A REAL ESTATE MANAGEMENT INFORMATION SYSTEM

Case Study: Property Masters Uganda

BY

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Abstract

This is a documentation of the computerized approach to improve record keeping and management decision-making practices of a real estate agency by using statistical summary data analysis and inference. The system was designed to improve on the efficiency of such a company's management through easy and quick access to all records. The computer package is named **REMIS**. The **REMIS** system has modules that provide tools to analyze data and make inferences about the data for management decision-making.

REMIS also provides a centralized management of a company's data by storing it in a database system where the data is managed by the database management system and all access to the data is through the database management system providing a key to effective data processing. This also reduces redundancies, making data management more efficient.

The system takes in sample/population data and calculates descriptive statistics like mean, variance, standard deviation, coefficient of variation, and the mean absolute deviation. This helps avoid the possible human errors of computing statistics thereby becoming reliable.

The system also takes in sample bivariate values for random variables and makes calculations for the Pearson product moment linear correlation coefficient and the linear regression line that can be used for testing the relationship that exists between two random variables and forecasting respectively. The package also takes in table values to calculate Chi-square tests, a non-parametric test of statistical significance for bivariate tabular analysis. Any appropriately performed test of statistical significance lets you know the degree of confidence you can have in accepting or rejecting a hypothesis.

The **REMIS** also offers secure storage of a company's data by ensuring that only authorized users use the system and providing backup facilities for the data.

In summary, a real time record keeping and analysis system was realized from the study. The following major contributions were made as a result of the study:

1. A linear regression forecasting system for any amount of data
2. An efficient record keeping system allowing data entry, update and deletion, while checking the consistency of the data.
3. Various descriptive and inferential statistics can be generated using the system
4. A statistical hypothesis testing tool for a given set of sample data
5. An automatic record and report generation tool
6. A database backup facility for the company’s data.

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CHAPTER ONE

Introduction

1.0 Management information system:

Information System: Is an open, purposive system that produces information using the input /output cycle. A purposive system is a system that seeks a set of related goals (**Accoff, Russell**, July 1971). An **information system** consists a set of devices, procedures and operating systems working around a criterion to process information and communicate it to the user for planning, control, decision-making and performance.

Management Information System: Is a combination of information systems. It is a person to machine system and of highly integrated information consisting of functions designed to provide management with a comprehensive picture of specific operations.

The key component of a management information system is a database. A **database** is a shared collection of logically related data and a description of this data to meet the information needs of an organization. A database integrates logically related data with a minimum amount of duplication.

When the information needs of management of a real estate agency are analyzed, they consist of records together with the properties that describe these records. Between these records are also logical relationships describing associations between these records. Property Masters Uganda is a real estate agency that specializes in property management by taking an immediate role between owners who wish to let or sell their properties and clients who want to rent or buy these properties. The company has a number of branches all over the country. However, the company is becoming so large that more and more administration staff is being employed to cope with the ever-increasing amount of paper work.

Further more, the communication and sharing of information between departments in the same branch is poor. The Kampala branch manager feels that too many mistakes are usually made and that reports produced do not provide management with the right information since they are prepared manually. Management does not usually have access to all the data pertinent to a decision. Consequently, management

must frequently deal with incomplete information. This is especially true when the data needed by the manager to make a decision is too much and the manager cannot look at each item of the data. Management therefore requires statistical computer packages designed in line with property management to enhance the ability to make prompt statistical analyses and summarize data in support of proper management decision-making.

1.1 Background:

Property Masters Uganda is Uganda's leading real estate dealer. The first branch office of the company was opened in Kampala in 19… Since then, the company has steadily grown and now has 12 branches in the major towns of the country. The company is now so large that more and more staff is being employed to cope with the increasing amount of paper work and business transactions with clients all over the country.

The company currently uses the manual filing system to hold all external and internal correspondence relating to clients and staff. A number of files concerning different transactions and information are labeled and stored in cabinets at a branch. For security purposes, the cabinets have locks. Whenever reference is to be made in the files, one has to go through the filing system, starting from the first entry until he or she finds what they want. This system used to work well when the company's business transactions and the number of staff were still small. However, with the increase in the number of transactions, the filing system is breaking down since different transactions have to be cross-referenced and processed.

Clients, staff and the manager of a branch nowadays want more and more information for decision-making. A need has also arisen to produce detailed monthly, quarterly and annual reports concerning the company's transactions, expenses and turnover. Due to the isolation of data in different files, it's difficult to access data that should be available for management to take decisions and to easily answer client's enquiries. Such data cannot be easily statistically analyzed to make inferences about the data items handled by a branch for proper management.

1.2 Problem Statement:

With the increase in the number of transactions at a branch, the total workload of the staff has become so big that the company is employing more staff to handle the ever-increasing amount of paper work. There is also a legal requirement to produce detailed monthly, quarterly and annual reports. Management also needs summarized statistical data in order to have access to all the data pertinent to a decision. Inferential statistics always act as a tool to have a look at all the data of an organization in a precise, summarized form.

Clearly, the manual system is inadequate for this type of work. The file system was originally developed in response to the needs of the company for more efficient data access. However, rather than establish a centralized store for a branch's operational data, a decentralized approach was taken, where each department stores and controls its own data. This kind of system has the following disadvantages:

i. Data is isolated making it more difficult to access.
ii. Most data items handled by more than one department are duplicated in each department leading to the wastage of time and resources.
iii. The data is not secure since any time the files can be stolen or can catch fire.

To become more effective, a new approach to the information needs of the company is required. A computer based information system can act as the most efficient way to handle all the information needs of Property Masters, using a database and a database management system. The advantages of using a computer in a management information system are:

i. When used as a data storage and retrieval device, the computer acts as the data librarian.
ii. The computer provides processing capabilities for the production of information.
iii. The computer serves as a communication device to obtain data or information from other computers.
iv. The computer provides information by producing tables, reports, charts, graphs, and formatted documents.
v. Statistical data can be easily analyzed using a computer.

1.3 Aims of the study:

This study was mainly aimed at raising other researcher's interest in the design of management information systems for real estates in Uganda with statistical applications.

1.4 Objectives of the Study:

i. Handle details for rent and sale of property from clients.
ii. Carry out data analysis and statistical inference.
iii. Allow different departments of a branch to access specific files through application programs designed specially for them.
iv. Produce financial and customer reports with detailed statistical analysis.
v. Handle staff's details and their different transactions with clients.
vi. Provide security to the company's data at a given branch.

1.5 Scope of the study:

The system covered the different departments at a branch. These included:

- The sales department: responsible for the selling and renting of properties. It also handles inquiries from clients.
- The contracts department: responsible for handling the lease agreements associated with the properties for rent.
- The payroll department: stores the details relating to each member of staff's salary.
- The personnel department: stores staff details.

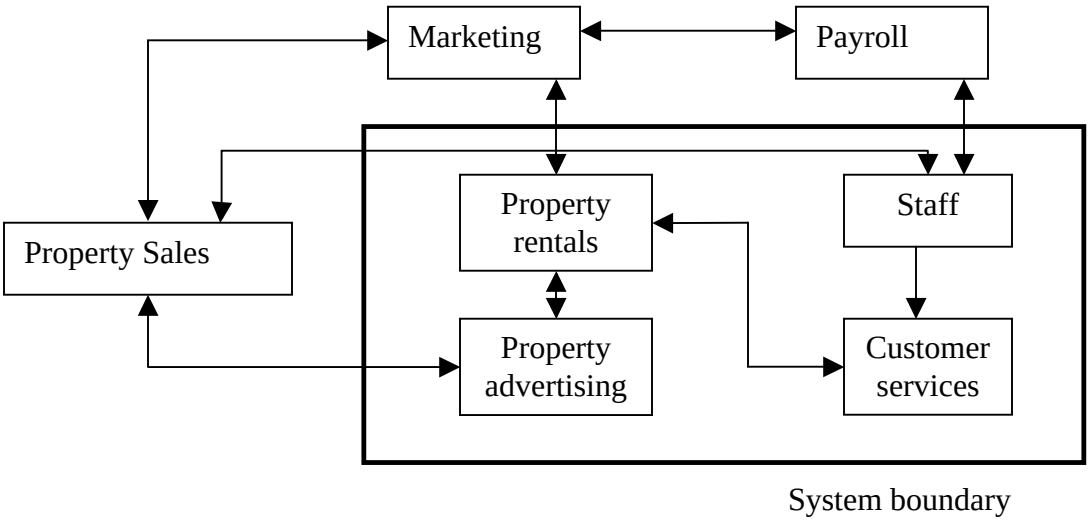


Figure 1.0: Scope of the study

CHAPTER TWO

Literature Review

2.0 Definition of a system:

Jerry FitzGerald and **Ardra F.FitzGerald** define a system as a network of interrelated procedures that are joined together to perform an activity or accomplish a specific objective. They noted that, a system could be classified as being open or closed. A **closed system** is one which automatically controls or modifies its own operation by responding to data generated by the system itself. It seldom if ever interacts with its environment to receive input or generate output. (**James C.Wetherbe**)

An **open system** is one, which does not provide for its own control or modification. It does not supervise itself so it needs to be supervised by people.

2.1 Management Information system:

Kroenke. Hatch defines a management information system as the development and use of effective information systems in the organization. He adds on that an information system is effective if it helps to accomplish the goals of the people and the organization that use it. An **Information system** is an open system that seeks a set of related goals, producing information using the input-output cycle**. (Acoff, Russell L, 1971)**

James C.Wetherbe 1979 defined a system as being a collection or arrangement of entities or things related or connected such that they form a unity or whole.

2.2 The Need for Real Estate Management Information System:

In their study of the role computer based management information systems can play in real estates in Asia, **Vijayanand Kommaluri** and **Venigandla Kishore Babu** (2003) noted that, the unprecedented population growth coupled with unplanned developmental activities has led to urbanization, which lacks infrastructure facilities. Part of the problem with today's urban structure is that it was built at a time when planning awareness was substantially different from today's. Consequently, in trying to retrofit existing system to achieve today's urban performance objectives, a major issue of

concern today in the survival of our cities is the problem of real estate management. Real estate information management system is the essential part for a real estate enterprise and is very important for the decision-makers and managers.

They carried out a study on part of Hyderabad city area in developing Real Estate Management Information System (RIMS). In order to pose questions in finding a home acceptable to all family at the right place at the right cost; a real estate management information system with an appropriate decision support system is necessary. Factors influencing decision-making were allocated weights and scores reflecting their importance. Once the weighting process had been completed, the data selected were combined in a GIS using a multi-criteria modeling Technique. The Multi Criteria Evaluation (MCE) technique allows map layers to be weighted to reflect their relative importance. A range of criteria that will influence the decision must be defined. The criteria can be thought as data layers for a GIS. Therefore MCE provides a framework for exploring solutions to decision-making problems.

Robert T. Vanderwerf laments that the task of real estate management and facility management is experiencing major change. Today, technology is breaking down the walls of how these tasks have traditionally been conducted. In more and more organizations business practices are evolving in such a way as to integrate new technologies as never before. (http://www.facilitycity.com/busfac/bf_03_05_cover2.asp)

Up to now it's been a very difficult road for the real estate and facilities professional, because the software packages relied upon were simple point solutions that did not cover the whole real estate process. Some existing software was large and cumbersome, and wasn't specifically tailored to real estate, meaning it didn't handle real estate processes particularly well; on top of that it was often very expensive and difficult to use. Existing software solutions were typically very costly to customize, and mostly incapable of handling correlative problems such as portfolio management, site acquisition and disposition, move and build-out management, property maintenance, property accounting, and lease administration. As a result, a functional solution that may have actually worked for its intended users was likely to also contain excess capability that was intended for a different group within the real estate or facilities organization. In

effect, these single function and extremely costly solutions were actually creating an environment characterized by redundancy and waste. This endeavor is fast becoming real estate and facility management's answer to doing more with less.

Robert T. Vanderwerf notes that, the two major areas of concern are identifying the most suitable properties, and negotiating the best possible lease for each property. In order to find the most appropriate properties, and optimize the company's real estate portfolio, an extensive amount of information needs to be gathered. Since many companies do not have easily accessible information regarding the properties they have in their own portfolios, analyzing and searching internally for suitable properties would be an ideal but difficult first step. The basic premise driving the search derives from the old adage that information is power. In this case, information translates into successful portfolio management.

He also argues that, the challenge to portfolio management is to provide a central information portal that instantly lets you access and manipulate data in multiple ways. Today there are enterprise class solutions designed specifically for the real estate and facilities professional. While many of these solutions are offered in the traditional delivery model of enterprise software, some are offered as a service for a fraction of the cost of installing and supporting software within the network. The technology also provides the most granular control over the shared data and who has access to it

Ray Viator Midwest (Real Estate News November 1st, 2001) reported that in order to remain competitive while also addressing the needs of clients and tenants, the real estate industry is embracing a variety of technology applications ranging from management information systems, Web-based and wireless programs and building security.

”Another important factor in security technology is the need for user-friendly systems. The more complicated the system, the more likely the operator won't be able to maintain It.” says Gene Sandburg, chairman of Kastle Systems, one of the largest security technology providers in the real estate industry. (Real Estate News November 1st, 2001)

2.3 Managing mountains of information

One of the fastest growing technology applications in the real estate industry involves improving the ability of building owners, property managers, corporate real estate departments and others to manage the vast amount of documentation involved in leasing and managing both a large number of properties and a large amount of space. The overall thrust of most of the services is to get real estate information on leased or owned property into an electronic format in order to be able to administer properties, process, pay and/or collect rent.

Thomas Ricci, vice president of the implementation services division of Management Reports International, says that while the real estate industry has usually been slow in adopting new technology, "now companies are being forced to adopt new technology because of the growing recognition that their clients are more sophisticated and require greater efficiencies and more information. " One of the oldest providers in this relatively new field is National Facilities Group; whose product SLIM (Strategic Lease Information Management) reduces the costs associated with managing complex portfolios of leased and owned properties. (Real Estate News November 1st, 2001)

One of the first challenges addressed by many of the latest real estate management information systems is the need for companies to be able to convert thousands of paper documents - from leases to contracts - into a secure digital form. Once in electronic or digital form, Brown says, the software program needs to be able to integrate with the company's other accounting and management information systems, regardless of whether those systems are from SAP, PeopleSoft, Oracle or another third-party supplier. In addition, the information needs to be linked to the company's other applications for fixed assets, maintenance and repairs.

2.4 Improving productivity

Another factor driving the rise in technology applications in the real estate industry, says Robert Cummings of SS&C Technologies, is the need to be able to handle more

properties and more information with less people. Companies are recognizing that with increased activity, they need more information, faster in order to stay competitive.

In addition, he notes that, staff members are being asked to do more, especially in larger companies. “Companies want the ability to do more analysis such as a lease analysis when renegotiating for a renewal.” Cummings says that the management information systems need to be robust and be able to handle many assumptions for a variety of factors, including expense fluctuations, especially utilities. Rather than offer just today's price, they need to be able to offer a package that gives an overview of operating costs over a period of time. Everyone is nervous about utility costs. The system needs to allow the ability to gather data on utilities, as well as property taxes, sales reporting and even the Consumer Price Index (CPI) and then integrate all that information. Cummings further argues that, the increased use of management information systems in the real estate industry has created new benefits. These systems have become collaboration vehicles throughout the enterprise. As commercial systems have become more open, it has enabled different systems and applications to talk with others

The proliferation of information management systems for the real estate industry, however, has also raised some concerns.

2.5 The next wave: Going wireless

Looking to the near future, most industry observers say wireless is probably next big technology area that is likely to have a dramatic impact on the real estate industry. Wireless technology will allow people in the field to get information into their databases without having to be physically tethered to the corporate database.

From management information systems to new security technology, the real estate industry is quickly beginning to recognize the important role that technology can play in improving their operations and reducing costs.

CHAPTER THREE

Methodology

3.0 Introduction:

This chapter describes the methods of forecasting and hypothesis testing. It describes the different methods the system uses to calculate inferential statistics and the tools used in designing and running the program.

3.1 Area of study:

The study aimed at designing a management information system for a real estate agency with statistical capabilities that could help a manager reduce the extent and uncertainty associated with decision making. The package has been designed with statistical analysis tools for developing a better understanding of variables surrounding a decision making process. The package can structure unorganized detail data into descriptive measures such as range, mean, mode and median on data such as employee salaries, total income and expenses. The package was also designed to compare two groups of data e.g. income and expenditure, and make forecasts based on the current data.

