ENSURING THE PROFITABILITY AND CONTINUITY OF PRIVATE HEALTH INSURANCE

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Abstract: *Every Insurance undertaking has to do with risk evaluation to ensure that the insurance business is always solvent and continue to exist. Health insurance like life insurance funds and non-life insurance funds must ensure that it remains in business and can discharge their liabilities as at when due. Hence the need to keep adequate reserves or economic capital always. The paper derives the methodology for deriving premiums taking into consideration the incidence of sickness and the medical bills. They are both assumed to follow a normal distribution with known means and standard deviations. The extra liability or reserves that must be kept is shown in a functional relationship. Various probabilities of ruin are used to compute the reserves. The reserves increases from 12.089% of the expected liability for a probability of ruin of 0.25 to 53.562% of normal liability for a probability of ruin of .001. The Insurance provider wants an almost guarantee that ruin or insolvency is impossible it goes for a probability of ruin of 0.001 and reserves is more than half the expected liabilities .*

Keywords*: incidence of sickness, medical claims, normal distribution, variances, probability of ruin and economic reserves, solvency.*

INTRODUCTION

The health sector in any country has been recognized as the primary empire of growth and development (obansa and akingbade, 2014). Therefore the economic reserve for insurance is of great importance.

Insurance providers over the years have had failures because their liabilities exceed their accumulate assets. There is need to forecast on the long term viability of the funds either with profit or without profit to meet its liabilities and also statutory required solvency ratio.

Solvency margin refers to a defined safety margin by which a company's assets must exceed its liabilities. Insurance companies or insurance providers are expected, like any company, to be able to evaluate their risk and ensure measures to adequately mitigate all risks continuously and consistently. A solvency margin acts as an extra guard in the event that risk occurrence exceeds the anticipated range for which measures have been taken; it serve to ensure that when supervisory authority involve their action to liquidate a company, there exist sufficient funds to meet their liabilities.

The paper sets out the expected liabilities and assets build up. There are various techniques for arriving at solvency margin or reserves.

The paper will use the Economic Scenario approach to calculate the economic capital by analyzing the change in the present value of future profits under different assumptions.

LITERATURE REVIEW

The 1970's is deemed the origin of insurance rules in Europe, as this is when the European Union (EU) commission decided on an approach involving two steps i.e. Solvency I and

Solvency II (Doff, 2008, Linder et al, 2004, and Eling et al 2008).

In EU 1973 and 1979 solvency regulation, set out two directives requiring insurers to establish a capital buffer (common minimum standard) to cope with the uncertainty of insurance business, the aim was to detect threats early in insurance firms so as to allow supervisor authorities ensure measure to secure policy holders, Eling and Holz muller (2008) noted that four systems ground the world today can be identified as good examples of different approaches to securing insurance funds as other system can be likened to them; these are the United States (U.S), European Union (E.U), New Zealand and Switzerland. They argued that the U.S. insurance market which as at 2006 held approximately 31% of the world's premium income ($1, 170 billion) has solvency regulation varied between its states. Prior to 1994 they relied on fixed minimum capital standards, however since then their National Aggregation of Insurance Commission (NAIC) developed RBC to ensure a more accurate reflection of size and risk exposure.

METHODOLOGY

We consider four risks in the health insurance liabilities; incidence of frequency of sickness, medical bills per sickness, expense risks and investment return risks.

Liabilities

Let l_x be the number of people aged x in the population, which is assumed to be stationary.

The proportion at age x sick is P_x and is normally distributed with mean μ_{IX} and variance δ^2_{IX},

N (μ_{IX}, δ^2_{IX}).

The medical bills M_x for a life aged x is normally distributed with mean μ_{2X} and variance δ^2_{2X} N(μ_{2X}, δ^2_{2X}).

The overhead expenses incurred that enabled commencement such as buildings is taken as G and yearly operating expenses S_t (including staff salaries) is taken as a function of time to cater for salary escalation.

The expected cost of medical bills for a life aged x is P_xM_x and for all the lives age x, it will be $\sum_{x=0}^{\infty}$ l_x E (P_x) E (M_x)

Let (P_1M_1, P_2M_2…….P_nM_n) denote a random sample of size n from e bivariate normal distribution with probability density function (P, M) and parameters μ_I, μ_2, δ^2_I, δ^2_2, and *P* where e is the correlation between P and M. Let P be the mean P_1, P_2…… P_n and M be mean of M_1, M_2 ,…… M_n. — —

P= $\sum_{x=1}^{n}$ P_i/n ; M = $\overline{\sum_{x=1}^{n}}$ M_i/n

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Using the principles of moment generating function of bivariate normal distribution of P and M has bivariate normal distribution with mean μ_{Ix}, μ_{2x} and correlation coefficient *P*.

The cost of medical bills for all ages = $\sum_{x=0}^{\infty} l_x E(P_x) E(M_x) = \sum_{x=0}^{\infty} C_n \mu_{1x} \times \mu_{2x}$.

Overhead expenses which is taken as a H is amortized over 10 years. Hence yearly cost is 0.1H. Operating expenses is taken as S_t which is function of t, time. Taking r% as the loading for profit and k% for contingencies.

