Vital Information

Instructor:
Pantelis Vlachos, Statistics
232K Baker Hall
268-1883
vlachos@stat.cmu.edu

Teaching Assistants:
Iuliana Ianus, Statistics
229J Baker Hall
iianus@stat.cmu.edu

Office Hours:
MWF 2:30–3:20
OR BY APPOINTMENT.

Graders:
Yangang Zhang yazhang@stat.cmu.edu
Jiayin Xiang jxiang@stat.cmu.edu

Required Text

Prerequisites
- A solid understanding of calculus, at the level of 21-122 (Calculus 2). This means that you must be able to integrate and differentiate standard functions (polynomials, exponentials, logarithms and trig functions), and you must be facile with techniques like integration by parts. A small amount of multivariable calculus and linear algebra will be used also.
- Sufficient familiarity with Andrew to write small programs in MATLAB or Minitab. Any specifics you need to know about these two packages will be covered in class or handouts. Please do not use other packages unless directed to do so by me.
Probability Theory and Random Processes

Probability theory underlies much of engineering analysis in electrical and computer engineering. It is also important in assessing the speed and efficiency of algorithms with typical (as opposed to worst-case) data, systems design, strategies for machine learning, computer vision and pattern recognition, and other topics in computer science.

Three different areas of probability theory are applied in ECE and CS:

- Probability models for reliability and for randomly evolving discrete processes (e.g., Networks, Systems Design, Switching, Algorithms).
- Transformations and filtering to reduce noise or make predictions for signals evolving continuously in time (e.g., Digital Communication, Signal Processing)
- Formal theories of inference and information used to create machines or programs that can make deductions from uncertain, inadequate, or noisy data (e.g., Computer Vision, Machine Learning, Speech Recognition, Coding Theory, Data Compression).

The primary goal of 36-217 is to give you a good foundation in the theory of probability, so that you can learn more about each of these areas of probability in your later coursework at CMU.

Unfortunately, probability theory without any applications is pretty dry stuff, so I will include some general application areas to illustrate concepts, including Monte Carlo simulation, Markov Chains, Reliability, and Continuous-Time Processes. Entire courses are based on each of these topics, so it is impossible to go into depth on any of them. However the exposure you gain here will be very valuable in your later coursework in ECE and CS.

Here is a rough course outline, with rough readings from Leon-Garcia. I will give you more detailed guidance on what to read as the course progresses.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Rough reading list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic data description</td>
<td>Handouts</td>
</tr>
<tr>
<td>Review of MATLAB</td>
<td>Handouts</td>
</tr>
<tr>
<td>Basic Probability</td>
<td>Leon-Garcia Ch. 2,</td>
</tr>
<tr>
<td>Discrete Random Variables</td>
<td>Leon-Garcia 3.1–3.6,</td>
</tr>
<tr>
<td>Law of Large Numbers</td>
<td>Handouts, Leon-Garcia 3.7, 3.9, 4.1–4.7 and 5.1–5.2</td>
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<td>First Midterm?</td>
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<tr>
<td>Markov Chains</td>
<td>Handouts, Leon-Garcia 6.1, 6.3 and 8.1–8.2</td>
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<tr>
<td>Continuous Random Variables</td>
<td>Leon-Garcia 3.1–3.6,</td>
</tr>
<tr>
<td>Central Limit Theorem</td>
<td>Handouts, Leon-Garcia 3.9, 4.1–4.7, 4.9 and 5.3</td>
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<tr>
<td>Second Midterm?</td>
<td></td>
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<tr>
<td>Continuous Time Processes</td>
<td>Leon-Garcia 4.8, 6.2, 6.4, 8.3</td>
</tr>
<tr>
<td>Reliability Theory</td>
<td>Leon-Garcia 3.10</td>
</tr>
<tr>
<td>Queueing Theory</td>
<td>Leon-Garcia 9.1–9.3</td>
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<tr>
<td>Signal Processing</td>
<td>Leon-Garcia 7.1–7.2</td>
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Course Grades

The final course grades will be based upon 600 points:

- Homework Assignments: 200 Points (all assignments combined)
- Two Midterm Exams: 100 Points Each
- Final Exam: 200 Points

I will drop your worst 100 points (the lower half of your homework scores, one midterm exam, or 50% of your final exam score) and use the remaining 500 points for your final grade. Grading is based on mastery of the material (90% guarantees an A, 80% a B, etc.).

Required Work

▷ Homework

I will assign approximately one problem set per week as homework. There will be mathematical problems, simulation and calculation problems using MATLAB and MINITAB, and reading and writing assignments, since all these are skills a good engineer should have.

All homework should be done in complete English sentences, with sensible math where necessary. Problems that are mostly math and hand-calculations should have enough English that someone can see what the problem is about without referring to the textbook. For calculations and simulations in MATLAB, the written interpretation and conclusions are at least as important as generation of appropriate m-files, diary files, raw output, etc.

Solution sheets will be handed out on the day that a homework assignment is due to provide immediate feedback. Consequently, late homework papers will not be accepted (except for excused illness). If you can’t make it to class, have a friend turn in your assignment for you. You should turn in assignments even if they are incomplete.

