DETERMINATION OF PREMIUMS PAYABLE BY MPESA AGENTS TO COVER AGAINST FRAUD

BY

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DECLARATION

This is my original work and has not been presented for award of degree in any other University

MAVITI MICHAEL KIOKO DATE

This project has been submitted for examination with our approval as university supervisors.

PROF. P.G.O WEKE DATE

PROF. R SIMWA DATE

DEDICATION

To my family; my beloved wife Gladwell Wambui Kioko, my children Francis Amani, Jaden Tumaini and Karyna Sifa

To my dear parents Mzee Ezekiel Maviti and Mum Lenah Nthoki who never went to school but gave their lives to raising me up and gave the opportunity to be educated.

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ABSTRACT

Mobile Money Transfer (MMT) services provided by Mobile Network Operators (MNO) enable funds transfers made on mobile phones of end-users using digital equivalent of cash (float) without involving the bank(Jürgen Repp∗, Roland Riek 2014Fraunhofer Institute SIT, Darmstadt, Germany). Mobile money fraud is therefore the illegal implant in the electronic financial chain where the perpetrator applies deceit in order to extort money electronically from the holders.

While MNOsin Kenya have done substantial work to advance fraud detection and prevention mechanism, incidents of successful losses due conning and defrauding are still high and affect the mobile money agents on a daily basis. M-Pesa from Safaricom Ltd is the dominant MMT platform in Kenya with a market niche of over 80%.With advancement in technology and especially digital systems capable behavioral analysis the fraudsters have equally developed ways which operate above the systems thus the resulting loses to mobile money agents are huge.

The focus of this research is to evaluate the probability that an attempt by fraudster to penetrate the Mobile Money chain players will be successful and that the agent will lose money thus affecting the business operation. This penetration is not ICT driven rather a social engineering of the human interface within the chain by false pretence in various forms. Having identified eminent failure of the controls which are in place we seek to offset the risk to insurance and determine the premiums which the agents would be needed to pay to get covered.

This research focused on risk profiling of M-Pesa agents in Murang'a and Nyeri in order to evaluate the probability that an attempt by authors of fraud will successful and lead to loss of money. The research undertakes a survey on agents operating in the business region of Murang'a and Nyeri. The region is further is further subdivided in to sub-region as per Safaricom regional business model. Risk profiling data was collected data through a questionnaire examining various parts of the MMT chain.

While the Mpesa agent faces other risks in business, fraud is one of the major implicit risk facing MPESA agents. The general objective of this research is to determine actuarially fair premium without loadings which an insurance carrier would charge to cover MPESA agents against the risk of loss of money through fraud and conning.

Some of the key findings were as follows;

- Out of 490 respondents 379 were female while 111 were male. This translates to 77% and 23 % respectively. This bias may be explained by the fact that most agents prefer to employ ladies to run their shops.
- The age between 18-40 years accounted for the 88%. This implies that the day to

day business of M-pesa is being run by the digital age

- Over 65% of the M-Pesa shops which participated in the survey have existed for at least over 1 year and above.
- Out of the 490 M-Pesa shops 53% have had an attempted fraud.
- Out of the 128 successful attempts, 80% were female while 20% were male. Murang'a, Sabasaba and Upper Nyeri contributed the biggest number of victims.
- Midpoints of the loss cohorts were used to come up with the frequency tables above. The expected responses were a total of 128 but 132 responded. This implies 6 agents who may not have been defrauded gave false responses. Amounts lost between Kshs 5,000 – 60,000.00 contributed to 75% of the losses and thus the likely claims to the insurance company.
- Training and learning from similar experiences plays a key role in fraud prevention. Though the data has an error of 2 points 36% of the unsuccessful cases were due to training and previous experiences.
- 69% of the participants on whom fraud was successful did not respond to this question. However instructions issued to agents via a phone call are the most commonly applied methods fraudsters.

- Out of 128 cases of fraud only 23 cases (33%) were reported to the police. 67 % of the participants went silent to the question for various reasons.

- Out of the 128 cases only 8% of the cases recorded some action by the police but have never been concluded.
- Out the 490 participants only 23% have a form of insurance cover.

- 46% of the participants expressed the desire for insurance to cover against fraud.

We adopted the Shapiro Wilks W Test of Normality and establish that the variables under consideration were not normally distributed.

The research established that fraud within M-Pesa agents is an insurable risk since the risk profile for each individual can be uniquely determined and hence used to determine the premiums payable to cover against fraud.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

MNO – Mobile Network Operator

SIM–Subscriber Interface Module

AML – Anti Money Laundering

MMT – Mobile Money Transfer

ATM – Automated Teller Machine

TDR – Trade Development Representative

ASM - Area Sales Manager

CHAPTER ONE: INTRODUCTION

1.2 Background of the study

In his research Using Trusts to Protect Mobile Money Customers (Jonathan Greenacre et al 2014) defines e-money as a type of stored value instrument that (i) issued on receipt of funds (ii) consists of electronically recorded value stored on a device (such a sever, card, or mobile phone); (iii) may be accepted as a means of payment by parties other than the issuer; and is convertible back to cash.

Mobile Money Transfer (MMT) is a financial service provided by Mobile Network operator (MNO) and is programmed to facilitate transfer of funds between the MNO subscribers through telephony channels. This method of funds transfer does not involve banking services. MMT is a fast growing market expected to reach 450 million subscribers in 2017 with a mobile transaction value of more than $721 Bn. (Gartner 2013)

M-Pesa designed by Safaricom Ltd in 2007 brought about excellent transformation in financial inclusion, and as such has been the fastest growing mobile money platform in the Sub-Saharan Africa. The growth of Mobile money has spread across East Africa with more providers joining in as follows;

Table: 1.1

	MNO	Other mobile-wallet-providers	**Total Number of MM-providers**	Market share of largest MM-provider (name)	*Selected regulated FIs offering digital access to accounts**
Kenya	• M-Pesa (Safaricom) • Orange Money • Yu Cash • Airtel Money	Tangaza MobiKash.	**6**	95,5% (Safaricom)	• *Equitel (Equity Bank)* • *KCB Mobi Bank*
Tan-zania	• M-Pesa (Vodacom) • Tigo Pesa • Ezy Pesa	SmartMoney	**4**	54% (Vodacom)	*POPOTE (Postbank)* *M-Pawa (Commercial Bank of Africa)***
Ugan-da	• Mobile Money (MTN) • Airtel Money • Africell Money • M-Sente (UTL)	Eezy Money SmartMoney Pay Way M-Cash	**8**	52,5% (MTN)	*KCB Mobi Bank* *CenteMobile (Centenary Bank)*

* Digital access to bank accounts, as opposed to mobile wallets, basically functions in the same way for cash-in, cash-out and money transfers.

** This is a fully digital savings-and credit-product.

Sources: Babcock (2015), CGAP (2016, 2017), Helix Institute (2015), Oketch (2017), USAID (2011).

With the exponential growth of MNOs and the mobile money platform, the authors of fraud have equally advanced their con art and have been able to lead successful attacks each day.

In adherence to Anti-money Laundering (AML) regulations MNOs are required to report ML activities and have thus employed various tools to aid in detection. The common approach to fraud detection in MMT is the use of classical statistical methods such as machine learning and data mining. (A. Sudjianto et al 2010). However for fraudsters to break the audit trail of the illegal activities, they practice the smurfing technique which involves multiple third parties, so called “smurfs” conducting money transfers on behalf of fraudsters.

A smurf or money mule, is recruited by fraudsters as a financial intermediary who accepts money from one fraudster to another for a fee. (Maria Zhdanova et al 2014).From experience the

fraudster or his agent, makes a hit at an M-Pesa agent and through his mules engages the chains randomly and completes in less than 5 Mins. The money is withdrawn from an unsuspecting M-Pesa agent thus converted into cash. In such a scenario it makes it practically impossible to engage law enforcement machineries in various parts of the country to track the transactions. Fraud detection is thus an aftermath with almost nil possibility of making a recovery.

The From a risk point of view M-Pesa agent, fraud and conning are synonymous and the phenomenon is continuously leading to losses and fallen businesses. Mobile money development in Kenya has thus tagged along fraud risks. This research therefore seeks to formulate a risk profiling for the purpose of calculating insurance premiums to cover against this risk.

Fraud in the context of mobile money is the intentional and deliberate action undertaken by players in the mobile financial services ecosystem aimed at deriving gain (in cash or e-money), and denying other players revenue and damaging the reputation of the other stakeholders. (JMudiri, 2011)

To understand the exploitation of this mobile money platform it's prudent for us to define the components of mobile money platform as below.

1.3 Definition

MPESA is a typical mobile money trading platform invented by Safaricom Ltd and is anchored on various players and stakeholders playing different roles in the accomplishment of the chain processes for the money to circulate. J Mundiri (2011) defines the stakeholders in the mobile money platform as follows.

1.3.1 Mobile Network Operator (MNO) – The provider of wireless telephony network infrastructure. They also congregate a large group of customers (subscribers) who use their network and thus able to transact electronically on the common platform. They are also the custodians of the digital processes and records and have the ability to monitor, regulate and terminate the transaction. They further ensure compliance with the telecommunication laws and regulations.

1.3.2 Financial institution- These institutions partner with the MNOs to provide the physical custody of the money. They further have an infrastructure which is technologically intertwined with the MNOs to facilitate interactions of parties to a transaction.

1.3.3 Agents- The MNOs have appointed persons and bank ATM systems to facilitate the conversion of cash into electronic format (input) and electronic money to physical notes and coins while keeping balanced records and charging the necessary fees.

1.3.4 The mobile money user - These are maintained by the subscribers using the services of the MNO. They perform the actual transactions like transfers, payments, deposits and withdrawals using their mobile phones.(Ojijo, n.d.)

1.4 The Architecture of Mobile Money Fraud

Fraud architects usually exploit the agent and the mobile money user through various avenues to gain unfairly. This research focuses on the avenues which fraudsters exploit to defraud the agents and how insurance cover may be used to offset this risk. Materialization of the risk oviatesloss of funds which can occur at any deployment stage in the ecosystem though the most vulnerable avenue - M-Pesa agent.

There are various types of frauds affecting the mobile money channel and are mainly defined according to the way they are executedand the stage affected by the mobile money deployment as below;(JMudiri, 2011)

1.4.1 Consumer Driven Fraud - Consumer driven fraud is thefraudthat is initiated by fraudsters posing as customers. Consumer fraud targets agents, other consumers, businesses and mobile financial service providers. Consumer-driven fraud is the most common fraud in the market and transcends the different stages of the deployment. It is more prevalent during the transaction activation stage of the business when consumers begin to trust the mobile financial service better but are yet to understand many of the potential risks in the service. Some ways of how this fraudis executedare as follows;

1.4.1.1 Counterfeit (fake) money – Fraudulent customers deposit counterfeit currency with agents and receive electronic money. They immediately withdraw the electronic money at other agent outlets, ATM devices or point of sale devices.

