Reuters 2016 Polling Data Analysis - Riley Smith's Replication of Jason Newsom's Analyses

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Contents

Setting Things Up in `R`

```
source("SETUP.R")
options(width = 70)
opts_chunk$set(fig.show = "asis", results = "asis",
    Rplot = TRUE, tidy = TRUE, fig.path = "graphics/reuters/Rplot_",
    fig.width = 7, fig.asp = 1, out.width = "0.9\\linewidth",
    Rplot = TRUE)

library(foreign)  ## read.spss() ##
library(car)  ## recode() ##
dat <- read.spss("data/reuters.sav", to.data.frame = TRUE)

dat <- within(dat, {
    recode(response, c("1=0", "2=1", "3=2"))
})
```

Notes on the `R-code` above: `SETUP.R` is the default `R-script` I source in the `"setup" code-chunk`[1] at the beginning of all `R markdown` documents. It contains global arguments for loading commonly used packages, setting options, and defining various R-object utilities and functions. I also use this script as a record of functions I create while working in `R`. The script is heavily commented throughout for explanatory purposes, as well as for giving credit where it is due

[1] see `help(package = knitr)`

(I've tried to keep up with all of the `R-code`, `LaTex`, and `R markdown` sources, but may have missed some along the way).

After sourcing `SETUP.R` and setting a few output options (`options()` & `opts_chunk$set()`), I load the `{foreign}` and `{car}` packages for the `read.spss()` and `recode()` functions, respectively. Then I read in (`read.spss()`) the Reuters polling dataset, "`reuters.sav`" and store it in `R` as a `dataframe` named "`dat`". Finally, I re-code the values for the "`dat$response`" variable, using the `{car}` package's `recode()` function to undo default numeric values 1,2,3 and label values.

__Note:__ This last recoding step seems unneccessary to me. I included it here based on Jason Newsom's code and in-class explanation, but when I run the rest of the analysis below without recoding, the results are the same. Is there a specific situation in which setting a discrete variable's values to '`0, 1, 2, ...`', versus '`1, 2, 3, ...`' is consequential to the analysis? Or is this a matter of personal preference for coding discrete variables? I think it would make more logical sense to me if, in this case, '`0`' strictly reflected '`No Response`', but that is not the case here, as '`0`' reflects both '`Other`' and '`No Response`'. Further, should '`Other`' responses not be coded as separate from '`No Response`', given that an '`Other`' response is absolutely qualitatively distinct from '`No Response`'?

Data-Cleaning & Preparation

A few things need to happen to help optimize the information we put into and get out of the binomial hypothesis testing for the polling data. Specifically, I want set all values of "`other`" to "`NA`" in `dat$response`, then drop all "`NA`" values since the analysis is only interested in responses for the two major candidates (i.e., *Clinton and Trump*).

Note that the common method for binomial tests in `R` is to use `exact.test = TRUE`, which is actually the most conservative approach and also no ideal for binomial tests. Use `prop.test()` for *approximate* tests. *(source: Jason Newsom)*

However, there are also some existing "`NAs`" in "`dat$party`", which need to be re-coded as well to avoid excluding rows with acceptable data values in `dat$response`.

`sapply()`, `apply()`, and `vapply()` are great function to get to know if you find yourself doing a ton of data cleaning/mining.

```
Risna <- function(x) sum(is.na(x))
## Getting a count of NA values in the original dataframe ##
sapply(dat, Risna)
```

```
>>       id response    party partmiss      ind
>>        0        0       70        0        0
```

```
R.na <- function(x, v = 0) {
    ## x = object to be manipulated, v = value to assign to NAs ##
    x <- ifelse(is.na(x), v, x)
    return(x)
}
```

`R.na()`: *"If x = NA (`is.na()`), replace x with v, otherwise leave x alone."*

```
Rmsmm <- function(x) {
    if (is.null(ncol(x))) {
        xM <- mean(x, na.rm = TRUE)
        xSD <- sd(x, na.rm = TRUE)
        xMIN <- min(x, na.rm = TRUE)
        xMAX <- max(x, na.rm = TRUE)
        xNA <- sum(is.na(x))
        summ <- data.frame(xM, xSD, xMIN, xMAX, xNA)
```

