

# Math 113 – Introduction to Applied Statistics

## Summer 2014 Course Syllabus

James Jones, Professor of Mathematics  
Mathematics & Sciences Division – Richland Community College

### Meeting Information

Section 01 meets from 10:00 - 11:50 am on Monday, Tuesday, Wednesday, and Thursday in room S137.

### Instructor Information

James Jones, Professor of Mathematics.

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Canvas: <https://richland.instructure.com>

### Office Hours

Office hours are not required during the summer term. Please email the instructor or see him before or after class if you need additional help.

### Text

Most of the material in the course will be presented through lecture and web pages. For those who wish to have a book for reference purposes, here is one that will work (and is inexpensive).

*The Complete Idiot's Guide to Statistics, 2<sup>nd</sup> edition.* Robert A. Donnelly, Jr. Copyright 2007, Alpha Books. ISBN 978-1-59257-634-0 (Optional).

### Student Audience

Transfer students in all disciplines. This is a general education course that meets the mathematics requirements for graduation, it does not lead to another course in statistics.

### Prerequisite

All of the following: (1) Successful completion (C or better grade) in MATH 098 - Intermediate Algebra, an ACT mathematics score of at least 22, or a satisfactory score on the Mathematics placement exam, (2) successful completion (C or better grade) in MATH 095 - Geometry or one year of high school geometry, and (3) eligibility for ENGL 101 - Composition 1.

### Course Description

MATH 113 - Introduction to Applied Statistics

Hours: 4 lecture - 0 lab - 4 credit

Math 113 is a general education statistics course that uses current technology to allow focusing on mathematical understanding instead of routine calculations. Descriptive statistics covered include frequency tables, graphs, and measures of location and variation. Topics from probability include probability rules, counting techniques, and probability distributions. Inferential statistics will cover estimation, confidence intervals, hypothesis testing, and probability values. Statistical methods covered include the one and two sample t-tests, one and two proportion tests, chi-square goodness of fit and test for independence, correlation, regression, and analysis of variance. This course makes heavy use of technology to solve problems involving real data.

Applicable toward graduation where program structure permits.

- Certificate or degree: All certificates, A.A.S., A.L.S., A.A, A.S.
- Group requirement: Mathematics
- Area of Concentration: Not applicable.

### Illinois Articulation Initiative (IAI)

The Illinois Articulation Initiative is a statewide transfer agreement. Their website is at

<http://www.itransfer.org>

Math 113, Introduction to Applied Statistics, satisfies the Illinois Articulation Initiative Definition of a General Education Mathematics Course. It corresponds to M1902, General Education Statistics.

## Guidelines for Assessment and Instruction in Statistics Education (GAISE)

The [GAISE College Report](#) was written in 2005 and is endorsed by the American Statistical Association (ASA) and the American Mathematical Association of Two-Year Colleges (AMATYC). It presents a guideline of what should be contained in an introductory statistics course.

### GAISE Recommendations

There are six recommendations of the GAISE report. This course follows these recommendations:

- Emphasize statistical literacy and develop statistical thinking.
- Use real data.
- Stress conceptual understanding, rather than mere knowledge of procedures.
- Foster active learning in the classroom.
- Use technology for developing concepts and analyzing data.
- Use assessments to improve and evaluate student learning.

### GAISE Goals

In addition, there are 22 goals listed in the GAISE report. This course seeks to meet these goals:

Students should believe and understand why:

- Data beat anecdotes
- Variability is natural, predictable, and quantifiable
- Random sampling allows results of surveys and experiments to be extended to the population from which the sample was taken
- Random assignment in comparative experiments allows cause-and-effect conclusions to be drawn
- Association is not causation
- Statistical significance does not necessarily imply practical importance, especially for studies with large sample sizes
- Finding no statistically significant difference or relationship does not necessarily mean there is no difference or no relationship in the population, especially for studies with small sample sizes

Students should recognize:

- Common sources of bias in surveys and experiments
- How to determine the population to which the results of statistical inference can be extended, if any, based on how the data were collected
- How to determine when a cause-and-effect inference can be drawn from an association based on how the data were collected (e.g., the design of the study)
- That words such as "normal," "random," and "correlation" have specific meanings in statistics that may differ from common usage

