Unlocking Shared Housing Supply in Canada: Happipad Final Presentation

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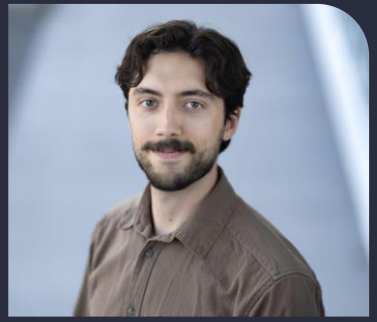
Contents

Our Team

Yuzhu Han

Background in statistics and urban planning



Foster Lockerbie

Background in psychology (statistics focus)

Jingran Zhao

Background in information management

Litao Zheng

Background in Mathematics and Statistics

What is Happipad?

Housing platform geared toward “unlocking underutilized housing”. Focused on providing affordable homes for seniors, refugees, and students.

Matches landlords with renters based on comprehensive profiles with list of habits and preferences.

Research questions

Can we effectively represent the housing demand and trends through dashboarding?

Can we predict which home listings will be rented?

Can we predict the appropriate price for rental listings?

Can we use any large language models to improve our predictive modelling?

Deliverables

Dashboards

Property and renter monitoring:
Property overview
Renter overview

Two Versions:
Dash and Tableau

Predictive Modelling

Predicting price of rental spaces based on home features

Using NLP to inform price predictions based on text responses

Final Report

Formal project report including:

