On Interaction in the Sales Function and Econometric Methods

By Jan Aarsø Nielsen*)

Resumé

One of the classic marketing problems is the exisence of interaction in the sales function of the firm. The author formulates an economic strategy to solve this problem by a simultaneous use of economic theory, mathematics and statistical induction. The main element in the strategy is different types of search-learning processes, based on multiple regression analysis and the statistical techniques of model-control. To attain economic lines to determine the test-level of the model-control the author defines the concept of sensitivity of the functional form.

1. The problem

Econometrics can be defined as the science in which economic theory, mathematics and statistical induction is used simultaneously in analysing and determining economic relations. This article deals with how to use this coupling of three scientific fields to offer further possibilities of solution to a classic marketing problem, namely how a decision maker must and can consider that *several* determinants influence the sales *at the same time as the partial relationships* between the sales and a given determinant *depends upon the values of the others.*

This problem, which shortly can be described as *interaction in the sales function of the firm,* has given rise to concepts like marketing mix, marketing-strategy, sales policy etc. Our problem in this article can be formulated as follows:

1. To examine the previous treatment of interaction within the statistical and marketing theory briefly,

2. in order to reach an econometric formulation of the sales function of the firm, which makes it possible to quantify the interaction in this function by application of the multiple regression analysis.

3. To show how an *ex-post control of the model* becomes necessary, and

*) Ass. professor, cand. merc. The Marketing Institute at The Copenhagen School of Economics and Business Administration. January 1972.

On Interaction in the Sales Function and Econometric Methods

By Jan Aarsø Nielsen*)

Resumé

One of the classic marketing problems is the exisence of interaction in the sales function of the firm. The author formulates an economic strategy to solve this problem by a simultaneous use of economic theory, mathematics and statistical induction. The main element in the strategy is different types of search-learning processes, based on multiple regression analysis and the statistical techniques of model-control. To attain economic lines to determine the test-level of the model-control the author defines the concept of sensitivity of the functional form.

1. The problem

Econometrics can be defined as the science in which economic theory, mathematics and statistical induction is used simultaneously in analysing and determining economic relations. This article deals with how to use this coupling of three scientific fields to offer further possibilities of solution to a classic marketing problem, namely how a decision maker must and can consider that *several* determinants influence the sales *at the same time as the partial relationships* between the sales and a given determinant *depends upon the values of the others.*

This problem, which shortly can be described as *interaction in the sales function of the firm,* has given rise to concepts like marketing mix, marketing-strategy, sales policy etc. Our problem in this article can be formulated as follows:

1. To examine the previous treatment of interaction within the statistical and marketing theory briefly,

2. in order to reach an econometric formulation of the sales function of the firm, which makes it possible to quantify the interaction in this function by application of the multiple regression analysis.

3. To show how an *ex-post control of the model* becomes necessary, and

*) Ass. professor, cand. merc. The Marketing Institute at The Copenhagen School of Economics and Business Administration. January 1972.

4. on this basis to sketch how the multiple regression analysis and the statistical techniques of *model control* may enter into the different types *search-learning processes, we consider being a way of solving the problem of interaction in the sales function of the firm.*

5. Further, we shall set up a procedure of how a decision maker can obtain economic lines to determine the test-level of the model-control. In this connection we shall define the concept of *sensitivity of the functional form.*

Our discussion can thus be said to contain an attempt to formulate an economic strategy to solve the interaction-problem.

2. A Fundamental Examination of the Previous Treatment of Interaction within Statistics and Marketing Theory

In the classical experiments the scientist carefully tried to fix each factor that determined his dependent variable with exception of the one whose effect he wanted to estimate. If several factors were under study, the researcher then proceeded to fix all independent variables except the second variable under study and so on.

