Best Linear Unbiased Estimation of Location and Scale Parameters in Generalized Exponential Distribution under Type-II Censoring

A. Vasudeva Rao, S. Bhanu Prakash* and Sd. Jilani

Department of Statistics, Acharya Nagarjuna University,Nagarjunanagar -522510,
Guntur, Andhra Pradesh, India.

* Corresponding author: prakash9293165890@gmail.com

Abstract- For standard generalized exponential distribution (GED)Raqab and Ahsanullah [1] have derived the exact forms of means, variances and covariancesof order statistics. Using these expressions they have obtained the necessary coefficients for computing the BLUEs of location and scale parameters of GE distributionfor known shape parameter $\alpha = 0.5(0.5)5.0$ for complete samples of size up to 10. In this paper, using the formulae given byRaqab and Ahsanullah [1], we have developed R-program for computingthe means of order statistics for samples of size up to 30; and the variances andcovariances of order statistics for samples of size up to 20 for standard GE distribution for $\alpha = 1.5(0.5)5.0$. Using these means, variances and covariances, we have extended the computation of the BLUEs of the location and scale parameters of GEDfor both complete sample and Type-II censoredsamples of size up to n=20. We have tabulated theBLUE coefficients for all complete samples of size n=11(1)20 for α=1.5(0.5)2.0(1.0)5.0. Further, we have developed R-code for computing the coefficients of the BLUEs of location and scale parameters based on any type II censored sample (including a complete sample) of size up to n=20 and for any choice of shape parameter α in the interval [1.5, 6.0]. Finally, we demonstratethe computation of theBLUEs with two data sets.

Index Terms-Generalized exponential distribution; Means, variances and covariances of order statistics; BLUEs of location and scale parameters.

I.INTRODUCTION

Gupta and Kundu [2] introduced the three-parameter generalized exponential (GE)distribution with the probability density function (pdf)

$$f(x;\alpha,\mu,\sigma) = \tfrac{\alpha}{\sigma} e^{-(x-\mu)/\sigma}\left(1-e^{-(x-\mu)/\sigma}\right)^{\alpha-1}; \quad 0 \le \mu < x < \infty,\ \alpha > 0 \text{ and } \sigma > 0 \quad (1.1)$$

and cumulative distribution function (cdf)

$$F(x;\alpha,\mu,\sigma) = \left(1-e^{-(x-\mu)/\sigma}\right)^{\alpha} \quad (1.2)$$

Hereμ, σ and αare location, scale and shape parameters respectively. Some authors, later, in many articles replaced the scale parameter σ in GE distribution with its reciprocal $\lambda = 1/\sigma$. However, in this paper, we consider the above form of three-parameter GE distribution (which is originally introduced by Gupta andKundu[2]) because one can compute the BLUEs only for location and scale parameters of a distribution using Lloyd [3] method. We denote the three parameter GE distribution as GE(α,μ,σ). Using a real data set,Gupta and Kundu[2] have shown that the three-parameter GEmodel (1.1) fits better than the three-parameter gamma or three-parameter Weibull in some practical situations.

Since, μ and σ are location and scale parameters, the distribution of Z=(X-μ)/σ is the standard GE distribution , whose pdf and cdf are given as

$$f(z;\alpha) = \alpha e^{-z}\left(1-e^{-z}\right)^{\alpha-1} \text{ and } F(z;\alpha) = \left(1-e^{-z}\right)^{\alpha}, \quad z>0,\ \alpha>0 \quad (1.3)$$

It is observed that the hazard function is nondecreasing if $\alpha > 1$, it is decreasing if $\alpha < 1$ and for $\alpha = 1$, it is constant. The GE has a unimodal and right-skewed density function. As the shape parameter increases the skewness gradually decreases. If the data come from a right-tailed distribution, then the GE can be used quite effectively for analyzing them.

Gupta and Kundu [4] considered different estimation procedures and compared their performances through numerical situations. Raqab and Ahsanullah[1] derived exact expressions for the single and product moments of order statistics from the standard GE distribution and hence obtained the coefficients of the best linear unbiased estimates (BLUEs) of the location and scale parameters of the GE model (1.1) for complete samples of size up to 10 for shape parameter $\alpha = 0.5(0.5)5.0$ .Raqab [5] derived the exact expressions for means, variances and covariances of record statistics from the GE distribution and computed the coefficients of BLUEs of location and scale parameters based on record statistics. Raqab [6] established several recurrence relations satisfied by the single and the product moments of order statistics from the standard GE distribution in terms of polygamma and hypergeometric functions and heexplained the recursive procedure of computing the single and the product moments of all order statistics for all sample sizes.Khan and Kumar [7] studied the explicit expressions and some recurrences relations for single and product moments of lower generalized order statistics from GE distribution.

The main aim of this paper is to extend the work ofRaqab and Ahsanullah[1] by providing the coefficients of the BLUEs of location and scale parameters of the GE distribution (1.1) for both complete and type-II censored samples of size up to 20. In Section 2, we have developed R-code for computingthe means, variances and covariances of order statistics of standard GE distribution by evaluating the formulae given by Raqab and Ahsanullah[1]. Using these means, variances and covariances.In Section 3, we have tabulatedthe coefficients of the BLUEs of location and scale parameters for complete samplesof size up to 20 for $\alpha = 1.5(0.5)2.0(1.0)5.0$. We have developed R-code for computing the coefficients of the BLUEs of location and scale parameters based on any Type-II censored sample (including a complete sample)of size up to n=20 and for any choice of shape parameter α in the interval [1.5, 6.0]. Finally, in section 4, we demonstrate the computation of the BLUEs with an illustration.

II. MEANS, VARIANCES AND COVARIANCES OF STANDARD ORDER STATISTICS

In order to computethe coefficients of the BLUEs for location and scale parameters of a population using Lloyd [3] method, we requirethe means, variances and covariances of order statistics from the corresponding standard population. Therefore, in this section, we have computed the means, variances and covariances of order statistics for standard GEpopulation (1.3) by evaluatingthefollowing exact and explicit expressions (derived by [1]) of first and second moments of i^{th} standard order statistic $Z_{i:n} (i = 1, 2, ..., n)$ and the product moment of i^{th} and j^{th} ($1 \le i < j \le n$) standard order statistics $Z_{i:n}$ and $Z_{j:n}$.

