PSC7475: Visualizing Distributions & Missing Data

Week 3: Lecture 3

Prof. Weldzius

Villanova University

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Studying political efficacy

- 2002 WHO survey of people in China and Mexico
- Goal: determine feelings of political efficacy
- Question: "How much say do you have in getting the government to address issues that interest you?"
  1. No say at all
  2. little say
  3. some say
  4. a lot of say
  5. unlimited say

Data

- Load the data:

```
library(tidyverse)
data(vignettes, package = "qss")
head(vignettes)
```

```
##   self alison jane moses china age
## 1    1      5    5     2     0  31
## 2    1      1    5     5     0  54
## 3    2      3    1     1     0  50
## 4    2      4    2     1     0  22
## 5    2      3    3     3     0  52
## 6    1      3    1     5     0  50
```

```
## Also works if you downloaded the data:
# vignettes <- read.csv("data/vignettes.csv")
```

Contingency table

- `count()` shows how many units are in each category of a variable:

```
vignettes %>%
  count(self)
```

```
##   self   n
## 1    1 327
## 2    2 210
## 3    3 130
## 4    4  56
## 5    5  58
```

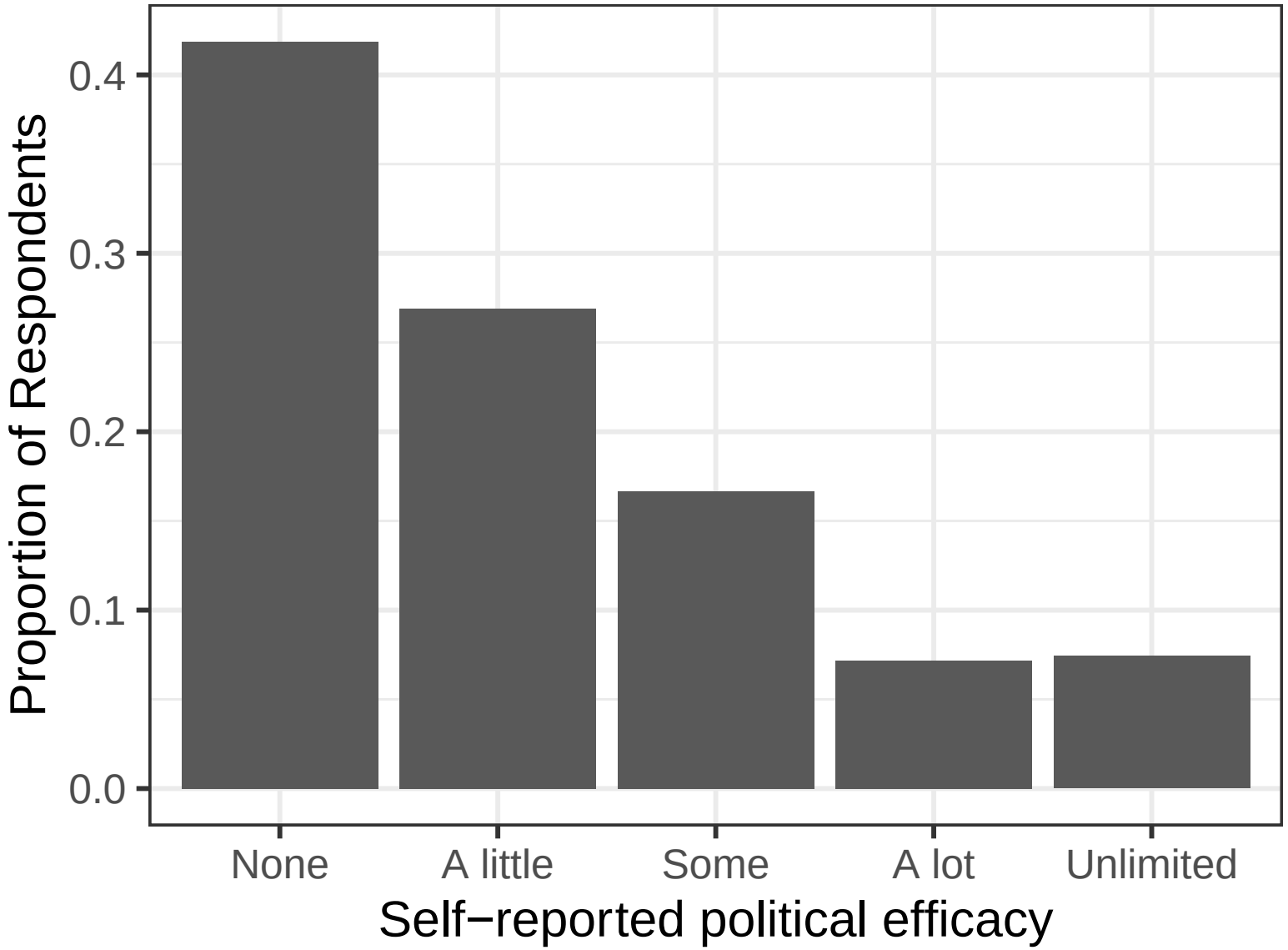
Contingency table (continued)