`Rmsmm()` is a function I wrote for creating a quick, simple, mostly report-ready, summary table reporting `mean, sd, min, max` (hence "msmm") for the numeric columns in a given table, dataframe, or matrix. The returned value from `R.msmm()` can be passed to `knitr::kable()` for creating a report-ready output table.

```
        names(summm) <- c("M", "SD", "Min", "Max", "NAs")
        return(summ)
    } else {
        nums <- sapply(x, is.numeric)
        xn <- x[, nums]
        xM <- dplyr::summarise_each(xn, funs(mean(., na.rm = TRUE)))
        xSD <- dplyr::summarise_each(xn, funs(sd(., na.rm = TRUE)))
        xMIN <- dplyr::summarise_each(xn, funs(min(., na.rm = TRUE)))
        xMAX <- dplyr::summarise_each(xn, funs(max(., na.rm = TRUE)))
        summ <- rbind(xM, xSD, xMIN, xMAX)
        row.names(summ) <- c("M", "SD", "Min", "Max")
        summ <- as.data.frame(t(summ))
        return(summ)
    }
}
```

Table 1: Summary information for '**party**' data column *before* recoding NAs

M	SD	Min	Max	NAs
0.4229113	0.4942345	0	1	70

```
unique(dat$party)
```

[1] 0 1 NA

```
dat$party <- sapply(dat$party, R.na, v = 99)
```

Table 2: Summary information for '**party**' data column *after* recoding NAs

M	SD	Min	Max	NAs
6.028432	22.84312	0	99	0

[1] 0 1 99

```
dat$response <- recode_factor(dat$response, ‘other/no opinion‘ = NA_character_)
## see 'recode_factor()' in the {dplyr} package ##
dat <- na.omit(dat)
sapply(dat, R.isna)  ## bye-bye NAs! ... again ##
```

```
  id response    party partmiss      ind
   0        0        0        0        0
```

```
## but this time we only lost data for rows with NA in dat$response (but
## we did lose ALL of the data for those rows, as these were removed
## from the dataframe entirely, though the original datafile remains
## untouched).
```

Now the data are, in my opinion, ready for analysis.

Analysis: Differences in Proportions of (non-"other") Polling Responses

```r
levels(dat$response)
```

[1] "Trump" "Clinton"

```r
poll.t <- table(dat$response)
## Why not make a table of the poll response counts for each candidate?
## ... ##
```

Table 3: Frequency Table of Polling Data

Response	Frequency
Trump	554
Clinton	677

Definition of a convenience function for the binomial test. I'm combining the `prop.test()` & `binom.test()` functions (`{pkg:stats}`) because I think it's kind of ridiculous that there is not already a combined function for these. I also don't particularly enjoy the default output format for either of these functions, so I'm breaking the function writing rule of simplicity (AKA: *"Curly's Law"*) and implementing some formatting tasks within the function as well.

Arguments (`R.binom_test()`):

`p`. The target proportion to be tested against the null hypothesis (H_0; π_0; see `pi0` below). *Synonymous Arguments:* `x` in `prop.test()` & `binom.test()`.

`N`. The size of the sample from which '*p*' is taken. *Synonymous Arguments:* `n` in `prop.test()` & `binom.test()`. *Synonymous Arguments:* `n` in `prop.test()` & `binom.test()`.

`pi0`. [Default = `0.5`]. A vector of probabilities of success corresponding to the value(s) in `p`. These probabilities represent the null hypothesis value (H_0; π_0) against which `p` is to be tested. *Synonymous Arguments:* `p` & `conf.level` (inverse) in `prop.test()` & `binom.test()`.

`exact`. Logical [Default = `FALSE`]. Should the the hypothesis be tested using an exact binomial test (i.e., `binom.test()`). If `FALSE` (the default), a test of equal or given proportions, depending on the lengths of `p` and `pi0` is conducted using `prop.test()`

`correct`. Logical Default = `FALSE`]. Synonymous with the `correct` argument in `prop.test()`.

