



# **Predictive Analytics Project: Manitoba Wildfire Prediction**

---

Angela Vargas – 3176229

Lillian Ugulu – 3172386





# AGENDA

---

- ☐ Introduction
- ☐ CRISP-DM Methodology
  - ☐ Business Understanding
  - ☐ Data Understanding
  - ☐ Data Preparation
  - ☐ Modeling
  - ☐ Evaluation
  - ☐ Deployment
- ☐ Conclusion
- ☐ References



[This Photo](#) by pngtree is licensed under [pngtree](#)

---

## INTRODUCTION

---

### **Project Overview:**

Develop a predictive model to forecast the occurrence and severity of wildfires, particularly forest fires using the Canadian Forest Fire Weather Index (FWI) System.

### **Importance of the Project:**

- To gain a deeper understanding of the main causes of wildfires here in Canada and the severity of each fire.
- Enhance early detection and resource allocation to mitigate wildfire impacts.



[Photo Link](#)



## BUSINESS UNDERSTANDING

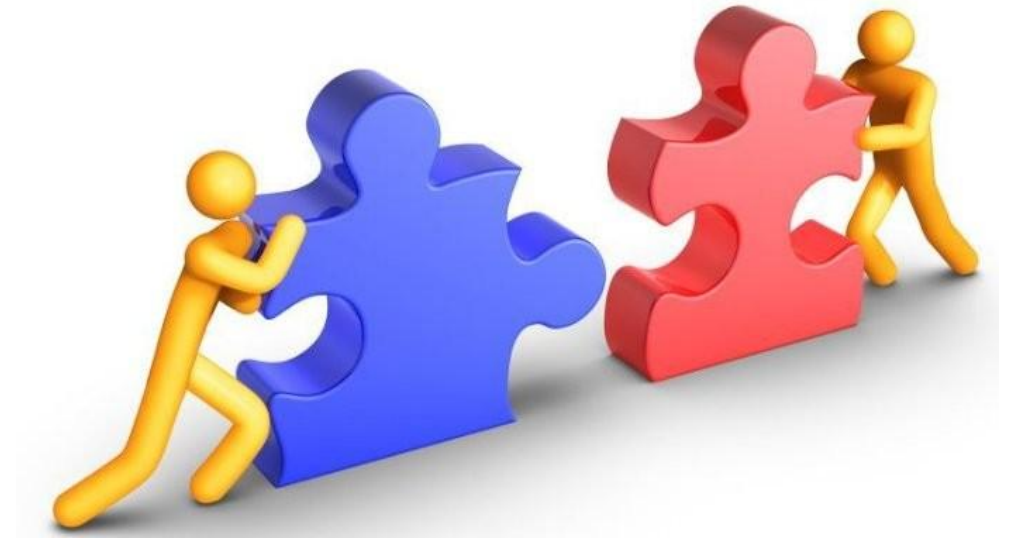
---

**Problem Understanding:** Research and identify the Canadian Wildfire Weather System, its background information, and historical wildfire information.

