



Finance simulation and planning with Machine Learning in SAP Datasphere

Andreas Forster
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Agenda

01

Extending SAC Planning

Use case and architecture

02

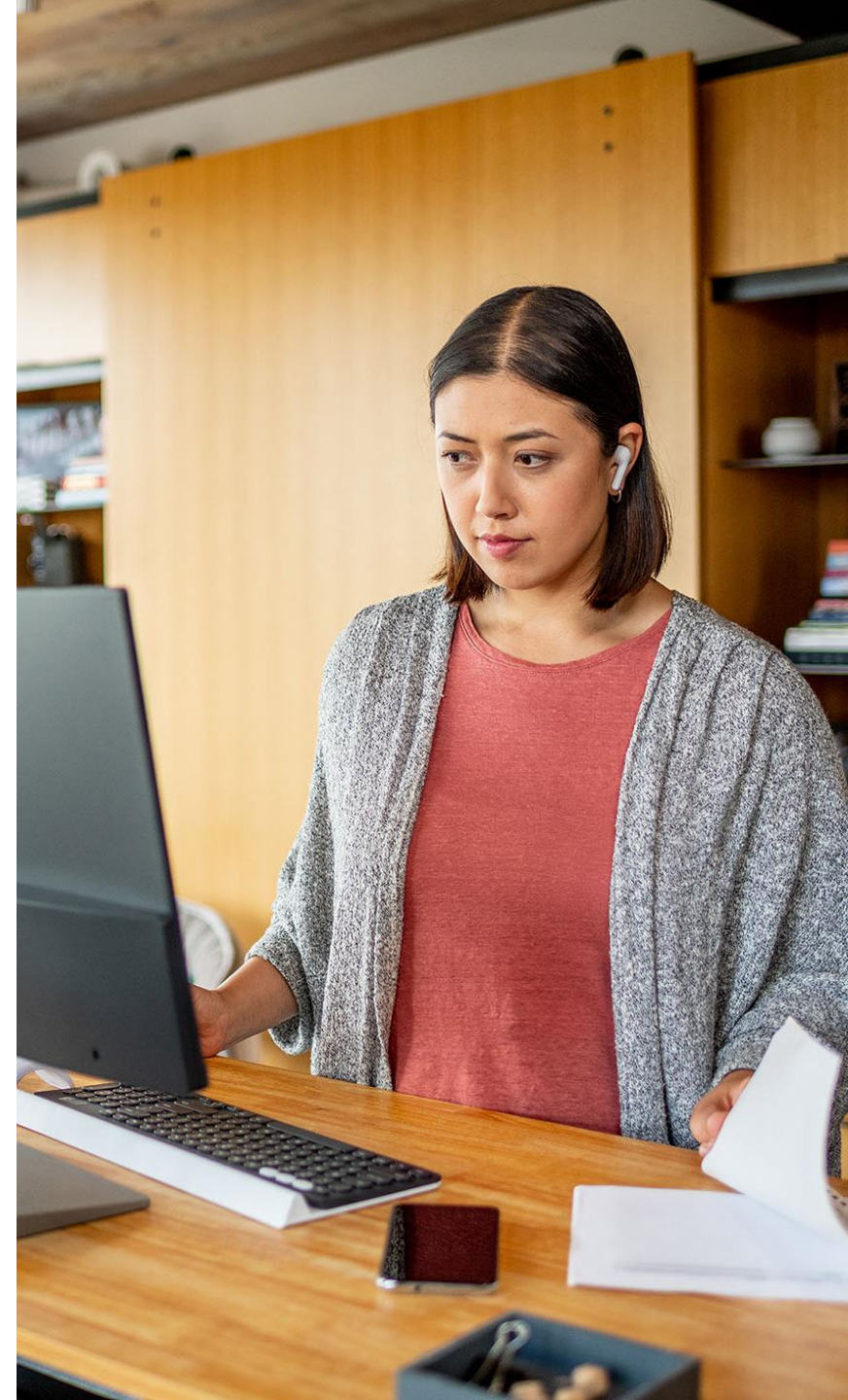
Demo

Risk assessment and mitigation

03

Machine Learning in SAP Datasphere

Details and how to start



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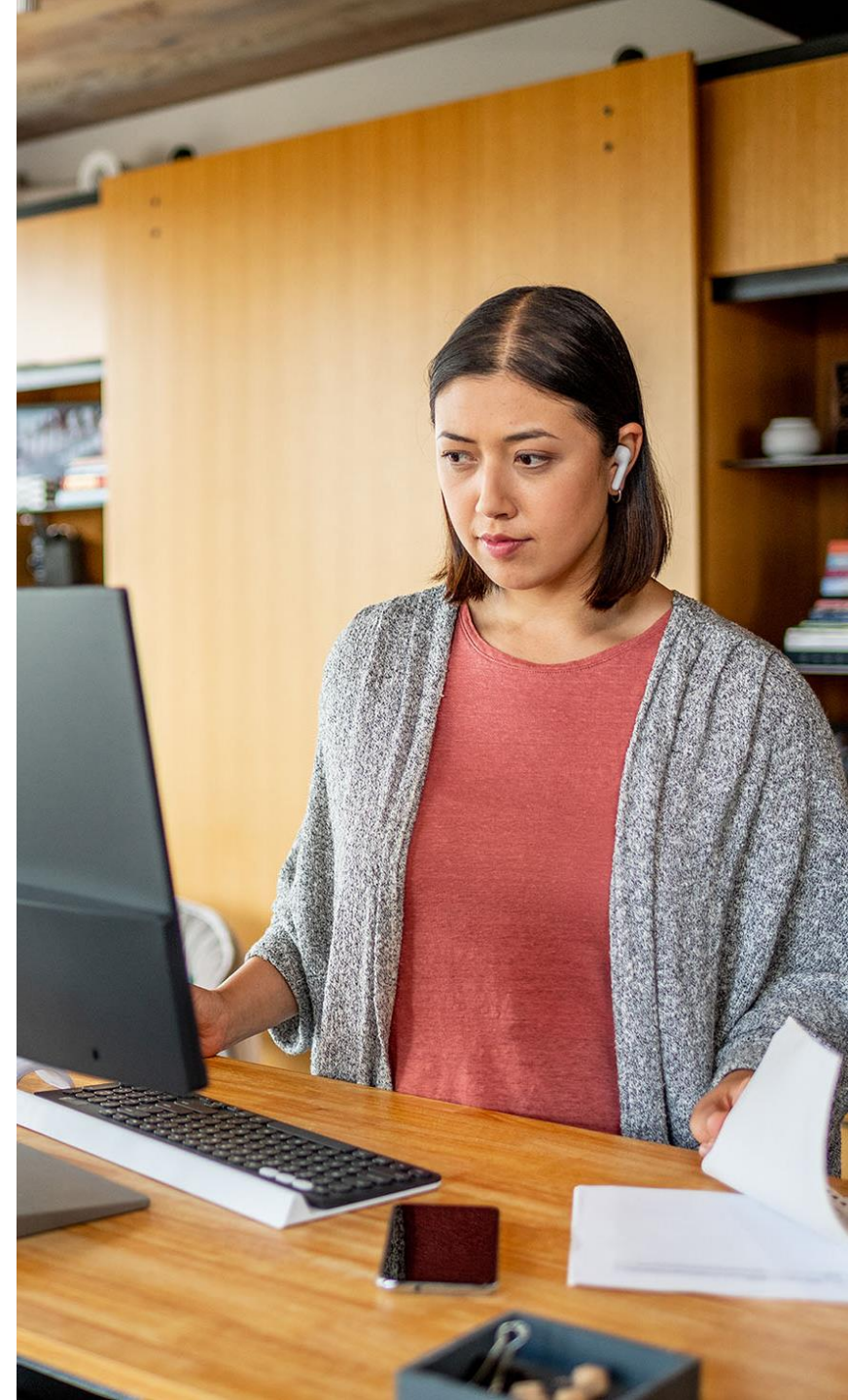
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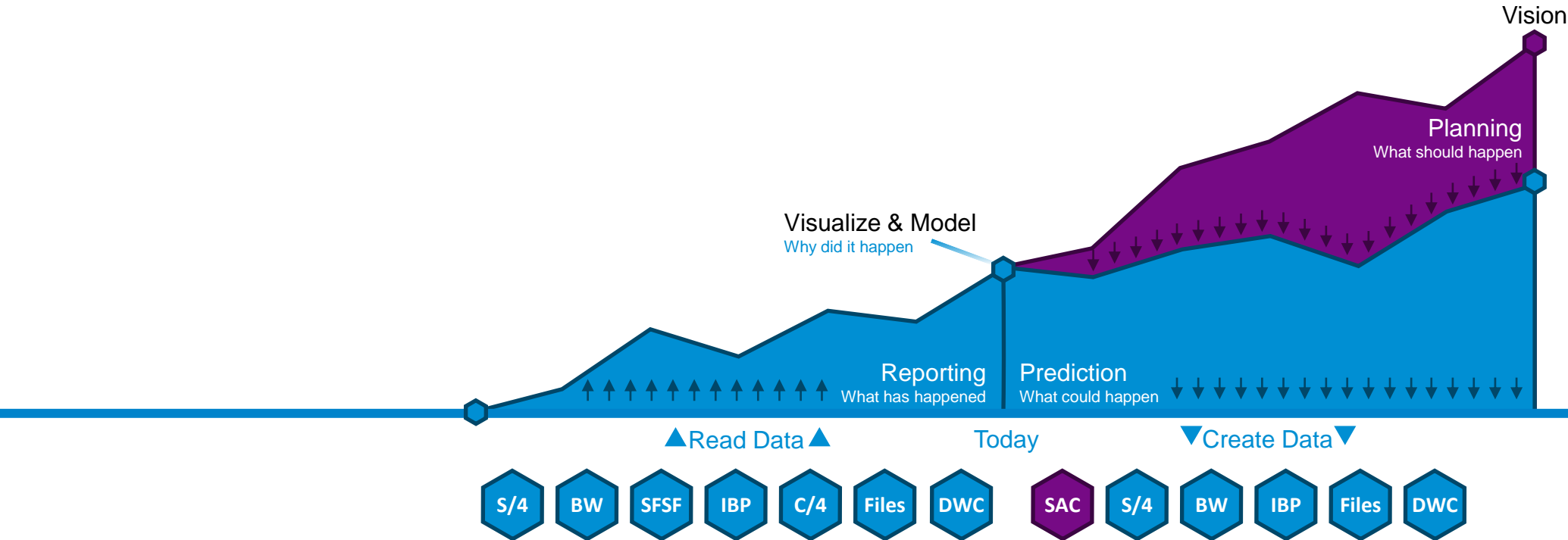


SAP Extended Planning and Analysis



PLAN TO WIN

Automate for Efficiency and Accuracy with Predictive Planning



- Long term driver based Financial forecasts generated in SAC by non statisticians – **Forecasting owned by FP&A to automate and improve accuracy with added influencer drivers**
- Native platform capabilities – **Embedded intelligence at a lower TCO**

Pro-active Business Steering with Flexible Simulations

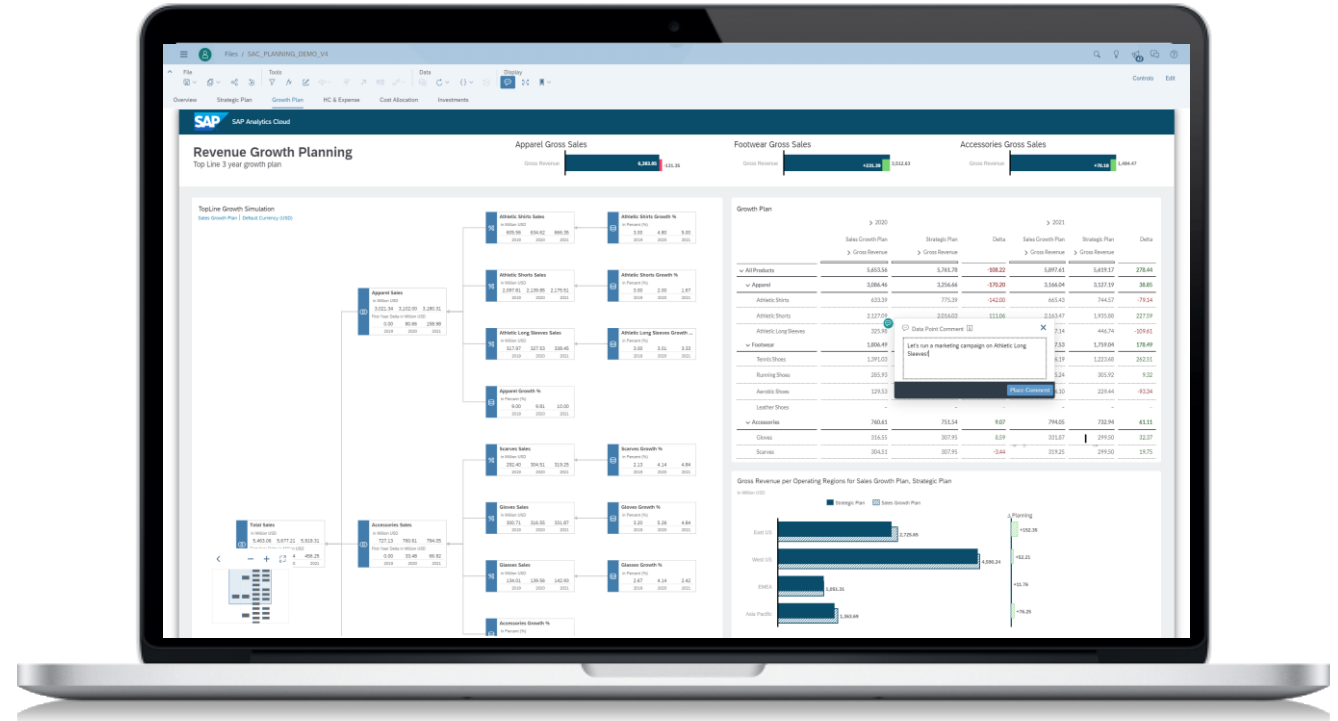
Driver based planning –
Efficient and accurate steering

