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Portfolio Selection on Some Insurance Companies (Aiico, Linkage, Niger, Mutual Benefit and Lasaco) Using Current Ratio

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ABSTRACT: This study investigate non-linear programming problem and its application to portfolio management. The data of return on asset of five different insurance companies namely: AIICO, LINKAGE, NIGER, MUTUAL BENEFIT, and LASACO insurance companies were collected between 2008 to 2017 and a model was fixed. These data were analyzed using quadratic programming in conjunction with LINDO software. It shows that all current ratioof the insurance companies (Linkage, Niger, Mutual Benefit, LASACO and AIICO) contribute to the investor's return. The result revealed that for a good product mixed, 24% of investor's capital should be invest on Linkage insurance company, LASACO insurance company, Niger insurance company , AIICO insurance company and remaining 4% should be allocated in Mutual Benefit insurance company, so as to maximize the investor's return.

KEYWORDS: Quadratic programming; current ratio; insurance companies; funds; investment and allocation.

I. INTRODUCTION

It is fast becoming a major means of getting profit by investing money in different securities, namely Quadratic programming (QP) is the process of solving a special type of mathematical optimization- problem specifically a (linearly constrained) quadratic optimization problem, problem of optimizing (minimizing or maximizing) a quadratic function of several variables subject to linear constraints on these variables. Quadratic programming is a particular type of nonlinear programming [1],[2],[11].

An example of a quadratic function is $2x_1^2 + 3x_2^2 + 4x_1x_2$ where x_1, x_2, x_3 are decision variables. A widely used QP problem is the Markowitz mean – variance portfolio optimization problem, where the quadratic objective is the portfolio variance (sum of the variances and covariance of individual securities), and the linear constraints specify a lower bound for portfolio return[7].

The current ratio is a liquidity ratio that measures whether a firm has enough resources to meet its short-term obligations. It compares a firm's current assets to its current liabilities [10],[9].

The current ratio is an indication of a firm's liquidity. Acceptable current ratios vary from industry to industry. In many cases, a creditor would consider a high current ratio to be better than a low current ratio, because a high current ratio indicates that the company is more likely to pay the creditor back. Large current ratios are not always a good sign for investors. If the company's current ratio is too high it may indicate that the company is not efficiently using its current assets or its short-term financing facilities.

II. LITERATURE REVIEW

Portfolio is a collection or an aggregation of investments tools such as stocks, shares, mutual funds, bonds, cash etc. It also indicate that the decision of future yet unknown is premise on the information gotten from the past. [3] used return on invested Capital to investigate how much Dangote can invest on three of his subsidiaries Viz. Dangote Cement, Dangote Sugar refinery and Dangote Flour given an amount available to him. Although, [4], in his PhD thesis was looked at various tools of decision making but he left out the issue of using turnover as a trial to make decision for future investment [5] was used dividend payout ratio as a determinant to investigate how to make selection of Bank shares in three different Banks, which are Zenith Bank, Guaranty Trust Bank plc, and First Bank plc.[6] worked on bonus share as a determinant for portfolio selection of Bank shares in three different Banks, which are Zenith Bank plc, Guaranty Trust Bank plc and First Bank Nigeria plc. Also, in this work, five (5) different

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insurance companies was used which includes AIICO Insurance Company, Linkage Insurance Company, LASACO Insurance Company, Niger Insurance Company and Mutual Benefit Insurance Company to investigate the percentage of investment on each company's current ratio.

III. METHOD OF DATA COLLECTION

For the purpose of this study, abstraction from established published sources was used. The data used in this study has already been in existence but were extracted and it is explained briefly below.

Table 1: **shows the percentage of current invested**

Insurance company	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
AIICO	23.54	44.12	57.33	59.86	63.84	53.02	56.75	40.36	65.48	60.99
LINKAGE	38.52	44.12	46.60	48.72	45.19	46.68	40.6	37.16	53.14	54.72
MUTUAL BENEFIT	40.81	44.32	54.73	54.27	52.45	52.72	51.2	53.32	62.27	56.87
NIGER	38.14	40.23	48.57	49.89	50.21	47.96	48.80	48.81	50.28	46.08
LASACO	20.33	35.12	37.23	44.65	37.77	32.50	29.77	27.22	45.65	43.08

IV. DATA ANALYSIS

An investor has fixed sum of money say K , to invest in five (5) insurance companies namely; Linkage, Mutual Benefit, Niger, AIICO and LASACO.

The Portfolio problem is to determine how much money the investor should allocate to each insurance company so that total expected return is greater than or equal to some lowest acceptable amount say T, and so that the total variance of future payment is minimized.

