# Library Circulation

Molly Braun

- PROBLEM: Can circulation be predicted?
- HYPOTHESIS: Library system circulation can be predicted using library and geographical characteristics.

# Data

- Institute of Museum and Library Services Public Library Survey (PLS)
  - Survey results of 9,305 library systems nationwide
- 2014 American Community Survey 5-year Estimates
  - Area Median Income (AMI) by state

# Data

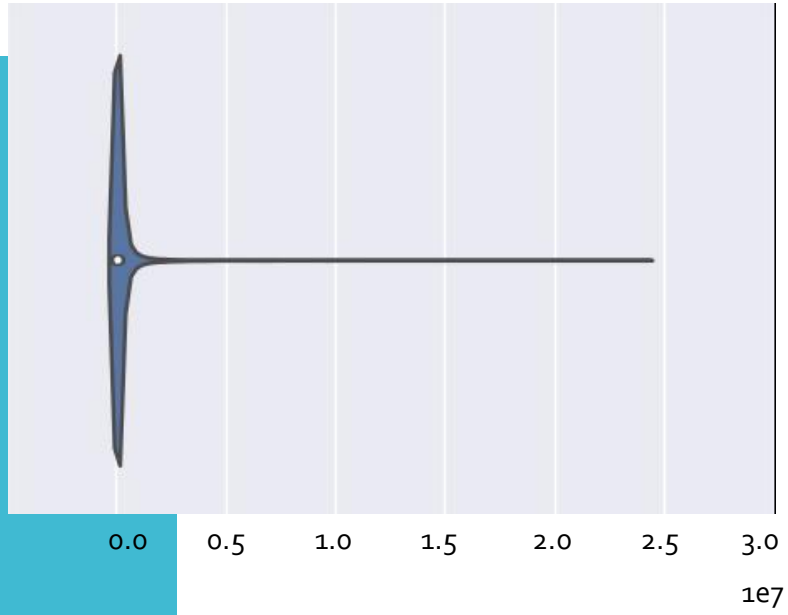
| Variable Name | Description | Type of Variable |
|---|---|---|
| TOTCIR | Total annual circulation | continuous |
| POPU_LSA | Population of the legal service area | Continuous |
| STINCOME | Household median income (dollars) | Continuous |
| BKVOL | Print materials | Continuous |
| EBOOK | Electronic books | Continuous |
| STGVT | Operating revenue from state government | Continuous |
| FEDGVT | Operating revenue from federal government | Continuos |
| LOCGVT | Operating revenue from local government | Continuous |
| TOTSTAFF | Total paid full time employees | Continuous |
| GEOCODE | Geographic Code | Categorical |
| OBEREG | Region | Categorical |
| LOCALE | Geographic location | Categorical |

# Data

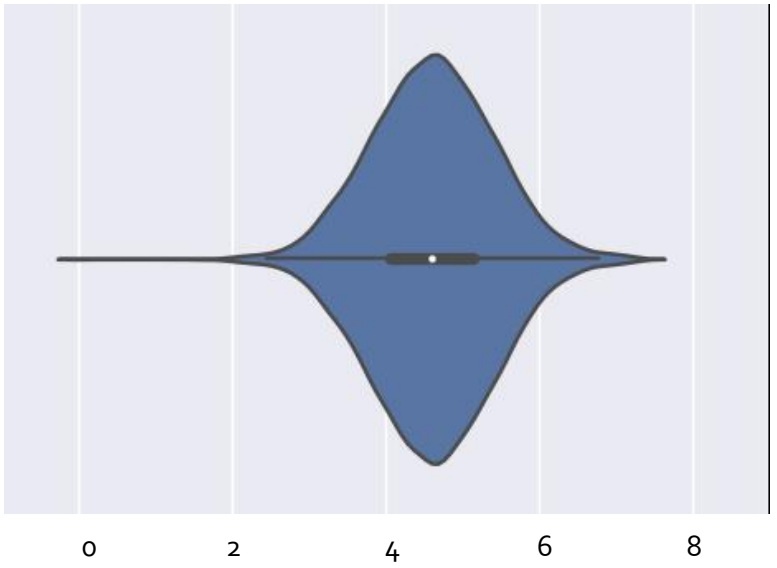
- Dropped missing income data
- Imputed median and mode for library data
- Log of continuous data because of skew
- Dummy variables for categorical data

