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ESTIMATION OF SHAPE (α) AND SCALE (λ) FOR TWO-PARAMETER NEW WEIGHTED EXPONENTIAL DISTRIBUTION BY LEAST SQUARE REGRESSION METHOD

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ABSTRACT

The objective of this paper is to estimate the parameters of New Weighted Exponential distribution with shape parameter(α) and scale parameter(λ). In this heuristic algorithm, the Least Squares Regression method is used to Estimates the parameters of New Weighted Exponential Distribution. We also computed Average Estimate(AE), Variance (VAR), Mean Absolute Deviation (MAD), Mean Square Error(MSE), Relative Error (RE) and Relative Absolute Bias (RAB) for both the parameters under grouped sample based on 1000 simulations to assess the performance of the estimators.
Keywords: New Weighted Exponential Parameters, Grouped sample, Least Square regression method, simulation.

INTRODUCTION

The method of Least Squares is about estimating parameters by minimizing the squared discrepancies between observed data, on the one hand, and their expected values on the other For example, variations in exam results Y are mainly caused by variation inabilities and diligence X of the students or variation in survival times Y are primarily due to variations in environmental conditions X. Given the value of X, the best prediction of Y (in terms of mean square error) is the mean f (X) of Y given X. We say that Y is a function of X plus noise. The least squares criterion is a computationally convenient measure of fit.It corresponds to maximum likelihood estimation when the noise is normally distributed with equal variances.

Least squares is a time-honored estimation procedure that was developed in dependently by Gauss (1795), Adrain Marie-Legendre (1806) and published in the first decade of the nineteenth century. It is perhaps the most widely used technique in geophysical data analysis. Unlike maximum likelihood, which can be applied to any problem for which we know the general form of the joint pdf, in least squares the parameters to be estimated must arise in expressions for the means of the observations. When the parameters appear linearly in these expressions then the least squares estimation problem can be solved in closed form, and it is relatively straight forward to derive the statistical properties for the resulting parameter estimates. Other measures off it are sometimes used, for example, least absolute deviations, which is more robust against outliers. Generally in many of the situations, we face some type of situations of non-monotonic failure rates to supervise the reliability analysis of the data.

In this Chapter, Section - 2, we develop a practical procedure to Estimation of shape (α) and Scale (λ) for Two-Parameter New Weighted Exponential Distribution by using the Least Square Regression Method. Hence we designate these estimators as Least Squares Method. In section -3, we discuss the procedure of observation from simulation result. In this Chapter, we consider two-parameter New Weighted Exponential distribution one Shape and one scale parameter.

1. Least squares Method to Estimate the New Weighted Exponential Distribution parameters:

Let $x_1, x_2, \ldots, x_n$ be a random sample of size n from NWED(α, λ), its Probability Density Function (pdf) and cumulative distribution function(CDF) are given by

$f(x, \alpha, \lambda) = (1+\lambda)\alpha.\ e^{\wedge} - (1+\lambda)\alpha x\ ; x>0, \alpha > 0, \lambda > 0$ (1.1)

α=shape parameter

λ=scale parameter

CDF $F(x;\alpha,\lambda) = 1 - e^{\wedge} -(1+\lambda)\alpha x; \quad x>0, \alpha > 0, \lambda > 0$ (1.2)

$1-F(X) = e^{\wedge}(-(1+\lambda)\alpha x)$ (1.3)

$1+F(X) = 2 - e^{\wedge}(-(1+\lambda)\alpha x)$ (1.4)

$$\frac{1-F(X)}{1+F(X)} = \frac{e^{\wedge}(-(1+\lambda)\alpha x)}{2-e^{\wedge}(-(1+\lambda)\alpha x)} \quad (1.5)$$

Appling log on both sides to (1.5)

$$\text{Log}\,\frac{1-F(X)}{1+F(X)} = \log\frac{e^{\wedge}(-(1+\lambda)\alpha x)}{2-e^{\wedge}(-(1+\lambda)\alpha x)}$$

$$\text{Log}\,\frac{1-F(X)}{1+F(X)} = -(1+\lambda)\alpha x - \log(2 - e^{\wedge}(-(1+\lambda)\alpha x) \quad (1.6)$$

Let us consider U=A+BV

$U = \text{Log}\,\frac{1-F(X)}{1+F(X)}$, V= -X , $A = -\log(2 - e^{\wedge}(-(1+\lambda)\alpha x)$, $B = (1+\lambda)\alpha$

