Gov 50: 10. Election Prediction

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1. Today’s agenda

2. Predicting presidential elections

3. Loops

4. Evaluating the predictions

1/ Today's agenda

Logistics

- Great job on HW2 + midterm!!
- Mid-semseter evaluation:
    - Going live today.
    - Important to get your feedback on how the course is going.
    - Will discuss results next week.
- Govt department climate survey
    - Gov concentrators will receive email from "Harvard College Institutional Research."
    - 10 minute survey about your experiences with the department.
    - Please help us lower the non-response bias!

Where are we? Where are going?

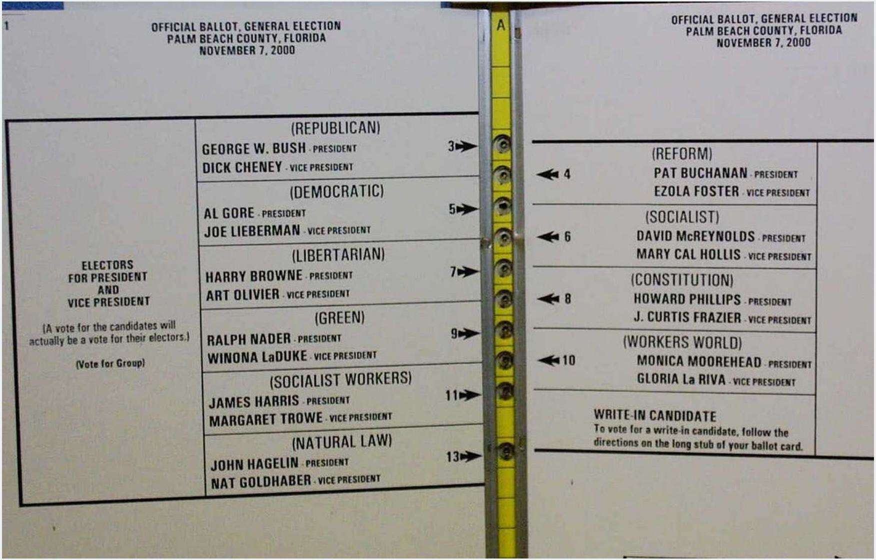
- Up to now: two uses for statistics in research
    - Causality: how one thing affects another
    - Measurement: amorphous concept $\rightsquigarrow$ data
- Now: third use of statistics
- **Prediction**: making a best guess about unknown quantity using data.
- Today: how to make and evaluate predictions.
    - prediction error, bias, (mis)classification
- Context: predicting US presidential election results.
- R tools: loops for repeated tasks

2/ Predicting presidential elections

Electoral College

- 2016 election popular vote:
  - Clinton: 65,853,516 (48.2%)
  - Trump: 62,984,825 (46.1%)
- Why did Trump win? **Electoral college**
  - Trump: 304, Clinton: 227
- Election determined by 77,744 votes (margins in WI, MI, and PA)
  - 0.056% of the electorate (~136 million)

Butterfly ballot



1

OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

ELECTORS
FOR PRESIDENT
AND
VICE PRESIDENT

(A vote for the candidates will actually be a vote for their electors.)

(Vote for Group)

