

# MATH 350: MATHEMATICAL PROBABILITY

Spring 2023: Section 1

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<u>Instructor Information</u>		<u>Course Information</u>	
<b>Name:</b>	Dr. Christina Durón	<b>Days:</b>	MTRF
<b>Email:</b>	<a href="mailto:christina.duron@pepperdine.edu">christina.duron@pepperdine.edu</a>	<b>Time:</b>	12:00PM – 12:50PM
<b>Office:</b>	RAC 105	<b>Location:</b>	RAC 170
<b>Office Phone:</b>	(310) 506 – 4832	<b>Module:</b>	In-person

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## Course Pages:

1. Courses (Required): <https://courses.pepperdine.edu>
2. Gradescope (Required): <https://www.gradescope.com>
3. Homepage (Optional): <https://cduron.info>

**Office Hours:** Office Hours will be held regularly in RAC 105 on

- Mondays and Fridays: 2:00PM – 3:00PM
- Tuesdays and Thursdays: 10:30AM – 11:30AM
- By appointment

In addition, questions may be addressed through email between 8AM – 5PM (PST) during the academic week. Please allow up to 24 hours for a response, although the instructor will strive to reply promptly.

## Course Materials:

- *Textbook:* The course textbook (electronic or hardcover) is *Introduction to Probability* by Anderson, Seppäläinen, and Valkó. While the textbook is not required, it is an encouraged resource. Should you purchase/rent the textbook, it is important that you *read the sections in addition to attending lectures and doing assigned work*.
- *Calculator:* A graphing calculator is a tool that will be used in this course. Any model in the TI-83 or TI-84 series is recommended. Models that can perform symbolic calculations (also known as CAS) are not allowed on exams and quizzes. CAS models include (but are not limited to) the TI-89, TI NSpire CAS and HP 50g. Students are not allowed to share calculators during quizzes and exams.
- *Software:* For this course, you will need daily access to a device with a reliable internet signal that can:
  - Access Courses.
  - Access Gradescope.
  - Scan and upload written work to Gradescope.
  - View and download PDF documents.

**Course Communications:** All course materials will be posted on Courses. Email, in-class announcements, and Courses announcements will be the primary methods to communicate course information. It is ultimately the student's responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes, by email, or through Courses.

**Course Prerequisites:** C– or better in Math 250 and either Math 221 or Math 320 is required.

**Course Description:** Math 350 provides an introduction to the theory of probability, the part of mathematics that studies random phenomena. We model simple random experiments mathematically and learn techniques for studying these models. Topics covered include probability spaces, random variables, weak law of large numbers, central limit theorem, and various discrete and continuous probability distributions.

**Student Learning Outcomes:** Upon completing this course, students should be able to:

1. Compute various standard probabilities.
2. Prove general statements about probabilities, events, and random variables.
3. Compute expected values and variances (and standard deviations) of continuous and discrete probabilities.
4. Use properties of expected value and variance to calculate these or derive conclusions about situations.
5. Compute conditional probabilities and to use Bayes' Theorem.
6. Use cumulative distribution functions, probability density functions, joint cumulative distribution functions, and joint probability density functions.
7. Prove the Law of Large Numbers and the Central Limit Theorem.
8. Use concepts from probability theory in a variety of real-world applications.

**Relation to Mathematics Program Learning Outcomes:** A student who completes a mathematics degree should be able to:

1. Formulate mathematical proofs that are clear, correct, complete, and logical.
2. Use appropriate mathematical ideas in applied or real-world contexts.
3. Integrate mathematical ideas from multiple courses to solve advanced problems.

**Relation to Pepperdine's Mission:** Pepperdine is a Christian university committed to the highest standards of academic excellence and Christian values, where students are strengthened for lives of purpose, service, and leadership. This course is designed to complement and supplement the overall mission of Pepperdine. Mathematics courses have historically been used to “train the mind” of students, to help students think more carefully and clearly. In logical preparation and in application of concepts, the study of mathematics helps prepare you for a life of purpose, service, and leadership.

