



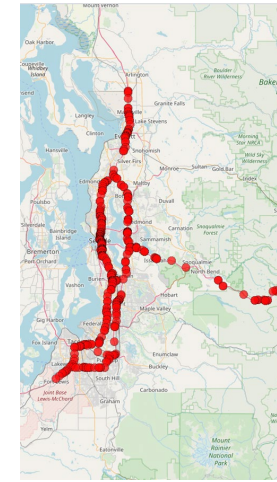
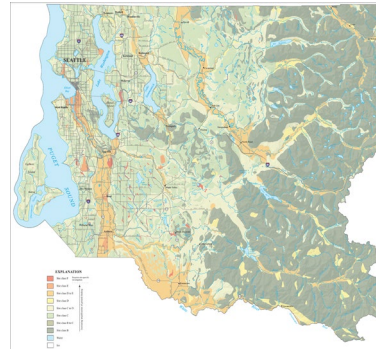
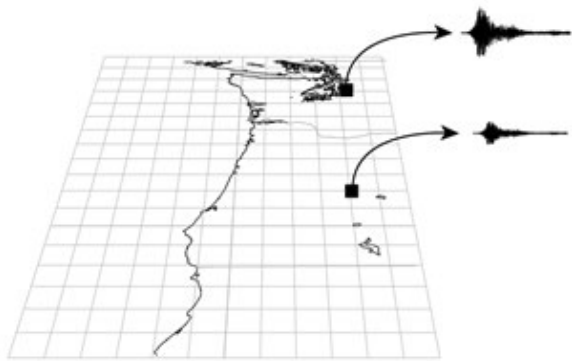
Identification of Critical Ground-Motion and Bridge Features for Performance Assessment of Regional Transportation Networks

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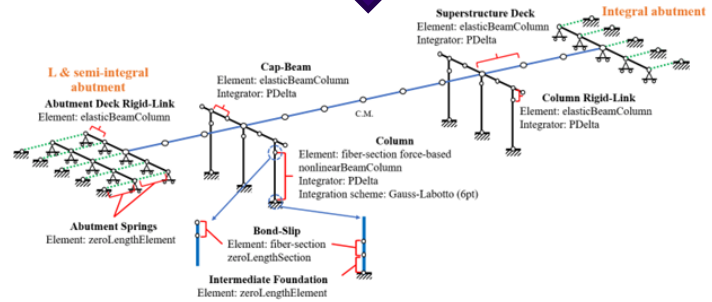
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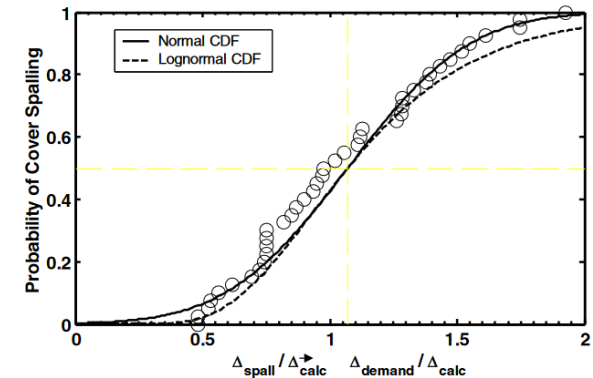
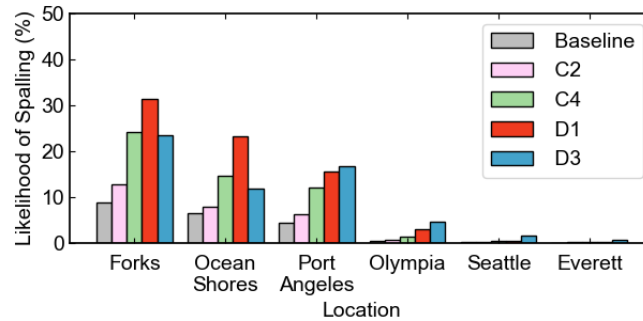
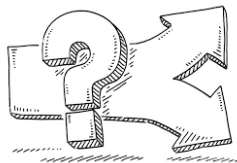