▷ Midterm Exams

The two midterm exams will be 90 minute evening exams. They are tentatively scheduled for:

<table>
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<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, September</td>
<td>6:30–8:00pm</td>
<td>TBA</td>
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<tr>
<td>Thursday, October</td>
<td>6:30–8:00pm</td>
<td>TBA</td>
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No makeup exams are planned. Students who must miss an exam for a health related reason should contact the instructor before the exam is given and provide an excuse from a health professional upon returning to class.

▷ Final Exam

Please be aware that the final exam will be administered at the time assigned by the CMU Registrar’s office. There are NO exceptions permitted, so be careful about scheduling your departure for Christmas vacation. The last date for final exams this term is Dec 16.
Grading on Homework and Exams

You should be aware that your work will be evaluated primarily on the method of solution and the ability to apply concepts. The numerical correctness of an answer plays a secondary role. A correct answer to a problem will receive more credit than an incorrect answer, but you will not receive any credit for a correct answer in which the method is either wrong or not given.

The Role of Homework

The homework assignments will contribute positively toward your final course grade; however, they are more valuable because they give you a chance to practice applying the concepts, and reinforce the material covered in class. How well or poorly you do on exams is usually directly related to how seriously you take the homework assignments all through the term.

Probability theory and stochastic modeling are skills best learned by trial and error, and by discussion. I encourage you to discuss homework problems with each other. However, your solutions and writeups to problems must be your own. Do not copy derivations, m-files, output files, writeups, etc. from any other source (another student, last year’s solutions, etc.), since I will treat this as cheating.

Policy on Cheating

Cheating and/or plagiarism will not be tolerated. Please see the 1997-98 CMU Student Handbook for definitions of cheating and plagiarism, and the severe consequences of such behavior. Some collaboration on the homework assignments is permitted, as described above. No collaboration is allowed on exams.

MATLAB and MINITAB

Most homework assignments will include some work with MATLAB, and one or two may include work with MINITAB. I will provide handouts to help you get started on these if you need them. Please use only the packages that I direct you to use.

Class Notes

There will be many handouts to supplement the textbook, which I will distribute in class.
Bboard, Data Directory and Web Page, Old Assignments

- There is a WWW bboard for this class,

  http://www.stat.cmu.edu/~vlachos/217/wwwboard/

Announcements and discussions of problems and other issues on the bboard are part of the class; please read it regularly. If you want to be sure that I see a question you post quickly, send a copy to vlachos@stat.cmu.edu also. If you have a private question or comment, or you are unsure whether your response to a bboard post is “giving the answer away”, send your response to me alone and I will post your answer to the bboard only if it is appropriate.

- We also have a class data directory, /afs/andrew/stat/data/217. As much as possible, I will leave copies of (1) m-files, documentation, and other useful aids for MATLAB homework problems; and (2) PostScript copies of handouts from class; in this directory and its subdirectories. On the Web, use URL http://www.stat.cmu.edu/~vlachos/217.

- I will hand out graded assignments in class. Unclaimed homework, as well as leftover copies of old handouts, will be left on one of the white bookshelves in the reception area of 132 Baker Hall.

Other Books

Here are some other books which interested students may find useful:

- Papoulis, *Probability and Statistics*
- O’Flynn, *Probabilities, Random Variables and Random Processes*
- Helstrom, *Probability and Stochastic Processes for Engineers*
- DeGroot, *Probability and Statistics*
- Devore, *Probability and Statistics for Engineering and the Sciences*
- Meyer, *Introductory Probability and Statistical Applications*
- Ross, *A First Course in Probability*
- Vardeman, *Statistics for Engineering Problem Solving*

If you are interested in computer simulation and experimentation with probability models, some good books to examine are:

Study Tips for 36-217: Probability Theory and Random Processes
or
How to Use Your Study Time More Efficiently

1. **Take notes in class, and read them** over within 24 hours of lecture (or at least once before the next lecture). As you reread your notes:
   - Highlight or make marginal notes for important words and concepts. This will help firm up your ideas, and will help you to actively learn the material. This review takes about 20–30 minutes and really yields a large return.
   - Re-do examples yourself, step by step, with pencil and paper. Examples sometimes look easy when explained in class, but often turn out to be much harder when you do them yourself.
   - Write down questions about things you do not understand. Bring these questions to lecture, recitation and to office hours and ask them.

2. Readings are assigned for each class. **Read them before the class for which they are assigned** if at all possible, and if not, then certainly after that class and before the next. Also, as you read, highlight, re-work examples yourself, and write down questions, as suggested above.

3. **DO HOMEWORK PROBLEMS.** Actively doing problems is the *only* way to learn the material.
   - Start early. Do not leave assignments until the night before they are due.
   - Try doing the problems yourself before discussing them with other people.

4. **Use office hours** productively. Bring your questions so we can talk about them. If you do (1)–(3) above, it will be much easier to isolate what is giving you trouble, or to extend your knowledge of something you already understand.

5. **Review solutions** to assignments and exams. Just because you got full credit on a homework or exam question does not necessarily mean you fully understand the question and the answer. Also, the solutions should serve as a model for how to write, using proper sentences and paragraphs, discussions and interpretations.

6. We will make every effort to help you learn the course material, but you must also make an effort to utilize the resources that are made available to help you. Please come talk to us—not only when you are having trouble but also when things are going well.