ANANLYSIS OF TIME TO RECRUITMENT OF A MANPOWER MODEL FOR AN ORGANIZATION WITH TWO SOURCES OF DEPLETION AND TWO COMPONENTS FOR THRESHOLD FOR THE DEPLETION OF MANPOWER

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ABSTRACT

A stochastic model is produced utilizing univariate policy of enlistment dependent on shock model approach. The inter-policy decision times and the inter-transfer decision times shape same recharging process for three grades to get the expected time to recruitment (ETR) and variance of time to recruitment (VTR). It is accepted that threshold for the loss of labor has two parts to be specific the most extreme permissible attrition and the greatest accessible manpower because of additional time work. There is a threshold level for the level of wastage and furthermore accessible for the labor hours because of additional time work. On the off chance that the aggregate loss of worker hours crosses the total of the threshold and the accessible labor hours because of additional time work the break down happens. The procedure that creates the loss of worker hours and the threshold together is linearly independent mathematical conditions for ETR and VTR are produced utilizing Laplace Transform.

INTRODUCTION

In the focused universe of today which is described by countless qualified people, labor arranging draws the genuine consideration of specialists occupied with this field, since every organization requires representatives with particular abilities in different fields to achieve its business goals, both now and in the future. Through labor arranging the administration of any association not just advances the ability and aptitudes of its HR, yet may likewise choose the ideal number and right sort of representatives accessible at the opportune place at the privilege time. Deciding labor arranging arrangements is a standout amongst the most basic and troublesome parts of an association. Specifically, after the enrollment, deciding advancement arrangements starting with one review then onto the next turns out to be more troublesome as the association requires more skill since it is connected to the efficiency upgrade of the association.

Numerous creators have expected the loss of labor is a sequence of independent and indistinguishably conveyed arbitrary variables. Uma et.al recommended two models in which threshold distributions following exponential and having SCBZ property to beat the issues with the steady threshold models. The aggregate of the most extreme permissible attrition and the most extreme accessible back up resource are considered as threshold in their papers. The backup resource is only the labor inventory available which can be utilized at whatever point there is a need. The long - run average cost per unit time for a single grade system under univariate policy of recruitment was developed by Rojamary and Uma.

MODEL DESCRIPTION

Consider an organization having single grade in which choices are taken indiscriminately age. The consumption of worker hours happens at each basic leadership age and furthermore because of exchange of faculty to the next association of a similar administration. It is expected that the interarrival times between progressive ages of strategy choices and that of exchanges are independent and identically distributed arbitrary factors . The renewal processes administering between inter-policy decisions times and inter-transfer decisions times are same . It is expected that the two sources of consumption are free. There is a threshold level for the level of wastage and furthermore accessible for the labor hours because of additional time work. On the off chance that the aggregate loss of worker hours crosses the total of the threshold and the accessible worker hours because of additional time work the separate happens. Enlistment takes place only at decision points and time of recruitment is negligible. The Enlistment is made at whatever point the total loss of worker hours surpasses the threshold of the organization.

NOTATIONS

$V_{i1}(V_{i2})$: independent and identically distributed continuous arbitrary factors denoting the loss of labor hours due to i^{th} policy decision (j^{th} transfer), $i, j \geq 1$. Its probability density function is h(.) (p(.)) and cumulative distribution is H(.) (P(.)).

E_1 (E_2): continuous arbitrary factors representing the threshold level of policy decisions (transfer) with probability density function $j_1(.)$ ($j_2(.)$) and cumulative distribution function $J_1(.)$ ($J_2(.)$).

$E = E_1 + E_2$: continuous arbitrary factors representing threshold level of the organization

Its probability density function is j(.) and cumulative distribution function is J(.).

U: continuous random variable representing the time to the breakdown of the organization. Its probability density function is V(.) and cumulative distribution function is V(.).

q(.) : probability density function of inter-decision times ,$q_m(.)$ and $q^*(.)$ are its m-fold convolution and Laplace transform respectively.

s(.) : probability density function of inter-transfer times with $s_n(.)$ and $s^*(.)$ are its n-fold convolution and Laplace transform respectively.

Q(.) : cumulative distribution function of inter- decision times with $Q_m(.)$ and $\overline{Q}(.)$ are its k-fold convolution and Laplace-Stieltjes transform respectively.

S(.) : cumulative distribution function of inter-transfer times with $S_n(.)$ and $\overline{S}(.)$ are its n-fold convolution and Laplace-Stieltjes transform respectively.

