
Index

- O and o notation, 141
- p^* formula, 153
 - density of MLE, 155
 - distribution function of MLE, 156
 - sample space derivative, 156
 - score function, and, 159
- r^* statistic, 156
 - no nuisance parameter, 156
 - with nuisance parameter, 156, 193
- ancillary statistic, *see* conditional inference
- asymptotic expansion, 142
- autoregressive process, 170
- Bartlett correction, 160
- Bayesian inference, 2, 22
 - asymptotics, 163–164
 - Bayes decision theory, 10, 28–32
 - Bayes factor, 73
 - Bayesian information criterion, and, 77
 - composite hypotheses, 75
 - interpretation, of, 74
 - simple hypotheses, 74
 - computational techniques, 42–48
 - Gibbs sampler, 42
 - Metropolis–Hastings sampler, 44, 53
 - empirical Bayes, 38, 171
 - hierarchical modelling, 48, 53
 - normal distribution, of, 24–28, 75
 - posterior distribution, 2, 22
 - predictive distribution, 52
 - prior distribution, 2, 10, 22, 39–42
 - conjugate, 24
 - improper, 31
 - Jeffreys prior, 40, 139
 - least favourable, 33
 - subjective, 41
 - uninformative, 40
- Behrens–Fisher problem, 204
- bootstrap, 3, 183, 190
 - constrained, 196
 - conventional, 194
 - iterated prepivoting, 200
 - Monte Carlo simulation, 190
 - percentile method, 199, 202
 - prepivoting, 194–201
 - substitution principle, 190
- Central Limit Theorem, 128
- completeness, *see* sufficiency
- conditional inference, 2, 105–111, 140, 208
 - ancillary statistic, 107, 153, 209
 - approximate ancillary, 154
 - Efron–Hinkley ancillary, 154
 - maximal ancillary, 108
 - no nuisance parameter, 107
 - nuisance parameter case, 107
 - specification, 153, 157, 200
 - conditionality principle, 107
 - stability, 209
- confidence set estimation, 1, 114, 191
- confidence set root, 191
- coverage error, 191
- criteria, for, 116–117
- general construction, for, 116
- likelihood, based on, 134
- pivotal quantity, via, 114–116
- convergence
 - almost sure, 127
 - in distribution, 128
 - in probability, 127
- Cornish–Fisher expansion, 149
- Cramér–Rao Lower Bound, 126
- exponential family, and, 127
- cumulant generating function, 141
- cumulants, 142
- data example
 - baseball, 35, 48, 52
 - bioequivalence, 201
 - coal-mining disasters, 55
 - gene expression, 57
 - leukaemia survival, 204, 213
- decision theory, 3, 4
 - action space, 4
 - Bayes principle, 4, 10
 - decision rule, 4–5
 - ϵ -Bayes, 11

