ChartReporter User Guide

Contents

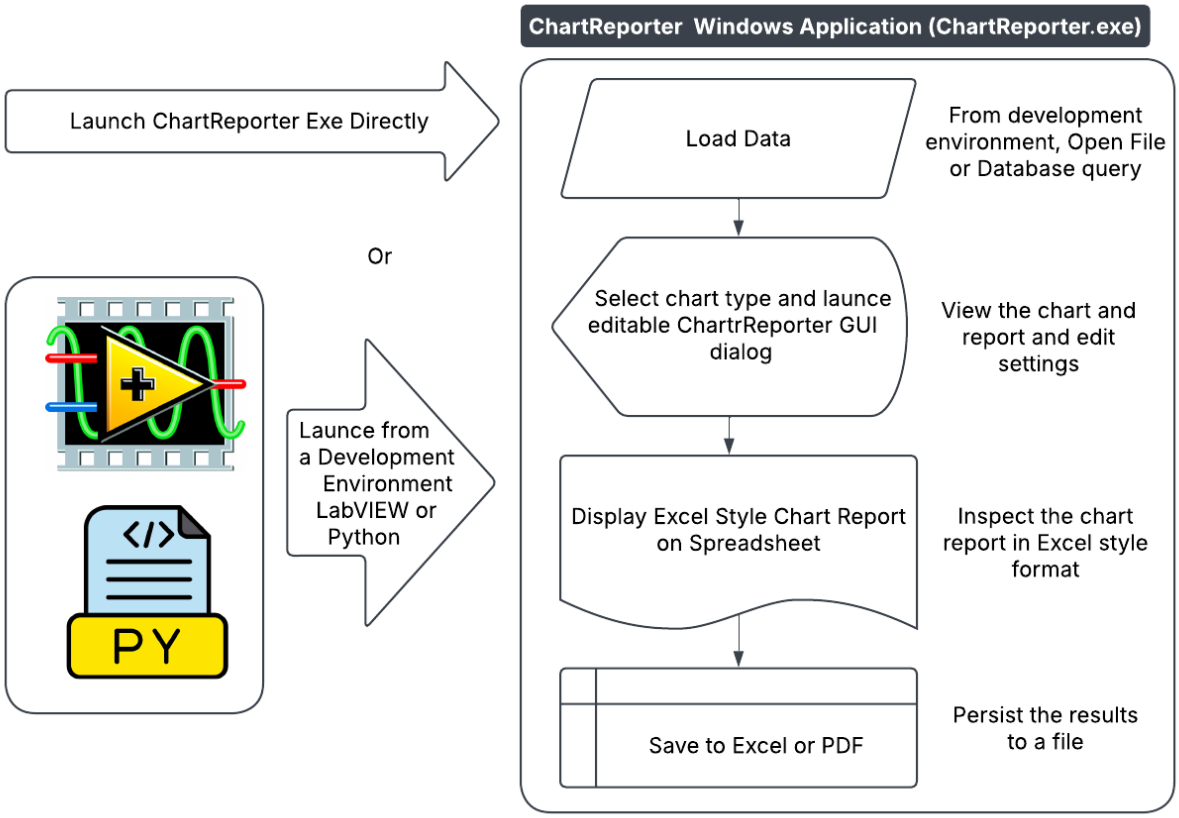
Overview

ChartReporter is a windows application that can produce full featured reports that include both charts and report analysis of the data. Key features are:

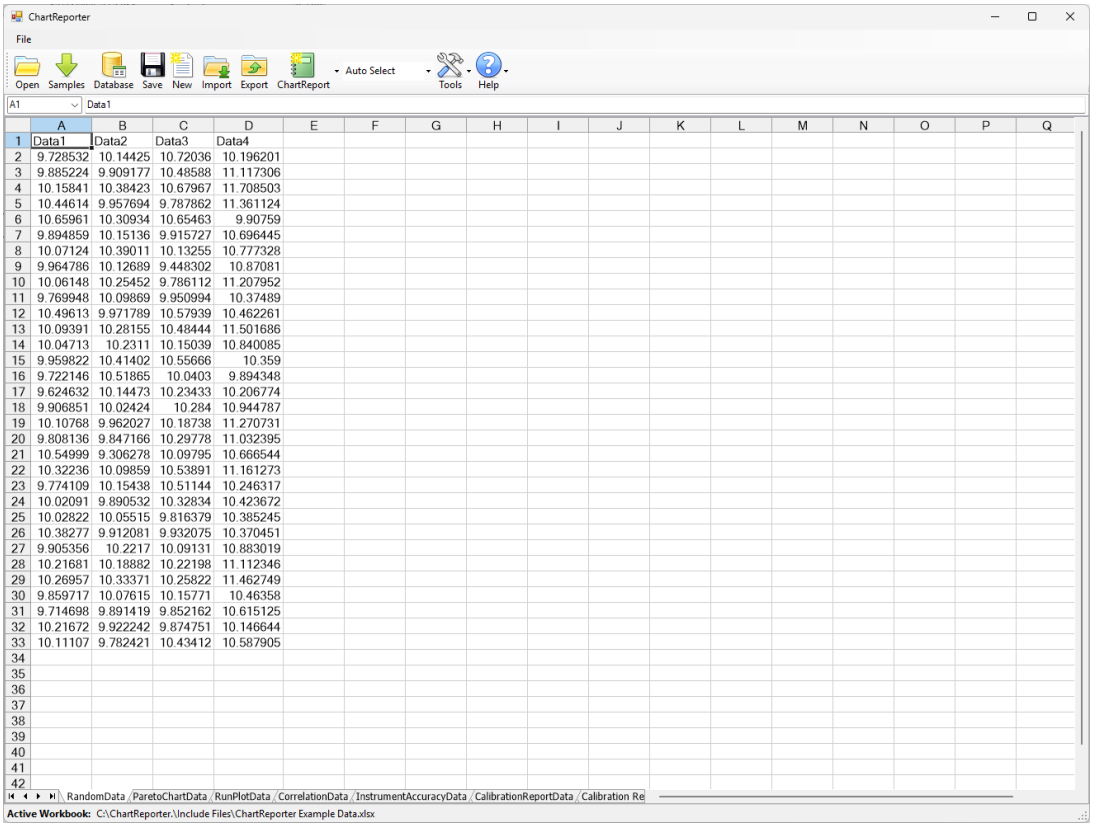
- The main user interface contains an Excel style workbook where data can either be imported from a file or sent directly into it from a separate development environment such as LabVIEW.
- Source code from a LabVIEW project can launch so developers can use the VIs to pass data and settings to the ChartReporter application via the Windows API.
- When a report is created inside ChartReporter, an application GUI is provided to edit settings to refine the report format before it is made final.
- Once a report is finalized on the application GUI, the both the chart and the analysis tables can be sent to a worksheet in the Main window.

The target audience are engineers, scientists, researchers, metrologists, or any others that are interested in analyzing data.

