T I M E P R E D I C T I O N

A N A L T E R N A T I V E A P P R O A C H

by

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ABSTRACT

The construction industry and its commercial and industrial clients have become increasingly aware of the importance of time in the planning and constructiion of projects. A comparison of the construction industries in the UK and the USA concluded that orthodox contract procedures in the UK are largely determined by public sector requirements of accountability and control, whereas private sector requirements are for speed and a clear allocation of responsibilities and tasks. The important relationship between time and cost has not been studied to any extent in UK practice.

It is clear from the little research that has been undertaken that the subjective methods of time prediction adopted by surveyors in the UK are far from being adequate when it can only be expected that 50% of contracts will meet the stipulated contract period. The problem is one of trying to predict a time period without being able to fully anticipate all possible future events. To date the industry has had no scientific method of making that time prediction, moreover it is often left simply to the judgement of a professional quantity surveyor. In order to provide a better and more effective time and cost control system, it is imperative that a more accurate system or predicting time is devised.

This research then aims to identify the factors affecting the time aspect of construction, to suggest which of those could be anticipated at a given point during the design procedure and to prepare a model whereby the time for consturction can be accurately predicted.

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This thesis is dedicated to the late David Azzaro whose advice and support proved invaluable and am only sad that he did not live to see the work in its completed state.

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Ian Mehrtens
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CHAPTER ONE

INTRODUCTION

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INTRODUCTION

The construction industry and its commercial and industrial clients have become increasingly aware of the importance of time in the planning and construction of projects. A comparison of the construction industries in the United Kingdom and the United States made by the Royal Institution of Chartered Surveyors (1979) concluded, inter alia, that orthodox contract procedures in the United Kingdom are largely determined by public sector requriements of accountability and control, whereas private sector requirements are for speed and a clear allocation of responsbilities and tasks. The important relationship between construction time and cost, however, although dealt with on a theoretical basis by Hillebrandt (The Economics of Construction), has not been studied to any extent in practice.

It is a common complaint of the client who obtains finance from an external source, that any increase, or indeed decrease, in the actual contract period can prove to be very expensive. A contract completed early is as much a failure as one completed late; the client may not obtain any benefit from early completion and may have paid out monies before it was needed thus losing interest on capital. It would, therefore, be an advantage to a client if he could be assured that, assuming there are no design modifications or any other unforseen changes, the contract period will remain as predicted.

The time/cost relationship is a very complex one that has attracted few research studies and is defined as the time taken to complete the project to practical completion (contract duration) as a function of cost (estimated contract value). Cost was chosen as the major explanatory variable, rather than size or some other factor, because it is considered that cost is a measure of both size and complexity. This is of course affected by many other factors and it is anticipated that these will be identified in the regression analysis carried out. It is assumed therefore that, for the purpose of this research, cost is taken as a proxy measure for size.

Contract period is defined as that time stated in the contract documents, where contract duration is how long the project actually took to complete. It is clear from reviewing other research in this area that there are difficulties in predicting time. It was decided therefore to see what results would emerge if a fairly simple approach, with a simple questionnaire were adopted.

Through his research in the seventies in Australia, Bromilow stated that:

> "Variations are the cause of many problems in building contracts and are the source of increase in time and cost and concluded that:

> Changes during construction are inevitable and must be allowed for in planning and carrying out building construction".

The problem is one of trying to predict a time period without being able to fully anticipate all possible future events. It is easy with hindsight to say that the period should have been 6 or 8 weeks longer. This research aims to identify the factors affecting the time aspect of construction, to suggest which of those could be anticipated at a given point during the design procedure and to take account of them in the original time calcluation.

An accurate time prediction will avoid any expensive increases in funding, will make more economic use of valuable resources and will help to keep the client satisfied. This research is presented in the following way:

Chapter Two deals with the problems of predicting time and sets out to identify those factors which may affect time within broad areas. These factors then form the basis of the data collection and statistical analysis.

Chapter Three is concerned with the current procedures available throughout the world for predicting time and deals with three such methods. The three models detailed each adopt a different perspective of time; the first is a general model intended for universal application (Bromilow); the second is related to a procurement method (Heery); and the third is related to a method of construction (CLASP). Each method is considered here in detail.

Chapter Four deals with the collection of data and its classification into categories. The data were collected by means of a questionnaire which resulted in a return of 21 per cent. This was disappointing but was considered sufficiently large to carry out an analysis. The data were analysed following the stepwise regression proccedure using the Statistical Package for Social Scientists (SPSS, Nie et al, 1979). The multiple regression analysis shows the strength of the relationship between the variables.

Chapter Five looks at the data by describing the variables and identifying those which have quantitative values and those which are qualitative in nature. The second part of the chapter analyses the data as produced using the stepwise regression procedure. Variables which are significant to the prediction of time are identified.

Chapter Six concludes this research and attempts to explain why those statistically significant variables are so important in the prediction of time.

CHAPTER TWO

TIME PREDICTION - THE PROBLEMS

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Introduction

Delay in construction means the time overrun beyond the stated contract period. For the building owner delay means the facilty is not available for use and lost revenues that can never be recovered. For the contractor delays means higher direct and overhead costs because of the extended period of construction with working capital tied up so that he may be prevented from pursuing other contracts. Delay usually involves loss on both sides.

A study by F.J. Bromilow was carried out during the period 1964-67 to investigate among other things, the differences between the contract period and the contract duration. He found that the differences between the contract period and the contract duration were substantial and much larger than commonly believed, (Bromilow 1969). The survey was directed to projects costing more than A$10,000 in value, located in or close to Canberra, Melbourne and Sydney with special attention to office building. The results showed that of the 329 contracts analysed, only 12.5% were completed within the time orginally expected and the overall average extra time taken exceeded 40%.

The Wood Report (1975) which carried out a survey of 2,000 public sector building and civil engineering projects demonstrated its results against three performance indicators. One of these is the time performance yardstick defined as the percentage difference between the original contract period and the contract duration. The statistical survey showed that contract periods are set rather loosely in that they were set mainly on intervals of three and six months. The average time overrun for the whole sample was 17.4% compared with the sample for this research of 21% and that of Bromilow's research at 40%.

The Banwell Report (1964), stated that:

> "insufficient regard is paid to the importance of value of time and its proper use in all aspects of the project from the client's original decision to build, through the design stages and up to final completion".

The results of the survey carried out under this research detailed in Chapters Four and Five confirm the findings of both Bromilow and Banwell. Of 214 Contracts taken from a wide range of environments and building types, 41% took longer to complete than orignally stated with an average overall extra time taken exceeding 21%. Of the remainder, 50% were completed on time and 9% were completed early.

It is clear that the subjective methods used by surveyors for predicting contract periods are far from being adequate since it can only be expected that 50% of contracts will meet the stipulated construction period. As indicated in Chapter Five, in some cases the reason why extra time was required is attributable to bankruptcy, a factor which could not have been foreseen at the time of predicting the contract period. What is not clear, however, is whether such bankruptcies were triggered by an unreasonably short construction period orginally being stated. Bromilow (1969) found that attempts to achieve very short contract periods were generally abortive. This chapter aims to identify the problems and the factors affecting that prediction.

Stage at which time prediction may be made

There can be a need for time prediction at various stages throughout the design. Even at the very earliest stages in the case of the developers budget, perhaps before there is any design, or the need may not arise until the design is complete. Expectations as to the actual date of completion may change as the design and construction processes proceed. To predict the time too early with insufficient data would be folly. As more information becomes available on the project so a more accurate prediction of construction time would be made.

The estimated cost of the project will vary and presumably become more accurate as the design develops. A prediction of time based upon cost will therefore take account of the improved information through the cost of the project. It is possible in this way to be able to predict time at almost any stage in the design process with varying degrees of accuracy and thus the client can be kept informed of any new developments in respect of time. This research is therefore aimed at any stage where an estimated cost is available to the surveyor. The degree of accuracy of that prediction must however be given in the context of the accuracy of the estimate of cost.

Factors affecting time

In order that an accurate prediction of the construction period may be made, it is first necessary to identify those factors which may affect the construction process adversely or otherwise. Almost every aspect of a project will have an effect upon how long it takes from starting on site to completion. These aspects can be grouped into four broad areas:

(1) physical effects

(2) environmental effects

(3) external effects

(4) managerial effects

(1) PHYSICAL EFFECTS

The term 'physical effects' is used here to embrace any factors directly associated with the building or land upon which it is to be built. Such factors will include:

(a) project type

(b) estimated cost of project

(c) size and complexity

The main physical effects arise from the inherent complexity and uncertainty about the building process. Complexity can be seen as the technical difficulties encountered in construction and uncertainty as unfamiliarity with the proposed scheme. These will inevitably have an adverse effect upon the cost of the project and in turn on the time taken to construct the building.

Where this complexity and uncertainty can be removed, as in the case of the CLASP School Programme, a direct relationship between time and cost can be established (see Chapter Three, Nottinghamshire County Council model). This inherent complexity is frequently experienced in the amount of services installations required such as heating, hot water, air-conditioning, gas, compressed air, light, power etc. It is expected that an increase in the amount of services required will lead to an increase in both time and cost.

It is clear that the cost of a project has some bearing upon how long it will take to construct. The relationship is not thought to be a simple one for traditionally constructed buildings, with the greater the cost the longer the time. Bromilow (1969) realised that there was a sensitivity of time performance to cost level and in his model, detailed in Chapter Three, he expressed this as a constant measuring the extent to which additional time is taken during construction as projects increase in size measured by cost. It is expected that the cost of a project will bear some relationship to the size of the project and in this respect cost is being used as a proxy measure for size. This may or may not be an accurate assessment of the relationship and may in some circumstances not stand true. It is however thought that this goes some way to explaining the size of the project together with its complexity of construction.

Uncertainty can also be created where there exists an overlap of design and construction. Although it could be expected that the overall time required for both processes will be reduced, the actual construction time and cost are increased in comparison with projects where this overlap did not occur (Ireland 1985)

The Wood Report (1975) in applying its time performance yardstick identified housing, medical and 'other building' categories as having the highest time overrun. Road and education projects conversely had

the lowest time overrun with education projects most consistently near the programme completion date. Clearly the pressures placed on the building team by the client have some bearing on the success of the project in terms of contract duration and in some cases this can be enforced with the careful choice of procurement method.

(2) ENVIRONMENTAL EFFECTS

The term 'environmental effects' is used here to identify any climatic or location factors which may affect the progress of the works. Such factors may include:

(a) the time of the year the project commences on site

(b) location of the site

On construction sites in the United Kingdom more delays and loss of working time are caused by rain than by other climatic condtions. (King 1981). The loss of time depends on the rain duration rather than the amount of rainfall. The notable feature of monthly averages of daytime rain duration is the low value in the summer months compared to winter months. This contrasts with the situation for rainfall amount where there is no marked seasonal variation in rainfall totals.

Where the effect of rain on outdoor working time is related to rain duration, King (1981) found that rain occupied between 4 per cent and 7 per cent of daytime hours with rain duration least in the summer

months. Considerable variations from this are not unusual. In many places during the summer there are only an average of two 'wet days' per month. A 'wet day' is considered to be one where for a total duration of two hours between 0700 and 1700 GMT the rainfall amount is at least 0.2 mm in the hour. In terms of duration, while the west is wetter than the east, these differences are not large.

The effect, on the construction processes, of rain and other climatic conditions is often greater than the duration of the climatic event. Outdoor work does not always stop and start in step with the rain. For some processes, work may have to be halted for the whole day even though the rain is actually falling for less than half this time. It has been found that most urban areas have between 30 and 50 'wet days' per year. It is important for some purposes to have a day with no interruptions by rain, although a very light fall may be tolerated. Days where the amount of rain is less than 0.2 mm are considered 'dry days'. Similarly it has been found that there are on average between 210 and 260 'dry days'.

(3) EXTERNAL EFFECTS

The term 'external effects' is used here to include any external forces which may affect the project. These may include:

(a) economic factors

(b) market forces

The effects of a change in the level of economic activity on the construction industry are well established and well documented. Hillebrandt (1979) defines the relationship of the construction industry to the economy in terms of basic supply and demand theory. The relationship between contract cost and contract duration is likely to change with time as a result of changing levels of activity within the industry and in response to the development of new constructional and contractual methods.

Organisations in the construction industry exercise less control over their market than in many manufacturing industries. Building is largely bespoke and as such the industry is less able to shape its market or to plan to take advantage of expected market trends. As a consequence, organisations in the construction industry face uncertainty about the future.

This uncertainty is formalised in two ways. Firstly by lack of forward commitment and a threat that resources will have to be redeployed. Not only are many construction materials and crafts used by other industries, but there is also a significant movement between the construction and other industries. Thus, the higher the level of activity in those other industries, the more difficult it is for

additional resources to be attracted into the construction industry without causing an overheating of the economy. An overheated economy is one where prices are higher than they would normally be, caused by excessive demand on a limited supply. These links can mitigate the effects of a downturn in construction demand provided that the other industries are not also depressed.

The second consequence of uncertainty is that organisations seek to obtain more work than would be required if the timing envisaged in the programmes of design and construction were realised. As a result, construction proceeds much more slowly than justified by the amount of work to be completed in the time allowed, with each organisation having a stockpile or work to be drawn on when projects are delayed.

(4) MANAGERIAL EFFECTS

The term 'managerial effects' is used here to identify the role of the professionals and contractor personnel in the progress of the works. These may include:

(a) procurement method

(b) client

A procurement method is a term used to describe the management approach and the conditions of contract in use on building projects.

Procurement methods are defined as the overall management structure and specific management practices in use on a project.

These are determined by the roles played by the participants as well as the formal contracts used. The term 'procurement method' has the sense of describing the roles of participants, the relationships between them both formal and informal, the timing of events and the practices and techniques of management in use. Examples of the more commonly used procurements methods are: a single lump sum contract on a fully documented scheme; provisional or partial quantities; cost reimbursement contracts; package deal contracts; management fee contracts. The wrong choice of procurement method will undoubtedly affect both the final cost and the contract duration time for the project.

Any organisation, in order to make the best of it circumstances, must arrange its affairs so that the resources deployed are utilised to the maximum advanatge. This utilisation of resources is measured in terms of productivity. Productivity is crucially affected by the interplay between design, which determines the buildability of projects, and management which is responsible for allcoating resources and for controlling time. A conflict often arises however in that the high utilisation of resources can always be achieved by a sufficiently slow rate of progress.

Uncertain control over timing of projects is however one characteristic of the construction industry. In occupations as fragmented and as interwoven as building, as much affected by site conditions and weather, there is an uncertainty surrounding the timing of projects.

SUMMARY

In practice the task of predicting time is considerably more complex than might be expected. Many things happen to interfere with the smooth flow of work: delays occasioned by the weather; by materials not being available or by being rejected upon inspection; technical hitches like the breakdown of equipment; uncertainty caused by inadequate detailing on the part of designers; delays whilst drawings are rectified or indeed produced for the first time.

Sometimes main contractors find it difficult to achieve effective control, especially when many nominated sub-contractors or suppliers are involved. Other disturbances are often external to the parties bound by the contract, more particularly where there is a lack of co-operation by statutory authorties.

By no means are the time overruns on contract time all the fault of the contractor. In many cases it is the client who has a large effect on the delay; by stopping work due to cash flow problems or not

providing the contractor with necessary information when it is requested. However, it is the cleint who is left to pay for the cost of any prolongation of the contract.

This research addresses many of these issues but acknowledges that some will fall outside of the bounds of prediction prior to the contract being signed and others are too general to be incorporated into a time prediction model. These issues are identified here and are such that surveyors, or those attempting to predict time, should be aware of their possible implications on time and cost.

1. Contractor personnel

Unless the project is based upon the design and build procurement method, it is unlikely that the contractor personnel would be known or or even anticipated during the early stages. The problem of contractor personnel should be catered for at the tendering stage. A good reputation for workmanship and mangerial ability should be high in priority when selecting a contractor. All too many contractors are selected on the basis of price alone with little attention being paid to a proven 'track record' with the client being left to pick up the pieces. In the worst event a wrong choice can result in contractor bankruptcy which in turn will lead to a significant increase in the time element and undoubtedly an increase in cost.

2. Economy

This will be reflected in the contract sum though again, in appraising tenders account should be taken of the effect of current market forces on productivity. This is not always a simple task of making an analysis of the economy, other factors need to be considered. If for example due to overheating of the economy, the cost of building increases 10% and the time taken to erect the building also increases 10%, then the time cost relationship is not affected. Inflation on the other hand may affect cost only, or as in the period 1980-84 it may have little if any effect. All these factors need to be borne in mind in making such value judgements.

3. Design

An essential component to successful completion appears to be a fully designed scheme prior to obtaining tenders. It should be the aim of the design team to have a fully detailed scheme at tendering stage and if necessary the obtaining of tenders should be delayed until such time as the scheme is fully designed. The effects of this are shown in this research and are well documented.

BIBLIOGRAPHY

THE BANWELL REPORT, The report of the committee on the placing and management of contracts for building and civil engineering works. Ministry of Public and Building Works, 1964.

BISHOP D. Productivity in the construction industry, Aspects of the economics of construction, Edited by Professor D.A. Turin, George Godwin, 1985.

BROMILOW F.J. Contract time performance, expectations and reality Building Forum Vol 1 No. 3 pp 70-80, September 1969

HILLEBRANDT P.M. Economic theory and the construction industry, Macmillan 1979

IRELAND V, The role of managerial actions in the cost, time and quality performance of high-rise commercial building projects, Construction Management and Economics Vol 3 pp 59-87, 1985

KING E.G.E. Daytime rain
Building Climatology Unit, Meteorological Office 1981

NEDO, How flexible is construction?

HMSO 1978

THE ROYAL INSTITUTION OF CHARTERED SURVEYORS, Pre-contract cost control and cost planning,

Quantity Surveyors Practice Pamphlet No. 2 RICS

THE WOOD REPORT, The public client and the construction industry,

Joint Working Party Studying Public Sector Purchasing NEDO

HMSO 1975

CHAPTER THREE

TIME PREDICTION - THE CURRENT METHODS

CHAPTER THREE

TIME PREDICTION : THE CURRENT PROCEDURES

Introduction

The prediction of the contract period is a requirement in producing necessary contract documentation. There is normally an obligation to provide a statement as to the length of the contract period. This is not always the case however as some Local Authority clients ask tenderers to quote both the cost sum and the time the tenderer requires to carry out the works. This time, if accepted, then becomes the contract period. In this case the time is being predicted, but by the tenderer and not the quantity surveyor, however it is likely that the client would have required some estimation of contract period prior to tendering to allow essential financial calculations to be made and to provide a check against tenderers estimations. Where there is a requirement for time prediction, then it can be considered in one of two ways:

1. that the cost of the project depends upon the time at which occupation is required (stipulated contract period).

2. that the contract period depends upon the size of the contract as measured by its cost (estimated contract value).

1. Stipulated contract period.

"It is often, and becoming prevalent, that a stipulated contract period is the determining factor of the contract value, not an unknown factor to be calculated from an estimated value" (Barnsley, Snell & Partners, Chartered Quantity Surveyors, Private Communication 1983).

This consideration does not require a prediction of time, rather it requires a skill on the part of the design team in designing the project so as to meet the often stringent time limits imposed by the client. The effects of an imposed contract period may, if particularly restrictive, be reflected in the cost of the project. This procedure is sometimes adopted where, for commercial or other reasons, a project is required for occupation on a set date.

This method is not of concern to this research as there is no specific requirement to predict time. The contract period has been pre-determined with the imposition of a completion date by the client.

2. Estimated contract value.

It is this aspect of the time/cost relationship to which this research is addressed. Atkin (1986) found that quantity surveyors are now, more and more, being called upon to give advice on the duration of projects, as well as their costs. The prediction of time, however is often thought to be an ability gained solely through experience.

> "The relationship between time and cost depends solely upon the ab ility of the people who are in control of the various aspects of the contract. The judgement of this is an art exercised by professional and businessmen, and acquired by experience and intelligence. It cannot be reduced to a statistical model".
>
> (Foster & Emery, Chartered Quantity Surveyors, Private Commuinication, 1983)

Research has shown, however, that the prediction of time is possible using statistical models. It is apparent that this non-systematic approach to predicting time is widely used within the profession. The most common approach to time prediction looks at the average amount spent per month and the time taken per 100 square metres of floor area

for a few recent contracts and interpolate, extrapolate and average to arrive at an estimate of time. A Study performed by the RICS (1979) found through an analysis of a sample of office buildings that the rate of construction per square metre of gross floor area was 157.5 sq. m. per week. Such estimations are shown to be very unsatisfactory (Bromilow 1969). A more accurate prediction will be made using an applicable systematic method utilizing relevant information thereby predicting time with certain confidence.

The following is a descriptive review of the research undertaken and the resulting methods for predicting time.

THE BROMILOW MODEL

The Building Research Division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), under the direction of Dr. F.J. Bromilow, undertook a great deal of research into the problem of time prediction in the late 1960's and 1970's. Their investigations have revealed that for the vast majority of projects, the estimated contract periods initially stated were found to be far below the actual times taken to completle the projects (Bromilow 1969).

It was found that when completed times written into contracts are compared with what is actually happening, it becomes clear that the

main reason why so much excess time appears to be required in some cases is because contract completion times tend to be rather optimistic, rather than because of fundamental differences in time requirements. Bromilow's results show that the writing in construction times known to be inadequate in hopes of spurring the contractor to greater endeavours, has little influence on the time actually taken in practice.

He concluded through his research that "attempts to achieve very short construction periods were generally abortive; no matter how short a time written into the contract, the actual result seems still to be much the same as it would have been anyway." (Bromilow 1969).

Following his research in 1969, Bromilow (1977) identified three stages from inception of the scheme through to practical completion. These are:

i Design and Documentation (pre-tender)

ii Tendering (calling, preparation, submission and evaluation of tenders)

iii Construction (from acceptance of the contractor to the practical completion of the works)

The model produced and explained later in this chapter, is applicable only to stages (i), design and documentation and (iii), construction. For stage (ii), tendering, Bromilow calculates the period based on a range of 30-60 days plus the actual time allowed for tendering.

Methodology

The Bromilow model is applied using the equation $T=KC^b$. It describes time where,

T = time required in working days

K = a constant describing the general level of time performance for A$1 million project.

C = estimated cost of the project in millions of Australian dollars adjusted to the 1972 cost figure.

b = a constant indicative of the sensitivity of time performance to cost level.

Constants K and b are calculated from the analysis of 309 contracts during the 1969 survey by Bromilow. Time taken is plotted against the final cost of the project. The graphs produced, Figures 1 and 2, relate to stages (i), design and documentation and (iii) construction respectively. They indicate the average performance (line X-X) and the

upper and lower quartile limits (marked Q-Q). The graphs are represented using logarithmic scales thus avoiding the overcrowding of the relatively large number of A$10,000 to A$1,000,000 contracts in the lower left hand corner of the figure. Constant b is a measure of the extent to which additional time is taken during construction as the projects get bigger.

The equation $T=KC^b$ is then applied to the stages (i) design and documentation and (iii) construction as follows:

(i) Design and Documentation

$T = KC^b$ where K=270 and b=0.18

$T = 270\ C^{0.18}$

This will give the average time allowance for design and documentation obtaining the constant K from the average line X-X. Should problems be an ticipated, then for constant K the upper quartile limit figure Q-Q of 370 should be used.

Similarly, the most reasonable expedited time can be calculated using the lower quartile figure Q-Q of 210 for constant K.

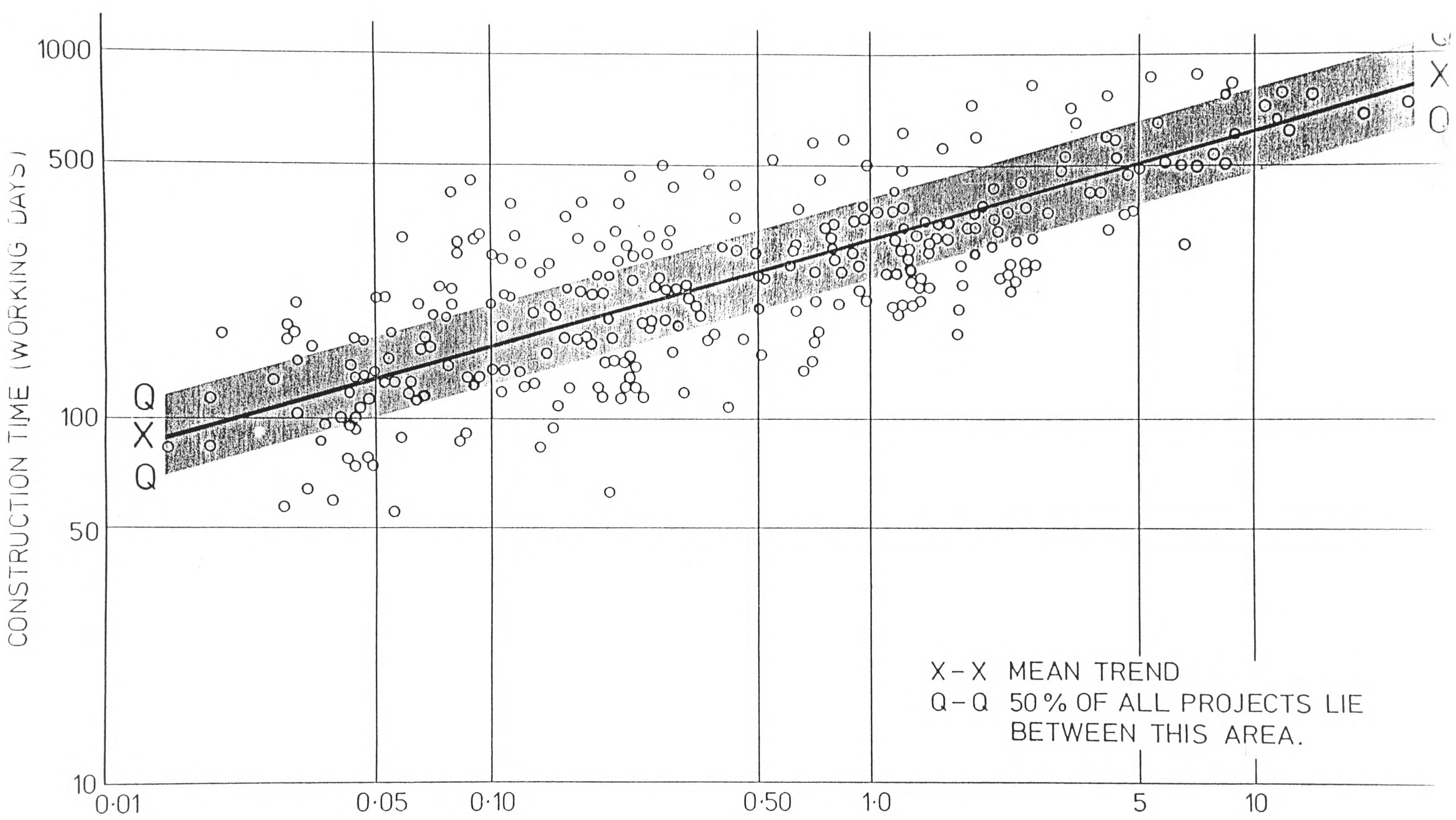


FIGURE 1

Construction time (up to practical completion) as function of cost
(Adjusted to labour and material prices at September 1972)

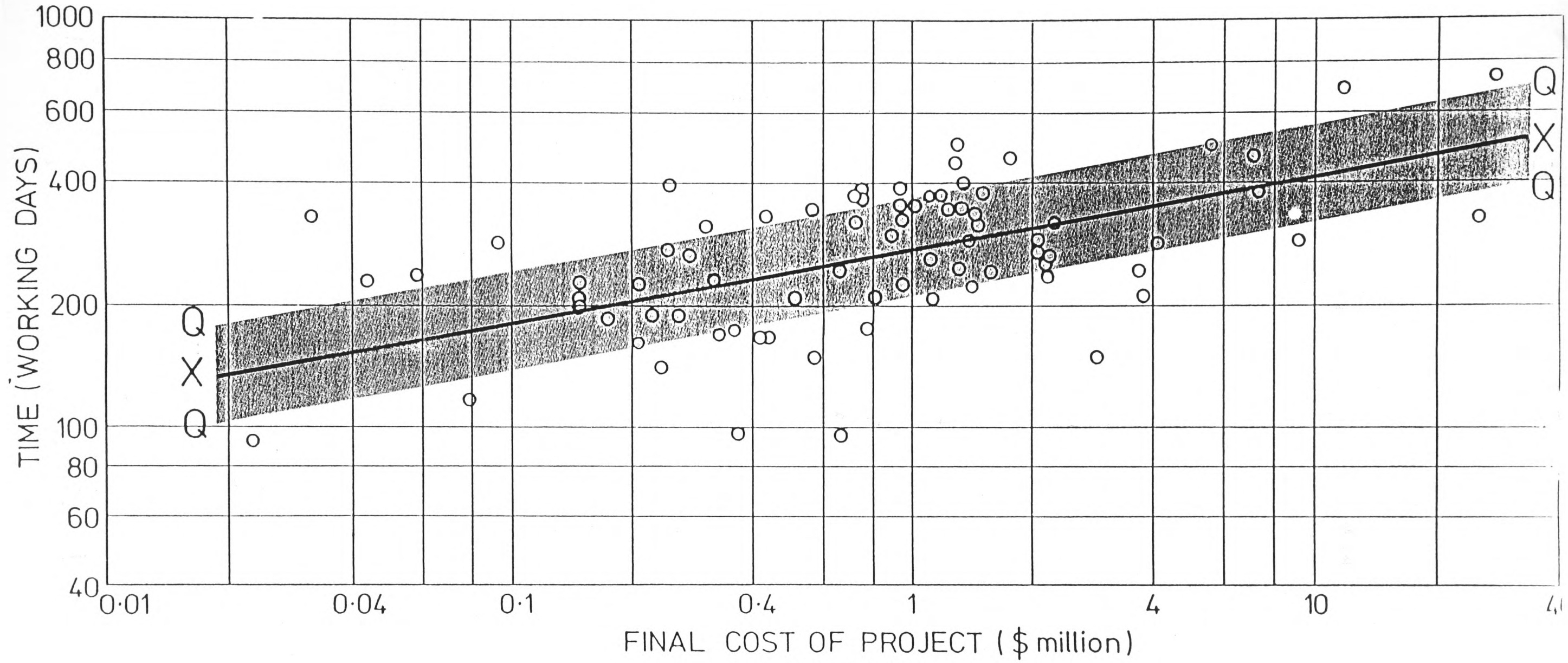


FIGURE 2

Time taken for design and documentation as function of cost
(Adjusted to labour and material prices at September 1972)

(ii) Construction

$T = KC^b$ where K=313 and b=0.30

$T = 313\ C^{0.30}$

This will give the average time allowance for construction obtaining constant K from the average line X-X. Should problems be anticipated then for constant K the upper quartile limit figure Q-Q of 407 should be used. Similarly the most reasonably expedited time can be calculated using the lower quartile figure Q-Q of 250 for constant K.

