Data Management

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0.1 Introduction

Goal:

- Create an organized dataset that focuses on my variables of interests.

- Create additional variables that I will need to analyze.

Dataset: International Multi-Centre Study of Statistics and Mathematics Anxieties and Related Variables in University Students (the SMARVUS Dataset)

Source: "This large, international dataset contains survey responses from N = 12,570 students from 100 universities in 35 countries, collected in 21 languages. We measured anxieties (statistics, mathematics, test, trait, social interaction, performance, creativity, intolerance of uncertainty, and fear of negative evaluation), self-efficacy, persistence, and the cognitive reflection test, and collected demographics, previous mathematics grades, self-reported and official statistics grades, and statistics module details. Data reuse potential is broad, including testing links between anxieties and statistics/mathematics education factors, and examining instruments' psychometric properties across different languages and contexts." (https://osf.io/mhg94/)

Variables of Interest:

- 'Var1': [Variable description]
- 'Var2': [Variable description]

Goals:

- Filter dataset to English speakers (my language) and Psychology Majors (majority of participants).
- Create total scores for measures.
- Create a new file with my filtered data.

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.1     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.4
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

```
source("loadData.R")
```

```
[1] "Data successfully loaded."
```

```r
head(df)
```

```
# A tibble: 6 x 788
  unique_id survey_id country  language incentive participation_context progress
  <chr>     <chr>     <chr>    <chr>    <chr>     <chr>                      <dbl>
1 01057178  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time      100
2 0300b5f2  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time      100
3 03f6503b  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time      100
4 0601d699  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time       78
5 08b6cb02  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time      100
6 0903d70d  airlangga Indones~ Bahasa ~ Prize Dr~ Remotely, in own time      100
# i 781 more variables: duration <dbl>, start_date <chr>, end_date <chr>,
#   university <chr>, eligibility_ug <chr>, eligibility_stats <chr>,
#   degree_major <chr>, degree_minor <chr>, degree_level_maths <chr>,
#   degree_level_maths_specify <chr>, degree_year <chr>, age <chr>,
#   gender <chr>, spld <chr>, attention_amnesty <chr>, Q7.1_1 <dbl>,
#   Q7.1_2 <dbl>, Q7.1_3 <dbl>, Q7.1_4 <dbl>, Q7.1_5 <dbl>, Q7.1_6 <dbl>,
#   Q7.1_7 <dbl>, Q7.1_8 <dbl>, Q7.1_9 <dbl>, Q7.1_10 <dbl>, Q7.1_11 <dbl>, ...
```

```r
# Alternative example

# Define the file path
# Load the CSV file
#df <- file.path("..", "data", "data.csv") %>%
#  read_csv()

# View the first few rows
#head(df)
```

0.2 Filtering Data

0.2.1 Check data prior to filtering

Review the majors and minors of participants. I will use this information to be aware of the levels of the variable when filtering.

```r
freq(as.ordered(df$degree_major), plot = FALSE)
```

```
as.ordered(df$degree_major)
                  Frequency  Percent Valid Percent Cum Percent
```

```
Arts & Humanities        232   1.8457        2.1007       2.101
Business & Finance       768   6.1098        6.9540       9.055
Education                397   3.1583        3.5947      12.649
Maths                    153   1.2172        1.3854      14.035
Psychology              8759  69.6818       79.3100      93.345
Sciences                 456   3.6277        4.1289      97.474
Social Sciences          247   1.9650        2.2365      99.710
Uncategorised             32   0.2546        0.2898     100.000
NA's                    1526  12.1400
Total                  12570 100.0000      100.0000
```

```
freq(as.ordered(df$degree_minor), plot = FALSE)
```

```
as.ordered(df$degree_minor)
                   Frequency   Percent Valid Percent Cum Percent
Arts & Humanities         15   0.11933        6.4935       6.494
Business & Finance        30   0.23866       12.9870      19.481
Education                 61   0.48528       26.4069      45.887
Maths                      4   0.03182        1.7316      47.619
Psychology               107   0.85123       46.3203      93.939
Sciences                   2   0.01591        0.8658      94.805
Social Sciences           12   0.09547        5.1948     100.000
NA's                   12339  98.16229
Total                  12570 100.00000      100.0000
```

```
freq(as.ordered(df$language), plot = 0)
```

```
as.ordered(df$language)
                 Frequency  Percent Cum Percent
Arabic                1490  11.8536       11.85
Bahasa Indonesia       697   5.5449       17.40
Chinese                323   2.5696       19.97
Dutch                  394   3.1344       23.10
English               5427  43.1742       66.28
Estonian                98   0.7796       67.06
French                 432   3.4368       70.49
German                 736   5.8552       76.35
Greek                   99   0.7876       77.14
Hebrew                 285   2.2673       79.40
Hungarian              206   1.6388       81.04
Italian                248   1.9730       83.02
```

```
Polish                   69   0.5489       83.56
Portuguese               68   0.5410       84.11
Romanian                317   2.5219       86.63
Serbian                 117   0.9308       87.56
Slovakian                88   0.7001       88.26
Slovenian                94   0.7478       89.01
Spanish                 523   4.1607       93.17
Turkish                 834   6.6348       99.80
Ukrainian                25   0.1989      100.00
Total                 12570 100.0000
```

```r
freq(as.ordered(df$attention_amnesty), plot = 0)
```

```
as.ordered(df$attention_amnesty)
      Frequency Percent Valid Percent Cum Percent
No          172   1.368         1.645       1.645
Yes       10281  81.790        98.355     100.000
NA's       2117  16.842
Total     12570 100.000       100.000
```

