THE PROGRAMMABLE CALCULATOR - A NEGLECTED TOOL?

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With the current boom in sales of microcomputers, the development of a vast amount of software for their use, and an emphasis on their applications to the mathematics curriculum, the programmable calculator may be fading into obscurity. It does, however, serve many useful purposes - in probability, number theory, calculus, statistics.

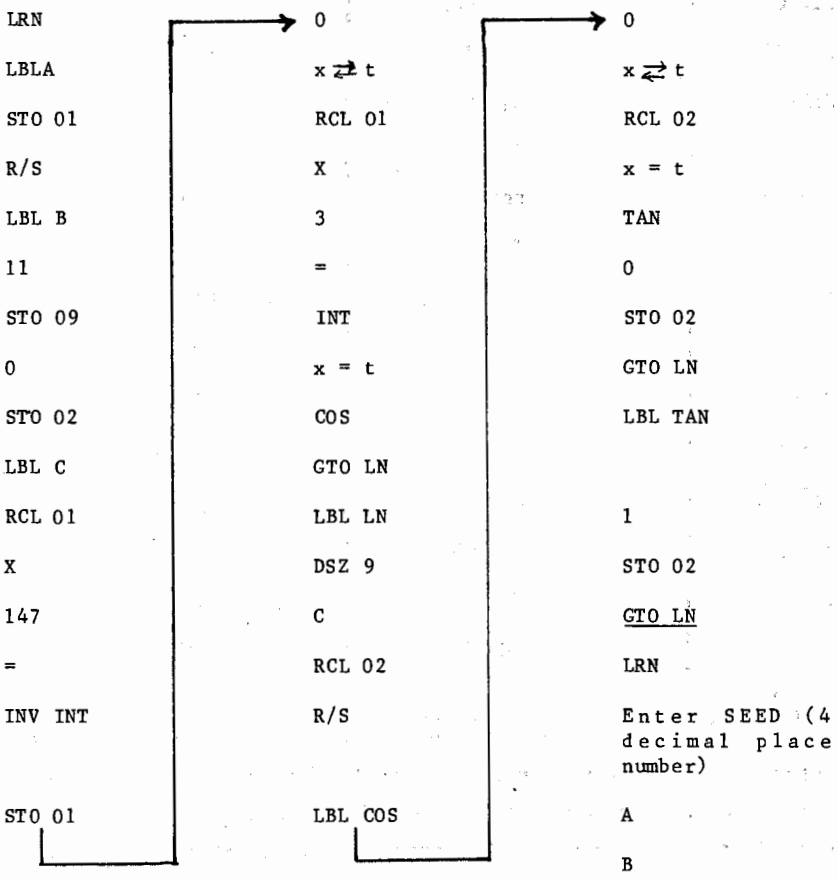
This paper will suggest a few ways in which programmable calculators have been used to enhanced the traditional curriculum. It will be left to the reader to evaluate the advantages or disadvantages of cost, portability, programming languages, and non-programming uses.

In units on an introduction to probability, the exercises are frequently too easy or too straightforward to be really interesting. Sophisticated counting techniques, linear algebra, calculus, or considerable ingenuity are required to solve the more challenging problems. But, these are the problems which generate enthusiasm and motivate further study of probability and statistics. A vast number of examples can be presented using simulation techniques and encouraging students to guess the answer from a relative frequency interpretation of probability. Following is a favorite exercise and a TI-58C program for simulating the game.

> Of the subjects of a certain king, not all are truthful. In fact, if a subject is selected at random, the probability that he <u>always</u> tells the truth is 2/3. However, the probability that he <u>never</u> tells the truth is 1/3. The king of this country is trying to decide whom to marry. There are only two possible choices, Princess Anne and Princess Barbara. One day the king whispers to one of his subjects that his choice is Anne. This confidant hastily whispers to another person, "The king has chosen _____." Which name he says depends, of

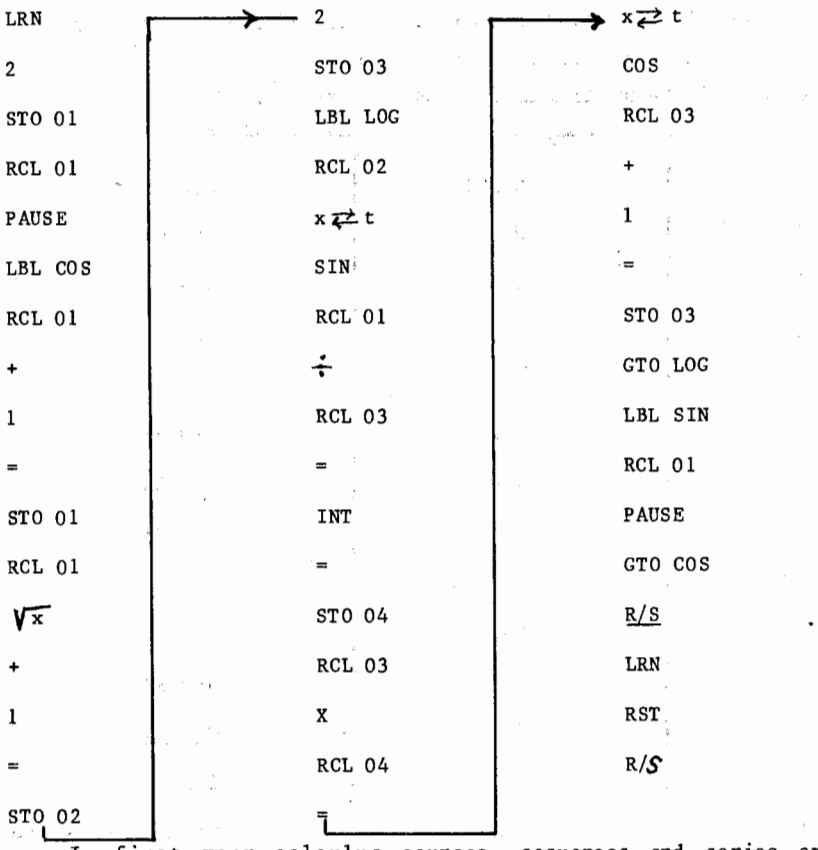
course, on whether or not he is truthful. So it goes. Each person, when he hears the rumor, whispers either the name he hears or the other to someone who has not heard. Assume that the king tells the truth. What is the probability that twelfth person has heard the truth?

