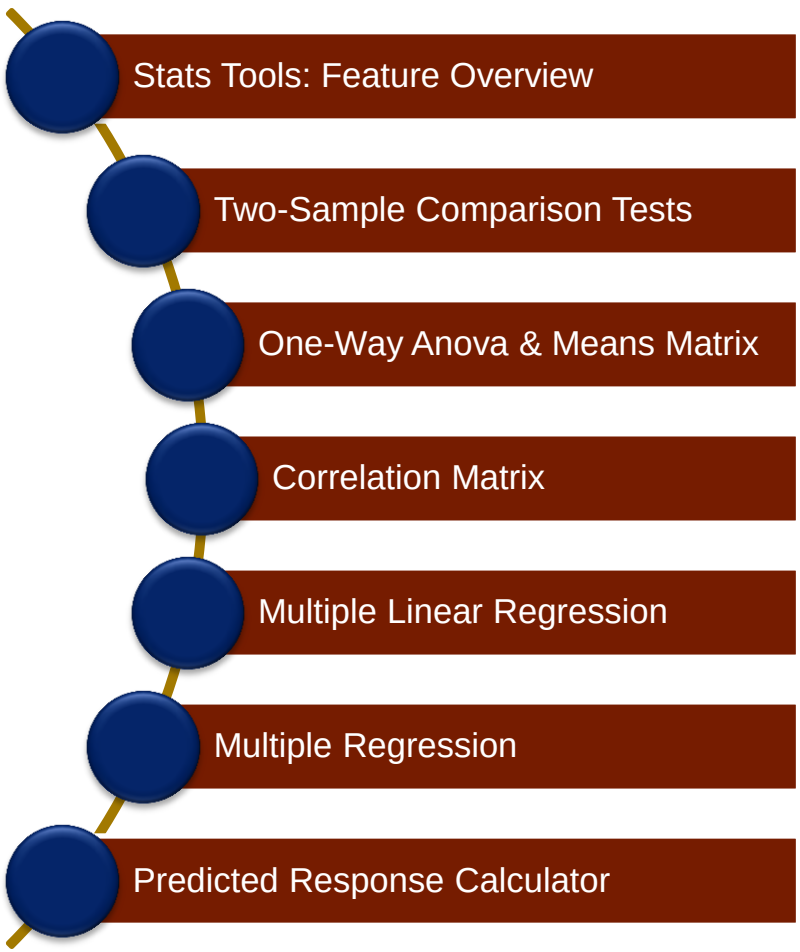
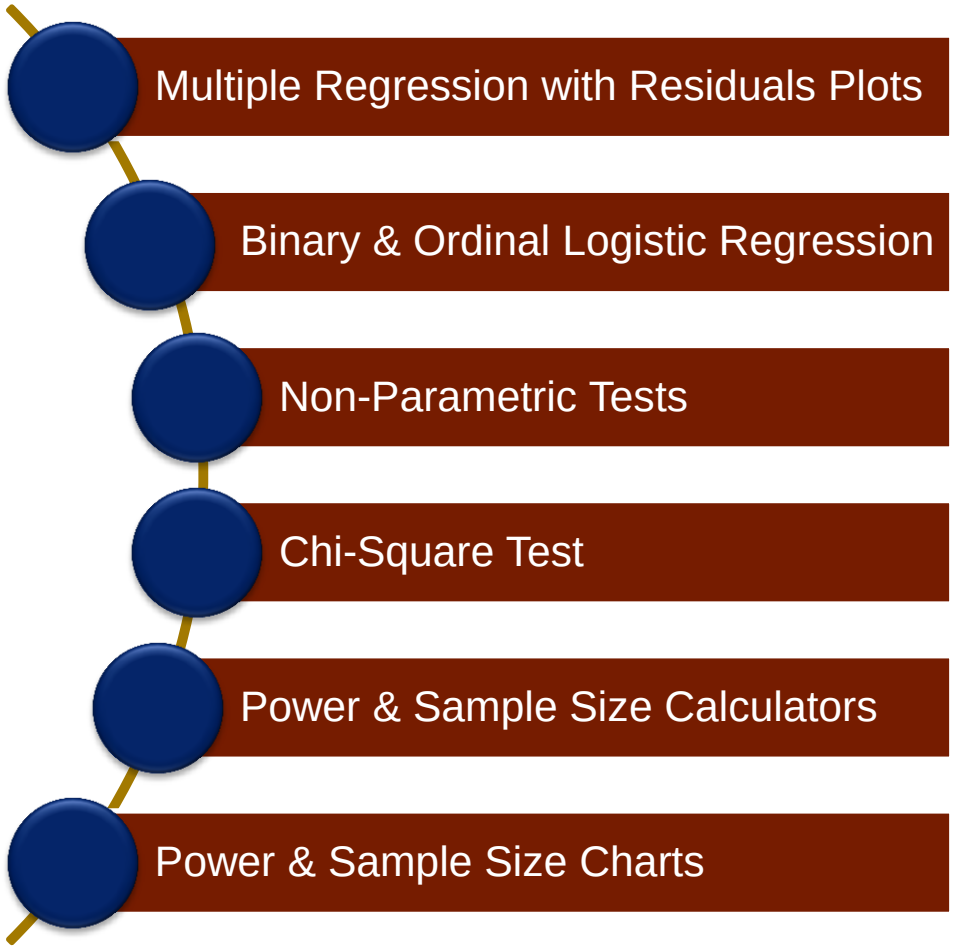
Statistical Tools - SigmaXL® Version 6.1