**Attendance and Class Participation Policy:** Participating in the course and attending lectures and other course events are vital to the learning process. As a result, students are expected to attend each class meeting and to arrive on time and ready to participate in discussion or group work with their peers. Students are responsible for the material covered if they are late or absent. If you are unexpectedly absent for medical or personal reasons, please inform the instructor within 24 hours, if at all possible, and provide a note from the appropriate party (e.g., doctor, Divisional Dean) excusing the absence.

**Classroom Behavior Policy:** To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a website, making phone calls). Students are asked to refrain from disruptive conversations during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion, and may be reported to the Divisional Dean.

**Gradescope:** Students are expected to create an account with Gradescope, linked to your @pepperdine.edu address. If you already have a Gradescope account linked to your @pepperdine.edu address, then you do not need to create another account. Students are expected to read the [guide for submitting work](#) to Gradescope. To upload your work, log into your Gradescope account, find the course Gradescope page, select the correct assignment, and upload your scanned work as a PDF file. If you cannot find the course Gradescope page, then you may need a course entry code (provided on Courses under Resources).

### Assignments and Examinations:

- **Quizzes** will be distributed electronically on Gradescope every Friday, with the exception of midterm examination weeks. Each quiz will be made available at 12AM (PST) and close at 11:59PM (PST) that same day. When a quiz is started, it must be completed on Gradescope within 30 minutes (unless otherwise stated). Each quiz will be worth 5 points. Students may use the textbook, class notes, and a graphing calculator on all quizzes, but peer collaboration and the use of unapproved sources (e.g., generative AI tools, the internet, cell phone) of any kind are not allowed.
- **Homework** will be distributed electronically (both on Gradescope and Courses), based in part on the text. Students are responsible for uploading properly scanned work (as a single PDF file) to Gradescope by 11:59PM on the indicated due date, and assigning the appropriate pages for each problem. The instructor will grade either a subset or all of the problems each week; graded work will be returned through Gradescope. Students must show all work in a legible, neat and organized manner to receive credit. No credit will be given if the solution is not justified, or if the work is illegible.

You are strongly encouraged to work with other students in doing the homework, but the homework turned in must be your own and represent your own thinking and your own work. Turning in the work of others (including that provided by generative AI tools), allowing others to copy your work, or copying from a solutions manual or other source is a violation of Seaver College' Code of Ethics (see your student handbook for more information). This can lead to a lowering of your course grade as well as counting as one of two ethics violations allowed at Seaver College. On each assignment, you will be asked to provide your collaborators.

*Please be aware that checking unsanctioned online sources for solutions is not allowed and may be reported as cheating. In addition, the use of generative AI tools is strictly prohibited; the use of such source will result in an automatic zero on the assignment/assessment and will be reported as cheating.*

- **Midterms** will be taken during the class period. Please refer to the calendar for the dates of these four exams. Each exam will be written to be completed within 45 minutes. See the cover page on each exam for specific instructions about the use of notes and technology.
- The **Final Exam** will take place on Tuesday, December 12, 2023, at 10:30AM – 1:00PM in our regular classroom. The grading policy for the midterm exams will be observed for the final exam. Please visit [Final Exams and Schedule of Classes](#) for more information.
  - All students enrolled in the course must take the final exam at the scheduled time. Exceptions are only granted if a student has two exams scheduled at the same time, or three exams scheduled on the same day. Students in these situations are expected to notify the instructor at least three weeks in advance.
- **Participation** is a vital component of class success. Students are expected to keep up with class, engage and participate both in large class discussions and group work, and in general contribute to a sense of classroom community. The participation grade is meant to encourage and reward class-wide (rather than individual) efforts to create a sense of classroom community so that this course can be effective, regardless of course modality. If each of you do all you can every day to participate as you are able, this can be a great course with everyone receiving 100% for participation. However, if you personally stop regularly attending and participating in class (without excused reasons) or if too few students participate for the course to run smoothly and effectively, the instructor reserves the right to implement individual or group participation requirements.

