***Algorithmic Trading***

***System***

***Business Case***

Okanagan College

Algorithmic Trading System

2024-04-09

Version 1.6

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| Revision | Date | Brief Summary of Changes |
| --- | --- | --- |
| Version 1.0 | 2023-10-26 | Baseline template of document |
| Version 1.1 | 2023-10-31 | Revisions to sections 1.1, 2, 5.1, and 7 |
| Version 1.2 | 2023-11-02 | Revisions to section 1 |
| Version 1.3 | 2023-11-05 | Final revisions to sections 1, 3, and 5 |
| Version 1.4 | 2023-12-06 | Revisions to sections 4, 7 |
| Version 1.5 | 2024-03-14 | Updated project milestones, updated dates/versions |
| Version 1.6 | 2014-04-09 | Final Revisions |

[**1. Executive Summary 1**](#_heading=)

[1.1 Issue 1](#_heading=h.30j0zll)

[1.2 Anticipated Outcomes 1](#_heading=h.1fob9te)

[1.3 Recommendation 1](#_heading=h.3znysh7)

[1.4 Justification 2](#_heading=h.2et92p0)

[**2. Key Acronyms and Abbreviations 2**](#_heading=h.tyjcwt)

[**3. Business Case Analysis Team 2**](#_heading=)

[**4. Problem Definition 3**](#_heading=)

[4.1 Problem Statement 3](#_heading=h.1t3h5sf)

[4.2 Organizational Impact 3](#_heading=h.4d34og8)

[4.3 Technology Migration 3](#_heading=h.2s8eyo1)

[**5. Project Overview 3**](#_heading=)

[5.1 Project Description 3](#_heading=h.17dp8vu)

[5.2 Goals and Objectives 4](#_heading=h.3rdcrjn)

[5.3 Project Performance 4](#_heading=h.lnxbz9)

[5.4 Project Assumptions 5](#_heading=h.35nkun2)

[5.5 Project Constraints 5](#_heading=h.1ksv4uv)

[5.6 Major Project Milestones 5](#_heading=h.2xcytpi)

[**6. Alternative Analysis 6**](#_heading=)

[**7. Approvals 7**](#_heading=)

# Executive Summary

This business case outlines how the Algorithmic Trading System (ATS) Project will address current business concerns, the project's benefits, recommendations and justification for the project. It also discusses detailed project goals, performance measures, assumptions, constraints, and alternatives.

## Issue

The data research team is looking to gain access to a larger dataset that will be used to train their Stock Market Forecasting machine learning (ML) algorithm. Their previous research was limited in scope and not as beneficial as they would like. The use of an improved dataset aims to increase the accuracy of the algorithm’s forecasts, making their research more meaningful.

## Anticipated Outcomes

The successful implementation of the ATS project would be a large step forward for the research efforts of the client. Automated data collection will significantly reduce the time and resources currently devoted to manual data collection. This will free up man hours and reduce the risk of human error. Access to a larger and more up-to-date dataset will improve the accuracy and reliability of the forecasting model. The project will be designed to be scalable and adaptable, allowing for the configuration of the data being collected (what stocks, how many stocks, etc..) and the data sources themselves. The implementation described above will be essential to the client's future stock market research.

## Recommendation

To address the business issue described in section 1.1, the recommended ATS project will deliver a maintainable, scalable, and well-documented software product. Some of the key features to meet the intended results are as follows:

* Data collection will be automatic and comprehensive
* Data integrity will be maintained via consistency testing and regular backups
* Researchers will be able to extract data from a larger dataset
* Researchers will have the ability to configure the system:
  + Configure what sources they wish to extract data from.
  + Configure what data they want/need.
* Researchers will be able to pull data from the system at any time

## Justification

The decision to implement the ATS project should be made from an evaluation of the available alternatives. Continuing with the client’s existing system would leave their business requirements unmet, meaning they would have a reduced ability to improve their ML model and continue their research. While purchasing third-party software would be a potentially usable alternative, an in-house solution is preferable for several reasons. The ATS project, developed by students, offers a much lower overall cost and, more importantly, a higher degree of customization and adaptability to the specific needs of the client. After the consideration of these alternatives, the ATS project remains the most optimal solution.