$h_m(.)$: probability density function of $\sum_{i=1}^{m} V_{i1}$, $h_m^*(.)$ is its Laplace transform

$p_n(.)$: probability density function of $\sum_{i=1}^{n} V_{i2}$, $p_n^*(.)$ is its Laplace transform

$P_n(.)$: cumulative distribution function of $\sum_{i=1}^{n} V_{i2}$, $\overline{P}_n(.)$ is its Laplace - Stieltjes transform

a_1, a_2 : parameters of the distribution function of thresholds E_1, E_2

b_1, b_2 : parameters of the distribution function of inter-decision times and inter transfer times .

m_1, m_2 : parameters of the distribution function of the loss of manhours due to decision and due to transfer.

ETR and VTR

In this section, the analytical expressions for the ETR and VTR are derived. The enlistment is done whenever the sum of loss of labor hours exceeds the sum $E_1 + E_2$.

$$P(U> t) = \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} (Q_m(t) - Q_{m+1}(t))(S_n(t) - S_{n+1}(t))$$

$$\int_0^{\infty}\int_0^{\infty}\int_{z_1+z_2}^{\infty} \frac{\phi_1\ \phi_2}{(\phi_1 - \phi_2)} (e^{-\phi_2 y} - e^{-\phi_1 y})\ dy dJ_m(x_1)\ dH_n(x_2)$$

$$= \frac{1}{(\phi_1 - \phi_2)} \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} (Q_m(t) - Q_{m+1}(t))\ (S_n(t) - S_{n+1}(t))$$

$$\left\{ \int_0^{\infty} \phi_1\, e^{-\phi_2 z_2}\ h_m^*(\phi_2)\, dH_n(z_2) - \int_0^{\infty} \phi_2\, e^{-\phi_1 z_2}\ h_m^*(\phi_1)\, dH_n(z_2) \right\}$$

$$= \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left(1 - (1 - p^*(\phi_2)) \sum_{n=1}^{\infty} Q_n(t)\ (p^*(\phi_2))^{n-1}\right)$$

$$\left(1 - (1 - p^*(\phi_2)) \sum_{m=1}^{\infty} Q_m(t)\ (h^*(\phi_2))^{m-1}\right)$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left(1 - (1 - p^*(\phi_1)) \sum_{n=1}^{\infty} Q_n(t)\ (p^*(\phi_1))^{n-1}\right)$$

$$\left(1 - (1 - h^*(\phi_1)) \sum_{m=1}^{\infty} Q_m(t)\ (h^*(\phi_1))^{m-1}\right)$$

$$1 - P(U > t) = V(t) = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{(1 - h^*(\phi_2)) \sum_{m=1}^{\infty} Q_m(t)\ (h^*(\phi_2))^{m-1}\right.$$

$$+ (1 - p^*(\phi_2) \sum_{n=1}^{\infty} Q_n(t)\ (h^*(\phi_2))^{n-1}$$

$$\left. -(1 - h^*(\phi_2))\,(1 - p^*(\phi_2)) \left(\sum_{m=1}^{\infty} Q_m(t)\, (h^*(\phi_2))^{m-1}\right) \left(\sum_{n=1}^{\infty} S_n(t)\, (h^*(\phi_2))^{n-1}\right)\right\} - \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)$$

$$+ (1 - h^*(\phi_1) \sum_{n=1}^{\infty} Q_n(t)\ (h^*(\phi_1))^{n-1} + (1 - p^*(\phi_1) \sum_{n=1}^{\infty} S_n(t)\ (h^*(\phi_1))^{n-1}$$

$$\left. - (1 - h^*(\phi_1))\ (1 - p^*(\phi_1)) \left(\sum_{m=1}^{\infty} Q_m(t)\ (h^*(\phi_1))^{m-1}\right) \left(\sum_{n=1}^{\infty} U_n(t)\ (h^*(\phi_1))^{n-1}\right)\right\} \quad (2)$$

$$v(t) = \frac{d}{dt} V(t)$$

$$= \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\Big\{(1 - h^*(\phi_2)) \sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_2))^{m-1} + (1 - p^*(\phi_2) \sum_{n=1}^{\infty} s_n(t)\,(p^*(\phi_2))^{n-1}$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\left(\sum_{n=1}^{\infty} S_n(t)\,(p^*(\phi_2))^{n-1}\right)\left(\sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_2))^{m-1}\right)$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\left(\sum_{n=1}^{\infty} s_n(t)\,(p^*(\phi_2))^{n-1}\right)\left(\sum_{m=1}^{\infty} Q_m(t)\,(h^*(\phi_2))^{m-1}\right)\Big\}$$

$$-\left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\Big\{(1 - h^*(\phi_1)) \sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_1))^{m-1}$$

$$+ (1 - p^*(\phi_1)) \sum_{n=1}^{\infty} S_n(t)\,(p^*(\phi_1))^{n-1}$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1))\left(\sum_{n=1}^{\infty} S_n(t)\,(p^*(\phi_1))^{n-1}\right)\left(\sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_1))^{m-1}\right)$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1))\left(\sum_{n=1}^{\infty} s_n(t)\,(p^*(\phi_1))^{n-1}\right)\left(\sum_{m=1}^{\infty} U_m(t)\,(h^*(\phi_1))^{m-1}\right)\Big\} \quad (3)$$

