Severity Sentinel: Predictive Analytics for Wildfire Risk from Cross-Domain Indicators

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Today's Agenda

Q1

The Problem

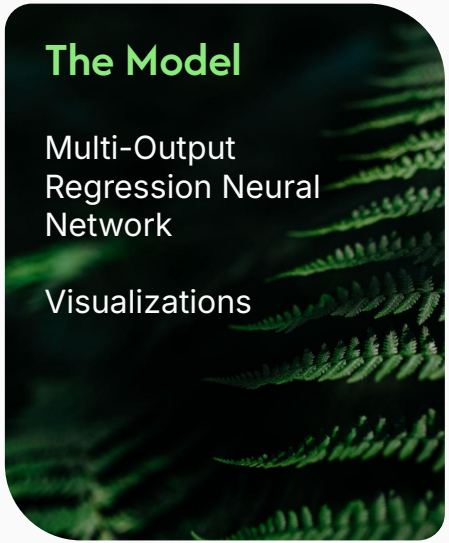
Severity over location

Q2

The Data

FPA FOD Database

Q3



The Model

Multi-Output Regression Neural Network

Visualizations

Q4

The Findings

Accuracy and Conclusions

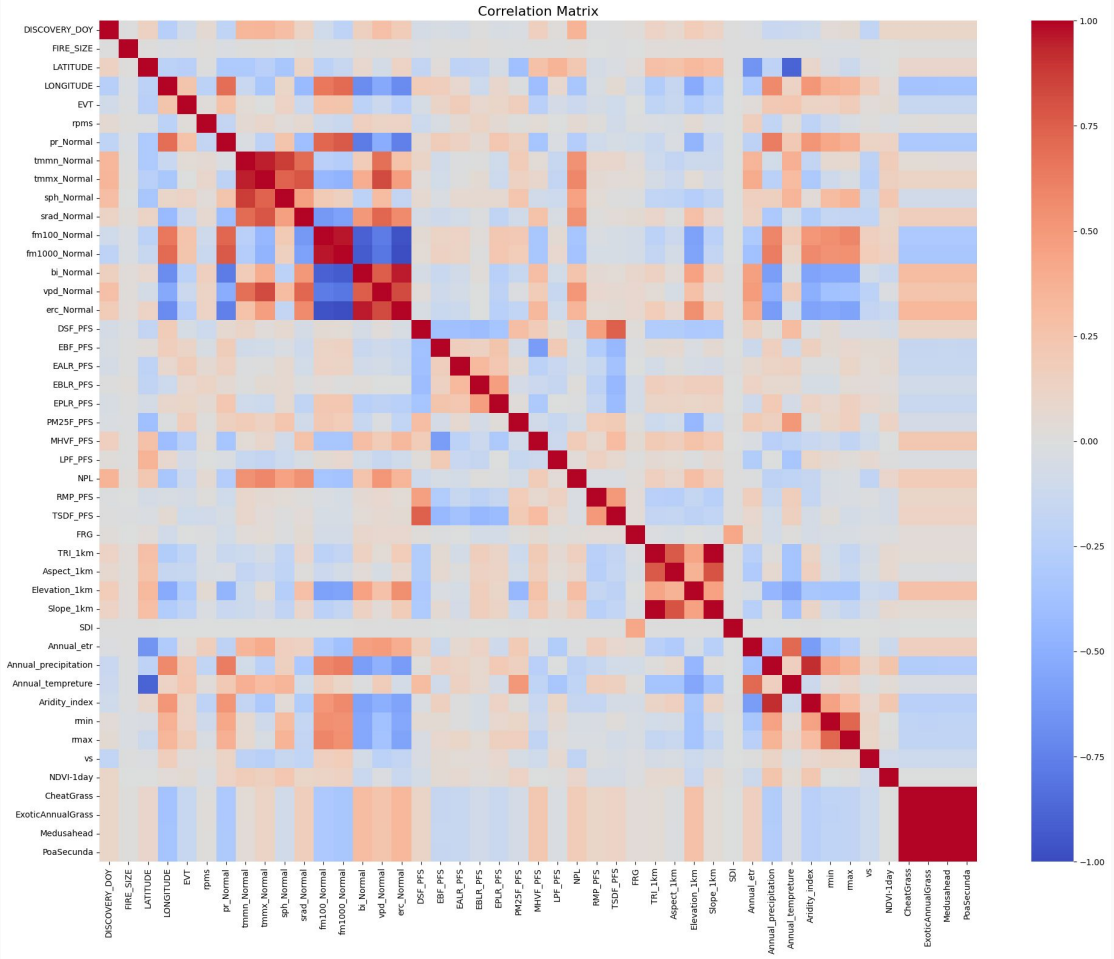
The Problem

- Most wildfire models predict where or when fires occur
- This project fills that gap with a model focused on **impact prediction**

Our Approach

If there was a fire at your location, what would the damages be?