Project research questions

Methods

Predictive modelling results and analysis

Dashboard explanation

Data Overview

Renters Dataset

- Desired lease term
- Budget
- City
- …

Hosts Dataset

- Location
- Preferred gender of roommates
- Disabilities
- …

Properties Dataset

- Rent price
- Property locations
- Furnishing details
- …

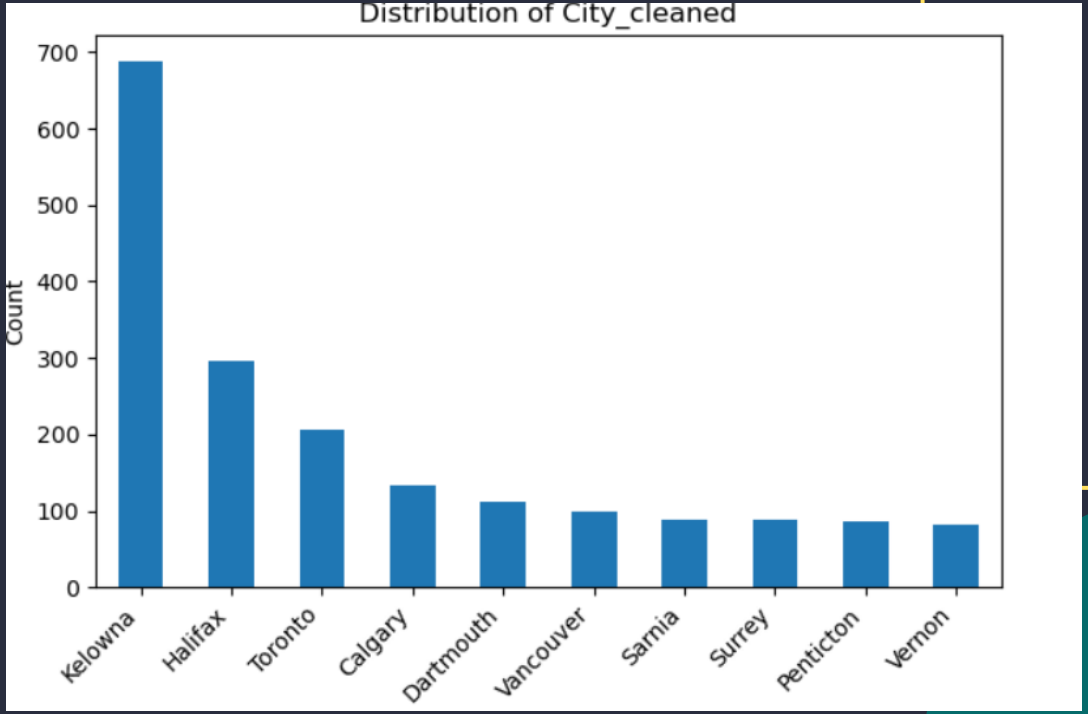
Contracts Dataset

- Monthly price of rent
- Lease term
- Location
- …

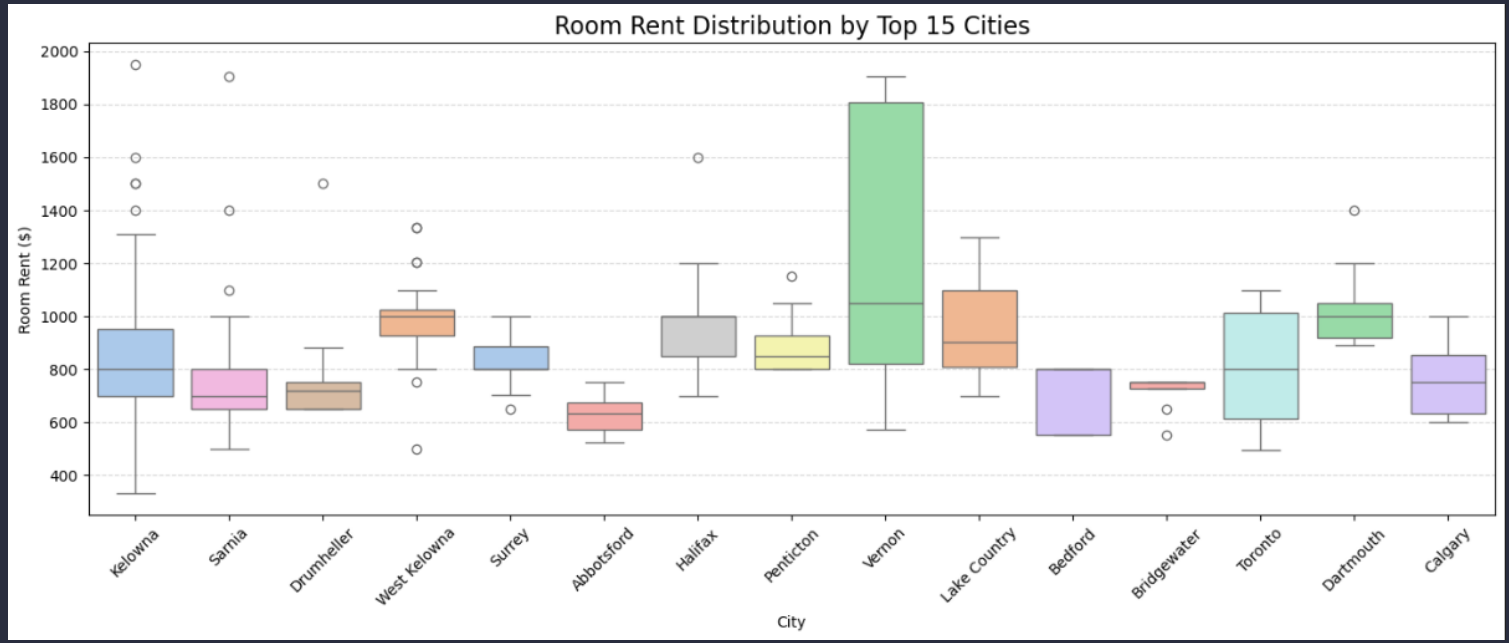
Data Cleaning

- Investigate outliers
  - determine which values are considered outliers and if they should remain in the dataset
- Remove test properties and listing
- Standardize columns (postal code, address, city, province)
- Binarize columns that contain multiple values
- Convert data types

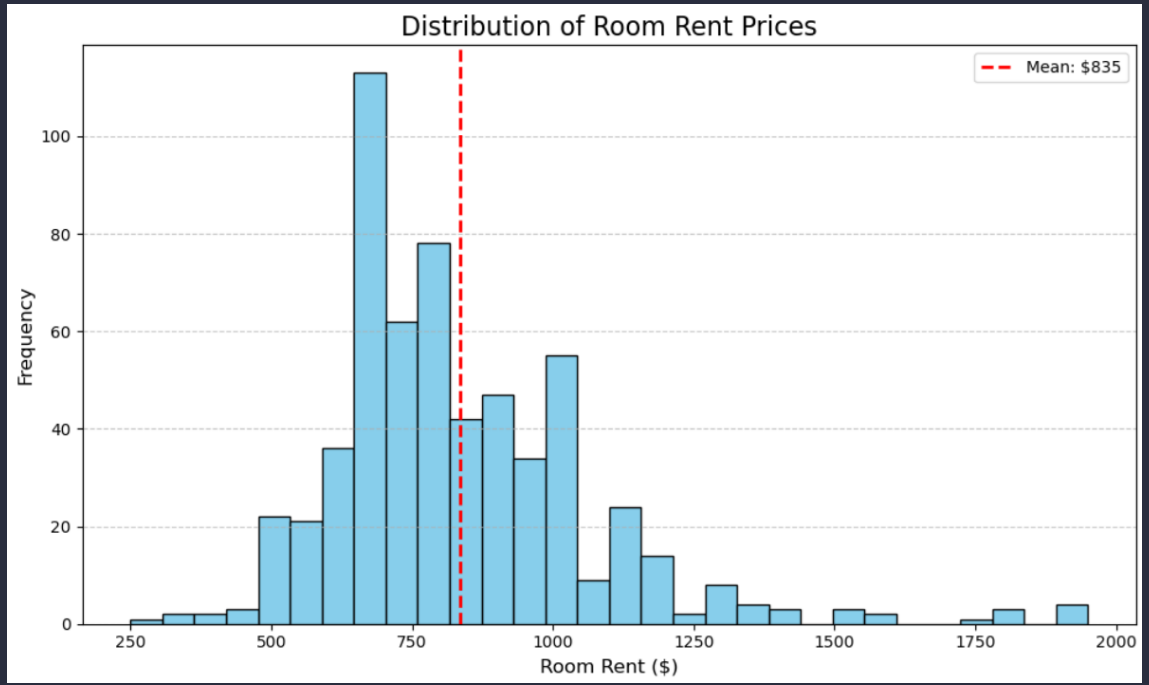
EDA - Hosts


Distribution of City_cleaned
Count
700
600
500
400
300
200
100
0
Kelowna
Halifax
Toronto
Calgary
Dartmouth
Vancouver
Sarnia
Surrey
Penticton
Vernon

