Predicting Earthquake Building Damage

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Nepal

2015

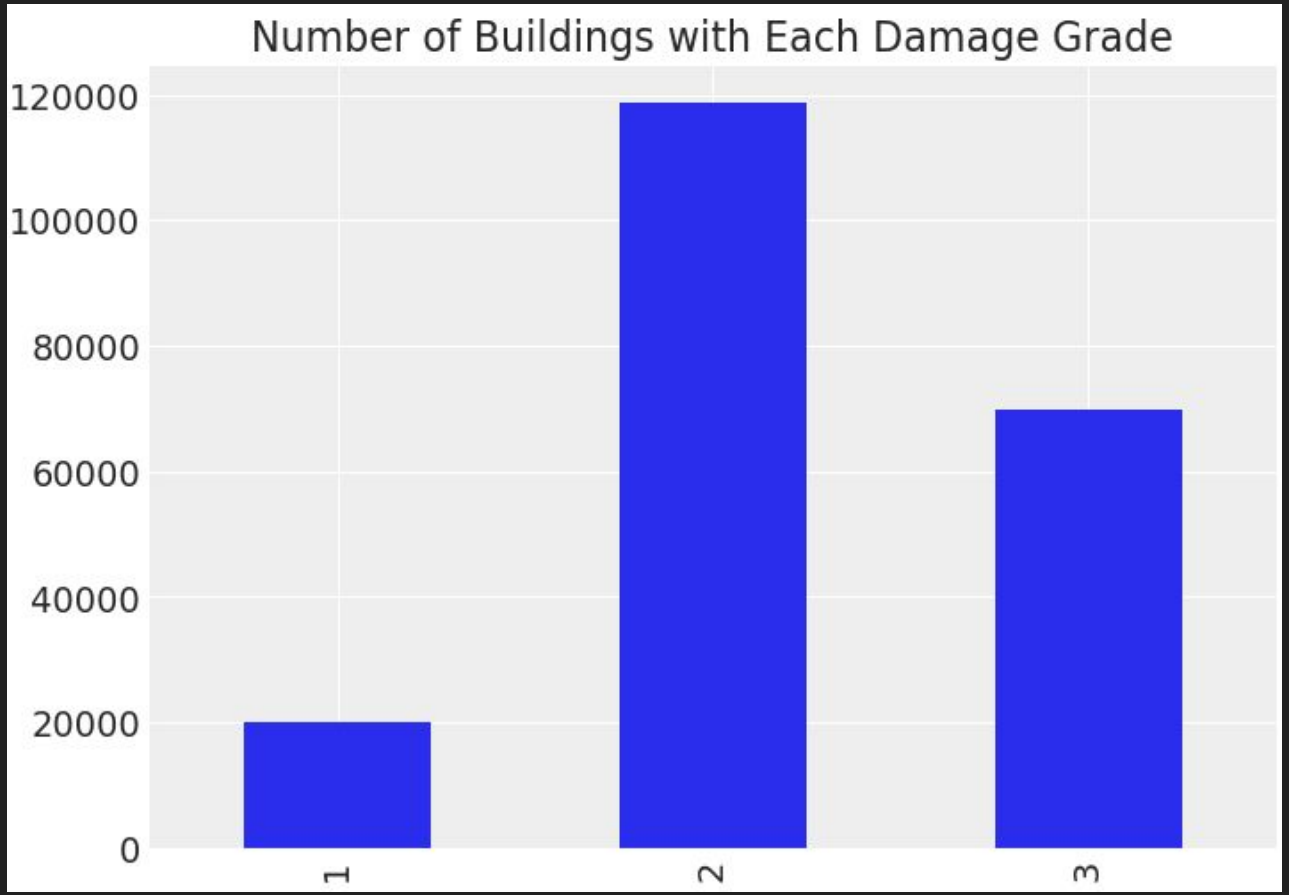
Data

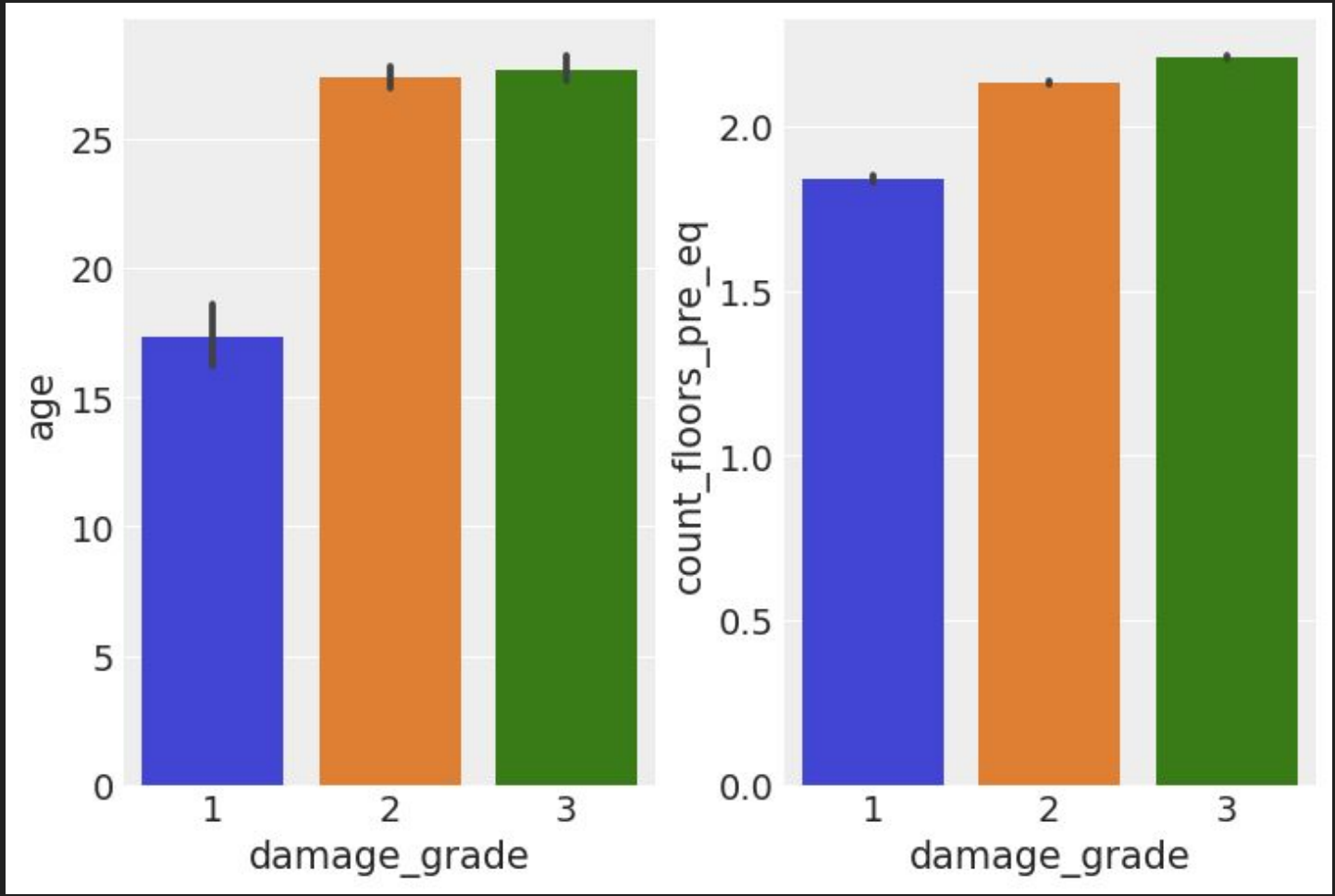
- 2015 Nepal Earthquake Open Data Portal
- National Planning Commission, Kathmandu Living Labs, and the Central Bureau of Statistics
- 208,480 buildings (rows)
- 38 predictors, mixed types (columns)
- Damage Grade of each building
  - 1 = low damage
