STRATEGIC DATA PROJECT

CLEAN: DATA BUILDING GUIDE

Strategic Data Project

Center for Education Policy Research at Harvard University

Contents

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Introduction

SDP DATA BUILDING GUIDE

Congratulations on identifying the data elements that are essential for conducting rigorous analyses in your organization. **Clean** is the next stage in the SDP Toolkit for Effective Data Use. To successfully move through the **Clean** stage, you should review the **Identify** component of this toolkit.

Upon completing this stage, you will have produced clean research files that will allow you to **Connect** and **Analyze** data related to college-going success in your agency.

The Tasks

Clean consist of five tasks that share a similar structure. The tasks are geared toward analysts with at least moderately strong data background and comfort with statistics. Each task provides hands-on experience building specific components of the research file used for the SDP College Going Diagnostic Analyses.

The tasks are listed as follows:

- Task 1: Student Attributes
- Task 2: Student School Year
- Task 3: Identifying the Ninth Grade Cohort
- Task 4: Student School Enrollment
- Task 5: Student Test Scores
- Task 6: Student Class Enrollment
- Task 7: NSC (National Student Clearinghouse) Data

Each task uses a raw input file and produces a cleaned output file that matches Identify.

Download these raw input files along with everything else you need for the toolkit as a zip file at sdp.cepr.harvard.edu/toolkit. When unzipped, this file will reveal an infrastructure including all the steps of the toolkit, the data files you need, and template files with R code.

In particular, in Clean, you will be working with the files in the **raw** folder. If you are using R, you can fill in the corresponding .R scripts in **programs** to go through the tasks.

How to Start

The beginning of the Data Building Guide is a Decision Rules Glossary (p. 6). This glossary provides decision rules for resolving data problems associated with particular variables. It is meant to be a quick-reference guide of rules that can be used with any software platform. These decision rules are then implemented in the step-by-step instructions the tasks provide.

SDP has also created a detailed **SDP R Glossary**, available as a separate document, that covers the R commands used throughout the toolkit. Commands are listed alphabetically and by subject.

As you go through a task, be sure to consult the data and code snippets to get a visual sense for the changes occurring at each step.

Task Structure

The tasks follow a logical sequence from **1** to **7**. Each task comes with its own raw input file that results in a cleaned output file that matches or extends the file **Identify**. We also provide all cleaned output files so you can check your answers after completing each task. If you have followed the task instructions correctly, you should arrive at the same cleaned output file.

In each task, you will also find:

- **Purpose:** — Clarifies the importance of the task.
- **How to Start:** — Identifies the input file(s) for the task.
- **Data Description:** — Describes data elements for the task.
- **Instructions:** — Provides instructions to transform data. These instructions include:
  - R code to help you execute the instructions through code
  - Data snapshots to help you visualize changes to the data at each step

Summary

Through the tasks, you will learn effective practices for: data transformation, variable construction, and implementation of key decision rules. The **Task Map** on the next page summarizes the inputs and outputs of each task and how the outputs are used in **Connect** to produce an analysis file. The Task Map also serves as a Table of Contents. If you need additional guidance, the friendly research team at SDP is available to help: **sdp@gse.harvard.edu** .

Task Map

This map summarizes the inputs and outputs for each task and how the outputs are used in Connect to produce the college-going analysis and college-going analysis on-track file.

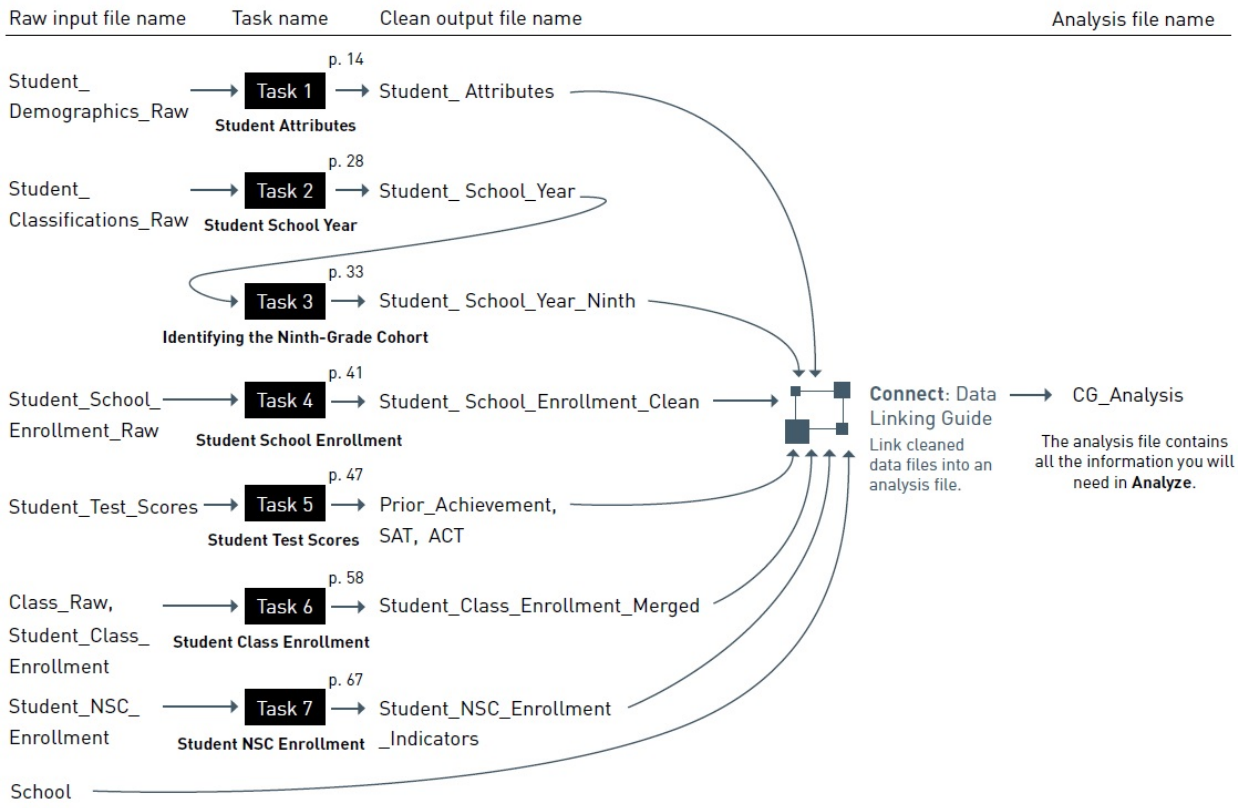


Figure 1: Taskmap

Decision Rules Glossary

Student_Attributes

Demographic, cohort, and graduation data for students.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			
male	Some students with conflicting genders may be observed.	If more than one gender observed, report the modal gender. If multiple modes report the most recent gender recorded.	**Task 1:** Student Attributes
race_ethnicity	Some students with moer than one race_ethnicity may be observed. For the purposes of anlysis, SDP consider race_ethnicity time invariant.	If more than one category selected serially in time, report the modal race/ethnicity. If multiple modes are observed, report the most recent race/ethnicity recorded.	**Task 1:** Student Attributes
race	Some students with more than one race may be ovserved. For the purposes of analysis, SDP considers race time invariant.	If more than one category selected serially in time, report the modal race. If multiple modes are observed, report the most recent race recorded.	
ethnicity	Some students with more than one ethnicity may be ovserved. For the purposes of analysis, SDP considers ethnicity time invariant.	If more than one ethnicity observed, report the modal ethnicity. If multiple modes are observed, the most recent ethnicity recorded.	
birth_date	Some students with more than one birth date may be observed. For the purposes of analysis, SDP considers birth_date time invariant.	If more than one birth date observed, report the modal birth date. If multiple modes, report the most recent birth date recorded. When evaluating modal birth date exclude birth dates that fall outside +/- four years of the expected birth date given grade level and school year.	
first_9th_school_ year_reported			
hs_diploma			**Task 1:** Student Attributes
hs_diploma_date	Some students with more than one diploma date may be observed. For the purposes of analysis, SDP considers hs_diploma_date time invariant.	If more than one diploma date is observed, report the first diploma date.	**Task 1:** Student Attributes
hs_diploma_type	Some students with more than one diploma type may be observed. For the purposes of the analysis, SDP considers hs_diploma_type to be time invariant.	If more than one type is observed, report the type associated with the first diploma date. If multiple diploma types are observed for the first diploma date, report the modal value. If there is no mode, report the most competitive diploma type. If there is a diploma date but no diploma type, report the diploma type as ”Unknown.”	**Task 1:** Student Attributes
zip_code			

Identifies unique observation: **sid**

Student_School_Year

Yearly classification and attendance data for students.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			
school_year			
grade_level	Some students with more than one grade level may be observed during a given school year.	If more than one grade level observed during a school year, report the highest grade level recorded.	**Task 2:** Student School Year
frpl	Some students with more than one free or reduced price lunch status may be observed during a given school year.	If more than one status is observed during the school year, report the highest non-null value.	**Task 2:** Student School Year
iep	Some studnets with more than one indivualized education plan status may be observed during a given school year.	If both ”no IEP” and ”has IEP” are observed during the same school year, report ”had IEP”.	**Task 2:** Student School Year
iep_classification	Some students with more than on individualized education plan classification may be observed during a given school year.	If more than one classification is observed during the school year, report the last non-null classification reported.	
ell	Some students with more than one English language learner status may be observed during a given school year.	If both ”not ell” and ”ell” are observed during the school year, report ”ell”.	**Task 2:** Student School Year
ell_classification	Some students with more than one English language learner classification may be observed during a given school year.	If more than one classification is observed during the school year, report the last non-null classification reported.	
gifted	Some students with more than one gifted status may be observed during a given school year.	If both ”not enrolled” and ”enrolled” are observed during the same school year, report ”enrolled”.	**Task 2:** Student School Year
gifted _classification	Some students with more than one gifted classification may be observed during a given school year.	If more than one classification is observed during the school year, report the last non-null classification reported.	
total_days_enrolled		If not reported, value may be calculated by number of school days between enrollment_date and withdrawal_date, or days_present + days_absent.	**Task 2:** Student School Year
total_days_absent		Cannot exceed the number of days enrolled.	**Task 2:** Student School Year
days_suspended_ out_of_school		Cannot exceed the number of days enrolled.	**Task 2:** Student School Year
days_suspended_ in_school		Cannot exceed the number of days enrolled.	**Task 2:** Student School Year

Identifies unique observation: **sid + school_year**

Student_School_Enrollment

School enrollment/withdrawal data for students.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			
school_year			
school_code			
enrollment_date **enrollment_code** **enrollment_code_desc** **withdrawal_date** **withdrawal_code** **withdrawal_code_desc**	Many different scenarios may be encountered: • Some enrollment spells may overlap at the same school. • Some enrollment spells may have a missing enrollment_date and withdrawal_date. • Some enrollment spells may have the same enrollment_date and withdrawal_date. • Some enrollment spells may begin after the withdrawal_date. • Some enrollment spells may begin after the end of the current school_year or before the beginning of the current school_year.	If enrollment spells overlap at the same school, consolidate enrollment observations into one enrollment period, using the earliest enrollment date and last withdrwal date and their corresponding codes and descriptions.	**Task 4:** Student School Enrollment
days_enrolled		Update days enrolled after you have consolidated overlapping enrollment observations.	**Task 4:** Student School Enrollment
days_present			

Identifies unique observation: **sid + school_year + school_code + enrollment_date**

Student_Test_Scores

Standardized test data for students (state standardized tests, advanced placement, SAT, ACT, etc). Every attempt at a test by a student should be recorded.

Drop any other abnormal enrollment observations.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			
test_code			
test_date	Students who re-take tests in the same year or are retained in a grade and re-take the same test in different years may have multiple observations for a single test code.	Take the earliest test in both cases.	**Task 5:** Student Test Scores
test_code_desc			
test_type			**Task 5:** Student Test Scores
grade_level			**Task 5:** Student Test Scores
test_subject			**Task 5:** Student Test Scores
test_version			**Task 5:** Student Test Scores
language_version			**Task 5:** Student Test Scores
raw_score **scaled_score**	The raw score or scaled score may be missing or take on values outside the accepted range. Additionally, a test observation may have a missing raw test score but not a missing scaled and vice versa.	Set scores outside the accepted range to missing. For instance, in the synthetic data, a test score of 0 is considered outside the accepted range and is set to missing. Based on knowledge of your agency, decide if all test observations should have both raw and scaled scores. One option would be to drop test observations missing either of the test scores. Here we only drop test observations that are missing both test scores	**Task 5:** Student Test Scores **Task 5:** Student Test Scores
performance_level			**Task 5:** Student Test Scores
standardized_score	The system may not provide a standardized score (i.e. mean zero, s.d. one).	Generate a standardized test score by subject, test type, and school year.	

Identifies unique observation: **sid + test_code + test_date**

Class

Class level scheduling data.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
cid			**Task 6:** Student Class Enrollment
school_year			**Task 6:** Student Class Enrollment
school_code			**Task 6:** Student Class Enrollment
course_code			**Task 6:** Student Class Enrollment
course_code _desc	Agencies often have a very large number of course names, in some cases, other criteria (e.g. department the course is listed in or length of the course) is needed to identify a course.	Use agency rules to flag math and English courses.	**Task 6:** Student Class Enrollment
section_code			
period_bell			
room_number			
tid			
semester_term _year			**Task 6:** Student Class Enrollment
graduation _requirement			
credits_possible			**Task 6:** Student Class Enrollment
instructional_level			
subject			**Task 6:** Student Class Enrollment

Identifies unique observation: **cid**

Student_Class_Enrollment

Class enrollment, grades, and credits earned data for students.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			**Task 6:** Student Class Enrollment
cid			**Task 6:** Student Class Enrollment
class_enrollment _date	Some class enrollment spells may overlap, students may have more than one class_enrollment_date and/or more than one class_withdrawal_date for the same cid, school_year, and marking_period.	For overlapping class enrollment spells, report the earliest enrollment date and latest withdrawal date.	**Task 6:** Student Class Enrollment
class_withdrawal _date	Some class enrollment spells may overlap, students may have more than one class_enrollment_date and/or more than one class_withdrawal_date for the same cid, school_year, and marking_period.	For overlapping class enrollment spells, report the earliest enrollment date and latest withdrawal date.	**Task 6:** Student Class Enrollment
credits_earned			**Task 6:** Student Class Enrollment
final_grade_mark			**Task 6:** Student Class Enrollment

Identifies unique observation: **sid + cid + enrollment_date**

Student_NSC_Enrollment

National Student Clearing House Student Tracker student-level data that provides information on postsecondary outcomes.

Data Element	Possible Scenario	SDP Decision Rule	Reference in Data Building Tasks
sid			**Task 7:** Student NSC Enrollment
college_code_branch			**Task 7:** Student NSC Enrollment
enrollment_begin		Identify the students's first college by the earliest enrollment date.	**Task 7:** Student NSC Enrollment
enrollment_end			**Task 7:** Student NSC Enrollment
record_found_yn			**Task 7:** Student NSC Enrollment
high_school_code			
high_school _grad_dt			
college_name			**Task 7:** Student NSC Enrollment
college_state		Create an indicator for in-state and one for out of state colleges.	**Task 7:** Student NSC Enrollment
year4year		Create two indicators to mark 4-year colleges and 2-year colleges. Combine "2-year" and "Less than 2 years".	**Task 7:** Student NSC Enrollment
public_private		Create two indicators for the two types.	**Task 7:** Student NSC Enrollment
enrollment_status		Sometimesstudents enroll in more than one college at the same time. When identifying first college, report the one with the highest enrollment status (F, H, L, in order of importance) and then by longest duration.	**Task 7:** Student NSC Enrollment
graduated			**Task 7:** Student NSC Enrollment
graduation_date			**Task 7:** Student NSC Enrollment
college_sequence			**Task 7:** Student NSC Enrollment
degree_title			**Task 7:** Student NSC Enrollment
major			**Task 7:** Student NSC Enrollment

Identifies unique observation: **sid + college_code_branch + enrollment_begin + enrollment_end**

Task 1: STUDENT ATTRIBUTES

PURPOSE

In **Task 1: Student Attributes**, you will take the `Student_Demographics_Raw` file and generate the clean `Student_Attributes` file that matches the specification in **Identify** with one observation per student.

The core of this task:

1. Create consistent gender indicators for students across years.
2. Create consistent race/ethnicity values for students across years.
3. Create consistent values for high school diploma indicators.

HOW TO START

To begin, open the `Student_Demographics_Raw` file in R. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 1**, start with the provided raw input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

DATA DESCRIPTION

The clean `Student_Attributes` file includes `sid`, `male`, `race_ethnicity`, `first_9th_school_year_reported`, `hs_diploma`, `hs_diploma_date`, and `hs_diploma_type`. Later analyses do not currently make use of birth dates and zip codes, and these variables are thus excluded. This file contains the combined `race_ethnicity` variable rather than separate variables for race and ethnicity.

The raw input file, `Student_Demographics_Raw`, varies from the clean `Student_Attributes` file in a number of ways. In `Student_Demographics_Raw`, `race_ethnicity` is coded as a string rather than numeric and does not distinguish between the designations multiple, "M", and other, "O". `Student_Demographics_Raw` is also a time-variant data set including `school_year` so the data is unique by `sid` and `school_year`. `Student_Attributes`, however, is unique by `sid` alone. The aim of this task will be to match `Student_Attributes` to be unique by `sid` only.

