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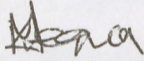
"THE MINIMIZATION OF ACCOUNTS RECEIVABLES IN THE WATER AND SEWERAGE DEPARTMENT OF NAIROBI CITY COUNCIL USING THE CREDIT SCORING TECHNIQUE."

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A MANAGEMENT RESEARCH PROJECT PAPER PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION OF THE UNIVERSITY OF NAIROBI.

This research paper is my original work and has not been presented for degree in any other university.

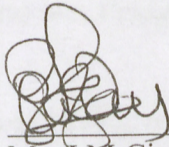


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ABSTRACT

This study sought to assess the willingness to pay rather than ability to pay of the domestic clients of the Water and Sewerage Department of the Nairobi City Council (WSD/NCC). The willingness to pay concept also referred to as creditworthiness.

Ten characteristics were employed as the independent or predictor variables to determine the credit scores (dependent variable) of the WSD/NCC domestic clients. The characteristics used were: employment status of the client; seniority of the position held in the work place; time spent by the client with current employer; industry in which the he or she is employed; ownership of the current residential house; time spent in that house; marital status and age of the client; the number of dependants of the client and the education background..

The domestic clients whose accounts receivable balance exceeded the bill representing a credit period of ninety days were classified as un-creditworthy, while those clients whose balance was less than the bill representing a credit period of ninety days were classified as creditworthy. This information was obtained from the credit records of the WSD/NCC.

The study used discriminant analysis statistical method to develop a credit-scoring model which utilized the ten independent variables above to predict the credit scores of the domestic clients.

The results of the prediction process indicated that the credit-scoring model developed was able to correctly predict the creditworthy clients by 62.6% and the un-creditworthy clients by 68.9%.

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LIST OF ABBREVIATIONS

CoD	Cash on Delivery
EIB	Export Import Bank
IDA	International Development Agency
KPLC	Kenya Power and Lighting Company
MOLG	Ministry of Local Government
MOWD	Ministry of Water Development
NCC	Nairobi City Council
OECD	Organization for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
SOM	Sewer Operations and Maintenance
WOM	Water Operations and Maintenance
WSD	Water and Sewerage Department
UoN	University of Nairobi

CHAPTER 1:

INTRODUCTION

1.1.1 BACKGROUND

Currently, Nairobi City Council (N.C.C.) has thirteen departments including the Water and Sewerage Department (W.S.D). The Council was appointed the Water Undertaker for Nairobi area in 1959 and the area of supply was extended in the 1960's and in 1974 according to the Water Act. The Water and Sewerage Department of the then Nairobi City Commission (NCC) was set up in 1970 as a pre-condition for a World Bank loan. Before then, the WSD was a separate division from the City Engineer's Department of the NCC.

The WSD after being established was responsible for: planning its future expansion; planning and managing its operations and affairs; and also carrying out its operations in accordance with sound business, financial, engineering and public utility practices.

Currently, the WSD/NCC is supposed to carry out its operations in a profit-oriented manner and also with regard to the requirements of Local Government Act, the NCC by-laws, and the Water Act.

The provision of water in the early 1900 was under the railway authorities that supplied water to the Nairobi townships through pipes erected in 1921. After this period the railway authorities sold the water supply to Nairobi Town Council, which was required to supply water to railway authorities free of charge for the first five years. Due to expansion, the demand for water exceeded the supply, which led to the harnessing of water from Kikuyu springs, then the construction of Nairobi Dam in 1946, then Ruiru Dam that was completed in 1950, then Sasumua Dam that was completed in 1956 and finally Thika Dam in 1994. The raw water that has been harnessed is treated at Kikuyu Springs, Kabete, Sasumua and Ng'ethu treatment works (Kanyuiro,1988).

1.1.2 THE STRUCTURE OF THE WSD/NCC

Presently a General Manager heads the WSD/NCC and is assisted by four Deputy General Managers in charge of Commercial, Water Operations and Maintenance (WOM), Sewer Operations and Maintenance (SOM) and Engineering Branches. There are six divisions in WSD namely: Kampala Road Depot, East Leigh Division, Nairobi Dam Division, Karen Division and Gatundu Division

Each of the divisions is headed by an Area Manager who is deputized by an Area Accountant with exception of Kampala Road Depot, which houses two Deputy General Managers for Water and Sewer Operations and Maintenance. All the divisions have cash offices where revenue for the WSD/NCC is collected to supplement the main cash office located at headquarters. The cashiers in all the revenue centres are under the control of the NCC Chief Revenue Officer and not the Area Management or the General Manager.

1.1.3 COMMERCIAL ACTIVITIES OF THE WSD/NCC

Commercial activities for WSD/NCC include opening of new water accounts, meter reading, billing, debt collection, receipts reconciliation, preparation of annual accounts/reports, budget preparation and payment of suppliers and other parties.

By June 2002 the WSD/NCC had two thousand five hundred employees of whom four hundred and fifty are in the Commercial Branch and the rest in the Water/Sewer Operations and Maintenance and Engineering Branches. The Department had 182,295 water accounts and 128,123 sewer accounts by June 2002 broken down as follows:

Table on number and category of the WSD/NCC accounts

CONSUMER CATEGORIES	CONNECTIONS	
	Year 2002	Percentage
Water		
Domestic consumers	164,172	90%
Non-domestic	<u>18,123</u>	<u>10%</u>
	<u>182,295</u>	<u>100%</u>
Sewer		
Domestic consumers	110,000	86%
Non-domestic consumers	<u>18,123</u>	<u>14%</u>
	<u>128,123</u>	<u>100%</u>

The water bills in the WSD/NCC are produced in 4 batches because the City of Nairobi is divided into four billing groups. The consumers who have no problems with their bills pay, but those with problems complain to the Department and their water/sewer accounts are placed under investigation state. If the complaints raised about an individual bill are genuine such as wrong meter readings, the consumer can be granted a credit due to over billing which reduces the outstanding debt of the consumer or a debit due to under billing which increases the outstanding debt of the consumer.

