Stochastic Model for Manpower Loss Due To Absenteeism When Preventive Strategies Are Adopted

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Abstract – The aim of this paper is to estimate the expected time to reach the breakdown point of an organization when some motivational factors are introduced to reduce absenteeism.

Keywords – Manpower loss, cumulative damage model, Motivational factors

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1.Introduction:

Absenteeism is a social phenomenon, an industrial malady and a labour problem.Absenteeism is a cancer retarding industrial growth.The absenteeism develops a considerable loss to the organization because work schedules gets upset and management has to provide overtime wages to meet the delivery dates. In brief, absenteeism saps the growth and efficiency of the industries.

The problem therefore calls for diagnosis and investigaton of the causes particularly from the point of initiating remedial action by the management of industrial undertakings. If the company provides positive incentives to workers in the form of motivational factors that normally influence workers to be absent is better than imposing penalties for discouraging absenteeism then the level of absenteeism will be reduced. The best reward for workers with low absenteeism is to grant additional time off for personal matters.

Several researchers [4,6]studied the relationship between other factual factors and absenteeism. . In [3] Lillie Guinell Morgann and Jeanne Brett Herman studied the perceived consequences of absenteeism. General damage processes are studied by Esary, Marshall and Proschan[2].Ramanarayanan [5] considers a device which is exposed to the cumulative damage process due to occurrence of shocks. Chithrakalarani .T and Yogeswari.A [1] has developed a cumulative damage model to estimate the expected time to reach the uneconomic status of an organization due to successive occurrence of absenteeism of workers. The aim of this paper is to estimate the expected time to reach the uneconomic status of an organization when some motivational factors are introduced to reduce the level of absenteeism.

2.The Model

Assumptions of the Model:

i) Absenteeism occurs at k random epochs and at every epoch there is random number of manpower loss.

ii) Man-hours lost due to the loss of manpower as a result of absenteeism if the motivational factors are not adopted.

iii) The probability of adopting the motivational factors in a single absenteeism epoch is p and q is the failure to use motivational factors so that p+q = 1

iv) The total loss of man-hours exceeds a particular level called the threshold level, the organization reaches the breakdown point or reaches an uneconomic status.

V) The process which generates the absenteeism, the sequence of losses {Xi } and threshold level Y are independent.

3. Notations

X_i - i.i.d. random variable denoting the magnitude of manpower loss due to the i^{th} absenteeism epoch.

Y - The threshold level causing the organization reaches an uneconomic status or breakdown point which is a continuous random variable and is assumed to be exponential with parameter θ .

T - Time to reach the threshold level.

U - random variable representing the time between two successive absenteeism epochs

F(.) - c.d.f of U

f(.) - p.d.f. of U

$V_k(t)$ – probability of exactly k absenteeism epochs in (0,t]

$F_n(.)$ – n fold convolution of F(.)

L(.) - c.d.f of T

L*(.) - Laplace Stieltjes transform of L(.)

W - i.i.d random variable representing the time between two Successive losses

G(.) - c.d.f of W

g(.) – p.d.f of W

G*(.) - Laplace Stieltjes transform of G(.)

4.Results:

The probability that the threshold level is not reached till t is

S(t) = P(T>t)

$$= \sum_{k=0}^{\infty} V_k(t) \, P\left(\sum_{i=1}^{k} X_i < Y\right)$$

$$L(t) = 1 - S(t) \quad \text{.........(1)}$$

Special case:

Assume that the threshold level is exponential with parameter θ.From Ramanarayanan (1976)

$$S(t) = \sum_{k=0}^{\infty} [G_k(t) - G_{k+1}(t)] \, \theta^k$$

From (1)

$$L(t) = \bar{\theta} \sum_{k=1}^{\infty} \theta^{k-1} G_k(t) \quad \text{...............(2)}$$

Taking Laplace Stieltjes transform of L(t) we get

$$L^*(S) = \frac{\bar{\theta} G^*(s)}{(1 - \theta G^*(S))} \quad \text{..................(3)}$$

By [2] the cumulative distribution G(.) of W is

$$G(W) = \sum_{n=1}^{\infty} q(\bar{q})^{n-1} f_n(W) \quad \text{.............(4)}$$

