

**Instructor:** Dr. Chris Lee      Trexler 270D      clee@roanoke.edu      (540) 375-2347

**Office Hours:** I am available for office hours: Mon/Wed: 1:00 – 3:00pm      Tue/Thu: 3:00-4:30pm  
All office hours are by appointment. To make an appointment, please use the link:  
**<https://drchrislee.youcanbook.me/>**

### **Course Description:**

As we surf the web, are we really exercising free will? Whether it be reading, shopping, or interacting socially, we'd like to think that we are in control of our choices. The reality is that web designers and marketers use conclusions drawn from vast amounts of data to carefully craft and control our web experiences and actions. This course provides an inquiry-focused introduction to the statistical methodologies necessary to successfully explore and answer this question. Along the way students will develop an understanding of how data is collected and used in relation to virtually everything we do on the internet.

**Statistics Objectives:** Provides an inquiry-focused introduction to statistical methodologies. Students will gain an understanding of how decision making is accomplished using modern statistical techniques. Topics include descriptive statistics, graphical methods, estimation, elementary probability, statistical inferences, and analysis of variance; students will apply the techniques of data analysis to data sets and/or statistical studies.

### **Learning Outcomes:**

1. Students will be able to use the methodologies of statistics to
  - a. Investigate a topic of interest and make decisions based on the results.
  - b. Design and carry out a simple statistical experiment.
  - c. Critique news stories and journal articles that include statistical information. In the critique students will recognize variability and its consequences, identify potential sources of bias and both proper and improper cause and effect inference.
2. Students will be able to articulate the importance and limitations of using data and statistical methods in decision making.
3. Students will be able to write about course topics clearly and effectively.
4. Students will be able to interpret quantitative information related to the course topic.

**Technology:** For some sections of the course students will need statistical software for calculations and graphics. Excel and Minitab are provided on college lab computers. Students will also need a scientific calculator.

### **Required Texts and Readings:**

- *Statistics in Practice*. Moore, Notz, & Fligner
- *Hooked: How to Build Habit Forming Products*, Nir Eyal.
- *A Writer's Reference (6<sup>th</sup> Ed) or equivalent*

**Attendance:** Attendance is critical to the understanding of the material in the course; it is both required and expected. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. I will assume that if you accumulate 3 unexcused absences you are not interested in completing the course and will drop you from the class with a grade of DF (dropped-failing) recorded, regardless of your current average in the course. You, your advisor, and the registrar will receive a warning email at your second unexcused absence. When absent, excused or unexcused, you are responsible for all material covered in class. Work missed due to either an unexcused or excused absence can only be made up when arrangements are made in advance of the absence.

**Reading and Participation:** The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a day-by-day outline of the sections that will be discussed in class. You are fully expected to have read the upcoming section before the class meeting! This does not mean you need to understand everything, but rather you should be familiar with the definitions and concepts from the sections; having read the section will allow you to ask better questions and follow along better in class.

**Practice Problems:** Mathematics is learned by practice, and there is no substitution for putting pencil to paper and working lots of problems. Practice problems will be assigned virtually every class period and students are expected to work them all. These problems are not an individual component of your grade, but tie directly to the topics being studied and will prepare you for the tests. On any given day students should turn in any problems on which they wish to receive feedback.

**Writing:** While knowing statistics is important, it is useless if you cannot communicate the ideas and concepts you have learned, and more importantly, apply them to a topic such as whether or not we have free will on the internet. There are four writing assignments throughout the semester. These are an important and significant component of the course. These assignments will push you to address issues from a statistical standpoint and improve your writing and communication skills.

**Writing Assignment 1:** This is personal, reflective opinion writing. You will be asked to describe some of your daily activities on the internet and think through how you may be being manipulated, or if you are above manipulation and are truly doing whatever you'd like on the internet.

**Article Analysis:** For this assignment you will critique an article from an established news source. The topic of the article will be the use of statistics by online entities. You will use the knowledge you have gained thus far in the course to critique the methods used by the author.

