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Estimated Average Time for Recruitment of Company Employees Based on Kumaraswamy Distribution

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Abstract

Recruitment of employees in a company is a process starting from selecting and receiving prospective employees, in order to find workers who are able to work in a company. However, companies must know when recruitment will open. The purpose of this research is to find out how long the average opportunity time of recruitment is. The method used is the Kumaraswamy distribution with three parameters α, β, λ as benchmarks for the estimated recruitment time, in order to find out how long the chances of the recruitment lasting using a simplified survival function using the properties of the Laplace transform. Based on the estimation of the average time of recruitment, the results show that the greater the value of the parameters α, β, λ the less chance the average recruitment time is or the tighter the prospective employees are accepted.

Keywords: Kumaraswamy distribution, survival function, Laplace transform, employee recruitment, parameters.

1. Introduction

Recruitment is the process of determining and attracting capable applicants to work in a company. The aim of recruitment is to receive as many applicants as possible according to the company's qualification needs from various sources so that it is possible to select prospective employees with the highest quality from the best. Each company usually has a management team to predict the expected time for each company (Simamora, 2006).

Human Resource Management (HR) is important in achieving goals. Generally, company leaders expect good performance from each employee in carrying out the tasks assigned by the company. The company carries out very strict selection. According to Sudiro (2011), selection is the process of selecting individuals who have relevant qualifications to fill positions in a company.

Many companies are engaged in production, marketing and other business activities. All companies are highly dependent on labor availability. Recruitment also cannot be done at any time, the fact is that recruitment involves costs, time and energy. Therefore, the time interval between hiring decisions is held by the management team in a company because decisions are taken by management. Therefore, the management team in a company must have a threshold level that has been set by the company (Rajarathinam & Manoharan, 2016).

Previous research entitled "Time to Recruitment In An Organization Through Three Parameters Generalized Exponential Model" by Kannadasan et al (2013). Next, we will replace the exponential distribution with the Kumaraswamy distribution with three parameters to determine how long the recruitment opportunity for a company will last.

In this study, three parameters of the Kumaraswamy distribution, namely α, β, λ, are discussed to estimate the average employee recruitment time, where to get how long the recruitment time is likely to last using a simplified survival function using the properties of the Lapace transformation to get expectation value and variance value.

2. Kumaraswamy Distribution for Estimating Average Recruitment Time

The Kumaraswamy distribution is a distribution of continuous random variables in probability theory and statistics. Kumaraswamy Distribution was introduced by a person named Poondi Kumaraswamy. The Kumaraswamy distribution is usually used for lower and upper bound variables (Nadarajah & Eljabri, 2013).

Definition 2.1 Jones (2009) The density function of the Kumaraswamy distribution is

$$f(x\colon \alpha,\beta) = \alpha\beta(1+x)^{-(\alpha+1)}(1-(1+x)^{-\alpha})^{\beta-1}, \tag{1}$$

where $0 < x < \infty$, $\alpha, \beta > 0$.

Furthermore, the Kumaraswamy distribution can be added with a positive parameter λ so the density function is as follows:

$$f(x;\alpha,\beta,\lambda) = \alpha\beta\lambda(1+x)^{-(\alpha+1)}(1-(1+x)^{-\alpha})^{\beta\lambda-1}, \tag{2}$$

where $0 < x < \infty, \alpha, \beta, \lambda > 0$.

Meanwhile, the cumulative function of the Kumaraswamy distribution is as follows:

$$F(x;\alpha,\beta,\lambda) = (1-(1+x)^{-\alpha})^{\beta\lambda} \tag{3}$$

X is a random variable, so the average of X is called the expected value or expectation of X and is symbolized by $E(X)$.

Definition 2.2 Ramachandran and Tsokos (2020) If X is a continuous random variable with a probability density function $f(x)$, then the expectation value of $X, E(X)$ is defined as

$$E(X) = \int_{-\infty}^{\propto} xf(x)\, dx. \tag{4}$$

If X is a random variable with a probability density function $f(x)$. Apart from expectation, the following property of opportunity is variance. The nature of this opportunity explains the level of diversity in the values of the random variables studied. The following are several definitions and theorems for calculating the variance value of a random variable.