1.4.1.2 Phishing – Fraudulent consumers send fake SMS to agents either from their handsets or generated from computers. The SMS looks genuine to the recipient.

1.4.1.3 Social engineering-The fraudster under false pretence as a customer, develop a relationship with agency employees and defraud the employees of cash or the float.

1.4.2 Agent Driven Fraud- The fraud is initiated and operated by agents or their employees.

1.4.4.1 Master agents defrauding agents

1.4.4.2 Employees defrauding agents

1.4.4.3 Split deposits

1.4.3 Business Partner Related Fraud- Business partner related frauds are more prevalent during the value addition stage of the deployment. This is mainly because business partnerships grow at this stage.

1.4.4.1 Employees of businesses defrauding customers

1.4.4.2 Employees of businesses defrauding the businesses

1.4.4 Mobile Financial Service Provider Fraud - This is a range of fraudulent activities perpetrated by the mobile financial service providers' employees.

1.4.4.1 Corruption within the mobile money business

1.4.4.2 Mobile operators' employees stealing funds from the business

1.4.4.3 Collusion between fraudulent mobile money employees and other fraudsters to carry out unauthorised SIM swaps.

1.4.4.4 Unauthorised access to financial records for personal gain.

1.4.4.5 Unauthorised transfer of funds from customers' accounts

1.4.5 System Related Fraud - System related fraud covers all fraud activities that affect the mobile money deployment through system weaknesses and processes. System-related fraud will cut across different stakeholders including agents, businesses, and mobile money operators. System-related fraud is highest when a platform has inadequate controls to guide in transaction processing.

1.4.4.1 Password/PIN sharing

1.4.4.2 Weak password and transaction PIN strength

1.4.4.3 Creation of fake and non-existent users on the mobile financial services platform

1.4.4.4 Fraud on multiple access channels

1.4.4.5 Individual users with multiple rights

1.5 Statement of the research problem

M-Pesa agent business may be classified as part of Small and Medium-scale Enterprises (SMEs) in Kenya. SMEs are important to almost all economies in the world and contribute to output and to creation of jobs. They are the nursery for large firms of the future and serve as the next step up for expanding micro enterprises. Evidence from literature reveals that SMEs contribute up to 70% of the national gross domestic product. (Daniel Quaye Impact of fraud on Ghanain SMEs and coping Mechanisms 2017)

In his research to establish the levels of electronic float held by M-Pesa agents FW Wambalaba(2012) established the below results;

Table 1.2: What is the daily value of your float?

Amount of Float	**Frequency**	**Percent**
0 – 4,999	1	0.9%
5,000 – 50,000	40	34.8%
50,001 – 100,000	42	36.5%
100,001 – 150000	10	8.7%
150,001 – 200,000	11	9.6%
Above 200,000	11	9.6%
Total	**115**	**100%**
Missing Data	14	

Publication: E-money for enhancing MDGS at bottom of the pyramid: A case study of M-Pesa agents in Kenya

The case has not changed much as of today since majority of agents or sub-agents treat the business as an alternative revenue channel and hence holding low levels of float. Recently MNOs have had to rein on the agents to maintain at least 25,000 and above.

With this scenario any materialization of a fraud incident may imply closing business which means loss to the MNO and the business operator to a greater percentage. Our problem was

therefore to come up with a risk profiling which would lead to calculation of actuarially fair premiums to cover the losses which may occur.

1.6 Objectives of the study

1.6.1 General objectives

While the Mpesa agent faces other risks in business, fraud is one of the major implicit risk facing MPESA agents.The general objective of this research is to determine actuarially fair premium without loadings which an insurance carrier would charge to cover MPESA agents against the risk of loss of money through fraud and conning.

1.6.2 Specific Objectives

In determining the premiums one challenge which we faced was estimating the probability that the risk fraud will materialize. The study, thus put together specific objectives which led to formulation of the risk profiling for M-Pesa agents as follows;

1.6.2.1 Gain insight whether one gender presents different risk profiles

1.6.2.2 The research sought to examine whether fraudster select their target based on age estimation. Age was divided into cohorts of 6 years from the employable age of 18 to 50 years and above.

1.6.2.3 The region where data was collected is Murang'a and Nyeri counties. This was further divided into seven (7) sub-regions with a view of understanding if there is a pattern in the way fraudsters distribute their activities.

1.6.2.4 Length of time of existence of the business in operation – From experience, new M-Pesa outlet shops are more likely to be targeted by fraudsters. The study therefore sought to gain clarity whether old shops have similar risk profiles as the new ones.

1.6.2.5 Experience on the subagent – In selecting their targets, fraudster seem to study their

areas of operations to mark new entrants in M-Pesa shop operations before making an attempt. The research was thus interested to see if there exists any co-relation between attempts and the length of stay of the sub-agent in the business.

1.6.2.6 Attempts made on the agent and whether it was a success or not – The question was whether the sub-agent has ever experienced an attempt to defraud him or her. This was taken in form of a count.

1.6.2.7Time of the year when an incident occurred – Seasonality in crime is an inherent factor. This is closely influenced by the existing needs of season like; demand for money to spend during holiday season; Days or weeks preceding school opening etc. This would form a point of emphasis during awareness sessions and thus assist in reducing the risk.

1.6.3 Other Objectives

1.6.3.1 The reasons why the attempt did or did not succeed– Though the research did not focus on prevention, data was collected indicating the various ways which Safaricom has been using to create awareness to agents thus create resilience against social engineering tactics. We tried to evaluate the penetration of information about fraud and whether it has been effective to theextend the agents can refer to the knowledge incase of an attempt. The various ways used to disseminate information about fraud are; information on print media from MPESA forums arranged by Safaricom, previous Experience with fraudsters, one-on-one training by TDRs and ASMs, Use of social media online warning sites like Buyers Beware Kenya, etc, agents' WhatsApp groups, discussions among friends and relatives on latest fraud-methods

1.6.3.2 Determining the methods of approach by fraudsters against the agents. Though it does not have direct impact on the risk profile of an individual agent, it does inform the areas of caution in order to minimize the success rate of fraudsters.

1.6.3.3 Feasibility study of the insurance product - During data collection we tried to visualize the business perspective of the insurance company. We therefore tried to evaluate whether the agents see the need for insurance and if so how much they would willing to pay. This would assist insurance companies to gauge the cashflows from the product. Further to this, we took cognizance of the fact that M-Pesa agents are in the category of SMEs and thus have high risk appetite. we therefore asked the following questions;

1.6.3.3.1 Do you have any insurance cover(s) apart from health insurance and NHIF?

1.6.3.3.2 If the answer to the above question is 'yes', what kind of cover(s) do you have?

1.6.3.3.3 Would you be interested in taking a (another) cover to protect you against loss due to fraud?

1.6.3.3.4 If yes, how much would you be willing to pay as premium per month?

Our end product is therefore to calculate the net premiums for the benefit to be paid on losses incurred due to fraud. The MNOs and law enforcement will definitely have the final word to the insurer for payments to be effected. This will minimize the moral hazard in the policy.

1.7 Motivation and significance of the study

Taking a bearing into the frequency, and the modus operandi of the fraudsters, we conceived a resilient persuasion that mobile money fraud has evolved at the same pace as the technological advancements which have been made over the last 15 years in the mobile money market. The fraudsters have learned to exploit the gaps which are presented by the systems and processes in Safaricom network to the magnitude of presenting a fake professional outlook to the MPESA agent and thus con them money mainly through social engineering.

1.7.1 The Thika Experience - In an MPESA agent's and assistant's training forum in Thika Makongeni in March 2017, I took a sampleof the number of people present and had experienced fraud or conning leading to loss of money. Slightly over 50% of the assistants and agents acknowledged to have been hit by fraudsters at one time in their operations. We took data and summed up the amounts which totalled to over Kshs 1,800,000.00 lost in over a period of 6 months within Thika Makongeni M-Pesa trading area. I therefore gained a quick insight into the extent of the vice and its impact on the agents. During the forums some incidents were narrated and that gave an indication on the tactics being employed by the fraudster.

1.7.2 Example of fraud Incident - On 20th Jan 2017 1045 hrs Ann who is employed in an MPESA outlet at Wabcom Ltd Thika town received a funds withdrawal message indicating one Mr John Mutheru Lolooisho of 0722789999 had withdrawn Kshs 150 transaction ID LHGX5TIV2T. There was no customer present in the shop. At 1050hrs Ann received a call from 0722000000 on her line and the caller identified himself as a Safaricom customer care staff who spoke with great courtesy and mastery of the English Language. The caller referred to the transaction ID and told her that from the Safaricom system the customer had made a wrong agent withdrawal and needed her to assist the affected customer with speed. The caller asked her to take the MPESA till handset and input a code *5230*xxxxxxxxx*66999*0000799333222#. Immediately she received a message indicating that a float of Kshs 66,999.00 had been transferred to one Mr Joel Kipngetich 0799333222.

What actually happened: In essence, someone accessed her phone, and saved his name,as 0722000000. So the customer care number and caller was fictitious.

1.8 Scope and Limitations

The study overall product is the estimation of the probability that a new M-Pesa agent or an existing one will lose money through fraud. This was attained through risk profiling of M-pesa agents in Murang'a and Nyeri which is assumed to play similarly in all other regions in Kenya.

The Net premiums expected to paid by the agents will be paid at the beginning of the year regardless of the seasons of the year when fraud may be viewed to be high. This seasonality may be used by the insurer to ensure precision in reserving in case of seasonal upsurge in claims. Though this left out, it is a strong tool for training and fraud awareness to the agents.

The reasons for unsuccessful attempt to defraud were not used during the analysis. This was viewed as tool which may be used by the MNO fraud fighting agents to gauge the penetration of awareness information among the M-Pesa agents.

The number of times fraud has materialized more than once was found to be negligible; however it may be useful information to the insurer for reserving.

Given that fraudsters do not have information on the amount of electronic float, therefore the amounts lost have more impact on the nature of the claims and not the probability of being defrauded. This was not considered in the agent risk profiling.

The tactics being used by the fraudsters are numerous. Though the research mentions the tactics our main interest is success of the attempted fraud. This information is useful to the MNO and the trainers of agents to ensure alertness in case any of the methods is employed. Again this information will be useful during investigation to arrive at a decision to pay the claims.

