



Practical SAS Programming

LIVE PROJECTS, REAL DATASETS, CASE
STUDIES AND PRACTICAL EXAMPLES

What is SAS?

SAS is one of the world's fastest and powerful software for data manipulation and statistical analysis.

It can perform the following tasks –

- ✓ It allows you to enter, retrieve and manage your data easily
- ✓ It can read data from various external sources (Excel, CSV, Text files, Databases, Webpage etc.)
- ✓ You can explore and manipulate data in SAS.
- ✓ It can analyse your data statistically and mathematically. Includes various statistical techniques.
- ✓ It can generate beautiful graphs and tables.
- ✓ You can run SQL queries on SAS datasets.
- ✓ You can automate repetitive tasks with SAS Macros.
- ✓ It can develop entirely new software applications.

Knowing SAS is an asset due to the following reasons -

- ✓ SAS has over 40,000 customers worldwide
- ✓ Over 90% of the top 100 global banks use SAS
- ✓ SAS has been recognised as a leader in advanced analytics according to 2017 Gartner report
- ✓ According to a massive study from MONEY and Payscale.com, SAS Analytics skills are the most valuable skills to have in today's job market.

Can I learn SAS?

Prerequisites to learn SAS

- ✓ Hard work
- ✓ Passion for learning

How to learn SAS Programming Faster

1. Learn by doing

The best way to learn how to program is by doing it. It's easy to spend hours reading about syntax, but computer languages like human languages require you to use them in order to understand them.

2. Google Is your Friend

If a particular concept doesn't make sense, be it on any site, in a textbook, or during class lecture, maintain your confidence and look for alternate online resources to learn the same content.

3. Don't be afraid to ask a question

There is no such thing as a stupid question.

What SAS stands for?



SAS Stands for **NOTHING**

In 1980s, 1990s and early 2000,
SAS was an abbreviation of 'Statistical Analysis System'.

At the present time,
Officially there is no full form of SAS. It's just SAS!

You might wonder why SAS institute did this and what would make this any difference. There are a lot of stories related to it.

One of the most popular one is SAS institute offers various analytics and business intelligence tools nowadays so they don't want their name to be restricted to only Statistics.



CHAPTER ONE

Get Free SAS Access



ARE YOU READY?

- A PUBLICATION OF LISTENDATA.COM -

01. Get Free SAS Copy Today



Accessing SAS was never so Easy!

SAS offers students, individual learners, instructors and researchers free access to SAS software. In short, free version of SAS software is available for every other use than commercial. **Two free software options are as follows -**

SAS OnDemand for Academics	SAS University Edition
Absolutely FREE	Absolutely FREE
No Installation Required	Installation Required
Internet Required	No Internet Required
Access from anywhere	Access where setup
Up to 5GB data storage.	Unlimited data storage



SAS OnDemand for Academics supports more modules than SAS University Edition. And it is complex to install SAS University Edition on 32bit operating systems. I personally prefer OnDemand for Academics over University Edition as it takes less than 5 minutes to set up.

SAS OnDemand for Academics

We can get SAS software for free by just registering to **SAS OnDemand for Academics software**. No installation is required for it and it's available for everyone .

Important Points

- Internet required to access the software
- Includes almost all SAS modules. It's a complete software!
- Can import your external files
- Ability to handle medium sized data files

The steps to register for SAS OnDemand for Academics software are as follows –

1. Visit the [SAS OnDemand for Academics registration page](#).
2. Enter your **First Name, Last Name, and Email Address** in the form. Select the **Country** in which you reside. Click Submit.
3. You will receive an email from SAS with the link to activate your profile.
4. If you are a new user, enter your **Email address** and **password**. Accept the license agreement and then click **Create Account**. If you are not a new user (already SAS Profile) and you have a user ID and SAS profile password. Accept the license agreement. Click **Continue**.
5. You will get an email with the subject '**You are ready to start using SAS OnDemand for Academics**' and user id. Click on the link specified in the email.
6. Enter your user id and password to log in to the software.

SAS OnDemand for Academics

Applications

[SAS® Studio](#) ← *Click on this link*

Write and run SAS code with a Web-based SAS development environment.

*Program 1

CODE LOG RESULTS OUTPUT DATA

```
1 data temp;
2 input x;
3 cards;
4 1
5 2
6 3;
7 run;
```

System Requirements

Since it runs on cloud, it requires a web browser. The following web browsers are supported :

- ✓ Microsoft Internet Explorer 9+
- ✓ Mozilla Firefox 14+
- ✓ Google Chrome 21+
- ✓ Apple Safari 5+

Support

If you face any issue(s) related to the software, you can write an email to SASAnalyticsU@sas.com

SAS University Edition

Alternatively you can also install SAS University Edition on your computer. SAS university edition is also free.

Important points:

- ✓ Unlimited data storage
- ✓ Works even without internet connection
- ✓ Import and export data to your local system
- ✓ Ability to handle large size datasets

Note : We have come across situation where SAS OnDemand is down due to server maintenance, You can make use of the SAS University edition on your computer.

