Introduction

Statistical tests and experimental design are the foundations of the Scientific Method. Without valid experiments and the assessment of quantitative data (numbers as opposed to ‘qualitative’ data which are feelings) no study can be scientific. Therefore, knowledge of statistical theory and practice is essential to being any kind of scientist, discovering any facts, or attempting to put theories together. To put this different way, if one does not know and understand how to design experiments and run statistics, one’s ability to do, teach, or understand science is limited to descriptions and stories. Without statistical analysis almost no information can be said to be reliable.

While it is true that in the days of Mendel counting proportions was enough to lead a researcher in the right direction, today well-designed experiments, scientific measuring devices, and several types of statistics are available to discover new knowledge. Scientific knowledge advances only by numerical testing of data. These days there is a lot of talk of ‘big data’ to refer to the huge amount of data being produced by sensors, satellites, and other devices, but there are pitfalls in testing large, complicated datasets. A real causal relationship is best seen by relatively simple tests of a single dependent variable in a direct experiment. And these sorts of experiments will be the focus of this course.

Because quantitative data is a foundation of science, statistics classes are necessary. And while they are necessary, I hope this class is not boring or unduly difficult. Rather, I hope that it becomes clear that statistics are critical and informative, and not as difficult as many people think. Also, I hope it becomes habit for you to examine the experimental design and statistics of every paper you read. Also the class should help you practice how to design your own research projects and analyze data you obtain.

The course is introductory and assumes no previous experience with statistics. Foundational terminology and concepts will be introduced and this will let the class then cover basic statistical tests. The class will cover both parametric and non-parametric tests. This class will include experimental design as well as statistics. The discussion of experimental design will cover some field methods for both plants and animals.

Bad experimental design can result in an entire experiment that is fatally flawed, as is shown by this quote from famous statistician Sir Ronald Fisher:

To call in the statistician after the experiment is done may be no more than asking him to perform a postmortem examination: he may be able to say what the experiment died of

Whitlock and Schluter p. 204
Class Objectives

1. Introduction to experimental design concepts, and to practice with designs.
2. Understanding writing hypotheses, and the logical structures of hypotheses.
3. An understanding of basic descriptive statistics, types of distributions, and basic inferential statistics.
4. Defining and understanding the assumptions requirements underlying these statistics.
5. Introduction to sampling techniques and constraints on study size.
6. Know the definition of statistical error types and statistical power.
7. The proper use and interpretation of parametric and non-parametric statistical tests.
8. Become familiar with data input and test outputs from MS Excel.
9. Understanding use and basic mathematic operations of linear regression and ANOVA.

Required Material

Required textbook:
Greenwood Village, Colorado. 768 pp.

Suggested reading:

Required Software

The software used in the course will be Microsoft Office Excel, Word and an Excel add-on called RealStatistics (available at: http://www.real-statistics.com/). For statistical tests the built-in functions of Excel will be used as well RealStatistics and calculators from websites I will give to you.

Please download the lecture videos and other files for the class, fast Internet access is a plus. You can go to a library or workplace to download the larger files or put them on a flash drive. Do not try to stream the video lectures, it will not work. Office 2007 (or later) is required. In addition an optional component of Office is useful for this class, install it from your MS Office DVD if it is not already on your machine: Analysis Toolpak – this is part of Excel and may need to be

Microsoft Office is available from the UNK computer store (called “UNK Connections”) for a reduced price. A school ID, or other verification of enrollment is required. The software is available for both PC and Mac. Adobe Shockwave in a browser or a standalone video player (e.g. Windows Media Player, VLC player) will be needed for viewing the lectures.

Course Grading

Grading for this course will be as follows (note Late Assignment Policy on page 2 of policy section). Note that the Participation grade is based on 2 quality posts per week on Discussion Board (see page 5).
Graded Assignments

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagiarism Assignment</td>
<td>10</td>
</tr>
<tr>
<td>Problem Assignments 3 @50 pts</td>
<td>150</td>
</tr>
<tr>
<td>Participation (Blackboard Discussion @ 10 pts per week, starts 3rd week, no points last 3 weeks of class)</td>
<td>100</td>
</tr>
<tr>
<td>Final Exam</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>460</strong></td>
</tr>
</tbody>
</table>

Grading Scale: The following scale will be used: A (90-100%), B+ (88-89%), B (82-87%), B- (80-81), C+ (78-79%), C (72-77%), C- (70-71), D+ (68-69%), D (62-67%), D- (60-61), F (Below 60%)

**Students with Disabilities or Those Who are Pregnant**

Withdraw (W) and Incomplete (I) Grades:

Until the conclusion of the 10th week of the semester, you may withdraw from any class and receive a grade of "W." This grade does not count toward your grade point average and merely indicates that you withdrew from (or "dropped") the class. No instructor can withdraw a student from the roster; that is, if you stop coming to class the instructor cannot withdraw you from the class. The instructor will be forced to assign you a failing ("F") grade for the class. Withdrawing from a class involves filling out a simple form that the instructor and student both sign and returning this form to the registrar's office by the withdraw deadline.

