# SAS® 9.4 and SAS® Viya® Functional Comparison

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# SAS 9.4 and SAS Viya Functional Comparison
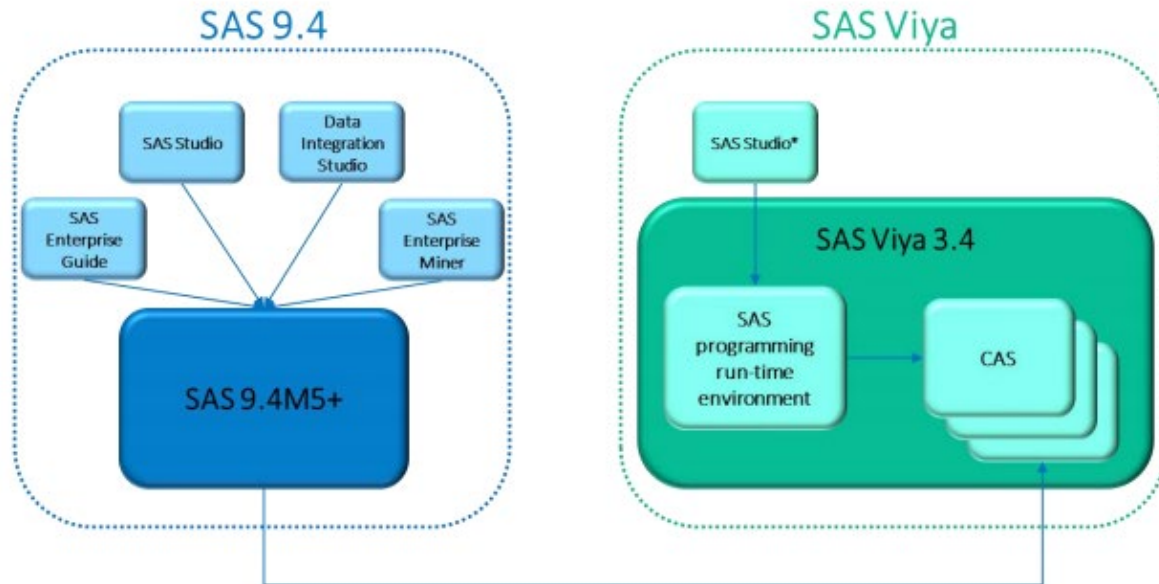
## SAS Platform

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, as well as integration with cloud environments, 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, it's helpful to compare the functional approaches delivered by each. Understanding these respective approaches will help you optimize the SAS Platform for your specific business needs by leveraging the engine or engines that make the most sense. 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 (September 2017), SAS 9.4 programming clients could take advantage of a SAS® Cloud Analytics Services (CAS) server in a SAS Viya environment. This means that, in most 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, SAS® 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.

Because 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 9.4 engine 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.

*Many SAS Viya clients (e.g., SAS Visual Analytics) do not submit SAS code, but rather 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. You can also view a recorded presentation on this topic entitled Leveraging SAS® Viya® to Improve Base SAS® Processes on communities.sas.com.

Other SAS Foundation products such as SAS/STAT®, SAS/GRAPH®, SAS/ETS®, and SAS/OR® are fully supported in a SAS Viya environment when they are included in related product offerings. Other SAS Foundation products, such as SAS/IML®, SAS/QC®, and many SAS/ACCESS® interfaces are available as add-on products to a SAS Viya order. Therefore, SAS Viya users have access to both the distributed computing capabilities of the SAS Viya products and the functionality of the 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.

The way in which SAS Foundation code is executed varies according to the clients that are used in a SAS 9 and SAS Viya environment. With SAS 9, both desktop clients (such as SAS Enterprise Guide and SAS® Add-In for Microsoft Office) and web clients (such as SAS Studio) submit code to a SAS object spawner that then routes the job 3 to an appropriate workspace server or to a stored process server. With SAS Viya, such requests are typically submitted

to a launcher server, which then 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. These files are stored in the `spre` directory of your SAS Viya installation. Although SAS Studio 5.x uses the launcher server method with SAS Viya, SAS Studio 4.x, which is the default SAS programming client for SAS Viya 3.3 and earlier, uses the SAS object spawner method.

## Distributed Processing

Perhaps the most significant core platform functional difference between SAS 9.4 and SAS Viya is in the way that each one handles distributed processing. SAS Viya leverages the CAS server, and SAS 9.4 uses SAS® LASR™, SAS® HighPerformance Analytics (HPA) and SAS® Grid Manager. Even though SAS LASR and HPA will remain only in SAS 9.4, SAS Grid Manager functionality will eventually be ported to SAS Viya environments (targeted for 2020). Because the CAS server is the third major evolution of the SAS distributed in-memory technology, it is no surprise that it offers the most value. Compared to HPA, the CAS server 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 in a SAS 9.4 environment can work in concert with a SAS Viya environment. "The grid" distributes multiple SAS 9.4 jobs from multiple users across a cluster of machines, and each job can be further parallelized with the DATA step and SAS procedure code executing across multiple worker nodes in a CAS server that is running in a companion SAS Viya environment.

## User Interfaces and Program Development

Although SAS 9.4 clients use a variety of interfaces, such as Java clients like SAS Enterprise Miner, .NET clients like SAS Enterprise Guide, and web clients like SAS Visual Analytics, SAS Viya clients all use a common HTML5 web interface. This common interface allows for all functionality to be merged into a single user experience. SAS 9.4 provides a launching page for certain web clients that is known as SAS® Home. This dashboard supports launcher tiles that are specific to the associated SAS products. SAS Viya provides a dashboard for all its web clients called SAS® Drive. This dashboard is oriented toward the user more than is SAS Home, enabling users to view, edit, and share content associated with their licensed SAS Viya products.

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 5.2 (delivered with SAS Viya) provides some unique features but does not yet provide full replacement value for all the capabilities that are provided by SAS Studio 3.x (delivered with SAS 9.4). For example, SAS Studio 5.2 can save programs to the local file system as well as the SAS® Infrastructure Data Server, and SAS Studio 3.x can save programs only to the local file system. Such an approach lends itself more readily to cloud deployments. On the other hand, SAS Studio 3.x provides support for the management of process flows, which remains to be delivered in a future release of SAS Studio 5.x. You can find an up-to-date feature comparison of the different versions of SAS Studio (and SAS Enterprise Guide) in SAS Studio's Help Center.

