

Index

- % R&R, *see* Percentage Gauge R&R
- α (alpha), *see* Intercept parameter/Significance level/Type I error
- β (beta), *see* Slope parameter/Type II error
- η (eta), *see* Population median
- μ (mu), *see* Population mean
- ν (nu), *see* Degrees of freedom
- ρ (rho), *see* Population correlation coefficient
- σ (sigma), *see* Population standard deviation
- σ^2 (sigma squared), *see* Population variance
- χ^2 (chi-square), *see* Tests for more than two proportions
 - 1 Proportion test 208, 209
 - 1-Sample t test 204
 - 1-Sample z test 194, 198, 202, 207
 - 2 Proportions test 218
 - 2² factorial experiments 293–312, 327, 386
 - 2³ factorial experiments 313–324
 - 2⁴ factorial experiments 324–326
 - 2^k factorial experiments 293, 294
 - 2^{k-p} fractional factorial experiments 326–337
 - 2-Sample t test 213
 - 3D Scatterplot 309
 - Absolute deviation 39, 40
 - Adjusted R², *see* R²/R-squared (adjusted)
 - Alias 324, 329, 332–335
 - Alternative hypothesis 186, 190
 - Analysis of variance (ANOVA) 229–237, 239, 241–243, 249, 276
 - Analyze 6, 7, 413
 - Analyze Factorial Design 299
 - Answers Knowledgebase 407
 - Append Graph to Report 18
 - Assignable cause 133, 135
 - Attribute agreement analysis 363–366
 - Autocorrelated process data 156
 - Available designs 314, 315, 387
 - Balanced ANOVA 241–243, 291–292
 - Bar Chart 98, 119, 120
 - Best Subsets Regression 384
 - Bias 348
 - Binning 29, 35
 - Binomial distribution 90–95, 116
 - Bins 26
 - Bivariate data 26, 67, 71, 77
 - Black Belts 7
 - Blocking in experimental designs 226, 248, 273, 344
 - Box, George E P 83, 107, 156, 269
 - Box-Cox transformation 179
 - Boxplot(s) 62–64
 - Brushing 65–66
 - Calibration 348
 - Capability Sixpack, *see also* Process Capability Analysis
 - nonnormal distribution 178
 - normal distribution 174
 - Central composite design 387–391
 - Central Limit Theorem 112, 113
 - Central tendency, *see* Location
 - Change data type 47
 - Chi-Square Test 257–259
 - Coded units 388, 395, 396
 - Coded variables 305, 324, 388
 - Coding data values 51
 - Coefficient of determination 73, 236, 371, 383
 - Column
 - date/time data 24, 41, 53, 147
 - numerical data 13, 14
 - text data 31, 145
 - Command
 - language 10
 - Line Editor 410
 - Menu 13, 97

- Command (*continued*)
 - Session 73, 97, 409, 410
 - Set 97
- Common cause(s) 16, 94, 124, 156
- Comparisons 154, 227, 233
 - Dunnnett's procedure 236–238
 - family error rate 230, 236, 238
 - Tukey's method 230, 232, 253, 257, 281, 289
 - with a control 236
- Complement of an event 85
- Component(s) of variance 243–245, 290–293, 347, 357–360
- Confidence interval(s) for
 - comparisons 230, 232, 238, 253, 281, 289
 - C_{pk} 175–177, 179, 180
 - difference between means 216
 - difference between proportions 218
 - mean 194, 197, 202, 203, 205
 - median 213
 - proportion 209, 363
 - sigma quality level 175–177, 179, 180
- Confounding 329
- Constant, in model 306
- Constant, in regression 395. *See also* Intercept parameter
- Constants in MINITAB 41, 121
- Continual improvement 1–3, 186
- Contour plot 310, 311, 386, 387, 389, 395
- Control chart(s) 8, 123–163
 - attribute data 143
 - constants 126–128, 137–138
 - count of nonconformities (C) 150
 - estimation of parameters 124, 126, 127/133, 137, 145
 - individuals (I or X) 124–127
 - means (Xbar) 133–137
 - measurement data 123
 - moving Ranges (MR) 128
 - nonconformities per unit (U) 151, 152
 - numbers nonconforming (NP) 149
 - proportion non-conforming (P) 143–149
 - ranges (R) 133–138
 - standard deviations (S) 159
 - subgroups (between/within) (I-MR-R/S) 163
 - tests 131
 - three sigma limits 124, 143
- Control group 236, 237
- Correlation 8, 72, 73, 76, 108
- Correlation coefficient 72–77
- Covariance 69–72, 80
- C_p index, *see* Process Capability Analysis
- C_p (Mallow's statistic) 384, 385
- C_{pk} index, *see* Process Capability Analysis
- C_{pm} index, *see* Process Capability Analysis
- Create Factorial Design 270, 294, 296, 314, 328, 386
- Create Indicator variable, *see* Brushing
- Critical region 189, 190, 201
- Cross Tabulation and Chi-Square 86
- Cube plot 296–298, 316–319, 324, 325, 329, 330
- Cumulative probability function 92, 93, 100–104
- Customer Tolerance range 167, 174
- Cutpoint(s) 29, 30, 35, 36
- d_2 constant 126, 137, 171, 173
- Data
 - input 13, 41–43
 - manipulation 11, 42–53
 - sets associated with book 23
 - sets in MINITAB, *see* DATA directory
 - transformation 179, 180, 206, 380, 381
 - window 12–14, 19, 42
- DATA directory 60
- Defect(s) 4, 7, 182, 413
- Defectives 180, 181
- Define 1, 6, 7
- Degrees of freedom 204, 215, 239, 240, 259
- Deming, W Edwards 2, 3, 154, 155, 407, 411
- Density Histogram 99–101
- Descriptive Statistics 33, 34
- Design of experiments (DOE) 8–10, 269, 270, 294
- Deviation 39
- Dialog box 13–15
- Discrimination ratio 361
- Distribution
 - multiple of a random variable 107
 - sample mean 111–113
 - sample proportion 115, 116
 - sum of independent random variables 108–111
- DMADV 7
- DMAIC 1, 6, 7, 412, 413
- DOE, *see* Design of experiments
- Dotplot (dot plot) 38, 200
- EDA, *see* Exploratory Data Analysis
- Edit Last Dialog 136
- Enable Commands, *see* Commands, Session
- Erase variables, 52

