Stevens Institute of Technology

School of Business

**AACSB
ASSURANCE OF LEARNING**

**Master of Science in**

**Business Intelligence
and Analytics**

 **(BI&A)**

**LEARNING GOAL # 5**

**Students can find and deploy business solutions based on analyses of large and heterogeneous data sets. [Creamer]**

**Responsibility: Germán Creamer**

March 2019

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# 1. INTRODUCTION: LEARNING GOAL BI&A #5

*Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.*

This goal is assessed in BIA 656 Statistical Learning and Analytics – a required course in the BI&A curriculum.

The aim of this learning goal is to assess students ability to work successfully on meaningful, hard problems that approach the size and complexity of a real business problem.

# 2. LEARNING OBJECTIVES AND TRAITS

|  |  |
| --- | --- |
|   | **BI&A Learning Goal - 5: Objectives and Traits** |
| **BIA 5** | Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.  |
| **Learning Objectives** |  |
| **Objective 1:** | Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets |
| **Traits** |  |
| Trait 1: | Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets |
| Trait 2: | Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  |
| Trait 3: | Student adapts and/or applies time series and/or machine learning methods to analyze and identify solutions for business problems |

# 3. RUBRICS

**Objective 1:** Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **BI&A LEARNING GOAL - 5: RUBRIC 1** |   |   |   |
| **BIA 5** | Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.  |
| **Objective 1** | Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets |
|   | **Trait** | **Poor** | **Good** | **Excellent** |
|   | **Value** | **0** | **5** | **10** |
| Trait 1: | Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | Does not identify any time series method | Identifies one time series method | Identifies one or more appropriate time series methods |
| Trait 2: | Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | Does not identify any machine learning method | Identifies one machine learning method | Identifies one or more appropriate machine learning methods |
| Trait 3: | Student adapts and/or applies time series and/or machine learning methods to analyze and identify solutions for business problems | Does not apply any method | Adapts and/or applies a method | Adapts and/or applies at least one relevant method |

**Criterion: Does not meet expectations: 0 – 14; Meets: 15-19; Exceeds: 20-30**

# 4. ASSESSMENT PROCESS

|  |  |  |
| --- | --- | --- |
| **Where and when measured?** | **How measured?** | **Criterion** |
| Course-embedded assignment and project in required course *BIA 656 Statistical Learning & Analytics. A*ssessed in the fall and spring (if class is offered) semester each year. | Description: assignments and project are graded by course owners and aggregated to obtain a total score.Sampling: All students in the BI&A 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 - INTRODUCTION

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 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.

# 6. RESULTS OF ASSESSMENT: Fall 2012

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 7 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 7 | 0 | 5.00 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 7 | 0 | 5.00 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 6 | 1 | 5.71 |
| **Average Grade (Maximum 10)** | **5.24** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **6** | **1** |

**COMMENTS:** Students were able to explore both time series and machine learning methods to large business databases; however they showed some confusion separating the computational aspects from the analytical aspects of these methods.

**REMEDIAL ACTIONS:**

* Separate the programming sessions from the analytical sessions, so that the methods are clearly understood independently of its programming aspects.
* Students participate in a programming bootcamp before the course starts.

# 7. RESULTS OF ASSESSMENT: Spring 2013

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 13 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 12 | 1 | 5.38 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 11 | 2 | 5.77 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 10 | 3 | 6.15 |
| **Average Grade (Maximum 10)** | **5.77** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **7** | **6** |

**COMMENTS:**

A large variety of methods were introduced to the students, however some of them indicated that they may have preferred a deeper exploration of fewer methods.

**REMEDIAL ACTIONS:**

* Use R and Weka as statistical and machine learning programs that review all the algorithms explored in the class.
* Focus the review of the main methods to their most important elements and skip unnecessary technical details.

# 8. RESULTS OF ASSESSMENT: Fall 2013

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 11 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 11 | 0 | 5.00 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 10 | 1 | 5.45 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 6 | 5 | 7.27 |
| **Average Grade (Maximum 10)** | **5.91** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **6** | **5** |

**COMMENTS:**

The group indicated that the content of the course was appropriate for two different courses: one for time series analysis and another one for machine learning methods.

**REMEDIAL ACTIONS:**

* The course should be mostly focused on statistical learning methods.
* Dedicate several sessions to the interpretation of the results and applications to business problems.

