

## Statistics 101 L: Paper Helicopter Project

Statistics is the study of how best to collect, summarize and draw conclusions from data. When working with data, one is always faced with variability. This project is intended to give you first hand experience in using the ideas of statistics to collect and perform a preliminary analysis of data. This project can be completed as an individual or a group project.

The focus of this project is on designing an experiment, recognizing and quantifying variability in the distribution of the response and using correlation and regression to help explain the variation in the response variable. Your experiment will involve a paper helicopter. A prototype of a paper helicopter is provided. There are many ways to evaluate the flight of the paper helicopter. There are also many factors that may affect that flight. The object of this project is to investigate the relationship between a factor that you can manipulate that may affect the flight of the paper helicopter and a measurement of some characteristic of the helicopter's flight. To do so, you should:

1. Phrase a hypothesis about the relationship between a numerical characteristic you can manipulate on the helicopter and a numerical characteristic describing the flight of the helicopter. For example: the heavier the paper the faster the helicopter will spin. Note you cannot choose this as your hypothesis.
2. Identify your explanatory variable and response variable. Remember that in order to use correlation and regression both variables must be numerical (quantitative). Indicate how you will measure the response variable.
3. Decide how you are going to design an experiment to investigate your hypothesis. You should think about the ideas presented in Chapter 13. You must have at least 5 levels of your explanatory variable. You must decide how to incorporate control, randomization and replication within your experiment.
4. Run the experiment and collect the data. This will require you to construct paper helicopters and fly them. You can make copies of the prototype helicopter. You must have a minimum of 30 data points.
5. Analyze your data. You can use JMP to construct plots and do calculations. Use methods from Part I and II of the text as appropriate. Remember that the focus of the analysis is on describing the distribution of the response and the relationship between the explanatory and response variable. Turning in JMP output is not enough. You must interpret the results of any analysis you do.
6. Write a final report that gives your hypothesis, the explanatory and response variables, a description of the design of your experiment, the analysis and interpretation of that analysis and a conclusion stating what you have learned about the hypothesis from your data. Be sure to include a copy of your data as an appendix to your report.

A major goal of this assignment is to give you an appreciation for obtaining useful data. Use the ideas of Chapter 13: Experiments and Observational Studies to assure that your data is reliable and accurate.

Grades will be determined on:

1. How well you used the ideas of Chapter 13 to design your experiment and collect your data. [18 pts]
2. Relevance and completeness of the analysis of the data and your interpretation of results. [18 pts]
3. Appropriateness of your conclusions and clarity of the final report. [9 pts]
4. Adherence to guidelines and deadlines provided in this handout and any oral instructions given in class. [5 pts]

**Time table:** 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.

**March 25:** Hypothesis formulated. Each group should submit the hypothesis to be investigated. Also include the explanatory and response variables and how you will measure the response.

**April 1:** A detailed description of your experiment should be turned in. This should include the factor that you will manipulate, the levels of the factor, what the experimental units are, what variables might affect the response and how you will control them, how replication will be incorporated in the experiment, how you will randomize. With the description you should include a JMP data table that gives the randomized order in which you will collect data.

**April 17:** Data collection completed. Email a JMP table containing the data to [wrstephe@iastate.edu](mailto:wrstephe@iastate.edu). Once the data are submitted, no changes can be made to the data. You will NOT get this copy back so make sure you have a copy for your group.

**April 24:** Final report due. Submit only one report per group, but include all group members' names on the report. Reports will NOT be returned. Each individual will receive a critique of the project and a project score.

**Guidelines:** Work submitted for this project must follow the guidelines below.

- All work submitted for this project must include the names of all group members. Group members omitted from certain stages of the project will not receive credit for that stage.
- The final report turned in for this project must be word-processed. Handwritten work will not be accepted.
- The final report must be printed using either an ink-jet or laser printer. Final reports printed on a dot-matrix printer will not be accepted.
- The final report must be written in the same manner as a term paper. The report should contain sections, paragraphs, complete sentences, and NO misspelled words. You should divide your report into sections, such as; hypothesis, design and data collection, data analysis and interpretation, etc. Make sure to clearly label these sections.
- All graphs and plots must be computer generated. Hand-drawn plots or graphs will not be accepted. Output and graphs from JMP can be Copy/Pasted into a Word file. JMP output can also be saved in a format (.RTF) compatible with WORD. To do this, make a copy of the output using Edit – Journal and save the journal.