

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

INSTITUTE OF DISTANCE LEARNING

DEPARTMENT OF COMPUTER SCIENCE



TOPIC:

**PROPOSED IMPLEMENTATION STRATEGIES FOR ADOPTION OF MOBILE
POINT OF SALE DEVICE**

**A Thesis Submitted to the Institute of Distance Learning, Kwame Nkrumah
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Degree in MSc. INFORMATION TECHNOLOGY**

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DECLARATION

I hereby declare that this submission is my own work towards the MSc and that, to the best of my knowledge. It contains neither material previously published by another person nor material which has been accepted for the award of any other degree of the university, except where due acknowledgement has been in the text.

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ABSTRACT

Technology within Financial Service Organizations in Ghana has gained roots since the emergence of the first Automated Teller Machine, alternate delivery channels and the creation of a national switch (E-Zwich) in April 2008 by the Bank of Ghana. However,

this research focuses on assessing the impact of Mobile Point of Sale device, an alternate delivery banking channel as against several discussions concerning; its impact penetration on the non-banking population, increasing the dormant bank customer base and increasing money mobilized from customers. In addition, various implementation strategies will be proposed after assessing the impact of Mobile Point of Sale device. Primary data was gathered from customers and Financial Service Organizations and captured into a Statistical tool and tested hypothetically via T-tests and Anova. Major findings indicated that impact penetration of non-banking population by the usage of Mobile Point of Sale devices was not the same. Time and convenience were assured even though security and accessibility were an issue. In terms of increasing the dormant bank customer base, convenience and security had different impacts with convenience impacting positively whereas security impacted negatively. With regards to money mobilized from customers using Mobile Point of Sale device, Microfinances and Nonbanking Financial Services showed increases although Banks and Savings & Loans did not show any increase in money mobilized. Major limitations to the impact of Mobile Point of Sale device was associated with security and accessibility. There will be no costs to customers of Financial Service Organizations that deploy Mobile Point of Sale devices since it will be considered as an alternate delivery banking channel to provide value added services to their customers. As such, proposed implementation strategies to augment these limitations was to implement a Mobile App or USSD banking service but preference was given to USSD due to its benefits over the Mobile App. USSD was identified to complement Mobile Point of Sale device since it provided a self-service customer interaction at a cheaper cost, ensured better security and was easily accessible without internet access.

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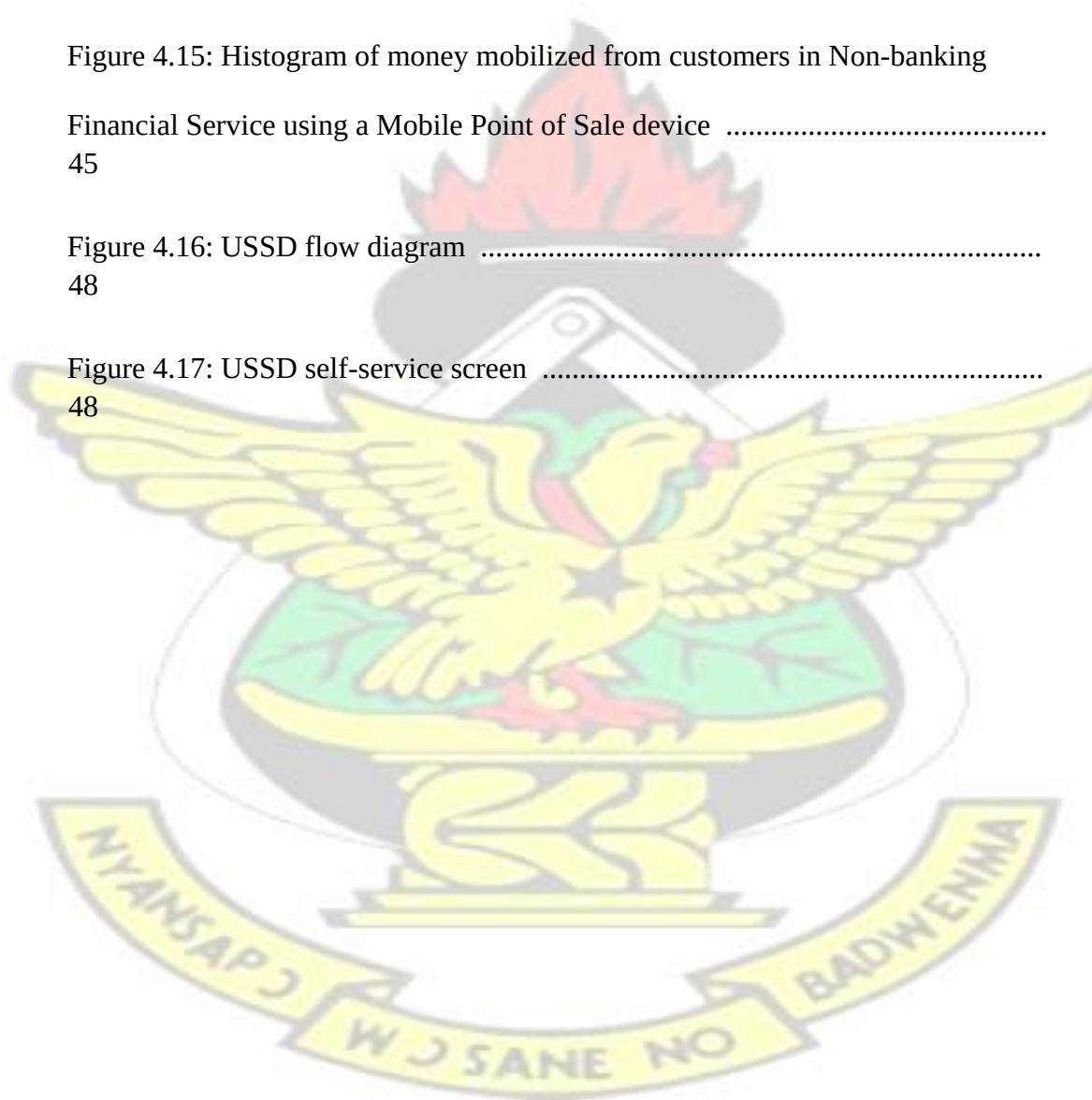
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CHAPTER ONE

INTRODUCTION

1.1. Introduction

Research conducted on Financial Services in Ghana by (Adams & Lamptey, 2009), revealed that the increase in Financial Service Organizations has not resulted in the growth of the banking customer base. As a result, Financial Service Organizations are unable to penetrate the unbanked population to mobilize enough funds. However, an earlier research by Abor (2004) on Financial Service Organizations showed that Information Technology has reduced customer transaction time and improved service delivery to customers. Out of the customers that partook in the survey, 88.5% of customers showed that customer transaction time was reduced whilst 80.4% agreed that service delivery was improved. Further to this (Baraghani, 2007), also verified that Information Technology has brought about innovations that have reduced time and efficiency in service delivery of customers in performing transactions with their Financial Service Organizations. It is therefore very important that Financial Service Organizations ensure that key performance indicators such as increase in customer, penetration of unbanked and deposit mobilization are achieved using Information Technology (Marc-Jordan, 2009).

1.2. Background of the Study

Achieving measurable key performance indicators cannot be merely achieved through changes in Business Strategy, Business Flows or Value Added Services (Bounie & Gaze, 2004). Financial Services rely heavily on mobilization and financial intermediation; hence a mobile and efficient technology that enhances payments will ensure growth in operations (Annon, 1999). This research will focus specifically on the Financial Service Organizations in achieving measurable key performance indicators. It will assess the impact of using Mobile Point of Sale Technology.

1.3. Problem Statement

Financial Service Organizations deploy various technologies particularly Mobile Point of Sale device in their operations but are unable to assess whether there is an impact. In a research conducted by (Narteh & Owusu-Frimpong, 2011), it was shown that Financial Service Organizations that deployed Mobile Point of Sale devices had not tested its impact scientifically. Problems facing Financial Service Organizations that were highlighted included a low growth of customers who bank and inability to penetrate the unbanked customer base.

According to (Amin, 2009), Financial Service organization spent a lot of money to set up Office Infrastructure. The costs in setting up these physical infrastructures were very expensive and could have been used to deploy less expensive solutions that can provide banking to customers. As such, alternate banking solutions that were less expensive than setting up physical branches was recommended. Another research by (Hinson et al, 2009), also showed that Financial Service Organizations are not mobile and agile since their only option of serving remote customers was to set up physical branches or mobilization centres. In effect their customers prefer to save and mobilize funds with any Financial Service Organization that they find convenient for them resulting in the same customers moving from one competitor to the other (Gerrard & Cunningham, 2003).

Financial Service Organizations have been advised to deploy alternative banking solutions that will enable them to service their customers at locations where they do not have branches. In addition, it will ensure that they can mobilize funds from their customers irrespective of proximity, time or place (Lu et al, 2003). It is perceived that Mobile Point of Sale device will impact Financial Service Organizations (Blankson et al, 2007) but it has not been proven scientifically. This is the problem that the research aims to solve as to whether there will be any positive impact on Financial Service Organizations.

1.4. Objectives

By using Mobile Point of Sale Technology, deposit mobilization, withdrawals and other transactions which are the core operations of Financial Service Organizations in Ghana will now be made available to customers at their convenience and at their door step. The main aims and objectives of the research will be:

- i. To determine the impact that Mobile Point of Sale Device has on the non-banking population.
- ii. To determine how Mobile Point of Sale Device has increased the dormant bank customer base.
- iii. To determine whether Mobile Point of Sale Device has caused an increase in money mobilized from customers.

In achieving these objectives, proposed implementation strategies specifically USSD and Mobile Apps, are suggested. Both technologies are termed as self-service technologies which will be used to complement notable factors such as saving time, convenience, security and ease of accessibility where Mobile Point of Sale Device fails to address in each objective.

1.5. Research Questions

With the introduction of Mobile Point of Sale Device, a new alternate delivery channel solution (Pousettchi et al, 2009); some major research questions have been highlighted:

- i. What will be the penetration impact of Mobile Point of Sale Device on the non-banking population?
- ii. How much will Mobile Point of Sale Device increase the dormant bank customer base?
- iii. How will Mobile Point of Sale Device increase money mobilized from customers?

1.6. Justification of the Research

The main intent of this research is to ascertain whether there will be an impact when Financial Service Organizations deploy an alternate delivery banking channel like the Mobile Point of Sale Device. Financial Service Organizations are adopting solutions to enable them provide services to their customers thereby achieving measurable key performance indicators (Benjamin, 2003). There are various alternate delivery banking solutions such as the ATM, Internet banking, Electronic fund transfer at point of sale (EFTPOS), Smartphone and printer via blue-tooth, Mobile Point of Sale Device, etc. that are being deployed.

However, this research is focusing on finding out whether Mobile Point of Sale Device will have an impact even though there have been strong recommendations over other solutions particularly by (Ondrus & Pigneur, July 2007). Several factors were also made by (Lin, 2011) for considering the Mobile Point of Sale device over other solutions based on data security, reliability and efficiency. Some recommendations have also been made by other authors about Mobile Point of Sale Device:

- i. Encryption of data (Park et al, 2011).
- ii. No interception of data (Park & Chen, 2007).
- iii. Longer battery-life (Liu & Li, 2010).
- iv. Enhanced network connections and powerful modems (Yu, 2012).
- v. Robust and is drop-tested from long heights (Jahangir & Begum, 2008).
- vi. Has payment platforms built into them (Kuisma et al, 2007).
- vii. On-board databases with fast processing speed.
- viii. Better specification and enhanced expansion slots (McCloskey, 2006).

Most of these researches about Mobile Point of Sale devices having an impact on Financial Service Organizations have been based on assumptions (Khalifa & Shen, 2008) and it will be justifiable to test scientifically this assertion scientifically.

CHAPTER TWO

LITERATURE REVIEW

2.1. Features of Mobile Point of Sale Device

Point of Sale is the physical location of a transaction but usually refers to any device or system used to record the transaction for the retailer. The birth of Mobile Point of Sale Device was witnessed around 2010. This stemmed from the use of Fourth Generation mobile phones with very high capabilities being used for payment (Gu et al, 2009). The usage of mobile phones to issue payment coined the term “m-commerce” which refers to the new payment technology between buyers and sellers using mobile phones as an alternative for credit and debit cards, cash, or other means of payment (Hamdi, 2011).

The success associated with mobile phones as a payment medium further opened up the avenues on improving on them (Mallat, 2007). It was by then that the Point of Sale system was introduced but this time around it being mobile unlike the older generations previously witnessed (Mattila et al, 2003). Mobile phones being used as a payment medium were deficient in so many capabilities namely; security and encryption of data, battery-life in operating over longer hours issuing payments, printer to issue out transactional receipts, performance specification in terms of processing, screen resolution and memory (Pousttchi, 2003). All these were factored into the development of the Mobile Point of Sale device making it the preferred choice of payment. Mobile Point of Sale Devices uses a variety of technologies for payments (Cudjoe et al, 2015). It uses the near field communications (NFC) which is a standards-based wireless communication technology that allows data exchange between devices in close contact (less than two inches to four inches) (Yan et al, 2013). With NFC, usually a mobile device embedded with an NFC chip sends encrypted data to an NFC-enabled POS device. Thus, the mode of payment is done when the consumer taps or waves their mobile device at the Point of

Sale Device rather than having to swipe the card or pay using cash. Radio frequency identification (RFID) is a technology that uses radio waves to transfer data from an electronic tag called an RFID tag. The RFID tag is decoded, and data is read by using the Point of Sale Device. RFID technology operates similarly to the NFC technology just that RFID operates in a longer transmission; this in effect makes RFID less secured than NFC technology when performing payments. 2D barcode technology can also be deployed using Mobile Point of Sale Device. Normally a Mobile Point of Sale Device scans account information from a consumer carrying a mobile device displaying a 2D barcode of the consumer's account details.

Another technology that is commonly deployed using the Mobile Point of Sale Device is the Wireless Application Protocol (WAP). This is a technology that allows information to be accessed over a mobile wireless network (Koenig-Lewis et al, 2010). Its main concept of operation is by allowing access to the internet from a mobile device (WAP browser), whereby the mobile device is the Mobile Point of Sale Device.

2.2. Mobile Point of Sale Device in Ghana

Ghana has had electronic revolution since 1995 with the emergence of the Automated Teller Machine (ATM) when The Trust Bank now part of EcoBank installed the first ATM in Ghana. Technological advancement improved when in May 1997, Social Security Bank now Socete General Bank delivered the first major cash card (Appiah & Agyemang, 2007). This unique product in Ghana by then was known as the "Sika Card"; a value card onto which cash amount was loaded electronically. It was until 2001, that Standard Chartered Bank introduced the first debit card in Ghana. This led to the creation of an 'E-Card', an online in real time card which changes are reflected on through transactions, the account balances were updated automatically.

However in April 2008, Ghana made a significant leap on technology by aiming to create a cashless society. This was due to the creation of a national switch (E-Zwich); an electronic payment system launched by the Bank of Ghana through its subsidiary Ghana Inter-bank Payment Settlement System (GHIPSS). The main bases were to serve as a common platform for all payment transactions in Ghana. GHIPSS' sole task was to liaise with the banks and nonbank financial institutions to improve upon the country's payment system. GHIPSS to further carry their work deployed Universal Electronic Payment System (UEPS) technology. This technology would set the tone for Mobile Point of Sale Device amongst financial institutions in Ghana.

The UEPS was built on a smart card technology to provide a fully integrated payment, switching and settlement system that is suitable for multiple applications, products and services. The technology was deployed to satisfy the needs and requirements of the banked, un-banked and under-banked populations. Another function of the UEPS was to ensure security in transferring funds between customers, merchants and financial service providers. Under the UEPS, transactions performed by customers would be both "online" and "offline". The essence of the online was to support the urban areas where network connectivity was needed for real time transactions (Chong et al, 2010). Also, the offline capability was specifically dedicated for customers in the rural and underdeveloped areas where network connectivity and infrastructure were lacking. Under the UEPS all transactions occurred between a client card and a merchant card or a bank tellers' card at a Point of Sale (POS) terminal or an Automated Teller Machine (ATM). The POS terminals were equipped with SIM cards. These POS terminals were either used at the banking premises or outside the banking premises whereby the customer slots the client card in the POS terminal. Once the authenticity of the client's card was validated, and then transactions can be initiated (Poku et al, 2014).