**Goal:** Predict the Fire Weather Index (FWI) to identify fire intensity and high-risk areas.

### Questions to Answer:

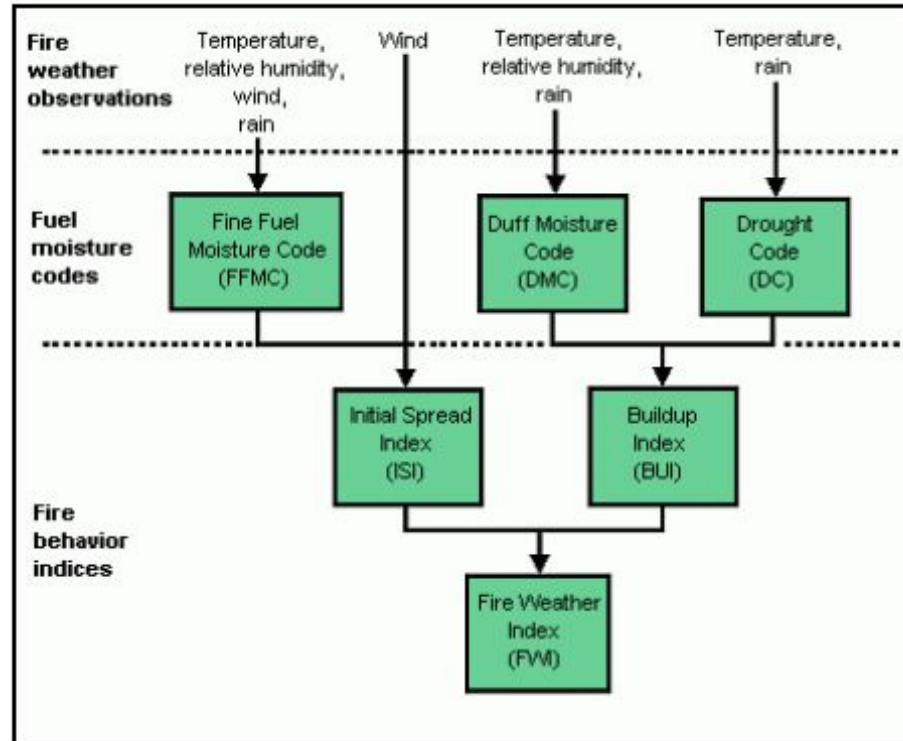
- What factors contribute to wildfire occurrences?
- What model gives the highest accuracy and takes less time?



[Photo Link](#)

# BUSINESS UNDERSTANDING

## Structure of the FWI System



<https://cwfis.cfs.nrcan.gc.ca/background/summary/fwi>



[Site Map](#) [Contact Government](#)

Search for programs and online services

SEARCH

RESIDENT AND ONLINE SERVICES

BUSINESS

GOVERNMENT

VISITORS

Economic Development, Investment, Trade and Natural Resources

Manitoba.ca > Economic Development, Investment, Trade and Natural Resources > Wildfire Service

## Weather Calculations Report

OBSERVED WEATHER  
2024-08-26

STATION	TEMP	RH	WD	WS	RAIN	FFMC	DMC	DC	ISI	BUI	FWI	DSR
ATIK LAKE	17.3	51.0	358.0	7.4	0.0	88.6	44.7	416.0	5.0	70.4	16.1	3.7
BEAUSEJOUR AG	21.1	56.0	327.0	18.1	0.6	83.8	31.6	391.1	4.4	52.6	12.4	2.4
BERENS RIVER (WCF)	18.2	65.0	295.0	21.0	0.2	59.1	5.2	111.5	1.1	9.3	0.6	0.0
BIRCH RIVER AG	21.5	40.0	297.0	15.4	0.0	89.0	70.7	544.7	8.0	106.7	28.0	9.9
BISSETT	22.9	55.0	295.0	5.6	0.0	58.5	8.7	140.4	0.5	15.0	0.4	0.0
BRANDON (YBR)	18.3	54.0	330.0	11.0	0.0	82.7	32.1	412.5	2.7	53.7	8.3	1.1
BURNWOOD LAKE	17.1	42.0	324.0	22.4	0.0	88.3	56.3	461.2	10.3	86.3	29.9	11.1
CACHE LAKE	18.7	50.0	245.0	10.9	0.0	77.0	8.2	212.9	1.5	14.9	1.5	0.1
CARBERRY (WZE)	18.4	57.0	315.0	13.0	0.0	85.4	36.6	389.8	4.2	59.3	12.8	2.5
CARMAN (WNK)	19.7	62.0	327.0	14.0	0.0	84.7	18.3	346.3	4.1	32.3	8.7	1.3
CHURCHILL (YYQ)	15.9	96.0	322.0	44.0	18.6	26.0	5.3	221.9	0.0	10.0	0.0	0.0
COLLINS BAY SK (WWC)	15.4	47.0	332.0	17.0	0.0	85.6	37.4	375.7	5.4	59.9	15.5	3.5
CREIGHTON (SK)	17.7	48.0	310.0	7.9	0.0	86.5	22.4	252.8	3.9	36.7	9.0	1.3
CYPRESS RIVER (POY)	19.7	51.0	332.0	17.0	0.0	86.3	23.5	367.8	5.9	40.5	13.5	2.7