3.2 System method of design

The design of the new system involved three stages. These included

1. Overall system design
2. Database design
3. **REMIS** application design

The overall system design involved the analysis of the existing system and the design of the new system.

3.3 Overall System design

The first part of the system development life cycle consisted of the analysis of the existing system. A detail study of the various components and operations of the current

system was undertaken. At this stage, the analyst worked closely with the staff of the company to study the business processes.

A structured questionnaire was administered to members of staff in different departments at a branch to capture the necessary facts about the current system. The key questions at this stage were:

- What is being done;
- How it is done;
- How frequently it occurs;
- Volume of transactions;
- How well the specified task is being performed;
- Existence of a problem;
- If a problem exists, its causes and size.

It also aimed at defining decision-making associated with workflow together with the information needed to support decision-making.

Output of this analysis consisted of functional requirements and isolation of deficiencies in the current system.

After determining the deficiencies in the current system, solutions to these deficiencies were designed. The determined solutions were designed in such a way that they would improve workflow and decision-making. They were also based on a cost-versus-benefit framework.

3.4 System Analysis and design:

3.4.1 Dataflow Analysis:

Dataflow analysis is a process used to determine how organization objectives are accomplished. This helps in the study of the use of data in each and every activity undertaken. Dataflow diagrams were used to graphically show the relations between processes and data, and in data dictionaries, which formally describe the system's data. The following tools were used for dataflow analysis:

(i) Dataflow diagram: this was used to graphically represent the system and show data flows to, from and within the system, processing functions and the storage of

this data. The data flow diagram was also used to determine the scope of the area under study.

(ii) Data dictionary: this is a documentation that supports a data flow diagram. It contains all the terms and their definitions for data flows and data stores that relate to the system. The data dictionary also helped the researcher avoid instances of calling the same data flow or data store by two different names or two different data names by the same names. More specifically, the data dictionary was used to store information about the database application's data.

3.5 Database design

The next stage in the design of the new system was the database design. The design of the database was done in four stages. These included:

1. Requirements analysis
2. Conceptual analysis
3. Logical database design
4. Physical database design

3.5.1 Database Requirement analysis

This aimed at determining the data, information, system components, and data processing and analysis functions required by the organization. A detail study of the various components and operations of the current system was undertaken. This was done using a structured questionnaire as a fact-finding technique.

This also aimed at defining decision-making associated with workflow together with the information needed to support decision-making. The outcome of requirement analysis for the system was the specification of the conceptual design.

3.5.2 Database Conceptual analysis

This phase of database design involved the creation of the data model of the pat of the enterprise that the study covered. The conceptual data model was built using the information documented in the requirements specification. Through out the process of developing the conceptual model, the model was being tested and validated against the users' requirements. The conceptual model involved description of entities, attributes and relations among entities independent of implementation details.

The following figure is an entity relationship model that was used for conceptual analysis.

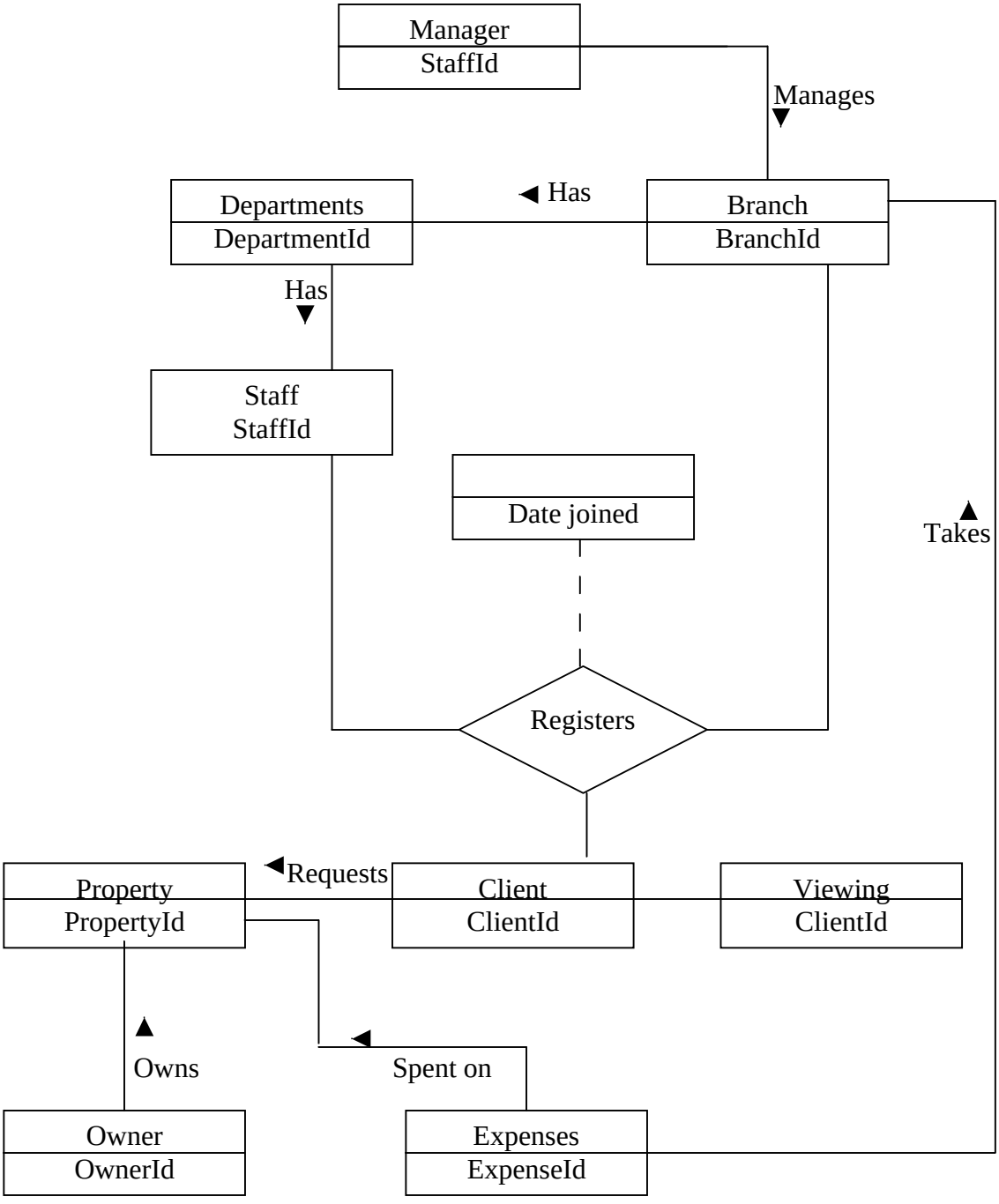


Figure 3.0: Entity relationship diagram for conceptual analysis model

3.5.3 Logical database design

This stage of database design aimed at transforming the conceptual data model into an internal model - schema that could be processed by a particular DBMS. The logical database design resulted into the creation of the logical data model. The technique of normalization was used to test the correctness of the logical data model. Normalization ensures that the relations derived from the data model do not display data redundancy (**Thomas Connolly and Carolyn Begg, 2001**), which could cause update anomalies when implemented. At this level, storage structures and access methods for the data were achieved plus the security protection to the database. An appropriate database management system was also selected. The database was designed in such a way to support application programs so that there is a flow of information between application programs and the database. The logical model also serves an important role during the operational maintenance stage of the system life cycle. Figure 3.1 shows the logical data model for the Real estate management system design.

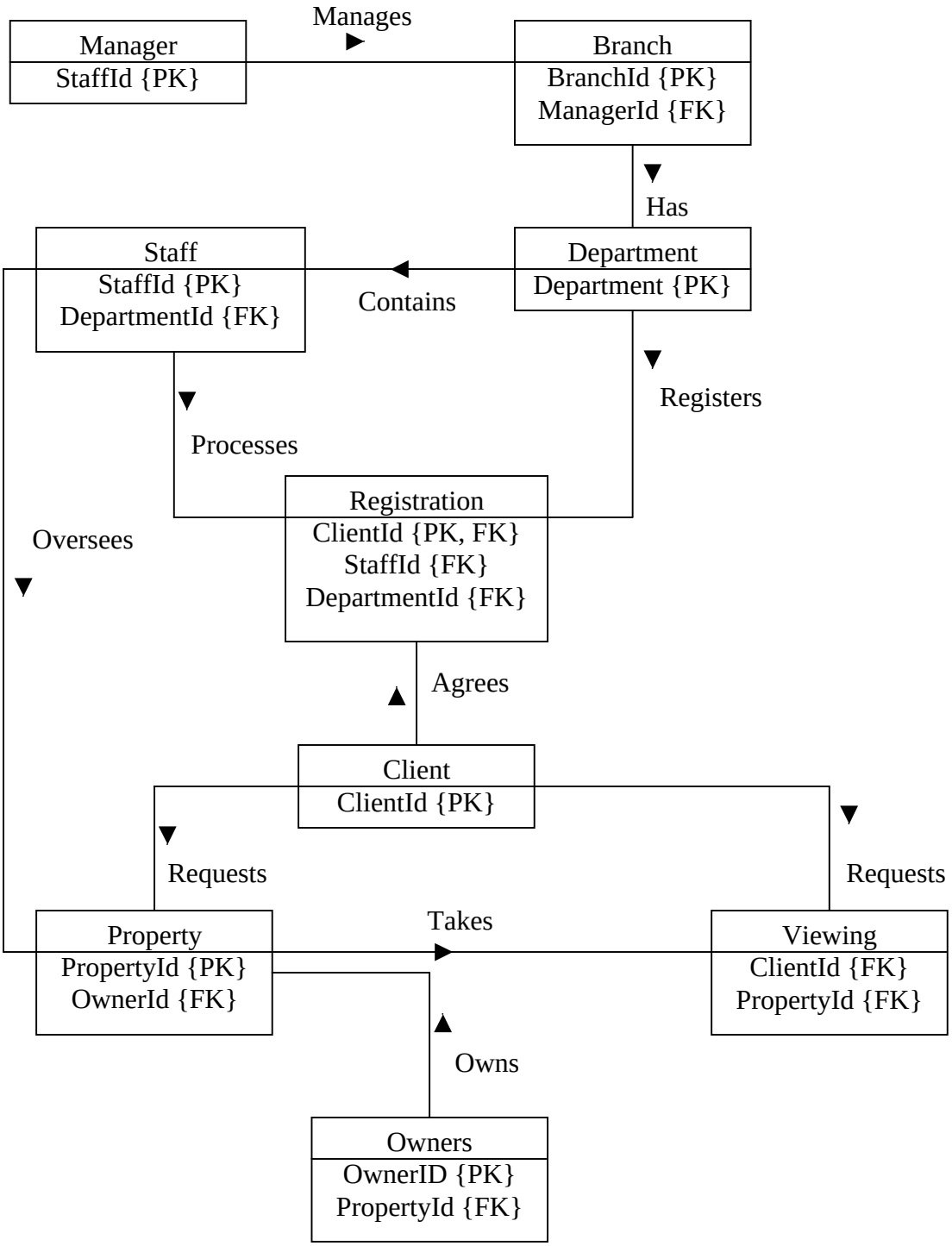


Figure 3.1: Relation diagram for the logical data model

3.5.4 Database physical design

This involved creation of relational tables and constraints on the tables from the information specified in the logical data model. It also involved identifying the specific storage structures and access methods for the data to achieve an optimum performance of the database, and designing security protection for the system.

3.6 REMIS Data Dictionary

Descriptive Statistics		
Name	**Description**	**Data type**
i, j, c	Variables used as counters	Integer
Age(1 to 1000)	Array to hold entries	Variant
Sum, sum	Sum of entries	Variant
Sunsq	Sum of squares of entries	Variant
Ave	Average of entries	Float
Var	Variance of entries	Float
Std	Standard deviation of entries	Float
MAD	Mean absolute deviation of entries	Float
Min	Minimum value of entries	Variant
Max	Maximum value of entries	Variant
Range	Range of entries	Variant
Chi square tests		
a, b	Variables used as counters	Integer
i, j	Number of row, Number of columns	Integer
SumX(1 to 6)	Array to hold table row sums	Variant
SumY(1 to 6)	Array to hold table column sums	Variant
SumXY	Total sum of table entries	Variant
Chisq	Computed chi square value	Float
E1(1 to 6)	Array to hold expected values of row 1 entries	Variant
E2(1 to 6)	Array to hold expected values of row 2 entries	Variant
E3(1 to 6)	Array to hold expected values of row 3 entries	Variant

E4(1 to 6)	Array to hold expected values of row 4 entries	Variant
Name	**Description**	**Data type**
E5(1 to 6)	Array to hold expected values of row 5 entries	Variant
E6(1 to 6)	Array to hold expected values of row 6 entries	Variant
D1(1 to 6)	Array to hold difference between expected values of row 1 and observed values of row 1	Variant
D2(1 to 6)	Array to hold difference between expected values of row 2 and observed values of row 2	Variant
D3(1 to 6)	Array to hold difference between expected values of row 3 and observed values of row 3	Variant
D4(1 to 6)	Array to hold difference between expected values of row 4 and observed values of row 4	Variant
D5(1 to 6)	Array to hold difference between expected values of row 5 and observed values of row 5	Variant
D6(1 to 6)	Array to hold difference between expected values of row 6 and observed values of row 6	Variant
df	Degrees of freedom	Integer
Critical	Observed critical value	Float
Linear regression and Correlation coefficient calculation		
i. j	Variables used as counters	Integer
Numbers()	Array to hold entries in lists	Variant
xVal()	Array to hold entries of the List 1 entries	Double
yVal()	Array to hold entries of the List 2 entries	Double
TotalX	Sum of List 1 entries	Double
TotalY	Sum of List 2 entries	Double
Xcounter	Counts number of entries in List 1	Integer
Ycounter	Counts number of entries in List 2	Integer
MeanX	Mean of List 1 entries	Double
MeanY	Mean of List 2 entries	Double
VarianceX	Variance of List 1 entries	Variant

VarianceY	Variance of List 2 entries	Variant
Name	**Description**	**Data Type**
StdDevX	Standard deviation of List 1 entries	Variant
StdDevY	Standard deviation of List 2 entries	Variant
SqrTotalX	Sum of squares of List 1 entries	Double
SqrTotalY	Sum of squares of List 2 entries	Double
Cc	Correlation coefficient	Double
a	Linear regression line Y intercept	Variant
B	Linear regression line slope	Variant
LCR1	Calculates linear correlation regression for List 2 as independent variable	Variant
LCR2	Calculates linear correlation regression for List 2 as independent variable	Variant

3.6 REMIS application design

This stage of the system development life cycle involved design of the user interface and application programs that use and process the database. All the functionality stated in the users' requirement was presented in the application design of the system. This involved designing the application programs that access the database and transaction design. In addition, an appropriate user interface was designed. The researcher designed the interface so that it could present the required information in a 'user-friendly' way.

3.7 Descriptive statistics and inferential statistics:

Statistical procedures are those procedures used in the collection, presentation, analysis, and interpretation of data. (Ronald E. Walpole). These methods can either belong to one of two major areas called descriptive statistics and statistical inference.

3.7.1 Descriptive statistics:

Comprises of those methods concerned with collecting and describing a set of data so as to yield meaningful information. The following descriptive statistics were included in the application:

(i) **Mean**: The arithmetic average; the sum divided by the number of cases.

$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$ where x_i: i=0,1,2,….. are the cases and n is the number of cases.

(ii) **Variance**: A measure of dispersion around the mean, equal to the sum of squared deviations from the mean divided by one less than the number of cases. The variance is measured in units that are the square of those of the variable itself.

Variance = $\frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2$ i , where x_i ; i=0,1,2,….. Are the cases $\bar{X}$ is the mean and n is the number of cases.

(iii) **Standard deviation**: A measure of dispersion around the mean, equal to the square root of the variance. The standard deviation is measured in the same units as the variable itself.

(iv) **Coefficient of variation**: A statistical measure of the deviation of a variable from its mean.