- using group_by we can convert these counts into proportions of units:

```
vignettes %>%
  group_by(self) %>%
  count() %>%
  ungroup() %>%
  mutate(prop = n / sum(n))
```

```
## # A tibble: 5 x 3
##    self     n   prop
##   <int> <int>  <dbl>
## 1     1   327 0.419
## 2     2   210 0.269
## 3     3   130 0.166
## 4     4    56 0.0717
## 5     5    58 0.0743
```

Useful way to visualize this information: barplot



Barplots in R

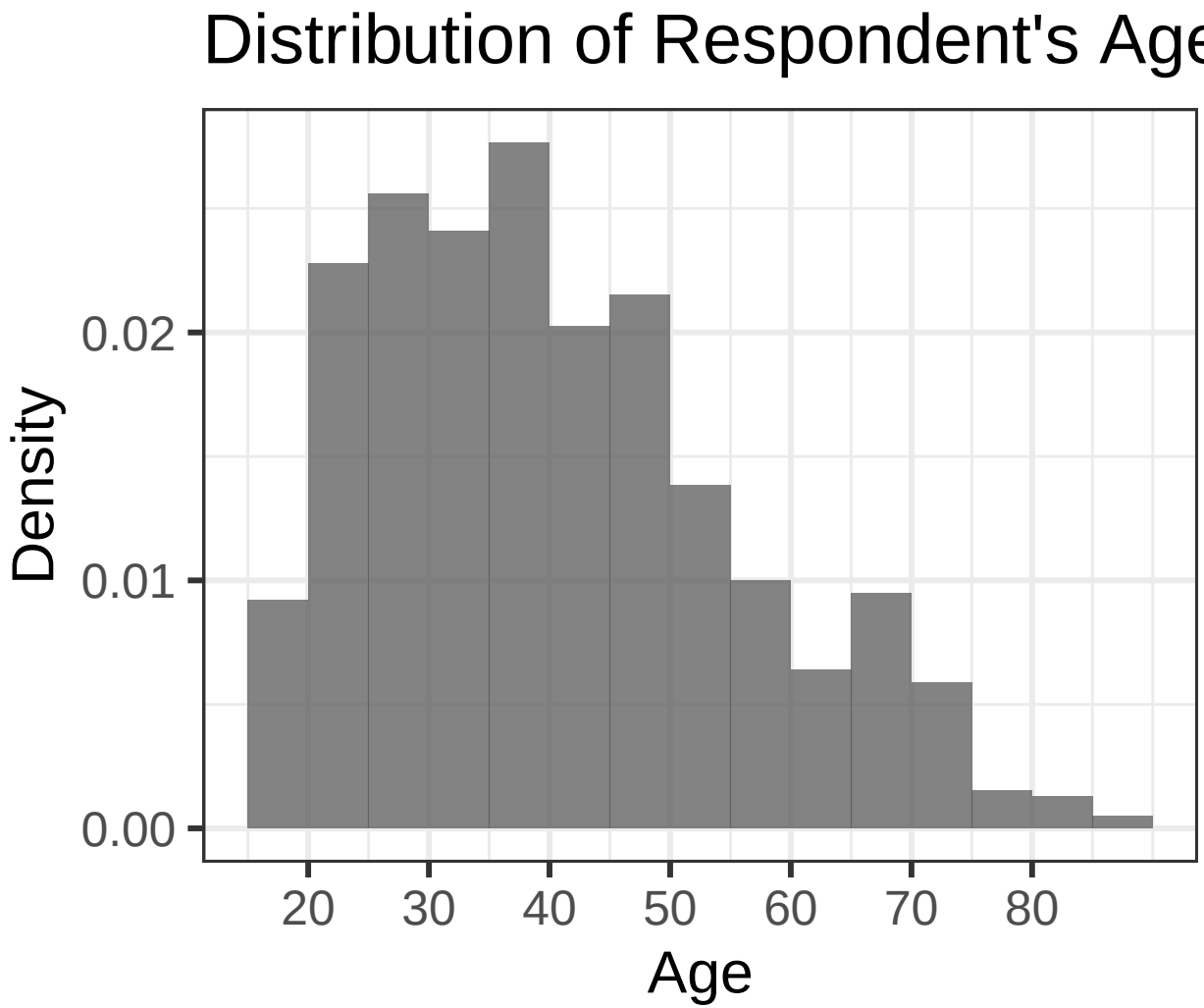
- The `barplot()` function can help us visualize a categorical variable:

```
vignettes %>%
  ggplot(aes(x = as.factor(self),y=..prop..,group = 1)) +
  geom_bar() +
  scale_x_discrete(labels = c("None", "A little",
                   "Some", "A lot", "Unlimited")) +
  xlab("Self-reported political efficacy") +
  ylab("Proportion of Respondents") +
  theme_bw()
```