[https://www.gov.mb.ca/conservation\\_fire/Wx-Report/2024/20240826-obs-wxrep.html](https://www.gov.mb.ca/conservation_fire/Wx-Report/2024/20240826-obs-wxrep.html)

## DATA UNDERSTANDING

### Data Collection:

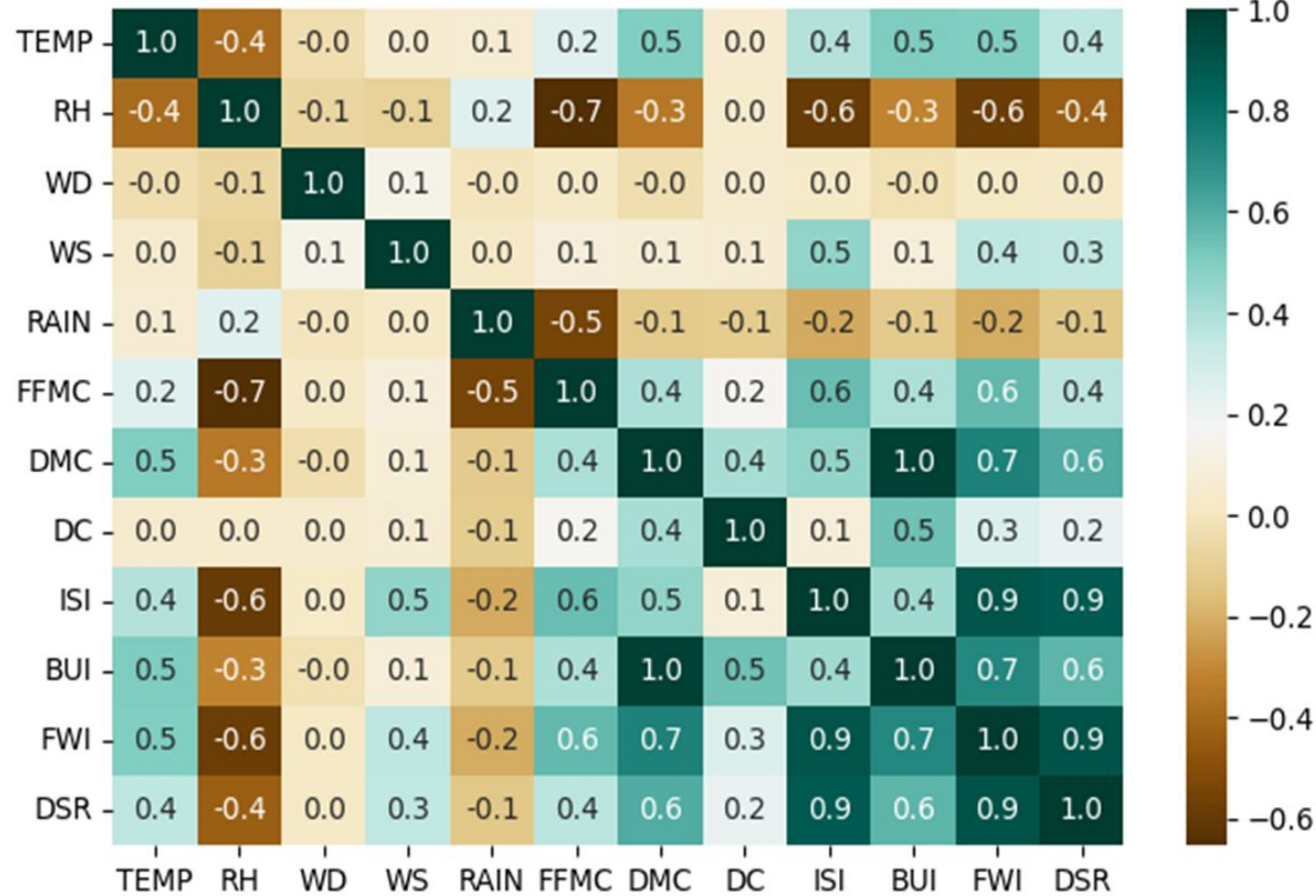
Gathered historical and current fire weather reports, fire occurrences, and FWI components (Fine Fuel Moisture Code, Duff Moisture Code, Drought Code, Initial Spread Index, Buildup Index, and Fire Weather Index) from Manitoba Natural Resources and Northern Development website.