Students should understand the parts of the process through which statistics works to answer questions, namely:

- How to obtain or generate data
- How to graph the data as a first step in analyzing data, and how to know when that's enough to answer the question of interest
- How to interpret numerical summaries and graphical displays of data—both to answer questions and to check conditions (to use statistical procedures correctly)
- How to make appropriate use of statistical inference
- How to communicate the results of a statistical analysis

Students should understand the basic ideas of statistical inference, including:

- The concept of a sampling distribution and how it applies to making statistical inferences based on samples of data (including the idea of standard error)
- The concept of statistical significance, including significance levels and p-values

- The concept of confidence interval, including the interpretation of confidence level and margin of error

Finally, students should know:

- How to interpret statistical results in context
- How to critique news stories and journal articles that include statistical information, including identifying what's missing in the presentation and the flaws in the studies or methods used to generate the information
- When to call for help from a statistician

## Course Objectives

In addition to the goals and objects defined in the GAISE report, upon successful completion of this course, a student should be able to:

- Create and interpret graphical representations of data.<sup>3</sup>
- Use technology when appropriate and know the limitations of technology.<sup>3</sup>
- Work collaboratively with others towards the completion of a common goal.<sup>1,3,4</sup>
- Use deductive reasoning and critical thinking to solve problems.<sup>2</sup>
- Apply common sense to mathematical problems.<sup>2</sup>
- Determine whether a statement can be proved or must be assumed.<sup>2</sup>
- Plan an experiment, gather and analyze the data, and interpret the results.<sup>1,2,3</sup>
- Explain the statistical results using common language.<sup>1,3</sup>
- Read a scenario and determine the proper statistical method for analyzing the data.<sup>2,3</sup>
- Effectively communicate the student's understanding of the subject.<sup>1,3</sup>

The numbered superscripts refer to the Richland Cross-Disciplinary Outcomes addressed by that objective.

## Type of Instruction

Instruction in this course will primarily occur through project-based learning. Along with this, we will use discussion, problem solving, activities, individual and group work, student questions, student participation, and lecture. Students are expected to have read the material before class and are strongly encouraged to come to class with a list of questions and to ask these questions. A substantial portion of this class will involve collaborative work with other students.

## Method of Evaluation

Evaluation could include any of the following: problem solving exams, objective exams, essays, research papers, oral presentations, group projects, individual projects, classroom participation, classroom activities, quizzes, and homework.

This course will use a non-traditional approach to evaluation. There will be no exams. Instead, the course will be project-based with near-daily assessment of your progress. These regular assessments will, for the most part, be incorporated into the class presentation. The instructor will ask questions; you will provide feedback, and that will be used to help determine your grade. You will provide your responses electronically so that you can get immediate feedback on whether or not you understand the material and the instructor can get a sense of where the class is. The instructor can then use this information to make adjustments in the schedule. Because these are incorporated into the course, there is no way to make up these assessments if you miss class.

Sometimes your responses will be used as a participation grade. When this happens, you are awarded points for being in class and providing feedback. It doesn't matter whether or not you get the right answer and sometimes there won't even be a right answer. Participation will compose 10% of your overall grade in the course. These points cannot be made up if you miss class.

Other times the feedback will be used to assess how well you have learned and can apply the concepts being taught. In these cases, you will be awarded points for providing the correct answers to the questions. Some instructors drop the lowest quiz (or two), but because these assessments will be worth different amounts of points, that becomes difficult to do. Instead, there will be a 10% grace factor applied to these in-class

assessments. That means that if you take a 10 point quiz, it will get recorded in the grade book as being a 9 point quiz. If you happen to score 10 points on it, then you have a little extra to help your grade. These points cannot be made up if you miss class.

Quizzes within Canvas may be used to assess concepts as well. These are usually untimed with multiple-attempts and are open for more than one day. The answers become available after the quiz closes, so quizzes cannot be made up or completed after the due date. There is no 10% discount applied to the Canvas quizzes.

Both in-class interactive assessments and Canvas quizzes make up Conceptual understanding will compose 50% of your overall grade in the course.

