MoreSteam®

2023
EngineRoom Validation Kit

EngineRoom Software Validation Kit

Welcome!

MoreSteam is dedicated to providing high-quality software and excellent customer service to our users. We recognize that your company may operate in a regulated environment and, as such, may need to document validation for your intended use of our software. To that end, we have prepared this software validation kit. Among other things, this kit provides documentation that our software has been rigorously tested against independent documented sources not affiliated with MoreSteam to ensure accuracy and reliability of the statistical analyses and output. The instructions and datasets in this documentation can be used as baseline data and results to compare with EngineRoom during the validation process.

In addition, this document provides information about our development lifecycle and the practices we use when validating EngineRoom prior to release. It includes the following:

1. Cover Letter
2. EngineRoom Software Development Life Cycle
3. EngineRoom Software Testing Protocol
4. EngineRoom Technical Specifications
5. EngineRoom Output validated against National Institute of Standards and Technology (NIST) Datasets
6. A link to resources housed within EngineRoom software containing datasets and output for several statistical tools. These in-applications resources can be refreshed and/or revisited for just-in-time validation assessments. A validated output file of numerically and visually accurate results for the tests provided by in the above project file, intended for comparison.

Follow these Instructions to run the validation procedures, i.e., by generating analytic outputs, which EngineRoom generates based on your commands, and matching the generated outputs with validated outputs:

1. First, ensure you have access to EngineRoom software via an active account and subscription. If you do not have an account or active subscription, you can either obtain a trial subscription here or by contacting MoreSteam at support@moresteam.com.
2. Next, access the EngineRoom Validation project housed within your EngineRoom subscription. Clicking the EngineRoom Validation project link should open the EngineRoom application. The EngineRoom Validation project will appear on EngineRoom's Welcome screen. Select the "Launch Project" button and access the project. In the event the EngineRoom Validation project does not appear in your account, or you have any difficulty accessing the project, please contact MoreSteam.

3. The EngineRoom Validation project includes multiple data sources (data sets) appearing on the left side of the workspace, and multiple completed studies (including graphical and numerical outputs) on the right side of the workspace. When selected, the completed studies are automatically refreshed based on the data sources relating to the studies.
4. Next, access the Validated EngineRoom Output PDF file provided by this Kit (the validated output and links to the pdf files can be located in the Table of Contents).
5. Compare the outputs generated by EngineRoom in the Validation Project the against the Validated EngineRoom Output.

Note:
Acceptable differences may be found because of:

- differences in browsers or browser settings (e.g.: colors on graphs)

- minor differences in the formatting of output in EngineRoom (e.g. line thickness, font appearance, etc.)

Other than acceptable differences, the multiple Validated EngineRoom outputs should match the outputs generated by the EngineRoom Validation project studies.

Compliance with CFR Title 21 – Part 11

- For purposes of U.S. Food and Drug Administration (FDA) validation, EngineRoom should be considered a tool. EngineRoom customers who are FDA-regulated might be expected to validate systems built using the EngineRoom application. Because EngineRoom is a tool, the user must demonstrate to the FDA that EngineRoom is being used correctly. See “Complying with United States Code of Federal Regulations, Title 21 Part 11" in Appendix 1: “FDA-related issues” in “The Quality Imperative” for more information.

- Customers can re-create analyses by saving and running/refreshing the provided EngineRoom Validation Project, which contains the aforementioned multiple data sources and studies with output. The study outputs represent the correct outputs for various data configurations and study settings and are included in a PDF file which can be used to check the results from the analyses.

EngineRoom Statistical Software provides password protection for viewing, opening, saving, and modifying project files. This protection serves as validation for the ongoing use and storage of project files and data. For complete control, password protection should be combined with a file or source control system to verify dates, times, and approved access.

At MoreSteam, we are committed to continuous improvement and strive to keep raising the bar in the field of quality improvement. If you have any questions regarding our validation policies and processes, please contact our Support Team by visiting https://www.moresteam.com/engineroom/support.cfm.

Sincerely,

Peg Pennington, President
MoreSteam.com LLC
9961 Brewster Lane
Powell, OH 43065

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Software Development Life Cycle

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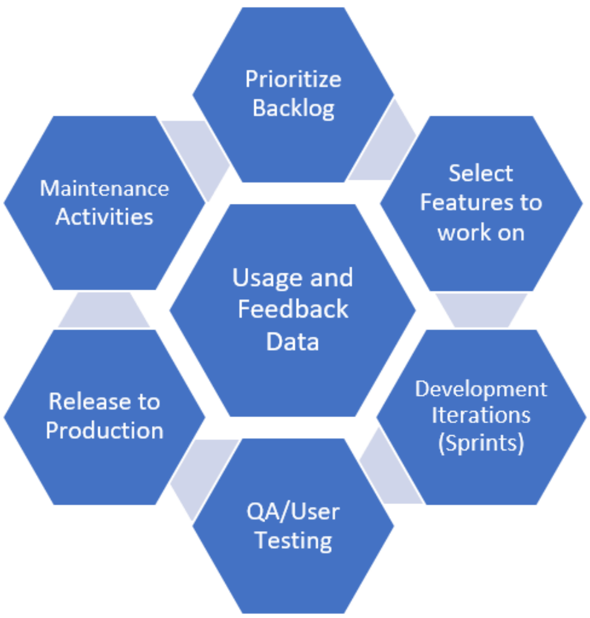
Section 1: Overview

MoreSteam uses an Agile Software Development Life Cycle that focuses on iterative and highly responsive software development.

Figure 1: High-Level Agile Software Development Life Cycle



MoreSteam's Agile system uses the Scrum framework to ensure rapid delivery of high-quality software, and a business approach that aligns development with customer needs and company goals.

The Scrum framework is distinguished by the following:

- Break work into cycles (usually 2 weeks long) called sprints
- Plan sprints based on important requirements for that point in time
- Don't estimate specific time; compare amount / size of work
- Review post-sprint to see how it went, what could be improved
- Collect feedback on the deliverables
- Daily stand up (5-10 minutes) meetings to highlight blockers and keep things moving

Section 2: Backlog Grooming and Prioritization

2.1 Responsibility

The EngineRoom Software Development team reviews the EngineRoom feature/item backlog on an ongoing, regular schedule in the agile project management database (Jira), and refines the requirements by incorporating stakeholder feedback and additional information as needed from Sales and Marketing, Product Management, and Technical Support. During the grooming process the backlog of items is prioritized and prepared for upcoming sprint planning sessions.

2.2 Location

The product backlog is made available to the company for reference and additional feedback, on the product's Agile Project Management Database (Jira) site.

2.3 Maintenance

The backlog is updated with all relevant and appropriate changes at each grooming session. All updates to the plan are the responsibility of the Development Team and Product Management.

All changes are reflected in the team Project Management (Jira) site.

Section 3: Project Initiation (Sprint Planning) Phase

3.1 Responsibility

During the sprint planning phase, the priorities of work are defined for the next two weeks.
The sprint is initiated by the development team.

3.2 Location

The sprint plan is made available to the company for reference and can be followed on the product's Agile Project Management Database (Jira) site.

3.3 Technical Team Role/Function

Team members choose their sprint cards (items) based on expertise and need. Paired programming is incorporated into the development process for developer growth opportunities and increased code quality.

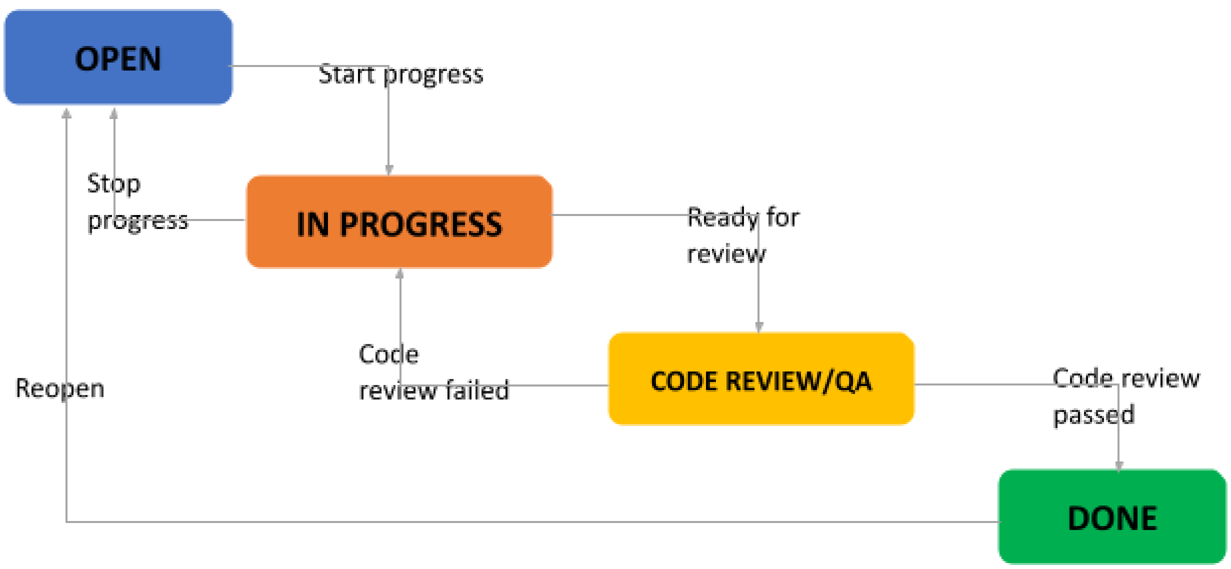
The team is responsible for generating its working backlogs and updating the Sprint Plan as deliverables are submitted. The team led by the Product Manager and other stakeholders define backlog items, including acceptance criteria and level of effort needed. The team also prioritizes the backlog based on user value as communicated by the stakeholders.

Section 4: Development Iterations (Sprint) Phase

During the Sprint, the requirements and design for the deliverables are refined, developed, and tested. This cycle is iterative, and each of these aspects is continually refined as development occurs.

This work occurs over multiple iterations as illustrated below.

Figure 2: Development Iteration (Sprint) Cycle



4.1 Design

The design is handled by the development team, led by the Product Manager, by soliciting information and feedback from all stakeholders. Large-scale design work is worked on collaboratively with the company's stakeholders.

The design is documented on the JIRA cards. The design will continue to develop as coding and testing continues, which is documented on the relevant Code Review artifacts (i.e. Pull Requests)

4.2 Development

The development team provides 'Show and Tell' demos to relevant stakeholders at the end of the sprint and once testing is passed, the deliverable is ready for release. The team collects detailed comments from all observers and reviewers, consolidates the findings, and updates their work backlogs accordingly.

4.3 Testing

Quality Assurance Testing is implemented as needed and as development progresses. During the Code Review phase, the reviewers test the relevant code for any bugs or localized changes.

Section 5: Software Release Phase

During the software release phase at the end of the Sprint, final testing occurs and the release is assessed for readiness. In addition, communication documents and assets are prepared and if needed, internal training is provided to ensure that customer-facing groups are prepared to support the release.

5.1 Final Testing

The standard process is:

- QA alongside code review

    a large change, conduct demonstrations (Show and Tell sessions) for stakeholders and customer facing groups

- Final regression testing before release to ensure that changes did not cause defects in any part of the system

For more information on test strategies, please see the EngineRoom Software Testing Protocol Document provided in this validation pack.

5.2 Software Readiness

The Product Manager and the Development Team are responsible for ensuring that all software requirements have been met and that the software is ready for release. The Product Manager works with Marketing and supported product teams to ensure supporting documents, communications and other resources are ready to be released at the time of the software release to production.

5.3 Internal Training

The Product Manager is responsible for coordinating all internal training necessary to support the software.

5.4 Release Communication

Project Management and Marketing are responsible for all release activities involving the branding, communication, training, selling, and delivery of a release.

Section 6: Production and Maintenance Phase

During the production and maintenance phase, the software is being supported in the field. As bugs and improvements are identified, they are documented and evaluated for inclusion in a future release of the software.

The Product Manager monitors the market needs, the usage and reported issues continuously. Any identified issues along with direct feedback from stakeholders is recorded and used to determine whether a released feature or tool needs to be reopened or fixed and added back to the backlog for prioritization.

Product releases can be either a Release (contains new functionality and bug fixes) or a Hotfix (a critical and urgent need).

Releases follow the same Product Development processes as a Major Release, with a few adjustments for the smaller scope and specific focus.

Hot Fixes are unplanned Maintenance Releases that are driven by a critical and urgent need. Hot Fixes contain Critical Bug Fixes that must be delivered to customers before the next planned Maintenance Release. The need for each Hotfix will be reviewed by the Development Team, the Product Manager and the Director of Product Development. If they determine that a Hotfix is warranted, it will be implemented and distributed to customers. The Hot Fix is managed like a Maintenance Release, with process and scope changes made as needed to deal with the specific bug fixes.

The development team follows an established cadence of feature releases and hotfix releases according to the sprint schedule (every two weeks).

EngineRoom Software Verification and Validation

Versions of third-party software used: R 3.5.0 and .NET Framework 4.6.2 with C# 7.0

Automated R Tests (Regression Tests)

- These test each of our R Scripts and make sure that the results are what we expect.
  - Utilize pre-existing JSON files in the repository containing the exact results of a given combination of inputs and options into a study.
  - For each noted combination of inputs and options, we run the script and check that its results match that of the JSON file.
- Tests are run before and after any changes to the R scripts are submitted to Code Review.
- Changes to formula calculations in a script trigger corresponding changes to the testing JSON files associated with the script, to account for the new calculations.
- Test data inputs are sourced from MoreSteam's courses (where data sets are validated using multiple commercial software packages and hand calculations) as well as text books and online data libraries (such as NIST, Kaggle and Github).
- If cases with specific inputs/options need to be accounted for that are not covered in the test battery, we add them to the tests.

Automated C# Tests (Unit Tests)

- For the tools coded in C#, unit tests are used to verify:
  - Studies run correctly
  - Studies contain expected results objects
  - Key calculations yield accurate values

Automated Test Info (Both C# and R)

- The builds for development and production proceed on the local development server. If any automated test fails, the build fails and does not push its artifacts to the development/production sites.

QA Testing (Manual Tests)

- While a code edit is undergoing Code Review, the reviewers test multiple situations relating to the code in order to stress test the edited code.
- Any unexpected behavior is noted and fixed immediately, while pre-existing bugs or aberrations are noted for resolution in a later sprint.
- Code Review is complete once all tests pass the evaluation criteria.

Smoke Testing (Manual Regression Tests)

- Before a major release, multiple team members implement a script to test specific parts of the application for incorrect behavior.
- Multiple browsers are tested to ensure cross-browser compatibility.

- If incorrect behavior is found that does not exist on the production server, it is patched and re-tested before release.
- If incorrect behavior is found that does exist on the production server, it is prioritized for resolution on the next sprint cycle.

EngineRoom Technical Specifications

System Requirements

Browser

- Chrome (Version 79+)
- Edge (Version 91+)
- Firefox (Version 78+)
- Safari (Version 13+)

Screen Resolution

- 1024 x 768 (minimum)
- 1920 x 1080 (recommended)

Operating Systems

- Microsoft Windows (7 and higher)
- Apple Mac OS X

Dataset Requirements

Supported Formats

- Microsoft Open XML format for spreadsheets (.XLSX and .CSV)

Note: If you do not have Microsoft Excel, your spreadsheet program may be capable of exporting to this format.

Maximum File Size

- Data files: 500kB (approximately 30,000 cells)
- Supporting files (images, PDF, etc.): 10 MB

Maximum Column Size

- 10,000 cells

Maximum Storage

- Data and supporting files: 500 MB

Comparison against NIST Statistical Standards using NIST Data Sets and Validated Output

The National Institute of Standards and Technology (NIST) provides a suite of Statistical Reference Data Sets (StRD) to assist in the evaluation of the numerical accuracy of statistical software. More information about these data sets is available at www.itl.nist.gov/div898/strd/.

The StRD data sets are the subject of this paper. The following sections report the results of tests that were run in EngineRoom. All tests used the same date: March 22, 2021. The tests were run for 64-bit systems on the latest versions of the following browsers (Note, IE is no longer supported in EngineRoom):

- Windows versions: Edge, Chrome
- macOS versions: Safari, Chrome

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I. Univariate Summary Statistics

URL: https://www.itl.nist.gov/div898/strd/univ/homepage.html
Selected 3 Data sets from the list: PiDigits, NumAcc2 and NumAcc4

Dataset Name	Level of Difficulty	Number of Observations	Source
PiDigits	Lower	5000	Observed
Lottery	Lower	218	Observed
Lew	Lower	200	Observed
Mavro	Lower	50	Observed
Michelso	Lower	100	Observed
NumAcc1	Lower	3	Generated
NumAcc2	Average	1001	Generated
NumAcc3	Average	1001	Generated
NumAcc4	Higher	1001	Generated

Univariate Summary Statistics Results Table:

Data Set	Size	Statistic	NIST Value	ER Value
PiDigits	5000	Mean	4.53480000000000	4.535
		Standard Deviation	2.86733906028871	2.867
		First-order Autocorrelation	-0.00355099287237872	-0.004

NumAcc2	1001	Mean	1.2	1.2
		Standard Deviation	0.1	0.1
		First-order Autocorrelation	-0.999	-1
NumAcc4	1001	Mean	10000000.2	10,000,000
		Standard Deviation	0.1	0.1
		First-order Autocorrelation	-0.999	-0.992

Full Results:

1. PiDigits:

NIST:

```
                                                    Certified Values
Sample Mean                                   ybar:   4.53480000000000
Sample Standard Deviation (denom. = n-1)         s:   2.86733906028871
Sample Autocorrelation Coefficient (lag 1) r(1): -0.00355099287237972

Number of Observations:                               5000
```

EngineRoom:

Statistics

	Y
Count	5,000
Min	0
Max	9
Mean	4.535
Median	5
Standard Deviation	2.867
Variance	8.222
Anderson-Darling Test Statistic	85.68
Anderson-Darling p-value	0
Skewness	-0.008
Kurtosis	-1.22

Correlation

R	-0.004

2. NumAcc2:

NIST:

```
                                                  Certified Values
 Sample Mean                                ybar:  1.2    (exact)
 Sample Standard Deviation (denom. = n-1)      s:  0.1    (exact)
 Sample Autocorrelation Coefficient (lag 1) r(1):  -0.999 (exact)

 Number of Observations:                             1001
```

EngineRoom:

Statistics

	Y
Count	1,001
Min	1.1
Max	1.3
Mean	1.2
Median	1.2
Standard Deviation	0.1
Variance	0.01
Anderson-Darling Test Statistic	179.2
Anderson-Darling p-value	0
Skewness	0
Kurtosis	-2.003

Correlation

R	-1

3. NumAcc4:

NIST:

```
                                                  Certified Values
 Sample Mean                                ybar:   10000000.2 (exact)
 Sample Standard Deviation (denom. = n-1)      s:   0.1        (exact)
 Sample Autocorrelation Coefficient (lag 1) r(1):   -0.999     (exact)

 Number of Observations:                             1001
```

EngineRoom:

Statistics

	Y
Count	1,001
Min	10,000,000
Max	10,000,000
Mean	10,000,000
Median	10,000,000
Standard Deviation	0.1
Variance	0.01
Anderson-Darling Test Statistic	179.2
Anderson-Darling p-value	0
Skewness	0
Kurtosis	-2.003

Correlation

R	-0.992

II. ANOVA

URL: https://www.itl.nist.gov/div898/strd/anova/anova.html

Selected 3 Datasets from the list: SiRstv, SmLs04 and SmLs08

Design: One-Way Balanced **Model:** $y_{ij} = \mu + \tau_i + \epsilon_{ij}$

Dataset Name	Level of Difficulty	Constant Leading Digits	Replicates per Cell	Number of Treatments	Source
SiRstv	Lower	3	5	5	Observed
SmLs01	Lower	1	21	9	Generated
SmLs02	Lower	1	201	9	Generated
SmLs03	Lower	1	2001	9	Generated
AtmWtAg	Average	7	24	2	Observed
SmLs04	Average	7	21	9	Generated
SmLs05	Average	7	201	9	Generated
SmLs06	Average	7	2001	9	Generated
SmLs07	Higher	13	21	9	Generated
SmLs08	Higher	13	201	9	Generated
SmLs09	Higher	13	2001	9	Generated

One-way ANOVA Results Table:

Data Set	Replicates	Statistic	NIST Value	ER Value
SiRstv	5	Between SS	5.11462616000000 E-2	0.0511
		Within SS	2.16636560000000 E-1	0.2166
		Between MS	1.27865654000000 E-2	0.0128
		Within MS	1.083180000000 E-2	0.0108
		F Statistic	1.18046237440255	1.18
SmLs04	21	Between SS	1.68000000000000	1.68
		Within SS	1.80000000000000	1.8
		Between MS	2.10000000000000 E-1	0.21

		Within MS	1.00000000000000 E-2	0.01
		F Statistic	2.10000000000000 E+1	21
SmLs08	201	Between SS	1.60800000000000 E+1	16.08
		Within SS	1.80000000000000 E+1	18.04
		Between MS	2.01000000000000	2.01
		Within MS	1.00000000000000 E-2	0.01
		F Statistic	2.01000000000000 E+2	200.6

1. **SiRstv:**

NIST:

```
Certified Values:

Source of                    Sums of               Mean
Variation          df        Squares               Squares              F Statistic

Between Instrument   4 5.11462616000000E-02 1.27865654000000E-02 1.18046237440255E+00
Within Instrument   20 2.16636560000000E-01 1.08318280000000E-02
```

EngineRoom:

ANOVA Table

	DF	Sum Sq	MeanSq	FValue
Instrument	4	0.0511	0.0128	1.18
Residuals	20	0.2166	0.0108	NA

2. **SmLs04:**

NIST:

```
Certified Values:

Source of                  Sums of               Mean
Variation          df      Squares               Squares              F Statistic

Between Treatment   8 1.68000000000000E+00 2.10000000000000E-01 2.10000000000000E+01
Within Treatment  180 1.80000000000000E+00 1.00000000000000E-02
```

EngineRoom:

ANOVA Table

	DF	Sum Sq	MeanSq	FValue	p-value
Treatment	8	1.68	0.21	21	0
Residuals	180	1.8	0.01	NA	NA

3. **SmLs08:**

NIST:

```
Certified Values:

Source of                  Sums of               Mean
Variation          df      Squares               Squares              F Statistic

Between Treatment    8 1.60800000000000E+01 2.01000000000000E+00 2.01000000000000E+02
Within Treatment  1800 1.80000000000000E+01 1.00000000000000E-02
```

EngineRoom:

ANOVA Table

	DF	Sum Sq	MeanSq	FValue
Treatment	8	16.08	2.01	200.6
Residuals	1,800	18.04	0.01	NA

III. Linear Regression

URL: https://www.itl.nist.gov/div898/strd/lls/lls.shtml

Data set: Norris

Linear Regression Results Table:

Data Set	**Sample size**	**Statistic**	**NIST Value**	**ER Value**
Norris	36	Par1 Coefficient	-0.262323073774029	-0.262
		Par1 SE	0.232818234301152	0.2328
		Par2 Coefficient	1.00211681802045	1.002
		Par2 SE	0.429796848199937 E-03	0.0004
		Residual S	0.884796396144373	SQRT(MSE) = SQRT(0.7829) = 0.8848
		R-sq	0.999993745883712	1
		Regression SS	4255954.13232369	4,255,954
		Regression MS	4255954.13232369	4,255,954
		Residual SS	26.6173985294224	26.62
		Residual MS	0.782864662630069	0.7829
		F Statistic	5436385.54079785	5,436,386

Norris:

NIST:

Certified Regression Statistics

Parameter	Estimate	Standard Deviation of Estimate
B0	-0.262323073774029	0.232818234301152
B1	1.00211681802045	0.429796848199937E-03

Residual Standard Deviation	0.884796396144373
R-Squared	0.999993745883712

Certified Analysis of Variance Table

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F Statistic
Regression	1	4255954.13232369	4255954.13232369	5436385.54079785
Residual	34	26.6173985294224	0.782864662630069	

EngineRoom:

y = -0.2623 + (1.002) * (x)

Regression Statistics

Correlation Coefficient, R	1
R Squared	1
Adjusted R Squared	1
Count	36

Coefficient Table

	Estimate	Std. Error	t value	p-value	95% CI (lower)	95% CI (upper)
(intercept)	-0.262	0.2328	-1.1	0.2677	-0.719	0.194
x	1.002	0.0004	2,300	0	1.001	1.003

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Regression	1	4,255,954	4,255,954	5,436,386	0
Residuals	34	26.62	0.7829	NA	NA
Total	35	4,255,981	NA	NA	NA

EngineRoom Validation Test Output

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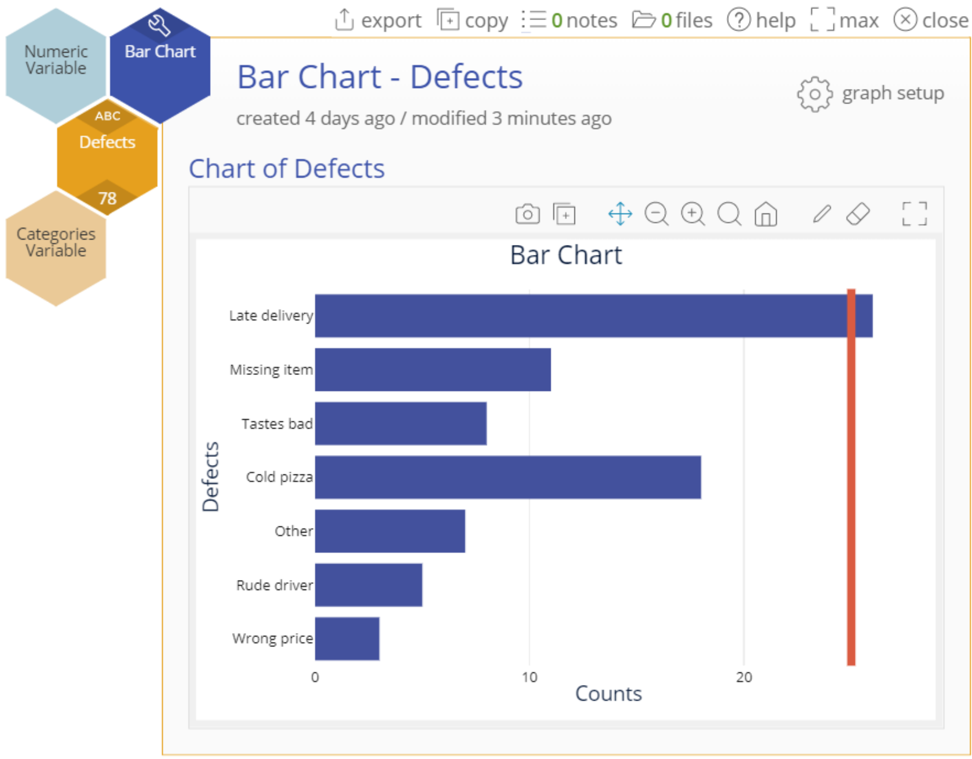
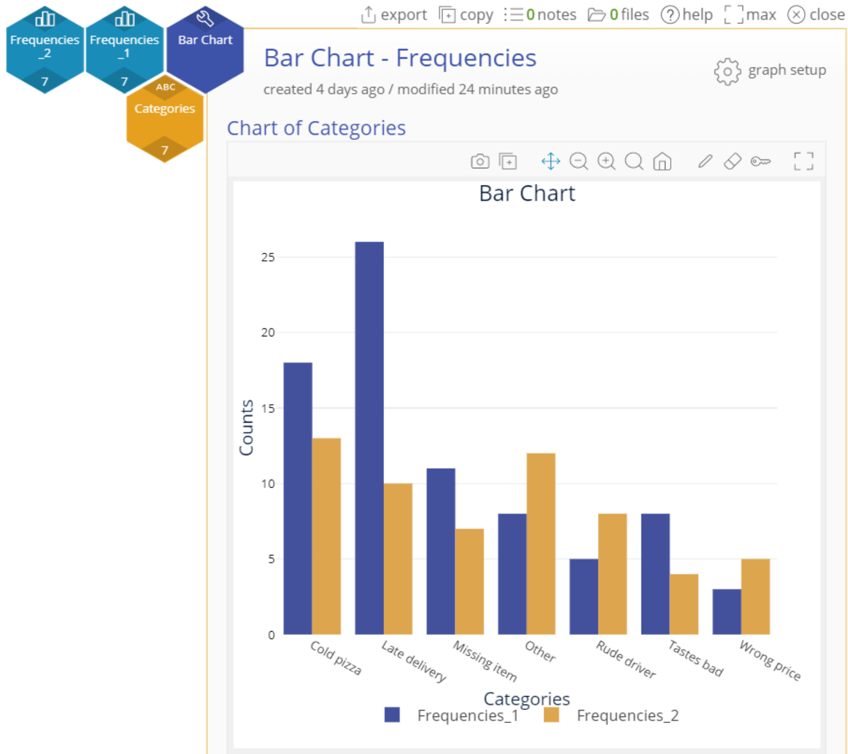
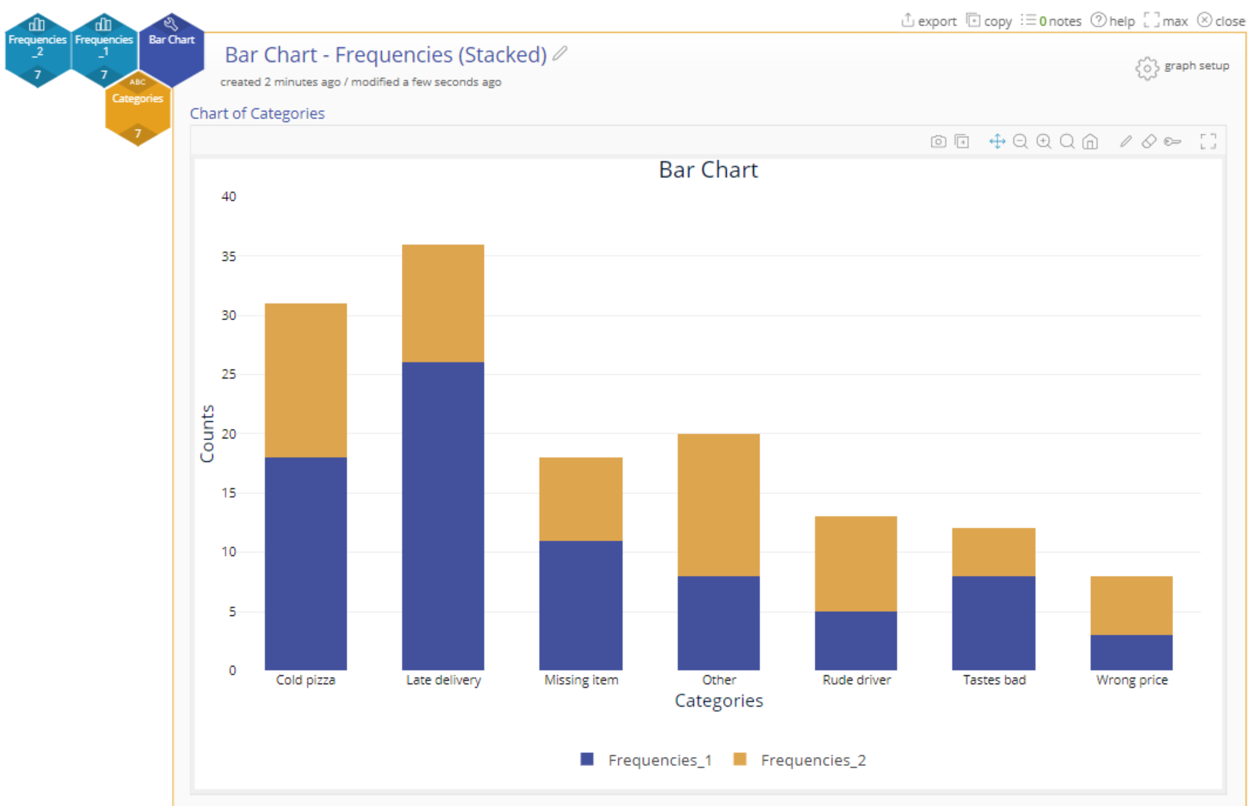
I. Dataset: BasicGraphs