`digits`. [Default = 2]. Number of digits to use when rounding

(round()) the final output values (does not influence the test calculation).

.... Additional arguments to be passed to either prop.test() or binom.test(), depending on the value set for exact (e.g., alternative).

Value (R.binomTest()): Returns a data.frame object containing the values returned by either prop.test() or binom.test(), depending on the value set for exact.

```
R.binom_test <- function(p, N, pi0 = 0.5, exact = FALSE, correct = FALSE,
    digits = 2, ...) {
    if (exact) {
        ## Hypothesis Testing
        BT <- stats::binom.test(x = p, n = N, p = pi0, ...)
    } else {
        BT <- stats::prop.test(x = p, n = N, p = pi0, correct = correct,
            ...)
    }
    ## The rest deals with formatting the output ##
    BT$data.name <- paste0(p, " out of ", N, " null probability ", BT$null.value)
    ## Above, I modified the default output value for *.test$data.name to
    ## print the actual data values, rather than the object names the values
    ## are stored under (see output below) ##
    BTCI <- paste0(round(BT$conf.int[[1]], digits = digits), ", ", round(BT$conf.int[[2]],
        digits = digits))
    BT$p.value <- round(BT$p.value, digits = 7)
    BT.df <- data.frame(c(BT[c("alternative", "null.value", "parameter",
        "estimate", "statistic", "p.value")], BTCI))
    row.names(BT.df) <- NULL
    return(BT.df)
}
```

Approximate Test (prop.test())

```
pt <- R.binom_test(p = poll.t["Clinton"], N = nrow(dat), pi0 = 0.5)
## ... Now we know where values for prop.test() came from :) ## There's
## more than one way to do that, by the way, but creating the table will
## come in handy later on too. ##
```

Table 4: 1-sample proportions test without continuity correction: *677 out of 1231*

H_1	π_0	df	p	χ_2	*p-value*	CI
two.sided	0.5	1	0.55	12	0.00046	0.52, 0.58

Exact Test (`binom.test()`)

```
et <- R.binom_test(p = poll.t["Clinton"], N = nrow(dat), pi0 = 0.5, exact = TRUE)
```

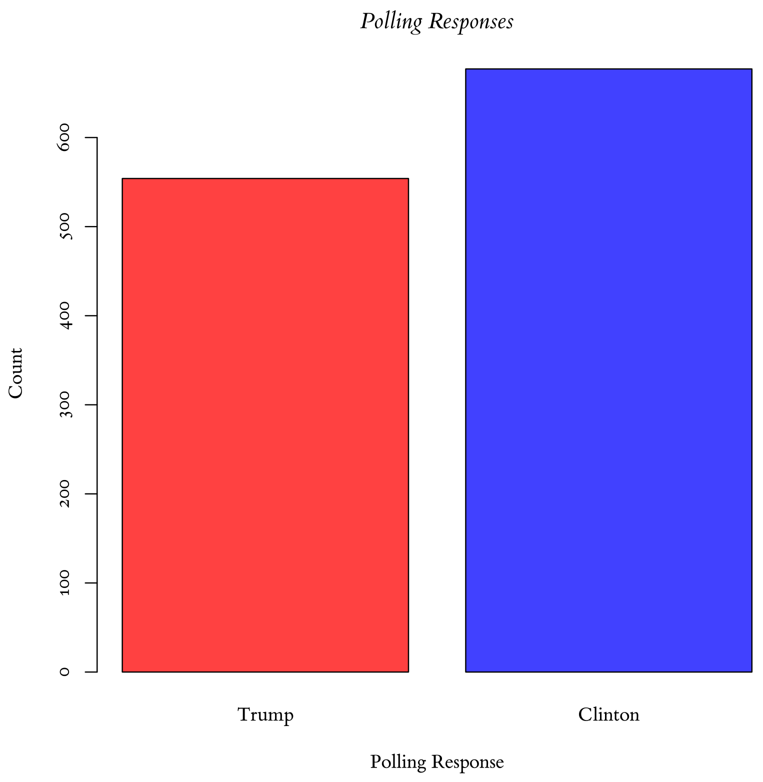
Table 5: 1-sample *exact* binomial test without continuity correction: *677 out of 1231*

H_1	π_0	n_{trials}	p	$n_{successes}$	*p-value*	CI
two.sided	0.5	1231	0.55	677	5e-04	0.52, 0.58

Plotting!

