SAS

tutorialspoint

SIMPLY EASY LEARNING

www.tutorialspoint.com

https://www.facebook.com/tutorialspointindia

https://twitter.com/tutorialspoint

About the Tutorial

SAS is a leader in business analytics. Through innovative analytics, it caters to business intelligence and data management software and services. SAS transforms data into insight which can give a fresh perspective to business.

Unlike other BI tools available in the market, SAS takes an extensive programming approach to data transformation and analysis rather than a drag-drop-connect approach. This makes it stand out from the crowd with enhanced control over data manipulation. SAS has a very large number of components customized for specific industries and data analysis tasks.

Audience

This tutorial is designed for all those readers who want to read and transform raw data to produce insights for business using SAS. Readers who aspire to become Data Analysts or Data Scientists can also draw benefits from this tutorial.

Prerequisites

Before proceeding with this tutorial, you should have a basic understanding of Computer Programming terminologies. A basic understanding of any of the programming languages will help you understand the SAS programming concepts. Familiarity with SQL will be an added benefit.

Disclaimer & Copyright

Table of Contents

About the Tutorial i
Audience i
Prerequisites i
Disclaimer & Copyright i
Table of Contents ii

1. SAS – Overview 1
Uses of SAS 1
Types of SAS Software 3
Libraries in SAS 4

2. SAS – Environment 5
Download SAS University Edition 5
The SAS Environment 14

3. SAS – User Interface 15
SAS Main Window 15
Code Autocomplete 16
Program Execution 16
Program Log 17
Program Result 17
Program Tabs 18

4. SAS – Program Structure 22
SAS Program Structure 22
DATA Step 22
PROC Step 23
The OUTPUT Step 23
The Complete SAS Program 24
Program Output 24

5. SAS – Basic Syntax 26
SAS Statements 26
SAS Variable Names 26
SAS Data Set 27
SAS File Extensions 27
Comments in SAS 28

6. SAS – Data Sets 29
SAS Built-In Data Sets 29
Importing External Data Sets 31

7. SAS – Variables 35
SAS Variable Types 35
Use of Variables in SAS Program 36
Using the Variables 37

8. SAS – Strings 39
Declaring String Variables 39
String Functions 40

9. SAS – Arrays 43
Accessing Array Values 44
Using the OF operator 44
Using the IN operator 45

10. SAS – Numeric Formats 47
Reading Numeric formats 47
Displaying Numeric formats 48

11. SAS – Operators 50
Arithmetic Operators 50
Logical Operators 51
Comparison Operators 52
Minimum/Maximum Operators 53
Concatenation Operator 54
Operators Precedence 55

12. SAS – Loops 56
Flow Diagram 56
SAS – DO Index Loop 57
SAS – DO WHILE Loop 58
SAS – DO UNTIL Loop 59

13. SAS – Decision Making 60
SAS – IF Statement 61
SAS – IF THEN ELSE Statement 63
SAS – IF THEN ELSE IF Statement 65
SAS – IF-THEN-DELETE Statement 66

14. SAS – Functions 68
Function Categories 68
Mathematical Functions 68
Date and Time Functions 69
Character Functions 70
Truncation Functions 71
Miscellaneous Functions 72

15. SAS – Input Methods 74
List Input Method 74
Named Input Method 75
Column Input Method 76
Formatted Input Method 77

16. SAS – Macros 79
Macro Variables 79
Local Macro Variable 80
Macro Programs 81
Commonly Used Macros 82
Macro % RETURN 83
Macro % END 84

17. **SAS – Date Times** **86**
SAS Date Informat 86
SAS Date output format 87

SAS DATA SET OPERATIONS **88**

18. **SAS – Read Raw Data** **89**
Reading ASCII (Text) Data Set 89
Reading Delimited Data 90
Reading Excel Data 91
Reading Hierarchical Files 92

19. **SAS – Write Data Sets** **94**
PROC EXPORT 94
Writing a CSV file 95
Writing a Tab Delimited File 96

20. **SAS – Concatenate Data Sets** **97**

21. **SAS – Merge Data Sets** **103**
Data Merging 103

22. **SAS – Subsetting Data Sets** **107**
Subsetting Variables 107
Subsetting Observations 109

23. **SAS – Sort Data Sets** **111**
Reverse Sorting 112
Sorting Multiple Variables 113

24. **SAS – Format Data Sets** **115**
Using PROC FORMAT 116

25. **SAS – SQL** **118**
SQL Create Operation 118
SQL Read Operation 119
SQL SELECT with WHERE Clause 120
SQL UPDATE Operation 121
SQL DELETE Operation 123

26. **SAS – ODS** **124**
Creating HTML Output 124
Creating PDF Output 126
Creating TRF(Word) Output 127

27. **SAS – Simulations** **129**

SAS DATA REPRESENTATION ... **130**

28. SAS – Histograms ... **131**
Simple Histogram ... 131
Histogram with Curve Fitting ... 132

29. SAS – Bar Charts ... **134**
Simple Bar chart ... 134
Stacked Bar chart ... 135
Clustered Bar chart ... 136

30. SAS – Pie Charts ... **138**
Simple Pie Chart ... 138
Pie Chart with Data Labels ... 140
Grouped Pie Chart ... 142

31. SAS – Scatter Plots ... **144**
Simple Scatterplot ... 144
Scatterplot with Prediction ... 145
Scatter Matrix ... 147

32. SAS – Boxplots ... **148**
Simple Boxplot ... 148
Boxplot in Vertical Panels ... 150
Boxplot in Horizontal Panels ... 150

SAS BASIC STATISTICAL PROCEDURE ... **152**

33. SAS – Arithmetic Mean ... **153**
Mean of a Dataset ... 153
Mean of Select Variables ... 154
Mean by Class ... 155

34. SAS – Standard Deviation ... **156**
Using PROC MEANS ... 156
Using PROC SURVEYMEANS ... 157
Using BY Option ... 159

35. SAS – Frequency Distributions ... **161**
Single Variable Frequency Distribution ... 161
Multiple Variable Frequency Distribution ... 163
Frequency Distribution with Weight ... 164

36. SAS – Cross Tabulations ... **165**
Cross Tabulation of 3 Variables ... 166
Cross Tabulation of 4 Variables ... 167

37. SAS – T-tests ... **169**
Paired T-test ... 170
Two Sample T-test ... 172

38. SAS – Correlation Analysis 173
Correlation Between All Variables 175
Correlation Matrix 176

39. SAS – Linear Regression 177

40. SAS – Bland-Altman Analysis 180
Enhanced Model 182

41. SAS – Chi-Square 184
Two-Way Chi-Square 186

42. SAS – Fisher's Exact Tests 188
Applying Fisher Exact Test 188

43. SAS – Repeated Measure Analysis 190

44. SAS — One Way Anova 193
Applying ANOVA 193
Applying ANOVA with MEANS 194

45. SAS – Hypothesis Testing 196

1. SAS – Overview

SAS stands for **Statistical Analysis Software**. It was created in the year 1960 by the SAS Institute. From 1st January 1960, SAS was used for data management, business intelligence, Predictive Analysis, Descriptive and Prescriptive Analysis etc. Since then, many new statistical procedures and components were introduced in the software.