(REPUBLICAN)
GEORGE W. BUSH - PRESIDENT
DICK CHENEY - VICE PRESIDENT
3

(DEMOCRATIC)
AL GORE - PRESIDENT
JOE LIEBERMAN - VICE PRESIDENT
5

(LIBERTARIAN)
HARRY BROWNE - PRESIDENT
ART OLIVIER - VICE PRESIDENT
7

(GREEN)
RALPH NADER - PRESIDENT
WINONA LaDUKE - VICE PRESIDENT
9

(SOCIALIST WORKERS)
JAMES HARRIS - PRESIDENT
MARGARET TROWE - VICE PRESIDENT
11

(NATURAL LAW)
JOHN HAGELIN - PRESIDENT
NAT GOLDHABER - VICE PRESIDENT
13

OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

4
(REFORM)
PAT BUCHANAN - PRESIDENT
EZOLA FOSTER - VICE PRESIDENT

6
(SOCIALIST)
DAVID McREYNOLDS - PRESIDENT
MARY CAL HOLLIS - VICE PRESIDENT

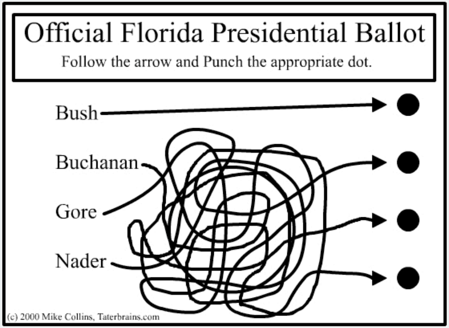
8
(CONSTITUTION)
HOWARD PHILLIPS - PRESIDENT
J. CURTIS FRAZIER - VICE PRESIDENT

10
(WORKERS WORLD)
MONICA MOOREHEAD - PRESIDENT
GLORIA La RIVA - VICE PRESIDENT

WRITE-IN CANDIDATE
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.

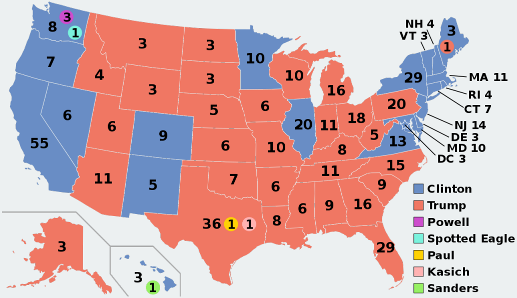
Florida 2000 recount

- National votes: Gore = 50,999,897 vs. Bush = 50,456,002
- Margin of victory in Florida: 537 votes (or 0.01% of all FL votes)!
- Recounts followed by the US Supreme court decision *Bush v. Gore*


Official Florida Presidential Ballot
Follow the arrow and Punch the appropriate dot.
Bush
Buchanan
Gore
Nader
(c) 2000 Mike Collins, Taterbrains.com

Predicting US Presidential Elections

- **Electoral college system**
  - Must win an absolute majority of 538 electoral votes
  - 538 = 435 (House of Representatives) + 100 (Senators) + 3 (DC)
  - Must win at least 270 votes
  - nobody wins an absolute majority ⇝ House vote
- Must predict winner of each state



Prediction strategy

- Predict state-level support for each candidate using polls
- Allocate electoral college votes of that state to its predicted winner
- Aggregate EC votes across states to determine the predicted winner
- Coding strategy:
    1. For each state, subset to polls within that state.
    2. Further subset the latest polls
    3. Average the latest polls to estimate support for each candidate
    4. Allocate the electoral votes to the candidate who has greatest support
    5. Repeat this for all states and aggregate the electoral votes
- Sounds like a lot of subsets, ugh...

3/ Loops

Multiplication

```r
values <- c(2, 4, 6)
```

- Let’s say you want to create a new variable that multiplies each value in a vector by 2.
  - Easy in R: `values * 2`
  - Pretend you didn’t know this approach

Manually changing values

```r
values <- c(2, 4, 6)

## number of values
n <- length(values)

## create container to hold results
results <- rep(NA, times = n)

## multiply each value by 2
results[1] <- values[1] * 2
results[2] <- values[2] * 2
results[3] <- values[3] * 2

## print results
results
```

```
## [1]  4  8 12
```

Loops in R

- Basic structure:

```
for (i in X) {
  expression1
  expression2
  ...
  expression3
}
```

- Elements of a loop:
  1. `i`: counter (can use any name)
  2. `X`: vector containing a set of ordered values the counter takes.
  3. `expression`: a set of expressions that will be repeatedly evaluated.
  4. `{ }`: curly braces to define beginning and end of the loop.
- Indentation is important for readability of the code.
- Code without loops first by setting counter to specific value.

Loop example

```
values <- c(2, 4, 6)

## number of values
n <- length(values)

## create container to hold results
results <- rep(NA, n)

## begin loop
for (i in 1:n) {
  results[i] <- values[i] * 2

  ## use cat() to display output
  cat(values[i], ”times 2 is equal to ”, results[i], ”\n”)
}
```

```
## 2 times 2 is equal to  4
## 4 times 2 is equal to  8
## 6 times 2 is equal to  12
```

2016 polling prediction

- Election data: `pres16.csv`

Name	Description
`state`	abbreviated name of state
`state.name`	unabbreviated name of state
`clinton`	Clinton's vote share (percentage)
`trump`	Trump's vote share (percentage)
`ev`	number of electoral college votes for the state