1.1.4 METER READING PROBLEMS

Meter reading is indispensable in developing country cities, where automatic metering has not been introduced (Kanywuiro,1988). It is a taxing job especially when the workforce of meter readers is small with only two hundred meter readers in the WSD/NCC. The situation is aggravated by the rapid expansion of Nairobi. The Meter Reading Section of WSD/NCC is also hindered by among other reasons: low morale among staff due to poor pay conditions; some meters are buried below ground due to unplanned building constructions hence preventing reading; there are many faulty meters; un-cooperative consumers who prevent meter reading; there has also been

deliberate interference with meters in order to prevent correct meter readings, among others (Hal crow, 2001).

1.1.7 BENCHMARKING OF WSD/NCC WITH OTHER UTILITY FIRMS

The problems faced the billing section of the WSD/NCC were also enumerated by Njonjo (1998) who studied water kiosks in Kibera residential area in Nairobi. The study results indicated that meter reading by the WSD/NCC staff was irregular and that many water kiosk owners did not believe the water meters functioned properly. Only thirty three percent of the water kiosk owners expected the meter readings for the year 1996 would be reflected in the meter records of the year 1998. This led the kiosk owners to default on monthly payment to the Council. The other factors according to the study that contributed to the non-payment of water bills included the unrealistic fluctuation of meter readings; delayed water billing by at least three to four months; also the fact that there was billing for sewer services even when there is no connection to the WSD/NCC sewer drainage system.

1.1.5 WATER BILLING SYSTEMS

The WSD/NCC has two billing computer systems one is referred to as "Main" system and the other as the "Custima" billing system. The main system produces the housing rent bills, water/sewer bills, land rates bills for NCC departments and also processes other non-billing work such as production of the payroll for the eighteen thousand work force. The "Custima" system comprises of water accounts of Westlands area, Parklands areas and also industrial area in Nairobi, where it produces 15,306 out of 182,295 water/sewer bills for the WSD.

The Custima system began as a pilot project aimed at having a streamlined billing system for the WSD and 15,306 water accounts were transferred to this system from the Main system. The Custima accounts were subjected to better treatment than the "main system" such as regular meter reading and monthly billing. The aim of this was to later implement the successes of the Custima system in the main system. This attempt did not succeed as the system could not hold the capacity that the "Main" system held and it was therefore partially implemented to its current status.

Source of long-term loan	Amount (KSh)
	8,998,076,820

1.1.7 BENCHMARKING OF WSD/NCC WITH OTHER UTILITY FIRMS

The WSD/NCC standing charges were Kshs.254 per month for domestic consumers who are supplied with sewer services and Kshs.190 for consumers without sewer services as at June 2002. There was a proposal to revise the WSD tariffs upwards by forty percent in the year 2001, which was not sanctioned by the Ministry of Local Government and Ministry of Water Development. If the revision had been sanctioned, the standing charges would have risen to Kshs.340 per month for consumers connected to sewer drainage and Kshs.266 per month for the ones without the sewer service. In comparison the KPLC as at June 2002 had standing charges of Kshs.75 per month for domestic consumers.

By the year June 2002, the number of consumers who were connected to water supply was 182,295 and those connected to sewer services supply were 128,123. The KPLC had 270,580 connections to power supply in Nairobi and 465,361 countrywide.

The usage of water is expected to be greater than that of power because water is a basic need. Consequently, the number of accounts maintained by WSD/NCC should be more than KPLC. The inefficient management of the WSD/NCC, may have caused the poor performance of the department.

1.1.8 INDEBTEDNESS OF THE WSD/NCC

The WSD/NCC has a perpetual problem of poor cash flows due to among other reasons the non-payment of water bills by consumers (Njonjo,1998). The poor cash flows have affected the repayment of loans to lenders like IDA, OPEC, and OECF by WSD/NCC and even affected the operations of the department. The schedule of external loans is listed below:

Table on long-term loan amounts owed by WSD/NCC as at 30th June 1998

<u>Source of long-term loan</u>	<u>Amount(Kshs)</u>
IDA	2,371,434,140
IBRD 1520 KE	108,890,000
OPEC Fund	16,509,660
EIB	309,284,100
ADB/ADF	450,646,280
OECD-Japan	367,275,460
Saudi Arabia	249,123,320
Kenya Government	40,000,000
HDD	84,933,860
Total	3,998,096,820

Source: Abstract of Accounts WSD/NCC 1998

1.1.9 PREPAYMENT WATER BILLS

The concept of prepayment of water supply service refers to the payment by consumers for water supply before its consumption. It has been operational in the United Kingdom for decades and its application in Africa is relatively new. In South Africa, non-payment by consumers of services provided by municipalities' water supply service in particular resulted in fifty to sixty percent of the over eight hundred municipalities being technically insolvent and no longer in a position to continue to provide quality services. The benefits of having a prepaid revenue system include increased revenue collections enabling provision of better services and conservation of water through eradication of wastage. The major problem in pre-paid system is resistance to the system by consumers initially which may be overcome by community involvement. (Rodeth, 1998).

Most of the Kenya local government authorities including NCC operate post paid billing system in offering water and sewer sanitation services. NCC uses prepaid billing system in services like rate payment, rent payment of NCC houses and car parking fee payment. If a prepaid system was to be implemented in the WSD/NCC in future, this study would be important in the determination of which clients to place in

either the prepaid or postpaid system. The creditworthy clients could be placed in the postpaid system because they are willing to pay while the un-creditworthy clients could be placed in the prepaid system because they are unwilling to pay. This would ensure that there are minimal cases of credit default.

1.1.10 ACCOUNTS RECEIVABLE AND TRADE CREDIT MANAGEMENT

The level of this investment in accounts receivable is dependent on the amount of credit sales and the time between making the sales and collecting the funds payment. The time between sale and payment is dependent on such factors as general swings in business cycle.

The level of risk a firm is willing to accept is a major consideration in making decisions regarding extension of credit. A restrictive credit policy reduces the payment default risk but may lead to loss of potential customers to competition that has liberal credit policy. The cost of a liberal credit policy include: an increased cost of credit department through the employment of more debt collection tools; increased potential for bad debts; also the opportunity cost in using the funds tied up in accounts receivable in more profitable activities of the organizations.