Here, $F(X) = \frac{i}{N+1}$, i=1,2,3……………..N

Where i → The ranked position of data point and N → The total number of units in the sample

$$\tilde{A} = \frac{\left(\sum_{i=1}^{n} v_i^2\right)\left(\sum_{i=1}^{n} u_i\right) - \left(\sum_{i=1}^{n} v_i\right)\left(\sum_{i=1}^{n} v_i u_i\right)}{\left(n\sum_{i=1}^{n} v_i^2\right) - \left(\sum_{i=1}^{n} v_i\right)^2} \quad \ldots(1.7)$$

$$\tilde{B} = \frac{n\left(\sum_{i=1}^{n} v_i u_i\right) - \left(\sum_{i=1}^{n} v_i\right)\left(\sum_{i=1}^{n} u_i\right)}{\left(n\sum_{i=1}^{n} v_i^2\right) - \left(\sum_{i=1}^{n} v_i\right)^2} \quad \ldots(1.8)$$

Once $\hat{A}$ and $\hat{B}$ obtained the values of $\hat{\alpha}$ and $\hat{\lambda}$ can easily be obtained.

2 .Simulation Study:

In order to obtain the least squares regression method estimators of shape (α)and scale (λ) is used to obtain estimators and to study their predictive properties by Average Estimate (AE), Variance (VAR), Standard Deviation (SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB). If $\hat{\psi}_{lm}$ is Least Squares Regression Method estimate of $\hat{\psi}_m$, m=1, 2 where $\psi_m$is a general notation that can be replaced by $\psi_{m_1} = \lambda, \psi_{m_2} = \alpha$ based on sample l, (l=1,2,…,r), then the Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD),Mean Square Error (MSE) and Relative Absolute Bias (RAB) are given respectively by

Average Estimate $(\hat{\psi}_m) = \frac{\sum_{i=1}^{r} \hat{\psi}_{lm}}{r}$

Variance$(\hat{\psi}_m)$ = $\frac{\sum_{i=1}^{r}(\hat{\psi}_{lm} - \overline{\hat{\psi}_{lm}})^2}{r}$

Standard Deviation$(\hat{\psi}_m)$ = $\sqrt{\frac{\sum_{i=1}^{r}(\hat{\psi}_{lm} - \overline{\hat{\psi}_{lm}})^2}{r}}$

Mean Absolute Deviation = $\frac{\sum_{i=1}^{r}(\left|\hat{\psi}_{lm} - \overline{\hat{\psi}_{lm}}\right|)}{r}$

Mean Square Error $(\hat{\psi}_m)$ = $\frac{\sum_{i=1}^{r}(\hat{\psi}_{lm} - \psi_m)^2}{r}$

Relative Absolute Bias$(\hat{\psi}_m)$ =$\frac{\sum_{i=1}^{r}|(\hat{\psi}_{lm} - \psi_m)|}{r\psi_m}$

Simulated Data Sets:

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes *n*=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-1 for the values of the parameters Shape=1 and Scale =1.

TABLE-1

Least Square Regression- Lomax Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.005079	0.000232	0.000000	0.007806	0.009142	0.061977
	λ	0.089842	0.072644	0.005277	0.161716	0.901032	0.089842
3	α	0.000547	0.000003	0.000000	0.000984	0.016317	0.004300
	λ	0.098906	0.088042	0.007751	0.178031	0.900012	0.098906
5	α	0.000880	0.000007	0.000000	0.001584	0.019695	0.006232
	λ	0.098240	0.086860	0.007545	0.176832	0.900031	0.098240
10	α	0.000782	0.000005	0.000000	0.001407	0.064031	0.003099
	λ	0.098437	0.087208	0.007605	0.177186	0.900024	0.098437
15	α	0.000699	0.000004	0.000000	0.001259	0.138732	0.001874
	λ	0.098601	0.087500	0.007656	0.177482	0.900020	0.098601
20	α	-0.000008	0.000000	0.000000	0.000014	5.366395	0.000003
	λ	0.100015	0.090028	0.008105	0.180028	0.900000	0.099985
25	α	-0.000016	0.000000	0.000000	0.000028	5.323288	0.000007
	λ	0.100031	0.090057	0.008110	0.180057	0.900000	0.099969
50	α	0.16004	0.000005	0	0.001644	0.037441	0.022058
	λ	0.760134	0.005269	0.000028	0.056071	0.062804	0.000734
100	α	0.166655	0.000002	0	0.001073	0.022829	9.70607
	λ	1.101546	0.0002	0	0.01104	0.010511	0.101546
200	α	0.167749	0.000008	0	0.002369	0.020117	5.466375
	λ	1.181462	0.002148	0.000005	0.034022	0.035076	0.181462

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes n=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-2 for the values of the parameters Shape= 3 and Scale =1.5.