However, these classical experimental designs ignore possible interactions among the factors assumed to affect the response, and, if interaction has any importance, varying one factor at a time must lead to that the scientist only gets some unconnected information *that cannot form a whole.* This is, of course, owing to the fact that, in order to carry out an experiment analysing the effect of a single variable you must fix the values/states of the other influencing factors at a given level, which means that the only thing the experiment estimates is the effect of the variable for the given combination of values/states of the other determinants. Being seldom interested exactly in this combination, this must imply, that neglecting the interaction involves that the *external validity* of the experiment is reduced.

In the theory of statistic experiments the realization of this has led to the formulation of designs that to some extent makes it possible to take this situation into account. Here we shall only mention the factorial designs characterized by analysing the value of the dependent variable for all combinations of states of the independent variables.

The variables underlying the mentioned states can be either quantitative or qualitative of nature but, and here we get to an essential point, the use of the designs *requires that variables, being of nature quantitative, are made qualitative, f. inst. through defining value-intervals as states.*

The fact that the factorial designs in principle implies discontinous variables, was, historically, considered unsatisfactory within the statistical theory. To solve this problems one has, therefore, developed methods and designs able to handle variables which can vary *quantitatively*. If *more* variables enter the model, which is certainly the situation in connection with the sales function of the firm, these methods are described as *multiple regression analysis* or *multiple correlation analysis*.

The classic economics was based mostly upon partial relations or partial models. By partial models we shall understand models with one dependent and *one* independent variable.

In principle this was true of both micro and macro-economics although the reasoning was surely most widely used within the former subject. As the normative micro-economics largely has taken over models, types of models, and methods from the "descriptive" micro-economics of the macro-economics, the partial models have been almost universal, *at least at the deductive level*. Thus it appears that the method of varying one factor at a time has been highly prevalent within the economic theory, which cannot surprise anybody, a.o. because economics has "grown up" in the classic, logical system as a special use of logical operations. However, in Danish micro-economics professor Arne Rasmussen in his thesis (Rasmussen, 1955, pag. 138 ff.) has opened to a more total way of consideration by pointing out the interaction in the sales function of the firm.

It should thus be clear that interaction in the sales function at the formal level has been discussed within marketing theory in a number of years. Later Arne Rasmussen has followed up this opening towards more total considerations in his article: "Veje til en flerparameterteori" (in English: "Paths to a multi-decision-variable-theory") (Rasmussen, 1967), in which a number of possible paths are discussed. The conclusion of Arne Rasmussen's article is that as progress one should apply the production theory concepts of restrictions, substitution and complementarism within the marketing theory. However, before formulating this conclusion several different ways are mentioned as leading to a multi-variable theory.

Among these are:

"The formal (abstract) consideration",

and,

"solution by simulation",

It is the idea of the following that one way to open up the problem of interaction is a *coupling* of these approaches. This involves the mentioned statistical methods to handle interaction, just as we must use a mathematical formulation of the sales function.

3. The Multiple Regression Analysis and Interaction in the Sales Function of the Firm

We will begin our discussion in this section by considering shortly the "simplest" quantitative way of analysing the interaction of the sales function, namely application of the factorial designs previously discussed.

However, when dealing with economics, including especially marketing problems, such a course should only be possible as an exception. Thus the factorial designs can only be used when *a few* discrete variables, which can only adopt few states, are determinants in the sales function of the firm. In any other case the problems around procuring data will make the design inapplicable to practice, which of course is due to the fact that one to a great extent must base upon survey-data within economics. But it might also be difficult to procure sufficient test-units, when it is about proper marketing-experiments, and, be it possible, the costs would probably be prohibitive.

This implies that we must consider the statistical methods that can handle quantitatively varying independent variables, and here the multiple regression analysis – as mentioned in section 2 – proves the most obvious one. This method is treated in most advanced statistical tests-books, and for a further treatment of the analysis, the conditions and problems in connection with its use in determining the sales function can be referred to Aarsø Nielsen (1970/1).

