

# Forecasting the Evolution of Vancouver's Business Landscape

UBC MDS Capstone Project Proposal

Aakanksha Dimri, Keanna Knebel, Jasmine Qin, Xinwen Wang

Mentor: Simon Goring

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## Executive summary

With a rising demand for future social services planning in Vancouver, the goal of this project is to provide data-driven strategies for individual businesses as well as a broader understanding of resource allocations in the neighbourhoods. To achieve this, we will use a wide range of machine learning methodologies to (1) develop a model to predict whether a business will renew its licence and (2) provide a geospatial summary of the business license history and the constructed forecast.

## Introduction

With government expenditures totalling 40% of the Gross Domestic Product and public organizations accounting for 20% of the country's employment, the Canadian public sector has established itself as a pillar in the national economy.<sup>[1]</sup> Due to its importance and potential for impact, it is critical that the public sector operates in an efficient and transparent manner. Accessible public data portals (e.g., Vancouver Open Data), in conjunction with data science techniques, represent one approach to address these demands.

In particular, the current socio-economic environment in Vancouver presents the challenge of balancing significant budgetary constraints with the increasing demand for medical and social services. Developing an understanding of how Vancouver's business landscape has evolved over time can help mitigate this challenge and gain insight on how to efficiently allocate the city's resources and services.

All businesses operating in the city of Vancouver must have a valid business licence which is required to be renewed every calendar year. As such, this dataset represents a yearly snapshot of the entire Vancouver business landscape. The renewal of business licences provides information regarding the spatial distribution, the temporal trends, and the volatility of businesses across Vancouver's neighbourhoods. While business licence renewal takes place on the individual scale, it is influenced by broader regional factors, such as the proximity to public transport, the demographics of the neighbourhood, and the national economic health.

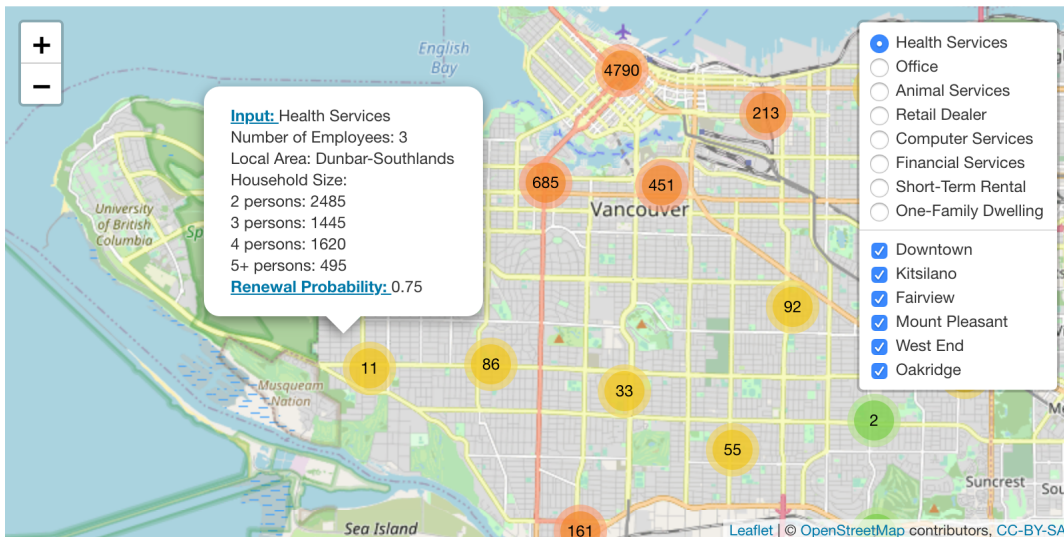


Figure 1: Descriptive and Simulated Information on Map

This proposal focuses on developing insight into Vancouver's business landscape which can be leveraged by policy-makers, planners, business owners, and others to improve efficiency. To achieve this we have established two main research objectives. (1) We will predict whether a business will renew its license, given a set of underlying factors. Given a reasonable set of factors drawn from public data, we can also begin to interpret the model output to provide (2) a broader geospatial summary of the evolution of Vancouver's business landscape.

