Stevens Institute of Technology

School of Business

**AACSB  
ASSURANCE OF LEARNING**

**Bachelor of Science in Quantitative Finance**

**LEARNING GOAL # 4**

**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: Germán Creamer**

December 2017

**TABLE OF CONTENTS**

[1. INTRODUCTION: LEARNING GOAL #4 3](#_Toc506038516)

[2. LEARNING OBJECTIVES AND TRAITS 3](#_Toc506038517)

[3. RUBRICS 4](#_Toc506038518)

[4. ASSESSMENT PROCESS 5](#_Toc506038519)

[5. RESULTS OF LEARNING GOAL ASSESSMENT – INTRO 6](#_Toc506038520)

[6. RESULTS OF ASSESSMENT: Fall 2012 7](#_Toc506038521)

[7. RESULTS OF ASSESSMENT: Fall 2013 8](#_Toc506038522)

[8. RESULTS OF ASSESSMENT: Fall 2014 9](#_Toc506038523)

[9. RESULTS OF ASSESSMENT: Fall 2015 10](#_Toc506038524)

[10. RESULTS OF ASSESSMENT: Fall 2016 11](#_Toc506038525)

[11. RESULTS OF ASSESSMENT: Fall 2017 12](#_Toc506038526)

[12. OUTCOMES: BSB LEARNING GOAL # 4 AFTER ROUNDS OF ASSESSMENT ………………………………………………………………………………………...13](#_Toc506038527)

[13. CLOSE LOOP PROCESS – CONTINUOUS IMPROVEMENT RECORD 14](#_Toc506038528)

[APPENDIX A: ASSESSMENT EXERCISE 16](#_Toc506038529)

# 1. INTRODUCTION: LEARNING GOAL #4

**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 - 4: Objectives and Traits** |
| **QF 4** | **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 - 4: RUBRIC 1** |  |  |  |
| **QF 4** | **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.

# 6. RESULTS OF ASSESSMENT: Fall 2012

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 14   
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 | 3 | 11 | 8.93 |
| Student tests alternative models and selects best model | 3 | 3 | 8 | 6.79 |
| Student forecasts time series with selected model and uses forecast to solve a specific financial problem (i.e. design at least a trading strategy). | 3 | 7 | 4 | 5.36 |
| **Average Grade (Out of 10) =** | | | | **7.02** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **3** | **0** | **11** |

**COMMENTS:** Students explored different time series methods and also learnt SAS; however the book’s examples were given in R. This slowed down the learning process of certain students that spent too much time learning SAS instead of learning the theoretical concepts.

**REMEDIAL ACTIONS:**

- An important proportion of students participate in introductory sessions of R and SAS in the QF200s courses.

* Include a brief introduction of R and SAS at the beginning of the course.
* Organize the course around R.
* Students can choose if they work with R or SAS.

# 7. RESULTS OF ASSESSMENT: Fall 2013

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 17   
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 | 10 | 7 | 7.06 |
| Student tests alternative models and selects best model | 0 | 9 | 8 | 7.35 |
| 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 | 11 | 6 | 6.76 |
| **Average Grade (Out of 10) =** | | | | **7.06** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **0** | **5** | **12** |

**COMMENTS:**

Students concentrated on time series concepts using R as the main statistical program. Several examples with real data were used to illustrate theoretical concepts.

**REMEDIAL ACTIONS:**

- Include intermediate readings that facilitate the analytical as well as intuitive understanding of time series concepts.

# 8. RESULTS OF ASSESSMENT: Fall 2014

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 25   
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 | 14 | 11 | 7.20 |
| Student tests alternative models and selects best model | 0 | 19 | 6 | 6.20 |
| 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 | 10 | 15 | 8.00 |
| **Average Grade (Out of 10) =** | | | | **7.13** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **0** | **7** | **18** |

**COMMENTS:**

Students read additional chapter on main textbook about how to develop and analyze a main forecasting project. Few students had difficulty solving some advanced exercises.

**REMEDIAL ACTIONS:**

Develop on-class exercises that help students to improve their forecasting skills.

# 9. RESULTS OF ASSESSMENT: Fall 2015

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 27   
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 | 2 | 5 | 12 | 7.00 |
| Student tests alternative models and selects best model | 4 | 7 | 12 | 6.93 |
| 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 | 11 | 12 | 7.67 |
| **Average Grade (Out of 10) =** | | | | **7.2** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **2** | **10** | **15** |

**COMMENTS:**

Students tried several class exercises.

**REMEDIAL ACTIONS:**

Require that students develop their own models and do not only use automated procedures such as the R auto.arima function to select the best model.

# 10. RESULTS OF ASSESSMENT: Fall 2016

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 34   
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 | 2 | 17 | 15 | 6.91 |
| Student tests alternative models and selects best model | 2 | 17 | 15 | 6.91 |
| Student forecasts time series with selected model and uses forecast to solve a specific financial problem (i.e. design at least a trading strategy). | 2 | 14 | 18 | 7.35 |
| **Average Grade (Out of 10) =** | | | | **7.06** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **2** | **13** | **19** |

**COMMENTS:**

Students did not have the knowledge of time series models that they were supposed to have considering the previous courses in econometrics and introductory time series that they already took. This affected their performance this cycle.

