



What's New in Base SAS[®] 9.4 and SAS[®] Viya[®]

The correct bibliographic citation for this manual is as follows: SAS Institute Inc. 2013. *What's New in Base SAS® 9.4 and SAS® Viya®*. Cary, NC: SAS Institute Inc.

What's New in Base SAS® 9.4 and SAS® Viya®

Copyright © 2013, SAS Institute Inc., Cary, NC, USA

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

July 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.

9.4-P12:basewn

Contents

Chapter 1 / Details about the New Features in Base SAS 9.4 and SAS Viya	1
Create and Run Python Objects in SAS	2
SAS 9.4M5 and Later, Integration with SAS Viya	2
Cloud Analytic Services	5
DS2 Language	7
FedSQL Language	12
Hadoop Support	16
SAS LIBNAME Engine for SAS Federation Server	18
Execute the DATA Step in New Supported Environments	20
Debugging SAS Code	20
Output Delivery System (ODS)	20
ODS Statistical Graphics	25
Creating Accessible Output Using ODS and ODS Graphics	29
Creating Maps Using ODS Graphics and Mapping Procedures	30
Performance	32
Extended Variable and Data Set Attributes	32
Locked-Down State	33
Preserving the SAS Environment	33
JSON Support	33
Saving Macro Code from an Input Stream	34
Transporting SAS Files	34
Universal Printing	35
Encryption	36
SAS Engines for Open-Source File Formats	39
Scalable Performance Data Engine	39
XMLV2 Engine	40
National Language Support (NLS)	40
Metadata	44
SAS Logging Facility	45
Application Response Measurement (ARM)	46
Email	46
Procedures	46
DATA Step Language Elements	53
System Options	58
SAS Macro Facility	60
SAS under UNIX	61
SAS under Windows	62
SAS under z/OS	63
Additional Information	65

Details about the New Features in Base SAS 9.4 and SAS Viya

<i>Create and Run Python Objects in SAS</i>	2
<i>SAS 9.4M5 and Later, Integration with SAS Viya</i>	2
<i>Cloud Analytic Services</i>	5
<i>DS2 Language</i>	7
<i>FedSQL Language</i>	12
<i>Hadoop Support</i>	16
<i>SAS LIBNAME Engine for SAS Federation Server</i>	18
<i>Execute the DATA Step in New Supported Environments</i>	20
<i>Debugging SAS Code</i>	20
<i>Output Delivery System (ODS)</i>	20
<i>ODS Statistical Graphics</i>	25
General Enhancements	25
ODS Graphics Procedures	25
ODS Graphics Designer	27
ODS Graphics Editor	28
SAS Graph Template Language	28
<i>Creating Accessible Output Using ODS and ODS Graphics</i>	29
<i>Creating Maps Using ODS Graphics and Mapping Procedures</i>	30
<i>Performance</i>	32
<i>Extended Variable and Data Set Attributes</i>	32
<i>Locked-Down State</i>	33
<i>Preserving the SAS Environment</i>	33
<i>JSON Support</i>	33
<i>Saving Macro Code from an Input Stream</i>	34
<i>Transporting SAS Files</i>	34

<i>Universal Printing</i>	35
<i>Encryption</i>	36
<i>SAS Engines for Open-Source File Formats</i>	39
<i>Scalable Performance Data Engine</i>	39
<i>XMLV2 Engine</i>	40
<i>National Language Support (NLS)</i>	40
<i>Metadata</i>	44
<i>SAS Logging Facility</i>	45
<i>Application Response Measurement (ARM)</i>	46
<i>Email</i>	46
<i>Procedures</i>	46
<i>DATA Step Language Elements</i>	53
<i>System Options</i>	58
<i>SAS Macro Facility</i>	60
<i>SAS under UNIX</i>	61
<i>SAS under Windows</i>	62
<i>SAS under z/OS</i>	63
<i>Additional Information</i>	65

Create and Run Python Objects in SAS

In SAS Viya 3.5 and the November 2019 release of SAS 9.4M6, you can submit [Python objects](#) to the CAS server using PROC FCMP or the DATA step.

In the [May 2019](#) release of SAS 9.4M6, you can create a Python object to execute a Python function using PROC FCMP. You execute Python objects using PROC FCMP or the DATA step. You cannot submit Python objects to the CAS server.

SAS 9.4M5 and Later, Integration with SAS Viya

Beginning with SAS 9.4M5, you can submit code to SAS Viya 3.3 and later releases of Cloud Analytic Services (CAS). From a SAS session with the CAS server, you can load data to CAS server memory. Then, you can save tables that are in CAS server memory and submit DATA step code, SAS Viya Analytic procedures, CAS server utility procedures, and Base SAS procedures.

For a complete overview, see [An Introduction to SAS Viya 3.5 Programming](#).

Here are the highlights:

- You can connect to the CAS server from all SAS programming environments.

Before you can submit programs to the CAS server from SAS 9.4, security certificates must be in place and you must be authorized to connect to the CAS server. For more information, see [Configure SAS 9.4 Clients to Work with SAS Viya in Encryption in SAS Viya: Data in Motion](#) and [Client Authentication Using an Authinfo File](#).

- The CAS LIBNAME engine provides Read and Write access to CAS tables from SAS. When the CAS LIBNAME engine is used by procedures that do all of their processing in SAS, the CAS table data is transferred between the SAS session and the CAS server as needed. For example, when PROC PRINT DATA= specifies a libref that is associated with the CAS engine, the CAS table is downloaded from the CAS server to SAS for PROC PRINT to process.

For more information, see “CAS LIBNAME Engine Overview” in [SAS Cloud Analytic Services: User’s Guide](#).

- In order for the DATA step to run on the CAS server, the CAS LIBNAME engine must be specified for both the input and output data and all DATA step code must be able to run on the CAS server. A few DATA step statements do not run in the CAS server. If the DATA step code is validated to run on the CAS server, it does. Otherwise, the DATA step runs in SAS.

For more information, see [SAS Cloud Analytic Services: DATA Step Programming](#).

- Caslibs are the mechanism for accessing CAS server memory. They provide in-memory space to hold tables, access controls, and data connection information. Caslibs provide a way to organize in-memory tables and identify a data source for saving and loading tables. They also provide a way to apply access controls to data. A table within a caslib is a temporary, in-memory copy of the original data. All operations on the CAS server that use data are performed on tables within a caslib. For more information, see “CASLIB Statement” in [SAS Cloud Analytic Services: User’s Guide](#).

- The CASUTIL procedure is a utility procedure that you can use to transfer data to and from CAS in-memory tables in a caslib, view file and table information, and drop or delete an in-memory table.

For more information, see “CASUTIL Procedure” in [SAS Cloud Analytic Services: User’s Guide](#).

You can load data serially with a data connector, or you can load data in parallel with a data connect accelerator. Data connect accelerators work with the SAS Embedded Process and must be licensed separately.

- The MDSUMMARY procedure computes basic descriptive statistics for variables across all observations or within groups of observations in parallel for data tables stored on the CAS server, ensuring full use of parallel processing.

For more information, see “MDSUMMARY Procedure” in [SAS Cloud Analytic Services: User’s Guide](#).

- Several procedures perform some processing on the CAS server: COPY, DS2, FedSQL, MEANS, REPORT, SUMMARY, TABULATE, and TRANSPOSE.
- In addition to processing NUMERIC and CHAR data, the CAS server supports the VARCHAR data type for DATA step processing. VARCHAR data is based on

the number of characters for a variable as compared to CHAR, which is based on the number of bytes for a variable.

Several procedures can read and process VARCHAR variable data in CAS tables: CONTENTS, COPY, DATASETS COPY and CONTENTS statements, EXPORT, IMPORT, PRINT, DOWNLOAD (SAS/CONNECT), and UPLOAD (SAS/CONNECT).

- All character data on the CAS server must be encoded as UTF-8. When the CAS engine reads or writes character data that is not encoded as UTF8, CAS transcodes the data to UTF-8. For multiple-byte data, SAS provides a CAS LIBNAME option and data set option, both with the name NCHARMULTIPLIER, and a system option, CASNCHARMULTIPLIER=, where you can specify a multiplier to increase byte size during transcoding. The option expands the byte size of fixed character variables (CHAR data type).

When you load data from databases using data connectors, you can use the CHARMULTIPLIER data connector option to modify the multiplier when the data originates from SBCS (single-byte character set) environments.

- You can submit SAS DS2 language statements to the CAS server by using PROC DS2. Most of the functionality of the DS2 language is supported on the CAS server.
- You can submit SAS FedSQL language statements to the CAS server by using PROC FEDSQL. FedSQL provides query and join functionality on the CAS server.
- You can use the CAS procedure and the CAS Language (CASL) to program using CAS actions.

For more information, see [CAS Procedure](#) and *SAS Cloud Analytic Services: CASL Programmer's Guide*.

- The SAS 9.4 and the SAS Viya documentation have been combined into one collection:

[SAS Programming Documentation](#)

Take some time to familiarize yourself with the collection organization.

DATA step language elements indicate whether they run on the CAS server:

- DATA step category tables list language elements that can run in a DATA step on the CAS server. For example, here is the [DATA Step Statements by Category](#). Scroll down to see the list of statements that run on the CAS server.
- If a language element cannot execute on the CAS server, the documentation contains a restriction indicating it is not valid to run on the CAS server. For example:

Restriction: This statement is not supported in a DATA step that runs in CAS.

Base SAS procedures can process CAS tables in SAS. A few, such as REPORT and SUMMARY, can process CAS tables on the CAS server. Procedure statement and options documentation indicates when a statement or option causes program execution on the CAS server.

Note: Included in your SAS 9.4M5 order are procedures that enable you to take advantage of additional functionality that is provided by SAS Viya. You must have a SAS Viya license in order to use the OPTNETWORK procedure and the procedures for these products:

- [SAS Econometrics](#)
- [SAS Visual Data Mining and Machine Learning](#)
- [SAS Visual Forecasting](#)
- [SAS Visual Statistics](#)
- [SAS Optimization](#)

To use SAS Optimization, you also need a SAS/OR license.

- [SAS Visual Text Analytics](#)
-

Cloud Analytic Services

For a complete list of what is new in [SAS Viya 3.5 Cloud Analytic Services](#), see the What's New section in [SAS Cloud Analytic Services: User's Guide](#). Here are the highlights:

- Support for Azure Data Lake Storage.
- Use PROC CASUTIL to perform these tasks:
 - rename tables
 - create table indexes
 - use a fileref to read external data
 - partition a table
 - update rows in a table
- New functions perform these tasks:
 - return session information
 - check for the existence of a particular caslib
 - obtain the CAS Server Monitor URL
- Use the credentials that are defined for your EC2 instance on S3.
- New CAS session options specify the following information:
 - whether to offload work to the Graphics Processing Unit (GPU), if it is available
 - the host and port for the SAS Code Debugger
 - the tenant ID to connect to an Azure storage system
- These are the new data connectors:
 - SAS Data Connector to MongoDB
 - SAS Data Connector to Salesforce
 - SAS Data Connector to ORC
- Here are enhancements to existing data connectors:

- Amazon Redshift: bulk unloading (data retrieval). Bulk-unloading support includes the new BULKUNLOAD= data connector option.
- PostgreSQL: bulk unloading (data retrieval). Bulk-unloading support includes these new data connector options: BULKUNLOAD=, BLDELDATFILE=, BLDELIMITER=, BLESCAPE=, BLFORMAT=, BLNULL, BLPSQLPATH=, BLQUOTE=, and LDPATH=.
- Teradata: support for the NUMBER data type.
- **PROC SORT** supports the ability to run the duplicate detection and manipulation options (NODUPKEY, NOUNIKEY, DUPOUT=, UNIOUT=) in CAS. This functionality is provided to facilitate migration of code for users of SAS Viya.

These enhancements are new in SAS 9.4M6:

- You can specify the **WHERE statement** in a DATA step that is running in CAS.
- To determine whether ASYNC processes are running in ASYNC actions or in a DATA step, use the **SESSBUSY function**.

For information about what is new for the CAS server, see [What's New in Cloud Analytic Services](#).

SAS 9.4M5 have these enhancements:

CAS statement

The AUTHDOMAIN= option specifies the name of an authentication domain object registered on the SAS Metadata Server that associates user credentials with an identity.

The CASSERVERMD= option specifies the name of a server object registered on the SAS Metadata Server that associates SAS Cloud Analytic Services connection parameters with a server name.

For more information, see “CAS Statement” in [SAS Cloud Analytic Services: User's Guide](#).

Note: These options can be set only from SAS 9.4M5 and not from SAS Viya 3.2.

Functions

CLIBEXIST indicates whether a caslib name exists.

GETCASURL returns the CAS Server Monitor URL.

GETLCASLIB returns the caslib that is associated with a CAS LIBNAME engine libref.

GETLSESSREF returns the name of the CAS session that is associated with the CAS LIBNAME engine.

GETLTAG returns the tag for a CAS LIBNAME engine libref that was specified by the TAB= LIBNAME statement option.

GETSESSOPT returns the value of a CAS session option.

SESSFOUND returns a value to indicate whether a named session that you started in your SAS session is found.

System Options

Data transfer of CAS tables can impede system performance if the CAS table is very large. You can use the **CASDATA LIMIT= system option** to limit the amount of data in a single CAS table that can be transferred from the CAS server to SAS. By default, the amount of data that can be read from a CAS table is 100M.

When SAS writes data to the CAS server using the CAS engine, the engine estimates the number of bytes that are needed to transcode the data to UTF-8 based on the character set of the SAS session. The character set is specified by the `ENCODING=` system option. SBCS environments estimate one byte in UTF-8 for every one byte in the local encoding. DBCS environments estimate 1.5 bytes in UTF-8 for every one byte in the local encoding. You can use the [CASNCHARMULTIPLIER= system option](#) to replace the estimate with an explicit value of the byte multiplier when you know the number of bytes that are needed to represent the data in UTF-8.

By default, the [DSCAS system option](#) is set so that the DATA step runs on your CAS server without specifying a session reference option in the DATA statement. If `NODSCAS` is set, the `SESSREF=` DATA statement option is required for the DATA step to run on the CAS server. To run the DATA step in SAS, you would set the `NODSCAS` option.

Note: These system options can be set only from SAS 9.4M5 and not from SAS Viya.

Macros

To use your SAS user-defined formats in the CAS server, you can migrate them from a SAS catalog to the CAS server using the autocall macro `%UDFSEL`. This macro generates a SELECT statement that you can use with the `FORMAT` procedure to migrate only the user-defined formats that your data is using. User-defined formats are stored in a CAS library in the CAS server. For more information, see [%UDFSEL Autocall Macro](#).

DS2 Language

[DS2](#) is a SAS proprietary programming language that is appropriate for advanced data manipulation and applications. DS2 is included with Base SAS and intersects with the SAS DATA step. It also includes additional data types, ANSI SQL types, programming structure elements, user-defined methods, and user-defined packages. Several DS2 language elements accept embedded FedSQL syntax, and the run-time-generated queries can exchange data interactively between DS2 and any supported database. This action enables SQL preprocessing of input tables, which effectively combines the power of the two languages.

The [DS2](#) procedure enables you to submit DS2 language statements from a Base SAS session.

[SAS 9.4M7](#) has these enhancements:

- Beginning with SAS 9.4M7 and SAS Viya 3.5, Spark is supported as a data source with the SAS DS2 and SAS FedSQL languages, when appropriate SAS/ACCESS software is installed. Access is read and write and on Linux only. You can submit requests to Spark through a SAS library and on the CAS server.
- In SAS 9.4M7 only, Yellowbrick is supported as a data source with the SAS DS2 and SAS FedSQL languages when appropriate SAS/ACCESS software is installed. Access is read and write through a SAS library only.

- Two DS2 and FEDSQL procedures support a new option in the CONN= procedure option for Teradata. The TPT_UNICODE_PASSTHRU= option allows Pass Through Characters (PTCs) to be imported into and exported from Teradata.

The TPT_DATA_ENCRYPTION= table option supports new aliases.

SAS Viya 3.5 has these enhancements:

- The documentation about the scope of package instances has been updated. The THIS and package-instance arguments of the NEW operator have been deprecated and removed from the _NEW_ operator for packages. The lifetime of a package instance now depends on whether a DS2 package variable references it. The lifetime of a package instance can extend beyond the scope in which the instance itself was created.
- Because some DS2 error messages that are written to the SAS log now contain an internal error code, an appendix that provides more information about the codes has been added to the documentation. If you contact SAS Technical Support, these internal error codes can help SAS more quickly determine the source of the problem.
- A DS2 program that runs in CAS can create a column with a VARBINARY data type, read a VARBINARY column from a CAS table, and write a VARBINARY column to a CAS table. In addition, a DS2 program that runs in CAS can create a column with a BINARY data type. However, it cannot read a BINARY data column from a CAS table or write a BINARY column to a CAS table.
- If you use in-database processing with the SAS Embedded Process on Teradata, note that the SASTransform table function has been deprecated. The SASTblOp table operator should be used with Teradata 14.10 or later.
- Write support is added for the MongoDB nonrelational database. Access is available through a SAS library or a caslib. Appropriate SAS/ACCESS software must be installed. For data type support, see [“Data Types for MongoDB” in SAS DS2 Language Reference](#).
- The following functions have been added:
 - COMPLEV returns the Levenshtein edit distance between two strings.
 - COMPCOST sets the costs of operations for later use by the COMPGED function.
 - COMPGED returns the generalized edit distance between two strings.
- The COMPRESS function now has an optional third argument, modifier, that specifies a character constant, variable, or expression in which each non-blank character modifies the action of the COMPRESS function.
- The maximum number of threads you can specify on the SET FROM statement is 100 if you are using an FCMP package.

Beginning in August 2019, PROC DS2 supports the Google BigQuery and Snowflake databases for SAS 9.4M6. Read and Write access is supported from a SAS library and from a CAS library. In CAS, DS2 creates in-memory tables from existing tables only. Appropriate SAS/ACCESS software must be installed.