0.2.2 Filtering the data

Eliminate any participants that did not pass the attention check items. Participants were directed to provide a particular response to each of the attention check items.

```r
filtered_df <- df %>%
  filter(
    attention_amnesty == "Yes") %>%
  filter(
    Q7.1_24  == 1,
    Q8.1_21  == 5,
    Q9.1_22  == 1,
    Q11.1_9  == 3,
    Q13.1_17 == 2,
    Q15.1_9  == 4) %>%
  filter(
    degree_major == "Psychology" |
    degree_minor == "Psychology") %>%
  filter(
    progress == 100) %>%
  filter(
    language == "English")
```

```
#View(filtered_df)
```

0.2.3 Check data after filtering

Use frequency tables to check filtered data.

```
attention_check_items <- c(
  "Q7.1_24",
  "Q8.1_21",
  "Q9.1_22",
  "Q11.1_9",
  "Q13.1_17",
  "Q15.1_9"
  )

# Generate frequency tables for each variable
invisible(lapply(attention_check_items, function(var) {
  cat("\n-----------------------------\n")
  cat("Frequency Table for", var, "\n")
  print(table(filtered_df[[var]]))
}))
```

```
-----------------------------
Frequency Table for Q7.1_24

   1
3077

-----------------------------
Frequency Table for Q8.1_21

   5
3077

-----------------------------
Frequency Table for Q9.1_22

   1
```

```
3077

------------------------------
Frequency Table for Q11.1_9

   3
3077

------------------------------
Frequency Table for Q13.1_17

   2
3077

------------------------------
Frequency Table for Q15.1_9

   4
3077
```

```
freq(as.ordered(filtered_df$attention_amnesty), plot = 0)
```

```
as.ordered(filtered_df$attention_amnesty)
      Frequency Percent Cum Percent
Yes        3077     100         100
Total      3077     100
```

```
freq(as.ordered(filtered_df$degree_major), plot = 0)
```

```
as.ordered(filtered_df$degree_major)
           Frequency Percent Cum Percent
Psychology      3077     100         100
Total           3077     100
```

```
freq(as.ordered(filtered_df$degree_minor), plot = 0)
```

```
as.ordered(filtered_df$degree_minor)
      Frequency Percent Valid Percent Cum Percent
NA's       3077     100
Total      3077     100             0
```

```
freq(as.ordered(filtered_df$progress), plot = 0)
```

```
as.ordered(filtered_df$progress)
      Frequency Percent Cum Percent
100        3077     100         100
Total      3077     100
```

```
freq(as.ordered(filtered_df$language), plot = 0)
```

```
as.ordered(filtered_df$language)
        Frequency Percent Cum Percent
English      3077     100         100
Total        3077     100
```

0.2.4 Drop variables

Remove variables that have be used in the filter and are no longer meaningful to include.

```
filtered_df <- filtered_df %>%
  select(
    -Q7.1_24,
    -Q8.1_21,
    -Q9.1_22,
    -Q11.1_9,
    -Q13.1_17,
    -Q15.1_9,
    -attention_amnesty,
    -degree_major,
    -degree_minor,
    -language,
    -progress)
```

```
#View(filtered_df)
```

0.3 Addressing Missing Values

Missing values do not appear to be an issue for the scale variables.

