



# Group Work Project

MScFE 610  
Econometrics

```
((($this->repo_path = $repo_path; if ($parse_ini['bare']) {$this->repo_path = $repo_path; $this->
($repo_path."/config"); if ($parse_ini['bare']) {$this->repo_path = $repo_path; $this->
path = $repo_path; if ($_init) {$this->run('init');}} else {throw new Exception('"' . $r
* new Exception('"' . $repo_path . '" is not a directory');}} else {if ($create_new) {if
)) {mkdir($repo_path); $this->repo_path = $repo_path; if ($_init) $this->run('init');}
istent directory');}} else {throw new Exception('"' . $repo_path . '" does not exist');}}
it" directory) * * @access public * @return string */ public function git_directory_pat
repo_path . "/.git";}} * * Tests if git is installed * * @access public * @return bool */
> array('pipe', 'w'), 2 => array('pipe', 'w'),); $pipes = array(); $resource = proc_open(
t_contents($pipes[1]); $stderr = stream_get_contents($pipes[2]); foreach ($pipes as $pipe
return ($status != 127);}} * * Run a command in the git repository * * Accepts a shell
,); $pipes = array(); /* Depending on the value of variables */
```

## Overview

This document describes the requirements for the three Group Work Project assignments which must be submitted at the end of week 3, 5, and 7 respectively. Within a week of each submission, your group will receive feedback from the WQU Instructional Team, enabling you to use the feedback to revise your assignment ahead of the second and third submissions. You will use the Group Work Forum to communicate with your peers throughout the course.

Please make use of the [LIRN Library](#) located on the left pane of your screen as the primary resource for your research.

Your research should favor authoritative, scholarly sources, and you must cite all sources where relevant. The task is not to reproduce the research of others, but instead to develop your own systematic narrative that addresses the research topic and is informed by the research of others. Not only are you required to cite accurate and relevant facts, but you must also present your own clear logic when linking and contextualizing these facts.

Visit the [Student Resource Center \(SRC\)](#) where you can find resources on **how to conduct research**, how to use different sources of information, how to **cite references to avoid plagiarism**, and how to use the **MLA citation style**.

**Note:** All Group Work Project assignments must be submitted via **Turnitin**, the anti-plagiarism software.

## Group Work Project Objectives

**Submission 1:** Apply basic statistics, regression analysis and univariate time series models using R

**Submission 2:** Analyze asset returns and volatility in a quantitative trading framework using univariate and multivariate econometric models

**Submission 3:** Design an algorithmic trading in R



Anyone considering an investment in a class of assets must understand the properties of the assets that compose that class. A good understanding requires a rigorous, systematic analysis. The econometric methods that you are learning in this course are the starting point of the arsenal of methods you will eventually learn as a financial engineer to obtain such an understanding. This project guides you in the steps of a financial time series forecasting and analysis.

As a financial engineer, you will eventually acquire the additional role of investing on behalf of others. To do this effectively, you must also be able to communicate your research results systematically and draw clear conclusions that a client can understand.

## Submission 1: Basic Statistics, Linear Regression, and Univariate Analysis

This submission requires you to implement linear regression in forecasting and analysis. Linear regression represents a basic econometric tool and it is the starting point for a variety of prediction models such as ARMA and non-linear algorithms. You will also use the Box-Jenkins approach for selecting the optimal parameters of ARMA forecasting model. Exogenous variables, which improve model forecasts, must be indicated at the end of this submission, to combine with finance theory and research.

### Basic Statistics

Download JP Morgan stock historical prices from [Yahoo Finance](#) with the following characteristics:

- **Period:** February 1, 2018 – December 30, 2018
- **Frequency:** Daily
- **Price considered in the analysis:** Close price adjusted for dividends and splits

Using this data and **R as the programming language**, calculate the following:

1. Average stock value
2. Stock volatility
3. Daily stock return

Using the same data above, calculate the following in **Excel** (you can use **OpenOffice** as an alternative to Excel):

1. Average stock value
2. Stock volatility
3. Daily stock return
4. Show JP Morgan stock price evolution using a scatter plot
5. Add a trendline to the graph (trendline options – linear)



## Linear Regression

1. Implement a two-variable regression in **R** language using the following data:
  - **Explained variable:** [JP Morgan](#) stock (adjusted close price)
  - **Explanatory variable:** [S&P500](#)
  - **Period:** February 1, 2018 – December 30, 2018
  - **Frequency:** Daily
2. With the same variables as above (JP Morgan Stock and S&P500), implement a two-variable regression in **Excel** using LINEST function and Analysis ToolPak.

