A SURVIVAL ANALYSIS OF THE SURRENDER OF LIFE INSURANCE POLICIES OF LIFE INSURANCE COMPANIES IN GHANA

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Outline of Presentation

Statement of the Problem

In recent years, life insurance companies in Ghana have had to grapple with the challenge of policy surrenders, as the rate keeps increasing to unprecedented levels by the day, in spite of the increasing education and awareness to boost the insurance penetration rate, which is currently below two per cent (2%).

Staggering data available indicate that for the period of January to December, 2013, partial and full surrenders/cancellations were in the region of seventy three per cent (73%)

Objectives

1. To use the Kaplan-Meier estimator to estimate the probability of a life insurance policy holder surrendering.

2. To determine the factors causing surrender of life insurance policies using the Cox proportional hazard model.

Methodology

Introduction

The major methods of survival analysis employed in our study are the Kaplan-Meier(product limit) estimator and the Cox proportional hazard model.

Methodology

Definition

The Kaplan-Meier estimator of the survival distribution is given by:

$$\hat{S}(t) = \prod_{t_i \leq t} \left(1 - \frac{d_i}{n_i}\right) \tag{1}$$

The variance of the estimator is given by the Greenwood's formula:

$$Var\left(\hat{S}(t)\right) = \left(\hat{S}(t)\right)^2 \sum_{t_j \leq t} \frac{d_j}{n_j(n_j - d_j)} \tag{2}$$

Assumptions Of The Kaplan-Meier Estimator

- There is presence of non-informative censoring.
- If a censored event occurs on an event time ,t_j then we assume that the event of interest occurred before the censored event

Methodology

Definition

According to the Cox PH model, the hazard function for life i at time t, denoted by $\lambda(t, \underline{z}_i)$, is given by:

$$\lambda(t, \underline{z}_i) = \lambda_0(t) \times exp(\underline{\beta}.\underline{z}_i^T) = \lambda_0(t) \times exp\left(\sum_{j=1}^{p} \beta_j \times X_{i,j}\right) \quad (3)$$

Assumptions Of The Cox PH Model

- The hazard function of two groups is proportional over time.
- The log of the hazard function is linear.

Residual Analysis

Definition

If X has the hazard function $\lambda(x|Z)$, then the cumulative hazard $\Lambda(x|Z)$ satisfies exponential(1). The Cox-Snell residual is defined(Cox and Snell,1986) as:

$$r_j = \hat{\Lambda}_0(T_j)\exp(\hat{\beta}' Z_j), j = 1, \ldots n \tag{4}$$

Plot of $\hat{\Lambda}_r(r_j)$ versus r_j will produce a straight line with slope 1 if the Cox model provides a good fit of the data.

Analysis and Results

The Kaplan-Meier Estimate

τ_j	n.risk	n.event	survival
1	73642	961	0.98695
2	72419	3458	0.93982
3	68269	15090	0.73209
4	52107	10457	0.58517
5	40497	7575	0.47571
6	30383	6826	0.36884
7	21171	4594	0.28880
8	15767	3437	0.22585
9	11629	2576	0.17582

τ_j	n.risk	n.event	survival
10	7774	2007	0.13043
11	5490	1466	0.09560
12	3868	1029	0.07017
13	2694	811	0.04904
14	1694	558	0.03289
15	1052	396	0.02051
16	557	190	0.01351
17	298	103	0.00884
18	145	18	0.00774

τ_j	$\hat{S}_{KM}(t)$	$\hat{F}(t)$	$\hat{f}(t)$
1	0.98695	0.01305	0.01305
2	0.93982	0.06018	0.04713
3	0.73209	0.26791	0.20773
4	0.58517	0.41483	0.14692
5	0.47571	0.52429	0.10946
6	0.36884	0.63116	0.10687
7	0.2888	0.7112	0.08004
8	0.22585	0.77415	0.06295
9	0.17582	0.82418	0.05003

τ_j	$\hat{S}_{KM}(t)$	$\hat{F}(t)$	$\hat{f}(t)$
10	0.13043	0.86957	0.04539
11	0.0956	0.9044	0.03483
12	0.07017	0.92983	0.02543
13	0.04904	0.95096	0.02113
14	0.03289	0.96711	0.01615
15	0.02051	0.97949	0.01238
16	0.01351	0.98649	0.007
17	0.00884	0.99116	0.00467
18	0.00774	0.99226	0.0011

Analysis and Results

Interpretation Of Results

Kaplan-Meier estimates indicates that, persons who subscribed to life policies had higher surrender probabilities within their first 3 and 4 years of subscription, with probabilities of 0.20773 and 0.14692 respectively.

The surrender probabilities then decreased marginally within periods 5 and 6 from 0.10946 to 0.10687. From period 6 to 7, there was a sharp decline in the probability to 0.08004. It then decreases steadily through to period 18.