It is thus this statistical method we look upon as the connection between the two by Arne Rasmussen (1967) established "Paths to a multi-variable-theory". First suppose that the firm has isolated the most essential sales determinants from the marketing theory and/or its experiences. As the multiple regression analysis under certain conditions is able to estimate the unknown parameters in the sales function if the firm is able to formulate the *functional form* in which these determinants should be linked with the parameters, *the problem is which functional form to choose.*

In our opinion, the marketing theory is able to deliver methods to isolate relevant sales determinants to a still larger extent than being able to assist in determining the functional form. This, of course, depends on the fact that economic research has almost entirely been persued as partial studies.

Theory does not tell when the sales function is linear in the independent variables, in the logarithms of these, in the reciprocal values, nor whether it is a question of quite different functional forms.

As it is a fact, however, that each functional form implies its own interaction pattern (Aarsø Nielsen, 1971) this means as to the solution of the interaction problem – as far as we can see – that the economist has only two alternatives. Either he can give "quantitatively" in and base on the concepts of substitution and complementarism, or still he can try to pull through by adapting himself. The procedure which we do find viable for the firm in trying to get through to a *quantification* of the interaction in its sales function should be a combination of two courses: namely a *deductive* and an *empiric* one. By use of the multiple regression analysis, it consists of trying different theoretical/empirical *non-rejectable* functional forms, linking the isolated sales determinants on some given data made up of connected values of sales and the sales determinants, and finally evaluate the result a.o. from the "goodness of fit" of the functional forms.

In our opinion this should imply that neither a priori knowledge nor the available data can solve by itself the problem: Which function the decision maker should choose, but the method must consist of a combination of the two procedures. However, this simultaneous use of deduction and empiricism has its serious danger because in principle one must a.o. a priori have formulated the non stochastic structure of the econometric model to be able to use the statistical techniques as this is part of the maintained hypotheses, i.e. the functional form should be known exactly. However, by the simulation method to choose functional form *this is exactly not the case.*

Choosing the functional form from its theoretical plausibility and on the basis of how well it fits the available data leads to that in principle the classic/statistical inferential processes *cannot be used on the same data.*

Then if we test the "goodness of fit" of the function, f.i. starting in Students-t-distribution, the danger arises that we come to the conclusion too often that the hypothesis should be accepted. This entire problem is of course "due to" the fact that the statistical inference theory enables us to choose between a confined set of alternative hypotheses. But it is insufficiently developed to make a choice possible between an undefined, unspecified number of alternative hypotheses, what it naturally never did pretend. The best and at the present phase of theory the only protection against the above mentioned danger will be testing the chosen function with the estimated parameters against data, which have not influenced the choice of the functional form. This implies that it is in this *model control* combined with and in addition to the multiple regression analysis we see the way towards further solution of the interaction problem in the sales function of the firm. This is subject of our discussion in the next section.

4. Model control as an Element in the Solution of the Interaction Problem

Suppose at first that the model depicting the sales function is formulated as a *time-series-model* i.e. a model assumed to be valid for a number of time periods. The estimation of the parameters then takes place on a set of connected values of the sales and the sales determinants isolated, dating from different *time-periods.*

The function chosen with parameters estimated on basis of the selected functional form can be tested either retrospectively or prospectively, i.e. as a comparison of ex-post prognosis, that is a hypothetical forecast of sales which answers the question what the prognosis in the decision-situation for the sales in the period "to come" should have been, had we known the true values of the sales determinants, and actual sales directed back or forward in the time-series respectively. For a more technically orientated treatment of model control can be referred to Aarsø Nielsen (1970/3).

In extension of the former section it should be underlined as to the retrospective method that of course you cannot control the realism of the model by means of the same data used to determine the function. This implies that normally it should be appropriate to divide a time-series-material into two parts, one determining and one controlling the function. However, the half of the time-series data, which is put aside for model control, must *by no means* form part of the choice of model. In the progressive description of the firm's decision-making process, about which we reason in this article, model-control is prospective, and this is consequently the subject of our discussion in the following.