Statistical Tools

- P-values turn red when results are significant (p-value < alpha)
- Descriptive Statistics including Anderson-Darling Normality test, Skewness and Kurtosis with p-values
- 1 Sample t-test and confidence intervals
- Paired t-test, 2 Sample t-test
- 2 Sample Comparison Tests
  - Normality, Mean, Variance, Median
  - Yellow Highlight to aid Interpretation

Back to Index

Statistical Tools

- One-Way ANOVA and Means Matrix
- Two-Way ANOVA
  - Balanced and Unbalanced
- Equal Variance Tests:
  - Bartlett
  - Levene
  - Welch's ANOVA
- Correlation Matrix
  - Pearson's Correlation Coefficient
  - Spearman's Rank

Back to Index

Statistical Tools

- Multiple Linear Regression
- Binary and Ordinal Logistic Regression
- Chi-Square Test (Stacked Column data and Two-Way Table data)
- Nonparametric Tests
- Power and Sample Size Calculators
- Power and Sample Size Charts

Back to Index

Statistical Tools: Two-Sample Comparison Tests

2 Sample Comparison Test - Overall Satisfaction		
Customer Type	1	2
Count	31	42
Mean	3.3935	4.2052
Median	3.5600	4.3400
Standard Deviation	0.824680	0.621200
AD Normality Test p-value	0.5306	0.0302
Test for Equal Variances:		
F-test (use with normal data):		
F	1.7624	
p-value (2-sided)	0.0916	
Levene's test (use with non-normal data):		
p-value (2-sided)	0.0443	
2 Sample t-test for means:		
Assume Equal Variance:		
t	-4.7991	
p-value (2-sided)	0.0000	
p-value (1-sided)	0.0000	
Assume Unequal Variance:		
t	-4.6007	
p-value (2-sided)	0.0000	
p-value (1-sided)	0.0000	
2 Sample Mann-Whitney test for medians:		
p-value (2-sided)	0.0000	
p-value (1-sided)	0.0000	

Rules based yellow highlight to aid interpretation!

P-values turn red when results are significant!

