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MULTIDISCIPLINARY RESEARCH FOR RURAL INNOVATION

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14-15 NOVEMBER 2018

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Preface

Papers

JOURNAL LINKS

PAPER

The Power of Weibull and Exponential Distributions On Testing Parameters Shape

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The Power of Weibull and Exponential Distributions On Testing Parameters Shape

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Abstract. We study the power in testing parameter shape of the Weibull and Exponential distributions and analyze it graphically. The power and plot of their graphs are computed using *R*-code. The results showed that the power of the distribution is depended on the parameter shapes.

2010 Mathematics Subject Classification : 62H10 62E17 62Q05
*Keyword***:** Distributions, parameter shape and power and size.

1. Introduction

The concept of power is defined as probability to reject H_0 *under* $H_a : \theta = \theta_a$ for testing hypothesis $H_0 : \theta = \theta_0$ versus $H_1 : \theta \neq \theta_0$, on parameter θ. The size is then given *under* $H_0 : \theta = \theta_0$. Here, we then wrote as $\pi(\theta_a) = P(reject\ H_0 \mid \theta = \theta_a)$ and $\alpha^* = \alpha(\theta_0) = P(reject\ H_0 \mid \theta = \theta_0)$ (Wackerly [4]). Note that α (level of significant) is commonly a special case of the $\alpha^* = \alpha\left(\theta\right)$.

Many authors already studied the power and size in computing the probability integral of the cumulative distribution function (cdf) of the distributions in testing intercept using non-sample prior information (NSPI), such as Pratikno [2], Khan and Pratikno [7] and Khan [8]. Moreover, Pratikno [3] and Khan et al. [14] already used the power ans size to compute the cdf of the bivariate noncentral *F (*BNCF*)* distribution of the pre-test test (PTT) in multivariate simple regression model (MSRM), multiple regression model (MRM) and parallel regression model (PRM). Furthermore, Khan [8,9], Khan and Saleh [11, 12,13], Khan and Hoque [10], Saleh [1], Yunus [6], and Yunus and Khan [5] also contributed in computing the values of the power of the test (PTT) on the estimation areas. In the context of the hypothesis testing with NSPI, the bivariate noncentral *F* distribution is used to compute the power of the pre-test test (PTT) on the MSRM, MRM and PRM. The formula of the power and size of the tests of the UT, RT and PTT are found in Pratikno [3] in testing hypothesis one-side or two-side hypothesis. Due to the probability integral of the power and size of the PTT is not simple and tend to be complex, so they are computed using *R-code*. The detail of the BNCF is found on Pratikno [2] and Khan et al.[14].

To compute the power of the Weibull and Exponential distributions and its application on the regression models, the steps of the research methodology are (1) find the sufficiently sstatistics, (2) determine the rejection area of the distributions using *uniformly most powerful test* (UMPT), and (3) derive the formula of the power of the distributions in testing one-side (or two-side) hypothesis.

The research presented the introduction in Section 1. Analysis of the power and size of the distributions are obtained in Section 2. Section 3 described the conclusion of the research.

2. The Power of the Distributions

2.1. The Power of the Weibull Distribution

In this section, we presented the formula and graphs of the power in testing parameters shape (δ , β) for one-side hypothesis on the Weibull distribution. The procedures are as follow: (1) find the statistics cukup, (2) determine the rejection area of the Weibull distribution using *uniformly most powerful test* (UMPT), (3) derive the formula of the power and compute the values of power and then plot them. This distribution is often applied in life testing of the components, so it is like Exponential distribution.