- decision rule (*cont.*)
 admissible, 7, 19
 Bayes, 10, 19, 29
 equaliser, 18
 extended Bayes, 11
 inadmissible, 7
 minimax, 8, 18–19, 32
 randomised, 11
 risk function, 4–7
 unbiased, 8–10
 finite decision problem, 11–18
 risk set, 12
 loss function, 4–5
 minimax principle, 4, 8
 utility, 5
 distribution constant statistic, 87, 108
- Edgeworth expansion, 148
 empirical distribution function, 190
 equivariant statistic, 87
 maximal invariant, from, 87
 exponential family, 81, 159
 conditional likelihood, in, 160
 Cramér–Rao Lower Bound, and, 127
 curved exponential family, 83
 full exponential family, 83
 hypothesis testing, multiparameter case, 112–114
 natural parameter space, 83
 natural parametrisation, 82
 natural statistics, 83
 properties, of, 83–86
 uniformly most powerful unbiased test, in one-parameter, 100–105
 exponential regression, 203, 213
- fiducial theory, 109
 Fisher information, *see* likelihood
 Fisherian inference, 2–3, 140, 191, 208
 frequentist inference, 2–3
- hypothesis testing, 1, 65, 98
 alternative hypothesis, 66
 composite hypothesis, 65
 likelihood ratio test, 68
 locally best test, 73
 monotone likelihood ratio family, 70–73
 multiparameter exponential family, in, 112–114
 Neyman–Pearson Theorem, 68–69
 null hypothesis, 66
 one-parameter exponential family, in, 100–105
 power, 67
 randomised test, 66
 similar test, 111, 169
 uniformly most powerful, 111
- simple hypothesis, 65
 test function, 66
 two-sided hypotheses, 99
 two-sided test, 99
 unbiased test, 99
 uniformly most powerful, 99
 uniformly most powerful test, 69
- invariant statistic, 86
 inverse Gaussian distribution, 197
- James–Stein estimator, 55
 Bayes risk, of, 39
 empirical Bayes interpretation, of, 39
 risk, of, 34
 Jeffreys prior, *see* Bayesian inference, prior distribution
 Jensen’s inequality, 95
- Kullback–Leibler distance, 172, 197, 200
- Laplace approximation, 152
 law of large numbers
 strong, 128
 weak, 128
 Lehmann–Scheffé Theorem, 95
 likelihood, 2, 23, 90, 121
 conditional likelihood, 146, 161
 Fisher information, 123, 131, 143
 log-likelihood, 121
 marginal likelihood, 145, 161
 observed information, 123, 131
 profile likelihood, 135, 192
 modified, 160, 161
 pseudo-likelihood, 146, 162
 score function, 122, 143
 likelihood principle, 29, 124
 likelihood ratio, 68, 90
 likelihood ratio test, *see* maximum likelihood, tests
 location-scale model, 87, 108, 155, 212
 configuration, 88
 exact conditional inference, in, 108
 Lugannani–Rice approximation, 151
- Mann–Wald notation, *see* O and o notation
 Markov chain Monte Carlo, 43
 maximal invariant statistic, 86
 ancillary, as, 153
 maximum likelihood, 2, 120
 estimator
 asymptotic efficiency, 131
 asymptotic normality, 129
 consistency, 129
 density, of, 151
 distribution function, of, 156
 likelihood equation, 121
 tests, 132

- likelihood ratio test, 132, 134, 160
- score test, 73, 133, 134, 137
- signed root likelihood ratio, 133, 156, 192
- Wald test, 133, 134, 137
- Wilks' Theorem, 132
- minimum variance unbiased estimator, 96
- model function, 1
- modified profile likelihood, *see* likelihood, profile
- moment generating function, 141
- moments, 141
- monotone likelihood ratio, 71
- Monte Carlo methods, 42, 190

- natural parametrisation, *see* exponential family
- natural statistics, *see* exponential family
- Neyman–Pearson Theorem, *see* hypothesis testing
- normal distribution, known coefficient of variation, 157, 196, 209, 211
- nuisance parameter, 65, 107, 135, 136, 143, 145

- observed information, *see* likelihood

- parameter, 1, 4
- parameter orthogonality, 143–145, 157
- parameter space, 4
- parametrisation invariance, 146–148, 157
- pivot, 114, 191, 193
- pivotal quantity, 114, 170
- point estimation, 1, 90
- posterior distribution, *see* Bayesian inference
- predictive inference, 1, 169
 - asymptotic methods, 179
 - Bayesian, 52
 - bootstrap methods, 183
 - decision theory approaches, 172
 - estimative density, 173
 - exact methods, 169
 - predictive density, 173
 - predictive likelihood, 175
 - approximate, 178
 - conditional, 177
 - prior distribution, *see* Bayesian inference
 - probability integral transform, 195
 - profile likelihood, *see* likelihood

- Rao–Blackwell Theorem, 96
- repeated sampling principle, 2–3, 191

- saddlepoint expansion, 149
- sample space, 4
- sample space derivative, *see* p^* formula
- score test, *see* maximum likelihood, tests
- shrinkage, 33, 172
- signed root likelihood ratio, *see* maximum likelihood, tests
 - adjusted, *see* r^* statistic
- Slutsky's Theorem, 128
- Stein's paradox, 7, 33
- stochastic asymptotic expansion, 142
- stochastic search procedures, 198–199
- sufficiency, 2, 91
 - complete sufficient statistic, 94
 - factorisation theorem, 91
 - likelihood ratio criterion, 91
 - minimal sufficient statistic, 92–93
 - sufficient statistic, 91

- transformation family, 86, 155
 - location-scale example, 87
 - maximal invariant statistic, in, 86

- variance component model, 205

- Wald test, *see* maximum likelihood, tests
- Weibull distribution, 212
- Wilk's Theorem, *see* maximum likelihood, tests