Math 510 Course Policies
Fall 2008

Class meets: Mon, Tues, Thurs, Fri: noon–12:50 p.m. in AC 245
Professor: Dr. Kevin Iga
Phone number: 456-4313 (office), (818) 384-0521 (cell)
Email: kiga@pepperdine.edu
Office: RAC 117
Office hours: Mon., Tues., Thurs., Fri. 10 a.m.–11 a.m.
Please come by my office hours whenever you have questions, and even if you don’t have questions. I am
also available at other times by appointment.
You are also required to come by my office at one time during the first or second week of the semester.
A signup will be passed around the class.
Calculator: A calculator is not required for this course, but you are allowed to use one for homework
and exams.
Prerequisites: Math 212 and either MATH 360 or MATH 221.
The language of probability is set theory, and the subject at this level involves proof writing and logical
reasoning, including mathematical induction. As a result, a proof writing course such as Math 360 or Math
220/221 is a prerequisite. There is also a practical, calculation-focused aspect to this course, and the key
ideas will involve some subjects you have had in calculus, up to multivariable calculus. Some of these concepts
that students are surprised to find necessary are: \( \sum \) summation notation, Taylor series, and switching
the order of integration in double and triple integrals. You may find it advantageous to review these at the
beginning of the semester.
Web page: http://math.pepperdine.edu/kiga/510
Email list: All students registered for this course will automatically have their Pepperdine emails added
to the Seaver official class list for this subject, math510.01@pepperdine.edu. This will be used to announce
corrections to homework assignments, changes in policy, and so on. If you do not read your Pepperdine
email, or if you are not officially registered for this course, let me know which email you do read so that I
can make sure you are contacted in case a critical announcement needs to be made.
Objectives: The student should be able:

• To compute various standard probabilities;
• To prove general statements about probabilities, events, and random variables;
• To compute expected values and variances (and standard deviations) of continuous and discrete prob-
  abilities;
• To use properties of expected value and variance to calculate these or derive conclusions about situa-
  tions;
• To compute conditional probabilities and to use Bayes’ theorem;
• To use cumulative distribution functions, probability density functions, joint cumulative distribution
  functions, and joint probability density functions;
To prove the Law of Large Numbers and the Central Limit Theorem;

To use concepts from probability theory in a variety of real-world applications.

Goals: The student should develop:

• An intuition for probability;
• A sense for how to approach mathematical questions involving randomness;
• An appreciation for the philosophical and theoretical issues raised by probability theory and randomness;
• An increased ability to do mathematical proofs;
• An appreciation for the beauty and practicality of mathematics.

Overview
Probability is a subject that is important for many disciplines, and so the subject is often taught at very different levels to different groups: majors in biology, economics, business, psychology, and so on. This particular version is more rigorous and more mathematical than the other undergraduate probability courses offered here, but it assumes no prior background in probability. It is primarily intended for math majors, engineering majors, and computer science majors, and those who want a more rigorous background in the subject (for instance, in preparation for graduate school).

We will begin with some combinatorics, which is the art of counting cleverly. Counting is foundational to the methods used in probability calculations, and since the numbers involved are often enormous, we need many clever techniques to count quickly, rather than one-by-one. This will be covered in chapter 1, which will take us the first two weeks or so.

The next week we will cover chapter 2, which introduces the set-theoretic, axiomatic approach to probability, and the first probability computations. Chapter 3 will take another week and covers the important concepts of conditional probability, independence, and the first example of statistical thinking: Bayes’ Theorem. This brings us to the first midterm.

The next four weeks until the second midterm cover chapters 4 and 5, which deal with random variables and probability distributions. Out of the unending array of probability problems, there is actually a list of only about a dozen kinds of random behavior that come up in the vast majority of situations in real life. These are called probability distributions, and we will closely examine the eight most useful ones. We will have a quiz on October 17 on these eight probability distributions to ensure you have these memorized.

Chapter 6, discusses how a problem may have many random variables, each with a probability distribution, and it is often important to recognize subtleties about how these relate to each other in a given problem. This will take one week.