Let, X be a random variable follows the Weibull distribution, the cdf and probability density function (pdf) of this distribution are then given as, respectively,

$$F(x)=\begin{cases}1-e^{-\left(\frac{x}{\delta}\right)^{\beta}} & , x\geq 0\\ 0 & , \text{otherwise}\end{cases} \qquad (1)$$

with parameter shape $\delta > 0$ and scale parameter $\beta > 0$, and

$$f(x)=\frac{dF(x)}{dx}=f(x)=\begin{cases}\frac{\beta}{\delta}\left(\frac{x}{\delta}\right)^{\beta-1}e^{-\left(\frac{x}{\delta}\right)^{\beta}} & , x\geq 0\\ 0 & , \text{otherwise}\end{cases} \qquad (2)$$

To compute the power of the distribution, we have to compute the sufficiently sstatistics. It is used to find the rejection area, as follow: (1) first define the *likelihood* function of the Weibull distribution as

$$f(x_1,\ldots,x_n\,|\,\delta)=g(s,\delta)\cdot h(x_1,\ldots,x_n) \qquad (3)$$

with $f(x)=\frac{\beta}{\delta}\left(\frac{x}{\delta}\right)^{\beta-1}e^{-\left(\frac{x}{\delta}\right)^{\beta}}$, $f(x_1,\ldots,x_n\,|\,\delta)=\prod f(x_i\,|\,\delta)=\frac{\beta}{\delta}\left(\frac{1}{\delta}\right)^{\beta-1}\left(\prod_{i=1}^{n}x_i\right)^{\beta-1}e^{-\left(\frac{1}{\delta}\right)^{\beta}\left(\sum_{i=1}^{n}x_i\right)^{\beta}}$,

$$g(s,\delta)=\frac{\beta}{\delta}\left(\frac{1}{\delta}\right)^{\beta-1} e^{-\left(\frac{1}{\delta}\right)^{\beta} s},\quad h(x_i)=\prod_{i=1}^{n}(x_i)^{\beta-1},\ i=1,2,\ldots,n, \text{ and } s=\sum_{i=1}^{n} x_i^{\beta}\ .$$

(2) using mathematical technique, we then get, $s=\sum_{i=1}^{n} x_i^{\beta}$ be sufficiently statistics of the parameter δ of the Weibull distribution, (3) the rejection region (*RR*) is found by UMPT and we then got as $P(s > \chi^2_{(2n,\alpha)})$, with s is sufficient statistics and δ is parameter shape of the Weibull distribution, and (4) finally, we derive the formula of power of the Weibull distribution for one-side testing hypothesis, $H_0 : \delta = \delta_0$ versus $H_1 : \delta > \delta_1$, is given as

$$\pi(\delta) = P\,(\text{reject } H_0 \mid \text{under } H_1) = P\left(\sum_{i=1}^{n} x_i^{\beta} > k\right) = P\left(\frac{2}{\delta^{\beta}}\sum_{i=1}^{n} x_i^{\beta} > c\right)$$
$$= P\left(\sum_{i=1}^{n} x_i^{\beta} > \chi^2_{(2n,\alpha)}\frac{\delta_0^{\beta}}{2}\right) = P\left(\chi^2 > \left(\frac{\delta_0}{\delta}\right)^{\beta}\chi^2_{(2n,\alpha)}\right), \text{ with } c=\chi^2_{(2n,\alpha)}. \qquad (4)$$

Following Pratikno [3] (here, $\alpha = 0.1, n = 10$ *and* 30) and using the equation (4), we then get the graphs of the power for $\alpha = 0.05$ and n=*40* , β =2,3,4,5, on hypothesis testing $H_0 : \delta = \delta_0 = 1$ versus $H_1 : \delta_0 > 1$, are presented in Figure 1.

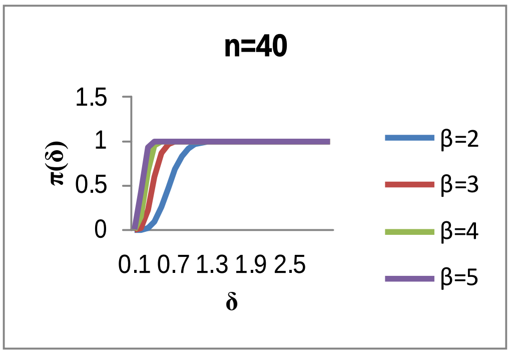

Figure 1. The graphs of power in testing parameter δ at $\alpha = 0.05$

Figure 1. showed that the graphs of the power tend to increase as the sample size (n) and β increase. In our simulation, we see that α has a little significant influence to the curve of the power of the parameter shape, especially when n = *30* (see Pratikno [3])

