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FORECASTING PRACTICES IN THE MANUFACTURING SECTOR IN MAURITIUS

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A research report submitted to the faculty of Commerce, Law and Management, University of Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Masters of Business Administration

Mauritius, September 2005

ABSTRACT

The research problem consisted of unveiling the current forecasting practices in terms of techniques, processes, resources/functions in the manufacturing sector in Mauritius.

The methodology consisted of sending a self-completed questionnaire that respondents who were mainly managers from the manufacturing sector had to answer. The results obtained were analysed mainly through descriptive statistics with some inferential statistical methods.

The findings of the research are threefold. Firstly in terms of techniques it was found that there was a lack of recent developments and the major types of techniques were judgemental techniques with rules of thumb and gut feel.

Secondly in terms of process, it was found that it was very unclear whether standard procedures existed for carrying forecasts and forecasts were found not to be credible in organisations.

Finally in terms of resources/functions it was found that there was insufficient training, little use of computer and computer software, no holistic approach to managing the forecasting function and that on the whole there was no organisational support to forecasting.

DECLARATION

I, Prakash Mungur declare that this research report is my own, unaided work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

_____

Prakash Mungur

20 September 2005

DEDICATION

I would like to dedicate this research to my wife Lovena, and my parents who have been very patient and understanding during the whole project.

ACKNOWLEDGEMENTS

I would like to thank the following persons without whom, this research would not have been possible:

My supervisor, Dr Anthony Stacey for his continuous support,

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1 Introduction

The researcher's aim in this study is to find out what is the current status of forecasting practises in the very young local manufacturing environment.

1.1 Definition of forecasting

Golden, Milewicz, & Herbig (1994) define forecasting as the process of predicting, or estimating some future event or condition, which is outside an organisation's control and provides a basis for managerial planning.

Forecasting can either be qualitative or quantitative or both. It can be very simple as well as extremely complex (Smith III, Herbig, Milewicz, & Golden, 1996). Amongst the numerous techniques are executive judgement, surveys, time-series analysis, correlation methods and market tests.

Executive judgment techniques can be very unscientific and very inexpensive. They are based on the intuition of the organisation's executives and rely entirely on their knowledge in their respective industries. But other executive judgement techniques such as the Delphi technique, are very scientific despite being qualitative. Forecasts based on surveys involve collecting opinions and expectations of customers or potential customers, experts and sales personnel concerning the future. Time-series analysis makes use of past historical data from which trends, cycles, seasonality and randomness are unravelled. Data correlations make use of regressions, with properly defined variables to forecast the future. Market tests involve introducing new products in selected areas and then measuring the customers' respond to changes in prices, quality, advertising etc. The above methods can also be used in combination with one another to yield the expected results.

Forecasting normally sets the basis for production planning, sales force distribution, proper advertising plans, estimating future cash flows, assessing the need for innovation and in considering the general position of the company in the future (Golden *et al,* 1994). Forecasting therefore helps a company to have a starting point from where strategies, plans and policies can be developed.

1.2 Background to the research problem

Golden *et al* (1994) say that managerial decisions at all levels are based explicitly or implicitly on some expectation concerning the future. Tersine (1980), states that the future is rarely certain and so some system of forecasting is necessary. Forecasting is a pivotal business function (Ireland & Bruce, 2000). When they are accurate, estimates of the future economic activity associated with specific courses of action can correctly guide corporate strategy in an uncertain environment; when they are inaccurate they can cause bankruptcy (Golden *et al,* 1994).

Many researches through the years have shown that forecasting can contain errors and biases. Forecasts are almost always wrong, but to a certain accepted degree (Smith III *et al*, 1996). Different firms use different kinds of forecasting with different time horizons in order to get the appropriate results.

A successful business thus depends to a very large extent to its ability to forecast the future. In today's world of hyper-competition it is of paramount importance to know in advance the customer's expectations since it is highly probable that the competitors already know them and are ready to seize any opportunity offered to them.

1.3 Context

1.3.1 The manufacturing sector in Mauritius

The manufacturing sector is a big contributor in the Gross National Product of Mauritius and it employs about 27% of the working population (The Central Statistical Office, 2004). The industry is mainly characterised by the textile industries and the commodities industries and it has not yet evolved to the manufacture of high-technology products such as personal computers, cars or other sophisticated products requiring highly qualified labour. It manufactures mostly for the consumption of the island itself and exports its products in very few quantities except for the textile and sugar where almost all the produce are meant for export.

1.3.2 Context of present research

The ultimate role of a company is to increase shareholder value. In environments of hyper-competition, nowadays companies are able to achieve this said objective by

having very well laid out strategies for the future. This applies to any company in any sector.

In manufacturing companies, consistent, systematic and appropriate forecasting processes have been found to considerably improve the return on shareholder value (Mentzer, 1999). Implying that forecasting is of paramount importance in this sector. Any company therefore projecting itself into the future should have a proper forecasting structure. In Mauritius though there is no literature from where it can be concluded that manufacturing companies have actually forecasting budgets and have propre forecasting plans.

From the personal experience of the researcher, not many managers are aware of the different methodologies available to perform the forecasting function. Synergy between marketing and production or sales and production in terms of forecast are very often non-existent.

As pointed out by Hughes (2001) poor support to the forecasting function from senior management is very common. Hughes (2001) also says that forecasting is rarely treated as a specialised professional function and receives low priority in most business.

Therefore a study that will shed light on the present situation of forecasting in Mauritius is right in context.

1.4 Research Problem

The aim of this research is to find out what are the Forecasting Practices in the manufacturing industries in Mauritius.

1.5 Sub problems

1. The first sub problem is to find out what are the forecasting techniques used by manufacturing companies in Mauritius.

2. The second sub-problem is to find out what are the forecasting processes used by manufacturing companies in Mauritius.

3. The third sub problem is to find out what are the resources/functions that are involved in the companies that forecast in Mauritius.

1.6 Purpose of study

The researches aim in this study is therefore firstly to unleash the different forecasting practices that are used by different firms in Mauritius. Secondly try to see what are the forecasting barriers existing and that could affect the use of forecasting in organisations. And finally to see what are the resources allocated to forecasting in organisations.

1.7 Delimitations

The study will not include forecasting practices in export.

The study will be limited to manufacturing industries only.

The study will look at forecasting of goods only, that is raw materials and finished goods only

1.8 Assumptions

All manufacturing companies in Mauritius having more than ten employees use forecasting.

According to the researcher's experience, the above assumption is quite reasonable. Companies that are in the manufacturing sector must have production plans, sales plan or at least budgets. These indicate that elementary forecasting is practiced though in certain cases, it might be found from the instrument the researcher is going to use, that companies affirm that they do not use any kind of forecasting method. Quantitative methods might not be present but in lots of cases companies use rules of thumb and gut feel which are informal forecasting methods. Hence the above assumption.

2 Literature Review

There are fewer theories as such devised by the researches in the field, as there are actual situation reporting done. In the subsections below some of the theories and reportings are reviewed. Propositions relevant to the research problem and sub problems are also generated in the null form

2.1 Bias in forecasting

According to Golden, Milewics and Herbig (1994), forecasters not always do scientific forecasting. They do sometimes add hopes and expectations, or secular, cyclical, or interdependent variables to the forecasting mix. Thus predictions are generated from hypotheses and beliefs. When this happens, there is always a risk that subjective bias is going to be introduced. This is particularly prevalent when forecasters are inexperienced or caught up in their enthusiasm for the product or market in question.

The positive recency effect, also known as the "gamblers' fallacy", very often catches up forecasters in sequences of positive events, occurring consecutively making them believe that the totality of their observations can be explained by some theories. When this happens their clients become the happiest since they get the kind of results that they wanted to have, at least in the short term (Wheeler & Shelley, 1987). But these forecasts are very often unrealistic and soon turn out to be merely illusory.

Proposition 1: Companies use judgmental Techniques.

Proposition 2: Forecasters bias their forecasts.

Possible sources of error and bias in forecasting are reluctance to seek possible evidence contrary to assumptions or to see trends and patterns in random events. Thus persons who receive repeated reinforcement in the form of confirmed predictions become convinced on the accuracy of their theories even when told that they are wrong. They test hypotheses and predictions that are least likely to refute their theories and are they are not prepared to go against their strongly held beliefs. They avoid evidences that contradict them, and seek to deny or devalue those evidences when they are encountered.

Proposition 3: Forecasters build their own theory.

Two factors affecting the above problem are the strength of belief in the built theories and the complexity of the situation. The greater the number of factors involved, the more scope there is for rationalising the outcome of faulty predictions (Evans, 1982).

2.2 Organisational issues in forecasting

Hughes (2001), says that forecasting in firms is particularly difficult when the life cycle of the product is very short. Typical of these products are high technology products. And as in this industry continual changes in technology are very common, alteration in the demand profile for production, which is very often coupled with high variety of demand, renders the forecaster's job extremely complex.

Proposition 4: Forecast accuracy depends on product life cycle.

The main findings of the author in his in his attempt to find the role of forecasting in changing organisational structures are as follows:

- There is continued strong preference of forecasters for judgmental techniques.
- There is little adoption of quantitative forecasting techniques.
- There is lack of awareness and knowledge of forecasting techniques.

Proposition 5: Forecasting techniques are not well known to practitioners.

- There is low priority given to forecasting with an average of 8.9% of forecaster's time spent on forecasting activities.

Proposition 6: Priority is not given to forecasting in organisations.

- The amount of training is insufficient in organisations.

Proposition 7: Forecasters are not well trained in organisations.

- Exploratory data analysis techniques are frequently used.
- Usage of computers and computer software is limited.

Proposition 8: Forecasters do not use computers and computer software to forecast

- Forecast errors are relatively high and increase as time horizon increase.

Proposition 9: There is a difference in forecast errors as time horizon increase.

Also barriers inhibiting the use of forecasting in organisations were identified and are summarised in the table below:

***Table 1:** Barriers to Forecasting*

Barrier	*% of respondents*
Insufficient time due to other works	41%
Insufficient resources	28%
Limited historical data base	24%
Insufficient training	23%
Lack of computer resources/skills	20%

Other barriers to the use of forecasting noted by the author are lack of importance attached to the function by senior management, lack of knowledge in the potential of forecasting, and lack of knowledge of how to carry out the function (Fildes & Hastings, 1994).

Proposition 10: Forecasters are involved in other duties.

Proposition 11: Forecasters do not have full historical database.

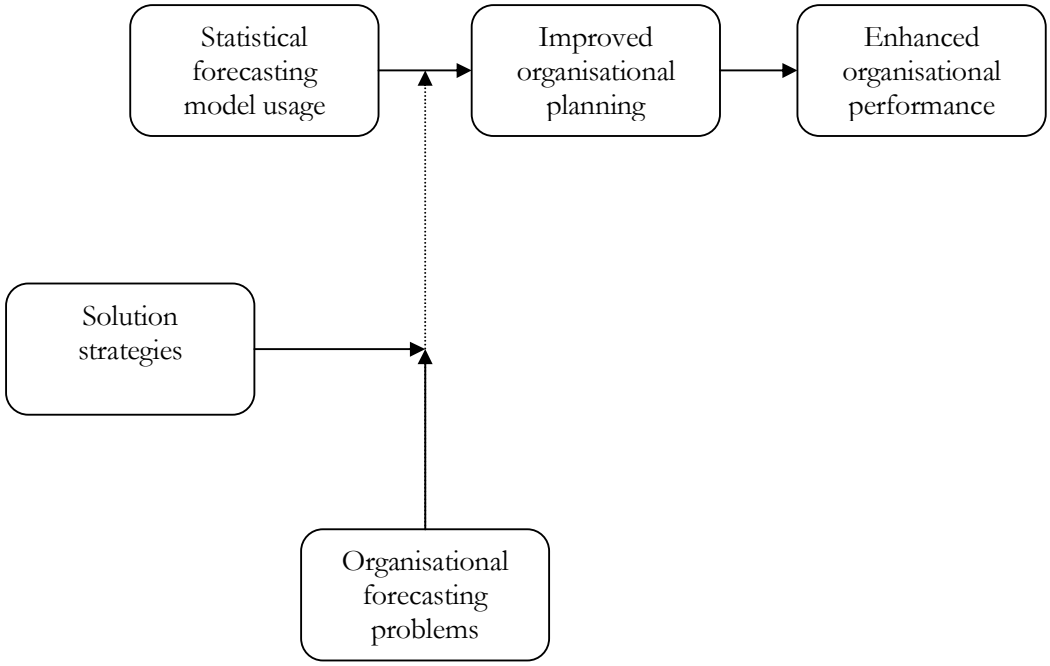
2.3 Managing the forecasting function

Sanders (1995) says that despite the fact that in the field of forecasting, there has been substantial increase in the range of the methods available over the past few decades, organisational forecasting patterns has not changed at the same rate through the same period of time. Organisations tend to rely mostly on judgemental forecasting which are very often made on an informal basis. Armstrong (1981) and Hogarth & Makridakis (1981) have demonstrated that statistical forecasting methods yield much superior results both in terms of accuracy and timeliness than the judgemental techniques. Good uses of statistical methods however have not been fully made by decision makers in the majority of companies. Also those with high turnovers were the ones that were mostly using the statistical methods.

Proposition 12: Decision makers do not use forecasts prepared by forecasters.

In his attempt to explain all the above findings, Sanders (1995) identifies and describes several organisational forecasting problems and the relationship in Figure 1 below is devised. It describes the relationship between statistical forecasting, organisational forecasting, solution strategies, and organisational planning.

Figure 1: *Relationship between statistical forecasting, organisational forecasting, solution strategies, and organisational planning*



Source: Adapted from Sanders (1995)

This theory therefore says that if the organisational forecasting problems are well identified together with the right solution strategies, these can be combined with the right forecasting model, which will lead to an improved organisational planning and ultimately an enhanced organisational performance.

The organisational forecasting problems and the associated solution strategies are summarised in Table 2 below:

Table 2: *Identified organisational problems and associated strategies*

Organisational forecasting problems	*Solution strategies*
Resistance to change	Pre-emptive organisational resistance training
Lack of forecast credibility	Highlight effective utilisation

Forecast bias	Changing rewards and incentives evaluation
Lack of recent improvements	Counteracting inertia
Lack of a base on which to build	Counteracting inertia
Lack of organisational support	Develop co-operative strategies

Sander's (1995) points in the above table are further explained below:

2.3.1 Resistance to Change

The changes that people mostly resist are those that pose personal threat in their respective workplace (Burke, 1982). Therefore the degree of acceptance of change depends a lot on the perceived threat that the change will bring to the individual and thus the way in which the whole process is managed is critical.

Formal statistical forecasting is viewed to many as threats, because firstly being associated to information technology, they are seen as substitutes to traditional technologies. But in fact they should have been seen as supplements instead and not threaten the established information-processing network, which includes both formal and informal sources of information. And as control of information is seen as source of power in organisations, loss of this control through replacement of traditional techniques by the new techniques brought by formal statistical forecasting make people become very resistant to the implementation of this new technique.

Also formal statistical methods are seen as complicated methods by a vast majority of managers. And the fact that ease of use (Mentzer & Cox, 1984), seems to be the major driver for the acceptance of forecasting methodologies, again this is another reason why forecasters are reluctant to the use of new methodologies.

Proposition 13: There is resistance to change during implementation of formal statistical forecasting

Solution Strategy: Pre-empting organisational resistance

Scenario writing can be used to diagnose resistance in the development of information technologies and thus be used as a basis for reducing uncertainty, removing stumbling

blocks and identifying incentives to gain co-operation. Then instead of imposing the new forecasting models, they should be introduced instead as supplements and complements to the traditional forecasting methods. Therefore as statistical forecasting will prove to be superior to the traditional methods, practitioners will gradually develop the acceptance, as their experience and reliance on the method will increase. Thus gradually the main source of decision making in the company will be based on the results of the statistical forecasts. Sanders (1995) here proposes that the statistical forecasts be introduced as an experiment, which will be then viewed as temporary and thus less threatening.

Solution Strategy: Training

Training that should be provided by individuals with strong teaching skills as well as technical expertise should shed the necessary light around the statistical forecasting mystery increasing the awareness in the subject. This will normally reduce the resistance to the new technique.

2.3.2 Lack of forecast credibility

In cases when statistical forecasting is made very often practitioners adjust their values judgementally as they believe that the model they use do not include inside information or experience. This lack of credibility is very often due to the fact that the forecast makers and the forecast users do not communicate to each other. And as very often these two persons are not the same one and it is always the decision maker who is held accountable for decisions, the latter will always adjust the forecast according to his judgement if he or she cannot understand the methodology (Sanders & Mandrodt, 1994).

The problem of credibility also arises when the decision makers are the top-level management who very often are not very knowledgeable about the subject, look down upon their juniors who make the forecast and therefore again make adjustments according to their judgement. This also a problem of organisational structure where decisions are made at such a high level where forecasts have hardly any impact on decision making.

Proposition 14: Forecasts are not credible in organisations.

Solution Strategy: Highlight effective utilisation

This must be done by emphasising and demonstrating the benefits in the use of formal forecasting procedures. Upper management should show their interest in statistical forecasting by using them in top-level decision-making or showing how successful decisions have been made out of its findings.

2.3.3 Forecast bias

Sanders here says that in many situations there is an incentive, which may be caused by an organisational reward system, to incorporate a self-serving bias in the forecast that represents personal or political organisational goals. And as often budgets allocated and performance appraisals are based on forecast, this can create incentives to either over forecast or under forecast.

Sometimes biases are also innocent when they are incorporated due to optimism or narrow view of company goals.

Solution Strategy: Changing forecaster's rewards and incentives

For all forecasting situations, performance criterion is typically accuracy of forecasting. But this is a practice that is followed by very few organisations. As pointed out by Wheelwright & Clark (1976), most forecasters like to be appraised on their forecasting methods rather that the accuracy they provide. But forecast users on their part see both methods use and accuracy of the forecasts as important in the exercise. Therefore it is critical that both side have the same appreciation and therefore agree on the same reward system.

2.3.4 Lack of recent improvements in forecasting

When there is a lack of resources and those present have been stretched to a maximum, very often there can be no further improvements in the forecasting function and a plateau is reached. Problems occurring in managerial communications lead to a lack of commitment to close the gap to the next level of progress which in turn lead to the only few improvements in the forecasting environment.

Solution Strategy: Counteracting inertia

Most organisations go through different stages in improving their forecasting methods. Those different stages can be identified by the forecasting methods used, the level of commitment devoted to the practice, the range of forecast applications and the expectations of the forecast performance. Key to the success of the introduction of a forecasting plan, and based on the different stages mentioned before, is the development plan for managing the implementation of the new technology. The net effect of the plan of progress and growth will go towards reducing any organisational inertia.

Top-management attention, allocation of sufficient resources for data processing and data procurement and handling, will provide supports towards the use and development of statistical forecasting, which is another factor that is helping to counteract the inertia.

2.3.5 Lack of a base on which to build

This is a problem that is related to the reluctance to abandon legacy systems and to move to new forecasting practices. Lack of good forecasting practices knowledge coupled with insufficient committed resources or lack of emphasis laid to the forecasting function or absence of systematic plan for improving forecasting may be resulting to the above problem of lack of base on which to build.

2.3.6 Lack of organisational support

Poor management support, lack of adequate data processing and computer support and lack of availability of relevant data are direct contributors to the lack of organisational support.

Proposition 15: There is no organisational support to the forecasting function.

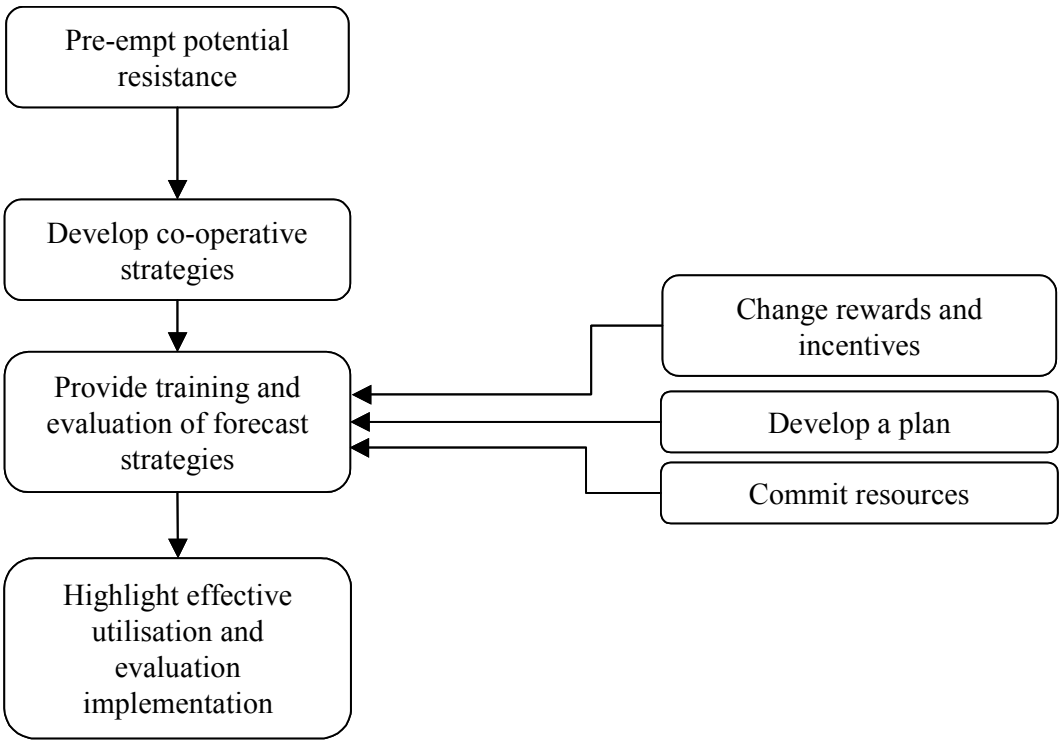
Solution Strategy: Develop co-operative strategies

For statistical forecasting to be successful, collaboration between both the users and the preparers at the beginning of the whole process is essential. This should be a fully-fledged management process with management of companies providing enough resources and time. An illustration of management support would to have a formal forecasting budget.

2.3.7 Model incorporating organisational foresting problems and their respective solution strategies

Following the identification of the major organisational problems and their respective solution strategies, Sanders therefore proposes the following model as shown in Figure 2 below:

Figure 2: *Model showing the flow of solution strategies in overcoming organisational forecasting problems*



Source: Adapted from Sanders (1995)

This model is a summary of all the issues discussed in the previous paragraphs but shows the different routes to follow to end to a proper usage of statistical forecasting.

Proposition 16: There is no holistic approach to manage the forecasting function.

2.4 Forecasting and organisational growth

The "Ev-Rev" model of Greiner was originally published in 1972 (Greiner, 1972). But in 1998, the author updated his article and republished it with some modifications (Greiner, 1998). His theory is has been taken up by Smith III *et al*, (1996) and is summarised below.

