



**Getting Started  
with SAS<sup>®</sup> Programming**

# **Using SAS<sup>®</sup> Studio in the Cloud**



**Ron Cody**

The correct bibliographic citation for this manual is as follows: Cody, Ron. 2021. *Getting Started with SAS® Programming: Using SAS® Studio in the Cloud*. Cary, NC: SAS Institute Inc.

### **Getting Started with SAS® Programming: Using SAS® Studio in the Cloud**

Copyright © 2021, SAS Institute Inc., Cary, NC, USA

ISBN 978-1-953329-20-2 (Hardcover)

ISBN 978-1-953329-16-5 (Paperback)

ISBN 978-1-953329-17-2 (Web PDF)

ISBN 978-1-953329-18-9 (EPUB)

ISBN 978-1-953329-19-6 (Kindle)

All Rights Reserved. Produced in the United States of America.

**For a hard copy book:** No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, or otherwise, without the prior written permission of the publisher, SAS Institute Inc.

**For a web download or e-book:** Your use of this publication shall be governed by the terms established by the vendor at the time you acquire this publication.

The scanning, uploading, and distribution of this book via the Internet or any other means without the permission of the publisher is illegal and punishable by law. Please purchase only authorized electronic editions and do not participate in or encourage electronic piracy of copyrighted materials. Your support of others' rights is appreciated.

**U.S. Government License Rights; Restricted Rights:** The Software and its documentation is commercial computer software developed at private expense and is provided with RESTRICTED RIGHTS to the United States Government. Use, duplication, or disclosure of the Software by the United States Government is subject to the license terms of this Agreement pursuant to, as applicable, FAR 12.212, DFAR 227.7202-1(a), DFAR 227.7202-3(a), and DFAR 227.7202-4, and, to the extent required under U.S. federal law, the minimum restricted rights as set out in FAR 52.227-19 (DEC 2007). If FAR 52.227-19 is applicable, this provision serves as notice under clause (c) thereof and no other notice is required to be affixed to the Software or documentation. The Government's rights in Software and documentation shall be only those set forth in this Agreement.

SAS Institute Inc., SAS Campus Drive, Cary, NC 27513-2414

February 2021

SAS® and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.

SAS software may be provided with certain third-party software, including but not limited to open-source software, which is licensed under its applicable third-party software license agreement. For license information about third-party software distributed with SAS software, refer to <http://support.sas.com/thirdpartylicenses>.

# Contents

<b>About This Book</b> .....	<b>ix</b>
<b>About The Author</b> .....	<b>xi</b>
<b>Acknowledgements</b> .....	<b>xiii</b>
<b>Part I: Getting Acquainted with the SAS Studio Environment</b> .....	<b>1</b>
<b>Chapter 1: Introduction to SAS OnDemand for Academics</b> .....	<b>3</b>
Introduction: An Overview of SAS OnDemand for Academics .....	3
Registering for ODA .....	4
Conclusion.....	10
<b>Chapter 2: The SAS Studio Interface</b> .....	<b>11</b>
Introduction.....	11
Exploring the Built-In Data Sets.....	13
Sorting Your Data .....	17
Switching between Column Names and Column Labels .....	18
Resizing Tables.....	19
Creating Filters .....	20
Conclusion.....	22
<b>Chapter 3: Importing Your Own Data</b> .....	<b>23</b>
Introduction.....	23
Uploading Data from Your Local Computer to SAS Studio.....	23
Listing the SAS Data Set.....	36
Importing an Excel Workbook with Invalid SAS Variable Names .....	41
Importing an Excel Workbook That Does Not Have Variable Names.....	42
Importing Data from a CSV File.....	43
Conclusion.....	43
<b>Chapter 4: Creating Reports</b> .....	<b>45</b>
Introduction.....	45
Using the List Data Task to Create a Simple Listing .....	46
Filtering Data .....	52
Sorting Data .....	54
Outputting HTML and PDF Files .....	59
Joining Tables (Using the Query Window) .....	61
Conclusion.....	68

