Index

(Note: Authors of books and articles listed in Sections 17.7 (p. 396), 18.5 (p. 408), 25.9 (pp. 581–584), 26.4 (p. 588) and in the main Bibliography (pp. 593–603) are not individually referenced in this index unless their names appear otherwise in the text.)

Absolute errors, minimizing sum of, 137, 567–568
Adcock, R.J., 91, 96
Added variable plot, 209
Addelman, S., 91, 96
Adjusted R^2, 139
Agard, D.B., 575
Aia, M.A., 254
Alias matrix, 236
All possible regressions, 329
Amer, F.A., 549
Analysis of variance:
  covariate, 474
  data, 476, 488, 498
  dummy variables, 474, 478, 480, 481, 499
  fixed effects, 473
  geometry of, 429, 432, 436
  in matrix terms, 138
  lack of fit, 50
  models, 476, 489
  one way model, 474–489
  overparameterized, 474
  pure error, 50
  restrictions, 475, 485
  response surfaces, 258
  straight line fit, 29–32
  two-way model, 488–499
  variable effects, 473
  via regression, 473–504
  why regression?, 474, 499
Anderson, D.J., 271
Anderson, R.L., 646
Anderson-Sprecher, R., 246
Andrews, D.F., 210, 570, 572
Anscombe, F.J., 69
Answers to exercises, 609–683
  chapters 1–3, 609–624
  chapter 4, 624–628
  chapters 5 and 6, 628–639
  chapter 7, 639–640
  chapter 8, 640
  chapter 9, 640–641
  chapter 10, 642–643
  chapter 11, 643
  chapter 12, 643–647
  chapter 13, 647–649
  chapter 14, 649–656
  chapter 15, 656–664
  chapter 16, 664–665
  chapter 17, 665
  chapter 18, 665
  chapter 19, 665–667
  chapter 20, 667–670
  chapter 21, 670–672
  chapter 22, 672–674
  chapter 23, 674–678
  chapter 24, 678–682
  chapter 25, 682
  chapter 26, 683
  true/false, 683
Arc-sine root transformation, 292, 293
Archer Daniels Midland, 463
Askin, R.G., 580
Atkinson, A.C., 70, 214, 215, 294, 662, 663
Authors associated with exercises, 695–696
Average $V(\hat{Y}_i)$, 87, 207, 244

b_0, b_1, 24, 25
Backwards elimination, 339–342
Baldwin, K.F., 390, 391
Banana-shaped contours, 511, 543
Bancroft, T.A., 646
Bargman, R.E., 246
Barker, F., 92, 96
Barnett, V., 70, 71, 90, 96, 215
Bartlett, M.S., 56, 91, 96, 293, 294
Basis, 438
Bates, D.M., and Watts, D.G., 516, 528, 529, 552, 553
Bauer, F.L., 378

Beaton, A.E., 569, 570
Becker, W., 246
Belsley, D.A., 70, 214, 215, 373–382
Berk, K.N., 209
Bertalanffy, L. von, 549
Best subsets regression, 334–335
Bias in b's, 235–238
  in anova, 238–239
Bibliography:
  chapter 2, 70
  chapter 8, 215
  chapter 17, 396
  chapter 18, 408
  chapter 25, 581–584
  chapter 26, 588
  main, 593–603
  also see "References"
Birch, J.B., 575
Bisgaard, S., 293, 294
Bonferroni, 142
Bootstrapping, 585–591
  nonparametric, 591
  pairs, 586
  parametric, 591
  residuals, 586
Booth, D.E., 209
Booth, G.W., 510
Box, G.E.P.:
  Booth-Peterson, 510
  and Coutie, 518
  and Cox, 279–281, 290, 294
  and Draper, 76, 147, 266, 271, 514, 516, 552, 569
  and Hunter, J.S., 230, 427
  and Hunter, W.G., 427, 551
  and Jenkins and Reinsel, 180, 198
  and Lucas, 551
  use and abuse, 328
  and Wetz, 244, 247
Box, J.F., 43
Breiman, L., 345
Bright, J.W., 463
Brown, P. J., 388
Brownlee data, 366, 663
  Dodge paper on, 663
Bunke, H., 553
Bunke, O., 393, 553
Burcar, Tamra J., 575, 576