The architecture of ChartReporter is shown below:



Main Application Window



	A	B	C	D
1	Data1	Data2	Data3	Data4
2	9.728532	10.14425	10.72036	10.196201
3	9.885224	9.909177	10.48588	11.117306
4	10.15841	10.38423	10.67967	11.708503
5	10.44614	9.957694	9.787862	11.361124
6	10.65961	10.30934	10.65463	9.90759
7	9.894859	10.15136	9.915727	10.696445
8	10.07124	10.39011	10.13255	10.777328
9	9.964786	10.12689	9.448302	10.87081
10	10.06148	10.25452	9.786112	11.207952
11	9.769948	10.09869	9.950994	10.37489
12	10.49613	9.971789	10.57939	10.462261
13	10.09391	10.28155	10.48444	11.501686
14	10.04713	10.2311	10.15039	10.840085
15	9.959822	10.41402	10.55666	10.359
16	9.722146	10.51865	10.0403	9.894348
17	9.624632	10.14473	10.23433	10.206774
18	9.906851	10.02424	10.284	10.944787
19	10.10768	9.962027	10.18738	11.270731
20	9.808136	9.847166	10.29778	11.032395
21	10.54999	9.306278	10.09795	10.666544
22	10.32236	10.09859	10.53891	11.161273
23	9.774109	10.15438	10.51144	10.246317
24	10.02091	9.890532	10.32834	10.423672
25	10.02822	10.05515	9.816379	10.385245
26	10.38277	9.912081	9.932075	10.370451
27	9.905356	10.2217	10.09131	10.883019
28	10.21681	10.18882	10.22198	11.112346
29	10.26957	10.33371	10.25822	11.462749
30	9.859717	10.07615	10.15771	10.46358
31	9.714698	9.891419	9.852162	10.615125
32	10.21672	9.922242	9.874751	10.146644
33	10.11107	9.782421	10.43412	10.587905

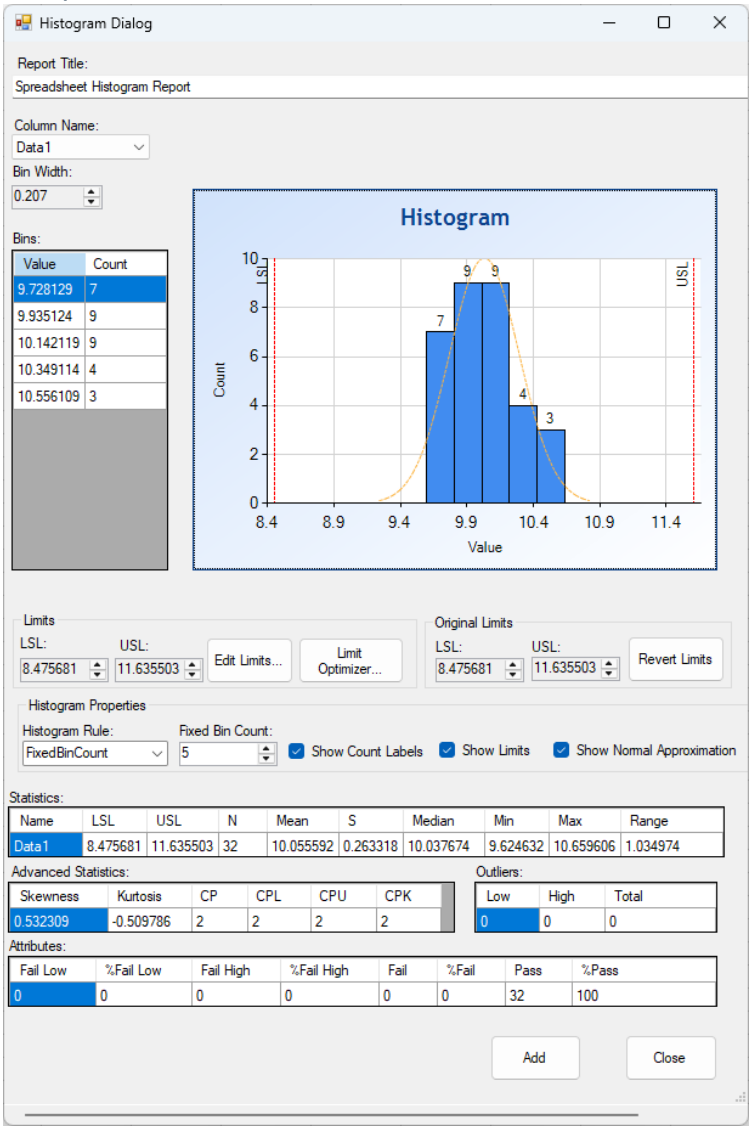
The form contains an Excel like interface, a Menu Bar, a Toolbar and a Status at the bottom of the form.

- Data can be loaded using either clicking **Open** or loaded automatically via an external development environment such as LabVIEW.
- A **Samples** button can be used to open a Workbook containing sample data to practice the capabilities.
- A **Database** button lets you query data from a database and copy it to a worksheet on the main application window.
- Once a report is created, the workbook can be saved using the **Save** tool.
- Clicking the **New** button clears the current worksheets and adds a blank worksheet named Sheet1.
- One or more worksheets from an external workbook or a CSV file can be imported by click the **Import** button. A dialog box guides you through the process. Selected worksheets can also be exported by clicking the **Export** button.
- A report can be started by first loading in data and then clicking the dropdown **ChartReport** button to select the chart report type. If data comes from an external application, the report starts automatically. The combo box to the right of the **ChartReport** button allows you to select a rectangular regio automatically or do a manual selection.
- A **Tools** button is provided to provide custom capabilities, reports or analysis
- A **Help** button is provided to give application help.

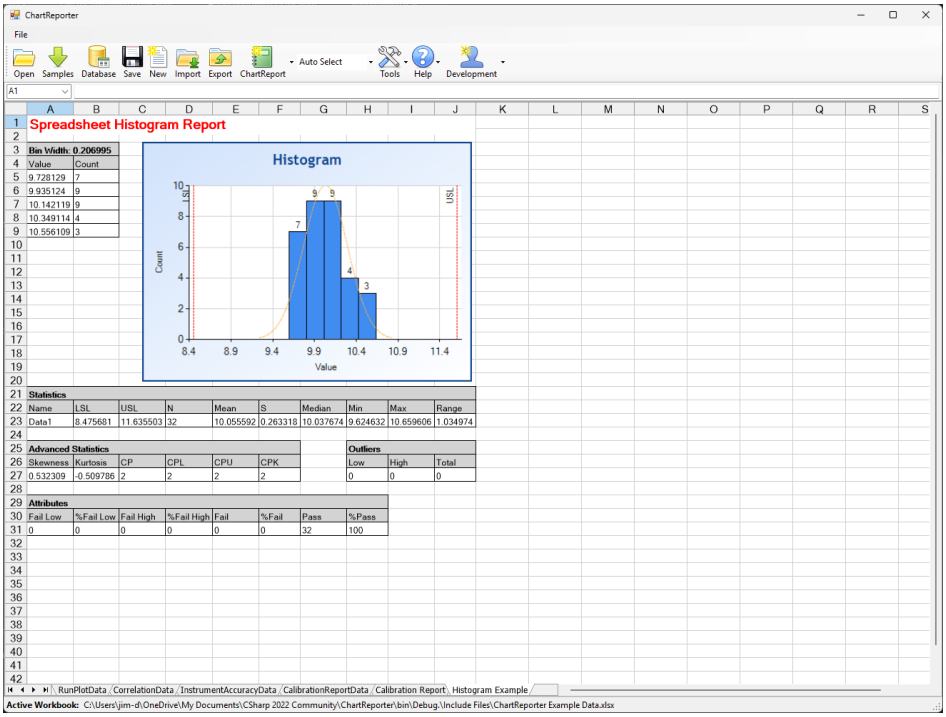
Interactive ChartReport Example

This shows an example Histogram ChartReport before it is committed to a worksheet. This allows editing of setup parameters, such as editing or optimizing limits. Observe that a normal approximation and test limits are shown optionally in the chart. Once editing is completed the user clicks the **Add** button to add the report to a worksheet.

