

Forecasting Shelter Demand for the Homeless in Saskatoon

Team Vision

Supervised by Wasim Ismail

Table Of Content



Introduction



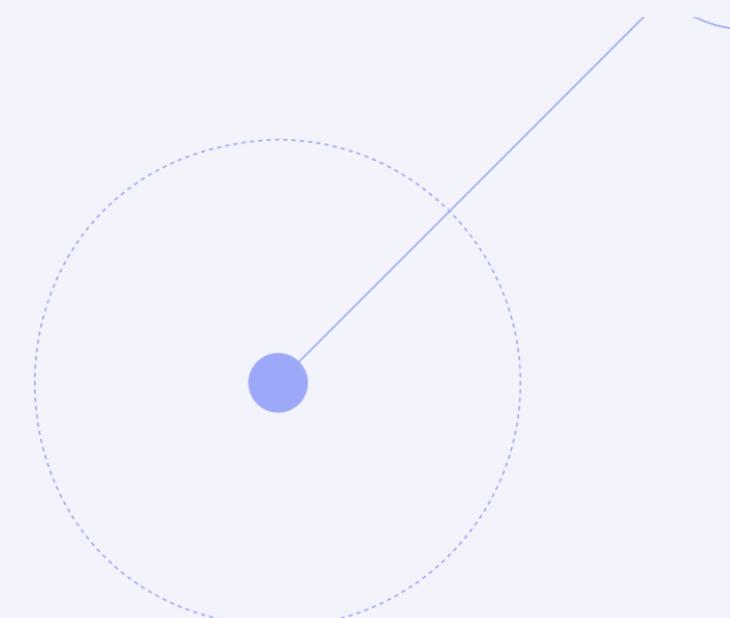
Methods



Results



Discussion



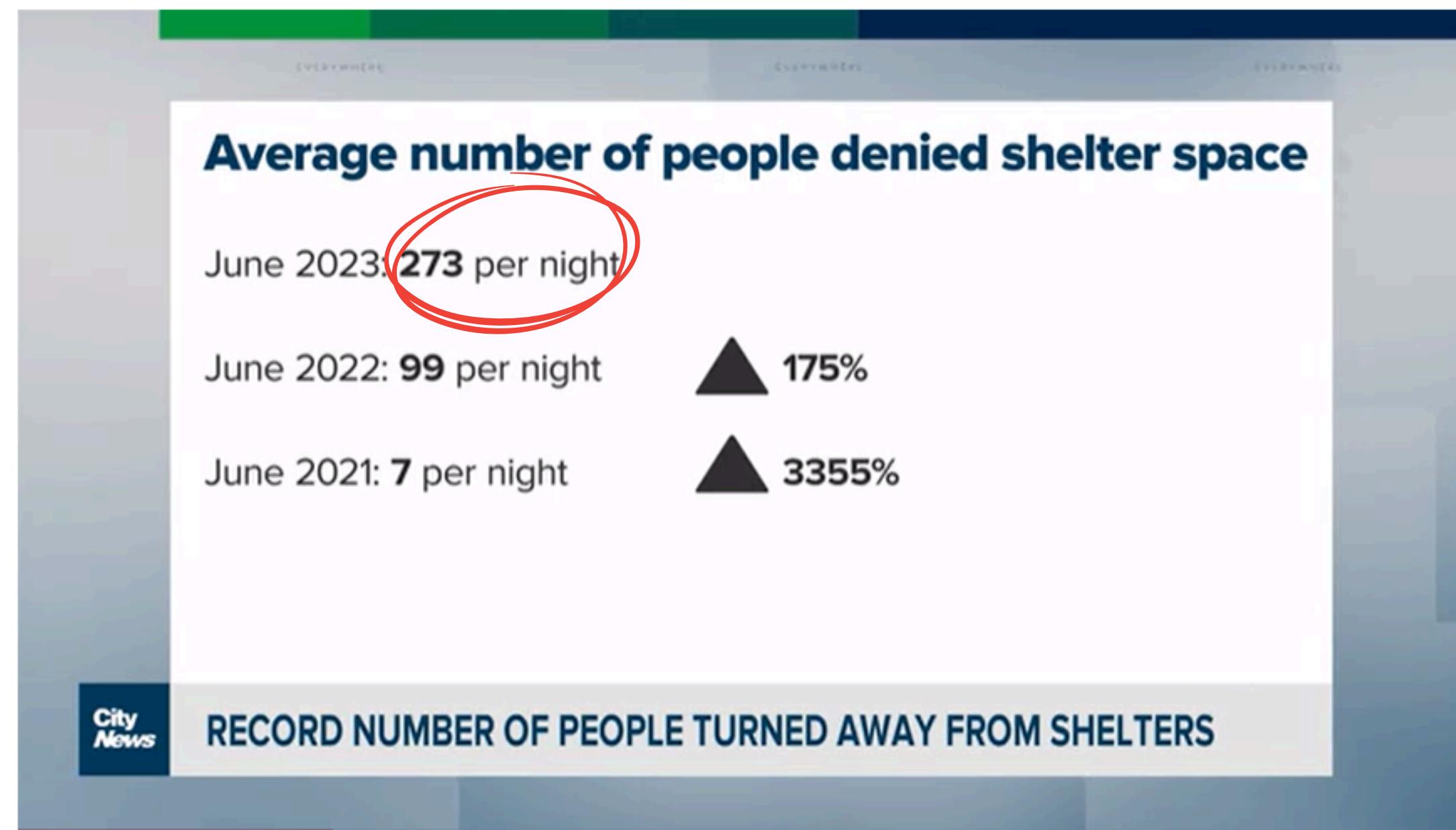
RBC BOREALIS

235,000

Number of Canadians
experiencing
homelessness each year

Let's SOLVE it

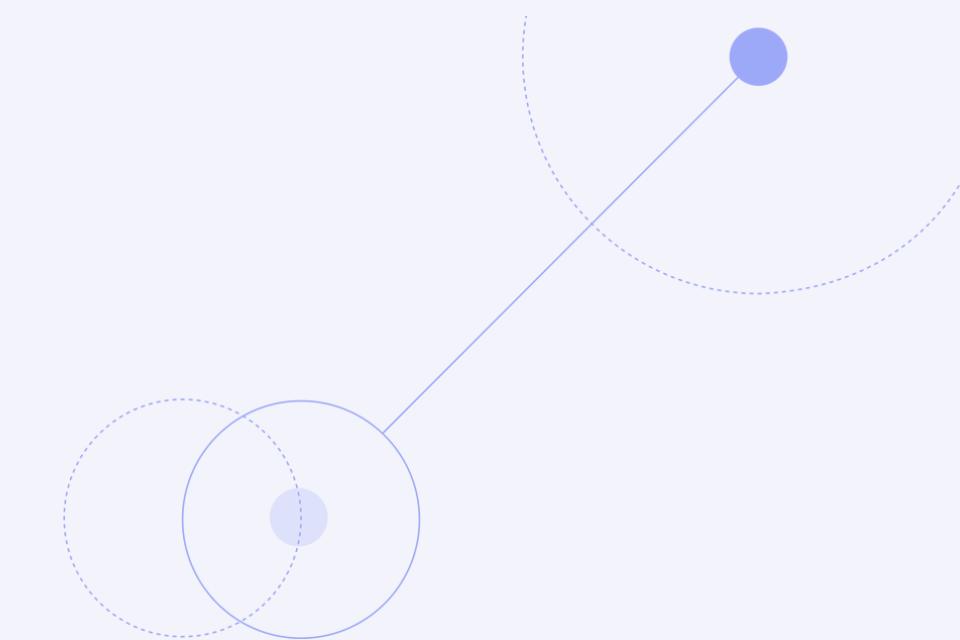
People turned away from Toronto shelters hits highest number ever recorded



The number of people turned away from Toronto's shelter system has been steadily increasing for months and hit a record high in June. Tina Yazdani with the startling numbers.

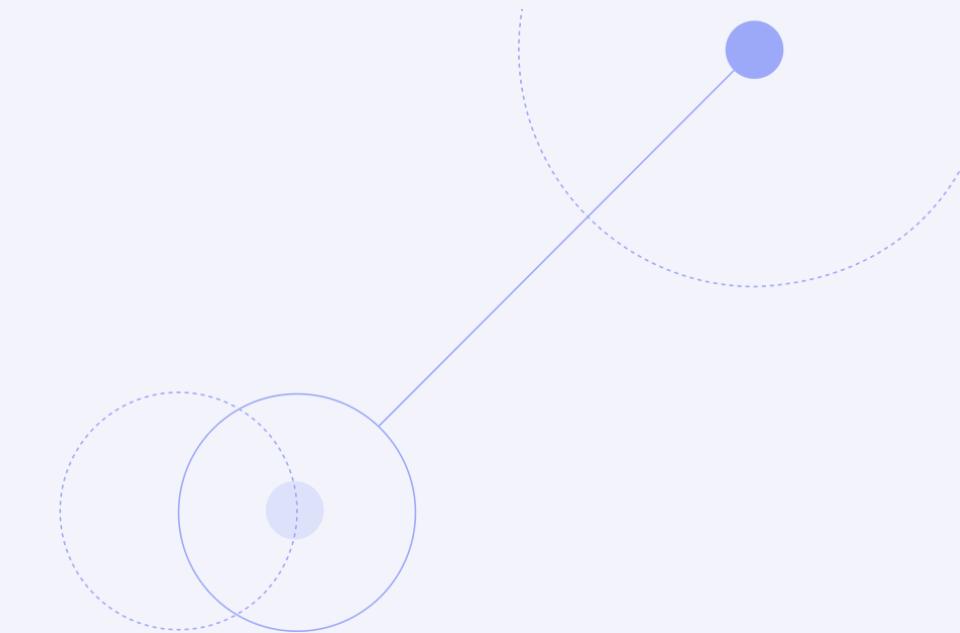
\$561 million

The amount the federal government plans to spend each year on homelessness programs through Infrastructure Canada.



