

▶ Technical Paper

# SAS<sup>®</sup> 9.4 and SAS<sup>®</sup> Viya<sup>®</sup> Functional Comparison

**Release Information**

Content Version: 1.0 September 2018

**Trademarks and Patents**

SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513.

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 registered trademarks or trademarks of their respective companies.

# Contents

<b>SAS 9.4 and SAS Viya Functional Comparison .....</b>	<b>1</b>
<b>SAS Platform.....</b>	<b>1</b>
<b>SAS Foundation .....</b>	<b>2</b>
<b>Distributed Processing .....</b>	<b>3</b>
<b>User Interfaces and Program Development .....</b>	<b>3</b>
<b>Administration .....</b>	<b>4</b>
<b>Operating Environments .....</b>	<b>4</b>
<b>Multi-tenancy .....</b>	<b>4</b>
<b>Platform Summary .....</b>	<b>5</b>
<b>Product Summary .....</b>	<b>5</b>
<b>Data Mining / Machine Learning .....</b>	<b>6</b>
<b>Econometrics .....</b>	<b>8</b>
<b>Optimization .....</b>	<b>8</b>
<b>Forecasting .....</b>	<b>8</b>
<b>Text Analytics .....</b>	<b>12</b>
<b>Visual Analytics .....</b>	<b>14</b>
<b>Visual Statistics .....</b>	<b>16</b>
<b>Data Management .....</b>	<b>16</b>
<b>Acknowledgements .....</b>	<b>20</b>

# SAS 9.4 and SAS Viya Functional Comparison

## SAS Platform

The SAS Platform comprises the software components that underpin SAS product offerings in analytics, data management, and visualization. These components provide support for foundational capabilities such as distributed processing, security, administration, program development and execution, resource management, user interfaces, and integration with operating systems and third-party software. SAS 9.4 and SAS Viya contribute software components that can be integrated into a unified SAS Platform.

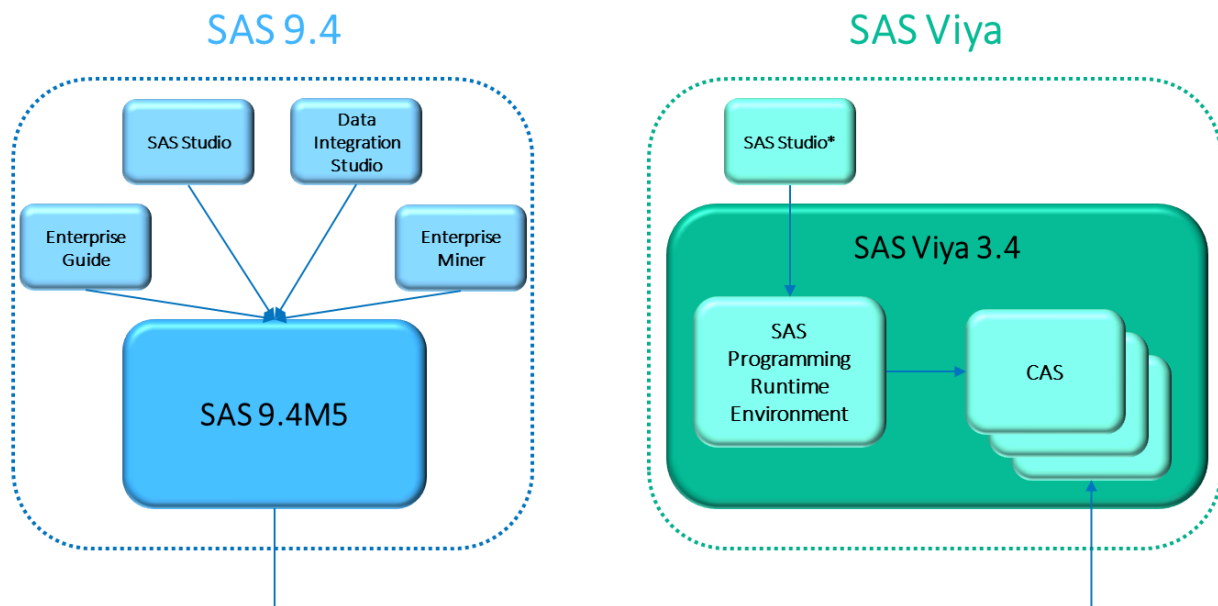
Although SAS 9.4 and SAS Viya represent two engines that support a common SAS Platform, there are important functional differences between the two. Understanding these differences will help you make an informed decision about which engine is most appropriate for a given use case or can help you decide whether both engines are warranted. SAS products have been developed to take advantage of both engines, and in many cases, you will find equivalent product functionality in both engines. This document highlights the similarities and differences between the engines and the products that leverage them.

Starting with the SAS 9.4M5 release, SAS 9.4 programming clients can take advantage of a CAS server in a SAS Viya environment. This means that, in many cases, you do not have to choose between the two engines. You can use a single SAS 9.4 client such as SAS Studio, SAS Enterprise Guide, Data Integration Studio, Display Manager System (DMS), or even a batch program to execute SAS 9.4 code that uses a SAS 9.4 server and SAS Viya procedures that use a CAS server, all within the same program.

Since SAS Viya deployments include a full SAS programming run-time environment, they can provide similar support to developers without the need for a separate SAS 9.4 environment. A SAS Viya client can execute both SAS 9.4 code in the SAS programming run-time environment and SAS Viya procedures using a CAS server.

The following diagram depicts the relationship between SAS programming clients and execution engines. All SAS programs are initially submitted to either the SAS 9.4M5+ or SAS programming run-time environment engine. Any SAS Viya procedure that is encountered by either engine is executed in the SAS Viya CAS server.

