Modeling the Effects of Atlantic Striped Bass Fishing Limits
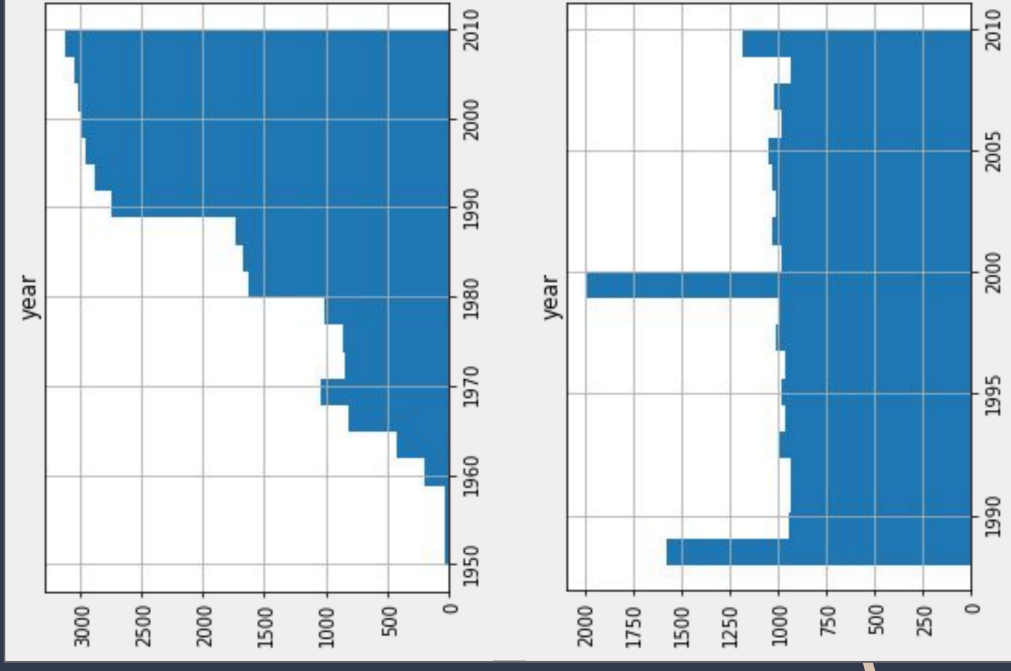
Multiple Regression of NW Atlantic Fishery Data

- Who: The Atlantic States Marine Fisheries Commission and Comparative Analytics of Marine Ecosystem Project (**CAMEO**) data science team

- What: Model the effects of Amendment 6 to the Fishery Management Plan (**FMP**), implemented February 2003 to set fishing quotas

- Why: The Striped Bass Technical Committee performs an annual assessment of fishing stocks, which this analysis will support

- CAMEO data covers 601 Atlantic fish species from 1950 to 2009

- Measurements in the data are abundance, abundance index, biomass, biomass index, average length, and average mass

- There is a significant increase in data collection in 1988

- Data is selected from 1988 to 2009, this allows for a train-test split of data before and after the announcement of the quota (2002).

- Striped bass are recorded as both adult and yoy (young-of-year)

- Predictor species will be the 33 other species recorded with distinct juvenile and adult populations, to ensure data was recorded consistently

