

## Table of Contents

---

# Integration Skills Training from SAS and Teradata

Version 15.00.1

## Module 0 - Course Introduction

Teradata/SAS Course Overview .....	0-3
Introductions .....	0-4
Course Modules & Timings .....	0-5
Ground Rules .....	0-6

## Module 1 - Connectivity Testing & In-Database Processing

Recommended Best Practices .....	1-3
SAS/ACCESS Family of Products .....	1-4
Testing Teradata/SAS Connectivity .....	1-5
Typical SAS/Teradata Configurations .....	1-6
Classroom SAS Environment .....	1-7
Your Teradata & SAS Training Environment .....	1-8
Data Structures Used in Some Exercises .....	1-9
Class System Check .....	1-10
SAS Connectivity Check .....	1-11
Protecting Your Teradata Password .....	1-12
Encoding Your RDBMS Password .....	1-13
When Using a SAS Server .....	1-14
Example Code: Password Encoding & Using the Encoded Password .....	1-15
Log: Password Encoding .....	1-16
Log: Using the Encoded Password .....	1-17
Instructor-led Exercise – Using PWENCODE .....	1-18
More on Program Sharing .....	1-19
What is Teradata? .....	1-20
What is SAS? .....	1-21
Getting the Best of Both Worlds! .....	1-22
Supporting Architecture .....	1-23
SAS and Teradata Together .....	1-24
SAS Analytics: In-Database Principles .....	1-26
In-Database Processing .....	1-27
Does SAS Programming Change? .....	1-28
How to Listen in on SAS’ Conversation with Teradata .....	1-29
SAS Generally Talks to T/D Via SQL .....	1-30
Exercise: Traditional PROC FREQ .....	1-31

Associated Editor & Log File Windows.....	1-32
Exercise: In-Database PROC FREQ .....	1-33
Associated Log File Window .....	1-34
Exercise: PROC MEANS In-Database.....	1-35
Associated Log File .....	1-36
“Running In-Database”.....	1-37
Teradata LIBNAME Code Running In-Database.....	1-38
Do All PROC Options Apply? .....	1-39
Associated SAS Log .....	1-40
SQL to Calculate the Median .....	1-41
SQL to Calculate the Media .....	1-42

## Module 2 - Implicit and Explicit SQL Pass-Through

Recommended Practices.....	2-3
SAS/Teradata: Interface Options .....	2-4
Best Practice Study Relevant Documentation .....	2-5
SAS Connectivity to Teradata .....	2-6
GUI Pitfall to Avoid: Often, Double-Clicking = Download .....	2-7
SAS/Enterprise Guide & Teradata (Preview).....	2-8
Implicit SQL Pass-Through: SAS/ACCESS .....	2-9
Implicit SQL Pass-Through: Steps .....	2-10
Implicit SQL Pass-Through: Cautions.....	2-11
Implicit SQL Pass-Through: Guidelines .....	2-12
How to Tell What Functions Are Passed to Teradata.....	2-13
(Partial) Results .....	2-14
SAS Functions Automatically Passed to Teradata – via Implicit SQL Pass-Through .....	2-15
Enabling Dynamic Function Mapping.....	2-16
SQL_FUNCTIONS – Used to Extend Translations .....	2-17
Teradata LIBNAME Code Running In-Database.....	2-18
Implicit SQL Pass-Through: Guidelines .....	2-19
Implicit SQL Pass-Through: Another Example .....	2-20
Explicit SQL Pass-Through: SAS/ACCESS .....	2-22
Explicit SQL Pass-Through: Example.....	2-23
Code Submitted Subsequently .....	2-24
Teradata Explain .....	2-25
Explicit SQL Pass-Through: SAS/ACCESS .....	2-26
Example .....	2-27
Another Example .....	2-28
Summary: The Two Standard Templates for Teradata SQL Submission from SAS .....	2-29
Practice Exercises – Using Base SAS .....	2-30
DBCONDITION: Key Data Set Option .....	2-31
Exercise.....	2-32
One Solution .....	2-33
Log File Excerpt .....	2-34
What if DBCONDITION had been used...? .....	2-35
LOG File Excerpt .....	2-36