  - 2 = medium damage
  - 3 = complete destruction

Priors

- Priors from knowledge/observations
  - Most buildings had some damage, some had severe damage
  - Damage grade 1 = 5%, grade 2 = 70%, grade 3 = 25%
- Priors from observed proportion
  - Buildings per grade/total buildings
  - Damage grade 1 = 9.7%, grade 2 = 57%, grade 3 = 33.4%

Exploratory Data Analysis




age
25
20
15
10
5
0
1
2
3
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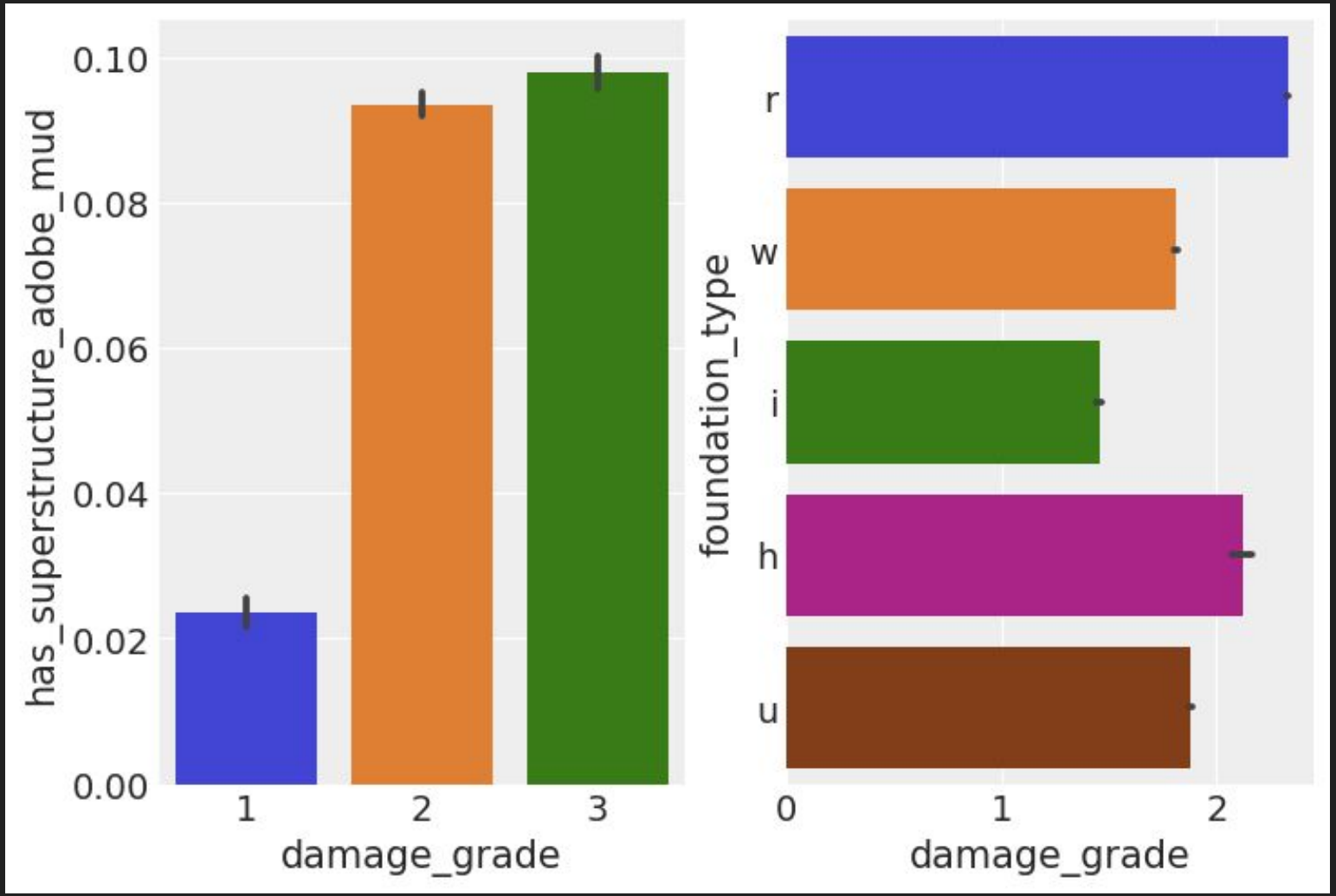
