Derived and Base Measure for Veracity

M(Ver) : Weighted sum of accuracy, completeness, currentness and availability

<table>
<tr><th colspan="4">Derived measure or indicator: M(ver)</th></tr>
<tr><td># 1</td><td>Derived measure or indicator
M(Ver): Weighted sum of accuracy, completeness, currentness and availability</td><td colspan="2">Formula

M(ver) = Accuracy(MDS)*W_{acc} + Completeness(MDS)*W_{comp} + Currentness(MDS)*W_{curr} + Availability(MDS)*W_{avail}

Each weight is set to ¼ by default.</td></tr>
<tr><td colspan="2">Link with the measurement goal (which goal)

Veracity</td><td>Responsible (who analyzes)

Developer

Data Analyst

Data Engineer

Data Scientist</td><td>Stakeholder (who uses)

Project Manager

Data Scientist

Senior Management</td><td>Frequency (when)

Veracity of dataset can be calculated on monthly, quarterly or yearly basis.</td></tr>
<tr><td colspan="2">Data source (where the measurement data will be extracted from)

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Storage of the result (where data will be stored after the extraction)

The data will be stored in excel file or database.

In our case we will be storing the result in jupyter notebook for reporting purpose.</td><td colspan="2">Data interpretation rules

Veracity can range between 0 and 1, higher veracity means better accuracy and trustworthiness of data whereas low veracity means unreliable data.

Veracity >= 0.8 means that the data quality is good and it can be used for machine learning model.

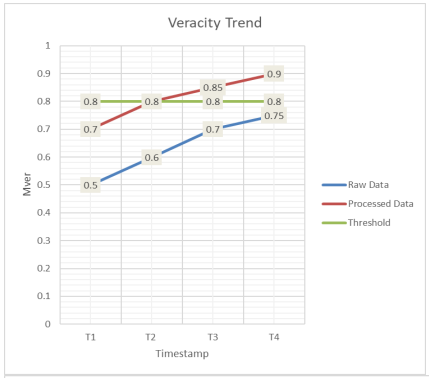
Veracity < 0.8 means that the data quality is good and it can be used for machine learning model.</td></tr>
</table>

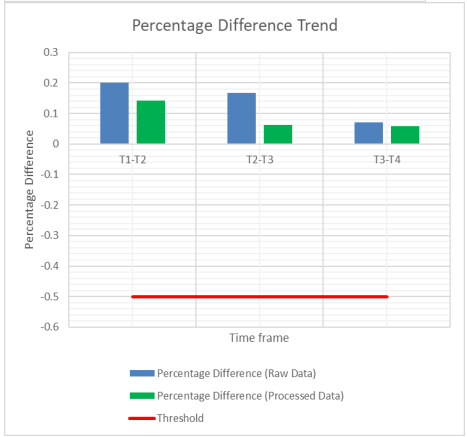
		The weights for each of the sub measures defines the importance of each sub measure in the calculation of veracity.

Analysis procedure

1. Retrieve recent accuracy value available at that timestamp from database.
2. Retrieve recent completeness value available at that timestamp from database.
3. Retrieve recent currentness value available at that timestamp from database.
4. Retrieve recent availability value available at that timestamp from database.
5. Use the weighted sum formula to calculate veracity
6. Analyze and interpret the results and make decisions

Presentation of the results (sketch illustrating what it looks like):





Potential decision making depending on the results

Veracity of data can be crucial for decision making process, for machine learning model to perform well veracity of data should be good enough, poor data from unreliable source can lead to failure of machine learning model. In business big data is used to study customer behaviour and if the veracity of data is low then this could lead to wrong decision making, however good quality data can be beneficial for the growth of the company.