Setup View



Worksheet View



Bin Width: 0.206995	
Value	Count
9.728129	7
9.935124	9
10.142119	9
10.349114	4
10.556109	3

Statistics									
Name	LSL	USL	N	Mean	S	Median	Min	Max	Range
Data1	8.475681	11.635503	32	10.055592	0.263318	10.037674	9.624632	10.659606	1.034974

Advanced Statistics					
Skewness	Kurtosis	CP	CPL	CPU	CPK
0.532309	-0.509786	2	2	2	2

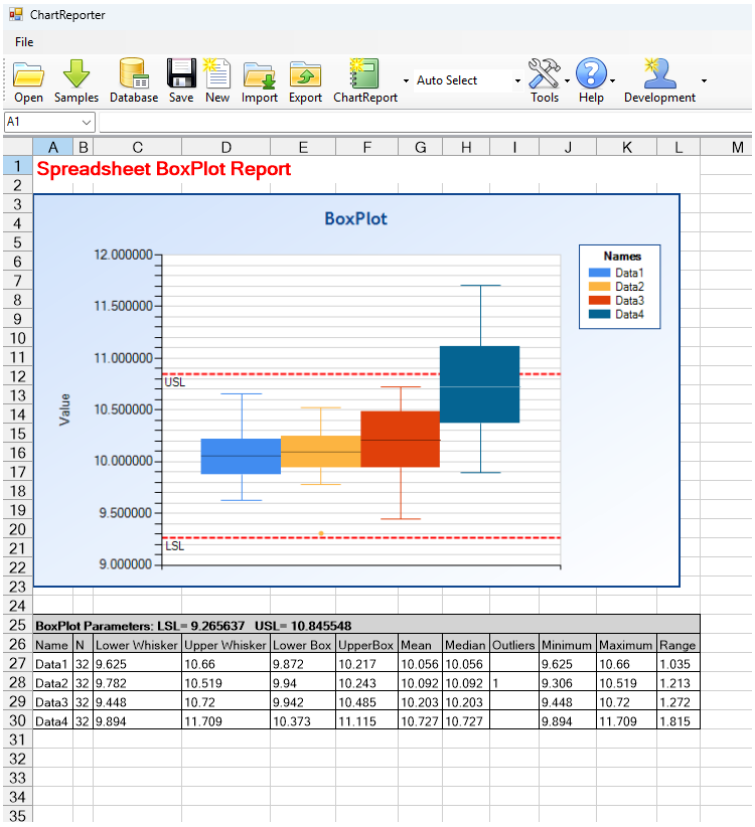
Outliers		
Low	High	Total
0	0	0

Attributes							
Fail Low	%Fail Low	Fail High	%Fail High	Fail	%Fail	Pass	%Pass
0	0	0	0	0	0	32	100

Chart Report Types

This section shows examples of each chart report as it appears on a worksheet after editing in the setup GUIs.

BoxPlot

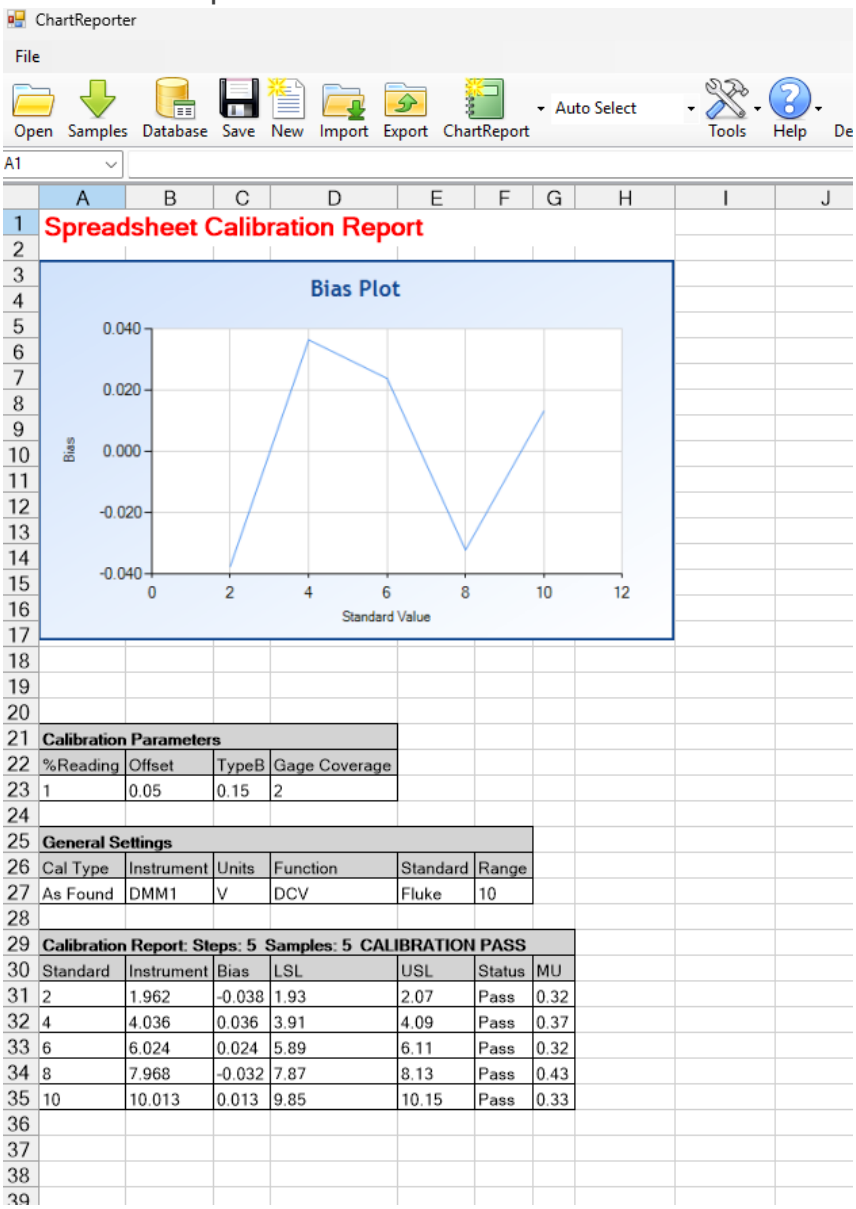


BoxPlot Parameters: LSL= 9.265637 USL= 10.845548

Name	N	Lower Whisker	Upper Whisker	Lower Box	UpperBox	Mean	Median	Outliers	Minimum	Maximum	Range
Data1	32	9.625	10.66	9.872	10.217	10.056	10.056		9.625	10.66	1.035
Data2	32	9.782	10.519	9.94	10.243	10.092	10.092	1	9.306	10.519	1.213
Data3	32	9.448	10.72	9.942	10.485	10.203	10.203		9.448	10.72	1.272
Data4	32	9.894	11.709	10.373	11.115	10.727	10.727		9.894	11.709	1.815

BoxPlots visualize a distribution of data by showing a solid box from the 25th percentile to the 75th percentile (Inner quartile Range) and end points of the distribution as typically min and max. Outliers are shown as dots. BoxPlots versus histograms are best used when there are small samples or when the distribution is not normal. BoxPlots are an excellent way to show multiple distributions side by side on the same chart.

