Life Insurance Cost Analysis Project

U of T Data Analytics Bootcamp - Group 9

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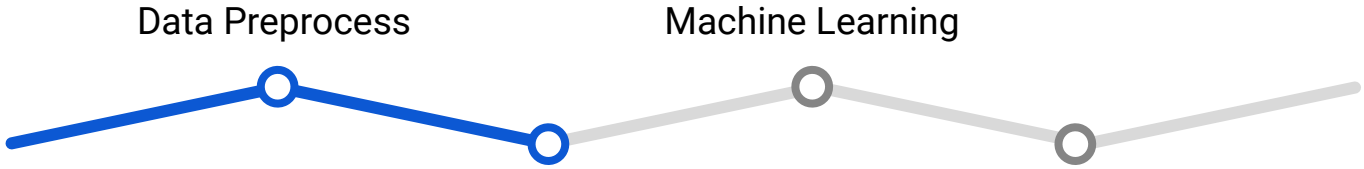
Project Overview

Life insurance is a valuable tool for Canadians to protect themselves from financial difficulties in the case of an unfortunate event, but many people are turned away from the cost. It would be beneficial to identify the variables related to life insurance premiums and guide customers to purchases.

We conducted analysis on a set of real life demographics data including age, gender, income, life insurance rates, and used machine learning to estimate the cost of life insurance and make recommendations to clients.