Under very unusual circumstances, a grade of incomplete ("I") may be issued. An incomplete is not a substitute for a "W" (withdraw), and it is not a substitute for a poor or failing grade. An incomplete is issued if circumstances beyond the student's control prevent the student from completing the required work for the class by the end of the semester (example: student is hospitalized during final exam week). If you qualify for an incomplete grade, it is expected that you will receive this grade in all your classes. An incomplete grade will give you an extension to complete outstanding work only; it is not an opportunity to "start over" in the class. All outstanding work must be completed within one year or the "I" grade automatically converts to a failing ("F") grade. An incomplete grade will be considered only during the final six weeks of the semester, after the deadline for receiving a "W" has passed.

Students with Disabilities or Those Who are Pregnant

Students with disabilities or those who are pregnant are encouraged to contact me for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students with documented disabilities or those who are pregnant. To receive accommodation services for a disability, students must be registered with UNK Disabilities Services Coordinator, David Brandt, in the Academic Success Office, 163 Memorial Student Affairs Building, 308-865-8214 or by email brandtdl@unk.edu. For those needing accommodation due to pregnancy, you need to visit with Student Health. The following link provides information for students and faculty regarding pregnancy rights. [http://www.nwlc.org/resource/pregnant-and-parenting-students-rights-faqs-college-and-graduate-students](http://www.nwlc.org/resource/pregnant-and-parenting-students-rights-faqs-college-and-graduate-students)

Attached is the link to the above statement for your convenience. [http://unkcms.unk.edu/offices/disability_services/](http://unkcms.unk.edu/offices/disability_services/)
Copyright Statement

The materials on this course website are only for the use of students enrolled in this course for purposes associated with this course and may not be retained or further disseminated. The materials on this course website may be protected by copyright, and any further use of this material may be in violation of federal copyright law.

Science does progress this way sometimes, thanks XKCD!
# Syllabus for Biol 827 Biostatistics

Here is the tentative schedule for the semester. Readings in both texts are specified, problems are given by chapter and number of problem to be completed. Problem sets are assigned for the week (for discussion board) and due Monday of the following week by 5:00 pm Central time.