The Laplace Stieltjes transform of G(W)

$$G^*(s) = \sum_{n=1}^{\infty} q(\bar{q})^{n-1} [f^*(S)]^n$$

$$= \frac{q f^*(S)}{[1 - \bar{q} f^*(S)]} \quad \text{............(5)}$$

Substituting (5) in (3) we get

$$L^*(S) = \frac{\bar{\theta} q f^*(S)}{[1 - \bar{q} f^*(S) - \theta f^*(S)]}$$

If F is exponential with parameter λ, then

$$L^*(S) = \frac{\bar{\theta} q \left[\frac{\lambda}{\lambda + S}\right]}{1 - \bar{q}\left(\frac{\lambda}{\lambda} + S\right) - \theta q\left(\frac{\lambda}{\lambda} + S\right)}$$

$$= \frac{\bar{\theta} q \lambda}{\lambda + S - \bar{q}\lambda - \theta q \lambda}$$

$$\text{Mean } \mu_{tA} = \frac{-d}{ds} L^*(S) \Big|_{S=0}$$

$$= \frac{1}{q \lambda \bar{\theta}}$$

This implies that the mean time to reach the breakdown point of an organization in the case of motivational factors are adopted is inversely proportional to the probability of motivational factors are not adopted.This enables to conclude that if the motivational factors such as positive incentives to the workers are adopted the magnitude of the absenteeism will be less and therefore the economic condition of the organization will be fairly sound.

$$\text{Now } \sigma_{tA}^{\,2} = \frac{\mathbf{1}}{\lambda^2 q^2 \bar{\theta} \mathbf{2}}$$

If q = 1 ,then the variance is

$$\sigma_t^{\,2} = \frac{\mathbf{1}}{\lambda^2 \bar{\theta} \mathbf{2}}$$

5.Numerical Illustrations

In this model the mean time to reach the uneconomic status or breakdown point of an organization and variance for the fixed value of θ and variations in q and λ are given in the table 1 and 2.

Table 1

q	Θ = .01			
	λ = 1	λ = 3	λ = 5	λ = 7
0.1	10.1010	3.3670	2.0202	1.443
0.2	5.0505	1.6835	1.0101	0.7215
0.3	3.3670	1.223	0.6734	0.4810
0.4	2.5253	0.8418	0.5041	0.3608
0.5	2.0202	0.67340	0.4040	0.2886
0.6	1.6835	0.5612	0.3367	0.2405
0.7	1.44300	0.4810	0.2886	0.2061
0.8.	1.2626	0.4209	0.2525	0.1804
0.9	1.223	0.3741	0.2245	0.1603

When θ = .01 is fixed, q and λ increases the mean time to breakdown decreases. It can also be observed that the value of the parameter of threshold distribution decreases the meantime to breakdown increases.

Figure 1

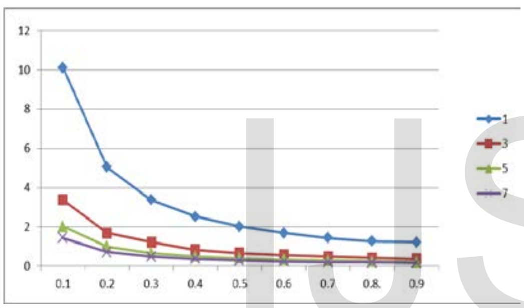
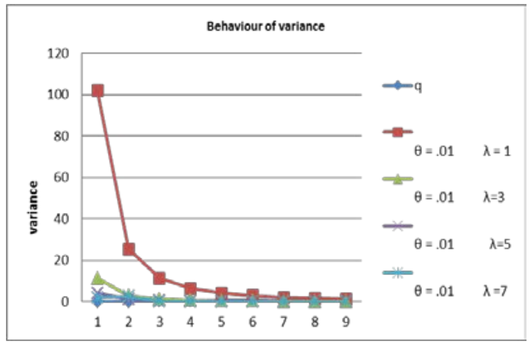


Table 2

q	θ = .01			
	λ = 1	λ=3	λ=5	λ =7
0.1	102.0302	11.3367	4.0812	2.0822
0.2	25.5075	2.8342	1.0203	2.5206
0.3	11.3367	1.2596	0.4535	0.2314
0.4	6.3771	0.7080	0.2551	0.1302
0.5	4.0812	0.4535	0.1632	0.0833
0.6	2.8342	0.3149	0.1134	0.0578
0.7	2.0822	0.2314	0.0833	0.0425
0.8	1.5942	0.1172	0.0638	0.0325
0.9	1.2596	0.1400	0.0504	0.0257

As could be seen from table 2 when θ = .01 is fixed , q and λ increases the variance decreases. It can also be observed that the value of the parameter of threshold distribution decreases the variance increases. The same could also be illustrated through a graph 2. It clearly shows that while the motivational factors such as positive incentives are not adopted the variance of time to breakdown decreases.

Figure 2



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