Cover Letter For Accompanying Proposal

TO: Bonnie Springer, Chair Faculty Curriculum Committee  
FROM: Robert Mignone, Chair Department of Mathematics  
RE: Proposal to add two Undergraduate Mathematics Courses  

November 19, 2014

Dear Dr. Springer:

The Department of Mathematics proposes two new mathematics courses:

MATH 460 Stochastic Processes

MATH 461 Time Series

Since these courses will be electives for the B.S., B.A. and the Minor in Mathematics, accompanying the course proposals are proposals for changes to the B.S., B.A. and the Minor in Mathematics.

Sincerely yours,

[Signature]

Robert Mignone
For the Curriculum Committee

Proposals for two new undergraduate mathematics courses:

MATH 460 Stochastic Processes

MATH 461 Time Series

Included Documents for both courses:
  • Course Form
  • Course Syllabus
  • Change in Major for the BA in Mathematics
  • Change in Major for the BS in Mathematics
  • Description of the BA major and the Tracks in the BS major
  • Change in Minor for the Minor in Mathematics
  • Description of the Minor in Mathematics
  • Accompanying signature sheets
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 two new undergraduate mathematics courses:

MATH 460 Stochastic Processes
MATH 461 Time Series

Included Documents for both courses:

Course Forms for Math 460 and Math 461
Course Syllabus for Math 460 and Math 461
Change in Major for the BA in Mathematics for each of Math 460 and Math 461
Change in Major for the BS in Mathematics for each of Math 460 and Math 461
Description of the BA major and the Tracks in the BS major
Change in Minor for the Minor in Mathematics for each of Math 460 and Math 461
Description of the Minor in Mathematics

Accompanying signature sheet
B. APPROVAL AND SIGNATURES.

1. Signature of Department Chair or Program Director: ________________________________ Date: 11/19/2014

2. Signature of Academic Dean: ________________________________ Date: 11/21/2014

3. Signature of Provost: ________________________________ Date: 10/22/14

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

5. Signature of Curriculum Committee Chair: ________________________________ Date: 1/20/2015

6. Signature of Budget Committee Chair (only for new programs):
   __________________________________________ Date: ______________

7. Signature of Academic Planning Committee Chair (only for new programs):
   __________________________________________ Date: ______________

8. Signature of Faculty Senate Secretary:
   __________________________________________ 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: Martin Jones          Phone: 953-5735          Email: jonesm@cofc.edu

Department or Program: Mathematics          School: School of Science and Mathematics

Subject Acronym and Course Number: MATH 460 Stochastic Processes

Catalog Year in which changes will take effect: FALL 2015

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)
☐ Change Part of an Existing Course (complete parts C, D, E, F, G, I, J)
  ☐ Course Number (you must submit a course deactivation request for the old 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)
☐ Reactivate a Previously-Deactivated Course (complete parts C, D, E, G, I, J)

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

We have taught this course several times now as a topics course and we would like to add it as a permanent offering.

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 course will be an elective course in the Mathematics Department. It will not be a required course for any of the major tracks, however it will be a recommended elective for the statistics track and the actuarial science track.
E. EXISTING COURSE INFORMATION. If you are proposing a new course, just leave this blank. Otherwise, please fill out all fields.

Department: 
School: 
Subject Acronym: 
Course Number: 

Credit hours: __ lecture __ lab __ seminar __ independent study
Contact hours: __ lecture __ lab __ seminar __ independent study

Course title:

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

Restrictions (pre-requisites, co-requisites, majors only, etc.):

Cross-listing, if any:

Is this course repeatable? □ yes  X 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: 460

Credit hours: 3 lecture __ lab __ seminar __ independent study
Contact hours: 3 __ lecture __ lab __ seminar __ independent study

Course title: Stochastic Processes

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

**Stochastic Processes** are sequences of random variables indexed in either discrete or continuous time units. They can be used to model systems that involve random elements as they evolve over time. In this course we will study Poisson processes, Markov chains, renewal processes, martingales, random walks, and Brownian motion.

Restrictions (pre-requisites, co-requisites, majors only, etc.): MATH 430 Mathematical Statistics I

If this is a newly-created course, is it intended to be the equivalent of an existing course? □ yes  X 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.

Is this course repeatable? □ yes  X 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  X no  What is the fee? $_____

This form was last updated on 12/13/13 and replaces all others.
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.

None, since we have already been offering Stochastic Processes as a topics course, there will be no additional costs.

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 stochastic models and how to apply them.</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 mathematical and probabilistic theory behind the construction of stochastic processes.</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 understand the mathematical proofs used in the development of the theory of stochastic processes and be able to reproduce these ideas.</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>4. Be able to use stochastic processes in real applications to model random phenomena.</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 to real world situations by modeling random elements as they evolve over time such as financial markets and production line processes using techniques of Stochastic Processes such as Poisson processes, Markov chains, renewal processes, Martingales, random walks, and Brownian motion. 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 statistical results from the techniques of Stochastic Processes. SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions. This program SLO will be addressed by the course student-learning outcome 3. 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 X yes ☐ no

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

J. CHECKLIST.

☐ I have completed all relevant parts of the form.

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

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

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

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

☑ I have submitted one Signature Form that lists all of the different forms I am submitting.
Math 460 Stochastic Processes
College of Charleston
Department of Mathematics
Fall 2012 Syllabus

INSTRUCTOR INFORMATION
Dr. Martin Jones
Office: RSS 345
Office Hours: T.B.A.
E-mail: jonesm@cofc.edu

Course Meetings
Mondays and Wednesdays in Maybank 224 from 7:00 - 8:15 PM.

Prerequisites
Math 430 Mathematical Statistics I or permission of the instructor.

Textbook
Stochastic Processes by Sidney I. Resnick. In this course, we will cover selections from Chapters 1–6.

Course Description
Topics will include probabilistic tools, Markov chains, renewal theory, point processes, continuous time Markov chains, and Brownian motion.

Student Learning Outcomes:
After completing this course, students will be able to

1. Recognize and apply different stochastic models.
2. Understand the theory behind the construction of stochastic processes.
3. Understand the proofs behind the theory of stochastic models.
4. Use stochastic processes in real applications to model random phenomena.

These outcomes will be assessed in homework and on in class exams.

Graded Assignments
In this course, we will have one midterm exam, a final examination, and bi-weekly homework.

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<tbody>
<tr>
<td>Midterm:</td>
<td>20%</td>
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<tr>
<td>Final Exam:</td>
<td>20%</td>
</tr>
<tr>
<td>Homework:</td>
<td>60%</td>
</tr>
</tbody>
</table>

Important Dates
Midterm: Wednesday, October 08
Final Exam: Wednesday, December 06

Course Grades
Midterm and Final Exams (20% each): These two in class exams will assess your understanding of the mathematical theory in the development of stochastic processes. You will be expected to reproduce short proofs, show facility with the probabilistic tools, and perform calculations and predictions using the stochastic models.

Homework (60%): Every other week you will be expected to turn in assigned problems from the text. These problems may be a combination of the theory of stochastic processes and their applications. Some will require the statistical software package R to
aid in the calculations and simulations of stochastic processes.