A firm should thus liberalize its credit standards to the point where profitability generated from the additional sales, is equal to the additional cost incurred in accepting additional accounts receivable (Engler,1978).

The WSD/NCC operates in an environment where there is little or no competition and its competition is from borehole owners who cannot pose a serious threat to the department. Given the situation, the WSD/NCC would benefit more by having a restrictive credit policy to maintain the accounts receivable amount to a minimal level. But, the WSD/NCC has a liberal credit policy, which is associated with high sales and high risk of credit payment default.

The liberal credit policy has led to a substantial account receivables amount of Kshs.4,009,220,000 against annual sales of Kshs. 1,988,469,840 as at 30th June 1998 (Abstract of Accounts,1998). Below is a table on the five year statistics of the

WSD/NCC on accounts receivables, credit sales and the debtor days ratio(accounts receivables / credit sales * 365 days). The sales of the department are always posts paid hence are credit sales.

Table on the WSD/NCC accounts receivables and sales statistics

Date	Accounts Receivables	Sales	Debtorday's ratio
	Kshs.	Kshs.	Days
June 1998	4,009,220,000	1,988,469,840	735
June 1997	3,141,127,540	1,848,388,240	620
June 1996	2,197,276,220	1,701,271,560	471
June 1995	1,829,322,020	1,261,940,160	529
June 1993	1,247,357,920	1,381,285,360	330

The debtor days ratio is also referred to as debt collection period ratio. It is customary to collect trade debts within ninety days in Kenya and therefore the WSD/NCC can be interpreted according to the ratio as facing a crisis in its debt collection activities. The table also shows that there is a trend of increasing amounts of accounts receivables from year 1993 to 1998.

The opportunity cost of tying up the Kshs.4 billion in accounts receivables can be illustrated by failure be the WSD/NCC to invest the funds tied up in accounts receivables in the Kenya Government treasury bonds that were earning an interest rate of over twelve percent per annum for the one year bond as at 30th June 1998. This means that the WSD/NCC lost over Kshs.480 million that year in opportunity cost.

The debt collection services by non-WSD/NCC staff were terminated by a Government of Kenya appointed inspection team in the year 2000 due to lack of accountability in debt commission claims. These non-staff debt collectors who included lawyers had been appointed to supplement the efforts of credit control staff of the WSD/NCC. The WSD/NCC later appointed an experienced debt collector from the KPLC in October 2001 to assist in recovery of accounts receivables, which were

being regarded as bad debts. The performance of the debt collector cannot be assessed because the latest set of accounting reports are dated June 1998 rather than current date.

In this way, the bank is able to use the credit scoring technique to evaluate credit

In order to enhance credit management, there is need to improve on credit analysis decision making, also referred to as credit selection which involves a credit applicant being granted credit facilities on the basis of creditworthiness assessment. The techniques involved include the assessment of the credit applicant's capacity, capital, character, collateral and conditions. Capacity referring to potential ability to repay credit grant, capital referring to the size of the credit applicant's resources, character referring to the willingness to comply with credit terms in terms of integrity and honesty of the applicant, collateral meaning the evaluation of the applicant's security for debt required, conditions referring to the economic and special conditions relating to applicant that may affect the decision to grant credit.

The net present value (NPV) is also another technique used in credit selection and is given by the following formula:

$$NPV = \frac{p \cdot R}{(1+r)^t} - C$$

Whereby C-refers to the incremental (variable) cost associated with the credit sale; R-refers to the sale amount; p-refers to probability that the receivable will be collected on due date; p*R-refers to the expected payment; r-refers to required rate of return and t-refers to length of credit period in days (Emery,1997).

Another technique of credit selection is use of credit scoring, which is used to judge a credit applicant's credit risk by considering the various characteristics of the applicant that are then quantitatively rated. The characteristics used include the applicant's age, occupation, employment duration, home ownership, years of residence, telephone and annual income (Mc Mennamin,1999).

Pandey,(1999) also indicated that the determinants of creditworthiness that can be used for individual credit applicants in credit scoring technique using the discriminant analysis method include; employment status; income level status; residence

ownership; marital status; age number of bank accounts held and integrity of the individual credit applicant.

In this study the researcher chose to use the credit scoring technique to evaluate credit default risk. This is because the other techniques of net present value and the technique for assessing the applicant's capacity, capital, character, collateral and conditions are both dependent on the variable of character assessment of the credit applicant which can scientifically be done using the credit scoring models.

The credit scoring techniques have in the past been applied in credit analysis decisions. One such credit scoring technique is the discriminant analysis technique that is able to predict which customer when granted credit facility is likely to default. Such a credit defaulting customer is regarded as being un-creditworthy and which one is unlikely to default is regarded as creditworthy (Van Horne,1998).

In Kenya, credit scoring has in the past been applied by lending institutions such as banks. These institutions have been capturing information about loan applicants by requesting the applicants to fill loan application forms. The data about a loan applicant is inserted in a credit score determination model used by the bank to establish a credit score. With such a score and experienced lending officers, the lending institutions are able to decide on whether or not to advance a loan to a prospective applicant.

1.2 STATEMENT OF THE PROBLEM

Initial investigations of the WSD/NCC revealed that accounts receivables were valued at Kshs.4,009,220,000 against annual sales of Kshs.1,988,469,840 and the debtor collection ratio was seven hundred and thirty five days as at 30th June 1998. This indicated that one of the main challenges faced by the management of the WSD/NCC is cash-flow enhancement through the reduction of the investment in accounts receivables. The inability for management to establish the creditworthiness¹ of clients before making credit grant decisions rendered formulation of strategies for minimization of accounts receivables difficult.

The past related studies done in Kenya had focused on developing models for bankruptcy prediction and assessment of the creditworthiness of firms rather than individuals. Bett,(1992) conducted a failure prediction study of banks in Kenya where he identified fourteen ratios that were critical for successful bank failure prediction.

