Undergraduate Research at BYU

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Undergraduate Research Focus

- All research universities require their faculty to publish.

- In our department, most of our research projects are with graduate students and other faculty.

- We also have an extra focus on undergraduate research and mentoring.

- I will describe two undergraduate research projects
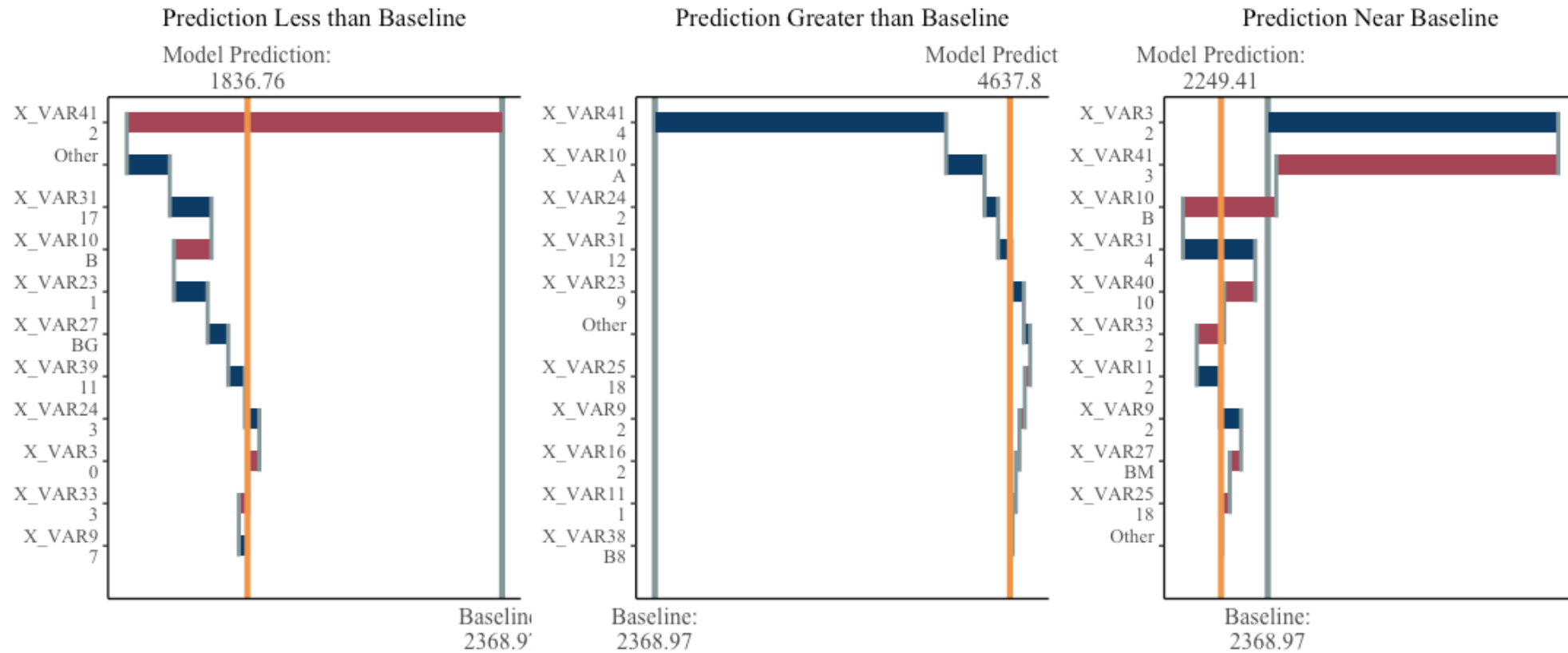 - Big Data Ratemaking
  - Auto Loss Costs

Big Data Ratemaking

Using a personal auto dataset of ~30M records, we

- Developed and compared many different models for frequency and severity using Spark and R
- Created a Github repository containing all of our code and results for reproducibility
- Developed mSHAP, Shapley values for multiplicative (frequency/severity) models.

Shapley Values

3 Individual Prediction Explanations

Big Data Ratemaking Benefits

- In total, the big data ratemaking project:
  - Provided funded research for a student
  - Produced two papers
  - Developed a Github repo to make future research on ratemaking easier

Auto Loss Cost Modeling

Jointly sponsored by the CAS, APCIA, and the SOA we analyzed the impact of various covariates on each personal auto coverage.

