A look into Kamala Harris' polls in the upcoming 2024 US Presidential Election*

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The 2024 US election has been seen as a close race between the Democratic nominess Kamala Harris, and the Republican Nominee Donald Trump, with each candidate holding down key states and matching each other in battleground states such as Pennsylvania and Georgia. This paper looks at the polling as of late October 2024 to see how Kamala Harris fares as the election draws near.

1 Introduction

The 2024 US Presidential race has been closely contested since incumbent president, Joe Biden, announced his exit from the race. The race is primarily between current VP, Democratic Party candidate Kamala Harris (with running mate Time Walz), and former president, Republican Party candidate Donald Trump (with running mate J.D. Vance). Polls across the country have conflicting reports on who will come out on top, with some sources suggesting an unheard-of tie in the eletoral college vote (269-269 vote distribution) (Lopez 2024).

To get a better grasp of nationwide and state opinions going into the election, a predictive model was created in this report. The model utilises data from fivethirtyeight.com, which hosts a dataset of diverse and reputable polls taken across the country. Using this data, we (INSERT WRANGLING DONE TO DATASHEET). Then we constructed a generalized linear model, predicting (INSERT PREDICTOR), using (INSERT PREDICTEES) as predictors. The results from the model show (INSERT RESULTS FROM MODEL)

Section 2 will outline the source of this data. Section 3 covers the model and it's parameters. Section 4 is where discussion will be made about the models predictions and how realistically they line up with current affairs. Finally, section 4 discusses any weakness and limitations that can be considered for another report.

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*Code and data are available at: https://github.com/Veyasan1/2024USElectionModel

2 Data

The dataset provided by fivethirtyeight contains over 15000 observations across 50 variables. Each observation is a poll conducted on the 2024 US Presidential Election. Pollsters are required by fivethirtyeight to disclose certain information about their poll, either publicly, or through an investigation. Of this information, a handful are key to the predictive model.

2.0.1 `end_date`

Every poll has a start and end date for querying its participants. Polls that are conducted closer to election day may be more reflective of American opinions as opposed to polls conducted in August or September. This is why we will be using this variable as one of our predictors in the model.

```
#### Plot data ####
just_harris_high_quality |>
  ggplot(mapping=aes(x = end_date)) +
  geom_histogram()
```
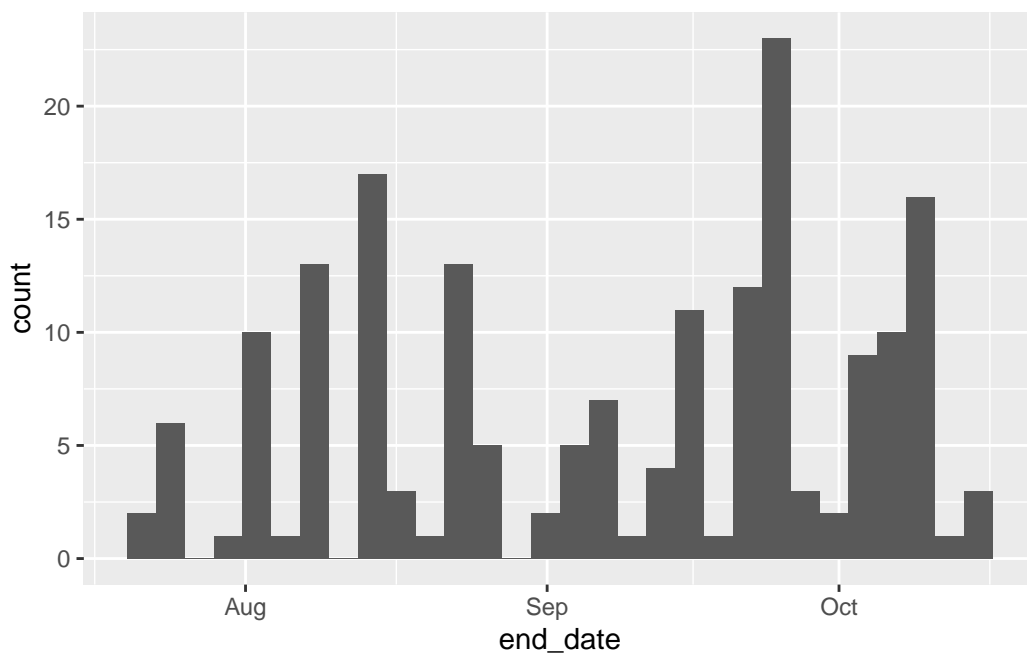


```
summary(just_harris_high_quality$end_date)
```

```
       Min.      1st Qu.       Median         Mean      3rd Qu.         Max.
"2024-07-22" "2024-08-15" "2024-09-14" "2024-09-07" "2024-09-26" "2024-10-16"
```

2.0.1.1 `poll_score`:

The error and bias associated with a pollster. Positive values indicate more bias and errors, negative values indicate less. This value will tell us if biases in polls influences the predicted percentages of each candidate

```r
#### Plot data ####
base_plot <- ggplot(just_harris_high_quality, aes(x = end_date, y = pct)) +
  theme_classic() +
  labs(y = "Harris percent", x = "Date")

# Color by pollscore
base_plot +
  geom_point(aes(color = factor(pollscore))) +
  geom_smooth() +
  theme(legend.position = "bottom")
```



```r
summary(just_harris_high_quality$pollscore)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.50   -1.50   -1.50   -1.31   -1.10   -1.10
```

```
summary(just_harris_high_quality$numeric_grade)
```
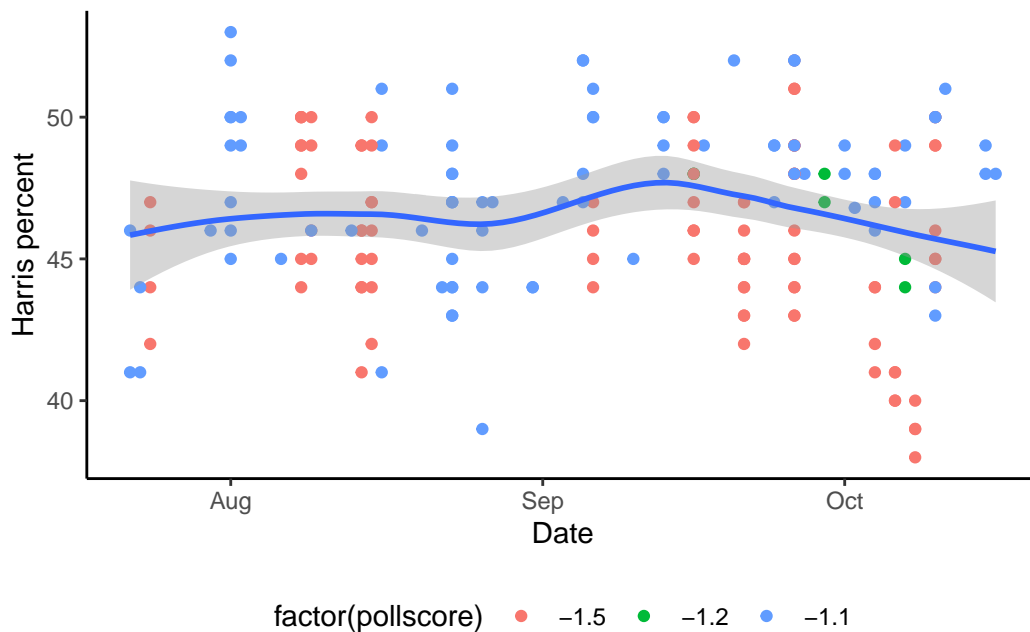
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
      3       3       3       3       3       3
```

2.0.2 `numeric_grade`

```r
#### Plot data ####
base_plot <- ggplot(just_harris_high_quality, aes(x = end_date, y = pct)) +
  theme_classic() +
  labs(y = "Harris percent", x = "Date")

# Color by numerical_grade
base_plot +
  geom_point(aes(color = factor(numeric_grade))) +
  geom_smooth() +
  theme(legend.position = "bottom")
```
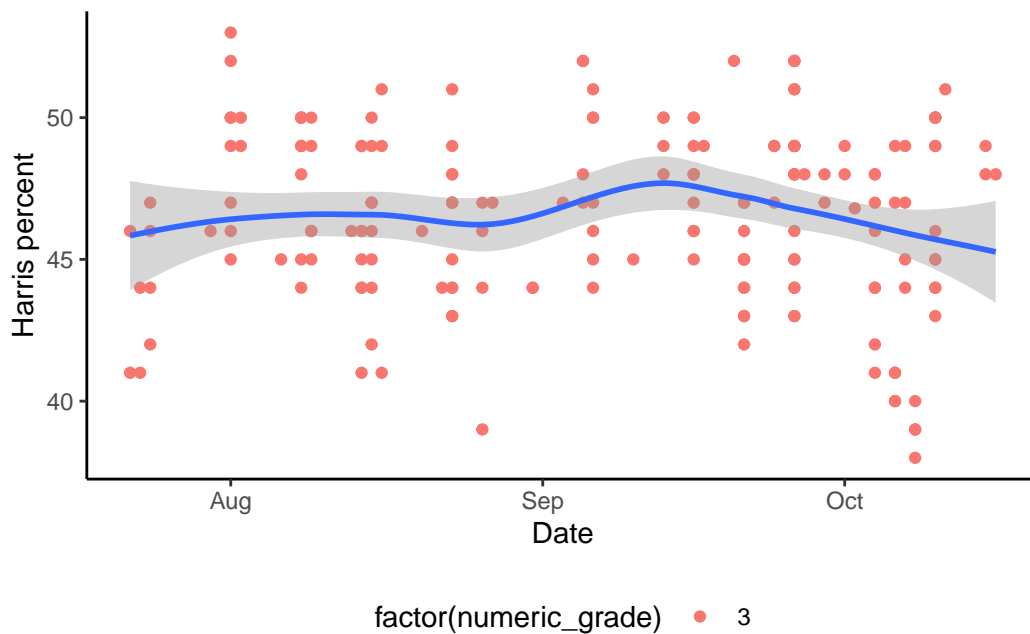
```
summary(just_harris_high_quality$pollscore)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  -1.50   -1.50   -1.50   -1.31   -1.10   -1.10
```

```
summary(just_harris_high_quality$numeric_grade)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
      3       3       3       3       3       3
```

```r
#### Plot data ####
base_plot <- ggplot(just_harris_high_quality, aes(x = end_date, y = pct)) +
  theme_classic() +
  labs(y = "Harris percent", x = "Date")

