# Report Calculations

Overview

Calculations turn raw process data into actionable information. This document highlights the different types of calculations offered by XLReporter.

- **Cell** calculations operate on cell values in the report.
- **Data Management** calculations perform more advanced calculations to those of cell calculations.
- **Data Group** calculations are processed on raw data before they are shown in a report.
- **Custom** calculations offer .NET developers the option to integrate their own custom logic.

Cell Calculations

XLReporter is based on the Microsoft Open XML standard, making the product have virtually all the same features as Microsoft Excel. The product supports over 440 of Excel's financial, date, time, text, lookup, mathematics, trigonometry, statistical, engineering, database, information, logical and web functions.

Cell functions can be applied the same way they are applied in Excel. For example, the following computes *SUM(D12:D35)* and shows the result in cell *B5*.
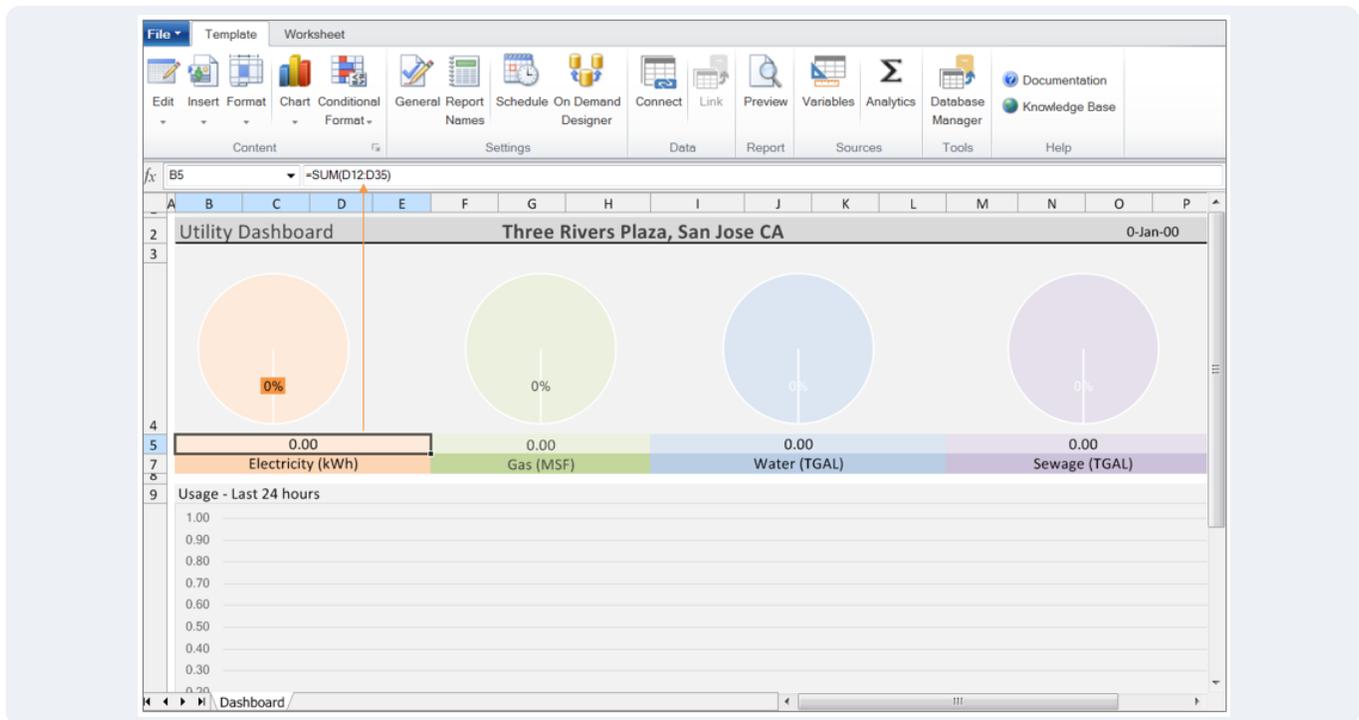
Below are a few examples of the standard cell functions offered:

AVERAGE	CONCATENATE	ISEVEN	ADDRESS	ACOSE	AVERAGEIF
MAX	REPLACE	ISTEXT	COLUMN	COMBIN	CHISQ.DIST
MIN	SUBSTITUTE	ISNA	HLOOKUP	AGGREGATE	FORECAST
COUNT	DATEDIFF	ISERROR	TRANSPOSE	FACT	GAMMA

All the functions can be applied to dynamic ranges which are determined when the report is produced e.g., to values over a batch or a machine cycle. A feature not readily available in Excel.

For example, in discrete manufacturing, the time taken for producing a batch can vary from batch to batch making the report data vary in rows from batch to batch. To produce consistent batch KPIs, XLReporter considers the variability of rows in the calculation of the KPIs.

