an effective organization?," is answered in the affirmative by reviewing the eight-year history of the Minnesota affiliate.

The eight annual conferences briefly sketched in this article show that the Minnesota Association of Colleges and Teachers of Agriculture (MACTA) has concentrated on achieving its purposes. The main thrust to attain these ends has been the improvement of instruction sessions at each annual meeting.

A large membership in MACTA and its parent organization has contributed to the success of the organization. In addition to the participation in annual meetings, a large percentage of members have served as officers, on committees, or with other responsibilities. One of the newer developments in attaining the purposes is the selecting of outstanding faculty members in MACTA to tie in with the teaching awards of the national organization, NACTA.

An evaluation of the organization in its brief history would indicate that it is carrying out and achieving its purposes. Although additional evaluation is needed to insure proper direction in the future, MACTA has been a dynamic and useful organization and faces the future with strength and promise.

Preliminary Design

Water Quality Monitoring Exercise With Simulated Historical Records

James A. Perry

Introduction

Laboratory and classroom exercises often discuss methods and techniques for measuring population variables, e.g., response curves, density functions. Students in upper level classes are expected to have some basic understanding of statistics and experimental design, and they are taught ways to apply those principles to the subject at hand. For example, forestry students are instructed in stand-inventory measurement data analysis and interpretation. Dairy Science students discuss measurements of milk production rates under different herd management regimes. Small grain classes discuss production per acre under different soil fertility conditions and rotations.

In all the above examples, students are expected to understand basic parametric statistics such as mean, variance, population, and sample attributes (though we usually "refresh their memories"). Class exercises are offered where different experimental conditions (e.g., different soil types, different feed qualities, varying amounts of rainfall) produce different response curves. Class discussion is used to integrate results and experimental conditions into cohesive summaries of the effects of different management schemes on selected variables.

Class exercises may be based on discussions from the text, the literature, the instructor's experience, or actual hands-on experience. Hands-on experience where students increase their participation in the exercise should improve understanding and retention. A goal of better teaching is to increase retention. Retention may be influenced by more hands-on experiences. These experiences may be strengthened through use of computer simulation data files (cf. Meadow, 1979; Meadow and Sleeter, 1982). This paper describes a laboratory exercise offered to water quality management classes in the College of Forestry at the University of Minnesota. The technique is simple, inexpensive, and may be applied to any field. It requires access to computing facilities (main-frame or micro) and a familiarity with the response curves involved. That is, some background data will be needed to generate the simulation. The exercise has been used on only a limited scale and is offered as a preliminary design. Other instructors may find ways to improve the technique; interaction with others who try the technique is invited.

Example: University of Minnesota's Forest Water Quality Management Course

Water quality is a growing concern in the quest to manage our natural resources effectively. Society must be assured an adequate supply of water of sufficiently high quality to meet its varied demands. Yet those very demands, and their impacts, place major stresses on both the quality and quantity of available water. In our Forest Water Quality Management class we discuss the variables that influence "water quality;" e.g., dissolved oxygen, pH, sediment, and dissolved residue. That is followed by a discussion of various activities that are conducted on forested lands, alternatives that exist for the way those activities are carried out, and effects of various alternatives on water quality.

A discussion of water quality impacts from various actions implies the existence of a data base from which impacts may be measured. That data base must be generated by an adequate monitoring program to measure water quality impacts from various activities (Perry and others, 1984; Schaeffer and others, 1984). The water quality class includes a laboratory section where students collect and analyze samples and interpret the results. Those results are interpreted in light of a simulated historical record; that record is the subject of this paper.

In a field situation, a biologist or engineer would have a record of water quality variables from a certain stream measured for several years before an activitiy occurred (Ponce, 1980; Averett, 1979). For example, three years of background data may be collected before a mine or timber sale is allowed to proceed. In a classroom situation, students are involved for 10-18

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weeks. Laboratory exercises in the form of field studies are valuable. Those exercises often must be completed near campus for logistical reasons. Yet historical data are often unavailable for those water bodies. Even without historical data the hands-on experience of collecting and interpreting data is critical. It is also important that the classroom exercise simulate a professional field situation as closely as possible.

