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## INTRODUCTION

Today more than ever, students and instructors want relevancy in the classroom situation. In many areas of management education relevancy can be obtained through the utilization of actual case histories depicting real life situations in business and industry. However, because of the confidentiality of individual personnel files, relevancy is often difficult to obtain in certain areas of personnel management. Few firms will permit students access to the real and confidential information available in personnel files. But analysis of this type of data is an important part of the educational process for students of personnel management. The problem is how to obtain realistic, personal information on employees without sacrificing the confidentiality of the personnel file.

We have found that Monte Carlo simulated data can be fitted rather accurately to the “real” distributions of characteristics of a firm’s employees. The aggregate of “real” information serves as the basic model and specific individual employee data is generated through the use of Monte Carlo simulation [4, pp. 1-4, esp. 4]. The specific generated data appear real but are, of course, fictional, thus protecting the confidentiality of the actual personnel records on which they are based.

This article describes an experiment in the use of Monte Carlo simulation to fabricate realistic personnel data. The experiment provided students with the opportunity to work with realistic information in the analysis of personnel records. Specifically the Monte Carlo simulation of individual personnel data provided students majoring in personnel management with the opportunity to utilize statistical techniques and computer resources in the analysis of realistic personnel file information.

### The Organization

The firm which provided the basis for the simulation was a small industrial goods manufacturing organization of approximately one-thousand employees. The firm was located in a metropolitan area of about 1 1/2 million population. The firm had been in operation for a number of years and had enjoyed a growth due to southeast Asia military demands. Most recently, however, demand had stabilized and had begun to decline.

The Monte Carlo simulation was used to generate a random sampling of employee records for use in evaluation of the personnel program. (The simulated employee records were only a portion of the entire material available to the student for his analysis of the overall personnel program.)

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### The Simulated Data

Eleven major variables provided the basis for the simulation. Aggregate information was obtained on age, sex, race, car ownership, marital status, home ownership, employment test score, education level, performance rating, disciplinary actions, and organizational assignment. The Monte Carlo simulation generated specific employee data based upon the above aggregate information.

Age, sex, and race were determined independently according to cumulative frequency distributions which characterized the employees of the simulated firm. Car ownership was likewise determined independent of other variables in the simulation. Marital status data from the firm were modified to fit the distributions of marital status as reported in the Statistical Abstract of the United States [5]. Thus, marital status was a function of both sex and age. Home ownership was made a function of marital status in the simulated data.

Employment test scores and education levels were generated through the use of an independent stochastic variate which was not made available to students (a surrogate for general intelligence). The employment test score was modified by sex and race; the test discriminated against females and members of specific minority groups. Education level was also modified by sex and race.

Performance ratings and disciplinary actions were assigned independent of other variables with one exception. In one of the organization's four departments a lower performance rating and a higher possibility of disciplinary action exists for minority group members. Both performance ratings and disciplinary actions fit the actual distribution as they occurred in the aggregate.

Specific variable functional relationships are indicated in Table 1.

TABLE 1  
Functional Relationships

Age = Independent  
Sex = Independent  
Race = Independent  
Car Ownership = Independent  
Marital Status =  $f(\text{Age, Sex})$   
Home Ownership =  $f(\text{Marital Status})$   
Employment Test Score =  $f(\text{"Intelligence Surrogate," Sex, Race})$   
Education Level =  $f(\text{"Intelligence Surrogate," Sex, Race})$   
Departmental Assignment =  $f(\text{Education Level})$   
Performance Rating =  $f(\text{Department, Race})$   
Disciplinary Action =  $f(\text{Department, Race})$   
\*"Intelligence Surrogate" = Independent

\*Not available to students; used to determine Employment Test Score, and Education Level.

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A number of qualifications should be pointed out. It should be noted that this simulation is not a dynamic, but a static simulation of data.<sup>1</sup> It should be further clarified that the simulation is not an “operational gaming” type of simulation. Operational gaming “refers to those simulations characterized by some form of conflict of interest among players ... within the framework of the simulated environment” [4, p. 3; see also 2]. The simulation here is used only to fabric ate data for analysis by students.<sup>2</sup>

### **STUDENT USE OF DATA**

The Monte Carlo simulated data were only a portion of a much larger set of data available to the students for analysis of the firm. The Monte Carlo simulated data represented a random sampling of one hundred employee personnel files. The data was presented in a precoded fashion, with coding interpretation, to acquaint the student with coding methods for personnel data and to facilitate punching of data cards for computer analysis. A sample of several employee records appears in Table 2.