<b>Chapter 5: Summarizing Data Using SAS Studio .....</b>	<b>69</b>
Introduction .....	69
Summarizing Numeric Variables .....	69
Adding a Classification Variable .....	73
Summarizing Character Variables .....	75
Conclusion .....	77
<b>Chapter 6: Graphing Data .....</b>	<b>79</b>
Introduction .....	79
Creating a Frequency Bar Chart .....	79
Creating a Bar Chart with a Response Variable .....	82
Adding a Group Variable .....	83
Creating a Pie Chart .....	85
Creating a Scatter Plot .....	86
Conclusion .....	88
<b>Part II: Learning How to Write Your Own SAS Programs .....</b>	<b>89</b>
<b>Chapter 7: An Introduction to SAS Programming .....</b>	<b>91</b>
SAS as a Programming Language .....	91
The SAS Studio Programming Windows .....	92
Your First SAS Program .....	92
How the DATA Step Works .....	98
How the INPUT Statement Works .....	102
Reading Delimited Data .....	102
How Procedures (PROCs) Work .....	105
How SAS Works: A Look Inside the “Black Box” .....	106
Conclusion .....	107
<b>Chapter 8: Reading Data from External Files .....</b>	<b>109</b>
Introduction .....	109
Reading Data Values Separated by Delimiters .....	109
Reading Data in Fixed Columns .....	114
Conclusion .....	118
Problems .....	118
<b>Chapter 9: Reading and Writing SAS Data Sets .....</b>	<b>121</b>
What’s a SAS Data Set? .....	121
Temporary Versus Permanent SAS Data Sets .....	123
Creating a Library by Submitting a LIBNAME Statement .....	124
Using the Library Tab to Create a Permanent Library .....	126
Reading from a Permanent SAS Data Set .....	127
Conclusion .....	128
Problems .....	128

<b>Chapter 10: Creating Formats and Labels .....</b>	<b>129</b>
What Is a SAS Format and Why Is It Useful?.....	129
Using SAS Built-in Formats .....	136
More Examples to Demonstrate How to Write Formats .....	136
Describing the Difference between a FORMAT Statement in a Procedure and a FORMAT Statement in a DATA Step .....	137
Making Your Formats Permanent.....	138
Creating Variable Labels .....	140
Conclusion.....	141
Problems .....	141
<b>Chapter 11: Performing Conditional Processing .....</b>	<b>143</b>
Introduction.....	143
Grouping Age Using Conditional Processing.....	143
Using Conditional Logic to Check for Data Errors .....	146
Describing the IN Operator.....	147
Using Boolean Logic (AND, OR, and NOT Operators).....	148
A Special Caution When Using Multiple OR Operators .....	149
Conclusion.....	151
Problems .....	151
<b>Chapter 12: Performing Iterative Processing: Looping .....</b>	<b>153</b>
Introduction.....	153
Demonstrating a DO Group.....	153
Describing a DO Loop .....	154
Using a DO Loop to Graph an Equation.....	157
DO Loops with Character Values .....	158
Leaving a Loop Based on Conditions (DO WHILE and DO UNTIL Statements) .....	159
LEAVE and CONTINUE Statements .....	162
Conclusion.....	164
Problems .....	164
<b>Chapter 13: Working with SAS Dates.....</b>	<b>167</b>
Introduction.....	167
Reading Dates from Text Data .....	168
Creating a SAS Date from Month, Day, and Year Values .....	170
Describing a Date Constant.....	170
Extracting the Day of the Week, Day of the Month, Month, and Year from a SAS Date.....	172
Adding a Format to the Bar Chart.....	174
Computing Age from Date of Birth: The YRDIF Function .....	175
Conclusion.....	176
Problems .....	176

<b>Chapter 14: Subsetting and Combining SAS Data Sets .....</b>	<b>179</b>
Introduction .....	179
Subsetting (Filtering) Data in a SAS Data Set.....	179
Describing a WHERE= Data Set Option .....	182
Describing a Subsetting IF Statement.....	183
A More Efficient Way to Subset Data When Reading Raw Data.....	184
Creating Several Data Subsets in One DATA Step.....	185
Combining SAS Data Sets (Combining Rows).....	185
Adding a Few Observations to a Large Data Set (PROC APPEND).....	187
Interleaving Data Sets .....	188
Merging Two Data Sets (Adding Columns) .....	188
Controlling Which Observations Are Included in a Merge (IN= Data Set Option).....	190
Performing a One-to-Many or Many-to-One Merge.....	192
Merging Two Data Sets with Different BY Variable Names.....	194
Merging Two Data Sets with One Character and One Numeric BY Variable .....	196
Updating a Master File from a Transaction File (UPDATE Statement).....	199
Conclusion .....	201
Problems .....	202
<b>Chapter 15: Describing SAS Functions .....</b>	<b>205</b>
Introduction .....	205
Describing Some Useful Numeric Functions .....	206
Describing Some Useful Character Functions.....	217
Conclusion .....	232
Problems .....	232
<b>Chapter 16: Working with Multiple Observations per Subject .....</b>	<b>235</b>
Introduction .....	235
Useful Tools for Working with Longitudinal Data.....	235
Describing First. and Last. Variables.....	236
Computing Visit-to-Visit Differences.....	237
Computing Differences between the First and Last Visits .....	238
Counting the Number of Visits for Each Patient .....	239
Conclusion .....	241
Problems .....	241
<b>Chapter 17: Describing Arrays.....</b>	<b>243</b>
Introduction .....	243
What Is an Array?.....	243
Describing a Character Array .....	245
Performing an Operation on Every Numeric Variable in a Data Set.....	246
Performing an Operation on Every Character Variable in a Data Set .....	247
Converting a Data Set with One Observation per Subject into a Data Set with Multiple Observations per Subject.....	248