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. This integration includes execution of SAS code as well as the generation

of SAS code from Python calls. The SASPy project, which is available on GitHub, provides this native Python interoperability for both SAS 9.4 and SAS Viya. For SAS Viya, you can also use the SAS Scripting Wrapper for Analytics Transfer (SWAT) Python package to call CAS server actions directly, skipping the translation layer. In fact, because the CAS server allows for direct calls from Python, R, Java, Lua, and REST APIs, you 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, which allows for ease in using ensemble modeling methods.

SAS 9.4 has rich support for stored processes, which allow for SAS programs to be defined and executed interactively, either through 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 functionality in SAS Studio 5.2 to define these programs. See SAS Studio 5.2 Developer's Guide: Working with Jobs for more details.

## 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. The only thing it shares with its SAS 9.4 counterpart is its name. The SAS Environment Manager interface for SAS 9.4 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 Environment Manager interface for SAS Viya provides similar metrics and reporting capabilities as the SAS 9.4 application but does not yet have as complete a set of real-time 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 command line interface (CLI) access to a real-time message bus that 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 (based on PostgreSQL) and SAS® Configuration Server (based on Consul). Another important distinction is that although SAS 9.4 uses identities from the SAS Metadata Server to define users and groups, SAS Viya leverages pre-existing customer directory services that are LDAP-based, such as 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 a Linux or Windows Server. 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 singlemachine environments in which the CAS server and all other supporting servers and services are 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 provides deployment automation scripts that are native to certain public cloud providers. For example, a SAS 9.4 SAS Grid Manager reference deployment is available as the SAS Grid on AWS Quick Start deployment script. A reference deployment containing SAS Visual Data Mining and Machine Learning, SAS Visual Statistics, and SAS Visual Analytics is available as the SAS Viya on AWS Quick Start deployment script. A similar offering is available for Microsoft Azure's Resource Manager as the SAS Viya Quickstart Template for Azure.

SAS is increasingly adopting strategies using Docker containers and Kubernetes orchestration to provide more composable, scalable, and maintainable deployments. The SAS® Analytics for Containers offering for SAS 9.4 provides customers with a way to build and deliver a SAS® Analytics Pro environment (for example, an environment that includes Base SAS, SAS/GRAPH, SAS/STAT, and SAS/ACCESS) as a Docker container. SAS Viya provides support for both pre-built Docker images as well as Docker recipes for building your own containers. Recipes for SAS Viya containers are maintained on GitHub. SAS® Cloud Software as a Service (SaaS) offerings of select SAS Viya products use Kubernetes to more easily orchestrate complex container-based deployments.

## Multi-tenancy

Both SAS 9.4 and SAS Viya provide support for separating processing and data and allocating them to "tenants," such as different 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, which locks their use and their access to data 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 among tenants. SAS Viya environments can be configured to handle tenants in the same fashion as SAS 9.4, using authorization settings and 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 tenant having no awareness of the others. A single provider tenant is used to manage all the other tenants, each of which has its own separate servers, user content, and web application entry points. Each tenant can also be configured to point to a different LDAP server for associated users and groups. 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 9.4M6 | 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 | ✔ | ✔[1] |
| Distributed Processing | SAS Grid Manager | ✔ | ✔ |
| | SAS LASR | ✔ | |
| | SAS High Performance Analytics | ✔ | |
| | CAS server | | ✔ |
| Interfaces | Batch | ✔ | ✔ |
| | SAS Studio | ✔ | ✔ |
| | SAS Enterprise Guide | ✔ | ✔ |
| | Open programming languages (Python, Java, R, Lua)[2] | | ✔ |
| | REST APIs | | ✔ |
| SAS Application Development | SAS® Stored Processes[3] | ✔ | |
| | Job definitions | | ✔ |
| Administration | LDAP integration for users and groups | | ✔ |
| | Monitoring and reporting | ✔ | ✔ |
| | Auditing | ✔ | ✔ |
| | CLIs | ✔ | ✔ |
| Operating Environments for Servers | Linux | ✔ | ✔ |
| | Windows | ✔ | ✔[4] |
| | 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.
1 Product availability based on licensed SAS Viya offering(s), not all of which are available on Windows
[2] Some Python capability is available for SAS 9.4 through the SASPy GitHub project
[3] SAS 9.4 stored processes can be accessed from SAS Viya reports.
[4] Single machine deployments

## Related Product Offerings

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.

| | |
|---|---|
| SAS® High-Performance Econometrics<br>SAS/ETS® | SAS® Econometrics |
| SAS High-Performance Optimization<br>SAS/OR | SAS® Optimization |
| SAS® High-Performance Forecasting<br>SAS® Forecast Server | SAS® Visual Forecasting |
| SAS® Text Miner<br>SAS® High-Performance Text Mining<br>SAS® Contextual Analysis | SAS® Visual Text Analytics (VTA) |
| SAS® Text Analytics languages | SAS Text Analytics languages (on SAS Viya) |
| SAS Visual Analytics (VA) | SAS Visual Analytics (on SAS Viya) |
| SAS® Visual Statistics<br>SAS® High-Performance Statistics<br>SAS® In-Memory Statistics<br>SAS/STAT<br>SAS Analytics Pro | SAS Visual Statistics (on SAS Viya) |
| SAS/CONNECT® | SAS/CONNECT (on SAS Viya) |

## Analytics Life Cycle

The SAS Platform provides software that supports all aspects of the analytics life cycle, from data to discovery to deployment. This is true for both SAS 9 and SAS Viya environments. SAS Viya environments more closely integrate this life cycle through both a common web-based interface and clients such as Model Studio and SAS Drive. The interface provides a task-oriented view of the software, abstracting away the underlying products that deliver the functionality. For example, SAS Viya users can simply select "Build Models" from a functional menu, without having to know that they are leveraging the SAS Visual Data Mining and Machine Learning product in the process.