Let X_1, X_2, X_3, X_4, X_5 designate the amount of money to be allocated to Linkage insurance company, Mutual Benefit insurance company, Niger insurance company, AIICO insurance company, and LASACO insurance company respectively and let X_{is} denote the return per naira invested from invested from the investment i (i = 1, 2, 3, 4, 5) during the S period of time in the past (S = 1, 2, 3, … 10). If the past history on return on asset is indicative of future performance, the expected future return per Naira from investment 1, 2,3,4,5 is

$$E_i = \frac{\sum_{s=x1}^{10} \text{bis}}{10}$$

And the expected return from five investments combines is

$$E = E_1X_1 + E_2X_2 + E_3X_3 + E_4X_4 + E_5X_5$$

The portfolio problem modeled as quadratic programming is Min $R = A^TCA$

Subject to: $X_1 + X_2 + X_3 + X_4 + X_5 = N$

$$E\,X_1 + E\,X_2 + E\,X_3 + E\,X_4 + E\,X_5 \geq K$$

$X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$, $X_4 \geq 0$, $X_5 \geq 0$, where **C** is the covariance matrix which is positive semi – definite that is

$$\begin{pmatrix} 169.029 & 55.2967 & 66.355 & 44.394 & 90.523 \\ 55.297 & 33.402 & 24.477 & 8.340 & 42.019 \\ 66.355 & 24.477 & 38.117 & 22.233 & 37.976 \\ 44.394 & 8.340 & 22.233 & 18.266 & 19.043 \\ 90.523 & 42.019 & 37.976 & 19.043 & 65.859 \end{pmatrix}$$

Expected returns of Current ratio for each insurance company were $52.53X_1$, 45.55 X_2, $52.30X_3$, $46.90X_4$, $35.33X_5$ respectively. The budget constraint investment portfolio optimization problem has five candidate assets (X_1, X_2, X_3, X_4, X_5) for our portfolio.

A. MODEL

In order to determine what fraction should be devoted (or of the Current ratiothat the investor should have) to each insurance company, so an expected return of at least 25% (equivalently, a growth factor 1.25) is obtained while minimizing the variance in return and not exceeding a budget constraint. Also impose a restriction that any given assets can constitute at most 25% of the portfolio. The variance if the entire portfolio is;

$R = 169.029X_1^2 + 33.402X_2^2 + 38.117X_3^2 + 18.266X_4^2 + 65.859X_5^2 + 55.297X_1X_2 + 66.355X_1X_3 + 44.394X_1X_4 + 90.523X_1X_5 + 24.477X_2X_3 + 8.340X_2X_4 + 42.019X_2X_5 +$

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$22.233X_3X_4 + 37.976X_3X_5 + 19.043X_4X_5 + (X_1 + X_2 + X_3 + X_4 + X_5 - 1)$

Subject to: $X_1 + X_2 + X_3 + X_4 + X_5 = 1$

Since variance is a measure of risk, need to be minimize, hence

MIN R $=169.029X_1^2 + 33.402X_2^2 + 38.117X_3^2 + 18.266X_4^2 + 65.859X_5^2 + 55.297X_1X_2 + 66.355X_1X_3 + 44.394X_1X_4 + 90.523X_1X_5 + 24.477X_2X_3 + 8.340X_2X_4 + 42.019X_2X_5 + 22.233X_3X_4 + 37.976X_3X_5 + 19.043X_4X_5$

Subject to:

! We start with #1.00

$X_1 + X_2 + X_3 + X_4 + X_5 = 1$

! We want to end with at least #1.20

$52.53X_1 + 45.55 X_2 + 52.30X_3 + 46.90X_4 + 35.33X_5 \geq 1.20$

! No asset may constitute more than 25% of the portfolio

$X_1 < 0.25$

$X_2 < 0.25$

$X_3 < 0.25$

$X_4 < 0.25$

$X_5 < 0.25$

The LINDO software was used to create the Lagrangian expression. The input procedure for LINDO required the model to be converted to the Linear form by written to obtain first order condition introduce Lagrangian multiplier for each constraint. There were seven (7) constraints, seven (7) dual variables devoted was used respectively as UNITY, RETURN, X_1FRAC, X_2FRAC, X_3FRAC, X_4FRAC, X_5FRAC.

The Lagrangian expression corresponding to the model is

MIN R $(X_1, X_2, X_3, X_4, X_5) = 169.029X_1^2 + 33.402X_2^2 + 38.117X_3^2 + 18.266X_4^2 + 65.859X_5^2 + 55.297X_1X_2 + 66.355X_1X_3 + 44.394X_1X_4 + 90.523X_1X_5 + 24.477X_2X_3 + 8.340X_2X_4 + 42.019X_2X_5 + 22.233X_3X_4 + 37.976X_3X_5 + 19.043X_4X_5 + (X_1 + X_2 + X_3 + X_4 + X_{5-1})$ UNITY $+ [1.20 - (52.53X_1 + 45.55 X_2 + 52.30X_3 + 46.90X_4 + 35.33X_5)$RETURN $+ (X_1 - 0.25) X_1$ FRAC $+ (X_2 - 0.25) X_2$ FRAC $+ (X_3 - 0. 25) X_3$ FRAC $+ (X_5 - 0.25) X_5$ FRAC