# SAS Program Execution



\*Most SAS Viya clients (e.g., SAS Visual Data Mining and Machine Learning) can call CAS directly

## SAS Foundation

At the core platform level, functionality is shared between SAS 9.4 and SAS Viya. First and foremost, both engines support the full complement of Base SAS. This means that SAS 9.4 programs can run unmodified within a SAS Viya client session. In a SAS Viya environment, some of the Base SAS procedures can take advantage of a CAS server, and others simply run on a traditional SAS Foundation server. You can find a list of CAS-enabled procedures in the [SAS 9.4 and SAS Viya 3.4 Programming Documentation: Base SAS Procedures Guide](#). In addition, the DATA step itself is CAS-enabled and can therefore take advantage of distributed processing for faster execution times. Care must be taken in converting existing DATA step code to run in CAS because splitting execution across multiple CAS server worker nodes can result in changes in behavior of automatic macro variables, which previously assumed single-threaded execution. Programmers are encouraged to read Steven Sober's 2018 SAS Global Forum paper entitled [My Experiences in Adopting SAS Cloud Analytic Services into Base SAS Processes](#) for more detail.

Other SAS Foundation products such as SAS/STAT, SAS/GRAPH, SAS/ETS, and SAS/OR are fully supported in a SAS Viya environment when included in related product offerings. Other SAS Foundation products, such as SAS/IML, SAS/QC, and a many SAS/ACCESS interfaces are available as add-on products to a SAS Viya order. Thus, SAS Viya users have access both to the distributed computing capabilities of the SAS Viya products plus the functionality of included SAS Foundation products. You can run your new SAS Viya code as well as your existing SAS code in your SAS Viya environment, which can access both the SAS Foundation server and the CAS server.

How SAS Foundation code is executed varies according to the clients that are used in a SAS 9 and SAS Viya environment. With SAS 9, desktop clients, such as SAS Enterprise Guide and SAS Add-In for Microsoft Office, as well as web clients, such as SAS Studio, submit code to a SAS Object Spawner that, in turn, routes the job to an

appropriate workspace server or a stored process server. With SAS Viya, such requests are typically submitted to a launcher server, which, in turn, routes the job to an appropriate compute server. The binary files that support the compute server execution are analogous to a SAS Foundation V9 installation and are referred to as the SAS programming run-time environment, which is stored in the `spre` directory of your SAS Viya installation. Although this is the way that SAS Studio 5.x works with SAS Viya, SAS Studio 4.x – the default SAS programming client for SAS Viya 3.3 and earlier – uses the SAS Object Spawner method of execution.

## Distributed Processing

Perhaps, the most significant core platform functional difference between SAS 9.4 and SAS Viya is in the way that each handles the distributed processing. SAS Viya leverages the CAS server, and SAS 9.4 uses SAS/LASR, which is the High-Performance Architecture (HPA) or SAS Grid Manager. Even though SAS/LASR and HPA will remain solely as SAS 9.4 approaches, SAS Grid Manager will eventually be available natively in SAS Viya environments (targeted for 2019). Since the CAS server is the third major evolution of the SAS distributed, in-memory technology, it's no surprise that it offers the most value. Compared to HPA, it performs better because it can retain data from one action to the next action rather than having to reload the same data from disk for each action. In comparison to both HPA and SAS/LASR, the CAS server offers dynamic scalability, a virtual memory footprint, high availability, parallel data loading, shared library access, and integration with open-source languages and REST APIs. SAS Grid Manager can work in concert with a SAS Viya environment. Even though “the grid” distributes multiple SAS 9.4 jobs from multiple users across a cluster of machines, each job can be parallelized with the DATA step and SAS procedure code that executes across multiple worker nodes in a CAS server that runs in a companion SAS Viya environment.

## User Interfaces and Program Development

SAS Viya has a single interactive development interface for SAS code – the SAS Studio web application. SAS 9.4 has several interfaces, including SAS Studio (a different version from the one delivered with SAS Viya), SAS Enterprise Guide, Display Manager System (DMS), and the Code Editor in SAS Data Integration Studio. SAS Studio 4.x and SAS 5.1, which are delivered with SAS Viya, do not yet provide full replacement value for all GUI capability that is provided by SAS Studio 3.x, which is delivered with SAS 9.4. For example, SAS Studio 3.x offers access to the local file system; SAS Studio 5.x does not provide access to the local file system.

Both SAS 9.4 and SAS Viya support batch execution of SAS code as well as integration with open development environments such as Jupyter Notebook. For SAS 9.4, this integration includes execution of SAS code as well as the generation of SAS code from Python calls. The [SASPy](#) project available on GitHub provides this native Python interoperability for both SAS 9.4 and SAS Viya. For SAS Viya, you can call CAS server actions directly, skipping the translation layer. In fact, since the CAS server allows for direct calls from Python, R, Java, Lua, and REST APIs, a developer can use any integrated development environment that supports these languages. Furthermore, you can call analytic functions that are provided by these alternative languages within SAS Visual Data Mining and Machine Learning jobs. Models created using these languages can be imported and managed using SAS Model Manager.

SAS 9.4 has rich support for stored processes, which allow for SAS programs to be defined and executed interactively, either via the SAS Stored Process Web Application, directly from a URL, or via clients such as SAS Enterprise Guide. A prompting framework is provided to support arguments that are passed to these programs at run time. Such programs can also be run in batch and can always take advantage of the SAS Stored Process Server. SAS Viya uses job definitions to manage such code and provides the [SAS Job Execution Web Application](#) to define these programs. A current limitation to the SAS Viya job execution framework is the absence of an interactive prompting framework.

## Administration

SAS 9.4 has several utilities to perform administrative functions: SAS Environment Manager, SAS Management Console, SAS Visual Analytics Administrator, and SAS Deployment Manager. For SAS Viya, all this functionality was collapsed into a single web application: SAS Environment Manager. For SAS Viya, SAS Environment Manager was totally rewritten. All it shares with its SAS 9.4 counterpart is its name. The SAS 9.4 Environment Manager GUI provides a rich set of near real-time reports about various process and system metrics as well as an advanced event handling interface. The SAS Viya Environment Manager GUI provides similar metrics and reporting capabilities but does not yet have quite as complete a set of streaming reports. Both environments supply a back-end data mart that contains historical metric and logging information for user-developed reports. SAS Viya adds an event-driven operations infrastructure to the mix, with access to a real-time message bus, which can be integrated with third-party monitoring applications.

