

Statistics 101: Group Project

Now that you know the principles of good experimental design, you are going to have the opportunity to design your own experiment, collect data, analyze the data, and write about your findings. This project will give you firsthand experience in using the ideas presented so far in STAT 101: you will have to use the techniques you've studied to collect and analyze the data and draw conclusions about your findings.

For this project, you will work in groups of four or five people. All members of your group will be equally responsible for the project, and all members will receive the same grade on this assignment.

Your experiment must develop and answer a question about one of the following:

- Strength of paper towels
- Flight of paper airplanes or paper helicopters or rubber bands
- Quality of microwave popcorn
- Distance a golf ball rolls
- Quality of batteries
- A topic of your choice but you must have your topic approved by your course instructor.

Your report and work on this project will be divided into four sections:

Research Question and Conjecture. First, decide what research question you will ask, what you conjecture as the answer to that question, and what explanatory and response variables you will collect to address the question. In order to use the analysis techniques you have learned in class, *you must make both the explanatory and response variables quantitative/numerical*. In the introductory section of your report, you will document these choices; your research question and a conjecture to the answer to this question, and the response and explanatory variables in your experiment. As a part of this first section, you will explain the purpose of your research and its relevance for your audience. For the audience to understand your later data analysis, you must begin with a direct, specific research question. For example, “Our research question is to look at the relationship between the height at which you drop a tennis ball and the number of bounces that occur before it comes to rest. We conjecture that if you drop a tennis ball from higher up, it will take more bounces before it comes to rest.” In this example, both variables height and number of bounces are clearly quantitative.

Experimental Design. For your experiment, you must use only one factor, the explanatory variable identified in the first section of your report. Use at least *five* levels for this factor and collect at least 30 data points, where data points are defined as rows in a JMP data table. In designing your experiment, define your experimental units and determine how you will incorporate three critical design elements: ***control of outside variables, randomization, and replication***. In the second section of your report, clearly document the specifics of your experimental design for your readers. Document how you conducted your experiment (i.e. what did each member of the group do while conducting the experiment). Describe your procedures specifically enough that your classmates could repeat your experiment after reading your report. At the end of the report in the appendix, you will include a table with the data collected as a part of your experiment.

Data Analysis. Once you collect your data, analyze the data to learn more about your research question. Since both your explanatory and response variables are quantitative, correlation and regression are *critical* analyses to perform. However, you will also want to describe the distribution of the response variable individually. Use JMP to conduct your analyses. Document the results of your analyses in the third section of your report. Include plots created by JMP: histograms or stem-and-leaf plots of your response variable, scatter plots of your data with a regression line, etc. However, plots are not enough—you must interpret the plots and statistics from JMP in the context of your problem. For example, “For every inch higher that we dropped the tennis ball, it bounced on average three more times before it came to rest.” Be sure to discuss (and illustrate with appropriate graphs) whether or not a linear model is appropriate for your data. Make sure to discuss any non-linear relationships with your course or lab instructor, as they will be able to provide more assistance in completing the data analyses for your project report.

Research Summary. In the final section of your report, reiterate your research question, explaining what you have learned about the question based on your experimental approach and your data analysis. Discuss any problems encountered while conducting your experiment or your data analysis. Pose questions for future study. This section should reinforce the results of your study, leaving readers prepared to replicate your research, improve upon it, or designing a related study of their own.

General Guidance

1. The audience for this report is your STAT 101 classmates. What this means, for example, is that you don't have to write down the formulas used to calculate the slope and intercept of the regression line, but you do need to write down the calculated regression line and interpret it appropriately to answer your research question.
2. A reader of your report should be able to identify all of the "W's" of your data: who, what, where, when, why, how.
3. All work (including e-mails) submitted for this project must include the names of all group members.
4. All work for this project will be submitted at the end of lab periods, except for the final report. Final reports must be typed and then printed using either an ink-jet or laser printer. You will turn in the paper final report in lecture on the due date (see below).
5. In general, think of the final report as a term paper. The report should contain a descriptive title; four clearly labeled sections; well-organized paragraphs with logical transitions; complete, grammatical sentences; *no* misspelled words, and thorough attention to the needs of the audience in understanding your research. Any tables, figures, graphs, etc. need to be numbered, captioned, and referred to in the text.
6. All graphs and plots must be *computer generated* using JMP. Each JMP analysis window can be saved as a MS Word file by selecting **File - Save As** from the JMP menu. Change the **Save as Type:** to (.DOC) and click Save.
7. The main course webpage includes an annotated example of a project write-up. Read through the write-up to become familiar with the format and level of detail expected for the project write-up.

Schedule

You may submit work anytime on or before the listed dates. Submissions after the dates listed below will result in deductions from your project score.

Lab—week of October 19: Form groups and write the first section of your project report. Hand this in at the end of the lab period.

Lab—week of October 26: Make edits to the first section of the project report based on feedback received from the course instructor. Design your experiment and write the second section of your project report. Hand this in at the end of the lab period.

Lab—week of November 9: Edit the first and second sections of the project report based on feedback received from the course instructor. Conduct your experiment. Make sure to edit the second section of the project again to reflect any changes to the experimental design made while conducting your experiment. One group member will need to email the first two sections of the paper and your data in a JMP data file to your course instructor no later than three days after the lab.

Lab—week of November 16: Edit the first and second sections of the project report based on feedback received from the course instructor. Work on the data analysis and write the third and fourth sections of the project report. One group member will need to email the rough draft of the project report to your course instructor no later than three days after the lab period.

Friday, December 4: Projects are due in lecture.

Grading

Draft Reports (20 points)

These points are awarded for meeting the first four deadlines with a reasonable product. Each deadline is worth 5 points and points will be deducted if you miss the deadline, don't make a good faith attempt at the assignment, or need major corrections to your work.

Final Report (30 points)

Section 1 (5 pts): Did you adequately explain your research question and which variables you used to study your research question?

Section 2 (10 pts): Did you appropriately use the concepts of experimental design in developing and conducting your experiment?

Section 3 (10 pts): Did you complete a full and appropriate analysis of your data in order to answer your research question?

Section 4 (5 pts): Did you draw the appropriate conclusions about your research question given your experiment and your data analysis? Did you indicate any problems or areas of future research about your question?