Visual impact analysis –
Quick problem resolution

Sophisticated business logic
in SAP finance portfolio

- Top down/bottom-up alignment
- Fx effects
- Allocations

Multiple scenarios easily
prepared and shared



Pro-active Business Steering with Flexible Simulations

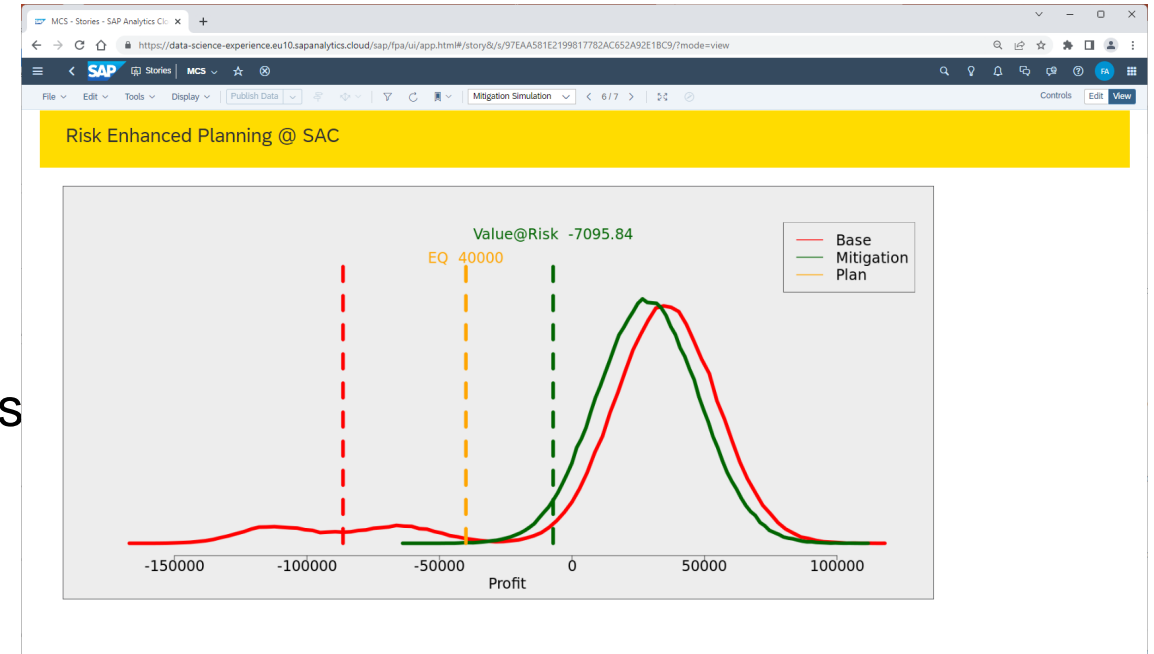
and the ability to leverage additional calculations (ML, Monte Carlo, ...) and data

Extend SAC Planning calculations capabilities with **native SAP HANA Cloud capabilities**

Address additional requirements like

- **Risk Simulations** (Monte Carlo) with Mitigations
- Specific Machine Learning algorithms
- Integrate price elasticity
- ...

The planning user remains in the existing **SAC Planning** interface



MCS
2 Filters

	Insolvency of big customers	Production stop	Decline Asia Market
Quantity	-1,000.00	-2,000.00	-500.00
Price	-	-	-
Var. Costs p.P.	-	-	-
Revenue	-	-	-
Var. Costs	-	-	-
Fix Costs	-	-	-
Misc. Costs	-	-30,000.00	-
Operating Profit	-	-30,000.00	-
Probability	0.05	0.10	0.03
Assessment	It is quite likely that.....		

Profit estimates under multiple uncertainties

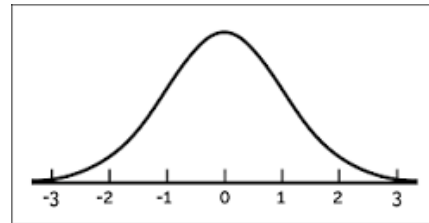
Monte Carlo simulation to understand risks, ie of profit, loss and negative equity

Basic example for revenue

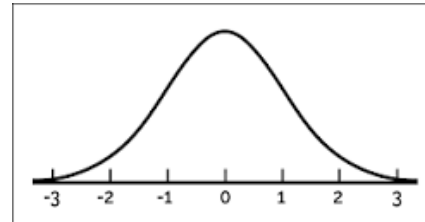
$$\text{Revenue} = 5'000 * 35 \text{ CHF} = 175'000 \text{ CHF}$$

A little more realistically

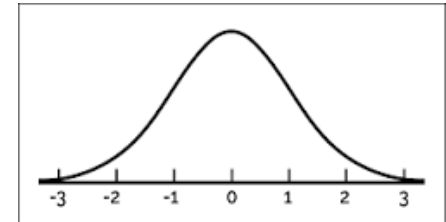
Revenue =



*



=



Similarly, uncertainties on costs and risks, but also ability to mitigate
How to assess, whether the risk to fall into negative equity is acceptable?

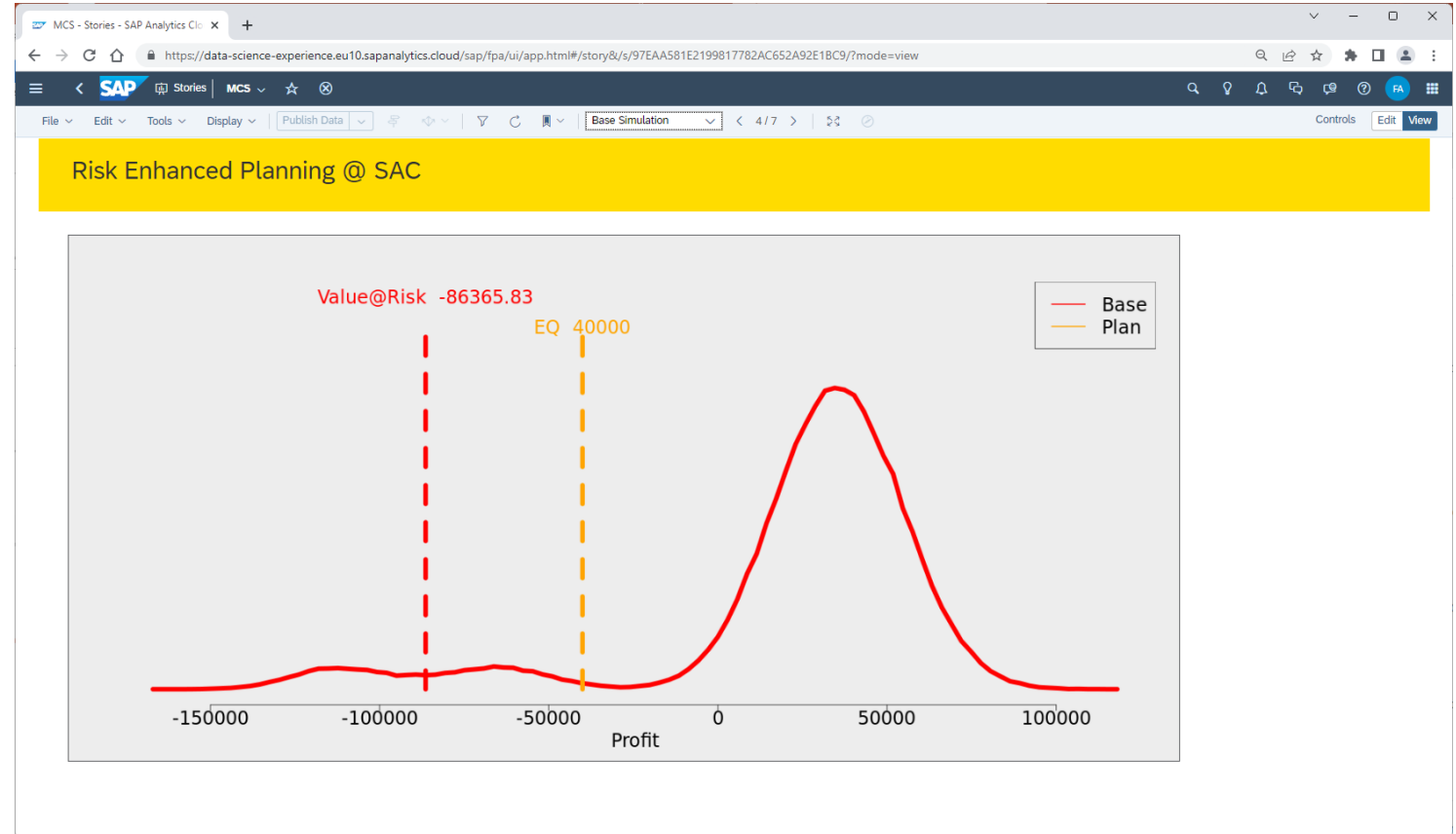
Profit estimates under multiple uncertainties

Monte Carlo simulation to understand risks, ie of profit, loss and negative equity

How to assess, whether the risk to fall into negative equity is acceptable?

Example:

- Calculate a very high number of **scenarios** (maybe 100.000 or more)
- Determine the **threshold** of the worst 5% outcomes



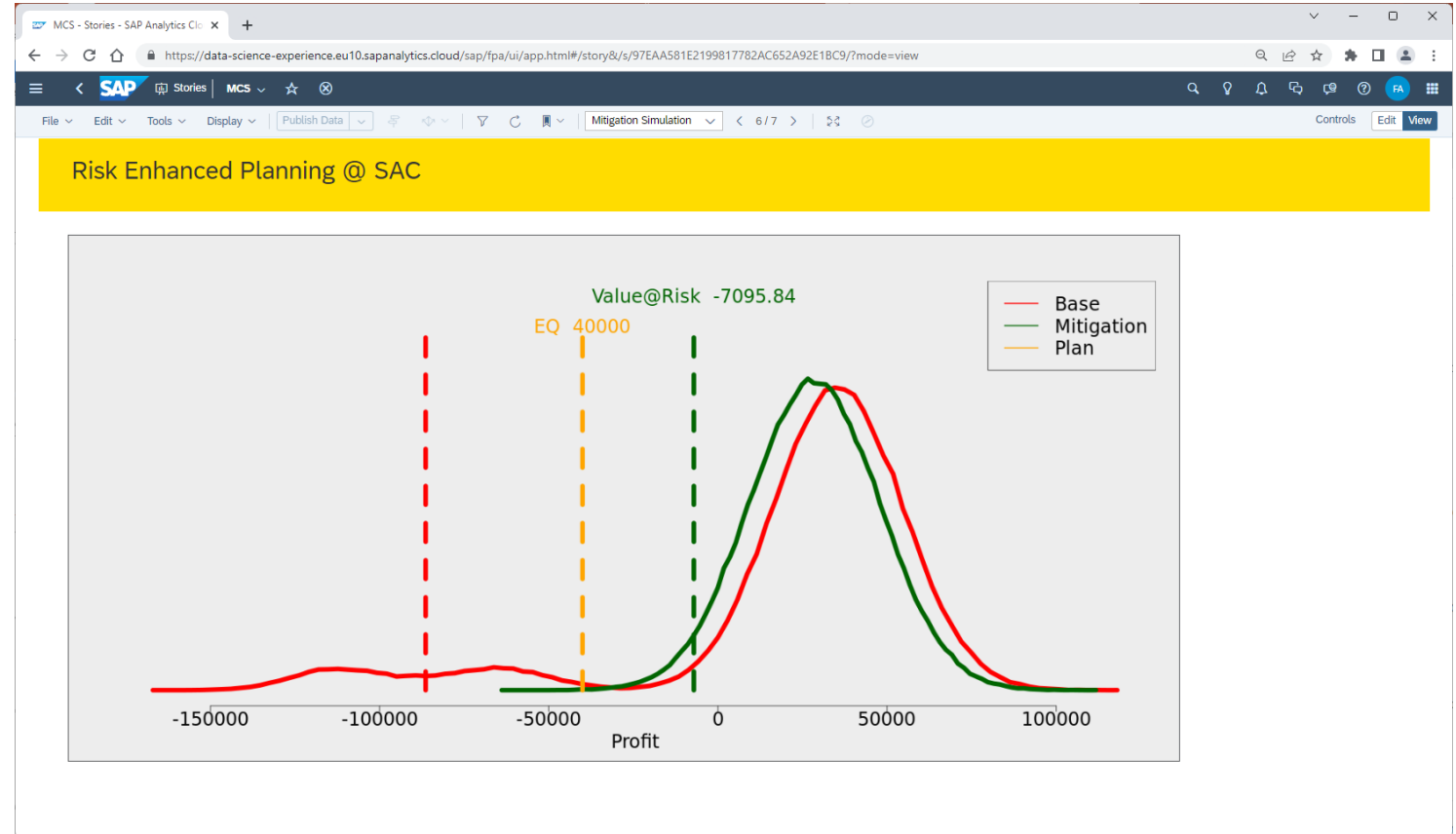
Profit estimates under multiple uncertainties

Monte Carlo simulation to understand risks, ie of profit, loss and negative equity

How to mitigate the risks?