Another key administrative difference between SAS 9.4 and SAS Viya is that the former uses the SAS Metadata Server to persist and manage data about your environment, including server and library definitions, security, user content, and configuration information. SAS Viya persists much of this information in the new SAS Infrastructure Data Server (PostgreSQL) and SAS Configuration Server (Consul). Another important distinction is that although SAS 9.4 uses Metadata Server-based identities to define users and groups, SAS Viya leverages pre-existing customer directory services, which are LDAP-based and are like Microsoft Active Directory. The advantage of SAS Viya is that administrators do not have to worry about keeping their SAS identities in sync with their LDAP identities as they do with SAS 9.4.

## Operating Environments

SAS 9.4 can be installed on a variety of operating systems, including z/OS and several flavors of Windows, UNIX, and Linux. SAS Viya can be installed on Linux or Windows Server (as of Q3 2018). SAS Viya on Windows is limited to SAS Visual Data Mining and Machine Learning, SAS Visual Statistics, and SAS Visual Analytics. It is also limited to single-machine environments with CAS server and all supporting servers and services installed on the same physical or virtual machine. Both SAS 9.4 and SAS Viya can be deployed to a public or private cloud, which can be used as an Infrastructure as a Service (IaaS). In addition, SAS Viya supports native deployment to public and private clouds, which support the Cloud Foundry Platform as a Service (PaaS) infrastructure.

Regarding containers, the SAS 9.4 Analytics for Containers offering provides customers with a way to build and deliver a SAS Analytics Pro environment (for example, Base SAS, SAS/GRAPH, SAS/STAT, and SAS/ACCESS) as a Docker container. SAS Viya provides a similar “programming-only” environment in a pre-packaged Docker container (as of Q3 2018). More Docker-based offerings are expected for SAS Viya in the future.

## Multi-tenancy

Both SAS 9.4 and SAS Viya provide support for the separation of processing and data to be allocated to different tenants, in the form of customers, departments, or levels of a deployment (for example, DEV [development], TEST, and PROD [production]). With SAS 9.4, multi-tenancy can be accomplished by allocating different SAS application servers to different tenants, locking their use and the data being accessed based on membership in groups that are associated with the respective tenants. SAS Grid Manager offers increased support for multi-tenancy, enabling advanced allocation of compute resources to tenants. SAS Viya environments can be configured to handle tenants in the same fashion as SAS 9.4, using authorization settings and setup of separate SAS and CAS run-time environments

for each tenant. SAS Viya also offers a more explicit form of multi-tenancy “out of the box,” which relieves the administrator of the burden of resource isolation and provides even more separation between tenants. In a true SAS Viya multi-tenant deployment, tenants are essentially given separate environments, with each having no awareness of the other. A single “provider” tenant is used to manage all the tenants, each of which has its own separate servers, user content, and web application entry points. A common set of services is used to support the entire multi-tenant environment, allowing for economy of scale in administrative functions such as software updates and horizontal scaling.

## Platform Summary

The following table summarizes the similarities and differences between certain core platform functionality in SAS 9.4 and SAS Viya deployments.

Category	Capability	SAS 9.4M5	SAS Viya 3.4
SAS Foundation	Base SAS	✓	✓
	Multi-threaded DATA step execution	✓	✓
	Extended data types	✓ (VARCHAR)	✓
	SAS/GRAPH, SAS/STAT, SAS/OR, SAS/ETS, SAS/IML, SAS/QC	✓	✓
Distributed Processing	SAS Grid Manager	✓	
	SAS/LASR	✓	
	High Performance Architecture	✓	
	CAS Server		✓
Interfaces	Batch	✓	✓
	SAS Studio	✓	✓ (GUI subset)
	Enterprise Guide	✓	✓
	Open Programming Languages (Python, Java, R, Lua)		✓
	REST APIs		✓
SAS Application Development	Stored Processes <sup>1</sup>	✓	
	Job Definitions		✓
Administration	LDAP integration for users and groups		✓
	Monitoring and reporting	✓	✓
	Auditing	✓	✓
	CLIs	✓	✓
Operating Environments for Servers	Linux	✓	✓
	Windows	✓	✓ <sup>2</sup>
	Solaris, HP, AIX	✓	
	z/OS	✓	
	Cloud - IaaS	✓	✓
	Cloud - PaaS (Cloud Foundry)		✓
	Docker containers	✓	✓
Note: A gray checkmark ( ✓ ) means that the capability is possible if both SAS 9.4 and SAS Viya are present.			
<sup>1</sup> SAS 9.4 stored processes can be accessed from SAS Viya reports.			
<sup>2</sup> As of September, 2018, a Windows server is limited to a single machine.			

## Product Summary

Many SAS Viya product offerings have counterparts in SAS 9.4. In many cases, the SAS Viya Customer Advantage Program can provide significant financial benefit to existing SAS 9.4 customers who license related SAS Viya offerings. The following table summarizes these related offerings.



<b>SAS 9.4 Offering</b>	<b>Related SAS Viya Offering</b>
SAS High-Performance Data Mining	SAS Visual Data Mining and Machine Learning
SAS Enterprise Miner	
SAS High-Performance Econometrics	SAS Econometrics
SAS/ETS	SAS Optimization
SAS High-Performance Optimization	
SAS/OR	SAS Visual Forecasting
SAS High-Performance Forecasting	
SAS Forecast Server	SAS Visual Text Analytics
SAS Text Miner	
SAS High-Performance Text Mining	
SAS Contextual Analysis	
SAS Text Analytics Languages	SAS Text Analytics Languages (on SAS Viya)
SAS Visual Analytics	SAS Visual Analytics (on SAS Viya)
SAS Visual Statistics	SAS Visual Statistics (on SAS Viya)
SAS High-Performance Statistics	
SAS In-Memory Statistics	
SAS/STAT	
SAS Analytics Pro	
SAS/CONNECT	

The following sections compare the capabilities in each of the offerings that is identified in this mapping.

## Data Mining / Machine Learning

In addition to supporting an expanding suite of analytic procedures, SAS Visual Data Mining and Machine Learning surfaces a broad set of capabilities within the SAS Viya common HTML5 interface. Data preparation, modeling, and integrated reporting all have interactive approaches, which are not present in SAS 9.4 data mining offerings. As with other products in SAS Viya, SAS Visual Data Mining and Machine Learning also supports the ability to access its functionality through open-source languages and REST APIs. The SAS 9.4 offerings do provide a few capabilities that are not yet present in SAS Viya. However, the latest version of SAS Visual Data Mining and Machine Learning provides complete replacement value for all machine learning methods and includes many that are not present in SAS 9.4.