# Data

Total Circulation, original




Total Circulation, transformed



# Model

- Two sets of variables predicting:
  - 1: Total circulation
  - 2: Circulation per capita
- Two types of models
  - Linear regression
  - Random forest regressor

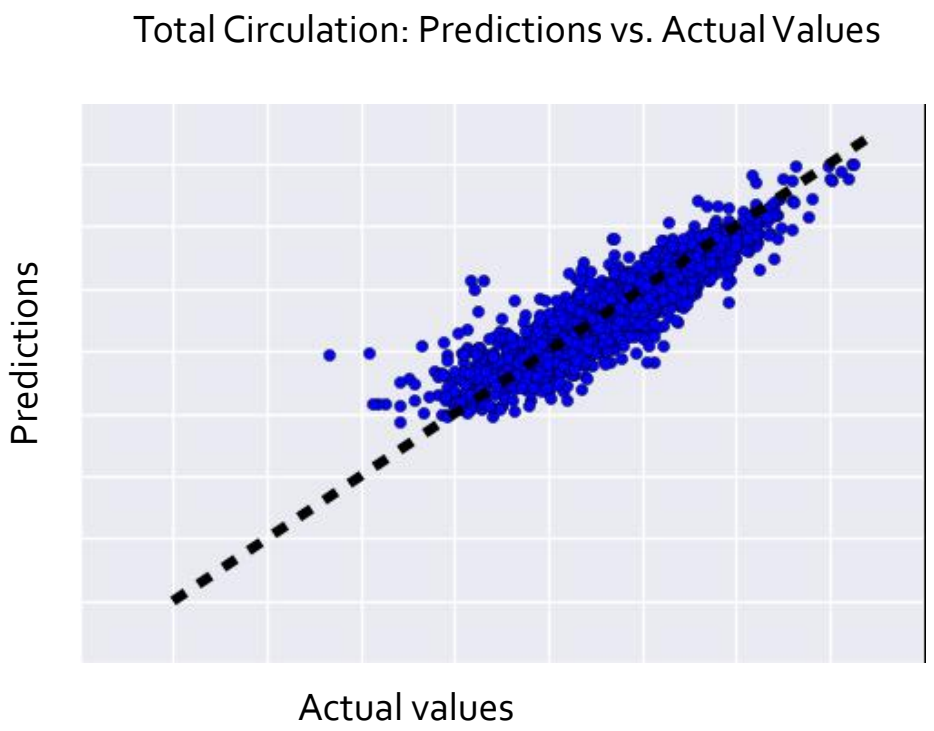
# Model 1: Total Circulation

- Input Data
  - Population of service area
  - State income
  - State government revenue
  - Geographic code
  - Geographic location
  - Region

