Walk Score Methodology

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Walk Score
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Introduction

The goal of this white paper is to provide a detailed explanation of the patent-pending "Street Smart" Walk Score algorithm, as well as the rationale for the choices we made while designing the algorithm.

If you are interested in using Walk Score data for your research or planning studies, visit http://www.walkscore.com/research/. We provide Walk Score and public transit data in a variety of formats, including GIS shapefiles.

To see a preview of Street Smart Walk Score, type an address into the Preview Street Smart search field here: http://www.walkscore.com/methodology.shtml

Street Smart Walk Score includes:

- Walking routes and distances to amenities
- Road connectivity metrics such as intersection density and block length
- Scores for individual amenity categories

Public Transit data and Transit Score is also available for researchers.

Data Sources: Walk Score uses data from a number of sources:

- Business listing data from Google and Localeze
- Road network data and park data from Open Street Map
- School data from Education.com
- Public transit data from over 200 transit agencies

How the Street Smart Walk Score Algorithm Works

We are currently working with Professor Larry Frank, Urban Design 4 Health, and the Walk Score advisory board to finalize the Street Smart Walk Score algorithm as part of a grant from Active Living Research, a national program of the Robert Wood Johnson Foundation.

Street Smart Walk Score calculates a score by mapping out the walking distance to amenities in 9 different amenity categories. In amenity categories where depth of choice is important, we count multiple amenities in a given category. Categories are also weighted according to their importance (details below). The distance to a location, counts, and weights determine a base score of an address, which is then normalized to a score from 0 to 100. After this, an address may receive a penalty for having poor pedestrian friendliness metrics, such as having long blocks or low intersection density.

The following categories, counts and weights are used:

```
amenity_weights = {
	"grocery": [3],
	"restaurants": [.75, .45, .25, .25, .225, .225, .225, .225, .2, .2],
	"shopping":  [.5, .45, .4, .35, .3],
	"coffee": [1.25, .75],
	"banks": [1],
	"parks": [1],
	"schools": [1],
	"books": [1],
	"entertainment": [1],
}
```

The numbers after a category indicate the assigned weight and number of counts of that amenity. More than one number means that more than one count of that amenity is included, with the second nearest amenity of that type receiving the weight of the second number, etc.

These weights were chosen based on our interpretation of current walkability research. Lee and Moudon (2006) find evidence that nearby grocery stores, restaurants/bars, banks and schools increase walking, as do areas with grocery/retail/restaurant clusters. Moudon et al. (2006) and Cerrin et al. (2007) both cite collected survey data showing that grocery stores, restaurants/bars, retail locations, coffee shops, and banks are common walking destinations. The Cerrin et al. (2007) survey responses find that people frequently walk to parks as well. The categories we use here are also similar to ones used in studies and work on walkability by Iacono et al. (2010), El-Geneidy and Levinson (2010), and Piekarski (2009).

The amenity categories have been determined from the available research to be of either of high importance to walkability, medium importance or low importance. This is reflected in the category weights. Grocery store and restaurants/bars have total category weights summing to 3, while shopping and coffee shops have weights summing to 2, while the other categories sum to 1.

Grocery stores receive the heaviest weight because they have been found to be drivers of walking (Lee and Moudon 2006), as well as the most common walking destination in surveys (Moudon et al. 2006, Cerrin et al. 2007).

Restaurants and bars are combined into a single category due to their overlapping nature: many restaurants have bars and many bars serve food. Restaurants/bars are found to be some of the most frequent walking destinations (Moudon et al. 2006, Cerin et al. 2007), so this category has a combined total weights of 3. Variety and options are important, so 10 counts of restaurants/bars are included, with the first counts receiving greater weight than the later counts to account for diminishing returns. Including 10 counts of restaurants also allows for more differentiation among high scoring locations, as 10 restaurants or bars must be very nearby to receive a perfect score.

The shopping category includes a variety of consumer retail business such as clothing, shoes, gift shops, specialty food stores, children's stores, etc. Shopping and retail are commonly used categories in the research literature, are one of the more common walking destinations (Cerin et al. 2007) and are found to increase walking (Lee and Moudon 2006). The category has a combined total weight of 2, and there are 5 counts included. Giving this category 5 counts demands a certain density of shopping locations for an address to score well.

For coffee shops, variety is also important, but not to the same degree that it is for restaurants and shopping. Two counts are included, so that in the ideal walkable area some choice is available. Additionally, coffee shops are found by both Cerin et al. (2007) and Moudon et al. (2006) to be important destinations, and the presence of nearby coffee shops gives an indication of the overall walkability of an area. Because of this, we have made the total weight of this category 2.