Definition 1. Ramachandran & Tsokos (2020) Suppose X is a random variable with expectation μ then the variance of the random variable

$$\sigma^2 = E[(X-\mu)^2]. \tag{5}$$

Definition 2. Spigel et al (2004) Let T be a random variable that represents the time of employee recruitment. The survival function is the probability that an individual will survive for more than time t, which is denoted by $S(t)$ and is defined

$$\begin{aligned} S(\mathrm{t}) &= \mathrm{P}(\mathrm{T} \geq \mathrm{t}), \\ &= 1 - \mathrm{P}(\mathrm{T} \leq \mathrm{t}), \\ S(\mathrm{t}) &= 1 - F(\mathrm{t}). \end{aligned} \tag{6}$$

Definition 2.5 Spiege (1999) Let $f(t)$ be a function of t for $t > 0$. Then the Laplace transform of $f(t)$ is expressed by $L[f(t)]$, defined as

$$\mathcal{L}[f(\mathrm{t})] = F(s) = \int_0^\infty e^{-st} f(t)dt. \tag{7}$$

The function $F(s)$ is the Laplace transform of $f(t)$.

3. Research Methodology

This research was carried out in the form of data simulation with three parameters from the Kumaraswamy distribution. The stages in this article are as follows:

a. Find out how long recruitment takes based on the Kumaraswamy distribution with the help of a simplified survival function using the properties of the Laplace transform.
b. Estimated average recruitment time based on three kumaraswamy distribution parameters.
c. Look for expected value and variance to determine the variability of hiring times.
d. Data simulation based on Kumaraswamy's three distribution parameters.

4. Estimated Average Time for Recruitment of Company Employees Based on Kumaraswamy Distribution

The density function and cumulative function in the kumaraswamy distribution in Definition 2.1, equation (2) can produce a parameter $\boldsymbol{\lambda}$ which is in equation (6) which is three parameters of the kumaraswamy distribution with the cumulative function being.

$$F(x;\alpha,\beta,\lambda) = (1-(1+x)^{-\alpha})^{\beta\lambda} \tag{9}$$

The estimate of the average recruitment time is obtained by determining how long a company will remain open for recruitment due to the large number of employees leaving, therefore the following equation is used to find out:

$$\bar{H}(x) = 1 + (x)^{\beta\lambda}. \tag{10}$$

The departure of employees from the company will reduce the effectiveness of the system, so the following equation is used:

$$P(X_i < Y) = \int_0^\infty g_k(x).\bar{H}(x)\, dx, \tag{11}$$

$g_k(x)$ is the result of the Laplace transformation of the convolution property and $\bar{H}(x)$ is the average employee turnover. The survival function shows that the cumulative threshold value does not match the expected time in recruitment and will last longer than the expected time with the equation, namely:

$$S(T) = P(T > t),$$
$$= \sum_{k=0}^{\infty} P,$$

P is the total cumulative threshold value where k is $(0, t]$, to determine policy decisions for each company, the following equation is used:

$$V_k(\,t) = F_k(t) - F_{k+1}(t). \tag{12}$$

The random variable c shows the inter-arrival time of recruitment which follows the three parameters of the Kumaraswamy distribution

$$I*(s) = \frac{[1 - g*(\beta\lambda)]f*(s)}{[1 - g*(\beta\lambda)\, f*(s)]}, \tag{13}$$

with $f*(s) = \frac{c}{c+s}$.

Based on equation (4.16), it is obtained

$$I*(s) = \frac{[1 - g*(\beta\lambda)]\frac{c}{c+s}}{\left[1 - g*(\beta\lambda)\frac{c}{c+s}\right]},$$
$$I*(s) = \frac{[1 - g*(\beta\lambda)]c}{\left[1 - g*(\beta\lambda)\frac{c}{c+s}\right]c+s},$$
$$I*(s) = \frac{c[1 - g*(\beta\lambda)]}{[c + s - g*(\beta\lambda).c]},$$
$$I*(s) = \frac{c[1 - g*(\beta\lambda)]}{[c + s - g*(\beta\lambda).c]}. \tag{14}$$

Next, look for the expected value from equation (4.17), then the following equation is obtained:

$$E(T) = \frac{[c + s - g*(\beta\lambda).c].0 - c[1 - g*(\beta\lambda)].1}{[c + s - g*(\beta\lambda).c]^2},$$
$$E(T) = \frac{c[1 - g*(\beta\lambda)]}{[c + s - g*(\beta\lambda).c][c + s - g*(\beta\lambda).c]}, \tag{15}$$

with $E(T) = -\frac{d}{ds} I*(s)$,

Suppose $s = 0$ then equation (15) is:

$$E(T) = \frac{c[1 - g*(\beta\lambda)]}{[c - g*(\beta\lambda).c][c - g*(\beta\lambda).c]},$$
$$E(T) = \frac{1}{c[1 - g*(\beta\lambda)]}, \tag{16}$$

simplify equation (16) for example

$$g*(.) = (\alpha),$$
$$g*(\beta\lambda) = \frac{\alpha}{\alpha + (\beta\lambda)},$$