Some students provided a zero for their grade but some students were using zero to represent in NA. Due to this discrepancy, grades of zero will be coded as in NA.

```
#How many students listed 0 as their grade? Math grade and Stats grade.
#freq(as.order(filtered_df$))
```

0.4 Creating Total Score for Measurements

My dataset contains the individual items on several measures. I will need to create a total score for total scores and sub-scales. Variables appear to be doubles, which will work for creating the total scores and subscales. Output will be hidden below to save space.

```
#Reverse coded items - NEW variables
filtered_df <- filtered_df %>%
  mutate(Q16.1_2_rev = 6 - Q16.1_2)

filtered_df <- filtered_df %>%
  mutate(across(c(Q16.1_3, Q16.1_4, Q16.1_5, Q16.1_7), ~ 6 - .,
                .names = "{.col}_rev"))
```

```
#Check that new reverse coded columns exist
print(colnames(filtered_df)[endsWith(colnames(filtered_df), "_rev")])
```

```
[1] "Q16.1_2_rev" "Q16.1_3_rev" "Q16.1_4_rev" "Q16.1_5_rev" "Q16.1_7_rev"
```

0.4.1 Statistics Anxiety, STARS

(Cruise et al., 1985; Hanna et al., 2008; Papousek et al., 2012)

Scale consists of 23 items: tests and class anxiety (8 items), interpretation anxiety (11 items), and fear of asking for help (4 items).

Uses Likert scale ranging from 1 = "no anxiety" to 5 = "a great deal of anxiety."

0.4.1.1 STARS modified for math

0.4.2 Mathematics Anxiety, R-MARS

(Baloğlu & Zelhart, 2007)

Subscales: Mathematics test anxiety (15 items), numerical task anxiety (5 original plus 4 modified items), and mathematics course anxiety (5 items).

Uses Likert-type scale ranging from 1 = "no anxiety" to 5 = "a great deal of anxiety".

0.4.2.1 R-MARS modified for stats

0.4.3 Trait Anxiety, STICSA

(Ree et al., 2008)

Subscales: cognitive (10 items) and somatic symptoms (11 items).

Uses Likert scale ranging from 1 = "not at all" to 4 = "very much so".

0.4.4 Test Anxiety, Revised Test Anxiety Scale (R TAS)

(Benson & El-Zahhar, 1994)

Subscales: worry (7 items), tension (6 items), test-irrelevant thinking (5 items), bodily symptoms (7 items). Secondary items may be removed. See citation above.

Uses Likert scale ranging from 1 = "almost never" to 4 = "almost always".

0.4.5 Fear of Negative Evaluation, Brief Fear of Negative Evaluation Scale - Straightforward (BNFE-S)

(Leary, 1983; Rodebaugh et al., 2004)

8 items.

Uses Likert scale ranging from 1 = "not at all characteristic of me" to 5 = "extremely characteristic of me".

0.4.6 Social Interaction Anxiety and Performance Anxiety, Liebowitz Social Anxiety Scale - Self Report (LSAS-SR)

(Baker et al., 2002; Liebowitz, 1987)

Subscales: interaction anxiety (fear/anxiety in social interactions, such as conversations or meeting new people; 12 items) and performance anxiety (fear/anxiety in performance-based situations, such as speaking in public; 12 items).