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Lecture</th>
<th>Readings</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 24</td>
<td>1</td>
<td>Lecture 01</td>
<td>Painless Stats <a href="#">here</a></td>
<td>Syllabus &amp; Introduction</td>
</tr>
<tr>
<td>Aug 31</td>
<td>2</td>
<td>Lecture 02</td>
<td>Chp 1 Statistics &amp; Samples</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 03</td>
<td>Chp 2 Displaying Data</td>
<td>Plagiarism Cert</td>
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<tr>
<td>Sept 7</td>
<td>3</td>
<td>Lecture 04</td>
<td>Chp 3 Describing Data</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 05</td>
<td>Chp 4 Estimating with Uncertainty</td>
<td></td>
</tr>
<tr>
<td>Sept 14</td>
<td>4</td>
<td>Lecture 06</td>
<td>Using Excel with Statistics</td>
<td>Assigned Readings Donovan and Weldon</td>
</tr>
<tr>
<td>Sept 21</td>
<td>5</td>
<td>Lecture 07</td>
<td>Chp 5 Probability</td>
<td>WS 1) 1.17 2.25, 3.15, 4.22 D&amp;W 1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture 08</td>
<td>RealStatistics (or webpages for stats)</td>
<td></td>
</tr>
<tr>
<td>Sept 28</td>
<td>6</td>
<td>Lecture 09</td>
<td>Chp 6 Hypothesis Testing</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 10</td>
<td>Chp 7 Analyzing Proportions</td>
<td></td>
</tr>
<tr>
<td>Oct 5</td>
<td>7</td>
<td>Lecture 11</td>
<td>Chp 8 Fitting Probability models</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 12</td>
<td>Chp 9 Contingency analysis</td>
<td></td>
</tr>
<tr>
<td>Oct 12</td>
<td>8</td>
<td>Lecture 13</td>
<td>Chp 10 The Normal Distribution</td>
<td>WS 2) 5.35, 6.25, 7.22, 8.14, 9.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture 14</td>
<td>Chp 11 Inference for Normal Population</td>
<td></td>
</tr>
<tr>
<td>Oct 19</td>
<td>9</td>
<td>Lecture 15</td>
<td>Chp 12 Comparing Two Means</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture 16</td>
<td>Chp 13 Handling Assumption Violations</td>
<td></td>
</tr>
<tr>
<td>Oct 26</td>
<td>10</td>
<td>Lecture 17</td>
<td>Expt Design and Stats Heath readings</td>
<td></td>
</tr>
<tr>
<td>Nov 2</td>
<td>11</td>
<td>Lecture 18</td>
<td>Experimental Design II Gotelli and Ellison: 6 (optional), 7, 8</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 19</td>
<td>Chp 14 Designing Experiments</td>
<td></td>
</tr>
<tr>
<td>Nov 9</td>
<td>12</td>
<td>Lecture 20</td>
<td>Chp 15 Comparing means &gt; 2 groups</td>
<td>WS 3) 10.19, 11.21, 12.18, 13.27, 14.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture 21</td>
<td>Chp 16 Correlation</td>
<td>Final Exam assigned</td>
</tr>
<tr>
<td>Nov 16</td>
<td>13</td>
<td>Lecture 22</td>
<td>Chp 17 Regression</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Lecture 23</td>
<td>Final Exam Lecture</td>
<td></td>
</tr>
<tr>
<td>Nov 23</td>
<td>14</td>
<td></td>
<td><strong>Thanksgiving Break</strong></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Week</td>
<td>Lectures</td>
<td>Readings</td>
<td>Assignments</td>
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<tr>
<td>Nov 30</td>
<td>15</td>
<td>Lecture 24</td>
<td>Chp 18 Multiple Explanatory Variables</td>
<td></td>
</tr>
<tr>
<td>Dec 7</td>
<td>16</td>
<td>Lecture 25</td>
<td>Chp 21 Meta-analysis</td>
<td>Class Review</td>
</tr>
<tr>
<td>Dec 14</td>
<td>17</td>
<td></td>
<td><strong>Final Exam Due Dec 16&lt;sup&gt;th&lt;/sup&gt; by 4:00 pm Central Time</strong></td>
<td></td>
</tr>
</tbody>
</table>
Orientation to Albrecht Blackboard Use
Version 1.91 Fall 2015
UNK Biology Department

Introduction:
The UNK Biology Distance Master’s program has a number of faculty participating. Part of the experience and challenge of the program is that, as in other professional situations, faculty are different from each other. Different faculty have different lecture styles, different discussion board expectations, different grading priorities, and even different methods to deliver class material. I realize this might be confusing for people, but hopefully the various methods will demonstrate what works and what does not for you in your own future careers. Please read this section as I try to clarify how I use Blackboard in this class.

Please contact me with any questions, also note that the UNK e-Campus website does provide both Video Tutorials and Atomic Learning Tutorials on using Blackboard, email, and MS Word see this page.

A note about Expectations:
I approach this program with the goal of providing, as closely as possible, the level of experience I was fortunate enough to experience in my graduate career at some very good universities. This means that generally my expectations are high. I will do my best to find, present, and interpret material I think is important and appropriate for the subject area of classes. I will also do my best to explain how the process of science works including experimental design, statistical testing, writing, and thought processes. I will also work to be as available as possible, and turn around Blackboard, emails, and graded work as quickly as I can.

It is my hope and expectation that everyone in this program is here because they enjoy biology and wish to become more knowledgeable and proficient at teaching or researching.

Here is a quick checklist of points that may help you succeed in the course, based on my experience as a graduate student and professor:

1. Have you prepared for class? Have you read the material, not just once but twice? Have you looked up authors, concepts, or words you were not familiar with before the reading? Do you understand how this reading fits into the discipline in general, and why it was assigned? Have you noticed the author, date, and author’s institution of the paper in addition to the data, statistical tests, and concepts in the paper?
2. Before asking an entire class what a word means have you tried to look it up? Did you try to find the word from appropriate, professional, recognized sources? Have you used the assignment itself, an index book section (if present), another biology text you own? Wikipedia is also a good place to start, but not a good place to end. Never use Wikipedia as a reference in a paper in this class.
3. Is the work you are turning in reflective of you as the professional you are working towards? Is the work well-researched? Do you have all the important concepts covered in your work? Is the organization of the paper clear and useful? Have you put in thought and work on the figures and tables to make them clear, professional, and are they referenced correctly? Has the work been proofread for
grammatical, factual, spelling, and formatting errors? Do you know what formatting is desired by the professor and done it?

