DU PONT SAS APPLICATIONS

Debra Milstein, E. I. du Pont de Nemours & Co., Inc.

Abstract

The Business Consulting Group in Du Pont's Information Systems Department offers consultation in operations research, quantitative problem-solving and small systems development to all operating and staff departments within the company. Typically, analytical models and computer programs are developed to facilitate decision-making. In many of these projects, the Statistical Analysis System (SAS) was chosen as an appropriate high-level programming language for implementing or contributing to a solution. Three such studies conducted during the 1980-82 period were:

- Simulation of Sales and Earnings - A SAS program was written to simulate the occurrence of possible events in the near future which would have an impact on forecasted sales and earnings of a product line. These are now being used by management to estimate future business trends.

- Product Profitability Study - A SAS program was developed to help select a product mix which will maximize profits while satisfying limited capacity constraints. The program will be used on an ongoing basis by management to determine profitable production strategies.

- Rail Fleet Simulation Data Preparation System - SAS programs were written to summarize and characterize data before being input to a fleet simulation model. The simulation model is then used to evaluate rail car fleet sizes for a particular Du Pont product line. The Data Preparation System will enable other analysts to operate the simulation with minimal user intervention.

These projects demonstrate the effective use of SAS in helping to provide quantitative information to Du Pont management. The use of SAS in these projects will ultimately assist management in making more informed business decisions and developing effective and competitive business strategies.

Introduction

The Business Consulting Group in the Information Systems Department of Du Pont offers a wide range of consulting services in the areas of operations research and small systems development to various Du Pont departments. The Statistical Analysis System (SAS) is a tool which is frequently used by the group.

This paper will discuss three projects completed at Du Pont by the Business Consulting Group for different business units within the company. The paper will demonstrate:

- The power and flexibility of SAS in different applications

- The value of information provided by SAS systems which were developed

- The ease with which Du Pont users can implement their systems.

The three projects which will be described are:

- Simulation of Sales and Earnings
- Product Profitability Study
- Rail Fleet Simulation Data Preparation System.

SIMULATION OF SALES AND EARNINGS

Background

A large operating department within Du Pont needed to develop a generalized simulation model to enable them to estimate future business trends for their products. This model could then be applied to any of their products to provide insights into business opportunities for one through five years in the future. The model would be used to assist management decisions in:

- Capacity and facilities planning
- Marketing strategies
- Investment strategies

Model Development

As a first step, a project team was created which consisted of a Business Consulting analyst, a statistician and an analyst in the operating department. The Business Consulting analyst and statistician worked with the client analyst to specify the system requirements. The developed system was to include:

- A model which could predict future sales and earnings for products based on future events which had some uncertainty associated with them. These events had a probability of occurrence as well as an estimated impact on sales and earnings. The model would have to simulate the
occurrence of these events based on the probabilities assigned to them.

- A data file which consisted of all the events to be incorporated in the model for a simulation run. This data file should be easily accessible for modification by the user.

- Both graphical and tabular output.

- Documentation of code as well as detailed user documentation. This documentation would increase the user's ability to operate, support, and assume responsibility for the completed system.

The system as specified was developed in less than two months. The development process consisted of:

- Coding the system to the user's specifications. SAS procedures and data steps were used for this.

- Validating results by using data from a prior year.

- Documenting the system, and assisting the client analyst in his initial use of the system.

Some of the SAS features which were especially helpful in the development process were:

- Random number generator for simulating uncertain events. For example, sampling from the uniform probability distribution was used in many instances.

- Arrays for storing events,

- "Proc Plot" for graphing data.

Benefits of System

The system is now being used by the client department to help predict future sales and earnings for a number of their products. When management is presented with results of the simulation runs, they can use the data to help decide whether to:

- Increase or decrease production of the product over the next few years,

- Increase or decrease their investment in the product and facilities supporting its production during the next five years

- Increase or decrease marketing resources allocated to the product in the near future.

Some of the benefits of using SAS were:

- Reduced development time - Since SAS includes high-level procedures for generating random numbers, and plotting graphs.

- Ease of use for the client - The operating department analyst was able to learn to run the system very quickly. At this date, he has assumed complete responsibility for the model.