For some years industry co-operation was sought to monitor the time performance of building contracts on an on-going basis. The task was accepted by the Australian Institute of Quantity Surveryors (AIQS) as a service to the industry as a whole. A committee was formed representing private and government sectors of the AIQS and members of the CSIRO with the objective of investigating the performance of the above model.

The AIQS monitored projects through the period 1970-76 (AIQS, 1980) and during this time a total of 419 projects were surveyed, some 70% being

government projects and the remaining 30% being private ones. The results showed that the type of equation reported in 1969 by Bromilow in an attempt to define the industry's actual time performance with regard to construction time, still applied.

The AIQS noted through their monitoring that the constant K made a 16% increase since 1969. It explained this by indicating that projects completed after 1974 would have been affected by the overheated economy of 1973 with its shortages of materials, skilled labour and managerial expertise and its extensive delays arising from disputes on labour matters. The sensitivity factor b remained the same at 0.30 as the time/cost relationship would not have changed through the overheating of the economy.

Bromilow (1971) found that the average amount of time actually absorbed during construction could well be defined as a function of the building cost and that, surprisingly, this function was not sensitive to a particular type of building. The Bromilow model therefore ignored the form of construction, the method of construction, regional price variations and meteorological factors. This may well be the case in Australia but the indications are that in the United Kingdom some, if not all of the above points, have some bearing on the time taken for constructing a project. This research will show which factors are sensitive to predicting time and the relative importance of each of them in that calculation.

THE HEERY MODEL

Heery (1975) proposed and described a definitive system for time and cost control that can be applied within any given programme of requirements, quality level or design goal. He argues that it is possible for architects, engineers and construction managers to exert a highly acceptable degree of control not only over the cost of building construction but also over the time required for the design and construction process. This time/cost control system has been effectively on a variety of projects both in the United States and throughout the world.

The time/cost control is seen as having strong links with architectural design. Both are indigenous parts of the process which create architecture. The time/cost control system began in the mid 1950's and had been developed as a definable method by 1961. It was seen as a development and improvement upon the traditional design and build method of procurement.

The Heery model (the time/cost control system) involves seven basic components that are either additions to or modifications of the traditional architectural service. These components are:

(a) pre-design project analysis

(b) systems approach to design

(c) an integral cost control system

(d) time control contract provisions

(e) scheduling and information systems

(f) bid and negotiation management

(g) management of contracts and construction

The time/cost control system which comprises the above seven components is merely a structured design and construction management service. The system is simply a series of interrelated procedures that suit the American design/construct process. The system falls into two distinct parts:

(a) - (b) : pre-contract design

(c) - (g) : construction

The system relies on the 'manager' adhering rigidly to each of the components relative to the design or construct stage. The two parts can be considered independently or together.

Time control and project acceleration is accomplished by a series of recommended actions outlined below. These embody the basic philosophy of the time/cost control system.

(1) analyse the client's purchasing power and obtain bids for, or negotiate, construction contracts as required.

(2) identify the constraints relative to site, design, construction, client and any formal approvals.

(3) schedule all design and construction actvities, identifying critical requirements based upon constraints identified under (2), the desired occupancy date or earliest feasible date. Any contingency time for likely extensions should be allowed.

(4) if possible, award early any construction contracts that can be undertaken whilst the design is completed.

(5) avoid any unnecessary phasing of the works.

(6) use procurement methods that are carefully tailored to the individual project and client.

(7) ensure that there is adequate competition whenever bidding is employed.

(8) centralise contract administration via the construction man ager.

(9) be diligent and resourceful throughout.

The constraints in a project (its design, schedule and construction management plan) will determine the feasibility of scheduled beneficial occupancy and final completion dates.

It is a basic concept of the time/cost control system that the construction contract format should always be kept in its simplest and most definitive form. In the United Kingdom, far from becoming simpler, construction contracts are becoming more complex whilst endeavouring to encompass all eventualities.

The Heery time/cost control system has been in existence for more than twenty five years. Its use has been limited to projects controlled by the Heery architectural practice though apparently with success. There has been no independent analysis of the system as used and it's success is only as indicated through the Heery practice. The nearest equivalent system in the UK is the design/build method of procurement. The Heery model does not, in essence, purport to be an all embracing system and it is acknowledged (in step (3) outlined above) that there will inevitably be extensions to the predicted contract period. The time/cost control system does not seem to be specifically concerned with time prediction, rather it appears to be a model for controlling a project.

THE NOTTINGHAMSHIRE COUNTY COUNCIL MODEL

Nottinghamshire County Council, which is a member of CLASP (Consortium of Local Authorities Schools Programme), have produced a procedural guide to contract periods for basic CLASP construction. This guide forms part of the County Architect's Contract Administration Handbook and is inserted into all CLASP contract documentation.

CLASP follows an industrialised construction system employing standard units developed by the Nottinghamshire County Council. The contracts are let through selective list competition and as such there is an element of experience of the form of construction with an apparent reduction in the resulting construction period. This being so there is seen to be a direct relationship between time and cost.

The following is a guide issued by the clasp to contract periods based upon estimated contract value as applicable in 1983:

Estimated Contract Value (in pounds)				Contract Period (in months)
		Not exceeding	75 000	4*
Exceeding	75 000	not exceeding	100 000	5*
Exceeding	100 000	not exceeding	150 000	6
Exceeding	150 000	not exceeding	200 000	6.5
Exceeding	200 000	not exceeding	250 000	7
Exceeding	250 000	not exceeding	400 000	7.5
Exceeding	400 000	not exceeding	500 000	8
Exceeding	500 000	not exceeding	600 000	9
Exceeding	600 000	not exceeding	700 000	10
Exceeding	700 000	not exceeding	800 000	11
Exceeding	800 000	not exceeding	900 000	12
Exceeding	900 000	not exceeding	1 000 000	13
Exceeding	1 000 000	not exceeding	1 100 000	14
Exceeding	1 100 000	not exceeding	1 250 000	15
Exceeding	1 250 000	not exceeding	1 500 000	16
Exceeding	1 500 000	not exceeding	1 750 000	17
Exceeding	1 750 000	not exceeding	2 000 000	18

* The period between contract signing and date for possession to be of sufficient length to allow materials and components to arrive on site and avoid delays. The short contract period requires the project to be fully designed prior to invitation to tender.

These periods have largely been determined by the delivery periods required by the nominated suppliers for CLASP components. It is acknowledged that these stated periods can only be applied to basic CLASP construction and may require some adjustments. In making any adjustments, considertion should be made of the following:

(1) construction other than CLASP

(2) inclusion of any alteration works

(3) site restrictions/difficulties

(4) high services element

(5) phased working

(6) works comprising several buildings on one site

(7) complexity of the project

(8) extensions to existing buildings

(9) holiday periods

(10) special client requirements

(11) statutory/client restrictions

(12) delivery periods of any special components

Although there is a basic guide to contract periods given, the very nature of construction work and its uniqueness means that for the majority of contracts, at least one of the above will always occur. There is no guidance on additions to the basic period, once again this is left to the discretion of the architect or quantity surveyor.

This guide has apparently been successful and is still in operation. The experience found by the NCC is that it is suitable only for the experienced contractors invited to tender. It appears to be essential that the contractors have an experienced working knowledge of the CLASP construction system in order that they can meet the demanding time schedule imposed on them. Its limitations of use precludes it from being used outside of the CLASP programme.

SUMMARY

The models identified here each have their own inherent strengths and weaknesses. However, they each identify areas which can be subsequent causes of an increase or a decrease in the contract duration. The Bromilow model is a general one, not restricted to any particular building type or method or procurement though it would appear to be limited to use in Australia. The Heery model is related to a procurement method not dissimilar to the design/build system used in the United Kingdom. It is restrictive and rigid and appears not to have been adopted by the American construction industry nor by the rest of the world. The CLASP model is related to construction method and is restricted only to CLASP developments. It provides a simple time/cost relationship based largely upon experience and feedback taking little account of other factors that may affect time.

The time/cost relationship is a complex one that has attracted few research studies. In each model identified above, cost appears to be the most useful and reliable predictor of time indicating that the hypothesis of cost being a measure of both size and complexity is a valid one. It is with this in mind that cost be the basis for predicting time in the model for this research.

BIBLIOGRAPHY

ATKIN B, Project planning and control,

Chartered Quantity Surveyor, September 1986, pp 11-13

BROMILOW F J, Building contract cost performance

The Building Economist, February 1971

BROMILOW F J, Contract time performance, expectations and reality

Building Forum Vol 1. No. 3 pp 70-80 September 1969

BROMILOW F J & HENDERSON J A, Procedures for reckoning and valuing the performance of building contracts,

Division of building research, CSIRO 1977, 2nd Ed

BROMILOW F J, HINDS M F & MOODY N F, AIQS survey of building contract time performance

The Building Economist, September 1980

HEERY G.T. Time, cost and architecture,

McGraw Hill, 1975

ROYAL INSTITUTION OF CHARTERED SURVEYORS, UK and US construction industries : a comparison of design and contract procedures,

RICS 1979

CHAPTER FOUR

TIME PREDICTION - THE SURVEY

CHAPTER FOUR

TIME PREDICTION - THE SURVEY

Introduction

The factors which affect time and the problems of predicting time have been identified in Chapter Two. The objective was to collect sufficient data to produce a reliable statistical analysis. The success of the research would depend largely upon the co-operation of the practising professional quantity surveyor. There are, amongst others, two large organisations which maintain a comprehensive data bank on the cost and time of construction projects. These are the Milton Keynes Development Corporation (MKDC) and the Building Cost Information Services (BCIS) of the Royal Institution of Chartered Surveyors (RICS). If the survey did not produce sufficient data then it would be necessary to supplement the survey data with additional data from the MKDC and the BCIS. These two organisations both gave their approval to this support though in the event it did not prove necessary to supplement the data.

The Pilot Survey

It was decided to attempt to collect the data through the use of a questionnaire. This was considered to be the most economic use of resources available. As is common with the use of questionnaires, it was decided first to test the form in the field before conducting the survey proper. Should it prove to be successful at the first attempt, then the pilot survey would provide a proportion of the total data used; if not, then it would save a lot of wasted time.

In designing the pilot survey questionnaire, a number of psychological factors were employed:

(a) It was considered important to keep the questionnaire as brief as possible, thus acknowledging the importance of the maxim 'time is money' in a professional office.

(b) The optimum physical size would be one sheet of A4 sized paper, with all the questions being self-explanatory, thus eliminating the need for an introductory sheet.

(c) Recognising that this was a pilot survey, an opportunity was given for the recipient to comment on the format of the questionnaire.

After several attempts, the attached questionnaire (Figure 3) was produced. A word processor was employed to produce a personal letter to accompany the questionnaire. As an incentive to respond, each practice was informed that they would receive a brief report outlining the findings of the research and that subsequently, should any computer software become available, they would be notified in advance.

Title of Research: THE INTER-RELATIONSHIP BETWEEN TIME AND COST FOR CONSTRUCTION PROJECTS.

CONFIDENTIAL INFORMATION	FOR OFFICE USE
Name of Office:.....	Reference No. :.....
Address :.....	Categorisation:.....
.....	Processed :.....
.....	
Date :.....	

PLEASE SUPPLY ANSWERS TO ALL QUESTIONS AS INDICATED circling as appropriate (Please complete in black ink)

1. TYPE OF PROJECT (not the name).	1. Residential.....H Commercial.....C Industrial.....I Educational.....E Recreational.....R Other(please state)..... .....
2. CONTRACT VALUE (as at start of contract - minimum value £100,000)	2. .....pounds
3. ORIGINAL CONTRACT PERIOD.	3. .....weeks
4. FINAL CONTRACT PERIOD.	4. .....weeks
5. DATE WORK COMMENCED ON SITE.	5. .....
6. BASE DATE FOR COST DATA.	6. .../....
7. LOCATION.	7. .....town/city .....county
8. FORM OF CONTRACT USED.	8. JCT Private with.....PQ JCT Private without....P JCT LA with.....LQ JCT LA without.....L Other(please state)..... .....
9. BASIS OF TENDER	9. Firm price.....F Fixed price.....Fp Fluctuating.....Fl
10.CLIENT BODY.	10.Private.....Pr Developer.....De Local Authority.....LA Central Government....CG Other..... .....

COMMENTS:

Figure 3.: Questionnaire Format for the Pilot Study

The pilot survey then was initiated to:

(a) test whether or not the questionnaire worked as expected and

(b) test the response to the request for suitable data.
One hundred questionnaires were sent out to twenty practices, each receiving five questionnaires.
The names and addresses of the practices were selected from the then current RICS Year Book. This is an Institution publication giving a comprehensive list of members in practices throughout the world.
In selecting the practices, at least one name came from each region, as categorised by the RICS, of the British Isles. None were sent overseas as the data was to be based on the British Isles only. All questionnnaires were sent out by post within a period of one week.

The response to the pilot survey was encouraging, if not somewhat surprising at 80% return within two months of posting. These questionnaires were analysed and the following points raised:

(a) in testing the response, it appeared that this method was an excellent one for collecting the data;

(b) not all partners completed the "name and address" portion. This might be either that the questionnaire is not explicit enough, or that the practice preferred to remain anonymous.

(c) from the questions asked, it was not always possible to determine the reasoning behind the data given.

(d) various comments were noted on the research. Such comments include:

> "Your questionnaires have been completed in full without an awful lot of difficulty, but I do feel that the matter will require consideration of certain other facts which do not come to light in the questionnaires."

> "As you did not suggest any sampling procedure, I have taken the six most recently completed contracts with a contract value in excess of £100 000".

> "You have stressed that you are basing your data on the original contract value but I would have thought the final value to be more appropriate."

It was decided, therefore, that before the survey proper be attempted, certain amendments had to be made to both the questionnaire and the letter. The following changes were incorporated:

(i) all parts of the form requiring answers were to be given a question number. In this way it was hoped that the 'name and address' section would be completed.

(ii) an additional question should be asked to establish the cause of delay, if any.

(iii) the letter should be more precise in terms of the research intentions.

The Survey Proper

The final questionnaire (Figure 4) and accompanying letter (Figure 5) were produced, account having been taken of the points raised above. It was decided again to have a mail shot to quantity surveying practices selected regionally, at random, from the RICS Year Book. It was expected that there would be a similar rate of return.

One thousand questionnaires were mailed within one month. As in the pilot survey, five questionnaires were sent to each practice. The rate of reply was initially good, leading to an expected rate of return in the region of 80%, but this unfortunately rapidly tailed off. A reminder letter (Figure 6) was sent to those practices who had not replied after two months.

After a period of four months, 212 completed questionnaires had been returned. This was disappointing following the successful pilot survey, but at 21% the rate of return was more than could be expected from a postal survey. It was decided that this number of questionnaires provided sufficient data to commence the analysis. Any late returned questionnaires could easily be incorporated into the analysis. In the event no further questionnaires were received.

Title of Research: THE INTER-RELATIONSHIP BETWEEN TIME AND COST FOR CONSTRUCTION PROJECTS.

PLEASE SUPPLY ANSWERS TO ALL QUESTIONS AS INDICATED (Please write in block capitals or use a typewriter).

1. Name of Office:..... Address :..... .... Date :.....	
2. TYPE OF PROJECT (not the name).	2. Residential.....H Commercial.....C Industrial.....I Educational.....E Recreational.....R Other(please state)..... .....
3. CONTRACT VALUE (as at start of contract - minimum value £100,000)	3. £.....
4. ORIGINAL CONTRACT PERIOD.	4. .....weeks/months
5. FINAL CONTRACT PERIOD.	5. .....weeks/months
6. ADDITIONAL WORK AUTHORISED WITH EXTRA TIME AND VALUE.	6. .....weeks/months £.....
7. SUGGESTED CAUSE OF DELAY. (If applicable)	7. Inclement weather.....IW Delay in drawing issue.D Bankruptcy.....B Strikes.....S Labour/materials shortage.....LM Other.....
8. DATE WORK COMMENCED ON SITE.	8. .../../....
9. BASE DATE FOR COST DATA.	9. .../....
10.LOCATION.	10.....town/city .....county
11.FORM OF CONTRACT USED.(eg JCT 80 Private with Quantities)	11.State exact form used... .....
12.CLIENT BODY.	12.Private.....Pr Developer.....De Local Authority.....LA Central Government....CG Other..... .....
13.BRIEF DESCRIPTION OF PROJECT: indicate the number of units,any abnormal inclusions and/or exclusions etc.	13..... ....

Figure 4.: Questionnaire Format Used in the Survey Study.

INM/RL1/PQS
517
3rd February 1983

Dear

As you are no doubt aware from recent articles in the quantity surveying press, the ultimate cost of the project is the all important figure that the client wishes to know. One major factor contributing to increased costs during the running of the contract, is an inaccurate estimation of the contract period. I am writing to you today to seek your support in a research project that I am undertaking to study the inter-relationship of time and cost for construction projects.

Briefly, I am trying to establish the relationship between time, in terms of contract period, and cost, this being the contract value, taking into account any contributory factors that become apparent. From the information received, a statistical model will be formulated to accurately predict the contract period using the estimated contract value. Ultimately, it is hoped that this model will form the basis of a piece of software to be used on micro-computers which are becoming more common in Quantity Surveying offices.

Could I therefore ask you if you could spare the time to complete the five questionnaires enclosed.Once completed, I would like them to be returned to me at the above address. I would stress that I do NOT wish to know the actual project name or that of the Main Contractor. This does not aid me and will only serve to breach the confidentiality between the client and the quantity surveyor.

I hope that you are able to help, but should you wish to discuss the matter further before returning the forms, then I would be pleased to hear from you. I would point out that the information will of course be kept in the strictest confidence. You will be entitled to a copy of the report, when published, and you will be notified of the sale of any anticipated software. I should be most grateful to have the completed forms as soon as possible.

Yours sincerely,

I.N. MEHRTENS B.Sc, ARICS.
Senior Lecturer in Quantity Surveying

Figure 5.: The Accompanying Letter to the Questionnaires.

INM/RL2/PQS
517
5th April 1983

Dear

You may recollect that I wrote to you at the beginning of the year with a request for help on a research project that I am undertaking at Thames Polytechnic into the inter-relationship between time and cost for construction projects. The request was for the completion of five questionnaires.

Looking at the responses to my request, I have noticed that I have not, as yet, received any reply from your practice. I realise that you are obviously very busy and that time is of a premium in any practice, but as I am sure you will appreciate, the success of this study depends entirely on the willingness and participation of the profession. I would stress again, that we do NOT wish to know any names; this information will not help us in our research and will only serve to breach the confidentiality between the contractor and the quantity surveyor.

Briefly, to remind you of the purposes and eventual aims of my work, I am trying to establish the relationship between time, in terms of contract period, and cost, this being the contract value, taking into account any contributory factors that become apparent. From the information received, it is anticipated that a statistical model will be formulated to accurately predict the contract period using the estimated contract value. Ultimately, it is hoped that this model will be the basis of a piece of software to be used on micro-computers which are becoming more common in quanitity surveying practices.

Could I therefore please ask for your assistance and hope that you find the time to complete the five questionnaires enclosed. Should you wish to discuss the matter further before returning the forms, then I would be pleased to hear from you. It ought to be pointed out that the information you will give will of course be kept in the strictest confidence. You will be entitled to a copy of the report, when published, and you will ne notified of the availability of any anticipated software.

I should be most grateful to have your completed forms as soon as possible, a pre-paid envelope is enclosed for your reply.

Yours sincerely,

I.N.Mehrtens B.Sc ARICS.
Senior Lecturer in Quantity Surveying.

Figure 6.: The Follow Up Reminder Letter.

Upon initial inspection of the questionnaires, it appeared that a wide range of building types had been submitted, so it ws decided that it would be advantageous at this stage to categorise the data into broad functional areas. A range of categorisations are available such as the CI/SfB. It was decided to adopt a simple functional system that could easily be identified and categorised without requiring any interpretation. The categories chosen were as follows:

H : housing or any other domestic dwelling

C : commercial properties

I : industrial units

E : educational buildings

R : recreational buildings

M : medical centres

T : transport buildings

S : sundry - any other buildings that could not be categorised above.

The number of projects returned and allocated to the categories above are as given in Figure 7 below:

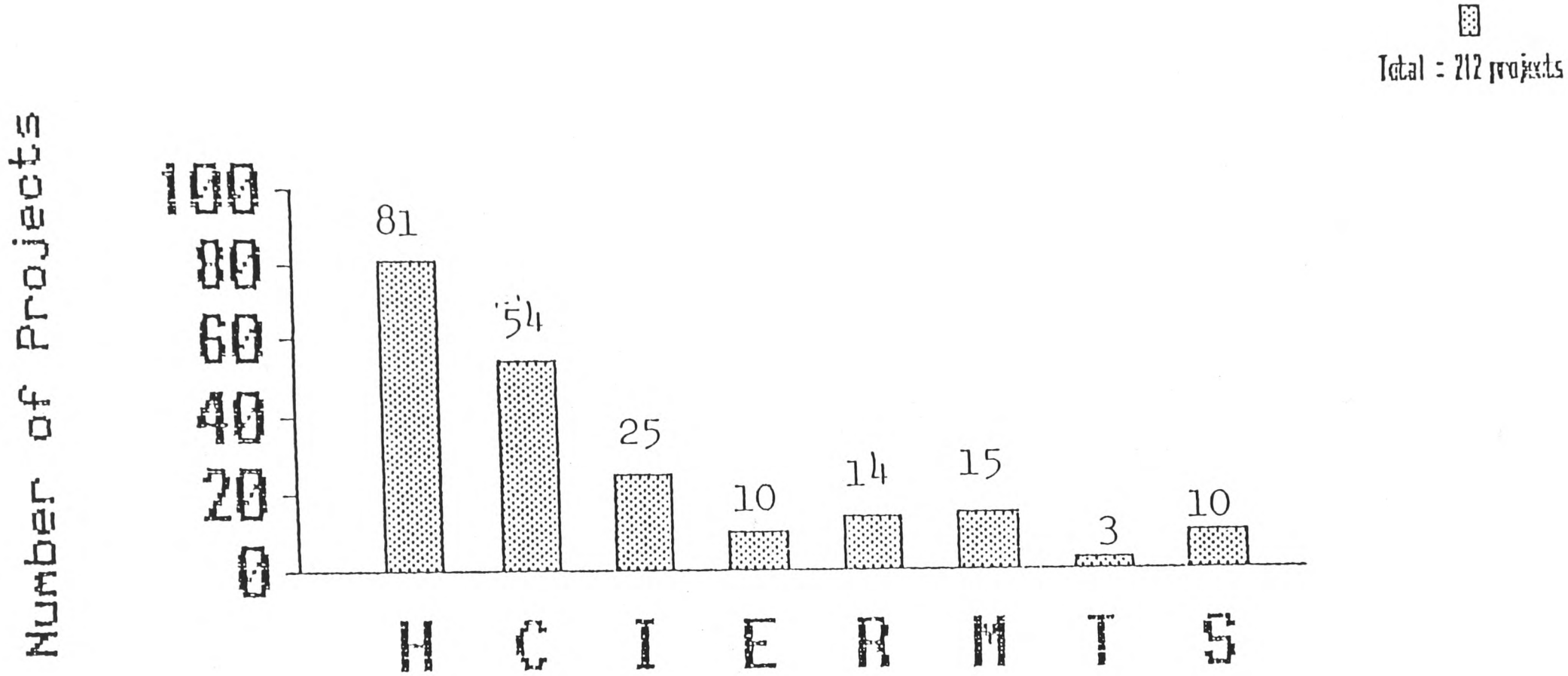


Figure 7 : Type of Project

It can be seen from Figure 7 that there was a wide range in the numbers of projects returned within each of the categories from T (transport) at 3 (1.5%) to H (housing) at 81 (38%). This range is much as could be expected from a random survey.

Multiple regression analysis

The aim of this reasearch is to be able to predict time using the estimated cost as the basis for that calculation. If the relationship was that simple, there would be no deviation from the stated contract period. Research has shown that this is not the case, suggesting that this simple relationship is not valid. Bromilow (1969) found that there was a linear relationship between time and cost but that this was subject to a constant describing the general level of time performance.

Multiple regression is a technique used successfully to establish interrelationships among large numbers of variables in a single set of previously undigested data. The advantage of multiple regression is that it shows both the combined effects of a set of independent variables and the separate effects of each independent variable.

Multiple regression assumes that the effects of the independent variables are linear: that is the effect of a unit difference in an

independent variable is the same at all points in the range of the variable. In order to measure the extent, or strength, or the linear relationship, the correlation coefficient can be calculated.

If r = +1 (-1) then there is complete positive (or negative) linear correlation. If r=0 then there is no linear correlation. In general terms the nearer the value of r is to +1 or -1, then the stronger is the linear relationship.

