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| For Academic Affairs and Research Use Only |
| Proposal Number | SM02 |
| CIP Code:  |  |
| Degree Code: |  |

**New or Modified Course Proposal Form**

**[X] Undergraduate Curriculum Council**

**[ ] Graduate Council**

|  |
| --- |
| **[X]New Course, [ ]Experimental Course (1-time offering), or [ ]Modified Course (Check one box)** |

Signed paper copies of proposals submitted for consideration are no longer required. Please type approver name and enter date of approval.

|  |  |
| --- | --- |
|  Hong Zhou 2/9/2022**Department Curriculum Committee Chair** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…**COPE Chair (if applicable)** |
| Amanda Lambertus 2/11/2022**Department Chair** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…**Head of Unit (if applicable)**   |
| John Hershberger 2/21/2022 Enter date…**College Curriculum Committee Chair** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…**Undergraduate Curriculum Council Chair** |
| Mary Elizabeth Spence 2/23/2022**Office of Assessment (new courses only)** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…**Graduate Curriculum Committee Chair** |
| 3/1/2022**Lynn Boyd College Dean** | Alan Utter 3/14/2022**Vice Chancellor for Academic Affairs** |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…**General Education Committee Chair (if applicable)**   |  |

1. **Contact Person (Name, Email Address, Phone Number)**

Mohamed Milad, mmilad@astate.edu Mathematics & Statistics Dept. (870) 972-3090

1. **Proposed starting term and Bulletin year for new course or modification to take effect**

**Fall 2022**

**Instructions:**

*Please complete all sections unless otherwise noted. For course modifications, sections with a “Modification requested?” prompt need not be completed if the answer is “No.”*

|  |  |  |
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|  | **Current (Course Modifications Only)** | **Proposed (New or Modified)** *(Indicate “N/A” if no modification)* |
| **Prefix** |  | **STAT** |
| **Number\*** |  | **4113** |
| **Title** |  | Statistical Machine Learning |
| **Description\*\*** |  | Statistical machine learning, focusing on classification and regression. Topics include classification, linear discriminant analysis, supervised and unsupervised learning, model selection, regularization, regression and classification trees, principal component analysis and clustering. The methods are applied to real data. Prerequisite: STAT 3243, Fall.  |

 ***\**** (Confirm with the Registrar’s Office that number chosen has not been used before and is available for use. For variable credit courses, indicate variable range. *Proposed number for experimental course is 9*.)

\*\*Forty words or fewer as it should appear in the Bulletin.

1. **Proposed prerequisites and major restrictions** **[Modification requested? [Yes/No]** No

(Indicate all prerequisites. If this course is restricted to a specific major, which major. If a student does not have the prerequisites or does not have the appropriate major, the student will not be allowed to register).

1. YES Are there any prerequisites?

STAT 3243 (Regression Analysis and ANOVA)

* 1. Why or why not?

The course will provide an overview to Statistical Machine Learning, as well as its fundamental models and techniques. The goal of the course is to give students a thorough understanding of how Statistical Machine Learning methods function and how statistical models may be applied to real world problems. Foundational knowledge from STAT 3243 (Regression Analysis and ANOVA) is required for successful completion of this course.

1. NO Is this course restricted to a specific major?
	1. If yes, which major? Enter text...
2. **Proposed course frequency [Modification requested? Yes/No]**

(e.g. Fall, Spring, Summer; if irregularly offered, please indicate, “irregular.”) *Not applicable to Graduate courses.*

Fall.

1. **Proposed course type [Modification requested? Yes/No]**

Will this course be lecture only, lab only, lecture and lab, activity (e.g., physical education), dissertation/thesis, capstone, independent study, internship/practicum, seminar, special topics, or studio? Please choose one.

Lecture

1. **Proposed grade type [Modification requested? Yes/No]**

What is the grade type (i.e. standard letter, credit/no credit, pass/fail, no grade, developmental, or other [please elaborate])

Standard Letter

1. No Is this course dual-listed (undergraduate/graduate)?
2. No Is this course cross-listed?

*(If it is, all course entries must be identical including course descriptions. Submit appropriate documentation for requested changes. It is important to check the course description of an existing course when adding a new cross-listed course.)*

**a.** – If yes, please list the prefix and course number of the cross-listed course.

 Enter text...

 **b.** – **Yes / No** Can the cross-listed course be used to satisfy the prerequisite or degree requirements this course satisfies?  Enter text...