- Decreased cost - Over $50,000 was saved by using SAS to develop the system in-house rather than using an outside consulting firm.

PRODUCT PROFITABILITY STUDY

Background

A large business unit in the Du Pont company produces a wide variety of products to be marketed worldwide. The manufacturing process for these products consists of a series of steps which are machine-dependent. Due to the multitude of products and the limited machine capacity available for one of these steps, the business unit requested a system which would help them to choose the most profitable products to be produced.

The requested system was to have the following characteristics:

- Should rank products within different classifications in order of their profitability.

- Should be easy to use so the client could assume full responsibility for the developed system.

- Should have the possibility of interfacing with a graphics package.

- Should require less than four months to develop due to the urgency of obtaining the results.

- Should have the potential to access statistical software at a later date.

It was decided that SAS would be the most likely language to satisfy these requirements.

Model Development

Model development was initiated in April 1980. A Business Consulting analyst was assigned to the project on a part-time basis. The Business Consulting analyst worked closely with the client who provided data and model specifications, as well as verified results of the model. Model development and testing were completed within the four month deadline.

Some of the features of the completed system are:
The complete SAS Product Profitability System consists of eight programs which rank products in different categories such as:
- Plant
- Business classification
- Market
- Sales class

The eight programs reside on TSO and may be submitted through batch processing on an IBM 3270 series terminal. The reports are generated by an IBM 3600 high speed laser printer.

The SAS programs compute a profitability index based on several variables:
- Raw material cost
- Direct labor cost
- Freight and duty
- Selling price

The analyst can perform a sensitivity analysis by varying components of raw material cost or selling price to see how this influences earnings.

The reports show several column entries including:
- Product
- Market
- Sales class
- Business classification
- Description
- Forecast sales
- Machine hours for critical manufacturing step
- Earnings per machine hour

Totals and averages are printed for many of the column entries.

The system is capable of being interfaced with a SAS/Graph system to produce color graphs of the data.

Results of the Project

The completed SAS Product Profitability System is now being used on a regular basis by the business analysts in the client organization. Some of the benefits accrued from its use are:
- The product profitability index computed by the SAS program allows personnel to select the most profitable product mix in plants which have limited machine capacity.
- Computerization of this process greatly reduces the time spent by the client to manually compute product profitabilities and rank the products.
- Color graphs produced from the data are valuable in management presentations.
- The system is easily operated by an analyst with no previous SAS experience. To assist him with the process of learning to operate the system, both on-line demonstrations and user documentation were presented.
- The programs can accept data on a variable number of products. Changes in the product mix require modifications of the data files which hold the product data; however, modification of the system code is not required.

FLEET SIMULATION DATA PREPARATION SYSTEM

Background

The systems group in one of the Du Pont staff departments is responsible for all large transportation and distribution systems within the company. Another function of the group is to develop analytical models aimed at improving distribution strategies for Du Pont products. To this end, a rail car fleet simulation model was developed using GASP, a Fortran-based simulation language. The fleet simulator models the activities associated with the movements of rail cars for a user-selected product line to allow the analyst to make judgements on the proper size of the rail fleet.

The fleet simulator is a valuable tool which the group wanted to offer to analysts in the company's various operating departments. However, they were limited in providing their services to as many clients as desired for the following reasons:
- Data preparation for the simulator was a time-consuming job which required data collection and compilation from two large existing systems.
- Only one engineer in the systems group was familiar enough with the process necessary to prepare the data for input to the system. The steps necessary to prepare data were too complex for analysts from other departments to conve-
niently assume responsibility for the data preparation function.

For these reasons, the staff department requested the part-time services of a Business Consulting analyst to develop a user-friendly system which would prepare data for input to the fleet simulator, and would facilitate use of the fleet simulator by other analysts.

System Development

The entire project was planned, defined and implemented by the Business Consulting analyst and the systems group engineer. The requirements which were agreed upon were as follows:

- The system should access history files in two rail information systems to obtain data on car usage and shipments of a user-specified product line during the past year.
- The appropriate data should be extracted from these files, analyzed, summarized and reformatted for input to the fleet simulator. The information which would be required for input to the simulator was as follows:
  - Source - Data on rail cars associated with specific ship points. Rail car costs were also required.
  - Destination - Data on shipments to particular customers.
  - Transit times - Data on average, minimum and maximum travel times to and from a destination.
- The system should require minimal user intervention. The analyst should be able to easily modify the system to prepare data for a different product line.
- The system to be developed must be able to interface with the Univac 1100 since the fleet simulator ran on the Univac.