**TABLE 2**  
Sample of Employee Records

SUB	AGE	SEX	RACE	CAR	WED	HOME	TEST	EDUC	DEPT	PERF	DISC
1	7	1	1	1	2	2	101	1	3	1	1
2	4	1	2	2	2	2	77	2	3	2	3
3	3	1	1	1	1	1	95	1	3	4	1

\*E.g., Subject One -- Between 45 and 49 years of age, Male, White, Owns car, Single, Rents, Test score 101, Some high school education, Works in Manufacturing department, Performance rating is “Very Low,” No disciplinary actions on record

Students had access to a number of standard packaged computer statistical routines for analysis of the information. Simple frequency distributions, means, standard deviations, tests of significance, contingency table analyses, etc. could be used by the student in his evaluation of the organization and its personnel program.

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<sup>1</sup> On static versus dynamic models, of. 4, pp. 17-18.

<sup>2</sup> Some instructional activities which are labeled “simulation” in the personnel management area perhaps should more accurately be called “role playing” [ef. 6].

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### **PEDAGOGICAL BENEFITS**

Use of Monte Carlo simulation to supplement case-type course projects offers a number of pedagogical benefits for both the instructor and the students. Some of the primary benefits are: analytical experience, confidentiality, realism, and flexibility.

#### Analytical Experience

Students do not merely generalize in their analysis of an organization's personnel management program but are given opportunities for realistic experience in analyzing specific employee records. Use of statistical tools and the computer is encouraged and in fact facilitated by the way the data are presented. The student is further encouraged to search for meaningful relationships and differences which may be symptomatic of problems or opportunities within the firm.

#### Confidentiality

Privileged individual employee record information is not used. However, the simulated fictional data are very real to the student. Further, instead of dealing with simple aggregate information as presented in many case-type problems, the simulated information permits the student to study individual employee records and consider an employee's individual characteristics. The real data that served as the basis for the simulated data are thus kept confidential and no privileged information is divulged.

#### Realism

Isolated textbook problems often do not develop the feel of working with a "real" management problem. The simulated data provides the student an opportunity to work with "realistic" data. The reality of the data is not lessened by the fact that only the aggregate data are real and the specific employee records are simulated.

#### Flexibility

Monte Carlo simulation allows the instructor a certain amount of flexibility in recreating and modifying the data base for a given management analysis problem. It is not difficult to think of further modifications of the data which might be introduced from one semester to another or from one class to another. Examples might include improvement of the employment test which currently has a built-in bias against females and minority group members, development of a relationship between home ownership and disciplinary action, etc.

### **CONCLUSION**

The use of Monte Carlo simulation to generate realistic data for study by students of personnel management has proven quite beneficial. The simulated data will continue to be modified and, hopefully, improved. A number of changes and improvements are presently contemplated.

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First, several more variables may be added to the list already available to the student. It is obvious that not all the variables presently used are of critical importance in analyzing the performance of the firm. However, variables such as marital status, home ownership and car ownership could also be indicative of a dimension of personality that might be described as "responsibility." The generation of data for employees who have left the firm thus might prove useful. Analysis of turnover in departments -- specifically of records of employees who have left the firm -- could indicate that such a measure of multidimensional responsibility might be useful in assessing areas of the firm which need corrective attention.

A second planned change in the simulation involves the continued modification of the data for use with different classes. Parameters and functional relationships could be changed to yield different data sets (some examples were mentioned in the discussion of "Flexibility" above).

Finally, the simulated data records might be subjected to validation beyond the face validity examinations given to the simulated subjects' records by the authors. The Turing test seems particularly appropriate as a validation technique here. In a Turing test, a knowledgeable person is asked to attempt to distinguish between which data are simulated and which data are real. If the expert is unable to distinguish between the simulated and actual data sets, it is assumed that the simulated data do indeed have validity [1, p. 143; see also 3, p. B-103].

In conclusion, it is evident that Monte Carlo simulation can be used to generate specific data based on actual characteristics in a real firm. Students using such data gain experience in analysis of realistic data through the use of statistical tools and computer resources. The use of Monte Carlo simulation is thus obviously not restricted to highly complex operational gaming applications. A simple static Monte Carlo simulation can be a very useful technique in the development of realistic employee record data for analysis by students of personnel management.

### REFERENCES

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