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# 9. RESULTS OF ASSESSMENT: Spring 2014

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 11 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 10 | 0 | 5.00 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 6 | 4 | 7.00 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 6 | 4 | 7.00 |
| **Average Grade (Maximum 10)** | **6.33** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **4** | **6** |

**COMMENTS:**

* The course put more emphasis on statistical learning methods and on business applications.
* The group indicated that the programming homeworks using Python were too demanding.

**REMEDIAL ACTIONS:**

* Align the homeworks with content covered in class and in the lab.
* Review Python during the lab sessions.

# 10. RESULTS OF ASSESSMENT: Fall 2014

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 26 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 13 | 13 | 7.50 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 20 | 6 | 6.15 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 13 | 13 | 7.50 |
| **Average Grade (Maximum 10)** | **7.05** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **13** | **13** |

**COMMENTS:**

* The course included several Python training sessions aligned with the content of the course.
* Several students indicated that wanted to have more time for the Bayesian methods.

**REMEDIAL ACTIONS:**

* Emphasize the review of Bayesian models and reduce time spent on basic models.

# 11. RESULTS OF ASSESSMENT: Fall 2016

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 11 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 5 | 5 | 7.09 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 6 | 5 | 7.27 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 5 | 6 | 7.73 |
| **Average Grade (Maximum 10)** | **7.36** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **1** | **4** | **6** |

**COMMENTS:**

* The course included a strong theoretical foundation section to improve the preparation of students for job interviews.

**REMEDIAL ACTIONS:**

* Expand the theoretical review to all the fundamental models.

# 12. RESULTS OF ASSESSMENT: Fall 2017

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Germán Creamer**

**NO. OF STUDENTS TESTED: 33 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 33 | 0 | 5.00 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 8 | 25 | 8.91 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 31 | 2 | 8.31 |
| **Average Grade (Maximum 10)** | **7.41** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **1** | **7** | **25** |

**COMMENTS:**

* The course put emphasis on the alignment of the project with the networking event of the school. In consequence, students could maximize their chances to get jobs as they network with managers of companies that recruit at Stevens.

**REMEDIAL ACTIONS:**

* Incorporate direct applications of machine learning models to business problems.

# 13. RESULTS OF ASSESSMENT: Fall 2018

**LEARNING GOAL # 5: Students can find and deploy business solutions based on analyses of large and heterogeneous data sets.**

**LEARNING OBJECTIVE # 1: Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.**

**ASSESSMENT DATE: ASSESSOR: Dragos Bozdog**

**NO. OF STUDENTS TESTED: 13 COURSE: BIA 656**

|  |  |  |
| --- | --- | --- |
|  | **Number of Students** |  |
| **Learning Goal Traits** | **Not Meet Expectat-ions** | **Meet Expectat-ions** | **Exceed Expectat-ions** | **Avg. Grade on Trait** |
| Student identifies and understands time series methods involved in the analysis of large and heterogeneous data sets | 0 | 11 | 2 | 7.79 |
| Student identifies and understands machine learning methods involved in the analysis of large and heterogeneous data sets  | 0 | 5 | 8 | 8.25 |
| Student adapts and/or applies optimization, time series and/or machine learning methods to analyze and identify solutions for business problems | 0 | 3 | 10 | 9.01 |
| **Average Grade (Maximum 10)** | **8.35** |

Does not meet expectations 0; meets 5; exceeds 10

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Students by Category**(Based on Average score across all traits) | **Not meet expectations** | **Meet Expectations** | **Exceed Expectations** |
|  | **0** | **5** | **8** |

**COMMENTS:**

* The course strengthen the theoretical foundation and increase focus on relevant machine learning models to business problems to be featured in the networking and poster event of the school.

**REMEDIAL ACTIONS:**

* Enrich the quality of the project report analysis and the poster for networking event.

# 14. OUTCOMES: BIA LEARNING GOAL # 5 AFTER ROUNDS OF ASSESSMENT

**After Seventh Round Review Fall 2018**

The course strengthen the theoretical foundation and increase focus on relevant machine learning models to business problems to be featured in the networking and poster event of the school.

**After Sixth Round Review Fall 2017**

The course put emphasis on the alignment of the project with the networking event of the school.

**After Fifth Round Review Fall 2016**

The course included a strong theoretical foundation section to improve the preparation of students for job interviews.

**After Fourth Round Review Fall 2014**

The course included several Python training sessions aligned with the content of the course.

**After Third Round Review Spring 2014**

The course put more emphasis on statistical learning methods and on business applications.

**After Second Round Review Fall 2013**

Classes were mostly oriented to the main concepts of the algorithms and lab helped to explore their application to particular problems.