The information contained in feasibility study section of the questionnaire is mainly to the advantage of the insurance to develop an insight of the expected uptake of the product and thus a forecast on the cash flows from the sale.

The study thus concentrates on the six (6) risk profiling factors as follows;

1.8.1 Age

1.8.2 Gender

1.8.3 Region

1.8.4 Experience

1.8.5 Attempts

1.8.6 Success rate

This research collected data on reporting of incidents to the police and the action taken if any. The general observation is that investigations, arrests and prosecutions have made little progress in curbing mobile money fraud. With this information, the deduction is that any loss will result in a claim and thus the legal aspect does not affect the risk profile.

CHAPTER TWO: LITERATURE REVIEW

In the financial year 2017/2018 M-Pesa registered 27% increase in users and cases of use which translates to Kes 30.0 Bn up from Kes 25.9 Bn for a similar period in the financial year 2016/2017 (Safaricom HY18 presentation 2018). Over the years Kenya has grown to be the global leader in mobile money. Other industry players joined in along the way, orange, Airtel, Yu and Equitel. (USAID, 2011).

Fraud is increasing dramatically with the expansion of modern technology and the global superhighways of communication, resulting in the loss of billions of dollars worldwide each year. Although prevention technologies are the best way to reduce fraud, fraudsters are adaptive and given time will usually find ways to circumvent such measures. Methodologies for the detection of fraud are essential if we are to catch fraudsters once fraud prevention has failed.

Richard J.Bolton and David J. Hand (2002)concentrate on statistical methods of detection and lay focus on credit card fraud, money laundering, telecommunication fraud, computer intrusion, medical and scientific fraud. In telecommunication fraud, they highlight two faces to fraud; Subscription fraud and superimposed fraud both of which target the Mobile Network Operator (MNO).Fraud detection is therefore a post hoc strategy being applied after fraud prevention has failed (Hand, 2002). It was however noted that the time of these publications was not consistent with the exponential evolution and growth of mobile money in Kenya. The avenues being exploited to commit fraud using mobile money and possibility of insuring the risk of fraud is not mentioned.

Preventing Mobile Money fraud following summary sketch to identify Fraud & Security threats to Mobile Money Services.

Theft of Mobile Money Customer Data

- Mobile malware
- PC malware
- Social engineering - Phishing (e-mail), Smishing (SMS) and Vishing (voice)
- Impersonation of company officials

Technical Attack on Mobile Money Services

- Near Field Communication (NFC) fraud
- Interception of transmission data (NFC)
- Denial of Service' attack on Mobile Money systems

Fraud Internal to Mobile Operator or Business Partner

- Commission fraud & dummy acounts
- Customer verification
- Applying credits / discounts
- Corrupt dealer or remittance agent
- Fraud by employees in outsourced business partner
- Reselling customer data
- Unauthorized service levels
- Provisioning services directly to network elements

Subscription Fraud

- Fraud against Mobile Money Services

Account Hijack/Takeover

- SIM swap
- Change MSISDN linked to the Mobile Money account

Money Laundering

- External risk
- Internal risk

Miscellaneous/Other

- Spoofing of authorisation SMS
- Handset theft
- Intentional transfer of funds to 'wrong number'

The proposed control mechanisms for combating mobile money fraud are classified into three areas

1) Customer Fraud Controls
2) Partner Management Risk Controls
3) Internal Fraud Controls

From our evaluation, these controls provide a biased cover towards the MNO but the merchant or the partner and in this case the MPESA agent remains exposed. Insurance as a cover from loss of funds is not given attention.

In his research Wambalaba, Francis W; Wambalaba et al 2012: E-Money for Enhancing MDGs at Bottom of the Pyramid: A Case Study of Mpesa Agents in Kenyaan overwhelming majority of respondents did not experience lack of a float to serve their customers, rather a fairly large number felt fraud was the major challenge followed by a slow system due to network congestion. The inherent risk of fraud was also noted with no clear mitigation.

India only permits providers to use semi-closed wallets in which stored value can only be traded between customers of the same scheme and cannot be cashed out. This is due to the fact that the operational risks have not been addressed. It is the gaps which exist in such an ecosystem that were exploited by employees of MTN Uganda to perpetrate loss of USD 3.5 Million.Jonathan Greenacre, (2014).

CHAPTER THREE: METHODOLOGY

This research sought to get an insight of how fraud in the mobile money market has affected M-Pesa agent business and thus come up with a fraud risk profiling. In addition we have used the results of the risk profile to calculating insurance premiums to cover against the risk of fraud. The premiums are assumed to be without loading.

3.1 Research Design

The approach used by the research is case study with both quantitative and qualitative analysis. To do this study we chose a small geographic region of Murang'a and Nyeri and further subdivided it into sub-regions which are recognized by Safaricom as trading zones headed by a trade representative. This facilitated the use of triangulation of exploratory research across the sub regions. This exploratory approach enabled us to comprehensively get a feel of what is on the ground which likely to be replicated across the country. This exploration is being viewed as a national pilot test for enhanced future designs for a comprehensive national study. We also engaged a descriptive research design approach in order to identify and document the factors with the agents which seem to influence a success in a fraud incident. We further wanted to observe any patterns emerging from times of the year, age of the agents, age of the business, gender attempted fraud, region awareness and role Safaricom and law enforcement can play to minimize fraud risk. These variables, though independent, play a joint role in determination of the probability of fraud risk happening.

3.2 Population and Sampling Design

Ideally, the target population would have been M-Pesa agents across the country but due to limitation in budget we concentrated our efforts within Murang'a and Nyeri geographical regions. In order to model out the effects of regional clusters we further subdivided the region

into sub-regions and Sabasaba, Muranga, Karatina, Lower Nyeri, Upper Nyeri, Othaya. Within each sub-region we engaged the local Safaricom Trade Development Representatives to conveniently distribute questionnaires to M-Pesa agents within his/her area. The initial target was to sample 2,500 agents within the region; however we got 490 responses.

3.3 Data collection and Analysis

The research collected data through questionnaires which were distributed to the M-Pesa agents which was focused on developing a risk profile. We sought to answer the question; If an M-Pesa agent business exists today in Murang'a and Nyeri, what is the probability that they will loose significant amount of money throughfraud/conning. The research further dependent on extensive field experience gathered by the researcher as an expert in the security and investigations of fraud. Live cases are highlighted to emphasize the susceptibility of agents to fraud. We also did extensive desktop literature review with a bias to the recent developments in the industry.

Through the questionnaire we laid focus on the various contributors to the fraud cycle for M-Pesa agents.

Due to the joint role, we decided to find their statistical probability distribution, mix them and find the resulting distributions which are important in determining the end probability of a success in a fraud attempt, which contributes in calculation of premiums. We mix the following distributions since the variables, through scatter plots, indicated that they follow the said distributions: Poisson, gamma and exponential distributions.

3.4 Mixture of Distributions

3.4.1 Mixing with Exponential Distribution

The pdf of Exponential distribution is $g(\lambda) = \mu e^{-\mu\lambda}; \lambda > 0$ **(3.4.1 a)**

The Mixed Poisson distribution is obtained as follows;

$$f(x) = \int_0^\infty \frac{e^{-\lambda}\lambda^x}{x!}\mu e^{-\mu\lambda}d\lambda$$

$$= \frac{\mu}{x!}\int_0^\infty e^{-\lambda(1+\mu)}\lambda^x d\lambda$$

Let $y = \lambda(1+\boldsymbol{\mu}) \Rightarrow \boldsymbol{\lambda} = \frac{\boldsymbol{y}}{\boldsymbol{1+\mu}}$; $dy = (1+\boldsymbol{\mu})d\lambda \Rightarrow d\lambda = \frac{dy}{1+\mu}$

Now

$$f(x) = \frac{\mu}{x!}\int_0^\infty e^{-y}y^x(\frac{1}{1+\mu})^x\frac{dy}{1+\mu}$$

$$= \frac{\mu}{x!}(\frac{1}{1+\mu})^{x+1}\int_0^\infty e^{-y}y^{(x+1)-1}dy$$

$$= \frac{\mu}{x!}\left(\frac{1}{1+\mu}\right)^{x+1}\Gamma(x+1)$$

$$= \mu(\frac{1}{1+\mu})^{x+1}\frac{1}{x!}x!$$

$$= \mu\left(\frac{1}{1+\mu}\right)^{x+1}$$

Therefore, $f(x) = \left(\frac{\mu}{1+\mu}\right)\left(\frac{1}{1+\mu}\right)^x; x = 0,1,2\ldots$, Which is a Geometric Distribution (Johnson et al, 1992). **(3.4.1)**

3.4.2 Mixing with Gamma Distribution with one parameter

The pdf of Gamma distribution with one parameter is, $g(\lambda) = \frac{e^{-\lambda}\lambda^{\alpha-1}}{\Gamma(\alpha)}; \lambda > 0, \alpha > 0$ **(3.4.2 a)**

Therefore, $f(x) = \int_0^\infty \frac{e^{-\lambda}\lambda^x}{x!}\frac{e^{-\lambda}\lambda^{\alpha-1}}{\Gamma(\alpha)}d\lambda$

$$= \frac{1}{x!\,\Gamma(\alpha)}\int_0^\infty e^{-2\lambda}\lambda^{x+\alpha-1}d\lambda$$

Let: $y = 2\lambda \Rightarrow \lambda = \frac{y}{2}$; $dy = 2d\lambda \Rightarrow d\lambda = \frac{dy}{2}$

Now,

$$f(x) = \frac{1}{x!\,\Gamma(\alpha)} \int_0^\infty e^{-y} \left(\frac{y}{2}\right)^{x+\alpha-1} \frac{dy}{2}$$

$$= \frac{1}{x!\,\Gamma(\alpha)} \left(\frac{1}{2}\right)^{x+\alpha} \int_0^\infty e^{-y} y^{x+\alpha-1} dy$$

$$= \frac{1}{x!\,\Gamma(\alpha)} \left(\frac{1}{2}\right)^{x+\alpha} \Gamma(x+\alpha)$$

$$= \frac{(x+\alpha-1)!}{x!\,(\alpha-1)!} \left(\frac{1}{2}\right)^{\alpha} \left(\frac{1}{2}\right)^{x}$$

$$f(x) = \binom{x+\alpha-1}{x} \left(\frac{1}{2}\right)^{\alpha} \left(\frac{1}{2}\right)^{x}; x = 0,1,2,\ldots$$