1. Bar Chart - Defects, Reference line = 25

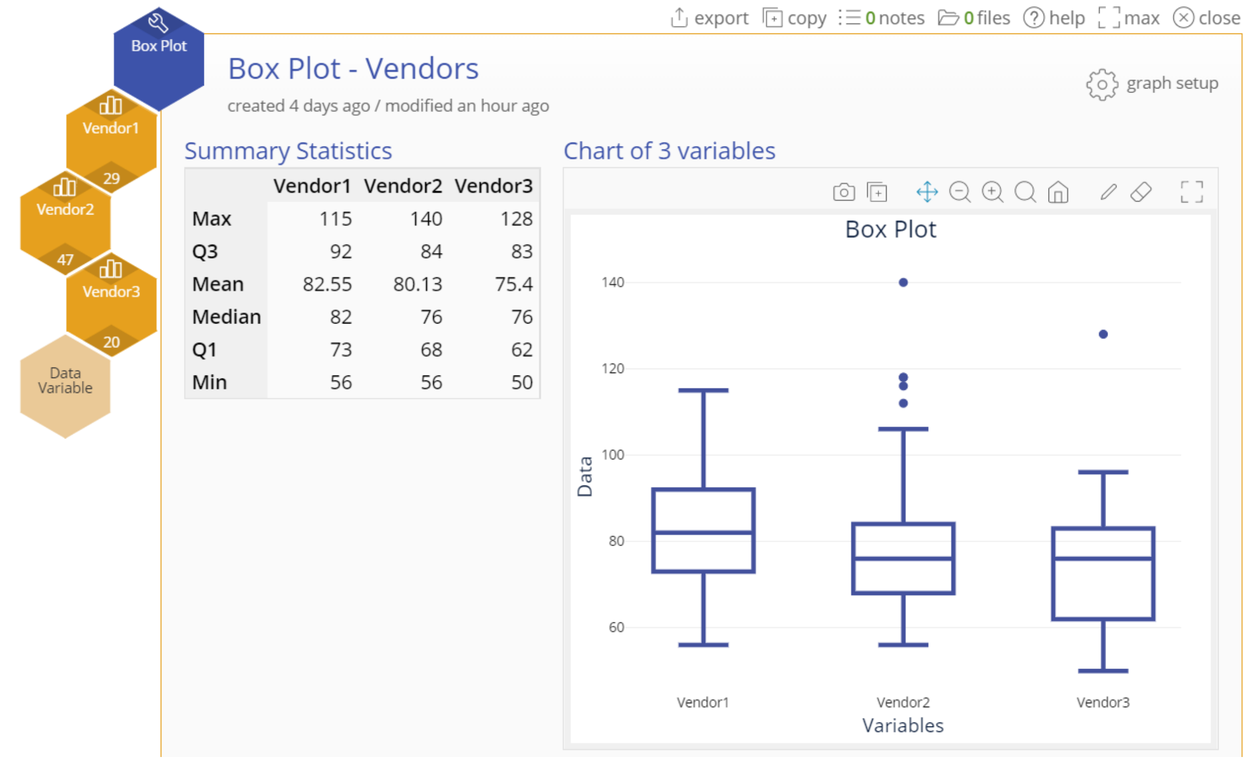


2. Bar Chart - Categories, Frequencies_1, Frequencies_2


Frequencies_2
Frequencies_1
Bar Chart
Categories
export copy 0 notes 0 files help max close
Bar Chart - Frequencies
created 4 days ago / modified 24 minutes ago
graph setup
Chart of Categories
Bar Chart
Counts
25
20
15
10
5
0
Cold pizza
Late delivery
Missing item
Other
Rude driver
Tastes bad
Wrong price
Categories
Frequencies_1
Frequencies_2

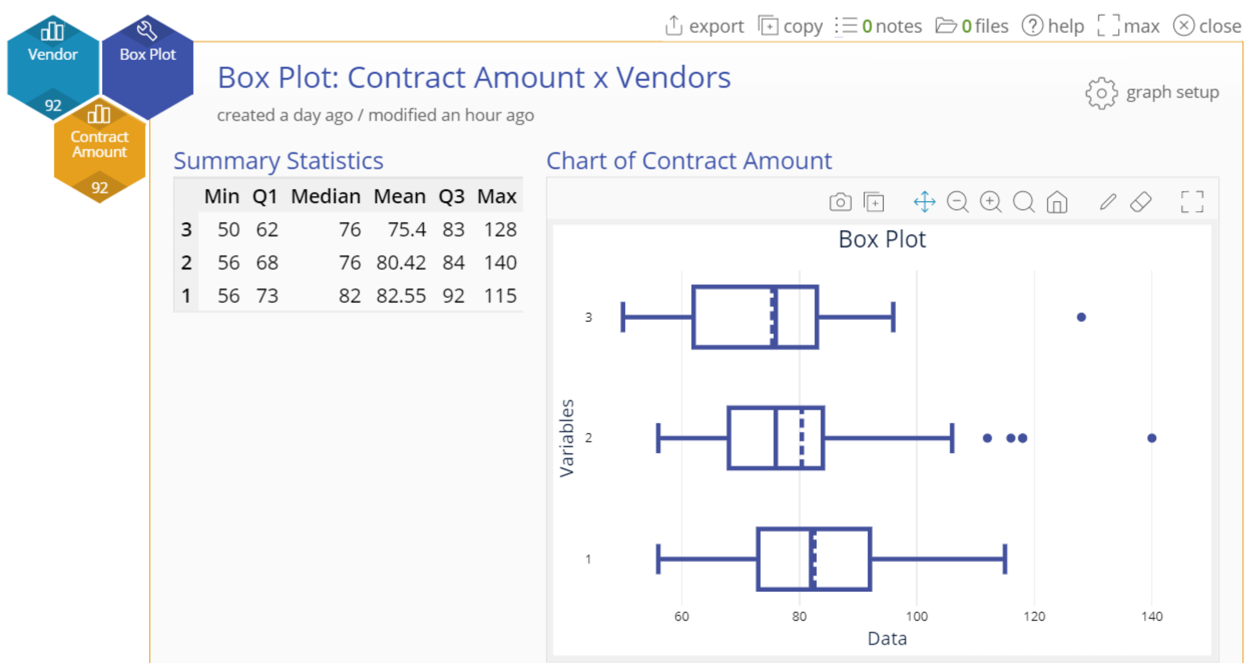

Frequencies_2
Frequencies_1
Bar Chart
Categories
export copy 0 notes help max close
Bar Chart - Frequencies (Stacked)
created 2 minutes ago / modified a few seconds ago
graph setup
Chart of Categories
Bar Chart
Counts
40
35
30
25
20
15
10
5
0
Cold pizza
Late delivery
Missing item
Other
Rude driver
Tastes bad
Wrong price
Categories
Frequencies_1
Frequencies_2

3. Box Plot - Vendors



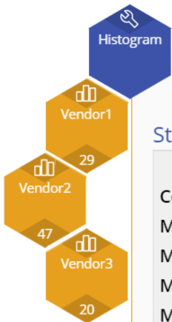
	Vendor1	Vendor2	Vendor3
Max	115	140	128
Q3	92	84	83
Mean	82.55	80.13	75.4
Median	82	76	76
Q1	73	68	62
Min	56	56	50

4. Box Plot: Contract Amount x Vendor



	Min	Q1	Median	Mean	Q3	Max
3	50	62	76	75.4	83	128
2	56	68	76	80.42	84	140
1	56	73	82	82.55	92	115

5. Histogram: Vendor1, Vendor2, Vendor3



export copy 0 notes 0 files help max close

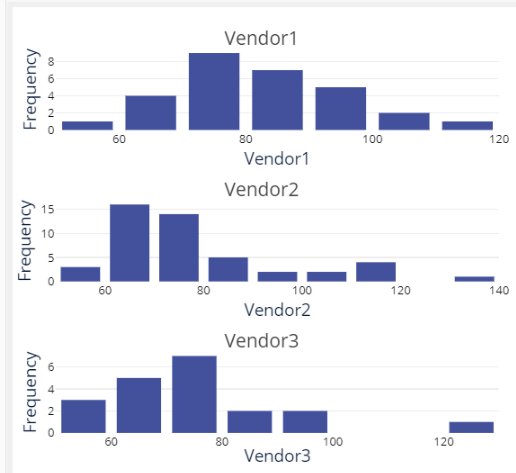
Histogram: Vendors

created a day ago / modified 2 hours ago

Statistics

	Vendor1	Vendor2	Vendor3
Count	29	47	20
Min	56	56	50
Max	115	140	128
Mean	82.55	80.13	75.4
Median	82	76	76
Standard Deviation	13.59	18.18	17.42
Variance	184.8	330.7	303.6
Anderson-Darling Test Statistic	0.403	2.498	0.6286
Anderson-Darling p-value	0.3352	0	0.087
Skewness	0.5567	1.422	1.355
Kurtosis	0.2043	1.754	3.346

Charts of 3 variables



6. Histogram: Contract Amount x Vendor

export copy 0 notes 0 files help max close

Histogram: Contract Amount x Vendors

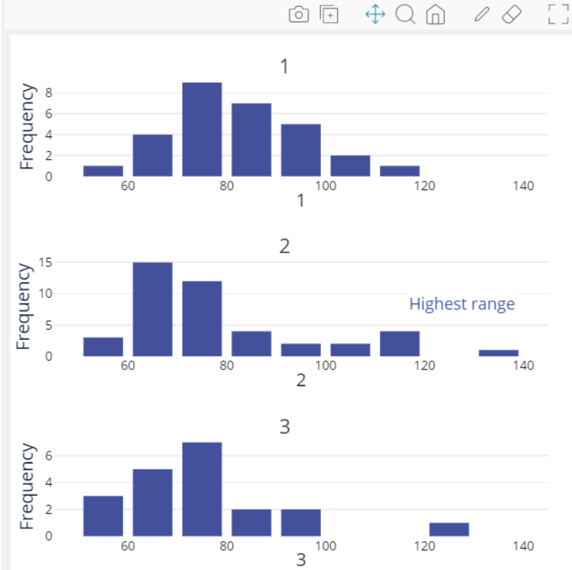
graph setup

created 2 minutes ago / modified 2 minutes ago

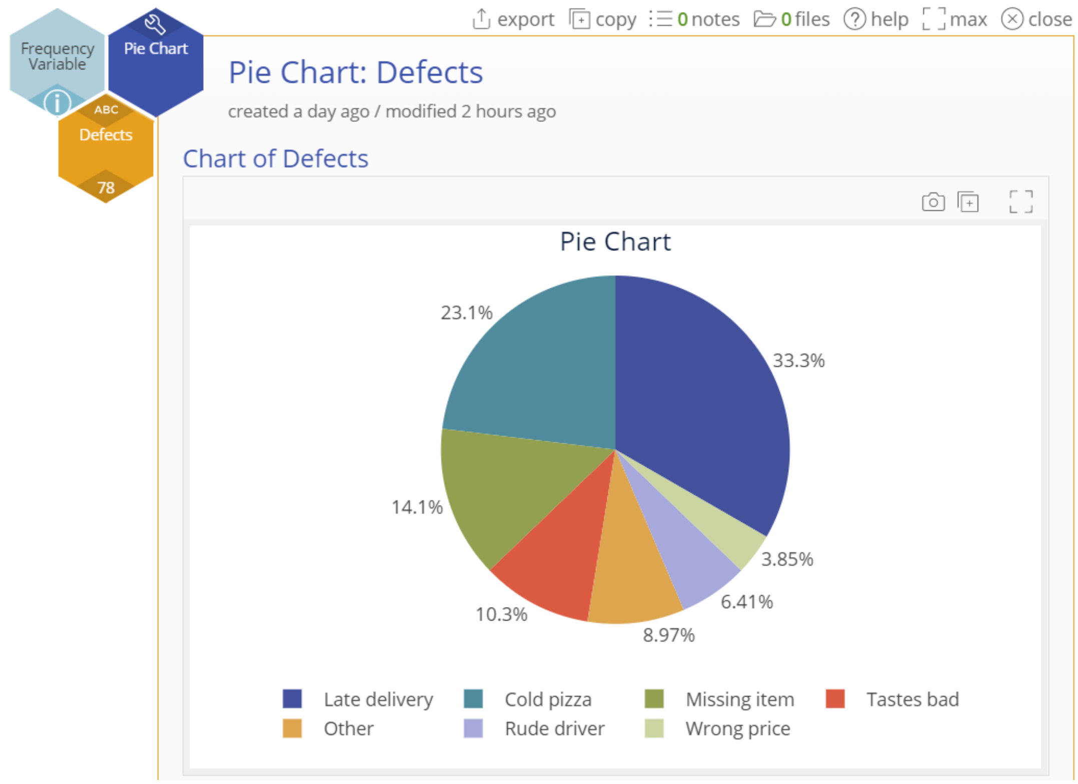
Statistics

	1	2	3
Count	29	43	20
Min	56	56	50
Max	115	140	128
Mean	82.55	80.42	75.4
Median	82	76	76
Standard Deviation	13.59	18.92	17.42
Variance	184.8	357.8	303.6
Anderson-Darling Test Statistic	0.403	2.313	0.6286
Anderson-Darling p-value	0.3352	0	0.087
Skewness	0.5567	1.347	1.355
Kurtosis	0.2043	1.374	3.346

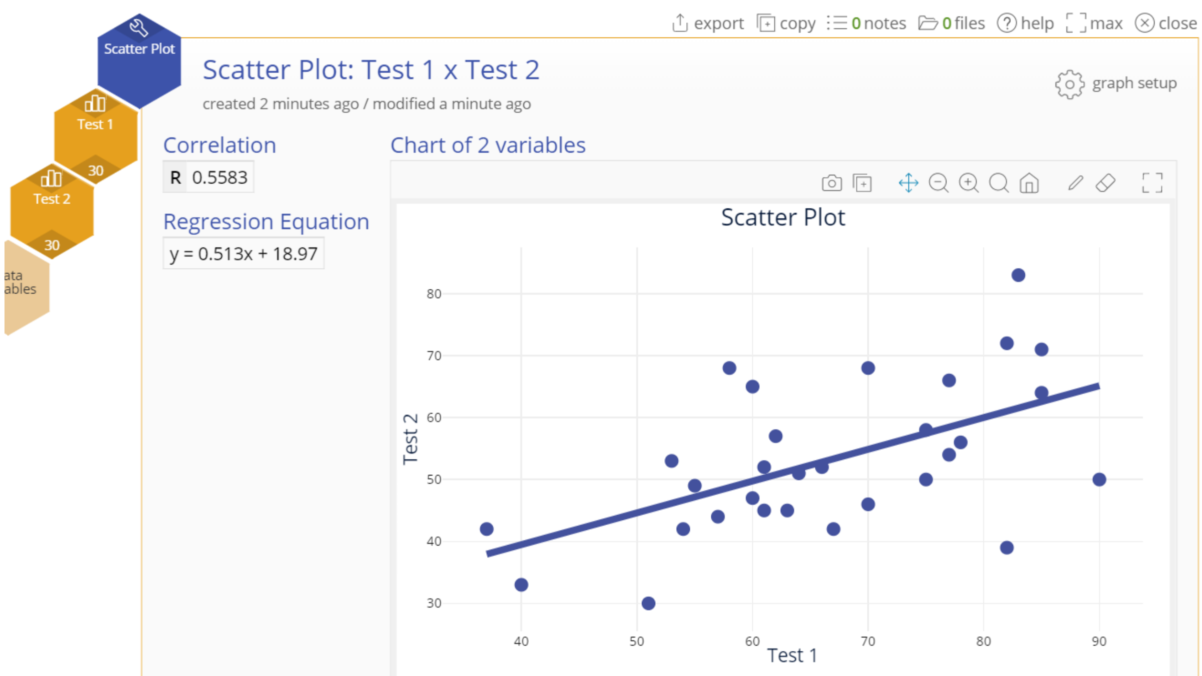
Charts of Contract Amount



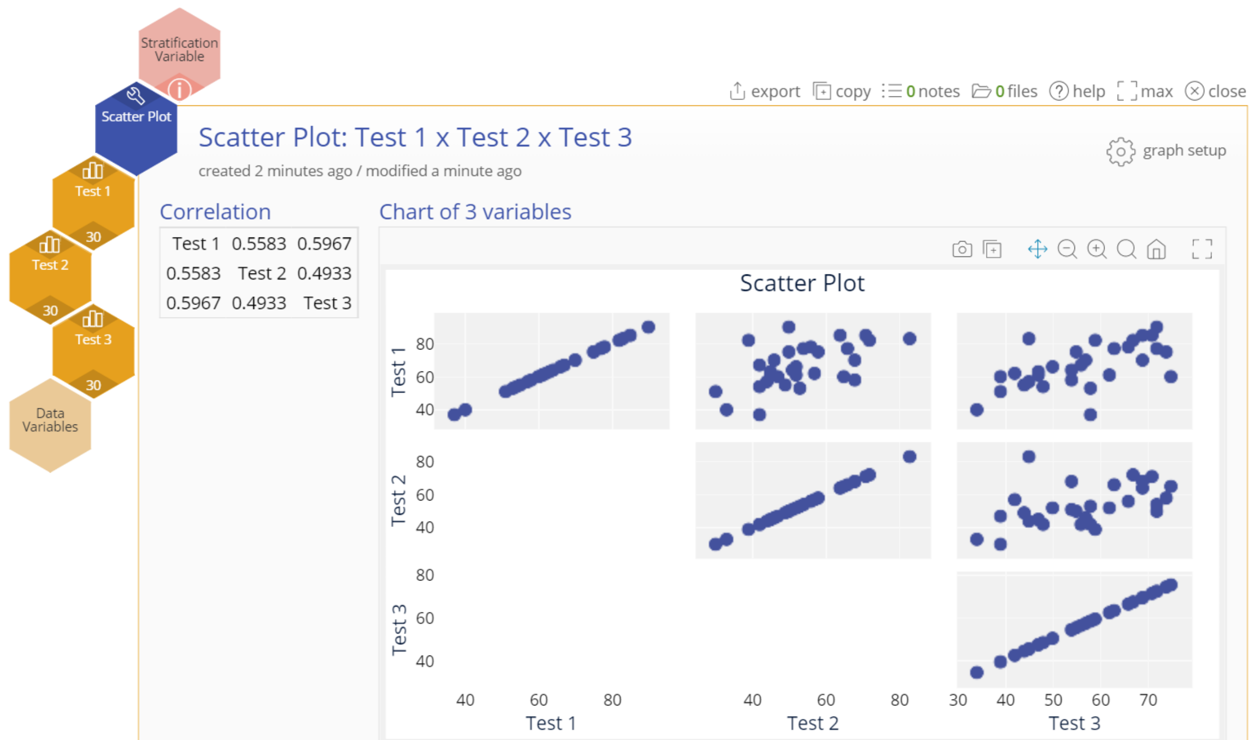
7. Pie Chart: Defects



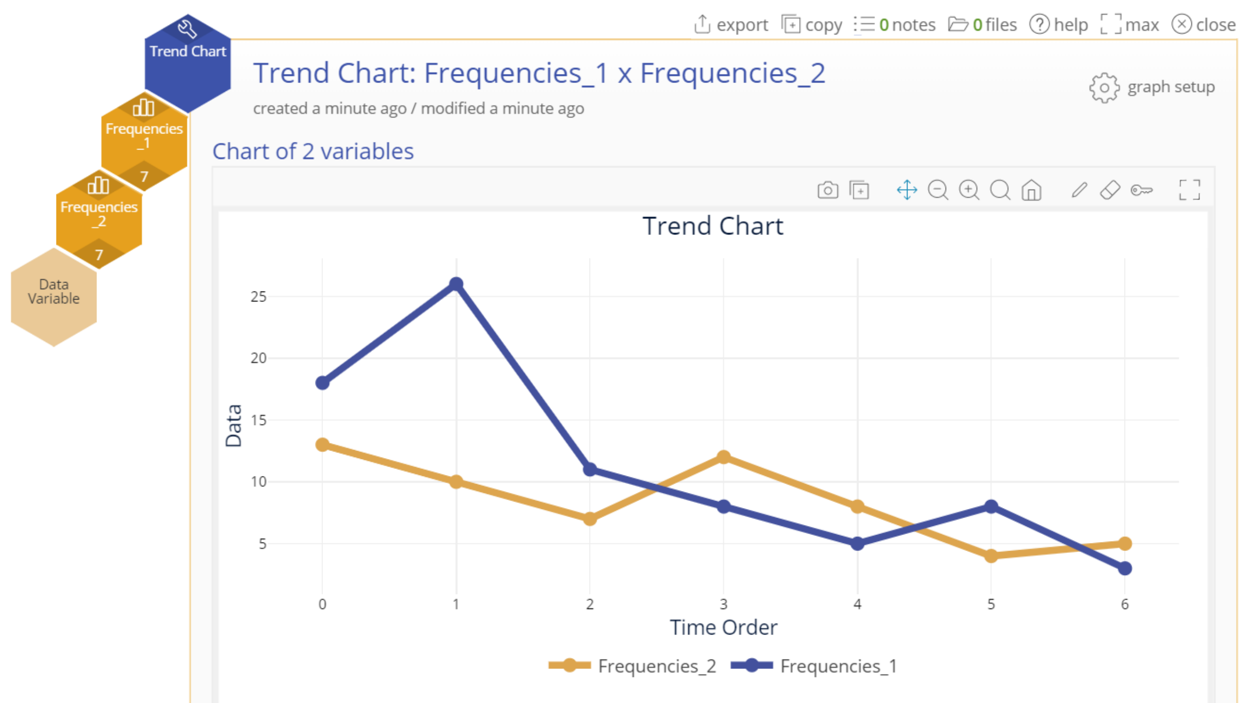
8. Scatter Plot: Test 1 x Test 2



9. Scatter Plot: Test 1 x Test 2 x Test 3



10. Trend Chart: Frequencies_1 x Frequencies_2



11. Pareto Analysis: Defects

Frequency Variable | Pareto Analysis | ABC Defects 78

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Pareto Analysis: Defects

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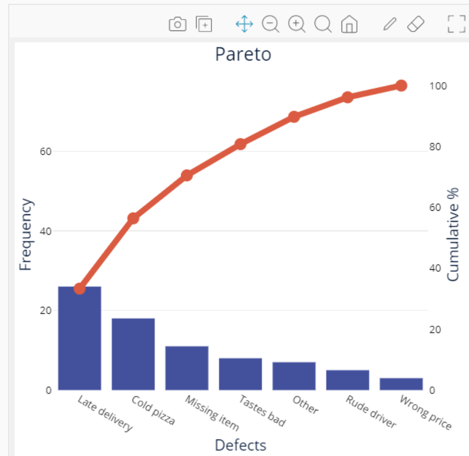
study setup

Results

	Frequency	Cumulative Frequency	Percentage	Cum Percentage
Late delivery	26	26	33.33	33.33
Cold pizza	18	44	23.08	56.41
Missing item	11	55	14.1	70.51
Tastes bad	8	63	10.26	80.77
Other	7	70	8.97	89.74
Rude driver	5	75	6.41	96.15
Wrong price	3	78	3.85	100

Chart of Defects



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II. Dataset: Measurement System Analysis

1. Gauge R&R: Measurement

Gauge R&R: Measurement

created a day ago / modified 2 hours ago

ANOVA Table - Crossed, with Interaction

	Df	Sum Sq	Mean Sq	F value	p-value
Part #	4	368.3	92.08	61,086	0
Operator	2	0	0	0.0023	0.9977
Operator*Part #	8	0.0121	0.0015	0.6615	0.7205
Repeatability	30	0.0684	0.0023		
Total	44	368.4			

ANOVA Table - Crossed, without Interaction

	Df	Sum Sq	Mean Sq	F value	p-value
Part #	4	368.3	92.08	43,508	0
Operator	2	0	0	0.0016	0.9984
Repeatability	38	0.0804	0.0021		
Total	44	368.4			

Gauge R&R - Variance Components (ANOVA) Method

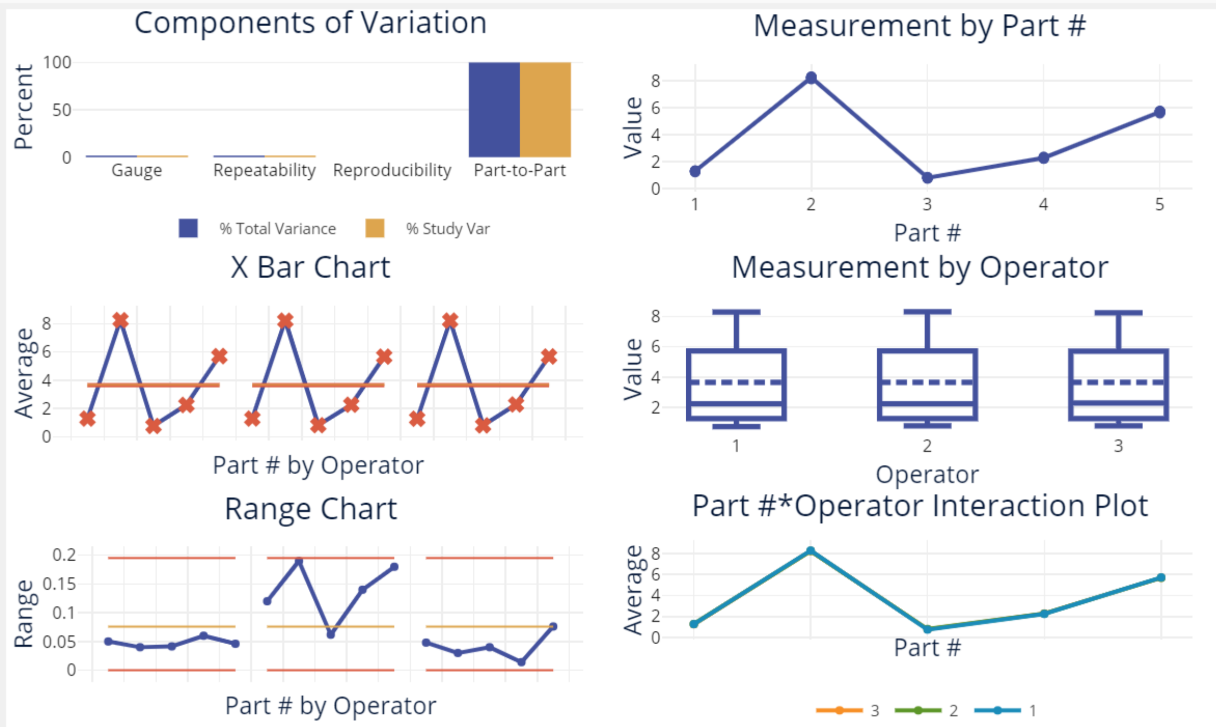
	VarComp	% Total Variance
Total Gauge R&R	0.0021	0.02
Repeatability	0.0021	0.02
Reproducibility	0	0
-Operator	0	0
Part-to-Part	10.23	99.98
Total Variance	10.23	100

Gauge R&R - AIAG Method

	Std Dev	StudyVar	% Study Var
Total Gauge R&R	0.046	0.276	1.44
Repeatability	0.046	0.276	1.44
Reproducibility	0	0	0
-Operator	0	0	0
Part-to-Part	3.199	19.19	99.99
Total Variance	3.199	19.19	100

Number of Distinct Categories	98

Charts of Measurement



2. Attribute Agreement Analysis: Binary

Attribute Agreement Analysis: Binary

created a day ago / modified 4 hours ago

Within Appraiser Agreement

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
Janet	20	20	100	86.09	100
Chris	18	20	90	68.3	98.77
Sam	19	20	95	75.13	99.87

Within Appraiser Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
Janet	F	1	0.2236	4.472	0
	P	1	0.2236	4.472	0
Chris	F	0.798	0.2236	3.569	0.0002
	P	0.798	0.2236	3.569	0.0002
Sam	F	0.886	0.2236	3.962	0
	P	0.886	0.2236	3.962	0

Each Appraiser Vs Standard

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
Janet	16	20	80	56.34	94.27
Chris	18	20	90	68.3	98.77
Sam	15	20	75	50.9	91.34

Each Appraiser Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
Janet	F	0.5604	0.1581	3.545	0.0002
	P	0.5604	0.1581	3.545	0.0002
Chris	F	0.8987	0.1581	5.684	0
	P	0.8987	0.1581	5.684	0
Sam	F	0.5422	0.1581	3.429	0.0003
	P	0.5422	0.1581	3.429	0.0003

Between Appraiser Agreement

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
All	10	20	50	27.2	72.8

Between Appraiser Fleiss Kappa Statistic

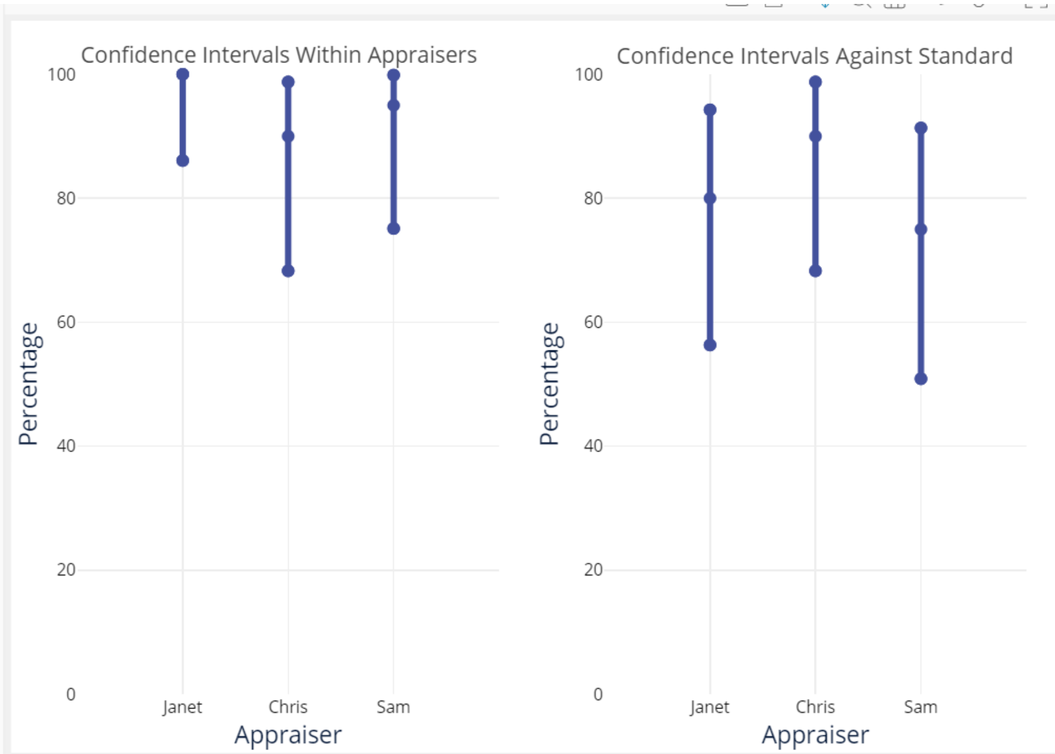
	Response	Kappa	SE Kappa	Z	p-value
All	F	0.4965	0.0577	8.6	0
	P	0.4965	0.0577	8.6	0

All Appraisers Vs Standard

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
All	10	20	50	27.2	72.8

All Appraisers Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
All	F	0.6671	0.0913	7.308	0
	P	0.6671	0.0913	7.308	0



