

Application For A Purdue University North Central Summer Faculty

Grant 2001:

Development of Advanced Statistical Graphing Calculator Programs

J.R.D. Kuhn

Mathematics and Physics Section, Purdue University North Central,

Westville, IN 46391-4197

Abstract

It is proposed that a number of sophisticated statistical TI-83 graphing calculator programs be written. Instead of being tied to statistical software packages such as SAS or Minitab or Splus on microcomputers, statistical researchers would be able to use these programs on their portable hand-held TI-83 calculators. These programs would be of immediate benefit, in particular, to students in undergraduate statistics courses.

1 Statement of the Problem

Graphing calculators have opened up a new analytical tool for statistical researchers and, most importantly, for educator in undergraduate statistics. Previous to these calculators, calculations were often tedious and time consuming. Examples presented in class, performed in homework assignments or asked on tests, necessarily involved small unrealistic data sets. Much class time was devoted to the *mechanics* of statistics, rather than the *concepts* of statistics. More specifically, much effort was spent on the proper use and interpretation of statistical tables or the clever manipulation of formulas, at the expense of developing the ideas and properties of the average, standard deviation and correlation coefficient.

The change in emphasis from the mechanics to the concepts of statistics has occurred in the last twenty years. First, in the 1960s and 1970s, computer programs, such as SAS, written for mainframes and microcomputers, were used by students for projects and homework assignments in computer labs, separate from the classroom. With the introduction of, first, scientific calculators in the early 1980s and, later, the first graphing calculators in the mid 1990s, the heavy number crunching aspects of statistics has steadily moved out of the computer labs and into the classrooms.

The last five years have seen a steady improvement in the complexity in the kind of statistical problem that scientific/graphing calculators have been able to handle. Early versions of such calculators were really no more than glorified scientific calculators able to calculate various summary statistics such as the average, median, standard deviation and percentiles with some simple graphing capabilities. More recent versions are now able to not only perform various statistical inference procedures such as z -tests, 2-proportion z -tests and Analysis of Variance (ANOVA) procedures, but also can produce a variety of statistical plots such as scatter plots, histograms and box plots.

Probably the most important change in graphing calculators has been their greatly expanded programming capabilities. Within the last year, the TI-83 plus calculator has introduced “flash-memory”, to allow programs to run quickly. Other improvements include various cables that allow programs to be easily transferred from one calculator to another and from microcomputers. This latter improvement now allows distance learning students to copy graphing calculator programs from the Internet, and so allow them to better participate in undergraduate statistics courses that store such programs on the Internet.

This grant would be used to devote time to creating a number of programs for the TI-83 plus graphing calculator that would be very useful in the teaching of undergraduate statistics. These programs would be added to the library of programs already created by the author.

2 Significance Of The Problem

The author believes these programs would be of *central* importance in the use of graphing calculators to teach undergraduate statistics. He believes that these programs would greatly enhance a student’s understanding of statistical concepts. Rather than discuss previously calculated problems, students would have “hands on” experience with the data and would develop the statistical problem “real time” using their calculators.

There are other reasons why this work is important. First, the resulting programs

would be published and made available to others involved in undergraduate statistical course work. Second, these programs may be added to the default statistical program library already available in the TI-83 calculator. Third, these programs would be available to the author for teaching statistical concepts in the various courses he teaches at Purdue University North Central. Fourth, these programs may be useful for statistical consulting work at Purdue University North Central. Fifth, at a much later date, these programs may even start to transplant, or at least complement, microcomputer statistical software such as Minitab or SAS or Splus.

3 Plan of Research

Some possible TI-83 graphing calculator programs and their purpose are now described.

Plots. The small library of plot types in the TI-83 plus calculator (histogram, scatter plot, box plot) would be expanded to include:

- $e \vee x$ plot (linear and quadratic)
- $e \vee \hat{y}$ plot (linear and quadratic)
- q-q plot (linear, quadratic and ANOVA)

All of these *graphical* tools are diagnostic in nature and are useful in statistics to determine whether or not the assumptions necessary to carry out the various statistical inference procedures are satisfied are not. The author believes this would be a *significant* improvement over the present situation where students “plug and chug” with statistical formulas, without any real sense of when and where these formulas can be used. The real-time investigation of data is now possible in class.

Sophisticated Statistical Inference. Again, the library of statistical inference procedures in the TI-83 plus calculator (z -test, x -interval and so on) would be expanded to include:

- correlation tests and CI (Fisher and exact)

- prediction intervals and simultaneous intervals
- contrast (pairwise and other variations) tests and confidence intervals

All of these tools are analytic in nature and would enhance the basic set of tools already available in the calculator. These tools are more realistic and readily applicable to actual statistical problems, than are the basic tools.

Percentiles. The noticeable lack of distribution percentile programs (there is only one on the TI-83, for the normal) would be expanded to include:

- t -distribution percentile
- F -distribution percentile
- χ^2 distribution percentile

These percentile programs would eliminate the present required use of t -tables, F -tables and χ^2 tables.

Dear Edward Bednar:

Please find enclosed an application for a Purdue University North Central Summer Faculty Grant – 2001, for your evaluation.

Thank you for your time and I look forward to your reply.

Thank you,

Jonathan Kuhn