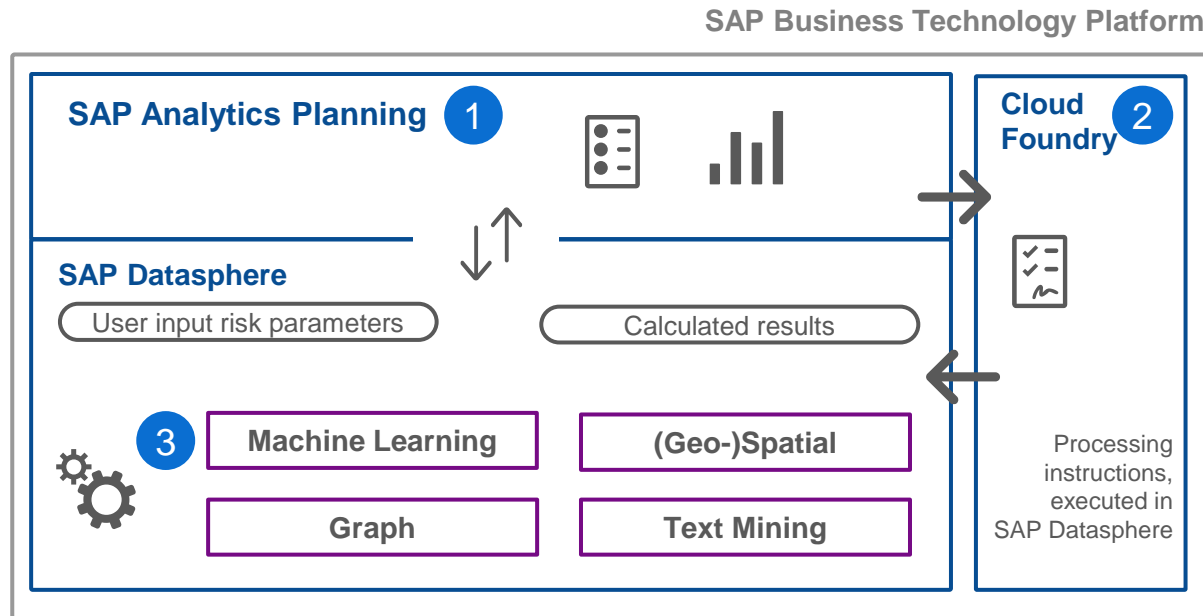
Example:

- **Add insurance options** to the logic, to replace risk with a cost
- Calculate a very high number of scenarios (maybe 100.000 or more)
- Determine the threshold of the worst 5% outcomes



Extending SAP Analytics Planning with custom logic

SAP BTP Architecture



- 1
 - Planning user enters details into SAC Planning grid
 - The data entered by the user is accessible in SAP Datasphere as remote table
 - Clicking a button on the SAC Planning interface triggers the processing
- 2
 - A SAC multi action is triggered by the button
 - A REST-API on Cloud Foundry gets called, which triggers the calculations in SAP Datasphere
- 3
 - SAP Datasphere simulates 100.000+ scenarios and determines the percentiles, which are written to a staging table
 - The Planning user sees the results in SAC Planning

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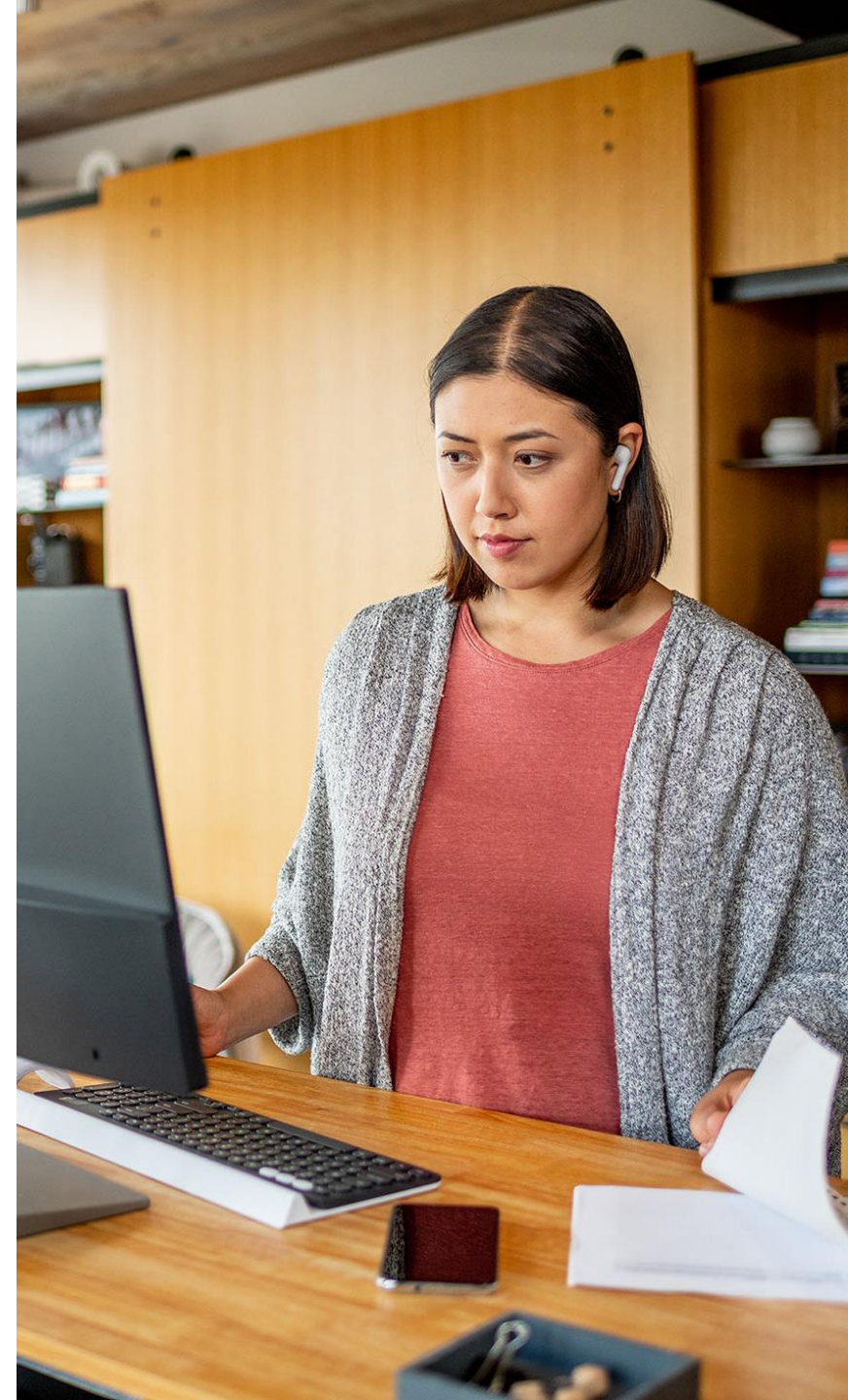
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Details and how to start





SAP Analytics Cloud

https://data-science-experience.eu10.sapanalytics.cloud/sap/fpa/ui/app.html#/story&/s/97EAA581E2199817782AC652A92E18C9/7mode=view

SAP Stories MCS

File Edit Tools Display Publish Data Mitigation 5 / 7

Mitigation

Run Simulation

Base Risks	Insolvency of big customers	Production stop	Decline Asia Market
Quantity	-1,000.00	-2,000.00	-500.00
Price	-	-	-
Var. Costs p.P.	-	-	-
Revenue	-	-	-
Var. Costs	-	-	-
Fix Costs	-	-	-
Misc. Costs	-	-30,000.00	-
Operating Profit	-	-30,000.00	-
Probability	0.05	0.10	0.03
Assessment	It is quite likely that....		

Mitigation	Insolvency of big customers	Production stop	Decline Asia Market
Quantity	-	-	-500.00
Price	-	-	-
Var. Costs p.P.	-	-	-
Revenue	-	-	-
Var. Costs	-	-	-
Fix Costs	-	-	-
Misc. Costs	-2,000.00	-5,000.00	-
Operating Profit	-2,000.00	-5,000.00	-
Probability	1.00	1.00	0.03
Assessment	Insurance is the best approach to overcome this critical issue.	No mitigation is necessary.	

Risk Enhanced Planning @ SAC

Operating Profit for Plan
3 Filters

37,000.00

Operating Profit

Revenue for Plan
3 Filters

175,000.00

Revenue

[Planning](#)

[Risks](#)

[Mitigation](#)



Plan Values

Run Simulation

MCS
2 Filters 3 Hidden

	Plan		
	2024		
	Value	StandardDeviation	Comment
Quantity	5,000.00	5.0000000	
Price	35.00	2.0000000	
Var. Costs p.P.	-18.00	-	
Revenue	175,000.00		
Var. Costs	-90,000.00	-	
Fix Costs	-40,000.00	5,000.0000000	
Misc. Costs	-8,000.00	4,000.0000000	
Operating Profit	37,000.00		

3) But inherent uncertainty



2) Expected profit

1) Existing equity

2 Filters 3 Hidden

	Actual	Plan
	2023	2024
	Value	Value
Equity	40,000.00	77,000.00
Liabilities	80,000.00	80,000.00
Equity and Liabilities	120,000.00	157,000.00
Fixed Assets	80,000.00	80,000.00
Current Assets	40,000.00	77,000.00
Assets	120,000.00	157,000.00



Risk Assessment

Run Simulation

1) Discrete risks with damage and probability

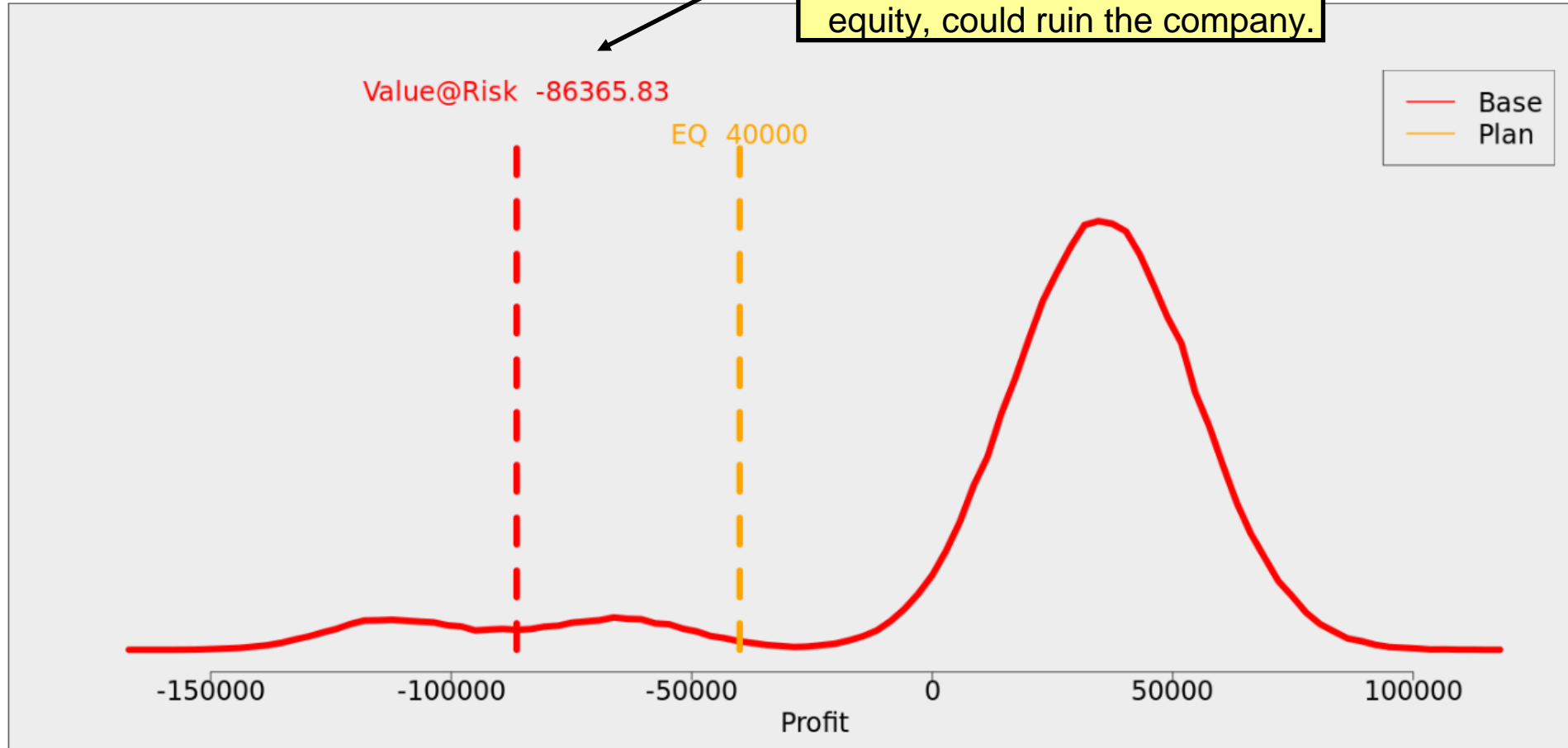
2) Trigger calculations

MCS
2 Filters

	Insolvency of big customers	Production stop	Decline Asia Market
Quantity	-1,000.00	-2,000.00	-500.00
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Probability	0.05	0.10	0.03
Assessment	It is quite likely that.....		

Risk Enhanced Planning @ SAC

1) Value at risk larger than equity, could ruin the company.