1. No Is this course in support of a new program?

a. If yes, what program?

 Enter text...

1. No Will this course be a one-to-one equivalent to a deleted course or previous version of this course (please check with the Registrar if unsure)?

a. If yes, which course?

Enter text...

**Course Details**

1. **Proposed outline** **[Modification requested? Yes/No]**

(The course outline should be topical by weeks and should be sufficient in detail to allow for judgment of the content of the course.)

**STAT 4113 Introduction to Statistical Machine Learning – Course Outline**

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| --- | --- |
| **Week** | **Category** |
| 1 | Introduction and statistical learning |
| 2-3 | Linear regression |
| 4-5 | Classification via logistic regression |
| 6 | Resampling methods |
| 7-9 | Model selection, regularization (ridge regression and LASSO) |
| 10-11 | Regression and classification trees |
| 12-13 | Supervised and unsupervised learning (Unsupervised learning analyzes and clusters unlabeled data sets using machine learning methods (for example K-mean clustering). These algorithms find hidden patterns in data without human action (thus the term "unsupervised").The concepts of clustering, association, and dimensionality reduction will be covered in this course.) |
| 14-15 | Principal component analysis  |
| 15 and Finals Week | Present course project |

1. **Proposed special features** **[Modification requested? Yes/No]**

(e.g. labs, exhibits, site visitations, etc.)

Class will take place in CSM 203, CSM 216, or CSM 217, all of which are computer labs.

1. **Department staffing and classroom/lab resources**

**Full time faculty/instructors**

1. Will this require additional faculty, supplies, etc.?

 No

1. **Yes / No** Does this course require course fees? No

 *If yes: please attach the New Program Tuition and Fees form, which is available from the UCC website.*

**Justification**

**Modification Justification (Course Modifications Only)**

1. Justification for Modification(s)

NA

**New Course Justification (New Courses Only)**

1. Justification for course. Must include:

 a. Academic rationale and goals for the course (skills or level of knowledge students can be expected to attain)

After taking this course the students will be able to: (1) understand the different subfields statistical machine learning, such as supervised and unsupervised learning and be familiar with essential algorithms from each subfield of machine learning. (2) Be able to identify whether statistical machine learning is appropriate for solving a given problem task and which class of algorithms is best suited for real-world problem solving. (3) Use statistical machine learning theory to combine multiple machine learning models via ensemble methods. (4) Learn about best-practices for statistical model selection and evaluation as well as algorithm comparisons including suitable statistical hypothesis tests. Statistical Machine Learning will provide the opportunities to gain fundamental knowledge in this field to the students who wants to pursue their further studies in Data Science and Machine Learning. Since machine learning is a booming field now, it will prepare students find jobs in industry.

b. How does the course fit with the mission of the department? If course is mandated by an accrediting or certifying agency, include the directive.

This course fits in well with our department’s mission of providing a quality education to students, graduates, undergraduates in variety majors and prepare students for a variety of future endeavors and careers in business, industry, government, research, and academia. This course will require students to choose and apply appropriate techniques to address research questions and hypotheses and communicate results clearly and effectively.

c. Student population served.

Juniors and seniors

d. Rationale for the level of the course (lower, upper, or graduate).

Juniors and seniors students can handle the level of difficulty of this course, provided they have successfully completed STAT 3243 (Regression Analysis and ANOVA).

**Assessment**

**Assessment Plan Modifications (Course Modifications Only)**

1. **Yes / No** Do the proposed modifications result in a change to the assessment plan?

 *If yes, please complete the Assessment section of the proposal*

**Relationship with Current Program-Level Assessment Process (Course modifications skip this section unless the answer to #18 is “Yes”)**

1. What is/are the intended program-level learning outcome/s for students enrolled in this course? Where will this course fit into an already existing program assessment process?

This course will serve as a junior/senior hour elective options for the B.S in Mathematics. It will not be a required course in the BS Math program at this time. However, it will also satisfy elective requirements for the undergraduate certificate in Statistics.

1. Considering the indicated program-level learning outcome/s (from question #19), please fill out the following table to show how and where this course fits into the program’s continuous improvement assessment process.

The course is not a requirement of the BS program, but students that enroll in the course will be satisfying the following program outcomes.