Problem Statement

Saskatoon's homeless population has tripled since 2022, overwhelming shelter systems. With weather extremes and rising need, shelters lack the foresight for proactive planning.



Goal

Build a predictive model to forecast bed occupancy in homeless shelters using publicly available data from Toronto and Calgary due to data limitations for Saskatoon.

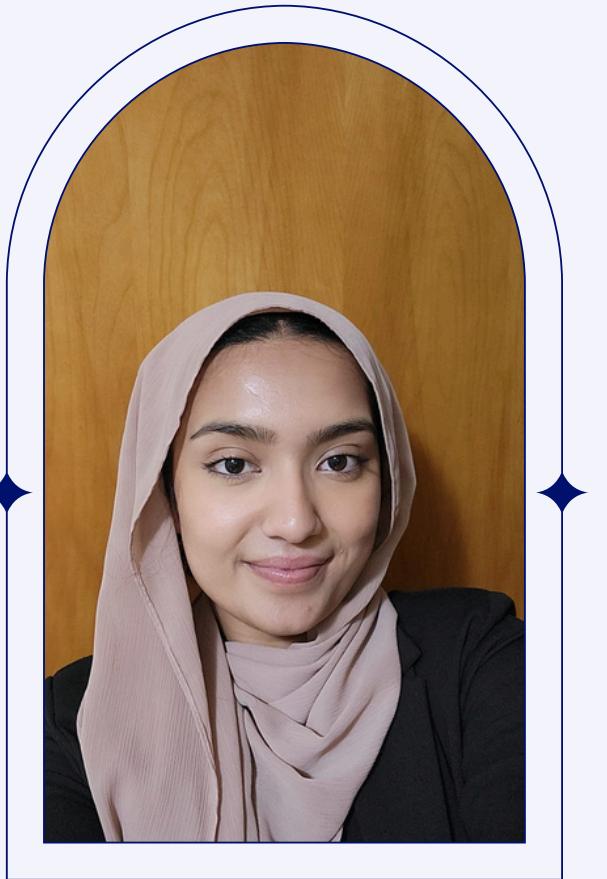
Meet the Team



HALEEMA AHMED



AMAMA RIDA



RUBANA SYEDA



MARYAM SAJJAD

Saskatoon Data Challenge

No accessible shelter occupancy datasets are currently available for Saskatoon.

Work with data from other Canadian cities - Calgary and Toronto.

Similar weather patterns, but still does not reflect Saskatoon.