The explicit expressions of the first andsecond moments of $Z_{i:n} (i = 1, 2, ..., n)$ are

$$a_{i:n} = E\left(Z_{i:n}\right) = \left[B\left(i, n-i+1\right)\right]^{-1} \sum_{l=0}^{n-i} \frac{(-1)^l \binom{n-i}{l}}{i+1} \left[\psi\left(\left(i+l\right)\alpha+1\right)+\gamma\right] \quad (2.1)$$

$$a_{i:n}^{(2)} = E\left(Z_{i:n}^2\right)$$
$$= \left[B\left(i, n-i+1\right)\right]^{-1} \sum_{l=0}^{n-i} \frac{(-1)^l \binom{n-i}{l}}{i+1} \left\{\left[\psi\left(\left(i+l\right)\alpha+1\right)+\gamma\right]^2 - \psi'\left(\left(i+l\right)\alpha+1\right)+\frac{\pi^2}{6}\right\} \quad (2.2)$$

where*B*(.,.) is a beta function and $\gamma = -\psi(1)$. Here $\psi(\cdot)$ and $\psi'(\cdot)$ are the digamma and tri-gamma functions, given by

$$\psi(u)=\frac{d}{du}\Gamma(u),\quad \psi'(u)=\frac{d}{du}\psi(u)\text{ where }\Gamma(u)=\int_0^\infty x^{u-1}e^{-x}dx. \quad (2.3)$$

Similarly, the product moment of $Z_{i:n}$ and $Z_{j:n}$ isgiven by

$$a_{i,j:n}=E\left(Z_{i:n}Z_{j:n}\right)$$
$$=C_{i,j:n}\alpha^2\sum_{k=1}^{\infty}\sum_{l=0}^{n-j}\sum_{m=0}^{j-i-1}(-1)^{l+m}\binom{j-i-1}{m}\binom{n-j}{l}\frac{\left[\psi\left((j+l)\alpha+k+1\right)+\gamma\right]}{k\left[(j+l)\alpha+k\right]\left[(i+m)\alpha+k\right]} \quad (2.4)$$

where $C_{i,j:n}=\dfrac{n!}{(i-1)!(j-i-1)!(n-j)!}$

Using Eq. (2.1), we canevaluate the means of order statistics of standard GE distribution. The variance ($b_{i,i:n}$) of order statistic $Z_{i:n}(i=1,2,\ldots,n)$ can be evaluated from the relation $b_{i,i:n}=a_{i:n}^{(2)}-a_{i:n}^2$ using Eqs. (2.1) and (2.2).The covariance ($b_{i,j:n}$) between order statistics $Z_{i:n}$ and $Z_{j:n}$ can be evaluated from the relation $b_{i,j:n}=a_{i,j:n}-a_{i:n}a_{j:n}$ using Eqs. (2.1) and (2.4). For evaluation of these means, variances and covariances of order statistics, we have developed the necessary R-code. Using this R-program, one can compute the means for all samples of size up to 30;variances and covariancesfor all samples of size up to 20 for shape parameter α =1.5(0.5)5.0. This R-code is presented in the appendix as *R-program 1* along with sample output of the program; means of order statistics for n=25 & 30; and variances and covariances of order statistics for n=15 & 20.

III. BLUE's OF LOCATION AND SCALE PARAMETERS BASED ON TYPE II CENSORED SAMPLES

In this section, we discuss best linear unbiased estimation of location and scale parameter in three-parameter generalized exponential distribution. We construct the BLUEs of location and scale parameters, with known shape parameterfor Type II censored samples.

Suppose $X_{r+1:n}\le X_{r+2:n}\le\ldots\le X_{n-s:n}$ is a Type II doubly censored sample (*r* left most observations and *s* right most observations are censored from a planned sample of size *n*) from the GE distribution (1.1). Since, the doubly censored sample includes left censored sample (s=0), right censored sample (r=0) and complete sample (r=s=0), the following development includes all these cases.

Let $Z_{i:n}=\left(X_{i:n}-\mu\right)/\sigma$, $\left(i=r+1,\ldots,n-s\right)$ so that $Z_{r+1:n}\le Z_{r+2:n}\le\ldots\le Z_{n-s:n}$ is a Type II doubly censored sample from thestandard GE distribution (1.3). Now, if the shape parameter α is known then the BLUEs of μ and σ, denoted by μ^* and σ^*, are given by (pl. see Lloyd [3])

$$\mu^*=\frac{\mathbf{a'B^{-1}a1'B^{-1}-a'B^{-1}1a'B^{-1}}}{\mathbf{\Delta}}\mathbf{X}\quad\text{and}\quad\sigma^*=\frac{\mathbf{1'B^{-1}1a'B^{-1}-1'B^{-1}a1'B^{-1}}}{\mathbf{\Delta}}\mathbf{X} \quad (3.1)$$

Where $\Delta=\left(\mathbf{a'B^{-1}a}\right)\left(\mathbf{1'B^{-1}1}\right)-\left(\mathbf{a'B^{-1}1}\right)^2$

Here $\mathbf{a}=(a_{r+1:n},...,a_{n-s:n})'$ and $\mathbf{B}=((b_{ij:n}))$, $r+1\le i,\, j\le n-s$ are respectively the mean vector and variance-covariance matrix of the order statistics $Z_{r+1:n}\le Z_{r+2:n}\le ...\le Z_{n-s:n}$ fromstandard GE distribution and $\mathbf{1}$ is a column vector of 1's of the same dimension of $\mathbf{a}$.

The variances and covariance of μ^* and σ^* are given by

$$\text{var}\left(\mu^*\right)=\sigma^2\left\{\frac{\mathbf{a}'\mathbf{B}^{-1}\mathbf{a}}{\mathbf{\Delta}}\right\},\quad \text{var}\left(\sigma^*\right)=\sigma^2\left\{\frac{\mathbf{1}'\mathbf{B}^{-1}\mathbf{1}}{\mathbf{\Delta}}\right\} \text{ and } \text{Cov}\left(\mu^*,\sigma^*\right)=-\sigma^2\left\{\frac{\mathbf{a}'\mathbf{B}^{-1}\mathbf{1}}{\mathbf{\Delta}}\right\} \quad (3.2)$$

Using the above formulae, we extend the computation of the coefficients of the BLUE's μ^* and σ^* for complete samples up to size n=11(1)20 and are presented in **Table1**along with the variances and covariance for shape parameter α =1.5(0.5)2.0(1.0)5.0.

