Environmental Forecasting CMSS 6352
Department of Physical and Environmental Sciences
Fall 2017

A. COURSE INFORMATION

Course number/section: CMSS-6352.001
Class meeting time: TR 12:30-1:45PM
Class location: BH-207
Course Website: 41472.201709 [FALL-17]

B. INSTRUCTOR INFORMATION

Instructor: Philippe Tissot
Office location: NRC 2801
Office hours: TR 04:00-05:00, regular availability with prior arrangement
Telephone: 361-825-3776
e-mail: philippe.tissot@tamucc.edu
Appointments: upon request

C. COURSE DESCRIPTION

Catalog 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.

Extended Course Description
Topics covered will include more specifically with adjustments based on class interests: analysis and predictions of environmental systems, deterministic and chaotic systems, climatic predictions, evaluation of forecasting models, analysis of time series, ARMA models, seasonal time series, multivariate time series, non-linear systems, artificial neural networks, random forest analysis, ensemble forecasting.

The course adopts a data intensive approach to the analysis and prediction of environmental systems well suited for a system science program. The course builds on the more mathematical focus of the program core courses with a progression focused on predictive modeling and data for homework and class projects selected by each student to complement and advance their research. The modeling techniques and skills acquired during the class are relevant to employment in agencies working with large environmental data sets and for other employment taking advantage of big data resources. Additional relevant skills include the development of a proposal and the evaluation of class peers’ proposals in a format similar to the proposal submission and review of federal agencies.
D. **PREREQUISITES AND COREQUISITES**

**Prerequisites**
CMSS 6303, Natural Systems Analysis, CMSS 6305, Natural Systems Modeling or approval of instructor.

**Corequisites**
None

E. **REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES**

**Required Textbook(s)**

**Optional Textbook(s) or Other References**

**Supplies**
None
F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. Recognize the differences between deterministic, chaotic, stochastic systems and the limits to their respective predictability.
2. Identify the differences between statistically based and first principle based models.
3. Generate climatic forecasts for environmental systems based on simple historical data sets.
4. Utilize computer technology (e.g. the Matlab computational environment) to analyze data and make environmental forecasts.
5. Apply a range of statistical measures to characterize the performance of forecasting models and analyze the results.
6. Recognize the differences between linear and non-linear forcings and implications in environmental systems.
7. Apply an AI or other modeling technique to compute environmental predictions.
8. Recognize the differences between training, verification, and testing sets and formulate strategies to divide historical data sets into training, verification and training sets.
9. Recognize different Artificial Intelligence based techniques applicable to the forecast of environmental systems.
10. Write a proposal for the design and application of a forecasting model to an environmental system.
11. Evaluate peer students proposals of forecasting models.
12. Design, apply and measure the performance of a forecasting model for a specific environmental system, preferably related to the student’s own research area.

G. 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.

H. MAJOR COURSE REQUIREMENTS AND GRADING

Student learning outcomes described in Section F will be assessed based on the evaluation instruments described in the tables below.
### ACTIVITY % of FINAL GRADE

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Research Proposal</td>
<td>15%</td>
</tr>
<tr>
<td>Assessment of Peers Research Proposals</td>
<td>10%</td>
</tr>
<tr>
<td>Mid-term Exam</td>
<td>20%</td>
</tr>
<tr>
<td>Project and Project Report/Poster</td>
<td>30%</td>
</tr>
<tr>
<td>Presentation</td>
<td>10%</td>
</tr>
</tbody>
</table>

### I. COURSE CONTENT/SCHEDULE

It would be great and really appreciated if the updated Syllabi is completed by September 15. (Please send Alison a copy of the updated Syllabi.)