3. Attribute Agreement Analysis: Ordinal data

Attribute Agreement Analysis: Ordinal data

created a day ago / modified 4 hours ago

Within Appraiser Agreement

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
1	4	10	40	12.16	73.76
2	6	10	60	26.24	87.84

Within Appraiser Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
1	1	0.7115	0.1826	3.897	0
	2	0.375	0.1826	2.054	0.02
	3	0.4886	0.1826	2.676	0.0037
	4	0.28	0.1826	1.534	0.0626
	5	0.1346	0.1826	0.7373	0.2305
	6	1	0.1826	5.477	0
	Overall	0.4687	0.0849	5.521	0
2	1	1	0.1826	5.477	0
	2	1	0.1826	5.477	0
	3	0.3182	0.1826	1.743	0.0407
	4	0.8137	0.1826	4.457	0
	5	1	0.1826	5.477	0
	6	-0.111	0.1826	-0.609	0.7286
	Overall	0.6685	0.0874	7.645	0

Within Kendall Coefficient of Concordance

	Kendall	Chi-Sq	DF	p-value
1	0.9224	24.91	9	0.0031
2	0.7605	20.53	9	0.0149

Each Appraiser Vs Standard

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
1	4	10	40	12.16	73.76
2	6	10	60	26.24	87.84

Each Appraiser Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
1	1	0.8693	0.1826	4.761	0
	2	0.5721	0.1826	3.133	0.0009
	3	0.7524	0.1826	4.121	0
	4	0.4526	0.1826	2.479	0.0066
	5	0.1285	0.1826	0.704	0.2407
	6	1	0.1826	5.477	0
	Overall	0.6268	0.0868	7.219	0
2	1	1	0.1826	5.477	0
	2	1	0.1826	5.477	0
	3	0.5937	0.1826	3.252	0.0006
	4	0.9111	0.1826	4.99	0
	5	1	0.1826	5.477	0
	6	0.148	0.1826	0.8108	0.2087
	Overall	0.7908	0.0884	8.951	0

Between Appraiser Agreement

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
All	2	10	20	2.521	55.61

Between Appraiser Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
All	1	0.8383	0.0816	10.27	0
	2	0.625	0.0816	7.655	0
	3	0.4205	0.0816	5.149	0
	4	0.4583	0.0816	5.613	0
	5	0.3208	0.0816	3.928	0
	6	0.3333	0.0816	4.082	0
	Overall	0.499	0.0384	13	0

Between Kendall Coefficient of Concordance

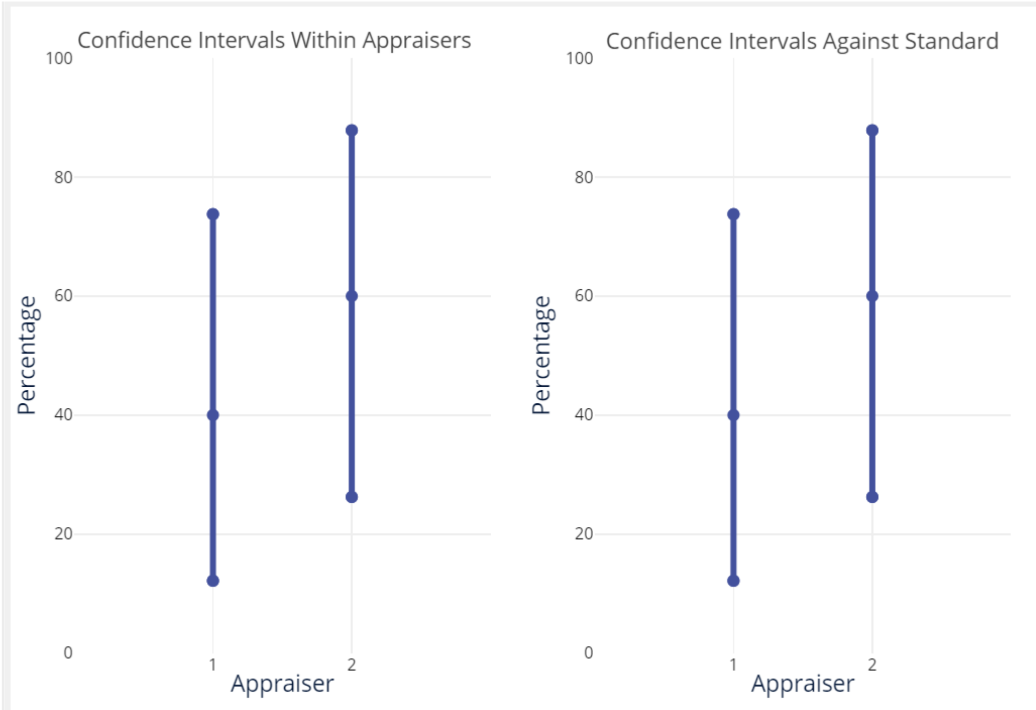
	Kendall	Chi-Sq	DF	p-value
All	0.7655	41.34	9	0

All Appraisers Vs Standard

	# Agreements	# Inspected	% Agreement	95% CI (lower)	95% CI (upper)
All	2	10	20	2.521	55.61

All Appraisers Fleiss Kappa Statistic

	Response	Kappa	SE Kappa	Z	p-value
All	1	0.9346	0.1291	7.24	0
	2	0.786	0.1291	6.089	0
	3	0.673	0.1291	5.213	0
	4	0.6819	0.1291	5.282	0
	5	0.5643	0.1291	4.371	0
	6	0.574	0.1291	4.446	0
	Overall	0.7088	0.0619	11.44	0



Confidence Intervals Within Appraisers
Percentage
Appraiser
Confidence Intervals Against Standard
Percentage
Appraiser

4. Process Capability Analysis: Width (lsl=0.8, target=0.85, usl=0.9)

Specifications

Lower Specification Limit:	0.8
Target:	0.85
Upper Specification Limit:	0.9
Specification Range (Tolerance)	0.1

Normality Test

Anderson-Darling Test Statistic	0.2326
Anderson-Darling p-value	0.794

Process Capability Statistics (Within)

Cp	0.8751
Cpk	0.8131
% Yield	99.02
Sigma	2.333

Process Capability Statistics (Overall)

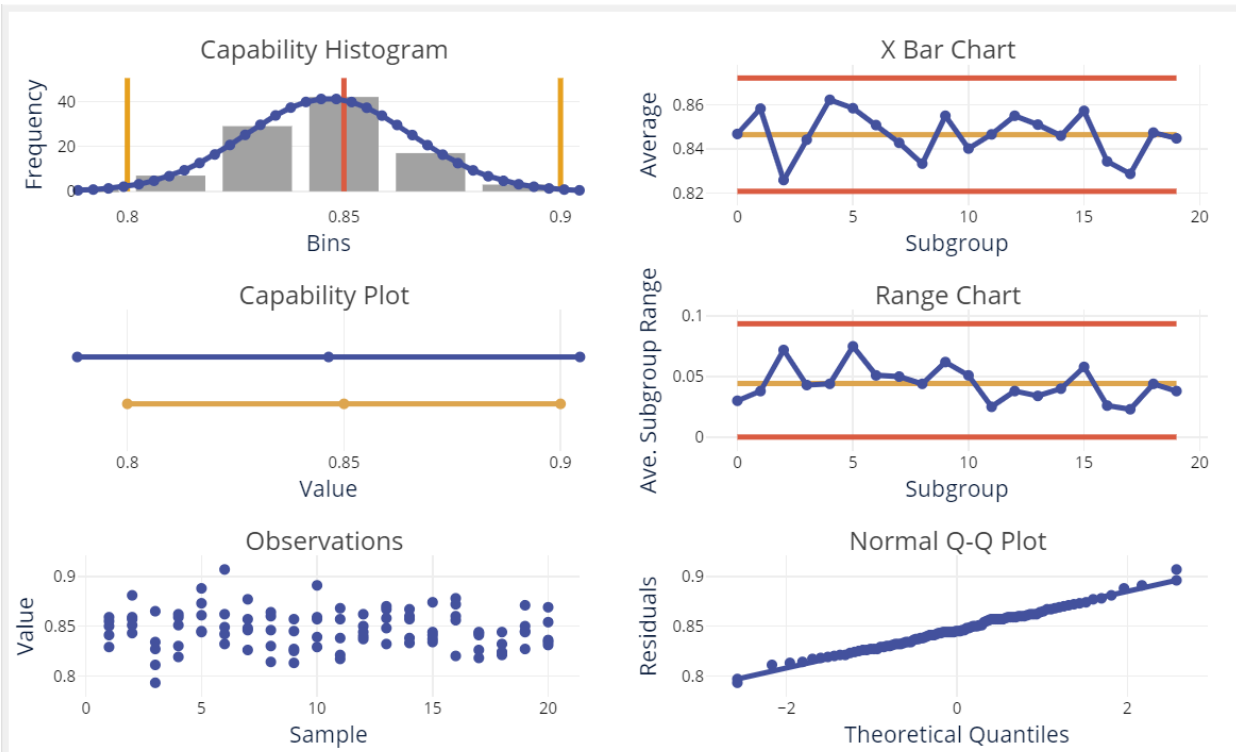
Pp	0.8617
Ppk	0.8007
Cpm	0.8475
% Yield	98.9
Sigma	2.291

Process Performance (% Defective)

	Observed	Expected (Within)	Expected (Overall)
% Below LSL	1	0.7356	0.8151
% Above USL	1	0.2468	0.2819
Total	2	0.9824	1.097

Process Characteristics

Sample Size	100
Subgroup Size	5
Number of Subgroups	20
Sample Mean	0.8465
Standard Deviation (Within)	0.019
Standard Deviation (Between)	0.0193



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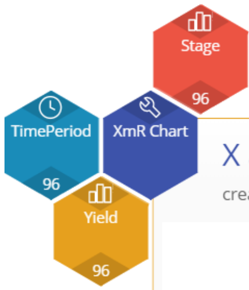
III. Dataset: Statistical Process Control

1. X and Moving Range Chart - Yield



X and Moving Range Chart - Yield

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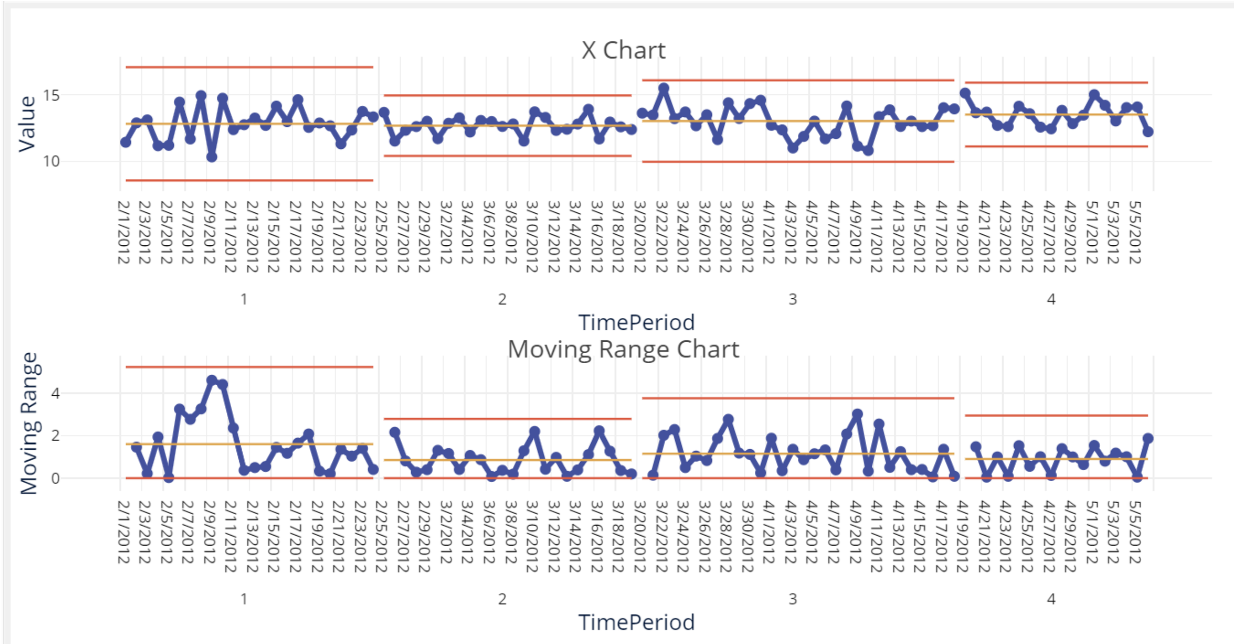
X Chart Statistics

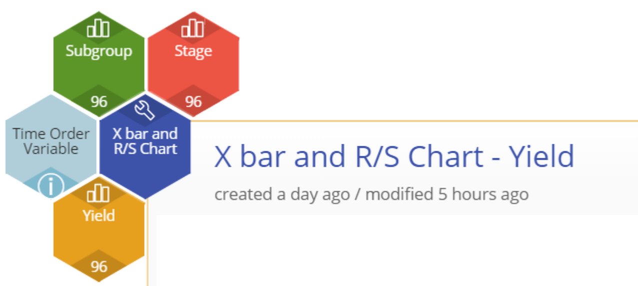
	Stage 1	Stage 2	Stage 3	Stage 4
UCL	17.08	14.95	16.09	15.91
Average	12.82	12.68	13.03	13.51
LCL	8.559	10.41	9.965	11.12

Moving Range Chart Statistics

	Stage 1	Stage 2	Stage 3	Stage 4
UCL	5.232	2.791	3.763	2.946
Average	1.601	0.8543	1.152	0.9018
LCL	0	0	0	0



2. X bar and R/S Chart - Yield

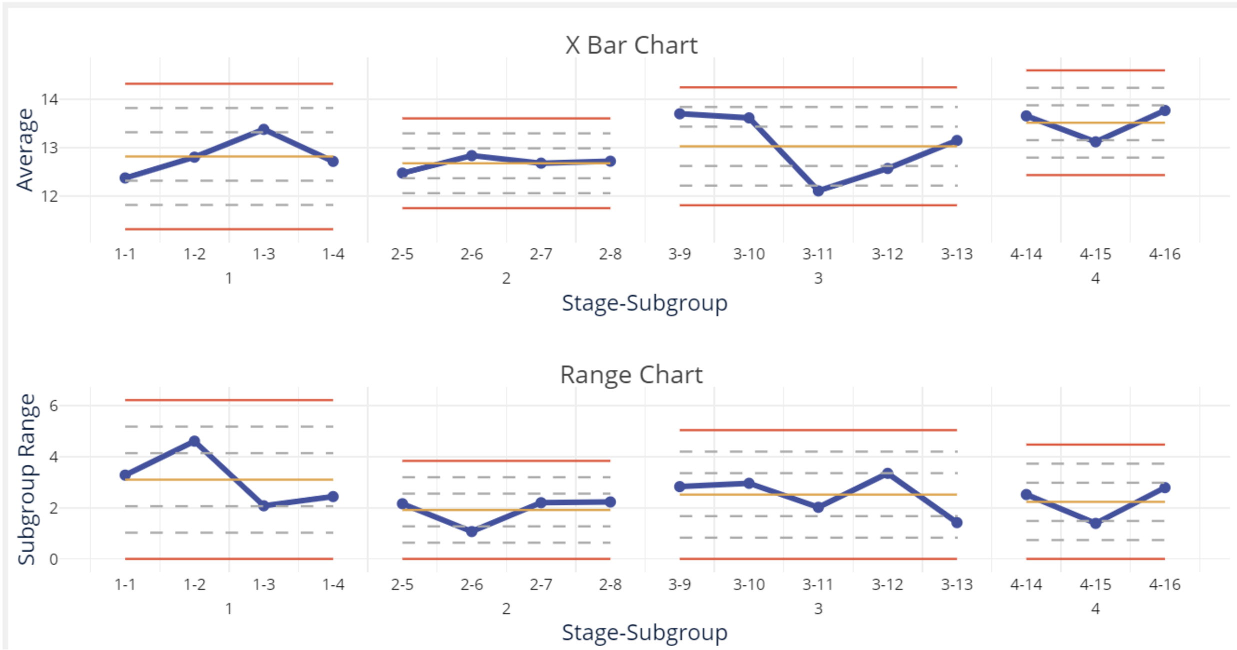


X Chart Statistics

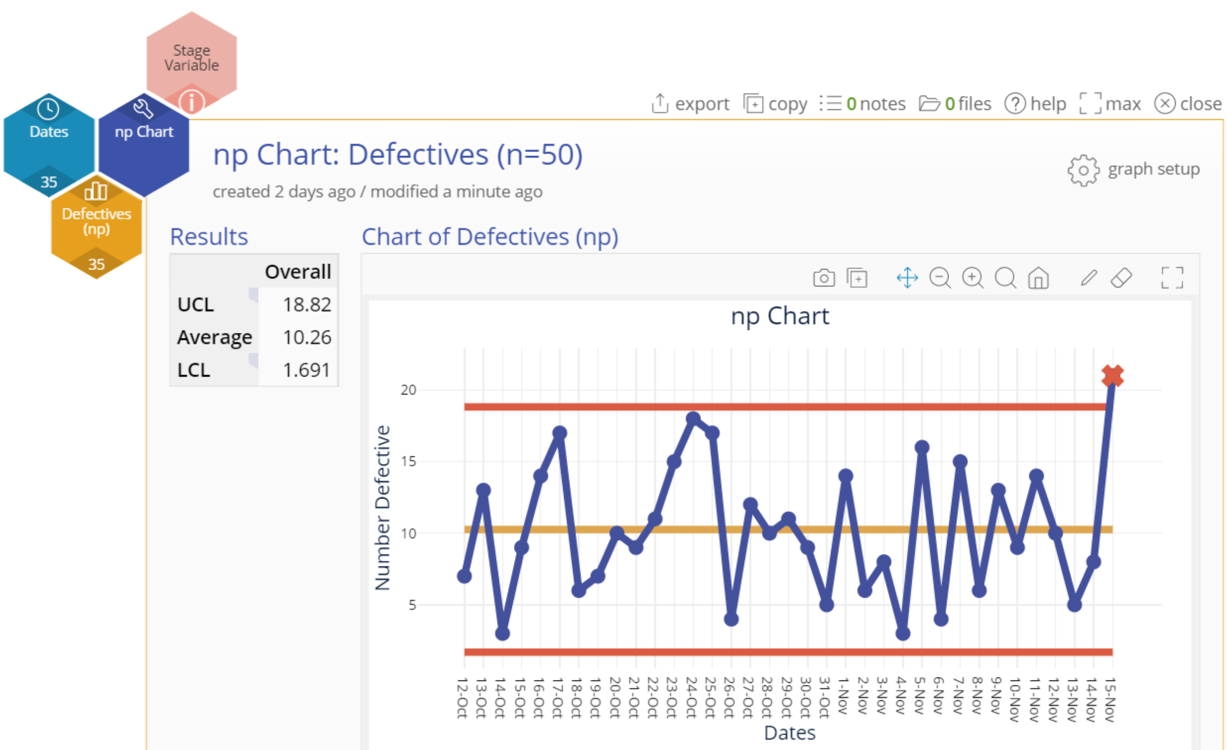
	Stage 1	Stage 2	Stage 3	Stage 4
UCL	14.32	13.6	14.24	14.59
Average	12.82	12.68	13.03	13.51
LCL	11.32	11.75	11.81	12.43

R Chart Statistics

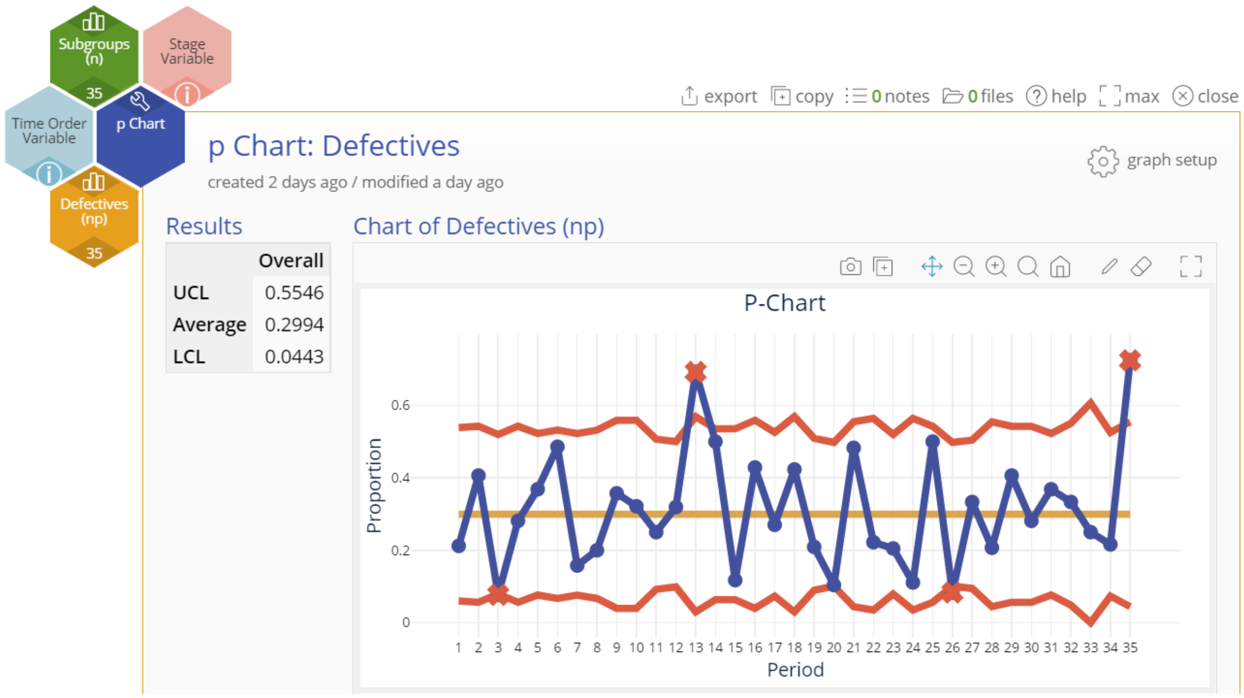
	Stage 1	Stage 2	Stage 3	Stage 4
UCL	6.217	3.838	5.042	4.476
Average	3.103	1.915	2.516	2.233
LCL	0	0	0	0



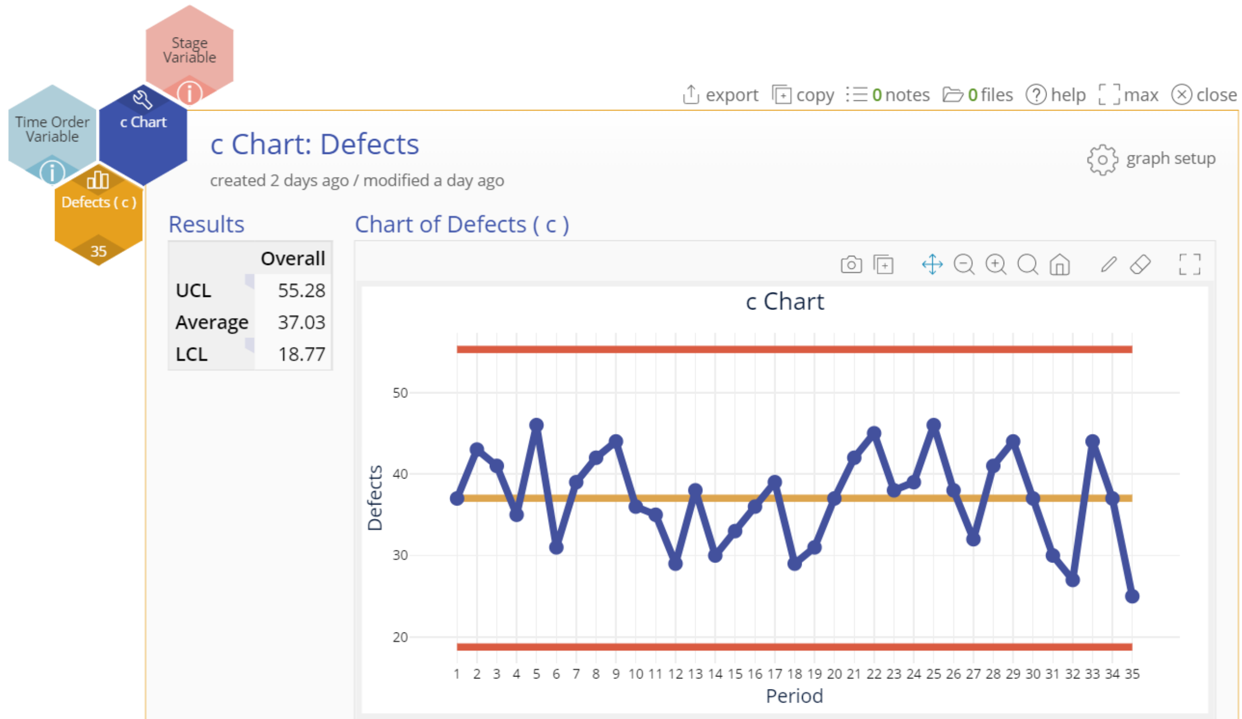
3. np Chart: Defectives (n=50)