SAS Output Window .....	2-37
Reason for This Behavior .....	2-38
Other Ways to Code This .....	2-39
Solutions.....	2-40
Associated Log File Excerpts .....	2-41
Options to Predict In-Database Results.....	2-43
Example .....	2-44
SAS Log Excerpt .....	2-45

## Module 3 - Teradata Concepts Every SAS User Should Know

Basic Teradata Terms.....	3-4
Bringing Basic Terms to Life.....	3-5
(Relevant) Teradata Database Objects .....	3-6
User Access Rights .....	3-7
User Defined Functions .....	3-8
Example Scoring UDF .....	3-9
User Defined Functions .....	3-10
SQL_FUNCTIONS & Teradata UDF's.....	3-11
Understanding SPOOL Space .....	3-12
SQL to Monitor Spool.....	3-13
Example (No Other Query Running) .....	3-14
Teradata Viewpoint: Best Way to Monitor/Manage Queries .....	3-15
Viewpoint: Aborting a Query/Session .....	3-16
What Makes Teradata So Fast?.....	3-17
Teradata Architecture – Nodes.....	3-18
Teradata Architecture – BYNET .....	3-19
Teradata Architecture as it Applies to a Typical Business Question .....	3-20
One Reason for Teradata's Speed .....	3-21
Example Data Definition Language (DDL) .....	3-22
Primary Keys and Primary Indexes Conceptually Different.....	3-23
How Does the Teradata Database Distribute Rows? .....	3-24
Primary Indexes .....	3-25
Creating a Primary Index .....	3-26
Primary Index Values.....	3-27
Accessing via a Unique Primary Index .....	3-28
Accessing via a Non-Unique Primary Index.....	3-29
Row Distribution Using a UPI .....	3-30
Row Distribution Using a NUPI .....	3-31
Row Distribution Using a Highly Non-Unique Index .....	3-32
Skewed Data .....	3-33
Access Using Partitioned Data.....	3-34
Logical Example of NPPI vs. PPI .....	3-35
Summary of PPI Benefits.....	3-36
(More) Teradata Indexes .....	3-37
Accessing Data without Indexes .....	3-38
SQL That Results in Full Table Scans .....	3-39

Sampling .....	3-40
Workflow Suggestions.....	3-41
Lesson: the Teradata Sampling Function .....	3-42
How Teradata Sampling Works.....	3-43
Sampling using the Sample Clause.....	3-44
Example Code.....	3-46
Other Sampling Notes or Considerations .....	3-47
SAS Data Set: Sample Creation .....	3-48
Associated SAS Log Excerpt.....	3-49
Exercise.....	3-50
Associated Log File .....	3-51
Temporary Tables.....	3-52
Suppose You Wanted to Build .....	3-53
SQL to Create Such a Table .....	3-54
SQL to Populate This Table .....	3-55
Submitting from SAS .....	3-56
Selected Volatile Table Features .....	3-57
Volatile Table Syntax .....	3-59
CREATE TABLE DDL SYNTAX .....	3-60
Simplest DDL Possible? .....	3-61
Column Data Type Attributes.....	3-62
Table Creation from Existing Tables.....	3-63
Example – CREATE TABLE AS Syntax .....	3-64
Better Example – Because Primary Index Explicitly Declared.....	3-66
Connection = GLOBAL Option .....	3-67
Connect Options: Mode and Case Sensitivity .....	3-68
How to Force Casespecific Comparisons in Teradata Mode.....	3-69
Recurrent Theme .....	3-70
How Should You Split Processing?.....	3-71
Similarities and Differences .....	3-72
Teradata and SAS – Similar Concepts.....	3-73
Teradata and SAS – Naming Conventions .....	3-74
Teradata and SAS – Data Types .....	3-75
SAS to SQL Translation Table .....	3-76
SAS to SQL Basics: Operators & Functions .....	3-77
SAS to SQL Basics: If-Then-Else .....	3-78