# Plots poll estimates and overall smoothing
base_plot +
  geom_point() +
  geom_smooth()
```
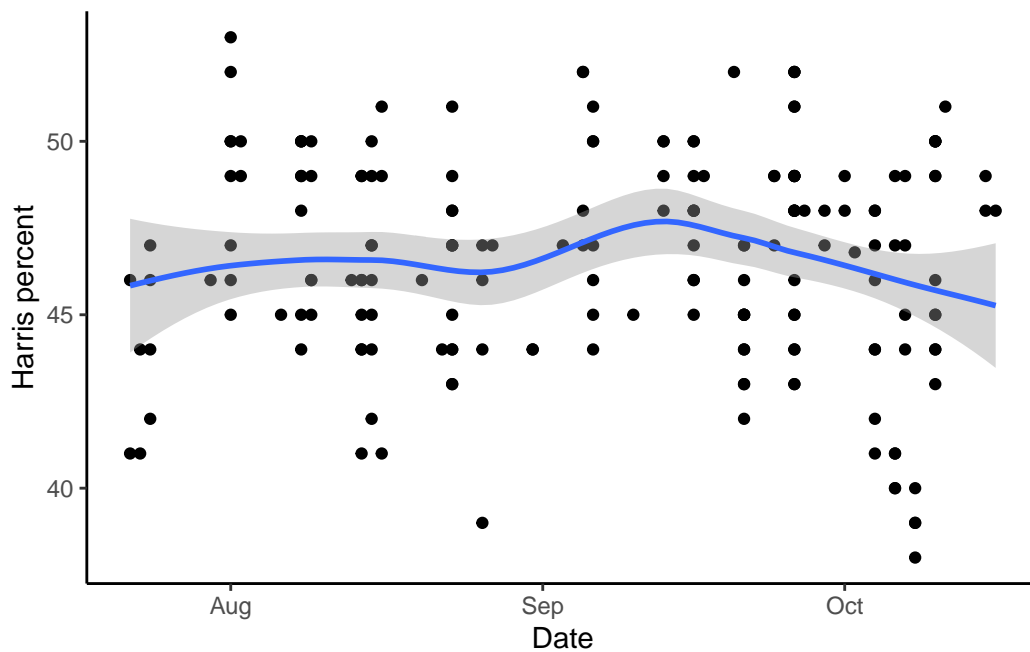
```
# Color by pollster
# This gets messy - need to add a filter - see line 21
base_plot +
  geom_point(aes(color = pollster)) +
  geom_smooth() +
  theme(legend.position = "bottom")
```
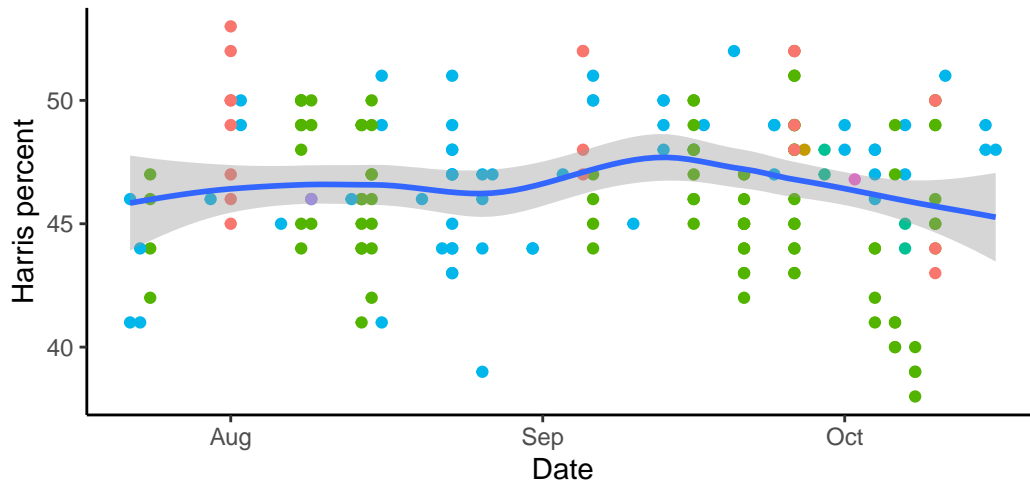