Before you download SAS University Edition, you need to meet minimum system requirement:

- ✓ 64 bit Hardware with minimum 1 GB Ram
- ✓ Latest Operating System (Windows 7 or later, Mac OS 10.8 or later)

One of the following browsers:

- ✓ Microsoft Internet Explorer 9+
- ✓ Mozilla Firefox 14+
- ✓ Google Chrome 21+
- ✓ Apple Safari 5+

SAS University Edition

Steps to download and Install SAS University Edition are as follows –

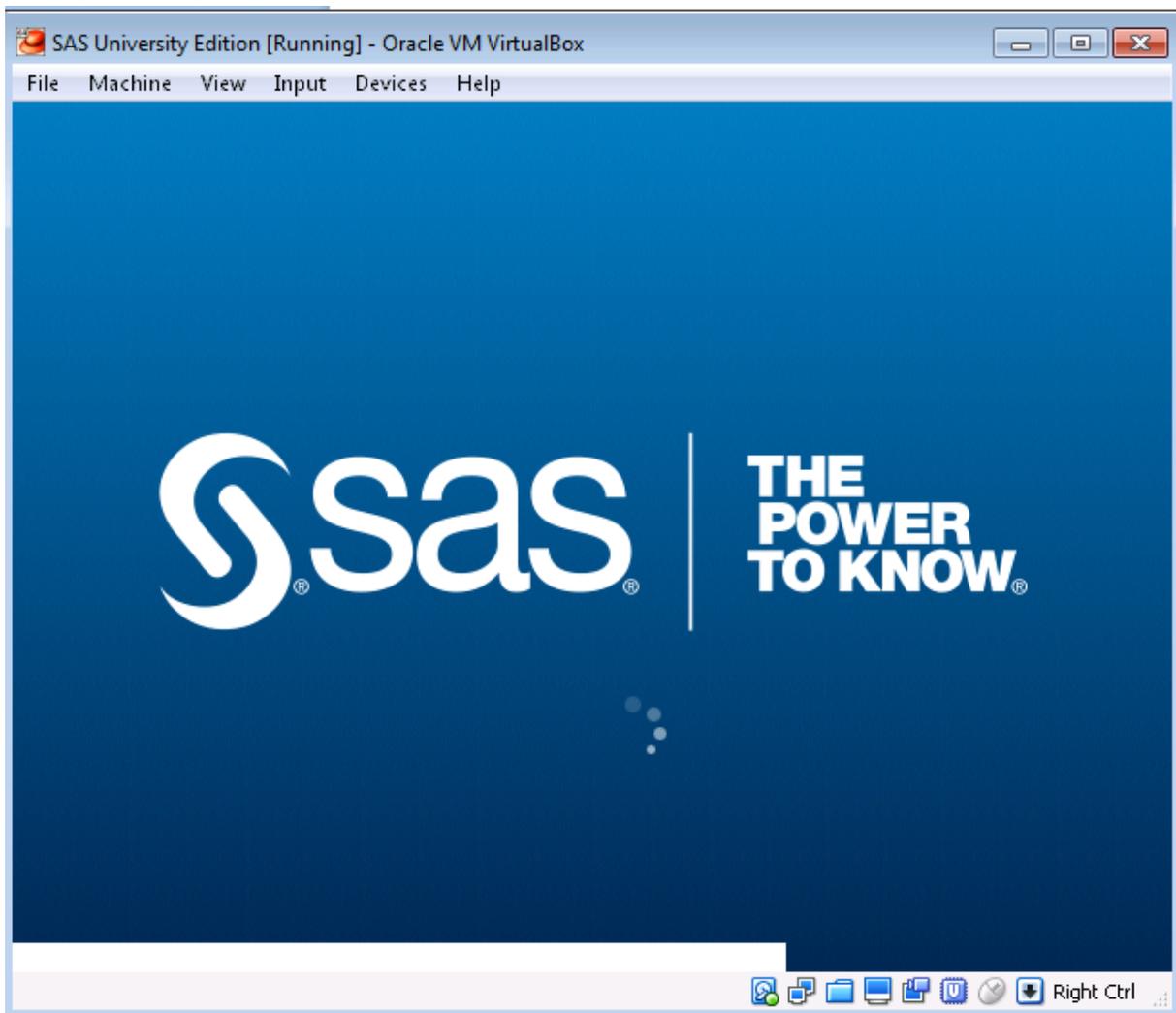
1. In order to install SAS University Edition, You need to download [Oracle VirtualBox](#).
2. Please download the Oracle VirtualBox based on the operating system on your computer. Once download is completed, please install Oracle VirtualBox.
3. Next you need to download [SAS University Edition vApp](#). Please note this is a large File (Around 2GB), It might take some time for you.
4. After your download is completed, you need add SAS University Edition vApp to Oracle VirtualBox.
 1. Launch the VirtualBox App
 2. Select File and then Import Appliance
 3. Select the location where you have downloaded SAS University Edition vApp . In most of the cases it will be download folder on your computer
 4. Click Next & then Import
5. You need to create a folder on your computer where you can save your SAS programs, data & results.
 1. On your local computer create a folder **SASUniversityEdition** (location you can remember) and subfolder called **myfolders**.
 2. Once done, go back to your **VirtualBox** application and select **Machine** from Menu bar and then select **Setting**
 3. On setting dialog box, you need to select Shared Folder & then click on 
 4. In the Add Share dialog box, select Other as the folder path.
 5. In Select folder window, You need to navigate to the myfolder you created in step 1 and click ok. Check on Auto-mount & ok to close the setting box.