# Model 1: Total Circulation

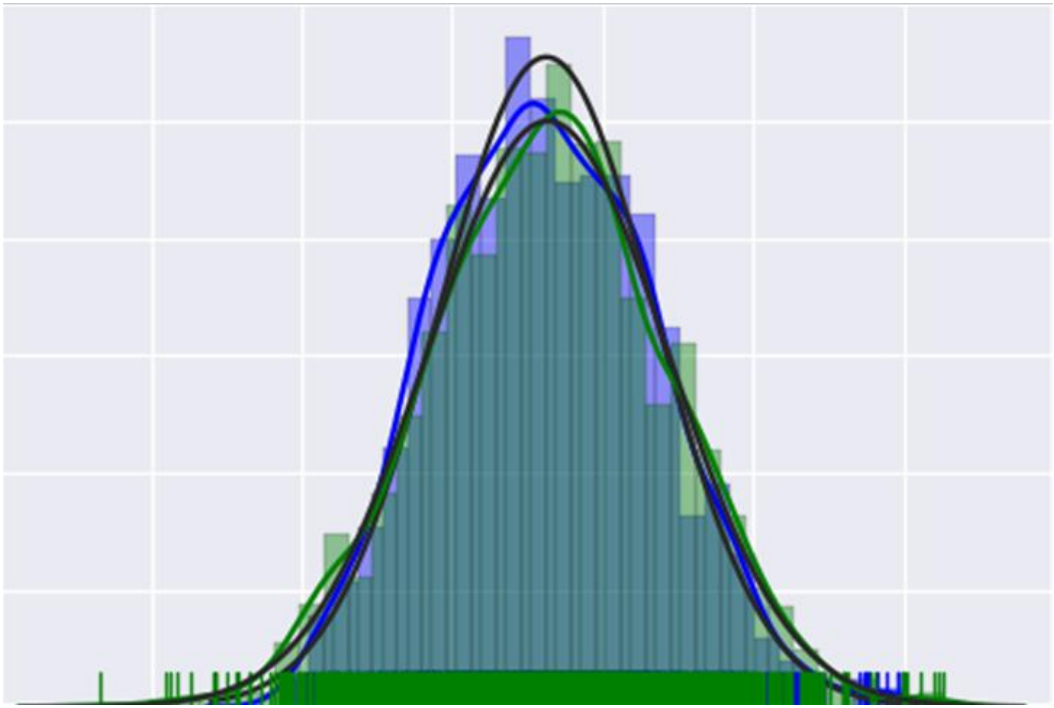
- Random Forest Regressor
  - Best estimator: Max depth = 27, Min sample split = 30
  - Mean squared error = 0.139

# Model 1: Total Circulation



# Model 1: Total Circulation

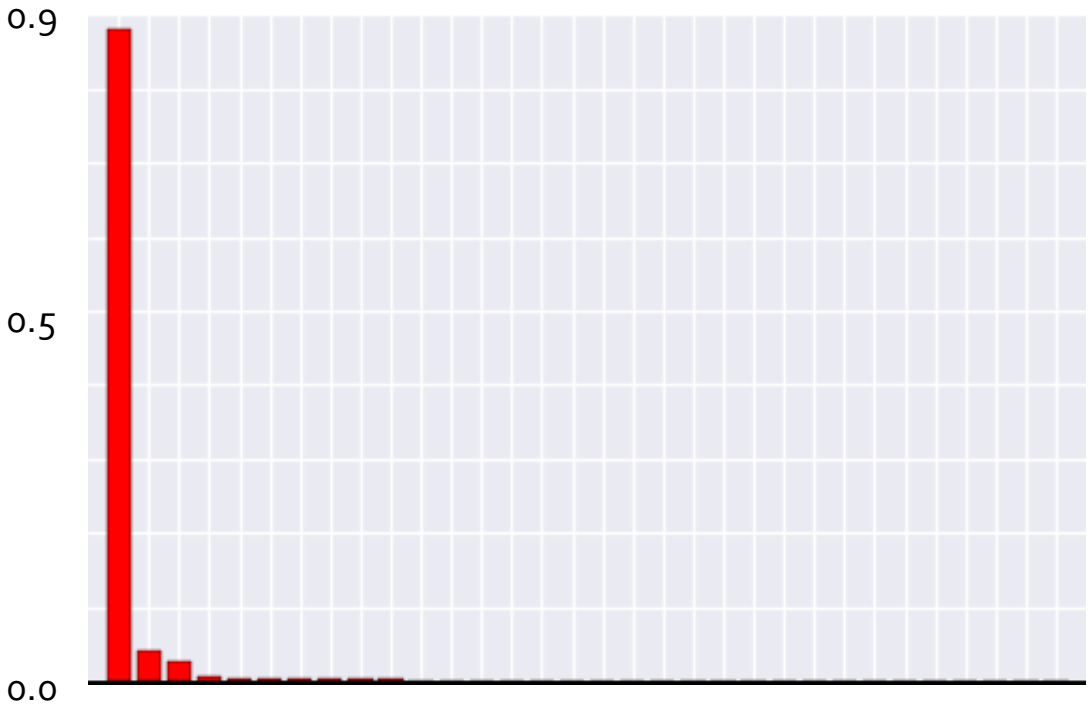
Total Circulation: Predictions and Actual Values