```
# Facet by pollster
# Make the line 21 issue obvious
# Also - is there duplication???? Need to go back and check
base_plot +
  geom_point() +
  geom_smooth() +
  facet_wrap(vars(pollster))
```
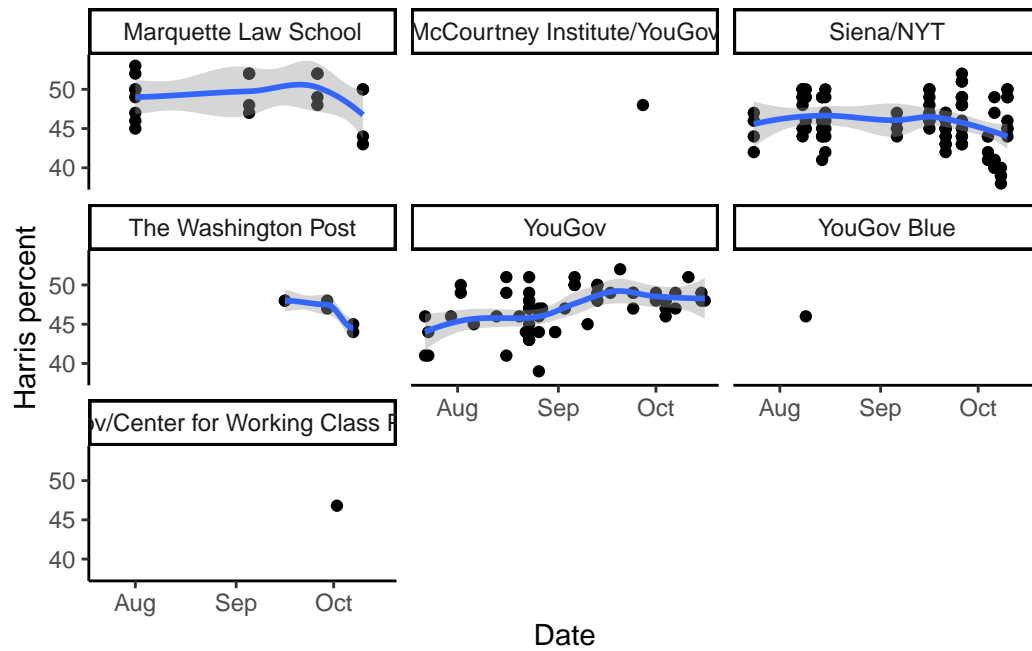
```
# Color by pollscore
base_plot +
  geom_point(aes(color = factor(pollscore))) +
  geom_smooth() +
  theme(legend.position = "bottom")
```
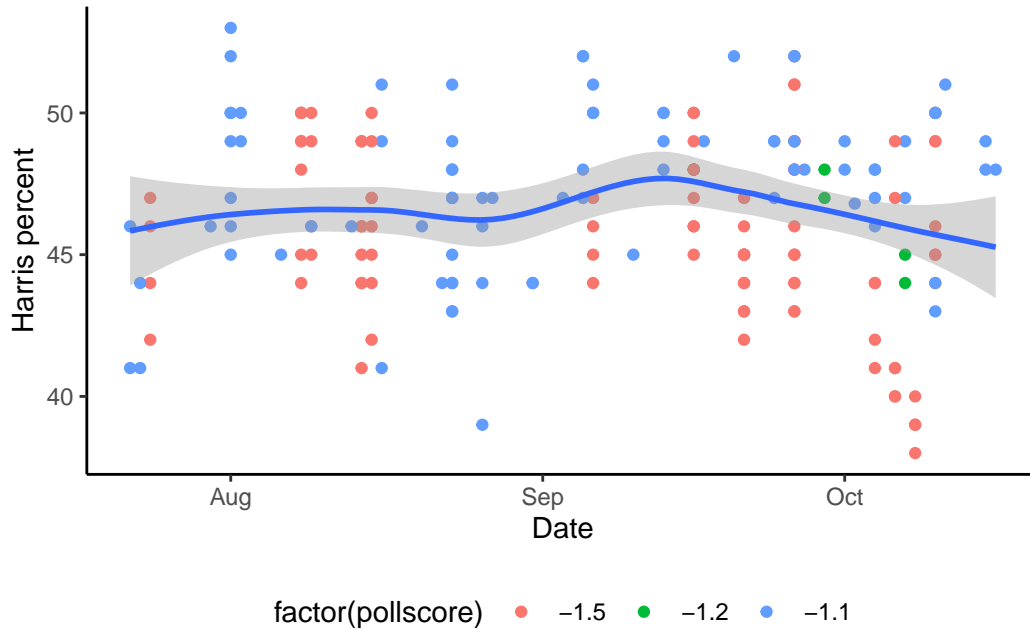
3 Measurement

The dataset comes from fivethirtyeight.com, a statistical analysis website dedicated to US sports and elections (Ryan Best, Aaron Bycoffe 2024). Fivethirtyeight takes polls conducted on a particular topic (in this case the 2024 US presidency), and aggregates them in one dataset.

Election polls are used to gauge public opinion about candidates, political topics, voter engagement, and public opinion of the election process. Election polls also serve as key insight to political organisations representing candidates, polls can show potential weak points across demographics.

Election polls are similarly to regular polls, they involve asking a sample population a series of questions via a delivery method. The key distinction is that election polls typically try to target *voters*, or people who are most likely to vote in the election cycle being investigated. This is a key challenge to pollsters, as there are many subgroups of voters, such as people who seldom vote or never vote. According to Pew Research, a third of US citizens did not vote in the 2020 election, despite the 2020 election cycle having high voter turnout (Keeter 2024). There may also be cases when respondents of a poll reconsider whether they will vote come election day.

Election polling has exploded in recent times according to Pew Research. They suggest that double there are double the amount of active pollsters in 2022 compared to 2000 (Keeter 2024).

One reason mentioned is the advent of online polling, which is simple, cheap, and can easily reach US citizens across the country, compared to traditional methods such as poll by phone and mail. As a result, while the diversity of pollsters has increased dramatically, the variance in results methodology, and ethics have also increased

Errors in election polling have been an issue in the last two cycles of presidential elections. Between the 2016 and 2020 elections, there has been a trend of pollsters not fully capturing Trump's support. For example in 2020, despite Biden winning the election, there were reports from the American Associcate for Public Opinion Research that national polls overstated his victory over Trump by 3.9 percentage points (Keeter 2024).

Fivethirty eight mitigates the influx of pollsters and the potential for errors by routinely checking up on pollsters as they produce reports. Fivethirtyeight checks every pollster, regardless of experience or prestige. There are 2 types of checks fivethirtyeight uses: Methodology and Ethics.

Methodology refers to the scientific rigor exhibited by the pollster, when conducting the poll, and in the presentation of the results. Fivethirtyeight requires each poll to have or easily obtain the following (Radcliffe and Morris 2023):

- Pollster Identity
- Survey Dates
- Population Sample (Size and other distinct attributes)
- Polling Method (How was the poll conducted?)
- Sponsors (Identity and Amount

Even if these conditions are met, fivethirtyeight may refuse to include certain polls in their data, due to flaws in methodology. Some examples include (Radcliffe and Morris 2023):

- Polls with inappropriate sample for target population
- Polls based upon predictive models
- Polls that implement recontact with participants (potential for bias to creep into the sample)
- Polls done by amateur/non-professional pollsters
- Polls with an "informed ballot" (when information about a candidate is given to the participant before they are asked who they would vote for)

The second check fivethirtyeight implements is ethical standard, adapted from the American Association for Public Opinion Research's Code of Professional Ethics and Practices . Fivethirtyeight may refuse to include polls that (Radcliffe and Morris 2023):

- Fabricate or falsify data

- Are associated with the betting industry

- Refuse to disclose their methodology, either in their findings, or after being contacted for clarification

- Misrepresent their true purpose (being part of campaign analysis or done for a particular party or candidate)

- Disclose errors that come about from their work, and rectify them as best as possible

- Utilize methods that will give misleading results

Fivethirtyeight will conduct an initial check on pollsters, seeing if their methodology and ethics are publicly available, and are in agreement with fivethirtyeight's checks. If unclear, fivethirtyeight will do a more thorough investigation of the pollster, and ask the organizers questions about their methodology and ethics if none were visible in the public report. If there are any violations in ethics, the severity on consequences will vary on what the offence is. If there is evidence of falsifying data or engaging in betting markets, the pollster is blacklisted from their data. Otherwise, pollsters are given a chance to fix ethical issues presented by fivethirtyeight. Failure to do so results in the pollster and any of its polls being taken off the dataset, but fivethirtyeight can reverse this decision if the pollster demonstrates satifactory ethics and methodology practices(Radcliffe and Morris 2023).

Partisan polls are a small subset of polls that are made with the backing or organizations affiliated with one or more political organizations. Fivethirtyeight will allow these polls into their data, but they will be marked as "Partisan", and extra checks are put in place to ensure the polling data hasn't been influenced unethically by the pollster or it's affiliated organizations (Radcliffe and Morris 2023).

4 Model

The model contains 4 parameters. They are pollster, state, sponsors, and methodology.

Pollster is the operator of the observed poll. Pollster provides a relatively easy way to identify trends in certain polls, depending on who is conducting them.

State tells us where the poll was conducted. Across the United States, ther are states that traditionally vote Democrat (New York, California), some that traditionally vote Republican (Texas, Florida), and 'swing states' (Michigan, Pennsylvania). Swing states in particular are the most interesting states to watch as votes from these states tend to win a candiate the US presidency.Knowing where the polls have been taken also lets us understand if their choice was one bound by the state's culture.

Sponsors are organizations that fund or otherwise assist the pollster in operating the poll. Sponsors carry the risk of bias with them, potentially influencing the pollster, and thus the polls to skew in a direction the sponsor favors preferably. Knowing who these sponsors are potemntially lets us make informed predictions on the outcome of polls.

Methodology is the way the poll was conducted. Sometimes the composition of the poll influences peoples votes, so this is an interesting parameter to track. This also lets us see if certain methods yield better or worse predictions.

5 Results
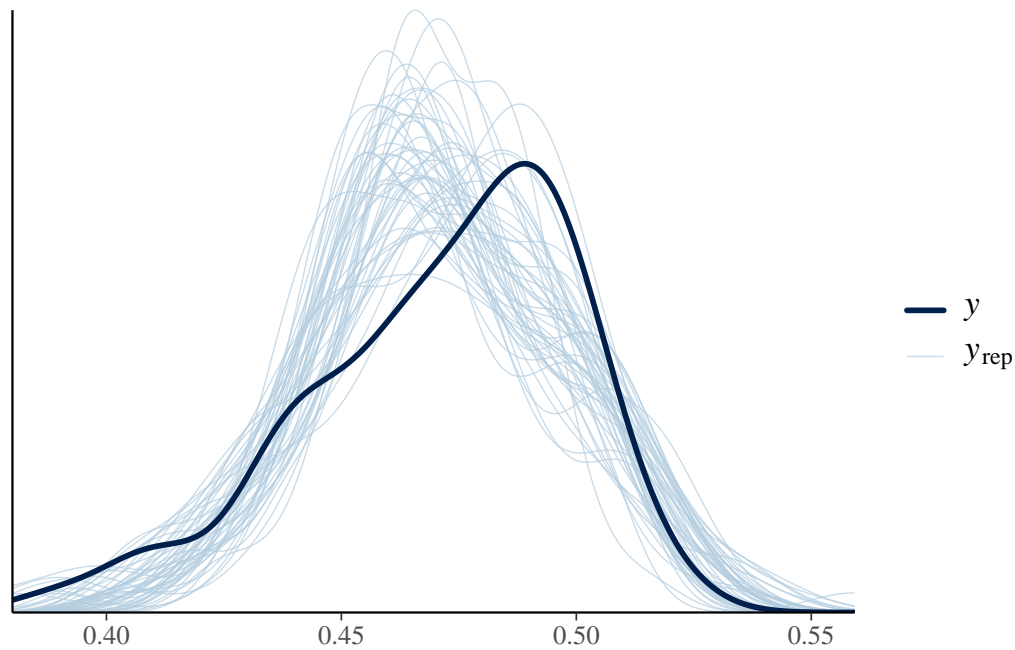