Technology


Data Preprocess
Machine Learning
Database
Data Visualization


jupyter


PostgreSQL


aws


python

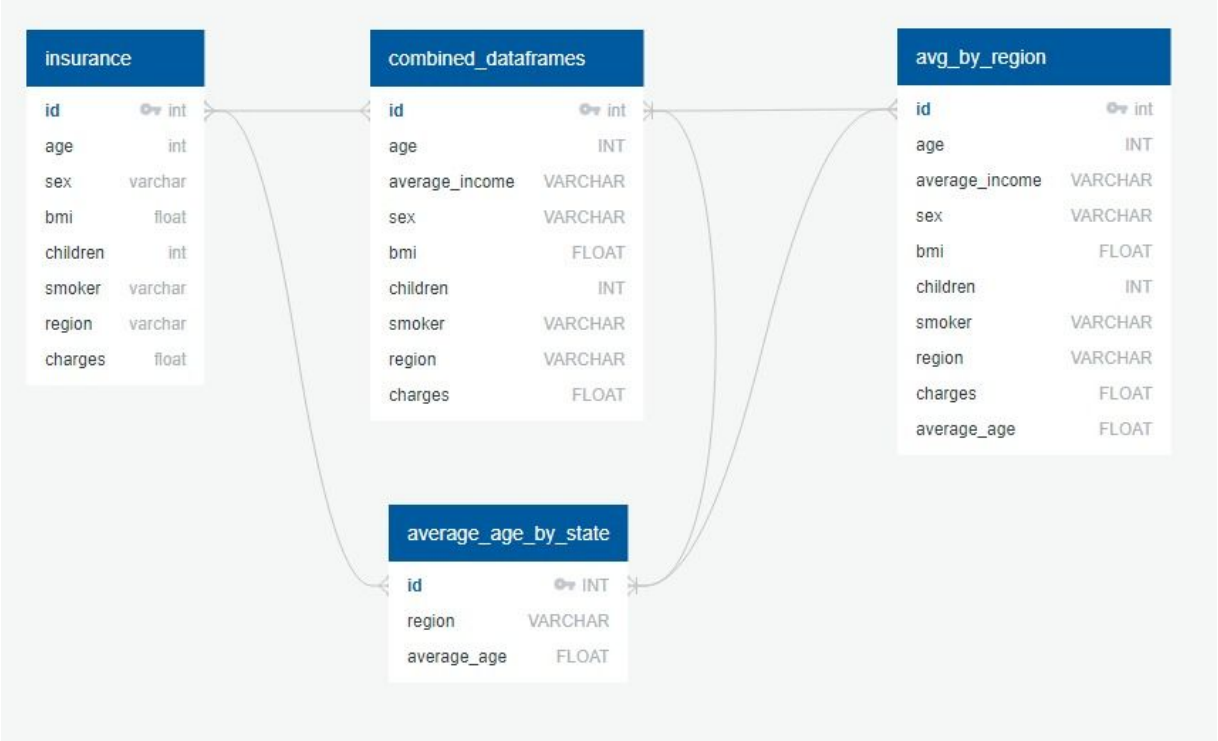

HTML
JS
CSS

Data Source

1. 1338 customer demographics data collected from Kaggle
2. Average income percentile by age collected from DQYDJ
3. List of US states by life expectancy collected from Wikipedia

	id	age	average_income	sex	bmi	children	smoker	region	charges	average_age
0	0	18	10753.5	male	33.77	1	no	southeast	1725.5523	78.43
1	1	18	10753.5	male	34.10	0	no	southeast	1137.0110	78.43
2	5	18	10753.5	male	31.68	2	yes	southeast	34303.1672	78.43
3	9	18	10753.5	female	36.85	0	yes	southeast	36149.4835	78.43
4	11	18	10753.5	female	38.28	0	no	southeast	1631.8212	78.43

Database - ERD



Data Processing - ETL

- Reformat and load in the raw data into a dataframe in Jupyter Notebook using Python Pandas Library
- Combined 3 different dataset by inner join: demographics data, average income, and life expectancy by states. "age" was the keyword used to combine the dataframes.
- The merged CSV files are connected to PostgreSQL Database, data is consolidated and stored on AWS
- 2 tables are created in SQL, inner join applied
- Data is scaled and normalized in the model

Machine Learning Model

Questions we hope to answer with the data

ML Goal: For the machine learning analysis, we used supervised machine learning model to explore the relationships between demographics variables and cost of life insurance to predict cost of life insurance.

Implications: By finding key elements that had strong correlations to the cost, such as age and income, we can provide a strong tool for customers who are considering purchasing life insurance.

Demographics Data explored:

- Age
- Gender
- BMI
- Number of Children
- Smoker (Yes or No)

Feature Engineering

- Target: identify which variable is highly correlated to the insurance cost
- Features: demographics data including age, bmi, number of children, average income, etc.
- Feature Engineering: use python to perform exploratory data analysis for identification, dropped uncorellated variables - sex and region
- Decision making: determine which variable is in high correlations and continue with training and testing, in our case smoker/non smoker had big impact on the life insurance costs

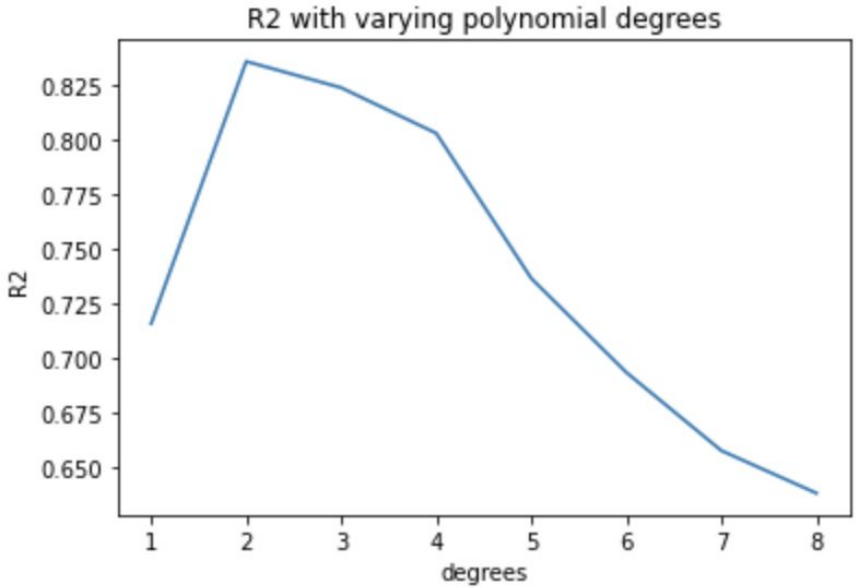
```
dummies = pd.get_dummies(complete_data_df[['sex', 'smoker', 'region']], drop_first=True)
text_features = pd.concat([complete_data_df.drop(['sex', 'smoker', 'region'],axis=1), dummies],axis=1)
text_features.head()
```