EDA - Contracts

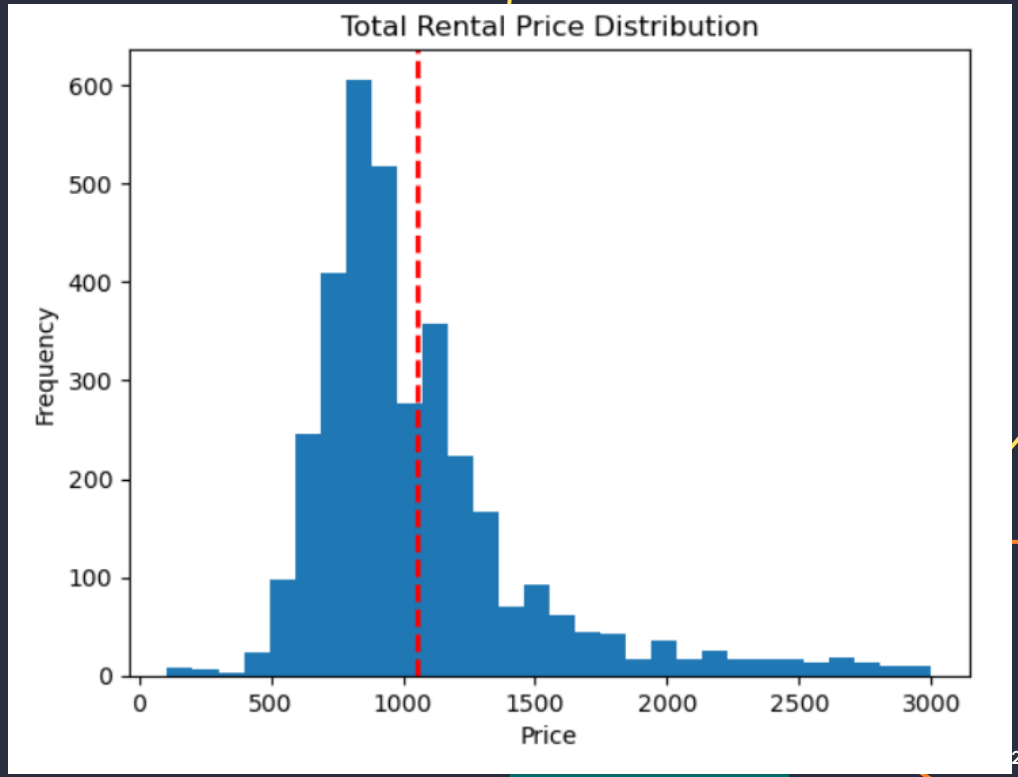


EDA - Contracts

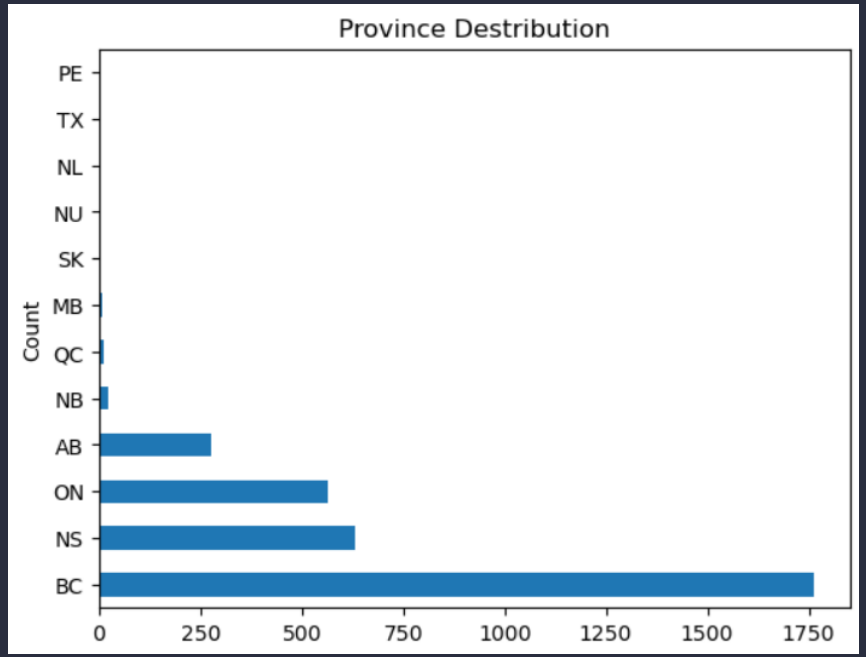


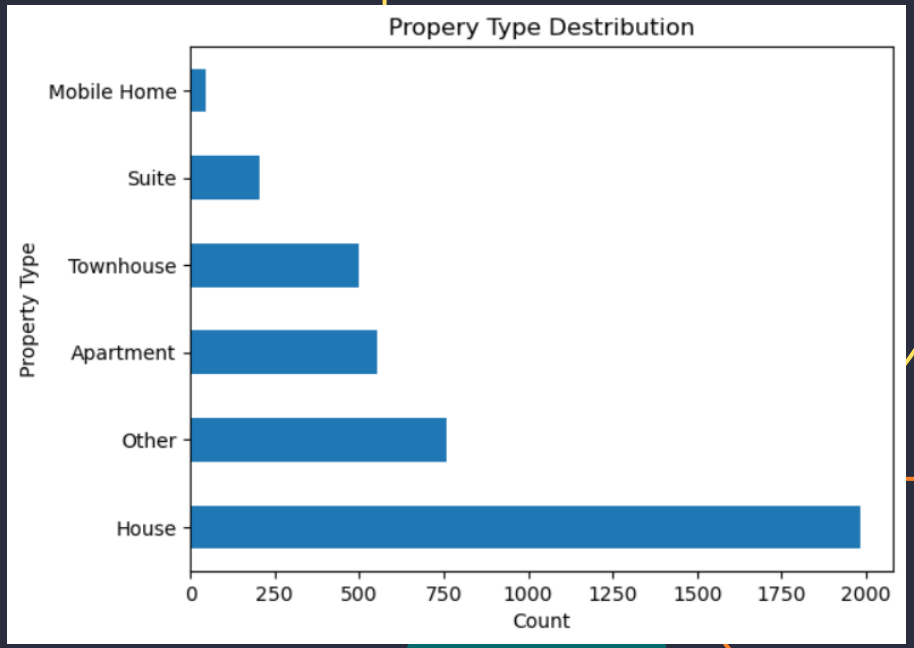
EDA - Properties

```
count      3666.000000
mean       1098.124326
std        2091.288179
min           0.000000
25%         756.000000
50%         947.040000
75%        1188.000000
max      118800.000000
Name: Total, dtype: float64
```