Uniqueness

Some agencies may record **race_ethnicity** and/or **gender** each school year. Alternatively, students may have multiple records for having attended ninth grade or multiple diploma dates and/or types. To fix this issue, you will create a `Student_Attributes` research file unique by `sid` alone starting from a `Student_Demographics_Raw` file that is unique by `sid` and `school_year`. Once the file is unique by `sid` as shown in **Identify**, it is ready for **Connect**.

Step 0: Load and Inspect the Data

```r
#  Step 0: Load the packages and prepare your R environment

library(tidyverse) # main suite of R packages to ease data analysis
library(magrittr) # allows for some easier pipelines of data

# Read in some R functions that are useful for toolkit tasks, see SDP R Glossary
# for details

source("R/functions.R")
library(haven) # required for importing .dta files
```

```r
#  Step 0: Load the college-going analysis file into Stata
#  using the haven library

# To read data from a zip file and unzip it in R we can
# create a connection to the path of the zip file
# To read data from a zip file we create a connection to the path of the
# zip file

tmpfileName <- "raw/Student_Demographics_Raw.dta"

# This assumes analysis is a raw subfolder from where the file is read,
# in this case inside the zipfile

con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")

# The zipfile is located in the subdirectory data, called raw.zip

stuatt <- read_stata(con) # read data in the data subdirectory
close(con) # close the connection to the zip file, keeps data in memory
```

```
glimpse(stuatt)
```

```
Observations: 87,534
Variables: 9
$ sid                           <dbl> 1, 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 4, ...
$ school_year                   <dbl> 2004, 2005, 2006, 2007, 2006, 2007, ...
$ male                          <dbl> 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, ...
$ race_ethnicity                <chr> "B", "H", "H", "H", "W", "B", "H", "...
$ birth_date                    <dbl> 10869, 10869, 10869, 10869, 11948, 1...
$ first_9th_school_year_reported <dbl> 2004, 2004, 2004, 2004, NaN, NaN, 20...
$ hs_diploma                    <dbl> 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, ...
$ hs_diploma_type               <chr> "", "", "", "", "Standard Diploma", ...
$ hs_diploma_date               <date> NA, NA, NA, NA, 2008-06-05, 2009-05...
```

```
head(stuatt)
```

```
# A tibble: 6 × 9
    sid school_year  male race_ethnicity birth_date
  <dbl>       <dbl> <dbl>          <chr>      <dbl>
1     1        2004     1              B      10869
2     1        2005     1              H      10869
3     1        2006     1              H      10869
4     1        2007     1              H      10869
5     2        2006     0              W      11948
6     2        2007     0              B      11948
# ... with 4 more variables: first_9th_school_year_reported <dbl>,
#   hs_diploma <dbl>, hs_diploma_type <chr>, hs_diploma_date <date>
```

```
# Checks that number of unique values of `sid` equals number of rows
# A quick way to test this in R
n_distinct(stuatt$sid) == nrow(stuatt) #n_distinct function is in dplyr package
```

```
[1] FALSE
```

Now drop the `first_9th_school_year_reported` variable. You will create a `first_9th_school_year_reported` variable in Task 3 that also imputes this variable for transfer-ins.

```
# In R one way to drop a variable is by assigning it a NULL value
stuatt$first_9th_school_year_reported <- NULL
# For testing purposes, let's specify a variable which indexes the SIDs
# we will use to check our work
idx <- c(2, 8552, 12506) # Specify which SIDs are interesting
# Now we can easily view only relevant data
stuatt[stuatt$sid %in% idx,]
```

```
# A tibble: 9 × 8
    sid school_year  male race_ethnicity birth_date hs_diploma
  <dbl>       <dbl> <dbl>          <chr>      <dbl>      <dbl>
1     2        2006     0              W      11948          1
2     2        2007     0              B      11948          1
3  8552        2005     1              W      12334          0
4  8552        2006     0              A      12334          0
5  8552        2006     1              W      12334          0
6  8552        2007     1              W      12334          0
7  8552        2009     1              W      12334          0
8 12506        2004     1              H      11803          0
9 12506        2005     0              H      11803          0
```

```
# ... with 2 more variables: hs_diploma_type <chr>, hs_diploma_date <date>
```

Step 1: Create one consistent value for gender across years

```
# Create one consistent value for gender for each student across years
# View the data

stuatt %>% arrange(sid, school_year) %>%
  select(sid, school_year, male) %>%
  filter(sid %in% idx)
```

```
# A tibble: 9 × 3
    sid school_year  male
  <dbl>       <dbl> <dbl>
1     2        2006     0
2     2        2007     0
3  8552        2005     1
4  8552        2006     0
5  8552        2006     1
6  8552        2007     1
7  8552        2009     1
8 12506        2004     1
9 12506        2005     0
```

Create a variable that shows how many unique values `male` assumes for each student. Name this variable `nvals_male`. Tabulate the variable and browse the relevant data.

```
# Step 1: Create an intermediate variable that counts the number of unique
# values observed for `male` per student

stuatt <- stuatt %>% group_by(sid) %>%
  mutate(nvals_male = length(unique(male))) %>% ungroup()
table(stuatt$nvals_male)
```

```
    1     2
87517    17
```

```
# Look at the values where more than one value is observed
stuatt %>% select(sid, school_year, male, nvals_male) %>%
  filter(nvals_male > 1)
```

```
# A tibble: 17 × 4
     sid school_year  male nvals_male
   <dbl>       <dbl> <dbl>      <int>
1      7        2004     1          2
2      7        2005     1          2
3      7        2006     1          2
4      7        2007     0          2
5      7        2008     1          2
6   8078        2004     1          2
7   8078        2005     0          2
8   8078        2006     1          2
9   8078        2007     1          2
10  8078        2008     1          2
11  8552        2005     1          2
```

```
12  8552        2006     0          2
13  8552        2006     1          2
14  8552        2007     1          2
15  8552        2009     1          2
16 12506        2004     1          2
17 12506        2005     0          2
```

```
# Or interactively in RStudio
# stuatt %>% select(sid, school_year, male, nvals_male) %>%
#   filter(nvals_male > 1) %>% View
```

Identify the modal gender. If multiple modes exist for a student, report the most recent gender recorded.

```
# Step 2: Identify the modal gender, if multiple modes exist, report the most
# recent gender

# Here is an example mode function in R taht mimics Stata
# We can read this function in or load it from another package
# library(eeptools)
# statamode creates a list of the modal values and assigns NA, missing,
# if more than one mode exists

statamode <- function(x) {
  z <- table(as.vector(x))
  m <- names(z)[z == max(z)]
  if(length(m) == 1){
    if(class(x) %in% c("numeric", "integer", "logical")){
      class(m) <- class(x)
    } else {
      class(m) <- "character"
    }
    return(m)
  }
  return(NA)
}

# Apply statamode to the data grouped by sid
stuatt <- stuatt %>% group_by(sid) %>%
  mutate(nvals_male = length(unique(male)),
         male_mode = statamode(male)) %>% ungroup()

# Check our work
stuatt %>% select(sid, male, male_mode, nvals_male) %>%
  filter(sid %in% idx)
```

```
# A tibble: 9 × 4
    sid  male male_mode nvals_male
  <dbl> <dbl>     <dbl>      <int>
1     2     0         0          1
2     2     0         0          1
3  8552     1         1          2
4  8552     0         1          2
5  8552     1         1          2
6  8552     1         1          2
7  8552     1         1          2
8 12506     1        NA          2
```

```
9 12506     0        NA          2
```

```
# Replace male with male_mode where male_mode is not missing
# In R we replace by vector so both sides of the <- have to have the same filter
# so they are the same length, otherwise R will recycle the elements on the
# right hand side and we will have the wrong values in place
stuatt$male[!is.na(stuatt$male_mode)] <-
  stuatt$male_mode[!is.na(stuatt$male_mode)]
```

```
idx <- c(8552, 12506)

stuatt %>% select(sid, school_year, male, nvals_male, male_mode) %>%
  filter(sid %in% idx)
```

```
# A tibble: 7 × 5
    sid school_year  male nvals_male male_mode
  <dbl>       <dbl> <dbl>      <int>     <dbl>
1  8552        2005     1          2         1
2  8552        2006     1          2         1
3  8552        2006     1          2         1
4  8552        2007     1          2         1
5  8552        2009     1          2         1
6 12506        2004     1          2        NA
7 12506        2005     0          2        NA
```

```
# If multiple modes exist, report the most recent gender recorded
stuatt %<>% arrange(sid, school_year) %>%
  group_by(sid) %>%
  mutate(temp_male_last = male[school_year == max(school_year)])

# Show sid 12506
stuatt %>% select(sid, school_year, male, nvals_male, male_mode, temp_male_last) %>%
  filter(sid == 12506)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year  male nvals_male male_mode temp_male_last
  <dbl>       <dbl> <dbl>      <int>     <dbl>          <dbl>
1 12506        2004     1          2        NA              0
2 12506        2005     0          2        NA              0
```

```
# Assign temp_male_last to the male variable in cases where no mode exists
stuatt$male[is.na(stuatt$male_mode)] <- stuatt$temp_male_last[is.na(stuatt$male_mode)]

# Check our work again
stuatt %>% select(sid, school_year, male, nvals_male, male_mode, temp_male_last) %>%
  filter(sid == 12506)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year  male nvals_male male_mode temp_male_last
  <dbl>       <dbl> <dbl>      <int>     <dbl>          <dbl>
1 12506        2004     0          2        NA              0
2 12506        2005     0          2        NA              0
```

```
# Drop temporary variables
stuatt %<>% select(-nvals_male, -male_mode, -temp_male_last)
```

Now check our work

```
table(stuatt$male)
```

```
    0     1
43660 43874
```

```
# Check nvals without creating the variable
stuatt %>% ungroup %>%
  group_by(sid) %>%
  summarize(nvals = n_distinct(male)) %>% select(nvals) %>%
  table
```

```
.
    1
21803
```

```
n_distinct(stuatt$sid)
```

```
[1] 21803
```

Step 2: Create one consistent value for race_ethnicicty

Recode the raw `race_ethnicity` variable as a numeric variable and label it. Replace the string race_ethnicity variable with the numeric one.

- 1 = African American, not Hispanic
- 2 = Asian American
- 3 = Hispanic
- 4 = American Indian
- 5 = White, not Hispanic
- 6 = Multiple / Other

```
# When R reads in Stata files using haven it creates a data type called
# labelled, for compatibility with Stata and most R functions, we convert
# this into a more standard factor variable

# Create a copy
stuatt$race_num <- stuatt$race_ethnicity
stuatt$race_ethnicity <- as_factor(stuatt$race_ethnicity)
table(stuatt$race_ethnicity) #check current values
```

```
    A     B     H   M/O    NA     W
 7303 25321 30444  2809  1129 20528
```

```
stuatt$race_num <- NA
stuatt$race_num[stuatt$race_ethnicity=='B'] <- 1
stuatt$race_num[stuatt$race_ethnicity=='A'] <- 2
stuatt$race_num[stuatt$race_ethnicity=='H'] <- 3
stuatt$race_num[stuatt$race_ethnicity=='NA'] <- 4
stuatt$race_num[stuatt$race_ethnicity=='W'] <- 5
stuatt$race_num[stuatt$race_ethnicity=='M/O'] <- 6
table(stuatt$race_num)
```

```
    1     2     3     4     5     6
25321  7303 30444  1129 20528  2809
```

```
idx <- c(8552)

stuatt %>% filter(sid %in% idx) %>%
  select(sid, school_year, race_ethnicity, race_num)
```

```
Source: local data frame [5 x 4]
Groups: sid [1]

    sid school_year race_ethnicity race_num
  <dbl>       <dbl>         <fctr>    <dbl>
1  8552        2005              W        5
2  8552        2006              A        2
3  8552        2006              W        5
4  8552        2007              W        5
5  8552        2009              W        5
```

```
# If the data were not coming from Stata, we would need to create a factor
# variable ourselves
# In R categorical variables are best represented as factors
# Factors can have values, order, and labels
# Create a labeled factor for the new race_num variable
stuatt$race_num2 <- factor(stuatt$race_num,
                           labels = c('Black', 'Asian', 'Hispanic',
                                      'Native American', 'White', 'MultipleOther'))

# Compare them to check using a cross-tabulation
table(stuatt$race_ethnicity, stuatt$race_num2)
```

```
      Black Asian Hispanic Native American White MultipleOther
  A       0  7303        0               0     0             0
  B   25321     0        0               0     0             0
  H       0     0    30444               0     0             0
  M/O     0     0        0               0     0          2809
  NA      0     0        0            1129     0             0
  W       0     0        0               0 20528             0
```

```
# Replace them
stuatt$race_ethnicity <- stuatt$race_num2
stuatt$race_num2 <- NULL

table(stuatt$race_ethnicity) # counts
```

```
         Black          Asian       Hispanic Native American          White
         25321           7303          30444            1129          20528
  MultipleOther
          2809
```

```
prop.table(table(stuatt$race_ethnicity))*100 #percentages
```

```
         Black          Asian       Hispanic Native American          White
```

```
      28.927045         8.343044        34.779628         1.289785        23.451459
  MultipleOther
       3.209039
```

Check: What does the distribution of your `race_ethnicity` variable look like? Let's redraw the tables above in a more readable format.

```
library(pander) # library to beautify output
pander(prop.table(table(stuatt$race_ethnicity))*100, style = "rmarkdown")
```

Table 8: Table continues below

Black	Asian	Hispanic	Native American	White
28.93	8.343	34.78	1.29	23.45

MultipleOther
3.209

```
pander(table(stuatt$race_ethnicity), style = "rmarkdown")
```

Table 10: Table continues below

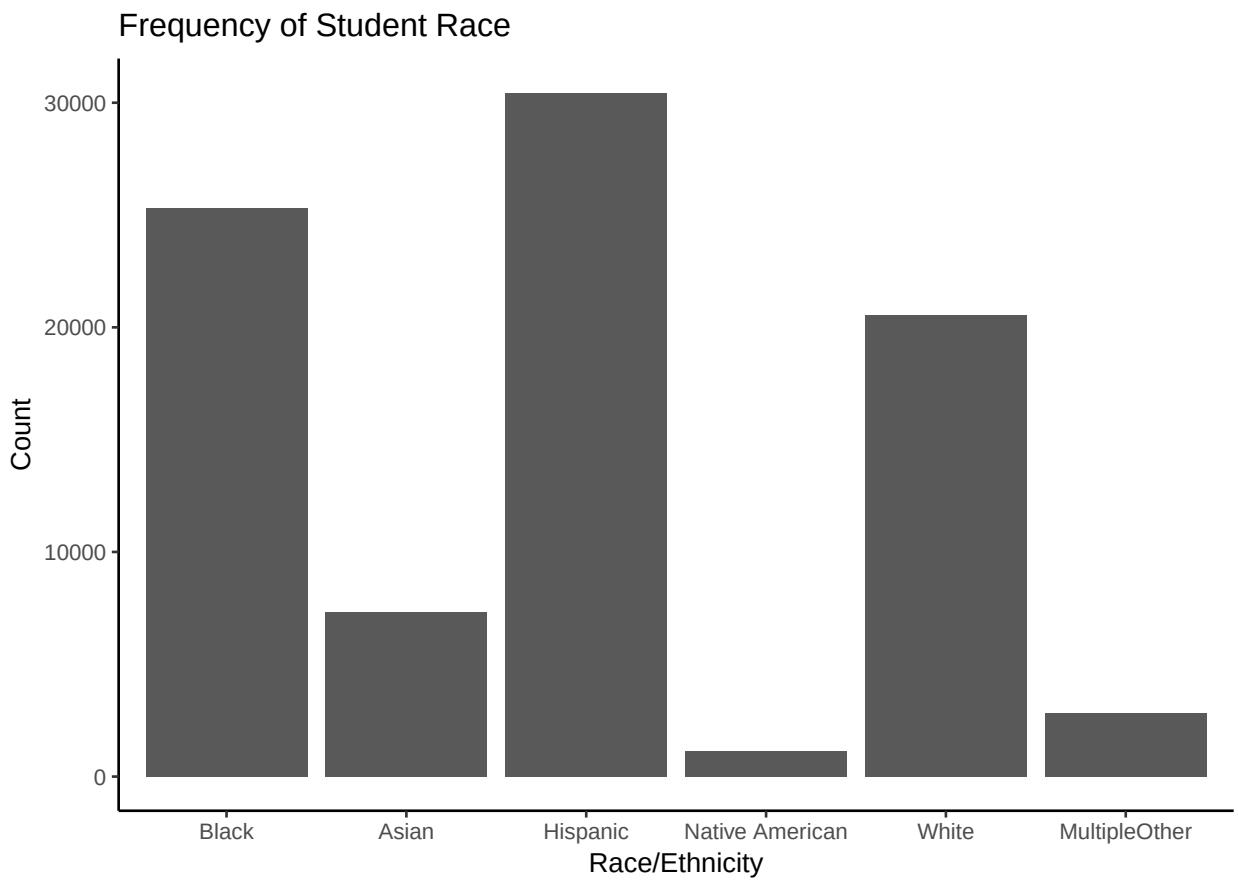
Black	Asian	Hispanic	Native American	White
25321	7303	30444	1129	20528