Kabiru,(2002) studied the relationship between credit risk assessment practice and the level of non-performing loans in Kenyan banks the study therefore focused on firms rather than individual clients. Kagundu,(2002) studied factors influencing credit rationing by commercial banks in Kenya which concentrated on corporate rather than individual bank clients. Kimura,(1982) developed a linear non-discriminant function using six ratios and found that the function had significant bankruptcy prediction power. Kiragu,(1991) developed a failure prediction model using price adjusted data to identify critical financial ratios with high corporate failure prediction abilities under inflationary conditions. These ratios possessed significant discriminating power. Rukwaro,(2001) studied credit rationing by micro finance institutions and its influence on the operations of small and micro enterprises with the aim of determining the criteria used for credit rationing which focused on micro enterprises. Studies done outside Kenya related to the present study include that of Brill, (1998)

¹ Creditworthiness for the purpose of this study refers to clients having an accounts receivable balance of less than the equivalent of 3 months average monthly consumption water bill.

studied application of credit scoring models in prediction of creditworthiness of women apparel corporate customers of a San Francisco based manufacturer. Chesser,(1974) studied use of discriminant analysis technique to predict loan repayment willingness of corporate clients. Da Vaney,(1999) compared credit scoring models developed for consumer education and commercial purposes. The study findings were that the characteristics of credit applicants being home renters, having less job tenure, having older automobiles and having monthly high debt payment to income ratio had great influence on both consumer education and commercial credit scoring models.

A gap of knowledge relating to in particular the prediction of creditworthiness of individual customers of public utility entities and in general the prediction of creditworthiness in Kenya was therefore created. This then called for investigation of creditworthiness of the WSD/NCC clients prior to making credit grant decisions for the purpose of minimizing the investment in accounts receivables.

1.3 OBJECTIVES OF THE STUDY

The overall objective of the study was to develop a credit scoring model that was capable of predicting creditworthiness of water and sewer services clients to facilitate credit grant decisions by management of the WSD/NCC in order to minimize the investment in accounts receivables. The specific study objectives are:

1. To establish the domestic clients of the WSD/NCC that had their accounts receivable balances greater than the water consumption bill for ninety days. Such clients were classified as un-creditworthy, while those whose balances were less than the bill for ninety days were classified as creditworthy.
2. To establish the coefficients of ten independent variables used to develop the credit scoring model.
3. To test the effectiveness of the credit scoring model developed using discriminant analysis.

1.4 HYPOTHESES TESTING

Null Hypotheses

The ten selected characteristics being applied as independent variables in the credit scoring model are not able to predict creditworthiness of the WSD/NCC domestic clients.

Alternative hypotheses

The ten selected characteristics being applied as independent variables in the credit scoring model are able to predict creditworthiness of the WSD/NCC domestic clients.

1.5 SIGNIFICANCE OF THE STUDY

The study would be of benefit to:

1. The WSD/NCC management, because it would be able to predict which credit applicant is likely to default or unlikely to default when granted credit terms.
2. In case a pre-paid system is adopted for water and sanitation services in future in Kenya, the study would be of benefit to water and sanitation services providers including the WSD/NCC management in deciding the clients to place under the prepaid and post-paid systems.
3. Financiers of the WSD/NCC may find the study important as it will indicate the cash enhancement capability through minimization of investment in accounts receivables and this is a factor for consideration when assessing the ability of the entity to repay loans granted.
4. The Government of Kenya may also find the study important to be able to advise the local government authorities on credit management matters.

5. The clients of the WSD/NCC would also find the study necessary because it will be able to inform them of the characteristics that management is using in determination of their creditworthiness.

6. To the academia in future studies on credit scoring models.

CHAPTER 2 :

LITERATURE REVIEW

2.1.1 DEFINITIONS

Credit risk management

This refers to the system, procedures and controls that a company has in place to ensure the efficient collection of customer payments and to minimize the risk of non-payment. Currently the credit risk management of the WSD/NCC is weak and inefficient.

Accounts receivables

Refers to the amount that is owed by trade debtors of a firm who arise as a result of the firm making credit sales to customers for example the WSD/NCC has an accounts receivable amount of Kshs.4,009,220,000.

Creditworthiness

Ordinarily refers to customers having willingness to pay for credit granted when the repayment is due. For the purpose of this study creditworthiness refers to clients of the WSD/NCC having an accounts receivable balance of less than the equivalent of ninety days water consumption bill.

The WSD/NCC categories of consumers are: the industrial consumers who use water as a main raw material in the manufacture of products, for example the Kenya Breweries LTD and the Nairobi Bottlers Company LTD; commercial consumers use water in their production process but not necessarily as an input, including all other privately owned enterprises in Nairobi; institutional consumers refer to public institutions like schools, parastatals and government departments; domestic consumers are people who use water for residential purposes. In the WSD/NCC domestic consumers constituted ninety percent water consumers and eighty six percent sewer services consumers category based on the WSD/NCC credit records of 2002.

2.1.2 ABILITY AND WILLINGNESS TO PAY

Credit-scoring models do not predict a company's ability to pay but rather the willingness to pay in a timely manner. Credit scoring models that measure the likelihood of delinquent payments – using actual payment history along with other financial and demographic statistics are useful tools for pre-qualifying sales prospects and making credit decisions. (Schepanski,1983).

2.1.3 CREDIT SCORING MODELS

Credit scoring is a technique where customers assess credit risk by way of assigning a numerical 'score' to data filled by credit applicant and using discriminant analysis to predict non-payment (McMenamin,1999).

Scoring refers to the mathematical or statistical process of converting the data about a prospective applicant or customer into quantifiable and objective forecast of the applicant's or customer's behavior (Brill,1998). Scoring models can be applied in areas targeting assessment of credit applicants hence the birth of credit scoring models. Credit scoring models are used in making of credit analysis decisions, where they measure the likelihood of delinquent payments using actual payment history of a credit applicant along with other financial and demographic data.

The whole concept of scoring depends on the fact that historical performance can be used to predict future performance. It is thus essential to have a stable environment as opposed to a very dynamic one for scoring to work efficiently as lack of consistency makes it difficult to forecast using historical data. Efficiency in this context refers to the speed of processing credit applications and the percentage of debts that will eventually be written off.