**Grading Scale:** Grades will be based on the percentage of points earned in the categories listed above. A (93-100%), A- (90-92%), B+ (87-89%), B (84-86%), B- (80-83%), C+ (77-79%), C (74-76%), C- (70-73%), D+ (67-69%), D (64-66%), D- (60-63%), F (below 60%).

**Attendance Policy**
You are expected to attend class every day. If you miss class, you will need to obtain notes from one of your classmates and talk with me about material that you do not understand. If for some reason you are not able to attend class the day that an assignment is due, you should email me your assignment that day. Late assignments will not be awarded full credit. Late assignments will not be accepted after graded papers are returned or problem solutions have been distributed. Make-up exams are only possible with proper documentation from the Absence Memo Office.

**Disability Policy**
If you have a documented disability that will affect your performance in this class, you should contact Disability Services (953-1431) and speak with me in private. No special testing accommodations can be made without a letter from Disability Services. It is the student’s responsibility to provide me with the accommodation envelope at least one week before any scheduled exam. Without exception, an examination must be taken at our scheduled class meeting time.

**Supplementary Material**
Supplementary materials for our course will be posted on OAKS.

**E-Mail**
The best way to contact me is by e-mail. Please always include your name, the course name, and the section number in your e-mails. In general, you should expect a response within two school days.

**Coverage of Topics**

- **Weeks 1 and 2:** Generating Functions, Simple Branching Processes, Limit Distributions, Stopping Times, Wald’s Identity.

- **Weeks 3 and 4:** Markov chain construction, higher order transition probabilities, transience and recurrence, periodicity, canonical decomposition of Markov chains, absorption probabilities, invariant measures, stationary distributions.

- **Weeks 5 through 7:** Introduction to renewal processes, renewal reward processes, renewal limit theorems, Blackwell and key renewal theorems, regenerative processes, queueing examples.

- **Weeks 8 and 9:** Introduction to point processes, Poisson processes, transforming Poisson processes, the order statistic property, thinning of Poisson processes, records.

- **Weeks 10 through 12:** Continuous time Markov chains, the backward equations and the generator matrix, Laplace transform methods, queueing networks, reversibility and uniformizability.

- **Weeks 13 through 15:** Brownian motion construction, the reflection principle, strong Markov property, distribution of the maximum of Brownian motion, Brownian motion with a drift, the Brownian bridge and the Kolmogorov-Smirnov statistic, Khintchine’s law of the iterated logarithm for Brownian Motion.
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: Martin Jones  Phone: 953-5735  Email: jonesm@cofc.edu

Department or Program: Mathematics  School: School of Science and Mathematics

Subject Acronym and Course Number: MATH 461 Time Series

Catalog Year in which changes will take effect: FALL 2015

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

- [X] Add a New Course (complete parts C, D, F, G, H, I, J)
- [ ] Change Part of an Existing Course (complete parts C, D, E, F, G, I, J)
  - [ ] Course Number (you must submit a course deactivation request for the old 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)
- [ ] Reactivate a Previously-Deactivated Course (complete parts C, D, E, G, I, J)

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

We have taught this course several times now as a topics course and we would like to add it as a permanent offering.

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 course will be an elective course in the Mathematics Department. It will not be a required course for any of the major tracks, however it will be a recommended elective for the statistics track and the actuarial science track.

This form was last updated on 12/13/13 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: 
School: 
Subject Acronym: 
Course Number: 

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

Course title: 

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

Restrictions (pre-requisites, co-requisites, majors only, etc.):

Cross-listing, if any:

Is this course repeatable? □ yes  X 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: 461

Credit hours: 3 lecture ___ lab ___ seminar ___ independent study
Contact hours: 3 lecture ___ lab ___ seminar ___ independent study

Course title: Stochastic Processes

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

Time series are sequences of data points measured typically at successive uniform time intervals. They are used in signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting, and control engineering. Time series analysis is a collection of methods for analyzing time series data in order to extract meaningful characteristics of the data. In this course we will study stationary processes, forecasting techniques, ARMA models, spectral analysis, non-stationary and seasonal models, and multivariate time series.

Restrictions (pre-requisites, co-requisites, majors only, etc.): MATH 430 Mathematical Statistics I

If this is a newly-created course, is it intended to be the equivalent of an existing course? □ yes  X 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 12/13/13 and replaces all others.
Is this course repeatable? □ yes  X 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  X 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.

None, since we have already been offering Time-Series Analysis as a topics course, there will be no additional costs.

H. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
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<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. Recognize different time series models and understand how to apply them.</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 mathematical and probabilistic theory behind the construction of time series models.</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 understand the mathematical proofs used in the development of the theory of time series models and be able to reproduce these ideas.</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>4. Be able to work with real time series data sets, apply the concepts of the theory and analyze the results.</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 to real world situations by modeling phenomena such as signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting and control engineering using techniques of Time-Series Analysis.

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 statistical results from the techniques of Time-Series Analysis.

SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions. This program SLO will be addressed by the course student learning outcome 3. above.

This form was last updated on 12/13/13 and replaces all others.
I. PROGRAM CHANGES. Will this course be added to the existing degree requirements or list of approved electives of a major, minor, or concentration X yes □ no

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

J. CHECKLIST.

X I have completed all relevant parts of the form.

☑ 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.

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

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

☑ I have submitted one Signature Form that lists all of the different forms I am submitting.
Math 461 Time Series
College of Charleston
Department of Mathematics
Fall 2013 Syllabus

INSTRUCTOR
Dr. Martin Jones
Office: RSS 345
Office Hours: T.B.A.
E-mail: jonesm@cofc.edu

INFORMATION

MEETINGS
Mondays and Wednesdays in Maybank 224 from 7:00 - 8:15 PM.

PREREQUISITES
Math 430 Mathematical Statistics I or permission of the instructor.

TEXTBOOK
course, we will cover selections from Chapters 1–7.

DESCRIPTION
Topics will include characteristics of time series, exploratory data analysis, ARIMA
models, spectral analysis and filtering, state-space models, statistical methods in the
frequency domain.

STUDENT LEARNING OUTCOMES:
After completing this course, students will be able to

1. Recognize and apply different time series models.
2. Understand the theory behind the construction of time series models.
3. Understand the proofs behind the theory of time series models.
4. Use time series methods to analyze real data sets.

These outcomes will be assessed in homework and on in class exams.

GRADED ASSIGNMENTS
In this course, we will have one midterm exam, a final examination, and bi-weekly
homework.

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IMPORTANT DATES

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<table>
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<tbody>
<tr>
<td>Midterm</td>
<td>Wednesday, October 08</td>
</tr>
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<td>Final Exam</td>
<td>Wednesday, December 06</td>
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</tbody>
</table>

COURSE GRADES
Midterm and Final Exams (20% each): These two in class exams will assess your
understanding of the mathematical theory in the development of time series models.
You will be expected to reproduce short proofs, show facility with the probabilistic
tools, and be able to analyze time series data using these models.

Homework (60%): Every other week you will be expected to turn in assigned problems
from the text. These problems may be a combination of theory ideas and applications.
Some will require the statistical software package R to aid in the calculations and analysis of time series data.