Cambridge Diploma problems, 170, 171, 470
Canonical mixture models, 413–415
Carroll, R.J., 291, 294
Centering data, 371
  and scaling, 373
  and singularity, 374
Central limit theorem, 35
Chatterjee, S., 70, 215
Checking models, 47–77, 205–215
Cheung, Ying Kuen (Ken), 588
Chi-squared table, 687
Clark, V., 210, 212
Clayton, D.G., 385
Cleveland, W.S., 198
Cochran, W.G., 56
Coding, 285
Coefficient of multiple determination, 139
Cohn, Frieda S., see Swed, F.S.
Collinearity, 369
Confidence contours, 142–147, 526, 543
Confidence intervals, 4, 34
  for $E(Y)$, 79–83, 141
  as tests, 37
  for transformation parameter, 282–285
  vs. regions, 142–147
Conformable, 8, 116
Continuity correction, 196–197
Contrasts, 162, 477
Cook, R.D., 70, 211, 212, 214, 215, 574, 581
Cooper, B.E., 466
Cornell, J.A., 416, 420, 422
Correction factors, 24
Correlation:
  (b_0, b_1), 129
  (b_i, b_j), 142, 143, 161
  between residuals, 206
  form of regression, 373–375
  formula, 41
  and regression, 42
  and R^2, 42
  serial, 179–181
  single, 43
Coutie, G.A., 518
Covariance, 79
  (b_0, b_1), 128
  (b_i, b_j), 138
  $(\bar{Y}, b_1)$, 80
Covariate, 474
Cox, D.R., 279, 281, 290, 294
C_p, 332–334, 389
Creasy, M.A., 92, 96
Curvature, nonlinear, 528

Daniel, C., 72, 332, 663
Data space, 20
Davies, O.L., table, 684
Dawkins, G.S., 463
Degrees of freedom, 30, 429
Delury, D.B., 463
Dependent variable, 17
Derivatives, 511
Derringer, G.C., 283
Design of experiment, 86, 550
  for mixtures, 416, 417
DFFITS, 214
Diagonal matrix, 9, 120
Diagram, scatter, 18
  model building, 552
  residual SS breakup, 50
Diggle, P.J., 198
Ding, G.G., 246
Dixon, W.J., 343
Dobson, A.J., 405, 408

Dodge, Y., 663 (N)
Dolby, G.R., 90, 96
Double exponential, 137, 567
Draper, N.R., 89, 96, 246
  Box and, 76, 147, 266, 271, 514, 516, 552, 569
  and Guttman, 147
  and Hunter, 288
  John and, 290
  and others, 419, 422
  tomatoes, 325
  and Yang, 231
Drawback, 342
Dressler, A., 93, 96
Driscoll, M.F., 271
Dropping X's, 260, 266–271
Dubey, S.D., 518
Dummy variables, 299–317
  how many?, 301
  infinite choices, 299
  general case, 311
  in anova, 473–504
  interactions in, 307
  quadratic model, 310
  segmented models, 311–317
  to separate blocks, 299
  two straight lines, 308
  valid?, 305
  verify, 306
Dunn, O.J., 210, 212
Durbin, J., 69, 180, 183, 190, 198
Durbin-Watson test, 69, 181–193
  Tables, 184–192

