Stevens Institute of Technology

School of Business

**AACSB  
ASSURANCE OF LEARNING**

**Master of Science in Financial Technology and Analytics**

**LEARNING GOAL #4**

**Students will be able to develop predictive forecasts using historical data.**

**Responsibility:** Dragos Bozdog

December 2023

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# INTRODUCTION: LEARNING GOAL #4

Goal: Students will be able to develop predictive forecasts using historical data.

Students will be expected to take various time series models and use them to develop predictive models. These students will be evaluated on their ability through their performance in FA542, with later reevaluations based on their performance later.

# LEARNING OBJECTIVES AND TRAITS

|  |  |
| --- | --- |
| Learning Goal 4: Students will be able to develop predictive forecasts using historical data. | |
| **Objective 1:** *Students will be able to calibrate models based on historical data* | |
| **Traits** |  |
| Trait 1: | Calibrate models based on ARMA models |
| Trait 2: | Calibrate models based on ARCH models (ARCH, GARCH, etc.) |
| **Objective 2:** *Students will be able to create a forecast using established parameters.* | |
| **Traits** |  |
| Trait 1: | Develop the mean forecast |
| Trait 2: | Develop the standard error of the forecast |

# RUBRICS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Objective 1** | *Students will be able to calibrate models based on historical data* | | | |
|  | **Trait** | **Poor** | **Good** | **Excellent** |
|  | **Value** | **0** | **8.5** | **10** |
| Trait 1: | Calibrate models based on ARMA models | Limited command of techniques used in this area | Good command of techniques used in this area | Strong command of techniques used in this area |
| Trait 2: | Calibrate models based on ARCH models (ARCH, GARCH, etc.) | Limited command of techniques used in this area | Good command of techniques used in this area | Strong command of techniques used in this area |
| **Objective 2** | *Students will be able to create a forecast using established parameters.* | | | |
|  | **Trait** | **Poor** | **Good** | **Excellent** |
|  | **Value** | **0** | **8.5** | **10** |
| Trait 1: | Develop the mean forecast | Limited command of techniques used in this area | Good command of techniques used in this area | Strong command of techniques used in this area |
| Trait 2: | Develop the standard error of the forecast | Limited command of techniques used in this area | Good command of techniques used in this area | Strong command of techniques used in this area |

**Criterion: Score below 7.49 is “below expectations”; between 7.5 and 9.49 is “meets expectations”; and greater than 9.5 is “exceeds expectations**



# ASSESSMENT PROCESS

|  |  |  |
| --- | --- | --- |
| **Where & when measured?** | **How measured?** | **Criterion** |
| Assessed in the spring or fall semester in FA542 Financial Time Series | Based on the students’ performance on assignments and exams in the class. | % of students get a grade of Meets expectations or better on the final assessment. |

# RESULTS OF LEARNING GOAL ASSESSMENT - INTRODUCTION

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

**Explanation of Direct Measurements**

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”.

The grading sheets for each team 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 and 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**

Indirectly assessed for some students through mock interviews. They are also assessed indirectly through competitions our students participate in. For example, every spring the Hanlon Center organizes the Algorithmic Trading Competition and many students participate in it. We further assess these goals through alumni surveys, advisory council feedback, employer input, and career fair feedbacks.

# RESULTS OF ASSESSMENT: Spring 2022

**LEARNING GOAL #1:**   
*Students will be able to develop predictive forecasts using historical data.*

**LEARNING OBJECTIVE #1:**   
*Students will be able to calibrate models based on historical data*

**ASSESSMENT DATE: May 16, 2022**

**ASSESSOR: Zachary Feinstein**

**NUMBER OF STUDENTS: 35  
COURSE: FA542**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Number of Students** | | |  |
| **Learning Goal Traits** | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** | **Average Grade** |
| 1: Calibrate models based on ARMA models | 2 | 10 | 23 | 8.00 |
| 2: Calibrate models based on ARCH models (ARCH, GARCH, etc.) | 2 | 3 | 30 | 9.00 |
| **Average Grade (Out of 10) =** | | | | 8.50 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | 1 | 11 | 23 |

**COMMENTS:** Students explored different time series models using data to calibrate those models. This was accomplished using R programming on financial market data. Students struggled with multivariate modeling when they had to model two series simultaneously; this was considered with vector autoregressive models (Trait 1). Using R packages and following sample code from the textbook and provided within the course, students excelled with ARCH models (Trait 2).

**REMEDIAL ACTIONS:**

* Provide additional sample code for multivariate models so that students understand the distinctions between multivariate and univariate models.
* Include consistent data set throughout the semester that students can use to compare models as we progress through the course.