Beginning in April 2019, PROC DS2 supports the MongoDB and Salesforce nonrelational databases for SAS 9.4M6. Access to both databases is Read-only and through a SAS library. Appropriate SAS/ACCESS software must be installed.

SAS 9.4M6 has these enhancements:

- The DS2 language supports these new data sources: Spark as well as databases (such as PostgreSQL) that are compliant with JDBC.
- Inline declarations can be specified for DO loop counters.
- The new \$UUID. format writes character data to the universally unique identifier (UUID) format.
- A RETAIN option has been added to the MERGE statement that produces a many-to-many match-merge that is similar to a DATA step merge.
- User-written DS2 methods that return a DOUBLE value now return the specified missing value. Previously, the regular SAS missing value (a period) was returned.
- These are the changes and enhancements for DS2 functions:
 - These functions have been added: CMISS, LOGISTIC, SAVING, SHA256, and SYSGET.
 - The SCAN function supports a modifier.
 - In an effort to align the SUBSTR(right of =) function with DATA step behavior, a length of 0 is now considered invalid.
- PROC DS2 supports databases that are compliant with JDBC, as data sources. When SAS/ACCESS Interface to JDBC is installed, you can access data in a database that is compliant with JDBC by assigning and referencing a libref. Or, you can submit a fully qualified data source connection string by using the NOLIBS and CONN= procedure options.
- You can direct the PROC DSTODS2 output file to a directory using the OUTDIR= argument.
- The SAS In-Database Code Accelerator can be executed on MapReduce or Spark. A new system option, `HADOOPPLATFORM=`, determines which execution platform is used. `HADOOPPLATFORM=` determines which execution platform is used. However, the `HADOOPPLATFORM=SPARK` option is not supported on the Windows operating system for the SAS In-Database Code Accelerator.
- The SAS In-Database Code Accelerator for Hadoop has these enhancements:
 - Supports the SCRATCH_DB option for a Hive database that is used when a temporary table is created.
 - SQL queries using a WHERE IN clause are now supported.
 - CEDA processing of SPD Engine input files is supported. Previously, only SPD Engine data sets whose architectures matched the architecture of the Hadoop cluster (that is, 64-bit Solaris or Linux) ran inside the database.
- These are the changes and enhancements for the DS2 HTTP package:
 - New methods are available for the HTTP package that enable you to specify a URL or proxy URL and a user name and password for those URLs, and to either specify an Open Authorization (OAuth) token or search for a token in the SAS environment.
 - If the content type is not set, the SETREQUESTBODYASSTRING method sets the default charset value to ISO-8859-1 (latin1) as specified by the 1.1 protocol.

The December 2017 release of [SAS 9.4M5](#) and [SAS Viya 3.3](#) has these enhancements:

- The SCOREACCEL procedure provides an interface to the CAS server for DATA step and DS2 model publishing and scoring. Models can be published and run in CAS or in Hadoop or Teradata.
- You can use new DS2 actions to publish and run DS2 models in the CAS server, Hadoop, or Teradata. Alternatively, you can use the new SCOREACCEL procedure from the SAS client.
- The SAS In-Database Code Accelerator for Hadoop honors the SCRATCH_DB option for a Hive database that is used when a temporary table is created.
- DS2 supports BIGINT (INT64) and INTEGER (INT32) as well as CHAR, DOUBLE, and VARCHAR data types in the CAS server. Columns defined as SMALLINT and TINYINT data types in CAS are now created as INTEGER instead of DOUBLE.
- You can now pass SQL text in the SET statement if you run the DS2 program with the runDS2 action.
- The SCAN function supports a modifier. The modifier is supported only on the CAS server.
- These functions are new:
 - The CMISS function counts the number of missing arguments.
 - The LOGISTIC function returns the logistic transformation of the argument.
 - The SAVING function returns the future value of a periodic saving.
- When using the HTTP package, if the content type is not set, the SETREQUESTBODYASSTRING method sets the default charset value to ISO-8859-1 (latin1) as specified by the HTTP 1.1 protocol.

SAS 9.4M5 has the following changes and enhancements:

- The DS2 language concepts have been moved from the [SAS DS2 Language Reference](#) to the new [SAS DS2 Programmer's Guide](#). In addition, to provide a more comprehensive user experience, information about using DS2 with the CAS server has been incorporated into this document.
- You can use PROC DS2 from SAS to execute on the CAS server. You connect to the CAS server using the SESSREF= or SESSUUID= procedure option. The SESSREF= option identifies the CAS session by its session name. The SESSUUID= option identifies the session by its universally unique identifier (UUID).
- A new procedure, DSTODS2, is available for translating a subset of your SAS DATA step code into DS2 code.
- Methods in thread programs now allow packages to be passed in as parameters.
- DS2 can access the Amazon Redshift, Microsoft SQLServer, and Vertica data sources.
- Two new predefined packages are available, PCRXFIND and PCRXREPLACE, for regular expression matching and substitution. These packages are based on the PCRE 2 open-source regular expression library.
- When a variable is used but not declared, a warning is sent to the SAS log. The warning now indicates the data type, length, and, in some cases, precision, that is assigned to the undeclared variable.

SAS 9.4M4 has the following changes and enhancements:

- The private access modifier is supported for attributes or methods that are intended for internal use within the package.
- Two new functions, DIF and LAG, enable you to access previous values of a variable or expression. These functions are useful for computing lags and differences of series.
- The DO statement enables you to use multiple index variable clauses separated by commas.
- The new INTNEST function calculates the number of whole periods of the smaller interval that fits into the period of the larger interval.
- Three new automatic variables, `_HOSTNAME_`, `_NTHREADS_`, and `_THREADID_`, enable you to subset a problem across a thread.
- The TIME and TIMESTAMP precision is now preserved across a THREAD and DATA boundary.

SAS 9.4M3 has the following changes and enhancements:

- SAS In-Database Code Accelerator has these enhancements:
 - The SET statement supports multiple tables and embedded SQL.
 - The Code Accelerator reads and writes HDFS-SPD Engine file formats.
 - The SAS log links to the MapReduce job log to find error messages when a Hadoop data or thread program fails.
- You can change the default behavior of a DS2 program by using the DS2_OPTIONS statement:
 - Specify how DS2 processes a division by zero operation.
 - Specify to write a note instead of an error message to the SAS log when an invalid function argument generates a missing value.
 - Specify how non-existent values are processed as ANSI SQL null values.
 - Specify to create a trace of executed statements.
- You can override the default data source connection with the specified data source connection string by using the NOLIBS CONN= option in the PROC DS2 statement.
- You can obtain information about a format or informat by using the FMTINFO() function. The function can return the format or informat category, whether it is a format or informat, the description, format width values, and decimal place values.
- Three new SQLSTMT methods enable you to retrieve the number of columns, the name of a column by column number, and the type of column by column number.
- You can parse JSON text by using the JSON DS2 package.
- The TZ package enables you to perform time zone processing.
- You can compare two character strings including and excluding trailing blanks, respectively, by using the CMP and CMPT functions.
- Match-merge data by using the MERGE statement.
- The SELECT statement in embedded SQL text supports the PARTITION BY, ORDER BY, INDSNUM, and WHERE clauses.

- Create a value based on US locales regardless of the current locale by using the BESTDOTX. format.
- Partition tables by using the DBCREATE_TABLE_OPTS table option.

SAS 9.4M2 has the following changes and enhancements:

- The SAS In-Database Code Accelerator for Hadoop runs the DS2 data program as well as the thread program inside the database.
- Nine new functions have been added.
- A new predefined HTTP package enables you to construct an HTTP client to access web services.
- A new logger, App.TableServices.d2pkg.HTTP, enables logging of HTTP traffic through the SAS logging facility.
- A connection string parameter is available when instantiating an SQLSTMT package.
- The Getting Started section has been rewritten and contains new examples.

SAS 9.4M1 has the following changes and enhancements:

- The PROC DS2 INDB= option has changed its name to DS2ACCEL. INDB= is still supported as an alias. However, the default value for the option has changed from YES to NO, which prevents DS2 code from executing in the database.
- The default behavior for the SAS In-Database Code Accelerator has changed. DS2 code is not executed inside the database by default. You must set either the new DS2ACCEL system option or the PROC DS2 DS2ACCEL option to ANY to enable DS2 code to run inside the database.
- The SAS In-Database Code Accelerator for Teradata now runs the DS2 data program as well as the thread program inside the database.
- Five new DS2 configuration and run-time loggers have been added to the SAS Logging Facility.
- You can use formatted log messages.

FedSQL Language

SAS FedSQL is a SAS proprietary implementation of the ANSI SQL:1999 core standard. It provides support for new data types and other ANSI 1999 core compliance features and proprietary extensions. FedSQL provides data access technology that brings a scalable, threaded, high-performance way to access, manage, and share relational data in multiple data sources. When possible, FedSQL queries are optimized with multi-threaded algorithms in order to resolve large-scale operations. For applications, FedSQL provides a common SQL syntax across all data sources. That is, FedSQL is a vendor-neutral SQL dialect that accesses data from various data sources without submitting queries in the SQL dialect that is specific to the data source. In addition, a single FedSQL query can target data in several data sources and return a single result table.

The `FEDSQL` procedure enables you to submit FedSQL language statements from a Base SAS session.

SAS 9.4M7 has these enhancements:

- Beginning with SAS 9.4M7 and SAS Viya 3.5, Spark is supported as a data source with the SAS DS2 and SAS FedSQL languages, when appropriate SAS/ACCESS software is installed. Access is read and write and on Linux only. You can submit requests to Spark through a SAS library and on the CAS server.
- In SAS 9.4M7 only, Yellowbrick is supported as a data source with the SAS DS2 and SAS FedSQL languages when appropriate SAS/ACCESS software is installed. Access is read and write through a SAS library only.
- Two DS2 and FEDSQL procedures support a new option in the CONN= procedure option for Teradata. The TPT_UNICODE_PASSTHRU= option allows Pass Through Characters (PTCs) to be imported into and exported from Teradata.

The TPT_DATA_ENCRYPTION= table option supports new aliases.

SAS Viya 3.5 has these enhancements:

- SAS FedSQL has the ability to read and write to MongoDB and Salesforce nonrelational databases with FedSQL when appropriate SAS/ACCESS software is installed. The functionality is available when accessing the databases through a SAS library and a CAS library.
- There are improvements to data type support for various third-party relational databases when appropriate SAS/ACCESS software is installed. The features are available when the databases are accessed through a SAS library.
 - FedSQL now creates VARCHAR columns containing greater than 65,535 characters as type STRING in Hive.
 - FedSQL now reads and writes Teradata NUMBER columns.
 - FedSQL now reads JSON columns in MySQL.
- The COMPRESS function supports a Modifier argument.
- FedSQL for CAS has the following new functionality in **SAS Viya 3.5**:
 - The following CNTL= instructions are new:
 - An optional dynamicCardinality instruction for the Cntl option directs the FedSQL query planner to perform a cardinality estimation before creating a query plan.
 - An optional optimizeVarbinaryPrecision instruction for the Cntl option optimizes VARBINARY precision by using a precision that is appropriate to the actual data, instead of the declared precision for VARBINARY columns.
 - An optional optimizeVarcharPrecision instruction for the Cntl option optimizes VARCHAR precision by using a precision that is appropriate to the actual data, instead of the declared precision for VARCHAR columns.
 - An optional showStages instruction for the Cntl option returns FedSQL query execution details, including times for intermediate stages, along with the FedSQL query plan.
 - The CAST function converts a column from one data type to another and also enables you to change the column's length.
 - The UNION set operator combines the result sets of two SELECT queries and returns unique rows from both result sets. Columns are combined by position by default. An optional CORRESPONDING keyword enables you to

combine columns based on a column name instead. An optional BY keyword enables you to submit a column list to the CORRESPONDING keyword.

- In earlier versions of SAS Viya, the DROP TABLE statement and REPLACE= table option considered global tables when enforcing name uniqueness rules and would drop and replace a table that was previously promoted. Beginning in SAS Viya 3.5, the DROP TABLE statement and REPLACE= table option operate exclusively on CAS session tables.
- Some FedSQL error messages that are written to the SAS log now contain an internal error code. If you contact Technical Support, these internal error codes can help SAS more quickly determine the source of the problem.

Beginning in August 2019, PROC FEDSQL supports the Google BigQuery and Snowflake databases for SAS 9.4M6. Read and Write access is supported from a SAS library and from a CAS library. In CAS, FedSQL creates in-memory tables from existing tables only. Appropriate SAS/ACCESS software must be installed.

Beginning in April 2019, PROC FEDSQL supports the MongoDB and Salesforce nonrelational databases for SAS 9.4M6. Access to both databases is Read-only and through a SAS library. Appropriate SAS/ACCESS software must be installed. In addition, explicit pass-through is supported. For more information, see the FedSQL SELECT, DESCRIBE TABLE, and EXECUTE statements in [FedSQL Statements](#). No table options are supported for these data sources.

These are the enhancements for SAS 9.4M6:

- PROC FEDSQL supports databases that are compliant with JDBC, as data sources. When SAS/ACCESS Interface to JDBC is installed, you can access data in a database that is compliant with JDBC by assigning and referencing a libref. Or, you can submit a fully qualified data source connection string by using the NOLIBS and CONN= procedure options.
- The FedSQL language creates VARCHAR columns that contain more than 65,535 characters as type STRING in Hive. For more information, see “[Data Types for Hive](#)” in [SAS DS2 Language Reference](#).

The December 2017 release of SAS 9.4M5 and SAS Viya 3.3 has these enhancements:

- Full support for SAS libraries and CAS libraries.
- Implicit pass-through for SQL-based CAS libraries.
- You can specify optional control parameters for the FedSQL query planner in CAS using the PROC FEDSQL option, CNTL= .
- FedSQL reads the new native CAS data types INT64 and INT32.

SAS 9.4M5 has the following enhancements:

- You can use PROC FEDSQL to execute on the CAS server. You connect to the CAS server using the SESSREF= or SESSUID= procedure option. The SESSREF= option identifies the CAS session by its session name. The SESSUID= option identifies the session by its universally unique identifier (UUID).
- Support for Amazon Redshift, Microsoft SQL Server, and Vertica data sources.
- New table options for Hive that allow additional database-specific options to be placed before and after the table name when you are creating a table.
- Support for querying SAS Cloud Analytic Services (CAS) tables.

- The ENCRYPT= table option supports stronger AES encryption for SAS data sets.
- SAS Scalable Performance Data (SPD) Server tables can now also be encrypted with the ENCRYPT= option.
- You can now get information about views from DICTIONARY.COLUMNS queries.
- Support for numerous functions.

SAS 9.4M4 has the following enhancements:

- Support for SAS Scalable Performance Data Server tables.
- Support for specifying three-level table names when creating access tables in Hive 0.14 and later.
- The new [DESCRIBE TABLE statement](#) that writes a CREATE TABLE statement to the SAS log for the table specified in the DESCRIBE TABLE statement.

SAS 9.4M3 has the following enhancements:

- Support for HAWQ and Impala distributions of Hadoop; support for Impala includes bulk loading.
- You can specify DBMS-specific syntax to append to the CREATE TABLE statement by using the DBCREATE_TABLE_OPTS= table option.
- Set the encoding for a SAS data set by using the ENCODING= table option.
- Use the DECIMAL/NUMERIC(p,s) data type for data definition and for reading in HDMD.
- Use the DECIMAL/NUMERIC(p,s) data type and the VARBINARY data type for data definition and for reading in Hive.
- The Hive ARRAY, MAP, STRUCT, and UNION complex types read from Hive.

SAS 9.4M2 has the following enhancements:

- Support for Hive, HDMD, and PostgreSQL data sources is new. Not all FedSQL statements are supported for each data source. To determine statement support, see the documentation for FedSQL statements.
- The CAST function for ODBC enables you to convert a value from one data type to another.
- The DBCREATE_INDEX_OPTS= table option for SASHDAT enables you to add DBMS-specific clauses to the end of the CREATE INDEX statement.
- The SQUEEZE= table option enables you to write the SASHDAT file in compressed format.

SAS 9.4M1 has the following enhancements:

- support for Memory Data Store (MDS), SAP HANA, and SASHDAT data sources
- rename table and rename column functionality in the ALTER TABLE statement
- several new [functions](#)

Hadoop Support

These are the enhancements to Hadoop for Base SAS and SAS/ACCESS for SAS 9.4M6:

- Information about IBM BigInsights and Pivotal has been removed from the [SAS Hadoop Configuration Guide for Base SAS and SAS/ACCESS](#) documentation. These Hadoop vendors have asked their customers to move to Hortonworks.
- If you are using Hortonworks version 3.0, select **No Filter** when using the SAS Deployment Manager to collect the Hadoop JAR files. This selection ensures that the correct line JAR files are obtained for running PROC HADOOP Pig jobs successfully.

In the December 2017 release of [SAS 9.4M5](#) and [SAS Viya 3.3](#), the SCOREACCEL procedure provides an interface to the CAS server for DATA step and DS2 model publishing and scoring. Models can be published and run in the DATA step, Hadoop or Teradata. For more information, see “[SCOREACCEL Procedure](#)” in [Base SAS Procedures Guide](#).

In [SAS 9.4M5](#), PROC SQOOP supports Linux clusters that are secured with Kerberos.

[SAS 9.4M4](#) has the following enhancements:

- The default behavior of the CFG= option in the FILENAME statement, Hadoop access method has changed. If CFG= is not provided, the SAS_HADOOP_CONFIG_PATH and SAS_HADOOP_JAR_PATH environment variables are scanned for the location of the required configuration files. In addition, Knox security is supported.
- The SPD Engine Hive SerDe can be used by the SAS Code Accelerator.

[SAS 9.4M3](#) has the following enhancements:

- SAS provides a custom Hive SerDe for SPD Engine data that is stored in HDFS. The SerDe makes the data available for applications outside of SAS to query.
- You can use the [SQOOP procedure](#) to access Apache Sqoop from a SAS session to transfer data between a database and HDFS.
- PROC HADOOP
 - You can now connect to a Hadoop cluster by copying the Hadoop configuration files to a physical location that is accessible to the SAS client machine. Once the files are accessible to the client, you simply set the SAS_HADOOP_CONFIG_PATH environment variable to the location of the configuration files.
 - You can use wildcard characters when specifying HDFS files for several HDFS statement options.
 - You can request recursive action to execute the operation on the specified directory as well as subdirectories for several HDFS statement options.
 - New HDFS statement options display the contents of files (CAT=), change file access permissions (CHMOD=), and list HDFS files (LS=).