SAS University Edition

Now you are all ready to launch your SAS University Edition vApp. Please follow the steps below :

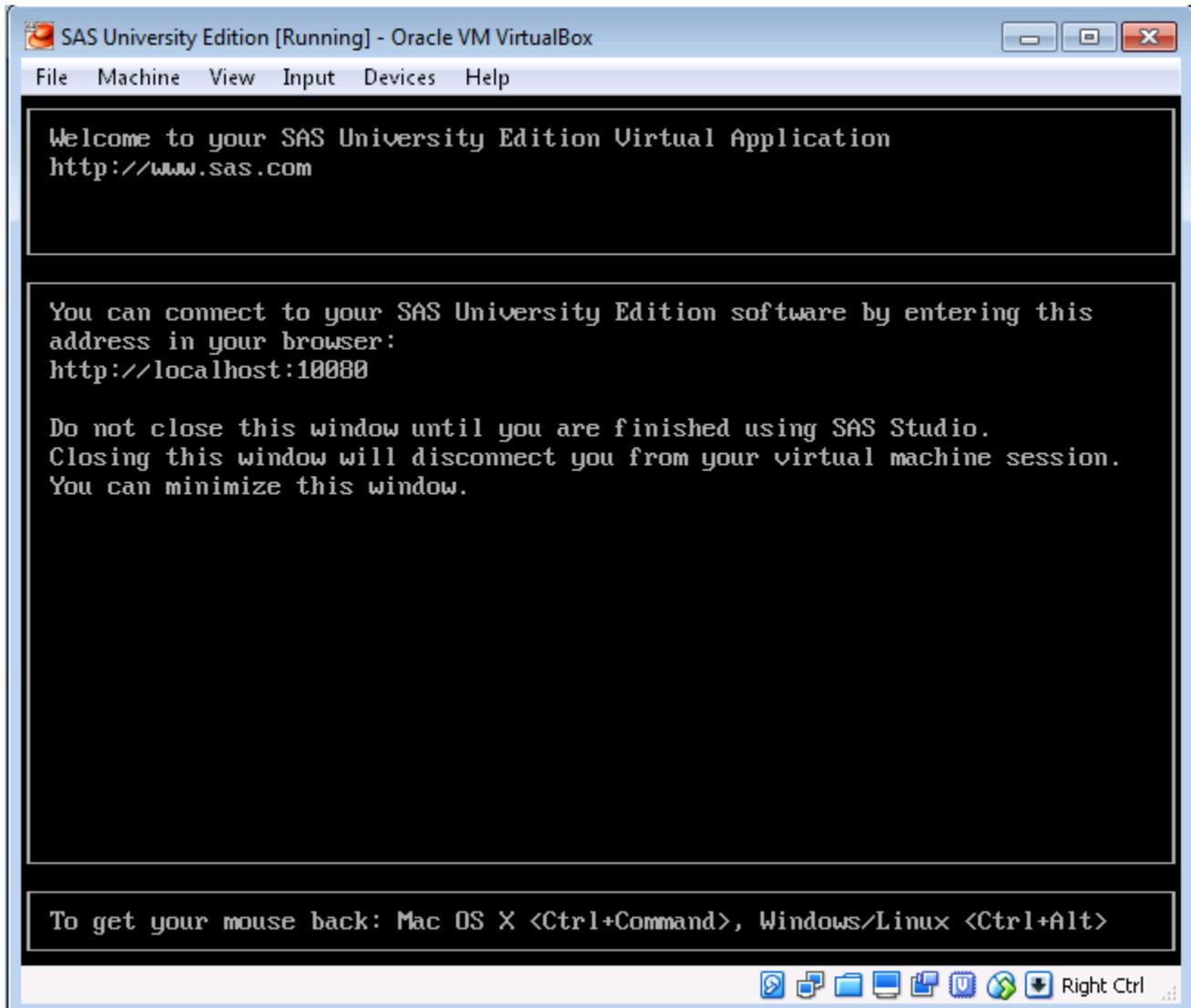
1. In VirtualBox, select the SAS University Edition vApp, and then select. It might take few minutes. Please note, when Virtual machine is running, your SAS logo window will be replace with a black screen . This is called welcome window. Don't close this window.