Which is a Negative Binomial distribution with parameters α and $\frac{1}{2}$, (Greenwood and Yule, 1920). **(3.4.2)**

3.4.3 Mixing with Gamma Distribution with two parameters

The pdf of Gamma distribution with two parameters is given by

$$g(\lambda) = \frac{\beta^\alpha}{\Gamma(\alpha)} e^{-\beta\lambda} \lambda^{\alpha-1}; \lambda > 0, \alpha > 0, \beta > 0$$

The mixed Poisson distribution is thus

$$f(x) = \int_0^\infty \frac{e^{-\lambda}\lambda^x}{x!} \frac{\beta^\alpha}{\Gamma(\alpha)} e^{-\beta\lambda} \lambda^{\alpha-1} d\lambda$$

$$= \frac{\beta^\alpha}{x!\,\Gamma(\alpha)} \int_0^\infty e^{-\lambda(1+\beta)} \lambda^{x+\alpha-1} d\lambda$$

Let: $y = \lambda(1+\beta) \Rightarrow \lambda = \frac{y}{1+\beta}$: $dy = (1+\beta)d\lambda \Rightarrow d\lambda = \frac{dy}{1+\beta}$

Now, $f(x) = \frac{\beta^{\alpha}}{x!\Gamma(\alpha)} \int_0^{\infty} e^{-y} \left(\frac{y}{1+\beta}\right)^{x+\alpha-1} \frac{dy}{1+\beta}$

$$= \frac{\beta^{\alpha}}{x!\,\Gamma(\alpha)} \left(\frac{1}{1+\beta}\right)^{x+\alpha} \int_0^{\infty} e^{-y} y^{x+\alpha-1} dy$$

$$= \frac{1}{x!\,\Gamma(\alpha)} \left(\frac{y}{1+\beta}\right)^{\alpha} \left(\frac{y}{1+\beta}\right)^{x} \Gamma(x+\alpha)$$

$$= \frac{(x+\alpha-1)!}{x!\,(\alpha-1)!} \left(\frac{y}{1+\beta}\right)^{\alpha} \left(\frac{y}{1+\beta}\right)^{x}$$

$$f(x) = \binom{x+\alpha-1}{x} \left(\frac{y}{1+\beta}\right)^{\alpha} \left(\frac{y}{1+\beta}\right)^{x}; x = 0,1,2, \ldots$$

(3.4.3)

Which is a Negative Binomial distribution with parameters α and $\frac{\beta}{1+\beta}$, (Greenwood and Yule, 1920).

3.5 Calculation of Probabilities

The data generated by the survey is largely discrete from mutually exclusive event and thus it suffices to use Ms Excel to compute the probabilities. To combine the effect of two or more variables, the following are the underlying concepts we apply to generate the probability used to calculate the premiums

3.5.1 Joint Distributions

In the following X and Y are discrete random variables. Definition: $f(x,y) = P(X = x, Y = y)$

Properties: (1) $f(x,y) \geq 0$, (2) $\sum_{x,y} f(x,y) = 1$

Representation: The most natural representation of a joint discrete distribution is as a distribution matrix, with rows and columns indexed by x and y, and the xy-entry being $f(x,y)$. This is analogous to the representation of ordinary discrete distributions as a single –row table. As in the one-dimensional case, the entries in a distribution matrix must be nonnegative and add up to 1.

3.5.2 Marginal distributions:

This is when the distribution of X and Y, when considered separately.

Definition

$$f_x(x) = P(X = x) = \sum_y f(x, y)$$

$$f_y(y) = P(Y = y) = \sum_x f(x, y)$$

Connection with distribution matrix: The marginal distributions $fX(x)$ and $fX(y)$ can be obtained from the distribution matrix as row sums and column sums of the entries. These sums can be entered in the "margins" of the matrix as an additional column and row.

Expectation and variance: $\mu_x, \mu_y, \sigma_y^2, \sigma_y^2$ denote the (ordinary) expectations and variances of X and Y, computed as usual: $\mu_x = \sum_x x f_X(x)$,etc

3.5.3 Computations with joint distributions:

Probabilities: Probabilities involving X and Y (e,g., $P(X + Y = 3)$ or $P(x \geq Y)$ can be computed by adding up the corresponding entries in the distribution matrix. More formally for any set R of points in the xy-plane, $P((X, Y) \in R)) = \sum_{(x,y)\in R} f(x, y)$.

Expectation of a function of X and Y (e.g., $\mu(x, y) = E\big(\mu(X, Y)\big) = \sum_{x,y} \mu(x, y) f(x, y)$. This formula can also be used to compute expectation and variance of the marginal distribution. For example $E(X) = \sum_{x,y} x f(x, y)$.

3.5.2 Independence of random variables:

3.5.2.1 Definition

X and Y are called independent if the joint p.m.f is the product of the individual p.m.f.'s i.e if $f(x, y) = f_x(x) f_y(y)$ for all values of x and y.

3.5.2.2 Properties of independent random variables:

If X and Y are independent then:

1) The expectation of the product of X and Y is the product of the individual expectations: $E(XY) = E(X)E(Y)$. More generally, this product formula holds for any expectation of the function X times a function of Y. For example: $E(X^2Y^2) = E(X^2)E(Y^2)$

2) The product formula holds for probabilities of the form P(some condition on X, some condition on Y) (where the comma denotes "and"): For example, $P(X \le 2, Y \le 3) = P(\le 2)P(Y \le 3)$

3) The covariance and correlation of X and Y are 0: $Cov(X,Y) = 0, \rho(X,Y) = 0$

4) The variance of the sum of X and Y is the sum of the individual variances: $Var(X+Y) = Var(X) + Var(Y)$

5) The moment-generating function of the sum of X and Y is the product of the individual moment-generating functions: $M_{X+Y}(t) = M_X(t)M_Y(t)$

(Note that it is the sum, $X+Y$, not the product XY, which has this property)

3.5.2.3Conditional Distributions:

3.5.3.3.1Definitions

Conditional distribution (p.m.f) of X given Y=y

$$g(x \mid y) = P(X = x \mid Y = y) = \frac{f(x,y)}{f_Y(y)}$$

conditional distribution (p.m.f) of Y given X=x:

$$h(y \mid x) = P(Y = y \mid X = x) = \frac{f(x,y)}{f_X(x)}$$

3.5.3.3.2 Connection with distribution matrix

Conditional distributions are the distributions obtained by fixing a row or column in the matrix and rescaling the entries in that row or column so that they again add up to 1. For example

$h(y \mid 2)$, the conditional distribution of Y given that X=2, is the distribution given by the entries in row2 of the matrix, rescaled by dividing by the row sum (namely,

$$f_X(2)) : h(y \mid 2) = \frac{f(2, y)}{f_X(2)}$$

3.5.3.3 Conditional expectations and variance

Conditional expectations, variances, etc., are defined and computed as usual, but with conditional distributions in place of ordinary distributions:

$$E(X \mid y) = E(X \mid Y = y) = \sum_x xg(x \mid y)$$
$$E(X^2 \mid y) = E(X^2 \mid Y = y) = \sum_x x^2 g(x \mid y)$$
$$Var(X \mid y) = Var(X \mid Y = y) = E(X^2 \mid y) - E(X \mid y)^2$$

More generally, for any condition (such as Y>0), the expectation of X given this condition is defined as

$$E(X \mid condition) = \sum_x xP(X = x \mid condition)$$

and can be computed by starting out with the usual formula for the expectation, but restricting to those terms that satisfy the condition.

CHAPTER FOUR: PRESENTATION OF DATA

4.1 Questionnaire and Data collection

To facilitate collection of data a questionnaire was designed a questionnaire as per below and distributed 2500 questionnaires. This was done through Safaricom Trade Development Representatives who are resident within sales regions for the purpose of driving M-Pesa business and closely supervising the M-Pesa agents.

Out of the 2500 questionnaire papers we received 490 respondents. The sample questionnaire are attached as ***Annex 1.***

4.2 Assumptions

4.2.1 The name of the agent or assistant, Agency name and the Till number have no influence on fraud. They were purely used to ensure discretion of the data.

4.2.2 How long the M-Pesa outlet has been in operation has a very passive effect on the probability of being targeted rather the fraudsters do their surveillance and target new employees.

4.2.3 The premium payable will be an annual and therefore the month when the fraud happened may not affect the probability except when looking at the distribution within the year.

4.2.4 Among the six factors which made the attempt to defraud unsuccessful none is mandatory for M-Pesa agents to put in place. It may be used to strengthen information passage to agents and participation in forums by Safaricom.

4.2.5 The amounts defrauded is more useful when doing reserving rather risk profiling.

4.2.6 How the fraud happened may not affect the amount of premiums or the decision by insurance to pay or not pay. This aspect may be used to strengthen controls and information passage to agents.

4.2.7 Actions by the police, any recoveries made after the incident, why the report was not made may be used to inform law liaison agents on improvement areas and does not elevate the risk profile of the shop being insured.

4.2.8 The quest of agent having insurance and how much they may be willing to pay may be used to gauge the penetration of the product.

4.3 Analysis and Results

4.3.1 Descriptive Statistics

Table 4.1 GENDER

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	379	77.3	77.3	77.3
	M	111	22.7	22.7	100.0
	Total	490	100.0	100.0	

Out of 490 respondents 379 were female while 111 were male. This translates to 77% and 23 % respectively. This bias may be explained by the fact that most agents prefer to employ ladies to run their shops.

Table 4.2 AGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24 years	107	21.8	21.8	21.8
	25-30 years	154	31.4	31.4	53.3
	31-35 years	109	22.2	22.2	75.5
	36-40 years	60	12.2	12.2	87.8
	41-45 years	30	6.1	6.1	93.9
	46-50 years	12	2.4	2.4	96.3
	above 50 years	18	3.7	3.7	100.0
	Total	490	100.0	100.0	

The age between 18-40 years accounted for the 88%. This implies that the day to day business of M-pesa is being run by the digital age.

Table 4.3 REGION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Karatina	11	2.2	2.2	2.2
	Lower Nyeri	72	14.7	14.7	16.9
	Murang'a	123	25.1	25.1	42.0
	Othaya	67	13.7	13.7	55.7
	Sabasaba	128	26.1	26.1	81.8
	Upper Nyeri	89	18.2	18.2	100.0
	Total	490	100.0	100.0	

Karatina region had low representation due to non-cooperation by the agents. The rest of the regions exhibited a fair distribution.

