ABSTRACT

AN ENVIRONMENTAL MODEL FOR
PERFORMANCE MEASUREMENT IN
MULTI-OUTLET BUSINESSES

by William R. Kinney, Jr.

Standards for evaluating the performance of outlet managers in companies with numerous outlets are difficult to formulate because of the differences in the profit potentials of the various outlets. Differences in measured performance (profit or other appropriate measure) among outlets may be explained by differences in the characteristics of the locations and the facilities of the outlets as well as the differences in the performance of the outlet managers. Since the location and facilities of an outlet are not controllable by the outlet manager, the effects of these "non-managerial" factors should be extracted before evaluating the performance of the manager.

For a small number of outlets, central marketing officials can be familiar with the potentials of the outlets and can subjectively adjust for the potential differences. However, for a large number of outlets, valid subjective adjustments for potential differences are not feasible.

The environmental model is an objective method for measuring and evaluating the performance of outlet managers. In applying the method, a linear statistical model of outlet performance is constructed relating responsibility accounting measures of outlet performance to the levels of the non-managerial factors under which the outlets are operated. The effects of the significant non-managerial factors are removed to provide a measure of performance which is more relevant to the actions of the

outlet manager. The ranking of the estimated managerial contributions forms a valid intraperiod standard.

Through the separation of the effects of the managerial and the location and facility factors the relative importance of the three factors can be determined. If managerial differences are important in determining outlet contribution, much effort and expense shquld be devoted to manager selection and training. If the contribution of the outlets depends primarily on the particular location and facilities of the outlet, then relatively more resources should be devoted to location and facility selection with less emphasis on the selection of managers.

In a broader sense, the environmental model can be used to maximize the profit of the multi-outlet business by examining relationships among the three broad factors explaining differences in performance among outlets. The specific relationships are of interest in planning outlet locations and facilities. While it is not feasible to rely upon only the model in making location and facility decisions, the model can be used to narrow the scope of detailed subjective investigations. The exploratory use of the model for investigating numerous possible locations and various combinations of facilities may point up attractive opportunities which would be overlooked by subjective research.

The environmental model has been formulated and tested in a national firm offering a wide range of goods and services by catalogs and retail stores. The study was limited to one region of the catalog sales division of the company. Data were collected on factors such as: population characteristics (income, ages, socio-economic characteristics), competition, age and condition of outlet facilities, district in which

located, and numbers of catalogs issued. Quadratic effects and first-order interactions were also tested.

In the test company there were non-managerial factors which explained statistically significant variation in the transforms of the net sales and the controllable expenses of the outlets. The location and facility differences of the outlets were of much greater importance in determining outlet performance than were the differences among the outlet managers. Thus the contribution of the outlet was a poor indicator of the performance of the outlet manager. If managers are evaluated on the basis of outlet performance, the potential of the outlet location and facilities is likely to be attributed (wrongly) to the outlet managers and significant errors in managerial performance evaluation will result.

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CHAPTER I

INTRODUCTION

Purpose and Organization of the Study

This dissertation is oriented to the special problems of measuring and evaluating the performance of outlet managers in the multi-outlet business. A theoretical solution to these problems will be presented and then tested in an actual business environment. The solution to be considered is an extension of the responsibility accounting concept to make intraperiod performance standards valid and operational.

Specifically, the purposes of this study are to (1) develop a statistical model which recognizes the effect of environmental and other non-managerial factors, as well as managerial contribution, in measuring the performance of outlets in multi-outlet businesses; (2) implement and test such a model; and (3) evaluate the implications of the model.

This analysis is needed to provide a better understanding of the profitability relationships in multi-outlet businesses. The model will provide a basis of comparison for evaluating managerial performance and guidelines for resource allocation.

Chapter One is a discussion of the concepts of measurement and performance standards in accounting. The inapplicability of traditional manager evaluation systems for the special problems of the multi-outlet organization is established.

In Chapter Two, the environmental model is presented in conceptual form with a general discussion of the uses, assumptions and limitations of linear statistical models. A plan for implementing the model, a discussion of the non-managerial factors and the revisions of accounting reports are also presented.

The construction and testing of the model in a multi-outlet business is the subject of Chapter Three. Two types of tests are involved: (1) tests for the presence of the assumptions basic to the analysis of linear statistical models, and (2) tests of statistical significance of the factors related to the measured performance of the outlets in the test firm. The background of the test firm and the factors and relationships tested will be presented, as well as the results and significance of the tests.

In Chapter Four, the implications of the environmental model for selecting and evaluating locations and facilities, and the implications for capital budgeting decisions will be presented.

The summary, conclusions and limitations of the study will be the subject of Chapter Five. Suggestions for additional research will be included.

Measurement and Performance Standards

Accounting information facilitates large scale operations by making possible a greater span of control of an individual over other individuals or groups. Through the use of accounting reports, a division of duties and specialization of activities can occur without loss of essential control and direction. When the decision maker has available the information which is necessary for decision making, he can make the

essential decisions covering a broader range of activities than he could if he gathered the information personally. The decision maker employs an information gathering specialist (in the present case, the accountant) and devotes his own attention to decision making.

Each activity of each member in an organization cannot be reported easily and is, individually, of no particular interest to the decision maker. The accountant must summarize the results of members' activities for reporting to the decision maker. Only the important results will be communicated if there is to be a saving of decision makers' time. In accounting, activities are first reduced to quantitative terms and then summarized. The accounting problem thus becomes one of deciding how to express or represent activities quantitatively.

Since an abstraction is being substituted for personal observation, there should be correspondence between the actual event or activity being measured and the impression formed in the mind of the decision maker as he reads the report. The report must contain not only the measurements which the decision maker would make if he could make the measurements personally, but it must also connote those subjective observations and evaluations which the decision maker would make if he could personally observe the activity.

This ideal is not often attainable--objective measurement and measurement rules may not allow expression of subjective observations. However, the net results of performance are eventually reflected in the accountant's measures. The accounting system may not reflect small departures from the performance which the decision maker would observe if he supervised personally, but hopefully, this small information loss will be more than offset by the economies of scale of the expanded

operations made possible by the division of duties and specialization. Wide departures from the performance expected by the decision maker will be detectable by reviewing the accountant's reports and the decision maker can act to correct these exceptional cases with a net gain in efficiency.

After receiving a measure of performance, the decision maker evaluates the performance and then exercises control over the activities through rewards or revisions of plans. The measure of performance by itself is of little value--there must be some basis for comparing the measured performance with a norm or standard of performance. When the decision maker personally supervises all work, the performance standards may be entirely subjective and could even be subconscious. In the larger organization, however, the performance standards must be formalized.

There are three basic comparison standards in accounting. These are: (1) predetermined standards--based on ideal or desired performance for the entity, individual or segment, (2) interperiod standards--based on past performance of the entity, individual or segment, and (3) intra-period standards--based on current performance of other entities, individuals or segments.

The choice of standard depends on the activities being measured and the reason for the evaluation of the performance of the particular segment. All three types of standards have limitations; Figure 1.1 is a diagram of the three standards. It shows the chief difficulty which must be overcome or recognized in the use of each of the standards.

The predetermined standards are of two basic types: the "absolute" standard based on physical measurements of activities or quantities and

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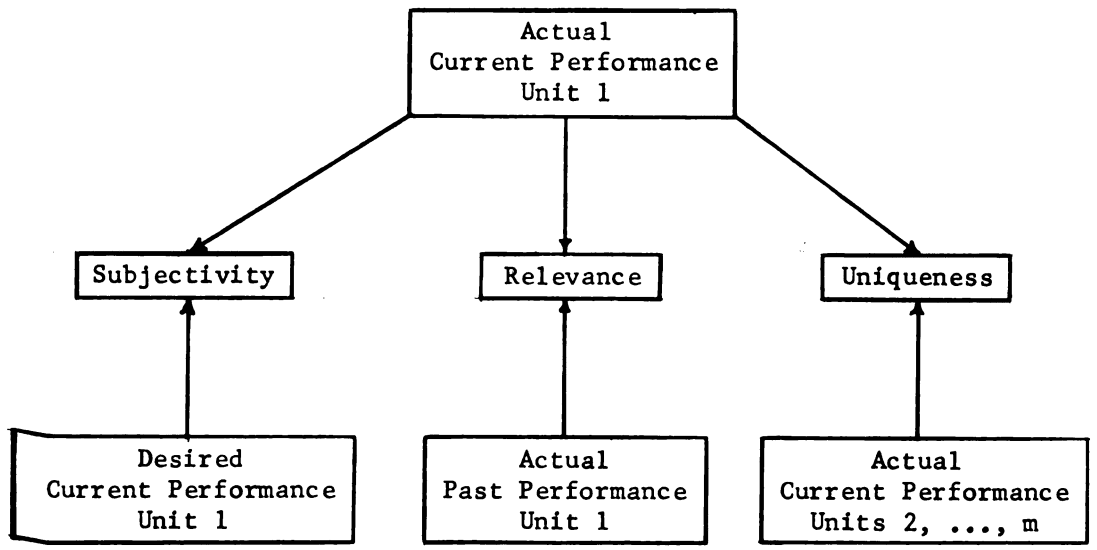
the "subjective" standard (budget) based on opinions, predictions or desires of the standard setter.

The limitations of the absolute standards are (1) the relatively small area of possible application and (2) the difficulty in establishing the standards even where they are applicable. Setting of valid standards for any but the most menial tasks becomes difficult, particularly in non-manufacturing work. Inputs in administrative, marketing and distributive activities can be determined and measured but outputs are often not subject to objective measurement. When the actual output is difficult to measure (or even determine), meaningful output standards are doubly difficult to formulate.

Figure 1.1. Performance standards



Subjective standards have wider applicability than do absolute standards but require the use of expert opinion. The expert's biases and errors of estimates and predictions are difficult to determine.

The obvious limitation of the interperiod standard is that of relevance. This limitation is so severe that this type of standard is of little value unless activities of segments cannot be reduced to a common denominator (such as dollars) or the activities are so diverse that the only basis for comparison is simply an improvement over prior periods. Other things being equal, improvement of the performance of the current period over that of previous periods indicates progress; but even the improved performance may be unsatisfactory when compared with other segments or on an absolute performance scale.

The intraperiod standard probably has the most potential for a great many applications. The intraperiod standard is not a measure of absolute efficiency but a comparison of one individual's actual performance with the actual performance of others faced with similar problems. An individual may be operating at only one-half of peak efficiency (measured on an absolute scale, if applicable) but if he is relatively the most efficient, he should receive whatever rewards go to the best performer.

One intraperiod standard--the rate of return on investment--has wide application and is considered by many to be the best single overall measure of performance of economic entities. The rate of return is a measure of success in earning a return on assets and success with respect to the nature and amount of capital employed.

The overall effectiveness of a management can be judged by a comparison of the rates of return among various companies. The basis for

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determining effectiveness is not actual performance compared with a measure of absolute performance but a comparison with how well others have been able to perform. An absolute standard isn't necessary for the investor--if he chooses the relatively most effective management (other things being equal) he will maximize his return. The application of the intraperiod standard will thus direct the investor to an efficient allocation of resources among companies.

Efficient resource allocation is a primary problem within the firm as well as among firms. The internal allocation of resources has become more important with the consolidation and integration of businesses because many segments of modern businesses are now larger than whole companies of a few decades ago. The problem for corporate management is how to measure performance of segments of the business to determine which segments are performing in a satisfactory manner and which are not.

Unfortunately, many of the market mechanisms which insure efficient allocation of resources among firms do not exist within the firm. In many internal situations, valid intraperiod standards are not possible because no two departments do the same job or the output of the departments are too difficult to measure. In other situations, the job assignments may be similar but differences in the environments in which the assignment is performed make direct comparisons of results hazardous.

The factors which must be considered in the determination of an appropriate standard by which to judge the performance of outlet managers in a multi-outlet business are now considered.

The Problem

In a production situation, an analysis of variations from budget or

physical or time standards may constitute an adequate performance measurement and evaluation system. Tasks are often repetitive and subject to rather precise measurement. Attempts to determine responsibility and associate costs with responsibility for control of costs have been generally successful. Responsibility accounting for sub-unit performance has been developed, both theoretically and practically, in an attempt to retain some of the advantages of competition in the large organization. Responsibility accounting for performance is an improvement over full allocation accounting because the performance measure of an individual does not include arbitrary allocations of costs which are not directly controllable by the individual.

The subjective nature of revenue standards and the lack of any meaningful absolute measure of sales potentials has prevented the development of a rigorous theory of predetermined standards for the marketing aspects of business. However, subjective performance goals or budgets have been employed in many businesses with much success. Managers in different divisions operate under different market conditions and face different potentials and limitations. In setting divisions' goals these differences are taken into consideration by top management.

Budgets for a division are admittedly subjective--there is generally no absolute measure of what sales or profit for a particular division should or could be for a particular period. But management can be intimately familiar with the potentials and limitations of the limited number of divisions and make valid allowances for these differences. Moreover, they may develop budgeting skills which make reliable estimates possible. In summary, each division and each time period is different, but due to

the familiarity of the top marketing management, adjustments are made in setting the standards of performance.

The same performance evaluation concepts which have been used successfully at the division level, have been extended to sub-divisions responsible for a particular product line or territory within divisions, and even to smaller operating units--such as local outlets--within subdivisions.

The focus on individual outlet managers is entirely proper--"Individuals operate organizations. Any management accounting system, to be effective, must be designed around the responsibility centers of individual managers."[1] But analysis based upon contribution to unallocable costs and profits is not an adequate measure for evaluating the performance of outlet managers in a large, multi-outlet organization because of a violation of the "controllability" criterion for both costs and revenue.

Managers of outlets generally have no choice as to the outlet to which they are assigned, the size, location or facilities of the outlet, and have little control over the incomes, buying habits or other characteristics of the population. Yet, the performance measure (the net contribution of the outlet) includes the effect of these factors which are not controllable by the outlet manager. Outlet manager performance measures should not reflect how well a particular combination of facilities, location and manager have done, but how well the manager has done with the resources at his disposal. The manager with more desirable resources at his disposal should naturally have larger reported outlet contributions.

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[1]Charles T. Horngren, Accounting for Management Control: An Introduction, Englewood Cliffs, N. J., Prentice-Hall, Inc., 1965, p. 267.

As currently practiced, responsibility accounting for outlet managers is only a slightly improved measure of outlet performance. The use of outlet contributions as intraperiod standards for evaluating outlet managers' performance is still far from valid because the differences in profit potentials among the outlets are not recognized in the standard.

It is relatively easy to compute the contribution of any operating unit to unallocable costs and profits but it is not easy to determine the extent to which each unit manager has effectively utilized the resources at his disposal. The inherent environmental factors which are not controllable by the outlet manager but which influence the performance of an outlet must be considered in the evaluation of the performance of the outlet manager. Only when the effects of the non-managerially controllable factors have been removed is it possible to determine the results peculiarly attributable to the manager's action.