CalibrationReport



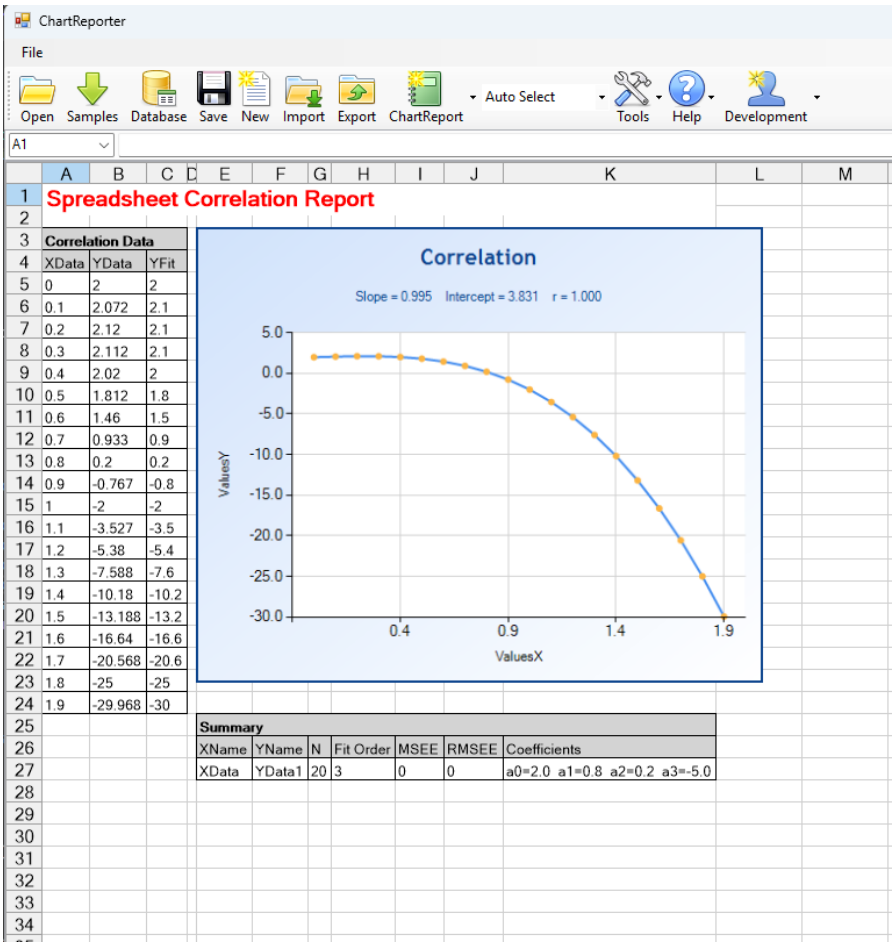
Calibration Parameters			
%Reading	Offset	TypeB	Gage Coverage
1	0.05	0.15	2

General Settings					
Cal Type	Instrument	Units	Function	Standard	Range
As Found	DMM1	V	DCV	Fluke	10

Calibration Report: Steps: 5 Samples: 5 CALIBRATION PASS						
Standard	Instrument	Bias	LSL	USL	Status	MU
2	1.962	-0.038	1.93	2.07	Pass	0.32
4	4.036	0.036	3.91	4.09	Pass	0.37
6	6.024	0.024	5.89	6.11	Pass	0.32
8	7.968	-0.032	7.87	8.13	Pass	0.43
10	10.013	0.013	9.85	10.15	Pass	0.33

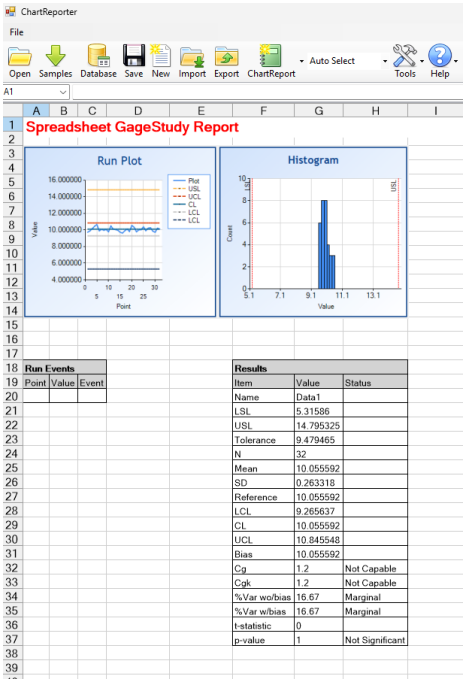
The CalibrationReport takes data from a calibration run, performs calibration calculations including Measurement Uncertainty and displays in the form of a report. Optionally the report can be copied onto an existing user specified report header excluding the chart to make your own custom standard report.

Correlation



The Correlation report provides a curve fit between two variables by allowing the user to adjust the fit order until the desired fit accuracy is determined. Polynomial coefficients are provided that can then be used to accurately determine a Y value given the X value. A use application is in a wind tunnel wind speed setup where a voltage is used to adjust the air velocity from a fan. Once the relationship coefficients are determined, the voltage setting for any specified air velocity can be set. A report tabulation of the polynomial coefficients and the resulting fit accuracy is provided.

GageStudy

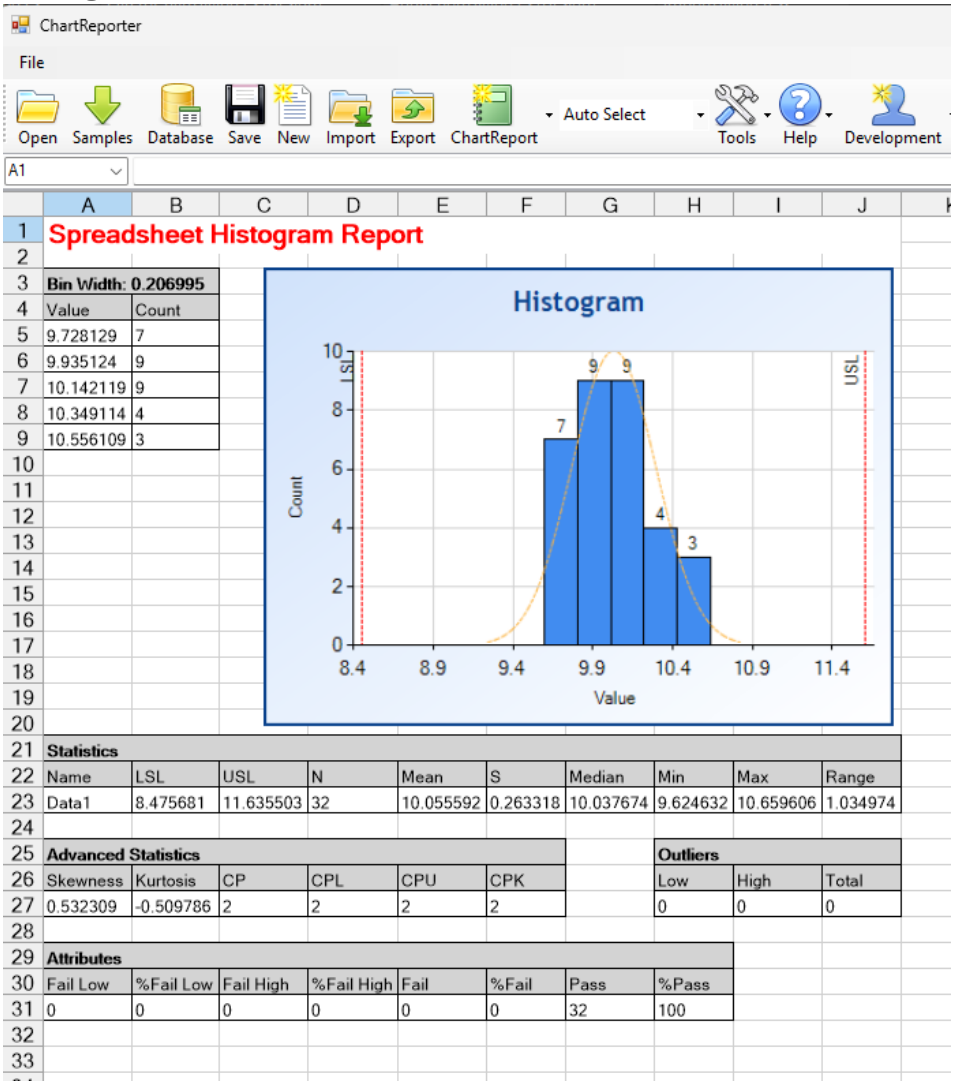


Run Events		
Point	Value	Event

Results		
Item	Value	Status
Name	Data1	
LSL	5.31586	
USL	14.795325	
Tolerance	9.479465	
N	32	
Mean	10.055592	
SD	0.263318	
Reference	10.055592	
LCL	9.265637	
CL	10.055592	
UCL	10.845548	
Bias	10.055592	
Cg	1.2	Not Capable
Cgk	1.2	Not Capable
%Var wo/bias	16.67	Marginal
%Var w/bias	16.67	Marginal
t-statistic	0	
p-value	1	Not Significant

GageStudy performs a Type 1 Gage Study on a single sample of gage data to check its suitability to make capable measurements considering the gage spec limits and a reference standard. The above two charts show the variability of the gage being studied as a RunPlot and as a Histogram. The GageStudy report among other items, the Gage capabilities Cg (variability only) and Cgk (variability considering the mean relative to the standard reference).