MultipleOther
2809

Let's also draw a figure to show this distribution.

```
library(ggplot2) # the best R library for plotting

qplot(stuatt$race_ethnicity,geom='bar') +
  theme_classic() + labs(x = 'Race/Ethnicity', y = 'Count',
                         title = "Frequency of Student Race")
```



Create a variable indicating how many unique values `race_ethnicity` assumes for each student called `nvals_race`.

```
# Create a variable indicating how many unique values `race_ethnicity` takes
# for each student

stuatt <- stuatt %>% group_by(sid) %>%
  mutate(nvals_race = n_distinct(race_ethnicity))

table(stuatt$nvals_race)
```

```
    1     2     3
87176   328    30
```

Create a variable that shows how many unique values `race_ethnicity` assumes for each student and `school_year`. Name this variable `nvals_race_yr`. Tabulate the variable and browse the relevant data.

```
# Create a variable that shows how many unique values `race_ethnicity`
# assumes for each student and school year.

stuatt <- stuatt %>% group_by(sid, school_year) %>%
  mutate(nvals_race_yr = n_distinct(race_ethnicity))

#Make a table
table(stuatt$nvals_race_yr)
```

```
    1     2
87528     6
```

```
# Browse the results
stuatt %>% select(sid, school_year, race_ethnicity, nvals_race, nvals_race_yr) %>%
  filter(nvals_race_yr > 1)
```

```
Source: local data frame [6 x 5]
Groups: sid, school_year [3]

    sid school_year race_ethnicity nvals_race nvals_race_yr
  <dbl>       <dbl>         <fctr>      <int>         <int>
1     3        2006       Hispanic          2             2
2     3        2006          Black          2             2
3  8552        2006          Asian          2             2
4  8552        2006          White          2             2
5 11382        2005       Hispanic          2             2
6 11382        2005  MultipleOther          2             2
```

If more than one race is reported in the same `school_year`, report students as multiracial, unless one of their reported `race_ethnicity` values is Hispanic. Report the student as Hispanic in that case.

```
# Generate a temporary hispanic variable
# Use ifelse function to recode variable

stuatt$temp_ishispanic <- ifelse(stuatt$race_num == 3 &
                                   stuatt$nvals_race_yr > 1, 1, 0)

stuatt %>% select(sid, school_year, race_ethnicity, nvals_race,
                  nvals_race_yr, temp_ishispanic) %>%
  filter(nvals_race_yr > 1)
```

```
Source: local data frame [6 x 6]
Groups: sid, school_year [3]

    sid school_year race_ethnicity nvals_race nvals_race_yr temp_ishispanic
  <dbl>       <dbl>         <fctr>      <int>         <int>           <dbl>
1     3        2006       Hispanic          2             2               1
2     3        2006          Black          2             2               0
3  8552        2006          Asian          2             2               0
4  8552        2006          White          2             2               0
5 11382        2005       Hispanic          2             2               1
6 11382        2005  MultipleOther          2             2               0
```

```
# Take the maximum value of temp_ishispanic by student by school_year
# This is creating a variable indicating if the student was ever
# listed as hispanic in a given school year

stuatt %<>% group_by(sid, school_year) %>%
  mutate(ishispanic = max(temp_ishispanic, na.rm=TRUE))

stuatt %>% select(sid, school_year, race_ethnicity, nvals_race, nvals_race_yr,
                  temp_ishispanic, ishispanic) %>%
  filter(nvals_race_yr > 1)
```

```
Source: local data frame [6 x 7]
Groups: sid, school_year [3]
```

```
    sid school_year race_ethnicity nvals_race nvals_race_yr temp_ishispanic
  <dbl>       <dbl>         <fctr>      <int>         <int>           <dbl>
1     3        2006       Hispanic          2             2               1
2     3        2006          Black          2             2               0
3  8552        2006          Asian          2             2               0
4  8552        2006          White          2             2               0
5 11382        2005       Hispanic          2             2               1
6 11382        2005  MultipleOther          2             2               0
# ... with 1 more variables: ishispanic <dbl>
```

```
# Replace hispanic values
stuatt$race_num[stuatt$nvals_race_yr > 1 & stuatt$ishispanic == 1] <- 3
stuatt$race_ethnicity[stuatt$nvals_race_yr > 1 & stuatt$ishispanic == 1] <- "Hispanic"
stuatt$race_num[stuatt$nvals_race_yr > 1 & stuatt$ishispanic != 1] <- 6
stuatt$race_ethnicity[stuatt$nvals_race_yr > 1 & stuatt$ishispanic != 1] <- "MultipleOther"

# Drop the temporary variables
stuatt <- select(stuatt, -ishispanic, -temp_ishispanic)

# Drop the duplicates resulting from fixing student with different race_ethnicity
# within a school year

# bind_rows allows us to bind two data frames with the same columns together
# The first data.frame will be all rows where the student-school_year race
# is consistent
# The second data.frame is all rows where student race varies by school_year,
# but we have corrected it and drop all duplicated rows using the distinct
# command

#NROW 87534
stuatt <- bind_rows(stuatt %>% filter(nvals_race_yr < 2),
                    stuatt %>% filter(nvals_race_yr > 1) %>%
                      distinct(sid, school_year, race_ethnicity, .keep_all=TRUE))
stuatt <- select(stuatt, -nvals_race_yr)

# Re arrange after binding the rows
stuatt %<>% arrange(sid, school_year)
```

```
# Before we fixed the data we had 87534 rows
# We had 3 students with 2 different races, so we had 6 rows where we needed 3
# This means we had 3 extra rows

nrow(stuatt) == 87534 - 3
```

```
[1] TRUE
```

Report the modal race. If multiple modes exist for a student, report the most recent race recorded.

```
# Calculate the modal race for a student over time, if multiple modes exist
# report the most recent
stuatt %<>% group_by(sid) %>%
  mutate(race_mode = statamode(race_ethnicity))

# tab1 <- table(modes$race_temp,modes$nvals)
# addmargins(tab1, FUN=list(Total=sum), quiet=TRUE)
```

```
stuatt %>% filter(sid == 8552) %>%
  select(sid, school_year, race_ethnicity, nvals_race, race_mode)
```

```
Source: local data frame [4 x 5]
Groups: sid [1]

    sid school_year race_ethnicity nvals_race race_mode
  <dbl>       <dbl>         <fctr>      <int>     <chr>
1  8552        2005          White          2     White
2  8552        2006  MultipleOther          2     White
3  8552        2007          White          2     White
4  8552        2009          White          2     White
```

```
stuatt$race_ethnicity[!is.na(stuatt$race_mode)] <- stuatt$race_mode[!is.na(stuatt$race_mode)]

stuatt %>% filter(sid == 8552) %>%
  select(sid, school_year, race_ethnicity, nvals_race, race_mode)
```

```
Source: local data frame [4 x 5]
Groups: sid [1]

    sid school_year race_ethnicity nvals_race race_mode
  <dbl>       <dbl>         <fctr>      <int>     <chr>
1  8552        2005          White          2     White
2  8552        2006          White          2     White
3  8552        2007          White          2     White
4  8552        2009          White          2     White
```

```
# Consider cases where the mode is not unique
stuatt %>% filter(sid == 2) %>%
  select(sid, school_year, race_ethnicity, nvals_race, race_mode)
```

```
Source: local data frame [2 x 5]
Groups: sid [1]

    sid school_year race_ethnicity nvals_race race_mode
  <dbl>       <dbl>         <fctr>      <int>     <chr>
1     2        2006          White          2      <NA>
2     2        2007          Black          2      <NA>
```

Find the most recent race.

```
# Define the most recent value of race observed
stuatt %<>% group_by(sid) %>%
  mutate(race_last = race_ethnicity[school_year == max(school_year)])

stuatt %>% filter(sid == 2) %>%
  select(sid, school_year, race_ethnicity, nvals_race, race_mode, race_last)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year race_ethnicity nvals_race race_mode race_last
  <dbl>       <dbl>         <fctr>      <int>     <chr>    <fctr>
1     2        2006          White          2      <NA>     Black
2     2        2007          Black          2      <NA>     Black
```

```
stuatt$race_ethnicity[is.na(stuatt$race_mode)] <- stuatt$race_last[is.na(stuatt$race_mode)]

stuatt %>% filter(sid %in% c(8552, 2)) %>%
  select(sid, school_year, race_ethnicity)
```

```
Source: local data frame [6 x 3]
Groups: sid [2]

    sid school_year race_ethnicity
  <dbl>       <dbl>         <fctr>
1     2        2006          Black
2     2        2007          Black
3  8552        2005          White
4  8552        2006          White
5  8552        2007          White
6  8552        2009          White
```

```
# Drop temporary variables
stuatt %<>% select(-nvals_race, -race_mode, -race_last, -race_num)
```

Check your work.

```
table(stuatt$race_ethnicity)
```

```
          Black           Asian        Hispanic Native American           White
          25323            7262           30443            1132           20553
  MultipleOther
           2818
```

Step 3: Create consistent values for high school diploma

Recode the `hs_diploma_type variable` as a numeric variable and label it. Replace the string `hs_diploma_type` variable with the numeric one. Use lower numbers for more competitive diploma types.

```
# 1. Recode the `hs_diploma_type variable` as a numeric variable and label it.
# Replace the string `hs_diploma_type` variable with the numeric one. Use lower
# numbers for more competitive diploma types.

# In R a factor variable behaves like a labeled numeric variable in Stata
# When reading the data in from a .dta file we can recover the numeric
# labels and ordering by using the `as_factor` function
stuatt$dipl_num <- as_factor(stuatt$hs_diploma_type)
```

```
# To show the work this saves if the data has already been labeled in Stata,
# the alternative method for manually recreating this is shown below
stuatt$dipl_num <- 4
stuatt$dipl_num <- ifelse(stuatt$hs_diploma_type == "College Prep Diploma",
                          1, stuatt$dipl_num)
stuatt$dipl_num <- ifelse(stuatt$hs_diploma_type == "Standard Diploma",
                          2, stuatt$dipl_num)
stuatt$dipl_num <- ifelse(stuatt$hs_diploma_type == "Alternative Diploma",
                          3, stuatt$dipl_num)

stuatt %>% select(sid, school_year, hs_diploma, hs_diploma_date,
```

```
                  hs_diploma_type, dipl_num) %>%
  filter(sid == 16)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year hs_diploma hs_diploma_date      hs_diploma_type dipl_num
  <dbl>       <dbl>      <dbl>          <date>                <chr>    <dbl>
1    16        2007          1      2008-05-14     Standard Diploma        2
2    16        2008          1      2008-05-14 College Prep Diploma        1
```

```
stuatt$hs_diploma_type <- NULL
stuatt$hs_diploma_type <- stuatt$dipl_num
stuatt$dipl_num <- NULL

stuatt %>% select(sid, school_year, hs_diploma, hs_diploma_date,
                  hs_diploma_type) %>%
  filter(sid == 16)
```

```
Source: local data frame [2 x 5]
Groups: sid [1]

    sid school_year hs_diploma hs_diploma_date hs_diploma_type
  <dbl>       <dbl>      <dbl>          <date>           <dbl>
1    16        2007          1      2008-05-14               2
2    16        2008          1      2008-05-14               1
```

Identify the first diploma date reported

```
# Now identify the first diploma date reported
stuatt %<>% arrange(sid, hs_diploma_date)

stuatt %<>% group_by(sid) %>%
  mutate(earliest_diploma_date = min(hs_diploma_date, na.rm=TRUE))

stuatt %>% select(sid, school_year, hs_diploma, hs_diploma_date,
                  hs_diploma_type, earliest_diploma_date) %>%
  filter(sid == 16)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year hs_diploma hs_diploma_date hs_diploma_type
  <dbl>       <dbl>      <dbl>          <date>           <dbl>
1    16        2007          1      2008-05-14               2
2    16        2008          1      2008-05-14               1
# ... with 1 more variables: earliest_diploma_date <date>
```

Create a variable that shows the earliest diploma type

```
# Create a variable that shows the earliest diploma type
# This statement is extra long and includes the mode because it needs to avoid
# ties in the earliest diploma date
stuatt %<>% group_by(sid) %>%
 mutate(earliest_dipl_type_mode =
          statamode(hs_diploma_type[hs_diploma_date==earliest_diploma_date]))
```

```
stuatt %>% select(sid, school_year, hs_diploma, hs_diploma_date,
                  hs_diploma_type, earliest_diploma_date,
                  earliest_dipl_type_mode) %>% filter(sid == 16)
```

```
Source: local data frame [2 x 7]
Groups: sid [1]

    sid school_year hs_diploma hs_diploma_date hs_diploma_type
  <dbl>       <dbl>      <dbl>          <date>           <dbl>
1    16        2007          1      2008-05-14               2
2    16        2008          1      2008-05-14               1
# ... with 2 more variables: earliest_diploma_date <date>,
#   earliest_dipl_type_mode <dbl>
```

Create a variable that shows the number of unique diploma types recorded for the first diploma date

```
# Number of unique diploma types for the first diploma date
stuatt %<>% group_by(sid) %>%
 mutate(nvals_dipl_type =
          length(unique(hs_diploma_type[hs_diploma_date==earliest_diploma_date])))

stuatt %>% select(sid, school_year, hs_diploma_type, earliest_diploma_date,
                  earliest_dipl_type_mode, nvals_dipl_type) %>%
  filter(sid %in% c(16, 20, 80))
```

```
Source: local data frame [8 x 6]
Groups: sid [3]

    sid school_year hs_diploma_type earliest_diploma_date
  <dbl>       <dbl>           <dbl>                <date>
1    16        2007               2            2008-05-14
2    16        2008               1            2008-05-14
3    20        2008               2            2008-05-14
4    20        2008               1            2008-05-14
5    80        2005               1            2008-05-14
6    80        2006               2            2008-05-14
7    80        2007               2            2008-05-14
8    80        2008               2            2008-05-14
# ... with 2 more variables: earliest_dipl_type_mode <dbl>,
#   nvals_dipl_type <int>
```

Identify the modal diploma type. If multiple modes exist for a student, report the diploma type in the earliest school year for the first diploma date

```
# 5. Identify the modal diploma type. If multiple modes exist for a
# student, report the diploma type in the earliest school year for
# the first diploma date

stuatt %<>% group_by(sid) %>%
  mutate(earliest_dipl_type_syear = hs_diploma_type[school_year == min(school_year)])

stuatt %>% select(sid, school_year, hs_diploma_type, earliest_diploma_date,
                  earliest_dipl_type_mode, nvals_dipl_type,
                  earliest_dipl_type_syear) %>%
  filter(sid %in% c(16, 20, 80))
```

```
Source: local data frame [8 x 7]
Groups: sid [3]

    sid school_year hs_diploma_type earliest_diploma_date
  <dbl>       <dbl>           <dbl>                <date>
1    16        2007               2            2008-05-14
2    16        2008               1            2008-05-14
3    20        2008               2            2008-05-14
4    20        2008               1            2008-05-14
5    80        2005               1            2008-05-14
6    80        2006               2            2008-05-14
7    80        2007               2            2008-05-14
8    80        2008               2            2008-05-14
# ... with 3 more variables: earliest_dipl_type_mode <dbl>,
#   nvals_dipl_type <int>, earliest_dipl_type_syear <dbl>
```

```
stuatt %<>% group_by(sid) %>%
  mutate(earliest_dipl_type_syear_mode = statamode(earliest_dipl_type_syear))

stuatt %>%
  select(sid, school_year, hs_diploma_type, earliest_diploma_date,
                 earliest_dipl_type_mode, nvals_dipl_type,
                 earliest_dipl_type_syear,
         earliest_dipl_type_syear_mode) %>%
  filter(sid %in% c(16, 20, 80))
```

```
Source: local data frame [8 x 8]
Groups: sid [3]

    sid school_year hs_diploma_type earliest_diploma_date
  <dbl>       <dbl>           <dbl>                <date>
1    16        2007               2            2008-05-14
2    16        2008               1            2008-05-14
3    20        2008               2            2008-05-14
4    20        2008               1            2008-05-14
5    80        2005               1            2008-05-14
6    80        2006               2            2008-05-14
7    80        2007               2            2008-05-14
8    80        2008               2            2008-05-14
# ... with 4 more variables: earliest_dipl_type_mode <dbl>,
#   nvals_dipl_type <int>, earliest_dipl_type_syear <dbl>,
#   earliest_dipl_type_syear_mode <dbl>
```