As the inter-decision times and inter transfer times follow exponential distributions with parameters b_1 and b_2 respectively,

$$v(t) = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\Big\{(1 - h^*(\phi_2)) \sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_2))^{m-1}$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\, b_1\, e^{-a_1 t\,(1 - h^*(\phi_2))} \sum_{n=1}^{\infty} S_n(t)\,(p^*(\phi_2))^{n-1}$$

$$+ (1 - p^*(\phi_2)) \sum_{n=1}^{\infty} s_n(t)\,(p^*(\phi_2))^{n-1}$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\, b_2\, e^{-a_2 t\,(1 - p^*(\phi_2))} \sum_{n=1}^{\infty} Q_n(t)\,(h^*(\phi_2))^{n-1} \Big\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right) \Big\{ (1 - h^*(\phi_1)) \sum_{m=1}^{\infty} q_m(t)\,(h^*(\phi_1))^{m-1}$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1))\, a_1 e^{-a_1 t (1 - h^*(\phi_1))} \sum_{n=1}^{\infty} S_n(t)\,(p^*(\phi_1))^{n-1}$$

$$+ (1 - p^*(\phi_1)) \sum_{n=1}^{\infty} s_n(t)\,(p^*(\phi_1))^{n-1}$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1))\, \phi_2\, e^{-a_2 t\,(1 - p^*(\phi_1))} \left(\sum_{m=1}^{\infty} S_m(t)\,(h^*(\phi_1))^{m-1} \right) \Big\}$$

$$v^*(s) = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right) \Big\{ \left((1 - h^*(\phi_2)) \sum_{m=1}^{\infty} (h^*(\phi_2))^{m-1}\, q_m^*(s) \right)$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2)) \sum_{n=1}^{\infty} b_1\, (p^*(\phi_2))^{n-1}\, \overline{S}_n(e+s)$$

$$+ (1 - p^*(\phi_2)) \left(\sum_{n=1}^{\infty} (p^*(\phi_2))^{n-1}\, s_n^*(s) \right)$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2)) \left(\sum_{m=1}^{\infty} b_2\, (h^*(\phi_2))^{m-1}\, \overline{Q}_m(g+s) \right) \Big\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right) \Big\{ (1 - h^*(\phi_1)) \left(\sum_{m=1}^{\infty} (h^*(\phi_1))^{m-1}\, q_m^*(s) \right)$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1)) \sum_{n=1}^{\infty} b_1\, (p^*(\phi_1))^{n-1}\, \overline{S}_n(d+s)$$

$$+ (1 - p^*(\phi_1)) \sum_{n=1}^{\infty} (p^*(\phi_1))^{n-1}\, s_n^*(s)$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1)) \left(\sum_{m=1}^{\infty} b_2\, (h^*(\phi_1))^{m-1}\, \overline{Q}_m(f+s) \right) \Big\} \quad (4)$$

Using the relation between the Laplace transform of the density function and Laplace transform of distribution function, we have

$$v^*(s) = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\Bigg\{(1 - h^*(\phi_2)) \sum_{m=1}^{\infty} (h^*(\phi_2))^{m-1}\, q_m^*(s)$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2)) \sum_{n=1}^{\infty} b_1\, (p^*(\phi_2))^{n-1}\, \frac{s_n^*(s+e)}{s+e}$$

$$+ (1 - p^*(\phi_2)) \sum_{n=1}^{\infty} (p^*(\phi_2))^{n-1}\, s_n^*(s)$$

$$- (1 - h^*(\phi_2))\,(1 - p^*(\phi_2)) \sum_{m=1}^{\infty} b_2\, (h^*(\phi_2))^{m-1}\, \frac{q_m^*(s+g)}{s+g}\Bigg\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\Bigg\{(1 - h^*(\phi_1)) \sum_{m=1}^{\infty} (h^*(\phi_1))^{m-1}\, q_m^*(s)$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1)) \sum_{n=1}^{\infty} b_1\, (p^*(\phi_1))^{n-1}\, \frac{s_n^*(s+d)}{s+d}$$

$$+ (1 - p^*(\phi_1)) \sum_{n=1}^{\infty} (p^*(\phi_1))^{n-1}\, s_n^*(s)$$

$$- (1 - h^*(\phi_1))\,(1 - p^*(\phi_1)) \sum_{m=1}^{\infty} b_2\, (h^*(\phi_1))^{m-1}\, \frac{q_m^*(s+f)}{s+f}\Bigg\}$$