## Important Dates:

Last day of Add/Drop period .....	August 25, 2023
Withdraw period begins .....	August 26, 2023
Last day to change Cr/NC status .....	September 5, 2023
<b>Midterm #1</b> .....	<b>September 26, 2023</b> ( <i>tentative</i> )
Last day to withdraw (with W) .....	October 17, 2023
<b>Midterm #2</b> .....	<b>November 7, 2023</b> ( <i>tentative</i> )
Last day to withdraw (with WP/WF) .....	December 1, 2023 (by 5PM)
Last day to submit Change of Final Exam form .....	December 1, 2023
<b>Final Exam</b> .....	<b>December 12, 2023</b>

**Make-Up Exams and Homework Extensions:** In general, there will be no make-up exams. However, in unusual circumstances beyond your control, a make-up exam may be given on a case-by-case basis. This may require providing a detailed account of the situation and, if applicable, supporting documents. Approval in these cases is at the sole discretion of the instructor and/or the Divisional Dean.

Homework assignments not turned in by the due date will receive an automatic zero. Extensions may be granted on a case by case basis (a valid reason must be given); all requests must be made at least 48 hours in advance of the due date(s); requests made within 48 hours of the due date(s) will not be granted.

**Dispute of Grade Policy:** Any questions regarding the grading of any assignment, quiz or exam need to be cleared up within one week after the graded item has been returned.

**Grading Scale and Policies:** Your work in this course will be weighted as follows:

- Participation (3%)
- Quizzes (7%)
- Homework (11%)
- Midterms (44%; 22% each)
- Final (35%)

The weighted percentages below correspond to your final letter grade:

A: 93 – 100%	B+: 87 – 89%	C+: 77 – 79%	D+: 67 – 69%	F: 0 – 59%
A–: 90 – 92%	B: 83 – 86%	C: 73 – 76%	D: 63 – 66%	
	B–: 80 – 82%	C–: 70 – 72%	D–: 60 – 62%	

**Note:** No extra credit or bonus points are offered in this course.

**Assistance:** I will be available in my office for questions during the posted Office Hours or whenever the door is open. If you need to reach me outside of those hours, please email me to make an appointment. There will be peer tutoring available in the Student Success Center most evenings. See <https://seaver.pepperdine.edu/academics/academic-support/student-success-center/departamental-tutoring.htm> for details.

**Class Expectations:** It is my goal to teach you all the material necessary to be successful in this course. In return, I expect that you will show up to class on time and ready to work. We will use calculators for mathematical applications, but I expect that you will refrain from the use of cell phones, tablets or laptops unless instructed otherwise.

In order to make the class more interesting, I will alternate between lectures and group activities. We can only cover all of the material successfully in this way if you make an effort to stay on task. Working in groups

is an excellent opportunity to learn from each other. You will know that you have mastered a subject when you can successfully teach that topic to a fellow student.

It is my expectation that you will spend at least two hours outside of class for every hour you spend in class studying and working on homework. If you put in eight hours a week, then you should be able to complete your assignments and study for your exams. If you do this for each class, then a 16 – 18 unit load will give you a 48 – 54 hour work week, which is not unreasonable in many professions.

As students at Pepperdine University, you are expected to approach this class with a Christian attitude. You should be willing to help your fellow classmates understand the material while working in groups or outside of class. Our classroom is a place to ask questions without feeling ashamed or looking foolish. Since your peers are entering this course with a broad spectrum of mathematical backgrounds, you should be patient with others asking questions and encourage one another in love.

As a professor at Pepperdine University, I will approach this class with a Christian attitude, viewing my role as that of a servant, being concerned first for your personal, especially intellectual, development. One of my goals is to build a community that is understanding and encourages one another. I commit to reporting grades that accurately and honestly reflect the level of work done in the class, as described in the paragraphs above.

