Texas A&M University-Corpus Christi

College of Science and Engineering
Department of Physical and Environmental Sciences

CMSS 6352: Environmental Forecasting

Fall 2013 - Course Syllabus

INSTRUCTOR:
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Office: NRC-2801 E-mail: philippe.tissot@tamucc.edu

Office hours: T 4:00-5:00 - R 4:00-5:00PM – regular availability with prior arrangement

CLASS MEETINGS:
TR 2:00-3:15 PM Classroom: OCNR-255

TEXTBOOKS:

Class Textbook, Required:

Secondary Class References (not required, available at time from instructor):

CMSS 6352 Syllabus – Fall 2013 - 1/6
I. COURSE DESCRIPTION
Statistical techniques and new artificial intelligence based techniques, such as neural networks, for the analysis of and forecasting of environmental systems. Emphasis on the forecasting of coastal and marine systems. Prerequisites: CMSS 6303, Natural Systems Analysis, CMSS 6305, Natural Systems Modeling or approval of instructor.

II. COURSE AUDIENCE
PhD Students in the Coastal and Marine Science System Science program are the primary audience for this course. Secondary audience includes graduate students (Masters) in Mathematics and Environmental Science and professional forecasters from the local office of the National Weather Service.

III. STUDENT LEARNING OUTCOMES
At the conclusion of this course the student should be able to:
1. Express forecasting problems with the proper mathematical formulation.
2. Recognize the differences between deterministic and chaotic systems and the limits to the forecasting of chaotic systems.
3. Identify the differences between statistically based and first principle based models.
4. Generate climatic forecasts for environmental systems based on simple historical data sets.
5. Utilize computer technology (the Matlab computational environment) to make environmental forecasts.
6. Apply a range of statistical measures to characterize the performance of forecasting models and analyze the results.
7. Recognize the main models presently used by researchers and state agencies to make forecasts for oceanographic, atmospheric and ecological systems.
8. Recognize the difference between linear and non-linear forcings in environmental systems.
9. Apply artificial neural network model to make basic environmental forecasts
10. Recognize the differences between training, verification, and testing sets and formulate strategies to divide historical data sets into training, verification and training sets.
11. Recognize the different Artificial Intelligence Based techniques applicable to the forecast of environmental systems.
12. Write a proposal for the design and application of a forecasting model to an environmental system.
13. Evaluate peer students proposals for forecasting models.
14. Design, apply and measure the performance of a forecasting model for a specific environmental system, preferably related to the student’s own research area.

IV. COURSE TOPICS
Forecasting of environmental systems, deterministic and chaotic systems, climatic forecasting, evaluation of forecasting models, analysis of time series, ARMA models, seasonal time series, multivariate time series, non-linear systems, artificial neural networks, ensemble forecasting.
V. INSTRUCTIONAL METHODS AND ACTIVITIES
Traditional lectures via board demonstrations and power point presentations, interactive model building with Matlab, classroom discussions, student projects, and visit of the local National Weather Service Office.

VI. EVALUATION AND GRADE ASSIGNMENT

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Overall Grade Percentage</th>
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<tbody>
<tr>
<td>Homework, Journal Article Reviews &amp; class topic presentations</td>
<td>15%</td>
</tr>
<tr>
<td>Mid-term Exam</td>
<td>20%</td>
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<tr>
<td>Research Proposal</td>
<td>15%</td>
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<tr>
<td>Assessment of Peers Research Proposals</td>
<td>10%</td>
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<tr>
<td>Project and Project Report/Poster</td>
<td>30%</td>
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<tr>
<td>Project Presentation</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>100%</strong></td>
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</tbody>
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Class Average X