$$= \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left[\frac{(1 - h^*(\phi_2))\, q^*(s)}{1 - h^*(\phi_2)\, q^*(s)} - \frac{b_1\, (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\, q^*(s+e)}{(s+e)\,(1 - p^*(\phi_2)\, q^*(s+e))}\right.$$

$$\left. + \frac{(1 - p^*(\phi_2))\, s^*(s)}{1 - p^*(\theta_2)\, s^*(s)} - \frac{b_2\, (1 - h^*(\phi_2))\,(1 - p^*(\phi_2))\, q^*(s+g)}{(s+g)\,(1 - h^*(\phi_2)\, q^*(s+g))}\right]$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left[\frac{(1 - h^*(\phi_1))\, q^*(s)}{1 - h^*(\phi_1)\, q^*(s)} - \frac{b_1\, (1 - h^*(\phi_1))\,(1 - p^*(\phi_1))\, q^*(s+d)}{(s+d)\,(1 - p^*(\phi_1)\, s^*(s+d))}\right.$$

$$+ \frac{(1-p^*(\phi_1))\, s^*(s)}{1-p^*(\phi_1)\, s^*(s)} - \left. \frac{b_2 (1-h^*(\phi_1))\,(1-p^*(\phi_1))\, q^*(s+f)}{(s+f)\,(1-h^*(\phi_1)\, q^*(s+f))} \right]$$

Since h(.) and p(.) follow exponential distributions with parameters m_1 and m_2 respectively, we have

$$h^*(\phi_i) = \frac{m_1}{m_1+\phi_i} \quad \text{and} \quad p^*(\phi_i) = \frac{m_2}{m_2+\phi_i}, \quad i = 1, 2$$

Taking

$J_1(s) = (b_1 + s)(m_1 + a_2) - b_1 m_1$; $J_2(s) = (b_2 + s)(m_2 + a_2) - a_2 m_2$

$J_3(s) = (b_1 + s)(m_1 + a_1) - b_1 m_1$; $J_4(s) = (b_2 + s)(m_2 + a_1) - b_2 m_2$

$K_1(s) = a_2 b_1 + s(m_1 + a_2)$; $K_2(s) = a_2 b_2 + s(m_2 + a_2)$

$K_3(s) = a_1 b_1 + s(m_1 + a_1)$; $K_4(s) = a_1 b_2 + s(m_2 + a_1)$

$L_1(s) = (b_2 + s)(m_1 + a_2)(m_2 + a_2) + b_1 a_2 (m_2 + a_2) - b_2 m_2 (m_1 + a_2)$

$L_2(s) = (b_1 + s)(m_1 + a_2)(m_2 + a_2) + b_2 a_2 (m_1 + a_2) - b_1 m_1 (m_2 + a_2)$

$L_3(s) = (b_2 + s)(m_1 + a_1)(m_2 + a_1) + b_1 a_1 (m_2 + a_1) - b_2 m_2 (m_1 + a_1)$

$L_4(s) = (b_1 + s)(m_1 + a_1)(m_2 + a_1) + b_2 a_1 (m_1 + a_1) - b_1 m_1 (m_2 + a_1)$

$$v^*(s) = \left(\frac{\phi_1}{\phi_1-\phi_2}\right)\left\{\frac{\phi_2\, b_1}{J_1(s)} + \frac{\phi_2\, b_2}{J_2(s)} - \phi_2^2\, b_1\, b_2 \left[\frac{m_1+\phi_2}{K_1(s)\, L_1(s)} + \frac{m_2+\phi_2}{K_2(s)\, L_2(s)}\right]\right\}$$

$$- \left(\frac{\phi_2}{\phi_1-\phi_2}\right)\left\{\frac{\phi_1\, b_1}{J_3(s)} + \frac{\phi_1\, b_2}{J_4(s)} - \phi_1^2\, b_1\, b_2 \left[\frac{m_1+\phi_1}{K_3(s)\, L_3(s)} + \frac{m_2+\phi_1}{K_4(s)\, L_4(s)}\right]\right\}$$

$$\frac{dv^*(s)}{ds} = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{\frac{-\phi_2\ b_1\ (m_1 + \phi_2)}{[J_1(s)]^2} - \frac{\phi_2\ b_2\ (m_2 + \phi_2)}{[J_2(s)]^2}\right.$$

$$+ \phi_2^2\ b_1\ b_2\ \left[\frac{(m_1 + \phi_2)[K_1(s)\,(m_1 + \phi_2)\,(m_2 + \phi_2) + L_1(s)\,(m_1 + \phi_2)]}{[K_1(s)\ L_1(s)]^2}\right.$$