**Student Accessibility:** Pepperdine University provides services and accommodations in accordance with the ADA and section 504 of the Rehabilitation Act. Pepperdine recognizes that each student is a unique individual and that the effect of a particular disability can vary from student to student. As a result, accommodations are determined through an interactive process with the student, the Office of Student Accessibility, and medical/mental health professionals.

Any student with a documented disability (chronic medical, physical, learning, psychological, or temporary) needing academic accommodations should contact the Office of Student Accessibility (Student Assistance Center, SAC #105, Phone: (310) 506 – 6500, Email: [student.accessibility@pepperdine.edu](mailto:student.accessibility@pepperdine.edu)) as early in the semester as possible. All discussions will remain confidential. For additional information, please visit <http://www.pepperdine.edu/student-accessibility/>.

**Ethics:** Academic Integrity is the expression of intellectual virtue in human beings as a result of their creation in God's image. It represents the convergence of the best of the human spirit and God's spirit, which requires personal, private and community virtue. As a Christian institution, Pepperdine University arms that integrity begins in our very created being and is lived out in our academic work. In order for the code to be effective, the community must maintain its health and vitality. This requires a genuine sense of maturity, responsibility, and sensitivity on the part of every member. Each member of the Seaver College community is expected to pursue their academic work with honesty and integrity.

Academic integrity is violated when one of the following events occurs:

- Plagiarism
- Cheating
- Fabrication, or
- Facilitating Academic Dishonesty

For a more detailed description of these violations, see <http://seaver.pepperdine.edu/academicintegrity/policies/violations.htm>. All violations will be reported and handled according to the Academic Integrity Committee Procedures. In particular, any instance of cheating or plagiarism on an assignment or exam will be reported and result in no credit. As a reminder, the use of generative AI, AI writing, or similar AI tools or services is not permitted in any aspect of this class; the use of such tools will be considered a violation of academic integrity and be reported accordingly.

**Course Evaluations:** Online course evaluations are conducted for all Seaver College courses and are part of Pepperdine University's commitment to excellence in teaching and learning. The evaluations provide useful feedback that faculty and schools use to improve the quality of instruction. Each instructor receives a compilation of the anonymous responses and comments to use in evaluating their own teaching and planning

future courses. Faculty do not have access to course evaluation data until all course grades are posted. The course evaluation period opens at 7AM on Monday, November 27 and closes before final exams begin (3AM on Monday, December 11). To access the online course evaluation system, you may log on directly at <https://courseeval.pepperdine.edu/>.

**Consent to be Recorded:** Class sessions may be recorded by the professor using the Zoom recording feature for instructional purposes. Participation in the class during live sessions implies consent to the recording of those sessions. If a student does not wish to be recorded, they must notify the instructor to see if arrangements can be made. If this is not possible for educational reasons, the student may need to enroll in a different course.

**Student and Faculty Privacy:** In order to safeguard the privacy of all our students and faculty in online learning environments, no individual may record, reproduce, screenshot, photograph or distribute any video, audio, or visual content from an online course. This restriction applies to, but is not limited to, live sessions, recorded lectures, live discussions, and discussion boards. The only exceptions to this policy are the instructional recordings referenced above and one screenshot per meeting/ discussion that faculty may take as a form of attendance. These screenshots may not be shared or used for any other purpose. Any violation of this policy may subject the individual to disciplinary and/or legal action.

**Intellectual Property:** Course materials prepared by the instructor, together with the content of all lectures and review sessions presented by the instructor, are the property of the instructor. Video and audio recording of lectures and review sessions without the consent of the instructor is prohibited. Unless explicit permission is obtained from the instructor, recordings of lectures and review sessions may not be modified and must not be transferred or transmitted to any other person. Electronic devices other than laptops (e.g., cell phones, recording devices) are not to be used during lectures or exams without prior permission of the instructor.