The other categories are deemed to be more or less equal and all receive a weight of one and have one count. The literature does not give a clear indication of which of these other categories should have a greater weight, while still indicating that they are important. However, they are not generally found to be as important as grocery stores, restaurants/bars, and retail, and it does not seem appropriate to include more than one count for any of them.

Adding and Removing Amenities

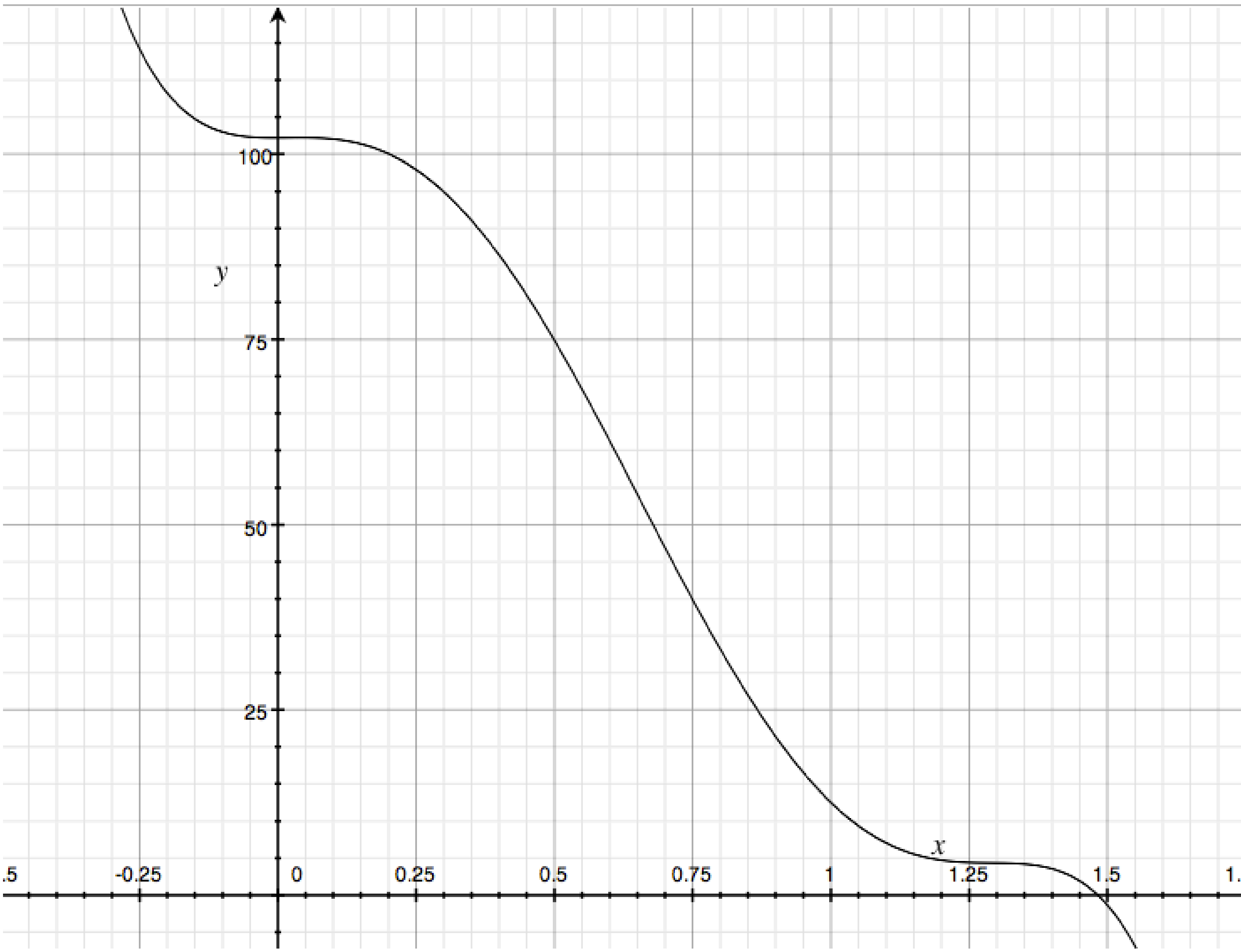
In addition to changes to the algorithm, "Street Smart" Walk Score allows visitors to the Walk Score website to add amenities that may be missing or to remove amenities that are closed or miscategorized. For example, if a retail location was missing, a user could add a new business to Walk Score. If a place had gone out of business or was closed, a user could remove this from Walk Score. Walk Score requires users to login to curate amenities and employs wiki-style editing, to prevent people from "gaming" the score by adding additional amenities.