According to Greiner (1998), for small companies, the founders own the company and are totally involved in the day to day running of the company. Therefore there is good communication between management and employees, who eventually make the company, react very fast to external changes. Therefore it can be suspected that the top management itself will do forecasting, with the forecasting efforts mainly based on subjective or qualitative factors received from the market (Smith III *et al*, 1996)

As the company grows, the company will start to have business managers managing business centres with a more formal type of communication with the top management. The management focus is efficiency of operations. And at this stage the sales and the production functions start to separate. It can be expected that the sales or production manager will be doing the forecast himself on few historical data, resulting in moderately satisfying results since the person doing the forecast will not probably be having the necessary know-how.

As the company will continue to grow profit centres will be put into place. Top management will start practising management by exception and will start to have very formal lines of communication. The person doing the forecast, who will still be probably a manager, will now have gained some training in forecasting and will start using basic software like MS-Excel to help him in the process.

At the fourth stage, the company evolves into one with very formal planning systems and the management focus is consolidation of the organisation. There is an increase in personnel at all level staffs to assist in controlling and reviewing operations. It will be expected that in this stage knowledgeable persons will start to perform the forecasting function yielding accurate results.

The fifth stage of growth is Greiner's ultimate step in organisational growth. The company now has investment centres and interdisciplinary teams and staff members to assist line managers, resulting in a mixture of expertise in various areas. It can be expected that the company will be having a dedicated function for forecasting with the adequate number of trained personnel with proper hardware and software at their disposal. All the techniques available would also be used together to increase the level of accuracy wanted.

Proposition 17: There is a significant difference in types of techniques in firms of different size.

Proposition 18: There is a significant difference in the amount of personnel involved in firms of different size.

3 Research Methodology

For this study, the main type of methodology used was quantitative. The researcher's aim was to describe the situation as it is at present in Mauritius. A survey therefore was done to collect data by using a self-completed questionnaire as described in section 3.1. The outcome of the research was then be analysed by using descriptive statistics.

3.1 Data collection

Data for this study was collected after having sent questionnaire to respondents through e-mail, complemented in cases where this facility is not applicable, by posted mail. Follow up was done by telephone. A cover letter from WITS Business school was also sent to provide legitimacy of the exercise.

3.2 The Population

The population consisted of managers and junior managers from a list of companies as described in section 3.3.

The targeted audience for the survey was:

1. General Managers,
2. Finance Managers,
3. Operations Managers,
4. Sales Managers,
5. Human Resource Managers,
6. Purchasing Managers,
7. IT Managers,
8. Owners.

Whenever the above persons were not available, their alternate that is their assistant were solicited. The above audience was chosen purposely since the researcher believes

from his own experience that the above category of people in any organisation represents the forecast users as well as the forecast preparers.

3.3 The Sample

The sample was chosen to be a convenience sample. Fifty companies were be selected from the list provided on the website of the Mauritius Export Development and Investment Authority.

The companies pulled out were those falling in the manufacturing sector and having a minimum of ten employees. Companies having less than ten employees would probably fall under the Small and Medium Enterprises (SME's) category but would have not yet grown to a size where forecasting would be practiced, hence these were not be considered.

The companies selected fell under the categories as listed below:

- Alcoholic beverages
- Pharmaceutics & medical
- Chemicals & fertilizers
- Plastic & rubber products
- Cosmetics & toiletries
- Printing, publishing & related products
- Fabrics, yarn & tread
- Ship models & gift items
- Flowers & related products
- Stuffed toys, toys & games
- Footwear, soles & related products
- Sunglasses, frames & lenses
- Hollowware & kitchenware
- Textile accessories

- Jewellery & precious stones
- Watches, clocks & dials
- Knitted wear
- Paints, putty & related products
- Leather articles
- Paper, carton products & labels

3.4 The instrument

The instrument for this exercise was in the form of a survey questionnaire (Appendix 1), that was derived mainly from the literature review. It consisted of 27 questions that were directly related to the propositions generated in the literature review.

3.4.1 The pre-test

After a first draft, a copy of the questionnaire was sent to three managers from Finance, Operations and Sales. The aim of this exercise was be to verify the appropriateness of the questions and whether the languages and the technical terms employed were familiar to the target audience. This was done on a face-to-face basis so that maximum amount of information were collected and the instrument was fully optimised after the exercise.

3.5 Validity and Reliability

3.5.1 Internal Validity

According to Leedy & Ormrod (2001), the internal validity of a research is the extent to which its design and the data that it yields allow the researcher to draw conclusions about cause-and-effect and other relationship within the data. That is the results are not ambiguous and cannot have several possible explanations.

This can be achieved by eliminating bias at the design of the instrument itself. The participants were therefore blinded to the main objective of the questionnaire, which was to find the actual status of forecasting in Mauritius.

3.5.2 External Validity

Leedy & Ormrod (2001) say that the external validity of a research study is the extent to which the conclusions of the research can be generalised to other contexts. Having a random sample with a size greater than thirty can ensure this. For the present research though at the beginning the sample is a convenience one, amongst list of manufacturing industries a random sample was drawn.

3.5.3 Reliability

The reliability of a measurement is the consistency with which the measuring instrument yields a certain result when the entity being measured hasn't changed (Leedy and Ormrod, 2001). For the present study the researcher has ensured reliability by having the same systematic way of proceeding with either the e-mail being sent to respondents or the follow up calls being made by telephone.

3.6 Method of Analysis

3.6.1 Correspondence Analysis and Rescaling

The instrument in Appendix 1 allowed the researcher to collect mainly ordinal data through the different Likert Scales devised. But as per Bendixen & Sandler (1995) the data collected can only be analysed after re-conversion to interval data. Therefore the method described by the above authors was used to convert the data to the needed interval data.

Bendixen & Sandler (1995) state that firstly the multivariate technique of Correspondence Analysis should be conducted on a frequency table of the raw data collected through the different Likert Scales. The Correspondence Analysis will then give as outputs values for a set of several principle coordinates and their respective qualities. But only the first two principle axes which normally account for the majority of the Eigen values, is chosen to construct the Correspondence Plot. The different points from the Likert Scale are then plotted on these two axes. When joined in their respective orders together, the scale points normally show the "horseshoe effect".

The Euclidean distance between all the scale points is obtained from the plot. The total distance is then apportioned across the intended length of the scale. The new scale

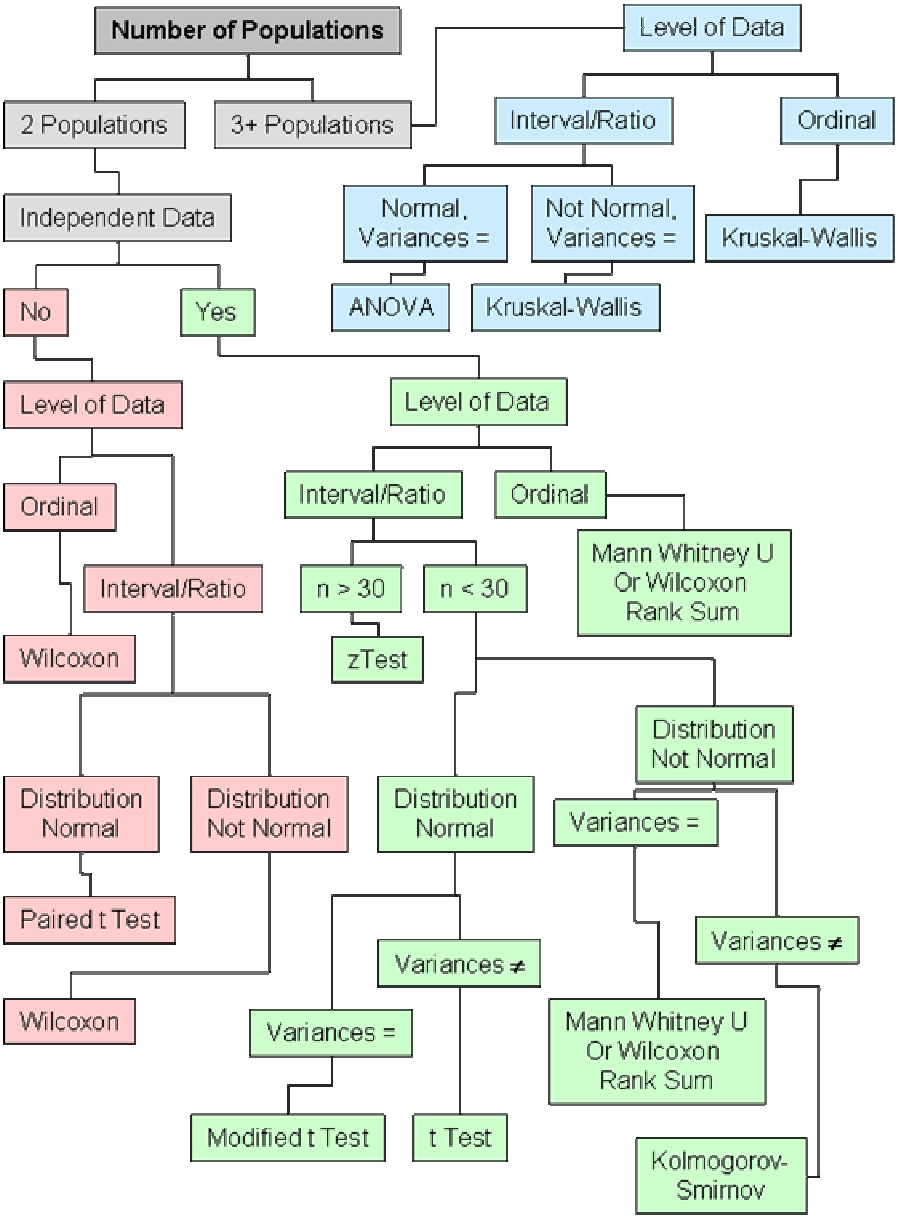
obtained is thus mapped on the original Likert Scale to obtain a whole set of new interval data. These can then be used with the normal statistical tools available.

3.6.2 Other methods of analysis

Analysis of Categories

When two or more populations had to be compared for similarities, the flow chart in Figure 3 below was used to decide upon which type of test was going to be used

***Figure 3**: Flow chart showing tests to be chosen for two more populations*



When ANOVA was used, the hypothesis was formulated as follows:

H_O: All means are equal.

H_1: At least two means are different

Multiple Comparison Procedures was also be invoked for the above to identify which categories that were not similar. In the event that the test for normality was not respected, the Kruskal-Wallis one-way analysis of variance was invoked as the non-parametric counterpart with the same hypotheses.

When Two sample t tests were used for assessing the similarity or dissimilarity for two groups of population, the hypotheses were as follows:

H_O: $\mu - \mu_1 = 0$, H_1: $\mu - \mu_1 \neq 0$

But when normality test was not respected and the samples were still symmetric, the non-parametric Mann-Whitney U test would be used. When the variances would not be equal, the Kolmogorov-Smirnov test would be performed. In both cases the hypotheses were the same as for the Two Sample t Tests.

Proportions

For Yes/No type question, the researcher collected data that was analysed in terms of proportions and hypotheses in the form below was whenever required:

H_O: $p \leq p_O$, H_1: $p > p_O$

Spearman's Correlation

For certain question with nominal level data, analysis was done by calculating the non-parametric Spearman's Correlation coefficient after identifying the right independent and dependent variables.

Content Analysis

This was done by gathering all the data of the open ended question and categorising them in themes that repeated the most in the statements given. Frequency counts were

then done on the categories and the results were then presented in bar charts or frequency tables.

Crunching of Data

NCSS together with MS Excel were used for all the above tests. The results were then tied up together for analysis which would then support or contradict the propositions that the researcher put foreword.

4 Presentation of Results

4.1 Introduction

This chapter gives a summary of the results that have been collected by the researcher after sending the questionnaire to the different respondents. It starts with a presentation of the results of the pre-test carried out on the instrument. Then the demographics of the sample are explained. All the questions that were not answered by Likert Scales are then unpacked before those that are answered by them are tackled.

4.2 Results of the pre-test

The pre-test consisted of testing the questionnaire on three different persons before sending it to the chosen respondents. But before this process was initiated the questionnaire was carefully designed so that it had the least number of pages possible and was laid out in a very attractive manner so as to leave the respondent with a good impression at the first sight itself. The persons chosen were mangers at Sofap Ltd and had no particular knowledge in the field of forecasting which could otherwise give rise to biases.

On the first run itself it was confirmed that the questionnaire was quite fluid and did not represent any difficulty in terms of its technicalities. The comments that came back were that the themes touched by each of the questions present were logically structured and therefore easy to answer. The average response time was about seven minutes.

4.3 Rate of response

Out of 50 questionnaires sent only 34 returned back to the researcher. For the majority of the positive responses obtained, follow up by phone was necessary. The explanation that was given to the researcher as to why the situation was so by the respondents themselves, was that the target audience which were managers and middle managers had very tight schedules and could therefore not find additional time to answer the questionnaire. But this explanation was more of a perception than what it was a reality since the average response time to answer the questionnaire was about only seven minutes as shown by the pre-test.

4.4 Demographics of the sample obtained

As previously mentioned, the study was geared towards collecting data only from the manufacturing companies. The target was managers and middle managers from the different companies being interviewed. The population obtained was broken down and analysed in the following sections.

Response per Industry

The industries that were covered in the study are presented in the table below:

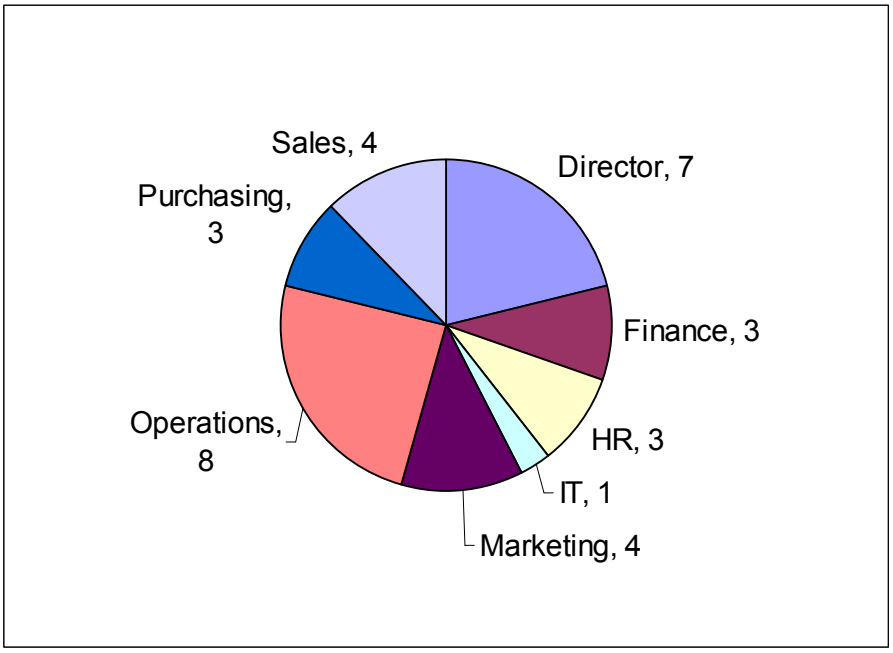
Table 3: *Number of responses per Industry*

Industry	Total
Alcoholic beverages	1
Chemicals & fertilizers	5
Fabrics, yarn & tread	4
Hollowware & kitchenware	4
Knitted wear	1
Paints,Putty & Related Products	8
Paper, carton products & labels	1
Pharmaceutics & medical	2
Plastic & rubber products	5
Printing, publishing and related products	2
Grand Total	33

Responses per Occupation

The Pie-chart below shows the responses obtained per occupation of the respondents.

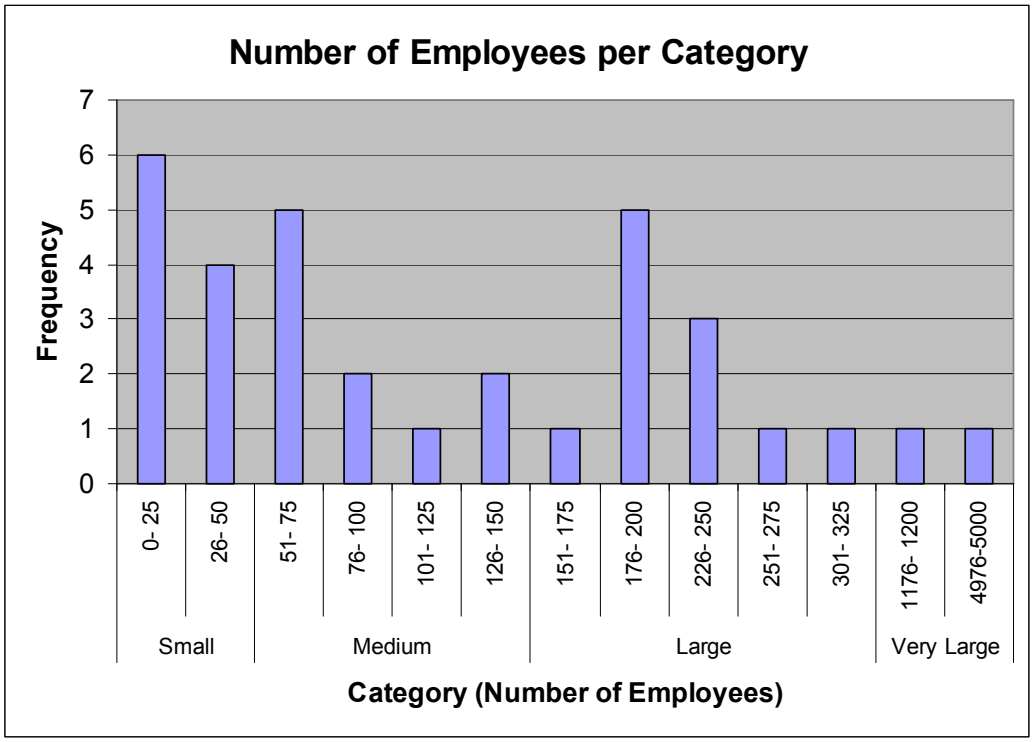
Figure 4: *Responses per Occupation*



Number of Employees in category

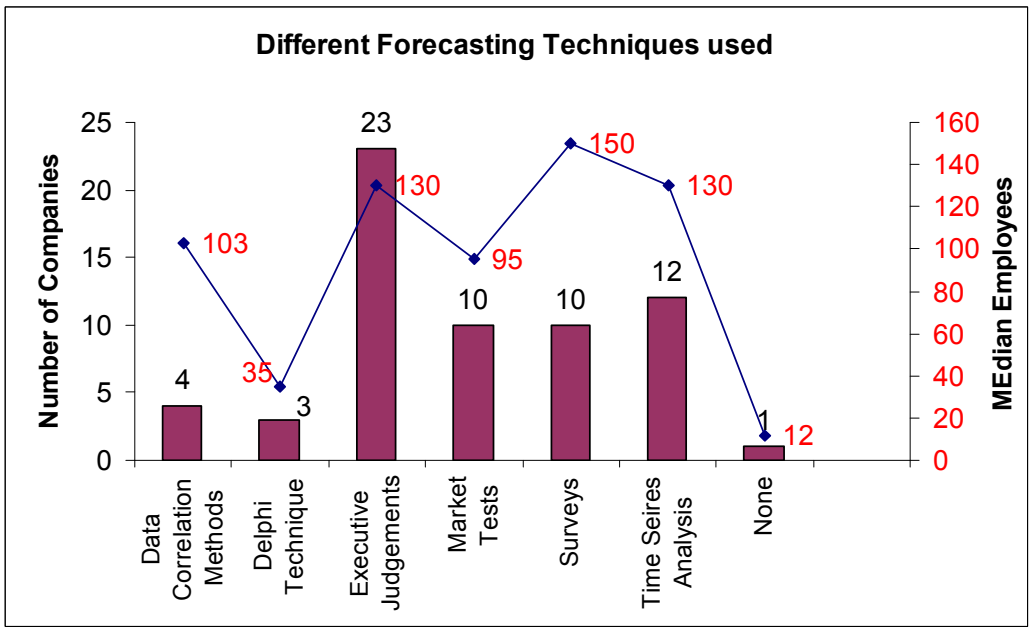
The company sizes in terms of personnel were assessed by categorising the data in groups of 25 and the result can be seen in the bar chart of Figure 5 below. As can be seen a large part of the sample obtained was in the group of small companies which meant that a consequent number of small companies with persons in the range of 10-50 were obtained in the sample. As for medium sized company the frequency count was eleven. The 151 to 325 group represented the typical "large company" in Mauritius and the frequency there was 11. Two very large companies also responded to the questionnaire and they had respectively 1200 and 5000 employees.

***Figure 5**: Bar chart representing Number of Employees per category*



4.5 Forecasting Techniques used

***Figure 6**: Bar chart showing the percentages of the different forecasting technique used in the manufacturing industry*



As can be depicted by the bar chart in Figure 6, data collected shows that the most popular forecasting technique is the "Executive Judgements" type of forecasting.

A secondary axis was also added to the bar chart of Figure 6. The aim of adding this secondary axis which represented the median of the employee size in the different companies was to see how this variable was changing with types of techniques used. The main deductions that were the most apparent were that small companies tend to use a particular set of techniques such as Delphi Techniques or Market Tests while big companies tend to use techniques such as Data correlation Method, Executive Judgment, Surveys and Time Series Analysis. But some small companies also do not make use of any of the forecasting techniques put forward in questionnaire.

4.6 Time Horizon of Forecasts

***Figure 7**: Time Horizon of Forecasts*

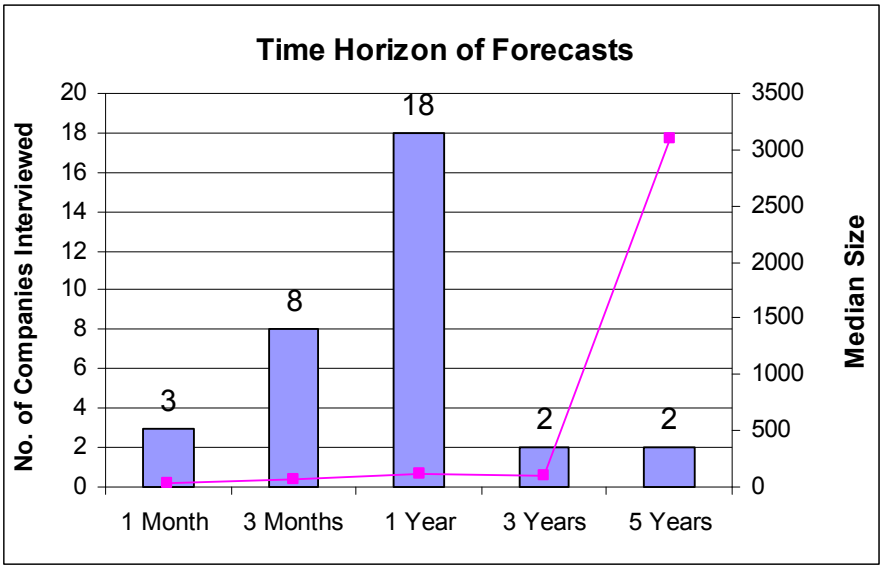


Figure 7 above shows a bar chart representing the amount of time ahead that companies are forecasting in Mauritius. Most of the companies as can be seen from above forecast over a period of one year.