Data Management

Data Management calculations tackle more in-depth calculations that are difficult (or impossible in some cases) to produce with cell calculations.

One example in this category is the Histogram which provides a count of how many times a cell value occurs in a list. This information could be used to produce a Pareto chart. In the following the Histogram in columns E and F is determined from the events in column C.

	A	B	C	D	E	F
2		Time	Event		Event	Freq.
3		1:00	Pressure Hi		Pressure Hi	3
4		1:11	Valve Shut		Valve Shut	2
5		1:45	Gate Flood		Material Jam	2
6		1:55	Pressure Hi		Open Fail	2
7		2:00	Material Jam		Gate Flood	1
8		2:34	Open Fail			
9		2:45	Valve Shut			
10		2:57	Open Fail			
11		3:01	Pressure Hi			
12		3:06	Material Jam			
13						

Advanced Calculations

Advanced cell calculations are a category of data management that provide industrial extensions to the standard cell calculations.

As an example, results from an external workbook containing industrial settings can be used to perform specialized business logic.

				Look-up Table for Required CT for 1 log Reduction in Giard															
	Input			Output															
Temp Degrees	Chlorine Conc	Lookup Row	pH																
4.5	2.5	4525	6.1	48															
C	(mg/l)	x	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.
0.0	0.0	0	46	48	49	51	52	54	56	58	61	63	65	68	71	73	7
0.5	0.0	500	46	48	49	51	52	54	56	58	61	63	65	68	71	73	7
0.5	0.2	502	46	48	49	51	52	54	56	58	61	63	65	68	71	73	7
0.5	0.4	504	46	48	49	51	52	54	56	58	61	63	65	68	71	73	7
0.5	0.6	506	47	49	51	52	54	56	58	60	63	65	67	70	72	75	7
0.5	0.8	508	48	50	52	53	55	57	59	61	64	66	68	71	74	76	7
0.5	1.0	510	49	51	53	55	57	59	61	63	66	68	70	73	76	78	8
0.5	1.2	512	51	53	55	56	58	60	62	65	67	70	72	75	78	80	8
0.5	1.4	514	52	54	56	57	59	61	64	66	69	71	74	77	80	83	8

The above lookup table is used in water treatment to calculate giardia levels using chlorine, temperature and pH. The tables are readily available from the EPA web site.

XLReporter takes process data from cells in the report and passes them to this external workbook (yellow) which performs the calculation using the lookup table. The calculated value is then shown in the report. The net result is that the core business logic is managed centrally, consistently, and external to the report.

Another example in this category is **Timestamp Convert** which converts *Coordinated Universal Time (UTC)* to local time and vice versa, accounting for daylight savings adjustments.

Data Group Calculations

Data Group calculations are used when process data is being collected in a historian, HMI, the XLReporter Analytic Logger, or another time indexed format. Calculations are performed over intervals of a time range, for example 'hourly values over a batch' or 'daily values over a month'. There is need to collect raw data into the report and summarize it with cell calculations because the results are returned directly from the data source. The calculations are performed either by the historian servers, or by XLReporter's calculation engine.

- **Historian**
  In this case, the calculated values are performed by the Historian and XLReporter simply uses the returned values for the report. The list of calculations available is determined by those supported by the historian.

- **XLReporter**
  In this case, XLReporter retrieves raw values from the historical data source and determines the calculated values using its calculation engine. A sampling of the calculations provided is listed below

General	Sample Analysis
First Sample	Sample Count
Time of First Sample	Sample Duration
Last Sample	
Time of Last Sample	**Performance**
Maximum	State Count
Time of Maximum	State Duration
Count	ON Count
Average	ON Duration
Total	OFF Count
Deviation	OFF Duration
Variance	
Quality	
Accumulation	**Energy**
First Accumulation	Produced Energy
Last Accumulation	Produced Emission
Difference	**Pulse Analysis**
First Difference	Pulse Count
First Accumulated Difference	Pulse Duration
Last Difference	Pulse Maximum
Last Accumulated Difference	Time of Pulse Maximum
	Pulse Minimum
	Time of Pulse Minimum

Custom Calculations

User Defined Calculations

Calculations can be provided by users familiar with .NET programming. To implement custom calculations, the user provides a meta data file that determines the user interface and the calculations as methods in a class library. This approach allows highly customized calculation logic to be easily managed, protected and left external to the report document.

Below is an implementation of a simple *Add Values* which provides the same functionality as the standard cell calculation *SUM*, applied to an entire column.

The input values are given in columns *B* and *C* and the result is shown in column *D*.

Industry Specific Calculations

XLReporter provides custom .NET calculations that are specific to Industries.

Below are some of the calculations for the wastewater treatment industry:

Name	Description
CT3Log	CT Required for 3-log inactivation of G. lamblia
VolTotal	Total volume of CT reactors