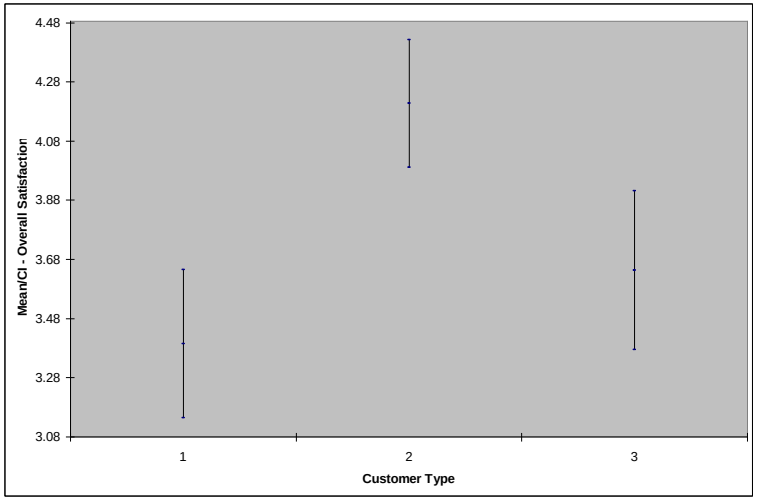
Back to Index

Statistical Tools: One-Way ANOVA & Means Matrix

One-Way ANOVA & Means Matrix: Overall Satisfaction				
H0: Mean 1 = Mean 2 = ... = Mean k				
Ha: At least one pair Mean i ≠ Mean j				
Customer Type	1	2	3	
Count	31	42	27	
Mean	3.3935	4.2052	3.6411	
Standard Deviation	0.824680	0.621200	0.670478	
UC (2-sided, 95%, pooled)	3.6441	4.4205	3.9096	
LC (2-sided, 95%, pooled)	3.1430	3.9900	3.3727	
ANOVA:				
Pooled Standard Deviation =	0.702810		R-Sq =	20.95%
DF =	97		R-Sq adj. =	19.32%
F =	12.856			
p-value =	0.0000			

Pairwise Mean Difference (row - column)	1	2	3
1	0	-0.811690	-0.247563
2		0	0.564127
3			0

Pairwise Probabilities	1	2	3
1		0.0000	0.1840
2			0.0016
3			



Back to Index

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Statistical Tools: Correlation Matrix

Pearson Correlations	Loyalty - Likely to Recommend	Overall Satisfaction	Responsive to Calls	Ease of Communications	Staff Knowledge
Loyalty - Likely to Recommend	1.0000	0.6599	0.5805	0.4622	0.0176
Overall Satisfaction		1.0000	0.8262	0.7454	0.0766
Responsive to Calls			1.0000	0.3791	0.0845
Ease of Communications				1.0000	0.0506
Staff Knowledge					1.0000

Pearson Probabilities	Loyalty - Likely to Recommend	Overall Satisfaction	Responsive to Calls	Ease of Communications	Staff Knowledge
Loyalty - Likely to Recommend		0.0000	0.0000	0.0000	0.8622
Overall Satisfaction			0.0000	0.0000	0.4490
Responsive to Calls				0.0001	0.4035
Ease of Communications					0.6171
Staff Knowledge					

Spearman Rank Correlations	Loyalty - Likely to Recommend	Overall Satisfaction	Responsive to Calls	Ease of Communications	Staff Knowledge
Loyalty - Likely to Recommend	1.0000	0.6167	0.5507	0.4071	-0.0190
Overall Satisfaction		1.0000	0.7782	0.7509	0.0890
Responsive to Calls			1.0000	0.3204	0.0895
Ease of Communications				1.0000	0.0716
Staff Knowledge					1.0000

Spearman Rank Probabilities	Loyalty - Likely to Recommend	Overall Satisfaction	Responsive to Calls	Ease of Communications	Staff Knowledge
Loyalty - Likely to Recommend		0.0000	0.0000	0.0000	0.8514
Overall Satisfaction			0.0000	0.0000	0.3786
Responsive to Calls				0.0012	0.3758
Ease of Communications					0.4792
Staff Knowledge					

Back to Index

Statistical Tools: Multiple Linear Regression

- Accepts continuous and/or categorical (discrete) predictors.
  - Categorical Predictors are coded with a 0,1 scheme making the interpretation easier than the -1,0,1 scheme used by competitive products.

- Interactive Predicted Response Calculator with 95% Confidence Interval and 95% Prediction Interval.

