SAS: An Introduction

What is SAS

- It is a Statistical Analysis System, a programming language composed of statements that specify how data to be processed and analyzed.

- A SAS program consists of a sequence of SAS statements grouped together into blocks, referred to as steps.
- SAS has **TWO** major steps:
  - Data steps: any portion of a SAS program that begins with a DATA statement and ends with a RUN statement is called a DATA Step.

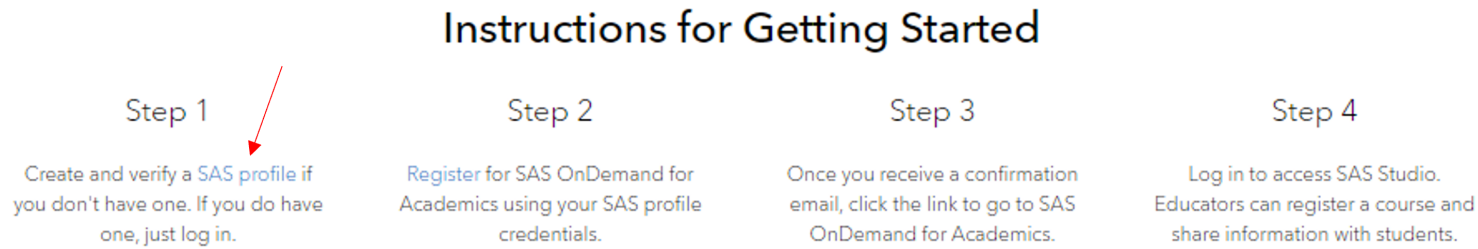
  - PROC Steps (Procedures): Any portion of a SAS program that begins with a PROC statement and ends with a RUN statement is called a PROC Step or Procedures.

- PROC steps are in-built programs that allow us to analyze the data contained in a SAS data set. PROC steps are used to calculate descriptive statistics, to generate summary reports, and to create summary graphs and charts.

Registering SAS OnDemand Account

- Purchasing SAS is expensive, however, there is a free version.
- There are few steps as instructed here: `https://www.sas.com/en_in/software/on-demand-for-academics/references/getting-started-with-sas-ondemand-for-academics-studio.html`.

  Scroll down and click on the link given:



You will be directed to:

`https://www.sas.com/profile/ui/#/create`

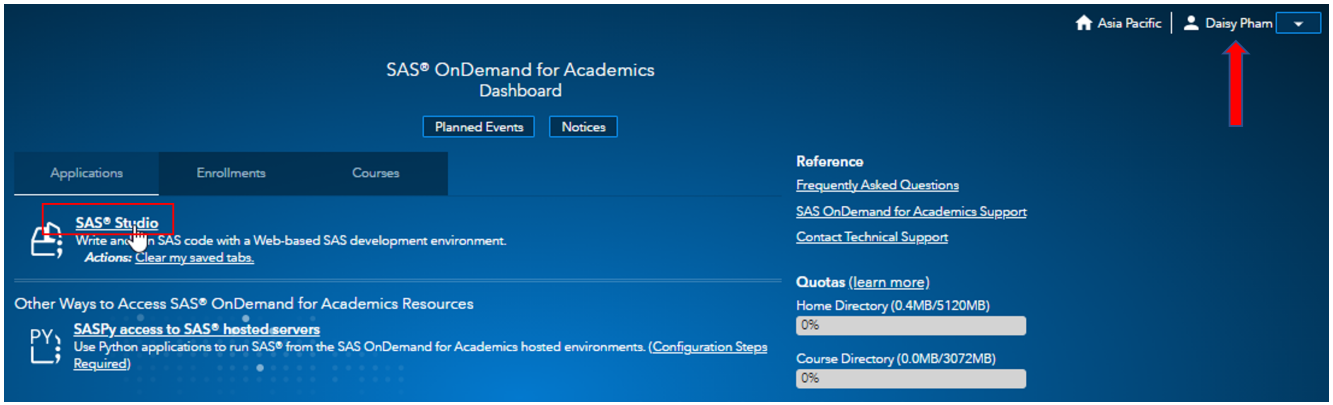
to creat your own profile.

SAS Starting

After creating your own profile, you can follow the steps given. An email will be sent to your registered email which gives you the link

