Tornado - Random Forests

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Introduction

Goal

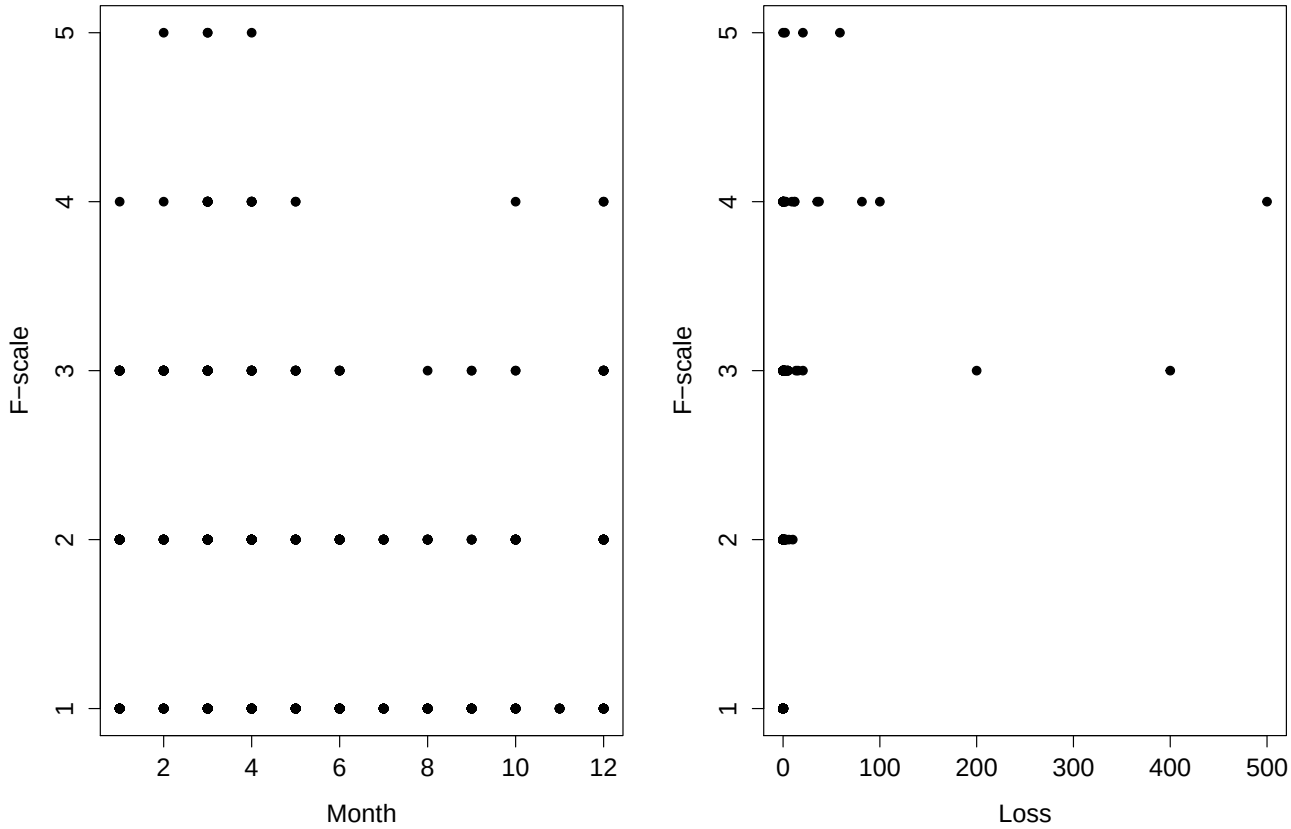
The goal of this analysis is to develop an objective model for classifying tornados

Data

Data on tornados in 2012 from the Storm Prediction Center (SPC)

- Fscale - Fujita Scale (Response - subjective)
- Number - SPC Tornado Number
- Month - Numeric Month Value
- Day - Day of the Month
- Time - Time Tornado First Reported
- Loss - Rounded Total Dollar Property Loss (in millions)
- CropLoss - Rounded Total Dollar Crop Loss (in millions)
- Length - Length of impact (in miles)
- Width - Width of impact (in yards)