Next compute the first order conditions

$\frac{\partial R}{\partial X1} = 32.058X_1 + 55.297X_2 + 66.355X_3 + - 44.394X_4 + 90.523X_5 +$ UNITY $-$ 52.53 RETURN $+ X_1$ FRAC > 0

$\frac{\partial R}{\partial X2} = 66.80X_2 + 55.297X_1 + 24.477X_3 + 8.340X_4 + 42.019X_5 +$ UNITY $-$ 45.55 RETURN $+ X_2$ FRAC > 0

$\frac{\partial R}{\partial X3} = 76.234X_3 + 66.355X_1 + 24.477X_2 - 22.233X_4 - 37.97X_5 +$ UNITY $-$ 52.30 RETURN $+ X_3$ FRAC > 0

$\frac{\partial R}{\partial X4} = 36.532X_4 - 44.394X_1 - 8.340X_2 + 22.233X_3 + 19.043X_5 +$UNITY $-$ 46.90 RETURN $+ X_4$ FRAC > 0

$\frac{\partial R}{\partial X5} = 36.532X_4 - 44.394X_1 - 8.340X_2 + 22.233X_3 + 19.043X_5 +$UNITY $-$ 46.90 RETURN $+ X_4$ FRAC > 0

$\frac{\partial R}{\partial UNITY} = X_1 + X_2 + X_3 + X_4 + X_5 - 1$

$\frac{\partial R}{\partial RETURN} = 1.19 - (E_1 X_1 + E_2 X_2 + E_3 X_3 + E_4 X_4 + E_5 X_5)$

Summing all the real constraints

$X_1 + X_2 + X_3 + X_4 + X_5 =1$

$52.53X_1 + 45.55 X_2 + 52.30X_3 + 46.90X_4 + 35.33X_5 \geq 1.20$

$X_1 < 0.25$

$X_2 < 0.25$

$X_3 < 0.25$

$X_4 < 0.25$

$X_5 < 0.25$

The final model is

Min $X_1 + X_2 + X_3 + X_4 + X_5 +$ UNITY + RETURN $+ X_1$FRAC$+ X_2$ FRAC $+ X_3$FRAC $+ X_4$FRAC $+ X_5$ FRAC

! FIRST ORDER CONDITION FOR X_1:

$32.058X_1 + 55.297X_2 + 66.355X_3 + - 44.394X_4 + 90.523X_5 +$ UNITY $-$ 52.53 RETURN $+ X_1$ FRAC > 0

! FIRST ORDER CONDITION FOR X_2:

$66.80X_2 + 55.297X_1 + 24.477X_3 + 8.340X_4 + 42.019X_5 +$ UNITY $-$ 45.55 RETURN $+ X_2$ FRAC > 0

! FIRST ORDER CONDITION FOR X_3:

$76.234X_3 + 66.355X_1 + 24.477X_2 - 22.233X_4 - 37.97X_5 +$ UNITY $-$ 52.30 RETURN $+ X_3$ FRAC > 0 ! FIRST ORDER CONDITION FOR X_4:

$36.532X_4 - 44.394X_1 - 8.340X_2 + 22.233X_3 + 19.043X_5 +$UNITY $-$ 46.90 RETURN $+ X_4$ FRAC > 0

! FIRST ORDER CONDITION FOR X_5:

$36.532X_4 - 44.394X_1 - 8.340X_2 + 22.233X_3 + 19.043X_5 +$UNITY $-$ 46.90 RETURN $+ X_4$ FRAC > 0

! …………. Start of "real" constraints…………

! Budget Constraint, Multiplier is UNITY.

$X_1 + X_2 + X_3 + X_4 + X_5 = 1$

! ……….Growth constraint, Multiplier is RETURN:

$52.53X_1 + 45.55 X_2 + 52.30X_3 + 46.90X_4 + 35.33X_5 > 1.20$

!MAX Fraction of X_1 multipliers is X_1 FRAC:

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$X_1 < .25$
!MAX Fraction 0f X_2 multipliers is X_2 FRAC:
$X_2 < .25$
!MAX Fraction 0f X_3 multipliers is X_3 FRAC:
$X_3 < .25$
!MAX Fraction 0f X_4 multipliers is X_4 FRAC:
$X_4 < .25$
!MAX Fraction 0f X_5 multipliers is X_5 FRAC:
$X_5 < .25$
END
QCP 7