$$\left.\left. + \frac{(m_2 + \phi_2)\ [K_2(s)\,(m_1 + \phi_2)\,(m_2 + \phi_2) + L_2(s)\,(m_2 + \phi_2)]}{[K_2(s)\ L_2(s)]^2}\right]\right\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left\{\frac{-\phi_1\ b_1\ (m_1 + \phi_1)}{[J_3(s)]^2} - \frac{\phi_1\ b_2\ (m_2 + \phi_1)}{[J_4(s)]^2}\right.$$

$$+ \phi_1^2\ b_1\ b_2\ \left[\frac{(m_1 + \phi_1)[K_3(s)\,(m_1 + \phi_1)\,(m_2 + \phi_1) + L_3(s)\,(m_1 + \phi_1)]}{[K_3(s)\ L_3(s)]^2}\right.$$

$$\left.\left. + \frac{(m_2 + \phi_1)\ [K_4(s)\,(m_1 + \phi_1)\,(m_2 + \phi_1) + L_4(s)\,(m_2 + \phi_1)]}{[K_4(s)\ L_4(s)]^2}\right]\right\}$$

The ETR is

$$\text{ETR} = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{\frac{m_1 + \phi_2}{b_1\ \phi_2} + \frac{m_2 + \phi_2}{b_2\ \phi_2}\right.$$

$$- \frac{b_2\ (m_1 + \phi_2)^2}{b_1\ \phi_2}\left[\frac{2\ b_1\ (m_2 + \phi_2) + b_2\ (m_1 + \phi_2)}{[b_2\ (m_1 + \phi_2) + b_1\ (m_2 + \phi_2)]^2}\right]$$

$$\left. - \frac{b_1\ (m_2 + \phi_2)^2}{b_2\ \phi_2}\left[\frac{2\ b_2\ (m_1 + \phi_2) + b_1\ (m_2 + \phi_2)}{[b_1\ (m_2 + \phi_2) + b_2\ (m_1 + \phi_2)]^2}\right]\right\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left\{\frac{m_1 + \phi_1}{b_1\,\phi_1} + \frac{m_2 + \phi_1}{b_2\,\phi_1}\right.$$

$$- \frac{b_2\,(\beta_1 + \phi_1)^2}{b_1\,\phi_1}\left[\frac{2\,b_1\,(m_2 + \phi_1) + b_2\,(m_1 + \phi_1)}{[b_2\,(m_1 + \phi_1) + b_1\,(m_2 + \phi_1)]^2}\right]$$

$$\left. - \frac{b_1\,(m_2 + \phi_1)^2}{b_2\,\phi_1}\left[\frac{2\,b_2\,(m_1 + \phi_1) + b_1\,(m_2 + \phi_1)}{[b_1\,(m_2 + \phi_1) + b_2\,(m_1 + \phi_1)]^2}\right]\right\} \quad (5)$$

$$\frac{d^2 v^*(s)}{ds^2} = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{\frac{2\,\phi_2\,b_1\,(m_1 + \phi_2)}{(\mathrm{J}_1(\mathrm{s}))^3} + \frac{2\,\phi_2\,b_2\,(m_2 + \phi_2)}{(\mathrm{J}_2(\mathrm{s}))^3}\right.$$

$$- \phi_2^2\,b_1\,b_2\left[\frac{2\,(m_1 + \phi_2)^3}{(K_1(s)\,\mathrm{L}_1(s))^3}\left[K_1(s)\,\mathrm{L}_1(s)\,(m_2 + \phi_2) - (\mathrm{K}_1(s)\,(m_2 + \phi_2) + \mathrm{L}_1(s))^2\right]\right.$$

$$\left.\left. + \frac{2\,(m_2 + \phi_2)^3}{(K_2(s)\,\mathrm{L}_2(s))^3}\left[\mathrm{K}_2(s)\,\mathrm{L}_2(s)\,(m_1 + \phi_2) - (\mathrm{K}_2(s)\,(m_1 + \phi_2) + \mathrm{L}_2(s))^2\right]\right]\right\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left\{\frac{2\,\phi_1\,b_1\,(m_1 + \phi_1)}{(\mathrm{J}_3(\mathrm{s}))^3} + \frac{2\,\phi_1\,b_2\,(m_2 + \phi_1)}{(\mathrm{J}_4(\mathrm{s}))^3}\right.$$

$$+ \phi_1^2\,b_1\,b_2\left[\frac{2\,(m_1 + \phi_1)^3}{(K_3(s)\,\mathrm{L}_3(s))^3}\left[K_3(s)\,\mathrm{L}_3(s)\,(m_2 + \phi_1) - (\mathrm{K}_3(s)\,(m_2 + \phi_1) + \mathrm{L}_3(s))^2\right]\right.$$

$$\left.\left. + \frac{2\,(m_2 + \phi_1)^3}{(K_4(s)\,\mathrm{L}_4(s))^3}\left[K_4(s)\,\mathrm{L}_4(s)\,(m_1 + \phi_1) - (\mathrm{K}_4(s)\,(m_1 + \phi_1) + \mathrm{L}_4(s))^2\right]\right]\right\}$$