Measures to Improve Resilience

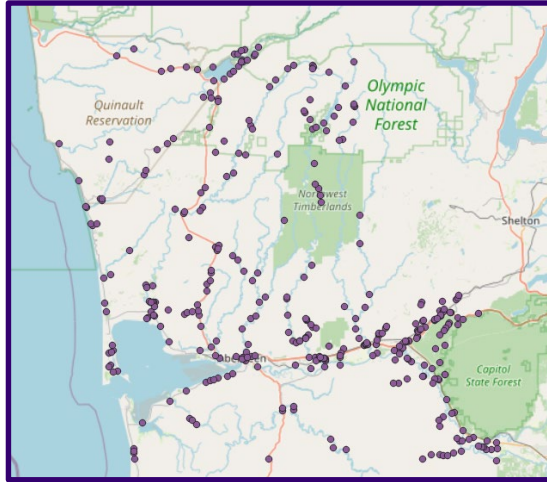


Societal Impacts

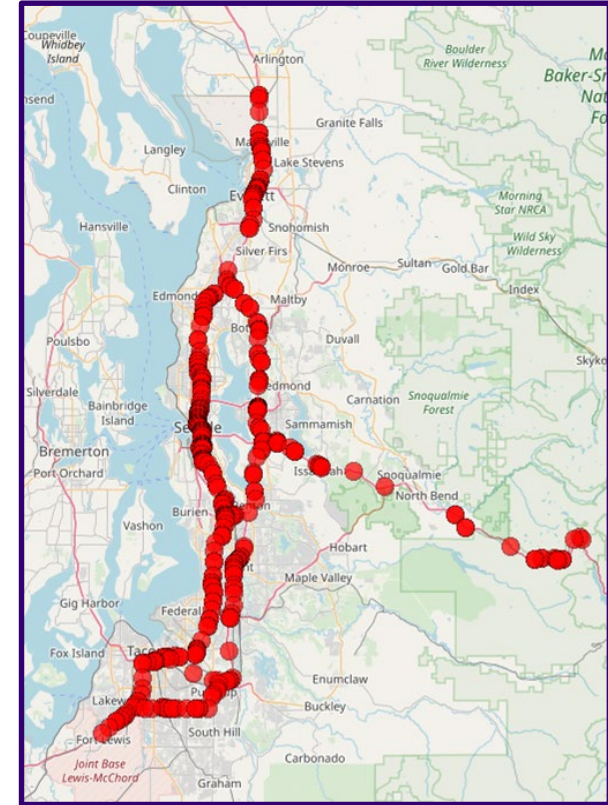


Scope: Regions

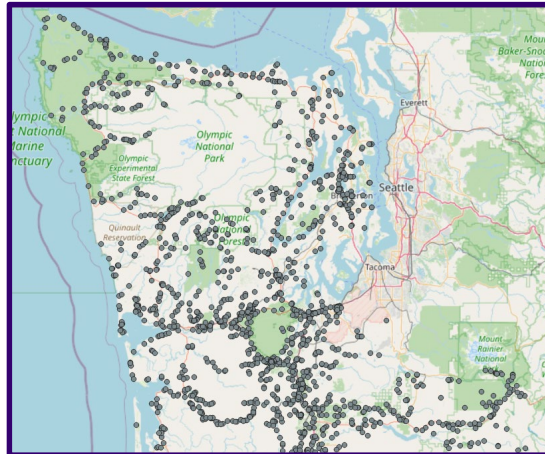
Grays Harbor County



**Puget Sound Region
(Major Highways)**

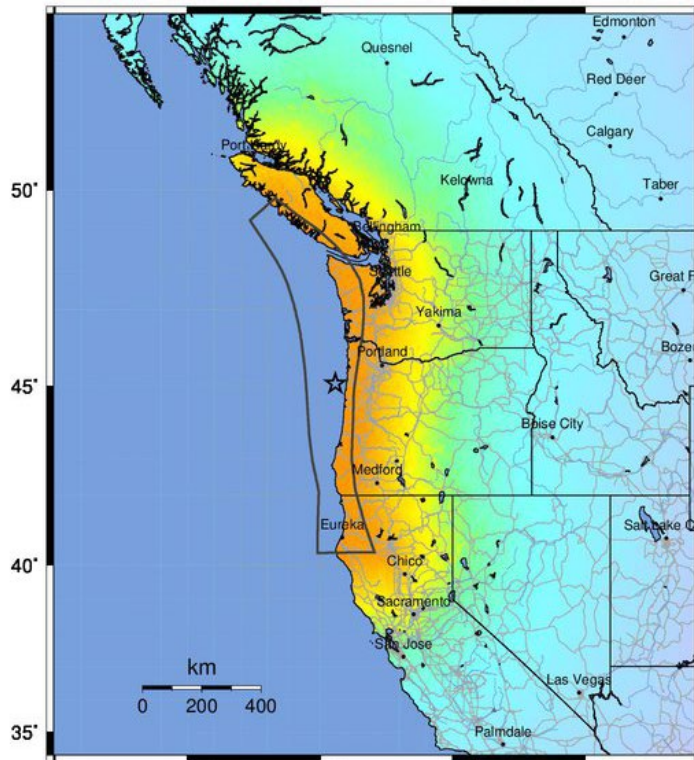


Olympic Peninsula

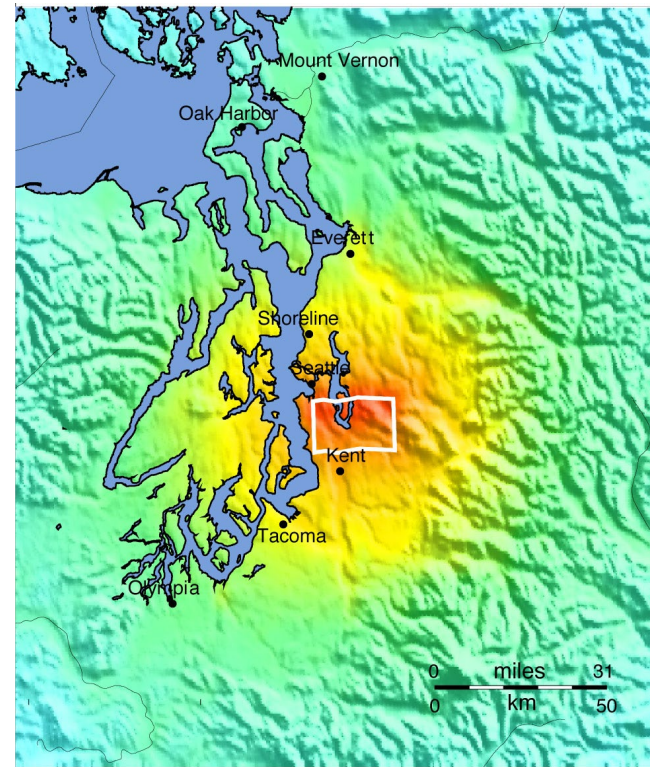