*For further assistance, please see the ‘Expanded Instructions’ document available on the UCC - Forms website for guidance, or contact the Office of Assessment at 870-972-2989.*

 *(Repeat if this new course will support additional program-level outcomes)*

|  |  |
| --- | --- |
| **Program-Level Outcome 1 (from question #19)** | Students will demonstrate sufficient mathematical and statistical knowledge to model or to apply their mathematical and statistical knowledge to a career related to data sciences. |
| Assessment Measure | Graded assignments (e.g., homework and projects) and exams will be used as the direct measureExit survey of the program is the indirect measure |
| Assessment Timetable | Data collected and reviewed every fall semester |
| Who is responsible for assessing and reporting on the results? | Program Director |
| **Program-Level Outcome 2 (from question #19)** | Students should be able to think analytically to decipher problems, solve them, interpret their solutions, and frame generalizations. They will read and construct mathematical and statistical arguments and proofs to support their thinking. |
| Assessment Measure | Graded assignments (e.g., homework and projects) and exams will be used as the direct measureExit survey of the program is the indirect measure. |
| Assessment Timetable | Data collected and reviewed every fall semester |
| Who is responsible for assessing and reporting on the results? | Program Director |
| **Program-Level Outcome 3 (from question #19)** | Students will formulate, represent, analyze, and interpret mathematical and statistical models derived from real-world contexts or mathematical and statistical problems. |
| Assessment Measure | Graded assignments (e.g., homework and projects) and exams will be used as the direct measureExit survey of the program is the indirect measure |
| Assessment Timetable | Data collected and reviewed every fall semester |
| Who is responsible for assessing and reporting on the results? | Program Director |

 **Course-Level Outcomes**

1. What are the course-level outcomes for students enrolled in this course and the associated assessment measures?

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| **Outcome 1** | Students will be able to identify whether statistical machine learning is appropriate for solving a given problem task and which class of algorithms is best suited for real-world problems. |
| Which learning activities are responsible for this outcome? | Assigned readings, lecture, lab assignments using Python or R, and activities with data sets, examples |
| Assessment Measure  | 2-3 exams and final project over the course of the semester. |
| **Outcome 2** | Students will have an in-depth understanding of principles and theory of statistical machine learning, which will guide them in the proper application of these methods to real world problems |
| Which learning activities are responsible for this outcome? | Assigned readings, lecture, lab assignments using Python or R, and activities with data sets, examples |
| Assessment Measure  | 2-3 exams and final project over the course of the semester |
| **Outcome 3** | Students will be able to implement the algorithms in the course using Python or R. |
| Which learning activities are responsible for this outcome? | Assigned readings, lecture, lab assignments using Python or R, and activities with data sets, examples |
| Assessment Measure  | 2-3 exams and final project over the course of the semester |

**Bulletin Changes**

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| **Instructions**  |
| **Please visit** [**http://www.astate.edu/a/registrar/students/bulletins/index.dot**](http://www.astate.edu/a/registrar/students/bulletins/index.dot) **and select the most recent version of the bulletin. Copy and paste all bulletin pages this proposal affects below. Please include a before (with changed areas highlighted) and after of all affected sections.** **\*Please note: Courses are often listed in multiple sections of the bulletin. To ensure that all affected sections have been located, please search the bulletin (ctrl+F) for the appropriate courses before submission of this form.**  |

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Bulletin changes (Before).

**STAT 3233. Applied Statistics I** For students in a variety of disciplines including the sciences, allied health fields, and education. Descriptive statistics for quantitative and qualitative data, normal distributions, correlation, linear regression, sample surveys, randomized com- parative experiments, sampling distributions, estimation and hypothesis testing for means and proportions. Prerequisite, MATH 1023 or equivalent. Fall, Spring, Summer.

**STAT 3243. Regression Analysis and Analysis of Variance (ANOVA)** Theory and practice of regression analysis and ANOVA. Introduction of simple and multiple linear regression, inferences about model parameters, regression diagnostics, variable selection, and model adequacy check- ing and regression approaches to ANOVA. Prerequisite, STAT 3233. Spring.

Bulletin changes (After).

**STAT 3233. Applied Statistics I** For students in a variety of disciplines including the sciences, allied health fields, and education. Descriptive statistics for quantitative and qualitative data, normal distributions, correlation, linear regression, sample surveys, randomized com­parative experiments, sampling distributions, estimation and hypothesis testing for means and proportions. Prerequisite, MATH 1023 or equivalent. Fall, Spring, Summer.

