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| Net Economic impact: Introduction of Street Car in Downtown Cincinnati  Exploratory Data Analysis, Predictive Analysis and Forecast |
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# Net Economic impact: Introduction of Street Car in Downtown Cincinnati

## Exploratory Data Analysis, Predictive Analysis and Forecast

Suspendisse potenti.

# Introduction

[The Cincinnati Streetcar](http://www.cincinnati-oh.gov/streetcar/design-route/) is a modern streetcar system designed to link major employment centers in downtown and uptown, connecting through Cincinnati's historic Over-the-Rhine neighborhood.

It will operate 18 hours a day, 365 days a year.

## Objective

The goal of the study is to analyze and predict the “net positive effect” on economy in the buffer zone around the streetcar route by selecting meaningful features from various data sets

## Motivation

The City of Cincinnati is the client. Downtown is Cincinnati’s largest employment center, with approximately 70,000 people in the area every day. It has been proven in cities from Atlanta to Seattle that fixed rails in the ground with thousands of potential riders **draw new storefronts and businesses**, as well as housing. That new development will put people to work and **boost the city’s tax revenue.** Also, here may have been inconveniences to the neighborhood, during the construction phase.  Hence, there are two camps of opinion -

* One opinion insists that the introduction of the streetcar is disruptive to the neighborhood (crowding, transient population, noise) and
* The other opinion is that it provides easy access to business, shops, dining and commuting to work and home and draws new business, expansion of storefronts, revenue from ridership, permit fees, property tax and restaurant license fee.

Three Buffer zones around the streetcar route has been established as shown below. The figure below is the plot of the downtown Cincinnati.

* CORE: The area shown in Red color is deemed the CORE Buffer zone. The Streetcar runs through the center of this area on a North South corridor.
* CENTER: The area shown in Magenta color is designated CENTER Buffer zone a
* EDGE: The area in Green color is EDGE Buffer zone

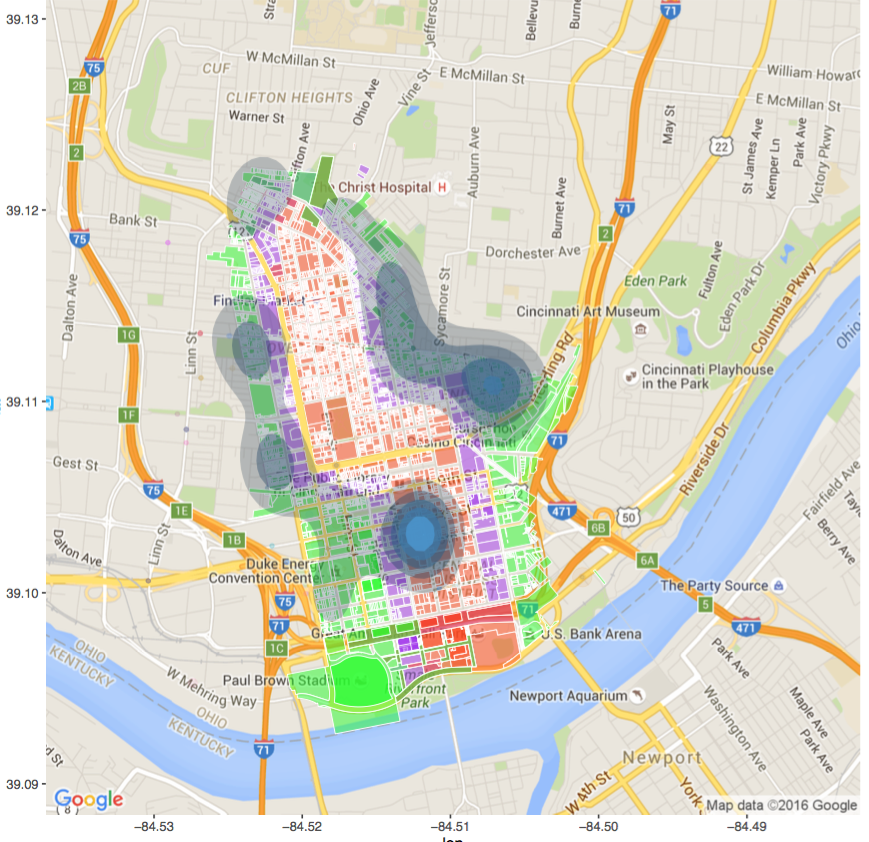


Table . plot of the Area under study illustrating the Buffer zones CORE, CENTER and EDGE around the Street Car route