The following diagram maps several SAS 9 and SAS Viya products to the workflow associated with this integrated approach to the analytics life cycle.
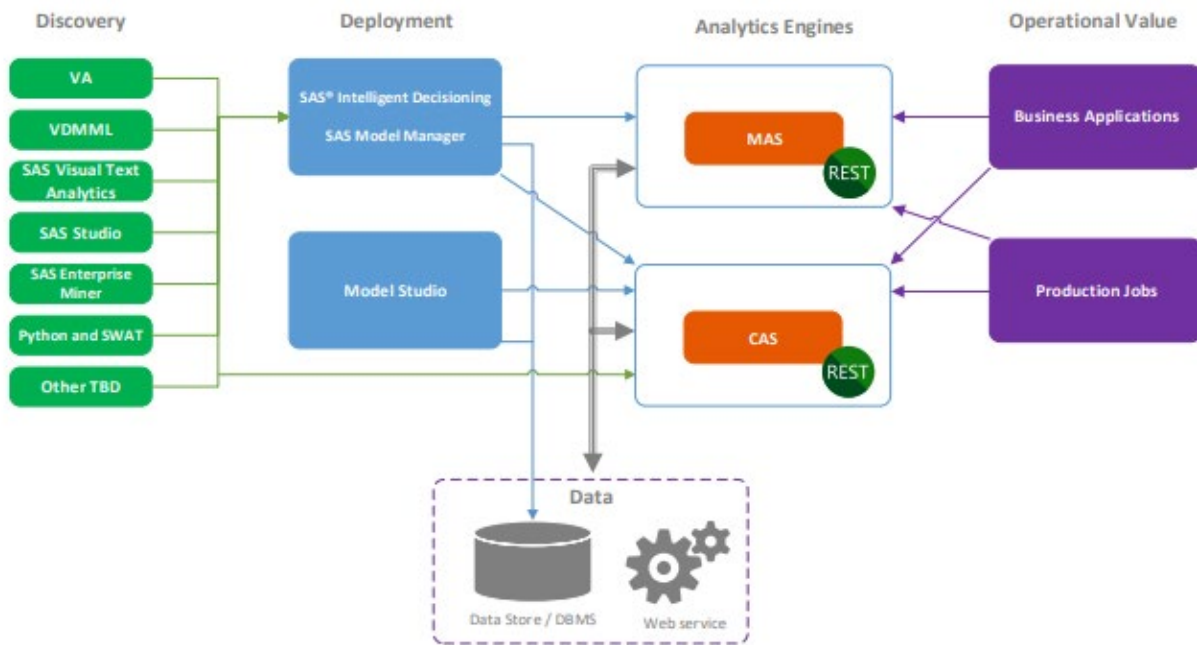


The following sections compare the capabilities of SAS 9 and SAS Viya in product areas mapping to this analytics life cycle.

## 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 sources that integrate directly with the CAS server in SAS Viya are known as data connectors. The number of data connectors continues to increase, but many sources are still supported only by the SAS 9.4 SAS/ACCESS products. However, SAS/ACCESS engines can be licensed with SAS Viya orders in order 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 9.4M6 | SAS/ACCESS® on Viya 3.4 | | SAS/ACCESS® on Viya 3.5 | |
|---|---|---|---|---|---|
| | | MVA | Connector | MVA | Connector |
| **Data Access** | | | | | |
| 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 | ✔ | ✔ | ✔ | ✔ | ✔ |
| SPD Engine | ✔ | ✔ | ✔ | ✔ | ✔ |
| SPD Server | ✔ | | | | |
| SAS/ACCESS® Interface to JDBC | ✔ | | ✔ | | ✔ |
| SAS/ACCESS® Interface to Hadoop (+ Spark SQL) | ✔ | | ✔ | | ✔ |
| SAS/ACCESS® Interface to Google BigQuery | ✔ | ✔ | ✔ | ✔ | ✔ |
| SAS/ACCESS® Interface to Salesforce | ✔ | | | ✔ | ✔ |
| SAS/ACCESS® Interface to Snowflake | ✔ | ✔ | ✔ | ✔ | ✔ |
| SAS/ACCESS® Interface to Mongo | ✔ | | | ✔ | ✔ |

| Capability | SAS In-Database and HPA on 9.4M6 | | | | | SAS In-Database on Viya 3.4 | | | SAS In-Database on Viya 3.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scoring | Code Accel | DQ | HPA Parallel | HPA Serial | Parallel | MVA Scoring | CAS Scoring | Parallel | MVA Scoring | CAS Scoring |
| **Data Access** | | | | | | | | | | | |
| 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 | | | | | ✔ | | | | | | |
| SPD Server | ✔ | | | | ✔ | | | | | | |
| SAS/ACCESS Interface to JDBC | | | | | | | | | | | |
| SAS/ACCESS Interface to Hadoop (+ Spark SQL) | | | | | | ✔ | | ✔ | ✔ | | ✔ |

| Capability | Data Management on 9.4M6 | | | | | | Data Management on Viya 3.4 | | | Data Management on Viya 3.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | All Viya Offerings | SAS Data Quality | SAS Data Preparation |
| **Data Access** | | | | | | | | | | | | |
| SPDS | | | | | | | | | ~cas? | | | ~cas? |
| Twitter | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Facebook | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Google Analytics | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| YouTube | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Google Drive | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| ESRI | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Local File | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Cloud Data Exchange | | | | | | | | | ✔ | | | ✔ |
| SAS Folder | | | | | | | | | | ✔ | | ✔ |
| Image File | | | | | | | | | | ✔ | | |
| Multi-worksheet Excel File | | | | | | | | | | ✔ | | ✔ |
| Multi-text File | | | | | | | | | | ✔ | | ✔ |
| AWS S3 Parquet | | | | | | | | | | ✔ | | ✔ |
| Azure Data Lake Orc and CSV | | | | | | | | | | ✔ | | ✔ |
| SAS ESP Window | | | | | | | | | | ✔ | | ✔ |
| **Data Governance** | | | | | | | | | | | | |
| SAS* Lineage - network diagram view | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| SAS Lineage - impact analysis view | | | | ✔ | ✔ | ✔ | | | | | | |
| SAS Lineage - governance view | | | | ✔ | ✔ | ✔ | | | | | | |
| SAS* Metadata Bridge support | ✔ | | | ✔ | | | | | | | | |
| Relationship loader support | ✔ | | | ✔ | ✔ | ✔ | | | | | | |
| SAS* Data Remediation - all functions | | | | ✔ | ✔ | ✔ | | | | | | |
| SAS* Business Data Network - all functions | | | | ✔ | ✔ | ✔ | | | | | | |
| Workflow support | | | | ✔ | ✔ | ✔ | | | | | | |
| **Data Quality** | | | | | | | | | | | | |
| SAS* Quality Knowledge Base for Contact Information | | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | | ✔ | ✔ |
| SAS* 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 | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Remove duplicates | | | | | | | | | | | ✔ | ✔ |
| Manage Columns | | | | | | | | | | | ✔ | ✔ |