Mitigation

Run Simulation

2) Trigger calculations

Base Risks

2 Filters

	Insolvency of big customers	Production stop	Decline Asia Market
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Mitigation

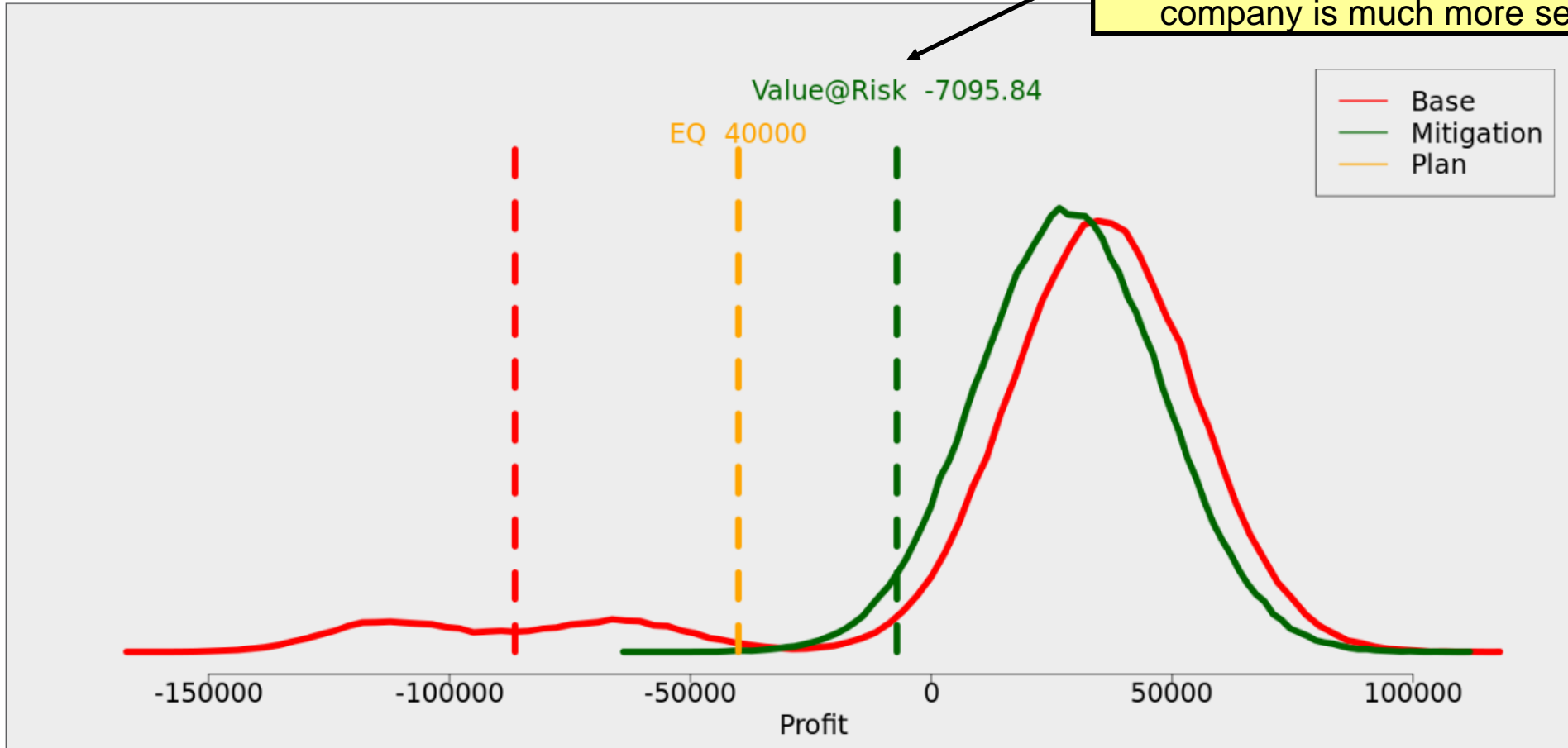
2 Filters

	Insolvency of big customers	Production stop	Decline Asia Market
Quantity	-	-	-500.00
Price	-	-	-
Var. Costs p.P.	-	-	-
Revenue	-	-	-
Var. Costs	-	-	-
Fix Costs	-	-	-
Misc. Costs	-2,000.00	-5,000.00	-
Operating Profit	-2,000.00	-5,000.00	-
Probability	1.00	1.00	0.03
Assessment	Insurance is the best approach to overcome this critical issue. No mitigation is nessesary.		

1) Mitigate risks

Risk Enhanced Planning @ SAC

1) Value at risk is less than equity, company is much more secure



Pro-active Business Steering with Flexible Simulations + Extensions

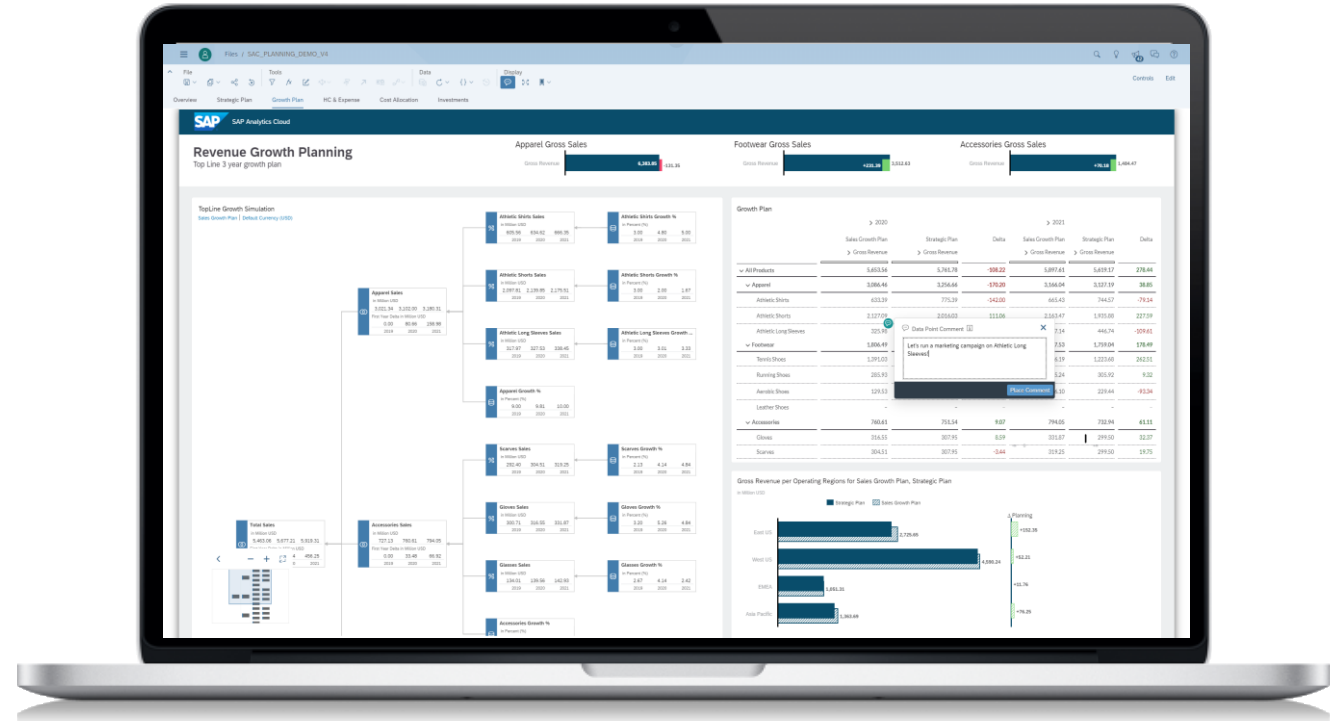
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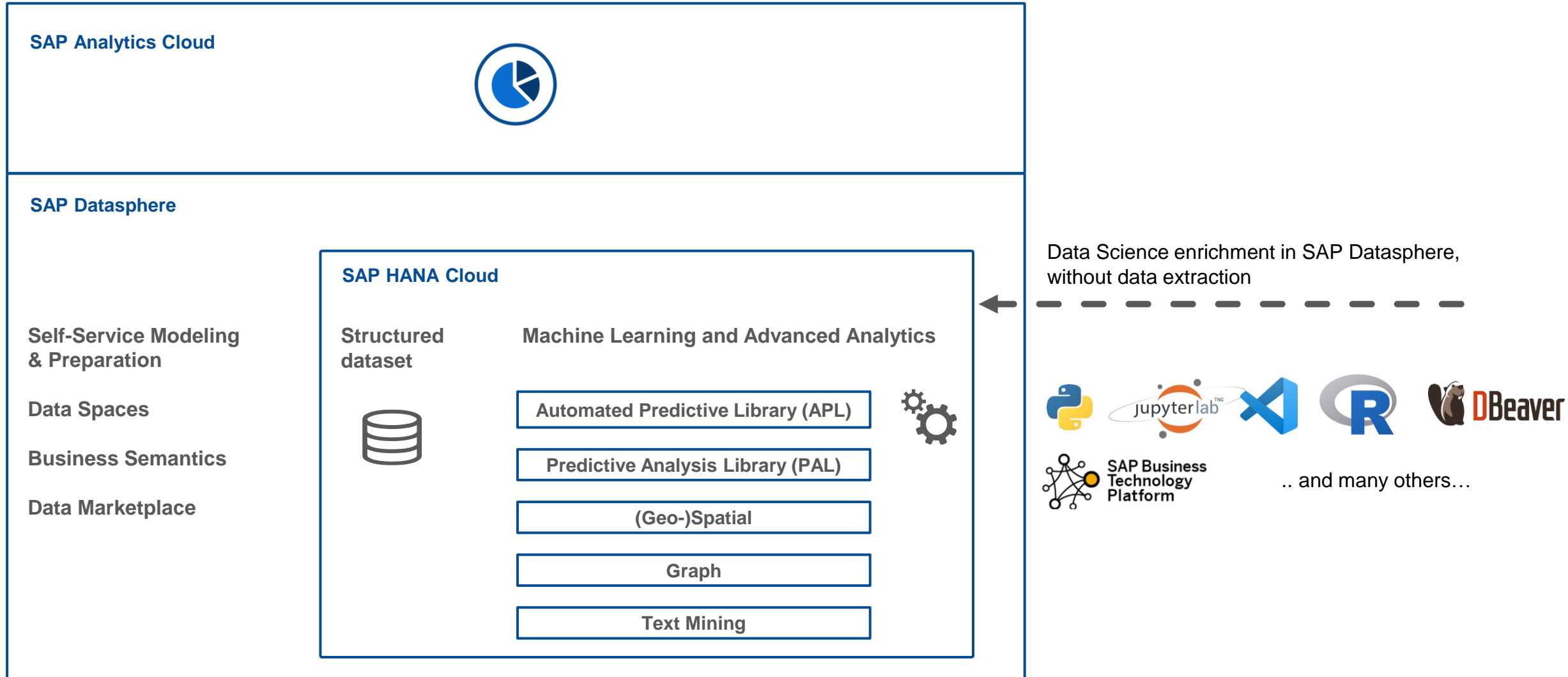
Machine Learning in SAP Datasphere

Details and how to start



SAP Datasphere / SAP HANA Cloud

Embedded Machine Learning and Advanced Analytics



SAP Datasphere / SAP HANA Cloud

Typical Scenarios Addressed with embedded Machine Learning

Machine Learning Categories



Predicting customer behavior like churn, fraud or buying behavior (**classification**)



Forecasting future sales, demand, cost, etc. based on historic time related data (**time series forecasting**)



Predicting car prices, based on model characteristics and market trends (**regression**)



Analyzing shopping baskets to suggest product placements or additional purchases to a customer (**association analysis**)



Enabling marketers to develop targeted marketing programs by grouping customers (**clustering**)



Detecting anomalies in financial transactions for fraud analysis, or in machine sensor data for predictive maintenance (**outlier detection**)



Provide personalized product recommendations by analyzing product associations, individual purchase history and external factors (**recommender system**)



In a given social network, you seek to infer which new interactions among its members are likely to occur in the near future (**link analysis / prediction**)

SAP Datasphere / SAP HANA Cloud

Automated or hand-crafted Machine Learning

Automated Predictive Library (APL)

- Framework that scales the use of Machine Learning
- Covers steps from variable selection, data preparation, variable encoding, missing value handling, outlier handling, binning and banding, model testing and best model selection
- **Proprietary framework**, with global and local explainability



Classification



Regression



Time series forecasting



Cluster analysis



Association analysis



Outlier detection



Recommender System



Link prediction

Predictive Analysis Library (PAL)

- Expert algorithm library, with over **100 classic and trending machine learning algorithms**
- Individual algorithms with full control for Data Scientists
- Requires manual insight, ie for parameterization
- Highly reproducible
- AutoML based on PAL in development (currently in beta)



SAP Datasphere / SAP HANA Cloud

Predictive Analysis Library (PAL)

Classification Analysis

- Decision Tree Analysis (CART, C4.5, CHAID), Logistic Regression, Support Vector Machine, K-Nearest Neighbor, Naïve Bayes, Confusion Matrix, AUC, [Online multi-class Logistic Regression*](#)
- Multilayer Perception (back propagation Neural Network)
- Random Decision Trees, [Hybrid Gradient Boosting Tree \(HGBT\)*](#), [Continuous HGBT*](#)
- [Unified Classification# incl. explainability, segmented \(massive\) classification](#)

Regression

- Multiple Linear Regression, [Online Linear Regression*](#)
- Polynomial-, Exponential-, Bi-Variate Geometric-, Bi-Variate Natural Logarithmic-Regression
- Generalized Linear Model (GLM)
- Cox Proportional Hazards Model
- Random Decision Trees, [Hybrid Gradient Boosting Tree \(HGBT\)*](#), [Continuous HGBT*](#)
- [Unified Regression* incl. explainability, segmented \(massive\) regression](#)

Pipeline and AutoML

- [Pipeline-models, -fit and -predict](#)
- [AutoML incl. data preprocessing, classification, regression, time series forecasting](#)

Cluster Analysis

- K-Means, Accelerated K-Means, K-Medoids, K-Medians, Geo- / DBSCAN, Agglomerate Hierarchical Clustering*, Slight Silhouette, Cluster Assignment
- Kohonen Self-Organizing Maps, Affinity Propagation, Gaussian Mixture Model
- [segmented \(massive\) Unified Clustering#](#), [Spectral clustering*](#)

Time Series Analysis

- Single-, Double-, Triple-, Brown-, Auto Exponential Smoothing, [Unified Exponential Smoothing \(incl. massive segmentation\)*](#)
- Auto-ARIMA, [Online ARIMA*](#), [Vector-ARIMA*](#), [ARIMA_EXPLAIN*](#)
- [Additive Model Analysis#](#), [GARCH*](#), [BSTS*](#)
- Croston, [Croston TSB*](#), Linear Regression with damped trend and seasonal adjust, [Intermittent Time Series Forecast*](#)
- [Fast Dynamic Time Warping#](#), [DTW*](#), Hierarchical Forecasting
- FFT, [Discrete Wavelet/ Wavelet Packet Transform*](#), [Periodogram*](#)
- White Noise-, Trend-, [Stationary-*](#), Seasonality-Test, Change Point Detection, [Bayesian Change Point Detection*](#), [Outlier Detection*](#), [TS Imputation*](#), Forecast Accuracy Measures
- [LSTM*](#), [Attention*](#), [LTSF*](#)
- [Segmented \(massive\) Forecasting*](#)