- Used **diverse data**: environmental, geographic, and policy-related features
- Focused on three percentile-based metrics for **different types of damages**
- Implemented a multi-output regression neural network in PyTorch
- Aims to **support better decision-making and resource planning**



FPA FOD Database

Raw Data

5.02GB

0.21GB
Cleaned Data

Years of data

28

From federal and local data

- Physical, Biological, Social, and Administrative data
- Cleaned via manual scanning of features and correlation analysis
  - Surprisingly: population density had little to no correlation with damage
- *Wanted to add* Random Forest

Rugged Data

2.3M
Data points

180 Acres
Of tracked burns

The Model

Data Preparation:

Categorical & Numerical

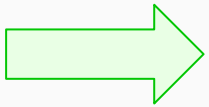
One hot encoding

Model Building:

3 hidden layers

ReLU activations

Sigmoid output layer



Optimization:

Gradient descent

Learning rate scheduler

Early Stopping

Evaluation:

MAE and R^2 score

Loss curves

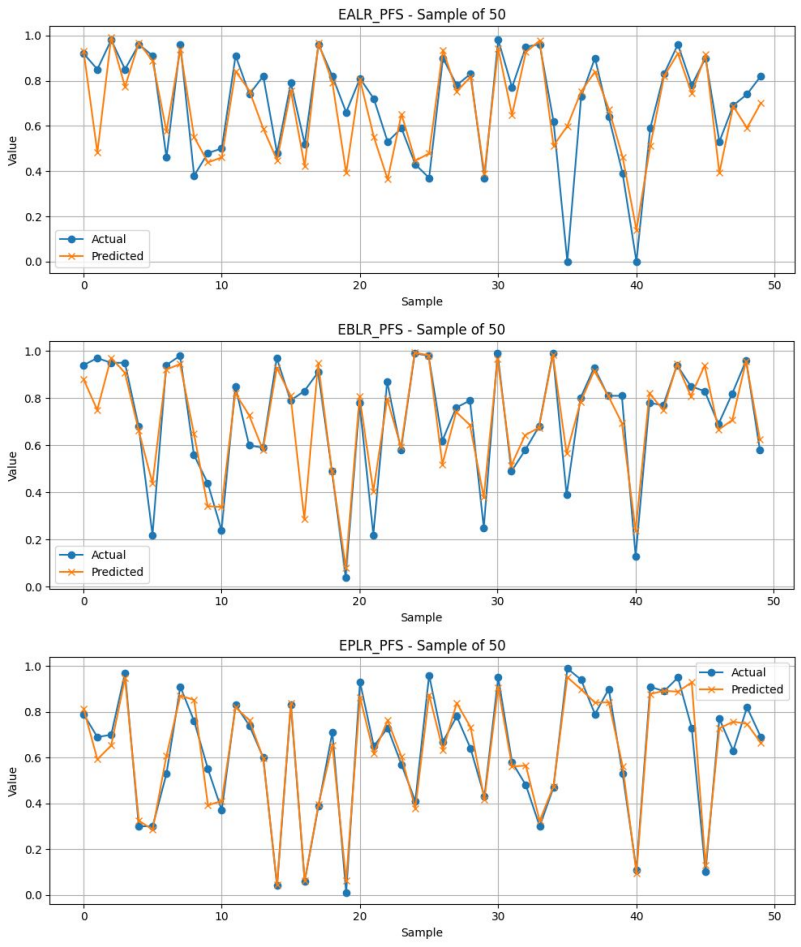
Predicted vs. Actual

Visualizations

- EALR_PFS - Expected agricultural loss rate (Natural Hazards Risk Index) (percentile)

- EBLR_PFS - Expected building loss rate (Natural Hazards Risk Index) (percentile)

- EPLR_PFS - Expected population loss rate (Natural Hazards Risk Index) (percentile)



Findings

Key Variables

Via Correlation:
EALR_PFS - Vegetation type and precipitation

EBLR_PFS - Diesel particulate matter and proximity to hazardous waste

EPLR_PFS - Dead fuel moisture, precipitation and energy burden*

*portion of income on home energy costs (e.g., electricity, natural gas, and other home heating fuels)

