Aquaculture & Fisheries

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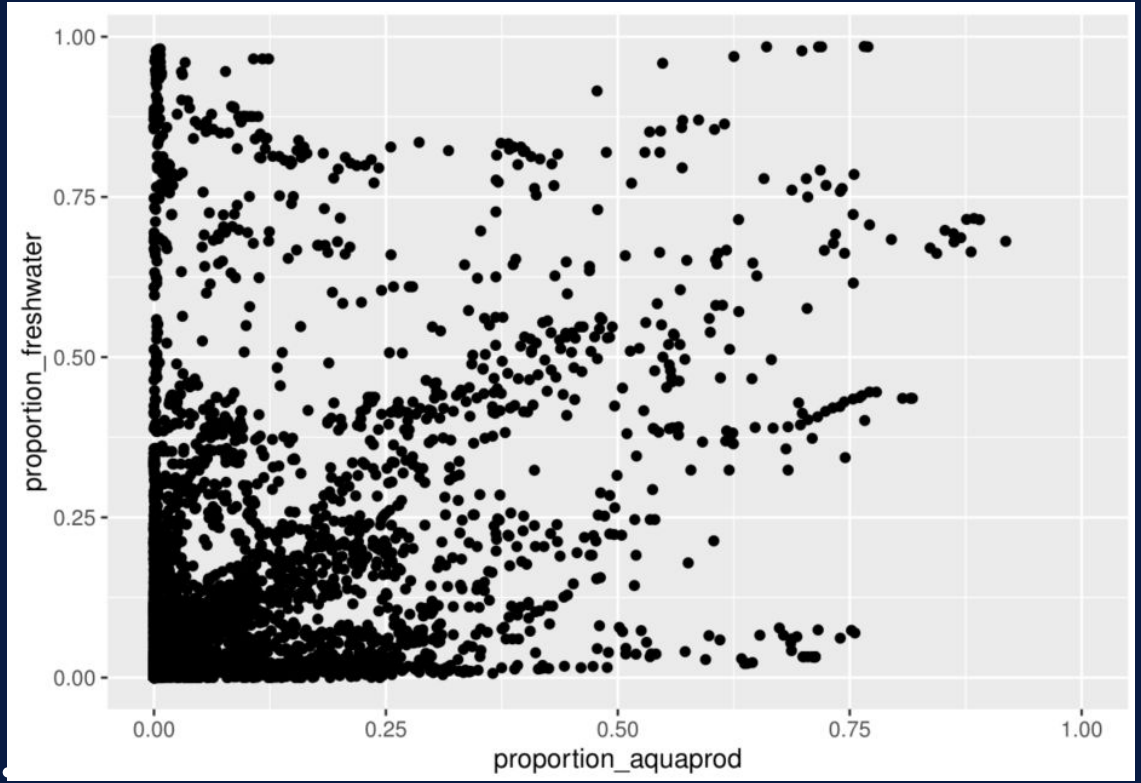
Intro + Hypothesis

- **Variables used:** types of fish that a country produces in a given year (measured in tons); carbon dioxide (CO_2) emissions per capita, and the average amount of fish consumption within a family per capita (measured in kilograms).
- **Time span:** 1960-2018

As the production of freshwater fish increases in a country, the levels of aquaculture also increase over time.

Scatterplot



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Context

About Aquaculture

- Aquaculture is defined by the National Ocean Service as “the breeding, rearing, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments.”

- The health of fish populations directly impacts how healthy marine ecosystems are. This can have a multitude of benefits, including the ability of the ecosystem to be a carbon sink.

Benefits of Aquaculture

- Underwater ecosystems provide important ecological services: carbon sink and coastal resilience

Aquaculture also has significant local economic impacts (and the absence of marine management can lead to local economic collapse)


Data/Methods

Methods

- Data from World Bank and United Nations Food and Agriculture Organization

Goals: understand all the variables within our dataset that have an impact; become more confident in the variable we are testing

Used machine learning models (elastic net and lasso) as well as linear regression

Steps

1. Create models (recipes and lm())
2. Set X and y, find lasso (glmnet()), then predict test data results based on model
    a. X * beta = y^
3. Find residuals between prediction (y^) and real result (y)
4. Take Root Mean Square Error (due to proportionality)
5. Rinse, repeat for different models, compare!

$$RMSE = \sqrt{\frac{1}{n}\Sigma_{i=1}^{n}\left(\frac{d_i - f_i}{\sigma_i}\right)^2}$$

Variables

```
$ year_only
$ country_name
$ proportion_aquaprod
$ consumption
$ proportion_freshwater
$ proportion_molluscs
$ proportion_pelagic
$ proportion_crustacean
$ proportion_cephalopods
$ proportion_marine
$ proportion_demersal
$ co2_emissions_per_capita
$ totalprod
```

- Focus on proportions to ensure fair weighting

Machine Learning Models

1. Lasso: alpha = 1, lambda = 1 SE
2. Lasso: alpha = 1 , lambda = min
3. Elastic net: alpha = 0.5, lambda = min

Root Mean Square Error = 0.6454

Linear Model

- Not as predictive, but interesting to compare to our machine learning results

	s1
(Intercept)	1.048396e-01
year_only	3.974055e-03
consumption	-1.852709e-03
proportion_freshwater	3.968056e-01
proportion_molluscs	3.923941e-01
proportion_pelagic	-8.627799e-02
proportion_crustacean	-1.316589e-01
proportion_cephalopods	-2.231290e-01
proportion_marine	-1.099479e-01
proportion_demersal	8.937554e-02
co2_emissions_per_capita	1.038095e-03
totalprod	3.444107e-09

	2.5 %	97.5 %
(Intercept)	1.042439e-01	1.093332e-01
year_only	3.253037e-03	3.724666e-03
consumption	-1.574529e-03	-3.535994e-04
proportion_freshwater	3.017924e-01	3.936918e-01
proportion_molluscs	2.243663e-01	3.465014e-01
proportion_pelagic	-1.569551e-01	-8.588168e-02
proportion_crustacean	-2.150702e-01	-9.272229e-02
proportion_cephalopods	-5.484913e-01	-3.208023e-01
proportion_marine	-1.322387e-01	-6.417181e-02
proportion_demersal	NA	NA
co2_emissions_per_capita	1.880669e-03	4.787783e-03
totalprod	2.643113e-09	4.720734e-09

Results

Elastic Model

- Below we show the variables and their coefficients (produced in the elastic net model with **lambda** = **min**; **alpha** = 0.5), and the confidence intervals (generated from the linear model).

consumption	-1.056257e-03	-1.499463e-03
Proportion_freshwater	1.088309e-01	2.062949e-01
Proportion_molluscs	-3.553389e-02	7.860618e-02
Proportion_pelagic	-4.100200e-01	-2.207952e-01
Proportion_crustacean	-4.394044e-01	-2.837336e-01
Proportion_cephalopods	-5.143409e-01	-6.983557e-01
Proportion_marine	-4.491053e-01	-2.453694e-01
Proportion_demersal	-2.577993e-01	-1.486996e-01
Co2_emissions_per_capita	7.989588e-04	1.444259e-03
totalprod	3.247480e-09	2.957627e-09

Linear Model

- From our linear model, we found all variables are statistically significant.
- Freshwater and molluscs are both positively associated

  - Freshwater
    - Coefficient (2.476e-01)
    - Standard error (2.109e-02)
    - T- value (11.743)

  Able to reject the null hypothesis

Conclusions

Thanks!

Any questions?

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