- You can submit a MapReduce program and Pig language code to a Hadoop cluster through the Apache Oozie RESTful API.
- FILENAME, Hadoop access method
 - The Hadoop access method supports the SAS_HADOOP_CONFIG_PATH environment variable. You no longer have to merge properties from multiple Hadoop configuration files into a single configuration file and specify the CFG= option.
 - The CONCAT and DIR Hadoop options are now mutually exclusive because the SAS_HADOOP_CONFIG_PATH environment variable is available.
- SAS 9.4 SPD Engine: Storing Data in the Hadoop Distributed File System
 - WHERE processing is optimized for MapReduce to support more WHERE expression conditions.
 - Concurrent access to data stored in HDFS is enhanced with a new distributed lock manager.
 - Parallel processing is expanded to write data.
 - SPD data sets can be read in HDFS through Hive.
- The SAS FedSQL language has enhanced support for data types:
 - The DECIMAL/NUMERIC(p,s) data type is supported for data definition and for reading in HDMD.
 - The DECIMAL/NUMERIC(p,s) data type and the VARBINARY data type are supported for data definition and for reading in Hive.
 - The Hive ARRAY, MAP, STRUCT, and UNION complex types read from Hive.
- For an overview of SAS and Hadoop, see [SAS and Hadoop Technology: Overview](#). To learn about common deployment scenarios, see [SAS and Hadoop Technology: Deployment Scenarios](#).

In SAS 9.4M2 the SPD Engine improves Hadoop performance in these ways:

- Creating a large SAS index for a data set in HDFS is much faster because the index is partitioned.
- The scope of the SPD Engine I/O block size is expanded; the default block size is 1 megabyte. The block size affects compressed, uncompressed, and encrypted data sets. The block size influences the size of I/O operations when reading all data sets and writing compressed data sets.
- Expanded support for parallel processing enables you to request parallel processing for all Read operations of data stored in HDFS. Use the SPDEPARALLELREAD= system option, the PARALLELREAD= LIBNAME statement option, or the PARALLELREAD= data set option.
- You can optimize the performance of WHERE processing by requesting that the subsetting of the data be performed in the Hadoop cluster. This takes advantage of the filtering and ordering capabilities of the MapReduce framework. Use the ACCELWHERE= LIBNAME statement option or the ACCELWHERE= data set option.

SAS 9.4M1 has the following enhancements:

- The HADOOP procedure now provides the PROPERTIES statement to submit configuration properties to the Hadoop server.

- You can now specify the NOWARN option in the PROC HADOOP HDFS statement to suppress the warning message when there is an attempt to delete a file that does not exist.
- The SPD Engine is enhanced to read, write, and update data in a Hadoop cluster through the HDFS.
- The FILENAME Hadoop Access Method statement, which enables you to access files on an HDFS, has been enhanced. A new option, NEW, is used in output mode in conjunction with the DIR option to create the directory that is specified in the FILENAME Hadoop statement.

For more information, see “HADOOP Procedure” in *Base SAS Procedures Guide*, *SAS SPD Engine: Storing Data in the Hadoop Distributed File System*, and *SAS DATA Step Statements: Reference*.

SAS 9.4M2 has the following enhancements:

- *SAS Hadoop Configuration Guide for Base SAS and SAS/ACCESS* is available from the support.sas.com [third-party site for Hadoop](#).
SAS Hadoop Configuration Guide for Base SAS and SAS/ACCESS explains how to configure SAS components so that you can use SAS technology to connect to Hadoop. Specific instructions are provided for the HADOOP procedure, the FILENAME statement Hadoop access method, the SAS Scalable Performance Data (SPD) Engine, and the SAS/ACCESS Interface to Hadoop.
- If `MSGLEVEL=I`, SAS writes Hadoop MapReduce job information to the SAS log.
- You can now submit HDFS commands through WebHDFS. The new SAS environment variable `SAS_HADOOP_RESTFUL` must be defined and set to the value 1. In addition, the Hadoop configuration file must include the properties for the WebHDFS location

SAS LIBNAME Engine for SAS Federation Server

In SAS 9.4M7 (July 2021), bulk-loading functionality is now available in the LIBNAME engine for SAS Federation Server. You request this functionality by setting the `BULKLOAD= LIBNAME` Statement option.

In SAS 9.4M7 (March 2021), the LIBNAME engine for SAS Federation Server is updated to support SAS Federation Server 4.4. This new server includes enhancements such as an additional remote driver for SAS client connections and new LIBNAME statement options.

- The FSNET driver, requested through the new `REMOTE_DRIVER= LIBNAME` statement option, uses an HTTPS protocol that is based on SAS Federation Server FSNet libraries to connect to SAS Federation Server.
- Here are new LIBNAME statement options:
 - `CONTEXTROOT=` and `PROXY=`, which enable you to manage an optional proxy server.

- LOGIN_TIMEOUT=, which sets a login time-out period for server connections.
- SSPI=, which enables single sign-on to SAS Federation Server, when the server is configured for single sign-on.
- REMOTE_DRIVER_OPTIONS=, which enables you to submit remote driver connection options to SAS Federation Server.

The COMPRESS= LIBNAME statement option, system option, and data set option are no longer supported.

In SAS 9.4M7, the LIBNAME engine for SAS Federation Support supports a new system option and five new LIBNAME statement options.

- The DBIDIRECTEXEC system option improves PROC SQL performance by passing certain statements to the database for processing.
- The DBCLIENT_MAX_BYTES= LIBNAME statement option enables you to specify the maximum number of bytes per single character in SAS session encoding when reading character data from a DBMS.
- A new performance feature speeds up fetch operations by beginning to cache data that is expected to be needed before the client requests it. Controlled with the PREFETCH= LIBNAME option, this feature is on by default. Several LIBNAME options are available to modify the default setting. For more information, see the PREFETCH= LIBNAME option.

The documentation has changed as follows:

- Mentions of MySQL support have been removed from the documentation. The SAS Federation Server Driver for MySQL is no longer supported by the server.
- Information about PROC SQL functionality that is available through the engine in “SAS Functionality Available Through the Engine” is modified.
- The documentation for the RENAME=data set option is clarified.

In SAS 9.4M6, the documentation for the READBUFF= LIBNAME statement option and the READBUFF= data set option was modified. The modifications clarify the default setting of the READBUFF= option.

In SAS Viya 3.5, the behavior of two LIBNAME options and their respective data set options have changed:

- The IGNORE_READ_ONLY_COLUMNS= LIBNAME option and data set option affect columns that are Read-only and have unique values. In SAS 9.4 and in earlier releases of SAS Viya, the options affect columns whose data types are Read-only.
- The READBUFF= LIBNAME option and data set option use a default block size of 64K to read data if the underlying database supports extended Fetch. The default number of rows is determined by dividing 64K with the width of a row. In SAS 9.4 and in earlier releases of SAS Viya, the options perform single-row Fetch by default.

The DBMS option is removed from the SPOOL= LIBNAME option documentation. It is not supported in SAS Viya or SAS 9.4.

In SAS 9.4M4, the new APPLICATIONNAME= LIBNAME statement option enables you to specify the client application’s name for auditing purposes.

Execute the DATA Step in New Supported Environments

In SAS 9.4M5, the DATA step can run on the CAS server. For more information, see [SAS Cloud Analytic Services: DATA Step Programming](#).

In SAS 9.4M2, DATA step processing in Hadoop is fully supported.

For more information, see [SAS LASR Analytic Server: Reference Guide](#) and [SAS In-Database Products: User's Guide](#).

In SAS 9.4M1, the DATA step can run in these environments, with limitations:

- in-memory, in the SAS LASR Analytic Server
- SAS Embedded Process for Hadoop (Preproduction)

Debugging SAS Code

SAS Viya 3.5 has two new debugging environments.

In SAS Studio 5.2, you click the **Debug** button to begin debugging the DATA step. For information about the SAS Studio DATA step debugger, see [Using the Data Step Debugger](#) in *SAS Studio: User's Guide*.

You can use the SAS Code Debugger to debug a subset of DATA step programming and Base SAS procedures, as well as some analytical procedures. For a list of SAS code that you can debug using the SAS Code Debugger, see “[Overview: FCMP Procedure](#)” in *Base SAS Procedures Guide*.

The original DATA step debugger remains available in the SAS windowing environment. The documentation for the original DATA step debugger has moved to [SAS Code Debugger: User's Guide](#).

Output Delivery System (ODS)

In SAS Viya 3.5, ODS has the following enhancements:

- The ODS Destination for Microsoft Word supports these new features:
 - The `COLUMNS=` option specifies the number of columns to place across each page of output.

- The **SUBJECT=** option inserts the text string that you specify as the subject into the metadata of a file.
- You can standardize Word-specific styles using the SAS Registry. For an example, see [“Changing SAS Registry Settings for ODS”](#) in *SAS Output Delivery System: User’s Guide*.
- SVG is a supported file type.
- The ODS Destination for Excel supports the **SUBJECT=** option.
- The ODS Destination for PowerPoint supports the **SUBJECT=** option.

SAS 9.4M6 has these new features:

- A preproduction version of the [ODS destination for Word](#) enables users to customize different aspects of Microsoft Word documents such as themes, table of contents, and orientation.
- The default style for HTML5 output has been changed from HTMLBlue to HTMLEncore.
- The [ODS PDF](#) statement has these enhancements:
 - The method that is used to build and compress PDF files has been enhanced, resulting in smaller file sizes.
 - You can use the [ACCESSIBLEPDF](#) system option to create accessible PDF files, by default.
 - The [ACCESSIBLE_IDENTIFIER](#) option adds an identifier to the metadata of the PDF file, confirming that the PDF produced by SAS meets the PDF Matterhorn Protocol.
 - Alternate text can be added to images that are specified by the [IMAGE=](#), [PREIMAGE=](#), and [POSTIMAGE=](#) style attributes.
- In the Report Writing Interface [TABLE_START](#) method, you can add a visible caption before each table by using the [CAPTION](#) argument.

In the December 2017 release of [SAS 9.4M5](#) and [SAS Viya 3.3](#), you can enable wrapping text in a designated Excel worksheet area by using the ODS EXCEL OPTIONS suboption FLOW.

[SAS 9.4M5](#) has these new features:

- You can use the [ODS EXCEL OPTIONS suboption SHEET_INTERVAL= “NOW”](#) to create a new worksheet.
- The [ODS HTML5 statement OUTLINE=](#) option specifies whether metadata in the table of contents is included in the body file.
- The [ODS PDF statement ACCESSIBLE option](#) is fully supported. Use this option to enable accessibility features for PDF output.
- The ODS RTF statement now supports a [NOTRKEEP](#) option to control whether the values of a single variable that would span a page break continue to the next page.

[SAS 9.4M4](#) has these new features:

- The ODS Graphics statement has these enhancements:
 - The new [NBINSMAX](#) option enables you to specify the maximum number of bins that are processed for histograms.
 - The new [NXYBINSMAX](#) option enables you to specify the maximum number of bins that are processed for heat maps.

- The ODS HTML5 statement supports accessibility. The ACCESSIBLE_GRAPH option is new in the ODS HTML5 statement. For more information, see [“Accessibility with HTML5” in SAS Output Delivery System: User’s Guide](#).
- The ODS PDF statement supports the new preproduction option, ACCESSIBLE. The ACCESSIBLE option enables accessibility features for PDF output.
- The HEADING statement is new in the ODS TEXT procedure. When you use the HEADING statement, SAS generates HTML heading tags and displays the text that you specify as standard HTML text headings in the output. For more information, see [“ODSTEXT Procedure” in SAS Output Delivery System: Procedures Guide](#).
- The DESCRIPTION= option is new for several methods in the Report Writing Interface (RWI) in ODS and for the ODS LAYOUT and ODS REGION statements. The DESCRIPTION= option enables you to specify alternative text for layouts and layout regions.

The DESCRIPTION= option is new for the following methods:

- IMAGE
- LAYOUT_ABSOLUTE
- LAYOUT_GRIDDED
- REGION (absolute)
- REGION (gridded)
- TABLE_START
- The DESCRIPTION= option is also new for the following ODS LAYOUT and ODS REGION statements:
 - ODS LAYOUT ABSOLUTE
 - ODS LAYOUT GRIDDED
 - ODS REGION Statement, Absolute
 - ODS REGION Statement, Gridded

SAS 9.4M3 has these enhancements:

- You can use the [ODS EXCEL](#) statement to create output for native Microsoft Excel files in the SpreadsheetML format.
- The [ODS POWERPOINT](#) statement supports background color or images, several options to customize transitions between slides, and the dynamic or explicit population of gridded layouts by groups, tables, pages, or procedures.
- The default EPUB version is [EPUB3](#).
- The ODS EPUB3 statement supports new EVENT= values for figures and custom entries in a table of contents.
- The [ODS ESCAPECHAR](#) statement supports new functions for use with the ODS EPUB3 statement:
 - Images and captions can be embedded in an EPUB3 e-book chapter. Audio and video are supported using the AUDIO and VIDEO functions, respectively.
 - You can include accessibility features for MathML by using the MATHML function.
 - You can create pop-up footnotes by using the NOTEREF function.

- The ODS EPUB and ODS EPUB3 statements no longer support the ENCODING= option. ODS uses the encoding that is specified in the SAS Registry. For more information, see [“Changing the ODS EPUB and EPUB3 Encoding Settings”](#) in *SAS Output Delivery System: User’s Guide*.
- The ODS GRAPHICS statement has these enhancements:
 - You can reset options to their default value by using the RESET option.
 - Two options have new names, LEGENDAREAMAX= and LOESSOBSMAX=. The original names, MAXLEGENDAREA= and LOESSMAXOBS= respectively, continue to be supported.
 - You can push and pop ODS GRAPHICS settings to a stack by using the PUSH or POP options. To specify the maximum stack depth, use the STACKDEPTHMAX= option.
 - To write the current ODS GRAPHICS setting to the SAS log, use the SHOW option.
- [Audio](#) and [video](#) are supported in HTML5 and EPUB output when you use the Report Writing Interface.

SAS 9.4M2 has the following changes and enhancements:

- For the ODS EPUB and ODS EPUB3 statements, the ODS ESCAPECHAR statement now supports these functions: BOLD, EMPHASIS, ITALIC, PDF, and STRONG.
- The ODS HTML5 statement supports these new options:

The SHOW_GRAPH_STYLES= option specifies whether the output contains elements from the graph style that is specified.

The USE_CSS_RESET= option turns off the default CSS styles information.
- The following ODS tagsets have been deprecated: DOCBOOK, HTMLCSS, IMODE, MVSHTML, PYX, SASREPORT family of tagsets, TPL_STYLE_LIST, TRPL_STYLE_MAP, WML, WMLOLIST, and XHTML.
- The *SAS Output Delivery System: User’s Guide* has been divided into three documents:

[SAS Output Delivery System: Procedures Guide](#). Syntax and information about ODS procedures that were previously documented in *SAS Output Delivery System: User’s Guide* are now documented here.

[SAS Output Delivery System: Advanced Topics](#). Advanced topics, such as the report writing interface and cascading style sheets, that were previously documented in *SAS Output Delivery System: User’s Guide* are now documented here.

[SAS Output Delivery System: User’s Guide](#). In addition to the document’s restructuring, the section “ODS Styles Reference” has been added. This section is intended to help you find ODS style-related information. The [Style Templates](#) chapter contains a table of the recommended and default styles for each destination. This chapter also contains a gallery with examples of each style and a program that enables you to create a gallery of your own. The [Style Elements](#) chapter contains a table of all available style elements. The [Style Attributes](#) chapter contains a table of all available style attributes and their full descriptions.

SAS 9.4M1 has these enhancements:

- The following options are new for the EPUB, MARKUP family, PRINTER family, and RTF ODS destinations:

- The **DOM** option specifies that the ODS document object model is written to the SAS log or an external file.
- The **CSSSTYLE=** option specifies a cascading style sheet to apply to your output.
- The **ODS EPUB3** statement supports HTML5, CSS2, CSS3, SVG, and user-specified audio and video. Any e-book reader that supports EPUB3 supports ODS EPUB3 audio and video.
- You can apply cascading style sheets (CSS) to many types of ODS output.
- The ODS GRAPHICS statement the **DATASKINMAX=** option specifies the maximum number of skinned graphical elements. Also, the ODS GRAPHICS statement supports the **BYLINE=** option and the **LOESSMAXOBS=** option.

In SAS 9.4, the **Report Writing Interface (RWI)** enables you to create and manipulate predefined ODS objects in a DATA step to create highly customized output.

There are four new ODS destinations, EPUB, EPUB3, HTML5, and the ODS destination for PowerPoint:

- The **ODS EPUB** statement creates e-books with the .epub extension. E-books that use the .epub format can be read by a wide variety of e-book readers.
- The **ODS HTML5** statement creates HTML output by using the 5.0 version of HTML.
- The **ODS POWERPOINT** statement creates PowerPoint slides. Slides can contain text, graphics, and tables.

There are three new procedures:

- The **ODSLIST** procedure creates lists that can be customized and nested.
- The **ODSTABLE** procedure creates table templates and binds them with the input data set in one statement. You can also name your templates and store them in a template store.
- The **ODSTEXT** procedure creates lists and paragraphs for your output.

You can arrange output on a page by using the ODS LAYOUT statement. Output can be arranged in an absolute location (absolute), or it can be arranged dynamically (gridded). **Absolute layout** enables you to specify an exact page location by using x and y coordinates. **Gridded layout** enables you to arrange output in a two-dimensional grid structure. Absolute layout is limited to one page and is supported by PRINTER destinations (PDF, PS, and PCL). Gridded layout is supported for HTML, POWERPOINT, and PRINTER destinations (PDF, PS, and PCL).