The following table compares the features in these respective releases.

Major Capability	Advanced Analytics 14.3 on 9.4M5			SAS Visual Data Mining and Machine Learning 8.2 on Viya	SAS Visual Data Mining and Machine Learning 8.3 on Viya
	SAS Enterprise Miner	SAS Factory Miner	SAS HP Data Mining (Code)		
Integrated Data Prep				✓	✓
Multiple Data Sources (after Data Prep)	✓		✓		
Integrated Reporting (Interactive Dashboards)				✓	✓
<b>General Features</b>					
Audio File Analysis					✓
Autotuning				✓	✓
Custom Extension Nodes	✓				
EM Batch Code Execution (migration)	n/a				✓
Included Text Mining (lightweight)				✓	✓
Incremental Response Models	✓				
Integrated Coding (Code node)	✓		✓	✓	✓
Interactive Binning	✓				
Interactive Modeling	minimal			✓	✓
K Fold Cross Validation	✓				✓
Model Lineage View					✓
Multiple-Pipeline Comparison				✓	✓
REST API calling Product				✓	✓
Reusable Model Templates (Central Storage)		✓		✓	✓
Som/Kohennen	✓				
Start/End Grps (Group Processing)	✓	✓			
Survival Data Mining	✓				
Time Series Data Mining	✓				
Two Stage Models	✓				
<b>Machine Learning Methods</b>					
Bayesian Networks	✓	✓	✓	✓	✓
Boolean Rules				✓	✓
Convolutional Neural Networks				✓	✓
Dirichlet Gaussian Mixture Models (GMM)					✓
Factorization Machines				✓	✓
Frequent Item Set Mining	✓	✓		✓	✓
Gradient Boosting	✓	✓		✓	✓
Isolation Forest					✓
K Nearest Neighbor				✓	✓
Image (incl. Biomedical) Processing / Object Detection				✓	✓
Market Basket Analysis	✓	✓		✓	✓
Model Interpretability (LIME, PDP, ICE)					✓
Moving Windows PCA				✓	✓
Multi-Task Learning					✓
Network Analytics/Community Detection	✓			✓	✓
Neural Networks	✓	✓	✓	✓	✓
Random Forest	✓	✓	✓	✓	✓
Recurrent Neural Network				✓	✓
Robust PCA				✓	✓
Semi-Supervised Learning					✓
Support Vector Data Description				✓	✓
Support Vector Machines	✓	✓	✓	✓	✓
Text Mining	✓			✓	✓
T-SNE					✓
Variable Clustering	✓			✓	✓

Major Capability	Advanced Analytics 14.3 on 9.4M5			SAS Visual Data Mining and Machine Learning 8.2 on Viya	SAS Visual Data Mining and Machine Learning 8.3 on Viya
	SAS Enterprise Miner	SAS Factory Miner	SAS HP Data Mining (Code)		
<b>Open Source</b>					
Open Source Calling SAS				✓	✓
SAS Calling Open Source	✓			minimal	✓
<b>Model Deployment</b>					
Model Retraining	✓	✓	✓	✓	✓
Batch Execution	✓	✓	✓	✓	✓
Model Manager Integration (Pushbutton)	✓	✓		✓	✓
SAS Data Step Score Code	✓	✓	✓	✓	✓
Astore Score Code	✓	✓	✓	✓	✓
PMML Score Code	✓				
C Score Code	✓				
Java Score Code	✓				
REST Scoring API				✓	✓
<b>Architecture</b>					
Browser Based (No install)	Java Web Start	✓	SAS Studio	✓	✓
Windows Based	✓	✓	✓		
Linux Based	✓	✓	✓	✓	✓
SMP mode (calling local non-in-memory data automatically)	✓	✓	✓		
MPP Mode	✓	✓	✓	✓	✓
Viya Integration (Calling from SAS 9)	✓				

## Econometrics

SAS Econometrics on SAS Viya provides full replacement value for all distributed procedures that are available with SAS High-Performance Econometrics on SAS 9.4, and it adds several more procedures such as HMM, CMDC, and CSPATIALREG. SAS Econometrics also includes a SAS/ETS license. The license allows a customer to run SAS/ETS procedures, thereby enabling them to address virtually any econometrics and time series analysis challenge. The SAS/ETS procedures execute only on the SAS Foundation server.

## Optimization

SAS Optimization on SAS Viya includes all the optimization capabilities (to build and solve optimization models) that have been under recent active development for SAS/OR. Several optimization solvers are implemented using distributed algorithms on CAS. Collectively, these distributed elements include and surpass the distributed optimization solver features of SAS High-Performance Optimization. Added features include a distributed mixed integer linear programming algorithm. Because SAS Optimization also includes a SAS/OR license, you can run SAS/OR procedures to use operations research methods in other areas such as project and resource scheduling. The SAS/OR procedures that are not included in SAS Optimization execute only on the SAS Foundation server.

## Forecasting

As previously mentioned, with the SAS Visual Data Mining and Machine Learning offering, SAS Visual Forecasting

provides a modern HTML5 interface, which is integrated across all SAS Viya products. It also shares the advantage of being callable by open-source programming languages as well as REST APIs.

Forecasting functionality is distributed more evenly when comparing SAS 9.4 Forecast Server and SAS Visual Forecasting on SAS Viya. Although they share many features, each supports unique capabilities as well. SAS Visual Forecasting includes a license for the SAS Forecast Server procedures and SAS/ETS procedures. All SAS Viya forecasting procedures are optimized for the highly performant, resilient CAS server. In a nutshell, both forecasting offerings provide a breadth of non-distributed capability. However, SAS Visual Forecasting offers new functionality, speed, and resilience.

The following table compares the features in these respective releases but does not reflect the additional functionality that is offered by the Forecast Server procedures and SAS/ETS procedures that are included with SAS Visual Forecasting.

