

A Proposal of Application of Mathematics in the Double Entry System of Accounting

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Abstract

Luca Pacioli is the initiator of double entry system and he was Professor of Geometry (university of Pisa Italy) but it is wonder that he could not use in mathematics in accounting. He introduced this system by changing certain basic rules of Mathematics and proved his wisdom in 1494 (A.D). Writing number in alphabets was in vogue in Europe, India, Arab and many other countries all over the world in accounting system before the invention of decimal system of Al Karezme (towards 8th century). We all know that, there was no '0' (zero), + or (-) sign in alphabetical accounting system such as Roman number I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XIII and in our country Kara, Ganda, Kia, Sata kia, chok. Unfortunately, we are using the decimal system in accounting but in case of addition and subtraction using the word debit and credit instead of + and (-). As a result, accounting has become a complex and abstruse subject. If debit and credit are excluded from the Accounting and the Mathematical addition and subtraction rules are adopted in accounting, it will be easier than traditional Debit-Credit system.

Key Words: *debit, credit, accounting*

Introduction

We all know the rules of addition but have we ever thought of their limitations? Very few people can satisfy these common questions. Our limitation lies in our observation. What we see or observe is analyzed by our brain at the rate of $\frac{1}{1000}$ per second or less than that, and instructs the relevant sense organs. Therefore, the formula comes 'wrong observation or understanding, wrong instruction.' It results in failure. Now what's the way out? In fact, the failure lies in observation and understanding. It is therefore certain that observing, thinking properly, and the correct relation between these will lead us to success. For instance, if a mango tree in a garden is observed by students of Botany, it will lead him to think of Photosynthesis growth, *flowering* and the species; if it is observed by a timber merchant, he will calculate total C.F.T of wood and the profit thereof; if it is seen by a poet, he will narrate its beauty and if it is seen by an environmentalist he will think of its preservation. In fact, the realization by persons is different and in history immortal are those who realize the truth. Such is the case with Scientist Newton who invented the "Law of Gravitation" by observing the fall of an apple from a tree (Hussain 2002).

The above instance is for us to follow the correct view of success of our studies. Luca Pacioli (1445-1517 A.D) was a professor of geometry in University of Pisa (Italy) and a cleric in the church (Shamim 2002).

He is called the father of "Double Entry System" in accounting but it is a wonder that he could not use Mathematics in Accounting. In 1494 he introduced some basic rules of accounting and become the father of double entry system. The question is the accounts of the Landlords, the Merchants and Kings, their wealth not kept or maintained before that? How the interests and profit due to transactions were added or subtracted in those days? Was there no system of keeping accounting in personal, social and community life or even in state affairs? There was certainly a system as history testifie it. So why should we consider Luca De Pacioli

as the father of accounting? Rather he may be called the father of the double entry system. "Luca Pacioli realized the truth that due to transaction two accounts or the interest of two parties were transferred into the equal amount of money or money's worth. He described the writing form of the rules of how the interest of the two parties or account is added or subtracted into equal amount due to transaction which is commonly known to us as double entry system" (Rahman 2003). In introducing this system, he changed certain basic rules of mathematics and proved his wisdom and concept.

Objective

To Prove effectiveness of application of mathematics in the double entry system of accounting.

Objective analysis

Luca de Pacioli, a proponent of debit credit, was a professor of Geometry at the University of Pisa Italy from 1502-1515. He did addition and subtraction by debit credit by omitting the 0, +, - sign. As a result, accounting has become a complex and difficult subject for the students, teachers and general public. Zero Indian invention. The decimal system (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, +, -, \times , \div Algebra) was invented by Abu Abdullah Muhammad Musa Al Khawarezi (781- 847 or 850) of Baghdad in 820 (A.D). Roman numerals were abandoned in Europe in 1583 (A.D) by Gregory XIII and introduce Abdullah's system. Abu Abdullah's decimal system was recognized in 1961 (A.D) all over the world. It can be proved that there are only 16 basic journal entry in Accounting all over the world.

Hypothesis, Research Question and Method of this Article

In 1999, a serious question arose throughout the Europe. The question was whether 1999 was the last year of the century or beginning. This is a big deal. Because the Roman numerals do not have 0, +, (-) sign. The numbers are started "i" and end "x". Therefore, the last year of the century should be 2000, not 1999. From this information hypothesis of this research has been postulated.