**Grading Scale:** Grades will be based on the percentage of points earned in the categories listed above. A (93-100%), A- (90-92%), B+ (87-89%), B (84-86%), B- (80-83%), C+ (77-79%), C (74-76%), C- (70-73%), D+ (67-69%), D (64-66%), D- (60-63%), F (below 60%).

**Attendance Policy**

You are expected to attend class every day. If you miss class, you will need to obtain notes from one of your classmates and talk with me about material that you do not understand. If for some reason you are not able to attend class the day that an assignment is due, you should email me your assignment that day. Late assignments will not be awarded full credit. Late assignments will not be accepted after graded papers are returned or problem solutions have been distributed. Make-up exams are only possible with proper documentation from the Absence Memo Office.

**Disability Policy**

If you have a documented disability that will affect your performance in this class, you should contact Disability Services (953-1431) and speak with me in private. No special testing accommodations can be made without a letter from Disability Services. It is the student’s responsibility to provide me with the accommodation envelope at least one week before any scheduled exam. Without exception, an examination must be taken at our scheduled class meeting time.

**Supplementary Material E-Mail**

Supplementary materials for our course will be posted on OAKS.

The best way to contact me is by e-mail. Please always include your name, the course name, and the section number in your e-mails. In general, you should expect a response within two school days.

**Coverage of Topics**

**Weeks 1 and 2:** Characteristics of time series data, measures of dependence, stationary time series, estimation of correlation, multidimensional series.

**Week 3:** Classical regression in time series, exploratory data analysis, smoothing time series.

**Weeks 4 through 6:** Autoregressive moving average models, difference equations, autocorrelation and partial autocorrelation, forecasting, building ARIMA models, multiplicative seasonal ARIMA models.

**Weeks 7 through 9:** Cyclical behavior and periodicity, spectral density, periodogram and Fourier transforms, nonparametric and parametric estimation, multiple series and cross spectra, linear filters, wavelets, signal extraction and optimal filtering.

**Weeks 10 and 11:** Long memory ARMA models, unit root testing, GARCH models, threshold models, multivariate ARMAX models.

**Weeks 12 and 13:** Filtering and forecasting with state-space models, maximum likelihood estimation, missing data modifications, structural models, bootstrapping state-space models, stochastic volatility, Monte Carlo methods.

**Weeks 14 and 15:** Spectral matrices, regression for jointly stationary series, regres-
cision with deterministic inputs, random coefficient regression, cluster analysis, principal component and factor analysis, the spectral envelope.
Instructions:
- Please fill out all of the portions of the form that are specified in section 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, please start by checking the detailed instructions on the website.
- Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: Martin Jones  Phone: 953-5735  Email: jonesm@cofc.edu  
School: Science and Mathematics  Department or Program: Mathematics  
Name and Acronym of Major: B.A. Mathematics MATH

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

X Change Request (fill out all sections)
- Add an existing course to requirements or electives  
  X Add a new course to requirements or electives (attach completed course form for each)  
- Delete courses from requirements or electives  
- Add or modify concentration*  
- Add or modify cognate*  

*Note: Only concentrations and cognates requiring **18 or more credit hours** will be tracked in Banner and Degree Works and noted on the transcript.

☐ Terminate Program (fill out E, G, H, and I)
  - Terminate degree
  - Terminate major
  - Terminate concentration
  - Terminate cognate

C. GENERAL INFORMATION

Number of Current Credit Hours (for existing program): ___36+___
Number of Proposed Credit Hours (for changed program): ___36+_______
Catalog Year in which changes will take effect: FALL 2015

D. CURRICULUM. Please list every change you are making below AND attach the current Program of Study Worksheet for this major (http://registrar.cofc.edu/program-of-study-resources/program-of-study-worksheets/index.php) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions. Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus.

This form was last updated on 6/6/2013 and replaces all others.
F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<th>Student Learning Outcomes</th>
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<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>
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<tr>
<td>1. Recognize different time series models and understand how to apply them.</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 mathematical and probabilistic theory behind the construction of time series models.</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>
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<td>3. Be able to understand the mathematical proofs used in the development of the theory of time series models and be able to reproduce these ideas.</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>
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<td>4. Be able to work with real time series data sets, apply the concepts of the theory and analyze the results.</td>
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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 to real world situations by modeling phenomena such as signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting and control engineering using techniques of Time-Series Analysis.

**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 statistical results from the techniques of Time-Series Analysis.

**SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions.** This program SLO will be addressed by the course student learning outcome 3. above.

II. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a program, please describe the effect on all programs that will be impacted; if you are adding or changing a program, please explain any overlap with existing programs at the College.

This form was last updated on 6/6/2013 and replaces all others.
These two courses will enrich the Mathematics B.A. degree by providing upper-level electives for students interested in probability, statistics and actuarial science.

I. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings (including new faculty/staff requests, library, or equipment) associated with your request.

None, since we have already been offering Time-Series Analysis as a topics course, there will be no additional costs.

J. CHECKLIST

☐ I have completed all relevant parts of the form.

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

☐ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☐ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the description and course list, exactly as it should appear in the catalog.

☐ I have submitted one Signature Form that lists all of the different forms I am submitting.
Math Major Requirements
Catalog Year: 2014-15
Degree: Bachelor of Arts
Credit Hours: 36+

"PR" indicates a pre-requisite. "CO" indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

☐ MATH 120 Introductory Calculus (4) PR: Placement or a C or better in MATH 111
☐ MATH 220 Calculus II (4) PR: MATH 120 or HONS 115
☐ MATH 203 Linear Algebra (3) PR: MATH 120 or instructor permission
☐ MATH 221 Calculus III (4) PR: MATH 220
☐ MATH 295 Introduction to Abstract Mathematics (3) PR: MATH 203 or 221
☐ MATH 303 Abstract Algebra I (3) PR: MATH 203 and MATH 295
☐ MATH 311 Advanced Calculus I (3) PR: MATH 221 and MATH 295
☐ MATH 315 Introduction to Complex Variables (3) PR: MATH 221 with a minimum grade of C or better

Select one of the following courses:

☐ MATH 403 Abstract Algebra II (3) PR: MATH 303
☐ MATH 411 Advanced Calculus II (3) PR: MATH 203 and MATH 311

Complete one of the following options:

Option 1: Select 6 credit hours from the following 300 and 400-level MATH courses of which at least 3 credit hours must be at the 400-level or above:

☐ MATH 305 Elementary Number Theory (3) PR: MATH 295 or instructor permission
☐ MATH 307 Discrete Structures II (3) PR: MATH 207 or MATH 295 or instructor permission
☐ MATH 320 History of Mathematics (3) PR: MATH 295
☐ MATH 323 Differential Equations (3) PR: MATH 221 and MATH 203 or instructor permission
☐ MATH 340 Axiomatic Geometry (3) PR: MATH 295 or instructor permission
☐ MATH 350 Statistical Methods II (3) PR: MATH 120 and MATH 250
☐ MATH 397 Research Experience Mathematics (0) PR: Only declared math majors may take a Zero Credit Research course; instructor permission and department chair approval
☐ MATH 399 Tutorial (3; repeatable up to 12 credit hours) PR: Junior standing; tutor and department chair permission
☐ MATH 401 Intro Point Set Topology (3) PR: MATH 311
☐ MATH 402 Advanced Linear Algebra (3) PR: MATH 203 and MATH 303 or MATH 311
☐ MATH 403 Abstract Algebra II (3) PR: MATH 303
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 411</td>
<td>Advanced Calculus II</td>
<td>MATH 203 and MATH 311</td>
</tr>
<tr>
<td>MATH 415</td>
<td>Complex Analysis (3)</td>
<td>MATH 311</td>
</tr>
<tr>
<td>MATH 417</td>
<td>Reading and Research (3)</td>
<td>Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td>MATH 418</td>
<td>Reading and Research (3)</td>
<td>Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td>MATH 421</td>
<td>Vector and Tensor Analysis (3)</td>
<td>MATH 311</td>
</tr>
<tr>
<td>MATH 423</td>
<td>Introduction to Partial Differential Equations (3)</td>
<td>MATH 221 and MATH 323</td>
</tr>
<tr>
<td>MATH 430</td>
<td>Mathematical Statistics I (3)</td>
<td>MATH 221</td>
</tr>
<tr>
<td>MATH 431</td>
<td>Mathematical Statistics II (3)</td>
<td>MATH 430</td>
</tr>
<tr>
<td>MATH 440</td>
<td>Statistical Learning I (3)</td>
<td>MATH 203 and MATH 220 and MATH 350</td>
</tr>
<tr>
<td>MATH 441</td>
<td>Statistical Learning II (3)</td>
<td>MATH 440</td>
</tr>
<tr>
<td>MATH 445</td>
<td>Numerical Analysis (3)</td>
<td>MATH 203 and MATH 245 and MATH 323</td>
</tr>
<tr>
<td>MATH 451</td>
<td>Linear Programming and Optimization (3)</td>
<td>MATH 203 and MATH 221 and CSCI 220 or MATH 245 or instructor permission</td>
</tr>
<tr>
<td>MATH 452</td>
<td>Operations Research (3)</td>
<td>MATH 203 and MATH 430 and CSCI 220 or MATH 245</td>
</tr>
<tr>
<td>MATH 455</td>
<td>Bayesian Statistical Methods (3)</td>
<td>MATH 430</td>
</tr>
<tr>
<td>MATH 470</td>
<td>Mathematical Modeling (3)</td>
<td>MATH 203 and MATH 323 and MATH 246 or CSCI 220 or instructor permission</td>
</tr>
<tr>
<td>MATH 485</td>
<td>Topics in Pure Mathematics (3)</td>
<td>Instructor permission</td>
</tr>
<tr>
<td>MATH 480</td>
<td>Topics in Applied Mathematics (3)</td>
<td>Instructor permission</td>
</tr>
<tr>
<td>MATH 490</td>
<td>Practicum in Mathematics (3)</td>
<td>Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td></td>
<td><strong>Option II: Complete the following:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>☐ MATH 499</td>
<td>Bachelor's Essay (6)</td>
</tr>
<tr>
<td></td>
<td>MATH 460</td>
<td>Stochastic Processes</td>
</tr>
<tr>
<td></td>
<td>MATH 481</td>
<td>Time Series</td>
</tr>
</tbody>
</table>
Czwazka, Franklin James

From: Mignone, Robert J
Sent: Thursday, December 18, 2014 11:36 AM
To: Jones, Martin L; Czwazka, Franklin James
Cc: Boyd, Cathy; Mackeldon, Jerry W
Subject: RE: MATH Curriculum Proposals for December 2014

Final work given. Go ahead Franklin. You're right about the teacher education track. No electives so leave 460 and 461 off. Bob

From: Jones, Martin L
Sent: Thursday, December 18, 2014 11:02 AM
To: Czwazka, Franklin James
Cc: Boyd, Cathy; Mackeldon, Jerry W; Mignone, Robert J
Subject: Re: MATH Curriculum Proposals for December 2014

Hello Franklin,

I'd better let Bob weigh in on the Teacher Education Track. It sounds good to me, but I would want him to give you the final word. Thanks so much for your help on this.

Best,
Martin

On Dec 18, 2014, at 10:25 AM, Czwazka, Franklin James wrote:

Martin,

Thank you for getting back to us so quickly. I have marked up the attached Program of Study worksheets for each track to show the inclusion of MATH 460 and 461. Please confirm that each is correct.

We do have a question about the Teacher Education Track since there are no electives listed only required courses. Should this track be excluded since it doesn't have a list of electives and therefore MATH 460 and 461 would not be added?

Thanks!
Franklin

From: Boyd, Cathy
Sent: Wednesday, December 17, 2014 5:08 PM
To: Czwazka, Franklin James; Mackeldon, Jerry W
Subject: FW: MATH Curriculum Proposals for December 2014

Response??

From: Jones, Martin L
Sent: Wednesday, December 17, 2014 4:55 PM
To: Mignone, Robert J
Hello Bob and Cathy. Our plan was to have Math 460 and 461 be elective courses in the stat track, but could be used as 400-level electives in any of the tracks. Best, Martin

Sent from my iPhone

On Dec 17, 2014, at 3:51 PM, "Mignone, Robert J" <MignoneR@cofc.edu> wrote:

HI Cathy,

I’m cc’ing Martin Jones on my response, since the proposals originated with Martin and he has the surest knowledge of where those courses belong in each of the five tracks for the BS, and the BA.

Bob

From: <Boyd>, Cathy Boyd <boydc@cofc.edu>
Date: Wednesday, December 17, 2014 at 3:12 PM
To: Robert Mignone <Mignonere@cofc.edu>
Cc: "Springer, Bonnie C" <SpringerB@cofc.edu>, Lynne Ford <fordl@cofc.edu>, "Czwazka, Franklin James" <CzwazkaF@cofc.edu>, Jerry Mackeldon <mackeldonj@cofc.edu>
Subject: MATH Curriculum Proposals for December 2014

Bob,

In our review of the MATH curriculum proposals received in December:
The major change proposals (both B.S. and B.A.) as well the minor change proposal don’t explicitly list the new MATH 460 and 461 course. We can amend the forms to explicitly list them once confirmed. Also neither major change proposals show exactly where the new courses will fall within the requirements. Also, there were two major changes (B.S.) submitted—we will just condense the changes into a single proposal.

In two of the tracks, Pure Math track and Applied Math track, and in the B.A. Math major, these two new 400 level courses would be added to the, “Select 6 credit hours from the following 400 level MATH courses”. But, there is no such section for the Actuarial track, the Statistics track, nor the Math with Teacher Education major. If these courses are to be added to these, it needs to be stated exactly where they should fall. Otherwise, these should be pulled from the MATH packet.

We will need to confirm that the only courses they’re adding are the new MATH 460 and 461 and also where they would fall within each track if they’re to count. Once received I will amend the forms accordingly and include the email exchange as documentation.