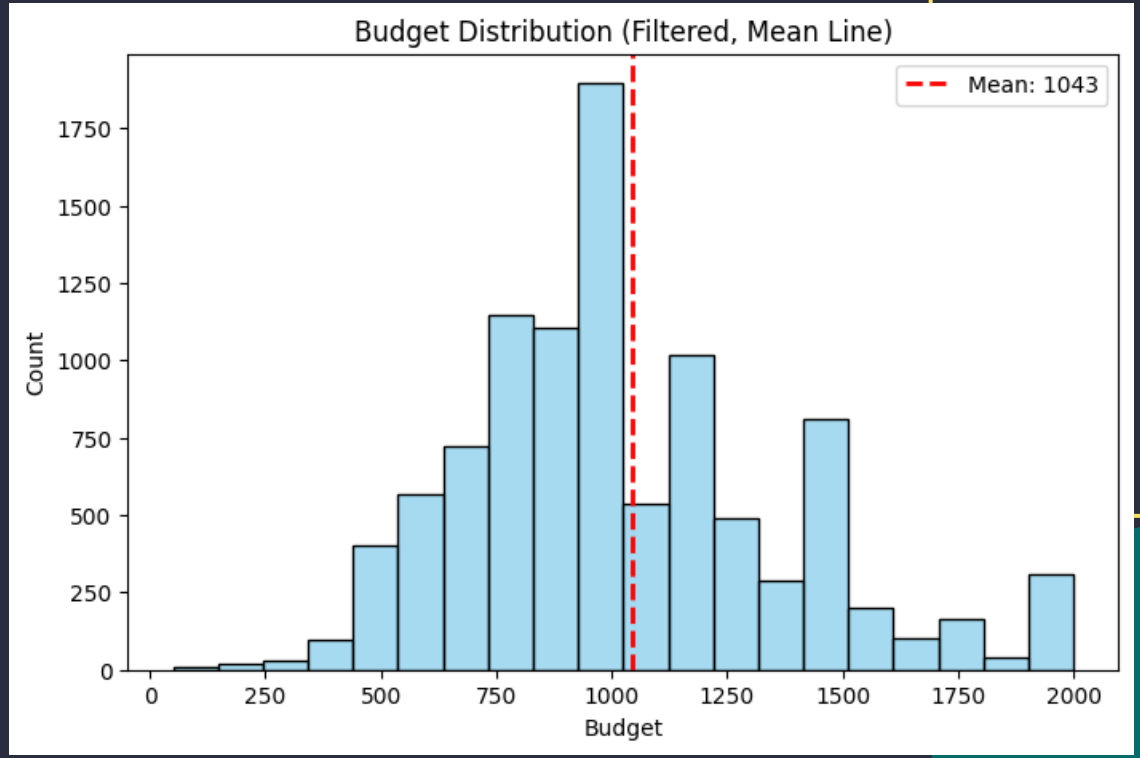


EDA - Properties

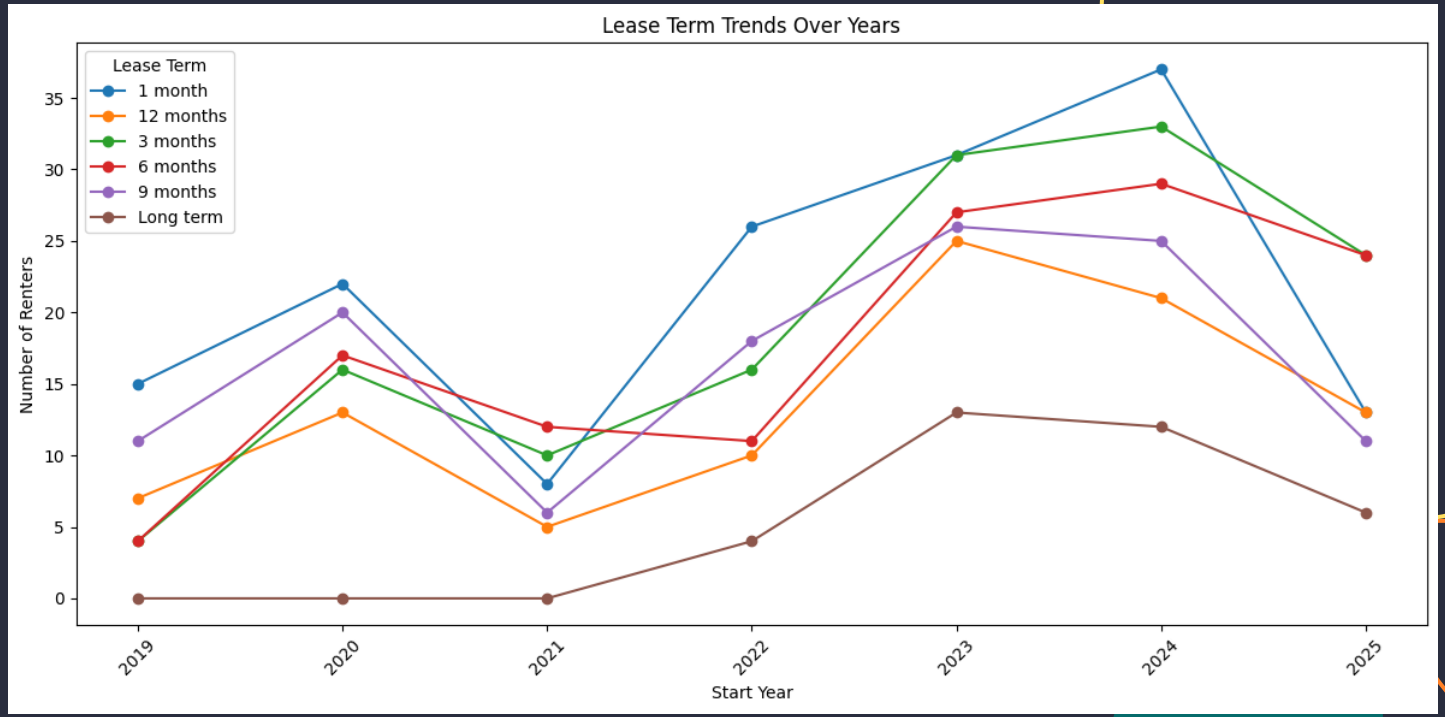




EDA - Renters


Budget Distribution (Filtered, Mean Line)
Mean: 1043
Count
Budget
0
250
500
750
1000
1250
1500
1750
2000

EDA - Renters


Lease Term Trends Over Years
Lease Term
1 month
12 months
3 months
6 months
9 months
Long term
Number of Renters
0
5
10
15
20
25
30
35
2019
2020
2021
2022
2023
2024
2025
Start Year