Histogram



Bin Width: 0.206995	
Value	Count
9.728129	7
9.935124	9
10.142119	9
10.349114	4
10.556109	3

Statistics

Name	LSL	USL	N	Mean	S	Median	Min	Max	Range
Data1	8.475681	11.635503	32	10.055592	0.263318	10.037674	9.624632	10.659606	1.034974

Advanced Statistics

Skewness	Kurtosis	CP	CPL	CPU	CPK
0.532309	-0.509786	2	2	2	2

Outliers

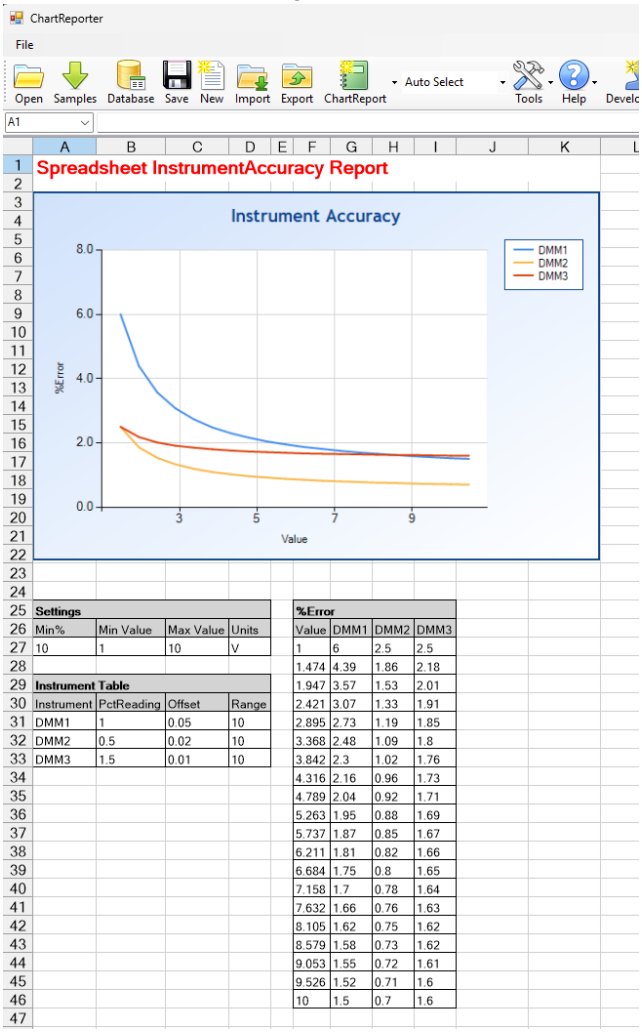
Low	High	Total
0	0	0

Attributes

Fail Low	%Fail Low	Fail High	%Fail High	Fail	%Fail	Pass	%Pass
0	0	0	0	0	0	32	100

Histogram Chart Report provides a feature-rich results and editing capability to view data in a histogram format. The dialog view allows users to edit how the histogram is presented. For example, number of bins, showing or hiding the normal approximation on the chart, showing or hiding histogram point values, etc. A limit optimizer too lets the user automatically adjust the limits based on a target Cpk.

InstrumentAccuracy



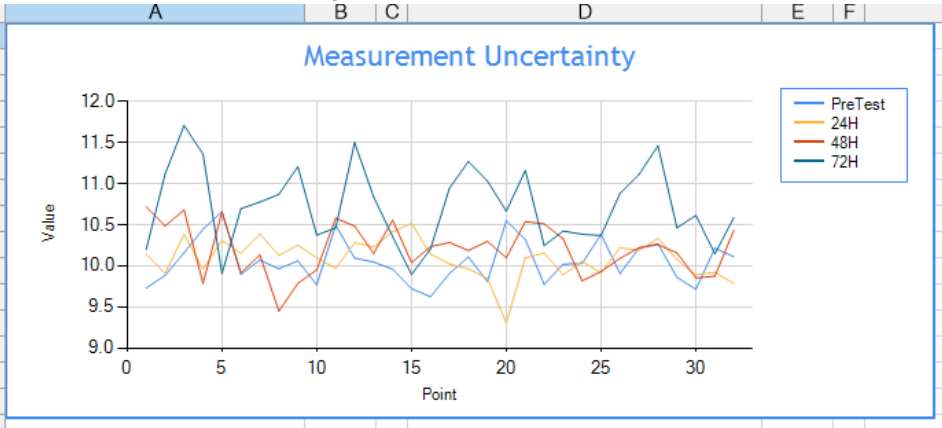
Settings			
Min%	Min Value	Max Value	Units
10	1	10	V

Instrument Table			
Instrument	PctReading	Offset	Range
DMM1	1	0.05	10
DMM2	0.5	0.02	10
DMM3	1.5	0.01	10

%Error			
Value	DMM1	DMM2	DMM3
1	6	2.5	2.5
1.474	4.39	1.86	2.18
1.947	3.57	1.53	2.01
2.421	3.07	1.33	1.91
2.895	2.73	1.19	1.85
3.368	2.48	1.09	1.8
3.842	2.3	1.02	1.76
4.316	2.16	0.96	1.73
4.789	2.04	0.92	1.71
5.263	1.95	0.88	1.69
5.737	1.87	0.85	1.67
6.211	1.81	0.82	1.66
6.684	1.75	0.8	1.65
7.158	1.7	0.78	1.64
7.632	1.66	0.76	1.63
8.105	1.62	0.75	1.62
8.579	1.58	0.73	1.62
9.053	1.55	0.72	1.61
9.526	1.52	0.71	1.6
10	1.5	0.7	1.6

The InstrumentsAccuracy chart type is a tool to characterize the accuracy of measuring instruments over s specified range based on %Reading Error, Offset Error and Range. The tool can be used to characterize a single instrument, or multiple instruments performing the same task to compare capabilities. The latter is useful if multiples manufacturers/models are being considered, and it is desired to select the best one for the task and cost.

MeasurementUncertainty



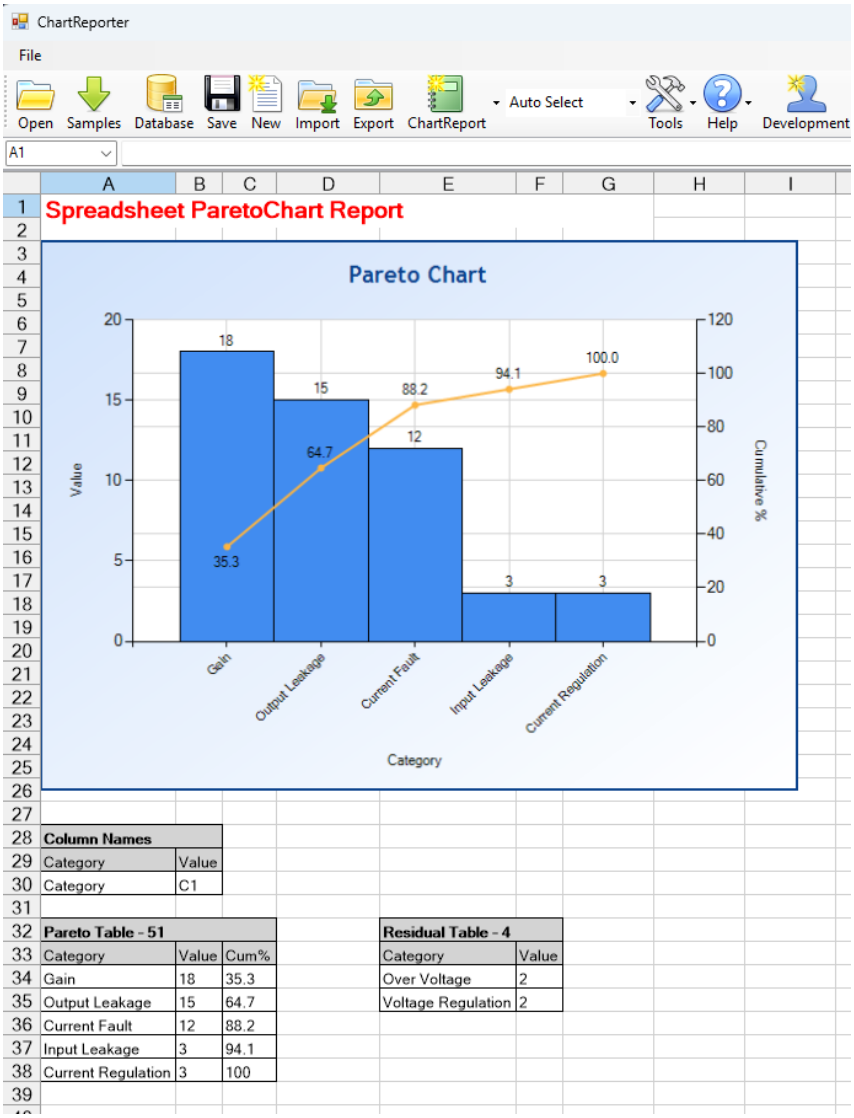
Settings	
Name	Value
Gage Resolution	0.01
STD Resolution	0.001
STD Expanded Uncertainty	0.2
STD Coverage	2
Gage Coverage	2