The resulting equation is obtained as follows:

$$E(T) = \frac{1}{c\left[1 - \frac{\alpha}{\alpha + (\beta\lambda)}\right]}, \tag{17}$$

simplifying equation (17) the following results are obtained:

$$E(T) = \frac{\alpha + (\beta\lambda)}{c[\alpha(\alpha + (\beta\lambda))]},$$

$$E(T) = \frac{\alpha + (\beta\lambda)}{c[\alpha^2 + \alpha(\beta\lambda)]}. \tag{18}$$

Next, looking for the expected value $E(T^2)$ from equation (16), the following results are obtained:

$$E(T^2) = \frac{c[1 - g*(\beta\lambda)].0 - 1.1}{c[1 - g*(\beta\lambda)]c[1 - g*(\beta\lambda)]},$$

$$= \frac{c[1 - g*(\beta\lambda)].0 - 1}{c[1 - g*(\beta\lambda)]c[1 - g*(\beta\lambda)]},$$

$$E(T^2) = \frac{2}{c^2[1 - g*(\beta\lambda)]^2}, \tag{19}$$

with

$$E(T^2) = -\frac{d^2}{ds^2}\mathrm{I}*(\mathrm{s}),$$

where $s = 0$, to simplify equation (4.22) let's say

$$g*(.) = (\alpha),$$

$$g*(\beta\lambda) = \frac{\alpha}{\alpha + (\beta\lambda)},$$

then the following equation is obtained:

$$E(T^2) = \frac{2}{c^2\left[1 - \frac{\alpha}{\alpha + (\beta\lambda)}\right]^2}, \tag{20}$$

simplifying equation (20) is obtained

$$E(T^2) = \frac{2[\alpha + (\beta\lambda)]^2}{c^2[(\alpha + \beta\lambda)]^2},$$

$$E(T^2) = \frac{2[\alpha + (\beta\lambda)]^2}{c^2[\alpha^2 + \alpha(\beta\lambda)]^2}, \tag{21}$$

To find the variance value, substitute equation (18) and equation (21) using Definition 2.3 to obtain the following:

$$V(T) = \frac{[\alpha + (\beta\lambda)]^2}{c^2[\alpha^2 + \alpha(\beta\lambda)]^2}. \tag{22}$$

The following is an estimate of the average time for employee recruitment in a company. To find out the average time, estimates for recruitment follow the three parameter Kumaraswamy distribution with inter-arrival time "c" by setting the three parameter values $\alpha = 0.5,1,1.5,2. \beta = 0.5,1,1.5,2.$ and $\lambda = 0.5,1,1.5,2.$ Adjusting the expected time values in the same way as the model variance values such as this provides possible clues regarding the consequences of infection for the time required for recruitment, etc.

The results of the expectation value and variance value with three parameters from the Kumaraswamy distribution, using R software for graphic results where the combination of parameter values α, β, λ. first to get the $E(T)$ value and the $V(T)$ value from the parameter α. The results can be shown in Figure 1.

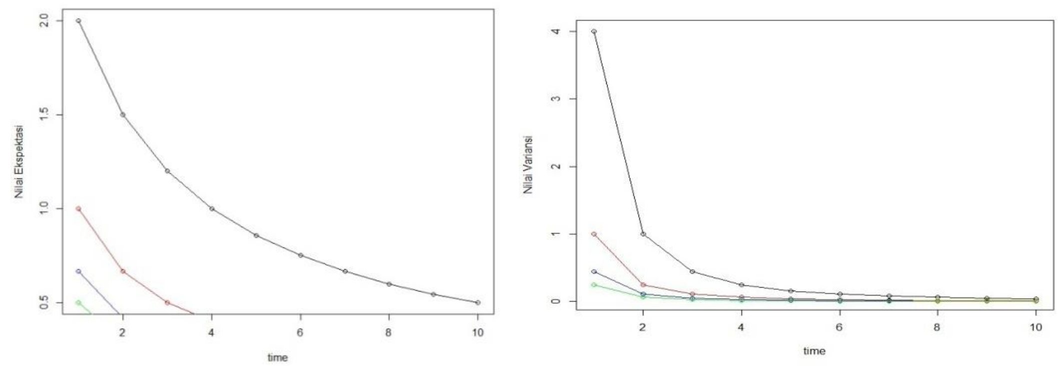

Figure 1: Expectation value and variance of parameters α increase and β, λ remain constant

Based on Figure 1, it is known that when the values for the parameters $\alpha = 0.5,1,1.5,2$. The results of expectations and variance in Figure 1 show that when the parameter value is greater, the average recruitment time decreases with the parameter values β and λ remaining constant. The black curve shows the value $\alpha = 0.5$, for the red curve the value $\alpha = 1$, for the blue curve the value $\alpha = 1.5$, while for the green curve the value $\alpha = 2$. The results can be shown in Figure 2.