Association Analysis

- Apriori, Apriori Lite, FP-Growth
- K-Optimal Rule Discovery (KORD) Discovery, Sequential Pattern Mining

Link Prediction

- Link Prediction (Common Neighbors, Jaccard's Coefficient, Adamic/Adar, Katz β), PageRank

Recommender Systems

- Factorized Polynomial Regression Models, Alternating least squares, Field-aware Factorization Machines (FFM)

Text Processing

- Conditional Random Field, Latent Dirichlet Allocation
- [TF-IDF*](#), [term analysis*](#), [text classification*](#), [get related terms / documents*](#), [get relevant terms / documents*](#), [get suggested terms*](#)

Data Preprocessing

- Sampling, Partitioning, [SMOTE](#), [TomekLink](#), [SMOTETomek#](#)
- Binning / Discretize, Missing Value Handling, Scaling, [Feature Selection*](#)
- [Isolation Forest*](#)

Statistical & Multivariate Analysis

- Univariate Analysis (Data Summary, Mean, Median, Variance, Stand. Deviation, Kurtosis, Skewness, ..)
- Kernel Density Estimation, Entropy
- Correlation Function ([with confidence](#))
- Multivariate Analysis (Covariance Matrix, Pearson Correlations Matrix), Condition Index
- Principal Component Analysis (PCA)/PCA Projection, TSNE, [Categorical PCA](#)
- Linear Discriminant Analysis
- Multidimensional scaling, Factor Analysis
- Chi-squared Tests: Quality of Fit, Test of Independence, ANOVA, F-test (equal variance test)
- One-sample Median Test, T Test, Wilcoxon Signed Rank Test, [Kolmogorov-Smirnov Test*](#)
- Inter-Quartile Range, Variance Test, Grubbs Outlier Test, Anomaly Detection (KMeans)
- Random Distribution Sampling, [Markov Chain Monte Carlo \(MCMC\)*](#)
- Distribution Fitting, Cumulative Distribution Function, Distribution Quantile
- Misc. Functions
 - Kaplan-Meier Survival Analysis, Weighted Scores Table, ABC Analysis, [Tree model visualization*](#)

SAP HANA – Machine Learning

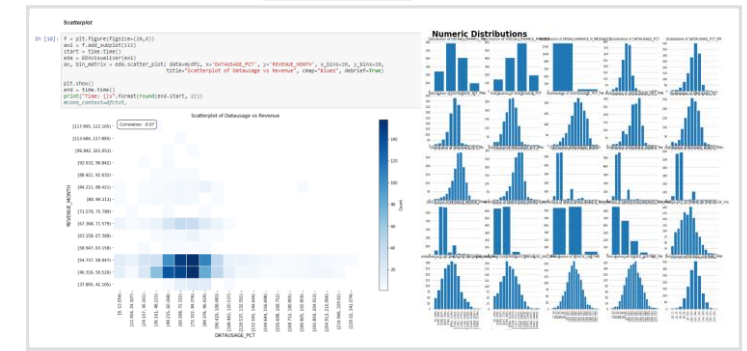
Python/R Machine Learning interfaces for Data Scientists

Leveraging SAP HANA's data science capabilities

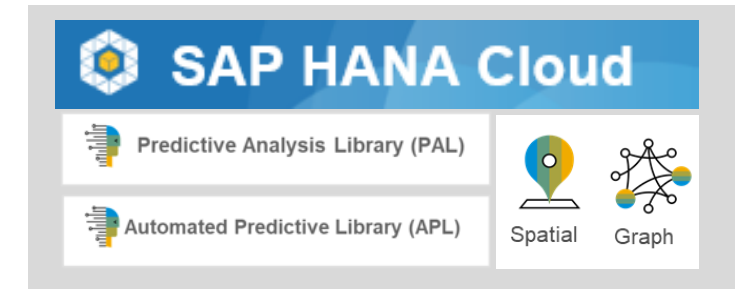
- Allow **scripting in Python or R**, while instructing remote processing of data and advanced analytics in SAP HANA Cloud
- Use the **HANA dataframe** object as virtual data reference for data preprocessing, transformation and analysis, including exploratory data analysis (EDA) visualizations
- Leverage the **Predictive Analysis Library (PAL)** in **Python / R**, allowing the expert Data Scientists a simple conversion from standard Python-packages to HANA embedded ML models and their operationalization
- **Automated Predictive Library (APL)** functions exposing SAP HANA's AutoML and non-expert predictive functions in **Python**
- Model storage and ML model performance reports
- Leverage SAP HANA **Spatial** and **Graph** capabilities in **Python**

Learn how to get started with [PAL and SAP HANA Cloud](#), [APL and SAP HANA Cloud](#) see [Python samples](#).

Data Scientist using R or Python



Python / R machine learning client



Python machine learning client documentation [here](#)

R machine learning client documentation [here](#)

SAP HANA – Machine Learning

Python/R Machine Learning interfaces for Data Scientists

- Native SAP HANA database client* for ODBC / JDBC / Python / ... see SAP Note [2939501](#)

- Documentation https://help.sap.com/viewer/product/SAP_HANA_CLIENT/latest
- Available for developers and data scientists from tools.hana.ondemand.com/#hanatools
- Expanded client distribution channels for Python client <https://pypi.org/project/hdbcli/>

hdbcli 2.11.14

```
pip install hdbcli
```

- Native Python machine learning client for SAP HANA Cloud

- Exposing SAP HANA data as HANA dataframe in Python
- Remote use of SAP HANA's machine learning-, spatial- and graph functions in Python
- Available with SAP HANA Client download + expanded distribution via PyPi <https://pypi.org/project/hana-ml/>

hana-ml 2.11.22010700

```
pip install hana-ml
```

*support for SAP HANA Cloud and SAP HANA Platform



What's New

What's New in the SAP HANA Client
Information about what's new and what's changed since the last release.
[Also available as PDF](#)

[SAP Note 2499500](#)
SAP HANA Client 2.4 Supported Platforms
[SAP Note 2939501](#)
SAP HANA Client Supported Platforms for 2.5 and Later

Installation and Upgrade

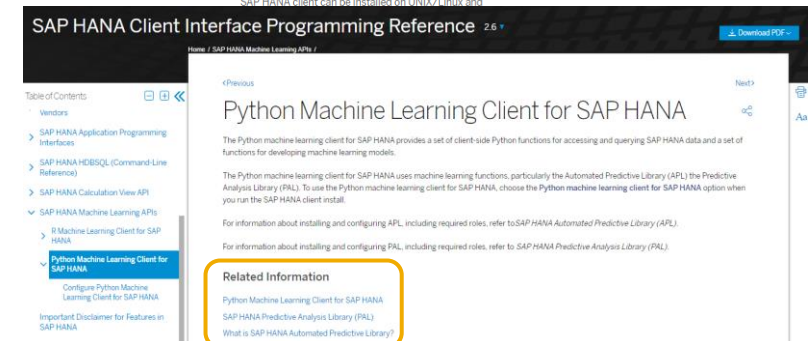
SAP HANA Client Installation and Update Guide
How to install the SAP HANA database clients for connecting applications to SAP HANA databases
[Also available as PDF](#)

Additional Information

SAP HANA Cloud
SAP HANA Platform
[SAP Note 2769719](#)
SAP HANA Client 2.0 Release and Maintenance Policy
[SAP HANA Client Tutorials](#)
Visit the SAP Developer Center for step-by-step tutorials on using client interfaces to connect to and query an SAP HANA database. To get you up and running quickly, the tutorials were designed to work with SAP HANA, express edition, but you can easily apply them to your SAP HANA Platform edition as well.

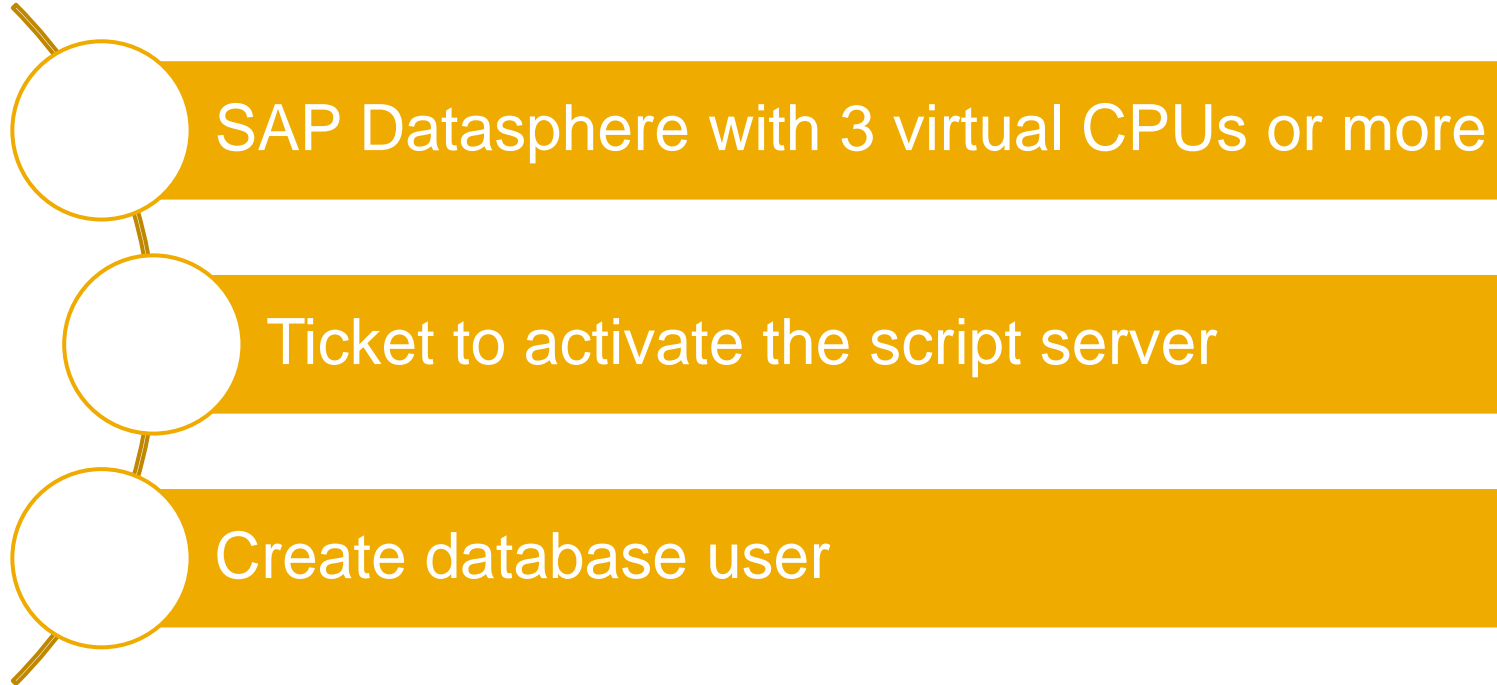
Reference

[SAP HANA Client Interface Programming Reference](#)
SAP HANA provides client interfaces for connecting applications in the SAP HANA client software package. The SAP HANA client can be installed on UNIX/Linux and



Setup

Machine Learning in SAP Datasphere



3 virtual CPUs or more

Cloud setup 1 / 3

<

SAP

Configuration

Data Integration

Security

Audit

Monitoring

IP Allowlist

Task Logs

Database Access

Tenant Configuration

SAP BW Bridge

Based on your needs, you can configure your tenant. Caution: once you save the configuration of your tenant, you cannot change it.

Our Recommendation

Storage: 512 GB

Compute Blocks: 7 Blocks

Memory: 420 GB

Customize Your Configuration

Storage: GB

Compute Blocks: Blocks

Memory: 120 GB

Total vCPUs: 8 vCPUs

Data Lake Storage: TB

SAP BW bridge Storage: GB

Allocated CUs: 4,300 CU

Capacity Units

Capacity Units (CU) are allocated to obtain storage and compute resources for your SAP Data Warehouse Cloud tenant.

