STAD94: Comparative Bayesian Analysis of Epidemiological Data in Disease Outbreaks

Project Overview:

This project aims to employ Bayesian statistical methods for analyzing epidemiological data from notable disease outbreaks, including Covid-19, Influenza, and Ebola. The primary goal is to model disease transmission dynamics and estimate crucial epidemiological parameters such as the basic reproduction number (R0), effective reproduction number (Rt), infection rate, incubation period, and recovery rates. By utilizing data from various outbreaks, this study intends to compare Bayesian estimates with those derived from classical or frequentist statistical methods, thereby evaluating the Bayesian approach's robustness and efficiency in real-world epidemiological scenarios.

Specific Objectives:

1) **Literature Review:**
   a. Conduct a comprehensive review of existing epidemiological statistical models and methodologies, focusing particularly on Bayesian techniques as detailed in "Bayesian Data Analysis" by Gelman et al.
   b. Identify and examine relevant books and papers specifically focusing on Bayesian methods in epidemiology to ensure a thorough understanding of current best practices and theoretical foundations in the field.
2) **Data Collection and Preparation:**
   Gather epidemiological data from diverse disease outbreaks (e.g., COVID-19, Zika, Ebola), with a focus on case numbers, recovery rates, and other pertinent metrics for analysis.
3) **Model Development and Analysis:**
   a. Develop and refine Bayesian models for disease spread utilizing concepts and methodologies introduced in the BDA book.
   b. Compare these Bayesian models with classical/frequentist statistical models to evaluate accuracy, computational efficiency, and uncertainty management.
   c. Estimate and compare key epidemiological parameters using both Bayesian and classical/frequentist approaches.
4) **Simulation and Validation:**
   Perform simulation studies to evaluate the developed Bayesian models' performance under various scenarios and data uncertainty levels.
5) **Case Studies and Real-World Application:**
   Apply the developed Bayesian models to actual data from recent disease outbreaks and assess their practical effectiveness and applicability.
6) **Reporting and Documentation:**
   Thoroughly document all methods, analyses, and findings in a detailed final report, ensuring clear and comprehensive communication of the research process and outcomes.