We have developed R-program for computation of the coefficients of the BLUEs μ^* and σ^* along with the variances and covariance of the estimators for any Type-II censored sample including complete samples up to size n=20; with any choiceof 0≤r ≤n-2 and 0≤s≤n-2such that r+s≤n-2; and for any choice of the shape parameter α in the interval [1.5, 6.0]. This R-code is given in the appendix as *R-program 2*.

IV. ILLUSTRATIONS

In this section, wedemonstrate the computation the BLUE's with two data sets. The first data set is the following ordered sample of size n=8 from GE(α,μ,σ)withα=2, which is simulatedby Raqab and Ahsanullah[1].

8.5347 9.4276 9.4673 9.7726 9.7854 10.1109 11.5356 15.1027

For the above complete sample,Raqab and Ahsanullah[1] computed the BLUE's and are given below along with the variances and covariance of the estimators.

μ*=7.93029 and σ*=1.67994,

Var(μ*)=0.078448σ^2, Var(σ*)=0.108276σ^2, and Cov(μ*,σ*)= -0.055374σ^2.

We consider the above sample with the last observation (15.1027) censored and based on this right censored sample (r=0 & s=1), we compute the BLUE's along with the standard errors of the estimates. The necessary coefficients of the BLUE's are computed using *R-program 2*(given in the appendix)with the input of α=2, n=8, r=0 & s=1; the output of the program is given below.

```
ENTER SHAPE PARAMETER OF STANDARD GE DISTRIBUTION (between 1.5 and 6.0)1: 2
2:
Read 1 item
 ENTER SAMPLE SIZE (n between 2 and 20)1: 8
2:
Read 1 item
 ENTER No. observations LEFT  censored (r between 0 and n-2)1: 0
2:
Read 1 item
 ENTER No. observations RIGHT censored (s between 0 and n-2)1: 1
2:
Read 1 item

Coefficients of the BLUE of Location parameter:
```

1.1709 0.0850 0.0064 -0.0291 -0.0476 -0.0589 -0.1267

Coefficients of the BLUE of Scale parameter:
-0.7885 0.0397 0.0969 0.1210 0.1313 0.1373 0.2623

Variances and covariance of the BLUEs:
0.0822 0.1235 -0.0629

CHECKS ON BLUE COEFFICIENTS:
SUM OF the BLUE COEFFICIENTS OF LOCATION= 1.000000
SUM OF the BLUE COEFFICIENTS OF SCALE= 0.000000

Using the abovecomputed coefficients of the BLUE's, their variances and covariance; we compute the BLUE's μ* and σ* along with the standard errors of the estimates based on the given right censored sample (last observation 15.1027 iscensored) and are given below.

$\mu^*=8.0480$, $\sigma^*=1.4435$, S.E.$(\mu^*)=\sqrt{0.0822}\sigma^*=0.4139$andS.E.$(\sigma^*)=\sqrt{0.1235}\sigma^*=0.5073$

We also obtain the BLUE of the population mean $T=E(Y)=\mu+(\Psi(3)+\gamma)\sigma$ and standard error of the estimate as

$T^*=\mu^*+(\Psi(3)+\gamma)\sigma^*=10.2132$, S.E.$(T^*)=0.5976$.

Further, we compute the BLUE's of μ,σ and T based on the given sample with various choices of r and s and are presented below along with the standard errors of the estimates.

r	s	μ*(S.E.(μ*))	σ* (S.E.(σ*))	T* (S.E.(T*))
0	2	8.1424(0.3689)	1.2479(0.4765)	10.0143(0.5502)
1	0	8.5199(0.5175)	1.3192(0.4872)	10.4987(0.5208)
1	1	8.7959(0.3846)	0.9398(0.3784)	10.2056(0.3889)
1	2	9.0673(0.2413)	0.5576(0.2502)	9.9037(0.2467)

The second data set considered by us is the following type II right censored sample (r=0 & s=5) of size n=20 from GE(α,μ,σ) with α=3, μ=0 and σ=1, which is simulated by Raqab and Madi [8].

0.65306, 0.67631, 0.68341, 1.05645, 1.46194, 1.71555, 1.73903, 1.78940, 1.79847, 1.82522, 1.95587, 2.16530, 2.35033, 2.38706, 2.39005.

In this example also for computing the coefficients of the BLUE's , we run*R-program 2*with the input ofα=3, n=20, r=0 &s=5 and the output is given below.

ENTER SHAPE PARAMETER OF STANDARD GE DISTRIBUTION (between 1.5 and 6.0)1: 3
2:
Read 1 item
ENTER SAMPLE SIZE (n between 2 and 20)1: 20
2:
Read 1 item
ENTER No. observations LEFT censored (r between 0 and n-2)1: 0
2:

Read 1 item
ENTER No. observations RIGHT censored (s between 0 and n-2)1: 5
2:
Read 1 item

Coefficients of the BLUE of Location parameter:
0.8997 0.1804 0.1309 0.0244 0.0821 -0.0180 0.0287 -0.0102 -0.0176 0.0014 -0.0444 0.0005
-0.0485 -0.0145 -0.1948

Coefficients of the BLUE of Scale parameter:
-0.5707 -0.0751 -0.0646 0.0506 -0.0495 0.0791 -0.0013 0.0537 0.0447 0.0303 0.0755 0.0186
0.0789 0.0322 0.2976

Variances and covariance of the BLUEs:
0.0468 0.0448 -0.0318

CHECKS ON BLUE COEFFICIENTS:
SUM OF the BLUE COEFFICIENTS OF LOCATION= 1.000000
SUM OF the BLUE COEFFICIENTS OF SCALE= 0.000000

Using the above coefficients of the BLUE's, we compute the BLUE's μ^* and σ^* based on the given type II right censored sample and are given below along with the standard errors of the estimates.

$\mu^*=0.2163$ and $\sigma^*=1.0402$, S.E.(μ^*)=0.2250 and S.E.(σ^*)=0.2202.