Even though the E-Zwich did not really catch up with the bank and non-bank financial institutions, the usage of the Mobile Point of Sale Device has been growing steadily amongst the financial service organizations. This is due to their operations and customer base. Most Financial service organizations and particularly the Micro Finance firms thrive on deposit mobilization which they intend lend out to customers to make profit. The Mobile Point of Sale Device technology has come to stay for them as it is the easier means of running their operations. Its deployment has been eminent now in Ghana and can be clearly seen across all Financial Service Organizations. The main categories of Financial Service Organizations that the research will dwell on are the Banks, Savings & Loans, Non-bank Financial Institutions and Microfinances. Also, investigations will be made as to whether there will be an equal impact by Mobile Point of Sale devices amongst these Financial Service Organizations. Furthermore, other assessments will be conducted to ascertain whether each specific Financial Service Organization has been impacted by a Mobile Point of Sale device.

2.3. Implementation strategy works by other researchers

Obiri-Yeboah et al (2013), conducted a research to find the number of times that customers used the various alternate delivery channels. A total of 90 customers which represented the frequency were selected from a Financial Service Organization to determine their usages.

Table 2.1: IT Services Used by Customers

IT Services Used by Customers	Frequency	Percent
ATM	90	100.0
Direct deposit and withdrawal services	40	44.4
Pay by phone system	18	20.0
Point of sale transfer terminal	31	34.4
Internet banking	48	53.3
Branch Networking	48	53.3
Electronic fund transfer at point of sale (EFTPOS)	3	3.3
Electronic cheque conversion	15	16.6
Personal computer banking	5	5.5

Source of field survey: (Poku et al, 2014), conducted June 2012.

From the data of the research, he proposed the increase of deployment of ATMs. The reasons for the proposal of ATM were due to its frequency. There is a strong critique regarding this fact in terms of ATM's efficiency. Usage-wise, the ATM has been successful, but this does not dispute the points iterated with problems associated with the ATM (Obiri-Yeboah et al, 2013). According to the authors there were several challenges facing the ATM despite its 100% service usage (Massoud et al, 2006):

- i. The ATM may not function well due to internet connectivity problems.
- ii. Regular break down and turn-around time in repairing ATMs.
- iii. It avoids personal interactions making it difficult to get solve issues.

The authors proposed a solution that can operate in an offline mode meaning it could operate with no network connectivity (Wang et al, 2006). Also, there were concerns raised about the regular break downs and turnaround time in repairing ATMs. A solution that is mobile and could be served to customers at their convenience was highly proposed due to another work by Nor & Pearson (2007). Another research proposed a solution that will be deployed and offer both human and technological interaction. These authors strongly proposed a Point of Sale device that can be placed at vantage areas and operated on with or without human assistance. This was in reference to earlier works done on interactive nature of Point of Sale devices. Another proposed implementation strategy of Mobile Point of Sale Device was made due to the frequent swallowing up of ATM cards and its associated issues (Amurthy& Redddy, 2012).

Obiri-Yeboah et al (2013) in their research to propose implementation strategy showed the abysmal performance of deposit and withdrawals of financial service organizations which was trailed by Mobile Point of Sale Device by a mere 5.9%. Findings indicated that direct deposit and withdrawal over-depended on human presence and time thus making it tedious and cumbersome to perform transactions in Financial Service Organizations.

Clearly from this assertion it is evidently clear that the Mobile Point of Sale Device has impacted the financial service organization. Further highlighting on the impact of the Mobile Point of Sale Device, it is appropriate to critique the appalling service usage of the Electronic fund transfer at point of sale (EFTPOS) at a mere 3.3%. The main service operated under the Electronic fund transfer at point of sale (EFTPOS) was the E-Zwich. Considerable research work has been conducted on the failure of the Electronic fund transfer at point of sale (EFTPOS) and particularly the E-Zwich in Ghana (Issahaku, 2012). According to the author who compared four services namely; ATM, E-Zwich, Mobile money and the Teller addressed the main challenges of the E-Zwich are as summarized in Table 2.2.

Table 2.2: Challenges faced by the E-Zwich

Challenges	Rank
Link Failure	1st
Frequent Breakdown of Machine	2nd
Slowness of Transaction	3rd
Long Queues	4th

Source: (Issahaku, 2012)

According to Issahaku (2012), link Failures associated with the E-Zwich were because the networks were dependent on the not so reliable network operators. This in effect makes it difficult in performing transactions as each transaction needs a dedicated network to perform (Quansah et al, 2010). Issahaku (2012) proposed a new implementation specifically Mobile Point of Sale device which will fix all the flaws identified in the E-Zwich. From findings, the Mobile Point of Sale Device which does not work in only GPRS mode, but also operates in EDGE and 3G capabilities will be a better implementation for Financial Service Organizations. Recommendations of the Mobile Point of Sale device were due to the peak times the E-Zwich which was realized to be busy when internet and telecommunication network usage were high, as a result, the sending of data to complete transactions timed out with the GPRS (Lee, 2009). Also, this GPRS technology was unable to process transactions when there was heavy traffic.

This is not the case with the Mobile Point of Sale Device that uses the reliable and fast EDGE and 3G technologies in sending data to complete transactions. Coupled to that, Mobile Point of Sale devices are built with powerful modems that can ensure stable network connectivity unlike the modems used in the E-Zwich. These powerful modems can maintain stability thereby allowing transactions to be completed once initial connection is established.

Frequent breakdown of machine was clearly seen as a bane of the E-Zwich. According to the author, there were few E-Zwich stand-alone machines operating across various financial service organizations. This as a result increased the rate at which the stand-alone machines were being used. There was no proper education on how it was to be used and maintained accordingly.

Nonetheless, these have been challenges that most often have been associated with the Mobile Point of Sale Device which is not correct.

It is in this regard, that the Mobile Point of Sale once again can make significant impact as compared to the E-Zwich (EFTPOS) (Dahlberg et al, 2008). The issue of frequency breakdown failure cannot be tagged to the Mobile Point of Sale Device as it is very robustly built unlike the E-Zwich. It is drop-tested from heights that the E-Zwich cannot withstand. Also commenting on the fact that just a few E-Zwich are used that's why it breaks down often is not correct. The memory and processing units of the E-Zwich have been realized to be very small hence unable to process transactions after a threshold is met. This has been generalized, whereas the standard Mobile Point of Sale Device is able to run over 100 transactions per day. This is further supported with a longer battery life that can run up to 8 hours. The number of transactional counts and battery life hamper the E-Zwich greatly thereby rendering its breakdown most often.

Again, comparing the E-Zwich to the Mobile Point of Sale Device, there is a large contrast in terms of memory size and processing capabilities. The Mobile Point of Sale Device offers very

high memory sizes and processing capabilities that make the processing of transactions very fast and seamless. The significant improvement of time and efficiency is something that customers crave and will be an impacting factor by the Mobile Point of Sale Device.

Surprisingly, long queues were not seen as a challenge with the E-Zwich since its patronage by customers was on the low side. This then has led to the ever-long queues that still exist in the banking halls. This trend is changing steadily as the usage of the Mobile Point of Sale Device across the financial service organizations serves the customers at the various places of convenience. This in effect is bringing technology to the customers whilst also serving their basic needs. The E-Zwich is usually stand alone and still stationed at the banking halls.

It in turn defeats its purpose of banking the unbanked and accessibility since the customer has to move to where it is to get served. All these are better enhanced by the Mobile Point of Sale device hence its percentage increase of 34.1% as compared to 3.3% of the Electronic fund transfer at point of sale (EFTPOS) specifically the E-Zwich (Obiri-Yeboah et al, 2013). The impact of Mobile Point of Sale Device in Ghana is steady and on the rise. Conducted research findings (Appiah et al, 2014), revealed that respondents were willing to use E-payments due to its several advantages to the customer.

There were benefits such as protection from theft and robbery, ease and convenience of transactions and also the drive of the Ghanaian economy into a cashless one from the high cost of printing notes and coins. Despite the successes of the ATM over the E-Zwich, the authors acknowledged the fact that more Mobile Point of Sale devices should be provided to facilitate the usage of such payment systems.

CHAPTER THREE

METHODOLOGY

3.1. Research Purpose

The intent of this section is to basically bring to bear how the purpose and aim of the research were conducted. The initial aspect will be to determine what will be done in the research. Also, the basis of choosing specific principles will be further explained.

3.2. Research Approach

The topic is about evolution of Mobile Point of Sale Device, its impact on financial service organizations in Ghana and proposed implementation strategies. This is an open theory which cannot be justified qualitatively, therefore a hypothesis will be set to ascertain its impact. Two set of questionnaires will be administered for both customers and staff of Financial Service Organizations. A population of 100,000 at a precision of $\pm 10\%$ will be chosen for both questionnaires. A sample size of 104 questionnaires will be used due to the population and precision chosen even though a sample of above 100 can be used.

The first questionnaire will be administered to customers of the various Financial Service Organizations across four (4) locations, namely; Agboghloshie Market – in Accra, Techiman Market – in Techiman, Sunyani Market – in Sunyani and Kejetia Market – in Kumasi. Likert scale and closed responses whereby the answers can be rated from 1 to 5 will be used so that the responses can analyzed using a statistical tool (IBM SPSS).

The second set of questionnaires to staff of Financial Service Organizations will also base on likert scale and closed responses with ratings between 1 to 5. This will also be analyzed using IBM SPSS statistical tool to test their impacts being assessed scientifically.

3.3. Research Strategy

All assertions will be based on an experiment. The research is looking at the use of real-world data and observations about information technology systems and their purposes they serve. As outlined in the various processes of performing experimental computer science, this will focus on explanation, data collection and data manipulation. In this experimental computer science research, the basics of any other experimental research will still be used based on the need for reproducibility and repetition of results as advocated by the scientific method.

3.4. Study Setting

The setting of the research scope on the small micro enterprise particularly the market. They will be the focus since their work and lives are mostly within the confines of the market place. A typical setting is captured in Figure 3.1.



Figure 3.1: Customer market setting

As seen in Figure 3.1, these people constitute the small micro enterprise and hence will be the focus of customers that the financial services organizations aim to service.

3.5. Population and Sample

The sample used will be people working in the small micro enterprise that are either banking or not in the Financial Service Organizations in Ghana. In specifying the population and sample, these four (4) key factors will be considered; sample size, representativeness and parameters of the sample, access to the sample and sampling strategy to be used. Precision for the sample size will depend on the margin of error which is referred to as sampling error.

Table 3.1: Sample Size for $\pm 5\%$ and $\pm 10\%$ Precision Levels, Confidence Level=95% & P=0.5.

Size of Population	Sample Size (n) for precision (e)	
	$\pm 5\%$	$\pm 10\%$
500	222	83
1,000	286	91
2,000	333	95
3,000	353	97
4,000	364	98
5,000	370	98
7,000	378	99
9,000	383	99
10,000	385	99
15,000	390	99
20,000	392	100
25,000	394	100
50,000	397	100
100,000	398	100
>100,000	400	100

Source of field survey: (Singh & Masuku, 2014), conducted June 2012.

Considering this research, a population of over 100,000 will be used since the number of customers within the Financial Service Organizations are above 100,000. From Table 3.1, the survey by (Singh & Masuku, 2014) can be interpreted as a sample size of 400 for a precision of $\pm 5\%$ and a sample size of 100 for a precision of $\pm 10\%$. Since the data collected is through

questionnaires, a precision of $\pm 10\%$ will be used, therefore a sample size of more than 100 precisely 104 will be used to administer both questionnaires.

3.6. Data Collection

Two (2) Questionnaires will be used for data collection. The first questionnaire designed will be used to collect data from customers in the micro enterprise business. Each customer will be given a questionnaire and they will be assisted to fill it. Even though the people sampled to fill the questionnaires will be assisted, there will be no bias or they would not be put on duress, what will be done is the questionnaire will be explained to them in the local dialect and their responses recorded on the questionnaire. The designed questionnaire will ensure that some standards will be followed to ensure good collection of data through:

- i. Usage of closed ended questions rather than open ended question.
- ii. Usage of Likert-like scale responses.

A typical closed ended question is “Will you save with a bank through a bank representative who operates a Mobile Point of Sale device”. This is a question which will produce a definite answer that can be measured quantitatively for people using the same questionnaires. Referring to the usage of Likert scale, this is whereby the responses gathered from the people will be weighted on a scale of say 1 to 5 with typical responses like “strongly disagree”, “disagree”, “undecided”, “agree” and “agree strongly”. For instance, “strongly disagree” can be set with a weight of 1 with “agree strongly” having a weight of 5. By so doing, it is easier to quantify the responses captured in the questionnaire. Both strategies will be used together to obtain the best data collection.

The second questionnaire will be used to collect data from staff of Financial Service Organizations. This two-way data collection technique will ensure that there is enough evidence to justify the research as it will not be only limited to data from questionnaire obtained from

customers but also data obtained from staff of Financial Service Organizations. Data from both questionnaires will be used to ascertain the result that the research aims to achieve.

3.7. Data Processing and Analysis

Data collected via the questionnaires and the secondary data will be tabularized into data spreadsheets and statistical tools. Spreadsheet that will be used for entry of the data collected will be the Microsoft Excel. In addition, the main statistical tool that will be used to help in the analysis of the collected data that is both the primary (questionnaire) and secondary data will be the SPSS statistical tool. This tool is very convenient for drawing out analysis and will be the main tool that will be used in analyzing the research. Aside SPSS being used for data analysis, it is also effective for processing data as well. By using both Microsoft Excel and the SPSS tool, the high accuracy of data entry, capturing, processing and analysis will be assured in obtaining the needed response from the research questions and topics set out.

3.8. Ethical Consideration

The whole principles of ethics will be applied through the preparation of this research so as to no infringe or violate the rights of any person. It is very important to notice that as per the Data Policy acts, confidential data should not be disclosed without the consent of the individual or party in question. It is for these same reasons that the research will be conducted in an ethical approach. In designing the questionnaire, the identity of the person filling the questionnaire should not be disclosed. These identities can be the name of the person or the mobile phone number.

Also, to ensure an ethical research, questionnaires will not be forced unto people to fill them to make up the numbers. The people should be willing to partake in the questionnaire since their opinions and decisions on the research topic will be very candid. Likewise, for secondary data,

the consent of the Financial Service Organization that data will be collected ought to be sought. This will have to be followed up properly to ensure that there are no ethical implications that may infringe on the researcher or the research topic.

3.9. Validity and reliability

Validity is an indication of how sound the research is. More appropriately, it pertains to both the design and the methods of the research. However, validity in data collection means that the findings will represent the questions that the research topic is claiming to measure. It is in this respect, that people in the small micro enterprise sector will be used to conduct the questionnaires designed. These people represent that section of people that would determine whether there is an impact of mobile point of sale devices in the financial service organizations. Also, a secondary data of the performance of some Financial Service Organizations will be analyzed and assessed to complement the primary data collected. This will assure a very valid research which meets the criteria of how valid a good research should be conducted.

Reliability of the research refers to the degree to which an assessment tool produces stable and consistent results. It is with this regard that already accomplished and established assessment tools like Microsoft Excel and SPSS will be used in the data entry, assessment, processing and analysis of the data collected. Computation of the hypothesis and other formula works will be handled using SPSS which will ensure that accuracy is maintained. Reliability is very important in research and a high priority will be placed on the reliability of the research. A very good research may not be reliable since data was not captured, analyzed or processed accurately.

High priority has been ensured to achieve both validity and reliability which will ensure that a very good research is conducted. It is for these reasons that Microsoft Excel and SPSS will be used in data capturing, processing and analysis.

3.10. Limitations and delimitations

Limitations of a research are the likely shortfalls that exist in the research and are out of the researcher's control. Regarding the research topic and the choice of people that is the micro enterprise sector, there are some limitations that must be accommodated. The people taking the questionnaire may not be an actual random sample since this will be conducted at the market area. The person taking the questionnaire could be a business owner, a shop attendant, a buyer, an errand boy, an errand girl or even a window shopper. Also, another limitation to the research will be the hypothesis chosen to test for data findings. The results that will be produced will be limited to the reliability of the test.

Hence the more reliable the test used, the more reliable the research and in effect a very valid research will be conducted. Another limitation to the research will be the geographic area where the primary data will be obtained from the people. The choice of geographic area will be predominantly the market areas since this is where the people in the micro enterprise can be found. However, it is a limitation to the research since there are people in the micro enterprise sector who are not necessarily found at the market. Delimitations on the contrary are within the control of the researcher and are set by the researcher. Considering the research topic, the delimitations set will focus on the research objectives, research questions, population and sample size, data collection and the tools for data processing.