SAS Window:



SAS University Edition

Welcome Screen:



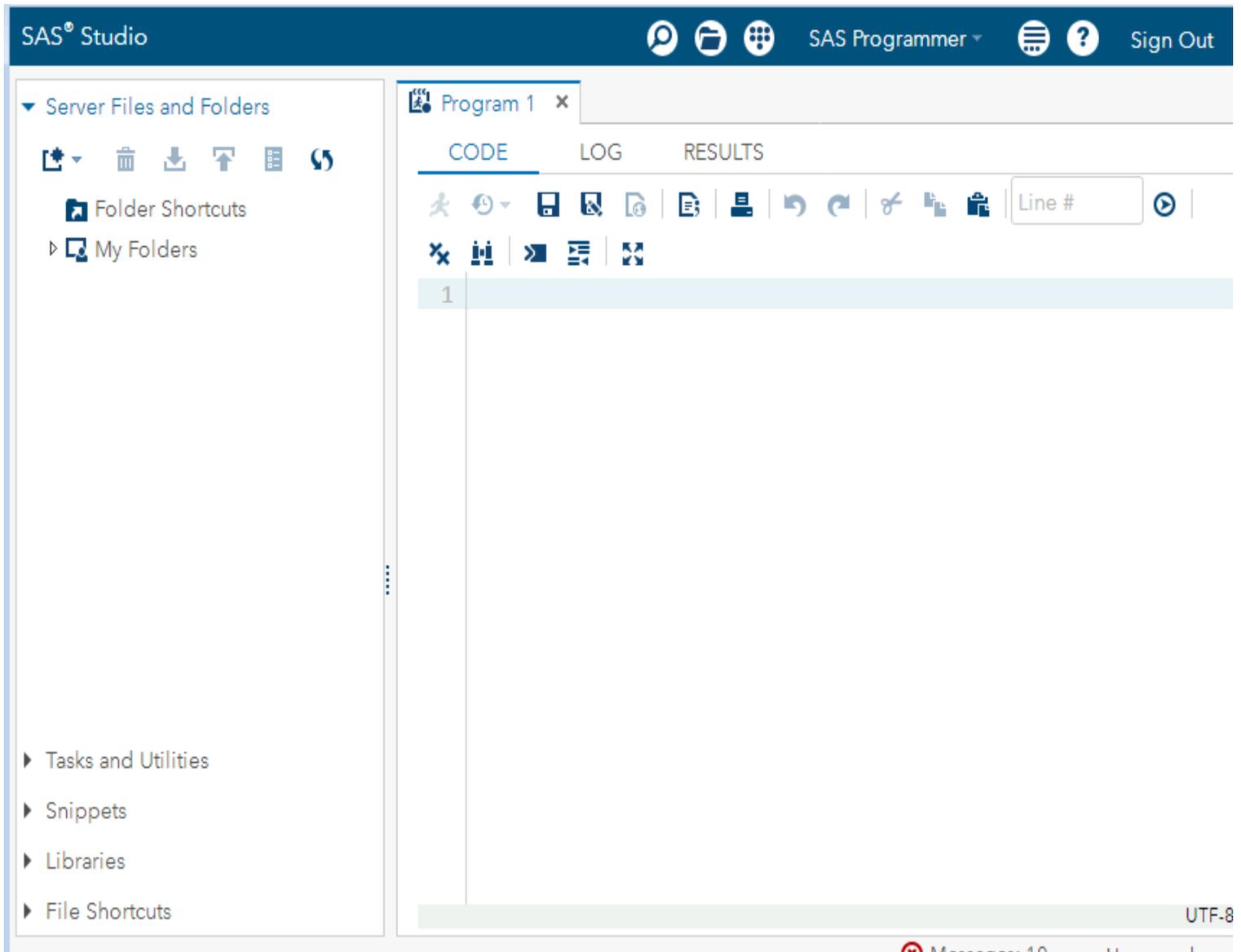
2. Once you see the above screen, Open the web browser on your local computer and enter <http://localhost:10080>

From SAS University Edition – Information Center , Please click on Start SAS Studio.

[Start SAS Studio >](#)

SAS University Edition

You are all set to write your first SAS program



Support

If you have any question, please feel free to write back to us or you can write an email to SASAnalyticsU@sas.com