Uses Likert scale ranging from 0 = "not at all" to 3 = "very much so".

```
LSAS_social_items <- c("Q12.1_5", "Q12.1_7", "Q12.1_10", "Q12.1_11",
                       "Q12.1_12", "Q12.1_15", "Q12.1_18", "Q12.1_19",
                       "Q12.1_22", "Q12.1_23", "Q12.1_24")

LSAS_performance_items <- c("Q12.1_1", "Q12.1_2", "Q12.1_3", "Q12.1_4",
                            "Q12.1_6", "Q12.1_8", "Q12.1_9", "Q12.1_13",
                            "Q12.1_14", "Q12.1_16", "Q12.1_17", "Q12.1_20",
                            "Q12.1_21")
```

0.4.7 Intolerance of Uncertainty Scale - Short Form (IUS-SF)

(Carleton et al. 2007)

Subscales: prospective anxiety (fear of the future and uncertainty-related anticipation; 6 items) and inhibitory anxiety (avoidance behavior due to uncertainty; 6 items).

Uses Likert scale ranging from 1 = "not at all characteristic of me" to 5 = "entirely characteristic of me".

```
IUS_prospective_items <- c(
  "Q14.1_1",
  "Q14.1_2",
  "Q14.1_4",
  "Q14.1_5",
  "Q14.1_8",
  "Q14.1_9"
  )

IUS_inhibitory_items <- c(
  "Q14.1_3",
  "Q14.1_6",
  "Q14.1_7",
  "Q14.1_10",
  "Q14.1_11",
  "Q14.1_12"
  )

filtered_df <- filtered_df %>%
  mutate(
    IUS_Prospective = rowSums(select(., all_of(IUS_prospective_items)), na.rm = TRUE),
    IUS_Inhibitory = rowSums(select(., all_of(IUS_inhibitory_items)), na.rm = TRUE)
  )
```

```r
filtered_df <- filtered_df %>%
  mutate(IUS_Total = IUS_Prospective + IUS_Inhibitory)
```

```r
print("IUS Prospective Anxiety")
```

```
[1] "IUS Prospective Anxiety"
```

```r
summary(filtered_df$IUS_Prospective)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   0.00   13.00   18.00   17.73   22.00   30.00
```

```r
print("IUS Inhibitory Anxiety")
```

```
[1] "IUS Inhibitory Anxiety"
```

```r
summary(filtered_df$IUS_Inhibitory)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    0.0    12.0    17.0    16.7    21.0    30.0
```

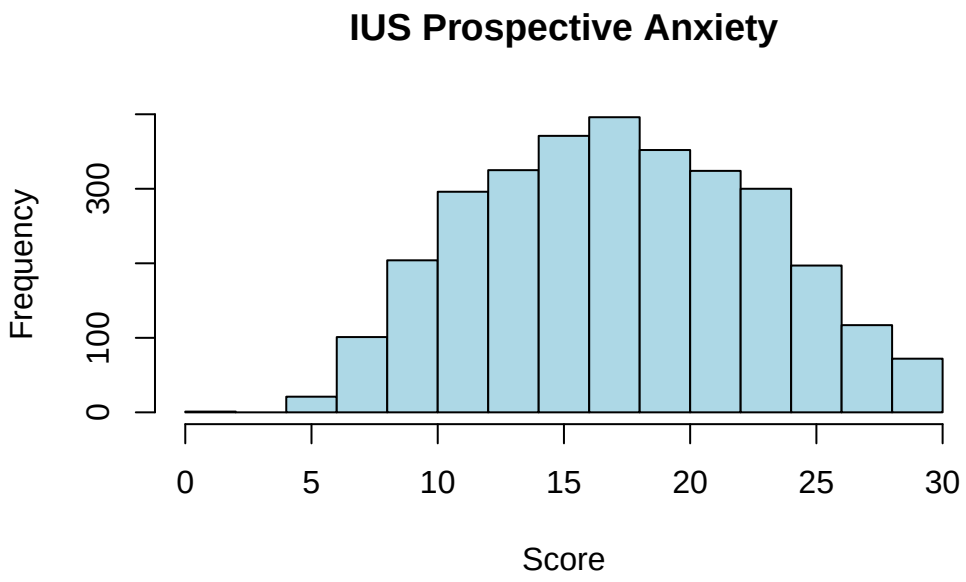
```r
print("Total IUS-SF Score")
```

```
[1] "Total IUS-SF Score"
```

