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Meantime to Recruitment for A Two Graded Manpower System with Depletion Having Independent and Identically Distributed Random Variables and Inter-Decision Times Involving Independent and Non-Identically Distributed Random Variables

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Abstract:
In this paper, a two graded organization subjected to random exit of personnel due to the policy decision taken by the organization is considered. There is an associated loss of manpower if a person quits the organization. As the exit of personnel is unpredictable, a new recruitment policy involving two thresholds for each grade, one is optional and the other is mandatory is suggested to enable the organization to plan its decision on recruitment. Based on shock model approach a mathematical model is constructed using an appropriate univariate policy of recruitment. Performance measures namely meantime to recruitment is obtained for when (i) The loss of manpower forms a sequence of independent and identically distributed exponential random variables. (ii) The inter-decision times are independent and non-identically distributed exponential random variables (iii) the optional and mandatory thresholds are exponential random variables.

Keywords: Manpower planning, shock models, univariate recruitment policy, Hypo-exponential distribution, Exponential distribution

1. INTRODUCTION

Consider an organization having two grades in which depletion of manpower occurs at every decision epoch. In the univariate policy of recruitment, based on shock model approach, recruitment is made as and when the cumulative loss of manpower crosses a threshold. Employing this recruitment policy, expected time to recruit is obtained under different conditions for several models in [[1], [5], [6], [7], [8], [9], [11], [12]]. In [[2],[3],[4]] for a single grade system, a univariate recruitment policy involving two thresholds is suggested and the meantime to recruitment is obtained under different conditions on the nature of the threshold for the three cases (i) The loss of manpower are independent and identically distributed exponential random variables ii) the inter-decision times are independent and identically distributed exponential random variables (iii) the optional and mandatory thresholds are exponential random variables. In [10] for a two grade system, a univariate recruitment policy involving two thresholds is suggested and the meantime to recruitment is obtained under different conditions on the nature of the threshold for the three cases (i) The loss of manpower are independent and identically distributed exponential random variables ii) the inter-decision times are independent and identically distributed exponential random variables (iii) the optional and mandatory thresholds are exponential random variables. In [13] for a single grade system, a univariate recruitment policy involving single source of non-identical wastages and inter-decision times has two components.

The objective of the present paper is to obtain the meantime to recruitment for a two graded system using the univariate recruitment policy considering the loss of manpower having independent and identically distributed exponential random variables and the inter-decision times are independent and non-identically distributed exponential random variables. These independent and non-identically distributed exponential random variables follow hypo-exponential distribution. Using this distribution we obtain the meantime to recruitment for a two graded system using the univariate recruitment policy considering optional and mandatory thresholds for both the grades follows exponential distribution.

2. MODEL DESCRIPTION AND ANALYSIS

X_i : The loss of manhours due to the i^{th} decision epoch i=1, 2, 3……forming a sequence of independent and identically distributed exponential random variables with parameter α , (α>0).

$G_i(.)$: The distribution function of X_i

$g_i(.)$: The probability density function of X_i with mean $\frac{1}{\alpha}$ (α>0)

S_k :Cumulative loss of manpower in the first k-decisions (k=1,2,3….), $S_k = \sum_{i=1}^{k} X_i$

$G_k(.)$: The distribution function of sum of k independent and identically distributed exponential random variables.

$g_k(.)$: The probability density function of S_k
$g_k^*(.)$: k-fold convolution of S_k
U_k: The inter-decision times are independent and non- identically distributed exponential random
variables between $(k-1)^{th}$ and k^{th} decisions with parameter β_k (β_k>0)
$F_k(.)$: The Distribution function of U_k
$f_k(.)$: The probability density function of U_k with mean $\frac{1}{\beta_k}$

we note that $F_k(t) = \sum_{i=1}^{k} b_i(1-e^{-\beta_i t})$

$$f^*{}_k(s) = \sum_{i=1}^{k} b_i \frac{\beta_i}{\beta_i+s} \text{where} b_i = \prod_{\substack{j=1\\ j\neq i}}^{k} \frac{\beta_j}{\beta_j-\beta_i}$$