Data



F-Scale	0	1	2	3	4	5
Freq	578	242	100	32	5	0

Data Cleaning

23 tornados were repeated in the data

Data Cleaning

23 tornados were repeated in the data

	Number	Date	State	F-scale	Injuries	Loss	Length
120	359692	2/29/12	IL	2	0	0.05	8.41
121	359692	2/29/12	IL	2	5	0.30	25.12
122	359692	2/29/12	KY	2	5	0.25	26.71

Model

Random Forest - The idea is to create a multitude of trees (forest)

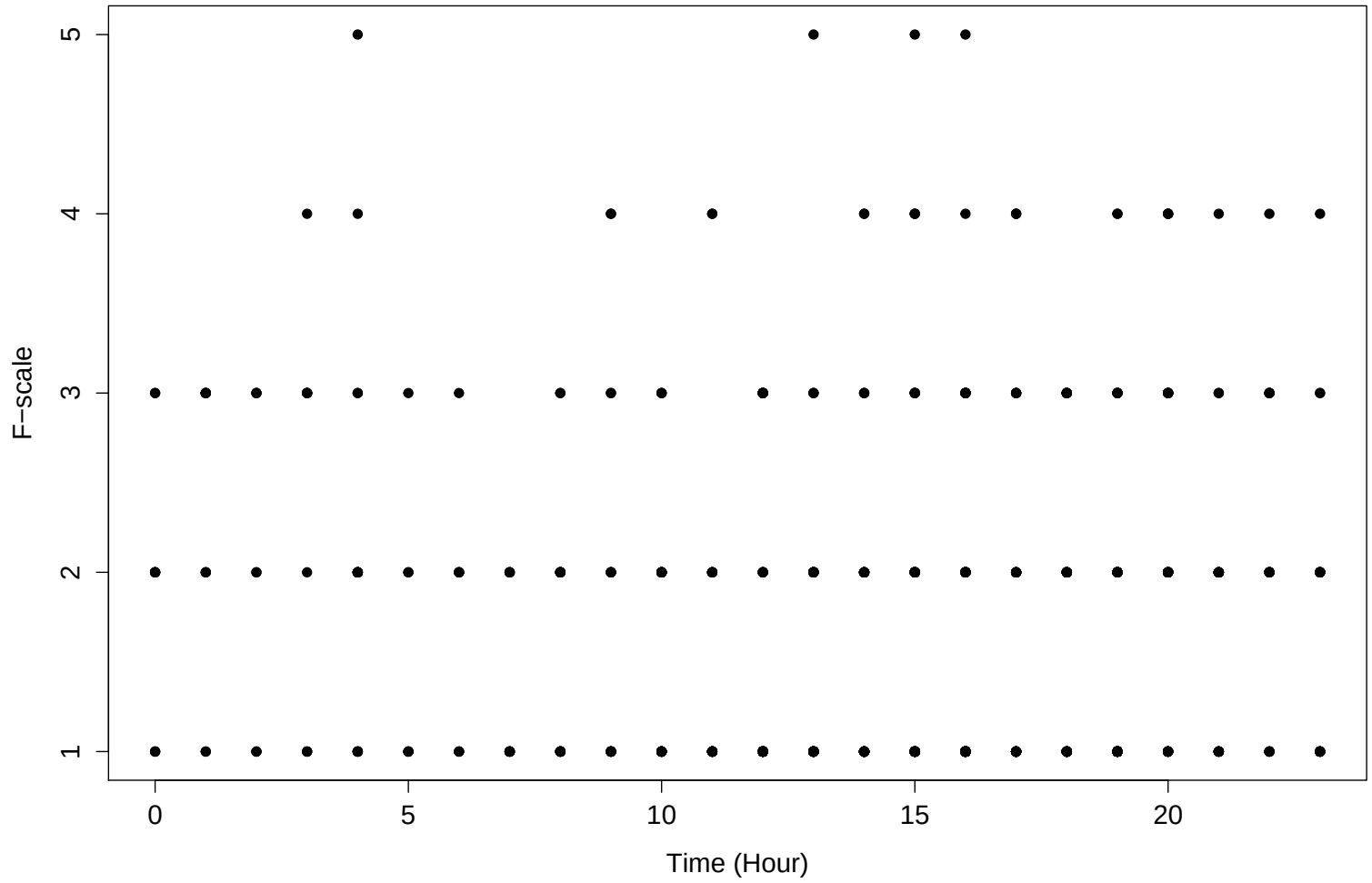
1. Take a bootstrap sample of size n.
2. At each split, randomly sample $m < P$ variables
3. Build a tree based on each set
    1. At each node, identify variable that has most correlation with output
    2. Identify a cut point that leads to the greatest reduction in error

