Cover Letter for Math 440 Prerequisite Change

The Math department proposes a change to the prerequisites for MATH 440 Statistical Learning I. The current prerequisites are “Math 203 Math 220 and Math 350”. We propose to change the prerequisites to “Math 203 and Math 350”. The rationale for this change follows directly from a change made during fall 2013 when the prerequisite for Math 203, Linear Algebra, was changed from “either Math 220 or permission of instructor” to “either Math 120 or permission of instructor”. The reason Math 220, Calculus II, is a prerequisite for Math 440, Statistical Learning I, followed directly from its being a prerequisite for Math 203. Once Math 220 had been dropped as a prerequisite for Math 203, it was no longer needed as a prerequisite for Math 440.

Note: This change is in support of the changes being proposed to the Data Science Program, which include removing Math 220 as a degree requirement. It currently is a degree requirement since, as explained above, it had been a prerequisite for Math 203 and currently is a prerequisite for Math 440.
FACULTY CURRICULUM COMMITTEE
SIGNATURE PAGE

• In section A, list ALL of the forms covered by this signature page. If you submit a form that is not listed in A, your proposal will be held back until we receive a new, updated signature page.
• You must obtain the signature of your department chair and dean before submitting your proposal.

A. FORMS COVERED BY THIS SIGNATURE PAGE. List each form you are submitting—for instance, PSYC 383, Course Form; PSYC, Change of Major Form; PSYC, Change of Minor Form.
Proposals for prerequisite change to MATH 440.

Cover Letter

Course Form for Math 440

Course Syllabus for Math 440

Accompanying signature sheet
B. APPROVAL AND SIGNATURES.

1. Signature of Department Chair or Program Director:
   [Signature]
   Date: 3-3-2015

2. Signature of Academic Dean:
   [Signature]
   Date: 3/4/2015

3. Signature of Provost:
   [Signature]
   Date: 3/16/2015

4. Signature of Business Affairs (only for course fees):
   [Signature]
   Date: ________________
   □ fee approved on __________
   □ BOT approval pending

5. Signature of Curriculum Committee Chair:
   [Signature]
   Date: 9/18/2015

6. Signature of Budget Committee Chair (only for new programs):
   [Signature]
   Date: ________________

7. Signature of Academic Planning Committee Chair (only for new programs):
   [Signature]
   Date: ________________

8. Signature of Faculty Senate Secretary:
   [Signature]
   Date: ________________

Date Approved by Faculty Senate: ________________
FACULTY CURRICULUM COMMITTEE
COURSE FORM

Instructions:
- Please fill out one of these forms for each course you are adding, changing, deactivating, or reactivating.
- Fill out the parts of the form specified in part B. You must do this before your request can move forward!
- Remember that your changes will not be implemented until the next catalog year at the earliest.
- If you have questions, start by checking the instructions on the website. Please feel free to contact the committee chairs with any remaining questions you might have.

A. CONTACT/COURSE INFORMATION.

Name: Bob Mignone Phone: 953-5740 Email: mignoner@cofc.edu

Department or Program: Mathematics School: Science and Mathematics

Subject Acronym and Course Number: MATH 440

Catalog Year in which changes will take effect: FALL 2016-2017

B. TYPE OF REQUEST. Please check all that apply, then fill out the specified parts of the form.

☐ Add a New Course (complete parts C, D, F, G, H, I, J, K)
☒ Change Part of an Existing Course (complete parts C, D, E, F, G, I, J, K)
   ☐ Course Number
   ☐ Course Name
   ☐ Course Description
   ☐ Credit/Contact Hours
   ☒ Restrictions (prerequisites, co-requisites, junior/senior standing, etc.)
☐ Deactivate an Existing Course (complete parts C, D, E, G, I, J, K)
☐ Reactivate a Previously-Deactivated Course (complete parts C, D, E, G, I, J, K)

C. RATIONALE AND EXPLANATION. Please describe your request and explain why you are making it.

The Math department proposes a change to the prerequisites for MATH 440. The current prerequisites are “Math 203 Math 220 and Math 350”. We propose to change the prerequisites to “Math 203 and Math 350”. The rationale for this change follows directly from a change made during fall 2013 when the prerequisite for Math 203 was changed from “either Math 220 or permission of instructor” to “either Math 120 or permission of instructor”. The reason Math 220 had been a prerequisite for Math 440 followed directly from its being a prerequisite for Math 203. Once Math 220 had been dropped as a prerequisite for Math 203, it was no longer needed as a prerequisite for Math 440.