I have attempted to bridge the gap from classroom to field by dividing the class into small teams (3-6 people each). Each team plays the role of a consultant hired to address a particular issue. For example, one team may represent a major development firm which is interested in building an industrial park around a small pond. Another team may represent a homeowners' association which wants more protection for the stream draining their small marsh. Each team is expected to prepare a study design, meet with the client (the instructor) to agree upon goals, outputs and time frames, and then to carry out the study. The study includes two final products: a preliminary data summary where potential interpretative problems are presented and agreed upon with the client, and an oral and written formal report at the conclusion of the study. Other teams in the class act as an audience at a public hearing for the oral presentation.

The study actually consists of a series of measurements made by the students, followed by a comparison of current and historical conditions. Based upon a written description of the history of the watershed (supplied by the instructor), a historical record of water quality variables, and data collected during the class, students make predictions of water quality impacts from the proposed activity. Students must present evidence that their results and predictions are statistically sound. Based on lectures and discussions, students also propose alternatives whereby the activity could be completed with less impact on water quality.

The Historical Record

I developed population means and variances for several water quality variables from two test watersheds. In most cases this was done by using published data collected by other agencies. For example, the U.S. Geological Survey has published water quality data for many streams in each state. State water pollution control agencies and public health agencies also have data, as do many local management groups like Councils of Governments (COG's). When population means and variances have been established, random numbers are generated within those limits. Many computer programs are available for the data generation and statistical analysis; I used MINITAB (Ryan and others, 1980) on an IBM 370 computer. The same approach could be used on any mainframe, or on microcomputers such as an IBM-PC or an Apple. MINITAB, as well as most other statistical packages, allows the generation of random number data files that fit specific criteria, such as a certain mean, variance, and statistical distribution.

Sample sizes and study sites are chosen to reflect what the students are predicted to develop. For example, in a 10 week quarter, students will collect about 30 water samples from each of two stream situations (upstream and downstream of the proposed activity). In a spring quarter class, those samples will be collected between March 15 and May 31. That is a period of spring rains and snowmelt, so discharge of the stream will vary widely, turbidity will be high, temperatures will be low. Therefore, a random number file was developed that simulated 10 years of data from each of two stations. Thirty samples for each variable from each station for each year were included. Variables were restricted to those that students would be able to measure (turbidity, suspended solids, dissolved oxygen, temperature, discharge, pH, etc.) Statistical properties of each data set were designed to simulate specific activities included in the watershed description. For example, a road was constructed 5 years ago on one watershed, so turbidity means and variances in the simulated record were increased for two years following construction.

The simulated historical data were stored in a read-only file; i.e., it can be read but is locked so it cannot be altered without a specific password. Such files are easily established with the advice of a computer management person. Students have access to that file, for their watershed, during the design phase of their study as well as during the analysis phase. The historical data may be utilized to predict required sample sizes if desired. After complete data collection, students store new data in a file parallel to the historical file. Any statistical programs in the package may be used to analyze results, including generation of hypothetical data based on predictions from this year's sampling effort. Generation of hypothetical data is particularly useful if students predict a major change due to an activity. A plot of predicted conditions under different management alternatives is an excellent visual aid in a presentation.

Use in Other Classes

The approach described in this paper may be used in any class in which the relationship between two or more variables is discussed. In the water quality example, I have simulated historical data to allow students to discuss changes over time. In other instances variables other than time may be important. For example, seed germination characteristics from various origins could be simulated, and students could compare those to seeds from their own experimental plot. Stand leaf area characteristics from one forest type on different soils or from several different foresty types could be simulated for comparison with a local stand where leaf area measurements are actually taken.