It is calculated as follows:

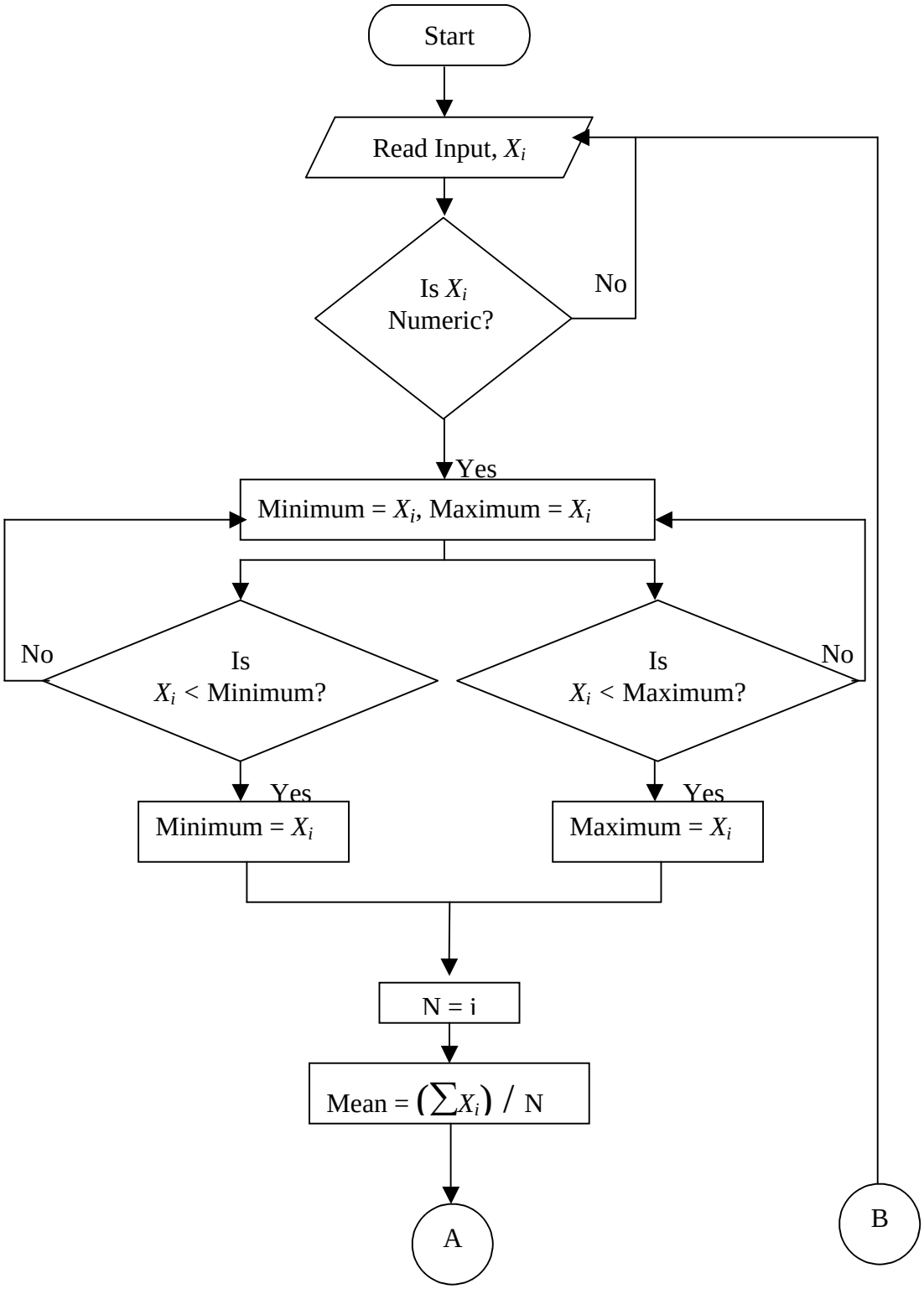
Coefficient of variation = Standard Deviation / Expected Return

(v) **Mean Absolute deviation**: The Mean absolute deviation a measure of the variation in a data set about the mean. It is defined as

$$AAD = \sum_{i=1}^{N}(|Y_i - \bar{Y}|)/N$$

Where $\bar{Y}$ is the mean of the data and $|Y|$ is the absolute value of Y. This measure does not square the distance from the mean, so it is less affected by extreme observations than are the variance and standard deviation.

3.7.2 Algorithms used for calculating descriptive statistics



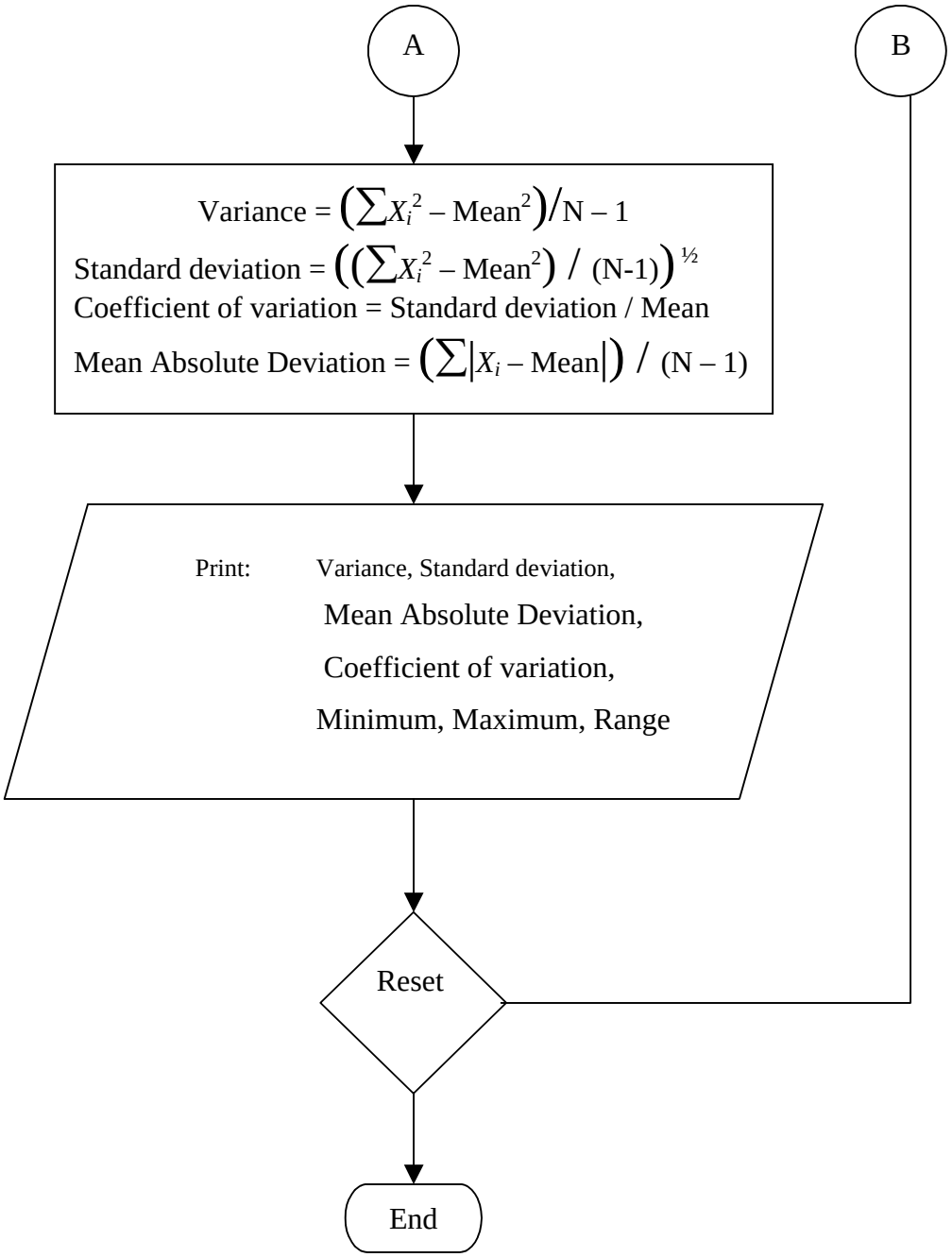


Figure 3.2: Flow chart for descriptive statistics

3.7.3 Pseudo code for calculating descriptive statistics

Input values X_i

Sum1 = 0, Sum2 = 0, Sum3 = 0, Minimum = X_i, Maximum = X_i

If inputted value is numeric

Number of values = N

For i = 1 to i = N

Sum1 = Sum1 + X_i

Sum2 = Sum2 + (X_i * X_i)

If X_i < Minimum then

Minimum = X_i

End if

If X_i > Maximum then

Maximum = X_i

End if

Next i

Mean = Sum1/N

Range = Maximum - Minimum

For i = 1 to i = N

Sum3 = Sum3 + Absolute Value (X_i – Mean)

Next i

Variance = 1/(N-1)[Sum2 – (Mean)^2]

Standard deviation = square root (Variance)

Coefficient of variation = Standard deviation / Mean

Mean Absolute Deviation = Sum3/(N-1)

Print Variance, Standard deviation, Mean Absolute Deviation

Print Coefficient of variation, Minimum, Maximum, Range

Else

Print inputted value not numeric

End

3.7.4 Statistical Inference:

Comprise those methods concerned with the analysis of a subset of data leading to predictions or inferences about the entire set of data. The following formulas were used to infer on the data:

(i) **Linear Regression and correlation[1] analysis**: Correlation and regression refer to the relationship that exists between two variables, X and Y, in the case where each particular value of X_i is paired with one particular value of Y_i. For example, the amount of money spent in advertisements for a particular property paired with the corresponding amount of time it takes to be purchased. Fundamentally, it is a variation on the theme of *quantitative functional relationship.* The *more* you have of this variable, the *more* you have of that one. Or conversely, the *more* you have of this variable, the *less* you have of that one. This procedure estimates the coefficients of the linear equation, involving a set of independent[2] variables that best predicts the value of the dependent[3] variable. In the package, it is used to forecast say the turnover and profits of a branch after a specified amount of time. The linear model has the form:

Y = a + bx; where x is either time or the specified independent variable. Assuming that the data can be fitted on a linear regression model, the coefficients will be predicted using the following formulas:

a = $\bar{Y}$ - b $\bar{X}$ where $\bar{X}$ is the mean of the independent variable, and $\bar{Y}$ is the mean of the dependent variable.

$$b = \frac{n\sum_{i=1}^{n} X_i Y_i - \sum_{i=1}^{n} X_i \sum_{i=1}^{n} Y_i}{n\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2}$$

[1] Correlation is the simultaneous change in value of two numerically valued random variables

[2] The Independent Variables in an analysis (also known as explanatory variables) are the variables being used to predict the value of the dependent variable. They are also called predictor variables

[3] A Dependent Variable in an analysis (also known as response variable) is a variable whose values are being predicted or modeled, usually because it is thought to be influenced or caused by the independent variable(s).

The package also measures the strength of the linear relationship between two sample variables using the **linear correlation coefficient**. The linear correlation coefficient ranges from –1 to +1. A correlation coefficient value near to –1 shows that there is a very good negative correlation between the two sets of variables, a correlation coefficient of 0 shows that there is no correlation between the two variables and a correlation coefficient near +1 shows that there is a very good positive correlation between the two variables. In the package, the following formula was used to calculate the Correlation coefficient value of any two randomly distributed samples.

Given two sets of data X_i and Y_j, the linear regression coefficient, R between the two variables is given by:

$$R = \frac{\left(n\sum X_i Y_j - \sum X_i \sum Y_i \right)}{\left(n\sum X_i^{\,2} - \left(\sum X_i \right)^2 \right)^{1/2} \left(n\sum Y_i^{\,2} - \left(\sum Y_i \right)^2 \right)^{1/2}}$$

3.7.5 Algorithms used for calculating Linear Regression and the Correlation coefficient, R

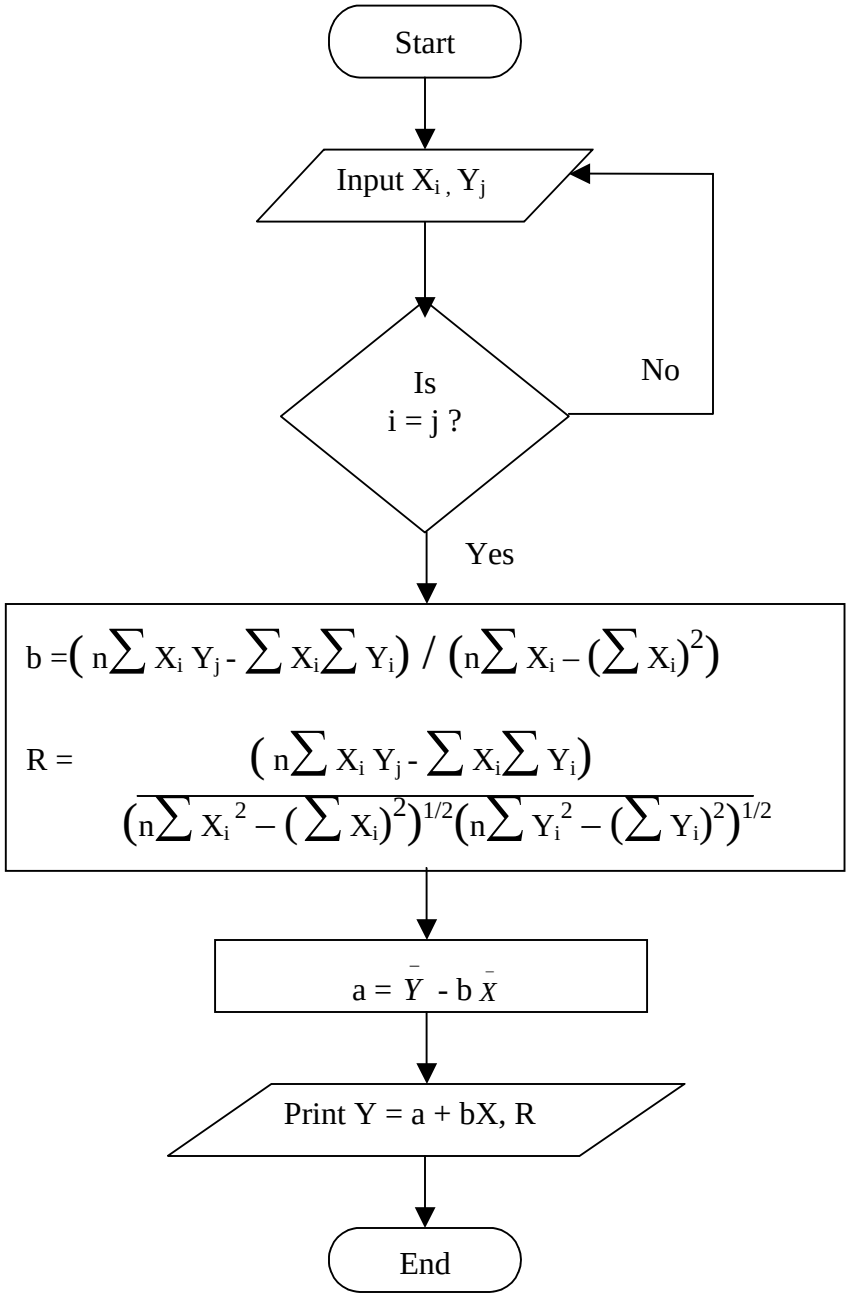


Figure 3.3: Flow chart for calculating linear regression equation and correlation coefficient

3.7.6 Pseudo code used for calculating the linear regression and correlation coefficient

Iput data for independent and dependent variables X_i, Y_i

SumX = 0, SumY = 0, SumXY = 0, SumsqX = 0, SumsqY = 0

If inputted value is numeric then

If i, j = N then

For i, j = 1 to i, j = N

SumX = SumX + X_i

SumY = SumY + Y_i

SumXY = SumXY + (X_i * Y_i)

SumsqX = SumsqX + (X_i * X_i)

SumsqY = SumsqY + (Y_i * Y_i)

Next i, j

End if

MeanX = SumX / N

MeanY = SumY / N

b = (N * sumXY – (SumX * SumY)) / ((N * SumX) – (SumX * SumX))

a = MeanY – (b * MeanX)

r = (N * sumXY – (SumX * SumY)) / (square root((N * SumsqX) – (SumX * SumX) * (square root((N * SumsqY) – (SumY * SumY)

Print: Linear regression equation is Y = a + bX, Linear regression coefficient = R

