Question on happiness			
Taking all things together, would you say you are:			
1 Very happy	2 Rather happy	3 Not very happy	4 Not at all happy

Appendix 3: Components of well-being in a flower vase⁴⁷



Components of well-being in a flower vase:

1. **Stems as objective dimensions**
2. **Flowers as outward facing weights**
3. **Water as fixed-individual effects**
4. **Vase as the psychological, satisfaction and happiness framing that we exist within.**

⁴⁷ Flower vase is a stock image taken from the internet.

Appendix 4: Table of all indicators and thresholds of Multidimensional Well-being Index

Indicators	Threshold for a Block Group to score 1 for well-being	Attribute Column ⁴⁸
Food Stamp	Greater than 90% of the households in a block group are not on food stamp support.	Gtr_90WB
Cost of Rent	Less than 30% of the total population in a block group are paying more than 30% or more of the gross income towards rent.	pt_WB
Crowding	Greater than 75% of the households in a block group do not suffer from crowding. Crowding is defined as an occupancy ratio of more than 1 person per room.	crowd_WB
Income Level	More than 80% of the household incomes in a block group are more than two times above the federal poverty level.	Inc_WB
Time to Work	Greater than 70% of the households in a block group enjoy commute time of 45 minutes or less.	time_WB
Proximity to Public Transit	Greater than 95% of the area of the block group are near any public transit option. Closer proximity to bus stops is defined as ¼ mile or less. Proximity to metro stations is defined as ½ mile or less.	(bus_cv_WB) + (mtr_cv_WB)
Health Insurance	Greater than 90% of the households in a block group report having health insurance.	Heath_WB
Proximity to Medical Facilities	Greater than 50% of the area of a block group are near any medical facilities. Proximity is defined as 1 mile or less.	hfac_WB
Job Opportunities	Greater than 50% of the households in a block group report having worked in the past 12 months.	work_WB
Job Security	Greater than 60% of the households who report working in the past 12 months are working full time.	FT_WB
Crimes and Collisions	Less than .2 total crimes and collisions in 2016 per capita in a block group.	Crim_C_WB
Child Care Need	Of the households in a block group with grandparents living with grandchildren, less than 25% of the grandparents report being fully responsible for the grandchildren.	FR_WB
Rental Turnover	Less than 10% of the rental households in a block group are new rentals. New rentals are defined as recent rentals in the last 3 years or less.	rent_WB
Education Attainment	Greater than 10% of the households in a block group report having attained a four-year degree or higher.	hiE_WB
Social Activities	Block group has 1 or more occurrence of the social activities. Social activities are tallied per block group.	socACT_WB
Linguistic Isolation	Less than 20% of the households in a block group report having limited English ability.	limE_WB
Pollution	Air pollution at less than 12 ug/m3 and water contamination at less than 629 in a block group.	air_wat_WB
Green Spaces	Greater than 50% of the area of a block group near a park or recreation facility. Proximity is defined as walking distance at ¼ mile or less.	park_WB
Flooding and Heating	Block groups with combined indices score equal to or below 5 (in a range of 0 to 15)	fld_heatWB
Walkability	Block groups with walkability score above 0.	walk_WB

⁴⁸ There are the direct variable column names in the master excel dataset.

Traffic Density	Block groups with less than 1.5 standard deviation in traffic density score.	trafden_WB
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Appendix 5: List of all maps

Types	Title of Map
Indicator	Percentage of Food Security by Block Group
	Percentage of Rent Burdened Households by Block Group
	Percentage of Crowding by Block Group
	Household Income Level by Block Group
	Percentage of Households with Reasonable Commute by Block Group
	Proximity to Bus Stops by Block Group
	Proximity to Metro Stops by Block Group
	Percentage of Households with Health Insurance by Block Group
	Proximity to Health Facilities by Block Group
	Percentage of Working Age Households with Job Opportunities in the Past 12 Months by Block Group
	Percentage of Working Households with Jobs Security by Block Group
	2016 Crimes and Collisions by Block Group
	Percentage of Households with Child Care Need by Block Group
	Percentage of Rental Turnover by Block Group
	Percentage of Educated Households by Block Group
	Percentage of Linguistic Isolation by Block Group
	Social Activities by Block Group
	Air Pollution and Water Contamination by Block Group
	Proximity to City Parks by Block Group
	Climate Vulnerability Score by Block Group
Walkability Index by Block Group	
Traffic Density by Block Group	
Domain	Community Score
	Community Index
	Environment Score
	Environment Index
	Intimacy Score
	Intimacy Index
	Material Well-being Score
	Material Well-being Index
	Security Index
	Health Index
	Productivity Index
Multidimensional Well-being	Multidimensional Well-being Score
	Multidimensional Well-being Index
	"0" Multidimensional Well-being Index
	Lowest Multidimensional Well-being Score

Endnotes

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