The data was also analysed to see whether the sizes of the company also influences the time horizon of forecasting. This was done by superimposing the median values (Table 4) obtained from NCSS in the bar chart of Figure 7 above. Details of the report from NCSS are given in Appendix 10.

From Figure 7 above, it is clearly found that amongst the five categories of time period, which are namely 1 Month, 3 Months, 1 Year, 3 Years and 5 Years all are similar except for the group 5 Years which show some differences from the rest. This would therefore tend to show that companies forecasting for five years are different in size compared to other companies.

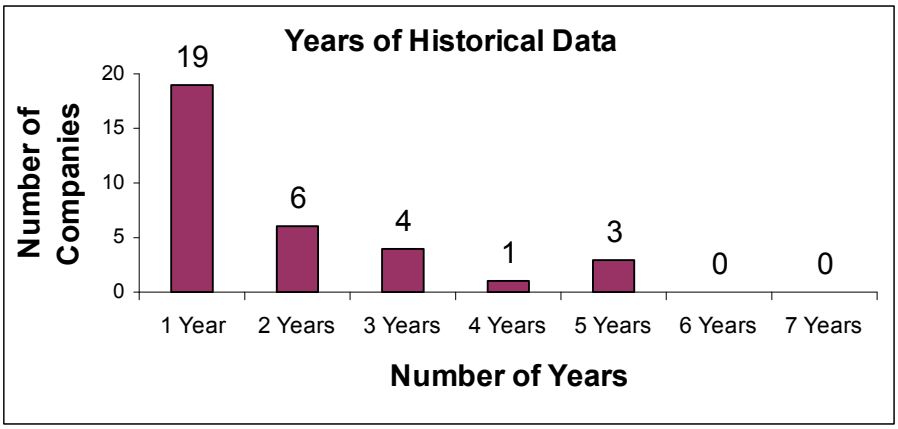
***Table 4**: Median of Periods of forecast*

Group Detail					
Group	**Count**	**Sum of Ranks**	**Mean Rank**	**Z-Value**	**Median**
1 Year	18	318.50	17.69	0.4519	110
1Month	3	36.50	12.17	-0.9080	35
3 Months	8	111.00	13.88	-1.0502	72.5
3 Years	2	30.00	15.00	-0.3018	107.5
5 Years	2	65.00	32.50	2.3389	3100

4.7 Historical Data Base

The Bar chart below (Figure 8) shows the percentage of companies working on the different years of historical data base. As can be seen a majority of companies (57.58%) use as historical data base one year.

***Figure 8**: Years of Historical Data Companies use*



To analyse the above, the researcher used the Spearman's Rank Correlation to see whether a relation existed companies using the different amount of years of historical data base and size of the company. The out put from NCSS for Spearman's Rank Correlation is shown in Table 5 below.

***Table 5**: Spearman's Rank Correlation for Years of Historical Data*

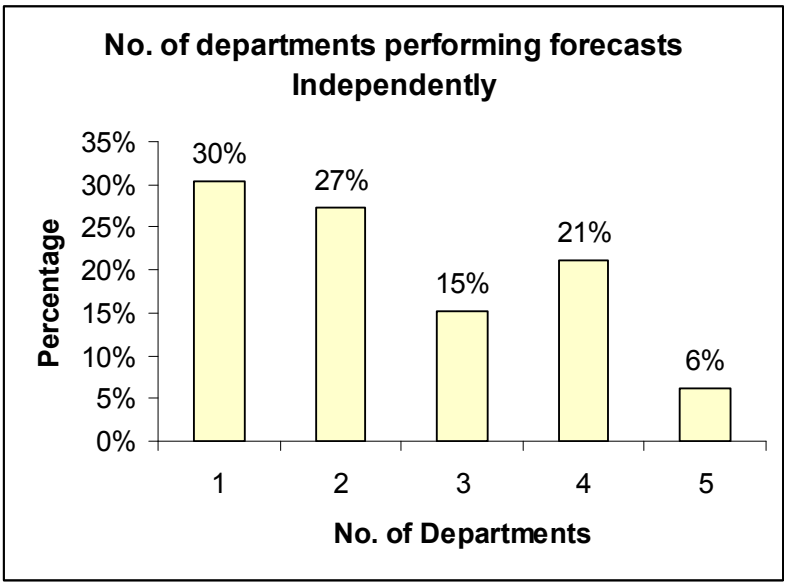
Spearman Correlations Section (Row-Wise Deletion)		
	No_of_Employees	Yrs_of_Hist_Data
No_of_Employees	1.000000	-0.210805
	0.000000	0.238965
	33.000000	33.000000
Yrs_of_Hist_Data	-0.210805	1.000000
	0.238965	0.000000
	33.000000	33.000000

As can be seen, a correlation between the two variables does exist but it is not a strong one.

4.8 Number of Departments performing Forecasts

This section shows that in the manufacturing sector, it is very frequent that more than one department do the forecasts independently. It is in fact noted that only 30% of the time that a company has only one department doing the forecasts. For the remaining 70%, at least two departments are performing the forecasts independently. Figure 9 below illustrates the situation.

***Figure 9**: Number of departments performing forecasts independently*



To reveal whether a correlation between size of company and number of departments carrying forecast existed, the Spearman's Rank correlation coefficient was determined. The results of the latter test are presented below.

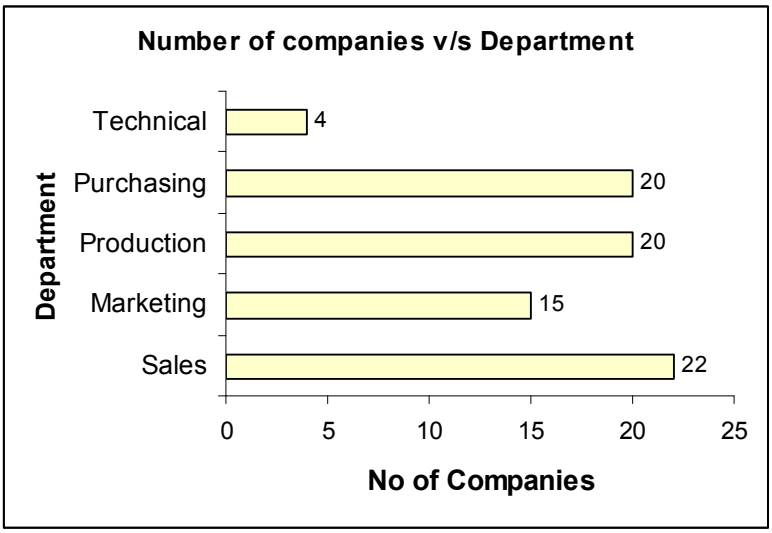
***Table 6**: Spearman's Rank Correlation for No of Employees against No of Departments*

Spearman Correlations Section (Row-Wise Deletion)		
	No_of_employees	No_of_Departments
No_of_employees	1.000000	0.170424
	0.000000	0.343016
	33.000000	33.000000
No_of_Departments	0.170424	1.000000
	0.343016	0.000000
	33.000000	33.000000

The fact that a value of 0.17 is obtained, shows that a positive correlation exists but it is not a strong one. Therefore it can be said that to some extent as company size increases the number of departments doing forecasts increases. But the significance value obtained shows that the sample might have been too small.

Therefore to get a clearer picture, the data was further analysed. When viewed in terms of the individual department performing forecasts, they yielded the bar chart of Figure 10. This data then went through a Two Sample t-Test to verify whether size of company was equal amongst all the different categories, which were the number of departments. A Two Sample t-Test was here used since a company responding to the questionnaire was allowed to give more than one answer.

***Figure 10**: Number of Companies v/s Department*



A summary of the results obtained from NCSS for the Two Sample t-Test carried out is presented in Table 7 which follows. Detailed results from NCSS for the above Two Sample t-Tests are presented in Appendix 11.

***Table 7**: Two Sample t-Test for Departments performing forecasts*

Categories Tested	Normality Tests	Equal Variance Tests	Type of Test	Decision
Marketing - Production	Reject	Can't Reject	Mann-Whitney U	Accept Ho
Marketing - Purchasing	Reject	Can't Reject	Mann-Whitney U	Accept Ho
Marketing - Sales	Reject	Reject	Kolmogorov - Smirnov	Accept Ho
Marketing - Technical	Reject	Can't Reject	Mann-Whitney U	Accept Ho
Production - Purchasing	Reject	Can't Reject	Mann-Whitney U	Accept Ho
Production - Sales	Reject	Reject	Kolmogorov - Smirnov	Accept Ho
Production - Technical	Reject	Reject	Kolmogorov - Smirnov	Accept Ho
Purchasing - Sales	Reject	Reject	Kolmogorov - Smirnov	Accept Ho
Purchasing - Technical	Reject	Reject	Kolmogorov - Smirnov	Accept Ho
Sales - Technical	Reject	Reject	Kolmogorov Smirnov	Accept Ho

Table 7 shows that for all the categories, the hypothesis that the medians in terms of size of company of the different departments carrying out the forecast are equal, cannot be rejected. Therefore a closer look was made to the median of the categories from the same report of Appendix 11. The results are summarised in Table 8 below.

***Table 8**: Median Statistics for Departments carrying forecasts*

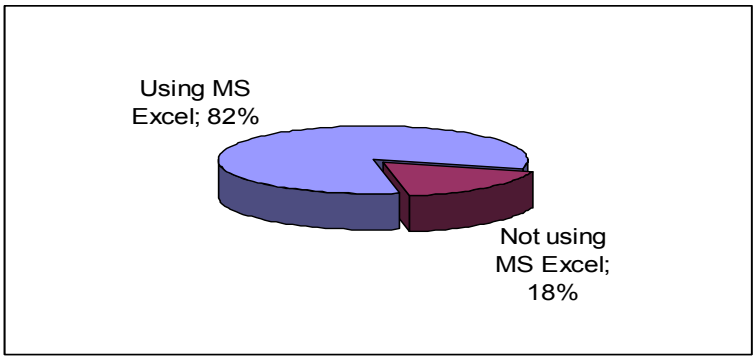
Variable	Count	Median
Marketing	15	130.00
Production	20	130.00
Purchasing	20	130.00

Sales	22	110.00
Technical	4	110.00

The results show that companies having as departments marketing, production and purchasing doing the forecasts tend to be companies that are bigger in size than companies where the sales and the technical department are carrying the forecasts.

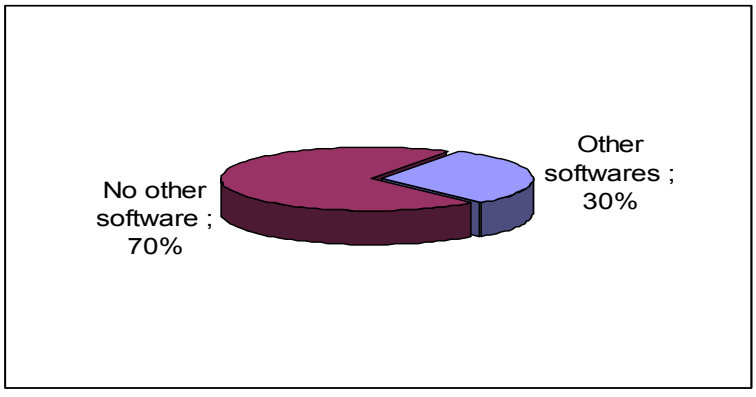
4.9 Software Packages

***Figure 11**: Percentage of companies using MS Excel*



As show in Figure 11 above 82% of respondents interviewed said that their companies are using MS Excel as a tool in forecasting.

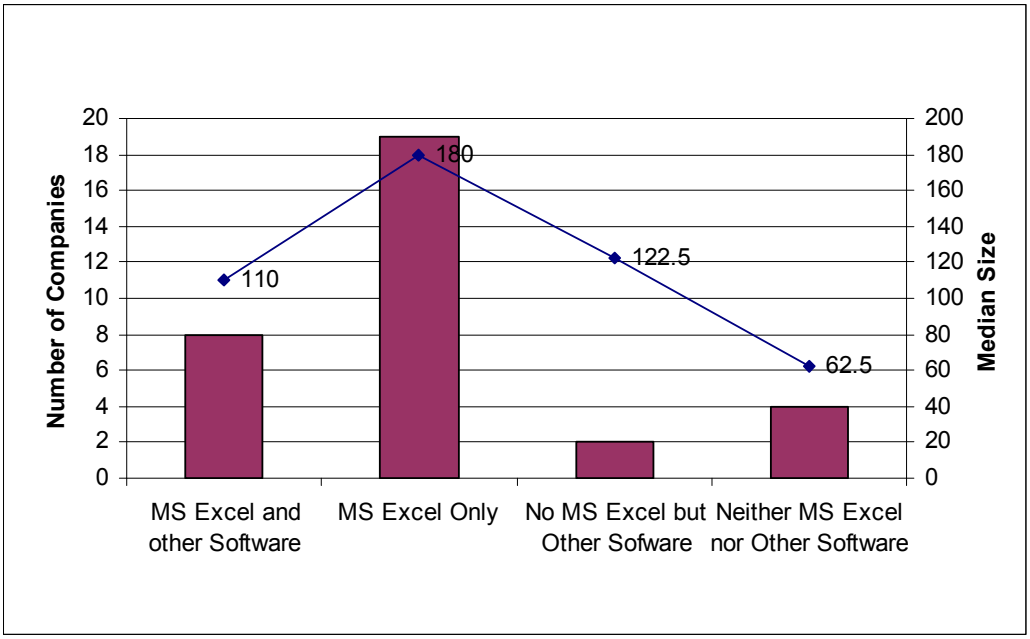
***Figure 12**: Percentage of companies using other software*



However, as shown in Figure 12 above the percentage of companies using other software than MS Excel is 30%.

When the above percentages are further exploded down, the figures shown below in Figure 13 are obtained. This allows a thorough picture of the different software being used.

***Figure 13**: Thorough Picture of software used*



On the above bar chart, the medians of the different categories obtained from NCSS in Table 9 (Appendix 7) are superimposed. This allows a clearer picture in terms of size and type of software used. It can be seen that for the category of companies that are using MS Excel the median is significantly higher and companies in the category of neither using MS Excel nor other software are significantly lower. As for the other two remaining groups, they have similar medians.

***Table 9**: Medians report for Types of Software*

Group Detail					
Group	**Count**	**Sum of Ranks**	**Mean Rank**	**Z-Value**	**Median**
Both	8	118.50	14.81	-0.7351	110
Excel	19	349.00	18.37	0.9471	180
Non-Excel	2	32.00	16.00	-0.1509	122.5
None	4	61.50	15.38	-0.3585	62.5

4.10 Rescaling of Likert Scales

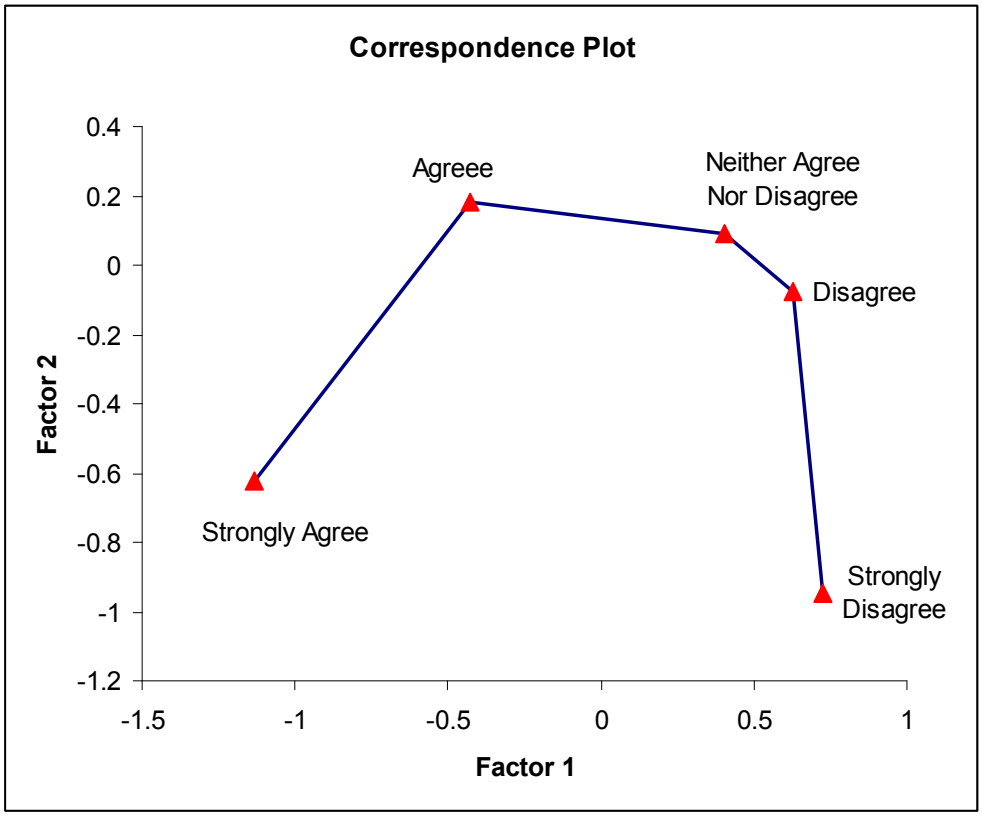
To analyse the ordinal data collected from the Liker Scales, the multivariate Correspondence Analysis was performed followed by a rescaling. The full output of the Correspondence Analysis can be found in Appendix 4. The rescaling procedure is detailed in Appendix 4. Table 10 below summarises the new rescaled ordinal value obtained.

***Table 10**: New Rescaled Values for the Likert Scales*

Scale Points	Ordinal Value	Rescaled Value
Strongly Disagree	1	1.00
Disagree	2	2.49
Neither Agree nor Disagree	3	2.83
Agree	4	3.51
Strongly Agree	5	5.00

When the points for Factor Axis 1 are plotted against the points for Factor Axis 2, the general "Horseshoe" effect is clearly seen (Figure 14). This confirms that the Euclidean distances between the ordinal scale points are not equal and hence the need for rescaling.

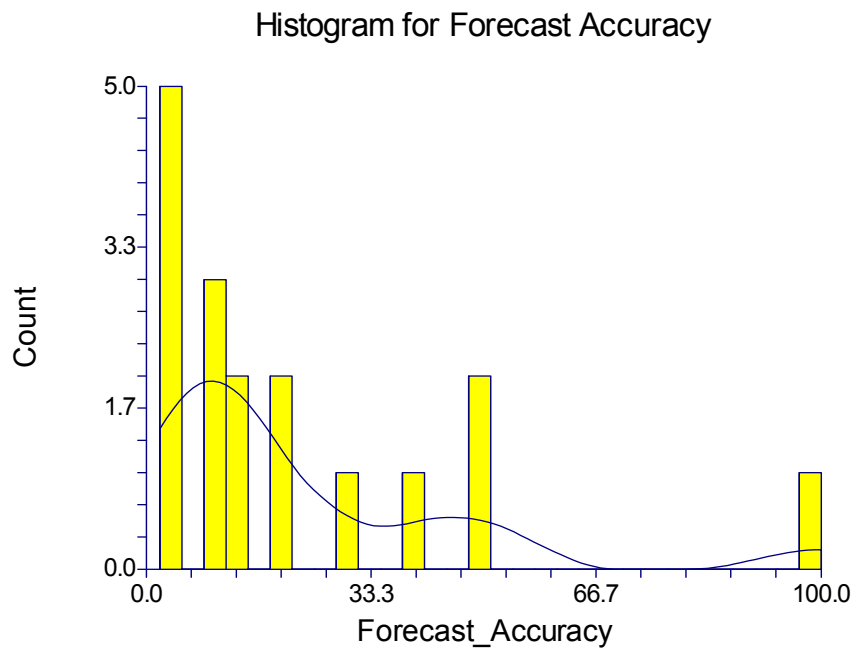
***Figure 14**: Horseshoe Effect*



4.11 Forecast Accuracy

The rate of response to this question was only 52%. This response rate gives an indication of how the forecast accuracies are not given their due consideration in companies. In fact for this question the researcher had to make several phone calls follow-ups to get the answers from the respondents. Lots of them admitted that they did not know their respective forecast accuracies. Figure 15 below shows a histogram for the distribution of the different responses obtained.

***Figure 15**: Forecast Accuracy*



The average forecast accuracy was 23.06, which is higher than the 20% that are given in literatures (Hughes, 2001) for the manufacturing sector. In order to investigate whether the value of 23.06 was obtained by chance or is in the 95% confidence interval, a hypothesis test was carried. The details of the test are presented in Appendix 6.

The test chosen here is the Wilcoxon Signed-Rank Test. The reason for choosing this non-parametric equivalent of the One Sample T-Test is that, as shown in the Table 11 below from the NCSS output, the data does not show the properties of a normal distribution.

***Table 11**: Test of Assumptions for Forecast Accuracy*

Tests of Assumptions Section			
Assumption	**Value**	**Probability**	**Decision (5%)**
Skewness Normality	3.2458	0.001171	Reject normality
Kurtosis Normality	2.6806	0.007349	Reject normality
Omnibus Normality	17.7210	0.000142	Reject normality

The output from NCSS for the Wilcoxon Signed-Rank Test is given in the Table 12 below. The null and alternate hypotheses were in the following form:

H_o: Median ≤ 20, H_a: Median >20

***Table 12**: Wilcoxon Signed-Rank Test*

Wilcoxon Signed-Rank Test for Difference in Medians

W Sum Ranks	Mean of W	Std Dev of W	Number of Zeros	Number Sets of Ties	Multiplicity Factor
64	66.5	19.25487	2	4	96

	Exact Probability		Approximation Without Continuity Correction			Approximation With Continuity Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Median<>20			0.1298	0.896695	Accept Ho	0.1039	0.917273	Accept Ho
Median<20			-0.1298	0.448348	Accept Ho	-0.1039	0.458636	Accept Ho
Median>20			-0.1298	0.551652	Accept Ho	-0.1558	0.561907	Accept Ho

As can be seen from the above, the hypothesis that the median is 20 can be retained thus confirming the null hypothesis.

An average of the rescaled data obtained from question number, which was "The forecast accuracy varies with your different products", was 3.46 which corresponded to a "4" and hence an "Agree". Therefore we conclude that forecast accuracy depends on life cycle of products.

To investigate whether a correlation existed between Forecast Accuracy and Time Horizon the normality of the variable Time Horizon was first checked. Table 13 below shows the results obtained.