Y_1,Y_2 :The continuous random variables denoting the optional thresholds levels for the grade 1 and grade 2 follows
Exponential distribution with parameters λ_1 and λ_2 rspectively.
Z_1,Z_2 :The continuous random variables denoting the
Mandatory thresholds levels for the grade1 and grade 2 follows exponential distribution with parameters
μ_1 and μ_2 respectively.
W : The continuous random variable denoting the time to Recruitment in the organization.
p : The probability that the organization is not going for recruitment whenever the total loss of manpower crosses the optional threshold Y
$V_k(t)$:The probability that exactly k decisions are taken in [0,t)
L(.) : Distribution function of W
l(.) : The probability density function of W
$l^*(.)$: The laplace transform of l(.)
E(W):The expected time to recruitment

3. MAIN RESULTS

The survival function of W is given by

$P(W > t) = \sum_{k=0}^{\infty}$ [Probability that exactly k-decisions are taken in [0,t),k=0,1,2…X (Probability that the total number of exits in these k-decisions does not cross the optional level Y or the total number of exits in these k-decisions crosses the optional level Y but lies below the mandatory level Z and the organization is not making recruitment)]

$$P(W>t)= \sum_{k=0}^{\infty} V_k(t)P(S_k < Y)$$

$$+\sum_{k=0}^{\infty} V_k(t)P(S_k \geq) P(S_k < Z)p \qquad (1)$$

For maxmium model, consider $P(S_k < Y)$, by the law of total probability

$$P(S_k<Y) = g_k^*(\lambda_1) + g_k^*(\lambda_2) - g_k^*(\lambda_1+\lambda_2)$$
$$=(g^*(\lambda_1))^k + (g^*(\lambda_2))^k - (g^*(\lambda_1+\lambda_2))^k \quad (2)$$
$$P(S_k<Y) = E_1^k + E_2^k - E_3^k \qquad (3)$$

Where $E_1 = g^*(\lambda_1)$, $E_2 = g^*(\lambda_2)$, $E_3 = g^*(\lambda_1+\lambda_2)$
Similarly

$$P(S_k<Z) =(g^*(\mu_1))^k + (g^*(\mu_2))^k - (g^*(\mu_1+\mu_2))^k \quad (4)$$
$$P(S_k<Z) = E_4^k + E_5^k - E_6^k \quad (5)$$

Where $E_4 = g^*(\mu_1)$, $E_5 = g^*(\mu_2)$, $E_6 = g^*(\mu_1+\mu_2)$

Substituting the equations (3) & (5) in equation (1),we get

$$P(W>t) = \sum_{k=0}^{\infty} V_k(t) [E_1^k + E_2^k - E_3^k]$$

$$+ p \sum_{k=0}^{\infty} V_k(t) [1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k] (6)$$

From renewal theory,it is known that
$V_k(t) = F_k(t) - F_{k+1}(t)$ with $F_0(t) = 1$

$$P(W>t) = \sum_{k=0}^{\infty} [F_k(t) - F_{k+1}(t)]\{[E_1^k + E_2^k - E_3^k]$$
$$+p[1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k]\}$$

Note that L(t) = 1-P(W>t) and taking laplace transform on both sides of (6) and $l(t) = \frac{d}{dt} L(t)$, we get

$$l^*(s) = \sum_{k=0}^{\infty} f_{k+1}^*(s)\{[E_1^k + E_2^k - E_3^k]$$
$$+p[1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k]\}$$
$$-\sum_{k=0}^{\infty} f_k^*(s)\{[E_1^k + E_2^k - E_3^k]$$
$$+p[1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k]\} \qquad (8)$$

Consider $l^*(s) = l_1^*(s) - l_2^*(s)$ (9)

