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Manpower Planning Process with Two Groups Using Statistical Techniques

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ABSTRACT: *According to Bartholomew and Forbes (1979 In any organization the required staff strength is maintained through new recruitments. In this paper, we consider the Recruitment model Manpower planning with two groups A and B. Group A consists of manpower other than top management level executives. Group B consists of top management level executives. The shortages of group A occur in accordance with Modified Erlang process and group B has shortage process with varying shortage rates. Recruitment is done to fill all the shortages of the two groups and find the expected time to recruit and recruitment time. Numerical illustrations are presented.*
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KEYWORDS: *Manpower planning, Recruitment, Modified Erlang , Setting the clock back to zero*

I. INTRODUCTION

Employees are the most important asset for a business. They serve to create or promote an organization's culture, and they significantly affect the success of a business. In challenging economic times, the cost of hiring inefficient personnel may prove to be detrimental to the profitability of an organization. An effective and thorough manpower-recruiting process requires an employer to carefully choose the most talented employees who will positively benefit the organization or business.

II. NEED FOR THE STUDY

A needs analysis initiates the manpower recruiting process. This phase entails identifying a vacant position or creating one to meet new needs that have arisen in the organization. this may be an entry mid- or upper-level management position. The employer then develops a job description describing the duties involved with this position. Criteria such as skills and competencies, experience, age, and education that best serve the position are also identified. Using this information, the employer prepares a standard application form to collate information provided by the applicants, in addition to their own resumes. The vacancy is then advertised.

III. REVIEW OF THE LITERATURE

The Manpower Planning Process (MPP) of an organization due to resignation, dismissal and death is called shortage. This shortage, due to the manpower loss, should be compensated by recruitment. But recruitment involves huge cost and hence cannot be made frequently to match the attritions. Hence the MPP is allowed to undergo Cumulative Shortage Process (CSP). The accumulated random amount of shortages due to successive attritions leads to the breakdown of the MPP when the total shortage crosses a random threshold level. The breakdown point or threshold is that point at which immediate recruitment becomes necessary. The shortage of MPP due to manpower loss depends on many factors. Such models have been discussed by Grinold and Marshall [5], Bartholomew and Forbes [7] and Vajda [6]. Statistical approach in manpower planning has been discussed by Bartholomew [1]. Markovian models are designed for shortage and promotion in MPP by Vassiliou [4]. Subramanian. V. [9] has made an attempt to provide optimal policy for recruitment, training, promotion and shortages in manpower planning models. Lesson [8] has given methods to compute shortages and promotion intensities which produce the proportions corresponding to some desired planning proposals. Esary et al. [3] have discussed that any component or device, when exposed to shocks which cause damage to the device, is likely to fail when the total accumulated damage exceeds a level called threshold. Gaver. D.P. [2] has discussed point process problems in Reliability Stochastic point processes.S. Mythili and R. Ramanarayanan have done probabilistic analysis of time to recruit and recruitment time in manpower planning [13]. They have also analysed the same in MPS with two groups [14].

In this paper, we consider MPP with two groups A and B. Group A consists of manpower other than top management level executives, group B consists of top management level executives. Group A is exposed to shortage process which is Modified Erlang. The shortage process of group B has varying short age rates. In this model, we apply a new concept that is slightly modified upon the concept introduced as Setting the Clock Back to Zero by Raja Rao [10] and studied by S. Murthy and R. Ramanarayanan [12]. Sathiyamoorthi. R. and Parthasarathy. S. [11] has found the expected time to recruit when threshold distribution has Setting the Clock Back to Zero property. The shortage rate changes after an exponential time from one rate to another. The time to recruit T is given by T = min{T_1, T_2} where T_1 and T_2 are the times to breakdown of groups A and B respectively. Assuming that the recruitment time R of a shortage is independent of the shortage magnitude, we find the joint Laplace-Stieltjes transform of time to recruit and recruitment time.