The default style for all Printer family destinations (PDF, PS, and PCL) has changed from Printer to **Pearl**.

The default HTML style for batch output on all hosts has changed from Default to **HTMLBlue**.

The **ODS GRAPHICS** statement now supports the **ATTRPRIORITY=** option and the **DRILLTARGET=** option. The default for the **ANTIALIASMAX=** option has changed from 600 to 4000. In **SAS 9.4M1**, the **DATASKINMAX=** option specifies the maximum number of skinned graphical elements. Also, in **SAS 9.4M1**, the ODS GRAPHICS statement supports the **BYLINE=** option and the **LOESSMAXOBS=** options.

The default device driver for the [RTF](#) and [TAGSETS.RTF](#) destination has changed to EMF.

The `BOX_SIZING` option overrides the default value of `BOX_SIZING` for certain destinations. See these ODS statements: [ODS EPUB](#), [ODS EPUB3](#), [ODS HTML](#), [ODS HTML5](#), [ODS PCL](#), [ODS PDF](#), [ODS PHTML](#), [ODS POWERPOINT](#), [ODS PRINTER](#), [ODS PS](#), [ODS RTF](#), and [ODS TAGSETS.RTF](#) statements in *SAS Output Delivery System: User's Guide*.

ODS Statistical Graphics

General Enhancements

Beginning in the May 2019 release of SAS 9.4M6, you can use [Introduction to SAS Platform Graphing](#) as a starting point for discerning charts and plots that you want to create. In this document, there is a gallery of charts and plots and the methods to create them using SAS visual tools or SAS graphing software in a programming environment.

[HTMLBlue](#) is the default style for the ODS HTML destination when you use SAS in the windowing environment and in batch mode. Previously, HTMLBlue was the default style only when you used SAS in the windowing environment.

A new `ATTRPRIORITY=` option for the ODS GRAPHICS statement specifies a priority for the cycling of attributes for group values. The `DRILLTARGET=` option enables you to specify the window where the drill-down output is displayed.

ODS Graphics Procedures

SAS 9.4M7 has this new feature. The `ROTATEALWAYS` suboption was added to the `FITPOLICY` option for all horizontal axes in the `SGPLOT` and `SGPANEL` procedures. When this suboption is used, the tick value text is always rotated, even when there is enough room to draw the text normally.

[SAS Viya 3.5](#) has these enhancements:

- The following changes apply to the `SGPLOT` and `SGPANEL=` procedures:
 - The `NOLIMITCAPS` option was added to the `DOT`, `HLINE`, and `VLINE` statements. This option suppresses the serif cap on limit lines.
 - In the fit plots (`LOESS`, `REG`, and `PBSPLINE`), the `FILL | NOFILL` and `OUTLINE | NOOUTLINE` suboptions were added to the `CLIATTRS=` option and the `CLMATTRS=` option. These suboptions give you more control over the display of confidence band features. You can now easily specify fills, outlines, and their attributes.
- The `STATFMT=` option was added to the `PIE` and `DONUT` statements in the `SGPIE` procedure. This option specifies the format of the displayed statistical value in the pie or donut chart.

Beginning in SAS 9.4M6, you can create pie charts and donut charts using the [SGPIE procedure](#). For SAS 9.4M6, the SGPIE procedure is preproduction.

SAS 9.4M5 has these enhancements:

- ODS Graphics provides enhanced support for vector graphics and now supports data tips and drill-down capability with HTML5 output. In addition, the ODS GRAPHICS statement provides a number of new features and options to control graphic output. Several of these options enable you to control the processing of large data sets. For example, the OBSMAX= option specifies the maximum number of observations that are processed.
- For the SGPLOT and SGPANEL procedures, the new LEGENDITEM statement creates a legend item that can be included in the legend. For example, to display annotation text within the legend area, you can define a LEGENDITEM statement with TYPE=TEXT and specify the text in the TEXT= option.
- Numerous plot and axis options were added to the SGPLOT and SGPANEL procedures to control and enhance the output of your graphs. These options affect a wide range of plot types. For example, you can display and change the appearance of line fill patterns in a number of plot types. This feature helps support accessibility. Graphs that use this feature do not rely on color alone to distinguish categories of data. Many other options were added to the procedures to facilitate enhanced output.
- The SGMAP procedure is a new ODS Graphics procedure that renders maps whose data has been prepared by any number of Base SAS mapping procedures such as GPROJECT. For more information, see [“Creating Maps Using ODS Graphics and Mapping Procedures” on page 30](#).

SAS 9.4M4 has these enhancements:

- The ELLIPSEPARM statement is new for the [SGPLOT](#) and [SGPANEL](#) procedures. The ELLIPSEPARM statement plots an ellipse with specified axis lengths, a specified slope for the major axis, and the ellipse center. The ELLIPSEPARM statement does not perform computations on input data to derive the location and shape of the ellipse.
- The new [ELLIPSE](#) statement for the SGPANEL procedure adds a confidence or prediction ellipse to another plot.

The following SGPANEL and SGPLOT procedure enhancements have been added to SAS 9.4M3:

- Five new plot statements enable heat maps, spline plots, and bar charts that are compatible with all basic plots.
- The attribute mapping feature maps ranges of continuous numeric values to graphical properties.
- A wide range of new options apply to plots, legends, axes, axis tables, and discrete attribute maps. These options enhance the ability to produce sophisticated graphs.

In SAS 9.4M2, the ODS Graphics procedures have been enhanced with the following features:

- a new text plot
- a new gradient legend
- several new options for controlling legends, axis tables, and graphical output

The following SGPANEL and SGPLOT procedure enhancements have been added to SAS 9.4M1:

- The FRINGE statement creates a fringe plot on the X or X2 axis of a plot.
- DROPLINE creates one or more drop lines from data point or data points to one or both axes. The lines can be horizontal, vertical, or both.
- POLYGON creates a polygon plot from data that is stored in a data set.
- You can define your own marker symbols to be used in plots that contain markers. The SYMBOLCHAR statement defines a marker symbol by using a Unicode character. The SYMBOLIMAGE statement defines a marker symbol by using an image that exists in the local file system.
- You can use annotation macros within a DATA step to simplify the process of creating annotation observations.

In SAS 9.4, the SGPANEL and SGPLOT procedures have new statements:

- The new INSET statement in the SGPANEL procedure adds a text box to each panel cell of the graph.
- The new BLOCK statement creates a plot that highlights ranges and creates rectangular blocks that contain text values.
- The new STYLEATTRS statement specifies group attributes for a graph.
- Two new statements in the SGPLOT procedure create an axis-aligned row or column of textual data. The XAXISTABLE and the YAXISTABLE statements place data values at specific locations inside or outside the axis.

For more information about these enhancements, see [SAS ODS Graphics: Procedures Guide](#).

ODS Graphics Designer

The ODS Graphics Designer has these changes and enhancements:

- The new Auto Charts feature enables you to create a group of graphs dynamically with a single click.
- Axis tables create plots of input data along the vertical or horizontal axis, placing data values at specific locations inside the axis.
- High-low charts create a display of floating vertical or horizontal lines or bars that represent high and low values.
- There are several updates to enhance graphs, plots, charts, and the appearance of axes.
- New ODS styles have been added: HTMLBlue, Dove, Pearl, and Raven.
- To change the default appearance of graphs, you can specify attributes for group values.
- You can change the attribute priority that determines the rotation pattern that is used for group values.

The following SAS ODS Graphics Designer enhancements have been added to SAS 9.4M3:

- Subpixel rendering has been implemented, resulting in clearer images.
- Enhancements to individual plots enable you to create more sophisticated graphs.

The following SAS ODS Graphics Designer enhancements have been added to [SAS 9.4M1](#):

- When working with automatically generated graphs, you can save the graphs as images or in other formats, including an ODS Graphics Designer file that you can later edit.
- For charts, such as bar charts, that enable you to specify a statistic, the default statistic is now MEAN. Previously, the default was SUM.
- You can save a graph to and open a graph from a remote server location.

For more information, see [SAS ODS Graphics Designer: User's Guide](#).

ODS Graphics Editor

The ODS Graphics Editor has these changes and enhancements:

- New ODS styles have been added: HTMLBlue, Dove, Pearl, and Raven.
- To change the default appearance of graphs, you can specify attributes for group values.
- You can change the attribute priority that determines the rotation pattern that is used for group values.

These enhancements are available in [SAS 9.4M3](#):

- You can edit TEXTPLOT plot properties.
- Groups are supported in Histograms.
- Subpixel rendering results in clearer images.
- With some limitations, you can adjust the viewport and view 3-D graph parameters.

Starting with [SAS 9.4M1](#), you can do the following:

- Modify several attributes and properties of a PATHDIAGRAM plot's graphical elements.
- Change all of the attributes and properties of the plot and axes of a LINECHART plot in the Plot Properties dialog box. In prior releases, you could edit only the general properties.

For more information, see [SAS ODS Graphics Editor: User's Guide](#).

SAS Graph Template Language

In [SAS 9.4M5](#), band plots, box plots, bubble plots, high-low charts, ellipse plots, and polygon plots now support fill patterns. Other changes enhance output. For more information, see “[What's New in SAS 9.4 Graph Template Language](#)” in [SAS Graph Template Language: Reference](#).

The SAS Graph Template Language has numerous changes to enhance graphs in SAS 9.4, and in the [first, second, third, and fourth maintenance releases](#) for SAS 9.4.

Creating Accessible Output Using ODS and ODS Graphics

For recommendations and to learn about creating accessible output, see [Creating Accessible SAS Output Using ODS and ODS Graphics](#).

SAS 9.4M6 has the following enhancements:

- Use the `CAPTION=` option to define a visible table caption, which is displayed when the `ACCESSIBLETABLE` system option has been specified. The `CAPTION=` option applies to PROC REPORT, PROC TABULATE, and the ODS Report Writing Interface. The `CAPTION=` option accepts `#BY` directives.
- New system options facilitate the creating of accessible content on a system-wide level:
 - The `ACCESSIBLECHECK` option checks your SAS programs for common violations of accessibility standards and writes messages to the SAS log if violations are found.
 - The `ACCESSIBLEGRAPH` option enables the `ACCESSIBLE_GRAPH` option in the ODS HTML5 destination by default.
 - The `ACCESSIBLEPDF` option enables the `ACCESSIBLE` option in the ODS PDF destination by default.
 - The `ACCESSIBLETABLE` option makes table captions visible and changes the layout of some tables to make them accessible. This option applies to tables that are generated by the PRINT, REPORT, and TABULATE procedures as well as the Report Writing Interface.
- The option `ATTRPRIORITY=NONE` in the ODS GRAPHICS statement is now the default setting for the [Daisy ODS style](#). Daisy is the recommended style for accessible output. In addition, the Daisy, HighContrast, and HighContrastLarge styles include an enhanced FOCUSLINK indicator.

SAS 9.4M5 has the following enhancements:

- Image maps are supported with SVG output using HTML5. However, image maps are supported only when the HTML5 SVG mode is `INLINE` (the default value).
- You can customize the appearance of focus indicators. A new FOCUSLINK style element is available to be used in a style template. Three new style attributes enable you to customize the focus outline pattern, width, and color.
- You can specify line fill patterns for supported plot types with all styles. Previously, fill patterns were available only when you used certain gray-scale styles. You can also change the appearance of the fill patterns.
- Accessibility metadata can be added to graphs using the `ACCESSIBLE_GRAPH` option and the ODS HTML5 statement.

Beginning with SAS 9.4M4, programmers can create accessible tables, graphs, and text by using the new accessibility features available in the following language

elements: [PROC PRINT](#), [PROC REPORT](#), [ODS Statistical Graphics procedures](#), or the [ODS Report Writing Interface](#) to create accessible output.

Creating Maps Using ODS Graphics and Mapping Procedures

SAS Viya 3.5 has these enhancements for the [SGMAP procedure](#):

- The STYLEATTRS statement enables you to specify color, marker, and other attributes for a graph. You no longer need to change the ODS style template to accomplish this.
- These are the general enhancements for the PROC SGMAP statement:
 - The CYCLEATTRS and NOCYCLEATTRS options specify whether plots are drawn with unique attributes in the graph. Automatic cycling of attributes is allowed.
 - The DATTRMAP= option and the RATTRMAP= option specify the discrete attribute map data set or the range attribute map data set, respectively, that you want to use with the SGMAP procedure. You use the DATTRMAP= option in conjunction with the ATTRID= option and the RATTRMAP= option in conjunction with the RATTRID= option. The ATTRID= option and the RATTRID= option specify the value of the ID variable that is contained in the discrete and range attribute map data sets, respectively.
 - You can specify coordinate system references directly in the PROC SGMAP statement with the MAPCS= and PLOTCS= options. This action negates the need to run PROC GPROJECT on a map data set to project the coordinates before using the projected data in the SGMAP procedure.
- PROC SGMAP has several [new options](#) for map, legend, and plot overlay statements. The following list summarizes the new functionality:
 - Sizing of all markers in a legend in proportion to the font size that is used for the legend value labels.
 - New color options.
 - Specify a value that determines which axis offsets can be affected by the plot.
 - Options to specify a value ID in a discrete or range attribute map set.
 - Automatic binning of a numeric response variable.
 - Code, label, and format data tip information to be displayed when you hover over a graphics element.
 - Ability to code an active link when selecting parts of the plot.
 - There are 30 new TEXT options. These options give you control over the appearance of text and titles on the map.
- Automatic legends are created differently now when the CHOROMAP statement is used. For more information, see [Controlling Legends with the SGMAP Procedure](#).

The SGMAP procedure has the following enhancements in SAS 9.4M6:

- You can use the NOAUTOLEGEND option in PROC SGMAP to suppress automatically creating a legend.
- The SERIES statement and several of its options are added for plot creation. Examples of series plot lines are streets, railroads, and waterways.
- The GRADLEGEND statement and several of its options are added for customizing legends with a numeric response variable. Only discrete key legends were created prior to SAS 9.4M6.
- The PROC SGMAP CHOROMAP statement is at production level. The procedure now accepts numeric response values. Statement options DISCRETE and LINEATTRS= are new:
 - The DISCRETE option handles response variable values and affects both the filled polygons and their respective legend entries.
 - The LINEATTRS= option on the CHOROMAP and SERIES statements enables the control of color, line style, and line thickness on polygon borders and series lines such as railroads.
- The CHOROMAP statement now processes unprojected map coordinates (LAT, LATITUDE, LONG, LON, and LONGITUDE) in addition to the projected X and Y coordinates. Unprojected choromaps can be overlaid on Open Street Maps and Esri maps.
- You can specify the percentage of transparency of a plot using the TRANSPARENCY option in the BUBBLE statement and in the CHOROMAP statement.
- The ability to specify bubble sizes in the BUBBLE statement with the BRADIUSMIN and BRADIUSMAX options.
- The GROUP= option is added to the BUBBLE, SCATTER, and SERIES statements.
- The NOMISSINGGROUP option is added to the BUBBLE, SCATTER, and SERIES statements. This option enables the use of groups when plotting multiple items that might not be at the same data points, and the skipping of missing plot values when the plot is being drawn.

Additional mapping features are available in Base SAS:

- [PROC GINSIDE](#), [PROC GPROJECT](#), [PROC GREDUCE](#), and [PROC GREMOVE](#) have moved from SAS/GRAPH to Base SAS and use ODS Graphics to create graphs. They are documented in [SAS/GRAPH and Base SAS: Mapping Reference](#).
- The [%CENTROID](#) macro that supports the SGMAP procedure has moved from SAS/GRAPH to Base SAS and is now an autocall macro. Running the [%ANNOMAC](#) macro before using [%CENTROID](#) is no longer necessary.

Beginning with SAS 9.4M5, mapping features are available in Base SAS. You can use the new SGMAP procedure to create maps and then overlay plots such as text, scatter, or bubble plots. PROC GEOCODE and PROC MAPIMPORT are now a part of Base SAS. For more information, see [SAS/GRAPH and Base SAS: Mapping Reference](#).

Also, in SAS 9.4M5, the maps data sets in the Mapsgfk library have been updated. The MAPSGFK= system option can now be updated using the APPEND= and INSERT= system options.

Performance

On host platforms other than z/OS, SAS is more efficient in writing output data, especially large amounts of data, when the data is aligned on a page boundary. You can use the [ALIGNSASIOFILES](#) system option to align output data on a page boundary. [ALIGNSASIOFILES](#) is set by default.

The optimization processes that determine the page size for SAS data sets and utility files have been enhanced. If the optimization processes are not ideal for your SAS session, you can use the [DATAPAGESIZE=](#) system option to revert to the settings that were in place prior to SAS 9.4.

I/O between SAS and RAID devices can improve when you use the [STRIPESIZE=](#) system option. The [STRIPESIZE=](#) system option enables you to set the page size for a SAS library to be the same size as the RAID stripe.

SAS uses temporary utility files for processing SAS data sets. I/O performance improves when the page size of the utility files is compatible with the page size for the data set. Two new system options, [UBUFNO=](#) and [UBUFSIZE=](#), enable you to configure buffers for utility files.

Processing a SAS view is improved using the [VBUFSIZE=](#) system option to set the size of the view buffer that holds output observations.

Extended Variable and Data Set Attributes

You can create custom attributes for variables and data sets by using extended attributes. You manage extended attributes by using the [DATASETS](#) procedure.

In addition to the [DATASETS](#) procedure, these procedures support extended attributes:

- [APPEND](#)
- [CIMPORT](#)
- [CONTENTS](#)
- [COPY](#)
- [CPORT](#)
- [DOWNLOAD](#)
- [MIGRATE](#)
- [SQL](#)
- [UPLOAD](#)

Locked-Down State

In SAS 9.4M2, the [LOCKDOWN statement](#) is enhanced so that certain access methods and their related procedures are disabled by default when a SAS session is locked down. However, the SAS server administrator can re-enable one or more of these access methods. For a list of the default locked-down restrictions, see “[SAS Processing Restrictions for Servers in a Locked-Down State](#)” in *SAS Language Reference: Concepts*.