Features	Description
STATION	Station name
TEMP	Temperature (°C)
RH	Relative Humidity
WD	Wind Direction
WS	Wind Speed (km/h)
RAIN	Rain (24-hour precipitation)
FFMC	Fine Fuel Moisture Code

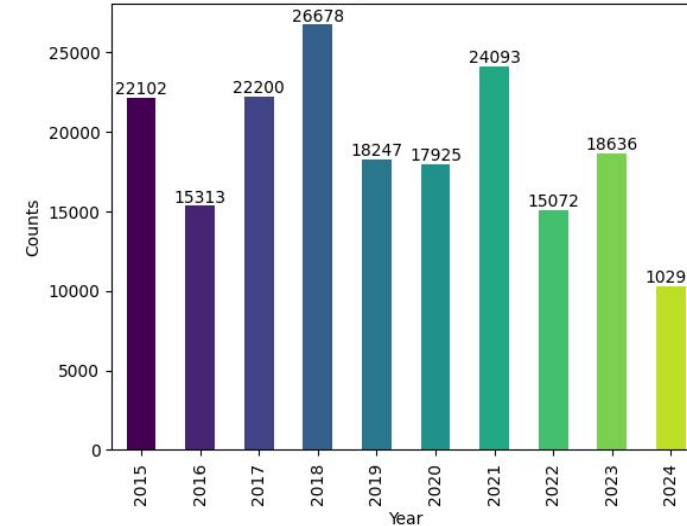
Features	Description
DMC	Duff Moisture Code
DC	Drought Code
ISI	Initial Spread Index
BUI	Buildup Index
FWI	Fire Weather Index
DSR	Daily Severity Rating
DATE	Date (Jan 2015 – Jul 2024)

# DATA UNDERSTANDING (Exploratory Analysis)

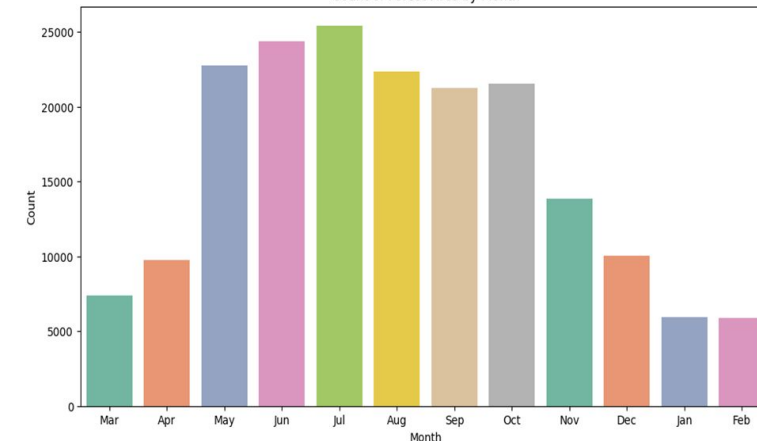
Feature Correlation MB Fire Weather Dataset