40163636 40193024
40194579 40201472

Accuracy:

<table>
<tr><th colspan="5">Derived measure or indicator: Accuracy</th></tr>
<tr><td>#1</td><td>Derived measure or indicator

Degree to which data attributes represent the true value in a specified context of use.</td><td colspan="3">Formula

Availability (MDS) = $\frac{Hacc}{Hmax}$</td></tr>
<tr><td colspan="2">Link with the measurement goal (which goal)

Veracity</td><td>Responsible (who analyzes)

Developer

Data Analyst

Data Engineer

Data Scientist</td><td>Stakeholder (who uses)

Senior management

Project manager

Data scientist

Data analyst</td><td>Frequency (when)

The accuracy of data set can be measured on monthly, quarterly or yearly basis.</td></tr>
<tr><td colspan="2">Data source (where the measurement data will be extracted from)

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Storage of the result (where data will be stored after the extraction)

The data will be stored in excel file or database.

In our case we will be storing the result in jupyter notebook for reporting purpose.</td><td colspan="2">Data interpretation rules

Successful request is categorized as a request which returns the correct result.

Every query to a database is considered as a request.

Accuracy = 1 - means that the data attributes always represent truth value. This is a desired value for implementation of a successful machine learning model.</td></tr>
</table>

		Accuracy = 0 means that data attributes do not hold true value . Accuracy >= 0.90 means that 90% of the data attribute holds true value which can be useful to train our machine learning algorithm. Accuracy could increase or decrease depending upon the dataset size increasing or decreasing.

Analysis procedure	**Presentation of the results (sketch illustrating what it looks like):**
1. Dataset is loaded using the analyses tool, excel file or jupyter notebook. 2. Lbd is counted using COUNT function to get number of records 3. P_j is calculated to get the total number of duplicate items and their specific count in each dataset using the function like COUNT() 4. H_{acc} and H_{max} are calculated using the formula. 5. Accuracy of the dataset will be calculated using the formula. 6. The value will be interpreted according to the decision making rules and appropriate decision will be taken.	Accuracy of the data will be presented as a single numerical value.

Potential decision making depending on the results	
Accuracy of the data attributes can give the overview about truthfulness of the data. This is an important measure in order to get the Machine Learning model trained with the correct data. If the accuracy value is more it will give the confidence to stakeholders in order to trust the results produced by the machine learning algorithms.	

Base Measure: p_j					
#2	**Measure (what: entity, attribute)** Measures the total number of duplicate items and their specific count in each dataset Entity: Dataset Attribute: Total number of duplicate items		**Scale type** Absolute	**Applicability** Helps us to understand how many duplicate records are there in the dataset and also their count in each dataset. Better understanding of data quality.	
Who measures?	**Source of measurement**	**Where to store the result**	**Tool**		**Time (when to measure)**
Developer Data Analyst Data Engineer Data Scientist	Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	CSV File Database	Excel Jupyter Notebook Python libraries for data analysis like pandas, numpy etc.		This metric could be measured on a monthly, quarterly or yearly basis to calculate the accuracy trend of the database.

Collection procedure (how to collect the data)	**Notes or comments:**
This can be calculated by using the excel built in function or python various data processing libraries.	

Base measure: Lbd(MDS)				
#3	**Measure (what: entity, attribute)** Measures the total number of records in multiple datasets. Entity: Dataset Attribute: Number of records	**Scale type** Absolute	**Applicability** Total number of records in data sets acts as a fundamental unit of measurement which can be used to calculate other derived measures. It also gives the idea about the sizeof the dataset.	
Who measures? Developer Data Analyst Data Engineer Data Scientist	**Source of measurement** Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	**Where to store the result** CSV File Database	**Tool** Excel Jupyter Notebook Python libraries for data analysis like pandas , numpy etc.	**Time (when to measure)** This metric could be measured after creation and after each update of datasets.

Collection procedure (how to collect the data)	**Notes or comments:**
The data is loaded into excel sheet or database and the total number of records can be retrieved from query the database or using inbuilt functions of excel.	The number of records will be counted for each dataset for all time periods. I.e Length of records will be counted for a dataset as a whole and for each time period separately E.g if we have dataset D1,D2 for time T1,T2 then number of records will be lbd(D1) = lbd(D1T1) + lbd(D2T2)

