IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Plant Pathology
Seed Science Center
Ames, IA 50011

October 2, 2015

TO: College Catalog and Curriculum Committee (GCCC)

FROM: Gary Munkvold, DOGE, Seed Technology & Business Graduate Program

RE: STB 536 Credit Adjustment

I am writing in regard to a credit discrepancy we have with one of the Seed Technology & Business (STB) courses in our curriculum. Currently, we offer one statistics course which serves as the only quantitative methods statistics course for the Graduate Program in STB (STB 536). This course was modeled after several other quantitative statistics courses offered at the university at the graduate level which are currently being offered for 2-3 academic graduate credits.

Within this course the instructor covers scientific method, experimental design, distributions and probability, central limit theorem, confidence intervals and hypothesis tests, binary and multivariate categorical data, continuous data, linear correlation, regression and prediction, and lastly, the analysis of variance. After reviewing all the topics covered, assignments and contact hours for students it has come to our attention that this amount of information and work warrants an increase in the number of credits our students receive for successful completion.

Currently, our students receive just one academic credit for this course. Because we believe all the information offered in this course is imperative for our students to learn while in the STB program, we are proposing the number of credits for this course be increased from one to two graduate credits.

We are attaching the course outline for your review. Please feel free to contact us with questions or concerns in regard to our request. Thank you for your time and consideration.

Sincerely,

Gary Munkvold, Professor & Seed Science & Technology Chair
DOGE, Seed Technology & Business Graduate Program

Course Syllabus

Course Instructor & Contact Information

Instructor: Dr. Laura C. Merrick

Instructor and curriculum developer for online graduate programs, including the Master of Science in Agronomy, Master of Science in Seed Technology & Business, Master of Science in Plant Breeding (online option), and Plant Breeding E-Learning Project in Africa

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*For **computer-related** problems or **Internet connection** problems*	**Resources & Contacts**: • ISU Solution Center at solution@iastate.edu or 515-294-4000 • Brenton Center for Agricultural Instruction & Technology Transfer at agonlinetech@iastate.edu or agonlinehelp@iastate.edu or 800-747-4478
*For problems with **Blackboard Learn***	**Resources & Contacts:** • Blackboard Learn help for ISU Students at agonlinetech@iastate.edu or solution@iastate.edu
*For problems with **accessing SAS** via the Agronomy Dept. remote server*	**Resources & Contacts:** • Agronomy Virtual Labs at bakerlab@iastate.edu or 515-294-4418
*For questions about **STB courses** or **STB program** in general*	**Contact:** • Lori Youngberg, Program Coordinator of the STB Program at seedgrad@iastate.edu or lyoung@iastate.edu or 515-294-9137
*For online **Glossary** and online **Algebra Review Guide***	**Resources:** • Algebra Review Guide at http://masters.agron.iastate.edu/tools/Algebra_Guide/index.html • Glossary at http://masters.agron.iastate.edu/tools/glossary/index.html *(Both developed by ISU Distance Programs in Agronomy faculty and staff)*

Course curriculum developed by Ron Mowers, Ken Moore, Dennis Todey, Matt Harbur, Kendra Meade, William Beavis & Laura Merrick

Course Index

Lesson Topic	Start/End Dates
Algebra Review Guide & associated practice problems *(this review is optional, but recommended)*	ideally prior to Aug 24
Unit 1: **Basic Principles**	Aug 24-31
Unit 2: **Distributions and Probability**	Aug 30-Sep 7
Unit 3: **Central Limit Theorem, Confidence Intervals, and Hypothesis Tests**	Sep 6-14
Unit 4: **Categorical Data - Binary**	Sep 13-21
Unit 5: **Categorical Data - Multivariate**	Sep 20-28
Unit 6: **Continuous Data**	Sep 27-Oct 5
Unit 7: **Linear Correlation, Regression and Prediction**	Oct 4-12
Unit 8: **The Analysis of Variance (ANOVA)**	Oct 11-19
FINAL EXAM	Oct 15-21

Depending on the lesson, required submissions for each Unit will include Homework Assignments, Discussion Topics, Discussion Summaries, and Unit Reflection learning journals. Due dates for graded homework assignments, discussions, reflective learning journals and the final exam are shown in the **Course Calendar**, which is available in **BLACKBOARD LEARN**. The lessons will occur on a weekly basis during the first 8 weeks of the fall semester. There is only one examination in the course—a **Final Exam**, which is comprehensive and consists of a multiple-choice online test component and a "take-home" test component.

