Numerical Simulation of the SIR Epidemic Model

Midway Project Report

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Group Members:

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0.1 Introduction

This document serves as a midway project report, summarizing the progress made in the development of the numerical simulation of the SIR epidemic model. The report outlines the assigned roles, tasks completed, challenges encountered, and the plan for the remaining work. The primary goal of this project is to implement and analyze the SIR model using numerical methods (Euler's method and Runge-Kutta 4th Order) and interpret its results in relation to real-world epidemic scenarios.

0.2 Project Kickoff Meeting (Friday, March 7th, 2025)

On March 7th, 2025, the team held an initial meeting to outline project objectives, define roles, and discuss implementation strategies. The meeting, led by group leader Samuel Quaigraine, focused on breaking the project into structured components and ensuring each team member had clear responsibilities.

0.2.1 Key Discussions and Decisions

- Explanation of the SIR model and its relevance.
- Discussion on the two numerical methods to be implemented.
- Division of tasks among team members.
- Establishing a communication and collaboration platform (WhatsApp group).

0.2.2 Assigned Roles

Name	Role
Mensah Maxwell Kobina Essa	Code Implementation and Visualization
Boateng Serwaa Stephanie	Mathematical Formulation and Report Writing
Ofosu Hackman	Report Writing and Mathematical Formulation
Banjeh Ernest Mwinlasunga	Visualization and Report Writing

0.3 Progress Made So Far

Throughout the week, multiple discussions were held via WhatsApp to track progress. The team successfully worked on the following areas:

0.3.1 Mathematical Formulation

- Defined the SIR model equations.
- Identified key parameters: infection rate (β) and recovery rate (γ).
- Explored the theoretical background of numerical methods.

0.3.2 Code Implementation and Visualization

- Developed Python scripts for Euler's method and RK4.
- Ran initial simulations for various step sizes and parameter values.
- Created visualizations of susceptible, infected, and recovered populations.

0.3.3 Report Writing

- Compiled an initial draft covering introduction and methodology.
- Structured report for analysis of numerical methods.
- Began LaTeX formatting.

0.4 Challenges Faced

- **Numerical Stability Issues:** Euler's method showed instability for larger step sizes.
- **Graphical Representation:** Some inconsistencies in visualization due to improper scaling.
- **Coordination and Scheduling:** Finding meeting times was difficult due to different schedules.

0.5 Key Findings So Far

- Euler's method is less accurate compared to RK4.
- Higher β values lead to a more rapid infection spread.
- Higher γ values result in faster recovery and a lower infection peak.

0.6 Next Steps

1. **Finalizing Mathematical Formulation:** Refining parameter sensitivity analysis.
2. **Refining Code Implementation:** Improving efficiency and stability.
3. **Enhancing Visualization:** Making graphs clearer and more readable.
4. **Completing Report Writing:** Adding discussions and real-world implications.
5. **Final Review and Submission:** Ensuring all components are complete and well-documented.

0.7 Conclusion

The team has made significant progress in implementing and analyzing the SIR model. Challenges such as stability issues and visualization inconsistencies have been addressed, and solutions are being refined. The next phase will focus on finalizing implementation, enhancing visualization, and completing the report.

The team remains committed to delivering a high-quality project and looks forward to successfully completing all tasks as planned.