IV. OBJECTIVE OF THIS PAPER

1. To analysis recruitment model of Recruitment model Manpower planning with two groups A and B

V. METHODOLOGY

In this paper we used following methodology. Exponential distribution, Laplance-Stieltjies tansformation and Setting the clock back to zero

VI. RESULT AND DISCUSSION

6.1 Assumptions

- Group A is given at the most *k* observation times each with exponential distribution with parameter 'λ' before recruitment. On completion of the first exponential observation time, recruitment is done with probability α , or, the second observation starts with probability β , where $\alpha+\beta=1$. The process is repeated upto *i* observations for $1\le i\le k-1$. On completion of the *k* th observation, recruitment is done with probability = 1. If T_1 is the time to recruit due to group A and X_1;X_2,…….. are the shortages caused by manpower loss in group A, then, $T_1=\sum_{j=1}^{k} X_j$ with probability $\alpha\beta^{k-1}$ for $1\le i\le k-1$ or, $T_1=\sum_{j=1}^{k} X_j$ with probability β^{k-1} Group B has shortage process with varying shortage rates. At time 0, the shortage rate of the group is μ. Let T_2 be the time at which breakdown of group B occurs necessitating immediate recruitment.
- Recruitment for MPP starts if either of the groups A or B has a breakdown. All the shortages due to manpower loss are compensated by recruitment.
- When recruitment is done due to breakdown of group A, recruitment time corresponding to the *i* th observation is R_i, $1\le i\le k$ When the breakdown occurs due to group B, recruitment is done for shortages in group B and also for shortages in group A for the number of observations completed. All the recruitment times are independent and identically and distributed random variables with distribution function R(y) such that $\int_{o}^{y} y\,dR(y)<\infty$.

6.2 Analysis

Based on the assumptions, recruitment starts at time T = min{T_1,T_2}. Identifying the exponential phase time of the modified Erlangian, the pdf of time T_1 is given by

$$f(x)=\alpha e^{-\lambda x}\lambda\sum_{i=0}^{k-2}\frac{(\lambda x)^{i}}{i!}\beta_i+\beta^{k-1}\lambda\frac{(\lambda x)^{k-1}}{(k-1)!}e^{-\lambda x} \qquad (1)$$

$$\frac{\partial^2}{\partial x \partial y} P\left(T \le x, Rt \le y\right) = \left(1 - H(x)\right) \begin{bmatrix} \lambda e^{-\lambda x} \alpha r^{*}(y) + \lambda \dfrac{(\lambda x)}{1!} e^{-\lambda x} \alpha \beta r^{*2}(y) \\ + \lambda \dfrac{(\lambda x)^2}{2!} e^{-\lambda x} \alpha \beta^2 r^{*3}(y) + \ldots\ldots\ldots\ldots \\ + \lambda \dfrac{(\lambda x)^{k-2}}{(k-2)!} e^{-\lambda x} \alpha \beta^{k-2} r^{*(k-1)}(y) \\ + \lambda \dfrac{(\lambda x)^{k-1}}{(k-1)!} e^{-\lambda x} \alpha \beta^{k-1} r^{*k}(y) \end{bmatrix} \quad (2)$$

$$+ h(x) \sum_{i=0}^{k-1} \frac{(\lambda x)^i}{i!} e^{-\lambda x} \alpha \beta^i r^{*(i+1)}(y)$$

The first term corresponds to breakdown due to group A and the second terms corresponds to breakdown due to group B Using (1) and (2), we get,

$$\frac{\partial^2}{\partial x \partial y} P\left(T \le x, Rt \le y\right) = \left[e^{-\mu_1 x} + e^{-\mu_2 x}\right] \sum_{i=0}^{k-2} \alpha e^{-\lambda x} \lambda \frac{\left(\lambda x\right)^i}{i!} \beta^i r^{*(i+1)}(y) \quad (3)$$

$$+ \left[e^{-\mu_1 x} + e^{-\mu_2 x}\right] e^{-\lambda x} \frac{\left(\lambda x\right)^{k-1}}{(k-1)!} \beta^{k-1} r^{*k}(y)$$

$$+ \left[\mu_1 e^{-\mu_1 x} + \mu_2 e^{-\mu_2 x}\right] \sum_{i=0}^{k-1} e^{-\lambda x} \frac{\left(\lambda x\right)^i}{i!} \beta^i r^{*(i+1)}(y)$$