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2.2.The Power of the Exponential Distribution

Similarly (see Section 2.1.), we then derived the graphs of the power in testing parameters shape (θ) for one-side hypothesis, $H_0:\theta=\theta_0$ versus $H_1:\theta>\theta_0$, on the Exponential distribution. Let, X be a random variable follows the Exponential distribution, the probability density function (pdf) is given as $f(\theta)=\frac{1}{\theta}e^{-\frac{x}{\theta}}, x>0$ sehingga $f(x_1,\cdots x_n|\theta)=\prod_{i=1}^{n}f(x_i|\theta)=\frac{1}{\theta^n}e^{-\frac{1}{\theta}\left(\sum_{i=1}^{n}x_i\right)}$. Therefore, we got $g(s,\theta)=\frac{1}{\theta^n}e^{-\frac{1}{\theta}(s)}$ with $h(x_i)=1$ nd sufficiently statistics s= $\left(\sum_{i=1}^{n}x_i\right)$.

By definition of the power and size, we derive the formula of the power and size of the Exponential distribution in testing parameter shape of the hypothesis, $H_0:\theta=\theta_0$ versus $H_1:\theta>\theta_0$, as follow, respectively.

$$\pi(\theta)=P(reject\ H_0|under\ H_1)=P\left(\sum_{i=1}^{n}x>k\right)=P\left(\frac{2}{\theta^n}\sum_{i=1}^{n}x>\chi^2_{2n}\right)$$
$$=P\left(\chi^2>\frac{\theta_1}{\theta^n}\chi^2_{2n}\right)=P\left(\chi^2>c_1\right)=\int_{c_1}^{\infty}f(x)dx, \text{ and} \tag{5}$$

$$\alpha(\theta_0)=\alpha(\theta)=P(reject\ H_0|under\ H_0)=P\left(\chi^2>\frac{\theta_0}{\theta^n}\chi^2_{2n}\right)$$
$$=P\left(\chi^2>c_0\right)=\int_{c_0}^{\infty}f(x)dx, \tag{6}$$

where *f(x)* follows Chi-Square distribution with *2n* degrees of freedom. Due to the probability integral of the power and size in the equation (5) and (6) are not simple and very complex, so they are computed using *R-code*. Similarly, the graphs are also figured using R-code. From the equation (5) and (6), we see that the power and size are influenced by parameter shape as well.

3. Conclusion

The reserach studied the power in testing parameter shape of the distributions and analyze it graphically. To compute the power and plot of their graphs, *R-code* is used. The results showed that the power of the distribution is influenced by the parameter shapes.

Acknowledgement

I thankfully acknowledge the excellent support of the Jenderal Soedirman University for providing me granting of research.

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[1] A.K.Md.E.Saleh, 2006, Theory of preliminary test and Stein-type estimation with applications. John Wiley and Sons, Inc., New Jersey.

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Program

First Day	Wednesday, 14th November 2018
08.00 - 08.30	Registration
08.30 – 09.00	Opening Ceremony: National Anthem "Indonesia Raya" Traditional Dance Welcoming Speech by Committee Chair (Dr. Amin Fatoni) Welcoming Speech by Chair of LPPM (Prof. Dr. Rifda Naufalin) Opening Speech by Rector of Unsoed (Prof. Dr. Suwarto)
09.00 – 09.15	Special Award for Lecturers
09.15 – 10.00	Keynote Speech: Assoc. Prof. Dr. Minako Sakai (University of New South Wales, Australia)
10.00 – 10.15	Coffee/Tea Break
10.15 – 11.00	Keynote Speech: Prof. Dr. Hitoshi Habe (Kindai University, Japan)
11.00 – 12.30	Plenary Session 1: Prof. Dr. Mohd. Marsin Sanagi (Universiti Teknologi Malaysia) Prof. Dr. Rifda Naufalin (Jenderal Soedirman University) Dr. Yusril Yusuf (Gadjah Mada University) Dr. Mulyoto Pangestu (Monash University)
12.30 – 13.15	Lunch
13.15 – 15.15	Parallel Session 1
15.15 – 15.30	Coffee/Tea Break
15.30 – 17.30	Parallel Session 2
19.00 – 21.00	Official Dinner
Second Day	**Thursday, 15th November 2018**
07.30 – 08.00	Registration
08.00 – 10.00	Parallel Session 3
10.00 – 10.15	Coffee/Tea Break
10.15 – 11.00	Keynote Speech: Dr. Jesus C. Fernandez (SEAMEO Biotrop)
11.00 – 11.45	Keynote Speech:

First Day	Wednesday, 14th November 2018
	Dr. Nguyễn Hữu Thọ (Thai Nguyen University, Vietnam)
11.45 – 12.30	Lunch
12.30 – 14.00	Plenary Session 2: Prof. Dr. Arief Anshory Yusuf (Padjajaran University) *Dr. Najib Kailani (Sunan Kalijaga State Islamic University)* Dr. M. Falikul Isbah (Gadjah Mada University)
14.00 – 14.45	Keynote Speech: Prof. Dr. Choi Jae Suk (Silla University, South Korea)
14.45 – 15.00	Coffee/Tea Break
15.00 – 17.00	Parallel Session 4
17.00 – 17.15	Closing Ceremony and Award Announcement

8	Formula Optimization and Characterization of Jam based on Carica Fruit (Carica pubescens, L) Santi Dwi Astuti, Erminawati

Group 2
Chair : Dr.Romanus Edy

1	The Power of Weibull and Exponential Distributions On Testing Parameters Shape B. Pratikno, Jajang , S.Y. Layyinah, G.M. Pratidina, and Y. D. Suryaningtiyas
2	The Addition of Liquid Sap Preservatives Made from Lime, Mangosteen peel, and Jackfruit wood on Quality Characteristics of Coconut Sugar Karseno, Tri Yanto
3	Investigation of Hydrolysis Using Cellulase Enzyme Produced From Cow Rumen And Fermentation Method for Producing Ethanol from Nypa (Nypa fruticans Wurmb) Midrib Wiludjeng Trisasiwi, Agus Margiwiyatno, Gunawan Wijonarko
4	The physical recovery models based on fluid manipulation on the body reversibility process in sub-maximum physical exercise. Moh. Nanang Himawan Kusuma, Didik Rilastiyo, Rohman Hodayat, Topo Suhartoyo, Muh. Syafei
5	FEEDING MOCAF BISCUITS ENRICHED WITH IRON AND PROTEIN FROM TEMPEH AND FISH ON HEMOGLOBIN LEVEL OF ANEMIC SPRAGUE DAWLEY RATS Hidayah Dwiyanti, Retno Setyawati, Nur Aini
6	Isolation and characterization of bioactive components of lemongrass (Cymbopogun citratus) Erminawati, Rifda Naufalin, Ike Sitoresmi, Wuryatmo Sidik and Nandarose Rucki
7	Importance-Performance Analysis and Customer Satisfaction Index on Laboratory Services in the Faculty Mathematics and Natural Sciences, University of Jenderal Soedirman Wuryatmo Akhmad Sidik, Sunardi and Supriyanto
8	Application of Concentrates Flower Kecombrang on Edible Coating as Antioxidant to Suppress the Oxidative Damage on Gourami Sausage During Storage Rifda Naufalin, Rumpoko Wicaksono, Erminawati, Poppy Arsil and Kris Imanias Trikasihputri Gulo
9	A review on optimization of lactic acid bacteria for production goat milk yogurt Ibrahim A, Rifda Naufalin, Erminawati, Hidayah Dwiyanti