La Monica et al,(1997) cautioned brokers about over reliance on credit scoring, arguing that credit scores can contain inaccurate information. Users of credit scoring models often gets no indication that a credit applicant has a low score which leads the user to make a subjective judgement regarding the creditworthiness of the borrower. Credit scores can also lead to the aspect of increased risk based pricing, whereby lenders would have to charge higher rates to consumers with low credit scores.

2.2 EMPIRICAL STUDIES ON PREDICTIVE MODELS

Altman,(1968) studied sixty six firms in his research on financial ratios, discriminant analysis and the prediction of corporate bankruptcy. His findings were five ratios when combined had the best predictive ability for the year prior to bankruptcy. These ratios were: working capital to total assets; retained earnings to total assets; earnings before interest and taxes to total assets; market value of equity to book value of total debt; sales to total assets His findings were that the multi discriminant analysis model had ninety five percent correct classification rate one year prior to bankruptcy.

Beaver,(1966) studied a sample of 79 firms which failed during 1954-1964 period. He examined thirty ratios and conducted a dichotomous classification test. The failure of a firm was predicted solely upon the knowledge of a given financial ratio. His findings were that two ratios had the strongest predictive power with each classifying eighty seven percent of the sample firms correctly, one year prior to failure. The ratios were the cash-flow to total debt ratio and net income to assets ratio.

Bett, (1992) conducted a study on Kenyan banks and financial institutions with the objective of establishing whether financial ratios can be used to discriminate between failed and unfailed firms. He did so by using multi discriminant analysis and developed an accounting model. Findings of the study were that the model was able to discriminate between the two groups and the ratios used included; net profit / total assets; net profit / total equity; quick ratio; net profit / paid up capital; quick assets / total deposits and the current ratio.

Brill, (1998) conducted a study on credit scoring systems where a San Francisco based manufacturer of medium priced women's apparel was involved. The predictor variables were: percent of trade balances past due date, accounts placed for collection, financial position, public finings and demographic information such as years in business, number of employees, industry and sales volume. The multi-linear regression model developed had seventy nine correct classification rate.

Chesser, (1974) studied predicting loan compliance using multi discriminant analysis techniques and identified six ratios that were considered as adequate predictors of bank loan compliances. These ratios are: cash and marketable securities to total assets; net sales to cash and marketable securities; earnings before interest and taxes to total assets; total debt to total assets; fixed assets to net worth and the working capital to net sales ratio. The model developed achieved up to seventy six percent correct classification one year before noncompliance.

Kabiru, L.M.G.(2002) sought to determine how banks assess credit risk in Kenya

De Vaney,(1999), studied two credit scoring models namely the consumer education and the commercial models to assess the features of both models and also to establish the variables that were strong indicators of creditworthiness status. The consumer education model is a model used for education of consumers on credit scoring and the predictor variables usually used in the model, while the commercial model is one that is used by businesses to evaluate credit requests. The results of the creditworthiness study showed that, the commercial model respondents that were likely to default if granted credit included: renters (not home owners); those with less job tenure; those with older automobiles and those with higher monthly debt payment to income ratio. The consumer education model respondents that were likely to default when granted credit included: renters; those with less job security and those with older automobiles.

Ewert,(1968) conducted a study on trade credit management: selection of accounts receivable using a multiple regression analysis of nine variables. He studied five hundred firms to distinguish good and bad trade accounts. His findings were the model correctly classified eighty seven percent of the firms. The variables were: prompt payment (% of Suppliers Reporting); slow payment (% of Suppliers Reporting); CoD terms (% of Suppliers Reporting); accounts in for collection (% of Suppliers Reporting); selling account three years or more (% of Suppliers Reporting); highest amount of credit granted; past due amount owed to suppliers; credit rating – Dun & Bradstreet and the firm's own premises.

Federal Bank of Atlanta,(2002) conducted a research on the effects of small business credit scoring on volume of credit availability based on the variables of quantity, price and risk. Results of the study indicated that the adoption of small business credit

scoring is associated with overall expanded credit availability, higher prices and greater loan risk for small business credit under one hundred thousand dollars. This outcome is attributed to net increase in lending to marginal borrowers that tend to pay relatively high loan prices because they generally have higher credit risk, have higher information opacity and are more costly to serve than borrowers that are not on the margin of acceptance or denial.

Kabiru J.M.G,(2002) sought to determine how banks assess credit risk in Kenya and also sought to establish whether a relationship exists between the credit risk assessment methods used and the level of non-performing loans in Kenyan banks. The findings were that banks considered the volatility of earnings; leverage levels; collateral; reputation and the business cycle as the most important qualitative factors in credit assessment. The study results also indicated that ninety four percent of Kenyan banks use qualitative credit assessment methods while six percent use quantitative methods.

Kagundu,(2002) sought to determine the factors that influence credit rationing to client firms by commercial banks in Kenya. The study also sought to establish the relative importance of the factors identified as influencing credit rationing by banks. A questionnaire was administered to banks seeking their opinion on the influencing factors. The study results indicated that the factors rated highly by banks as influencing credit rationing included: past debt servicing performance by client firm; degree of the client firm's financial leverage; size of the client firm; age of client firm; geographic location of client firm and the reputation of the client firm.

Kiragu,(1991) studied a model using price adjusted accounting data that could be used to predict corporate failure and to identify critical financial ratios with high corporate failure prediction abilities under inflationary conditions. The researcher conducted financial analysis of companies that had gone into receivership and used multivariate discriminant analysis to identify ratios, which could accurately discriminate between failed companies and non-failed ones. Results of the study showed that some financial ratios are able to discriminate between failing firms and non-failing firms correctly. The ratios that possessed significant discriminating power included: change in

monetary liabilities and retained earnings to total assets, liquidity ratios and debt ratios (times interest earned and fixed interest charge coverage).