**LEARNING OBJECTIVE #2:**   
*Students will be able to create a forecast using established parameters.*

**ASSESSMENT DATE: May 16, 2022**

**ASSESSOR: Zachary Feinstein**

**NUMBER OF STUDENTS: 35**

**COURSE: FA542**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Number of Students** | | |  |
| **Learning Goal Traits** | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** | **Average Grade** |
| 1: Develop the mean forecast | 4 | 12 | 19 | 7.14 |
| 2: Develop the standard error of the forecast | 9 | 14 | 12 | 5.43 |
| **Average Grade (Out of 10) =** | | | | 6.29 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | 5 | 18 | 12 |

**COMMENTS:** Students utilized different modeling techniques for forecasting time series. For linear time series models, both theoretical and Monte Carlo approaches were considered. For nonlinear time series models, Monte Carlo approaches were emphasized. Students performed well with the theoretical mean forecast for linear time series models but had more difficulty (but still met expectations) with Monte Carlo approaches (Trait 1). There were significantly more difficulties for the standard error of the forecast, especially for multi-step ahead forecasting (Trait 2).

**REMEDIAL ACTIONS:**

* Provide more sample code for Monte Carlo simulations for forecasting (mean and standard error).
* Emphasize formulas for multi-step ahead forecasting in linear models early in the semester. Currently this was only provided at the end of a lecture and may have been overlooked by students on review.

# RESULTS OF ASSESSMENT: Fall 2023

**LEARNING GOAL #1:**   
*Students will be able to develop predictive forecasts using historical data.*

**LEARNING OBJECTIVE #1:**   
*Students will be able to calibrate models based on historical data*

**ASSESSMENT DATE: Fall 2023**

**ASSESSOR: Dragos Bozdog**

**NUMBER OF STUDENTS: 24  
COURSE: FA542**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Number of Students** | | |  |
| **Learning Goal Traits** | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** | **Average Grade** |
| 1: Calibrate models based on ARMA models | 3 | 17 | 4 | 8.21 |
| 2: Calibrate models based on ARCH models (ARCH, GARCH, etc.) | 2 | 16 | 6 | 8.50 |
| **Average Grade (Out of 10) =** | | | | 8.36 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | 2 | 17 | 5 |
| **Students meeting or exceeding expectations:** | 22 | | |

**COMMENTS:** The overall results indicate that most the students are meeting or exceeding the expectations.

**REMEDIAL ACTIONS:**

* Provide additional numerical examples and sample code for ARMA and ARCH models.

**LEARNING OBJECTIVE #2:**   
*Students will be able to create a forecast using established parameters.*

**ASSESSMENT DATE: Fall 2023**

**ASSESSOR: Dragos Bozdog**

**NUMBER OF STUDENTS: 24**

**COURSE: FA542**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Number of Students** | | |  |
| **Learning Goal Traits** | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** | **Average Grade** |
| 1: Develop the mean forecast | 5 | 13 | 6 | 8.53 |
| 2: Develop the standard error of the forecast | 1 | 4 | 19 | 9.58 |
| **Average Grade (Out of 10) =** | | | | 9.06 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Not Meet Expectations** | **Meets Expectations** | **Exceeds Expectations** |
| **Total Students by Category**  *(Based on average score across all traits)* | 0 | 18 | 6 |
| **Students meeting or exceeding expectations:** | 24 | | |

**COMMENTS:** The overall results indicate that most of the students are meeting or exceeding the expectations.

**REMEDIAL ACTIONS:**

* Provide more examples for multi-step ahead forecasting in linear models.

# OUTCOMES: MFTA LEARNING GOAL #4 AFTER ROUNDS OF ASSESMENTS

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

|  |  |  |
| --- | --- | --- |
|  | Objective 1  *Students will be able to calibrate models based on historical data* | Objective 2  *Students will be able to create a forecast using established parameters.* |
| Spring 2022 | 8.50 | 6.29 |
| Fall 2023 | 8.36 | 9.06 |

# CLOSE LOOP PROCESS – CONTINUOUS IMPROVEMENT RECORD

Assurance of Learning

Assessment/Outcome Analysis

Close Loop Process - Continuous Improvement Record

**Program:** Master of Science in Financial Technology and Analytics

**Goal 4:** Students will be able to develop predictive forecasts using historical data.

**Goal Owner:** Dragos Bozdog

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

FA542 Time Series with Applications to Finance

**How Measured:** Based on student performance on the assignments in the course.

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

|  |  |
| --- | --- |
| When Assessed: | Fall 2023 |
| Remedial Action | * Provide additional numerical examples and sample code for ARMA and ARCH models. * Provide more examples for multi-step ahead forecasting in linear models. |
| Outcome from Previous Assessment | * The performance on the objective 2 increased and most students are meeting expectations |
| When Assessed: | Spring 2022 |
| Remedial Action | * Provide additional sample code for multivariate models so that students understand the distinctions between multivariate and univariate models. * Include consistent data set throughout the semester that students can use to compare models as we progress through the course. * Provide more sample code for Monte Carlo simulations for forecasting (mean and standard error). * Emphasize formulas for multi-step ahead forecasting in linear models early in the semester. Currently this was only provided at the end of a lecture and may have been overlooked by students on review. |
| Outcome from Previous Assessment | * N/A |