Distance Decay Function

The distance decay function determines what percentage of a full score a category will receive based on the distance between the address being examined, which we refer to as the origin, and an amenity's location. We use a polynomial distance decay function that gives full score or near full score for amenities that are within .25 miles of the origin. After this, scores decrease with distance smoothly. At a distance of one mile, amenities receive only about 12% of the score they would have had if they were right next to the origin. After one mile, scores decrease less quickly with greater distance, until they reach 1.5 miles, after which they do not count towards the final score.

Using the standard speed of 3mph, .25 miles is a 5-minute walk, 1 mile is 20-minute walk and 1.5 miles is a 30-minute walk. Based on our reading of travel surveys, we think the distance decay function reflects actual walking behavior.

Transportation planning guidelines commonly cite .25 miles as a goal for distance between transit stops (Ontario Ministry of Municipal Affairs and Housing 1992, Transit Supportive Development (No date given)), while Destinations 2030 and Turner, Shunk and Hottenstein (1998) give evidence that 1.5 miles is reasonable upper bound. Distances in these ranges are common in the literature (Lee and Moudon 2006, Cerrin et al. 2006, Kockelman 1996, Iacono et al. 2010).



Here is a picture of the distance decay function. The x-axis is the distance from the address of interest or origin, and the y-axis is the percentage of a full score that an amenity will receive. There is a maximum score of 100 and a minimum score of 0.

The distance decay function for parks is shifted .25 miles to the right. The distance to a park is often calculated from the center of the park, instead of the park entrance. We have shifted it out .25 miles to compensate for this.

Pedestrian Friendliness Metrics

There are two measures of pedestrian friendliness that are examined in the algorithm: intersection density and average block length. We are also calculating link/node ratio but do not include it in the Walk Score since link/node ratio overlaps with the other measures and is more difficult for consumers to understand.

Intersection density and block length are commonly used measures in walkability research (Saelens et al. 2003, Ewing and Cervero 2010, Lee and Moudon 2006, Leslie et al. 2005, Berrigan et al. 2010). Areas with poor pedestrian friendliness are penalized a certain percentage of what they would have scored otherwise. A location can receive a penalty of up to 10% of the total score.

Intersection density (intersections per square mile):
over 200: no penalty
150-200: 1% penalty
120-150: 2% penalty
90-120: 3% penalty
60-90: 4% penalty
under 60: 5% penalty

Average block length (in meters):
under 120 m: no penalty
120-150 m: 1% penalty
150-165 m: 2% penalty
165-180 m: 3% penalty
180-195m: 4% penalty
over 195m: 5% penalty

Because these measures can be computed using a variety of methods, the examination of our data played a strong role in how we have chosen to evaluate them along with the literature on the subject.

The intersection density metrics are influenced by the LEED-ND credits available for different levels of intersection density (U.S. Green Building Council 2009), as well as the guidelines created by Aurbach (2009).

The average block length cutoffs are created from looking at the examples and goals from different cities, such as Portland, Nashville, Houston, and New York (Dill 2003, Open Street Map 2010).

It is common in the literature to see built form or pedestrian design measures created from these same metrics. We feel it is best to use the combination of intersection density and average block length. These two metrics are related, but they measure different built form traits, which gives the algorithm a greater balance.

Computing the Walk Score

When an address is inputted, the algorithm creates a score for each amenity in each category based on the street network distance and weight of the amenity. In the above set up, if a grocery store is right next to the address being examined (within .2 miles), the grocery store category will receive a full score of 3. If a grocery store is over 1.5 miles from an address, the grocery score category will receive a score of zero. The distance decay function dictates what score it will receive in between these distances.

The total sum of the weights listed above is 15. However, the walk scores are linearly expanded to range from 0 to 100. This means that after calculating the base of an amenity score by its weight and distance to the address in question, it must be multiplied by approximately 6.67 ($\approx$100/15). So a grocery store could contribute a maximum of about 20 ($\approx$3 x 6.67) to the final walk score of an address. Amenity categories with a weight of 1 could contribute a score of 6.67 total.

After multiplying each category score by 6.67, the category scores are added to each other to compute the total walk score, which will range from 0 to 100. It is this score that can be penalized by the pedestrian friendliness measures, losing 0 to 10% of this score.

After the penalties are taken into account, the final walk score has been computed.

Contact Us

If you are interested in using Walk Score in your research, please contact professional@walkscore.com.