In SAS 9.4M1, if you are running SAS in a client/server environment, the SAS Application Server administrator can create an environment in which your SAS client has limited access to a pre-defined directories and files on the server. All other directories and files are inaccessible. When SAS is in a locked-down state, access to some SAS language elements is also [restricted](#).

Preserving the SAS Environment

When the [PRESENV=](#) system option is set, the Work library data sets and catalogs, and the values of global statements, macro variables, and system options can be preserved between SAS sessions. You use the [PRESENV](#) procedure to preserve your environment settings and variable definitions to be used in a subsequent SAS session.

JSON Support

The [JSON](#) procedure reads data from a SAS data set and writes the data to an external file in JSON representation.

In SAS 9.4M4, the [JSON LIBNAME statement](#) enables you to associate a libref with a JSON document.

In SAS 9.4M3, you can create and parse JSON text by using the DS2 JSON package.

Saving Macro Code from an Input Stream

The new [STREAM](#) procedure enables you to process arbitrary text that contains SAS macro specifications in an input stream. The procedure can expand macro code and store it in a file.

Transporting SAS Files

[Moving and Accessing SAS Files](#) has been updated to include information about the following changes:

- The CPORT and CIMPORT procedures now support the Extended Attributes feature.
- The CPORT and CIMPORT procedures do not transfer data mining database catalog entries from SAS 9.3 or earlier versions of SAS.
- The COMPRESS= option in the CIMPORT procedure is added to allow compressing the CIMPORT data set. You can specify the type of compression used.

[SAS 9.4M5](#) has these enhancements:

- A section was added to the document about migrating data to UTF-8 encoding to support multilingual usage and to support SAS Viya.

In [SAS 9.4M4](#), these macros in the autocall library have been enhanced:

- The %XPTCOMMN macro recognizes that when a data set conforms to the V5 specification and you use the %LOC2XMP macro to create a V5 transport file, PROC COPY and the XPORT engine can read the transport file.
- The %XPT2LOC macro no longer requires quotation marks to be part of the name in the transport file if a memname needs to be an n-literal string. In addition, creating an n-literal string was changed to occur when generating DATA step code that converts a transport file to a SAS data set.

[SAS 9.4M3](#) has these enhancements:

- PROC CIMPORT supports the ability to import data sets created in non-UTF-8 SAS sessions into UTF-8 SAS sessions.

In [SAS 9.4M2](#), macros have been added to the autocall library to read from or write to transport files in SAS Version 5 (V5) or SAS Version 8 (V8) formats. The macros are as follows:

- %LOC2XPT
- %XPT2LOC

- %XPTCOMMN

For more information, see [“What's New in Moving and Accessing SAS 9.4 Files” in *Moving and Accessing SAS Files*](#).

Universal Printing

SAS now creates TIFF images and the [EMFPlus](#) and [EMFDual](#) metafile formats.

[Transparency](#) is supported for EMF Universal Printers and GIF images within PostScript files.

You can add a [printer's mark](#) that is not visible in Universal Printing output by using the [COLOPHON=](#) system option.

You can [animate multi-page GIF images and SVG files](#) by setting these system options: [ANIMATION=](#) , [ANIMDURATION=](#) , [ANIMLOOP=](#) , [ANIMOVERLAY](#) , [SVGAUTOPLAY](#) , [SVGFADEIN=](#) , [SVGFADEMODE=](#) , and [SVGFADEOUT=](#) .

SVG documents can be [magnified](#) by setting the [SVGMAGNIFYBUTTON](#) system option. SAS embeds a magnify tool in the document when the SVG document is created.

SAS supports the following new [font](#) replacements:

- The Monotype Sans WT (J,K,SC,TC) fonts are replaced by the new Arial Unicode MS font.
- The Thorndale Duospace WT (J,K,SC,TC) fonts are replaced by the new Times New Roman Uni font.
- Sim Hei, SimSun, and NSimSun are replaced by CSongGB18030C-Light, CSongGB18030C-LightHWL, MYingHei_18030_C-Medium, and MYingHei_18030_C-MediumHWL.

In [SAS 9.4M5](#), new AvenirNextforSAS and HelveticaNeueforSAS fonts replace the Avenir Next LT W04, Avenir NextCyr W04, and Helvetica LT Pro fonts.

In [SAS 9.4M4](#), Universal Printing supports the following new fonts:

- Helvetica LT Pro
- Symbola

In [SAS 9.4M3](#), Universal Printing supports Avenir Next TrueType fonts.

In [SAS 9.4M2](#), if you specify italic or bold style on a universal printer font that does not have an italic or bold style, the font is now displayed as italic or bold. For more information, see [“Slanting and Emboldening Fonts” in *SAS Language Reference: Concepts*](#).

Encryption

SAS/SECURE increases the security of stored passwords by using SAS004 encoding. SAS004 encoding uses [Advanced Encryption Standard \(AES\)](#) with 64-bit salt. In SAS 9.4M5, encoding type SAS005 is added.

You can now use AES to encrypt SAS data sets. AES-encrypted data files are supported using these SAS language elements:

- In Base SAS and the SPD Engine, you use the ENCRYPT= and ENCRYPTKEY= data set options to specify the encryption key.

Table 1.1 Data Set Options to Specify an Encryption Key

Base SAS	<p>“ENCRYPT= Data Set Option” in SAS Data Set Options: Reference</p> <p>“ENCRYPTKEY= Data Set Option” in SAS Data Set Options: Reference</p>
SPD Engine	<p>“ENCRYPT= Data Set Option” in SAS Scalable Performance Data Engine: Reference</p> <p>“ENCRYPTKEY= Data Set Option” in SAS Scalable Performance Data Engine: Reference</p>

- [APPEND](#) procedure
- [CONTENTS](#) procedure
- [COPY](#) procedure
- [SASFILE](#) statement [ENCRYPTKEY=](#) option

The [SAS Logging Facility](#) now supports full logging and debugging of encryption activity.

On a Windows server or client, the user can import [digital certificates](#) to a Machine Store as well as to a Personal Store.

IMPORTANT TLS version 1.2 is the default protocol supported in SAS 9.4. Earlier versions of TLS and SSL are insecure.

IMPORTANT For SAS 9.4 and all maintenance releases of SAS 9.4, updated versions of OpenSSL are provided and updated through hot fixes for UNIX and z/OS.

SAS 9.4M6 has these changes and enhancements:

- The default version of TLS that is supported by SAS is TLS 1.2 for Linux, UNIX, and z/OS. Windows versions of SAS support the TLS versions that Windows supports.
- TLS is supported for these Integrated Object Model (IOM) servers and server processes that provide IOM Bridge access:
 - SAS Metadata Server
 - SAS OLAP Server
 - SAS Workspace Server
 - SAS Stored Process Server
 - SAS Pooled Workspace Server
 - Object Spawner

On all IOM servers, the [NETENCRYPTALGORITHM](#) system option is specified to enable TLS encryption on the server.

- The [SSLCACERTDIR](#) system option specifies the location of the trusted certificate authorities (CAs) found in OpenSSL format. This option is valid on Linux, UNIX, and z/OS.
- [PROC S3](#) supports encryption when working with the Amazon S3 or Amazon Redshift environment. This support includes the new [ENCKEY](#) statement that enables you to register encryption keys. There are also new options available with the [COPY](#), [GET](#), [GETDIR](#), [INFO](#), [PUT](#), and [PUTDIR](#) statements that enable encryption.

[SAS 9.4M5](#) has these changes and enhancements:

- New system options have been added for Linux, UNIX, and z/OS:
 - [SSLCACERTDATA](#) specifies the trusted certification authority (CA) certificate in base64 encoded string.
 - [SSLCIPHERLIST](#) specifies a list of cipher suites to use.
 - [SSLSNIHOSTNAME=](#) enables the client to use Server Name Indication (SNI) in the TLS handshake to identify the server name that it is trying to connect to. The environment variable, [SSL_USE_SNI](#), is now used only to disable SNI.
- By default the SNI is sent to the web servers in the TLS handshake.
- New encoding type [SAS005](#) uses AES encryption with a 256-bit fixed key and a 64-bit random salt value. [SAS005](#) increases security for stored passwords by using the SHA-256 hashing algorithm and is hashed for additional iterations.
- For more security, you can use [SHA256-10000](#) for internal account passwords used in metadata. [SHA256-10000](#) is the same as [SHA256](#), but is hashed for additional iterations.
- To access SAS Viya services, use the [SAS_VIYA_TOKEN](#) environment variable. This environment variable provides the OAuth token that is needed for a user to access SAS Viya services.
- To allow a SAS 9.4 client to use the same TLS certificates as those used by SAS Viya, use the [CAS_CLIENT_SSL_CA_LIST](#) environment variable. The environment variable points to the path and filename of the file that contains the list of trusted certificate authority (CA) certificates.
- Beginning in the December 2017 release of [SAS 9.4M5](#), on Linux, if the root CA is already in the OpenSSL trusted certificate store, Lua, Python, and SWAT

clients should work without having to set the `CAS_CLIENT_SSL_CA_LIST=` environment variable.

- When encrypting data at rest, you can now specify data set option `ENCRYPT=AES2`. AES2 is another key generation algorithm for AES encryption. Using the `PROC AUTHLIB CREATE` statement, you can use AES2 key generation for libraries and data sets that are bound using metadata objects.

In SAS 9.4M4, the OpenSSL libraries provided by SAS have been updated for UNIX and z/OS. For SAS 9.4 and all maintenance releases of SAS 9.4, updated versions of OpenSSL are provided and updated through hot fixes. For the latest information about OpenSSL security advisories under consideration for software fixes for SAS components, see <http://support.sas.com/security/openssl-security-advisories.html>.

In SAS 9.4M3, these are the encryption enhancements:

- The SAS Deployment Wizard automates the process of updating the TLS certificates on UNIX servers. At installation, a list of CA certificates that are distributed with Mozilla software products (Mozilla CA bundle) is used as the site-signed list. You can then use the SAS Deployment Wizard to add your own trusted certificates. The combination generates a new trusted CA list.
- The `SAS_SSL_CIPHER_LIST` environment variable enables you to specify the ciphers that can be used for OpenSSL under UNIX and z/OS.

Note: This environment variable was made available in maintenance releases prior to SAS 9.4M3 through hot fixes. However, beginning with SAS 9.4M5, a best practice is to use the `SSLCIPHERLIST=` system option to specify the ciphers that can be used for OpenSSL under UNIX, and z/OS.

- Certificates are now located in the `trustedcerts.pem` file. The location of the file is automatically specified during installation by using the `SSLCALISTLOC=` system option.

In SAS 9.4M1, the following enhancements were made:

- The default location for the `TLS Certificate Authority (CA)` changed for the UNIX and z/OS foundation servers. The default location is specified by the `SSLCALISTLOC=` option in configuration files.
- `Subject Alternative Names (SAN)` in TLS certificates are supported. Server Name Indications (SNI) in the TLS handshake between clients and servers are supported. These are now supported on UNIX and z/OS clients and servers.
- Environment variables `SSL_CERT_DIR` and `SSLCACERTDIR` can now be used to point to the location of certificates. These environment variables are supported on UNIX and z/OS servers.
- An administrator can store an AES encryption key for the metadata-bound library so that a user with access authorization can access the metadata-bound data set without supplying the key-in code.

SAS Engines for Open-Source File Formats

Beginning in [SAS Viya 3.5](#), SAS supports Apache ORC tables by using the SAS ORC engine.

The SAS ORC engine can create or access an ORC table that is stored in one of the following storage systems:

- Microsoft Azure Data Lake Storage Gen2
- Linux for x64 distributions that are supported by SAS

For more information, see [SAS Viya Engine for ORC: Reference](#).

Scalable Performance Data Engine

The Scalable Performance Data Engine (SPD Engine) enables the caching of opened SPD Engine files. New SPD Engine data set options enable AES (Advanced Encryption Standard) encryption. For more information about updating data using the SPD Engine in a Hadoop environment, see [“Hadoop Support” on page 16](#) and [SAS Scalable Performance Data Engine: Reference](#).

In SAS 9.4M7, the `-yarnrm` and `-host` options provide customizations to the `sashiveserdespde-installjar.sh` script.

In SAS Viya 3.5, you can override and change the encoding when reading or writing SAS data sets using the `INENCODING= LIBNAME` statement option.

In SAS 9.4M6, for both HDFS and non-HDFS file systems, access is expanded to the FEDSQL procedure, FedSQL language, DS2 procedure, and DS2 language.

SAS 9.4M5 has the following enhancement:

- The SPD engine supports cross-environment data access (CEDA) with additional restrictions. For more information, see [“Accessing SPD Engine Files on Another Host” in SAS Scalable Performance Data Engine: Reference](#).

SAS 9.4M2 has the following changes and enhancements:

- SPD Engine does not support `DLDMGACTION=NOINDEX`, but does support `ABORT`, `FAIL`, `PROMPT`, and `REPAIR`.
- The new `LIBNAME` statement options enable you to do the following:

The `IOBLOCKSIZE=` option enables you to specify the size, in bytes, of a block of observations to be used in an I/O operation.

The `COMPRESS=` option enables you to compress an SPD Engine data set on disk as it is being created.

XMLV2 Engine

In SAS 9.4M7, or if you apply a hot fix to SAS 9.4 or to SAS Viya, the behavior of the AUTOMAP= LIBNAME statement option is changed. Some XML entities are not supported.

In SAS 9.4M6, two LIBNAME statement options expand column variable lengths:

- The **CHARMULTIPLIER=** option expands column (variable) lengths by a default multiplier value that is based on the session encoding. These column (variable) lengths are specified in an XMLMap.
- The **DERIVECHARMULTIPLIER=** option expands column (variable) lengths by a default multiplier value that is based on the session encoding. These columns (variable) lengths are specified in an XMLMap.

In SAS9.4M4, the new PREFIXATTRIBUTES= option specifies whether the element name is concatenated to the attribute name when generating each XMLMap COLUMN element.

In SAS 9.4, XMLV2 engine functionality for the z/OS environment changed from preproduction to production. The engine is production in all SAS 9.4 operating environments.

National Language Support (NLS)

SAS Viya 3.5 has these [changes and enhancements](#):

- Aliases and POSIX numbers are updated for these locales:
 - Chinese_China
 - Chinese_HongKong
 - Chinese_Macau
 - Chinese_Singapore
 - Chinese_Taiwan
 - Serbian_Serbia
 - SerbianLatin_Serbia
- These formats are new:
 - **NLTIMEL** converts a SAS time value to the time value of the specified locale, and then writes the value as a time value in a long-uniform pattern.
 - **NLTIMEM** converts a SAS time value to the time value of the specified locale, and then writes the value as a time value in a medium-uniform pattern.
 - **NLTIMES** converts a SAS time value to the time value of the specified locale, and then writes the value as a time value in a short-uniform pattern.

- These formats have been restored to [SAS Viya 3.5](#):
 - [JNENGO](#) writes SAS date values as Japanese dates as reign, year, month, and day.
 - [JNENGOT](#) writes SAS datetime values as Japanese datetimes as reign, year, month, day, hour, and minute, and with narrow characters for numbers.
 - [JNENGOTW](#) writes SAS datetime values as Japanese datetimes as reign, year, month, day, hour, and minute, and with wide characters for numbers.
 - [JNENGOW](#) writes SAS date values as Japanese dates as reign, year, month, and day, and with wide characters for numbers.
- The [JNENGO](#) informat has been restored to [SAS Viya 3.5](#). The [JNENGO](#) informat reads Japanese kanji date values.
- These functions have been enhanced:
 - You can modify the functionality of the [KCOMPARE](#) function by using [modifiers](#).
 - The [KPROPDATA](#) function [PUNC option](#) converts commonly used 8-bit punctuation.
- These [LIBNAME](#) statement options are new:
 - You can exclude variables for data processing by using the [CVPEXCLUDE](#) statement option.
 - You can include variables for data processing by using the [CVPINCLUDE](#) statement option.

In [SAS 9.4M6](#), you can use modifiers to change the functionality of the [KCOMPRESS](#) function.

[SAS 9.4M5](#) has these changes and enhancements:

- To avoid character truncation when you copy data to a new encoding, you can use the macro [%COPY_TO_NEW_ENCODING](#).
- SAS supports the locale Tagalog-Philippines.
- The [DTWEEKV](#) format writes a week and datetime number in decimal format by using the V algorithm.
- The [CALL KSCANX](#) routine returns the position and length of the nth word from a character string.
- The [KCOUNTC](#) function counts the number of individual characters in a character string.
- The [KCOUNTX](#) function counts the number of times that a specified substring appears within a character string.
- The [KCOUNTW](#) function counts the number of words in a character string.
- The [KFOUND](#) function searches for a specific substring of characters within a character string.
- The [KFOUNDC](#) function searches a string for any character in a list of characters.
- The [KFOUNDW](#) function returns the character position of a word in a string or the number of the word in a string.
- The [KSCANX](#) function selects a specified word from a character expression.
- The [KLEFT](#) function documentation includes the table [Unicode Spaces That Are Removed by KLEFT, KRIGHT, and KTRIM](#).

- Information about data normalization has been added to the [KSTRIP function](#).
- The [NLSTRMON informat](#) reads the month name in the specified locale and converts it to a numeric value.

[SAS 9.4M3](#) has these enhancements:

- New locales are [Kazakh_Kazakhstan \(kk_KZ\)](#) and [Basque_Spain \(eu_ES\)](#).
- The [ManxGaelic_UnitedKingdom \(gv_GB\)](#) locale is deprecated.
- The [KINDEXB](#) function searches a character expression for a string of characters.
- The [KINDEXCB](#) function searches a character expression for a character string as a pattern for languages that use DBCS.
- The I18N level changed for numerous functions. For more information, see [“Internationalization Compatibility for SAS String Functions” in SAS National Language Support \(NLS\): Reference Guide](#).
- Sorting by the SORT and SQL procedures is based on the session locale when the [SORTSEQ= system option](#) is set to LINGUISTIC.