Learning Outcomes

- Examine approaches to **experimentation** used in agricultural research and appreciate the roles of **replication**, **randomization**, and **design control**
- Identify **types of data** *(quantitative, qualitative, binary, multivariate, continuous)* collected in agricultural experiments and demonstrate how to organize, summarize, analyze, and present results of data using Microsoft Excel and SAS
- Illustrate how to create and test a **scientific hypothesis**
- Recognize the **normal distribution** and understand proper **sampling** to represent a **population**
- Compute **probabilities for binary situations** and estimate **confidence intervals**
- Conduct statistical **tests of independence** and **tests of heterogeneity** for multivariate data
- Use **t-tests** to assess for **significance** and know how **sample means** relate to **population means**
- Distinguish between the use of **correlation** and **regression**, understand the value of **prediction**, and inspect **linear relationships** between **dependent variables** and **independent variables**
- Demonstrate the conceptual basis for the **analysis of variance** (**ANOVA**) and learn how to construct the **linear additive model** for a one-factor ANOVA

Course Overview

Review of Basic Algebra

Numbers and measurements are taken regularly on all types of data in agricultural applications, for example, yield amounts, fertilizer rates, seed counts, etc. How these data are gathered, analyzed, and interpreted is the subject of this course. For many this course will be quite challenging because it will require use of algebraic skills that may have been learned, but not used in many years.

Before beginning the course, be sure to review materials on basic algebra in the **ALGEBRA REVIEW GUIDE** (available at http://masters.agron.iastate.edu/tools/Algebra_Guide/index.html). At the end of the review guide, take the PRACTICE PROBLEMS Self-Test to assure yourself that you are prepared for the materials in this course.

Lesson Curriculum Materials

The purpose of this course is to develop an understanding of statistics and statistical design using agricultural examples. While you may never design an experiment yourself, knowledge of the underlying statistics and assumptions someone else has made in their design and analysis of an experiment can be of great value in interpreting experimental results. Each lesson in the course consists of a variety of curriculum materials:

- REQUIRED
  - **UNIT LESSON** documents containing the main lesson text *(consisting of a downloadable PDF document in each lesson Unit folder in* **BLACKBOARD LEARN**)
  - **READING ASSIGNMENT** drawn from the required textbook: **Clewer, A. G., and D. H. Scarisbrick. 2001. *Practical Statistics and Experimental Design for Plant and Crop Science.* John Wiley & Sons, NY.** ISBN-13: 978-0471899099; ISBN-10: 0471899097.
  - **DISCUSSION TOPIC** participation *(comments, responses, and summaries must be posted by students in the* **BLACKBOARD LEARN** *Discussion Board by their due dates. Please note that Units 3 and 5 do not have Discussion Topics associated with them, but the rest of the lesson units do)*
  - **HOMEWORK ASSIGNMENT** *(completed homework must be uploaded to* **BLACKBOARD LEARN** *by their due dates*)
  - **UNIT REFLECTION** that functions as a learning journal *(completed lesson reflections must be posted in* **BLACKBOARD LEARN** *by their due dates*)

- RECOMMENDED BUT NON-GRADED
  - **SELF-TEST STUDY QUESTIONS** *(located in each lesson Unit in* **BLACKBOARD LEARN**; note that these are non-graded activities, but strongly encouraged as learning tools)
  - **EXERCISES USING EXCEL OR SAS** *(located in each lesson Unit in* **BLACKBOARD LEARN**; aside from exercises using Excel or SAS that are required parts of homework assignments, with

the lesson units there are many exercises that are non-graded activities, but strongly encouraged as learning tools)

- **INTERACTIVE SIMULATIONS** using either Microsoft Excel or Java applets computer programs *(located either online or lesson Unit folders in* BLACKBOARD LEARN; these are non-graded activities, but strongly encouraged as learning tools)

Why Excel and SAS?