The other main component of the course will be projects. Some of these projects will be individual and some of them will involve group work. Projects will compose 40% of your overall grade in the course. Projects are due at 5:00 pm on the due date. For the mini-projects, which are essentially quick group projects worked over 1-2 days in class, lack of attendance will lower your grade proportional to the amount of class you missed. Projects may be turned in late, but they will lose 20% of their value for each class period they are late.

## Grading Policy

Letter grades will be assigned to final adjusted scores as follows:

A: 90-100%      B: 80 - 89%      C: 70-79%      D: 60-69%      F: below 60%

The final score will be weighted according to these three categories:

Concepts: 50%      Projects: 40%      Participation: 10%

All grades will be entered into the Canvas learning management system. Canvas has a What-If feature that allows you to play around with your grades. If you are concerned about your grades, see the instructor.

Scoring is subject to revision if mistakes are found in the grading. This is especially true with Canvas quizzes. Your grade may increase or decrease when this happens. For this reason, you should strive to do better than the minimum needed.

There is no rounding of grades or extra credit in this course beyond the 10% grace factor on the in-class concept assessments. The course is a marathon, not a sprint at the end. You must perform consistently throughout the semester to earn a good grade. If you are one point short of the next higher grade at the end of the semester, you will get the lower grade.

Concept grades and participation points cannot be made up.

Projects will be due at 5 pm on the due date unless otherwise noted. Late projects lose 20% of their original value per class period. The student must notify the instructor that late work has been submitted.

No late work will be accepted after the final.

## Written Work

All written work should be submitted in electronic form. There should be a cover page with the title of the assignment and the student's name. Headings should be used appropriately to mark-up the document. All reference works used, including books, videos, etc., are to be cited using APA (preferred) or MLA notation. All work is to utilize the English language correctly. It is suggested that the Academic Success Center be utilized for assistance in the preparation of written work. If written work is submitted late, the instructor may take appropriate deductions from the grade.

## Attendance Policy

If you miss the first day of class or any two consecutive days after that without communicating with the instructor, you may be dropped.

Attendance is recorded every class period. Since the course does not directly follow a textbook, attendance is the primary method of obtaining the information in the course. Statistics is a cumulative subject and each day builds on the previous day's material.

Students who, because of excessive absences, cannot complete the course successfully, are required to be administratively dropped from the class at midterm. If a student stops attending after midterm, it is the student's responsibility to withdraw to avoid an "F". Do not stop attending and assume that you will be withdrawn from the class by the instructor.

The student is responsible for all assignments, changes in assignments, or other verbal or written information given in the class, whether in attendance or not. There will be some kind of assessment almost nearly every day as part of the classroom presentation. These may not be made up if you miss class (you may attend the other section of the course on the same day provided that there are available seats).

If a student must miss class, a call to the instructor (RCC's phone system has an answering system) should be made or an email message (preferred) sent.

## Calculators

A calculator is required for this course. It does not have to be a graphing calculator, but it should be a scientific calculator with the ability to square a number and find the square root of a value. You are responsible for knowing how to use your calculator. If you do not know, then ask. Bring the calculator every day to class.

## Additional Supplies

The student should bring a pencil, paper, and calculator to class each day. You may occasionally want a ruler or graph paper. There will be a paper punch and stapler in the classroom.

## Collaborative Work

This is an *applied* statistics course. We will be doing several activities and projects in this course that require group work. Much of this time will be spent in the classroom, but there will also be time outside of class required. Computer software will be used for analysis of the data.

Some of these projects will be designed by the instructor and involve the entire class. One of the projects will be a capstone project designed by each individual group and approved by the instructor. This project will include a written paper and oral presentation of the results to the class of their findings.

## Technology

The use of technology in this course is consistent with the Technology Statement in the [Illinois Mathematics & Computer Science Articulation Guide](#) (IMACC, 2008, p. 4). Technology is used to enhance the learning of Statistics, but it is not the focus of the instruction.

This course makes heavy use of technology. It is highly recommended that students be familiar with the following software before attempting this course: e-mail, internet web browser, word processor, spreadsheet, and presentation software. In addition, students should be able to perform file navigation and understand the different types of files and the role of file extensions in naming. Richland offers free workshops for students who need additional computer literacy skills. Students who have weak technology skills may feel overwhelmed by the technology used in the class.