Bar Plot of Polling Data (using R's Base Graphics)

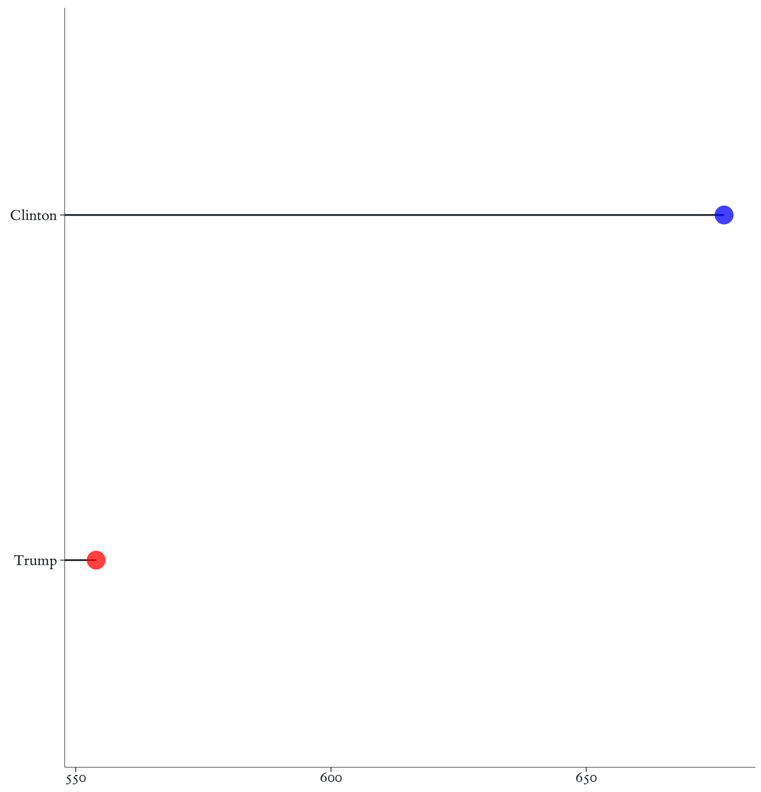
```
electpal <- c("red", "blue")
electpal <- sapply(electpal, adjustcolor, alpha = 0.75, USE.NAMES = FALSE)

palette(electpal)
barplot(poll.t, ylab = "Count", xlab = "Polling Response", family = "ETBembo",
    col = electpal, main = "Polling Responses")
```



Dot-Plot of Polling Data using the `ggplot2` package.

This would actually be interesting to do with repeated-measures data with the candidates on the `Y-axis` and time (in months/weeks) on the `X-axis`.

