DESIGNING A MEANINGFUL FINAL PROJECT FOR AN INTRODUCTORY STATISTICS COURSE

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Abstract

In this paper, a method on how to effectively design a final project to assign to an introductory statistics course is proposed. This paper explains how a selection of topics that are important issues either on campus, in the community, or facing college students today can be the focus of a student research paper involving an opinion based survey.

1. Introduction

Over the past years, incorporating a written research project in an introductory statistics course has become an important assessment. The inclusion of a final project follows the guidelines set forth by the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report* [1]. Proper design of the expectations for the project and the grading rubric are necessary for student success. However, directing the students toward a meaningful project design with results that are applicable and understandable can be daunting.

To combat the challenges faced in proper design, students are given a selection of topics to choice from that are important issues either on campus, in the community, or facing college students today. Issues in which all people in the population can have an opinion on. They decide what they are interested in finding out about their topic and then make two predictions; one prediction in regards to the overall opinion of their sample and one prediction about how groups in their sample may respond differently. They will be analyzing their data descriptively and then using their data to test their predictions in regards to the populations as a whole.

The students design a survey on StatCrunch [2] to gather data. The survey must gather the following information: basic demographics, information regarding the habits or behaviors as it may pertain to the theme of the project, and opinions of the issues the project is addressing. After a large sample of data is gathered, the statistical analysis begins. Students must complete a written paper and present their findings.

The paper is constructed with a title page, introduction, summary of the data collection process, analysis of the descriptive statistics, inferential methods to test their predictions, and a final conclusion that discusses any shortcomings. Students use StatCrunch to create graphs, calculate descriptive statistics, find confidence intervals, and run tests of significance and include these results in their paper.

Providing direction on a theme for a final project that addresses issues relevant to the students, detailed directions and a grading rubric have made the final project less of a mystery. Students find ownership and pride in the project and the results are often shared to other departments on campus who would benefit from them.

2. Background
Flagler College is a four-year, independent, nonsectarian institution offering programs leading to a baccalaureate degree. The college is located in the historic district of St. Augustine, FL two miles from the Atlantic Ocean. With a 40% male and 60% female ratio, Flagler College has approximately 2,500 students. MAT 223 Statistics is a general education course that is required for all students regardless of their major. Therefore, in one class, there may business majors as well as fine art majors. Students come from all academic levels although they are encouraged to take the course during their freshman year. The prerequisite is MAT 113 Intermediate Algebra and the course is worth 3 credit hours.

The textbook currently in use is the 12th Edition of *Elementary Statistics* [3] and the course is conducted through MyStatLab [4]. Classes are taught in a computer lab with one student per computer although the students are placed in groups of two or three randomly each day. Typically, the class size ranges from 18 to 25 students. Throughout the semester, students use StatCrunch to investigate large data sets in class and on homework. On the first day of class, students take a class survey and the data gathered is shared with the students on a StatCrunch group page. Students also gather data throughout the semester and use the data collected in class activities.

3. Goals of the Final Project
The project is cumulative, and will use much of what a student has learned in the introductory course. The students will ask a question(s) and have a theme, devise a plan to gather the data to answer their question(s), collect and analyze the data, and then present their results to the class and submit a written report. The goal of this assignment is to expose the student to the entire statistical process.

4. Shortcomings in Previous Project Designs
After more than five years of projects, ten semesters of directing and grading student work, and ten project designs that were reworked over and over again, my project design still needed some help. Hours had been spent trying to find resources on the internet, but the student results always came up short.

The main problem with the student projects were the topics chosen. Students' main topics seem to consistently focus on alcohol use and the drinking age, drug use and legalization, favorites (like color, music, car choices, beach time, etc.) and then came working out. None of these topics truly helped the student understand the statistical process in a deeper way which is one of the goals of the projects. All students want the drinking age lowered; almost all students wanted to legalize marijuana, and the favorite time to go to the beach

for college students is in the summer during midday. Unfortunately, a statistical project was not needed to find these results.

5. Positive Change

The idea of a service learning project had always intrigued me but frightened me at the same time. Sending one hundred introductory statistics students out into the community did not seem advisable and I certainly did not want that type of responsibility. Therefore, the idea of a service learning project that addressed issues on campus or college students as a whole became a natural solution to designing a worthwhile project.

6. Project Themes

Departments and organizations on campus are solicited for topics of interest to them and the college as a whole. Students have the option to develop their own ideas but they must select a topic that all students can have an opinion on. Since the population for the project is all Flagler College students, they must be careful in designing their surveying techniques so that all students in the population can take their survey. Furthermore, all students have the ability to be part of their sample. Therefore, they need to poll students around campus and not simply rely on friends to answer their survey. Also, the surveys must be designed in such a way that the students' final paper not only describes student opinion but include a possible solution to positive change as necessary. Examples of recent topics of interest include:

- Freshmen Orientation
- First Year Experience
- Learning Communities
- Attendance Policy
- Plus/Minus Grading Scale
- Writing Intensive Course
- Dorm Life (restrictions/coed)
- Dining Hall Hours of Operation
- Smoking on Campus
- Transportation (shuttle system)
- Social Media (regarding Flagler College events)

7. Steps in the Project Process

The final project is assigned mid-semester and is due on the last day of class. Presentations are also completed during the last class meeting. The project involves various steps to complete.