Hypothesis: If debit- credit is removed from accounting, then accounting will become easier for everyone.

So where did debit and credit come from? By searching for the answer that the accounting equation (Assets=Liabilities + owner's equity) was actually wrong.

The research is basically library based. Necessary information has been collected from library secondary sources like books, journal, and through online.

Mathematical Analyses of Double Entry System

Where is the difference between addition and subtraction of mathematics and that of accounting? Many student, teachers or common people gets shrink hearing debit and credit since the rules of mathematical addition or subtraction has not been followed fully in the above accounting. Actually, what matters? "To find out the mystery we are to trace back. Abu Abdullah Mohammad Musa Al- Kharezme (Died 847 or 850 A.D at Baghdad (Ali 2022) invented the rules of addition and subtraction. It is recognized by all that Al-Kharezme is the father of Algebra. Algebra is the Latin transcription of "Elmul Zabir wal Mukabila" by Al Kharezme. He is the first who introduced the concept of equation system all over the world and he also invented Decimal system" (Ali 2022).

His rules of addition and subtraction are widely accepted throughout the world till date. The rules are: Rule of addition $++ = + (+)$

(b) Rule of addition $-- = - (+)$

2. (a) Rule of subtraction $+- = -/+ (-)$

(b) Rule of subtraction $-+ = -/+ (-)$

Then why has Luca Pacioli used debit and credit to double entry system instead of + and (-) to find out the interest into the equal amount of money or money's worth between the two parties or account due to transaction? If we look at the history, we found that in Europe Roman number was used at large before the

12th century. The addition and subtraction in Roman number is unlike that of decimal number. Moreover, there is no + or (-) sign in Roman number. Look at the following difference:

I=1, II=2, III=3, IV=4, V=5, VI=6, VII=7, VIII=8, IX=9, X=10, XI=11, XII=12, XXXV =35, XL=40, L=50, LX=60, LXX=70, C=100, M=1000 etc. (Hossain 2003)

The Roman numbers are increased by leaps with the increase of their mathematical value. As there is no + (-) sign in Roman number, before the entrance of decimal system in Europe the word 'Add' or 'Less' used to be written in all business transactions. For example, subtract C=100 From M=1000, they are used to write:

M=1000
Less C= 100
CM =900

Or in order to add they would be written:

M=1000
Add C= 100
MC =900

It is obvious that in Roman number the debit and credit does not mean addition or subtraction (Wilson 1967) It is beyond saying that such writing a large number in Roman makes mathematics outcaste in the world of modern science. By binding a man tightly if we ask him to walk easily, it certainly reveals our silly mind. Similarly with a large quantity of Roman number and our conventional number the development of science is unimaginable. Before the invention of addition and subtraction of Al Kharezme the transactional interest of either parties or account were written in alphabets in equal amount in different countries in the world. Still the rule is prevalent in business transaction. As in country the businessmen write 'add' of their money or money's worth interest increase and 'Less' of their money or money's worth interest decrease. In accounting the word debit and credit mathematically do the same function as addition or subtraction. Institutions of the Florence Bank in Italy for the first time started writing debit in one page and credit in another page in the books of accounts in 1211 A.D (Hossain 2000) However then the debit and credit word did not do the functions of add or less. Evidently it can be said that in Europe in 1211 Roman letters were in vogue and the addition or subtraction in Roman letters were not done by debit and credit.

In the first part of 12th century decimal system gradually entered into Europe. The importance of Italy as a port for trade and commerce increased after 1492. Due to increase in area of trade and commerce, Luca Pacioli came forward to reform the limitations of double entry system.

In our country *Kara, Ganda, Kranti Chohk, Sata Kia* (Mukharzi 1868) were in vogue in business transactions. Perhaps at the end of the British regime or at the very beginning of Pakistan regime decimal system were introduced instead of this conventional accounting system.

Decimal system

The decimal system i.e ; 1,2,3,4,5,6,7,8,9 , 20, ...30.... etc. is the invention of the Arabian by Abu Abdullah Mohammad Musa Al Kharezme (Ali 2022). After 1492 European were widely introduced with the decimal system. But many believe that "0" (Zero) is the invention of Indian. Humans have been for the invention of "0" (Zero) trying for thousands of years.