If multiple diploma types were recorded for the same school year and first diploma date, report the most competitive diploma type

```
# 6. If multiple diploma types were recorded for the same school year and first
# diploma date, report the most competitive diploma type

stuatt %<>% group_by(sid) %>%
  mutate(temp_most_compet = min(earliest_dipl_type_syear))

stuatt %>%
  select(sid, school_year, hs_diploma_type, earliest_diploma_date,
                 earliest_dipl_type_mode, nvals_dipl_type,
                 earliest_dipl_type_syear,
```

```
        earliest_dipl_type_syear_mode, temp_most_compet) %>%
  filter(sid %in% c(16, 20, 80)) %>% as.data.frame()
```

```
  sid school_year hs_diploma_type earliest_diploma_date earliest_dipl_type_mode
1  16        2007               2            2008-05-14                      NA
2  16        2008               1            2008-05-14                      NA
3  20        2008               2            2008-05-14                      NA
4  20        2008               1            2008-05-14                      NA
5  80        2005               1            2008-05-14                       2
6  80        2006               2            2008-05-14                       2
7  80        2007               2            2008-05-14                       2
8  80        2008               2            2008-05-14                       2
  nvals_dipl_type earliest_dipl_type_syear earliest_dipl_type_syear_mode
1               2                        2                             2
2               2                        2                             2
3               2                        2                            NA
4               2                        1                            NA
5               2                        1                             1
6               2                        1                             1
7               2                        1                             1
8               2                        1                             1
  temp_most_compet
1                2
2                2
3                1
4                1
5                1
6                1
7                1
8                1
```

```
# Replace original diploma type variable starting with most specific case, and
# working backward

stuatt$nvals_dipl_type <- NULL

stuatt$hs_diploma_type[!is.na(stuatt$temp_most_compet)] <-
  stuatt$temp_most_compet[!is.na(stuatt$temp_most_compet)]

stuatt$hs_diploma_type[!is.na(stuatt$earliest_dipl_type_syear_mode)] <-
  stuatt$earliest_dipl_type_syear_mode[!is.na(stuatt$earliest_dipl_type_syear_mode)]

stuatt$hs_diploma_type[!is.na(stuatt$earliest_dipl_type_mode)] <-
  stuatt$earliest_dipl_type_mode[!is.na(stuatt$earliest_dipl_type_mode)]

stuatt %>%
    select(sid, school_year, hs_diploma_type, earliest_diploma_date,
           earliest_dipl_type_mode,
           earliest_dipl_type_syear,
           earliest_dipl_type_syear_mode, temp_most_compet) %>%
    filter(sid %in% c(16, 20, 80)) %>% as.data.frame()
```

```
  sid school_year hs_diploma_type earliest_diploma_date earliest_dipl_type_mode
1  16        2007               2            2008-05-14                      NA
2  16        2008               2            2008-05-14                      NA
```

```
3  20        2008              1            2008-05-14                    NA
4  20        2008              1            2008-05-14                    NA
5  80        2005              2            2008-05-14                     2
6  80        2006              2            2008-05-14                     2
7  80        2007              2            2008-05-14                     2
8  80        2008              2            2008-05-14                     2
  earliest_dipl_type_syear earliest_dipl_type_syear_mode temp_most_compet
1                        2                             2               2
2                        2                             2               2
3                        2                            NA               1
4                        1                            NA               1
5                        1                             1               1
6                        1                             1               1
7                        1                             1               1
8                        1                             1               1
```

If there are any missing diploma types, mark these as an unknown diploma type

```
# If there are any missing diploma types, mark these as an unknown
# diploma type

stuatt$hs_diploma_type[is.na(stuatt$hs_diploma_type) &
                         !is.na(stuatt$hs_dipoma_date)] <- 4
```

Finally, replace `hs_diploma_date` with the first `hs_diploma_date`

```
# Finally, replace hs_diploma_date with the first hs_diploma_date

stuatt$hs_diploma_date <- stuatt$earliest_diploma_date

# Make sure that diploma is set to 1 if there is a diploma date reported

stuatt$hs_diploma[!is.na(stuatt$hs_diploma_date)] <- 1

# Drop all temporary variables we created

stuatt %<>% select(-earliest_diploma_date, -earliest_dipl_type_mode,
                   -earliest_dipl_type_syear, -earliest_dipl_type_syear_mode,
                   -temp_most_compet)

stuatt %>%
    select(sid, school_year, hs_diploma_type) %>%
    filter(sid %in% c(16, 20, 80)) %>% as.data.frame()
```

```
  sid school_year hs_diploma_type
1  16        2007              2
2  16        2008              2
3  20        2008              1
4  20        2008              1
5  80        2005              2
6  80        2006              2
7  80        2007              2
8  80        2008              2
```

Step 4: Clean up and save data file

```
# Drop school year as you no longer need it
stuatt %<>% select(-school_year, -birth_date)

# Drop duplicate values

tmp <- stuatt[!duplicated(stuatt),]

# Check that the file is unique by sid

nrow(tmp) == length(unique(stuatt$sid))
```

```
[1] TRUE
```

```
# Deduplicate

rm(tmp)
stuatt <- stuatt[!duplicated(stuatt),]

# Save the current file as Student_Attributes.rda
# Create a clean directory
# dir.create("clean")
# save(stuatt, file = "clean/Student_Attributes.rda")
# Or if you want to save the Stata file
# write_dta(stuatt, file = "clean/Student_Attributes.dta")

# Clean up the workspace
rm(con, idx, tmpfileName, stuatt)
```

Task 2: STUDENT SCHOOL YEAR

PURPOSE

In **Task 2: Student School Year**, you will take the `Student_Classifications_Raw` file and generate a clean `Student_School_Year` output file that matches the specification in Identify with one observation per student and school year. To do so, you will first ensure only one grade level is assigned per student per school year. Then, you will process the free or reduced price lunch (FRPL) variable (a proxy for students' poverty status), individualized education program (IEP) variable, English language learner (ELL) variable, and gifted variable. You will also examine the total days enrolled, days absent, and days suspended variables.

The core of this task:

1. Resolve instances when students have more than one grade level in a school year
2. Keep the highest value of FR PL reported by student by school year
3. If a student has both "has IE P" and "no IE P" reported in a school year, keep "has IEP"
4. If a student has both "has ELL" and "no ELL"" reported in a school year, keep "has ELL"
5. If a student is observed as both gifted eligible and not eligible, report eligible
6. Explore `days_enrolled`, `days_absent` and `days_suspended`
7. Drop duplicate observations to make the file unique by student and school year

After this, you will have a data set unique by student and school year that allows you to assign students to the appropriate ninth grade cohort in **Task 3**.

HOW TO START

To begin, open the `Student_Classifications_Raw` file in R. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 2**, start with the provided raw input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

Step 0: Load the data file

```
# Read in Stata
library(haven) # required for .dta files

# To read data from a zip file we create a connection to the path of the
# zip file
tmpfileName <- "raw/Student_Classifications_Raw.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
stuclass <- read_stata(con) # read data in the data subdirectory
glimpse(stuclass)
```

```
Observations: 88,260
Variables: 10
$ sid                          <dbl> 1, 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 4, 5,...
$ school_year                  <dbl> 2004, 2005, 2006, 2007, 2006, 2007, 20...
$ grade_level                  <dbl> 9, 9, 10, 11, 10, 11, 10, 8, 9, 11, 10...
$ frpl                         <chr> "N", "N", "R", "R", "F", "F", "F", "F"...
$ iep                          <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,...
$ ell                          <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,...
$ gifted                       <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,...
$ total_days_enrolled          <dbl> 210, 210, 210, 210, 172, 172, 228, 228...
$ total_days_absent            <dbl> 14, 6, 1, 5, 22, 57, 7, 15, 15, 7, 7, ...
$ days_suspended_out_of_school <dbl> 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 11, 0...
```

Step 1: Create one consistent grade level

Keep the highest `grade_level` when a student has multiple grade levels within the same year

```
# Keep the highest grade_level when a student has multiple grade levels
# within the same year

# distinct values function
nvals <- function(x){
  length(unique(x))
}


varIdx <- c("sid", "school_year", "grade_level", "nvals_grade",
            "max_grade_level")

stuclass %<>% group_by(sid, school_year) %>%
  mutate(nvals_grade = n_distinct(grade_level),
         max_grade_level = max(grade_level))
```

```
stuclass %>% select(one_of(varIdx)) %>%
  filter(sid == 3)
```

```
Source: local data frame [3 x 5]
Groups: sid, school_year [2]

    sid school_year grade_level nvals_grade max_grade_level
  <dbl>       <dbl>       <dbl>       <int>           <dbl>
1     3        2006          10           1              10
2     3        2007           8           2               9
3     3        2007           9           2               9
```

```
stuclass$grade_level[stuclass$nvals_grade > 1] <-
  stuclass$max_grade_level[stuclass$nvals_grade > 1]

stuclass %>% select(one_of(varIdx)) %>%
  filter(sid == 3)
```

```
Source: local data frame [3 x 5]
Groups: sid, school_year [2]

    sid school_year grade_level nvals_grade max_grade_level
  <dbl>       <dbl>       <dbl>       <int>           <dbl>
1     3        2006          10           1              10
2     3        2007           9           2               9
3     3        2007           9           2               9
```

```
stuclass %<>% select(-nvals_grade, -max_grade_level)
```

Step 2: Create one consistent FRPL value

Recode raw `frpl` variable with string type to numeric type

```
# Recode raw frpl variable with string type to numeric type

stuclass$frpl_num <- NA
stuclass$frpl_num[stuclass$frpl == "N"] <- 0
stuclass$frpl_num[stuclass$frpl == "R"] <- 1
stuclass$frpl_num[stuclass$frpl == "F"] <- 2

stuclass %>% select(sid, school_year, grade_level, frpl, frpl_num) %>%
  filter(sid == 80)
```

```
Source: local data frame [5 x 5]
Groups: sid, school_year [4]

    sid school_year grade_level  frpl frpl_num
  <dbl>       <dbl>       <dbl> <chr>    <dbl>
1    80        2005           9     N        0
2    80        2005           9     R        1
3    80        2006          10     N        0
4    80        2007          11     N        0
5    80        2008          12     N        0
```

```
stuclass$frpl <- NULL
stuclass$frpl <- stuclass$frpl_num
```

```
stuclass$frpl_num <- NULL

stuclass %>% select(sid, school_year, grade_level, frpl) %>%
  filter(sid == 80)
```

```
Source: local data frame [5 x 4]
Groups: sid, school_year [4]

    sid school_year grade_level  frpl
  <dbl>       <dbl>       <dbl> <dbl>
1    80        2005           9     0
2    80        2005           9     1
3    80        2006          10     0
4    80        2007          11     0
5    80        2008          12     0
```

Ensure that `frpl` is consistent by `sid` and `school_year`. In cases where multiple values exist, report the highest value. Follow the same procedure as Step 1 for `grade_level`.

```
# 2. Ensure that frpl is consistent by sid and school_year. In cases where
#  multiple values exist, report the highest value. Follow the same procedure
#  as Step 1 for grade_level.

# Check if there are any cases where different values of frpl status are reported
#  in a year

stuclass %<>% group_by(sid, school_year) %>%
  mutate(nvals_frpl = n_distinct(frpl))

table(stuclass$nvals_frpl)
```

```
    1     2     3
87773   430    57
```

```
# Report the highest value of frpl by year for each student, selecting
# free over reduced over not participating

stuclass %<>% group_by(sid, school_year) %>%
  mutate(highest_frpl = max(frpl))

stuclass$frpl <- stuclass$highest_frpl

# Label the values so they are easy to understand

# drop the temporary values we created

stuclass %<>% select(-nvals_frpl, -highest_frpl)
```

Step 3: Create one consistent IEP value

```
# Follow the same procedure as Step 1 for grade_level.
# Report the highest value of iep by year for each student,
#  selecting has iep over not iep.
```

```
stuclass %<>% group_by(sid, school_year) %>%
  mutate(highest_iep = max(iep)) %>%
  ungroup() %>%
  mutate(iep = highest_iep) %>%
  select(-highest_iep)
```

Step 4: Create one consistent ELL value

```
# Follow the same procedure as Step 1 for grade_level.

#  Report the highest value of ell by year for each student, selecting is
#  ell over not ell.

stuclass %<>% group_by(sid, school_year) %>%
  mutate(highest_ell = max(ell)) %>%
  ungroup() %>%
  mutate(ell = highest_ell) %>%
  select(-highest_ell)
```

Step 5: Create one consistent gifted value

```
# Follow the same procedure as Step 1 for grade_level.

#  Report the highest value of gifted by year for each student, selecting
#  is enrolled in gifted program over not enrolled.

stuclass %<>% group_by(sid, school_year) %>%
  mutate(highest_gifted = max(gifted)) %>%
  ungroup() %>%
  mutate(gifted = highest_gifted) %>%
  select(-highest_gifted)
```

Step 6: Drop any unneeded variables and save the file

```
# Drop duplicate observations

stuclass <- stuclass[!duplicated(stuclass),]

# Make sure your file is now unique by student and school year

nrow(stuclass) == n_distinct(paste0(stuclass$sid, stuclass$school_year))
```

```
[1] TRUE
```

```
# Save the current file as Student_School_Year.dta which you will need for Task 3.


# dir.create("clean")
# save(stuclass, file = "Student_School_Year.rda")
# Or if you want to save the Stata file
# write_dta(stuclass, file = "clean/Student_Attributes.dta")
```

```
# Clean up the workspace
rm(con, tmpfileName, stuclass, varIdx)
```

Task 3: IDENTIFYING THE NINTH-GRADE COHORT

PURPOSE

In **Task 3**: Identifying the Ninth Grade Cohort, you will identify the school year students first appear in ninth grade using the clean `Student_School_Year` research file from **Task 2**. This essential step allows you to form student cohorts and examine longitudinal college-going outcomes.

The core of this task:

1. Flag the first school year a student enrolls in grades 9, 10, 11, or 12.
2. Identify the school year in which the student was first observed in 9th grade.
3. Impute the school year in which transfer students would have been in grade 9.
4. Replace the `first_9th_school_year_observed` with the correctly imputed values.

After completing this task, you will have a clean `Student_School_Year` file that identifies first-time ninth graders. This file is used both to assemble the analysis file in **Connect** and to complete **Task 4**.

HOW TO START

To begin, open the `Student_School_Year` file, just created in **Task 2**, in R. *Note if you are doing this in one sitting you can just keep it in your workspace.* If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 3**, start with the cleaned output file from **Task 2**. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

DATA DESCRIPTION

The input file in this case, `Student_School_Year`, also the output from **Task 2**, now follows the structure of `Student_School_Year` in **Identify** so it is unique by `sid` and `school_year`. The aim of this task will be to create a `first_9th_school_year_observed` variable using the variables in the file.

Uniqueness

This dataset was cleaned in **Task 2** and is now unique by `sid` and `school_year`.

Step 0: Load the Student_School_Year data file

```
# Read in Stata
library(haven) # required for .dta f;iles

# To read data from a zip file we create a connection to the path of the
# zip file
tmpfileName <- "clean/Student_School_Year.dta"
con <- unz(description = "data/clean.zip", filename = tmpfileName,
           open = "rb")
stusy <- read_stata(con) # read data in the data subdirectory
glimpse(stusy)
```

```
Observations: 87,530
Variables: 10
$ sid                          <dbl> 1, 1, 1, 1, 2, 2, 3, 3, 4, 4, 4, 5, 6,...
$ school_year                  <dbl> 2004, 2005, 2006, 2007, 2006, 2007, 20...
$ grade_level                  <dbl> 9, 9, 10, 11, 10, 11, 10, 9, 11, 10, 9...
$ frpl                         <dbl+lbl> 0, 0, 1, 1, 2, 2, 2, 2, 0, 0, 0, 1...
$ iep                          <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1,...
$ ell                          <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,...
$ gifted                       <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,...
$ total_days_enrolled          <dbl> 210, 210, 210, 210, 172, 172, 228, 228...
$ total_days_absent            <dbl> 14, 6, 1, 5, 22, 57, 7, 15, 7, 7, 60, ...
$ days_suspended_out_of_school <dbl> 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 11, 0, 0...
```

Step 1: Flag the first school year a student enrolls each grade

```
# Create four binary indicators to flag the first school year a student
# enrolls in grades 9, 10, 11, or 12.
stusy %>% filter(sid == 1) %>% select(sid, school_year, grade_level)
```

```
# A tibble: 4 × 3
    sid school_year grade_level
  <dbl>       <dbl>       <dbl>
1     1        2004           9
2     1        2005           9
3     1        2006          10
4     1        2007          11
```

```
stusy %<>% group_by(sid, grade_level) %>%
  mutate(tmpG = ifelse(school_year == min(school_year), 1, NA),
         observed_g = 1)

stusy %>% filter(sid == 1) %>% select(sid, school_year, grade_level,
                                      tmpG, observed_g)
```

```
Source: local data frame [4 x 5]
Groups: sid, grade_level [3]

    sid school_year grade_level  tmpG observed_g
  <dbl>       <dbl>       <dbl> <dbl>      <dbl>
1     1        2004           9     1          1
2     1        2005           9    NA          1
3     1        2006          10     1          1
4     1        2007          11     1          1
```

```
# Use tidyr to spread first_flag and observed_g out into multiple indicator
# variables
library(tidyr)
stusy$first_flag <- stusy$grade_level
stusy <- spread(stusy, key = first_flag, value = tmpG, sep = "") %>%
  select(-one_of("first_flag3", "first_flag5", "first_flag6", "first_flag7",
                 "first_flag8", "first_flag13", "first_flag17"))
stusy$observed <- stusy$grade_level

# Fill in a 1 because we want the observed vectors to populate all values
# for a student
```

```
stusy <- spread(stusy, key = observed, value = observed_g, sep = "_") %>%
  select(-one_of("observed_3", "observed_5", "observed_6",
                 "observed_7", "observed_8", "observed_13",
                 "observed_17")) %>%
  group_by(sid, school_year) %>%
  mutate(observed_9 = max(observed_9, na.rm=TRUE),
         observed_10 = max(observed_10, na.rm=TRUE),
         observed_11 = max(observed_11, na.rm=TRUE),
         observed_12 = max(observed_12, na.rm=TRUE)) %>%
  mutate(observed_9 = ifelse(is.finite(observed_9), 1, 0),
         observed_10 = ifelse(is.finite(observed_10), 1, 0),
         observed_11 = ifelse(is.finite(observed_11), 1, 0),
         observed_12 = ifelse(is.finite(observed_12), 1, 0))

# Check how many students are identified as enrolled in grades 9, 10, 11, or 12

# Create a temporary dataframe of only the variables we are interested in for
# tabulation
tmp <- stusy %>%
  select(num_range(prefix= "observed_", range = 9:12)) %>%
  distinct(.keep_all=TRUE)

table(tmp$observed_9)
```

```
    0     1
66643 20887
```

```
table(tmp$observed_10)
```

```
    0     1
71496 16034
```

```
table(tmp$observed_11)
```

```
    0     1
78046  9484
```

```
table(tmp$observed_12)
```

```
    0     1
81910  5620
```

```
rm(tmp) # remove our temporary data, note the original data will stay
```