Type B Uncertainties	
Name	Value
Gage Resolution Uncertainty	0.003
Standard Resolution Uncertainty	0.032
Standard Combined Uncertainty	0.1

Study Results	
Name	Value
Instrument	DMM1
Units	Volts
Samples	32
Trials	4
Repeatability	0.749
Reproducibility	0.311
Type A Uncertainty	0.81
Type B Uncertainty	0.11
Combined Uncertainty	0.11
Gage Coverage	2
Expanded Uncertainty	0.21

The MeasurementUncertainty chart report provides a full measurement uncertainty analysis including running GR&R to obtain repeatability and reproducibility values to calculate the Type A statistical variation component. The user can also input custom Type B uncertainties not otherwise provided in the default settings. The automation means that it can provide a useful add-on for other development environments such as LabVIEW and .NET.

ParetoChart



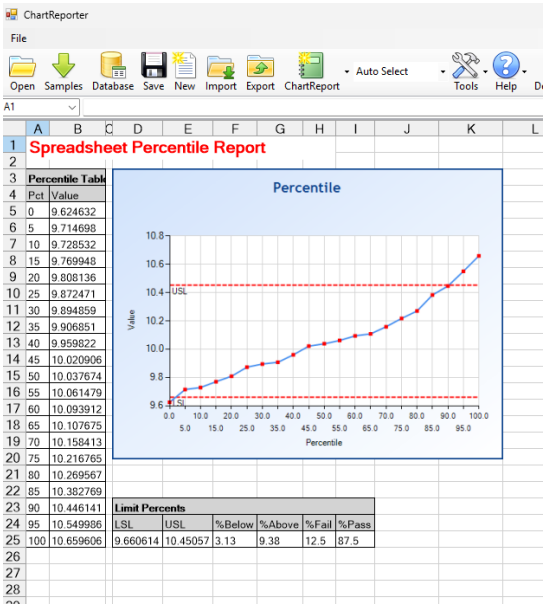
Column Names	
Category	Value
Category	C1

Pareto Table - 51		
Category	Value	Cum%
Gain	18	35.3
Output Leakage	15	64.7
Current Fault	12	88.2
Input Leakage	3	94.1
Current Regulation	3	100

Residual Table - 4	
Category	Value
Over Voltage	2
Voltage Regulation	2

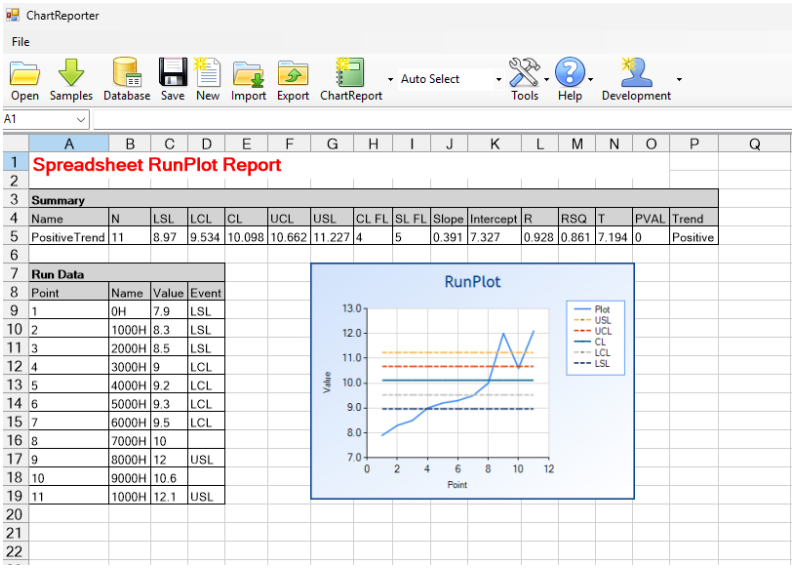
Determines the vital few category names that exhibit the highest frequency. The dialog view allows reducing the number to consider using the Maximum Categories entry in cases where there are many trivial ones. Residuals, if any, are shown on the right.

Percentile



The Percentile ChartReport provides a view of the distribution data percentiles. This is useful if it is important to granularly determine percentiles from data min to max.

RunPlot



Spreadsheet RunPlot Report

Summary

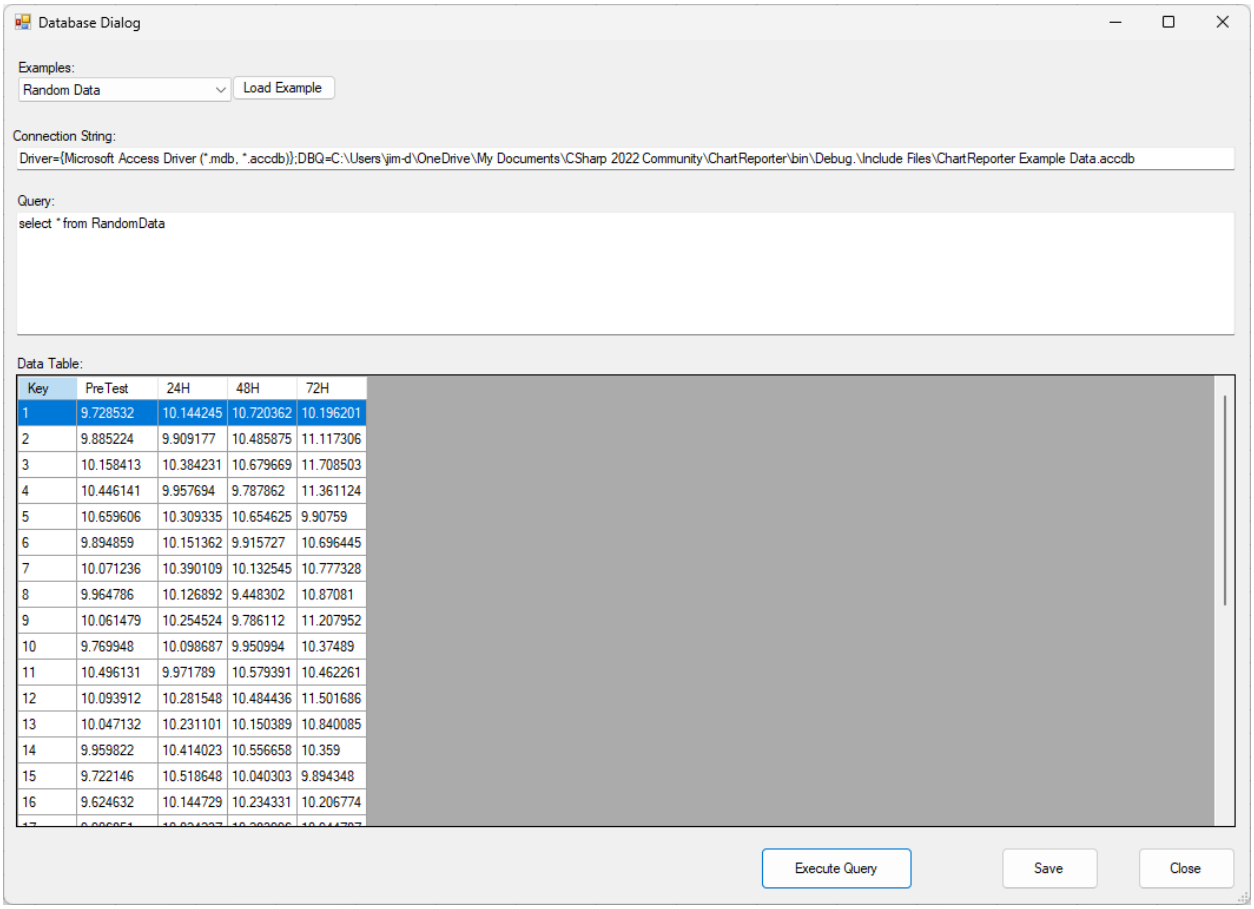
Name	N	LSL	LCL	CL	UCL	USL	CL FL	SL FL	Slope	Intercept	R	RSQ	T	PVAL	Trend
PositiveTrend	11	8.97	9.534	10.098	10.662	11.227	4	5	0.391	7.327	0.928	0.861	7.194	0	Positive