Let $\mathrm{L}_{1i} = \left(L_i(s)\right)_{s=0}$, i = 1, 2

Then,

$$(ETR^2) = \left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{\frac{2(m_1 + \phi_2)^2}{(b_1\ \phi_2)^2} + \frac{2(m_2 + \phi_2)^2}{(b_2\ \phi_2)^2} - \phi_2^2\ b_1\ b_2\left[\frac{2(m_1 + \phi_2)^3}{(L_{11}\ \phi_2\ b_1)^3}(L_{11}a_2b_1\right.\right.$$

$$(m_2 + a_2) + (a_2b_1)^2 (m_2 + a_2)^2 + (L_{11})^2) + \frac{2(m_2 + \phi_2)^3}{(L_{12}\ \phi_2\ b_2)^3}(L_{12}\ \phi_2\ b_2\ (m_1 + \phi_2)$$

$$\left.\left. + (\phi_2\ b_2)^2\ (m_1 + \phi_2)^2 + (L_{12})^2)\right]\right\} - \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left\{\frac{2(m_1 + \phi_1)^2}{(b_1\ \phi_1)^2} + \frac{2(m_2 + \phi_1)^2}{(b_2\ \phi_1)^2}\right.$$

$$-\phi_1^2\ b_1\ b_2\left[\frac{2(m_1 + \phi_1)^3}{(L_{13}\ \phi_1\ b_1)^3}(L_{13}a_1b_1\ (m_2 + a_1) + (a_1b_1)^2(m_2+a_1)^2+(L_{13})^2)\right.$$

$$\left.\left. + \frac{2(b_2 + \phi_1)^3}{(L_{14}\ \phi_1\ b_2)^3}(L_{14}\ \phi_1\ b_2\ (m_1 + \phi_1) + (\phi_1\ b_2)^2\ (m_1 + \phi_1)^2 + (L_{14})^2)\right]\right\} \quad (6)$$

$$VTR = (ETR^2) - (ETR)^2$$

$$= \left\{\left(\frac{\phi_1}{\phi_1 - \phi_2}\right)\left\{\frac{2(m_1 + \phi_2)^2}{(b_1\ \phi_2)^2} + \frac{2(m_2 + \phi_2)^2}{(b_2\ \phi_2)^2} - \phi_2^2\ b_1\ b_2\left[\frac{2(m_1 + \phi_2)^3}{(L_{11}\ \phi_2\ b_1)^3}(L_{11}a_2b_1\right.\right.\right.$$

$$(m_2 + a_2) + (a_2b_1)^2 (m_2 + a_2)^2 + (L_{11})^2) + \frac{2(m_2 + \phi_2)^3}{(L_{12}\ \phi_2\ b_2)^3}(L_{12}\ \phi_2\ b_2\ (m_1 + \phi_2)$$

$$\left.\left. + (\phi_2\ b_2)^2\ (m_1 + \phi_2)^2 + (L_{12})^2)\right]\right\} - \left(\frac{\phi_2}{\phi_1 - \phi_2}\right)\left\{\frac{2(m_1 + \phi_1)^2}{(b_1\ \phi_1)^2} + \frac{2(m_2 + \phi_1)^2}{(b_2\ \phi_1)^2}\right.$$

$$-\phi_1^2\ b_1\ b_2\left[\frac{2(m_1 + \phi_1)^3}{(L_{13}\ \phi_1\ b_1)^3}(L_{13}a_1b_1\ (m_2 + a_1) + (a_1b_1)^2(m_2+a_1)^2+(L_{13})^2)\right.$$

$$+ \frac{2(b_2 + \phi_1)^3}{(L_{14}\ \phi_1\ \mathrm{b}_2)^3} (\mathrm{L}_{14}\ \phi_1\ b_2\ (m_1 + \phi_1) + (\phi_1\ b_2)^2\ (m_1 + \phi_1)^2 + (\mathrm{L}_{14})^2) \Bigg]\Bigg\}\Bigg\}$$

$$-\Bigg\{ \left(\frac{\phi_1}{\phi_1 - \phi_2}\right) \Bigg\{ \frac{m_1 + \phi_2}{b_1\ \phi_2} + \frac{m_2 + \phi_2}{b_2\ \phi_2}$$

