## Stock Market Data Analyzer – Design and Test Documentation

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## Project Overview

The Stock Market Data Analyzer is a C++ console-based application that enables investors to:

* Explore historical price data stored in a self‑balancing AVL Tree (O(log n) operations).
* Compute technical indicators (SMA, EMA, daily change, ROI, volatility).
* Compare tickers side‑by‑side and run “what‑if” trade simulations.

CSV files can be imported/exported, and all interactions are driven through a menu‑based CLI.

## 1. Design Phase – Challenges & Key Decisions

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| # | Topic | Challenge | Meeting Discussions | Final Decision |
| 1.1 | Data‑Structure Selection | Needed a data structure that contained data in order and allowed for quick access. | Considered Red‑Black Tree, AVL, and D‑Heap‑backed priority queue; must handle millions of inserts from CSV. | Chose AVL Tree for predictable performance for search, insert and delete operaions (fits project requirement). |
| 1.2 | Import stock data | Access to stock data to perform operations. | Choose between API or CSV. Easier to implement vs more access to different stocks. | Choose API for current data and CSV for testing on custom stock data. |
| 1.3 | Interface Design & Menu Flow | Make a CLI intuitive for non‑technical users. | Flat vs. nested menus, show hidden options, error handling. | Adopted numbered main menu; invalid entries loop until valid. |

## 2. Testing Phase Notes

### 2.1 Manual Testing

* Imported an year of Apple (AAPL) prices and verified AVL height ≈ log₂ n.
* Calculated 20-day SMA, 50-day EMA, 30-day Volatility and cross‑checked against Excel.
* Ran a buy‑and‑hold simulation (Jan 2024 → Dec 2024) and validated ROI.

### 2.2 Edge‑Case Testing

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| Test Case | Expected Outcome | Result |
| Query outside date range | Stock not found message | Passed |
| Extremely sorted CSV (worst‑case) | Tree rotations keep height ≈ log n | Passed |

## 3. Team Communication & Workflow

Tools:

* Microsoft Teams – weekly meetings.
* Git (GitHub) – version control.
* Visual Studio 2022 (vcpkg) – development environment.

## 4. Future Improvements

1. GUI front-end using .NET MAUI for cross‑platform visualisation.
2. Additional financial metrics (RSI, Bollinger Bands, MACD).
3. Parallel CSV loader to ingest decades of data faster.

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