***Table 13**: Normality tests for Time Horizon of Forecasts*

Normality Test Section of Time_Horizon					
Test Name	**Test Value**	**Prob Level**	**10% Critical Value**	**5% Critical Value**	**Decision (5%)**
Shapiro-Wilk W	0.8545993	0.000430			Reject normality
Anderson-Darling	2.373161	0.000005			Reject normality
Martinez-Iglewicz	0		1.136248	1.207987	Can't reject normality
Kolmogorov-Smirnov	0.2766509		0.139	0.152	Reject normality
D'Agostino Skewness	0.7156	0.474237	1.645	1.960	Can't reject normality
D'Agostino Kurtosis	1.2361	0.216424	1.645	1.960	Can't reject normality
D'Agostino Omnibus	2.0400	0.360593	4.605	5.991	Can't reject normality

Since the normality of the data can not be sustained a Spearman's Rank Correlation Test was carried.

***Table 14**: Spearman's Correlation for Forecast Accuracy and Time Horizon*

Spearman Correlations Section (Row-Wise Deletion)		
	Forecast_Accuracy	Time_Horizon
Forecast_Accuracy	1.000000	0.204708
	0.000000	0.430612
	17.000000	17.000000
Time_Horizon	0.204708	1.000000
	0.430612	0.000000
	17.000000	17.000000

The results obtained show that a slight positive correlation exists.

4.12 Number of persons doing forecasts

In order to investigate whether a correlation exist between number of people doing forecasts and number of employees, the data was run through NCCS. A test of normality was firstly performed and the results are tabled below.

***Table 15**: Normality tests for Number of Forecasters*

Normality Test Section of No_of_Forecasters					
Test Name	**Test Value**	**Prob Level**	**10% Critical Value**	**5% Critical Value**	**Decision (5%)**
Shapiro-Wilk W	0.4725021	0.000000			Reject normality
Anderson-Darling	5.095303	0.000000			Reject normality
Martinez-Iglewicz	8.624592		1.136248	1.207987	Reject normality
Kolmogorov-Smirnov	0.3340493		0.139	0.152	Reject normality
D'Agostino Skewness	6.2429	0.000000	1.645	1.960	Reject normality
D'Agostino Kurtosis	5.2178	0.000000	1.645	1.960	Reject normality
D'Agostino Omnibus	66.1998	0.000000	4.605	5.991	Reject normality

Since all the test for normality are rejected the Spearman's Rank Correlation is used rather than the Pearson's Correlation.

Results of the Spearman's Rank Correlation are shown in Table 16 below.

***Table 16**: Spearman's Rank Correlation for Number of Employees and Number of Forecasters*

Spearman Correlations Section (Row-Wise Deletion)		
	No_of_Employees	No_of_Forecasters
No_of_Employees	1.000000	0.547313
	0.000000	0.000980
	33.000000	33.000000
No_of_Forecasters	0.547313	1.000000
	0.000980	0.000000
	33.000000	33.000000

Therefore it can be concluded that a correlation does exist between the above two variables

Also amongst the 33 respondents, 39.4% replied that the forecaster is an identified person in the company. Since the sample in this case was greater than 30, the distribution was assumed to be normal and confidence interval at 95% was calculated using NCSS. Detail of this procedure can be seen in Appendix 8.

The out put from NCSS are presented below:

***Table 17**: Results from Confidence Interval from NCSS*

Numeric Results			
Precision	**C.C. Confidence Coefficient**	**N Sample Size**	**P0 Baseline Proportion**
0.15546	0.95209	33	0.39000
Summary Statements			
A sample size of 33 produces a 95% confidence interval equal to the sample proportion plus or minus 0.15546 when the estimated proportion is 0.39000.			

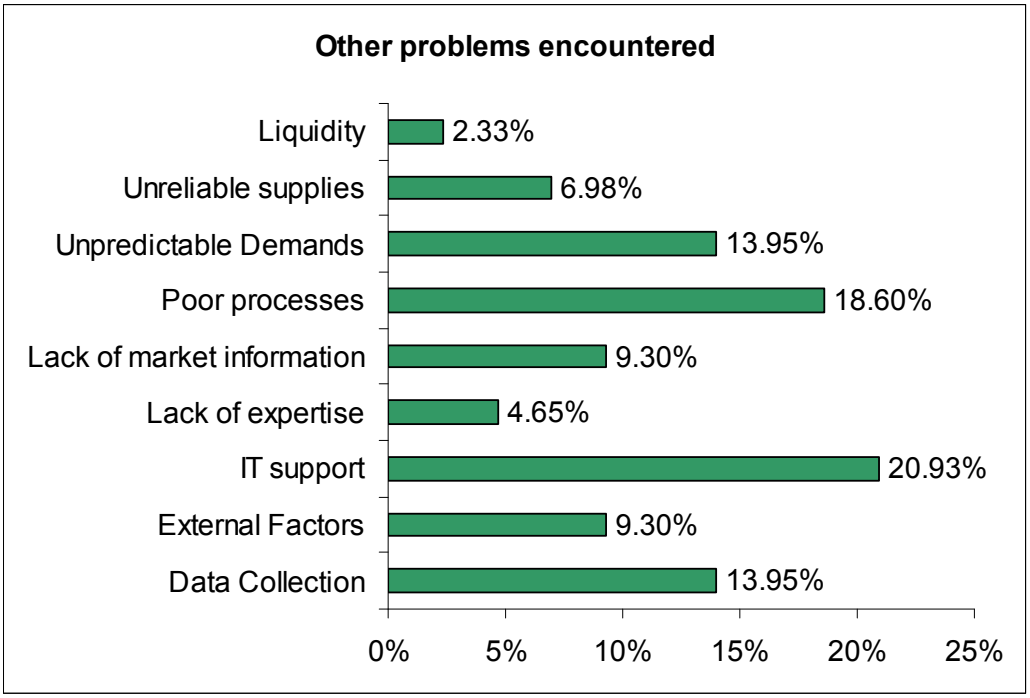
Therefore as can be concluded from above, it can be said with a 95% confidence interval level that the proportion of companies having identified forecasters is 39±15%.

4.13 Other problems encountered

In order to depict other problems that persons using forecasting in the manufacturing sector might be encountering, an open-ended question was asked to the respondents. This question which was question number 27 of the instrument was the following: "What is the biggest problem your company faces in its forecasting process?"

Content Analysis was used to analyse the answers to this question. The response rate was 64% and the answers which were categorised in major groups of problems are presented in the bar chart of figure below:

***Figure 16**: Other problems encountered in forecasting*



The details of the above chart are given in Appendix 9.

4.14 Answers to Likert Scales

The answers to questions 3 to 6, 9 to 13, 16, 18 to 20 and 23 to 25 are summarised in Figure 17 below.

***Figure 17**: Responses to Likert Scale questions*



5 Interpretation of results

In this section the researcher proceeds by going through each of the sub problems that will be supported by the respective propositions which will themselves be either sustained or refuted by the questions of the instrument.

5.1 Sub problem one – the forecasting techniques used by manufacturing companies in Mauritius

This sub problem was analysed through proposition 1, 4, 5, 9, 11 and 17.

5.1.1 Companies use judgemental techniques

Golden *et al*, (1994) say that companies not always do scientific forecasting. The forecasting mix according to these authors, sometimes contain hopes and expectations, or secular, cyclical or interdependent variables. That is to say that forecasts are very often based on hypotheses and beliefs. Hughes (2001) found in his study on forecasting practice that there is a continued strong preference of forecasters for judgemental techniques. Sanders (1995) also substantiate the above fact by saying that forecasters tend to rely mostly on very informal judgemental techniques. Hence was extracted the above proposition.

The question that tested the above proposition was question 2 from the questionnaire. The answers to this question was analysed in the previous chapter in section 4.5. The first part of the analysis clearly showed that the most popular type of forecasting technique was the "Executive Judgements" technique with a percentage of occurrences of 36.51%. Hence the proposition that companies use judgemental techniques is sustained both in current literatures and in reality in Mauritius in the manufacturing sector.

5.1.2 Forecast accuracy depends on product life cycle

This proposition was tackled by questions number 6, 8 and 9 of the instrument.

The proposition, that forecast accuracy depends on product life cycle, was derived from Hughes (2001) who says that typically for technology products, when the life cycle is short, forecasting becomes difficult.

Question number 6 was which was based on a Likert Scale was designed to establish the fact that product life cycle was different in the sector. And after rescaling in chapter 4, an average of 3.76 was obtained which corresponded to an "Agree". This implies that in the manufacturing sector, the products are indeed in different stages of their life cycle.

The above fact established, the next step was to see whether forecast accuracy was dependent on product life cycle. This issue was addressed by question 9 which was whether forecast accuracy was varying with different product life cycle. The average of the answers obtained from this Likert Scale question was 3.46 which corresponded to an "Agree". Therefore the manufacturing sector generally agrees with the statement that was set in question 9 and hence confirming that forecast accuracy depends on stages product life cycle. This latter statement is therefore sustained both in the literatures and in reality.

Also as showed by Hughes (2001), question 8 demonstrated that in the Mauritian manufacturing sector the forecast accuracy was in the region of 20% with an average of 23.06 with a confidence interval of 95%. But the low response rate obtained for this question showed that forecast accuracy is not a major priority amongst practitioners in the sector

5.1.3 Forecasting techniques are not well known to practitioners

This proposition was supported by question 10 of the instrument. An average of 2.73 showed that professionals of the sector tend to neither agree nor disagree with the statement that forecasting techniques are not well known to practitioners. Hughes (2001) says the following:

1. There is continued strong preference of forecasters for judgmental techniques.
2. There is little adoption of quantitative forecasting techniques.
3. There is lack of awareness and knowledge of forecasting techniques.

All the above points according to the above author tend confirm proposition number 5. And the answer to question 10 despite the fact that could not give a clear answer did not show that the respondents did not agree with the statement. In fact the above proposition should be looked at jointly with question 2 of proposition one which

proves that judgemental techniques are by far the most common method of forecasting in the sector. Hence other forecasting techniques are not well known to practitioners.

5.1.4 There is a difference in forecast errors as time horizon increases

Question number 7 which was designed to know over what period of time was the people in the manufacturing sector forecasting, supported the above proposition.

In fact the Spearman's Rank Correlation Test of chapter 4 for question 7 showed that there was a positive correlation of 0.20 which meant that as time horizon increased, the forecast accuracy increased. This conclusion is in agreement with the findings of Hughes (2001). But a high p-value was obtained due to the fact that the sample was fairly small.

5.1.5 Forecasters do not have full historical database

According to the survey carried by Hughes (2001) in the electronic and financial industry in Scotland, one of the main barriers to forecasting was in 24 % of cases, limited historical database. To verify whether this was the case proposition number 11 came out. This proposition was tested by question number 17 from the instrument.

The findings from question 17 were that for 57.58% of the respondents, the amount of historical data being used was one year. This would be in agreement with the findings of Hughes (2001) since for any good model of forecasting the more there are data, the better the model.

5.1.6 There is a significant difference in types of techniques in firms of different size

An ANOVA test on the data collected from question 7 coupled with an analysis of medians (Box Plots) showed that companies forecasting over longer period of time were significantly different in size compared to companies forecasting over shorter time horizon. This would reinforce the theory derived by Smith III et al, (1996) whereby as companies grow, the more structured they become and thus the more they are able to use sophisticated methods of forecasting and thus being able to forecast over longer period of time.

Upon further analysis of the data collected from question 17 (Spearman's Rank Correlation Test), it was also found that a slight negative correlation existed between size of the company and time horizon being used. Deeper analysis of the above correlation from the medians and box plots of the different categories showed that big companies were using large historical database. This finding was again in concordance with the "Ev-Rev" theory of Smith III *et al,* (1996) derived from Greiner (1972) and Greiner (1998).

A deeper decomposition of question 2 also gave a result that was in favour of the theory of the above authors. The findings were that the types of techniques that were used by large companies were significantly different from the type of techniques being used by small companies. On one side, the large companies were using techniques such as Data correlation Method, Executive Judgment, Surveys and Time Series Analysis. And on the other side small companies were using Delphi Techniques, Market Tests or no technique at all. But a major drawback of the researcher's conclusion was that the sample was a quite small one.

Question 26 was also designed to support proposition 17 above. If a correlation between number of people involved in preparing forecasts and number of persons employed in companies existed this would again show agreement with Smith *et al*, (1996) and Greiner (1998). As companies grow big, the number of employees in the company also increases. And if coupled to that increase number of persons dedicated to forecasts also increases the researcher would therefore be able to sustain proposition 17. Findings from the analysis of question 26 show that a positive correlation of 0.55 with a p value of 0.00098 exists. Hence proposition 17.

5.2 Sub problem two – Forecasting Processes used by manufacturing companies in Mauritius

This sub problem was analysed through proposition 2, 3, 12, 13, 14 and 18

5.2.1 Forecasters bias their forecasts

Golden *et al*, (1994) say that when predictions are generated from hypotheses and beliefs, there is always a risk that subjective bias be introduced. This is particularly prevalent for inexperienced forecasters who are often very enthusiastic about their product or their market. The biased forecasters are reluctant to seek possible evidence

contrary to their assumptions or to see trends and patterns in random events. Hence the above proposition was derived.

Question 3 which asked the respondents to give their answers over a Liker Scale for the statement "The forecasts are modified to fit the judgement or gut feel of other managers" was intended to test the above proposition. After rescaling under the previous chapter, the average of the answers to this question corresponded to a "Neither agree nor disagree". This means that it can't be said that the above proposition is true but the contrary of the proposition is not sustained also. Therefore to be conservative the conclusion that the researcher draws is that proposition 2 can not be rejected since there is not enough evidence to do so.

5.2.2 Forecasters build their own theory

To sustain the above proposition, the researcher extracted information from two questions of the instrument. The first question which was question 4 asked the respondents whether a standard procedure for performing the forecasts existed. The second question that was to support the above proposition was question 5 which asked the respondents whether there was objectivity in the forecasts of their forecasters. Thus if from question 4 the answer was converging towards a "disagree" and so was the answer from question 5, this would indirectly mean that forecasters are building their own theory.

Golden *et al*, (1994) say that the effect known as "gamblers' fallacy" occurs when forecasters are caught up in sequences of positive events occurring consecutively making them believe that the totality of their observation is explained by some theories of theirs. The answers that the researcher obtained from question 4 and 5 were "neither agree nor disagree". The conclusion that the author draws is similar to the one drawn for proposition 2 which is that there is not enough evidence that would reject proposition 3 hence forecasters do build their own theory.

5.2.3 Decision makers do not use forecasts prepared by forecasters

Sanders (1995) found that good use of statistical methods is not fully made by decision makers in majority of companies. Substantial increase in the methods of forecasting available has not been noticed, however as shown by Armstrong (1981) and Hogarth & Makridakis (1981), the benefit of using these statistical tools are numerous when it

comes to accuracy and timeliness. To verify the status of the findings of Sanders (1995) in the manufacturing sector of Mauritius, Proposition 12 above was brought up and this was tested through questions 18, 20 and 21 of the instrument.

Question 18, which asked whether forecasting results were used in decision making, was a Likert Scale based question. The question was just a reformulated version of the above proposition which the respondents had to answer. The result which came out was an "Agree" from the rescaling procedure used. This question was proving Sander's statement to be untrue but the answers obtained for this question must be looked at together with the answers from questions 20 and 21 to get a better picture of the situation.

Question 20 asked the respondents whether forecasting was done by more than one department. This would indirectly show if several departments were making their own forecasting that there is no trust in the forecast and thus the need for each one to do its own forecast. But the answer to this question was a "Neither agree nor disagree". This answer could not therefore allow the researcher to draw any meaningful conclusion. Therefore the answer to question 21 was analysed.

Despite the fact that the respondents were claiming that firstly decision makers were making use of the forecast prepared by the forecast preparers and secondly that forecasting was not done by more than one department, the answer to question 21, to which the respondents had to say which departments were doing the forecasts, showed that in 70% of cases more than two departments were doing the forecasts. This result therefore shows that since forecasts are made by several departments, there is no trust in the forecasts and thus the decision makers do not make use of the results of the different forecasts and thus this confirms the findings of Sanders (1995).

5.2.4 There is resistance to change during implementation of formal statistical forecasting

According to Sanders (1995), one of the most common obstacles to the use of formal statistical forecasting methods as tools in organisational forecasting is resistance to change. Burke (1982) states that changes that are mostly resisted are changes that pose personal threat to peoples' respective workplace. And very often new technologies that would comprise formal statistical techniques are perceived as threats in organisations

since they very often compel people to get out of their routine comfort zones. As described in section 2.3.1, statistical forecasting which indirectly bring along new technologies are seen as substitutes instead of being seen as supplements to the already existing information-processing network that encompasses both formal and informal sources of information. The above perception would also lead some people to believe that their power influence would erode since information which is also a source of power, would no more be under their control. Mentzer & Cox (1984) on their part describe that ease of use is a major driver in the acceptance of forecasting technologies. And as formal statistical techniques are seen as complicated methods by the majority of managers, they are therefore very poorly accepted in organisations.

To verify the conclusions of the above authors in the manufacturing sector of Mauritius Question 19 of the instrument was designed by the researcher. The question was a Likert Scale based and asked the respondents whether forecasters of their respective organisations would resist the implementation of a formal statistical forecasting technique. The answers that were obtained for this question was an "Agree" which therefore confirmed the findings of the authors mentioned in the previous paragraph.

5.2.5 Forecasts are not credible in organisations

Sanders and Manrodt (1994) found that statistical forecasts are almost always modified by practitioners to fit their judgements. The reasons being that firstly the practitioners believe that they are normally in possession of insider information that the forecasting model they use is not capable of knowing. Secondly as very often the methodology is not well understood by many of the forecast users, who are not always the forecast preparers, and as the forecasts preparers believe that they are held accountable for the forecasting results, Sanders and Manrodt (1994) say that the forecasts will hence always be modified to match the understanding of the forecast users. Thirdly, very often since the decision makers are top-level management who are not very knowledgeable about forecasting techniques look down up on their juniors who prepare the forecasts and thus make amendments to the forecasts. As a result of all the above facts found by the above mentioned authors, forecasts are not credible in organisations. To verify the above findings in the Mauritian context, question 18, 20 and 21 were designed.

Question 18 confirmed after a rescaling procedure that forecasting results were used in decision making. But if question 20 supported by question 21, proved that there were

several forecasts prepared in organisations independently, this would indirectly show that there is no trust in the forecasts and hence no credibility.

The answer that was extracted from question 20 after rescaling showed that the respondents neither agreed nor disagreed with the statement that several departments were doing their forecasts independently. But when question 21 was analysed thoroughly it was seen that in 70% of cases, more that two departments were doing the forecasts independently. Therefore this proves the finding of Sanders and Manrodt (1994) to be true for the manufacturing sector of Mauritius as well.

5.2.6 There is a significant difference in the amount of personnel involved in firms of different size

As described before, the theory derived by Smith III et al, (1996) says that as companies grow, the more structured they become and the more they are able to use sophisticated methods of forecasting and thus needing more personnel in the process. Question 26 from the instrument was intended to test the above statement. The question asked the respondents how many persons were involved in the forecasting process in their respective organisations.

The answers were analysed inferentially and the conclusion that was drawn was that a positive correlation existed between the number of forecasters and the number of employees in organisations. This implies that as firm grow in size, the number of forecasters in the organisation increase hence confirming the theory of Smith et al, (1996).

5.3 Sub problem three – Resources/functions that are involved in that forecast in the manufacturing sector in Mauritius

This sub problem was analysed through proposition 6, 7, 8, 10, 15 and 17.

5.3.1 Priority is not given to forecasting in organisations

Hughes (2001) found that with an average of 8.9% of time dedicated to forecasting in the Scottish electronic industry, organisations do not give priority to forecasting. To verify the validity of the above finding in the Mauritian manufacturing sector, the researcher designed Question 12 whereby the respondents had to answer a Likert scale which asked whether forecasting is given priority in their respective organisations.

The answer that was obtained after rescaling was equivalent to an "agree". This was very much in contradiction to what Hughes (2001) found in the Scottish electronic industry. This is also confirmed in Question 2 of the instrument where it is seen that only one respondent out of 33 was not making use of any kind of forecasting. However it should be noted that the answer from Question 12 is not giving a picture in terms of quality of the forecasts being carried and the type of structures in place in organisations that would support the whole process.

5.3.2 Forecasters are not well trained in organisations

The above proposition was again formulated from the findings of Hughes (2001) from the survey of the electronic industry in Scotland. The author found that 23% of his respondents had insufficient training as a major barrier to forecasting in their respective organisations. Fiddles & Hastings (1994) found on their part, that there was a lack of knowledge of how to carry out the forecasting function.

The above finding was verified for its validity in the Mauritian manufacturing market through Question 11 of the instrument where the respondents had to rate the statement that "forecasters are especially qualified or trained for their duty" on a Likert scale. The answer that was obtained after rescaling was very close to a "disagree". This answer would be in accordance to what was found by Hughes (2001).

5.3.3 Forecasters do not make use of computers and computer software to forecast

The above proposition was derived from Hughes's (2001) study of the Scottish electronic industry. Sanders (1995) also found that lack of organisational support resulted in no use of computer support to the forecasting function. To verify the findings of these authors, the researcher designed Questions 13, 14 and 15 of the instrument.

Question 13 asked the respondents whether forecasters in their respective organisations used computer supports. This was a Likert scale based question which after rescaling yielded an "agree" as answer. The latter answer was proving the proposition above to be true. Question 14 however was showing that 82% of the respondents were using Microsoft Excel as software for performing forecasts while Question 15 was showing that for 30% of cases other software in combination with Microsoft Excel were being

used. A further breakdown of the above answers obtained showed that 12% of the total of the respondents were not using any kind of software and only 6% of the companies were using specialised software.

It could be concluded therefore, that the answer from Question 13 was in contradiction to the answers of question 14. But it should be understood that Microsoft Excel is standard software that is bundled with Microsoft Office that most companies would purchase for office works. The answer therefore to Question 15 was the one that was really showing which were the organisations that were using computer support. Therefore it can be said that the findings of Hughes (2001) and Sanders (1995) are also true in the Mauritian context.

5.3.4 Forecasters are involved in other duties

Hughes (2001) noted that for 41% of cases, insufficient time due to other duties was one of the major inhibitors to the use of forecasting in organisations. This finding was verified in the Mauritian manufacturing sector through Question 16 of the instrument.

Question 16 was another Likert Scale based question that put forward the statement that "the amount of time spent by forecasters on forecasting is sufficient" and which the respondents had to rate from "Strongly Disagree" to "Strongly Agree". The answer that was obtained after rescaling corresponded to a "Disagree". This finding therefore confirmed the findings of the above author in that forecasters in the manufacturing sector in Mauritius also spend very little of their time doing forecasting.

5.3.5 There is no organisational support to the forecasting function

The above proposition was derived from Sanders (1995), who states that poor management, lack of adequate data processing and computer support and lack of availability of relevant data are direct contributors to the lack of organisational support.

To verify whether lack of organisational support was also a problem in Mauritius, the researcher firstly used Question 11 of the instrument. This was a Likert scale based question which asked the respondents to rate the statement that "forecasters are especially qualified or trained for their duty" on a strongly agree to a strongly disagree scale. The answer that came out was an equivalent of a "disagree". This fact showed that since forecasters were not getting especial training, a poor management of the

whole forecasting process was very apparent and hence there was no organisational support to the forecasting function.

