November 11, 1982

Mathematical Association of America
1529 Eighteenth Street, NW
Washington, DC 20036

Dear Sir:

Enclosed are an abstract and outline of the paper 'Using Microcomputers to Illustrate Concepts in Probability and Statistics.' I am submitting this for the contributed paper session at the Denver meeting entitled 'The use of computers in undergraduate mathematics instruction,' with session leader Ronald H. Wenger, University of Delaware.

Concerning the equipment that would be required for this presentation - the minimum equipment required would be an overhead projector. If a TRS-80 Model III Microcomputer were available and if the computer could drive a sufficient number of monitors for the audience to see, the examples could be illustrated 'live'. Another alternative would be for me to use the overhead projector for the formal presentation and then be available in some room at a later time so that participants could have a hands-on experience.

Please forward these materials to Ronald Wenger.

Thank you.

Sincerely,

Elliot A. Tanis
Professor of Mathematics

EAT/lm

ABSTRACT

Using Microcomputers to Illustrate Concepts in Probability and Statistics

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One way in which computers can be used in the statistics curriculum is for helping students understand more clearly basic concepts in probability and statistics. Two important ingredients are necessary to accomplish this:

1) a good software package that makes effective use of the graphics capabilities of the computer being used,

2) exercises and examples that have sound educational value.

More than 200 exercises of varying degrees of difficulty have been written to accompany a year long course in mathematical statistics and probability. Among the 54 subroutines in the supporting computer software are subroutines for:

1) depicting a histogram and/or empirical distribution function with the option of superimposing the theoretical probability density function and/or distribution function, respectively;

2) illustrating confidence intervals;

3) scatter diagrams;

4) giving values of important distribution functions and their inverses;

5) simulating random samples from several distributions.

Currently the software that has been developed is written in BASIC for the Radio Shack TRS-80 computer. We plan to make the necessary modifications so that these materials can be used with other microcomputers. An earlier version of these materials is written in FORTRAN and can be used in either batch or interactive mode on most large computer systems. That package is distributed by CONDUIT, P.O. Box 388, Iowa City, IA 52240.

OUTLINE OF PRESENTATION

Using Microcomputers to Illustrate Concepts in Probability and Statistics

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I. Overview of the materials that are available

- A. Exercises
- B. Computer software

II. Description of ways in which the materials can be used.

- A. Students solve exercises in a laboratory setting
- B. Professor and/or student(s) prepare a demonstration for a statistics class
- C. Materials form a basis for an undergraduate research project

III. Solutions of four of the exercises

A. Example 1. Simulate 200 observations of a binomial random variable X for which $n = 11$ and $p = 0.6$. Use the fact that X is the sum of 11 Bernoulli trials. Superimpose the binomial probability function on the relative frequency histogram of the observations of X. See Figure 1 for a typical solution.

B. Example 2. Illustrate empirically that the sum of two 'random numbers,' selected at random from the interval (0,1), has a triangular distribution. Superimpose the probability density function on the relative frequency histogram of 200 observations of sums of pairs of random numbers.

C. Example 3. Simulate 50 random samples of size 10 from a normal distribution having mean $\mu = 40$ and variance $\sigma^2 = 12$. For each sample, calculate the endpoints for a 90% confidence interval for μ, assuming that μ and σ^2 are unknown, using $\bar{x} \pm 1.833s/\sqrt{10}$. The confidence intervals are depicted in Figure 3. A horizontal line is drawn at $\mu = PM = 40$.

D. Example 4. Simulate a random sample of size $n = 50$ from a bivariate normal distribution for which $\mu_X = 50$, $\sigma_X^2 = 36$, $\mu_Y = 70$, $\sigma_Y^2 = 64$, and $\rho = 0.75$. Figure 4 shows a scatter plot for such a simulation.