- Arguments:
  - `aes()`: the aestetic mapping of the plot (what you see)
  - `scale_x_discrete()`: changes the scale of the axis
  - `xlab()`, `ylab()` are axis labels
  - `theme_bw()` removes grey background

Histogram

- **Histograms** visualize density of a continuous/numeric variable



How to create histograms?

- How to create a histogram by hand:
  1. create bins along the variable of interest
  2. count number of observations in each bin
  3. **density** = bin height

$$\text{density} = \frac{\text{proportion of observations in bin}}{\text{bin width}}$$

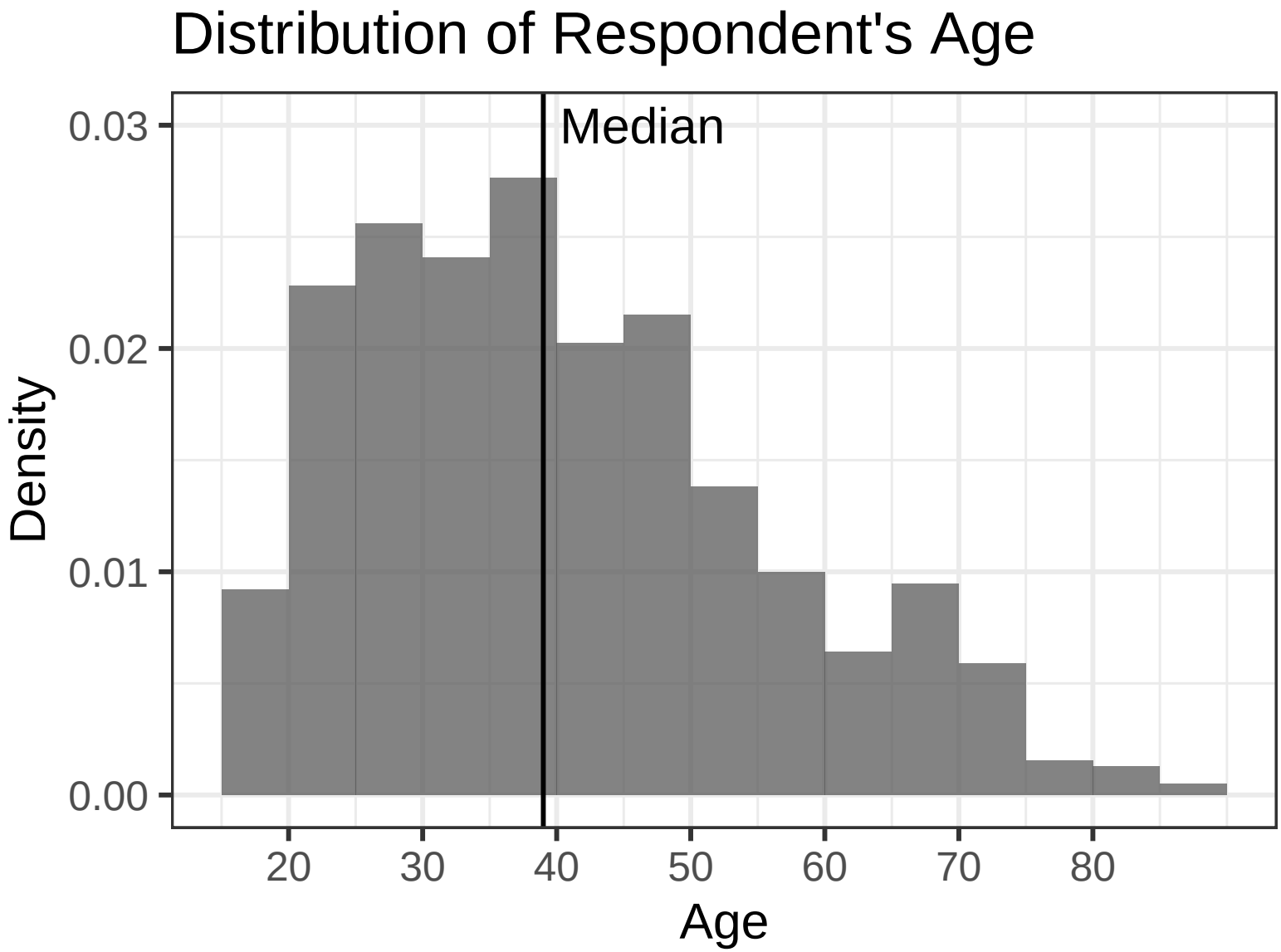
- The areas of the bins = proportion of observations in those bins.
  - $\rightsquigarrow$ area of the blocks sum to 1 (100%)
  - With equal-width bins, height is proportional to proportion in bin.