Thanks!
Franklin
Instructions:
• Please fill out all of the portions of the form that are specified in section 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, please start by checking the detailed instructions on the website. Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.
Name: Martin Jones Phone: 953-5735 Email: jonesm@cofc.edu
School: Science and Mathematics Department or Program: Mathematics
Name and Acronym of Minor: Mathematics MATH

B. TYPE OF REQUEST. Please check all that apply, then fill out the specified parts of the form.
☐ Add a New Minor (complete all portions)
☒ Change an Existing Minor (complete C, D, E, G, H, and I)
   ☐ Add existing course or courses to requirements or electives
   ☐ Add new course(s) to requirements or electives (attach completed course form for each)
   ☐ Delete courses from requirements or electives
☐ Terminate a Minor (complete E, G, H, and I)

C. GENERAL INFORMATION.
Number of Current Credit Hours (for existing minors): 21
Number of Proposed Credit Hours (for new or changing minors): 21
Catalog year in which changes will take effect: FALL 2015
☐ Interdisciplinary (please see guidelines on the Curriculum Committee website and include acknowledgments from relevant departments)

According to academic policy, students may not obtain a major/concentration and minor in the same subject. Will students in specific majors be prohibited from declaring this minor because of this policy?
☐ Yes—Which major(s) or concentration(s)?
☐ No

D. CURRICULUM. For a changed minor, please list every change you are making below AND attach the current catalog entry for this minor (from the Minor Requirements section) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus. For

This form was last updated on 6/6/2013 and replaces all others.
a new program, please submit the complete curriculum and catalog description exactly as they should appear in the catalog.

There will be no changes to the catalog entry for the Mathematics Minor. These courses will be elective options for students wishing to complete the Mathematics Minor Program. No changes in the hours or requirements will be made as a result of the addition of these to courses to the Mathematics course listings.

\[ \text{E. RATIONALE AND EXPLANATION. Please provide a narrative addressing the request you are making and why you are making it. In addition, for a new minor, please address its objectives, provide evidence of student interest (e.g. interviews with student focus groups, enrollment in special-topics courses in this area), and explain how the minor supports the liberal arts tradition as well as the mission of the institution.} \]

We have taught these two courses as topics courses for several years and we would now like to add them to our course listings. They will be available as elective courses for students in the Mathematics Minor Program.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT.
G. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

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<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>
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<td>2. Understand the mathematical and probabilistic theory behind the construction of time series models.</td>
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This form was last updated on 6/6/2013 and replaces all others.
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 to real world situations by modeling phenomena such as signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting and control engineering using techniques of Time-Series Analysis.

**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 statistical results from the techniques of Time-Series Analysis.

I. IMPACT ON EXISTING PROGRAMS AND COURSES. Please describe the impact of this request on other programs and courses. If you are deleting a minor, please identify all programs that will be affected. If you are adding or changing a minor, please explain any overlap with existing programs at the College.

The addition of these two courses will enhance the options of students seeking upper-level elective courses in the Mathematics Minor Program. They will be particularly attractive to students with an interest in probability and statistics.

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

Since we have already been offering Stochastic Processes as a topics course, there will be no additional costs.

K. CHECKLIST.

- I have completed all relevant parts of the form.
- I have attached a cover letter that describes my request and lists all the documents I am submitting.
- I have attached a Course Form for each newly-created or modified course.
- (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.
- I have provided the complete curriculum for the minor, including the description and course list, exactly as it should appear in the catalog.
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Two courses from “Languages and Society” (6 credit hours):

ANTH 205 Language and Culture
COMM 215 Communication, Identity and Community
COMM 380 Studies in Communication (when appropriate to the area of language and linguistics)
ENGL 309 English Language - Grammar and History
HIST 272 Pre-Colonial Africa
LING 290 Special Topics in Linguistics (depending on course topic)
LING 490 Special Topics (depending on course topic)
PSYC 358 Non-Verbal Communication
PSYC 378 Psychology of Language
SPAN 447 Spanish Dialectology
SPAN 448 Spanish Sociolinguistics
SPAN 590 Spanish Linguistics – Special Topics (with special permission)

NOTE: Any new, additional, or special topics courses in the areas of socio- or psycholinguistics will be considered for inclusion toward this requirement on an individual basis.

One elective from any of the above areas, LING 498 or LING 499, an approved Independent Study or Bachelor’s Essay course in another program on a topic also approved by the Linguistics Program director. (3 credit hours).

NOTE: FREN 630 Seminars in French Language Studies (with special permission); Director must approve topic for the minor.

This program can benefit a variety of students and programs, for example:

• Language majors
• SNAP program students (by providing some alternative courses for language requirements)
• School of Education, Health, and Human Performance majors (especially in the areas of English as a Second Language and Special Education)

NOTE: Courses transferred to the College that count for requirements in different departments, must contain one-third linguistic content (similar to those courses taught here), to satisfy the minor requirement.

Mathematics Minor

Credit Hours: 21-23

Minor Requirements:

See also Academic Regulations on page 16.

MATH 120 Introductory Calculus
MATH 220 Calculus II
MATH 203 Linear Algebra

Ten additional credit hours at the 200 level or above, of which three credit hours must be at the 300 level or above.

See course listings for a complete list of courses offered.

Meteorology Minor

Credit Hours: 18

Minor Requirements:

At least nine credit hours in the minor at the 200 level or above must be earned at the College of Charleston.

Core courses (one from the following):

PHYS 105 Introduction to Meteorology
PHYS 308 Atmospheric Physics

One year of basic physics (two courses):

PHYS 101
Czwazka, Franklin James

From: Mignone, Robert J
Sent: Thursday, December 18, 2014 11:36 AM
To: Jones, Martin L; Czwazka, Franklin James
Cc: Boyd, Cathy; Mackeldon, Jerry W
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Cc: "Springer, Bonnie C" <SpringerB@cofc.edu>, Lynne Ford <fordl@cofc.edu>, "Czwazka, Franklin James" <CzwazkaF@cofc.edu>, Jerry Mackeldon <mackeldonj@cofc.edu>
Subject: MATH Curriculum Proposals for December 2014

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Thanks!
Franklin

Franklin J. Czwazka, M.A.
Catalog Manager | Office of the Registrar, College of Charleston
66 George Street | Charleston, SC 29424
843.953.5421 (voice) | 843.953.6560 (fax) | czwazkaf@cofc.edu
Office of the Registrar website: http://registrar.cofc.edu/
Academic Catalogs: http://catalogs.cofc.edu/
FACULTY CURRICULUM COMMITTEE  
CHANGE/DELETE PROGRAM FORM

Instructions:
• Please fill out all of the portions of the form that are specified in section 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, please start by checking the detailed instructions on the website.
• Please feel free to contact the committee chair with any remaining questions you might have.

A. CONTACT INFORMATION.

Name: Martin Jones  
Phone: 953-5735  
Email: jonesm@cofc.edu

School: Science and Mathematics  
Department or Program: Mathematics

Name and Acronym of Major: B.S. Mathematics MATH

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

☐ Change Request (fill out all sections)
  ☐ Add an existing course to requirements or electives
  ☒ Add a new course to requirements or electives (attach completed course form for each)
  ☐ Delete courses from requirements or electives
  ☐ Add or modify concentration*
  ☐ Add or modify cognate*

*Note: Only concentrations and cognates requiring 18 or more credit hours will be tracked in Banner and Degree Works and noted on the transcript.

