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## Application of Continued Fractions in Controlling Micro finance staff Deception

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### Abstract

A simple finite continued fraction is a finite expression obtained through an iterative process of representing a number. We investigate the advantage of simple continued fraction in controlling Micro finance staff Deception.

**Key words:** Continued fraction, Deception, Micro finance, internal control.

### 1 Introduction

We are living in a world which is complex and fast changing. This is an epoch in which the world depends on the use of high levels of knowledge and skills. There is a need to build a knowledge based society to address the current complex and fast changing world.

Microfinance is the provision of financial services to low-income clients, including consumers and the self-employed, who traditionally lack access to banking and related services.

Microfinance Refers to institutions that specialize in making very small loans to very poor persons in developing countries. Instead of using collateral to assure repayment, these lenders harness social pressure within the borrower's community. The provision of small loans (microcredit) to poor people to help them engage in productive activities or grow very small businesses. The term may also include a broader range of services, including credit, savings, and insurance. The main idea seems straightforward: micro = really small, so microfinance is financial service in small amounts for poor people.

The last definition, from PBS, adds a twist: a reference to the lender's purpose---to support microenterprise. That's a vestige of the term's

evolution. In 1971, Intel released the first microprocessor, the 4004. (There followed the 8008, the 8080, the 8086 and 8088, the 80286, 80386, the 80486...then the branded Pentium series.) By 1973, "microprocessor" had appeared in the American newspaper of record, and around then, I think, "micro-" gained currency. Jeff Ashe told me that it was a volunteer for Accion's program in Recife, Brazil, named Bruce Tippet who in 1974 coined the term "microenterprise" or "microbusiness" to describe informal businesses run by poor people. Accion lent money to the microenterprises in Recife, leading to the phrase "microenterprise credit." Much later (does anyone know the history?) came the term "microcredit." Hans Dieter Seibel says that he coined "microfinance" in 1990 to signify the conceptual expansion beyond credit to savings and insurance. But through much of the 1970s and 1980s, what we call "microcredit" was termed "microenterprise credit."

I think most knowledgeable people in the world microfinance (however defined) have moved beyond the equation of microcredit with enterprise. (Alas Kiva's web site hasn't: ever borrower there is an "Entrepreneur.") It is widely recognized that poor people use credit for many

things besides investment that this is often a good thing, and that money is so fungible that you can't really tell people what to do with it anyway. I, at any rate, am not confused on this point: microfinance should not be defined by the lender's purpose.

But here's a bigger source of confusion, a circa-2000 tally of accounts at "Alternative Financial Institutions," which generally aim to serve people too poor to interest commercial banks:

Microfinance institutions give microloans to entrepreneurs who otherwise don't qualify for a standard bank loan. / Credit: isak55 | Shutterstock  
Deception is defined as any behavior by which one person intends to gain a dishonest advantage over another. In other words Deception is an act of commission which is intended to cause wrongful gain to one person and wrongful loss to the other, either by way of concealment of facts or otherwise.

Deception has been the precipitating factor in the distress of Dedebit Micro finance, and as much as various measures have been taken to minimize the incidence of Deception, it still rises by the day because fraudster always device tactical ways of committing deception. This has become a point of great attention in the Dedebit Micro finance sector.

Deception is one of the numerous enemies of the business world. The high incidence of Deception within the Micro finance industry has become a problem to which solution must be provided in view of the large sums of money involved and its adverse implications on the economy.

Deception in its effects reduces the assets and increases the liability of any company. In the case of Micro finance, this may result in the loss of potential customers or crisis of confidence of Micro finance by the public and in the long run end up in another failed Micro finance situation. Special organizations have been formed to combat it and International Police (Interpol) tries to deal with it at the international level, but it has not been eradicated (Nwankwo, 1991). An analysis made of cases brings out broadly the following

major elements responsible for the commission of Deception in Micro finance.

- a) Active involvement of the staff-both supervisor and secretary either independent of external elements or in connivance with outsiders
- b) Failure on the part of the Micro finance staff to follow carefully laid down instructions and guidelines
- c) There has been a growing collusion between business, top Micro finance executives, civil servants and politicians in power to de deception the Micro finance, by getting the rules bent, regulations Deception and Micro finance norms thrown to the winds.