Where $l_1^*(s) = \sum_{k=0}^{\infty} f_{k+1}^*(s)\{[E_1^k + E_2^k - E_3^k]$
$$+p[1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k]\}$$

$$l_2^*(s) = \sum_{k=0}^{\infty} f_k^*(s)\{[E_1^k + E_2^k - E_3^k]$$
$$+p[1-(E_1^k + E_2^k - E_3^k)][E_4^k + E_5^k - E_6^k]\}$$

Consider $l_1^*(s)$, by the hypothesis of $f_k^*(s)$

$$l_1^*(s) = \sum_{k=0}^{\infty} \sum_{i=1}^{k+1} a_i \frac{\beta_i}{\beta_i+s} [E_1^k + E_2^k - E_3^k]$$
$$+p \sum_{k=0}^{\infty} \sum_{i=1}^{k+1} a_i \frac{\beta_i}{\beta_i+s} [E_4^k + E_5^k - E_6^k]$$
$$- p \sum_{k=0}^{\infty} \sum_{i=1}^{k+1} a_i \frac{\beta_i}{\beta_i+s} [(E_1E_4)^k + (E_1E_5)^k$$
$$-(E_1E_6)^k + (E_2E_4)^k + (E_2E_5)^k - (E_2E_6)^k$$
$$-(E_3E_4)^k - (E_3E_5)^k + (E_3E_6)^k]$$
$$= \sum_{i=1}^{\infty} \frac{1}{\beta_i}\left[\sum_{k=i-1}^{\infty} E_1^k + \sum_{k=i-1}^{\infty} E_2^k - \sum_{k=i-1}^{\infty} E_3^k\right]$$
$$+p\sum_{i=1}^{\infty} \frac{1}{\beta_i}\left[\sum_{k=i-1}^{\infty} E_4^k + \sum_{k=i-1}^{\infty} E_5^k - \sum_{k=i-1}^{\infty} E_6^k\right]$$
$$- p \sum_{i=1}^{\infty} \frac{1}{\beta_i}[\sum_{k=i-1}^{\infty} (E_1E_4)^k + \sum_{k=i-1}^{\infty} (E_1E_5)^k$$
$$- \sum_{k=i-1}^{\infty} (E_1E_6)^k + \sum_{k=i-1}^{\infty} (E_2E_4)^k + \sum_{k=i-1}^{\infty} (E_2E_5)^k$$

$$-\sum_{k=i-1}^{\infty} (E_2E_6)^k - \sum_{k=i-1}^{\infty} (E_3E_4)^k$$

$$-\sum_{k=i-1}^{\infty} (E_3E_5)^k + \sum_{k=i-1}^{\infty} (E_3E_6)^k]$$

$$E(W_1) = \sum_{i=1}^{\infty} \frac{1}{\beta_i}\left[m_1n_1^{i-1} + m_2n_2^{i-1} - m_3n_3^{i-1}\right]$$

$$+\sum_{i=1}^{\infty} \frac{1}{\beta_i}p\left[m_4n_4^{i-1} + m_5n_5^{i-1} - m_6n_6^{i-1}\right]$$

$$-p\sum_{i=1}^{\infty} \frac{1}{\beta_i}\left[\frac{a_1a_4(n_1n_4)^{i-1}}{\alpha\left(\lambda_1+\mu_1\right)+\lambda_1\mu_1}\right.$$

$$+\frac{a_1a_5(n_1n_5)^{i-1}}{\alpha\left(\lambda_1+\mu_2\right)+\lambda_1\mu_2} - \frac{a_1a_6(n_1n_6)^{i-1}}{\alpha\left(\lambda_1+\mu_1+\mu_2\right)+\lambda_1(\mu_1+\mu_2)}$$

$$+\frac{a_2a_4(n_2n_4)^{i-1}}{\alpha\left(\lambda_2+\mu_1\right)+\lambda_2\mu_1} + \frac{a_2a_5(n_2n_5)^{i-1}}{\alpha\left(\lambda_2+\mu_2\right)+\lambda_2\mu_2}$$