Derived measure or indicator: H_{acc}			
#1	**Derived measure or indicator** Entropy of the given dataset	**Formula** $H_{acc} = \log_2(Lbd) - ((1/Lbd) * \sum_{j=1}^{k} p(j) * log2(p(j))$	
Link with the measurement goal (which goal) Veracity	**Responsible (who analyzes)** Developer Data Analyst Data Engineer Data Scientist	**Stakeholder (who uses)** Developer	**Frequency (when)** The Hacc of data set can be measured on monthly, quarterly or yearly basis.
Data source (where the measurement data will be extracted from) Credit Card classification - https://www.kaggle.com/datasets/samue	**Storage of the result (where data will be stored after the extraction)** The data will be stored in excel file or database.	**Data interpretation rules** This measure will be used to calculate the accuracy measure. If the value of Hacc is greater than Hmax, accuracy value will be more and hence the data attribute has truth value.	

lcortinhas/credit-card-classification-clean-data	In our case we will be storing the result in jupyter notebook for reporting purpose.	

Analysis procedure

1. Dataset is loaded using the analyses tool, excel file or jupyter notebook.
2. Lbd is counted using COUNT function to get number of records
3. P_j is calculated to get the total number of duplicate items and their specific count in each dataset using the function like COUNT()
4. H_{acc} is calculated using the formula mentioned above.

Potential decision making depending on the results

Higher accuracy of data means that decisions taken will be accurate and machine learning model will perform well.

Presentation of the results (sketch illustrating what it looks like):

H_{acc} of the data will be presented as a single numerical value.

<table>
<tr><th colspan="5">Derived measure or indicator: H_{max}</th></tr>
<tr><td>#3</td><td colspan="2">Derived measure or indicator

Maximum Entropy of the given dataset</td><td colspan="2">Formula

$H_{max}\ (MDS) = \log_2(Lbd)$</td></tr>
<tr><td colspan="2">Link with the measurement goal (which goal)

Veracity</td><td>Responsible (who analyzes)

Developer

Data Analyst

Data Engineer

Data Scientist</td><td>Stakeholder (who uses)

Developer</td><td>Frequency (when)

The Hmax of data set can be measured on monthly, quarterly or yearly basis.</td></tr>
<tr><td colspan="2">Data source (where the measurement data will be extracted from)

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Storage of the result (where data will be stored after the extraction)

The data will be stored in excel file or database.

In our case we will be storing the result in jupyter notebook for reporting purpose.</td><td colspan="2">Data interpretation rules

This measure will be used to calculate the accuracy measure. If the value of Hmax is less than Haccw, accuracy value will be more and hence the data attribute has truth value.</td></tr>
</table>

Analysis procedure	**Presentation of the results (sketch illustrating what it looks like):**
1. Dataset is loaded using the analyses tool, excel file or jupyter notebook. 2. Lbd is counted using COUNT function to get number of records 3. H_{max} is calculated using the formula mentioned above.	H_{max} of the data will be presented as a single numerical value.
Potential decision making depending on the results This value is being used to calculate accuracy.	

Completeness:

Derived measure or indicator: Completeness

# 2	**Derived measure or indicator** Completeness : Degree to which subject data associated with an entity has values for all expected attributes and related entity instances in a specific context of use.	**Formula** $$Com_m\ (MDS) = \frac{[rec\_no\_null\ (MDS)]}{Lbd(MDS)}$$	
Link with the measurement goal (which goal) Veracity	**Responsible (who analyzes)** Developer Data Analyst Data Engineer Data Scientist	**Stakeholder (who uses)** Project Manager Data Scientist	**Frequency (when)** Completeness of the data can be calculated at the start of the project, periodically at certain time intervals or it could be calculated eack time a new data is loaded into the system.
Data source (where the measurement data will be extracted from) Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	**Storage of the result (where data will be stored after the extraction)** The data will be stored in excel file or database. In our case we will be storing the result in jupyter notebook for reporting purpose.	**Data interpretation rules** Successful request is categorized as a request which returns the correct result. Every query to a database is considered as a request. Completeness = 1 - means that the subject data associated with an entity has values for all expected attributes and related entity instances. This is a desired value for implementation of a successful machine learning model.	