Random Forests

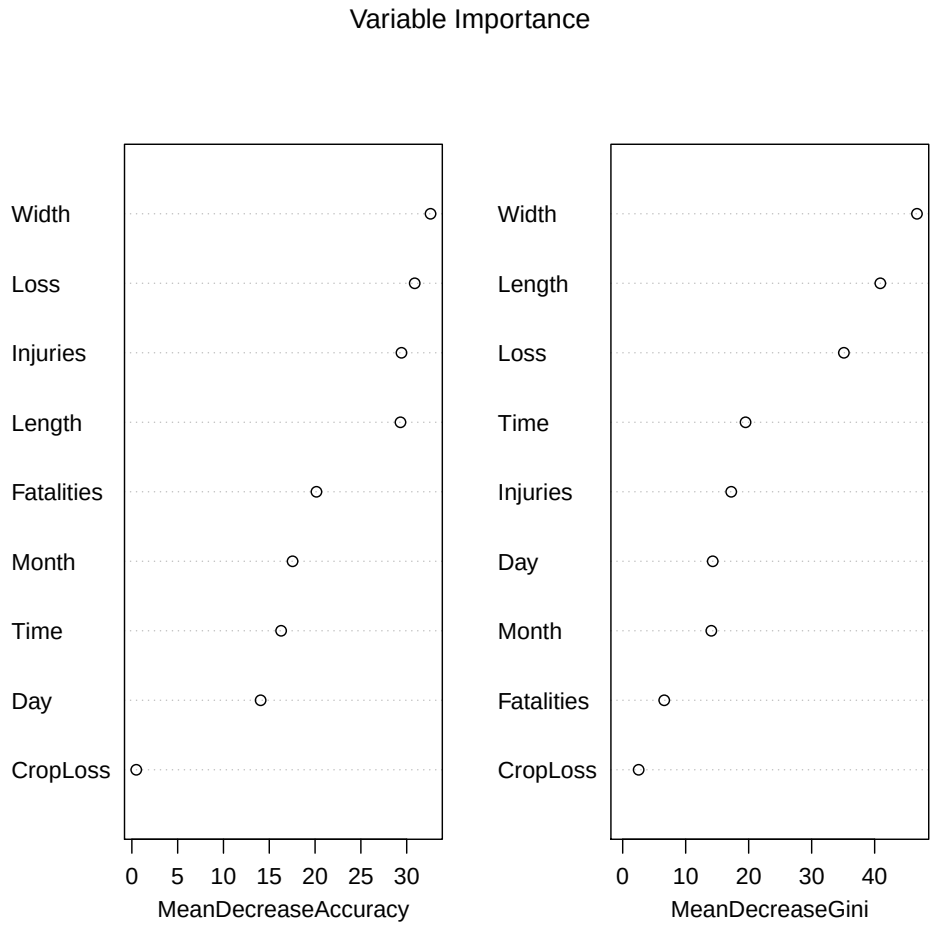
+ Better predictive power than trees
  - Choosing a subset of variables decorrelates the trees
+ Gives us an objective way of classifying tornados
- However, random forests are not very interpretable