Question 22 was a second question that was used by the researcher to verify the above proposition. The question asked the respondents whether the forecaster is an identified person in their respective company. The answer that was obtained was that 39±15% of the respondents had the forecaster identified in their respective companies. This meant that a relatively low proportion of companies in Mauritius had a well defined structure for carrying forecasting thus again proving Sanders (1995) statements above to be true.

In the same line of reasoning as Question 22, Question 24 asked the respondents on a Likert scale whether the forecast preparers are the forecast users. If forecasters were preparing forecasts for decision makers who would be making decisions based on these forecasts, this would confirm the presence of a forecasting structure in the organisations. Since the answer that was obtained was an "agree", this would again tend to confirm the findings of Sanders (1995) above whereby there is no organisational support to the forecasting function.

Finally Question 23, which was another Likert scale based question, and asked the respondents to rate the statement "there are sufficient resources attached to the forecasting function" on the strongly agree to a strongly disagree scale. The answer that was obtained was a "Disagree". This fact again proved Sanders (1995) findings to be true. Therefore on the whole, considering the answers obtained from questions 11, 22, 23 and 24, it can be said that organisation in Mauritius do not support the forecasting function.

5.3.6 There is no holistic approach to manage the forecasting function

Sanders (1995) say that for statistical forecasting to be successful, collaboration between both users and preparers of forecasts from the beginning of the whole process is essential. The author highlights a different number of solution strategies that if implemented helps overcoming organisational forecasting problems. Some of these solution strategies are:

1. Pre-empt potential resistance

2. Provide training and evaluation of forecast strategies

3. Develop plans

4. Commit resources

Absence of the above would indicate that the forecasting function is not managed in all its dimensions, i.e. not managed holistically.

To verify whether there is a holistic approach to the forecasting process in the Mauritian context, the researcher went through questions 11, 24, 25 and 27 of the instrument.

Question 11 as already discussed in the previous section showed that there was no organisational support in terms of training of the forecasters. Question 24 also from the previous section, also showed there was no organisational support in that forecasts users are actually the forecast preparers. Question 25 asked the respondents whether the forecast ability of their competitor were being taken into consideration in the process of forecasting. A positive answer would have shown that the forecasting process was being looked at in all its dimensions. But the answer that was obtained after rescaling was the equivalent of a "disagree". This therefore confirmed that fact the forecasting process was not being looked at holistically.

Question 27 was an open ended question and asked the respondents to list the major problems that their respective companies were facing with respect to the forecasting process. The problem that was the most recurrent amongst the answers that was collected was IT support. The second problem that was the most recurrent was that there were poor processes in place. Unpredictable demands and poor data collection were the problems which according to the respondents were the third most recurrent. Question 27 therefore confirmed that the whole forecasting process in the Mauritian manufacturing sector was not being managed using a holistic approach.

6 Conclusions and recommendations

6.1 Summary

To summarise the research problem which was "What are the forecasting practices in the manufacturing sector in Mauritius", a brief of the findings of each of the sub problems are presented in the following sections.

6.1.1 The forecasting techniques used by manufacturing companies in Mauritius

Literatures on forecasting sustained that companies use judgemental techniques for their forecasts. This fact was tested in the Mauritian environment and was found to be consistent. This therefore lead to the conclusion that the types of forecasting carried out in Mauritius are still very unsophisticated and simple and did not keep up with the many recent developments that have occurred in the field of forecasting. This conclusion was consolidated by the fact that the research also showed that forecasting techniques are not well know to practitioners in the field. Rules of thumb and gut feel are therefore very common type of informal forecasting methods in use.

The "Ev-Rev" theory of Smith III *et al* (1996) and Greiner (1998), whereby as company grow significant differences are noticeable in the types of techniques used, was proved to be also true in the Mauritian context. In fact as the companies grew in size, the historical databases being used as well as the amount of persons dedicated to the function were also growing.

The research showed that as time horizon of forecasts increased, the forecasting errors also increased. It was proven also that full historical databases were not available to the forecasters and the majority of them were in fact using only one year of historical database.

With a forecast accuracy that turned around 23% at a confidence level of 95%, the researcher established that forecast accuracy does depend on product life cycle in the Mauritian manufacturing sector. This is also the situation in other part of the world as reported in the different literatures.

6.1.2 The forecasting processes used by manufacturing companies in Mauritius

Sanders (1995) showed that decision makers do not make use of the forecasts prepared by the forecast preparers. This was proven to be true in the Mauritian context. In fact the researcher showed that forecasts in the majority of cases were being done by more than one department independently showing that there is no trust in what other persons from other departments were doing. It could be proven that forecasts are not credible in organisations. The forecasts are very often modified to fit judgements, insider information or gut feel which the forecasters believe that the forecasting models being used are not capable of reproducing.

To the question whether there existed a standard procedure when performing forecasts, the researcher found that the practitioners in the manufacturing sector could not provide clear answers. This would mean that the procedures existed but were not being followed or were not well defined. This therefore again show that along with the little developments that have occurred in the types of techniques used, the processes behind to support these techniques are also still lagging behind.

When the processes are changed to accommodate formal statistical forecasting techniques, upfront resistance would occur according to the respondents who went through the instrument. This could explain the very premature state of forecasting in terms of techniques and processes in the Mauritian manufacturing sector.

Also as highlighted in the previous section, as companies grew in size, the amount of personnel dedicated to forecasting also grew. This would mean that in such cases the forecasting processes in the small firms would be significantly different from the forecasting processes in large firms.

It could be shown in Mauritius that forecasters were building their own theory and were having their forecasts biased. These facts could be related to Golden *et al* (1995), who showed that risks of introducing subjective bias in forecasts existed when forecasts are generated from beliefs and hypotheses and forecasters build their own theory when they are caught up in the effect known as "gamblers fallacy".

6.1.3 The resources/functions that are involved in forecasting

Regarding the above, the researcher found that firstly managers in the manufacturing sector were agreeable to the fact that forecasting is given priority in organisations. However deeper analysis showed that forecasters are insufficiently trained as was being reported in literatures. Therefore the managers were being contradictory to the latter fact. This could be explained by the fact that since forecasting was being acknowledged to be very important in organisations, there was a perception that forecasting was being given priority.

Forecasting as a function in organisations is in fact not given its due support. The person carrying out the forecasts in the majority of cases is not an identified one. Forecasters have very often to share their time with other work thus making the time spent on forecasting very little. Computers and computer software are used by only a little portion of the practitioners in the field. All of the above lead to the conclusion that in the manufacturing sector in Mauritius, there is no organisational support to the forecasting function.

Finally it was found that there was no holistic approach to manage the forecasting function. As already mentioned in the previous paragraph, there was no IT support with poor processes in place. Organisations are not keen at looking at what the competition is doing so that they can keep up with the changes occurring in the manufacturing environment.

6.1.4 Summary of forecasting practices in Mauritius

A summary of the findings described above in given in bullet form in Table 18 below.

***Table 18**: Summary of Forecasting Practices*

Forecasting Practices in the Manufacturing sector in Mauritius		
Techniques	Processes	Resources/Function
• Heavy use of Judgemental techniques • Gut feel and rules of thumb • Unsophisticated and simple – lack of recent developments • Differing techniques with differing company size • Forecast accuracy of 23%	• Forecasts done by more than one department independently • Forecasts nor credible in organisations • Forecasts modified to fit judgements • Greater number of forecasters as size of company grow • Forecasters build their own theory • Resistance to change when implementing formal statistical forecasting	• Insufficient training • Little use of computer and computer software • No holistic approach to manage the forecasting function • No organisational support

6.2 Limitations

A major limitation of the study was the fact that the sample size was very small. This did not allow the use of inferential statistical methods and compelled the researcher in using mainly descriptive statistical methods. This was firstly due to the fact that the manufacturing sector in Mauritius is still in its growth phase and is limited in terms of the number of organisations that constitute it. This fact already predetermined the relatively small number of companies who could answer the research questionnaire.

Secondly, many companies that were classified as manufacturing companies were employing less than ten persons. Since the research was to exclude organisation not having more than ten employees many of the firms contacted could not qualify for the study. Hence the above resulted in the fact that the sample size was very small.

6.3 Recommendations

Sanders (1995) says that if organisational forecasting problems are well identified together with the right solution strategy that would tackle those problem, an appropriate forecasting model can be established that will lead to an improved organisational planning and ultimately an enhanced organisational performance.

In the Mauritian context, using the problems identified in Table 18, organisations could make use of the solution strategies proposed by Sanders (1995) to overcome the said problems. These could be summarised as follows:

***Table 19**: Proposed solutions for problems associated to forecasting*

Identified Problems	Proposed solutions
Lack of recent developments – Use of Judgemental techniques	• Arouse top management attention and involvement to counteract the inertia
Forecasts are not credible in organisations	• Top management to show their interest in formal statistical forecasting • Top management to highlight successful decisions made from the results of formal statistical forecasting • To emphasise and demonstrate the benefits of using formal statistical forecasting methods
Resistance to implementation of formal statistical methods	• Pre-empt organisational resistance by using scenario writing • Introducing forecasting models as supplements and complements to traditional forecasting methods
No organisational support	• Enhance collaboration between users and preparers by establishing fully fledged management process with top management providing enough resources and time

6.4 Suggestion for further research

Further research in the filed of forecasting in manufacturing sector in Mauritius would be firstly to expand on the three sub problems that comprise the present research problem. Thus papers on Techniques, Processes and Resources/Functions separately could be researches on their own in the Mauritian manufacturing sector.

Secondly the present research highlighted a major weakness within itself which was a relatively small sample size. Therefore one area of research would be to re-do the whole exercise after five years whereby lots of the now small firms which are too small to be included in the respondents list, would have had enough time to grow big enough and hence become potential candidates for the response questionnaire. This would also allow to see the progress of forecasting with time.

Amongst the many factors that the respondents considered to be impacting on forecasting was "unpredictable demands". A research paper on why certain demands are unpredictable in the Mauritian manufacturing sector would therefore also be of high interest.

Finally with the facts obtained from the present research, linking how strategies are built with the results of forecasting could be another research report. This research would show in another dimension what kind of importance and priority forecasting in given in the local manufacturing sector.

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Appendix 1: The Instrument

Please tick only one box per question, unless otherwise indicated.

1. How many employees does your company have?

_____

2. Which of the following forecasting techniques are used in your company? (*Tick more than one if necessary*)

Data correlation Methods	☐	Delphi Technique	☐
Executive Judgements	☐	Market Tests	☐
Surveys	☐	Time Series Analysis	☐
None	☐		

3. The forecasts are modified to fit the judgments or gut feel of other managers.

Strongly Disagree	☐	Disagree	☐	Neither Agree nor Disagree	☐	Agree	☐	Strongly Agree	☐

4. The forecasters in my company have a standard procedure for performing the forecasts.

Strongly Disagree	☐	Disagree	☐	Neither Agree nor Disagree	☐	Agree	☐	Strongly Agree	☐

5. There is objectivity in the forecasts of the forecasters.

Strongly Disagree	☐	Disagree	☐	Neither Agree nor Disagree	☐	Agree	☐	Strongly Agree	☐

6. Our products are in different stages of their life cycle.

Strongly Disagree	☐	Disagree	☐	Neither Agree nor Disagree	☐	Agree	☐	Strongly Agree	☐

7. Over what period of time does your company forecast?

1 Month	☐	3 Month	☐	1 Year	☐	3 Years	☐	5 Years	☐

8. What is the percentage error on your forecasts?

_____

9. The forecast accuracy varies with your different products.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

10. Are your forecasting practitioners "forecast literate"?

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

11. The forecasters are especially qualified or trained for their duty.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

12. Forecasting is an important process in my company.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

13. The forecasters use computer supports.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

14. MS Excel is used as a forecasting support software package.

Yes ☐ No ☐

15. There are other software packages used for the forecasts.

Yes ☐ No ☐

16. The amount of time spent by forecasters on forecasting is sufficient.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

17. How many years of historical data do the forecasters work on?

1 yr ☐ 2 yr ☐ 3 yr ☐ 4 yr ☐ 5 yr ☐

6 yr ☐ 7 yr ☐ >7 yr ☐

18. Forecasting results are used in decision making.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

19. Forecasters will not resist the implementation of a formal statistical forecasting technique.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

20. Forecasting is done by more than one department independently.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

21. What is/are the department/s that perform/s the forecasts? (*Tick more than one if necessary)*

Sales ☐ Marketing ☐ Production ☐ Purchasing ☐ Technical ☐

22. The forecaster is an identified person in the company.

Yes ☐ No ☐

23. There are sufficient resources attached to the forecasting function.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

24. The forecast preparers are the forecast users.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

25. The forecasting ability of your competitor is taken into consideration in the process of forecasting.

Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree ☐

26. How many people are directly involved in the forecasting process?

_____

27. What is the biggest problem your company faces in its forecasting process?

_____
_____
_____
_____
_____

Appendix 2: List of Propositions

PROPOSITION 1: COMPANIES USE JUDGMENTAL TECHNIQUES. 5
PROPOSITION 2: FORECASTERS BIAS THEIR FORECASTS. 5
PROPOSITION 3: FORECASTERS BUILD THEIR OWN THEORY. 5
PROPOSITION 4: FORECAST ACCURACY DEPENDS ON PRODUCT LIFE CYCLE. 6
PROPOSITION 5: FORECASTING TECHNIQUES ARE NOT WELL KNOWN TO PRACTITIONERS. 6
PROPOSITION 6: PRIORITY IS NOT GIVEN TO FORECASTING IN ORGANISATIONS. 6
PROPOSITION 7: FORECASTERS ARE NOT WELL TRAINED IN ORGANISATIONS. 6
PROPOSITION 8: FORECASTERS DO NOT USE COMPUTERS AND COMPUTER SOFTWARE TO FORECAST....6
PROPOSITION 9: THERE IS A DIFFERENCE IN FORECAST ERRORS AS TIME HORIZON INCREASE. 6
PROPOSITION 10: FORECASTERS ARE INVOLVED IN OTHER DUTIES. 7
PROPOSITION 11: FORECASTERS DO NOT HAVE FULL HISTORICAL DATABASE. 7
PROPOSITION 12: DECISION MAKERS DO NOT USE FORECASTS PREPARED BY FORECASTERS. 7
PROPOSITION 13: THERE IS RESISTANCE TO CHANGE DURING IMPLEMENTATION OF FORMAL STATISTICAL FORECASTING.....9
PROPOSITION 14: FORECASTS ARE NOT CREDIBLE IN ORGANISATIONS. 10
PROPOSITION 15: THERE IS NO ORGANISATIONAL SUPPORT TO THE FORECASTING FUNCTION.....12
PROPOSITION 16: THERE IS NO HOLISTIC APPROACH TO MANAGE THE FORECASTING FUNCTION.....13
PROPOSITION 17: THERE IS A SIGNIFICANT DIFFERENCE IN TYPES OF TECHNIQUES IN FIRMS OF DIFFERENT SIZE. 14
PROPOSITION 18: THERE IS A SIGNIFICANT DIFFERENCE IN THE AMOUNT OF PERSONNEL INVOLVED IN FIRMS OF DIFFERENT SIZE.....15

	Question No.																																															
Respondent	1	14	15	22	8	26	2a	2b	2c	2d	2e	2f	2g	7a	7b	7c	7d	7e	17a	17b	17c	17d	17e	17f	17g	21a	21b	21c	21d	21e	3	4	5	6	9	10	11	12	13	16	18	19	20	23	24	25
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Appendix 4: Correspondence Analysis

Correspondence Analysis Report

Page/Date/Time 1 28/05/2005 13:58:20
Database
Variables SD to SA

Raw Data Section

C1	SD	D	NAND	A	SA	Total
3	1	7	7	16	2	33
4	0	11	10	12	0	33
5	1	6	8	17	1	33
6	0	1	2	23	7	33
9	0	4	3	23	3	33
10	1	10	19	3	0	33
11	0	17	12	4	0	33
12	1	0	3	16	13	33
13	0	4	4	19	6	33
16	1	20	5	7	0	33
18	0	2	5	22	4	33
19	0	9	6	16	2	33
20	0	8	6	19	0	33
23	4	15	8	6	0	33
24	1	8	6	14	4	33
25	4	17	7	5	0	33
Total	14	139	111	222	42	528

Correspondence Analysis Report

Page/Date/Time 2 28/05/2005 13:58:20
Database
Variables SD to SA

Eigenvalue Section

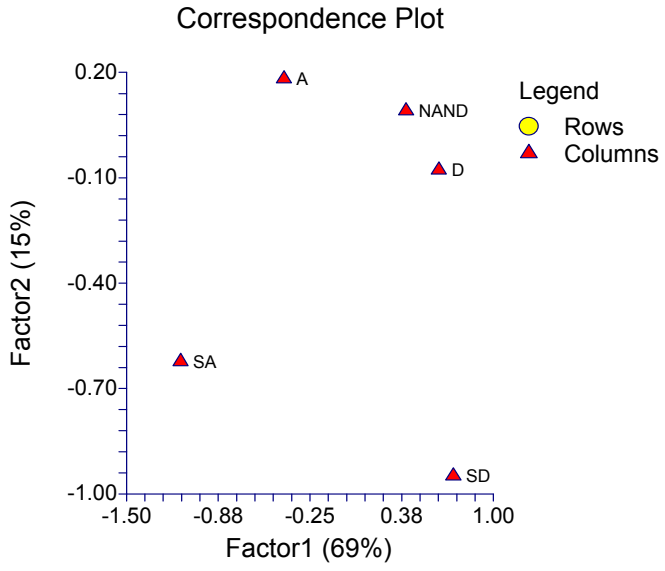
Factor No.	Eigenvalue	Individual Percent	Cumulative Percent	Bar Chart
1	0.331031	68.58	68.58	|||\

3 5	0.063	0.011	0.082	-0.035	0.015	0.000	83.00.000076
4 6	0.063	0.096	0.742	-0.859	0.995	0.139	4.00.046151
5 9	0.063	0.046	0.354	-0.500	0.706	0.047	32.80.015645
6 10	0.063	0.127	0.980	0.707	0.510	0.094	44.40.031220
7 11	0.063	0.087	0.672	0.728	0.789	0.100	27.30.033147
8 12	0.063	0.205	1.584	-1.033	0.673	0.201	34.90.066670
9 13	0.063	0.043	0.330	-0.568	0.978	0.061	8.60.020146
10 16	0.063	0.084	0.646	0.649	0.652	0.080	36.20.026320
11 18	0.063	0.047	0.365	-0.561	0.862	0.059	21.80.019664
12 19	0.063	0.006	0.045	-0.054	0.064	0.001	75.30.000180
13 20	0.063	0.022	0.169	-0.035	0.007	0.000	85.10.000077
14 23	0.063	0.090	0.697	0.685	0.673	0.089	34.90.029313
15 24	0.063	0.004	0.028	-0.123	0.540	0.003	42.70.000941
16 25	0.063	0.108	0.831	0.752	0.681	0.107	34.40.035362

Principal Coordinate Section for Rows - Axis 2

Name	Mass	Inertia	Distance	Factor	COR	CTR	AngleEigenvalue
1 3	0.063	0.003	0.025	0.090	0.324	0.007	55.30.000503
2 4	0.063	0.022	0.173	0.251	0.364	0.055	52.90.003941
3 5	0.063	0.011	0.082	0.200	0.483	0.035	45.90.002492
4 6	0.063	0.096	0.742	-0.010	0.000	0.000	89.30.000006
5 9	0.063	0.046	0.354	0.256	0.184	0.057	64.60.004081
6 10	0.063	0.127	0.980	0.060	0.004	0.003	86.50.000228
7 11	0.063	0.087	0.672	0.055	0.004	0.003	86.20.000186
8 12	0.063	0.205	1.584	-0.664	0.278	0.383	58.20.027550
9 13	0.063	0.043	0.330	-0.027	0.002	0.001	87.30.000047
10 16	0.063	0.084	0.646	-0.089	0.012	0.007	83.60.000498
11 18	0.063	0.047	0.365	0.203	0.113	0.036	70.40.002569
12 19	0.063	0.006	0.045	0.169	0.634	0.025	37.20.001785
13 20	0.063	0.022	0.169	0.380	0.856	0.126	22.30.009032
14 23	0.063	0.090	0.697	-0.356	0.182	0.110	64.70.007942
15 24	0.063	0.004	0.028	-0.111	0.443	0.011	48.30.000773
16 25	0.063	0.108	0.831	-0.405	0.197	0.143	63.60.010244

