THE USE OF SIMULATION IN ACCOUNTING: A MANAGERIAL EMPHASIS

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This paper reviews some of the uses of simulation in accounting. The primary
thrust of the paper is toward the area of managerial accounting. However, the
paper also examines the use of simulation in auditing and in the public sector.

1. INTRODUCTION

1.1 Purpose

The purpose of this paper is to:

o review some of the major applications of
   simulation in accounting

o provide a focus and an organization of the
   use of simulation in accounting.

An examination of the accounting literature will
find a diverse set of applications of simulation.
The reader would find one application there and
maybe two in another location, etc. Further,
some classic sources in accounting do not reflect
simulation in their indices, though terms of
other analytic tools like linear programming and
regression are common. Kottas and Law (1978)
have noted that the accounting literature has a
"negative" orientation toward simulation. This
is certainly not a criticism, but merely a re-
flection of "what is" the state of the use of
simulation in accounting.

This paper has as its motivation the desire to
summarize in a single location, a set of refer-
ences in accounting and simulation and a review
of the corresponding simulation models in use in
the accounting literature to aid in integrating,
to a greater extent, simulation into accounting.

1.2 The Accounting Framework

In accounting, the major uses of simulation occur
in management accounting, auditing, and public
sector accounting. This paper follows those
lines of analysis but the primary emphasis is on
management accounting. In addition, the paper
recognizes that there are two major users of
accounting models

o practitioners in accounting

o researchers in accounting.

The first group deals with accounting models in
practice, while the second is concerned with re-
search in and with accounting models.

1.3 Outline of Paper

The paper is outlined as follows. In Section 2,
the findings of a recent study on the use of
quantitative methods by controllers is reviewed
to aid in the analysis of the use of simulation
in accounting in practice. Section 3 surveys the
management accounting literature to determine
what kinds of uses of simulation have been made
in management accounting. Section 4 surveys the
uses of simulation in research in management
accounting. Section 5 surveys some uses of sim-
ulation in auditing practice and Section 6 re-
views the use of simulation in research in aud-
iting. Section 7 reviews some uses of simulation
in public sector accounting.

1.4 Limitations of Paper

This paper does not claim to be an all encompass-
ing review of simulation in accounting. Neither
time or space allow for a complete analysis.
Instead this paper is a beginning of an analysis
of the use of simulation in accounting.

This paper is seen as an evolving document. The
author is interested in expanding the paper. As
a result, the author would be interested in other
applications, major references, etc. that the
reader may be aware of. The author also welcomes
comments about the contents, readability, etc.

2. USE OF SIMULATION IN MANAGERIAL ACCOUNTING
   PRACTICE

A recent paper by Kiani-Aslani (1977-78) surveyed
the controllers of the Fortune 500 to determine
the use of quantitative models by the controllers.
Of the 500 surveyed, 208 returned usable responses
and those 208 responses, 176 reported use of

quantitative methods. The 176 used an average of about 2.6 simulation applications per respondent.

Table 1 provides a summary of the types of problems for which simulation is used and the number of respondents who used simulation for the various problems included in the survey findings. This list of problems to which simulation has been applied is substantial. Further, some may not consider many of these applications as accounting problems. This suggests that a number of "non-accounting" problems are in the decision making realm of controllers.

Table 2 summarizes the frequency of use of simulation. It is clear that most uses of simulation are not a routine phenomenon (less than 20% is on a routine basis). More than likely, most controllers use simulation to help them solve non routine problems of the type listed in Table 1.

Table 3 summarizes the satisfaction associated with the use of simulation. About 80% reported fair to very good as a level of satisfaction with simulation. When simulation is being used it is apparently meeting their needs.

Table 4 summarizes the frequency and satisfaction compared to other quantitative techniques used by controllers. Simulation is ranked second only to forecasting in terms of satisfaction and only third to forecasting and inventory models when compared to other non traditional accounting tools. This would exclude the traditional accounting concepts of present value and flexible budgeting.

TABLE 1

NUMBER OF CONTROLLERS REPORTING TYPES OF PROBLEMS IN WHICH SIMULATION IS USED [1][2]

Production Planning and Control	58
Financial Forecasting and Budgeting	46
Facilities Planning	39
Distribution	37
Forecasting Demand, Supply, Price	35
Replacement and Maintenance of Machinery/Equipment	35
Inventory Analysis and Control	30
Production Mix	29
Plant and Warehouse Allocation	27
Capacity	27
Analyzing Capital Investment	23
Project Planning and Control	22
Make or Buy Decisions	17
Planning and Controlling the Budgetary Process	13
Planning and Implementint Revisions of Accounting Systems (e.g. Standard Costs)	12

[1] Source: Kiani-Aslani (1977-78)

[2] Total of Respondents who used quantitative tools was 176.

TABLE 2

FREQUENCY OF USE OF SIMULATION [1][2]

LEVEL OF FREQUENCY	(FREQUENCY) FREQUENCY	(FREQUENCY) PERCENTAGE
Routinely	33	19
Periodically	49	28
Occassionally	53	30
Rarely	23	13
No Use Reported	18	10
	176	100

[1] Source: Kiani-Aslani (1977-78)

[2] Based on 176 responses that reported use of quantitative tools. Derived from 208 usable responses.

