Getting Started

Load the usual packages (which should now include huxtable!). Remember to include warning = FALSE, header = FALSE, message = FALSE to suppress the loading output.

```
library(tidyverse)
library(huxtable)
```

We will be using the gss dataset for this review. Load the gssr package, the gss_doc documentation, and the gss_all dataframe.

```
library(gssr)
data(gss_doc)
data(gss_all)
```

Create a new dataframe called review. Filter the gss_all dataframe to keep only those observations from the 2010 waves and after. Select the variables we want.

If you will be pulling the same variables in multiple chunks, it might make sense to store their names in a vector so you don't have to type them all every time.

If you did this before the previous chunk, you could use the object name my_variables in the select function (note that you will get a warning if you don't assert you are using all_of the variables):

```
review <- gss_all |>
  filter(year>=2010) |>
  select(all_of(my_variables))
```

Clean Up

The big thing to do before starting analyses is to confirm that all missing values have been coded as NA. Run a summary of the review dataframe to make sure NAs have been captured.

```
##
                        intspace
                                          consci
                                                          relig16
         year
                                                                               race
##
    Min.
            :2010
                    Min.
                            :1.00
                                     Min.
                                             :1.000
                                                       Min.
                                                               : 1.000
                                                                          Min.
                                                                                  :1.000
##
    1st Qu.:2012
                     1st Qu.:2.00
                                     1st Qu.:1.000
                                                       1st Qu.: 1.000
                                                                          1st Qu.:1.000
                                                       Median : 1.000
##
    Median:2014
                    Median:2.00
                                     Median :2.000
                                                                          Median :1.000
                                                       Mean
##
    Mean
            :2014
                            :2.08
                                             :1.643
                                                               : 2.008
                                                                                  :1.361
                    Mean
                                     Mean
                                                                          Mean
##
    3rd Qu.:2016
                     3rd Qu.:3.00
                                     3rd Qu.:2.000
                                                       3rd Qu.: 2.000
                                                                          3rd Qu.:2.000
##
    Max.
            :2018
                    Max.
                             :3.00
                                     Max.
                                             :3.000
                                                       Max.
                                                               :13.000
                                                                          Max.
                                                                                  :3.000
                    NA's
                                     NA's
                                                       NA's
                                                               :75
##
                             :6287
                                             :4188
##
       hispanic
                            sex
                                              educ
                                                                age
##
    Min.
            : 1.000
                       Min.
                               :1.000
                                        Min.
                                                : 0.00
                                                          Min.
                                                                  :18.00
    1st Qu.: 1.000
                       1st Qu.:1.000
                                         1st Qu.:12.00
                                                          1st Qu.:34.00
##
    Median : 1.000
                       Median :2.000
                                        Median :13.00
                                                          Median :48.00
##
##
    Mean
            : 1.692
                       Mean
                               :1.554
                                        Mean
                                                :13.64
                                                          Mean
                                                                  :48.72
##
    3rd Qu.: 1.000
                       3rd Qu.:2.000
                                        3rd Qu.:16.00
                                                          3rd Qu.:62.00
                               :2.000
##
            :50.000
                                                :20.00
                                                                  :89.00
    Max.
                       Max.
                                        Max.
                                                          Max.
##
    NA's
            :33
                                        NA's
                                                :20
                                                          NA's
                                                                  :34
##
           id
##
    Min.
            :
                1
    1st Qu.: 589
##
    Median:1178
##
##
            :1201
    Mean
##
    3rd Qu.:1767
##
    Max.
            :2867
##
```

Recall that you can use the gss_get_marginals() function with gss_doc to see the labels for specific variables. This is a nice place to use the my_variables vector. If you save the output of this function, you will be able to easily refer to it later. I recommend opening the spreadsheet view of my codebook (in the top right pane) after running the chunk below.

```
my_codebook <- gss_get_marginals(varnames = my_variables, data = gss_doc) |>
    select(id, percent, n, value, label)
```