$$-\frac{a_2a_6(n_2n_6)^{i-1}}{\alpha\left(\lambda_2+\mu_1+\mu_2\right)+\lambda_2(\mu_1+\mu_2)}$$

$$-\frac{a_3a_4(n_3n_4)^{i-1}}{\alpha\left(\lambda_1+\lambda_2+\mu_1\right)+(\lambda_1+\lambda_2)\mu_1}$$

$$-\frac{a_3a_5(n_3n_5)^{i-1}}{\alpha\left(\lambda_1+\lambda_2+\mu_2\right)+(\lambda_1+\lambda_2)\mu_2}$$

$$\left.-\frac{a_3a_6(n_3n_6)^{i-1}}{\alpha\left(\lambda_1+\lambda_2+\mu_1+\mu_2\right)+(\lambda_1+\lambda_2)(\mu_1+\mu_2)}\right]$$

$$E(W_1)=\left[m_1\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_1^{i-1} + m_2\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_2^{i-1}\right.$$

$$\left.-m_3\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_3^{i-1}\right] + p\left[m_4\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_4^{i-1}\right.$$

$$\left.+m_5\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_5^{i-1} - m_6\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_6^{i-1}\right]$$

$$-p\left[\frac{a_1a_4}{\alpha\left(\lambda_1+\mu_1\right)+\lambda_1\mu_1}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_4)^{i-1}\right.$$

$$+\frac{a_1a_5}{\alpha\left(\lambda_1+\mu_2\right)+\lambda_1\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_5)^{i-1}$$

$$-\frac{a_1a_6}{\alpha\left(\lambda_1+\mu_1+\mu_2\right)+\lambda_1(\mu_1+\mu_2)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_6)^{i-1}$$

$$+\frac{a_2a_4}{\alpha\left(\lambda_2+\mu_1\right)+\lambda_1\mu_1)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_4)^{i-1}$$

$$+\frac{a_2a_5}{\alpha\left(\lambda_2+\mu_2\right)+\lambda_2\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_5)^{i-1}$$

$$-\frac{a_2a_6}{\alpha\left(\lambda_2+\mu_1+\mu_2\right)+\lambda_2(\mu_1+\mu_2)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_6)^{i-1}$$

$$-\frac{a_3a_4}{\alpha\left(\lambda_1+\lambda_2+\mu_1\right)+(\lambda_1+\lambda_2)\mu_1}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_4)^{i-1}$$

$$-\frac{a_3a_5}{\alpha\left(\lambda_1+\lambda_2+\mu_2\right)+(\lambda_1+\lambda_2)\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_5)^{i-1}$$

$$\left.+\frac{a_3a_6}{\alpha\left(\lambda_1+\lambda_2+\mu_1+\mu_2\right)+(\lambda_1+\lambda_2)(\mu_1+\mu_2)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_6)^{i-1}\right]$$

(11)

Consider $l_2^*(s) = \sum_{k=0}^{\infty}\sum_{i=1}^{k} a_i\frac{\beta_i}{\beta_i+s}[E_1^k + E_2^k - E_3^k]$

$$+p\sum_{k=0}^{\infty}\sum_{i=1}^{k} a_i\frac{\beta_i}{\beta_i+s}[E_4^k + E_5^k - E_6^k]$$

$$-p\sum_{k=0}^{\infty}\sum_{i=1}^{k} a_i\frac{\beta_i}{\beta_i+s}[(E_1E_4)^k + (E_1E_5)^k$$

$$-(E_1E_6)^k + (E_2E_4)^k + (E_2E_5)^k - (E_2E_6)^k$$

$$-(E_3E_4)^k - (E_3E_5)^k + (E_3E_6)^k]$$

$$E[W_2] = \sum_{i=1}^{\infty}\frac{1}{\beta_i}\left[\sum_{k=i}^{\infty}E_1^k + \sum_{k=i}^{\infty}E_2^k - \sum_{k=i}^{\infty}E_3^k\right]$$