Step 2: Identify when a student was first observed in 9th grade

```
# Create a variable that lists the first school year a student is observed as
# enrolled in grade 9.

stusy %<>% group_by(sid) %>%
  mutate(first_9th_schyear_obs = min(school_year[grade_level == 9]))
```

```
# If a student has no values of school_year where grade_level ==9 then
# R will assign this a value of infinite, which is slightly different
# than missing

# work around weird way R handles minimum of an empty vector
stusy$first_9th_schyear_obs[!is.finite(stusy$first_9th_schyear_obs)] <- NA

# Check data
stusy %>% filter(sid == 1) %>%
  select(sid, school_year, grade_level, first_flag9, observed_9,
         first_9th_schyear_obs)
```

```
Source: local data frame [4 x 6]
Groups: sid [1]

    sid school_year grade_level first_flag9 observed_9 first_9th_schyear_obs
  <dbl>       <dbl>       <dbl>       <dbl>      <dbl>                 <dbl>
1     1        2004           9           1          1                  2004
2     1        2005           9          NA          1                  2004
3     1        2006          10          NA          0                  2004
4     1        2007          11          NA          0                  2004
```

```
stusy %>% ungroup %>% distinct(sid, first_9th_schyear_obs) %>%
  select(first_9th_schyear_obs) %>% unlist %>% table
```

```
.
2004 2005 2006 2007 2008 2009
   1 4884 4405 4524 5018   12
```

```
# Say something about missing values in the list...
```

Step 3: Impute the grade 9 school year for transfer students

```
# Impute first_9th_school_year_observed as school_year - 1, school_year - 2, or
# school_year - 3 for students first observed in 10th, 11th or 12th grade
# as transfer-ins

stusy$first_flag10[!is.finite(stusy$first_flag10)] <- 0
stusy$first_flag11[!is.finite(stusy$first_flag11)] <- 0
stusy$first_flag12[!is.finite(stusy$first_flag12)] <- 0

stusy$tempfirst9year <- ifelse(stusy$first_flag10 == 1,
                               stusy$school_year - 1,
                               ifelse(stusy$first_flag11 == 1,
                               stusy$school_year - 2,
                               ifelse(stusy$first_flag12 == 1,
                               stusy$school_year - 3,
                               NA)))

stusy %>% filter(sid == 2) %>%
  select(sid, school_year, grade_level, first_9th_schyear_obs,
         tempfirst9year)
```

```
Source: local data frame [2 x 5]
Groups: sid [1]
```

```
    sid school_year grade_level first_9th_schyear_obs tempfirst9year
  <dbl>       <dbl>       <dbl>                 <dbl>          <dbl>
1     2        2006          10                    NA           2005
2     2        2007          11                    NA           2005
```

```
# What is up with 2003 in the table here in Stata documentation

stusy %<>% group_by(sid) %>%
  mutate(tempfirst9year = min(tempfirst9year, na.rm=TRUE))

stusy$first_9th_schyear_obs[is.na(stusy$first_9th_schyear_obs) &
                              !is.na(stusy$tempfirst9year)] <-
  stusy$tempfirst9year[is.na(stusy$first_9th_schyear_obs) &
                         !is.na(stusy$tempfirst9year)]

stusy$tempfirst9year <- NULL
```

Review the distribution of `first_9th_school_year_observed` for students who transferred in grades 10-12

```
# Review the distribution of first_9th_school_year_observed for students who
# transferred in grades 10-12

stusy %>% ungroup %>%
  filter(first_flag10 > 0) %>%
  filter(observed_9 == 0) %>%
  distinct(sid, first_9th_schyear_obs) %>%
  select(first_9th_schyear_obs) %>% unlist %>% table
```

```
.
2004 2005 2006 2007 2008 2009
  17 3764 3402 3722 4307    1
```

```
stusy %>% ungroup %>%
  filter(first_flag11 ==1) %>%
  filter(observed_9 == 0 & observed_10 == 0 & observed_11 == 1) %>%
  distinct(sid, first_9th_schyear_obs) %>%
  select(first_9th_schyear_obs) %>% unlist %>% table
```

```
.
2004 2005 2006 2007 2008
   3 3068 2965 3238   19
```

```
stusy %>% ungroup %>%
  filter(first_flag12 ==1) %>%
  filter(observed_9 == 0 & observed_10 == 0 & observed_11 == 0 &
           observed_12 == 1) %>%
  distinct(sid, first_9th_schyear_obs) %>%
  select(first_9th_schyear_obs) %>% unlist %>% table
```

```
.
2004 2005 2006 2007
  18 2836 2643   29
```

Step 4: Adjust the imputation for some students

Flag students who are observed to be in a lower grade in a subsequent school year.

```
# Flag students who are observed to be in a lower grade in a subsequent
# school year.

stusy %<>% arrange(sid, school_year) %>%
  group_by(sid) %>%
  mutate(grade_lag = lag(grade_level, order_by = school_year)) %>%
  mutate(grade_flag = ifelse(grade_lag > grade_level &
                               !is.na(grade_lag > grade_level), 1, 0)) %>%
  mutate(grade_flag_max = max(grade_flag, na.rm=TRUE)) %>%
  select(-grade_lag)


stusy %>% select(sid, school_year, grade_level,
                 first_9th_schyear_obs, grade_flag, grade_flag_max) %>%
  filter(sid == 3)
```

```
Source: local data frame [2 x 6]
Groups: sid [1]

    sid school_year grade_level first_9th_schyear_obs grade_flag grade_flag_max
  <dbl>       <dbl>       <dbl>                <dbl>      <dbl>          <dbl>
1     3        2006          10                 2007          0              1
2     3        2007           9                 2007          1              1
```

Flag the first school year in which students appear in high school grades

```
# Flag the first school year in which students appear in high school grades

stusy %<>% group_by(sid) %>%
  mutate(first_9th_flag = ifelse(school_year ==
                                   min(school_year[grade_level %in% c(9:12)]),
                                 1, 0))


stusy %>% select(sid, school_year, grade_level,
                 first_9th_schyear_obs, grade_flag, grade_flag_max,
                 first_9th_flag) %>%
  filter(sid == 3)
```

```
Source: local data frame [2 x 7]
Groups: sid [1]

    sid school_year grade_level first_9th_schyear_obs grade_flag grade_flag_max
  <dbl>       <dbl>       <dbl>                <dbl>      <dbl>          <dbl>
1     3        2006          10                 2007          0              1
2     3        2007           9                 2007          1              1
# ... with 1 more variables: first_9th_flag <dbl>
```

Replace the `first_9th_school_year_observed` with the correctly imputed values.

```
# Replace the first_9th_school_year_observed with the correctly imputed values.
stusy$temp4_first9year <- NA

for(g in c(10, 11, 12)){
  stusy$temp4_first9year[stusy$grade_flag_max == 1 &
                           stusy$first_9th_flag == 1 &
```

```
                          stusy$grade_level == g] <-
  stusy$school_year[stusy$grade_flag_max == 1 &
                          stusy$first_9th_flag == 1 &
                          stusy$grade_level == g] - (g - 9)
}

stusy %<>% group_by(sid) %>%
  mutate(temp5_first9year = min(temp4_first9year, na.rm=TRUE))


stusy %>% select(sid, school_year, grade_level,
                 first_9th_schyear_obs, grade_flag, grade_flag_max,
                 first_9th_flag, temp4_first9year, temp5_first9year) %>%
  filter(sid == 3)
```

```
Source: local data frame [2 x 9]
Groups: sid [1]

    sid school_year grade_level first_9th_schyear_obs grade_flag grade_flag_max
  <dbl>       <dbl>       <dbl>                 <dbl>      <dbl>          <dbl>
1     3        2006          10                  2007          0              1
2     3        2007           9                  2007          1              1
# ... with 3 more variables: first_9th_flag <dbl>, temp4_first9year <dbl>,
#   temp5_first9year <dbl>
```

```
stusy$first_9th_schyear_obs[stusy$grade_flag_max == 1 &
                            !is.na(stusy$temp5_first9year)] <-
  stusy$temp5_first9year[stusy$grade_flag_max == 1 &
                            !is.na(stusy$temp5_first9year)]


stusy %>% ungroup %>% distinct(sid, first_9th_schyear_obs) %>%
  select(first_9th_schyear_obs) %>% unlist %>% table
```

```
.
2002 2003 2004 2005 2006 2007 2008 2009
   4    9   22 5706 5154 5217 5459   11
```

Step 5: Drop unneeded variables and save the file

```
#  Keep relevant variables

stusy %<>% select(sid, school_year, grade_level, frpl, iep, ell, gifted,
                  total_days_enrolled, total_days_absent,
                  days_suspended_out_of_school, first_9th_schyear_obs)

#  Make directory and save
# dir.create("clean")
# save(stusy, file = "clean/Student_School_Year_Ninth.rda")
#  Or if you want to save the Stata file
# write_dta(stusy, file = "clean/Student_School_Year_Ninth.dta")

# Clean up the workspace
rm(con, tmpfileName, stuclass, varIdx)
```

```
rm(stusy)
```

Task 4: STUDENT SCHOOL ENROLLMENT

PURPOSE

In Task 4: Student School Enrollment, you will take the `Student_School_Enrollment_Raw` file and generate the `Student_School_Enrollment` file that matches the specification in **Identify**. After matching **Identify**, you will take your dataset a few steps further by consolidating overlapping enrollment spells and determining the last withdrawal code for each student to yield the file `Student_School_Enrollment_Clean`.

The core of this task:

1. Create a `school_start` and `school_end` variable.
2. Remove abnormal enrollment observations with missing enrollment and withdrawal dates along with enrollment or withdrawal dates that are not in the right order.
3. Consolidate overlapping enrollments by student by school.
4. Update `days_enrolled` based on the consolidated enrollments using the new enrollment and withdrawal dates.
5. Determine the last withdrawal code for each student. You will use this data in later analyses to determine a student's end of high school outcomes.

After completing this, you will have a clean `Student_School_Enrollment` file. This process sets up our analyses for high school graduation and college enrollment and persistence outcomes.

HOW TO START

To begin, open the `Student_School_Enrollment_Raw` file in R. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 4**, start with the provided input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

Step 0: Load the Student_School_Enrollment_Raw data file

```
# Step 0: Load the Student_School_Enrollment_Raw data file
# Read in Stata
library(haven) # required for .dta f;iles

# To read data from a zip file we create a connection to the path of the
# zip file
tmpfileName <- "raw/Student_School_Enrollment_Raw.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
stuenr <- read_stata(con) # read data in the data subdirectory
glimpse(stuenr)
```

```
Observations: 95,935
Variables: 8
$ sid                  <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 3, 3, 4, 4, 4...
$ school_year          <dbl> 2004, 2004, 2005, 2005, 2006, 2006, 2007, 2007...
$ school_code          <dbl> 486, 486, 485, 486, 485, 485, 485, 485, 486, 4...
$ enrollment_date      <date> 2003-06-25, 2003-08-29, 2005-01-28, 2004-09-0...
$ enrollment_code_desc <chr> "Grade 9", "Grade 9", "Grade 9", "Grade 9", "G...
$ withdrawal_date      <date> 2003-07-05, 2004-06-08, 2005-06-07, 2005-02-1...
```

```
$ withdrawal_code_desc <chr> "Promoted End Year", "Retained in Grade", "Tra...
$ days_enrolled        <dbl> 10, 284, 130, 161, 0, 283, 284, NaN, 282, 191,...
```

Step 1: Create a school_start and school_end variable

```
#  Step 1: Create a school_start and school_end variable
#  In this example, school start is August 1, and school end is July 31 of
#  each school year. This may be different in your agency.

library(lubridate) # handle dates and times in R correctly

stuenr$school_start <- mdy(paste0("08", "01", stuenr$school_year-1))
stuenr$school_end <- mdy(paste0("07", "31", stuenr$school_year))

#  - Caution - ##
#  In R we have to create a character string that we convert to a date
#  Converting numerics to dates and times can introduce errors
#  - Caution - ##
```

Step 2: Remove abnormal enrollment observations

```
#  Step 2: Remove abnormal enrollment observations.

# Drop observations missing both enrollment and withdrawal dates.
stuenr %<>% filter(!is.na(enrollment_date) & !is.na(withdrawal_date))

# Drop observations with enrollment and withdrawal dates on same day.
stuenr %<>% filter(!enrollment_date == withdrawal_date & !is.na(enrollment_date))

# Drop observations with withdrawal date earlier than enrollment date.

stuenr %<>% filter(!is.na(withdrawal_date) & !withdrawal_date < enrollment_date)

# Drop observations with enrollment date after the end of the current school year.

stuenr %<>% filter(school_end > enrollment_date)

# Drop observations with enrollment date before the beginning of the current
# school year.

stuenr %<>% filter(school_start <= enrollment_date)

# Drop observations with withdrawal date more than one month after the end
# of the school year.

stuenr %<>% filter(withdrawal_date <= (school_end + 31) & !is.na(withdrawal_date))

# Check to make sure enrollment dates are in the correct school year.

table(stuenr$enrollment_date >= stuenr$school_start)
```

```
 TRUE
93772
```

```
table(stuenr$enrollment_date <= stuenr$school_end)
```

```
 TRUE
93772
```

Step 3: Consolidate overlapping enrollments by student by school

```
# Sort enrollment spells in ascending order and then check how many overlapping
# enrollment spells exist for a student at the same school.

stuenr %<>% arrange(sid, school_code, enrollment_date)

stuenr %<>% group_by(sid, school_code) %>%
  mutate(lag_withdrawal_date = lag(withdrawal_date)) %>% ungroup %>%
  group_by(sid, school_code, school_year) %>%
    mutate(min_enroll_date = min(enrollment_date))

 table(stuenr$enrollment_date <= stuenr$lag_withdrawal_date &
         !is.na(stuenr$lag_withdrawal_date))
```

```
FALSE  TRUE
93090   682
```

```
# 682?
#
# tmp <- stuenr %>% filter(sid == 2) %>%
#   select(sid, school_year, school_code, enrollment_date,
#          enrollment_code_desc, withdrawal_date, lag_withdrawal_date,
#          withdrawal_code_desc, min_enroll_date)

#  For overlapping observations, replace the enrollment date and enrollment code
#  description of all but the first enrollment spell with the earliest enrollment
#  date

stuenr$enrollment_date[stuenr$enrollment_date <= stuenr$lag_withdrawal_date &
                         !is.na(stuenr$lag_withdrawal_date)] <-
  stuenr$min_enroll_date[stuenr$enrollment_date <=
                           stuenr$lag_withdrawal_date &
                         !is.na(stuenr$lag_withdrawal_date)]

stuenr %>% filter(sid == 2) %>%
  select(sid, school_year, school_code, enrollment_date,
         enrollment_code_desc, withdrawal_date,
         withdrawal_code_desc)
```

```
Source: local data frame [3 x 7]
Groups: sid, school_code, school_year [2]

    sid school_year school_code enrollment_date enrollment_code_desc
  <dbl>       <dbl>       <dbl>          <date>                <chr>
1     2        2006         486      2005-08-27             Grade 10
2     2        2007         486      2006-08-29             Grade 11
3     2        2007         486      2006-08-29             Grade 11
```

```
# ... with 2 more variables: withdrawal_date <date>, withdrawal_code_desc <chr>
```

```
#  Replace the withdrawal date and withdrawal code description of the earliest
#  enrollment spell with the latest withdrawal date.

# Sort the data first so that latest withdrawal
# information appears as the first record.

stuenr %<>% arrange(sid, school_code, enrollment_date, withdrawal_date)

stuenr %>% filter(sid == 2) %>%
  select(sid, school_year, school_code, enrollment_date,
         enrollment_code_desc, withdrawal_date,
         withdrawal_code_desc)
```

```
Source: local data frame [3 x 7]
Groups: sid, school_code, school_year [2]

    sid school_year school_code enrollment_date enrollment_code_desc
  <dbl>       <dbl>       <dbl>          <date>                <chr>
1     2        2006         486      2005-08-27             Grade 10
2     2        2007         486      2006-08-29             Grade 11
3     2        2007         486      2006-08-29             Grade 11
# ... with 2 more variables: withdrawal_date <date>, withdrawal_code_desc <chr>
```

```
# Replace withdrawal_date
# Replace withdrawal_code_description

stuenr %<>% group_by(sid, school_code, enrollment_date) %>%
  mutate(withdrawal_date = last(withdrawal_date),
         withdrawal_code_desc = last(withdrawal_code_desc))
```

