

SAS Academy For Clinical Programming

1. [BASE SAS PROGRAMMER \(Hours: 52\)](#)

This course is for users who want to learn how to write SAS programs to access, explore, prepare, and analyze data. It is the entry point to learning SAS programming for data science, machine learning, and artificial intelligence. It is a prerequisite to many other SAS courses. If you do not plan to write SAS programs and you prefer a point-and-click interface, you should attend the *SAS Enterprise Guide 1: Querying and Reporting* course.

Learn how to

- use SAS Studio and SAS Enterprise Guide to write and submit SAS programs
- access SAS, Microsoft Excel, and text data
- explore and validate data
- prepare data by sub setting rows and computing new columns
- analyze and report on data
- export data and results to Excel, PDF, and other formats
- use SQL in SAS to query and join tables.
- understand and control DATA step processing
- create an accumulating column and process data in groups
- manipulate data with functions
- convert column type
- create custom formats
- concatenate and merge tables
- process repetitive code
- restructure tables.

Prerequisites

Before attending this course, you should have experience using computer software. Specifically, you should be able to

- understand file structures and system commands on your operating systems
- access data files on your operating systems.

No prior SAS experience is needed.

Software Addressed

Base SAS This course also addresses SAS/ACCESS Interface to PC Files.

Course Contents

Essentials

- the SAS programming process

- using SAS programming tools
- understanding SAS syntax

Accessing Data

- understanding SAS data
- accessing data through libraries
- importing data into SAS

Exploring and Validating Data

- exploring data
- filtering rows
- formatting columns
- sorting data and removing duplicates

Preparing Data

- reading and filtering data
- computing new columns
- conditional processing

Analyzing and Reporting on Data

- enhancing reports with titles, footnotes, and labels
- creating frequency reports
- creating summary statistics reports

Exporting Results

- exporting data
- exporting reports

Using SQL in SAS

- using Structured Query Language in SAS
- joining tables using SQL in SAS

Controlling DATA Step Processing

- setting up for this course
- understanding DATA step processing
- directing DATA step output

Summarizing Data

- creating an accumulating column

- processing data in groups

Manipulating Data with Functions

- understanding SAS functions and CALL routines
- using numeric and date functions
- using character functions
- using special functions to convert column type

Creating Custom Formats

- creating and using custom formats
- creating custom formats from tables

Combining Tables

- concatenating tables
- merging tables
- identifying matching and nonmatching rows

Processing Repetitive Code

- using iterative DO loops
- using conditional DO loops

Restructuring Tables

- restructuring data with the DATA step
- restructuring data with the TRANSPOSE procedure

Array Processing in Data Step

- Introduction to table Lookup Techniques
- One-Dimensional Arrays
- Multidimensional Arrays
- Loading a Multidimensional Array from a SAS Data set

2. Introduction to Clinical Trials Research (Hours: 2)

- Environment and Guiding Principles
- Preparing Clinical Trial Data
- Classifying Clinical Trial Data

3. CDISC Study Data Tabulation Model (SDTM) Guidelines (Hours: 3)

- Introduction to Clinical Data Interchange Standards Consortium (CDISC)
- Fundamentals of the Study Data Tabulation Model (SDTM)

- The General Observations Class
 - Interventions Class
 - Events Class
 - Findings Class
- Datasets Other than General Observation
 - Models for Special-Purpose Domains
 - Trial Design Model (TDM) Datasets
 - Relationship Datasets
 - Study Reference Datasets
- Assumptions for Domain Models

4. Implementing the CDISC SDTM with Base SAS (Hours: 10)

- Base SAS Programs for SDTM Conversions
- Building SDTM Datasets
 - Building the Special-Purpose DM and SUPPDM Domains
 - Building the AE Events Domain
 - Building the LB Finding Domain

5. CDISC Analysis Dataset Model (ADaM) Guidelines (Hours: 2)

- Fundamentals of ADaM
- Subject-Level Analysis Dataset (ADSL)
- Basic Data Structure (BDS)

6. Implementing the CDISC ADaM with Base SAS (Hours: 10)

- Building the Subject-Level Analysis Dataset (ADSL)
- Building the Adverse Events Analysis Dataset (ADAE)

7. SAS SQL 1: Essentials (Hours: 20)

This course teaches you how to process SAS data using Structured Query Language (SQL).

Learn how to

- query and subset data
- summarize and present data
- combine tables, including complex joins and merges
- create and modify table views and indexes
- replace multiple DATA and PROC steps with one SQL query.

