EMP 219 - Computational Mathematics

Term Project
Computational Mathematics - Numerical Methods

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1 Introduction

This report represents the numerical method term project, the following methods are implemented:

- The Jacobi method.
- The Newton-Raphson method.
- Trapezoidal method.
- Bisection method.
- Simpson's 1/3 rule.
- The trapezoidal method.
- Euler's method.
- Heun's method.
- Linear regression with :
  - Power model.
  - Exponential model.
  - Growth-rate model.

A GUI for the linear regression includes the linear model and all the linearized models are included. Project is in `SageMath`, written and run via `Jupyter` notebooks.

2 SageMath

`SageMath` is a free open-source mathematics software system licensed under the GPL. It builds on top of many existing open-source packages: `NumPy`, `SciPy`, `matplotlib`, `Sympy`, `Maxima`, `GAP`, `FLINT`, `R` and many more. Access their combined power through a common, Python-based language or directly via interfaces or wrappers with features covering many aspects of mathematics, including algebra, combinatorics, graph theory, numerical analysis, number theory, calculus and statistics.

Mission: Creating a viable free open source alternative to `Magma`, `Maple`, `Mathematica` and `Matlab`.

`SageMath` uses a syntax resembling `Python`'s, supporting procedural, functional and object-oriented constructs.

Website: `https://www.sagemath.org/`

2.1 Installation

Installation guide of SageMath:

https://doc.sagemath.org/html/en/installation/index.html

Source code via github:

https://github.com/sagemath/sage/

SageMath 9.3 (Windows installer 0.6.3):

https://github.com/sagemath/sage-windows/releases

Instead of installing SageMath on your machine, you can work via CoCalc

2.2 CoCalc

CoCalc (formerly called SageMathCloud) is a web-based cloud computing (SaaS) and course management platform for computational mathematics. Part of the Sage project, it supports editing of Sage worksheets, LaTeX documents and Jupyter notebooks. CoCalc runs an Ubuntu Linux environment that can be interacted with through a terminal, additionally giving access to most of the capabilities of Linux.

Website: https://cocalc.com/