Blackboard:
The Blackboard Classroom (Bb) software is the main portal for the class work in the UNK Biology Distance Master’s program. Being familiar with Bb is helpful for success in the program. Here are the components are the ones I use the most:

1. Course Documents:
   a. This is where I place pdf files and video files that are the lectures for classes
   b. These files should be downloaded (not streamed) for printing out or viewing
   c. Some of these files are large and should be downloaded on fast internet connections
   d. I may post other papers here as well as book sections or links to other sites, these are class materials and should be read and have notes made on them.

2. Discussion Board:
   a. This section of Blackboard is how you will communicate with me and each other in the class.
   b. In my classes Discussion Board is an important part of the class experience, there are lot of points associated with participation on Discussion Board.
   c. Typically each discussion board is opened Monday around 9:00 am Central Time, and closed Sunday night around 10:00 pm Central Time (I reserve the right to change these times).
   d. Because discussion boards are important, posts will be graded.
      i. I expect at least two useful postings each week and not all on Sunday night.
      ii. The quality of your contribution. This is a somewhat subjective category, but the more thoughtful your comments the better the quality of discussion will be. Your comments should be at least a few sentences. Conciseness and clarity are necessary to keep the work load for this class to a reasonable level, i.e.: page long postings are discouraged. Your comments should be supported with information, file attachments or web sites, and should be relevant to the current topic of discussion. References are encouraged.
      iii. How well you interact as classmates. Your responses should demonstrate that you are aware of the discussion that has been taking place. Go beyond stating “I agree” with someone with someone by stating your reasoning. But be polite and constructive in your responses to other students and me.

3. Assignments:
   a. Many, if not all the assignments in the class will appear here, so please find this area of Blackboard
   b. There are two types of assignment functions I use most:
      i. Tests: these are timed tests, typically multiple choice tests that are available for a limited amount of time. That time frame is usually opening them at Friday at 5:00 pm on the week they are assigned and closing them on the following Monday at 10:00 pm Central Time. These tests are to be completed online within a time limit (e.g. 30 minutes) once started.
      ii. Papers: I use the ‘assignment function’ to create a link through which you can upload your documents. This system has the distinct advantage over email in that papers go directly to a ‘space’ that is specific to one person for one assignment. Users will see a green exclamation point in the Gradebook for the assignment when you have uploaded the document.
1. This function also can be set to be available for a limited amount of time. Papers are typically due Mondays at 10:00 pm Central Time. Typically I post the assignments at least 1 week ahead of the deadline.

4. Gradebook:
   a. This is the area of Blackboard where grades are recorded and displayed, these are the actual grades I use, so check your grades often.
   b. Note the symbols in Blackboard. The responsibility is yours to make sure assignments are in on time, uploaded correctly, and that the correct file is uploaded. If the wrong file is uploaded, or the file is late, penalty of at least 10% will be assessed.
      i. Empty assignment: this means no file has been uploaded, or test taken according to Blackboard. You do not want see this if you have taken a test or uploaded a file.
      
      ii. Green exclamation point: this means that Blackboard has received a file, or that a test has been taken. A file that is uploaded may still be corrupt, or a person could still have uploaded the wrong file, but whatever it is, Blackboard has it. This is fine, with the two exceptions given above, and it means I have to grade the assignment before you will see a grade. Any paper, and any tests with subjective questions (such as fill-in, short answer) will have this symbol until I graded.

      iii. Red exclamation point: this symbol is bad. This symbol means that a file failed to upload correctly, or a test failed while being taken. This symbol means that you and I need to talk by email, phone and figure out a solution. This needs to be done before the due date of the assignment. If you do not contact me before the due date, late penalties will be assessed of 10% of grade if late, and 10% per 24 hour period after that.
5. Announcements:
   a. These are the text entries you see just below the title for the class when you enter Blackboard
   b. I will post class information here, such as changes to the syllabus or answering a question that is coming up repeatedly.
   c. Please check this area several times a week on your way to Discussion Board, Assignments, or Gradebook.

6. Other Features:
   a. There are other features of Blackboard that I use from time to time so please look around at the program.