Table 4.4 LENGTH OF TIME FOR SHOP OPERATION

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3 Months	35	7.1	7.1	84.7
	3.1 months - 6 months	34	6.9	6.9	35.1
	6.1 Months to 1 year	61	12.4	12.4	73.3
	1.1-2 Years	65	13.3	13.3	13.3
	2.1-3 Years	73	14.9	14.9	28.2
	4.1-5 Years	47	9.6	9.6	54.1
	5.1-6 Years	33	6.7	6.7	60.8
	6.1-7 Years	21	4.3	4.3	77.6
	Over 7 Years	75	15.3	15.3	100.0
	Total	490	100.0	100.0	

Over 65% of the M-Pesa shops which participated in the survey have existed for at least over 1 year and above.

Table 4.5 FRAUD ATTEMPTS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	230	46.9	46.9	46.9
	Yes	260	53.1	53.1	100.0
	Total	490	100.0	100.0	

Out of the 490 M-Pesa shops 53% have had an attempted fraud.

Table 4.6 SUCCESS/FAILURE OF FRAUD ATTEMPT BY GENDER

			GEND		
			F	M	Total
Successful Fraud	No	Count	272	90	362
		% within GEND	71.8%	81.1%	73.9%
	Yes	Count	107	21	128
		% within GEND	28.2%	18.9%	26.1%
Total		Count	379	111	490
		% within GEND	100.0%	100.0%	100.0%

Comment: Out of the 128 successful attempts, 80% were female while 20% were male. Murang'a, Sabasaba and Upper Nyeri contributed the biggest number of victims.

Table 4.7 Frequency of fraud in a year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 – Once a year	123	25.1	82.0	82.0
	2 – Twice a year	21	4.3	14.0	96.0
	3 – Thrice a year	3	.6	2.0	98.0
	4 – Four times in a year	1	.2	.7	98.7
	6 – Six times in a year	1	.2	.7	99.3
	7 – seven times in a year	1	.2	.7	100.0
	Total	150	30.6	100.0	
Missing	System	340	69.4		
Total		**490**	**100.0**		

The response data was not consistent, however the indication is that most of the agents have only suffered once.

Table 4.8 Amounts of money lost

	Mid-point	Frequency	Percent	Valid Percent	Cumulative Percent
Amounts lost	5500	26	20%	20%	20%
	15000	17	13%	13%	34%
	25000	19	15%	15%	48%
	35000	16	13%	13%	61%
	45000	18	14%	14%	75%
	55000	5	4%	4%	79%
	65000	6	5%	5%	84%
	75000	3	2%	2%	86%
	85000	2	2%	2%	88%
	95000	1	1%	1%	88%
	100000	9	7%	7%	95%
No responses		6	5%	5%	100%
Total		128			

Midpoints of the loss cohorts were used to come up with the frequency tables above.The expected responses were a total of 128 but 132 responded. This implies 6 agents who may not have been defrauded gave false responses. Amounts lost between Kshs 5,000 – 60,000.00 contributed to 75% of the losses and thus the likely claims to the insurance company.

Table 4.9 Reason why attempt was not successful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Info from Agents whatsapp groups	9	2%	2%	2%
	Discussing with Friends and relatives	19	5%	5%	8%
	M-pesa Print Info from Safaricom and forums	28	8%	8%	15%
	Training by TDRs & ASMs	77	21%	21%	37%
	Previous similar experiences	23	6%	6%	43%
	Social media	1	0%	0%	43%
	Unspecified	205	57%	57%	100%
	Total	**362**	**100%**	**100%**	

Comment: Training and learning from similar experiences plays a key role in fraud prevention. Though the data has an error of 2 points 36% of the unsuccessful cases were due to training and previous experiences.

Table 4.10 How the fraud was committed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Involving fake money	4	3%	3%	3%
	Fraudulent call from 0722000000	7	5%	5%	9%
	Drugged	7	5%	5%	14%
	Suspicious deposit from unknown number	1	1%	1%	15%
	Snatching of the Till Handset	3	2%	2%	17%
	others	8	6%	6%	23%
	Instruction from a call by unknown number	10	8%	8%	31%
	No response	88	69%	69%	100%
	Total	128			

69% of the participants on whom fraud was successful did not respond to this question. However instructions issued to agents via a phone call are the most commonly applied methods fraudsters.

Table 4.11 Reports to the police about fraud

		Successful Fraud	Percent	Valid Percent	Cumulative Percent
Reporting to police	No	19	15%	15%	15%
	Yes	23	18%	18%	33%
	No response	86	67%	67%	100%
Total		128			

Out of 128 cases of fraud only 23 cases (33%) were reported to the police. 67 % of the participants went silent to the question for various reasons.

Table 4.12 Action by the police

		Successful Fraud			
		Yes	**Percent**	**Valid Percent**	**Cumulative Percent**
Action of police	Nothing	12	9%	9%	9%
	Investigation going on	8	6%	6%	16%
	Full amount recovered	2	2%	2%	17%
	Part recovery of the lost amount	0	0%	0%	17%
	Fraudster arrested and prosecuted	0	0%	0%	17%
	Fraudsters arrested and case pending	0	0%	0%	17%
No responses		**106**	**83%**	**83%**	**100%**
Total		**128**			

Out of the 128 cases only 8% of the cases recorded some action by the police but have never been concluded.

Table 4.13Reasons for not reporting

		Sucessful Fraud			
		Yes	**Percent**	**Valid Percent**	**Cumulative Percent**
Reasons for not reporting to the police	I was embarrassed	8	6%	6%	6%
	I felt Police will take me around	19	15%	15%	21%
	I felt investigations will take long	7	5%	5%	27%
	others	3	2%	2%	29%
	No response	91	71%	71%	100%
Total		**128**			

The general responses indicate unreliability of the police.

Table 4.14 Do you have an insurance cover

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	377	76.9	76.9	76.9
	Yes	113	23.1	23.1	100.0
	Total	490	100.0	100.0	

Out the 490 participants only 23% have a form of insurance cover.

Table 4.15 The type of insurance cover

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	aviation	1	.2	.9	.9
	Fire domestic	2	.4	1.9	2.8
	fire commercial	14	2.9	13.1	15.9
	motor private	18	3.7	16.8	32.7
	Motor Commercial	3	.6	2.8	35.5
	Theft	18	3.7	16.8	52.3
	Personal	38	7.8	35.5	87.9
	WIBA	3	.6	2.8	90.7
	Others	10	2.0	9.3	100.0
	Total	107	21.8	100.0	
Missing	System	383	78.2		
Total		490	100.0		

Table 4.16 How much Premiums are paid currently

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	750	34	6.9	39.1	39.1
	1500	5	1.0	5.7	44.8
	2500	10	2.0	11.5	56.3
	3500	14	2.9	16.1	72.4
	4500	2	.4	2.3	74.7
	5000	22	4.5	25.3	100.0
	Total	87	17.8	100.0	
Missing	System	403	82.2		
Total		490	100.0		

Table 4.17 Need any other policy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NO	267	54.5	54.5	54.5
	YES	223	45.5	45.5	100.0
	Total	490	100.0	100.0	

Comment: 46% of the participants expressed the desire for insurance to cover against fraud.

Table 4.18 How much you are willing to pay for insurance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	750	154	31.4	75.1	75.1
	1500	18	3.7	8.8	83.9
	2500	11	2.2	5.4	89.3
	3500	7	1.4	3.4	92.7
	4500	8	1.6	3.9	96.6
	5000	7	1.4	3.4	100.0
	Total	205	41.8	100.0	
Missing	System	285	58.2		
Total		490	100.0		

Table 4.19 Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
AGE	490	2.71	1.512	1.031	.110	.712	.220
Midpoint of shop life	490	3.3550	3.69952	10.022	.110	167.478	.220
Midpoint of experience	490	2.2845	1.68133	.394	.110	-1.281	.220
Successful Fraud	490	1.26	.440	1.090	.110	-.814	.220
Amounts lost	132	33946.9697	27424.65442	1.016	.211	.299	.419
Premiums currently paid	87	2597.70	1764.622	.234	.258	-1.601	.511
How much you are willing to pay	205	1295.12	1160.566	2.181	.170	3.537	.338
Valid N (listwise)	4						

Table 4.20 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
GEND	.510	129	.000	.433	129	.000
AGE	.238	129	.000	.848	129	.000
Midpoint of shop life	.140	129	.000	.887	129	.000
Midpoint of experience	.214	129	.000	.867	129	.000
Attempted Fraud	.527	129	.000	.062	129	.000
Sucessful Fraud	.540	129	.000	.237	129	.000
Frequency of fraud in a years	.465	129	.000	.328	129	.000
LOSS	.153	129	.000	.869	129	.000

a. Lilliefors Significance Correction

4.4 Shapiro Wilks W Test

W ≈ the correlation between given data and ideal normal scores

W = 1 when your sample- variable data are perfectly normal (perfect H_0)

When W is significantly smaller than 1 = non- normal (H_a is accepted)

Shapiro- Wilk's W is recommended for small and medium samples up to n = 2000

$$W = \frac{(\sum_{i=1}^{n} a_i x_{(i)})^2}{\sum_{i=1}^{n} \left(x_i - \bar{x}\right)^2}$$

If $p <$ then 0.05, reject the H_0 because the test is significant

In our case we therefore adopted the Shapiro Wilks W Test of Normality and establish that the variables under consideration are not normally distributed.