`https://welcome.oda.sas.com`

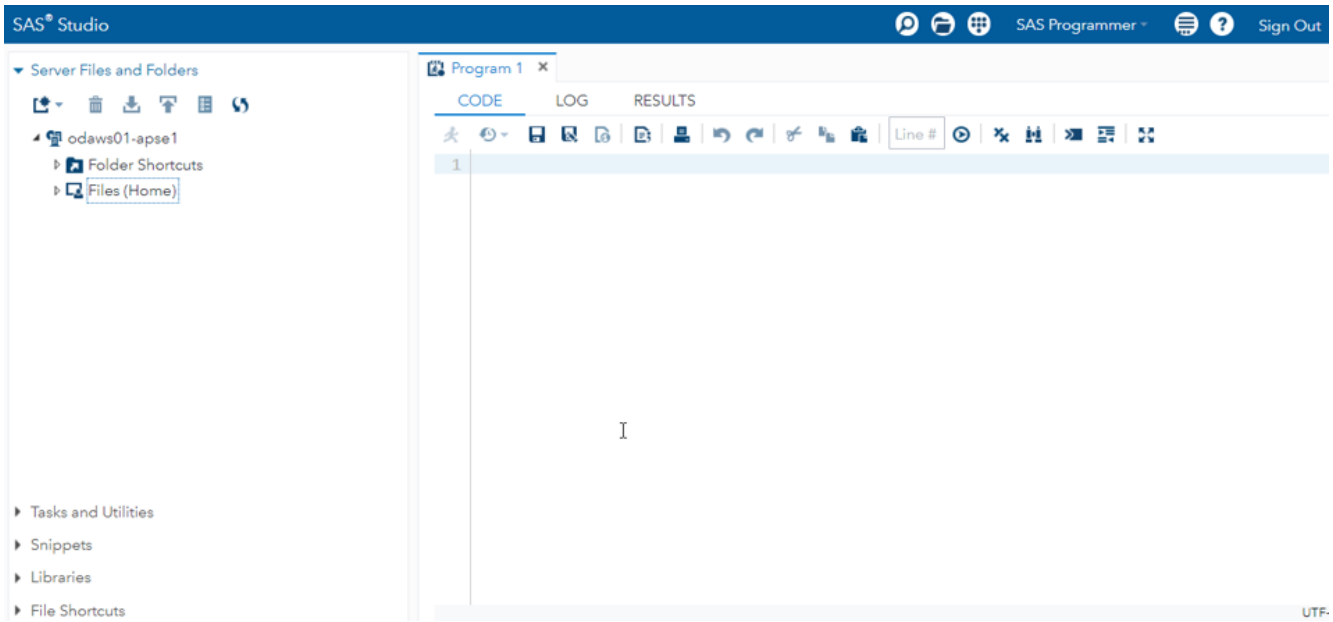
Open the link, you will have



Click “SAS Studio”.

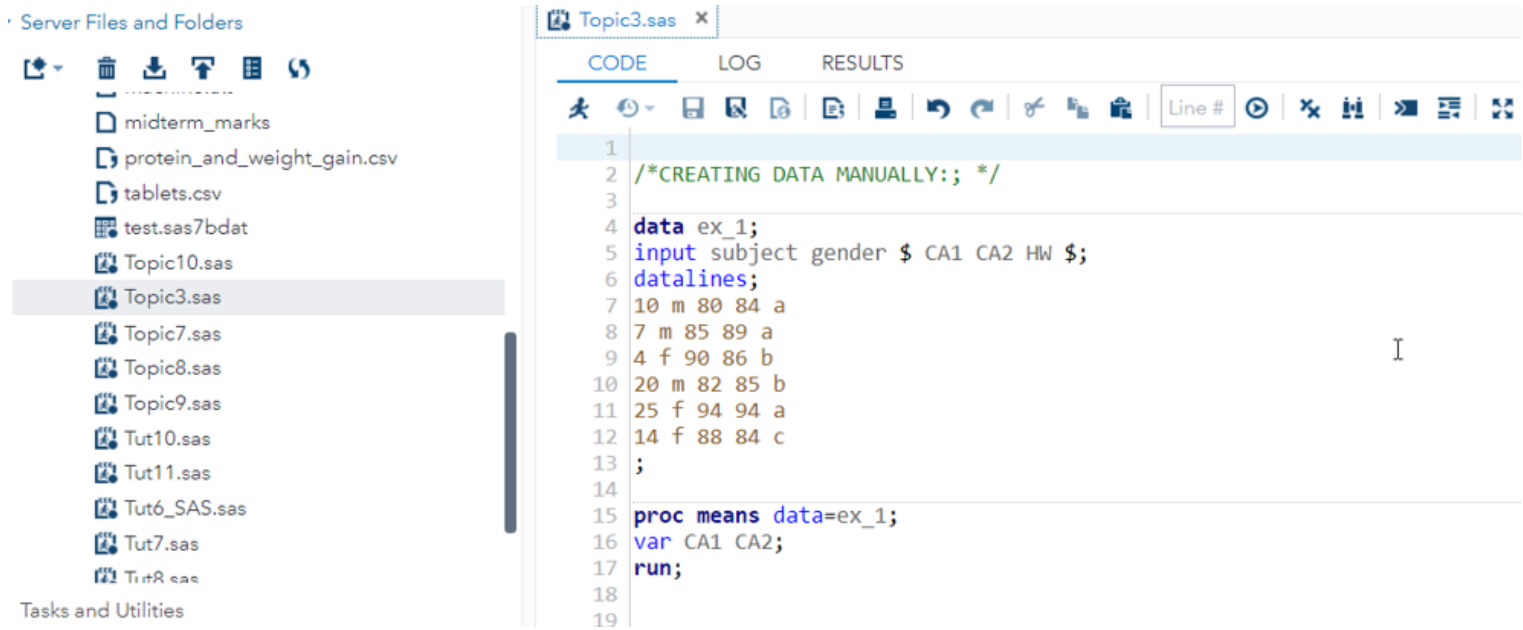
SAS Studio

You should see the window where we can start to write the code, or upload files.