Microsoft Excel is a very good spreadsheet program familiar to most agricultural scientists and students, but it is inadequate for many statistical analyses. Excel is an excellent program for data entry, ease in copying and pasting, page and print set up, and formatting. Thus, it is an excellent tool to enter data and format tables of results. However, SAS software is superior for many statistical analyses (SAS once stood for "Statistical Analysis System", but is just pronounced "sass" now). It is fairly easy to import data from Excel into SAS and to copy results into Word documents or Excel sheets, and your assignments will give you practice in this type of presentation skill.

As the complexity of the analyses you learn increases, the tools in Excel will become less useful and robust and SAS or another statistical program will become the preferred program for analyzing your results. SAS can handle missing data correctly, something Excel does not do. The SAS program does calculations in a higher precision mode than does Excel, and in certain cases Excel can incorrectly compute the standard deviation and other statistics. SAS is a very standard statistical analysis program. It has capabilities far in excess to what will be needed in this class, but which may be useful to you later as you progress with your quantitative skills. Given the limited time period of this class, your exposure to SAS will be extremely limited—you will have only a brief introduction in the last lesson, Unit 8. However due to its wide use in academia, technology, and business, we thought that it would be useful for you to gain brief exposure to it through this course. SAS has been around a long time and the SAS interface reflects this legacy. It originally ran on mainframe computers and received instructions and data from stacks of punch cards. We will be using the interactive programming interface, which may seem foreign to you at first. However it can be mastered and you may find it to be a very powerful tool for analyzing data in the future—perhaps in the context of your Creative Component project for the STB graduate program or for future projects in your workplace. Once you get used to interpreting SAS output, you should be better able to interpret output from the many other statistical computing programs, such as Minitab, Genstat, R, or JMP. The Clewer & Scarisbrick textbook includes examples of computer output from SAS and from the former two software programs as well.

Exercises within the lesson text and homework assignments are designed to illustrate how to use Excel and the statistical program SAS to manipulate and view data and to calculate various statistics. By the end of the course you will become quite proficient in using Excel to do statistical calculations, and in Unit 8, you will have a brief introduction to SAS. Both Excel and SAS can be accessed and run via a Remote Desktop Connection using the Agronomy Virtual Labs of ISU Department of Agronomy. More detailed instructions about SAS will be given in Unit 8. The examples and exercises were developed for Excel 2010 or 2013 and SAS 9.3 or 9.4. They can be run in other versions, but the instructions in your

lessons may not work the same. Individual exercises are included as the topic is discussed within the unit. The directions include links to data files appropriate to the exercise.

Additional Curriculum Materials

There is one activity that employs a simulation run in Excel, but additionally some lesson units contain simulation demonstrations that are **Java applets** from David Lane, a statistics professor at Rice University. Applets are known as "little applications" or programs typically run in Java in affiliation with a standard web browser program. They are integrated into the lessons to allow the student to modify experimental data and see the results immediately. The applets are available online and constitute simulations and demonstrations of statistical concepts available from the Rice Virtual Lab in Statistics. The applets are in the public domain and can be used without restriction. More detailed instructions for accessing and running the simulations will be provided in specific Unit Lesson documents. The URL for each applet will be provided so that you can locate the appropriate simulation online on the RVLS website, although we will likely run the simulations using a web browser in the Agronomy Virtual Labs so that the most recent updated version of Java is available. *[However, note that recent versions of the browsers Google Chrome, Internet Explorer, and Mozilla Firefox do not interface well with the Javascript used in the RVLS demonstrations since strict rules for Java security are increasingly being enforced. Although we have used the RVLS demonstrations in the past for this course, this semester we may be prevented for having them run properly unless their Javascript is enhanced. I am working with the IT staff in the ISU Agronomy Department to try to resolve the Java-related problems so that these simulations will run.]*