The problem of model control is then: First a regression equation is formed with numerical parameter values, estimated from a sample, and it is assumed to give a reasonable description of reality including the interaction in the function, during the sample period. Then it is to be settled if the identical regression equation describes the reality realistically, also in the following prediction-period(s).

Thus what we want to examine is, whether the regression equation with the estimated parameters gives an adequate description of the combined sample- and forecast-periods.

Given a-priori specifications and a functional form in the combined periods, we must then test the hypothesis that the function is the same in the prediction period as in the sample period. If this hypothesis is accepted, it means that the estimated regression function has *predicted* the sales as well as could be expected in the light of its ability to explain the variation in sales during the sample period. Since this must be presumed to be comparatively well, (otherwise it made no sense at all controlling the model) this means that the estimated regression function gives an acceptable description of the firm's sales function, incorporating the interaction in the combined sample and forecast-periods. If the null hypothesis is rejected, this *either* suggest that a *structural* change has taken place from the end of the sample period to the prediction-period, and including the point whether the a priori specifications do hold or do not, *or* as least as likely, that the regression function is inadequate as an explanation of the combined periods. In the latter case the explanatory power which the regression function with the given functional form has had during the sample-period can be characterized as random, which was just one of the dangers mentioned in section 3. In either case the rejection of the hypothesis indicates that the regression function does not represent a theory adequate to explain reality as far as choice of determinating variables and/or the functional form describing the interaction between these is concerned.

In case the regression coefficients are estimated on time-series-data, rejecting the hypothesis means that the modeltest has rejected the *stability assumption* or, which must not be ignored, that the decision maker operates with an unrealistic model, so in fact reality is fairly stable.

Let us at first suppose the firm to presume this last a priori. The decision maker now has to try to establish another model describing reality. We shall assume, when dealing with *the interaction* in the sales function, that the determinants are fixed, isolated by marketing theory and experience, so that *the inadequacy of the regression function is only due to the choice of functional form.*

Then, the firm must search for a *new* functional form, be it among the remaining alternatives already advanced or quite new ones.

Testing these functional forms cannot take place on the basis of the data of the previous period, because these data from part of the choice of functional form via being used to evaluate the alternative first chosen. The connected values of sales and the isolated determinants to be used must be "absolutely new", i.e. they must by no means have been involved in a previous choice of functional form. Is this not the fact, the statistical inference-techniques cannot be used as earlier mentioned (the maintained hypotheses are chosen not to be inconsistent to the available data). Concerning the choice of new functional form this implies that the only use the decision maker might have of the last sample period is that it gives a better basis of choice via the consistency of the maximum-likelihood-estimators.

The firm now selects a functional form for the following period, after which an ex-post testing is carried out again based on the data from the new period and so on.

Thus in a stable reality we see a solution of the interaction-problem in the sales function of the firm in a *dynamic search/learning process starting in an econometric formulation of the sales function, the multilple regression analysis and the connected statistical tests for controlling the model.*