**Project:** Prior to the date this project is started, you will have read the entire book *Hooked: How to Build a Habit Forming Product* by Nir Eyal. You will then propose your own product that you would like to bring to market. This may be a competitor to Facebook, a photo sharing site, a new game, or any other such similar product. Your initial product design will be well thought out. Then, you will apply statistical concepts you have learned in this course. You will design and identify the importance features of statistical studies of data you will measure about users of your products. You will describe how you will apply this quantitative information to make decisions or draw conclusions about needed changes to your product to increase success. Finally, you will discuss how you will handle uncertainty in the data you propose to measure. How will uncertainty affect your analysis and continued development of your product?

**Late Work:** Unless specific permission is given in advance of the due date, no late work will be accepted.

**Grading:** Components of a student's grade will be weighted as follows:

Tests: 80%      Short Writing: 5%      Project: 15%

A grade scale will be determined after final averages are computed, but will be not be lower than the scale given below.

|   |    |    |    |    |    |    |    |    |    |    |    |   |
|---|----|----|----|----|----|----|----|----|----|----|----|---|
| 0 | 60 | 63 | 67 | 70 | 73 | 77 | 80 | 83 | 87 | 90 | 93 |   |
|   | F  | D- | D  | D+ | C- | C  | C+ | B- | B  | B+ | A- | A |

**Testing:**

We will be making use of "Mastery-Based Testing". This system is very different from what you are used to – do not hesitate to ask me questions in class or my office at any time. In the mathematics community

many are working with and researching this technique, one of the best starting sources for understanding can be found at <https://mbtmath.wordpress.com>. Much of what you'll find on the next two pages is taken from this resource.

**Short Description:** You only receive credit for answers that demonstrate you completely understand (have mastered) a topic. But, you get many chances to display mastery throughout the semester with no penalty at all for earlier attempts.

**Long Description:**

The course has been boiled down to 18 essential types of questions, or "topics", your mastery of questions on these topics is assessed through four tests and the final exam. Each problem submitted is graded as either "Master" or "Not Mastered". A grade of Master indicates that you have demonstrated full understanding of the concept being tested and further work on the topic is not necessary. Once you have mastered a problem you need not ever attempt it again on a future test, including the final exam. There is no penalty whatsoever for multiple attempts taken to achieve mastery.

- Test 1: Topics 1-3
- Test 2: Topics 1-6.
- Test 3: Topics 1-9.
- Test 4: Topics 1-12.
- Test 5: Topics 1-15.
- Test 6: Topics 1-18.
- Final Exam: Topics 1-18.

Your overall exam grade (tests and final) is then determined by the number of questions/topics you have mastered.

|                   |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |
|-------------------|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|
| <b>#Mastered</b>  | 18  | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9  | 8  | 7  | 6  | 5  | 4  | 3  | 2  | 1 |
| <b>Exam Grade</b> | 100 | 96 | 92 | 88 | 84 | 80 | 76 | 72 | 68 | 64 | 60 | 56 | 50 | 40 | 30 | 20 | 10 | 0 |

**Notes on Master-Based Testing** (in no specific order, credit to Austin Mohr)

- Clear content objectives, students continually know exactly what they need to work on to improve.
- Credit only for eventual mastery. No partial credit.
- Multiple attempts with complete forgiveness.
- A points-based system sets arbitrary deadlines by which time perfection must be attained or else penalties a
- Perseverance
  - Points – try a problem once, maybe twice, hope for the best.
  - Mastery – Keep trying until you succeed (and I know you can)
- Use of feedback on exams
  - Points – do I agree with the instructors grading
  - Mastery – what can I do to fully demonstrate that I understand the concept (improvement!)
- Reduced Test Anxiety
  - Points – every test has the potential to damage your GPA.
  - Mastery – no one test can harm your grade.
- Intelligent Test Preparation: You may actually choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all. Given time constraints of the latter tests, most students will only be able to focus on 5-8 problems in 60 minutes.
- Formative Assessment
  - Points: How many points is this error worth?
  - Mastery: Will the student benefit from studying the concept again?
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10...
- In most points-based systems, a blank exam question is a heavy blow to a student's grade. On the other hand, a student who provides a couple relevant formulas and something resembling the beginning of a solution may receive half credit or more. In the presence of constrained study time, a good strategy is to learn some basics about every test item. Such a student may earn half credit on most items together with a few lucky shots on easier items, which amounts to a passing grade overall. Take a moment to consider whether this experience has adequately prepared the student to apply mathematical thinking to nontrivial problems in the future.