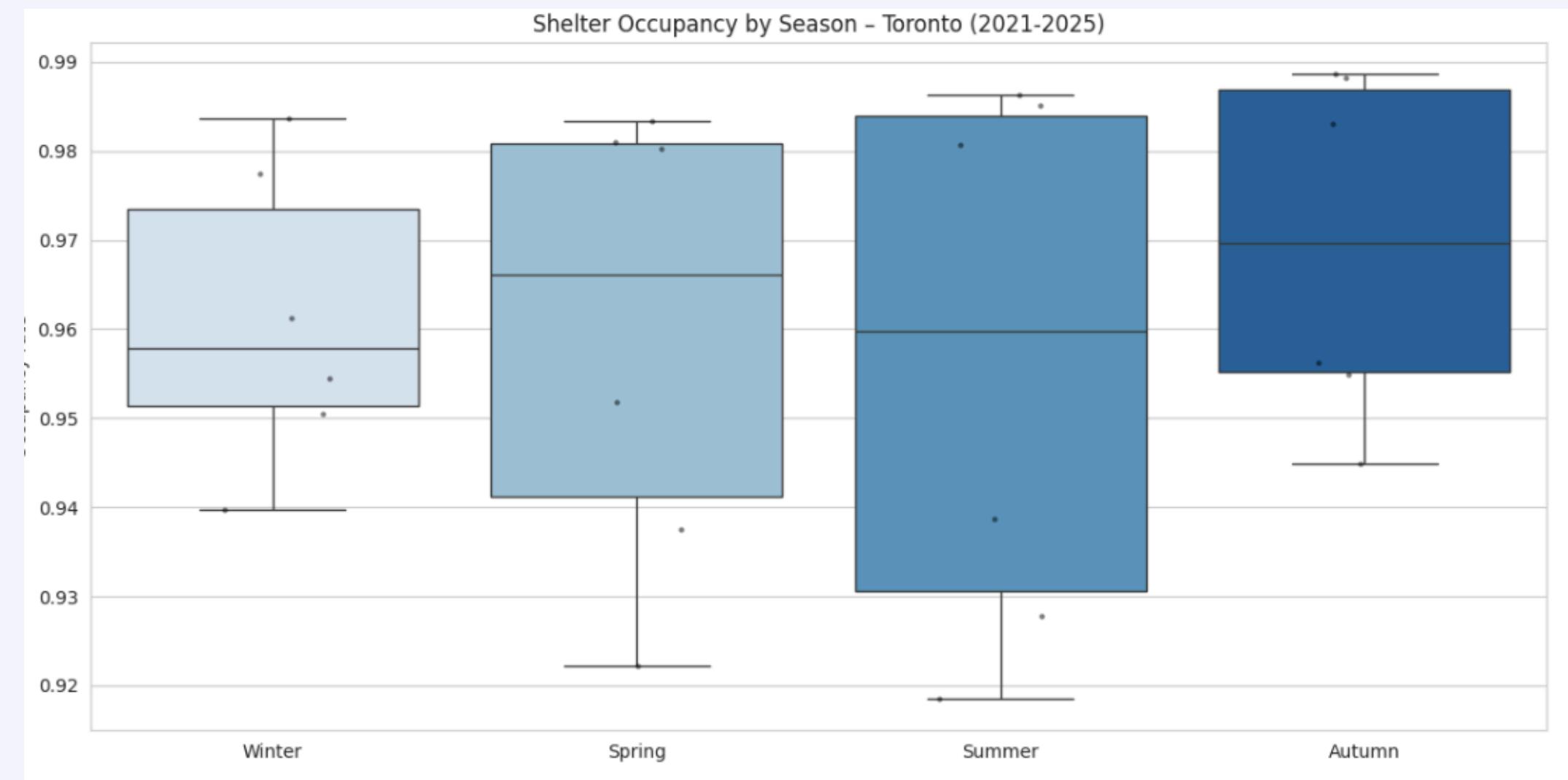
Data quality and availability are crucial if we want to use AI models to solve an issue.



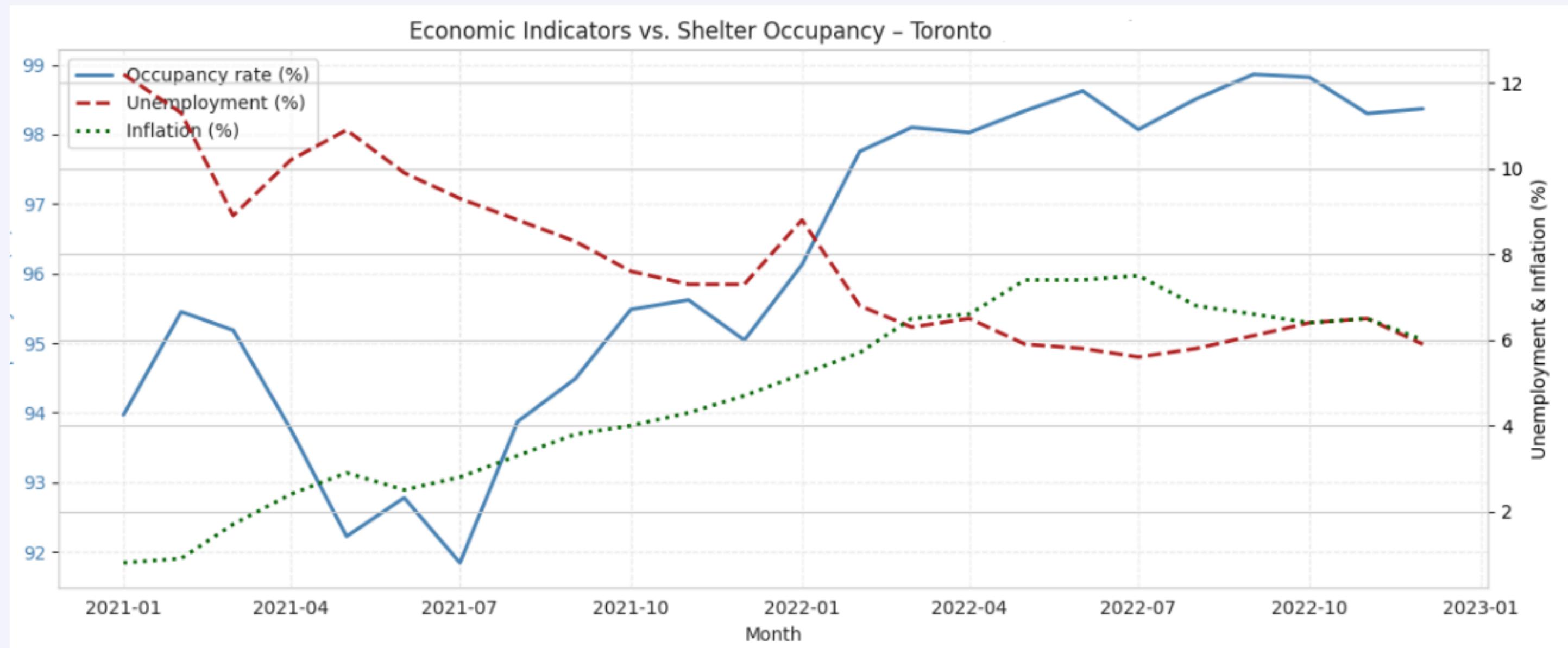
Data Exploration (EDA)