- Estimation 8, 171, 176, 185, 203, 324, 356
- Estimation of standard deviation 41, 126, 136, 137
- Event 85
- Expected value 94, 95, 239
- Experimental design 248, 249, 270, 271, 296
- Exploratory Data Analysis 8, 57–65

- F-distribution 232, 236, 240, 287
- Factor Level Combination(s) 270
- Factor(s) 6, 17, 78, 124, 156, 185, 269–271
- Factorial experiment(s) 269–273, 276, 293, 294, 326, 327
- Fall-out (ppm) 165–169, 171
- False alarm 135
- Family error rate, *see* Comparisons
- File types 42, 53
- Fisher, Ronald A 57, 84, 201, 232
- Fit Additive Model 249, 252, 276, 278
- Fit(s), *see* Fitted value
- Fitted line plot 371, 374, 375
- Fitted value(s) (Fit(s)) 278, 280, 281, 285–287, 307, 370
- Fixed effects model 238–239, 251–253, 280–281, 287
- FLC(s), *see* Factor Level Combination(s)
- Format Column 120
- Four in one plot 234
- Fractional factorial experiment 327, 328, 332
- Frequency Histogram 99
- F-test 236, 260
- Full factorial experiment 270, 293–294
- Funnel plot 152–154, 181

- Gage R&R Study (Crossed) 359–361
- Gage R&R Study (Nested) 361, 362
- Gauge repeatability and reproducibility (R&R) studies 356
- Gage Run Chart 357–358
- Gaussian distribution, *see* Normal distribution
- General factorial experiments 270–293
- General Linear Model 252–256, 281, 288
- Gosset, William S. 84, 204
- Green Belts 7

- Help 16, 17, 400–403
- Hi 62, 308
- Histogram 26–32
- History 12, 19, 410

- I chart, *see* Control charts
- Improve 1, 2, 6–8, 83, 123, 185, 186, 269
- I-MR-R/S charts, *see* Control charts
- Inadequate measurement units 354–356
- Independent events 87
- Independent random variables 108–111
- Individual value plot 194, 200
- Individuals chart, *see* Control charts
- Input(s) 6, 10, 186, 367
- Interaction effect(s) 269, 274, 275, 284–288, 290, 300–307, 321
- Interaction(s) plot 274–276, 295–296, 300–301
- Interaction plot matrix 276, 296, 297
- Intercept parameter 369, 375, 381
- Inter-quartile range (IQR) 61
- Interval(s) 27–30
- Inverse cumulative probability 105, 189, 192
- IQR, *see* Inter-quartile range

- Jitter 216, 224, 245, 276

- Kappa statistic 363–366
- Kruskal-Wallis test 246, 247

- Leaf value 58, 59
- Level of significance, *see* Significance level
- Levene's test 260, 261
- Line of steepest ascent 310, 312
- Linearity 347, 350–354
- Lo 62, 308
- Location 11, 15, 27, 31–35
- Logarithmic transformation 380
- LCL, Lower Control(Chart) Limit, *see* Control charts, three sigma limits
- LSL, Lower Specification Limit 35, 165