1.5
1.0
0.5
0.0
1
2
3
damage_grade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0.08
0.06
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2
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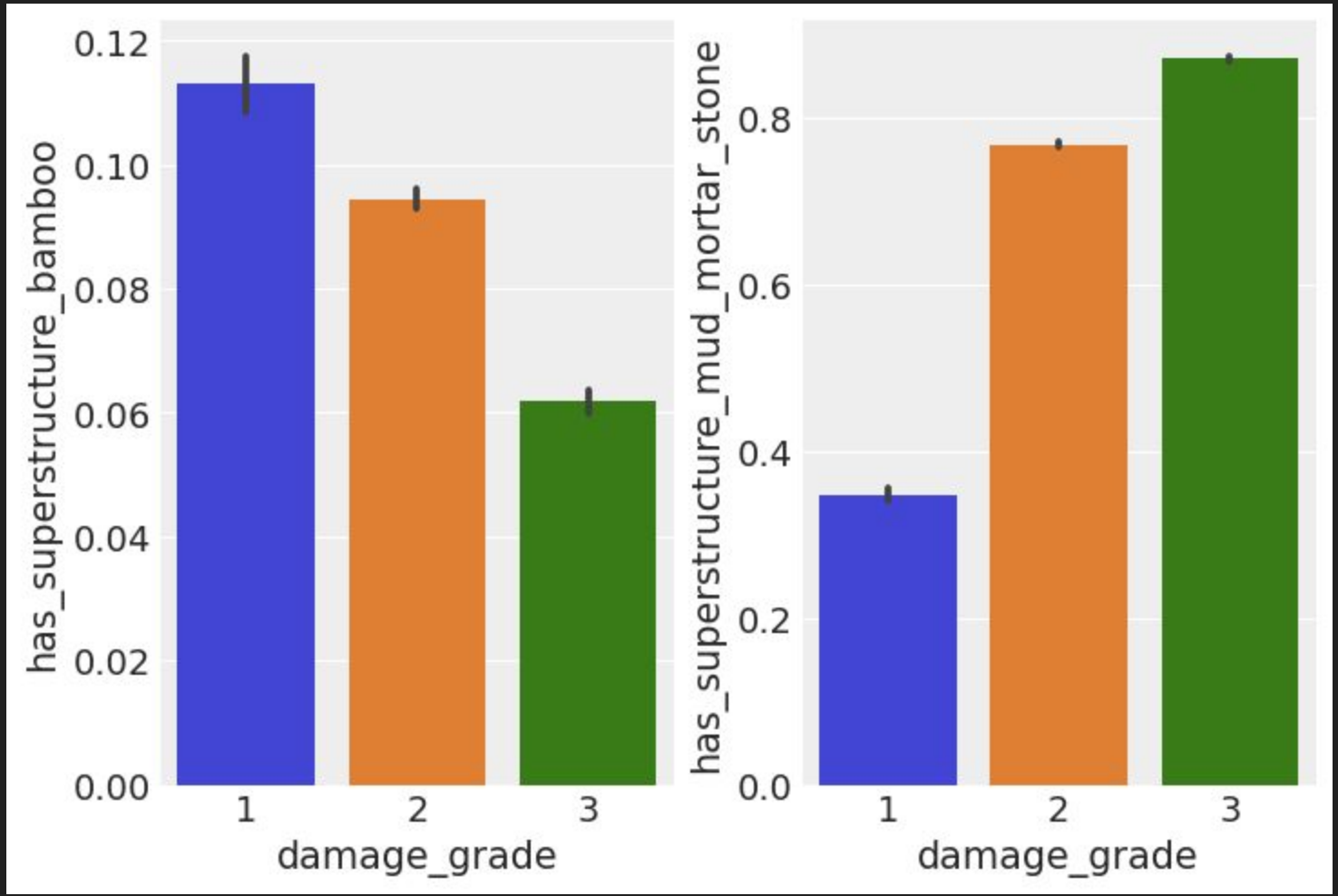
foundation_type
r
w
i
h
u
0
1
2
damage_grade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2
3
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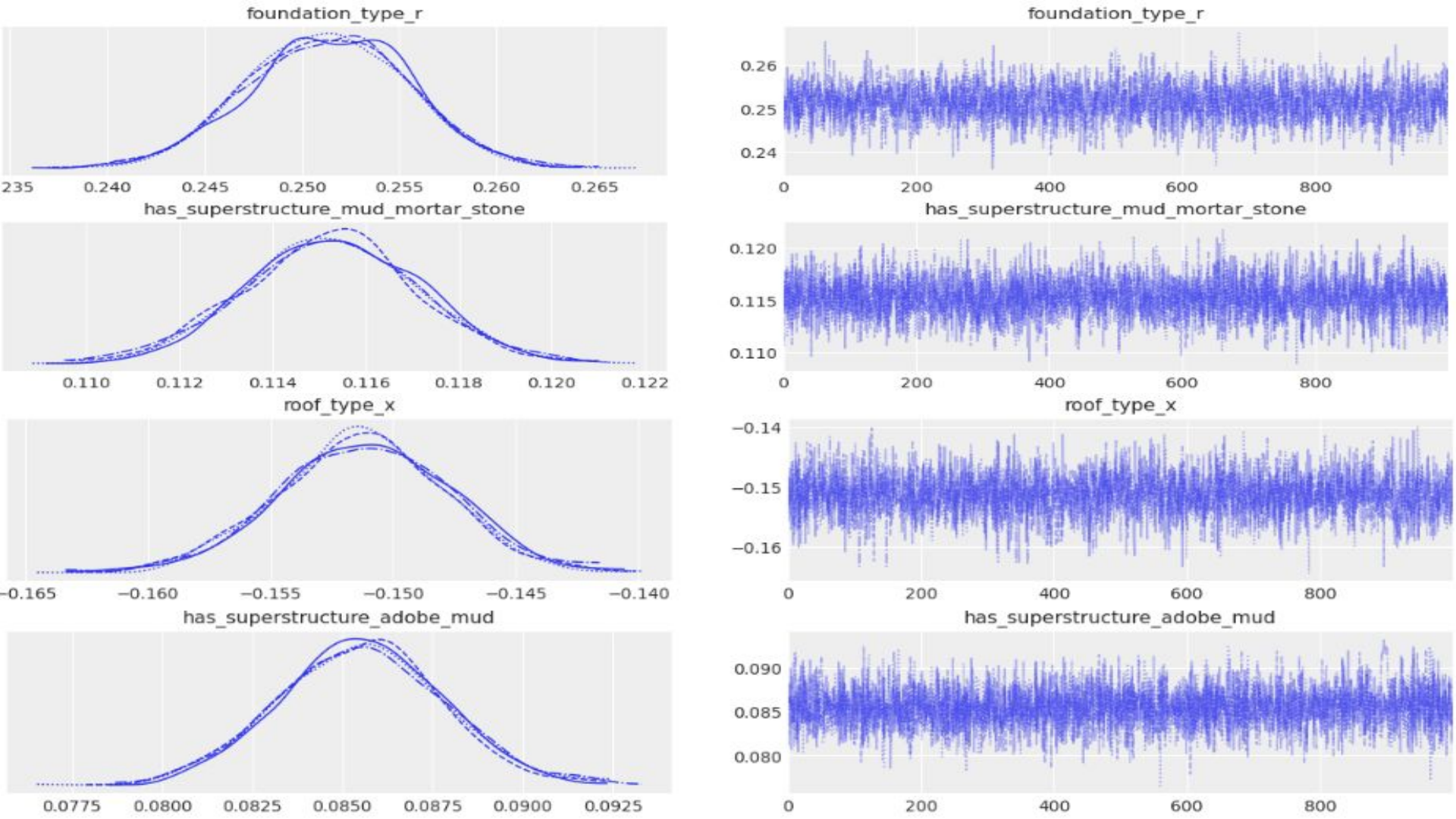