## Module 4 - Reading from & Writing to Teradata from SAS

Extracting Data from Teradata to SAS .....	4-4
Potential Uses for Teradata Source Tables .....	4-5
Default Extract Behavior and Options .....	4-6
Consideration 1: How Large is the Volume of Data?.....	4-7
Consideration 2: How often will the Data be Accessed by SAS?.....	4-8
Consideration 3: For What Purpose is the Data Being Accessed?.....	4-9
Coding Tips to Reduce Data Extract Size.....	4-10
Module 4: Lab Exercise #1 .....	4-11
Module 4: Lab Exercise #2 .....	4-12
Creating a SAS Data Set .....	4-13
Creating a SAS Data Set Method 1: Using a SAS Data Step .....	4-14
Creating a SAS Data Set Method 2: Using PROC SQL .....	4-17
Creating a SAS Data Set Method 3: Using FastExport .....	4-18
Revisiting an Earlier Example .....	4-19
Watch What Happens.....	4-20
Compare the Logs .....	4-21
Pitfall to Avoid: Load/Unload Utility Options on LIBNAMES .....	4-22
Creating a SAS Data Set Method 3: Using TPT FastExport .....	4-23
Creating a Text File from a Teradata Table – Using a SAS NULL Data Set .....	4-24
Writing Data to Teradata from SAS.....	4-25
Ways to Write Data to Teradata Tables .....	4-26
Key Point to Remember!.....	4-27
Temporary Table Handling.....	4-28
DBMSTEMP: SAS 9.2 Option .....	4-29
How to Create Such a Table, with Data.....	4-30
Associated Log File .....	4-31
Creating a More Optimal Table .....	4-32
Many SAS Syntax Forms to Drop a Table.....	4-33
Another Way to Create a Volatile Table.....	4-34
To Append Data from SAS .....	4-35
Associated Log File .....	4-36
Syntax to Delete Rows from a Table .....	4-37
Associated Log File .....	4-38
Consider the Following Variation .....	4-39
DBCOMMIT SAS Load Option .....	4-40
MULTISTMT SAS Load Option.....	4-41
Uploading/Writing a Permanent Table with FastLoad –SAS DATA Step Syntax.....	4-42
Uploading/Writing a Table with FastLoad – Using SAS PROC SQL Syntax .....	4-43
Example Syntax for Uploading acct_nbr .....	4-44
Note Resultant DDL.....	4-45
Module 4: Lab Exercise #3 .....	4-46
One Solution .....	4-47
Associated SAS Log .....	4-48
Uploading/Writing to a New Table with the FASTLOAD Option, SAS PROC SQL Syntax ..	4-49
Another Solution to the Exercise .....	4-50
Associated SAS Log .....	4-51

Joins .....	4-52
Explicit SQL Pass-Through.....	4-53
Associated SAS Log.....	4-54
Remember: GUI Tools Won't See Temporary Tables .....	4-55
Ways to Prove It's There .....	4-56
Merges and Joins .....	4-57
Useful SUGI Paper .....	4-58
Matching SAS & Teradata Concepts.....	4-59
Demonstration.....	4-61
PROC COMPARE.....	4-62
Resulting Output .....	4-63
Teradata-SAS Merge Behavior.....	4-64
Sorting Options.....	4-65
Ordering Tables and Data Sets Two MERGE Code Samples .....	4-66
Module 4: Lab Exercise #4.....	4-67
Module 4: Lab Exercise #5.....	4-68
SAS/ACCESS to Teradata – Data Set and Libname Options .....	4-69
SAS/ACCESS to Teradata – Data Set Options .....	4-70
Module 4: Independent Lab Exercise #1 .....	4-71
Module 4: Independent Lab Exercise #2 .....	4-72
Module 4: Independent Lab Exercise #3 .....	4-73
Module 4: Independent Lab Exercise #4 .....	4-74
Module 4: Independent Lab Exercise #5 .....	4-75
Module 4: Independent Lab Exercise #6 .....	4-76
Module 4: Review Questions.....	4-77