☐ Terminate Program (fill out E, G, H, and I)
  ☐ Terminate degree
  ☐ Terminate major
  ☐ Terminate concentration
  ☐ Terminate cognate

C. GENERAL INFORMATION

Number of Current Credit Hours (for existing program): ___46___
Number of Proposed Credit Hours (for changed program): ___46+_______
Catalog Year in which changes will take effect: FALL 2015

D. CURRICULUM. Please list every change you are making below AND attach the current Program of Study Worksheet for this major (http://registrar.cofc.edu/program-of-study-resources/program-of-study-worksheets/index.php) with changes marked in RED. Additions should show where the course will be inserted, deletions should be noted by crossing out the course, and moves indicated with arrows. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions. Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus.

This form was last updated on 6/6/2013 and replaces all others.
E. **RATIONALE AND EXPLANATION.** Please provide a narrative addressing the request you are making and why you are making it.

We have offered these courses as topics courses in the past and would now like to add them permanently to our course listings.

*add MATH 460 and MATH 461
see attached email from Martin Jones*

F. **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><strong>1. Recognize different time series models and understand how to apply them.</strong></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><strong>2. Understand the mathematical and probabilistic theory behind the construction of time series models.</strong></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><strong>3. Be able to understand the mathematical proofs used in the development of the theory of time series models and be able to reproduce these ideas.</strong></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><strong>4. Be able to work with real time series data sets, apply the concepts of the theory and analyze the results.</strong></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 to real world situations by modeling phenomena such as signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting and control engineering using techniques of Time-Series Analysis.

**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 statistical results from the techniques of Time-Series Analysis.

**SLO 3 Students write complete, grammatically and logically correct arguments to prove their conclusions.** This program SLO will be addressed by the course student learning outcome 3. above.

H. **IMPACT ON EXISTING PROGRAMS AND COURSES.** Please describe the impact of this request on other programs and courses. If you are deleting a program, please describe the effect on all programs that will be impacted; if you are adding or changing a program, please explain any overlap with existing programs at the College.

This form was last updated on 6/6/2013 and replaces all others.  
Page 2 of 3
These two courses will enrich the Mathematics B.S. degree by providing upper-level electives for students interested in probability, statistics and actuarial science.

I. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings (including new faculty/staff requests, library, or equipment) associated with your request.

None, since we have already been offering Time-Series Analysis as a topics course, there will be no additional costs.

J. CHECKLIST

☐ I have completed all relevant parts of the form.

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

☐ I have attached a Course Form for each newly-created or modified course.

☐ (For proposals that affect other departments in any way) I have attached an acknowledgement from the relevant department.

☐ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the description and course list, exactly as it should appear in the catalog.

☐ I have submitted one Signature Form that lists all of the different forms I am submitting.
Math Major with Statistics Track Requirements
Catalog Year: 2014-15
Degree: Bachelor of Science
Credit Hours: 46+

“PR” indicates a pre-requisite. “CO” indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

☐ MATH 120  Introductory Calculus (4) PR: Placement or C- or better in MATH 111
☐ MATH 220  Calculus II (4) PR: MATH 120 or HONS 115
☐ MATH 203  Linear Algebra (3) PR: MATH 120 or instructor permission
☐ MATH 221  Calculus III (4) PR: MATH 220

Select one of the following tracks (Actuarial, Applied, Pure, Statistics or Teacher Education):

Statistics Track

☐ MATH 295  Introduction to Abstract Mathematics (3) PR: MATH 203 or MATH 221
☐ MATH 311  Advanced Calculus I (3) PR: MATH 221 and MATH 295
☐ MATH 250  Statistical Methods I (3) PR: MATH 105 with a C- grade or better or MATH 111 or MATH 120 or permission of instructor
☐ MATH 350  Statistical Methods II (3) PR: MATH 120 and MATH 250
☐ MATH 430  Mathematical Statistics I (3) PR: MATH 221
☐ MATH 431  Mathematical Statistics II (3) PR: MATH 430

Select one of the following course/lab pairings:

☐ ____________________  ☐ ____________________  lab

CSCI 220  Computer Programming I (3) PR: CSCI 120 or CSCI 180 or CSCI 210 or MATH 111 or department permission
CSCI 220L Computer Programming I Lab (1) PR or CO: CSCI 220

OR

MATH 245  Numerical Methods and Mathematical Computing (3) PR: MATH 203 or MATH 220 or instructor permission; CO: MATH 246
MATH 246  Mathematical Computing and Programming Lab (1) PR: MATH 220 or instructor permission

Select 9 additional credit hours from the following:

☐ ____________________  ☐ ____________________  ☐ ____________________

CSCI 334  Data Mining (3) PR: CSCI 221 and MATH 207 and MATH 250
MATH 440  Statistical Learning I (3) PR: MATH 203 and MATH 220 and MATH 350
MATH 441  Statistical Learning II (3) PR: MATH 440
MATH 451  Linear Programming and Optimization (3) PR: MATH 203 and MATH 221, and CSCI 220 or MATH 245, or instructor permission
MATH 452  Operations Research (3) PR: MATH 203 and MATH 430, and CSCI 220 or MATH 245
MATH 455  Bayesian Statistical Methods (3) PR: MATH 430

MATH 460  Stochastic Processes
MATH 461  Time Series
MATH 475* Statistical Consulting (3) PR: MATH 350 and one of MATH 440 or MATH 441 or MATH 451 or MATH 452 or CSCI 334

Note: *MATH 475 Statistical Consulting is the recommended capstone for this track.
Math Major with Actuarial Track Requirements
Catalog Year: 2014-15
Degree: Bachelor of Science
Credit Hours: 52+

"PR" indicates a pre-requisite. "CO" indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

☐ MATH 120    Introductory Calculus (4) PR: Placement or C or better in MATH 111
☐ MATH 220    Calculus II (4) PR: MATH 120 or HONS 115
☐ MATH 203    Linear Algebra (3) PR: MATH 120 or instructor permission
☐ MATH 221    Calculus III (4) PR: MATH 220

Select one of the following tracks (Actuarial, Applied, Pure, Statistics or Teacher Education):

Actuarial Track
☐ MATH 250    Statistical Methods I (3) PR: MATH 105 with a C-grade or better or MATH 111 or MATH 120 or permission of instructor
☐ MATH 350    Statistical Methods II (3) PR: MATH 120 and MATH 250
☐ MATH 430    Mathematical Statistics I (3) PR: MATH 221
☐ MATH 431    Mathematical Statistics II (3) PR: MATH 430

Select one of the following course/lab pairings:

☐ ___________    ☐ ___________ lab

CSCI 220    Computer Programming I (3) PR: CSCI 120 or CSCI 180 or CSCI 210 or MATH 111 or department permission
CSCI 220L   Computer Programming I Lab (1) PR or CO: CSCI 220

OR

☐ MATH 245    Numerical Methods and Mathematical Computing (3) PR: MATH 203 or MATH 220 or instructor permission; CO: MATH 246
☐ MATH 246    Mathematical Computing and Programming Lab (1) PR: MATH 220 or instructor permission

Select 3 additional credit hours from the following:

☐ ___________

☐ MATH 440    Statistical Learning I (3) PR: MATH 203 and MATH 220 and MATH 350
☐ MATH 445    Numerical Analysis (3) PR: MATH 203 and MATH 245 and MATH 323
☐ MATH 451    Linear Programming and Optimization (3) PR: MATH 203 and MATH 221, and CSCI 220 or MATH 245, or instructor permission

Business Coursework

☐ ACCT 203    Financial Accounting (3) PR: Sophomore standing
☐ ACCT 204    Managerial Accounting (3) PR: ACCT 203; sophomore standing
☐ ECON 200    Principles of Microeconomics (3) PR: None
☐ ECON 201    Principles of Macroeconomics (3) PR: ECON 200

MATH 460    Stochastic Processes
MATH 461    Time Series
FINC 303  Business Finance (3) PR: ACCT 203, 204, ECON 200, 201, MATH 104/250; junior standing

FINC 385  Individual Risk Management and Insurance (3) PR: Junior standing
Math Major with Applied Track Requirements
Catalog Year: 2014-15
Degree: Bachelor of Science
Credit Hours: 46+

"PR" indicates a pre-requisite. "CO" indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

Required Courses

☐ MATH 120  Introductory Calculus (4) PR: Placement or C- or better in MATH 111
☐ MATH 220  Calculus II (4) PR: MATH 120 or HONS 115
☐ MATH 203  Linear Algebra (3) PR: MATH 120 or instructor permission
☐ MATH 221  Calculus III (4) PR: MATH 220

Select one of the following tracks (Actuarial, Applied, Pure, Statistics or Teacher Education):

Applied Track

☐ MATH 245  Numerical Methods and Mathematical Computing (3) PR: MATH 203 or MATH 220 or instructor permission; CO: MATH 246
☐ MATH 246  Mathematical Computing and Programming Lab (1) PR: MATH 220 or instructor permission
☐ MATH 295  Introduction to Abstract Mathematics (3) PR: MATH 203 or MATH 221
☐ MATH 311  Advanced Calculus I (3) PR: MATH 221 and MATH 295
☐ MATH 315  Introduction to Complex Variables (3) PR: MATH 221 with a grade of C or better
☐ MATH 323  Differential Equations (3) PR: MATH 221 and MATH 203 or instructor permission
☐ MATH 430  Mathematical Statistics I (3) PR: MATH 221

Select one of the following courses:

☐ MATH 303  Abstract Algebra I (3) PR: MATH 203 and MATH 295
☐ MATH 402  Advanced Linear Algebra (3) PR: MATH 203, and MATH 303 and/or MATH 311

Select two courses from the following:

☐ MATH 423  Introduction to Partial Differential Equations (3) PR: MATH 221 and MATH 323
☐ MATH 431  Mathematical Statistics II (3) PR: MATH 430
☐ MATH 445  Numerical Analysis (3) PR: MATH 203 and MATH 245 and MATH 323
☐ MATH 451  Linear Programming and Optimization (3) PR: MATH 203 and MATH 221, and CSCI 220 or MATH 245, or instructor permission
☐ MATH 452  Operations Research (3) PR: MATH 203 and MATH 430, and CSCI 220 or MATH 245
☐ MATH 470  Mathematical Modeling (3) PR: MATH 203 and MATH 323, and MATH 246 or CSCI 220, or instructor permission

Select one additional course at the 400-level or above:

☐
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 401</td>
<td>Intro Point Set Topology (3)</td>
<td>PR: MATH 311</td>
</tr>
<tr>
<td>MATH 402</td>
<td>Advanced Linear Algebra (3)</td>
<td>PR: MATH 203 and MATH 303 or MATH 311</td>
</tr>
<tr>
<td>MATH 403</td>
<td>Abstract Algebra II (3)</td>
<td>PR: MATH 303</td>
</tr>
<tr>
<td>MATH 411</td>
<td>Advanced Calculus II (3)</td>
<td>PR: MATH 203 and MATH 311</td>
</tr>
<tr>
<td>MATH 415</td>
<td>Complex Analysis (3)</td>
<td>PR: MATH 311</td>
</tr>
<tr>
<td>MATH 417</td>
<td>Reading and Research (1-3)</td>
<td>PR: Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td>MATH 418</td>
<td>Reading and Research (1-3)</td>
<td>PR: Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td>MATH 421</td>
<td>Vector and Tensor Analysis (3)</td>
<td>PR: MATH 311</td>
</tr>
<tr>
<td>MATH 423</td>
<td>Introduction to partial Differential Equations (3)</td>
<td>PR: MATH 221 and MATH 323</td>
</tr>
<tr>
<td>MATH 430</td>
<td>Mathematical Statistics I (3)</td>
<td>PR: MATH 221</td>
</tr>
<tr>
<td>MATH 431</td>
<td>Mathematical Statistics II (3)</td>
<td>PR: MATH 430</td>
</tr>
<tr>
<td>MATH 440</td>
<td>Statistical Learning I (3)</td>
<td>PR: MATH 203 and MATH 220 and MATH 350</td>
</tr>
<tr>
<td>MATH 441</td>
<td>Statistical Learning II (3)</td>
<td>PR: MATH 440</td>
</tr>
<tr>
<td>MATH 445</td>
<td>Numerical Analysis (3)</td>
<td>PR: MATH 203 and MATH 245 and MATH 323</td>
</tr>
<tr>
<td>MATH 451</td>
<td>Linear Programming and Optimization (3)</td>
<td>PR: MATH 203 and MATH 221 and CSCI 220 or MATH 245 or instructor permission</td>
</tr>
<tr>
<td>MATH 452</td>
<td>Operations Research (3)</td>
<td>PR: MATH 203 and MATH 430 and CSCI 220 or MATH 245</td>
</tr>
<tr>
<td>MATH 455</td>
<td>Bayesian Statistical Methods (3)</td>
<td>PR: MATH 430</td>
</tr>
<tr>
<td>MATH 470</td>
<td>Mathematical Modeling (3)</td>
<td>PR: MATH 203 and MATH 323 and MATH 246 or CSCI 220 or instructor permission</td>
</tr>
<tr>
<td>MATH 485</td>
<td>Topics in Pure Mathematics (3)</td>
<td>Pr: Instructor permission</td>
</tr>
<tr>
<td>MATH 480</td>
<td>Topics in Applied Mathematics (3)</td>
<td>Pr: Instructor permission</td>
</tr>
<tr>
<td>MATH 490</td>
<td>Practicum in Mathematics (3)</td>
<td>PR: Senior standing; instructor and department chair permission</td>
</tr>
<tr>
<td>MATH 499</td>
<td>Bachelor's Essay (6)</td>
<td>PR: Instructor and department chair permission</td>
</tr>
</tbody>
</table>

- MATH 460: Stochastic Processes
- MATH 461: Time Series
Math Major with Pure Track Requirements  
Catalog Year: 2014-15  
Degree: Bachelor of Science  
Credit Hours: 46+

"PR" indicates a pre-requisite. "CO" indicates a co-requisite.

Courses within this major may also satisfy general education requirements. Please consult http://registrar.cofc.edu/general-edu for more information.