[SAS 9.4M2](#) has the following changes and enhancements:

- A [new chapter](#) was added to define time zones and to explain how SAS processes them.
- **Formats:**
 - The new [BESTDOTX](#) format specifies that SAS choose the best notation and use a dot as a decimal separator.
 - The country Latvia is added to these formats: [NLMNIEUR](#) and [NLMNLEUR](#).
- **Functions:**
 - The new [KUPDATES](#) function inserts, deletes, and replaces character value contents.
 - The new [TZONEDSTNAME](#) function returns a daylight saving time name.
 - The new [TZONEDSTOFF](#) function returns the time zone offset value for the specified daylight saving time.
 - The new [TZONESSTNAME](#) function returns a standard time zone name.
 - The new [TZONESSTOFF](#) function returns the time zone offset value for the specified standard time.
 - The [KCVT](#) function was updated with DBCS, SBCS, and MBCS information, and references to DBCSLANG and DBCSTYPE were removed.
 - The [KUPDATE](#) function NLSCOMPATMODE option was removed.
- **Informats:**
 - The country Latvia is added to the [NLMNIEUR](#) and [NLMNLEUR](#) informats.
 - The new [NLDATEW](#) informat reads the date value in the specified locale, and then converts the date value to the local SAS date and the day of the week.
 - The new [NLDATMW](#) informat reads the date value in the specified locale, and then converts the date value to the local SAS day of the week and the datetime.
 - The new [NLDATMAP](#) informat reads the date value in the specified locale, and then converts the date value to the local SAS datetime with a.m. or p.m.
 - Aliases were added to the [NLDATE](#) , [NLTIME](#) , and [NLDATM](#) informats.

- System options:

The new [NLDECSEPARATOR](#) system option specifies whether SAS produces locale-sensitive numeric output for the decimal separator or continues to format numbers with U.S. English preferences.

The [DFLANG](#) system option was enhanced to support the locale option.

The [NLSCOMPATMODE](#) system option is removed from the document.

These are the changes and enhancements for [SAS 9.4](#):

You can create a data set that contains information about a locale. The data in the data set is used by SAS to process locale information. You use the [LOCALEDATA](#) procedure to manage and view the data, and to save the data to the SAS registry. You specify the name of the locale data set by using the [LOCALEDATA=](#) system option.

SAS can now process data by using a time zone other than your local time zone. You use the [TIMEZONE=](#) system option to specify a time zone. New time zone formats use the ISO 8601 standard to format dates, times, and datetime values by using Universal Coordinate Time (UTC). New time zone functions enable you to determine time zones and time zone offsets, and to convert datetime values between SAS and UTC. A new SAS datetime constant enables a SAS datetime value to have a time zone offset.

In addition to the time zone functions, there are new functions for these tasks:

- converting characters to base characters by using the [BASECHAR](#) function
- removing leading and trailing blanks from a character string by using the [KSTRIP](#) function
- specifying the locale keys for the current SAS session by using the [SETLOCALE](#) function

You can specify a translation table to transcode parts of SAS between EBCDIC and ASCII by using the [MAPEBCDIC2ASCII=](#) system option.

To keep the language of the SAS log as English, set the [ODSLANGCHANGE](#) and [LOGLANGCHG](#) system options.

Set the language for international date formats and informats to the locale that is specified by the [LOCALE=](#) system option. To do this, specify the [LOCALE](#) argument for the [DFLANG=](#) system option.

SAS uses the value of the [LOCALE=](#) system option to set the [PAPERSIZE=](#) option to either LETTER or A4 when you specify the [LOCALE](#) argument for the [PAPERSIZE=](#) system option.

SAS now supports the English_Malta (en_MT), Greek_Cyprus (el_CY), and Irish_Ireland (ga_IE) [locales](#).

ISO-8859-13 (Latin 7) and ISO-8859-15 (Latin 10) are new [encodings](#) that SAS supports.

Metadata

SAS data can be bound to metadata and subject to metadata layer permissions. A metadata-bound library is a physical library that is tied to a corresponding metadata object. You use the [AUTHLIB](#) procedure to manage metadata-bound libraries.

In SAS 9.4M7, the METALIB procedure now allows the creation of a table object name that is up to 60 characters. A table object's name includes the SAS table name and an optional prefix text string.

In SAS 9.4M6, the database credentials that are specified in the PROC METALIB [DBAUTH statement](#) override any other predefined authentication types.

SAS 9.4M5 has these enhancements:

- With the [PROC AUTHLIB CREATE statement](#), you can use AES2 key generation for libraries and data sets that are bound using metadata objects.
- [PROC METALIB](#) has changed how it handles case updates for DBMS columns. In previous releases, when a column name in a DBMS table's metadata definition matched a column name in the data source, but the column name had a different case (for example, lowercase instead of uppercase), the column definition was deleted and re-created to match the case of the column name in the data source. Beginning with SAS 9.4M5, PROC METALIB updates the column definition in-place. The change preserves column mappings. Case-only column updates to metadata for SAS data sources have been performed in all SAS 9.4 versions.

SAS 9.4M3 has the following changes and enhancements:

- The METADATA procedure supports the <CLUSTER/> XML element, which can be used to direct the METHOD=STATUS query in the IN= argument to the metadata server cluster's master node without knowing or specifying its connection parameters.
- Cluster synchronization checking is available in the SAS Management Console Metadata Manager Analyze/Repair wizard and the sas-analyze-metadata batch tool. For more information, see [SAS Intelligence Platform: System Administration Guide](#).
- The METALIB procedure statement [DBAUTH](#) enables you to specify database authentication credentials for libraries that have an authentication type of Prompt in their server definition, directly in the PROC METALIB request.
- The metadata engine enables you to specify database authentication credentials directly in the LIBNAME statement by using the DBUSER= and DBPASSWORD= LIBNAME options.
- The DATA step function, [METADATA_GETURI](#), constructs a URL for SAS web applications by using information from the SAS Metadata Repository.

SAS 9.4M2 has the following changes and enhancements:

- The METALIB procedure checks for and updates a table definition's library ownership if the table definition being updated is using a different library definition than the one with which it was created. This is useful when importing and exporting data.

- The SAS Metadata Server sends alert email reminder messages after the initial notification of the alert condition “journal commit task stopped running.” The server terminates itself if the alert condition is not addressed within a configured period of time.

In SAS 9.4M1, an administrator can use the [AUTHLIB](#) procedure to require that all data sets in a metadata-bound library be automatically encrypted using the `REQUIRE_ENCRYPTION=YES` option in the `CREATE` or `MODIFY` statements.

The metadata server connection system options support use of a system [connection profile](#) to connect to the SAS Metadata Server.

The [METAOPERATE](#) procedure and the [METADATA](#) procedure have been enhanced to operate in a clustered [SAS Metadata Server configuration](#) and in a single SAS Metadata Server configuration.

The Metadata LIBNAME Engine supports [extended attributes](#) on SAS data sets and libraries.

A new metadata DATA step function, [METADATA_APPPROP](#), returns the value of a specified property for a specified SoftwareComponent or DeployedComponent.

Processing of the [METAAUTORESOURCES](#) system option has changed. Now, library assignments that are stored in metadata are always applied before library assignments in the AUTOEXEC file.

SAS Logging Facility

The SAS Logging facility uses the [ConsoleAppender](#) to write messages to z/OS system consoles.

You can specify whether a [logger's additivity and level settings](#) are permanent or can be modified programmatically by setting a logger's IMMUTABILITY setting.

Three [new loggers](#) support auditing logging configurations.

Two new loggers support [auditing access to SAS data sets](#).

Two new loggers support [auditing access to metadata-bound libraries](#).

You can specify the client ID in the DEFAULT and TRACE [conversion patterns](#).

SAS 9.4M2 has the following changes and enhancements:

- [ConsoleAppender](#) has the following new parameters:
 - The ImmediateFlush parameter enables you to force messages to be written to the console immediately as they are received.
 - The Target parameter enables you to write messages to the console's standard error stream instead of the standard output stream. This parameter is valid only for Windows and UNIX environments.
- The new FilePermissions parameter of [FileAppender](#) and [RollingFileAppender](#) enables you to set permissions on log files.
- The default level for the root logger is INFO.

Application Response Measurement (ARM)

When you have an [ARM appender](#) that is defined in the XML configuration file, you no longer need to set the `ARMAGENT=LOG4SAS` system option. ARM sets `ARMAGENT` to `LOG4SAS` internally.

There are three new ARM metrics for the [ARM_DSIO subsystem](#):

- `NOBS` reports the number of observations in the file.
- `NVAR` reports the number of variables in the file.
- `NOBSREAD` reports the number of observations read.

Email

When you send email by using SAS and an SMTP server, you can use the `EMAILACKWAIT=` system option to set the number of seconds to wait for an acknowledgment from the SMTP server.

The new `EMAILHOST=` system option arguments `PORT`, `SSL`, `STARTTLS`, `USERID`, `PWD`, and `AUTH` enhance email security.

In [SAS 9.4M5](#), the `FILENAME` statement, `EMAIL (SMTP)` supports attaching more than one file using multiple `!EM_ATTACH!` directives. The [FILENAME statement](#), [ZIP](#) access method supports GZIP files.

Beginning with [SAS 9.4M4](#), you can set an email sensitivity flag on emails that originate from SAS using the [FILENAME Statement](#), [EMAIL \(SMTP\) Access Method](#).

Procedures

[SAS Viya 3.5](#) has these changes and enhancements:

- The [CIMPORT procedure](#) has these enhancements:
 - `PROC CIMPORT` can be used to import a file that was created in UTF-8 encoding into non-UTF-8 SAS sessions and output corresponding data sets.
 - When a transport file is imported, the original string variable length might not be large enough for the transcoded strings. To ensure that your destination

buffer size is sufficient for transcoded data, specify the `EXTENDVAR=` and the `EXTENDFORMAT =` options in the `PROC CIMPORT` statement.

- `PROC DS2` enhancements: See “[DS2 Language](#)” on page 7.
- The [EXPORT procedure](#) supports all access types that are available in the [FILENAME statement](#).
- `PROC FEDSQL` enhancements. For more information, see “[FedSQL Language](#)” on page 12.
- The [IMPORT procedure](#) supports all access types that are available in the [FILENAME statement](#).
- In `PROC S3`, you can save LIST output to an external file using the `OUT=` option.
- The [SCOREACCEL procedure](#) adds support for publishing a model to a global model table:
 - You publish a model to a global model table by using the `PUBLISHGLOBAL=` option in the `PUBLISHMODEL` statement.
 - You delete a model from a global model table by using the `DELETEGLOBAL=` option in the `DELETEMODEL` statement.
- [PROC SQOOP](#) support was added for the `HIVE_SERVER=` option to connect to the Hive server and port, and the `HIVE_URI=` option to specify the JDBC URI. The `HIVE_URI=` option is required when connecting to a Kerberized HDP 3.1 cluster when the `hive-site.xml` file does not contain the Zookeeper service.

[SAS 9.4M6](#) has these changes and enhancements:

- [PROC FCMP](#) has these option enhancements:
 - Use the `OUTFILE=` option to write referenced functions and the main program to a text file. Programs that have been parsed by `PROC FCMP`, including macro variables, can be exported.
 - The `OUTITEMSTORE=` option exports symbols, referenced functions, and the main program to the specified item store.
- [PROC HDMD](#) supports managed, external, and transactional tables for Hive 3.0. By default, a new table is created as managed and transactional.
- When you invoke a web service using `PROC HTTP`, you can set SSL options by using the [SSLPARMS statement](#). This statement is not valid in SAS Viya 3.4 or SAS Viya 3.5.
- In May 2019, the documentation includes the following corrections:
 - [PROC HTTP](#) has a new authentication option, `AUTH_NONE`, and options that enable URL redirection, `FOLLOWLOC` and `NOFOLLOWLOC`.
 - You can use `WEBUSERNAME=` as an alias for the `USERNAME=` procedure option and `WEBPASSWORD=` as an alias for the `PASSWORD=` procedure option.
 - The `CLEAR_COOKIE_CACHE` procedure option has been renamed to `CLEAR_COOKIES`.
 - The `NO_COOKIE_CACHE` option has been renamed to `NO_COOKIES`.
 - Support for the `OAuth_BEARER=` procedure option has been clarified.
- The default behavior of the `PROC HTTP DEBUG` statement has changed. The HTTP request body and response body are now written as binary, instead of

text. The DEBUG statement also has new options, in addition to Level=, to enable you to specify the parts of the HTTP request that you want to debug.

- Information about the scope of variables and other objects that are defined for PROC LUA is added to the documentation.
- When you use the PROC PROTO LINK statement to load modules that are written in C or C++, you can specify only load modules whose paths are registered by the administrator using the PROTO LIBS= system option.
- You can create a table of contents that contains #BY directives using the CONTENT= option in PROC PRINT, PROC REPORT, and PROC TABULATE when used with the ACCESSIBLETABLE system option.
- The CAPTION= option for PROC REPORT and the PROC TABULATE TABLE statement creates a visible and accessible table caption when used with the ACCESSIBLETABLE system option.
- PROC S3 supports server-side encryption in an Amazon S3 or Amazon Redshift environment. This support includes the new ENCKEY statement that enables you to register encryption keys. Support for server-side encryption was also added to the COPY, GET, GETDIR, INFO, PUT, and PUTDIR statements.
- If you use the V9 engine to create a PROC SQL view that contains a USING clause, the view is not accessible in SAS 9.4M5 or earlier releases. For more information, see CREATE VIEW Statement.

The December 2017 release of SAS 9.4M5 and SAS Viya 3.3 has these enhancements:

- The FMTC2ITM procedure converts one or more format catalogs into a single item store that can be used with the CAS server. Use the item store as input to the CAS server addFmtLib action to add a format library to a session.
- PROC LUA supports the VARCHAR data type.
- You can manage objects in Amazon S3 using the S3 procedure.
- Publish and execute DATA step and DS2 models in CAS or an external database using the SCOREACCEL procedure.

SAS 9.4M5 has these changes and enhancements:

- PROC AUTHLIB supports AES2 encryption.
- PROC COPY copies data using CAS server actions when the IN= option and the OUT= option are both set to the CAS engine libref. No data is transferred between SAS and the CAS server.
- PROC DS2 supports Amazon Redshift, Microsoft SQL Server, and Vertica data sources. PROC DS2 is available in both SAS 9.4 and SAS Viya. You connect to the CAS server using the SESSREF= or SESSUID= procedure option. The SESSREF= option identifies the CAS session by its session name. The SESSUID= option identifies the session by its universally unique identifier (UUID). The NOLIBS CONN= option includes connection parameters for SAS Scalable Performance Data (SPD) Server.
- The new DSTODS2 procedure enables you to translate a subset of your SAS DATA step code into DS2 code.
- PROC FEDSQL supports Amazon Redshift, Microsoft SQL Server, and Vertica data sources. PROC FEDSQL is available in both SAS 9.4 and SAS Viya. You connect to the CAS server using the SESSREF= or SESSUID= procedure option. The SESSREF= option identifies the CAS session by its session name. The SESSUID= option identifies the session by its universally unique identifier

(UUID). The NOLIBS CONN= option includes connection parameters for SAS Scalable Performance Data (SPD) Server.

- These procedures support CAS tables that have variables with a data type of VARCHAR: CONTENTS, COPY, DATASETS COPY and CONTENTS statements, EXPORT, IMPORT, and PRINT. PROC CONTENTS reports the number of characters or bytes for a variable.
- PROC FCMP supports [dictionaries](#) and [Analytic Store](#) scoring models.
- PROC [HTTP](#) adds a DEBUG statement, OAUTH_BEARER= and TIMEOUT= procedure options, and PROC HTTP response status macro variables.
- PROC REPORT, TABULATE, MEANS, and SUMMARY can summarize data using the CAS server.
- PROC [SQOOP](#) supports workflows and Kerberos on Linux, and the WFHDFSPATH= option is now optional.

[SAS 9.4M4](#) has these changes and enhancements:

- PROC [RANK](#) and PROC [SORT](#) support the Hive database management system.
- PROC DS2 and PROC FEDSQL can be used to read, write, and update SPD Server tables.
- The [S3 Procedure](#) enables you to perform object management for objects in Amazon S3. These objects include buckets, files, and directories.

[SAS 9.4M3](#) has these changes and enhancements:

- The [AUTHLIB](#) procedure PURGE statement removes any retained metadata-bound library credentials older than a given date of replacement. The MODIFY statement PURGE= option can be used to remove all retained metadata-bound library credentials if all tables in the library are successfully modified to the newer credentials.
- The [DATEKEYS](#) procedure provides a way to create and manage date keys that are associated with time computations. A SAS date key is used to describe a date or time interval that is associated with special events such as holidays and sale periods.
- You can use the PROC FCMP [STATIC](#) statement to retain a variable's value from a previous call until the variable is reassigned.
- PROC [HADOOP](#)
 - You can use wildcards in syntax in several HDFS statement commands such as COPYTOLOCAL.
 - You can request recursive action in an HDFS statement operation that executes the operation on the specified directory as well as subsequent directories.
 - There are new HDFS statement commands to list files (LS), list contents of files (CAT), and change permissions (CHMOD).
 - An alternate method to specify the location of the Hadoop configuration file is to specify the location by using the SAS_HADOOP_CONFIG_PATH environment variable.
 - You can submit a MapReduce program and Pig language code to a Hadoop cluster through the Apache Oozie RESTful API.
- PROC [HTTP](#)

- Expands method support to include all methods that support the HTTP/1.1 standard and are supported by the target server.
- Custom request headers can be specified as name=value pairs in a HEADERS statement or by submitting a fully formatted input file from a fileref.
- Input data can be specified in a quoted string or submitted from a fileref.
- For web servers that support it, the procedure uses connection caching and cookie caching by default. You can toggle the behavior of both types of caching and clear the caches within the procedure by specifying procedure arguments. Or you can turn cookie caching off by using a macro variable.
- The documentation for the HDMD procedures has moved from *SAS/ACCESS for Relational Databases: Reference* to *Base SAS Procedures Guide*.
- Using the [LUA](#) procedure, you can run LUA code within a SAS session. The LUA procedure also enables you to call SAS functions from within blocks of LUA code.
- For the [MIGRATE](#) procedure, the default value of BUFSIZE has changed. The new default is the buffer page size of the current session. To continue using the previous behavior, which is to clone the page size of the members from the source library, specify BUFSIZE=KEEPSIZE.
- The [PRINTTO](#) procedure enables you to restore the previous location of the SAS log and LISTING output files. SAS saves the path of the SAS log and LISTING output files in automatic macro variables.
- The [PRODUCT_STATUS](#) procedure returns a list of the SAS Foundation products that are installed on your system, along with the version numbers of those products.
- PROC [SQL](#) supports linguistic collation with the SORTSEQ statement option.
- The following procedures support the Impala, HAWQ, and SAP HANA database management systems:
 - PROC DS2
 - PROC FedSQL
 - PROC MEANS
 - PROC RANK
 - PROC REPORT
 - PROC SORT
 - PROC SUMMARY
 - PROC TABULATE

[SAS 9.4M2](#) has the following changes and enhancements:

- The [CIMPORT](#) procedure SORT option causes the data set that is being imported to be re-sorted according to the destination operating system's collating sequence.
- The [DS2](#) procedure XCODE= option controls the behavior of the SAS session when an NLS transcoding failure occurs. In addition, the SYSCC macro variable now contains the current SAS condition code that is returned to your operating environment.