Histograms in R (geom_histogram())

```
vignettes %>%
  ggplot(aes(x = age,
             y = ..density..)) +
  geom_histogram(binwidth = 5, # how wide for each bin
                 boundary = 0, # bin position
                 alpha=0.75) + # reduces opaqueness
  scale_x_continuous(breaks = seq(20, 80,by = 10)) +
  labs(title = "Distribution of Respondent's Age",
       y = "Density",
       x = "Age") +
  theme_bw()
```

-labs sets the titles for the plot (used xlab and ylab in previous plot)
-scale_x_continuous sets the scale for the x-axis

Histograms in R: adding a vertical `median` line

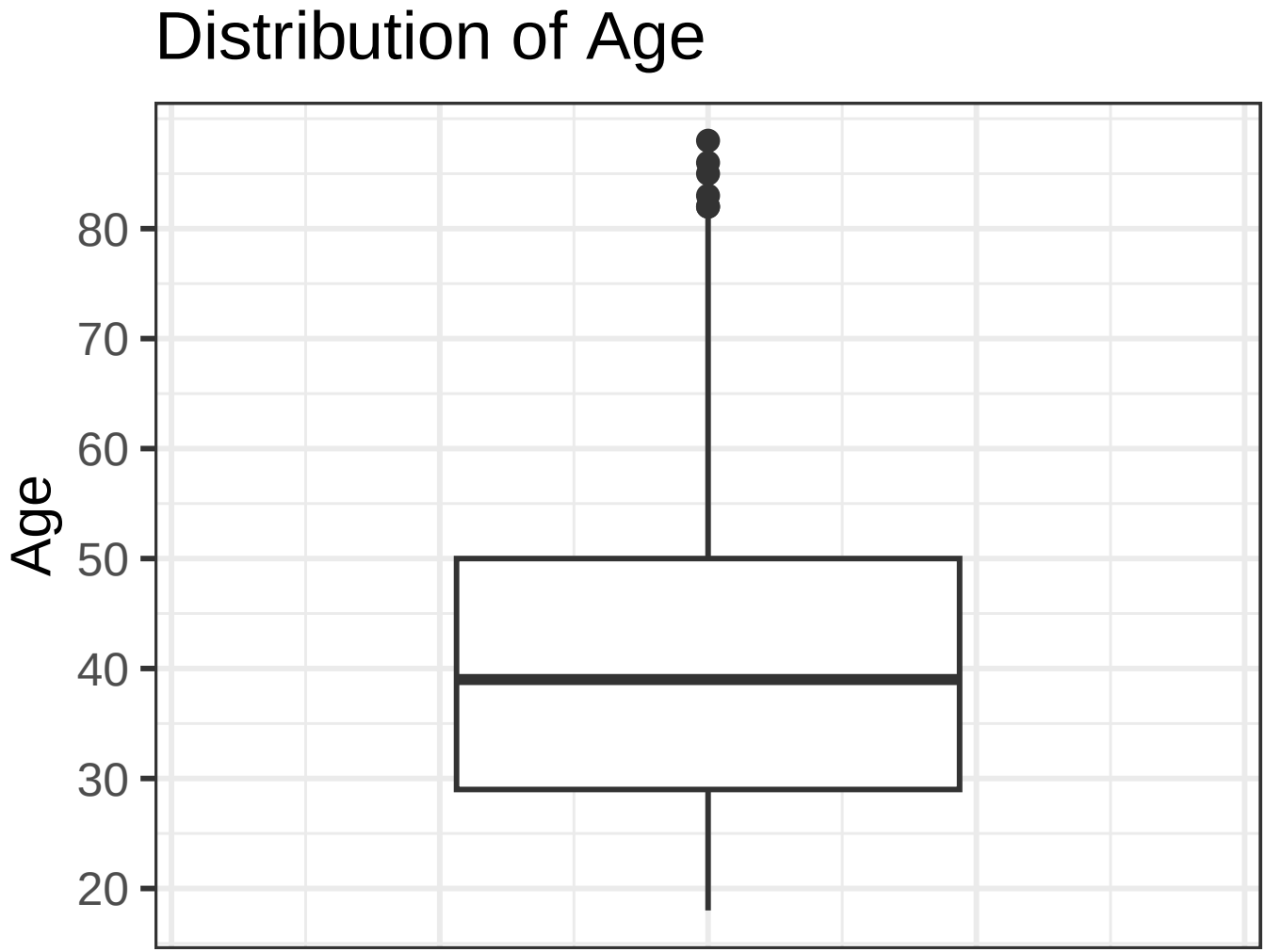


Histograms in R: adding a vertical `median` line

```
vignettes %>%
  ggplot(aes(x = age,
             y = ..density..)) +
  geom_histogram(binwidth = 5, # how wide for each bin
                 boundary = 0, # bin position
                 alpha=0.75) + # reduces opaqueness
  geom_vline(xintercept = median(vignettes$age)) +
  annotate(geom = "text", x = median(vignettes$age),
           y=.03, label = "Median", hjust = -0.1) +