The "broad and superficial" strategy employed above earns no credit under a mastery-based system. Instead, a student who wishes to earn a passing exam grade must *fully* understand an appreciable subset of the main ideas of the course, and a student wishing to earn an A grade must *fully* understand most or all of the main ideas of the course. Even if students spend no time studying a particular item, I contend that the experience of pursuing deep understanding on the other items leaves them in a stronger position to engage deeply with the troublesome topic when it is needed in the future. Moreover, depth of understanding is critical to one's ability to apply existing mathematical knowledge in novel domains.

**Cell Phones:** This is very simple - no cells phones are allowed to be used or even visible in our classroom.

This includes before, during, and after class. If a cell phone is seen, the student will be asked to leave the classroom and the day will be counted as an unexcused absence.

**Academic Integrity:** Students are expected to follow the integrity policy detailed in the handbook *Academic Integrity at Roanoke College*. Additionally, if you are ever uncertain as to how the College's policy pertains to any assignment or exam in this course, please ask me for clarification. The bottom line is that all work that a student submits for a grade must be **solely** the work of that student unless the instructor has given explicit permission for students to work together.

You will have the opportunity on some quizzes and our main project to collaborate with another as you work in pairs. It is critical that you understand that collaboration means both parties are contributing equally and meaningfully to the assignment. Adding your name to the work of another, as well as using a divide-and-conquer approach, are both examples of seeking credit for work that is not your own.

**MCSP Conversations:** The Math, Computer Science and Physics department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions will engage the community to think about ongoing research, novel applications and other issues that face our discipline.

Sessions are currently being scheduled, and all will be announced in advance.

Members of this class are invited to be involved with all of these meetings; however participation in **at least one** of these sessions is mandatory. After attending, students will submit within one week of the presentation a one-page+ paper reflecting on the discussion. This should *not* simply be a regurgitation of the content, but rather a personal contemplation of the experience.

**The Writing Center @ Roanoke College**, located on the Lower Level of Fintel Library, offers tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of competence may visit the Writing Center at any point in their process—including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. The Writing Center is open Sunday through Thursday from 4 to 9 pm. Simply stop in, or schedule an appointment by going to [www.roanoke.edu/writingcenter](http://www.roanoke.edu/writingcenter), where our staff members and workshops are also posted. Questions? Email [writingcenter@roanoke.edu](mailto:writingcenter@roanoke.edu) or call 375-4949. Like our Facebook page for hours and event updates!

**Subject Tutoring**, located on the lower level of Fintel Library (Room 5), is open 4 p.m. – 9 p.m., Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are highly trained Roanoke College students who offer one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250 & Social Sciences (see all available subjects at [www.roanoke.edu/tutoring](http://www.roanoke.edu/tutoring)). Tutoring sessions are available in 15, 30, or 45-minute appointments. Feel free to drop by for a quick question or make an appointment at [www.roanoke.edu/tutoring](http://www.roanoke.edu/tutoring) for a longer one-on-one appointment. For questions or concerns, please call 540-375-2590 or [subject\\_tutoring@roanoke.edu](mailto:subject_tutoring@roanoke.edu).

**The Office of Disability Support Services (DSS)**, is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. DSS provides reasonable accommodations to students with documented disabilities. To register for Disability Support Services, students must self-identify to the Office of Disability Support Services, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact JoAnn Stephens-Forrest, MSW, Coordinator of Disability Support Services, at 540-375-2247 or e-mail her at: [stephens@roanoke.edu](mailto:stephens@roanoke.edu) to schedule an appointment. If you have registered with DSS in the past, and would like to receive academic accommodations for this semester, please contact Ms. Stephens-Forrest at your earliest convenience, to schedule an appointment.