0.8
0.6
0.4
0.2
0.0
1
2
3
damage_grade

Models

- Linear Discriminant Analysis (LDA)
- Quadratic Discriminant Analysis (QDA)
- Logistic Regression
- MCMC, trace plots, density plots

Accuracy	Training Data	Testing Data
LDA	43.9%	11.1%
QDA	25.1%	6.5%
Logistic Regression	90.9%	90.8%
BMA	90.9%	90.8%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0.24
0
200
400
600
800
has_superstructure_mud_mortar_stone
0.110
0.112
0.114
0.116
0.118
0.120
0.122
has_superstructure_mud_mortar_stone
0.120
0.115
0.110
0
200
400
600
800
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−0.155
−0.150
−0.145
−0.140
roof_type_x
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−0.15
−0.16
0
200
400
600
800
has_superstructure_adobe_mud
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0.0800
0.0825
0.0850
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0.080
0
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400
600
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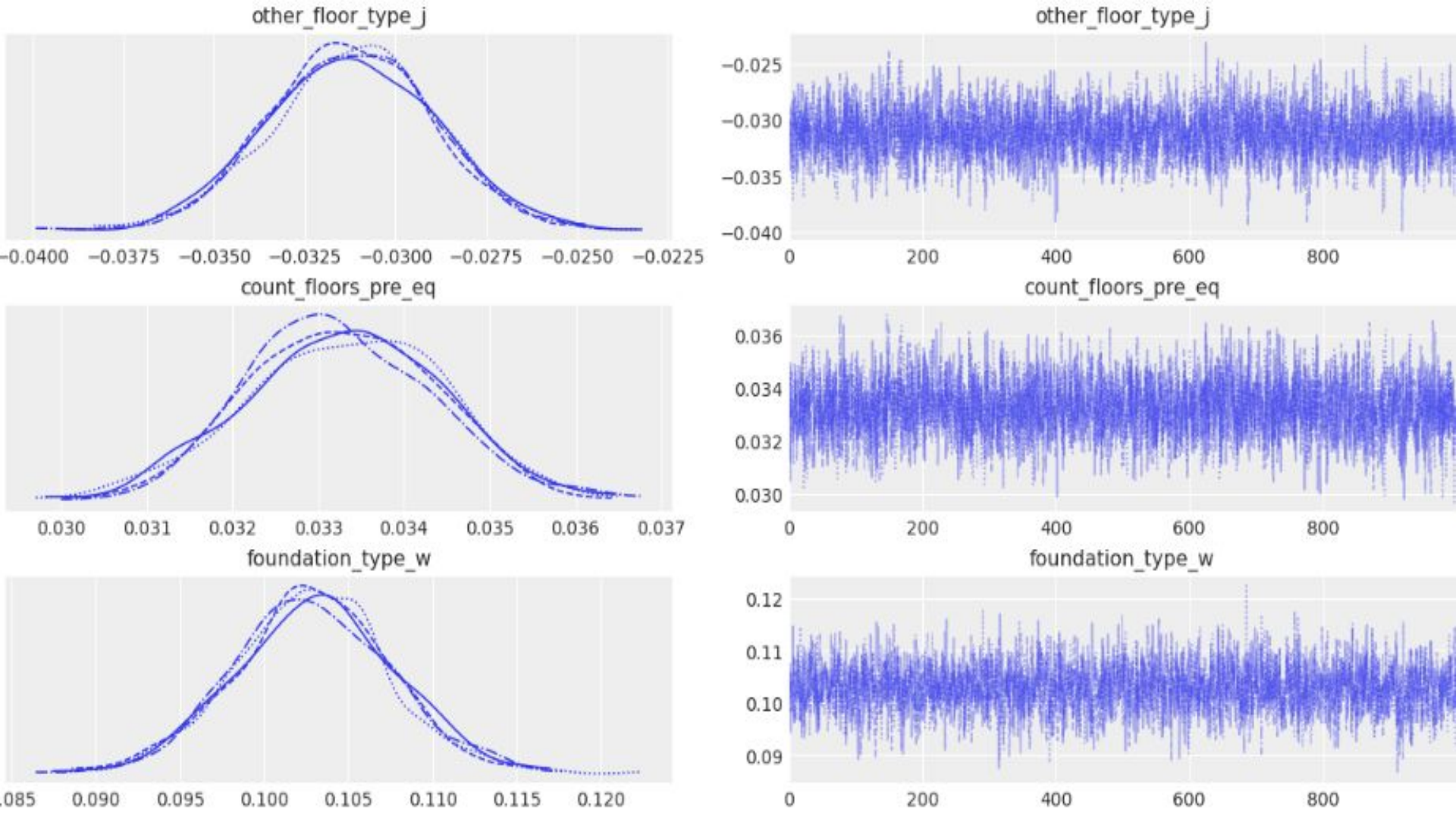
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−0.030
−0.035
−0.040
0 200 400 600 800
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0.034
0.032
0.030
0 200 400 600 800
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0.10
0.09
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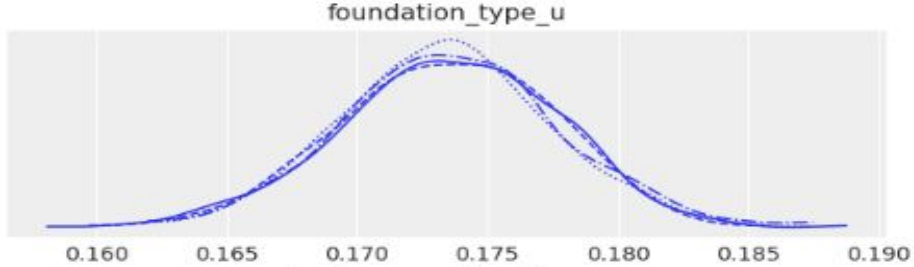