End if

Else

Print: Inputted value not numeric

End

3.7.8 Chi square test of independence:

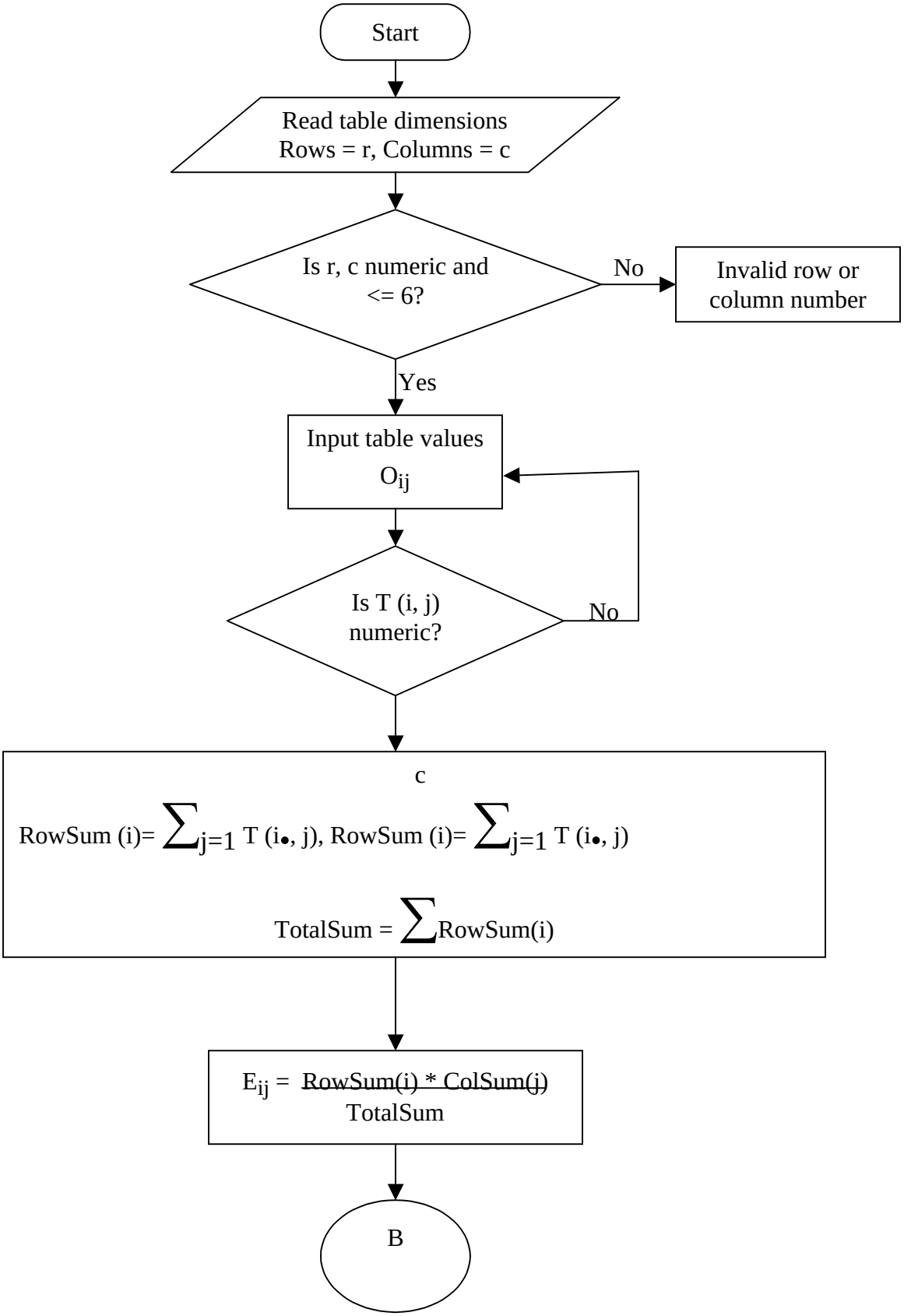
Chi Square is a non-parametric test of statistical significance for bivariate tabular analysis. Any appropriately performed test of statistical significance lets you know the degree of confidence you can have in accepting or rejecting a hypothesis. Typically, the hypothesis tested with Chi Square is whether or not two different samples are different enough in some characteristic or aspect of their behaviour that we can generalize from our samples that the populations from which our samples are drawn are also different in the behaviour or characteristic. The chi-square test of independence is used to test the null hypothesis that the frequency within cells of a given table is what would be expected, when the sums of elements within rows and columns are computed. The expected value within each cell, if the null condition is true (i.e., if the factors have no significant influence on observed frequencies in the population), is simply the product of the row total and column total divided by the overall sample N for the test of independence. If O_{ij} is the observed frequency and E_{ij} the expected frequency for the cell corresponding to the i^{th} condition and the j^{th} group, then chi-square is:

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where $E_{ij} = \dfrac{n \times C_{ij}}{\text{Overall Total}}$

If the calculated chi square value is larger than the critical value in that cell, the data present a statistically significant relationship between the variables in your table. The critical value is usually got from statistics tables.

3.7.9 Algorithms used for calculating Chi Square



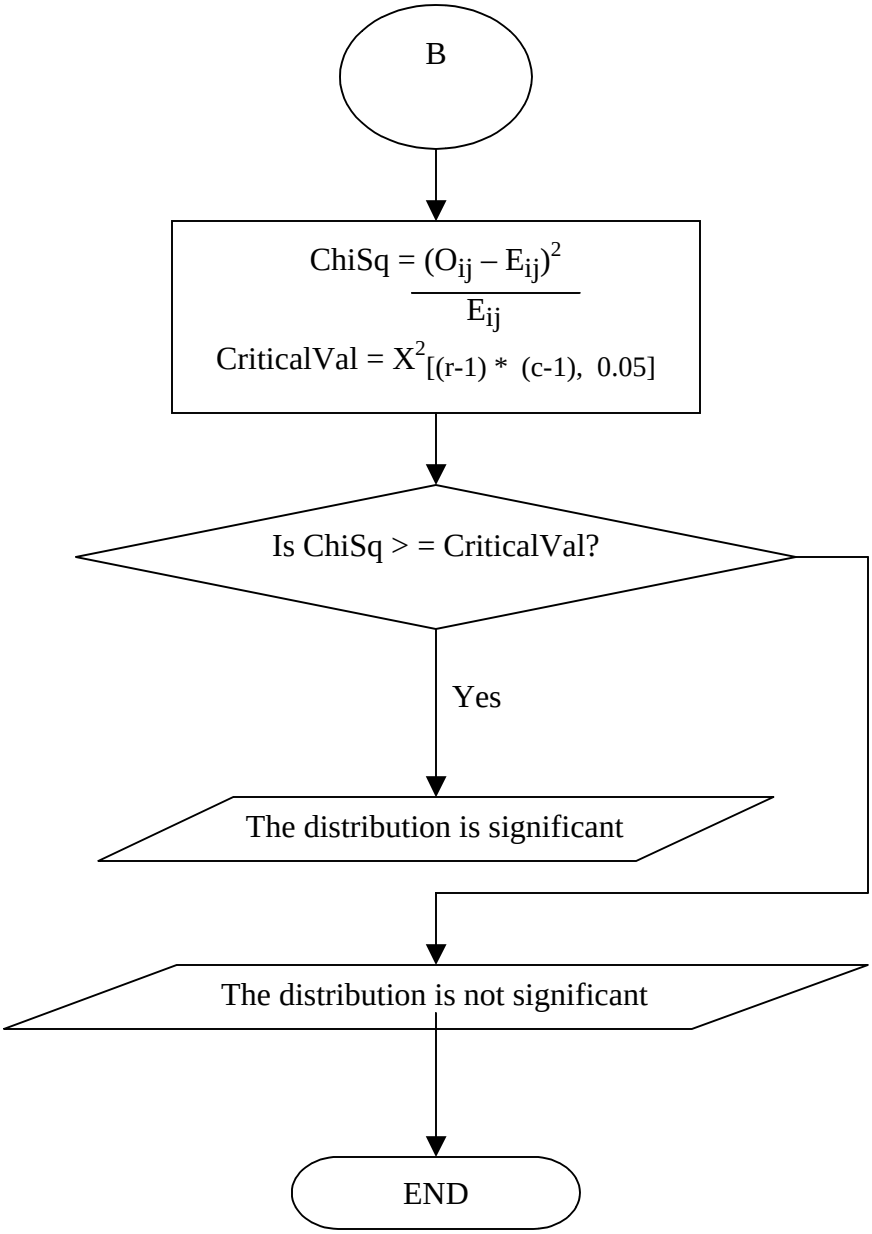


Figure 3.4: Flow chart for calculating Chi Square

3.7.10 Pseudo code used for calculating the Chi square tests

Input the number of rows, r and the number of columns, c

RowSum= 0, ColSum = 0, TotalSum = 0, chisq = 0

If inputted number of columns or rows is less than 0 or greater than 6 then

Print: Too few rows or columns

Or

Print: Too many rows or columns

Else

If inputted value is numeric then

Display table with r rows and c columns

Input values O_{ij} in table

If inputted value is numeric then

For i = 1, j = 1 to i = r, j = c

RowSum = RowSum + $O_{i.}$

ColSum = ColSum + $O_{.j}$

Next i, j

TotalSum = Sum (RowSum)

For i=1, j=1 to i=r, j=c

Expected frequency, E_{ij} = (RowSum * ColSum) / TotalSum

Next i, j

For i=1, j=1 to i=r, j=c

Chisq = chisq + $((O_{ij} - E_{ij}) / E_{ij})$

Next i, j

Print: Chi square value is Chisq

CriticalVal = $X^2_{[(r-1) * (c-1), 0.05]}$

If Chisq is greater than Critical value

Print: The distribution is significant

End if

If Chisq is less than Critical value

```
                    Print: the distribution is not significant
                End if
            End if
        Else
            Print: Inputted value not numeric
        End if
End if
End
```

3.8 System Implementation:

This involved the physical realization of the database and the application design. The system was implemented with full consideration of the above noted design considerations. In order to make the package easy to use, it was implemented using object oriented programming. In order to facilitate easy navigation by the user through the different parts of the package, it is menu driven, where by a user can jump to any part of the package without having to quit from the current transaction.

The **REMIS** implementation was based on two tools; Microsoft Access database management system and Microsoft Visual Basic for Applications programming language. **REMIS** handles the traditional duties of information storage in files. It stores the information inform of tables in a database. The database of which is managed by MS Access database management system. This makes it eases editing, update, retrieval, and deletion. Security and integrity controls for the system were also implemented.

3.8.1 Backup and recovery

The new system was designed with a backup facility that requires every system user to back up the database before exiting from the system. The system requires that a copy of the database on the computer's disks which is made periodically and kept on magnetic table or other removable medium. This essential precaution was included to cater for cases of disk crash or accidentally deleting the only copy of the database. Ideally the backup copies should be kept at a different site or in a fire safe since, though company hardware may be insured against fire, the data on it is almost certainly neither neither insured nor easily replaced.

3.8.2 Testing:

This involved executing application programs to discover the consequences of system malfunction by subjecting the system to extensive processing of real and fabricated transactions that represent normal and abnormal conditions. This aimed at determining whether the system works well and whether it is the right system.

3.8.3 Maintenance:

After implementation, the system now remains in a maintenance mode until it is replaced by a new system. The need for maintenance arises from a possible failure to anticipate all requirements during system design or from change in the company requirements.

3.8.4 Limitations of the study:

The following are the limitations the researcher faced:

1) Time to carry out the research: The time interval the researcher was supposed to finish the project was very short compared to the amount of work that was supposed to be done. This led to a number of functions being left out in order to meet the completion deadline.
2) Poor facilitation: The researcher was not facilitated in any way and therefore had to meet all the expenses of the project. This led to financial constraints during the system development.

CHAPTER 4

THE REMIS PACKAGE

4.0 Introduction:

This chapter discusses and presents the computer package called **REMIS** to implement the methods discussed in the previous chapter. The package was developed by the researcher during the course of the study to assist a real estate manager put a good use to the big amount of information available for decision-making.

During the design of the **REMIS** package, the user was the main consideration in mind, to enable easy interaction with the package. To enable this, a menu driven system with help features was designed. The system does not require any training and knowledge of particular programming syntax as applies to most other packages. Just logging on and you are started, since the package is menu driven.

4.1 System Design

4.1.1 The Real Estate Management Information System (REMIS)

REMIS is a program to help a manager make more informative and profitable management decisions. This program in a database application language, which will record company detail and store it in a database, which can be used as a benchmark for analyzing future, deals. The first step in analyzing a prospective decision is to understand the data being used. This program increases the decision-making capability by maximizing the efficiency and accuracy of the data inputting process with the use of statistics and linked fields, eliminating any unnecessary re-keying of data. The **REMIS** was designed using Microsoft Access database management system, and Visual basic programming language. Various inferences can be got using the **REMIS** to help the manager summarize data. Finally, the **REMIS** presents the manager with an automatic record and report generation tool, sorted according to the user's needs.

4.1.2 The Existing system

The current system being used consists of a manual filing system. The company currently uses the manual filing system to hold all external and internal correspondence relating to clients and staff. A number of files concerning different transactions and information are labeled and stored in cabinets at a branch. For security purposes, the cabinets have locks. Whenever reference is to be made in the files, one has to go through the filing system, starting from the first entry until he or she finds what they want. This system used to work well when the company's business transactions and the number of staff were still small. However, with the increase in the number of transactions, the filing system is breaking down since different transactions have to be cross-referenced and processed.

Clients, staff and the manager of a branch nowadays want more and more information for decision-making. A need has also arisen to produce detailed monthly, quarterly and annual reports concerning the company's transactions, expenses and turnover. Due to the isolation of data in different files, it's difficult to access data that should be available for management to take decisions and to easily answer client's enquiries. Such data cannot be easily statistically analyzed to make inferences about the data items handled by a branch for proper management.

4.1.3 Limitations of the existing system

The existing system currently has the following limitations:

1. Separation and isolation of data: When data is isolated in separate files, it becomes more difficult to access data that should be available. This difficulty is compounded when we require data from more than two files.
2. Duplication of data: Owing to the decentralized approach taken by each department, the file-based approach encourages duplication of data.
3. Company data is exposed to risks of being lost through theft and fire outbreaks.

4.2 REMIS program analysis

4.2.0 Introduction:

After critically analyzing the existing system and its limitations, the new system was designed with an intention of minimizing to the least extent the limitations of the old system. This aimed at removing the current manual filing system for record keeping and helping the manager make quick decisions based on sample statistics and analyzed data. The **REMIS** package was designed using the Visual Basic programming language and the Microsoft Access database management system. This allowed the researcher to fully implement the system requirements as already been discussed in Chapter Four.

4.2.1 A brief description of Visual Basic

Visual Basic is a high level programming language evolved from the earlier DOS version called BASIC. BASIC means **B**eginners' **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. It is a fairly easy programming language to learn. The codes look a bit like English Language. Different software companies produced different version of BASIC, such as Microsoft QBASIC, QUICKBASIC, GWBASIC, IBM BASICA and so on.

VISUAL BASIC is a VISUAL and events driven Programming Language. These are the main divergence from the old BASIC. In BASIC, programming is done in a text-only environment and the program is executed sequentially. In VISUAL BASIC, programming is done in a graphical environment. Because users may click on a certain object randomly, so each object has to be programmed independently to be able to response to those actions (events). Therefore, a VISUAL BASIC Program is made up of many subprograms, each has its own program codes, and each can be executed independently and at the same time each can be linked together in one way or another.

4.2.2 A brief description of Microsoft Access

Microsoft Access is a typical personal computer based database management system capable of storing, sorting, and retrieving data for a variety of applications. Access provides a Graphical User Interface to create tables, reports, queries, forms and tools to develop customised applications using Microsoft Visual Basic for Applications language.

Microsoft Access can as well be used as a standalone system on a single personal computer or as a multi-user system on a personal computer network.

4.3 General structure of the package

This section describes the general structure of the package and an overview of all the modules in the package and their interdependences. The figure below shows the system flow chart.