A critical aspect of the research delimitation pertains to the data collection whereby closed-ended Likert scale responses will be used rather than open-ended responses, which is likely to deviate from the research topic. This style has been chosen to ensure that the research in terms of data

collection remains in the sole control of the researcher and does not become a limitation to the research topic. In order to ensure a good research work, the data collection should be within the control of the researcher conducting the research.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. General Discussion and Challenges

Overall, the research was very thought provoking and gave an insight to the questions of the research. The collection of data which was via questionnaires was collected over a period of 5 months. On the issue of how Mobile Point of Sale devices could increase the dormant bank base, these were organized as a Customer Questionnaire and a Financial Service Organization questionnaire. Regarding the Customer questionnaire, a population of over one hundred thousand (100,000) was considered due to the population of people who bank with Financial Service Organizations and because a sample size of above 100 to gather enough data to analyze. There were challenges associated with administering the questions since most customers that were visited at random did not cooperate easily. Also, the responses were gathered around 4 markets namely; Agbogbloshie, Techiman market, Sunyani Market and Kejetia within different month periods from December 2015 to April 2016. Techiman and Sunyani markets were very unfavourable since the mismanagement of Microfinances had become an issue whereby customers lost their savings and investment after these Microfinances (DKM, God is Love, etc.) had folded up and abandoned business without the knowledge of the customers who have saved with them.

Customers of Agbogbloshie and Kejetia were very receptive towards answering questions posed in the questionnaire because they believed that most of their challenges and issues will be relayed to their bankers. Also, it was the first time that they were experiencing such moment

whereby they were asked to fill questionnaires about service delivery of their banks. Nonetheless, their attention was not easily worn into gathering feedback and several explanations had to ensue in order to capture their responses. Surprisingly, the questionnaires administered within the Financial Service Organizations were the toughest. Particularly, staffs of Banks and Savings & Loans were very hesitant and adamant upon giving responses. Most of them were of the view that data was being gathered to sell off to a competitor organization to improve their product offerings. Most staffs had signed and agreed to non-disclosure and confidential information and had to seek the go-ahead from their employers. Some customers were unwilling to go that extent to answer responses to the researcher whereby they were not obliged to provide information of the organization.

Most staff within the Financial Service Organization sector were not accustomed to giving feedback to aid research works and that was the largest challenge. Even though questionnaires were meant to be collected after a week of providing to the respondents, it took about a month to receive the answered questionnaire. These challenges were not experienced amongst the customers when the Customer questionnaires were administered. Most of the Customer questionnaires were administered on the spot. The only difficulty was to convince the customer and get their audience to provide feedback.

4.2. Recommendation to Challenges in Future Researches

Operations of Financial Service Organizations have evolved tremendously notwithstanding the fact that technological innovation has not been deployed entirely within its operations. Research through the setup of Research and Development units should be properly factored in the operations on Financial Service Organizations. Most business processes have been handed on from various legacy systems and models which do not function as per current trend of

technology. All priorities are focused on year to year running which only culminates into short term planning.

There are little frameworks and conferences conducted by the regulatory bodies (Bank of Ghana) which usually brings key stakeholders within the industry to brainstorm and embrace findings obtained from research works. Further to this, there should be more collaborative efforts amongst Fintech companies, Financial Organizations and independent research bodies. These are very useful since most research findings are furnished to Fintech companies who must partner with Financial Service Organizations to design product for their customers' needs. Media and education awareness should be increased to equip customers about the happenings and trends within Financial Service Organizations to whip up their knowledge on researches conducted. This will encourage more research works around the Financial Service industry.

4.3. Impact of Mobile Point of Sale Device on the non-banking population

On the penetration impact of Mobile Point of Sale Device, intent was to ascertain whether Mobile Point of Sale Device had an impact on the population that do not bank with a Financial Service Organization. Once the impact was known, it would be possible to determine if the deployment of the technology had been important to Financial Service Organizations. Alternative solutions could then be proposed should it fail to have an impact on the non-banking population. Research results for this were derived from Customer questionnaire since these asked respondents about impact of Mobile Point of Sale Device.

Even though, the respondents were within the banking population; their responses would invariably impact the non-banking population. Therefore, this measure will be used to assess

whether Mobile Point of Sale Device would impact those in the non-banking population. Four questions were posed to Customers that have used Mobile Point of Sale Device:

- i. Using a Mobile Point of Sale device saves time?
- ii. Will funds be secured when transacting using a Mobile Point of Sale device?
- iii. Is there easier accessibility when using a Mobile Point of Sale device?
- iv. Are Mobile Point of Sale devices convenient when transacting with them?

Statistical data and tables were used to measure time using Mobile Point of Sale Device. Key information such as mean, mode, standard deviation was computed using the statistical tool IBM SPSS Statistics 23.

Table 4.1: Time saving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	1.9	9.1	9.1
	3	9	8.7	40.9	50.0
	4	6	5.8	27.3	77.3
	5	5	4.8	22.7	100.0
	Total	22	21.2	100.0	
Missing	System	82	78.8		
Total		104	100.0		

Source: Author's Construct

No customer chose a response rating of one (1) even though there were responses which had ratings between 2 and 5. Responses from customers revealed that 21.2% representing twenty (22) customers had used Mobile Point of Sale devices. Other statistics like Skewness, kurtosis, standard error of mean, standard error of Skewness and standard error of kurtosis were also added to give more information. Mean and standard deviations of the responses were 3.64 and .953 respectively. All these statistics helped to ascertain with others the impact of Mobile Point of Sale device on the non-banking population.

Table 4.2: Time saving statistics

N	Valid	22
	Missing	82

Mean	3.64
Std. Error of Mean	0.203
Median	3.5
Mode	3
Std. Deviation	0.953
Variance	0.909
Skewness	0.114
Std. Error of Skewness	0.491
Kurtosis	-0.934
Std. Error of Kurtosis	0.953
Range	3
Minimum	2
Maximum	5
Sum	80

Source: Author's Construct

On the security of funds using a Mobile Point of Sale Device, responses which were rated 1 to 5 were gathered from all twenty-two (22) customers who had used devices.

Table 4.3: Funds are secured

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	3.8	18.2	18.2
	2	9	8.7	40.9	59.1
	3	7	6.7	31.8	90.9
	4	1	1.0	4.5	95.5
	5	1	1.0	4.5	100.0
	Total	22	21.2	100.0	
Missing	System	82	78.8		
Total		104	100.0		

Source: Author's Construct

Table 4.4: Funds are secured statistics

N	Valid	22
	Missing	82
Mean		2.36
Std. Error of Mean		0.214
Median		2.00
Mode		2
Std. Deviation		1.002
Variance		1.004
Skewness		0.725

Std. Error of Skewness	0.491
Kurtosis	0.957
Std. Error of Kurtosis	0.953
Range	4
Minimum	1
Maximum	5
Sum	52

Source: Author's Construct

On the easier accessibility in using a Mobile Point of Sale device, out of a total of twenty-two (22) customers, 45.5% chose a rating of 2, 4.5% which constituted one (1) customer chose 1 whilst the response ratings of 3, 4 and 5 were 31.8%, 13.6% and 4.5% respectively.

Table 4.5: Easy accessibility of funds

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	1	1.0	4.5	4.5
2	10	9.6	45.5	50.0
3	7	6.7	31.8	81.8
4	3	2.9	13.6	95.5
5	1	1.0	4.5	100.0
Total	22	21.2	100.0	
Missing System	82	78.8		
Total	104	100.0		

Source: Author's Construct

Considering easy accessibility of funds, majority of the customers chose a rating response of 2 whilst the average rating was 2.68. This meant that the customers did not agree that it was easy accessing funds. A range of 4, median of 2.5 and standard deviation of .945 were also recorded. Skewness, kurtosis with their standard errors were .721, .341, .491 and .953 respectively.

Table 4.6: Easy accessibility of funds statistics

N	Valid	22
	Missing	82
Mean		2.68
Std. Error of Mean		0.202
Median		2.5
Mode		2
Std. Deviation		0.945
Variance		0.894

Skewness	0.721
Std. Error of Skewness	0.491
Kurtosis	0.341
Std. Error of Kurtosis	0.953
Range	4
Minimum	1
Maximum	5
Sum	59

Source: Author's Construct

On the measure of convenience using Mobile Point of Sale device, data statistics were gathered from respondents.

Table 4.7: Convenient to use

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 2	1	1.0	4.5	4.5
3	8	7.7	36.4	40.9
4	8	7.7	36.4	77.3
5	5	4.8	22.7	100.0
Total	22	21.2	100.0	
Missing System	82	78.8		
Total	104	100.0		

Source: Author's Construct

Mean from the responses were high resulting to 3.77. This was associated with a standard deviation of .869. Median was 4 whereas Skewness and kurtosis were .006 and -.804. Range was 3 as a result of the highest and lowest scoring rates of 5 and 2. Two (2) modes were captured which were scoring ratings of 3 and 4, with the lowest being scoring rating of 3 chosen.

Table 4.8: Convenient to use statistics

N	Valid	22
	Missing	82
Mean		3.77
Std. Error of Mean		0.185
Median		4
Mode		3a
Std. Deviation		0.869

Variance	0.755
Skewness	0.006
Std. Error of Skewness	0.491
Kurtosis	-0.804
Std. Error of Kurtosis	0.953
Range	3
Minimum	2
Maximum	5
Sum	83

a. Multiple modes exist. The smallest value is shown

Source: Author's Construct

Based on the statistics gathered, impact of mobile point of sale device on the non-banking population was tested hypothetically. Two statistical tests were performed with Anova used as the first statistical test to find out whether all the means were same:

- i. Using a Mobile Point of Sale device saves time?
- ii. Will funds be secured when transacting using a Mobile Point of Sale device?
- iii. Is there easier accessibility when using a Mobile Point of Sale device?
- iv. Are Mobile Point of Sale devices convenient when transacting with them?

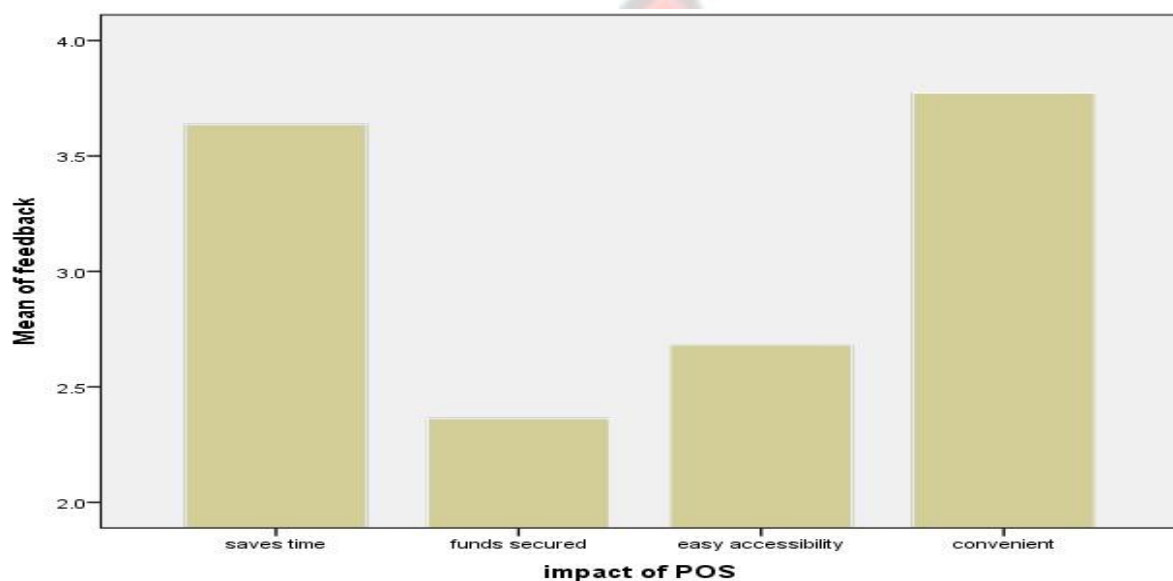
This determined whether all questions had the same impact or others had a better impact than the other. Hypothesis tests were either a null hypothesis denoted by H_0 when all means were the same, or an alternate hypothesis also denoted by H_a when there was at least one difference amongst the means. In addition, T-tests with responses listed as a rating of one (1), least degree of truth to five (5), the most degree of truth was used to determine the positive impact of each whereby a value of 3.5 was chosen as the population mean.

Anova statistical tests was used to determine whether the impact was the same:

Table 4.9: Descriptives of impact of Mobile Point of Sale device

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
saves time	22	3.64	0.953	0.2	3.21	4.06	2	5
funds secured	22	2.36	1.002	0.21	1.92	2.81	1	5
easy accessibility	22	2.68	0.945	0.2	2.26	3.1	1	5
Convenient	22	3.77	0.869	0.19	3.39	4.16	2	5
Total	88	3.11	1.108	0.12	2.88	3.35	1	5

Source: Author's Construct

**Figure 4.1: Descriptive means of impact of Mobile Point of Sale device**

Data from Table 4.9 was used to compute difference between and within groups, sum of squares between and within groups, mean square between and within groups and F value.

Table 4.10: Anova results on impact of Mobile Point of Sale device

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	32.045	3	10.682	11.99	0
Within Groups	74.818	84	0.891		
Total	106.864	87			

Source: Author's Construct

The results were computed into a formula $F(x, y) = z, p < .05$ whereby x was the difference between groups, y was the difference within groups, z (critical value) was the result derived from the F distribution table (see appendix) and p was the level of significance at 5%.

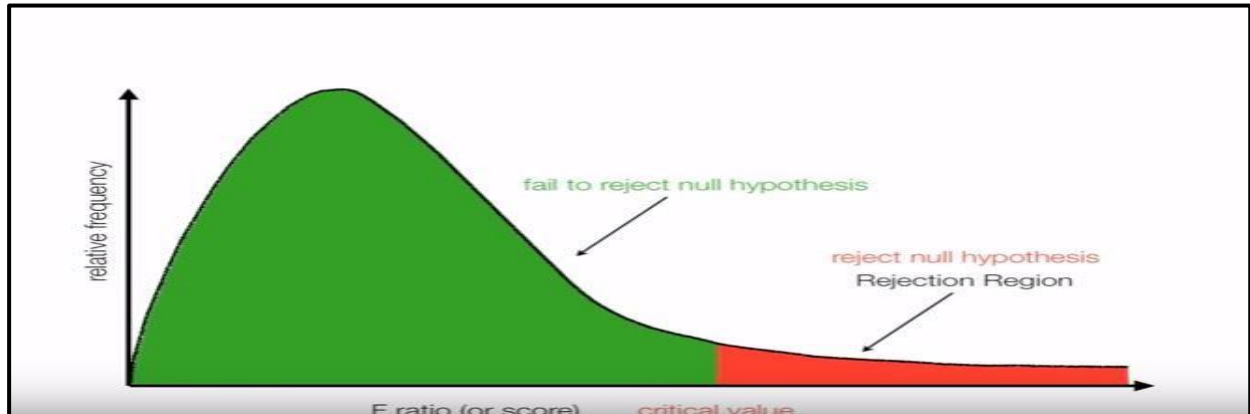


Figure 4.2: Determine hypothesis using F result from Anova and critical value

The formula $F(x, y) = z, p < .05, F(3, 84)$ was computed from the F distribution table (see appendix) which produced a result of 2.71. The F value derived from the Anova table which was 11.993 was more than the z (critical value) which was the computation from the F distribution table. Since, the F value which was 11.993 was more than z (critical value) and lay within the right side of z (critical value), the null hypothesis was rejected, and the alternate hypothesis chosen. This meant that there was the same impact of Mobile Point of Sale device on the non-banking population. Further T-tests were conducted to find out which ones had a positive impact. T-test was chosen over Z-test since the population standard deviation was unknown and the sample size was less than thirty (30).

T-test was used to determine whether using a Mobile Point of Sale device saved time. This was measured against a test value of 3.5 and if the p value was less than 0.05 the null hypothesis was rejected, and the alternate hypothesis accepted.