Performance measures for retail outlets include: gross margin, contribution to unallocable costs and profits, outlet "profit," rate of return on investment, share of market, and some other less comprehensive measures.

Present methods of performance evaluation for retail outlets encompass the contribution statement and comparisons of actual results with those of last year or with a subjective estimate (budget) of what should have taken place this year in a particular outlet. Estimates of what should occur under current conditions are generally considered to be superior to the results of past, non-comparable periods as a yardstick for performance. Each outlet and each time period is different, and adjustments for those important differences must be made in operating plans if valid standards of performance are to be obtained.

Although the need for such adjustments is clear, the implementation of a valid "adjustment system" is difficult.

Carefully thought out, detailed budgets for individual outlets for each week or month are often not economically feasible. One individual cannot be familiar with the potentials of several hundred outlets of a company. Also, standards of performance set by district supervisors of outlet managers reflect the personal biases of the supervisors and differences in budgeting skills among supervisors. Even if the outlet managers participate in the formulation of their budgets, the most persuasive manager will receive the most favorable budget--and he may or may not be the best performer on the job. Since incentive systems and promotions are often tied to achieving quotas or budgets, this problem becomes quite important.

Beyond these practical difficulties, traditionally conceived budgets estimate the wrong quantity from the point of view of outlet manager evaluation. The budgeted contribution is the desired performance of the combination of location, facilities and the manager. Success in meeting or exceeding such budgets is evidence of <u>marginal</u> efforts of the manager and is not indicative of the overall relative usefulness of the manager to the company. Since this "overall usefulness" type of budget is not in use today, it is questionable whether such budgeting is practical. Indeed, a priori, it seems that the setting of such "managerial performance only" budgets would be much more difficult than the outlet performance budget and subject to much greater errors, biases and inconsistencies than the outlet performance budget.

In addition to needing a basis for evaluating outlet managerial personnel, the top management of a multi-outlet business needs

information regarding the effectiveness of outlet locations and facilities apart from managerial contribution. The breakdown of profits among these three types of factors is important because excellence in one factor can disguise a lack of excellence in another. The firm will maximize profits if its outlets are located in the "best" locations with the optimal facility combinations and staffed with the "best" managers available.

To achieve this overall excellence, a given outlet can be expanded, contracted, remodeled, relocated, restaffed or eliminated. Thus, the need for objective data on location and facilities effectiveness is much like the need for managerial performance measurement. Top management also needs information on facilities and locations to aid in planning expansions into new areas and new types of outlets. Past trends and relationships can be extracted much as the investor projects past earnings performance.

This dissertation deals with the development of a statistical model approach to help solve many of the measurement and evaluation problems associated with the modern multi-outlet business by explicitly considering the inherent environmental factors in the traditional accounting measurement and reporting system.

The multi-outlet business is defined as one in which there is a large number of relatively homogeneous outlets in which the outlet managers' functions and responsibilities are virtually the same. The only differences in outlets are the location and facility differences--none of which are controllable by the outlet manager. A "large number" of outlets is a number large enough for the limitations on subjective estimates of profit potentials discussed earlier to apply.

CHAPTER II

THE MODEL

The performance measurement and evaluation system for multi-outlet businesses to be considered in this dissertation is an extension of the responsibility accounting concept to make intraperiod performance standards valid and operational. The extended system will utilize responsibility accounting data in conjunction with statistical techniques for estimating the effects upon outlet performance of the non-managerially controllable environmental factors under which an outlet is operated and the effect of the actions of the outlet manager after considering the effects of the environmental factors.

Statements of outlet contribution to unallocable costs and profit, alone, cannot serve as the basis of intraperiod standards for managerial performance because of differences in the environments among the outlets --differences in profit potentials. For contribution statements to be a valid measure of managerial performance, it must be assumed that the potentials of all outlets are equal; that all managers are subject to the same environment. Under these conditions, managers working at the same levels of efficiency and competence would yield equal contributions at the various locations. Such an assumption is clearly untenable; even to the casual observer, environments and potentials among the outlets are not the same. Outlet contributions must be adjusted for the differences in environments before managers can be compared. The relative

importance of the environmental factors, levels of factors, and level combinations are also of interest in location and facility selection.

The proposed "environmental model" is an objective method for estimating the portion of the measured performance[1] of an outlet attributable to the environmental factors and the portion attributable to the outlet manager. The basic requirement for the environmental model is that the measured performance of an outlet depend upon or be related to the levels of certain environmental factors under which the outlet is operated, in addition to depending upon the outlet manager's actions. Only the environmental factors which are not controllable by the outlet manager will be considered in the model. These factors will be referred to as "non-managerial" factors. The manager should be held responsible for the effects of any factors controllable by him.

No two outlets are ever exactly comparable, but through the use of statistical tools, the effects of the non-managerial factors can be extracted. Since the estimated managerial contribution does not depend upon the levels of the non-managerial factors (these effects having been stripped away) the managerial contributions are comparable and one manager's contribution can be compared directly with the contributions of others.

The Non-managerial Factors

The nature and number of non-managerial factors which are relevant for a particular business depends upon the nature of the business and

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[1] "Measured performance" could be any measure of outlet performance such as sales, controllable expenses, net contribution, or a transformation of one of these variables.

the products being offered. For example, the factors related to the performance of variety stores may be much different from the factors related to the performance of restaurants.

A classification scheme for a particular non-managerial factor is needed if the average performance of outlets differs among the various levels of the factor under which the outlets are operated.[2] In general, as the complexities of the product being offered and the restrictions placed on the outlet managers increase, the complexity of the non-managerial factor structure increases. The only requirements for the inclusion of a factor in the model are: (1) the factor can be measured at each outlet or the outlets can be classified as being in some category of a nominal classification and (2) the classification can "explain" some of the variation in performance among outlets.

A few examples of possible non-managerial factors are listed below. Some of the factors are overlapping and much confounding[3] could result. This is a general list, however, and is not intended to be a list of factors for a specific firm.

(1) Physical Facilities of the Outlet:
    - Investment in the outlet
    - Age of the outlet
    - Square feet of floor space
    - Feet of window (display) space
    - Basic building model
    - Service facilities
    - Amount of available parking

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[2]The familiar rate of return on investment is actually a "one-way" classification, and thus, the environmental model is just an extension of the same concept by adjusting simultaneously for other non-managerial factors.

[3]The effects of two factors are said to be "confounded" if it is impossible to separate the effects by statistical analysis.

(2) Location Characteristics of the Outlet:
- State
- City
- Neighborhood location (downtown, residential, suburban, etc.)
- Store complex (number and nature of other stores in the immediate shopping area)
- Proximity to traffic arteries
- Number and nature of competitors in trade area
- Socio-economic status of customers
- Total population in trade area
- Median family income in trade area
- Median age of population in trade area

It is possible that two or more of these factors are related to outlet performance in the same way. Investment, floor space and basic building model may all be measures of the general physical attractiveness of the outlet. Tests of colinearity can be made to avoid a "double counting" of factors which could logically be considered to be estimates of the same underlying phenomenon.

The possible relationships of the facility factors to outlet performance are fairly straightforward. Investment, age, and footage are measurable on a cardinal scale while the basic building model could be nominally classified as type A, B, or C, or as the "new" or "old" model. The "new" model outlets might be expected to perform better than the "old" model outlets--the environmental model indicates how much better the "new" outlets should be, based on the average performance of the "new" outlets compared with the average performance of the "old" outlets. Different outlet model types may also perform at different levels.

The location factors require more explanation. A nominal classification as to the state in which the outlet is located may be necessary because the outlets in one state may, on the average, perform at a different level than outlets in other states. Differences in physical, political, economic and social climates may be underlying causes of

differences in potentials for the outlets among the states. As a simple example, the sales potentials of ice cream parlors located in Michigan may be less than the potentials of those located in Oklahoma because of the higher average temperatures and the longer "ice cream season" in Oklahoma. Furthermore, there may be only a small difference in the average performance of outlets in Michigan and Indiana during most years, but there may be a "heat wave" in a particular year which is much more severe in Indiana than is experienced in Michigan. To the extent that the differences in the weather have affected the relative sales potentials for the outlets in the states (as measured by differences in the average sales of the outlets in the states), adjustments should be made. The adjustments in a particular year may be much larger than those necessary in the average year.

A better basis for such weather adjustments might be a mean temperature classification or perhaps a district classification within states. A district effect could also arise because differences in skills of the district supervisors affect the average performance of outlets within the districts.

A state classification is needed when average performance of outlets differs among the states, whatever the reason. As indicated above, the state effect could perhaps be analyzed into components such as mean temperature which the state classification may only approximate. The question to be answered is: Does the added explanatory value of the more complex model justify the added cost of installing and operating the refined classification system? The approximate nature of some of the following classifications should be noted.

A city effect may arise because the average performance of outlets located in city A is different from the average performance of outlets in other cities. The effect may be related to population differences, family income differences or age differences. Or, one city could be primarily an industrial city while another is a commercial city. City A may have limited consumer shopping while city B serves as a regional shopping city and have potential greater than that indicated by its population, family incomes and other characteristics.

The neighborhood location classification may be needed because outlets located downtown perform, on the average, at a level different from those located uptown or in suburban areas or shopping centers. The store complex (number and nature of other stores in the immediate shopping area) may considerably enhance the attraction of any store within the complex due to the variety of different products and services offered.[4] The potential of an outlet in a planned complex may be greater than that of an outlet in an unplanned complex. Furthermore, outlets in regional shopping centers may have different potentials than those in neighborhood shopping centers. Available parking and proximity to traffic arteries can yield a difference in the potentials of outlets in otherwise similar shopping centers.

The number and nature of competitors in the trade area of an outlet is probably of considerable importance. A manager facing a small number of competitors should do better than one facing a large number. And, even though the number of competitors may be the same at two locations,

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[4]Bernard J. LaLonde, "Differentials in Supermarket Drawing Power and Per Capita Sales by Store Complex and Store Size," unpublished Ph.D. dissertation, Michigan State University, 1961, p. 12.

the nature of the competitor can be important--an outlet facing a competitor which has an extremely good location, large service staff, attractive facilities or well-established reputation should not be expected to perform as well as another outlet in a location where the competitors have less desirable locations and facilities.

The median age in the community or perhaps a breakdown into numbers of people in various age groups may be important for businesses whose outlets sell consumer durables, baby items, rocking chairs or other products for which sales may be related to the ages of the populace.

The discussion of possible factors could be extended to cover many specific types of multi-outlet businesses. The above discussion is only an indication of a few, general, possibilities. From the viewpoint of evaluating outlet managers, the particular non-managerial factors explaining variation in performance among the outlets is not important. The only reason for considering the factors is to eliminate their effects in order to compute a manager's contribution.

From the viewpoint of top management, both managerial contribution and the non-managerial factors are important because top management can, in the long run, control both of these profit-related factors. Within certain constraints, such as available funds, contract commitments and costs of abandonment, top management can expand, contract, remodel, relocate or restaff any outlet. The use of the environmental model in making such decisions will be discussed in Chapter Four.

Rather than continue the discussion of factors in general, the subject will be dropped temporarily and taken up again in Chapter Three in the specific context of the test firm. The next topic is a presentation

of the statistical properties, assumptions and limitations of the proposed environmental model.

The Statistical Model

The environmental model is a linear statistical model of outlet performance in which it is assumed that the measured performance[5] of an outlet can be described as the sum of: (1) the effects of the levels of the non-managerial factors under which the outlet is operated, (2) the effect of the outlet manager's actions after considering the effects of the non-managerial factors, and (3) a portion not explained by the model.

The environmental model is in contrast to a more general model which is implied by the use of a responsibility accounting system in a multi-outlet business. Under a responsibility accounting system, the performance of an outlet is assumed to be attributable solely to the actions of the outlet manager. In a multi-outlet business the only standard with which to compare the measured performance of an outlet is the intraperiod standard of the current performance of the other outlets. Recall that in Chapter One intraperiod standards were rejected because of irrelevance, and valid predetermined standards were not operational in the multi-outlet case due to the large number of outlets for which potentials could not be adequately determined. In such a situation, the only comparison which can be made is the performance of a particular outlet with the average performance of all outlets. An implicit assumption is, then, that the potentials of the outlets are equal and therefore performance should be the same at all outlets unless there is a

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[5]See footnote 1 on page 14.

difference in the performances of the managers.

The model implied by the use of such a responsibility accounting system is:

$$Y_j = A^* + M^*_j.$$

In the model, Y_j is the measured performance of outlet j for time period t, A* is the average performance of all outlets and M^*_j is the effect of the actions of the manager of the outlet. Thus, it can be seen that the manager of an outlet at which the measured performance is above the average will be deemed to be a "better-than-average" manager and vice versa. The potential of the outlet above (or below) that of the average outlet (i.e., the effect of the non-managerial factors) is incorrectly attributed to the actions of the outlet manager.

The environmental model makes use of concomitant information--the levels of the non-managerial factors which are assumed to be related to outlet performance. By fitting the environmental model, the difference in performance which is assumed to be attributable to the concomitant variables is removed before considering the performance of the outlet manager.

The environmental model is a variation of a "covariance" model, so named because the covariance of the concomitant variables and measured performance is specifically considered. A variation from the usual covariance model is required because the levels of many non-managerial factors remain constant over a relatively long period of time.[6]

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[6]Other non-managerial factors such as demographic characteristics do change quite often and are measurable but are not measured because the extra expense incurred in obtaining such measurements would likely outweigh their value.

To formulate the environmental model, consider a multi-outlet business in which there are "n" non-managerial factors which explain significant variation in the measured performance among the "m" outlets of the firm. It is desired to estimate the relative managerial performance among the m outlet managers (after considering the effect of the non-managerial factors) for a particular time period t. Managerial performance is assumed to be constant throughout time period t. Reports of outlet performance are made for p sub-periods within time period t. The sub-period measurements of outlet performance are seasonally adjusted to remove the variation in performance which is due to seasonal influences. The p measurements of outlet performance over time period t are p measurements of the performance of the same combination of non-managerial factors and outlet manager.

The performance of a typical outlet j for sub-period of time k can be described as:

$$Y_{jk} = A + B_1X_{1j} + \ldots + B_nX_{nj} + M_j + U_{jk}.$$

In this expression, Y_{jk} is the seasonally adjusted measured performance of outlet j for sub-period k. The term A is the overall regression constant or the Y-axis intercept and the $\sum_{i=1}^{n} (B_iX_{ij})$ is the sum of the effects of the levels of the non-managerial factors under which outlet j is operated. The "B_i"s are the regression coefficients which express the relationships between the non-managerial factors and measured outlet performance. Each X_{ij} is the level of the non-managerial factor i at outlet j.

M_j represents the effect of the actions of the manager of outlet j. M_j is defined more explicitly on pages 24 and 25. For the multi-outlet

business as a whole, there are m "M_j"s.