```
Model Info:
 function:     stan_glmer
 family:       binomial [logit]
 formula:      cbind(num_harris, sample_size - num_harris) ~ (1 | pollster) +
         (1 | state) + (1 | sponsors) + (1 | methodology)
 algorithm:    sampling
 sample:       4000 (posterior sample size)
 priors:       see help('prior_summary')
 observations: 63
 groups:       sponsors (11), state (9), pollster (4), methodology (2)
```

```
Estimates:
                                                                                   mean    sd
(Intercept)                                                                        -0.1    0.3
b[(Intercept) sponsors:Carolina_Forward]                                            0.0    0.1
b[(Intercept) sponsors:CATO_Institute]                                              0.0    0.1
b[(Intercept) sponsors:CBS_News]                                                    0.2    0.0
b[(Intercept) sponsors:Economist]                                                   0.0    0.0
b[(Intercept) sponsors:Institute_for_Global_Affairs]                               -0.1    0.1
b[(Intercept) sponsors:Jacobin]                                                     0.0    0.1
b[(Intercept) sponsors:Saint_Louis_University]                                     -0.1    0.1
b[(Intercept) sponsors:The_Philadelphia_Inquirer]                                   0.0    0.1
b[(Intercept) sponsors:The_Times_of_London_|_SAY24]                                -0.1    0.1
b[(Intercept) sponsors:University_of_Texas]                                         0.0    0.1
b[(Intercept) sponsors:Yahoo_News]                                                  0.0    0.0
b[(Intercept) state:Arizona]                                                        0.0    0.0
b[(Intercept) state:Georgia]                                                        0.0    0.0
b[(Intercept) state:Michigan]                                                       0.0    0.0
b[(Intercept) state:Missouri]                                                       0.0    0.0
b[(Intercept) state:National]                                                       0.0    0.0
b[(Intercept) state:North_Carolina]                                                 0.0    0.0
b[(Intercept) state:Pennsylvania]                                                   0.0    0.0
b[(Intercept) state:Texas]                                                          0.0    0.0
b[(Intercept) state:Wisconsin]                                                      0.0    0.0
b[(Intercept) pollster:Siena/NYT]                                                   0.0    0.1
b[(Intercept) pollster:YouGov]                                                      0.0    0.1
b[(Intercept) pollster:YouGov_Blue]                                                 0.0    0.1
b[(Intercept) pollster:YouGov/Center_for_Working_Class_Politics]                    0.0    0.1
b[(Intercept) methodology:Live_Phone]                                               0.0    0.3
b[(Intercept) methodology:Online_Panel]                                            -0.1    0.3
Sigma[sponsors:(Intercept),(Intercept)]                                             0.0    0.0
Sigma[state:(Intercept),(Intercept)]                                                0.0    0.0
Sigma[pollster:(Intercept),(Intercept)]                                             0.0    0.1
Sigma[methodology:(Intercept),(Intercept)]                                          0.2    0.5
                                                                                    10%    50%
(Intercept)                                                                        -0.4   -0.1
b[(Intercept) sponsors:Carolina_Forward]                                           -0.1    0.0
b[(Intercept) sponsors:CATO_Institute]                                             -0.1    0.0
b[(Intercept) sponsors:CBS_News]                                                    0.1    0.2
b[(Intercept) sponsors:Economist]                                                   0.0    0.0
b[(Intercept) sponsors:Institute_for_Global_Affairs]                               -0.1   -0.1
b[(Intercept) sponsors:Jacobin]                                                    -0.1    0.0
b[(Intercept) sponsors:Saint_Louis_University]                                     -0.2   -0.1
```