- The [FEDSQL](#) procedure XCODE= option controls the behavior of the SAS session when an NLS transcoding failure occurs.
- The [FONTREG](#) procedure OPENTYPE statement specifies one or more directories to be searched for valid OpenType font files. The ability to use a fileref was added. This ability enables you to use the FILENAME statement and its features.
- The [OPTIONS](#) procedure LISTOPTSAVE option lists the system options that can be saved by using the OPTSAVE procedure or the DMOPTSAVE command. The OPTIONS procedure now displays passwords in the SAS log as 8 Xs, regardless of the actual password length.
- The [REPORT](#) procedure now supports statistical keywords P20, P30, P40, P60, P70, and P80. A new section was added to describe the use of ODS Styles with PROC REPORT.
- When SAS is in a locked-down state, the [SOAP](#) procedure is not available if the HTTP access method has not been re-enabled in the autoexec file.

In [SAS 9.4M1](#), the following enhancements were made:

- The [CIMPORT](#) procedure provides the ability to determine the encoding of data sets in a transport file through the ENCODINGINFO= option. The encoding information is displayed in the SAS log.
- The [CIMPORT](#) and [CPORT](#) procedures now transport data sets with time zone offsets. PROC CPORT must specify the DATECOPY option.
- A link and supporting text were added for Microsoft Excel functions that are available to [PROC FCMP](#).
- The [HTTP](#) procedure now allows the HTTP_TOKENAUTH option to generate a one-time password from the metadata server to access the SAS Content Server, and supports user identity authentication. If the server that you are connecting to supports the NTLM (forThe UNIVARIATE procedure Windows only) protocol or the Kerberos authentication protocols, then you do not need to specify a user name and password. As long as your current user identity has permissions, authentication is established.

[SAS 9.4](#) has these changes and enhancements:

- The [DELETE](#) procedure has been reinstated.
- The International Components for Unicode (ICU) version is used to sort data sets with a linguistic collating sequence. The [CONTENTS](#) procedure or DATASETS procedure [CONTENTS](#) statement output shows the ICU version number of a data set that is linguistically sorted. With the [COPY](#) or [MIGRATE](#) procedure, if a data set's ICU version number differs from the current SAS session, the data set retains its sort order in the OUT= destination library, but the sort indicator is removed.
- JMP files that you specify in the [IMPORT](#) or [EXPORT](#) procedure, or in a [LIBNAME](#) statement, must be Version 7 or later. This enables you to export SAS data sets to JMP files for viewing in a variety of ways, such as with the JMP Graph Builder iPad application.
- With the [FORMAT](#) procedure, a month can be formatted using a shortened version by specifying the number of characters to use in the %nB directive. The range to specify a default length of an informat, picture, or format is 1–32767.
- With the [OPTIONS](#) procedure, you can list options that can be saved using the OPTSAVE procedure or the DMOPTSAVE command.

- The **PRINT** procedure enables you to specify labels for the sums and grand totals. For the PROC PRINT statement STYLE= option, style attributes for the HEADER location no longer affect the Obs column heading. You specify style attributes for the Obs column heading by using the OBSHEADER location.
- The **PRINTTO PRINT=** statement opens the LISTING destination. You no longer need to specify the ODS LISTING statement before you use the PRINTTO procedure.
- The **QDEVICE** procedure enables you to specify additional device libraries and catalogs. The NAMETYPE variable has been renamed to TYPE. The General and Font reports include new information. Character variable lengths in report output data sets have a fixed length of 128 characters. The LENGTH statement is no longer required when reports are merged or concatenated.
- The **SQL IPONEATTEMPT** option enables the termination of an SQL query if implicit pass-through fails. The BUFFERSIZE option for the PROC SQL statement has been replaced with the UBUFSIZE option. The BUFFERSIZE option that was used before SAS 9.4 is the same as the UBUFSIZE option and is still supported. As of SAS 9.4, UBUFSIZE is the preferred option.
- The **XSL** procedure now enables the PARAMETER statement to pass a parameter value to an XSL style sheet.

The following enhancements have been made to Base SAS statistical procedures:

- The CORR procedure can now create an output data set that contains polychoric correlation statistics and an output data set that contains polyserial correlation statistics.
- The FREQ procedure now does the following:
 - supports Blaker, exact mid-p, likelihood ratio, and logit binomial confidence limits
 - provides score confidence limits for the odds ratio and relative risk and displays them in the corresponding plots
 - provides Mantel-Haenszel, stratified Newcombe, and summary score estimates of the common risk (proportion) difference, which can be displayed in the risk difference plot
 - produces mid p-values for exact tests
 - colors mosaic plot tiles according to the values of the Pearson residuals or the standardized residuals
 - displays the Pearson residuals in the CROSSLIST table
- The UNIVARIATE procedure now enables you to overlay histograms that are associated with different levels of a CLASS variable onto a single plot. The procedure also offers improved maximum likelihood estimation for Johnson SU distribution parameters and it calculates the geometric means of analysis variables.

DATA Step Language Elements

In SAS 9.4M1, you can save either column labels or column names for the data set that you are viewing in VIEWTABLE.

In addition to the language elements that are mentioned in other sections of this overview, these language elements are new or enhanced:

Data Set Options

In SAS Viya 3.4, the [WHERE= data set option](#) is supported in CAS for input data sets and is not supported in CAS for output data sets.

In SAS Viya 3.3, to specify the maximum amount of memory in bytes that each thread should allocate for in-memory blocks before converting to a memory-mapped file, use the [MAXTABLEMEM= data set option](#).

In the December 2017 release of SAS 9.4M5 and SAS Viya 3.3, when you use the CAS LIBNAME engine, you can use the [MAXTABLEMEM=](#) data set option to specify the maximum amount of memory in bytes that each thread should allocate for in-memory blocks before converting to a memory-mapped file.

Beginning with SAS 9.4M5, the ENCRYPT= data set option supports AES2 encryption.

In SAS 9.4, you can use the EXTENDOBSCOUNTER= system option to extend the observation count for the SAS session. The default value of the [EXTENDOBSCOUNTER=](#) data set option has been changed to YES.

Note: A SAS data set that is created with EXTENDOBSCOUNTER=YES is incompatible with releases prior to SAS 9.3.

Component Objects

In SAS Viya 3.5 and the November 2019 release of SAS 9.4M6, you can submit to the CAS server [Python objects](#) by using PROC FCMP or the DATA step.

In the May 2019 release of SAS 9.4M6, you can use a [Python object](#) to execute a Python function using PROC FCMP. You can execute the Python object using either PROC FCMP or the DATA step. You cannot submit Python objects to the CAS server.

The documentation has been reorganized to differentiate objects that you create using PROC FCMP and objects that you create using the DATA step.

Use the *keysum* argument tag in the [DECLARE](#) statement or [_NEW_](#) operator to specify the name of a variable that tracks the key summary for all keys.

Use the [DO_OVER](#) method in an iterative DO loop to traverse the duplicate keys.

Formats and Informats

In SAS Viya 3.4, the [\\$UUID. informat](#) converts a UUID to binary data.

In SAS 9.4M4, the new ODDSRw.d format supports writing values as odds ratios.

In SAS 9.4M2, new aliases were added for some time zone informats. For more information, see “[Enhancements to Existing Informats](#)” in *SAS Formats and Informats: Reference*.

New ISO 8601 formats, [B8601DX](#), [B8601LX](#), [B8601TX](#), [E8601DX](#), [E8601LX](#), and [E8601TX](#) can be used to format dates, times, and datetime values for time zones by using Universal Coordinate Time (UTC).

Some [format values](#) might differ slightly when the [DECIMALCONV=](#) system option is set to STDIEEE.

Functions

In [SAS Viya 3.5](#), these are the changes and enhancements:

- There are several new Git functions, and the Git functions that began with [GITFN_](#) have been deprecated and replaced with [functions that begin with GIT_](#).
- The [COMPSRV_OVAL](#) function returns the original, possibly unsafe value of an input parameter or global macro variable passed into the compute server.
- The [COMPSRV_UNQUOTE2](#) function un.masks matched pairs of quotation mark characters in an input parameter or global macro variable.

In [SAS 9.4M6](#), you can [manage a Git repository](#) using a set of new Git functions.

In the December 2017 release of [SAS 9.4M5](#) and [SAS Viya 3.3](#), you can set the working directory using the [DLBCDIR](#) function.

[SAS 9.4M5](#) has these changes and enhancements:

- SAS supports three families of pseudorandom number generators: Mersenne twister generators, a permuted congruential generator (PCG), and two ThreeFry generators. New random-number generators (RNG) generate numbers in parallel and distributed environments. You can select from a number of algorithms using the [CALL STREAMINIT](#) and [CALL STREAM](#) routines. New best practices for generating random numbers are to use these routines. SAS also supports a hardware-based RNG on certain chipsets.

The older random-number functions ([NORMAL](#), [UNIFORM](#), [RANBIN](#), [RANCAU](#), [RANEXP](#), [RANGAM](#), [RANNOR](#), [RANPOI](#), [RANTBL](#), [RANTRI](#), and [RANUNI](#)) are deprecated. These functions are still supported in the [DATA](#) step, but are not recommended for serious statistical analyses. Because the underlying algorithm is not appropriate for parallel computations, the legacy functions are not supported in newer SAS procedures that are designed to execute in parallel on a grid of computers. For more information, see “[Using Random-Number Functions and CALL Routines in the DATA Step](#)” in *SAS Functions and CALL Routines: Reference*.

- Using the [CALL STREAMINIT](#) routine, you can specify the type of random-number generator that you would like to use.
- The [CALL STREAM](#) routine specifies a random-number stream to use for subsequent calls to the [RAND](#) function.
- The [CALL STREAMREWIND](#) routine rewinds a stream to its initial state for subsequent random-number generation.

In [SAS 9.4M4](#), a reference to the ICSF cryptographic software from IBM is added to the [SHA256](#) function for the z/OS platform.

In [SAS 9.4M3](#), these functions are new or enhanced:

- To determine the category of a format or informat, or to query decimal and width ranges for format or informat values, use the [FMTINFO\(\)](#) function.

- The HOLIDAY functions are no longer experimental:
 - **HOLIDAYCK** returns the number of occurrences of the holiday value between two dates.
 - **HOLIDAYCOUNT** returns the number of holidays defined for a SAS date value.
 - **HOLIDAYNAME** returns the name of the holiday that corresponds to the SAS date or a blank string if a holiday is not defined for the SAS date.
 - **HOLIDAYNX** returns the n^{th} occurrence of the holiday relative to the date argument.
 - **HOLIDAYNY** returns the n^{th} occurrence of the holiday for the year.
 - **HOLIDAYTEST** returns 1 if the holiday occurs on the SAS date value.

The **SHA256HMACHEX** function returns the result of the message digest of a specified string by using the HMAC algorithm.

SAS has several new functions:

- **COT** returns the cotangent.
- **CSC** returns the cosecant.
- **DOSUBL** imports macro variables from the calling environment, and exports macro variables back to the calling environment after the function invokes the SAS code in the text string.
- **FCOPY** copies a record from one fileref to another fileref, and returns a value that indicates whether the record was successfully copied.
- **SEC** returns the secant.

The **CALL IS8601_CONVERT** routine allows the year, month, day, hour, minutes, and seconds to have missing values.

The **PUTC** and **PUTN** functions can override the justification of your output. You can center, right-align, or left-align the output that you create.

If the **SCAN** or **KSCAN** function returns a value to a variable that has not yet been given a length, then that variable is given the length of the first argument.

The **DATE**, **DATETIME**, **TIME**, and **TODAY** functions return date and time values for the time zone that is specified by the **TIMEZONE=** system option.

In the Normal Mixture distribution for the **CDF**, **PDF**, **SDF**, **LOGCDF**, **LOGPDF**, **LOGSDF**, **QUANTILE**, and **SQUANTILE** functions, weights must be nonnegative. If the sum of the weights does not equal 1, they are treated as relative weights and adjusted so that the sum equals 1.

Statements

SAS 9.4M7 has these changes and enhancements:

- The **FILENAME Statement Azure Access Method** enables access to data in Microsoft Azure Data Lake Storage Gen2.
- The **FILENAME Statement S3 Access Method** enables access to data in Amazon S3 files.

SAS Viya 3.5 has these changes and enhancements:

- The **DESCENDING** option in the **BY statement** is now supported for a DATA step that is running in CAS. The option is supported only for the second and subsequent variables in a CAS DATA step and not for the first variable in a BY statement.

- The [FILENAME statement Azure access method](#) enables access to data in Microsoft Azure Data Lake Storage Gen2.
- The [FILENAME statement S3 access method](#) enables access to data in Amazon S3 files.

In the May 2019 release of [SAS 9.4M6](#), you can use the [INFILE statement STATUS option](#) to specify a variable whose value contains the return status code from a URL request.

In [SAS 9.4M6](#), you can [enable the LIST statement to write log data in hexadecimal format for all lines of your input data](#) using the `HEXLISTALL` argument in the `DATA` statement.

The December 2017 release of [SAS 9.4M5](#) and [SAS Viya 3.3](#) has this enhancement:

- You can store and retrieve files within the SAS Viya File Service using the [FILENAME Statement, FILESRVC Access Method](#).

[SAS 9.4M5](#) has the following changes and enhancements:

- Global statements now reside in a new documentation, [SAS Global Statements: Reference](#)
- The `FILENAME` statement, `EMAIL (SMTP)` access method supports attaching more than one file using multiple `!EM_ATTACH!` directives.
- The `FILENAME` statement, `ZIP` access method supports GZIP files.

[SAS 9.4M4](#) has the following changes and enhancements:

- [FILENAME, Hadoop access method](#)
 - The default behavior of the `CFG=` option has changed. If `CFG=` is not provided, the `SAS_HADOOP_CONFIG_PATH` and `SAS_HADOOP_JAR_PATH` environment variables are now scanned for the location of the required configuration files.
 - Knox security is now supported.
- [FILENAME Statement, EMAIL \(SMTP\) Access Method](#), can set an email sensitivity flag on emails that originate from SAS.
- The [JSON LIBNAME statement](#) enables you to associate a libref with a JSON document.

[SAS 9.4M3](#) has the following changes and enhancements:

- [FILENAME, FTP access method](#)
 - Filenames can contain UTF-8 characters. Only hosts whose FTP servers support the `OPTS UTF8 ON` or `OPTS UTF-8 ON` FTP protocol commands can read these filenames.
 - The FTP access method supports Secure FTP by using Transport Layer Security(TLS). There are three new statement options available:
 - The `AUTHTLS` option enables you to issue the FTP `AUTH TLS` command.
 - The `PBSZ` option enables you to specify the FTP Data Channel Protection Buffer Size.
 - The `PROT` option enables you to specify the FTP Data Channel security command.
- [FILENAME, Hadoop access method](#)

- The Hadoop access method supports the SAS_HADOOP_CONFIG_PATH environment variable. You no longer have to merge properties from multiple Hadoop configuration files into a single configuration file and specify the CFG= option.
- The CONCAT and DIR Hadoop options are now mutually exclusive because the SAS_HADOOP_CONFIG_PATH environment variable is available.
- **FILENAME, ZIP access method**
 - You can specify an encoding for ZIP file entry names and comments that are different from the current session encoding by using the NAMEENCODING= option.
 - Wildcards (*) are supported in the MEMBER= syntax for reading or checking the existence of entries in the ZIP file.

SAS 9.4M2 has the following changes and enhancements:

- The following SAS statements have been enhanced:
 - Using the [FILENAME Statement, EMAIL \(SMTP\) Access Method](#), you can embed attachments in an email by using HTML. In addition, you can now specify a message/rfc822 content type. In [SAS 9.4M4](#), you can set an email sensitivity flag on emails that originate from SAS.
 - Using the [FILENAME Statement, Hadoop Access Method](#), you can now submit HDFS commands through WebHDFS. The new SAS environment variable SAS_HADOOP_RESTFUL must be defined and set to the value 1. In addition, the Hadoop configuration file must include the properties for the WebHDFS location.
- For more information, see “Enhanced SAS DATA Step Statements” in [SAS DATA Step Statements: Reference](#).
- The following FILENAME statement access methods are not available when SAS is in a locked-down state: EMAIL (SMTP), FTP, Hadoop, SOCKET (TCPIP), and URL (HTTP). However, the SAS server administrator can re-enable one or more of these access methods.

[FILENAME Statement, DATAURL Access Method](#) enables you to read data from user-specified text.

You can use the [FILENAME Statement, Hadoop Access Method](#) to create a directory.

Stream-record format has been added to the RECFM= option for the FILENAME Statement, SFTP Access Method. Data is transferred in image (binary) mode.

The [FILENAME Statement, URL Access Method](#) has new options to specify an Accept: header and to create connections when accessing a URL through a proxy.

You can use the [FILENAME Statement, WebDAV Access Method](#) to specify the name of an authentication domain metadata object, create a directory, and delete a directory.