With the introduction of JMP (Jump) for statistics, SAS took advantage of the **graphical user interface** (GUI) which was introduced by the Macintosh. Jump is basically used for applications like Six Sigma, designs, quality control and engineering and scientific analysis.

SAS is platform independent which means you can run SAS on any operating system either Linux or Windows. SAS is driven by SAS programmers who use several sequences of operations on the SAS datasets to make proper reports for data analysis.

Over the years SAS has added numerous solutions to its product portfolio. It has solution for Data Governance, Data Quality, Big Data Analytics, Text Mining, Fraud management, Health science etc. We can say that SAS has a solution for every business domain.

To have a glance at the list of products available you can visit **SAS Components**.

Uses of SAS

SAS is basically worked on large datasets. With the help of SAS software, you can perform various operations on data. Some of the operations include:

- Data management
- Statistical analysis
- Report formation with perfect graphics
- Business planning
- Operations research and project management
- Quality improvement
- Application development
- Data extraction
- Data transformation
- Data updation and modification

If we talk about the components of SAS, then more than 200 components are available in SAS.

S.N.	SAS Component & their Usage
1	**Base SAS** It is a core component which contains data management facility and a programming language for data analysis. It is also the most widely used.
2	**SAS/GRAPH** Creates graphs, presentations for better understanding and showcases the result in a proper format.
3	**SAS/STAT** Perform Statistical analysis with the variance analysis, regression, multivariate analysis, survival analysis, and psychometric analysis, mixed model analysis.
4	**SAS/OR** Operations research.
5	**SAS/ETS** Econometrics and Time Series Analysis.
6	**SAS/IML** Interactive matrix language.
7	**SAS/AF** Applications facility.
8	**SAS/QC** Quality control.
9	**SAS/INSIGHT** Data mining.
10	**SAS/PH** Clinical trial analysis.
11	**SAS/Enterprise Miner** Data mining

Types of SAS Software

Let us now understand the different types of SAS software.

- Windows or PC SAS
- SAS EG (Enterprise Guide)
- SAS EM (Enterprise Miner i.e. for Predictive Analysis)
- SAS Means
- SAS Stats

We use Windows SAS in large organizations and also in training institutes. A few organizations also use Linux but there is no graphical user interface so you have to write code for every query. In Window SAS, there are a lot of utilities available that help the programmers and also reduce the time of writing the codes.

A SaS Window has 5 parts.

S.N.	SAS Window & their Usage
1	**Log Window** is like an execution window where we can check the execution of the SAS program. We can also check the errors here. It is very important to check the log window every time the program is run. This facilitates proper understanding about the execution of our program.
2	**Editor Window** is that part of SAS where we write all the codes. It is like a notepad. .
3	**Output Window** is the result window where we can see the output of our program.
4	**Result Window** is like an index to all the outputs. All the programs that we have run in one session of the SAS are listed here and you can open the output by clicking on the output result. But these are mentioned only in one session of the SAS. If we close the software and then open it, the Result Window will be empty.
5	**Explore Window** has all the libraries listed in it. You can also browse your system SAS supported files from here.

Libraries in SAS

Libraries are storage locations in SAS. You can create a library and save all the similar programs in that library. SAS provides you the facility to create multiple libraries. A SAS library is only 8 characters long.

There are two types of libraries available in SAS:

S.N.	SAS Window & their Usage
1	**Temporary or Work Library** This is the by default library of SAS. All the programs that we create are stored in this work library if we do not assign any other library to them. You can check this work library in the Explore Window. Suppose you create a SAS program and have not assigned any permanent library to it..... and if you end the session. The problem will be - when you start the software then this program will not be in the work library. This will only be there in Work library as long as the session is active.
2	**Permanent Library** These are the permanent libraries of SAS. We can create a new SAS library by using SAS utilities or by writing the codes in the editor window. When we create a program in SAS and save it in these permanent libraries, it will be available as long as we want it.

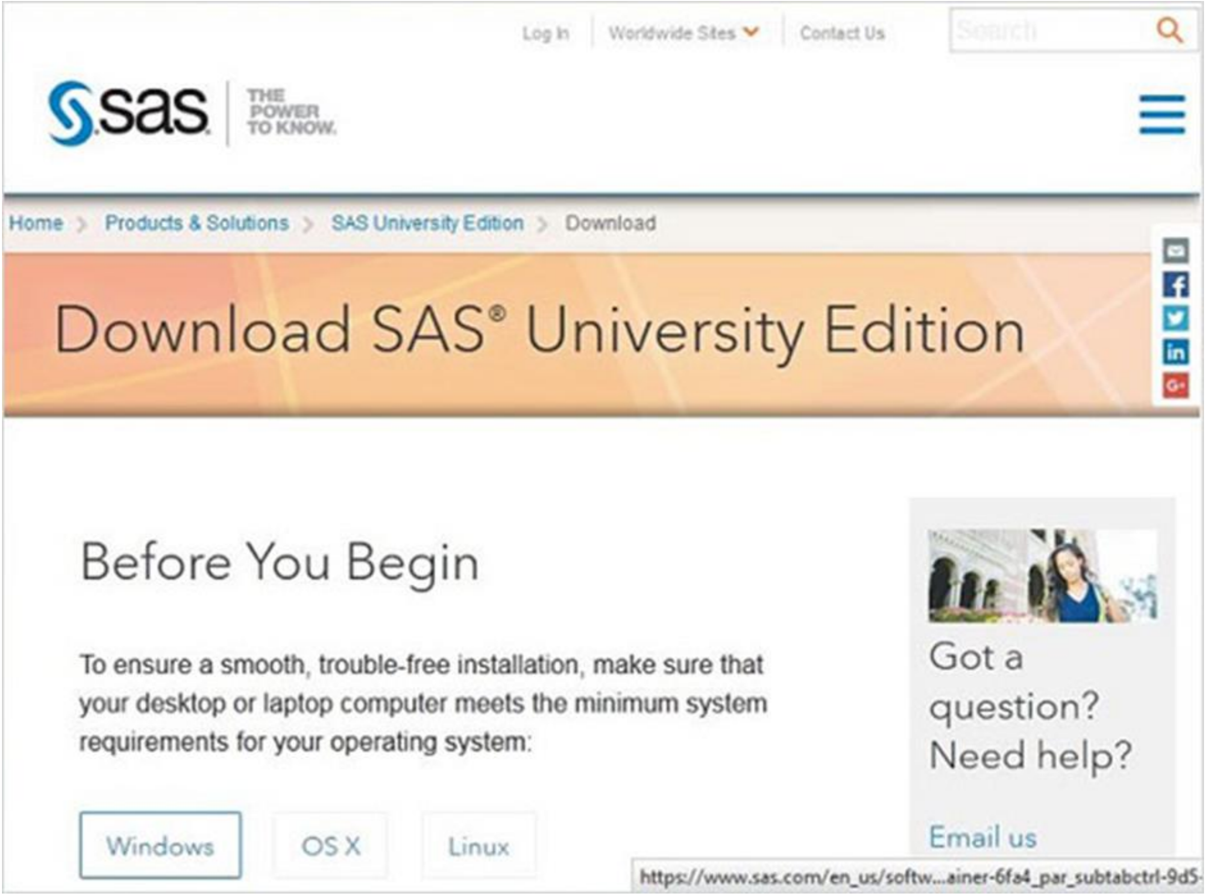
2. SAS – Environment

SAS Institute Inc. has released a free **SAS University Edition.** This provides a platform for learning SAS programming. It provides all the features that you need to learn in BASE SAS programming which in turn enables you to learn any other SAS component.