A multiple linear regression model is adopted for the analysis of the relationship between the duration of time for completing the project as the response variable and those variables affecting the response as the regressors. If we denote the response variable by Y and the regressors as X1, X2,..... Xk then the model can be written as:

$$Y = B1 + B1X1 + B2X2 + ...+ BkXk + E$$

where E is assumed to be an independent random error having a normal distribution with zero mean and some constant variance. The B's are constants whose values are estimated by the method of least squares. The least squares estimates of the B's are determined on the basis of the criterion that these estimates make the sum of squares of the error term E a minimum.

With so many variables in the equation, the choice of regression equation became significant. It had been estimated that the questionnaires would produce at least ten variables, each of which could significantly affect the time factor.

The choice of selecting the best regression equation is therefore critical to the success of the analysis. Two opposed criteria are usually involved in this selection process:

(a) to make the equation useful for predictive purposes, it is desirable to use as many variables as possible so that reliable values can be determined.

(b) because of the methods involved in obtaining information on a large number of variables and subsequently monitoring them, it is desirable to include as few variables as possible in the equation.

The compromise between these two extremes is what is usually called 'selecting the best regression equation'. There is no unique procedure for doing this and personal judgement plays a large part in the selection process.

The following procedures were examined:

(1) **Backward Elimination Procedure**

This me thod attempts to permit the examination of only the "best" regression containing a certain number of variables. The basic steps are as follows:

(a) a regression equation containing all the variables is computed.

(b) the partial F-test value is calculated for every variable as though it were the last variable to enter the equation.

(c) the lowest partial F-test value (F1) is compared with a pre-selected percentage point (FO).

(i) If F1 < FO, then that variable is removed from consideration and the regression equation is recomputed in the remaining variables.

(ii) If F1 > FO, then the regression equation calculated is adopted.

(2) Forward Selection Procedure

The previous method begins with the largest regression, using all variables and subsequently reduces the number of variables in the equation until a satisfactory decision is reached. The forward selection procedure is an attempt to achieve a similar conclusion working from the opposite direction.

The order of insertion of the variables is determined by using the partial correlation coefficient as a measure of the importance of variables not yet in the equation.

As soon as the partial F-value related to the most recently entered variable becomes non-significant, the process is terminated.

(3) Stepwise Regression Procedure

This is a combination of the backward and forward procedures. The improvements made involve the re-examination at every stage of the regression of the variables incorporated into the model at previous stages.

> A variable which may have been the best single variable to enter at an early stage may, at a later stage, be superfluous because of its relationships with other variables now in the equation. Any variable which provides a non-significant contribution is removed from the model. This process is continued until no more variables will be admitted to the equation and no more are rejected.

Examining the three available procedures it is clear that for this research the stepwise regression procedure will provide the best fit solution. The characteristic considered most important is that of re-examining all variables for significance at every step, a feature that does not exist in either of the other procedures. For this reason it was decided to apply the stepwise regression procedure to the data collected. The results contained in chapters five and six are those produced using this facility within the computer programme Statistical Package for Social Scientists (SPSS). This package is a set of programmes that enables a variety of statistical analyses to be made quickly and accurately.

The questionnaires allowed for the full range of project types in that none were specifically excluded. As some project category groupings had relatively few returns, and with so many variables in the

equation, it was necessary to combine some groups to create the files for use in the SPSS regression analysis. At this stage there was no evidence to suggest that each project type would react differently. If the results of the grouped files suggested that they did, then it would be necessary to separate the types again and re-examine the groupings. The files created are as follows:

1.	Residential	38%
2.	Commerical	25%
3.	Remainder	37%
4.	All combined	100%

The description and analysis of data is provided in Chapter Five and where it will be seen that it was not necessary to re-examine the groups as there was a large degree of commonality in the results.

CHAPTER FIVE

TIME PREDICTION - AN ALTERNATIVE APPROACH

DESCRIPTION OF DATA

Introduction

An analysis of the questionnaires shows that there are a number of variables that were required to be included in the regression. It is the purpose of this research to show, through the regression analysis, which if any, of the variables identified affect the time/cost relationship and to what extent. It was realised in preparing these variables for inclusion in the regression annalysis that while some were quantitative, others were qualitative (indicated below by *). Where the variable is quantitative, no problem exists in that the value label attached will be the quantity recorded. The same theory cannot be applied to the qualitative variables. It was decided to adopt a binary coding with 0 indicating a category of the variable not being present and 1 indicating the category being present. The following variables were identified from the questionnaires and labelled ready for inclusion in the stepwise regression package within the SPSS programme.

Final Contract Period	FCP
Type of Work	TOW *
Client Body	CLIENT *
Form of Contract	FOC *
Type of Contract	TOC *
Geographical Location	LOCTN *
Date Work Started	DWS *
Adjusted Original Contract Value	AOCV
Adjusted Additional Contract Value	AACV
Causes of Delay	A B C D E *

FINAL CONTRACT PERIOD (FCP)

The FCP is represented numerically in weeks. This is not the original contract period as stated in the contract documentation, but is the actual time that the contract took to complete. The value labels attached are the number of weeks taken for the contract to be completed. (C1)

TYPE OF WORK (TOW)

Here it is intended to indicate whether the project is new work or refurbishment of an existing property. Within the industry, it is believed that refurbishment work takes longer to complete than anticipated. The value labels attached are as follows:

(C2)

0 = New work

1 = Refurbishment

CLIENT BODY (CLIENT)

Here an attempt is being made to classify the client into the broad terminology of commercial or quasi/non-commercial. This will give an indication of profit making motivation and may have some relationship to the time taken for construction. The value labels attached are as follows:

C3.....C7

0 0 0 0 0 = Private

1 0 0 0 0 = Developer

0 1 0 0 0 = Local Authority

0 0 1 0 0 = Central Government

0 0 0 1 0 = Housing Association

0 0 0 0 1 = Other

FORM OF CONTRACT (FOC)

With a wide range of standard forms of contract available, it is anticipated that this might have an influence on the time/cost relationship. The reasons why there are so many forms of contract available are that they are all designed to meet particular contractual requirements and it has been shown that the wrong choice of contract can have a detrimental effect on client time. The value labels attached are as follows:

C8.....C15

0 0 0 0 0 0 0 0 = LA Edition with quantities

1 0 0 0 0 0 0 0 = LA Edition without quantities

0 1 0 0 0 0 0 0 = Private Edition with quantities

0 0 1 0 0 0 0 0 = Private Edition without quantities

0 0 0 1 0 0 0 0 = Fixed Fee

0 0 0 0 1 0 0 0 = Fluctuating Fee

0 0 0 0 0 1 0 0 = Management Design and Build

0 0 0 0 0 0 1 0 = GC/Works/1

0 0 0 0 0 0 0 1 = Other

TYPE OF CONTRACT (TOC)

It is thought that depending upon the way in which increased costs are recovered, there may be an incentive to complete early or to delay. The value labels attached are as follows:

C16

0 = Fixed costs

1 = Fluctuating costs

GEOGRAPHICAL LOCATION (LOCTN)

An attempt is being made here to determine whether a pattern emerges for any particular region of the UK. Depressed regions, where work is not readily available, may harbour greater incentives to complete projects 'on time', with the hope that more work may follow. The value labels attached are as follows:

C17.....C28

0 0 0 0 0 0 0 0 0 0 0 0 = Northern

1 0 0 0 0 0 0 0 0 0 0 0 = Yorkshire & Humberside

0 1 0 0 0 0 0 0 0 0 0 0 = East Midlands

0 0 1 0 0 0 0 0 0 0 0 0 = East Anglia

0 0 0 1 0 0 0 0 0 0 0 0 = South East

0 0 0 0 1 0 0 0 0 0 0 0 = London

0 0 0 0 0 1 0 0 0 0 0 0 = SE Counties

0 0 0 0 0 0 1 0 0 0 0 0 = Southern Counties

0 0 0 0 0 0 0 1 0 0 0 0 = South West

0 0 0 0 0 0 0 0 1 0 0 0 = West Midlands

0 0 0 0 0 0 0 0 0 1 0 0 = North West

0 0 0 0 0 0 0 0 0 0 1 0 = Wales

0 0 0 0 0 0 0 0 0 0 0 1 = Scotland

DATE WORK STARTED (DWS)

The seasonal effect of building is well documented. The date work starts on site is categorised here into half years:

C29

1 = Summer season (April - September)

2 = Winter season (October - March)

ADJUSTED ORIGINAL CONTRACT VALUE (AOCV)

The original contract value is the agreed value at the time of signing the contract. Upon examination of the questionnaires, it appeared that all analysed contract values fell within the range of £100 000 - £4 000 000. To analyse the values, it is necessary to bring all cost to a common base using indices. It was decided to use the BCIS Tender Price Index adjusted to the 4thQ 1977. The adjusted date is irrelevant in that the actual adjusted cost is not important - it is the way in which the cost reacts to the variables being applied. The indices used are given below.

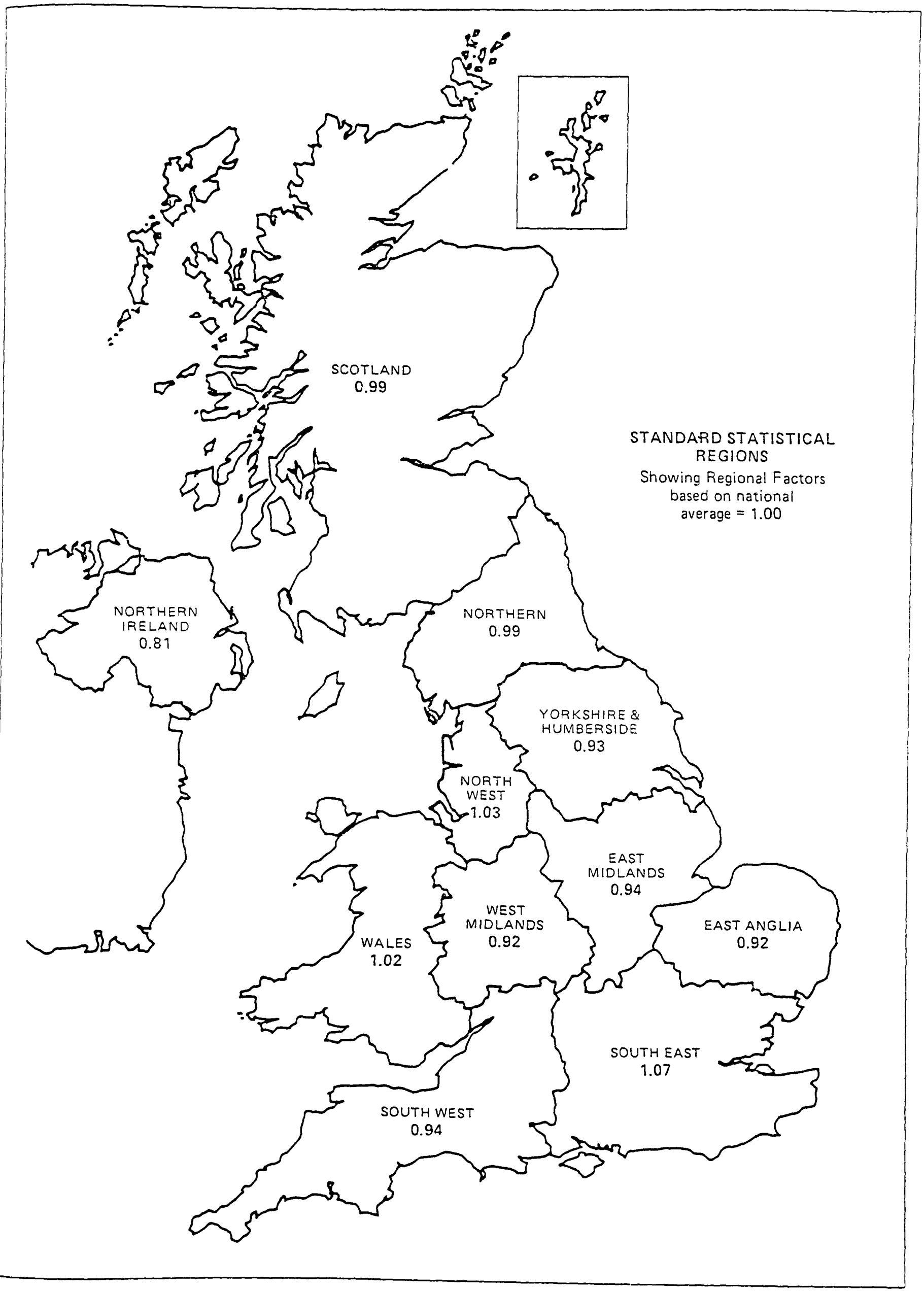
Index Base: 1st Quarter 1974

Quarter		Tender Price Index
1974	i	100
	ii	100
	iii	99
	iv	100
1975	i	105
	ii	103
	iii	105
	iv	105
1976	i	111
	ii	109
	iii	113
	iv	116
1977	i	120
	ii	130
	iii	133
	iv	129

1978	i	137
	ii	146
	iii	154
	iv	160
1979	i	172
	ii	179
	iii	199
	iv	212
1980	i	214
	ii	226
	iii	227
	iv	214

The cost of a building is also affected by its location. In bringing all costs to a common base, it is recognised that some factor must be applied to take account of the variance due to location. Once again it was decided to use the BCIS and in particular the Location factors as published. The following location factors are based on a national average = 1.00 and are derived upon analysis of all the tender prices calculated over the period 1975 - 1980. (See Figure 8.)

Figure 8 Regional Factors



Northern	0.99
Yorkshire & Humberside	0.93
East Midlands	0.94
East Anglia	0.92
South East	1.07
London	1.07
Southern Counties	1.07
South West	0.94
West Midlands	0.92
North West	1.03
Wales	1.02
Scotland	0.99

The AOCV therefore takes account of both the time difference and the location. The value labels attached are the actual figures as calculated. (C30)

ADJUSTED ADDITIONAL CONTRACT VALUE (AACV)

It was realised that in many projects, the client authorises additional spending on the contract. This extra spending often results in an additional time requirement. As with the original contract value, adjustments for time and location also had to be made. The value labels attached are the actual figures as calculated. (C31)

CAUSES OF DELAY (A B C D E)

It has been suggested that many contracts are subject to delays. The questionnaire attempts to identify the causes of these delays and to reconcile the discrepancy between original and final contract periods. The value labels attached are as follows:

(C32..C35)

0 0 0 0 = Inclement weather

1 0 0 0 = Delay in drawing issue

0 1 0 0 = Bankruptcy

0 0 1 0 = Strikes

0 0 0 1 = Labour/Material shortages

The questionnaires allowed for the full range of project types in that none were specifically excluded. There seemed no evidence to suggest that they would react to the analysis in differing ways. It was decided to categorise into project types initially to identify the category of data. The distribution is as follows:

Housing	81
Commerical	54
Industrial	25
Educational	10
Recreational	14
Medical	15
Transport	3
Sundry	10
TOTAL	212

As a number of the project types have very small amounts of data it was decided to cre ate four files based purely on a random numerical assessment. The files created are as follows:

1.	Residential	81	(38%)
2.	Commercial	54	(26%)
3.	Remainder	77	(36%)
4.	All combined	212	(100%)

Using the SPSS package, the data was input within the confines of the pre-established variable labels identified earlier in this chapter. The following, Figures 9,10 and 11, are copies of the completed questionnaires for the Transport category which form the basis for the input data for File 3 (Remainder). The names and addresses have been omitted from the copies to maintain the confidentiality promised to contributors of data for this research.

Title of Research: THE INTER-RELATIONSHIP BETWEEN TIME AND COST FOR CONSTRUCTION PROJECTS.

PLEASE SUPPLY ANSWERS TO ALL QUESTIONS AS INDICATED (Please write in block capitals or use a typewriter).

1. Name of Office:..... Address :..... .....PROJECT 1..... ..... Date :.....	
2. TYPE OF PROJECT (not the name).	2. Residential.....H Commercial.....C Industrial.....I Educational.....E Recreational.....R Other(please state)..... ...TRANSPORT.....
3. CONTRACT VALUE (as at start of contract - minimum value £100,000)	3. £297 709...
4. ORIGINAL CONTRACT PERIOD.	4. .20.....weeks/~~month~~s
5. FINAL CONTRACT PERIOD.	5. .40½.....weeks/~~month~~s
6. ADDITIONAL WORK AUTHORISED WITH EXTRA TIME AND VALUE.	6. ..7½.....weeks/~~month~~s £34 828.
7. SUGGESTED CAUSE OF DELAY. (If applicable)	7. Inclement weather.....(IW) Delay in drawing issue.D Bankruptcy.....B Strikes.....(S) Labour/materials shortage.....LM Other.....
8. DATE WORK COMMENCED ON SITE.	8. .15/.1/.79.
9. BASE DATE FOR COST DATA.	9. NOV/.78.
10.LOCATION.	10..LONDON.....town/city .....county
11.FORM OF CONTRACT USED.(eg JCT 80 Private with Quantities)	11.State exact form used... JCT 63 LA with Quants...
12.CLIENT BODY.	12.Private.....Pr Developer.....De Local Authority.....(LA) Central Government....CG Other..... .....
13.BRIEF DESCRIPTION OF PROJECT: indicate the number of units,any abnormal inclusions and/or exclusions etc.	13 Passenger & staff accomm at 5 No railway stations (stations kept in operation throughout)

Figure 9

Title of Research: THE INTER-RELATIONSHIP BETWEEN TIME AND COST FOR CONSTRUCTION PROJECTS.

PLEASE SUPPLY ANSWERS TO ALL QUESTIONS AS INDICATED (Please write in block capitals or use a typewriter).

1. Name of Office:.....	
Address :.....	
.....PROJECT 2.....	
Date :.....	
2. TYPE OF PROJECT (not the name).	2. Residential.....H Commercial.....C Industrial.....I Educational.....E Recreational.....R Other(please state)..... .....**TRANSPORT**.....
3. CONTRACT VALUE (as at start of contract - minimum value £100,000)	3. **£9 048 686.**
4. ORIGINAL CONTRACT PERIOD.	4. ...**25**.....~~weeks~~/months
5. FINAL CONTRACT PERIOD.	5. ...**27**.....~~weeks~~/months
6. ADDITIONAL WORK AUTHORISED WITH EXTRA TIME AND VALUE.	6. ....**2**.....~~weeks~~/months £...-...
7. SUGGESTED CAUSE OF DELAY. (If applicable)	7. Inclement weather.....IW Delay in drawing issue.D Bankruptcy.....B Strikes.....S Labour/materials shortage.....LM Other.....
8. DATE WORK COMMENCED ON SITE.	8. **.1./.6/.80.**
9. BASE DATE FOR COST DATA.	9. **MAR/.80.**
10.LOCATION.	10.**ROTHERHAM**.....town/city ..**S.Yorks**.....county
11.FORM OF CONTRACT USED.(eg JCT 80 Private with Quantities)	11.State exact form used... **JCT 63 LA with Qaunts...**
12.CLIENT BODY.	12.Private.....Pr Developer.....De Local Authority.....(LA) Central Government....CG Other..... .....
13.BRIEF DESCRIPTION OF PROJECT: indicate the number of units,any abnormal inclusions and/or exclusions etc.	13.**Parking for 180 buses & workshops, admin and ancillicary buildings** .....

Figure 10

Title of Research: THE INTER-RELATIONSHIP BETWEEN TIME AND COST FOR CONSTRUCTION PROJECTS.

PLEASE SUPPLY ANSWERS TO ALL QUESTIONS AS INDICATED (Please write in block capitals or use a typewriter).

1. Name of Office:..... Address :..... ....PROJECT 3..... ..... Date :.....	
2. TYPE OF PROJECT (not the name).	2. Residential.....H Commercial.....C Industrial.....I Educational.....E Recreational.....R Other(please state)..... **VEHICLE MAINT GARAGE**....
3. CONTRACT VALUE (as at start of contract - minimum value £100,000)	3. **£226 142**...
4. ORIGINAL CONTRACT PERIOD.	4. ....**6**.....~~weeks~~/months
5. FINAL CONTRACT PERIOD.	5. ....**7**.....~~weeks~~/months
6. ADDITIONAL WORK AUTHORISED WITH EXTRA TIME AND VALUE.	6. ...**NIL**.....~~weeks~~/months £.....
7. SUGGESTED CAUSE OF DELAY. (If applicable)	7. Inclement weather.....IW Delay in drawing issue.D Bankruptcy.....B Strikes.....S Labour/materials shortage.....LM Other.....
8. DATE WORK COMMENCED ON SITE.	8. **.15/.9/.80.**
9. BASE DATE FOR COST DATA.	9. .../....**FIXED PRICE**
10.LOCATION.	10.**BIRMINGHAM**.....town/city .....county
11.FORM OF CONTRACT USED.(eg JCT 80 Private with Quantities)	11.State exact form used... **JCT 63 LA with Quants**...
12.CLIENT BODY.	12.Private.....Pr Developer.....De Local Authority.....LA Central Government...(CG) Other..... .....
13.BRIEF DESCRIPTION OF PROJECT: indicate the number of units,any abnormal inclusions and/or exclusions etc.	13.**Alteration and completion of warehouses to form vehicle maintenance garage**

Figure 11

ANALYSIS OF DATA

Introduction

Initially the regression was perfomed on three sets of data, Files 1, 2 & 3 (Residential, Commerical and Remainder respectively). The output from these three files was then analysed to determine any commonality of findings. As will become apparent later in this chapter, there being some apparent degree of commonality, it was decided to perform the regresssion analysis on File 4, All Combined. the output from this file then formed the basis for determining the regression equation and identifying the significant variables affecting the prediction of time. The output is presented in Appendix A to this thesis.

The data presented here shows for each regression analysis performed, the significant variables in the order in which they appear with their relative values. Beyond the step presented, no further variables were found to be statistically significant. The following is a list of the variables as presented in the regression together with their definitions for ease of reference. Amplification of these can be found in the first part of this chapter, Description of Data.

Variable	Definition	Abbreviation
C1	Final Contract Period	FCP
C2	Type of Work	TOW
C3 - C7	Client Body	CLIENT
C8 - C15	Form of Contract	FOC
C16	Type of Contract	TOC
C17 - C28	Location	LOCTN
C29	Date Work Started	DWS
C30	Adjusted Original Contract Value	AOCV
C31	Adjusted Additional Contract Value	AACV
C32 - C35	Causes of Delay	A B C D

Using the SPSS programme, a stepwise regression analysis was performed on the data within each defined category. In all cases the dependent variable C1 was the final contract period (FCP) as it is intended to indicate which variables are statistically significant in predicting time. The output from the regression indicates the combined effects of a set of independent variables C2 - C35.

Interpreting the regression output

Multiple linear regression extends bivariate regression by incorporating multiple independent variables. The model assumes that there is a normal distribution of the dependent variable (C1) for every combination of the values of the independent variables (C2 to C35) in the model. For example, with time (FCP) as the dependent variable and adjusted original contract value (AOCV) and date work started (DWS) as the independent variables, it is assumed that for every combination of AOCV and DWS there is a normal distribution of FCP and that, though the means of these distributions may differ, they all have the same variance.

One of the first steps in developing an equation with several independent variables, is to calculate a correlation matrix of all variables. The following is an extract from the matrix produced for File 1, Residential. The full matrix can be seen in Appendix A with the SPSS output.

	C29 (DWS)	C30 (AOCV)
C1	-0.04666	0.72965
C24	-0.03415	-0.08067
C25	-0.04464	-0.03997
C26	0.23583	-0.08672
C27	-0.24268	-0.06709
C28	0.01359	0.00318
C29	1.00000	-0.10451
C30	-0.10451	1.00000
C31	-0.05123	0.57813

The matrix shows the correlations between the dependent variable and the indepent variables and also the correlations between the indepent variables themselves. The correlation coefficients indicate the strength of the linear relationship. The largest value possible is +1 or -1 which occurs when the points fall exactly on a line. A value of 0 indicates no linear relationship.

For multiple regression it is possible to assign relative importance to each independent variable. For example, it may be desirable to know whether AOCV is more influential than DWS in predicting FCP. There are two possible answers depending upon which one of the following questions is asked.

1. How important are AOCV and DWS when each of them alone is used to predict FCP?

2. How important are AOCV and DWS when, along with other independent variables in the regression equation, they are used to predict FCP?

The first question is answered by looking at the correlation coefficients between FCP and the independent variable. The larger the coefficient is in absolute value, the stronger the linear association. From the matrix above, AOCV correlates more highly with FCP than does DWS (0.72965 and -0.04666 respectively). Thus you would assign more importance to AOCV than to DWS as a predictor to FCP.

The answer to the second question is more complicated. When individual independent variables are correlated among themselves, the unique contribution is difficult to assess. Any statement about an independent variable is contingent upon the other variables in the equation. For example, the regression coefficient B for AOCV is 0.000033 when it is the sole independent variable in the equation, compared with 0.000044 when the other independent variables enter the equation.

For each analysis performed a variety of statistical data are produced. The following is a guide to interpreting the output.

Multiple r: the correlation between the dependent variable and the entire set of independent variables. The nearer the value to +1 or -1 the stronger is the linear relationship The multiple r is the multivariate counterpart to the simple correlation r.

r square: the proportion of variance in the dependent variable associated with the independent variables. This proportion is a good indicator of the explanatory power of the regression model. The closer r squared is to +1, the stronger the assumed positive relationship of an r squared of 0.9946 indicates that about 99% of the variation in the estimate is explained by the variables in the model.

B: the regression coefficient which measures the rate of change in the dependent variable C1 per unit change in the independent variable C2 to C35.

SE B: the standard error of the regression coefficient B.

F-Value: the value of the F-test.

Residential

Number of cases 81

Regression Variables C1 to C35

Regression = C1 with C2 to C35

The regression ceased to produce any new significant variables after step 6. The variables identified are as follows:

Multiple r = 0.84939

r square = 0.72146

Sig. F-value = 4.08

Variable	B	SE.B	F-Value
C30	0.4142304E-04	0.00000	112.785
C19	-65.16674	17.95783	13.169
C16	25.28013	7.42620	11.588
C25	21.36383	6.60377	10.466
C33	12.43794	4.74802	6.862
C28	-14.21492	6.76968	4.409
Constant	31.11160		

C30	AOCV
C19	LOCTN (East Anglia)
C16	TOC
C25	LOCTN (West Midlands)
C33	DELAY (Bankcruptcy)
C28	LOCTN (Scotland)

Commerical

Number of cases	54
Regression	Variables C1 to C35
	Regression = C1 with C2 to C35

The regression ceased to produce any new significant variables after step 4. The variables identified are as follows:

Multiple r = 0.91984

r squared = 0.84610

Sig F-Value = 4.08

Variable	B	SE.B	F-Value
C31	0.2177883E-04	0.00000	50.117
C30	0.9080989E-05	0.00000	36.458
C33	19.88923	5.66136	12.342
C28	-17.94202	8.14052	4.858
Constant	41.47678		

C31	AACV
C30	AOCV
C33	DELAY (Bankruptcy)
C28	LOCTN (Scotland)

Remainder

Number of cases 77

Regression Variables C1 to C35

Regreession = C1 with C2 to C35

The regression ceased to produce any new significant variables after step 9.

The variables identified are as follows:

Multiple r = 0.85678

r square = 0.73408

Sig F-Value = 4.08

Variable	B	SE.B	F-Value
C30	0.1568047E-04	0.00000	95.915
C33	26.421204	6.27862	17.708
C14	73.03123	13.76409	28.153
C4	33.04466	9.05469	13.319
C16	13.14206	6.17692	4.527
C29	13.53457	5.65839	5.713
C18	23.80272	11.47206	4.305
C26	13.29007	6.08866	4.764
C9	18.47974	9.00584	4.211

Constant -19.52984

C30	AOCV
C33	DELAY (Bankruptcy)
C14	FOC (GC/Wks/1)
C4	CLIENT (Local Authority)
C16	TOC
C29	DWS
C18	LOCTN (East Midlands)
C26	LOCTN (North West)
C9	FOC (JCT 63 Private Edition with Quantities)

All combined

Number of cases 212

Regression Variables C1 to C35

Regression = C1 with C2 to C35

The regression ceased to produce any new significant variables after step 9. The variables identified are as follows:

Multiple r = 0.79287

r square = 0.62865

Sig F-Value = 3.84

Variable	B	SE.B	F-Value
C30	0.1350130E-04	0.00000	100.065
C33	19.79271	3.93187	25.340
C16	17.69783	4.53627	15.221
C4	32.88517	6.90145	22.705
C6	24.03747	5.54860	18.768
C31	0.1016660E-04	0.00000	15.037
C14	50.83213	12.42133	16.747
C35	17.68011	8.29145	4.547
C9	13.90079	6.89980	4.059
Constant	10.17404		

C30	AOCV
C33	DELAY (Bankruptcy)
C16	TOC
C4	CLIENT (Local Authority)
C6	CLIENT (Housing Association)
C31	AACV
C14	FOC (GC/ Wks/1)
C35	DELAY (Labour/materials shortage)
C9	FOC (JCT 63 LA Edition with Quantities)

The multiple regression equations obtained from the previous three analyses suggest several findings.