Plots



Appendix 5: Rescaled Data

	Question No.															
Respondent	3	4	5	6	9	10	11	12	13	16	18	19	20	23	24	25
1	3.5	2.8	3.5	3.5	3.5	2.8	2.5	5.0	5.0	2.5	2.8	5.0	2.5	2.5	5.0	2.5
2	2.5	3.5	3.5	3.5	2.8	2.5	2.5	3.5	3.5	2.5	3.5	3.5	3.5	2.5	2.5	2.8
3	3.5	2.5	3.5	5.0	3.5	2.8	2.5	3.5	3.5	2.8	2.5	2.8	3.5	1.0	3.5	2.5
4	2.5	2.5	3.5	3.5	2.5	2.8	2.5	3.5	2.8	2.5	3.5	3.5	3.5	1.0	2.5	2.5
5	5.0	3.5	3.5	3.5	3.5	2.5	2.5	3.5	2.8	2.5	3.5	2.8	3.5	2.5	3.5	2.5
6	2.5	3.5	2.8	3.5	3.5	2.5	2.5	3.5	3.5	2.5	3.5	3.5	2.8	3.5	2.5	2.8
7	3.5	2.8	3.5	3.5	5.0	2.8	2.5	2.8	2.5	2.5	3.5	2.8	2.5	2.8	3.5	1.0
8	2.5	3.5	2.5	3.5	3.5	2.5	3.5	3.5	3.5	3.5	3.5	2.5	2.8	3.5	2.5	2.8
9	3.5	2.5	2.8	2.8	3.5	2.8	2.8	3.5	3.5	2.5	3.5	2.5	3.5	1.0	3.5	1.0
10	2.8	3.5	2.5	3.5	3.5	2.5	2.8	5.0	2.5	2.8	3.5	2.5	3.5	2.8	2.5	2.5
11	3.5	2.8	3.5	3.5	3.5	2.8	2.5	5.0	5.0	2.5	2.8	3.5	2.8	2.5	3.5	2.5
12	5.0	2.8	3.5	5.0	3.5	2.8	2.8	3.5	2.8	3.5	2.8	3.5	2.5	3.5	3.5	2.5
13	3.5	2.5	2.5	3.5	2.5	2.8	2.8	3.5	2.5	2.8	3.5	3.5	2.5	2.5	3.5	2.8
14	3.5	2.5	2.5	3.5	3.5	2.5	2.5	3.5	3.5	2.5	2.8	2.5	2.5	2.5	5.0	1.0
15	3.5	2.8	3.5	3.5	3.5	2.8	2.5	5.0	5.0	2.5	2.8	5.0	2.5	2.5	5.0	2.5
16	3.5	2.5	3.5	3.5	3.5	1.0	2.5	3.5	3.5	3.5	2.5	2.5	2.8	2.5	3.5	2.5
17	3.5	2.5	2.5	3.5	2.8	2.5	2.5	3.5	3.5	1.0	3.5	3.5	3.5	1.0	3.5	1.0
18	3.5	2.8	3.5	3.5	3.5	2.8	2.5	1.0	3.5	2.5	3.5	3.5	2.5	2.5	2.5	2.5
19	2.8	2.8	3.5	3.5	3.5	2.5	2.5	5.0	3.5	2.5	5.0	2.8	3.5	2.5	3.5	2.8
20	2.5	2.8	2.8	3.5	3.5	2.8	2.8	5.0	3.5	2.8	3.5	2.8	3.5	2.5	3.5	2.5
21	2.8	3.5	2.8	5.0	3.5	2.8	3.5	3.5	5.0	2.5	3.5	3.5	3.5	2.5	2.8	2.5
22	2.8	3.5	2.8	3.5	3.5	2.8	2.8	5.0	3.5	2.8	5.0	3.5	3.5	2.8	2.8	2.5
23	2.8	3.5	3.5	5.0	3.5	3.5	2.8	5.0	3.5	3.5	3.5	3.5	3.5	2.8	1.0	2.8
24	3.5	3.5	2.5	2.5	2.5	2.8	2.8	5.0	3.5	3.5	3.5	3.5	3.5	2.8	3.5	3.5
25	3.5	2.8	3.5	3.5	3.5	2.8	2.8	5.0	5.0	2.5	3.5	3.5	3.5	2.5	3.5	3.5
26	2.5	3.5	1.0	3.5	5.0	2.5	3.5	2.8	2.8	3.5	3.5	2.5	2.8	2.8	2.5	2.8
27	1.0	2.5	3.5	3.5	2.5	2.8	2.8	5.0	3.5	2.5	3.5	2.5	3.5	3.5	2.8	3.5
28	2.8	3.5	2.8	3.5	3.5	2.8	2.8	3.5	3.5	2.5	3.5	3.5	3.5	2.8	2.8	2.5
29	3.5	2.8	2.8	5.0	5.0	2.8	3.5	5.0	3.5	2.5	3.5	3.5	2.5	2.5	2.5	2.5
30	2.8	2.5	5.0	5.0	3.5	3.5	2.5	3.5	5.0	2.5	5.0	3.5	3.5	3.5	2.8	3.5
31	3.5	3.5	3.5	2.8	2.8	3.5	2.8	3.5	3.5	3.5	5.0	2.8	2.8	3.5	2.8	3.5
32	2.5	2.5	2.8	3.5	3.5	2.5	2.5	2.8	3.5	2.5	3.5	2.5	3.5	2.5	3.5	2.5
33	3.5	2.5	3.5	5.0	3.5	2.8	2.5	5.0	2.5	2.5	3.5	2.5	3.5	2.8	5.0	2.5

Appendix 6: Hypothesis test on Forecast Accuracy

One-Sample T-Test Report

Page/Date/Time 1 6/3/2005 9:49:49 AM
Database
Variable Forecast_Accuracy

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Forecast_Accuracy	17	23.05882	25.14327	6.098138	10.13135	35.9863

T for Confidence Limits = 2.1199

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality	3.2458	0.001171	Reject normality
Kurtosis Normality	2.6806	0.007349	Reject normality
Omnibus Normality	17.7210	0.000142	Reject normality
Correlation Coefficient			

T-Test For Difference Between Mean and Value Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	Power (Alpha=.05)	Power (Alpha=.01)
Forecast_Accuracy<>20	0.5016	0.622781	Accept Ho	0.075908	0.018094
Forecast_Accuracy<20	0.5016	0.688610	Accept Ho	0.016757	0.002649
Forecast_Accuracy>20	0.5016	0.311390	Accept Ho	0.122174	0.031072

Nonparametric Tests Section

Quantile (Sign) Test

Hypothesized Value	Quantile	Number Lower	Number Higher	Prob Lower	Prob HigherBoth Prob
20	0.5	10	5	0.940765	0.1508790.301758

Wilcoxon Signed-Rank Test for Difference in Medians

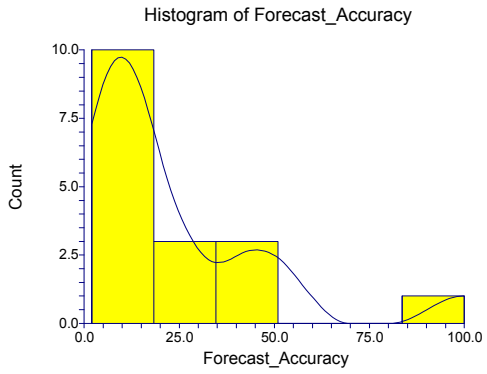
W Sum Ranks	Mean of W	Std Dev of W	Number of Zeros	Number Sets of Ties	Multiplicity Factor
68.5	75	21.02974	2	4	132

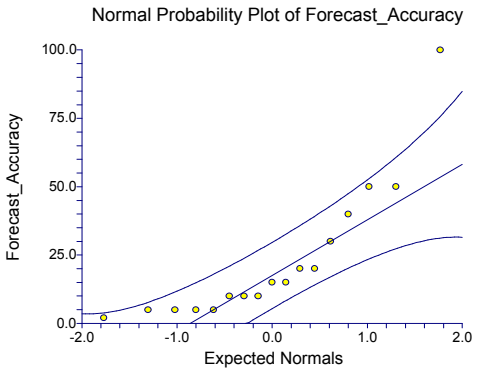
	Exact Probability		Approximation Without Continuity Correction			Approximation With Continuity Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Median<>20			0.3091	0.757256	Accept Ho	0.2853	0.775406	Accept Ho
Median<20			-0.3091	0.378628	Accept Ho	-0.2853	0.387703	Accept Ho
Median>20			-0.3091	0.621372	Accept Ho	-0.3329	0.630381	Accept Ho

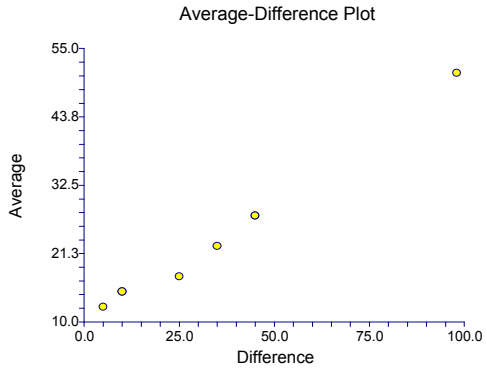
One-Sample T-Test Report

Page/Date/Time 2 6/3/2005 9:49:49 AM
Database
Variable Forecast_Accuracy

Plots Section







Appendix 7: Median Report of Size of company with varying types of Software

Page/Date/Time 2 03/07/2005 11:17:19
Database
Response No_of_emplyees

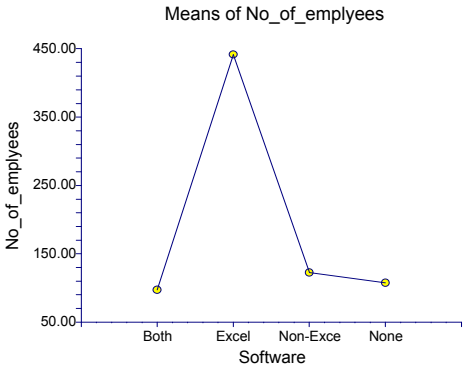
Group Detail

Group	Count	Sum of Ranks	Mean Rank	Z-Value	Median
Both	8	118.50	14.81	-0.7351	110
Excel	19	349.00	18.37	0.9471	180
Non-Excel	2	32.00	16.00	-0.1509	122.5
None	4	61.50	15.38	-0.3585	62.5

Means and Effects Section

Term	Count	Mean	Standard Error	Effect
All	33	298.1515		23.28927
A: Software				
Both	8	97.125	316.6239	73.83572
Excel	19	441.4211	205.4527	418.1318
Non-Excel	2	122.5	633.2478	99.21072
None	4	107.5	447.7738	84.21072

Plots of Means Section



Appendix 8: Confidence Interval for proportion of Forecasters

Confidence Interval of A Proportion

Page/Date/Time 1 05/06/2005 10:19:36

Numeric Results

Precision	C.C. Confidence Coefficient	N Sample Size	P0 Baseline Proportion
0.15546	0.95209	33	0.39000

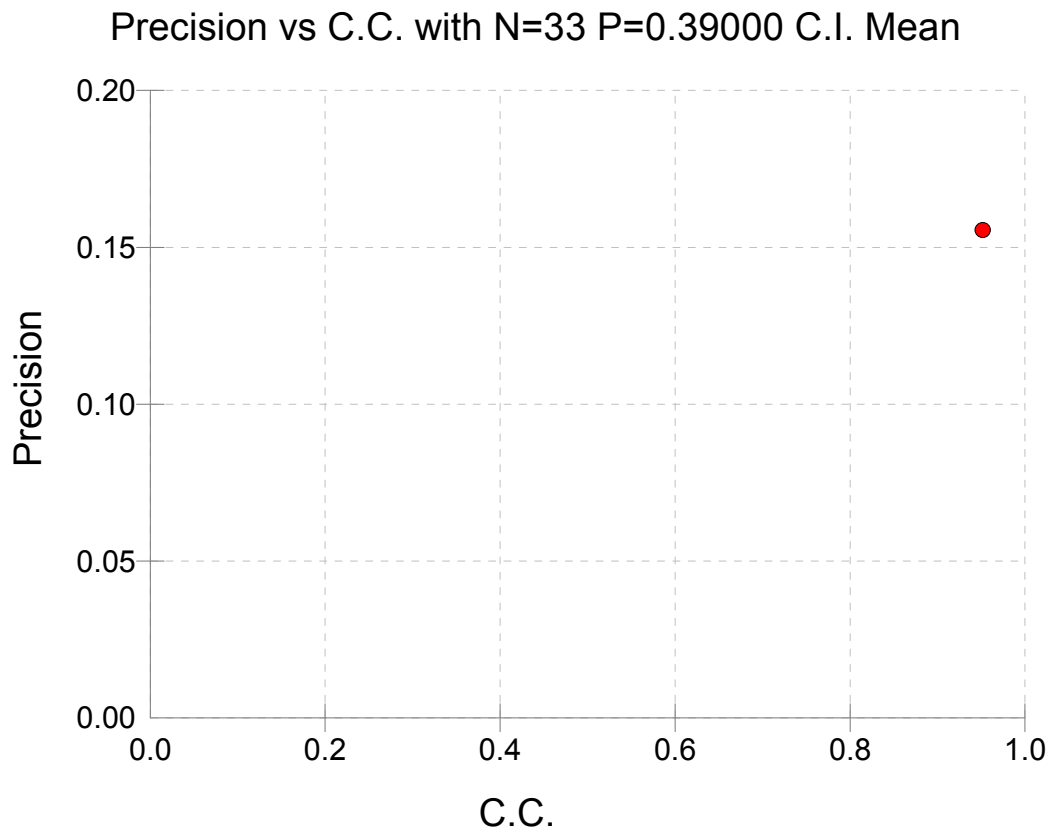
Report Definitions

Precision is the plus and minus value used to create the confidence interval.
Confidence Coefficient is probability value associated with the confidence interval.
N is the size of the sample drawn from the population.
P0 is the estimated baseline proportion.

Summary Statements

A sample size of 33 produces a 95% confidence interval equal to the sample proportion plus or minus 0.15546 when the estimated proportion is 0.39000.

Chart Section



Appendix 9: Frequency table for other problems encountered

Count of Respondent		
Problem Category	Answer to Question No.27	Total
Data Collection	Absence of data	1
	Accurate data collection and classification	1
	Accurate data identification	1
	Availabily of Historical Data	1
	Data capture	1
	No back data	1
Data Collection Total		6
External Factors	Pressure from supplier to buy bulk.	1
	Unstabillity of raw material price	1
	Weather Conditions	2
External Factors Total		4
IT support	Cannot depend totally on historical data	1
	Converting Data into infromation to be used in decision making	1
	Lack of IT Support	1
	Lack of MRP system	1
	Limited IT support	1
	No IT Support System	1
	No reliable tool	1
	Obtaining information from IT Dept	1
	Simple Models used	1
IT support Total		9
Lack of expertise	Limited forecasting skills	1
	Not everybody equipped to do the forecasts	1
Lack of expertise Total		2
Lack of market information	Absence of technical information	1
	Legal and market changes	1
	Not enough market information	1
	Obtaining information from local ministries	1
Lack of market information Total		4
Poor processes	Accuracy of forecast not checked	1
	Legacy Systems	1
	Limited trend analysis	1
	No established process	1
	No forecasting structure	1
	No formal system in place	1
	No proper formalised forecasting	1
	Sales and Marketing not invloved	1
Poor processes Total		8
Unpredictable Demands	Accuracy of customer's forecast	2
	Changing Fashion trends	1
	Customers do not respect their forecasts	1
	Irregular orders from customers	1
	Seasonality – Unpredicatable demands due to epidemies	1
Unpredictable Demands Total		6
Unreliable supplies	Disponibility of Raw material on world market	1
	Fluctuation of raw materials cost	2
Unreliable supplies Total		3
Liquidity	Liquidity problem	1
Liquidity Total		1
Grand Total		43

Appendix 10: Median Report of Size of company with varying Periods of Forecast

Page/Date/Time 2 29/05/2005 10:14:12
Database
Response No_of_employess

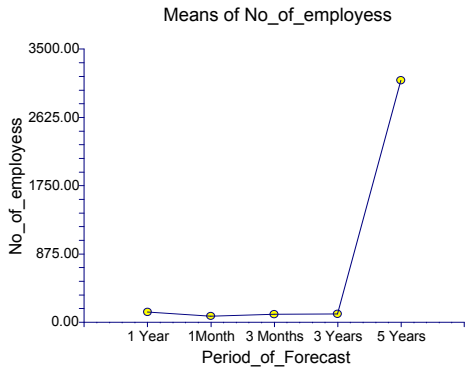
Group Detail

Group	Count	Sum of Ranks	Mean Rank	Z-Value	Median
1 Year	18	318.50	17.69	0.4519	110
1Month	3	36.50	12.17	-0.9080	35
3 Months	8	111.00	13.88	-1.0502	72.5
3 Years	2	30.00	15.00	-0.3018	107.5
5 Years	2	65.00	32.50	2.3389	3100

Means and Effects Section

Term	Count	Mean	Standard Error	Effect
All	33	298.1515		106.6944
A: Period_of_Forecast				
1 Year	18	131.6667	121.62	24.97222
1Month	3	80	297.9069	-26.69444
3 Months	8	101.75	182.4299	-4.944445
3 Years	2	107.5	364.8599	0.8055556
5 Years	2	3100	364.8599	2993.306

Plots of Means Section



Appendix 11: Two Sample t-Tests for Departments carrying forecasts

Two-Sample Test Report

Page/Date/Time 1 26/06/2005 17:20:18
Database
Variable No_of_Employees

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	536.1334	1268.353	327.4872	-166.257	1238.524
Department=Production	20	415.3	1108.604	247.8914	-103.5428	934.1428

Note: T-alpha (Department=Marketing) = 2.1448, T-alpha (Department=Production) = 2.0930

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	33	120.8333	1179.023	402.713	-698.4923	940.159
Unequal	27.89	120.8333	1684.554	410.7287	-720.6528	962.3195

Note: T-alpha (Equal) = 2.0345, T-alpha (Unequal) = 2.0488

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.3000	0.766022	Accept Ho	0.059784	0.013108
Difference < 0	0.3000	0.616989	Accept Ho	0.026261	0.004468
Difference > 0	0.3000	0.383011	Accept Ho	0.088362	0.020759

Difference: (Department=Marketing)-(Department=Production)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.2942	0.770789	Accept Ho	0.059303	0.012930
Difference < 0	0.2942	0.614605	Accept Ho	0.026679	0.004570
Difference > 0	0.2942	0.385395	Accept Ho	0.087274	0.020377

Difference: (Department=Marketing)-(Department=Production)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Marketing)	4.5546	0.000005	Reject normality
Kurtosis Normality (Department=Marketing)	4.0389	0.000054	Reject normality
Omnibus Normality (Department=Marketing)	37.0573	0.000000	Reject normality
Skewness Normality (Department=Production)		5.2257	0.000000Reject normality
Kurtosis Normality (Department=Production)	4.5328	0.000006	Reject normality
Omnibus Normality (Department=Production)	47.8543	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	1.3090	0.575138	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0753	0.785486	Cannot reject equal variances

Two-Sample Test Report

Page/Date/Time 2 26/06/2005 17:20:18
Database
Variable No_of_Employees

Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	130	40	270
Department=Production	20	130	40	190

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Marketing	169	289	270	29.9348
Department=Production	131	341	360	29.9348

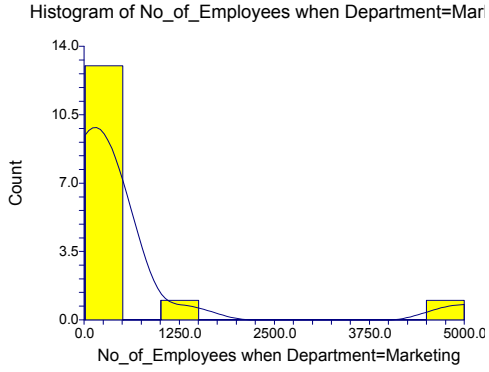
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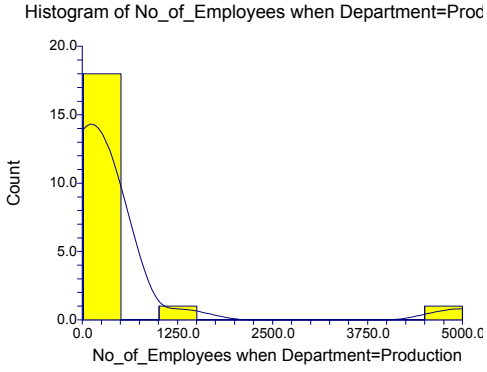
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			0.6347	0.525616	Accept Ho	0.6180	0.536569	Accept Ho
Diff<0			0.6347	0.737192	Accept Ho	0.6514	0.742611	Accept Ho
Diff>0			0.6347	0.262808	Accept Ho	0.6180	0.268284	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.200000	0.4382	.050	Accept Ho	0.8343
D(1)<D(2)	0.033333	0.4382	.025	Accept Ho	
D(1)>D(2)	0.200000	0.4382	.025	Accept Ho	

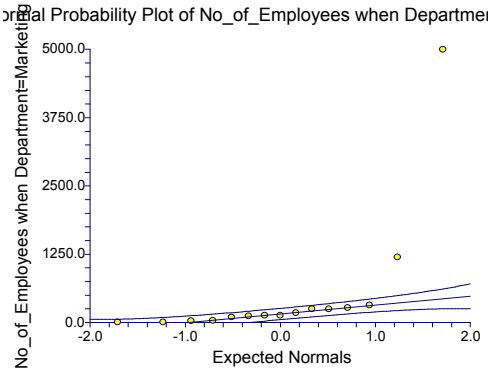
Plots Section

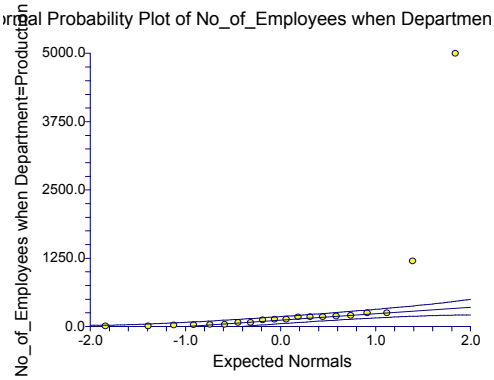


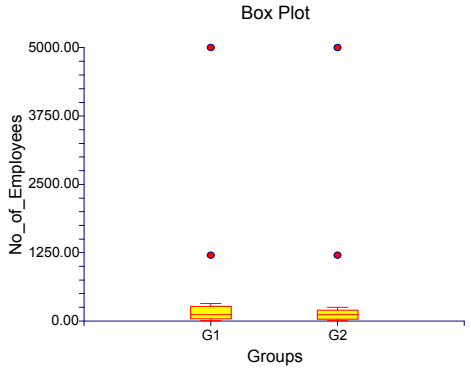


Two-Sample Test Report

Page/Date/Time 3 26/06/2005 17:20:18
Database
Variable No_of_Employees







Two-Sample Test Report

Page/Date/Time 4 26/06/2005 17:20:18
Database
Variable No_of_Employees

Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	536.1334	1268.353	327.4872	-166.257	1238.524
Department=Purchasing	20	367.6	1092.994	244.401	-143.9371	879.1371

Note: T-alpha (Department=Marketing) = 2.1448, T-alpha (Department=Purchasing) = 2.0930

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	33	168.5333	1170.601	399.8365	-644.9402	982.0068
Unequal	27.62	168.5333	1674.322	408.6315	-669.0246	1006.091

Note: T-alpha (Equal) = 2.0345, T-alpha (Unequal) = 2.0497

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.4215	0.676119	Accept Ho	0.069410	0.016275
Difference < 0	0.4215	0.661941	Accept Ho	0.019803	0.003156
Difference > 0	0.4215	0.338059	Accept Ho	0.108987	0.027319

Difference: (Department=Marketing)-(Department=Purchasing)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.4124	0.683205	Accept Ho	0.068362	0.015876
Difference < 0	0.4124	0.658397	Accept Ho	0.020312	0.003271
Difference > 0	0.4124	0.341603	Accept Ho	0.107037	0.026583

Difference: (Department=Marketing)-(Department=Purchasing)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Marketing)	4.5546	0.000005	Reject normality
Kurtosis Normality (Department=Marketing)	4.0389	0.000054	Reject normality
Omnibus Normality (Department=Marketing)	37.0573	0.000000	Reject normality
Skewness Normality (Department=Purchasing)		5.4208	0.000000Reject normality
Kurtosis Normality (Department=Purchasing)	4.6798	0.000003	Reject normality
Omnibus Normality (Department=Purchasing)	51.2858	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	1.3466	0.537168	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.1701	0.682666	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	130	40	270
Department=Purchasing	20	130	70	186

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Marketing	170.5	290.5	270	29.93691
Department=Purchasing	129.5	339.5	360	29.93691