	id	age	average_income	bmi	children	charges	average_age	sex_male	smoker_yes	region_northwest	region_southeast	region_southwest
0	0	18	10753.5	33.77	1	1725.5523	78.43	1	0	0	1	0
1	1	18	10753.5	34.10	0	1137.0110	78.43	1	0	0	1	0
2	5	18	10753.5	31.68	2	34303.1672	78.43	1	1	0	1	0
3	9	18	10753.5	36.85	0	36149.4835	78.43	0	1	0	1	0
4	11	18	10753.5	38.28	0	1631.8212	78.43	0	0	0	1	0

Machine Learning Model - Polynomial Regression

Benefits: Great for determining relationship between multiple inputs (independent variables) and single output (dependent variable)

Limitations: Very sensitive to outliers. The model will not perform as expected if there are outliers. This means the data we input into the model must be very clean

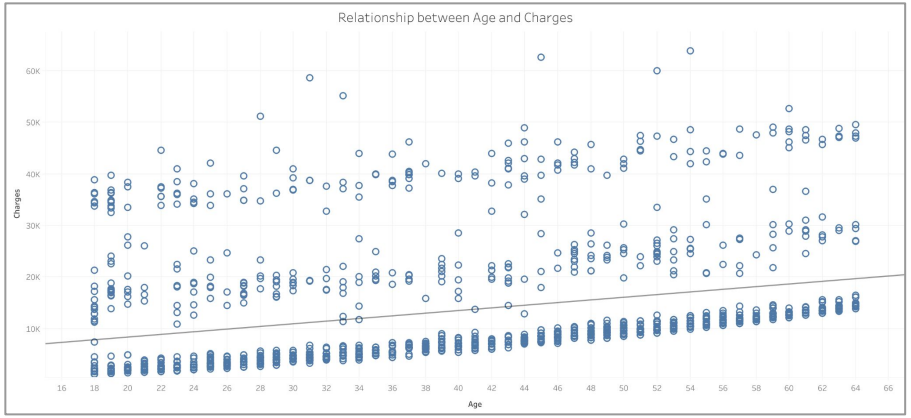


	Actual	Predicted
1	1137.01100	8785.042078
266	9549.56510	13655.922585
1145	4320.41085	7567.592284
1148	5125.21570	6901.977921
760	33900.65300	18640.067289
...	...	...
1318	14119.62000	18981.727525
1134	21472.47880	29179.698731
155	5245.22690	3642.861827
838	15820.69900	9509.292537
606	44641.19740	37874.131071