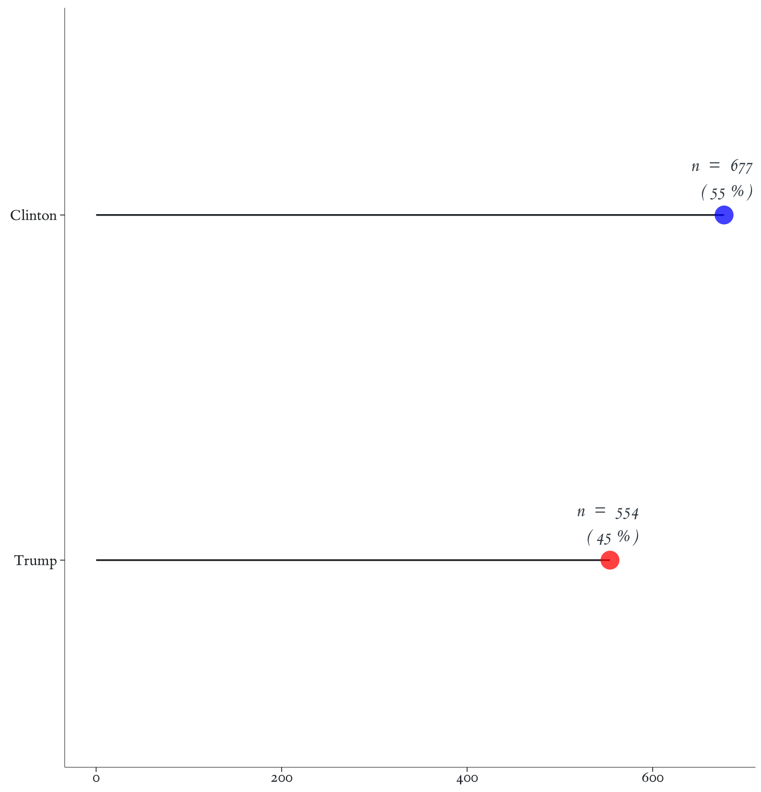
```
poll.df <- as.data.frame(poll.t)
names(poll.df) <- c("Response", "Frequency")
poll.df$N <- rep(x = nrow(dat), times = nrow(poll.df))
n <- poll.df[, 2]
bpoll <- ggplot(poll.df, aes(x = Frequency, y = Response)) + geom_segment(aes(yend = Response),
    xend = 0, colour = mypal[20]) + geom_point(size = 5, aes(colour = Response)) +
    scale_colour_manual(values = electpal, guide = FALSE) + labs(y = "",
    x = "") + thm_tft(xline = TRUE, yline = TRUE)
bpoll
```



Don't forget to set the x-and-y-limits! Otherwise, you could be presenting a potentially misleading visualization of the data. Since these are polling data, there is a true "zero" such that `0` would reflect `0` votes for a given candidate in a given poll.[2] The data should thus be represented according to its appropriate scale limits.

[2] \textit{This has happened for one of the two current major party presidential candidates in the very recent past - I will not say who.}

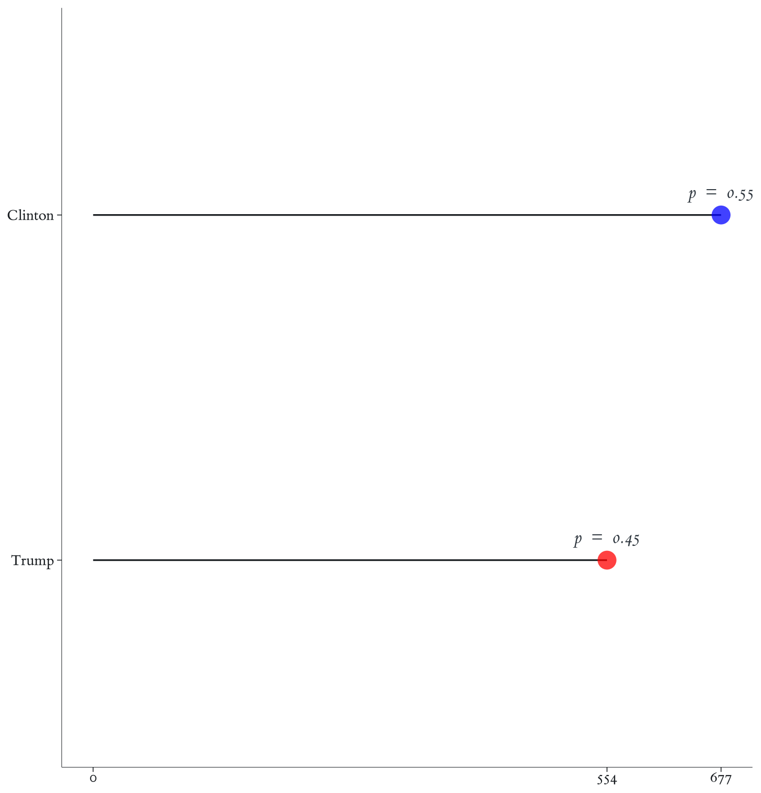
```
bpoll + xlim(0, max(poll.df$Frequency)) + geom_text(vjust = -0.5, hjust = 0.5,
    stat = "identity", position = "identity", colour = mypal[19], size = rel(4),
    aes(family = "ETBembo", fontface = "italic", label = paste("n  = ",
        n, "\n", "(", round(n/poll.df$N * 100), "%", ")")))
```



