

Uncertainties: Bayesian vs. Frequentist

Students

- Fabrizio Rompineve, Alessandra Baas, Mathis Kolb, Anja Butter

General

- Studied main properties of Bayesian and Frequentist approach e.g. different definition of probability and according advantages and disadvantages

Definition of probability

- Frequentist:
 - Probability is defined in terms of a large number of identical, independent trials N as the limit ratio s/N , where s states how often something happened
 - Uses *pdf* for data, for fixed parameter values
- Bayesian:
 - Probability as a personal degree of belief
 - Bayes Theorem
 - Conditional Probability: $P(A|B)$ probability of A , given that B has happened
 - $P(A|B) = P(B|A) P(A) / P(B)$ → posterior probability distribution

Hypothesis testing

- Frequentist approach based on p-value and or likelihood ratio
- Basic concept studied with simple counting experiment
- Look Elsewhere Effect leads to dilution of significance
- Investigation of CIs method with frequentist terminology
- Bayesian approach more naturally suited for making statements about degree of believe about two hypothesis in the light of data
- Complication: nuisance parameters require integration and need of prior for these

Review

- Clarification of basic terminology
- Deeper understanding of approximate methods in context of bayesian and frequentist approach
- Recapitulated use of p-values in context of a search analysis; problems arising from treatment of systematics
- Follow-up: Investigate in full detail an example of hypothesis testing in Bayesian case; Intensify understanding of application possibilities of approximate methods in context of coverage or goodness of fit test; Further studies on treatment of Look Elsewhere effect in modern analysis

References

- Feldman, Cousins: A Unified Approach to the Classical Statistical Analysis of Small Signals
- Louis Lyons: BAYES AND FREQUENTISM: A PARTICLE PHYSICIST'S PERSPECTIVE
- A.L. Read, Modified frequentist analysis of search results