		Completeness = 0 means that data attributes hold null value . Completeness >= 0.90 means that 90% of the data attribute holds non null value which can be useful to train our machine learning algorithm. Completeness could increase or decrease depending upon the dataset size increasing or decreasing.

Analysis procedure	**Presentation of the results (sketch illustrating what it looks like):**
1. Dataset is loaded using the analyses tool, excel file or jupyter notebook. 2. Lbd is counted using COUNT function to get number of records 3. Rec_no_null is calculated to get the total number of no null items and their specific count in each dataset using the function like COUNT() 4. Completeness of the dataset will be calculated using the formula. 5. The value will be interpreted according to the decision making rules and appropriate decision will be taken.	Completeness of the data will be presented as a single numerical value.

Potential decision making depending on the results	
Completeness of the data attributes can give the overview about absoluteness of the data. This is an important measure in order to get the Machine Learning model trained with the correct data. If the completeness value is more it will give the confidence to stakeholders in order to trust the results produced by the machine learning algorithms.	

Base measure: Rec_no_null (MDS)					
#1	**Measure (what: entity, attribute)** Measures the total number of records with no null values. Entity: Dataset Attribute: Number of records		**Scale type** Absolute	**Applicability** Total number of no null records in data sets acts as a fundamental unit of measurement which can be used to calculate other derived measures.	
Who measures? Developer Data Analyst Data Engineer Data Scientist	**Source of measurement** Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	**Where to store the result** CSV File Database	**Tool** Excel Jupyter Notebook Python libraries for data analysis	**Time (when to measure)** Length of the data set can be measured each time new data is loaded into the database.	

			like pandas , numpy etc.	
Collection procedure (how to collect the data) The data is loaded into excel sheet or database and the total number of no null records can be retrieved from query the database or using inbuilt functions of excel.		**Notes or comments:** None		

Base measure: Lbd(MDS)				
#2	**Measure (what: entity, attribute)** Measures the total number of records in multiple datasets. Entity: Dataset Attribute: Number of records	**Scale type** Absolute	**Applicability** Total number of records in data sets acts as a fundamental unit of measurement which can be used to calculate other derived measures. It also gives the idea about the sizeof the dataset.	
Who measures? Developer Data Analyst Data Engineer	**Source of measurement** Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-	**Where to store the result** CSV File Database	**Tool** Excel Jupyter Notebook	**Time (when to measure)** Length of the data set can be measured each time new data is

Data Scientist	card-classification-clean-data		Python libraries for data analysis like pandas , numpy etc.	loaded into the database.

Collection procedure (how to collect the data)	**Notes or comments:**
The data is loaded into excel sheet or database and the total number of records can be retrieved from query the database or using inbuilt functions of excel.	The number of records will be counted for each dataset for all time periods. I.e Length of records will be counted for a dataset as a whole and for each time period separately E.g if we have dataset D1,D2 for time T1,T2 then number of records will be lbd(D1) = lbd(D1T1) + lbd(D2T2)

Currentness:

Derived measure or indicator: Currentness		
# 4	**Derived measure or indicator** Currentness: Degree to which data has attributes that are of the right age in a specific context of use.	**Formula** Currentness(MDS) = $\frac{[rec\_acc\_age(MDS)]}{Lbd(MDS)}$

Link with the measurement goal (which goal)	**Responsible (who analyzes)**	**Stakeholder (who uses)**	**Frequency (when)**
Veracity	Developer Data Analyst	Project Manager Data Scientist	Currentness of the data can be calculated at the start of the project, periodically at

<table>
<tr><td></td><td>Data Engineer

Data Scientist</td><td></td><td>certain time intervals or it could be calculated eack time a new data is loaded into the system.</td></tr>
<tr><td>Data source (where the measurement data will be extracted from)

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Storage of the result (where data will be stored after the extraction)

The data will be stored in excel file or database.

In our case we will be storing the result in jupyter notebook for reporting purpose.</td><td colspan="2">Data interpretation rules

For counting total number of records, every record should be considered for counting without any filters on data.

Data older than 10 years will be considered old data.

Currentness of data will be measured based on threshold value meaning that the currentness of the dataset should be above a certain value.