Efroymson, M.A., 338
Eisenhart, C., 45, 195, 196
Ellerton, R.R., 249
Erjavec, J., 552
Error space, 428
Errors:
  additive, 278
  in Y and X, 89
  in more X's, 231
  multiplicative, 278
  structure, 277
Estimation, linear:
  least squares, 23, 135–147, 428, 457–459
  maximum likelihood, 137
Estimation, nonlinear
  initial estimates, 517, 547
  least squares, 506–515
  Marquardt's compromise, 515–516
  steepest descent, 513
Estimation space, 428, 438
Estimator, bias in, 235–238
  minimum variance unbiased, 136
Evans, R.J., 92, 96
Examination of regression equation:
  adjusted R^2, 139
  Cook's statistic, 210–214
  extra SS, 149–153
  how useful?, 156, 243–250
  polynomials, 152
  R^2, 33, 138–140, 245–246, 452–453
  residuals, 59–69, 207–210
  $s/\overline{Y}$, 159
  se(b_i), 36, 38, 160
  se($\hat{Y}_i$), 80–83, 161–162
  test for regression β_0, 38–39
Exercises:
  answers, see Answers
  for chapters, 1–3, 96–114
  for 4, 132–134
  for 5–6, 169–177
  for 7, 198–203
  for 8, 215
  for 9, 233–234
  for 10, 241–242
  for 11, 250
  for 12, 272–275
  for 13, 294–298
  for 14, 317–325
  for 15, 355–368
  for 16, 385–386
  for 17, 400
  for 18, 408
  for 19, 425
  for 20, 444–446
  for 21, 459–460
  for 22, 469–472
  for 23, 500–504
  for 24, 553–565
  for 25, 584
  for 26, 591
Expected value of MS, 240
  of quadratic form, 239
  of SS, 240
Experimental choice, 86
Experimental designs:
  nonlinear case, 550
  one-way anova, 474
  response surface, 255–259
  strategy discussion, 86–89
  two-way anova, 488
Extra SS, 149–153
  geometry, 454–459
  polynomials, 150, 152, 259

Families of straight lines, 307–309, 321–324
F and R^2, 243, 250 (11E), 453
F distribution, 3
  $F(1, \nu) = t^2(\nu)$, 39, 153, 163
  extra SS, 149–152
  for general linear hypothesis, 219
  partial, 153, 335–343
  sequential, 151
  tables, 688–693
  test for lack of fit, 50
  test for regression, 38
  F-to-enter, 338
  F-to-remove, 338
Farebrother, R.W., 385

Feared model, 235
Firey, P.A., 619
Fisher, J., 43
Fisher, R.A., 43, 461, 463
  table, 686
Fixed effects, 473
Flodin, N.W., 563
Forcing models through points, 233 (F,G,H), 641 (G)
Forsythe, A.B., 343, 568
Forward selection, 336, 338
Frank, I., 345
Freeman, M.F., 292–294
Freund, R.J., 169
Friedman, J., 345
Fuller, E.S., 293, 294

Gallant, A.R., 553
Galton, F., 45
Gamma function, 1
Gauss, C.F., 45, 136
Gauss-Markov theorem, 136
General linear hypothesis, 217–221
Generalized least squares, 221–224, 405, 572
Generalized linear models, see GLIM
Generalized inverse, 441–444
Geometry of linear squares, 427–460, 511–513, 530–539
  anova, 429, 432, 436
  basics, 427
  basis, 438
  error space, 428
  estimation space, 428, 438
  generalized inverse, 441–444
  hat matrix, 436
  Moore-Penrose inverse, 442
  normal equations, 430
  null hypothesis, 447–453
  null space, 437
  orthogonal basis, 438
  orthogonal vectors, 429
  orthogonalizing, 430–432, 435
  orthonormal basis, 438
  projection algebra, 448
  projection matrix, 435, 437
  pure error, 439–441, 536–537
  Pythagoras, 429, 537
  R^2, 452
  R^2 changes, nested models, 452
  range space, 437
  Seber, G.A.F., 438
  sequence of regressions, 454–459
  singular $\mathbf{X}'\mathbf{X}$, 433
Geometry of nonlinear least squares, 539–543
Gergonne, J.D., 45
Gibson, W.M., 92, 96
GLIM, 401–408
  acronym, 401
  binomial, 402, 404
  canonical form, 402
  deviance, 406
  exponential distribution, 403
  exponential family, 402
  further reading, 408
  gamma distribution, 403
  link function, 404, 407
  log-odds ratio, 402, 405
  maximum likelihood, 406
  natural parameter, 402
  negative binomial, 403
  normal distribution, 402
  overdispersion, 402
  Pareto distribution, 403
  Poisson distribution, 403, 406
  programs, 405
Goldsmith, R.L., 354
Goldstein, M., 392
Gorman, J.W., 332
Gram-Schmidt, 385
Gray, J.B., 209
Graybill, F.A., 147
Grechanovsky, E., 343
Gregory, F.G., 544
Grids and plots, 516
Growth models, 543–550
  Gompertz, 548
  logistic, 545, 547
  mechanistic, 544
  monomolecular, 544
  types, 544
  von Bertalanffy's, 549
Guarnieri, J.A., 91, 96
Guttman, Irwin, 147