The process of downloading and installing SAS University Edition is very simple. It is available as a virtual machine which needs to be run on a virtual environment. You need to have virtualization software already installed in your PC before you can run the SAS software. In this tutorial, we will be using **VMware**. The following are the details of the steps to download, setup the SAS environment and verify the installation.

Download SAS University Edition

SAS University Edition is available for download at the URL SAS University Edition. Please scroll down to read the system requirements before you begin the download. The following screen appears on visiting this URL.



Setup virtualization software

Scroll down on the same page to locate the installation step 1. This step provides the links to get the suitable virtualization software. In case you already have any one of these software installed in your system, you can skip this step.

Step 1: Make sure you have a compatible virtualization software package.

Because SAS University Edition is a virtual application (or vApp), you need virtualization software to run it. If you don't already have a compatible virtualization software package, download one using the links below.

Windows	Oracle VM VirtualBox	VMware Workstation 12 Player
OS X	Oracle VM VirtualBox	VMware Fusion for OS X 7 or later
Linux	Oracle VM VirtualBox	VMware Player for Linux 7 or later

Quick start virtualization software

In case you are completely new to the virtualization environment, you can familiarize yourself with it by going through the following guides and videos available as step 2. You can skip this step in case you are already familiar.

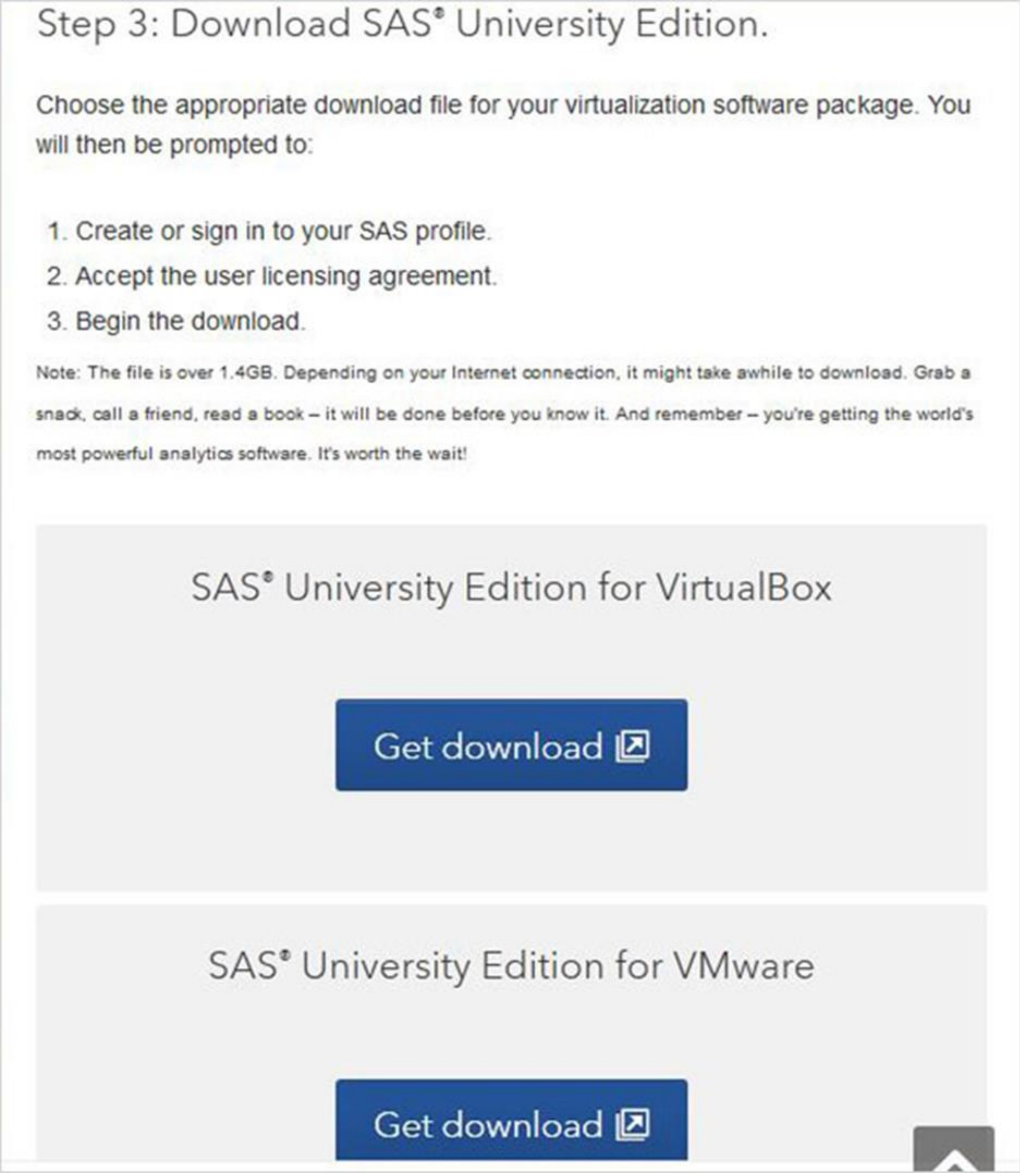
Step 2: Get the Quick Start Guide (PDF or video) for your virtualization software package.

Don't just *download* the PDF – actually *read* it. Or watch the video if that's more your thing. Or do both! You'll find a lot of useful info in the Quick Start Guides, including step-by-step instructions. Seriously. You won't regret it.

- **Oracle VirtualBox Quick Start Guide**
  Download the PDF
  Watch the video
- **VMware Player Quick Start Guide**
  Download the PDF
  Watch the video
- **VMware Fusion Quick Start Guide**
  Download the PDF
  Watch the video