**STAT 3243. Regression Analysis and Analysis of Variance (ANOVA)** Theory and practice of regression analysis and ANOVA. Introduction of simple and multiple linear regression, inferences about model parameters, regression diagnostics, variable selection, and model adequacy check­ing and regression approaches to ANOVA. Prerequisite, STAT 3233. Spring.

**STAT 4113. Statistical Machine Learning** Statistical machine learning, focusing on classification and regression. Topics include classification, linear discriminant analysis, supervised and unsupervised learning, model selection, regularization, regression and classification trees, principal component analysis and clustering. The methods are applied to real data. Prerequisite: STAT 3243, Fall.

Page 441 in the undergraduate bulletin

Before:

**Major in Mathematics**

**Bachelor of Science**

A complete 8-semester degree plan is available at https://www.astate.edu/info/academics/degrees/

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| **University Requirements:**  |  |
| See University General Requirements for Baccalaureate degrees (p. 44)  |  |
| **First Year Making Connections Course:**  | **Sem. Hrs.**  |
| MATH 1093, Making Connections - Mathematics  | **3**  |
| **General Education Requirements:**  | **Sem. Hrs.**  |
| See General Education Curriculum for Baccalaureate degrees (p. 84) **Students with this major must take the following:** *MATH 2204, Calculus I* *PHYS 2034, University Physics I* *Twelve hours in Social Sciences (Required Departmental Gen. Ed. Option), including one of the following:* *ANTH 2233, Introduction to Cultural Anthropology* *GEOG 2613, Introduction to Geography* *HIST 1013, World History to 1500* *HIST 1023, World History since 1500*  | **36**  |
| **Major Requirements:**  | **Sem. Hrs.**  |
| CS 2114, Structured Programming  | 4  |
| MATH 2183, Discrete Structures  | 3  |
| MATH 2214, Calculus II  | 4  |
| MATH 3254, Calculus III  | 4  |
| MATH 3243, Linear Algebra  | 3  |
| MATH 3303, Modern Algebra I  | 3  |
| MATH 4403, Differential Equations  | 3  |
| MATH 4553, Advanced Calculus I  | 3  |
| PHYS 2044, University Physics II  | 4  |
| STAT 3233, Applied Statistics I  | 3  |
| STAT 4453, Probability and Statistics I  | 3  |
| **Select one of the following:**

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| --- |
| MATH 4423, Modern Algebra II MATH 4563, Advanced Calculus II STAT 4463, Probability and Statistics II  |

 | 3  |
| **Mathematics or Statistics Electives (select four of the following):** MATH 3273, Applied Complex Analysis MATH 3323, Mathematical Modeling MATH 3343, College Geometry MATH 3353, History of Mathematics MATH 4413, Partial Differential Equations MATH 4423, Modern Algebra II *If not taken to satisfy Major Requirements* MATH 4513, Applied Mathematics MATH 4533, Numerical Methods MATH 4563, Advanced Calculus II *If not taken to satisfy Major Requirements* STAT 4483, Statistical Methods Using R STAT 4463. Probability and Statistics II  | 12  |
| **Sub-total**  | **52**  |
| **Electives:**  | **Sem. Hrs.**  |
| Electives (Eight hours must be upper-level)  | **29**  |
| **Total Required Hours:**  | **120**  |

After:

**Major in Mathematics**

**Bachelor of Science**

A complete 8-semester degree plan is available at https://www.astate.edu/info/academics/degrees/

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| --- | --- |
| **University Requirements:**  |  |
| See University General Requirements for Baccalaureate degrees (p. 44)  |  |
| **First Year Making Connections Course:**  | **Sem. Hrs.**  |
| MATH 1093, Making Connections - Mathematics  | **3**  |
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| **Major Requirements:**  | **Sem. Hrs.**  |
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| MATH 2214, Calculus II  | 4  |
| MATH 3254, Calculus III  | 4  |
| MATH 3243, Linear Algebra  | 3  |
| MATH 3303, Modern Algebra I  | 3  |
| MATH 4403, Differential Equations  | 3  |
| MATH 4553, Advanced Calculus I  | 3  |
| PHYS 2044, University Physics II  | 4  |
| STAT 3233, Applied Statistics I  | 3  |
| STAT 4453, Probability and Statistics I  | 3  |
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|  |
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| **Sub-total**  | **52**  |
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