Course Materials

Registered students will be able to download the course materials from the Web prior to the class. These materials may include a .pdf copy of the course notes, a .pdf copy of the course workbook, and exercise files. To understand how to participate in a Live Web class and what to expect, print and review the [Quick Reference](#) (.pdf)

Software Addressed

Base SAS This course is appropriate for students who are using SAS 9 software.

Course Contents

Introduction

- overview of SAS Foundation
- course logistics
- course data files
- introducing the Structured Query Language

Basic Queries

- overview of the SQL procedure
- specifying columns
- specifying rows

Displaying Query Results

- presenting data
- summarizing data

SQL Joins

- introduction to SQL joins
- inner joins
- outer joins
- complex SQL joins

Subqueries

- noncorrelated subqueries
- in-line views

Set Operators

- introduction to set operators
- the UNION operator
- the OUTER UNION operator
- the EXCEPT operator
- the INTERSECT operator

Creating Tables and Views

- creating tables with the SQL procedure
- creating views with the SQL procedure

Advanced PROC SQL Features

- dictionary tables and views
- using SQL procedure options
- interfacing PROC SQL with the macro language

Learning More

- SAS resources
- beyond this course

8. [SAS Macro Language 1: Essentials](#) (Hours: 20)

This course focuses on the components of the SAS macro facility and how to design, write, and debug macro systems. Emphasis is placed on understanding how programs with macro code are processed.

Learn how to

- perform text substitution in SAS code
- automate and customize the production of SAS code
- conditionally or iteratively construct SAS code
- use macro variables and macro functions.

Course Materials

Registered students will be able to download the course materials from the Web prior to the class. These materials may include a .pdf copy of the course notes, a .pdf copy of the course workbook, and exercise files. To understand how to participate in a Live Web class and what to expect, print and review the [Quick Reference](#) (.pdf).

Software Addressed

Base SAS This course is appropriate for students who are using SAS 9 software.

Course Contents

Introduction

- course logistics
- purpose of the macro facility
- program flow

Macro Variables

- introduction to macro variables
- automatic macro variables
- macro variable references
- user-defined macro variables
- delimiting macro variable references

- macro functions

Macro Definitions

- defining and calling a macro
- macro parameters

DATA Step and SQL Interfaces

- creating macro variables in the DATA step
- indirect references to macro variables
- creating macro variables in SQL

Macro Programs

- conditional processing
- parameter validation
- iterative processing
- global and local symbol tables

Learning More

- SAS resources
- beyond this course

Supplemental Materials

- program flow

9. [Implementing the CDISC SDTM and ADaM with Macro Programming and SQL \(Hours: 5\)](#)

- Use SQL Procedure to create Data sets
 - Use CREATE TABLE query to create Study Tabulations and Analysis Datasets
 - Use Join and Union clauses to combine multiple tables
- Use Macro Programming to automate tasks
 - Create a macro to derive ISO8601 date string from SAS date or datetime component variables
 - Create a macro to derive SDTM study day variable
 - Create a macro to calculate change from baseline

10. [SAS Report Writing: Essentials \(Hours: 24\)](#)

This course teaches you how to create detail and summary tabular reports using Base SAS procedures. You also learn how to enhance your reports using the Output Delivery System (ODS).

Learn how to

- Enhance PROC PRINT detail tabular reports.
- Create PROC TABULATE summary tabular reports.
- Create PROC REPORT detail and summary tabular reports.
- Send report output to third-party and SAS ODS destinations.
- Enhance reports using ODS options and statements.

Course Materials

Registered students will be able to download the course materials from the Web prior to the class. These materials may include a .pdf copy of the course notes, a .pdf copy of the course workbook, and exercise files. To understand how to participate in a Live Web class and what to expect, print and review the [Quick Reference](#) (.pdf).

Software Addressed

Base SAS This course is appropriate for students who are using SAS 9 software.

Course Contents

Introduction to Reporting and ODS

- Course logistics.
- Introduction to reporting.
- Introduction to ODS.
- ODS with the SAS interfaces.
- Creating reports with the PRINT procedure.

Getting Started with the TABULATE Procedure

- Introduction to the TABULATE procedure.
- Creating the structure of the table.
- Adding overall summarizations.
- Adding additional statistics.

Doing More with the TABULATE Procedure

- Enhancing with labels and formats.
- Enhancing with options.
- Adding trafficlighting.
- Adding additional style attributes.