Capability	Forecast Server 14.3 on 9.4M5		SAS Visual Forecasting 8.2 on Viya 3.3	SAS Visual Forecasting 8.3 on Viya 3.4
	Forecast Studio	Time Series Studio		
Forecasting Procedures	✓		✓	✓
Time Series Explorer / Viewer	✓ After forecasting only	✓	✓ Facet search based only	✓ Facet search based only
Segmentation		✓		✓ Imported using _seg_ variable in the attributes table
Segmentation Template				✓
Automatic Model Selection	✓		✓	✓
Hierarchical Forecasting	✓		✓	✓
Hierarchical Reconciliation	✓		✓ TD only in TSReconcile; aggregation for BU using TSMODEL or FEDSQL	✓ TD only in TSReconcile; aggregation for BU using TSMODEL or FEDSQL
Temporal Reconciliation	✓			
Automatic Outlier Detection (ARIMA only)	✓			✓ PROCS only
Concept of a Project	✓	✓	✓	✓
Project Archive/Unarchive	✓	✓	✓ Applicable project settings only; project data must be manually loaded into CAS	✓ Applicable project settings only; project data must be manually loaded into CAS
Events	✓		✓ Built-in calendar and holiday events only; PROC based only	✓ Default calendar events and Importing events
Events Management	✓			✓ Create event repository using FS procedures or in FS
Import Event Repository	✓			✓
Export Event Repository	✓			
Event Selection	✓			✓
Events Management - CRUD	✓			
Assign events to individual or subsets of time series (EventBY capability)				✓ PROCS only
Overrides Hierarchical	✓			
Overrides Attribute Based with Dynamic Overrides Disaggregation & Forecast Optimization			✓	✓

Capability	Forecast Server 14.3 on 9.4M5		SAS Visual Forecasting 8.2 on Viya 3.3	SAS Visual Forecasting 8.3 on Viya 3.4
	Forecast Studio	Time Series Studio		
Overrides Impact Analysis	✓		✓	✓
Interactive Modeling	✓			
Mandatory Override Justifications				
Tracking for Overrides				
Tracking				
Forecast Value Added (FVA) Analysis				
Forecast Model Monitoring				
Custom Models	✓		✓ PROCS only	✓ PROCS only
Combination Models	✓			
Neural Network Modeling Strategies				✓ 3 types - Panel Series, Stacked, and Multistage
View Diagnostics	✓			
Compare Models	✓			
Rolling Simulations	✓			
Goal Seeking				
"What if ..." or Scenario Analysis	✓			
Batch Execution	✓		✓	✓
Stability Monitoring			✓	✓
REST API			✓	✓
Data Preparation Integration			✓	✓
Model Manager integration				
VA Integration				✓ Limited to input and a subset of output tables
Lineage Integration				✓ Basic Lineage
SAS Drive Integration				✓
Singular Spectrum Analysis (SSA)			✓ PROCS only	✓ PROCS only
Motif Analysis			✓ PROCS only	✓ PROCS only
Time Series Missing Value Imputations				✓ PROCS only
Vector Time Series Similarity Measures				✓ PROCS only
Time Series Filtering				✓ PROCS only
Subspace Tracking				✓ PROCS only
Importing FS projects into VF			✓ Settings only	✓ Settings only

## Text Analytics

Text Analytics functionality appears in several offerings: SAS Text Miner and SAS Contextual Analysis on SAS 9.4 and Visual Data Mining and Machine Learning and Visual Text Analytics on SAS Viya. The offerings that are based on SAS Viya add social media connectors as well as some unique features such as hierarchical column sorting and categorical cutting and pasting. The SAS Visual Text Analytics offering on SAS Viya provides replacement value for SAS 9.4 text analytic capability.

Note that some of the text analytic functionality that is based on SAS Viya is available only as CAS actions and is not surfaced in the visual interface. Also note that SAS Visual Text Analytics offers tight integration with both SAS Visual Analytics and SAS Data Preparation.

The following table compares text analytic features in SAS 9.4 offerings and SAS Viya offerings.

Capability	Text Analytics on 9.4M5 SAS Contextual Analysis		Text Analytics on Viya 3.3		Text Analytics on Viya 3.4	
	Text Miner	ECC add-on	VDMML 8.2	VTA 8.2	VDMML 8.3	VTA 8.3
Document Conversion (From File server directory)	✓	✓			✓	✓
Document Conversion (In-Hadoop)						Programming thru SAS Studio
Web crawl	✓	✓				
Social Media Connectors			✓ Data Prep	✓ Data Prep	✓ Data Prep	✓ Data Prep
Text Summarization		✓ ECC add-on		✓ Action & SAS Studio Task		✓ Action & SAS Studio Task
Document De-Duplication		✓ ECC add-on				
Smart Data Segment				✓ Action only		✓ Action & SAS Studio Task
Parsing	✓	✓	✓	✓	✓	✓
Misspellings detection	✓	✓				✓
Interactive synonym management	✓					
Term similarity scores in UI				✓		✓
Dynamic Rule Building (using Terms/Textual Elements)				✓		✓
Topics SVD	✓	✓	✓	✓	✓	✓
Topics LDA				✓ Action only		✓ Action & SAS Studio Task
Create user-defined topics	✓			✓		✓
Merge Topics		✓		✓		✓
Split Topics		✓				✓
Topics curation (rename, term/doc cut-off)	✓					
Save user-defined topics and terms (for collaboration & promotion)						✓
Text Clustering	✓					
Text Profiling	✓					
Recurrent Neural Networks					✓ Action only	✓ Action only
Rule Generation using Probablistic Semantics (PROSE)						✓ Action only
Predefined concepts/Standard Entities	✓	✓	✓	✓	✓	✓
Enabling / Disabling select predefined concepts	✓	✓		✓ All or none		✓ All or none
Custom Concepts	✓ add-on product	✓		✓		✓
Concept Case Sensitivity		✓				✓
Set primary vs. supporting (helper) concept				✓		✓
Content Categorization (rules based)		✓		✓		✓
Boolean Rules (automatic rule generation)	✓	✓	✓	✓	✓	✓
Category relevancy (not in UI in SCA, but there in scoring)		✓		✓		✓
Managing more structured columns	✓		✓	✓	✓	✓
Columns sort by hierarchies				✓		✓
Cut/paste concepts, categories				✓		✓
Save Topics output data	✓			✓		✓
Save Categories output data (Transactional)				✓		✓
Save Categories output data (Modeling)						✓
Report / Results for text analytics nodes	✓				✓	✓
Text specific best practice pipeline templates				✓		✓
Change project data source	✓	✓	✓		✓	✓
Sentiment scoring in UI (Document level)		✓		✓		✓
Sentiment (feature level) score code		✓		✓		✓
Topics scoring	✓		✓	✓	✓	✓
Concepts score code		✓		✓		✓
Category score code		✓		✓		✓