An Easy Example (1)

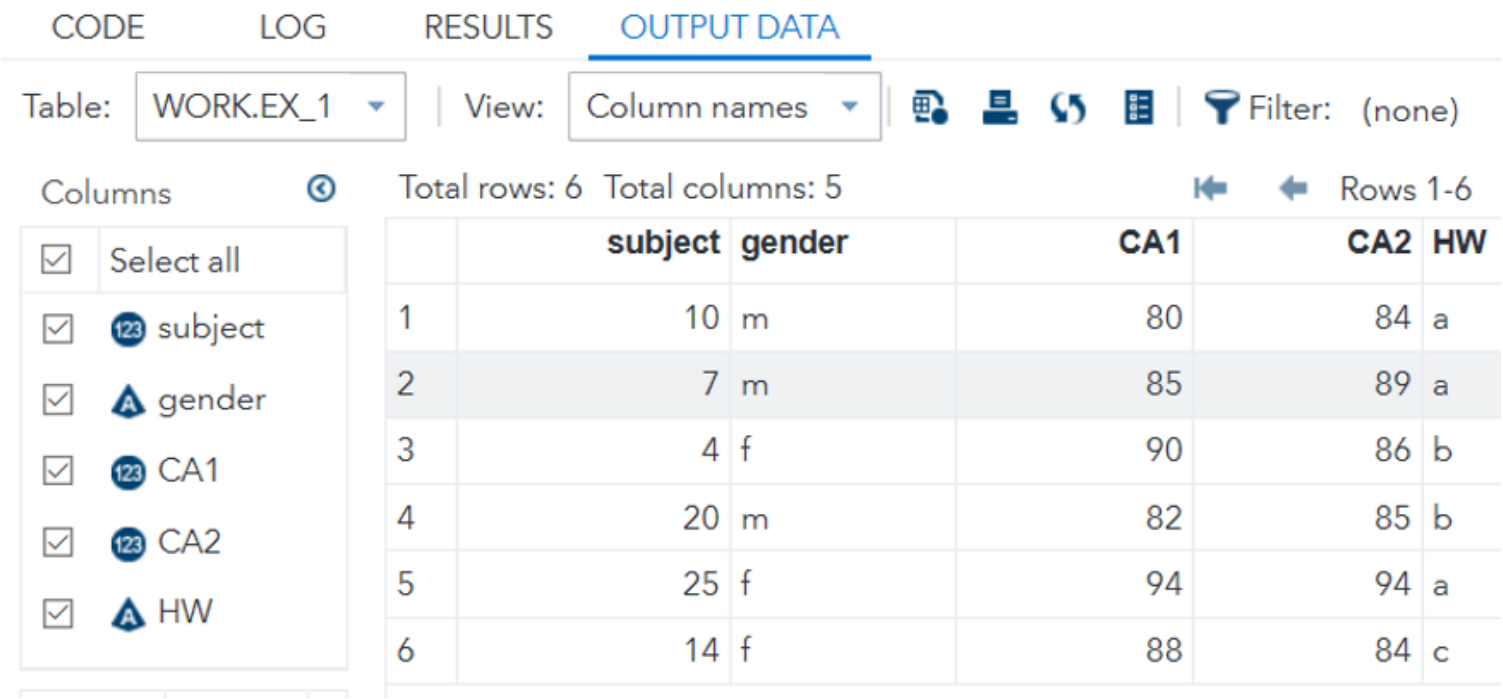
Few lines of code to create a dataset (manually) and derive simple descriptive statistics.



Click the "running man" to run the code.

An Easy Example (2)

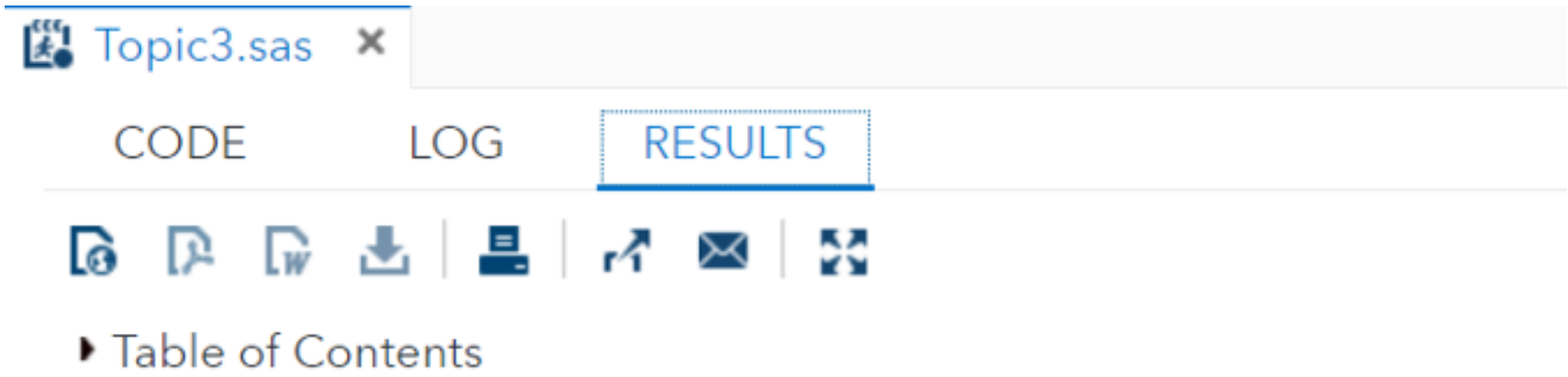
The output for data:



	subject	gender	CA1	CA2	HW
1	10	m	80	84	a
2	7	m	85	89	a
3	4	f	90	86	b
4	20	m	82	85	b
5	25	f	94	94	a
6	14	f	88	84	c