We worked on three separate iterations of this project

Determining which covariates are most important

Forecasting time series trends with ARIMA models

Building DLMs to locate possible changepoints

Auto Loss Cost - Covariates

- For comprehensive frequency, if we separate the 10 states with the most hail events in the sample range (TX, KS, NE, OK, SD, MO, IA, NC, CO, IL) we see:
  - More pronounced seasonal effect
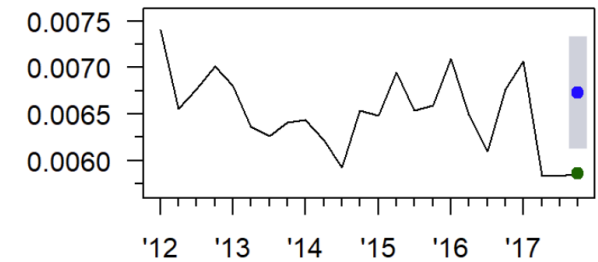 - Higher frequency in the hail season
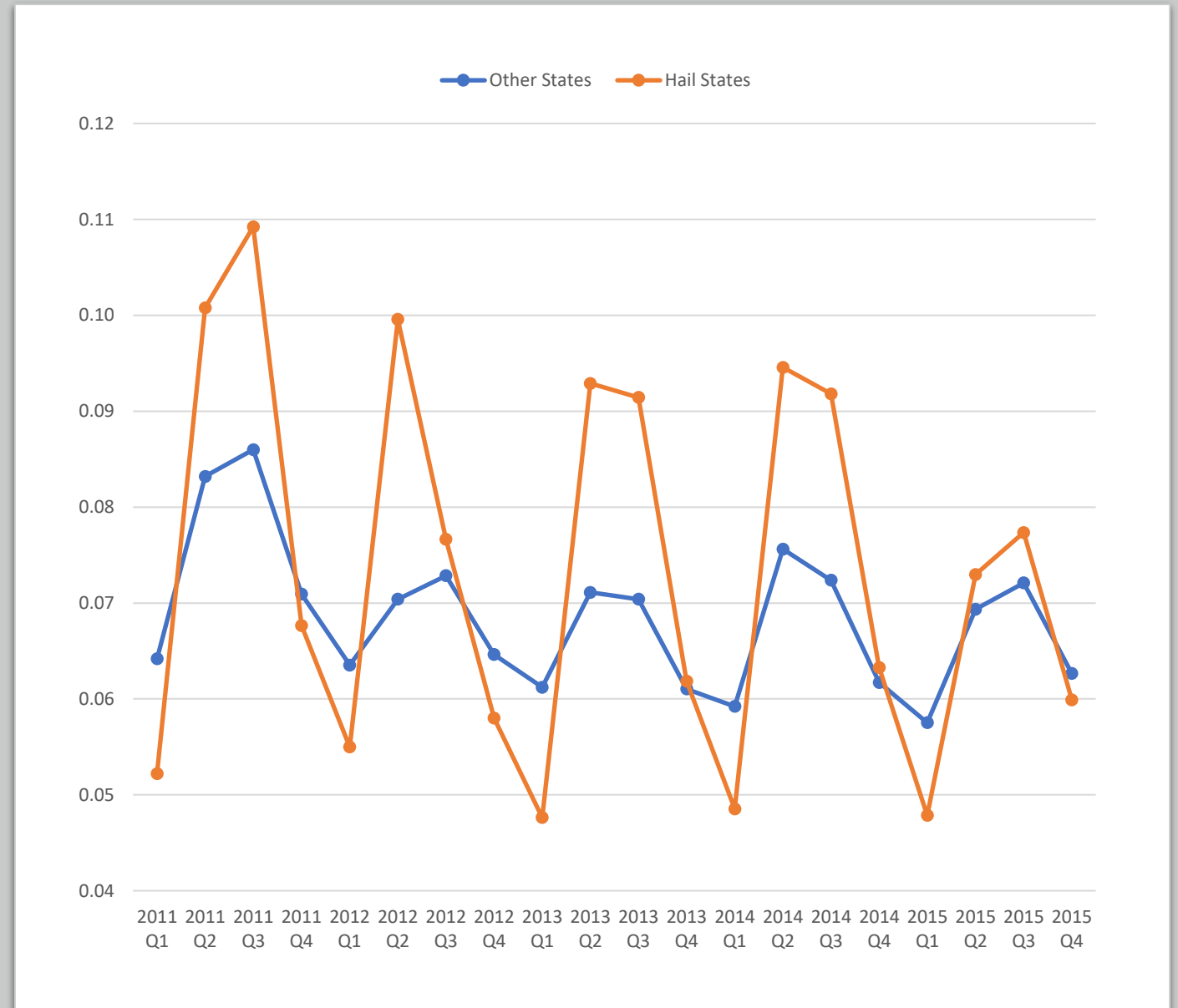
Auto Loss Cost - Trends

- In addition to modeling the effect of covariates, we used ARIMA models to forecast the costs in future months.

- Here are four coverages where the results fell outside the 95% prediction intervals.