## Univariate Time Series

Download the following data:

- **Data source:** <https://fred.stlouisfed.org/series/CSUSHPIA>
- Period considered in the analysis: January 1987 – latest data
- **Frequency:** monthly data

With this data, do the following using **R** or **Python** languages:

1. Forecast S&P/Case-Shiller U.S. National Home Price Index using an ARMA model.
2. Implement the Augmented Dickey-Fuller Test for checking the existence of a unit root in Case-Shiller Index series.
3. Implement an ARIMA(p,d,q) model. Determine p, d, q using Information Criterion or Box-Jenkins methodology. **Comment the results.**
4. Forecast the future evolution of Case-Shiller Index using the ARMA model. Test model using in-sample forecasts.

Write a report where you research and suggest types of exogenous variables that can improve forecasts. In your references, **indicate four (4) research articles or books at minimum.**

## Submission Requirements

Submit the following documents for your assignment:

- **A 500-word report** in PDF format, must be **separate** from the other documents
- Excel spreadsheets
- Source code if applicable. Include comments to explain how the code runs

**Note:** The PDF file with your report must be uploaded **separately** from the zipped folder that includes your other files. This allows Turnitin to generate the similarity report.



## Submission 2: Volatility and Multivariate Analysis

Financial variables have a time varying mean and periods of relatively low tranquility followed by periods of high variability. For this submission you will extend ARMA Box-Jenkins methodology to stochastic volatility models (GARCH), provide short term forecasts, and identify data patterns. You will also implement cointegration and VECM framework to calculate equilibrium levels for financial variables.

For this submission you can use either **R** or **Python** languages.

### Volatility Analysis

Forecast Apple daily stock return using a GARCH model. Use [Yahoo Finance](#) as your data source.

1. Select one type of GARCH model (ARCH, GARCH-M, IGARCH, EGARCH, TARCH, multivariate GARCH, etc.) to complete your analysis. **Explain your choice.**
2. Forecast the next period daily return ( $t+1$ ) using the chosen model. Select the timeframe in the analysis. Provide charts and comments.

### Multivariate Analysis

Calculate the equilibrium FX for your local currency and do the following:

1. Describe the economic theories and models used to calculate equilibrium FX.
2. Indicate macroeconomic variables used to determine the equilibrium FX.
3. Explain the connection between linear regression and Vector Error Correction (VEC).
4. Calculate the equilibrium FX using VEC and comment all your results. You may use the Behavioral Equilibrium Exchange Rate (BEER) approach

In the written report for this submission, provide four (4) research articles or books at minimum.

### Submission Requirements

Submit the following documents for your assignment:

- **A 1,000-word report** in PDF format, must be **separate** from the other documents
- Excel spreadsheets
- Source code if applicable. Include comments to explain how the code runs

**Note:** The PDF file with your report must be uploaded **separately** from the zipped folder that includes your other files. This allows Turnitin to generate the similarity report.





## Submission 3: Algorithmic Trading Strategy

For this submission, you will extend ARMA to model non-linear patterns, which are often encountered in financial time series data. Basic forms of neural networks are implemented to obtain short-term predictions that can be used as trading signals in algorithmic trading strategies.

### Developing an Algorithmic Trading Strategy

Design your own algorithmic trading strategy, with the following characteristics:

- Number of assets in the strategy: One or more assets
- **Type of asset:** Select the type of asset that you prefer: stock, commodity, FX, crypto etc)
- **Timeframe:** Your choice
- **Coding language:** R or Python. You can use Excel for basic calculations and testing
- **Model:** regression, ARMA, GARCH, VAR, VEC or any other quantitative model you know. You can combine the selected model with technical analysis indicators (MA, MACD, Bollinger bands, etc.) as shown in the examples provided in the course. You may also use a machine learning algorithm (optional).

### Writing Your Report and Submission Requirements

Write a well-structured formal report on the algorithmic trading strategy that you have developed (1,500 words at minimum excluding code and comments). The report must include the following sections:

- Introduction
- Description of the trading strategy that you have developed, step by step
- The R or Python code that you have developed including clear comments
- Excel calculations (if used): include screenshots of your calculations and the used parameters
- Calculation of returns, cumulative returns, standard deviation, and forecasts
- The results of your analysis and the obtained charts
- Possible ways for improving the algorithmic trading strategy that you have developed
- Conclusions, and References
- Source code. Include comments to explain how the code runs

**Note:** The PDF file with your report must be uploaded **separately** from the zipped folder that includes code, comments, and calculation on Excel spreadsheets. This allows Turnitin to generate the similarity report.