Step 4: Update days_enrolled based on consolidated enrollments

```
stuenr$days_enrolled <- stuenr$withdrawal_date - stuenr$enrollment_date

stuenr %>% filter(sid == 2) %>%
  select(sid, school_year, school_code, enrollment_date,
         enrollment_code_desc, withdrawal_date,
         withdrawal_code_desc, days_enrolled)
```

```
Source: local data frame [3 x 8]
Groups: sid, school_code, enrollment_date [2]

    sid school_year school_code enrollment_date enrollment_code_desc
  <dbl>       <dbl>       <dbl>          <date>                <chr>
1     2        2006         486      2005-08-27             Grade 10
2     2        2007         486      2006-08-29             Grade 11
3     2        2007         486      2006-08-29             Grade 11
# ... with 3 more variables: withdrawal_date <date>,
#   withdrawal_code_desc <chr>, days_enrolled <time>
```

Step 5: Determine the last withdrawal code for each student

You will use this data in later analyses to determine a student's end of high school outcomes.

```
stuenr %<>% arrange(sid, withdrawal_date)

stuenr %>% filter(sid == 16) %>%
  select(sid, school_year, school_code, enrollment_date,
         enrollment_code_desc, withdrawal_date,
         withdrawal_code_desc)
```

```
Source: local data frame [2 x 7]
Groups: sid, school_code, enrollment_date [2]

    sid school_year school_code enrollment_date enrollment_code_desc
  <dbl>       <dbl>       <dbl>          <date>                <chr>
1    16        2007         450      2007-01-07             Grade 11
2    16        2008         450      2007-08-20             Grade 12
# ... with 2 more variables: withdrawal_date <date>, withdrawal_code_desc <chr>
```

```
stuenr %<>% group_by(sid) %>%
  mutate(last_withdrawal_reason = last(withdrawal_code_desc))

stuenr %>% filter(sid == 16) %>%
  select(sid, school_year, school_code, enrollment_date,
         enrollment_code_desc, withdrawal_date,
         withdrawal_code_desc, last_withdrawal_reason)
```

```
Source: local data frame [2 x 8]
Groups: sid [1]

    sid school_year school_code enrollment_date enrollment_code_desc
  <dbl>       <dbl>       <dbl>          <date>                <chr>
1    16        2007         450      2007-01-07             Grade 11
2    16        2008         450      2007-08-20             Grade 12
# ... with 3 more variables: withdrawal_date <date>,
#   withdrawal_code_desc <chr>, last_withdrawal_reason <chr>
```

Step 6: Drop unneeded variables and save

```
#  Drop duplicate records

stuenr %<>% select(-min_enroll_date, -lag_withdrawal_date)
stuenr <- ungroup(stuenr) %>% distinct(sid, school_year, school_code,
                                       enrollment_date, .keep_all = TRUE)

#  Confirm that file is unique by student, school_year, school_code,
#  and enrollment_date

n_distinct(paste0(stuenr$sid, stuenr$school_year, stuenr$school_code,
            stuenr$enrollment_date)) == nrow(stuenr)
```

```
[1] TRUE
```

```
#  Save the current file as Student_School_Enrollment_Clean

#  Make directory and save
# dir.create("clean")
```

```
# save(stuenr, file = "clean/Student_School_Enrollment_Clean.rda")
#  Or if you want to save the Stata file
# write_dta(stuenr, file = "clean/Student_School_Enrollment_Clean.dta")

rm(tmp, stuenr); gc()
```

```
         used (Mb) gc trigger (Mb) max used (Mb)
Ncells  650135 34.8    1770749 94.6  1770749 94.6
Vcells 1016861  7.8    7825812 59.8  9782264 74.7
```

Task 5: STUDENT TEST SCORES

PURPOSE

In **Task 5:** Student Test Scores, you will take the `Student_Test_Scores` file, containing data on all the tests a student has taken and matching the structure of **Identify**. Through this task, you will generate three different clean output files that contain a single score and test-taking instance for each student:

- Prior Achievement (one 8th grade state test score per student),
- SAT scores (one SAT score per student), and
- ACT scores (one ACT score per student).

The file for Prior Achievement will contain students' achievement on state standardized Math and English Language Arts tests in 8th grade. This will allow you to control for prior academic achievement when you examine college-going outcomes. The SAT and ACT score files will be used for defining highly qualified high school graduates.

The core of this task:

- Prior Achievement

1. Clean state test scores and resolve instances where students took the same test multiple times.
2. Standardize test scores to a mean of 0 and a standard deviation of 1. This allows you to compare across tests and years when different score scales were used.
3. Generate a composite math and English score for scaled and standardized test scores in eighth grade.

- SAT

1. Clean SAT test scores and resolve instances where students took the same test multiple times.
2. Generate a total SAT score based on math, verbal, and writing scores.

- ACT

1. Clean ACT test scores and resolve instances where students took the same test multiple times.

After completing this, you will have a Prior_Achievement file with 8th grade test scores. You will also have SAT and ACT files. All three files will be used in **Connect**.

HOW TO START

To begin, open the `Student_Test_Scores` file in R. This file contains data on State assessments, SAT, and ACT scores. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 5**, start with the provided input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

DATA DESCRIPTION

The input file, `Student_Test_Scores`, follows the structure of `Student_Test_Scores` in Identify so it is unique by `sid`, `test_code`, and `test_date`. The aim of this task will be to create three separate clean output files, Prior_Achievement, SAT, and ACT, that report only one test score per student. This means that for eight grade prior achievement duplicates of the same test taken in the same and different years will need to be resolved. Also any duplicates of SAT or ACT scores will need to be resolved as well.

Uniqueness

Prior Achievement (8th grade state test scores).

Ideally, state test data in its raw form is unique by `sid`, `test_subject`, `grade_level`, and `school_year`. However, some students re-take the same test for the same grade in the same year. To fix this, you will make the 8th grade test score data in `Student_Test_Scores` unique by `sid`, `test_subject`, `grade_level`, and `school_year` by removing any same year repeat test taking instances. Then, you will manipulate the data so tests for different subjects in the same `grade_level` fall on the same row so the data is unique by `sid`, `test_subject`, and `grade_level`. As a final step, if a student took the same test in different years (e.g. by repeating a grade), you will take the earliest instance. The data will finally be unique by `sid` and is considered a clean file and ready to be incorporated into the analysis file in **Connect**.

SAT

Ideally, SAT test data in its raw form is unique by `sid`. However, some students re-take the SAT. To fix this, you will take the data unique by `sid`, `test_subject`, and `test_date` and reshape it so the data will finally be unique by `sid` and is considered a clean file and ready to be incorporated into the analysis file in **Connect.**

ACT

Ideally, ACT test data in its raw form is unique by `sid`. However, some students re-take the ACT. To fix this, you will take the data unique by `sid`, `test_subject`, and `test_date` and reshape it so the data will finally be unique by `sid` and is considered a clean file and ready to be incorporated into the analysis file in **Connect**.

Part I: Clean Prior Achievement Scores

Step 0: Load the Student_Test_Scores data file

```
# Read in Stata
library(haven) # required for .dta f;iles
# To read data from a zip file we create a connection to the path of the
# zip file
tmpfileName <- "raw/Student_Test_Scores.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
stutest <- read_stata(con) # read data in the data subdirectory
close(con)
# Convert to R style
stutest$test_subject <- as_factor(stutest$test_subject)
stutest$test_subject <- tolower(as.character(stutest$test_subject))
glimpse(stutest)
```

```
Observations: 100,705
Variables: 10
$ sid                   <dbl> 6, 6, 7, 7, 7, 7, 7, 7, 8, 8, 8, 8, 9, 9, 9,...
$ test_type             <chr> "State", "State", "State", "State", "State",...
$ school_year           <dbl> 2007, 2007, 2004, 2004, 2005, 2005, 2007, 20...
$ test_date             <date> 2007-04-15, 2007-04-15, 2004-04-15, 2004-04...
```

```
$ grade_level            <dbl> 8, 8, 8, 8, 9, 9, 10, 10, 8, 8, 8, 8, 7, 7, ...
$ test_subject           <chr> "math", "ela", "math", "ela", "math", "ela",...
$ scaled_score           <dbl> 726, 678, 722, 728, 851, 729, 609, 616, 698,...
$ performance_level      <dbl> 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 2, 2, 2, 2, 2,...
$ performance_level_desc <chr> "On the Way to Proficient", "On the Way to P...
$ raw_score              <dbl> 35, 31, 40, 36, 59, 41, 18, 19, 35, 46, 40, ...
```

Step 1: Keep only state test scores in 8th grade

```
#  Keep only the variables you need and limit the sample to state test scores
#  in 8th grade.

statetest <- stutest %>%
            select(sid, test_type, test_subject, school_year,
                   grade_level, scaled_score, raw_score, test_date) %>%
    filter(test_type == "State" & grade_level == 8)

# Leave the original stutest, we will come back to this later. In R
# we can keep multiple datasets open in the workset at the same time.
```

Step 2: Clean up raw and scaled scores

```
#  Clean up raw and scaled scores.
#  Change raw and scaled scores to missing if zero.

# A forloop in R
for(var in c("raw_score", "scaled_score")){
  statetest[, var][statetest[,var] == 0] <- NA
}

# Drop observations missing both a raw and scaled test score.
statetest %<>% filter(!is.na(raw_score) | !is.na(scaled_score))
```

Step 3: Identify same-year repeat test takers

```
#  Identify same-year repeat test takers and take the highest test score
#  For ties in scores, take the last date tested

statetest %<>% arrange(sid, test_subject,
                       grade_level, school_year, scaled_score)

statetest %>% filter(sid == 595) %>%
  select(sid, test_type, school_year, test_date, grade_level,
         test_subject, scaled_score, raw_score)
```

```
# A tibble: 3 × 8
    sid test_type school_year  test_date grade_level test_subject scaled_score
  <dbl>     <chr>       <dbl>     <date>       <dbl>        <chr>        <dbl>
1   595     State        2007 2007-04-15           8          ela          789
2   595     State        2007 2007-04-15           8          ela          799
3   595     State        2007 2007-04-15           8         math          770
# ... with 1 more variables: raw_score <dbl>
```

```
statetest %<>% group_by(sid, test_subject, school_year, grade_level) %>%
  mutate(keep_flag = scaled_score == max(scaled_score) &
           test_date == max(test_date)) %>%
  ungroup %>%
  filter(keep_flag) %>%
  select(-keep_flag)

statetest %>% filter(sid == 595) %>%
  select(sid, test_type, school_year, test_date, grade_level,
         test_subject, scaled_score, raw_score)
```

```
# A tibble: 2 × 8
    sid test_type school_year  test_date grade_level test_subject scaled_score
  <dbl>     <chr>       <dbl>     <date>       <dbl>        <chr>        <dbl>
1   595     State        2007 2007-04-15           8          ela          799
2   595     State        2007 2007-04-15           8         math          770
# ... with 1 more variables: raw_score <dbl>
```

```
# Verify that each student has only one state test in a
# subject in a school year.

statetest %>% distinct(sid, test_subject, grade_level, school_year) %>%
  nrow == nrow(statetest)
```

```
[1] TRUE
```

Step 4: Reshape the data

Reshape the data so math and ELA tests appear on the same row.

```
#  Reshape the data so math and ELA tests appear on the same row.
statetest <- reshape(as.data.frame(statetest),
                v.names = c("raw_score", "scaled_score"),
                timevar = c("test_subject"),
                idvar = c("sid", "test_type", "test_date",
                          "school_year", "grade_level"),
                direction = "wide",
                sep = "_")
```

Step 5: Compute standardized test scores

Compute standardized test scores. Standardized means the test score will have a mean 0 and standard deviation 1.

```
#  Compute standardized test scores with mean 0 and standard deviation 1.
statetest$scaled_math_std <- scale(statetest$scaled_score_math)
statetest$scaled_ela_std <- scale(statetest$scaled_score_ela)

statetest %>% select(scaled_math_std, scaled_ela_std) %>%
  na.omit %>% summary
```

```
 scaled_math_std.V1   scaled_ela_std.V1
 Min.   :-3.351985   Min.   :-4.141948
 1st Qu.:-0.674740   1st Qu.:-0.602611
 Median :-0.005428   Median : 0.095516
 Mean   : 0.003436   Mean   : 0.000262
```

```
 3rd Qu.: 0.679449   3rd Qu.: 0.679993
 Max.   : 5.100017   Max.   : 5.761703
```

Step 6: Identify different-year repeat test takers

Find repeat test takers and take the earliest test score.

```
#  Identify different-year repeat test takers and take the earliest test score.

#  In R we can do this all at once using group_by
statetest %<>% group_by(sid) %>%
  mutate(keep_flag = test_date == min(test_date)) %>%
  filter(keep_flag) %>% select(-keep_flag)
```

Step 7: Verify the data and drop unneeded variables

Verify that each student has only one state test, and drop unneeded variables.

```
#  Verify that each student has only one state test, and drop unneeded variables
nrow(statetest) == n_distinct(statetest$sid)
```

```
[1] TRUE
```

```
statetest %<>% select(-test_date, -test_type)
```

Step 8: Generate composite scaled and standardized scores

Generate composite scaled and standardized scores that average ELA and math scores.

```
#  Generate composite scaled and standardized scores that average ELA and
#  math scores.
statetest$scaled_score_composite <- (statetest$scaled_score_ela +
                                       statetest$scaled_score_math) /2
statetest$scaled_score_composite_std <- (statetest$scaled_math_std +
                                           statetest$scaled_ela_std) /2
```

Step 9: Save the current file as Prior_Achievement.dta.

```
#  Save the current file as Prior_Achievement.dta.

statetest %<>% arrange(sid, school_year, grade_level) %>%
  select(sid, school_year, grade_level, raw_score_math, raw_score_ela,
         scaled_score_math, scaled_score_ela, scaled_score_composite,
         scaled_math_std, scaled_ela_std, scaled_score_composite_std)

#  Make directory and save
# dir.create("clean")
# save(statetest, file = "clean/Prior_Achievement.rda")
#  Or if you want to save the Stata file
# write_dta(statetest, file = "clean/Prior_Achievement.dta")

rm(tmp, statetest); gc()
```

```
          used (Mb) gc trigger (Mb) max used (Mb)
Ncells  659354 35.3    1770749 94.6  1770749 94.6
```

```
Vcells 2039160 15.6    6260649 47.8  9782264 74.7
```

Part II: Clean SAT Scores

The steps here are condensed because the process is very similar to the process for state assessment scores.

```
#  Keep only the variables and limit the sample to SAT.
sattest <- stutest %>% filter(test_type == "SAT")
sattest %<>% select(sid, test_subject, test_date, scaled_score)

#  Drop duplicate observations and any observations missing test scores.
sattest %<>% distinct()
sattest %<>% filter(!is.na(scaled_score))

#  Reshape the data so that math, ELA, and writing scores appear on one row
#  by student and test date.
sattest <- reshape(as.data.frame(sattest),
                v.names = c("scaled_score"),
                timevar = c("test_subject"),
                idvar = c("sid", "test_date"),
                direction = "wide",
                sep = "_")

#  Rename for convenience
names(sattest) <- c("sid", "sat_test_date", "sat_math_score",
                    "sat_verbal_score", "sat_writing_score")
sattest %<>% arrange(sid, sat_test_date)

#  Identify repeat test takers and take the earliest test score.

sattest %<>% group_by(sid) %>%
  mutate(keep_flag = sat_test_date == min(sat_test_date)) %>%
  filter(keep_flag) %>% select(-keep_flag)

#  Verify that the file is now unique by student.
nrow(sattest) == n_distinct(sattest$sid)
```

```
[1] TRUE
```

```
#  Verify that test scores from the component subjects are not missing and
#  generate total scores.

table(!is.na(sattest$sat_math_score) & !is.na(sattest$sat_verbal_score))
```

```
TRUE
 271
```

```
sattest$sat_total_score <- sattest$sat_math_score + sattest$sat_verbal_score

table(!is.na(sattest$sat_math_score) & !is.na(sattest$sat_verbal_score) &
        !is.na(sattest$sat_writing_score))
```

```
TRUE
 271
```

```
sattest$sat_total_score_plus_writing <- sattest$sat_math_score +
  sattest$sat_verbal_score + sattest$sat_writing_score

#  Save the current file as SAT.dta.

#  Make directory and save
# dir.create("clean")
# save(sattest, file = "clean/SAT.rda")
#  Or if you want to save the Stata file
# write_dta(sattest, file = "clean/SAT.dta")
rm(sattest); gc()
```

```
         used (Mb) gc trigger (Mb) max used (Mb)
Ncells  660129 35.3    1770749 94.6  1770749 94.6
Vcells 2041654 15.6    6260649 47.8  9782264 74.7
```

Part III: Clean ACT Scores

Steps are condensed because of their similarity to the steps above.

```
#  Keep only the variables you need and limit the sample to ACT.
acttest <- stutest %>% filter(test_type == "ACT")
acttest %<>% select(sid, test_subject, test_date, scaled_score)

#  Identify repeat test takers and take the earliest test score.

acttest %<>% group_by(sid) %>%
  mutate(keep_flag = test_date == min(test_date)) %>%
  filter(keep_flag) %>% select(-keep_flag)

#  Keep and rename the relevant variables.
acttest %>% select(sid, test_date, scaled_score)
```

```
Source: local data frame [2,544 x 3]
Groups: sid [2,544]

     sid  test_date scaled_score
   <dbl>     <date>        <dbl>
1     10 2008-04-06           14
2     16 2008-02-07           17
3     30 2008-04-06           17
4     38 2008-02-07           19
5     40 2008-04-06           29
6     67 2008-04-06           16
7     73 2008-02-07           13
8     74 2007-10-07           28
9     77 2008-04-06           20
10    80 2008-04-06           18
# ... with 2,534 more rows
```

```
names(acttest) <- c("sid", "act_test_date", "act_composite_score")

#  Verify that the file is now unique by student.
nrow(acttest) == n_distinct(acttest$sid)
```

```
[1] TRUE
```

```
#  Save the current file as ACT.dta.
#  Make directory and save
# dir.create("clean")
# save(acttest, file = "clean/ACT.rda")
#  Or if you want to save the Stata file
# write_dta(acttest, file = "clean/ACT.dta")
rm(acttest); gc()
```

```
          used (Mb) gc trigger (Mb) max used (Mb)
Ncells  659813 35.3    1770749 94.6  1770749 94.6
Vcells 2040268 15.6    6260649 47.8  9782264 74.7
```

Task 6: STUDENT CLASS ENROLLMENT

PURPOSE

In **Task 6:** `Student Class Enrollment`, you will take the `Class_Raw` file and the `Student_Class_Enrollment` file to create the `Student_Class_Enrollment_Merged` file that combines these two files together. The combined file will identify a unique observation by student and class id. To obtain this file, you will first clean the `Class_Raw` file to identify core courses in math and ELA based on the course description variable and match the specification in **Identify**. This will make the class file unique by class id. Second, you will merge the Class file and the Student Class Enrollment file and make it unique by student id and class id.