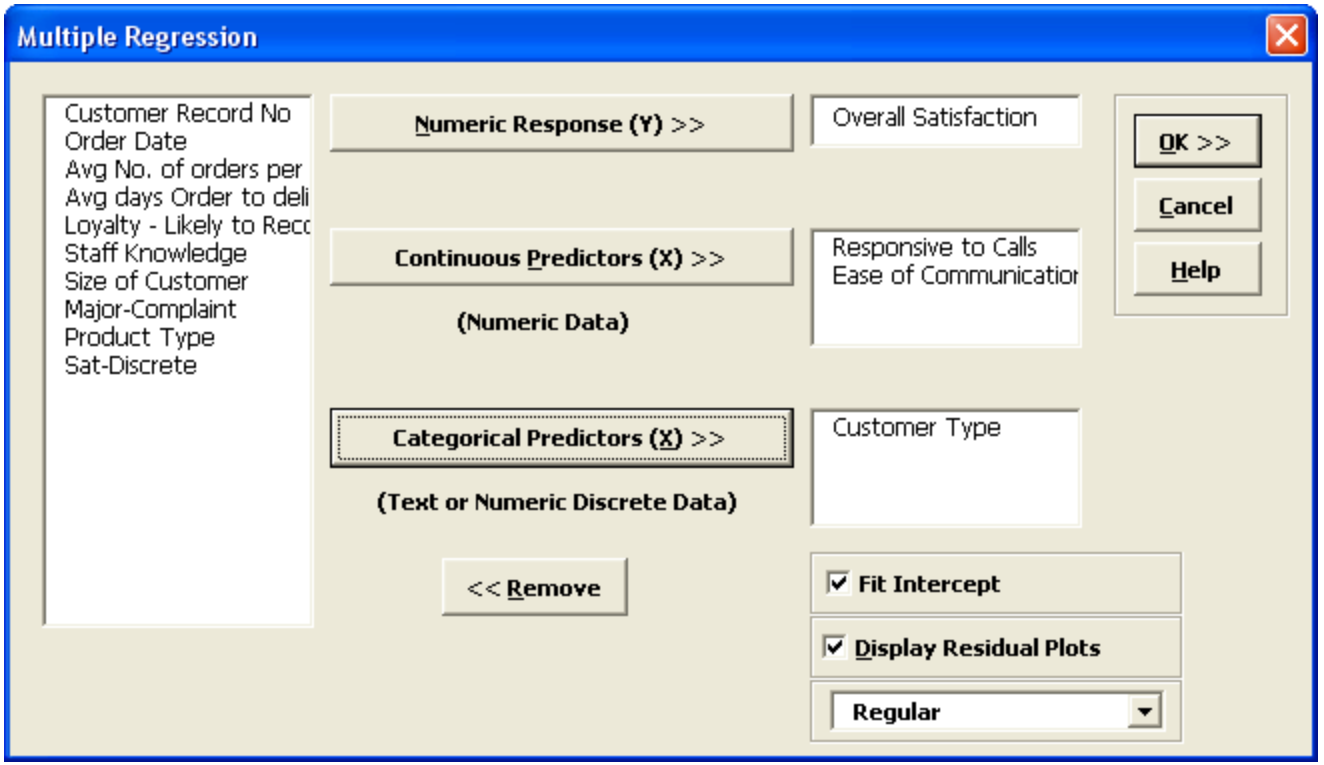
Back to Index

Statistical Tools: Multiple Linear Regression

- Residual plots: histogram, normal probability plot, residuals vs. time, residuals vs. predicted and residuals vs. X factors
- Residual types include Regular, Standardized, Studentized
- Cook's Distance (Influence), Leverage and DFITS
- Highlight of significant outliers in residuals
- Durbin-Watson Test for Autocorrelation in Residuals with p-value
- Pure Error and Lack-of-fit report
- Collinearity Variance Inflation Factor (VIF) and Tolerance report
- Fit Intercept is optional

Back to Index

Statistical Tools: Multiple Regression



Multiple Regression accepts Continuous and/or Categorical Predictors!

Back to Index

Statistical Tools: Multiple Regression

Multiple Regression Model: Overall Satisfaction = (0.552345) + (0.427400) * Responsive to Calls + (0.409625) * Ease of Communications + (0.132728) * Customer Type_2 + (0.023142) * Customer Type_3

Model Summary:

R-Square	90.58%
R-Square Adjusted	90.18%
S (Root Mean Square Error)	0.245199119

Parameter Estimates:

Predictor Term	Coefficient	SE Coefficient	T	P	VIF	Tolerance
Constant	0.552345	0.120148	4.5972	0.0000		
Responsive to Calls	0.427400	0.023788018	17.967	0.0000	1.2116	0.825379
Ease of Communications	0.409625	0.031120872	13.162	0.0000	1.3246	0.754950
Customer Type_2	0.132728	0.063914154	2.0767	0.0405	1.6551	0.604180
Customer Type_3	0.023141785	0.065217411	0.354841	0.7235	1.3944	0.717173

Analysis of Variance for Categorical (Discrete) Predictors:

Predictor Term	DF	SS	MS	F	P
Customer Type	2	0.299651	0.149825574	2.492000584	0.0881

Analysis of Variance for Model:

Source	DF	SS	MS	F	P
Model	4	54.901	13.725	228.29	0.0000
Error	95	5.7116	0.060122608		
Total (Model + Error)	99	60.612	0.612246		

Durbin-Watson Test for Autocorrelation in Residuals:

DW Statistic	1.7302
P-Value Positive Autocorrelation	0.0888
P-Value Negative Autocorrelation	0.9137

Durbin-Watson Test with p-values for positive and negative autocorrelation!