## Data Product

The proposed final product consists of a data pipeline as well as a geospatial visualization of Vancouver's business landscape. Users will be able to locate a specific zone on the interactive map and view relevant descriptive information for a given year, such as business type distribution and census data [Figure 1]. The data pipeline will pass processed input data of a specific business to a machine learning model and produce a predicted renewal probability.

## Data Science Techniques

### Data Sources

The primary dataset utilized in this project consists of all Vancouver Business Licence applications from 1997 to the current date. This data is made available as part of the city of Vancouver’s Open Data Portal and regulated under the terms of the Open Government Licence – Vancouver. The most pertinent features present in this dataset are business type, location, and number of employees.

In addition to the business licence dataset, the Canadian census surveys provide another important source of data for this project. The census data is hosted on the Vancouver Open Data Portal and provides demographic information such as population density, average income, age distribution, and ethnicity. The current census dataset aggregates the demographic data by Vancouver neighbourhoods. As the project progresses, we may choose to further refine our model by obtaining census data aggregated at the postal code level.

### Possible Data Sources <sup>[2]</sup>

Data	Explanation	Spatial Scale	Temporal Scale
<a href="#">Business License 1997-2012</a>	Business information and its license status for business in Vancouver area	Point location	Annual
<a href="#">Business License 2013-current</a>	Business information and its license status for business in Vancouver area	Point location	Annual
<a href="#">Census Local Area Profile 2016</a>	Census information in Vancouver	Local District	Annual
<a href="#">Census Local Area Profile 2011</a>	Census information in Vancouver	Local District	Annual
<a href="#">Census Local Area Profile 2006</a>	Census information in Vancouver	Local District	Annual
<a href="#">Census Local Area Profile 2001</a>	Census information in Vancouver	Local District	Annual
<a href="#">Local Area Boundary</a>	Geospatial boundary for Vancouver 22 local area	Local District	Not Applicable
<a href="#">Disability Parking</a>	Location for disability parking space	Point Location	Not Applicable
<a href="#">Parking Meters</a>	Parking meters location and rate in Vancouver	Point Location	Not Applicable
<a href="#">Business Improvement Area</a>	Area where business join together to promote commercial viability of their district	Local District	Not Applicable

### Methodologies

Synthesizing information across various data sources is a crucial initial step shared by the two research questions being proposed. It can provide an integrated summary of the business environment by adding demographics and other social components, and allows us to build a more valuable predictive model for the license renewal probability. At this point, the key difficulty is the different temporal and spatial scales among the collected datasets. For example, licences are applied annually and locations can be pinpointed on map, whereas census profile is collected every 5 years and aggregated at neighbourhood level. The best solution is to interpolate the census data for a given year and to construct spatial configuration around an individual business.

The next step is to build a baseline model using logistic regression with the processed data. Logistic regression is a powerful first attempt because it can produce a probability distribution, affording greater insight to the clients. Once we have developed the baseline model, we will implement regularization techniques to mitigate overfitting and model complexity. We may also draw on techniques from survival analysis to examine business renewal over extended periods. Parallel to the development of predictive models, we will also create a visualization to display geospatial information using Python and deploy the results.

The datasets pose some possible difficulties for us. First, due to the size of the datasets, it is more efficient to use a Postgres database to store the processed data. In addition, temporal dependence of a business renewed in consecutive years and geospatial correlation of clustered businesses must be addressed. Furthermore, some variables may serve as proxies for underlying factors not included in the model. For example, a significant indicator may be the number of employees in the license dataset. Capital spent, however, can in fact be the hidden factor that influences both the number of employees and the likelihood of success.

## Timeline



Figure 2: Project Timeline (red line is current project stage)

## References

1. [Statistics Canada](#). Reproduced and distributed on an “as is” basis with the permission of Statistics Canada
2. [Contains information licensed under the Open Government Licence – Vancouver](#)