Run Data

Point	Name	Value	Event
1	0H	7.9	LSL
2	1000H	8.3	LSL
3	2000H	8.5	LSL
4	3000H	9	LCL
5	4000H	9.2	LCL
6	5000H	9.3	LCL
7	6000H	9.5	LCL
8	7000H	10	
9	8000H	12	USL
10	9000H	10.6	
11	1000H	12.1	USL

A RunPlot is used to track a test result through several process steps and detect any out-of-control points or trend characteristics. In the example, a positive trend is detected. The Event column of the Run Data table shows any points that are not in control.

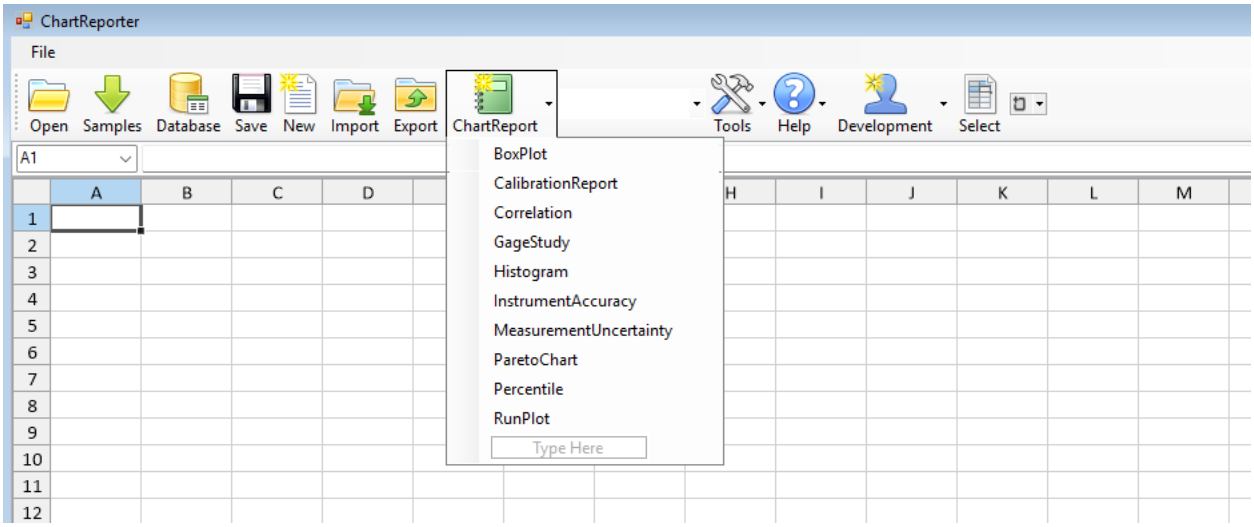
Getting Data from a Database



To obtain data from a database first click **Database** on the main window toolbar. Then you can enter the database **Connection String** and **Query**. Click **Execute Query** executes the query as shown above. Clicking **Save** saves the data table to a worksheet on the Main window. Then you can run one of the reports that supports this kind of data.

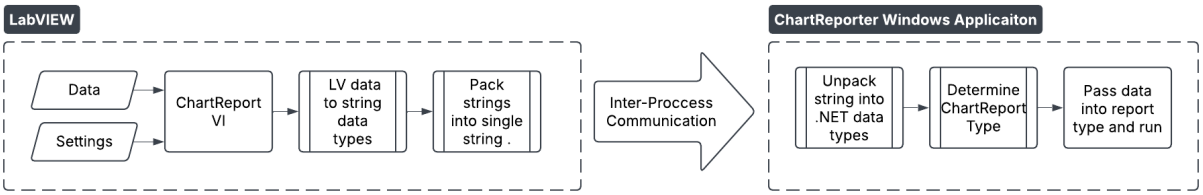
Running ChartReporter as Stand-Alone

When operating ChartReporter as a stand-alone application, data is first loaded into the application using the Open tool. The user then selects a worksheet and data and clicks the ChartReport drop down and clicks a selection to run the report using data from the selected (visible) worksheet.

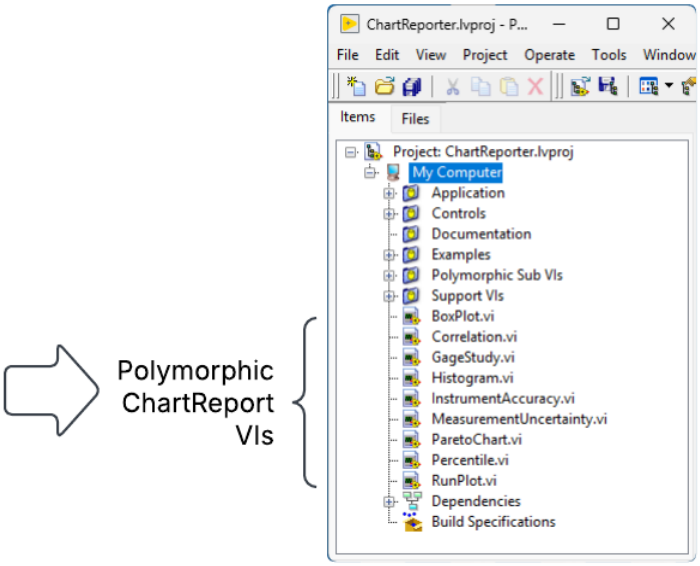


Running ChartReporter using LabVIEW

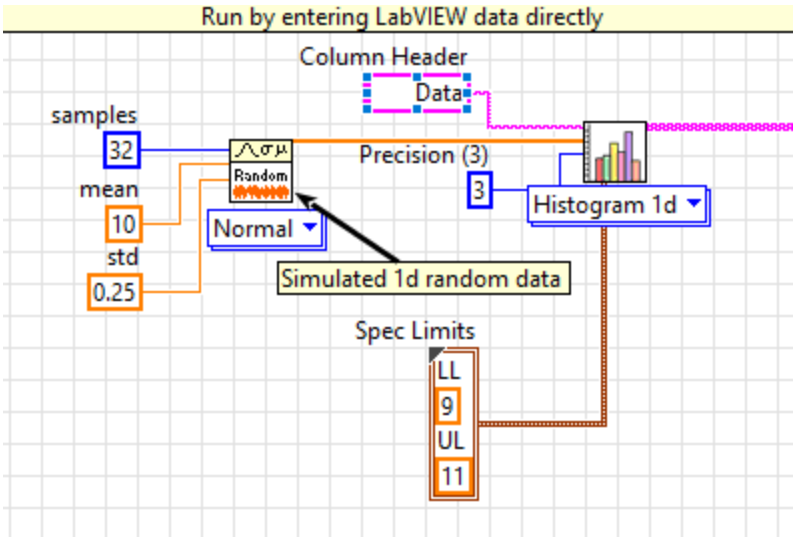
A LabVIEW project is provided to run chart reports from it such that data and required functionality is passed from the LabVIEW environment to the .NET ChartReporter application using inter-process communication as shown below.