- Polling data `polls16.csv`

Name	Description
`state`	abbreviated name of state in which poll was conducted
`middate`	middate of the period when poll was conducted
`daysleft`	number of days between middate and election day
`pollster`	name of organization conducting poll
`clinton`	predicted support for Obama (percentage)
`trump`	predicted support for McCain (percentage)

Some preprocessing

```
# election results by state
pres16 <- read.csv(”data/pres16.csv”)

# polling data
polls16 <- read.csv(”data/polls16.csv”)

# calculate Trump's margin of victory
polls16$margin <- polls16$trump - polls16$clinton
pres16$margin <- pres16$trump - pres16$clinton
```

What does the data look like?

```r
head(polls16)
```

```
##   state  middate daysleft                pollster
## 1    AK  8/11/16       89  Lake Research Partners
## 2    AK  8/20/16       80            SurveyMonkey
## 3    AK 10/20/16       19                  YouGov
## 4    AK 10/26/16       13 Google Consumer Surveys
## 5    AK  9/30/16       39 Google Consumer Surveys
## 6    AK 10/12/16       27 Google Consumer Surveys
##   clinton trump margin
## 1    30.0  38.0   8.00
## 2    31.0  38.0   7.00
## 3    37.4  37.7   0.30
## 4    38.0  39.0   1.00
## 5    47.5  36.7 -10.76
## 6    34.6  30.0  -4.62
```

Poll prediction for each state

```r
poll.pred <- rep(NA, 51) # place holder
```

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st.names <- unique(polls16$state)
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poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names
```

Poll prediction for each state

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poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names

for (i in 1:51) {
```

Poll prediction for each state

```r
poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names

for (i in 1:51) {
  state.data <- subset(polls16, subset = (state == st.names[i]))
```

Poll prediction for each state

```r
poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names

for (i in 1:51) {
  state.data <- subset(polls16, subset = (state == st.names[i]))

  latest <- state.data$daysleft == min(state.data$daysleft)
```

Poll prediction for each state

```r
poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names

for (i in 1:51) {
  state.data <- subset(polls16, subset = (state == st.names[i]))

  latest <- state.data$daysleft == min(state.data$daysleft)

  poll.pred[i] <- mean(state.data$margin[latest])
}
```

Poll prediction for each state

```r
poll.pred <- rep(NA, 51) # place holder

# get list of unique state names to iterate over
st.names <- unique(polls16$state)

# add labels to holder
names(poll.pred) <- st.names

for (i in 1:51) {
  state.data <- subset(polls16, subset = (state == st.names[i]))

  latest <- state.data$daysleft == min(state.data$daysleft)

  poll.pred[i] <- mean(state.data$margin[latest])
}

head(poll.pred)
```

```
##     AK     AL     AR     AZ     CA     CO
##  14.73  29.72  20.02   2.50 -23.00  -7.05
```

4/ Evaluating the predictions

Polling errors

- **prediction error** = actual outcome − predicted outcome

```
errors <- pres16$margin - poll.pred
names(errors) <- st.names
```

- **Bias**: average prediction error

```
mean(errors)
```

```
## [1] 3.81
```

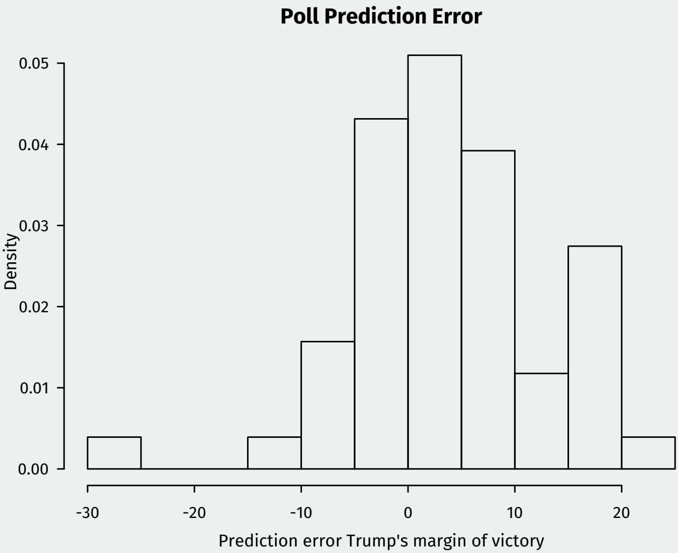
- **Root mean-square error**: average magnitude of the prediction error

```
sqrt(mean(errors^2))
```

```
## [1] 9.6
```