<table>
<thead>
<tr>
<th>Grade</th>
<th>Class Average X</th>
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<tbody>
<tr>
<td>A - Excellent</td>
<td>X ≥ 85.0%</td>
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<tr>
<td>B – Good</td>
<td>70.0% ≤ X &lt; 85.0%</td>
</tr>
<tr>
<td>C - Satisfactory</td>
<td>55.0% ≤ X &lt; 70.0%</td>
</tr>
<tr>
<td>D - Passing</td>
<td>40.0% ≤ X &lt; 55.0%</td>
</tr>
<tr>
<td>F - Failing</td>
<td>X &lt; 40.0%</td>
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VII. ATTENDANCE AND OTHER COURSE POLICIES

Students are required to attend all class meetings. Participation is essential to do well in the class. Discussions and student input are considered an important part of the class. Class exams cannot be retaken other than for an excused absence. Excused absences are limited to medical emergencies that can be certified in writing by a physician, participation in a TAMUCC sanctioned event or other similar circumstances justified in writing and specified in the TAMUCC graduate catalog for the ongoing academic year. Assignments are expected on time unless prior arrangements are made. Such prior arrangements will be granted only in exceptional circumstances as well. Submitting an assignment late without prior arrangement may lead to a grade of 0 and at least to a substantial penalty.
ACADEMIC INTEGRITY

The instructor expects a high level of personal integrity on the part of students enrolled in the course. Please review the University policies on academic integrity and honesty listed in the Catalog under Academic Integrity and Academic Honesty in the General Academic Policies and Regulations section of the catalog. The instructor will follow these guidelines if infractions such as plagiarism or other dishonest conduct occurs as part of this class. These guidelines will be followed for both the evaluation of the gravity of the infraction and the determination of an appropriate penalty. Any student who has been penalized for academic dishonesty has the right to appeal the judgment or the penalty assessed. The Appeals Procedure will be the same as that specified for grade appeals. The grade appeals procedure may be found in the University Rules & Procedures website at: http://academicaffairs.tamucc.edu/Rules_Procedures/index.html.

GRADE APPEAL PROCESS:

As stated in University Rule 13.02.99.C2, Student Grade Appeals, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Rule 13.02.99.C2, Student Grade Appeals, and University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules Web site at http://www.tamucc.edu/provost/university_rules/index.html. For assistance and/or guidance in the grade appeal process, students may contact the Office of Student Affairs.

DROPPING A CLASS:

The Instructor hopes that you never find it necessary to drop this or any other class. However, unforeseen circumstances in the middle of the term may make dropping a course necessary or wise. Please consult with the Instructor before you decide to drop to be sure it is the best thing to do. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class.
VIII. NOTICE TO STUDENTS WITH DISABILITIES

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call or visit Disability Services at (361) 825-5816 in Driftwood 101. Certain accommodations for the successful completion of the course by students with disabilities, like testing in a quiet, secluded room, or providing extra time as deemed appropriate, can be made, after the above office has determined the appropriateness of such accommodations for the disabled student. Any action regarding such accommodation will require prior written notice to the instructor by the Office for Students with Disabilities.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

IX. TENTATIVE COURSE PROGRESSION

The class will tentatively follow the succession of topics below. As this is a small graduate class with 5 students during its past 3 offerings, some adjustments in the topics covered and scheduling will be made after the first week based on student feedback and to better address students’ needs and interests. The class by class schedule of the 2011 class is available on demand.

Introduction to forecasting and chaotic systems, formulation of forecasting problems, statistically and first principle based systems
   Review of relevant probability and statistics concepts
   Simple climatic forecasts
   Forecast evaluations, verification
   Analysis of time series, ARMA models, spectral analysis
   Seasonal time series and multivariate time series
Description of present atmospheric, ocean, and ecological models used for coastal and marine systems
Visit of local office of National Weather Service Presentation– Discussion of student proposals
Survey of Artificial Intelligence (AI) techniques used in the environmental sciences
   Artificial Neural Networks (ANN)
   Random Forests (RFs)
Application of ANNs and RFs to environmental forecasting problems
   Ensemble forecasting and other forecasting techniques
   Presentations
BIBLIOGRAPHY