Data and Sources

## Data Sources

**Data source** would be from [Open Data Cincinnati](https://data.cincinnati-oh.gov/) and Cincinnati Area Geogaphic Information Systems ([CAGIS), City of Cincinnati, OH.](http://cagismaps.hamilton-co.org/cagisportal)

1. **Study Area Parcels : There are three .csv files** . The PARCELID will uniquely identify data in other files if the parcel is classified as being in CORE BUFFER zone, CENTER BUFFER zone, EDGE BUFFER zone or none at all. The following table features are of interest in the 3 files : Each file has about 1000-2000 observations

|  |  |  |  |
| --- | --- | --- | --- |
| Column name | Example Data | Description | Source |
| PARCELID | 7500010007 | Unique id to identify parcels | StreetCarParcels\_CORE.csv  StreetCarParcels\_CENTER.csv  StreetCarParcels.EDGE.csv |
| EXLUCODE | C | Existing Land use Code |
| MKTLND | 28180 | Market Value of the Land |
| MKTIMP | 90810 | Market value of the Improvements |
| ADDRNO | 1208 | Address, street and type of street |
| ADDRST | SYCAMORE |
| ADDRSF | ST |

**Table 2: .csv files are used to identify the parcel id. of the three areas around the Street Car - Core, Center and Edge Buffer zones**

1. **Tax Information 2007-2015 .fwf :** Data was provided for 9 years in Fixed Width Format in 9 files. This Dataset needed to be converted to .csv format. The key feature that will be subset from this is parcel\_id and Tax information. A time series analysis on the taxes will be performed to forecast the revenues to the City of Cincinnati. Each file has 30,0000 observations and is at least 300 MB is size

|  |  |  |  |
| --- | --- | --- | --- |
| Column Name | Example Data | Description | Source |
| SMDA\_NUM | 10001000100 |  | Data2/taxinfo/2007/taxinfo2007.csv  .  .  .  Data2/taxinfo/2015/taxinfo2015.csv |
| UNIT |  |  |
| LOC\_STREET |  | Location e.g for 2327 Sussex Ave., Cincinnati Oh |
| LOC\_HOUSE\_NO | 2327 |
| LOC\_ST\_DESC | SUSSEX |
| LOC\_ST\_IND | AV |
| LOC\_ST\_DIR |  |
| VALID\_SALE | Y | Yes or No |
| MKT\_LAND\_VAL | 23000 | Value of the Land |
| NUM\_PARCEL | 3 | Number of Parcels |
| DEED\_TYPE |  |  |
| MKT\_IMPR\_VAL | 140570 | Market value of the Land |
| SALE\_AMOUNT | 116000 |  |
| SALE\_DATE | 20121129 |  |
| MKT\_TOTAL | 163570 | Mkt Total Val |
| NEW CONSTR | N | Was this a newly constructed building |
| ANNUAL\_TAXES | 3693.14 | Annual Taxes Billed |
| ACRES | 0.246 | Acreage of the building |  |
| TAXES\_PAID |  | Annual Taxes Paid |
| PARCEL\_ID | 10001000100 | Unique identification number of parcels |
| DELQ\_TAXES | 6088.56 | Delinquent taxes |

**Table 3. Features selected from Property Tax Information from years 2007 - 2015**

# Extraction, Translation and Loading of Data

**Upon looking at the features from files mentioned in Tables 1 and 2.**

1. **Study area**: Data around the Street car route is divided into 3 Buffer zones. The StreetCarParcels\_CORE.csv, StreetCarparcels\_CENTER.csv and StreetCarparcels.csv files identify the parcels belonging to the zone. The unique identifier is parcel id. In the taxinfo files, the PARCELID will be used to classify/ subset an observation to be belonging to CORE, EDGE or CENTER areas. For the Buffer areas under study, preliminary exploration of the data was done : <https://github.com/krajeshj/Streetcar0719/blob/master/ExploratoryDataAnalysis.md>

2. **Property Tax information 2007-2015** : The original datasets were provided in fixed width format. An R script converted it to .csv file. The problem here was each of the groups of years 2007, 2008 and 2009-2014 and 2015 had different column widths. Luckily, there was clear documentation of field widths. As a result, the files have been successfully converted to .csv file except for the year 2008.

