Computer Projects in a Group Format in a Freshman Level Statistics Course

Hasan Hamdan
Department of Mathematics and Statistics
James Madison University
Harrisonburg, VA, 22807, USA.

Abstract

Group projects as a supporting method of learning in a general education statistics course is discussed. The case for the need of computer projects in general and in a group format is made. A general description of how do I apply it at James Madison is presented. The method is working very well and the students seem to love it.

Key words: Computer projects; Teamwork; Conceptual understanding; Real data set

1. Introduction

Group projects in a statistics course can be a very valuable means of learning, particularly in a general education course such as elementary statistics.

We hear how important teamwork is in the real world at all job levels and titles. Recently it has become one of the most important skills one can have in the corporate and business world, in education, in health sciences, in politics and economics and in almost all fields of work. Livingstone and Lynch (2000) and others, pointed out that developing students with particular cognitive, communication and personal interactive skills can make a real impact and contribution on the long term economic regeneration and competitiveness. It is an important part of the real world work culture. See Cohen and Baily (1997) for a complete and comprehensive study on teams at the organizational setting. There are many blogs, web sites, online forums and vast amount of academic and business literature that address this topic from different angles. And just to mention some of the topics discussed in the online forums are on how to use the social learning skills effectively, how it is usually easier to achieve set goals or increase productivity and how to train kids at early age in schools to learn these skills. There are so many human resource companies that deliver professional programs related to teamwork that are tailored towards the field of interest. Just to mention few, see teamworkservices.com, http://serc.carleton.edu/introgeo/cooperative/index.html and http://www.collegenquirer.com/love-them-or-hate-them-dealing-with-group-projects-in-college/.
At the college level, group projects are sometimes viewed as a cooperative learning approach that can be used as an effective alternative to the traditional lecture.

Cheong (2010) explored using cooperative and group-based learning through peer-to-peer evaluation in a newly created capstone course in the information systems program.

In our case, these tools are actually integrated in a general education course in a way that best achieve the specific goals of the course.

One of my colleagues in Project NExT (New Experiences in Teaching, a program of the MAA) once told me "If you need to teach the students a good habit, you have to hit them early, hit them hard and hit them very often arguing that learning a new habit is exactly like learning a new game or learning a new language". Group projects at this early stage can teach students the value of teamwork.

I decided to write this article after attending and presenting at a local regional conference about teaching mathematics and statistics.

My colleague, Arlene Casiple, normally gives individual projects, and I always assign group projects. Although we didn't have any quantitative comparison, we were encouraged to share our ideas about group projects at the elementary level.

This article has four parts. First is a discussion for the need of computer projects in a basic statistics course and why the group-format is recommended.

Applying it at JMU is the next section. In this section, the class and course information in general and group and project information are presented. Disadvantages associated with group projects will be shared. Finally, conclusions and future ideas are presented in the last section.

2. Why Projects?

2.1 Why Do We Need Computer Projects at This Level?

Computer projects in an elementary statistics course have short term objectives and long term objectives. I can list five short term objectives. First is to support the conceptual understanding of the material. Giving projects allow students to see concepts more than once, and that reinforcement allows students more opportunity to remember the concepts. A second objective is to offer students an alternative method for learning important concepts. Some students are visual; they learn if they can see it or can see it in different forms. A third objective is it to apply what they learn to real life situations outside the classroom.

This, of course, answers the typical question of, "Why do we need this?". The fourth objective is to help students in their major, analyzing data related to their fields (biology, chemistry, economics, psychology sociology, business, etc.). This can be done by choosing appropriate dataset.

Lastly, group projects offer a mean to recruit students for upper level statistics course. Projects should end with questions that triggers students' curiosity. I don't think we have a shortage of these kind of questions. We hope students will be seeking answers to these questions.

Let us consider long term objectives. First is to motivate the students to learn more about the subject. Of course, this overlaps with the short term objectives since it is a result of making students curious and not bored. Second, students learn the importance of quantitative reasoning. This one clearly is an objective of the course as a whole.

A third objective is to change students attitudes toward statistics courses. This one can be achieved by creating a more interactive environment in the lab. Familiarity with and use of commercial statistical packages like SPSS, SAS and other softwares. Knowing how to analyze data using a statistical software often enhance students' interest in the course. It may also help students with their undergraduate theses.

Finally, group projects can sharpen students' communication skills, especially in writing and reading. This can be achieved by asking students to write their findings or conclusions in paragraph forms.

2.2 Why Groups?

There are many reasons for preferring group projects over individual projects in a statistics class. First, it is easier to satisfy short term objectives. Second, it gives more opportunity to ask additional questions in each project and to give a great number of projects without concern for grading. This is important for professors with large classes. Third, projects can be complex and challenging because of collective effort that should be employed in these projects. Fourth, it is easier to create an interactive classroom environment with groups than it is with individuals. Fifth, group projects teach social skills, and enhance students confidence, leadership and responsibility.

Finally, and most importantly, the group projects teach students the value of teamwork. I loved one of the team work slogans (TEAM, Together Everyone Achieves More). Assigning one score for each project makes each member of the team very responsible because no one wants to bear the responsibility for a less desirable score.

