ADVANCED BAYESIAN MODELING

A NORMAL HIERARCHICAL MODEL:
MOTIVATION: 2016 POLLS DATA

2016 Presidential Polls Example

Several national polls were conducted leading up to the 2016 US presidential election on November 7.

We consider seven polls conducted November 3 and later that were for a two-way race between Hillary Clinton and Donald Trump.

$$
\begin{aligned}
y_j &= \text{Clinton lead (percentage points) in poll } j \\
\sigma_j &= \text{half margin of error of } y_j \\
j &= 1, \ldots, 7
\end{aligned}
$$

Data in file `polls2016.txt`:

```
# 2016 U.S. presidential election race between H. Clinton and D. Trump
# National poll results for two-way race, conducted November 3 and later
# y = percentage of Clinton lead, ME = margin of error

poll        y   ME
YouGov      4   1.7
Bloomberg   3   3.5
ABCWaPo     3   2.5
Fox         4   2.5
IBD         1   3.1
Monmouth    6   3.6
NBCWSJ      5   2.73
```

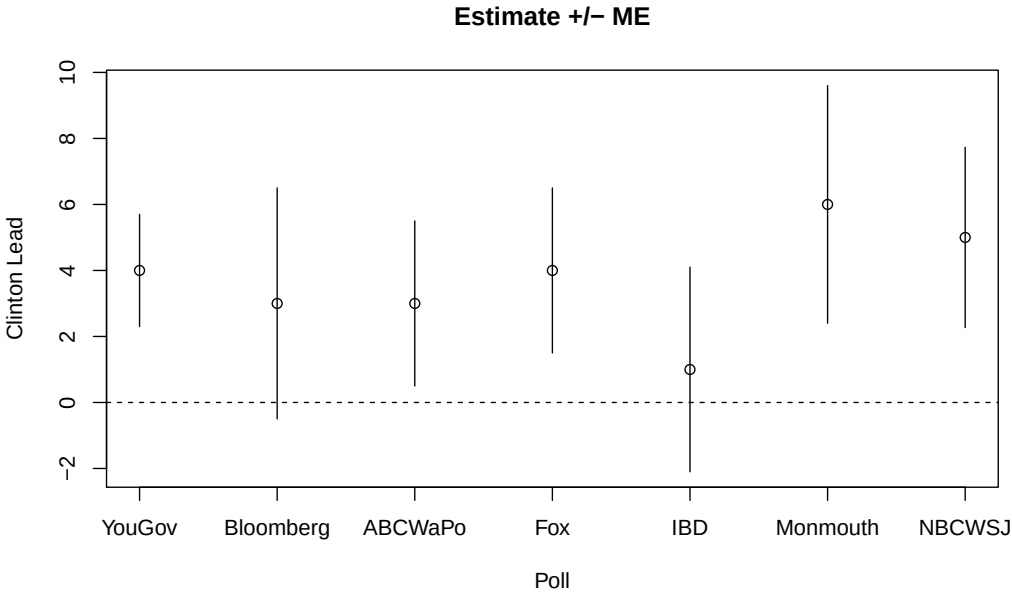
From: Nationwide opinion polling for the United States presidential election, 2016. (2017, June 7). In *Wikipedia, The Free Encyclopedia*. Retrieved June 19, 2017 from `https://en.wikipedia.org/w/index.php?title=Nationwide_opinion_polling_for_the_United_States_presidential_election,_2016&oldid=784210571`

In R, read data:

```
> d <- read.table("polls2016.txt", header=TRUE)
```

Graph estimates plus/minus margin of error:

```
> with(d, plot(1:7, y, ylim=c(min(y-ME),max(y+ME)), xaxt="n",
+              main="Estimate +/- ME", xlab="Poll", ylab="Clinton Lead"))
> with(d, segments(1:7,y-ME,1:7,y+ME))
> axis(1, at=1:7, labels=d$poll)
> abline(h=0, lty=2)
```


Estimate +/− ME
Clinton Lead
10
8
6
4
2
0
−2
YouGov
Bloomberg
ABCWaPo
Fox
IBD
Monmouth
NBCWSJ
Poll

Overall, polls appear to favor Clinton by a reasonable margin.

How a Bayesian analysis can help:

- Produce better estimates of Clinton's lead through pooling data
- If these polls are typical, help assess effectiveness of polling in general

Want a Bayesian hierarchical model that will

- Allow the Clinton lead to differ for different polls
- Expect that Clinton leads from different polls are related (through a population of polls)