Getting Started with the REPORT Procedure

- Introduction to the REPORT procedure.
- Creating a detail report.
- Creating a summary report with the GROUP usage.
- Creating a summary report with the ACROSS usage.
- Computing an additional column.

Doing More with the REPORT Procedure

- Adding summary lines.
- Customizing break lines.
- Adding trafficlighting and style attributes.
- Using the CALL DEFINE statement.

Using ODS Destinations

- Introduction to ODS destinations.
- PRINTER and RTF destinations.
- CSV and HTML destinations.
- Excel and other destinations.
- SAS destinations.

Doing More with ODS

- Using ODS options and statements.
- Using ODS ESCAPECHAR.
- Controlling bookmarks and the table of contents.
- Using ODS layout.

Introduction to SG Procedures

- Introduction to ODS Graphics.
- Using the SG procedures.

11. Data Visualization Using SAS ODS Graphics (Hours: 24)

This course teaches you how to write SAS programs that use ODS Graphics to produce high-quality data visualizations. ODS Graphics is part of Base SAS.

Learn how to

- Use the SG PLOT procedure to create a wide variety of single-cell graphs.
- Use the SG PANEL and SG SCATTER procedures to create multi-cell graphs.
- Use the SG PIE procedure to create pie and donut charts.
- Use the SG MAP procedure to render maps with overlaid plots.
- Enhance visualizations with graph elements such as style attributes, axes, and legends.
- Customize visualizations by adding features from annotation or attribute map tables.
- Use ODS statements to deliver graphs in multiple formats.
- Use Graph Template Language to create graphs with the full ODS Graphics functionality.

Course Contents

Getting Started

- Setting up for this course.
- Data visualization with SAS programming overview.
- Layers of a graph.

SGPLOT Procedure

- Introduction.
- Bar charts.
- Dot, line, scatter, and series plots.
- Additional basic plots.
- Distribution plots.
- Fit and confidence plots.

Enhancing Visualization Appearance

- Style templates, colors, and fonts.
- Group attributes.
- Reference lines and text boxes.
- Axis appearance.
- Legend appearance.
- User-defined style templates.
- Additional statements and examples.

Multi-cell Procedures

- Introduction.
- SG PANEL procedure.
- SG SCATTER procedure.

Additional Procedures

- SG PIE procedure.
- SG MAP procedure.

Customizing Visualizations

- Introduction to SG annotation.
- Drawing space.
- LINE and ARROW functions.
- TEXT and TEXTCONT functions.
- SG attribute maps.

More with ODS Graphics

- ODS GRAPHICS and destination statements.

- ODS layout.
- Statistical procedures.

Graph Template Language

- Introduction.
- Graph Template Language syntax.
- Dynamic and macro variables.

12. Tables, Listing, and Figures using GRAPH and REPORT Procedures (Hours: 5)

- Creating Tables
- Creating Listings
- Output Appearance Options
- Common Clinical Trial Graphs
- Exporting Data

13. Define.XML Basics (Hours: 2)

- Define.XML for CDISC SDTM
- Define.XML for CDISC ADaM
- Programming Considerations

14. Validation of SDTM and ADaM (Hours: 3)

- Reviewing Programming Log
- Using SAS Programming Procedures for Data Validation

15. Introduction to Statistics & Commonly used Methods (eLearning)

- Generate descriptive statistics and explore data with graphs.
- Perform analysis of variance and apply multiple comparison techniques.
- Perform linear regression and assess the assumptions.
- Use regression model selection techniques to aid in the choice of predictor variables in multiple regression.
- Use diagnostic statistics to assess statistical assumptions and identify potential outliers in multiple regression.
- Use chi-square statistics to detect associations among categorical variables.
- Fit a multiple logistic regression model.
- Score new data using developed models.

SAS Certification exams & Credentials

This course is mapped to TWO credentials as below:

1. SAS Certified Specialist: Base Programming Using SAS 9.4
2. SAS Certified Professional: Clinical Trials Programming Using SAS 9.4

Participants will be awarded SAS certified digital badges for these on clearing respective SAS exams

Besides participants will also be awarded participation certificate & Learn SAS digital badges for –

1. SAS Programming 1: Essentials
2. SAS Programming 2: Data Manipulation Techniques
3. SAS SQL1: Essentials
4. SAS Macro Language 1: Essentials
5. SAS Report Writing
6. Data Visualization Using SAS ODS Graphics
7. SAS Programming for Clinical Trials
8. Data Analysis and Reporting for Clinical Trials