Currentness(Dataset) >= 0.7 - relevant for use in machine learning model

Currentness(Dataset) between 0.5 and 0.7 - relevant for use in machine learning model with some caution.

Currentness(Dataset) <= 0.5 - can be used for training machine learning model after checking the relevancy of data.</td></tr>
<tr><td colspan="2">Analysis procedure

1. Dataset is loaded using the analyses tool, excel file or jupyter notebook.
2. Total number of records are calculated using inbuilt COUNT() function or its equivalent</td><td colspan="2">Presentation of the results (sketch illustrating what it looks like):

Currentness of the data will be presented as a single numerical value.</td></tr>
</table>

3. Number of records within acceptable range will be calculated by applying filter over timestamp of data record. 4. Currentness of the dataset will be calculated using the formula. 5. Currentness of each dataset will be added to get the total currentness of MDS at various stages of data processing. 6. The value will be interpreted according to the decision making rules and appropriate decisions will be taken.	
Potential decision making depending on the results If the currentness of the data is within the acceptable range then the data can be used to train machine learning models to identify recent trends in data. If the data is too old then the decision derived from the data would not be relevant to the current scenario. Data needs to be updated if the dataset currentness value is too low.	

Base measure: Lbd(MDS)			
#1	**Measure (what: entity, attribute)** Measures the total number of records in multiple datasets. Entity: Dataset Attribute: Number of records	**Scale type** Absolute	**Applicability** Total number of records in data sets acts as a fundamental unit of measurement which can be used to calculate other derived measures. It also gives the idea about the sizeof the dataset.

Who measures?	**Source of measurement**	**Where to store the result**	**Tool**	**Time (when to measure)**
Developer Data Analyst Data Engineer Data Scientist	Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	CSV File Database	Excel Jupyter Notebook Python libraries for data analysis like pandas , numpy etc.	Length of the data set can be measured each time new data is loaded into the database.

Collection procedure (how to collect the data)	**Notes or comments:**
The data is loaded into excel sheet or database and the total number of records can be retrieved from query the database or using inbuilt functions of excel.	The number of records will be counted for each dataset for all time periods. I.e Length of records will be counted for a dataset as a whole and for each time period separately E.g if we have dataset D1,D2 for time T1,T2 then number of records will be lbd(D1) = lbd(D1T1) + lbd(D2T2)

Base measure: Rec_acc_age (MDS)			
#2	**Measure (what: entity, attribute)**	**Scale type** Absolute	**Applicability** The number of records in acceptable range brackets is a relevant metric for calculating

	Provides the total number of records with ages that fall within the acceptable range based on the upper and lower quartiles of the Box and Whisker. Entity: Dataset Attribute: number of records within acceptable age range		currentness of data and it also tells helps us analyze the age of dataset and its relevancy of future use.

Who measures?	**Source of measurement**	**Where to store the result**	**Tool**	**Time (when to measure)**
Developer Data Analyst Data Engineer Data Scientist	Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	CSV File Database	Excel Jupyter Notebook Python libraries for data analysis like pandas , numpy etc.	Total number of records with acceptable age range should be measured before calculating currentness of data. This could happen before the start of the project, periodically at certain time intervals to keep the track of currentness of data or whenever a new data is loaded into system.

Collection procedure (how to collect the data)	**Notes or comments:**

The data can be collected by applying control limits for the acceptable ranges over time attribute and filtering the number of records within acceptable ranges.	The number of records within acceptable ranges will be calculated for each dataset D(i) and not for each time stamp.