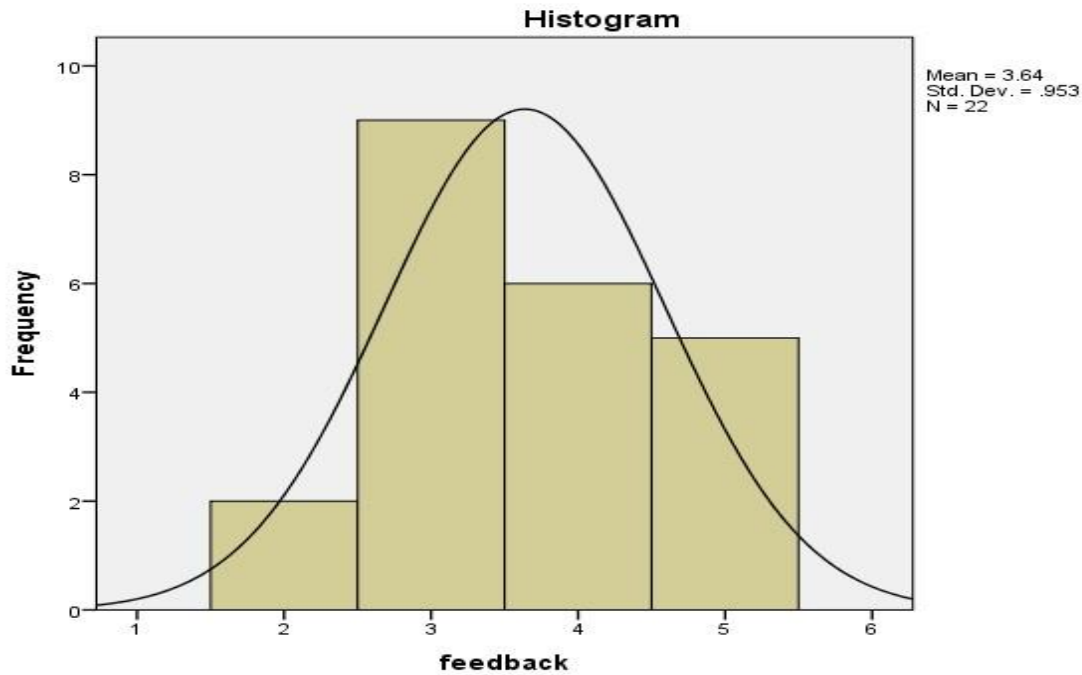


Figure 4.3: Histogram showing Mobile Point of Sale device saves time

Table 4.11: T-test results of Mobile Point of Sale device saves time

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	0.671	21	0.510	0.136	-0.29	0.56

Source: Author's Construct

From Table 4.11, $T(21) = 0.671$, $p = 0.510$ where 21 represented the degree of freedom and p was the significance value. P value was more than 0.05, therefore the null hypothesis was failed to be rejected, $H_0: \mu \geq 3.5$. This meant that Mobile Point of Sale device saved time and impacted the non-banking population positively.

T-tests were used to determine whether funds were secured when a transaction was done with a Mobile Point of Sale device.

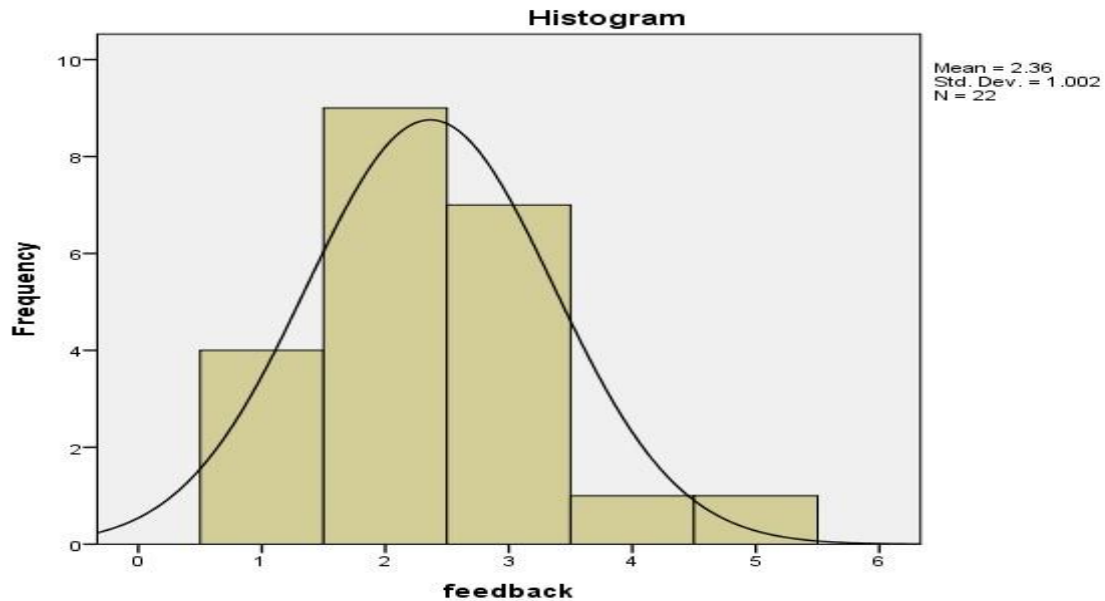


Figure 4.4: Histogram showing funds are secured when using a Mobile Point of Sale device

Table 4.12: T-test results of funds are secured when using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-5.319	21	0.000	-1.136	-1.58	-0.69

Source: Author's Construct

From Table 4.12, $T(21) = -5.319$, $p = 0.000$ where 21 represented the degree of freedom and p was the significance value. P value was less than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was rejected and the alternate hypothesis $H_a: \mu < 3.5$ accepted. This meant that funds were not secured, and Mobile Point of Sale device did not impact the non-banking population positively.

T-tests were used to ascertain whether there was easier accessibility when a Mobile Point of Sale device was used.

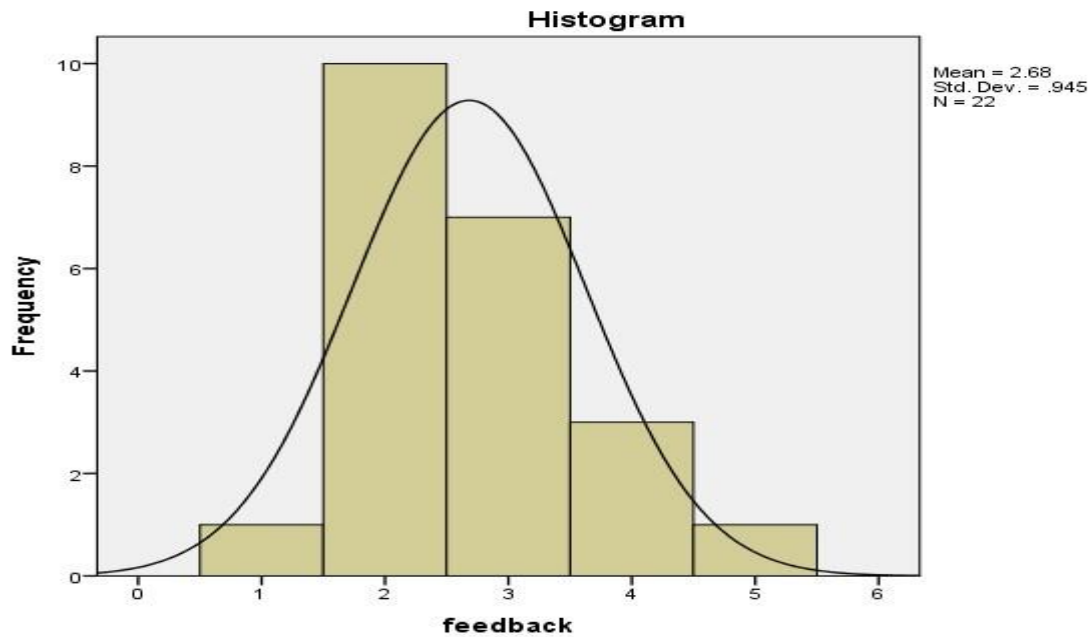


Figure 4.5: Histogram showing easier accessibility when using a Mobile Point of Sale device

Table 4.13: T-test results of easier accessibility when using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-4.059	21	0.001	-0.818	-1.24	-0.4

Source: Author's Construct

From Table 4.13, $T(21) = -4.059$, $p = 0.001$ where 21 represented the degree of freedom and p was the significance value. P value was less than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was rejected and the alternate hypothesis $H_a: \mu < 3.5$ was accepted. This therefore meant that funds were not easily accessible, and that Mobile Point of Sale device did not impact the non-banking population positively as assessed by the statistical results.

T-tests were also used to ascertain if there was convenience when Mobile Point of Sale devices were used.

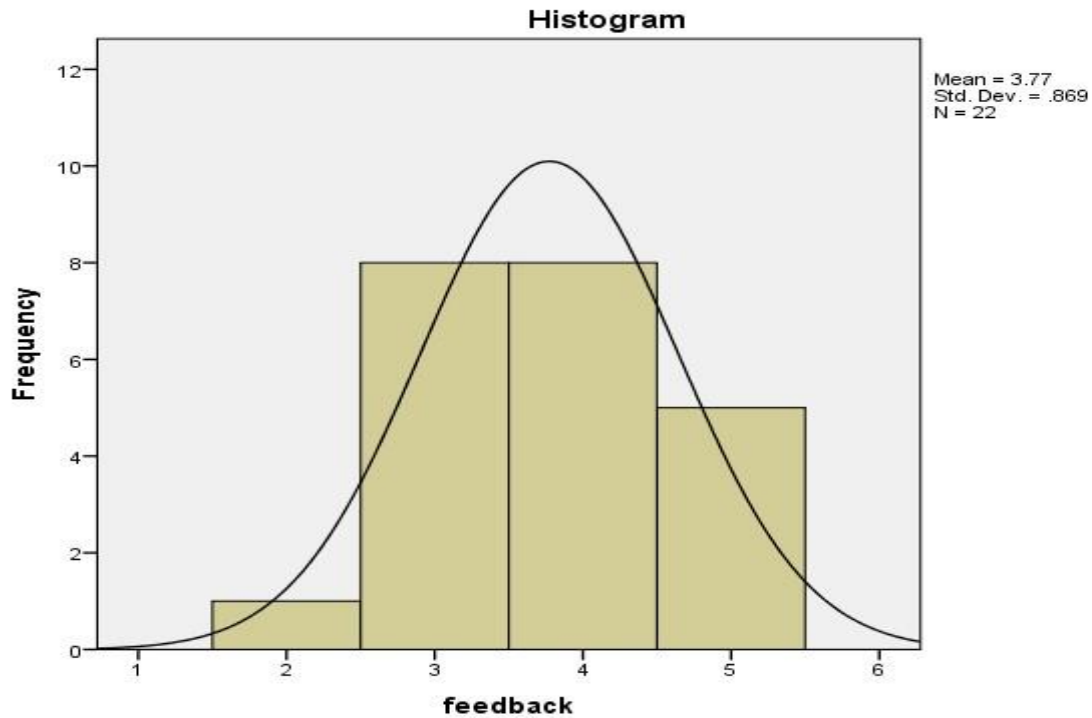


Figure 4.6: Histogram showing convenience when using a Mobile Point of Sale device

Table 4.14: T-test results of convenience when using a Mobile Point of Sale device

	Test Value = 3.5					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	1.472	21	0.156	0.273	-0.11	0.66

Source: Author's Construct

From Table 4.14, $T(21) = 1.472$, $p = 0.156$ where 21 represented the degree of freedom and p was the significance value. P value was greater than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was failed to be rejected. This meant that there was convenience when Mobile Point of Sale devices were used.

Anova statistical tests conducted showed the impact of Mobile Point of Sale device on the nonbanking population were not the same. Hypothesis tests further conducted indicated that the following had a positive impact on the non-banking population:

- i. Using a Mobile Point of Sale device saves time?

ii. Are Mobile Point of Sale devices convenient when transacting with them?

However, these did not have a positive impact the non-banking population:

i. Will funds be secured when transacting using a Mobile Point of Sale device? ii.

Is there easier accessibility when using a Mobile Point of Sale device?

4.4. Mobile Point of Sale Device has increased the dormant bank customer base

How much Mobile Point of Sale Device increased the dormant bank customer base was assessed to determine increase within dormant bank customer based on usage of Mobile Point of Sale devices by customers. Most dormant customers did not bank regularly and spent less time outside of their workplace. Hence, there was the need to provide banking to them to make deposits and withdrawals via a Mobile Point of Sale device. Ease of accessibility of funds and the convenience in accessing them were used as the main measure in determining the impact.

Customers were sampled from four (4) cities; Sunyani, Techiman, Kumasi and Accra whereby questionnaires were administered to one hundred and four (104) customers with questions about the usage of Mobile Point of Sale devices. Questionnaires administered to customers in Accra was during December 2015, whilst questionnaires administered in Techiman, Sunyani and Kumasi occurred during February, March and April 2016 respectively. Specific questions were whether there is an easier accessibility and whether there was convenience in using a Mobile Point of Sale device. Twenty-two (22) customers had used a Mobile Point of Sale device who responded by rating whether it provided easier accessibility or was convenient from one (1) to five (5) whereby one (1) meant a low impact and five (5) meant a high impact.

Table 4.15: Case processing summary between easy accessibility and convenience

		Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent

easy accessibility of funds * convenient to use	22	21.2%	82	78.8%	104	100.0%
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Source: Author's Construct

Table 4.16: Cross tabulation between accessibility and convenience

		convenient to use				Total
		2	3	4	5	
easy accessibility of funds	1	0	1	0	0	1
	2	1	5	4	0	10
	3	0	1	3	3	7
	4	0	1	1	1	3
	5	0	0	0	1	1
Total		1	8	8	5	22

Source: Author's Construct

From the Customer questionnaire administered responses were gathered which posed direct responses from customers regarding easy accessibility and convenience of Mobile Point of Sale device. Responses of easy accessibility and convenience gathered from customers who had used Mobile Point of Sale device was generalized to customers who do not perform regular transactions (dormant customers).

Anova was used to find out whether convenience and accessibility had the same impact on dormant customer base based on the following:

- Is there easier accessibility when using a Mobile Point of Sale device?
- Are Mobile Point of Sale devices convenient when transacting with them?

Hypothesis tests were either a null hypothesis (H_0) which meant the same means, or an alternate hypothesis (H_a) when at least a difference existed among the means. T-test was further used to measure the impact of each. A population mean of 3.5 was chosen to perform Anova for accessibility and convenience in Table 4.17.

Table 4.17: Descriptives of increase in dormant customer base by Mobile Point of Sale device

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
easy accessibility	22	2.68	0.945	0.202	2.26	3.10	1	5
Convenient	22	3.77	0.869	0.185	3.39	4.16	2	5
Total	44	3.23	1.054	0.159	2.91	3.55	1	5

Source: Author's Construct

Table 4.18: Anova results of dormant customer base by Mobile Point of Sale device

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13.091	1	13.091	15.874	0.000
Within Groups	34.636	42	0.825		
Total	47.727	43			

Source: Author's Construct

To determine the hypotheses, the following result was computed into a formula $F(x, y) = z, p < .05$ whereby x was the difference between groups, y was the difference within groups, z (critical value) was the result derived from the F distribution table (see appendix) and p was the level of significance which stood at 5%. The difference between groups was 1 and the difference within groups was 42. Therefore, from the formula a computation of $F(1, 42)$ resulted to 4.07 from the F distribution table (see appendix). However, from the Anova results table, F was 15.874 which was more than the critical value of 4.07. This lay on the right side of z (critical value) when it was plotted.

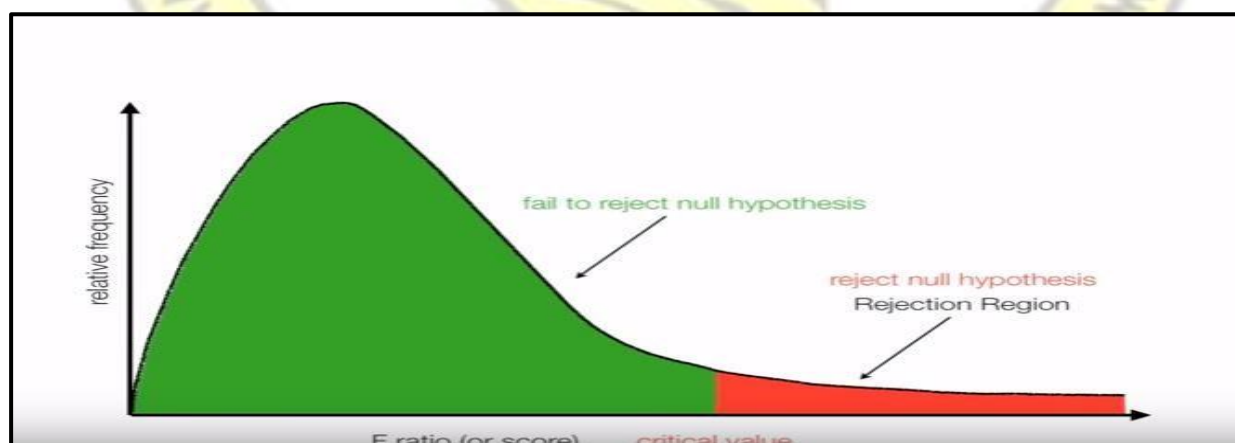


Figure 4.7: Determine hypothesis using F result from Anova and critical value

From the results, the null hypothesis was rejected. The alternate hypothesis was rather accepted since enough evidence was not provided from the sample data since convenience and accessibility of Mobile Point of Sale devices did not have the same impact on the dormant customer base.