Hadi, A.S., 70, 215
Hald data, 329, 348
  in examples:
  all regressions, 330, 348–355
  backward elimination, 339–342
  conditioning, 380
  mixture analysis, 413–416
  ridge analysis, 389–391
  rreg, 579
  stepwise, 336–339
Hamilton, D., 169
Hampel, F.R., 570, 572
Hartley, H. O., 44, 56, 461, 463, 510
  tables, 684, 687–693
Harvey, P.H., 92, 96
Hat matrix **H**, 205–207
  as projection **P**, 436
Hawkins, D.M., 70, 215
Healy, M.J.R., 246
Herschel, J.F.W., 59
Hilbe, J.M., 401, 408
Hill, R.W., 572, 575
Hines, R.J.O. and Hines, W.G.S., 214
Hinshaw,W.M., 226
History of regression, 45
Hoerl, A.E., 387, 389–392

Hogg, R.V., 580
Holland, P.W., 572, 575
Hsieh, Monica, 580
Huber, P.J., 570, 573–575, 577
Huff, D., 42
Hunter, J.S., 230, 427
Hunter, W.G., 288, 427, 551, 552
Hypher, R. Peter, 623
Hypothesis testing, 217–221

Idempotent, 205, 206
  H, 205; **I** − **H**, 206
Ill-conditioned data, 369–385, 637 (V)
Influential observations:
  Atkinson's modification, 214
  Cook's statistics, 210–214
  DFFITS, 214
Initial estimates, 517, 547
Intrinsically linear, 278, 506
Intrinsically nonlinear, 278, 506
Inverse regression:
  one X, 83–86
  more X's, 229–230

Jackson, J.E. 638
Jaske, D.R., 136
Jefferys, 93, 96
Jenkins, G.M., 180, 198
John, J.A. (Nye), 290
Joiner, B.L., 291
Jowett, G.H., 92, 96
Joint confidence region:
  for linear model, 142–146, 538–540
  for nonlinear model, 516, 526–528
  for regression function, 83
  worked example, 175 (M), 635–636 (M)
Judge, G.G., 229

Kelly, G., 94, 96, 572
Kendall, M.G., 95, 96
Kennard, R.W., 387, 389–392
Kennedy, P., 246
Kleiner, B., 198
Kronmal, R.A., 254
Ku, H.H., 45
Kuh, E., 70, 214, 215
Kurotori, I.S., 418, 422
Kvalseth, T.O., 246

L_1 regression, 137, 567–568
Lack of fit, 47, 50
  diagram, 50
Lagrange's undetermined multipliers, 231–233
  restricted estimation, 229, 234 (I)
  ridge regression, 392
Largey, A., 147
LaMotte, L.R., 209
Lawton, W.H., 638
Least absolute deviations, 137, 567–568
Least median of squares regression, 577
Least squares, 22
  algebraic properties, 137
  generalized, 221–224
  geometry, see Geometry
  nonlinear, 506–508, 545
  properties (under normality), 140
  restricted, 229, 234, 392
  weighted, 223, 226
  why?, 136
Legendre, A.M., 45
Levoy, A.M., 70, 215, 577
Levenberg, K., 515
Levene's test, 57–59
Lewis, T., 70, 215
Lim, T.-S., 59
Linde, L.M., 210, 211
Lindley, D.V., 195
Linear hypothesis, 217–221
Linear model, 21
Linearization, 505–513, 522–524, 542
Little, J.K., 641
Logistic growth model, 545–547
Loh, W.-Y., 59
Lucas, H.L., 550
Lurking variables (comments by G.E.P. Box), 328