TABLE-2

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.005079	0.000232	0.000000	0.009142	0.007806	0.061977
	λ	0.096614	0.084008	0.007057	0.173905	0.900115	0.096614
3	α	0.000237	0.000001	0.000000	0.000427	0.005025	0.003338
	λ	0.099842	0.089715	0.008049	0.179715	0.900000	0.099842
5	α	0.000891	0.000007	0.000000	0.001604	0.001184	0.025321
	λ	0.099406	0.088934	0.007909	0.178931	0.900004	0.099406
10	α	-0.000002	0.000000	0.000000	0.000003	6.057651	0.000001
	λ	0.100001	0.090002	0.008100	0.180002	0.900000	0.099999
15	α	0.001881	0.000032	0.000000	0.003385	1.897777	0.001363
	λ	0.098746	0.087757	0.007701	0.177743	0.900016	0.098746
20	α	0.010450	0.000983	0.000001	0.018809	15.079834	0.000263
	λ	0.093034	0.077897	0.006068	0.167461	0.900485	0.093034
25	α	-0.000001	0.000000	0.000000	0.000002	3.618685	0.000001
	λ	0.100001	0.090001	0.008100	0.180001	0.900000	0.099999
50	α	0.198431	0.000002	0	0.001228	0.029144	6.158356
	λ	1.190216	0.002227	0.000005	0.039507	0.038409	0.190216
100	α	0.187068	0.000002	0	0.001002	0.026638	6.83931
	λ	1.175902	0.002141	0.000005	0.040108	0.033083	0.175902
200	α	0.21554	0.000019	0	0.003623	0.029993	4.082366
	λ	1.319061	0.014082	0.000198	0.08322	0.115882	0.319061

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes *n*=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-3 for the values of the parameters Shape=1.5 and Scale =3.

TABLE-3

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.002975	0.000080	0.000000	0.005356	0.006293	0.039228
	λ	0.088098	0.069852	0.004879	0.158577	8.549025	0.029366
3	α	0.003202	0.000092	0.000000	0.005763	0.016949	0.025284
	λ	0.087193	0.068424	0.004682	0.156948	8.552868	0.029064
5	α	0.000376	0.000001	0.000000	0.000677	0.043035	0.001815
	λ	0.098496	0.087314	0.007624	0.177294	8.506037	0.032832
10	α	-0.000007	0.000000	0.000000	0.000013	4.725497	0.000003
	λ	0.100029	0.090052	0.008109	0.180052	8.499884	0.033343
15	α	-0.000007	0.000000	0.000000	0.000013	5.857331	0.000003
	λ	0.100029	0.090052	0.008109	0.180052	8.499885	0.033343
20	α	-0.000140	0.000000	0.000000	0.000252	19.286648	0.000032
	λ	0.100560	0.091011	0.008283	0.181008	8.497763	0.033520

25	α	-0.000539	0.000003	0.000000	0.000970	219.616791	0.000036
	λ	0.102156	0.093923	0.008822	0.183881	8.491422	0.034052
50	α	0.159773	0.000004	0	0.001615	0.037601	0.021315
	λ	0.758433	0.005158	0.000027	0.055423	5.029783	0.000163
100	α	0.166304	0.000002	0	0.001067	0.023119	10.66301
	λ	1.093573	0.00018	0	0.010304	3.634643	0.000268
200	α	0.167362	0.000008	0	0.002335	0.020444	5.857409
	λ	1.171244	0.002013	0.000004	0.032789	3.34636	0.001638

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes *n*=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-4 for the values of the parameters Shape=2 and Scale =1.5.