- The abundance index measurement has the best data quality by far and is selected as metric to model for fish populations

```
Missing Values
ecosystem            0
species              0
year                 0
biomass            294
abundance          294
biomass_index      296
abundance_index      7
avg_len             73
avg_mass           296
source               0
agency               0
season               0
species_lower        0
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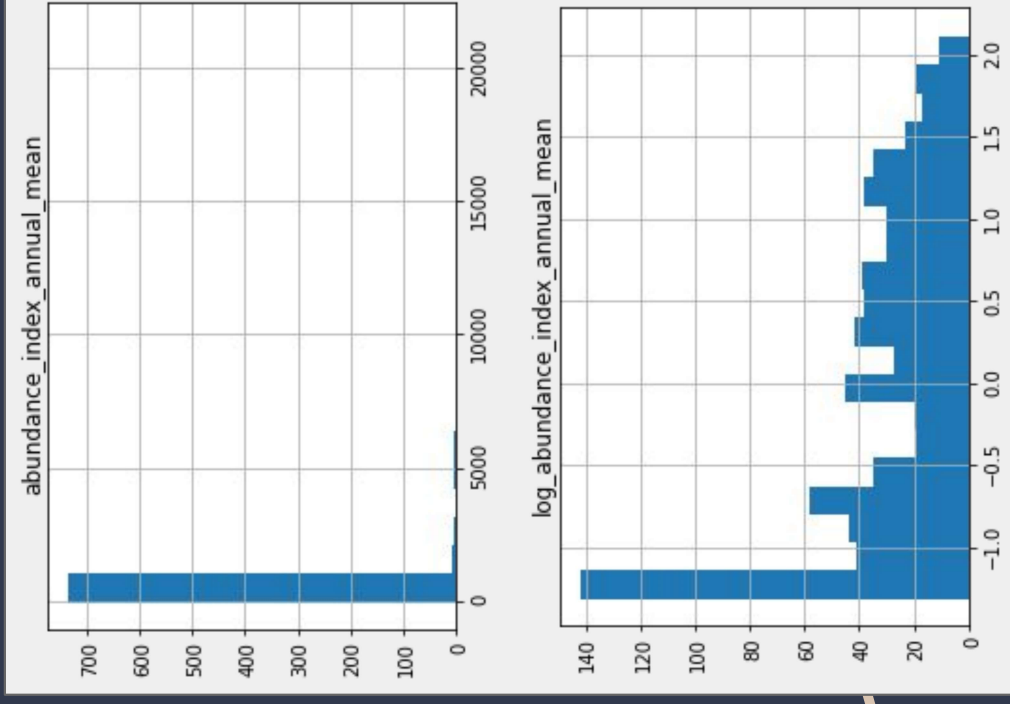
- Abundance index for the same species, recorded the same year, but in different regions is summarized by a mean value
  - Summary statistic is mean rather than sum, as abundance index is a measure of fish caught relative to population size
- Abundance index mean values show a highly right skewed distribution. A log transform is performed to reduce the distribution skew
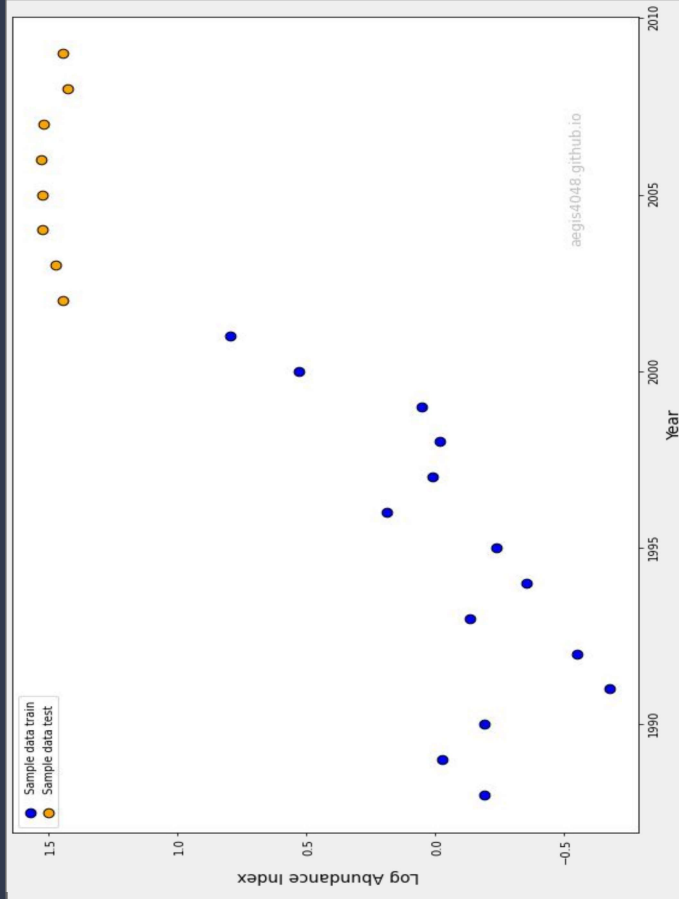
- The abundance index for adult striped bass sharply increases in 2002 and levels off in the following years

- Fishing increase occurs year prior to the implementation of the 2003 FMP quota
  - Possibly due to market reaction to earlier announcements

- This is likely up to the quota maximum, and maintaining at this level

- Regressions model were created for abundance index of adult striped bass, predicted by the 33 other juvenile and adult populations