**REMEDIAL ACTIONS:**

The course was modified to include basic topics as well as some advanced material. The following course will have a more advanced content of time series and machine learning methods.

# 11. RESULTS OF ASSESSMENT: Fall 2017

**LEARNING GOAL #4:***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.*

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**ASSESSMENT DATE:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 33   
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 | 26 | 7 | 6.45 |
| Student tests alternative models and selects best model | 4 | 22 | 7 | 5.79 |
| 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 | 27 | 6 | 9.05 |
| **Average Grade (Out of 10) =** | | | | **7.1** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **4** | **14** | **15** |

**COMMENTS:**

The course had more advanced material and incorporated a new section of machine learning. This affected the students’ performance this cycle.

**REMEDIAL ACTIONS:**

Students would have a stronger probability background as a new course will be offered in the following years. More practical exercises will be used to help the students learn how to use machine learning methods in finance.

# 12. RESULTS OF ASSESSMENT: Fall 2018

**LEARNING GOAL #4:***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:   
ASSESSOR: Germán Creamer  
NUMBER OF STUDENTS TESTED: 46   
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 | 26 | 0 | 20 | 6.52 |
| Student tests alternative models and selects best model | 19 | 3 | 24 | 6.48 |
| 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 | 0 | 46 | 8.96 |
| **Average Grade (Out of 10) =** | | | | **7.32** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | **3** | **15** | **28** |

**COMMENTS:**

The course switched to Python as the main programming language. It also incorporated more ML models and put less emphasis on time series models. However, some students struggled with Python as the programming of their previous time series course was R.

**REMEDIAL ACTIONS:**

The programming language may shift back to R, and the course will be divided between a time series and a machine learning section.

# 13. OUTCOMES: BSB LEARNING GOAL # 4 AFTER ROUNDS OF ASSESSMENT

Students were able to explore different time series methods on several economic and financial problems using the R programming language. They studied several applied financial time series concepts through different applied labs that helped them to prepare the final project.

The following table shows the average scores on each goal objective for the last 5 years.

|  |  |
| --- | --- |
|  | Objective 1  Develop sound financial time series |
| Fall 2012 | 7.02 |
| Fall 2013 | 7.06 |
| Fall 2014 | 7.13 |
| Fall 2015 | 7.2 |
| Fall 2016 | 7.06 |
| Fall 2017 | 7.10 |
| Fall 2018 | 7.32 |

# 14. 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 4:** 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:** German Creamer

**Where Measured:** Course embedded project in required course. **QF 301** Financial Time Series.

**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 develop sound financial time series based on major economic and financial trends and events.* |
| **When Assessed:** | *Fall 2018* |
| **Remedial Action** | *The programming language may shift back to R, and the course will be divided between a time series and a machine learning section.* |
| **Outcome from previous assessment:** | *The course had more advanced material and incorporated a new section of machine learning. This affected the students’ performance this cycle.* |
| **When Assessed:** | *Fall 2017* |
| **Remedial Action** | *Students would have a stronger probability background from previous courses and more practical machine learning exercises will be used.* |
| **Outcome from previous assessment:** | *Students did not have the knowledge of time series models that they were supposed to have.* |
| **When Assessed:** | *Fall 2016* |
| **Remedial Action** | *Course includes a combination of basic and advanced forecasting methods.* |
| **Outcome from previous assessment:** | *Students explored different models without only using the automatic solution as the default procedure.* |
| **When Assessed:** | *Fall 2015* |
| **Remedial Action** | *- Require that students develop their own models and do not only use automated procedures such as the R auto.arima function to select the best model.* |
| **Outcome from previous assessment:** | *-The course included several labs oriented to improve the students’ forecasting skills. Students learned to use automated procedures to select the best models, although some of the students only used these methods in their projects ignoring other analytical methods.* |
| **When Assessed:** | *Fall 2014* |
| **Remedial Action** | *- Develop on-class exercises that help students to improve their forecasting skills.* |
| **Outcome from previous assessment:** | *- Students read additional chapter on main textbook about how to develop and analyze a main forecasting project. This helped students to understand what was expected and improve their final project.* |
| **When Assessed:** | *Fall 2013* |
| **Remedial Action** | *- Include intermediate readings that facilitate the analytical as well as intuitive understanding of time series concepts.* |
| **Outcome from previous assessment:** | *- Students were able to explore different time series methods on several economic and financial problems using the R programming language. They studied several applied financial time series concepts through different applied labs that helped them to prepare the final project.* |
| **When Assessed:** | *Fall 2012* |
| **Remedial Action** | *-An important proportion of students participate in introductory sessions of R and SAS in the QF200s courses.*  *-Include a brief introduction of R and SAS at the beginning of the course.*  *-Organize the course around R.*  *-Students can choose if they work with R or SAS.* |

# APPENDIX A: ASSESSMENT EXERCISE

The main evaluation of this goal is based on the individual contribution to a final group project. The main objective of the project is to apply the theory of time series to analyze a financial problem using historical datasets. Students are expected to use most of the methodologies reviewed in class and present different forecasting scenarios with their financial recommendations.

The final report must include at least the following sections:

* Organization or area of application
* Problem
* Solution
* Results
* Lessons learned