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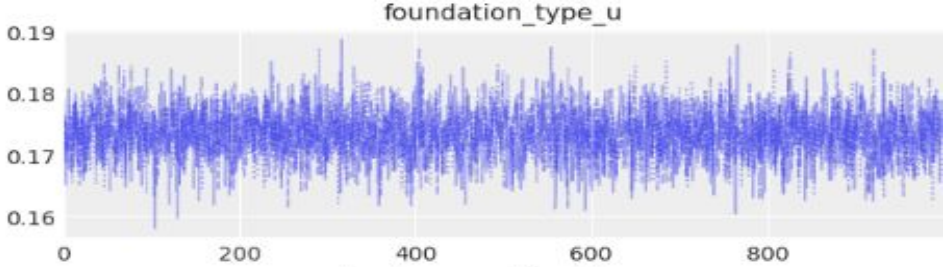
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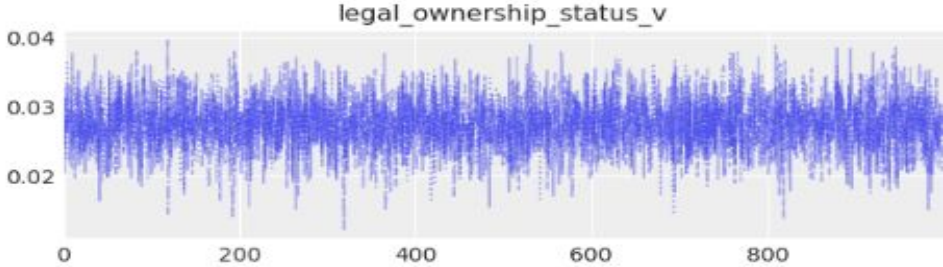
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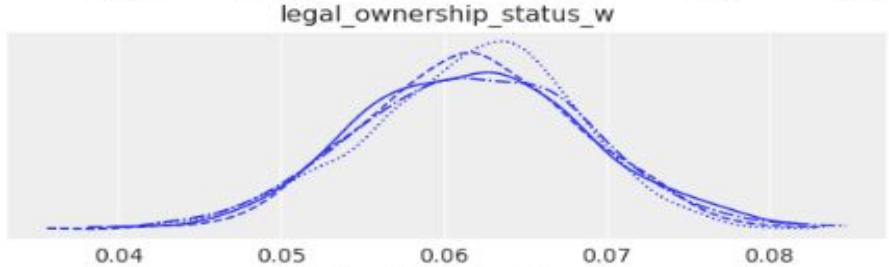
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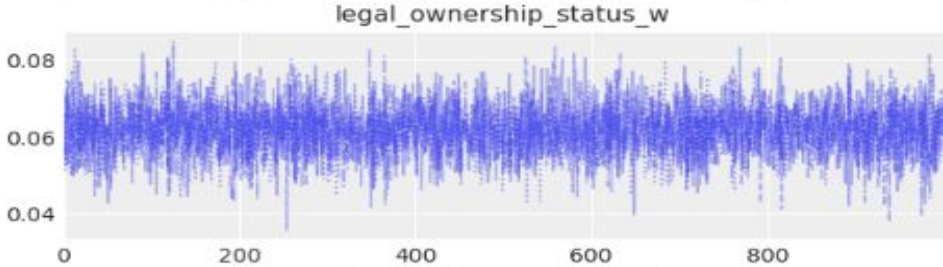
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0.04