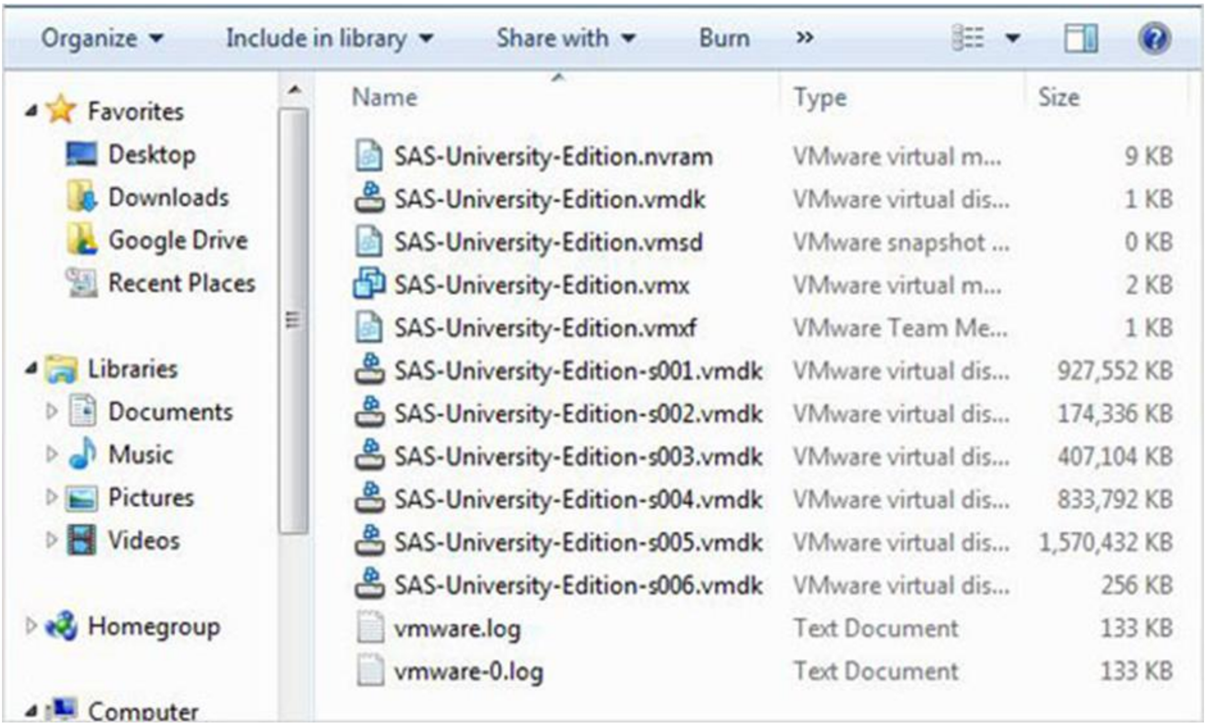
Download the Zip file

In step 3, you can choose the appropriate version of the SAS University Edition compatible with the virtualization environment you have. It downloads as a zip file with the name similar to unvbasicvapp__9411005__vmx__en__sp0__1.zip



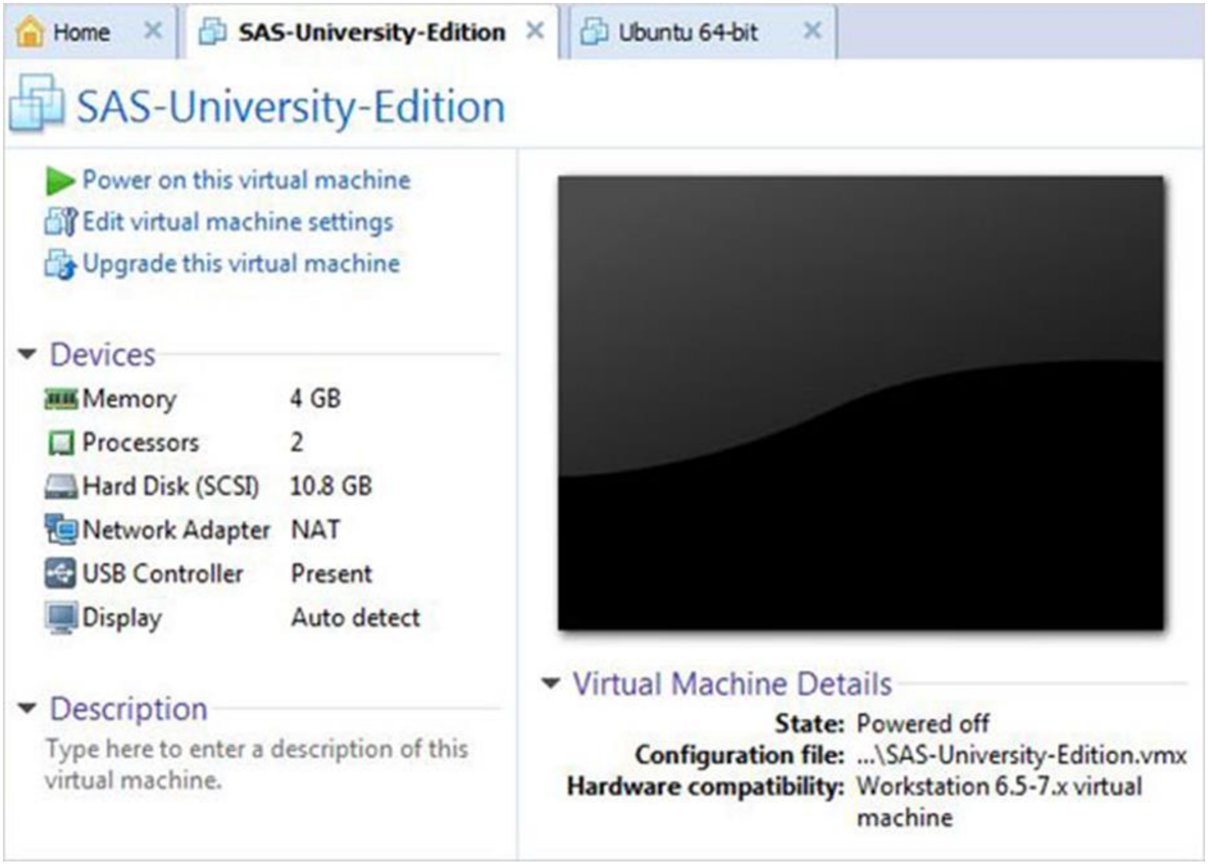
Unzip the Zip file

The zip file above needs to be unzipped and stored in an appropriate directory. In our case, we have chosen the VMware zip file which shows the following files after unzipping.