7.1 Selecting Groups and Topics

After working with the students in groups for the first half of the semester, students' statistical understanding, work ethics, and personalities are evident. Therefore, they can be assigned into groups of two or three students in such a way that no group is filled with all struggling students nor with all A students. A twenty minute introduction to the project

is given and then the students select a theme and post it on the discussion board for all students to see. No two groups in one class can have the same theme.

7.2 Creating a StatCrunch Survey
Once the theme is approved, the students develop a survey on StatCrunch, share it with the group site, and keep it closed for responses. The survey has a strict format; the first question is gender, the second question is age, the next few questions include demographics important to the project theme (For example, do you smoke; do you have friends who smoke?), and the last group of questions are opinion based questions. These last questions are the motivation of the project. (For example, does cigarette smoking outside the entrances to the campus buildings bother you?) The data collected on these questions will give interest and purpose to the project. At least one of the last questions needs to focus on a solution to present to the college. (For example, do you think Flagler College should be a smoke free campus?)

7.3 Gathering Data
Once the students' surveys are approved and opened for responses, the students gather data from at least one hundred Flagler College students. This step seems to take the most time and dedication on the part of the groups. Many of them post their surveys online on social media and most poll students around campus. One recent group gave candy away to anyone willing to taking their survey.

7.4 Research
Flagler College is a member of the Independent College and Universities of Florida organization (ICUF). Therefore, while the students are actively gathering data, they are required to research how at least three other ICUF schools handle the situation they are exploring (For example, do the other schools have designated smoking areas; are other schools smoke free?) Since the focus of this project is to understand the statistical process, it is important to research other institutions of higher education similar to Flagler College. However, this is a minimum part of their final project grade as there are occasions when no information can be found.

7.5 Describing the Sample Data
Once all sample data is collected, the group will use descriptive statistics to explain their sample. Appropriate graphs and summary statistics are used to describe the basic demographics and opinions of the students. Furthermore, it is necessary that at least one graph and accompanying summary statistics is created to compare the opinions between different groups. (For example, compare the opinions of a smoke free campus between students with and without friends who smoke.) All graphs, tables, and summary statistics outputs must be included directly in the final paper.

7.6 Testing the Student's Claim
Students are required to make two claims; one regarding the population of Flagler College students and the other comparing the opinion between two groups. Therefore, they will run two hypothesis tests (a one-sample and a two-sample test) and create two

corresponding confidence intervals (a one-sample and a two-sample confidence interval). Typically, students run a test of majority and find a corresponding confidence interval to determine the percent of the population of Flagler College who have a particular opinion. (For example, test the claim that the majority of Flagler College students support a smoke free campus and then create a confidence interval to estimate the percent of the population who want a smoke free campus.) For the two-sample situation, students generally choice to compare proportions. (For example, compare the opinions of a smoke free campus between students with and without friends who smoke and then create a confidence interval to estimate the difference in the percent of students supporting a smoke free campus who have or do not friends who smoke.) All statistical outputs of the test results and confidence intervals must be included in the final paper.

7.7 Stating a Conclusion
One of the most important parts to the project is the conclusion. That is, based on their results should Flagler College consider a change? In what way should they change? Furthermore, the students need to reflect on how to improve their study if they had the chance to redo the project. The conclusions they present here are what is shared with other departments on campus.

8. Video Instruction
Only one full class meeting is dedicated to the project. Therefore, the students are responsible to meet out of class to develop and create their survey, gather their data, produce graphs, calculate summary statistics, run hypothesis tests, and generate confidence intervals. This can be overwhelming for a first semester college student. Therefore, video instruction has been created and is available to the students on the class website. They will finding a video explaining how to develop a survey based on a sample survey and a video for how to create a survey on StatCrunch. Additional videos for how to use StatCrunch are also available. These videos focus on sample results gathered on my sample survey while explanations of my thought process in developing a sample project are verbalized. Students are very appreciative of the video instruction.

9. Detailed Project Directions and Thorough Grading Rubric
Very detailed project directions are given to the students on the first day the project is assigned as well as a thorough grading rubric. The grading rubric is designed as a template so the students know the format of the final report. The grading rubric template is available to the students in electronic form so they can edit the content and add their graphs, statistical outputs, explanations and interpretations in the correct locations. This structure helps in grading the paper and allows the students to know exactly what is expected of them.

10. Shortcomings in the New Project Design
Having a service learning project for the college has been an excellent addition to the final project design. However, there are still some shortcoming to the project design. In particular, since the sampling technique is not perfect, the samples are not simple random samples. Furthermore, the students create their own surveys, although they are reviewed,

they are not perfect either. Lastly, although emphasis is placed on having the students interpret and analyze the data correctly, not all students correctly analyze the data. Therefore, either the results are not shared with others on campus or the instructor is responsible for investigating the data gathered to present before sharing the results.

11. Conclusion

Although improvements can always be made to a project design, this approach has helped the students through the process and given them the understanding of the complete statistical process. In my experience, when a student selects a topic that is important to them, they feel ownership of the project and develop a deeper appreciation of the significance of the project overall. One student this past semester said the project was an excellent review of the all the material covered during the semester and helped her to see the connections. That is a comment any instructor would be happy to have a student report.

References

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