Your contract

Available Units:

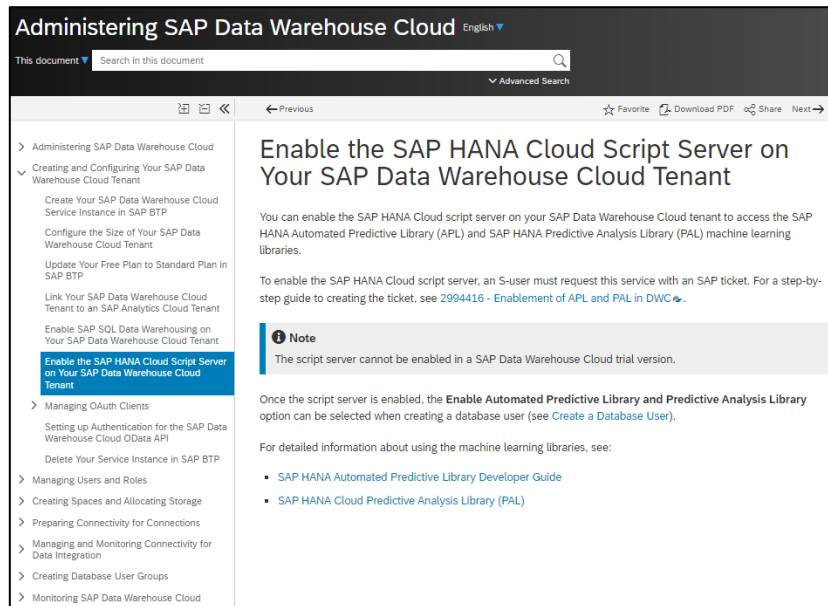
15,000 CU

Blog: Configure the Size of Your SAP Data Warehouse Cloud Tenant

<https://blogs.sap.com/2022/02/18/configure-the-size-of-your-sap-data-warehouse-cloud-tenant/>

Ticket to activate the script server

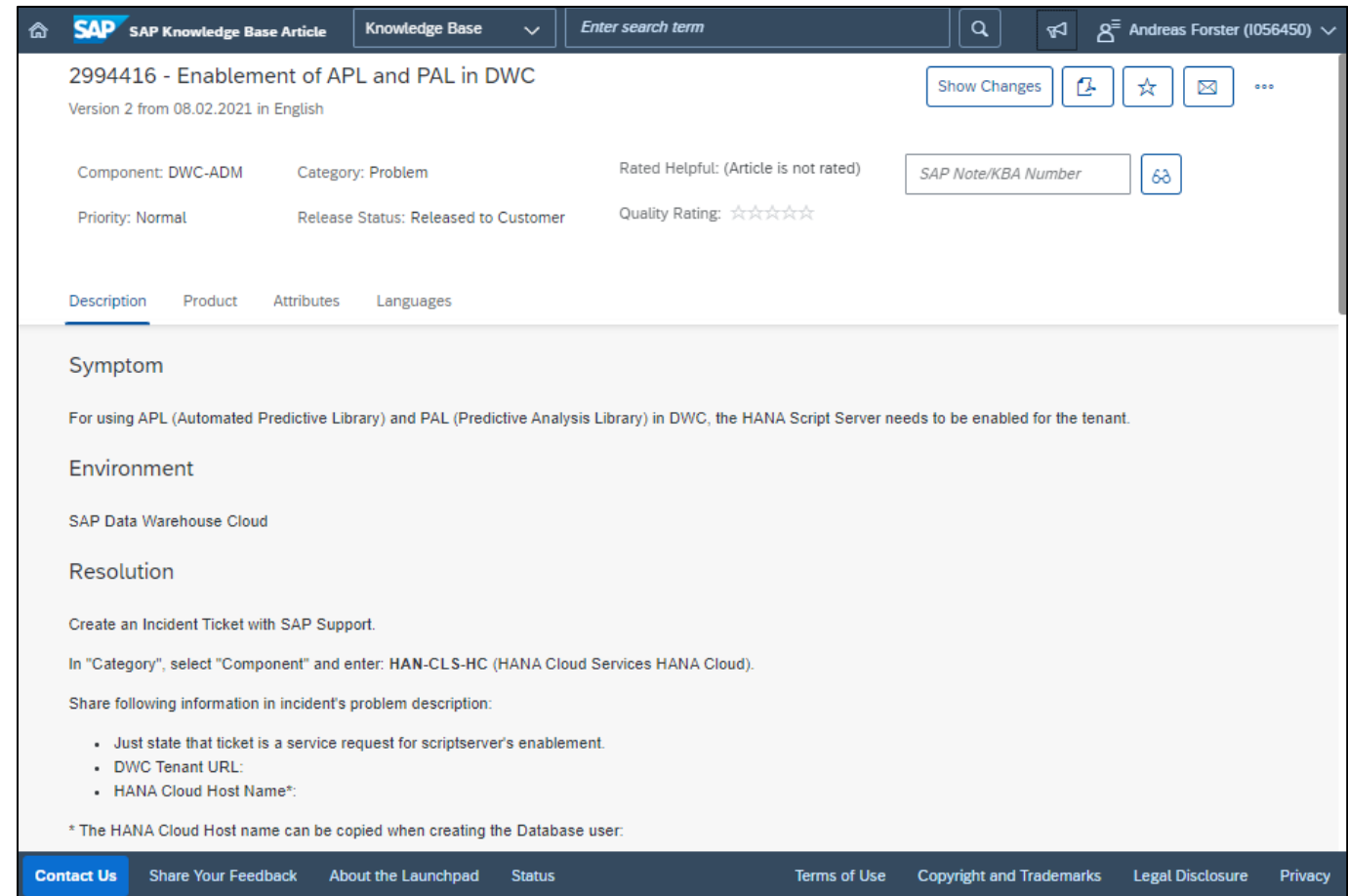
Cloud setup 2 / 3



The screenshot shows the SAP Administering SAP Data Warehouse Cloud documentation page. The left sidebar contains a navigation menu with the following items: Administering SAP Data Warehouse Cloud, Creating and Configuring Your SAP Data Warehouse Cloud Tenant, Managing OAuth Clients, Managing Users and Roles, Creating Spaces and Allocating Storage, Preparing Connectivity for Connections, Managing and Monitoring Connectivity for Data Integration, Creating Database User Groups, and Monitoring SAP Data Warehouse Cloud. The main content area is titled "Enable the SAP HANA Cloud Script Server on Your SAP Data Warehouse Cloud Tenant". It includes a note stating: "The script server cannot be enabled in a SAP Data Warehouse Cloud trial version." and a section for detailed information about using the machine learning libraries, which includes links to the SAP HANA Automated Predictive Library Developer Guide and the SAP HANA Cloud Predictive Analysis Library (PAL).



No additional APL/PAL installation required



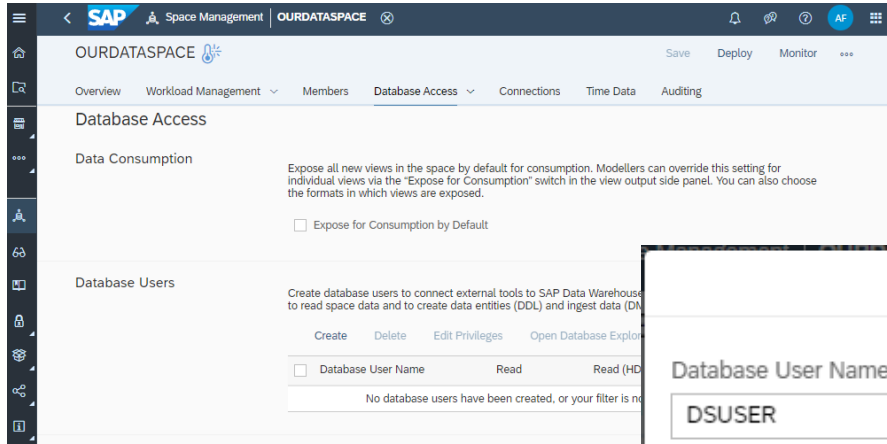
The screenshot shows the SAP Knowledge Base Article 2994416 - Enablement of APL and PAL in DWC. The article is Version 2 from 08.02.2021 in English. It includes a table with the following information: Component: DWC-ADM, Category: Problem, Rated Helpful: (Article is not rated), Priority: Normal, Release Status: Released to Customer, Quality Rating: ☆☆☆☆☆, and SAP Note/KBA Number: 2994416. The article is categorized under Description, Product, Attributes, and Languages. The main content area is titled "Symptom" and describes the issue: "For using APL (Automated Predictive Library) and PAL (Predictive Analysis Library) in DWC, the HANA Script Server needs to be enabled for the tenant." The "Environment" section lists "SAP Data Warehouse Cloud". The "Resolution" section provides instructions on how to create an incident ticket with SAP Support, including the category "HAN-CLS-HC (HANA Cloud Services HANA Cloud)" and the problem description "Just state that ticket is a service request for scriptserver's enablement." It also lists the required information for the ticket: DWC Tenant URL and HANA Cloud Host Name*. A note at the bottom states: "* The HANA Cloud Host name can be copied when creating the Database user."

SAP Note 2994416: Enablement of APL and PAL in DWC

<https://launchpad.support.sap.com/#/notes/2994416>

Create database user

Cloud setup 3 / 3



Create Database User

Database User Name Suffix: *

DSUSER

22 characters remaining

☐ Enable Password Policy

☒ Enable Automated Predictive Library (APL) and Predictive Analysis Library (PAL)

Read Access to the Space Schema

Allow the database user to connect external tools to the space schema and read views that are exposed for consumption.

Space Schema: OURDATASPACE

☒ Enable Read Access (SQL)

Allow the user to grant read access to other users.

☐ With Grant Option

Make your space data available in your HDI containers.

☐ Enable HDI Consumption

Create Cancel

Database User Details

Database User Name: OURDATASPACE#DSUSER

Open SQL Schema: OURDATASPACE#DSUSER

Space Schema: OURDATASPACE

Host Name: hana.prod-eu10.hanacloud.on... Port: 443

Password

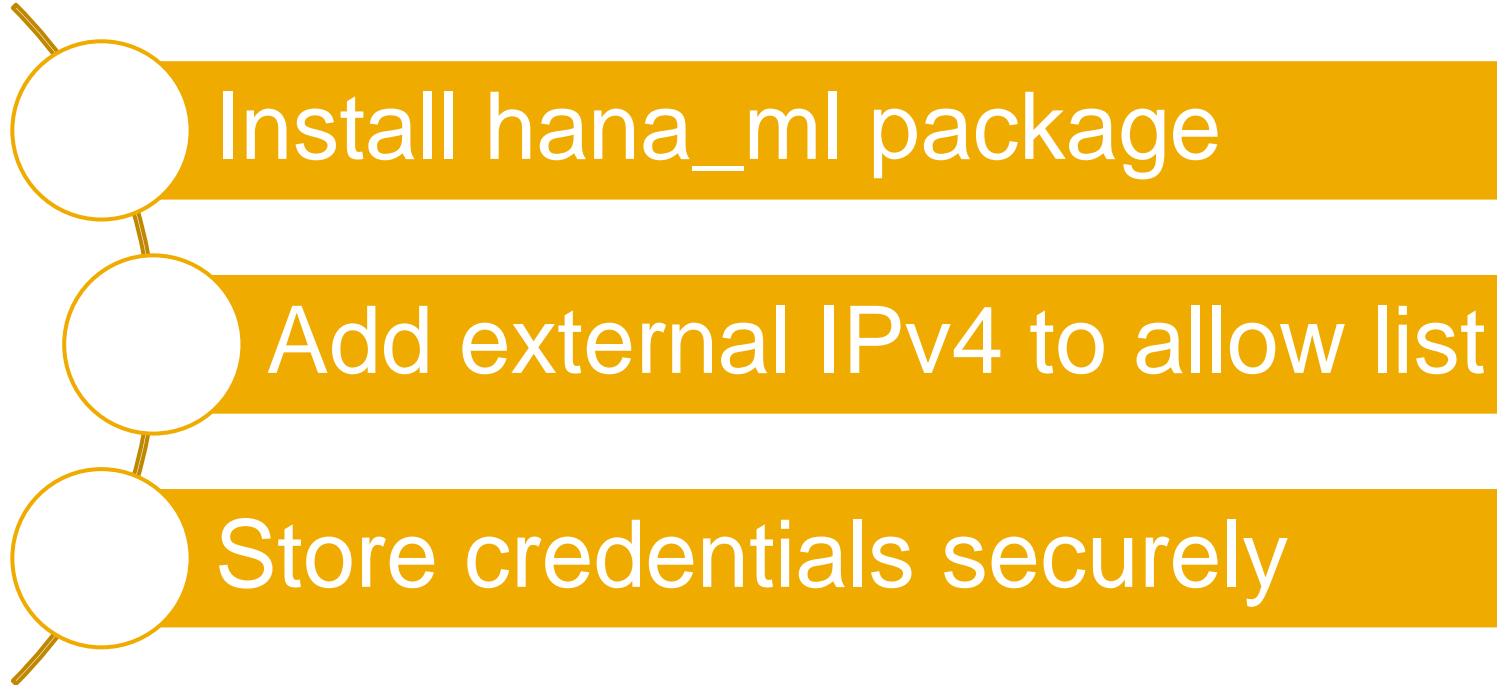
To set up a connection to this database user, please copy your password. If you forget your password, you can always request a new one.

Password: Request New Password

Close

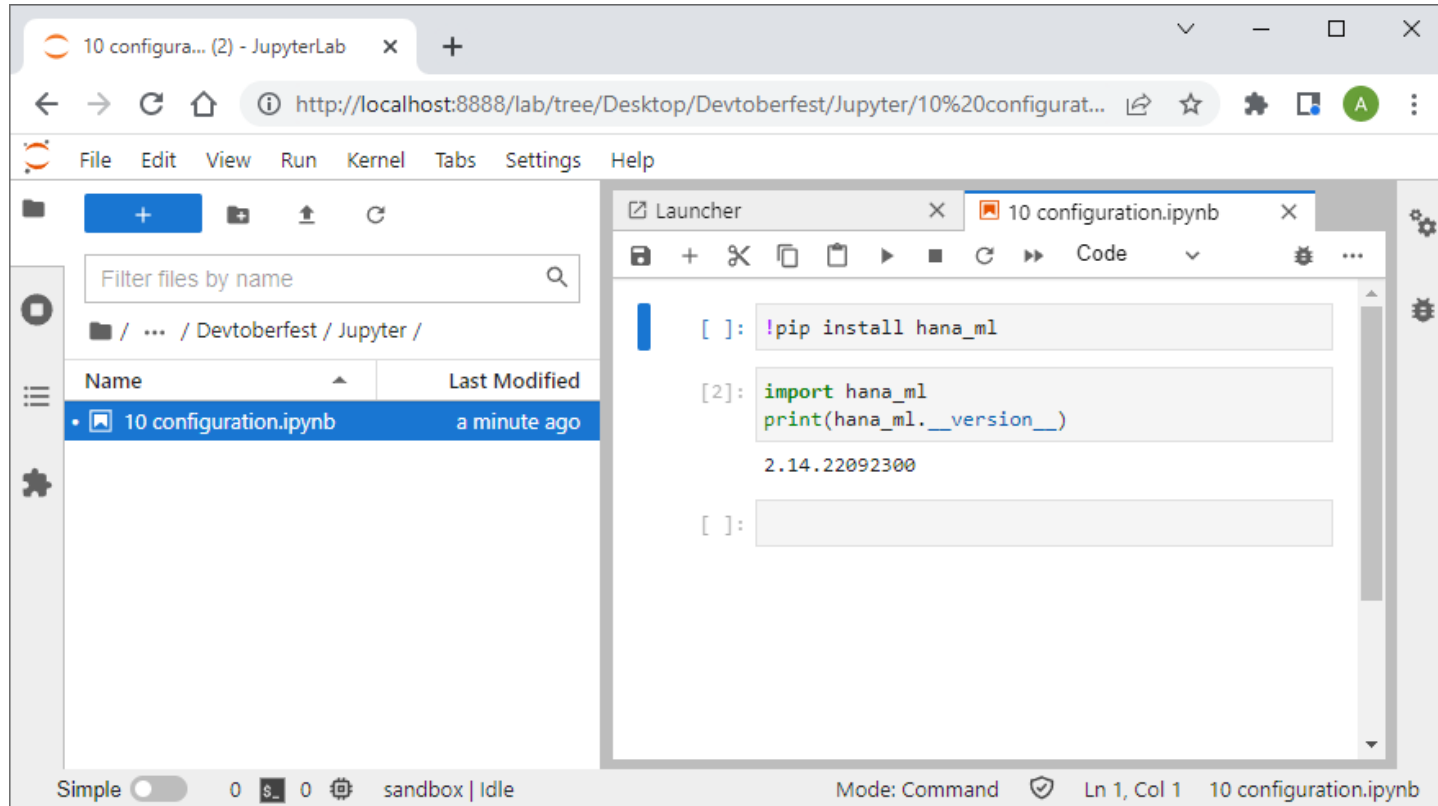
Client Setup (Python)