T-tests was performed to test whether there was an easier accessibility when using a Mobile Point of Sale device were used. To attain a positive impact, a value of 3.5 was chosen since it is above the mid-mark of 3 which was above the neutral rating between 1 and 5. The null hypothesis was $H_0: \mu \geq 3.5$, whilst the alternate hypothesis was $H_a: \mu < 3.5$, where μ was the population mean.

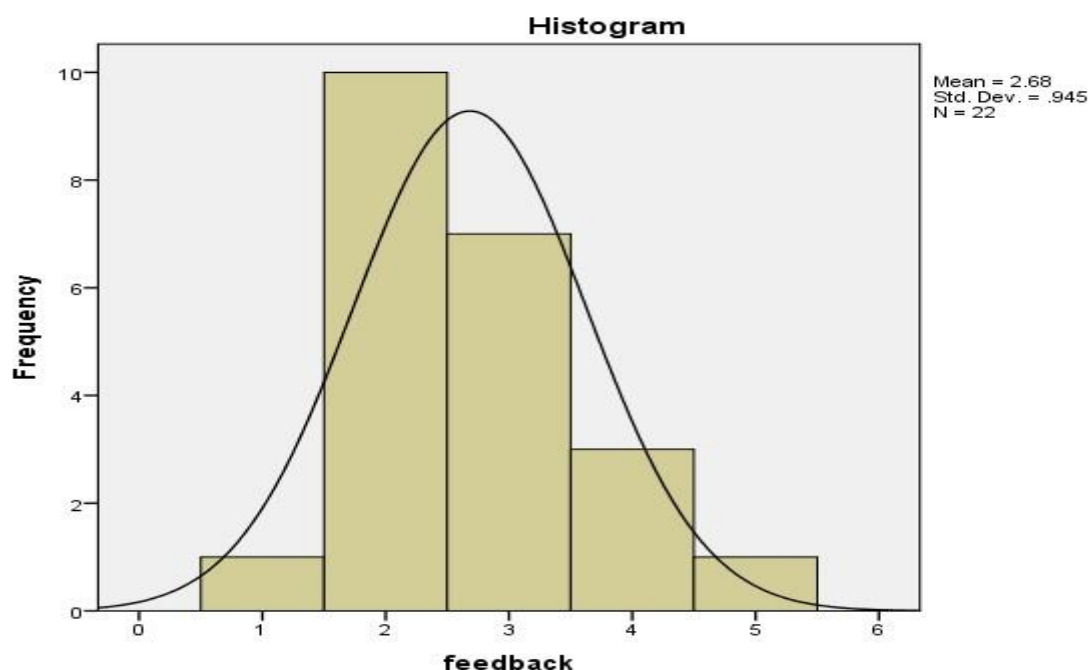


Figure 4.8: Histogram showing easier accessibility when using a Mobile Point of Sale device

Table 4.19: T-test results of easier accessibility when using a Mobile Point of Sale device

Test Value = 3.5					
T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	

Feedback	-4.059	21	0.001	-0.818	Lower	Upper
					-1.24	-0.40

Source: Author's Construct

From Table 4.19, $T(21) = -4.059$, $p = 0.001$ where 21 represented the degree of freedom and p was the significance value. P value was less than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was rejected and the alternate hypothesis $H_a: \mu < 3.5$ accepted. This meant that funds were not easily accessible when Mobile Point of Sale device was used and would not impact the dormant bank customer base positively.

Further T-tests were performed to test whether Mobile Point of Sale devices were convenient when transacted with them.

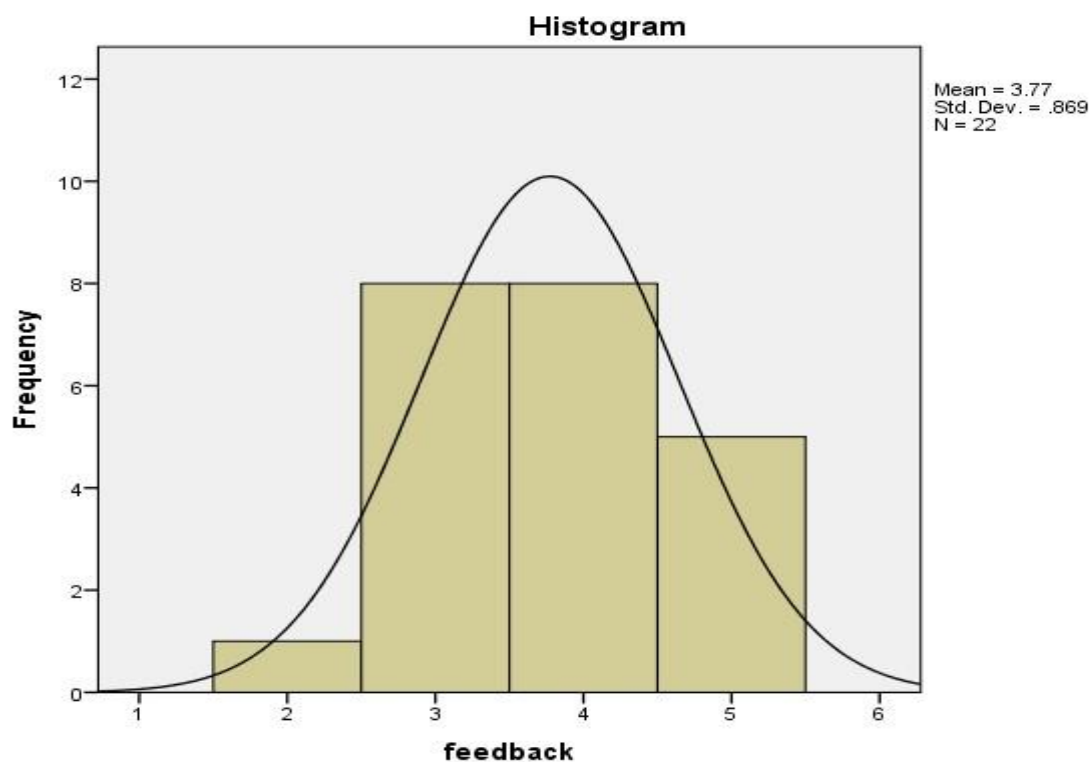


Figure 4.9: Histogram showing convenience when using a Mobile Point of Sale device

Table 4.20: T-test results of convenience when using a Mobile Point of Sale device

Test Value = 3.5						
T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		
				Lower	Upper	

Feedback	1.472	21	0.156	0.273	-0.11	0.66
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Source: Author's Construct

From Table 4.20, $T(21) = 1.472$, $p = 0.156$ where 21 represented the degree of freedom and p was the significance value. P value was greater than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was failed to be rejected. This meant there was convenience in using Mobile Point of Sale device which impacted the dormant bank customer base positively when it is used by Financial Service Organizations.

4.5. Mobile Point of Sale Device will increase money mobilized from customers

A total of one hundred and four (104) questionnaires were administered to staffs based on a selection of twenty-six (26) staffs each of the types of Financial Service Organizations, namely; Banks, Non-banking Financial Services, Savings & Loans and Microfinances. This was used to determine whether there is an increase in money mobilized through Mobile Point of Sale devices for Financial Service Organizations.

Table 4.21: Attracted more deposits

	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	2.9	2.9	2.9
2	25	24.0	24.0	26.9
3	47	45.2	45.2	72.1
4	19	18.3	18.3	90.4
5	10	9.6	9.6	100.0
Total	104	100.0	100.0	

Source: Author's Construct

From Table 4.21, three (3) staffs chose a lower rating of one (1) for more deposits mobilized by the organization. A total percentage of 73.1% chose a rating of three (3) or more.

Table 4.22: Attracted more deposits statistics

N	Valid	104
	Missing	0

Mean	3.08
Std. Error of Mean	0.094
Median	3.00
Mode	3
Std. Deviation	0.962
Variance	0.926
Skewness	0.310
Std. Error of Skewness	0.237
Kurtosis	-0.209
Std. Error of Kurtosis	0.469
Range	4
Minimum	1
Maximum	5
Sum	320

Source: Author's Construct

Table 4.23: Cross tabulation between attracted more deposits and bank classification

		Bank classification				Total
		Bank	microfinance	non-banking finan. service	savings and Loans	
mobile	1	1	2	0	0	3
point of sale	2	7	11	4	3	25
has	3	11	9	12	15	47
attracted	4	4	3	7	5	19
more						
deposits for	5	3	1	3	3	10
the						
organisation						
Total		26	26	26	26	104

Source: Author's Construct

Anova was done to test whether all the various Financial Service Organizations (Banks, Nonbanking Financial Services, Savings & Loans and Microfinances) had the same impact of increasing money mobilized from customers. A null hypothesis denoted by H_0 , meant that all means were the same and an alternate hypothesis denoted by H_a , meant there was at least one difference existed among the means. Also, a second statistical test was done to determine if each category of Financial Service Organization had an impact of increasing money mobilized from customers.

Table 4.24: Descriptives of increase in money mobilized from customers by Mobile Point of Sale device

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Banks	26	3.04	1.038	0.204	2.62	3.46	1	5
savings and loans	26	2.58	0.902	0.177	2.21	2.94	1	5
Microfinance	26	3.38	0.898	0.176	3.02	3.75	2	5
non-banking finan. Service	26	3.31	0.838	0.164	2.97	3.65	2	5
Total	104	3.08	0.962	0.094	2.89	3.26	1	5

Source: Author's Construct

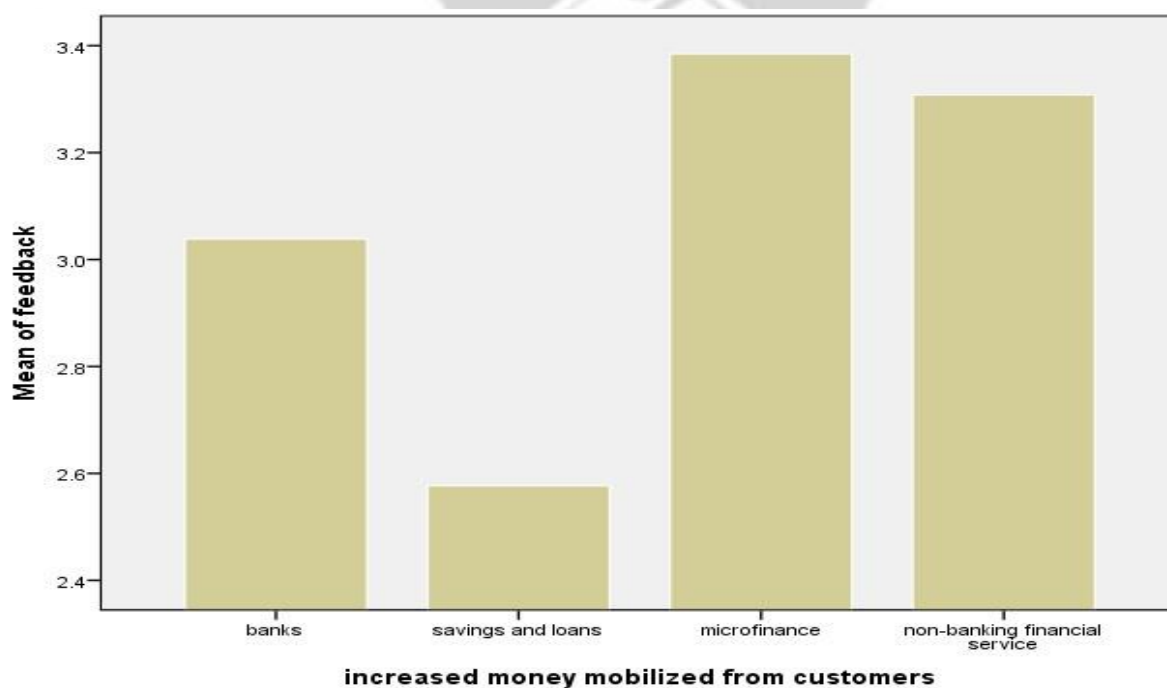


Figure 4.10: Descriptive means of increase in money mobilized from customers by Mobile Point of Sale device

Table 4.25: Anova results of money mobilized from customers by Mobile Point of Sale device

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10	3	3.462	4.072	0.009
Within Groups	85	100	0.850		

Total	95	103			
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Source: Author's Construct

Results were computed into a formula $F(x, y) = z, p < .05$ whereby x was the difference between groups, y was the difference within groups, z (critical value) was the result derived from the F distribution table (see appendix) and p was the level of significance which stood at 5%.

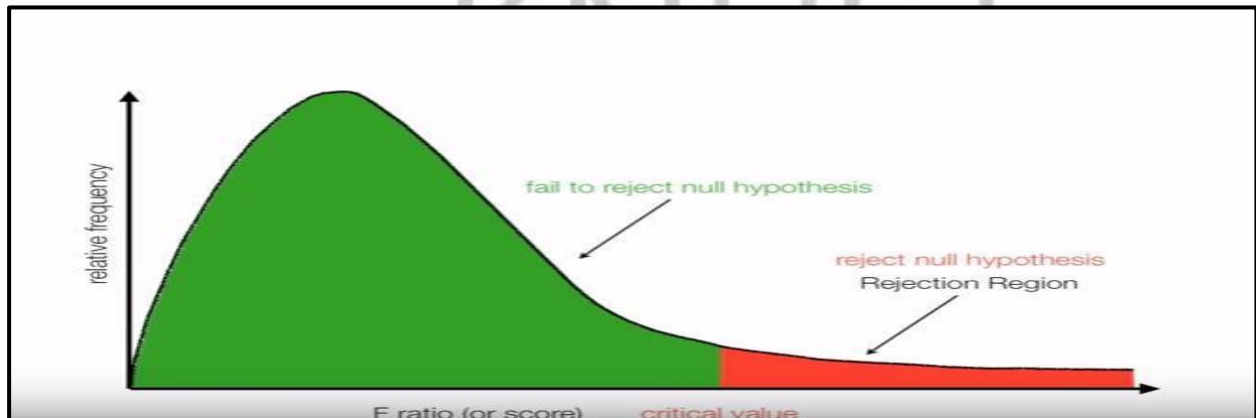


Figure 4.11: Determine hypothesis using F result from Anova and critical value

From the formula $F(x, y) = z, p < .05$, $F(3, 100)$ was computed from the F distribution table (see appendix) which produced a result of 2.70. The F value derived from the Anova table which was 4.072 was more than the z (critical value) which was the computation from the F distribution table. Since, the F value which was 4.072 was more than z (critical value) and lay within the right side of z (critical value) the null hypothesis was rejected whilst the alternate hypothesis was chosen. The impact of Financial Service Organizations (Banks, Non-banking Financial Services, Savings & Loans and Microfinances) were determined as not the same and that not all of them increased money mobilized from customers.

T-tests were done to determine which Financial Service Organization had a positive impact. A test value of 3.5 was chosen since the population standard deviation was not known and also the sample size tested, twenty-six (26) was less than thirty (30). T-tests were done for Banks to determine its impact.