$$+p\sum_{i=1}^{\infty}\frac{1}{\beta_i}\left[\sum_{k=i}^{\infty}E_4^k + \sum_{k=i}^{\infty}E_5^k - \sum_{k=i}^{\infty}E_6^k\right]$$

$$-p\sum_{i=1}^{\infty}\frac{1}{\beta_i}\left[\sum_{k=i}^{\infty}(E_1E_4)^k + \sum_{k=i}^{\infty}(E_1E_5)^k\right.$$

$$-\sum_{k=i}^{\infty}(E_1E_6)^k + \sum_{k=i}^{\infty}(E_2E_4)^k + \sum_{k=1}^{\infty}(E_2E_5)^k$$

$$-\sum_{k=i}^{\infty}(E_2E_6)^k - \sum_{k=i}^{\infty}(E_3E_4)^k$$

$$\left.-\sum_{k=i}^{\infty}(E_3E_5)^k + \sum_{k=i}^{\infty}(E_3E_6)^k\right]$$

$$E(W_2) = \sum_{i=1}^{\infty}\frac{1}{\beta_i}\left[m_1n_1^i + m_2n_2^i - m_3n_3^i\right]$$

$$+\sum_{i=1}^{\infty}\frac{1}{\beta_i}p\left[m_4n_4^i + m_5n_5^i - m_6n_6^i\right]$$

$$-p\sum_{i=1}^{\infty}\frac{1}{\beta_i}\left[\frac{a_1a_4(n_1n_4)^i}{\alpha\left(\lambda_1+\mu_1\right)+\lambda_1\mu_1}\right.$$

$$+\frac{a_1a_5(n_1n_5)^i}{\alpha\left(\lambda_1+\mu_2\right)+\lambda_1\mu_2}$$

$$-\frac{a_1a_6(n_1n_6)^i}{\alpha\left(\lambda_1+\mu_1+\mu_2\right)+\lambda_1(\mu_1+\mu_2)}$$

$$+\frac{a_2a_4(n_2n_4)^i}{\alpha\left(\lambda_2+\mu_1\right)+\lambda_2\mu_1}$$

$$+\frac{a_2a_5(n_2n_5)^i}{\alpha\left(\lambda_2+\mu_2\right)+\lambda_2\mu_2}$$

$$-\frac{a_2a_6(n_2n_6)^i}{\alpha\left(\lambda_2+\mu_1+\mu_2\right)+\lambda_2(\mu_1+\mu_2)}$$

$$-\frac{a_3a_4(n_3n_4)^i}{\alpha\left(\lambda_1+\lambda_2+\mu_1\right)+(\lambda_1+\lambda_2)\mu_1}$$

$$+\frac{a_3a_5(n_3n_5)^i}{\alpha\left(\lambda_1+\lambda_2+\mu_2\right)+(\lambda_1+\lambda_2)\mu_2}$$

$$\left.-\frac{a_3a_6(n_3n_6)^i}{\alpha\left(\lambda_1+\lambda_2+\mu_1+\mu_2\right)+(\lambda_1+\lambda_2)(\mu_1+\mu_2)}\right]$$

$$E(W_2)=\left[m_1\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_1^i+m_2\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_2^i-m_3\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_3^i\right]$$

$$+p\left[m_4\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_4^i+m_5\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_5^i-m_6\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_6^i\right]$$

$$-p\left[\frac{a_1a_4}{\alpha\left(\lambda_1+\mu_1\right)+\lambda_1\mu_1}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_4)^i\right.$$

$$+\frac{a_1a_5}{\alpha\left(\lambda_1+\mu_2\right)+\lambda_1\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_5)^i$$

$$-\frac{a_1a_6}{\alpha\left(\lambda_1+\mu_1+\mu_2\right)+\lambda_1(\mu_1+\mu_2)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_6)^i$$

$$+\frac{a_2a_5}{\alpha\left(\lambda_2+\mu_2\right)+\lambda_2\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_5)^i$$