```
b[(Intercept) sponsors:The_Philadelphia_Inquirer]                        -0.1   0.0
b[(Intercept) sponsors:The_Times_of_London_|_SAY24]                       -0.1  -0.1
b[(Intercept) sponsors:University_of_Texas]                               -0.1   0.0
b[(Intercept) sponsors:Yahoo_News]                                         0.0   0.0
b[(Intercept) state:Arizona]                                              -0.1   0.0
b[(Intercept) state:Georgia]                                               0.0   0.0
b[(Intercept) state:Michigan]                                              0.0   0.0
b[(Intercept) state:Missouri]                                             -0.1   0.0
b[(Intercept) state:National]                                              0.0   0.0
b[(Intercept) state:North_Carolina]                                        0.0   0.0
b[(Intercept) state:Pennsylvania]                                          0.0   0.0
b[(Intercept) state:Texas]                                                 0.0   0.0
b[(Intercept) state:Wisconsin]                                             0.0   0.0
b[(Intercept) pollster:Siena/NYT]                                         -0.1   0.0
b[(Intercept) pollster:YouGov]                                            -0.1   0.0
b[(Intercept) pollster:YouGov_Blue]                                       -0.1   0.0
b[(Intercept) pollster:YouGov/Center_for_Working_Class_Politics]          -0.1   0.0
b[(Intercept) methodology:Live_Phone]                                     -0.3   0.0
b[(Intercept) methodology:Online_Panel]                                   -0.4   0.0
Sigma[sponsors:(Intercept),(Intercept)]                                    0.0   0.0
Sigma[state:(Intercept),(Intercept)]                                       0.0   0.0
Sigma[pollster:(Intercept),(Intercept)]                                    0.0   0.0
Sigma[methodology:(Intercept),(Intercept)]                                 0.0   0.1
                                                                          90%
(Intercept)                                                                0.2
b[(Intercept) sponsors:Carolina_Forward]                                   0.1
b[(Intercept) sponsors:CATO_Institute]                                     0.0
b[(Intercept) sponsors:CBS_News]                                           0.2
b[(Intercept) sponsors:Economist]                                          0.1
b[(Intercept) sponsors:Institute_for_Global_Affairs]                       0.0
b[(Intercept) sponsors:Jacobin]                                            0.1
b[(Intercept) sponsors:Saint_Louis_University]                             0.0
b[(Intercept) sponsors:The_Philadelphia_Inquirer]                          0.1
b[(Intercept) sponsors:The_Times_of_London_|_SAY24]                        0.0
b[(Intercept) sponsors:University_of_Texas]                                0.0
b[(Intercept) sponsors:Yahoo_News]                                         0.1
b[(Intercept) state:Arizona]                                               0.0
b[(Intercept) state:Georgia]                                               0.0
b[(Intercept) state:Michigan]                                              0.0
b[(Intercept) state:Missouri]                                              0.0
b[(Intercept) state:National]                                              0.1
b[(Intercept) state:North_Carolina]                                        0.0
b[(Intercept) state:Pennsylvania]                                          0.0
```

```
b[(Intercept) state:Texas]                                            0.0
b[(Intercept) state:Wisconsin]                                        0.1
b[(Intercept) pollster:Siena/NYT]                                     0.2
b[(Intercept) pollster:YouGov]                                        0.1
b[(Intercept) pollster:YouGov_Blue]                                   0.1
b[(Intercept) pollster:YouGov/Center_for_Working_Class_Politics]      0.1
b[(Intercept) methodology:Live_Phone]                                 0.4
b[(Intercept) methodology:Online_Panel]                               0.2
Sigma[sponsors:(Intercept),(Intercept)]                               0.0
Sigma[state:(Intercept),(Intercept)]                                  0.0
Sigma[pollster:(Intercept),(Intercept)]                               0.1
Sigma[methodology:(Intercept),(Intercept)]                            0.7


Fit Diagnostics:
             mean   sd    10%   50%   90%
mean_PPD 630.2     3.3 626.0 630.2 634.3


The mean_ppd is the sample average posterior predictive distribution of the outcome variable

MCMC diagnostics
                                                            mcse Rhat
(Intercept)                                                  0.0  1.0
b[(Intercept) sponsors:Carolina_Forward]                     0.0  1.0
b[(Intercept) sponsors:CATO_Institute]                       0.0  1.0
b[(Intercept) sponsors:CBS_News]                             0.0  1.0
b[(Intercept) sponsors:Economist]                            0.0  1.0
b[(Intercept) sponsors:Institute_for_Global_Affairs]         0.0  1.0
b[(Intercept) sponsors:Jacobin]                              0.0  1.0
b[(Intercept) sponsors:Saint_Louis_University]               0.0  1.0
b[(Intercept) sponsors:The_Philadelphia_Inquirer]            0.0  1.0
b[(Intercept) sponsors:The_Times_of_London_|_SAY24]          0.0  1.0
b[(Intercept) sponsors:University_of_Texas]                  0.0  1.0
b[(Intercept) sponsors:Yahoo_News]                           0.0  1.0
b[(Intercept) state:Arizona]                                 0.0  1.0
b[(Intercept) state:Georgia]                                 0.0  1.0
b[(Intercept) state:Michigan]                                0.0  1.0
b[(Intercept) state:Missouri]                                0.0  1.0
b[(Intercept) state:National]                                0.0  1.0
b[(Intercept) state:North_Carolina]                          0.0  1.0
b[(Intercept) state:Pennsylvania]                            0.0  1.0
b[(Intercept) state:Texas]                                   0.0  1.0
b[(Intercept) state:Wisconsin]                               0.0  1.0
b[(Intercept) pollster:Siena/NYT]                            0.0  1.0
```

