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## Sequence of threshold in manpower planning through stochastic models

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### Abstract

We propose a stochastic model to study the damage process acting on the organization that is non-linear. So, any statistical model of a complex phenomenon not only need to be an approximation of real world but also has to be addressed to a specific target, to respond a precise question about the phenomenon. The Expected time to reach the threshold in an organization is a vital event in manpower planning. In this paper, statistical model developed to obtain the expected time using Modified Weibull Distribution for reaching threshold level. The simulation results were studied to illustrate the proposed model.

**Keywords:** Manpower planning, Organization, Survival, Stochastic, Threshold

### 1. Introduction

A Manpower structure can conveniently be described as a random dynamic system of stocks and flows. Recruitment is a main activity for every organization, whenever they expand or wants to increase its efficiency or wants to fill up the vacancies that arise in a large amount. Exits of personnel which is in other words known as wastage is an important aspect in manpower planning. Length of service in a grade should necessarily be a natural criterion for promotion in order to create a healthy atmosphere among the employees. Suppose an organization faces the shortage in technical personal that it can be compensates/shared by some of non-technical personnel at certain period because the organization is not to recruit immediately.

### 2. Model Descriptions

The threshold level is represented by a random variable following a Modified Weibull Distribution. At every epoch a random number of persons quit the organization. The organization is exposed to a break down situation when the number of exits of personnel exceeds a "threshold level". The organization takes decisions on revising policies at random times, where the inter-decision times, which are called epochs, are identically independently distributed random variable.

One can see for more detail in <sup>[1, 2]</sup> about the expected time to cross the threshold level of the organization. At a given time  $t$ , the people working in an organization can be classified into groups or categories on the basis of same attribute, such as for example, profession, age, grade or any other form of hierarchy.

### 3. Development of shock model to known the breakdown point

It is observed that the Modified Weibull Distribution <sup>[3]</sup> has decreasing or unimodal probability density function and it can have increasing, decreasing and constant hazard functions.

$$F(x; \alpha, \beta, \gamma) = 1 - e^{-\alpha x - \beta x^\gamma}$$

$$\bar{H}(x) = 1 - F(x) = e^{(-\alpha x + \beta x)^\gamma}, \gamma = 1$$

$$P(X_i < Y) = \int_0^\infty g_k^*(x) e^{(-\alpha x + \beta x)} dx$$

$$= [g^*(\alpha + \beta)]^k$$

$S(t) =$  the survival function ie.,

It may happen that successive shock become increasingly effective in causing damage, even though they are independent. This means that  $V_k(t)$ , the distribution function

of the  $k^{\text{th}}$  damage is decreasing in  $k= 1, 2$ , for each  $t$  [4]. Counting renewal process is been used in equation (1).

$$P(T > t) = \sum_{k=0}^{\infty} V_k(t)P(X_i < Y) \tag{1}$$

$$1 - [1 - g^*(\alpha + \beta)] \sum_{k=1}^{\infty} F_k(t) [g^*(\alpha + \beta)]^{k-1}$$

$F_k(t)$ =Probability that there are exactly 'k' policies decisions in (0,t]

Taking Laplace transform of  $L(T) = 1 - S(t)$ , we get

$$L(T) = [1 - g^*(\alpha + \beta)] \sum_{k=1}^{\infty} F_k(t) [g^*(\alpha + \beta)]^{k-1} \tag{1}$$

let a continuous random variable U denoting inter-arrival time between decision epochs which follows exponential distribution. Now  $f^*(s) = \frac{c}{c+s}$ , substituting in the below equation (3), we get

$$L^*(s) = \frac{[1 - g^*(\alpha + \beta)]f^*(s)}{[1 - g^*(\alpha + \beta)]f^*(s)} \tag{3}$$

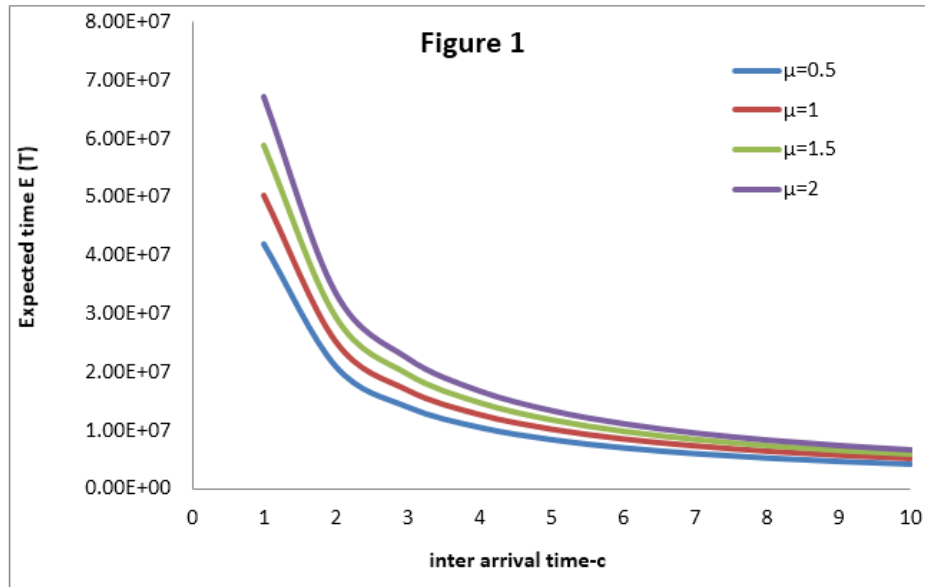
$$\frac{[1 - g^*(\alpha + \beta)] \frac{c}{c+s}}{[1 - g^*(\alpha + \beta)] \frac{c}{c+s}}$$

on simplification, we get

$$\frac{c[1 - g^*(\alpha + \beta)]}{[c + s - g^*(\alpha + \beta)]c} \tag{4}$$

$$g^*(.) \sim \exp(\mu) \qquad g^*(\lambda) \sim \exp\left(\frac{\mu}{\mu + (\alpha + \beta)}\right)$$

$$E(T) = \frac{\mu + (\alpha + \beta)}{c(\alpha + \beta)} \tag{5}$$



**Fig 1:** value of the parameter  $\mu$  increases, the expected time is also found decreasing

#### 4. Conclusion

On the basis of the expressions derived for the expected time the behavior of the change in different parameters is observed in the figure 1.

When  $\mu$  is kept fixed, the inter-arrival time 'c' which follows exponential distribution, is an increasing parameter. Therefore, the value of the expected time  $E(T)$  to cross the threshold of recruitment is decreasing, for all cases of the parameter value  $\mu = 0.5, 1, 1.5, 2$ . When the value of the parameter  $\mu$  increases, the expected time is also found decreasing, is observed in Figure 1.

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