Group 3
Chair : Dr.Uyi Sulaiman

1	STUDY GRADIENT AND MOISTURE OF SAND EMBANKMENT ON PEAT SUBJECTED VIBRATION POTENTIAL OF LIQUEFACTION *Soewignjo Agus Nugroho a*) Agus Ika Putra b), Muhamad Yusa c), and Syawal Satibi d)*
2	THE EFFECT OF COMPACTION METHOD ON COMPRESSIVE STRENGTH OF SELF COMPACTING CONCRETE (SCC) IN LABORATORY *Agus Maryoto*
3	PETROLOGY AND TRACE ELEMENT STUDY OF IGNEOUS ROCK IN AYAH, KARANGBOLONG DOME, CENTRAL JAVA *Fadlin(a*), Gentur Waluyo(b), Sekar Ramadhani R(c), Wildan Nur H(d), Arifudin Idrus(e)*
4	SLIP SURFACE IDENTIFICATION BASED ON ANALYTICAL ENGINEERING PROPERTIES IN THE WEATHERING OF BRECCIA AT MOUNT PAWINIHAN LANDSLIDE, CENTRAL JAVA, INDONESIA

3. Conclusion

The reserach studied the power in testing parameter shape of the distributions and analyze it graphically. To compute the power and plot of their graphs. *R-code* is used. The results showed that the power of the distribution is influenced by the parameter shapes.

Acknowledgement

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References

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distribution is often applied in life testing of the components, so it is like Exponential distribution.

Let, X be a random variable follows the Weibull distribution, the cdf and probability density function (pdf) of this distribution are then given as, respectively,

$$F(x)=\begin{cases}1-e^{-\left(\frac{x}{\delta}\right)^{\beta}} & ,x\geq 0\\ 0 & ,\text{otherwise}\end{cases} \quad (1)$$

with parameter shape $\delta>0$ and scale parameter $\beta>0$, and

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2.2.The Power of the Exponential Distribution

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sehingga $f(x_1,\cdots x_n|\theta)=\prod_{i=1}^{n} f(x_i|\theta)=\frac{1}{\theta^n}e^{-\frac{1}{\theta}\sum x_i}$. Therefore, we got $g(s,\theta)=\frac{1}{\theta^n}e^{-\frac{1}{\theta}(s)}$ with $h(x)=1$ nd sufficiently statistics s= $\sum_{i=1}^{n} x_i$.

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$$\alpha(\theta_0)=\alpha(\theta)=P(\text{reject } H_0 \text{ under } H_0)=P\left(\chi^2>\frac{\theta_0}{\theta}\chi^2_{2n}\right)$$
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The Power of Weibull and Exponential Distribution on Testing Parameters Shape.

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The Power of Weibull and Exponential Distributions On Testing Parameters Shape