Scope: Earthquake Scenarios

**CSZ Full Rupture
(~M9)**



**Seattle Fault
(~M7.1)**

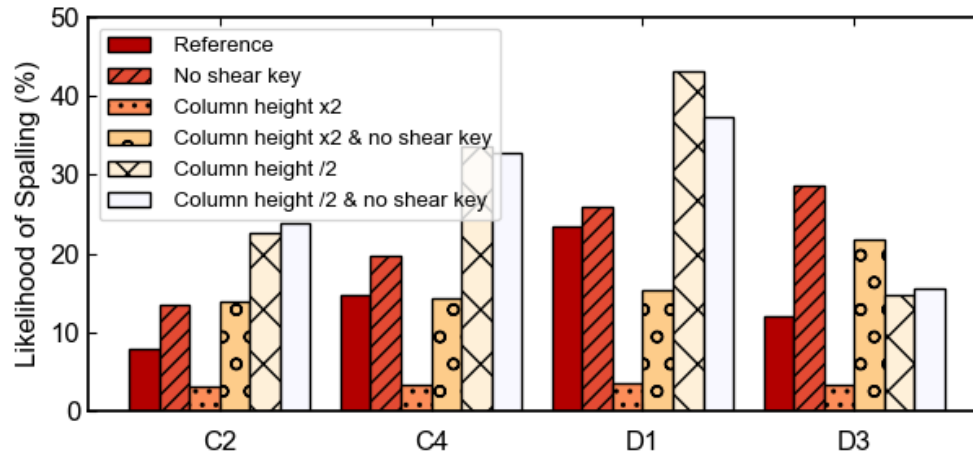


Scope: Impacts

- > Bridge Closures/Restrictions of Individual Bridges
- > Network Connectivity
- > Post-Earthquake, Pre-Tsunami Evacuation
- > Health Care System Operation and Access
- > Disparate Impacts
 - Geography
 - Ethnic and Economic Communities