<table>
<thead>
<tr>
<th>DATE (BY DAY OR WEEK)</th>
<th>TOPIC</th>
<th>CHAPTER(S)</th>
<th>ASSIGNMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 9/5</td>
<td>Class introduction &amp; discussion of environmental systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 9/7</td>
<td>Types of environmental systems, dynamics and modeling approaches,</td>
<td>Read Trauth Chapter 1</td>
<td>Hmwrk #1: Send an e-mail to the instructor with a short paragraph describing the topic you would like to study (&lt;100 words) and the data set(s) that could support your study (data set not included in 100 words)</td>
</tr>
<tr>
<td>9/12</td>
<td>Predictability of environmental systems and chaotic nature of the</td>
<td>Read Wilks Chaps 1 &amp; 2</td>
<td>Hmwrk #2: Prepare and send the instructor one graph with spatial or time series data related to the topic you want to study</td>
</tr>
<tr>
<td>T 9/12</td>
<td>No Class – Class replaced by field trip to NWS a Friday morning later during semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 9/14</td>
<td>Mechanistic modeling and discretization of an environmental system/</td>
<td></td>
<td>Hmwrk #3: Augment your graph constructed as part of hwrk #2 with statistical measures including mean,</td>
</tr>
<tr>
<td>T 9/19</td>
<td>Start of Probabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Topics</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------</td>
<td>--------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>R 9/21</td>
<td>Probabilities, Bayes theorem &amp; application, descriptive statistics</td>
<td>Preferably use your selected computational environment</td>
<td></td>
</tr>
<tr>
<td>T 9/26</td>
<td>Artificial Neural Networks</td>
<td>Hmwrk #4: Select computational environment and implement Trauth problems from Chaps 1 &amp; 2</td>
<td></td>
</tr>
<tr>
<td>R 9/28</td>
<td>Random Forests</td>
<td><strong>Proposal Titles and Outlines</strong></td>
<td></td>
</tr>
<tr>
<td>T 10/3</td>
<td>Wilks Chapter 3</td>
<td>Read assigned sections from Wilks Chapter 3</td>
<td></td>
</tr>
<tr>
<td>R 10/5</td>
<td>Topics from Wilks Chapters 4 &amp; 5</td>
<td>Read assigned sections from Wilks Chapters 4,5</td>
<td></td>
</tr>
<tr>
<td>T 10/10</td>
<td>Topics from Wilks Chapters 4 &amp; 5</td>
<td>Read assigned sections from Wilks Chapters 4,5</td>
<td></td>
</tr>
<tr>
<td>R 10/12</td>
<td>Topics from Wilks Chapters 4 &amp; 5</td>
<td>Hmwrk #6: Discretization homework</td>
<td></td>
</tr>
<tr>
<td>T 10/17</td>
<td>Topics from Wilks Chapters 4 &amp; 5</td>
<td>Read assigned sections from Wilks Chapters 4,5</td>
<td></td>
</tr>
<tr>
<td>R 10/19</td>
<td>No Class – Class replaced by Friday afternoon discussion &amp; presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 10/20</td>
<td>Afternoon discussion (likely 2-3pm) with Dr. Valliapa Lakshmanan followed by presentation at TAMUCC College of Science and Engineering Series, HRI 127</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T 10/24</td>
<td>Data Imputation</td>
<td>Read data imputation text provided</td>
<td></td>
</tr>
<tr>
<td>T 10/26</td>
<td>Data Imputation &amp; Cycles, Harmonic and Spectral Analysis</td>
<td>Class Project Proposals Due</td>
<td></td>
</tr>
<tr>
<td>R 10/31</td>
<td>Cycles, Harmonic and Spectral Analysis</td>
<td>Peer Proposals Reviews Due</td>
<td></td>
</tr>
<tr>
<td>T 11/2</td>
<td>Statistical Forecasting</td>
<td>Read Wilks Chapt. 7.1 &amp; 7.2</td>
<td></td>
</tr>
<tr>
<td>R 11/2</td>
<td></td>
<td><strong>Mid-Term Grades</strong></td>
<td></td>
</tr>
<tr>
<td>T 11/7</td>
<td>Statistical Forecasting</td>
<td>Read Wilks Chapt. 7.3 &amp; 7.4</td>
<td></td>
</tr>
<tr>
<td>R 11/9</td>
<td>Statistical Forecasting</td>
<td>Read Wilks Chapt. 7.5-7.8</td>
<td></td>
</tr>
</tbody>
</table>
The overall class schedule will be discussed with the class at the beginning of the semester and potentially adjusted. In particular the timing of the visit to the National Weather Service will be discussed in class. The final exam time is tentatively reserved for project presentations but the overall schedule of project presentations will be discussed in class.

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES

Attendance/Tardiness
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.

Late Work and Make-up Exams
Assignments are expected on time unless prior arrangements are made. Such prior arrangements will be granted only in exceptional circumstances. Submitting an assignment late without prior arrangement may lead to a grade of 0 and at least to a substantial penalty.

Extra Credit
There are no provisions for extra credit.
Cell Phone Use
Cell phones must be set on vibrate and phone calls are allowed only in case of emergencies (provide explanation with the instructor once the emergency is resolved).

Laptop Use
Laptop use in the classroom is allowed when related to the class.

Food in Class
Allowed depending on building/room policies.

Missed Exam
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.

Participation
Participation is expected in classroom discussions, contributions from the students’ research relevant experience and other relevant participation within limit set by the instructor.

Others
None

K. COLLEGE AND UNIVERSITY POLICIES

- Academic Integrity (University)
University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- Classroom/Professional Behavior
Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.
• **Statement of Civility**
Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

• **Deadline for Dropping a Course with a Grade of W (University)**
I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course. 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. Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

• **Grade Appeals (College of Science and Engineering)**
As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, 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 Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

• **Disability Services**
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 (361) 825-5816 or
visit Disability Services in Corpus Christi Hall 116.

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.

http://disabilityservices.tamucc.edu/

• **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

• **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.