TABLE 3

SATISFACTION OF USE OF SIMULATION [1][2]

LEVEL OF SATISFACTION	(SATISFACTION) FREQUENCY	(SATISFACTION) FREQUENCY
Very Good	12	21
Good	36	64
Fair	31	54
Poor	9	16
No Satisfaction Reported	12	21
	100	176

[1] Source: Kiani-Aslani (1977-78)

[2] Based on 176 responses that reported use of quantitative tools. Derived from 208 usable responses.

TABLE 4

FREQUENCY OF USE AND SATISFACTION - RANKING OF ALL QUANTITATIVE TECHNIQUES [1]

FREQUENCY	SATISFACTION
1 Present Value	1 Present Value Concepts
2 Flexible Budgeting	2 Flexible Budgeting
3 Forecasting Techniques	3 Forecasting Techniques
4 Inventory Models	4 Simulation Models
5 Simulation Models	5 Statistical Techniques
6 Sensitivity Analysis	6 Inventory Models
7 Statistical Techniques	7 Linear Programming
8 Linear Programming	8 Network Analysis
9 Network Analysis	9 Sensitivity Analysis

[1] Source: Kiani-Aslani (1977-78)

3. USES OF SIMULATION IN MANAGEMENT ACCOUNTING
    PRACTICE

While the previous section reported the results
of a survey of controllers, this section concen-
trates on the models that appear in the manage-
ment accounting literature. This section is ori-
ented toward the models, as used by the pract-
itioner. The applications discussed in this
section include

   o Planning and Budgeting Models

   o Forecasting Sales

   o Capital 'Investment and Replacement Analysis

   o Product Mix

   o Planning and Controlling Budgeting and
      Other Projects.

For the interested reader there are a number of
insightful reviews of management accounting in
general, for example, Horngren (1982), Kaplan
(1977-78, 1981, 1982) or Dopuch et. al. (1974).
A useful bibliography of applications of simul-
ation that have appeared in Operations Research
and Management Science is Marshall and Richards
(1978). A useful bibliography in management
accounting appears in Klemstine and Maher (1982).

3.1 Planning and Budgeting Models

Probably the largest use of simulation in account-
ing is the area of budgeting and planning models.
Simulation increases the effectiveness of budget-
ing and planning by allowing the user to evaluate
a large number of alternatives by allowing the
introduction of risk, examining more complex
relationships, etc. As noted in Anthony and
Dearden (1980), "Simulation is probably the most
useful of the mathematical techniques advocated
for the budgeting process."

A number of reviews of financial planning and
budgeting models are available. These include
Naylor and Schauland (1975), Gershefski (1969),
Mattessich (1961) and Locasio. Dopuch et. al.
(1974) devotes the most extensive discussion of
simulation that was encountered in cost account-
ing textbooks to the topic of planning and bud-
geting models.

3.2 Forecasting Sales

An important use of simulation is the development
of forecasts (See e.g. Moslove and Simkin (1981)).
Forecasts are developed using causal models. The
model is then analyzed using various assumptions
or with the causal variables treated as random
variables. Demski and Feltham (1972).

3.3 Capital Investment and Replacement Analysis

A problem that has received substantial attention
in the finance and accounting literature is the
use of simulation in the analysis of capital in-
vestments. Hertz (1964) was the first to suggest
simulation in this arena. Kennedy (1968) later
placed the capital investment problem in a dec-
ision support-like environment.

3.4 Product Mix

A important concern to the firm is determining

the desirable sales mix of products. Simulation
is an ideal tool for analysis of assumptions, in-
troduction of risks, and determining key vari-
ables. (See, for example, Louderback and Dominiak
(1975)).

3.5 Planning and Controlling Budgeting and Other
     Projects

Typically, PERT-like tools are used to help plan
and control projects. Often simulation is added
to account for interaction of variables, to intro-
duce uncertainty, etc. In a similar manner sim-
ulation can be used to aid in planning and con-
trolling the budgeting process. (See, for exam-
ple, Morse (1977)).

4. THE USE OF SIMULATION IN MANAGEMENT
    ACCOUNTING RESEARCH

Simulation has been used by accounting research-
ers to analyze a broad range of problems. The
use of simulation in accounting research has taken
the following forms,

   (1) Evaluating the impact by the accounting
        system on behavior

   (2) Evaluating varying techniques on a common
        basis

   (3) Developing approximations to interacting
        random variables.

The applications that have utilized simulation
include,

   o Aggregation of Information

   o Product Costing

   o Cost Allocation

   o Cost Volume Profit

   o Capital Investment

   o Performance Evaluation and Variance Analysis.

The structuring of these applications is borrowed,
in part, from Kaplan (1977) and Kemstine and
Maher (1982).

4.1 Aggregation of Information

Accounting systems by their very nature are
systems that aggregate information. Feltham
(1977) analyzes the consequences of aggregation
of information by utilizing simulation to study
payoff consequences.