The invention of decimal system has become easy due to its acquaintance with the Indian mathematics (Gokul 2016). So, it is often regarded as the brain child of the Indian mathematics. Writing numbers in alphabets was in vogue both in Europe and Arabs before the invention of decimal system. During that period in accounting, single entry system and sometimes double entry systems were practiced as addition or subtraction. How ever no + (-) sign were used. Instead, as has already been mentioned. In 1582 Gregory XIII introduced decimal calendar instead of Roman calendar due to its limitations (Sah 2000). As a result, in Europe decimal system got recognition officially. In order to hold up local tradition Luca Pacioli used Al Kharezme's addition and subtraction rules in his double entry system but dropped + (-) sign and adopted the words debit and credit in lieu of addition and deduction.

The book “Hisab Al Kathayem” was translated as “Elchataym” in Europe and Luca Pacioli discussed “Hisab Al Kathayem” in his book “**Suma De –Arithtica Geomatrica Proportioniet Proportionlita**” (Ali 2022). Here is evident that in making double entry system this book helped much. Because in this book so many equations of mathematics have been dealt with. In this connection Luca Pacioli may be called the follower of Al Kharezme. Unfortunately, we are using the decimal system in accounting but in case of addition and subtraction using the word debit and credit instead of + (-). As a result, accounting has become a complex and abstruse subject.

Rules of addition and deduction of Al Kharezmi according to decimal system

Rules of addition:

- First rule:** $+20+20=+40$, i e; same mathematical value/ sign will be the placed before next number which is placed before previous number.
- Second rule:** $-20-20=-40$, i e; same mathematical value/ sign will be placed before next number which is placed before previous number.

Rules of deduction:

Opposite mathematical value / sign of previous number which is placed before it must be placed before next number.

- First rule:** $+50 -30 = +20$.
Here (-) is considered opposite number.
- Second rule:** $-50+30 = -20$.
Here + is considered opposite number.

Everybody learnt these rules in our childhood. How Luca Pacioli used this rule in his book has been discussed here:

Luca Pacioli critically observed that there are four elements in Accounting i,e:

- 1) Assets
- 2) Expenses
- 3) Income
- 4) Liabilities

If first rule of addition is applied in case of Assets and expenses then:

- Mathematical value /sign received from assets = + or debit.
- Mathematical value /sign received from expenses = + or debit.
- So, their mathematical value/sign will be always + or debit.

Now if we want to add any amount with + (Dr) assets and + (Dr) expenses, then in journal assets and expenses account must be given + or (Dr). Otherwise, no addition will be made. When assets and expenses will increase then we add. For example, if we want to add assets worth of Tk 100 with previous assets account which had + Tk 40 balance in journal then that assets account will be given + or debit with Tk 100. Therefore, in ledger the balance of assets account will be $+40+100=+140$. (In this case, Luca Pacioli uses two debits. So total debit balance will be debit Tk 40 and debit Tk. 100= Tk. 140 Dr.

The following journal will be made:

Asset Account +Dr 100
 Another account –Cr 100

In ledger:

+Dr Assets Account

Date	Account titles	+ Dr	–Cr	Dr +Balance(Tk)
	Balance			+40
	Another account	+100		+140

Again, if we want to deduct any amount with + (Dr) assets and + (Dr) expenses then is journal assets and expenses account must be given – or (Cr). Otherwise, no deduction will be made. When assets and expenses will decrease then we deduct. For example, if we want to deduct assets worth of Tk 10 with previous assets account which had + Tk 40 balance in journal then that assets account will be given (–) or credit with Tk 10. Therefore, in ledger the balance of assets account will be $+40 - 10 = +30$. (In this case, Luca Pacioli uses one debit and one other credit. So total

debit balance will be debit Tk 40 and credit Tk 10 = Tk 30 Dr.

The following journal will be made;

Another Account +Dr 10
 Asset account –Cr 10

In ledger:

+Dr Assets Account				
Date	Account titles	+ Dr	–Cr	Dr+Balance(Tk)
	Balance			+40
	Another account		–10	+30

In accounting, Rules followed by expense is as same as assets.

If second rule of addition is applied in case of liabilities and income then:

Mathematical value /sign received from liabilities = (–) or credit.

Mathematical value /sign received from income = (–) or credit.

