Intro to Data Science Schedule

Monday July 12

9-9:30: Course Overview

9:30-10:30: Coding & Python Basics

10:30-10:45: Break

10:45-12:15: Fundamentals of Data Manipulation

12:15-1:15: Lunch

1:15-3:15: Data Visualization

3:15-3:30: Break

3:30-4:30: Ethical Issues in Data Science

4:30-5: Questions & Project Planning

5-5:30: Artificial Intelligence (AI) Institute

Tuesday July 13

9-9:30: Clustering Using K-Means

10:30-10:45: Break

10:45-12:15: Linear and Logistic Regression Methods

12:15-1:15: Lunch

1:15-4:00: Group Work on Course Project

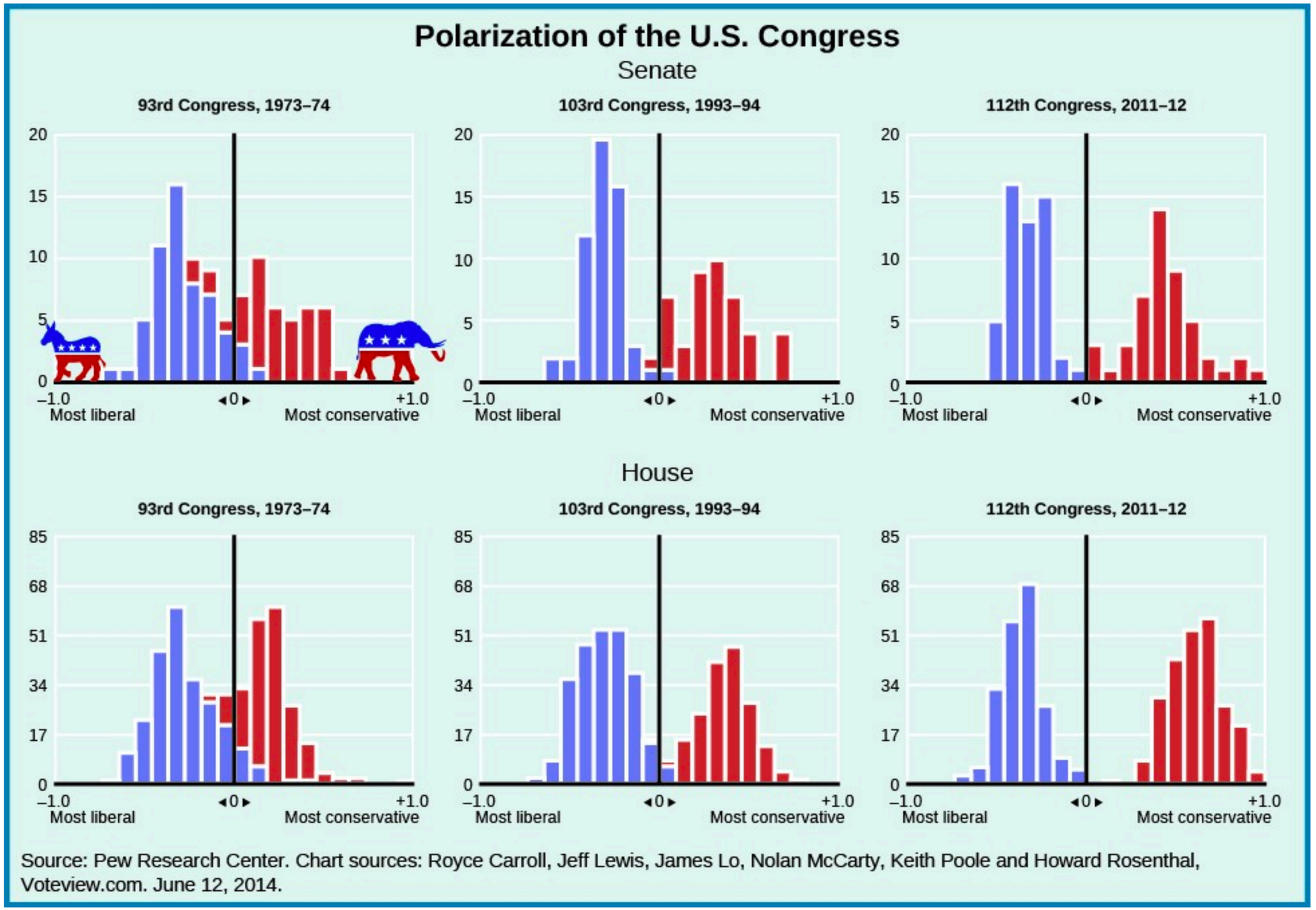
4:00-4:30: Project Presentations and Discussion

