Stevens Institute of Technology

School of Business

**AACSB
ASSURANCE OF LEARNING**

**Bachelor of Science in Quantitative Finance**

 **(QF)**

**LEARNING GOAL # 3**

**Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system.**

**Responsibility: Zachary Feinstein**

December 2021

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# 1. INTRODUCTION: LEARNING GOAL #3

**Goal: Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system.**

*Objective 1: Students develop sound financial time series models based on major economic and financial trends and events.*

This goal is assessed in QF301 Financial Time Series – a required course in the QF curriculum.

# 2. LEARNING OBJECTIVES AND TRAITS

|  |  |
| --- | --- |
|   | **QF Learning Goal - 3: Objectives and Traits** |
| **QF 3** | **Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system.** |
| **Learning Objectives** |  |
| **Objective 1:** | *Students develop sound financial time series models based on major economic and financial trends and events.* |
| **Traits** |   |
| Trait 1: | Student identifies appropriate models for the time series under study |
| Trait 2: | Student tests alternative models and selects best model |
| Trait 3: | Student forecasts time series with selected model and uses forecast to solve a specific financial problem (i.e. test different trading strategies).  |

# 3. RUBRICS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **QF LEARNING GOAL - 3: RUBRIC 1** |   |   |   |
| **QF 3** | **Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system.** |
| **Objective 1** | *Students develop sound financial time series models based on major economic and financial trends and events.* |
|   | **Trait** | **Poor** | **Good** | **Excellent** |
|   | **Value** | **0** | **5** | **10** |
| Trait 1: | Student identifies appropriate models for the time series under study | Does not identify any time series method | Identifies one time series method | Identifies one or more appropriate time series methods |
| Trait 2: | Student tests alternative models and selects best model | Does not test any alternative method | Tests alternative methods | Tests alternative methods and selects at least one relevant method |
| Trait 3: | Student forecasts time series with selected model and uses forecast to solve a specific financial problem (i.e. design at least a trading strategy). | Does not forecast any time series | Forecasts time series without including any additional application | Forecasts time series and includes results of at least one application (i.e. design at least a trading strategy) |
| **Criterion:****Does not meet expectations: 0 – 14; Meets: 15-19 ; Exceeds: 20-30**   |

# 4. ASSESSMENT PROCESS

|  |  |  |
| --- | --- | --- |
| **Where & when measured?** | **How measured?** | **Criterion** |
| Course-embedded project in required course *QF301 Financial Time Series. A*ssessed in the Fall semester each year. | Description: project is graded by course owners and aggregated to obtain a total score.Sampling: All students in the QF program are assessed. | 85% of students get a grade of GOOD or better as measured by the rubric for this learning goal |

# 5. RESULTS OF LEARNING GOAL ASSESSMENT – INTRO

The results of the initial learning goal assessments carried out to date are included below.

**Explanation**

Each learning goal has a number of learning objectives, and performance on each objective is measured using a rubric that, in turn, contains a number of desired “traits.” Students are scored individually on each trait.

The grading sheets for each student are used to develop a Summary Results Sheet for each learning goal objective. A selection of these summaries is included below.

The first table in the Summary Results Sheet for a learning objective/trait gives the counts of students falling in each of the three categories:

* Does Not Meet Expectations
* Meets Expectations
* Exceeds Expectations

The right-hand column in the table is used to record the average score of the students on each trait. This table provides an indication of the relative performance of students on each trait.

The second table on each sheet provides the counts of students who fall in each of the above three categories for the overall learning objective.

The person doing the assessment provides explanatory comments and recommendations on the bottom of the Results Summary Sheet. The recommendations improve content or pedagogy changes for the next time the course is given.

**Explanation of Indirect Measurements**

Indirect measurements will be taken at periodic intervals. Depending on the measurement chosen a diagnostic tool will be selected for analysis. The indirect measurements being considered are:

* Internships
* job placement statistics
* starting salaries
* mid-career salaries (5 years out)

# 6. RESULTS OF ASSESSMENT: Fall 2021

NOTICE THAT THE DIRECT ASSESSMENT IS DONE FOR ON CAMPUS; WEBCAMUS AND COMBINED THIS IS NOW A REQUIREMENT FOR AOL

WE WILL START ASSESSMENTS IN FALL OF 2021

## The direct measurement is the written assignment

1. Indirect measurement is use periodically.

# RESULTS OF ASSESSMENT: Fall 2021

**LEARNING GOAL #3:***Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system.*

**LEARNING OBJECTIVE #1:***Students develop sound financial time series models based on major economic and financial trends and events.*

*.*

**ASSESSMENT DATE: December 17, 2021**

 **ASSESSOR: Zachary Feinstein**

**NUMBER OF STUDENTS TESTED: 95
COURSE: QF301**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** | **Average Grade** |
| Student identifies appropriate models for the time series under study | **0** | **11** | **84** | **9.42** |
| Student tests alternative models and selects best model | **8** | **13** | **74** | **8.47** |
| Student forecasts time series with selected model and uses forecast to solve a specific financial problem (i.e. design at least a trading strategy). | **0** | **26** | **69** | **8.63** |
| **Average Grade (Out of 10) =** | **8.84** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category***(Based on average score across all traits)* | **0** | **15** | **80** |

**COMMENTS:** Students explored different statistical learning techniques through R. This matched the sample code provided by the assigned textbooks and the code provided within the course. Difficulties with installing Keras (neural network package) in R caused difficulties in exploring that tool. Many students struggled to expand their analysis beyond simply forecasting time series (Train 3). Throughout the semester, the importance of testing alternative models (Trait 2) was emphasized which ultimately assisted in identifying appropriate models (Trait 1) as well.