Toronto Shelter Occupancy (2021-2025) and
Calgary Shelter Dataset

- Weather Data: Max/Min Temp, Snow on Ground, Precipitation
- Economic Data (Monthly):
 - Inflation Rate Change
 - Unemployment Rate
 - Consumer Price Index (CPI)



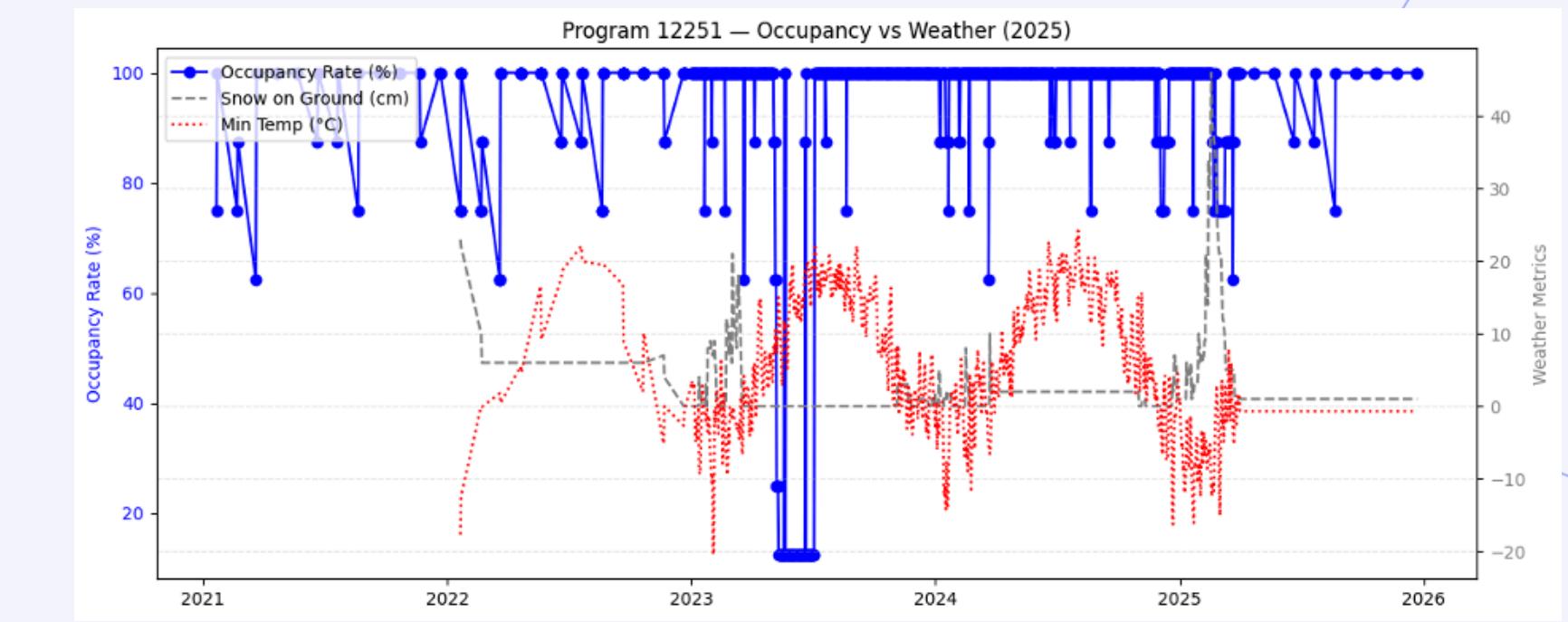
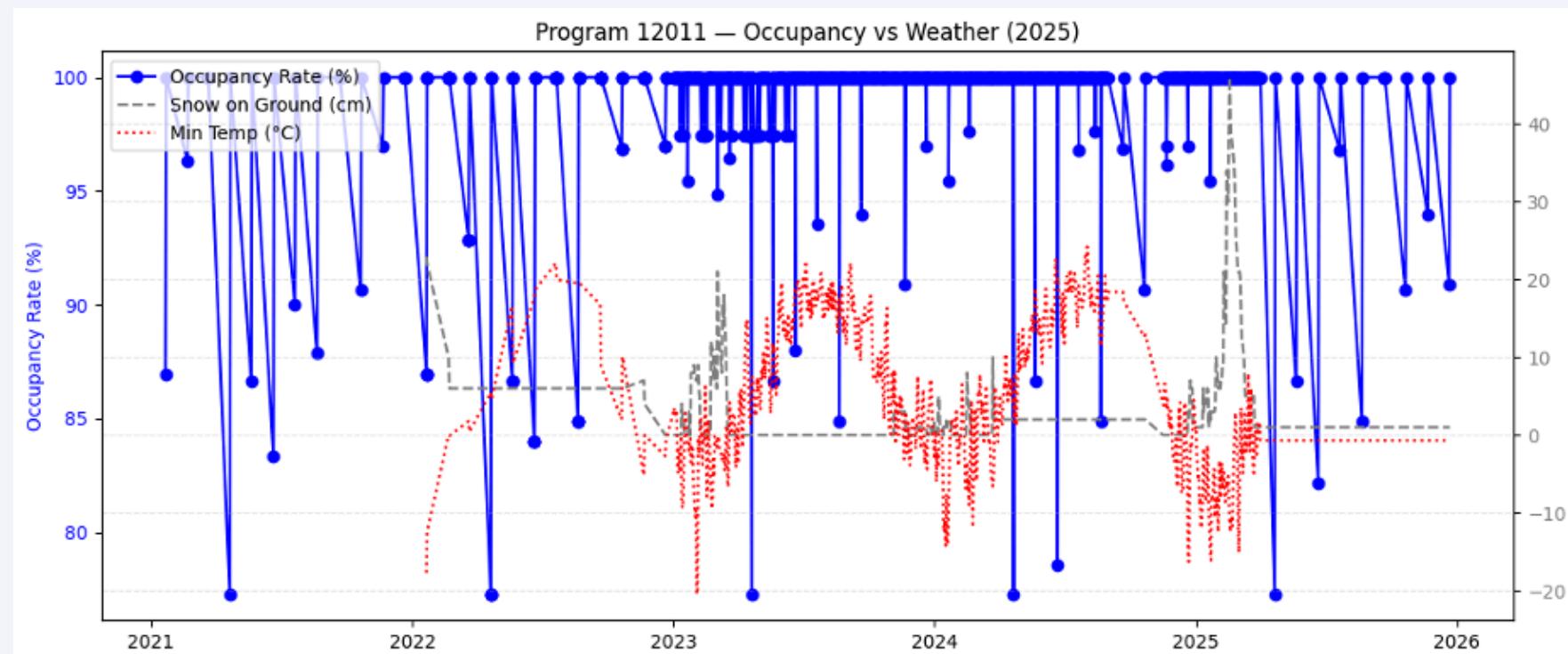
Key Insights From Data Exploration