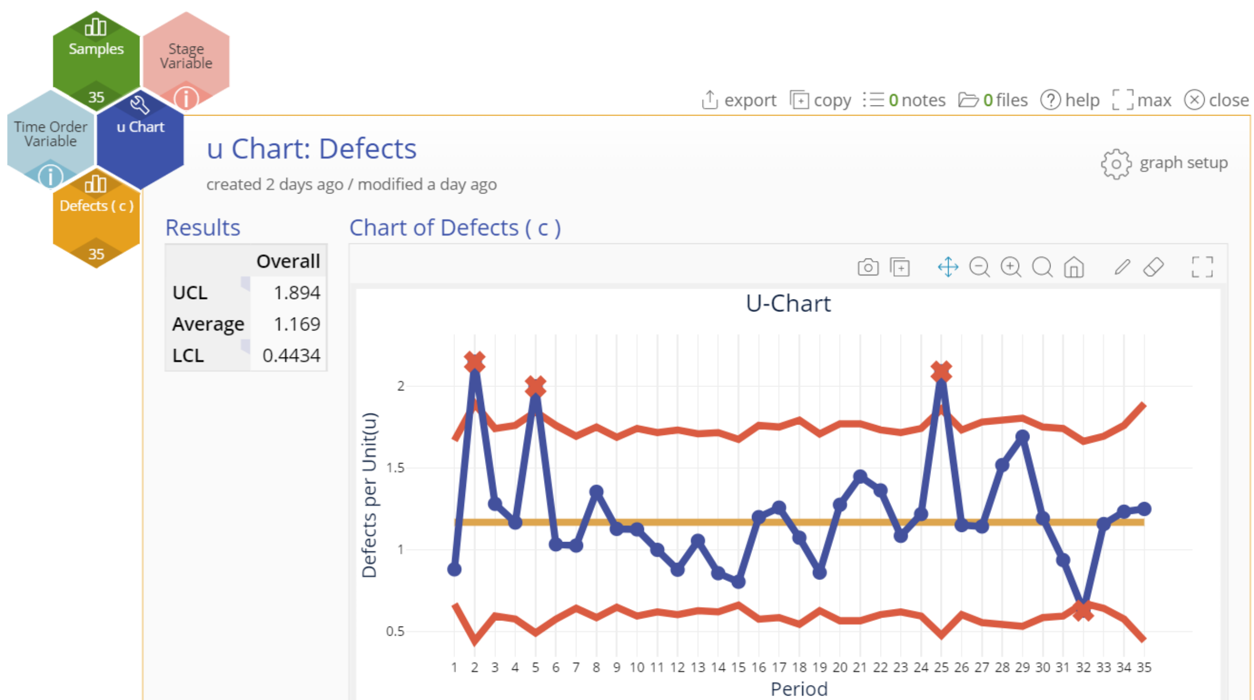
4. p Chart: Defectives



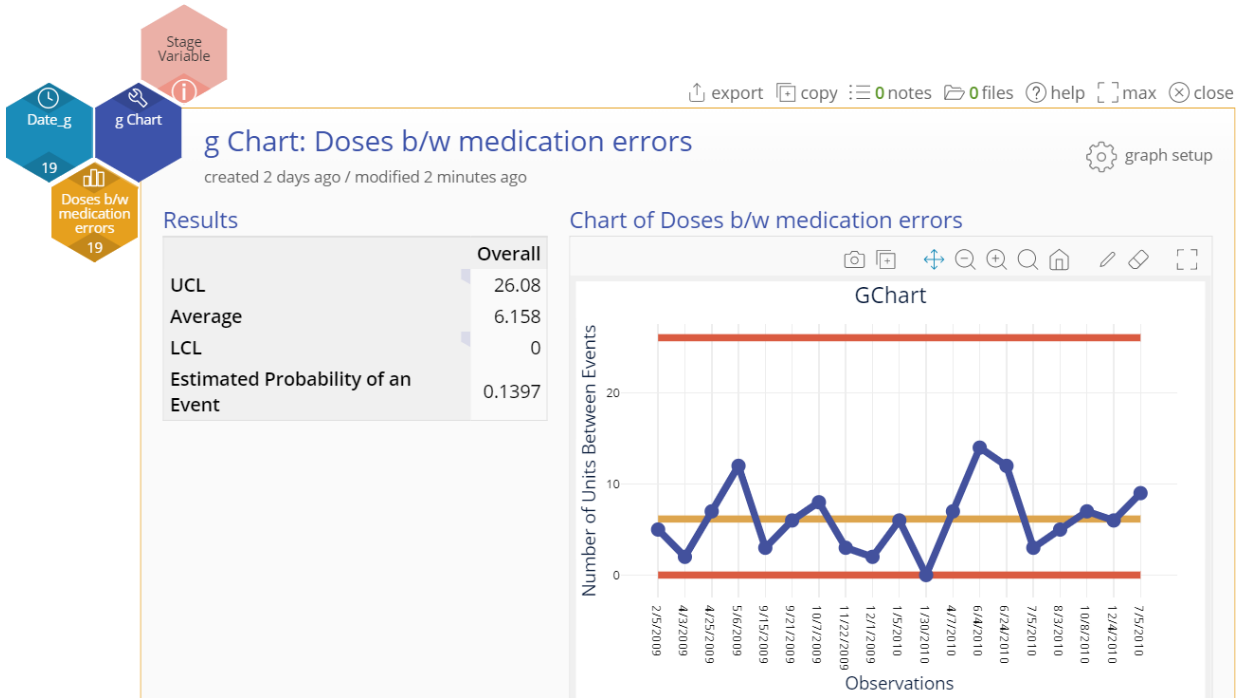
5. c Chart: Defects



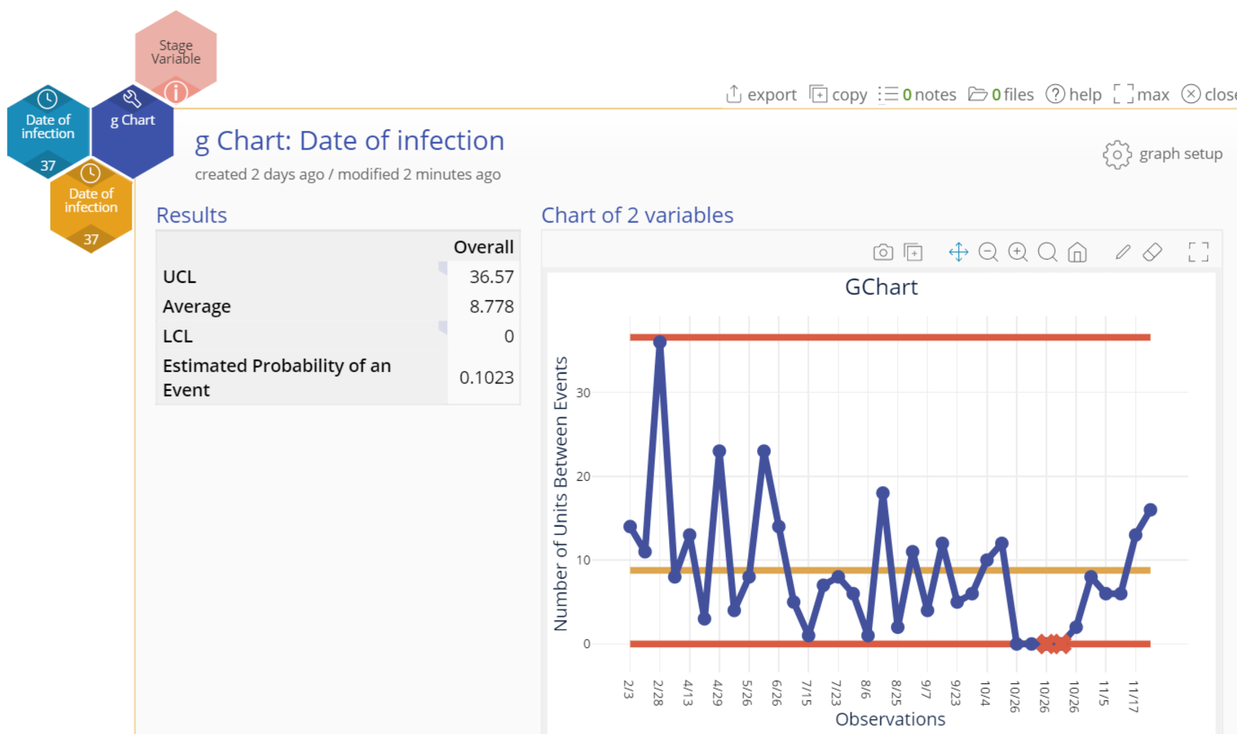
6. u Chart: Defects



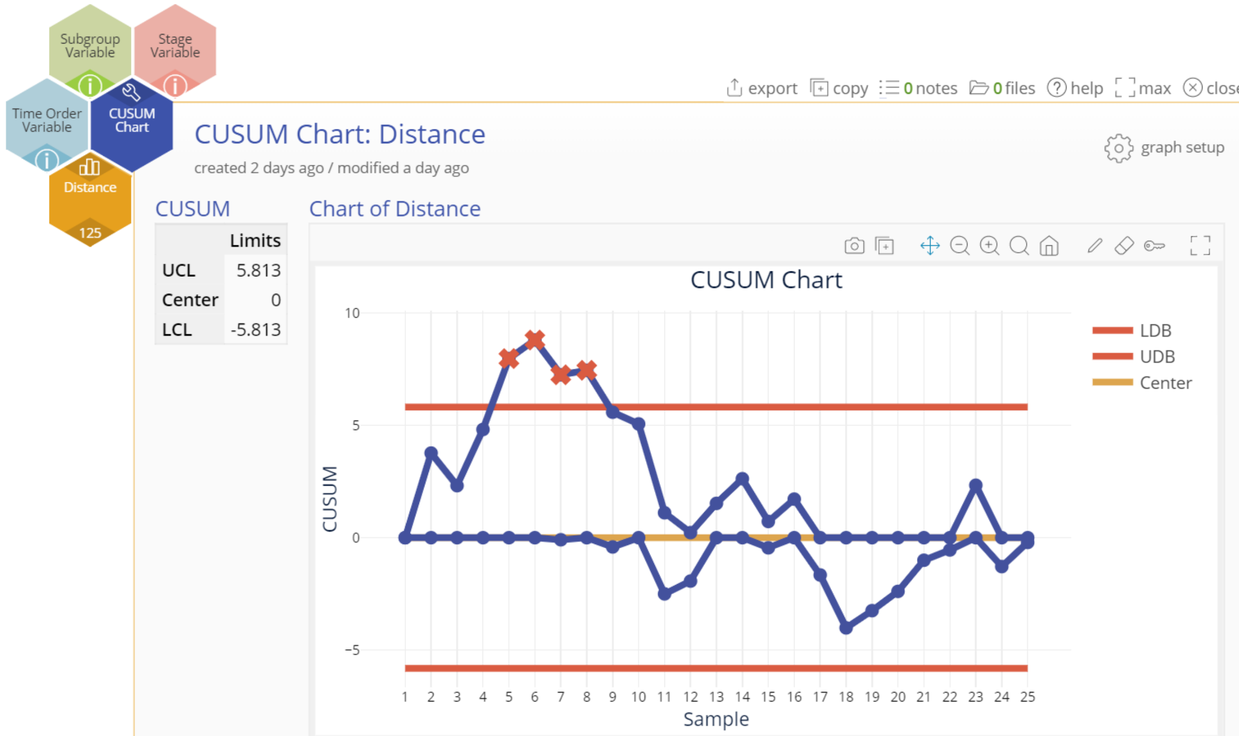
7. g Chart: Doses b/w medication errors



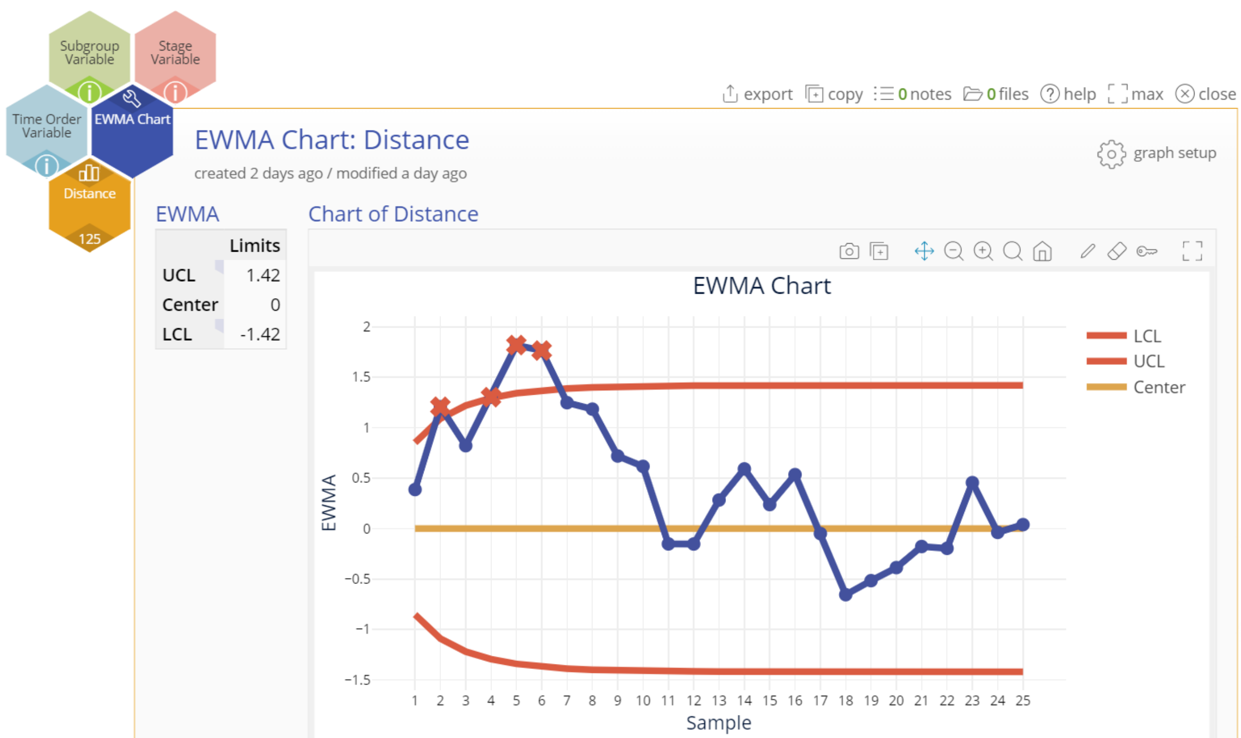
8. g Chart: Date of infection



9. CUSUM Chart: Distance



10. EWMA Chart: Distance



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IV. Dataset: ParametricHypTests

1. 1 Proportion Test: Pass

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1 Proportion Test

Pass

80

1 Proportion Test: Pass

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assumptions | test setup

Conclusion At the 5% level, reject the null hypothesis. There is sufficient evidence that the proportion of the event '1' in 'Pass' is greater than '0.5'.

Null Hypothesis The proportion of the event '1' in 'Pass' is less than or equal to '0.5'.

Alternative Hypothesis The proportion of the event '1' in 'Pass' is greater than '0.5'.

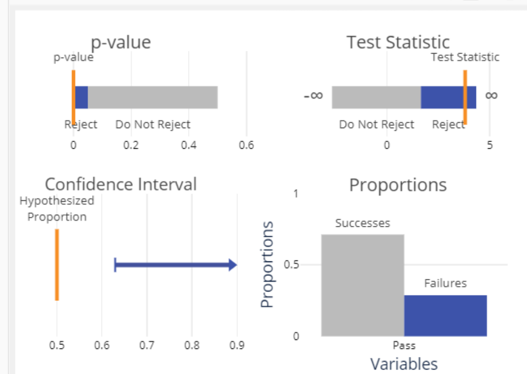
Hypothesis Test Results

Lower Cut-off < Upper Cut-off < Test Statistic	-Inf < 1.645 < 3.801
p-value < alpha	1e-04 < 0.05
95% Confidence Interval	(0.6293, Inf)

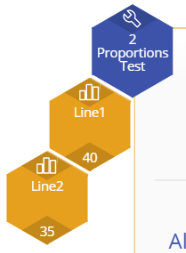
Sample Summary

Sample	Sample Size (n)	Success	Count	Proportion
Pass	80	1	57	0.7125

Charts of Pass



2. 2 Proportions Test: Line1 x Line2



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2 Proportions Test: Line1 x Line2

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assumptions test setup

Conclusion At the 5% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the proportion of the event '1' in 'Line1' is equal to that in 'Line2'.

Null Hypothesis The proportion of the event '1' in 'Line1' is equal to that in 'Line2'.

Alternative Hypothesis The proportion of the event '1' in 'Line1' is NOT equal to that in 'Line2'.

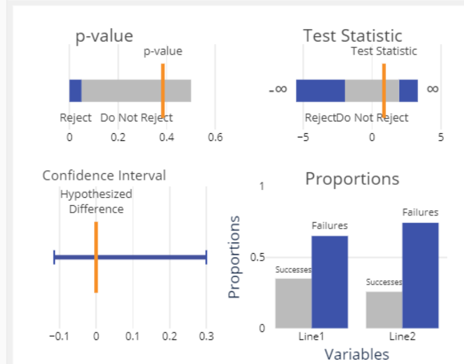
Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	-1.96 < 0.8701 < 1.96
p-value > alpha	0.3842 > 0.05
95% Confidence Interval	(-0.1141, 0.2998)

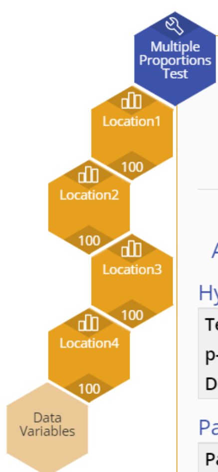
Sample Summary

Sample	Sample Size (n)	Success	Count	Proportion
Line1	40	1	14	0.35
Line2	35	1	9	0.2571
Pooled Proportion	75	1	23	0.3067
Estimated Difference				0.0929

Charts of 2 variables



3. Multiple Proportions Test: Locations



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Multiple Proportions Test: Locations

created 2 days ago / modified a minute ago

assumptions test setup

Conclusion At the 5% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the proportions of 1 are equal across all groups.

Null Hypothesis The proportions of 1 are equal across all groups.

Alternative Hypothesis The proportions of 1 are NOT equal across all groups.

Hypothesis Test Results

Test Statistic < Critical Chi-Square Cut-off	2.741 < 7.815
p-value > alpha	0.4333 > 0.05
Degrees of freedom	3

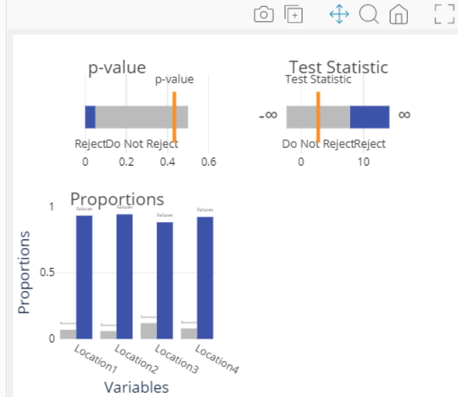
Pairwise Comparisons

PairIJ	|pi - pj|	Critical Value	Significant?
(Location1,Location2)	0.01	0.0974	FALSE
(Location1,Location3)	0.05	0.1155	FALSE
(Location1,Location4)	0.01	0.1041	FALSE
(Location2,Location3)	0.06	0.1125	FALSE
(Location2,Location4)	0.02	0.1008	FALSE
(Location3,Location4)	0.04	0.1183	FALSE

Sample Summary

Sample	Sample Size (n)	Success	Count	Proportion

Charts of 4 variables



Sample Summary

Sample	Sample Size (n)	Success	Count	Proportion
Location1	100	1	7	0.07
Location2	100	1	6	0.06
Location3	100	1	12	0.12
Location4	100	1	8	0.08
Pooled Proportion	400	1	33	0.0825

4. 1 Mean t-Test: Values

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1 Mean t-Test

Values

9

1 Mean t-Test: Values

created 2 days ago / modified a day ago

assumptions test setup

Conclusion At the 10% level, reject the null hypothesis. There is sufficient evidence that the mean of 'Values' is less than '5'.

Null Hypothesis The mean of 'Values' is greater than or equal to '5'.

Alternative Hypothesis The mean of 'Values' is less than '5'.

Hypothesis Test Results

Test Statistic < Lower Cut-off < Upper Cut-off	-2.562 < -1.397 < Inf
p-value < alpha	0.0168 < 0.1
90% Confidence Interval	(-Inf, 4.904)
Degrees of freedom	8

Sample Summary

	Values
Count	9
Min	4.4
Max	5.1
Mean	4.789
Median	4.7
Standard Deviation	0.2472
Variance	0.0611

Charts of Values

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1 Mean t-Test

Values

9

1 Mean t-Test: Values

created 2 months ago / modified 2 months ago

assumptions test setup

Conclusion At the 10% level, reject the null hypothesis. There is sufficient evidence that the mean of 'Values' is less than '5'.

Null Hypothesis The mean of 'Values' is greater than or equal to '5'.

Alternative Hypothesis The mean of 'Values' is less than '5'.

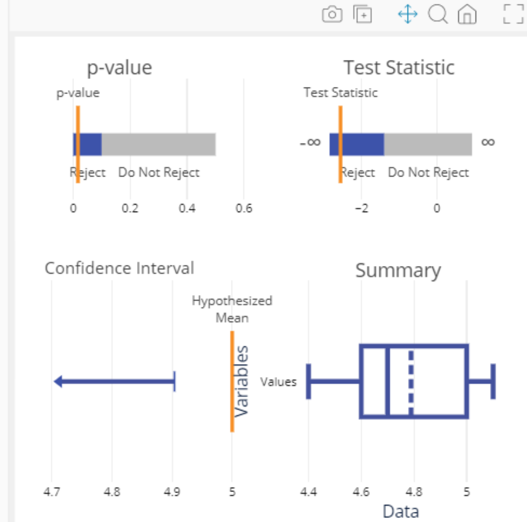
Hypothesis Test Results

Test Statistic < Lower Cut-off < Upper Cut-off	-2.562 < -1.397 < Inf
p-value < alpha	0.0168 < 0.1
90% Confidence Interval	(-Inf, 4.904)
Degrees of freedom	8

Sample Summary

	Values
Count	9
Min	4.4
Max	5.1
Mean	4.789
Median	4.7
Standard Deviation	0.2472
Variance	0.0611
Anderson-Darling Statistic	0.3266
Anderson-Darling p-value	0.4419
Skewness	-0.029
Kurtosis	-1.242

Charts of Values



5. 2 Means t-Test: BTU

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2 Means t-Test

BTU.ln_1 40

BTU.ln_2 50

2 Means t-Test: BTU

created 2 days ago / modified a day ago

assumptions | test setup

Conclusion At the 5% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the mean of 'BTU.ln_1' is greater than or equal to the mean of 'BTU.ln_2'.

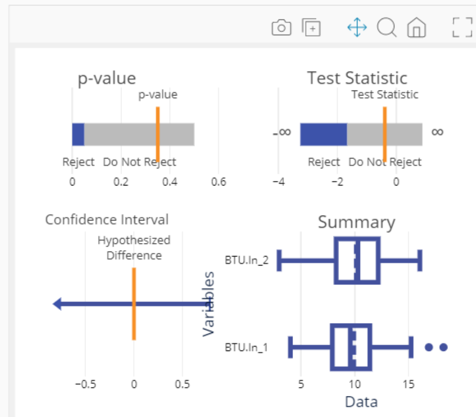
Null Hypothesis The mean of 'BTU.ln_1' is greater than or equal to the mean of 'BTU.ln_2'.

Alternative Hypothesis The mean of 'BTU.ln_1' is less than the mean of 'BTU.ln_2'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	-1.662 < -0.3848 < Inf
p-value > alpha	0.3506 > 0.05
95% Confidence Interval	(-Inf, 0.781)
Degrees of freedom	88

Charts of 2 variables

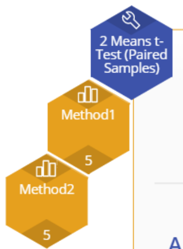


Sample Summary

	BTU.ln_1	BTU.ln_2
Count	40	50
Min	4	2.97
Max	18.26	16.06
Mean	9.908	10.14
Median	9.59	10.29
Standard Deviation	3.02	2.767

Standard Deviation	3.02	2.767
Variance	9.12	7.656
Anderson-Darling Statistic	0.4745	0.1896
Anderson-Darling p-value	0.2283	0.8951
Skewness	0.7075	-0.099
Kurtosis	0.784	-0.272

6. 2 Means t-Test (Paired Samples): Methods



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2 Means t-Test (Paired Samples): Methods

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assumptions | test setup

Conclusion At the 5% level, reject the null hypothesis. There is sufficient evidence that the mean of the difference ('Method1' - 'Method2') is less than '0'.

Null Hypothesis The mean of the difference ('Method1' - 'Method2') is greater than or equal to '0'.

Alternative Hypothesis The mean of the difference ('Method1' - 'Method2') is less than '0'.

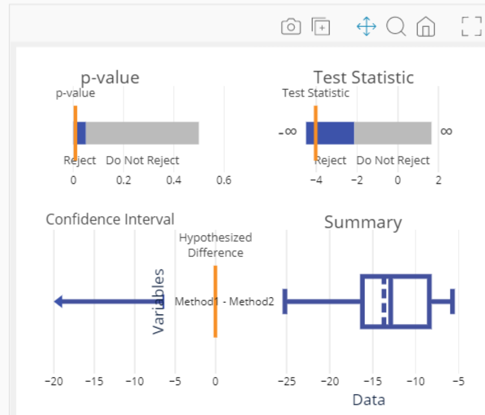
Hypothesis Test Results

Test Statistic < Lower Cut-off < Upper Cut-off	-4.023 < -2.132 < Inf
p-value < alpha	0.0079 < 0.05
95% Confidence Interval	(-Inf, -6.431)
Degrees of freedom	4

Sample Summary

	Method1 - Method2
Count	5
Min	-25.2
Max	-5.7
Mean	-13.68
Median	-12.9
Standard Deviation	7.603
Variance	57.81

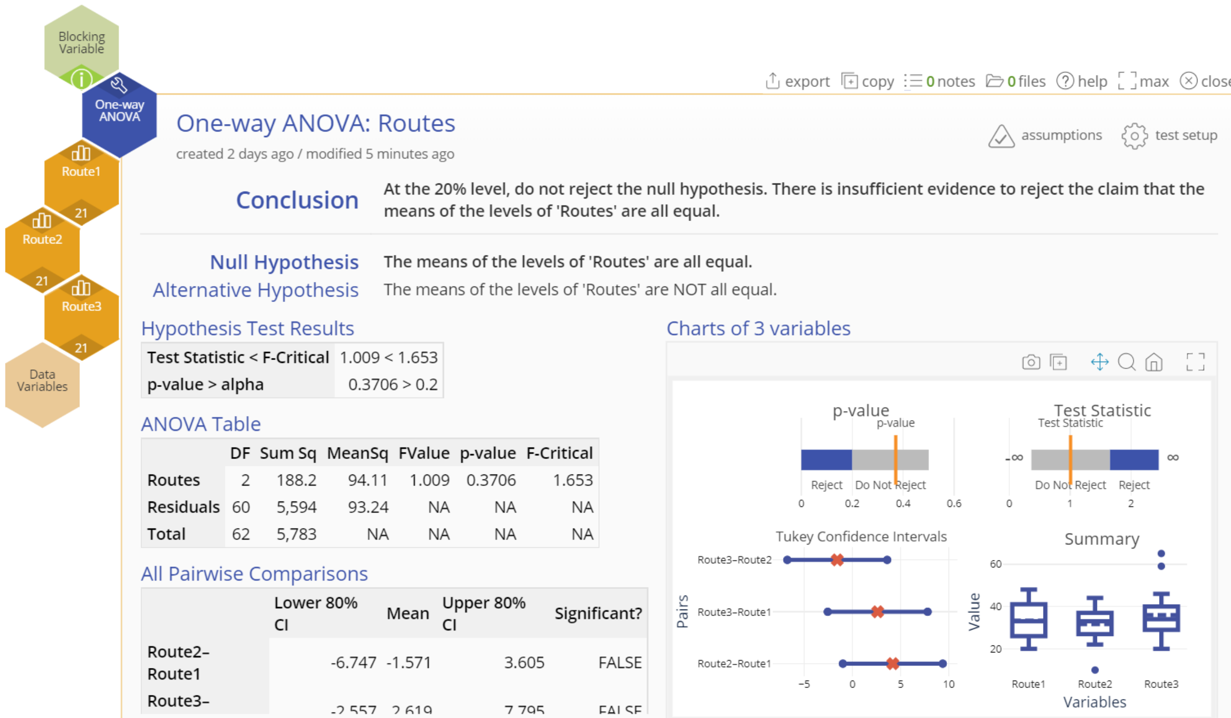
Charts of 2 variables



Sample Summary

	Method1 - Method2
Count	5
Min	-25.2
Max	-5.7
Mean	-13.68
Median	-12.9
Standard Deviation	7.603
Variance	57.81
Anderson-Darling Statistic	NA
Anderson-Darling p-value	NA
Skewness	-0.843
Kurtosis	0.4109

7. One-way ANOVA: Routes



All Pairwise Comparisons

	Lower 80% CI	Mean	Upper 80% CI	Significant?
Route2–Route1	-6.747	-1.571	3.605	FALSE
Route3–Route1	-2.557	2.619	7.795	FALSE
Route3–Route2	-0.986	4.19	9.366	FALSE

Sample Summary

	Route1	Route2	Route3
Count	21	21	21
Min	20	10	20
Max	48	44	65
Mean	33.29	31.71	35.9
Median	33	33	34
Standard Deviation	8.861	8.451	11.39
Variance	78.51	71.41	129.8
Anderson-Darling Test Statistic	0.3627	0.2358	0.5409
Anderson-Darling p-value	0.4088	0.7595	0.1454
Skewness	0.0985	-0.588	1.048
Kurtosis	-1.272	0.687	1.181

8. Blocked One-way ANOVA: Routes x Make

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Blocked One-way ANOVA: Routes x Make

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assumptions test setup

Conclusion At the 10% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the means of the levels of 'Routes' are all equal across the levels of 'Make'.

Null Hypothesis The means of the levels of 'Routes' are all equal across the levels of 'Make'.

Alternative Hypothesis The means of the levels of 'Routes' are NOT all equal across the levels of 'Make'.

Hypothesis Test Results

Test Statistic < F-Critical	1.087 < 2.396
p-value > alpha	0.3439 > 0.1

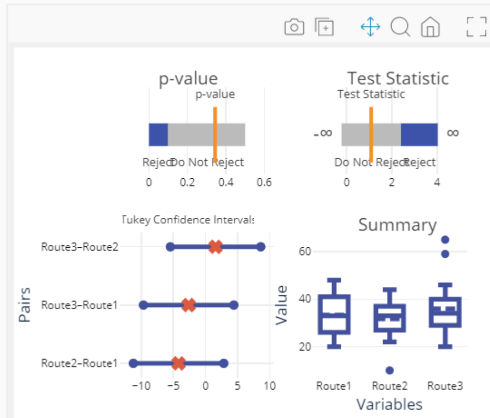
ANOVA Table

	DF	Sum Sq	MeanSq	FValue	p-value	F-Critical
Routes	2	188.2	94.11	1.087	0.3439	2.396
Make	2	574.6	287.3	3.32	0.0432	NA
Residuals	58	5,020	86.55	NA	NA	NA
Total	62	5,783	NA	NA	NA	NA

All Pairwise Comparisons

	Lower 90% CI	Mean	Upper 90% CI	Significant?
Route2–Route1	-5.467	1.571	8.61	FALSE

Charts of 4 variables



All Pairwise Comparisons

	Lower 90% CI	Mean	Upper 90% CI	Significant?
Route2–Route1	-5.467	1.571	8.61	FALSE
Route3–Route1	-9.66	-2.619	4.419	FALSE
Route3–Route2	-11.23	-4.19	2.848	FALSE

Sample Summary

	Route1	Route2	Route3
Count	21	21	21
Min	20	10	20
Max	48	44	65
Mean	33.29	31.71	35.9
Median	33	33	34
Standard Deviation	8.861	8.451	11.39
Variance	78.51	71.41	129.8
Anderson-Darling Test Statistic	0.3627	0.2358	0.5409
Anderson-Darling p-value	0.4088	0.7595	0.1454
Skewness	0.0985	-0.588	1.048
Kurtosis	-1.272	0.687	1.181

9. 1 Variance Chi-Square Test: AtoBDist

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1 Variance Chi-Square Test

AtoBDist 125

1 Variance Chi-Square Test: AtoBDist

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assumptions test setup

Conclusion At the 5% level, reject the null hypothesis. There is sufficient evidence that the variance of 'AtoBDist' is greater than '9'.

Null Hypothesis The variance of 'AtoBDist' is less than or equal to '9'.

Alternative Hypothesis The variance of 'AtoBDist' is greater than '9'.

Hypothesis Test Results

Lower Cut-off < Upper Cut-off < Test Statistic	-Inf < 151 < 167.9
p-value < alpha	0.0053 < 0.05
95% Confidence Interval	(10.01, Inf)
Degrees of freedom	124

Sample Summary

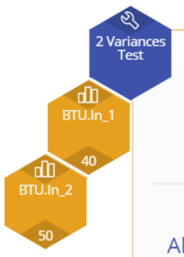
	AtoBDist
Count	125
Min	-7.303
Max	8.023
Mean	0.4417
Median	0.13
Standard Deviation	3.491
Variance	12.19

Charts of AtoBDist

Sample Summary

	AtoBDist
Count	125
Min	-7.303
Max	8.023
Mean	0.4417
Median	0.13
Standard Deviation	3.491
Variance	12.19
Anderson-Darling Statistic	0.8911
Anderson-Darling p-value	0.0222
Skewness	0.1245
Kurtosis	-0.823

10. 2 Variances Test: BTU



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2 Variances Test: BTU

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assumptions test setup

Conclusion At the 5% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the variance of 'BTU.In_1' is equal to the variance of 'BTU.In_2'.

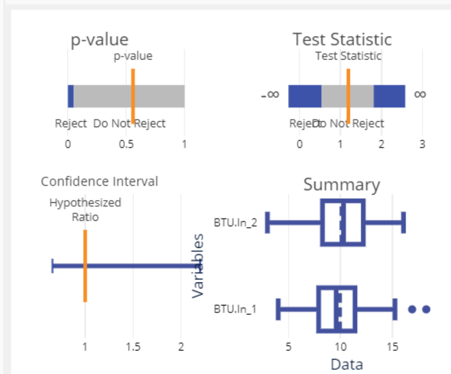
Null Hypothesis The variance of 'BTU.In_1' is equal to the variance of 'BTU.In_2'.

Alternative Hypothesis The variance of 'BTU.In_1' is NOT equal to the variance of 'BTU.In_2'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	0.5416 < 1.191 < 1.808
p-value > alpha	0.5578 > 0.05
95% Confidence Interval	(0.6587, 2.199)
Degrees of freedom	(39, 49)

Charts of 2 variables



Sample Summary

	BTU.In_1	BTU.In_2
Count	40	50
Min	4	2.97
Max	18.26	16.06
Mean	9.908	10.14
Median	9.59	10.29
Standard Deviation	3.02	2.767
Variance	9.12	7.656
Anderson-Darling Statistic	0.4745	0.1896
Anderson-Darling p-value	0.2283	0.8951
Skewness	0.7075	-0.099
Kurtosis	0.784	-0.272

11. 2 Variances Test: Summary data

Group Variable
2 Variances Test
Data Variables

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2 Variances Test: Summary data

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assumptions test setup

Conclusion At the 5% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the variance of 'A' is equal to the variance of 'B'.

Null Hypothesis The variance of 'A' is equal to the variance of 'B'.

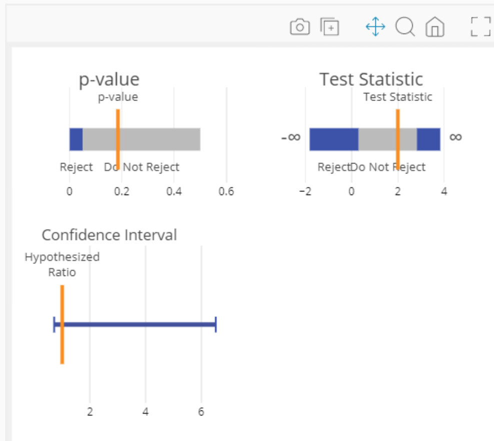
Alternative Hypothesis The variance of 'A' is NOT equal to the variance of 'B'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	0.3066 < 2 < 2.814
p-value > alpha	0.185 > 0.05
95% Confidence Interval	(0.7108, 6.522)
Degrees of freedom	(11, 18)

Sample Summary

	A	B
Count	12	19
Standard Deviation	2	1.414
Variance	4	2



12. Multiple Variances Test: Routes

Multiple Variances Test

Route1 21

Route2 21

Route3 21

Data Variables

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Multiple Variances Test: Routes

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assumptions test setup

Conclusion At the 20% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the variances are equal across all groups.

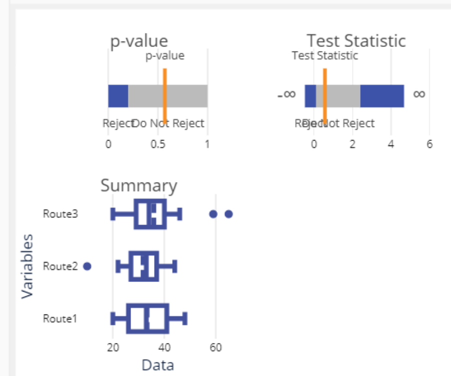
Null Hypothesis The variances are equal across all groups.

Alternative Hypothesis The variances are NOT equal across all groups.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	0.1055 < 0.5676 < 2.393
p-value > alpha	0.5699 > 0.2
Degrees of freedom	(2, 60)

Charts of 3 variables



Sample Summary

	Route1	Route2	Route3
Count	21	21	21
Min	20	10	20
Max	48	44	65
Mean	33.29	31.71	35.9
Median	33	33	34
Standard Deviation	8.861	8.451	11.39
Variance	78.51	71.41	129.8
Anderson-Darling Statistic	0.3627	0.2358	0.5409
Anderson-Darling p-value	0.4088	0.7595	0.1454
Skewness	0.0985	-0.588	1.048
Kurtosis	-1.272	0.687	1.181

Back

V. Dataset: NonParametricHypTests

1. 1 Sample Sign Test: Fillwt

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1 Sample Sign Test

Fillwt

38

1 Sample Sign Test: Fillwt

created 2 days ago / modified a day ago

assumptions test setup

Conclusion At the 15% level, reject the null hypothesis. There is sufficient evidence that the median of 'Fillwt' is less than '1'.

