

# Advanced Probability Modeling and Techniques

## MATP 4960/6960 — Fall 2007

Peter Kramer

August 28, 2007

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Office hours: TBA on Friday, August 31

Website: <http://www.rpi.edu/~kramep/AdvProb/advprob2007.html>

**Classes** Tuesdays and Fridays, 2:00-3:50 PM in Low 3130

**Prerequisites** Familiarity with probability theory at an undergraduate level (MATP 4600).

**Requirements** 4 homework assignments, which will be posted on the course website, and a final exam. The first homework will be assigned on or before September 4 and be due on September 21.

The course grade will be determined by a 70% weighting of homework and a 30% weighting of the final exam. Students *registered for MATP 6960* whose homework shows clear positive evidence of representing their own thinking will be allowed to skip the final exam and have their course grade determined completely (100%) by their homework scores. Students registered for MATP 4960 must take the final exam in any case. The final exams for MATP 6960 and 4960 are different.

Each assignment and final exam will be scored out of 100 points, though usually more than 100 points are available so that students have some choice in which problems to invest their effort. MATP 4960 students will be allowed to solve any of the MATP 6960 problems for credit, in addition to some additional (less difficult) problems. I certainly do not expect every student to work on every problem, but rather expect students to work out some subset of the homework problems with care, diligence, and clarity of presentation. The grading standard will correspond to this expectation. That is, the full points for a problem are

generally only awarded for a solution which approaches the problem with the elegance and efficiency which should be expected from a proper understanding of the lectures and the readings. Moreover, all nontrivial steps must be explained, particularly those involving the concepts and techniques covered in this course. Routine calculations involving lower-level mathematical manipulations such as matrix algebra and calculus can be summarized without providing details. If you use a numerical software package such as MATLAB or Maple to assist your calculations, please attach a copy of your code or worksheet.

	Average Score (rounded)	Grade
	93–	A
	90–92	A-
	87–89	B+
	83–86	B
Grading scale for MATP 4960:	80–82	B-
	77–79	C+
	73–76	C
	70–72	C-
	63–70	D+
	50–62	D
	0–49	F
	Average Score (rounded)	Grade
	96–	A
	90–95	A-
	83–89	B+
Grading scale for MATP 6960:	76–82	B
	70–75	B-
	63–69	C+
	56–62	C
	50–55	C-
	0–49	F

Late homework will be penalized 10 points per business day, and no credit will be awarded once solutions are posted (which can be as soon as the next class). A homework submitted on the due date but after the time specified will be penalized 5 points.

**Midterm Assessment** When your second homework is returned, you will receive a projection of your course grade based on your performance to that point. At least if I remember. (Feel free to ask if I forget.)

**Grade Appeals** First of all, you are always welcome to ask me during office hours, for an explanation for why a problem solution was deemed incorrect or incomplete. I certainly would like all students to understand how to solve the

problems, and to resolve any confusion about what constitutes a proper solution. The following applies only to situations in which the student is asking for a change in the score.

The only circumstance under which an appeal of a homework score will be entertained is a demonstrable factual error in grading, meaning either that scores were incorrectly totaled, or a correct response was marked incorrect. To determine whether your response met the criteria for being deemed correct, you should first consult the homework solutions, when they are posted. Uniform standards for partial credit are applied for the class, so I will not revisit the amount of points awarded for an incorrect or incomplete solution just because you think or feel you deserved more points. Any request for a grade correction must be made within one week of the date the solutions are posted for that homework.

If you think you have not been meted due justice by me, your next step is to present your concern to the chair of the Department of Mathematical Sciences.

If any grade appeal is deemed to be frivolous (meaning it falls outside the guidelines of a legitimate appeal as described above), the student making the frivolous appeal will be warned. Any future frivolous appeal will be penalized by a deduction from the homework score equal to the number of points concerned in the frivolous appeal.

**Academic Integrity** You are encouraged to work in small groups on the homework assignments, but your actual solutions should be your own work. That is, you should feel free to discuss how to approach the problems, to consult on how to do certain calculations, or to check your results. But you should never be copying from other students. I will only give credit for work that demonstrates that you understand what you are doing. Therefore, be sure to explain all major steps, especially how you are setting up the problem. It is not necessary to provide detailed reports on routine calculations, but do at least explain in words what you are doing.

If you obtained assistance from anyone outside of the course or any written material beyond the lecture notes and the recommended text for the course, you must explicitly acknowledge the source.

If the solutions of two or more students do not demonstrate sufficient independence of thought, but do not rise to the level of academic dishonesty, then I may either simply split the points earned among all parties whose collective mind produced the solution and/or render all parties ineligible for exemption from the final exam. Flagrantly corrupt homeworks will earn no credit, and clear violations of academic integrity will also be reported to the Dean of Students' Office. The distinction between "insufficient independence of thought"

and “academic dishonesty” is primarily a matter of whether the work demonstrates an intent to misrepresent one’s own work. If you are not clear on the concept of academic dishonesty, you might consult the *Rensselaer Handbook of Students Rights and Responsibilities* or ask me directly about my expectations for integrity.

**Attendance** You don’t have to tell me if you miss a class. But don’t expect me to spend much time giving you help with homework if you’re not attending class.

**Course Objectives :**

- Experience in setting up and using probabilistic models to analyze systems with uncertainty
- Increased familiarity and facility in calculating with probabilistic models

**Topics :**

- Probability Formulated with Measure Theory
- Finite and Infinite Collections of Random Variables
- Generating and Characteristic Functions
- Random Walks
- Conditional Probability and Expectation
- Collections of Gaussian Random Variables
- Convergence of Random Variables
- Probabilistic Limit Theorems
- Large Deviation Theory
- Entropy and Information
- Applications

**Textbook** You should have one good book on probability theory for reference. I will generally excerpt core reading material and post it on the website (through library reserves). The following book is my recommendation for an appropriate probability book, and it will be available in hardcopy with the class reserves.

- Bertsekas & Tsitsiklis, *Introduction to Probability*