APPENDIX

R-program 1: R-code for computing means, variances and covariances of ordered statistics of standard GED

```
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-CODE COMPUTES MEANS OF ORDER STATISTICS OF STANDARD GENERALIZED EXPONENTIAL DISTRIBUTION  @
# FOR DIFFERENT CHOICES OF SHAPE PARAMETER alpha FOR ALL SAMPLES OF SIZE UP TO 30     @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
sink("I:/banu/GEMOS");
alphav=c(1.5,2.0,2.5,3.0,3.5,4.0,4.5,5.0)
cat("\n MEANS OF SINGLE ORDER STATISTICS FOR STANDARD GENERALISED EXPONETIAL DISTRIBUTION");
cat("\n FOR DIFERENT VALUES OF SHAPE PARAMETER (alpha) FOR SAMPLE SIZE n=1(1)30.");
cat("\n\n   ni   alpha=");
for (alpha in alphav) cat(" ",format(alpha,nsmall=1),"  ");
cat("\n\n");
for (n in 1:30){
for (r in 1:n){
cat(format(n,width=4));
cat(format(r,width=3),"\t");
for (alpha in alphav){
             cat(format(round(GEMOM1(n,r,alpha),digits=4),nsmall=4),"\t");}
cat("\n");}
cat("\n");}
sink();
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-CODE COMPUTES VARIANCES AND COVARIANCES OF ORDER STATISTICS OF STANDARD GENERALIZED EXPONENTIAL @
#  DISTRIBUTION FOR DIFFERENT CHOICES OF SHAPE PARAMETER alpha FOR ALL SAMPLES OF SIZE UP TO 20         @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
sink("I:/banu/GEVC");
alphav=c(1.5,2.0,2.5,3.0,3.5,4.0,4.5,5.0);
cat("\n VARIANCES AND COVARIANCES OF ORDER STATISTICS FOR STANDARD GENERALISED EXPONETIAL DISTRIBUTION");
cat("\n FOR DIFERENT VALUES OF SHAPE PARAMETER (alpha) FOR SAMPLE SIZE n=2(1)20.");
cat("\n\n   ni   j alpha=");
for (alpha in alphav) cat(" ",format(alpha,nsmall=1),"     ");
cat("\n\n");
for (n in 2:20)
for (r in 1:n)
for (s in r:n){cat(format(n,width=4));
cat(format(r,width=5));
cat(format(s,width=4),"     ");
for (alpha in alphav){
if (r==s){cat(format(round(GEMOM2(n,r,alpha)-GEMOM1(n,r,alpha)**2,digits=6),nsmall=6),"  ");}
else  { cat(format(round(GEPM(n,r,s,alpha)-GEMOM1(n,r,alpha)*GEMOM1(n,s,alpha),digits=6),nsmall=6),"  ");}
```

```
     }
cat("\n");}
sink();
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES MEAN OF R-th ORDER STATISTICS OF STANDARD GENERALIZED  @
# EXPONENTIAL DISTRIBUTION                                                        @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEMOM1=function(n,r,alpha){
GEMOM1=0;
for (i in 0:(n-r)) {
t=digamma((r+i)*alpha+1)+0.577215;
GEMOM1=GEMOM1+(-1)**i*comb(n-r,i)/(r+i)*t;
}
GEMOM1=GEMOM1/beta(r,n-r+1);
return(GEMOM1);
}
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES SECOND ORDER MOMENT OF R-th ORDER STATISTIC OF STANDARD @
# GENERALIZED EXPONENTIAL DISTRIBUTION                                             @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEMOM2=function(n,r,alpha){
GEMOM2=0;
for (i in 0:(n-r)) {
t=(digamma((r+i)*alpha+1)+0.577215)**2-trigamma((r+i)*alpha+1)+pi**2/6;
GEMOM2=GEMOM2+(-1)**i*comb(n-r,i)/(r+i)*t;}
GEMOM2=GEMOM2/beta(r,n-r+1);
return(GEMOM2);
}

#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES PRODUCT MOMENTS BETWEEN R-th AND S-th ORDER STATISTICS OF STANDARD  @
# GENERALIZED EXPONENTIAL DISTRIBUTION                                                         @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEPM=function(n,r,s,alpha){
GEPM=0;
GEPM1=0;
crs=(factorial(n)/factorial(r-1)/factorial(s-r-1)/factorial(n-s));
for (i in 0:(n-s)) {
for (j in 0:(s-r-1)){
GEPM1=0;
for (k in 1:200)GEPM1=GEPM1+(digamma((s+i)*alpha+k+1)+0.5772157)/(k*((s+i)*alpha+k)*((r+j)*alpha+k));
GEPM=GEPM+((-1)**(i+j))*comb(s-r-1,j)*comb(n-s,i)*GEPM1;
}
}
GEPM=GEPM*(alpha**2)*crs;
return(GEPM);
}
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS FUNCTION COMPUTES COMBINOTORIAL(n,r)                             @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
comb=function(n,r){
comb=1;
if (r==0) return(1);
for (i in 1:r) comb=comb*(n-i+1)/i;
return(comb);
}
```

Sample output of R-program 1:

MEANS OF SINGLE ORDER STATISTICS FOR STANDARD GENERALISED EXPONETIAL DISTRIBUTION
FOR DIFERENT VALUES OF SHAPE PARAMETER (alpha) FOR SAMPLE SIZE n=25 and 30.

n	i\alpha=	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
25	1	0.1121	0.1981	0.2867	0.3731	0.4555	0.5335	0.6069	0.6760
25	2	0.1937	0.3117	0.4249	0.5303	0.6277	0.7177	0.8010	0.8784
25	3	0.2669	0.4061	0.5344	0.6510	0.7569	0.8536	0.9423	1.0242
25	4	0.3368	0.4921	0.6315	0.7561	0.8681	0.9696	1.0621	1.1471
25	5	0.4054	0.5739	0.7222	0.8532	0.9699	1.0751	1.1705	1.2579
25	6	0.4739	0.6537	0.8094	0.9457	1.0664	1.1745	1.2724	1.3617
25	7	0.5432	0.7329	0.8951	1.0359	1.1599	1.2706	1.3705	1.4615
25	8	0.6140	0.8125	0.9804	1.1251	1.2521	1.3651	1.4667	1.5591
25	9	0.6868	0.8933	1.0663	1.2147	1.3443	1.4592	1.5624	1.6561
25	10	0.7624	0.9762	1.1539	1.3054	1.4373	1.5541	1.6587	1.7535
25	11	0.8413	1.0618	1.2438	1.3983	1.5323	1.6507	1.7566	1.8524
25	12	0.9242	1.1511	1.3369	1.4941	1.6301	1.7500	1.8571	1.9539