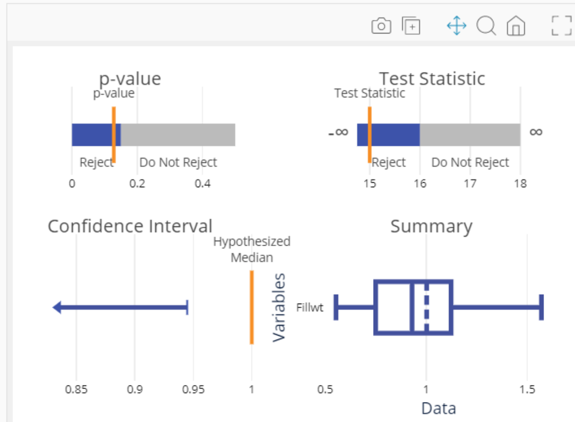
Null Hypothesis The median of 'Fillwt' is greater than or equal to '1'.

Alternative Hypothesis The median of 'Fillwt' is less than '1'.

Hypothesis Test Results

Test Statistic < Lower Cut-off < Upper Cut-off	15 < 16 < Inf
p-value < alpha	0.1279 < 0.15
87.21% Confidence Interval	(-Inf, 0.9448)
Sample Size for Test (excluding ties)	38
Sample Median	0.93

Charts of Fillwt



Sample Summary

	Fillwt
Count	38
Min	0.5539
Max	1.57
Mean	1.002
Median	0.93
Standard Deviation	0.2651
Variance	0.0703
Anderson-Darling Statistic	1.061
Anderson-Darling p-value	0.0077
Skewness	0.5664
Kurtosis	-0.329

2. 1 Sample Wilcoxon Signed Ranks Test: Fillwt

1 Sample Wilcoxon Test
Fillwt
38

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1 Sample Wilcoxon Signed Ranks Test: Fillwt

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assumptions test setup

Conclusion At the 15% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the median of 'Fillwt' is greater than or equal to '1'.

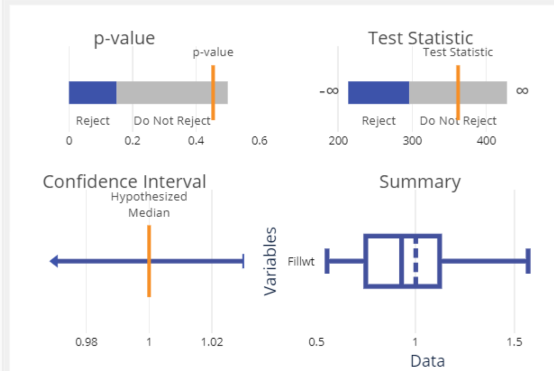
Null Hypothesis The median of 'Fillwt' is greater than or equal to '1'.

Alternative Hypothesis The median of 'Fillwt' is less than '1'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	296 < 362 < Inf
p-value > alpha	0.4538 > 0.15
85% Confidence Interval	(-Inf, 1.03)
Significance Level	0.15
Sample Size for Test (excluding ties)	38
Estimated Median	0.9959

Charts of Fillwt



Sample Summary

	Fillwt
Count	38
Min	0.5539
Max	1.57
Mean	1.002
Median	0.93
Standard Deviation	0.2651
Variance	0.0703
Anderson-Darling Statistic	1.061
Anderson-Darling p-value	0.0077
Skewness	0.5664
Kurtosis	-0.329

3. Paired Samples Sign Test: Drug A, B

Paired Samples Sign Test

Drug A 10

Drug B 10

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Paired Samples Sign Test: Drug A, B

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assumptions test setup

Conclusion At the 10% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the median of the differences ('Drug A' - 'Drug B') is equal to '0'.

Null Hypothesis The median of the differences ('Drug A' - 'Drug B') is equal to '0'.

Alternative Hypothesis The median of the differences ('Drug A' - 'Drug B') is NOT equal to '0'.

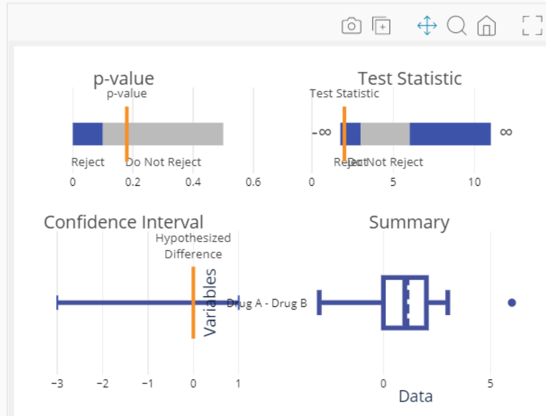
Hypothesis Test Results

Test Statistic < Lower Cut-off < Upper Cut-off	2 < 3 < 6
p-value > alpha	0.1797 > 0.1
97.85% Confidence Interval	(-3, 1)
Sample Size for Test (excluding ties)	9
Median of Differences	-1

Sample Summary

	Drug A - Drug B
Count	10
Min	-3
Max	6
Mean	1.1
Median	1
Standard Deviation	2.378
Variance	5.656
Anderson-Darling Statistic	0.4277
Anderson-Darling p-value	0.2479
Skewness	0.4721
Kurtosis	1.759

Charts of 2 variables



4. Paired Samples Wilcoxon Signed Ranks Test: Drug A, B

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Paired Samples Wilcoxon Test

Drug A 10

Drug B 10

Paired Samples Wilcoxon Signed Ranks Test: Drug A, B

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assumptions | test setup

Conclusion At the 10% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the median of the differences ('Drug A' - 'Drug B') is equal to '0'.

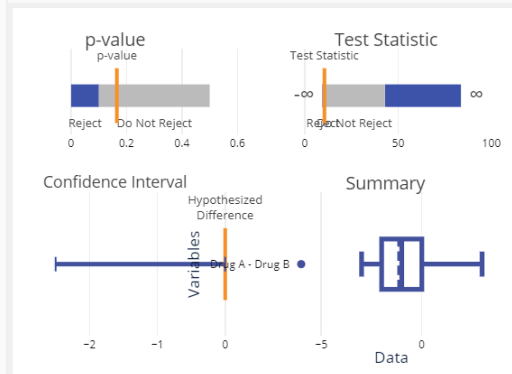
Null Hypothesis The median of the differences ('Drug A' - 'Drug B') is equal to '0'.

Alternative Hypothesis The median of the differences ('Drug A' - 'Drug B') is NOT equal to '0'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	10 < 10.5 < 43
p-value > alpha	0.1651 > 0.1
90% Confidence Interval	(-2.5, 5.116e-05)
Significance Level	0.1
Sample Size for Test (excluding ties)	9
Median of Differences	-1

Charts of 2 variables



Sample Summary

	Drug A - Drug B
Count	10
Min	-6
Max	3
Mean	-1.1
Median	-1
Standard Deviation	2.378
Variance	5.656
Anderson-Darling Statistic	0.4277
Anderson-Darling p-value	0.2479
Skewness	-0.472
Kurtosis	1.759

5. Mann Whitney Wilcoxon Test: BTU (normal approximation)

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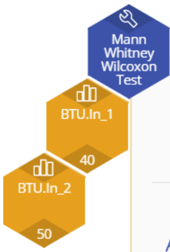

Mann Whitney Wilcoxon Test: BTU (normal approximation)

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assumptions test setup

Conclusion At the 15% level, do not reject the null hypothesis. There is insufficient evidence to reject the claim that the median of 'BTU.In_1' is greater than or equal to the median of 'BTU.In_2'.

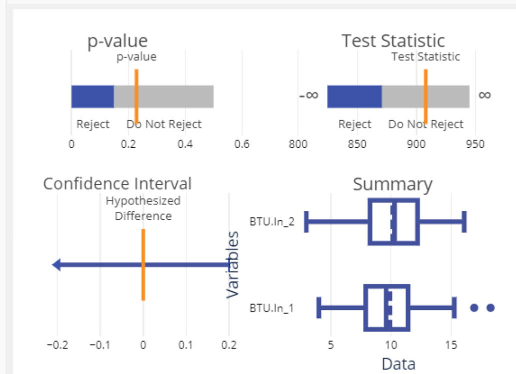
Null Hypothesis The median of 'BTU.In_1' is greater than or equal to the median of 'BTU.In_2'.

Alternative Hypothesis The median of 'BTU.In_1' is less than the median of 'BTU.In_2'.

Hypothesis Test Results

Lower Cut-off < Test Statistic < Upper Cut-off	871 < 908 < Inf
p-value > alpha	0.2287 > 0.15
85% Confidence Interval	(-Inf, 0.2)
Significance Level	0.15
Sample Size for Test (excluding ties)	40
Median of Differences	NA

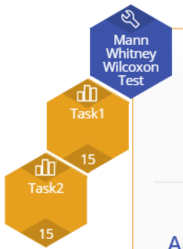
Charts of 2 variables



Sample Summary

	BTU.In_1	BTU.In_2
Count	40	50
Min	4	2.97
Max	18.26	16.06
Mean	9.908	10.14
Median	9.59	10.29
Standard Deviation	3.02	2.767
Variance	9.12	7.656
Anderson-Darling Statistic	0.4745	0.1896
Anderson-Darling p-value	0.2283	0.8951
Skewness	0.7075	-0.099
Kurtosis	0.784	-0.272

6. Mann Whitney Wilcoxon Test: Task 1, 2 (Exact test)



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Mann Whitney Wilcoxon Test: Task 1, 2 (Exact test)

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assumptions test setup

Conclusion At the 15% level, reject the null hypothesis. There is sufficient evidence that the median of 'Task1' is greater than the median of 'Task2'.

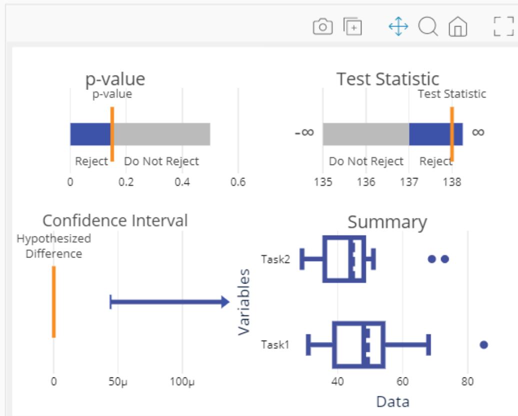
Null Hypothesis The median of 'Task1' is less than or equal to the median of 'Task2'.

Alternative Hypothesis The median of 'Task1' is greater than the median of 'Task2'.

Hypothesis Test Results

Lower Cut-off < Upper Cut-off < Test Statistic	-Inf < 137 < 138
p-value < alpha	0.1497 < 0.15
85% Confidence Interval	(4.42e-05, Inf)
Significance Level	0.15
Sample Size for Test (excluding ties)	15
Median of Differences	5.5

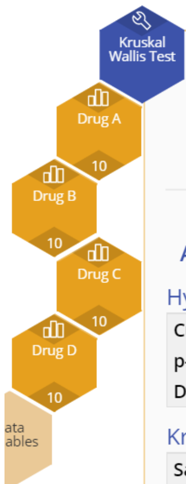
Charts of 2 variables



Sample Summary

	Task1	Task2
Count	15	15
Min	31	29
Max	85	73
Mean	49.2	44.6
Median	48	44
Standard Deviation	14.14	12.68
Variance	200	160.7
Anderson-Darling Statistic	0.4849	0.6214
Anderson-Darling p-value	0.1927	0.0856
Skewness	1.209	1.119
Kurtosis	1.677	1.105

7. Kruskal Wallis Test: Drug



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Kruskal Wallis Test: Drug

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assumptions test setup

Conclusion At the 20% level, reject the null hypothesis. There is sufficient evidence that the medians of the levels of 'Drug' are NOT equal.

Null Hypothesis The medians of the levels of 'Drug' are equal.

Alternative Hypothesis The medians of the levels of 'Drug' are NOT equal.

Hypothesis Test Results

Cut-off < Test Statistic	4.642 < 9.36
p-value < alpha	0.0249 < 0.2
Degrees of freedom	3

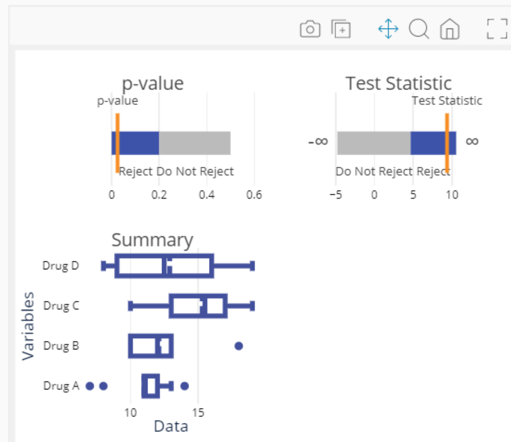
Kruskal Wallis Ranks Table

Sample	Sample Size (n)	Sample Median	Average Rank
Drug A	10	11	14.45
Drug B	10	12	17.55
Drug C	10	15.5	29.5
Drug D	10	12.5	20.5

Pairwise Comparisons

Comparison	Zij	Z*	Significant?
Drug B,Drug A	0.5929	2.128	FALSE
Drug C,Drug A	2.879	2.128	TRUE

Charts of 4 variables



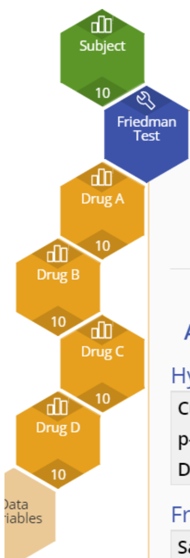
Pairwise Comparisons

Comparison	Zij	Z*	Significant?
Drug B,Drug A	0.5929	2.128	FALSE
Drug C,Drug A	2.879	2.128	TRUE
Drug D,Drug A	1.157	2.128	FALSE
Drug C,Drug B	2.286	2.128	TRUE
Drug D,Drug B	0.5643	2.128	FALSE
Drug D,Drug C	1.721	2.128	FALSE

Sample Summary

	Drug A	Drug B	Drug C	Drug D
Count	10	10	10	10
Min	7	10	10	8
Max	14	18	19	19
Mean	11	12.1	15.3	12.9
Median	11	12	15.5	12.5
Standard Deviation	2.108	2.378	2.869	4.122
Variance	4.444	5.656	8.233	16.99
Anderson-Darling Statistic	0.564	0.7885	0.2172	0.2897
Anderson-Darling p-value	0.1072	0.0264	0.7817	0.5371
Skewness	-0.8	1.835	-0.376	0.3627
Kurtosis	0.4781	4.346	-0.348	-1.117

8. Friedman Test: Drug x Subject



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Friedman Test: Drug x Subject

created 2 days ago / modified 2 minutes ago

assumptions test setup

Conclusion At the 10% level, reject the null hypothesis. There is sufficient evidence that the medians of the levels of 'Drug' are NOT all equal across the levels of 'Subject'.

Null Hypothesis The medians of the levels of 'Drug' are all equal across the levels of 'Subject'.

Alternative Hypothesis The medians of the levels of 'Drug' are NOT all equal across the levels of 'Subject'.

Hypothesis Test Results

Cut-off < Test Statistic	6.251 < 14.12
p-value < alpha	0.0027 < 0.1
Degrees of freedom	3

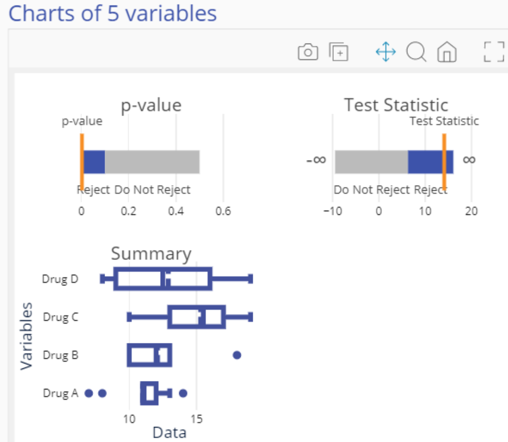
Friedman Ranks Table

Sample	Sample Size (n)	Sum of Ranks
Drug A	10	16
Drug B	10	24
Drug C	10	36.5
Drug D	10	23.5

Pairwise Comparisons

Comparison	Zij	Z*	Significant?
Drug B,Drug A	1.386	2.394	FALSE
Drug C,Drug A	3.551	2.394	TRUE

Charts of 5 variables



Pairwise Comparisons

Comparison	Zij	Z*	Significant?
Drug B,Drug A	1.386	2.394	FALSE
Drug C,Drug A	3.551	2.394	TRUE
Drug D,Drug A	1.299	2.394	FALSE
Drug C,Drug B	2.165	2.394	FALSE
Drug D,Drug B	0.0866	2.394	FALSE
Drug D,Drug C	2.252	2.394	FALSE

Sample Summary

	Drug A	Drug B	Drug C	Drug D
Count	10	10	10	10
Min	7	10	10	8
Max	14	18	19	19
Mean	11	12.1	15.3	12.9
Median	11	12	15.5	12.5
Standard Deviation	2.108	2.378	2.869	4.122
Variance	4.444	5.656	8.233	16.99
Anderson-Darling Statistic	0.564	0.7885	0.2172	0.2897
Anderson-Darling p-value	0.1072	0.0264	0.7817	0.5371
Skewness	-0.8	1.835	-0.376	0.3627
Kurtosis	0.4781	4.346	-0.348	-1.117

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VI. Dataset: Regression

1. Simple Regression: Score1 x Score2

Simple Regression: Score1 x Score2

created 2 days ago / modified a day ago

Score2 = 1.118 + (0.2177) * (Score1)

Regression Statistics

Regression Model

Score2 = 1.118 + (0.2177) * (Score1)

Regression Statistics

Correlation Coefficient, R	0.9784
R Squared	0.9572
Adjusted R Squared	0.9511
Count	9

Coefficient Table

	Estimate	Std. Error	t value	p-value	NALowerCI95	NAUpperCI95
(intercept)	1.118	0.1093	10	0	NA	NA
Score1	0.2177	0.0174	13	0	NA	NA

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Regression	1	2.542	2.542	156.6	0
Residuals	7	0.1136	0.0162	NA	NA
Total	8	2.656	NA	NA	NA

Regression Statistics

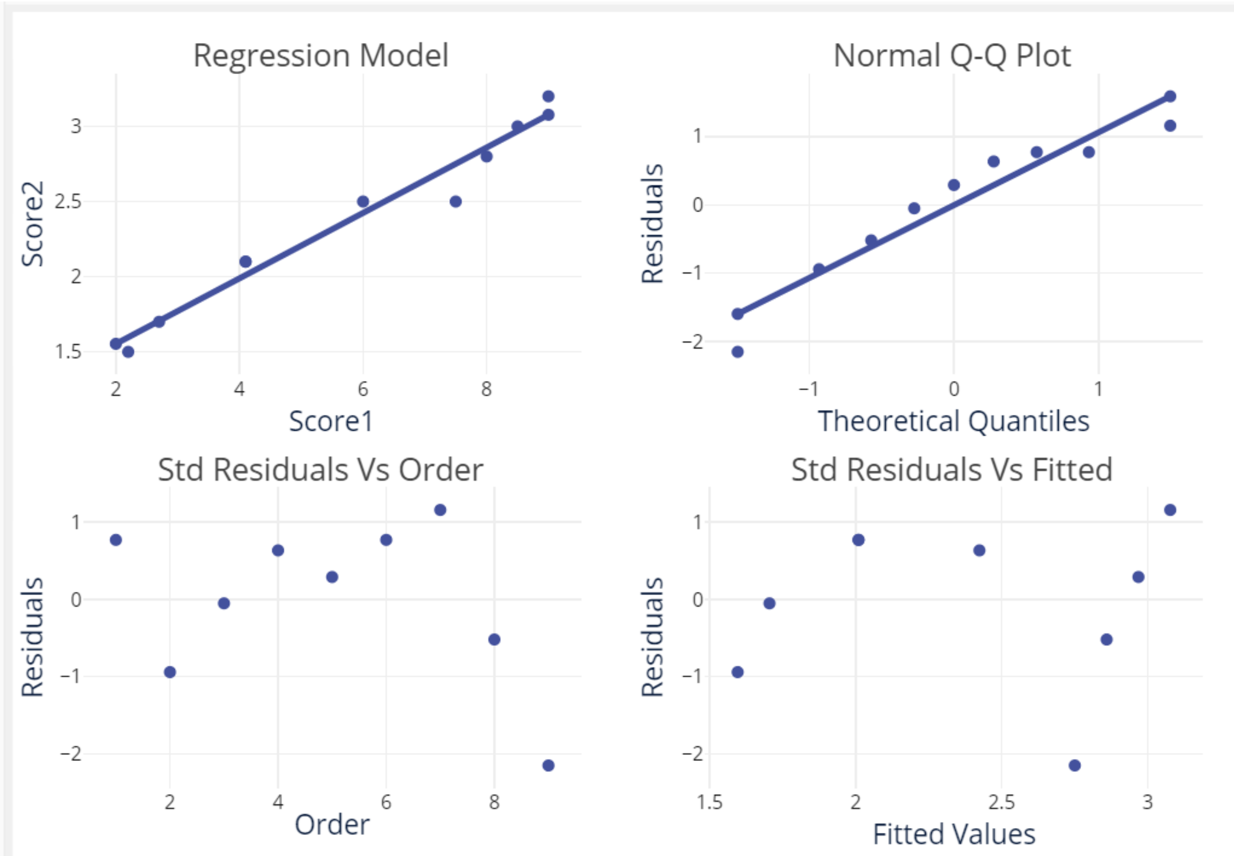
Correlation Coefficient, R	0.9784
R Squared	0.9572
Adjusted R Squared	0.9511
Count	9

Coefficient Table

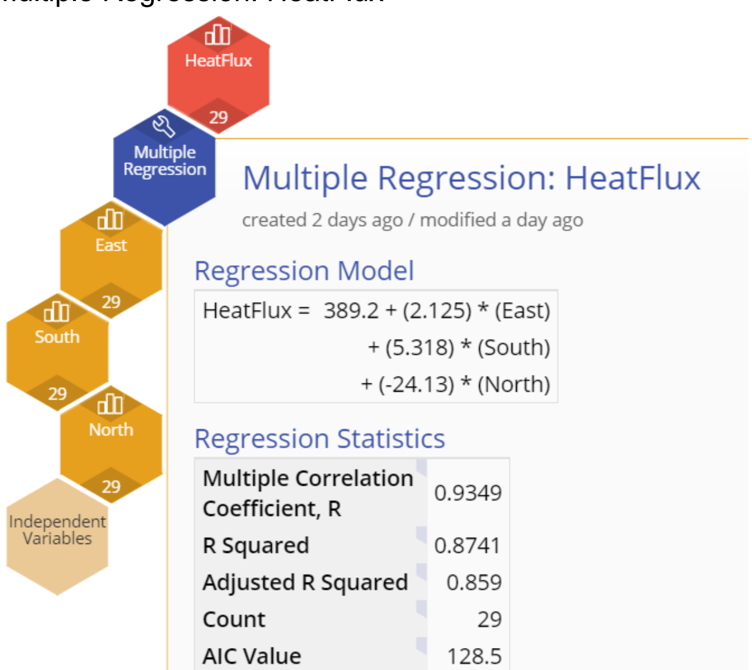
	Estimate	Std. Error	t value	p-value	90% CI (lower)	90% CI (upper)
(intercept)	1.118	0.1093	10	0	0.9379	1.297
Score1	0.2177	0.0174	13	0	0.1891	0.2463

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Regression	1	2.542	2.542	156.6	0
Residuals	7	0.1136	0.0162	NA	NA
Total	8	2.656	NA	NA	NA



2. Multiple Regression: HeatFlux



Coefficient Table

	Estimate	Std. Error	t value	p-value	95% CI (lower)	95% CI (upper)
(intercept)	389.2	66.09	5.9	0	259.6	518.7
East	2.125	1.214	1.7	0.0925	-0.256	4.505
South	5.318	0.9629	5.5	0	3.431	7.206
North	-24.13	1.869	-13	0	-27.79	-20.47

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Regression	3	12,834	4,278	57.87	0
Residuals	25	1,848	73.92	NA	NA
Total	28	14,682	NA	NA	NA

Variation Inflation Factors

	VIF Value
East	1.122
South	1.206
North	1.091

Variables Not in Model

Normal Q-Q Plot
Residuals
Theoretical Quantiles
Std Residuals Vs Order
Residuals
Order
Std Residuals Vs Fitted
Residuals
Fitted Values

3. Logistic Regression: RestingPulse

Logistic Regression: RestingPulse

created 2 days ago / modified a day ago

Response Information

Value	Count
1	70
0	22
Total	92
Iterations	4

Final Model Information

Final Model	logit(RestingPulse) = (-1.987) + (-1.193)*(Smokes) + (0.02502)*(Weight)
Log Likelihood	-46.82

Estimated Response Model

	Coefficients	S.E.	Z	p-value	Lower 90% CI	Upper 90% CI
(intercept)	-1.987	1.679	-1.183	0.2367		
Smokes	-1.193	0.553	-2.157	0.031	-2.103	-0.283
Weight	0.025	0.0123	2.042	0.0412	0.0049	0.0452

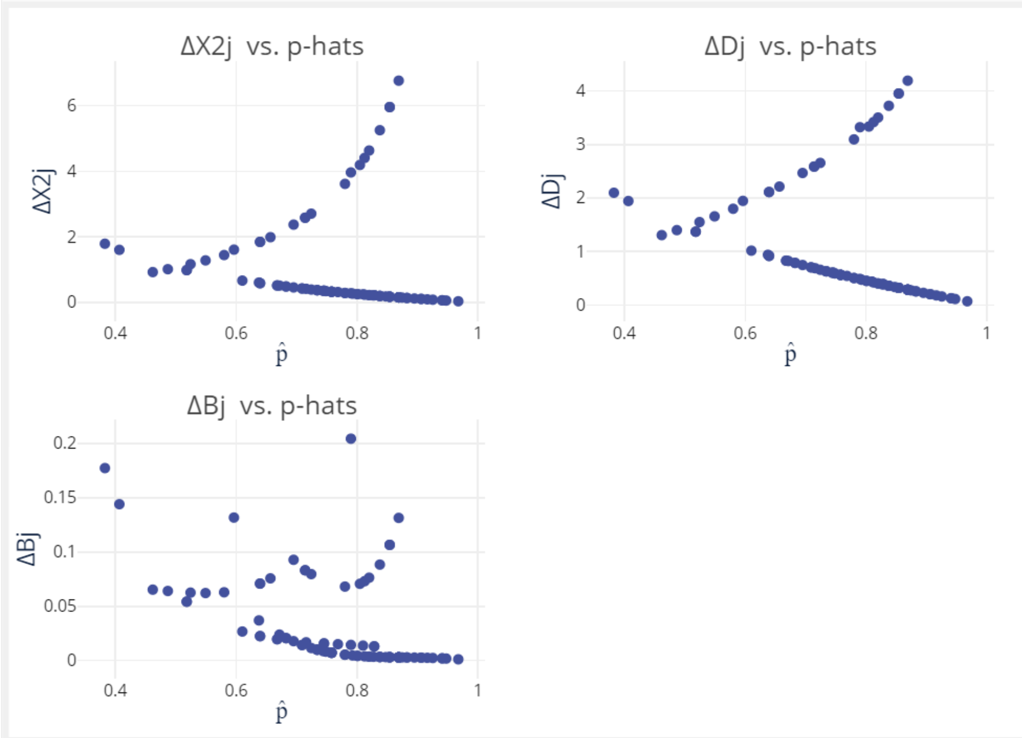
	Odds Ratio	Lower 90% CI	Upper 90% CI
Smokes	0.3033	0.1221	0.7532
Weight	1.025	1.005	1.046

Test of Model Fit

	Chi-Square	DF	p-value
Model Significance	7.574	2	0.0227
Pearson	88.63	89	0.4911
Deviance	93.64	89	0.3477
Hosmer-Lemeshow	5.037	8	0.7536

Test of Multicollinearity

Variable	VIF
Smokes	1.042
Weight	1.042



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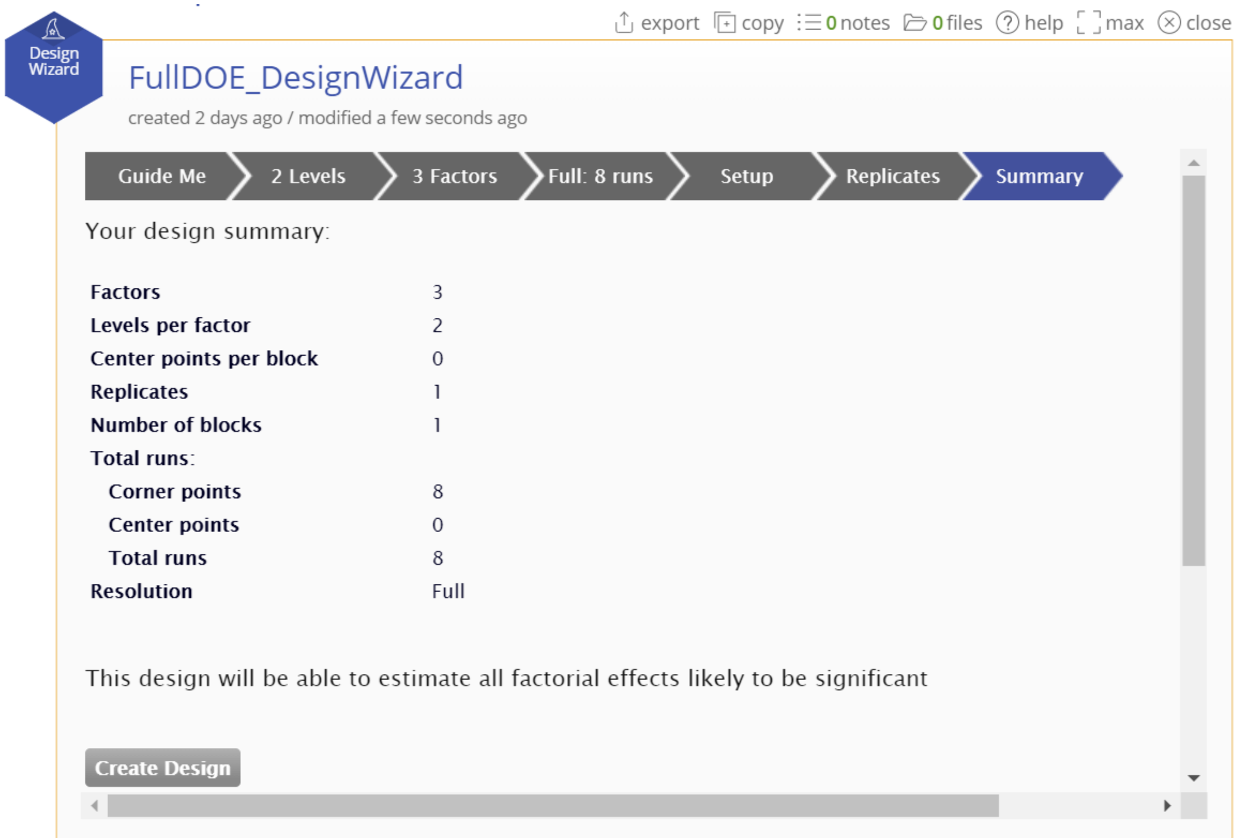
VII. Dataset: DOE_Full