CHAPTER TWO

Getting started with SAS



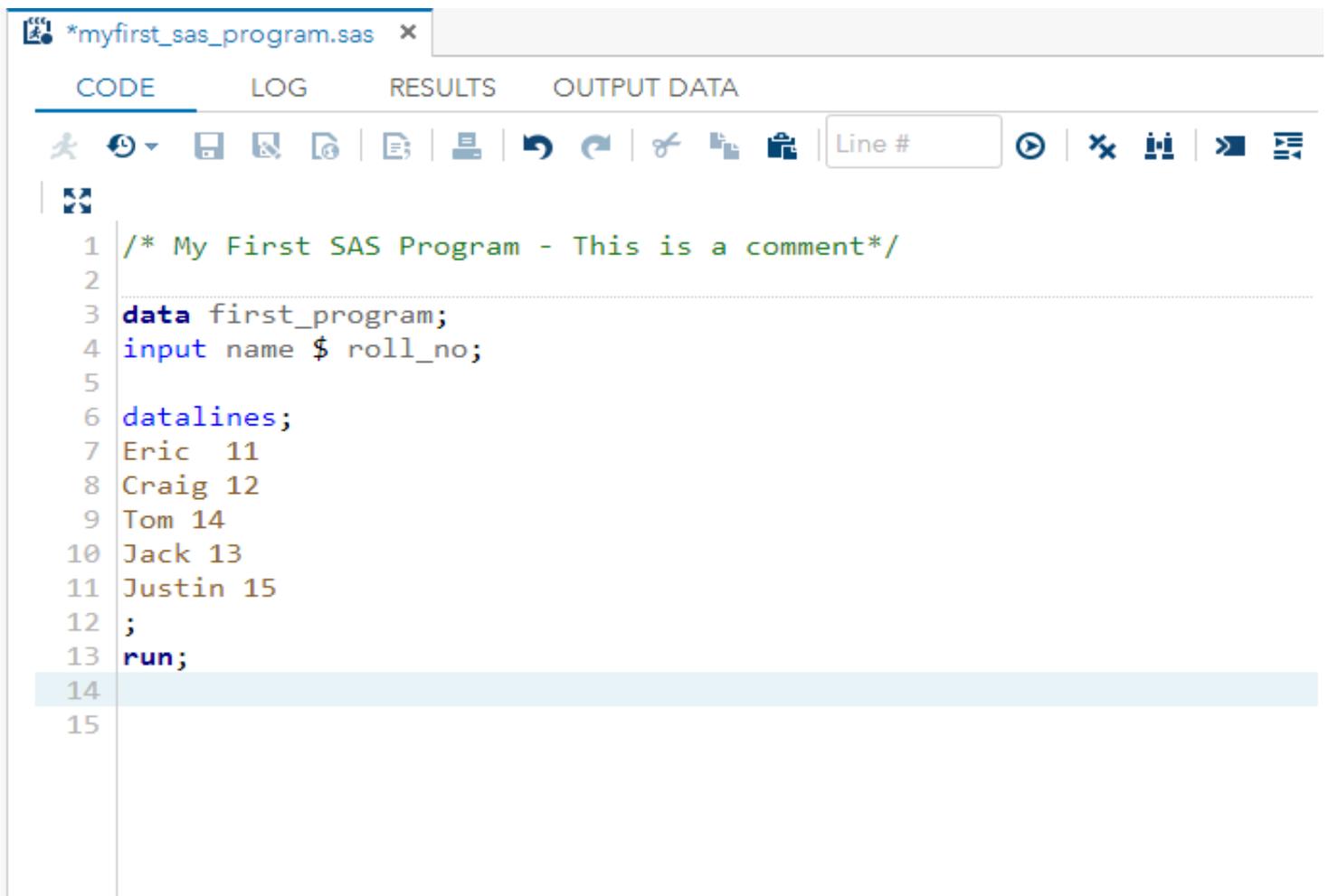
ARE YOU READY?

My First SAS Program

SAS Program

A SAS program is a sequence of statements executed in order. A statement gives information or instructions to SAS.