ISSN 2250-3153

25 13	1.0120	1.2447	1.4343	1.5940	1.7318	1.8531	1.9612	2.0589
25 14	1.1057	1.3439	1.5369	1.6989	1.8385	1.9610	2.0702	2.1687
25 15	1.2064	1.4499	1.6461	1.8103	1.9515	2.0752	2.1853	2.2845
25 16	1.3158	1.5642	1.7635	1.9298	2.0724	2.1973	2.3083	2.4082
25 17	1.4359	1.6890	1.8912	2.0594	2.2035	2.3294	2.4412	2.5419
25 18	1.5695	1.8271	2.0320	2.2021	2.3475	2.4745	2.5871	2.6883
25 19	1.7207	1.9826	2.1901	2.3620	2.5086	2.6365	2.7499	2.8518
25 20	1.8953	2.1613	2.3714	2.5449	2.6928	2.8216	2.9357	3.0381
25 21	2.1030	2.3730	2.5854	2.7606	2.9096	3.0393	3.1541	3.2571
25 22	2.3605	2.6343	2.8490	3.0257	3.1759	3.3064	3.4218	3.5253
25 23	2.7010	2.9785	3.1954	3.3736	3.5248	3.6561	3.7722	3.8762
25 24	3.2080	3.4890	3.7081	3.8877	4.0399	4.1720	4.2887	4.3931
25 25	4.2148	4.4992	4.7204	4.9014	5.0546	5.1874	5.3046	5.4095

30 1	0.0987	0.1791	0.2634	0.3465	0.4263	0.5021	0.5737	0.6414
30 2	0.1697	0.2804	0.3883	0.4898	0.5842	0.6718	0.7531	0.8289
30 3	0.2328	0.3636	0.4860	0.5983	0.7011	0.7952	0.8820	0.9621
30 4	0.2924	0.4386	0.5717	0.6918	0.8004	0.8993	0.9897	1.0731
30 5	0.3502	0.5089	0.6508	0.7770	0.8906	0.9929	1.0862	1.1714
30 6	0.4076	0.5767	0.7258	0.8577	0.9743	1.0791	1.1751	1.2644
30 7	0.4644	0.6445	0.7989	0.9350	1.0554	1.1632	1.2615	1.3487
30 8	0.5238	0.7094	0.8706	1.0113	1.1349	1.2449	1.3432	1.4366
30 9	0.5783	0.7763	0.9413	1.0830	1.2099	1.3215	1.4235	1.5132
30 10	0.6380	0.8417	1.0124	1.1604	1.2867	1.3962	1.5037	1.5948
30 11	0.7034	0.9098	1.0828	1.2318	1.3641	1.4799	1.5827	1.6748
30 12	0.7629	0.9787	1.1588	1.3111	1.4416	1.5581	1.6640	1.7598
30 13	0.8349	1.0526	1.2334	1.3871	1.5221	1.6399	1.7458	1.8412
30 14	0.8983	1.1253	1.3107	1.4676	1.6026	1.7218	1.8302	1.9265
30 15	0.9729	1.2027	1.3906	1.5495	1.6862	1.8077	1.9148	2.0119
30 16	1.0472	1.2829	1.4742	1.6347	1.7733	1.8950	2.0041	2.1023
30 17	1.1273	1.3668	1.5609	1.7236	1.8636	1.9866	2.0960	2.1946
30 18	1.2123	1.4565	1.6532	1.8176	1.9589	2.0827	2.1931	2.2924
30 19	1.3035	1.5517	1.7509	1.9171	2.0597	2.1845	2.2955	2.3954
30 20	1.4020	1.6542	1.8558	2.0236	2.1674	2.2931	2.4048	2.5053
30 21	1.5093	1.7653	1.9692	2.1386	2.2835	2.4101	2.5225	2.6235
30 22	1.6275	1.8871	2.0933	2.2642	2.4102	2.5376	2.6506	2.7521
30 23	1.7593	2.0225	2.2308	2.4032	2.5502	2.6784	2.7920	2.8941
30 24	1.9088	2.1754	2.3858	2.5596	2.7076	2.8366	2.9508	3.0533
30 25	2.0819	2.3518	2.5642	2.7393	2.8883	3.0180	3.1328	3.2357
30 26	2.2882	2.5612	2.7756	2.9520	3.1019	3.2323	3.3476	3.4510
30 27	2.5443	2.8204	3.0366	3.2143	3.3652	3.4962	3.6120	3.7159
30 28	2.8835	3.1627	3.3807	3.5596	3.7113	3.8430	3.9594	4.0636
30 29	3.3893	3.6714	3.8912	4.0712	4.2238	4.3561	4.4730	4.5776
30 30	4.3949	4.6799	4.9014	5.0826	5.2359	5.3689	5.4862	5.5912

VARIANCES AND COVARIANCES OF ORDER STATISTICS FOR STANDARD GENERALISED EXPONETIAL DISTRIBUTION FOR DIFERENT VALUES OF SHAPE PARAMETER (alpha) FOR SAMPLE SIZE n=15 and 20.

