TSM_AdvStDaAn

Tracking excercises of MSE module Advanced Statistical Data Analyses of the MSc. in Engineering. The module consists of two parts:

- Part I: Advanced Regression Modelling
- Part II: Bayesian Statistic

The two parts consist of the following detailed program.

Part I: Advanced Regression Modelling

1. Introduction
2. Review of Multiple Linear Regression 2.1 Initial Remarks 2.2 Analysing Fuel Consumption Using Multiple Linear Regression 2.3 Discussing Some Published Results 2.4 Prediction 2.A Least Square Estimation 2.B Hypthesis Testing and Confidence Intervals 2.C Comparing Nested Models 2.D Model Adequacy Checking and Model Improving 2.E Multicollinearity 2.F Categorical Predictors 2.G Variable Selection
3. Some Advanced Topics in Linear Regression Modelling 3.1 Weighted Least Squares and Robust Fitting 3.2 Other Estimators 3.3 Fitting Smooth Functions and Additive Models 3.4 Statistical Model Building
4. Essentials of Generalised Linear Models - GLM 4.1 Binary Response 4.2 GLM - A Unifying Model Family 4.3 Fitting a GLM and Wald-Type Inference 4.4 Inference Based on Deviances and Variable Selection 4.5 Confidence Intervals 4.6 Dispersion Parameter 4.7 Diagnostics - Model Adequacy Checking
5. Some Extensions of Basic GLM 5.A Generalised Additive Models 5.B Rate Models 5.C Quasi Approach 5.D Multinomial Models
6. Model Simplification and Inference 6.1 Inference Based on Deviances and Variable Selection 6.2 Residual deviance if $\phi = 1$ 6.3 Variable selection (AIC)
7. Diagnostics and Model Improvements 7.1 Dispersion Parameter 7.1.1 Its estimation 7.1.2 Models with $\phi = 1$ and overdispersion 7.2 Model Adequacy Checking - Diagnostics 7.2.1 Defining residual in case of glm 7.2.2 Do the basic diagnostic plots still work? 7.3 Generalised Additive Models (GAM)
8. Some Extensions of Basic GLM 8.1 Rate Models 8.2 Quasi Approach 8.3 Multinomial Models

Part II: Beyesian Statistic

1. What is Bayesian Data Analysis? 1.1 What is Bayesian Data Analysis? 1.1.1 Frequentist Approach vs. Bayesian Data Analysis 1.2 Swedish Fish Inc.'s Salmon signup model 1.2.1 Problem description 1.2.2 Bayesian Analysis 1.3. Workflow of Bayesian Data Analysis 1.3.1 Recipe
2. Approximate Bayesian Computation (ABS) 2.1 Approximate Bayesian Computation 2.1.1 Bayes theorem 2.1.2 Rejection algorithm 2.2 A/B testing with Swedish Fish Inc. 2.2.1 Swedish Fish Inc.'s advertising strategy 2.2.2 Build full probabilistic model and evaluate strategies
3. Exact Bayesian Data Analysis, Discrete Probability Models 3.1 Binomial Model 3.1.1 Conjugate prior, update rule and examples 3.2 Geometric model 3.2.1 Conjugate prior, update rule and examples 3.3 Poisson Model 3.3.1 Conjugate prior, update rule and examples 3.4 Poisson model 3.4.1 Conjugate prior, update rule and examples 3.5 Hypergeometric model 3.5.1 Conjugate prior, update rule and examples

4. Exact Bayesian Data Analysis, Continuous Probability Models 4.1 Exponential model 4.1.1 Conjugate prior, update rule and examples 4.2 Gaussian Model 4.2.1 Conjugate prior, update rule and examples

5. Markov chain Monte Carlo (MCMC) methods 5.1 MCMC intuitive 5.1.2 Explanation of algorithm 5.2 MCMC more formal 5.2.1 Definitions 5.3 Monte Carlo 5.3.1 Algorithm 5.4 Bayesian Apporach to Linear Regression 5.4.1 Linear Regression 5.4.2 Setting up a full probabilistic model 5.4.3 Sampling from the posterior distribution