Welcome to Statistics! The objective of this course is to develop skills analyzing and interpreting statistical data. Although examples will be drawn principally from biology, business, and science, the thrust of the course is on the underlying statistical techniques, all of which have applications to a wide array of other phenomena.

**Course Catalog Description:**

_This course provides an introduction to statistics, concentrating on statistical concepts and the “why and how” of statistical methodology. The course focuses on learning to ask appropriate questions, collect data effectively, summarize and interpret information, and understand the limitations of statistical inference._

**Specific Learning Goals:**

After successfully completing this course, you should be able to:

1. describe data distributions using appropriate statistical language;
2. design and implement effective data collection strategies;
3. make good judgments about the validity of claims based on statistical evidence;
4. articulate the basic reasoning of inferential statistics, specifically with regard to confidence intervals and significance tests;
5. select and use appropriate statistical tools to make an inference about a population using data from a sample;
6. use a computer to explore, motivate, and answer statistical questions

More broadly, this class should serve to improve your capacity to think critically about quantitative claims of the sort often found in popular media outlets, and to express your opinions about such claims in a language that is clear, succinct, and meaningful.

**Required Text:**

Other Requirements:

- Laptop capable of running the computer software R. (I will ask you to bring this class.)
- Three-ring binder (or something comparable) in which to store class portfolio. (I will collect these periodically.)
- A lab notebook (marble covered, 9.75x7.50)
- [Optional] A calculator capable of performing scientific calculations (The TI-83, TI-86, and TI-89 are all good options. There are also smart phone apps that mimic these devices.)

Grade Distribution:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Labs</td>
<td>10%</td>
</tr>
<tr>
<td>Participation</td>
<td>10%</td>
</tr>
<tr>
<td>Project</td>
<td>5%</td>
</tr>
<tr>
<td>Exams</td>
<td>45%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20%</td>
</tr>
</tbody>
</table>

The final grading scale is as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt; 93.3</td>
<td>73.3 – 76.6</td>
</tr>
<tr>
<td>A-</td>
<td>90.0 - 93.3</td>
<td>70.0 – 73.3</td>
</tr>
<tr>
<td>B+</td>
<td>86.6 - 89.9</td>
<td>66.6 – 69.9</td>
</tr>
<tr>
<td>B</td>
<td>83.3 - 86.6</td>
<td>63.3 – 66.6</td>
</tr>
<tr>
<td>B-</td>
<td>80.0 - 83.3</td>
<td>60.0 – 63.3</td>
</tr>
<tr>
<td>C+</td>
<td>76.6 - 79.9</td>
<td>&lt; 59.9</td>
</tr>
</tbody>
</table>

Class Expectations:

This class will be taught in an “Inquiry-Based Learning” (IBL) style, meaning that instead of allocating our class-time to lectures, we will use most of our time together to actively pose, debate, and answer questions that get at the heart of the material we are trying to master. IBL emerges from the philosophy that learning works best when the learner discovers ideas rather than simply has them presented in finished form: to really understand a subject, the learner needs to think not just about how to solve problems, but also about how to pose, assess, and communicate them. In describing an IBL classroom, a colleague of mine noted that “Classrooms shouldn’t be places where young people come to watch old people work.” Our classroom won’t be. In this setting, my role as the professor is to help guide you towards productive discovery, and your job as the learner is to be curious, engaged, and communicative.
There are a number of ways to structure an IBL class, but salient features of this class will include the following:

- Hands-on activities instead of lecture
- An emphasis on group work
- Lots of dialogue and discussion
- Student presentations
- A supportive environment in which to take “risks”
- An emphasis on communication, both oral and written
- A need for trust and confidence, both student-student and student-professor

A typical day in my classroom will start with me posing one or two questions that pertain to material we have already covered. The problems will tie into the previous day’s homework, and I’ll call on students to provide answers. New material will be presented in summary form, generally a brief presentation of no more than 10-15 minutes. The remainder of the class will consist of an exploration of this new material in small groups, punctuated with student presentations of select solutions and, hopefully, some lively discussion, all held together with occasional professorial input. The questions we address in class won’t always exactly mirror the problems in the book, but by working through them, and presenting solutions to your peers, you will develop the technical and communicational skills needed to solve both book problems and problems from the broader world.

*Productive failure* is an idea that lies at the root of our approach. When you’re trying to learn something, never making a mistake is generally a sign that you’re not pushing yourself hard enough. This class should be a safe and supportive space in which to get things wrong. When talking or presenting, you are challenged to work slightly outside of your comfort zone, to volunteer answers when you have a pretty good idea but aren’t 100% certain, to risk a conjecture that might turn out to be off the mark. And when you are listening to fellow students talk, you are challenged to pay strict attention, to flag small errors of language or comprehension, and to politely and respectfully help guide one another towards a clearer and truer picture of the matter at hand. Failure is part of the design spec for this class, and it can be hard, but you will not be struggling alone.