n	i	j alpha=	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
15	1	1	0.013476	0.023858	0.033724	0.042503	0.050140	0.056748	0.062473	0.067458
15	1	2	0.011606	0.018833	0.025165	0.030501	0.034968	0.038725	0.041910	0.044635
15	1	3	0.010616	0.016425	0.021311	0.025324	0.028624	0.031363	0.033663	0.035615
15	1	4	0.009978	0.014949	0.019025	0.022317	0.024995	0.027199	0.029038	0.030592
15	1	5	0.009520	0.013929	0.017475	0.020306	0.022590	0.024459	0.026011	0.027318
15	1	6	0.009172	0.013170	0.016339	0.018845	0.020854	0.022491	0.023845	0.024982
15	1	7	0.008894	0.012576	0.015460	0.017724	0.019528	0.020993	0.022202	0.023214
15	1	8	0.008666	0.012096	0.014755	0.016829	0.018475	0.019807	0.020903	0.021819
15	1	9	0.008474	0.011697	0.014174	0.016094	0.017613	0.018838	0.019844	0.020684
15	1	10	0.008310	0.011359	0.013684	0.015478	0.016891	0.018029	0.018961	0.019739
15	1	11	0.008167	0.011067	0.013263	0.014950	0.016276	0.017340	0.018211	0.018935
15	1	12	0.008042	0.010813	0.012898	0.014493	0.015743	0.016745	0.017563	0.018243
15	1	13	0.007930	0.010588	0.012576	0.014092	0.015277	0.016224	0.016996	0.017638
15	1	14	0.007830	0.010388	0.012291	0.013737	0.014864	0.015763	0.016496	0.017104
15	1	15	0.007741	0.010208	0.012035	0.013419	0.014495	0.015353	0.016051	0.016629
15	2	2	0.021546	0.032373	0.041273	0.048479	0.054348	0.059188	0.063231	0.066651
15	2	3	0.019734	0.028296	0.035054	0.040387	0.044655	0.048130	0.051005	0.053419
15	2	4	0.018560	0.025786	0.031343	0.035657	0.039072	0.041829	0.044097	0.045992
15	2	5	0.017717	0.024044	0.028818	0.032480	0.035356	0.037665	0.039555	0.041129
15	2	6	0.017074	0.022745	0.026961	0.030166	0.032666	0.034664	0.036295	0.037649
15	2	7	0.016560	0.021728	0.025523	0.028386	0.030608	0.032376	0.033816	0.035009