  scale_x_continuous(breaks = seq(20, 80,by = 10)) +
  labs(title = "Distribution of Respondent's Age",
       y = "Density",
       x = "Age") +
  theme_bw()
```

Boxplot

- A **boxplot** can characterize the distribution of continuous variables



Boxplots in R

- "Box" represents range between lower and upper quartile
- "Whiskers" represents either:
  - 1.5 x IQR or max/min of the data, whichever is smaller
  - Points beyond whiskers are outliers
- Use `geom_boxplot()` in `ggplot`

Boxplots in R

```
vignettes %>%
  ggplot(aes(y = age)) +
  geom_boxplot() +
  scale_y_continuous(breaks = seq(20, 80,by = 10)) +
  xlim(-.75,.75) +
  labs(title = "Distribution of Age", y = "Age") +
  theme_bw() +
  theme(axis.text.x=element_blank(),
        axis.ticks.x=element_blank())
```

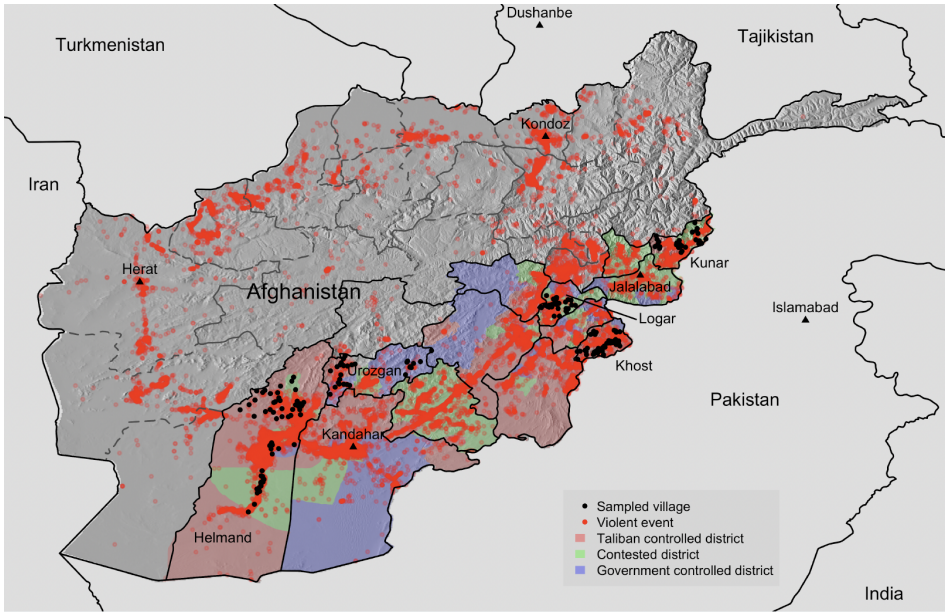
- Added options:
  - `scale_y_continuous`: scale the y axis
  - `xlim`: alter range of x-axis so box is less wide
  - `theme_bw`: removes grey background
  - `theme`: allows you to adjust other parts of figure