```
b[(Intercept) pollster:YouGov]                                          0.0  1.0
b[(Intercept) pollster:YouGov_Blue]                                     0.0  1.0
b[(Intercept) pollster:YouGov/Center_for_Working_Class_Politics]        0.0  1.0
b[(Intercept) methodology:Live_Phone]                                   0.0  1.0
b[(Intercept) methodology:Online_Panel]                                 0.0  1.0
Sigma[sponsors:(Intercept),(Intercept)]                                 0.0  1.0
Sigma[state:(Intercept),(Intercept)]                                    0.0  1.0
Sigma[pollster:(Intercept),(Intercept)]                                 0.0  1.0
Sigma[methodology:(Intercept),(Intercept)]                              0.0  1.0
mean_PPD                                                                 0.1  1.0
log-posterior                                                           0.2  1.0
                                                                        n_eff
(Intercept)                                                             1057
b[(Intercept) sponsors:Carolina_Forward]                                3675
b[(Intercept) sponsors:CATO_Institute]                                  2260
b[(Intercept) sponsors:CBS_News]                                        1801
b[(Intercept) sponsors:Economist]                                       1779
b[(Intercept) sponsors:Institute_for_Global_Affairs]                    2664
b[(Intercept) sponsors:Jacobin]                                         3099
b[(Intercept) sponsors:Saint_Louis_University]                          2119
b[(Intercept) sponsors:The_Philadelphia_Inquirer]                       3338
b[(Intercept) sponsors:The_Times_of_London_|_SAY24]                     3061
b[(Intercept) sponsors:University_of_Texas]                             2310
b[(Intercept) sponsors:Yahoo_News]                                      1793
b[(Intercept) state:Arizona]                                            3497
b[(Intercept) state:Georgia]                                            4801
b[(Intercept) state:Michigan]                                           3925
b[(Intercept) state:Missouri]                                           2186
b[(Intercept) state:National]                                           2422
b[(Intercept) state:North_Carolina]                                     3719
b[(Intercept) state:Pennsylvania]                                       3689
b[(Intercept) state:Texas]                                              3501
b[(Intercept) state:Wisconsin]                                          2260
b[(Intercept) pollster:Siena/NYT]                                       2528
b[(Intercept) pollster:YouGov]                                          1953
b[(Intercept) pollster:YouGov_Blue]                                     2369
b[(Intercept) pollster:YouGov/Center_for_Working_Class_Politics]        2291
b[(Intercept) methodology:Live_Phone]                                   1177
b[(Intercept) methodology:Online_Panel]                                 1128
Sigma[sponsors:(Intercept),(Intercept)]                                 1617
Sigma[state:(Intercept),(Intercept)]                                    1438
Sigma[pollster:(Intercept),(Intercept)]                                 1854
Sigma[methodology:(Intercept),(Intercept)]                              1315
```
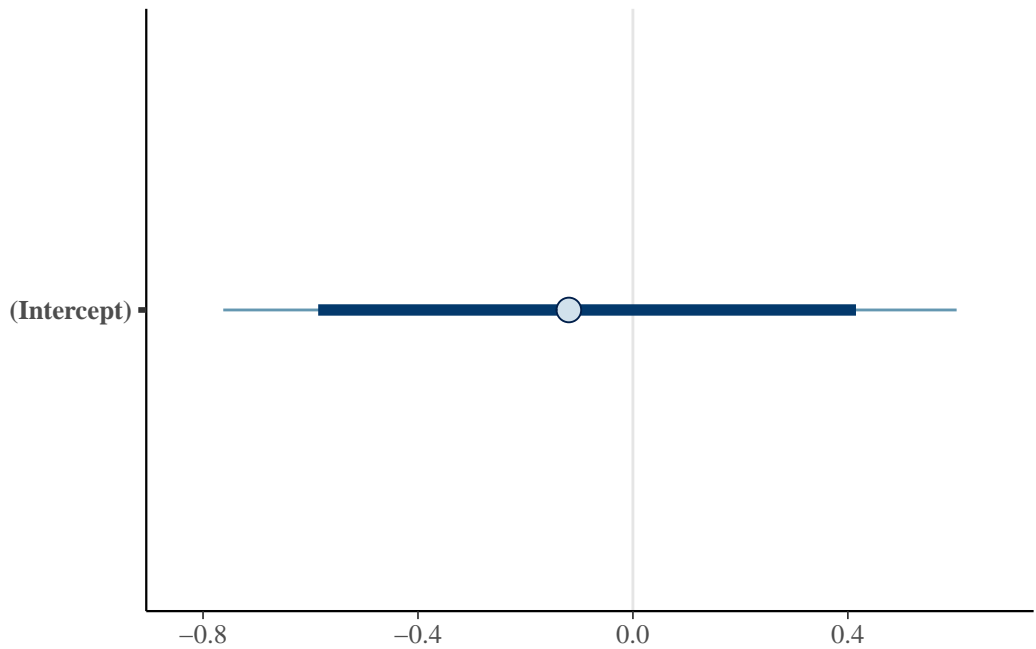
```
mean_PPD                                                          3720
log-posterior                                                     949

For each parameter, mcse is Monte Carlo standard error, n_eff is a crude measure of effective
```



```
Model Info:
 function:     stan_glm
 family:       gaussian [identity]
 formula:      pct ~ ns(end_date_num, df = 5) + pollster + state + sponsors +
       methodology
 algorithm:    sampling
 sample:       4000 (posterior sample size)
 priors:       see help('prior_summary')
 observations: 69
 predictors:   28

Estimates:
                                          mean    sd    10%    50%    90%
(Intercept)                               43.5   4.5  37.7   43.5   49.3
ns(end_date_num, df = 5)1                  0.5   1.7  -1.6    0.5    2.7
ns(end_date_num, df = 5)2                  6.0   1.7   3.8    6.0    8.1
```