| Capability | Data Management on 9.4M6 | | | | | | Data Management on Viya 3.4 | | | Data Management on Viya 3.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | All Viya Offerings | SAS Data Quality | SAS Data Preparation |
| **Data Integration** | | | | | | | | | | | | |
| 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 | ✔ | | | ✔ | | | | | | | | |
| Simple Random Partition | | | | | | | | | | | | ✔ |
| **General** | | | | | | | | | | | | |
| Project management | | | | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Reusable job/program creation | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Job/program schedulability | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Job monitoring | | | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Reporting (either VAAR or VA as pre-req) | | | | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Business rules (SAS Business Rules) | | | | ✔ | | | | | | | | |
| Column Label Support | | | | | | | | | | | | ✔ |
| Download to CSV/tab delimited file | | | | | | | | | | | | ✔ |
| AI Driven Transformation Suggestions | | | | | | | | | | | | ✔ |

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).

## Visualization

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 includes many new features, such as CAS enablement, a brand new HTML5 look-and-feel, and full replacement value for the 7.x functionality. VA 7.5 was retrofitted with a similar HTML5 look-and-feel, in addition to including several features previously only available with VA 8.x on SAS Viya.

The following table compares the features in these respective releases.

| Category | Capability | SAS Visual Analytics 7.4 on 9.4M5 | SAS Visual Analytics 7.5 on 9.4M6 | SAS Visual Analytics 8.3 on Viya | SAS Visual Analytics 8.4 on Viya | SAS Visual Analytics 8.5 on Viya |
|---|---|---|---|---|---|---|
| Data Access & Preparation | YouTube | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Facebook | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Twitter | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Google Analytics | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Google Drive | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Other RDBMS Data Access as supported by the platform | ✔ | ✔ | ✔[1] | ✔[1] | ✔[1] |
| Reporting | Dynamic Text | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Dynamic report summaries | | | ✔[2] | ✔ | ✔ |
| | Geo - display regions(choropleths) and coordinates in a single object | | | | | ✔ |
| | Geo - display labels and data values on a region map | | | | | ✔ |
| | Geo - create custom geo objects with multiple data layers | | | | | ✔ |
| | Geo Custom regions for geographical maps (e.g. sales territories) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Geo Enrichment (Data Import of Esri Demographics) | | | ✔ | ✔ | ✔ |
| | Geo Selection - Travel Time, Travel Distance | | | ✔ | ✔ | ✔ |
| | Geo Search | | | ✔ | ✔ | ✔ |
| | Geo Web Map layers (via Data Driven Content object) | | | ✔ | ✔ | ✔ |
| | Geo Clustering | | | ✔ | ✔ | ✔ |
| | Geo Contour Map | | | ✔ | ✔ | ✔ |
| | Geocoding (from Manage Data-Import) | | | ✔ | ✔ | ✔ |
| | Geo Points of Interest - Pin Management, Routing, Identify Place | | | ✔ | ✔ | ✔ |
| | Geo Demographics - based on Geo Selected area | | | ✔ | ✔ | ✔ |
| | Cell Graph support | | ✔ | ✔ | ✔ | ✔ |
| | Support Right-to-Left orientation | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Path Analysis (Sankey Diagram plus analytics) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Auto-Interactions across objects | | | ✔ | ✔ | ✔ |
| | Two-way filter interactions between objects | | | ✔ | ✔ | ✔ |
| | Number Compaction | | ✔ | ✔ | ✔ | ✔ |
| | Auto-Refresh per object (streaming data) | | | ✔ | ✔ | ✔ |
| | Report Data Views | | | ✔ | ✔ | ✔ |
| | Data item labels with the same name | | | | ✔ | ✔ |
| | Object templates | | | ✔ | ✔ | ✔ |
| | Object templates with data | | | | ✔ | ✔ |
| | Multi-edit Formats | | ✔ | ✔ | ✔ | ✔ |
| | Multi-edit aggregations | | ✔ | ✔ | ✔ | ✔ |
| | Scoped aggregations | | | ✔ | ✔ | ✔ |
| | Aggregate a specific range of cell values in a table (e.g. moving average) | | | ✔ | ✔ | ✔ |
| | Multi-level aggregations (aggregatetable function)) | | | ✔ | ✔ | ✔ |
| | Reuse Filters (Common filters) | | | ✔ | ✔ | ✔ |
| | Undo/Redo | | ✔ | ✔ | ✔[3] | ✔ |
| | Save User State | | | ✔ | ✔[3] | ✔ |
| | Playable Dashboards | | ✔ | ✔ | ✔ | ✔ |
| | Multi-Data Source Joins | | | ✔ | ✔ | ✔ |
| | Desging grid lines | | ✔ | ✔ | ✔ | ✔ |
| | Freeze Columns | | ✔ | | ✔ | ✔ |
| | Column total disabling | | ✔ | ✔[2] | ✔ | ✔ |
| | Key Value | | ✔ | ✔ | ✔ | ✔[3] |
| | Parallel Coordinates Plot | | | ✔ | ✔ | ✔ |
| | Measure Correlations in Data Pane | | ✔ | | ✔ | ✔ |
| | Suggestions Pane | | ✔ | | ✔ | ✔ |
| | Quick Start Pane (recents, favorites, thumbnails, search) | | | | ✔ | ✔ |
| | Single application for report design and exploration | | ✔ | ✔ | ✔[3] | ✔ |
| | Single application for report design and view | | | | ✔ | ✔ |
| | Viewer customizations with governance | | | | ✔ | ✔ |
| | Report sharing (user-to-user) | | | ✔ | ✔[3] | ✔ |
| | Copy link dialog and options | | | ✔ | ✔[3] | ✔[3] |
| | Print to PDF using current browser resolution (WYSIWYP) | | | | ✔ | ✔ |