7. Scientific Writing
   a. I will include documents in Blackboard/Course Documents folder to help with scientific writing. I hope to see the highest level of professional writing in assigned papers.
   b. I encourage everyone to work on improving their writing skills, as I continue to work on mine. Everyone in the program should have at least a few papers from primary journals from other classes or your own reading. If not, get a few from the UNK library collection that you have access to as a UNK student. Recent papers from a major journal should be read for style, voice, formatting. Such examples will show you how to build sentences, tables, figures, paragraphs, references and abstracts. Everything you need to know is there. Also, you can always ask for feedback on sample writing!
Dr. Albrecht Class Policies  
Version 1.71 Spring 2015

Introduction:  
Every institution has its rules and policies and UNK and the Biology Department have them too. Because of the distance education environment the degree of communication between student and faculty can be difficult, and misunderstandings do happen. Please keep in mind “talking” over the computer is not the same as face to face – several types of communication are lost. Please be patient and allow more time than you might otherwise to get the solution you need. Here are the policies that will be in place for this class.

Policies:
1. Paper formatting: All work turned in for this class should have the following formatting
   a. Size 12 font, 1” margins all around the page, page numbers present, no right justification
   b. Header information on the first page: name, class, date, assignment
   c. All text double-spaced with proper English spelling and grammar used. The writing should be simple, clear, scientific writing style. At the least this means: subject-verb-direct object structured sentences.
   d. Tables must be labeled at the top and have captions that explain them.
   e. Figures must be labeled below and have captions that explain them. No titles within the phase space such as the Excel default.
   f. All work turned in should have correct references. All citations must be (author year) format in text (including figures and tables if they are adapted from existing work) with full citations at the end of the paper. See below for details on formatting.
      i. Citations are needed if textbook or lecture material is used (especially when quoted!). This is both the legal necessity and good practice for work beyond class.
      ii. Full citations should be in a “References” section at the end of each paper and follow these formats, reverse indented, and alphabetical by author:
   g. Failure to do any of these can result in letter grade reductions.

Citation Style Examples:
Books:

Computer Program:

Journal Article:

Website:

2. Plagiarism and Cheating:
   a. Please see and complete this page - I require everyone in the class has visited this site, take the quiz and send me a completion certificate (Test & Certificate section) by the 5:00 pm Central Time on the second Friday of the semester. Every semester, even if you have done it before. Send a screenshot, scan, or other image pasted into a Word document to the column in Blackboard - Assignments. The reason? So everyone knows exactly what plagiarism is. ALL sources in anything turned in for this class must be cited, including figures and anything taken from class texts (such as copying the text of problems), every time!
   b. Also see the UNK Student Handbook for UNK policy statement on plagiarism
   c. I consider plagiarism a scourge and a stain on science and detrimental to the progress of humanity. Penalties include zeros on questions, or entire tests, or failing the class outright in addition to letters in the permanent files here at UNK
   d. Citation information for APA style is given at the UNK eCampus website here
   e. A quick rule: more than 3 words in a row from any source must be referenced
   f. Do not communicate with outside experts to answer tests. Assignments are meant to assess your knowledge, not that of others.
   g. Work individually unless directed into groups. Your work should be your own, and any personal pronouns used in your writing (which should be few in any case) should reflect this, i.e. no ‘we’ in assignments you work on by yourself.

3. Late work/technical difficulties:
   a. Late work will be subject to the following grade reductions:
      i. 10% reduction of grade for any work submitted after stated deadline
      ii. A further 10% grade reduction for each 24 hour period past the stated deadline
   b. I understand that online classes demand attention to deadlines. However, this graduate program is not a self-paced one. This program is structured to academic terms and time frames (such as breaks) as the brick and mortar University of Nebraska system. In general people in the program show great dedication and hope this tradition continues.
   c. Technical difficulties are part of the reality of the online world. Given that truism, do NOT wait to submit assignments until the last minute or hour of a deadline. Both you and I cannot be responsible for failures of power, computers, computer networks, or even Blackboard. Do not procrastinate; turn assignments in early, so there is time to resubmit if there are any problems.
   d. Important: please install and run some sort of anti-virus and anti-malware software on your computer. This is for all of us in the class, so that viruses are not spread through the class:
      i. Microsoft Security Essentials (recommended):
      ii. other maintenance software such as System Mechanic (my favorite), Symantec System Works
      iii. Malwarebytes Anti-malware

4. Online etiquette:
   a. Please be respectful of others in the class, even me. It is easy to be more confrontational via electronic post than in person. I understand conversations may become heated, and irony, even sarcasm may be attempted at times be used to make a point; however such attempts are often not understood via posts. Please try to remain civil at all times.
   b. Posts I deem as offensive or inflammatory towards others or me will be removed from the discussion boards. If this becomes a continuing problem, grade reductions may result. I will keep copies of such posts.