All class lectures and materials herein, including but not limited to, pre-recorded and live lectures, live discussions and discussion boards (and recordings thereof), posted course materials, visual materials that accompany lectures/discussions, and virtual whiteboard notes (collectively "Course Intellectual Property") remain the intellectual property of the faculty member or other third-parties. No individual may record, reproduce, screenshot, photograph, or distribute any Course Intellectual Property in partial or full-format without the permission of the professor. Any violation of this policy may subject the individual to disciplinary and/or legal action.

**Subject to Change Statement:** Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

#### **Tentative Schedule:**

MONDAY	TUESDAY	THURSDAY	FRIDAY
<b>Aug 21st</b> 1 Probability Spaces (Section 1.1)	<b>22nd</b> 2 Counting (Section 1.2)	<b>24th</b> 3 Counting (Section 1.2)	<b>25th</b> 4 Infinite Sample Spaces (Section 1.3)  <b>Quiz #1 Due on GS at 11:59 PM (PST)</b>

MONDAY	TUESDAY	THURSDAY	FRIDAY
<b>28th</b> <b>5</b> Rules of Probability (Section 1.4)  <b>HW #1 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>29th</b> <b>6</b> Conditional Probability (Section 2.1)	<b>31st</b> <b>7</b> Conditional Probability (Section 2.1)	<div style="border: 1px solid black; padding: 2px;">Sep 1st</div> <b>8</b> Bayes' (Section 2.2)  <b>Quiz #2 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>4th</b> <b>9</b> <b>NO CLASS</b> <i>Labor Day</i>	<b>5th</b> <b>10</b> Independence (Section 2.3)  <b>HW #2 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>7th</b> <b>11</b> Random Variables (Section 1.5)	<b>8th</b> <b>12</b> Random Variables (Section 1.5)  <b>Quiz #3 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>11th</b> <b>13</b> Distribution of Random Variables (Section 3.1)  <b>HW #3 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>12th</b> <b>14</b> Cumulative Distribution Functions (Section 3.2)	<b>14th</b> <b>15</b> Independent Trials (Section 2.4)	<b>15th</b> <b>16</b> Independent Trials (Section 2.4)  <b>Quiz #4 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>18th</b> <b>17</b> Expectation (Section 3.3)  <b>HW #4 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>19th</b> <b>18</b> Expectation (Section 3.3)	<b>21st</b> <b>19</b> Expectation (Section 3.3)	<b>22nd</b> <b>20</b> Variance (Section 3.4)  <b>Quiz #5 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>25th</b> <b>21</b> Midterm #1 Review	<b>26th</b> <b>22</b> <b>MIDTERM #1</b>	<b>28th</b> <b>23</b> Gaussians (Section 3.5)	<b>29th</b> <b>24</b> <b>NO CLASS</b> <i>Faculty Conference</i>
<div style="border: 1px solid black; padding: 2px;">Oct 2nd</div> <b>25</b> Gaussians (Section 3.5)  <b>HW #5 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>3rd</b> <b>26</b> Normal Approximations (Section 4.1)	<b>5th</b> <b>27</b> Normal Approximations (Section 4.1)	<b>6th</b> <b>28</b> Law of Large Numbers (Section 4.2)  <b>Quiz #6 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>9th</b> <b>29</b> Applications of the Normal Approximation (Section 4.3)  <b>HW #6 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>10th</b> <b>30</b> Applications of the Normal Approximation (Section 4.3)	<b>12th</b> <b>31</b> Poisson Approximation (Section 4.4)	<b>13th</b> <b>32</b> <b>NO CLASS</b> <i>Fall Break</i>



