Software Requirement Specification (SRS)

Project Name: P&SO;

Project Code: 06

Monte Carlo Simulation for Financial Risk Analysis using Parallel Computing

1.0 Project Code

06

2.0 Title of the Project

Monte Carlo Simulation for Financial Risk Analysis using Parallel Computing

3.0 Introduction

This document provides a detailed description of the requirements for the Monte Carlo Simulation for Financial Risk Analysis project.

3.1 Purpose

This SRS defines the system's functionality, performance requirements, interfaces, and constraints. It serves as a reference for developers, project guides, reviewers, and stakeholders involved in the development and evaluation of the project.

3.2 Document Conventions

No special document conventions are used in this SRS.

3.3 Intended Audience and Reading Suggestions

Business Development Team, BD Head, Executive Director, Heads of Departments, Project Guide, Developers, and Reviewers.

3.4 Project/Product Scope

This project is intended for internal academic and research use. The system simulates financial market behavior, analyzes financial risks, and evaluates performance improvements through parallelization. The project focuses on financial risk modeling and not real-time trading systems.

3.5 References

Monte Carlo Methods in Finance – Paul Glasserman; MPI and OpenMP Programming Manuals; CUDA Programming Guide (NVIDIA); Financial Risk Management textbooks.

4.0 Overall Description

Monte Carlo Simulation is a computational technique that uses random numbers to estimate numerical results. In finance, it is widely used to price financial options, estimate risk, and analyze uncertainty under different market conditions. This project integrates MPI, OpenMP, and GPU acceleration to improve execution speed and accuracy.

4.2 Project/Product Functions

Simulation of random financial scenarios, option pricing using Monte Carlo methods, calculation of Value at Risk (VaR), risk analysis under different market conditions, parallel execution using MPI and OpenMP, GPU-accelerated simulations, performance and speedup analysis, and visualization of simulation results.

4.4 Operating Environment

Server: Linux OS; Languages: Python/C/C++; Tools: MPI, OpenMP, CUDA/OpenCL. Client: Browser-based clients on Windows or Linux systems.

4.5 Design and Implementation Constraints

Requires Linux-based systems for MPI and GPU support. GPU acceleration depends on CUDA-enabled hardware. Parallel execution is limited by the availability of CPU cores and cluster nodes.

5.0 External Interface Requirements

Command-line interface for simulation execution, graphical output using plots and charts, and automated email reporting facility.

6.0 System Features

Monte Carlo simulation, random number generation, option pricing, Value at Risk calculation, risk analysis, parallelization using MPI/OpenMP, GPU acceleration, variance reduction techniques, numerical stability handling, and performance measurement.

7.0 Other Non-Functional Requirements

Performance efficiency, system safety, data security, software accuracy, scalability, reliability, and maintainability.

8.0 Acceptance Criteria

Monte Carlo simulations run correctly, option pricing and VaR results are accurate, parallel versions demonstrate measurable speedup, GPU acceleration improves performance, and results are clearly visualized and documented.

9.0 Deliverables

Software source code, simulation results, performance analysis report, user manual, installation manual, and final project report.