Our Premium for all age x for each year.

$$\text{Prem} = \frac{(1+k+r)\{\sum_{x=0}^{\infty} l_x \mu_{1x} \times \mu_{2x} + 0.1H\}}{\sum_{x=0}^{\infty} l_x}$$

At 95% confidence, the incidence of sickness and medical bills falls into these confidence levels, Z = 1.96

$\mu_{1x} \pm Z\,\delta^2_{Ix}$ and $\mu_{2x} \pm Z\,\delta^2_{2x}$.

If we introduce the single premium for the business as a continuity, at time t.

$$\text{Prem}_t = \frac{Z_t (1+i)^{-t}}{\sum_{x=0}^{\infty} l_x} = \frac{Z_t (1+i)^{-x-t}}{\sum l_x (1+i)^{-x}}.$$

Where $Z_t = (1+k+r)(\sum_{x=0}^{\infty} l_x \mu_{1x} \mu_{2x} + S_t + 0.1H)$

At 95% confidence, on the upper limit, liability, Z_t

$Z_t = (1+k+r)\{\sum_{x=0}^{\infty} l_x (\mu_{1x} + Z\,\delta_{Ix})(\mu_{2x} + Z\,\delta_{2x}) + S_t + 0.1H\}$

If operating expenses, S_t is escalating at the rate s per year, $S_t = (1+s)^t$,

$S_t = S(1+s)^t$

$Z_t = (1+k+r)\{\sum_{x=0}^{\infty} l_x (\mu_{1x} + z\,\delta_{Ix})(\mu_{2x} + z\,\delta_{2x}) + S(1+s)^t + 0.1H\}$

The additional liabilities unexpected at any confidence level at time t

$t = (1+k+r)\{\sum_{x=0}^{\infty} l_x (\mu_{1x} Z\,\delta^2_x + Z\,\delta_{1x}\mu_{2x} + Z^2\,\delta_{1x}\delta_{2x}) + S\{(1+S)^t - 1\}$

These unexpected liabilities require reserves set aside to make the health insurance business solvent.

In the language of ruin probability the probability is 0.025 or 2.5% of the times will the reserves for extra liability fail.

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Let F(x) = $1/\sqrt{2\pi}\int_{-\infty}^{x} e^{-1/2t^{2}}\,dt$

F(x)	Z (score)
.999	3.090
.995	2.576
.990	2.326
.975	1.960
.950	1.645
.75	.674

Reserves R_t is a function of $R_t = f(k, r, l_x, z, \delta_{1x}, \delta_{2x}, S, s, t)$.

CASE STUDY

Table 1: Medical Bills

Age Group: Abridged Life Table

	0-9	10-29	30-49	50-69	>70
L_x	90069	86969	80935	63670	18700
Proportion sick per week μ_{1x}	.002	.0015	0.003	.003	.002
Standard deviation of proportion sick δ_{1x}	.0003	.0003	.00025	0.000032	.00041
Medical bill per week μ_{2x}	5, 000	7, 200	5, 500	5100	2000

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Standard deviation of medical bill δ_{2x}	750 27.386	620 24.899	515 22.694	500 22.361	320 17.889

S: operating expenses is taken as ₦2million per week and salary escalation is taken as s/52 per week and s is taken as 6%.

Loading, k is 10% and loading for profit r is taken 15%

Extra liability is EZ_t at time t

$EZ_t = (1+ k + r) \{\sum_{x=0}^{\infty} l_x (z\mu_{1x}\delta_{2x} + z\, \mu_{2x}\, \delta_{1x} + z^2\, \delta_{1x}\, \delta_{2x}) + S\, \{(1+S)^t-1\}$.

Normal liability that equates present value of assets at

$NL = (1+ k + r) \{\sum_{x=0}^{\infty} l_x\mu_{1x}\, \mu_{2x}+S_t + 0.1H\}$

From the level study

Normal liability = 4272243

Table 2: Economic Reserves.

F(x)	Probability of Ruin	Z score	Economic Reserves	Percentage of Liability
.999	.001	3.090	2, 288, 300	53.562
.995	.005	2.576	1, 878, 748	43.976
.990	0.01	2.326	1, 688, 800	39.530
.0975	0.025	1.96	1, 401, 353	32.801
0.950	0.05	1.645	1, 184, 596	26.558
.75	0.25	0.674	516, 443	12.089

The economic reserve to be kept is 12.089% of the normal liability at time 0 for a probability of ruin of .25. The economic reserve for a probability of ruin of .05 is 26.558% of normal liability. It rises to 53.562% for economic reserves of the normal liability for a probability of ruin of .001. Thus, there is a chance of 1, in 100 that when the economic reserve is 53.562% of normal liability, the health insurance programme can become insolvent. This can arise because of increment in the incidence of sickness and medical expenses.

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CONCLUSION

There is need for a health insurance provider to have good estimates of the variables entering into the computations of premium, expectations of liabilities and assets. The probability distribution functions for each variable such as incidence of sickness and medical bills should be ascertained and adequate records of all claims and sickness incidence should be kept. This will enable the health provider to make realistic estimates according to her own experience.

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