So, their mathematical value/sign will be always (–) or credit

Now if we want to add any amount with (–) Cr. liabilities and (–) Cr income then is journal liability and income account must be given (–) or Cr. Otherwise no addition will be made. When liability and income will increase then we add. For example, if we want to add liability worth of Tk 100 with previous assets account which had (–) CrTk 40 balance in journal then that liability account will be given (–) or credit with Tk 100. Therefore, in ledger the balance of liability account will be $-40 - 100 = -140$. (In this case, Luca Pacioli uses two credits. So total credit balance will be credit Tk 40 and credit Tk 100 = Tk.140 Cr.

The following journal will be made;

Another account +Dr 100
 Liability account –Cr 100

In ledger

–Cr Liability Account				
Date	Account titles	+ Dr	–Cr	– (Cr) Balance (Tk)
	Balance			–40
	Another account		–100	–140

Now if we want to deduct any amount with (–) Cr liabilities and (–) Cr income then is journal liability and income account must be given + or Dr. Otherwise no deduction will be made. When liability and income will decrease then we deduct. For example, if we want to deduct liability worth of Tk 10 with previous assets account which had (–) CrTk 40 balance in journal then that liability account will be given + or debit with Tk 10. Therefore, in ledger the balance of liability account will be $-40 + 10 = -30$. (In this case, Luca Pacioli uses one credit and one debit. So total credit balance will be credit Tk 40 and debit Tk 10 = Tk 30 Dr.

The following journal will be made:

Liability Account +Dr 10
 Another account –Cr 10

In ledger

–Cr Liability Account				
Date	Account titles	+ Dr	–Cr	Cr–Balance (Tk)
	Balance			–40
	Another account	+10		–30

In Accounting, Rules followed by income is as same as liability.

Why did Luca Pacioli make addition and deduction through journal?

Now look the demerit of addition and deduction in Al Kharezme:

$$+100+400+500+400+600=+2,000$$
$$-400-800-300-100-400=-2,000$$

We don't know why we make this addition. In future chaos may be arisen among interested parties for transaction. So, in order to remove the problem of addition and deduction of mathematics, Luca Pacioli introduced journal for increasing and decreasing interest due to transaction. Luca Pacioli identified that a transaction is involved with two set of account or parties.

If the first rules of addition are applied in assets and expenses and second rules are applied in income and liability, the following mathematical value will be obtained;

$$+ (\text{Dr}) \text{ Assets} \quad - (\text{Cr}) \text{ Liability}$$
$$+ (\text{Dr}) \text{ Expenses} \quad - (\text{Cr}) \text{ Income}$$

If any financial changes occur in interested parties or account for transaction, then addition will be made with one party or account and deduction will be made with another party or account. **It is remembered that, Increase = Add and Decrease = Deduct**

Rule-1 When expense increases and asset decreases by a transaction, we should have to subtract from asset and add to expense following basic journal entry will be made:

$$\text{Increased expense +Dr.}$$
$$\text{Decreased asset -Cr.}$$

Rule-2 When expense decreases and asset increase by a transaction, we should have to subtract from expense and add with asset following basic journal entry will be made:

$$\text{Increased asset +Dr.}$$
$$\text{Decreased expense -Cr.}$$

(N.B One transaction never at the same time has addition with asset and addition with expense. Oppositely one transaction never at the same time has addition with income and addition with liability.)

Rule-3 When income increase and liability decreases by a transaction, we should have to subtract from liability and add with income following basic journal entry will be made:

Decreased liability +Dr.

$$\text{Increased income -Cr.}$$

Rule-4 When income decrease and liability increases by a transaction, we should have to subtract from income and add with liability following basic journal entry will be made:

$$\text{Decreased income +Dr.}$$
$$\text{Increased liability -Cr.}$$

Rule-5 When assets increases and liability increases by a transaction, we should have to add with both asset and liability following basic journal entry will be made:

$$\text{Increased asset +Dr.}$$
$$\text{Increased liability -Cr.}$$

Rule-6 When assets decrease and liability decreases by a transaction, we should have to subtract from asset and liability following basic journal entry will be made:

$$\text{Decreased liability +Dr.}$$
$$\text{Decreased asset -Cr.}$$

Rule-7 When income increases and asset increases by a transaction, we should have to add with both income and asset following basic journal entry will be made:

$$\text{Increased asset +Dr.}$$
$$\text{Increased income -Cr.}$$

Rule-8 When Income decreases and asset decreases by a transaction, we should have to subtract from both income and asset following basic journal entry will be made:

$$\text{Decreased income +Dr.}$$

Decreased asset–Cr.

