Teaching the Introductory Statistics Course with a Lotus 1-2-3 Package

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1.   Introduction

At Baruch College all undergraduates in the School of Business and Public Administration are required to take a one semester introductory level course in statistics. Students majoring in certain quantitative disciplines are also required to take an additional semester of intermediate statistics as well. In addition, there is an intensified introductory graduate level course required for all MBA students, which is equivalent to the two undergraduate courses.

With the advent of the personal computer and more user-friendly data analysis packages it became clear that teaching these statistics courses while incorporating the computer was no longer an option but a necessity. Computer labs began to crop up at our College and packages such as SPSSX, SAS, Minitab, BMDP and Statgraphics were made available to all the students. Teachers trying to incorporate the computer into their courses found that more time was spent showing students how to get the proper output from these packages and less time was being given to teaching statistical concepts. Even after spending hours of precious classroom time on the use of the packages, students continued to put data into these packages without having a clear understanding of the statistical methods, which resulted in many misuses of the methodology. It became obvious that data analysis computer packages alone at the introductory and intermediate level were not achieving a better understanding of statistical concepts. This observation led to the development of the Lotus 1-2-3 package *LEARNSTAT*, which the authors currently use in their statistics courses.

The major difference in our package versus the conventional data analysis package is that it was written to teach, develop, and reinforce the statistical concepts behind the methods as well as to do the usual data analysis found in other computer packaged programs. In addition, *LEARNSTAT* was designed to be used with portable projection equipment as an integral part of the lecture to enhance the students' understanding of the statistical concepts.

In this paper we will explain the development of our package, how and why it is used in the classroom, and why we feel it is a better way of teaching statistics.

2.   What is *LEARNSTAT*?

LEARNSTAT is a Lotus 1-2-3 computer package designed specifically for the use of teaching introductory and intermediate statistics. Among the topics covered in the *LEARNSTAT* package are: Descriptive Statistics; Frequency Distributions; Binomial, Poisson and Hypergeometric Distribution; Normal Distribution and Computing Areas Under the Normal Curve; One and Two Sample Inference Procedures for Means and Proportions; Chi Square Tests; Analysis of Variance; Simple and Multiple Regression; Nonparametric Procedures. In addition to these topics there are programs devoted to data generation, data handling, and several simulation programs to aid in understanding various topics.

When using a *LEARNSTAT* program students are guided along by the program and need not know Lotus 1-2-3 in order to use it. Failsafes are provided throughout. For example, once a program is chosen the student is asked if they are certain they want the program and can abort their choice if necessary. Similar failsafes are also provided when it comes to erasing data and throughout the use of *LEARNSTAT*.

LEARNSTAT provides a statistical package which reinforces the concepts which the student is being taught by the teacher through examples and graphics. For example, when learning descriptive statistics, the students can use sets of data already on file or put in their own data from the keyboard to get the descriptive measures for their sample. A discussion can then follow as to what these measures are telling them about their sample, along with a view of a Box and Whisker plot for discussion about the shape of the data. *LEARNSTAT* then gives them an opportunity to view the data in an ordered array and see what that sample actually looks like. The observations made when seeing the actual data help to lock in the ideas discussed in class.

Unlike most data analysis packages which can only handle raw data, *LEARNSTAT* can handle both raw data and summary data. Since many textbook problems rely on summary data, students can do most of the standard textbook problems assigned in the lab and for homework.

To develop this package properly the authors first ran small experimental sections of introductory statistics and then in future semesters continued to use *LEARNSTAT* in their regular introductory sections as well as intermediate courses. The package has been revised every semester, for the past three years, using the classroom experience to make *LEARNSTAT* a better way of teaching statistics.

3.   How do we use *LEARNSTAT* to teach statistics?

As we mentioned previously, at Baruch College we have portable projection equipment which is brought into the classroom. Thus, one way we use *LEARNSTAT* is to enhance our teaching of statistics by using it during our lectures. A typical lesson will have some talk and chalk discussion of a topic, perhaps even going over some simple computation and important ideas. Then the time is right for *LEARNSTAT*.