Observations by Year from 2015 to 2024



Count of Forest Fires by Month





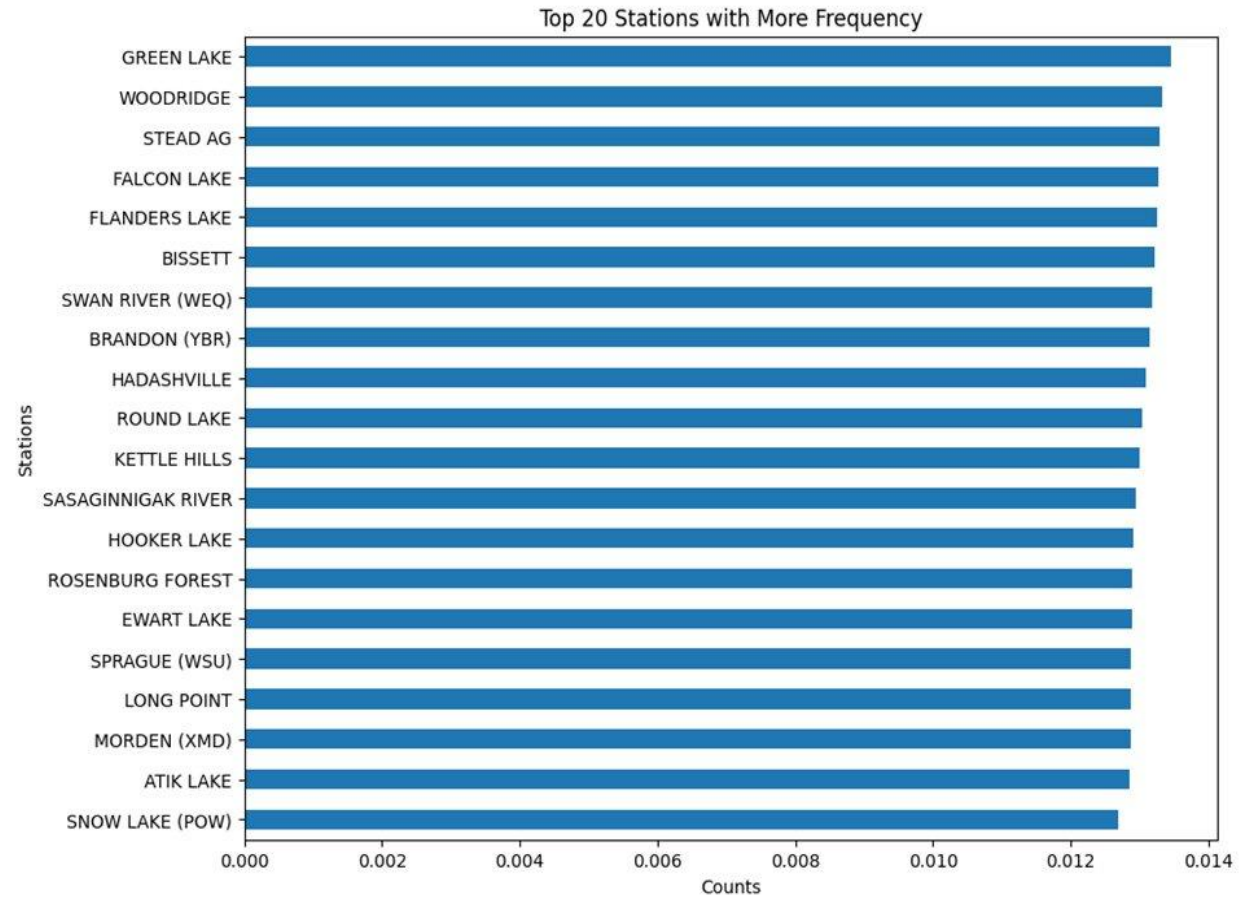
# DATA PREPARATION

## Data Cleaning:

Normalized station names, due to updates on some station names through time.