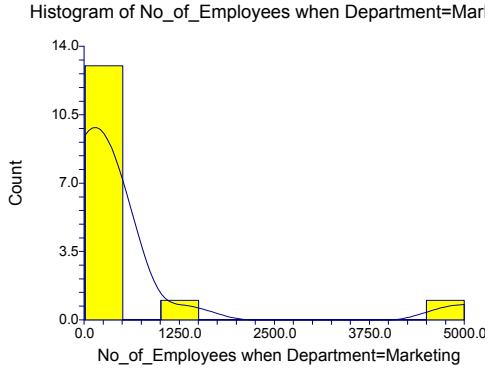
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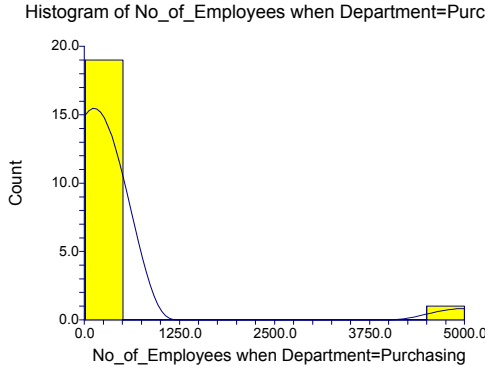
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			0.6848	0.493487	Accept Ho	0.6681	0.504088	Accept Ho
Diff<0			0.6848	0.753257	Accept Ho	0.7015	0.758497	Accept Ho
Diff>0			0.6848	0.246743	Accept Ho	0.6681	0.252044	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.250000	0.4382	.050	Accept Ho	0.5870
D(1)<D(2)	0.066667	0.4382	.025	Accept Ho	
D(1)>D(2)	0.250000	0.4382	.025	Accept Ho	

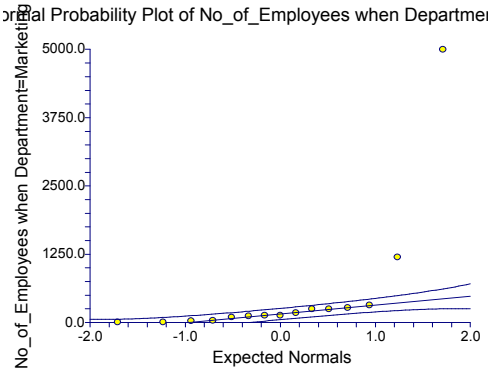
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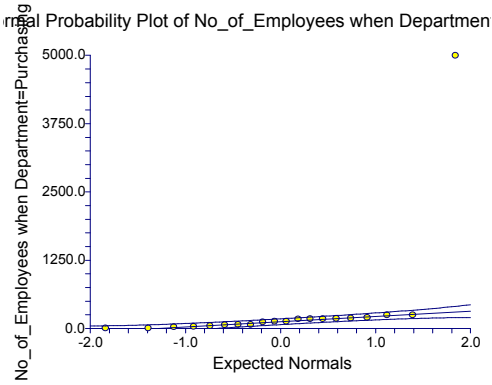


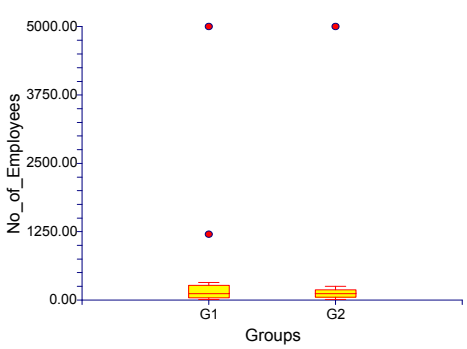


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	536.1334	1268.353	327.4872	-166.257	1238.524
Department=Sales	22	164.8636	247.4641	52.75953	55.14418	274.5831

Note: T-alpha (Department=Marketing) = 2.1448, T-alpha (Department=Sales) = 2.0796

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	35	371.2697	824.7609	276.1671	-189.3793	931.9187
Unequal	14.73	371.2697	1292.268	331.7099	-336.8857	1079.425

Note: T-alpha (Equal) = 2.0301, T-alpha (Unequal) = 2.1349

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	1.3444	0.187479	Accept Ho	0.257630	0.097873
Difference < 0	1.3444	0.906260	Accept Ho	0.001520	0.000147
Difference > 0	1.3444	0.093740	Accept Ho	0.372024	0.150714

Difference: (Department=Marketing)-(Department=Sales)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	1.1193	0.280950	Accept Ho	0.182049	0.057630
Difference < 0	1.1193	0.859525	Accept Ho	0.003314	0.000402
Difference > 0	1.1193	0.140475	Accept Ho	0.282022	0.095713

Difference: (Department=Marketing)-(Department=Sales)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Marketing)	4.5546	0.000005	Reject normality
Kurtosis Normality (Department=Marketing)	4.0389	0.000054	Reject normality
Omnibus Normality (Department=Marketing)	37.0573	0.000000	Reject normality
Skewness Normality (Department=Sales)	5.0858	0.000000	Reject normality
Kurtosis Normality (Department=Sales)	4.4525	0.000008	Reject normality
Omnibus Normality (Department=Sales)	45.6901	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	26.2697	0.000000	Reject equal variances
Modified-Levene Equal-Variance Test	1.6664	0.205205	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	130	40	270
Department=Sales	22	110	35	180

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Marketing	198.5	318.5	285	32.25933
Department=Sales	131.5	384.5	418	32.25933

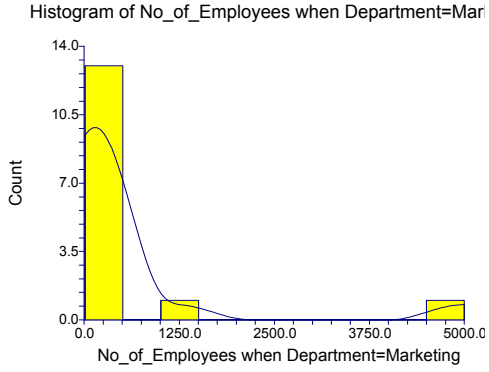
Number Sets of Ties = 11, Multiplicity Factor = 210

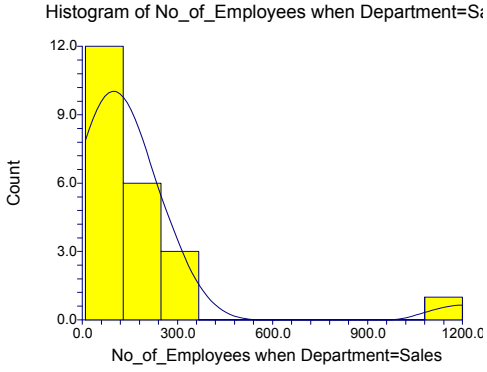
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			1.0385	0.299056	Accept Ho	1.0230	0.306327	Accept Ho
Diff<0			1.0385	0.850472	Accept Ho	1.0540	0.854049	Accept Ho
Diff>0			1.0385	0.149528	Accept Ho	1.0230	0.153163	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.218182	0.4299	.050	Accept Ho	0.6913
D(1)<D(2)	0.042424	0.4299	.025	Accept Ho	
D(1)>D(2)	0.218182	0.4299	.025	Accept Ho	

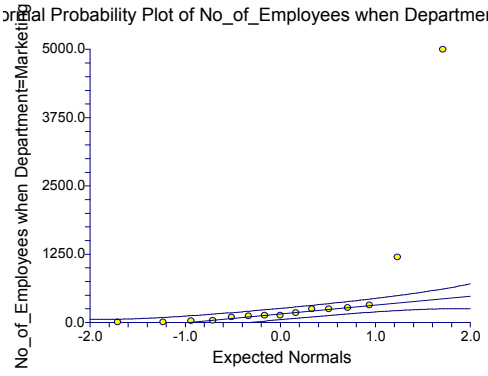
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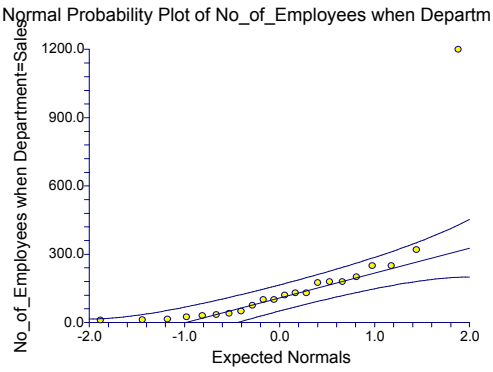


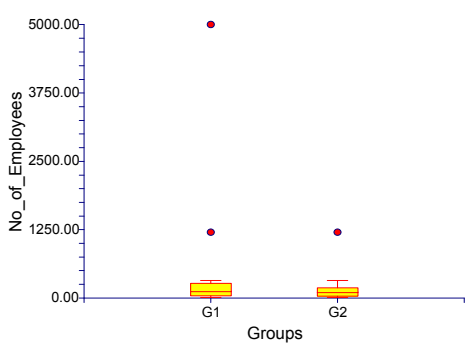


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	536.1334	1268.353	327.4872	-166.257	1238.524
Department=Technical	4	1307.5	2462.781	1231.391	-2611.335	5226.334

Note: T-alpha (Department=Marketing) = 2.1448, T-alpha (Department=Technical) = 3.1824

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	17	-771.3666	1547.635	870.9026	-2608.811	1066.077
Unequal	3.44	-771.3666	2770.2	1274.194	-4550.472	3007.738

Note: T-alpha (Equal) = 2.1098, T-alpha (Unequal) = 2.9659

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-0.8857	0.388131	Accept Ho	0.133201	0.038516
Difference < 0	-0.8857	0.194066	Accept Ho	0.213546	0.065684
Difference > 0	-0.8857	0.805934	Accept Ho	0.006271	0.000826

Difference: (Department=Marketing)-(Department=Technical)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-0.6054	0.582608	Accept Ho	0.074265	0.015864
Difference < 0	-0.6054	0.291304	Accept Ho	0.125211	0.028189
Difference > 0	-0.6054	0.708696	Accept Ho	0.015787	0.002869

Difference: (Department=Marketing)-(Department=Technical)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Marketing)	4.5546	0.000005	Reject normality
Kurtosis Normality (Department=Marketing)	4.0389	0.000054	Reject normality
Omnibus Normality (Department=Marketing)	37.0573	0.000000	Reject normality
Skewness Normality (Department=Technical)	0.0000		
Kurtosis Normality (Department=Technical)		1.000000	Cannot reject normality
Omnibus Normality (Department=Technical)			
Variance-Ratio Equal-Variance Test	3.7703	0.071388	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.9107	0.353305	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Marketing	15	130	40	270
Department=Technical	4	110		

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Marketing	33	153	150	9.973649
Department=Technical	27	37	40	9.973649

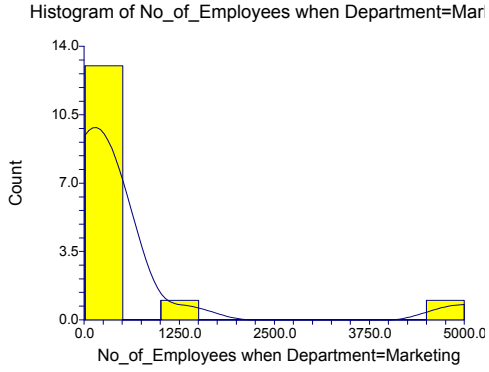
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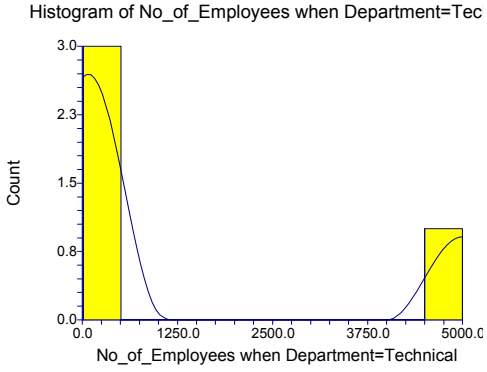
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			-0.3008	0.763573	Accept Ho	-0.2507	0.802077	Accept Ho
Diff<0			-0.3008	0.618214	Accept Ho	-0.3509	0.637178	Accept Ho
Diff>0			-0.3008	0.381786	Accept Ho	-0.2507	0.401038	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.233333	0.6872	.050	Accept Ho	0.9791
D(1)<D(2)	0.183333	0.6872	.025	Accept Ho	
D(1)>D(2)	0.233333	0.6872	.025	Accept Ho	

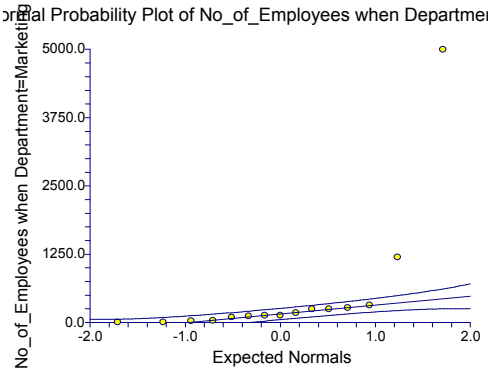
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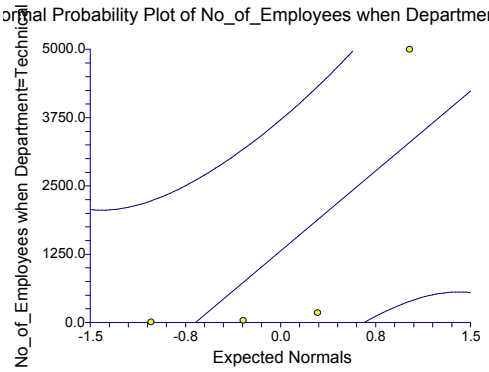


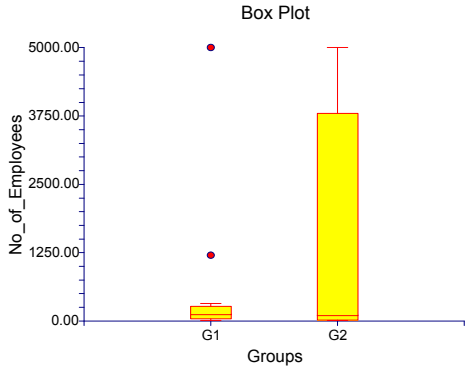


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Production	20	415.3	1108.604	247.8914	-103.5428	934.1428
Department=Purchasing	20	367.6	1092.994	244.401	-143.9371	879.1371

Note: T-alpha (Department=Production) = 2.0930, T-alpha (Department=Purchasing) = 2.0930

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	38	47.7	1100.827	348.1121	-657.016	752.416
Unequal	37.99	47.7	1556.804	348.1121	-657.0207	752.4207

Note: T-alpha (Equal) = 2.0244, T-alpha (Unequal) = 2.0244

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.1370	0.891735	Accept Ho	0.052047	0.010644
Difference < 0	0.1370	0.554133	Accept Ho	0.037582	0.006974
Difference > 0	0.1370	0.445867	Accept Ho	0.065490	0.014114

Difference: (Department=Production)-(Department=Purchasing)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.1370	0.891735	Accept Ho	0.052047	0.010644
Difference < 0	0.1370	0.554133	Accept Ho	0.037582	0.006974
Difference > 0	0.1370	0.445867	Accept Ho	0.065490	0.014114

Difference: (Department=Production)-(Department=Purchasing)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Production)		5.2257	0.000000Reject normality
Kurtosis Normality (Department=Production)	4.5328	0.000006	Reject normality
Omnibus Normality (Department=Production)	47.8543	0.000000	Reject normality
Skewness Normality (Department=Purchasing)		5.4208	0.000000Reject normality
Kurtosis Normality (Department=Purchasing)	4.6798	0.000003	Reject normality
Omnibus Normality (Department=Purchasing)	51.2858	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	1.0288	0.951356	Cannot reject equal variances
Modified-Levene Equal-Variance Test	0.0247	0.875905	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Production	20	130	40	190
Department=Purchasing	20	130	70	186

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Production	199.5	409.5	410	36.88339
Department=Purchasing	200.5	410.5	410	36.88339

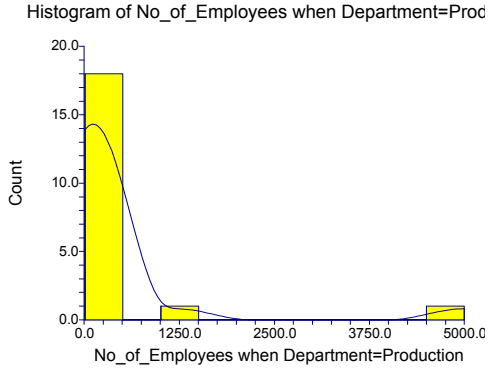
Number Sets of Ties = 13, Multiplicity Factor = 294

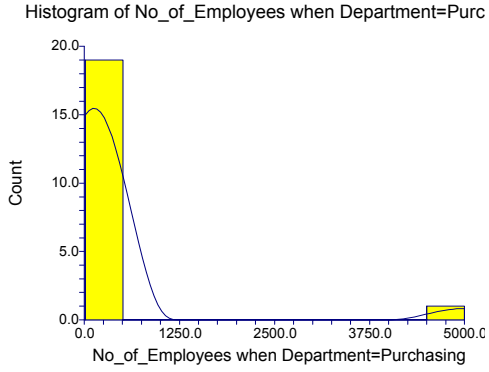
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			-0.0136	0.989184	Accept Ho	0.0000	1.000000	Accept Ho
Diff<0			-0.0136	0.494592	Accept Ho	0.0000	0.500000	Accept Ho
Diff>0			-0.0136	0.505408	Accept Ho	-0.0271	0.510815	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.100000	0.4071	.050	Accept Ho	1.0000
D(1)<D(2)	0.100000	0.4071	.025	Accept Ho	
D(1)>D(2)	0.050000	0.4071	.025	Accept Ho	

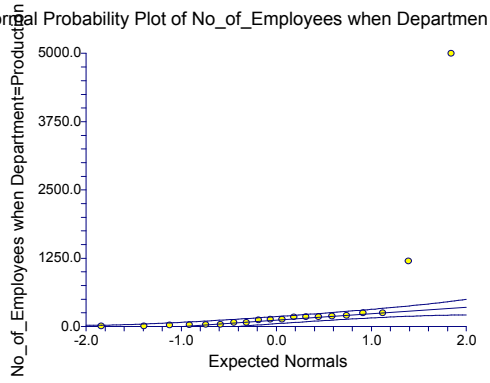
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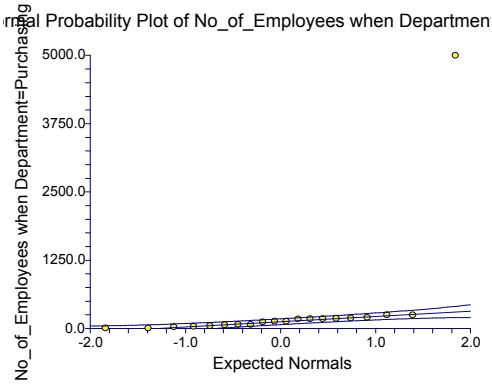


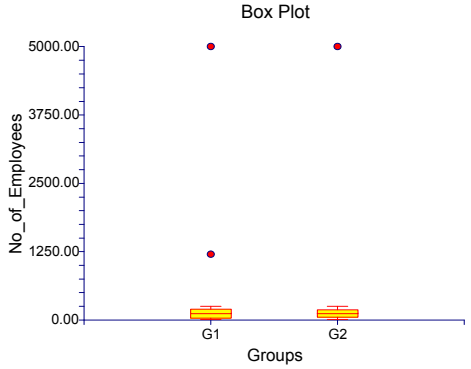


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Production	20	415.3	1108.604	247.8914	-103.5428	934.1428
Department=Sales	22	164.8636	247.4641	52.75953	55.14418	274.5831

Note: T-alpha (Department=Production) = 2.0930, T-alpha (Department=Sales) = 2.0796

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	40	250.4364	784.8101	242.4727	-239.6193	740.492
Unequal	20.72	250.4364	1135.888	253.4438	-277.0599	777.9326

Note: T-alpha (Equal) = 2.0211, T-alpha (Unequal) = 2.0813

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	1.0328	0.307882	Accept Ho	0.172101	0.056657
Difference < 0	1.0328	0.846059	Accept Ho	0.003901	0.000442
Difference > 0	1.0328	0.153941	Accept Ho	0.264525	0.092088

Difference: (Department=Production)-(Department=Sales)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.9881	0.334486	Accept Ho	0.156405	0.048305
Difference < 0	0.9881	0.832757	Accept Ho	0.004639	0.000569
Difference > 0	0.9881	0.167243	Accept Ho	0.245453	0.080597

Difference: (Department=Production)-(Department=Sales)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Production)		5.2257	0.000000Reject normality
Kurtosis Normality (Department=Production)	4.5328	0.000006	Reject normality
Omnibus Normality (Department=Production)	47.8543	0.000000	Reject normality
Skewness Normality (Department=Sales)	5.0858	0.000000	Reject normality
Kurtosis Normality (Department=Sales)	4.4525	0.000008	Reject normality
Omnibus Normality (Department=Sales)	45.6901	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	20.0691	0.000000	Reject equal variances
Modified-Levene Equal-Variance Test	1.0312	0.315976	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Production	20	130	40	190
Department=Sales	22	110	35	180

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Production	238.5	448.5	430	39.63641
Department=Sales	201.5	454.5	473	39.63641

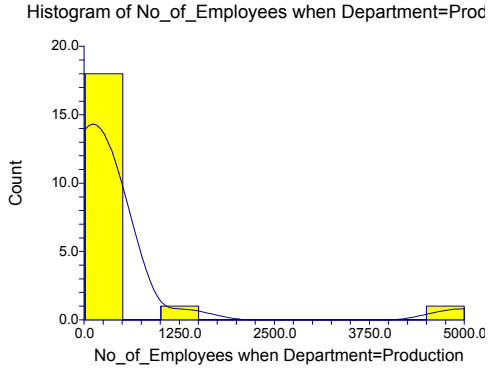
Number Sets of Ties = 14, Multiplicity Factor = 264

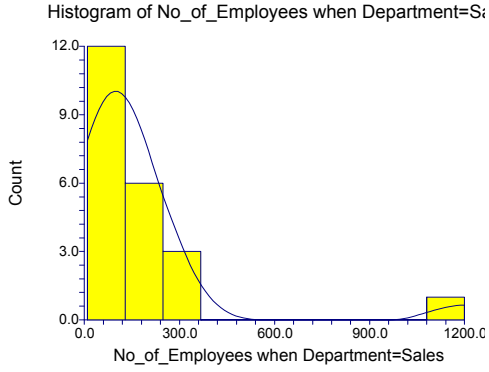
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Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			0.4667	0.640684	Accept Ho	0.4541	0.649737	Accept Ho
Diff<0			0.4667	0.679658	Accept Ho	0.4794	0.684158	Accept Ho
Diff>0			0.4667	0.320342	Accept Ho	0.4541	0.324868	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.100000	0.3980	.050	Accept Ho	0.9991
D(1)<D(2)	0.054545	0.3980	.025	Accept Ho	
D(1)>D(2)	0.100000	0.3980	.025	Accept Ho	