Table 4.21 **Group Statistics**

	GEND	N	Mean	Std. Deviation	Std. Error Mean
AGE	F	379	2.61	1.444	.074
	M	111	3.05	1.689	.160
Midpoint of shop life	F	379	3.3196	3.99623	.20527
	M	111	3.4762	2.43831	.23143
Midpoint of experience	F	379	2.3582	1.68791	.08670
	M	111	2.0331	1.64132	.15579
Attempted Fraud	F	379	1.55	.498	.026
	M	111	1.46	.501	.048
Successful Fraud	F	379	1.28	.451	.023
	M	111	1.19	.393	.037
Frequency of fraud in a years	F	124	1.26	.795	.071
	M	26	1.35	.745	.146
Amounts Lost	F	111	33954.9550	28114.34037	2668.49510
	M	21	33904.7619	24063.25988	5251.03380

Table 4.22 **Independent Samples Test**

		Levene's Test for Equality of Variances							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower
AGE	Equal variances assumed	1.46	0.23	-2.71	488	0.007	-0.439	0.162	-0.758
	Equal variances not assumed			-2.49	160	0.014	-0.439	0.177	-0.788
Midpoint of shop life	Equal variances assumed	0.08	0.77	-0.39	488	0.695	-0.15662	0.39961	-0.94179
	Equal variances not assumed			-0.51	297.56	0.613	-0.15662	0.30935	-0.76541
Midpoint of experience	Equal variances assumed	0.7	0.4	1.796	488	0.073	0.32509	0.18104	-0.03063
	Equal variances not assumed			1.823	183.57	0.07	0.32509	0.17829	-0.02667
Attempted Fraud	Equal variances assumed	0.22	0.64	1.759	488	0.079	0.095	0.054	-0.011
	Equal variances not assumed			1.754	178.56	0.081	0.095	0.054	-0.012
Successful Fraud	Equal variances assumed	19.2	0	1.968	488	0.05	0.093	0.047	0
	Equal variances not assumed			2.12	202.13	0.035	0.093	0.044	0.006
Frequency of fraud in a years	Equal variances assumed	0.56	0.46	-0.52	148	0.605	-0.088	0.17	-0.423
	Equal variances not assumed			-0.54	37.916	0.591	-0.088	0.163	-0.417
Amounts lost	Equal variances assumed	1.34	0.25	0.008	130	0.994	50.19305	6551.20012	-12910.5729
	Equal variances not assumed			0.009	31.285	0.993	50.19305	5890.18014	-11958.4809

Table 4.23 Gender, Age and Region Cross-Tabulation

Row Labels	Karatina	Lower Nyeri	Murang'a	Othaya	Sabasaba	Upper Nyeri	Grand Total	% by Age Cohorts
Female								
18-24 Years	1	29	28	4	13	19	94	25%
25-30 Years	2	15	34	9	33	20	113	30%
31-35 Years	4	9	19	14	22	15	83	22%
36-40 Years	1	5	11	4	16	11	48	13%
41-45 Years	1	2	3	6	6	5	23	6%
46-50 Years		1	3	2	2	2	10	3%
Above 50 Years		1	2	2	1	2	8	2%
Female Total	**9**	**62**	**100**	**41**	**93**	**74**	**379**	
Male								
18-24 Years		5	4	2	2	1	14	13%
25-30 Years		3	7	10	12	7	39	35%
31-35 Years		2	4	4	14	2	26	23%
36-40 Years	1		5	5	1	1	13	12%
41-45 Years	1		1		4	1	7	6%
46-50 Years					2		2	2%
Above 50 Years			2	5		3	10	9%
Male Total	**2**	**10**	**23**	**26**	**35**	**15**	**111**	
Grand Total	**11**	**72**	**123**	**67**	**128**	**89**	**490**	
% by region	2%	15%	25%	14%	26%	18%		

Table 4.24 – Summary of probabilities

Success in Fraud attempt	Yes								
Count of Attempt	**Column Labels**								
Row Labels	**Karatina**	**Lower Nyeri**	**Murang'a**	**Othaya**	**Sabasaba**	**Upper Nyeri**	**Grand Total**	**Grand Total**	**PROB(Gender,Age,Experience,Shop life, Amount defrauded,From survey region**
Female									0.00000000
18-24 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
30,001-40,000			1				1	1	0.00204082
60,001-70,000			1				1	1	0.00204082
1.1-2 Years Total			**2**				**2**	2	0.00408163
1.1-2 Years Total			2				2	2	0.00408163

2.1-3 Years									0.00000000
1.1-2 Years									0.00000000
30,001-40,000				1			1	1	0.00204082
1.1-2 Years Total				**1**			**1**	1	0.00204082
3.1 months - 6 months									0.00000000
10,001-20,000			1				1	1	0.00204082
3.1 months - 6 months Total			**1**				**1**	1	0.00204082
3.1-4 Years									0.00000000
over 100,000						1	1	1	0.00204082
3.1-4 Years Total						**1**	**1**	1	0.00204082
2.1-3 Years Total			1	1		1	3	3	0.00612245
3.1 months - 6 months									0.00000000
3.1 months - 6 months									0.00000000
10,001-20,000		1					1	1	0.00204082
3.1 months - 6 months Total		**1**					**1**	1	0.00204082
5.1-6 Years									0.00000000
1,000-10,000			1				1	1	0.00204082
5.1-6 Years Total			**1**				**1**	1	0.00204082
3.1 months - 6 months Total		1	1				2	2	0.00408163
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
1,000-10,000			1				1	1	0.00204082
40,001-50,000			1				1	1	0.00204082
4.1-5 Years Total			**2**				**2**	2	0.00408163
Over 7 Years									0.00000000
40,001-50,000			1				1	1	0.00204082
Over 7 Years Total			**1**				**1**	1	0.00204082
4.1-5 Years Total			3				3	3	0.00612245
6.1 Months - I Year									0.00000000
2.1-3 Years									0.00000000
1,000-10,000						1	1	1	0.00204082
2.1-3 Years Total						**1**	**1**	1	0.00204082
6.1 Months to 1 year									0.00000000
1,000-10,000		1					1	1	0.00204082
20,001-30,000			1				1	1	0.00204082
40,001-50,000		1		1	1		3	3	0.00612245
6.1 Months to 1 year Total		**2**	**1**	**1**	**1**		**5**	5	0.01020408
6.1-7 Years									0.00000000

60,001-70,000			1				1	1	0.00204082
6.1-7 Years Total			**1**				**1**	1	0.00204082
6.1 Months - I Year Total		2	2	1	1	1	7	7	0.01428571
Less than 3 months									0.00000000
Less than 3 Months									0.00000000
1,000-10,000		1					1	1	0.00204082
30,001-40,000					1		1	1	0.00204082
40,001-50,000				1			1	1	0.00204082
Less than 3 Months Total		**1**		**1**	**1**		**3**	3	0.00612245
Less than 3 months Total		1		1	1		3	3	0.00612245
Over 5 Years									0.00000000
Less than 3 Months									0.00000000
50,001-60,000						1	1	1	0.00204082
Less than 3 Months Total						**1**	**1**	1	0.00204082
Over 5 Years Total						1	1	1	0.00204082
18-24 Years Total		**4**	**9**	**3**	**2**	**3**	**21**	21	0.04285714
25-30 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
1,000-10,000						2	2	2	0.00408163
20,001-30,000						1	1	1	0.00204082
30,001-40,000			1				1	1	0.00204082
70,001-80,000					1		1	1	0.00204082
1.1-2 Years Total			**1**		**1**	**3**	**5**	5	0.01020408
2.1-3 Years									0.00000000
1,000-10,000				1			1	1	0.00204082
50,001-60,000					1		1	1	0.00204082
over 100,000					1		1	1	0.00204082
2.1-3 Years Total				**1**	**2**		**3**	3	0.00612245
Over 7 Years									0.00000000
1,000-10,000			1				1	1	0.00204082
Over 7 Years Total			**1**				**1**	1	0.00204082
1.1-2 Years Total			2	1	3	3	9	9	0.01836735
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
20,001-30,000					1	1	2	2	0.00408163
50,001-60,000		1					1	1	0.00204082
2.1-3 Years Total		**1**			**1**	**1**	**3**	3	0.00612245
2.1-3 Years Total		1			1	1	3	3	0.00612245

3.1 months - 6 months									0.00000000
3.1 months - 6 months									0.00000000
10,001-20,000			1				1	1	0.00204082
3.1 months - 6 months Total			**1**				**1**	1	0.00204082
3.1 months - 6 months Total			1				1	1	0.00204082
3.1-4 Years									0.00000000
3.1-4 Years									0.00000000
20,001-30,000					1	2	3	3	0.00612245
over 100,000			1				1	1	0.00204082
3.1-4 Years Total			**1**		**1**	**2**	**4**	4	0.00816327
3.1-4 Years Total			1		1	2	4	4	0.00816327
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
10,001-20,000						1	1	1	0.00204082
70,001-80,000					1		1	1	0.00204082
4.1-5 Years Total					**1**	**1**	**2**	2	0.00408163
4.1-5 Years Total					1	1	2	2	0.00408163
6.1 Months - I Year									0.00000000
6.1 Months to 1 year									0.00000000
1,000-10,000			2				2	2	0.00408163
10,001-20,000				1			1	1	0.00204082
30,001-40,000						1	1	1	0.00204082
60,001-70,000						1	1	1	0.00204082
over 100,000		1					1	1	0.00204082
6.1 Months to 1 year Total		**1**	**2**	**1**		**2**	**6**	6	0.01224490
6.1 Months - I Year Total		1	2	1		2	6	6	0.01224490
Over 5 Years									0.00000000
5.1-6 Years									0.00000000
20,001-30,000					1		1	1	0.00204082
30,001-40,000					1		1	1	0.00204082
40,001-50,000			1				1	1	0.00204082
5.1-6 Years Total			**1**		**2**		**3**	3	0.00612245
6.1-7 Years									0.00000000
over 100,000			1				1	1	0.00204082
(blank)			1				1	1	0.00204082
6.1-7 Years Total			**2**				**2**	2	0.00408163
Over 5 Years Total			3		2		5	5	0.01020408
25-30 Years Total		**2**	**9**	**2**	**8**	**9**	**30**	30	0.06122449
31-35 Years									0.00000000

1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
20,001-30,000					1		1	1	0.00204082
1.1-2 Years Total					**1**		**1**	1	0.00204082
2.1-3 Years									0.00000000
1,000-10,000		1					1	1	0.00204082
2.1-3 Years Total		**1**					**1**	1	0.00204082
1.1-2 Years Total		1			1		2	2	0.00408163
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
(blank)						1	1	1	0.00204082
2.1-3 Years Total						**1**	**1**	1	0.00204082
3.1-4 Years									0.00000000
20,001-30,000					1		1	1	0.00204082
40,001-50,000			1				1	1	0.00204082
3.1-4 Years Total			**1**		**1**		**2**	2	0.00408163
2.1-3 Years Total			1		1	1	3	3	0.00612245
3.1 months - 6 months									0.00000000
3.1 months - 6 months									0.00000000
1,000-10,000					1		1	1	0.00204082
(blank)		1					1	1	0.00204082
3.1 months - 6 months Total		**1**			**1**		**2**	2	0.00408163
3.1 months - 6 months Total		1			1		2	2	0.00408163
3.1-4 Years									0.00000000
3.1-4 Years									0.00000000
10,001-20,000					1		1	1	0.00204082
3.1-4 Years Total					**1**		**1**	1	0.00204082
Over 7 Years									0.00000000
30,001-40,000			1				1	1	0.00204082
Over 7 Years Total			**1**				**1**	1	0.00204082
3.1-4 Years Total			1		1		2	2	0.00408163
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
1,000-10,000				1			1	1	0.00204082
4.1-5 Years Total				**1**			**1**	1	0.00204082
4.1-5 Years Total				1			1	1	0.00204082
6.1 Months - I Year									0.00000000
6.1 Months to 1 year									0.00000000
1,000-10,000				1	1		2	2	0.00408163