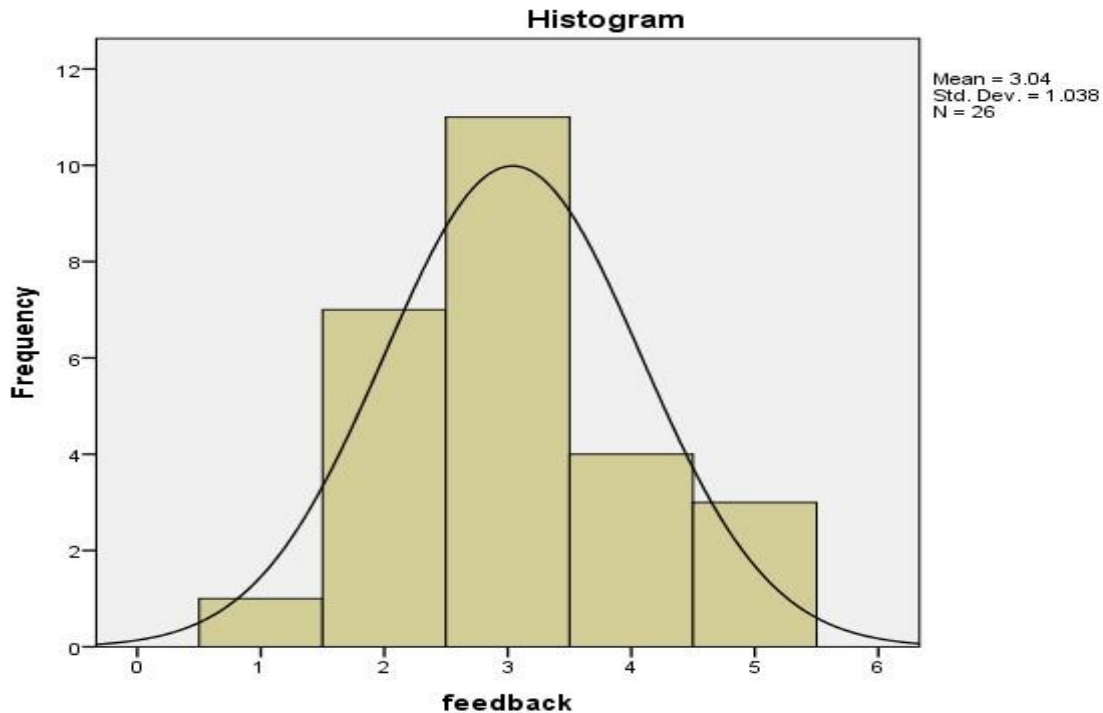


Figure 4.12: Histogram showing increase in money mobilized from customers in banks using a Mobile Point of Sale device

Table 4.26: T-test results of money mobilized from customers in banks using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-2.266	25	0.032	-0.462	-0.88	-0.04

Source: Author's Construct

From Table 4.26, $T(25) = -2.266$, $p = .032$ where 25 represented the degree of freedom and p was the significance value. P value was less than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was rejected. This meant there was not enough evidence that there was an increase in money mobilized from customers of banks when a Mobile Point of Sale device was used.

T-tests were computed on Savings and Loans to find out whether there was a strong impact by Mobile Point of Sale device to increase money mobilized from its customers. A histogram and a T-test table were captured based on the sample data used.

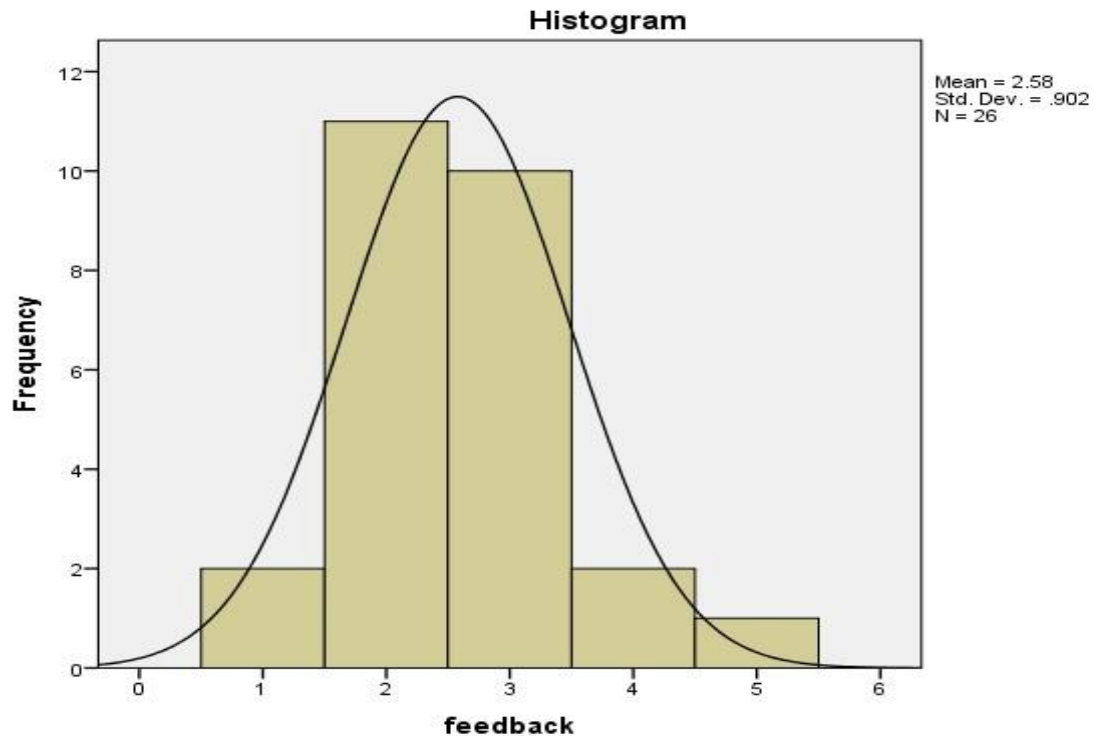


Figure 4.13: Histogram showing increase in money mobilized from customers in Savings and Loans using a Mobile Point of Sale device

Table 4.27: T-test results of money mobilized from customers in Savings and Loans using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-5.217	25	0.000	-0.923	-1.29	-0.56

Source: Author's Construct

From Table 4.27, $T(25) = -5.217$, $p = .000$ where 25 represented the degree of freedom and p was the significance value. P value was less than 0.05, therefore the null hypothesis was rejected which meant there was not enough evidence that there was an increase in money mobilized from customers of Savings and Loans.

T-tests were computed to test the impact by Microfinance. A p value lower than 0.05 meant that there was no impact to increase money mobilized from customers of microfinance whilst a value

higher than 0.05 would have meant an increase in money mobilized from customers of Microfinance.

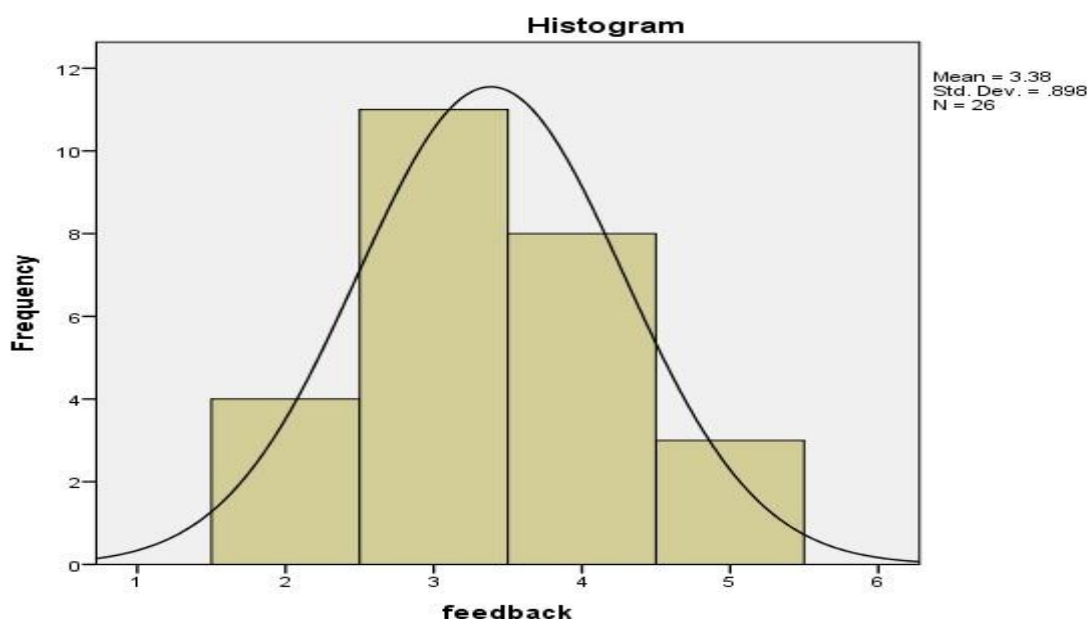


Figure 4.14: Histogram showing increase in money mobilized from customers in Microfinance using a Mobile Point of Sale device

Table 4.28: T-test results of money mobilized from customers in Microfinance using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-0.655	25	0.518	-0.115	-0.48	0.25

Source: Author's Construct

From Table 4.28, $T(25) = -0.655$, $p = .518$ where 25 represented the degree of freedom and p was the significance value. Since the P value was greater than 0.05, the null hypothesis was failed to be rejected which meant there was enough evidence that there was an increase in money mobilized from customers of Microfinance.

T-tests were computed to test if there was a positive impact by Mobile Point of Sale device to increase money mobilized from customers of the Non-banking Financial Services.

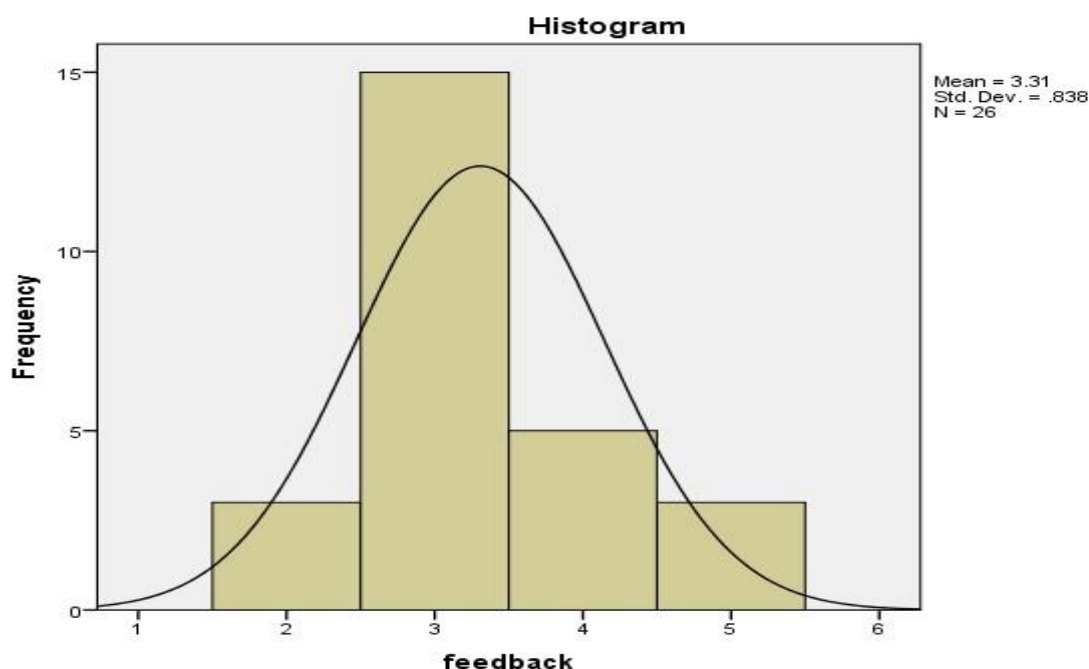


Figure 4.15: Histogram showing increase in money mobilized from customers in Nonbanking Financial Service using a Mobile Point of Sale device

Table 4.29: T-test results of money mobilized from customers in Non-banking Financial Service using a Mobile Point of Sale device

	Test Value = 3.5					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Feedback	-1.171	25	0.253	-0.192	-0.53	0.15

Source: Author's Construct

From Table 4.29, $T(25) = -1.171$, $p = 0.253$ where 25 represented the degree of freedom and p was the significance value. The P value was greater than 0.05, therefore the null hypothesis, $H_0: \mu \geq 3.5$ was failed to be rejected. This showed that there was an increase in money mobilized from customers of Non-banking Financial Services.

In summary, T-tests performed individually for all the categories of Financial Service Organizations indicated that there was no impact in increase of money mobilized from customers of both Banks and Savings and Loans. However, there was an increase in money mobilized from customers of both Microfinances and Non-banking Financial Services.

4.6. Proposed implementation strategies

It was clear that not all Financial Service Organizations had the same impact when they were tested hypothetically using Anova Statistical tests to determine their penetration impact and their effect on increasing the dormant bank customer base. Also, the impact across all Financial Service Organizations were not the same when tested to determine whether money mobilized from customers was increased. Even though, further tests conducted showed that money mobilized was increased from some Financial Service Organizations when tested using T-tests.

When the penetration impact of Mobile Point of Sale Device on the non-banking population was tested, there was a strong impact in terms of saving time and convenience even though results showed that there was no security and easier accessibility with Mobile Point of Sale devices. This could be attributed to the human element whereby the customer will feel there is no privacy. Besides there is no personal feel from the customer perspective.

Addressing results of increasing the dormant bank customer base by Mobile Point of Sale Device, both accessibility and convenience showed that there were different impacts when tested with Anova. T-tests performed for each showed that there was no accessibility but there was rather convenience when each was tested. Also, the impact of increasing money mobilized from customers across all Financial Service Organizations were different. However, additional T-tests performed uniquely show that there was not enough evidence to justify that there will be strong or positive impacts by Mobile Point of Sale devices being used at Banks and Savings & Loans. Contrary to this, T-tests performed for Microfinances and Non-banking Financial Services indicated strongly the positive that Mobile Point of Sale devices will impact their various customers.

Issue of funds and accessibility can be better complemented by a self-service technology. USSD development comes to mind considering the significant impact it can make towards the areas of accessibility and security. Choice of USSD as a self-service technology that can complement the flaws of the Mobile Point of Sale as opposed to Mobile apps are due to these factors:

- i. USSD is accessible on any mobile phone. This is very important to penetrate the unbanked and dormant customer base with a technology that is accessible by all.
- ii. Data is not required. This is usually not the case with mobile apps which require internet.
- iii. There is a strong human interaction for customers who all use mobile phones. It involves basic instruction like dialing a set of numbers and characters to proceed.
- iv. Security is ensured since a USSD session cannot be hacked into. With USSD sessions transmission of data times out and cannot be tapped into unlike with mobile apps whereby there could be bugs which might lead to exploitation of the app.
- v. It is inexpensive to use USSD since no costs are borne by the mobile user or customer who is initiating a command.

After carefully assessing the impact of Mobile Point of Sale Device in increasing money mobilized from customers it was shown that Banks and Savings & Loans were shown did not have a strong or positive impact. Banks and Savings & Loans are on the high end of Financial Service Organizations, and it was not really a surprise when their impact was not strong. This is because their customer bases are mostly made up of the “elite” who rather like to do selfservice banking than via a Mobile Point of Sale device which involves human interaction.

However, the impact of Mobile Point of Sale device was shown to be stronger at Microfinances and Non-banking Financial Service Organizations whereby their customer base involved mostly customers in the informal sector and white-collar job category. The main difference attributes to self-service which can be offered by either a USSD or a Mobile app development. These

technologies can be both proposed but there is a preference for USSD due to its advantages early highlighted over the Mobile app technology.