Morton,(1978) studied trade credit and business liquidity aiming at establishing the accounting ratios that could predict a downward credit rating by Dun & Bradstreet Agency. He studied twenty accounting ratios using multiple discriminant analysis and out of the ratios examined, four exhibited statistically significant deterioration prior to trade credit downgrades received by those firms. These ratios were: return on tangible net worth; return on working capital; percentage profit; percentage cash flow change. The study findings were that the model had seventy four percent correct classification for the year in which the rating agency made its discrimination.

Roczbach et al,(1998) examined whether an a loan assessment model meant for assisting banks to minimize on incorrectly classified loans and which possesses a variable censoring threshold and sample selection effects is capable of predicting the decision to provide loans or not and also the survival period of granted loans. The study results showed that the model is an effective tool for separation of applicants with short survival times from those with long survival times.

3.2.1 THE DISCRIMINANT ANALYSIS TECHNIQUE

Rukwaro,(2001) studied credit rationing by micro finance institutions and its influence on the operations of small and micro enterprises with the aim of determining the criteria used for credit rationing. The study findings were that the credit applicant's ability to pay; profitability and regularity of savings determined the amount a loan applicant would be allowed to borrow. Other criteria used in assessment of creditworthiness included nature of business done by applicant; business location; level of savings; maintenance of proper accounts; having nil outstanding debts and cohesiveness of the group in which the applicant belonged to.

Yong,(1978) conducted a study on evaluation of accounts receivable. The purpose was to provide a method for evaluating investments in accounts receivables that was consistent with the wealth maximization objective. The findings were that the net present value of evaluating investments in account receivables is conceptually correct and is consistent with wealth maximization objective.

CHAPTER 3:

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In order to investigate the potential for the application of credit scoring technique in this study, ten non-numerical characteristics of domestic clients were applied as independent or predictor variables. The non-numerical characteristics were capable of indicating the level of responsibility of the WSD/NCC clients and hence their creditworthiness status. These characteristics were chosen for this study because they had been researched upon in the past by De Vaney et al,(1999). Pandey,(1999) and Mc Menemin,(1999). These characteristics are also being used in loan request forms by the banking industry in Kenya to predict loan / credit default.

The ten non-numerical characteristics relating to the WSD/NCC domestic client used as predictor variables in the study were: the employment status; seniority in the work place; time spent with current employer; industry employed in; ownership of the house currently residing in; time spent in the house; marital status; age; number of dependants and the education background.

3.2.1 THE DISCRIMINANT ANALYSIS TECHNIQUE

This is a technique for analyzing data when the criterion or dependent variable is categorical in nature while the predictor or independent variables are of interval nature. (Malhotra,1996).

The model involves linear function of the following form:

$$D = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + \dots + B_KX_K$$

Where:

B_0 = constant

D = discriminant score

X = predictor or independent variables

B = discriminant coefficients or weights

The objectives of discriminant analysis include:

- Examination of whether significant differences exist among groups in terms of predictor variables.
- Determination of which predictor variables contribute to most inter-group differences.
- Classification of observations into one of the groups under investigation based on values of the predictor variables.

Evaluation of the accuracy of the classification of observations into groups by the discriminant function developed (Bett, 1992).

3.2.2 INDICATORS OF THE EFFECTIVENESS OF THE DISCRIMINANT FUNCTION

(a) CLASSIFICATION MATRIX

Classification matrix or confusion matrix or prediction matrix refers to a matrix, which contains the number of correctly classified and misclassified cases and is of the form:

<u>Actual group membership</u>	<u>Predicted group membership</u>	
	Group 1	Group 2
Group 1	C 1	I 1
Group 2	I 2	C 2

Where: C = correct classification
I = incorrect classification (Malhotra,1996).

(b) EIGEN VALUE

This is the ratio of between group to within group sum of squares. A large eigen value equal or greater than one indicates superior discriminant function. Eigen values approaching zero indicate the presence of collinearity in the model. Collinearity is an inherent problem in multiple discriminant analysis that distorts facts. It arises where the independent or predictor variables that are used in a model are highly correlated such that their effect will be similar to that of a single one that has been used twice in the model thus creating biasness in the coefficients of the model (Kleinbaum,1988).

Eigen value = $\frac{\text{Between group sum of squares}}{\text{Within group sum of squares}}$

Within group sum of squares

3.5 THE SAMPLE

Out of the 164,172 domestic clients, a sample of three hundred clients was selected

3.3 POPULATION

The total number of water accounts in the WSD/NCC stood at 182,295 as at June 2002. The breakdown of the 182,295 accounts is: 164,172 domestic accounts and 18,123 industrial, commercial and institutional accounts. The 164,172 represented the population for this study that focused on domestic clients only because the consumption of water and sanitation services from the WSD/NCC is mainly by the domestic clients rather than by commercial, industrial or institutional categories.

After data collection, the three hundred WSD/NCC domestic clients formed the

3.4 DATA COLLECTION

Both primary and secondary data were used in the study in order to compare the actual creditworthy status that was contained in the secondary data with the predicted creditworthy status that was contained in the primary data. The primary data collection method was used for the study where the researcher used a questionnaire with ten questions relating to the ten non-numerical variables that were used as independent or predictor variables in the discriminant analysis model developed.

After data collection, the three hundred WSD/NCC domestic clients formed the

The secondary data collection method was used whereby data relating to the indebtedness of the domestic clients of the WSD/NCC was obtained from the credit records. In case a water account had a problem the WSD/NCC isolates it and puts it under investigation state until the problem is resolved which is usually done in two months. This study did not consider the accounts that had problems. The discriminant analysis model developed generated credit scores for the WSD/NCC clients and such scores were then compared to the indebtedness status of the clients to determine the extent of accuracy of the model.

The creditworthiness status was determined by comparing the domestic clients of the WSD/NCC that had their accounts receivable balances equal to the average of the ninety days water consumption bill. The domestic clients were categorized as un-

creditworthy if their debt exceeded the ninety days water consumption bill, while those whose debt was less were classified as creditworthy.