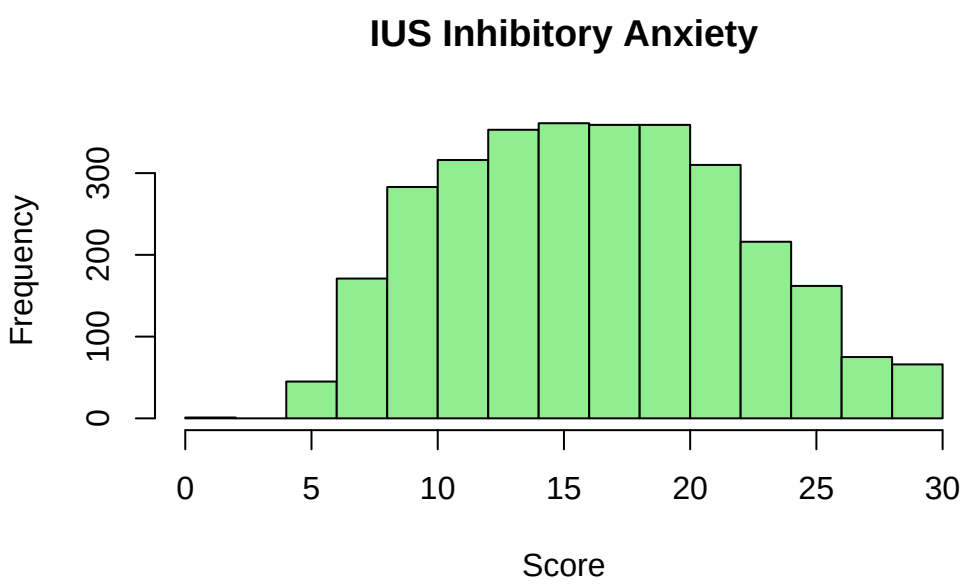
```r
summary(filtered_df$IUS_Total)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   0.00   26.00   34.00   34.43   42.00   60.00
```

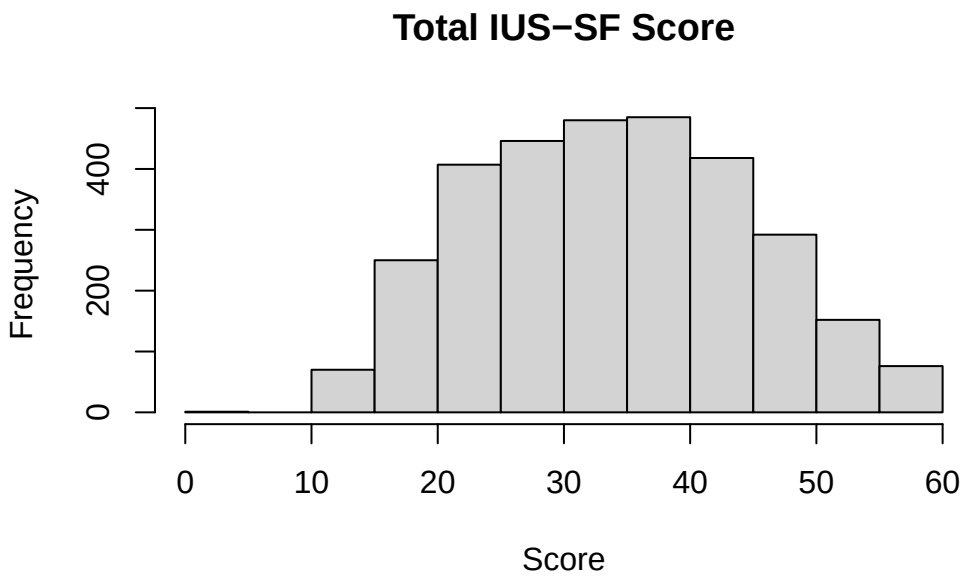
```r
hist(filtered_df$IUS_Prospective,
     main="IUS Prospective Anxiety",
     xlab="Score",
     col="lightblue"
     )
```




```
hist(filtered_df$IUS_Inhibitory,
     main="IUS Inhibitory Anxiety",
     xlab="Score",
     col="lightgreen"
     )
```




```
hist(filtered_df$IUS_Total,
     main="Total IUS-SF Score",
     xlab="Score",
     col="lightgray"
     )
```



0.4.8 Creativity Anxiety Scale (CAS)

(Daker et al., 2020)

Subscales: creativity (8 items) and non-creativity (8 items).

