Course website

http://math.pugetsound.edu/~jbernhard

Contact information

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   For my office hours, see the course website. My office phone number is 253.879.3812, but
the phone is usually one of the slowest ways to reach me. Email is usually much faster. (All
of my email is forwarded to another account, so you may receive email from me at that ac-
count as well.) Neither phone nor email will necessarily reach me “after hours” (on nights and
weekends), so please take that into account when you contact me via either one.

   The course website is the best resource for information about the course. Among other
things, it contains a complete calendar for the semester, including all assignments. Also, if you
email me a password when I request one, you will be able to access your grade-to-date any time
during the semester via the course website.

Course goals

The main goals of this course are:

1. To improve your ability to learn mathematics.

2. To practice reading, writing, and presenting mathematics.

3. To learn about the subject of probability theory.

The third goal includes building a solid foundation in probability theory, one suitable for pur-
suing (among other things) any of the following:

• graduate studies in statistics

• graduate studies in mathematics or applied mathematics

• an actuarial career

   The more specific learning objectives for this course are listed at the end of this document.

Prerequisites

To take this course, you should have successfully completed Mathematics 280 (Multivariate
Calculus) and Mathematics 290 (Linear Algebra). If you have not completed both of these,
please see me so that we can discuss the suitability of this course for you.
Course materials

As a text for this course, we will just use course notes from class. However, for those wanting an additional resource to consult, I recommend the book *Elementary Probability for Applications* by Rick Durrett, which will be available at the campus bookstore soon.

No other particular course materials are required, although you may find it convenient at times to use a calculator or a computer program such as R, SAGE, or Wolfram Alpha.

That being said, I will expect your work to be word-processed in LaTeX and submitted by email in pdf format. You will not be graded on your LaTeX typographical skills, but you will need to be able to use them to communicate clearly.

Coursework

The coursework consists of:

- Approximately weekly **homework assignments**, usually due in class on Wednesdays.
- Three take-home **tests** dispersed throughout the semester.
- A **project** at the end of the semester.

There is **no final exam** for this course. The course is finished on the last day of class.

The **homework assignments** are to help you learn the material that will be covered on the tests, and you should use them as a learning tool. You are allowed to work with others on all homework problems except those designated as solo problems. The solo problems will give you practice in the solitary problem-solving skills required for the take-home tests.

On each homework assignment, you will turn in by email both the solo and the other problems, both in the same file. I will grade all the problems, and the solo problem will be worth twice the weight of each of the other problems. You should write up the solo problem exactly as you would write up a test problem, and I will give more extensive feedback on it.

Feel free to ask me questions about any of the problems during my office hours (or by appointment if you can’t make it to those). If you are not solving all of the homework problems, you are falling behind on the course.

On the **tests**, you will be allowed to use the online course text, class notes that you have taken yourself or have acquired before the test starts, and all homework that you have submitted to me on time prior to the start of the test.

The **project** will involve both giving an in-class presentation and writing a paper on a probability theory topic that you have chosen and I have approved.

Grading

Your grade will be based on **my assessment of your understanding of the material**. By default, I will weight the various components of the course as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Test 1</td>
<td>15%</td>
</tr>
<tr>
<td>Test 2</td>
<td>20%</td>
</tr>
<tr>
<td>Test 3</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>15%</td>
</tr>
</tbody>
</table>
However, these weights are subject to change due to individual circumstances, so if you believe the above components do not accurately represent your understanding of the material, please let me know. If the circumstances dictate, I can work with you to find another way to demonstrate your understanding of the material.

**Late work policy**

I will not accept late work without an appropriate reason, which you should explain to me before the work is late if possible. If you are falling behind or need to turn something in late, please see me so that we can discuss it.

**Attendance policy**

I will not be taking attendance in this class. You are responsible for the material that we cover in class whether or not you are in attendance. Since it is extremely difficult to keep up in the course without attending regularly, I expect absences to be rare. I do not ordinarily give make-up tests, so if you must be absent during one of those, please let me know as early as possible so that we can discuss the situation.