The unexplained portion (U_{jk}) is due to chance or the inherently uncertain world in which the outlet is operated. The unexplained portion will be assumed to have an expectation of zero and be randomly distributed about that expectation. Thus, the expectation of measured performance ($E(Y_{jk})$) is equal to $A + \sum_{i=1}^{n} B_i X_{ij} + M_j$. More will be said about the unexplained term in a subsequent section concerning tests of hypotheses.

The parameters A, B_1, ..., B_n, M_1, ..., M_m, expressing the relationship between the independent variables and the dependent variable are not known and must be estimated. There are several methods for estimating these parameters. The only estimation method to be considered in this dissertation is the method of least squares. The derivation of the method of least squares is available in many statistics texts and will not be repeated here.[7]

The definition of the managerial contribution (M_j) is the key to the special estimation problem posed by the environmental model. Once the nature of M_j has been clarified, the estimates of the parameters can be determined by using the usual least squares method.

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[7]For example, see Donald A. S. Fraser, Statistics: An Introduction, John Wiley & Sons, Inc., New York, New York, 1958, pp. 228-240; or John E. Freund, Mathematical Statistics, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1962, pp. 321-325.

In vector notation, the expectation of the measured performance of the m outlets for time period t can be described as:

$$E\begin{bmatrix} Y_{11} \\ \vdots \\ Y_{1k} \\ \vdots \\ Y_{m1} \\ \vdots \\ Y_{mk} \end{bmatrix} = \begin{bmatrix} 1 \\ \vdots \\ 1 \\ \vdots \\ 1 \\ \vdots \\ 1 \end{bmatrix} A + \begin{bmatrix} X_{11} \\ \vdots \\ X_{11} \\ \vdots \\ X_{1m} \\ \vdots \\ X_{1m} \end{bmatrix} B_1 + \ldots + \begin{bmatrix} X_{n1} \\ \vdots \\ X_{n1} \\ \vdots \\ X_{nm} \\ \vdots \\ X_{nm} \end{bmatrix} B_n + \begin{bmatrix} Z_1 \\ \vdots \\ Z_1 \\ \vdots \\ Z_1 \\ \vdots \\ Z_1 \end{bmatrix} M_1 + \ldots + \begin{bmatrix} Z_m \\ \vdots \\ Z_m \\ \vdots \\ Z_m \\ \vdots \\ Z_m \end{bmatrix} M_m.$$

In this expression $Z_1 = 1$ for all Y_{jk} with $j = 1$, and 0 for all other Y_{jk}; $Z_2 = 1$ for all Y_{jk} with $j = 2$, and 0 for all other Y_{jk}, and so on.

The expectation of outlet performance is assumed to be contained in the space generated by the "one" vector, the n X_i vectors, and the m Z_j vectors. Examination of this assumption space reveals that the space generated by the one vector and the X_i vectors is a subspace of the space generated by the Z_j vectors. To illustrate, let $\mathcal{Z}_j$ denote the Z_j vector. The one vector is equal to $\sum_{j=1}^{m} \mathcal{Z}_j$ and each X_i vector is equal to $\sum_{j=1}^{m} \mathcal{Z}_j X_{ij}$. Thus, the normal equations to be solved to estimate the parameters will be linearly dependent. Therefore, without some restriction, there is no unique solution to the normal equations. The number of possible solutions is, in fact, infinite. The determination of a particular solution from this infinite number of possible solutions depends upon the definition of the managerial contribution.

For the environmental model, a unique solution is determined by defining the managerial contribution (M_j) as the expectation of measured

performance of an outlet for sub-period k minus the sum of the regression constant and the effect of the non-managerial factors. Thus:

$$M_j = E(Y_{jk}) - (A + \sum_{i=1}^{n} B_i X_{ij}).$$

The $E(Y_{jk})$ is estimated by the average of the measured performance of outlet j over all k sub-periods of t; A and the "B_i"s can be estimated using the usual least squares procedure. The estimated contribution of the manager of a typical outlet j ($\hat{M}_j$) is the difference between the average of the measured performance of the outlet over time period t and the expected performance of the outlet considering only the levels of the non-managerial factors under which the outlet is operated. Thus:

$$\hat{M}_j = \bar{Y}_{j\cdot} - (\hat{A} + \sum_{i=1}^{n} \hat{B}_i X_{ij}).$$

An example of the computation of $\hat{M}_j$ is included in Appendix A.

$\hat{M}_j$ is not solely a function of the actions of the outlet manager: the effect of any non-managerial factors not explicitly considered in the model and the effects of managerial action are confounded in $\hat{M}_j$. However, all non-managerial factors thought to explain significant variation in performance among outlets can be tested for inclusion in the model. Furthermore, even if the effect of only a single non-managerial factor is removed, $\hat{M}_j$ is an improvement over a measure of outlet performance because the effect of one non-managerially controllable factor has been removed from the measure of performance.

The sum of the estimated managerial contributions will be equal to zero. The average of the estimated managerial contributions will be

zero: a manager with a zero contribution will be assumed to be an average manager. The better than average manager will have a positive contribution and the below average manager will have a negative contribution. In the test company (and likely in other applications) the managerial contribution estimates were approximately normally distributed about the zero mean. The contribution estimates were converted to a standard normal distribution and percentile standings were determined using a cumulative standard normal table. For evaluating the performances of managers, the estimated percentile standing of a manager is a measure of performance with a "built in" intraperiod standard of comparison.

The expression "linear" is used in several senses in mathematics and a few words of explanation are in order. "Linear" in linear model means that the dependent variable can be expressed as a linear combination of the parameters and unexplained terms. It does not mean that the relationship between variables is expressible only as a first-order equation. The relationship between variables may be a second, third, or "n"th order polynomial. These higher order relationships can be expressed in the linear (combination) model by letting independent variable X_2 equal $(X_1)^2$, X_3 equal $(X_1)^3$ and so on.

The use of cubic and higher order terms can be dangerous. As Fraser has stated, "A cubic term is a fast-changing function; if its coefficient is in error, the estimate of the mean response can be very much in error, especially for values of the controllable variable away from those for which data were obtained."[8] This limitation of linear

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[8]Fraser, p. 296.

models should not be particularly troublesome in the multi-outlet business case since there are few factors which could logically be cubically related to the measured performance of outlets and virtually none of a fourth or higher order.

In addition to the higher order effects of primary factors, interactions among factors can also be estimated in the linear model. An interaction effect exists when a combination of factor levels yields results different from the sum of the effects of individual factor levels considered alone. Estimates of the effect of interaction among various combinations of two primary factors say, X_1 and X_2, can be generated by including an interaction term X_3, where X_3 is equal to X_1 multiplied by X_2.

When many primary factors are considered, all possible interactions cannot, in general, be estimated because of the limited number of outlets available. The number of possible interactions increases geometrically as primary factors are added to the model. However, many of the logically important interactions can often be estimated. In the test company, all interactions which were thought to be important were tested.

The Testing of Hypotheses

Many accounting reports are based, in part, upon estimates and yet carry no statement as to the variance of the reported amounts or even a caveat as to the fact that estimates are being used. In the environmental model, no statistical assumptions are necessary for a least squares estimate of the effect of any factor. However, it is possible and desirable to estimate the variance of the estimates of the parameters and thus obtain some assurance as to the precision of the parameter

estimates. It is desirable to have some assurance that the estimated effects of the factors--both non-managerial and managerial--are statistically significant and cannot easily be explained by chance.

To make inferences and tests of significance from the estimates, certain statistical assumptions must be met or the analysis must be extended or revised to account for the lack of the required assumptions.

There are three assumptions basic to the standard analysis of linear models. These are:

(1) Homogeneity of variances--the variances of the unexplained terms do not depend on the levels of the independent variables.

(2) Independence--the unexplained terms for the different observations are statistically independent.

(3) Normality--the unexplained terms are normally distributed.

There are numerous tests available for determining whether these assumptions are met.[9]

When the original data do not satisfy the assumptions, all is not lost. One common way of meeting the assumptions is to transform the data so that the transformed data meet the assumptions. A single transformation may suffice or perhaps a series of transformations--each for a separate deficiency--may meet the requirements. Fortunately, a transformation to correct one deficiency often helps to correct another.[10]

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[9]The specific tests used to test the assumptions for the test company will be presented on pages 55 and 56.

[10]Bernard Ostle, Statistics in Research, The Iowa State University Press, Ames, Iowa, 1963, p. 340.

In the company tested the assumption of homogeneity of variances of the original dependent variables (sales and controllable expenses) was not justified. Rather, the variability of these performance measures increased as the magnitude of the variables increased. This same relationship would seem likely in other multi-outlet businesses. For the test company, a logarithmic transformation of sales and a square root transformation of controllable expenses satisfied the required assumption.

Even when all of the assumptions cannot be met by transformation, the procedures can sometimes be revised so that a meaningful analysis is possible. Much of the work in the statistics literature in recent years has dealt with the analysis of experiments for which the basic assumptions are not met. If the assumptions are not met, the analysis is often complicated considerably but is not impossible.

Under conditions of homogeneity of variances, independence and normality discussed above, hypotheses concerning the parameters can readily be tested by an analysis of variance. Specifically, the hypothesis that a parameter or group of parameters is equal to zero can be tested. Since the analysis of variance for the environmental model is no different from the analysis of other linear statistical models, a discussion of analysis of variance will not be presented here. For a discussion of analysis of variance in general, see Fraser[11] or Freund.[12]

In summary, statistical inference is a means by which the validity of the environmental model approach to performance measurement in

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[11]Fraser, pp. 261-269.

[12]Freund, pp. 331-337.

multi-outlet businesses can be established.

The conceptual model has been presented. The incorporation of the estimates of managerial performance into the accounting system will now be discussed.

Revisions to the Accounting System

The environmental model requires no changes in the traditional accounting system to generate the revised managerial performance reports. The only added features required are the non-managerial factor classifications and the level of each factor under which each outlet is operated.

In some applications of the environmental model (for example, in those applications involving no transformation) it may be possible to account for the dollar contribution of an outlet before occupancy costs as the sum of the estimated dollar effects of the non-managerial factors and managerial contribution and the dollars not explained by the model. It is questionable whether the estimated dollar effect of managerial contribution should be reported even in those (few) applications in which it is possible. It is questionable because the estimated managerial contribution is a measure of the relative value of a manager when compared to other managers and not a measure of the absolute value of a manager to a company. The percentile standings of managers are less likely to be misinterpreted and can be explained more easily to the outlet managers and other operating personnel.

The only change in the outlet operating reports is the addition of the percentile standing of the outlet manager which is based on the results of his actions, given the potential of the resources at his disposal. Figure 2.1 is a hypothetical performance report for outlet

number one for the month of January, 1967.

In the example, the environmental model analysis has been performed on sales and controllable expenses as well as the net contribution of the outlet. This division of net contribution into the two components was made because the factors associated with revenue differences may be considerably different from the factors associated with expense differences. By separating the components of the net contribution and performing a separate analysis on each component, the precision of the estimates may be improved if the non-managerial factors are related to the components in different ways. A factor which significantly influences both sales and controllable expenses may have offsetting effects and thus, the factor bears no significant relationship to the net contribution. Furthermore, managerial excellence in selling may offset poor cost control or vice versa. Controllable expenses could be further divided into components if desired.

Figure 2.1. Hypothetical performance report

OUTLET NUMBER ONE
CONTRIBUTION STATEMENT
Month of January, 1967

		Percentile Standing of Manager
Sales:	$10,000	86
Controllable Expenses:	7,000	45
Net Contribution before Occupancy Costs	$ 3,000	70
Outlet Occupancy Costs:	500	
Net Contribution to Unallocable Costs and Profits	$ 2,500	

Occupancy costs are shown separately because the occupancy costs are generally not controllable by the outlet manager. The occupancy costs are included on the performance report because the costs are relevant when evaluating the performance of the combination of the outlet location, facilities and manager.

During January, the manager of outlet number one did quite well in the selling aspects of the business, given the environment within which he operated, but a little below average in cost control. The estimated net managerial contribution is above average but if the outlet manager could exert more effort in the control of expenses and reduce expenses without reducing sales, he could improve his overall measure of performance and percentile standing.

To illustrate the possible usefulness of the environmental approach to performance measurement, consider Figure 2.2 in which contribution statements for three additional outlets are presented. The relationships shown are hypothetical but similar results were found in the test company (see pages 53 and 54). The last line of Figure 2.2 is the percentile standing of the outlet managers based upon the responsibility accounting model discussed on pages 20 and 21. Such a percentile standing is not generally computed in a responsibility accounting system. The standing has been presented here to illustrate the changes in rankings of managerial performance when the non-managerial factors are considered.

When considering the net contribution of the outlets as a measure of managerial performance, the manager of outlet number one appears to perform on a par with the manager of outlet number two, to perform poorer than the manager of outlet number three and perform much poorer

than the manager of outlet number four. If the potential of the resources at the disposal of the outlet managers is considered (by using the environmental model to estimate the effects of the various non-managerial factors), it is discovered that the manager of outlet number one is performing much better than the managers of outlets two and four and on a par with the manager of outlet number three. Outlet contribution is thus not a good indicator of managerial performance.

Figure 2.2. Hypothetical performance reports for selected outlets for January, 1967

	Outlet							
	1		2		3		4	
	$	PSM*	$	PSM	$	PSM	$	PSM
Sales	10,000	86	10,000	40	6,000	86	20,000	33
Controllable expenses	7,000	45	7,000	35	2,000	45	13,000	38
Net contribution before occupancy costs	3,000	70	3,000	37	4,000	70	7,000	35
Percentile based on Responsibility Accounting	(40)		(40)		(55)		(80)	

*Percentile standing of managerial performance based upon the environmental model

District supervisors and top management officials of multi-outlet businesses realize that there are differences in the profit potential among the various outlets. Management may be familiar with or suspect several factors as being important determinants of outlet performance. The questions which need to be answered are: How important are the known or suspected factors? Are there other non-managerial factors which are important? Are interactions among factors important? The environmental model is an objective method for obtaining answers to

these questions.

To continue the illustration, assume that the firm is organized into districts and that the district supervisors have the authority to hire and dismiss outlet managers within their districts and can control the levels of some of the non-managerial factors under which the outlets are operated. The average estimated percentile standing of the managers in a particular district is a measure of the skills and performance of the district supervisor in hiring and supervising his subordinates. The magnitude of the non-managerial factors which the district supervisor can control (or perhaps the ratio of controllable to non-controllable factors) gives an indication of the sensitivity of the operations of the district to the district supervisor's control.

It may be tempting to extend the measure of outlet manager performance and evaluate the district supervisors' performance on the basis of the magnitude of the controllable non-managerial factors as an indication of a district supervisor's success in adjusting the controllable factors to a maximum expected contribution. Such an extension is hazardous, however, because there are differences in the relative potentials of the districts. An expected contribution analysis for districts would be necessary to evaluate their relative potentials for the extension to be valid.