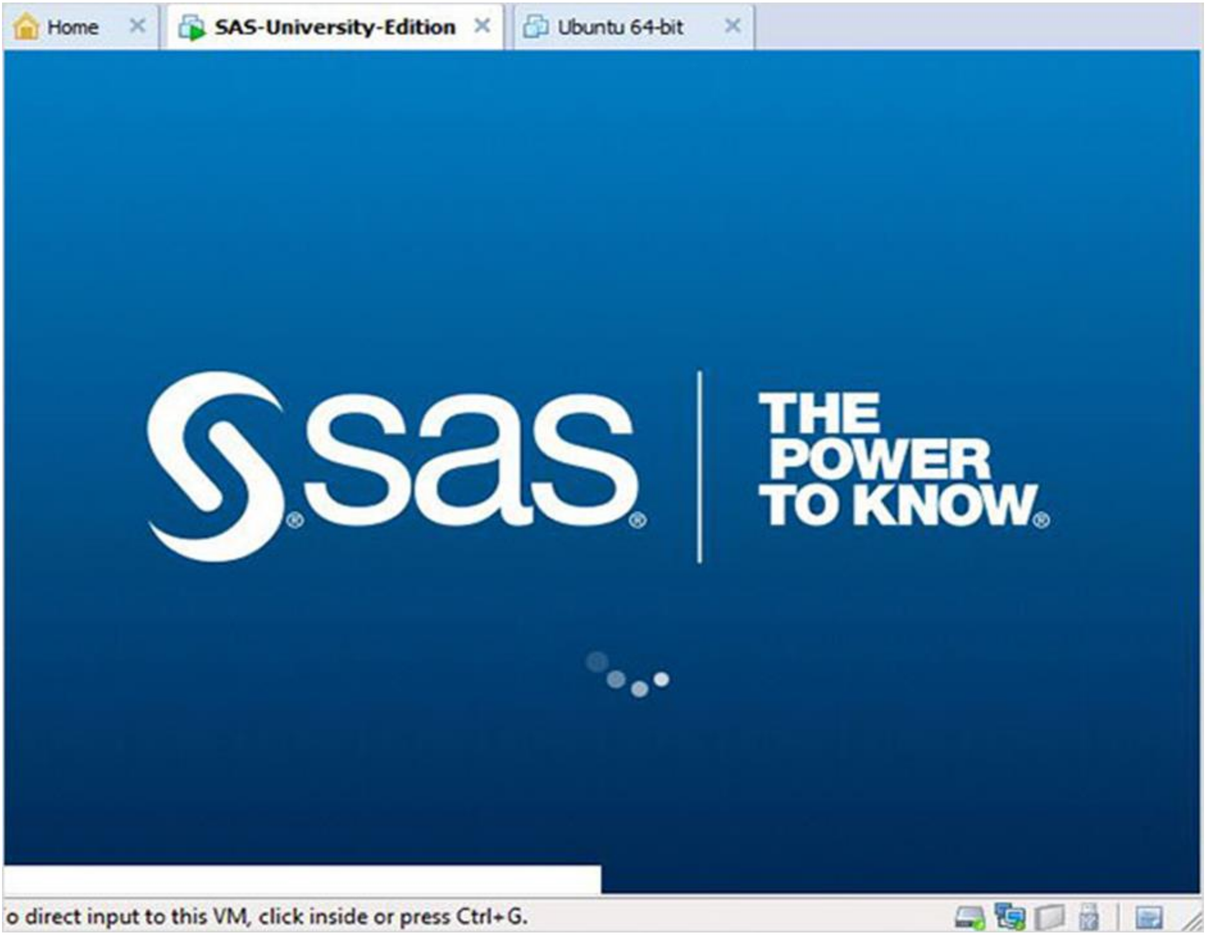
Loading the virtual machine

Start the VMware player (or workstation) and open the file which ends with an extension. vmx. The following screen appears. Please notice the basic settings like memory and hard disk space allocated to the vm.

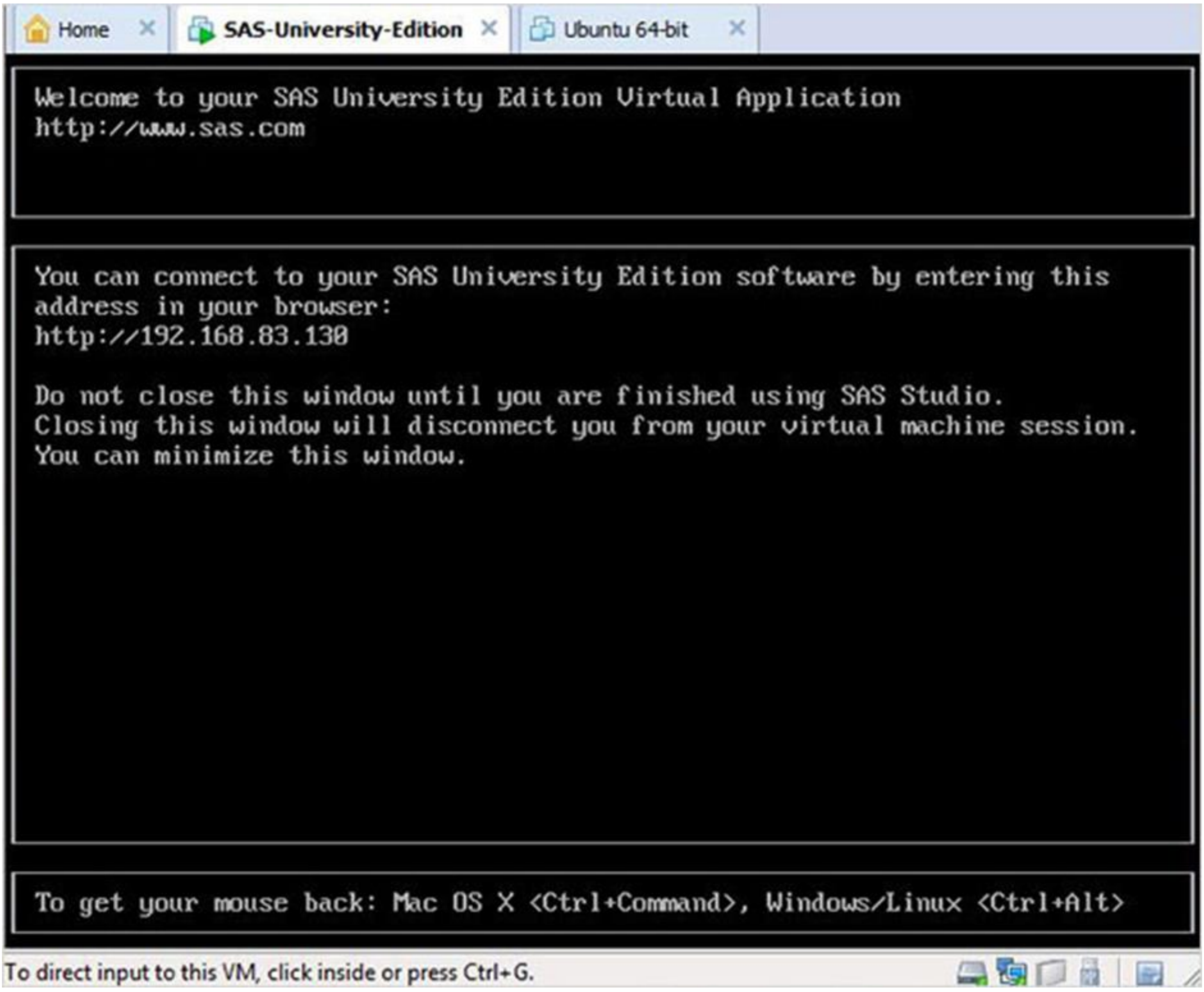


Power on the virtual machine

Click the **Power on this virtual machine** alongside the green arrow mark to start the virtual machine. The following screen appears.