## Handling Missing Values:

- Removed rows with 90% incomplete data.
- Applied Imputation Method (K-Nearest Neighbors (KNN) Imputation): Use KNN to fill missing values based on similar data points.





# MODELING

---

## Model Development:

Built and validated machine learning regression models to predict wildfire occurrence and severity, and fine-tuned predictive models for fire outbreaks. Complemented by classification to categorize the risk level based on the estimated FWI.



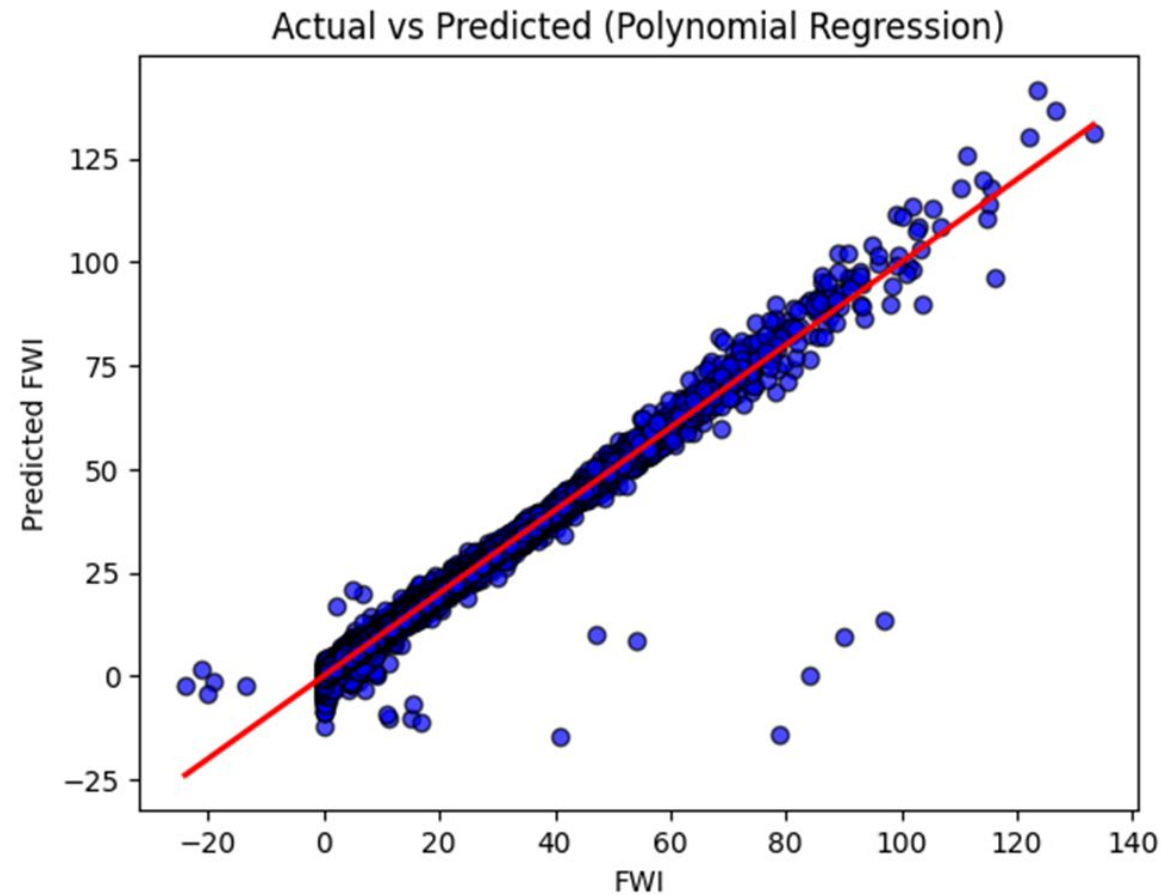
[Photo Link](#)