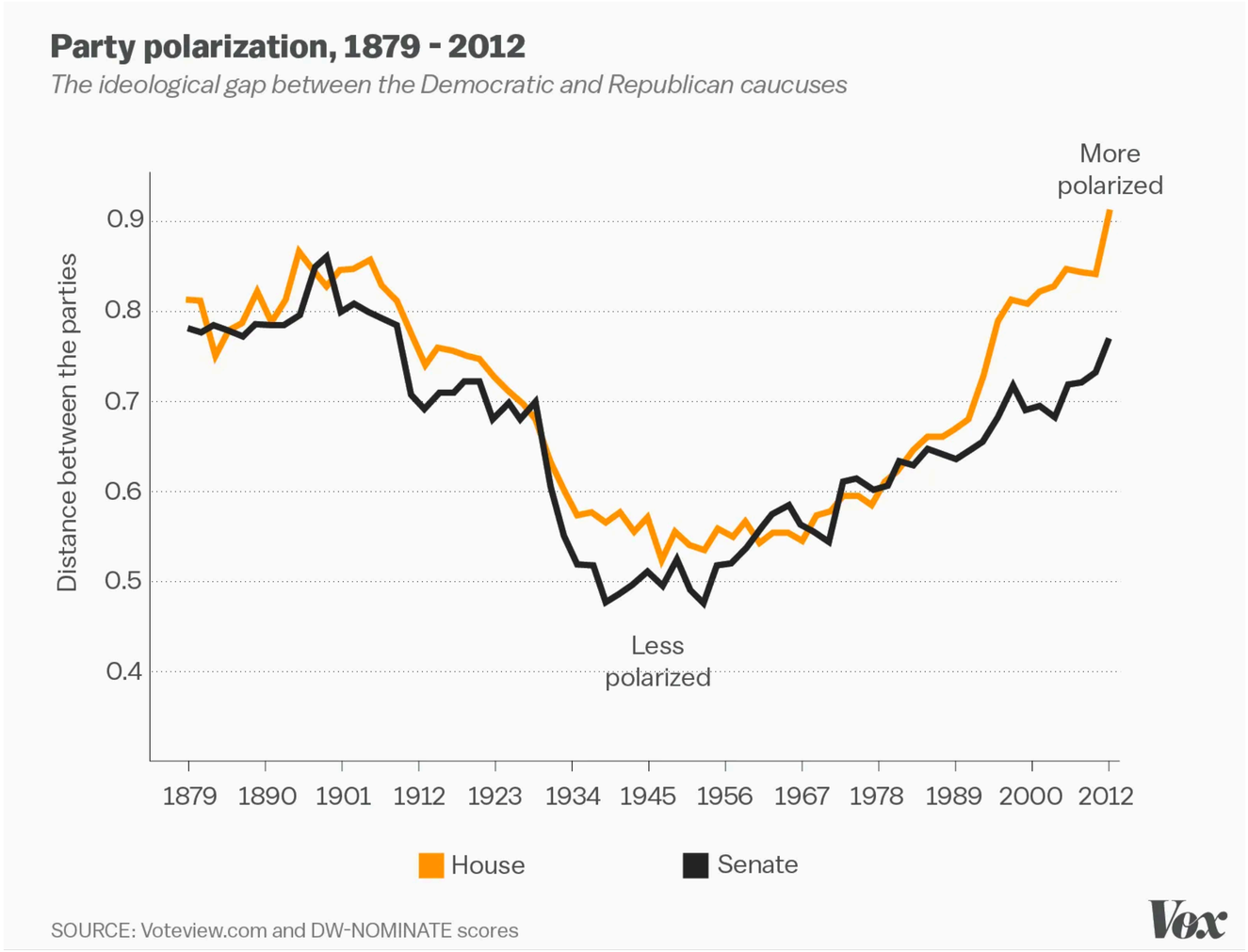
4:30-5:00: Final Thoughts and Questions

Project Logistics

- **goals:**
  - get more independent experience working on data analysis and results interpretation in python
  - explore details of skills we cover that are of interest to you
  - have some freedom to pose and answer a specific research question about the project you choose
- work in pairs: in-person work together; virtual work together — will have a time block to choose shortly
- two prompts to choose from: suggested project work will be closely outlined, but you are free to jump ahead to more open ended parts
- expectation: get through at least most of the prompted portion of the project and be prepared to give a 1-2 minute report back on how it went, what you learned