Chapter 7 gets to more theoretical facts about properties of means and variances, and theoretical though it is, the consequences are very important in applications. These lead to powerful ways of looking at probability problems that make many difficult problems easy, and many seemingly impossible problems possible. In practice, these facts are used far more often than the more straightforward, calculational techniques introduced earlier. A strong mastery of this material is crucial to statistics and other applications. We will spend about two weeks on this material, and then have the third midterm.
After the third midterm we will spend the remaining three weeks or so on a variety of advanced topics, such as the Law of Large Numbers (which is foundational to why probability techniques work), the Central Limit Theorem (which is foundational to why statistics techniques work), processes, Markov chains, information, and simulation, as time permits.

**Probability vs. Statistics:** Probability and Statistics often go together as subjects. Some courses combine the two into a single semester. (These are not as thorough as this sequence, however). Math 510 covers probability, and Math 511 covers statistics.

Probability and statistics are related in the same way that differentiation and integration are related: they ask opposite questions. A typical probability question supposes you have a fair coin that you toss ten times, and asks how likely it will be that it comes up heads 6 out of the 10 times. A typical statistics question supposes you have a coin that you toss in the air 10 times, with it coming up heads 6 times, and asks whether you think the coin is fair.

The analogy goes further: understanding statistics without a solid understanding of probability is as impossible as learning integration without first learning differentiation well. Probability is not always easy—in fact, many questions in probability are still active areas of research. But in some ways it is more straightforward than statistics, where the debates on the proper techniques, and on the criteria on judging whether one technique is superior to another, can be endless.

If you can take both Math 510 and Math 511, you will be richly rewarded in your new perspective on the world around you. So much thinking in decision making requires dealing with unknowns, and probability provides a framework for understanding such situations; on the other hand, the modern world is full of statistical data, whether in the news, in politics, in making sound financial choices, in choosing where to live, in dealing with medical decisions, and on and on. In fact, it is not a stretch to say that a truly educated person today must know statistics.

**Grading:**

A grade of C indicates an ability to do homework-like problems, and memorization of all techniques and definitions. In order to receive a B, a student must demonstrate a deeper knowledge of the material, being able to apply the course material to new circumstances where applicable. An A student must demonstrate this kind of deep understanding in all of the covered topics, as well as be able to draw new conclusions from known facts in a logical manner, and must also demonstrate persistence and diligence. In the other direction, a grade of D shows only superficial understanding of the material, and shows inconsistency to do straightforward problems. An F grade indicates that the student has severe gaps in even superficial understanding of the material in the course.

The grade will be determined by percentages as follows:

- Homework: 30%
- Midterm 1: 15%
- Midterm 2: 15%
- Midterm 3: 15%
- Final: 25%

**Total: 100%**

I realize that on occasion, not everything is going well, and from time to time, this will happen on an exam day. Since the final exam covers all of the material from all exams, the solution is as follows: the final exam grade will substitute for your lowest midterm grade if this is to your advantage. This will automatically be done at the end of the semester, as long as it is to your advantage to do so. Borderline grades could go either way, depending on the effort I see you put into the class.
Homework: Homework will be assigned twice a week: homework assigned on Tuesday will be due on Friday, and homework assigned on Friday will be due on Tuesday. Homework should be turned in at the beginning of class.

Remember that the primary place where learning happens is in the homework, so take the homework seriously. The lowest homework score will be dropped, but you should do your best on all your homework assignments.

Late assignments: You must give me notice that you are going to turn in an assignment late the class before the assignment is due, or it will not be accepted. You must also have a good reason. These reasons will be treated on a case-by-case basis. When you obtain permission to turn in an assignment late, we will discuss a new due date for that homework.

Collaboration: You are encouraged to collaborate on all homework assignments, unless otherwise specified. This means you work on it independently before discussing it with each other, and it means you must thoroughly understand how to do the problem before writing it up. You must write up your answers separately; you cannot turn in one homework for more than one person, nor can you simply include photocopies of other students’ work. There is no limit to the size of a group for collaboration, although 3–5 people tends to be an efficient size.

You should also use these groups to ask questions of each other to better understand the material. If you do not see each other frequently, you should set up a regular time and place to meet to work on assignments. If you do not have a group, talk to me and I can place you in a group. If you do not wish to work in a group, that is your prerogative but this will be a disadvantage to you.