4.3.1 SYSTEM HIPPO CHART:

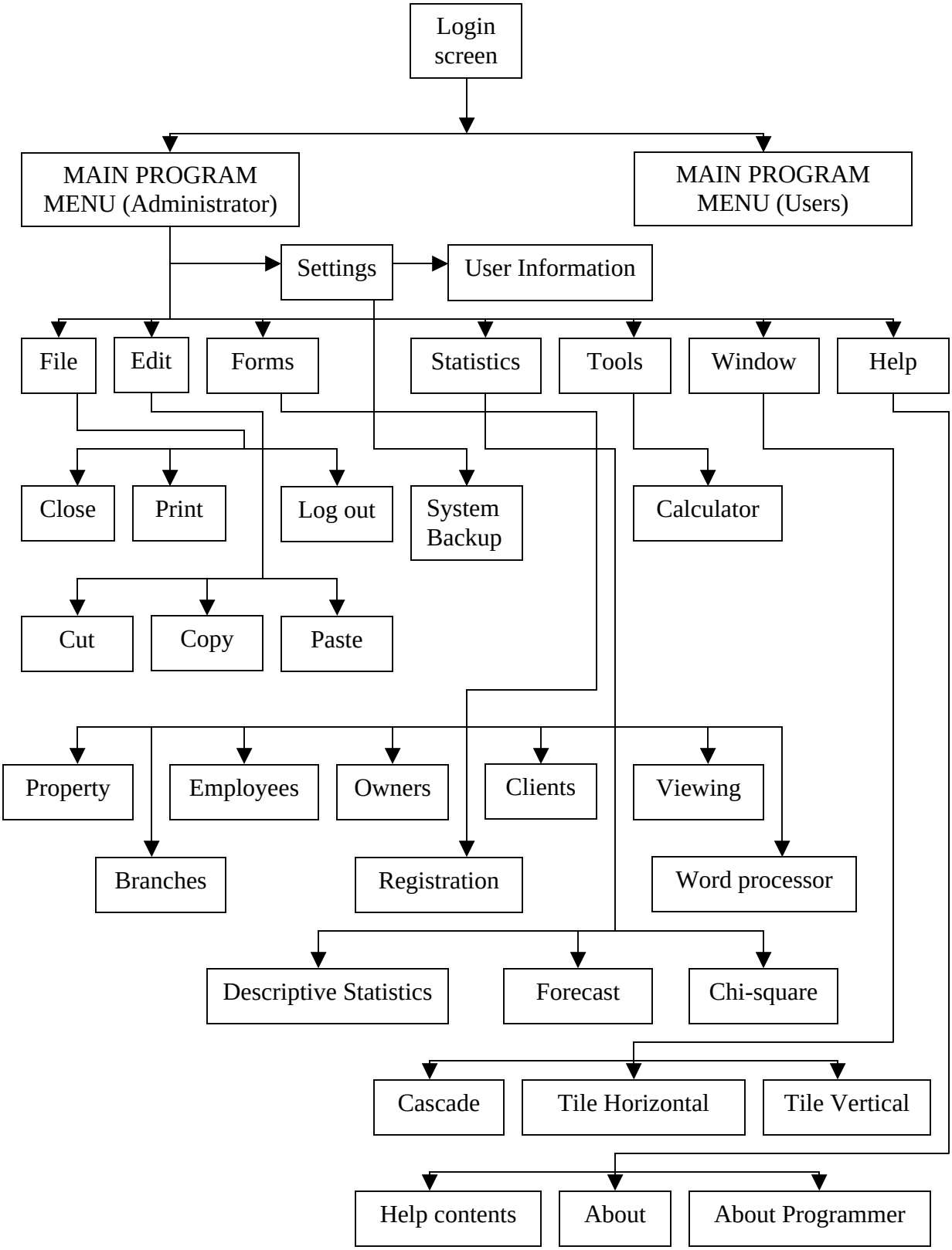


Figure 4.0: System Hippo Chart

4.3.2 Logging into the system:

In order to ensure that unauthorized users do not get access to the company's data, the system is pass word protect and requires users to login in order to access the system information. The figure below shows the system login screen. Only the system administrator can create new users and delete existing users.

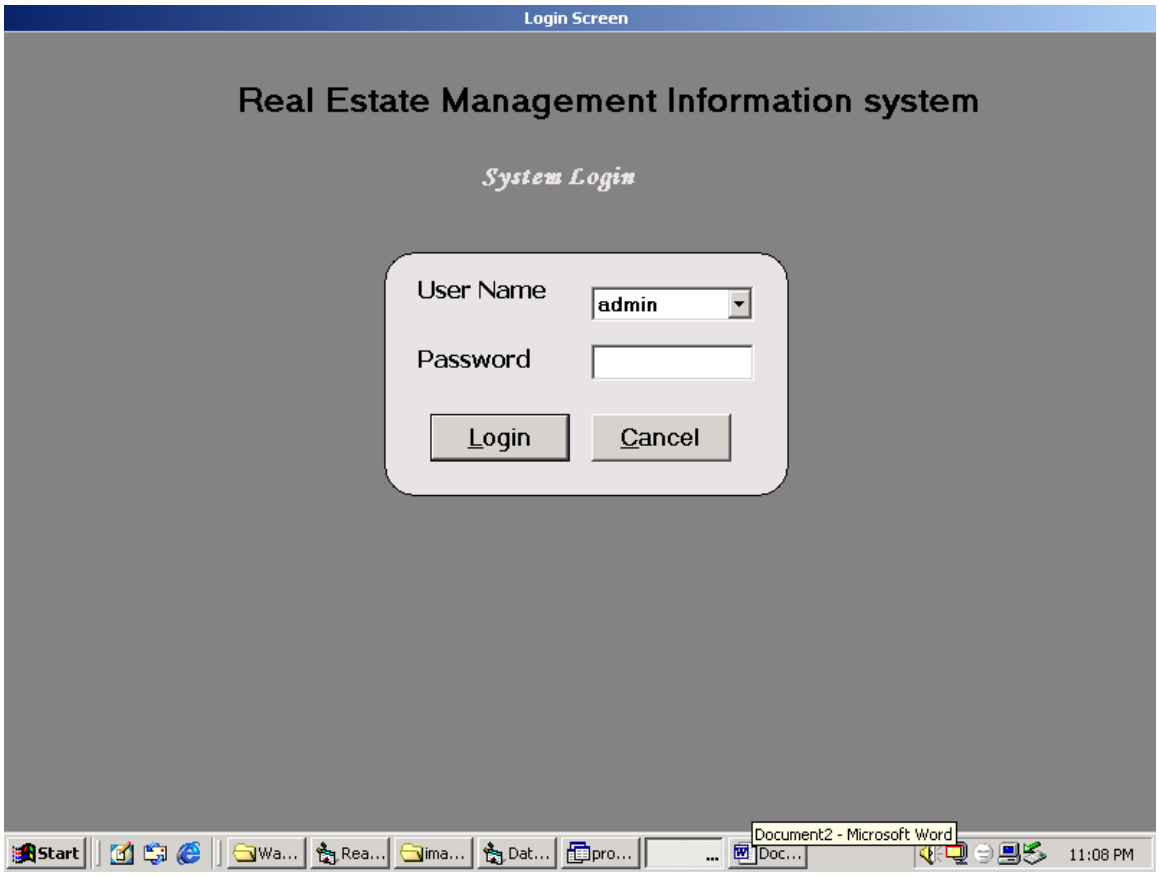


Figure 4.1: System login screen

4.3.3 System menu

The system is menu driven and therefore a user only requires clicking on the menu option and access all the other sub menu options under the current menu. This allows easy accessibility of all the package features. The system consists of seven menu options as shown in the figure below. Each of these options is further divided into sub menu options, which are used for calling different form layouts for the execution of the different transactions described in the previous chapter. The system menu consists of:

1. File menu

2. Edit menu
3. Forms menu
4. Statistics menu
5. Tools menu
6. Window menu
7. Help menu

4.3.4 The File menu:

The File menu consists of the following submenus

- Close submenu option: Used for closing the system when the current user wants to completely quit the system. This action can also be executed by clicking **X** at the far right of the title bar.
- Print submenu option: Used for printing a report. This action can also be implemented by clicking the print icon on the report tool bar.
- Exit submenu option: Used for logging off the current user from the system. This option takes the user to the system login screen.

4.3.5 The Edit menu:

The Edit menu consists of the following submenu options:

- Cut submenu option
- Copy submenu option
- Paste submenu option

4.3.6 The Forms menu:

This menu forms the underlying core for all the package database operations. It consists of different submenu options used for data manipulation. This involves data retrieval, insertion, update, and deletion. The Forms menu consists of the following submenu options:

- Property submenu option: Used for properties data manipulation by the user. Through this submenu option, the user can view property records, update property records, search for property records, and generate reports concerning the available properties using the property toolbar options.

- Employees submenu option: Used for employees data manipulation by the user. Through this submenu option, the user can view employee records, update employee records, search for employee records, and generate reports on employees using the employee toolbar options.
- Owners submenu option: Used for property owners data manipulation by users. Through this submenu option, the user can view owner records, search for owner records, update owner records and generate reports on property owners using the Property Owners toolbar options.
- Clients submenu option: Used for clients' data manipulation by users. Through this submenu option, the user can view client records, search for client records, update client records and generate reports on clients using the Client menu toolbar options.
- Viewings submenu option: Used for Property Viewings data manipulation. Through this submenu option, the user can view the Property viewings and the clients' comments, search for particular property viewings and generate reports on the property viewings using the Property Viewings toolbar options.
- Branches submenu options: Used for data manipulations of information concerning the company branches. Reports and searches about branches can be made using this submenu option.
- Registration submenu option: Used for manipulating data concerning the registration of clients.
- Spread sheet submenu option: the package also provides the user with a spreadsheet package for different data calculations. The spreadsheet submenu option opens a spread sheet which the user can user irrespective of whether the user has one on the current computer or not.

4.3.7 Statistics menu

This menu contains all the underlying statistical calculations in the package. It contains three submenu options that lead to the form layouts for statistical calculations.

The statistics menu option consists of the following submenu options:

- Descriptive statistics submenu option: through this option, a user can calculate the previously mentioned descriptive statistics for any raw data for a sample or a

population. The statistics include; mean, variance, standard deviation. Mean absolute value, maximum, minimum, range, and mean absolute value.

- Forecast submenu option: this is a path for calculation of the linear regression coefficient and regression line for making forecasts on variables. The user can use this submenu path to calculate the correlation coefficient of two data sets.
- Chi-square submenu option: this is a path through which the user can make chi-square tests on data in a given table. The submenu option leads the user to the chi square generation form.

4.3.8 Tools menu

This menu consists of only one submenu option. The Calculator submenu option under the Tools menu is used to call Microsoft windows calculator. Using this submenu option, the user can perform basic arithmetic tasks with an on-screen calculator.

4.3.9 Settings menu

This menu consists of two submenu options. These include:

- User information submenu option: this is a path through which the systems administrator can manipulate system user information. It's the system's administrator who can access this submenu option for manipulation of user information.
- System Backup submenu option: this is a path through which any user can backup the system's database to prevent data loss incase of problems. Through this submenu option, data can be written to magnetic tape or other removable medium.

4.3.10 Window menu

Consists of the Window cascade, Tile Horizontal and Tile vertical submenu options used for arranging the currently open windows of the package.

4.3.11 Help menu

Consists of three submenu options used for help. These include:

- Help contents submenu option: Contains online user help for the use of the system and system definitions. The user can browse through the different help files available.
- About submenu option: Shows the user the current version of the package.

- About programmer submenu option: Shows the user the particulars of the person who designed the package, for any further reference.

4.4 Data Capture

The system uses raw data captured using data entry forms. Each submenu option in the Forms menu options can be used to capture the data for that particular dataset it refers to. The user is supposed to save the data inputted after data capture for it to be fed into the database.

4.5 System validation and control checks

During data entry, consistency checks were included into the system to minimize errors that the data input might have. Some of the consistency checks provided include;

- Invalid data entered
- Invalid search criteria
- Record not found
- Out of range
- Too many rows or columns
- Too few rows or columns

4.6 System Backup:

REMIS presents the data users with a database backup facility where by any authorized user can make a copy of the system's database onto magnetic tape or other removable medium such as diskettes and flash memory drives.

4.7 User manual

4.7.1 Hardware and software requirements

For optimum performance, make sure that your computer has at least the minimum required hardware before you install the **REMIS** software package. This package will run on a microcomputer that has the following:

- Microcomputer with a Pentium II (or equivalent) processor or higher
- A hard disk with at least 30 megabytes (MB) of fre**e** space.
- A CD-ROM drive.
- A minimum of 48 MB of RAM.

4.7.2 REMIS Installation procedure

To install the **REMIS** software, you will need to use the Setup program provided on the **REMIS** installation CD-ROM.

To install the package onto your hard disk from Microsoft Windows:

1. Turn on your computer and allow Windows to load.
2. Logon to Windows as a user with local administrator privileges.
3. Insert the **REMIS** CD into your CD-ROM drive. The Setup program will launch automatically.
4. If the setup program does not run, or you have downloaded it from another computer, use Windows Explorer or the "Run" command in the Start menu to locate the setup.exe program on the CD and run the program.
5. Follow the setup instructions on the screen and ignore any error messages that come up during installation.
6. If your Windows operating system does not contain an up-to-date (secure) installer, one will automatically be installed. This process may require you to restart your computer.

REMIS uninstall procedure

To uninstall **REMIS**, use the Remove Program function in Windows:

1. From the Windows **Start** menu, select **Settings** then **Control Panel.**
2. From within the Control Panel, select **Add/Remove Programs**.
3. Select **REMIS** from the list of software.
4. Click the **Add/Remove** button.

4.7.3 Using REMIS

The system requires a user to login first. The systems administrator can provide the login user name and password. Once a user is logged in, the package is menu driven and one has to simply navigate through the menu options to get started. For any help concerning using the system, the user is advised to refer to the Help menu of the package.

4.8 Package sample outputs

This section shows some of the outputs that can be got from the package.

System main menu:

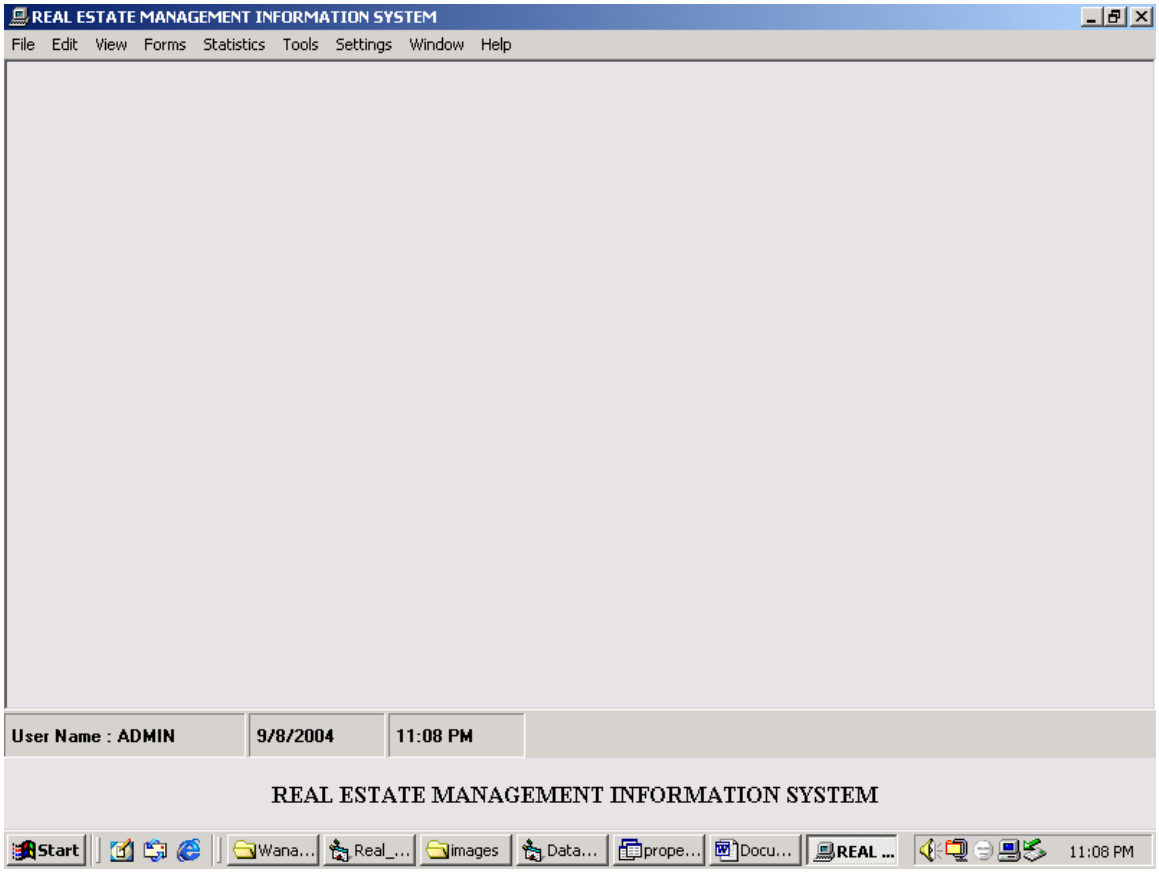


Figure 4.2: System main menu

The above figure shows the system's main menu. The user only needs to navigate through the menu options to get started. For more information, refer to Help menu.