An environmental model for district supervisors' performance is not appropriate or necessary. There are not enough districts to generate precise estimates of the influences of all of the non-managerial factors affecting district contribution and the responsibilities of the district supervisors are not likely to be homogeneous among districts. Furthermore, a subjective standard is probably adequate at the district level.

There are only a few districts and an experienced top management official can probably establish adequate predetermined standards for the small number of districts. Since one official can be familiar with all of the districts, this individual could set all the district budgets and there would be no bias caused by differences among the budget-setting officials. In short, the districts meet the requirements for a predetermined standard system for performance evaluation.

The environmental model is a performance measurement and evaluation tool to be used by top management and district supervisors to evaluate the performance of subordinates. The sum of the measured performances of all outlets is equal to $mp(\hat{A} + \sum_{i=1}^{n} \hat{B}_i \bar{X}_i.)$ --the sum of the estimated managerial contributions (for the company as a whole) is zero. It is only for segment analysis that the environmental model has meaning.

Implications

The implications of the model for evaluation of outlet manager performance have been discussed already. There are other implications, however, for manager, location and facilities selection.

One possible conclusion from the analysis is that there is relatively little difference in performance among the managers. That is, most of the difference in performance among outlets is due to the differences in the levels of non-managerial factors such as outlet location and outlet facilities. In this case, the analysis would indicate that perhaps more resources should be devoted to outlet location and facilities selection and fewer resources to manager selection. Furthermore, the relative magnitude of the non-managerial effects are

indicative of which factor levels and combinations of factor levels are the most productive in terms of measured performance results.

An alternative conclusion could be that the managerial effect is quite large: that is, non-managerial factors explain relatively little of the differences in the various outlets' performance. The evaluation of managers on the basis of the performance of their outlets may yield the same relative ranking as an evaluation based on the imputed managerial contributions, and if so, the outlet performance may serve as a valid intraperiod standard of performance. In this case, the model building and analysis of variance will have been worthwhile because it shows that the use of the performance of the outlets as an intraperiod standard is justified, and that considerable resources should be devoted to manager selection and training and perhaps fewer resources to location and facility selection.

The outlet with the smallest reported dollar contribution to unallocable costs and profits isn't necessarily the outlet which should be eliminated if an outlet is to be eliminated. Additional information and analysis is needed. The environmental model can provide some of the information needed for such an analysis.

Poor reported contribution can be due to a poor location or poor facilities or poor management or some combination of these factors. A good location with poor facilities and a poor manager should probably be remodeled and restaffed, not eliminated. A poor location with good facilities and a good manager should be eliminated and the funds and manager thus freed could be transferred to a better location.

From the analysis of the effects of facilities, marginal rates of contribution could be developed for comparison with marginal investment

required in remodeling an outlet. Indeed, "response surface" techniques could be incorporated to determine the optimum combination of levels of factors for location and facilities (that is, the combination yielding maximum expected contribution). The predictive value of such a system could be compared with selection techniques currently being used by the firm. The implications of the environmental model for location and facility selection will be discussed in more detail in Chapter Four.

The implementation, testing and evaluation of the environmental model approach in an actual multi-outlet business is the subject of Chapter Three.

CHAPTER III

TESTING THE MODEL

The construction and testing of an environmental model for performance measurement in a multi-outlet business is the subject of this chapter. Two groups of tests will be conducted. In the first group are the tests for the presence of the underlying assumptions for the analysis of linear models. The second group consists of the tests of significance of the non-managerial factors which are being considered to explain the variation of the sales and controllable expenses of the outlets.

The tests of the assumptions make possible the use of statistical inference in the analysis of the results of the environmental model. Tests of significance of the factors give the level of confidence in the results of the analysis.

This chapter begins with a discussion of the background of the test company and the specific non-managerial factors and relationships tested.

The Test Company

A national company offering a wide range of consumer goods and services through retail stores and catalog order centers was selected as the firm on which to test the environmental model approach to performance measurement. The study was limited to catalog order centers. Catalog order desks in retail stores of the firm are included in the retail

store division and were not included in the study. The test firm satisfied the requirements of the definition of a multi-outlet business as defined in Chapter One (page 12).

The order centers were chosen because of several distinct advantages inherent in the nature of the catalog order business, including the overall comparability of the centers. The ease of classifying the centers as to the levels of the non-managerial factors is perhaps the greatest advantage of the company as a test firm. There is generally only one order center in a city and the problems related to location within cities are largely avoided.

One complete region in which there are ten districts was the basis for the model building. The complete region preserves the operationality of the model in that a complete operating segment of the national organization is included. There were 105 order centers operated in the region in 1964, 117 in 1965, and 116 in 1966. Of these outlets, 20 were located in the "core city" of large metropolitan areas and were excluded from the study primarily because of the difficulty of defining market areas, breaking down population characteristics and other problems of classifying the outlets.[1] In addition, the metropolitan outlets exhibited considerably more variation in sales and controllable expenses so that even a "core city" effect was not meaningful. Regression coefficients based on outlets located in towns and cities with from 5,000 to 50,000 inhabitants might be considerably distorted by the inclusion of a few outlets from a heterogeneous population of cities with as many

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[1]This lack of detailed demographic data from secondary sources could be overcome with market analysis.

as 500,000 inhabitants. For these reasons the core city outlets were not included in this study.

Outlet managers have primary responsibility for the hiring and retention of outlet employees. The typical outlet staff includes the outlet manager and from two to six employees. There is no complicated managerial hierarchy within the outlets which might influence operating results.

All order centers are of approximately the same size. Because of this, managers are not generally promoted to larger outlets but are promoted to district supervisor and supervise from ten to fifteen outlets. The identification of managerial skills is particularly important in order to retain the excellent managers through promotion.

The company already has a contribution accounting system in operation and this makes the extension of the responsibility accounting concept by the use of the environmental model easier. Monthly operating statements are the most frequent comprehensive reports in the test company. Monthly inputs for the model were possible, but since the resources available for data collection were limited, it was deemed advantageous to use a longer time period to allow an indication of the stability of the relationships over time rather than a more detailed estimate of performance for a shorter period. Quarterly data on outlet sales and controllable expenses were collected for the three-year period ending December 31, 1966.

The portion of the company tested is admittedly a simplified situation but more complicated organizations and factor structures can be introduced in other applications through appropriate revisions of the

model.[2] The present objective is to determine whether the basic concept of the environmental model is implementable and potentially useful in multi-outlet businesses. To meet this objective, the following primary hypothesis was developed and tested.

The Hypothesis

The primary hypothesis of this study is: There are non-managerial factors which explain significant variation in the measured performance of outlets in a multi-outlet business. Non-managerial factors influencing revenues may be considerably different from those related to expense differences and for this reason the two will be analyzed separately.

Formulating the Model for Testing

In formulating the model for testing, corporate marketing officials were asked to identify the non-managerial factors which they believed might cause differences in measured performance among the outlets. From the discussions with corporate officials and a review of the related literature, the initial formulation of the model was derived.

The dependent variables analyzed were net outlet sales and the outlet expenses which were controllable by the outlet manager. As mentioned in Chapter Two, the analysis could be performed on individual components of net sales and controllable expenses to gain additional insight into the operations of the outlets. In this study, however, the analysis

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[2] A complete model of the test firm including both retail store and catalog divisions could be developed.

was limited to the overall measures of performance because of the exploratory nature of the study.

Data on seventeen non-managerial factors (see Figure 3.1) were gathered for all outlets for consideration in the initial formulation of the model. The demographic characteristics of the communities in which the outlets are located were obtained from various publications of the Bureau of the Census of the United States Department of Commerce. Information about the other location characteristics, the physical facilities of the outlets and the other factors were obtained from the financial, personnel and property records of the test company.

From this group of seventeen primary factors, forty-four additional variables were created and tested to determine whether any quadratic effects or certain logically important first-order interaction effects could explain significant variation in the dependent variables.

The same factors which were considered for sales were considered for controllable expenses except that sales was included as an independent variable in the analysis of controllable expenses. It might appear circular to remove the effect of sales, which is partially controllable by the manager, as a non-managerial factor in the analysis of controllable expenses. However, to a large extent the expenses of an outlet are determined by the volume of sales due to the direct nature of commissions and order processing costs. If the manager keeps his expenses at a lower level for a given volume of sales than the average manager does, he should be congratulated. The deletion of sales from the controllable expense equation would merely emphasize the other factors (other than sales) which are related to the <u>sales</u> of the outlet.

Figure 3.1. Primary non-managerial factors considered in the initial formulation of the model

Location Characteristics of the outlet:

Demographic characteristics:

* 1. Population
* 2. Median family income
* 3. Median years of schooling
* 4. Percentage of population which is non-white
* 5. Median age

Other:

6. District in which outlet is located
7. Location within city (i.e. in a shopping center or other location)
8. Distance from distribution center (warehouse)
9. Competition - primary catalog competitor - retail store
10. Competition - primary catalog competitor - catalog outlet
11. Competition - secondary catalog competitor #1
12. Competition - secondary catalog competitor #2
13. Competition - secondary catalog competitor #3

Physical Facilities of the outlet:

* 14. Years since last remodeling of the outlet
* 15. Years since outlet first opened in community

Other Factors:

* 16. Managerial tenure in years
* 17. Number of catalogs issued by the outlet

*Indicates quadratic effect tested

The population of the cities varied from approximately 5,000 to 200,000, with only about ten percent above 75,000. It would be expected that average sales would increase with increasing population but at a decreasing rate due to the greater retail competition in the larger towns and thus, the greater availability of goods from alternative sources.

The relationship of median family income to sales might be expected to be an inverted "U" shape due to income and substitution effects (to the detriment of catalog order center because of the nature of its product offering) which occur as family incomes rise.

The median years of schooling classification is intended to approximate possible differences in buying habits of different socio-economic classes of consumers. Office workers and factory workers may earn equal wages but have different buying habits. The median years of schooling may provide useful insight into the socio-economic makeup of the community.

The classification, "percentage of population which is non-white" arises because of considerations similar to the median years of schooling classification. Non-whites may shop in different establishments and types of establishments than do whites. The effect of the difference in potential due to race should be reflected in the performance measure of the outlet manager.

The reasons for the inclusion of the median age, district and location within cities factors have been discussed in Chapter Two.

Increasing distances from the warehouse should be a detriment to the outlets for two reasons. First, as distance increases, the effective price to the customer increases due to the increased transportation charge which is added to the order price. Second, as distance increases, the delivery time increases and the relative advantage of local retail competitors increases. A third detriment does not arise in the region studied but might arise in other regions. The third detriment occurs when another catalog competitor has a warehouse closer to the city in question than the firm does and the competitor can thus offer faster

service and reduced transportation charges. In this study, all catalog competitors' warehouses are located in the same city.

Since there is little difference in facilities among the outlets there are few facility differences which can be tested. The average outlet has approximately twenty-five hundred square feet of space with very little deviation among outlets. The size variable was ignored because of the lack of significant size differences.

The firm does not have definite outlet model types such as exist in service station chains and many food chains. Outlet designs change gradually over time and are tailored to the store complex in which the individual outlet is located. Thus, the length of time since the last remodeling of the outlet is perhaps the best measure of the general attractiveness of the outlet facilities.

The years since the outlet was first opened in the community is a complex factor. The age of the outlet facilities may give a measure of the general surroundings in which the outlet is located (other stores in the neighborhood may not have been remodeled). This effect would presumably be negatively related to sales. On the positive side, the age gives a measure of the length of exposure of the community to the firm. The algebraic sign of the age effect can perhaps indicate which of these aspects prevails if indeed the age factor is significant.

The competitors of a catalog order center are difficult to define and classify. Due to the complete line of goods and services offered by the firm, almost any business in the community could be considered as a competitor of the outlet. Total square feet of retail selling space in the city was considered as a possible factor basis but data were not readily available for the small communities. Furthermore,

different mixes of retail competition would likely have more influence on the outlet than the total space available.

For practical reasons, the presence of other catalog order firms' outlets in the community were the only competitive factors tested. The presence of the primary catalog competitor was further distinguished as to the type of facility--that is, a retail store or a catalog order center. Two of the secondary catalog competitors are well established catalog firms which offer goods only through the catalog. The third is a national dry goods chain which has only recently entered the durable goods market and established a mail order department in many of the local retail stores that do not offer a complete line of durable goods. This third secondary competitor has had an excellent reputation for its medium-priced soft goods lines for many years. For application of the environmental model to other types of multi-outlet businesses, better measures of competitive factors can undoubtedly be developed and the precision of the analysis increased accordingly.

The effects of many of the location and facility factors discussed above may be of specific interest in planning new locations, store remodelings and expansions.

Managerial tenure was tested because years of experience may be related to outlet performance in several ways. As tenure increases, customer loyalties may be developed resulting in increased sales, while experience in managing employees and cost control may help reduce expenses. The effect of tenure should be removed to avoid underestimating the capabilities of an inexperienced but otherwise excellent manager. The nature of the tenure relationship may also be of interest in planning managerial tenure periods and job rotation policies.

The number of catalogs issued by the outlet is probably the most important single non-managerial factor related to sales because it is proof of past purchases from the firm. Catalogs are issued after a customer has ordered a minimum number of times from the company. The manager has limited discretion in issuing catalogs for promotional purposes. The number of catalogs is important because outlets in two cities with equal populations and other location factors and facility factors may have different profit potentials because the number of past customers (and thus the number of current catalog holders) is different. The catalogs are virtually the only form of local advertising utilized by the outlets.

With this background, the construction of the final model, the tests performed and the results of those tests begins.

The Model

All of the primary non-managerial factors listed in Figure 3.1 and the derived factors (quadratic effects and interactions) were thought to be potentially significant in explaining variation in the measured performance among outlets. Some were thought to be highly significant while others were thought to be of only minimum significance. To determine the relative importance of individual non-managerial factors a "stepwise addition of variables" was performed. In the stepwise addition of variables, the independent variable which reduces the unexplained sum of squares the most is the first independent variable added to the regression equation. The procedure is then repeated until the variable considered for addition to the equation is not significant at some prespecified significance level. For the test company the .05

significance level was used.

With the individually significant non-managerial factors thus determined, a procedure fitting all of the significant factors simultaneously was conducted. Figure 3.2 is a list of the non-managerial factors which were significant, the algebraic sign of the coefficient of the factor and the number of years in which the factors were significant. The factors are listed in approximately the order in which they were added to the equations in the stepwise additions of variables. In Appendix B, the factors are listed (by year) in the order in which they were added to the equations.