(3) can be simplified by taking Double Laplace transform.

$$E\left(e^{-\in T} e^{-\eta Rt}\right) = \left\{\frac{r^*(\eta)}{\lambda + \in + \mu_1 - \lambda \beta r^*(\eta)}\right\} \times \left[\left(\mu_1 + \alpha\lambda\right) - \alpha\lambda \left(\frac{\lambda \beta r^*(\eta)}{\lambda + \in + \mu_1}\right)^{k-1} - \mu_1 \left(\frac{\lambda \beta r^*(\eta)}{\lambda + \in + \mu_1}\right)^{k}\right]$$

$$+ \left(\frac{r^*(\eta)}{\lambda + \in + \mu_2 - \lambda \beta r^*(\eta)}\right) \times \left[\left(\mu_2 + \alpha\lambda\right) - \alpha\lambda \left(\frac{\lambda \beta r^*(\eta)}{\lambda + \in + \mu_2}\right)^{k-1} - \mu_2 \left(\frac{\lambda \beta r^*(\eta)}{\lambda + \in + \mu_2}\right)^{k}\right]$$

$$+ \beta^{k-1} \left(\frac{r^*(\eta)}{\lambda + \in + \mu_1}\right)^k + \beta^{k-1} \left(\frac{\lambda r^*(\eta)}{\lambda + \in + \mu_2}\right)^k .$$

(4)

for $\eta = 0$ and $\in = 0$, we obtain from (6)

$$E(e^{-\in t}) = \frac{\lambda \alpha \left[1 - \left(\dfrac{\lambda \beta}{\lambda + \in + \mu_1}\right)^{k-1}\right]}{\lambda + \in + \mu_1} + \frac{\lambda \alpha \left[1 - \left(\dfrac{\lambda \beta}{\lambda + \in + \mu_2}\right)^{k-1}\right]}{\lambda + \in + \mu_2}$$

$$= \beta^{k-1} \left(\frac{\lambda}{\lambda + \in + \mu_1}\right)^k + \beta^{k-1} \left(\frac{\lambda}{\lambda + \in + \mu_2}\right)^k$$

$$+ \frac{\mu_1 \left[1 - \left(\dfrac{\lambda \beta}{\lambda + \in + \mu_1}\right)^{k}\right]}{\lambda + \in + \mu_1} + \frac{\mu_2 \left[1 - \left(\dfrac{\lambda \beta}{\lambda + \in + \mu_2}\right)^{k}\right]}{\lambda + \in + \mu_2} . \quad (5)$$

$$E\left(e^{-\eta Rt}\right)=\left\{\frac{r^{*}(\eta)}{\lambda+\mu_1-\lambda\beta r^{*}(\eta)}\right\}\times\left[(\mu_1+\alpha\lambda)-\alpha\lambda\left(\frac{\lambda\beta r^{*}(\eta)}{\lambda+\mu_1}\right)^{k-1}-\mu_1\left(\frac{\lambda\beta r^{*}(\eta)}{\lambda+\mu_1}\right)^{k}\right]$$

$$+\left(\frac{r^{*}(\eta)}{\lambda+\mu_2-\lambda\beta r^{*}(\eta)}\right)\times\left[(\mu_2+\alpha\lambda)-\alpha\lambda\left(\frac{\lambda\beta r^{*}(\eta)}{\lambda+\mu_2}\right)^{k-1}-\mu_2\left(\frac{\lambda\beta r^{*}(\eta)}{\lambda+\mu_2}\right)^{k}\right] \quad (6)$$

$$+\beta^{k-1}\left(\frac{r^{*}(\eta)}{\lambda+\mu_1}\right)^{k}+\beta^{k-1}\left(\frac{\lambda r^{*}(\eta)}{\lambda+\mu_2}\right)^{k}$$