Comments: You should include comments about the class at the top of your homework assignments. These comments can be “You go too fast”, “You say ‘um’ too often”, “I like this chapter”, “This is too easy/hard”, “Can we have more applications to Computer Science”, “Everything’s okay”, and so on. You will not be graded on these comments, but they will affect how I teach the class, and may make the class more enjoyable for you.

Class participation: You are expected to actively participate in class. Many students view learning as a passive act, where the teacher takes the only active role, and the student simply listens, or at most takes notes. This view is not advisable in this class. Here, you will need to take an active role in learning the material. You are in charge of your education, and you should take responsibility to learn the material as thoroughly as you can. Part of this involves asking questions in class, even questions that may sound “stupid”. A question clearing up a point you do not understand is, by definition, not stupid. Similarly, when I ask the class questions, you should try to answer them, even if you’re not sure of the answer. Your best guess is, by definition, not stupid.

There will also be times when the class will discuss a topic and you are expected to participate in the discussion. Correct answers are irrelevant for the grading of discussion; all that matters is that you participate in some meaningful way.

Class participation will be used to decide borderline cases in the final grade. Remember that since there are 12 grades (counting +’s and −’s), almost everyone in the class will be a borderline case.

Pre-class preparation: You are expected to read through the section of the book we are covering before you come to class. If you don’t understand something, write down specific questions you have to ask in class.

Attendance: Attendance is important simply due to the difficulty of the course. Missing one class may have the effect of your not being able to follow any of the classes for the rest of the term. Furthermore, those who do not attend classes will have poor scores on class participation and this will also affect your grade.
short, skip class at your peril.

**Holidays:**
- Labor Day: Sep. 1
- Conference: Oct. 3
- Thanksgiving break: Nov. 27–28

**Quizzes:** There will be a few quizzes to encourage drill on material to be memorized. These differ from exams (below) in that they involve no problem-solving. These will be counted as homework scores.

**Exams:** There will be three midterms, and one final. Each midterm counts for 15% of your grade, the final counts for 25%, and homework counts for 30%.

The final exam grade will substitute for your lowest midterm grade if this is to your advantage. Note that borderline cases will be resolved by class participation, as noted above.

<table>
<thead>
<tr>
<th>Test</th>
<th>Date</th>
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<tbody>
<tr>
<td>Midterm 1</td>
<td>Sep 22 in class</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>Oct 20 in class</td>
</tr>
<tr>
<td>Midterm 3</td>
<td>Nov 13 in class</td>
</tr>
<tr>
<td>Final</td>
<td>Dec 10 (10:30 am to 1:00 pm)</td>
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The class before each exam is reserved for review. You are allowed to bring into each midterm one 3 × 5 index card, which you can use to write notes (both sides). Details on this will be described before the first midterm. You may bring in two such cards for the final exam.

No notes can be used for a quiz, since quizzes are for the purpose of ensuring memorization.

**Extra Credit:** In addition, students may boost their grade by working on an independent project that is suitable to the material. Students interested in doing this should initiate such requests, preferably by suggesting a problem they find interesting and consulting with me to see if it is appropriate for the course. All such requests must be requested and agreed upon before work on the project begins. The project must be completed before the beginning of the last week of class.

**Christian attitude:** Although not part of the grading for this course, you are expected to approach this class with a Christian attitude, being willing to help your fellow classmates to understand the material outside of class, being willing to be corrected by your fellow classmates when you see they are right, but firm in your conviction otherwise, being bold to ask questions without feeling ashamed of looking foolish, encouraging one another in love, being patient with those who are asking questions, and preferring a grasp of the material, which is enduring and becomes part of you, over a grade, which is transient, external, and shallow. You should diligently devote the time you spend on this class as to the Lord. As cheating harms both the cheater and the rest of the class (though in different ways), you should not cheat, nor should you provide temptations for others to cheat.

For my part, I commit to approaching this class with a Christian attitude, viewing my role as that of a servant, being concerned first for your personal, especially intellectual, development. I will also seek to produce an environment of encouragement and love, that fosters a sense of community and understanding. I commit to reporting grades that accurately and honestly reflect the level of work done in the class, as described in the paragraphs above. I also commit the time I spend preparing for this class as to the Lord, and I will pray for all individuals in the class on a regular basis, understanding that even as I may seek to educate, God provides the true transformation.