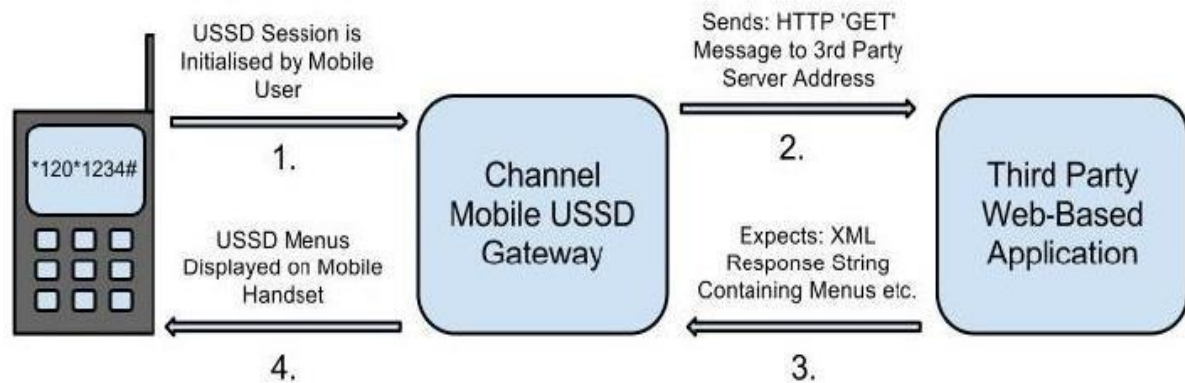


Figure 4.16: USSD flow diagram

From Figure 4.16, a customer initiates the USSD code which is dialed from the mobile phone and sent to the Mobile USSD Channel Gateway which authenticates the sim card number details using a security password. Once authentication and verification are successful, a message is sent to the Third-Party Web-based application server. It receives the request and returns the response in the form of XML back to the Mobile USSD Channel Gateway which returns the data and displays it as a USSD menu on the handset of the customer. Transactions that can be initiated by a customer to create a self-service feel to complement the deployment of Mobile Point of Sale devices are shown in Figure 4.17:

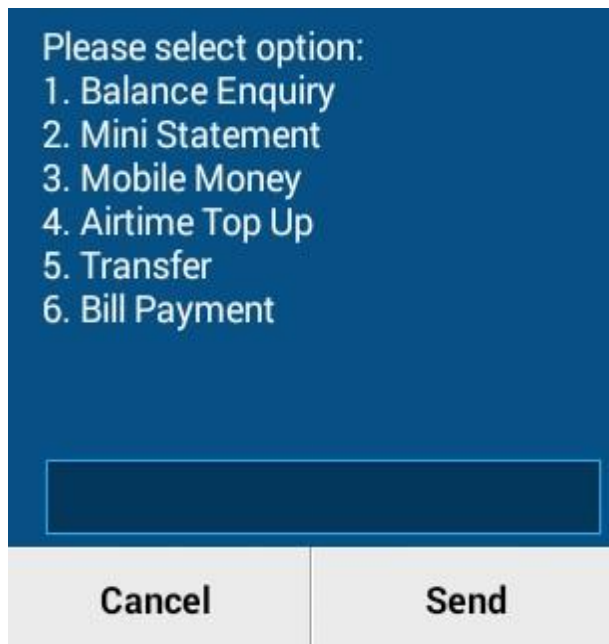


Figure 4.17: USSD self-service screen

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Summary of Findings

Findings brought to bear the uneven impact across Financial Service Organizations via the deployment of Mobile Point of Sale devices. Impact penetration of non-banking population by the usage of Mobile Point of Sale devices was not the same. The technology saved time and provided convenience towards its usage. On the contrast, security and accessibility were not present. In terms of increasing the dormant bank customer base, convenience and security had different impacts. Convenience impacted the dormant customer base whereas security of funds did not show positive impact towards causing an increase in dormant bank customer base. With regards to money mobilized from customers, the impact was not the same. Microfinances and Non-banking Financial Services showed a positive impact whereas Banks and Savings & Loans did not have a positive impact when using Mobile Point of Sale device.

A major implication indicated a successful deployment of the Mobile Point of Sale technology solution within the lower ranks of Financial Service Organizations namely; Microfinance and

Non-banking Financial Services. High-end ones like Banks and Savings & Loans rather showed an unsuccessful deployment of this solution. It implies that more Mobile Point of Sale devices should be deployed by Microfinances and Non-banking Financial Services. However, there should be awareness about the technology since there was insecurity towards it which resulted to accessibility not making an impact. Banks and Savings & Loans should consider deployment of alternative solutions such as Mobile App and USSD but preferably USSD to achieve a positive impact towards security and accessibility not provided by the Mobile Point of Sale device technology.

5.2. Recommendations

It was realized that there is low awareness being created for Mobile Point of Sale device technology by Financial Service Organizations. The gap of inaccessibility and security can be bridged by creating awareness through marketing campaigns like market storms, radio and television adverts. Financial Service Organizations especially Microfinances and Non-banking Financial Services should invest more into Mobile Point of Sale device solutions. They ought to be agile by ensuring that proximity of the devices from their customers is improved. Also, Financial Service Organizations specifically Banks and Savings and Loans must consider deploying alternative solutions to enhance their operations. USSD is being preferred over Mobile App solutions due to its ubiquitous nature of accessibility over all mobile devices and factors like security. This research has evaluated the impact of Mobile Point of Sale device technology which can significantly impact Financial Service but will challenge other researchers to either conduct future research around this area of study or embark on exploiting other technology particularly USSD and its impact towards Financial Service Organizations in Ghana.

5.3. Limitations of Study

The research was limited to the impact of Mobile Point of Sale device technology within Financial Service Organizations. Although it can be deployed across Logistics industry, Medical Health and Insurance industries, the intent of the research was to evaluate it in terms of Financial Service Organizations. It is therefore imperative that this research should be limited to the capability and usage of Mobile Point of Sale devices only in the Financial Service Organizations. Evaluation of impact of this solution outside the Finance sector should be considered as being a whole research work.

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APPENDIX

TABLE E										
F critical values										
		Degrees of freedom in the numerator								
	<i>p</i>	1	2	3	4	5	6	7	8	9
Degrees of freedom in the denominator	1	.100	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44
		.050	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88
		.025	647.79	799.50	864.16	899.58	921.85	937.11	948.22	956.66
		.010	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1
		.001	405284	500000	540379	562500	576405	585937	592873	598144
	2	.100	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37
		.050	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37
		.025	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37
		.010	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37
		.001	998.50	999.00	999.17	999.25	999.30	999.33	999.36	999.37
	3	.100	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25
		.050	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85
		.025	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54
		.010	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49
		.001	167.03	148.50	141.11	137.10	134.58	132.85	131.58	130.62
	4	.100	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95
		.050	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04
		.025	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98
		.010	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80
		.001	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00
	5	.100	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34
		.050	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82
		.025	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76
		.010	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29
		.001	47.18	37.12	33.20	31.09	29.75	28.83	28.16	27.65
	6	.100	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98
		.050	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15
		.025	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60
		.010	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10
		.001	35.51	27.00	23.70	21.92	20.80	20.03	19.46	19.03
	7	.100	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75
		.050	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73
		.025	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90
		.010	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84
		.001	29.25	21.69	18.77	17.20	16.21	15.52	15.02	14.63



TABLE E

F critical values (continued)

Degrees of freedom in the numerator										
10	12	15	20	25	30	40	50	60	120	1000
60.19	60.71	61.22	61.74	62.05	62.26	62.53	62.69	62.79	63.06	63.30
241.88	243.91	245.95	248.01	249.26	250.10	251.14	251.77	252.20	253.25	254.19
968.63	976.71	984.87	993.10	998.08	1001.4	1005.6	1008.1	1009.8	1014.0	1017.7
6055.8	6106.3	6157.3	6208.7	6239.8	6260.6	6286.8	6302.5	6313.0	6339.4	6362.7
605621	610668	615764	620908	624017	626099	628712	630285	631337	633972	636301
9.39	9.41	9.42	9.44	9.45	9.46	9.47	9.47	9.47	9.48	9.49
19.40	19.41	19.43	19.45	19.46	19.46	19.47	19.48	19.48	19.49	19.49
39.40	39.41	39.43	39.45	39.46	39.46	39.47	39.48	39.48	39.49	39.50
99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.48	99.49	99.50
999.40	999.42	999.43	999.45	999.46	999.47	999.47	999.48	999.48	999.49	999.50
5.23	5.22	5.20	5.18	5.17	5.17	5.16	5.15	5.15	5.14	5.13
8.79	8.74	8.70	8.66	8.63	8.62	8.59	8.58	8.57	8.55	8.53
14.42	14.34	14.25	14.17	14.12	14.08	14.04	14.01	13.99	13.95	13.91
27.23	27.05	26.87	26.69	26.58	26.50	26.41	26.35	26.32	26.22	26.14
129.25	128.32	127.37	126.42	125.84	125.45	124.96	124.66	124.47	123.97	123.53
3.92	3.90	3.87	3.84	3.83	3.82	3.80	3.80	3.79	3.78	3.76
5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.70	5.69	5.66	5.63
8.84	8.75	8.66	8.56	8.50	8.46	8.41	8.38	8.36	8.31	8.26
14.55	14.37	14.20	14.02	13.91	13.84	13.75	13.69	13.65	13.56	13.47
48.05	47.41	46.76	46.10	45.70	45.43	45.09	44.88	44.75	44.40	44.09
3.30	3.27	3.24	3.21	3.19	3.17	3.16	3.15	3.14	3.12	3.11
4.74	4.68	4.62	4.56	4.52	4.50	4.46	4.44	4.43	4.40	4.37
6.62	6.52	6.43	6.33	6.27	6.23	6.18	6.14	6.12	6.07	6.02
10.05	9.89	9.72	9.55	9.45	9.38	9.29	9.24	9.20	9.11	9.03
26.92	26.42	25.91	25.39	25.08	24.87	24.60	24.44	24.33	24.06	23.82
2.94	2.90	2.87	2.84	2.81	2.80	2.78	2.77	2.76	2.74	2.72
4.06	4.00	3.94	3.87	3.83	3.81	3.77	3.75	3.74	3.70	3.67
5.46	5.37	5.27	5.17	5.11	5.07	5.01	4.98	4.96	4.90	4.86
7.87	7.72	7.56	7.40	7.30	7.23	7.14	7.09	7.06	6.97	6.89
18.41	17.99	17.56	17.12	16.85	16.67	16.44	16.31	16.21	15.98	15.77
2.70	2.67	2.63	2.59	2.57	2.56	2.54	2.52	2.51	2.49	2.47
3.64	3.57	3.51	3.44	3.40	3.38	3.34	3.32	3.30	3.27	3.23
4.76	4.67	4.57	4.47	4.40	4.36	4.31	4.28	4.25	4.20	4.15
6.62	6.47	6.31	6.16	6.06	5.99	5.91	5.86	5.82	5.74	5.66
14.08	13.71	13.32	12.93	12.69	12.53	12.33	12.20	12.12	11.91	11.72



TABLE E

F critical values (continued)

		Degrees of freedom in the numerator								
<i>p</i>		1	2	3	4	5	6	7	8	9
Degrees of freedom in the denominator	8	.100	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.56
		.050	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.39
		.025	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.36
		.010	11.26	8.65	7.59	7.01	6.63	6.37	6.18	5.91
		.001	25.41	18.49	15.83	14.39	13.48	12.86	12.40	11.77
	9	.100	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.44
		.050	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.18
		.025	7.21	5.71	5.08	4.72	4.48	4.32	4.20	4.03
		.010	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.35
		.001	22.86	16.39	13.90	12.56	11.71	11.13	10.70	10.11
	10	.100	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.35
		.050	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.02
		.025	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.78
		.010	10.04	7.56	6.55	5.99	5.64	5.39	5.20	4.94
		.001	21.04	14.91	12.55	11.28	10.48	9.93	9.52	8.96
	11	.100	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.27
		.050	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.90
		.025	6.72	5.26	4.63	4.28	4.04	3.88	3.76	3.59
		.010	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.63
		.001	19.69	13.81	11.56	10.35	9.58	9.05	8.66	8.12
	12	.100	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.21
		.050	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.80
		.025	6.55	5.10	4.47	4.12	3.89	3.73	3.61	3.44
		.010	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.39
		.001	18.64	12.97	10.80	9.63	8.89	8.38	8.00	7.48
	13	.100	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.16
		.050	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.71
		.025	6.41	4.97	4.35	4.00	3.77	3.60	3.48	3.31
		.010	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.19
		.001	17.82	12.31	10.21	9.07	8.35	7.86	7.49	6.98
	14	.100	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.12
		.050	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.65
		.025	6.30	4.86	4.24	3.89	3.66	3.50	3.38	3.21
		.010	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.03
		.001	17.14	11.78	9.73	8.62	7.92	7.44	7.08	6.58
	15	.100	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.09
		.050	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.59
		.025	6.20	4.77	4.15	3.80	3.58	3.41	3.29	3.12
		.010	8.68	6.36	5.42	4.89	4.56	4.32	4.14	3.89
		.001	16.59	11.34	9.34	8.25	7.57	7.09	6.74	6.26
	16	.100	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.06
		.050	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.54
		.025	6.12	4.69	4.08	3.73	3.50	3.34	3.22	3.05
		.010	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.78
		.001	16.12	10.97	9.01	7.94	7.27	6.80	6.46	5.98
	17	.100	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.03
		.050	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.49
		.025	6.04	4.62	4.01	3.66	3.44	3.28	3.16	2.98
		.010	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.68
		.001	15.72	10.66	8.73	7.68	7.02	6.56	6.22	5.75

TABLE E

F critical values (continued)

Degrees of freedom in the numerator										
10	12	15	20	25	30	40	50	60	120	1000
2.54	2.50	2.46	2.42	2.40	2.38	2.36	2.35	2.34	2.32	2.30
3.35	3.28	3.22	3.15	3.11	3.08	3.04	3.02	3.01	2.97	2.93
4.30	4.20	4.10	4.00	3.94	3.89	3.84	3.81	3.78	3.73	3.68
5.81	5.67	5.52	5.36	5.26	5.20	5.12	5.07	5.03	4.95	4.87
11.54	11.19	10.84	10.48	10.26	10.11	9.92	9.80	9.73	9.53	9.36
2.42	2.38	2.34	2.30	2.27	2.25	2.23	2.22	2.21	2.18	2.16
3.14	3.07	3.01	2.94	2.89	2.86	2.83	2.80	2.79	2.75	2.71
3.96	3.87	3.77	3.67	3.60	3.56	3.51	3.47	3.45	3.39	3.34
5.26	5.11	4.96	4.81	4.71	4.65	4.57	4.52	4.48	4.40	4.32
9.89	9.57	9.24	8.90	8.69	8.55	8.37	8.26	8.19	8.00	7.84
2.32	2.28	2.24	2.20	2.17	2.16	2.13	2.12	2.11	2.08	2.06
2.98	2.91	2.85	2.77	2.73	2.70	2.66	2.64	2.62	2.58	2.54
3.72	3.62	3.52	3.42	3.35	3.31	3.26	3.22	3.20	3.14	3.09
4.85	4.71	4.56	4.41	4.31	4.25	4.17	4.12	4.08	4.00	3.92
8.75	8.45	8.13	7.80	7.60	7.47	7.30	7.19	7.12	6.94	6.78
2.25	2.21	2.17	2.12	2.10	2.08	2.05	2.04	2.03	2.00	1.98
2.85	2.79	2.72	2.65	2.60	2.57	2.53	2.51	2.49	2.45	2.41
3.53	3.43	3.33	3.23	3.16	3.12	3.06	3.03	3.00	2.94	2.89
4.54	4.40	4.25	4.10	4.01	3.94	3.86	3.81	3.78	3.69	3.61
7.92	7.63	7.32	7.01	6.81	6.68	6.52	6.42	6.35	6.18	6.02
2.19	2.15	2.10	2.06	2.03	2.01	1.99	1.97	1.96	1.93	1.91
2.75	2.69	2.62	2.54	2.50	2.47	2.43	2.40	2.38	2.34	2.30
3.37	3.28	3.18	3.07	3.01	2.96	2.91	2.87	2.85	2.79	2.73
4.30	4.16	4.01	3.86	3.76	3.70	3.62	3.57	3.54	3.45	3.37
7.29	7.00	6.71	6.40	6.22	6.09	5.93	5.83	5.76	5.59	5.44
2.14	2.10	2.05	2.01	1.98	1.96	1.93	1.92	1.90	1.88	1.85
2.67	2.60	2.53	2.46	2.41	2.38	2.34	2.31	2.30	2.25	2.21
3.25	3.15	3.05	2.95	2.88	2.84	2.78	2.74	2.72	2.66	2.60
4.10	3.96	3.82	3.66	3.57	3.51	3.43	3.38	3.34	3.25	3.18
6.80	6.52	6.23	5.93	5.75	5.63	5.47	5.37	5.30	5.14	4.99
2.10	2.05	2.01	1.96	1.93	1.91	1.89	1.87	1.86	1.83	1.80
2.60	2.53	2.46	2.39	2.34	2.31	2.27	2.24	2.22	2.18	2.14
3.15	3.05	2.95	2.84	2.78	2.73	2.67	2.64	2.61	2.55	2.50
3.94	3.80	3.66	3.51	3.41	3.35	3.27	3.22	3.18	3.09	3.02
6.40	6.13	5.85	5.56	5.38	5.25	5.10	5.00	4.94	4.77	4.62
2.06	2.02	1.97	1.92	1.89	1.87	1.85	1.83	1.82	1.79	1.76
2.54	2.48	2.40	2.33	2.28	2.25	2.20	2.18	2.16	2.11	2.07
3.06	2.96	2.86	2.76	2.69	2.64	2.59	2.55	2.52	2.46	2.40
3.80	3.67	3.52	3.37	3.28	3.21	3.13	3.08	3.05	2.96	2.88
6.08	5.81	5.54	5.25	5.07	4.95	4.80	4.70	4.64	4.47	4.33
2.03	1.99	1.94	1.89	1.86	1.84	1.81	1.79	1.78	1.75	1.72
2.49	2.42	2.35	2.28	2.23	2.19	2.15	2.12	2.11	2.06	2.02
2.99	2.89	2.79	2.68	2.61	2.57	2.51	2.47	2.45	2.38	2.32
3.69	3.55	3.41	3.26	3.16	3.10	3.02	2.97	2.93	2.84	2.76
5.81	5.55	5.27	4.99	4.82	4.70	4.54	4.45	4.39	4.23	4.08
2.00	1.96	1.91	1.86	1.83	1.81	1.78	1.76	1.75	1.72	1.69
2.45	2.38	2.31	2.23	2.18	2.15	2.10	2.08	2.06	2.01	1.97
2.92	2.82	2.72	2.62	2.55	2.50	2.44	2.41	2.38	2.32	2.26
3.59	3.46	3.31	3.16	3.07	3.00	2.92	2.87	2.83	2.75	2.66
5.58	5.32	5.05	4.78	4.60	4.48	4.33	4.24	4.18	4.02	3.87