6.1 Months to 1 year Total				**1**	**1**		**2**	2	0.00408163
6.1 Months - I Year Total				1	1		2	2	0.00408163
Less than 3 months									0.00000000
6.1 Months to 1 year									0.00000000
40,001-50,000						1	1	1	0.00204082
6.1 Months to 1 year Total						**1**	**1**	1	0.00204082
Less than 3 months Total						1	1	1	0.00204082
Over 5 Years									0.00000000
5.1-6 Years									0.00000000
1,000-10,000			1				1	1	0.00204082
30,001-40,000						1	1	1	0.00204082
over 100,000						1	1	1	0.00204082
5.1-6 Years Total			**1**			**2**	**3**	3	0.00612245
6.1-7 Years									0.00000000
1,000-10,000					1		1	1	0.00204082
6.1-7 Years Total					**1**		**1**	1	0.00204082
Over 5 Years Total			1		1	2	4	4	0.00816327
31-35 Years Total		**2**	**3**	**2**	**6**	**4**	**17**	17	0.03469388
36-40 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
10,001-20,000			1	1			2	2	0.00408163
30,001-40,000			1				1	1	0.00204082
1.1-2 Years Total			**2**	**1**			**3**	3	0.00612245
2.1-3 Years									0.00000000
1,000-10,000			1				1	1	0.00204082
2.1-3 Years Total			**1**				**1**	1	0.00204082
1.1-2 Years Total			3	1			4	4	0.00816327
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
20,001-30,000						1	1	1	0.00204082
30,001-40,000						1	1	1	0.00204082
(blank)						1	1	1	0.00204082
2.1-3 Years Total						**3**	**3**	3	0.00612245
2.1-3 Years Total						3	3	3	0.00612245
3.1-4 Years									0.00000000
3.1-4 Years									0.00000000
10,001-20,000						1	1	1	0.00204082
80,001-90,000			1				1	1	0.00204082

3.1-4 Years Total			**1**			**1**	**2**	2	0.00408163
3.1-4 Years Total			1			1	2	2	0.00408163
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
40,001-50,000		1					1	1	0.00204082
80,001-90,000					1		1	1	0.00204082
4.1-5 Years Total		**1**			**1**		**2**	2	0.00408163
4.1-5 Years Total		1			1		2	2	0.00408163
6.1 Months - I Year									0.00000000
6.1 Months to 1 year									0.00000000
20,001-30,000	1				1		2	2	0.00408163
6.1 Months to 1 year Total	**1**				**1**		**2**	2	0.00408163
6.1 Months - I Year Total	1				1		2	2	0.00408163
Less than 3 months									0.00000000
Less than 3 Months									0.00000000
1,000-10,000						1	1	1	0.00204082
Less than 3 Months Total						**1**	**1**	1	0.00204082
Less than 3 months Total						1	1	1	0.00204082
Over 5 Years									0.00000000
4.1-5 Years									0.00000000
40,001-50,000						1	1	1	0.00204082
4.1-5 Years Total						**1**	**1**	1	0.00204082
5.1-6 Years									0.00000000
70,001-80,000			1				1	1	0.00204082
5.1-6 Years Total			**1**				**1**	1	0.00204082
6.1-7 Years									0.00000000
30,001-40,000				1			1	1	0.00204082
6.1-7 Years Total				**1**			**1**	1	0.00204082
Over 7 Years									0.00000000
over 100,000						1	1	1	0.00204082
Over 7 Years Total						**1**	**1**	1	0.00204082
Over 5 Years Total			1	1		2	4	4	0.00816327
36-40 Years Total	**1**	**1**	**5**	**2**	**2**	**7**	**18**	18	0.03673469
41-45 Years									0.00000000
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
10,001-20,000			1				1	1	0.00204082
30,001-40,000						1	1	1	0.00204082
2.1-3 Years Total			**1**			**1**	**2**	2	0.00408163

2.1-3 Years Total			1			1	2	2	0.00408163
3.1 months - 6 months									0.00000000
3.1 months - 6 months									0.00000000
20,001-30,000				1			1	1	0.00204082
3.1 months - 6 months Total				**1**			**1**	1	0.00204082
3.1 months - 6 months Total				1			1	1	0.00204082
3.1-4 Years									0.00000000
3.1-4 Years									0.00000000
20,001-30,000						1	1	1	0.00204082
3.1-4 Years Total						**1**	**1**	1	0.00204082
Less than 3 Months									0.00000000
30,001-40,000					1		1	1	0.00204082
Less than 3 Months Total					**1**		**1**	1	0.00204082
3.1-4 Years Total					1	1	2	2	0.00408163
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
10,001-20,000				1			1	1	0.00204082
over 100,000		1					1	1	0.00204082
4.1-5 Years Total		**1**		**1**			**2**	2	0.00408163
Over 7 Years									0.00000000
50,001-60,000	1						1	1	0.00204082
Over 7 Years Total	**1**						**1**	1	0.00204082
4.1-5 Years Total	1	1		1			3	3	0.00612245
6.1 Months - I Year									0.00000000
6.1 Months to 1 year									0.00000000
10,001-20,000				1			1	1	0.00204082
6.1 Months to 1 year Total				**1**			**1**	1	0.00204082
6.1 Months - I Year Total				1			1	1	0.00204082
41-45 Years Total	**1**	**1**	**1**	**3**	**1**	**2**	**9**	9	0.01836735
46-50 Years									0.00000000
3.1-4 Years									0.00000000
3.1-4 Years									0.00000000
10,001-20,000				1			1	1	0.00204082
40,001-50,000					1		1	1	0.00204082
3.1-4 Years Total				**1**	**1**		**2**	2	0.00408163
3.1-4 Years Total				1	1		2	2	0.00408163
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000

30,001-40,000			1				1	1	0.00204082
4.1-5 Years Total			**1**				**1**	1	0.00204082
4.1-5 Years Total			1				1	1	0.00204082
Less than 3 months									0.00000000
1.1-2 Years									0.00000000
40,001-50,000		1					1	1	0.00204082
1.1-2 Years Total		**1**					**1**	1	0.00204082
Less than 3 months Total		1					1	1	0.00204082
46-50 Years Total		**1**	**1**	**1**	**1**		**4**	4	0.00816327
Above 50 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
20,001-30,000						1	1	1	0.00204082
1.1-2 Years Total						**1**	**1**	1	0.00204082
1.1-2 Years Total						1	1	1	0.00204082
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
1,000-10,000						1	1	1	0.00204082
2.1-3 Years Total						**1**	**1**	1	0.00204082
2.1-3 Years Total						1	1	1	0.00204082
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
(blank)					1		1	1	0.00204082
4.1-5 Years Total					**1**		**1**	1	0.00204082
4.1-5 Years Total					1		1	1	0.00204082
Over 5 Years									0.00000000
Over 7 Years									0.00000000
40,001-50,000		1					1	1	0.00204082
Over 7 Years Total		**1**					**1**	1	0.00204082
Over 5 Years Total		1					1	1	0.00204082
Above 50 Years Total		**1**			**1**	**2**	**4**	4	0.00816327
Female Total	**2**	**12**	**28**	**13**	**21**	**27**	**103**	103	0.21020408
Male									0.00000000
18-24 Years									0.00000000
1.1-2 Years									0.00000000
Over 7 Years									0.00000000
10,001-20,000					1		1	1	0.00204082
Over 7 Years Total					**1**		**1**	1	0.00204082
1.1-2 Years Total					1		1	1	0.00204082
3.1 months - 6 months									0.00000000

3.1 months - 6 months									0.00000000
1,000-10,000		1					1	1	0.00204082
30,001-40,000		1					1	1	0.00204082
3.1 months - 6 months Total		**2**					**2**	2	0.00408163
3.1 months - 6 months Total		2					2	2	0.00408163
6.1 Months - I Year									0.00000000
2.1-3 Years									0.00000000
90,001-100,000			1				1	1	0.00204082
2.1-3 Years Total			**1**				**1**	1	0.00204082
Over 7 Years									0.00000000
1,000-10,000		1					1	1	0.00204082
Over 7 Years Total		**1**					**1**	1	0.00204082
6.1 Months - I Year Total		1	1				2	2	0.00408163
18-24 Years Total		**3**	**1**		**1**		**5**	5	0.01020408
25-30 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
1,000-10,000			1		1		2	2	0.00408163
30,001-40,000				1			1	1	0.00204082
1.1-2 Years Total			**1**	**1**	**1**		**3**	3	0.00612245
2.1-3 Years									0.00000000
60,001-70,000			1				1	1	0.00204082
2.1-3 Years Total			**1**				**1**	1	0.00204082
1.1-2 Years Total			2	1	1		4	4	0.00816327
3.1 months - 6 months									0.00000000
6.1 Months to 1 year									0.00000000
60,001-70,000				1			1	1	0.00204082
6.1 Months to 1 year Total				**1**			**1**	1	0.00204082
3.1 months - 6 months Total				1			1	1	0.00204082
4.1-5 Years									0.00000000
5.1-6 Years									0.00000000
40,001-50,000		1					1	1	0.00204082
5.1-6 Years Total		**1**					**1**	1	0.00204082
6.1-7 Years									0.00000000
40,001-50,000				1			1	1	0.00204082
6.1-7 Years Total				**1**			**1**	1	0.00204082
4.1-5 Years Total		1		1			2	2	0.00408163
6.1 Months - I Year									0.00000000

6.1 Months to 1 year									0.00000000
(blank)						1	1	1	0.00204082
6.1 Months to 1 year Total						**1**	**1**	1	0.00204082
6.1 Months - I Year Total						1	1	1	0.00204082
25-30 Years Total		**1**	**2**	**3**	**1**	**1**	**8**	8	0.01632653
31-35 Years									0.00000000
1.1-2 Years									0.00000000
1.1-2 Years									0.00000000
1,000-10,000					1		1	1	0.00204082
1.1-2 Years Total					**1**		**1**	1	0.00204082
1.1-2 Years Total					1		1	1	0.00204082
2.1-3 Years									0.00000000
2.1-3 Years									0.00000000
1,000-10,000		1					1	1	0.00204082
2.1-3 Years Total		**1**					**1**	1	0.00204082
2.1-3 Years Total		1					1	1	0.00204082
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
10,001-20,000					1		1	1	0.00204082
4.1-5 Years Total					**1**		**1**	1	0.00204082
4.1-5 Years Total					1		1	1	0.00204082
6.1 Months - I Year									0.00000000
6.1 Months to 1 year									0.00000000
20,001-30,000					1		1	1	0.00204082
6.1 Months to 1 year Total					**1**		**1**	1	0.00204082
6.1 Months - I Year Total					1		1	1	0.00204082
Less than 3 months									0.00000000
Less than 3 Months									0.00000000
1,000-10,000					1		1	1	0.00204082
Less than 3 Months Total					**1**		**1**	1	0.00204082
Less than 3 months Total					1		1	1	0.00204082
31-35 Years Total		**1**			**4**		**5**	5	0.01020408
36-40 Years									0.00000000
1.1-2 Years									0.00000000
Over 7 Years									0.00000000
20,001-30,000				1			1	1	0.00204082
50,001-60,000				1			1	1	0.00204082
Over 7 Years Total				**2**			**2**	2	0.00408163