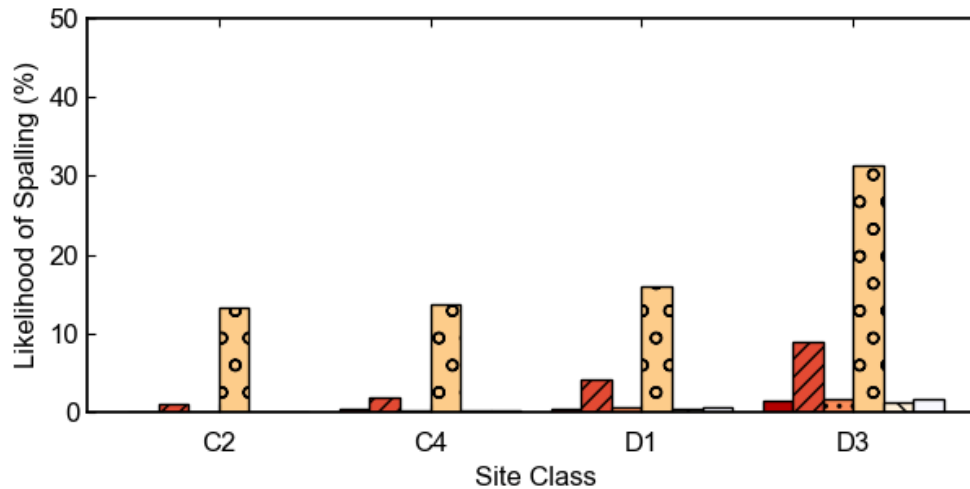
M9: Effects of Column Height and Shear Key

Ocean Shores



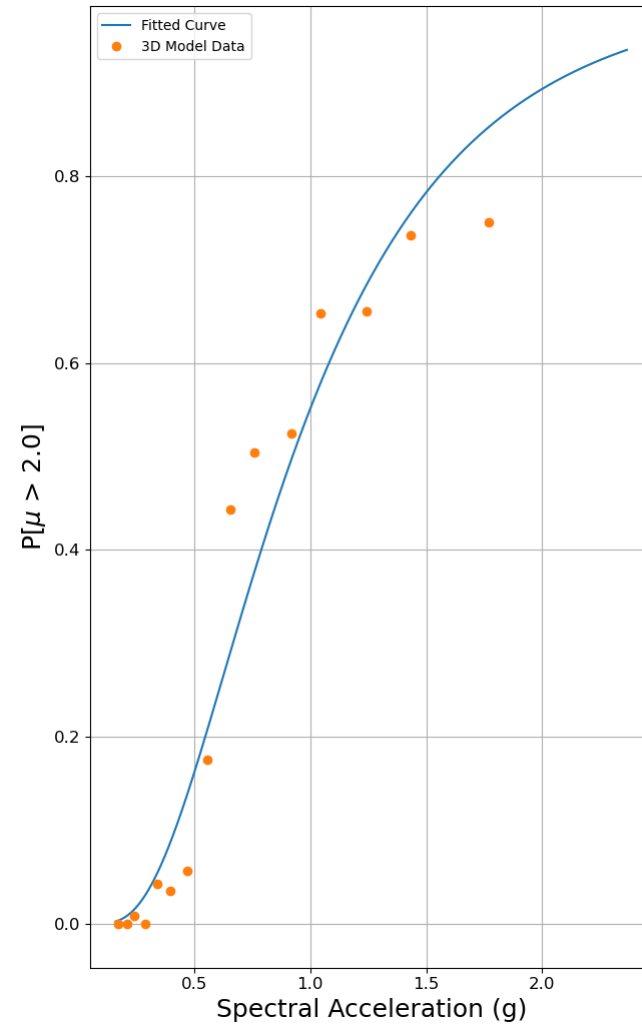
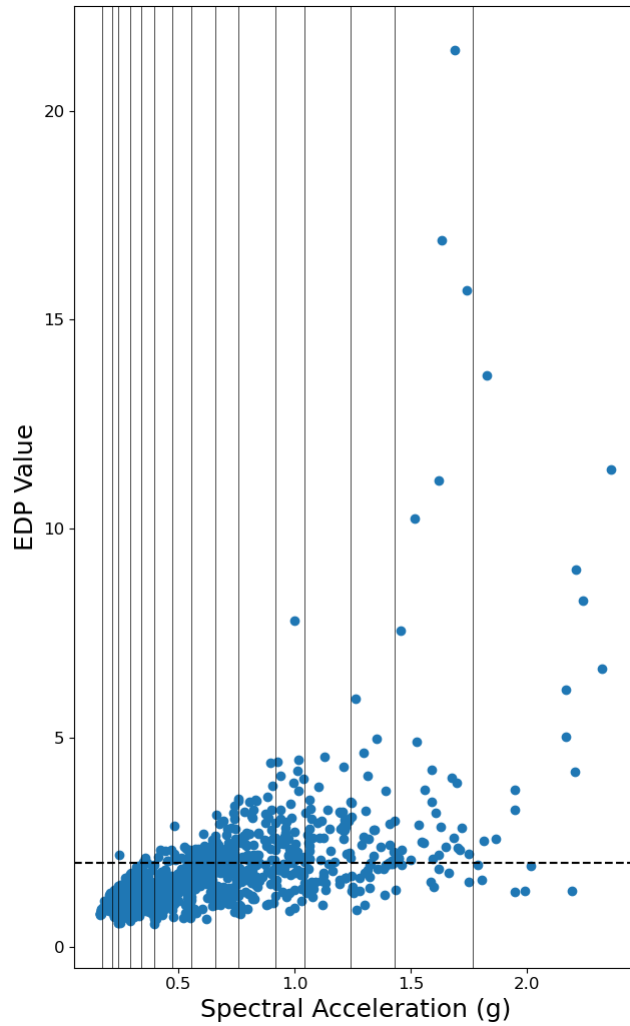
Intense Shaking