	AOCV	LOCTN	DWS	AACV	FOC	CLIENT	DELAY	TOC
Residential	X	X					X	X
Commerical	X	X		X			X	
Remainder	X	X	X		X	X	X	X

There is an apparent commonality in the selection of the significant variables by the regression analysis. In every case it appears that AOCV, LOCTN and DEL AY are significant. It was therefore decided to look at the output from the All Combined file. The findings are as follows:

	AOCV	LOCTN	DWS	AACV	FOC	CLIENT	DELAY	TOC
Residential	X	X					X	X
Commercial	X	X		X			X	
Remainder	X	X	X		X	X	X	X
All	X		X	X	X	X	X	X

The selection of the variables to predict time has, to some extent, been arbitrary. It is unlikely that all relevant variables have been identified and measured. Doubtless some good variables have been excluded, while some of those included may not be very good predictors. This is not unusual; it is necessary to build the model from the available data as voluminous or scant as they may be.

As there was a degree of commonality of results it was decided to use the All Combined file to calculate the regression equation for predicting time. This file contains the largest amount of data available and was therefore considered to be most reliable. From the output, it appears that AOCV and DELAY are the most influential predictors of time with LOCTN and TOC being the next best predictors.

From the All Combined output we can use the following regression equation for the purposes of predicting time:

$$\begin{aligned}\text{Time (in weeks)} = {} & 10.17 + [0.0000135013\ C30] \\ & + [19.79\ C33] + [17.70\ C16] \\ & + [32.89\ C4] + [24.04\ C6] \\ & + [0.00001017\ C31] + [50.83\ C14] \\ & + [17.68\ C35] = [13.90\ C9]\end{aligned}$$

C30 = AOCV [Value adjusted for location to 4thQ 1977]

C33 = DELAY [Bankruptcy]

C16 = TOC [Fluctuating costs]

C4 = CLIENT [Local Authority]

C6 = CLIENT [Housing Association]

C31 = AACV [Value adjusted for location to 4thQ 1977]

C14 = FOC [GC/Wks/1]

C35 = DELAY [Labour/Materials shortage]

C9 = FOC [JCT Local Authority Ed with quantities]

This means that applying the criteria listed above in terms of the variables, it is possible to predict the time required for a project in weeks from start on site to practical completion.

BIBLIOGRAPHY

ASHWORTH A, Regression analysis for building contractors, MSc thesis
Loughborough Univeristy, 1977

BLAND J A, Statistics for construction students,
Construction Press, 1985

DRAPER N R & SMITH H, Applied regression analysis
Wiley Interscience, 1966

DUBOIS E N, Essential statistical methods for business,
McGraw Hill 1979

EHRENBERG A S C, Data reduction,
Wiley Interscience, 1978

HEDDERSON J, SPSS made simple,
Wadsworth 1987

NIE et al, SPSS user guide,
McGraw Hill 1982

NORUSIS M J, SPSS introductory guide,

McGraw Hill, 1987

ROBINSON C & RUDDOCK L, Quantitative methods for surveyors,

Construction Press, 1984

CHAPTER SIX

CONCLUSION

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CONCLUSION

The time taken for construction is a much maligned element of the total project. It has been seen through this research and other relevant studies that the predicted time is frequently exceeded. To date, the industry has had no scientific method of making that time prediction, moreover it is often left to the judgement of a professional quantity surveyor. This contrasts with the often very sophisticated models for controlling time when the project is actually under construction. Clearly to accurately control an inaccurately predicted time value makes nonsense of the control system. In order to provide better and more effective time and cost control it is imperative that a more accurate system for predicting time is devised. This research set out to identify those factors affecting the time/cost relationship and attempts to prepare a model whereby the time for construction can be accurately predicted.

The results are promising: this research has indicated that a number of factors are significant in predicting time and demonstrates that it is possible to quantify the effects thus producing a more accurate assessment of the time element. From the output detailed in Chapter Five, the regression performed on all the data (File 4 : All Combined), identified nine significant variables. These are:

AOCV	:	Adjusted original contract value
DELAY	:	Bankruptcy
TOC	:	Fixed or fluctuating contract
CLIENT	:	Local Authority
CLIENT	:	Housing Association
AACV	:	Adjusted additional contract value
FOC	:	GC/Wks/1 form
DELAY	:	Labour/materials shortage
FOC	:	JCT 63 LA Edition with quantities form

These factors then are all proven to have a significant effect on time and should be allowed for in any predictive calculation. The following is an interpretation of the possible reasons why those variables should be significant.

AOCV

The cost of the project, as submitted by the successful tenderer, should clearly represent the size, complexity, quality and function of the building. It has been demonstrated through the regression analysis that the original contract value is significant in the prediction of the contract period. The accuracy of this prediction must therefore be dependent upon the accuracy of the prediction of the contract value during the design stage.

A single unit price rate method of estimating contract value is by definition limited in that it is attempting to be the panacea for all eventualities. As the design develops, so too should the estimate as the method of calculation becomes more comprehensive. It follows therefore that an accurate estimation of contract value shou ld lead to an accurate prediction of the contract period.

Where the cost is identified as signficant in the prediction of time, it follows that the surveyor should be more diligent in the prediction of cost. A poor estimation of cost in the early stages of design may have been the basis of the prediction of time resulting in an underestimation of the contract period, the reality being a higher contract value which may manifest itself in an overrun on the contract period.

Bennett (1982) found that the mean deviation of estimates of cost from tenders ranged from 5.5% to 18% depending upon which method of estimation is adopted. With this apparent deviation, it follows from this research that similar deviation in time may also occur. It has been found through this research that the mean overrun on contract period was 14% which equates with Bennett's research on estimates and tenders.

On the basis of the findings of this research it can be stated that if the profession were more diligent in their assessment of estimated contract value, the estimated time could be made more accurate since cost is a component of the prediction equation.

As we have seen in the previous chapter this component contributes 0.0000135 weeks of the contract period per £1 change in cost.

DELAY : Bankruptcy

A bankruptcy during the duration of the contract will, not surprisingly, cause serious delay to the progress of the works. This is not a factor which can be anticipated at the outset not should it be allowed for in the prediction of time. It is the responsibility of the Architect to select a contractor, through whichever means he feels appropriate, who is unlikely to go bankrupt. This is not always possible to do as it is impossible for the Architect to be informed of the internal machinations of the organisation. The best that can be expected is for the risk of bankruptcy to be minimised.

Its identification in this model merely shows the average quantifiable effect a bankruptcy will have should it occur, based on the sample used in this analysis. It is shown that an addition of 19.79 weeks is taken to complete a project when bankruptcy occurs. The figure merely serves as a guide to the building team in the event of bankruptcy.

TOC : Fixed or fluctuating cost contracts

The basis upon which contract costs are reimbursed is clearly important to both the client and the contractor. At tendering stage, the tenderers will be informed through the contract documentation of whether the costs will be fixed for the duration of the contract period (fixed costs) or whether they will be increased in line with inflation (fluctuating costs).

Normally fixed cost contracts are restricted to contract periods of 12 months and under so as to minimise the risk of loss on recovery of costs to the contractor.

This information is important to the tenderer for, if a fixed cost basis is stipulated, then he needs to make allowances in his prices

for any likely increases in costs over the period of the contract. A fluctuating cost contract removes that element of risk for the contractor but leaves the client with an undefined contract value at the start of the contract upon which he may have to arrange finance.

The basis of recovery of costs then may provide for the client an incentive or disincentive to complete the project on time. A fixed cost contract may mean the contractor absorbing costs not allowed for in the tender price should the contract go beyond the stated contract period. As a result, the regression equation makes no addition to contract time for fixed price contracts.

Fluctuating contracts on the other hand, may provide a source of extra income generation. As time progresses and moves further from the base date for prices, the effects of inflation become greater. As a consequence, there could almost be a disincentive to complete on time. A contractually allowable extension of time will not attract any penalties through the contract but may increase the profit made through increased costs. As a result, the regression equation makes an addition of 17.7 weeks to the contract period for fluctuating contracts.

CLIENT : Local Authority or Housing Association

The Wood Report (1975) found that the pressures placed upon the building team by the client have some bearing on the success of the project in terms of contract duration. Clearly then the client body can go some way to ensuring that contracts are completed on time.

This research has identified two particular client bodies whose existence apparently increases the time required for completion of a project. The individual effect of each on the contract period is different:

Local Authority	:	+ 32.89 weeks
Housing Association	:	+ 24.04 weeks

These two bodies fall within the category of quasi-commerical clients whose overall objective in development terms is one of social commitment and therefore essentially a non-profit making organisation. As a quasi-commercial client, the organisation will yield a return during the course of the development through such activities as rent collection though this return is not expected to be a profit for the organisation and as such all revenue will be returned into the organisation. This social attitude may be the catalyst insofar as adhering rigidly to completion dates - the prime objective is to provide a satisfactory scheme and not to produce a profit.

Both Local Authorities and Housing Associations adopt a non-corporate management strategy. The Bains Report (1972) concluded by believing that local government should adopt a corporate approach in order to ensure that their resources are deployed most effectively and that they become both efficient and effective in their operation. Similarly, Housing Assocaitions are non-profit making often charitable organisations set up on a non-corporate structure to serve the needs of the community at large in terms of the provision of housing.

Clearly this non-corporate structure goes a long way to determining the efficiency of the client organisation and hence its appearance in the regression. The existence of either a Local Authority or a Housing Association client will result in an increased contract period, in relation to any other type of client.

AACV : Additional Adjusted Contract Value

As with the original adjusted contract value, the cost of the project is a large determining factor in the time allowance for the construction of the project. It is often the case, that after the original contract limit has been set and agreed by the client, additional reequirements are made by the client which inevitably

involve some cost implication. This may occur either before or after the contract has been signed. If it is before the signing of the contract then there is little problem in that the predicted contract period can simply be altered to take account of these additional requirements.

The regression model here indicates that the following addition to the contract period should be made based on the additional contract value:

Additional Period = 0.0000102 weeks

The problem occurs, as is often the case, when this event takes place after the signing of the contract and during the progress of the works. To some extent the effect is detrimental as this would undoubtedly affect the preset construction programme and to alter it would probably increase the additional time allowance. The allowance indicated above is not intended to apply in this situation though it could be used by the building team as a guide to the likely additional effect.

FOC : GC/WKS/1 Form and JCT 63 LA Edition with quantities

There are a variety of standard forms of contract in use in the construction industry. The choice of a particular form will depend upon the circumstances surrounding the project. The forms are often

more suited to either building or civil engineering, although forms are available that are appropriate to both these sectors of the construction industry. The status of the designer will also affect this choice. Local Authorities and particularly central government departments have devised their own forms of contract. Although the central government form is considerably different, local authorities will often use a version of a form that is also used in the private sector. Another factor affecting the choice of form is the size of the project, since the erection of small works need not embrace the complete conditions necessary on major contracts.

This choice of form of contract has undoubtedly left the industry with something of a dilemma in ensuring that the correct form of contract is chosen for the conditions applying. The Banwell Report (1964) recommended that a single form of contract for the whole of the construction industry was both desirable and practicable. This suggestion has never been acted upon, indeed since the report was made many more forms have been introduced which led to clouding the issue further. Central government departments will most likely continue to use the GC/Wks/1 form as will local authorities contunue to use JCT 63 Local Authority Editions (or their most recent updated edition, currently JCT80).

There is some link here with the forms of contract identified by the regression as being significant to the prediction of time and the

client bodies which also affect the time prediction. The forms identified here are both used by quasi-commerical clients and have links with the non-corporate status that they enjoy.

Unlike many other standard forms of contract in use in the UK, these two forms are seldom used by bodies other than local or central government departments.

Clearly the choice of form of contract is important to the issue of satisfactory completion of contracts within the stipulated contract period. Whilst it is not the objective of this research to indicate where and when to use a particular form of contract it is important to know the effect that a particular form of contract may have on the contract period. In this respect two forms of contract were identified by the regression as having a time implication. The effects are as follows:

GC/Wks/1 form : + 50.83 weeks

JCT 63 LA ed : + 13.90 weeks

Having identified the significant factors affecting the prediction of time and attempted to explain their appearance, from the regression performed and detailed in Chapter Five, the following factors should be taken into account in the prediction equation:

FOOTNOTE

The variables identified on this page and on page 103 require further explanation.
CLIENT : The Housing Association being more specialised should therefore be more efficient thereby attracting a lower time implication.
FOC : GC/Wks/1 contracts tend to be of much greater value and as a result a larger time implication would be expected.
The coefficients represent the number of weeks taking account of the effects of the other variables in the equation.

$$\text{Time} = 10.17 + 0.0000135\ C30 + 19.79\ C33 + 17.70\ C16 + 32.89\ C4 + 24.04\ C6 + 0.0000102\ C31 + 50.83\ C14 + 17.68\ C35 + 13.90\ C9$$

where C30 = AOCV (estimated original cost)

C33 = DELAY (Bankruptcy)

C16 = TOC (0 if fixed contract, 1 if fluctuating costs)

C4 = CLIENT (Local Authority)

C6 = CLIENT (Housing Association)

C31 = AACV (estimated additional cos t)

C14 = FOC (GC/Wks/1)

C35 = DELAY (labour/materials shortage)

C9 = FOC (JCT 63 LA Ed with quantities)

Since the delay factors Bankruptcy and Labour/Materials shortage cannot be foreseen at the time of prediction, they can be dropped out of the prediction equation or equivalently C33 and C35 each assumes the value 0.

APPLICATION OF THE EQUATION TO A RANDOM SAMPLE OF QUESTIONNAIRES

	CALCULATED (WEEKS)	ORIGINAL (WEEKS)	ACTUAL (WEEKS)
HOUSING			
H4	68	36	82
H17	125	108	152
H37	57	40	42
H56	80	91	104
H69	71	65	100
H79	82	72	80
INDUSTRIAL			
I1	94	144	87
I15	44	36	29
I21	81	39	51
COMMERCIAL			
C21	114	69	82
C29	248	156	289
C36	78	96	120
C44	48	50	54
EDUCATIONAL			
E2	80	56	87
E7	77	56	53
MEDICAL			
M3	77	66	83
RECREATIONAL			
R2	100	96	110
TRANSPORT			
T1	46	20	41
SUNDRY			
S4	87	70	72
S10	82	74	92

What appears to be clear from the testing of the equation is that where an unrealsitic time is stated in the contract documents, this leads to a time well beyond that calculated using the equation. This is in line with the findings of Bromilow (refer Chapter three).

This research has attempted to look at the problems of predicting the time required for constructon of building projects. The investigations have centred on the factors affecting time and the effects these have had on actual construction periods. The statistical analysis made resulted in a simplistic model for predicting the construction period.

The results from the application of the equation to a random sample of questionnaires on page 109 show the model to be adequate for predicting time. The following are two possible areas for taking the research further, these being:-

(1) The data collected has all been brought to a common cost base of 4th quarter 1977 for analysis purposes. The results therefore relate to the state of the industry and the economy as it was at that time. It would be interesting to determine whether the model would change for different calendar dates with the ultimate aim of producing a generic model that could be used, regardless of date.

(2) The model could be further refined with some investigation of how the significant variables inter-relate and whether these variables change with the date.

It is hoped that this initial piece of work is taken further as it is believed that it is possible to make a more accurate assessment of the time taken than it appears currently to be possible to do.

REFERENCES

ASHWORTH A Regression analysis for building contractors,

MSc Thesis,

Loughborough University, 1977

ATKIN B, Project planning and control,

CQS September 1986, pp 11-13

BENNETT J, Cost planning and computers

Building Cost Techniques Ed. P S Brandon,

Spon, 1982

BISHOP D, Productivity in the construction industry, Aspects of the economics of construction Edited D A Turin,

George Godwin, 1975

BLAND J A Statistics for construction students,

Construction Press, 1985

BON R, Choices, values and time

Spon, for CIB, Vol 14 No. 4, July-August 1986, pp 223-225

BON R, Timing of space: Some thoughts on building economics

Habitat Intl Vol 10 No 4 1986 pp 101 - 107

BROMILOW F J Building contract cost performance,

The Building Economist, February 1971

BROMILOW F J Contract time performance, expectations and reality

Building Foruym Vol 1 No 3 September 1969 pp 70-80

BROMILOW F J and HENDERSON J A Procedures for reckoning and valuing the performance of building contracts.

CSIRO 2nd Edition, 1977

BROMILOW F J HINDS M F AND MOODY N F , AIQS Survey of building contract time performance,

The Building Economist, September 1980

DEPARTMENT of the ENVIRONMENT, The new local authorities : Management and structure, (The Bains Report),

HMSO 1972 pp 6-7

DRAPER N R and SMITH H Applied regression analysis

Wiley Interscience 1966

DUBOIS E N Essential statistical methods for business,

McGraw Hill 1979

EHRENBRG A S C Data Reduction,

Wiley Interscience 1978

HAMBRIDGE B W Productivity, Time and Cost

CIOB, No. 10 1982

HAWES J. Better productivity, greater efficiency

CQS October 1984

HEDDERSON J SPSS made simple

Wadsworth 1987

HEERY C T Time, cost and architecture

McGraw Hill 1975

HILLEBRANDT P M Economic theory and the construction industry

Macmillan, 1;979

IRELAND V, The role of managerial actions in the cost, time and quality performance of high-rise commercial building projects

Construction Management and Economics Vol 3 1985 pp 59-87

KING E G E Daytime Rain

Building Climatogoly Unit, Met Office 1981

METEOROLOGICAL OFFICE, Weather services for builders

Met. Office 1980

MINISTRY of PUBLIC AND BUILDING WORKS, The report of the committee on the placing and management of contracts for building and civil engineering works (The Banwell Report),

HMSO 1964

NEDO How flexible is construction?

HMSO 1978

NEDO The public client and the construction industry (The Wood Report),

HMSO 1975

NIE et al, SPSS user guide

McGraw Hill 1987

QS Division of the RICS, Pre-contract cost control and cost planning, (Practice Pamphlet No. 2)

RICS 1982

RICS UK and US construction industries: a comparison of design and contract procedures

RICS 1979

ROBINSON C and RUDDOCK K, Quantitative methods for surveyors

Construction Press, 1984

SNEDEN J A Time as money

CQS November 1987

THOMSON N D Contractual procedures in PSA

BRE May 1977

APPENDIX A

SPSS STATISTICAL DATA OUTPUT EXTRACTS

```
SPSS FOR ND-500, VERSION M, RELEASE 8.0A, OCTOBER 15, 1979
DEFAULT SPACE ALLOCATION..     ALLOWS FOR..    81 TRANSFORMATIONS
WORKSPACE     57344 BYTES                     327 RECODE VALUES + LAG VARIABLES
TRANSPACE      8192 BYTES                    1314 IF/COMPUTE OPERATIONS
LABELSPACE    32768 BYTES                   32768 BYTES MEMORY RESIDENT FILE SPACE

     1 RUN NAME            RESIDENTIAL2
     2 FILE NAME           STUDY5
     3 VARIABLE LIST       C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,
     4                     C15,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,
     5                     C27,C28,C29,C30,C31,C32,C33,C34,C35,
     6 INPUT MEDIUM        DISK
     7 N OF CASES          81
     8 INPUT FORMAT        FREEFIELD
     9 REGRESSION          VARIABLES = C1 TO C35
    10                     REGRESSION = C1 WITH C2 TO C35 RESID=0/
    11 STATISTICS          ALL

***** REGRESSION PROBLEM REQUIRES  21840 BYTES WORKSPACE, NOT INCLUDING RESIDUALS *****

    12 READ INPUT DATA
```

FILE STUDY5 (CREATION DATE = 04/25/88)

VARIABLE	MEAN	STANDARD DEV	CASES
C1	79.3457	32.6394	81
C2	.1975	.4006	81
C3	.0000	.0000	81
C4	.5802	.4966	81
C5	.0000	.0000	81
C6	.3086	.4648	81
C7	.0000	.0000	81
C8	.0494	.2180	81
C9	.4198	.4966	81
C10	.0000	.0000	81
C11	.0000	.0000	81
C12	.0000	.0000	81
C13	.0000	.0000	81
C14	.0000	.0000	81
C15	.0000	.0000	81
C16	.9136	.2827	81
C17	.0247	.1561	81
C18	.0617	.2422	81
C19	.0247	.1561	81
C20	.0247	.1561	81
C21	.1852	.3909	81
C22	.1111	.3162	81
C23	.0741	.2635	81
C24	.0247	.1561	81
C25	.1111	.3162	81
C26	.1728	.3805	81
C27	.0370	.1900	81
C28	.0988	.3002	81
C29	1.6049	.4919	81
C30	544461.2099	721411.8654	81
C31	33115.0247	91963.4741	81
C32	.2840	.4537	81
C33	.2593	.4410	81
C34	.1481	.3575	81
C35	.0741	.2635	81

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1.00000	-.13052	99.00000	.05611	99.00000	-.01948	99.00000	.09419	-.05611	99.00000	99.00000	99.00000
C2	-.13052	1.00000	99.00000	.10782	99.00000	-.13011	99.00000	.45939	-.10782	99.00000	99.00000	99.00000
C3	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C4	.05611	.10782	99.00000	1.00000	99.00000	-.78557	99.00000	.19385	-1.00000	99.00000	99.00000	99.00000
C5	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C6	-.01948	-.13011	99.00000	-.78557	99.00000	1.00000	99.00000	-.15229	.78557	99.00000	99.00000	99.00000
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	.09419	.45939	99.00000	.19385	99.00000	-.15229	99.00000	1.00000	-.19385	99.00000	99.00000	99.00000
C9	-.05611	-.10782	99.00000	-1.00000	99.00000	.78557	99.00000	-.19385	1.00000	99.00000	99.00000	99.00000
C10	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000
C13	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C15	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C16	.33920	.15259	99.00000	.00550	99.00000	.01527	99.00000	.07010	-.00550	99.00000	99.00000	99.00000
C17	.01302	.12088	99.00000	-.18707	99.00000	.23814	99.00000	-.03626	.18707	99.00000	99.00000	99.00000
C18	.01150	-.12726	99.00000	.01027	99.00000	-.06032	99.00000	-.05846	-.01027	99.00000	99.00000	99.00000
C19	.30733	-.07894	99.00000	.13533	99.00000	-.10631	99.00000	-.03626	-.13533	99.00000	99.00000	99.00000
C20	-.04339	-.07894	99.00000	.13533	99.00000	-.10631	99.00000	-.03626	-.13533	99.00000	99.00000	99.00000
C21	.21244	.40209	99.00000	.08348	99.00000	.02548	99.00000	.47809	-.08348	99.00000	99.00000	99.00000
C22	-.24114	.02193	99.00000	-.01769	99.00000	-.15119	99.00000	-.08058	.01769	99.00000	99.00000	99.00000
C23	-.08585	-.02193	99.00000	-.04599	99.00000	.11717	99.00000	-.06447	.04599	99.00000	99.00000	99.00000
C24	-.15621	-.07894	99.00000	-.18707	99.00000	.23814	99.00000	-.03626	.18707	99.00000	99.00000	99.00000
C25	.13066	-.17541	99.00000	-.01769	99.00000	-.06614	99.00000	-.08058	.01769	99.00000	99.00000	99.00000
C26	.06559	-.14478	99.00000	-.07433	99.00000	.04800	99.00000	-.10419	.07433	99.00000	99.00000	99.00000
C27	-.07867	-.09730	99.00000	.03434	99.00000	.01048	99.00000	-.04470	-.03434	99.00000	99.00000	99.00000
C28	-.11451	.04363	99.00000	.19771	99.00000	-.22119	99.00000	-.07545	-.19771	99.00000	99.00000	99.00000
C29	-.04666	.14722	99.00000	.02906	99.00000	-.06142	99.00000	.06763	-.02906	99.00000	99.00000	99.00000
C30	.72965	-.08612	99.00000	.04549	99.00000	-.03611	99.00000	-.02405	-.04549	99.00000	99.00000	99.00000
C31	.59052	.13905	99.00000	.05247	99.00000	-.08276	99.00000	.26714	-.05247	99.00000	99.00000	99.00000
C32	.00679	.03141	99.00000	.20273	99.00000	-.12440	99.00000	.10921	-.20273	99.00000	99.00000	99.00000
C33	.19606	-.15200	99.00000	-.01057	99.00000	.03162	99.00000	-.00482	.01057	99.00000	99.00000	99.00000
C34	-.07623	.05496	99.00000	.00261	99.00000	-.12817	99.00000	-.09505	-.00261	99.00000	99.00000	99.00000
C35	.21498	.09648	99.00000	.04953	99.00000	.01512	99.00000	.15311	-.04953	99.00000	99.00000	99.00000

FILE STUDY5 (CREATION DATE = 04/25/88)

	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
C1	99.00000	99.00000	99.00000	.33920	.01302	.01150	.30733	-.04339	.21244	-.24114	-.08585	-.15621
C2	99.00000	99.00000	99.00000	.15259	.12088	-.12726	-.07894	-.07894	.40209	.02193	-.02193	-.07894
C3	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C4	99.00000	99.00000	99.00000	.00550	-.18707	.01027	.13533	.13533	.08348	-.01769	-.04599	-.18707
C5	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C6	99.00000	99.00000	99.00000	.01527	.23814	-.06032	-.10631	-.10631	.02548	-.15119	.11717	.23814
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	99.00000	99.00000	99.00000	.07010	-.03626	-.05846	-.03626	-.03626	.47809	-.08058	-.06447	-.03626
C9	99.00000	99.00000	99.00000	-.00550	.18707	-.01027	-.13533	-.13533	-.08348	.01769	.04599	.18707
C10	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C15	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C16	99.00000	99.00000	99.00000	1.00000	.04894	.07889	.04894	.04894	.14662	-.31068	.08699	-.23420
C17	99.00000	99.00000	99.00000	.04894	1.00000	-.04081	-.02532	-.02532	-.07585	-.05625	-.04500	-.02532
C18	99.00000	99.00000	99.00000	.07889	-.04081	1.00000	-.04081	-.04081	-.12228	-.09068	-.07255	-.04081
C19	99.00000	99.00000	99.00000	.04894	-.02532	-.04081	1.00000	-.02532	-.07585	-.05625	-.04500	-.02532
C20	99.00000	99.00000	99.00000	.04894	-.02532	-.04081	-.02532	1.00000	-.07585	-.05625	-.04500	-.02532
C21	99.00000	99.00000	99.00000	.14662	-.07585	-.12228	-.07585	-.07585	1.00000	-.16855	-.13484	-.07585
C22	99.00000	99.00000	99.00000	-.31068	-.05625	-.09068	-.05625	-.05625	-.16855	1.00000	-.10000	-.05625
C23	99.00000	99.00000	99.00000	.08699	-.04500	-.07255	-.04500	-.04500	-.13484	-.10000	1.00000	-.04500
C24	99.00000	99.00000	99.00000	-.23420	-.02532	-.04081	-.02532	-.02532	-.07585	-.05625	-.04500	1.00000
C25	99.00000	99.00000	99.00000	-.17088	-.05625	-.09068	-.05625	-.05625	-.16855	-.12500	-.10000	-.05625
C26	99.00000	99.00000	99.00000	.14059	-.07273	-.11725	-.07273	-.07273	-.21792	-.16161	-.12929	-.07273
C27	99.00000	99.00000	99.00000	-.17234	-.03120	-.05030	-.03120	-.03120	-.09349	-.06934	-.05547	-.03120
C28	99.00000	99.00000	99.00000	.10182	-.05267	-.08491	-.05267	-.05267	-.15782	-.11704	-.09363	-.05267
C29	99.00000	99.00000	99.00000	-.06879	.12858	-.10753	-.03415	-.03415	-.00482	-.03571	-.06071	-.03415
C30	99.00000	99.00000	99.00000	.16775	.07837	-.05552	.68697	-.03752	.16389	-.17286	-.08658	-.08067
C31	99.00000	99.00000	99.00000	.10940	-.01204	-.08069	.01235	-.05765	.41119	-.08619	-.10086	-.05691
C32	99.00000	99.00000	99.00000	.09624	.07624	-.04775	.07624	-.10020	-.01827	-.04840	.13552	.07624
C33	99.00000	99.00000	99.00000	.18196	-.09413	.08238	-.09413	.08741	.00806	.05976	-.16733	-.09413
C34	99.00000	99.00000	99.00000	-.11910	-.06635	.03744	-.06635	.15759	.06958	.07372	-.11795	-.06635
C35	99.00000	99.00000	99.00000	.08699	.25877	-.07255	.25877	-.04500	-.01348	-.10000	.10000	-.04500