RESEARCH FINDINGS

3.5 THE SAMPLE

Out of the 164,172 domestic clients, a sample of three hundred clients was selected for this study using the stratification random sampling method based on the WSD/NCC six divisions. For each sample selected the actual creditworthiness of the sample was established by checking the accounts receivable balance from the credit records and then a questionnaire was sent to the account holder / client of the WSD/NCC.

3.6 DATA ANALYSIS

After data collection, the three hundred WSD/NCC domestic clients formed the analysis sample² and the validation sample³. The analysis and validation samples were further be divided into the creditworthy and un-creditworthy groups based on the accounts receivable balance in the WSD/NCC credit records. The aim was to check the accuracy of the results of the credit scoring model developed in this study that has ten predictor variables.

The analysis sample was used to develop the discriminant analysis function's coefficients or weights using the Statistical Package for Social Scientists (SPSS), while the validation sample was for testing the accuracy of the discriminant function's classification of observations into creditworthy and un-creditworthy group.

² Analysis sample refers to the sample to be used in the development of the discriminant analysis function.

³ Validation sample refers to the sample which is reserved for validation or testing the accuracy of the discriminant analysis function developed.

CHAPTER 4:

RESEARCH FINDINGS

4.1 INTRODUCTION

In accordance with the objectives set out in chapter two, the results of analysis are documented in this chapter. The data collection exercise led to collection of the following data: One hundred and six domestic clients who were classified as un-creditworthy and ninety one domestic clients who were classified as creditworthy. A total of one hundred and ninety seven observations were analyzed. The classification based on creditworthiness information was obtained from the credit records of the WSD/NCC.

4.2 THE EFFECTIVENESS OF THE CREDIT SCORING MODEL

The credit scoring model used in the study can be assessed for effectiveness based on the classification matrix and the eigen value statistical.

4.2.1 CLASSIFICATION / MATRIX INDICATOR

Using the validation sample in the study, the discriminant analysis model developed was able to predict or classify the actual creditworthiness status of domestic clients of the WSD/NCC as follows: out of one hundred and six actual un-creditworthy observations, 68.9% or seventy three observations were correctly classified (predicted) as un-creditworthy while the remaining 31.1% or thirty three observations were incorrectly classified as creditworthy.

Out of ninety one actual creditworthy observations, 62.6% or fifty seven observations were correctly classified (predicted) as creditworthy while the remaining 37.4% or thirty four observations were incorrectly classified as un-creditworthy.

Table of classification matrix:

	<u>Actual group membership</u>		<u>Predicted group membership</u>	
	Creditworthy	Un-creditworthy	Total	
(Observations)				
Un-creditworthy	73	33	106	
Creditworthy	34	57	91	
(Percentages)				
Un-creditworthy	68.9%	31.1%	100%	
Creditworthy	37.4%	62.6%	100%	

The findings of the classification matrix indicate that the discriminant analysis model had a correct classification or hit rate of 66% that is $(68.9\% + 62.6\%) / 2$. The 62.6% indicated the correctly classified creditworthy observations, while the 68.9% indicated the correctly classified un-creditworthy observations. The 31.1% indicated the incorrectly classified creditworthy observations, while the 37.4% indicated the incorrectly classified un-creditworthy observations.

4.2.2 EIGEN VALUE INDICATOR

This is the ratio of between the group to within the group sum of squares. A large eigen value equal or greater than one indicates superior discriminant function. Eigen values approaching zero indicates the presence of collinearity in the model which arises where the independent or predictor variables that are used in a model are highly correlated such that their effect will be similar to that of a single one that has been

used twice in the model thus creating biasness in the coefficients of the model (Kleinbaum,1988).

The study's eigen value (appendix two) was 0.275, which indicates that the model developed had collinearity problem. This is evidenced by the fact that the independent or predictor variables used in the study seem to influence each other. For example the age of an individual is likely to determine employment status, position held in the firm, time employed, time at current residence, ownership of residence, marital status, number of dependents and even the education status.

4.3 WEIGHTS OF THE INDEPENDENT / PREDICTOR VARIABLES TO THE DISCRIMINANT SCORES

The relative importance (weight) of each independent variable used in discriminant analysis models, determines the discriminant scores produced by the model. The weights of independent variables can be obtained from the model's standardized canonical coefficients. The independent variables with relatively large standardized coefficients contribute more to discriminating power of the model (Malhotra,1996).

The discriminant analysis model used in the study had ten independent variables and the standardized canonical discriminant model coefficients were:

$$D = 0.062X_1 + 0.688X_2 - 0.394X_3 + 0.058X_4 + 0.43X_5 - 0.11X_6 + 0.013X_7 + 0.054X_8 + 0.27X_9 - 0.208X_{10} \quad (\text{appendix 2}).$$

Where D represents the discriminant scores and X_i represents the independent variables as follows: X_1 -employment status of the domestic client ; X_2 -client's seniority of position in the work place; X_3 -time spent with current employer; X_4 -industry where the client is employed; X_5 -ownership of the house where client currently resides; X_6 -time spent in house currently residing in; X_7 -marital status of the client; X_8 -age of client; X_9 -number of dependants of client and X_{10} -education background of client.

From the standardized canonical discriminant coefficient model above, the independent variables can be listed according to their predictive power which is given by size of the coefficients as follows: seniority of position; followed by ownership of house; time spent with current employer; number of dependants; then education background; time spent in current house; employment status; industry of employment; age and lastly marital status.

5.1 INTRODUCTION

The Fisher's linear discriminant functions for the creditworthy and un-creditworthy groups according to the analysis were as follows:

Creditworthy group:

$$D = - 44 + 4.95X_1 + 7.02X_2 - 0.535X_3 + 0.624X_4 + 6.24X_5 + 1.12X_6 + 7.19X_7 + 6.85X_8 + 6.3X_9 + 3.1X_{10}$$

Un-creditworthy group:

$$D = - 42.77 + 4.81X_1 + 5.44X_2 - 0.2X_3 + 0.65X_4 + 5.45X_5 + 1.2X_6 + 7.17X_7 + 6.78X_8 + 6.1X_9 + 3.3X_{10}$$

The results of the Fisher's linear discriminant functions in this study based on the size of the coefficients indicate that the variables with the greatest predictive power were marital status, age, number of dependants, residence ownership, position held and employment status. These results are similar to those of the study done by De Vaney et al(1999) which indicated that the predictor variables that had the most predictive power were residence ownership, job tenure, age of automobile and the ratio of monthly debt payment to income.