Baseline Model Performance

Random Forest

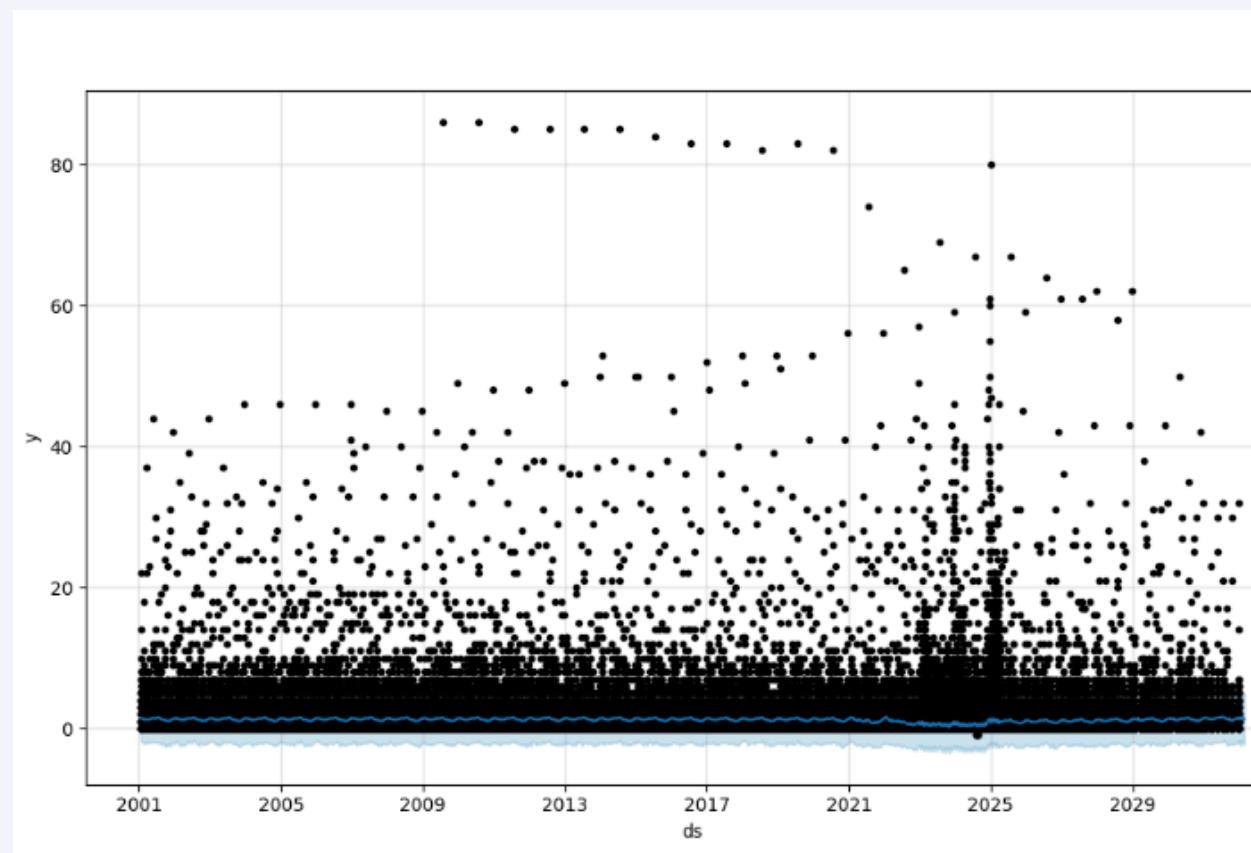
- Random forest functions as a supervised learning model for both regression and classification.
- Handles nonlinear relationships and interactions between variables without requiring extensive feature engineering.
- The model's inputs included temporal features (day, month, year), shelter identifiers, the previous day's occupancy rate, and weather variables such as minimum temperature, snow on ground, and total precipitation.
- Less sensitive to outliers and overfitting compared to single decision trees.



Baseline Model Performance

Prophet by Meta

- Prophet by Meta is easy to use and incorporate into the project as a baseline model.
- Functions as a time-series model.
- Able to add regressors like weather and economic features to make the data more accurate.
- Works well with homelessness data since it is affected by the seasons, and Prophet has seasonality analysis.



	ds	yhat	yhat_lower	yhat_upper	y	cutoff	
0	2003-05-21	1.620413	-2.099958	5.622256	0.0	2003-04-28	
1	2003-05-21	1.620413	-2.218126	5.389995	5.0	2003-04-28	
2	2003-05-21	1.620413	-2.290068	5.524635	0.0	2003-04-28	
3	2003-05-21	1.620413	-2.363179	5.254540	3.0	2003-04-28	
4	2003-05-21	1.620413	-2.790490	5.458783	10.0	2003-04-28	
	horizon	mse	rmse	mae	mdape	smape	coverage
0	37 days	7.507825	2.740041	1.259052	inf	1.672524	0.956581
1	38 days	7.462489	2.731756	1.261567	inf	1.672018	0.956884
2	39 days	7.344213	2.710021	1.255925	inf	1.674286	0.956976
3	40 days	7.280839	2.698303	1.247878	inf	1.675698	0.957132
4	41 days	7.499426	2.738508	1.248607	inf	1.675749	0.956848

LSTM

What is LSTM?

- LSTM is an advanced recurrent neural network (RNN) architecture
- Uses a unique structure of gates that regulate the flow of information

What we chose LSTM?