Let's combine values from the race and hispanic variables to make a new variable called racehisp. The easiest way to do this is to first make a binary variable distinguishing those who are not Hispanic from those who are. The value of 1 for the hispanic variable is for respondents who are not Hispanic. We can use that in the ifelse function to create our binary variable.

```
review <- review |>
   mutate(anyhispanic = ifelse(hispanic==1, 0, 1))
```

Now we can combine values from this new anyhispanic variable and the race variable to create the racehisp categories:

Sometimes it's easier to create new variables instead of changing the values and labels of existing variables. Here we'll create new variables called science (taking the values of consci) and space (taking the values of intspace).

We can also collapse existing categories into bigger categories. We'll use the relig16 variable as an example, creating a new variable called religion with broader categories.

```
table(review$relig16)
```

```
##
##
      1
                          5
                3
                               6
                                             10
                                                  11
                                                       12
                                                             13
## 6102 3827 199 1007
                              51
                                   60
                                        74
                                             55 244
                         64
                                                              4
```

Here we'll put all the respondents with values of 6-9 in the "Eastern" category, and those who are not Eastern, Protestant, Catholic, Jewish, or None in "Other":

Three Way Table

For each religious category, we want to know the proportion with each level of confidence in science who are in each category of interest in space. One way to do this is with <code>group_by()</code> and <code>summarize()</code>. For that approach, we would need binary variables for each of the <code>space</code> categories. This might seem tedious, but in the long run it is more efficient since it will allow you to manipulate the variables for other purposes later.

For each combination of religion and science, we can now summarize the means of each space binary variable (which represent the proportion of respondents in the related category of space interest):

'summarise()' has grouped output by 'religion'. You can override using the '.groups'
space summary

```
## # A tibble: 28 x 5
## # Groups: religion [7]
## religion science not_interested moderately_interested very_interested
```

##		<fct></fct>	<fct></fct>	<dbl></dbl>	<dbl></dbl>	<dbl></dbl>
##	1	${\tt Protestant}$	Hardly any	0.596	0.288	0.116
##	2	${\tt Protestant}$	Only some	0.354	0.493	0.153
##	3	${\tt Protestant}$	A great deal	0.207	0.474	0.319
##	4	${\tt Protestant}$	<na></na>	0.342	0.459	0.2
##	5	Catholic	Hardly any	0.585	0.264	0.151
##	6	Catholic	Only some	0.346	0.47	0.184
##	7	Catholic	A great deal	0.22	0.445	0.335
##	8	Catholic	<na></na>	0.313	0.449	0.238
##	9	Jewish	Hardly any	0.5	0.5	0
##	10	Jewish	Only some	0.161	0.581	0.258
##	#	with 18	more rows			

Those NAs for science and religion are annoying. One way to get rid of them is to filter them out. You can do that with an extra line in the chunk above. But we'll redo the whole chunk to compare them, though note it's not necessary to run this twice:

'summarise()' has grouped output by 'religion'. You can override using the '.groups'

```
space_summary
```

```
## # A tibble: 18 x 5
## # Groups:
               religion [6]
      religion
                              not interested moderately interested very interested
##
                 science
##
      <fct>
                 <fct>
                                       <dbl>
                                                              <dbl>
                                                                              <dbl>
## 1 Protestant Hardly any
                                       0.596
                                                              0.288
                                                                              0.116
   2 Protestant Only some
                                       0.354
                                                              0.493
                                                                              0.153
##
## 3 Protestant A great deal
                                       0.207
                                                              0.474
                                                                              0.319
## 4 Catholic Hardly any
                                                              0.264
                                       0.585
                                                                              0.151
                 Only some
## 5 Catholic
                                       0.346
                                                              0.47
                                                                              0.184
## 6 Catholic
                 A great deal
                                       0.22
                                                              0.445
                                                                              0.335
## 7 Jewish
                 Hardly any
                                       0.5
                                                              0.5
                                                                              0
```