# Feature selection

Yearly Tax Data from Years 2007-2015 is available from the Assessors office and a few features have been identified for selection. These may be classified into the following categories. These selections are indicative of economic growth – Market Value, Asssesed taxes, Revenue from Taxes paid, Sales data , Foreclosure Data and New Construction Flag

|  |  |  |  |
| --- | --- | --- | --- |
| Sl | VARIABLE | Description | Data Set |
| 1 | PARCELID | *A Unique identifier of the parcel* | Data Set 001 |
| 2 | ADDRNO | *Address for plotting on ggplot or other package to identify spatial correlation* |
| 3 | ADDRST |
| 4 | ADDRSF |
| 5 | EXLU\_CODE | *Existing Land Use code* |
| 6 | MKT\_LAND\_VAL | *Market Value of land, Improvements, and Total* | Data set 002 - 010 |
| 7 | MKT\_IMPR\_VAL |
| 8 | MKT\_TOTAL |
| 9 | ANNUAL\_TAXES | *Net Prop Tax revenue: Annual Taxes assessed, Taxes actually Paid, and Delinquent Taxes* |
| 10 | TAXES\_ PAID |
| 12 | DELQ\_TAXES |
| 13 | ACRE | *Acreage to compute Property Value / sq. ft.* |
| 14 | SALE\_AMT | *Sales data of Property : Amount, Sale Date, New Construction or Foreclosure* |
| 15 | VALID\_SALE |
| 16 | SALE\_DATE |
| 17 | NEW\_CONSTR |
| 18 | FORECL\_FLAG |
| 19 | DEED\_TYPE | *Type of Deed for Classification* |
|  |  |  |
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**Table 4. There are several features available in the data set for years 2007-2015. The features in the table above have been selected and are indicators of Market value of the parcel, Annual taxes, Acre-age, Sales Data. These are representative of the net economic effect.**

* The City is divided into parcels.
* Each Parcel is uniquely identified by a Parcel id.

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| **PARCELID** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **DummyVars** |
|  |  |  |  |  |  |  |  |  |  |  |
| Over 300,000 observations | | | | | | | | | | |
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**Table 5 Parcel id uniquely identifies an observation. Each year from 2007-2015 has a subset of features shown in Table 4. A set of Dummy variables will be used to identify CENTER, CORE and EDGE Buffer parcels.**

Exploratory Data Analysis:

* **Exploration of Project Data**
* **Github R markdown :  [https://github.com/krajeshj/Streetcar0719/blob/master/ExploratoryDataAnalysis.md](https://github.com/krajeshj/Streetcar0719/blob/master/ExploratoryDataAnalysis.md" \t "_blank)**
* Exploratory analysis of the three buffer zones on the basis of Existing Land Use classification was done
  + Distribution of Parcels vs. Existing Land Use
  + Market Value of the parcels on the basis of Existing Land Use
* The distribution across the Existing Land Use classes is not uniform
* Parcels with High Market Land Value are classified as
  + C - Commercial
  + IN - Instituitional
  + MU - Mixed Use
  + MF - Multi- Family
  + O - Office
  + PS - Public / Semi Public
  + SF - Single Family
  + VA - Vacant
* Parcels with high Market Land values also imply more Property Tax revenue coming into the City of Cincinnati.
* Particular attention should be paid to these Existing Land Use parcels when performing the detailed Analysis/Forecast.

Figure 3. ggplot of CENTER Buffer Zone

Figure 1. ggplot of the observations of CORE Buffer



Figure 3. ggplot of the observations of the EDGE Buffer Zone

Build Models for Time Series analysis

Visualization of Forecast data

Code on github

Bibliography

References

1. <https://dev.socrata.com/foundry/data.cincinnati-oh.gov/emnx-rw6d>
2. <http://www.cincinnati.com/story/news/2016/05/05/streetcar-nation-kc-opens-friday-cincy-next/83874740/>