- Handling of sequential data
- Time series forecasting
- Captures Temporal Dependencies
- Handles Variable-Length Sequences
- Supports Multivariate Inputs
- Better at Avoiding Vanishing Gradients

LSTM

Model Work Flow

Data
Collection

Data
Pre-processing

Feature
Engineering

LSTM Model
Training

Feature- Based
Adjustments

Prediction
Outputs

2 Types of LSTM

Univariate LSTM

Focusing on a single dependent variable
for combined city average
(Baseline LSTM)

Multivariate LSTM

Focusing on a multiple dependent
variable for combined city average



Multivariate LSTM Results

Dataset 2021-2025

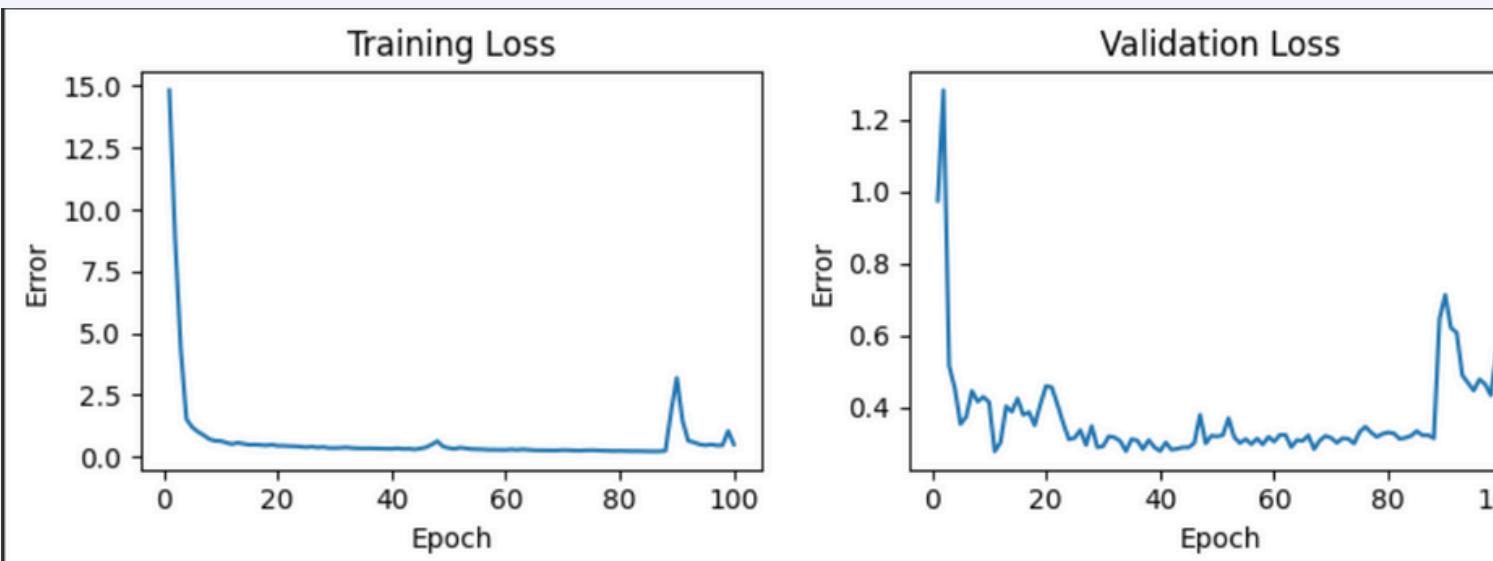
Approach 1:

Features used:

- Occupancy date, Max temperature, Min temperature, Total precipitation, Inflation rate change, Unemployment rate, CPI value, Occupied percentage

- Results

- MAE Loss: 0.826
 - MRSE Loss: 1.037



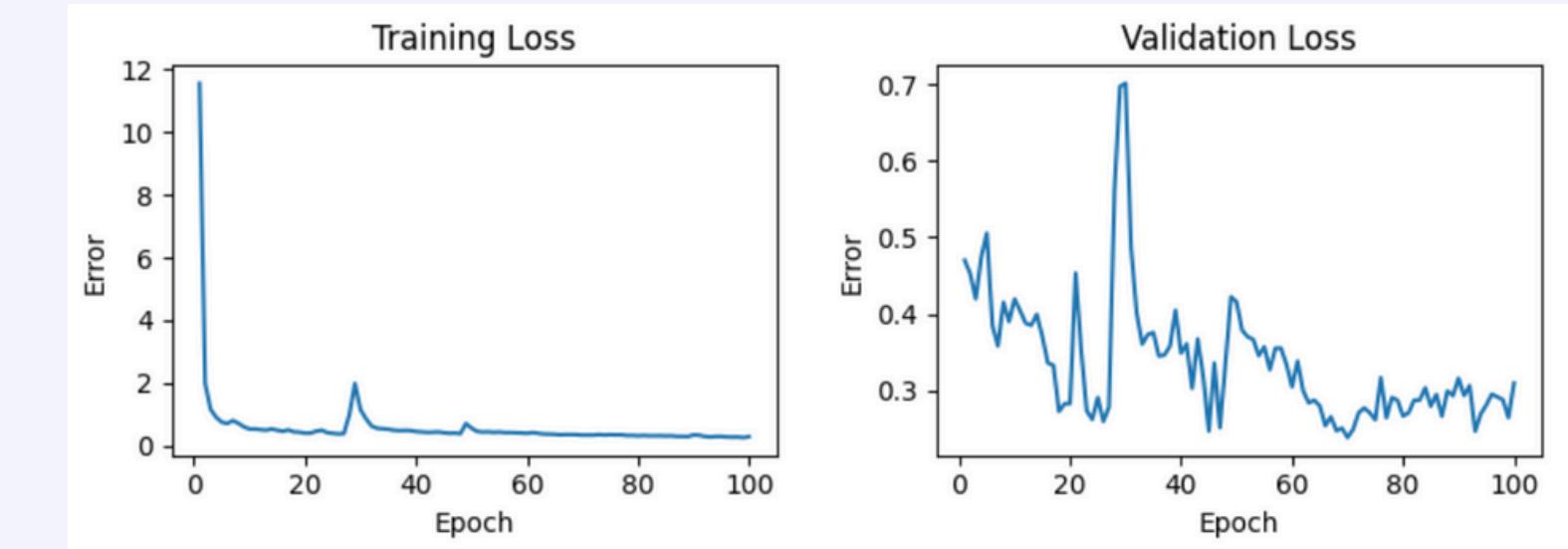
Approach 2:

Features used:

- Occupancy date, Max temperature, Min temperature, Total precipitation, Occupied percentage