TABLE-4

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.006605	0.000393	0.000000	0.011889	0.003711	0.070504
	λ	0.093395	0.078504	0.006163	0.168111	0.900436	0.093395
3	α	0.000817	0.000006	0.000000	0.001471	0.016726	0.006362
	λ	0.099183	0.088535	0.007838	0.178529	0.900007	0.099183
5	α	- 0.000685	0.000004	0.000000	0.001233	21.551369	0.000147
	λ	0.100685	0.091237	0.008324	0.181233	0.900005	0.099315
10	α	- 0.000122	0.000000	0.000000	0.000219	4.697829	0.000056
	λ	0.100122	0.090219	0.008140	0.180219	0.900000	0.099878
15	α	- 0.001071	0.000010	0.000000	0.001927	89.277794	0.000113
	λ	0.101071	0.091937	0.008452	0.181927	0.900011	0.098929
20	α	0.001305	0.000015	0.000000	0.002350	0.142514	0.003446
	λ	0.098695	0.087666	0.007685	0.177650	0.900017	0.098695
25	α	-0.00084	0.000006	0.000000	0.001526	82.786522	0.000093
	λ	0.100848	0.091532	0.008378	0.181526	0.900007	0.099152
50	α	0.249535	0.000034	0	0.004645	0.044826	5.584974
	λ	1.236826	0.00625	0.000039	0.058062	0.062337	0.236826
100	α	0.21599	0.000016	0	0.002429	0.032856	5.211791
	λ	1.261209	0.011373	0.000129	0.079789	0.079603	0.261209
200	α	0.188606	0.000009	0	0.002277	0.025844	5.766408
	λ	1.171126	0.001093	0.000001	0.024895	0.030377	0.171126

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newto n-Raphson simulation the process is repeated 10,000 times for different sample sizes *n*=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-5 for the values of the parameters Shape=1.5 and Scale =2.

Table-5

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.001395	0.000018	0.000000	0.002512	0.006764	0.017283
	λ	0.095814	0.082622	0.006826	0.172465	3.708548	0.047907
3	α	0.000604	0.000003	0.000000	0.001088	0.016365	0.004748
	λ	0.098187	0.086765	0.007528	0.176736	3.703660	0.049093
5	α	-0.00015	0.000000	0.000000	0.000280	12.207241	0.000044
	λ	0.100466	0.090841	0.008252	0.180839	3.699070	0.050233
10	α	-0.001082	0.000011	0.000000	0.001948	252.926056	0.000068
	λ	0.103247	0.095939	0.009204	0.185844	3.693612	0.051623
15	α	-0.000003	0.000000	0.000000	0.000005	4.056858	0.000001
	λ	0.100009	0.090016	0.008103	0.180016	3.699982	0.050004
20	α	-0.000687	0.000004	0.000000	0.001236	73.087051	0.000080
	λ	0.102060	0.093747	0.008788	0.183709	3.695922	0.051030
25	α	0.000000	0.000000	0.000000	0.000000	3.069857	0.000000
	λ	0.100000	0.090000	0.008100	0.180000	3.700000	0.050000
50	α	0.159904	0.000005	0	0.001628	0.03753	0.021659
	λ	0.759229	0.00521	0.000027	0.055729	1.544724	0.000302
100	α	0.166475	0.000002	0	0.00107	0.022985	10.19394
	λ	1.097319	0.000188	0	0.010639	0.815022	0.000453
200	α	0.167549	0.000008	0	0.002351	0.020296	5.67169
	λ	1.17603	0.00208	0.000004	0.0334	0.681007	0.002455

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes *n*=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-6 for the values of the parameters Shape= 4 and Scale =4.5.

TABLE-6

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.002184	0.000043	0.000000	0.003932	0.007531	0.025894
	λ	0.097270	0.085153	0.007251	0.175086	15.316455	0.024317
3	α	0.000176	0.000000	0.000000	0.000317	0.009475	0.001815
	λ	0.099780	0.089604	0.008029	0.179603	15.301323	0.024945
5	α	0.000228	0.000000	0.000000	0.000411	0.024837	0.001451
	λ	0.099715	0.089487	0.008008	0.179486	15.301712	0.024929
10	α	-0.001082	0.000011	0.000000	0.001948	252.926056	0.000068
	λ	0.099713	0.095939	0.009204	0.185844	3.693612	0.051623
15	α	-0.000003	0.000000	0.000000	0.000005	4.056858	0.000001
	λ	0.099723	0.090016	0.008103	0.180016	3.699982	0.050004
20	α	-0.000687	0.000004	0.000000	0.001236	73.087051	0.000080
	λ	0.099678	0.093747	0.008788	0.183709	3.695922	0.051030
25	α	0.000000	0.000000	0.000000	0.000000	3.069857	0.000000
	λ	0.099543	0.090000	0.008100	0.180000	3.700000	0.050000
50	α	0.159646	0.000004	0	0.001603	0.037655	0.021012
	λ	0.757737	0.005111	0.000026	0.055145	10.517378	0.000096
100	α	0.16614	0.000002	0	0.001065	0.023237	11.119718
	λ	1.090193	0.000174	0	0.010013	8.467153	0.000183
200	α	0.167184	0.000008	0	0.002319	0.020573	6.031701
	λ	1.166925	0.001948	0.000004	0.032203	8.028264	0.001224

We evaluated the performance of the Least Square Regression (LR) method for estimating the Shape(α)and Scale (λ) parameters of New Weighted Exponential distribution by using Newton-Raphson simulation the process is repeated 10,000 times for different sample sizes n=2(50)200.