As was anticipated, the number of catalogs issued by an outlet was the most important factor related to the logarithm of net outlet sales for all three years. The negative sign of the coefficient of the quadratic term (which was significant in two of the three years) indicates that, as the absolute number of catalogs issued by an outlet increases, the sales per additional catalog decreases. For the range tested, the relationship of sales to the number of catalogs was constantly increasing. That is, the stationary point (the point at which the first derivative is equal to zero), beyond which total sales decrease with each additional catalog issued, was far to the right of the range of the numbers of catalogs which were actually issued by the outlets.

The years since the opening of the outlet in a community was also significant in all three years. The positive sign of the linear term indicates that the exposure of the firm to the community was associated with increased sales. As with catalogs, sales increase at a decreasing rate until a maximum is reached. The stationary point is at approximately twenty-five years which was well within the range tested. In a

study of six supermarket chains, Applebaum found a similar age-sales relationship.[3]

Figure 3.2. Significant non-managerial factors

Logarithm of Net Outlet Sales

Significant 3 Years	Significant 2 Years	Significant 1 Year
+ Number of catalogs issued	- Number of catalogs issued (quadratic effect)	+ Median age (quadratic effect)
+ Years since opening	- Median age	+ Population X Median family income
+ Median family income	- Years since opening (quadratic effect)	+ Shopping center X Population
+ Years since remodeling	- Secondary competitor #3	- Population X Secondary competitor #3
+ Years since remodeling (quadratic effect)	+ Median years of schooling	
* District	+ Median years of schooling (quadratic effect)	

Square Root of Controllable Expenses

Significant 3 Years	Significant 2 Years	Significant 1 Year
+ Sales	- Managerial tenure	+ Distance from distribution center

*The sign of the district effect for a particular district may be positive or negative. The sum of the district effects is zero.

Median family income was positively related to sales and there were no significant quadratic effects during any year. Thus, the higher the median family income of a community the higher the expected sales of an outlet located in the community. As with some of the other non-managerial factors, the relationships may not hold for median family

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[3]William Applebaum, "Store Performance in Relation to Location and Other Characteristics," Chain Store Age, Executive Edition, v. 41, November, 1965, p. E16.

incomes beyond the range tested. The highest median family income for the communities in the study was under $10,500.

The shape of the "years since remodeling--logarithm of sales" curve was similar to the "years since opening--logarithm of sales" curve, but the years since remodeling curve reaches a maximum much earlier than does the years since opening curve. It may appear unusual that sales continue to rise for a few years after remodeling rather than tapering off as the remodeled facilities age. A possible explanation of this is that part of the decision to remodel is based on a higher than average rate of growth of the community in which an outlet is located. This higher than average rate of growth disguises for a time the effect of the aging of the remodeled facilities.

Differences in average outlet performance among the districts were significant for all three years. Since the evaluation of the performance of district supervisors was not of interest, the underlying cause of the differences among districts was not investigated. Whether the differences in potential are due to differences among the supervisors, differences in climate or other factors is of no consequence in evaluating the performance of the outlet managers. The district factor is considered only because the effect of factors beyond the control of the outlet manager should be removed from the measure of his performance.

The remainder of the non-managerial factors listed in Figure 3.2 were significant in only one or two of the three years. Thus, less reliance can be placed on the results of any analysis based on their inclusion. However, the nature of the relationships indicated by these factors is of interest in understanding the profitability factors within the firm. For this reason, a brief discussion of the possible

significance of these factors is included.

Median age in the test region ranged from twenty-one to thirty-nine. The younger median ages were associated with higher sales and the older median ages were associated with somewhat lower sales. The positive sign of the quadratic effect (significant in only one year) indicates that the "median age--logarithm of sales" curve is "U" shaped. However, the indicated stationary point is very near the right bound of the median ages in the communities tested. In general, the higher the median age in a community the smaller the expected sales of an outlet.

The median years of schooling factor seems to indicate that the outlets located in "white collar" communities are likely to have higher sales than those located in "blue collar" communities. The correlation of median family income with median years of schooling was near zero.

The presence in a community of what was thought to be the primary catalog competitor of the test firm had no significant impact on outlet sales for the region and time periods tested. The presence of the third secondary competitor did have a significant effect on outlet sales in two of the three years, however. This can possibly be explained by the competition of the medium-priced soft goods lines which the competitor can offer from stock. Fashion merchandise makes up a large part of the sales of most of the outlets of the test firm.

Three interaction effects were significant. The Population X Median family income interaction indicates that large populations and high median family incomes, <u>in combination</u>, yield sales that are higher than can be explained by the levels of population and median family income alone. Similarly, in large communities, outlets located in shopping centers seem to do much better than those in other locations within

cities. The presence of the third secondary competitor in a large community may be particularly disadvantageous to an outlet. The presence of the third secondary competitor was not highly correlated with population (correlation coefficient was approximately .18).

As was to be expected, sales was the most important independent variable related to controllable expenses. Managerial tenure was significant in two of the three years and was negatively related to expenses. As tenure increased, controllable expenses decreased; the effect of tenure should be considered in the environmental model so that the inexperienced managers will not be underevaluated. The presumed distance effect was significant in only one year and thus, does not appear to be of particular importance, at least for the test region.

The partitions of the sum of squares, the related degrees of freedom and the computation of the test statistic for testing the significance of differences among the managers for the three test years are presented in Table 3.1 and Table 3.2. The multiple coefficient of determination (R^2) is the ratio of the sum of squares explained by the model (after the mean) to the total sum of squares (after the mean). The multiple coefficient of determination can be interpreted as the proportion of the variation of the dependent variable which is "explained" by the model.

The variation explained by the environmental model is much smaller for controllable expenses than is explained for sales. Part of the unexplained variation in expenses is due to accounting adjustments of prior quarters operating results for many of the outlets. If these adjustments could be analyzed and redistributed to the appropriate periods, more of the variation of the controllable expenses could be explained by

Table 3.1. Analysis of variance: logarithm of net outlet sales

1966

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	8.725958	19	.459260		
Managers	2.424825	76	.031906	15.236867	.01
Unexplained	.603032	288	.002094		
Total (after the mean)	11.753815	383			

$R^2 = .949$

1965

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	8.512137	19	.448007		
Managers	2.438300	77	.031666	15.246027	.01
Unexplained	.604403	291	.002077		
Total (after the mean)	11.554840	387			

$R^2 = .948$

1964

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	5.519646	20	.275982		
Managers	1.533705	64	.023964	9.132621	.01
Unexplained	.669221	255	.002624		
Total (after the mean)	7.722572	339			

$R^2 = .913$

Table 3.2. Analysis of variance: square root of controllable expenses

1966 Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	110,080	2	55,040.0		
Managers	24,462	93	263.0	1.493	.025
Unexplained	50,713	288	176.1		
Total (after the mean)	185,255	383			
	R^2 = .726				

1965 Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	36,432	2	18,216.0		
Managers	54,658	94	581.5	2.514	.01
Unexplained	67,319	291	231.3		
Total (after the mean)	158,409	387			
	R^2 = .575				

1964 Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	Significance
Non-managerial factors (after the mean)	29,540	2	14,770.0		
Managers	34,403	82	419.5	2.346	.01
Unexplained	45,590	255	178.8		
Total (after the mean)	109,533	339			
	R^2 = .584				

the model.

The total variation explained by the model is the sum of the amount explained by the non-managerial factors and the amount explained by the differences among managers after considering the non-managerial factors. For sales, the non-managerial factors explained 74.3%, 73.7%, and 71.4% of the variation for 1966, 1965, and 1964 respectively, while differences among managers explained 20.6%, 21.1%, and 19.9% of the total. For controllable expenses, the non-managerial factors explained 59.4%, 23.0%, and 27.0% of the variation and 13.2%, 34.5%, and 31.4% was explained by differences among managers.

Nearly four times as much of the variation in the logarithm of sales among outlets is explained by the levels of the non-managerial factors under which the outlets were operated than by differences among managers after considering the non-managerial factors!

A Statistical Note

To determine whether the three assumptions basic to the analysis of linear models were justified in the test company, three tests of the assumptions were conducted. Bartlett's Test for Homogeneity of Variances[4] was used to test for the homogeneity of variances assumption. The hypothesis of homogeneity had to be rejected for the seasonally adjusted sales and controllable expenses. However, when sales were subjected to a logarithmic transformation and expenses subjected to a square root transformation, the hypothesis could not be rejected at the

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[4]M. S. Bartlett, "Some Examples of Statistical Methods of Research in Agriculture and Applied Biology," Journal of Royal Statistical Society, (Supplement), v. 4, 1937, p. 137.

.05 level of significance. The standard deviation of sales and the variance of controllable expenses were apparently proportional to the means of these variables for the outlets in question. These transformations are "order preserving": the relative rank order of the sales and controllable expenses of the outlets is preserved for the transformed values of these variables.

The Kolmogorov-Smirnov Test for Goodness of Fit[5] was conducted to test the assumption of normality. The normality assumption was justified at the .05 significance level for the transforms of sales and controllable expenses. To test for independence or random unexplained terms, the Durbin-Watson "d" statistic[6] was computed. The computed "d" statistic exceeded the approximate upper bound for the test statistic in all six analyses and thus the hypothesis of random unexplained terms was not rejected.

Testing the Primary Hypothesis

The primary hypothesis, that there are non-managerial factors which explain significant variation in measured performance of outlets of a multi-outlet business, has been accepted for the test company. The logarithms of net outlet sales and the square roots of controllable expense meet the assumptions basic to the analysis of linear models and there are non-managerial factors which explain significant variation in

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[5]F. J. Massey, Jr., "The Kolmogorov-Smirnov Test for Goodness of Fit," Journal of the American Statistical Association, v. 46, 1951, pp. 68-78.

[6]J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression," Biometrika, v. 37, 1950, pp. 409-428, and v. 38, 1951, pp. 159-178.

these measures of outlet performance.

Starting from the logical need for adjustments for differences in potentials of outlets of multi-outlet businesses, it has been shown that through the use of the environmental model significant variation in performance among outlets can be explained by factors not under the control of the outlet managers. Also, it has been shown that managerial differences (after considering the effects of the non-managerial factors) explain significant variation in the measured performance among outlets.

These findings have important implications for performance evaluation. If managers in the test company were evaluated on the basis of the contributions of the outlets to which they had been assigned, an average manager fortunate enough to be assigned to an outlet with a high potential would be very much overrated. Likewise, an excellent manager assigned to an outlet with low potential would receive a relatively low evaluation. In other words, the potential of the outlet is likely to be attributed (wrongly) to the performance of the outlet manager. Since significant managerial differences seem to exist, substantial resources should be devoted to manager selection and training.

The "Carryover" Effect

A problem which has received little attention in the accounting literature is the importance of a residual or "carryover" effect of the actions of previous managers of an entity on the current performance of the entity. This problem is of particular interest when using the environmental model because the goal of the model (for performance measurement) is to make intraperiod standards valid by removing the effect of significant factors which the outlet manager cannot control

from the measure of his performance. Certainly the effect upon current operations of previous managers is not under the control of the present manager. Furthermore, after all significant, measurable, non-managerial factors have been considered, there may still remain some non-managerial influences which affect the performance of a particular outlet which cannot be identified or measured on a company-wide basis. The effects of these factors are confounded with the manager's contribution.

Even though the effects of such carryover and non-quantifiable factors cannot be segregated for individual outlets, it is possible to test whether such effects seem to exist for the region as a whole over time. If such effects are not significant for the region as a whole over time, increased confidence in the ability of the environmental model to remove the effects of non-managerial influences from the managerial performance measure is justified.

The expected contribution of the average manager is zero and his percentile standing is the 50th percentile. To illustrate the problem of the carryover effect, assume that manager number one of a particular outlet has been performing at the 95th percentile according to the environmental model and is promoted or resigns. If manager number two (the successor of manager one at the outlet) is an average manager, the percentile standing of the second manager (which has an expectation of 50) may also be quite high if there is a strong carryover and/or non-quantifiable effect. This high ranking would diminish over time to the 50th percentile as the carryover effect became less important and the true contribution of manager number two became apparent.

The percentile standing of a manager who stays at one outlet for several years will probably not change drastically over the periods; it

would be expected that the performance of a manager in year one would be about the same in year two and year three. However, if there are no strong carryover and non-quantifiable effects, there should be a considerable difference in the percentile standings of three different managers each assigned to an outlet for a period of one year.

To test the importance of such carryover and non-quantifiable effects, the eighty-four outlets which operated all three years were divided into three groups according to the number of managers which the outlet had over the three-year period. Thirty-five outlets were in group one which had a single manager over the period. Thirty-eight outlets were in group two which were the outlets with two managers. Only eleven outlets were in group three which had three managers over the period.

The variance of the estimated managerial contribution at each outlet was computed and the average variance for the three groups compared. The hypotheses tested were: The average variance of group three is greater than the average variance of group one or group two and, the average variance of group two is greater than the average variance of group one.

The results of the tests were not conclusive. The average variance of group two was significantly larger than the average variance of group one. However, the hypotheses concerning group three had to be rejected; the average variance of group three was not significantly larger than the average variance of either group one or two. The result of one test indicates little carryover while the other tests indicate that a strong carryover effect may exist. Group three was a small group and may not be representative of the outlets with three managers in three years for

the company as a whole. However, additional testing will be necessary to verify the effect of managerial carryover and non-quantifiable factors on the results of the environmental model.

Summary

The results of the tests of the primary hypothesis presented in this chapter do not "prove" that the environmental model is the best way to evaluate the performance of the managers of the outlets of the test company or even that the model is worth its cost of operation. It has been demonstrated that, in the test case, there were identifiable and measurable non-managerial factors which explained significant variation in the results of operations of the outlets.

The environmental model is an objective method for comparing the performances of all managers in all districts. District supervisors may be better able to evaluate the performance of the managers in their own particular districts because of the expert knowledge and familiarity with the potentials which exist at each outlet. Some of the "potential" characteristics may not be quantifiable and can be accounted for only by subjective evaluations. However, even if the district supervisors can rank their own managers adequately, the problem of comparisons among districts would remain.

Through the use of the environmental model, the performance of the outlet and its manager has been separated into components attributable to the various location and facility factors and the contribution of the manager. The location and facility factors, from a managerial performance measurement point of view, are of interest only so that the effect of these factors can be removed. However, these factors which

are not controllable by the outlet manager are controllable at some level of higher management.

The implications of the environmental model for the location and facility selection function of management is the subject of Chapter Four.

CHAPTER IV

IMPLICATIONS OF THE MODEL FOR LOCATION AND FACILITY SELECTION

The use of the environmental model for estimating outlet contribution to unallocable costs and profits which will result from various combinations of the location and facility factors is the subject of this chapter.

The net income of a multi-outlet business is equal to the sum of the contributions of the outlets to unallocable costs and profits minus the unallocable costs. Company net income can be increased by actions which will increase the sum of outlet contributions relatively more than unallocable costs or by actions which will reduce the unallocable costs relatively more than sum of the outlet contributions. The requirements of multi-outlet businesses for control of unallocable costs are essentially no different from other large organizations and such control systems will not be discussed here. The maximization of the sum of the contributions of the outlets is the route to higher profits which will be considered.