SAS was selected to do the system development for the following reasons:

- SAS data steps could be used to extract the appropriate information and analyze the data effectively.
- A SAS system would be easy for users to operate. The user could use IBM 3270 series terminals which are readily available in most of the operating departments. Many company analysts are already familiar with the IBM Time Sharing Option (TSO) and the Standard Programming Facility (SPF) which would enable the user to easily access and maintain SAS programs and files.
- Files could easily be transferred from the IBM environment to the Univac.
- SAS runs would be relatively inexpensive.
- SAS would conveniently perform sorts on data and merging of any files which needed to be coordinated.
- SAS could be used to easily format data according to the requirements of the fleet simulator. A SAS data step could also be used to write the formatted data to a file which would be accessible by the fleet simulator.

The SAS Data Preparation system would improve on the original method of collecting and preparing data for input to the simulator in the following ways:

- The SAS system would automate the data input function. There would be less likelihood of error due to the use of standard computerized techniques for extraction and summarization of the data.
- The SAS system would enable more analysts to work with the fleet simulator in less amount of time.

Development of the system using SAS progressed and was completed during the spring and summer of 1982. During this time, the Business Consulting analyst worked with the systems group engineer to code and test three separate modules used to prepare the source, destination and transit data which was required by the fleet simulator. Once the individual modules had been successfully compared against a prior run of the fleet simulator using manually prepared data, the modules were combined. Combining the modules allowed the analyst to submit one SAS job to prepare all the data required as opposed to submitting three separate jobs and then concatenating separate output files into one file. After full development of the system, on-line demonstrations and detailed user documentation were developed for presentation to analysts in other departments. The SAS Data Preparation System is now being used by several analysts in conjunction with the fleet simulator to evaluate the distribution strategies of their specific product lines.

Benefits of the System

Some of the benefits achieved from the SAS Data Preparation System have been:

- Dramatic productivity improvement. It now takes an analyst less than one day to modify the SAS program, submit the program batch via TSO, transfer the IBM files to Univac and run the fleet simulator. Prior to mechanization of the
system, the process would have taken at least 3 weeks of an analyst's time.

- More applications possible - Due to the reduced time required for data preparation, an analyst can perform more simulations. In addition, more analysts are able to utilize the simulator.

- Minimal costs to Du Pont - Development of the system cost less than $20,000 in personnel and computer costs. In addition, operation of the system is very inexpensive. It costs approximately $20.00 to prepare the data for a single base case simulation run. Further simulation trials for the same product line to evaluate different distribution scenarios may only require on-line modification of the data files which have already been prepared by the SAS system. Otherwise, if additional SAS runs are necessary, they are not costly.

- Extremely valuable information provided to the operating departments in Du Pont - Since the analysts in many departments now have convenient access to the fleet simulator by using the Data Preparation System they are provided with important data to:
  - Evaluate the size and composition of their current fleet in terms of cost and service, and compare these to other alternatives which they can simulate.
  - Choose the best alternative for implementation.

  This type of information will help to make the operation of Du Pont’s rail fleet more time and cost effective. This could lead to such benefits as:

  - Increased customer satisfaction
  - Reduced fleet size
  - Reduced inventory levels.

  Since the cost of one rail car is at least $80,000, even the elimination of one car in the Du Pont fleet could generate substantial cost avoidance benefits to the company.

Conclusion

As detailed in this paper, SAS was successfully used by the Business Consulting Group in three projects conducted for different departments within the Du Pont Company. The systems developed with SAS were specifically designed to address a wide variety of business needs and have effectively satisfied these needs. In every case, SAS is helping Du Pont management make more informed business decisions by enabling analysts to process information quickly. Due to increasing recognition of SAS as an easy-to-use and powerful tool, in-house SAS courses are now being offered by the Du Pont Company.

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If there are any questions regarding this paper, please contact:

D. Milstein
MG4-1
Wilmington, DE 19898