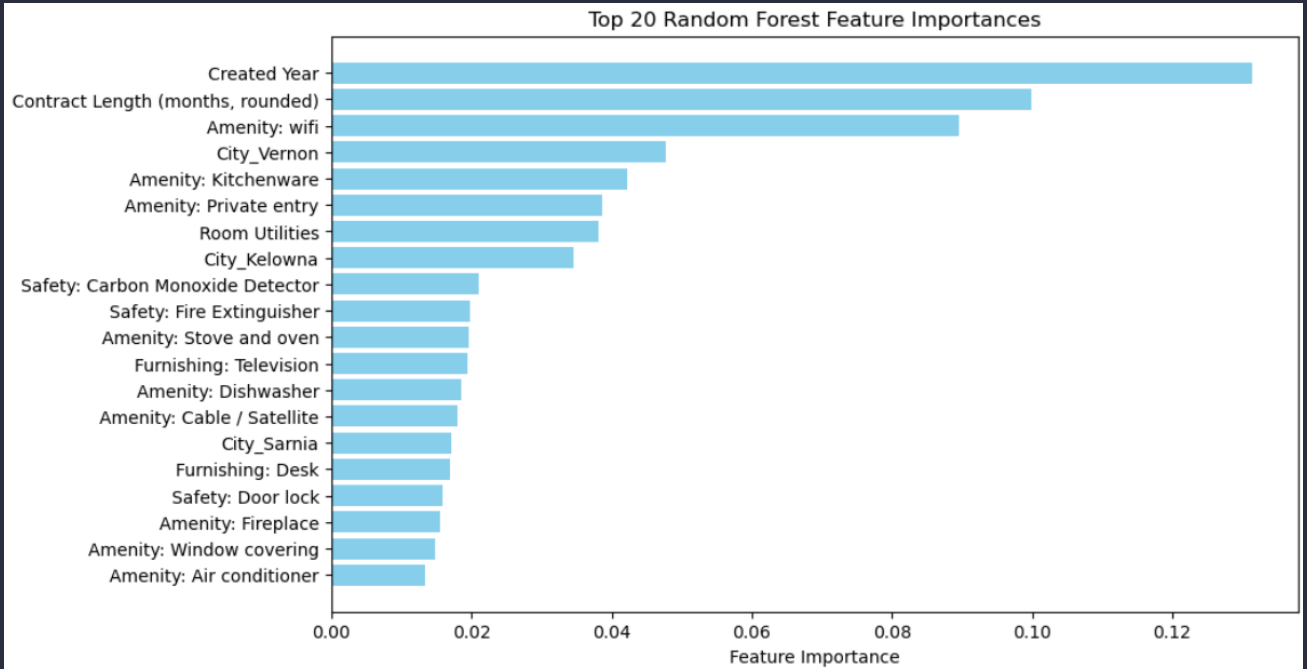
Results:

Predictive Modelling - price predictions

Model Name	RMSE	Relative Error
XGBoost (target encoding)	137.41	16.46%
XGBoost (one-hot encoding)	141.89	16.99%
Random Forest	133.60	16.00%
LightGBM	137.42	16.46%
Random Forest + NLP	140.43	16.82%

Results:

Predictive Modelling
- price predictions



Results:

Predictive Modelling
- Rental Likelihood Classifier

- Target variable: a binary column indicating whether the property has a rental record in the contracts dataset
- 5-fold Random Forest:

```
Fold 1 — Accuracy: 0.921, F1: 0.179
Fold 2 — Accuracy: 0.926, F1: 0.062
Fold 3 — Accuracy: 0.925, F1: 0.141
Fold 4 — Accuracy: 0.906, F1: 0.136
Fold 5 — Accuracy: 0.921, F1: 0.179
Mean Accuracy:  0.920
Mean Precision: 0.902
Mean Recall:    0.077
Mean F1 Score:  0.140
```

		Predict	
		0	1
True	0	3693	4
	1	321	27

NLP - Ollama

Ollama is a command-line platform for running large language models (LLMs) on local computer for offline text generation and analysis

- natural language processing tasks such as summarization, text classification, etc.

Mistral:

- Good balance between accuracy and speed
- Run efficiently on local hardware

NLP - Ollama

Expected output columns:

- number_of_people: number of people mentioned in the description
- bedrooms: how many bedrooms for rent
- pets_allowed: whether pets are allowed on the property
- property_size: the size of the property
- shared_spaces: a list of shared spaces in the rental listing
- bathroom_type: the bathroom would be shared or private
- nearby_amenities: a list of nearby amenities, such as bus stop
- unique_features: unique features of the property

NLP - Ollama

Input prompt 1:

Return a JSON object with:
- Number Of People (how many people the space is for or referenced)
- Number Of Pets (how many pets are mentioned)
- Property Size (e.g., small, medium, large, unknown)
- Shared Spaces (e.g., kitchen, living room)
- Bathroom Type (shared or private)
- Nearby Facilities (e.g., bus stop, store)

If the information is missing, return "unknown".

NLP - Ollama

Example output 1:

Number Of People	Number Of Pets	Property Size	Space Type	Shared Spaces	Bathroom Type
Unknown	Unknown	Unknown	Room	['Kitchen', 'Bathroom']	Shared
2	unknown	unknown	apartment	['living room', 'kitchen']	private
1	2	Unknown	Room	['kitchen', 'bathroom', 'living room', 'laundry	Shared
Unknown	Unknown	Unknown	Room	['kitchen', 'living room']	Unknown
unknown	unknown	unknown	unknown	unknown	unknown
unknown	unknown	unknown	unknown	unknown	unknown
unknown	unknown	unknown	master bedroom	['kitchen', 'laundry room', 'cozy living room']	private

NLP - Ollama

Input prompt final:

Schema:
{{
"number_of_people": "integer or 'unknown'",
"bedrooms": "integer or 'unknown'",
"pets_allowed": "true, false, or 'unknown'",
"property_size": "'small', 'medium', 'large', or 'unknown'",
"shared_spaces": "comma-separated string or 'unknown'",
"bathroom_type": "'private', 'shared', or 'unknown'",
"nearby_amenities": "comma-separated string from [bus, store, recreation centre/pool, school and university] or 'unknown'",
"unique_features": "semicolon-separated string or 'unknown'"
}}