Each unit begins with a summary of **Learning Objectives** that will be covered for the specific lesson. There is also a **Lesson Summary** on the last page of the Unit Lesson document. Some students find it useful to scan the summary before going through the text of the lesson. There is a **Question & Answer** page before the summary with questions on the unit from students who took the course already. Frequently students can find good answers to their questions just by checking the Q & A, so I encourage you to review them as a routine part of lesson coverage.

Course Philosophy

The knowledge and skills you learn in this course can set you apart from others in your ability to interpret experimental information. I am sure you will agree that individuals who are proficient in analyzing information and communicating the results tend to be highly successful. We consider this ability to be one of the core competencies of a M.S.-level seed technologist, horticulturist, agronomist, or plant breeder. Knowledge and skills gained in this course regarding statistical concepts and techniques can be applied to business contexts as well.

Learning how to use the quantitative methods presented in this class is qualitatively different than most of what you have learned and will learn in your studies. Like any skill you learn, it takes practice to master the quantitative methods you will be learning. The homework lessons are designed to help you

gain understanding and proficiency in using these tools. Think of it this way—you would not expect to know how to play a piano or bowl a perfect game after reading about them. The same is true here; you need to spend some time *practicing* to become comfortable using these methods.

The homework assignment each week will help you further understand and apply the lesson material and develop your ability to use Excel or SAS to understand and interpret data from various experiments. Questions on the homework should be answered completely. Material should be organized with graphs, figures, or charts included as necessary. Points will be counted off for homework that is difficult to read or poorly organized. This course is a math-related course and it is very critical that for homework and the Final Exam you **show your problem-solving work completely**—that means include and display for the instructor all intermediate steps as you work to find the correct final answer. Even if your final answer may be wrong, you can receive partial credit if intermediate steps are shown and won't receive any if intermediate steps are not included in your submission to the instructor. Homework is designed as a way for you to learn and practice your analytical skills. If you really want to learn the material it is important that you avoid taking shortcuts on the homework. The Final Exam is designed to assess your knowledge and ability to apply it. By taking the homework seriously you will be much better prepared to do well on the exam.

In addition to the Instructor, you are encouraged to interact with each other for help in learning the material. Therefore, part of the grade for this course is based on posting to the **BLACKBOARD LEARN** Discussion Board. Some discussion questions are required (these are labeled clearly in the lesson text as **Discussion Topics** or **DT**). Additionally each week student representatives from each of four Discussion Groups will contribute a **DT Summary** for their group for the rest of the class to read. Questions about any course-related topic at any time are encouraged in looking for help from other students. Aside from Discussion Topics and Discussion Summaries, there is a central location called the **Community Message Board** that is intended to be an open forum for members of the class to post questions and answers about lesson content or homework assignments. In fact extra credit points can be obtained by answering correctly questions pertaining to course content before the Instructor posts the answer.

STB/AGRON 536 is a very detailed course. Stay current and deal with questions as they arise. I will do my best to answer your questions in a timely way. Rather than email to the instructor, I would like for you to post lesson content and homework assignment-related questions to the course **Community Message Board** in the Discussion area in **BLACKBOARD LEARN**. This posting of questions and answers in **BLACKBOARD LEARN** will allow other students to benefit from your question and you may find that another student can help you faster or perhaps explain a concept better than I can—and in doing so, you can earn extra credit points.

Study Tips:

- **Start each lesson on the date indicated on the calendar.** You will need to complete approximately one unit each week. Allow about 8 hours per unit (4 hours to read and work through the unit + 2 hours to do assignments, participate in discussions, reflect on the lesson in

the lesson reflection journal + 2 hours for textbook readings). Spread your study time over several days. Work ahead when you know that you will be out-of-town or unable to do a lesson during its designated week. Do not get behind!