15	2	8	0.016139	0.020904	0.024368	0.026964	0.028969	0.030562	0.031853	0.032921
15	2	9	0.015783	0.020219	0.023414	0.025795	0.027627	0.029077	0.030252	0.031221
15	2	10	0.015479	0.019637	0.022609	0.024812	0.026502	0.027836	0.028914	0.029802
15	2	11	0.015214	0.019136	0.021918	0.023972	0.025542	0.026778	0.027776	0.028597
15	2	12	0.014981	0.018698	0.021317	0.023242	0.024710	0.025864	0.026793	0.027556
15	2	13	0.014774	0.018310	0.020788	0.022602	0.023981	0.025063	0.025933	0.026647
15	2	14	0.014588	0.017965	0.020317	0.022034	0.023335	0.024354	0.025173	0.025844
15	2	15	0.014421	0.017655	0.019896	0.021526	0.022759	0.023722	0.024495	0.025129
15	3	3	0.029255	0.040129	0.048425	0.054835	0.059895	0.063973	0.067322	0.070118
15	3	4	0.027535	0.036614	0.043364	0.048497	0.052505	0.055710	0.058327	0.060501
15	3	5	0.026297	0.034167	0.039909	0.044225	0.047568	0.050226	0.052387	0.054176
15	3	6	0.025350	0.032338	0.037361	0.041103	0.043984	0.046264	0.048111	0.049637
15	3	7	0.024594	0.030904	0.035385	0.038698	0.041235	0.043237	0.044853	0.046185
15	3	8	0.023971	0.029740	0.033796	0.036774	0.039045	0.040830	0.042270	0.043453
15	3	9	0.023448	0.028771	0.032480	0.035190	0.037248	0.038862	0.040158	0.041223
15	3	10	0.022997	0.027949	0.031371	0.033858	0.035740	0.037211	0.038394	0.039363
15	3	11	0.022606	0.027239	0.030417	0.032717	0.034452	0.035807	0.036891	0.037779
15	3	12	0.022261	0.026618	0.029588	0.031727	0.033336	0.034589	0.035592	0.036412
15	3	13	0.021955	0.026069	0.028856	0.030856	0.032357	0.033523	0.034455	0.035216
15	3	14	0.021680	0.025579	0.028206	0.030084	0.031490	0.032580	0.033450	0.034159
15	3	15	0.021431	0.025139	0.027623	0.029393	0.030714	0.031738	0.032553	0.033217
15	4	4	0.037488	0.048348	0.056241	0.062161	0.066740	0.070379	0.073334	0.075781
15	4	5	0.035822	0.045154	0.051812	0.056748	0.060538	0.063532	0.065955	0.067953
15	4	6	0.034543	0.042760	0.048537	0.052783	0.056023	0.058571	0.060626	0.062316
15	4	7	0.033521	0.040880	0.045992	0.049722	0.052553	0.054772	0.056557	0.058022
15	4	8	0.032680	0.039352	0.043942	0.047269	0.049784	0.051749	0.053325	0.054617
15	4	9	0.031969	0.038080	0.042245	0.045248	0.047509	0.049270	0.050682	0.051836
15	4	10	0.031361	0.036998	0.040810	0.043545	0.045598	0.047195	0.048469	0.049510
15	4	11	0.030829	0.036063	0.039578	0.042088	0.043965	0.045421	0.046583	0.047531
15	4	12	0.030362	0.035246	0.038503	0.040820	0.042548	0.043886	0.044952	0.045819
15	4	13	0.029946	0.034522	0.037556	0.039706	0.041305	0.042541	0.043523	0.044322
15	4	14	0.029572	0.033876	0.036714	0.038716	0.040203	0.041349	0.042259	0.042999
15	4	15	0.029234	0.033295	0.035958	0.037831	0.039217	0.040284	0.041131	0.041818
15	5	5	0.046758	0.057594	0.065195	0.070775	0.075029	0.078374	0.081070	0.083288
15	5	6	0.045109	0.054575	0.061121	0.065885	0.069496	0.072323	0.074594	0.076457
15	5	7	0.043787	0.052198	0.057948	0.062101	0.065234	0.067678	0.069637	0.071240
15	5	8	0.042696	0.050265	0.055387	0.059064	0.061827	0.063975	0.065692	0.067096
15	5	9	0.041776	0.048651	0.053264	0.056558	0.059024	0.060936	0.062461	0.063706
15	5	10	0.040985	0.047279	0.051469	0.054447	0.056667	0.058385	0.059754	0.060869
15	5	11	0.040296	0.046093	0.049924	0.052635	0.054651	0.056207	0.057444	0.058451
15	5	12	0.039688	0.045053	0.048577	0.051060	0.052901	0.054319	0.055445	0.056360
15	5	13	0.039147	0.044134	0.047389	0.049674	0.051363	0.052663	0.053693	0.054529
15	5	14	0.038660	0.043312	0.046331	0.048442	0.050000	0.051195	0.052141	0.052909
15	5	15	0.038221	0.042573	0.045382	0.047339	0.048780	0.049883	0.050756	0.051463
15	6	6	0.057583	0.068393	0.075772	0.081098	0.085114	0.088246	0.090755	0.092809
15	6	7	0.055915	0.065449	0.071882	0.076494	0.079954	0.082643	0.084792	0.086548
15	6	8	0.054536	0.063048	0.068737	0.072790	0.075819	0.078166	0.080037	0.081563
15	6	9	0.053371	0.061043	0.066127	0.069730	0.072412	0.074486	0.076136	0.077479
15	6	10	0.052369	0.059335	0.063916	0.067147	0.069545	0.071394	0.072863	0.074057
15	6	11	0.051494	0.057857	0.062012	0.064930	0.067089	0.068750	0.070068	0.071138
15	6	12	0.050723	0.056562	0.060351	0.063000	0.064956	0.066457	0.067646	0.068610
15	6	13	0.050036	0.055415	0.058884	0.061302	0.063081	0.064444	0.065522	0.066396
15	6	14	0.049418	0.054390	0.057577	0.059791	0.061416	0.062659	0.063641	0.064435
15	6	15	0.048859	0.053466	0.056404	0.058437	0.059926	0.061063	0.061959	0.062684
15	7	7	0.070627	0.081414	0.088615	0.093743	0.097575	0.100543	0.102909	0.104839
15	7	8	0.068906	0.078464	0.084784	0.089259	0.092588	0.095161	0.097207	0.098872
15	7	9	0.067449	0.075995	0.081599	0.085546	0.088473	0.090728	0.092518	0.093974
15	7	10	0.066195	0.073889	0.078897	0.082408	0.085003	0.086999	0.088580	0.089863
15	7	11	0.065100	0.072065	0.076568	0.079711	0.082028	0.083806	0.085212	0.086353
15	7	12	0.064132	0.070465	0.074533	0.077362	0.079442	0.081034	0.082291	0.083310
15	7	13	0.063270	0.069047	0.072736	0.075292	0.077166	0.078598	0.079728	0.080641
15	7	14	0.062494	0.067778	0.071133	0.073450	0.075144	0.076436	0.077454	0.078277
15	7	15	0.061791	0.066634	0.069693	0.071797	0.073332	0.074501	0.075421	0.076163
15	8	8	0.086855	0.097623	0.104679	0.109647	0.113330	0.116167	0.118420	0.120251
15	8	9	0.085044	0.094591	0.100797	0.105145	0.108358	0.110826	0.112782	0.114368
15	8	10	0.083481	0.092001	0.097499	0.101334	0.104158	0.106324	0.108036	0.109424
15	8	11	0.082115	0.089754	0.094652	0.098054	0.100552	0.102464	0.103973	0.105195
15	8	12	0.080907	0.087782	0.092162	0.095193	0.097413	0.099108	0.100445	0.101525
15	8	13	0.079828	0.086031	0.089960	0.092669	0.094648	0.096157	0.097345	0.098303
15	8	14	0.078858	0.084464	0.087995	0.090421	0.092190	0.093535	0.094593	0.095445
15	8	15	0.077979	0.083050	0.086228	0.088404	0.089985	0.091187	0.092130	0.092889
15	9	9	0.107795	0.118545	0.125479	0.130314	0.133874	0.136605	0.138765	0.140515
15	9	10	0.105845	0.115348	0.121434	0.125659	0.128761	0.131132	0.133001	0.134509
15	9	11	0.104136	0.112569	0.117936	0.121647	0.124363	0.126435	0.128065	0.129378
15	9	12	0.102623	0.110126	0.114873	0.118142	0.120529	0.122346	0.123773	0.124920
15	9	13	0.101272	0.107956	0.112161	0.115047	0.117148	0.118745	0.119996	0.121000
15	9	14	0.100054	0.106011	0.109738	0.112287	0.114138	0.115542	0.116640	0.117518
15	9	15	0.098949	0.104255	0.107557	0.109807	0.111437	0.112670	0.113631	0.114397
15	10	10	0.136047	0.146782	0.153612	0.158334	0.161791	0.164432	0.166513	0.168197
15	10	11	0.133891	0.143309	0.149262	0.153357	0.156339	0.158597	0.160355	0.161747
15	10	12	0.131978	0.140250	0.145448	0.149010	0.151595	0.153548	0.155061	0.156252
15	10	13	0.130267	0.137529	0.142067	0.145164	0.147406	0.149092	0.150393	0.151409
15	10	14	0.128723	0.135087	0.139041	0.141731	0.143670	0.145123	0.146236	0.147097
15	10	15	0.127321	0.132879	0.136314	0.138640	0.140310	0.141553	0.142495	0.143211
15	11	11	0.176474	0.187197	0.193936	0.198561	0.201930	0.204493	0.206508	0.208135
15	11	12	0.174007	0.183274	0.189043	0.192947	0.195723	0.197745	0.199220	0.200267
15	11	13	0.171798	0.179791	0.184736	0.188062	0.190408	0.192094	0.193295	0.194109
15	11	14	0.169801	0.176660	0.180874	0.183689	0.185652	0.187036	0.187985	0.188580
15	11	15	0.167986	0.173823	0.177381	0.179733	0.181344	0.182439	0.183136	0.183497
15	12	12	0.239363	0.250075	0.256735	0.261274	0.264566	0.267062	0.269020	0.270597
15	12	13	0.236332	0.245216	0.250499	0.253785	0.255767	0.256783	0.257008	0.256537
15	12	14	0.233656	0.241042	0.245352	0.247936	0.249365	0.249910	0.249706	0.248823
15	12	15	0.231208	0.237225	0.240629	0.242529	0.243379	0.243384	0.242642	0.241194