Machine Learning in SAP Datasphere

- 
- 1. Install hana_ml package
 - 2. Add external IPv4 to allow list
 - 3. Store credentials securely

Install Python Machine Learning Client for SAP HANA (hana_ml package)

Client setup 1 / 3



The Python Package Index (PyPI):

<https://pypi.org/project/hana-ml/>

Documentation:

<https://help.sap.com/doc/1d0ebfe5e8dd44d09606814d83308d4b/latest/en-US/index.html>

Add external IPv4 address to allow list

Client setup 2 / 3

- Get your **external** IPv4 address, ie from a site like <https://www.showmyip.com/>
- 192.168.0.0 to 192.168.255.255 is **not** an external IP address
- Add the address to the allow list in SAP Datasphere in System → Configuration



The screenshot displays the SAP Data Warehouse Cloud user interface. On the left is a dark sidebar with navigation options: Home, Repository Explorer, Apps (Data Marketplace, Business Builder, Data Builder, Data Access Controls, More), Space Management, System Monitor, Content Network, Security, Transport, Data Sharing Cockpit, and System. The main content area is titled 'System / Configuration' and features a top navigation bar with tabs: Data Integration, Tenant Links, Security, Audit, Monitoring, IP Allowlist (selected), Task Logs, Database Access, and SAP BW Bridge. Below the tabs, the 'IP Allowlist' section contains an informational message: 'If you want to connect a client in your local network to the database of SAP Data Warehouse Cloud, add the external IPv4 address of the client to the allowlist first. When using a network firewall, add the external IPv4 address of the proxy. The IP you enter needs to be your public internet IP. This list is for any trusted IPs other than Cloud Connector IPs.' Below this message is a table titled 'IP Ranges (41 of 95)' with columns for 'Add', 'Delete', 'Edit', 'Save', and a search bar. The table body is currently empty, showing only checkboxes for each row.

Store credentials securely

Client setup 3 / 3 (optional, but recommended)

1) Test connection from Python to SAP Datasphere with hardcoded credentials

```
import hana_ml.dataframe as dataframe
conn = dataframe.ConnectionContext(address='[REDACTED].hana.prod-eu10.hanacloud.ondemand.com',
                                   port=443,
                                   user='OURDATASPACE#DSUSER',
                                   password='[REDACTED]')

conn.connection.isconnected()
```

True

2) Store credentials securely in the [Secure User Store](#) from the SAP HANA Client



```
Command Prompt

C:\Program Files\SAP\hdbclient>hdbuserstore -i SET MYDWC "[REDACTED].hanacloud.ondemand.com:443" OURDATASPACE#DSUSER
Password:
Retroactive report: Operation succeed.

C:\Program Files\SAP\hdbclient>
```

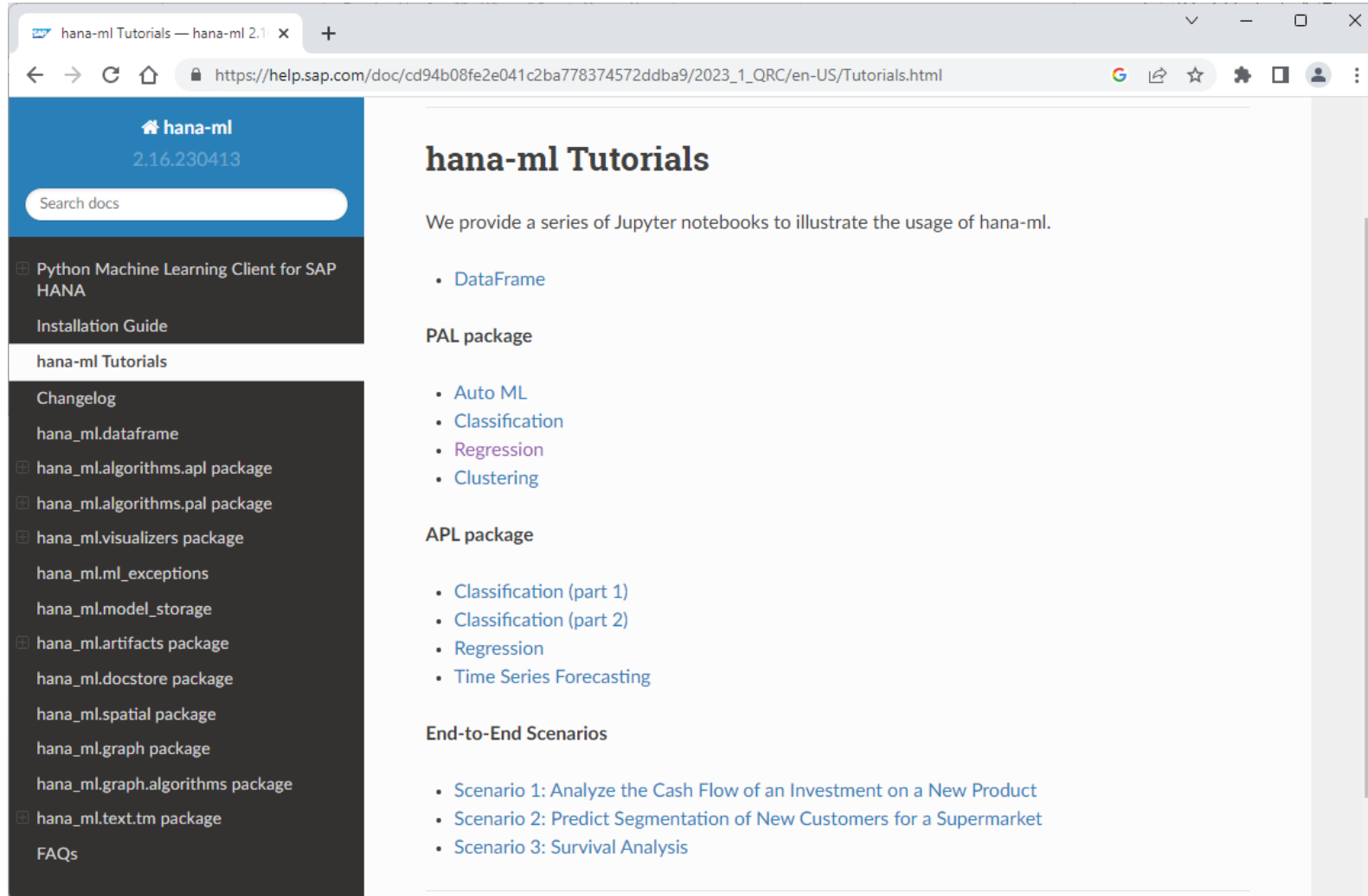
3) Logon with these securely stored credentials

```
conn = dataframe.ConnectionContext(userkey='MYDWC')
conn.connection.isconnected()
```

True

Get Started

Tutorials



The screenshot shows a web browser window displaying the SAP HANA ML Tutorials page. The browser's address bar shows the URL: https://help.sap.com/doc/cd94b08fe2e041c2ba778374572ddba9/2023_1_QRC/en-US/Tutorials.html. The page has a blue header with the 'hana-ml' logo and version '2.16.230413'. A search bar is present. The left sidebar contains a navigation menu with the following items: Python Machine Learning Client for SAP HANA, Installation Guide, hana-ml Tutorials (selected), Changelog, hana_ml.dataframe, hana_ml.algorithms.apl package, hana_ml.algorithms.pal package, hana_ml.visualizers package, hana_ml.ml_exceptions, hana_ml.model_storage, hana_ml.artifacts package, hana_ml.docstore package, hana_ml.spatial package, hana_ml.graph package, hana_ml.graph.algorithms package, hana_ml.text.tm package, and FAQs. The main content area is titled 'hana-ml Tutorials' and contains the text: 'We provide a series of Jupyter notebooks to illustrate the usage of hana-ml.' Below this, there are three sections: 'DataFrame' with a link to 'DataFrame'; 'PAL package' with links to 'Auto ML', 'Classification', 'Regression', and 'Clustering'; 'APL package' with links to 'Classification (part 1)', 'Classification (part 2)', 'Regression', and 'Time Series Forecasting'; and 'End-to-End Scenarios' with links to 'Scenario 1: Analyze the Cash Flow of an Investment on a New Product', 'Scenario 2: Predict Segmentation of New Customers for a Supermarket', and 'Scenario 3: Survival Analysis'.

hana-ml
2.16.230413

Search docs

Python Machine Learning Client for SAP HANA
Installation Guide
hana-ml Tutorials
Changelog
hana_ml.dataframe
hana_ml.algorithms.apl package
hana_ml.algorithms.pal package
hana_ml.visualizers package
hana_ml.ml_exceptions
hana_ml.model_storage
hana_ml.artifacts package
hana_ml.docstore package
hana_ml.spatial package
hana_ml.graph package
hana_ml.graph.algorithms package
hana_ml.text.tm package
FAQs

hana-ml Tutorials

We provide a series of Jupyter notebooks to illustrate the usage of hana-ml.

- [DataFrame](#)

PAL package

- [Auto ML](#)
- [Classification](#)
- [Regression](#)
- [Clustering](#)

APL package

- [Classification \(part 1\)](#)
- [Classification \(part 2\)](#)
- [Regression](#)
- [Time Series Forecasting](#)

End-to-End Scenarios

- [Scenario 1: Analyze the Cash Flow of an Investment on a New Product](#)
- [Scenario 2: Predict Segmentation of New Customers for a Supermarket](#)
- [Scenario 3: Survival Analysis](#)

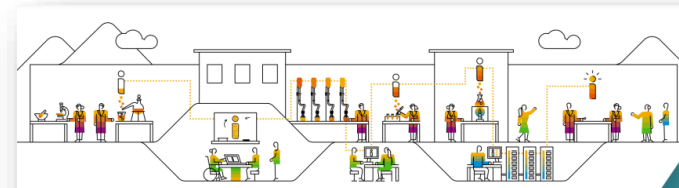
https://help.sap.com/doc/cd94b08fe2e041c2ba778374572ddba9/latest/en-US/hana_ml.html

Cutting-Edge Genius

iwb von natur aus
klimafreundlich

Utilities

Using Machine Learning to Predict
Solar Power Production in the City of
Basel (Switzerland)





**SAP Innovation Awards 2023
Entry Pitch Deck**

**Using machine learning to predict solar power
production in the city of Basel (Switzerland)**

IWB Industrielle Werke Basel, Switzerland

PUBLIC

 **SAP
Innovation
Awards 2023**



<https://www.sap.com/idea-place/sap-innovation-awards/entries/2023-award.html>

Maschine Learning mit SAP Datasphere

Hands-On Workshop

Datum: 20. September 2023

Zeit: 09:00 - 12:30 Uhr

Location: SAP Office Zürich

Sprache: Deutsch

Zur Anmeldung

<https://events.sap.com/ch/ml-sap-datasphere-workshop/de/home>

Thank you.