Back to Index

Statistical Tools: Multiple Regression – Predicted Response Calculator with Confidence Intervals

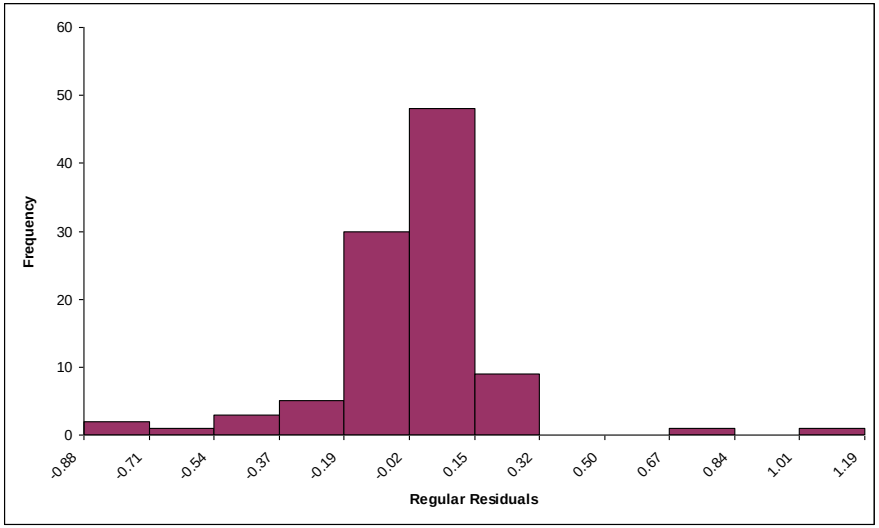
Predicted Response Calculator:

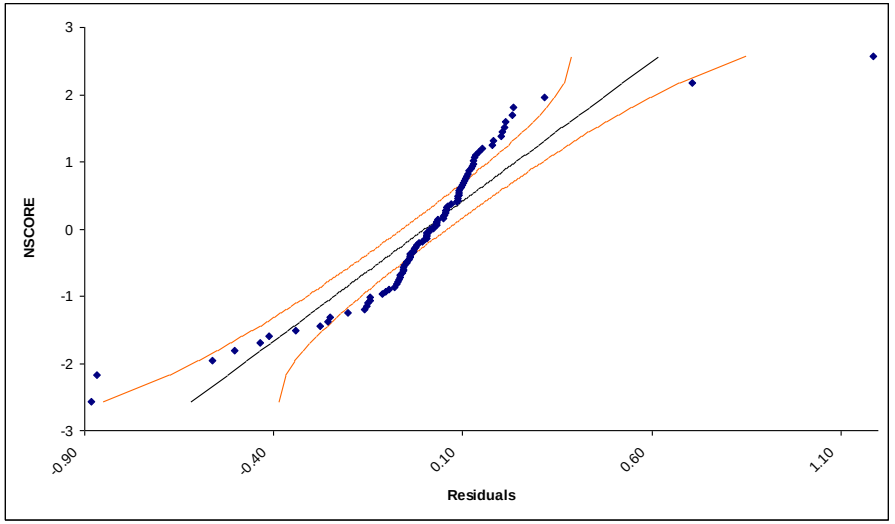
Predictors	Enter Settings:	Predicted Response	Lower 95% CI	Upper 95% CI	Lower 95% PI	Upper 95% PI
Responsive to Calls	5	0.99238657	4.778492731	4.961905131	4.374854056	5.365543806
Ease of Communications	5					
Customer Type_2	1					
Customer Type_3	0					