## EVALUATION

Models	R-squared (R <sup>2</sup> )	Mean Squared Error (MSE)	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)	Training Time	Testing Time
Random Forest Regressor	0.998	0.214	0.463	0.057	97.323 sec	2.390 sec
Gradient Boosting Regressor	0.998	0.216	0.465	0.067	39.858 sec	0.366 sec
Decision Tree Regressor	0.996	0.446	0.668	0.089	0.694 sec	0.011 sec
KNN Regressor	0.989	0.1153	1.074	0.536	0.211 sec	1.938 sec
Multivariable Regression	0.950	5.088	2.256	1.393	0.049 sec	0.049 sec
<b>Polynomial Regression</b>	<b>0.994</b>	<b>0.584</b>	<b>0.764</b>	<b>0.411</b>	<b>1.003 sec</b>	<b>0.013 sec</b>

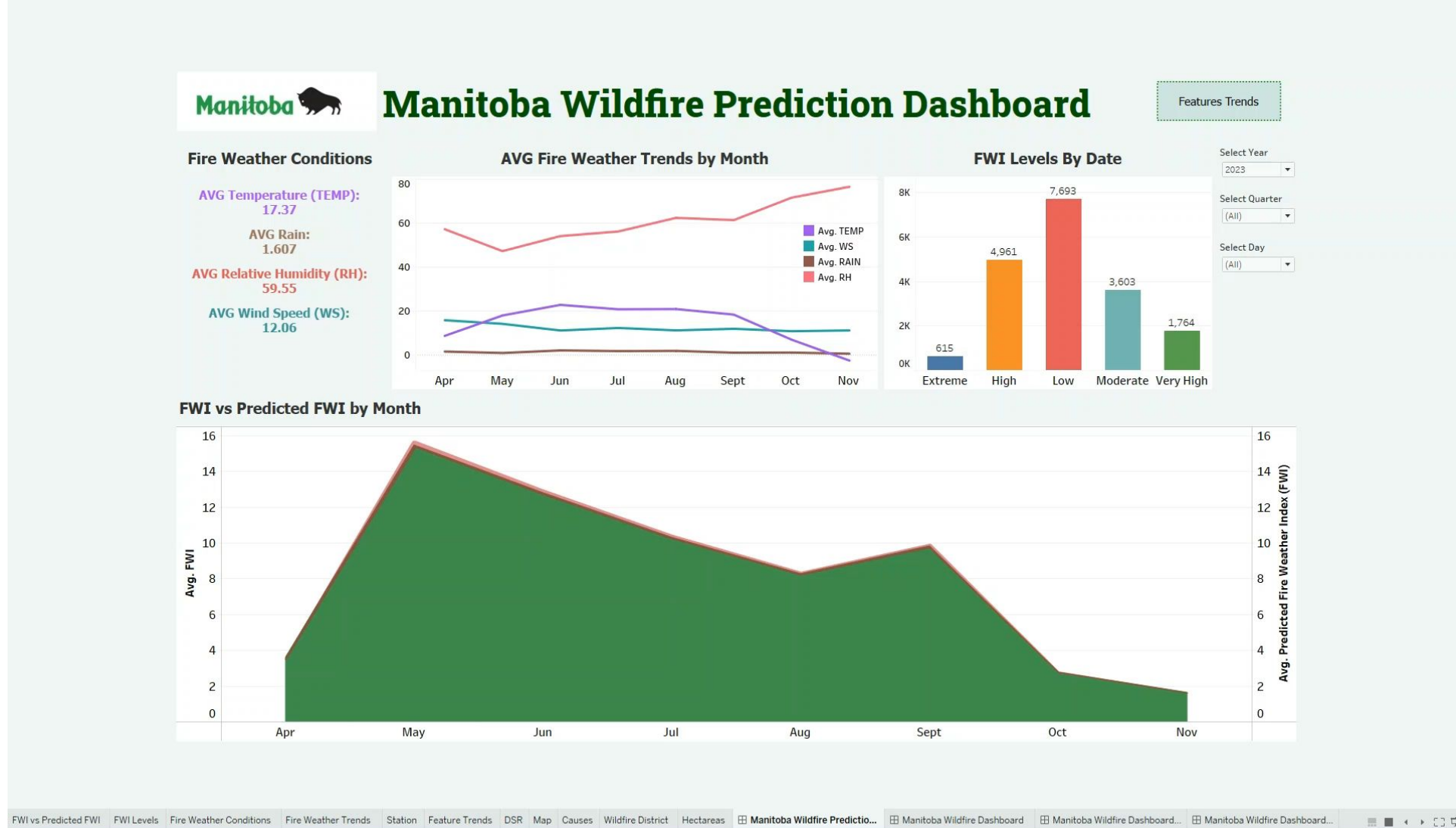
## EVALUATION

### Regression Model Comparison: FWI Actual vs Predicted



FWI	DSR	Predicted Fire Weather Index (FWI)	FWI Levels
16.8	4	16.56200584	High
18.7	4.9	18.44921279	High
5.6	0.6	5.390683358	Moderate
26.9	9.2	26.83955504	Very High
5.4	0.5	5.0718327	Moderate
22.5	6.7	22.05331347	Very High
26.2	8.8	26.00503468	Very High
5.8	0.6	5.508083279	Moderate
27.7	9.7	27.25526749	Very High
13.4	2.7	13.14791733	High
14	2.9	13.55125528	High
11.5	2	11.47935505	High
10.5	1.7	10.3453414	High
21.4	6.1	20.82983119	Very High
11.8	2.1	11.51721944	High
6.3	0.7	6.015195824	Moderate
13.8	2.8	13.3983693	High
8.1	1.1	7.817369957	Moderate
13.2	2.6	12.77886276	High
4.8	0.4	4.602686665	Low
10.1	1.6	9.814556515	Moderate
18.8	4.9	18.51562628	High
17.6	4.4	17.15070916	High

# DASHBOARD DEPLOYMENT





## CONCLUSION

---

### Questions Answered

Factors that contribute to wildfire occurrences:

- Human
- Nature
- Temperature
- Relative Humidity
- Wind Speed
- Precipitation (Rain)

Best Model:

Polynomial regression model was the best performing model after evaluation and test run on real data.

## REFERENCES

---

Canada, N. R. (n.d.). *National wildland fire situation report*. Canadian Wildland Fire Information System.

<https://cwfis.cfs.nrcan.gc.ca/report>

<https://cwfis.cfs.nrcan.gc.ca/background/summary/fwi>

Canadian Forest Index – Fire Research. Fire Research and Management Exchange System - Government of Canada. <https://www.frames.gov/documents/alaska/c5/files/FWI-history.pdf>

National Forestry Database, Forest Fires. <http://nfdp.ccfm.org/en/data/fires.php#tab313>

Manitoba Government. (n.d.). *Province of Manitoba: Natural resources and northern development*.

Province of Manitoba - Natural Resources and Northern Development.

[https://www.gov.mb.ca/conservation\\_fire/Wx-Report/index.html](https://www.gov.mb.ca/conservation_fire/Wx-Report/index.html)

Shmuel, A., & Heifetz, E. (2023, August 16). *A machine-learning approach to predicting daily wildfire expansion rate*. MDPI. <https://www.mdpi.com/2571-6255/6/8/319#B39-fire-06-00319>

Weather Guide for Canadian Forest Fire. BD Lawson,. Natural Resources Canada.

chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cfs.nrcan.gc.ca/pubwarehouse/pdfs/29152.pdf

---



[Photo Link](#)

---

An aerial photograph of a large forest fire. Thick, billowing white and grey smoke rises from the burning area, partially obscuring the sky. Below the smoke, bright orange and yellow flames are visible, consuming the forest floor and some trees. The surrounding forest consists of tall, dark green coniferous trees. The overall scene is dramatic and intense.

THANK YOU!!!