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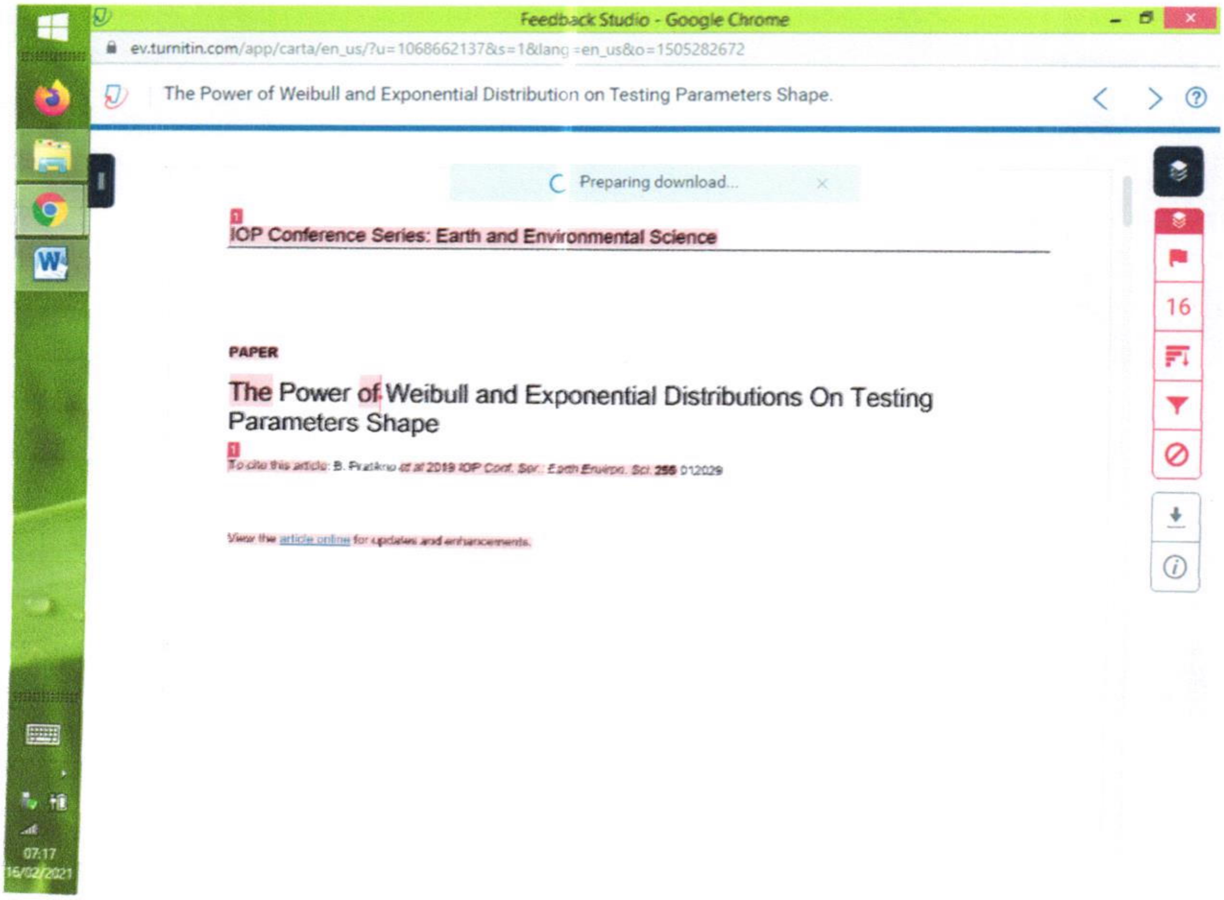
is commonly a special case of the $\alpha^{*} = \alpha(\theta)$.

Many authors already studied the power and size in computing the probability integral of the cumulative distribution function (cdf) of the distributions in testing intercept using non-sample prior information (NSPI), such as Pratikno [2], Khan and Pratikno [7] and Khan [8]. Moreover, Pratikno [3] and Khan et al. [14] already used the power ans size to compute the cdf of the bivariate noncentral *F* (BNCF) distribution of the pre-test test (PTT) in multivariate simple regression model (MSRM), multiple regression model (MRM) and parallel regression model (PRM). Furthermore, Khan [8,9], Khan and Saleh [11, 12,13], Khan and Hoque [10], Saleh [1], Yunus [6], and Yunus and Khan [5] also contributed in computing the values of the power of the test (PTT) on the estimation areas. In the context of the hypothesis testing with NSPI, the bivariate noncentral *F* distribution is used to compute the power of the pre-test test (PTT) on the MSRM, MRM and PRM. The formula of the power and size of the tests of the UT, RT and PTT are found in Pratikno [3] in testing hypothesis one-side or two-side hypothesis. Due to the probability integral of the power and size of the PTT is not simple and tend to be complex, so they are computed using *R-code*. The detail of the BNCF is found on Pratikno [2] and Khan et al.[14].

To compute the power of the Weibull and Exponential distributions and its application on the regression models, the steps of the research methodology are (1) find the sufficiently sstatistics, (2) determine the rejection area of the distributions using *uniformly most powerful test* (UMPT), and (3) derive the formula of the power

The Power of Weibull and Exponential Distribution on Testing Parameters Shape

IOP Conference Series: Earth and Environmental Sciences 255(2019) 012029; doi: 10.1088/1755-1315/255/1/012029



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