1. FullDOE_DesignWizard



2. FullDOE_Analyzer

Response 8
DOE Analyzer
Design matrix 3

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FullDOE_Analyzer

created 2 days ago / modified 15 minutes ago

restore default study setup

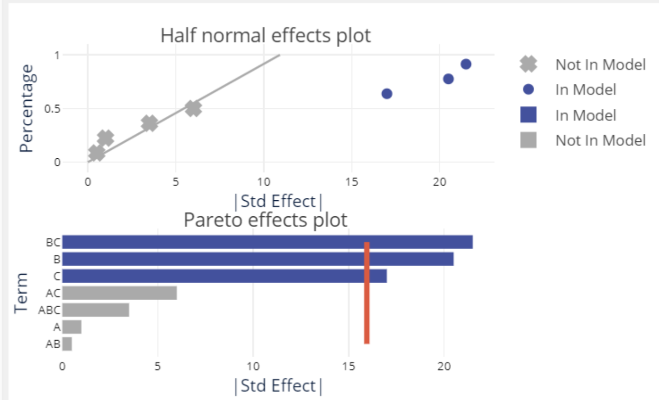
Summary | Model Output | Factorial Plots

Design Summary

Number of Runs	8
Number of Factors	3
Number of center points per block	0
Number of blocks	1
Number of replicates	1
Runs per replicate	8
Significance (α) Level	0.2
Number of Responses	1

Factor Information

Factor	Name	Coded Levels	Uncoded Levels
A	Brand	-1, 1	Cheap, Costly
B	Temp	-1, 1	4, 6
C	Power	-1, 1	75, 100



Half Normal Effects

Term	|Effect Size|
B-Temp	20.5
C-Power	17
BC	21.5

Summary | Model Output | Factorial Plots

Model Equations

Coded Model	Response = 66.5 + -10.75*BC + -10.25*B + -8.5*C
Uncoded Model	Response = -199 + -0.86*BC + -10.25*B + -0.68*C

Effects Coefficient

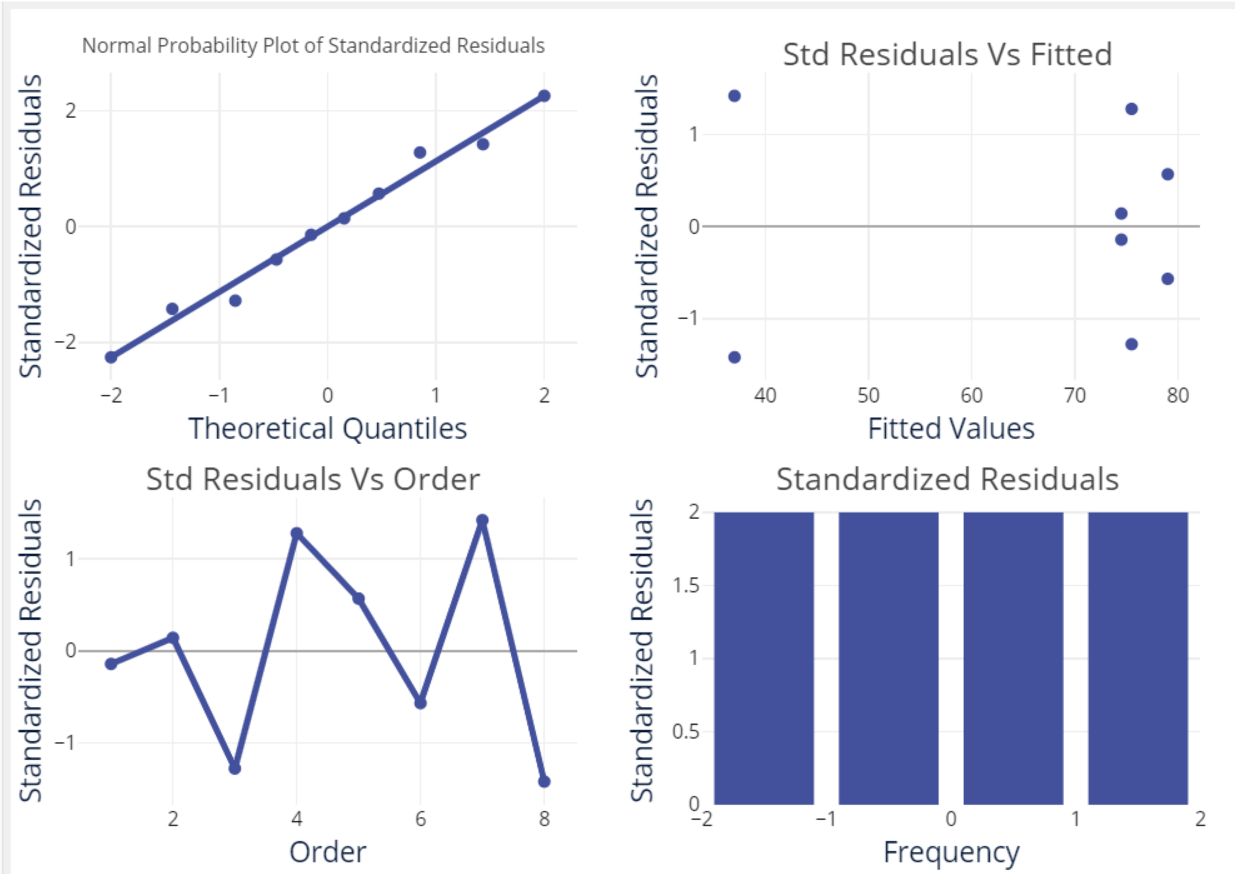
	Effect Size	Coefficients	Standard Error	80% CI (lower)	80% CI (upper)
Constant	NA	66.5	1.759	63.8	69.2
BC	-21.5	-10.75	1.759	-13.45	-8.053
B-Temp	-20.5	-10.25	1.759	-12.95	-7.553
C-Power	-17	-8.5	1.759	-11.2	-5.803

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Model	3	2,343	781	31.56	0.003
BC	1	924.5	924.5	37.35	0.0036
B-Temp	1	840.5	840.5	33.96	0.0043
C-Power	1	578	578	23.35	0.0084
Residuals	4	99	24.75	NA	NA
Total	7	2,442	NA	NA	NA

Model Statistics

Standard Error	4.975
R Squared	0.9595
Adjusted R Squared	0.9291



Summary | Model Output | Factorial Plots

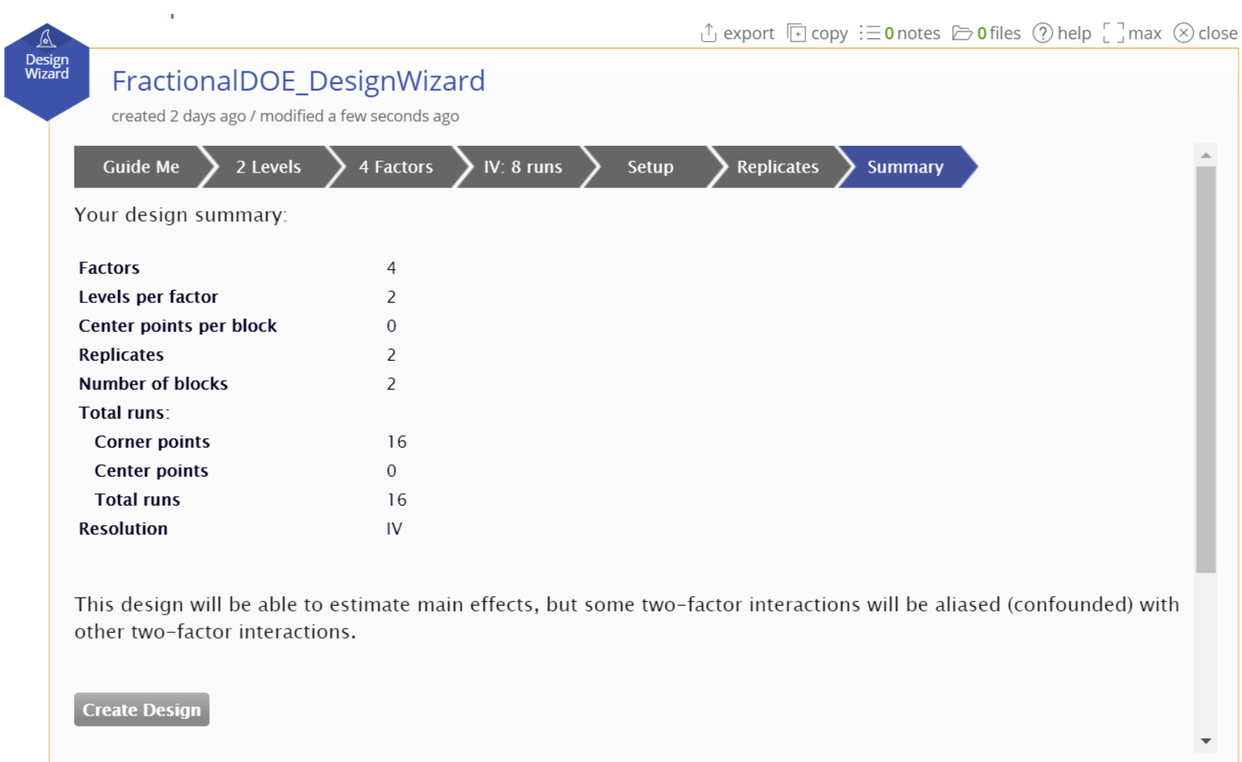
Factor Information

Factor	Name	Coded Levels	Uncoded Levels
A	Brand	-1, 1	Cheap, Costly
B	Temp	-1, 1	4, 6
C	Power	-1, 1	75, 100

main effect plots interaction plots cube plots

VIII. Dataset: DOE_Fractional

1. FractionalDOE_DesignWizard



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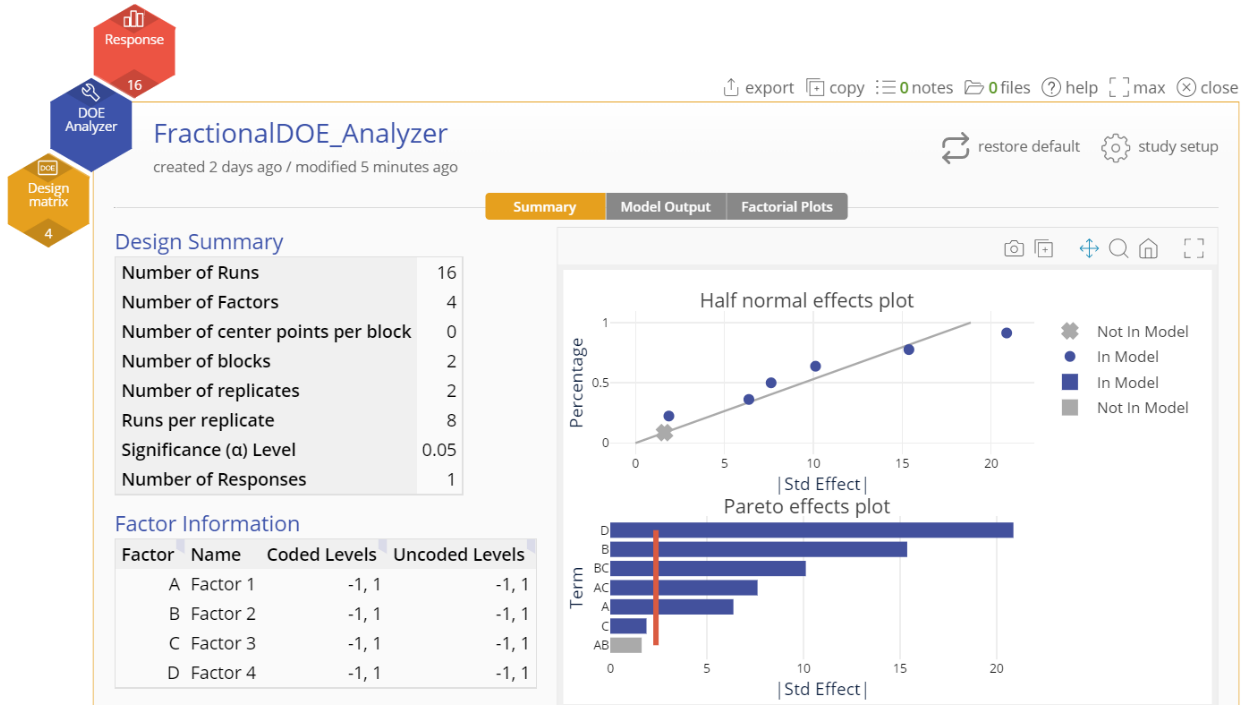
2. FractionalDOE_Analyzer



Design Summary

Number of Runs	16
Number of Factors	4
Number of center points per block	0
Number of blocks	2
Number of replicates	2
Runs per replicate	8
Significance (α) Level	0.05
Number of Responses	1

Factor Information

Factor	Name	Coded Levels	Uncoded Levels
A	Factor 1	-1, 1	-1, 1
B	Factor 2	-1, 1	-1, 1
C	Factor 3	-1, 1	-1, 1
D	Factor 4	-1, 1	-1, 1

Half Normal Effects

Term	|Effect Size|
A-Factor 1	6.375
B-Factor 2	15.38
C-Factor 3	1.875
D-Factor 4	20.88
AC	7.625
BC	10.12

Summary | **Model Output** | Factorial Plots

Model Equations

Coded Model	Response = 70.06 + 10.44*D + -7.69*B + 5.06*BC + -3.81*AC + 3.19*A + -0.94*C
Uncoded Model	Response = 70.06 + 10.44*D + -7.69*B + 5.06*BC + -3.81*AC + 3.19*A + -0.94*C

Effects Coefficient

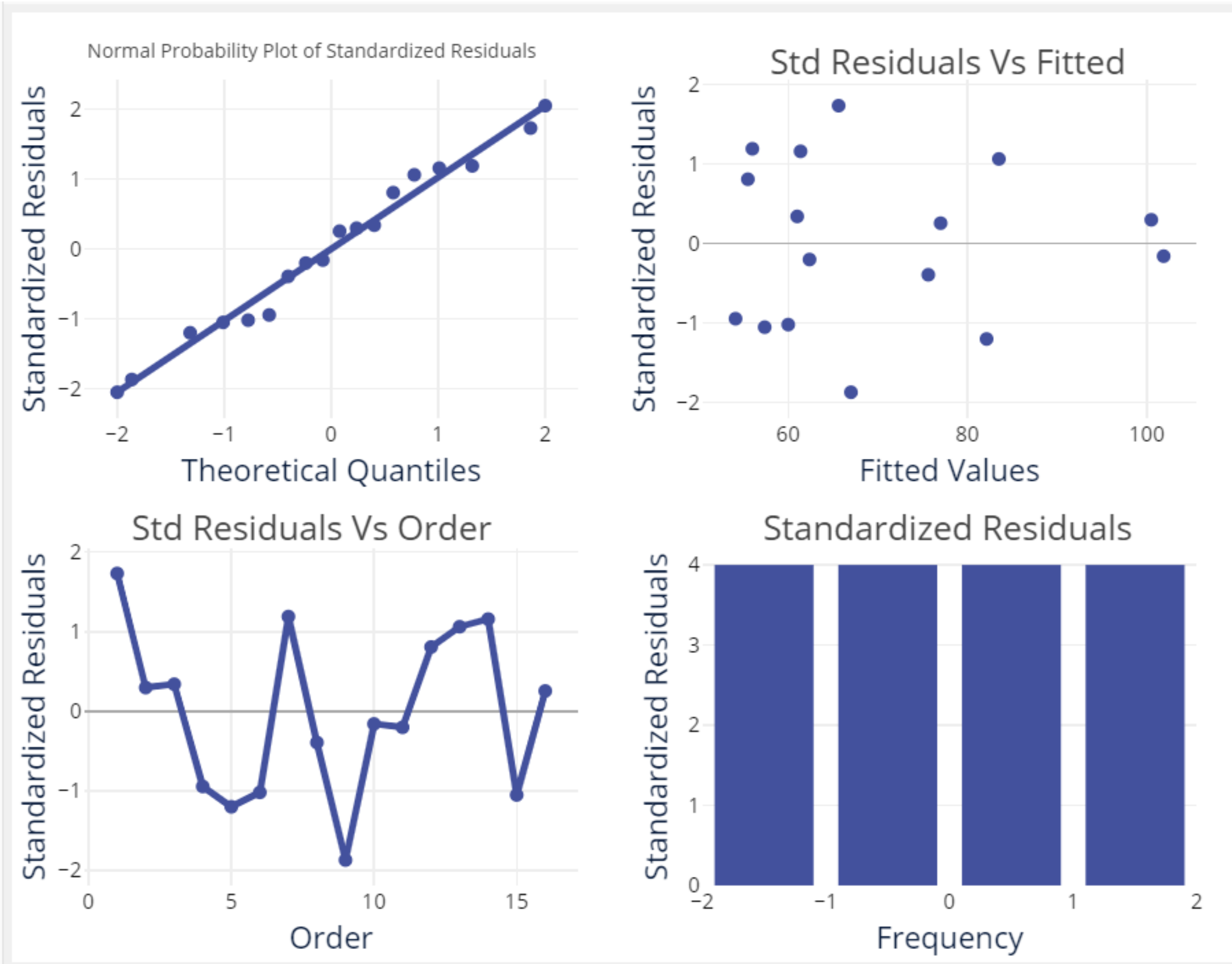
	Effect Size	Coefficients	Standard Error	95% CI (lower)	95% CI (upper)
Constant	NA	70.06	4.16	60.47	79.66
D-Factor 4	20.87	10.44	4.16	0.8437	20.03
B-Factor 2	-15.37	-7.687	4.16	-17.28	1.906
BC	10.12	5.062	4.16	-4.531	14.66
AC	-7.625	-3.812	4.16	-13.41	5.781
A-Factor 1	6.375	3.187	4.16	-6.406	12.78
C-Factor 3	-1.875	-0.938	4.16	-10.53	8.656

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Block	1	7.563	7.563	0.0273	0.8728
Model	6	3,508	584.6	2.111	0.1618
D-Factor 4	1	1,743	1,743	6.294	0.0364
B-Factor 2	1	945.6	945.6	3.414	0.1018
BC	1	410.1	410.1	1.481	0.2583
AC	1	232.6	232.6	0.8398	0.3863
A-Factor 1	1	162.6	162.6	0.587	0.4656
C-Factor 3	1	14.06	14.06	0.0508	0.8274
Residuals	8	2,216	276.9	NA	NA
Total	15	5,731	NA	NA	NA

Model Statistics

Standard Error	16.64
R Squared	0.6134
Adjusted R Squared	0.2752


Normal Probability Plot of Standardized Residuals
Standardized Residuals
Theoretical Quantiles
Std Residuals Vs Fitted
Standardized Residuals
Fitted Values
Std Residuals Vs Order
Standardized Residuals
Order
Standardized Residuals
Standardized Residuals
Frequency


Summary
Model Output
Factorial Plots
Factor Information
Factor Name Coded Levels Uncoded Levels
A Factor 1 -1, 1 -1, 1
B Factor 2 -1, 1 -1, 1
C Factor 3 -1, 1 -1, 1
D Factor 4 -1, 1 -1, 1
Page 1
Page 2
Factor 1 * Factor 2
Factor 1 * Factor 3
Factor 1 * Factor 4
Factor 2 * Factor 3
Response
Factor 1
Factor 2
Factor 2: 1
Factor 2: -1
Factor 3: 1
Factor 3: -1
Factor 4: 1
Factor 4: -1
main effect plots
interaction plots
cube plots

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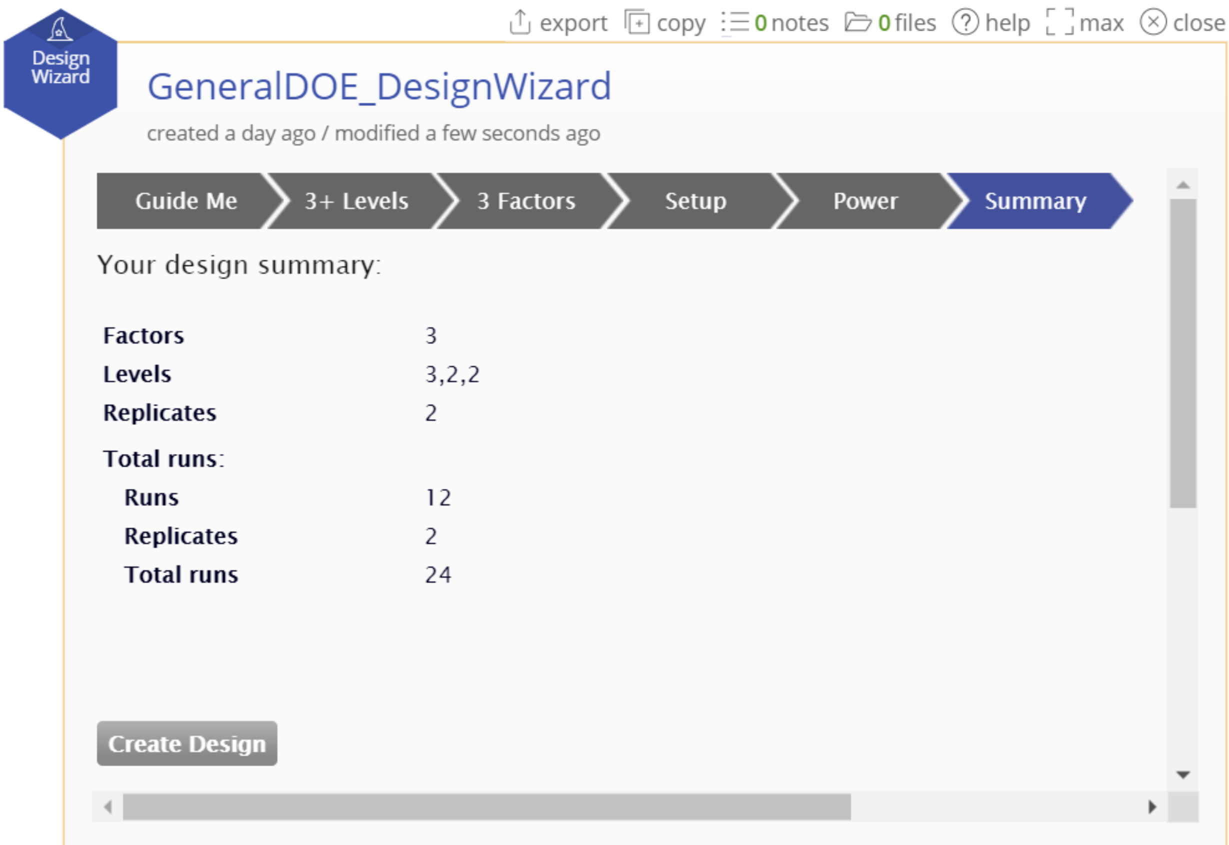
IX. Dataset: DOE_General

1. GeneralDOE_DesignWizard



2. GeneralDOE_Analyzer

Deviation from Target 24

DOE Analyzer

Design matrix 3

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GeneralDOE_Analyzer

created a day ago / modified 2 minutes ago

restore default study setup

Summary | Model Output | Factorial Plots

Design Summary

Number of Runs	24
Number of Factors	3
Number of blocks	2
Number of replicates	2
Runs per replicate	12
Significance (α) Level	0.15
Number of Responses	1

Factor Information

Factor	Name	Coded Levels	Uncoded Levels
A	Percent Carbonation	1, 2, 3	10, 12, 14
B	Pressure	1, 2	25, 30
C	Line Speed	1, 2	200, 250

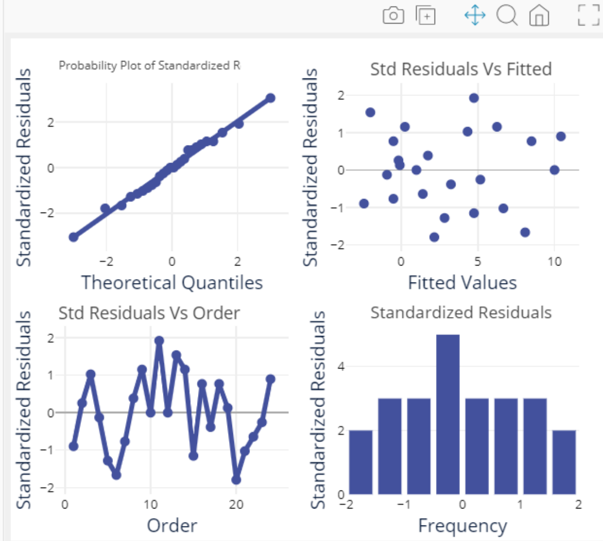
Summary | Model Output | Factorial Plots

ANOVA

	DF	Sum Sq	Mean Sq	F value	p-value
Block	1	1.042	1.042	1.639	0.2187
Model	6	325.4	54.24	85.36	0
A-Percent Carbonation	2	252.7	126.4	198.9	0
B-Pressure	1	45.38	45.38	71.41	0
C-Line Speed	1	22.04	22.04	34.69	0
AB	2	5.25	2.625	4.131	0.0358
Residuals	16	10.17	0.6354	NA	NA
Total	23	336.6	NA	NA	NA

Model Statistics

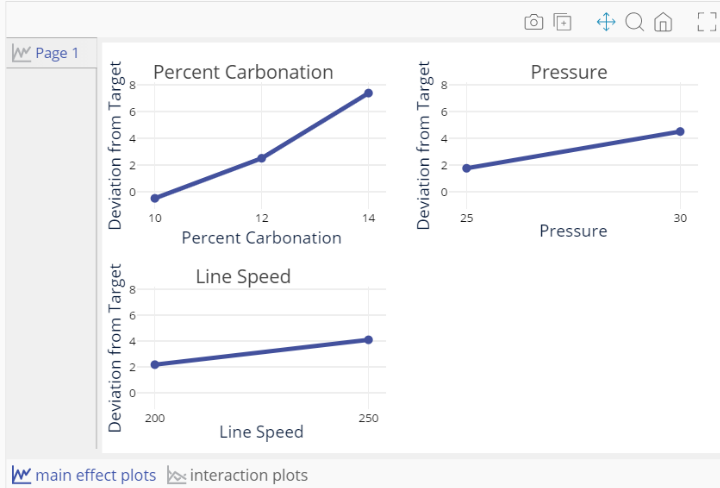
Standard Error	0.7971
R Squared	0.9698
Adjusted R Squared	0.9566



Summary | Model Output | Factorial Plots

Factor Information

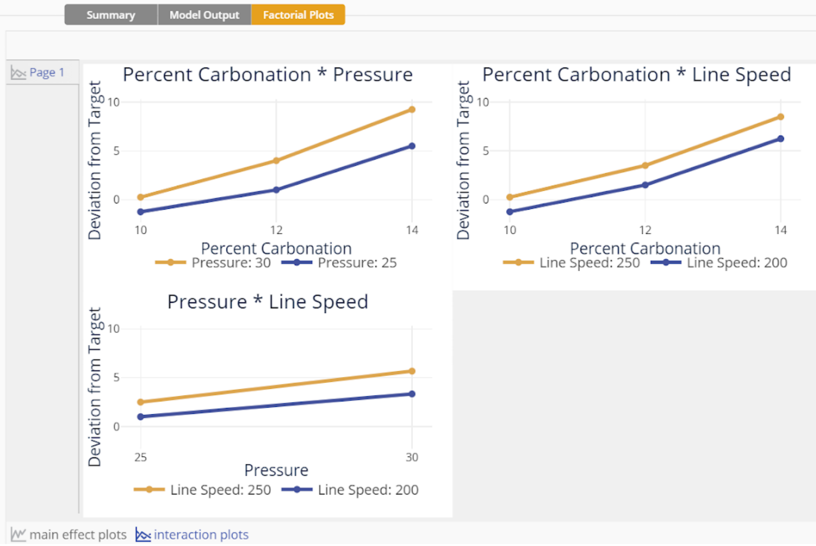
Factor	Name	Coded Levels	Uncoded Levels
A	Percent Carbonation	1, 2, 3	10, 12, 14
B	Pressure	1, 2	25, 30
C	Line Speed	1, 2	200, 250



Summary | Model Output | Factorial Plots

Factor Information

Factor	Name	Coded Levels	Uncoded Levels
A	Percent Carbonation	1, 2, 3	10, 12, 14
B	Pressure	1, 2	25, 30
C	Line Speed	1, 2	200, 250



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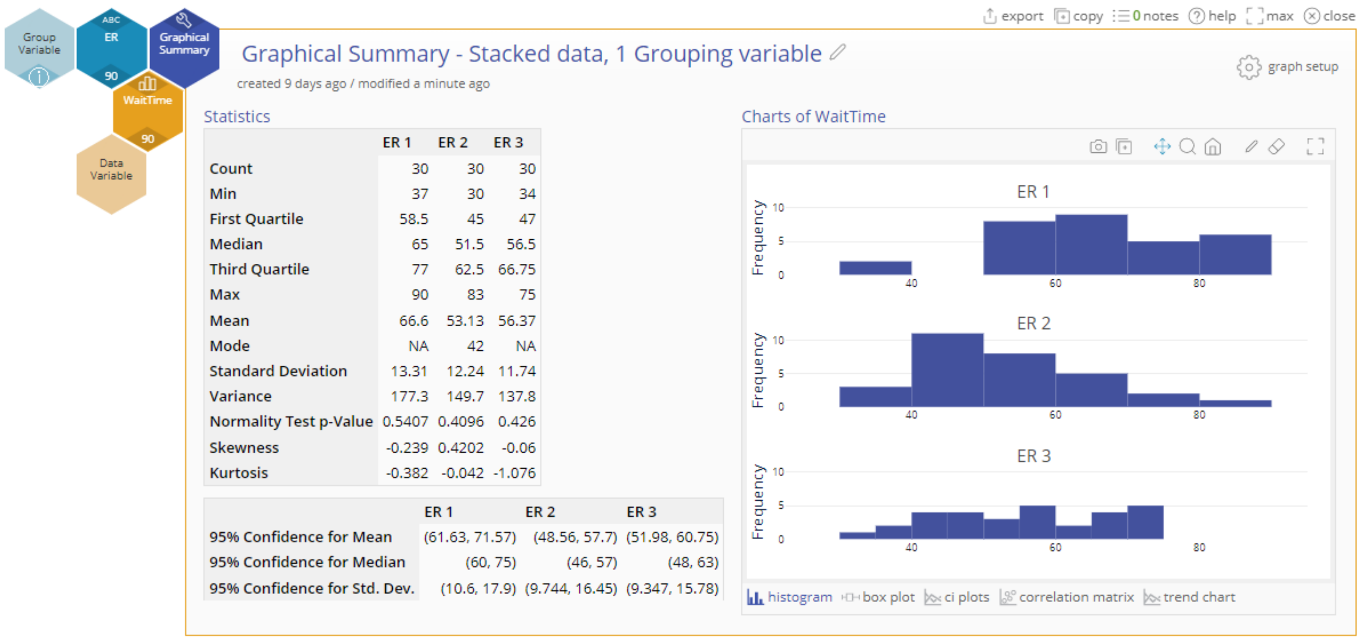
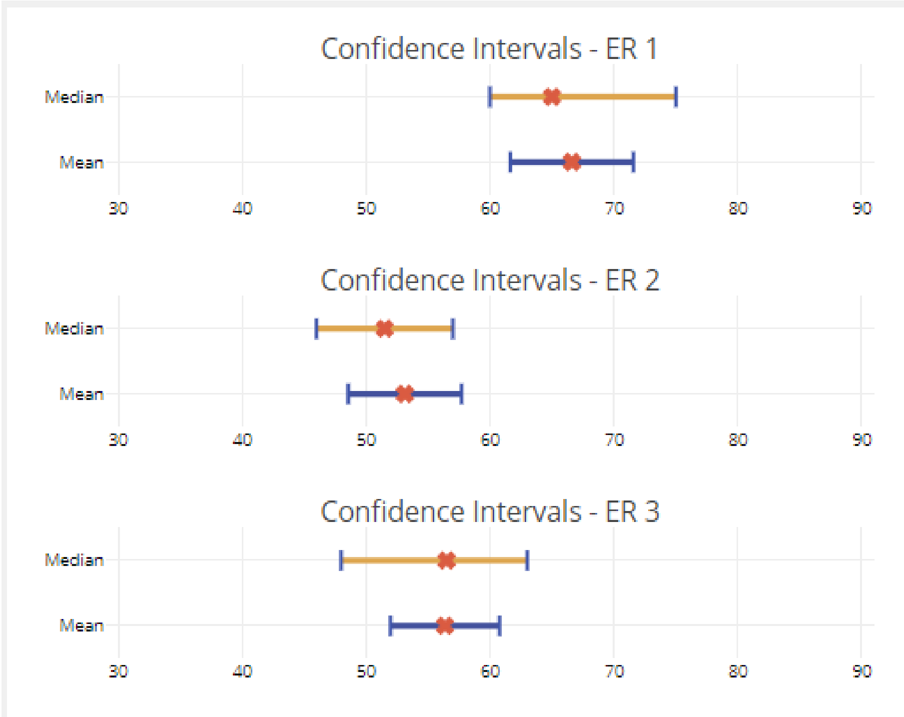
X. Dataset: Graphical_Summary