**REMEDIAL ACTIONS:**

* Students can choose if they want to work with R or Python (especially for Neural Networks).
* Add further assignment problems earlier in the semester in which students need to use the forecasts to solve specific financial problems (beyond forecasting).
* Include open-ended homework problems for students to gain more experience in identifying appropriate models and testing alternative models.

# 7. Outcomes from Previous Assessments:

The following table shows the average scores on each goal objective.

|  |  |
| --- | --- |
|  | Objective 1Develop sound financial time series |
| Fall 2021 | 8.84 |

# 8. Close Loop Process – Continuous Improvement Record

Assurance of Learning

Assessment/Outcome Analysis

Close Loop Process - Continuous Improvement Record

**Program:** Bachelor of Science in Quantitative Finance

**Goal 3:** Students are able to develop and use financial models and technical systems from a perspective of a broad critical understanding of the financial system

**Goal Owner:** Zachary Feinstein

**Where Measured:** Students are assessed in the fall in the required course:

QF301

**How Measured:** Project is required by course owner and aggregate to obtain a total score.

**Closing the Loop: Actions taken on specific objectives**

|  |  |
| --- | --- |
| **Objective 1** | *Students will be able to write effectively.* |
| **When Assessed:** | *Fall 2021* |
| **Remedial****Action** | * Students can choose if they want to work with R or Python (especially for Neural Networks).
* Add further assignment problems earlier in the semester in which students need to use the forecasts to solve specific financial problems (beyond forecasting).
* Include open-ended homework problems for students to gain more experience in identifying appropriate models and testing alternative models.
 |
| **Outcome from previous assessment** |  |

**Appendix: Final Project used for Assessment**

**Introduction**

For your final project for the semester, you will work in small teams (of 4 people) to use machine learning to build a tool to do predictive analytics and portfolio optimization on financial data.

Broadly your projects will consist of three inter-related topics:

1. accessing and discussing applicable financial data;
2. selecting appropriate machine learning method(s); and
3. results and analysis.

***You will get the most out of the project if you interact with Professor Feinstein during this assignment, especially when planning a topic.***

**Important Dates**

|  |  |  |
| --- | --- | --- |
| **Milestone** | **Date** | **Deliverables** |
| Team Formation | 11/5 | Submit as text on Canvas. One per group. Include the names for the members of the team. |
| Project Proposal | 11/12 | Submit **pdf** on Canvas. One per group. |
| Final Report | 12/5 | Submit **pdf** on Canvas. One per group. |
| Project Presentation | 12/6 or 12/10 [in class] | Submit **pdf** of slides on Canvas. One per group. |

**Project Components**

**Data Collection and Discussion**

Download financial data from the database of your choice (e.g., Bloomberg, WRDS, *Yahoo Finance*, ...). You should spend time deciding on the appropriate data to analyze and whether it is sufficient for the method you will want to implement.

**Machine Learning Methods**

Given the data you have collected, choose machine learning method(s) to analyze your data. This can be as simple as a linear regression, but could also be a recurrent neural network (for instance). Give serious thought to your proposed method(s) as you will need to justify your choice(s).

**Results and Analysis**

Implement your methodology on your collected data in order to test the results. You may want to compare your chosen methodology to a simple baseline in order to determine performance. You should remark on whether your methodology appears suitable to answer the desired question; statistical analysis is *strongly* encouraged.

**Deliverables**

**Deliverable #1: Team Formation**

You will submit your choices for teams for projects. Teams should consist of **4 students**. If you have trouble forming a group of 4 for any reason (whether that means you are a single individual or have a partial group of 2 or 3 students), please submit that by the deadline. Professor Feinstein will then do his best to form groups from those that need assistance in doing so. Groups can be hybrid between sections, *but* if so all students in that group must be available in either section slot to allow for the scheduling of presentations.

**Deliverable #2: Project Proposal**

You will submit a formal proposal for your project. This should give as much details as possible about what specifically you will consider in your topic. As part of your proposal, you **must** provide details on teammate assignments to each task of your project. It is highly recommended that you provide a detailed timeline in the form of a Gantt chart detailing the activities necessary to complete your project, timelines for start and end dates of each task, and the aforementioned teammate assignments to each task.

**Deliverable #3: Final Report**

You will submit your final write-up, which should include all of the information detailed below. This should be presented in roughly the order given, but your write-up need not have corresponding sections or bullet points. The write-up should be about 6-10 double-spaced pages, Times New Roman 12pt font. This does not include any appendices (of, e.g., any additional R code) you may wish to include. This paper may be written in RMarkDown if desired. Any external resources used should have clear citations and a reference page at the end of your work. All group members should contribute to the analysis and write-up as detailed in your Project Proposal. The report should include an appendix describing the contributions of each team member. This report **must** be submitted in pdf format; your code may be requested if not clear in the document so please keep that available.

1. **Overview** of the problem statement.
2. Detailed description of the **data collected** and why it is appropriate for the problem being considered. Mention any data cleaning if required.
3. Detailed description of the **machine learning method(s)** and why it is appropriate for the problem being considered. If comparison to a *baseline* model is to be studied, provide the details of this methodology as well.
4. Describe the **results** obtained by your methodology on the data. Analyze these results to provide a recommendation.
5. **Next steps**: What do you recommend as a result of your analysis? Do you suggest attempting different algorithms or a larger test or more data? etc... What else could be done with the problem, but time did not permit?

**Deliverable #4: Project Presentation**

The final week of the semester is dedicated to group presentations. Each group will give a **10 minute presentations**. Each team member should present on their contributions to the work. An additional 1-2 minutes will be used for questions from Professor Feinstein as well as the audience. Slides must be uploaded to Canvas at least 30 minutes prior to class on Monday, December 6. If for some reason you or one of your teammates *needs* to attend remotely, please contact me as soon as possible to make arrangements.