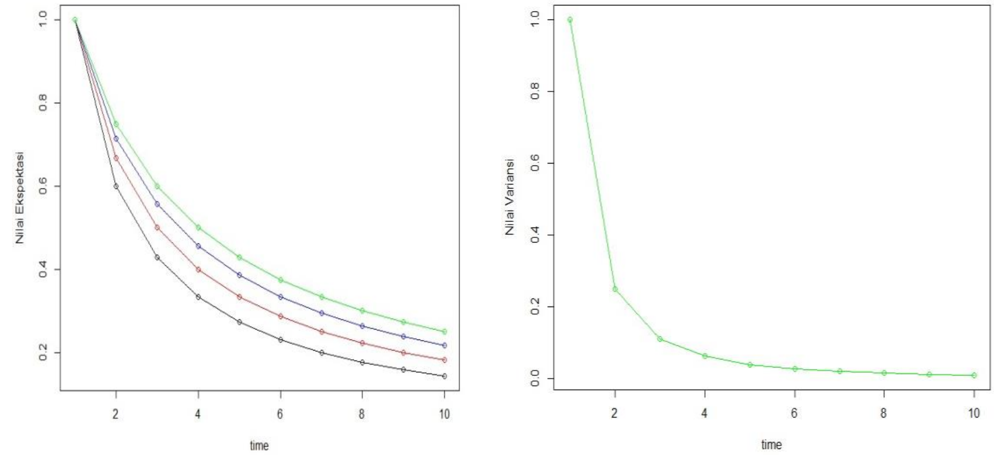

Figure 2: Expectation value and variance of parameters β increase and α, λ remain constant

Based on Figure 2, it is known that when the values for the parameters $\beta = 0.5,1,1.5,2$. The results of expectations and variance in Figure 2 show that when the parameter value is greater, the average recruitment time decreases. For the results of expectations, it can be said to produce an average value over time that is almost the same. The variance for parameter β is the same value so that there is an accumulation of each graph where the parameter values α and λ are fixed. The black curve shows the value $\beta = 0.5$, for the red curve the value $\beta = 1$, for the blue curve the value $\beta = 1.5$, while for the green curve the value $\beta = 2$. The results can be shown in Figure 1.

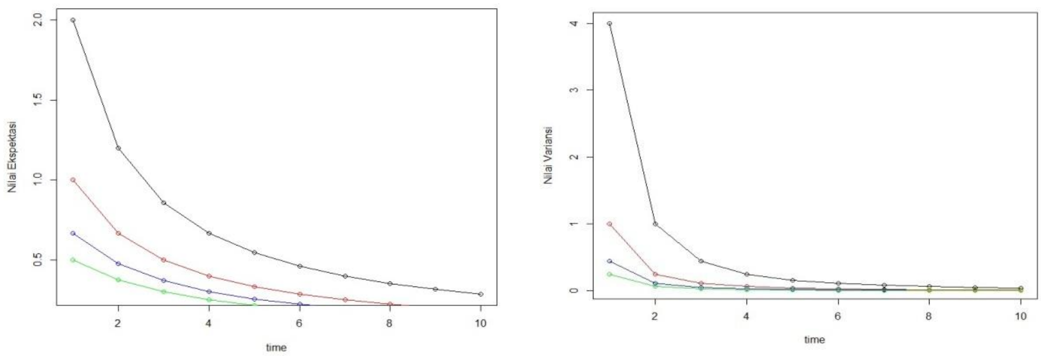

Figure 3. The expectation value and variance of the parameter λ increase and α, β are the same

Based on Figure 3, it is known that when the values for the parameters $\lambda, \alpha, \beta = 0.5,1,1.5,2$. The results of expectations and variance in Figure 3 show that when the parameter value is greater, the average recruitment time decreases. For the results of expectations, it can be said to produce an average value over time with almost the same variance so that there is a buildup from the sixth recruitment, where every chart. The black curve shows the value λ, α, $\beta = 0.5$, for the red curve the value $\lambda, \alpha, \beta = 1$, for the blue curve the value $\lambda, \alpha, \beta = 1.5$, while for the green curve the value $\lambda, \alpha, \beta = 2$.

5. Conclusion

Based on the discussion that has been presented, it can be concluded that the results of estimating the average time for recruiting employees using three Kumaraswamy distributions, produce an average time value in the form of expected value and variance for each recruitment which shows that when the parameter values α, β, λ increase, the opportunity The average employee recruitment time is decreasing and the chances of prospective employees being accepted are also getting smaller. Meanwhile, the value of the parameter λ was deliberately given the same value as the parameters α, β to find out different results, but the resulting expected value and variance were almost the same when the value of the parameter α. So, changes in parameter values in α, β, λ affect the estimated average probability of employee recruitment time.

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