##	8	Jewish	Only some	0.161	0.581	0.258
##	9	Jewish	A great deal	0.167	0.633	0.2
##	10	Eastern	Hardly any	0.5	0	0.5
##	11	Eastern	Only some	0.2	0.4	0.4
##	12	Eastern	A great deal	0.2	0.333	0.467
##	13	Other	Hardly any	0.4	0.6	0
##	14	Other	Only some	0.472	0.321	0.208
##	15	Other	A great deal	0.184	0.469	0.347
##	16	None	Hardly any	0.455	0.242	0.303
##	17	None	Only some	0.352	0.496	0.152
##	18	None	A great deal	0.23	0.378	0.393

You can clean up the column names of this table and wrap it in huxtable before you knit. The new part of the code below is how to create a grouping row to use the "Interest in Space" header across the three levels of that variable. The idea is to first insert a new row, then merge it across columns 3:5, and finally assert that there are two rows (1:2) that should be treated as the table's header.

Dealing With NAs In Other Functions

For mean and standard deviation, remove NAs by adding na.rm = TRUE:

```
mean(review$age)

## [1] NA

mean(review$age, na.rm = TRUE)

## [1] 48.72003
```

Interest in Space

Religion	Confidence in Science	None	Moderate	Very
Protestant	Hardly any	0.596	0.288	0.116
Protestant	Only some	0.354	0.493	0.153
Protestant	A great deal	0.207	0.474	0.319
Catholic	Hardly any	0.585	0.264	0.151
Catholic	Only some	0.346	0.47	0.184
Catholic	A great deal	0.22	0.445	0.335
Jewish	Hardly any	0.5	0.5	0
Jewish	Only some	0.161	0.581	0.258
Jewish	A great deal	0.167	0.633	0.2
Eastern	Hardly any	0.5	0	0.5
Eastern	Only some	0.2	0.4	0.4
Eastern	A great deal	0.2	0.333	0.467
Other	Hardly any	0.4	0.6	0
Other	Only some	0.472	0.321	0.208
Other	A great deal	0.184	0.469	0.347
None	Hardly any	0.455	0.242	0.303
None	Only some	0.352	0.496	0.152
None	A great deal	0.23	0.378	0.393

sd(review\$educ)

[1] NA

sd(review\$educ, na.rm = TRUE)

[1] 3.05107

For correlation, restrict the estimation to cases with values for both variables by adding use = "complete":

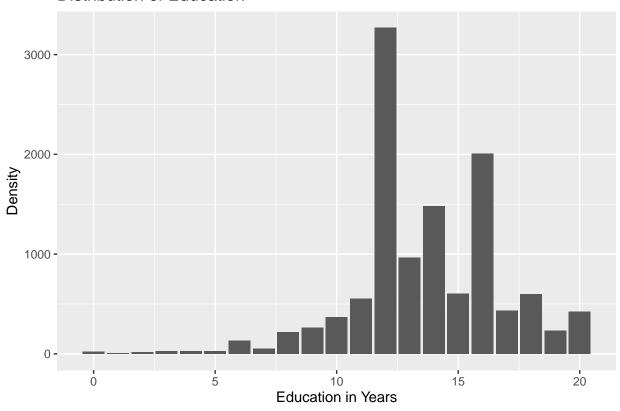
cor(review\$age, review\$educ, use = "complete")

[1] -0.0319707

For ggplot, R knows to only use complete cases but will warn you that it is doing so. To drop the warning, add warning = FALSE to the start of the code chunk:

Don't know how to automatically pick scale for object of type haven_labelled. Default

Distribution of Education



Remember to change the axis labels and add a title to the figure above!

Basic linear models also know to drop NAs. The notes section of the summary informs you how many cases have been deleted from the estimates (in the example below, 6315 observations are deleted due to missingness).