NLP - Ollama

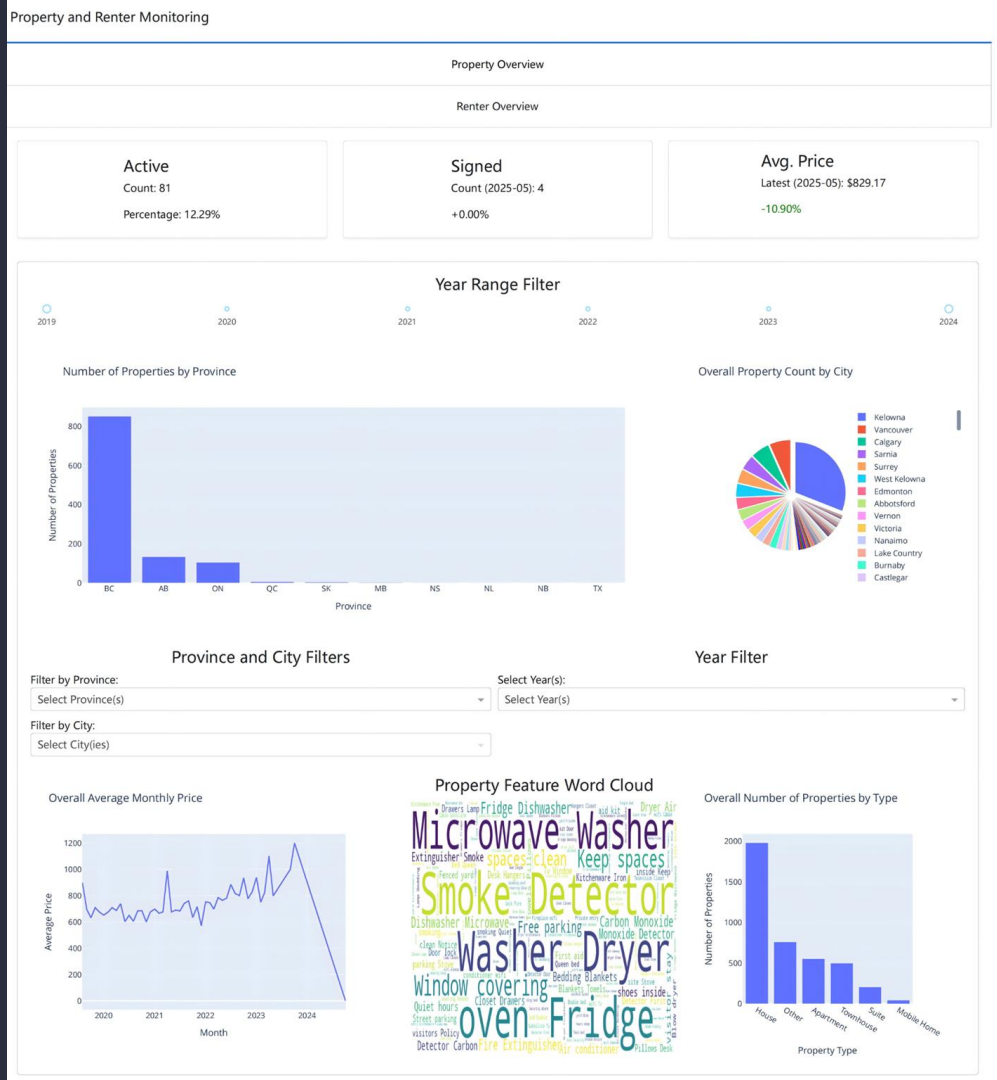
Example output final:

number_of_people	bedrooms	pets_allowed	property_size	shared_spaces	bathroom_type	nearby_amenities	unique_features
unknown	1	unknown	unknown	unknown	private	bus, unknown	parking
unknown	unknown	unknown	medium	unknown	unknown	bus, store, recreation centre/pool,	five minute walk to the beach;
unknown	unknown	unknown	unknown	living room	unknown	bus, store, recreation centre/pool,	none
unknown	unknown	unknown	unknown	unknown	unknown	unknown	suitable for students
unknown	1	unknown	unknown	living room, kitchen	unknown	bus, store, recreation centre/pool	fireplace
unknown	1	unknown	unknown	unknown	unknown	unknown	unknown
unknown	1	unknown	unknown	unknown	unknown	unknown	Queen bedroom
1	unknown	unknown	medium	kitchen	unknown	bus, store, recreation centre/pool	furnished room, electricity, W
unknown	unknown	unknown	unknown	unknown	private	unknown	unknown
unknown	1	unknown	medium	unknown	unknown	bus, school (UBCO)	spacious