Although the spirit of what I’m shooting for with this IBL style class is probably clear, here is a minimalist list of concrete expectations:

- attend class daily
- do all assigned homework
- participate actively in class discussions and class group work activities
- volunteer to present solutions on the board
- volunteer answers to questions I pose, and to ask your own questions when you are confused, uncertain, or simply thinking outside the box
- be courteous and supportive of your fellow learners
- help create a classroom that is a supportive, energetic, respectful place to learn.

More broadly, my basic hope and expectation is that you will engage the spirit of Inquiry Based Learning with enthusiasm, openness, and joy (it *is* fun), and help make this class a fun and supportive place in which to learn statistics.

Lastly, a word about goals and outcomes: the goal in IBL is to produce critical thinkers who have a strong, creative command of the subject material. There is ample research evidence to support the IBL model, and I’m happy to share it with you if you’d care to see it. For me, one of the strongest
element of IBL is the host of secondary skills you develop almost “for free”, including skills in abstract thinking, working from first principles, working with other people, and communicating your ideas. As my colleague Dana Ernst has noted, “All of the secondary skills you will develop in this course are highly valued by society. Whether you become a teacher, a lawyer, an engineer, or an artist, what differentiates you from your competition is your ability to think critically at a high level, collaborate professionally, and communicate effectively.”

**Details About Class Activities:**

*Class rhythm:*

Our class meets Monday, Wednesday, Thursday, and Friday. I think of Monday, Wednesday, and Friday as our “learn new material” days, and Thursday as the day to consolidate old material. Mondays, Wednesdays, and Fridays will typically involve a little bit of explanation of new material on my part, student responses to questions I pose, and some group work, often involving a computer. Thursdays will generally be what I call a “Lab”, which I conceive of as a group-based, exploratory computer session that challenges you to make connections and investigate implications of material you’ve already learned.

On exam weeks, this rhythm gets mixed up a bit. I will generally administer exams on Thursdays, and we’ll spend Wednesday reviewing. On exam weeks we generally won’t have Practica.

*Group work:*

The importance of *group work* in IBL style learning is hard to overstate. Indeed, most of the in-class learning happens with the help of peers: in small peer groups, you discuss and evaluate ideas, you figure out how to formulate solutions, and ultimately you present these solutions to the class at large. The peer group thus provides ideas, feedback, support, and a set of other learning models.

In order to order to give you practice working with a variety of groups, I will assign everyone to a team of 3-4 people at the beginning of the term and then periodically shuffle these groups thereafter.

*Daily Homework:*

As noted above, new material is introduced on Mondays, Wednesdays, and Fridays. Most of these days, I will assign somewhere between two and six problems to do for homework, work that is due at the beginning of the next class (Thursdays don’t count as “class days” for this scheme.) The problems that I assign will be natural outgrowths of the work you do in class, and often involve manipulating data sets on a computer. Most of the daily problems will be “book problems”, although sometimes I’ll give you problems that don’t come from the book. The purpose of the daily homework is threefold: one, to reinforce active learning between each class session, two, to give you practice engaging with the book (which can be difficult!), and three, to help prepare you for quizzes and tests.

You should feel free to work with whomever you wish to solve the Daily Homework, but you should always write up your own solutions in your own words. We’ll often start out our class day by sharing solutions to at least a subset of these daily homework problems, and I expect you to volunteer solutions on a regular basis. (See “Participation”, below.) If you didn’t manage to solve a problem, you can fill in your homework sheet based on the answers your peers provide, but I ask you
to do this using special “felt-tip” pens that I provide, so I can distinguish between what you brought to class and what you took.

Your Daily Homework will be graded by a student grader, who will provide comments like “make sure you write in complete sentences”, or “explain your reasoning”, but won’t provide detailed solutions. Daily homework solutions are to be written out in complete sentences, and you need to make an effort to articulate your thought process, not merely provide “an answer.” However, your daily solutions don’t need to be “polished”, and can include things such as cross-outs, “notes to self”, page references, hand-sketched figures, etc. Your daily homework will be graded on a 0-3 scale, as follows:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>All problems attempted; correct answers, strong effort to articulate thought process</td>
</tr>
<tr>
<td>2</td>
<td>Most problems attempted; correct solutions, but not a great articulation of thought process</td>
</tr>
<tr>
<td>1</td>
<td>Half or fewer of the problems attempted; incorrect and ill-articulated answers</td>
</tr>
<tr>
<td>0</td>
<td>Nothing submitted</td>
</tr>
</tbody>
</table>

At the end of the term I will drop your two lowest daily homework scores.