D. IMPACT ON EXISTING PROGRAMS AND COURSES. Please briefly describe the impact of your request on your own programs and courses as well other programs and courses. If another program requires the course, you must submit their written acknowledgement with this proposal. Also, the affected program must describe any change in the number of credit hours they require. Include a list of similar courses in other departments and explain any overlap.

This change impacts the Data Science Major Program and is consistent with proposed changes to that program. The Data Science Program is a joint program between the Department of Mathematics and the Department of Computer Science, and we are proposing (in a separate proposal) that Math 220 be dropped as a required course from the Data Science Major.

This form was last updated on 06/03/13 and replaces all others.
E. **EXISTING COURSE INFORMATION.** If you are proposing a new course, just leave this blank. Otherwise, please fill out all fields.

Department: Math  
School: SSM  
Subject Acronym: MATH  
Course Number: 440

Credit hours: ___3 lecture ___ lab ___ seminar ___ independent study  
Contact hours: ___3 lecture ___ lab ___ seminar ___ independent study

Course title: Statistical Learning I

Course description (maximum 50 words, exactly as it appears in the catalog):

Introduction to various approaches to statistical learning including empirical processes, classification and clustering, nonparametric density estimation and regression, model selection and adaptive procedures, bootstrapping and cross-validation.

Restrictions (pre-requisites, co-requisites, majors only, etc.):
Prerequisites are Math 203, 220 and Math 350.

Cross-listing, if any:

Is this course repeatable?  
☐ yes  ☒ no  
If yes, how many total credit hours may the student earn?  _____

F. **NEW COURSE INFORMATION.** If you are deactivating a course, leave this blank. Otherwise, please fill out all fields. For changed courses, use **boldface** for the information that is changing.

Department: Mathematics  
School: SSM  
Subject Acronym: MATH  
Course Number: 440

Credit hours: ___3 lecture ___ lab ___ seminar ___ independent study  
Contact hours: ___3 lecture ___ lab ___ seminar ___ independent study

Course title: Statistical Learning I

Course description (maximum 50 words, exactly as it appears in the catalog):

Introduction to various approaches to statistical learning including empirical processes, classification and clustering, nonparametric density estimation and regression, model selection and adaptive procedures, bootstrapping and cross-validation.

Restrictions (pre-requisites, co-requisites, majors only, etc.):  MATH 203 and 350

If this is a newly-created course, is it intended to be the equivalent of an existing course?  
☐ yes  ☐ no

If so, which course?  ______________________

If equivalent, will the newly-created course replace the existing course?  
☐ yes  ☒ no

Note: If yes, you must deactivate that course by submitting an **additional Course Form.**

Cross-listing, if any (submit approval from relevant department):

Note: Cross-listed courses are equivalent.

This form was last updated on 06/03/13 and replaces all others.
Is this course repeatable? ☐ yes ☒ no If yes, how many total credit hours may the student earn? _____

Is there an activity, lab, or other fee associated with this course? ☐ yes ☒ no What is the fee? $_____

Note: The Senate cannot approve new fees. Business Affairs will submit any such request to the Board of Trustees. The course can still be created, but the fee will not be attached until the Board has approved it.

G. COSTS. List all of the new costs or cost savings (including new faculty/staff requests, library, equipment, etc.) associated with your request.

There may be some cost savings if fewer students need to take Math 220.

H. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>What will students know and be able to do when they complete the course?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1. Be able to recognize different statistical learning approaches such as Empirical Risk Minimization, Vapnik-Chervonenkis Entropy, Structural Risk Minimization and Local Risk Minimization.</td>
<td>Students will be assessed on homework projects and on in class tests. They should be able to show proficiency at a B level or higher.</td>
</tr>
<tr>
<td>2. Understand the statistical learning paradigm.</td>
<td>Students will be assessed on homework projects and on in class tests. They should be able to show proficiency at a B level or higher.</td>
</tr>
<tr>
<td>3. Be able to apply Structural and Local Risk Minimization to a variety of categories.</td>
<td>Students will be assessed on homework projects and on in class tests. They should be able to show proficiency at a B level or higher.</td>
</tr>
</tbody>
</table>

How does this course align with the student learning outcomes articulated for the major, program, or general education? What program-level outcome or outcomes does it support? Is the content or skill introduced, reinforced, or demonstrated in this course?