	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35
C1	.13066	.06559	-.07867	-.11451	-.04666	.72965	.59052	.00679	.19606	-.07623	.21498
C2	-.17541	-.14478	-.09730	.04363	.14722	-.08612	.13905	.03141	-.15200	.05496	.09648
C3	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C4	-.01769	-.07433	.03434	.19771	.02906	.04549	.05247	.20273	-.01057	.00261	.04953
C5	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C6	-.06614	.04800	.01048	-.22119	-.06142	-.03611	-.08276	-.12440	.03162	-.12817	.01512
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	-.08058	-.10419	-.04470	-.07545	.06763	-.02405	.26714	.10921	-.00482	-.09505	.15311
C9	.01769	.07433	-.03434	-.19771	-.02906	-.04549	-.05247	-.20273	.01057	-.00261	-.04953
C10	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C15	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C16	-.17088	.14059	-.17234	.10182	-.06879	.16775	.10940	.09624	.18196	-.11910	.08699
C17	-.05625	-.07273	-.03120	-.05267	.12858	.07837	-.01204	.07624	-.09413	-.06635	.25877
C18	-.09068	-.11725	-.05030	-.08491	-.10753	-.05552	-.08069	-.04775	.08238	.03744	-.07255
C19	-.05625	-.07273	-.03120	-.05267	-.03415	.68697	.01235	.07624	-.09413	-.06635	.25877
C20	-.05625	-.07273	-.03120	-.05267	-.03415	-.03752	-.05765	-.10020	.08741	.15759	-.04500
C21	-.16855	-.21792	-.09349	-.15782	-.00482	.16389	.41119	-.01827	.00806	.06958	-.01348
C22	-.12500	-.16161	-.06934	-.11704	-.03571	-.17286	-.08619	-.04840	.05976	.07372	-.10000
C23	-.10000	-.12929	-.05547	-.09363	-.06071	-.08658	-.10086	.13552	-.16733	-.11795	.10000
C24	-.05625	-.07273	-.03120	-.05267	-.03415	-.08067	-.05691	.07624	-.09413	-.06635	-.04500
C25	1.00000	-.16161	-.06934	-.11704	.04464	-.03997	-.09837	-.04840	-.20917	.07372	.20000
C26	-.16161	1.00000	-.08965	-.15132	.23583	-.08672	-.01927	-.07062	.32562	-.00681	-.12929
C27	-.06934	-.08965	1.00000	-.06492	-.24268	-.06709	-.07106	-.12350	.03315	-.08179	-.05547
C28	-.11704	-.15132	-.06492	1.00000	.01359	.00318	-.01797	-.02493	-.00699	-.02157	-.09363
C29	.04464	.23583	-.24268	.01359	1.00000	-.10451	-.05123	-.05117	-.04055	.19483	.03571
C30	-.03997	-.08672	-.06709	.00318	-.10451	1.00000	.57813	.08745	.00132	-.12412	.18306
C31	-.09837	-.01927	-.07106	-.01797	-.05123	.57813	1.00000	.08309	.09458	-.02101	-.00185
C32	-.04840	-.07062	-.12350	-.02493	-.05117	.08745	.08309	1.00000	-.37255	-.26261	-.17811
C33	-.20917	.32562	.03315	-.00699	-.04055	.00132	.09458	-.37255	1.00000	-.24672	-.16733
C34	.07372	-.00681	-.08179	-.02157	.19483	-.12412	-.02101	-.26261	-.24672	1.00000	-.11795
C35	.20000	-.12929	-.05547	-.09363	.03571	.18306	-.00185	-.17811	-.16733	-.11795	1.00000

FILE STUDY5 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 1.. C30

MULTIPLE R	.72965
R SQUARE	.53238
ADJUSTED R SQUARE	.52647
STANDARD ERROR	22.46040

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	45373.21275	45373.21275	89.94239
RESIDUAL	79.	39853.10823	504.46972	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.3301197E-04	.72965	.00000	89.942
(CONSTANT)	61.37194			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.06818	-.09934	.99258	.777
C3	999999.99999	99999.99999	.00000	99999.999
C4	.02297	.03355	.99793	.088
C5	999999.99999	99999.99999	.00000	99999.999
C6	.00688	.01005	.99870	.008
C7	999999.99999	99999.99999	.00000	99999.999
C8	.11180	.16345	.99942	2.141
C9	-.02297	-.03355	.99793	.088
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C16	.22309	.32161	.97186	8.998
C17	-.04443	-.06478	.99386	.329
C18	.05217	.07617	.99692	.455
C19	-.36720	-.39022	.52808	14.011
C20	-.01603	-.02343	.99859	.043
C21	.09542	.13765	.97314	1.506
C22	-.11855	-.17076	.97012	2.343
C23	-.02285	-.03329	.99250	.087
C24	-.09799	-.14283	.99349	1.624
C25	.16008	.23391	.99840	4.515
C26	.12984	.18916	.99248	2.895
C27	-.02986	-.04357	.99550	.148
C28	-.11684	-.17086	.99999	2.345
C29	.02992	.04351	.98908	.148
C31	.25338	.30233	.66577	7.847
C32	-.05746	-.08370	.99235	.550
C33	.19510	.28530	1.00000	6.911
C34	.01456	.02113	.98459	.035

FILE STUDY5 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 2.. C19

MULTIPLE R	.77691
R SQUARE	.60359
ADJUSTED R SQUARE	.59342
STANDARD ERROR	20.81192

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	51441.69714	25720.84857	59.38282
RESIDUAL	78.	33784.62384	433.13620	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.4442494E-04	.98190	.00000	100.181
C19	-76.75477	-.36720	20.50584	14.011
(CONSTANT)	57.05320			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.07556	-.11951	.99184	1.116
C3	999999.99999	99999.99999	.00000	99999.999
C4	.06255	.09822	.97742	.750
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.02338	-.03688	.98612	.105
C7	999999.99999	99999.99999	.00000	99999.999
C8	.10463	.16607	.99868	2.184
C9	-.06255	-.09822	.97742	.750
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C16	.19975	.31142	.96354	8.269
C17	-.07457	-.11736	.98199	1.075
C18	.05119	.08117	.99690	.511
C20	-.01587	-.02518	.99859	.049
C21	.02611	.03948	.90590	.120
C22	-.09563	-.14902	.96272	1.749
C23	-.01750	-.02769	.99211	.059
C24	-.08701	-.13763	.99178	1.487
C25	.14973	.23743	.99683	4.600
C26	.12502	.19778	.99215	3.135
C27	-.02438	-.03863	.99508	.115
C28	-.13777	-.21819	.99429	3.849
C29	.04401	.06942	.98640	.373
C31	.07108	.07008	.38537	.380
C32	-.05150	-.08147	.99186	.514
C33	.16299	.25664	.98289	5.429
C34	.02163	.03408	.98392	.090
C35	.13961	.21418	.93298	3.702

* M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   C1

VARIABLE(S) ENTERED ON STEP NUMBER 3..   C16

MULTIPLE R	.80127
R SQUARE	.64203
ADJUSTED R SQUARE	.62809
STANDARD ERROR	19.90503

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	3.	54718.11905	18239.37302	46.03456
RESIDUAL	77.	30508.20194	396.21041	

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
C30	.4212955E-04	.93117	.00000	95.129
C19	-71.51290	-.34212	19.69681	13.182
C16	23.05914	.19975	8.01874	8.269
(CONSTANT)	37.10715			

-------------- VARIABLES NOT IN THE EQUATION --------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.11187	-.18355	.96374	2.650
C3	999999.99999	99999.99999	.00000	99999.999
C4	.06032	.09967	.97729	.763
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.02563	-.04254	.98599	.138
C7	999999.99999	99999.99999	.00000	99999.999
C8	.09078	.15122	.99335	1.779
C9	-.06032	-.09967	.97729	.763
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C17	-.07988	-.13226	.98130	1.353
C18	.03385	.05627	.98889	.241
C20	-.02701	-.04504	.99542	.154
C21	.00512	.00810	.89644	.005
C22	-.04222	-.06638	.88490	.336
C23	-.03874	-.06414	.98103	.314
C24	-.04558	-.07397	.94296	.418
C25	.18889	.31055	.96761	8.112
C26	.09649	.15865	.96770	1.962
C27	.00779	.01281	.96877	.012
C28	-.15820	-.26243	.98504	5.621
C29	.05356	.08880	.98415	.604
C31	.08999	.09321	.38403	.666
C32	-.06884	-.11417	.98460	1.004
C33	.13251	.21621	.95297	3.727
C34	.04150	.06847	.97437	.358
C35	.12472	.20075	.92746	3.192

FILE STUDY5 (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 4.. C25

MULTIPLE R	.82253
R SQUARE	.67656
ADJUSTED R SQUARE	.65953
STANDARD ERROR	19.04496

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	4.	57660.31764	14415.07941	39.74265
RESIDUAL	76.	27566.00335	362.71057	

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
C30	.4177306E-04	.92329	.00000	102.070
C19	-68.49691	-.32770	18.87546	13.169
C16	26.85623	.23264	7.78723	11.894
C25	19.49574	.18889	6.84517	8.112
(CONSTANT)	31.59163			

VARIABLES NOT IN THE EQUATION

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.08429	-.14369	.94009	1.581
C3	999999.99999	99999.99999	.00000	99999.999
C4	.06193	.10765	.97722	.879
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.01227	-.02136	.98091	.034
C7	999999.99999	99999.99999	.00000	99999.999
C8	.10465	.18293	.98827	2.597
C9	-.06193	-.10765	.97722	.879
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C17	-.06990	-.12157	.97841	1.125
C18	.04901	.08543	.98264	.551
C20	-.01793	-.03141	.99303	.074
C21	.03900	.06402	.87140	.309
C22	-.00479	-.00777	.85281	.005
C23	-.02261	-.03923	.97362	.116
C24	-.02669	-.04535	.93351	.155
C26	.12625	.21610	.94771	3.674
C27	.02736	.04711	.95866	.167
C28	-.13993	-.24283	.97398	4.699
C29	.04701	.08195	.98292	.507
C31	.14449	.15520	.37317	1.851
C32	-.06325	-.11030	.98371	.924
C33	.17562	.29583	.91770	7.193
C34	.03130	.05425	.97146	.221
C35	.08322	.13681	.87407	1.431

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 5.. C33

MULTIPLE R	.83956
R SQUARE	.70486
ADJUSTED R SQUARE	.68519
STANDARD ERROR	18.31343

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	5.	60072.70580	12014.54116	35.82350
RESIDUAL	75.	25153.61518	335.38154	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.4107262E-04	.90781	.00000	106.258
C19	-62.16714	-.29741	18.30324	11.536
C16	23.95727	.20753	7.56573	10.027
C25	22.95635	.22241	6.70751	11.713
C33	12.99958	.17562	4.84703	7.193
(CONSTANT)	30.71037			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.04691	-.08148	.89050	.495
C3	999999.99999	99999.99999	.00000	99999.999
C4	.06111	.11119	.97720	.926
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.01256	-.02291	.98091	.039
C7	999999.99999	99999.99999	.00000	99999.999
C8	.11090	.20281	.98698	3.174
C9	-.06111	-.11119	.97720	.926
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C17	-.04862	-.08777	.96188	.574
C18	.03990	.07270	.97974	.393
C20	-.03022	-.05528	.98790	.227
C21	.05399	.09247	.86565	.638
C22	-.02268	-.03838	.84478	.109
C23	.01390	.02468	.93047	.045
C24	-.01386	-.02457	.92838	.045
C26	.08322	.14275	.86841	1.539
C27	.01915	.03447	.95644	.088
C28	-.13074	-.23713	.97089	4.409
C29	.05040	.09196	.98254	.631
C31	.13921	.15651	.37303	1.858
C32	.00770	.01282	.81787	.012
C34	.07427	.13116	.92056	1.295
C35	.10767	.18380	.86013	2.587

FILE STUDY5 (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 6.. C28

MULTIPLE R	.84939
R SQUARE	.72146
ADJUSTED R SQUARE	.69887
STANDARD ERROR	17.91088

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	6.	61487.15016	10247.85836	31.94473
RESIDUAL	74.	23739.17083	320.79961	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.4142304E-04	.91555	.00000	112.785
C19	-65.16674	-.31176	17.95783	13.169
C16	25.28013	.21899	7.42620	11.588
C25	21.36383	.20698	6.60377	10.466
C33	12.43794	.16804	4.74802	6.862
C28	-14.21492	-.13074	6.76968	4.409
(CONSTANT)	31.11160			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.04732	-.08461	.89049	.526
C3	999999.99999	99999.99999	.00000	99999.999
C4	.09295	.17013	.93320	2.176
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.04709	-.08570	.92255	.540
C7	999999.99999	99999.99999	.00000	99999.999
C8	.09937	.18619	.97789	2.622
C9	-.09295	-.17013	.93320	2.176
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C17	-.05938	-.11001	.95586	.894
C18	.02698	.05033	.96966	.185
C20	-.03818	-.07176	.98430	.378
C21	.02378	.04083	.82104	.122
C22	-.03814	-.06603	.83509	.320
C23	-.00338	-.00612	.91499	.003
C24	-.01984	-.03619	.92654	.096
C26	.06010	.10436	.83980	.804
C27	.01159	.02145	.95327	.034
C29	.05376	.10093	.98189	.751
C31	.11732	.13493	.36847	1.354
C32	-.00150	-.00256	.81446	.000
C34	.07192	.13072	.92028	1.269
C35	.09763	.17105	.85511	2.200

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 7.. C8

MULTIPLE R	.85505
R SQUARE	.73111
ADJUSTED R SQUARE	.70533
STANDARD ERROR	17.71779

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	7.	62310.14899	8901.44986	28.35578
RESIDUAL	73.	22916.17199	313.92016	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.4144646E-04	.91607	.00000	115.385
C19	-64.11453	-.30673	17.77612	13.009
C16	24.41311	.21147	7.36563	10.986
C25	22.29776	.21603	6.55800	11.561
C33	12.75460	.17231	4.70091	7.362
C28	-13.16955	-.12113	6.72775	3.832
C8	14.87719	.09937	9.18821	2.622
(CONSTANT)	30.84117			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.11958	-.19372	.70568	2.807
C3	999999.99999	99999.99999	.00000	99999.999
C4	.07359	.13350	.88478	1.306
C5	999999.99999	99999.99999	.00000	99999.999
C6	-.02823	-.05128	.88753	.190
C7	999999.99999	99999.99999	.00000	99999.999
C9	-.07359	-.13350	.88478	1.306
C10	999999.99999	99999.99999	.00000	99999.999
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	999999.99999	99999.99999	.00000	99999.999
C15	999999.99999	99999.99999	.00000	99999.999
C17	-.05383	-.10133	.95275	.747
C18	.03538	.06696	.96316	.324
C20	-.03342	-.06386	.98196	.295
C21	-.03750	-.05734	.62864	.238
C22	-.02873	-.05043	.82838	.184
C23	.00747	.01370	.90494	.014
C24	-.01616	-.02998	.92532	.065
C26	.07770	.13580	.82136	1.353
C27	.01630	.03065	.95122	:068
C29	.04652	.08863	.97626	.570
C31	.05904	.06252	.30152	.282
C32	-.01178	-.02040	.80735	.030
C34	.08314	.15303	.91084	1.726
C35	.08131	.14268	.82810	1.496

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SPSS FOR ND-500, VERSION M, RELEASE 8.0A, OCTOBER 15, 1979
DEFAULT SPACE ALLOCATION..     ALLOWS FOR..    81 TRANSFORMATIONS
WORKSPACE     57344 BYTES                     327 RECODE VALUES + LAG VARIABLES
TRANSPACE      8192 BYTES                    1314 IF/COMPUTE OPERATIONS
LABELSPACE    32768 BYTES                   32768 BYTES MEMORY RESIDENT FILE SPACE

                1 RUN NAME            COMMERCIAL2
                2 FILE NAME           STUDY6
                3 VARIABLE LIST       C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,
                4                     C15,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,
                5                     C27,C28,C29,C30,C31,C32,C33,C34,C35,
                6 INPUT MEDIUM        DISK
                7 N OF CASES          54
                8 INPUT FORMAT        FREEFIELD
                9 REGRESSION          VARIABLES = C1 TO C35
               10                     REGRESSION = C1 WITH C2 TO C35 RESID=0/
               11 STATISTICS          ALL

***** REGRESSION PROBLEM REQUIRES  21840 BYTES WORKSPACE, NOT INCLUDING RESIDUALS *****

               12 READ INPUT DATA
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VARIABLE	MEAN	STANDARD DEV	CASES
C1	62.9815	41.1250	54
C2	.3333	.4758	54
C3	.2593	.4423	54
C4	.0556	.2312	54
C5	.0370	.1906	54
C6	.0000	.0000	54
C7	.0000	.0000	54
C8	.0000	.0000	54
C9	.7963	.4065	54
C10	.0185	.1361	54
C11	.0370	.1906	54
C12	.0000	.0000	54
C13	.0185	.1361	54
C14	.0185	.1361	54
C15	.0185	.1361	54
C16	.7963	.4065	54
C17	.0556	.2312	54
C18	.0370	.1906	54
C19	.0185	.1361	54
C20	.0741	.2644	54
C21	.3148	.4688	54
C22	.0741	.2644	54
C23	.1111	.3172	54
C24	.0185	.1361	54
C25	.0000	.0000	54
C26	.1296	.3390	54
C27	.0556	.2312	54
C28	.1111	.3172	54
C29	1.4444	.5016	54
C30	1477541.6296	1933613.4458	54
C31	243014.7778	1061036.3703	54
C32	.1111	.3172	54
C33	.2407	.4315	54
C34	.0926	.2926	54
C35	.0370	.1906	54

FILE STUDY6 (CREATION DATE = 04/25/88)

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1.00000	-.20216	.02412	.11322	.47904	99.00000	99.00000	99.00000	-.33203	-.09097	-.08655	99.00000
C2	-.20216	1.00000	-.32869	.00000	-.13868	99.00000	99.00000	99.00000	.16256	-.09713	.06934	99.00000
C3	.02412	-.32869	1.00000	-.14349	-.11602	99.00000	99.00000	99.00000	-.12047	-.08126	.10774	99.00000
C4	.11322	.00000	-.14349	1.00000	-.04757	99.00000	99.00000	99.00000	-.47953	-.03331	-.04757	99.00000
C5	.47904	-.13868	-.11602	-.04757	1.00000	99.00000	99.00000	99.00000	-.38775	-.02694	-.03846	99.00000
C6	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000
C9	-.33203	.16256	-.12047	-.47953	-.38775	99.00000	99.00000	99.00000	1.00000	-.27158	-.38775	99.00000
C10	-.09097	-.09713	-.08126	-.03331	-.02694	99.00000	99.00000	99.00000	-.27158	1.00000	-.02694	99.00000
C11	-.08655	.06934	.10774	-.04757	-.03846	99.00000	99.00000	99.00000	-.38775	-.02694	1.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000
C13	.08435	-.09713	-.08126	.56635	-.02694	99.00000	99.00000	99.00000	-.27158	-.01887	-.02694	99.00000
C14	-.09097	-.09713	-.08126	-.03331	.70040	99.00000	99.00000	99.00000	-.27158	-.01887	-.02694	99.00000
C15	.76201	-.09713	-.08126	-.03331	.70040	99.00000	99.00000	99.00000	-.27158	-.01887	-.02694	99.00000
C16	.23338	.06503	-.12047	.12267	.09919	99.00000	99.00000	99.00000	-.14165	.06947	-.14428	99.00000
C17	-.11101	-.17150	-.14349	-.05882	-.04757	99.00000	99.00000	99.00000	.12267	-.03331	-.04757	99.00000
C18	-.03361	.06934	-.11602	-.04757	-.03846	99.00000	99.00000	99.00000	.09919	-.02694	-.03846	99.00000
C19	-.08422	-.09713	-.08126	-.03331	-.02694	99.00000	99.00000	99.00000	.06947	-.01887	-.02694	99.00000
C20	-.11615	-.05000	.15538	-.06860	-.05547	99.00000	99.00000	99.00000	.14306	-.03885	-.05547	99.00000
C21	.04728	.11278	.05392	.18374	.07820	99.00000	99.00000	99.00000	-.35017	-.09311	.28933	99.00000
C22	.15806	-.20000	-.00598	.24010	-.05547	99.00000	99.00000	99.00000	-.03251	-.03885	-.05547	99.00000
C23	.10429	.12500	.05976	-.08575	-.06934	99.00000	99.00000	99.00000	.03251	-.04856	-.06934	99.00000
C24	-.05051	-.09713	-.08126	-.03331	-.02694	99.00000	99.00000	99.00000	.06947	-.01887	-.02694	99.00000
C25	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C26	-.19604	.07797	.02330	-.09360	-.07569	99.00000	99.00000	99.00000	.19519	-.05301	-.07569	99.00000
C27	-.08918	.17150	-.14349	-.05882	-.04757	99.00000	99.00000	99.00000	.12267	-.03331	-.04757	99.00000
C28	.22434	-.12500	.05976	-.08575	.24268	99.00000	99.00000	99.00000	-.11379	.38851	-.06934	99.00000
C29	.03791	.00000	-.10394	-.21693	.21926	99.00000	99.00000	99.00000	.08225	-.12286	.02193	99.00000
C30	.76796	-.41195	.07768	.09598	.33834	99.00000	99.00000	99.00000	-.46005	-.04867	-.04391	99.00000
C31	.82419	-.12709	-.08023	-.04846	.67736	99.00000	99.00000	99.00000	-.27124	-.02472	-.04382	99.00000
C32	-.08083	.00000	-.20917	.17150	-.06934	99.00000	99.00000	99.00000	.03251	-.04856	-.06934	99.00000
C33	.41275	.06126	.16107	.05253	.11893	99.00000	99.00000	99.00000	-.14539	-.07735	.11893	99.00000
C34	-.05160	.04518	-.18898	-.07748	-.06265	99.00000	99.00000	99.00000	.16157	-.04388	-.06265	99.00000
C35	-.08174	-.13868	.33150	-.04757	-.03846	99.00000	99.00000	99.00000	.09919	-.02694	-.03846	99.00000

	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
C1	.08435	-.09097	.76201	.23338	-.11101	-.03361	-.08422	-.11615	.04728	.15806	.10429	-.05051
C2	-.09713	-.09713	-.09713	.06503	-.17150	.06934	-.09713	-.05000	.11278	-.20000	.12500	-.09713
C3	-.08126	-.08126	-.08126	-.12047	-.14349	-.11602	-.08126	.15538	.05392	-.00598	.05976	-.08126
C4	.56635	-.03331	-.03331	.12267	-.05882	-.04757	-.03331	-.06860	.18374	.24010	-.08575	-.03331
C5	-.02694	.70040	.70040	.09919	-.04757	-.03846	-.02694	-.05547	.07820	-.05547	-.06934	-.02694
C6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C9	-.27158	-.27158	-.27158	-.14165	.12267	.09919	.06947	.14306	-.35017	-.03251	.03251	.06947
C10	-.01887	-.01887	-.01887	.06947	-.03331	-.02694	-.01887	-.03885	-.09311	-.03885	-.04856	-.01887
C11	-.02694	-.02694	-.02694	-.14428	-.04757	-.03846	-.02694	-.05547	.28933	-.05547	-.06934	-.02694
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	1.00000	-.01887	-.01887	.06947	-.03331	-.02694	-.01887	-.03885	.20265	-.03885	-.04856	-.01887
C14	-.01887	1.00000	-.01887	.06947	-.03331	-.02694	-.01887	-.03885	.20265	-.03885	-.04856	-.01887
C15	-.01887	-.01887	1.00000	.06947	-.03331	-.02694	-.01887	-.03885	-.09311	-.03885	-.04856	-.01887
C16	.06947	.06947	.06947	1.00000	-.27879	.09919	-.27158	-.20808	-.05317	.14306	.03251	.06947
C17	-.03331	-.03331	-.03331	-.27879	1.00000	-.04757	-.03331	-.06860	-.16440	-.06860	-.08575	-.03331
C18	-.02694	-.02694	-.02694	.09919	-.04757	1.00000	-.02694	-.05547	-.13293	-.05547	-.06934	-.02694
C19	-.01887	-.01887	-.01887	-.27158	-.03331	-.02694	1.00000	-.03885	-.09311	-.03885	-.04856	-.01887
C20	-.03885	-.03885	-.03885	-.20808	-.06860	-.05547	-.03885	1.00000	-.19172	-.08000	-.10000	-.03885
C21	.20265	.20265	-.09311	-.05317	-.16440	-.13293	-.09311	-.19172	1.00000	-.19172	-.23965	-.09311
C22	-.03885	-.03885	-.03885	.14306	-.06860	-.05547	-.03885	-.08000	-.19172	1.00000	-.10000	-.03885
C23	-.04856	-.04856	-.04856	.03251	-.08575	-.06934	-.04856	-.10000	-.23965	-.10000	1.00000	-.04856
C24	-.01887	-.01887	-.01887	.06947	-.03331	-.02694	-.01887	-.03885	-.09311	-.03885	-.04856	1.00000
C25	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C26	-.05301	-.05301	-.05301	.19519	-.09360	-.07569	-.05301	-.10916	-.26159	-.10916	-.13644	-.05301
C27	-.03331	-.03331	-.03331	.12267	-.05882	-.04757	-.03331	-.06860	-.16440	-.06860	-.08575	-.03331
C28	-.04856	-.04856	.38851	.03251	-.08575	-.06934	-.04856	-.10000	-.23965	-.10000	-.12500	-.04856
C29	-.12286	.15357	.15357	-.01028	-.05423	.21926	.15357	.03162	-.04458	-.11068	.03953	.15357
C30	.11597	-.06563	.53958	.18221	.03088	-.12197	.02067	-.15989	.00824	.14848	.18260	.04536
C31	-.03176	-.02841	.97726	.10720	-.05232	-.04288	-.03055	-.06173	-.06976	-.04643	-.05740	-.03044
C32	-.04856	-.04856	-.04856	-.11379	.42875	-.06934	-.04856	-.10000	-.11278	.35000	-.12500	-.04856
C33	-.07735	-.07735	.24394	.06971	-.13657	-.11043	-.07735	-.15927	.17789	.17152	.07657	-.07735
C34	-.04388	-.04388	-.04388	.16157	-.07748	-.06265	-.04388	.39754	-.07897	-.09035	-.11294	-.04388
C35	-.02694	-.02694	-.02694	.09919	-.04757	-.03846	-.02694	-.05547	-.13293	-.05547	-.06934	-.02694

FILE STUDY6 (CREATION DATE = 04/25/88)