$$- \frac{b_2\ (m_1 + \phi_2)^2}{b_1\ \phi_2} \left[\frac{2\ b_1\ (m_2 + \phi_2) + b_2\ (m_1 + \phi_2)}{[b_2\ (m_1 + \phi_2) + b_1\ (m_2 + \phi_2)]^2}\right]$$

$$- \frac{b_1\ (m_2 + \phi_2)^2}{b_2\ \phi_2} \left[\frac{2\ \mathrm{b}_2\ (m_1 + \phi_2) + b_1\ (m_2 + \phi_2)}{[b_1\ (m_2 + \phi_2) + b_2\ (m_1 + \phi_2)]^2}\right]\Bigg\}$$

$$- \left(\frac{\phi_2}{\phi_1 - \phi_2}\right) \Bigg\{ \frac{m_1 + \phi_1}{b_1\ \phi_1} + \frac{m_2 + \phi_1}{b_2\ \phi_1} - \frac{b_2\ (\beta_1 + \phi_1)^2}{b_1\ \phi_1} \left[\frac{2\ b_1\ (m_2 + \phi_1) + b_2\ (m_1 + \phi_1)}{[b_2\ (m_1 + \phi_1) + b_1\ (m_2 + \phi_1)]^2}\right]$$

$$- \frac{b_1\ (m_2 + \phi_1)^2}{b_2\ \phi_1} \left[\frac{2\ b_2\ (m_1 + \phi_1) + b_1\ (m_2 + \phi_1)}{[b_1\ (m_2 + \phi_1) + b_2\ (m_1 + \phi_1)]^2}\right]\Bigg\}^2$$

NUMERICAL ILLUSTRATION

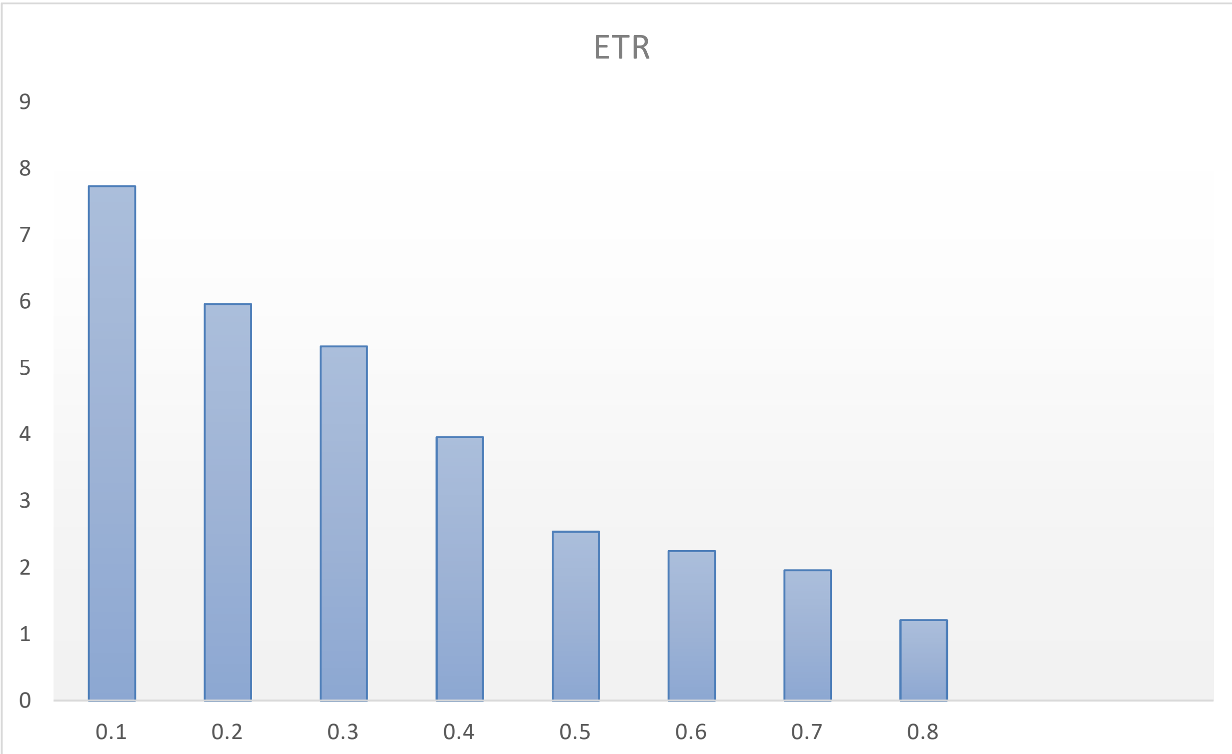
The estimations of ETR and VTR can be determined numerically using the above expressions when the estimations of the different parameters are given.