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| Category | Capability | SAS Visual Analytics 7.4 on 9.4M5 | SAS Visual Analytics 7.5 on 9.4M6 | SAS Visual Analytics 8.3 on Viya | SAS Visual Analytics 8.4 on Viya | SAS Visual Analytics 8.5 on Viya |
|---|---|---|---|---|---|---|
| Approachable Analytics | Decision Tree | ✔ | ✔ | ✔[3] | ✔ | ✔[3] |
| | Automated Explanation | | | ✔[2] | ✔[3] | ✔ |
| | Automated Prediction | | | | | ✔ |
| | Related measures | | ✔ | | ✔ | ✔ |
| | Text summarizing analytical object results | | | | | ✔ |
| Customize | Consume SAS Stored Processes | ✔ | ✔ | | | |
| | Consume SAS Job Execution results | | | ✔[2] | ✔ | ✔ |
| | Create custom graph objects (templates) | ✔ | ✔ | ✔ | ✔[3] | ✔[3] |
| | Include Web content | | ✔ | ✔ | ✔ | ✔ |
| | Data driven content (3rd party objects) | | | ✔ | ✔ | ✔ |
| | SAS Visual Analytics SDK | | | | ✔ | ✔[3] |
| Enterprise Support | Accessibility - Graphics Accelerator | | ✔ | ✔[2] | ✔ | ✔ |
| | Accessibility - alternate text for screen readers and tagged PDF option | | | | | ✔ |
| | Distribute Reports (scheduled) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Notify stakeholders to alert conditions in reports | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Localize report content | ✔ | ✔[3] | ✔ | ✔[3] | ✔ |
| | Audit Reporting | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Refresh reports automatically | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Refresh report pages and objects automatically | | | ✔[2] | ✔[3] | ✔ |
| | Autosave | | | ✔ | ✔ | ✔ |
| | Lineage | | | ✔ | ✔ | ✔ |
| | SAS Drive | | | ✔ | ✔[3] | ✔[3] |
| | Product Tour in SAS Drive and SAS Visual Analytics | | | | ✔ | ✔ |
| Native Apps | Mobile Device Management support (3rd party providers) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Offline report viewing | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Windows 10 | ✔ | ✔ | ✔ | ✔ | ✔ |
| | iOS | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Android | ✔ | ✔ | ✔ | ✔ | ✔ |
| | SDK for mobile apps | ✔ | ✔ | ✔ | ✔ | ✔ |
| Operating Environment | Linux server | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Windows server | ✔ | ✔ | ✔[2] | ✔ | ✔ |
| | Internet Explorer browser | ✔ | | | | |
| | Edge browser | | ✔ | ✔ | ✔ | ✔ |
| | Safari browser (Mac) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Chrome browser (Windows) | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Firefox browser (Windows) | ✔ | ✔ | ✔ | ✔ | ✔ |

[1] SAS Viya data access is limited compared to SAS 9. See the list of supported data sources in the Data Management section.
[2] The functionality is available as of September, 2018.
[3] The functionality has been enhanced.

# 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 that are not present in SAS 9.4 data mining offerings. As with other products in SAS Viya, SAS Visual Data Mining and Machine Learning 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 Visual Data Mining and Machine Learning 8.4 on Viya | SAS Visual Data Mining and Machine Learning 8.5 on Viya |
| --- | --- | --- | --- | --- | --- | --- |
| | SAS Enterprise Miner | SAS Factory Miner | | | | |
| Integrated data prep | | | ✔ | ✔ | ✔ | ✔ |
| Interactive model editing (VA models in Model Studio) | | | | | ✔ | ✔ |
| Multiple data sources (after data prep) | ✔ | | | | | |
| Integrated reporting (interactive dashboards) | | | ✔ | ✔ | ✔ | ✔ |
| Model assessment NLG | | | | | ✔ | ✔ |
| Model insight reporting | | | | | ✔ | ✔ |
| **General Features** | | | | | | |
| 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 | ✔ | | | | | Incl. w/ Risk |
| Interactive modeling | minimal | | ✔ | ✔ | ✔ | ✔ |
| K Fold cross validation | ✔ | | | ✔ | ✔ | ✔ |
| Model lineage view | | | | ✔ | ✔ | ✔ |
| Multiple-pipeline comparison | | | ✔ | ✔ | ✔ | ✔ |
| Pipeline annotations | | | | | ✔ | ✔ |
| REST API Scoring | | | ✔ | ✔ | ✔ | ✔ |
| REST API Retraining | | | | | ✔ | ✔ |
| REST API Automated Modeling | | | | | | ✔ |
| Reusable model templates (central storage) | | ✔ | ✔ | ✔ | ✔ | ✔ |
| Segment profile | | | | | ✔ | ✔ |
| Som/Kohennen | ✔ | | | | | |
| Start/End Groups (group processing) | ✔ | ✔ | | | | |
| Survival data mining | ✔ | | | | | |
| Time series data mining | ✔ | | | | | |
| Two stage models | ✔ | | | | | |