Capability	Text Analytics on 9.4M5		Text Analytics on Viya 3.3		Text Analytics on Viya 3.4	
	Text Miner	SAS Contextual Analysis	VDMML 8.2	VTA 8.2	VDMML 8.3	VTA 8.3
ASTORE support			✓ Topics SVD only	✓ Topics SVD only	✓ Topics SVD only	✓ Topics SVD only
Languages	27	31	30	30	32	32
Document Search enabled in UI	✓					✓
Search (actions/API)			✓	✓	✓	✓
Concepts model scoring in ESP		✓		✓		✓
Category model scoring in ESP		✓		✓		✓
Sentiment model scoring in ESP		✓		✓		✓
Topics SVD model scoring in ESP			✓	✓	✓	✓
Concepts model scoring in Hadoop		✓		✓		✓
Category model scoring in Hadoop		✓		✓		✓
Sentiment model scoring in Hadoop		✓		✓		✓
Topics model scoring in Hadoop						
RNN model scoring						✓ Action only
Topics LDA model scoring						✓ Action & SAS Studio Task
Boolean Rules scoring						✓ Action & SAS Studio Task
REST API			✓ limited text mining features	✓	✓ limited text mining features	✓
Collaboration: Pipeline and Node sharing			✓	✓	✓	✓
Project Import / Export		✓		✓		✓
Visualization and Reporting (VA Integration)			✓	✓	✓	✓
Data Preparation (DS Integration)			✓	✓	✓	✓
Model Manager Integration						✓
SAS Drive Integration					✓	✓
Data Lineage Integration					✓	✓
Migrating SAS Contextual Analysis projects (json import/export)		✓				✓

## Visual Analytics

SAS Visual Analytics is divided into the 7.x series running on SAS 9.4 and the 8.x series running on SAS Viya. VA 8.x brings many new features, including CAS-enablement and a brand new HTML5 look-and-feel, in addition to full replacement value for the 7.x functionality.

The following table compares the features in these respective releases.

Category	Capability	SAS Visual Analytics 7.4 on 9.4M5	SAS Visual Analytics 8.2 on Viya	SAS Visual Analytics 8.3 on Viya
Data Access & Preparation	YouTube	✓	✓	✓
	Facebook	✓	✓	✓
	Twitter	✓	✓	✓
	Google Analytics	✓	✓	✓
	Google Drive	✓	✓	✓
	From Clipboard	✓		
	Other RDBMS Data Access as supported by the platform	✓	✓ <sup>1</sup>	✓ <sup>1</sup>
Reporting	Dynamic Text	✓	✓	✓
	Multi-value parameters	✓	✓	✓
	Cascading prompt controls	✓	✓	✓
	Custom polygons for geographical maps (e.g. sales territories)	✓	✓	✓
	Geo-Enrichment		✓	✓
	Geocoding		✓	✓
	Pin-Location and Travel-time Analysis		✓	✓
	Map layers (via Data Driven Content object)		✓	✓
	Sort based on custom order	✓	✓	✓
	Include spark lines in list tables	✓	✓	✓
	Cell Graph support			✓
	Group gauges by a category	✓	✓	✓
	Horizontal & vertical containers (scrollable)	✓	✓	✓
	Include links to additional content in text	✓	✓	✓
	Support Right-to-Left orientation	✓	✓	✓
	Add reference lines to graphs	✓	✓	✓
	Sankey Diagram	✓	✓	✓
	Report Linking (manual one-way filter actions)	✓	✓	✓
	Auto-Interactions across objects		✓	✓
	Two-way filter interactions between objects		✓	✓
	Number Compaction			✓
	Auto-Refresh per object (streaming data)			✓
	Report Data Views			✓
	Object templates			✓
	Multi-edit Formats			✓
	Multi-edit aggregations			✓
	Scoped aggregations		✓	✓
	Multi-level aggregations (aggregatable function)			✓
	Reuse Filters			✓
	Undo/Redo (design-time)		✓	✓
Save User State (Viewer)			✓	
Playable Dashboards (Viewer)			✓	
Multi-Data Source Joins (Design time)			✓	
Designing grid lines			✓	
Parameterize display rules	✓	✓	✓	
Approachable Analytics	Forecasting	✓	✓	✓
	Fit Line	✓	✓	✓
	Decision Tree	✓	✓	✓
	Automated Analysis			✓ <sup>2</sup>
	Correlation Matrix	✓	✓	✓
Customize	Consume SAS Stored Processes	✓		
	Consume SAS Job Execution results			✓
	Create custom graph objects (templates)	✓		✓
	Include Web content		✓	✓
	Data driven content (3rd party objects)		✓	✓
Enterprise Support	Distribute Reports (scheduled)	✓	✓	✓
	Notify stakeholders to alert conditions in reports	✓	✓	✓
	Localize report content	✓	✓	✓
	Audit Reporting	✓		✓
	Refresh reports automatically	✓	✓	✓
	Autosave	✓	✓	✓
	Lineage		✓	✓
	SAS Drive			✓
	Allow guests to view reports	✓	✓	✓

Category	Capability	SAS Visual Analytics 7.4 on 9.4M5	SAS Visual Analytics 8.2 on Viya	SAS Visual Analytics 8.3 on Viya
Native Apps	Mobile Device Management support (3rd party providers)	✓	✓	✓
	Offline report viewing	✓	✓	✓
	Windows 10	✓	✓	✓
	iOS	✓	✓	✓
	Android	✓	✓	✓
	Natural Language Understanding	✓	✓	✓
Operating Environment	SDK Support for mobile apps	✓	✓	✓
	Linux server	✓	✓	✓
	Windows server	✓	✓	✓ <sup>2</sup>
	Internet Explorer browser	✓	✓	✓
	Edge browser	✓	✓	✓
	Safari browser (Mac)	✓	✓	✓
	Chrome browser (Windows)	✓	✓	✓
Firefox browser (Windows)	✓	✓	✓	

<sup>1</sup>SAS Viya data access is limited compared to SAS 9. See the list of supported data sources in the Data Management section.