### Course Schedule

This course expects you to spend at least 12 hours of work each week inside and outside of class.

|                           |        |  |               |
|---------------------------|--------|--|---------------|
| Wed                       | 30-Aug | Intro  |               |
| Fri                       |        | Topic 1 – Picturing Distributions with Graphs      | Chapter 1     |
| Mon                       | 4-Sep  | Topic 2 – Describing Distributions with Numbers    | Chapter 2     |
| Wed                       |        | Topic 3 – The Normal Distribution                  | Chapter 3     |
| Fri                       |        | review   |               |
| Mon                       | 11-Sep | <b>Test 1</b>                                      |               |
| Wed                       |        | "Hooked" book discussion, chapters 1-2             |               |
| Fri                       |        | Topic 4 – Scatterplots and Correlation             | Chapter 4     |
| Mon                       | 18-Sep | Topic 5- Regression                                | Chapter 5     |
| Wed                       |        | Topic 6 – Two-way Tables                           | Chapter 6     |
| Fri                       |        | review   |               |
| Mon                       | 25-Sep | <b>Test 2</b>                                      |               |
| Wed                       |        | Topic 7 – Producing Data                           | Chapters 9,10 |
| Fri                       |        | Topic 8 – Introduction to Probability              | Chapter 11    |
| Mon                       | 2-Oct  | Topic 9 – General Rules of Probability             | Chapter 12    |
| Wed                       |        | review   |               |
| Fri                       |        | <b>Test 3</b>                                      |               |
| Mon                       | 9-Oct  | "Hooked" book discussion, chapters 3-5             |               |
| Wed                       |        | Topic 10 – Sampling Distributions for a proportion | Chapter 15    |
| Fri                       |        | Topic 11 – Confidence Intervals                    | Chapter 16    |
| <b>Fall Break</b>         |        |  |               |
| Mon                       | 23-Oct | Topic 12 – Tests of Significance                   | Chapter 17    |
| Wed                       |        | review   |               |
| Fri                       |        | <b>Test 4</b>                                      |               |
| Mon                       | 30-Oct | Project Assignment / Group work                    |               |
| Wed                       |        | Topic 13 – Comparing Two Proportions               | Chapter 18    |
| Fri                       |        | Topic 14 – Sampling Distribution for a Mean        | Chapter 19    |
| Mon                       | 6-Nov  | Group work   |               |
| Wed                       |        | Topic 15 – Inference about a Population Mean       | Chapter 20    |
| Fri                       |        | review   |               |
| Mon                       | 13-Nov | <b>Test 5</b>                                      |               |
| Wed                       |        | Group work   |               |
| Fri                       |        | Topic 16 – Comparing Two Means                     | Chapter 21    |
| Mon                       | 20-Nov | Project presentations                              |               |
| <b>Thanksgiving Break</b> |        |  |               |
| Mon                       | 27-Nov | Topic 17 – The Chi-Square Test                     | Chapter 24    |
| Wed                       |        | Topic 17 – The Chi-Square Test                     | Chapter 24    |
| Fri                       |        | Topic 18 – One-Way Analysis of Variance            | Chapter 26    |
| Mon                       | 4-Dec  | review   |               |
| Wed                       |        | <b>Test 6</b>                                      |               |
| Fri                       |        | Projects Due / Review                              |               |
| Wed                       | 13-Dec | <b>Final Exam 8:30-11:30am</b>                     |               |

| <b>Content Areas</b>                        | <b>Chapters</b> |
|---|-----------------|
| 1. Picturing Distributions with Graphs      | 1               |
| 2. Describing Distributions with Numbers    | 2               |
| 3. The Normal Distribution                  | 3               |
| 4. Scatterplots and Correlation             | 4               |
| 5. Regression                               | 5               |
| 6. Two-Way Tables                           | 6               |
| 7. Producing Data: Sampling and Experiments | 9, 10           |
| 8. Introduction to Probability              | 11              |
| 9. General Rules of Probability             | 12              |
| 10. Sampling Distribution for a Proportion  | 15              |
| 11. Confidence Intervals: The Basics        | 16              |
| 12. Test of Significance: The Basics        | 17              |
| 13. Comparing Two Proportions               | 18              |
| 14. Sampling Distribution for a Mean        | 19              |
| 15. Inference about a Population Mean       | 20              |
| 16. Comparing Two Means                     | 21              |
| 17. The Chi-Square Test                     | 24              |
| 18. One-Way Analysis of Variance            | 26              |