This is new: notice how we are redefining the space factor variable to have a numeric scale in the chunk below. Each of the three factor levels will be assigned a number from 1-3. Since we asserted that the order of levels is "Not at all interested" / "Moderately interested" / "Very interested", now higher scores tell us that respondents are more interested in space. (This is a neat trick, but in general be careful with this approach. It only works if you can assume that the distance between each level is even.)

```
model1 <- lm(as.numeric(space) ~ religion, data = review)</pre>
summary(model1)
##
## Call:
## lm(formula = as.numeric(space) ~ religion, data = review)
##
## Residuals:
##
        Min
                   1Q
                        Median
                                      3Q
                                              Max
## -1.23596 -0.88193 0.06037
                                0.11807
                                         1.11807
```

```
##
## Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
##
## (Intercept)
                              0.01384 135.940 < 2e-16 ***
                   1.88193
## religionCatholic 0.05769
                                       2.613 0.00900 **
                              0.02208
## religionJewish
                              0.07544
                                       2.647 0.00814 **
                   0.19970
## religionEastern
                   0.35402
                              0.07904 4.479 7.65e-06 ***
## religionOther
                              0.06094 0.543 0.58708
                   0.03310
                              0.03619
## religionNone
                   0.09317
                                       2.574 0.01007 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.05 '.' 0.1 ' ' 1
##
```

Residual standard error: 0.7341 on 5450 degrees of freedom

(6315 observations deleted due to missingness)

F-statistic: 6.564 on 5 and 5450 DF, p-value: 4.254e-06

Multiple R-squared: 0.005986,

##

By default, the fitted.values function will not work if there are NAs in your model. If you have missing values in your model, it is better to use fitted() and add na.action = na.exclude to your lm() code. Now when you run the fitted() function any observations not included in your model will have NA as their predicted value.

Adjusted R-squared: 0.005074

```
## Min. 1st Qu. Median Mean 3rd Qu. Max. NA's ## 1.882 1.882 1.882 1.920 1.940 2.236 6315
```

Let's add a model with a control variable and an interactive model.

Use huxreg to combine all three models into your final table:

```
huxreg(model1, model2, model3,
       statistics = c("Number of Observations" = "nobs"),
       coefs = c("(Intercept)" = "(Intercept)",
                 "Religion = Catholic" = "religionCatholic",
                 "Religion = Jewish" = "religionJewish",
                 "Religion = Eastern" = "religionEastern",
                 "Religion = Other" = "religionOther",
                 "Religion = None" = "religionNone",
                 "Science Confidence = Only Some" = "scienceOnly some",
                 "Science Confidence = A Great Deal" = "scienceA great deal",
                 "Catholic X Only Some" = "religionCatholic:scienceOnly some",
                 "Jewish X Only Some" = "religionJewish:scienceOnly some",
                 "Eastern X Only Some" = "religionEastern:scienceOnly some",
                 "Other X Only Some" = "religionOther:scienceOnly some",
                 "None X Only Some" = "religionNone:scienceOnly some",
                 "Catholic X A Great Deal" = "religionCatholic:scienceA great deal",
                 "Jewish X A Great Deal" = "religionJewish:scienceA great deal",
                 "Eastern X A Great Deal" = "religionEastern:scienceA great deal",
                 "Other X A Great Deal" = "religionOther:scienceA great deal",
                 "None X A Great Deal" = "religionNone:scienceA great deal")) |>
 set caption("Add A Title Here") |>
 theme compact()
```

Using Markdown For Reports

Hiding Code and Inline Code

Let's start with a case where your output is a single number, like a mean. Imagine you are working on the descriptives part of your project and want to include the mean of age. The place to start is with a regular code chunk with the mean() function:

```
mean(review$age, na.rm=TRUE)
```

```
## [1] 48.72003
```

But say you want R to run a code chunk and have only the output - not the code! - show up in your file. Simply add echo = FALSE to the first fence:

```
## [1] 48.72003
```

If you want to integrate a single number into your document, you can use inline code. Without opening a full code chunk, just use one backtick to open and close your fence. Then write a sentence as you normally would, and let R Markdown replace your code with the output:

The mean of age is 48.72.