| 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 Visual Data Mining and Machine Learning 8.4 on Viya | SAS Visual Data Mining and Machine Learning 8.5 on Viya |
|---|---|---|---|---|---|---|
| | SAS Enterprise Miner | SAS Factory Miner | | | | |
| **Machine Learning Methods** | | | | | | |
| Automated feature engineering package | | | | | ✔ | Node |
| Automated interpretability action package | | | | | ✔ | ✔ |
| Automated model composer (automated modeling) | | | | | ✔ | Node |
| Bayesian networks | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Boolean rules | | | ✔ | ✔ | ✔ | ✔ |
| Convolutional neural networks | | | ✔ | ✔ | ✔ | ✔ |
| Dirichlet Gaussian Mixture Models (GMM) | | | | ✔ | ✔ | ✔ |
| Ensemble | | | | | ✔ | ✔ |
| Factorization machines | | | ✔ | ✔ | ✔ | ✔ |
| Frequent item set mining | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Gaussian regression | | | | | ✔ | ✔ |
| Gradient boosting | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Isolation forest | | | | ✔ | ✔ | ✔ |
| K nearest neighbor | | | ✔ | ✔ | ✔ | ✔ |
| Kernel PCA | | | | | | ✔ |
| Image (incl. biomedical) processing | | | ✔ | ✔ | ✔ | ✔ |
| Image Object Detection | | | | | ✔ | ✔ |
| Image keypoints detection | | | | | ✔ | ✔ |
| Image segmentation | | | | | ✔ | ✔ |
| Market basket analysis | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Model interpretability (LIME, PDP, ICE) | | | | ✔ | ✔ | Kernel Shap |
| Moving windows PCA | | | ✔ | ✔ | ✔ | ✔ |
| Multi-task learning | | | | ✔ | ✔ | ✔ |
| Network analytics/community detection | ✔ | | ✔ | ✔ | ✔ | ✔ |
| Neural networks | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Random forest | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Recurrent neural network | | | ✔ | ✔ | ✔ | ✔ |
| Reinforcement Learning (Batch) | | | | | | ✔ |
| Robust PCA | | | ✔ | ✔ | ✔ | ✔ |
| Semi-Supervised learning | | | | ✔ | ✔ | ✔ |
| Sparse Data Machine Learning | | | | | ✔ | ✔ |
| Support vector data description | | | ✔ | ✔ | ✔ | ✔ |
| Support vector machines | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Support vector regression | | | | | ✔ | ✔ |
| Text mining | ✔ | | ✔ | ✔ | ✔ | ✔ |
| T-SNE | | | | ✔ | ✔ | ✔ |
| Variable clustering | ✔ | | ✔ | ✔ | ✔ | ✔ |
| **Open Source** | | | | | | |
| Open source calling SAS | | | ✔ | ✔ | ✔ | ✔ |
| SAS calling open source | ✔ | | minimal | ✔ | ✔ | ✔ |
| **Model Deployment** | | | | | | |
| Publish to MAS | | | | | ✔ | ✔ |
| Model scoring (node) | | | | | ✔ | ✔ |
| Model retraining | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Batch execution | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Model Manager integration (pushbutton) | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Score code editor in code node | | | | | ✔ | ✔ |
| SAS DATA step score code | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Astore score code | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| PMML score code | ✔ | | | | | |
| C score code | ✔ | | | | | |
| Java score code | ✔ | | | | | |
| REST scoring API | | | ✔ | ✔ | ✔ | ✔ |
| **Architecture** | | | | | | |
| Browser based (no install) | Java Web Start | ✔ | ✔ | ✔ | ✔ | ✔ |
| Windows based | ✔ | ✔ | | | ✔ | ✔ |
| Linux based | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| SMP mode (calling local non-in-memory data automatically) | ✔ | ✔ | | | | |
| MPP mode | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| SAS 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 recently been developed 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 capabilities include distributed computation features in mixed integer linear programming, nonlinear programming, black-box (derivative-free) optimization, and constraint programming. In addition, the solveBlackbox action is added for derivative-free optimization, and you can use BY-group processing with the runOptmodel action to build and solve a large volume of optimization models from indexed input data.

Because SAS Optimization also includes a SAS/OR license, you can run SAS/OR procedures in order to use operations research methods in optimization and in other areas such as project and resource scheduling. These SAS/OR procedures execute 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 by REST APIs.

Forecasting functionality is distributed evenly between 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 15.1 on 9.4M6 | | SAS Visual Forecasting 8.2 on Viya 3.3 | SAS Visual Forecasting 8.3 on Viya 3.4 | SAS Visual Forecasting 8.4 on Viya 3.4 | SAS Visual Forecasting 8.5 on Viya 3.5 |
|---|---|---|---|---|---|---|
| | Forecast Studio | Time Series Studio | | | | |
| Forecasting procedures | ✔ | | ✔ | ✔ | ✔ | ✔ |
| Time series explorer / viewer | ✔ Forecasts only | ✔ Time Series only | ✔ Facet search based only | ✔ Facet search based only | ✔ Facet search based only | ✔ Facet search based only |
| Nested facets in Viewers and Overrides | | | | | | ✔ |
| Predefined set of time series descriptive statistics attributes (min, max, mean, missing, etc.) | ✔ | ✔ | | | ✔ | ✔ |
| Predefined set of forecasting derived attributes (model properties, statistics of fit) | ✔ | | | | ✔ | ✔ |
| Predefined set of demand classification derived attributes | | | | | ✔ | ✔ |
| Predefined set of volume/volatility derived attributes | | | | | ✔ | ✔ |
| Filters using descriptive statistics | ✔ | ✔ | | | ✔ | ✔ |
| Filters using model properties and statistics of fit | ✔ | | | | ✔ | ✔ |
| Predefined attributes available for use in faceted filters for viewers - Time series based attributes available in all viewers - Forecasting based attributes available in forecast viewer and overrides | | | | | ✔ | ✔ |
| Envelope plots | | ✔ | | | ✔ | ✔ |
| Display single or multiple time series / forecasts | ✔ Single Forecast only | ✔ Time Series only | | | ✔ | ✔ |
| View model list in forecast viewer | ✔ | | | | ✔ | ✔ |
| Filter manager - project wide | ✔ | ✔ From Tree Only | | | ✔ | ✔ |
| External Segmentation | | ✔ | | ✔ Imported using _seg_ variable in the attributes table | ✔ Imported using _seg_ variable in the attributes table | ✔ Imported using _seg_ variable in the attributes table |
| External Segmentation template using imported _seg_ attribute | | | | ✔ Numeric Only | ✔ | ✔ |
| Prebuilt segmentation template based on demand classification segmentation | | | | | ✔ | ✔ |
| Nested pipeline for each individual segment | | | | | ✔ | ✔ |
| Nested demand classification segmentation within an individual segment | | | | | ✔ | ✔ |
| Automatic model selection | ✔ | | ✔ | ✔ | ✔ | ✔ |
| Hierarchical forecasting | ✔ | | ✔ | ✔ | ✔ | ✔ |
| Hierarchical reconciliation | ✔ | | ✔ TD only in TSReconcile; aggregation for BU using TSMODEL or | ✔ TD only in TSReconcile; aggregation for BU using TSMODEL or | ✔ TD only in TSReconcile; aggregation for BU using TSMODEL or | ✔ TD only in TSReconcile; aggregation for BU using TSMODEL or |
| Temporal reconciliation | ✔ | | | | | |
| Automatic outlier detection (ARIMA only) | ✔ | | | ✔ Code 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 | ✔ Applicable project settings only; project data must be manually loaded into CAS | ✔ Applicable project settings only; project data must be manually loaded into CAS |