1. Graphical Summary - Stacked data, 1 Grouping variable

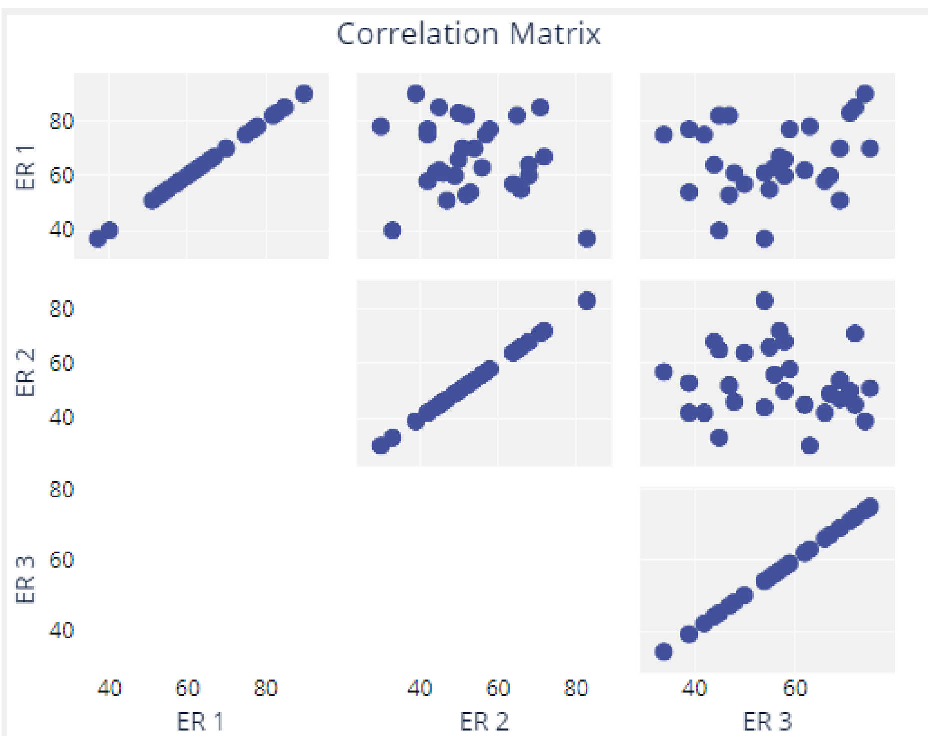


	ER 1	ER 2	ER 3
Count	30	30	30
Min	37	30	34
First Quartile	58.5	45	47
Median	65	51.5	56.5
Third Quartile	77	62.5	66.75
Max	90	83	75
Mean	66.6	53.13	56.37
Mode	NA	42	NA
Standard Deviation	13.31	12.24	11.74
Variance	177.3	149.7	137.8
Normality Test p-Value	0.5407	0.4096	0.426
Skewness	-0.239	0.4202	-0.06
Kurtosis	-0.382	-0.042	-1.076

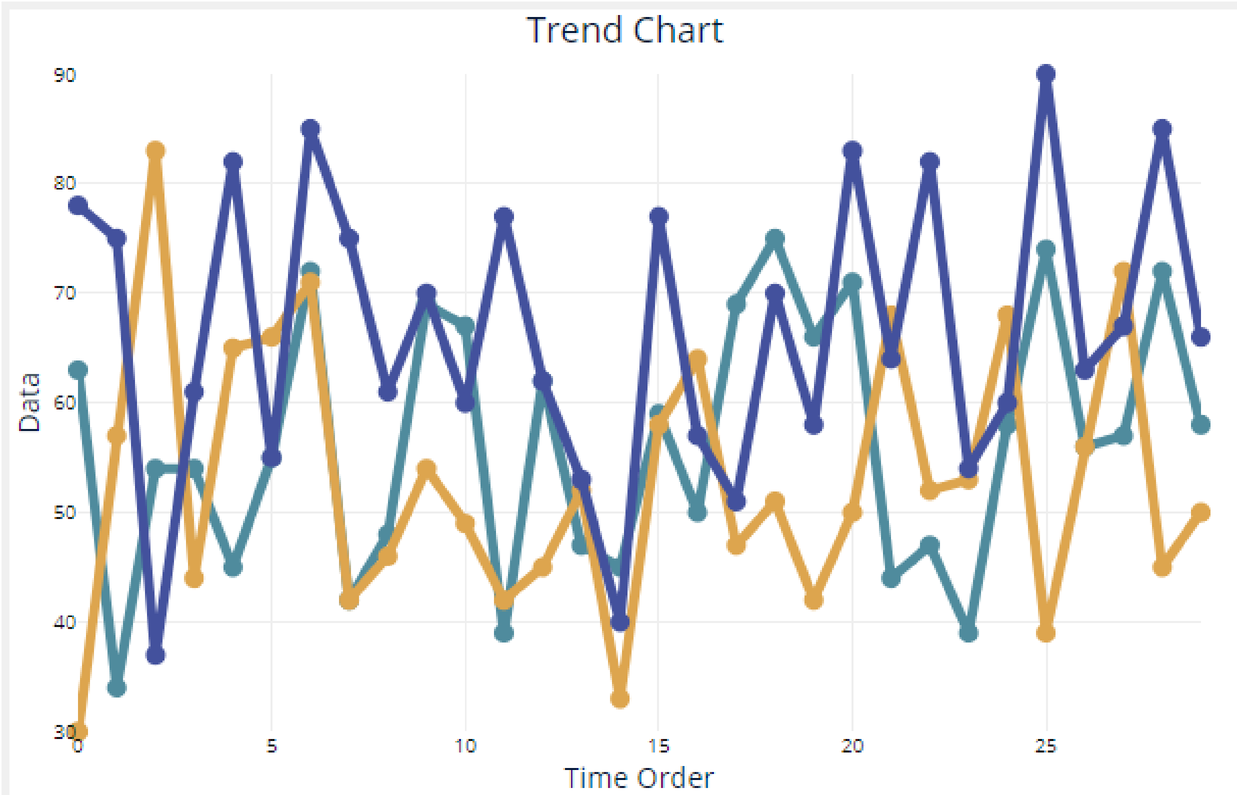
	ER 1	ER 2	ER 3
95% Confidence for Mean	(61.63, 71.57)	(48.56, 57.7)	(51.98, 60.75)
95% Confidence for Median	(60, 75)	(46, 57)	(48, 63)
95% Confidence for Std. Dev.	(10.6, 17.9)	(9.744, 16.45)	(9.347, 15.78)



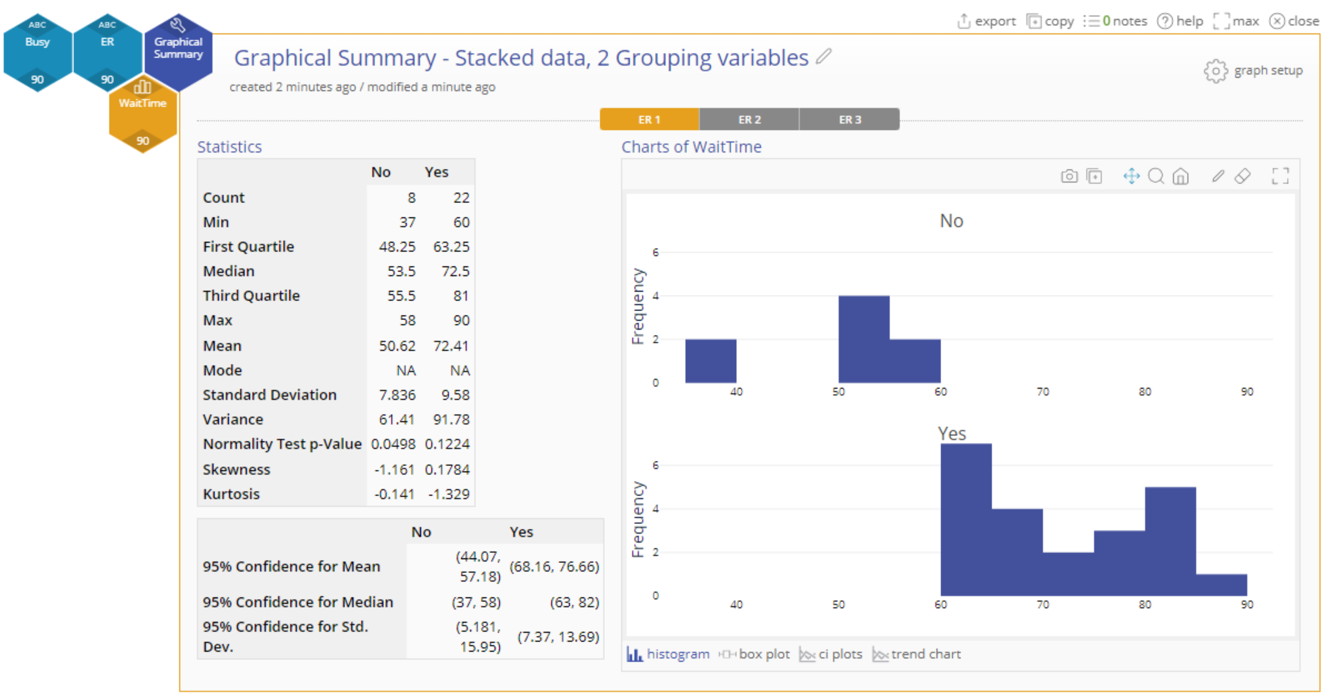
Confidence Intervals - ER 1
Median
Mean
30
40
50
60
70
80
90
Confidence Intervals - ER 2
Median
Mean
30
40
50
60
70
80
90
Confidence Intervals - ER 3
Median
Mean
30
40
50
60
70
80
90



Correlation Matrix
ER 1
ER 2
ER 3
80
60
40
ER 1
ER 2
ER 3
40
60
80

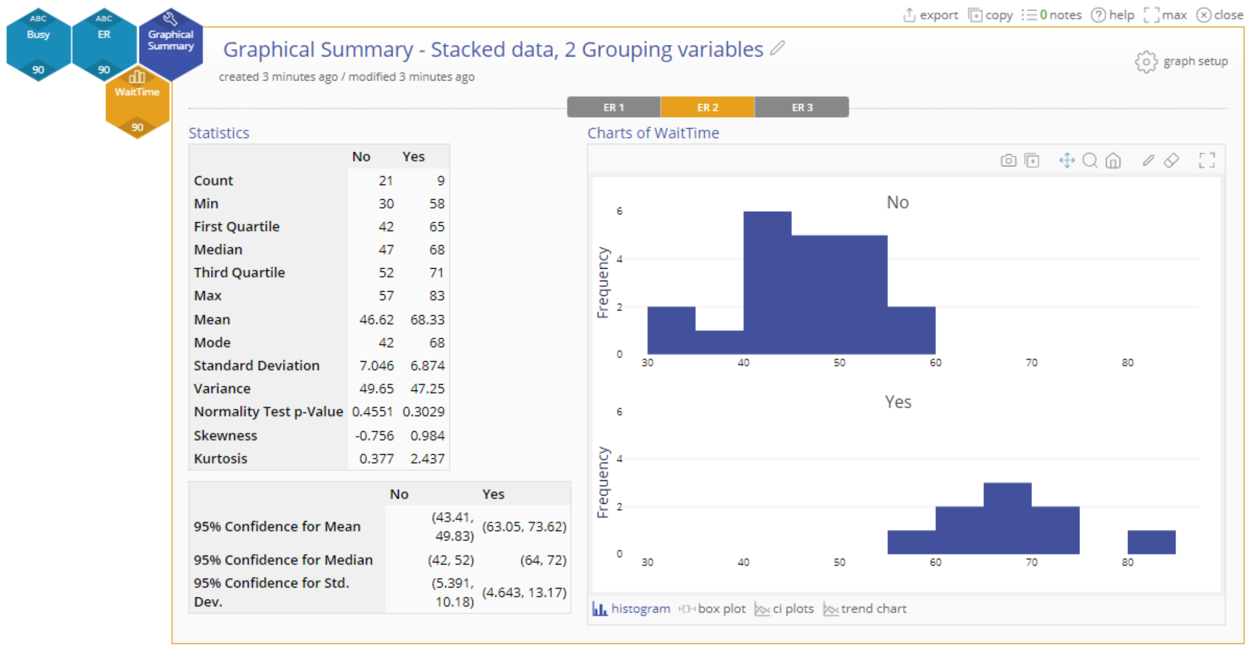


2. Graphical Summary - Stacked data, 2 Grouping variables:



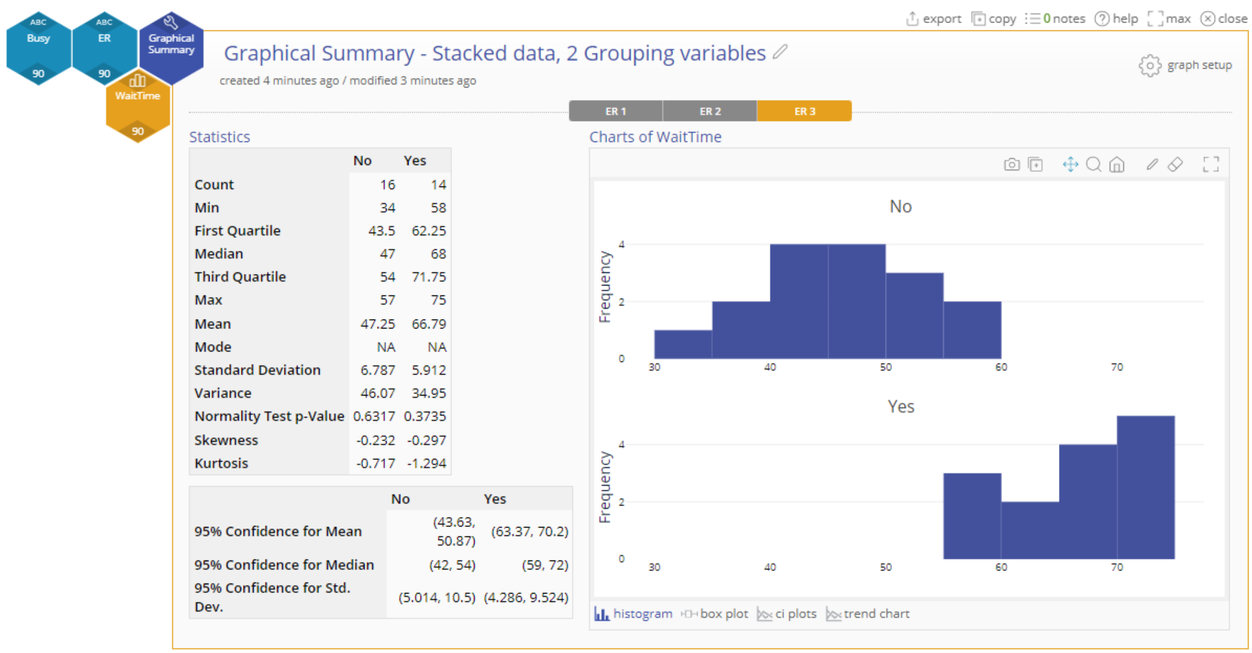
	No	Yes
Count	8	22
Min	37	60
First Quartile	48.25	63.25
Median	53.5	72.5
Third Quartile	55.5	81
Max	58	90
Mean	50.62	72.41
Mode	NA	NA
Standard Deviation	7.836	9.58
Variance	61.41	91.78
Normality Test p-Value	0.0498	0.1224
Skewness	-1.161	0.1784
Kurtosis	-0.141	-1.329

	No	Yes
95% Confidence for Mean	(44.07, 57.18)	(68.16, 76.66)
95% Confidence for Median	(37, 58)	(63, 82)
95% Confidence for Std. Dev.	(5.181, 15.95)	(7.37, 13.69)



	No	Yes
Count	21	9
Min	30	58
First Quartile	42	65
Median	47	68
Third Quartile	52	71
Max	57	83
Mean	46.62	68.33
Mode	42	68
Standard Deviation	7.046	6.874
Variance	49.65	47.25
Normality Test p-Value	0.4551	0.3029
Skewness	-0.756	0.984
Kurtosis	0.377	2.437

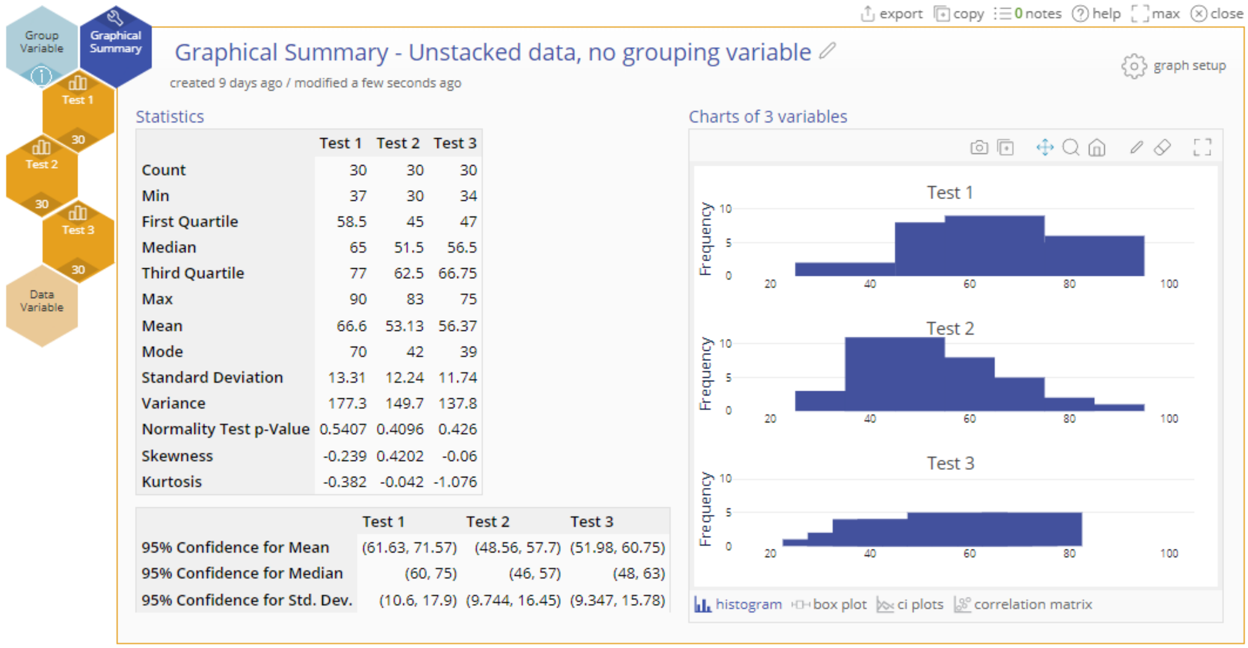
	No	Yes
95% Confidence for Mean	(43.41, 49.83)	(63.05, 73.62)
95% Confidence for Median	(42, 52)	(64, 72)
95% Confidence for Std. Dev.	(5.391, 10.18)	(4.643, 13.17)



	No	Yes
Count	16	14
Min	34	58
First Quartile	43.5	62.25
Median	47	68
Third Quartile	54	71.75
Max	57	75
Mean	47.25	66.79
Mode	NA	NA
Standard Deviation	6.787	5.912
Variance	46.07	34.95
Normality Test p-Value	0.6317	0.3735
Skewness	-0.232	-0.297
Kurtosis	-0.717	-1.294

	No	Yes
95% Confidence for Mean	(43.63, 50.87)	(63.37, 70.2)
95% Confidence for Median	(42, 54)	(59, 72)
95% Confidence for Std. Dev.	(5.014, 10.5)	(4.286, 9.524)

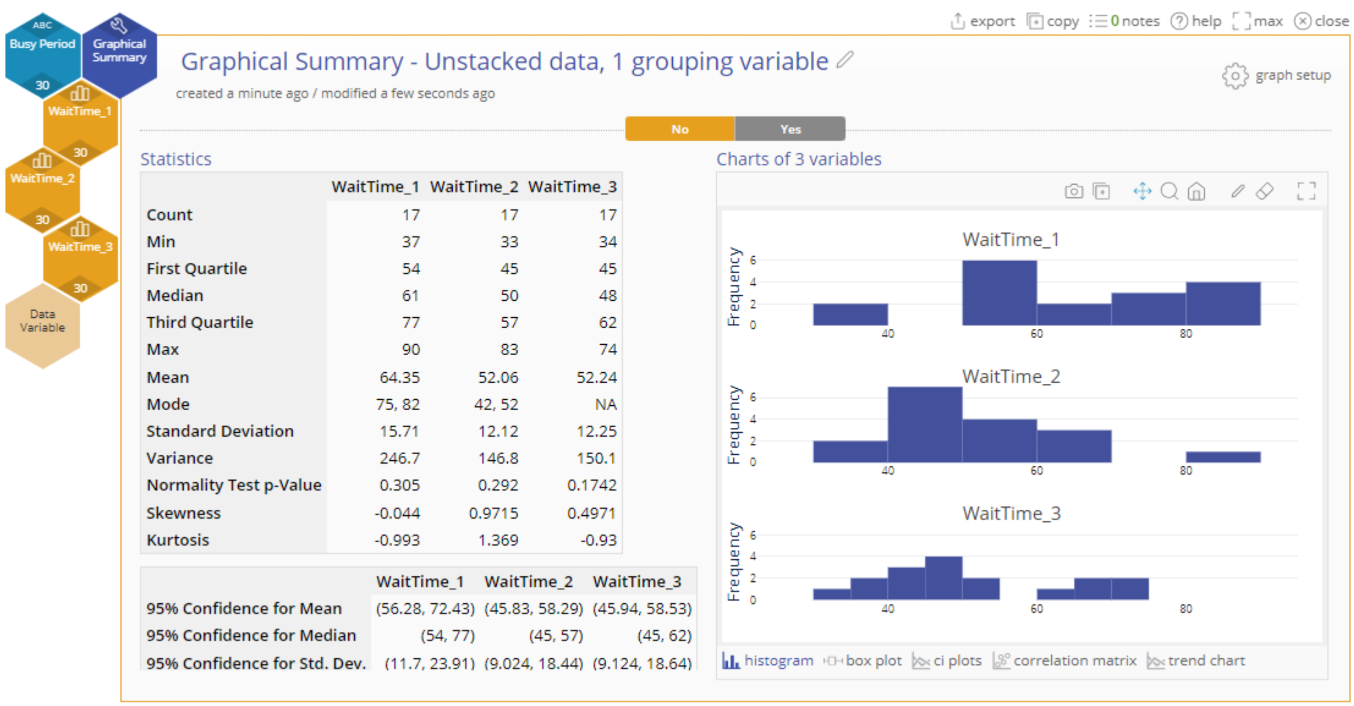
3. Graphical Summary - Unstacked data, no grouping variable



	Test 1	Test 2	Test 3
Count	30	30	30
Min	37	30	34
First Quartile	58.5	45	47
Median	65	51.5	56.5
Third Quartile	77	62.5	66.75
Max	90	83	75
Mean	66.6	53.13	56.37
Mode	70	42	39
Standard Deviation	13.31	12.24	11.74
Variance	177.3	149.7	137.8
Normality Test p-Value	0.5407	0.4096	0.426
Skewness	-0.239	0.4202	-0.06
Kurtosis	-0.382	-0.042	-1.076

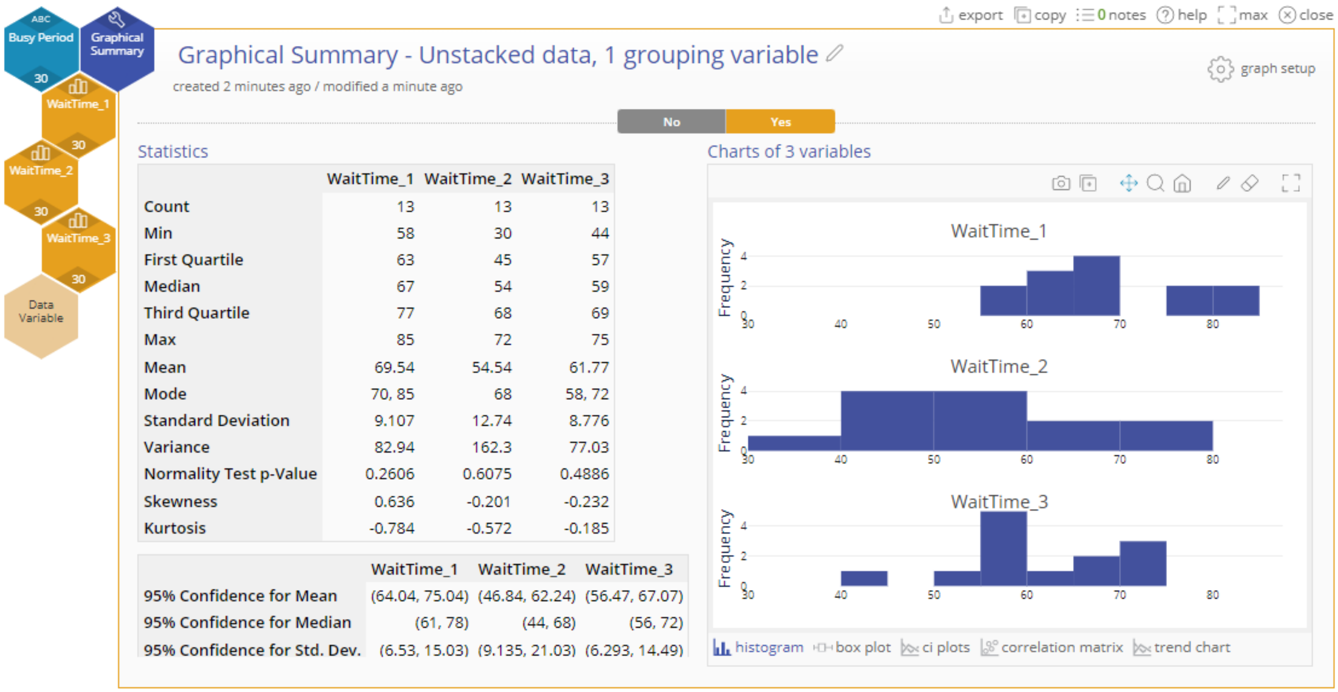
	Test 1	Test 2	Test 3
95% Confidence for Mean	(61.63, 71.57)	(48.56, 57.7)	(51.98, 60.75)
95% Confidence for Median	(60, 75)	(46, 57)	(48, 63)
95% Confidence for Std. Dev.	(10.6, 17.9)	(9.744, 16.45)	(9.347, 15.78)

4. Graphical Summary - Unstacked data, 1 grouping variable



	WaitTime_1	WaitTime_2	WaitTime_3
Count	17	17	17
Min	37	33	34
First Quartile	54	45	45
Median	61	50	48
Third Quartile	77	57	62
Max	90	83	74
Mean	64.35	52.06	52.24
Mode	75, 82	42, 52	NA
Standard Deviation	15.71	12.12	12.25
Variance	246.7	146.8	150.1
Normality Test p-Value	0.305	0.292	0.1742
Skewness	-0.044	0.9715	0.4971
Kurtosis	-0.993	1.369	-0.93

	WaitTime_1	WaitTime_2	WaitTime_3
95% Confidence for Mean	(56.28, 72.43)	(45.83, 58.29)	(45.94, 58.53)
95% Confidence for Median	(54, 77)	(45, 57)	(45, 62)
95% Confidence for Std. Dev.	(11.7, 23.91)	(9.024, 18.44)	(9.124, 18.64)



	WaitTime_1	WaitTime_2	WaitTime_3
Count	13	13	13
Min	58	30	44
First Quartile	63	45	57
Median	67	54	59
Third Quartile	77	68	69
Max	85	72	75
Mean	69.54	54.54	61.77
Mode	70, 85	68	58, 72
Standard Deviation	9.107	12.74	8.776
Variance	82.94	162.3	77.03
Normality Test p-Value	0.2606	0.6075	0.4886
Skewness	0.636	-0.201	-0.232
Kurtosis	-0.784	-0.572	-0.185

	WaitTime_1	WaitTime_2	WaitTime_3
95% Confidence for Mean	(64.04, 75.04)	(46.84, 62.24)	(56.47, 67.07)
95% Confidence for Median	(61, 78)	(44, 68)	(56, 72)
95% Confidence for Std. Dev.	(6.53, 15.03)	(9.135, 21.03)	(6.293, 14.49)

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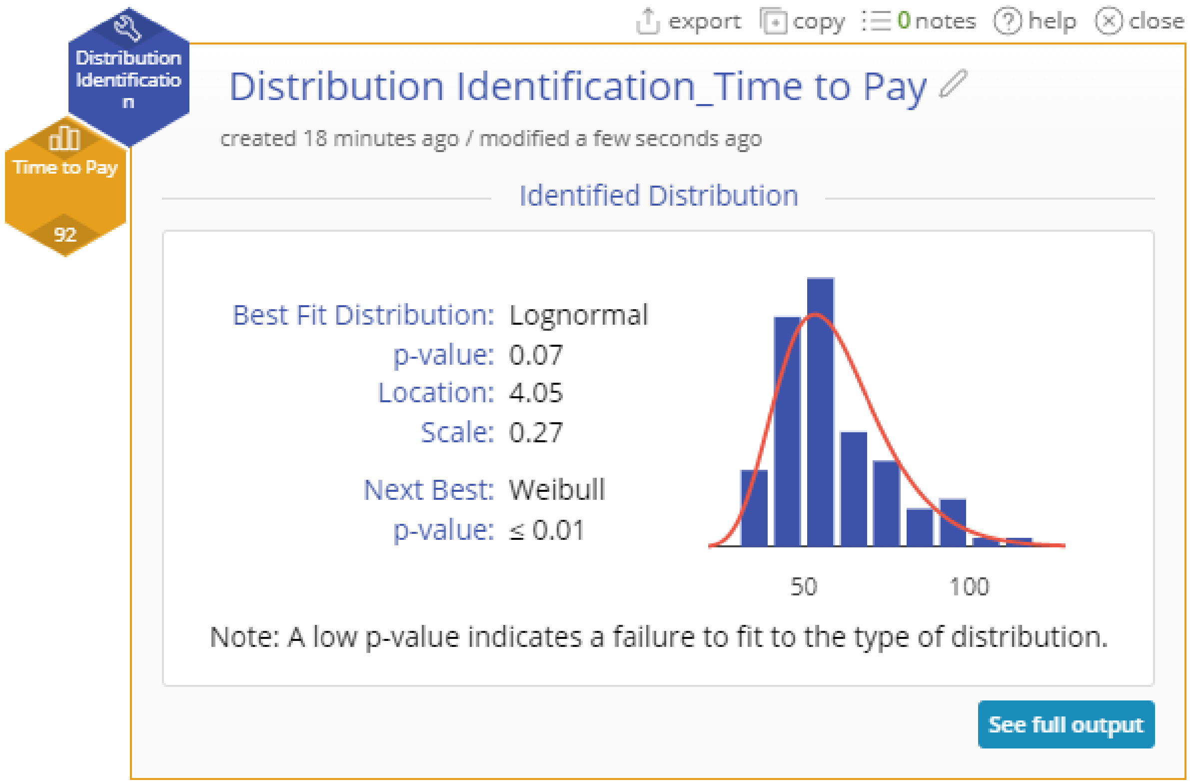
XI. Dataset: Distribution ID