M-estimators, 568–573
Mace, G.M., 92, 96
MacGregor, J.F., 552
Magee, L., 246
Mallows, C.L. (C_p), 332–334
Marquardt, D.W., 375, 400, 515
  compromise, 515
Matrix, matrices:
  addition and subtraction, 7
  anova, 127, 130
  conformable, 8, 116
  determinant, 11–13, 119, 120
  diagonal, 9, 120
  factor in, 13, 122
  general, 6–13
  general regression, 135
  idempotent, 205, 206
  identity, 9, 119
  inverse, 10, 119
  model, 117
  multiplication, 8, 116
  normal equations, 123
  orthogonal, 117
  partitioned, 121
  for quadratic, 117
  results, 147–148
  singular, 125
  symmetric, 8
  for straight line, 115
  transpose, 7, 118
  useful results, 147–148
  unit, 9, 119
  variance-covariance, 129, 138

McCullagh, P., 406, 408
Mead, R., 518
Mean square, 30
Mechanistic models, see nonlinear
Medawar, P.B., 549
Mercer, L.P., 563
Metakides, T., 463
Mezaki, R., 552
Michaelis-Menten model, 562 (T, U)
Mickey, M.R., 210, 211
Miller, A.J., 59, 345
Miller, R.G., 83, 94, 96
Minimum variance unbiased, 136
Mitra, Sujit, 169
Mixture experiments, 409–425
  canonical models, 413–415
  Cornell, J., 416, 420, 422
  designs for, 416, 417
  Draper, N.R., 419, 422
  examples, 418–419
  experimental spaces, 409–412
  Hald data, 413–416
  Kurotori, I.S., 418, 422
  models for, 412–415
  pseudo-coordinates, 417
  references, 422
  restrictions, 416–419
  Scheffé, H., 413, 416, 422
  Spillers Milling, 419
  working variables, 422–425
Models:
  anova, 1 way, 476
  anova, 2 way, 489
  Gompertz, 548
  growth, 543–550
  Hill, 562 (T)
  logistic, 545, 547
  Michaelis-Menten, 562 (T, U)
  for mixtures, 412–415
  monomolecular, 544
  types, 544
  von Bertalanffy, 549
Montgomery, D.C., 580
Mooney, R.W., 254
Moore-Penrose inverse, 442
Morgan, P.H., 563
Mullett, G.M., 400
Multicollinearity, 369
  measuring, 375–382
Multiple correlation coefficient, 33
  also see R^2
Multiple responses, nonlinear, 552

Nagelkerke, N.J.D., 246
Nelder, J.A., 406, 408, 547
Nelson, L.S., 192
Nonlinear estimation, 505–565
  assumptions of, 505–508, 544, 545
  approximating expansion, 509
  confidence contours, 526, 543
  convergence, 510, 547
  curvature measures, 528, 543
  derivatives, 511
  designs for, 550
  estimation, 508
  example, 518–528
  geometry, 511–513, 530–543
  growth models, 543–550
  grids and plots, 516
  initial estimates, 278, 517, 547
  intrinsically linear, 278, 506
  intrinsically nonlinear, 278, 506
  least squares, 506–508, 545
  Levenberg, K., 515
  linearization, 508–513, 522–524, 542
  Marquardt's compromise, 515
  models, 505, 543–550
  multiple responses, 552
  nonlinearity, 528–529
  normal equations, 507, 519
  normalizing elements, 528
  notation, 506
  output features, 527
  overparameterization, 529
  parameter, 505
    space, 532, 537, 543
  pure error, 525, 536
  reparameterization, 529
  sample space, 532, 535, 539
  singular values, 527
  starting values, 278, 517, 547
  steepest descent, 513
  Taylor series, 508, 515
  wrong model, 535, 545
Normal:
  approximation, 195
  distribution, 1
  equations, 23, 123, 430, 507, 519
  table, 684–685
Normality assumptions, 34
Notation, nonlinear, 506
Null hypothesis:
  general, 217–221
  geometry, 447–453
  projection algebra, 448
Null space, 437