The core of this task:

1. Using the Class file:

a. Drop incomplete observations
b. Flag core math and English courses based on the course description

2. Merging the Student Class Enrollment file:

a. Merge the Class file onto the `Student_Class_Enrollment_Raw` file
b. Evaluate course marks and drop courses with no record of completion
c. Evaluate course enrollment so that each student has only one enrollment record for a course

The `Student_Class_Enrollment_Merged` file will be used in **Connect** to create on-track indicators for students. On-track indicators explore year-by year academic progress towards high school graduation and college readiness. For instance, using course credit and course grade information, one might ask what percent of students earn the minimum number of credits in their core courses to satisfy agency graduation requirements?

HOW TO START

To begin, open the `Class_Raw` file in R. This file contains data linking students to teachers. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided. In the second part of this task, you will then use the `Student_Class_Enrollment` file. If this is your first time attempting **Task 6**, start with the provided input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

DATA DESCRIPTION FOR RAW FILE

The input file, `Class_Raw`, varies from Class in **Identify** in a number of key ways. Most importantly, the data is not unique by `cid` as shown in **Identify**. For instance, there may be more than one course description that describes the same course. Also, a `tid` is not included as it is not required for the questions later asked in this toolkit. Support for a `Class` file with `tid`

will come with the Human Capital version of the toolkit. The aim of this task then is to eliminate any duplicate course code descriptions and match the `Class` file in **Identify** in its structure and uniqueness so it is unique by `cid` alone.

Uniqueness

The input file, Student_Class_Enrollment_Raw, follows the structure of `Student_Class_Enrollment` in Identify so it is unique by `sid`, `cid`, and `class_enrollment_date`. The aim of this task then is to take things one step further by consolidating any overlapping enrollment spells for the same student and `cid`.

Part I: Clean the Class File

Step 0: Load the Class_Raw data file

```
# Read in Stata
library(haven) # required for .dta f;iles

# To read data from a zip file we create a connection to the path of the
# zip file
tmpfileName <- "raw/Class_Raw.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
classRaw <- read_stata(con) # read data in the data subdirectory
close(con)
glimpse(classRaw)
```

```
Observations: 135,969
Variables: 8
$ cid                <dbl> 541631401, 432349312, 802451252, 831688206, 343...
$ credits_possible   <dbl> 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 3.0, 0.5, 0.5, 0....
$ school_year        <dbl> 2007, 2005, 2007, 2009, 2007, 2008, 2008, 2008,...
$ school_code        <dbl> NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, Na...
$ section_code       <dbl> NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, Na...
$ instructional_level <dbl> NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, Na...
$ course_code_desc   <chr> "ELECTIVE II", "ELECTIVE II", "ELECTIVE II", "E...
$ course_code        <dbl> NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, Na...
```

```
tmpfileName <- "raw/Student_Class_Enrollment.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
stuclass <- read_stata(con) # read data in the data subdirectory
close(con)
glimpse(stuclass)
```

```
Observations: 1,010,819
Variables: 8
$ sid                  <dbl> 13281, 18950, 18950, 17817, 4739, 4739, 6737,...
$ cid                  <dbl> 227008230, 488826242, 441147758, 64721603, 59...
$ class_enrollment_date <date> 2006-08-13, 2007-08-13, 2007-08-13, 2005-08-...
$ class_withdrawal_date <date> 2007-07-01, 2008-06-30, 2008-06-30, 2006-07-...
$ marking_period       <chr> "S2", "S1", "S2", "S2", "Q4", "Q3", "S2", "S2...
$ final_grade_mark     <chr> "B-", "A", "A", "D", "C", "D", "A-", "C+", "F...
$ final_grade_mark_num <dbl> 2.7, 4.0, 4.0, 1.0, 2.0, 1.0, 3.7, 2.3, 0.0, ...
$ credits_earned       <dbl> 0.5, 0.5, 0.5, 1.0, 0.5, 0.5, 0.5, 0.5, 0.0, ...
```

Step 1: Identify the critical variables that identify a class

```
#  Identify the critical variables that identify a class.

local_ids <- c("cid", "school_year", "school_code", "section_code",
                     "course_code")
#  Drop the observations where any of the critical variables are missing
classRaw %<>%
  filter(complete.cases(.[, local_ids]))
```

Step 2: Flag core math and English courses

Note that agencies may have varying consistency in course names and use different criteria to identify a core course vs an elective.

In some cases, other criteria may have to be applied to identify core courses (e.g. the department the course is # listed in, or length of the course.)

We provide a simplified version of the cleaning process for the class file: work within your agency to determine the best criteria.

```
#  Tabulate course names
table(classRaw$course_code_desc)
```

```
     ALGEBRA   ALGEBRA II     CALCULUS   ELECTIVE I  ELECTIVE II ELECTIVE III
        6202           21          218        27468        23679        23702
 ELECTIVE IV       ENG 10   ENGLISH 09   ENGLISH 10   ENGLISH 11   ENGLISH 12
       32184          101         7799          177          418          287
   ENGLISH 9         GEOM     GEOMETRY    OTHER ELA   OTHER MATH   STATISTICS
        7913         2444         2409          151          310           68
TRIGONOMETRY
          44
```

```
#  Flag math courses based on the tabulation results
#  Generate a flag variable
classRaw$math_flag <- NA

#  Use the grep function to identify course names that contain common word
#  stems, but slightly different spellings, e.g.Algebra I and Algebra-I

#  In R the patterns need to have no spaces in the grep command
#  The spaces will be matched
#  The | = OR
#  grep does partial matching
#  grepl returns TRUE/FALSE, as.numeric converts this to 1/0
classRaw$math_flag <- as.numeric(grepl("GEOM|ALGEBRA|MATH|STAT|CALC|TRIG",
                                       classRaw$course_code_desc))

#  Check the results of flagging your variables
table(classRaw$course_code_desc, classRaw$math_flag)
```

```
                0     1
  ALGEBRA       0  6202
  ALGEBRA II    0    21
  CALCULUS      0   218
```

```
  ELECTIVE I   27468     0
  ELECTIVE II  23679     0
  ELECTIVE III 23702     0
  ELECTIVE IV  32184     0
  ENG 10         101     0
  ENGLISH 09    7799     0
  ENGLISH 10     177     0
  ENGLISH 11     418     0
  ENGLISH 12     287     0
  ENGLISH 9     7913     0
  GEOM             0  2444
  GEOMETRY         0  2409
  OTHER ELA      151     0
  OTHER MATH       0   310
  STATISTICS       0    68
  TRIGONOMETRY     0    44
```

```
#  Repeat this process for flagging ELA courses
classRaw$ela_flag <- NA
classRaw$ela_flag <- as.numeric(grepl("ENG|ELA",
                                      classRaw$course_code_desc))

#  Check the results of flagging your variables
table(classRaw$course_code_desc, classRaw$ela_flag)
```

```
                 0     1
  ALGEBRA       6202     0
  ALGEBRA II      21     0
  CALCULUS       218     0
  ELECTIVE I   27468     0
  ELECTIVE II  23679     0
  ELECTIVE III 23702     0
  ELECTIVE IV  32184     0
  ENG 10           0   101
  ENGLISH 09       0  7799
  ENGLISH 10       0   177
  ENGLISH 11       0   418
  ENGLISH 12       0   287
  ENGLISH 9        0  7913
  GEOM          2444     0
  GEOMETRY      2409     0
  OTHER ELA        0   151
  OTHER MATH     310     0
  STATISTICS      68     0
  TRIGONOMETRY    44     0
```

Step 4: Drop any unneeded variables and drop duplicates

```
#  Drop the course_code_desc, as it is no longer needed.
classRaw %<>% select(-course_code_desc)

#  Collapse the data
classRaw %<>% distinct()
```

```
#  Verify that the data is unique by cid, and also unique by school year,
#  school code, section code and course code.
nrow(classRaw) == n_distinct(classRaw$cid)
```

```
[1] TRUE
```

```
classRaw %>% distinct(school_year, school_code,
                      section_code, course_code) %>%
  nrow == nrow(classRaw)
```

```
[1] TRUE
```

Part II: Clean the Student_Class_Enrollment file

Step 0: Load the Student_Class_Enrollment data file

This was done above simultaneously with the class file.

Step 1: Merge on the temporary Class file

Merge on the temporary Class file you saved earlier to the `Student_Class_Enrollment file`

In R you can merge two datasets using the familiar language of SQL and joins. `inner_join` tells R to retain only observations matched between both datasets.

```
#  Merge classRaw and stuclass together
#  keep only files merged from both files
stuclass <- inner_join(stuclass, classRaw, by = "cid")
```

Step 2: Evaluate course marks

```
#  Evaluate course marks
table(stuclass$final_grade_mark, round(stuclass$credits_possible, digits = 1))
```

```
          0    0.1    0.2    0.3    0.4    0.5    0.6    0.8    0.9      1
          0      0      0      0      0      7      0      0      0      0
  A    3168      6   2179     24      2 184776      1      4      0   3347
  A-    397      0    654     26      0  84078      2      0      0   1153
  A+    591      1    884      4      0  56697      0      1      0    634
  B     577      3    900     34      1 127798      0      2      1   2329
  B-    131      0    340      8      0  65004      0      0      0   1033
  B+    235      0    440     23      0  53348      3      0      0    874
  C     311      2    469     16      1  93813      2      0      0   1672
  C-     66      0    160      2      0  46522      0      0      0    786
  C+     69      1    182      5      0  40178      0      0      0    669
  D     157      1    209      3      0  55659      1      1      0    925
  D-     33      0     75      0      0  32917      0      0      0    510
  D+     25      0     67      2      0  19732      0      0      0    356
  DF      0      0      0      0      0      5      0      0      0      0
  F     304      4    308      0      0  89928      0      0      0   1284
  NGPA 3773      0    107      1      0   9670      0      0      0    163
  P    4942      2    870      0      0  10976      0      0      0    396

        1.2    1.5    1.7    1.8      2      3      5    130
```

```
          0     0     0     0     0     0     0     0
A         4   125     1     1     1     0     0     1
A-        0    27     0     1     1     0     0     0
A+        0    15     0     0     2     0     0     0
B         2    39     1     0     1     0     0     0
B-        0     9     0     0     1     0     0     0
B+        0     9     0     0     1     1     0     0
C         0    37     0     1     2     0     0     0
C-        0     5     0     0     0     0     0     0
C+        0     5     0     0     0     0     1     0
D         1     7     0     0     0     1     4     0
D-        0     3     0     0     0     0     0     0
D+        0     0     0     0     0     0     1     0
DF        0     0     0     0     0     0     0     0
F         0    24     0     0     0     1     2     0
NGPA      0    12     0     0     0     0     0     0
P         0     2     0     0     0     0     0     0
```

```
table(stuclass$final_grade_mark, stuclass$final_grade_mark_num)
```

```
          0   0.4   0.6   0.7     1   1.3   1.9     2   2.3   2.7
          0     0     0     0     0     0     0     0     0     0
A         0     0     0     0     0     0     0     0     0     0
A-        0     0     0     0     0     0     0     0     0     0
A+        0     0     0     0     0     0     0     0     0     0
B         0     0     0     0     0     0     0     0     0     0
B-        0     0     0     0     0     0     0     0     0 66526
B+        0     0     0     0     0     0     0     0     0     0
C         0     0     0     0     0     0     0 96326     0     0
C-        0     0     0     0     0     0 47541     0     0     0
C+        0     0     0     0     0     0     0     0 41110     0
D         0     0     0     0 56969     0     0     0     0     0
D-        0     0     0 33538     0     0     0     0     0     0
D+        0     0     0     0     0 20183     0     0     0     0
DF        0     0     5     0     0     0     0     0     0     0
F     91855     0     0     0     0     0     0     0     0     0
NGPA      0   687     0     0     0     0     0     0     0     0
P         0     0     0     0     0     0     0     0     0     0

          3   3.3   3.7     4   4.3
          0     0     0     0     0
A         0     0     0 193640     0
A-        0     0 86339     0     0
A+        0     0     0     0 58829
B    131688     0     0     0     0
B-        0     0     0     0     0
B+        0 54934     0     0     0
C         0     0     0     0     0
C-        0     0     0     0     0
C+        0     0     0     0     0
D         0     0     0     0     0
D-        0     0     0     0     0
D+        0     0     0     0     0
DF        0     0     0     0     0
```

```
  F         0       0       0       0       0
  NGPA      0       0       0       0       0
  P         0       0       0       0       0
```

Some letter marks (NGPA and P) indicate that they do not count toward GPA, so you may leave the numeric mark as missing.

Step 3: Evaluate course completion

```
#  Evaluate course completion
#  Drop observations that have no record of course completion
stuclass %<>% filter(!is.na(final_grade_mark) &
                       !is.na(final_grade_mark_num) &
                       !is.na(credits_earned))
```

Step 4: Evaluate course enrollment

```
#  Evaluate course enrollment

#  Fix cases where a student has multiple observations for the same course
#  with the same year and marking period (i.e. with overlapping enrollment dates)

# Remove enrollment and withdrawal dates that are not in the current school year.
library(lubridate) # handle dates and times in R correctly
stuclass$school_start <- mdy(paste0("08", "01", stuclass$school_year-1))
stuclass$school_end <- mdy(paste0("07", "31", stuclass$school_year))

stuclass$class_enrollment_date[stuclass$class_enrollment_date <
                                 stuclass$school_start |
                                 stuclass$class_enrollment_date >
                                 stuclass$school_end] <- NA
stuclass$class_withdrawal_date[stuclass$class_withdrawal_date <
                                 stuclass$school_start |
                                 stuclass$class_withdrawal_date >
                                 stuclass$school_end] <- NA
stuclass %<>% select(-school_start, -school_end)

# Check for correct changes
stuclass %>% filter(sid == 2251 & cid == 78150780) %>%
  select(sid, cid, school_code, school_year, class_enrollment_date,
         class_withdrawal_date)
```

```
# A tibble: 4 × 6
    sid      cid school_code school_year class_enrollment_date
  <dbl>    <dbl>       <dbl>       <dbl>                <date>
1  2251 78150780         540        2006            2005-08-12
2  2251 78150780         540        2006            2005-09-21
3  2251 78150780         540        2006            2005-12-23
4  2251 78150780         540        2006            2005-09-13
# ... with 1 more variables: class_withdrawal_date <date>
```

```
# Identify the variables that identify a course
local_ids <- c("sid", "cid", "school_year", "marking_period")

#  Populate all enrollments with the earliest enrollment date
stuclass %<>% ungroup %>%
```

```
  group_by(sid, cid, school_year, marking_period) %>%
  arrange(class_enrollment_date) %>%
  mutate(first_enroll = min(class_enrollment_date, na.rm=TRUE))

stuclass$class_enrollment_date <- stuclass$first_enroll
stuclass %<>% select(-first_enroll)

stuclass %>% ungroup %>% filter(sid == 2251 & cid == 78150780) %>%
  select(sid, cid, school_code, school_year, class_enrollment_date,
         class_withdrawal_date)
```

```
# A tibble: 4 × 6
    sid      cid school_code school_year class_enrollment_date
  <dbl>    <dbl>       <dbl>       <dbl>                 <date>
1  2251 78150780         540        2006             2005-08-12
2  2251 78150780         540        2006             2005-08-12
3  2251 78150780         540        2006             2005-08-12
4  2251 78150780         540        2006             2005-08-12
# ... with 1 more variables: class_withdrawal_date <date>
```

```
#  Populate all enrollments with the latest withdrawal date

stuclass %<>% ungroup %>%
  arrange(sid, cid, school_year, marking_period, class_withdrawal_date) %>%
  group_by(sid, cid, school_year, marking_period) %>%
  mutate(last_withdraw = max(class_withdrawal_date, na.rm=TRUE))

stuclass %>% ungroup %>% filter(sid == 2251 & cid == 78150780) %>%
  select(sid, cid, class_enrollment_date,
         class_withdrawal_date, last_withdraw)
```

```
# A tibble: 4 × 5
    sid      cid class_enrollment_date class_withdrawal_date last_withdraw
  <dbl>    <dbl>                <date>                <date>        <date>
1  2251 78150780            2005-08-12            2005-08-17    2005-11-02
2  2251 78150780            2005-08-12            2005-08-27    2005-11-02
3  2251 78150780            2005-08-12            2005-11-02    2005-11-02
4  2251 78150780            2005-08-12                  <NA>    2005-11-02
```

```
stuclass$class_withdrawal_date <- stuclass$last_withdraw
stuclass$last_withdraw <- NULL

stuclass %>% ungroup %>% filter(sid == 2251 & cid == 78150780) %>%
  select(sid, cid, school_code, school_year, marking_period,
         section_code, class_enrollment_date,
         class_withdrawal_date, class_withdrawal_date)
```

```
# A tibble: 4 × 8
    sid      cid school_code school_year marking_period section_code
  <dbl>    <dbl>       <dbl>       <dbl>          <chr>        <dbl>
1  2251 78150780         540        2006             S1            7
2  2251 78150780         540        2006             S1            7
3  2251 78150780         540        2006             S1            7
4  2251 78150780         540        2006             S1            7
# ... with 2 more variables: class_enrollment_date <date>,
```

```
#   class_withdrawal_date <date>
```