Review

- Visualizing single discrete/categorical variables: **barplots**
- Visualizing continuous variables: **histograms, boxplots**

Civilian attitudes and war against insurgency

- War in Afghanistan: counter-insurgency war
  - Military against insurgents
  - Key to victory: winning hearts and minds of civilians
  - Aid provision, information campaign, minimizing civilian casualties
- How does exposure to violence affect support for Taliban coalition?



Afghan study

```
library(tidyverse)
data(afghan, package = "qss")
head(afghan[,1:8])
```

```
##   province     district village.id age educ.years employed
## 1    Logar Baraki Barak         80  26          10        0
## 2    Logar Baraki Barak         80  49           3        1
## 3    Logar Baraki Barak         80  60           0        1
## 4    Logar Baraki Barak         80  34          14        1
## 5    Logar Baraki Barak         80  21          12        1
## 6    Logar Baraki Barak         80  18          10        1
##         income violent.exp.ISAF
## 1 2,001-10,000                0
## 2 2,001-10,000                0
## 3 2,001-10,000                1
## 4 2,001-10,000                0
## 5 2,001-10,000                0
## 6         <NA>                0
```

Missing data

- **Nonresponse**: respondent can't or won't answer question
  - Sensitive questions $\rightsquigarrow$ **social desirability bias**
  - Some countries lack official statistics like unemployment
  - Leads to missing data
- Missing data in R: a special value `NA`
- Causes problems with calculating statistics:

```
## prop. of those who got hurt by ISAF
mean(afghan$violent.exp.ISAF)
```

```
## [1] NA
```

Handling missing data in R

- Adding `na.rm = TRUE` to some functions removes missing data

```
afghan %>% summarize(mean(violent.exp.ISAF, na.rm = TRUE))
```

```
##   mean(violent.exp.ISAF, na.rm = TRUE)
## 1                            0.3748626
```

- Or, you can remove missing values using `na.omit()` function:

```
afghan %>% summarize(mean(na.omit(violent.exp.ISAF)))
```

```
##   mean(na.omit(violent.exp.ISAF))
## 1                       0.3748626
```

Handling missing data in R

- See number of NAs with count() + group_by()

```
afghan %>%
  group_by(violent.exp.ISAF) %>%
  count()
```

```
## # A tibble: 3 x 2
## # Groups:   violent.exp.ISAF [3]
##   violent.exp.ISAF     n
##              <int> <int>
## 1                0  1706
## 2                1  1023
## 3               NA    25
```

Available-case vs. complete-case analysis

- **Available-case analysis**: use the data you have for that variable:

```
afghan %>%
  summarize(sum(!is.na(violent.exp.ISAF)))
```

```
##   sum(!is.na(violent.exp.ISAF))
## 1                          2729
```

```
afghan %>%
  summarize(mean(violent.exp.ISAF,na.rm=TRUE))
```

```
##   mean(violent.exp.ISAF, na.rm = TRUE)
## 1                            0.3748626
```

Available-case vs. complete-case analysis

- **Complete-case analysis**: only use units that have data on all variables
  - Also called **listwise deletion**

```
dim(na.omit(afghan))
```

```
## [1] 2554   11
```

```
afghan %>%
  na.omit() %>%
  summarize(mean(violent.exp.ISAF))
```

```
##   mean(violent.exp.ISAF)
## 1              0.3719655
```

Non-response and other biases

- Nonresponse can create bias
- More violent areas $\rightsquigarrow$ more non-response:

```
afghan %>%
  group_by(province) %>%
  summarize(
    violent.exp.taliban = mean(is.na(violent.exp.taliban)),
    violent.exp.ISAF = mean(is.na(violent.exp.ISAF)))
```

```
## # A tibble: 5 x 3
##   province violent.exp.taliban violent.exp.ISAF
##   <chr>                  <dbl>            <dbl>
## 1 Helmand              0.0304           0.0164
## 2 Khost                0.00635          0.00476
## 3 Kunar                0                0
## 4 Logar                0                0
## 5 Uruzgan              0.0620           0.0207
```

- $\rightsquigarrow$ oversampling citizens with less exposure to violence!