My First SAS Program



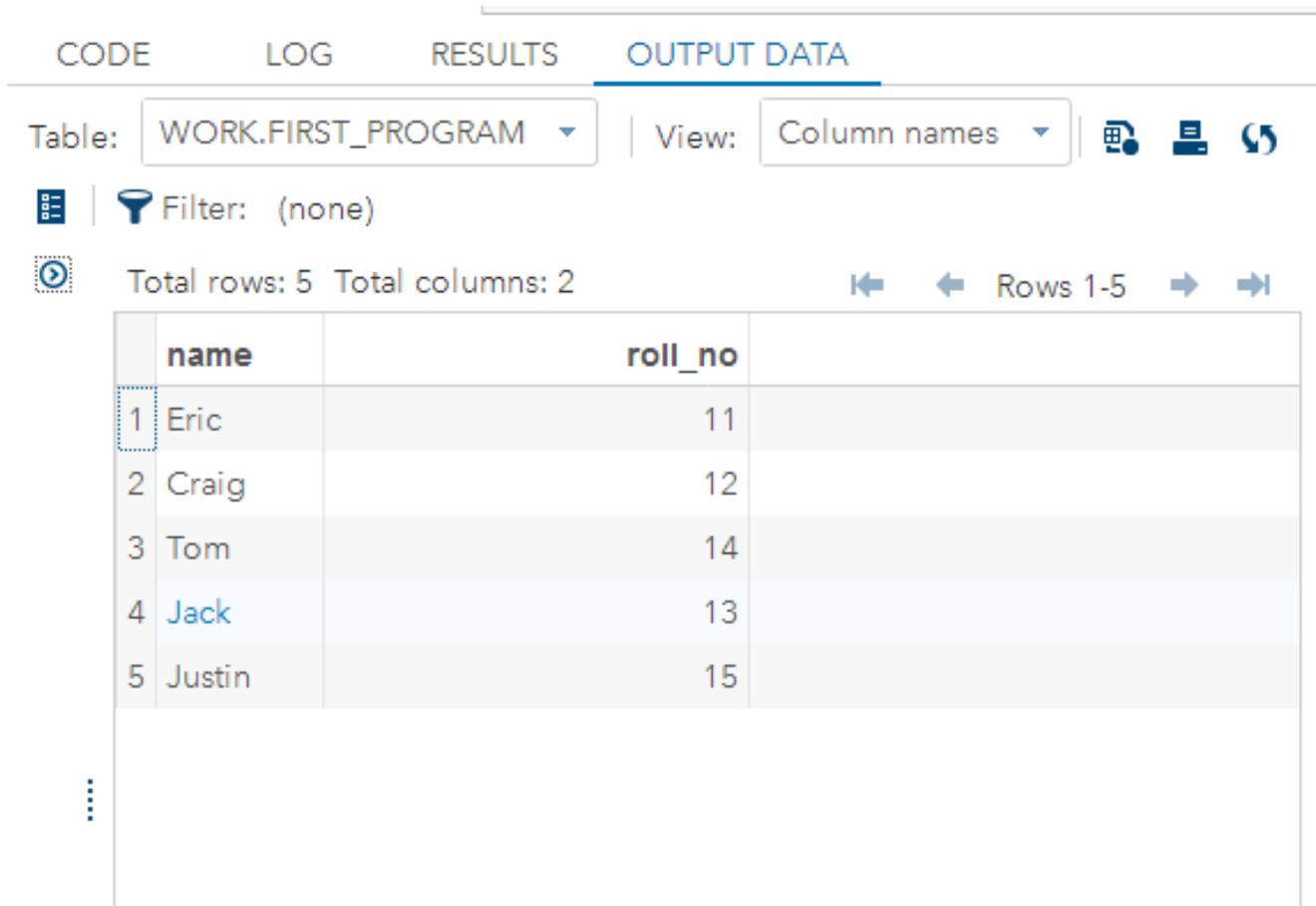
```
*myfirst_sas_program.sas x
CODE LOG RESULTS OUTPUT DATA
Line #
1 /* My First SAS Program - This is a comment*/
2
3 data first_program;
4 input name $ roll_no;
5
6 datalines;
7 Eric 11
8 Craig 12
9 Tom 14
10 Jack 13
11 Justin 15
12 ;
13 run;
14
15
```

In the above program , by using **DATALINES** statement we are trying to read the data. You can click on  or press F3 from your keyboard to run your SAS program.

My First SAS Program (contd.)

SAS Output Data Window :

Here you can see the information about your SAS Dataset.



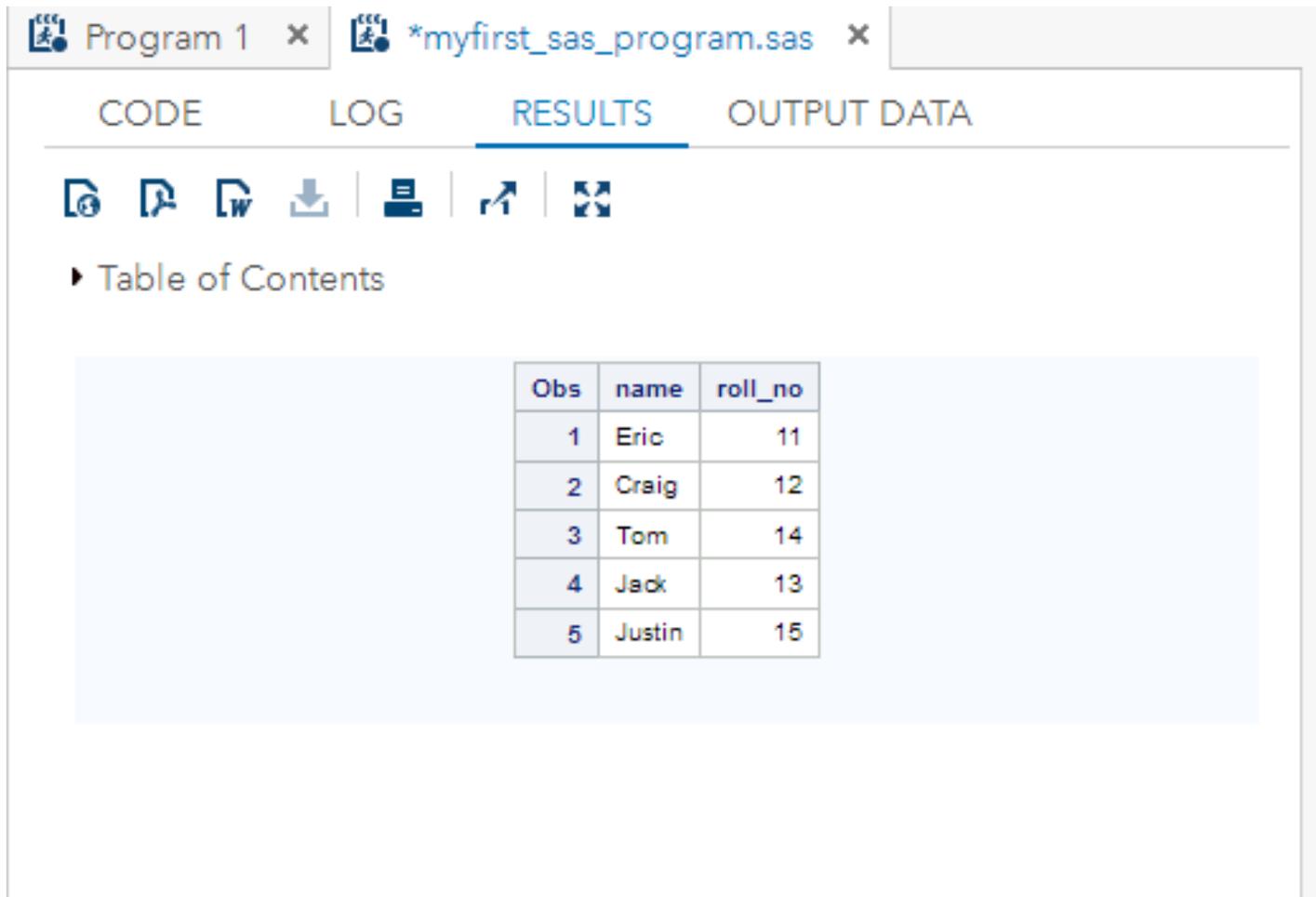
The screenshot shows the SAS Output Data Window interface. At the top, there are tabs for CODE, LOG, RESULTS, and OUTPUT DATA. Below the tabs, the current table is identified as 'WORK.FIRST_PROGRAM' and the view is set to 'Column names'. There are icons for grid, print, and refresh. A filter icon is shown with the text 'Filter: (none)'. Below that, it indicates 'Total rows: 5' and 'Total columns: 2'. Navigation arrows are present, with 'Rows 1-5' selected. The main area displays a table with the following data:

	name	roll_no	
1	Eric	11	
2	Craig	12	
3	Tom	14	
4	Jack	13	
5	Justin	15	

Output window displays the output of the program we submit. Here we can see the output datasets and browse the data values in sas datasets.

My First SAS Program (contd.)

Result Window:



The screenshot shows the SAS Results window for a program named *myfirst_sas_program.sas. The window has tabs for CODE, LOG, RESULTS (selected), and OUTPUT DATA. Below the tabs is a toolbar with icons for back, forward, print, and other actions. A 'Table of Contents' section is visible, followed by a table of results.

Obs	name	roll_no
1	Eric	11
2	Craig	12
3	Tom	14
4	Jack	13
5	Justin	15

To display sas dataset in **RESULTS** window, we can use **PROC PRINT** procedure.

```
proc print data=first_program; run;
```

This information will be shown in **RESULTS** window.

SAS DATASET

What is SAS Dataset?

Data must be in a special form to make SAS understand.

SAS dataset has two parts -

- ✓ Descriptor
- ✓ Data values

Descriptor

This describes the content of a SAS dataset. It contains the following information -

- ✓ Dataset name
- ✓ Number of observation & Variable
- ✓ Created & last modified date
- ✓ Data type information about each variable etc.

Data Values

It contains the actual data that has been collected.

SAS DATASET

Variable & Observations:

In SAS dataset rows are called observation and columns are called variable.

VARIABLES

	name	roll_no
1	Eric	11
2	Craig	12
3	Tom	14
4	Jack	13
5	Justin	15

OBSERVATIONS

Data Type

Raw data comes in many different forms but SAS only has two data types –

- ✓ Numeric - Numbers
- ✓ Character – character or text data

SAS DATASET

Missing Data:

When we read the data from external sources, data may be incomplete. Value for particular variable in some observation may be missing. SAS uses different methods to represent missing values for numeric and character variable

- ✓ Missing character data are represented by blanks
- ✓ Missing numeric data are represented by a single period (.).

Rules for SAS Names :

You decide the name of variables in a dataset & the dataset themselves. There are certain rules you need to keep in mind

- ✓ All names must be 32 characters or fewer in length.
- ✓ The first character appearing in a name must be a letter or an underscore (_).
- ✓ Names can contain only letters, numerals, or underscores (_).
- ✓ No Special characters allowed like %\$!*&#@.
- ✓ Names can contain upper- and lowercase letters.

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.

Basic SAS Programming Rules

✓ All SAS statements (except those containing data) must end with a **semicolon (;)**.

Example : "DATA example1;" is an example of a SAS statement.

✓ Any number of SAS statements can appear on a single line provided they are separated by a **semicolon**.

Example : "DATA example1; Input Name \$ ID;" is an example of a SAS statement.

✓ SAS statements are not case sensitive, that is, they can be entered in lowercase, uppercase, or a mixture of the two.

Comments :

To make your programs more understandable, you can insert comments into your programs. There are two ways

✓ Starts with an asterisk (*) and ends with a semicolon (;).

✓ Starts with a slash asterisk (/*) and ends with an asterisk slash (*/).

