

Course 4 - Bayesian Statistics

Week 1

- LO 1. Work with the discrete form of Bayes' rule.
- LO 2. Define the concepts of prior, likelihood, and posterior probability and identify how they relate to one another.
- LO 3. Use Bayes' rule to compare multiple hypotheses about a discrete random variable.
- LO 4. Update prior probabilities through an iterative process of data collection.
- LO 5. Understand the differences between Frequentist and Bayesian definition of probability and how they apply to inference.
- LO 6. Conduct both a Bayesian and Frequentist analysis of data to make inferences about a proportion.

Week 2

- LO 1. Identify the difference between a discrete and continuous random variable and define their corresponding probability functions.
- LO 2. Elicit prior beliefs about a parameter in terms of a Beta, Gamma, or Normal distribution.
- LO 3. Understand the concept of conjugacy and know the Beta-Binomial, Poisson-Gamma, and Normal-Normal conjugate families.
- LO 4. Make inferences about a proportion using a conjugate Beta prior.
- LO 5. Make inferences about a rate of arrival using a conjugate Gamma prior.
- LO 6. Make inferences about the mean of a normal distribution when the variance is known.

- LO 7. Articulate the differences between a Frequentist confidence interval and a Bayesian credible interval.
- LO 8. Derive the posterior predictive distribution for very simple experiments.
- LO 9. Define the concepts of prior, likelihood, and posterior probability and identify how they relate to one another.

Week 3

- LO 1: Understand the concept of loss functions and how they relate to Bayesian decision making.
- LO 2: Make optimal decisions given a posterior distribution and a loss function.
- LO 3: Decide between hypotheses given a loss function.
- LO 4: Compare multiple hypotheses using Bayes Factors.
- LO 5: Conceptualize Lindley's paradox and how the Bayes Factor depends on prior elicitation.
- LO 6: Make inferences about a proportion using a conjugate Beta prior.
- LO 7: Identify assumptions relating to a statistical inference.
- LO 8: Create point estimates and credible intervals by averaging over multiple hypotheses.

Week 4

- LO 1: Understand the basics of Bayesian linear regression and how it relates to Frequentist regression.
- LO 2: Identify the assumptions of linear regression and assess when a model

may need to be improved.

LO 3: Check the assumptions of a linear model.

LO 4: Identify outliers and high leverage points in a linear model.

LO 5: Interpret Bayesian credible and predictive intervals in the context of multiple linear regression.

LO 6: Use principled statistical methods to select a single parsimonious model.

LO 7: Implement Bayesian model averaging for both prediction and variable selection.

LO 8: Understand the importance and use of MCMC within Bayesian model averaging.

LO 9: Deduce how wrong model assumptions affect model results.

LO 10: Understand the purpose of prior distributions within Bayesian model averaging.