# Module 5 - Advanced SQL Structures SAS Can Exploit

Teradata Date Arithmetic .....	5-4
Sample Article.....	5-5
SYS_CALENDAR.CALENDAR.....	5-6
Example: Replacing Use of INTNX .....	5-7
BIGINT Handling (SAS Problem Note 39831).....	5-8
Exercise: BIGINT Handling .....	5-9
BIGINT Exercise .....	5-10
Teradata Subqueries .....	5-12
Code .....	5-13
Results .....	5-14
Derived Tables .....	5-15
Results .....	5-16
Consider These Four Queries.....	5-17
Results .....	5-18
Correlated Subqueries .....	5-19
One Solution .....	5-20
Results .....	5-21
Understanding Teradata Analytics.....	5-22
Ordered (or Windowed) Analytic(al) Functions .....	5-23
Consider the Following Table - TM_WORKSHOP.fc_transactionsns .....	5-24
Average Transaction Amount for Each Date .....	5-25
Results .....	5-26
But What about the Cumulative Average?.....	5-27
Syntax for Ordered Analytic Functions – Moving Averages.....	5-28
Interpreting the Syntax.....	5-29
SQL for the Cumulative Average .....	5-31
Cumulative Average, from SAS .....	5-32
Results .....	5-33
SQL for Cumulative & Moving Averages .....	5-34
Module 5: Lab Exercise # 1 .....	5-35
Module 5: Lab Exercise # 1 Discussion.....	5-36
Moving Differences .....	5-37
Module 5: Lab Exercise #2 .....	5-38
Module 5: Lab Exercise #2 Solution.....	5-39
Teradata Ranking Functions .....	5-40
Parameterizing Ranking Functions .....	5-41
Module 5: Lab Exercise #3 .....	5-42
Module 5: Lab Exercise #3 Solution.....	5-43
Descriptive Statistics.....	5-44
Module 5: Lab Exercise #4 .....	5-45
Variable Transformation Operations.....	5-46
Dummy Coding and Contrast Coding.....	5-47
Module 5: Lab Exercise #5 .....	5-48
Variable Recoding.....	5-49
Module 5: Lab Exercise #6 .....	5-50
Variable Rescaling .....	5-51

Module 5: Lab Exercise #7 .....	5-52
Standardization .....	5-53
Module 5: Lab Exercise #8 .....	5-54
Miscellaneous Transformations & Functions .....	5-56
Module 5: Lab Exercise #9 .....	5-57
Understanding Denormalization.....	5-59
Module 5: Lab Exercise #10.....	5-60
Module 5: Lab Exercise #10 Solution .....	5-61

## Module 6 - The Teradata Data Set Builder for SAS

Contents .....	6-3
What is the Teradata Data Set Builder for SAS?.....	6-4
How is this Tool Used?.....	6-5
What is the Data Set Builder for SAS?.....	6-6
Profiling Functions & Features.....	6-7
Data Reorganization/Transformation Functions.....	6-8
Using the Data Set Builder (or Profiler) 7 Basic Steps to Results.....	6-9
Demonstration or Instructor-Led Exercise .....	6-10
Step 5 .....	6-11
Steps 6 & 7.....	6-12
Variations.....	6-13
For SAS Users .....	6-14
Duplicate (Address) Checking.....	6-15
Explicit SQL Pass-Through.....	6-17
Example: Embedding Duplicate Check in SAS .....	6-18
Log File Results.....	6-19
Frequency Analysis .....	6-20
Frequency Analysis – Options.....	6-21
Values Analysis .....	6-22
For SAS Users... .....	6-23
Statistics Analysis .....	6-24
Compare to PROC MEANS (Module 1).....	6-25
Histogram Analysis .....	6-26
Data Reorganization & Transformation .....	6-28
Remember Cumulative Average? .....	6-29
Example Variable Creation.....	6-30
Results.....	6-31
Remember Subqueries? .....	6-32
Two Variable Creations Used.....	6-33
Subquery Embedding.....	6-34
Results.....	6-35
Module 5's Transformations.....	6-36
Remember Exercise #10 – Denormalization? .....	6-37
Results.....	6-38

## Module 7 - SAS/Enterprise Guide

Recommended Practices .....	7-3
SAS Enterprise Guide .....	7-4
SAS (the Company) & Enterprise Guide .....	7-8
Enterprise Guide – Behind the Scenes .....	7-9
Configure EG Properly .....	7-10
Turn on Debug Options & Project Logging.....	7-11
Where Should Options be Input? .....	7-12
Turn SQLGENERATION On.....	7-13
One-Way Frequencies = PROC FREQ .....	7-14
Associated Project Log .....	7-15
Summary Statistics = PROC MEANS .....	7-16
Turn DBIRECTEXEC On .....	7-17
Query Builder Pass-through Options .....	7-18
Use EG's PREVIEW Options.....	7-19
Leverage Info Maps & Stored Processes .....	7-20
Example of Sampling Stored Process .....	7-21
Pitfalls to Avoid .....	7-22