Availability:

Derived measure or indicator: Availability				
#5	**Derived measure or indicator** Currentness of the data will be presented as a single numerical value.	**Formula** Availability(MDS) $= \frac{[n\_succ\_req(MDS)]}{n\_req(MDS)}$		
Link with the measurement goal (which goal)		**Responsible (who analyzes)**	**Stakeholder (who uses)**	**Frequency (when)**
Veracity		Developer	Senior management	The availability of data set can be measured on

	Data Analyst Data Engineer Data Scientist	Project manager Data scientist Data analyst	monthly, quarterly or yearly basis.
Data source (where the measurement data will be extracted from) Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data	**Storage of the result (where data will be stored after the extraction)** The data will be stored in excel file or database. In our case we will be storing the result in jupyter notebook for reporting purpose.	**Data interpretation rules** Successful request is categorised as request which returns correct result. Every query to a database is considered as request. Availability = 1 - means that the database is available at all times, for every request a successful result has been returned. This is a desired value for implementation of successful machine learning model. Availability = 0 means that database does not return result for any request. Availability >= 0.99 means that 99% of the request were successful. This is a acceptable value for training a machine learning and the model will train in time. Availability >=90 means that 90% of the request were successful and this could increase the training time of machine learning model significantly as data might not be available for 10% of the cases. More number of requests are required to fetch data.	

		Availability could increase or decrease depending upon the number of successful requests to database. If number of successful requests fall then the availability is expected to go down.

Analysis procedure 1. Dataset is loaded using the analyses tool, excel file or jupyter notebook. 2. Total number of requests and successful requests are retrieved from the query log or issue log. 3. Availability of the dataset will be calculated using the formula. 4. The value will be interpreted according to the decision-making rules and appropriate decision will be taken.	**Presentation of the results (sketch illustrating what it looks like):** Availability of the data will be presented as a single numerical value.
Potential decision making depending on the results Availability of the dataset can give an overview of the resiliency of the system infrastructure, low availability could lead to decrease in confidence of stakeholders in the system leading to abandoning of the system whereas high availability could increase the confidence of stakeholders which is preferred by stakeholders for training machine learning model.	

<table>
<tr><th colspan="6">Base measure: N_succ_req (MDS)</th></tr>
<tr><td>#1</td><td colspan="2">Measure (what: entity, attribute)

Measures the number of successful request from an API server, database etc.

Entity: Dataset

Attribute: number of successful requests</td><td>Scale type

Absolute</td><td colspan="2">Applicability

The number of successful request gives us the metric to calculate availability and gives us the intuition about the likelihood of success of a request to an API or database.</td></tr>
<tr><td colspan="2">Who measures?

Developer

Data Analyst

Data Engineer

Data Scientist</td><td>Source of measurement

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Where to store the result

CSV File

Database</td><td>Tool

Excel

Jupyter Notebook

Python libraries for data analysis like pandas , numpy etc.</td><td>Time (when to measure)

This metric could be measured on a monthly, quarterly or yearly basis to calculate the availability trend of the database.</td></tr>
<tr><td colspan="3">Collection procedure (how to collect the data)

Generally API request or queries are logged for future/audit references therefore count the number of requests for which the correct responses have been returned from the database or dataset.</td><td colspan="3">Notes or comments:

In case of static dataset count the number of successful queries on the database.</td></tr>
</table>

<table>
<tr><th colspan="6">Base measure: N_req (MDS)</th></tr>
<tr><td>#2</td><td colspan="3">Measure (what: entity, attribute)

Measures the total number of requests to a database within a given timeframe.

Entity: Dataset

Attribute: Total number of requests to dataset.</td><td>Scale type

Absolute</td><td>Applicability

The number of request to a database could be considered as the fundamental unit of database which gives us the idea about the frequency of usage an importance of the dataset. More number of requests means that the database is usage is high and it is important.</td></tr>
<tr><td colspan="2">Who measures?

Developer

Data Analyst

Data Engineer

Data Scientist</td><td>Source of measurement

Credit Card classification - https://www.kaggle.com/datasets/samuelcortinhas/credit-card-classification-clean-data</td><td>Where to store the result

CSV File

Database</td><td>Tool

Excel

Jupyter Notebook

Python libraries for data analysis like pandas , numpy etc.</td><td>Time (when to measure)

This metric could be measured on a monthly, quarterly or yearly basis to calculate the availability trend of the database.</td></tr>
<tr><td colspan="3">Collection procedure (how to collect the data)
Generally, API request or queries are logged for future/audit references therefore count the number of requests/queries performed on database or dataset.</td><td colspan="3">Notes or comments:

In case of static dataset count the number of queries on the database.</td></tr>
</table>