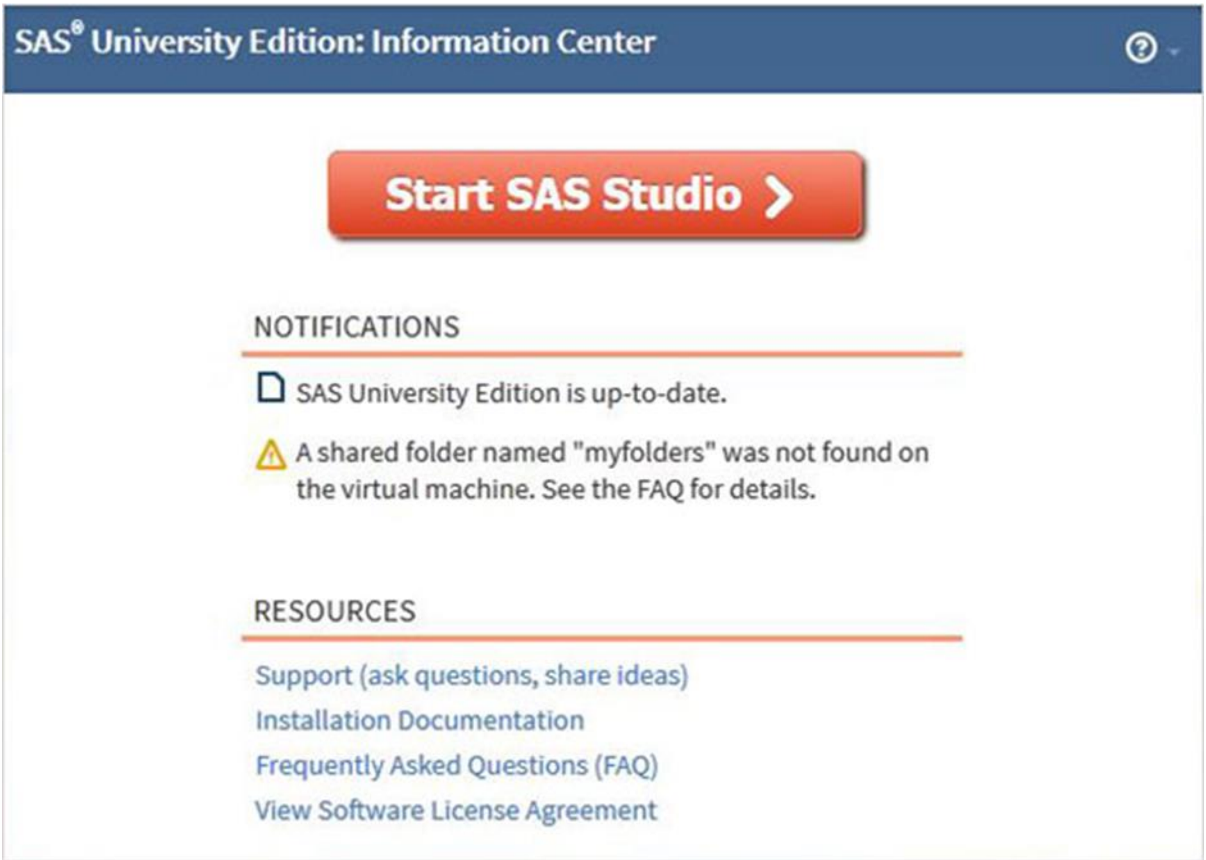


The following screen appears when the SAS vm is in the state of loading after which the running vm gives a prompt to go to a URL location that will open the SAS environment.



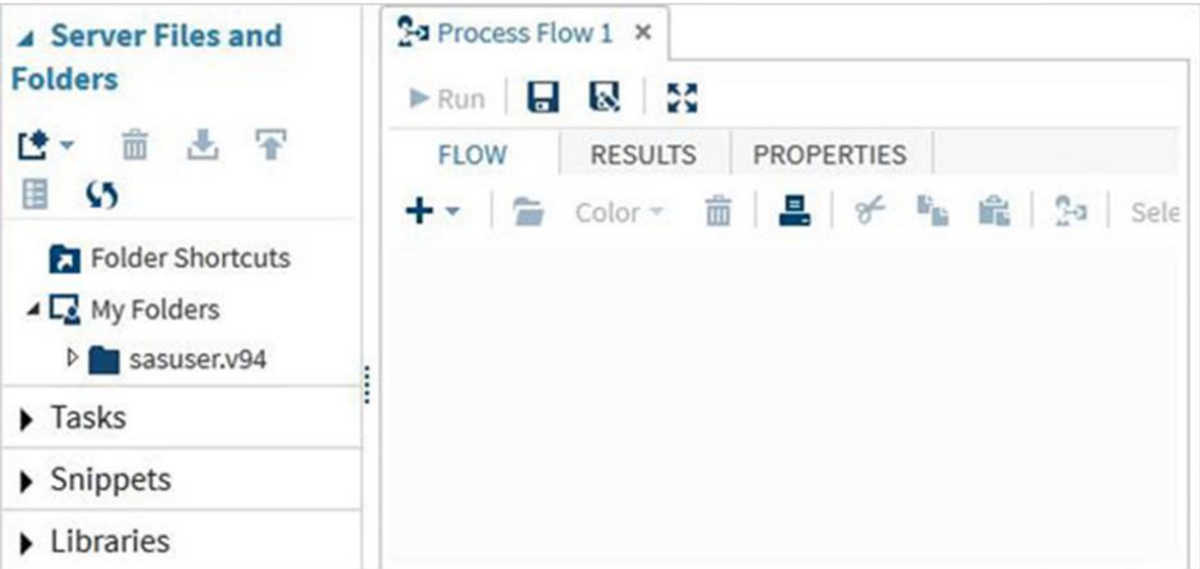
Starting SAS studio

Open a new browser tab and load the above URL (which differs from one PC to another). The following screen appears indicating the SAS environment is ready.

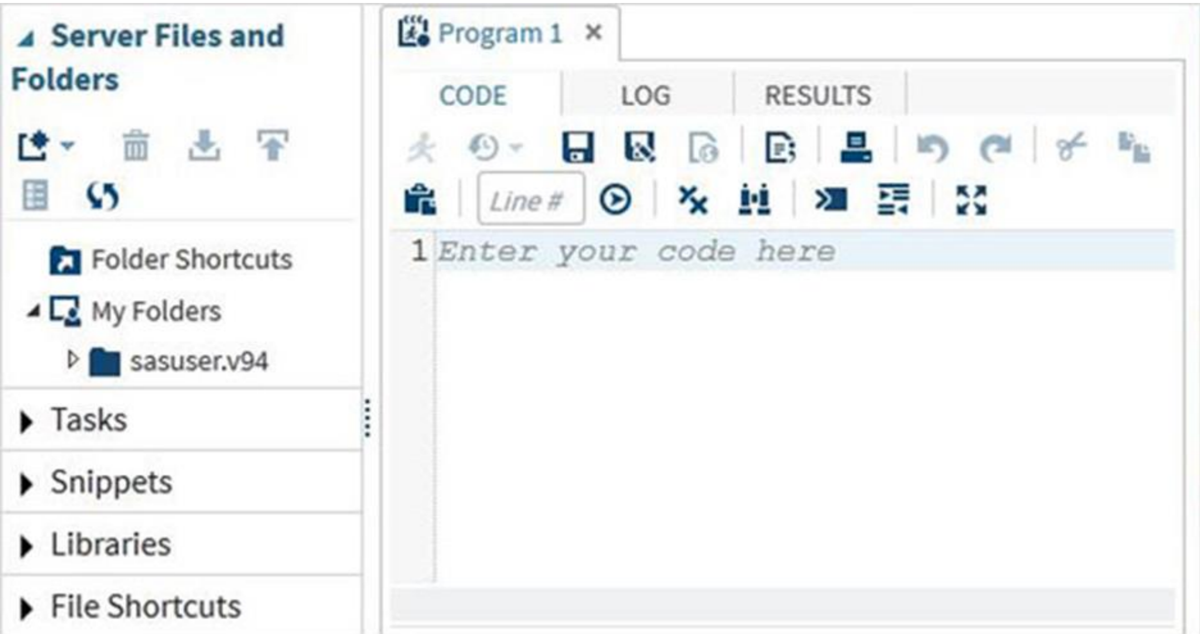


The SAS Environment

On clicking the **Start SAS Studio,** we get the SAS environment which by default opens in the visual programmer mode as shown in the following screenshot.