4.2 Product Costing

One of the major controversies in accounting has
been the analysis of direct costing versus ab-
sorption costing. The controversy is essentially
a question of how should fixed costs be treated.
Bailey (1973) used simulation to compare the
effects of the costing method on management
decisions.

4.3 Cost Allocation

Cost Allocation is the process of allocating
those costs not directly attributable to a part-
icular product, department, division, etc. There

are numerous techniques of cost allocation. Jensen (1973) has used simulation to analyze some of the methods under simulated conditions to obtain a statistical analysis of the allocation results.

4.4 Cost - Volume - Profit (CVP) Analysis

CVP analysis refers to the traditional breakeven analysis. The basic relationship used is

    Profits = Quantity Sold * (Sales Price -
              Variable Costs) - Fixed Costs.

The accounting literature had a number of papers that develop closed form results in this area. Simulation has also been used. Ferrara et. al. (1972) use simulation to investigate the case where sales price and amount sold are two independent normal random variables. Liao (1975) provided an analysis of sales and profits that would produce a closed form distribution for the random variable profit based on any distributions for the other random variables.

However, as noted in Kottas and Law (1978) these authors have "implied that simulation may be either too inaccurate, too expensive or both". In Kottas and Law (1978), the authors show that simulation is a useful, inexpensive and accurate approach to solving CVP problems.

4.5 Capital Investment

Sundem (1974) used simulation to compare capital budgeting decision models. In that paper be found that simple models can be used to improve the decision making capabilities of more sophisticated models.

4.6 Performance Evaluation and Variance Analysis

Performance evaluation is by its very nature an evaluation of the impact of accounting systems on human behavior. This has probably been the area experiencing the most extensive use of simulation in accounting research. Demeski (1969, 1970, 1971), Sweringa and Demski (1972) and Lin have studied the impact on a manager of using different evaluation measures. The decision setting in Demski (1970) is a single variable, while Demski (1971) is a multivariate setting. Sweringa and Demski (1972) extended Demski (1971) to include additional incentives. Lin (1978) introduces a multiple objective setting to the previous studies. Finally, Magee (1976) utilizes simulation experimentation to compare different cost variance investigation models to determine how a rational manager should behave.

5. USE OF SIMULATION IN AUDITING PRACTICE

5.1 Simulation Modeling

One of the major uses of simulation is in the auditing high risk areas (Porter and Perry (1981)). In this case an actual model is built of the process of concern. Key audit variables are included in the model to aid the audit. If actual operations deviate significantly from the model findings then this can signal that there is further audit work to determine the differences.

5.2 Parallel Simulation

Another use of simulation in auditing is parallel simulation. As noted in the Systems Auditability and Control Study (1977), "Parallel simulation programs accept and process the same input data as their corresponding application programs; they use the same master files and attempt to produce the same results. This simulation process allows verification of computer applications for correct

o input data validation

o computations and processing logic

o masterfile updating logic

o controls and balancing procedures.

This method is described as parallel because all transactions for a particular processing cycle are processed by the normal application program as well as by the simulation program. Simulation results are compared with application program results to enable an independent and objective check by the auditor."

6. USE OF SIMULATION IN AUDITING RESEARCH

One of the primary uses of simulation in auditing research is that of comparing alternative methodologies. Characteristic of this research is Kinney (1979) and Kinney and Salamon (1982).

In order to validate a reported account balance the auditor will utilize tests of details and analytic review. The analytic review is oriented towards establishing a test of "reasonableness" of reported balances. One methodology that has been used to help with this problem is regression (Kinney (1979)). In Kinney (1982), two variations of using regression in analytic review were compared using a simulation of 200 audit years. The simulation was used to characterize the advantages and disadvantages of the respective models.

7. USE OF SIMULATION IN PUBLIC SECTOR ACCOUNTING

Decision makers in the public sector face many of the same problems as those in the private sector. Thus, many of the same applications of the private sector accountants can also be used by the public sector accountants. However, the public sector does face some unique accounting problems. A model to address some of these problems was discussed in Johnson et. al. (1977). In particular, the public sector is concerned with analyzing property tax collections and other fiscal policies. These were the focus of the RAFT model (Johnson et. al. 1977).

There has also been work in the area of simulation and public sector budgeting. Crecine (1967) presents a positive theory of the budgeting process in large municipalities. His model was subsequently tested on data from Cleveland, Detroit, and Pittsburgh.

8. CONCLUSION

The purpose of this paper has been to review some major applications of the use of simulation in

accounting and to provide an organization for the uses of simulation in accounting. The emphasis has been on managerial accounting.

As has been discussed, simulation is a useful tool to the practitioner. The uses in managerial accounting range from planning and budgeting to the process of controlling, planning and budgeting. Simulation is also actively used in auditing high risk areas and in the analysis of public sector fiscal policies.

Simulation is also of use to the accounting researcher. Simulation has been used in auditing to compare different audit methodologies. Simulation has also furnished management accounting researchers with insight into the behavior of costs and human behavior.

However, it appears that simulation in accounting has an identity problem. By bringing the uses of simulation and references of the uses of simulation in accounting together in this paper perhaps accountants can focus on other potential uses of simulation to solve existing problems in accounting.

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