<sup>2</sup>The functionality is available as of September, 2018.

## Visual Statistics

SAS Visual Statistics on SAS Viya provides many of the same features that are provided in the SAS Visual Statistics 7.x series running on SAS 9.4. In addition, it includes equivalents to most of the distributed SAS procedures that are available with SAS High-Performance Statistics, as well as new procedures such as the PHSELECT, PCA, and SPC. SAS Visual Statistics includes a SAS/STAT license. This allows a customer to run SAS/STAT procedures, thereby enabling them to address virtually any statistical challenge. This offering also includes SAS/GRAPH, which means that all components of SAS Analytics Pro come with the SAS Visual Statistics offering. The SAS/STAT and SAS/GRAPH procedures execute only within the SAS Foundation server. Like other products included in SAS Viya, SAS Visual Statistics also supports the ability to access its functionality through open-source languages and REST APIs. Note that SAS In-Memory Statistics on Hadoop is not available with SAS Viya.

## Data Management

Perhaps the most significant difference between data management products in SAS 9.4 and SAS Viya is in the supported data sources. The list of supported sources that integrate directly with the CAS server in SAS Viya, which are known as data connectors, continues to increase, but many sources are still supported only by the SAS 9.4 SAS/ACCESS products. Regardless, SAS/ACCESS engines can be licensed with SAS Viya orders to provide access to data sources that are not yet CAS-enabled. Such access is enabled with the SAS programming run-time environment, which is included with SAS Viya orders. Although this access does not take advantage of the distributed processing of the CAS server, it does provide compatibility with preexisting SAS 9.4 code and data sources.

One key advantage of SAS Viya over SAS 9.4 is in parallel data access through the CAS data connect accelerators. Also, there are several cloud-based data sources, such as Twitter and Google, that are supported by SAS Viya.

A wealth of data management capability beyond data access (such as data governance, data quality, and data integration) is available through the SAS Data Preparation and SAS Data Quality offerings on SAS Viya.

The following tables compare data management capabilities offered in SAS 9.4 and SAS Viya.

Capability	SAS/ACCESS on 9.4M5	SAS/ACCESS on Viya 3.4	
		MVA	Connector
<b>Data Access</b>			
SAS/ACCESS Interface to ADABAS	✓		
SAS/ACCESS Interface to Amazon Redshift	✓	✓	✓
SAS/ACCESS Interface to Aster	✓		
SAS/ACCESS Interface to CA IDMS	✓		
SAS/ACCESS Interface to DATACOM/DB	✓		
SAS/ACCESS Interface to DB2	✓	✓	✓
SAS/ACCESS Interface to GreenPlum	✓	✓	
SAS/ACCESS Interface to Hadoop	✓	✓	✓
SAS/ACCESS Interface to HAWQ	✓	✓	
SAS/ACCESS Interface to Impala	✓	✓	✓
SAS/ACCESS Interface to IMS-DL/I	✓		
SAS/ACCESS Interface to INFORMIX	✓		
SAS/ACCESS Interface to Microsoft SQL Server	✓	✓	✓
SAS/ACCESS Interface to MySQL	✓	✓	✓
SAS/ACCESS Interface to Netezza	✓		
SAS/ACCESS Interface to ODBC	✓	✓	✓
SAS/ACCESS Interface to OLEDB	✓		
SAS/ACCESS Interface to ORACLE	✓	✓	✓
SAS/ACCESS Interface to ORACLE Rdb	✓		
SAS/ACCESS Interface to PC Files	✓	✓	✓
SAS/ACCESS Interface to PostgreSQL	✓	✓	✓
SAS/ACCESS Interface to R/3	✓		
SAS/ACCESS Interface to SAP HANA	✓	✓	✓
SAS/ACCESS Interface to SAP ASE	✓		
SAS/ACCESS Interface to SAP IQ	✓		
SAS/ACCESS Interface to SYSTEM 2000	✓		
SAS/ACCESS Interface to Teradata	✓	✓	✓
SAS/ACCESS Interface to the PI System	✓		
SAS/ACCESS Interface to Vertica	✓	✓	✓
SPDE	✓	✓	✓
SPDS	✓		
SAS/ACCESS Interface to JDBC			✓
SAS/ACCESS Interface to Hadoop (+ Spark SQL)			✓

Capability	SAS In-Database and HPA on 9.4M5					SAS In-Database on Viya 3.4		
	Scoring	Code Accel	DQ	HPA Parallel	HPA Serial	Parallel	MVA Scoring	CAS Scoring
<b>Data Access</b>								
SAS/ACCESS Interface to ADABAS					✓			
SAS/ACCESS Interface to Amazon Redshift					✓			
SAS/ACCESS Interface to Aster	✓				✓			
SAS/ACCESS Interface to CA IDMS TM					✓			
SAS/ACCESS Interface to DATACOM/DB					✓			
SAS/ACCESS Interface to DB2	✓				✓			
SAS/ACCESS Interface to GreenPlum	✓	✓		✓	✓			
SAS/ACCESS Interface to Hadoop	✓	✓	✓	✓	✓	✓		✓
SAS/ACCESS Interface to HAWQ					✓			
SAS/ACCESS Interface to Impala					✓			
SAS/ACCESS Interface to IMS-DL/I					✓			
SAS/ACCESS Interface to INFORMIX					✓			
SAS/ACCESS Interface to Microsoft SQL Server					✓			
SAS/ACCESS Interface to MySQL					✓			
SAS/ACCESS Interface to Netezza	✓				✓			
SAS/ACCESS Interface to ODBC					✓			
SAS/ACCESS Interface to OLEDB					✓			
SAS/ACCESS Interface to ORACLE	✓			✓	✓			
SAS/ACCESS Interface to ORACLE Rdb					✓			
SAS/ACCESS Interface to PC Files					✓			
SAS/ACCESS Interface to PostgreSQL					✓			
SAS/ACCESS Interface to R/3					✓			
SAS/ACCESS Interface to SAP HANA	✓			✓	✓			
SAS/ACCESS Interface to SAP ASE					✓			
SAS/ACCESS Interface to SAP IQ					✓			
SAS/ACCESS Interface to SYSTEM 2000					✓			
SAS/ACCESS Interface to Teradata	✓	✓	✓	✓	✓	✓		✓
SAS/ACCESS Interface to the PI System					✓			
SAS/ACCESS Interface to Vertica					✓			
SPDS	✓				✓			
SAS/ACCESS Interface to JDBC								
SAS/ACCESS Interface to Hadoop (+ Spark SQL)						✓		✓