An Easy Example (3)

The results of running the code:



The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
CA1	6	86.5000000	5.2057660	80.0000000	94.0000000
CA2	6	87.0000000	3.8987177	84.0000000	94.0000000

Some Basic SAS Program Rules (1)

Rules for SAS statements:

- All SAS statements (except those containing data) must end with a semicolon (;).
- SAS statements typically begin with a SAS keyword. (DATA, PROC).
- SAS statements are not case sensitive, that is, they can be entered in lowercase, uppercase, or a mixture of the two.
  Example : SAS keywords (DATA, PROC) are not case sensitive
- A delimited comment begins with a forward slash-asterisk (/*) and ends with an asterisk-forward slash (*/). All text within the delimiters is ignored by SAS.

Some Basic SAS Program Rules (2)

Rules for SAS names:

- All names must contain between 1 and 32 characters.
- The first character appearing in a name must be a letter (A, B, ...Z, a, b, ... z) or an underscore (_). Subsequent characters must be letters, numbers, or underscores. That is, no other characters, such as $, %, or & are permitted. Blanks also cannot appear in SAS names.
- SAS names are not case sensitive, that is, they can be entered in lowercase, uppercase, or a mixture of the two. (SAS is only case sensitive within quotation marks.)

Rules for SAS variables:

- If the variable in the INPUT statement is followed by a dollar sign ($), SAS assumes this is a character variable. Otherwise, the variable is considered as a numeric variable.

General Form of a DATA Step

data data_set_name;
input variables;
datalines;
the lines of data
;
run;

Input Format (Free Format)

For the **free format**: the code as in the photo in slide 8 is an example.

- The "$" sign implies that the variable right before it is a character variable.

- Can use "." for a missing value.

Input Format (Fixed Format)

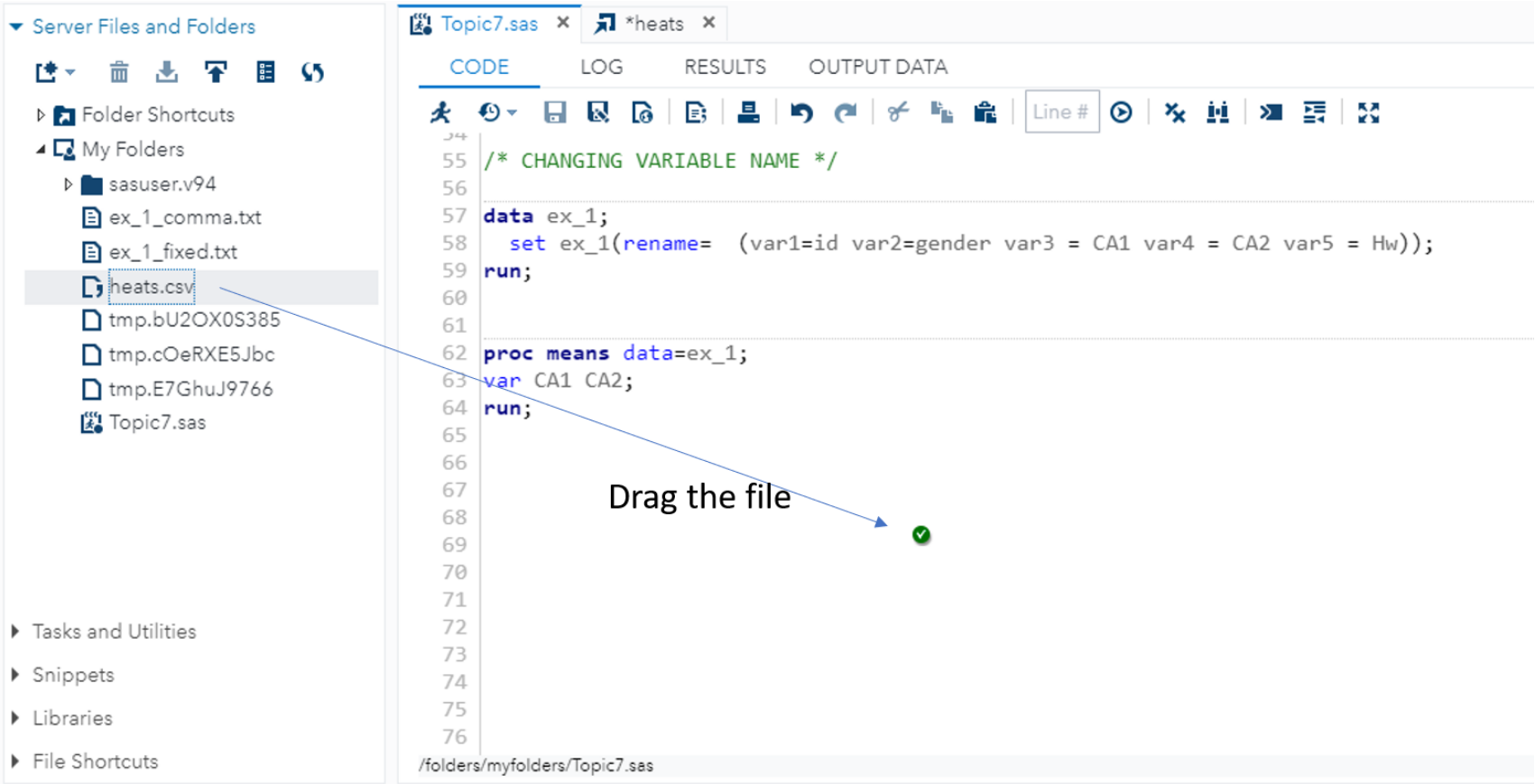
- For manually creating a **fixed format** data, the code below is an example.
  data ex_1_fix;
  input subject 1-2 gender $ 3 CA1 5-6 CA2 8-9 HW $ 10;
  datalines;
  10m 80 84a
  7 m 85 89a
  14f 88 84c
  ⋮
- In the chunk of code above, subject's value take the first two positions/columns; gender's value is at the third position/column and it is a categorical variable. The 4th position/column is a space,...