Seattle



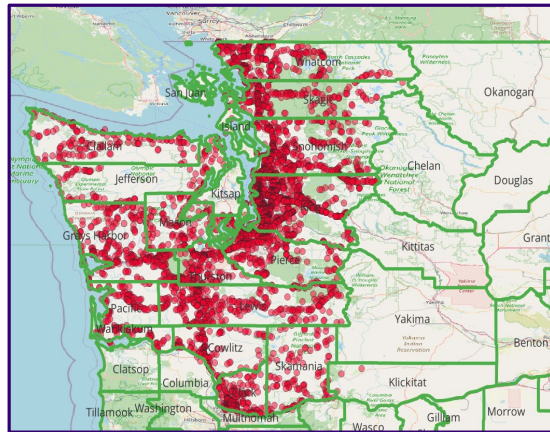
Targeted Damage

Structural Demands (EDPs)

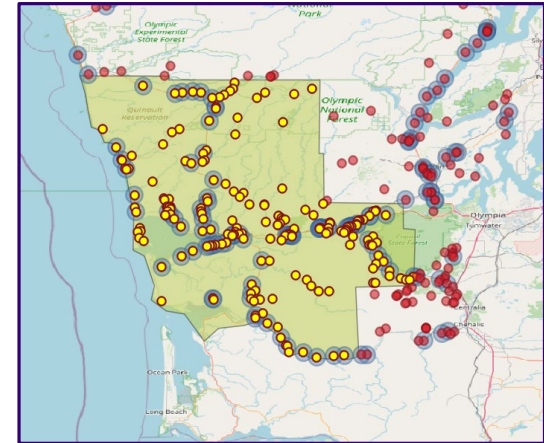


Inferring Target Bridge Properties from NBI

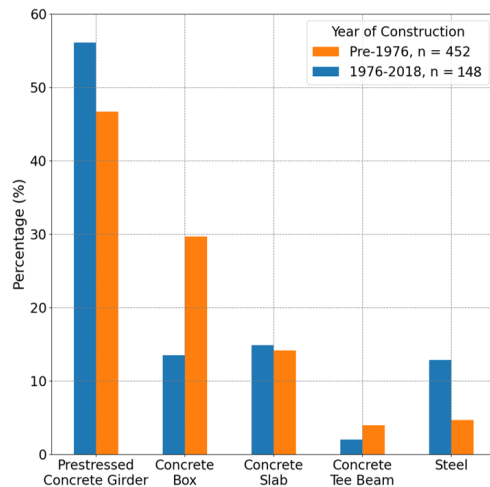
**National Bridge Inventory
(~8000 Bridges)**