If reality is in itself unstable, a necessary model revision means that the firm might easily be destitute as regards data when having to decide for the next period. The only way of getting the sales function determined is in the other principal way in which models can be formulated and data be found, namely *a cross-section model with the corresponding data.* Unlike the time-series-model this type of model is characterized by being assumed valid in a number of different units at the same time just as the data, which form the basis of the estimation of the parameters, belong to the same period of time.
In this connection it can be mentioned that the firms are expected to have to base on cross-sectional analyses increasingly, because continously growing innovation-activity f.i., and with this a steady decrease of the lifetime of goods should make an assumption of stability in a time-series-model ever more unrealistic, or consequently involve impossibility of procuring a "sufficiently" large sample-period.
The influence of the sales determinants appears by cross-section analysis in classifying the universe into groups, which differ substantially as to these variables, f.i. in income groups, groups of potential consumers that have been differently exposed to masscommunication. If considerable, regional differences in the size of the determinants is prevalent the universe can be organized from a geographical point of view. This, of course, creates a problem concerning possible special local conditions.
Assume the regression function to be determined *from cross-sectional data,* the number of connected values of the dependent and the independent variables is normally much bigger than at time-series-analysis. This implies that the available data with some sense can be divided in two parts, the one to be used to choose the functional form, whilst the other one is used to test the predictive power of the estimated model. Contrary to what is often the case at time-series-analysis it should not be difficult to divide the material in cross-sectional models to avoid the influence from knowledge of the entire sample affecting the choice of function, as the part of the data reserved for controlling the model, typically should be so big that, if one does not analyse it carefully before this choice, one would hardly know so much about it's characteristics, that it can influence the choice very much.
In a cross-sectional model the hypothesis to be tested is that the function (model) is identical for the part of the data used for the first choice of functional form and for the items set aside for model con-

trol. If the hypothesis is rejected, it means that the *assumption of homogeneity* does not hold, or what cannot be ignored by analogy with the stability assumption situation, namely that reality is in fact homogeneous "enough" so the necessary model revision is caused by an insufficient model.
Assume that in fact reality is homogeneous, and, as in the time-series-model let us adopt the assumption that the isolated determinants are fixed. If so, a rejection of the hypothesis means that the functional form chosen to describe the interaction in the sales function is unrealistic on the cross-sectional basis.
Then, if the firm has used the entire section set apart for control, it will have to wait for the next period to get further determination of the interaction. If the "control"-parts, however, are divided at random into a number of subgroups the firm has a possibility of testing an alternative function, chosen on basis of the original "estimation section", and the part used for the first test, on the next subgroup of the cross-sectional-material.
This of course demands a sample of some size, just as the procedure involves a problem as to how many subgroups the "controlpart" should be divided into a priori.
In a homogeneous reality *we thus see a solution to the interaction problem as a static search-learning process, starting in the above mentioned econometric methods.*
As a basis of our further discussion we shall now roughly systematize reality as follows:

		stability	
		stable	unstable
homogeneity	homogeneous	situation 4	situation 2
	inhomogeneous	situation 1	situation 3

Figure 1.

If reality is inhomogeneous, but stable, (situation 1) the outlined *dynamic* search/learning process should as mentioned be an approach to solve the interaction problem. As to situation 2 the procedure should be as stated in the exposition of the *static* search/learning-process. If reality is neither stable nor homogeneous (situation 3) or do we not "consider the strong cases", if reality does not have these characteristics to a certain degree, we cannot solve the problem of interaction by any of the outlined search/learning processes; neither can, as far as we know, any other quantitative methods. In this case the decision maker must, when planning his marketing action, base on the concepts of complementarism and substitution and verbal reasoning for one period at a time. If reality is relatively stable, i.e. it does not change significantly from each period and it is reasonably homogeneous, i.e. comparatively analogous behavior appears to equal objective conditions, so that f.inst. one geographical area can be assumed to buy the same quantity of the firm's product, as if it has been another geographical area, the values of the sales determinants being identical (situation 3), *a possibility arises of linking the static and the dynamic search/learning process.* Starting point should be taken in a *combined time-series- and cross-sectional model,* which can (the determinants entering statically and supposing the cross-sectional model is valid for geographical regions) be stated as

$q_i^t = q(D_{1i}^t, D_{2i}^t, \ldots, D_{ni}^t, a_1, a_2, \ldots, a_r)$;
$t = 1, 2, \ldots, T$ indicating time-period

and

$i = 1, 2, \ldots, G$ indicating geographical region.