- Macro(s) 10, 154, 407–411
- MAD, *see* Mean absolute deviation
- Main effect(s) 274, 279–285, 296, 305
- Main effects plot 274, 287, 288, 296, 331
- Make Patterned Data 117, 119, 145, 147
- Mann-Whitney test 221–223
- Margin of error 203, 204
- Marginal plot 67, 68
- Master Black Belts 7
- Matrix 71–74
- Matrix plot 74–76
- Mean 14, 31, 33–35, 41
- Mean absolute deviation (MAD) 40
- Mean squared deviation (MSD) 40

- Measure 1, 6–8, 347
- Measure of location 15, 31, 33
- Measure of variability 33, 39–41
- Measurement 7, 9, 23, 347–362
- Measurement process 9, 78
- Measurement system 60, 293, 347–366
- Median 14, 15, 21, 24, 31, 33, 60–64, 210–213
- Menus 13
- Menu command, *see* Commands
- Midpoint 29, 30, 35
- MiniGuide 21, 403–405
- MINITAB 1, 9, 10
- Minitab Inc 9, 10, 399
- MINITAB Project 12, 18, 19, 37
- MINITAB Worksheet 12, 13, 19, 22, 23, 37, 42
- Modelling 8, 69, 367, 412
- Move columns 52
- MR chart, *see* Control charts
- MSD, *see* Mean squared deviation
- Multiple regression 381–386
- Multi-vari chart 77–79
- Multivariate data 26, 57, 74–77
- Multivariate statistical methods 412
- Mutually exclusive events 86

- Natural Tolerance Range 167, 174
- Nonconforming 4, 89, 102–106, 143, 149, 165, 181
- Nonconformity 150, 151
- Nonlinear relationship 73, 77
- Nonlinearity 380
- Nonparametric tests 194, 210–213, 221–223, 224, 226
- Normal distribution 83, 98–107
- Normal probability plot of (standardized) effects 319, 320, 325, 326
- Normal probability plot, *see* Normality test
- Normality test 103, 104
- NP chart, *see* Control charts
- Null hypothesis 186, 190
- Number of distinct categories 361–362

- One-sample t-test 223
- One-tailed test 190
- One-Way ANOVA 229–238
- Open Worksheet 23, 42
- Outcome 84–86
- Outlier detection 61, 62
- Outliers 61–64

- P chart, *see* Control charts
- Paired t-test 225, 226
- Parameter(s) of distributions 41, 90, 96, 100, 206, 259
- Parameters in regression 369, 375, 381
- Pareto plot of (standardized) effects 320, 321
- PDSA, *see* Plan-Do-Study-Act Cycle
- Pearson product moment correlation, *see* Correlation coefficient
- Percentage gauge R&R 359, 360, 362
- Percentile 61, 105
- Performance measures 6, 213, 367
- Place bounds on control limits 162
- Plan-Do-Study-Act Cycle 2, 3
- Poisson distribution 96–98
- Population
 - correlation coefficient, 73
 - mean 40, 41, 94, 95
 - median 222
 - standard deviation 40, 41, 94, 95
 - variance 95
- Power 190–194
- Power and sample size 207, 209
- P_p index, *see* Process Performance Indices
- P_{pk} index, *see* Process Performance Indices
- Prediction intervals 373, 383
- Predictor(s) 6, 367, 368, 378, 382–384
- Probability 83–89
- Probability density function 100, 102, 107, 109, 113
- Probability function 89–93
- Process Capability Analysis, 165–184, *see also* Capability Sixpack
 - attribute data, 180
 - binomial 180
 - C_p index 167–169, 171–176
 - C_{pk} index 167–169, 171–176
 - C_{pm} index 175
 - measurement data, 166
 - non-normal 178, 179
 - normal 171
 - Poisson 181, 182
 - and sigma quality levels, 175
 - using data transformation, 179
- Process Improvement 6, 7
- Process model 6, 7, 367
- Process Performance Indices 173
- Project, *see* MINITAB Project
- P-value 17, 73, 103, 178, 187, 188, 201, 202

- Quadratic regression 77, 375–379

- Quality 1, 2
- Quality Companion 412
- Quality improvement 1–5
- Quartiles 35, 60, 61, 64