We can also change it to the SAS programmer mode by clicking on the dropdown.



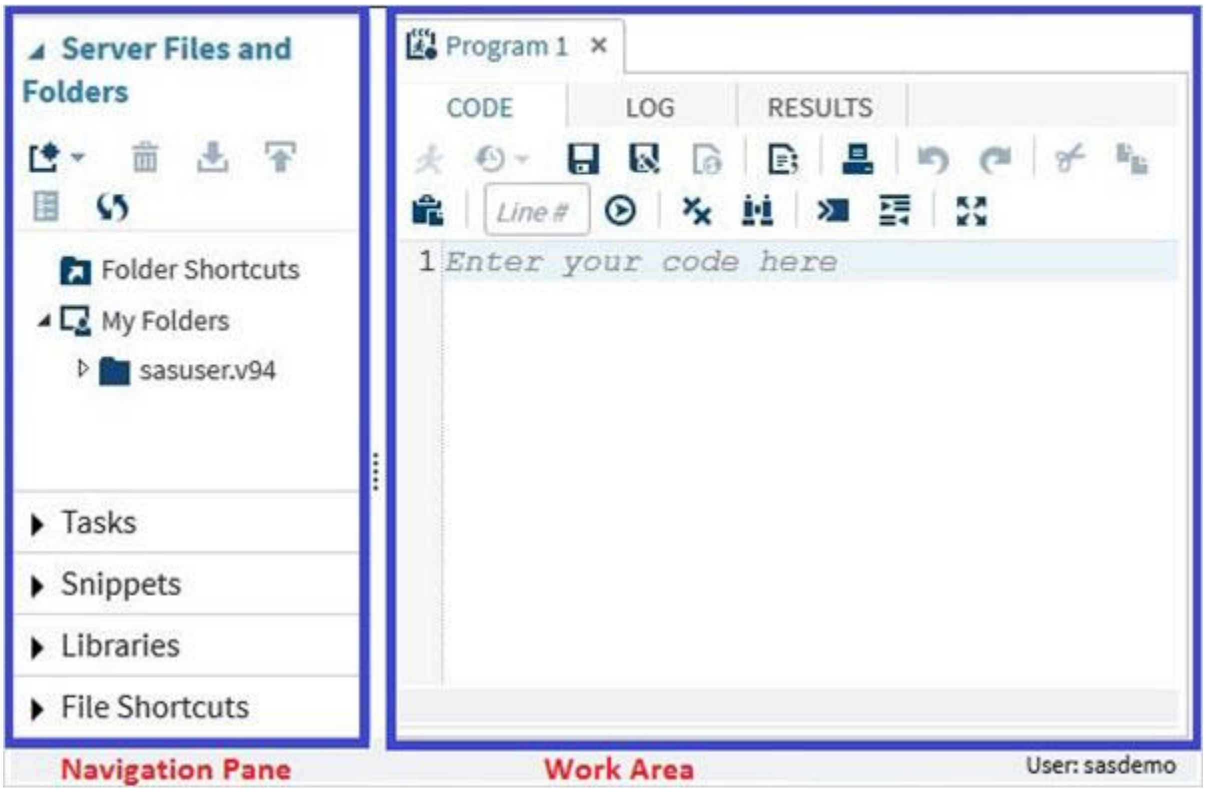
We are now ready to write the SAS Programs.

3. SAS – User Interface

SAS Programs are created using a user interface known as **SAS Studio**. In this chapter, we will discuss the various windows of SAS User Interface and their usage.

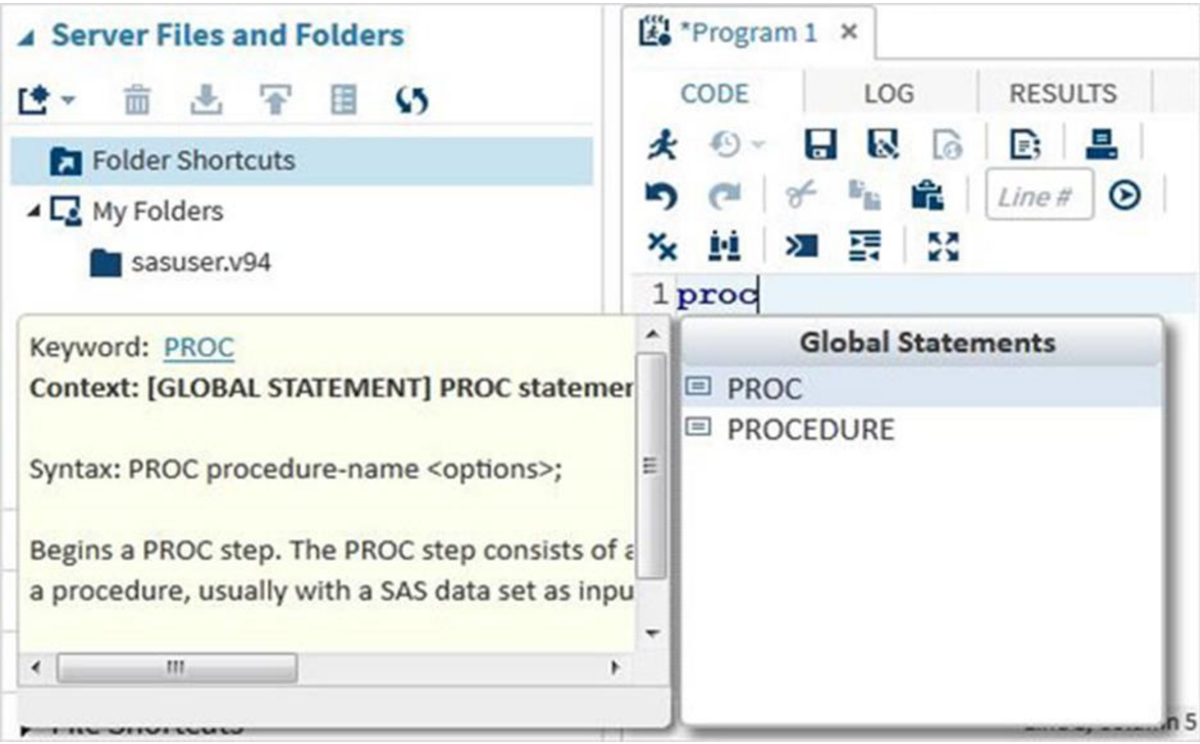
SAS Main Window

This is the window you see on entering the SAS environment. The **Navigation Pane** is to the left. It is used to navigate various programming features. The **Work Area** is to the right. It is used for writing the code and executing it.