q_i^t refers to the sales, whilst d_{ji}^t represents the j'th sales determinant of the i'th region in the t'th time-period. Further a_p; $p = 1, 2 \ldots, r$ are the parameters of the model.
The model is a time-series model because it is assumed valid to a given geographical region for several time-periods (the stability-characteristic). It is cross-sectional because it is assumed applying to all geographical units in a given period (the homogeneity characteristic).
The problem now left for clarification is, of course, as we have all along been reasoning on the assumption-basis, *how the firm should act to realize, whether reality is stable, homogeneous respectively.* Within the compass of this article we shall shortly mention two courses of action.
Firstly a mainly deductive procedure, containing reasoning about the autonomy of the equation together with observation of the phenomena which from the first reasonings can be assumed to influence the function. The *other* procedure can roughly be formulated like this: If the decision maker repeatedly has to reject alternative functional forms on cross-sectional respectively time-series data, the probability that reality is homogeneous or stable respectively, is decreasing.

In our discussion so far we have, generally speaking, been reasoning exclusively technical-statistical-wise. However, it must be clear that the entire model-control/revisionproblem should be subject to an economic analysis. Only in cases where the profit gained by improved decision-making exceeds the costs of revision it should be wise to revise the model, or put in another way, the loss from deciding on an unrealistic model must, of course, be greater than the costs of revision, if the model revision should be worth while. This is, naturally, rather a banal and inoperationel thing.

At present stage of science we see the following way solving the problem. The entry should be via determining the level of the model-test, i.e. the probability of rejecting the hypothesis, when correct, which is of course only to postpone the problem if you are unable to establish some lines at least for determining this level. The lines we think should be taken into consideration here – besides the quite natural one, that the greater the revision costs are, the lower the level should be – *is a question of the sensitivity of the functional form.* Supposing that the firm has only one goal: maximization of profit, which implies that the cost function must be taken into consideration, the content of this concept can be illustrated as follows (for a further treatment can be referred to Aarsø Nielsen (1971)):
Assume the decision maker estimates that the functional form is f^*, and therefore, he chooses his marketing strategy as being $h(f^*)$ by means of f.inst. the mathematical maximization algorithms. The real form of function now being $\hat{f}$, a standard turns up of the size of the mistake, measured by the profit-consequences, when contemplating the difference:

$$S(\hat{f}) = \hat{f}(h(\hat{f})) - \hat{f}(h(f^*)).$$

This indicates the difference between the maximally obtainable profit and the profit in fact obtained when deciding on the estimated functional form, i.e. the loss which the decision maker suffers, seen from *the opportunity cost-point of view,* by not having full information as to the form of the sales function. This loss can be nominated "the sensitivity of functional form".
This we shall further concretize to reach an applicable procedure. Assume as follows:

1. The determinants of the decision model are given.
2. The decision variables are continuous.
3. The decision maker has complete knowledge of the cost function in the decision model both as regards the form and the values of parameters.
4. The decision criterion is maximizing the expected profit.
5. The decision maker has determined n alternative functional forms, $f_1, f_2, \ldots, f_n$ and thinks that the true form is among these (or will in any case search no longer).
6. In each of these forms the decision maker can estimate the parameters by means of the discussed simulation on a certain number of observations.
7. The decision maker has a priori estimates of the values of the non-controllable variables for the next period. These estimates might f. inst. be extracted from already published forecasts.

The form on which decision making was based in the past period was f_i.

In applied situations imagine that the estimates of assumption 6 and 7 be the most exact information the firm will or can get. *In other words, the decision maker has "cut through" and is willing to accept the established estimates.*

If the decision maker chooses again to base upon f_i, this involves, via the algorithms of maximization, that h_i becomes the optimum marketingstrategy. This leads to the following formulation of the decision-table:

Figure 2.

	f_1	f_2	. . . f_n
h_1	0	$\pi_{22} - \pi_{12}$	. . . $\pi_{nn} - \pi_{1n}$
h_2	$\pi_{11} - \pi_{21}$	0	. . . $\pi_{nn} - \pi_{2n}$
.	.	.	.
.	.	.	.
.	.	.	.
h_n	$\pi_{11} - \pi_{n1}$	$\pi_{22} - \pi_{n2}$	. . . 0

The content of the matrix consists of sensitivity-values, π_{ii} being the maximally obtainable profit when f_i is the true form and the decision maker decides from this point of view, and π_{ji} is the profit that is actually attained when deciding h_j from an assumption that f_j is the true form, when in fact the form is f_i. It is quadratic $n \times n$ and the diagonal consists of 0-values.