Average Estimate (AE), Variance (VAR), Standard Deviation(SD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) of Least Squares method for the estimators of location and scale parameters of the New Weighted Exponential distribution are evaluated. The simulated results were presented in Table-7 for the values of the parameters Shape= 4 and Scale = 1.

TABLE-7

Least Square Regression- New Weighted Exponential Distribution

Sample Size	Para meters	AE	VAR	SD	MAD	MSE	RAB
2	α	0.204571	0.000096	0	0.008443	0.042464	1.859224
	λ	0.985576	0.001643	0.000003	0.033878	0.001851	0.00925
3	α	0.227846	0.000063	0	0.005551	0.064853	0.090742
	λ	0.836788	0.004502	0.00002	0.059139	0.03114	0.009588
5	α	0.248904	0.000012	0	0.002639	0.096232	0.009373
	λ	0.759116	0.002222	0.000005	0.031758	0.060247	0.01034
10	α	0.370972	0.000513	0	0.020239	0.109966	8.243104
	λ	1.13449	0.00122	0.000001	0.021298	0.019307	0.13449
15	α	0.22124	0.000097	0	0.007137	0.06491	0.009045
	λ	0.890276	0.011641	0.000136	0.068889	0.02368	0.012409
20	α	0.232106	0.000038	0	0.004634	0.044776	10.27067
	λ	1.240608	0.010986	0.000121	0.081709	0.068879	0.240608
25	α	0.242275	0.000022	0	0.003553	0.046968	8.462509
	λ	1.263778	0.051189	0.00262	0.183935	0.120768	0.263778
50	α	0.198431	0.000002	0	0.001228	0.029144	6.158356
	λ	1.190216	0.002227	0.000005	0.039507	0.038409	0.190216
100	α	0.21599	0.000016	0	0.002429	0.032856	5.211791
	λ	1.261209	0.011373	0.000129	0.079789	0.079603	0.261209
200	α	0.191266	0.000002	0	0.001116	0.022813	3.754093
	λ	1.264369	0.003082	0.00001	0.037772	0.072973	0.264369

3 . OBSERVATIONS AND CONCLUSIONS FROM SIMULATION RESULTS OBSERVATIONS:

1. The Average Estimate (AE), Variance (VAR), Standard deviation (STD), Mean Absolute Deviation (MAD), Mean Square Error (MSE) and Relative Absolute Bias (RAB) are independent of true values of the parameters of Shape (α)and Scale (λ).

2. The estimated values of Average Estimate (AE) of Shape parameter (α) is decreasing and Scale parameter (λ) by Least Square Regression Method were increasing when sample size (n) is increasing in most of the situations.

3. Standard Deviation (SD)of estimated values of Shape parameter (α) is zero in most of the cases and decreasing in some cases and Scale parameter (λ) by Least Square Regression Method were decreasing in some cases and increasing in some cases when sample size(n) is increasing.

4. Mean Absolute Deviation (MAD) of estimated values of Shape parameter (α) are decreasing and Scale parameter (λ) are increasing by Least Square Regression Method in some cases when sample size (n) is increasing.

5. Mean Square Error (MSE) of estimated values of Shape parameter (α) are increasing in most of the cases when sample size (n) is increasing and Scale parameter (λ) by Least Square Regression Methods were approximately equal when sample size (n) is increasing when most of the cases.

6. Relative Absolute Bias (RAB)of estimated values of Shape parameter (α) are gradually increasing when sample size(n) is increasing and Scale parameter (λ) by Least Square Regression Method were decreasing

when Sample size(n) is increasing.

7. Estimated value of Shape parameter(α) by Least Squares Regression Method is having less variance(VAR)when compared to the estimated values of Scale parameter (λ)by Least Square Regression Method.

8.Estimated value of Shape parameter(α)by Least Squares Regression Method is having less Mean Absolute Deviation (MAD) when compared to the estimated value of Scale parameter (λ) by using Least Square Regression Method.

REMARKS:

1. Variances of the Shape parameter (α) and Scale parameter (λ) are decreasing when Sample size increases.
2. When compared with small sample sizes the Shape parameter (α) and Scale parameter (λ) estimators in large sample are more efficient in all above tables.

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