- R chart, *see* Control charts
- R²/R-squared 371, 372, 376, 383–385
- R²(adj)/R-squared (adjusted) 384, 385
- r², *see* Coefficient of determination
- Random data 94, 109, 111, 228
- Random effects model 241–246, 290–293
- Random events 96
- Random variable(s)
 - continuous 22, 83, 99, 100, 123
 - discrete 23, 55, 83, 89–92, 96, 123
- Random variation 124, 227, 239, 241
- Randomization 227–229, 272, 295
- Randomized complete block experiments 248–254
- Range 39
- Ranking 53, 221, 222
- Reference lines 35, 37, 69, 124, 131, 165
- Regression 8, 69, 77, 367–386
- Regression with a single predictor variable 367–375
- Reliability and survival statistics 411
- Repeatability 347, 349, 351, 356–362
- Replication(s)/Replicate(s) 227, 238, 240, 243, 270, 294
- ReportPad 9, 11, 12, 18–22
- Reproducibility 347, 349, 350, 356–362
- Residual plots 230, 234–236, 276–278, 370, 385
- Residual(s) 230, 233–236, 276–280, 285–287, 369, 370
- Resolution 269, 294, 315, 329, 332–335
- Response(s) 6, 7, 227, 367
- Response Optimizer 307–309, 331, 332
- Response surface 310–312, 386–390
- Response surface design 387–391
- Row Statistics 110, 112
- Rules for probabilities 86, 87
- Run length 138
- Run(s) 271, 272, 294, 295, 314, 315, 328, 329

- S chart, *see* Control charts
- Sample mean 41
- Sample size determination 203, 204
- Sample space 84–86, 89
- Sample standard deviation 40, 41
- Save Current Worksheet 22, 53
- Save Project 18, 21
- Scale 29, 30, 35
- Scatterplot 67–69, 77
- Scatterplot with Groups 80
- Session command, *see* Command
- Session Window 12, 13, 18, 33, 34
- Set command, *see* Command
- Shewhart, Walter A 2, 3, 8, 84, 123, 124
- Show Design icon 340, 341
- Sigma Quality Level 3–5, 88, 89, 103–107, 175–181
- Sign test 211–213, 223–226
- Significance level 17, 188, 189, 192, 193, 202
- Six Sigma 1, 3–7
- Six Sigma process 106, 107
- Six Sigma project 7
- Six Sigma Roadmap 6–7
- Slope 71, 73, 354
- Slope parameter 369, 372
- Sorting 53
- Special cause variation 17, 62, 124, 126, 129, 131
- Specification limits 16, 35–39, 102, 165, 171–175
- Spread, *see* Variability
- Stable, predictable process 16, 26, 124, 133.
 - See also* Statistical control
- Stack columns 42–44
- Stack blocks of columns 47
- Stack rows 158
- Stages with control charts 141, 142
- Standard normal distribution 100, 102, 206, 372
- Standardized effects 319, 320
- Standardized residuals 372
- Standardized values/variables 72, 80, 176, 196
- StatGuide 21, 22, 34, 403–406
- Statistical control 124, 133, 144
- Statistical model(s) 83–117
- Stem value 58, 59
- Stem-and-Leaf display 57–61
- Stratification 50
- Subdialog box 13
- Subgroup(s) 13–15, 54, 124–127, 133–136
- Submit Commands 410
- Subscripts 44–46, 51, 52
- Subset Worksheet 65
- Sum of independent random variables 108–111
- Surface plot 310, 311, 387–390
- Survival statistics, *see* Reliability and survival statistics

- t distribution 204–206, 236
- Tables 50, 86, 257
- Tally Individual Variables 50
- Tampering 154, 155
- Target 1, 5, 6, 12, 105–107, 154–157
- Test statistic 202, 204–206, 230, 240, 248, 258–259
- Test for a single proportion *see* 1 Proportion test
- Test for equality of variance 259–262
- Tests for evidence of special causes *see* Control chart, tests
- Tests for more than two proportions 257–259
- Tests for two proportions *see* 2 Proportions test
- Tests of hypotheses 201, 202
- Time Series Plot 47, 400–403
- Toolbar(s) 12, 19, 20
- Trials 90, 93
- t-test 204–208
- Tutorials 406, 407
- Two-sample t-test 213–217
- Two-tailed test 201
- Two-Way ANOVA 276–279
- Type I Error 188, 229, 238, 257
- Type II Error 188, 190, 221
- U chart, *see* Control charts
- Uniform distribution 109, 110
- Unstack columns 51, 52
- Update Graph Automatically 127
- UCL, Upper Control(Chart) Limit, *see* Control charts, three sigma limits
- USL, Upper Specification Limit 35, 165
- Variability 11, 27, 37–41
- Variable name 13, 44, 92
- Variance components 242, 291, 293, 357, 358
- Variance-covariance matrix 71
- Weibull distribution 178
- Wilcoxon test 213
- Worksheet, *see* MINITAB Worksheet
- X chart, *see* Control charts
- Xbar chart, *see* Control charts
- Xs 6–8, 61, 68, 75, 76, 367
- Yellow Belts 7
- Ys 6–8, 61, 68, 75, 76, 367
- z-test 194–201