A. **Results Obtained Using Lindo Software**

AT 20%
LP OPTIMUM FOUND AT STEP 0
OBJECTIVE FUNCTION VALUE
1) 1.000000

VARIABLE	VALUE	REDUCED COST
X1	0.200000	0.000000
X2	0.200000	0.000000
X3	0.200000	0.000000
X4	0.200000	0.000000
X5	0.200000	0.000000
UNITY	0.000000	1.000000
RETURN	0.000000	1.000000
X1FRAC	0.000000	1.000000
X2FRAC	0.000000	1.000000
X3FRAC	0.000000	1.000000
X4FRAC	0.000000	1.000000
X5FRAC	0.000000	1.000000

NO. ITERATIONS = 0

AT 21%
LP OPTIMUM FOUND AT STEP 0
OBJECTIVE FUNCTION VALUE
1) 1.000000

VARIABLE	VALUE	REDUCED COST
X1	0.210000	0.000000
X2	0.210000	0.000000
X3	0.160000	0.000000
X4	0.210000	0.000000
X5	0.210000	0.000000
UNITY	0.000000	1.000000
RETURN	0.000000	1.000000
X1FRAC	0.000000	1.000000
X2FRAC	0.000000	1.000000
X3FRAC	0.000000	1.000000

NO. ITERATIONS = 0

AT 22%
LP OPTIMUM FOUND AT STEP 0
OBJECTIVE FUNCTION VALUE
1) 1.000000

VARIABLE	VALUE	REDUCED COST
X1	0.210000	0.000000
X2	0.210000	0.000000
X3	0.160000	0.000000
X4	0.210000	0.000000
X5	0.210000	0.000000
UNITY	0.000000	1.000000
RETURN	0.000000	1.000000
X1FRAC	0.000000	1.000000
X2FRAC	0.000000	1.000000
X3FRAC	0.000000	1.000000
X4FRAC	0.000000	1.000000
X5FRAC	0.000000	1.000000
X1FRAX	0.000000	0.000000

NO. ITERATIONS = 0

AT 23 %
LP OPTIMUM FOUND AT STEP 0
OBJECTIVE FUNCTION VALUE
1) 1.000000

VARIABLE	VALUE	REDUCED COST
X1	0.230000	0.000000
X2	0.230000	0.000000
X3	0.230000	0.000000
X4	0.080000	0.000000
X5	0.230000	0.000000
UNITY	0.000000	1.000000
RETURN	0.000000	1.000000
X1FRAC	0.000000	1.000000
X2FRAC	0.000000	1.000000
X3FRAC	0.000000	1.000000
X4FRAC	0.000000	1.000000
X5FRAC	0.000000	1.000000

NO. ITERATIONS = 0

AT 24%
LP OPTIMUM FOUND AT STEP 0
OBJECTIVE FUNCTION VALUE
1) 1.000000

VARIABLE	VALUE	REDUCED COST
X1	0.240000	0.000000
X2	0.240000	0.000000
X3	0.040000	0.000000
X4	0.240000	0.000000
X5	0.240000	0.000000
UNITY	0.000000	1.000000
RETURN	0.000000	1.000000
X1FRAC	0.000000	1.000000
X2FRAC	0.000000	1.000000
X3FRAC	0.000000	1.000000
X4FRAC	0.000000	1.000000
X5FRAC	0.000000	1.000000
X1FRAX	0.000000	0.000000

NO. ITERATIONS = 0

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V. DISCUSSION OF RESULT

Table 2: The summary of the results for the purpose of comparison and decisions

T	X1	X2	X3	X4	X5	Variance	LP optimum step
1.20	0.200000	0.200000	0.200000	0.200000	0.200000	1.000000	0
1.21	0.210000	0.210000	0.160000	0.210000	0.210000	1.000000	0
1.22	0.220000	0.220000	0.120000	0.220000	0.220000	1.000000	0
1.23	0.230000	0.230000	0.800000	0230000	0.230000	1.000000	0
1.24	0.240000	0.240000	0.400000	0.240000	0.240000	1.000000	0

The increment that yield the minimum percent with mixed investment opportunity is 4%. Hence the optimum solution to the model is X_1= 24%, X_2 = 24%, X_3 = 4%, X_4 = 24%, and X_5 = 24%

VI. CONCLUSION

Portfolio selection of current ratio of the five selected insurance companies in Nigeria was performed using the past financial records of each insurance companies between 2008 to 2017which is ten years precisely. Also, it shows how allocation of available fund by investors should be done to available investment open to investors. This research has addressedthe problem of how much an investor should allocate to each insurance companies in order to minimize risk and maximize return. It was concluded that all current ratioof the insurance companies (Linkage, Niger, Mutual Benefit, LASACO and AIICO) contribute to the investor's return.

From table 2, the result revealed that for a good product mixed, 24% of investor's capital should be invest on Linkage insurance company, LASACO insurance company, Niger insurance company , AIICO insurance company and remaining 4% should be allocated in Mutual Benefit insurance company, so as to maximize the investor's return.

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