The only requirements for use of the technique are access to a computer with a random number generator and statistical package, and some data collection activity to be conducted by the class. It is important to be able to control population parameters (mean and variance) with the random number generator in order to provide realistic simulations, and to provide flexibility in historical conditions. In the water quality example, I have used the normal distribution for simulated variables. In actuality a poisson or negative logarithmic may be more realistic in ecological applications (Pielou, 1969; Sokal and Rohlf, 1981). With the random number generator found in most statistical packages available for mini or micro computers (e.g., SAS, SPSS), a statistical distribution, as well as population parameters may be defined **a priori.** Thereafter all that would be required is the instructor's knowledge of the populations, and the laboratory facilities in which students may make their measurements.

Summary

I suggest that material from laboratory experiences will be recalled and used more effectively if students are intensively involved in data collection and analysis. To be relevant, that data collection must be a realistic imitiation of actual field conditions. However, most fields require data collected over many different sets of conditions or long periods of time. This paper describes a way to create a realistic simulation of a long term historical record. Data is simulated by a computer with a random number generator; random numbers are generated following known statistical properties of actual populations. Students then collect a limited quantity of their own data, and perform statistical tests on the new, and the historical data. Interpretations of their analyses are developed based on issues discussed in other segments of the class. The design is preliminary; it has been used on a limited scale at the University of Minnesota. Other instructors are encouraged to try the technique, and offer suggestions for improvement.

Literature Cited

Averett, R.C. 1979. The use of select parametric statistics for the analysis of water quality data. Paper presented at USGS-BLM Conference on Water Quality in Energy Areas. Jan. 10-11, 1979; Denver, CO. 16 p.

Meadow, C.T. 1979. **DUCSOOP User's Manual.** School of Library and Information Sciences. Drexel University, Philadelphia, PA. 32 pp.

Meadow, C.T. and E.L. Sleeter, 1982. DUSCOOP — a simulation program for systems analysis classes. **J. Educ. for Librarianship** 23(2):96-109.

Perry, J.A., R.C. Ward, and J.C. Loftis. 1984. Survey of State Water Quality Monitoring Programs. **Environ. Manage.** 8(1): In Press.

Pielou, E.C. 1969. **An Introduction to Mathematical Ecology.** John Wiley and Sons, NY. 286 p.

Ponce, S.L. 1980. **Water Quality Monitoring Programs.** USDA — Forest Service, WSDG Technical Paper WSDG-TP-00002; Fort Collins, CO. 70 p.

Ryan, T.A., B.L. Joiner, and B.F. Ryan. 1980. **MINITAB Reference Manual, 1980.** Pennsylvania State University, State College, PA. 134 pp.

Schaeffer, D.J., H.W. Kerster, J.A. Perry, S.L. Sokolik and D.K. Cox. 1984. The Environmental Audit I: Concepts. Submitted to **Jour. Water Pollut. Contr. Fed.**

Sokal, R.R. and F.J. Rohlf. 1981. **Biometry.** Second Edition. W.H. Freeman and Co., San Francisco. 859 p.

NACTA

INTERNATIONAL AGRICULTURE

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Philosophy of International Agricultural Development

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"Helping people help themselves" should be the basic underlying philosophical foundation for designing international projects and programs in developing nations. People in developing nations the world over tend to have, in varying degrees, an interwoven ethnic and national pride that is characterized by cultural dignity and personal integrity. Hence, regardless of what stage of development a nation has reached, its people have their pride, dignity, and integrity. Constantly providing the populace in a developing nation with charitable bounties from more developed nations can ultimately result in destroying these qualities. However, donor nations that design projects and programs aimed at helping people help themselves can reinforce and instill pride, dignity, and integrity.

To achieve this end, three essential functions must be addressed. First is identification of talents and skills that exist within a society. These talents and skills are already in place and are being passed on from one generation to another because they have helped the society survive for hundreds of years. These time-seasoned, inherent capabilities are an integral part of a culture and can often be readily incorporated into a well planned development project. Innovative use of these abilities can enhance the acceptance and effectiveness of introducting modern agricultural concepts. By identifying and fusing such talents and skills into a plan of work, modern concepts can become more palatable to the populace.

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