CHAPTER 5 :

THE RESEARCH CONCLUSIONS, LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH.

5.1 INTRODUCTION

The null hypotheses to be tested in this study were that, the ten selected characteristics applied as independent variables are not able to predict creditworthiness of the WSD/NCC domestic clients.

Based on the research findings in chapter 4, the credit scoring model developed using the ten independent variables was able to predict creditworthiness of the domestic clients of the WSD/NCC with an accuracy (hit) rate of sixty six percent according to the classification matrix results and therefore the null hypothesis should be rejected.

The results of the Fisher's linear discriminant functions in this study based on the size of the coefficients indicate that the variables with the greatest predictive power were marital status, age, number of dependants, residence ownership, position held and employment status.

These results confirm those of past studies on credit scoring. Da Vaney(1999), credit scoring study had findings that indicated that the individuals likely to default when granted credit were: renters rather than home owners; individuals with less job tenure; those with older automobiles; individuals with higher ratios of monthly debt payment to income. Mc Mennamin,(1999) also indicated that the characteristics to use as predictor variables in a credit scoring model of assessing individuals include the applicant's age, occupation, employment duration, home ownership, years of residence, telephone and annual income.

5.2 LIMITATIONS OF THE STUDY

The results of the study should be interpreted in the light of the following limitations:

- a) There was a collinearity problem where the ten predictor variables used in the study seem to have influence on each other, thereby distorting results of the research.
- b) The WSD/NCC has had numerous complaints from the public including domestic clients over its billing and credit records. Hence the researcher cannot rule out the influence of poor billing and credit record system affecting the results of the research.
- c) Some important independent variables were omitted from the study because according to a pilot questionnaire, domestic clients of the WSD/NCC felt the information required was very confidential and were not willing to divulge it freely. Such independent variables included: Monthly debt payment as a percentage of gross income, frequency of wage payment (whether daily / weekly / monthly) and the gross income status that would measure the ability to pay commitments. Such confidential information is required by banks in the processing of loan requests from clients.
- d) The past research done on credit scoring models in particular the independent variables used is not readily available as most of it has been done commercially and hence is treated confidential for competitive reasons.

5.3 SUGGESTIONS FOR FURTHER RESEARCH

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- a) A similar study can be undertaken on the non-domestic clients of the WSD/NCC but using different independent variables that can measure the credit worthiness of firms rather than individuals. The variables to use include: percent of trade balances past due date, accounts placed for collection, financial position, public finings and demographic information such as years in business, number of employees, industry and sales volume (Brill,1998).
 - b) Utility institutions offering water, power and communication services such as the Kenya Power and Lighting Company and Telkom Kenya company can also be studied to assess the applicability of credit scoring models in Kenya.
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Appendix 1

University of Nairobi / Nairobi City Council Research Study

Domestic category consumers Questionnaire

1. State your employment status: (a) employed (b) self-employed.
2. Please state position held _____
3. State the time spent with the current employer : (a) over 15 years
(b) 10 – 14 years (c) 6 – 9 years (d) 3 – 5 years (e) 1 – 2 years
(f) less than 1 year
4. State which Industry in which you are employed in:
(a) professional services e.g law firm, audit firm etc
(b) information technology
(c) other services e.g civil service
(d) retail trade
(e) catering
(f) building and construction
(g) heavy manufacturing
(h) others
5. State your residence ownership status. Whether living in: (a) own house
(b) rented house (c) company house
6. State the time you have spent in the current house: (a) over 15 years
(b) 10 – 14 years (c) 6 – 9 years (d) 3 – 5 years (e) 1 – 2 years
(f) less than 1 year
7. State your marital status: (a) single (b) married (c) divorced
(d) others e.g widowed

8. State your age bracket: (a) above 50 years (b) 41 – 50 years (c) 31- 40 years
(d) 26 – 30 years (e) 21- 25 years

9. State the number of dependants that you have : (a) none (b) one (c) two (d)
3 – 4 (e) 5 and above

10. State your educational background:

(a) university- postgraduate level

(b) university under-graduate level

(c) college level

(d) secondary/high school level

(e) primary school level

Appendix 2

Discriminant Analysis Results

Key: uncredit = un-creditworthy domestic customers of the WSD/NCC

credit-w = creditworthy domestic customers of the WSD/NCC

Eigenvalues

Function Correlation	Eigenvalue	% of Variance	Cumulative %	Canonical
1	.275 (a)	100.0	100.0	.465

¢
a First 1 canonical discriminant functions were used in the analysis.

¢

Standardized Canonical Discriminant Function Coefficients

	Function credit-w
E status	.062
Position	.688
Tim Empl	-.394
Empl ind	.058
Res-own	.430
TS_HSE	-.110
M status	.013
Age	.054
Depend	.270
Educ	-.208

Classification Function Coefficients

	C status	
	uncredit	credit-w
E status	4.815	4.952
Position	5.439	7.017
Tim Empl	-.203	-.535
Empl ind	.652	.677
Res-own	5.450	6.241
TS_HSE	1.203	1.117
M status	7.167	7.193
Age	6.783	6.848
Depend	6.076	6.313
Educ	3.343	3.105
(Constant)	-42.770	-44.040

φ
Fisher's linear discriminant functions

Classification Results Table

			Predicted Membership		Total
		C status	.00	1.00	
Original	Count	uncredit	77	29	106
		credit-w	32	59	91
	%	uncredit	72.6	27.4	100.0
		credit-w	35.2	64.8	100.0
Cross-validated(a)	Count	uncredit	73	33	106
		credit-w	34	57	91
	%	uncredit	68.9	31.1	100.0
		credit-w	37.4	62.6	100.0

¢

(a) Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.

(b) 69.0% of original grouped cases correctly classified.

(c) 66.0% of cross-validated grouped cases correctly classified.

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