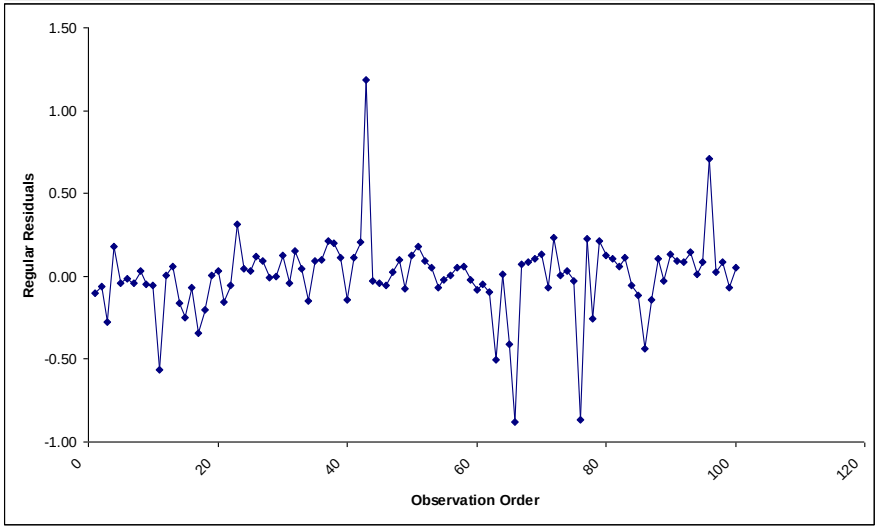
Easy-to-use Calculator with Confidence Intervals and Prediction Intervals!

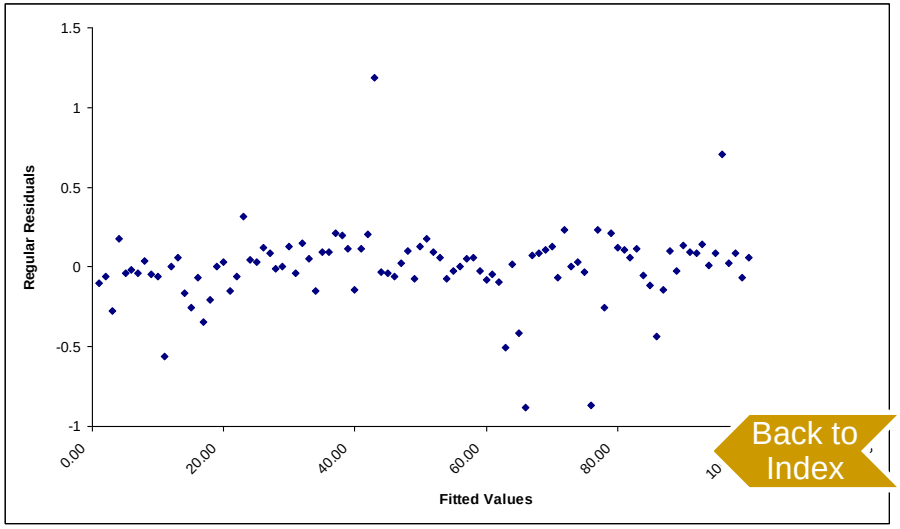
Back to Index

Statistical Tools: Multiple Regression with Residual Plots









Back to Index

Statistical Tools: Binary and Ordinal Logistic Regression

- Powerful and user-friendly logistic regression.
- Report includes a calculator to predict the response event probability for a given set of input X values.
- Categorical (discrete) predictors can be included in the model in addition to continuous predictors.
- Model summary and goodness of fit tests including Likelihood Ratio Chi-Square, Pseudo R-Square, Pearson Residuals Chi-Square, Deviance Residuals Chi-Square, Observed and Predicted Outcomes – Percent Correctly Predicted.

Back to Index

Statistical Tools: Nonparametric Tests

- 1 Sample Sign
- 1 Sample Wilcoxon
- 2 Sample Mann-Whitney
- Kruskal-Wallis Median Test
- Mood's Median Test
- Kruskal-Wallis and Mood's include a graph of Group Medians and 95% Median Confidence Intervals
- Runs Test

Back to Index

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Statistical Tools: Chi-Square Test

Chi-Square Test			
Major-Complaint - Customer Type			
Observed Counts	1	2	3
Difficult-to-order	5	9	5
Not-available	2	0	2
Order-takes-too-long	1	3	6
Return-calls	19	28	13
Wrong-color	4	2	1
Expected Counts	1	2	3
Difficult-to-order	5.8900	7.9800	5.1300
Not-available	1.2400	1.6800	1.08
Order-takes-too-long	3.1000	4.2000	2.7000
Return-calls	18.600	25.200	16.200
Wrong-color	2.1700	2.9400	1.8900
Std. Residuals	1	2	3
Difficult-to-order	-0.366718	0.361076	-0.057396402
Not-available	0.682500	-1.2961	0.885270
Order-takes-too-long	-1.1927	-0.585540	2.0083
Return-calls	0.092747779	0.557773	-0.795046
Wrong-color	1.2423	-0.548219	-0.647380
Chi-Square	12.211		
DF	8		
p-value	0.1420		

Note: 9 out of 15 cells have expected counts less than 5.