- Results

- MAE Loss: 0.872
 - MRSE Loss: 1.073



Model Accuracy Comparison

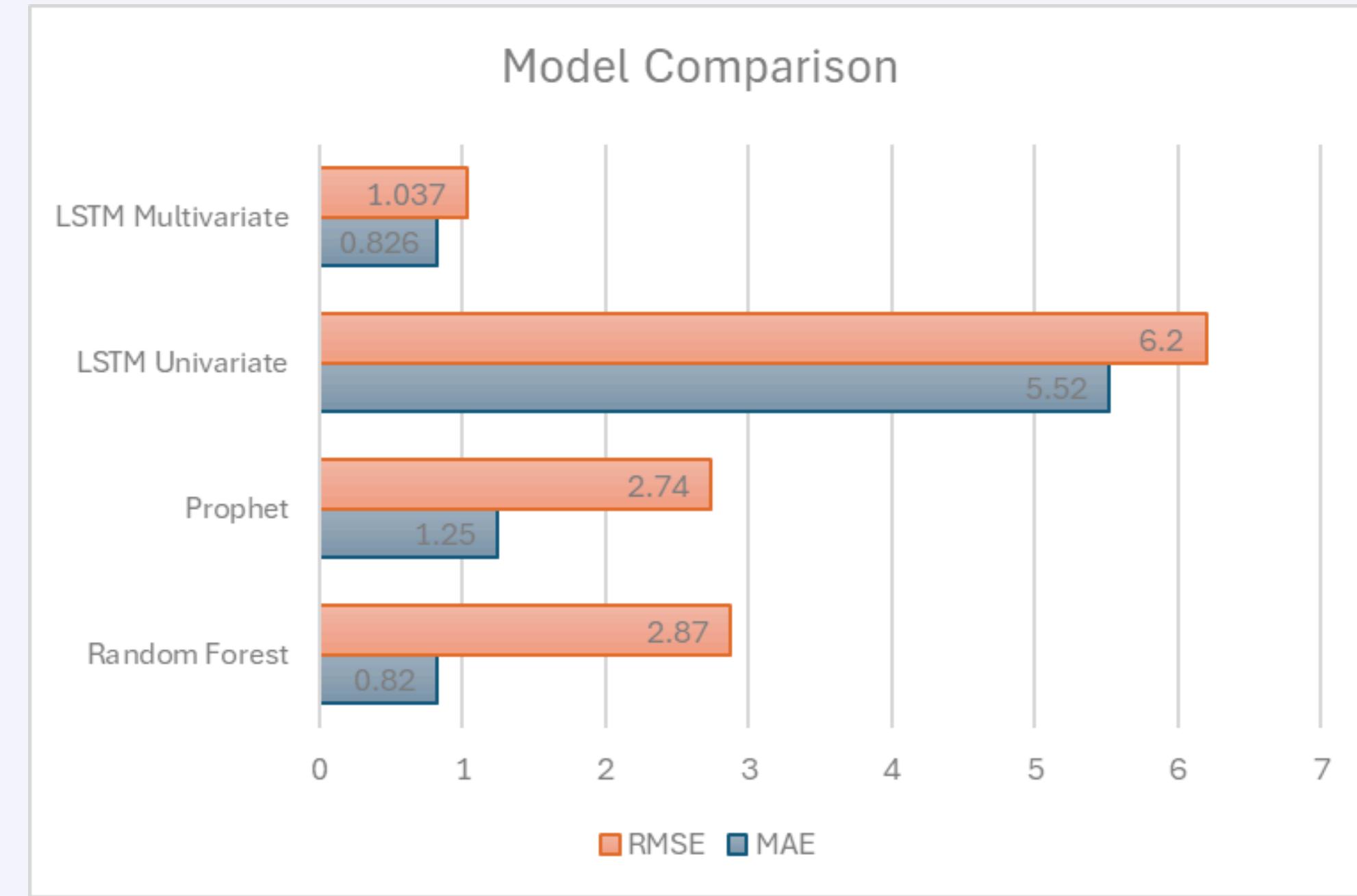


Figure: Error metrics for different models

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DEMO



Shelter Management Dashboard

 Review
Prediction Model

Shelter Overview

014-TOR-CENTRE

Toronto Downtown Shelter

Occupancy Rate

87%

Beds Available

13

Contact

shelter@email.ca

(123) 456-7890

Weather Conditions

-14°C -8°C

Min

Max

Snow on
Ground**12 cm**

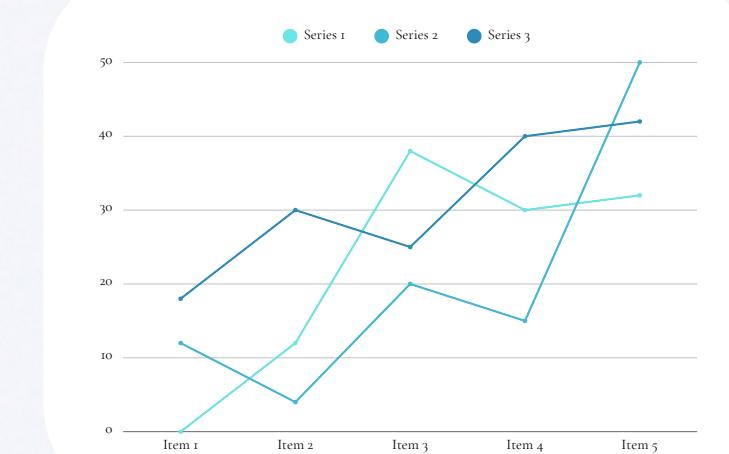
Wind Chill

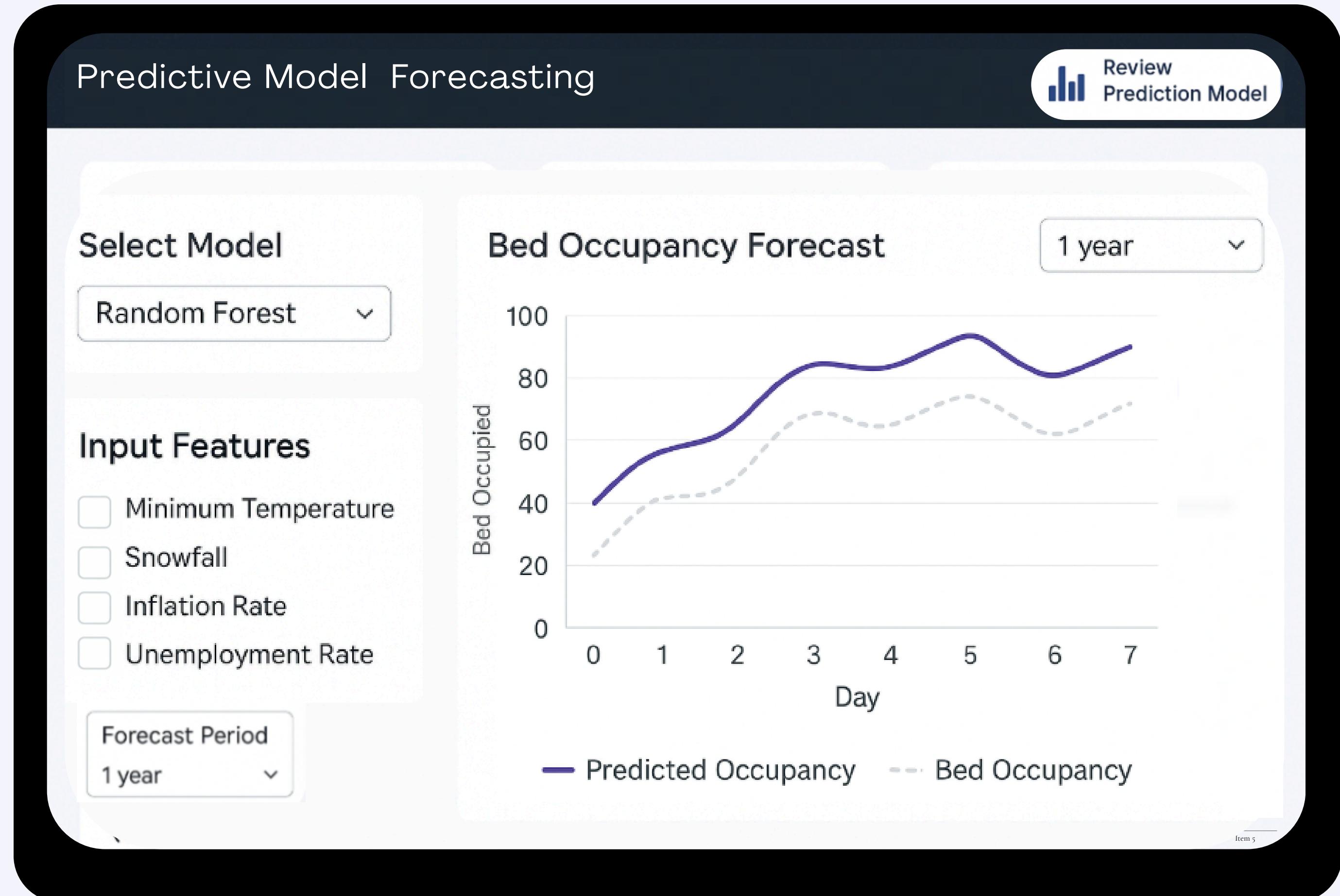
-20°CCold Weather
Warning Issued

Resources



Blankets

35Hot Meals
Remaining**72**Medical
Supplies**Low**



Actions After Prediction

 Review
Prediction Model

Manage Internal Resources

-  Prepare Additional Beds
-  Mobilize Extra Supplies
-  Deploy Extra Staff

Coordinate with Other Shelters

-  Send Status Alert
-  Request Additional Beds
-  Communicate Live Updates

Emergency Measures

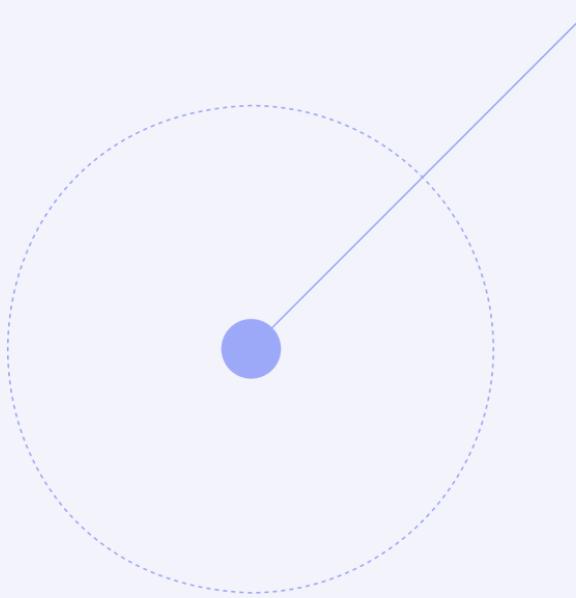
-  Stop New Admissions
-  Contact Emergency Services



Request