Converting a Data Set with Multiple Observations per Subject into a Data Set with One Observation per Subject.....	249
Conclusion.....	251
Problems .....	251
<b>Chapter 18: Displaying Your Data.....</b>	<b>253</b>
Introduction.....	253
Producing a Simple Report Using PROC PRINT .....	253
Using Labels Instead of Variable Names as Column Headings .....	256
Including a BY Variable in a Listing.....	258
Including the Number of Observations in a Listing .....	259
Conclusion.....	260
Problems .....	260
<b>Chapter 19: Summarizing Data with SAS Procedures .....</b>	<b>261</b>
Introduction.....	261
Using PROC MEANS (with the Default Options).....	261
Using PROC MEANS Options to Customize the Summary Report.....	264
Computing Statistics for Each Value of a BY Variable .....	265
Using a CLASS Statement Instead of a BY Statement .....	267
Including Multiple CLASS Variables with PROC MEANS.....	268
Statistics Broken Down Every Way .....	268
Using PROC MEANS to Create a Summary Data Set .....	269
Letting PROC MEANS Name the Variables in the Output Data Set.....	271
Creating a Summary Data Set with CLASS Variables.....	272
Using a Formatted CLASS Variable .....	273
Demonstrating PROC UNIVARIATE .....	274
Conclusion.....	278
Problems .....	279
<b>Chapter 20: Computing Frequencies .....</b>	<b>281</b>
Introduction.....	281
Creating a Data Set to Demonstrate Features of PROC FREQ .....	281
Using PROC FREQ to Generate One-Way Frequency Tables .....	283
Creating Two-Way Frequency Tables .....	285
Creating Three-Way Frequency Tables.....	287
Using Formats to Create Groups for Numeric Variables .....	288
Conclusion.....	289
Problems .....	289
<b>Index.....</b>	<b>291</b>





# About This Book

## What Does This Book Cover?

This book has two goals: the first is to show readers how to use a free version of SAS called SAS OnDemand for Academics, including how to use point-and-click menus to view, summarize, and analyze data using built-in SAS Studio tasks. The second goal is to teach readers how to program using SAS.

The first part of the book shows readers how to register for SAS OnDemand for Academics. The remaining chapters in this section explore how to use the SAS Studio tasks to inspect, summarize, display, and, finally, how to create graphical representations of data.

The second part of the book is an introduction to SAS programming. Starting from basic concepts, this part of the book discusses conditional logic, looping, SAS functions, and some slightly more advanced topics such as how to analyze longitudinal data and transform SAS data sets.

Although this book covers basic and intermediate topics, more advanced topics such as SAS date interval functions and Perl regular expressions are not covered.

## Is This Book for You?

This book is appropriate for beginners as well as intermediate programmers. Even people with advanced SAS programming skills might find this book useful to learn how to use SAS Studio tasks in a cloud-based environment.

## What Are the Prerequisites for This Book?

There are essentially no prerequisites for people thinking about buying this book.

## What's New in This Edition?

Parts of this book are similar to an earlier book called *An Introduction to SAS® University Edition*. However, because that book used SAS University Edition while this book uses SAS OnDemand for Academics, it should rightfully be considered a new book and not a second edition of the older book.

## What Should You Know about the Examples?

This book includes tutorials for you to follow to gain hands-on experience with SAS. All the programs and data sets used in the text, as well as data used for the end-of-chapter problems, are included in a free download from the SAS author site. Every topic in the programming section is introduced by one or more examples.

### Software Used to Develop the Book's Content

Every program in the book was written and run using SAS OnDemand for Academics, the SAS cloud-based platform.

### Example Code and Data

You can access the example code and data for this book by linking to its author page at <https://support.sas.com/cody>.