Green=actual values
Blue=predictions

# Model 1: Total Circulation

- Feature importance
  - Most important: Population of service area



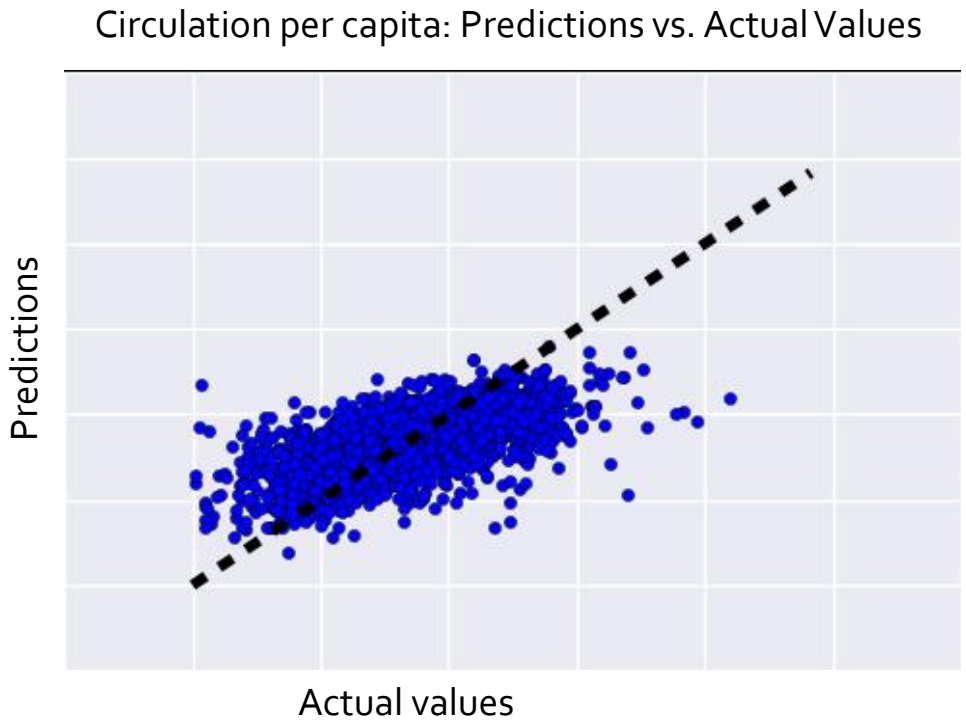
# Model 2: Circulation per Capita

- Input Data
  - State income
  - Print materials
  - Electronic books
  - State government revenue
  - Federal government revenue
  - Local government revenue
  - Full time employees
  - Geographic code
  - Geographic location
  - Region

# Model 2: Circulation per Capita

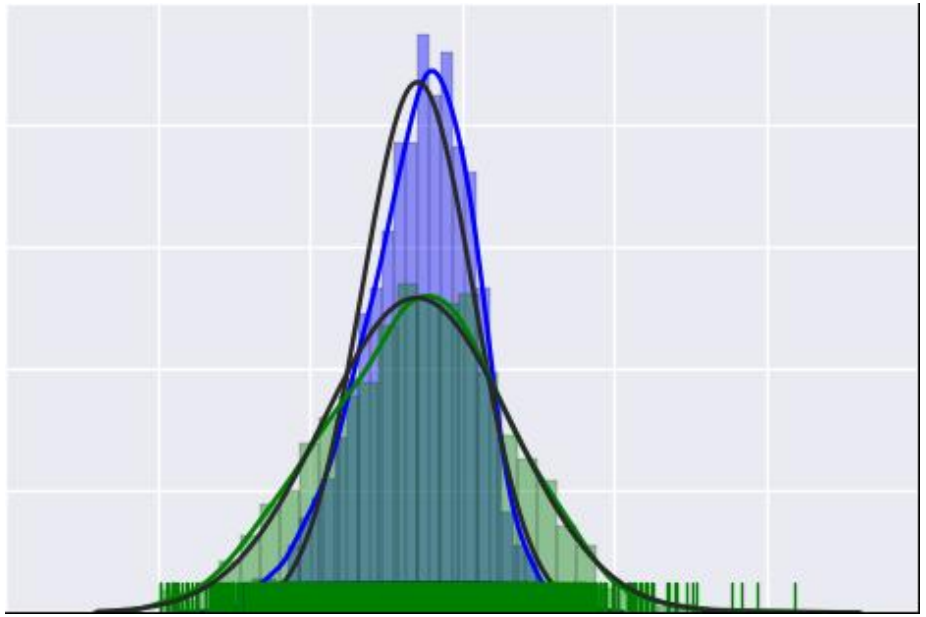
- Random Forest Regressor
  - Best estimator: Max depth = 22, Min sample split = 20
  - Mean squared error = 0.061