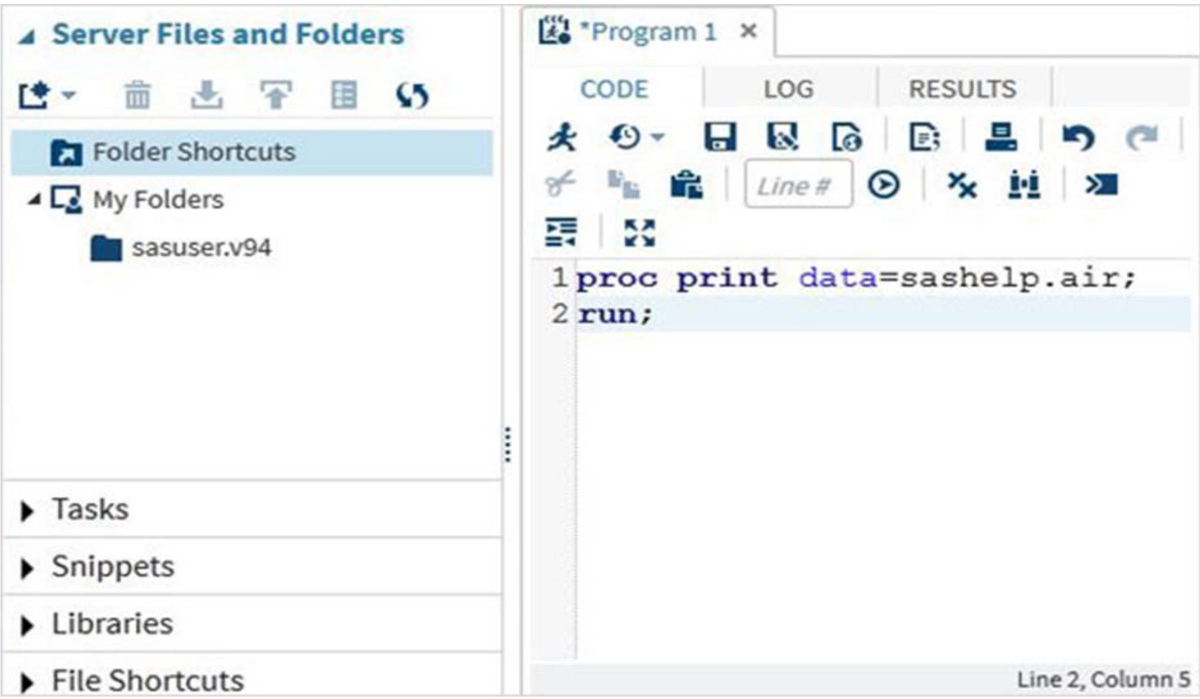
Code Autocomplete

This feature helps in getting the correct syntax of the SAS keywords and also provides link to the documentation for the keywords.



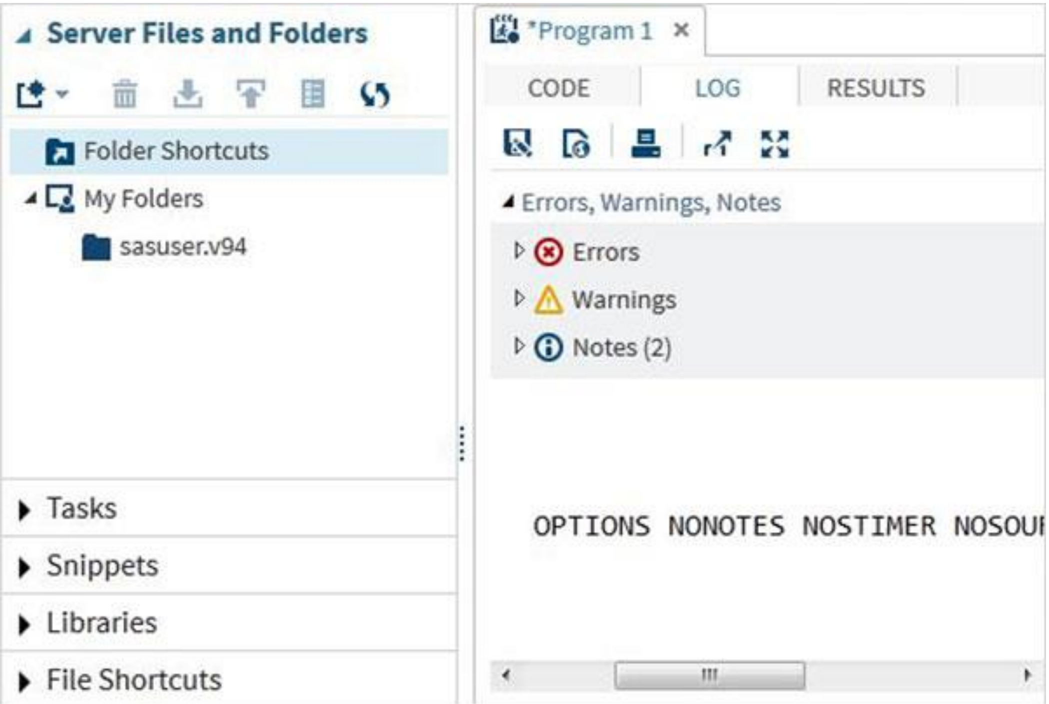
Program Execution

The execution of code is done by pressing the run icon, which is the first icon from left or the F3 button.



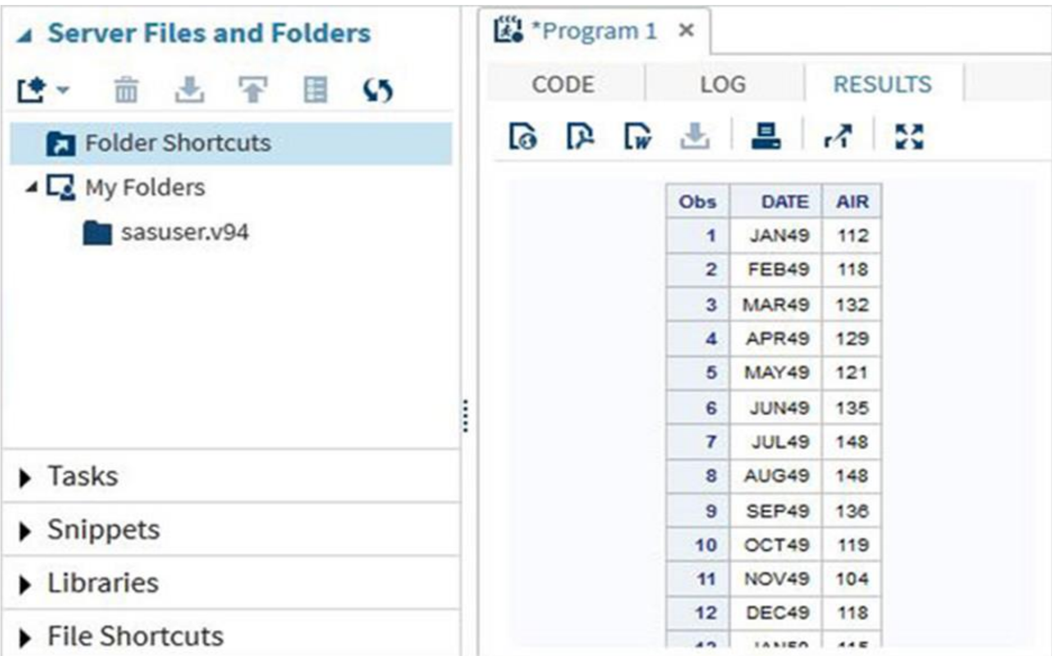
Program Log

The log of the executed code is available under the **Log** tab. It describes the errors, warnings or notes about the program's execution. This is the window where you get all the clues to troubleshoot your code.



Program Result

The result of the code execution is seen in the RESULTS tab. By default, they are formatted as html tables.



End of ebook preview

If you liked what you saw…

Buy it from our store @ **https://store.tutorialspoint.com**