Further, in plots like these, where discrete data with a relatively small number of categories[3] are juxtaposed with a continuous scale, setting the continuous axis' limits (in this case the `x-axis`) can help to further disambiguate the information.

[3] My persona rule of thumb for what constitutes a "relatively small category" is $N_{categories} \leq 5$

```
bpoll2 <- bpoll + scale_x_continuous(breaks = c(0, n), limits = c(0, max(n)))

bpoll2 + geom_text(vjust = -1.5, hjust = 0.5, stat = "identity", position = "identity",
    colour = mypal[19], size = rel(4), aes(family = "ETBembo", fontface = "italic",
        label = paste("p  = ", round(n/poll.df$N, digits = 2))))
```



Categorical Data Visualization - ***Mosaic Plots***

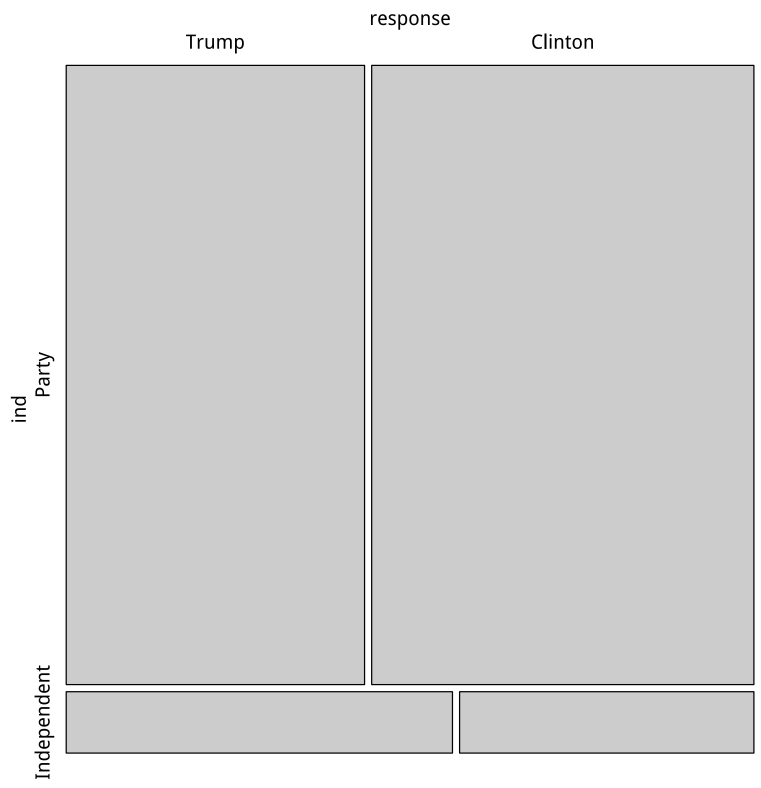
The below `R-Code` is copied directly from Dr. Jason Newsom's *"Mosaic Plots"* handout

```
dat <- within(dat, {
    resp.F <- factor(response)
    ind.F <- factor(ind)
})

tbl <- table(dat$ind.F, dat$resp.F)
tbl
```