| Capability | Forecast Server 15.1 on 9.4M6 | | SAS Visual Forecasting 8.2 on Viya 3.3 | SAS Visual Forecasting 8.3 on Viya 3.4 | SAS Visual Forecasting 8.4 on Viya 3.4 | SAS Visual Forecasting 8.5 on Viya 3.5 |
| --- | --- | --- | --- | --- | --- | --- |
| | Forecast Studio | Time Series Studio | | | | |
| Events | ✔ | | ✔ Built-in calendar and holiday events only; Code only | ✔ Default calendar events and Importing events | ✔ Default calendar events and Importing events | ✔ Default calendar events and Importing events |
| Events management | ✔ | | | ✔ Create event repository using FS procedures or in FS | ✔ Create event repository using FS procedures or in FS | ✔ Create event repository using FS procedures or in FS |
| Import event repository | ✔ | | | ✔ | ✔ | ✔ |
| Export event repository | ✔ | | | | | |
| Automatic event selection in modeling | ✔ | | | ✔ | ✔ | ✔ |
| Project level default event usage | ✔ | | | ✔ | ✔ | ✔ |
| Modify event usage in each modeling node | | | | ✔ | ✔ | ✔ |
| Events management - CRUD | ✔ | | | | | |
| Assign events to individual or subsets of time series (EventBY capability) | | | | ✔ Code only | ✔ Code only | ✔ Code only |
| Overrides using modeling hierarchy | ✔ | | | | | |
| Overrides using attribute based filters | | | ✔ | ✔ | ✔ | ✔ |
| Overrides impact analysis | | | ✔ | ✔ | ✔ | ✔ |
| Interactive modeling | ✔ | | | | | |
| Mandatory override justifications | | | | | | |
| Tracking for overrides | | | | | | |
| Forecast tracking | | | | | | |
| Forecast Value Added (FVA) analysis | | | | | | |
| Monitoring Forecast Model Fitness | | | | | | |
| Custom models | ✔ | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| Task management (diagnose, fit, forecast, etc.) | ✔ | | ✔ Available in some modeling nodes but not all of them | ✔ Available in some modeling nodes but not all of them | ✔ Available in some modeling nodes but not all of them | ✔ Available in some modeling nodes but not all of them |
| Import custom model selection list | ✔ | | | ✔ Code or Hierachical Forecasting Modeling Strategy only | ✔ Code or Hierachical Forecasting Modeling Strategy only | ✔ Code or Hierachical Forecasting Modeling Strategy only |
| Combination models | ✔ | | | ✔ Code or Hierachical Forecasting Modeling Strategies only | ✔ Code or Hierachical Forecasting Modeling Strategies only | ✔ Code or Hierachical Forecasting Modeling Strategies only |
| Machine learning modeling strategies | | | | ✔ 3 types - Panel Series, Stacked, and Multistage | ✔ 3 types - Panel Series, Stacked, and Multistage | ✔ 3 types - Panel Series, Stacked, and Multistage |
| View model diagnostics | ✔ | | | | | |
| Compare Models | ✔ | | | | | |
| Rolling simulations | ✔ | | | | | |
| Goal seeking | | | | | | |
| "What if ..." or scenario analysis | ✔ | | | | | |
| Batch execution | ✔ | | ✔ | ✔ | ✔ | ✔ |
| Code in modeling nodes can be modified and customized | | | | ✔ Except for Hierarchical Forecasting, Panel Series Neural Network, and Stacked Modeling | ✔ Except for Hierarchical Forecasting, Panel Series Neural Network, and Stacked Modeling | ✔ Except for Hierarchical Forecasting, Panel Series Neural Network, and Stacked Modeling |
| Macros for project lifecycle management (create, run, copy, delete, etc.) | ✔ | | | | | |
| Prebuilt reports | ✔ | | | | | |
| Stability monitoring | | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| REST API | | | ✔ | ✔ | ✔ | ✔ |
| Data Preparation integration | | | ✔ | ✔ | ✔ | ✔ |
| Model Manager integration | | | | | | |

| Capability | Forecast Server 15.1 on 9.4M6 | | SAS Visual Forecasting 8.2 on Viya 3.3 | SAS Visual Forecasting 8.3 on Viya 3.4 | SAS Visual Forecasting 8.4 on Viya 3.4 | SAS Visual Forecasting 8.5 on Viya 3.5 |
| --- | --- | --- | --- | --- | --- | --- |
| | Forecast Studio | Time Series Studio | | | | |
| VA integration | | | | ✔ Limited to input and a subset of output tables by default | ✔ Limited to input and a subset of output tables by default | ✔ Limited to input and a subset of output tables by default |
| Lineage integration | | | | ✔ Basic Lineage | ✔ Basic Lineage | ✔ Basic Lineage |
| SAS Drive integration | | | | ✔ | ✔ | ✔ |
| Singular Spectrum Analysis (SSA) | | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| Multivariate Singular Spectrum Analysis (SSA) | | | | | ✔ Code only | ✔ Code only |
| Motif analysis | | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| Time series missing value imputations | | | | ✔ Code only | ✔ Code only | ✔ Code only |
| Time series similarity analysis | ✔ Using SAS/ETS | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| Vector time series similarity analysis | | | | | ✔ Code only | ✔ Code only |
| Time series distance measures | | | | | ✔ Code only | ✔ Code only |
| Time frequency analysis | | | ✔ Code only | ✔ Code only | ✔ Code only | ✔ Code only |
| Time series filtering | | | | ✔ Code only | ✔ Code only | ✔ Code only |
| Subspace tracking | | | | ✔ Code only | ✔ Code only | ✔ Code only |
| Importing FS projects into VF | | | | ✔ Settings only | ✔ Settings only | ✔ Settings only |
| Interpretability - NLG project summary | | | | | ✔ | ✔ |
| External Language Support (Python and R) | | | | | | ✔ Code only |
| Time Series Dimension Reduction | | | | | | ✔ Code only |