MONDAY	TUESDAY	THURSDAY	FRIDAY
<b>16th</b> <b>33</b> <b>NO CLASS</b> <i>Fall Break</i>	<b>17th</b> <b>34</b> Exponential Distribution (Section 4.5)	<b>19th</b> <b>35</b> Moment Generating Functions (Section 5.1)  <b>HW #7 Due on GS at 11:59 PM (PST)</b>	<b>20th</b> <b>36</b> Moment Generating Functions (Section 5.1)  <b>Quiz #7 Due on GS at 11:59 PM (PST)</b>
<b>23rd</b> <b>37</b> Distribution of a Function of a Random Variable (Section 5.2)	<b>24th</b> <b>38</b> Distribution of a Function of a Random Variable (Section 5.2)	<b>26th</b> <b>39</b> Joint Distribution of Discrete Random Variables (Section 6.1)  <b>HW #8 Due on GS at 11:59 PM (PST)</b>	<b>27th</b> <b>40</b> Joint Distribution of Discrete Random Variables (Section 6.1)  <b>Quiz #8 Due on GS at 11:59 PM (PST)</b>
<b>30th</b> <b>41</b> Joint Distribution of Continuous Random Variables (Section 6.2)	<b>31st</b> <b>42</b> Joint Distribution of Continuous Random Variables (Section 6.2)	<div>Nov 2nd</div> <b>43</b> Joint Distributions and Independence (Section 6.3)  <b>HW #9 Due on GS at 11:59 PM (PST)</b>	<b>3rd</b> <b>44</b> Sums of Independent Random Variables (Section 7.1)  <b>Quiz #9 Due on GS at 11:59 PM (PST)</b>
<b>6th</b> <b>45</b> Midterm #2 Review	<b>7th</b> <b>46</b> <b>MIDTERM #2</b>	<b>9th</b> <b>47</b> Linearity of Expectation (Section 8.1)	<b>10th</b> <b>48</b> Expectation and Independence (Section 8.2)
<b>13th</b> <b>49</b> Covariance and Correlation (Section 8.4)  <b>HW #10 Due on GS at 11:59 PM (PST)</b>	<b>14th</b> <b>50</b> Covariance and Correlation (Section 8.4)	<b>16th</b> <b>51</b> Sums and Moment Generating Functions (Section 8.3)	<b>17th</b> <b>52</b> Law of Large Numbers (Section 9.2)  <b>Quiz #10 Due on GS at 11:59 PM (PST)</b>
<b>20th</b> <b>53</b> <b>NO CLASS</b> <i>Thanksgiving Break</i>	<b>21st</b> <b>54</b> <b>NO CLASS</b> <i>Thanksgiving Break</i>	<b>23rd</b> <b>55</b> <b>NO CLASS</b> <i>Thanksgiving Break</i>	<b>24th</b> <b>56</b> <b>NO CLASS</b> <i>Thanksgiving Break</i>
<b>27th</b> <b>57</b> Law of Large Numbers (Section 9.2)  <b>HW #11 Due on GS at 11:59 PM (PST)</b>	<b>28th</b> <b>58</b> Central Limit Theorem (Section 9.3)	<b>30th</b> <b>59</b> Conditional Distribution of a Discrete Random Variable (Section 10.1)	<div>Dec 1st</div> <b>60</b> Conditional Distribution for Jointly Continuous Random Variables (Section 10.2)  <b>Quiz #11 Due on GS at 11:59 PM (PST)</b>



MONDAY	TUESDAY	THURSDAY	FRIDAY
<b>4th</b> <b>61</b> Conditional Expectation (Section 10.3)  <b>HW #12 Due on GS</b> <b>at 11:59 PM (PST)</b>	<b>5th</b> <b>62</b> Conditional Expectation (Section 10.3)	<b>7th</b> <b>63</b> <b>Final Review</b>	<b>8th</b> <b>64</b> <b>Final Review</b>  <b>Quiz #12 Due on GS</b> <b>at 11:59 PM (PST)</b>
<b>11th</b> <b>65</b>	<b>12th</b> <b>66</b> <b>FINAL EXAM</b> <b>10:30AM – 1:00PM</b>	<b>14th</b> <b>67</b>	<b>15th</b> <b>68</b>

**Note:** This calendar is tentative. For up-to-date information, see the course page on Courses.