	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35
C1	99.00000	-.19604	-.08918	.22434	.03791	.76796	.82419	-.08083	.41275	-.05160	-.08174
C2	99.00000	.07797	.17150	-.12500	.00000	-.41195	-.12709	.00000	.06126	.04518	-.13868
C3	99.00000	.02330	-.14349	.05976	-.10394	.07768	-.08023	-.20917	.16107	-.18898	.33150
C4	99.00000	-.09360	-.05882	-.08575	-.21693	.09598	-.04846	.17150	.05253	-.07748	-.04757
C5	99.00000	-.07569	-.04757	.24268	.21926	.33834	.67736	-.06934	.11893	-.06265	-.03846
C6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C9	99.00000	.19519	.12267	-.11379	.08225	-.46005	-.27124	.03251	-.14539	.16157	.09919
C10	99.00000	-.05301	-.03331	.38851	-.12286	-.04867	-.02472	-.04856	-.07735	-.04388	-.02694
C11	99.00000	-.07569	-.04757	-.06934	.02193	-.04391	-.04382	-.06934	.11893	-.06265	-.03846
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	99.00000	-.05301	-.03331	-.04856	-.12286	.11597	-.03176	-.04856	-.07735	-.04388	-.02694
C14	99.00000	-.05301	-.03331	-.04856	.15357	-.06563	-.02841	-.04856	-.07735	-.04388	-.02694
C15	99.00000	-.05301	-.03331	.38851	.15357	.53958	.97726	-.04856	.24394	-.04388	-.02694
C16	99.00000	.19519	.12267	.03251	-.01028	.18221	.10720	-.11379	.06971	.16157	.09919
C17	99.00000	-.09360	-.05882	-.08575	-.05423	.03088	-.05232	.42875	-.13657	-.07748	-.04757
C18	99.00000	-.07569	-.04757	-.06934	.21926	-.12197	-.04288	-.06934	-.11043	-.06265	-.03846
C19	99.00000	-.05301	-.03331	-.04856	.15357	.02067	-.03055	-.04856	-.07735	-.04388	-.02694
C20	99.00000	-.10916	-.06860	-.10000	.03162	-.15989	-.06173	-.10000	-.15927	.39754	-.05547
C21	99.00000	-.26159	-.16440	-.23965	-.04458	.00824	-.06976	-.11278	.17789	-.07897	-.13293
C22	99.00000	-.10916	-.06860	-.10000	-.11068	.14848	-.04643	.35000	.17152	-.09035	-.05547
C23	99.00000	-.13644	-.08575	-.12500	.03953	.18260	-.05740	-.12500	.07657	-.11294	-.06934
C24	99.00000	-.05301	-.03331	-.04856	.15357	.04536	-.03044	-.04856	-.07735	-.04388	-.02694
C25	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C26	99.00000	1.00000	-.09360	-.13644	-.01233	-.20710	-.08164	-.13644	-.21731	.06692	.21624
C27	99.00000	-.09360	1.00000	-.08575	-.05423	-.16103	-.00591	.17150	-.13657	.20144	-.04757
C28	99.00000	-.13644	-.08575	1.00000	-.07906	.17591	.43225	-.12500	.21440	-.11294	.24268
C29	99.00000	-.01233	-.05423	-.07906	1.00000	.06449	.12694	-.07906	-.15497	-.15714	.21926
C30	99.00000	-.20710	-.16103	.17591	.06449	1.00000	.60063	.01833	.13339	-.19044	-.12422
C31	99.00000	-.08164	-.00591	.43225	.12694	.60063	1.00000	-.05371	.31458	-.04161	-.04393
C32	99.00000	-.13644	.17150	-.12500	-.07906	.01833	-.05371	1.00000	-.19908	-.11294	-.06934
C33	99.00000	-.21731	-.13657	.21440	-.15497	.13339	.31458	-.19908	1.00000	-.17987	-.11043
C34	99.00000	.06692	.20144	-.11294	-.15714	-.19044	-.04161	-.11294	-.17987	1.00000	-.06265
C35	99.00000	.21624	-.04757	.24268	.21926	-.12422	-.04393	-.06934	-.11043	-.06265	1.00000

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 1.. C31

MULTIPLE R	.82419
R SQUARE	.67928
ADJUSTED R SQUARE	.67312
STANDARD ERROR	23.51267

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	60889.00197	60889.00197	110.13741
RESIDUAL	52.	28747.97951	552.84576	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C31	.3194488E-04	.82419	.00000	110.137
(CONSTANT)	55.21840			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.09901	-.17342	.98385	1.581
C3	.09084	.15988	.99356	1.338
C4	.15351	.27075	.99765	4.034
C5	-.14641	-.19019	.54118	1.914
C6	999999.99999	99999.99999	.00000	99999.999
C7	999999.99999	99999.99999	.00000	99999.999
C8	999999.99999	99999.99999	.00000	99999.999
C9	-.11709	-.19900	.92643	2.103
C10	-.07064	-.12469	.99939	.805
C11	-.05054	-.08916	.99808	.409
C12	999999.99999	99999.99999	.00000	99999.999
C13	.11063	.19526	.99899	2.021
C14	-.06761	-.11933	.99919	.737
C15	-.96624	-.36176	.04496	7.680
C16	.14671	.25757	.98851	3.624
C17	-.06807	-.12004	.99726	.746
C18	.00174	.00306	.99816	.000
C19	-.05910	-.10431	.99907	.561
C20	-.06553	-.11549	.99619	.689
C21	.10529	.18546	.99513	1.817
C22	.19676	.34706	.99784	6.984
C23	.15210	.26814	.99671	3.951
C24	-.02544	-.04491	.99907	.103
C25	999999.99999	99999.99999	.00000	99999.999
C26	-.12961	-.22810	.99333	2.799
C27	-.08432	-.14889	.99997	1.156
C28	-.16223	-.25832	.81316	3.646
C29	-.06781	-.11877	.98389	.730
C30	.42695	.60277	.63924	29.105
C32	-.03667	-.06466	.99712	.214
C33	.17034	.28551	.90104	4.526
C34	-.01734	-.03059	.99827	.048

C35	-.04562	-.08048	.99807	.332

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 2.. C30

MULTIPLE R	.89208
R SQUARE	.79581
ADJUSTED R SQUARE	.78780
STANDARD ERROR	18.94412

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	71334.12222	35667.06111	99.38448
RESIDUAL	51.	18302.85926	358.87959	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C31	.2200530E-04	.56774	.00000	51.464
C30	.9080670E-05	.42695	.00000	29.105
(CONSTANT)	44.21680			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.05681	.11298	.80764	.646
C3	.03769	.08209	.96878	.339
C4	.10250	.22376	.97318	2.635
C5	-.09363	-.15139	.53384	1.173
C6	999999.99999	99999.99999	.00000	99999.999
C7	999999.99999	99999.99999	.00000	99999.999
C8	999999.99999	99999.99999	.00000	99999.999
C9	.02333	.04584	.78831	.105
C10	-.05629	-.12441	.99760	.786
C11	-.04303	-.09512	.99760	.457
C12	999999.99999	99999.99999	.00000	99999.999
C13	.05447	.11875	.97046	.715
C14	-.04703	-.10384	.99550	.545
C15	-.55984	-.25221	.04144	3.397
C16	.09798	.21319	.96679	2.381
C17	-.09533	-.21003	.99119	2.308
C18	.04352	.09553	.98368	.461
C19	-.07596	-.16782	.99668	1.449
C20	-.01320	-.02882	.97259	.042
C21	.08411	.18531	.99120	1.778
C22	.12751	.27492	.94918	4.088
C23	.06384	.13572	.92299	.938
C24	-.05298	-.11682	.99274	.692
C25	999999.99999	99999.99999	.00000	99999.999
C26	-.06420	-.13878	.95425	.982
C27	-.01777	-.03855	.96117	.074
C28	-.11989	-.23763	.80220	2.992
C29	-.06272	-.13767	.98367	.966
C32	-.05857	-.12916	.99311	.848
C33	.19772	.41423	.89621	10.357
C34	.05582	.12075	.95545	.740
C35	-.00383	-.00840	.98310	.004

FILE STUDY6 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 3.. C33

MULTIPLE R	.91151
R SQUARE	.83085
ADJUSTED R SQUARE	.82070
STANDARD ERROR	17.41395

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	3.	74474.69611	24824.89870	81.86397
RESIDUAL	50.	15162.28537	303.24571	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C31	.1919442E-04	.49522	.00000	42.282
C30	.9446167E-05	.44414	.00000	37.073
C33	18.84226	.19772	5.85498	10.357
(CONSTANT)	39.82375			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.03945	.08589	.80184	.364
C3	-.00269	-.00630	.92536	.002
C4	.08714	.20826	.96628	2.222
C5	-.05776	-.10153	.52266	.510
C6	999999.99999	99999.99999	.00000	99999.999
C7	999999.99999	99999.99999	.00000	99999.999
C8	999999.99999	99999.99999	.00000	99999.999
C9	.04534	.09738	.78008	.469
C10	-.04216	-.10209	.99173	.516
C11	-.07039	-.16928	.97839	1.446
C12	999999.99999	99999.99999	.00000	99999.999
C13	.06604	.15790	.96701	1.253
C14	-.03280	-.07932	.98962	.310
C15	-.27058	-.12542	.03634	.783
C16	.08874	.21189	.96441	2.303
C17	-.07354	-.17669	.97651	1.579
C18	.06552	.15699	.97131	1.238
C19	-.06349	-.15375	.99206	1.186
C20	.01786	.04227	.94731	.088
C21	.04551	.10755	.94468	.573
C22	.08983	.20766	.90390	2.208
C23	.04015	.09305	.90862	.428
C24	-.04076	-.09853	.98841	.480
C25	999999.99999	99999.99999	.00000	99999.999
C26	-.02277	-.05273	.90719	.137
C27	.01309	.03081	.93660	.047
C28	-.13840	-.30033	.79655	4.858
C29	-.02440	-.05755	.94084	.163
C32	-.02402	-.05717	.95784	.161
C34	.09703	.22614	.91883	2.641
C35	.01753	.04200	.97077	.087

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 4.. C28

MULTIPLE R	.91984
R SQUARE	.84610
ADJUSTED R SQUARE	.83354
STANDARD ERROR	16.77869

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	4.	75842.28236	18960.57059	67.34964
RESIDUAL	49.	13794.69912	281.52447	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C31	.2177883E-04	.56190	.00000	50.117
C30	.9080989E-05	.42697	.00000	36.458
C33	19.88923	.20871	5.66136	12.342
C28	-17.94202	-.13840	8.14052	4.858
(CONSTANT)	41.47678			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.01921	.04336	.78384	.090
C3	.01170	.02851	.91397	.039
C4	.07962	.19911	.96252	1.982
C5	-.07175	-.13181	.51937	.849
C6	999999.99999	99999.99999	.00000	99999.999
C7	999999.99999	99999.99999	.00000	99999.999
C8	999999.99999	99999.99999	.00000	99999.999
C9	.04032	.09071	.77905	.398
C10	.01723	.03905	.79034	.073
C11	-.07972	-.20050	.97339	2.010
C12	999999.99999	99999.99999	.00000	99999.999
C13	.06423	.16099	.96681	1.277
C14	-.03802	-.09632	.98791	.450
C15	-.42043	-.20000	.03483	2.000
C16	.08845	.22141	.96440	2.474
C17	-.08026	-.20189	.97387	2.040
C18	.05790	.14517	.96750	1.033
C19	-.06705	-.17017	.99127	1.431
C20	.00660	.01630	.93978	.013
C21	.01432	.03433	.88439	.057
C22	.07927	.19139	.89724	1.825
C23	.02810	.06797	.90043	.223
C24	-.04389	-.11119	.98780	.601
C25	999999.99999	99999.99999	.00000	99999.999
C26	-.03948	-.09511	.89320	.438
C27	-.00051	-.00126	.92596	.000
C29	-.04287	-.10496	.92279	.535
C32	-.03604	-.08954	.94960	.388
C34	.08281	.20090	.90570	2.019
C35	.05927	.14236	.88772	.993

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 5.. C16

MULTIPLE R	.92393
R SQUARE	.85365
ADJUSTED R SQUARE	.83840
STANDARD ERROR	16.53183

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	5.	76518.52054	15303.70411	55.99573
RESIDUAL	48.	13118.46095	273.30127	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C31	.2185138E-04	.56377	.00000	51.957
C30	.8726463E-05	.41030	.00000	33.896
C33	19.45279	.20413	5.58496	12.132
C28	-17.91228	-.13817	8.02077	4.987
C16	8.947191	.08845	5.68797	2.474
(CONSTANT)	34.96012			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.00391	.00893	.76453	.004
C3	.02636	.06508	.89217	.200
C4	.07115	.18146	.95203	1.600
C5	-.07959	-.14965	.51734	1.077
C6	999999.99999	99999.99999	.00000	99999.999
C7	999999.99999	99999.99999	.00000	99999.999
C8	999999.99999	99999.99999	.00000	99999.999
C9	.04656	.10722	.77609	.547
C10	.00800	.01850	.78317	.016
C11	-.06820	-.17394	.95211	1.466
C12	999999.99999	99999.99999	.00000	99999.999
C13	.05975	.15335	.96413	1.132
C14	-.04599	-.11903	.98040	.675
C15	-.36748	-.17783	.03427	1.535
C17	-.05989	-.14796	.89323	1.052
C18	.04712	.12010	.95083	.688
C19	-.04635	-.11586	.91442	.639
C20	.02348	.05852	.90937	.161
C21	.02103	.05157	.87987	.125
C22	.06981	.17175	.88582	1.428
C23	.02883	.07151	.90037	.242
C24	-.04985	-.12922	.98353	.798
C25	999999.99999	99999.99999	.00000	99999.999
C26	-.06828	-.16277	.83177	1.279
C27	-.01624	-.04025	.89950	.076
C29	-.04173	-.10477	.92264	.522
C32	-.02629	-.06652	.93741	.209
C34	.06592	.15998	.86187	1.235
C35	.04743	.11568	.87072	.637

SPSS BATCH SYSTEM

SPSS FOR ND-500, VERSION M, RELEASE 8.0A, OCTOBER 15, 1979
DEFAULT SPACE ALLOCATION.. ALLOWS FOR.. 81 TRANSFORMATIONS
WORKSPACE 57344 BYTES 327 RECODE VALUES + LAG VARIABLES
TRANSPACE 8192 BYTES 1314 IF/COMPUTE OPERATIONS
LABELSPACE 32768 BYTES 32768 BYTES MEMORY RESIDENT FILE SPACE

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 1 RUN NAME            INDUS-EDUC-MEDIC
 2 FILE NAME           STUDY9
 3 VARIABLE LIST       C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,
 4                     C15,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,
 5                     C27,C28,C29,C30,C31,C32,C33,C34,C35,
 6 INPUT MEDIUM        DISK
 7 N OF CASES          77
 8 INPUT FORMAT        FREEFIELD
 9 REGRESSION          VARIABLES = C1 TO C35
10                     REGRESSION = C1 WITH C2 TO C35 RESID=0/
11 STATISTICS          ALL
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***** REGRESSION PROBLEM REQUIRES 21840 BYTES WORKSPACE, NOT INCLUDING RESIDUALS *****

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12 READ INPUT DATA
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VARIABLE	MEAN	STANDARD DEV	CASES
C1	59.3247	39.5383	77
C2	.2727	.4483	77
C3	.1039	.3071	77
C4	.4545	.5012	77
C5	.1039	.3071	77
C6	.0000	.0000	77
C7	.0130	.1140	77
C8	.0000	.0000	77
C9	.3896	.4909	77
C10	.0130	.1140	77
C11	.0000	.0000	77
C12	.0000	.0000	77
C13	.0000	.0000	77
C14	.0519	.2234	77
C15	.0260	.1601	77
C16	.7662	.4260	77
C17	.0519	.2234	77
C18	.0519	.2234	77
C19	.0000	.0000	77
C20	.0649	.2480	77
C21	.1429	.3522	77
C22	.0130	.1140	77
C23	.0909	.2894	77
C24	.0390	.1948	77
C25	.0779	.2698	77
C26	.2597	.4414	77
C27	.0519	.2234	77
C28	.1299	.3384	77
C29	1.4675	.5022	77
C30	768984.4026	1621967.9260	77
C31	211341.1299	876697.8072	77
C32	.2338	.4260	77
C33	.2338	.4260	77
C34	.1299	.3384	77
C35	.0130	.1140	77

FILE STUDY9 (CREATION DATE = 04/25/88)

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1.00000	-.00506	-.21627	.30453	.09796	99.00000	.04870	99.00000	-.30288	-.02139	99.00000	99.00000
C2	-.00506	1.00000	-.20851	.31944	-.11295	99.00000	-.07024	99.00000	-.19026	-.07024	99.00000	99.00000
C3	-.21627	-.20851	1.00000	-.31083	-.11594	99.00000	-.03906	99.00000	.16436	-.03906	99.00000	99.00000
C4	.30453	.31944	-.31083	1.00000	-.31083	99.00000	-.10471	99.00000	-.72932	-.10471	99.00000	99.00000
C5	.09796	-.11295	-.11594	-.31083	1.00000	99.00000	-.03906	99.00000	-.27204	-.03906	99.00000	99.00000
C6	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	.04870	-.07024	-.03906	-.10471	-.03906	99.00000	1.00000	99.00000	.14358	-.01316	99.00000	99.00000
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000
C9	-.30288	-.19026	.16436	-.72932	-.27204	99.00000	.14358	99.00000	1.00000	-.09164	99.00000	99.00000
C10	-.02139	-.07024	-.03906	-.10471	-.03906	99.00000	-.01316	99.00000	-.09164	1.00000	99.00000	99.00000
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000
C13	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	.30348	-.14335	-.07971	-.21369	.68746	99.00000	-.02685	99.00000	-.18702	-.02685	99.00000	99.00000
C15	-.11567	-.10000	.47958	-.14907	-.05560	99.00000	-.01873	99.00000	-.13047	-.01873	99.00000	99.00000
C16	.26939	-.07516	-.21420	.13446	.08751	99.00000	.06336	99.00000	-.12503	-.20767	99.00000	99.00000
C17	.02488	-.14335	-.07971	-.09616	-.07971	99.00000	-.02685	99.00000	.17299	-.02685	99.00000	99.00000
C18	.10682	-.01195	-.07971	.02137	-.07971	99.00000	-.02685	99.00000	.05299	-.02685	99.00000	99.00000
C19	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C20	-.07195	-.16137	.08300	-.02887	-.08973	99.00000	-.03023	99.00000	.11369	-.03023	99.00000	99.00000
C21	.21016	.08333	.10426	.14907	-.01738	99.00000	-.04683	99.00000	-.09785	-.04683	99.00000	99.00000
C22	-.11192	-.07024	-.03906	-.10471	-.03906	99.00000	-.01316	99.00000	.14358	-.01316	99.00000	99.00000
C23	-.15097	-.09221	.04038	-.28868	.04038	99.00000	-.03627	99.00000	.21054	-.03627	99.00000	99.00000
C24	-.14348	.02740	.15140	-.04901	-.06856	99.00000	-.02310	99.00000	-.02324	-.02310	99.00000	99.00000
C25	-.08134	.14835	-.09898	.22114	.05980	99.00000	-.03335	99.00000	-.23225	-.03335	99.00000	99.00000
C26	.14138	.10278	-.00756	.05407	.08950	99.00000	.19365	99.00000	-.16958	.19365	99.00000	99.00000
C27	.01594	-.14335	.11209	-.09616	-.07971	99.00000	-.02685	99.00000	.17299	-.02685	99.00000	99.00000
C28	-.13695	.02366	-.13155	-.04232	.12168	99.00000	-.04432	99.00000	.00823	-.04432	99.00000	99.00000
C29	-.16678	-.04782	.19277	-.22811	.02216	99.00000	.12241	99.00000	.10536	.12241	99.00000	99.00000
C30	.65374	-.16049	-.03572	.12967	-.01182	99.00000	-.03702	99.00000	-.12130	.04634	99.00000	99.00000
C31	.36836	-.12091	.20991	.03218	-.05962	99.00000	-.02768	99.00000	.01812	-.01124	99.00000	99.00000
C32	.08605	.00626	-.08751	-.07283	-.08751	99.00000	-.06336	99.00000	.12503	.20767	99.00000	99.00000
C33	.30010	.00626	-.18807	.23530	.01306	99.00000	.20767	99.00000	-.18959	-.06336	99.00000	99.00000
C34	-.06122	.11040	-.13155	.19044	-.13155	99.00000	-.04432	99.00000	-.07099	-.04432	99.00000	99.00000
C35	-.04475	-.07024	.33688	-.10471	-.03906	99.00000	-.01316	99.00000	.14358	-.01316	99.00000	99.00000

	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
C1	99.00000	.30348	-.11567	.26939	.02488	.10682	99.00000	-.07195	.21016	-.11192	-.15097	-.14348
C2	99.00000	-.14335	-.10000	-.07516	-.14335	-.01195	99.00000	-.16137	.08333	-.07024	-.09221	.02740
C3	99.00000	-.07971	.47958	-.21420	-.07971	-.07971	99.00000	.08300	.10426	-.03906	.04038	.15140
C4	99.00000	-.21369	-.14907	.13446	-.09616	.02137	99.00000	-.02887	.14907	-.10471	-.28868	-.04901
C5	99.00000	.68746	-.05560	.08751	-.07971	-.07971	99.00000	-.08973	-.01738	-.03906	.04038	-.06856
C6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	99.00000	-.02685	-.01873	.06336	-.02685	-.02685	99.00000	-.03023	-.04683	-.01316	-.03627	-.02310
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C9	99.00000	-.18702	-.13047	-.12503	.17299	.05299	99.00000	.11369	-.09785	.14358	.21054	-.02324
C10	99.00000	-.02685	-.01873	-.20767	-.02685	-.02685	99.00000	-.03023	-.04683	-.01316	-.03627	-.02310
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	99.00000	1.00000	-.03823	-.00898	-.05479	-.05479	99.00000	-.06169	.07167	-.02685	.12954	-.04713
C15	99.00000	-.03823	1.00000	-.10272	-.03823	-.03823	99.00000	-.04303	-.06667	-.01873	.23238	.38908
C16	99.00000	-.00898	-.10272	1.00000	-.00898	.12929	99.00000	.14556	-.03758	.06336	-.25230	-.04737
C17	99.00000	-.05479	-.03823	-.00898	1.00000	-.05479	99.00000	-.06169	-.09556	-.02685	-.07402	-.04713
C18	99.00000	-.05479	-.03823	.12929	-.05479	1.00000	99.00000	-.06169	-.09556	-.02685	-.07402	-.04713
C19	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C20	99.00000	-.06169	-.04303	.14556	-.06169	-.06169	99.00000	1.00000	-.10758	-.03023	-.08333	-.05306
C21	99.00000	.07167	-.06667	-.03758	-.09556	-.09556	99.00000	-.10758	1.00000	-.04683	-.12910	-.08220
C22	99.00000	-.02685	-.01873	.06336	-.02685	-.02685	99.00000	-.03023	-.04683	1.00000	-.03627	-.02310
C23	99.00000	.12954	.23238	-.25230	-.07402	-.07402	99.00000	-.08333	-.12910	-.03627	1.00000	-.06367
C24	99.00000	-.04713	.38908	-.04737	-.04713	-.04713	99.00000	-.05306	-.08220	-.02310	-.06367	1.00000
C25	99.00000	.15027	-.04747	-.29735	-.06805	-.06805	99.00000	-.07661	-.11868	-.03335	-.09193	-.05853
C26	99.00000	-.00520	-.09673	.18722	-.13866	-.13866	99.00000	-.15610	-.24183	-.06795	-.18732	-.11927
C27	99.00000	-.05479	-.03823	-.00898	-.05479	-.05479	99.00000	-.06169	-.09556	-.02685	-.07402	-.04713
C28	99.00000	-.09043	-.06309	.12211	-.09043	-.09043	99.00000	-.10181	-.15772	-.04432	-.12217	-.07779
C29	99.00000	-.10206	.17427	-.15895	.01523	-.10206	99.00000	-.14130	-.01063	.12241	.06585	.08036
C30	99.00000	.07412	-.01628	.09494	.22687	-.01386	99.00000	-.07381	.22727	-.04529	.02955	-.04370
C31	99.00000	-.02739	-.01413	-.08041	-.00167	-.04680	99.00000	-.04667	.37505	-.02783	-.05492	-.04364
C32	99.00000	.00898	-.09020	-.12994	-.12929	.14725	99.00000	-.14556	.12527	.20767	.03881	-.11121
C33	99.00000	.00898	-.09020	.08757	.00898	.00898	99.00000	-.02102	.03758	-.06336	-.06793	-.11121
C34	99.00000	-.09043	-.06309	.12211	.25774	-.09043	99.00000	.21176	-.04732	-.04432	-.12217	-.07779
C35	99.00000	-.02685	-.01873	.06336	-.02685	-.02685	99.00000	.43529	-.04683	-.01316	-.03627	-.02310

FILE STUDY9 (CREATION DATE = 04/25/88)

	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35
C1	-.08134	.14138	.01594	-.13695	-.16678	.65374	.36836	.08605	.30010	-.06122	-.04475
C2	.14835	.10278	-.14335	.02366	-.04782	-.16049	-.12091	.00626	.00626	.11040	-.07024
C3	-.09898	-.00756	.11209	-.13155	.19277	-.03572	.20991	-.08751	-.18807	-.13155	.33688
C4	.22114	.05407	-.09616	-.04232	-.22811	.12967	.03218	-.07283	.23530	.19044	-.10471
C5	.05980	.08950	-.07971	.12168	.02216	-.01182	-.05962	-.08751	.01306	-.13155	-.03906
C6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C7	-.03335	.19365	-.02685	-.04432	.12241	-.03702	-.02768	-.06336	.20767	-.04432	-.01316
C8	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C9	-.23225	-.16958	.17299	.00823	.10536	-.12130	.01812	.12503	-.18959	-.07099	.14358
C10	-.03335	.19365	-.02685	-.04432	.12241	.04634	-.01124	.20767	-.06336	-.04432	-.01316
C11	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C14	.15027	-.00520	-.05479	-.09043	-.10206	.07412	-.02739	.00898	.00898	-.09043	-.02685
C15	-.04747	-.09673	-.03823	-.06309	.17427	-.01628	-.01413	-.09020	-.09020	-.06309	-.01873
C16	-.29735	.18722	-.00898	.12211	-.15895	.09494	-.08041	-.12994	.08757	.12211	.06336
C17	-.06805	-.13866	-.05479	-.09043	.01523	.22687	-.00167	-.12929	.00898	.25774	-.02685
C18	-.06805	-.13866	-.05479	-.09043	-.10206	-.01386	-.04680	.14725	.00898	-.09043	-.02685
C19	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C20	-.07661	-.15610	-.06169	-.10181	-.14130	-.07381	-.04667	-.14556	-.02102	.21176	.43529
C21	-.11868	-.24183	-.09556	-.15772	-.01063	.22727	.37505	.12527	.03758	-.04732	-.04683
C22	-.03335	-.06795	-.02685	-.04432	.12241	-.04529	-.02783	.20767	-.06336	-.04432	-.01316
C23	-.09193	-.18732	-.07402	-.12217	.06585	.02955	-.05492	.03881	-.06793	-.12217	-.03627
C24	-.05853	-.11927	-.04713	-.07779	.08036	-.04370	-.04364	-.11121	-.11121	-.07779	-.02310
C25	1.00000	-.17220	-.06805	-.11231	-.07819	-.08504	-.06856	-.04609	.06839	-.11231	-.03335
C26	-.17220	1.00000	-.13866	-.22884	.15727	-.07749	-.11788	-.04726	.09270	.03547	-.06795
C27	-.06805	-.13866	1.00000	-.09043	.01523	-.01947	.11163	.14725	.00898	-.09043	-.02685
C28	-.11231	-.22884	-.09043	1.00000	-.05229	-.11275	-.08946	-.12211	-.12211	.08060	-.04432
C29	-.07819	.15727	.01523	-.05229	1.00000	-.20968	-.01558	.22045	-.27156	.10257	-.10749
C30	-.08504	-.07749	-.01947	-.11275	-.20968	1.00000	.50082	.17820	-.03739	-.09328	-.00693
C31	-.06856	-.11788	.11163	-.08946	-.01558	.50082	1.00000	.04605	.00387	-.05208	-.01644
C32	-.04609	-.04726	.14725	-.12211	.22045	.17820	.04605	1.00000	-.30508	-.21339	-.06336
C33	.06839	.09270	.00898	-.12211	-.27156	-.03739	.00387	-.30508	1.00000	-.21339	-.06336
C34	-.11231	.03547	-.09043	.08060	.10257	-.09328	-.05208	-.21339	-.21339	1.00000	-.04432
C35	-.03335	-.06795	-.02685	-.04432	-.10749	-.00693	-.01644	-.06336	-.06336	-.04432	1.00000