From (5) and (6), by differentiating,

$$E(T)=\frac{1}{\lambda\alpha+\mu_1}\left[1-\left(\frac{\lambda\beta}{\lambda+\mu_1}\right)^{k}\right]+\frac{1}{\lambda\alpha+\mu_2}\left[1-\left(\frac{\lambda\beta}{\lambda+\mu_2}\right)^{k}\right]. \quad (7)$$

$$E(Rt)=E(R)\left\{1+\frac{\lambda\beta}{\lambda\alpha+\mu_1}\left[1-\left(\frac{\lambda\beta}{\lambda+\mu_1}\right)^{k-1}\right]+\frac{\lambda\beta}{\lambda\alpha+\mu_2}\left[1-\left(\frac{\lambda\beta}{\lambda+\mu_2}\right)^{k-1}\right]\right\} \quad (8)$$

6.3 Numerical Illustration

By giving different values to the parameters in E(T) and E(Rt) and by varying λ from 1 to 10, we present the graphs of E(T) and E(Rt).

Table 1: $\mu_1=0.07,\mu_2=0.05,\alpha=0.4,\beta=0.6,k=2,E(R)=3$

λ	1	2	3	4	5	6	7	8	9	10
ET	3.479	1.923	1.320	1.003	0.809	0.678	0.583	0.512	0.456	0.411
E(RT)	2.71	3.32	3.45	3.35	3.29	3.25	3.22	3.19	3.17	3.16

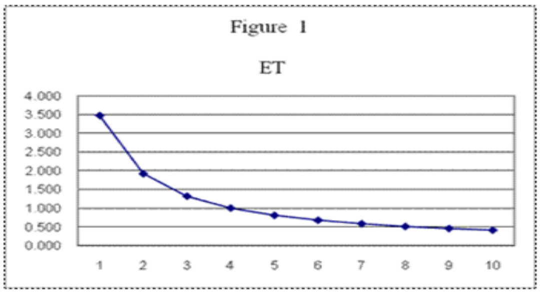

Figure 1

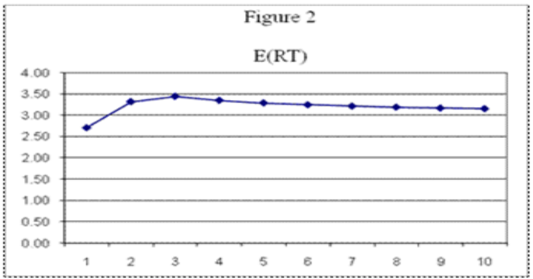

Figure 2

Table 1: $\mu_1=0.07,\mu_2=0.05,\alpha=0.6,\beta=0.4,k=2,E(R)=3$

	1	2	3	4	5	6	7	8	9	10
ET	2.876	1.566	1.069	0.810	0.652	0.546	0.469	0.411	0.366	0.330
E(RT)	2.640	2.500	2.431	2.385	2.350	2.321	2.298	2.278	2.260	2.245

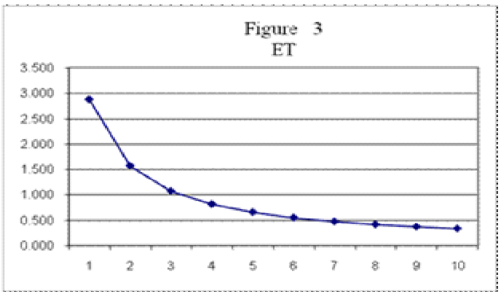

Figure 3

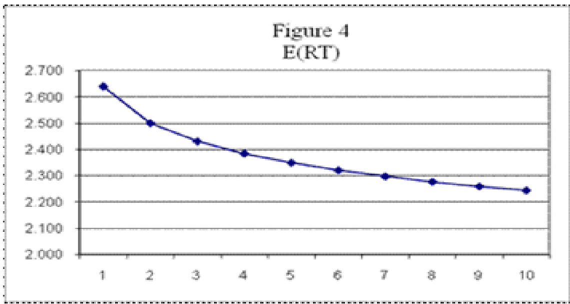

Figure 4

VII. CONCLUSION

From tables 1 and 2, we observe the behavior of E(T) and E(Rt) i.e., mean time to recruit and mean Recruitment time for fixed values of $\alpha, \beta, k, \mu_1, \mu_2$ and E(R). When the parameter λ increases, the value of E(T) increases and E(Rt) decreases. When α increases, both E(T) and E(Rt) decrease.

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