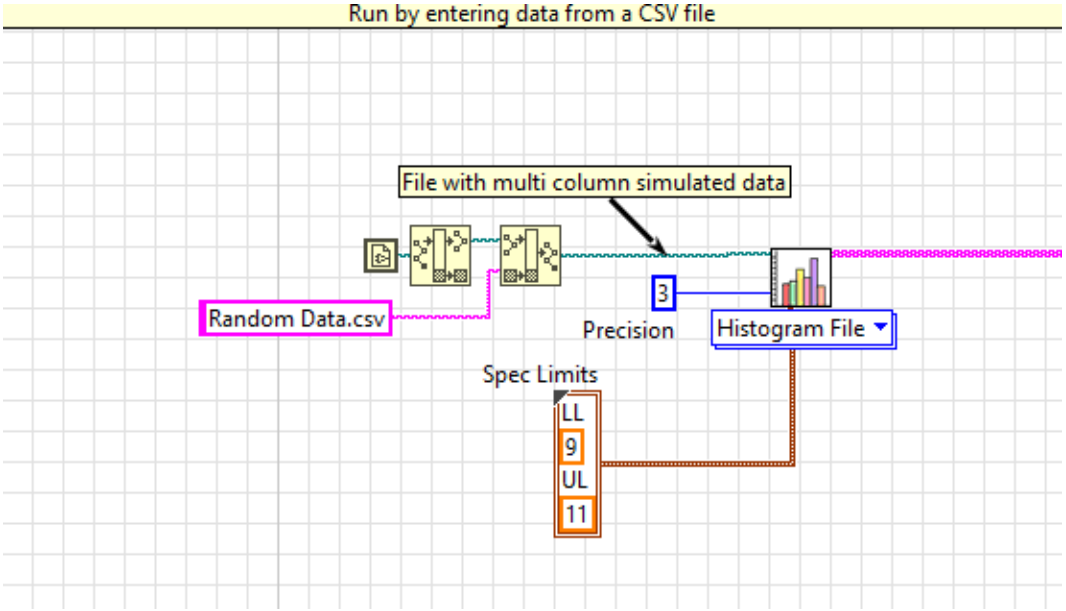


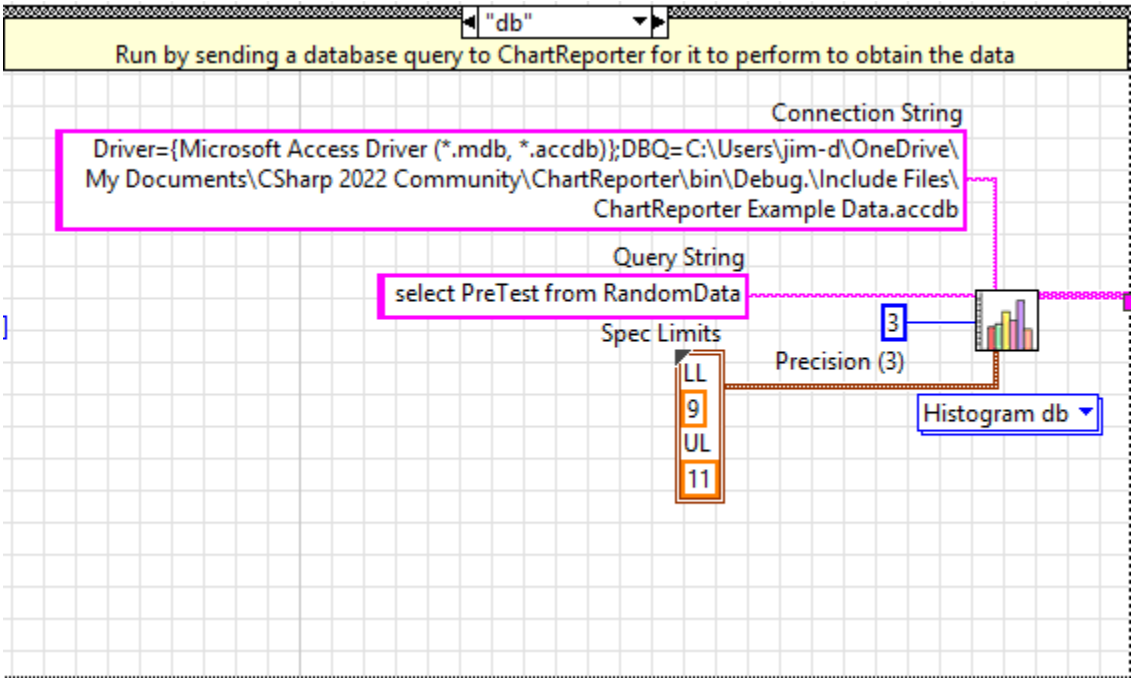
The LabVIEW project provides all the chart reports that are supported in the ChartReporter windows application. A screenshot of the LabVIEW project is shown below.



The polymorphic ChartReport VIs allows users to enter data from several methods, such as LabVIEW data input or a file or a database query.


Run by entering LabVIEW data directly
Column Header
Data
samples
32
mean
10
std
0.25
Random
Normal
Precision (3)
3
Histogram 1d
Simulated 1d random data
Spec Limits
LL
9
UL
11


Run by entering data from a CSV file
File with multi column simulated data
Random Data.csv
3
Precision
Histogram File
Spec Limits
LL
9
UL
11


"db"
Run by sending a database query to ChartReporter for it to perform to obtain the data
Connection String
Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=C:\Users\jim-d\OneDrive\
My Documents\CSharp 2022 Community\ChartReporter\bin\Debug.\Include Files\
ChartReporter Example Data.accdb
Query String
select PreTest from RandomData
Spec Limits
LL
9
UL
11
3
Precision (3)
Histogram db

Running ChartReporter using Python

A Python file is provided to demonstrate examples of how to use Python to run Chart Reports. The screenshot below shows performing a histogram ChartReport by inputting data directly from a database query or from a file. The python file can be modified by the user to implement their own Chart Reports for any of the supported chart types.

```python
def histogram(data_format_number):
    report_type = "Histogram"
    existing_workbook = ""
    lsl = 9
    usl = 11.0
    property_list = [lsl, usl]
    match data_format_number:
        case 1: # Data
            report_title = "Python Histogram Data Example"
            column_headers = ["Data1", "Data2", "Data3", "Data4"]
            datatable = random_normal_datatable([10, 10.1, 9.9, 10], .25, 32, 3)
            run_data_chartreport(report_type, report_title, existing_workbook, column_headers, datatable, property_list)
        case 2: # Database
            report_title = "Python Histogram Database Example"
            connection_string = "Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=" + database_file_path
            query_string = "select Data1, Data2, Data3, Data4 from RandomData"
            run_database_chartreport(report_type, report_title, existing_workbook, connection_string, query_string, property_list)
        case 3: # File
            report_title = "Python Histogram File Example"
            file_path = r"C:\ChartReporter\Include Files\ChartReporter Example Data.xlsx"
            worksheet_name = "RandomData"
            run_file_chartreport(report_type, report_title, existing_workbook, file_path, worksheet_name, property_list)
```