REMIS property details navigation facility

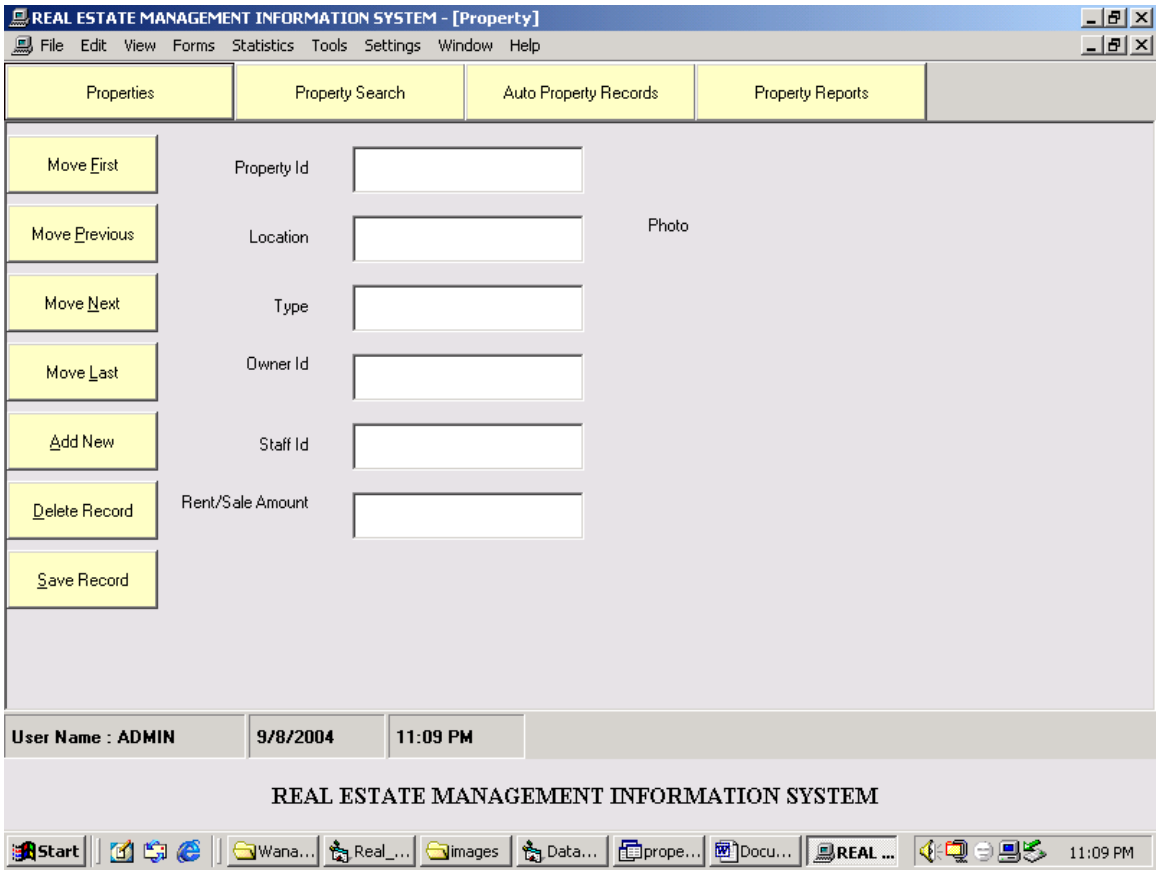


Figure 4.3: Property details navigation

Figure 4.3 shows the output when on clicks Forms menu option | Properties submenu option | Properties toolbar option. One can navigate through the records using the navigation buttons shown on the left.

REMIS automatic property generation facility

Figure 4.4 shows the output when a user clicks Forms menu option | Properties submenu option | Auto property Record toolbar option. One only needs to put the property id and the details of that property will be displayed.

Figure 4.5 also shows the output when a user clicks Forms menu option | Properties submenu option | Property search toolbar option. The user can search for property by any desired field. Click on the field with which you want to search and the property will be displayed.

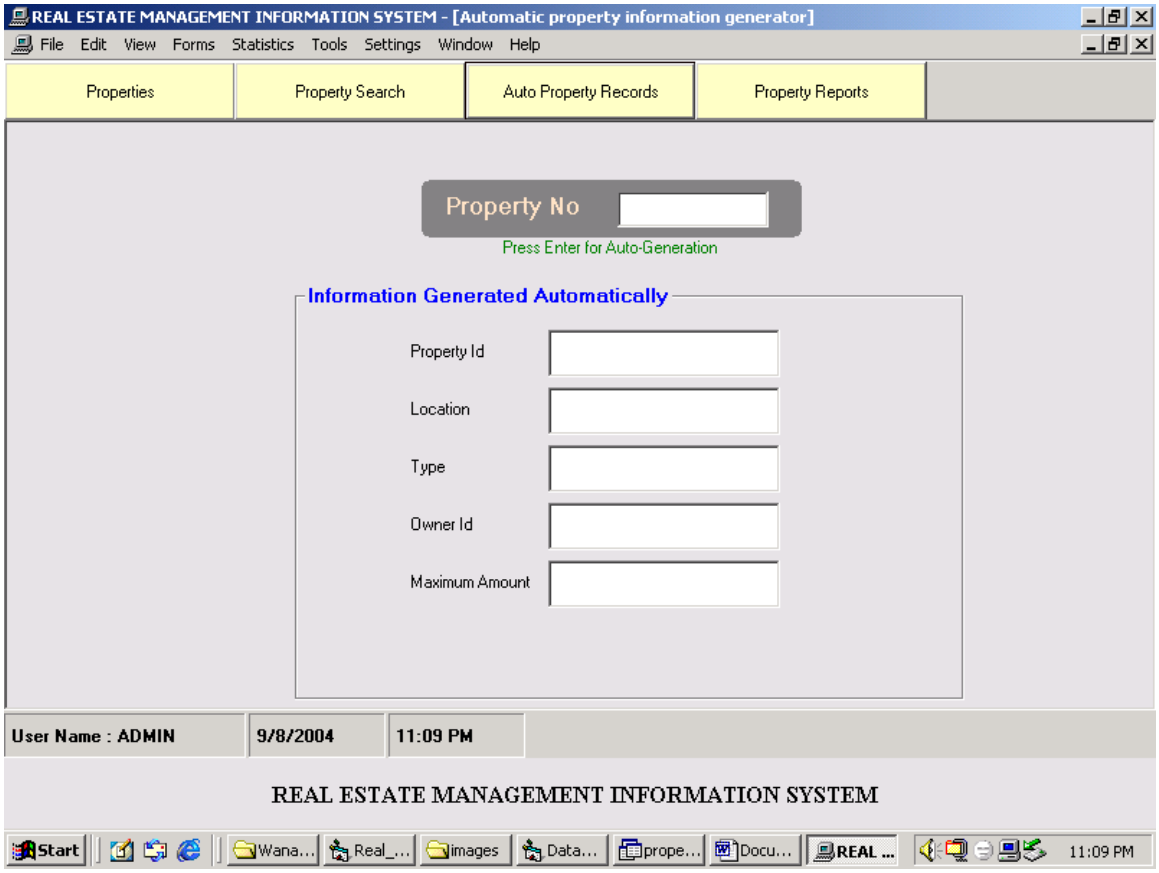


Figure 4.4: REMIS automatic property information generator

REMIS Property report generation facility

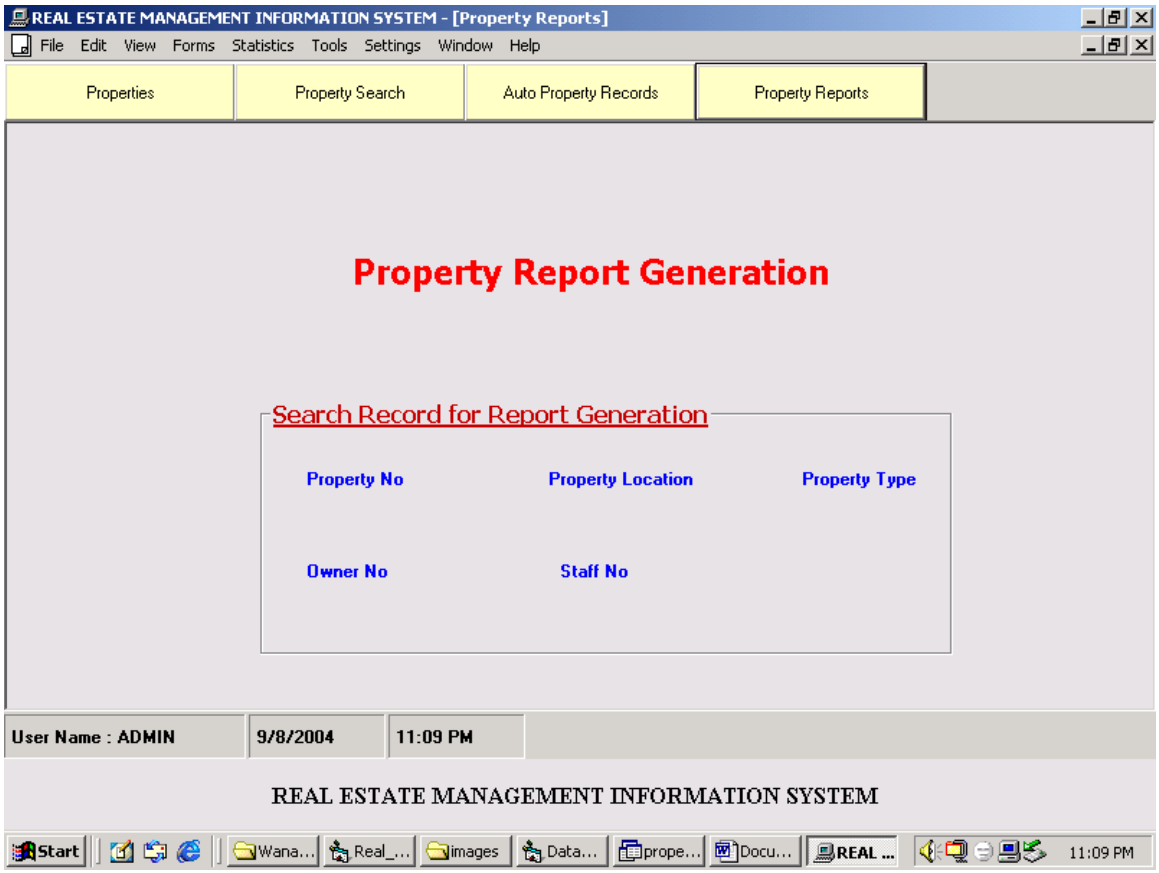


Figure 4.5: Property report generator

The figure above shows the facility **REMIS** uses to generate reports about property. To create reports about property, click Forms on the system menu | Property submenu option | Property reports toolbar option. One only needs to click on the field and enter the value with which the search should be made. A report will be generated.

REMIS employees' details navigation facility

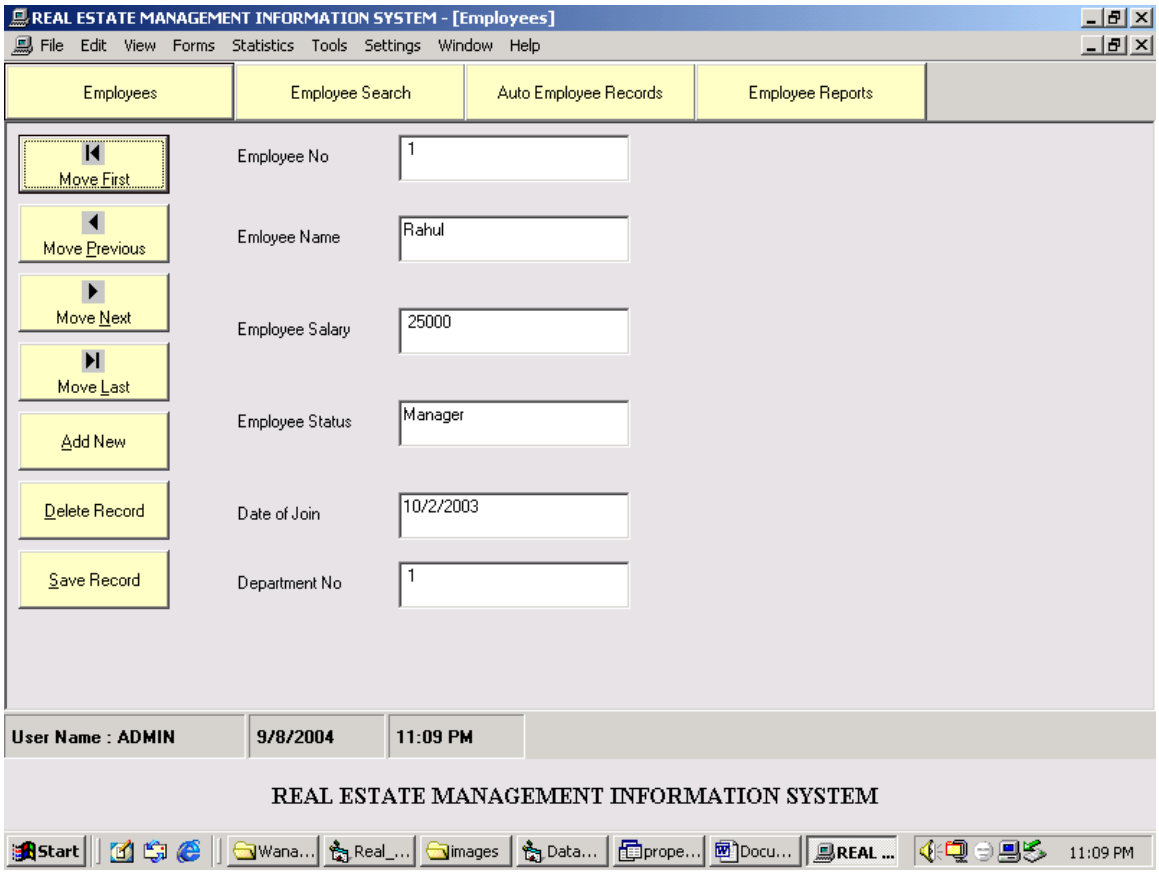


Figure 4.6:Employee details navigation facility

Figure 4.6 shows the output when a user clicks Forms menu | Employees submenu option | Employees toolbar option. Navigation through records can be done using the command buttons on the left hand side of the facility.