In 2008, Ogidefa <sup>[10]</sup> reported that the problem of Deception in banking system may have some attachments which are:

- a) Bank malpractices.
- b) Failure to appoint trusted and honest official as the representative in the clearing house.
- c) Failure to change representative on regular basis.
- d) Failure to provide locked boxes or bags for carrying cheques to and from the central banks.
- e) Inadequate training facilities for clearing staff both in the offices and central bank
- f) Negligence in checking clearing cheques from the Bank to avoid a case of possible short change of cheque

It was also reported that deception is an anti economic process and must properly be dealt with. He made it clear that for any banking institution to stand there must be proper management and trusted worker that are psychologically fit before employment. Deception was also referred to as a virus which spreads from the micro finance sector to other economic activities and organization even the government and that for any economy to be balanced; an anti deception virus should be injected to the micro finance industry to completely eradicate deception

from the system. In view of the gravity of deception in micro finance, the management of various micro finance had employed different measures, such as establishment of internal control unit, deception alerts, security measures etc., yet deception has continued in an upward trend, and this has called the effectiveness of these measures into question (Okubena, 1998). It was suggested by Nwankwo (1991) that on the discussion of the anatomy of deception, management should evolve positive attitudes towards safeguarding the micro finance assets and ensuring that staffs do not exploit the weakness in internal control. He further said that the policies should stress the cardinal principles of separation of duties to ensure that one person does not originate and complete an assignment or entry. In 2009, Abiola<sup>[1]</sup> investigated some practical means of minimizing the incidence of fraud in banks. It was revealed that so many factors contributed to the incidence of deception in the micro finance amongst which are poor management of policies and procedures, inadequate working conditions, micro finance's staff staying longer on a particular job, and staff felling frustrated as a result of poor recommendations. In this work, we introduce an internal control method since deception is caused majorly by the micro finance staff. Job rotation involves shifting a person from one job to another, so that he is able to understand and learn what each job involves. In an organization like debit micro finance, job rotation should be undertaken to prevent employees from doing any kind of deception, that is, if a person is handling a particular job for a very long time he will be able to find loopholes in the system and use them for his benefit and indulge in bogus practices. Job rotation avoids this.

## 2 Preliminaries

Mathematics as a science, studies past discoveries in calculations. Those who wish a particular field of mathematics, whether it is statistics, abstract algebra, or continued fractions, will first need to study their fields past. The origin of continued

fraction is traditionally placed at the time of the creation of Euclid's algorithm. However, Euclid's algorithm is used to find the greatest common Factors (GCF) of two numbers or integers  $a$  and  $b$ . for example, if we are given two integers  $a$  and  $b$ , one can find the (GCF) of  $(11, 13) = 1$  and (GCF) of  $(12, 60) = 12$  and so on. However, algebraically manipulating the algorithm, one can derive the simple continued fraction of the rational  $p/q$  as opposed to the GCF of  $p$  and  $q$ . A finite continued fraction is a finite expression obtained through an iterative process of representing a number as the sum of its integer part and the reciprocal of another number, then writing this other number as the sum of its integer part and another reciprocal, and so on. The iterations terminated after finitely many steps. All integers in the sequence must be positive. Simple Continued fractions are extremely important in the theory of rational approximation. Simple Continued fraction representation for a number is finite if and only if the number is rational. The study of simple continued fractions is motivated by a desire to have "mathematically pure" representation for the real numbers.

A simple continued fraction is an expression of the form

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \dots}}} = [a_0; a_1, a_2, \dots]$$

Where  $a_0, a_1, a_2, \dots$  real numbers with  $a_1, a_2, \dots$  are positive. If the expression contains finitely many terms, then it is called a *Finite Continued fraction*; otherwise it is called an *Infinite Continued fraction*. The real numbers

$a_0, a_1, a_2, \dots$  are called the *partial quotients* of the continued fraction. The continued fraction above is said to be *Simple*, if the real numbers

$a_0, a_1, a_2, \dots$  are all integers. Every finite continued fraction represents a rational number, and every rational number can be expressed as a finite continued fraction, c.f. <sup>[5,6]</sup> Simple Continued fraction has a number of useful applications in solving physical problems such as some Diophantine equations and chaotic problems and used to approximate the periods of the planets

around the sun. In this work, we used simple continued fraction to solve Micro finance staff deception.

### 3 Main Results

Here, we state the Proposition that would be used in the work.

#### 3.1 Proposition.

Any rational number can be represented as a simple continued fraction.

To calculate the continued fraction of  $b = \frac{p}{q}$ ;  $q \neq 0$ , we write the integer part which is called the *floor of b*. Then we subtract this integer part from  $b$ , hence, we proceed to find the reciprocal of the difference and repeat the process over and over again. The process will only terminate if  $b$  is rational. Thus, the process terminates since  $b$  is a rational number.