$$-\frac{a_2a_6}{\alpha\left(\lambda_2+\mu_1+\mu_2\right)+\lambda_2(\mu_1+\mu_2)}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_6)^i$$

$$-\frac{a_3a_4}{\alpha\left(\lambda_1+\lambda_2+\mu_1\right)+(\lambda_1+\lambda_2)\mu_1}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_4)^i$$

$$-\frac{a_3a_5}{\alpha\left(\lambda_1+\lambda_2+\mu_2\right)+(\lambda_1+\lambda_2)\mu_2}\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_5)^i$$

$$+\frac{a_3a_6}{\alpha\left(\lambda_1+\lambda_2+\mu_1+\mu_2\right)+(\lambda_1+\lambda_2)(\mu_1+\mu_2)}$$

(12)

$$\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_3n_6)^i$$

Note that E(W) = E(W_1) – E(W_2) (13)

$$E(W)=(m_1A_1+m_2A_2-m_3A_3)$$

$$+p(m_4A_4+m_5A_5-m_6A_6)$$

$$-p\left(\frac{a_1a_4}{\alpha\left(\lambda_1+\mu_1\right)+\lambda_1\mu_1}\right.$$

$$+\frac{a_1a_5}{\alpha\left(\lambda_1+\mu_2\right)+\lambda_1\mu_2}A_8$$

$$-\frac{a_1a_6}{\alpha\left(\lambda_1+\mu_1+\mu_2\right)+\lambda_1(\mu_1+\mu_2)}A_9$$

$$+\frac{a_2a_4}{\alpha\left(\lambda_2+\mu_1\right)+\lambda_1\mu_1)}A_{10}$$

$$+\frac{a_2a_4}{\alpha\left(\lambda_2+\mu_2\right)+\lambda_2\mu_2}A_{11}$$

$$-\frac{a_2a_6}{\alpha\left(\lambda_2+\mu_1+\mu_2\right)+\lambda_2(\mu_1+\mu_2)}A_{12}$$

$$-\frac{a_3a_4}{\alpha\left(\lambda_1+\lambda_2+\mu_1\right)+(\lambda_1+\lambda_2)\mu_1}A_{13}$$

$$-\frac{a_3a_5}{\alpha\left(\lambda_1+\lambda_2+\mu_2\right)+(\lambda_1+\lambda_2)\mu_2}A_{14}$$

$$\left.+\frac{a_3a_6}{\alpha\left(\lambda_1+\lambda_2+\mu_1+\mu_2\right)+(\lambda_1+\lambda_2)(\mu_1+\mu_2)}A_{15}\right) \quad (14)$$

Where

$m_1=\frac{a_1}{\lambda_1}$ and $n_1=\frac{\alpha}{a_1}$, $a_1=\alpha+\lambda_1$; $m_2=\frac{a_2}{\lambda_2}$ and $n_2=\frac{\alpha}{a_2}$, $a_2=\alpha+\lambda_2$

$m_3=\frac{a_3}{\lambda_1+\lambda_2}$ and $n_3=\frac{\alpha}{a_3}$, $a_3=\alpha+\lambda_1+\lambda_2$;

$m_4=\frac{a_4}{\mu_1}$ and $n_4=\frac{\alpha}{a_4}$, $a_4=\alpha+\mu_1$

$m_5=\frac{a_5}{\mu_2}$ and $n_5=\frac{\alpha}{a_5}$, $a_5=\alpha+\mu_2$;

$m_6=\frac{a_6}{\mu_1+\mu_2}$ and $n_6=\frac{\alpha}{a_6}$, $a_6=\alpha+\mu_1+\mu_2$

$A_1=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_1^{i-1}$, $A_2=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_2^{i-1}$, $A_3=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_3^{i-1}A_4=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_4^{i-1}$, $A_5=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_5^{i-1}$, $A_6=\sum_{i=1}^{\infty}\frac{1}{\beta_i}n_6^{i-1}A_7=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_4)^{i-1}$, $A_8=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_5)^{i-1}$

$A_9=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_1n_6)^{i-1}$, $A_{10}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_4)^{i-1}$,

$A_{11}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_5)^{i-1}$ $A_{12}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_2n_6)^{i-1}$,

$A_{13}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_4)^{i-1}$, $A_{14}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_5)^{i-1}$

$A_{15}=\sum_{i=1}^{\infty}\frac{1}{\beta_i}(n_3n_6)^{i-1}$.