**Detailed Bridge Database
(~800 Bridges)**



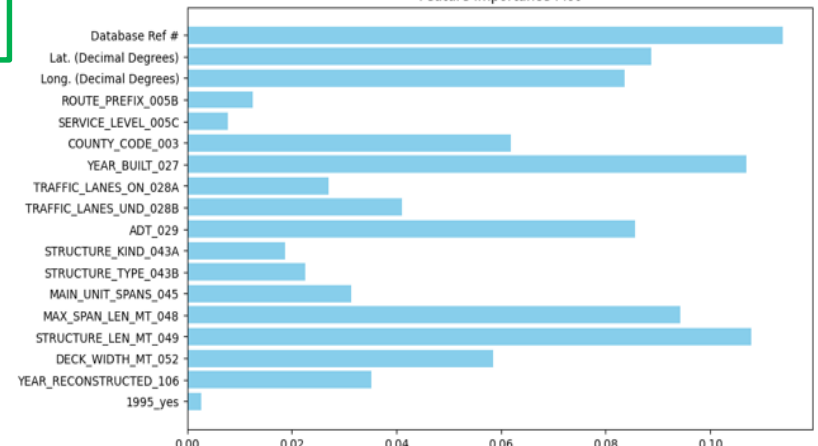
Target Properties



**Train
Algorithm**

**Implement
Algorithm**

Feature Importance



Target Column Properties (Column Shear)

- > Spacing of Transverse Reinforcement
- > # Columns per Bent
- > Column Clear Height
- > Column Aspect Ratio, H/D
- > Longitudinal Reinforcement Ratio
- > Transverse Reinforcement Ratio
- > C/D for Column Shear Failure

Work Flow

LOAD

1. Concatenate Target Features w/ NBI Data
2. Dropped bridges (rows) with 'missing' or 'unknown' values, 'single span' or 'walls' as the support structure
3. Dropped features (columns) with 'missing' or 'unknown' values, all unique values, or only 1 unique value.

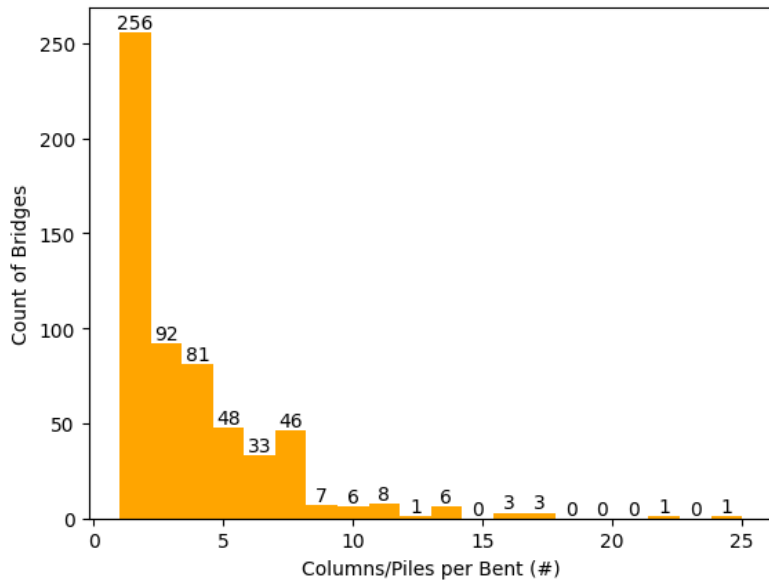
ENCODE

1. Encode nominal (non-ordered categorical variables) using ___ (OHE/Binary/etc.).
2. Encode ordinal (ordered categorical variables) using scikit-learn OrdinalEncoder)
3. For Classification Tasks- (Columns/Piles per bent) encode target variable (ordered categorical) with scikit-learn LabelEncoder
4. For SVM features are scaled