Reading Data Files (1)

Most of us are using SAS studio, watching the video in the link below to know how to import an external data file to SAS studio.

`https://video.sas.com/detail/video/4664358166001/using-the-import-data-utility-in-sas-studio`

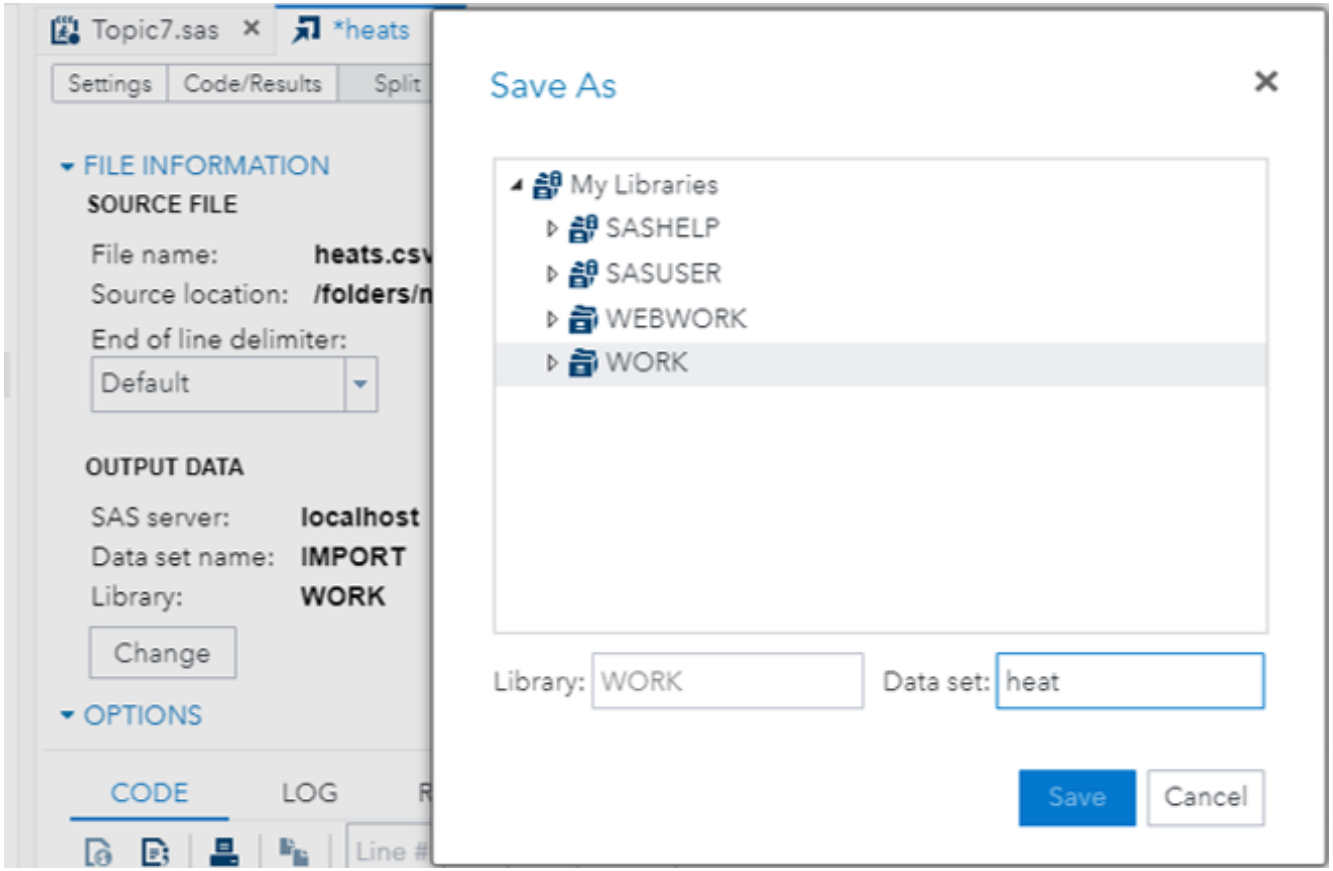
Reading Data Files (2)



Drag the file that you want to open to the code window.