One-way anova, 474–489
Order = degree (of polynomial)
Orthogonal:
  basis, 438
  columns in **X**, 165–167
  polynomials, 461–472
  polynomials, tables, $n \leq 12$, 466–467
  vectors, 10, 117, 429
Orthogonalizing **X** matrices, 382–385
  (Gram-Schmidt)
Outliers, 62, 75
Overparameterization, 474, 529

Palmreading, 105 (V)
Parameter, 18
  are they stable?, 551–552
  space, 532–537
Partial F-test:
  definition, 153
  in selection procedures, 335–342
  true probability levels, 342
  two-X example, 159–160
Partial SS, 153, 159–160
  Schey's examples, 167–169
Partitioned matrix, 121–122
  useful results, 147–148
Payne, C., 388
Pearson, E.S., 44, 461, 463
  tables, 684, 687–693
Peixoto, J.L., 269, 271
Peterson, T.I, 510
Pinsker, I., 343
Plackett, R.L., 45, 485
Plots:
  in nonlinear estimation, 516
  normal, 70–76
  queries 1–3 on, 63–67
  residuals, 50–69
Polynomial models, 252
  dropping rules, 268, 270
  dropping terms, 266–271
  examples, 254–266
Predicted value, 22
Predictor variable, 17
  errors in, 89–96, 231
Pregibon, D., 210
Probability paper, 76
Probability tables, 684–693
Projection matrix, 435–437
  as hat matrix **H**, 205–207
Proportions as responses, 291–293
  arc-sine transformation, 292–293
  log-odds transformation, 292, 407
Pseudo-coordinates, 417
Pure error, 47–59, 525, 536
  approximate, 54
  design in blocks, 265
  diagram, 50
  generic cases, 55
  geometry, 439–441, 536
  homogeneity, 56–59
  X's added, 632
  X's dropped, 264
Pythagoras, 429, 537

Queries 1–3 on residuals, 63–67

R^2, 33, 138–139, 141, 157, 245–246
  adjusted for df, 139–140
  conversation on, 245–246
  distribution of, 141
  and F, 243, 250 (11E), 453
  geometry of, 452
  in matrix terms, 138
  maximum value, 53
  references, 246
  used in example, 157–158
Ralston, A., 338
Ramsay, J.O., 570
Range space, 437
Ranked residual regression, 577
Rao, C.R., 147
Ratkowsky, D.A., 553
References for:
  bootstrapping, 588
  GLIM, 408
  regression, 593–603
  residuals, 70, 215
  ridge regression, 396
  robust regression, 581–584
Regression for anova models, 473–504
Reinsel, G.C., 180, 198
Reisch, C., 379
Reject, or not, 37
Reparameterization, 529
Repeat runs, see pure error
Resampling procedures, 585–591
Residuals, 26–27, 59–69, 69–70, 181–193, 193–196
  behavior, 60
  books on, 70, 215
  correlation between, 206
  dependence, 68
  Durbin-Watson test, 69–70, 181–193
  externally studentized, 208
  extra SS for e_i, 207
  influential, 210–214
  internally studentized, 207
  non-normal, 61
  normal plots, 61, 70–76
  outliers, 62, 75
  partial residuals, 209
  plots of, 59–69
  queries 1–3, 63–67
  references on, 70, 215
  runs test, 193–196
  serial correlation, 179–181
  standardized, 207
  statistics for, 67
  types, 205–209
  variances of, 206
Response surfaces, 254–271
Response transformation, 253–254, 277–294
Response variable, 17
Restricted least squares, 229, 233–234, 447–452
Restrictions, anova, 475, 485
Reynolds, Penny, 96
Richards, F.J. 549
Ridge regression, 387–400
  basic form, 387
  Bayesian view of, 392
  canonical form, 397–400
  choice of parameter, 390, 391, 395, 397