### SAS OnDemand for Academics



This book is compatible with SAS OnDemand for Academics. If you are using SAS OnDemand for Academics, then begin here: [https://www.sas.com/en\\_us/software/on-demand-for-academics.html](https://www.sas.com/en_us/software/on-demand-for-academics.html).

## Where Are the Exercise Solutions?

Solutions to the odd-numbered problems are included at the end of the book as well and in the free download from the author site. Self-learners or instructors can request the solutions to the even-numbered problems by contacting SAS Press.

## We Want to Hear from You

SAS Press books are written *by* SAS Users *for* SAS Users. We welcome your participation in their development and your feedback on SAS Press books that you are using. Please visit [sas.com/books](https://sas.com/books) to do the following:

- Sign up to review a book
- Recommend a topic
- Request information on how to become a SAS Press author
- Provide feedback on a book

Do you have questions about a SAS Press book that you are reading? Contact the author through [saspress@sas.com](mailto:saspress@sas.com) or [https://support.sas.com/author\\_feedback](https://support.sas.com/author_feedback).

SAS has many resources to help you find answers and expand your knowledge. If you need additional help, see our list of resources: [sas.com/books](https://sas.com/books).

# Chapter 1: Introduction to SAS OnDemand for Academics

Introduction: An Overview of SAS OnDemand for Academics .....	3
Registering for ODA.....	4
Conclusion .....	10

## Introduction: An Overview of SAS OnDemand for Academics

SAS is many things: A data analysis tool, a programming language, a statistical package, a tool for business intelligence, and more. Until recently, you could only get access to SAS by paying a license fee (this could be an individual license, or a license purchased by a company for as many users as necessary).

The really big news is that anyone can now obtain SAS for FREE! It’s called SAS OnDemand for Academics—but don’t be fooled by the name. **Anyone can use this free version of SAS, not just students enrolled in a class.**

Some of you might know about a SAS product called the SAS University Edition. This was another free version of SAS, but you had to download software to create a virtual computer on your real computer, then download the SAS software, and finally, set up a way to read and write files from your “real” computer to the “virtual computer.” This caused many people massive headaches (including this author). The great news about SAS OnDemand for Academics (hence forth called ODA – OnDemand for Academics) is that **you don’t have to download anything!** You access SAS on a cloud platform. Also, reading data from your real computer is quite simple.

And now for the caveats: This product was developed so that people can use it to learn how to program and run tasks using SAS. It is not supposed to be used for commercial purposes. One final note: there is a 5-gigabyte limit for data files, but that is certainly not a problem for learning how to use SAS.

On many college campuses, students taking statistics courses, or any course that needs a powerful analytic tool could access a computer language called R, for free. Since free is better than not free, these institutions sometimes choose to use R instead of SAS. That is fine, except that when these students graduate, they find that in the corporate world, SAS is by far the major package for powerful statistical analysis, data manipulation, and reporting. By offering a free version of SAS, users now have a choice between SAS or R and SAS Institute is hoping that the majority of users will choose SAS.

#### 4 Getting Started with SAS Programming

ODA uses SAS Studio as the interface. SAS Studio provides an environment that includes a point-and-click facility for performing many common tasks, such as producing reports, graphs, data summaries, and statistical tests. For those who either enjoy programming or have more complicated tasks, SAS Studio also enables you to write and run your own programs.