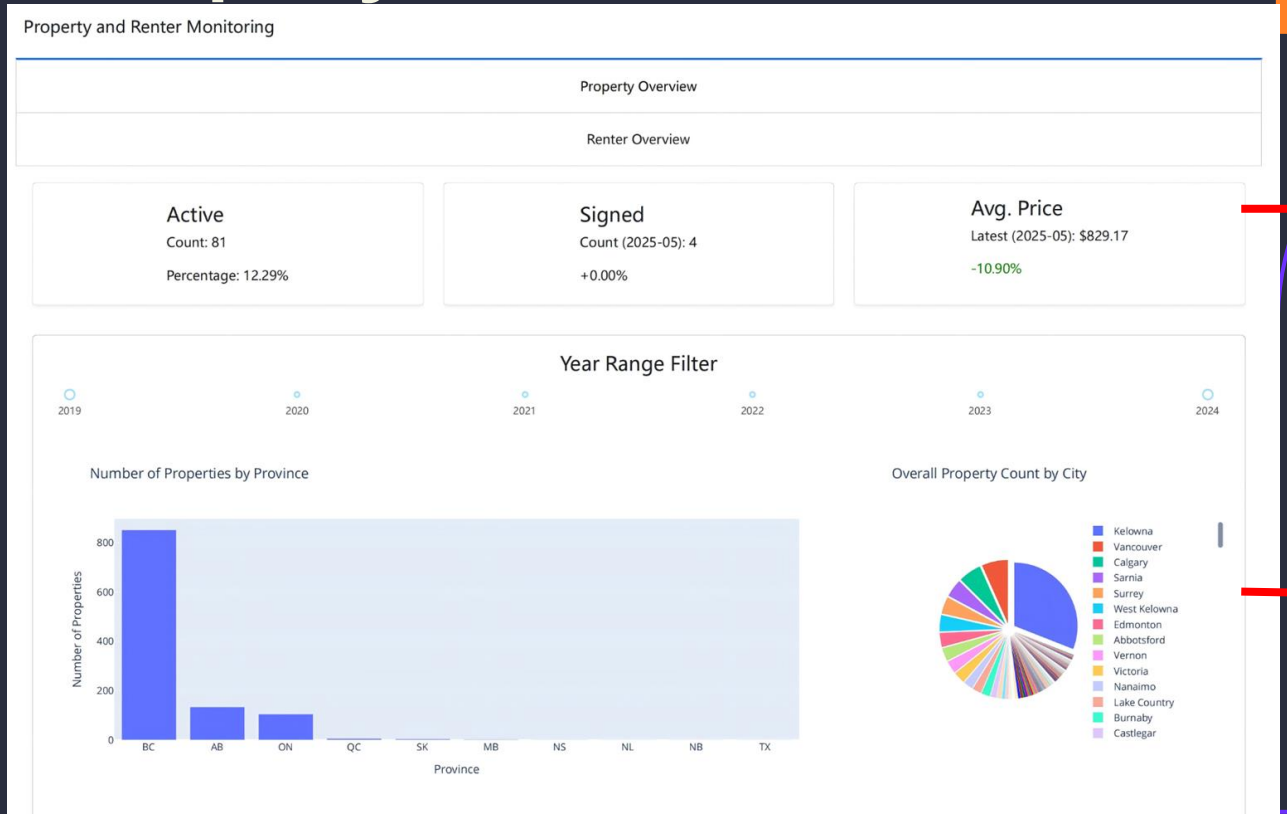
Happipad

Dashboard(Dash): Property Overview

- Property Status
- Geographical Distribution
- Property Characteristics



Dashboard(Dash): Property Overview



Property Status

Location Distribution

Dashboard(Dash): Property Overview

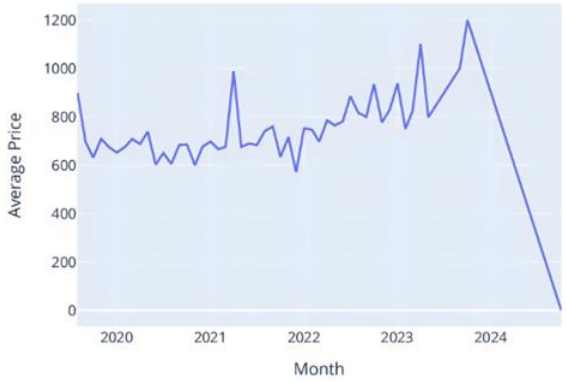
Other Features

Filter by Province:
Select Province(s)

Select Year(s):
Select Year(s)

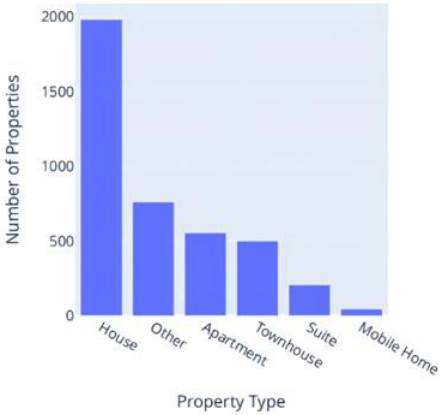
Filter by City:
Select City(ies)