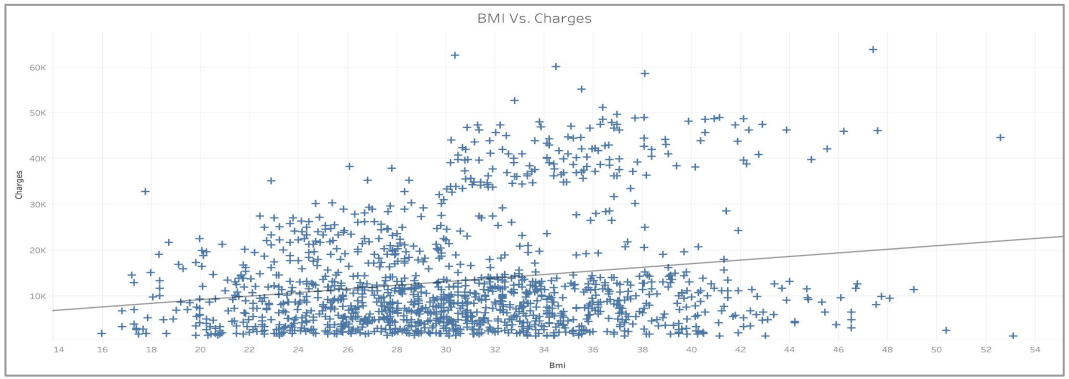
268 rows × 2 columns

Dashboard

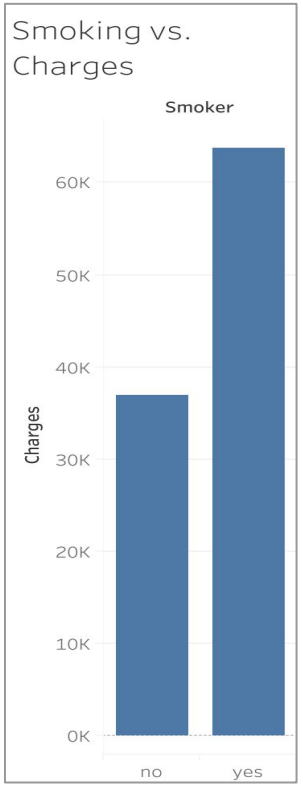
Age vs. Charges



BMI vs. Charges



Smoking vs. Charges



Interactive Webpage

Link of webpage: https://life-insurance-quote-project.herokuapp.com/predict

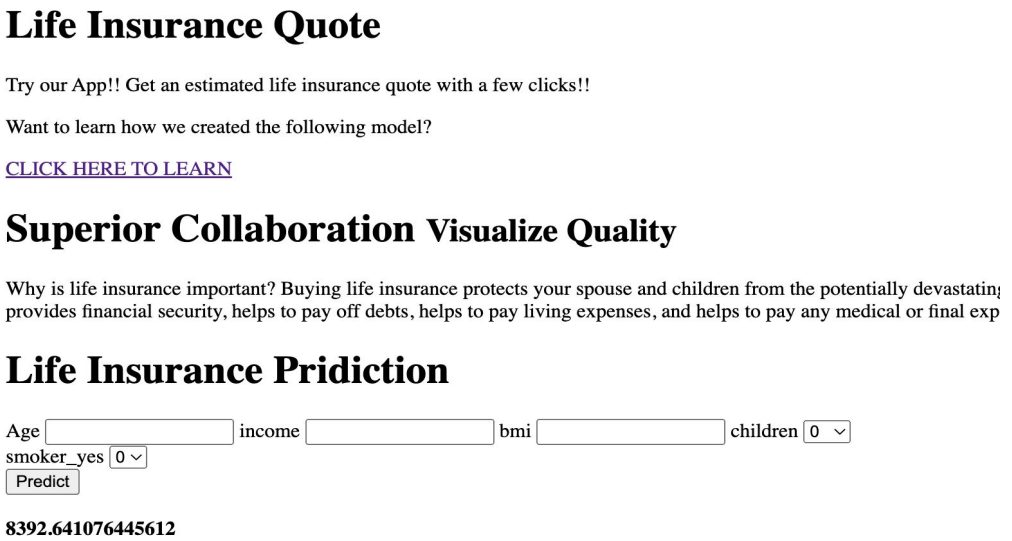
Real World Application

For Clients:

- Find the right coverage for individuals by simply entering demographics info
- Plan ahead and protect loved ones

For Companies:

- Ready to use machine learning model for application
- Identify premium rates for clients by only a few client data inputs



Key Takeaways

Challenges: Needed more variables to test the model, we tried to find different statistics and combine data frames, but it would be good if we have an original dataset that includes more columns.

Recommendation for future analysis: Look into different life insurance costs by country and region. The dataset we had was US demographics, if we could find any Canadian data and the life insurance companies information, it would be great for companies to compare and identify their competitive advantages.

What could have done differently: Do more research to find datasets which includes actual age data instead of scraped average numbers into our Machine Learning Model as we believe it might improve the accuracy of model.

THANK YOU