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 1.. C30

MULTIPLE R	.65374
R SQUARE	.42738
ADJUSTED R SQUARE	.41974
STANDARD ERROR	30.11813

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	50776.22991	50776.22991	55.97632
RESIDUAL	75.	68032.65321	907.10204	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1593607E-04	.65374	.00000	55.976
(CONSTANT)	47.07009			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.10249	.13369	.97424	1.347
C3	-.19317	-.25511	.99872	5.151
C4	.22352	.29289	.98319	6.944
C5	.10570	.13967	.99986	1.472
C6	999999.99999	99999.99999	.00000	99999.999
C7	.07300	.09640	.99863	.694
C8	999999.99999	99999.99999	.00000	99999.999
C9	-.22692	-.29765	.98529	7.194
C10	-.05179	-.06837	.99785	.348
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	.25643	.33794	.99451	9.541
C15	-.10506	-.13882	.99974	1.454
C16	.20921	.27522	.99099	6.064
C17	-.13013	-.16748	.94853	2.136
C18	.11590	.15315	.99981	1.777
C19	999999.99999	99999.99999	.00000	99999.999
C20	-.02382	-.03140	.99455	.073
C21	.06493	.08356	.94835	.520
C22	-.08248	-.10888	.99795	.888
C23	-.17044	-.22514	.99913	3.951
C24	-.11513	-.15200	.99809	1.750
C25	-.02594	-.03415	.99277	.086
C26	.19320	.25454	.99399	5.127
C27	.02868	.03790	.99962	.106
C28	-.06406	-.08411	.98729	.527
C29	-.03107	-.04014	.95603	.119
C31	.05466	.06252	.74918	.290
C32	-.03145	-.04089	.96824	.124
C33	.32500	.42918	.99860	16.708
C34	-.00024	-.00032	.99130	.000

C35	-.04022	-.05316	.99995	.210

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 2.. C33

MULTIPLE R	.72997
R SQUARE	.53285
ADJUSTED R SQUARE	.52023
STANDARD ERROR	27.38643

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	63307.64276	31653.82138	42.20415
RESIDUAL	74.	55501.24035	750.01676	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1623228E-04	.66589	.00000	70.142
C33	30.16386	.32500	7.37942	16.708
(CONSTANT)	39.79102			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.10241	.14789	.97424	1.632
C3	-.13644	-.19588	.96280	2.913
C4	.15313	.21553	.92543	3.556
C5	.10161	.14865	.99970	1.649
C6	999999.99999	99999.99999	.00000	99999.999
C7	.00613	.00876	.95601	.006
C8	999999.99999	99999.99999	.00000	99999.999
C9	-.16937	-.24122	.94755	4.510
C10	-.03184	-.04645	.99405	.158
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C14	.25263	.36857	.99437	11.476
C15	-.07617	-.11097	.99148	.910
C16	.18084	.26228	.98267	5.393
C17	-.13616	-.19399	.94822	2.854
C18	.11316	.16555	.99974	2.057
C19	999999.99999	99999.99999	.00000	99999.999
C20	-.01606	-.02343	.99399	.040
C21	.04925	.07010	.94622	.360
C22	-.06156	-.08978	.99371	.593
C23	-.14938	-.21797	.99466	3.641
C24	-.07940	-.11531	.98534	.984
C25	-.04749	-.06908	.98851	.350
C26	.16518	.23997	.98592	4.460
C27	.02600	.03804	.99955	.106
C28	-.02284	-.03294	.97131	.079
C29	.06960	.09542	.87786	.671
C31	.04489	.05683	.74867	.237
C32	.07569	.10384	.87906	.796
C34	.07440	.10577	.94420	.826
C35	-.01963	-.02866	.99590	.060

FILE STUDY9 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 3.. C14

MULTIPLE R	.77221
R SQUARE	.59631
ADJUSTED R SQUARE	.57972
STANDARD ERROR	25.63218

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	3.	70847.25917	23615.75306	35.94436
RESIDUAL	73.	47961.62394	657.00855	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1577313E-04	.64706	.00000	75.186
C33	29.88797	.32202	6.90721	18.724
C14	44.71518	.25263	13.19975	11.476
(CONSTANT)	37.88572			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.13897	.21396	.95687	3.454
C3	-.11749	-.18092	.95717	2.436
C4	.22750	.33475	.87401	9.086
C5	-.13808	-.15722	.52341	1.825
C6	999999.99999	99999.99999	.00000	99999.999
C7	.01315	.02022	.95531	.029
C8	999999.99999	99999.99999	.00000	99999.999
C9	-.12667	-.19086	.91649	2.722
C10	-.02435	-.03820	.99317	.105
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.06710	-.10509	.99018	.804
C16	.18529	.28905	.98238	6.564
C17	-.11767	-.17985	.94304	2.407
C18	.12715	.19980	.99682	2.994
C19	999999.99999	99999.99999	.00000	99999.999
C20	-.00185	-.00290	.99084	-001
C21	.03487	.05330	.94326	.205
C22	-.05581	-.08753	.99319	.556
C23	-.18499	-.28796	.97814	6.510
C24	-.06861	-.10709	.98352	.835
C25	-.08952	-.13834	.96410	1.405
C26	.16531	.25834	.98592	5.149
C27	.03963	.06226	.99668	.280
C28	-.00190	-.00293	.96478	.001
C29	.09430	.13851	.87089	1.408
C31	.06713	.09116	.74445	.603
C32	.07590	.11200	.87906	.915
C34	.09673	.14742	.93760	1.600
C35	-.01315	-.02064	.99524	.031

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 4.. C4

MULTIPLE R	.80097
R SQUARE	.64155
ADJUSTED R SQUARE	.62163
STANDARD ERROR	24.32054

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	4.	76221.69040	19055.42260	32.21603
RESIDUAL	72.	42587.19272	591.48879	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1491015E-04	.61166	.00000	72.628
C33	24.75361	.26670	6.77148	13.363
C14	53.87231	.30436	12.88746	17.474
C4	17.94710	.22750	5.95389	9.086
(CONSTANT)	31.11611			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.07368	.11324	.84671	.922
C3	-.05673	-.08832	.86895	.558
C5	-.07428	-.08735	.49563	.546
C6	999999.99999	99999.99999	.00000	99999.999
C7	.05169	.08315	.92762	.494
C8	999999.99999	99999.99999	.00000	99999.999
C9	.12972	.12722	.34479	1.168
C10	-.00085	-.00141	.98112	.000
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.03724	-.06125	.96985	.267
C16	.16476	.27127	.97176	5.640
C17	-.08461	-.13545	.91861	1.327
C18	.12513	.20866	.99673	3.232
C19	999999.99999	99999.99999	.00000	99999.999
C20	.00419	.00696	.99005	.003
C21	.00582	.00936	.92654	.006
C22	-.03589	-.05947	.98426	.252
C23	-.13729	-.21854	.90817	3.561
C24	-.06267	-.10377	.98275	.773
C25	-.16110	-.25406	.89149	4.899
C26	.15585	.25820	.98386	5.072
C27	.06509	.10782	.98339	.835
C28	.00179	.00294	.96450	.001
C29	.13842	.21243	.84423	3.355
C31	.08366	.12031	.74124	1.043
C32	.08226	.12877	.87838	1.197
C34	.04228	.06602	.87373	.311
C35	.00851	.01410	.98506	.014

FILE STUDY9 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 5.. C16

MULTIPLE R	.81727
R SQUARE	.66793
ADJUSTED R SQUARE	.64454
STANDARD ERROR	23.57284

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	5.	79355.68554	15871.13711	28.56171
RESIDUAL	71.	39453.19757	555.67884	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1457887E-04	.59807	.00000	73.414
C33	23.76508	.25605	6.57649	13.058
C14	53.64241	.30306	12.49163	18.441
C4	16.51430	.20934	5.80230	8.101
C16	15.29162	.16476	6.43897	5.640
(CONSTANT)	20.54820			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.09350	.14845	.83714	1.577
C3	-.02644	-.04208	.84121	.124
C5	-.11628	-.14004	.48167	1.400
C6	999999.99999	99999.99999	.00000	99999.999
C7	.04038	.06733	.92331	.319
C8	999999.99999	99999.99999	.00000	99999.999
C9	.13989	.14245	.34434	1.450
C10	.03334	.05614	.94173	.221
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.02401	-.04089	.96346	.117
C17	-.08155	-.13561	.91831	1.311
C18	.10577	.18169	.97989	2.390
C19	999999.99999	99999.99999	.00000	99999.999
C20	-.02246	-.03828	.96479	.103
C21	.01942	.03233	.92064	.073
C22	-.05013	-.08600	.97718	.522
C23	-.10310	-.16577	.85857	1.978
C24	-.05757	-.09898	.98177	.693
C25	-.11559	-.17782	.78590	2.286
C26	.12991	.21971	.94989	3.551
C27	.06458	.11113	.98338	.875
C28	-.02344	-.03951	.94296	.109
C29	.15944	.25273	.83432	4.776
C31	.11400	.16845	.72509	2.044
C32	.10590	.17085	.86431	2.105
C34	.01938	.03115	.85808	.068
C35	-.00487	-.00836	.97851	.005

FILE STUDY5 (CREATION DATE = 04/29/83)

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 6.. C29

MULTIPLE R	.83014
R SQUARE	.68914
ADJUSTED R SQUARE	.66249
STANDARD ERROR	22.96992

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	6.	81875.66425	13645.94404	25.86333
RESIDUAL	70.	36933.21887	527.61741	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1527223E-04	.62651	.00000	81.851
C33	27.16594	.29270	6.59452	16.970
C14	57.10298	.32261	12.27470	21.642
C4	18.57112	.23541	5.73169	10.498
C16	16.78622	.18086	6.31144	7.074
C29	12.55263	.15944	5.74375	4.776
(CONSTANT)	-1.461282			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.10297	.16870	.83439	2.021
C3	-.03819	-.06266	.83676	.272
C5	-.13940	-.17259	.47655	2.119
C6	999999.99999	99999.99999	.00000	99999.999
C7	.01499	.02546	.89651	.045
C8	999999.99999	99999.99999	.00000	99999.999
C9	.20224	.20792	.32858	3.118
C10	.02083	.03613	.93504	.090
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.04307	-.07524	.94863	.393
C17	-.08766	-.15055	.91689	1.600
C18	.12212	.21568	.96960	3.366
C19	999999.99999	99999.99999	.00000	99999.999
C20	.00358	.00621	.93529	.003
C21	.00770	.01321	.91511	.012
C22	-.06471	-.11421	.96836	.912
C23	-.10286	-.17094	.85857	2.077
C24	-.06224	-.11056	.98080	.854
C25	-.10527	-.16703	.78252	1.980
C26	.10246	.17490	.90577	2.177
C27	.06613	.11761	.98327	.968
C28	-.00558	-.00964	.92945	.006
C31	.09972	.15171	.71948	1.625
C32	.07947	.13020	.83431	1.190
C34	.00655	.01084	.85233	.008
C35	.01792	.03142	.95591	.068

FILE STUDY9 (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 7.. C18

MULTIPLE R	.83881
R SQUARE	.70360
ADJUSTED R SQUARE	.67353
STANDARD ERROR	22.59124

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	7.	83593.74760	11941.96394	23.39890
RESIDUAL	69.	35215.13552	510.36428	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1539653E-04	.63161	.00000	85.858
C33	27.47636	.29604	6.48801	17.935
C14	58.54074	.33073	12.09775	23.416
C4	18.78795	.23816	5.63844	11.103
C16	15.42110	.16615	6.25182	6.084
C29	13.62010	.17300	5.67894	5.752
C18	21.61621	.12212	11.78142	3.366
(CONSTANT)	-3.446139			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.10551	.17699	.83408	2.199
C3	-.03078	-.05163	.83403	.182
C5	-.12746	-.16119	.47405	1.814
C6	999999.99999	99999.99999	.00000	99999.999
C7	.01785	.03103	.89606	.066
C8	999999.99999	99999.99999	.00000	99999.999
C9	.18811	.19754	.32688	2.761
C10	.01981	.03519	.93498	.084
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.04108	-.07348	.94838	.369
C17	-.08146	-.14309	.91450	1.421
C19	999999.99999	99999.99999	.00000	99999.999
C20	.01727	.03051	.92428	.063
C21	.01763	.03087	.90953	.065
C22	-.06115	-.11048	.96752	.840
C23	-.09804	-.16675	.85732	1.945
C24	-.05717	-.10389	.97902	.742
C25	-.10106	-.16413	.78174	1.883
C26	.12475	.21550	.88451	3.312
C27	.07365	.13390	.97975	1.241
C28	.01117	.01961	.91309	.026
C31	.10299	.16041	.71911	1.796
C32	.05465	.08973	.79885	.552
C34	.02192	.03692	.84091	.093
C35	.02471	.04430	.95306	.134

* M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   C1

VARIABLE(S) ENTERED ON STEP NUMBER 8..   C26

MULTIPLE R	.84697
R SQUARE	.71736
ADJUSTED R SQUARE	.68411
STANDARD ERROR	22.22206

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	8.	85229.13863	10653.64233	21.57395
RESIDUAL	68.	33579.74449	493.81977	

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1558575E-04	.63937	.00000	90.563
C33	26.14670	.28171	6.42367	16.568
C14	57.93588	.32732	11.90468	23.684
C4	18.17602	.23040	5.55648	10.700
C16	12.78080	.13771	6.31849	4.092
C29	11.52310	.14637	5.70375	4.081
C18	24.88577	.14060	11.72733	4.503
C26	11.17514	.12475	6.14082	3.312
(CONSTANT)	-.9432243			

-------------- VARIABLES NOT IN THE EQUATION --------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.09158	.15621	.82239	1.676
C3	-.03519	-.06042	.83306	.245
C5	-.14184	-.18312	.47108	2.325
C6	999999.99999	99999.99999	.00000	99999.999
C7	-.00028	-.00050	.87690	.000
C8	999999.99999	99999.99999	.00000	99999.999
C9	.22942	.24316	.31751	4.211
C10	-.01136	-.02000	.87605	.027
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	-.02870	-.05229	.93785	.184
C17	-.06540	-.11644	.89615	.921
C19	999999.99999	99999.99999	.00000	99999.999
C20	.04121	.07325	.89277	.361
C21	.05564	.09598	.84080	.623
C22	-.04873	-.08962	.95603	.543
C23	-.08084	-.13920	.83799	1.324
C24	-.04279	-.07900	.96322	.421
C25	-.08249	-.13554	.76299	1.254
C27	.09403	.17301	.95672	2.067
C28	.04855	.08391	.84422	.475
C31	.11676	.18545	.71297	2.386
C32	.05349	.08992	.79879	.546
C34	.02465	.04251	.84053	.121
C35	.03125	.05731	.95031	.221

FILE STUDY9 (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 9.. C9

MULTIPLE R	.85678
R SQUARE	.73408
ADJUSTED R SQUARE	.69835
STANDARD ERROR	21.71533

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	9.	87214.66586	9690.51843	20.55011
RESIDUAL	67.	31594.21725	471.55548	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1568047E-04	.64326	.00000	95.915
C33	26.42104	.28467	6.27862	17.708
C14	73.03123	.41260	13.76409	28.153
C4	33.04466	.41888	9.05469	13.319
C16	13.14206	.14160	6.17692	4.527
C29	13.52457	.17179	5.65839	5.713
C18	23.80272	.13448	11.47206	4.305
C26	13.29007	.14836	6.08866	4.764
C9	18.47974	.22942	9.00584	4.211
(CONSTANT)	-19.52984			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.08598	.15108	.82106	1.542
C3	-.00666	-.01155	.79861	.009
C5	-.03014	-.03001	.26369	.060
C6	999999.99999	99999.99999	.00000	99999.999
C7	-.02309	-.04139	.85420	.113
C8	999999.99999	99999.99999	.00000	99999.999
C10	.03265	.05657	.79842	.212
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	.04512	.07451	.72503	.368
C17	-.08366	-.15239	.88230	1.569
C19	999999.99999	99999.99999	.00000	99999.999
C20	.03163	.05781	.88824	.221
C21	.04724	.08385	.83769	.467
C22	-.06238	-.11770	.94672	.927
C23	-.08274	-.14686	.83784	1.455
C24	-.02284	-.04293	.93987	.122
C25	-.07520	-.12722	.76104	1.086
C27	.08015	.15106	.94456	1.541
C28	.07479	.13129	.81956	1.158
C31	.10785	.17627	.71033	2.116
C32	.03101	.05304	.77810	.186
C34	.00647	.01140	.82638	.009
C35	.02420	.04567	.94757	.138

* M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 10.. C31

MULTIPLE R	.86159
R SQUARE	.74234
ADJUSTED R SQUARE	.70330
STANDARD ERROR	21.53665

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	10.	88196.27856	8819.62786	19.01489
RESIDUAL	66.	30612.60456	463.82734	

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1426933E-04	.58537	.00000	58.807
C33	25.66526	.27653	6.24859	16.870
C14	73.66065	.41616	13.65769	29.088
C4	32.64734	.41384	8.98434	13.205
C16	14.12063	.15214	6.16291	5.250
C29	12.60978	.16017	5.64695	4.986
C18	24.45728	.13818	11.38656	4.614
C26	14.00418	.15633	6.05848	5.343
C9	17.68791	.21959	8.94831	3.907
C31	.4863881E-05	.10785	.00000	2.116
(CONSTANT)	-18.46636			

-------------- VARIABLES NOT IN THE EQUATION --------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.09042	.16126	.81956	1.735
C3	-.03540	-.06020	.74497	.236
C5	-.03747	-.03787	.26325	.093
C6	999999.99999	99999.99999	.00000	99999.999
C7	-.01981	-.03605	.85323	.085
C8	999999.99999	99999.99999	.00000	99999.999
C10	.03803	.06685	.79627	.292
C11	999999.99999	99999.99999	.00000	99999.999
C12	999999.99999	99999.99999	.00000	99999.999
C13	999999.99999	99999.99999	.00000	99999.999
C15	.04787	.08028	.72457	.422
C17	-.06759	-.12275	.84984	.994
C19	999999.99999	99999.99999	.00000	99999.999
C20	.03172	.05889	.88824	.226
C21	.01924	.03310	.76266	.071
C22	-.06005	-.11508	.94612	.872
C23	-.06945	-.12384	.81914	1.012
C24	-.01912	-.03649	.93836	.087
C25	-.06869	-.11781	.75779	.915
C27	.07038	.13386	.93221	1.186
C28	.07801	.13906	.81875	1.282
C32	.04095	.07085	.77136	.328
C34	.00528	.00945	.82627	.006
C35	.02479	.04754	.94753	.147

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SPSS FOR ND-500, VERSION M, RELEASE 8.0A, OCTOBER 15, 1979
DEFAULT SPACE ALLOCATION..     ALLOWS FOR..    81 TRANSFORMATIONS
WORKSPACE     57344 BYTES                     327 RECODE VALUES + LAG VARIABLES
TRANSPACE      8192 BYTES                    1314 IF/COMPUTE OPERATIONS
LABELSPACE    32768 BYTES                   32768 BYTES MEMORY RESIDENT FILE SPACE

                1 RUN NAME              FULL-STEPWISE-REGRESSION
                2 FILE NAME             STUDYDWS
                3 VARIABLE LIST         C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,
                4                       C15,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,
                5                       C27,C28,C29,C30,C31,C32,C33,C34,C35,
                6 INPUT MEDIUM          DISK
                7 N OF CASES            212
                8 INPUT FORMAT          FREEFIELD
                9 REGRESSION            VARIABLES = C1 TO C35
               10                       REGRESSION = C1 WITH C2 TO C35 RESID=0/
               11 STATISTICS            ALL


***** REGRESSION PROBLEM REQUIRES  21840 BYTES WORKSPACE, NOT INCLUDING RESIDUALS *****


               12 READ INPUT DATA
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FILE STUDYDWS (CREATION DATE = 04/25/88)

VARIABLE	MEAN	STANDARD DEV	CASES
C1	67.9057	38.4074	212
C2	.2594	.4394	212
C3	.1038	.3057	212
C4	.4009	.4912	212
C5	.0472	.2125	212
C6	.1179	.3233	212
C7	.0047	.0687	212
C8	.0189	.1364	212
C9	.5047	.5012	212
C10	.0094	.0969	212
C11	.0094	.0969	212
C12	.0000	.0000	212
C13	.0047	.0687	212
C14	.0236	.1521	212
C15	.0142	.1184	212
C16	.8302	.3764	212
C17	.0425	.2021	212
C18	.0519	.2223	212
C19	.0142	.1184	212
C20	.0519	.2223	212
C21	.2028	.4031	212
C22	.0660	.2489	212
C23	.0896	.2863	212
C24	.0283	.1662	212
C25	.0708	.2570	212
C26	.1934	.3959	212
C27	.0472	.2125	212
C28	.1132	.3176	212
C29	1.5142	.5010	212
C30	863681.1557	1490931.1210	212
C31	151313.1226	756083.0801	212
C32	.2217	.4164	212
C33	.2453	.4313	212
C34	.1274	.3342	212
C35	.0425	.2021	212

FILE STUDENTS CREATION DATE = 04/29/80

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1.00000	-.12324	-.12672	.20372	.12249	.10014	.01454	.08992	-.22010	-.06089	-.05834	99.00000
C2	-.12324	1.00000	-.16612	.10865	-.08093	-.11631	-.04075	.23430	-.03787	-.05776	.05356	99.00000
C3	-.12672	-.16612	1.00000	-.27838	-.07571	-.12442	-.02343	-.04719	.12053	-.03321	.12679	99.00000
C4	.20372	.10865	-.27838	1.00000	-.18203	-.29913	-.05632	.16951	-.82586	-.07984	-.07984	99.00000
C5	.12249	-.08093	-.07571	-.18203	1.00000	-.08135	-.01532	-.03085	-.22461	-.02171	-.02171	99.00000
C6	.10014	-.11631	-.12442	-.29913	-.08135	1.00000	-.02517	-.05070	.36220	-.03568	-.03568	99.00000
C7	.01454	-.04075	-.02343	-.05632	-.01532	-.02517	1.00000	-.00955	.06820	-.00672	-.00672	99.00000
C8	.08992	.23430	-.04719	.16951	-.03085	-.05070	-.00955	1.00000	-.13999	-.01353	-.01353	99.00000
C9	-.22010	-.03787	.12053	-.82586	-.22461	.36220	.06820	-.13999	1.00000	-.09852	-.09852	99.00000
C10	-.06089	-.05776	-.03321	-.07984	-.02171	-.03568	-.00672	-.01353	-.09852	1.00000	-.00952	99.00000
C11	-.05834	.05356	.12679	-.07984	-.02171	-.03568	-.00672	-.01353	-.09852	-.00952	1.00000	99.00000
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000
C13	.03610	-.04075	-.02343	.08415	-.01532	-.02517	-.00474	-.00955	-.06950	-.00672	-.00672	99.00000
C14	.11152	-.09199	-.05289	-.12715	.69851	-.05683	-.01070	-.02155	-.15689	-.01517	-.01517	99.00000
C15	.15455	-.07091	.22114	-.09802	.16172	-.04381	-.00825	-.01661	-.12094	-.01169	-.01169	99.00000
C16	.30512	.00973	-.17566	.11366	.04137	.08746	.03114	.06272	-.09624	-.08582	-.08582	99.00000
C17	-.03673	-.07125	-.07165	-.12452	-.04685	.06809	-.01450	-.02920	.16179	-.02055	-.02055	99.00000
C18	.04331	-.04142	-.07960	.02559	-.05205	-.01960	-.01610	-.03244	.01906	-.02283	-.02283	99.00000
C19	.12328	-.07091	-.04077	.06496	-.02666	-.04381	-.00825	-.01661	-.04107	-.01169	-.01169	99.00000
C20	-.09877	-.08994	.12960	-.01781	-.05205	-.08554	-.01610	-.03244	.06160	-.02283	-.02283	99.00000
C21	.14728	.20993	.09761	.04211	-.00157	-.00257	-.03473	.27492	-.08688	-.04923	.19347	99.00000
C22	-.03553	-.07072	-.02820	.01499	-.05916	-.03833	-.01831	-.03687	.03548	-.02595	-.02595	99.00000
C23	-.06000	.00267	.05568	-.15560	.00808	.03888	-.02160	-.04351	.11264	-.03062	-.03062	99.00000
C24	-.12652	-.03612	.03520	-.08158	-.03797	.11399	-.01175	-.02367	.05528	-.01666	-.01666	99.00000
C25	.04485	-.03742	-.09390	.14961	.02538	.01318	-.01900	-.03827	-.13138	-.02693	-.02693	99.00000
C26	.01928	.00990	-.00998	.01368	.06005	.00611	.14059	-.06790	-.04045	.07576	-.04779	99.00000
C27	-.05113	-.03017	-.00275	-.04583	-.04950	-.01237	-.01532	-.03085	.08690	-.02171	-.02171	99.00000
C28	-.03797	-.00769	-.02395	.04184	.13117	-.13064	-.02460	-.04955	-.09270	.11913	-.03487	99.00000
C29	-.03367	.01554	-.00963	-.05205	.03822	.03354	.06692	.06544	.01861	-.00276	-.00276	99.00000
C30	.61253	-.19531	.10405	-.03162	.09921	-.08800	-.02846	-.03682	-.09583	.01612	.01213	99.00000
C31	.46427	-.07964	.08333	-.03245	.19777	-.06278	-.01371	-.00204	-.05096	-.00795	-.01852	99.00000
C32	.04192	-.00501	-.14438	.14263	-.06519	-.01910	-.03674	.09291	-.08453	.06538	-.05208	99.00000
C33	.29182	-.03728	-.01424	.09286	.02830	.02950	.12076	.00152	-.09309	-.05563	.05777	99.00000
C34	-.05150	.06441	-.13000	.09165	-.08500	-.05194	-.02630	-.05298	-.01775	-.03728	-.03728	99.00000
C35	.09088	-.01788	.15850	.01869	-.04685	.06809	-.01450	.14275	.02141	-.02055	-.02055	99.00000

FILE STUDYDWS (CREATION DATE = 04/25/88)