0
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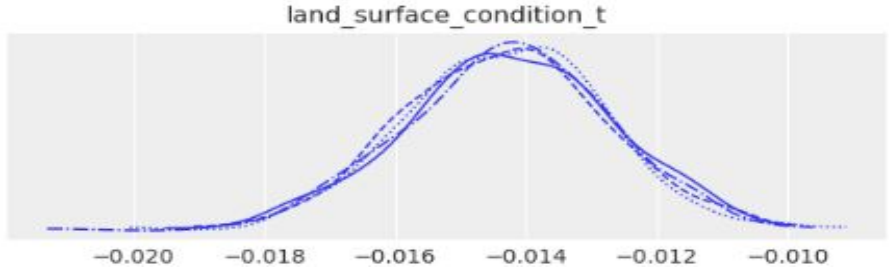
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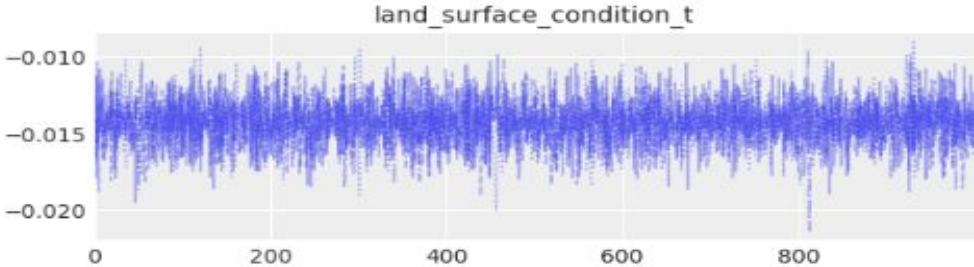
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−0.020
0
200
400
600
800

Conclusions

- Logistic regression performs best
- QDA and LDA should not be used for predictions
- Further model explorations recommended
- Apply to other similar case studies