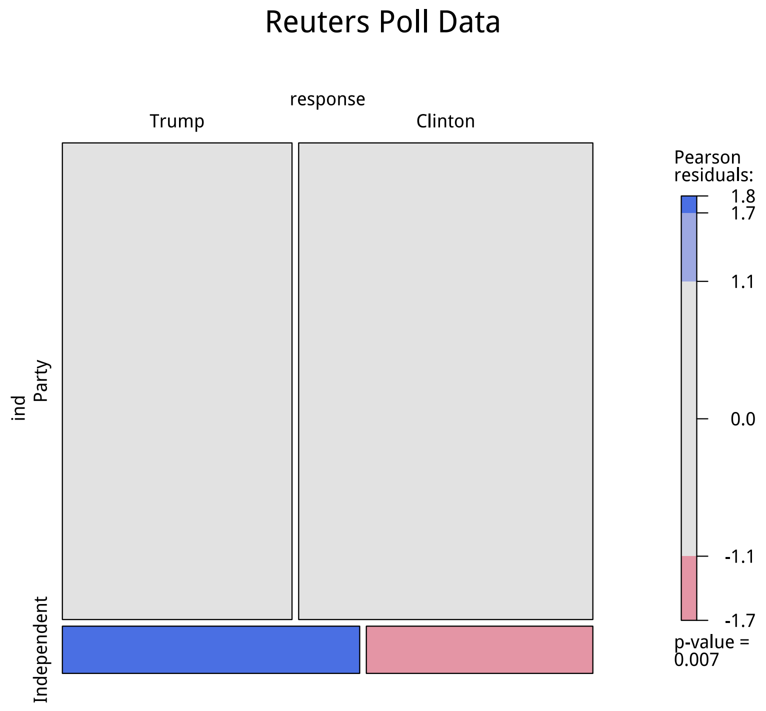
```
Trump Clinton
```

0 491 629 1 63 48

```
library(vcd)

dimnames(tbl) <- list(ind = c("Party", "Independent"), response = c("Trump",
    "Clinton"))
mosaic(tbl)  # is sufficient, main gives the title, and gp=shading_hcl and gp_args changes the cutoffs for
```



```r
mosaic(tbl, main = "Reuters Poll Data", gp = shading_max)
```



[ToDo]

- ☐ *Find method for entering expected values into binomial test function(s) (e.g., when you want to compare Oregon's polling estimates to those of the general US population).*

✓~~Binomial Tests~~
✓~~Barplot~~
✓~~Clemson Dot Chart~~
✓~~Mosaic Plot~~

References[4]

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[4] **Note:** This document was created using ***R**-v3.3.1* R Core Team, *R*, and the following ***R**-packages*: *base-v3.3.* R Core Team, *R*, *bibtex-v0.4.* Francois, *Bibtex*, *car-v2.1.* Fox and Weisberg, *An R Companion to Applied Regression*, *dplyr-v0.5.* Wickham and Francois, *Dplyr*, *DT-v0.2.* Xie, *DT*, *extrafont-v0.17.* Chang, *Extrafont*, *ggplot2-v2.1.* Wickham, *Ggplot2*, *knitcitations-v1.0.* Boettiger, *knitcitations*, *knitr-v1.14.* Xie, *Dynamic Documents with R and Knitr*, *pander-v0.6.* Daroczi and Tsegelskyi, *Pander*, *papaja-v0.1.* Aust and Barth, *Papaja*, *plyr-v1.8.* Wickham, "The Split-Apply-Combine Strategy for Data Analysis.", *rmarkdown-v1.0.* Allaire et al., *rmarkdown*, *scales-v0.4.* Wickham, *Scales*, *tidyr-v0.6.* Wickham, *Tidyr*, *ggthemes-v3.2.* Arnold, *Ggthemes*, *gtable-v0.2.* Wickham, *Gtable*, *kableExtra-v0.0.* Zhu, *KableExtra*, *tufte-v0.2.* Xie and Allaire, *Tufte*, *vcd-v1.4.* Meyer, Zeileis, and Hornik, "Residual-Based Shadings for Visualizing (Conditional) Independence".", *devtools-v1.12.* Wickham and Chang, *Devtools*, *highlight-v0.4.* Francois, *Highlight*, *sysfonts-v0.5.* Qiu and others, *Sysfonts*, and *showtext-v0.4.* Qiu, *Showtext*

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