Differences in the contributions of outlets arise from differences in three broad factors: the locations of the outlets, the facilities of the outlets and the outlet managers. To maximize the sum of the outlet contributions, top management can (within certain constraints such as available funds, contract commitments, and costs of abandonments)

expand, contract, remodel, relocate or restaff and outlet or build new outlets.

In the previous chapters the primary emphasis has been on measuring and evaluating the performance of outlet managers. The use of the environmental model to gain a better understanding of the relationships among the various location and facility factors is yet to be considered. With a better understanding of these relationships, locations and facilities can be manipulated to increase the net income of the company.

The specific non-managerial factors and relationships among factors were of no interest when evaluating outlet managers, because the levels of the factors were not controllable by the outlet managers. The only reason for considering the factors was to remove their effects from the outlet operating results. The scope of the investigation is now expanded to include specific non-managerial factor---outlet contribution relationships.

Since top management can (within constraints) control the factors which are not controllable by the outlet manager, the specific factors and relationships among factors which are related to outlet performance are of interest when making location and facility decisions. Levels of factors can be adjusted to yield the maximum expected contribution from an outlet or group of outlets. The question which must be answered before such a maximization process can take place is "How is outlet performance related to the levels of the location and facility factors?" The environmental model will be used to answer this question.

The estimates of contribution relationships by the use of the environmental model are based on an analysis of the performance of the outlets in operation at the present time. Thus when using the

environmental model to predict the performance of future outlets or the effect of future changes in present outlets, it is implicitly assumed that the present relationships will extend into the (near) future. Since it is known that relationships change over time, it may be desirable to base predictions of future performance on the trends in relationships instead of the relationships which exist at the present time. With objective information as to how contribution is related to present combinations of location and facility factors (and trends in such relationships) management can reduce the uncertainty in making decisions concerning future combinations of factors.

A major benefit of using the environmental model is the separation of the effects of the three major determinants of outlet contributions so that informed "piecemeal" decisions as to the desirability of changing the levels of one or more of the factors can be made.

Since an outlet may have many managers over its life, location and facility decisions should not be biased by the inclusion of the contribution of a different-from-average manager. For location and facility decisions, therefore, the estimated managerial contribution term in the outlet performance equation should be the expectation of estimated managerial contribution which is zero.

The Profitability Measures

In evaluating the performance of outlet managers it is desirable to separate net contribution of the outlet into its component parts of sales and controllable expenses to give separate evaluations of the manager on his performance in selling and cost control. When making location and facility decisions, such a division is not necessary: the

net contribution of an outlet is all that is of interest.

Under a responsibility accounting system, outlet occupancy costs would be an expense allocated to the outlets but not charged against the outlet managers because the occupancy costs cannot be controlled by the outlet managers. When making location and facility decisions such costs are, of course, relevant. Occupancy costs could be subtracted from outlet contribution before occupancy costs and the analysis performed on the resulting net contribution to unallocable costs and profits. However, it seems logical that the factors determining occupancy costs can be best estimated by considering such costs separately from sales and controllable expenses because occupancy costs are likely to be related to different factors than are sales and controllable expenses. Sales may be closely related to population and median family income while construction costs or rental payments are related to other factors not closely related to population or median family income.

Estimates of occupancy costs for outlets could be determined by an analysis of the relationship of construction costs (or value of rentals) in the communities in which the present outlets of the firm are located. These relationships could then be applied to the locations and facilities being considered.

The two measures to be used in estimating outlet performance in this chapter are (1) outlet contribution before occupancy costs (i.e., outlet sales minus controllable expenses), and (2) outlet occupancy costs.

Determining Optimum Location and Facility Combinations

The determination of optimum location and facility combinations for

present outlets and potential outlets will now be discussed. The approach taken will parallel the presentation of O. L. Davies[1] in a chapter entitled, "The Determination of Optimum Conditions." Davies was concerned with yield in a chemical process while the yield in the present application is outlet contribution before occupancy costs. An optimum combination for a given outlet is that combination which yields the maximum expected contribution to unallocable costs and profits of the company.

The determination of and adjustment to optimum combinations of factors for given outlets is not equivalent to the maximization of the net income of a multi-outlet business. The maximization of the net income of a multi-outlet business is an extremely complex subject; it involves the determination of optimum firm size and capital funds market considerations as well as the determination of optimum location and facility combinations for given outlets. A detailed analysis of the maximization of company net income is clearly beyond the scope of this paper. However, the results of the environmental model might be used to advantage in such an analysis.[2]

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[1]Davies, O. L. (Ed.), The Design and Analysis of Industrial Experiments, Hafner Publishing Company, New York, 1956, pp. 495-551.

[2]The environmental model may also be useful in estimating cash flows for use in many of the capital budgeting models available today. In the test company, outlet sales depended on the length of time the outlet had been in the community and a definite pattern of cash flows followed a remodeling of the outlet facilities. The exact capital budgeting analysis which should be used by the multi-outlet business is beyond the scope of this study. The purpose here is merely to indicate how the data necessary for many of the decision models available today might be generated.

The adjustment to optimum combinations involves the expansion, contraction, remodeling, relocation or discontinuance of existing outlets and the planning of new outlets.

Facility changes are piecemeal revisions and the effect of a facility change is not difficult to visualize. The procedure is similar to partial differentiation in that the change in the level of only one factor is being considered while the levels of the other factor(s) are being held constant. To estimate the change in contribution resulting from a change in a factor such as store size of the addition or deletion of a service, it is only necessary to compute the expected contribution under the two conditions. By substituting the new values of the variable being considered for change into the outlet performance equation, the total expected contribution after the change can be computed. The expected contribution of the present combination would then be subtracted from the contribution of the revised outlet and the difference compared with the estimated cost of the revision in making the capital expenditure decision.

When making location and facility decisions for increasing the number of outlets, numerous combinations of facility and location factors are possible and the effect of changes in several factors at once is difficult to visualize. To help visualize the environmental model approach, a two and three non-managerial factor geometric representation will be utilized.

In a two factor model the relationship between the factors and outlet performance is a surface. The surface represents the performance response of the outlets to the various combinations of the location and

facility factors. In a three factor model, the response "surface" is a solid of varying density.

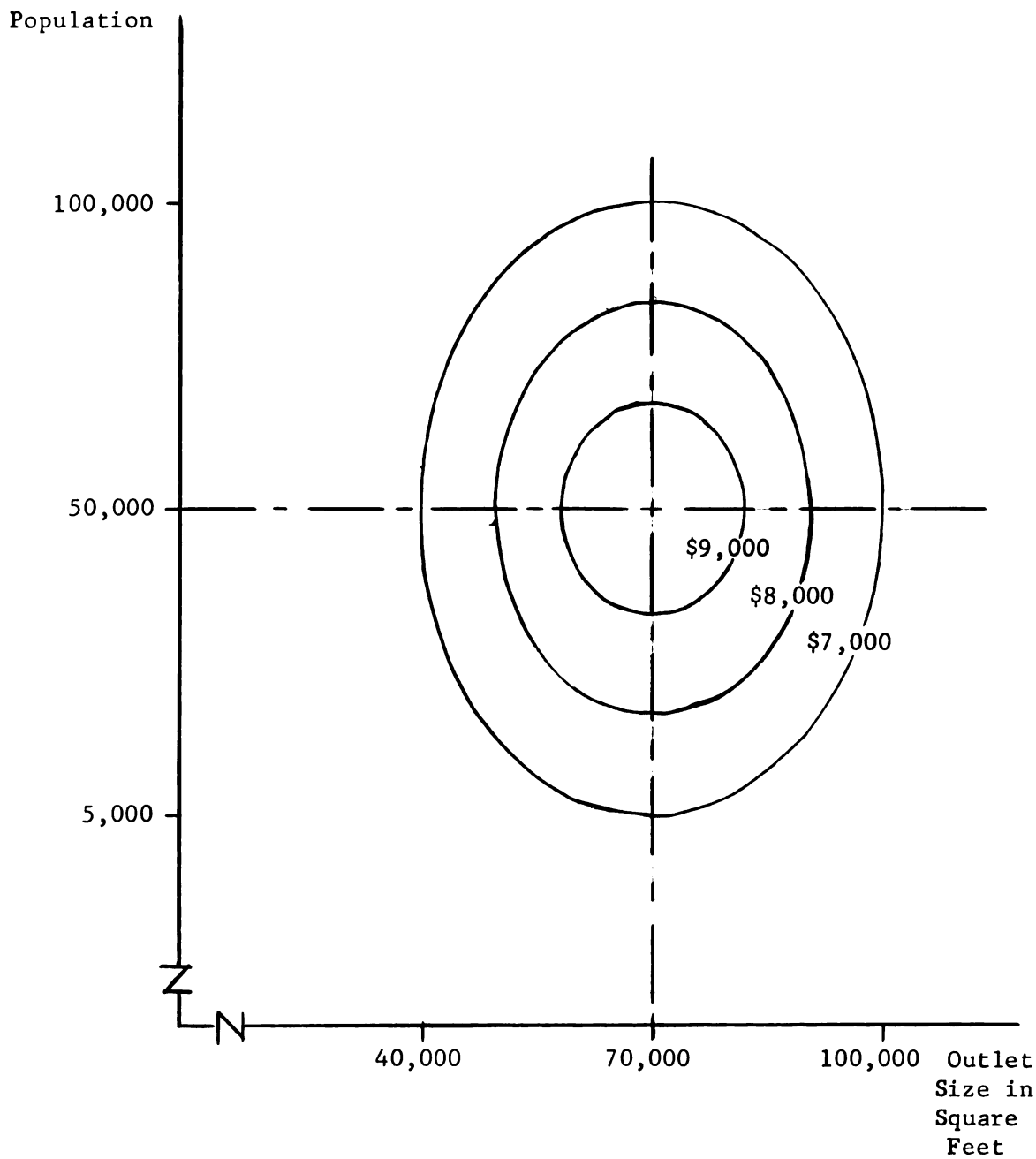
A contour map of the response surface can aid in the visualization of the expected effect of changes in up to three location and/or facility factors. While in many applications (as in the test company) there will be more than three significant non-managerial factors, the plotting of the contour of a two or three factor surface can still be useful because the two or three most important factors will often account for most of the variation in performance among the outlets. The algebraic model can, of course, be used for an "n" factor model and rank all possible locations and combinations of facilities which may be considered.

The Geometric Representation

Assume that the relationship shown in Figure 4.1 is the true, but unknown, relationship between the population of the city in which an outlet is located, the size of the outlet and the contribution of the outlet. The contour lines are the same as the lines of a contour map of geographic terrain--the lines on a map of terrain represent the locus of all combinations of the factors which yield equal contributions. The rate of ascent can be judged by the closeness of the contour lines.

In Figure 4.1, the optimum combination would be to locate outlets in cities with populations of 50,000 people and to build outlets with 70,000 square feet of floor space. This relationship can be estimated by the use of the environmental model and the performance of the present outlets. If the present outlets are located in cities ranging from 5,000 to 100,000 in population and are sized from 40,000 to 100,000

Figure 4.1. A two-factor surface



square feet, the true response surface can probably be estimated fairly accurately. That is, if the present outlets are a representative sample of all of the possible combinations, then the estimation of the response surface from the performance of the present outlets should give good predictions of the contributions of the future outlets.

Once the expected contributions of the possible future locations and facilities have been estimated, the estimated occupancy costs can be subtracted and the outlets ranked as to profitability. The entire exploration process can be programmed for a computer and the computer could develop the data showing the most attractive location and facility combinations.

It is not reasonable to assume that the environmental model can be relied upon as the only location and facility selection mechanism. However, the model could be used to scan a large number of locations and compute the expected contribution of all facility combinations for these locations. The Rayco Company has used a similar computer prediction and scanning system with much success.[3]

Some combinations which would likely be unprofitable could be eliminated from consideration by the location and research staff and some quite attractive combinations which may have been overlooked by the staff will be considered and noted. Some relationships considered to be of little importance by the research department may prove to be highly correlated with outlet contribution. The use of the model would replace intuition with objective estimates of expected performance based on the performance of the present outlets. Once the number of possible

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[3]"Can a Computer Tell You Where to Locate Stores?", Chain Store Age, Executive Edition, January, 1961, pp. E27-E28, E38.

locations and facility combinations has been reduced, specific estimates of construction costs from local contractors or estimates of rentals from local realtors can be substituted for the index of construction or rental costs from secondary sources. This substitution will improve the estimate of the expected net benefits from the new outlet and possibly help to further decide the desirable course of action.

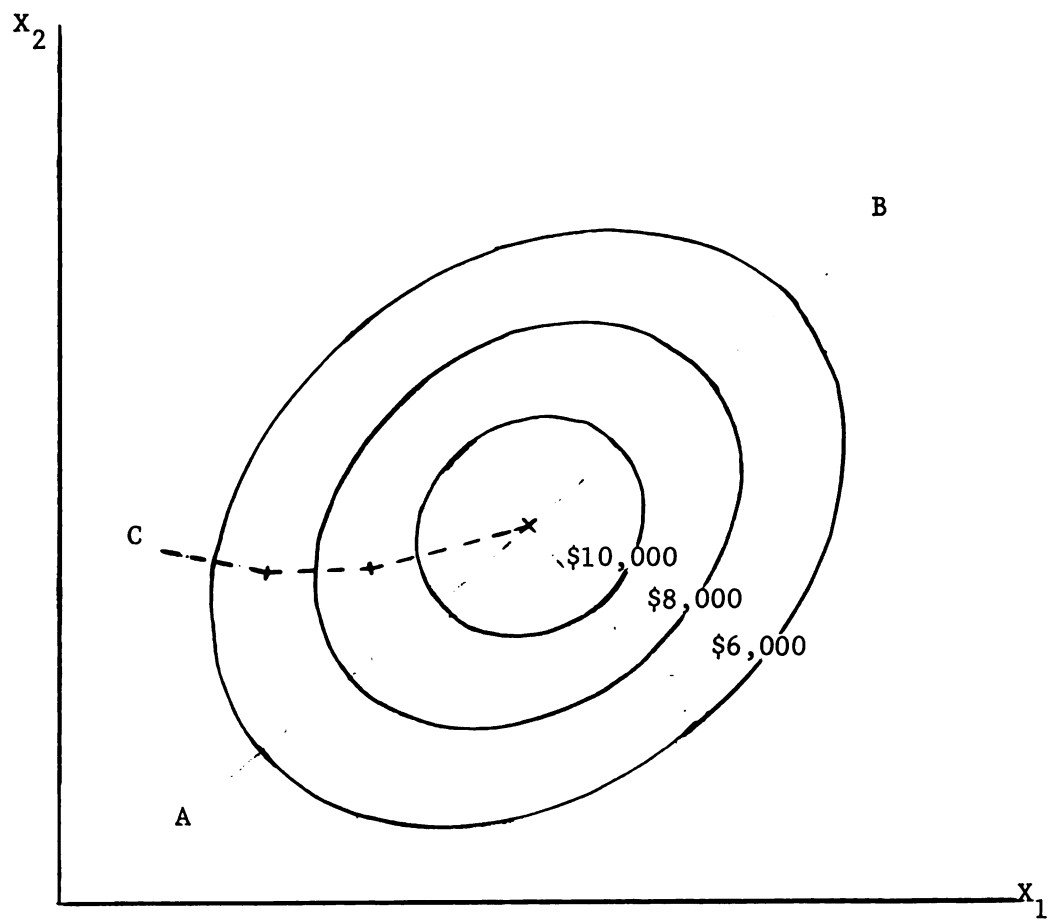
When the present outlets are not representative of the possible combinations, the expected contributions of outlets with factor combinations far from the levels tested may be very much in error. For example, assume that the present outlets of a firm are at combinations of factors near point A in Figure 4.2. From this sample of all possible X_1 and X_2 combinations, the linear effects of the factors would dominate. Even if the quadratic effects were significant, the effects would be small and the estimates of the quadratic coefficients would likely be very much in error.