Table 1 ETR

b_1	ETR
0.1	7.7342
0.2	5.9625
0.3	5.3265
0.4	3.9621
0.5	2.5423
0.6	2.2523
0.7	1.9623
0.8	1.2123

$(L_{11} = 0.1, b_2 = 0.2, m_1 = 0.1, m_2 = 0.2, \phi_1 = 0.1, \phi_2 = 0.2, a_1 = 0.4)$

Figure 1



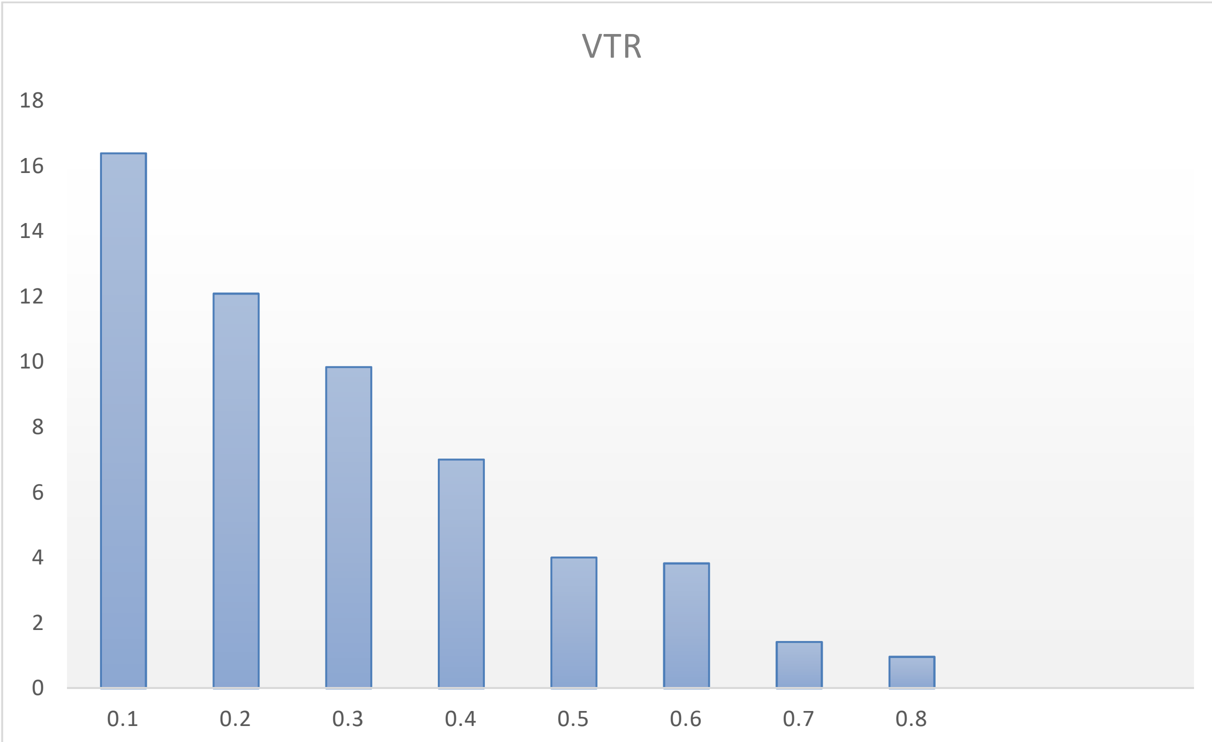
Effect of mean survival on ETR, b_1 is shown in Y-axis and ETR in x–axis

Table 2 VTR

b_1	**VTR**
0.1	16.4015
0.2	12.0970
0.3	9.8451
0.4	7.0127
0.5	4.0064
0.6	3.8286
0.7	1.4216
0.8	0.9652

($L_{11} = 0.1, b_2 = 0.2, m_1 = 0.1, m_2 = 0.2, \phi_1 = 0.1, \phi_2 = 0.2, a_1 = 0.4$

Figure 2



Effect of mean survival on VTR,$b_1$is showninYaxisandVTRinx–axis

Conclusions

From the above tables, when $b_1$increases and keeping all the parameters fixed, the ETR and VTR decreases.

For genuine applications, the consequences of any exploration work ought to be reasonable. On account of stochastic models this is especially fundamental since the outcomes determined depend on genuine components. In any industry or association, the uses of stochastic model are of incredible need and it is likewise helpful in each territory of human action. It is essential to distinguish those regions of human action where the disequilibrium emerges on the interest for labor and the supply. For the advancement of human asset administration the change of genuine circumstances into scientific model and distinguishing proof of those regions are to be broke down.

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