**Required Courses**

- **MATH 120**  
  Introductory Calculus (4) PR: Placement or C- or better in MATH 111

- **MATH 220**  
  Calculus II (4) PR: MATH 120 or HONS 115

- **MATH 203**  
  Linear Algebra (3) PR: MATH 120 or instructor permission

- **MATH 221**  
  Calculus III (4) PR: MATH 220

Select one of the following tracks (Actuarial, Applied, Pure, Statistics or Teacher Education):

**Pure Track**

- **MATH 295**  
  Introduction to Abstract Mathematics (3) PR: MATH 203 or MATH 221

- **MATH 303**  
  Abstract Algebra I (3) PR: MATH 203 and MATH 295

- **MATH 311**  
  Advanced Calculus I (3) PR: MATH 221 and MATH 295

- **MATH 315**  
  Introduction to Complex Variables (3) PR: MATH 221 with a grade of C or better

- **MATH 323**  
  Differential Equations (3) PR: MATH 221, and MATH 203 or instructor permission

- **MATH 340**  
  Axiomatic Geometry (3) PR: MATH 295 or instructor permission

Select one of the following course/lab pairings:

- **CSCI 220**  
  Computer Programming I (3) PR: CSCI 120 or CSCI 180 or CSCI 210 or MATH 111 or department permission

- **CSCI 220L**  
  Computer Programming I Lab (1) PR or CO: CSCI 220

**OR**

- **MATH 245**  
  Numerical Methods and Mathematical Computing (3) PR: MATH 203 or MATH 220 or instructor permission; CO: MATH 246

- **MATH 246**  
  Mathematical Computing and Programming Lab (1) PR: MATH 220 or instructor permission

Select one of the following courses:

- **MATH 403**  
  Abstract Algebra II (3) PR: MATH 303

- **MATH 411**  
  Advanced Calculus II (3) PR: MATH 203 and MATH 311

Select 6 credit hours from the following 400-level MATH courses:

- **MATH 401**  
  Intro Point Set Topology (3) PR: MATH 311

- **MATH 402**  
  Advanced Linear Algebra (3) PR: MATH 203, and MATH 303 and/or MATH 311

- **MATH 403**  
  Abstract Algebra II (3) PR: MATH 303
MATH 411  Advanced Calculus II (3) PR: MATH 203 and MATH 311
MATH 415  Complex Analysis (3) PR: MATH 311
MATH 417  Reading and Research (1-3) PR: Senior standing; instructor and department chair permission
MATH 418  Reading and Research (1-3) PR: Senior standing; instructor and department chair permission
MATH 421  Vector and Tensor Analysis (3) PR: MATH 311
MATH 423  Introduction to Partial Differential Equations (3) PR: MATH 221 and MATH 323
MATH 430  Mathematical Statistics I (3) PR: MATH 221
MATH 431  Mathematical Statistics II (3) PR: MATH 430
MATH 440  Statistical Learning I (3) PR: MATH 203 and MATH 220 and MATH 350
MATH 441  Statistical Learning II (3) PR: MATH 440
MATH 445  Numerical Analysis (3) PR: MATH 203 and MATH 245 and MATH 323
MATH 451  Linear Programming and Optimization (3) PR: MATH 203 and MATH 221, and CSCI 220 or MATH 245, or instructor permission
MATH 452  Operations Research (3) PR: MATH 203 and MATH 430, and CSCI 220 or MATH 245
MATH 455  Bayesian Statistical Methods (3) PR: MATH 430
MATH 470  Mathematical Modeling (3) PR: MATH 203 and MATH 323, and MATH 246 or CSCI 220, or instructor permission
MATH 480  Topics in Applied Mathematics (3; repeatable) PR: Instructor permission
MATH 485  Topics in Pure Mathematics (3) PR: Instructor permission
MATH 490  Practicum in Mathematics (3) PR: Senior standing; instructor and department chair permission
MATH 499  Bachelor's Essay (3) PR: Instructor and department chair permission

MATH 460  Stochastic Processes
MATH 461  Time Series
Final work given. Go ahead Franklin. You’re right about the teacher education track. No electives so leave 460 and 461 off. Bob

Hello Franklin,

I’d better let Bob weigh in on the Teacher Education Track. It sounds good to me, but I would want him to give you the final word. Thanks so much for your help on this.

Best,
Martin

On Dec 18, 2014, at 10:25 AM, Czwaszka, Franklin James wrote:

Martin,

Thank you for getting back to us so quickly. I have marked up the attached Program of Study worksheets for each track to show the inclusion of MATH 460 and 461. Please confirm that each is correct.

We do have a question about the Teacher Education Track since there are no electives listed only required courses. Should this track be excluded since it doesn’t have a list of electives and therefore MATH 460 and 461 would not be added?

Thanks!
Franklin

Response??

From: Jones, Martin L
Sent: Wednesday, December 17, 2014 4:55 PM
To: Mignone, Robert J
Cc: Boyd, Cathy  
Subject: Re: MATH Curriculum Proposals for December 2014

Hello Bob and Cathy. Our plan was to have Math 460 and 461 be elective courses in the stat track, but could be used as 400-level electives in any of the tracks. Best, Martin

Sent from my iPhone

On Dec 17, 2014, at 3:51 PM, "Mignone, Robert J" <MignoneR@cofc.edu> wrote:

Hi Cathy,

I’m cc’ing Martin Jones on my response, since the proposals originated with Martin and he has the surest knowledge of where those courses belong in each of the five tracks for the BS, and the BA.

Bob

From: <Boyd>, Cathy Boyd <boydc@cofc.edu>  
Date: Wednesday, December 17, 2014 at 3:12 PM  
To: Robert Mignone <Mignoner@cofc.edu>  
Cc: “Springer, Bonnie C” <SpringerB@cofc.edu>, Lynne Ford <fordl@cofc.edu>, “Czwazka, Franklin James” <CzwazkaF@cofc.edu>, Jerry Mackeldon <mackeldonj@cofc.edu>  
Subject: MATH Curriculum Proposals for December 2014

Bob,

In our review of the MATH curriculum proposals received in December:
The major change proposals (both B.S. and B.A.) as well the minor change proposal don’t explicitly list the new MATH 460 and 461 course. We can amend the forms to explicitly list them once confirmed. Also neither major change proposals show exactly where the new courses will fall within the requirements. Also, there were two major changes (B.S.) submitted—we will just condense the changes into a single proposal.

In two of the tracks, Pure Math track and Applied Math track, and in the B.A. Math major, these two new 400 level courses would be added to the, “Select 6 credit hours from the following 400 level MATH courses”. But, there is no such section for the Actuarial track, the Statistics track, nor the Math with Teacher Education major. If these courses are to be added to these, it needs to be stated exactly where they should fall. Otherwise, these should be pulled from the MATH packet.

We will need to confirm that the only courses they’re adding are the new MATH 460 and 461 and also where they would fall within each track if they’re to count. Once received I will amend the forms accordingly and include the email exchange as documentation.

Thanks!
Franklin

Franklin J. Czwazka, M.A.
Catalog Manager | Office of the Registrar, College of Charleston
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Office of the Registrar website: http://registrar.cofc.edu/
Academic Catalogs: http://catalogs.cofc.edu/