- **Do each 'Self-Test Question' and 'Try This! Activity' as encountered.** They are ungraded, but are designed to enhance your learning, to provide opportunities to apply the information presented, and to let you evaluate your understanding of the material. You can repeat the 'Self-Tests Questions", run the simulations, or perform the Excel exercises as often as desired.
- **Assignments and Discussion Topics** may be done as they appear in the Unit Lesson or after you finish the lesson and readings. Be sure to submit to **BLACKBOARD LEARN** all assignments, discussion postings and discussion summaries on time. While you may work ahead (if necessary), the most interactive environment occurs when all students are on the same lesson. There are two Discussion Topics for Unit 8, with DT 8.2 pertaining to the 'Try This!' on One-way ANOVA. Some other units (Unit 3 and Unit 5) do not have a Discussion Topic.
- **Interact with your classmates and instructor.** Discussions on the **Community Message Board** can be used for anything course related. Many students will have similar questions, which can be solved together. Extra credit can be earned by helping your classmates resolve problems.
- **Do the text readings.** Readings from the main Unit Lesson text and the Clewer & Scarisbrick textbook complement each other and are both required.
- **Something unclear?** Consult with your instructor or classmates. This is a very detailed course. Use each other to help sort problems out.

Course Grading

Student assignments for the course include:

Weekly assignments - these are to be completed and emailed in a Word document to me by 6:00 PM CST on the completion due date. **I will not grade late assignments.** Some of these assignments are carried over from one semester to the next. They are designed to help you master the material covered in the lesson. Please do not make the mistake of thinking you can learn the material by turning in someone else's work. This action is not only dishonest; it will significantly impair your learning of the material. Like any other tool, you only become proficient in using statistical tools by practice and that is the reason you are given homework assignments. If for any reason you find yourself getting frustrated, put the work aside for a while and try later, ask a question on the **Community Message Board**, or contact me and I will help you work through the problem.

Perhaps the most important part of learning how to use the quantitative methods is learning how to effectively communicate the results. Your assignments also will be graded on spelling, grammar, and readability. This ability to communicate clearly is important for correctly expressing your results to others. You should be comfortable enough with your presentation that you could confidently and proudly present it to your supervisor or customer.

Discussion Topics - are included in the Unit Lesson text and must be answered. Answering the discussion questions or following up classmates' previous postings with thoughtful, detailed responses are required to obtain full credit for the discussion topic. The students will be divided up into a total of four (4) Discussion Groups to allow for ease of participation; for each Discussion Topic, one member of each group will prepare and submit a summary to **BLACKBOARD LEARN**.

Reflective Learning journal - at the end of each unit is a reflective learning journal or **Unit Reflection**. This reflection activity is used to help us learn how to improve the unit. The question on major points of the lesson unit can also be useful for you to review for the Final Exam. It is not necessary to spend too much time on a summary of the unit—this is for your benefit. We are more interested in your feedback and on what you did and did not understand. Questions are encouraged.

Final exam - this will consist of two components—one test component will be taken and submitted online and the other will be in the form of "take-home exam" to be then submitted to the instructor upon completion. Both must be completed within specified time limits and submitted in **BLACKBOARD LEARN**. More detailed information will be sent nearer the exam time. The exam materials will be available for access online from Thursday October 15-Wednesday October 21.

The relative contributions to the Course Grading System of required course elements are show below:

Course Grading System	Contribution to Final Course Grade
Assignments	~50%
Discussions	~10%
Reflective Learning Journal	~10%
Final Exam	~30%

Letter grades for the course will be assigned as follows:

A:	93-100
A-:	90-92
B+:	87-89
B:	83-86
B-:	80-82
C+:	77-79
C:	74-76
C-:	70-73
D+:	68-69
D:	65-67
F:	<65