Reading Data Files (3)

- After the data file that you want to open is dragged and dropped into the code window, then a new window (which has the name as the name of the file) will open, it has the code for how to import this data file. You can import the file from this window or copy the code to open the file.



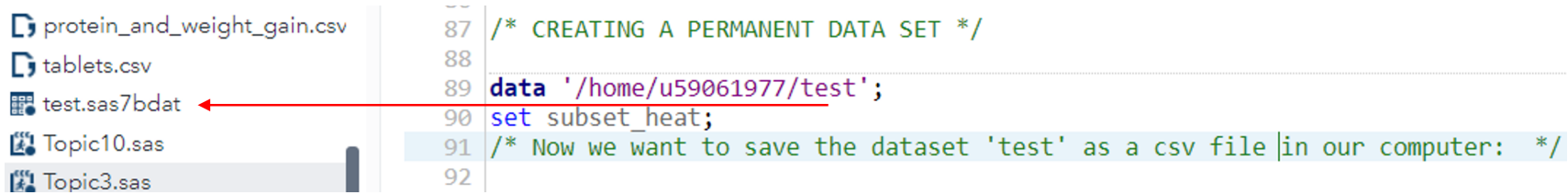
Reading Data Files (4)

- The SAS data set will be created under the name "heat" in the Work directory.
- The SAS data sets in the Work directory are temporary and will be lost once we logoff the SAS studio session.

```
FILENAME REFFILE '/home/u59061977/heats.csv';

PROC IMPORT DATAFILE=REFFILE
    DBMS=CSV
    OUT=WORK.heat;
    GETNAMES=YES; /* this will set the name for the variable/columns as the same as in
RUN;

PROC CONTENTS DATA=WORK.heat; RUN;

proc means data = heat;
var heat;
run;
```

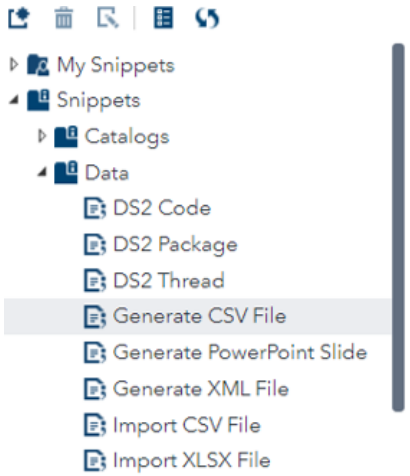
Saving Data

To create a permanent dataset:



Saving Data as a CSV File

After creating the permanent dataset named 'test' in SAS, now we want to save it as a csv file in our computer: (1) click "Generate CSV File" and (2) make necessary changes acordingly, then (3) run.




```
89  data '/home/u59061977/test';
90  set subset_heat;
91  /* Now we want to save the dataset 'test' as a csv file in our computer:  */
92
93  libname example '/home/u59061977';
94  run;
95
96  proc export data=example.test
97              outfile=_dataout
98              dbms=csv replace;
99  run;
100
101 %let _DATAOUT_MIME_TYPE=text/csv;
102 %let _DATAOUT_NAME=test.csv;
103
104 /* Click 'Open', then a file name test.csv has saved to your computer */
105 /* this file test.csv has variable 'heat' with 15 observations > 135 */
```

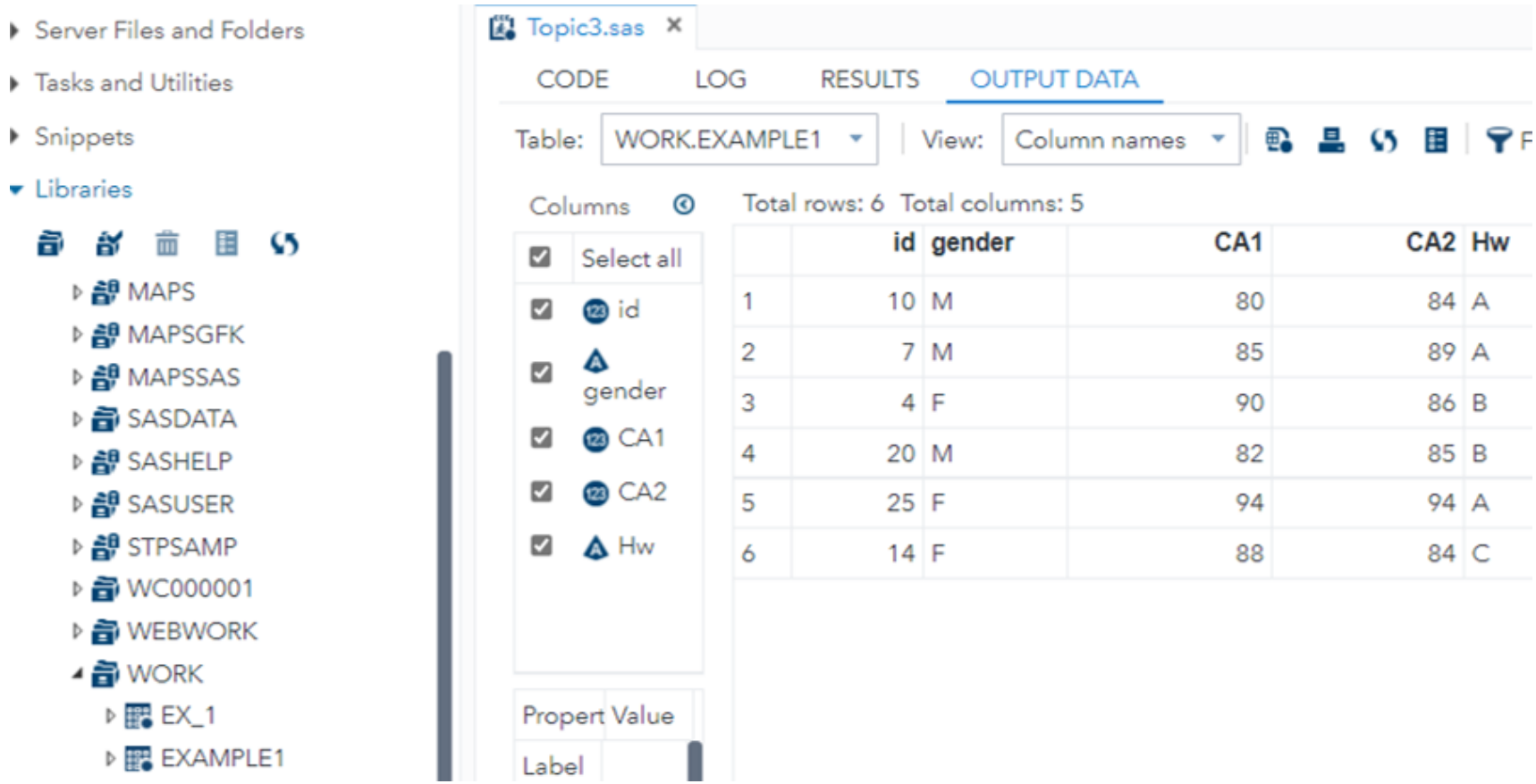
You can read from the link below:
`https://communities.sas.com/t5/SAS-Communities-Library/How-to-Export-SAS-Datasets-as-a-CSV-File-in-SAS-University/ta-p/441569`