Other Options For Hiding Code

If you want to run the code chunk so you can see the output in your notebook but with neither the code nor the output showing up in your knitted file, use include = FALSE.

I recommend starting with include = FALSE for your final project, so you can see all your output but then selectively choose what to include and what not to include in your knitted report.

If for some reason you want to show the code but not the output, use eval = FALSE.

```
mean(review$age, na.rm=TRUE)
```

R Markdown Tips

Some other things to know about writing in R Markdown...

Use hashtags for headings. One hashtag is for a big heading; additional hashtags shrink the size. For example:

Biggest Heading

Big Heading

Small Heading

Smallest Heading

If you want to italicize text, wrap it within single asterisks. If you want to bold text, wrap it within double asterisks. And if you want to italicize and bold text, wrap it within triple asterisks.

It can sometimes be helpful to highlight original variable names or unusual terms within tickmarks. But note this is similar to the inline code we saw earlier. As long as the word or phrase does not start with a single r, R will not try to run it as code. See the preview file for the difference in what these tickmarks represent:

The mean of age is 48.72.

To create an ordered list, leave an empty line and then:

- Start
- Each
- Item
- With
- A
- Dash

To create a numbered list, leave an empty line and then:

- 1. Start
- 2. Each
- 3. Item
- 4. With
- 5. A
- 6. Number and a period

To add a horizontal line rule, include at least three dashes on a single line:

And to add a page break:

It's Also The Start Of A New Section

Formatting Summary Tables

We have seen huxtable() and huxreg() a lot. They are great. Use them.

Here's another example of how to use huxtable() in combination with group_by() and summarize() to make a nice summary table. Let's start with the code for getting means and standard deviations of the age and educ variables for each religion group:

If we huxtable this table, we'll have the religion categories in the rows and the means and standard deviations in the columns:

```
huxtable(summary_table) |>
  insert_row("", "Age", "", "Education", "", after = 0) |>
  merge_cells(1, 2:3) |>
  merge_cells(1, 4:5) |>
  set_contents(2, 1:5, c("Religion", "Mean", "SD", "Mean", "SD")) |>
  set_header_rows(1:2, TRUE) |>
  set_caption("Summary Table: Age and Education by Religion") |>
  set_align(everywhere, 2:5, "center") |>
  theme_compact()
```

Note that huxtable() also works well with t.test() after asserting that the results should be in tidy format (by wrapping the t.test() function in tidy())...

```
...and prop.test()...
space religion <- review |>
     filter(religion=="Protestant" | religion=="None") |>
     select(religion, space_very_interested) |>
     droplevels()
space_religion_table <- table(space_religion$religion,</pre>
                              space_religion$space_very_interested)
tidy((prop.test(space_religion_table))) |>
 huxtable() |>
 select(-c(method, parameter)) |>
 set_caption("Proportion Test: Protestant vs No Religion and Very Interested in Space")
 theme_compact()
...and chisq.test()...
tidy(chisq.test(review$sex, review$consci)) |>
 huxtable() |>
 select(-c(method, parameter)) |>
 set caption("Chi-square Test: Sex and Confidence in Science") |>
 theme_compact()
...and fisher.test()...
educ 11 years only <- review |>
     filter(educ==11) |>
     select(educ, religion, space)
chisq.test(educ_11_years_only$religion, educ_11_years_only$space)$expected
## Warning in chisq.test(educ 11 years only$religion, educ 11 years only$space):
## Chi-squared approximation may be incorrect
##
                              educ_11_years_only$space
## educ_11_years_only$religion Not interested Moderately interested
                    Protestant
##
                                  45.9183673
                                                          54.5918367
##
                    Catholic
                                   30.4897959
                                                          36.2489796
                    Jewish
##
                                   0.3673469
                                                         0.4367347
                                   0.3673469
##
                    Eastern
                                                          0.4367347
##
                    Other
                                   3.3061224
                                                           3.9306122
##
                    None
                                    9.5510204
                                                         11.3551020
```

```
##
                              educ_11_years_only$space
## educ_11_years_only$religion Very interested
##
                    Protestant
                                    24.4897959
                    Catholic
##
                                   16.2612245
##
                    Jewish
                                    0.1959184
##
                    Eastern
                                    0.1959184
##
                    Other
                                    1.7632653
                    None
                                     5.0938776
##
tidy(fisher.test(educ_11_years_only$religion, educ_11_years_only$space,
                   simulate.p.value = TRUE)) |>
 huxtable() |>
 select(-c(method)) |> # Just drop method here; fisher.test output does not include per
 set_caption("Fisher Test: Religion and Interest in Space") |>
  theme_compact()
```