Rule-9 When increases an asset and another asset decreases by a transaction, we should have to subtract from decreased asset and add with increased asset following basic journal entry will be made:

Increased asset +Dr.

Decreased asset–Cr.

Rule-10 When decreases an expense and another expense increases by a transaction, we should have to subtract from decreased expense and add with increased expense following basic journal entry will be made:

Increased expense +Dr.

Decreased expense–Cr.

Rule-11 When decreases an income and another income increases by a transaction, we should have to subtract from decreased income and add with increased income following basic journal entry will be made:

Decreased income +Dr.

Increased income–Cr.

Rule-12 When decreases a liability and another liability increases by a transaction, we should have to subtract from decreased liability and add with increased liability; following basic journal entry will be made:

Decreased liability +Dr.

Increased liability–Cr.

Rule-13 When an expense increases and a liability increases by a transaction, we should have to add with both expense and liability following basic journal entry will be made:

Increased expense +Dr.

Increased liability–Cr

Rule-14 When an expense decreases and a liability decreases by a transaction, we should have to subtract from both expense and liability basic journal entry is to be,

Decreased liability +Dr.

Decreased expense–Cr.

Rule-15 When an expense increases and an income increases by a transaction, we should have to add with both expense and liability following basic journal entry will be made:

Increased expense +Dr.

Increased income–Cr.

Rule-16 When an expense decreases and an income decreases by a transaction, we should have to subtract from both expense and income following basic journal entry will be made:

Decreased income +Dr.

Decreased expense –Cr.

There is no addition and subtraction in accounting other than these sixteen types of addition and subtraction. These rules are regarded either as rules of + Dr, –Cr or Golden Rules of Accounting.

In brief these rules are as follows:

Increase	Decrease
Assets Increase + Dr.	Assets Decrease –Cr
Expense Increase +Dr.	Expense Decrease –Cr
Income increase – Cr.	Income Decrease +Dr.
Liability Increase –Cr.	Liability Decrease +Dr.

Concluding Remarks

The addition and subtraction which are made to ledger on the basis of journal +Dr and –Cr. Analysis of two-fold aspect is meant mathematically the rules of + and (–) by which the changeable interest of addition

and subtraction are made to ledger. The mathematical rules of addition and subtraction are closely related to expense, assets, income and liability. It is essential to know about the four above mentioned asset, expense, income and liabilities in order to acquire the rules of mathematical $++ = + (+)$ and $-- = - (+)$.

If traditional debit and credit are excluded from accounting, the additional advantages which we get are as follows:

1. We do not have to teach the computer about that debit means + and credit means (-).
2. The phobia of debit and credit will be eliminated from mass people.
3. We will be free from addition and subtraction with alphabet.
4. Journal entry will be easier. So common people of little knowledge can acquire accounting literacy.
5. There will be no difference between the golden rules of accounting and the mathematical rules of addition and subtraction.
6. There will be no difference between accounting equation and journal and ledger.

References

Ali MA. [Internet].2022. The Contribution of Muslims in Science; [cited 2023 october 23]. Available from: [http:// www.banglanet.com](http://www.banglanet.com)

Gokul S. 2016. Accounting Theory and Management. Calcutta, India. 69p

Hossain H. 2000. Advanced accounting. Chittagong: Saikat prokasoni.51p.

Hussain SMZ. 1999.The Rape of Darkness. Dhaka: Rohel Publication. 1p.

Hussain SMZ. 2002. The Beauty of Mathematics. Dhaka: Rohel Publication.p.9-13.
Bangladesh

Mukharzi NM.1868. Nobo Dara pat. Calcatta India.2p.

Rahman M. 2003.Basic Accounting. Kushtia: Publicacation.104p.

Shamim M. 2002. History of Accounting. Dhaka: Life publisher.4p.

Sah SM.1987.The History of Month of Moon. Dhaka: Islamic foundation.12p.

Wilson JD.1967. Elementary Mathematics a Modern Approach. New York: Mc Graw Hill.40p.

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