## Registering for ODA

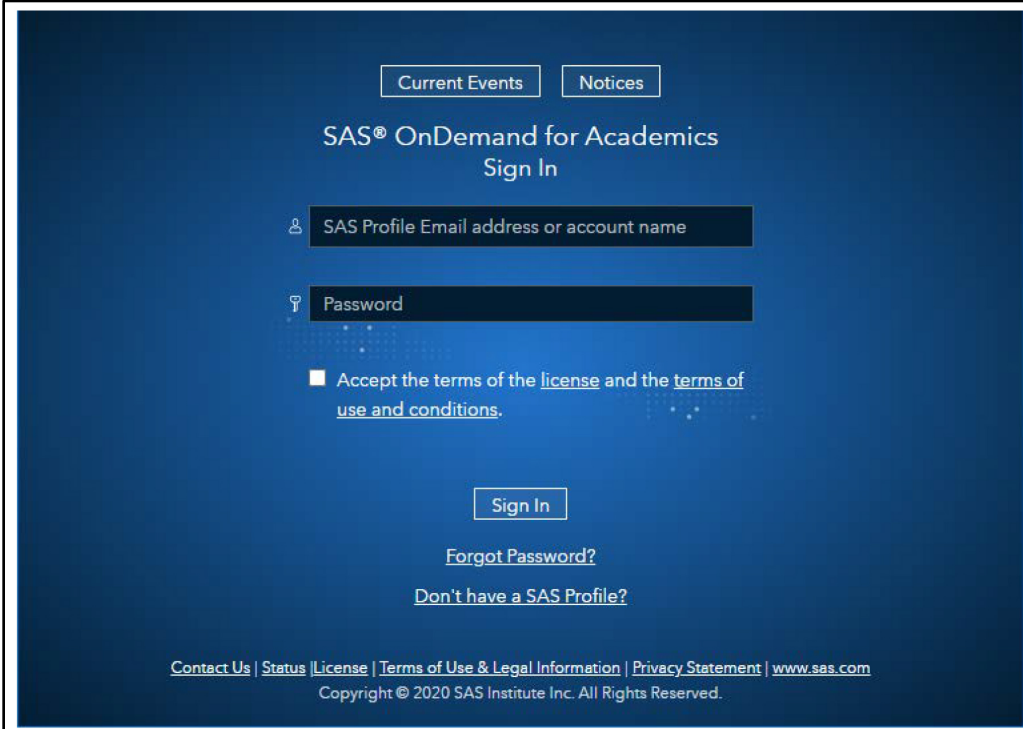
To gain access to ODA, you need to register with SAS Institute. Part of the registration process is to create a SAS profile. If you already have a SAS profile, skip that portion of the instructions.

To start, point your browser to:

<https://welcome.oda.sas.com>

This brings up the screen shown here.

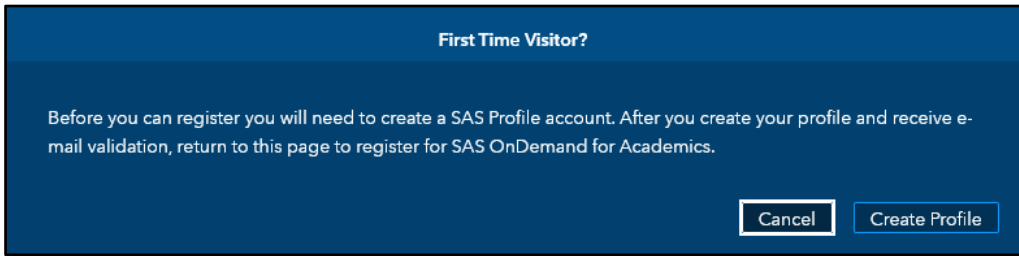
**Figure 1.1: Registration Screen for ODA**



The screenshot shows the SAS OnDemand for Academics Sign In page. At the top, there are two buttons: "Current Events" and "Notices". Below these is the title "SAS® OnDemand for Academics" and "Sign In". There are two input fields: "SAS Profile Email address or account name" and "Password". Below the password field is a checkbox labeled "Accept the terms of the [license](#) and the [terms of use and conditions](#)". At the bottom, there is a "Sign In" button, and two links: "Forgot Password?" and "Don't have a SAS Profile?". At the very bottom, there are links for "Contact Us", "Status", "License", "Terms of Use & Legal Information", "Privacy Statement", and "www.sas.com", followed by the copyright notice "Copyright © 2020 SAS Institute Inc. All Rights Reserved."


If you do not have a SAS Profile, click “Don’t have a SAS Profile.” You will see the screen shown in Figure 1.2.

Figure 1.2: First Time Visitor



Click Create Profile.

Figure 1.3: Enter Your Personal Information

 THE POWER TO KNOW. SAS Profile

Step 1 of 2: Tell us about yourself.

Preferred Language

First Name \*

Last Name \*

Email \*

Country/Region \*

Affiliation With SAS \*

Company/Organization \*

\*Required

By the way, if you are self-employed or “retired” as I am, just enter self-employed or retired, or whatever describes your situation.

Finally, click “Agree with terms” and click the box Create Profile.

Figure 1.4: Agree with Terms and Continue

Affiliation With SAS \*  
Customer/User

Company/Organization \*  
SAS Institute Inc

\*Required

Yes, I would like to receive occasional emails from SAS and its affiliates about SAS products, events, free white papers, special offers, etc. I understand that all personal information will be handled in accordance with the SAS Privacy Statement. [Learn more.](#)

I agree to the [terms of use and conditions.](#) \*

Create profile

After clicking "Create profile," you will receive a verification email with instructions for setting your password and activating your profile.