Labs:

Trying to do statistics in the 21st century without the help of a computer is almost inconceivable. Accordingly, one of the goals of this course is to help you gain computational fluency with statistical software. Computational fluency means that you should feel comfortable using the software, you should understand its strengths and limitations, and you should be able to employ it effectively as a means to analyzing real-life data sets.

To help you achieve these goals, I intend to have a “Lab” most Thursdays. You are expected to bring your laptop and a lab notebook to class on Lab days, and, with the help of a partner, to work through a “computational guided inquiry” that I organize in advance. These exercises will generally have you investigate ideas that have been presented the previous week. You will use your lab notebook to sketch plots, make conjectures, record results, and write reflections. After each lab you will submit (via Dropbox) an electronic file with your calculations, and (in hardcopy) your lab notebooks with your reflections and results.

Please note that even though labs will be done with partners, you should write up and submit your own copy of the solutions. I will grade your labs on a scale from 0-10, evaluating both content and style. The lowest lab score will be dropped at the end of the term.

Participation:

Since active participation by each member of the class is a critical element in the success of the IBL classroom, participation counts as 10% of your total grade in this course. This grade will be evenly apportioned along the following axes:

- Presentations of homework solutions

Discussing solutions to homework problems is a central activity in this class. I expect you to participate by volunteering to go to the board and present your work. To gain any points in the “presentations” portion of your participation grade, you need to present at least four times over the course of the semester, and at least once between each exam. This requirement is a minimum: stronger and more frequent presentations will be rewarded with higher grades.
Some notes on style: though the environment in this class should be informal and friendly, what we’re doing is serious business. The presentations made by students are a foundational part of this class, and they should be taken with great seriousness. I ask that the following points be kept in mind during students presentations:

- The point of the presentation is not to convince me that you’ve done the problem, but rather to make the problem and its solution clear to your peers.
- When possible, presenters are to write in complete sentences, using proper English grammar.
- Presenters should explain their reasoning, not simply show techniques.
- Fellow students can ask questions at any point, and should pay attention both to what is written on the board and what is said by the speaker. Anything that is unclear or incorrect should be noted and addressed.
- Since the presentation is directed at students, the presenter should make appropriate eye contact and try to gage how well students are following the argument.

• Other forms of in-class participation

Aside from presenting homework solutions, there are a variety of other ways to participate in this class.

- Ask questions! Anytime, anywhere, and on any topic. Good options include during student presentations, during my “lectures”, within your working groups, before and after class, during office hours, etc.
- Answer questions! Sometime I or a student will ask questions, and we’ll need answers. If you have ideas, share them!
- Bring in statistical tidbits to share with the class. (Factoids, newspaper articles, whatever.)
- Participate actively in your group—talk, share notes and ideas, organize get-togethers outside of class to review Weekly Homework or test questions. The extent to which each group will be a resource is limited only by the engagement of its members.

• Portfolio

I ask you to keep a portfolio of all your work in this class. The portfolio should be a three-ring binder (or something capable of holding and organizing loose leaf papers) and consist of the following sections:

1. Your Daily Homework solutions
2. Your completed in-class worksheets
3. Printed versions of your graded electronic lab submissions

If you want to use this portfolio as a place to store your other class materials, you might also some other sections, although these are optional. Example include:

4. (Notes)
5. (Exams)
6. (Reference materials)
I’ll ask you turn this portfolio in periodically. The purpose of the portfolio is both organizational and archival: it holds your work together in one place, and it also provides a record of what you’ve learned and how you’ve progressed.

*Project:*

There will be one project assigned during the last couple of weeks of class. The project is designed to synthesize the many ideas and techniques that this class addresses. It is also designed to illustrate the wide applicability of the material this class covers, and to give you an opportunity to use this material in a creative way to investigate a real-world problem of immediate relevance. To ground these projects in “relevance”, I ask that the topic be something that has to do with Tacoma. There are many options, and I will help narrow down your choices, but example topics might include regional distribution of high school test scores, environmental contamination patterns, income inequality, and demographic distributions, among others.

I will provide you with detailed specifications as we start to work on the project, but meanwhile, anticipate that it will involve data collection, various forms of statistical analysis, and a formal, typed write-up. You will be expected to use your computer to process the data, form plots, and perform analysis, and your final write-up is expected to be a polished, professional looking report.

If you want to work with a partner on this assignment, you are welcome to do so.