REMIS employee records automatic generation facility

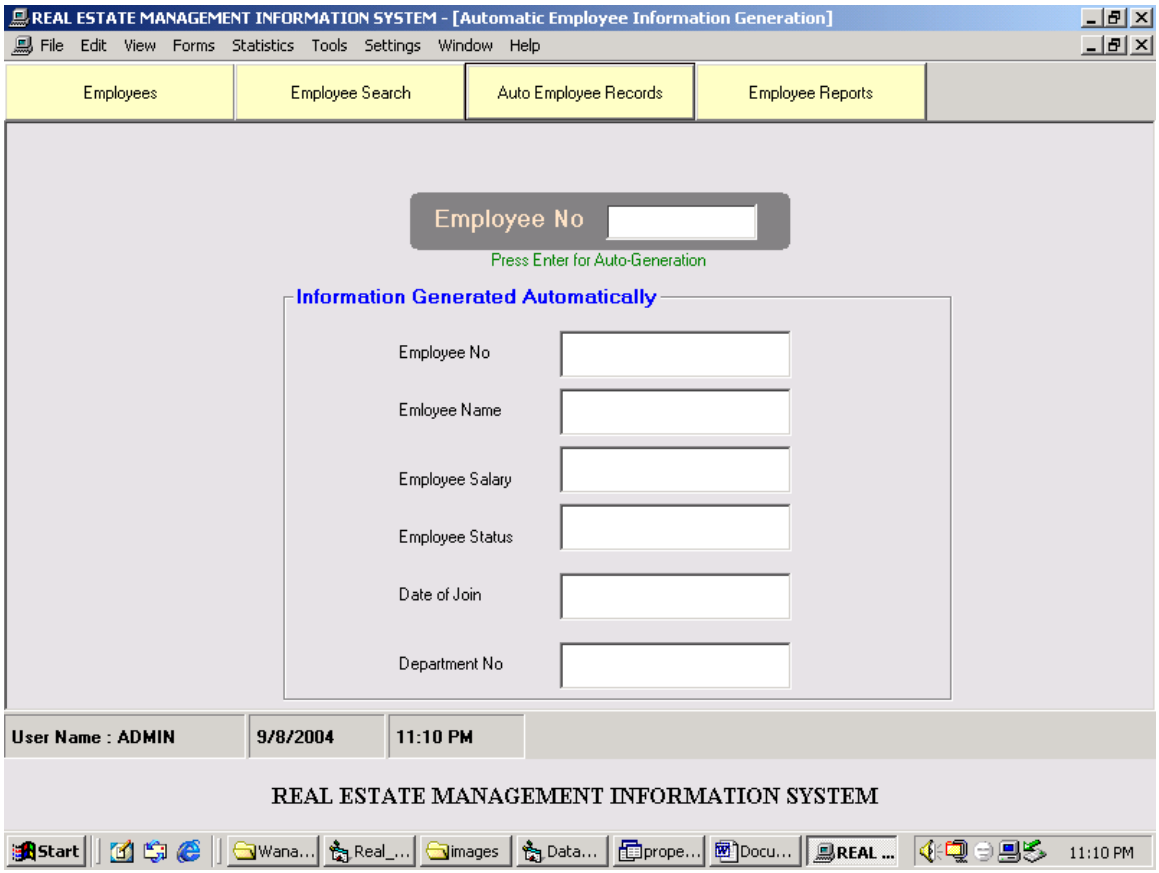


Figure 4.7: Automatic employee information generation

The figure above shows the result the output when a user clicks Forms menu | Employees submenu option | Auto Employee Records toolbar option. The user has to enter the employee's id to generate information about that particular employee.

REMIS employee reports generation facility

Figure 4.8: Employee reports generation facility

Figure 4.8 shows the output when a user clicks Forms menu | Employees submenu option | Employee reports toolbar option. All a user has to do is click on the field with which the search should be made and enter the search criteria. In the input box that pops up.

Figure 5.9 shows the output when a user clicks Department No and enters department number 2. The report outputs all the employees in department 2.

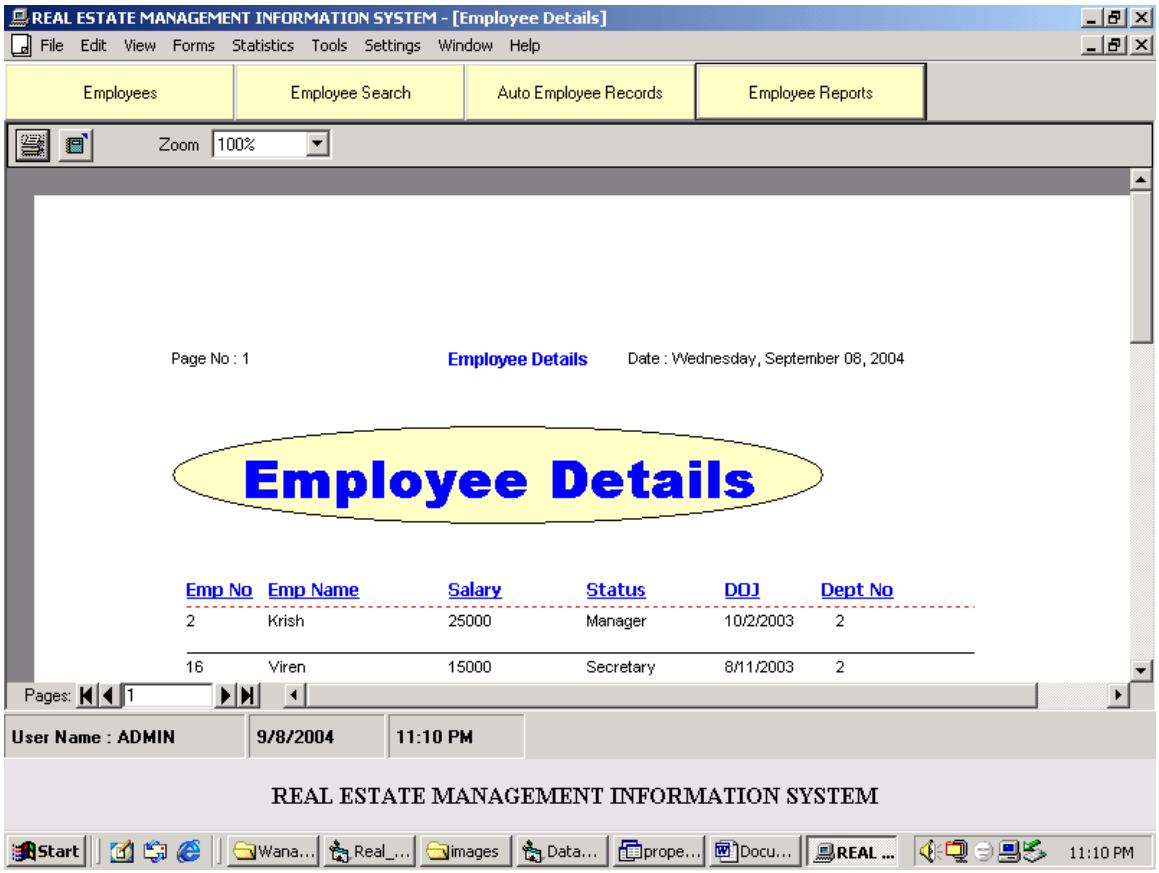


Figure 4.9: Employee details report

Note: The above outputs also apply to any other option chosen from the Forms menu option. These include: Clients, Branches, Viewing and Registration.

REMIS descriptive statistics calculation facility

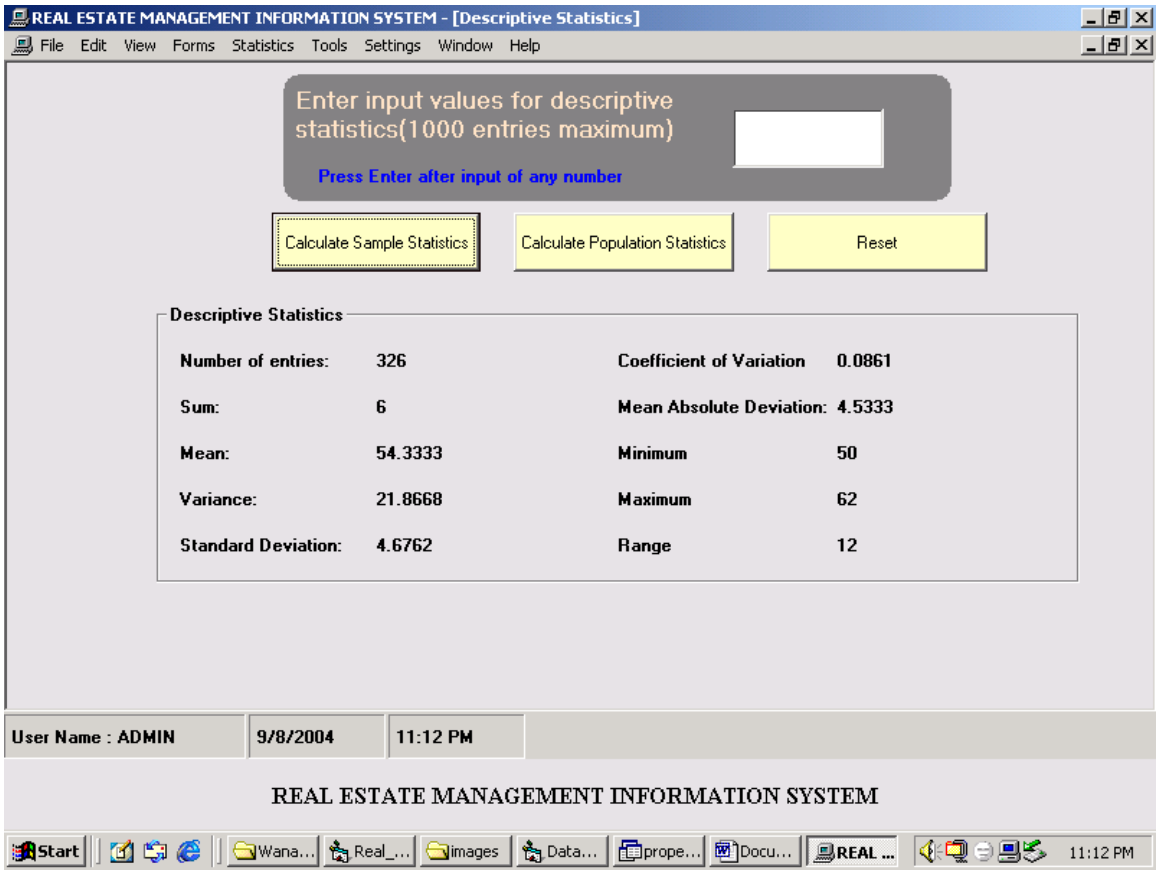


Figure 4.10: REMIS descriptive statistics calculator

The figure above shows the output when a user clicks Statistics menu | Descriptive statistics submenu option. Values whose statistics are to be calculated are entered in the text box above. For each entry, a user has to click <ENTER> for it to be counted as input. The statistics will be calculated for a sample or a population.

REMIS Linear regression and correlation facility

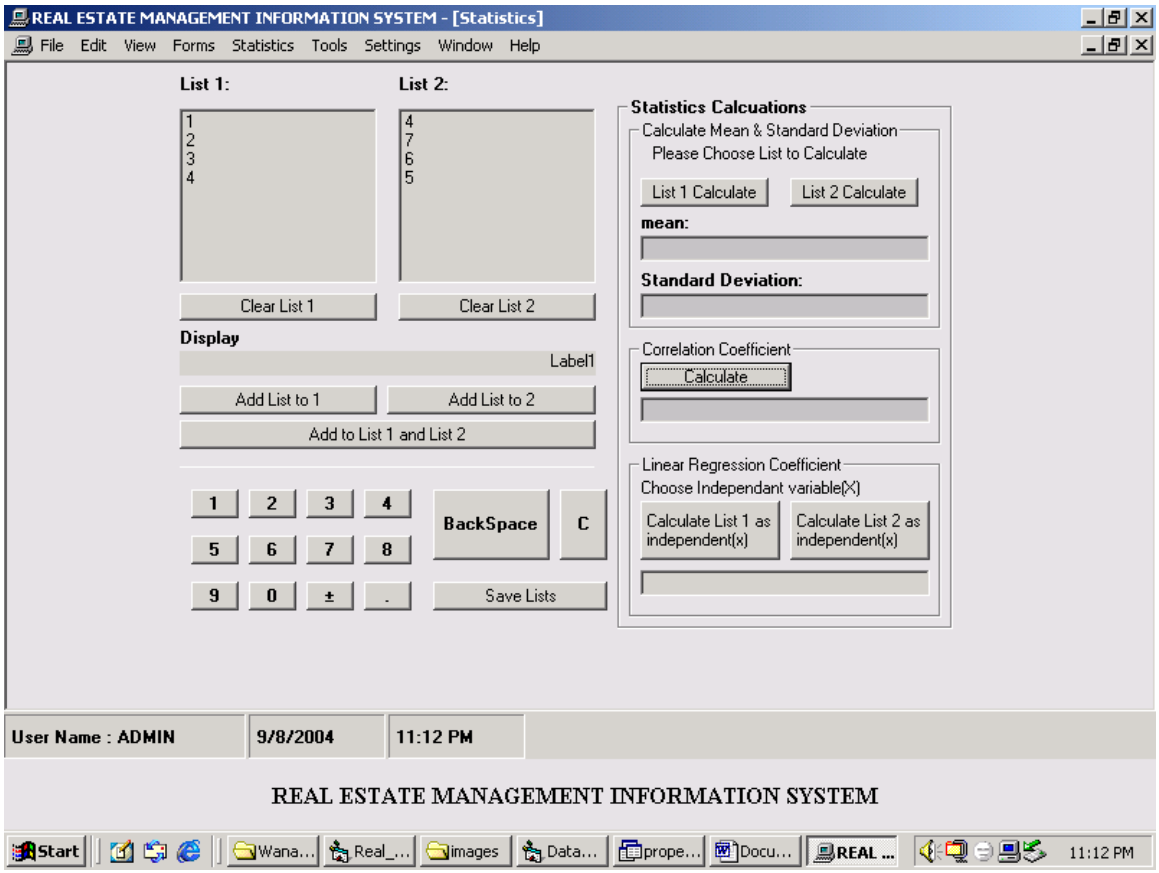


Figure 4.11: Linear regression and correlation facility

The above figure shows the facility used to calculate the linear regression coefficient and correlation coefficient. The user inputs the values of the random variables in list 1 and list 2 using the command buttons at the bottom left corner of the facility. The command buttons were used to prevent unnecessary errors during data input. Each and every time a user enters a value, he/she specifies the list where to input the value using the Add to List1 or Add to List 2 buttons. Calculations can be made for the List 1 and List 2 mean and standard deviation in the statistics section. The correlation coefficient is then generated using the correlation coefficient calculate command button. The user then has to choose which list represents the independent variable and click on the appropriate command button to generate the linear regression coefficient. The value inputted in List 1 and List 2 can be saved for use next time the user wants to run the same operations.

REMIS chi square test facility

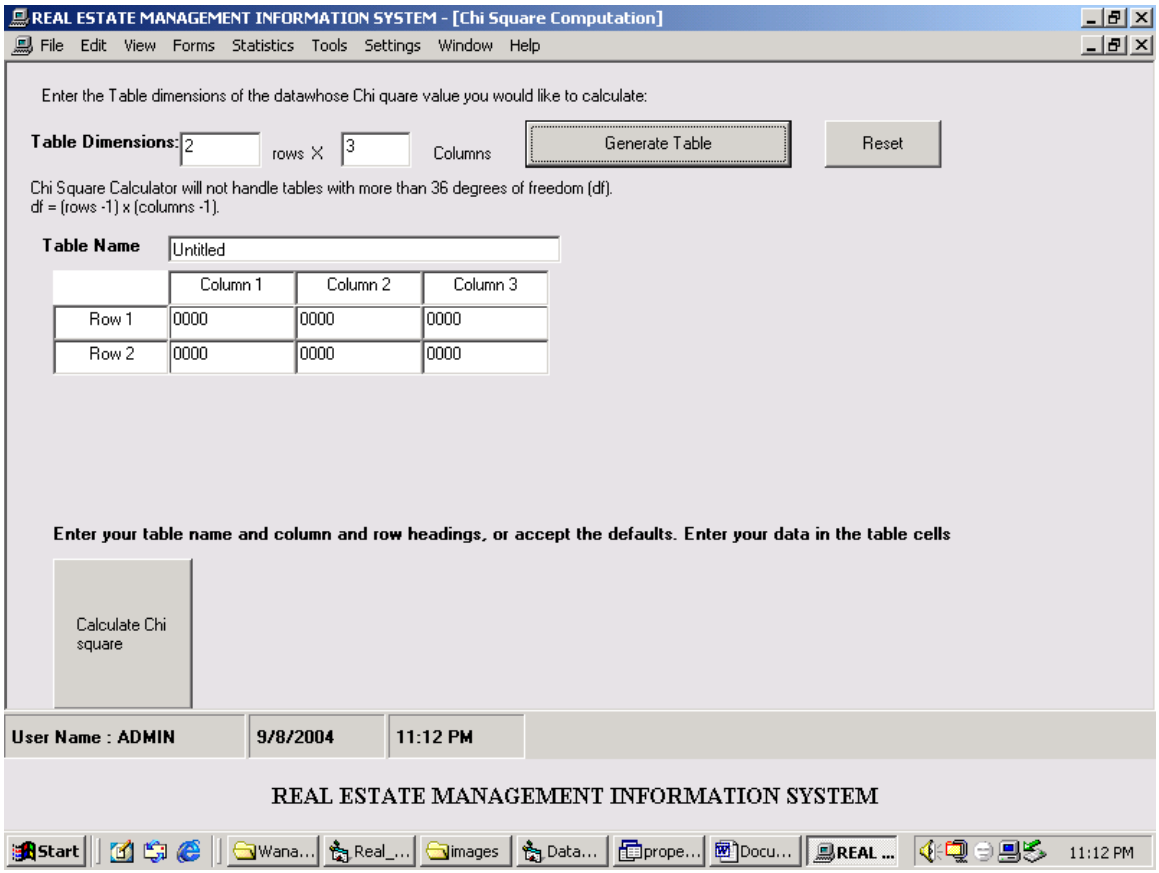


Figure 4.12: Chi Square test facility

Figure 4.12 shows the output when a user clicks Statistics | Chi square tests. The user is prompted to input the size of the table by specifying the number of rows and for the test. The facility handles a maximum of six rows and six columns. The user has to then click the Generate table command button for a table with the specified number of rows and columns to be generated. The user then enters the table name and row/column headings, or can accept the defaults as shown in Figure 4.12. The user has to then click the Calculate chi square command button after entering data in the rows and columns.

