National College of Ireland

Configuration Manual

MSc Research Project
Programme Name: MSc. FinTech, Practicum (MSCFTD1)

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Student ID: x23338792

School of Computing
National College of Ireland

Supervisor: Dr. Brian Byrne

National College of Ireland

MSc Project Submission Sheet

School of Computing

Student Name: Rishabh Sanjaybhai Patel

Student ID: x23338792

Programme: MSc. FinTech **Year:** 2024-25

Module: MSc (Research) Practicum

Lecturer: Dr. Brian Byrne

Submission Due Date: 11-08-2025

Project Title: Bitcoin as a Global Reserve Currency: Evaluating Challenges, Technological Approaches, and Future Viability

Word Count: 1024 **Page Count: 5**

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
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Signature: Rishabh Sanjaybhai Patel

Date: 11-08-2025

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Section 1

Requirements and Dependencies:

The quantitative analysis for this project was executed within a **Google Colab** environment, leveraging Python 3 as the primary programming language. This choice provided a powerful, cloud-based platform for data processing and model training, sidestepping local hardware limitations and facilitating easy collaboration. To ensure the reproducibility and integrity of the analysis, a specific set of Python libraries was utilized. **Pandas** was foundational for all data manipulation tasks, enabling efficient handling and cleaning of the large-scale Bitcoin price datasets. **NumPy** provided the necessary tools for complex numerical operations, while **Matplotlib** and **Seaborn** were instrumental in generating high-quality visualizations, from price charts to diagnostic plots of model residuals.

For the core time-series modeling, several specialized libraries were essential. The **statsmodels** library was employed for the implementation and analysis of the traditional ARIMA model, providing a robust statistical framework for our baseline forecasting. The **arch** library, a critical dependency for this research, was specifically used to construct and analyze the GARCH model. This library's specialized functions allowed for a sophisticated examination of Bitcoin's volatility clustering a key empirical finding of the study. Since arch is not a standard component of the Colab environment, an explicit installation command, !pip install arch, was executed in the notebook's initial cell. Finally, the deep learning component of the project relied on the **Keras** API, which runs on the **TensorFlow** backend. Keras provided a high-level, user-friendly interface for building, training, and evaluating the LSTM model, enabling a more advanced, non-linear approach to time-series forecasting. The combination of these libraries created a powerful and complete analytical pipeline for the project.

Section 2

Code Description:

All of the quantitative analysis is contained in the **RP12345practicum_final(1).ipynb** notebook. We designed this document to be a step-by-step guide through the entire process. It starts with the initial cells focused on **Data Acquisition and Cleaning**, which is where we load the historical Bitcoin price data into a pandas DataFrame. This step is super important for making sure our data is high-quality and ready for modeling.

The main part of the notebook is where we implement three different **Time-Series Models**, each chosen for a specific reason. First, we used the **ARIMA (AutoRegressive Integrated Moving Average)** model as our baseline. It's a great tool for identifying long-term trends and short-term patterns, and its results gave us something to compare our more advanced models against. After that, we introduced the **GARCH (Generalized Autoregressive Conditional Heteroskedasticity)** model. We used GARCH specifically to tackle Bitcoin's high volatility. Its ability to show us "volatility clustering" where big swings follow big swings was a cornerstone of our research, giving us a way to quantify risk. Finally, we built an **LSTM (Long Short-Term Memory)** model, which is a type of deep learning model that's perfect for handling the complex, non-linear patterns you see in financial data. This model's training and forecasting sections show a much more advanced approach to predicting the market. We wrapped everything up in a **Model Evaluation** section, where we looked at quantitative metrics and charts to judge the performance of each model and draw our final conclusions.

Section 3

Execution Instructions:

To fully replicate the quantitative analysis and reproduce the results of the project, please follow these instructions precisely. The process is designed to be straightforward and self-contained within the Google Colab environment. First, open the **RP12345practicum_final(1).ipynb** file. The first executable cell in the notebook is a critical step; you must run the command !pip install arch to install the GARCH modeling library, as it is not included in the default Colab installation. After this dependency is resolved, you can proceed to execute the remaining code cells in a sequential manner, from top to bottom. Each cell's output will display key analytical results, including model summaries with statistical coefficients, alongside a series of informative plots. These visualizations, such as the ARIMA forecast, the GARCH conditional volatility plot, and the LSTM training loss charts, are essential for understanding the findings. The final markdown cell provides a concise written conclusion of the quantitative analysis, summarizing the key takeaways from the models' performance and their implications for the research question. By following these steps, you will be able to fully engage with the project's methodology and empirical evidence.

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