The [FILENAME Statement, ZIP Access Method](#) enables you to access ZIP files.

The [LOCK](#) statement NOMSG option disables errors and warnings to the SAS log.

The [MODIFY](#) and [SET](#) statement option CUROBS creates and names a variable that contains the observation number that was just read from the data set. A new

option, KEYRESET, controls whether a KEY= search should begin at the top of the index for the data set that is being read.

In SAS 9.4, the [TERMSTR= option](#) in the INFILE statement automatically normalizes imported copies of Windows files that are being read by SAS when in a UNIX environment. This enables easier sharing of files between the environments.

System Options

New system options in [SAS 9.4M7](#) support connecting to a Microsoft Azure storage system.

- The [AZUREAUTHCACHELOC system option](#) specifies the location of a file that contains login information for connecting to a Microsoft Azure storage system.
- The [AZURETENANTID system option](#) specifies the tenant ID for connecting to a Microsoft Azure storage system.

Also in this release the default value for the YEARCUTOFF option has changed from 1926 to 1940.

These are the new features for [SAS Viya 3.5](#):

- The [AZUREAUTHCACHELOC system option](#) specifies the location of a file that contains login information for connecting to a Microsoft Azure storage system.
- The [AZURETENANTID system option](#) specifies the tenant ID for connecting to a Microsoft Azure storage system.
- The [DEBUGOPT system option](#) specifies the host and port where debugging SAS languages occurs.

New system options in [SAS 9.4M6](#) support accessible output. For more information, see [“Creating Accessible Output Using ODS and ODS Graphics” on page 29](#).

[SAS 9.4M5](#) has the following changes and enhancements:

- Instead of using the DSACCEL system option to enable parallel processing of the DATA step on the CAS server, you use the DSCAS system option.
- Options that allow the K, M, G, or T numeric notation for kilo, mega, giga, or tera can now be specified as KB, MB, GB, or TB.
- The value of the MAPSGFK= system option can be modified using the APPEND= and INSERT= system options.

[SAS 9.4M4](#) has the following changes and enhancements:

- The SVGTITLE= system option is enhanced for accessibility. If one or more TITLE= statements are specified before ODS GRAPHIC procedures that create SVG images, the values of the TITLE statements are added to the value of the SVGTITLE= option.
- The QUOTELENMAX system option displays a warning in the SAS log if a string in quotation marks is too long.

[SAS 9.4M3](#) has the following changes and enhancements:

- You can control the locations of the SAS/IML package collections by using the `IMLPACKAGEPRIVATE=`, `IMLPACKAGEPUBLIC=`, and `IMLPACKAGESYSTEM=` system options.
- The `UBUFNO=`, `UBUFSIZE=`, and `VBUFSIZE=` options are included in the PERFORMANCE PROC OPTIONS Group. The `FONTSLLOC=` option is included in the ODSPRINT= PROC OPTIONSs Group.

In SAS 9.4M2 has the following changes and enhancements:

- If `MSGLEVEL=I`, then SAS writes Hadoop MapReduce job information to the SAS log.
- On host platforms other than z/OS, the `UTILLOC=` system option accepts a filename as an argument. The file contains a list of directories that SAS can use to select the location for utility files. Allowing SAS to select utility file locations can help balance server I/O workloads.
- The `OPTIONS` procedure displays passwords in the SAS log as 8 Xs, regardless of the actual password length.

In SAS 9.4M1 has the following changes and enhancements:

- The `OPTMODEL` procedure can now use the SAS language compiler for nonlinear statistical modeling or optimization in the `CMPLIB=` system option.
- The `DSACCEL=` system option enables you to specify whether a DATA step is enabled for parallel processing in supported environments. The DATA step can run, with limitation, in the SAS LASR Analytic Server and Hadoop environments.
- The `DS2ACCEL` system option specifies whether DS2 code is enabled for parallel processing in supported environments that use the SAS In-Database Code Accelerator.

These are the changes and enhancements for SAS 9.4:

The default values of these system options have changed:

- The default value of the `CPUCOUNT=` system option is ACTUAL or 4 for systems that have more than four processors.
- The default value of the `DMSOUTSIZE=` system option is 2147483647.
- The default value of the `LRECL=` system option is 32767.
- The default value of the `YEARCUTOFF=` system option is 1926.

You can specify the SAS Clinical Standards Toolkit global standards library by using the `CSTGLOBALLIB=` option. Use the `CSTSAMPLELIB=` option to specify the sample library.

The `DECIMALCONV=` system option enables you to process floating-point numbers that follow the IEEE Standard for Floating-Point Arithmetic 754–2008.

You can use the `EXTENDOBSCOUNTER=` system option to extend the observation count in 32-bit SAS data files.

In the `LOGPARM=` system option, the file that is specified by the `SYSIN` option can be used in the log name by using the `%P` directive. `ROLLOVER=n` is not supported for logs in z/OS data sets.

The `SQLIPONEATTEMPT=` system option enables the termination of an SQL query if implicit pass-through fails.

Instead of a note, you can specify whether to issue a warning message or an error message to the SAS log when a variable is not initialized. You can also specify not

to issue a note. You use the `VARINITCHK=` system option to specify what is written to the SAS log.

SAS Macro Facility

These automatic macro variables are new:

- `SYSDATASTEPHASE` ensures that the macro is being executed as part of the proper phase of a DATA step. The value indicates the current active phase of the DATA step.
- `SYSHOSTINFOLONG` contains the operating environment information that is displayed when the `HOSTINFOLONG` option is specified.
- `SYSPROCESSMODE` contains the name of the current SAS session run mode or server type.
- `SYSTIMEZONE` contains the time zone name based on the current value of the `TIMEZONE` option.
- `SYSTIMEZONEIDENT` contains the time zone ID based on the current value of the `TIMEZONE` option.
- `SYSTIMEZONEOFFSET` contains the time zone offset based on the current value of the `TIMEZONE` option.

`SAS 9.4M5` has these enhancements:

- These automatic macro variables are new:
 - Use `SYSINCLUDEFILEDEVICE` to determine the device type on the current `%INCLUDE` file.
 - Use `SYSINCLUDEDIR` to determine in which directory the current `%INCLUDE` file was found.
 - Use `SYSINCLUDEFILEFILEREFS` to determine whether a fileref was used to access the current `%INCLUDE` file.
 - Use `SYSINCLUDEFILENAME` to determine the name of the current `%INCLUDE` file.
 - Use `SYSMAXLONG` to return the maximum long integer value allowed under Linux.
- The `_USER_` option has been added to the `%SYSRPUT` statement.

In `SAS 9.4M3`, the `MVARSIZE` system option now has a default value of 65,534.

In `SAS 9.4M2`, two new options were added to the `%PUT` statement:

- The `_READONLY_` option lists all user-defined read-only macro variables, regardless of scope.
- The `_WRITABLE_` option lists all user-defined read and write macro variables, regardless of scope.

In December 2014, a new appendix lists all SAS macro error and warning messages, causes, and solutions.

SAS under UNIX

You can set the number of seconds that SAS waits for a locked file to become available by setting the `FILELOCKWAIT=` system option.

The `HOSTINFOLONG` system option writes additional operating environment information to the SAS log when SAS starts.

When the `RTRACE` system option argument `VER` is set, SAS writes the version number and other trace information for each module that SAS loads.

The `X` command now supports the `SETENV | UNSETENV` commands to set or delete the environment.

In SAS 9.4M5, you can use the new environment variable `AUTHINFO` to specify the location of the `authinfo` file that you use to authenticate to a CAS server.

In SAS 9.4M4, the following new options are available in the `CLEANWORK` utility:

- The `-V` option supports the generation of verbose log output.
- The `-LOG` option enables you to save output to a log file.

SAS 9.4M3 has the following enhancements:

- The default value for the `MVARSIZE` system option has changed from 32K to 65,534.
- You can run external Lua files from the command line by invoking the `-SYSIN` option. You can also run an external Lua file from within SAS by using an `%INCLUDE` statement.
- A new chapter has been added to the SAS 9.4 Companion for UNIX Environments that describes useful [utilities](#) that are available for system administrators.
- When you use the `X` command with the `SETENV` command to create an environment variable, the value of the environment variable is fully expanded before the environment variable is created.

SAS 9.4M2 has the following changes and enhancements:

- It is no longer necessary to use the UUID Generator Daemon to generate UUIDs for SAS sessions that execute on UNIX hosts. For more information, see [“What Is the Object Spawner?”](#) in *SAS Language Reference: Concepts*.
- The BMDP procedure has been deprecated. If you call the BMDP procedure, SAS does not attempt to run BMDP software. However, the BMDP engine, which enables SAS to convert to and from BMDP files, is still available.
- The new `PERMISSION=` option for the `FILE` and `FILENAME` statements enables you to specify Read, Write, and Execute permissions for the specified fileref. You also specify whether the permissions that you set apply to you, to the group owner of the file, or to other users.
- The following `FILENAME` statement access methods are not available when SAS is in a locked-down state: `EMAIL`, `FTP`, `Hadoop`, `HTTP`, `SOCKET`, `TCPIP`, and `URL`. However, the SAS server administrator can re-enable one or more of these access methods.

- The **OPLIST** system option automatically masks any password values that are specified when invoking SAS. Only the masked values appear in the SAS log.
- You can expand the filename that is generated by the **RTRACELOC** system option to include the process ID, date, and system time. Include %p, %d, or %t, respectively, to include these values in the filename. Here is an example:

```
mytrace.%d.%t.%p
```

- A new chapter was added to explain environment variables that are used under UNIX environments.
- If you set the **PATHENCODING** environment in your UNIX environment, any path you provide in a SAS program must include characters that are recognized by both the **PATHENCODING** environment variable and the SAS session encoding. Specifically, to specify a **PATHENCODING** value of UTF-8 in a SAS session that uses English (**LANG=EN**), you must specify a session encoding of UTF-8 or **SAS_U8**.
- A new chapter, “Performance Considerations under UNIX,” explains the use of the **iotest.sh** tool for measuring system performance.

In **SAS 9.4M1**, the following access methods are new:

- **ACTIVEMQ** enables SAS programs to send messages to and receive messages from an ActiveMQ message broker through the HTTP protocol.
- **JMS** enables SAS programs to send messages to and receive messages from any JMS API-compliant message service.

For more information, see “What's New in the SAS 9.4 Companion for UNIX Environments” in *SAS Companion for UNIX Environments*.

SAS under Windows

SAS 9.4M5 has these enhancements:

- Windows 2016 is supported.
- JRE 1.7 Update 151 replaces previous versions of the JRE.

For more information, see “What's New in the SAS 9.4 Windows Companion” in *SAS Companion for Windows*.

In **SAS 9.4M2**, the following changes were made:

- The **Cleanwork Utility**, **cleanwork.exe**, is now a console-based application and is installed as part of Base SAS in the **SASROOT** directory.
- The new **PERMISSION=** option for the **FILE** and **FILENAME** statements enables you to specify Read, Write, and Execute permissions for the specified fileref. You also specify whether the permissions that you set apply to you, to the groups that you are a member of, or to all users.
- The following **FILENAME** statement access methods are not available when SAS is in a locked-down state: **EMAIL**, **FTP**, **Hadoop**, **HTTP**, **SOCKET**, **TCPIP**, and **URL**. However, the SAS server administrator can re-enable one or more of these access methods.

- You can expand the filename that is generated by the [RTRACELOC](#) system option to include the process ID, date, and system time. Include %p, %d, or %t, respectively, to include these values in the filename. Here is an example:

```
mytrace.%d.%t.%p
```

In [SAS 9.4M1](#), the following changes were made:

- Details were added in support of [the Windows 32-bit architecture](#).
- The accessibility topic was removed. An accessibility topic is available from the [Base product documentation](#) page.

Beginning with [SAS 9.4](#), Windows XP, Windows Server 2003, and Windows Vista are no longer supported.

Additional operating environment information can be written to the SAS log when the [HOSTINFOLONG](#) system option is set.

You can set the number of seconds that SAS waits for a locked file to become available by setting the [FILELOCKWAIT=](#) system option.

JRE 1.6.0_23 was replaced with JRE 1.6.0_24.

In the SAS Help and Documentation, accessibility to many equations is improved. These equations are encoded using mathML. Screen readers can easily read equations, and low-vision users can enlarge equations.

SAS under z/OS

In the [May 2019](#) release of [SAS 9.4M6](#), the [FILE statement](#) and the [INFILE statement](#) cannot modify or override the device type that was set by an earlier [FILENAME](#) statement.

In [SAS 9.4M6](#), the default value of the [MSYMTABMAX](#) option is 2,097,152 bytes (2MB).

[SAS 9.4M5](#) has these changes and enhancements:

- SAS supports eight-character TSO user IDs on z/OS V2R3.
- SAS supports the CSSTMP email server on z/OS V2R3.
- PROC RELEASE does not release unused space in a PDSE.
- The FILEBUFNO system option specifies how many memory buffers to allocate for reading and writing.

[SAS 9.4M4](#) has the following enhancements:

- SAS supports the IBM z/OS V2R2 Extended Format Generation Data Groups (GDGs).
- The INFILE and FILE statements support BUFNO= processing.
- The SHA256 function has been enhanced. A reference to the ICSF cryptographic software from IBM has been added for the z/OS platform.

In [SAS 9.4M2](#), the following changes were made:

- Large block size support for SAS Libraries on tape devices improves performance and efficiency. To enable this capability for a particular library,

specify `DLLBI=YES` in the `LIBNAME` statement. To enable this capability for all sequential libraries on tape, specify the `DLLBI` system option.

- The `LOCKDOWN` feature is supported for foundation servers. This allows the server administrator to specify a restricted set of z/OS data sets and UFS paths that are available to clients of the server. When SAS is in the locked-down state, access to certain system interfaces is also disabled.
- If the `zHPF` facility is enabled on the processor, on the disk device, and on the channels that connect them, then SAS generates TCW channel programs. These TCW channel programs execute in transport mode when reading direct access bound libraries that are residing in `DSORG=PS` data sets. This style of channel program can perform I/O in less elapsed time than the CCW channel programs (command mode) that are traditionally used by SAS. CCW channel programs are still used for Write operations, and they are also used for read processing if `zHPF` is not available or is disabled.

In SAS 9.4, these are the new and enhanced features:

These SAS language elements are new:

- The `ZDSRATT` function returns RACF security attributes for a z/OS data set name or returns UNIX security attributes (including ACL definitions) for a UFS file or directory.
- The `HOSTINFOLONG` system option specifies to print additional operating environment information in the SAS log when SAS starts.
- The `SORTCUT` system option specifies a cutoff value that is the number of observations in a data set for which SAS sorts the data. If the number of observations is greater than the value of the `SORTCUT` system option, the host sort performs the sort.

These SAS language elements have been enhanced:

- The `ZDSLST` function supports the specification of up to 30 path components in a UFS directory path.
- The `FILENAME` statement supports the `DATAURL`, `EMAIL`, `WebDAV`, and `ZIP` device types.
- The default value of the `CARDIMAGE` system option is `NOCARDIMAGE`.

The following system options have been deprecated:

- `AUTHENCR`
- `AUTHPROVIDERDOMAIN`
- `HELPCASE`

The `USEREXIT` option specifies the name of the exec that the `SASRX` exit calls as a user exit instead of executing `SASCP`.

Diagnostic messages can be created when a utility file is closed if you set the `TKOPT_TKIOP_DIAG_SPACE` option in the `TKMVSENV` file. These messages detail the space allocation that is associated with the utility file allocation and the amount of space that the utility file actually used.

For more information, see “What's New in SAS 9.4 Companion for z/OS” in *SAS Companion for z/OS*.

Additional Information

For more information about new features, see these documents:

- [SAS Cloud Analytic Services: User's Guide](#)
- [SAS Cloud Analytic Services: CASL Reference](#)
- [Base SAS Procedures Guide](#)
- [Base SAS Procedures Guide: Statistical Procedures](#)
- [Encryption in SAS](#)
- [Moving and Accessing SAS Files](#)
- [SAS and Hadoop Technology: Overview](#)
- [SAS Companion for UNIX Environments](#)
- [SAS Companion for Windows](#)
- [SAS Companion for z/OS](#)
- [SAS Component Objects: Reference](#)
- [SAS Data Set Options: Reference](#)
- [SAS DATA Step Statements: Reference](#)
- [SAS Global Statements: Reference](#)
- [SAS DS2 Programmer's Guide](#)
- [SAS DS2 Language Reference](#)
- [SAS FedSQL Language Reference](#)
- [SAS Viya: FedSQL Programming for SAS Cloud Analytic Services](#)
- [SAS Formats and Informats: Reference](#)
- [SAS Functions and CALL Routines: Reference](#)
- [SAS Global Statements: Reference](#)
- [SAS Guide to Metadata-Bound Libraries](#)
- [SAS Graph Template Language: Reference](#)
- [SAS Graph Template Language: User's Guide](#)
- [SAS Interface to Application Response Measurement \(ARM\): Reference](#)
- [SAS Language Reference: Concepts](#)
- [SAS Language Interfaces to Metadata](#)
- [SAS Logging: Configuration and Programming Reference](#)
- [SAS Macro Language: Reference](#)
- [SAS National Language Support \(NLS\): Reference Guide](#)
- [SAS ODS Graphics Designer: User's Guide](#)
- [SAS ODS Graphics Editor: User's Guide](#)

- [SAS ODS Graphics: Procedures Guide](#)
- [SAS Output Delivery System: User's Guide](#)
- [SAS Output Delivery System: Procedures Guide](#)
- [SAS Output Delivery System: Advanced Topics](#)
- [SAS Scalable Performance Data Engine: Reference](#)
- [SAS SQL Procedure User's Guide](#)
- [SAS System Options: Reference](#)
- [SAS XMLV2 and XML LIBNAME Engines: User's Guide](#)
- [SAS SPD Engine: Storing Data in the Hadoop Distributed File System](#)
- [SAS/ACCESS for Relational Databases: Reference](#)
- [SAS Intelligence Platform: Security Administration Guide](#)
- [SAS Intelligence Platform: Application Server Administration Guide](#)