Emergency Funding

System Suggests: Prepare 10 additional beds and coordinate with Shelter ID 015 (80% capacity)

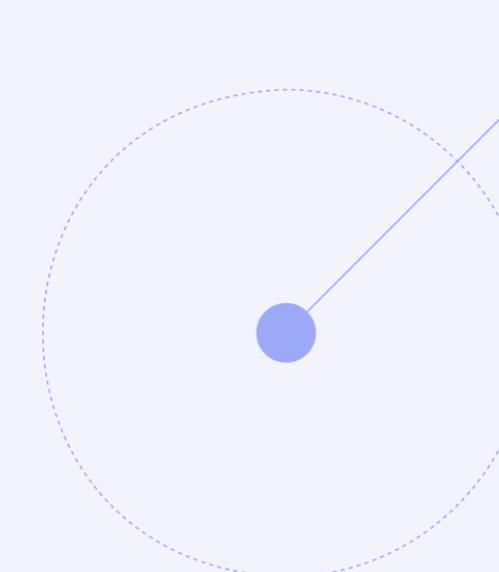
Accomplishments & Learnings



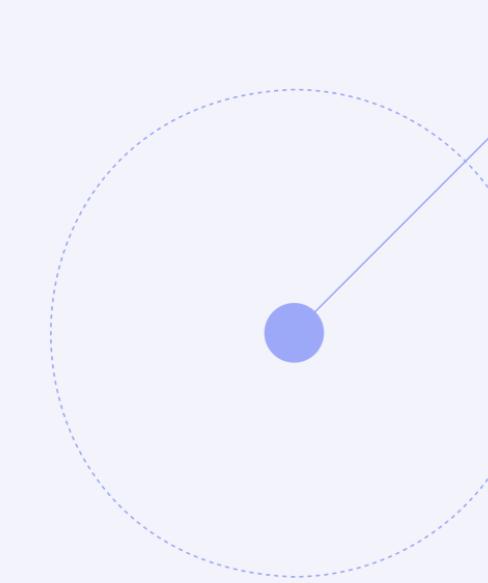
- Explored many new kinds of models that we trained
- Got results that are promising and we can work with
- Data quality importance
- Working as a team to plan a project from start to end

Future Work

- Integrate Saskatoon-specific data
- Add features: wind chill, program usage, event-based surges
- Collaborate with local shelters for input & feedback
- Enable early warnings to support proactive resource planning



Conclusion



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Let's SOLVE it



A large, bold, dark teal text "Thank you" is centered in the lower-left quadrant. The background features abstract geometric elements: a solid blue circle in the upper-right, a dashed blue circle overlapping it, a solid blue circle in the lower-left, and a dashed blue circle overlapping it. A thin blue line extends from the bottom-left corner towards the center.

Thank you