Capability	Data Management on 9.4M5						Data Management on Viya 3.4		
	SAS Data Integration Server	SAS Data Quality Server	SAS Data Loader for Hadoop	SAS Data Management	SAS Data Quality	SAS Data Governance	All Viya Offerings	SAS Data Quality	SAS Data Preparation
	<b>Data Access</b>								
SPDS									
Twitter							✓	✓	✓
Facebook							✓	✓	✓
Google Analytics							✓	✓	✓
YouTube							✓	✓	✓
Google Drive							✓	✓	✓
ESRI							✓	✓	✓
Local File							✓	✓	✓
Cloud Data Exchange							✓	✓	✓
<b>Data Governance</b>									
SAS Lineage - network diagram view				✓	✓	✓	✓	✓	✓
SAS Lineage - impact analysis view				✓	✓	✓			
SAS Lineage - governance view				✓	✓	✓			
Metadata bridge support	✓			✓					
Relationship loader support	✓			✓	✓	✓			
SAS Data Remediation - all functions				✓	✓	✓			
SAS Business Data Network - all functions				✓	✓	✓			
Workflow support				✓	✓	✓			
<b>Data Quality</b>									
Quality Knowledge Base for Contact Information		✓	✓	✓	✓	✓		✓	✓
Quality Knowledge Base for Product Data		✓		✓	✓	✓			
Change case	✓		✓	✓	✓	✓	✓	✓	✓
Convert column	✓		✓	✓	✓	✓	✓	✓	✓
Rename column	✓		✓	✓	✓	✓	✓	✓	✓
Remove column	✓		✓	✓	✓	✓	✓	✓	✓
Split column	✓		✓	✓	✓	✓	✓	✓	✓
Trim whitespace	✓		✓	✓	✓	✓	✓	✓	✓
Calculated column creation	✓		✓	✓	✓	✓	✓	✓	✓
Custom code transformation	✓		✓	✓	✓	✓	✓	✓	✓
Data quality - UI driven		✓	✓	✓	✓				
Casing (QKB)		✓	✓	✓	✓			✓	✓
Parsing (QKB)		✓	✓	✓	✓			✓	✓
Field extraction (QKB)		✓	✓	✓	✓			✓	✓
Gender analysis (QKB)		✓	✓	✓	✓			✓	✓
Identification analysis (QKB)		✓	✓	✓	✓			✓	✓
Match codes (QKB)		✓	✓	✓	✓			✓	✓
Standardize (QKB)		✓	✓	✓	✓			✓	✓
Profiling - UI driven			✓	✓	✓	✓			
Basic profiling	✓		✓	✓	✓	✓	✓	✓	✓
Advanced profiling (table/column)			✓	✓	✓	✓		✓	✓
Advanced profiling (custom metrics)			✓	✓	✓	✓			
Matching/clustering	✓		✓	✓	✓	✓		✓	✓
Survivorship			✓	✓	✓	✓			
Address verification (batch)			✓	✓	✓	✓			
Geocoding (batch)			✓	✓	✓	✓			
Data monitoring			✓	✓	✓	✓			
Unstructured contextual extraction			✓	✓	✓	✓			
Reference data management			✓	✓	✓	✓			
Data type identification								✓	✓
Tagging							✓	✓	✓
<b>Data Integration</b>									
Append	✓		✓	✓	✓	✓	✓	✓	✓
Join	✓		✓	✓	✓	✓	✓	✓	✓
Filter	✓		✓	✓	✓	✓	✓	✓	✓
Transpose	✓		✓	✓	✓	✓	✓	✓	✓
SPDS Integration	✓		✓	✓	✓	✓			
Message queue integration	✓		✓	✓	✓	✓			
Change data capture	✓		✓	✓	✓	✓			
Conditional flow logic	✓		✓	✓	✓	✓			
Slowly changing dimensions	✓		✓	✓	✓	✓			
Advanced Hadoop integration	✓		✓	✓	✓	✓			
Publish actions	✓		✓	✓	✓	✓			
SAP integration	✓		✓	✓	✓	✓			
Advanced SQL functions	✓		✓	✓	✓	✓			
Complex ETL data flows	✓		✓	✓	✓	✓			
<b>General</b>									
Project management							✓	✓	✓
Reusable job/program creation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Job/program schedulability	✓	✓	✓	✓	✓	✓	✓	✓	✓
Job monitoring			✓	✓	✓	✓	✓	✓	✓
Reporting (either VAAR or VA as pre-req)				✓	✓	✓	✓	✓	✓
Business rules (SAS Business Rules)				✓	✓	✓			

Note that cells with a diagonal background fill pattern represent functionality that is available only in the “Advanced” flavor of a given offering (for example: SAS Data Management Advanced).

## Acknowledgements

I would like to thank the following content contributors and reviewers, without whom this paper would not have been possible: Ron Agresta, Saurabh Gupta, Anand Chitale, Jonathan Wexler, Ed Hughes, Manoj Chari, Joe Katz, Udo Sglavo, Radhika Kulkarni, Maura Stokes, Simon McGrother, Vicki Leary, and Pratima Gokhale.



To contact your local SAS office, please visit: [sas.com/offices](http://sas.com/offices)

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. Copyright © 2014, SAS Institute Inc. All rights reserved.

---