Most of the technology we're going to use is free, open source, or web-based so that there is no additional cost to the students and you can use them after you leave this course. Some software is commercial, but in those cases, Richland Community College has a license to use them. Here is a list of some of the computer packages we may use in this course.

### Canvas

Instructure's Canvas project is the learning management system used by Richland Community College. It is available at <https://richland.instructure.com>

## Minitab

Minitab is the statistical software package of choice for this class. It is powerful and makes nice graphs. Minitab is fairly easy to use if you are familiar with a spreadsheet like Excel.

Minitab is installed on the computers in S137, the Academic Success Center, and the Open Computer Lab. Richland's license for Minitab does not allow for home use, but students will be able to get most of their work done at school. There is a 30 day trial version of Minitab available on the web for downloading at <http://www.onthehub.com/minitab>. You may also purchase a six month copy that will last the entire semester. Minitab is available only for Windows.

## Google Drive

This class is very collaborative in nature; in other words, there will be a lot of group work. In previous semesters, we've used MediaWiki as a collaboration tool, but the learning curve on it was pretty steep and students began to feel the class was about the technology rather than about statistics.

Google has an online system called "Google Drive" (*formerly called Google Docs*) that provides access to documents, spreadsheets, presentations, forms, and drawings. With the exception of the forms, these can be shared and edited by more than one user at a time.

## Question Press

Question Press is a web-based classroom and audience response system. It allows for interactive quizzing, feedback, and participation. It works from desktop computers and mobile devices and will be the main instrument used for assessing classroom performance.

The instructor's Question Press page is at <http://www.questionpress.com/james>

## StatKey

StatKey is an online statistics package written by Lock, Lock, Lock, Lock, and Lock. Although we're not using their textbook, they've made the tool freely available over the Web. We will use this package for randomization testing.

The StatKey software is at <http://lock5stat.com/statkey/>

## Other Software and Websites

This course is fluid and other software packages or websites may be incorporated into the class.

## Additional Help

The student is encouraged to seek additional help when the material is not comprehended. Mathematics is a cumulative subject; therefore, getting behind is a very difficult situation for the student. There are several places where you can seek additional help in your classes.

You may use a recording device to record the lectures. Feel free to use a camera or cell phone to take pictures of the boards if you have trouble getting all of the information into your notes.

## Instructor

I try to make myself as available to the students as I can. My office hours are listed at the beginning of this syllabus, but those are just the times I'm scheduled to be in my office. Grab me and ask me questions if you see me in the hallway. Ask questions before or after class. If I'm in my office and it's not my scheduled office hours, go ahead and stop in.

The instructor should be considered the authoritative source for material related to this class. If a tutor or other student says something that disagrees with the instructor, believe the instructor.

## Study Groups

Probably the best thing you can do for outside help is to form a study group with other students in your class. Work with those students and hold them accountable. You will understand things much better if you explain it to someone else and study groups will also keep you focused, involved, and current in the course.

## Academic Success Center

The Academic Success Center consolidates several student services into one area. It is located in the south

wing of the first floor next to the Kitty Lindsay Learning Resources Center (library).

### Testing

The testing center is located in room S116. You must provide a photo identification and know the name of your instructor to use this service.

Quality tutors for the upper level mathematics are difficult to find. Please consider forming a study group among your classmates.

### Tutoring

The tutoring center provides tutoring on a walk-in or appointment basis in room S118. They also have computers with the mathematical software loaded on it.

### Accommodations

There are accommodations available for students who need extended time on tests, note takers, readers, adaptive computer equipment, braille, enlarged print, accessible seating, sign language interpreters, books on tape, taped classroom lectures, writers, or tutoring. If you need one of these services, then you should see Learning Accommodation Services in room C148. If you request an accommodation, you will be required to provide documentation that you need that accommodation.

## College & Division Policies

### Academic Dishonesty

Each student is expected to be honest in his/her class work or in the submission of information to the College. Richland regards dishonesty in classroom and laboratories, on assignments and examinations, and the submission of false and misleading information to the College as a serious offense.