1.1-2 Years Total				2			2	2	0.00408163
Over 5 Years									0.00000000
5.1-6 Years									0.00000000
40,001-50,000			1				1	1	0.00204082
5.1-6 Years Total			**1**				**1**	1	0.00204082
Over 7 Years									0.00000000
over 100,000				1			1	1	0.00204082
Over 7 Years Total				**1**			**1**	1	0.00204082
Over 5 Years Total			1	1			2	2	0.00408163
36-40 Years Total			**1**	**3**			**4**	4	0.00816327
46-50 Years									0.00000000
4.1-5 Years									0.00000000
4.1-5 Years									0.00000000
40,001-50,000					1		1	1	0.00204082
4.1-5 Years Total					**1**		**1**	1	0.00204082
4.1-5 Years Total					1		1	1	0.00204082
46-50 Years Total					**1**		**1**	1	0.00204082
Above 50 Years									0.00000000
6.1 Months - I Year									0.00000000
Over 7 Years									0.00000000
60,001-70,000				1			1	1	0.00204082
Over 7 Years Total				**1**			**1**	1	0.00204082
6.1 Months - I Year Total				1			1	1	0.00204082
Over 5 Years									0.00000000
5.1-6 Years									0.00000000
20,001-30,000				1			1	1	0.00204082
5.1-6 Years Total				**1**			**1**	1	0.00204082
Over 5 Years Total				1			1	1	0.00204082
Above 50 Years Total				**2**			**2**	2	0.00408163
Male Total		**5**	**4**	**8**	**7**	**1**	**25**	25	0.05102041
Grand Total	**2**	**17**	**32**	**21**	**28**	**28**	**128**	128	0.26122449

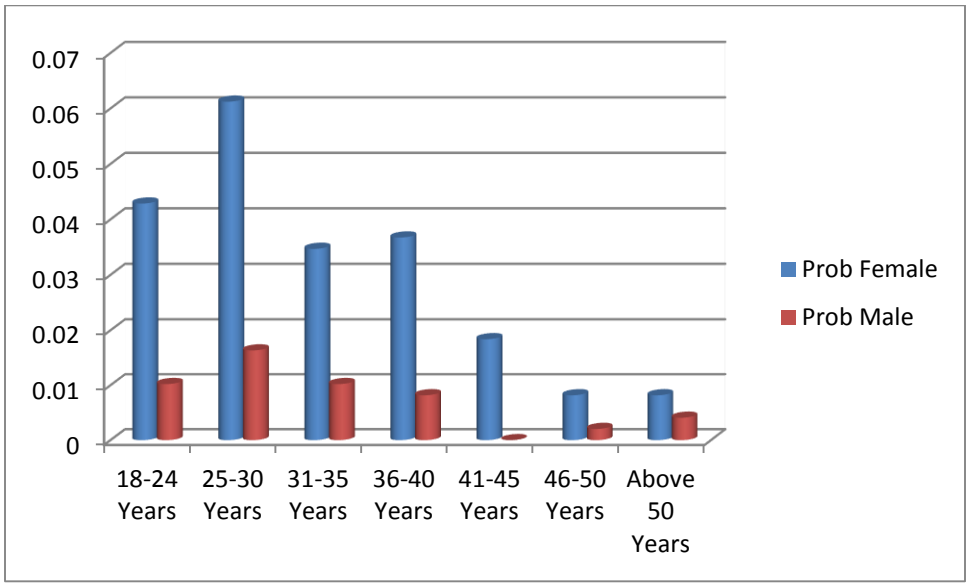
Example: The row highlighted red will be read as Probability that a male aged above 50Years whose shop has been in existence for over 5years and he has experience of over 5years will be defrauded successfully.

Table 4.25 Comparison of Probability with Age and gender

Row Labels	Prob Female	Prob Male	Grand Total
18-24 Years	0.042857143	0.010204082	0.053061224
25-30 Years	0.06122449	0.016326531	0.07755102
31-35 Years	0.034693878	0.010204082	0.044897959
36-40 Years	0.036734694	0.008163265	0.044897959

41-45 Years	0.018367347	0	0.018367347
46-50 Years	0.008163265	0.002040816	0.010204082
Above 50 Years	0.008163265	0.004081633	0.012244898

Chart 4.1 Comparison of Probability with age and Gender



For both genders age 18-30 years exhibits the highest vulnerabilities to fraud. There is therefore need for enhanced training.

4.5 Calculation of premiums without loadings

Net premiums is the expected value of the of the policy's benefits less the expected present value of future premiums. The net premium calculation does not take into account future expenses associated with

For yearly renewable term insurance, the cost of each years insurance is easily determined as follows;

$$\begin{bmatrix} Amount\ of \\ insurance \end{bmatrix} \times \begin{bmatrix} probability\ of \\ death \end{bmatrix} \times \begin{bmatrix} PV\ \$1\ for\ period \\ funds\ are\ held \end{bmatrix}$$

Amount of insurance –This will be the float being insured.

Probability of death – Probability of fraud happening

Period funds are held - will be 1 year

4.6 Conclusions and Recommendations

4.6.1 Conclusions

Fraud risk within M-pesa agents is an insurable risk. While we have attempted to quantify the probability of fraud for our research population to be 0.26122449, the risk profiling process which we have walked through can be personalized and thus come up with a standard calculator which give a quick indicator to the person seeking insurance. This can be stretched further and be used by insurance companies' calculation of reserves.

From this research we made the following conclusions

4.6.1.1 77% female against 23 % male constituted the total population. This indicates that M-Pesa agents will preferably employ female assistants. This may be attributed to the fact that shop management is inclined to front office management, an area where ladies are naturally endowed.

4.6.1.2 Female population exhibited higher vulnerability to fraud risk. This however may be biased because the female number of participants in research was higher than that of the male.

4.6.1.3 Over 86% of the participants in the research were aged between 18 to 40 years. This is also the age bracket which may referred to as the "digital age". They are characterized by great exploration and experimentation with digital platforms. The places them at the vulnerable edge to fraud risk.

4.6.1.4 Within the age bracket under consideration, the Female population exhibited an approximate total probability of 0.175510205 against 0.04489796 for the male population. Within this age bracket, the most vulnerable age was 18-25 years. There is therefore need for more training and supervision if the risk is to be reduced.

4.6.1.5 Over 65% of the M-Pesa shops which participated in the survey have existed for at least over 1 year and above. Out of the 260 attempts to defraud over 40% of the M-Pesa shop have been in existence for less than 2 years. This implies that a new shop is more likely to be targeted than a shop which has been in existence for a long time.

4.6.1.6 Experience of the shop attendant was established to be directly related to the ability to withstand any attempt to be defrauded. Out of the 128 cases of successful fraud attempts, slightly over 50% of the shop attendants had experience of less than two years.

4.6.1.7 Each region was established to have an average of 21 successful cases of fraud with a standard error of 0.3. The location of the shop does not therefore influence the probability of an attempt or success. This is attributed to the high mobility of fraudsters and the communication networks which they have established.

4.6.1.8 82% of the participants were defrauded only once. Therefore for calculation of reserves it would be fair consideration to assume a maximum number of claims to be only one.

The modus operandi of the fraudsters was established to be anchored on main tactics;

4.6.1.8.1 Use of drugs to confuse the victim (famously known as *'the devils breathe')*

4.6.1.8.2 Suspicious deposit from unknown number then followed by fraudulent calls.

4.6.1.8.3 Snatching of the Till Handset

4.6.1.8.4 Instruction from a call by unknown number purporting to be from Safaricom office.

4.6.1.9 Out of 128 cases of fraud only 23 cases (33%) were reported to the police. 67 % of the participants went silent to the question.

4.6.2 Recommendations

4.6.2.1 The research successfully outlined a clear risk profiling method for determining the risk of fraud to an M-Pesa agent. Using the above method, a simple program can be designed in excel such that input of the variables gives a defined number which is a probability that an Mpesa agent of a certain gender, age, with x years of experience, working in a shop which has been in existence for defined period of time and from known region will be targeted and the attempt will be successful thus resulting in an insurance claim.

4.6.2.2 The research explored the reasons why attempts to defraud failed. The data collected indicated that there are 6 main channels of information through which agents were made aware of the existing fraud tactics. These were;

4.6.2.2.1 Info from Agents whatsapp groups

4.6.2.2.2 Discussing with Friends and relatives

4.6.2.2.3 M-pesa Print Info from Safaricom and forums

4.6.2.2.4 Training by TDRs & ASMs

4.6.2.2.5 Previous similar experiences

4.6.2.2.6 Social media

4.6.2.3 While all the information platforms provided useful information to the agents, training by TDRs and ASMs was found to be most effective way. MNOs should therefore re-emphasize training of agents in order to prepare them for any eventuality of attacks. This training should especially be re-emphasized for new sub-agents, the less experienced and those below the age of 30 years.

4.6.2.3 Out of 128 cases of fraud only 23 cases (33%) were reported to the police. 67 % of the participants went silent to the question for various reasons. Only 8% of the cases reported to the police were acted upon in some way like ongoing investigations and arrest of the perpetrators of the fraud. The participants had various reasons why they did not fall back to law enforcement for a solution to the fraud.

4.6.2.3.1 Felt embarrassed

4.6.2.3.2 Felt Police will take them round

4.6.2.3.3 Felt investigations will take long and will be expensive

4.6.2.4 While only 23% of the total participants have insurance covers, 46% expressed interest in getting insurance against fraud coupled with the willingness to pay premiums. Insurance against fraud was therefore established to be important and needs to be rolled out as a product.

4.6.2.4 It is recommended that this model of a research be scaled to cover the whole country. This will give an insight to the state of fraud in mobile money business and thus insurance companies can offer more competitive rates.

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