```
ns(end_date_num, df = 5)3                               2.6   1.3  0.9   2.6   4.2
ns(end_date_num, df = 5)4                               5.5   2.5  2.3   5.5   8.8
ns(end_date_num, df = 5)5                               2.6   1.3  0.9   2.6   4.2
pollsterYouGov                                         -0.8   3.5 -5.4  -0.8   3.7
pollsterYouGov Blue                                     0.8   4.1 -4.5   0.9   6.0
pollsterYouGov/Center for Working Class Politics -0.5   4.0 -5.7  -0.5   4.5
stateGeorgia                                           -0.8   2.3 -3.7  -0.8   2.1
stateMichigan                                           1.6   1.9 -0.8   1.6   3.9
stateMissouri                                          -1.2   3.8 -6.1  -1.1   3.7
stateNational                                           2.7   1.7  0.6   2.7   4.8
stateNorth Carolina                                     0.8   4.1 -4.5   0.9   5.9
statePennsylvania                                       1.4   1.9 -1.0   1.4   3.7
stateTexas                                              0.2   3.7 -4.5   0.2   4.9
stateWisconsin                                          3.9   1.9  1.5   3.9   6.4
sponsorsCATO Institute                                  0.6   2.2 -2.2   0.7   3.4
sponsorsCBS News                                        3.2   1.9  0.7   3.3   5.8
sponsorsEconomist                                      -0.6   2.0 -3.1  -0.6   2.0
sponsorsInstitute for Global Affairs                   -1.9   2.4 -5.0  -1.9   1.3
sponsorsJacobin                                        -0.6   4.0 -5.6  -0.6   4.5
sponsorsSaint Louis University                         -1.2   3.9 -6.2  -1.3   3.8
sponsorsThe Philadelphia Inquirer                       0.6   4.0 -4.5   0.5   5.7
sponsorsThe Times of London | SAY24                    -0.7   2.5 -3.9  -0.7   2.5
sponsorsUniversity of Texas                             0.2   3.7 -4.5   0.1   4.9
sponsorsYahoo News                                     -0.9   2.0 -3.4  -0.9   1.7
methodologyOnline Panel                                -0.6   4.0 -5.8  -0.6   4.5
sigma                                                   1.8   0.2  1.6   1.8   2.1

Fit Diagnostics:
          mean   sd   10%   50%   90%
mean_PPD 47.2    0.3 46.8  47.2  47.6

The mean_ppd is the sample average posterior predictive distribution of the outcome variable

MCMC diagnostics
                                      mcse Rhat n_eff
(Intercept)                           0.1  1.0  3911
ns(end_date_num, df = 5)1             0.0  1.0  4168
ns(end_date_num, df = 5)2             0.0  1.0  4307
ns(end_date_num, df = 5)3             0.0  1.0  5617
ns(end_date_num, df = 5)4             0.0  1.0  4275
ns(end_date_num, df = 5)5             0.0  1.0  5032
pollsterYouGov                        0.1  1.0  3431
pollsterYouGov Blue                   0.1  1.0  4413
```

```
pollsterYouGov/Center for Working Class Politics 0.1  1.0  5651
stateGeorgia                                    0.0  1.0  3565
stateMichigan                                   0.0  1.0  2129
stateMissouri                                   0.1  1.0  4195
stateNational                                   0.0  1.0  2519
stateNorth Carolina                             0.1  1.0  4535
statePennsylvania                               0.0  1.0  2077
stateTexas                                      0.1  1.0  4581
stateWisconsin                                  0.0  1.0  2138
sponsorsCATO Institute                          0.1  1.0  1876
sponsorsCBS News                                0.0  1.0  1512
sponsorsEconomist                               0.1  1.0  1529
sponsorsInstitute for Global Affairs            0.0  1.0  2379
sponsorsJacobin                                 0.1  1.0  5423
sponsorsSaint Louis University                  0.1  1.0  4066
sponsorsThe Philadelphia Inquirer               0.1  1.0  4921
sponsorsThe Times of London | SAY24             0.1  1.0  2165
sponsorsUniversity of Texas                     0.1  1.0  4140
sponsorsYahoo News                              0.0  1.0  1631
methodologyOnline Panel                         0.1  1.0  4370
sigma                                           0.0  1.0  3318
mean_PPD                                        0.0  1.0  4790
log-posterior                                   0.1  1.0  1278
```

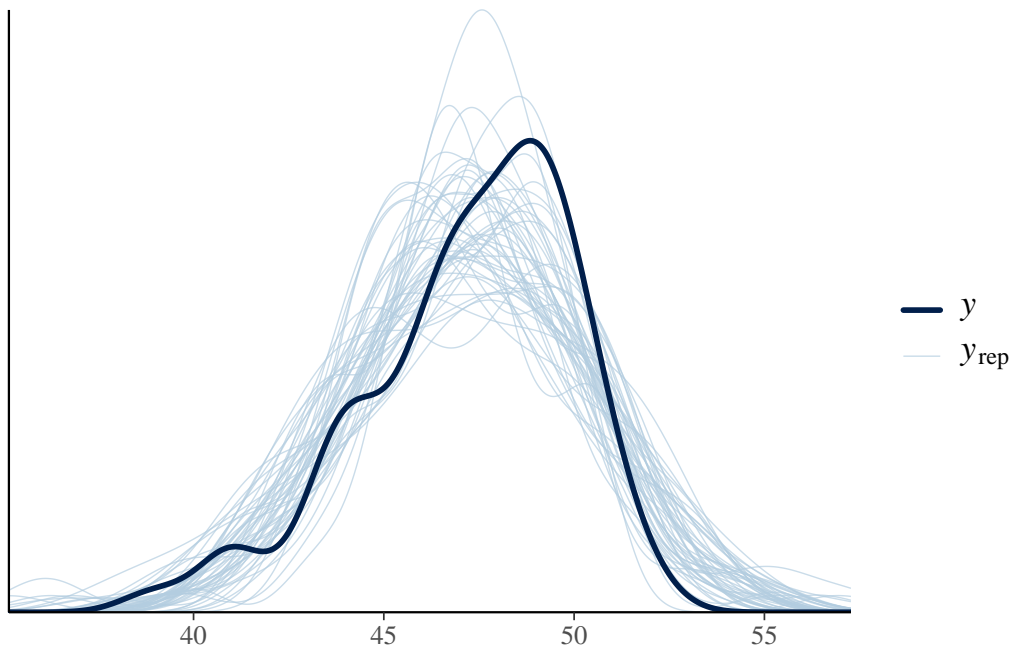For each parameter, mcse is Monte Carlo standard error, n_eff is a crude measure of effective

Figure 1: Street tree count of 10 most popoulus tree species in Toronto up to September 2024

6 Discussion

6.1 Trends from pollsters

6.2 Trends from states

6.3 Trends from sponsors

6.4 Trends from methodology

6.5 Weaknesses and next steps

7 Appendix

7.1 Pollster Analysis

7.2 Poll Blueprint

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