- i. We find the continued fraction representation of  $\frac{274}{3200}$

We follow the algorithm

1.  $b = \frac{274}{3200} = 0.085625$  and integer part = 0
2.  $a_0 = [b] = 0$
3.  $b = \frac{1}{(b-a_0)} = 11.67883211$  and integer part = 11
4.  $a_1 = [b] = 11$
5.  $b = \frac{1}{(b-a_1)} = 1.47311828$  and integer part = 1
6.  $a_2 = [b] = 1$
7.  $b = \frac{1}{(b-a_2)} = 2.1136$  and integer part = 2
8.  $a_3 = [b] = 2$
9.  $b = \frac{1}{(b-a_3)} = 8.8$  and integer part = 8
10.  $a_4 = [b] = 8$
11.  $b = \frac{1}{(b-a_4)} = 1.25$  and integer part = 1
12.  $a_5 = [b] = 1$
13.  $b = \frac{1}{(b-a_5)} = 4$  and integer part = 4
14.  $a_6 = [b] = 4$

Since  $b - a_6 = 0$ ; we stop

The required continued fraction is  $[0; 11, 1, 2, 8, 1, 4]$

$$\rightarrow \frac{274}{3200} = [0; 11, 1, 2, 8, 1, 4]$$

The above example shows that the algorithm stops after finitely many steps.

- ii. We find the continued fraction representation of  $\frac{11}{31}$

1.  $b = \frac{11}{31} = 0.354838$  and integer part = 0
2.  $a_0 = [b] = 0$
3.  $b = \frac{1}{(b-a_0)} = 2.818187454$  and integer part = 2
4.  $a_1 = [b] = 2$
5.  $b = \frac{1}{(b-a_1)} = 1.222214481$  and integer part = 1
6.  $a_2 = [b] = 1$
7.  $b = \frac{1}{(b-a_2)} = 4.500166506$  and integer part = 4
8.  $a_3 = [b] = 4$
9.  $b = \frac{1}{(b-a_3)} = 2$  and integer part = 2
10.  $a_4 = [b] = 2$

Since  $b - a_4 = 0$ ; we stop

The required continued fraction is  $\frac{11}{31} = [a_0; a_1, a_2, a_3, a_4] = [0; 2, 1, 4, 1]$ .

- iii. We show the continued fraction representation of  $\frac{5}{33}$

1.  $b = \frac{5}{33} = 0.1515151$  and integer part = 0
2.  $a_0 = [b] = 0$
3.  $b = \frac{1}{(b-a_0)} = 6.60000$  and integer part = 6
4.  $a_1 = [b] = 6$
5.  $b = \frac{1}{(b-a_1)} = 1.666666$  and integer part = 1
6.  $a_2 = [b] = 1$
7.  $b = \frac{1}{(b-a_2)} = 1.500001$  and integer part = 1
8.  $a_3 = [b] = 1$
9.  $b = \frac{1}{(b-a_3)} = 2$  and integer part = 2
10.  $a_4 = [b] = 2$

Since  $b - a_4 = 0$ ; we stop

The required continued fraction is  $\frac{5}{33} = [0; 4; 6; 1; 1; 2]$ .

#### 4 Applications of Results

In this section, we discuss the application of the results in controlling Micro finance Deception. Usually, as the account is being balanced at the end of the month, the algorithm in the section above will run automatically. If the steps terminate, the Micro finance staff A will be rotated to another assignment. If it does not, Micro finance staff A will maintain the position until another month when the algorithm will run. Once the algorithm terminates at the end of the month, the staff is rotated. Suppose we have  $b = \frac{274}{3200}$ ; it implies that 274 customers out of 3200 customers that visited a particular Micro finance staff were attended to by a Micro finance staff, A. The process terminates at step 14. This means for staff A to have attended to 274 customers that month out of total of 3200 customers that were attended to in the Micro finance, staff A must be rotated. Also, for  $b = \frac{5}{33}$  the process terminates at step 10. For  $b = \frac{11}{31}$  it stops at step 10. We found out that if we have  $b = \frac{139}{1600}$ , it terminates at stage 19, for  $b = \frac{155}{1600}$  it terminates at stage 36.

#### 5 Conclusions

The algorithm provided in this work will enable the management of the Micro finance staff to rotate their staff.

The rotation of job cannot be influenced by the Micro finance officials.

The Micro finance staff cannot pre-determine when he will be rotated.

Even if the Micro finance staff attends to few or many customers, this does not determine the rotation.

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