TABLE E

F critical values (continued)

		Degrees of freedom in the numerator								
<i>p</i>		1	2	3	4	5	6	7	8	9
Degrees of freedom in the denominator	18	.100	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.00
		.050	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.46
		.025	5.98	4.56	3.95	3.61	3.38	3.22	3.10	2.93
		.010	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.60
		.001	15.38	10.39	8.49	7.46	6.81	6.35	6.02	5.56
	19	.100	2.99	2.61	2.40	2.27	2.18	2.11	2.06	1.98
		.050	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.42
		.025	5.92	4.51	3.90	3.56	3.33	3.17	3.05	2.88
		.010	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.52
		.001	15.08	10.16	8.28	7.27	6.62	6.18	5.85	5.39
	20	.100	2.97	2.59	2.38	2.25	2.16	2.09	2.04	1.96
		.050	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.39
		.025	5.87	4.46	3.86	3.51	3.29	3.13	3.01	2.84
		.010	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.46
		.001	14.82	9.95	8.10	7.10	6.46	6.02	5.69	5.24
	21	.100	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.95
		.050	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.37
		.025	5.83	4.42	3.82	3.48	3.25	3.09	2.97	2.80
		.010	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.40
		.001	14.59	9.77	7.94	6.95	6.32	5.88	5.56	5.11
	22	.100	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.93
		.050	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.34
		.025	5.79	4.38	3.78	3.44	3.22	3.05	2.93	2.76
		.010	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.35
		.001	14.38	9.61	7.80	6.81	6.19	5.76	5.44	4.99
	23	.100	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.92
		.050	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.32
		.025	5.75	4.35	3.75	3.41	3.18	3.02	2.90	2.73
		.010	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.30
		.001	14.20	9.47	7.67	6.70	6.08	5.65	5.33	4.89
	24	.100	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.91
		.050	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.30
		.025	5.72	4.32	3.72	3.38	3.15	2.99	2.87	2.70
		.010	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.26
		.001	14.03	9.34	7.55	6.59	5.98	5.55	5.23	4.80
	25	.100	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.89
		.050	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.28
		.025	5.69	4.29	3.69	3.35	3.13	2.97	2.85	2.68
		.010	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.22
		.001	13.88	9.22	7.45	6.49	5.89	5.46	5.15	4.71
	26	.100	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.88
		.050	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.27
		.025	5.66	4.27	3.67	3.33	3.10	2.94	2.82	2.65
		.010	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.18
		.001	13.74	9.12	7.36	6.41	5.80	5.38	5.07	4.64
	27	.100	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.87
		.050	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.25
		.025	5.63	4.24	3.65	3.31	3.08	2.92	2.80	2.63
		.010	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.15
		.001	13.61	9.02	7.27	6.33	5.73	5.31	5.00	4.57

TABLE E*F* critical values (continued)

Degrees of freedom in the numerator										
10	12	15	20	25	30	40	50	60	120	1000
1.98	1.93	1.89	1.84	1.80	1.78	1.75	1.74	1.72	1.69	1.66
2.41	2.34	2.27	2.19	2.14	2.11	2.06	2.04	2.02	1.97	1.92
2.87	2.77	2.67	2.56	2.49	2.44	2.38	2.35	2.32	2.26	2.20
3.51	3.37	3.23	3.08	2.98	2.92	2.84	2.78	2.75	2.66	2.58
5.39	5.13	4.87	4.59	4.42	4.30	4.15	4.06	4.00	3.84	3.69
1.96	1.91	1.86	1.81	1.78	1.76	1.73	1.71	1.70	1.67	1.64
2.38	2.31	2.23	2.16	2.11	2.07	2.03	2.00	1.98	1.93	1.88
2.82	2.72	2.62	2.51	2.44	2.39	2.33	2.30	2.27	2.20	2.14
3.43	3.30	3.15	3.00	2.91	2.84	2.76	2.71	2.67	2.58	2.50
5.22	4.97	4.70	4.43	4.26	4.14	3.99	3.90	3.84	3.68	3.53
1.94	1.89	1.84	1.79	1.76	1.74	1.71	1.69	1.68	1.64	1.61
2.35	2.28	2.20	2.12	2.07	2.04	1.99	1.97	1.95	1.90	1.85
2.77	2.68	2.57	2.46	2.40	2.35	2.29	2.25	2.22	2.16	2.09
3.37	3.23	3.09	2.94	2.84	2.78	2.69	2.64	2.61	2.52	2.43
5.08	4.82	4.56	4.29	4.12	4.00	3.86	3.77	3.70	3.54	3.40
1.92	1.87	1.83	1.78	1.74	1.72	1.69	1.67	1.66	1.62	1.59
2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.94	1.92	1.87	1.82
2.73	2.64	2.53	2.42	2.36	2.31	2.25	2.21	2.18	2.11	2.05
3.31	3.17	3.03	2.88	2.79	2.72	2.64	2.58	2.55	2.46	2.37
4.95	4.70	4.44	4.17	4.00	3.88	3.74	3.64	3.58	3.42	3.28
1.90	1.86	1.81	1.76	1.73	1.70	1.67	1.65	1.64	1.60	1.57
2.30	2.23	2.15	2.07	2.02	1.98	1.94	1.91	1.89	1.84	1.79
2.70	2.60	2.50	2.39	2.32	2.27	2.21	2.17	2.14	2.08	2.01
3.26	3.12	2.98	2.83	2.73	2.67	2.58	2.53	2.50	2.40	2.32
4.83	4.58	4.33	4.06	3.89	3.78	3.63	3.54	3.48	3.32	3.17
1.89	1.84	1.80	1.74	1.71	1.69	1.66	1.64	1.62	1.59	1.55
2.27	2.20	2.13	2.05	2.00	1.96	1.91	1.88	1.86	1.81	1.76
2.67	2.57	2.47	2.36	2.29	2.24	2.18	2.14	2.11	2.04	1.98
3.21	3.07	2.93	2.78	2.69	2.62	2.54	2.48	2.45	2.35	2.27
4.73	4.48	4.23	3.96	3.79	3.68	3.53	3.44	3.38	3.22	3.08
1.88	1.83	1.78	1.73	1.70	1.67	1.64	1.62	1.61	1.57	1.54
2.25	2.18	2.11	2.03	1.97	1.94	1.89	1.86	1.84	1.79	1.74
2.64	2.54	2.44	2.33	2.26	2.21	2.15	2.11	2.08	2.01	1.94
3.17	3.03	2.89	2.74	2.64	2.58	2.49	2.44	2.40	2.31	2.22
4.64	4.39	4.14	3.87	3.71	3.59	3.45	3.36	3.29	3.14	2.99
1.87	1.82	1.77	1.72	1.68	1.66	1.63	1.61	1.59	1.56	1.52
2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.84	1.82	1.77	1.72
2.61	2.51	2.41	2.30	2.23	2.18	2.12	2.08	2.05	1.98	1.91
3.13	2.99	2.85	2.70	2.60	2.54	2.45	2.40	2.36	2.27	2.18
4.56	4.31	4.06	3.79	3.63	3.52	3.37	3.28	3.22	3.06	2.91
1.86	1.81	1.76	1.71	1.67	1.65	1.61	1.59	1.58	1.54	1.51
2.22	2.15	2.07	1.99	1.94	1.90	1.85	1.82	1.80	1.75	1.70
2.59	2.49	2.39	2.28	2.21	2.16	2.09	2.05	2.03	1.95	1.89
3.09	2.96	2.81	2.66	2.57	2.50	2.42	2.36	2.33	2.23	2.14
4.48	4.24	3.99	3.72	3.56	3.44	3.30	3.21	3.15	2.99	2.84
1.85	1.80	1.75	1.70	1.66	1.64	1.60	1.58	1.57	1.53	1.50
2.20	2.13	2.06	1.97	1.92	1.88	1.84	1.81	1.79	1.73	1.68
2.57	2.47	2.36	2.25	2.18	2.13	2.07	2.03	2.00	1.93	1.86
3.06	2.93	2.78	2.63	2.54	2.47	2.38	2.33	2.29	2.20	2.11
4.41	4.17	3.92	3.66	3.49	3.38	3.23	3.14	3.08	2.92	2.78

TABLE E

F critical values (continued)

		Degrees of freedom in the numerator								
<i>p</i>		1	2	3	4	5	6	7	8	9
Degrees of freedom in the denominator	28	.100	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90
		.050	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29
		.025	5.61	4.22	3.63	3.29	3.06	2.90	2.78	2.69
		.010	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23
	29	.001	13.50	8.93	7.19	6.25	5.66	5.24	4.93	4.50
		.100	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89
		.050	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28
		.025	5.59	4.20	3.61	3.27	3.04	2.88	2.76	2.67
	30	.010	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20
		.001	13.39	8.85	7.12	6.19	5.59	5.18	4.87	4.45
	40	.100	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88
		.050	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27
		.025	5.57	4.18	3.59	3.25	3.03	2.87	2.75	2.65
		.010	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17
	50	.001	13.29	8.77	7.05	6.12	5.53	5.12	4.82	4.39
		.100	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83
		.050	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18
		.025	5.42	4.05	3.46	3.13	2.90	2.74	2.62	2.53
	60	.010	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99
		.001	12.61	8.25	6.59	5.70	5.13	4.73	4.44	4.02
	100	.100	2.81	2.41	2.20	2.06	1.97	1.90	1.84	1.80
		.050	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13
		.025	5.34	3.97	3.39	3.05	2.83	2.67	2.55	2.46
		.010	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89
	200	.001	12.22	7.96	6.34	5.46	4.90	4.51	4.22	4.00
		.100	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77
		.050	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10
		.025	5.29	3.93	3.34	3.01	2.79	2.63	2.51	2.41
	1000	.010	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82
		.001	11.97	7.77	6.17	5.31	4.76	4.37	4.09	3.86
	1000	.100	2.76	2.36	2.14	2.00	1.91	1.83	1.78	1.73
		.050	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03
		.025	5.18	3.83	3.25	2.92	2.70	2.54	2.42	2.32
		.010	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69
	1000	.001	11.50	7.41	5.86	5.02	4.48	4.11	3.83	3.61
		.100	2.73	2.33	2.11	1.97	1.88	1.80	1.75	1.70
		.050	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98
		.025	5.10	3.76	3.18	2.85	2.63	2.47	2.35	2.26
	1000	.010	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60
		.001	11.15	7.15	5.63	4.81	4.29	3.92	3.65	3.43
	1000	.100	2.71	2.31	2.09	1.95	1.85	1.78	1.72	1.68
		.050	3.85	3.00	2.61	2.38	2.22	2.11	2.02	1.95
		.025	5.04	3.70	3.13	2.80	2.58	2.42	2.30	2.20
		.010	6.66	4.63	3.80	3.34	3.04	2.82	2.66	2.53
	1000	.001	10.89	6.96	5.46	4.65	4.14	3.78	3.51	3.30

TABLE E*F* critical values (continued)

Degrees of freedom in the numerator										
10	12	15	20	25	30	40	50	60	120	1000
1.84	1.79	1.74	1.69	1.65	1.63	1.59	1.57	1.56	1.52	1.48
2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.79	1.77	1.71	1.66
2.55	2.45	2.34	2.23	2.16	2.11	2.05	2.01	1.98	1.91	1.84
3.03	2.90	2.75	2.60	2.51	2.44	2.35	2.30	2.26	2.17	2.08
4.35	4.11	3.86	3.60	3.43	3.32	3.18	3.09	3.02	2.86	2.72
1.83	1.78	1.73	1.68	1.64	1.62	1.58	1.56	1.55	1.51	1.47
2.18	2.10	2.03	1.94	1.89	1.85	1.81	1.77	1.75	1.70	1.65
2.53	2.43	2.32	2.21	2.14	2.09	2.03	1.99	1.96	1.89	1.82
3.00	2.87	2.73	2.57	2.48	2.41	2.33	2.27	2.23	2.14	2.05
4.29	4.05	3.80	3.54	3.38	3.27	3.12	3.03	2.97	2.81	2.66
1.82	1.77	1.72	1.67	1.63	1.61	1.57	1.55	1.54	1.50	1.46
2.16	2.09	2.01	1.93	1.88	1.84	1.79	1.76	1.74	1.68	1.63
2.51	2.41	2.31	2.20	2.12	2.07	2.01	1.97	1.94	1.87	1.80
2.98	2.84	2.70	2.55	2.45	2.39	2.30	2.25	2.21	2.11	2.02
4.24	4.00	3.75	3.49	3.33	3.22	3.07	2.98	2.92	2.76	2.61
1.76	1.71	1.66	1.61	1.57	1.54	1.51	1.48	1.47	1.42	1.38
2.08	2.00	1.92	1.84	1.78	1.74	1.69	1.66	1.64	1.58	1.52
2.39	2.29	2.18	2.07	1.99	1.94	1.88	1.83	1.80	1.72	1.65
2.80	2.66	2.52	2.37	2.27	2.20	2.11	2.06	2.02	1.92	1.82
3.87	3.64	3.40	3.14	2.98	2.87	2.73	2.64	2.57	2.41	2.25
1.73	1.68	1.63	1.57	1.53	1.50	1.46	1.44	1.42	1.38	1.33
2.03	1.95	1.87	1.78	1.73	1.69	1.63	1.60	1.58	1.51	1.45
2.32	2.22	2.11	1.99	1.92	1.87	1.80	1.75	1.72	1.64	1.56
2.70	2.56	2.42	2.27	2.17	2.10	2.01	1.95	1.91	1.80	1.70
3.67	3.44	3.20	2.95	2.79	2.68	2.53	2.44	2.38	2.21	2.05
1.71	1.66	1.60	1.54	1.50	1.48	1.44	1.41	1.40	1.35	1.30
1.99	1.92	1.84	1.75	1.69	1.65	1.59	1.56	1.53	1.47	1.40
2.27	2.17	2.06	1.94	1.87	1.82	1.74	1.70	1.67	1.58	1.49
2.63	2.50	2.35	2.20	2.10	2.03	1.94	1.88	1.84	1.73	1.62
3.54	3.32	3.08	2.83	2.67	2.55	2.41	2.32	2.25	2.08	1.92
1.66	1.61	1.56	1.49	1.45	1.42	1.38	1.35	1.34	1.28	1.22
1.93	1.85	1.77	1.68	1.62	1.57	1.52	1.48	1.45	1.38	1.30
2.18	2.08	1.97	1.85	1.77	1.71	1.64	1.59	1.56	1.46	1.36
2.50	2.37	2.22	2.07	1.97	1.89	1.80	1.74	1.69	1.57	1.45
3.30	3.07	2.84	2.59	2.43	2.32	2.17	2.08	2.01	1.83	1.64
1.63	1.58	1.52	1.46	1.41	1.38	1.34	1.31	1.29	1.23	1.16
1.88	1.80	1.72	1.62	1.56	1.52	1.46	1.41	1.39	1.30	1.21
2.11	2.01	1.90	1.78	1.70	1.64	1.56	1.51	1.47	1.37	1.25
2.41	2.27	2.13	1.97	1.87	1.79	1.69	1.63	1.58	1.45	1.30
3.12	2.90	2.67	2.42	2.26	2.15	2.00	1.90	1.83	1.64	1.43
1.61	1.55	1.49	1.43	1.38	1.35	1.30	1.27	1.25	1.18	1.08
1.84	1.76	1.68	1.58	1.52	1.47	1.41	1.36	1.33	1.24	1.11
2.06	1.96	1.85	1.72	1.64	1.58	1.50	1.45	1.41	1.29	1.13
2.34	2.20	2.06	1.90	1.79	1.72	1.61	1.54	1.50	1.35	1.16
2.99	2.77	2.54	2.30	2.14	2.02	1.87	1.77	1.69	1.49	1.22