If the company projected contributions based on the regression coefficients computed from the outlets near point A, it would locate new outlets at combinations of large values of X_1 and X_2--say near point B. By so doing, the contributions of the new outlets would be very little different from the contributions of the old outlets. Company profit would likely be reduced if one of the factors was square feet of floor space because of higher occupancy costs of the new larger outlets. While such a dramatic underestimate of contributions may not be likely in practical situations, significant (and costly) errors from extrapolation are possible.

If changes are made in the direction of the steepest ascent of the contribution "hill" as indicated by the model, and if the changes are

relatively small so that the relationships expressed by the model still apply (at least approximately), the profit of the company will rise. By repeating the process of estimating the coefficients and locating the new outlets in the direction of steepest ascent, the contribution hill can be climbed and the optimum conditions eventually determined. The path taken would be approximately perpendicular to the equi-contribution contour lines. The path from point C to the optimum combination in three steps is also illustrated in Figure 4.2.

Figure 4.2. Determining optimum conditions



In some multi-outlet businesses, there may be no unique maximum expected contribution as existed in Figure 4.1 and Figure 4.2. Davies[4] presents three examples in which no such maximum exists (see Figure 4.3). The shape of the contribution contour can have significant implications for location and facility selection. For example, in Figure 4.3 (a) there is a strong interaction between X_1 and X_2. If the factors are outlet size and median age in the neighborhood, the company could keep outlet contributions constant and reduce occupancy costs by shifting to small outlets in neighborhoods with many older citizens.

Figure 4.3 (b) illustrates the desirability of testing more factors than are expected to be significant to be sure that all, possibly significant factors are investigated--not just the ones which are logically the most important. Suppose that the firm's present outlets are located near point A and the firm considers expanding its operations through the addition of outlets. From a one-way analysis based only on factor X_1, it appears that high contributions are associated with large values of X_1. If the additions are made in that direction, company profits will rise. By considering only factor X_1, however, point B is mistaken for the optimum point. Point B is an optimum but only for the given value of X_2! If the original outlets were located near C and only X_2 was varied, the same point B would have been reached. Only by considering the two factors simultaneously would the true relationship between X_1, X_2 and outlet contribution be discovered.

The accuracy of the predictions of the model may signal the need for considering additional factors. If the variance of the estimates of

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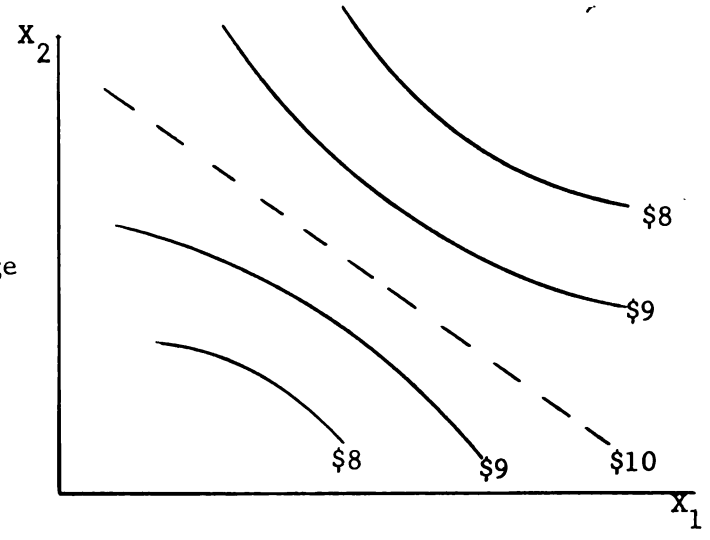
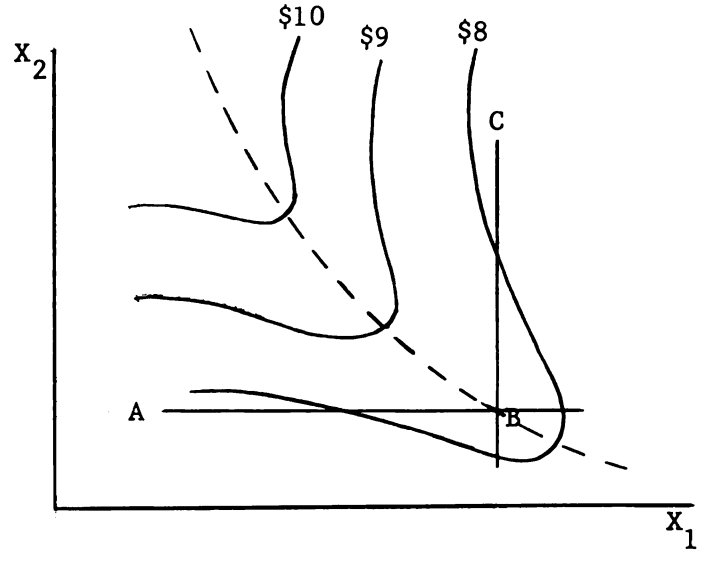
[4]Davies, p. 504.

Figure 4.3. Other two-factor surfaces

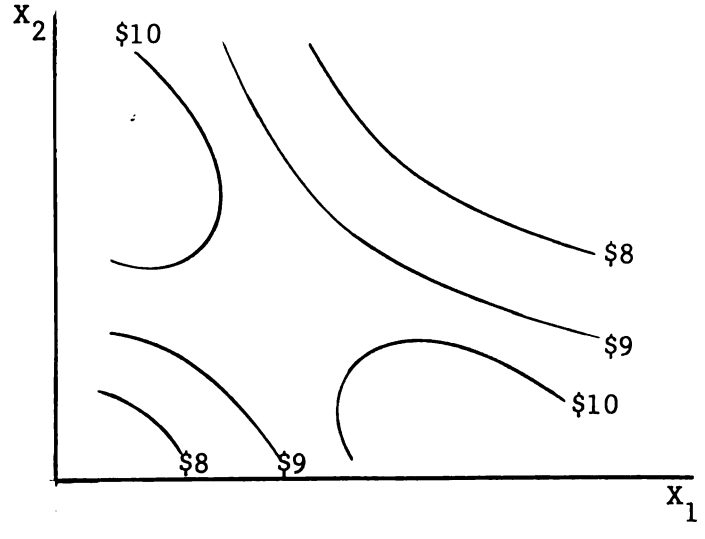
(a) Stationary Ridge



(b) Rising Ridge



(c) Minimax



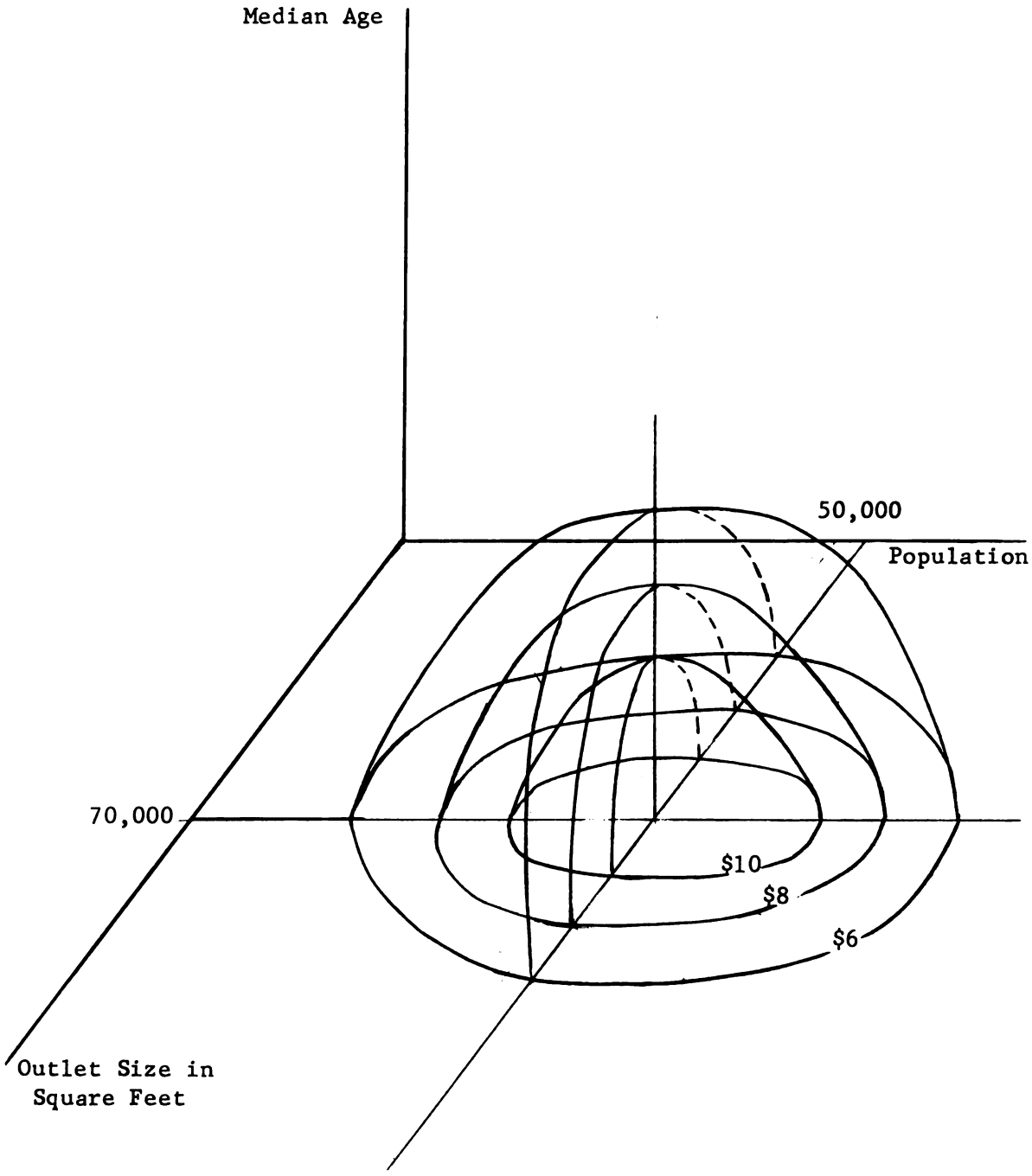
expected outlet performance is large, a factor which has not been considered may explain much of the variance of the estimates. The example in Figure 4.1 could be expanded by considering a third factor, say median age in a community. By adding a third dimension for age, the locus of the equi-contribution lines might be represented by the concentric shells shown in Figure 4.4. The relationships for store size and population are the same as in Figure 4.1: only the third, previously unconsidered factor is added.

Other Location and Facility Problems

In the test company, all non-managerial data were gathered from the financial, property and personnel records of the firm or from published secondary data. In other applications such data will not be adequate, especially for scanning new sites. The needed data may require first-hand knowledge and observation.

For most multi-outlet businesses, several outlets may be located in one community or metropolitan area. In these companies the location of the outlets within the city becomes much more important than was true for the test firm with only one outlet per community. When there are several outlets in one locale, the problem of overlapping trade areas may reduce the efficiency of the outlets. That is, a new outlet may simply take away the customers from the present outlets of the company. Profits of the company will be reduced because combined sales have remained approximately constant while occupancy costs and salaries have risen. For such firms, a "proximity to other outlets" factor should be investigated and possibly included in the model. The shopping habits of consumers in the community would be of interest in such an investigation.

Figure 4.4. A three-factor surface



Montgomery Ward & Company has had some success in defining trade areas by tracing automobile license tags observed in shopping centers to the addresses of the owners of the automobiles on the automobile registrations.[5] Such an analysis could be more informative than a mere spatial analysis because of differences in access roads and traveling habits.

Store saturation[6] for the type of outlet in question could be investigated by an analysis of competition and a breakdown of retail sales in the area. Not only existing facilities and competition but also planned additions of competitors should be considered.

The types of goods being offered by the outlets help determine the number and location of outlets within a community. For outlets offering "convenience" goods (low in unit value, quickly consumed and standardized in nature) the primary consideration should be the accessibility of the outlet.[7] Proximity to traffic arteries, volume and nature of traffic, and ease of entry and exit for parking may be very important considerations for locating "convenience" outlets. Even the side of the street on which the outlet is located may be important in attracting the segment of traffic important to the outlet. A doughnut shop may find it desirable to locate to the right side of work-bound traffic while a convenience grocery may locate to the right of home-bound

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[5]"Area Research Gives Ward Detailed Basis for Growth," Chain Store Age, Executive Edition, December, 1964, p. E28.

[6]"Saturation implies a balance between the amount of existing retail store facilities and their use (which in turn is a reflection of need)." (William Applebaum and Saul B. Cohen, "Trading Area Networks and Problems of Store Saturation," Journal of Retailing, Winter 1961-62, p. 35).

[7]John E. Mertes, "A Retail Structural Theory for Site Analysis," Journal of Retailing, Summer 1964, p. 19.

traffic. The environmental model can be used to measure the importance of these factors.

For "comparison" goods (characterized by high unit value and relative durability) fewer outlets may be needed but the location of the few may be quite important. Stores offering the same type of comparison goods are often located together. If an outlet offering the same type of goods is located elsewhere, it may not even be considered by some potential customers or gain such consideration only by offering sizeable discounts from the usual price. Neither situation is desirable unless a large difference in occupancy cost can offset the disadvantage of the location. Again, the use of the environmental might reveal such a relationship.

Summary

The use of the environmental model in location and facility planning is potentially of great benefit. The outlets of a multi-outlet business are a large number of homogeneous units which, individually, are an insignificant part of the whole organization. There are far too many outlets for a detailed subjective analysis of each possible change for each outlet. The environmental model provides an objective method for estimating the effect of numerous possible changes.