Figure 1.5: Verifying Your Email Address

**sas** | THE POWER TO KNOW. SAS Profile

**Thank you for creating a SAS Profile. You're almost done!**

A verification email has been sent to the address you provided. To verify your email address and activate your profile, click the link in the email (subject: *Please activate your SAS Profile*). You will then be prompted to set a password.

It may take a few minutes for the email to reach your inbox. If you do not receive the email, check your junk email folder.

To ensure that emails from SAS are not blocked by your mailserver, add [sas.com](#) to your list of safe sender domains.

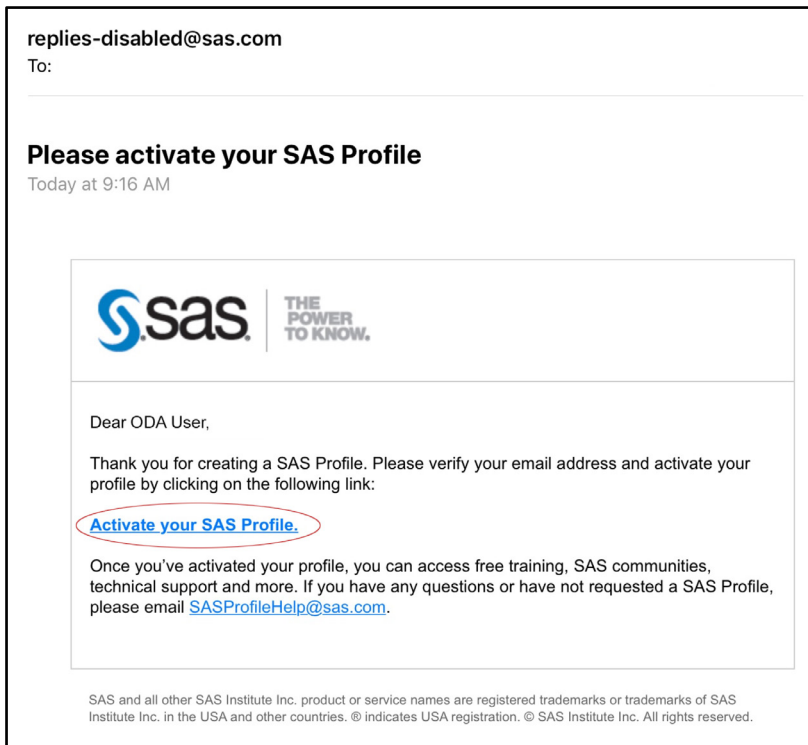
If you have trouble creating your SAS profile, send email to [SASProfileHelp@sas.com](mailto:SASProfileHelp@sas.com).

[Privacy Statement](#) | [Terms of Use and Legal Information](#)

Copyright © SAS Institute Inc. All rights reserved.

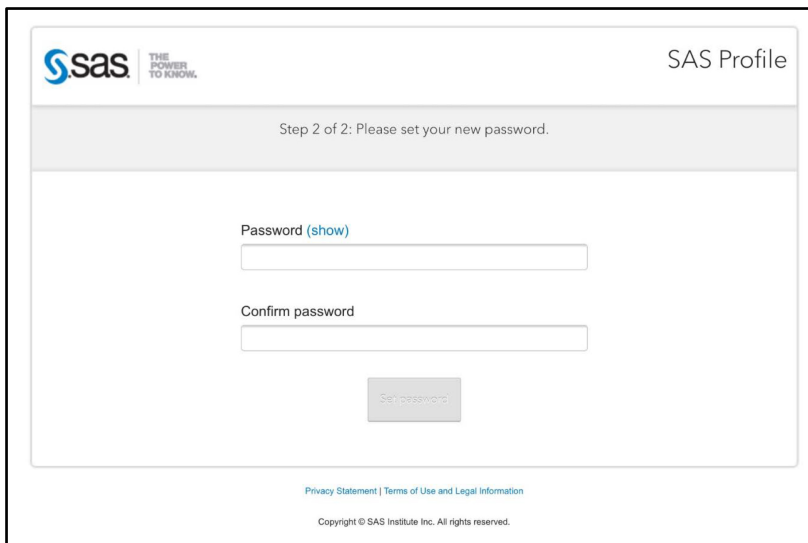
When your email arrives (this might take some time, perhaps a day), click “Activate your profile.”

**Figure 1.6: Activate Your Profile**



Choose your password and confirm.