**Academic honesty**

On homework problems not designated as solo problems, you are allowed to work with anyone (including each other, tutors, and me) as long as you do so in a way that helps you learn the material. (This, of course, means that your write-ups must be your own.) You are not allowed to work with anyone else on the homework problems that are designated as solo problems.

You are not allowed to work with anyone on any of the tests, and you should not discuss a test with anyone until the class has completed it and turned it in. If you have any questions on the solo problems or tests, you are allowed to ask me but no one else.

On the project, you are allowed to work with others only to the extent that they provide routine editing of your paper and routine feedback on your presentation. Questions about all other aspects of the project should be directed to me and no one else.

For general information on issues of academic honesty, see the official University of Puget Sound academic honesty policy at:

http://www.pugetsound.edu/student-life/student-resources/student-handbook/academic-handbook/academic-integrity/

**Classroom Emergency Response Guidance**

Please review university emergency preparedness, response procedures and a training video posted at www.pugetsound.edu/emergency/. There is a link on the university home page. Familiarize yourself with hall exit doors and the designated gathering area for your class and laboratory buildings.
If building evacuation becomes necessary (e.g. earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.

If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Lie on the floor out of sight and away from windows and doors. Place cell phones or pagers on vibrate so that you can receive messages quietly. Wait for further instructions.

Office of Accessibility and Accommodations

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Peggy Perno, Director of the Office of Accessibility and Accommodations, 105 Howarth, 253.879.3395. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Copyright and Fair Use

Course materials are subject to the copyright law of the United States (Title 17 U.S. Code). They are for educational purposes only and limited to students enrolled in the course. Further reproduction or distribution is prohibited.

Other

Feel free to contact me with any questions you have regarding the course. I very much want each and every one of you to succeed in this class.

I look forward to an enjoyable class with you this semester!
Learning objectives

The specific **learning objectives** for this course are as follows:

- To be able to define basic concepts related to discrete probability theory, such as **experiment**, **outcome**, **event**, **sample space**, **disjoint events**, **independent events**, and **probability function**.

- To be able to state and apply the theorem that if a sample space is finite and all outcomes are equally probable, then the probability of an event equals the number of outcomes in the event divided by the number of outcomes in the sample space.

- To be able to define **random variable**.

- To be able to define the **distribution** of a discrete random variable and the **probability mass function** of a discrete random variable.

- To be able to define and use **Bernoulli distributions**, **geometric distributions**, and **Poisson distributions**.

- To be able to define and use important statistics for discrete random variables, such as the **expected value (mean)**, **variance**, **standard deviation**, and more generally **moments**.

- To be able to define and apply basic counting techniques such as the **multiplication principle**, **combinations**, and **permutations**.

- To be able to define and apply **binomial coefficients**, **binomial distributions**, and **multinomial coefficients**.

- To be able to define and apply **conditional probability**.

- To be able to state and apply **Bayes’ formula**.

- To be able to define and apply basic concepts related to considering more than one random variable simultaneously, such as **joint distribution**, **marginal distribution**, **conditional distribution**, and **independence of discrete random variables**.

- To know that the variance of a sum of random variables is in general not equal to the sum of their variances, but that if the random variables are independent it is.

- To be able to state and apply basic concepts related to finite, discrete-time Markov chains, such as **Markov property**, **Markov chain**, **transition matrix**, **stochastic matrix**, **absorbing state**, and **absorption time**.

- To be able to state and apply the fundamental convergence theorem for finite, discrete-time Markov chains.

- To be able to define and apply basic concepts related to continuous random variables, such as **cumulative distribution function**, **probability density function**, **quantile**, **median**, **quartile**, **expected value**, **variance**, **standard deviation**, and **moments**.

- To be able to define and apply some of the most common distribution families of continuous random variables, such as **uniform distributions**, **exponential distributions**, and **normal distributions**.
• To be able to compute the probability density function of \( f(X) \), where \( f : \mathbb{R} \rightarrow \mathbb{R} \) is a monotone increasing function and \( X \) is a random variable whose probability density function is given.

• To be able to state and apply one of the simpler forms of the central limit theorem.