# Model 2: Circulation per Capita



# Model 2: Circulation per Capita

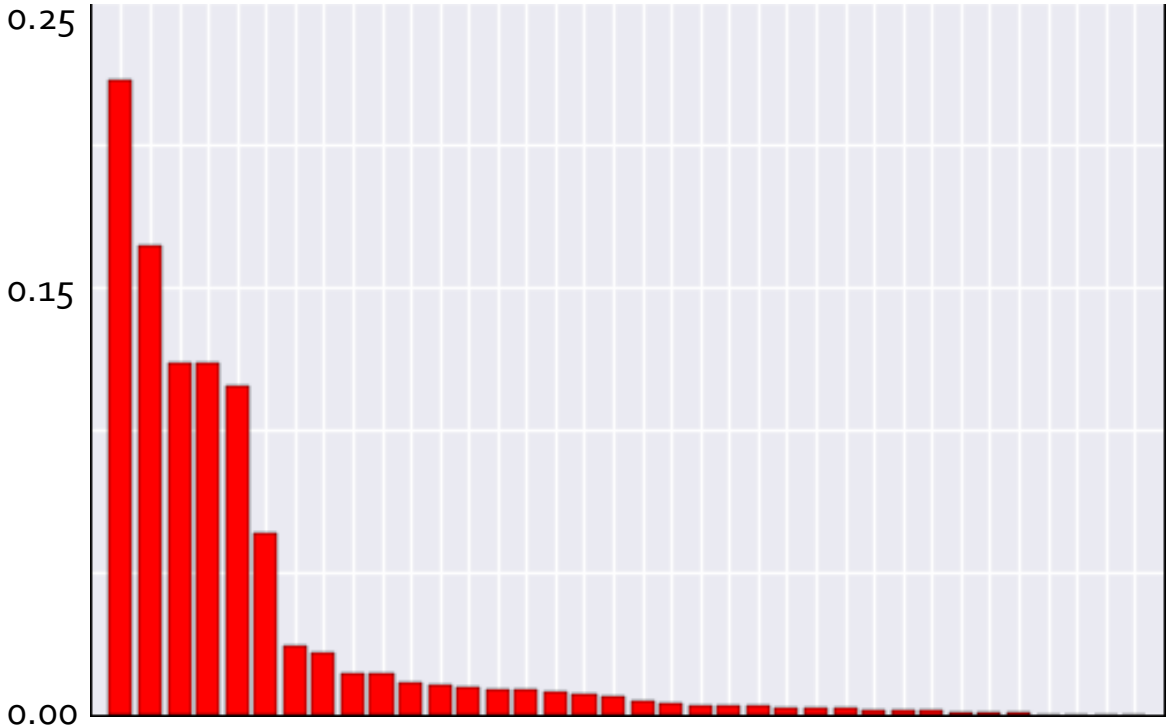
Circulation per capita: Predictions and Actual Values



Green=actual values
Blue=predictions

# Model 2: Circulation per Capita

- Feature importance
  - Most important: electronic books, state income, local government revenue, book volume, state government revenue



# Results

- Random forest regressor had lower mean squared error for both sets of models.
- Population of service area had a big effect on total circulation

# Next Steps

- Add more demographic data
  - Age
  - AMI by census tract