Quantifying Political Polarization





- use clustering to test hypothesis that the US Senate (and the House) has become more polarized in terms of voting blocks across time

- could test other countries; could analyze with or without knowledge of party

1) Load data set on Congressional voting from a 2 year time increment

2) Clean data to obtain wide form with yea/nay/abstain indicated for each senator and corresponding bill vote

3) Compute and plot yeas/nays of each senator in a term; look to identify distinguishable clusters

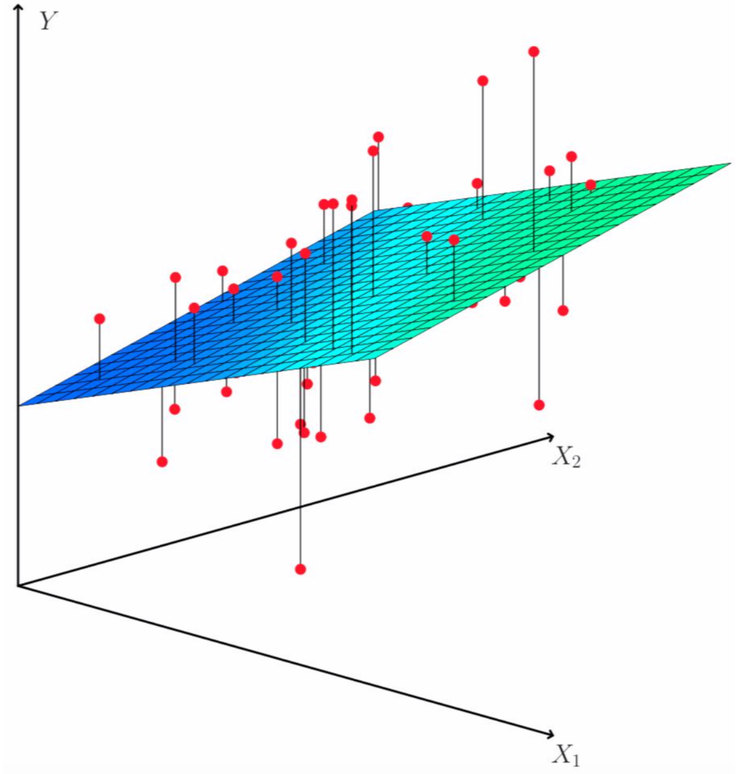
4) Perform principal components analysis on the vote distribution of all senators and plot first two components to again see if data clusters

5) Perform clustering and compare to visualized distribution of yeas/nays as well as principal components

6) Compute a measure of how distinct the clusters are

7) Make comparisons of cluster separation score across time

Multiple Linear Regression



- Is at least one feature useful in predicting the response?
- Do all of the features help to explain the response?
- Or can we reduce to a few?
- How well does the model fit the data?
- How well does a subset of features do?

Model Selection: Which features to keep?

- Try all p features, choose the best combo.
- There are 2^p possible models, so for $p = 30$ that's $2^{30} \approx 10^9$ models to test

selection: A greedy algorithm for selecting features

1) Fit a null model with an intercept but no slope

2) Fit p individual SLR models — 1 for each feature. Add to the null model the one that improves the null model best (e.g., decreases SSE most, increases F-statistic most

3) Fit $p - 1$ MLR — 1 for each of the remaining features along with the feature you isolated from step 2. Add one that improves the model performance most.

Backward selection: greedy algorithm for removing features

1) Fit model with all available features

2) Remove the feature with the largest p-value (i.e. the significant feature)

3) Repeat until some stopping criterion is reached. (e.g., some threshold SSE, or some fixed number of features)