Table 1: Add A Title Here

	(1)	(2)	(3)
(Intercept)	1.882 ***	1.564 ***	1.521 ***
	(0.014)	(0.047)	(0.059)
Religion = Catholic	0.058 **	0.025	0.045
	(0.022)	(0.027)	(0.114)
Religion = Jewish	0.200 **	0.112	-0.021
	(0.075)	(0.092)	(0.508)
Religion = Eastern	0.354 ***	0.267 **	0.479
	(0.079)	(0.101)	(0.508)
Religion = Other	0.033	-0.002	0.079
	(0.061)	(0.071)	(0.324)
Religion = None	0.093 *	0.061	0.328 *
	(0.036)	(0.045)	(0.138)
Science Confidence = Only Some		0.239 ***	0.279 ***
		(0.049)	(0.064)
Science Confidence $=$ A Great Deal		0.535 ***	0.592 ***
		(0.050)	(0.065)
Catholic X Only Some			-0.007
			(0.121)
Jewish X Only Some			0.318
			(0.524)
Eastern X Only Some			-0.079
			(0.533)
Other X Only Some			-0.143
			(0.340)
None X Only Some			-0.327 *
			(0.153)
Catholic X A Great Deal			-0.044
			(0.122)
Jewish X A Great Deal			-0.059
			(0.525)
Eastern X A Great Deal			-0.325
			(0.525)
Other X A Great Deal			-0.029
			(0.341)
None X A Great Deal			-0.277
			(0.153)
Number of Observations *** $p < 0.001$; ** $p < 0.01$; * $p < 0.01$	5456 0.05.	3377	3377

Table 2: Summary Table: Age and Education by Religion

	$\mathbf{A}\mathbf{g}$	\mathbf{e}	Education		
Religion	Mean	SD	Mean	SD	
Protestant	51	17.9	13.7	2.81	
Catholic	47.9	17.1	13.5	3.35	
Jewish	56.2	18	16	2.67	
Eastern	41.6	16.4	15.2	3.38	
Other	38.4	15.4	13.4	2.68	
None	41.6	16	13.6	3.07	

Table 3: T Test: Difference in Mean Age between Jewish and Eastern Respondents

estimate	${\bf estimate 1}$	${\bf estimate 2}$	statistic	p.value	conf.low	conf.high	alternative
14.7	56.2	41.6	8.33	1.5e-15	11.2	18.1	two.sided

Table 4: Proportion Test: Protestant vs No Religion and Very Interested in Space

estimate1	estimate2	statistic	p.value	conf.low	conf.high	alternative
0.791	0.714	14	0.000186	0.0333	0.122	two.sided

Table 5: Chi-square Test: Sex and Confidence in Science

 statistic
 p.value

 60.4
 7.81e-14

Table 6: Fisher Test: Religion and Interest in Space

p.value alternative 0.032 two.sided