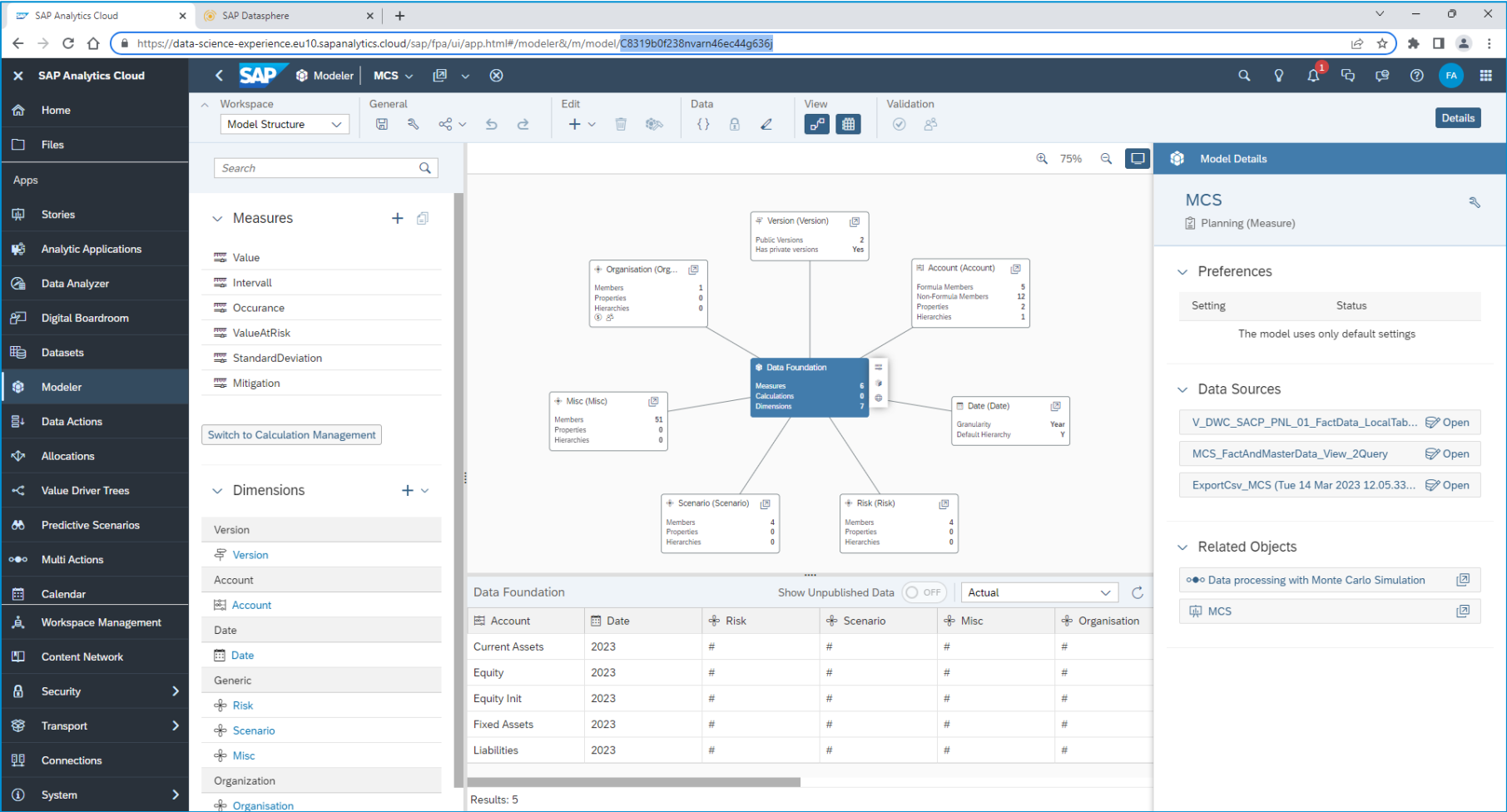


Andreas Forster
andreas.forster@sap.com



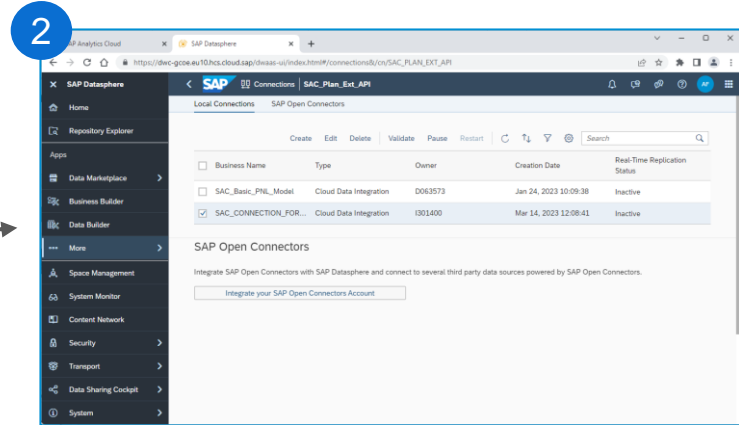
Exposing SAC Planning input to SAP Datasphere

SAC Planning model



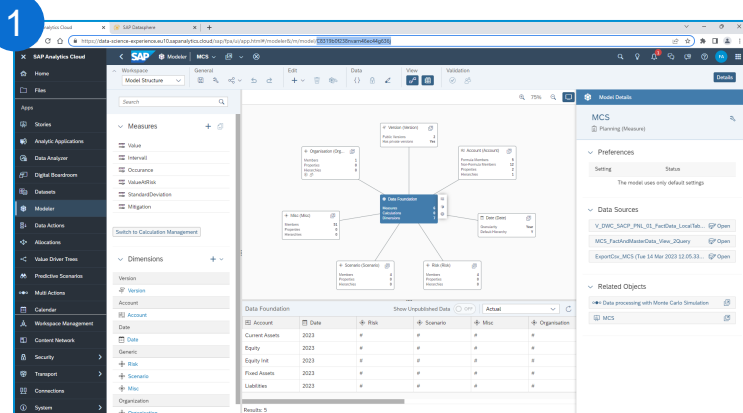
Exposing SAC Planning input to SAP Datasphere

SAP Datasphere connection

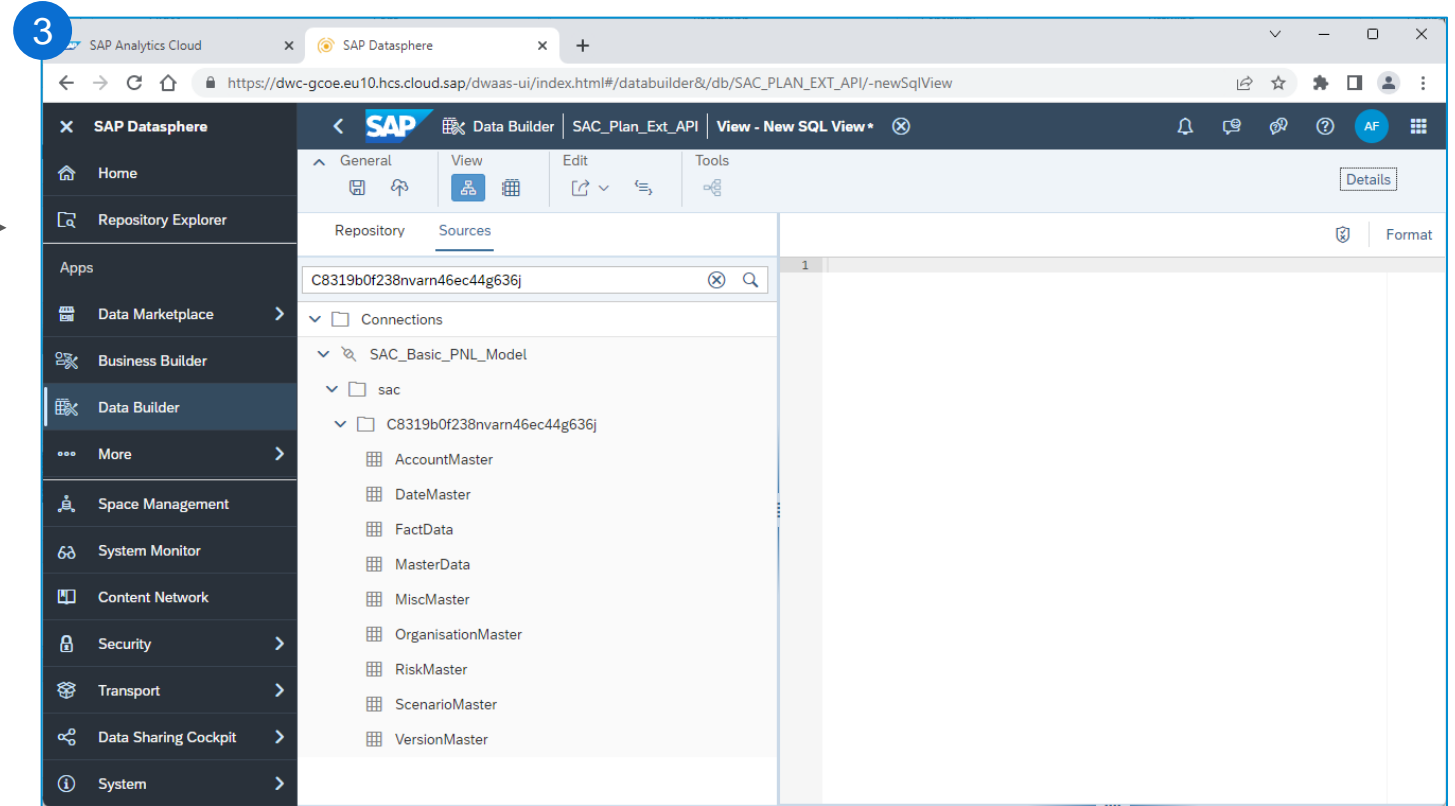


SAP Datasphere Connection

CDI / DPA



SAC Planning model



SAP Datasphere View to import a remote table

Exposing SAC Planning input to SAP Datasphere

Remote or replicated table

The screenshot displays the SAP Datasphere Data Integration Monitor interface. The left sidebar contains navigation options: SAP Datasphere, Home, Repository Explorer, Apps (Data Marketplace, Business Builder, Data Builder, More), Space Management, System Monitor, Content Network, Security, Transport, Data Sharing Cockpit, and System. The main area shows the 'Remote Table Monitor' for 'SAC_Plan_Ext_API'. It includes resource usage metrics: 'Used In-Memory (MiB) 0.00 MiB' and 'Used Disk (MiB) 0.29 MiB'. Below these, a table lists 25 remote tables. A context menu is open over the 'Table' column, showing options: 'Load New Snapshot', 'Remove Replicated Data', 'Enable Real-Time Access', and 'Go to Connections List'.

Connection	Table	Table Replication	Schedule Replication	Refresh Frequ...	
SAC_Basic_PNL_Model	DateMaster			---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_AuditData_RemoteT...			---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_DateMaster_Remote...			---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_FactData_RemoteTa...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_MasterData_Remote...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_SAP_FI_BPL_GLAC...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_VersionMaster_Rem...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_XPA_DEMO_COMPA...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_XPA_DEMO_CUSTO...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_XPA_DEMO_PRODU...	Remote		---	>
SAC_CONNECTION_FOR_EXPORT	DWC_SACP_PNL_01_XPA_DEMO_REGIO...	Remote		---	>
SAC_Basic_PNL_Model	FactData	Remote		---	>

SAP Datasphere Data Integration Monitor

Exposing SAC Planning input to SAP Datasphere

Expose for consumption

The screenshot displays the SAP Datasphere Data Builder interface. The browser address bar shows the URL: https://dwc-gcoe.eu10.hcs.cloud.sap/dwaas-ui/index.html#/databuilder&/db/SAC_PLAN_EXT_API/V_MCS_AccountMaster_Remote_Table_NEW. The interface includes a left sidebar with navigation icons, a top navigation bar with the SAP logo and 'Data Builder' label, and a main workspace. The workspace is divided into three sections: 'Repository' on the left, a central SQL editor, and 'Model Properties' on the right. The SQL editor contains the following query:

```
1 SELECT "ID","accType","FormulaText","HierarchySequence","Description"
2 FROM "MCS_AccountMaster_RemoteTable_NEW"
```

The 'Model Properties' panel on the right shows the following configuration:

- Business Name:** V_MCS_AccountMaster_Remote_Table_NEW
- Technical Name:** V_MCS_AccountMaster_Remote_Table_NEW
- Language:** SQL (Standard Query)
- Semantic Usage:** Relational Dataset
- Expose for Consumption:** ON (radio button selected)
- Run in Analytical Mode:** OFF (radio button selected)
- Status:** Deployed

SAP Datasphere Data Builder

Exposing SAC Planning input to SAP Datasphere

Expose for consumption

DBeaver 22.3.4 - View_MCS_FactData_and_Masterdata

Database Navigator: DW_C_GLOBAL, DW_C_TENANT_OWNER, I063463#I063463, PAL_STEM_TRIDF, PUBLIC, SAC_PLAN_EXT_API, View_MCS_FactData_and_Masterdata

	ABC Version	ABC Date	ABC Account	ABC Organisation	ABC Risk	ABC Scenario	ABC Misc	123 Value	123 Intervall	123 Occurance	123 ValueAtRisk	123 StandardDeviation	123 N
1	public.Actual	2023	Current Assets	#	#	#	#	40,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
2	public.Actual	2023	Equity	#	#	#	#	30,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
3	public.Actual	2023	Equity Init	#	#	#	#	40,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
4	public.Actual	2023	Fixed Assets	#	#	#	#	80,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
5	public.Actual	2023	Liabilities	#	#	#	#	80,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
6	public.Plan	2024	Current Assets	#	#	#	#	42,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
7	public.Plan	2024	Equity Init	#	#	#	#	40,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
8	public.Plan	2024	Fix Costs	#	#	#	#	-40,000	[NULL]	[NULL]	[NULL]	5,000	[NULL]
9	public.Plan	2024	Fixed Assets	#	#	#	#	80,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
10	public.Plan	2024	Liabilities	#	#	#	#	80,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
11	public.Plan	2024	Misc. Costs	#	#	#	#	-8,000	[NULL]	[NULL]	[NULL]	4,000	[NULL]
12	public.Plan	2024	Misc. Costs	#	R1	#	#	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
13	public.Plan	2024	Misc. Costs	#	R2	#	#	-30,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
14	public.Plan	2024	Preis	#	#	#	#	45	[NULL]	[NULL]	[NULL]	2	[NULL]
15	public.Plan	2024	Probability	#	R1	#	#	0.05	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
16	public.Plan	2024	Probability	#	R2	#	#	0.1	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
17	public.Plan	2024	Probability	#	R3	#	#	0.03	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
18	public.Plan	2024	Quantity	#	#	#	#	5,010	[NULL]	[NULL]	[NULL]	5	[NULL]
19	public.Plan	2024	Quantity	#	R1	#	#	-1,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
20	public.Plan	2024	Quantity	#	R2	#	#	-2,000	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
21	public.Plan	2024	Quantity	#	R3	#	#	-500	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
22	public.Plan	2024	Var. Costs	#	#	#	#	-1,800	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]
23	public.Plan	2024	Var. Costs p.P.	#	#	#	#	-18	[NULL]	[NULL]	[NULL]	[NULL]	[NULL]

Database Tasks - General

Name	Last Run	Last Result	Type	Project
------	----------	-------------	------	---------

Task executions: type a part of error message

Time	Duration	Result
------	----------	--------

Data is accessible from SAP HANA Database Explorer, DBeaver, SQL, etc...