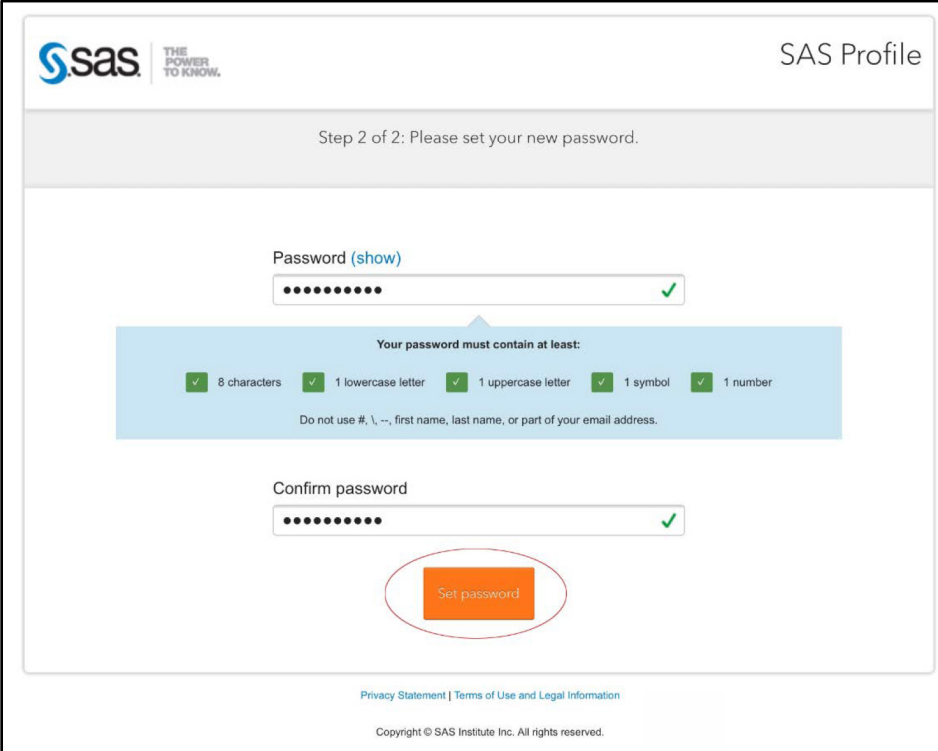
**Figure 1.7: Choose Your Password and Confirm**



## 8 Getting Started with SAS Programming

Note that your password must contain at least 8 characters and include at least 1 lowercase letter, 1 uppercase letter, 1 symbol, and 1 number.

**Figure 1.8: Continuing the Password Selection**



sas THE POWER TO KNOW SAS Profile

Step 2 of 2: Please set your new password.

Password (show) ✓

Your password must contain at least:

- ✓ 8 characters
- ✓ 1 lowercase letter
- ✓ 1 uppercase letter
- ✓ 1 symbol
- ✓ 1 number

Do not use #, \, --, first name, last name, or part of your email address.

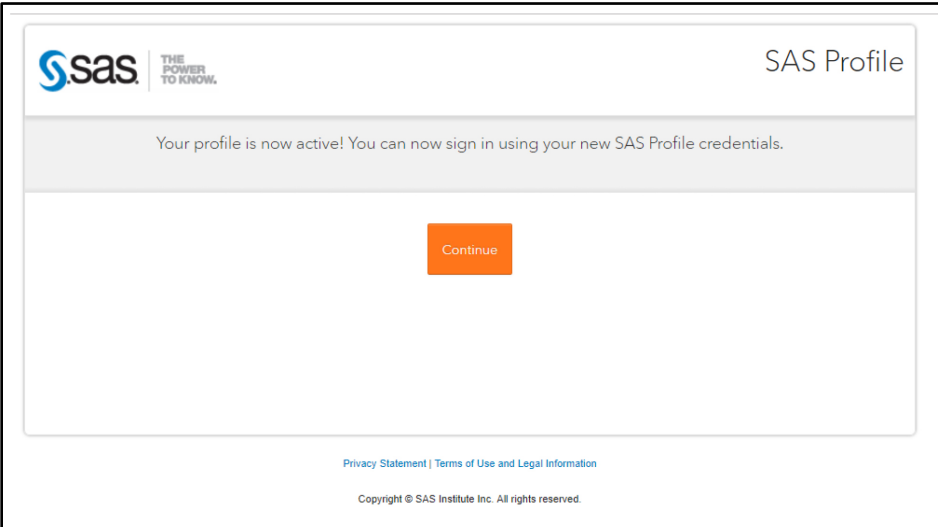
Confirm password ✓

Set password

[Privacy Statement | Terms of Use and Legal Information](#)

Copyright © SAS Institute Inc. All rights reserved.