Keeping a Subset of Variables (1)

- Consider data set "ex_1_comma.txt" which has 6 observations, 5 variables of: subjects, gender, CA1, CA2 and HW but there is no name given in this data set.
- Reading data set "ex_1_comma.txt" into SAS and set the name for this dataset as "example1" and name these variables as: id, gender, CA1, CA2 and HW.

```
* IMPORTING DATA FROM A TEXT FILE:;

FILENAME REFFILE '/home/u59061977/ex_1_comma.txt';

PROC IMPORT DATAFILE=REFFILE
    DBMS=DLM
    OUT=WORK.example1;
    DELIMITER=",";
    GETNAMES=NO; /*  the given dataset doesnot have any variable name */
    DATAROW=1;
RUN;

/* CHANGING VARIABLE NAMES */

data example1;
  set example1(rename=  (var1=id var2=gender var3 = CA1 var4 = CA2 var5 = Hw));
run;
```

Keeping a Subset of Variables (2)



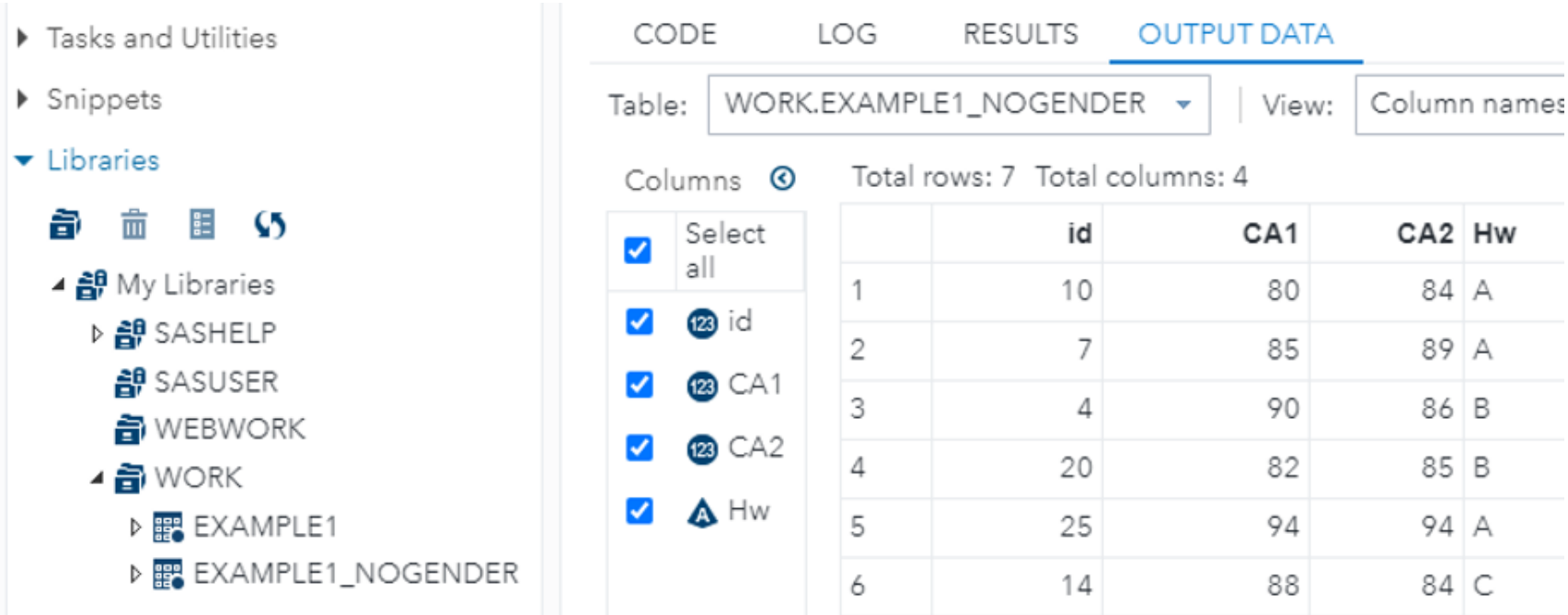
Now, from this data set "example1", we want to keep 4 variables, and discard gender.