The following program simulates the experiment:

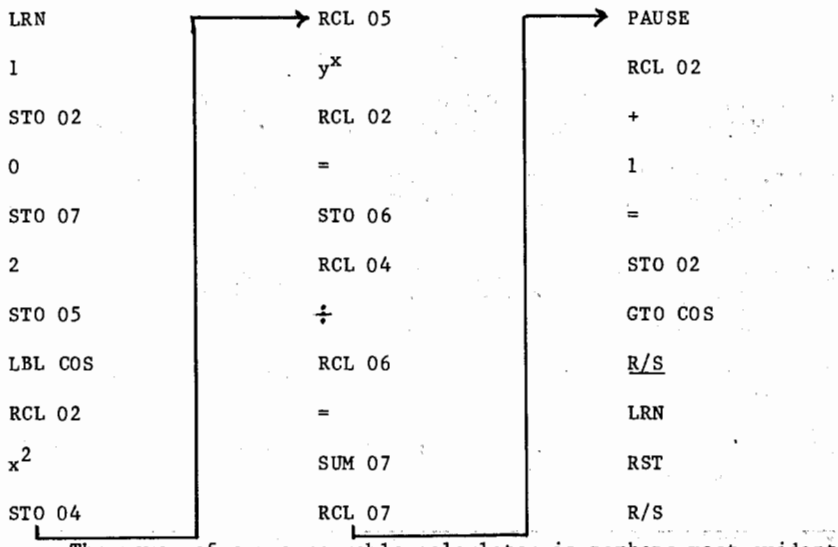


Elementary topics in number theory provide a second example of a segment of the mathematics curriculum in which programmable calculators can be used effectively. Testing numbers to determine if they are prime, using Euclid's algorithm to find the greatest common divisor, and multiplying two numbers modulo m are just a few

of the many examples that can provide programming practice. Usually, our class favorite number theory program is the one below, written for a TI-58C calculator, which displays primes.



In first year calculus courses, sequences and series are introduced along with a number of tests for convergence or divergence. But, if a series converges, the student is rarely asked to consider to what number it converges. Programmable calculators provide a convenient tool for adding a finite number of terms of an infinite series, and then forming a conjecture about the sum of the series. For example, it is easy to prove that $\sum_{n=1}^{\infty} n^2/2^n$ converges by using the Ratio Test. A TI-58C program for adding the terms of the series is given below. The program can be terminated when the answer becomes "obvious."



The power of a programmable calculator is perhaps most evident in statistics course. For a modest investment of money a statistics module can be purchased for a TI-58C or HP 41-C calculator, which provides built-in programs for a great number of statistical procedures, including histogram construction, analysis of variance, linear and non-linear regression models, binomial distributions, t-tests, and contingency tests. The beginning statistics student will find it easier to use a programmable calculator rather than the elaborate statistical software packages designed for large computers or expensive statistical packages designed for microcomputers. Here, then, is a significant instance in which students need only use a programmable calculator; they do not need to program it themselves. And here is an advantage of a programmable calculator over a microcomputer.

Modern technology is advancing calculators and computers at a mind boggling rate. And, the ways in which they can be integrated into the mathematics curriculum are becoming more apparent. But, just as one doesn't need a Rolls Royce to drive to the grocery, one may not need an expensive computer to deal with all aspects of mathematics. Consider a programmable calculator!

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EXPONENTIATION IN PASCAL

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Most people will agree that Pascal is fast and elegant and is a good language to use when teaching programming. But while they're saying things like that they also want the language to do all sorts of things that may or may not be academic in nature. One good example of this confusion is the way that Pascal deals with some arithmetic functions. If I am strictly a programmer, then I want the language environment that I'm using to be a completely transparent vehicle for me to communicate my algorithms to the machine . . . and I want the thing to work with as little effort from me as possible. But if I'm a teacher, then I want a language environment that causes my students to actually think through what they want the machine to do. In fact, the reason that Pascal has so many adherents in the schools is precisely because Wirth