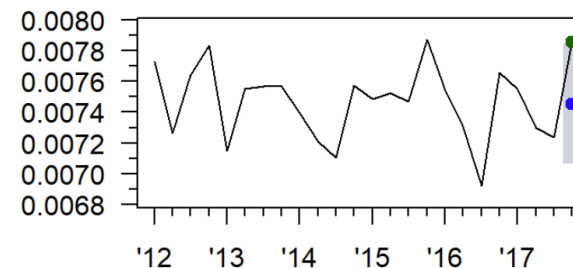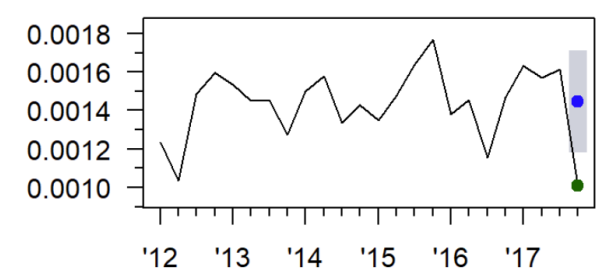- We published results for all states and coverages.
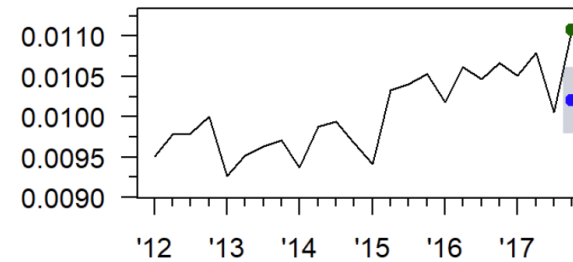
Auto Loss Cost – DLMs

- Using dynamic linear models, we predicted where there may have been structural shifts in the various costs.

- We found three separate potential change points for each state and coverage.
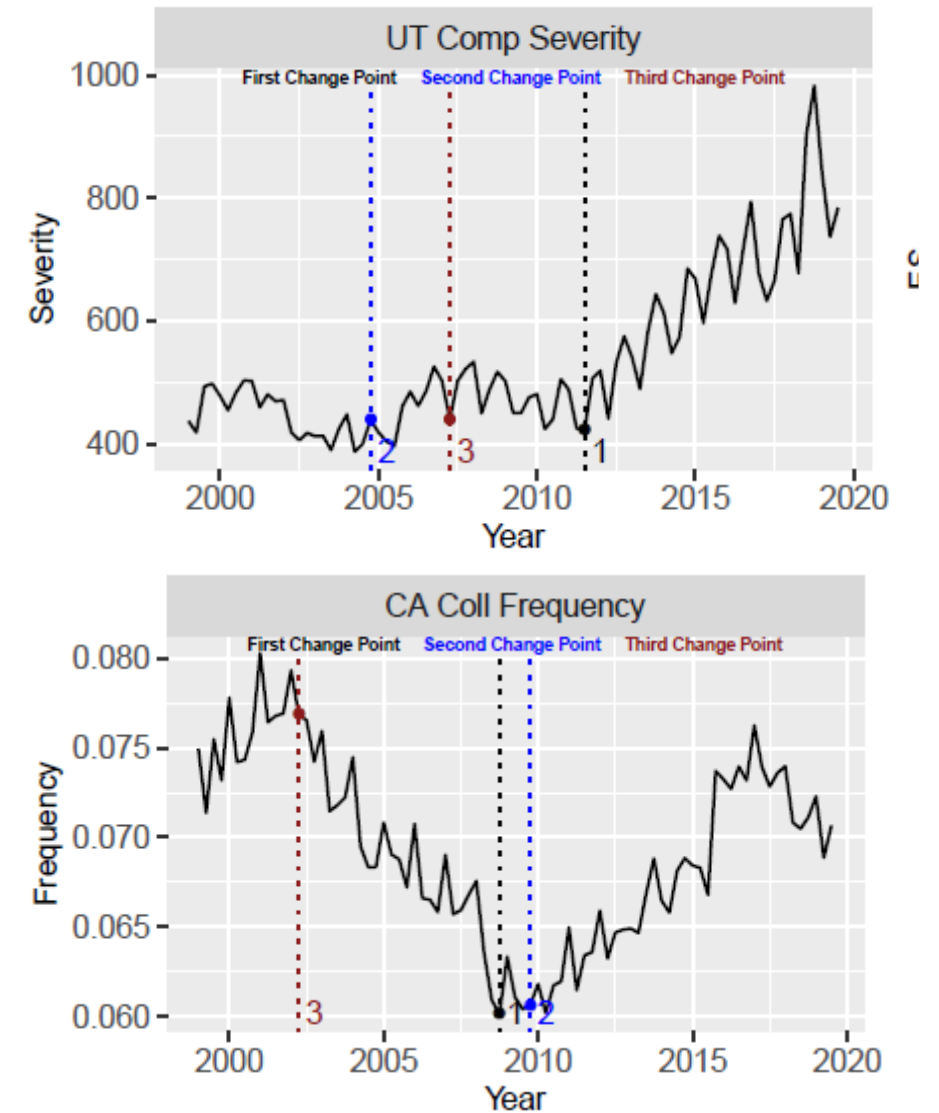
Auto Loss Cost Benefits

- In total, the auto loss cost project:
  - Provided funded research opportunities and real-world experience for 30 students
  - Produced three sets of reports available on the CAS website (https://www.casact.org/article/third-report-auto-loss-cost-trends-issued)
  - One paper currently under review at Variance

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