**SLO 1 Using algebra, geometry, calculus and other track-appropriate sub-disciplines of mathematics, students model phenomena in mathematical terms.** This program student-learning outcome will be met through applications of structural risk minimization to normal model mixtures or linear basis expansion regression. **SLO 2 Using algebra, geometry, calculus and other track-appropriate sub-disciplines of mathematics, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.** This program student-learning outcome will be met through applications to real world situations by using the models from SLO 1 to derive results from questions posed in normal model mixtures or linear basis expansion regression. **SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions.** This program SLO will be addressed by the arguments used to prove their conclusions from SLO 2 above.

I. PROGRAM CHANGES. Will this course be added to the existing degree requirements or list of approved electives of a major, minor, or concentration? ☐ yes ☒ no

If yes, please attach a Change Minor and/or Change Major/Program Form as appropriate

This form was last updated on 06/03/13 and replaces all others.
J. CHECKLIST.

X I have completed all relevant parts of the form.

X I have attached a cover letter that describes my request and lists all the documents I am submitting.

X (For new courses only) I have attached a syllabus.

X (For courses used in any way by other departments, including cross-listing) I have attached an acknowledgement from the relevant department.

X (For courses intended to fulfill a Gen Ed requirement) I have submitted the proposal to the Gen Ed committee.

X I have submitted one Signature Form that lists all of the different forms I am submitting.
STATISTICAL LEARNING I
MATH 440
FALL 20xx

Instructor:  James E. Young, Ph.D.
Office:     RSS 323
Phone:      953-7295
E-mail:     youngj@cofc.edu

Office Hours: Tue and Thu: 10:45 – 12:15


Method of Teaching: Lecturing including active learning.

Grading:

Homework (due biweekly) (25%)  
Project (due December 10) (25%)  
Midterm (due October 11) (25%)  
Final Exam (due December 7) (25%)

Grading Scale
A is 90 or above; A- is 87 to 89; B+ is 84 to 86; B is 80 to 83; B- is 77 to 79; C+ is 74 to 76; C is 70 to 73; C- is 67 to 69; D+ is 64 to 66; D is 60 to 63; D- is 59; F is 58 and below.

Course Objectives: Students will learn the various approaches to statistical learning.

Course Student Learning Outcomes: Students will

1. be able to recognize different statistical learning approaches such as Empirical Risk Minimization, Vapnik-Chervonenkis Entropy, Structural Risk Minimization and Local Risk Minimization.

2. understand the statistical learning paradigm.

3. be able to apply Structural and Local Risk Minimization to a variety of categories.
Mathematics Program Student Learning Outcomes

SLO 1 Using algebra, geometry, calculus and other track-appropriate sub-disciplines of mathematics, students model phenomena in mathematical terms.

SLO 2 Using algebra, geometry, calculus and other track-appropriate sub-disciplines of mathematics, students derive correct answers to challenging questions by applying the models from SLO 1.

SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions.