Once the statistical methods have been taught, we reinforce the concepts through many examples. There are several data sets, of various character, on file. Some are symmetric, some are skewed, some have outliers, some come from normal populations, etc. We see how our statistical methods work with these varying samples. For example, when teaching confidence intervals, a considerable time is first spent showing students how the confidence intervals are derived and what the confidence interval means. Then various cases are discussed (i.e. normal data, non-normal data, variance known, variance unknown) and the proper methods are presented. The next step is to move the lesson to *LEARNSTAT*. First, time is taken to reinforce the concept of a confidence interval. This is done by using the simulation program for confidence intervals. We may for example choose the program that simulates random samples from normal populations. We would choose a normal population and specify the true mean. Then a sample size, n, and a level of confidence either 95% or 99% is chosen. The program simulates 100 samples of size n for the mean μ and computes the corresponding 100 confidence intervals for μ. Once this is done the simulation program tells us how many of these confidence intervals actually capture the true mean. The authors recall the reaction of the students when computing 99% confidence intervals. The first time, two confidence intervals did not capture the true mean. The instructor suggested that during the next simulation all the confidence intervals may capture the true mean and they did!! The point is made and the concept is reinforced. The next step is to analyse the data in the files. Confidence intervals are computed and discussions follow as to what these confidence intervals are telling us. *Real data analysis with understanding in the classroom!!*

After each new method is completed students are instructed to go to the computer lab and work on some practice problems. Once the students have the hands-on experience with the new methods they proceed to work on their homework. Homework problems are assigned requiring computation and interpretation. *LEARNSTAT* allows the students to concentrate their efforts on interpretation rather than computation.

Students who have personal computers at home or work which have Lotus 1-2-3 on them are given copies of *LEARNSTAT* so that they are not confined to doing their practice problems and homework in the computer lab at school.

Examinations are given in the computer labs. The students perform all calculations using *LEARNSTAT*. Questions put more emphasis on understanding the statistical concepts and methods than on calculation.

4. Why is teaching with *LEARNSTAT* better than the usual methods?

The best way to utilise a teaching, data analysis package such as *LEARNSTAT* is to use it in the classroom as well as for homework and lab assignments. At Baruch College we are fortunate to have equipment which projects the computer screen onto a larger screen that the entire class can see. The use of *LEARNSTAT* becomes an essential part of the lesson. Prior to the acquisition of this equipment, most classes using *LEARNSTAT* met in a computer lab in order to integrate the package with the lesson, often wasting teaching time in making sure all students are viewing the same output on the screen. On the other hand, it has the benefit of giving the students hands-on experience while the lesson is actually being taught. Thus, there are benefits with each method.

In a typical course, using either talk and chalk or an overhead projector, there is less flexibility in the instructor's lesson than using *LEARNSTAT* in the classroom or lab. With these other methods, when teaching topics such as descriptive statistics or confidence intervals and using raw data, the instructor is limited to few observations or to "giving" the students the summary statistics they will need to perform their calculations. These calculations often distract the students from learning and understanding the concepts involved with the statistical procedures.

In the research and working world, students who only take an introductory statistics course will not be concerned about calculations but rather with interpreting results. Teaching with *LEARNSTAT* allows the students to concentrate on interpreting results instead of calculations.

When using this package, the statistics teacher can do many more problems during a session. The students are able to work with real data while learning the methods. The instructor is able to answer questions during the lecture by actually showing the students what may happen under various situations since the computer is in the classroom to handle the questions. Question: "How will these statistics change if we eliminate the outliers in the data?" Answer: "Let's eliminate the outliers and see." *LEARNSTAT* is programmed to allow the outliers to be easily eliminated and the students actually see how the statistics change. This is difficult to do with the conventional classroom methods.

Moreover, because computing statistics by hand from raw data is so time-consuming and distracting, students are often "given" summary statistics in problems, and then lose sight of the fact that when they are using statistical methods in their jobs or research, they must gather the data and get these summary statistics themselves. With *LEARNSTAT* students are continuously reminded of this fact by using real data.

During the course, students become computer confident, confident that they understand statistical methods, and therefore confident in their ability to perform proper data analysis. This is a major goal and accomplishment of teaching with *LEARNSTAT*.

5.   Conclusions

Teaching statistics with a computer package is clearly the wave of the future. More and more students have their own personal computers, just as years ago students began obtaining their own calculators. There isn't a statistics course given that does not require a student to have a calculator, so it may be in the next few years with personal computers. Computations should no longer be the emphasis of an introductory course in statistics. The proper statistical package allows students to concentrate on data analysis instead of computation.

We feel *LEARNSTAT* is an excellent way of obtaining the goals of computer confidence, reinforcing the ideas behind the statistical methods, the proper use of statistical methods when using a packaged program, and good data analysis.

Computers are in everyone's future; statistical computer packages like *LEARNSTAT* enable statistics students to face the future with confidence.