1. Distribution Identification_Time to Pay: Summary output



2. Distribution Identification_Time to Pay: Full output:

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Distribution Identification_Time to Pay

created 21 minutes ago / modified a minute ago

graph setup

Best Fit Lognormal Distribution
Next Best Fit Weibull Distribution

Quick Reference Table

Best Fit Distribution	Lognormal
p-value	0.0661
Location	4.051
Scale	0.2734
Mean	4.051
Standard Deviation	0.2734

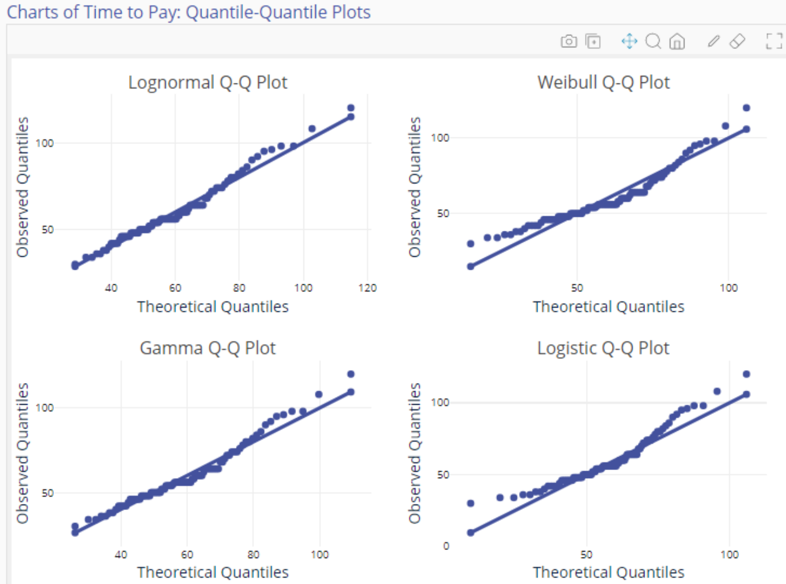
Goodness of Fit Tests

	AD Test Statistic	AD p-Value
Lognormal	0.6983	0.0661
Weibull	2.704	≤ 0.01
Gamma	1.085	≤ 0.01
Logistic	1.544	≤ 0.005
Normal	2.322	< 0.005
Exponential	23.1	< 0.005

ML Estimates of Distribution Parameters

	Location	Shape	Scale
Lognormal	4.051		0.2734
Weibull		3.505	66.09
Gamma		13.31	4.482
Logistic	57.72		9.252
Normal	59.67		17.3
Exponential			59.67

Charts of Time to Pay: Quantile-Quantile Plots



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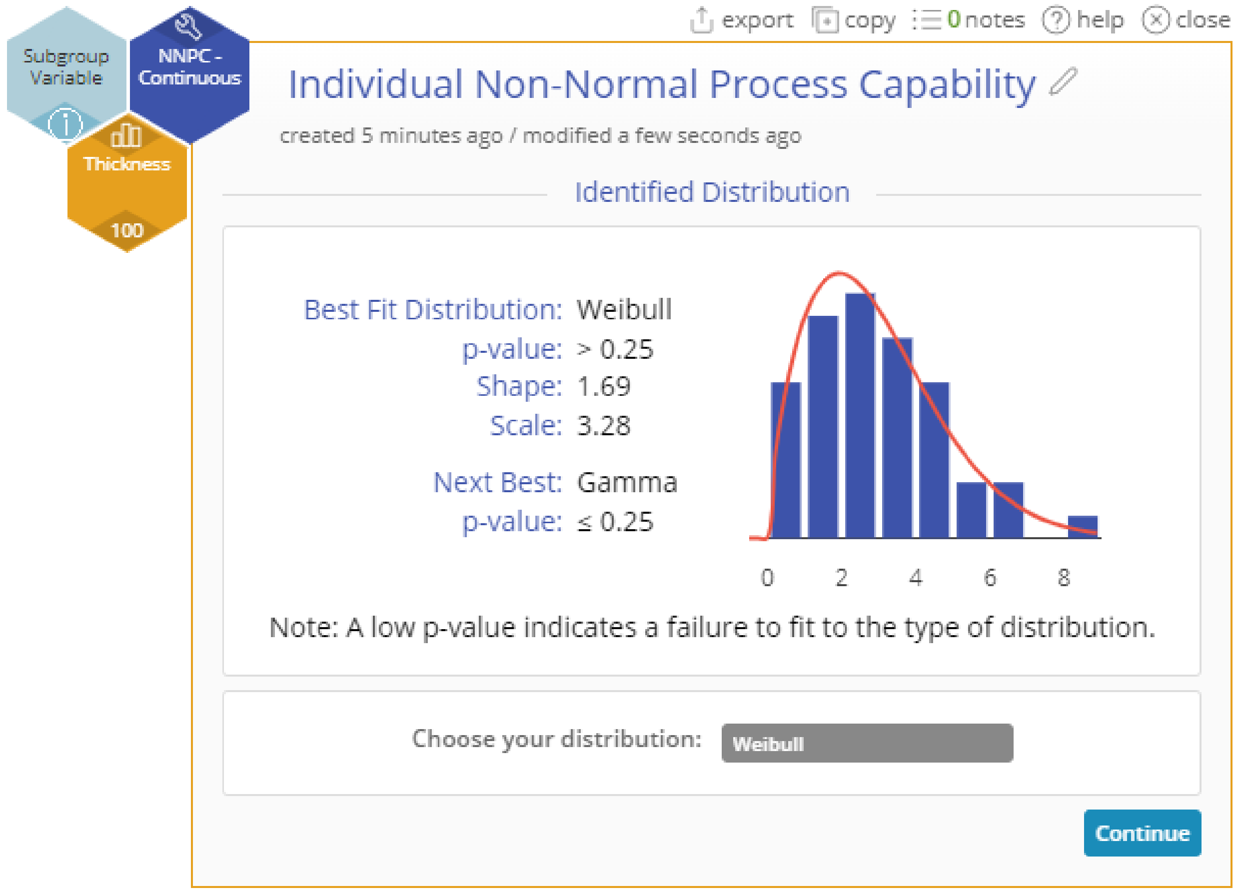
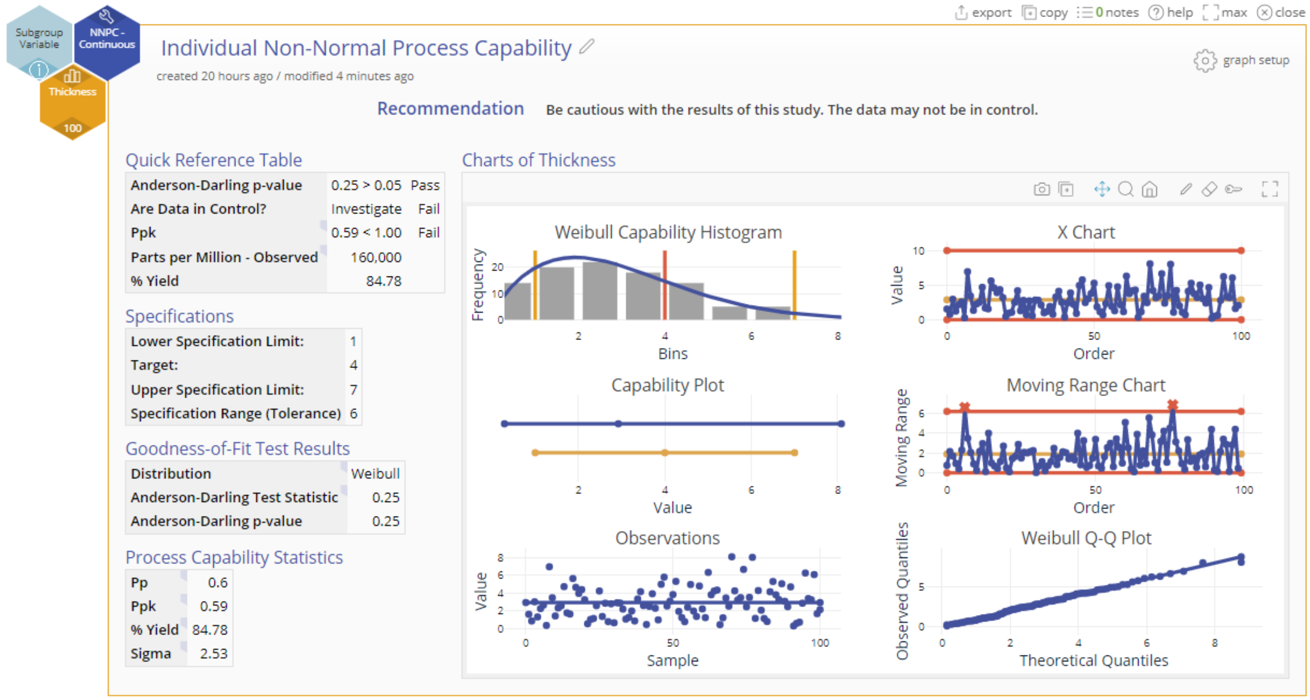
XII. Dataset: NNPC - Continuous

1. Individual Non-Normal Process Capability





Remaining tables:

Process Performance (% Defective)

	Observed	Expected
% Below LSL	14	12.53
% Above USL	2	2.69
Total	16	15.22
Parts per Million	160,000	152,236

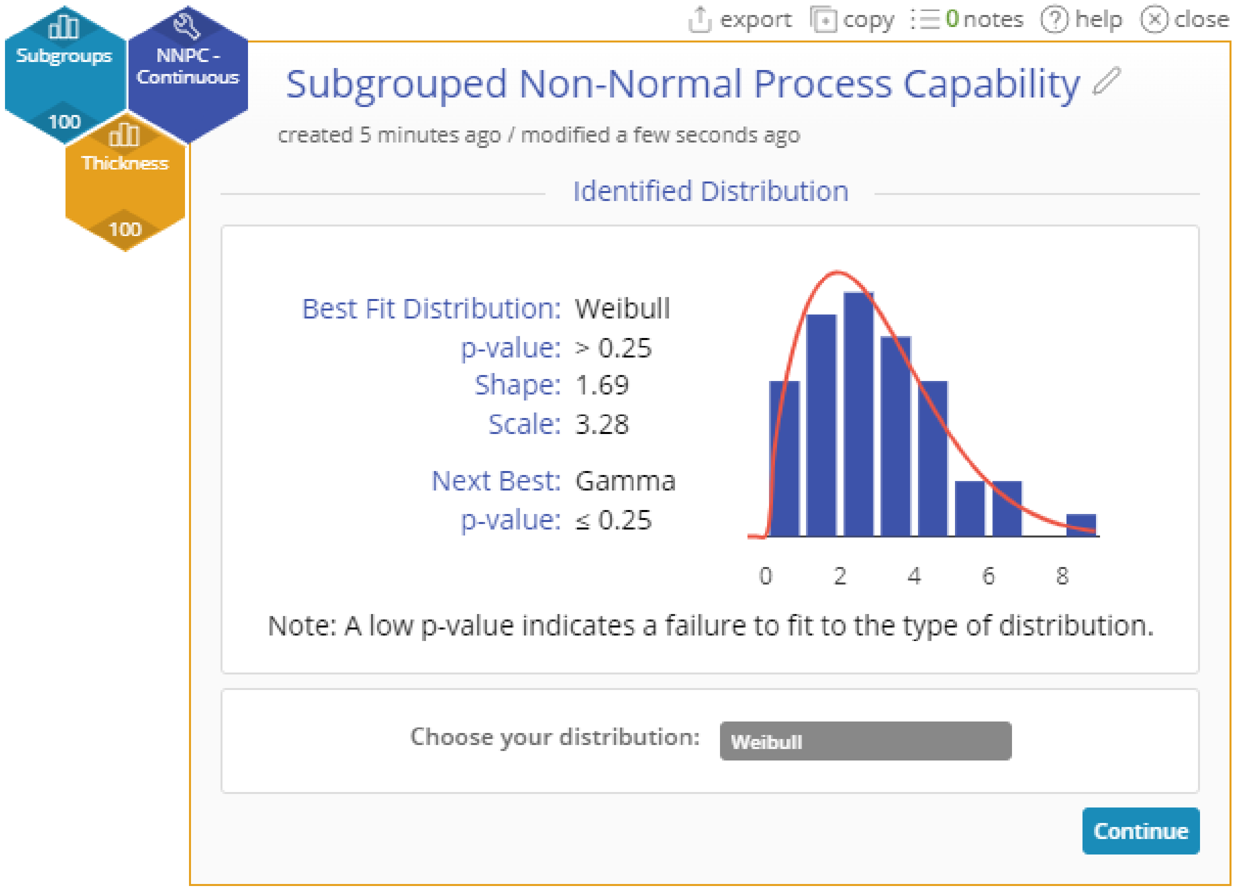
Process Characteristics

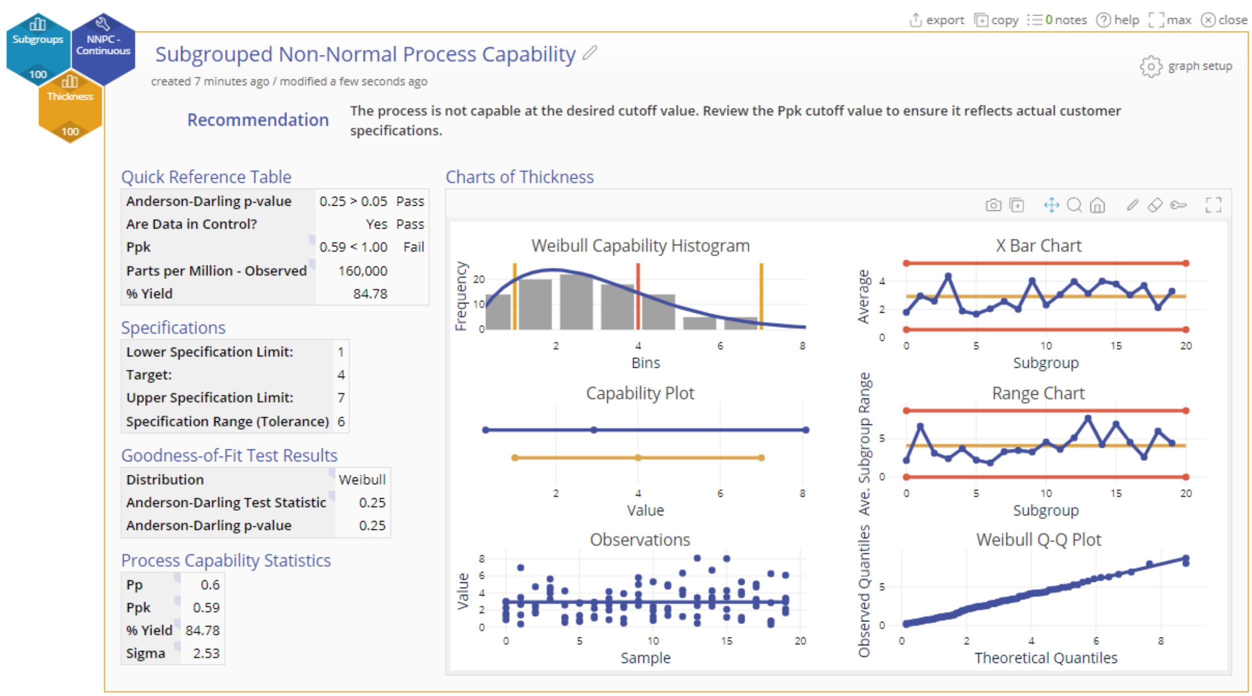
Sample Size	100
Subgroup Size	1
Number of Subgroups	100
Sample Mean	2.92
Standard Deviation	1.79

Distribution Parameters

Distribution	Weibull
Location	N/A
Shape	1.69
Scale	3.28

2. Subgrouped Non-Normal Process Capability


export
copy
0 notes
help
close
Subgroups
100
NNPC - Continuous
Thickness
100
Subgrouped Non-Normal Process Capability
created 5 minutes ago / modified a few seconds ago
Identified Distribution
Best Fit Distribution: Weibull
p-value: > 0.25
Shape: 1.69
Scale: 3.28
Next Best: Gamma
p-value: ≤ 0.25
0 2 4 6 8
Note: A low p-value indicates a failure to fit to the type of distribution.
Choose your distribution:
Weibull
Continue


export
copy
0 notes
help
max
close
Subgroups
100
NNPC - Continuous
Thickness
100
Subgrouped Non-Normal Process Capability
created 7 minutes ago / modified a few seconds ago
graph setup
Recommendation
The process is not capable at the desired cutoff value. Review the Ppk cutoff value to ensure it reflects actual customer specifications.
Quick Reference Table
Anderson-Darling p-value 0.25 > 0.05 Pass
Are Data in Control? Yes Pass
Ppk 0.59 < 1.00 Fail
Parts per Million - Observed 160,000
% Yield 84.78
Specifications
Lower Specification Limit: 1
Target: 4
Upper Specification Limit: 7
Specification Range (Tolerance) 6
Goodness-of-Fit Test Results
Distribution Weibull
Anderson-Darling Test Statistic 0.25
Anderson-Darling p-value 0.25
Process Capability Statistics
Pp 0.6
Ppk 0.59
% Yield 84.78
Sigma 2.53
Charts of Thickness
Weibull Capability Histogram
Frequency
Bins
X Bar Chart
Average
Subgroup
Capability Plot
Value
Range Chart
Ave. Subgroup Range
Subgroup
Observations
Value
Sample
Weibull Q-Q Plot
Observed Quantiles
Theoretical Quantiles

Remaining tables:

Process Performance (% Defective)

	Observed	Expected
% Below LSL	14	12.53
% Above USL	2	2.69
Total	16	15.22
Parts per Million	160,000	152,236

Process Characteristics

Sample Size	100
Subgroup Size	5
Number of Subgroups	20
Sample Mean	2.92
Standard Deviation	1.79

Distribution Parameters

Distribution	Weibull
Location	N/A
Shape	1.69
Scale	3.28

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XIII. Dataset: Non Normal Process Capability - Discrete Data

1. Binomial Non Normal Process Capability

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Binomial Non Normal Process Capability

created 13 minutes ago / modified a few seconds ago

graph setup

Process Performance (% Defective)

	Observed	Lower CI	Upper CI
% Defective	4.42	3.65	5.29
PPM Defective	44,153	36,459	52,930
Process Z (Sigma Level)	1.7	1.62	1.79

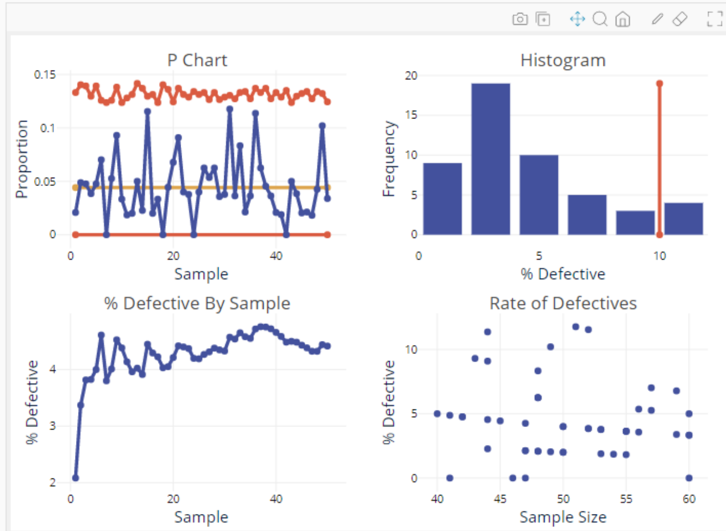
Specifications

Target (%Defective) for Binomial and Target (#Defects) for Poisson	10

Process Characteristics

Sample Size	Variable
Number of Samples	50

Charts of 2 variables



2. Poisson Non Normal Process Capability

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Poisson Non Normal Process Capability

created a minute ago / modified a few seconds ago

graph setup

Process Performance Defects Per Unit (DPU)

	Observed	Lower CI	Upper CI
Mean DPU	0.29	0.25	0.34
Minimum DPU	0		
Maximum DPU	0.67		

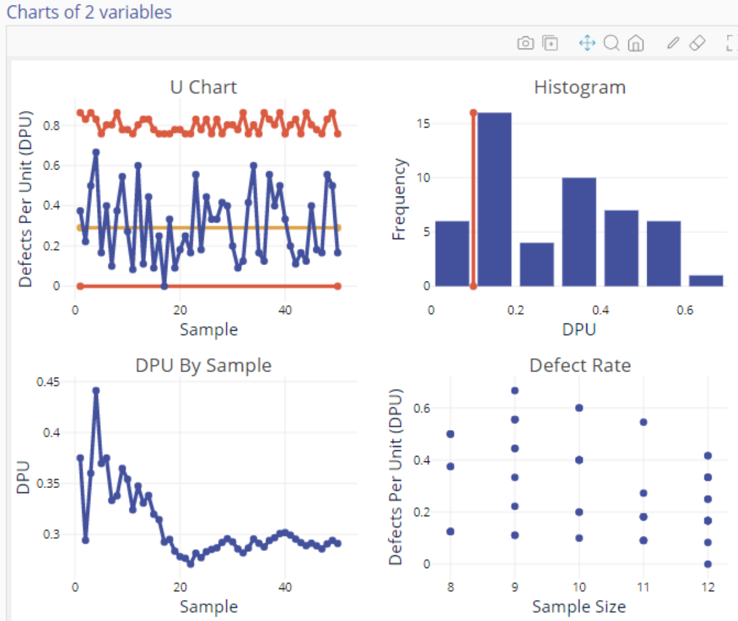
Specifications

Target (%Defective) for Binomial and Target (#Defects) for Poisson	0.1

Process Characteristics

Sample Size	Variable
Number of Samples	50

Charts of 2 variables



XIV. Dataset: Classification and Regression Trees

1. Bank Churn Data Classification Tree: 70-30 training-test data split

Bank Churn Classification Tree

created 5 minutes ago / modified 2 minutes ago

study setup

Recommendation There is an unequal distribution of classes in the response variable. One class makes up over 70% of the total observations; this indicates a moderate imbalance which can adversely affect the performance of the tree. You may be able to improve the results by adding more observations on the minority (under-represented) class to the data.

Binary Classification Statistics

Class		Training	Testing
Existing Customer	Accuracy	92.9%	91.3%
	Precision	94%	92.6%
	True Positive Rate	97.8%	97.4%
	False Positive Rate	32.8%	39.9%
	True Negative Rate	67.2%	60.1%
	False Negative Rate	2.17%	2.56%
	F-1 Score	95.9%	95%

Response Information

Dataset	N	Split	Class	Count	Split
Training	7,088	70%	Existing Customer	5,957	84%
			Attrited Customer	1,131	16%
Testing	3,039	30%	Existing Customer	2,543	83.7%
			Attrited Customer	496	16.3%
Overall	10,127	100	Existing Customer	8,500	83.9%
			Attrited Customer	1,627	16.1%

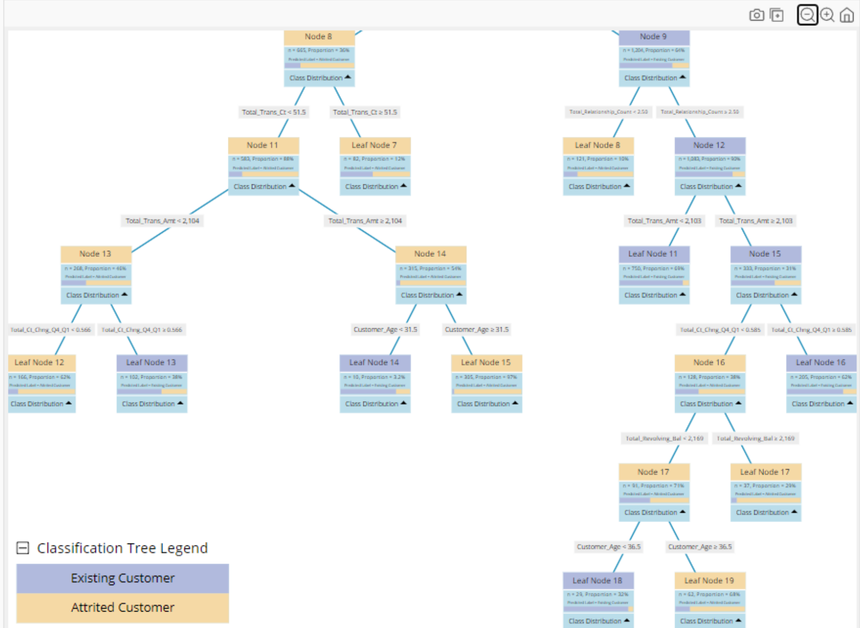
Model Summary

Minimum Samples per Node	10
Maximum Tree Depth	9
Leaf (Terminal) Node Count	18

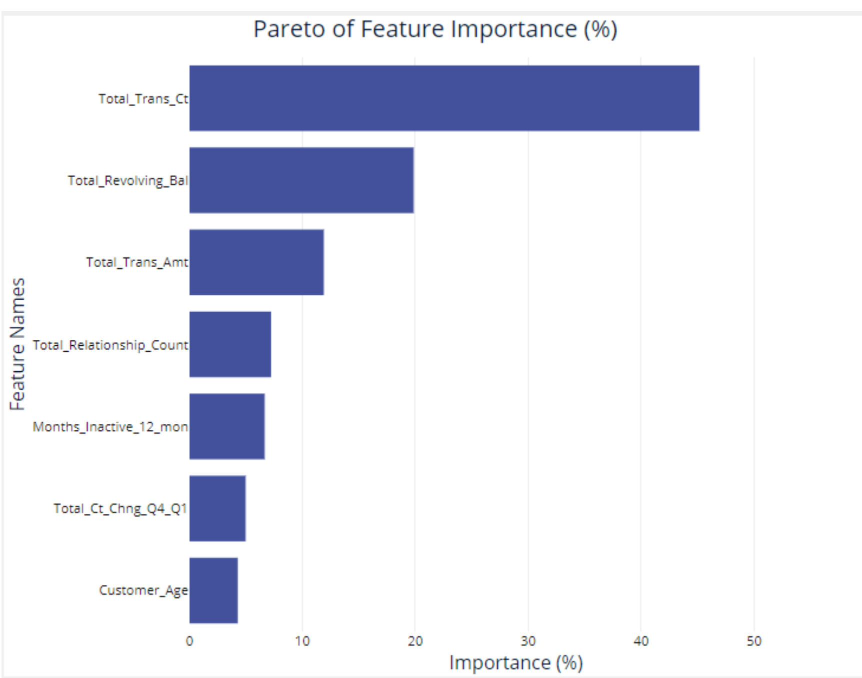
Feature Importance (%) for Attrition_Flag

Total_Trans_Ct	45.2
Total_Revolving_Bal	19.8
Total_Trans_Amt	11.9
Total_Relationship_Count	7.22
Months_Inactive_12_mon	6.65
Total_Ct_Chng_Q4_Q1	4.97
Customer_Age	4.27

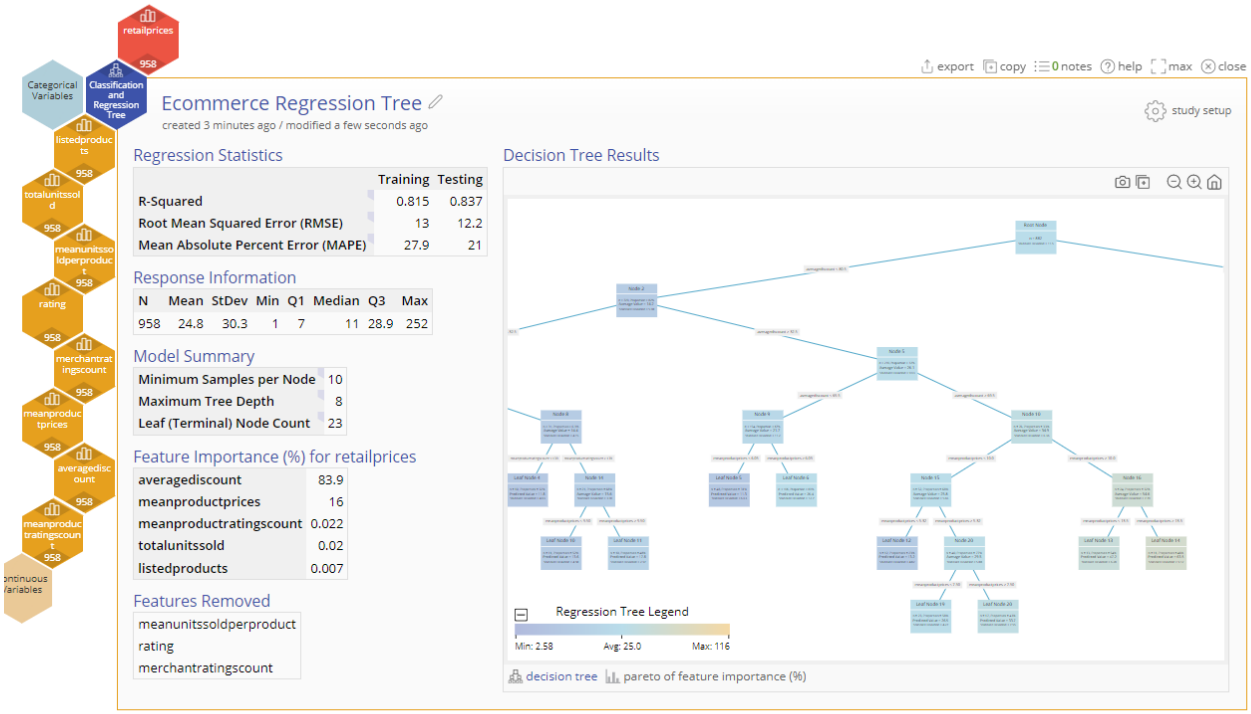
Decision Tree Results

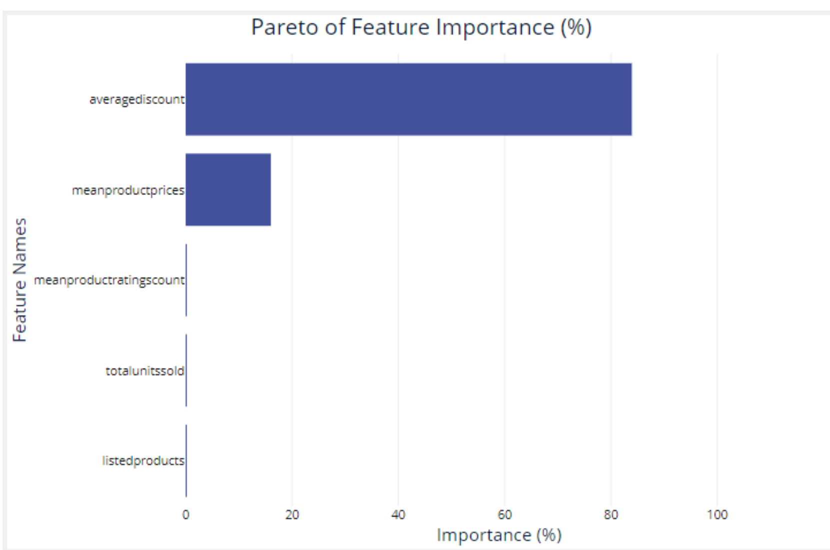


decision tree | pareto of feature importance (%)



2. Ecommerce Data Regression Tree: 10-fold Cross-validation





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