Overall Average Monthly Price

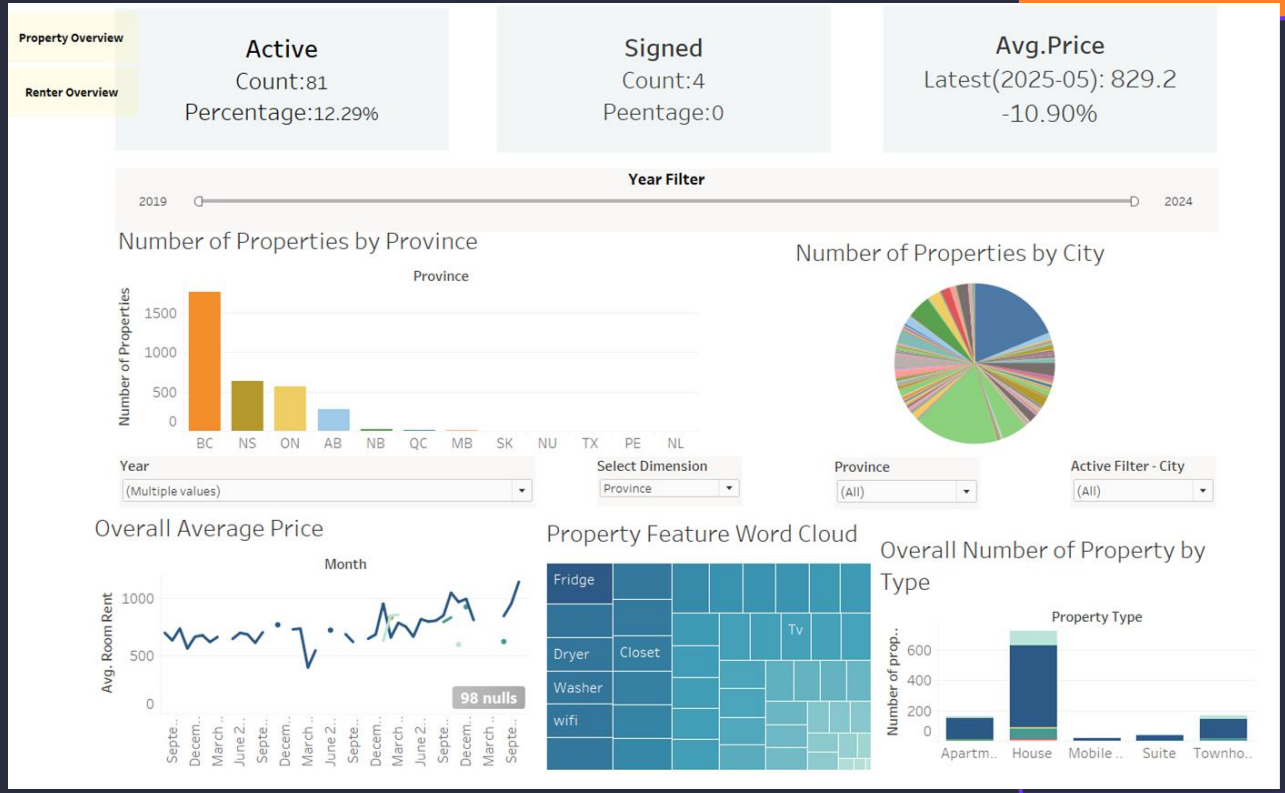


Property Feature Word Cloud

Overall Number of Properties by Type

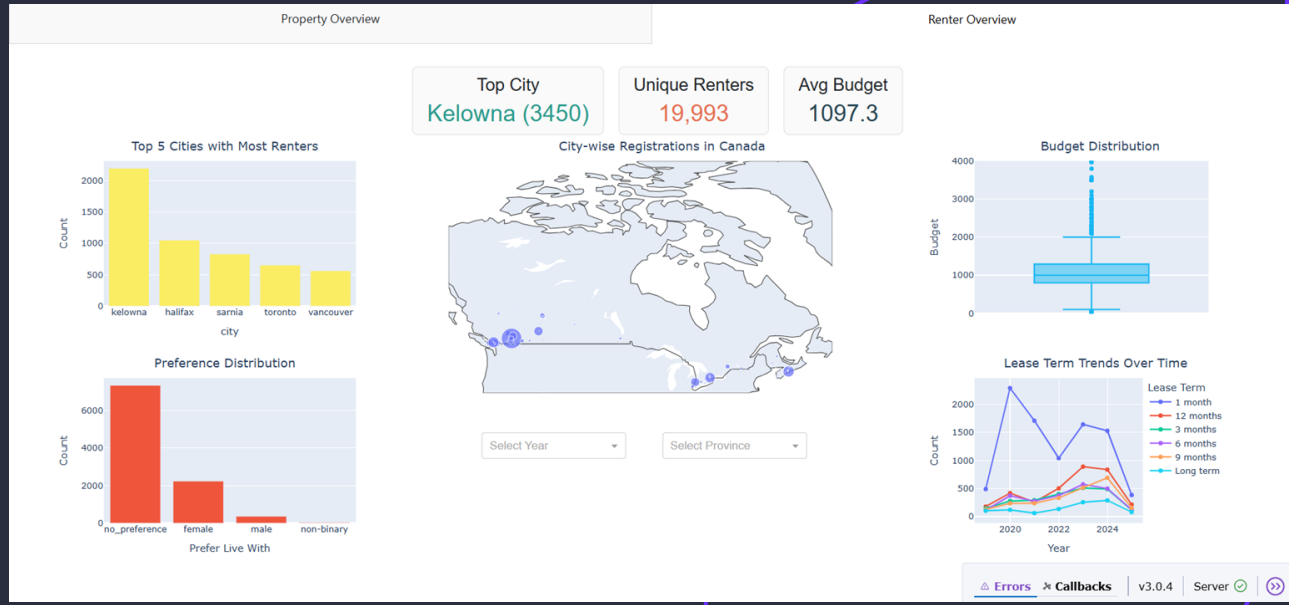


Dashboard(Tableau): Property Overview

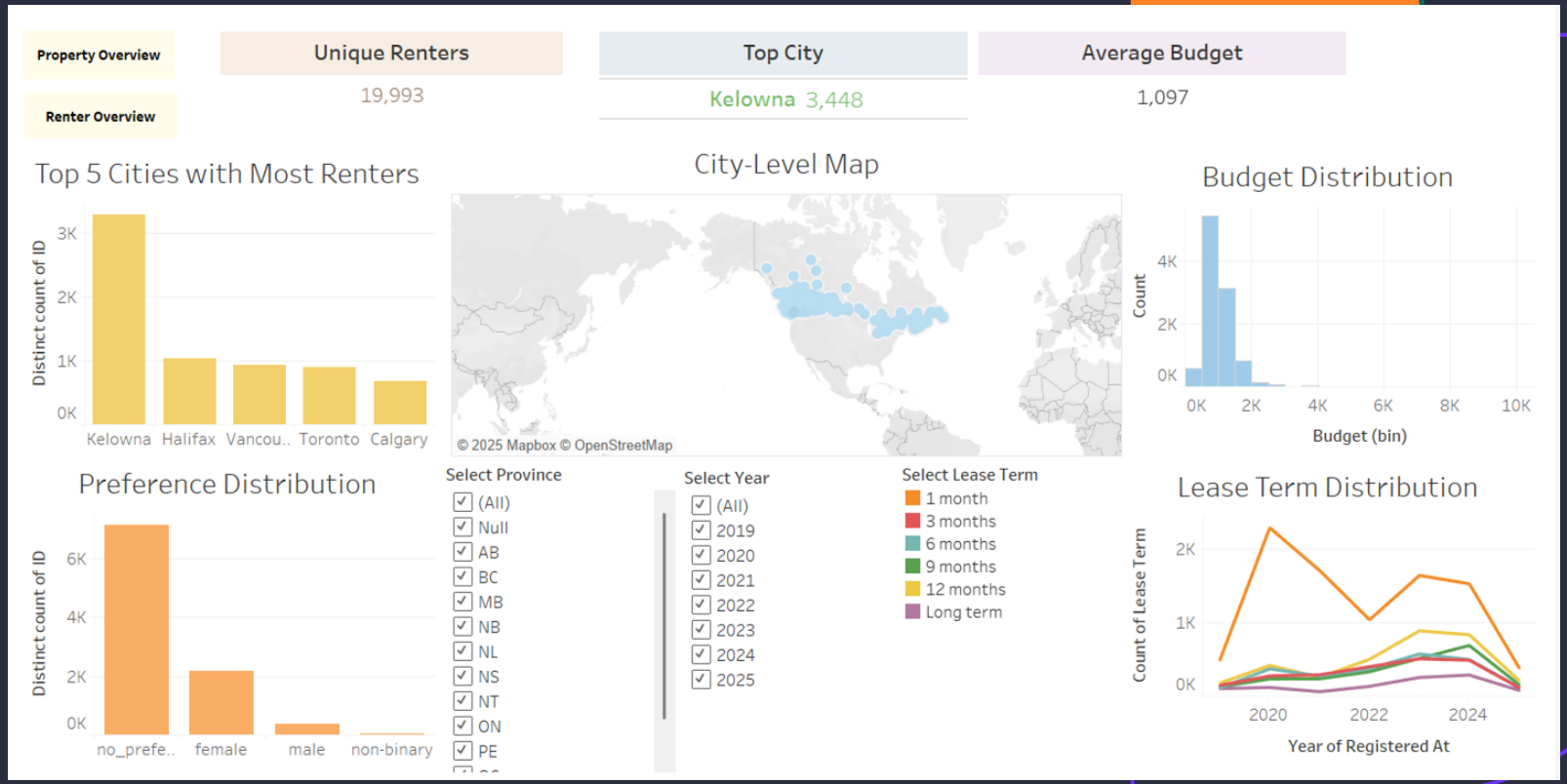


Dashboard(Dash): Renter Overview

- Basic Information card: Top City, Unique Renters, Average Budget
- Canada map showing renter distribution
- Budget Distribution
- Lease term distribution
- Filter dropdowns: Year, Province



Dashboard(Dash): Renter Overview



Conclusion

- Two dashboards (Property and Renter Overview):
  - Help Happipad monitor business
  - Help Happipad understand their clientele
- Modelling Framework
- Ollama with Mistral

Future works:

- Monitor model performance as dataset grows
- Build a streamlined process to continuously update the dashboard

Acknowledgement

Happipad

MDS Capstone

Dr. Scott Fazackerley

Thank you!