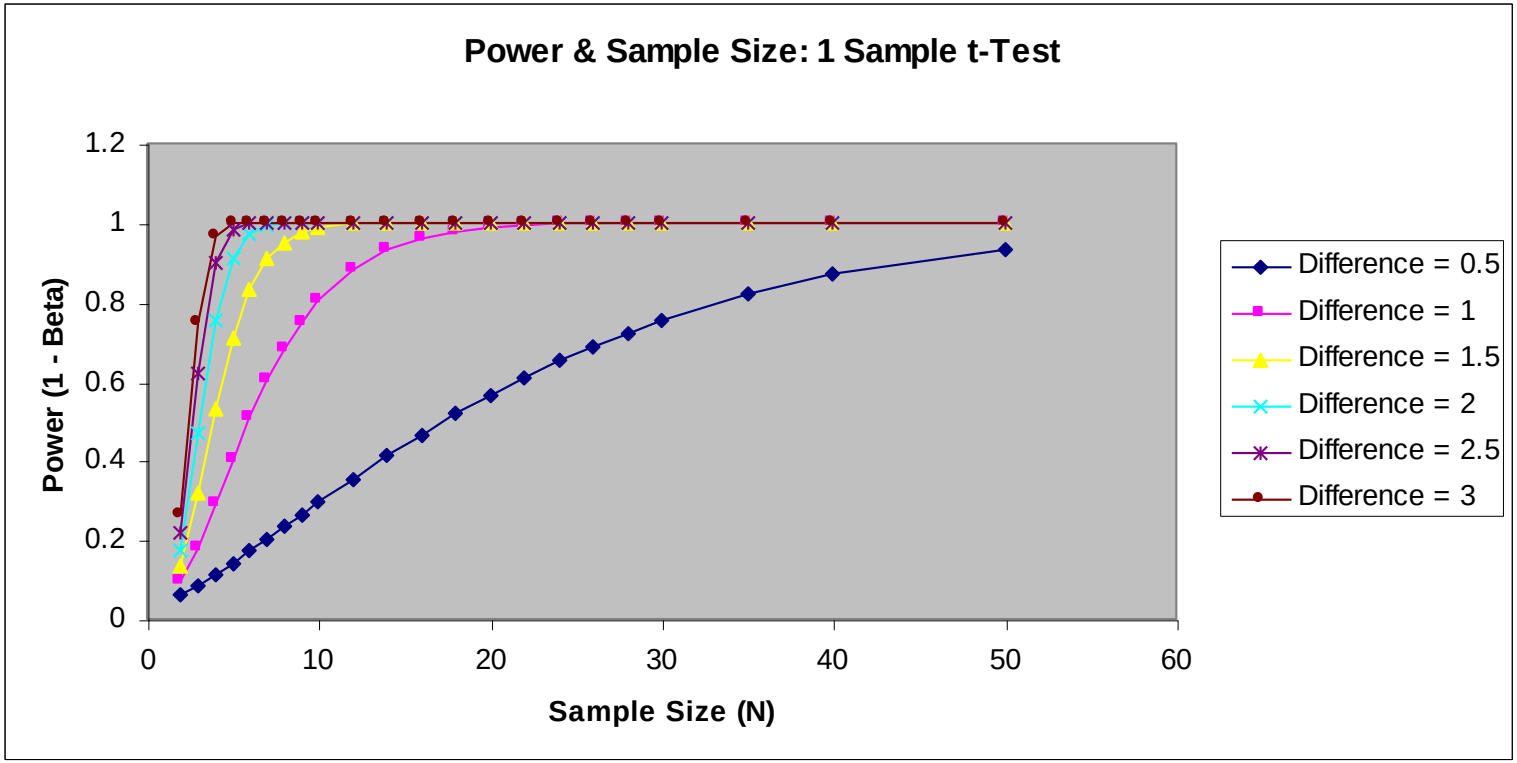
Back to Index

Statistical Tools: Power & Sample Size Calculators

- 1 Sample t-Test
- 2 Sample t-Test
- One-Way ANOVA
- 1 Proportion Test
- 2 Proportions Test
- The Power and Sample Size Calculators allow you to solve for Power (1 – Beta), Sample Size, or Difference (specify two, solve for the third).

Back to Index

Statistical Tools: Power & Sample Size Charts



Back to Index