*Exams:*

I will give three tests during the semester. Each test will have two parts, a take-home part and an in-class part. For the take-home part, you are welcome to work with your in-class group, though as usual, everyone needs to write up and turn in their own solutions. All the take-home parts will involve some use of the computer, and you’ll generally have a couple of days to work. The in-class part will be administered during a regular class session (generally Thursdays), and computers will not be allowed, although you will be allowed to bring a calculator and one 3x5 index card with whatever notes you wish. Material for each test will generally be chosen from the material we have most recently studied, but each test is theoretically “cumulative” in the sense that any material we have covered is fair game for any test.

Tentative dates for the in-class exams are Thursday September 25, Thursday October 16, and Thursday November 13.

*Final Exam:*

There will be a cumulative, “mastery-based” final exam administered during our allotted exam slot in finals week. The dates and times for these exams are:

- (Section E) Monday, December 15th, 12:00-2:00pm
- (Section F) Friday, December 19th, 12:00-2:00pm

To pass the class, you must take the final exam at the assigned time, above. The exam will have two parts. Part 1 of the final contains basic problems that all students should be able to do to demonstrate a basic knowledge of Math 160. Completing Part 1 successfully (i.e. getting all problems correct except maybe a couple of minor errors) allows a student to keep his/her preliminary grade, or get at least a C- in the course. Part 2 contains more challenging problems.
Course Content and Schedule:

For a detailed class calendar, please consult the class webpage (its URL is at the very top of this syllabus.) Broadly, we will cover the following material in the following timeframe:

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks 1-4</td>
<td>Collecting and Summarizing Data</td>
</tr>
<tr>
<td>Weeks 5-7</td>
<td>Probability and Random Variables</td>
</tr>
<tr>
<td>Weeks 8-11</td>
<td>Confidence Intervals and Hypothesis Tests</td>
</tr>
<tr>
<td>Weeks 12-15</td>
<td>Regression and Chi-Square Analysis</td>
</tr>
</tbody>
</table>

Policies:

Attendance:

 Built into the philosophy of inquiry-based learning is the idea that we help one another to learn. As a consequence, your daily attendance in class is very important, not just for your own benefit, but for that of your peers.

I will take role every day and verify attendance. You are allowed to miss up to three days with no penalty. After three missed classes, two things happen: 1) every additional absence causes you to lose 10% of your final participation grade, and 2) I reserve the right to drop you from the class.

Late work:

I do not accept late daily homework. Built into my policy of dropping the lowest two homework scores is the idea that you might get sick once in a while and miss an assignment—if that happens, simply think of the missed work as “dropped” and carry on. If you miss more than two homeworks for legitimate reasons (e.g. death in the family, medical emergency, etc.) talk to me and we’ll work out something equitable.

Labs, take home exams and the project can be turned in late, but you lose one letter grade for each day these assignment are late.

Planned Absences:

If you need to be absent for some family or medical emergency, you should contact me in advance (if possible) or as soon as possible after the emergency. The same goes for student athletes who need to miss class for games. If you miss a test for a legitimate reason, I will generally simply omit that test from your final grade, rather than administer a make-up test.

Classroom policies:

You are welcome to bring a cup of coffee or a bottle of water to class, but please eat your meals outside of class. Please turn off your phones and keep your laptops closed, unless we happen to be doing a computer exercise. You can take a bathroom break if necessary, but please make this the exception, not the rule—in general, I don’t want people entering and leaving the room during class.

Academic integrity:
It is your responsibility to understand the academic integrity policy of the university. You can find this policy in the Academic Handbook, and it is also available online at: http://www.pugetsound.edu/student-life/student-resources/student-handbook/academic-handbook/academic-integrity/.

Not citing other people’s work, turning in the same work to satisfy two different classes, citing false information, or plagiarism are all violations of the academic integrity policy. Such violations are taken very seriously, and will be reported if discovered.

**Disabilities:**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Peggy Perno, Director of Student Accessibility and Accommodation, 105 Howarth Hall, 253-879-3395. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

**Getting Help:**

There are free statistics tutors that meet in the foyer of Thompson 390. Their schedule will be posted as soon as it is available. These tutors follow a “drop-in hours” paradigm. If you want to schedule an appointment, you can do so with tutors at the CWLT. You should also take advantage of the fact that you are at a small college by consulting with me as often as necessary. During my office hours (which are posted at the beginning of this syllabus, and on the course webpage) you should feel free to drop by, no appointment necessary. In general, I try to adhere to an “open door” policy in the sense that you should feel free to come in to my office whenever the door is open (and I try to keep it open as much as possible.) If you can’t make my office hours and don’t succeed in finding me in my office at other times, you should send me an email and we will set up an appointment.

**Classroom Emergency Response Guidance**

Please review university emergency preparedness and response procedures 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.