# Key Acronyms and Abbreviations

| ATS | Algorithmic Trading System |
| --- | --- |
| ML | Machine Learning |

# Business Case Analysis Team

The following individuals comprise the business case analysis team. They are responsible for the analysis and creation of the ATS Project business case.

| **Role** | **Description** | **Name/Title** |
| --- | --- | --- |
| Project Clients | Provide executive support for the project. All ideas flow from these individuals, including the business case | Gaetan Hains & Albert Wong |
| Scrum Master | Lead the team through the project and flesh out the requirements, alongside reviewing the business case | Jake Fischer |
| Product Owners | Manage the business case and project team | Ben Carrier & Jacob Rawlings |
| Developers | Code and write the business case itself | Various |

## 

# Problem Definition

## Problem Statement

During their initial research, the data research team was training their ML model using a small amount of data which was collected manually. Due to the volatile nature of the stock market and its related data, this small dataset was insufficient in producing the most accurate model possible. Having a larger dataset, with up-to-date data, allows the model’s forecasts to be better in line with current market data. Manually collecting this amount of data would be time-consuming and unreasonable. Automating data collection would save the team time and effort.

## Organizational Impact

The ATS will positively impact our stakeholders by providing them with a larger dataset to work with. Without the ATS, the stakeholders' normal operating structure may introduce small sample size biases and influence any calculated results derived from the data.

The ATS team will require space for data storage, which will be provided by IONOS to maintain the database, and back-ups and store archived data.

## Technology Migration

Users of the ATS will need to learn how to export data from the database using the IONOS hosting dashboard. Data can be exported to CSV, allowing it to be used easily with ML models. This will allow data to be accessed easily and reduce the need for manual data intervention.

# Project Overview

## Project Description

The Algorithmic Trading System (ATS) project is aimed at improving the client's ability to effectively train their Stock Market Forecasting machine learning model. Given the ever-changing and highly volatile nature of the stock market, real-time and accurate data are important, and data sources are prone to frequent updates and new data being continuously generated.

The project's primary objective is to address these challenges by improving the availability and quality of data to the client. This will be achieved through the following processes:

* **Data Collection:** ATS will connect to external data providers to access up-to-date and reliable market information.
* **Data Processing:** Techniques will be used to sanitize, normalize, and potentially enhance acquired data, to ensure its accuracy and consistency.
* **Data Warehousing:** A data warehouse will be built to store large amounts of historical market data. ***Note:*** The data warehouse is part of the future state of the ATS.
* **Automation:** The entire data collection and processing workflow will be automated to provide a consistent stream of up-to-date data to the client.

This project will result in the client having a large, up-to-date dataset readily available to them. Allowing them to focus on their research and expectantly improving their Stock Market Forecasting Model.

## Goals and Objectives

The ATS project’s purpose is to fulfill the business requirements specified by the client. The following table lists the business concerns that the ATS plans to mitigate:

| **Business Goal/Objective** | **Description** |
| --- | --- |
| Improve ML research efforts | A broader set of data will allow stock market forecasting ML models to be better trained. Resulting in more accurate predictions and more valuable research. |
| Reduce workload | The automatic data collection workflow decreases time spent on collecting data. |

## 

## Project Performance

The following table lists the performance metrics used for evaluating system performance and how they are measured:

| **Key Resource/Process/Service** | **Performance Measure** |
| --- | --- |
| Data Accuracy | Automatically collected data can be compared with manually collected data to ensure accuracy. |
| Data Processing Speed | The data collection process should take less than 6 hours from the start of execution. A maximum of 24 hours may be allowed in some cases. |
| Data Storage Efficiency | The amount of storage space required for collected data will be tracked to reduce the risk of future storage costs. |
| Scalability | Ensure that changes in system configuration (i.e. an increase in the number of stock data being collected) will not significantly hinder system performance. |
| System Reliability | System downtime will be tracked to ensure data consistency. |
| User Satisfaction | Feedback is gathered from system users based on how the system satisfies their requirements. |
| ML Prediction Accuracy | Prediction accuracy scores for models trained with the new dataset can be compared to models trained on the old dataset. More accurate scores are expected with the automated system. |