The firm is now ex ante the model control and considers the test-level. The economic consequences of choosing the respective functional forms is of an estimated, prognostic character, i.e. ex ante the next period. From the established matrix of sensitivity the following lines can be given to determine the test-level: If we examine the i'th *column* this indicates the losses occuring if the decision maker commits an error of Type I, i.e. rejecting the hypothesis when correct. The maximum value in this column is thus the maximum loss which arises from committing an error of this type. Of course the concrete loss depends on which form is chosen, when f_i is rejected.

It is obvious that the greater the sensitivity to occur in this column is, the more the decision maker should guard against rejecting the hypothesis, when correct, i.e. the lower the level of the test should be.

If we examine the *i'th row* of the matrix it depicts the losses, the decision maker suffers from committing an error of Type II, i.e. accepting the hypothesis (decide h_i), when it is in fact wrong. If these values of sensitivity are great *compared to the revision-costs,* this tends towards greater power of the model-test. Guardening against Type I error and Type II error is, of course, competing considerations. The greater the protection taken against a Type I error, the larger the risk of making a Type II error, and vice versa. The conclusion of these arguments is then the following *qualitative* decision-rule:

1. the larger the costs of revising the model,
2. the greater the sensitivity of making a Type I error,
3. the smaller the sensitivity of making Type II errors,

the lower the test-level of the model control.

The novelty of this decision rule, in continuation of the tabulation of the sensitivity, is in our opinion that we get an applicable procedure established, which is capable of fixing the level of the model-test by introducing a loss-function, showing the respective losses of choosing other fnnctional forms than the "true" one.

Within the statistical decision theory and econometrics, one has exclusively been operating with loss functions for parameters and non-controllable variables, just as one has never, as far as we are informed, tried to make applicable lines indicating how to determine the level of the model-test.

We mentioned that the decision maker on his part had "cut through" as regards the parameter estimates and the prognosis of the non-controllables.

This, however, means that the concrete guiding assertions to be formulated are conditioned in the sense that their correctness presupposes that the values of these model-components are true. Wrong conclusions might thus occur, when this is *not* the case, which of course, is not normality.

On the other hand the procedure established is, as far as we can see, the only possibility a decision maker has (at the present stage of science) to determine the test-level. A concrete quantitative determination of the test-level is, as it should have appeared, impossible at the moment. So we conclude by pointing out the research problems implied by attempting to couple the stipulated search-learning-techniques, the costs of modelrevision, the test-level, and the sensitivity of the functional form.

Litterature:

1. Russell L. Ackoff: Scientific Method: Optimizing applied research decisions. New York, 1962.
2. Jan Aarsø Nielsen: Virksomhedens afsætningsfunktion og den lineære multiple regressionsanalyse I. Page 53–87 in Markedskommunikasjon 1970/1. Oslo.
3. Jan Aarsø Nielsen: Virksomhedens afsætningsfunktion og den lineære multiple regressionsanalyse II. Page 67–88 in Markedskommunikasjon 1970/3. Oslo.
4. Jan Aarsø Nielsen: Modeller til styring af virksomhedens informationsindsamling. København, 1971 (not published).
5. Arne Rasmussen: Pristeori eller Parameterteori. København, 1955.
6. Arne Rasmussen: Veje til en Flerparameterteori. Page 63–69 in „Afhandlinger fra Handelshøjskolen". København, 1967.