Keeping a Subset of Variables (3)

We use the code:

```
data example1_nogender;
set example1;
keep id CA1 CA2 HW;
run;
```

Then a new dataset "example1_nogender" will be created in Work directory which has 4 variables except 'gender'.



Dropping a Subset of Variables

Suppose we want to drop the variable 'id' from the data set.

```
data example1_drop_id;
set example1;
drop id;
run;
```

Then a new dataset "example1_drop_id" will be created in Work directory which has 4 variables except 'id'.

Concatenating Datasets

Suppose we have a dataset for male (e.g. `example1_m` and a dataset for female (e.g. example1_f) from the original dataset "example1". We need to combine the two datasets (by rows/observations) to do analysis, then we use the code:

```
data example1_concat;
set example1_m example1_f;
run;
```

Match Merging Datasets

- A dataset "example1_nogender" that consists of 4 variables: id, CA1, CA2 and HW.
- Another dataset "example1_drop_id" that consists of 4 variables: gender, CA1, CA2 and HW. The values of variables in this dataset come from the same subjects in "example1_nogender", respectivelly.
- We want to merge these two datasets into one.

Sort "example1_nogender" by a common variable, 'CA1':

```
proc sort data = example1_nogender;
by CA1;
```

Sort "example1_drop_id" by the common variable 'CA1':

```
proc sort data = example1_drop_id;
by CA1;
```

Merging these two datasets, the new dataset is named as "example1_merge".

```
data example1_merge;
merge example1_drop_id example1_nogender;
by CA1;
run;
```

Transforming Data and Creating a New Variable

- A new variable 'ave_mark' is created, which is the average mark of CA1 and CA2.

- Another variable 'final_grade' is defined as: if 'ave_mark' is at least 90 and HW is grade A then final grade is A; if 'ave_mark' is at least 85 and HW is grade A or B the final grade is B; otherwise the final grade is C.

```
*   TRANSFORMING DATA:   ;

data example1_transf;          <-- New dataset
set example1;                  <-- Original dataset
ave_mark= (CA1 + CA2)/2;       <-- New variable
if HW = "." then final_grade= "";
else if ave_mark >= 90 and HW = "A" then final_grade = "A";
else if ave_mark >= 85 and (HW = "A" or HW= "B") then final_grade= "B";
else final_grade= "C";
run;
```

Give Rank to a Sorted Data

- Dataset "example1_transf" has variable 'ave_mark'.
- We want to give rank to students based on this variable 'ave_mark'.

```
proc sort data = example1_transf;
by descending ave_mark;
data example1_rank;
set example1_transf;
rank = _n_;
run;
```

Total rows: 6 Total columns: 8 Rows 1-6

id	gender	CA1	CA2	Hw	ave_mark	final_grade	rank
25	F	94	94	A	94	A	1
4	F	90	86	B	88	B	2
7	M	85	89	A	87	B	3
14	F	88	84	C	86	C	4
20	M	82	85	B	83.5	C	5
10	M	80	84	A	82	C	6

The General Form of a do Loop

```
do <index variable> = <beginning number> to <ending number>;
statements;
end;
```

An example:

- There are 15 observations, where measurements 'y' is a scale; first factor (categorical variable) has 3 outcomes, denoted as 1,2 and 3;
- Second factor has 5 outcomes denoted as 1,2,3,4 and 5.

An Example of do Loop (1)

```
data exdo;
do factora = 1 to 3;
    do factorb = 1 to 5;
        input y @ @;
        output;
    end;
end;
datalines;
22 24 16 18 19
15 21 26 16 25
14 28 21 19 24
run;
```

First variable with 3 outcomes

Second variable with 5 outcomes

3rd variable, needs to key in values

An Example of do Loop (2)

The output is

Total rows: 15 Total columns: 3

	factora	factorb	y
1	1	1	22
2	1	2	24
3	1	3	16
4	1	4	18
5	1	5	19
6	2	1	15
7	2	2	21
8	2	3	26
9	2	4	16
10	2	5	25
11	3	1	14
12	3	2	28
13	3	3	21
14	3	4	19
15	3	5	24

Functions Defined by Users

Creating and calling functions in SAS is not as straight forward as in R or Python. You can read about functions defined by user in the link given below:

`https://documentation.sas.com/?docsetId=proc&docsetTarget=n0pio2crltpr35n1ny010zrfbvc9.htm&docsetVersion=9.4&locale=en`

After opeing the link and read the overview, you can read the continued parts (in the left panel), like concepts, usage, examples, etc.