Cox-PH Model

	coef	exp(coef)	z	Pr(>|z|)
age	-1.208e-02	9.880e-01	-24.834	<2e-16
gender1	9.089e-02	1.095e+00	10.735	<2e-16
Income	-7.443e-07	1.000e+00	-0.506	0.6129
dissatisfied. customer1	7.537e-02	1.078e+00	8.882	<2e-16
new.policy1	2.655e-02	1.027e+00	0.655	0.5124
interest. arbitrage1	1.757e-02	1.018e+00	2.115	0.0344
emergency. fund1	1.037e-01	1.109e+00	11.514	<2e-16

Analysis and Results

	coef	exp(coef)	z	p
age	-0.012084	0.987989	-24.84	<2e-16
gender1	0.090841	1.095095	10.73	<2e-16
dissatisfied. customer1	0.074999	1.077883	8.86	<2e-16
interest. arbitrage1	0.017154	1.017302	2.07	0.038
emergency. fund1	0.102740	1.108203	11.57	<2e-16

Analysis and Results

The Final Model

putting in the estimates of the β^s into the final model,

$$\lambda(t|z) = \lambda_0 \exp(-0.012084 age + 0.090841 gender1 + 0.074999 dissatisfaction1 + 0.017154 interestrate1 + 0.102740 emergencyfund1)$$

Cox-Snell Residual Analysis

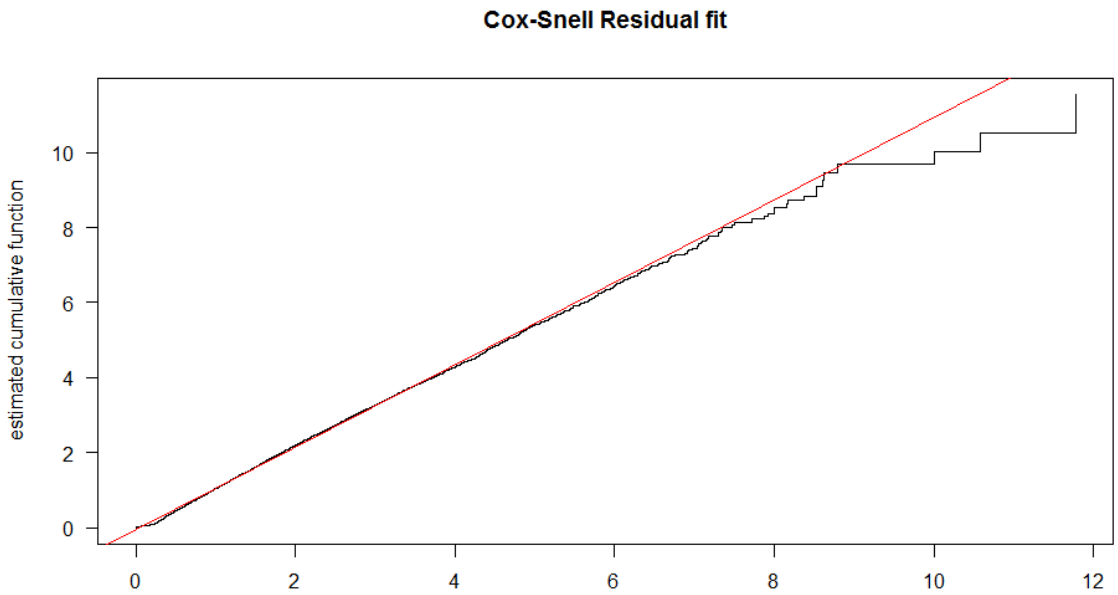

Figure 1: Cox-Snell Residual Plot

Conclusions and Recommendation

Conclusions

- From the analysis, it is observed that the prospect of surrendering of life policies increases during first 3 years from the policy inception date. The highest probability of surrendering of policies occurs at time 3 (years) from the Kaplan-Meier estimates and has a probability value of 0.20773 being approximately 21%.

- From the Cox-PH model, it is found that with the factors considered, it can be inferred that surrender of life policies does not depend on the income level of the the policyholder and subscription onto new policies but on age, gender,policyholder's dissatisfaction with services provided by insurer, need for emergency fund, interest rate arbitrage and other factors that might have not been considered.

Recommendations

- It is recommended that, advertisement and marketing strategies should be geared towards enticing more females to subscribe onto the life policies.
- Insurers are recommended to design life policies that will suit the youth to increase/sustain their retention rate of their polices in the life companies.
- Management should implement measures that would help cater for client needs in respect of areas including response to feed back, grievances, among others.
- Insurers should implement policies that would allow its policyholders who have had their policy in force for some minimum number of years to qualify to apply for policy loans in times of emergency.

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THANK YOU