Errors :

Like other programming languages, SAS programs simply doesn't work the first time. You should expect errors. You might forget a semicolon at the end of a statement or misspell a word or doesn't use the correct syntax. Remember you can always fix them.

Building Blocks of SAS Program

SAS programs are constructed by two basic building blocks

- ✓ DATA Step
- ✓ PROC Step

DATA Step:

*Any portion of a SAS program that begins with a DATA statement and ends with a RUN statement is called a **DATA Step**.*

DATA steps are used to manage data. In detail, DATA steps are used to read raw or external data into a SAS data set, to modify data values, and to subset or merge data sets.

```
data customer;  
name='Justin';  
Telephone_number=1234567891;  
run;
```

PROC Step:

*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**.*

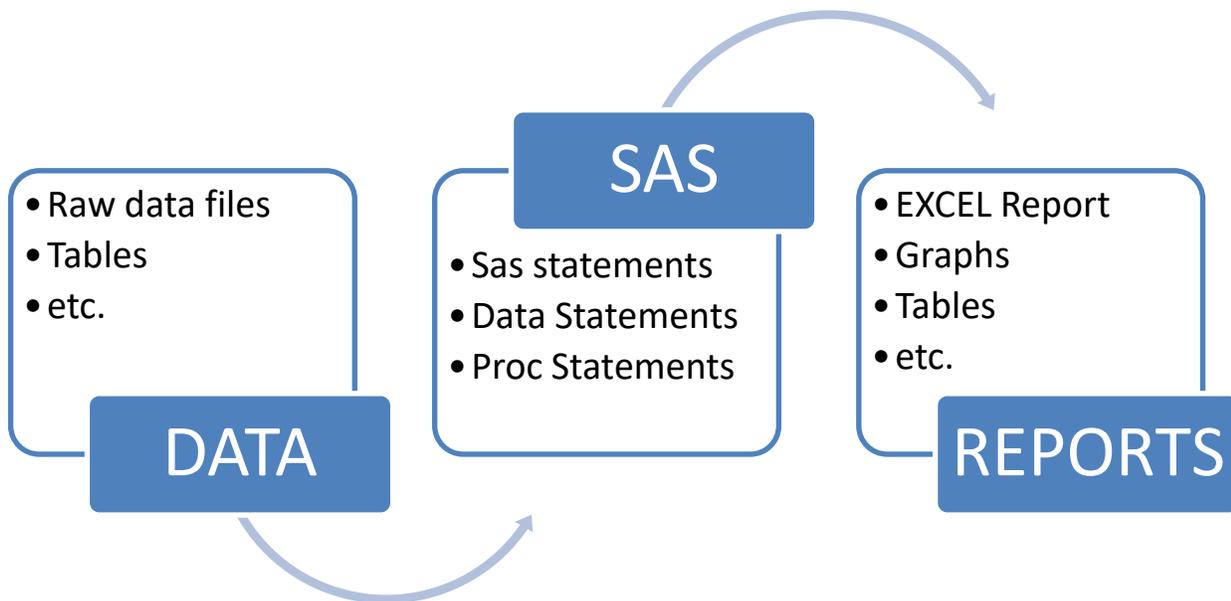
PROC steps are in-built programs that allow us to analyze the data contained in a SAS data set. PROC steps are used to calculate descriptive statistics, to generate summary reports, and to create summary graphs and charts.

```
Proc print data=customer;  
RUN;
```

Flow of a SAS program

Flow of a SAS program:

- ✓ We read data from external data sources into SAS datasets
- ✓ We use SAS data step to manipulate data
- ✓ We analyze and generate reports using DATA/PROC Step.



Data Step Execution:

Data step allows you to read, modify data in a flexible way. It's a very important to understand how data step is executed.

Data steps executes line by line and observation by observation.

SAS Library

A SAS library is simply a location where SAS data sets are stored.

There are two types -

- ✓ Temporary library or work library
- ✓ Permanent library

Temporary :

When you don't specify a library name at all, then the file is stored in a temporary SAS library called **Work**. When you close out the SAS session in which you created the SAS file, the temporary library and all of its files are removed from your computer's memory.

Example:

```
data example;
```

*In this case, example is a data set that is stored in **work** library.*

Permanent:

If you use a library name other than the default library name 'Work' when creating a SAS file, then the file is stored permanently until you delete it. That is, you can use permanent SAS libraries and their contents in subsequent SAS sessions.

You can specify the library name followed by **dot (.) sign** and then data set name.

Example:

```
data mydata.example;
```

*In this case, example is a data set that is stored in **mydata** library.*

SAS Options

The **OPTIONS** statement is part of a SAS program and affects all steps that follow it. This is one of the special statement which does not belong to DATA STEP or PROC Step.

We use option statement to change SAS system option. The changes will remain in effect or rest of the session or until changed gain.

Syntax :

```
OPTIONS <options>;
```

Example :

You want your SAS program to read only 10 observations. This method is very useful when you want to test your program.

```
OPTIONS OBS = 100;
```

All the datasets in your program will not contain more than 100 observation.

We will look for other options available in this training module later.