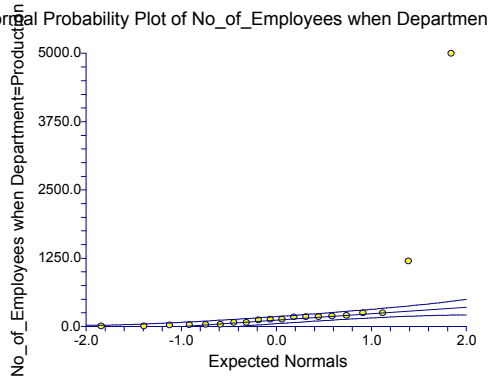
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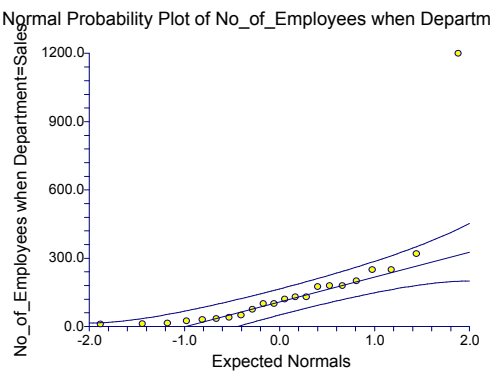


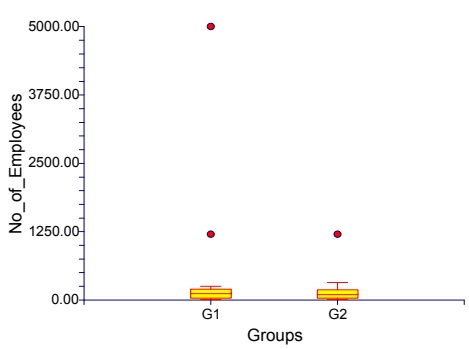


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Production	20	415.3	1108.604	247.8914	-103.5428	934.1428
Department=Technical	4	1307.5	2462.781	1231.391	-2611.335	5226.334

Note: T-alpha (Department=Production) = 2.0930, T-alpha (Department=Technical) = 3.1824

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	22	-892.2	1374.226	752.6946	-2453.193	668.7931
Unequal	3.25	-892.2	2700.795	1256.094	-4722.867	2938.467

Note: T-alpha (Equal) = 2.0739, T-alpha (Unequal) = 3.0497

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-1.1853	0.248529	Accept Ho	0.205411	0.069939
Difference < 0	-1.1853	0.124264	Accept Ho	0.309970	0.112685
Difference > 0	-1.1853	0.875736	Accept Ho	0.002596	0.000288

Difference: (Department=Production)-(Department=Technical)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-0.7103	0.525154	Accept Ho	0.082401	0.017780
Difference < 0	-0.7103	0.262577	Accept Ho	0.142072	0.032403
Difference > 0	-0.7103	0.737423	Accept Ho	0.012780	0.002310

Difference: (Department=Production)-(Department=Technical)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Production)		5.2257	0.000000Reject normality
Kurtosis Normality (Department=Production)	4.5328	0.000006	Reject normality
Omnibus Normality (Department=Production)	47.8543	0.000000	Reject normality
Skewness Normality (Department=Technical)	0.0000		
Kurtosis Normality (Department=Technical)		1.000000	Cannot reject normality
Omnibus Normality (Department=Technical)			
Variance-Ratio Equal-Variance Test	4.9351	0.021230	Reject equal variances
Modified-Levene Equal-Variance Test	1.5698	0.223386	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Production	20	130	40	190
Department=Technical	4	110		

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Production	41.5	251.5	250	12.88185
Department=Technical	38.5	48.5	50	12.88185

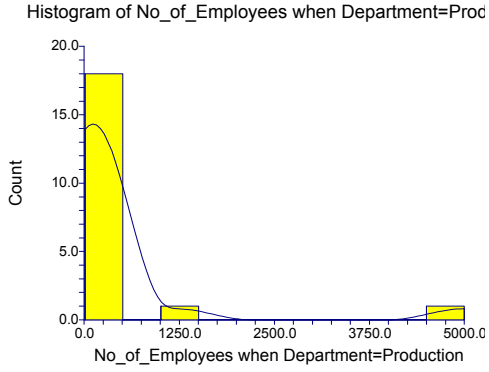
Number Sets of Ties = 7, Multiplicity Factor = 60

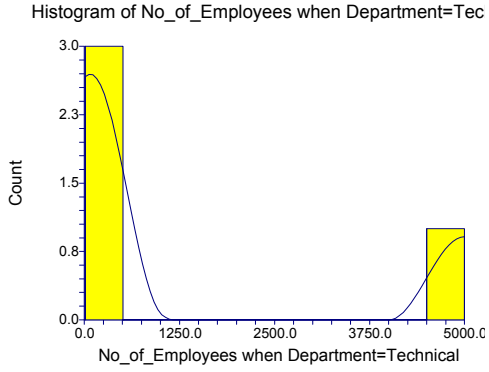
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			-0.1164	0.907302	Accept Ho	-0.0776	0.938123	Accept Ho
Diff<0			-0.1164	0.546349	Accept Ho	-0.1553	0.561691	Accept Ho
Diff>0			-0.1164	0.453651	Accept Ho	-0.0776	0.469062	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.200000	0.6729	.050	Accept Ho	0.9985
D(1)<D(2)	0.200000	0.6729	.025	Accept Ho	
D(1)>D(2)	0.200000	0.6729	.025	Accept Ho	

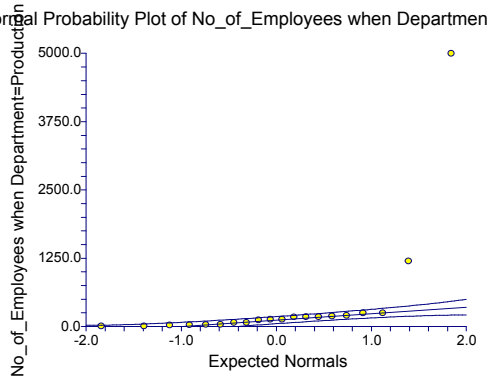
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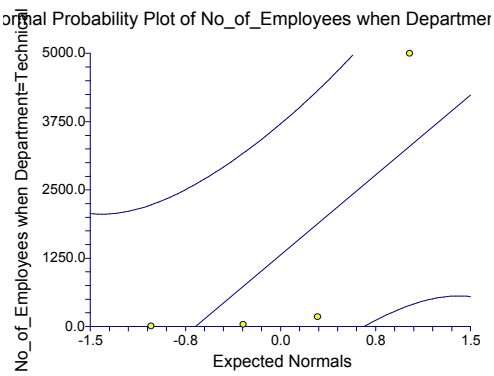


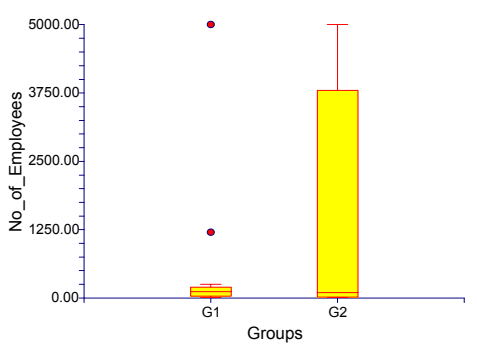


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Purchasing	20	367.6	1092.994	244.401	-143.9371	879.1371
Department=Sales	22	164.8636	247.4641	52.75953	55.14418	274.5831

Note: T-alpha (Department=Purchasing) = 2.0930, T-alpha (Department=Sales) = 2.0796

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	40	202.7364	774.3401	239.2379	-280.7816	686.2543
Unequal	20.77	202.7364	1120.658	250.0308	-317.58723.0527	

Note: T-alpha (Equal) = 2.0211, T-alpha (Unequal) = 2.0810

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.8474	0.401800	Accept Ho	0.131318	0.039313
Difference < 0	0.8474	0.799100	Accept Ho	0.006603	0.000828
Difference > 0	0.8474	0.200900	Accept Ho	0.208475	0.065882

Difference: (Department=Purchasing)-(Department=Sales)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	0.8108	0.426648	Accept Ho	0.120924	0.034276
Difference < 0	0.8108	0.786676	Accept Ho	0.007550	0.001010
Difference > 0	0.8108	0.213324	Accept Ho	0.194821	0.058581

Difference: (Department=Purchasing)-(Department=Sales)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Purchasing)		5.4208	0.000000Reject normality
Kurtosis Normality (Department=Purchasing)	4.6798	0.000003	Reject normality
Omnibus Normality (Department=Purchasing)	51.2858	0.000000	Reject normality
Skewness Normality (Department=Sales)	5.0858	0.000000	Reject normality
Kurtosis Normality (Department=Sales)	4.4525	0.000008	Reject normality
Omnibus Normality (Department=Sales)	45.6901	0.000000	Reject normality
Variance-Ratio Equal-Variance Test	19.5079	0.000000	Reject equal variances
Modified-Levene Equal-Variance Test	0.6333	0.430861	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Purchasing	20	130	70	186
Department=Sales	22	110	35	180

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Purchasing	240.5	450.5	430	39.63964
Department=Sales	199.5	452.5	473	39.63964

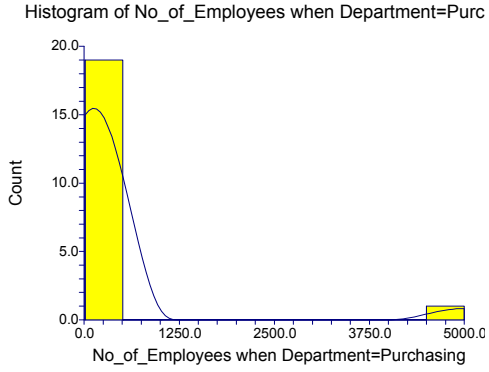
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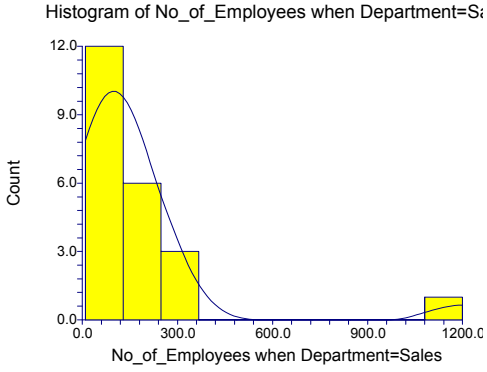
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			0.5172	0.605045	Accept Ho	0.5045	0.613878	Accept Ho
Diff<0			0.5172	0.697477	Accept Ho	0.5298	0.701865	Accept Ho
Diff>0			0.5172	0.302523	Accept Ho	0.5045	0.306939	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.122727	0.3980	.050	Accept Ho	0.9874
D(1)<D(2)	0.054545	0.3980	.025	Accept Ho	
D(1)>D(2)	0.122727	0.3980	.025	Accept Ho	

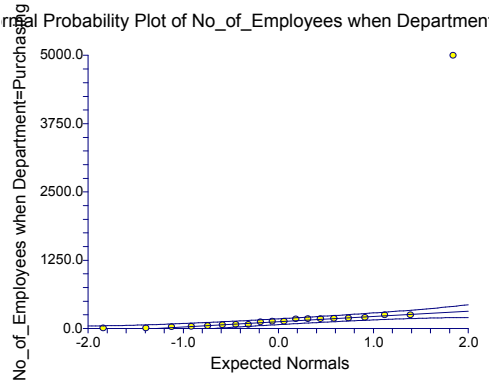
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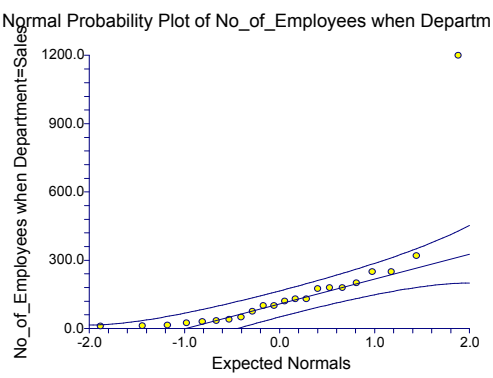


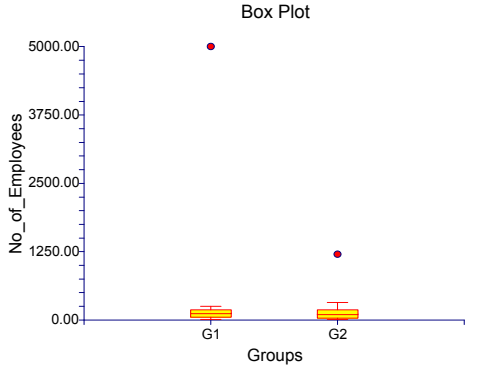


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Purchasing	20	367.6	1092.994	244.401	-143.9371	879.1371
Department=Technical	4	1307.5	2462.781	1231.391	-2611.335	5226.334

Note: T-alpha (Department=Purchasing) = 2.0930, T-alpha (Department=Technical) = 3.1824

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	22	-939.9	1363.384	746.7563	-2488.578	608.7779
Unequal	3.24	-939.9	2694.426	1255.41	-4772.729	2892.929

Note: T-alpha (Equal) = 2.0739, T-alpha (Unequal) = 3.0530

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-1.2586	0.221352	Accept Ho	0.225648	0.079463
Difference < 0	-1.2586	0.110676	Accept Ho	0.335448	0.126400
Difference > 0	-1.2586	0.889324	Accept Ho	0.002079	0.000222

Difference: (Department=Purchasing)-(Department=Technical)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-0.7487	0.504689	Accept Ho	0.085966	0.018658
Difference < 0	-0.7487	0.252345	Accept Ho	0.148999	0.034243
Difference > 0	-0.7487	0.747655	Accept Ho	0.011763	0.002117

Difference: (Department=Purchasing)-(Department=Technical)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Purchasing)		5.4208	0.000000Reject normality
Kurtosis Normality (Department=Purchasing)	4.6798	0.000003	Reject normality
Omnibus Normality (Department=Purchasing)	51.2858	0.000000	Reject normality
Skewness Normality (Department=Technical)	0.0000		
Kurtosis Normality (Department=Technical)		1.000000	Cannot reject normality
Omnibus Normality (Department=Technical)			
Variance-Ratio Equal-Variance Test	5.0771	0.018972	Reject equal variances
Modified-Levene Equal-Variance Test	1.7775	0.196105	Cannot reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Purchasing	20	130	70	186
Department=Technical	4	110		

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Purchasing	43.5	253.5	250	12.88185
Department=Technical	36.5	46.5	50	12.88185

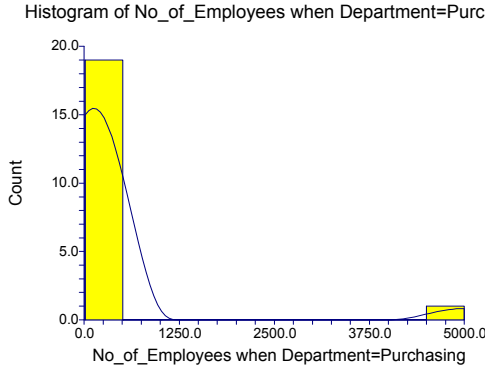
Number Sets of Ties = 7, Multiplicity Factor = 60

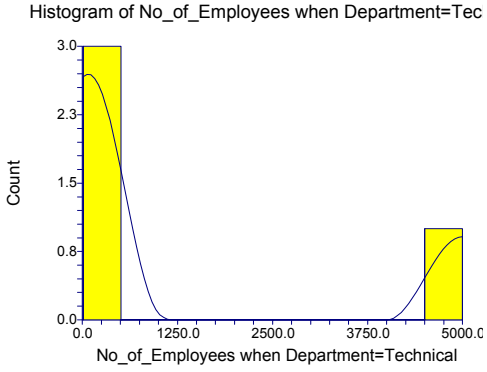
	Exact Probability		Approximation Without Correction			Approximation With Correction		
Alternative Hypothesis	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)	Z-Value	Prob Level	Decision (5%)
Diff<>0			-0.2717	0.785853	Accept Ho	-0.2329	0.815850	Accept Ho
Diff<0			-0.2717	0.607074	Accept Ho	-0.3105	0.621915	Accept Ho
Diff>0			-0.2717	0.392926	Accept Ho	-0.2329	0.407925	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.300000	0.6729	.050	Accept Ho	0.8780
D(1)<D(2)	0.200000	0.6729	.025	Accept Ho	
D(1)>D(2)	0.300000	0.6729	.025	Accept Ho	

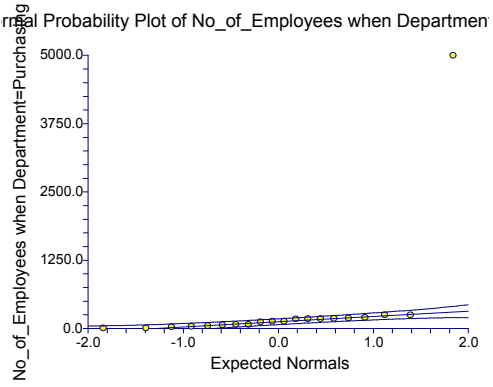
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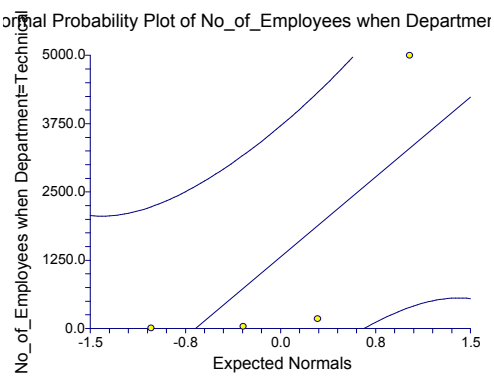


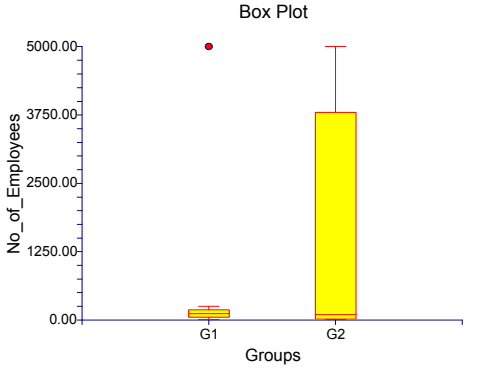


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Descriptive Statistics Section

Variable	Count	Mean	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Department=Sales	22	164.8636	247.4641	52.75953	55.14418	274.5831
Department=Technical	4	1307.5	2462.781	1231.391	-2611.335	5226.334

Note: T-alpha (Department=Sales) = 2.0796, T-alpha (Department=Technical) = 3.1824

Confidence-Limits of Difference Section

Variance Assumption	DF	Mean Difference	Standard Deviation	Standard Error	95% LCL of Mean	95% UCL of Mean
Equal	24	-1142.636	900.969	489.7283	-2153.386	-131.8869
Unequal	3.01	-1142.636	2475.183	1232.52	-5056.955	2771.683

Note: T-alpha (Equal) = 2.0639, T-alpha (Unequal) = 3.1759

Equal-Variance T-Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-2.3332	0.028345	Reject Ho	0.609979	0.343705
Difference < 0	-2.3332	0.014173	Reject Ho	0.732955	0.450490
Difference > 0	-2.3332	0.985827	Accept Ho	0.000045	0.000003

Difference: (Department=Sales)-(Department=Technical)

Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	T-Value	Prob Level	Decision (5%)	PowerPower (Alpha=.05)	(Alpha=.01)
Difference <> 0	-0.9271	0.422042	Accept Ho	0.102788	0.022646
Difference < 0	-0.9271	0.211021	Accept Ho	0.181056	0.042514
Difference > 0	-0.9271	0.788979	Accept Ho	0.008072	0.001443

Difference: (Department=Sales)-(Department=Technical)

Tests of Assumptions Section

Assumption	Value	Probability	Decision(5%)
Skewness Normality (Department=Sales)	5.0858	0.000000	Reject normality
Kurtosis Normality (Department=Sales)	4.4525	0.000008	Reject normality
Omnibus Normality (Department=Sales)	45.6901	0.000000	Reject normality
Skewness Normality (Department=Technical)	0.0000		
Kurtosis Normality (Department=Technical)		1.000000	Cannot reject normality
Omnibus Normality (Department=Technical)			
Variance-Ratio Equal-Variance Test	99.0438	0.000000	Reject equal variances
Modified-Levene Equal-Variance Test	5.9688	0.022295	Reject equal variances

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Median Statistics

Variable	Count	Median	95% LCL of Mean	95% UCL of Mean
Department=Sales	22	110	35	180
Department=Technical	4	110		

Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians

Variable	Mann Whitney U	W Sum Ranks	Mean of W	Std Dev of W
Department=Sales	43	296	297	14.04958
Department=Technical	45	55	54	14.04958

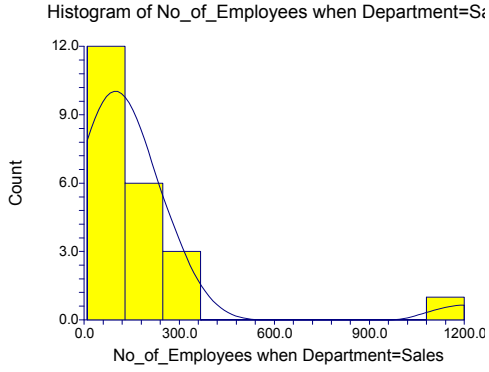
Number Sets of Ties = 6, Multiplicity Factor = 54

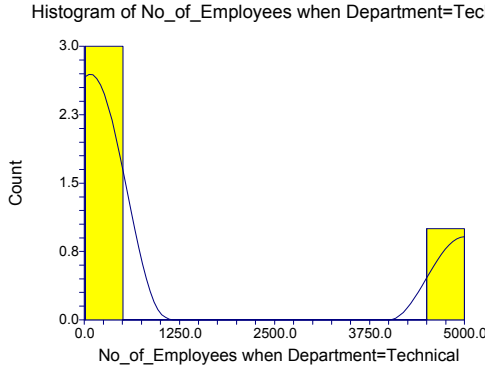
Alternative Hypothesis	Exact Probability Prob Level	Exact Probability Decision (5%)	Approximation Without Correction Z-Value	Approximation Without Correction Prob Level	Approximation Without Correction Decision (5%)	Approximation With Correction Z-Value	Approximation With Correction Prob Level	Approximation With Correction Decision (5%)
Diff<>0			0.0712	0.943257	Accept Ho	0.0356	0.971611	Accept Ho
Diff<0			0.0712	0.471629	Accept Ho	0.0356	0.485805	Accept Ho
Diff>0			0.0712	0.528371	Accept Ho	0.1068	0.542512	Accept Ho

Kolmogorov-Smirnov Test For Different Distributions

Alternative Hypothesis	Dmn Criterion Value	Reject Ho if Greater Than	Test Alpha Level	Decision (Test Alpha)	Prob Level
D(1)<>D(2)	0.250000	0.6688	.050	Accept Ho	0.9582
D(1)<D(2)	0.250000	0.6688	.025	Accept Ho	
D(1)>D(2)	0.204545	0.6688	.025	Accept Ho	

Plots Section





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