If present relationships in a company between the location and facility factors and outlet contribution hold for future outlets, good predictions should result. The identification and measurement of the relevant factors and trends in factors may be much more difficult for other applications of the model than it was for the test company. However, the saving of real estate research investigation costs and the

improved predictive power of the model may be well worth the effort and expense of the use of the model.

CHAPTER V

SUMMARY AND CONCLUSIONS

In this chapter, the environmental model is summarized and the conclusions from the testing of the model presented. The limitations of the study and areas for further research are indicated.

Summary of the Environmental Model

Any measure of performance must be compared with a standard or norm of performance before the measure is meaningful. In accounting, there are three types of standards: (1) interperiod standards, (2) intraperiod standards, and (3) predetermined standards.

Standards for evaluating the performance of outlet managers in companies with numerous outlets are difficult to formulate because of the differences in the profit potentials of the various outlets. Differences in measured performance among outlets may be explained by differences in the locations and facilities of the outlets as well as the differences in the performance of the outlet managers. Since the location and facilities of an outlet are not controllable by the outlet manager, the effects of these "non-managerial" factors should be extracted before evaluating the performance of the outlet manager.

Interperiod standards have limited applicability and are of very little use in multi-outlet organizations. The use of predetermined standards is difficult because of the large number of outlets.

Predetermined standards set by central corporate officials cannot reflect the differences in profit potentials of the outlets and standards set by district supervisors don't allow a valid comparison of managers among districts.

The environmental model is an objective method for estimating and extracting the effects of the non-managerial factors causing significant differences in the measured performance of the outlets. In applying the method, a linear statistical model of the performance of the outlets is constructed using accounting data on outlet sales and controllable expenses and data on the levels of the non-managerial factors under which the outlets are operated. The effects of significant non-managerial factors are removed from the outlet performance to provide a measure of performance which is more related to the actions of the outlet manager.

By removing the effects of the non-managerial factors from the performance measure of the outlet manager, the use of the environmental model makes the measures comparable among the managers. The ranking of estimated managerial contributions forms a valid intraperiod standard.

The model utilizes responsibility accounting performance data already gathered in the usual course of business and relates this data to the levels of the environmental factors under which the outlets are operated.

Through the separation of the effects of the three broad factors, the relative importance of the manager and the location and facility factors can be determined. If managerial differences are important in determining outlet contribution, much effort and expense should be devoted to manager selection and training. If the contribution of the outlets depends primarily on the particular location and facilities of

the outlet, then relatively more resources should be devoted to location and facility selection with less emphasis on the selection of managers.

In a broader sense, the environmental model can be used to maximize the profit of the multi-outlet business by examining interrelationships among the three broad factors explaining differences in performance among outlets. The specific non-managerial factors and relationships among the factors are of interest in planning outlet locations and facilities. It is not feasible to rely on only the model to make location and facility decisions, but the model can be used to narrow the scope of detailed subjective investigations. The exploratory use of the model for investigating numerous possible locations and various combinations of facilities may point up attractive opportunities which would be overlooked by subjective research. Furthermore, the model could help quantify certain concepts and relationships which have been discussed in only qualitative terms.

The environmental model has been formulated and tested in a national firm offering a wide range of goods and services through catalogs and retail stores. The study was limited to the catalog sales division of the company. The factor structure for the firm was a relatively simple one; complications will undoubtedly arise in other applications of the model.

In the test company there were non-managerial factors which explained significant variation in the transforms of net sales and controllable expenses of the outlets. The location and facility differences among the outlets were of much greater importance in determining outlet contribution than were the differences among the outlet managers.

The environmental model approach to performance measurement is applicable to only a limited number of businesses. There must be a large number of relatively homogeneous outlets. The large number of outlets is necessary to "average out" chance fluctuations to generate the overall effects of the factors. With only a few heterogeneous outlets, considerable confounding of factor effects will result because of too few observations to be able to separate the effects of all of the factors. Fortunately the limitations of predetermined standards are less critical when used in firms with a few outlets.

Potential Advantages and Disadvantages of the Model

The environmental model for performance measurement can have the following advantages as a tool for evaluating managerial performance in multi-outlet businesses.

Relevance: The environments in which outlets are operated do not have equal potentials for profits. It is the effect of the actions of the outlet manager and not the effect of the combination of location, facilities and the manager that is needed in evaluating the performance of an outlet manager. The environmental model provides a relevant measure of performance and a valid intraperiod standard with which to judge the measured performance of a manager.

Objectivity: In a responsibility accounting system, arbitrary allocations of certain common costs are eliminated from the performance measure of outlets. In the environmental model approach, the effects of all significant non-managerial influences are objectively estimated and removed from the measure of performance of the outlet manager.

Implementability: The environmental model is in agreement with current responsibility accounting concepts and can be implemented with presently generated accounting data and certain other information concerning the levels of the environmental factors under which outlets are operated.

One limitation of the use of the environmental model could be the lack of acceptance of the model results as a valid measure of performance by the outlet managers. For example, it may be difficult to convince a manager whose outlet may have the highest contribution in all districts, that his performance is not satisfactory considering the potential of the outlet as estimated by the model. Such a dramatic change in ranking is possible if managers are assigned to outlets with different potentials. Some of the better managers will be assigned to the poorer outlets and some of the poorer managers will be assigned to the better outlets. This is an education problem, however, and should be overcome if the value of the environmental model approach can be demonstrated. Most managers will agree that the profit potentials of the outlets are not equal and the environmental model is an objective method of making adjustments for the effects of classifiable differences in potentials.

Other possible disadvantages of the model are the difficulty in identifying and measuring the relevant non-managerial factors and the difficulty of classifying the outlets according to these factors. Additional empirical testing will show whether these practical problems can be overcome.

Limitations of the Study

In the tests conducted in this study, an environmental model was constructed and the results of the model analyzed. The model was not used in the day-to-day operations of the test firm. Thus, the behavioral effects of the model as a motivating and control device have not been investigated. This problem may have considerable importance and should be investigated on an individual firm basis before installing the environmental model in the accounting system.

As stated earlier, the test company was selected for its characteristics which simplify the formulation and testing of the model. Most other multi-outlet businesses will have a more complicated non-managerial factor structure. There are no problems in theory in extending the environmental model approach to companies with a complex factor structure.

Another limitation of the study concerns the predictive power of the environmental model over time. For planning new outlets, it is future relationships and not current relationships that are of interest. Populations, products and buying habits change over time. Store locations and facilities mature and decline. The usefulness of the environmental model for location and facility selection may be in estimating trends in relationships and not the relationships at any particular point in time. The inputs for the environmental model are past performance data and thus if the type of location or facility being considered is substantially different from present and past outlets the potential of the new locations and facilities cannot be accurately estimated by the model.

Areas for Additional Research

The areas for additional research are related to the limitations of the present study.

The behavioral implications of all standards used in accounting is an area in need of much research. Adverse reaction of subordinates may completely outweigh the advantages of a standard. Numerous cases of practical problems with standards and motivation could be cited. Most of these cases involve production or time standards.

The use of standards in marketing (and particularly standards for sales) is a much more recent development in accounting and very little is known about the effects of such standards on marketing personnel. An investigation of the effects of the environmental model on outlet managers may well provide insight into the broader area of marketing standards. The environmental model as a test mechanism has the advantage of being objective and can even be used to test the effects of factors which the outlet managers themselves consider to be causes of differences in profit potentials.

The application of the environmental model to companies with more complicated factor structures will present practical problems. However, the complex firm is the one in which mathematical tools like the environmental model are most needed. In a small firm, the owner can direct the operations of the entire firm by personal observation and subjective standards of performance. In a large firm, the number of outlets alone makes a more structured evaluation system necessary.

The adaptation of linear statistical models to complex problems of analysis has been taking place for several decades in the natural sciences and more recently in the social sciences. There are many

statistical tools now available for use in constructing an environmental model for a very complex multi-outlet business. Such applications should be attempted.

The environmental model has been tested over only one three-year period. The time period was relatively short and no attempt was made to extract trends in relationships over time. The use of the environmental model to extract trends in location and facility relationships should be attempted and then followed by an analysis of the predictive power of the model.

Conclusion

The environmental model offers many potential benefits to the multi-outlet business with a small addition to the costs of the operation of a responsibility accounting system. Theoretically, the model offers a solution to the problem of objective measurement of the performance of outlet managers and provides guides to resource allocation in selecting managers, locations and facilities.

The empirical testing of the model indicates that the effects of the non-managerial factors are significant and can be much more important than the manager in determining outlet contribution to unallocable costs and profits. It has been shown that the rankings of managerial performance based on the environmental model can be grossly different from the rankings of outlet performance. If the assumptions of the environmental model are valid, the test results indicate that intraperiod standards based on outlet contributions may be a very poor approximation to rankings based upon the estimated effects of managerial actions. Poor managers may be given preference over excellent managers if the

outlet contributions are taken as the measure of managerial performance. The error is due to the confounding of the effects of the location and facility factors with the effects of the manager's actions.

Generalization to other multi-outlet businesses is hazardous. However, on the basis of the test results, the environmental model seems to offer much insight into the profitability relationships in the multi-outlet business.

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APPENDIX A

AN ILLUSTRATIVE COMPUTATION OF ESTIMATED MANAGERIAL CONTRIBUTION

The purpose of this appendix is to illustrate the computation of the estimated contribution of the manager to the measured performance of an outlet and the estimated percentile standing of the manager's performance. The computation of the estimated contribution and percentile standing of the manager of outlet number one of the test company to the logarithm of sales for 1966 will be illustrated.

Outlet number one issued 2,000 catalogs during 1966. The outlet was first opened in the community in 1938 and last remodeled in 1947. The community in which the outlet is located has a median age of 33 years, a median family income of $5,500, and a population of 13,100. The third secondary competitor operates an outlet in the community.

The seasonally adjusted net sales by quarter for 1966 for the outlet were: $81,423, $73,712, $78,946 and $71,225. The logarithms of net sales were: 4.910747, 4.867538, 4.897330 and 4.852632. $\bar{Y}_{1.}$ was thus equal to 4.882061.

Table A.1 illustrates the computation of the non-managerial factor effects (outlet one is located in district one and the district one effect for 1966 was − .100226).

Substituting into the formula for the estimate of managerial contribution, it is seen that $\hat{M}_1$ is equal to .094930.

Table A.1. Computation of the non-managerial factor effects for outlet number one for 1966

Factor	Parameter Estimate[a] ($\hat{B}_i$)	x	Factor Level (X_{i1})	=	Estimated Factor Effect ($\hat{B}_i X_{i1}$)
Number of catalogs issued[b]	.010499		20		.209980
Number of catalogs issued (quadratic effect)	−.000001		400		−.000400
Years since opening	.010837		28		.303436
Median age	−.006972		33		−.230076
Median family income[b]	.002983		55		.164065
District 1	−.100216		1		−.100216
District 2	xxx		0		0
.	.		.		
.	.		.		
.	.		.		
District 10	xxx		0		0
Population[b] X Secondary Competitor #3	−.000144		131		−.018864
Years since remodeling	.016374		19		.311106
Years since remodeling (quadratic effect)	−.000423		361		−.152703
Years since opening (quadratic effect)	−.000199		784		−.156016
Population[b] X median family income[b]	.000002		7205		.014410
			$\sum_{i=1}^{20} B_i X_{i1}$		.344712

[a] See Appendix Table B.3.

[b] Factor level measured in one-hundreds.

$$\hat{M}_1 = \bar{Y}_{1.} - (\hat{A} + \sum_{i=1}^{20} \hat{B}_i X_{i1})$$

$$= 4.882061 - (4.442419^{a} + .344712)$$

$$= .094930.$$

As was mentioned on page 26, the estimated managerial contributions for the test company were approximately normally distributed. The estimated standard deviation of the managerial contribution estimates for 1966 was .083246. The distribution of estimated managerial contributions was converted to a standard normal distribution by dividing each contribution by the standard deviation.

The manager of outlet one had a "standardized" estimated contribution of 1.140--(.094930/.083246)--that is, the manager of outlet one was performing at a level 1.140 standard deviations above the average for all managers. By referring to a cumulative standard normal table, it is seen that 1.140 is at the 87th percentile in a standard normal distribution.

Thus, it is estimated that the manager of outlet number one performed at a level above that of 87 percent of his fellow managers for 1966.

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[a]See Appendix Table B.3.

APPENDIX B

PARAMETER ESTIMATES - 1964, 1965, 1966

Table B.1. Parameter estimates[a]
1964

Logarithm of Net Outlet Sales

Factor	Estimate
Regression constant	6.028347
Number of catalogs issued[b]	.003656
Years since remodeling	.017253
Years since remodeling (quadratic effect)	− .000609
Median age	− .008571
Median age (quadratic effect)	.001260
Secondary competitor #3	− .336354
Years since opening[b]	.001903
Median family income[b]	.004326
Median years of schooling	.004962
Shopping center X population[b]	.000093
Median years of schooling (quadratic effect)	.000237

Square Root of Controllable Expenses

Factor	Estimate
Regression constant	53.307352
Sales	.026709
Distance from distribution center	4.420873

[a]Non-managerial factors are listed in the order in which they were added to the equations in the stepwise addition of variables.

[b]Factor level measured in one-hundreds.

Table B.2. Parameter estimates[a]
1965

Logarithm of Net Outlet Sales

Factor	Estimate
Regression constant	4.462961
Number of catalogs issued[b]	.004280
Years since remodeling	.014347
Years since remodeling (quadratic effect)	− .000524
Numbers of catalogs issued (quadratic effect)	− .000001
Years since opening	.010399
Years since opening (quadratic effect)	− .000208
Secondary competitor #3	− .340534
Median family income[b]	.003801
Median years of schooling	.004325
Median years of schooling (quadratic effect)	.000143

Square Root of Controllable Expenses

Factor	Estimate
Regression constant	55.222405
Sales	.039237
Managerial tenure	− 1.532677

[a]Non-managerial factors are listed in the order in which they were added to the equations in the stepwise addition of variables.

[b]Factor level measured in one-hundreds.

Table B.3. Parameter estimates[a]
1966

Logarithm of Net Outlet Sales

Factor	Estimate
Regression constant	4.442419
Number of catalogs issued[b]	.010499
Number of catalogs issued (quadratic effect)	− .000001
Years since opening	.010837
Median age	− .006972
Median family income[b]	.002983
Population X secondary competitor #3	− .000144
Years since remodeling	.016374
Years since remodeling (quadratic effect)	− .000423
Years since opening (quadratic effect)	− .000199
Population[b] X median family income[b]	.000002

Square Root of Controllable Expenses

Factor	Estimate
Regression constant	58.899033
Sales	.053328
Managerial tenure	− 1.718602

[a]Non-managerial factors are listed in the order in which they were added to the equations in the stepwise addition of variables.

[b]Factor level measured in one-hundreds.