Model Assumptions

For classification trees, we assume data is non-linear

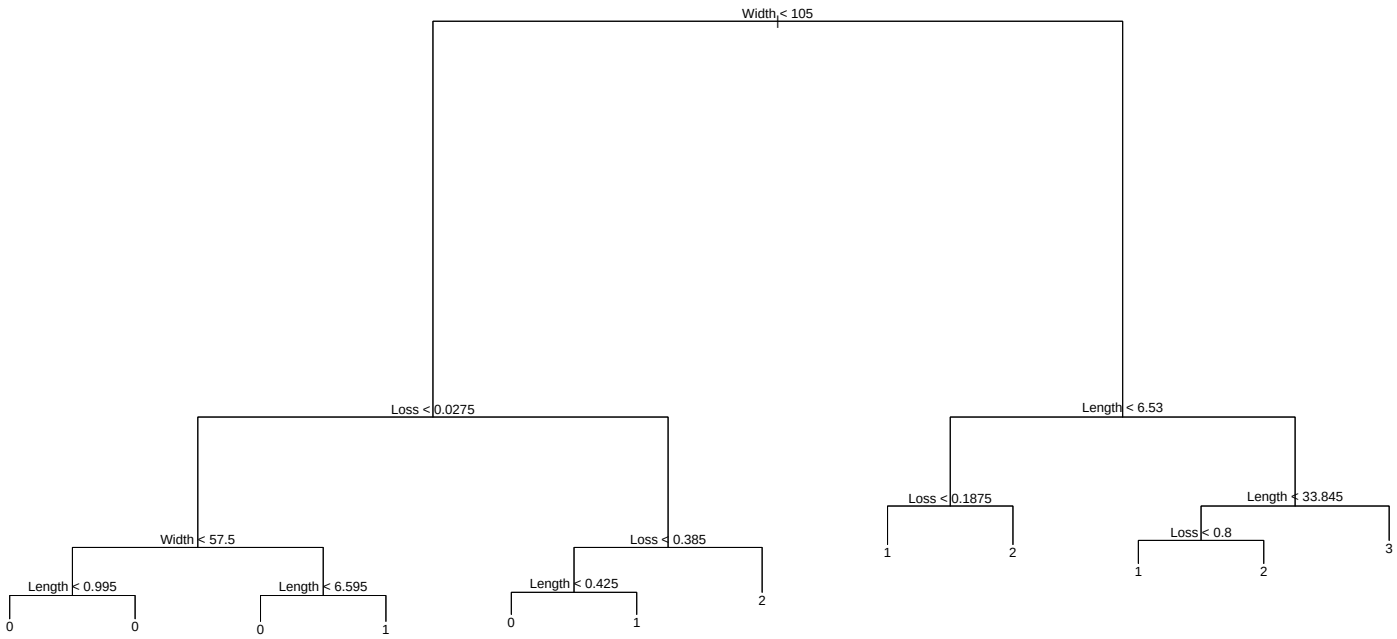


Most Important Variables



The most important variables in predicting Fscale are: Loss, Width, and Length.

Tree



How would a scientist use this model?

Confusion Matrix

	0	1	2	3	4	class.error
0	515.00	58.00	3.00	0.00	0.00	0.11
1	88.00	135.00	17.00	1.00	0.00	0.44
2	4.00	43.00	44.00	4.00	0.00	0.54
3	0.00	5.00	15.00	4.00	0.00	0.83
4	0.00	1.00	1.00	2.00	0.00	1.00

Note: Error rate is lower for small Fscales

Conclusions

- Error Rate $\approx 26\%$
- Objective and takes into account past data
- Predicts low Fscales well (because more data)

Future

- Need more data for Fscale $= 4$
- Compare different methods (e.g. trees, bagging, etc.)

Teamwork

- Did Analysis together
- Sorah: Introduction, Model, Data
- Arthur: Results, Conclusions, Future