	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
C1	.03610	.11152	.15455	.30512	-.03673	.04331	.12328	-.09877	.14728	-.03553	-.06000	-.12652
C2	-.04075	-.09199	-.07091	.00973	-.07125	-.04142	-.07091	-.08994	.20993	-.07072	.00267	-.03612
C3	-.02343	-.05289	.22114	-.17566	-.07165	-.07960	-.04077	.12960	.09761	-.02820	.05568	.03520
C4	.08415	-.12715	-.09802	.11366	-.12452	.02559	.06496	-.01781	.04211	.01499	-.15560	-.08158
C5	-.01532	.69851	.16172	.04137	-.04685	-.05205	-.02666	-.05205	-.00157	-.05916	.00808	-.03797
C6	-.02517	-.05683	-.04381	.08746	.06809	-.01960	-.04381	-.08554	-.00257	-.03833	.03888	.11399
C7	-.00474	-.01070	-.00825	.03114	-.01450	-.01610	-.00825	-.01610	-.03473	-.01831	-.02160	-.01175
C8	-.00955	-.02155	-.01661	.06272	-.02920	-.03244	-.01661	-.03244	.27492	-.03687	-.04351	-.02367
C9	-.06950	-.15689	-.12094	-.09624	.16179	.01906	-.04107	.06160	-.08688	.03548	.11264	.05528
C10	-.00672	-.01517	-.01169	-.08582	-.02055	-.02283	-.01169	-.02283	-.04923	-.02595	-.03062	-.01666
C11	-.00672	-.01517	-.01169	-.08582	-.02055	-.02283	-.01169	-.02283	.19347	-.02595	-.03062	-.01666
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	1.00000	-.01070	-.00825	.03114	-.01450	-.01610	-.00825	-.01610	.13648	-.01831	-.02160	-.01175
C14	-.01070	1.00000	-.01862	-.01250	-.03272	-.03636	-.01862	-.03636	.07621	-.04133	.06006	-.02652
C15	-.00825	-.01862	1.00000	-.05218	-.02523	-.02803	-.01435	-.02803	-.06043	-.03186	.10222	.22037
C16	.03114	-.01250	-.05218	1.00000	-.09170	.10580	-.05218	-.00748	.00943	-.03150	-.07801	-.07433
C17	-.01450	-.03272	-.02523	-.09170	1.00000	-.04926	-.02523	-.04926	-.10621	-.05599	-.06606	-.03593
C18	-.01610	-.03636	-.02803	.10580	-.04926	1.00000	-.02803	-.05473	-.11800	-.06221	-.07340	-.03992
C19	-.00825	-.01862	-.01435	-.05218	-.02523	-.02803	1.00000	-.02803	-.06043	-.03186	-.03759	-.02045
C20	-.01610	-.03636	-.02803	-.00748	-.04926	-.05473	-.02803	1.00000	-.11800	-.06221	-.07340	-.03992
C21	.13648	.07621	-.06043	.00943	-.10621	-.11800	-.06043	-.11800	1.00000	-.13413	-.15827	-.08609
C22	-.01831	-.04133	-.03186	-.03150	-.05599	-.06221	-.03186	-.06221	-.13413	1.00000	-.08343	-.04538
C23	-.02160	.06006	.10222	-.07801	-.06606	-.07340	-.03759	-.07340	-.15827	-.08343	1.00000	-.05355
C24	-.01175	-.02652	.22037	-.07433	-.03593	-.03992	-.02045	-.03992	-.08609	-.04538	-.05355	1.00000
C25	-.01900	.07834	-.03306	-.16917	-.05810	-.06455	-.03306	-.06455	-.13919	-.07337	-.08658	-.04709
C26	-.03371	.00260	-.05867	.15784	-.10310	-.11455	-.05867	-.11455	-.24699	-.13020	-.15364	-.08357
C27	-.01532	-.03458	-.02666	-.01789	-.04685	-.05205	-.02666	-.05205	-.11223	-.05916	-.06981	-.03797
C28	-.02460	-.05553	.08324	.08229	-.07523	-.08358	-.04281	-.08358	-.18023	-.09501	-.11210	-.06098
C29	-.07082	-.03550	.11646	-.06260	.01744	-.02790	.03656	-.07045	-.02602	-.00753	.00764	.05208
C30	.10327	.02843	.20481	.10558	.13384	-.06130	.17330	-.07983	.14643	-.00358	.07526	-.02777
C31	-.01381	-.01208	.39919	-.01442	-.01365	-.04137	-.01929	-.03735	.13361	-.04379	-.04416	-.03127
C32	-.03674	-.00812	-.06394	-.03081	.05659	.02874	.03220	-.12485	-.01505	.08670	.03132	-.02261
C33	-.03925	-.01636	.02452	.11184	-.06566	.01492	-.06830	-.03451	.06688	.06913	-.06373	-.09729
C34	-.02630	-.05937	-.04577	.05973	.05992	-.02558	-.04577	.22959	-.01676	.01236	-.11987	-.06520
C35	-.01450	-.03272	-.02523	.09523	.07170	-.04926	.17285	.05622	-.04803	-.05599	.01584	-.03593

	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35
C1	.04485	.01928	-.05113	-.03797	-.03367	.61253	.46427	.04192	.29182	-.05150	.09088
C2	-.03742	.00990	-.03017	-.00769	.01554	-.19531	-.07964	-.00501	-.03728	.06441	-.01788
C3	-.09390	-.00998	-.00275	-.02395	-.00963	.10405	.08333	-.14438	-.01424	-.13000	.15850
C4	.14961	.01368	-.04583	.04184	-.05205	-.03162	-.03245	.14263	.09286	.09165	.01869
C5	.02538	.06005	-.04950	.13117	.03822	.09921	.19777	-.06519	.02830	-.08500	-.04685
C6	.01318	.00611	-.01237	-.13064	.03354	-.08800	-.06278	-.01910	.02950	-.05194	.06809
C7	-.01900	.14059	-.01532	-.02460	.06692	-.02846	-.01371	-.03674	.12076	-.02630	-.01450
C8	-.03827	-.06790	-.03085	-.04955	.06544	-.03682	-.00204	.09291	.00152	-.05298	.14275
C9	-.13138	-.04045	.08690	-.09270	.01861	-.09583	-.05096	-.08453	-.09309	-.01775	.02141
C10	-.02693	.07576	-.02171	.11913	-.00276	.01612	-.00795	.06538	-.05563	-.03728	-.02055
C11	-.02693	-.04779	-.02171	-.03487	-.00276	.01213	-.01852	-.05208	.05777	-.03728	-.02055
C12	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
C13	-.01900	-.03371	-.01532	-.02460	-.07082	.10327	-.01381	-.03674	-.03925	-.02630	-.01450
C14	.07834	.00260	-.03458	-.05553	-.03550	.02843	-.01208	-.00812	-.01636	-.05937	-.03272
C15	-.03306	-.05867	-.02666	.08324	.11646	.20481	.39919	-.06394	.02452	-.04577	-.02523
C16	-.16917	.15784	-.01789	.08229	-.06260	.10558	-.01442	-.03081	.11184	.05973	.09523
C17	-.05810	-.10310	-.04685	-.07523	.01744	.13384	-.01365	.05659	-.06566	.05992	.07170
C18	-.06455	-.11455	-.05205	-.08358	-.02790	-.06130	-.04137	.02874	.01492	-.02558	-.04926
C19	-.03306	-.05867	-.02666	-.04281	.03656	.17330	-.01929	.03220	-.06830	-.04577	.17285
C20	-.06455	-.11455	-.05205	-.08358	-.07045	-.07983	-.03735	-.12485	-.03451	.22959	.05622
C21	-.13919	-.24699	-.11223	-.18023	-.02602	.14643	.13361	-.01505	.06688	-.01676	-.04803
C22	-.07337	-.13020	-.05916	-.09501	-.00753	-.00358	-.04379	.08670	.06913	.01236	-.05599
C23	-.08658	-.15364	-.06981	-.11210	.00764	.07526	-.04416	.03132	-.06373	-.11987	.01584
C24	-.04709	-.08357	-.03797	-.06098	.05208	-.02777	-.03127	-.02261	-.09729	-.06520	-.03593
C25	1.00000	-.13512	-.06140	-.09859	.01059	-.08656	-.05280	-.01441	-.07180	.00495	.12438
C26	-.13512	1.00000	-.10895	-.17495	.14146	-.12351	-.07741	-.06008	.10946	.02788	-.04387
C27	-.06140	-.10895	1.00000	-.07950	-.09533	-.06855	.04855	.04194	-.02342	-.01826	-.04685
C28	-.09859	-.17495	-.07950	1.00000	-.03990	.01254	.11564	-.08317	.00392	-.00253	-.00139
C29	.01059	.14146	-.09533	-.03990	1.00000	-.10755	.01807	.06441	-.14775	.08827	.06425
C30	-.08656	-.12351	-.06855	.01254	-.10755	1.00000	.53882	.05253	.02610	-.13194	-.00821
C31	-.05280	-.07741	.04855	.11564	.01807	.53882	1.00000	-.00695	.11397	-.04265	-.03304
C32	-.01441	-.06008	.04194	-.08317	.06441	.05253	-.00695	1.00000	-.30426	-.20389	-.11238
C33	-.07180	.10946	-.02342	.00392	-.14775	.02610	.11397	-.30426	1.00000	-.21779	-.12004
C34	.00495	.02788	-.01826	-.00253	.08827	-.13194	-.04265	-.20389	-.21779	1.00000	-.08044
C35	.12438	-.04387	-.04685	-.00139	.06425	-.00821	-.03304	-.11238	-.12004	-.08044	1.00000

FILE STUDYDWS (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 1.. C30

MULTIPLE R	.61253
R SQUARE	.37519
ADJUSTED R SQUARE	.37222
STANDARD ERROR	30.43128

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	116778.95854	116778.95854	126.10266
RESIDUAL	210.	194473.15466	926.06264	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1577915E-04	.61253	.00000	126.103
(CONSTANT)	54.27751			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.00375	-.00466	.96186	.005
C3	-.19254	-.24226	.98917	13.031
C4	.22331	.28237	.99900	18.108
C5	.06234	.07847	.99016	1.295
C6	.15524	.19564	.99226	8.318
C7	.03200	.04047	.99919	.343
C8	.11262	.14238	.99864	4.324
C9	-.16290	-.20513	.99082	9.181
C10	-.07078	-.08953	.99974	1.689
C11	-.06578	-.08321	.99985	1.457
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02744	-.03453	.98934	.250
C14	.09418	.11910	.99919	3.007
C15	.03037	.03761	.95805	.296
C16	.24316	.30590	.98885	21.576
C17	-.12088	-.15154	.98209	4.913
C18	.08117	.10249	.99624	2.219
C19	.01766	.02200	.96997	.101
C20	-.05020	-.06330	.99363	.841
C21	.05885	.07364	.97856	1.140
C22	-.03334	-.04217	.99999	.372
C23	-.10670	-.13460	.99434	3.856
C24	-.10959	-.13859	.99923	4.093
C25	.09861	.12428	.99251	3.279
C26	.09641	.12103	.98475	3.107
C27	-.00919	-.01160	.99530	.028
C28	-.04566	-.05777	.99984	.700
C29	.03258	.04098	.98843	.352
C31	.18913	.20157	.70967	8.851
C32	.00977	.01234	.99724	.032
C33	.27602	.34907	.99932	29.000
C34	.02984	.03742	.98259	.293

FILE STUDYDWS (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 2.. C33

MULTIPLE R	.67181
R SQUARE	.45132
ADJUSTED R SQUARE	.44607
STANDARD ERROR	28.58519

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	140475.52927	70237.76463	85.95846
RESIDUAL	209.	170776.58394	817.11284	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1559355E-04	.60532	.00000	139.479
C33	24.58086	.27602	4.56452	29.000
(CONSTANT)	48.40854			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.00549	.00726	.96082	.011
C3	-.18786	-.25220	.98889	14.129
C4	.19918	.26758	.99022	16.041
C5	.05521	.07414	.98950	1.150
C6	.14655	.19698	.99124	8.396
C7	-.00159	-.00213	.98442	.001
C8	.11193	.15101	.99864	4.854
C9	-.13881	-.18576	.98260	7.434
C10	-.05548	-.07477	.99660	1.169
C11	-.08191	-.11039	.99655	2.566
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.01577	-.02116	.98758	.093
C14	.09893	.13349	.99890	3.774
C15	.02486	.03284	.95768	.225
C16	.21530	.28729	.97695	18.712
C17	-.10194	-.13605	.97730	3.922
C18	.07661	.10322	.99597	2.240
C19	.03859	.05117	.96466	.546
C20	-.04124	-.05546	.99258	.642
C21	.04123	.05495	.97458	.630
C22	-.05270	-.07097	.99519	1.053
C23	-.08885	-.11935	.99002	3.006
C24	-.08370	-.11242	.98990	2.663
C25	.11852	.15902	.98767	5.396
C26	.06567	.08741	.97204	1.601
C27	-.00319	-.00430	.99483	.004
C28	-.04666	-.06298	.99983	.828
C29	.07465	.09912	.96741	2.064
C31	.15242	.17212	.69968	6.351
C32	.10412	.13363	.90377	3.782
C34	.09447	.12343	.93662	3.218
C35	.13088	.17541	.98557	6.603

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 3.. C16

MULTIPLE R	.70471
R SQUARE	.49661
ADJUSTED R SQUARE	.48935
STANDARD ERROR	27.44586

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	3.	154570.90318	51523.63439	68.39950
RESIDUAL	208.	156681.21002	753.27505	

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
C30	.1502375E-04	.58320	.00000	138.944
C33	22.48792	.25251	4.40922	26.012
C16	21.97169	.21530	5.07928	18.712
(CONSTANT)	31.17337			

VARIABLES NOT IN THE EQUATION

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.00210	-.00291	.95964	.002
C3	-.15304	-.21067	.95393	9.614
C4	.17806	.24826	.97855	13.596
C5	.04913	.06886	.98869	.986
C6	.12743	.17802	.98234	6.774
C7	-.00616	-.00861	.98397	.015
C8	.09808	.13783	.99413	4.008
C9	-.12285	-.17112	.97666	6.244
C10	-.03815	-.05349	.98981	.594
C11	-.06230	-.08726	.98762	1.588
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02119	-.02968	.98695	.182
C14	.10189	.14351	.99871	4.353
C15	.04218	.05800	.95179	.699
C17	-.08110	-.11243	.96741	2.650
C18	.05340	.07464	.98348	1.160
C19	.05277	.07290	.96066	1.106
C20	-.04221	-.05927	.99256	.730
C21	.04409	.06134	.97441	.782
C22	-.04440	-.06238	.99366	.809
C23	-.07218	-.10090	.98367	2.129
C24	-.07073	-.09900	.98611	2.049
C25	.15550	.21517	.96388	10.049
C26	.03138	.04302	.94630	.384
C27	-.00140	-.00197	.99476	.001
C28	-.06444	-.09051	.99318	1.710
C29	.08264	.11449	.96612	2.749
C31	.17950	.21057	.69276	9.604
C32	.10484	.14047	.90376	4.167
C34	.07291	.09894	.92697	2.046
C35	.10837	.15069	.97336	4.810

FILE STUDYDWS (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 4.. C4

MULTIPLE R	.72639
R SQUARE	.52764
ADJUSTED R SQUARE	.51851
STANDARD ERROR	26.65073

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	4.	164227.96156	41056.99039	57.80545
RESIDUAL	207.	147024.15165	710.26160	

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
C30	.1523154E-04	.59127	.00000	151.150
C33	21.19053	.23795	4.29591	24.332
C16	19.98567	.19584	4.96145	16.226
C4	13.92156	.17806	3.77550	13.596
(CONSTANT)	27.37915			

VARIABLES NOT IN THE EQUATION

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.02123	-.03009	.94906	.187
C3	-.11356	-.15573	.88836	5.120
C5	.08534	.12127	.95395	3.075
C6	.20580	.28104	.88088	17.666
C7	.00671	.00965	.97884	.019
C8	.07116	.10185	.96769	2.159
C9	.08131	.06510	.30275	.877
C10	-.02654	-.03833	.98547	.303
C11	-.04912	-.07083	.98193	1.039
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.03749	-.05397	.97892	.602
C14	.12580	.18150	.98321	7.017
C15	.05854	.08278	.94440	1.421
C17	-.06284	-.08942	.95656	1.661
C18	.05159	.07444	.98337	1.148
C19	.03746	.05322	.95343	.585
C20	-.03903	-.05657	.99223	.661
C21	.03644	.05228	.97259	.565
C22	-.04667	-.06768	.99350	.948
C23	-.04807	-.06868	.96408	.976
C24	-.05895	-.08498	.98155	1.499
C25	.12801	.18003	.93433	6.901
C26	.03480	.04925	.94596	.501
C27	.00668	.00969	.99269	.019
C28	-.07045	-.10209	.99206	2.170
C29	.08978	.12830	.96465	3.448
C31	.18362	.22233	.69251	10.712
C32	.07318	.09949	.87308	2.060
C34	.05485	.07644	.91737	1.211
C35	.10516	.15093	.97304	4.802

* M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * *

VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   C1

VARIABLE(S) ENTERED ON STEP NUMBER 5..   C6

MULTIPLE R	.75163
R SQUARE	.56495
ADJUSTED R SQUARE	.55439
STANDARD ERROR	25.63860

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	5.	175840.54450	35168.10890	53.50082
RESIDUAL	206.	135411.56870	657.33771	

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1583180E-04	.61457	.00000	173.948
C33	20.31549	.22812	4.13801	24.103
C16	17.24125	.16895	4.81748	12.808
C4	19.10252	.24433	3.83558	24.804
C6	24.45021	.20580	5.81718	17.666
(CONSTANT)	24.39319			

------------- VARIABLES NOT IN THE EQUATION --------------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.00111	.00163	.93703	.001
C3	-.07524	-.10530	.85213	2.299
C5	.11713	.17153	.93311	6.215
C7	.01863	.02789	.97523	.160
C8	.07298	.10884	.96761	2.458
C9	.01214	.00993	.29084	.020
C10	-.01704	-.02561	.98310	.135
C11	-.03844	-.05765	.97891	.684
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.03990	-.05984	.97877	.737
C14	.14652	.21919	.97357	10.346
C15	.06886	.10133	.94194	2.127
C17	-.07568	-.11199	.95270	2.604
C18	.05854	.08795	.98215	1.598
C19	.03599	.05328	.95338	.584
C20	-.01898	-.02851	.98140	.167
C21	.03156	.04717	.97198	.457
C22	-.03986	-.06020	.99225	.746
C23	-.05033	-.07492	.96395	1.157
C24	-.08061	-.12039	.97044	3.015
C25	.11184	.16330	.92758	5.617
C26	.04122	.06075	.94499	.759
C27	.01321	.01995	.99157	.082
C28	-.04499	-.06732	.97384	.933
C29	.08559	.12741	.96420	3.383
C31	.18839	.23763	.69222	12.269
C32	.06129	.08668	.87008	1.552
C34	.06275	.09105	.91599	1.714
C35	.09157	.13660	.96803	3.898

FILE STUDYDWS (CREATION DATE = 04/25/88)

* MULTIPLE REGRESSION * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 6.. C31

MULTIPLE R	.76780
R SQUARE	.58951
ADJUSTED R SQUARE	.57750
STANDARD ERROR	24.96485

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	6.	183487.11460	30581.18577	49.06777
RESIDUAL	205.	127764.99861	623.24390	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1320098E-04	.51245	.00000	90.279
C33	18.44764	.20715	4.06440	20.601
C16	18.78022	.18403	4.71142	15.889
C4	19.42509	.24846	3.73592	27.035
C6	24.85116	.20918	5.66547	19.241
C31	.9569720E-05	.18839	.00000	12.269
(CONSTANT)	24.22126			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	-.00522	-.00789	.93560	.013
C3	-.07660	-.11036	.85208	2.515
C5	.09186	.13642	.90532	3.868
C7	.02074	.03196	.97506	.209
C8	.06807	.10446	.96666	2.250
C9	.01730	.01456	.29075	.043
C10	-.01326	-.02052	.98254	.086
C11	-.03066	-.04729	.97651	.457
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02821	-.04344	.97330	.386
C14	.15263	.23489	.97223	11.913
C15	.01498	.02130	.83004	.093
C17	-.05902	-.08938	.94158	1.643
C18	.05875	.09088	.98215	1.699
C19	.05862	.08853	.93616	1.612
C20	-.02037	-.03150	.98132	.203
C21	.02225	.03418	.96859	.239
C22	-.03003	-.04659	.98828	.444
C23	-.03374	-.05142	.95306	.541
C24	-.07847	-.12064	.97026	3.013
C25	.11345	.17054	.92749	6.111
C26	.04314	.06545	.94485	.878
C27	-.00310	-.00479	.98097	.005
C28	-.06827	-.10414	.95521	2.237
C29	.06933	.10564	.95320	2.302
C32	.06156	.08962	.87008	1.652
C34	.05090	.07583	.91097	1.180
C35	.09274	.14241	.96798	4.223

* MULTIPLE REGRESSION * * * * * * * * * * * * *

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 7.. C14

MULTIPLE R	.78241
R SQUARE	.61216
ADJUSTED R SQUARE	.59885
STANDARD ERROR	24.32576

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	7.	190536.62661	27219.51809	45.99892
RESIDUAL	204.	120715.48660	591.74258	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1305691E-04	.50685	.00000	92.932
C33	18.38505	.20644	3.96039	21.550
C16	18.62533	.18251	4.59102	16.458
C4	21.34032	.27295	3.68233	33.586
C6	26.76205	.22526	5.54813	23.267
C31	.9911126E-05	.19511	.00000	13.841
C14	38.53831	.15263	11.16554	11.913
(CONSTANT)	22.53581			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.00839	.01299	.92850	.034
C3	-.05791	-.08521	.83986	1.485
C5	-.04083	-.04398	.45011	.393
C7	.02432	.03856	.97452	.302
C8	.06792	.10723	.96666	2.361
C9	.18918	.14479	.22717	4.347
C10	-.00837	-.01331	.98151	.036
C11	-.02562	-.04064	.97543	.336
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02753	-.04360	.97328	.387
C15	.02024	.02959	.82920	.178
C17	-.05108	-.07948	.93903	1.291
C18	.06428	.10222	.98089	2.143
C19	.06178	.09596	.93578	1.887
C20	-.01314	-.02087	.97908	.088
C21	.00927	.01460	.96154	.043
C22	-.02316	-.03693	.98622	.277
C23	-.03949	-.06186	.95176	.780
C24	-.07432	-.11750	.96953	2.842
C25	.09714	.14926	.91580	4.626
C26	.04242	.06621	.94483	.894
C27	.00287	.00456	.97946	.004
C28	-.05910	-.09257	.95166	1.755
C29	.07491	.11736	.95199	2.835
C32	.05942	.08900	.86993	1.621
C34	.05888	.09013	.90872	1.663
C35	.09660	.15256	.96738	4.838

FILE STUDYDWS (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 8.. C35

MULTIPLE R	.78816
R SQUARE	.62119
ADJUSTED R SQUARE	.60626
STANDARD ERROR	24.10013

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	8.	193346.36458	24168.29557	41.61090
RESIDUAL	203.	117905.74862	580.81650	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1306094E-04	.50701	.00000	94.739
C33	19.55601	.21959	3.95961	24.392
C16	17.64476	.17290	4.57024	14.906
C4	21.05145	.26926	3.65054	33.254
C6	25.92784	.21824	5.50974	22.145
C31	.9958779E-05	.19605	.00000	14.237
C14	39.14286	.15502	11.06539	12.513
C35	18.35833	.09660	8.34679	4.838
(CONSTANT)	22.47253			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.01079	.01689	.92795	.058
C3	-.08402	-.12219	.80120	3.061
C5	-.03766	-.04104	.44988	.341
C7	.02409	.03863	.97452	.302
C8	.05566	.08806	.94829	1.579
C9	.18139	.14035	.22680	4.059
C10	-.00695	-.01119	.98130	.025
C11	-.02572	-.04127	.97543	.345
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02510	-.04023	.97266	.327
C15	.02094	.03098	.82916	.194
C17	-.05871	-.09217	.93382	1.731
C18	.07031	.11294	.97732	2.610
C19	.04577	.07079	.90623	1.017
C20	-.01890	-.03034	.97563	.186
C21	.01310	.02085	.96006	.088
C22	-.01902	-.03065	.98434	.190
C23	-.04146	-.06570	.95138	.876
C24	-.06971	-.11138	.96715	2.538
C25	.08537	.13155	.89938	3.557
C26	.04729	.07459	.94259	1.130
C27	.00743	.01194	.97726	.029
C28	-.05896	-.09344	.95166	1.779
C29	.07012	.11101	.94950	2.520
C32	.07888	.11782	.84510	2.844
C34	.07256	.11149	.89436	2.542

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 9.. C9

MULTIPLE R	.79287
R SQUARE	.62865
ADJUSTED R SQUARE	.61211
STANDARD ERROR	23.92059

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	9.	195668.83263	21740.98140	37.99579
RESIDUAL	202.	115583.28058	572.19446	

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
C30	.1350130E-04	.52411	.00000	100.065
C33	19.79271	.22225	3.93187	25.340
C16	17.69783	.17342	4.53627	15.221
C4	32.88517	.42062	6.90145	22.705
C6	24.03747	.20233	5.54860	18.768
C31	.1016660E-04	.20014	.00000	15.037
C14	50.83213	.20132	12.42133	16.747
C35	17.68011	.09303	8.29145	4.547
C9	13.90079	.18139	6.89980	4.059
(CONSTANT)	10.17404			

VARIABLES NOT IN THE EQUATION

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.00706	.01115	.92634	.025
C3	-.06389	-.09087	.75119	1.674
C5	.04766	.04380	.31359	.386
C7	.02043	.03307	.97278	.220
C8	.05676	.09070	.94815	1.667
C10	.02688	.04092	.86097	.337
C11	.00547	.00831	.85662	.014
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02687	-.04348	.97226	.381
C15	.07059	.09655	.69470	1.891
C17	-.06998	-.11023	.92133	2.472
C18	.06541	.10593	.97396	2.281
C19	.04116	.06421	.90378	.832
C20	-.02554	-.04129	.97024	.343
C21	.01562	.02510	.95928	.127
C22	-.02687	-.04358	.97674	.382
C23	-.04133	-.06616	.95138	.884
C24	-.06370	-.10253	.96211	2.135
C25	.08558	.13318	.89938	3.630
C26	.05526	.08773	.93576	1.559
C27	.00074	.00119	.97152	.000
C28	-.04893	-.07775	.93764	1.222
C29	.08064	.12819	.93841	3.358
C32	.07154	.10754	.83921	2.352
C34	.06617	.10240	.88947	2.130

FILE STUDYDWS (CREATION DATE = 04/25/88)

* M U L T I P L E R E G R E S S I O N * * * * * * * * * * * * * VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE.. C1

VARIABLE(S) ENTERED ON STEP NUMBER 10.. C25

MULTIPLE R	.79702
R SQUARE	.63524
ADJUSTED R SQUARE	.61709
STANDARD ERROR	23.76639

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	10.	197719.03928	19771.90393	35.00436
RESIDUAL	201.	113533.07393	564.84116	

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	BETA	STD ERROR B	F
C30	.1360927E-04	.52830	.00000	102.812
C33	20.19294	.22674	3.91217	26.642
C16	19.45715	.19066	4.60065	17.886
C4	31.47650	.40260	6.89671	20.830
C6	23.12452	.19464	5.53362	17.463
C31	.1019022E-04	.20060	.00000	15.304
C14	48.41814	.19176	12.40613	15.232
C35	15.55958	.08187	8.31285	3.503
C9	13.93058	.18177	6.85534	4.129
C25	12.78842	.08558	6.71245	3.630
(CONSTANT)	8.418014			

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
C2	.01147	.01825	.92384	.067
C3	-.05644	-.08071	.74591	1.311
C5	.04393	.04071	.31337	.332
C7	.01959	.03198	.97268	.205
C8	.06399	.10282	.94184	2.137
C10	.02913	.04474	.86041	.401
C11	.00715	.01095	.85631	.024
C12	999999.99999	99999.99999	.00000	99999.999
C13	-.02491	-.04065	.97170	.331
C15	.07067	.09753	.69470	1.921
C17	-.06482	-.10281	.91754	2.137
C18	.06893	.11254	.97229	2.566
C19	.04799	.07532	.89846	1.141
C20	-.02003	-.03260	.96575	.213
C21	.02848	.04567	.93836	.418
C22	-.02135	-.03486	.97217	.243
C23	-.03429	-.05517	.94405	.611
C24	-.05910	-.09583	.95888	1.854
C26	.06543	.10414	.92414	2.193
C27	.00500	.00814	.96894	.013
C28	-.04265	-.06817	.93192	.934
C29	.08169	.13101	.93827	3.493
C32	.07658	.11598	.83673	2.727
C34	.06605	.10313	.88947	2.150