# Text Analytics

Text Analytics functionality appears in several offerings: SAS Text Miner and SAS Contextual Analysis on SAS 9.4 and SAS Visual Data Mining and Machine Learning and SAS 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 the 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 9.4M6 | | 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 | VTA 8.4 |
| Document conversion (from file server directory) | ✔ | ✔ | | | ✔ | ✔ | ✔ |
| Document conversion (In-Hadoop) | | | | | | ✔ Programming thru SAS Studio | ✔ Programming thru SAS Studio |
| Web crawl | ✔ | ✔ | | | | | |
| Social media connectors | | | ✔ Data Prep | ✔ Data Prep | ✔ Data Prep | ✔ Data Prep | ✔ Data Prep |
| Text summarization | | ✔ ECC add-on | | ✔ Action & SAS Studio Task | | ✔ Action & SAS Studio Task | ✔ Action & SAS Studio Task |
| Document de-duplication | | ✔ ECC add-on | | | | | |
| Smart data segment | | | | ✔ Action only | | ✔ Action & SAS Studio Task | ✔ 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 | ✔ 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 | | | | | | ✔ Action only | ✔ Action UI (experimental) |
| Predefined concepts/standard entities | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Enabling / disabling select predefined concepts | ✔ | ✔ | | ✔ All or none | | ✔ 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 9.4M6 — Text Miner | Text Analytics on 9.4M6 — SAS Contextual Analysis | Text Analytics on Viya 3.3 — VDMML 8.2 | Text Analytics on Viya 3.3 — VTA 8.2 | Text Analytics on Viya 3.4 — VDMML 8.3 | Text Analytics on Viya 3.4 — VTA 8.3 | Text Analytics on Viya 3.4 — VTA 8.4 |
|---|---|---|---|---|---|---|---|
| ASTORE support | | | ✔ Topics SVD only | ✔ Topics SVD only | ✔ Topics SVD only | ✔ Topics SVD only | ✔ Topics, Categories, Concepts, Sentiment, RNN |
| Languages | 27 | 31 | 30 | 30 | 32 | 32 | 33 |
| 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 | ✔ Action only |
| Topics LDA model scoring | | | | | | ✔ Action & SAS Studio Task | ✔ Action & SAS Studio Task |
| Boolean rules scoring | | | | | | ✔ Action & SAS Studio Task | ✔ 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 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 PHSELECT, PCA, and SPC. See SAS Visual Statistics 8.4 Procedures for a complete list. SAS Visual Statistics includes a SAS/STAT license. This license enables you to run SAS/STAT procedures, which enable you to address virtually any statistical challenge. This offering also includes SAS/GRAPH, which means that all components of SAS Analytics Pro are included with the SAS Visual Statistics offering. The SAS/STAT and SAS/GRAPH procedures run 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.

## Model Management

Both SAS 9.4 and SAS Viya have a product named SAS® Model Manager to store, validate, assess, compare, and publish analytical models. Many of the features available in SAS Model Manager on SAS 9.4 are present in the SAS Viya version. The SAS Viya version extends the product to include an HTML5-based interface and an open, modern,

microservices architecture. SAS Viya's centralized model repository not only supports the ability to import models from a SAS 9.4 environment, but also offers model registration from a broader set of modeling environments including SAS Model Studio (available with SAS Visual Data Mining and Machine Learning [VDMML] and SAS Visual Text Analytics), SAS Studio, SAS Visual Analytics, and SAS Visual Statistics. SAS Viya's version also supports Python and R models for more open modeling support, including publishing to run-time containers. Once registered in the common model repository, you can proactively monitor both SAS and open-source classification and prediction model performance in order to identify deviations in model output or model input data.

In both SAS 9.4 and SAS Viya, the analytics life cycle extends beyond registering and monitoring analytical models. The life cycle includes operationalizing models for scoring in batch, in database, in Hadoop, and within the SAS® Micro Analytical Service. SAS Model Manager on SAS Viya adds support for retraining VDMML models using the Model Studio interface, which ensures that the most effective model is driving business operations and decisions. And like the other microservice-based products in SAS Viya, SAS Model Manager supports open REST APIs for ease of access by clients such as SAS Intelligent Decisioning and SAS Event Stream Processing.

## Decision Management

The SAS 9.4 decision management offerings are SAS® Decision Manager (DcM) and SAS® Real-Time Decision Manager (RTDM). SAS Decision Manager is the predecessor to the current SAS Viya offering, which is SAS® Intelligent Decisioning. Capabilities that are currently unique to RTDM, part of the Customer Intelligence portfolio, include several features for constructing decisions, as with the cross-table node, and staging treatments for delivery at a future date. SAS Decision Manager on SAS 9.4 includes unique features such as BY-group processing when running batch decisions and rule generation.

SAS Intelligent Decisioning brings together many of the features found in DcM and RTDM such as treatment management and advance flow management. It delivers the advantages of SAS Viya products, including an integrated HTML5 interface, fault-tolerant scalable architecture, open REST APIs, and SAS Drive's centralized content management. It also supports deploying models in the SAS Viya portable ASTORE format, which can be prouced by other clients such as SAS Visual Data Mining and Machine Learning.

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