Uses Likert scale ranging from 0 = "not at all" to 4 = "very much".

Sum.

```
#Create list of items for each subscale

CAS_creativity_items <- c(
  "Q13.1_1",
  "Q13.1_2",
  "Q13.1_3",
  "Q13.1_4",
  "Q13.1_5",
  "Q13.1_6",
  "Q13.1_7",
  "Q13.1_8"
  )

CAS_non_creativity_items <- c(
```

```
  "Q13.1_9",
  "Q13.1_10",
  "Q13.1_11",
  "Q13.1_12",
  "Q13.1_13",
  "Q13.1_14",
  "Q13.1_15",
  "Q13.1_16"
  )

#Generate subscale scores
filtered_df <- filtered_df %>%
  mutate(
    CAS_creativity = rowSums(select(., all_of(CAS_creativity_items)), na.rm = TRUE),
    CAS_noncreativity = rowSums(select(., all_of(CAS_non_creativity_items)), na.rm = TRUE)
  )
```

```
freq(as.ordered(filtered_df$CAS_creativity), plot = 0)
```

```
as.ordered(filtered_df$CAS_creativity)
      Frequency  Percent Cum Percent
8            61   1.9825       1.982
9            81   2.6324       4.615
10           72   2.3399       6.955
11           67   2.1774       9.132
12           68   2.2099      11.342
13          100   3.2499      14.592
14           98   3.1849      17.777
15          108   3.5099      21.287
16          134   4.3549      25.642
17          130   4.2249      29.867
18          146   4.7449      34.612
19          148   4.8099      39.422
20          125   4.0624      43.484
21          137   4.4524      47.936
22          142   4.6149      52.551
23          157   5.1024      57.654
24          158   5.1349      62.788
25          162   5.2649      68.053
26          125   4.0624      72.116
27          116   3.7699      75.886
28          124   4.0299      79.916
```

```
29           99   3.2174      83.133
30          107   3.4774      86.610
31           74   2.4049      89.015
32           92   2.9899      92.005
33           54   1.7550      93.760
34           43   1.3975      95.158
35           41   1.3325      96.490
36           29   0.9425      97.433
37           21   0.6825      98.115
38           26   0.8450      98.960
39           24   0.7800      99.740
40            8   0.2600     100.000
Total      3077 100.0000
```

```
freq(as.ordered(filtered_df$CAS_noncreativity), plot = 0)
```

```
as.ordered(filtered_df$CAS_noncreativity)
      Frequency  Percent Cum Percent
8           176   5.7199        5.72
9           146   4.7449       10.46
10          139   4.5174       14.98
11          127   4.1274       19.11
12          134   4.3549       23.46
13          120   3.8999       27.36
14          166   5.3949       32.76
15          166   5.3949       38.15
16          205   6.6623       44.82
17          169   5.4924       50.31
18          163   5.2974       55.61
19          149   4.8424       60.45
20          160   5.1999       65.65
21          120   3.8999       69.55
22          113   3.6724       73.22
23          103   3.3474       76.57
24          107   3.4774       80.05
25           87   2.8274       82.87
26           73   2.3724       85.25
27           78   2.5349       87.78
28           63   2.0474       89.83
29           59   1.9175       91.75
30           40   1.3000       93.05
31           50   1.6250       94.67
```

```
32            37   1.2025       95.87
33            34   1.1050       96.98
34            19   0.6175       97.60
35            22   0.7150       98.31
36            13   0.4225       98.73
37             9   0.2925       99.03
38            13   0.4225       99.45
39             8   0.2600       99.71
40             9   0.2925      100.00
Total       3077 100.0000
```

0.4.9 Analytic Thinking, Cognitive Reflection Task (CRT)

(Frederick, 2005; Shenhav et al. 2012)

Responses must be coded. Skipped.

0.4.10 Self efficacy, New General Self Efficacy Scale (NGSE)

(Chen et al., 2001)

8 items.

Uses Likert scale of 1 = "strongly disagree" to 5 = "strongly agree".

0.4.11 Persistence, Attitude Towards Mathematics Survey (ATMS)

(Miller et al., 1996)

8 items.

Uses Likert scale of 1 = "strongly disagree" to 5 = "strongly agree".

0.5 Split Data