A student who cheats, plagiarizes, or furnishes false, misleading information to the College is subject to disciplinary action up to and including failure of a class or suspension/expulsion from the College.

### Non-Discrimination Policy

Richland Community College policy prohibits discrimination on the basis of race, color, religion, sex, marital or parental status, national origin or ancestry, age, mental or physical disability (except where it is a bonafide occupational qualification), sexual orientation, military status, status as a disabled or Vietnam-era veteran.

### Electronic Communication Devices

The Mathematics and Sciences Division prohibits the use of cell phones, pagers, and other non-learning electronic communication equipment within the classroom. All equipment must be turned off to avoid disturbances to the learning environment. If a student uses these devices during an examination, quiz, or any graded activity, the instructor reserves the right to issue no credit for these assignments. The instructor needs to approve any exceptions to this policy.

## Richland Cross-Disciplinary Outcomes

The course objectives listed in this document make reference to these items.

1. The degree-seeking student will be able to communicate effectively (read, write, speak and listen).
2. The degree-seeking student will think critically and creatively.
3. The degree-seeking student will manage technology and evaluate information in various research and applied contexts.
4. The degree-seeking student will act professionally and responsibly.

## Topical Outline

This course is going to be data driven and fluid. Instead of having a textbook that defines how much time is spent on each topic, it will be the data that defines how much time is spent. We will take a data set and fully explore it, beginning with the context of the data, describing it visually and numerically, and then using inferential statistics to perform confidence intervals and hypothesis tests. When we have exhausted one set of data, we will move on to another and repeat the process to learn new material.

That makes defining how much time will be spent on each topic very difficult. The following topical outline is an estimate of how much time will be spent on each topic and is aligned with the chapters in the textbook. However, we won't be using learning the material in this order.

#### Descriptive Statistics – 14 hours

- Introduction to statistics and data
- Ways of classifying data, levels of measurement
- Critical thinking skills
- Charts and graphs: Frequency distributions, bar charts, stem and leaf plots
- Describing a distribution: shape, center, spread
- Measures of center: mean, median, mode, midrange
- Measures of spread: range, variation, variance, standard deviation, interquartile range
- Measures of shape: Empirical rule, Chebyshev's rule, skewness, kurtosis
- Measures of relative position: quartiles, percentiles, midquartile

#### Probability – 14 hours

- Fundamentals of probability
- Probabilities from frequency tables
- Unions and intersections
- Addition rule for "or" and multiplication rule for "and"
- Tree diagrams
- Conditional probabilities
- Counting techniques
- Random variables
- Mean, variance, and standard deviation of a discrete random variable
- Binomial and multinomial distributions
- Mean, variance, and standard deviation for binomial distribution
- Standard normal distribution. Finding areas from z-scores and z-scores from areas.
- Applications of the normal distribution. Converting from and to raw scores.

#### Inferential Statistics – 15 hours

- Randomization testing
- Types of sampling and sampling errors
- Sampling distributions and the Central Limit Theorem
- Student's t distribution
- Sampling distributions for proportions
- Confidence intervals for the population mean and population proportion
- Hypothesis testing fundamentals
- Probability value approach comparing p-value to significance level
- Confidence interval approach comparing claimed value to confidence interval
- Types of errors, significance level, p-value
- Decisions vs conclusions
- Testing a claim about a single population mean and proportion
- Testing a claim about two population means and proportion
- Paired samples t-test

#### Advanced Inferential Statistics – 18 hours

- Linear correlation
- Hypothesis test for correlation
- Regression analysis, finding regression equation from summary statistics and correlation coefficient
- Explained, unexplained, and total deviations
- Coefficient of determination
- Table of coefficients and Analysis of Variance. F distribution.
- Multiple regression, adjusted R squared (time permitting)\*



- Chi-square distributions
- Chi-square goodness of fit test (multinomial experiments)
- Chi-square test for independence, test for homogeneity
- One-Way Analysis of Variance
- Two-Way Analysis of Variance (time permitting)\*

\* The multiple regression and two-way ANOVA sections are not covered in the optional textbook. They will be covered in class if time permits.