Model Accuracy

Stats

```
EALR_PFS: R² = 0.8376, MAE = 0.0680
EBLR_PFS: R² = 0.8619, MAE = 0.0632
EPLR_PFS: R² = 0.8866, MAE = 0.0648
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Mean Average Error

Why Hesitate

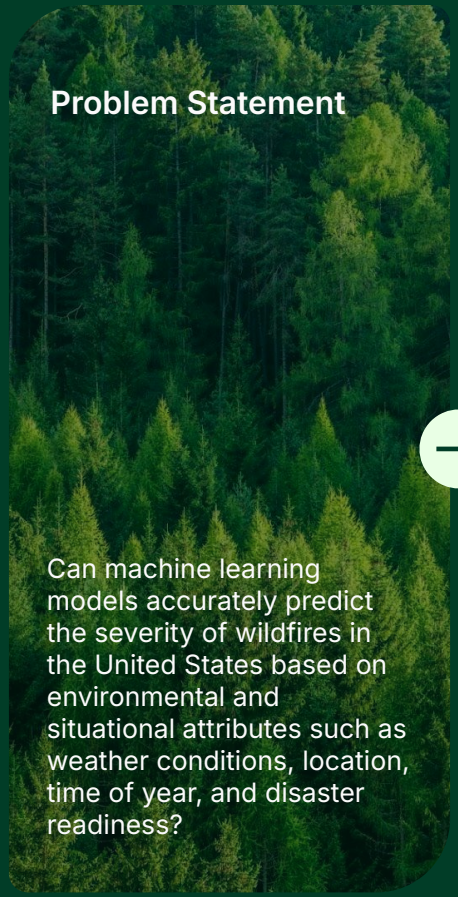
Lack of personal actionable insights

ToDo — Random Forest, User Input

Lack of specific monetary conversions

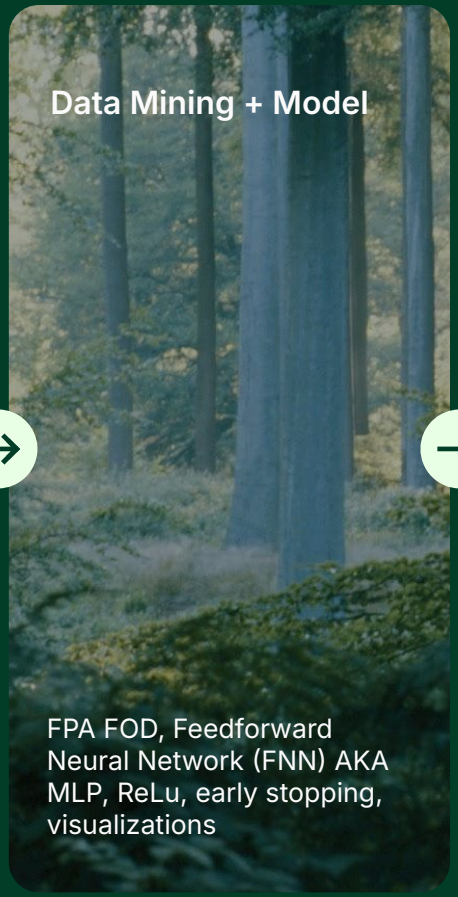
ToDo — Find real meaning of percentiles

Let's discuss



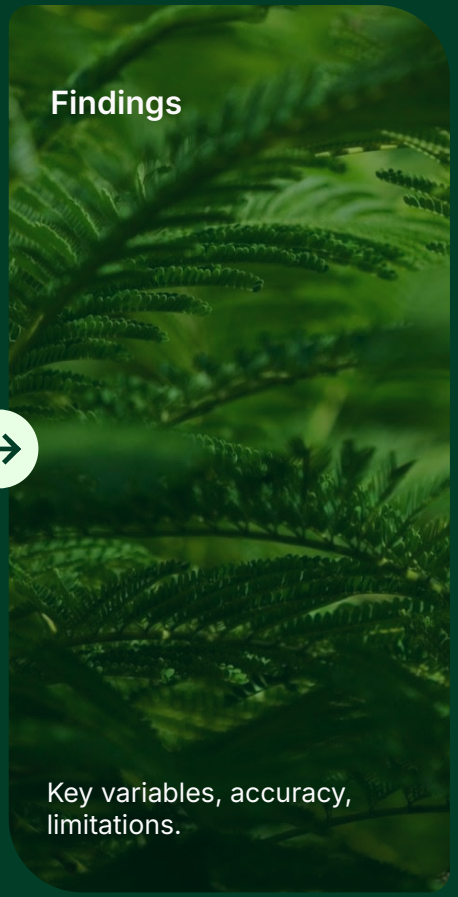
Problem Statement

Can machine learning models accurately predict the severity of wildfires in the United States based on environmental and situational attributes such as weather conditions, location, time of year, and disaster readiness?



Data Mining + Model

FPA FOD, Feedforward Neural Network (FNN) AKA MLP, ReLu, early stopping, visualizations



Findings

Key variables, accuracy, limitations.

Thank you!

Severity Sentinel: TIM147 Group 7