## Project Assumptions

* System users are familiar with the environment (IONOS) and tools used for the extraction of stock data (phpMyAdmin)
* Project will be migrated from the development environment to the production environment.
* Data will be collected from the [Financial Modeling Prep API](https://site.financialmodelingprep.com/developer/docs).

## Project Constraints

* Data collection processes rely on the availability of data from external sources.
  + Disruptions and inaccuracies in data sources may affect the system's ability to provide accurate data

* Data will be stored using a third-party hosting provider (IONOS).
  + Storage per database is currently limited to 2GB
  + Database integrity is contingent on the state of the hosting service

* Time constraints
  + Initial Project development is restricted to the months of the 2023 fall semester (September 7 - December 7)
  + The ATS Maintenance development is restricted to the months of the 2024 winter semester (January 10-April 10)

## Major Project Milestones

The following table outlines the main milestones to be reached during project development. As planning and development proceed, subsequent milestones may be added to express specific checkpoints throughout each project phase.

| **Milestones/Deliverables** | **Target Date** |
| --- | --- |
| Project Inception | 2023-10-22 |
| Project Elaboration | 2023-11-05 |
| Project Construction Phase 1 | 2023-11-19 |
| Project Construction Phase 2 and Prototype Release | 2023-11-30 |
| Reviewed/Refactored Prototype Final Release | 2023-12-10 |
| Environment Configuration | 2024-01-31 |
| UI Prototype | 2024-02-14 |
| Redundant Data Source Support | 2024-02-28 |
| Improved Logging System and Functioning CI | 2024-03-13 |
| Beta Testing | 2024-03-27 |
| Final Release | 2024-04-10 |

# Alternative Analysis

Several alternative options were explored to tackle the business challenge, each of which was carefully evaluated but ultimately not chosen for specific reasons, as elaborated below.

| **No Project (Status Quo)** | **Reasons For Not Selecting Alternative** | **Reasons To Approve Alternative** |
| --- | --- | --- |
| Maintain the current manual trading approach where traders make decisions without automated software. | * Limited scalability. * Susceptible to human errors. | * No initial software development costs. * High degree of control and flexibility |
| **Alternative Option 1** | **Reasons For Not Selecting Alternative** | **Reasons To Approve Alternative** |
| In-house development | * Less experienced * Time Constraints * In-house maintenance and support | * Low labour cost * Ownership * Data Control * Customization * Potential cost savings over time * Highly customizable |
| **Alternative Option 2** | **Reasons For Not Selecting Alternative** | **Reasons To Approve Alternative** |
| Third-party software purchase | * High cost * Potentially not scalable * Lack of customization with premade software | * Less time developing * Easy to set up * Will have long time support * Reduced risk |

After careful evaluation of these alternatives, it is recommended to pursue the in-house development (Alternative Option 1) of algorithmic trading software. While this option involves higher initial costs and a longer timeline, it offers the greatest potential for tailoring the software to the client’s specific needs, achieving long-term cost savings, and improved research. We believe this alternative aligns most effectively with the organization's goals and strategic objectives.

# Approvals

The signatures of the individuals below signify their comprehension of the document's intent and content. By signing this document, you express your approval of the proposed project detailed in this business case and your consent for us to proceed with the necessary steps to formally initiate the project as per the outlined details.

| **Approver Name** | **Title** | **Signature** | **Date** |
| --- | --- | --- | --- |
| Gaetan Hains | Stakeholder |  |  |
| Albert Wong | Stakeholder |  |  |
| Jacob Rawlings | Product Owner |  |  |
| Ben Carrier | Product Owner |  |  |