Equation (14) is the meantime to recruitment for maximum model.

4. NUMERICAL ILLUSTRATION

The meantime to recruitment for the maximum model in the following table by keeping the parameters of optional and mandatory are fixed and varying the parameter of loss of manhour α, and the parameters of inter-decision times β_1,β_2,β_3,β_4,β_5.

λ_1 = 0.01, λ_2= 0.02, μ_1= 0.03, μ_2 = 0.04, p= 0.06

α	β_1	β_2	β_3	β_4	β_5	E(W)
0.2	0.06	0.07	0.08	0.09	0.10	1.3970 x 10^3
0.25	0.06	0.07	0.08	0.09	0.10	1.7553 x 10^3
0.30	0.06	0.07	0.08	0.09	0.10	2.1133 x 10^3
0.35	0.06	0.07	0.08	0.09	0.10	2.4711 x 10^3
0.40	0.06	0.07	0.08	0.09	0.10	2.8287 x 10^3
0.2	**0.06**	0.07	0.08	0.09	0.10	1.3970 x 10^3
0.2	**0.31**	0.07	0.08	0.09	0.10	1.0916 x 10^3
0.2	**0.56**	0.07	0.08	0.09	0.10	1.0589 x 10^3
0.2	**0.81**	0.07	0.08	0.09	0.10	1.0464 x 10^3
0.2	**1.06**	0.07	0.08	0.09	0.10	1.0398 x 10^3
0.2	0.06	**0.07**	0.08	0.09	0.10	1.3970 x 10^3
0.2	0.06	**0.32**	0.08	0.09	0.10	1.1492 x 10^3
0.2	0.06	**0.57**	0.08	0.09	0.10	1.1188 x 10^3
0.2	0.06	**0.82**	0.08	0.09	0.10	1.1069 x 10^3
0.2	0.06	**1.07**	0.08	0.09	0.10	1.1006 x 10^3
0.2	0.06	0.07	**0.08**	0.09	0.10	1.3970 x 10^3
0.2	0.06	0.07	**0.33**	0.09	0.10	1.1929 x 10^3
0.2	0.06	0.07	**0.58**	0.09	0.10	1.1647 x 10^3
0.2	0.06	0.07	**0.83**	0.09	0.10	1.1535 x 10^3
0.2	0.06	0.07	**1.08**	0.09	0.10	1.1475 x 10^3
0.2	0.06	0.07	0.08	**0.09**	0.10	1.3970 x 10^3
0.2	0.06	0.07	0.08	**0.34**	0.10	1.2269 x 10^3
0.2	0.06	0.07	0.08	**0.59**	0.10	1.2009 x 10^3
0.2	0.06	0.07	0.08	**0.84**	0.10	1.1904 x 10^3
0.2	0.06	0.07	0.08	**1.09**	0.10	1.1847 x 10^3
0.2	0.06	0.07	0.08	0.09	**0.10**	1.3970 x 10^3
0.2	0.06	0.07	0.08	0.09	**0.35**	1.2539 x 10^3
0.2	0.06	0.07	0.08	0.09	**0.60**	1.2300 x 10^3
0.2	0.06	0.07	0.08	0.09	**0.85**	1.2202 x 10^3
0.2	0.06	0.07	0.08	0.09	**1.10**	1.2148 x 10^3

5. CONCLUSION

The influence of nodal parameters on the performance measure meantime to recruitment for the maximum model is reported below

(i) It is observed that when the loss of man hour α increases, the mean time to recruitment increases.
(ii) If the inter-decision times $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are increases separatly, the mean time to recruitment decreases.

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