Step 5: Drop any unneeded variables and save the file

```
#  Drop any unneeded variables, drop duplicates, and save the file
#  Drop duplicate values
stuclass %<>% ungroup %>% distinct()

#  Verify that the file is unique by sid and cid
nrow(stuclass) == n_distinct(paste0(stuclass$sid, stuclass$cid, sep ="_"))
```

```
[1] TRUE
```

```
#   Order the variables

stuclass %<>% select(sid, cid, school_year, school_code, course_code,
                     marking_period, section_code, instructional_level,
                     credits_possible, math_flag, ela_flag,
                     class_enrollment_date, class_withdrawal_date,
                     final_grade_mark, final_grade_mark_num,
                     credits_earned)
#  Sort the data
stuclass %<>% ungroup() %>%
  arrange(sid, school_year, marking_period, cid)

#  Save the current file as Student_Class_Enrollment_Merged.dta.
#  Make directory and save

# dir.create("clean")
# save(stuclass, file = "clean/Student_Class_Enrollment_Merged.rda")
#  Or if you want to save the Stata file
# write_dta(stuclass, file = "clean/Student_Class_Enrollment_Merged.dta")
```

Task 7 STUDENT NSC ENROLLMENT

PURPOSE

In **Task 7:** `Student NSC Enrollment`, you will take the `Student_NSC_Enrollment` file that matches the specification in Identify and produce a `Student_NSC_Enrollment_Indicators` file that includes some of the first college enrollment indicators you will need for further analysis.

College enrollment data is obtained from the National Student Clearinghouse (NSC). NSC matches students from a file your agency sends, including student id, student name, high school from where the student graduated, graduation date, and some other variables. For more information on the NSC matching process and requirements, visit http: //www.studentclearinghouse.org/high_schools/studenttracker

To learn more about cleaning the NSC data and how to use NSC files, consult the NSC Missing Manual

The core of this task:

1. Rename the variables typically returned by NSC
2. Format the date values
3. Standardize the variables that reflect the type of college the student enrolls in
4. Create a college graduation indicator
5. Interpret the college enrollment status

6. Identify the first college the student attended

After this task, you will merge the `Student_NSC_Indicators` file onto the college-going analysis file from **Connect**. You will use this file and the high school graduation variables you will also create in **Connect** to then to generate further college-going variables, such as variables that indicating if a student enrolled in college the fall after graduation, enrolled in college a year after graduation, and persisted through subsequent years of college.

HOW TO START

To begin, open the `Student_NSC_Enrollment` file in R. This file contains data on college enrollment and persistence for students in your agency. If you do not have R, you can follow the steps of the task by looking at the instructions and data snippets we have provided.

If this is your first time attempting **Task 7**, start with the provided input file. This file teaches you SDP's cleaning methodology and allows you to check answers from a common dataset.

DATA DESCRIPTION

The input file, `Student_NSC_Enrollment`, follows the structure of `Student_NSC_Enrollment` in **Identify** so it is unique by `sid`, `college_code_branch`, `enrollment_begin`, and `enrollment_end`. This usually equates to a semester. Though the exact structure of the data you receive from NSC may vary, it will likely look something like this. The aim of this task then is to become familiar with the NSC data and start building college enrollment outcomes that will be expanded upon in **Connect**.

Uniqueness

This dataset matches the specification in Identify and is unique by `sid`, `college_code_branch`, `enrollment_begin`, and `enrollment_end`.

Clean

Step 0: Load the Student_NSC_Enrollment data file

```
#  Load the Student_NSC_Enrollment data file
# Read in Stata
library(haven) # required for .dta files
# To read data from a zip file we create a connection to the path of the
# zip file

tmpfileName <- "raw/Student_NSC_Enrollment.dta"
con <- unz(description = "data/raw.zip", filename = tmpfileName,
           open = "rb")
stunsc <- read_stata(con) # read data in the data subdirectory
close(con)
glimpse(stunsc)
```

```
Observations: 11,985
Variables: 15
$ sid                <dbl> 7, 10, 10, 10, 10, 10, 16, 20, 24, 24, 30, 33, ...
$ record_found_yn    <chr> "N", "Y", "Y", "Y", "Y", "Y", "Y", "Y", "Y", "Y...
$ enrollment_begin   <dbl> NaN, 20100109, 20090523, 20090110, 20090829, 20...
$ enrollment_end     <dbl> NaN, 20100503, 20090814, 20090505, 20091215, 20...
$ college_code_branch <chr> "", "746460-00", "746460-00", "746460-00", "746...
```

```
$ college_name        <chr> "", "COMMUNITY COLLEGE 400", "COMMUNITY COLLEGE...
$ college_state       <chr> "", "FL", "FL", "FL", "FL", "FL", "MA", "FL", "...
$ yr2_yr4             <chr> "", "2-year", "2-year", "2-year", "2-year", "2-...
$ public_private      <chr> "", "Public", "Public", "Public", "Public", "Pu...
$ enrollment_status   <chr> "", "L", "L", "H", "L", "F", "F", "W", "F", "F"...
$ graduated           <chr> "N", "N", "N", "N", "N", "N", "N", "N", "N", "N...
$ graduation_date     <dbl> NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, NaN, Na...
$ college_sequence    <dbl> NaN, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, ...
$ degree_title        <chr> "", "", "", "", "", "", "", "", "", "", "", "",...
$ major               <chr> "", "", "", "", "", "", "", "", "", "", "", "",...
```

Step 1: Rename variables and format them for analysis

```
#  Rename variables and format them for analysis

# Rename variables to indicate that they are NSC variables.
names(stunsc) <- c("sid", "n_record_found_yn", "n_enrollment_begin",
                   "n_enrollment_end", "n_college_opeid",
                   "n_college_name", "college_state","yr2_yr4",
                   "public_private", "n_enrollment_status",
                   "graduated", "n_degree_date",
                   "n_enrl_sequence", "degree_title", "major")

# Format the date values as dates.
library(lubridate)
stunsc <- as.data.frame(stunsc)

for(i in c("n_enrollment_begin", "n_enrollment_end",
           "n_degree_date")){
  stunsc[, i] <- lubridate::ymd(as.character(stunsc[, i]))
}

stunsc %>% filter(sid == 13047) %>%
  select(sid, n_record_found_yn, n_enrollment_begin,
         n_enrollment_end, n_college_name, yr2_yr4,
         public_private, n_enrollment_status, graduated)
```

```
    sid n_record_found_yn n_enrollment_begin n_enrollment_end
1 13047                 Y         2009-01-10       2009-05-05
2 13047                 Y         2008-08-30       2008-12-17
3 13047                 Y         2009-08-29       2009-12-15
4 13047                 Y         2008-08-30       2008-12-16
       n_college_name yr2_yr4 public_private n_enrollment_status graduated
1 B COMMUNITY COLLEGE  2-year         Public                   F         N
2     UNIVERSITY OF B  4-year        Private                   F         N
3 B COMMUNITY COLLEGE  2-year         Public                   H         N
4 B COMMUNITY COLLEGE  2-year         Public                   H         N
```

```
#  Drop missing
stunsc %<>% filter(stunsc$college_state != "")

#  Standardize types of college by:
#  2-year and 4-year college
stunsc$n_college_4yr <- ifelse(stunsc$yr2_yr4 == "4-year", 1, 0)
stunsc$n_college_2yr <- ifelse(stunsc$yr2_yr4 == "2-year" |
```

```
                                stunsc$yr2_yr4 == "Less Than 2 Years",
                              1, 0)
stunsc$yr2_yr4 <- NULL

# Public and private college
table(stunsc$public_private)
```

```
Private  Public
   2660    8237
```

```
stunsc$n_college_public <- ifelse(stunsc$public_private == "Public", 1, 0)
stunsc$n_college_private <- ifelse(stunsc$public_private == "Private", 1, 0)
stunsc$public_private <- NULL

# In-state and out-of-state college
table(stunsc$college_state)
```

```
  CA   FL   IL   MA   NY   TX
1915 1905 1683 1865 1779 1750
```

```
stunsc$n_college_instate <- ifelse(stunsc$college_state == "MA", 1, 0)
stunsc$n_college_outstate <- ifelse(stunsc$college_state != "MA", 1, 0)
stunsc$college_state <- NULL

# Create a college graduation indicator.
stunsc$n_degree <- ifelse(stunsc$graduated == "Y", 1, 0)
stunsc$graduated <- NULL

# Interpret enrollment status.
table(stunsc$n_enrollment_status)
```

```
       F    H    L    W
  30 8693 1350  551  273
```

```
stunsc$n_enrl_status <- factor(stunsc$n_enrollment_status,
                               levels = c("F", "H", "L", "W",
                                          "A", "D"))
stunsc$n_enrollment_status <- NULL
```

For enrollment status, the following labels apply:

- "F" = full time
- "H" = half time
- "L" = less than half time
- "W" = withdrew
- "A" = leave of absence
- "D" = deceased

Step 2: Identify first college attended by type

Identify first college attended by type (any, 4-year and 2-year) that didn't result in a withdrawal.

```
#  Identify first college attended by type (any, 4-year and 2-year)
#  that didn't result in a withdrawal.
```

```
#  Calculate the days enrolled.
stunsc$days_enrolled <- stunsc$n_enrollment_end - stunsc$n_enrollment_begin

# Identify the first college a student enrolled in by type
# (any, 2-year, and 4-year).
stunsc %>% filter(sid == 13047) %>%
  select(sid, n_record_found_yn, n_enrollment_begin,
         n_enrollment_end, n_college_name,
         n_enrl_status, n_college_4yr, n_college_2yr)
```

```
    sid n_record_found_yn n_enrollment_begin n_enrollment_end
1 13047                 Y         2009-01-10       2009-05-05
2 13047                 Y         2008-08-30       2008-12-17
3 13047                 Y         2009-08-29       2009-12-15
4 13047                 Y         2008-08-30       2008-12-16
       n_college_name n_enrl_status n_college_4yr n_college_2yr
1 B COMMUNITY COLLEGE             F             0             1
2     UNIVERSITY OF B             F             1             0
3 B COMMUNITY COLLEGE             H             0             1
4 B COMMUNITY COLLEGE             H             0             1
```

```
# Create a status flag variable that indicates minimum of partial enrollment
stunsc %<>% group_by(sid) %>%
  mutate(flag_status = ifelse(n_enrl_status %in% c("F", "H", "L"), 1, 0))

stunsc %>% filter(sid == 13047) %>%
  select(sid, n_record_found_yn, n_enrollment_begin,
         n_enrollment_end, n_college_name,
         n_enrl_status, n_college_4yr, n_college_2yr, flag_status)
```

```
Source: local data frame [4 x 9]
Groups: sid [1]

    sid n_record_found_yn n_enrollment_begin n_enrollment_end
  <dbl>             <chr>             <date>           <date>
1 13047                 Y         2009-01-10       2009-05-05
2 13047                 Y         2008-08-30       2008-12-17
3 13047                 Y         2009-08-29       2009-12-15
4 13047                 Y         2008-08-30       2008-12-16
# ... with 5 more variables: n_college_name <chr>, n_enrl_status <fctr>,
#   n_college_4yr <dbl>, n_college_2yr <dbl>, flag_status <dbl>
```

```
# In this block of code we are picking the first enrollment date for each of the
# types of schools (4yr, 2yr, any) that is enrolled at all (at least partial),
# and picking the first date that meets the status requirement

stunsc %<>% group_by(sid) %>%
  arrange(sid, n_enrollment_begin, n_enrl_status, days_enrolled) %>%
  mutate(first_enr_date_4yr = n_enrollment_begin[flag_status > 0
                                                 & n_college_4yr == 1][1]) %>%
  mutate(first_enr_date_2yr = n_enrollment_begin[flag_status > 0
                                                 & n_college_2yr == 1][1]) %>%
  mutate(first_enr_date_any = n_enrollment_begin[flag_status > 0][1])
```

```
stunsc %>% filter(sid == 13047) %>%
  select(sid,n_enrollment_begin,
         n_enrollment_end,
         n_enrl_status, n_college_4yr, n_college_2yr, flag_status,
         first_enr_date_2yr, first_enr_date_4yr,
         first_enr_date_any) %>% as.data.frame
```

```
    sid n_enrollment_begin n_enrollment_end n_enrl_status n_college_4yr
1 13047         2008-08-30       2008-12-17             F             1
2 13047         2008-08-30       2008-12-16             H             0
3 13047         2009-01-10       2009-05-05             F             0
4 13047         2009-08-29       2009-12-15             H             0
  n_college_2yr flag_status first_enr_date_2yr first_enr_date_4yr
1             0           1         2008-08-30         2008-08-30
2             1           1         2008-08-30         2008-08-30
3             1           1         2008-08-30         2008-08-30
4             1           1         2008-08-30         2008-08-30
  first_enr_date_any
1         2008-08-30
2         2008-08-30
3         2008-08-30
4         2008-08-30
```

```
stunsc %>% filter(sid == 13047) %>%
  select(sid, n_college_opeid,
         n_enrl_status, n_college_4yr, n_college_2yr, flag_status,
         first_enr_date_2yr, first_enr_date_4yr,
         first_enr_date_any) %>% as.data.frame
```

```
    sid n_college_opeid n_enrl_status n_college_4yr n_college_2yr flag_status
1 13047       416739-00             F             1             0           1
2 13047       164039-00             H             0             1           1
3 13047       164039-00             F             0             1           1
4 13047       164039-00             H             0             1           1
  first_enr_date_2yr first_enr_date_4yr first_enr_date_any
1         2008-08-30         2008-08-30         2008-08-30
2         2008-08-30         2008-08-30         2008-08-30
3         2008-08-30         2008-08-30         2008-08-30
4         2008-08-30         2008-08-30         2008-08-30
```

```
# Here we are breaking ties by first picking the highest enrollment status,
# and in the case of a tie there, picking days enrolled

stunsc %<>% group_by(sid) %>%
  arrange(sid, desc(n_enrl_status), desc(days_enrolled)) %>%
    mutate(first_college_any_opeid = n_college_opeid[first_enr_date_any ==
                                                       n_enrollment_begin][1],
           first_college_4yr_opeid = n_college_opeid[first_enr_date_4yr ==
                                      n_enrollment_begin & n_college_4yr > 0][1],
           first_college_2yr_opeid = n_college_opeid[first_enr_date_2yr ==
                                     n_enrollment_begin & n_college_2yr > 0][1]) %>%
  ungroup

# Get the college name and id for the first enrollment date
```

```
stunsc %>% filter(sid == 13047) %>%
  select(sid, n_college_opeid,
         n_enrl_status, n_college_4yr, n_college_2yr,
         first_enr_date_2yr, first_enr_date_4yr,
         first_enr_date_any,
         first_college_any_opeid,
         first_college_4yr_opeid, first_college_2yr_opeid) %>% as.data.frame
```

```
    sid n_college_opeid n_enrl_status n_college_4yr n_college_2yr
1 13047       164039-00             H             0             1
2 13047       164039-00             H             0             1
3 13047       164039-00             F             0             1
4 13047       416739-00             F             1             0
  first_enr_date_2yr first_enr_date_4yr first_enr_date_any
1         2008-08-30         2008-08-30         2008-08-30
2         2008-08-30         2008-08-30         2008-08-30
3         2008-08-30         2008-08-30         2008-08-30
4         2008-08-30         2008-08-30         2008-08-30
  first_college_any_opeid first_college_4yr_opeid first_college_2yr_opeid
1               164039-00               416739-00               164039-00
2               164039-00               416739-00               164039-00
3               164039-00               416739-00               164039-00
4               164039-00               416739-00               164039-00
```

Step 3: Drop any unneeded variables, and save the file

```
#  Drop the unneeded variables
# drop temp* nvals* days_enrolled
stunsc$flag_status <- NULL

#  Sort the data
stunsc %<>% ungroup() %>%
  arrange(sid, n_enrollment_begin)

#  Save the current file as Student_NSC_Enrollment_Indicators.dta
#  Make directory and save
# dir.create("clean")
# save(stunsc, file = "clean/Student_NSC_Enrollment_Indicators.rda")
#  Or if you want to save the Stata file
# write_dta(stunsc, file = "clean/Student_NSC_Enrollment_Indicators.dta")
```

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