Figure 4.13 shows the output when the user clicks the Calculate Chi button.

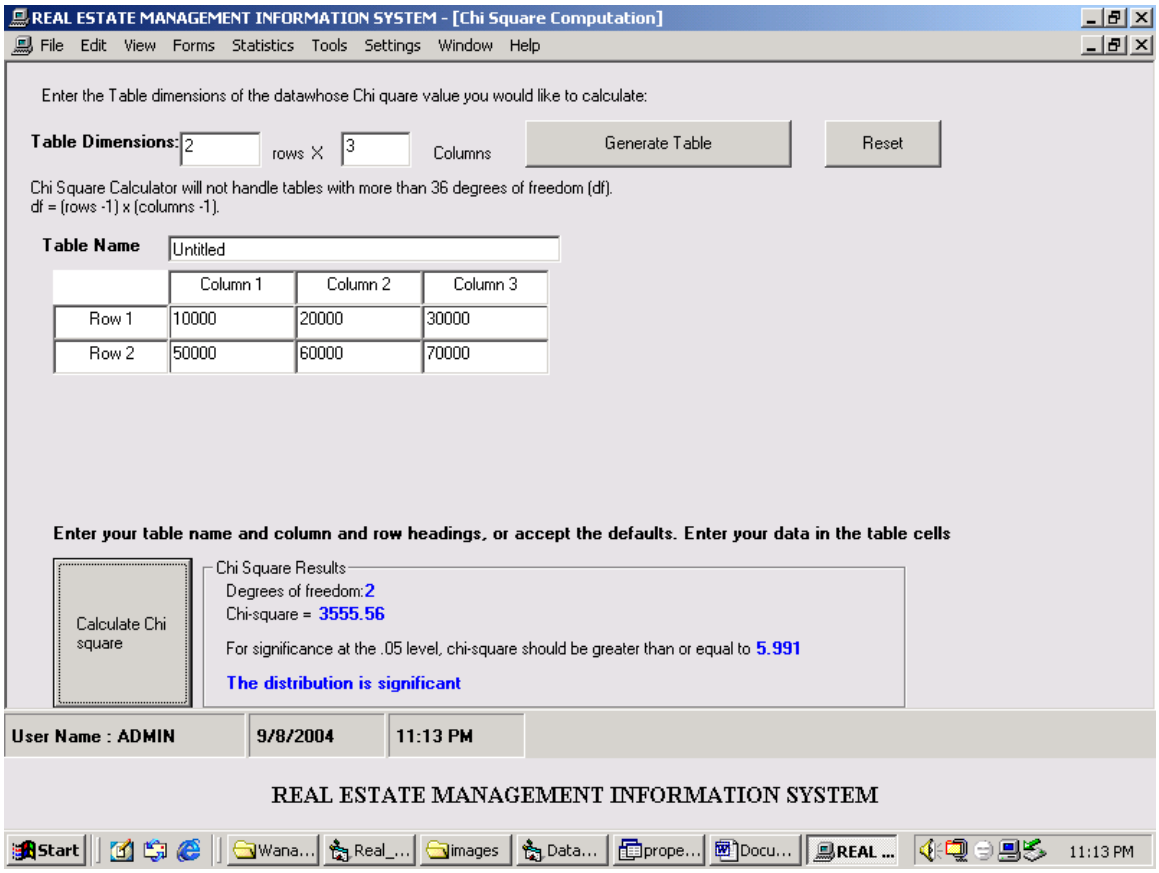


Figure 4.13: Chi square output

REMIS user information control facility

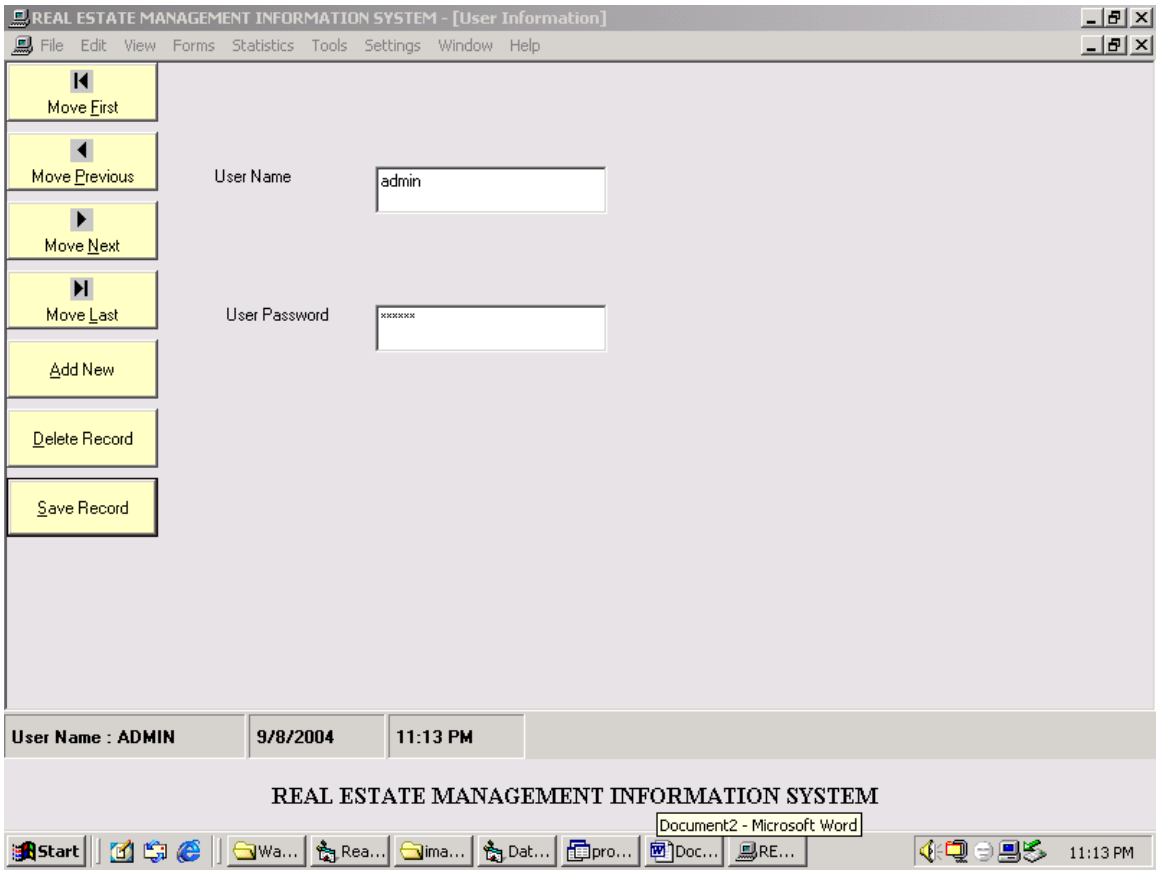


Figure 4.14: User information control facility

The figure above shows the facility the system administrator can use to control user names and pass words. It can be got through he path: Settings menu | User information submenu option. New users can be added and old users deleted using the command buttons on the left side of the facility.

REMIS database backup facility

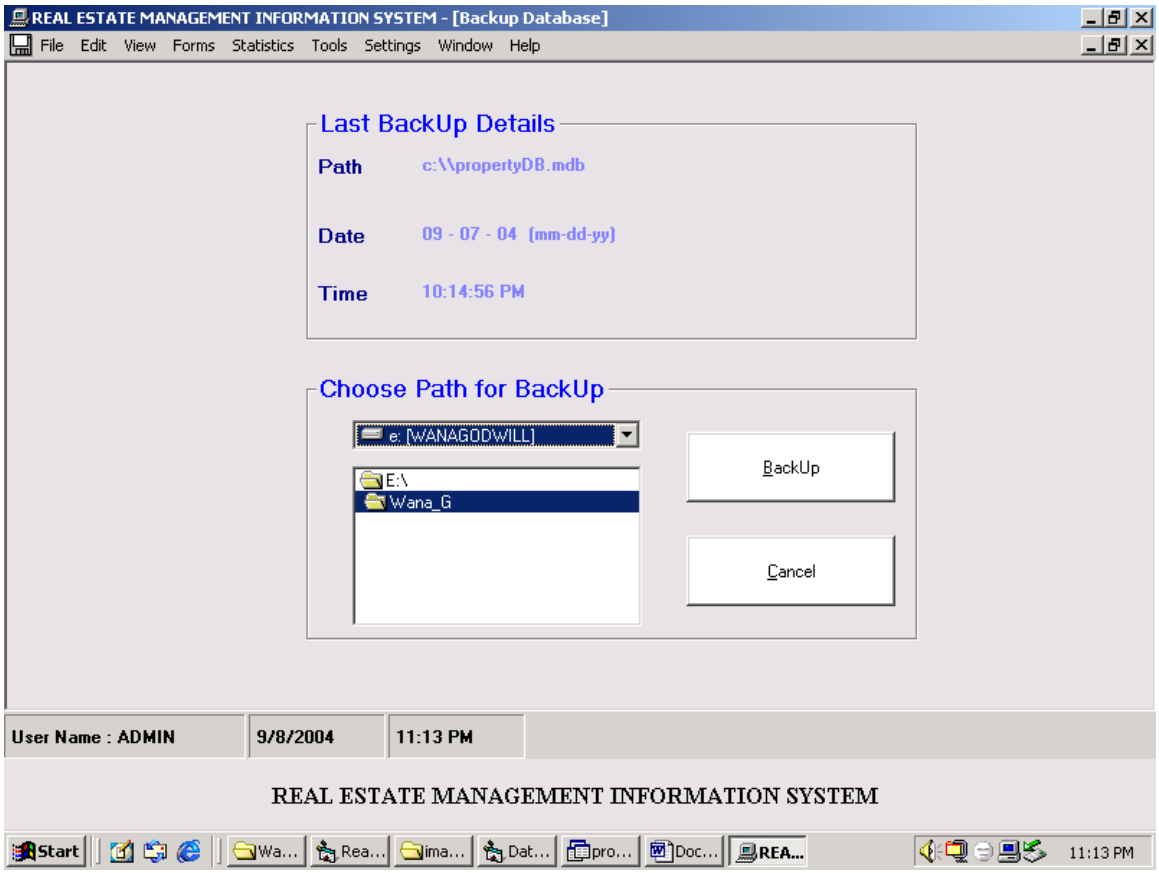


Figure4.15: Database backup facility

The above figure shows the result when the user clicks, Settings | Database backup. The facility shows the user when the last backup was made, the time it was made and the path to where the database was saved. The user can specify the path for backup by using the directory box on the bottom of the facility.

CHAPTER FIVE

Discussion, Conclusion and recommendations

5.0 Introduction:

This chapter summarizes the contents of the project report and the **REMIS** package in general. The section first discusses about the entire package as a whole, then makes conclusions and recommendations and finally presents the areas for further study.

5.1 Designed software

The study came up with a management information system, designed to help a real estate manager make good use of the big amount of information at his disposal by summarizing it into descriptive and inferential statistical values. . This program increases the decision-making capability of a manager by maximizing the efficiency and accuracy of the data inputting process with the use of forms and linked fields, eliminating any unnecessary re-keying of data.

The designed system also offers security to the company's data by storing all the information in a database and backing it up each and every time changes are made to the database.

5.1.1 Company information details

The package handles all the information that the company uses and presents it to the user in a precious way whenever needed by storing it into a relational database. The package uses forms to navigate through records make the necessary changes and add/delete records from the database. The package handles company details for rent and sale of property plus the client, property owners and company staff details.

5.1.2 Data analysis and statistical inference

The package carries out analysis on the data fed into the database and presents summaries to the user that can aid in quick decision making basing on the results. Descriptive statistics such as mean, standard deviation, range, coefficient of variation, mean absolute deviation are calculated which summarize the data and help the user get a more greater understanding of data. The package also calculates inferential statistics that can be used

to infer on any amount of data. Chi square tests and regression analysis tests are executed in the package. These can be used as a benchmark for future business deals in the organization.

5.1.3 Financial and customer reports

The package produces reports for all the records stored in the database to present an effective way for a user to present data in a printed format. Most of the information in the reports comes from an underlying table in the database, which is the source of the report's data.

5.1.4 Staff details and their transactions with clients

The package handles all the company staff details plus their respective transactions with clients. This helps the manger to know the exact staff member who dealt with a particular client.

5.1.5 Data security

The package offers high security to the company's data by authenticating the users of the system, thus unauthorized users of the company data cannot have access to its data. This is done through the use of usernames and passwords provided by the system's administrator for a particular user to log into the system.

The package also offers safety to the company data stored in the system by allowing users to make regular backups to the data stored in the database. This is implemented by a database backup facility where by a user is prompted to backup the data on the computer's disks which is made periodically and kept on magnetic tape or other removable medium. This essential precaution was included to cater for cases of disk crash or accidentally deleting the only copy of the database. The backup copies should be kept at a different site or in a fire safe since, though company hardware may be insured against fire, the data on it is almost certainly neither neither insured nor easily replaced

5.2 Conclusion and Recommendations

Research and design efforts successfully produced a real estate management system that increases the decision-making capability of a real estate manager by maximizing the efficiency and accuracy of the data inputting process with the use forms and statistical data analysis. The key main objectives for designing this system were:

1. Carry out data analysis and statistical inference: in **REMIS** data analysis and statistical analyses are delivered inform of descriptive and inferential statistics to the user. As shown in the previous chapter, the system can calculate descriptive statistics and carry out statistical inferences basing on existing data.
2. Handle details for rent and sale of property from clients: the system uses a relational database to handle these details, which can be manipulated easily with the wide variety of search facilities in the system.
3. Produce financial and customer reports: Perhaps the most powerful aspect of this program is the number of reports that can be generated from the information contained in the tenant information database. The **REMIS** implements this by an automatic report generation facility as described in the previous chapter. The program gives the user different options of report generation that can be used by any member of the company.
4. Handle staff's details and their different transactions with clients: again the system uses a relational database to handle details concerning staff plus their different transactions with clients.
5. Provide security to the company's data at a branch: the **REMIS** allows the system administrator to authenticate all the users by the use of user names and password so that unauthorized users do not get access to the company's data. The system also provides backup facilities to the company's data each and every time a user logs in.

The development and implementation of this system has also helped the researcher gain a lot of knowledge concerning systems design and implementation during the course of the study, which was one of the aims the research was undertaken.

The **REMIS** system cannot be considered a finished application as yet. It is still at an alpha version stage. There is work to be done to get the program to a commercial level. There are, as well, points that offer opportunities for further development:

- During the development of **REMIS**, to reduce the program's complexity, and thus make it manageable by just one coder, some compromises had to be made. This affected especially the program's functionality as concerns the needs of a real estate agency. The routines that were simplified in this way should now be revised and versions with more Real estate functionalities adopted.
- The errors still present in the program have to be fixed. No large program, however, is error free, but an acceptable level has to be achieved.
- The system's help facility is still too broad to offer help to users. This needs to be upgraded to a full **REMIS** help version.
- Authentication of the system should be further improved to allow the system administrator to grant data access privileges to the users so that user's can have read or write or both privileges to the database.

Apart from these changes and others that have passed the developer's consent, the system has to be used. That is the best way of finding errors and getting feedback from the users for new improvements. These changes do not affect the basic structure of the program. They are expected in a system moving from alpha version to a full commercial version.

5.3 Areas of further research

Connected specifically to the **REMIS** system there are some topics that should be of interest to the future development of management information systems, as well as to other researchers.

1. The **REMIS** system provides few statistical measures for decision-making and data analysis. Any future development of a real estate management information system should include more statistical measures to avail a number of tools for data analysis and statistical inference.

2. Any further development of real estate management information systems should be aimed at designing web based applications to allow remote access of the company data, plus all the current statistical functionalities in the current systems.

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