Ridge regression (*Continued*)
Hald data example, 389
Lagrange multipliers, 392
least squares connections, 388, 396
opinion, 395
possible selection use, 391
phoney data view, 394
restricted least squares view, 392–393
selected references, 396
simulations, 395
trace, 387
when correct, 391–395
Riggs, D.A., 91, 96
Robust regression, 567–584
Burcar tree data, 575–577
Cook's statistic, 574, 581
generalized least squares, 572
Hald data rreg example, 579
L_1 regression, 567
least absolute deviations, 567
least median of squares regression, 577
M-estimators, 568–573
ranked residuals regression, 577
references, 581–584
rreg, 577
scale factor s, 568, 580
steam data rreg example, 579
steel data Huber example, 573–574
tree data Huber example, 575–577
tuning constants, 571, 580
weight functions, 571
weighted least squares, 572
Wilcoxon weights, 578
Robson, D.S., 463
Rosenblatt, J.R., 291
Ross, G.J.S., 553
Rotatable, 255, 257
Rounding errors, 123–124
Rousseeuw, P.J., 70, 215, 577
Roy, S.N., 148
Royston, J.P., 62
rreg, 577
Runs in residuals, 192–198
Runs test, 192–198
Ruppert, D., 291, 294

Sample space, 532–536, 539–543
wrong model, 535–536
Sarhan, A.E., 148
Savin, N.E., 183, 198
Scalar, 7
Scale factor, 568, 580
Scaling data, 373
and centering, 373
and singularity, 374
Scheffé, H., 413, 416, 422
Schemper, M., 246
Schey, H.M., 167, 169
Scott, A.J., 246
Scott, W.F., 195
Searle, S.R., 64, 619
Seber, G.A.F., 438, 516, 553
Second order, 21
examples, 254–266
Segmented models, 311–317
Selection procedures, 327–345
all regressions, 329–334
backward elimination, 339–342
best subsets, see subset
drawback, 342
forward selection, 336, 338
Hald data examples, 329–345
Hald data computations, 348–355
Mallows C_p, 332–334
significance levels, 342
steam data examples, 345–347
stepwise, 335–339
subset regression, 334–335
summary, 344–345
variations, 343–344
Sequential sums of squares, 151–152
examples, 159–160, 167–169
F-test, 159–160, 167–169
in selection procedures, 336
Serial correlation, 179–181
Shah, A.K., 246, 671
Shapiro-Wilk test, 62
Significance levels, 5–6, 342–343
Singer, J.D., 246
Singular $\mathbf{X}'\mathbf{X}$, 125–127, 433–435
generalized inverse, 441–444
Skeleton anova table, 33
Smith, A.F.M., 392
Smith, Harry, 518
Snee, R.D., 385, 400
Solutions, see answers
Soh, Y.C., 92, 96
Spang, H.A., 515
Spencer, J.E., 147
Spillers Milling, 419
Sprent, P., 90
Stabilizing variance, 291–294
Stack loss data, 366 (N), 663 (N)
Standard deviations/errors
of b_0, b_1, 36, 38, 129
of b_i, 138, 142
of $\hat{Y}_i$, 80–83
Standardized residuals footnote, 207
Steam data, 21, 46
confidence intervals and region for (b_0, b_1), 635–636
full data, 46
used for bootstrap example, 588
used for condition example, 380
used for rreg example, 579
used for selection procedures, 345–347
used for two-X example, 154–162
Steel data, 573–575, 586–587
Steepest descent, 513
Stepwise regression, 335–339