- Models are trained on data from 1988-2001 and tested on 2002-2009

- Evaluated by mean squared error and mean absolute error, multiple linear regression outperformed both lasso and ridge regression

	model	Model MSE	Model MAE
0	LinearRegression()	0.192055	0.388406
0	Lasso()	2.255915	1.501358
0	Ridge()	0.217596	0.421377
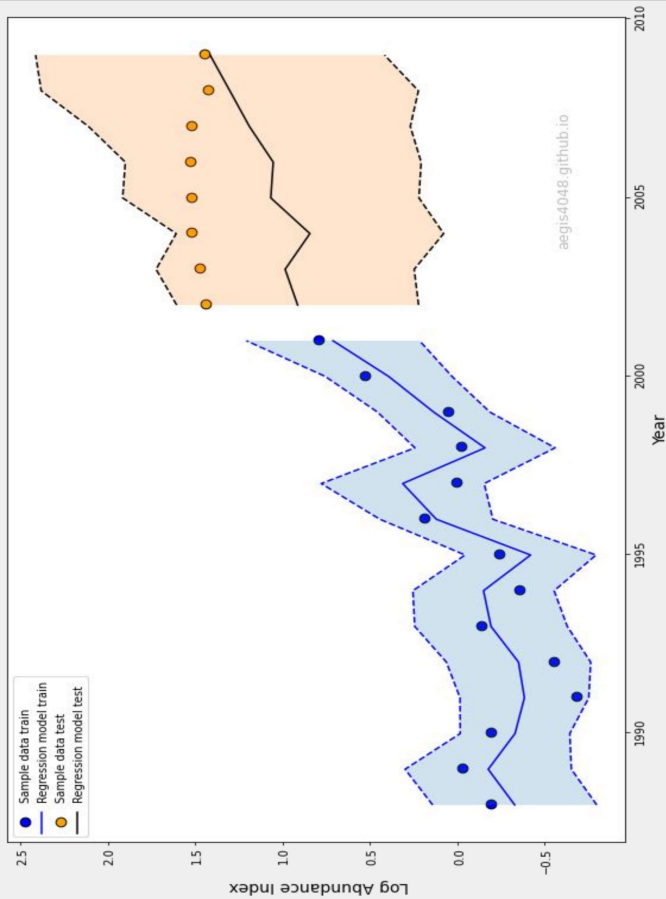
- The multiple linear regression model predicts abundance index in the absence of the quota or quota announcement

- Predicted abundance index is lower than actual data for the period of 2002-2009

- The prediction is trending upward and in the years following 2009 would most likely exceed actual
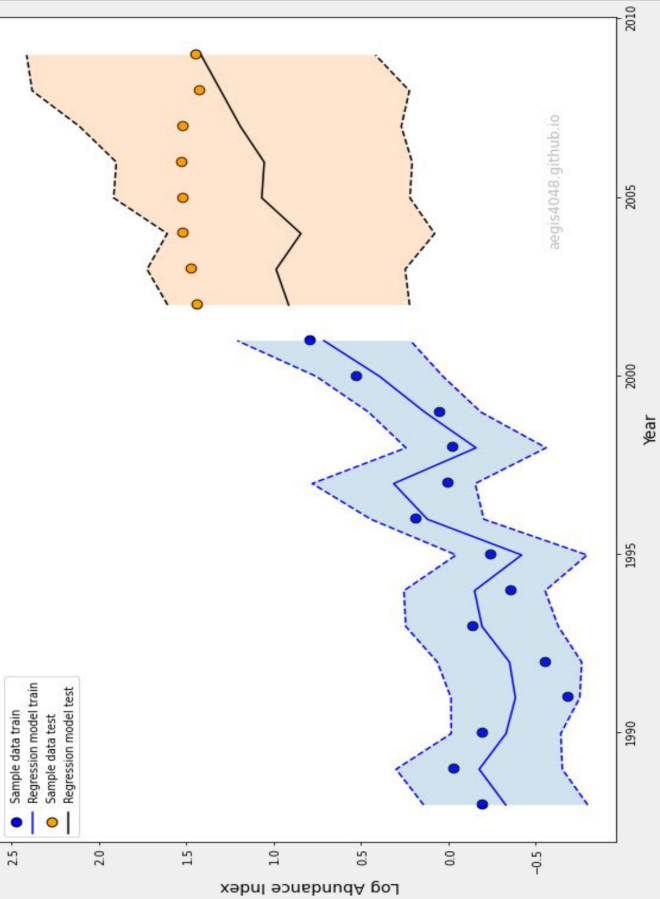
Two key points:

- The sharp increase in abundance index in 2002
- The prediction exceeding actual after 2009

Considerations:

- For the Striped Bass Technical Committee to recommend the continuation of the 2003 quota, or fishing would be in exceed current levels (post-2009)
- For the Atlantic States Marine Fisheries Commision to consider that future quotas may cause an initial jump in fishing metrics
- Further research would be required to determine fishing stock health for Atlantic Striped Bass or other species, the current data set is only for fish caught rather than fish not caught

Q&A