**Figure 1.9: A Verification Email Will be Sent**



sas THE POWER TO KNOW SAS Profile

Your profile is now active! You can now sign in using your new SAS Profile credentials.

Continue

[Privacy Statement | Terms of Use and Legal Information](#)

Copyright © SAS Institute Inc. All rights reserved.



You are now ready to sign in to OnDemand for Academics (ODA).

**Figure 1.10: Signing into OnDemand**

The screenshot shows the SAS OnDemand for Academics Sign In page. At the top, there are two buttons: "Current Events" and "Notices". Below them is the title "SAS® OnDemand for Academics Sign In". There are two input fields: "SAS Profile Email address or account name" and "Password". Below the password field is a checkbox labeled "Accept the terms of the [license](#) and the [terms of use and conditions](#)." Below the checkbox is a "Sign In" button. Below the "Sign In" button are two links: "Forgot Password?" and "Don't have a SAS Profile?". At the bottom, there is a footer with links: "Contact Us | Status | License | Terms of Use & Legal Information | Privacy Statement | www.sas.com" and "Copyright © 2020 SAS Institute Inc. All Rights Reserved."

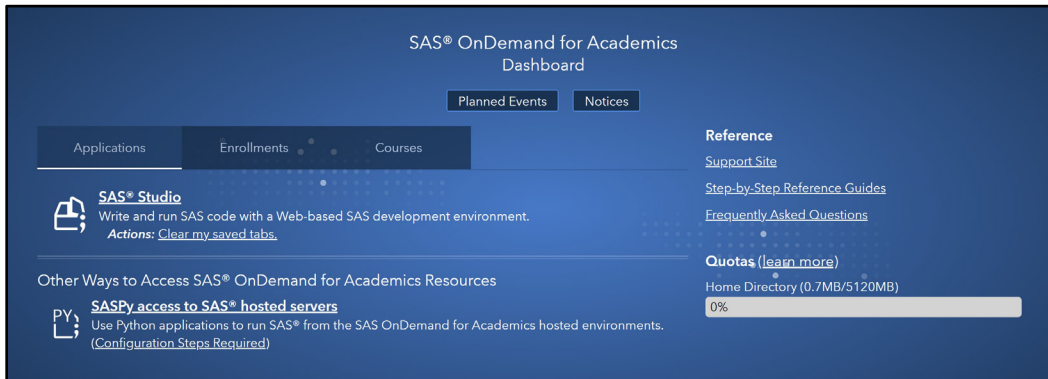
Be sure to accept terms and then click “Sign In.” You will be asked to select a region.

**Figure 1.11: Select a Region**

The screenshot shows a dialog box titled "Need help selecting your home region?". Below the title is a horizontal line. Below the line is the text: "In most cases, the site performance from your typical usage location will indicate the best choice. Below, you can perform a simple test to estimate that performance if you are currently at that location." Below the text is a button labeled "Compare Performance of All Regions". Below the button is another horizontal line. Below the line is the text: "Alternatively, we can suggest a region based on your expected usage location if you select that location below. If you are currently at that location, you can select **(Current Location)** to detect it automatically." Below the text is a dropdown menu with the text "(Current Location)" and a downward arrow. Below the dropdown menu is a button labeled "Suggest".

You are done. Once you have received an email saying that your account is ready to use, you can select SAS Studio.

**Figure 1.12: Start SAS Studio**



Click SAS Studio.

## Conclusion

Registering for OnDemand for Academics is really quick and easy. Just follow all the prompts and it should only take a few minutes of your time (you will need to wait for your profile to be accepted).

# Ready to take your SAS<sup>®</sup> and JMP<sup>®</sup> skills up a notch?



Be among the first to know about new books,  
special events, and exclusive discounts.


**[support.sas.com/newbooks](https://support.sas.com/newbooks)**

Share your expertise. Write a book with SAS.

**[support.sas.com/publish](https://support.sas.com/publish)**

Continue your skills development with free online learning.

**[www.sas.com/free-training](https://www.sas.com/free-training)**

 [sas.com/books](https://sas.com/books)  
for additional books and resources.

  
**THE POWER TO KNOW.**

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. \* indicates USA registration.  
Other brand and product names are trademarks of their respective companies. © 2020 SAS Institute Inc. All rights reserved. M2063821 US.1120