**After First Round Review Spring 2013**

Only few students participated in the bootcamp, however students made a real effort to solve by themselves several programming exercises. As a result, they were able to learn some specific procedures of SAS and R that are relevant for the area of Business Intelligence. The group studied deeper several analytical topics as it spent less time than the previous semester debugging programs and solving computational problems

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

|  |  |
| --- | --- |
|  | Objective 1Use analytical methods |
| Fall 2012 | 5.24 |
| Spring 2013 | 5.77 |
| Fall 2013 | 5.91 |
| Spring 2014 | 6.33 |
| Fall 2014 | 7.05 |
| Fall 2016 | 7.36 |
| Fall 2017 | 7.41 |
| Fall 2018 | 8.35 |

# 15. CLOSE LOOP PROCESS – CONTINUOUS IMPROVEMENT RECORD

**Assurance of Learning**

**Assessment/Outcome Analysis**

**Close Loop Process - Continuous Improvement Record**

**Program:** Master of Science in Business Intelligence & Analytics

**Goal 5:** Students can solve, communicate and deploy business solutions based on analyses of large and heterogeneous data sets.

**Goal Owner:** Germán Creamer

**Where Measured:** Course-embedded assignment and project in required course **BIA 656** Statistical Learning & Analytics. Assessed in the fall and spring (if class is offered) semester each year.

**How Measured:** Description: assignments and project are graded by course owners and aggregated to obtain a total score.

Sampling: All students in the BI&A program are assessed.

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

|  |  |
| --- | --- |
| **Objective 1** | *Students use analytical methods to find solutions for business problems that involve large and heterogeneous data sets.* |
| **When Assessed:** | *Fall 2018:* |
| **Remedial Action** | *- Enrich the quality of the project report analysis and the poster for networking event.* |
| **Outcome from previous assessment:** | *- The course incorporated relevant projects related to machine learning for business problems.* |
| **When Assessed:** | *Fall 2017:* |
| **Remedial Action** | *- Incorporate direct applications of machine learning models to business problems.* |
| **Outcome from previous assessment:** | *- The course included a strong theoretical foundation section to improve the preparation of students for job interviews.* |
| **When Assessed:** | *Fall 2016:* |
| **Remedial Action** | *-Expand the theoretical review to the main models explored in this course.* |
| **Outcome from previous assessment:** | *- Several students indicated that wanted to have more time for the Bayesian methods.* |
| **When Assessed:** | *Fall 2014:* |
| **Remedial Action** | *-Emphasize the review of Bayesian models and reduce time spent on basic models.* |
| **Outcome from previous assessment:** | * *The course put more emphasis on statistical learning methods and on business applications.*
* *The group indicated that the programming homeworks using Python were too demanding.*
 |
| **When Assessed:** | *Spring 2014* |
| **Remedial Action** | *-Align the homeworks with content covered in class and in the lab.-Review Python during the lab sessions.* |
| **Outcome from previous assessment:** | *The course put more emphasis on statistical learning methods and on business applications.* |
| **When Assessed:** | *Fall 2013* |
| **Remedial Action** | *-The course should be mostly focused on statistical learning methods.**-Dedicate several sessions to the interpretation of the results and applications to business problems.* |
| **Outcome from previous assessment:** | *Classes were mostly oriented to the main concepts of the algorithms and lab helped to explore their application to particular problems.*  |
| **When Assessed:** | *Spring 2013* |
| **Remedial Action** | *-Use R and Weka as statistical and machine learning programs that review all the algorithms explored in the class.**-Focus the review of the main methods to their most important elements and skip unnecessary technical details.* |
| **Outcome from previous assessment:** | *Only few students participated in the bootcamp, however students made a real effort to solve by themselves several programming exercises. As a result, they were able to learn some specific procedures of SAS and R that are relevant for the area of Business Intelligence.**The group studied deeper several analytical topics as it spent less time than the previous semester debugging programs and solving computational problems.*  |
| **When Assessed:** | *Fall 2012* |
| **Remedial Action** | *Separate the programming sessions from the analytical sessions, so that the methods are clearly understood independently of its programming aspects.**-Students participate in a programming bootcamp before the course starts.* |

# APPENDIX A

**Assessment Exercise: Final Project**

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 time series or machine learning algorithms to analyze a business problem using historical datasets. Students are expected to use methods reviewed in class and present different forecasting scenarios with their recommendations.

The final report includes the following sections:

* Introduction:
	+ Domain, organization or area of application
	+ Problem
* Methodology: solution proposed
* Results
* Conclusions: Lessons learned and future research.