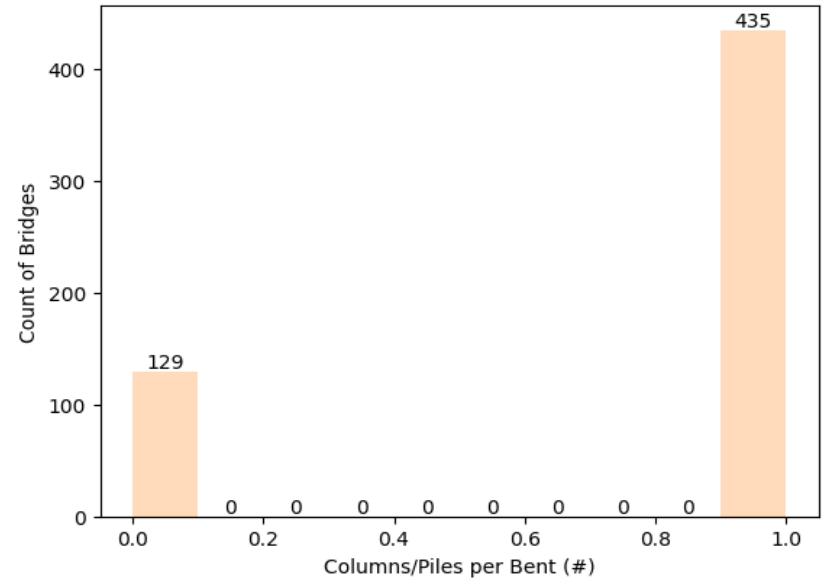
DIVIDE

1. 100 bridges set aside for final testing - never used in training or validation
2. 70% training/30% validation for each target (see target slides for exact population)

Preliminary Results: # Columns per Bent



Raw Data

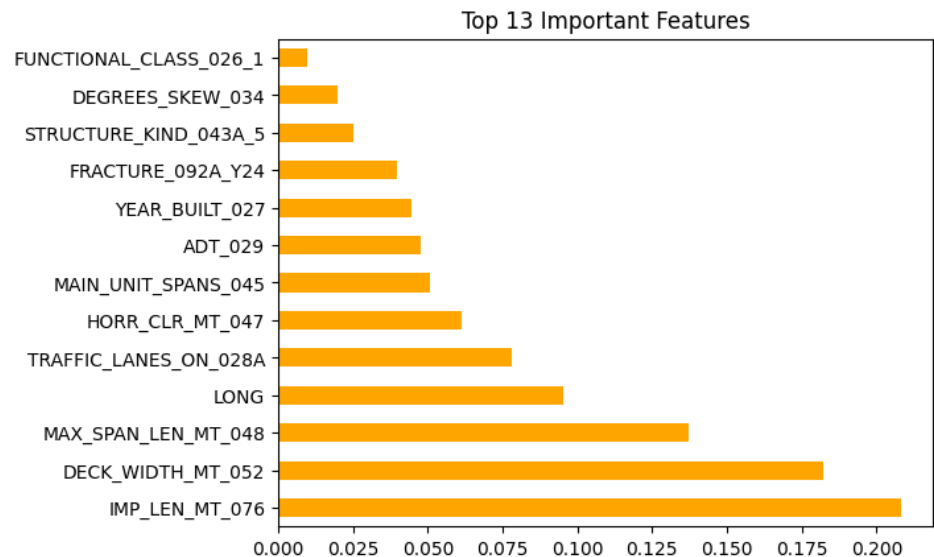


Encoded Data

Preliminary Results: # Columns per Bent

Columns/Piles per Bent	Baseline	
	Accuracy	F1 Score
Decision Tree	75%	0.75
Random Forest	81%	0.82
Support Vector Machine	88%	0.88
Neural Network	89%*	0.88*
XGBoost (18 June)	87%	0.86
AutoGluon (LightGBM)	94%+	0.96+

Developing Metrics
for Measuring
Success



Summary

- > Developing Testbed with Varying
 - Regions
 - Earthquakes
 - Measures of Impact
 - Level of Detail
- > Identify Effects of Level of Knowledge/Analysis
 - Ground Motions
 - Site Conditions
 - Bridge Inventory
 - Structural Analysis
- > Exploring Use of Machine Learning to Infer Critical Bridge Properties from Information in the National Bridge Inventory (NBI).



Thank you