STATISTICAL LEARNING I (MATH 440)
COURSE OUTLINE
Fall 20xx

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Text Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/21</td>
<td>Introduction, background, and motivation</td>
<td>1</td>
</tr>
<tr>
<td>8/23</td>
<td>Statistical learning paradigm</td>
<td>2.1-2.2</td>
</tr>
<tr>
<td>8/28</td>
<td>Empirical risk minimization (ERM) induction</td>
<td>2.3-2.4;2.6-2.7;2.9;notes</td>
</tr>
<tr>
<td>8/30</td>
<td>Consistency of ERM induction</td>
<td>notes</td>
</tr>
<tr>
<td>9/4</td>
<td>Uniform one-sided convergence characterization of the consistency of ERM induction</td>
<td>7.9 notes</td>
</tr>
<tr>
<td>9/6</td>
<td>Vapnik-Chervonenkis (VC) entropy for family of indicators</td>
<td>notes</td>
</tr>
<tr>
<td>9/11</td>
<td>Uniform convergence of frequencies to their probabilities</td>
<td>notes</td>
</tr>
<tr>
<td>9/13</td>
<td>VC entropy for a family of real-valued functions</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>9/18</td>
<td>Uniform convergence of sample means to their expectations</td>
<td>notes</td>
</tr>
<tr>
<td>9/20</td>
<td>Popper nonfalsifiability applied to statistical learning</td>
<td>notes</td>
</tr>
<tr>
<td>9/25</td>
<td>Guest lecture</td>
<td></td>
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<tr>
<td>9/27</td>
<td>Exponential rate of convergence for ERM induction for classification: finite family</td>
<td>notes</td>
</tr>
<tr>
<td>10/2</td>
<td>Exponential rate of convergence for ERM induction for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/4</td>
<td>Growth of growth function and VC dimension of family of indicators</td>
<td>7.9; notes</td>
</tr>
<tr>
<td></td>
<td><strong>Begin MIDTERM</strong></td>
<td></td>
</tr>
<tr>
<td>10/9</td>
<td>Constructive distribution-free exponential bounds on generalization ability (capacity) of learners for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/11</td>
<td>Exponential rate of convergence for ERM induction for regression: finite case</td>
<td>notes</td>
</tr>
<tr>
<td></td>
<td><strong>MIDTERM due</strong></td>
<td></td>
</tr>
<tr>
<td>10/16</td>
<td>Exponential rate of convergence for ERM induction for regression: universally bounded nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/18</td>
<td>Exponential rate of convergence for ERM induction for regression: nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/23</td>
<td>Structural risk minimization (SRM) induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/25</td>
<td>Consistency of SRM induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/30</td>
<td>Asymptotic rate of convergence for SRM induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/1</td>
<td>Application of SRM induction to normal mixture models</td>
<td>notes</td>
</tr>
<tr>
<td>11/8</td>
<td>Application of SRM induction to linear basis expansion regression</td>
<td>2.8; 5; notes</td>
</tr>
</tbody>
</table>
11/13 Local risk minimization (LRM) induction
11/15 Application of LRM induction to local kernel smoothing regression 2.8; 6; notes
11/20 Upper bounds for LRM induction notes
11/27 Ill-posed problems and method of regularization 2.8; 5.8; notes
11/29 Stochastic ill-posed problems
Begin FINAL EXAM 2.8; 5.8 notes
12/7 FINAL EXAM due
12/10 PROJECT due

Note: This schedule is meant as a guide. Some sections or subsections may be omitted depending on availability of time and/or superceding priorities. Any deviations from this schedule will be announced in advance.

Class attendance policy: Every student is expected to attend every class. If extreme circumstances necessitate an absence, get the notes and assignment from a classmate or see me. You are responsible for making up any missed work. Four or more absences from the class will result in a grade of WA (See p. 18 of the Undergraduate Catalog for more information). I encourage you to see me with any problems you may have, either during my office hours, or make an appointment to see me at another time if your work schedule conflicts.

Honor Code and Academic Integrity: (language provided by the Dean of Students)

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each instance is examined to determine the degree of deception involved.

Incidents where the professor believes the student’s actions are clearly related more to ignorance, miscommunication, or uncertainty, can be addressed by consultation with the student. We will craft a written resolution designed to help prevent the student from repeating the error in the future. The resolution, submitted by form and signed by both the professor and the student, is forwarded to the Dean of Students and remains on file.

Cases of suspected academic dishonesty will be reported directly to the Dean of Students. A student found responsible for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

It is important for students to remember that unauthorized collaboration--working together without permission--is a form of cheating. Unless a professor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as a PDA), copying from another’s exam, fabricating data, and giving unauthorized assistance.

Remember, research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the professor.

Students can find a complete version of the Honor Code and all related processes in the Student Handbook.

Students with Disabilities
If you have a learning disability that will affect your performance in this class, you should contact Disability Services (953-1431) and talk to me in private. I can make no special testing allowances without
documentation from Disability Services. Appointments with Disability Services for alternate testing must be made by the student at least three days in advance of the test.