Stigler, S.M., 45
Straight line fit, 15–45
  checking, 47–77
  fitting, 15–45
  matrix algebra for, 115–132
  special topics, 79–96
  steam data used, 21
Stuart, A., 95, 96
Studentized residuals, 207, 208
Sum(s) of squares (SS)
  break-up of residual SS, 50
  extra, 29–32, 149–153
  expected value of, 240
  for hypothesis, 219
  for regression, 138
  function, 23, 135, 507
  introduced, 29–30
  lack of fit, 50
  of set of linear functions, 162–165
  partial, 153
  pure error, 49–53
  residual, 30
  sequential, 151–152, 167–169
  S_{YY}, 25
Summary data, 467–469
Summary of matrix development, 130
Swed, F.S. (Cohn, F.S.), 195, 196

t-distribution, 2
t-table, 686
$t^2(\nu) = F(1, \nu)$, 39, 153, 163
TA data, 112 (II), 623 (II)
Table 2.1 data, 51
Tables, 684–693
  chi-squared, 687
  Durbin-Watson, 184–193
  F, 688–693
  Nelson, L.S., 192
  normal, 684–685
  robust regression, 570
  runs test, 196–197
  Savin-White, 185–193
  t, 686
  variance stabilization, 292
  worthwhile regressions, 249–250
Takayama, T., 229
Teachers pay exercise, 359–361
Tentatively entertain model, 21, 47
Tessier, G., 92, 96
Tests of hypotheses, 217–221
Tibshirani, R., 345
Toman, R.J., 332
Transformations in X's
  logarithm, 253
  powers, 252
  reciprocal, 253
  square root, 253
Transformations in Y
  arc-sin root, 292, 293
  Box-Cox method, 280–283
  confidence statements, 280–283
  modulus family, 290
  maximum likelihood, 281
  other plots for, 289
  Poisson data, 294
  power family, 279–286
  predictions, 278
  proportions, 292, 293
  residuals, 286
  second method, 286–289
  two parameter family, 290
  variance stabilization, 291–292
Transpose of matrix, 7, 118
Tree data (Tamra J. Burcar), 110 (EE and FF), 575–577
True/false questions, 605–608
  answers (all are true), 683
Tukey, J.W., 67, 69, 291–294, 569, 570
Tuning constants, 571, 580
Turkey data, 302, 309
Two-way anova, 488–499

Unbiased estimate, 136, 235, 236
Unit matrix, 9, 119
Unplanned data analysis, comments by G.E.P. Box, 328
Useful regressions, 243–250

Variable effects, 473
Variable selection procedures, see Selection
Variables, names of, 17
$V(b_0)$, $V(b_1)$, 126
$V(b_i)$, 138, 142
$V(\hat{Y})$, 130
Variance-covariance matrix, 129, 138
Variance stabilizing transformation, 291–292
von Bertalanffy growth model, 549
von Neumann, 181

Wald, A., 91, 96
Waterman, M.S., 229
Watson, G.S., 69, 180–193
  DW tables, 184–192
Watts, D.G.
  Bates and, 516, 528, 529, 552, 553
  Willan and, 147
Wedderburn, R.W.M., 404
Wei, W.S., 198
Weisberg, S., 147
Weight functions, 571
Weighted least squares, 223–229
  data example, 226–229
  example, 224–226
  in robust estimation, 572
Weisberg, S., 70, 145, 215
Welsch, R.E., 70, 214, 215
Wetz, John, 244, 247
White, K.J., 183, 198
Wilcoxon weights in rreg, 578
Wild, C.J., 246, 516, 553

Wilf, H.S., 338
Wilk (Shapiro-Wilk test), 62
Wilkie, D., 463
Willan, A.R., 147
Willett, J.B., 246
Williams, E.J., 86, 230
Williams, W.T., 549
Willis, J.B., 364 (K)
Wishart, J., 463
Wong, M.Y., 90, 96
Wood, F., 72, 332, 663 (N)
Woodall, W.H., 209
Wrong model, 535, 545
  feared, 235

Yang, Y. (Fred), 231
Yates, F., 461, 463
  table, 686