Histogram of the errors

```
hist(errors, freq = FALSE, main = ”Poll Prediction Error”,
     xlab = ”Prediction error Trump's margin of victory”)
```



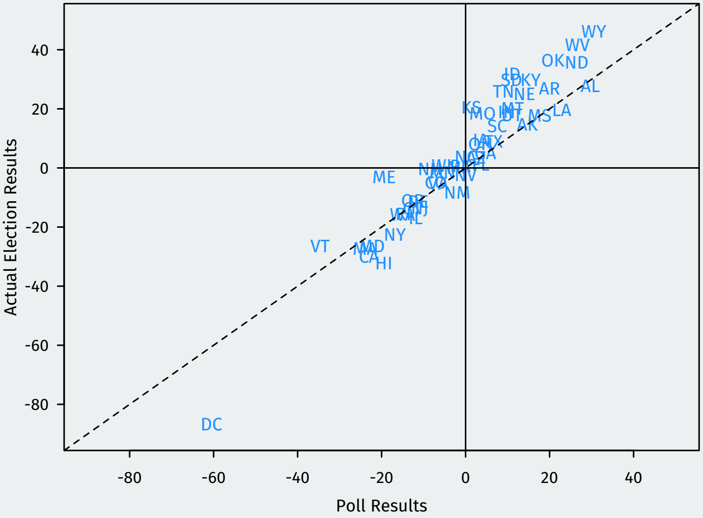
Poll Prediction Error

State-by-state errors

```
plot(poll.pred, pres16$margin, type = ”n”, main = ””,
     xlim = c(-90, 50), ylim = c(-90, 50),
     xlab = ”Poll Results”,
     ylab = ”Actual Election Results”)

text(poll.pred, pres16$margin, pres16$state,
     col = ”dodgerblue”)

abline(a = 0, b = 1, lty = ”dashed”) ## 45-degree line
abline(v = 0)
abline(h = 0)
```


WY
WV
OK
ND
ID
SD
KY
TN
NE
AR
AL
KS
MO
IN
MT
UT
MS
LA
SC
AK
IA
OH
TX
NC
GA
AZ
FL
NH
WI
PA
MI
MN
NV
ME
CO
VA
NM
OR
DE
CT
RI
NJ
WA
IL
NY
VT
MA
MD
CA
HI
DC
40
20
0
-20
-40
-60
-80
Actual Election Results
-80
-60
-40
-20
0
20
40
Poll Results

Classification

- Election prediction: need to predict winner in each state:

```r
sum(pres16$ev[pres16$margin > 0])
```

```
## [1] 305
```

```r
sum(pres16$ev[poll.pred > 0])
```

```
## [1] 244
```

- Prediction of binary outcome variable = **classification problem**
- Wrong prediction ⇝ misclassification
  1. **true positive**: predict Trump wins when he actually wins.
  2. **false positive**: predict Trump wins when he actually loses.
  3. **true negative**: predict Trump loses when he actually loses.
  4. **false negative**: predict Trump loses when he actually wins.
- Sometimes false negatives are more/less important: e.g., civil war.

Classification based on polls

- Accuracy: `sign()` returns `1` for a positive number, `-1` for a negative number, and `0` for 0.

```r
mean(sign(poll.pred) == sign(pres16$margin))
```

```
## [1] 0.902
```

- Which states did polls call wrong?

```r
pres16$state[sign(poll.pred) != sign(pres16$margin)]
```

```
## [1] MI NC NV PA WI
## 51 Levels: AK AL AR AZ CA CO CT DC DE FL GA HI ... WY
```

- What were the actual margins?

```r
pres16$margin[sign(poll.pred) != sign(pres16$margin)]
```

```
## [1]  0.22  3.66 -2.42  0.71  0.77
```

How does 538/NYT difer?

- What we did is the core idea behind election forecasters like 538 and the NYT election prediction.
- What do they do differently?
  - Use a longer history of polls but down-weight older polls.
  - Up-weight/down-weight polls from polling firms with low/high past prediction error.
  - Up-weight polls with better methodologies.
  - Combine poll-based predictions with predictions based on “fundamentals” like economic performance, popularity of the incumbent president.

Next week

- Prediction using linear regression.
- DataCamp assignment 4 due on Thursday
- HW 3 goes out on Tuesday
- Mid-semester evaluation survey online now.