3. Applying it at JMU

3.1 Course and Class Information

Elementary statistics at JMU is a three-credit, freshman-level and general education course. At least 70% of the audiences are non-science students such as psychology, health science, business, sociology and other fields. The class size is 35 and the course is a prerequisite for many psychology courses and statistics course. The course is taught mainly by statisticians but because of the large number of sections offered, mathematicians and part time faculty have to teach it.

The text book we currently use is Essential Statistics by David S. Moore. We also have used Statistics: The Exploration and Analysis of Data by Jay Devore and Roxy Peck and Statistics: The Art of Learning from Data by Agresti and Franklin. Currently, we are in the processes of changing the textbook. Each section is scheduled to meet in a class room lab equipped with SPSS once a week.

3.2 Forming Groups

Students should be free to choose their groups at the beginning of the semester, possibly at the end of the first week to avoid problems with adding students or dropping the course.

Group sizes of 3 or 4 are highly recommended. Groups larger than this may face meetings problems because of conflicts in schedules. Although students these days use Googledocs to share and work on documents remotely without actually needing to meet physically, they are still required to meet in person which will help the social interaction in this large general education courses. General rules are given at the beginning of the semester.

For example, students are not obligated to stay in the same group but it is recommended they do so. Communication between different groups is also allowed and encouraged.

3.3 Projects

Projects can cover many topics starting with projects on descriptive statistics using all possible graphical and numerical summaries appropriately as they have been taught at this level. It is important to know that these projects are doable by the available statistical software. Describing the distribution of qualitative and quantitative variables, illustrating the concept of probability, correlation and regression, inference about the parameters of one population, inference about the parameters of two populations, and combinations of these topics are easy to create and have very useful educational results. Projects normally end with some challenging questions that motivate the next topic or even the next course. Finally, file-and -data management, like data editing, importing data, splitting data, recording variables and transforming variables are also learned along the way.

I always give at least three computer projects. Normally; the first project is done before we start summarizing bivariate data, the students are given a real dataset and asked to answer specific questions using graphical and numerical summaries for univariate data which they have learned in the first four chapters. They are also asked to split the dataset or categorize some of the variables. They are also asked questions about relationships between two quantitative variables which they have not seen yet. At this point; questions like these are intended to motivate the next topic. In the second project, the students are asked again about the distributions of certain variables, about correlation, regression, outliers, influential observations, and doing regression for different parts of the data and compare the models. Motivating or challenging questions are about multiple regression, missing values and the effects of outliers. The third project is given to them after they have just learned the Central Limit Theorem. In the third project; the students are asked to generate their own data and to apply the Central Limit Theorem. They are asked to generate binomial data with different parameters and looking at the distribution of the proportion of success. They are also asked to generate data from exponential and normal distribution and investigate the shape and variability of the distribution of the sample mean as the sample size increases. Motivating questions are about confidence intervals and hypothesis tests concerning the population mean. The last project is about comparing the means of two populations using independent samples t-test or matched pairs. The motivating question(s) are about comparing the means of 3 or for groups.

4. Disadvantages

We have discussed positive aspects that result from giving group projects at the freshman level. Unfortunately, one does need to be aware of the disadvantages associated with this experience.

The first observation is one of human nature. Sometimes we find incompatibility of student personalities in the groups. There is a possibility that one of the group members will dominate the rest of the group. Sometimes there is a member who doesn't mind having someone else do the work for him. We cannot totally eliminate these problems, but we can minimize them. One suggestion is to have a lab test at the end of the semester (They have that for a chemistry lab, for physics labs and biology labs, why not for statistics labs?). Also, we should talk with students repeatedly during the semester as a way of monitoring the process through open and direct channels of communication.

The second disadvantage is the facility requirements such as computer labs, software licenses and trained professors.

The lack of the professors training in software use could limit the kind of problems suitable for group projects. For example, in many schools, mathematicians have to teach these statistics courses because of the lack of statisticians who are more experienced with the software.

Last but not least, the extra work for professors grading, making the projects, and teaching the software make the applicability of these difficult especially where the teaching load is large and the class size is large.

5. Conclusion

Learning statistics through analyzing data by discussing and sharing ideas with other students through groups has worked very well in my classes. I have not measured the efficiency of group projects quantitatively as a learning tool, but it seems to work very well. The students love working with other students, it and they seem to enjoy the project themselves. I have found that students learn to value team work. In particular, out of the 117 sampled students, 67 favored group projects over working individually. However, when the numbers are broken by semester 43 out of 66 spring students favored group projects over individual projects. Although I have not repeated this survey officially but I have done it many times casually an these numbers don't seem to change i.e. More spring students favor group projects compared to fall students. One possible reason for that might be the fact that the majority of the students in this course are freshman. For freshman students, many challenges can distract them from focusing on finding the best learning tools. Basically the main challenge is adjusting to the new college environment. This is one area that needed to be further explored.

These results can be used a tentative and preliminary indication that students can be taught to value teamwork, something that doesn't normally come naturally. Further and more in-depth statistical study is needed. In particular, we hope to compare the effect of group projects to the effect of individual projects in achieving the short term objectives quantitatively.

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