15	13	13	0.350830	0.361533	0.368122	0.372586	0.375811	0.378248	0.380156	0.381689
15	13	14	0.345448	0.352125	0.354433	0.353897	0.351170	0.346579	0.340313	0.332495
15	13	15	0.341700	0.346156	0.346754	0.344670	0.340397	0.334180	0.326160	0.316437
15	14	14	0.601159	0.611853	0.618379	0.622777	0.625940	0.628326	0.630189	0.631684
15	14	15	0.562571	0.546852	0.522994	0.493077	0.458262	0.419325	0.376840	0.331267
15	15	15	1.601463	1.612150	1.618620	1.622957	1.626067	1.628406	1.630228	1.631689
20	1	1	0.008802	0.016750	0.024691	0.031975	0.038442	0.044118	0.049089	0.053453
20	1	2	0.007537	0.013099	0.018210	0.022644	0.026427	0.029652	0.032414	0.034795
20	1	3	0.006867	0.011355	0.015310	0.018650	0.021448	0.023801	0.025796	0.027503
20	1	4	0.006434	0.010289	0.013596	0.016341	0.018615	0.020511	0.022106	0.023467
20	1	5	0.006129	0.009554	0.012436	0.014802	0.016739	0.018350	0.019709	0.020850
20	1	6	0.005874	0.009005	0.011585	0.013682	0.015410	0.016808	0.017972	0.018978
20	1	7	0.005734	0.008569	0.010932	0.012841	0.014354	0.015654	0.016718	0.017620
20	1	8	0.005486	0.008239	0.010417	0.012127	0.013555	0.014653	0.015626	0.016374
20	1	9	0.005478	0.007934	0.009964	0.011651	0.012919	0.014033	0.014904	0.015732
20	1	10	0.005261	0.007694	0.009597	0.011049	0.012327	0.013279	0.014033	0.014630
20	1	11	0.005200	0.007507	0.009349	0.010814	0.011856	0.012754	0.013684	0.014336
20	1	12	0.005162	0.007295	0.008972	0.010311	0.011503	0.012395	0.012897	0.013584
20	1	13	0.004998	0.007158	0.008832	0.010117	0.011049	0.011842	0.012709	0.013169
20	1	14	0.005007	0.006992	0.008558	0.009777	0.010799	0.011603	0.012142	0.012773
20	1	15	0.004900	0.006880	0.008390	0.009571	0.010485	0.011223	0.011883	0.012355
20	1	16	0.004864	0.006751	0.008213	0.009341	0.010237	0.010965	0.011542	0.012046
20	1	17	0.004806	0.006650	0.008058	0.009149	0.010007	0.010695	0.011264	0.011734
20	1	18	0.004760	0.006550	0.007916	0.008968	0.009796	0.010462	0.011006	0.011460
20	1	19	0.004717	0.006461	0.007786	0.008804	0.009604	0.010246	0.010771	0.011208
20	1	20	0.004677	0.006378	0.007666	0.008653	0.009428	0.010048	0.010556	0.010977
20	2	2	0.013677	0.021964	0.029096	0.035034	0.039960	0.044076	0.047547	0.050505
20	2	3	0.012475	0.019074	0.024521	0.028936	0.032533	0.035499	0.037976	0.040071
20	2	4	0.011696	0.017300	0.021804	0.025391	0.028281	0.030645	0.032609	0.034257
20	2	5	0.011130	0.016075	0.019955	0.023023	0.025473	0.027454	0.029088	0.030471
20	2	6	0.010739	0.015148	0.018613	0.021297	0.023415	0.025183	0.026600	0.027789
20	2	7	0.010280	0.014462	0.017577	0.019957	0.021888	0.023317	0.024640	0.025626
20	2	8	0.010233	0.013830	0.016655	0.019002	0.020721	0.022283	0.023231	0.024393
20	2	9	0.009677	0.013415	0.016085	0.017933	0.019576	0.020563	0.021787	0.022314
20	2	10	0.009722	0.013039	0.015545	0.017554	0.018739	0.020096	0.021281	0.022330
20	2	11	0.009557	0.012423	0.014717	0.016333	0.018295	0.019415	0.019409	0.020296
20	2	12	0.009064	0.012441	0.014766	0.016468	0.017079	0.017997	0.020027	0.020245
20	2	13	0.009394	0.011949	0.013946	0.015440	0.017228	0.018312	0.017980	0.019338
20	2	14	0.008891	0.011881	0.013875	0.015432	0.016290	0.017123	0.018437	0.018539
20	2	15	0.009020	0.011512	0.013473	0.014840	0.016046	0.016971	0.017441	0.018257
20	2	16	0.008809	0.011417	0.013214	0.014598	0.015613	0.016379	0.017131	0.017613
20	2	17	0.008758	0.011194	0.012960	0.014256	0.015254	0.016072	0.016682	0.017214
20	2	18	0.008661	0.011041	0.012734	0.013986	0.014946	0.015693	0.016306	0.016807
20	2	19	0.008584	0.010888	0.012523	0.013729	0.014649	0.015374	0.015957	0.016437
20	2	20	0.008511	0.010749	0.012331	0.013494	0.014381	0.015077	0.015638	0.016099
20	3	3	0.018050	0.026366	0.032992	0.038248	0.042469	0.045914	0.048768	0.051168
20	3	4	0.016932	0.023937	0.029370	0.033610	0.036976	0.039700	0.041944	0.043823
20	3	5	0.016132	0.022249	0.026908	0.030496	0.033323	0.035601	0.037466	0.039023
20	3	6	0.015490	0.020998	0.025104	0.028223	0.030688	0.032618	0.034252	0.035568
20	3	7	0.015087	0.019994	0.023648	0.026532	0.028670	0.030553	0.031828	0.033099
20	3	8	0.014481	0.019217	0.022651	0.025034	0.027035	0.028262	0.029837	0.030654
20	3	9	0.014439	0.018568	0.021605	0.024100	0.025745	0.027625	0.028467	0.029747
20	3	10	0.013970	0.017739	0.020653	0.022714	0.024906	0.025835	0.026463	0.027172
20	3	11	0.013495	0.017975	0.020684	0.022666	0.022895	0.024388	0.027090	0.027516
20	3	12	0.014024	0.016605	0.018973	0.020894	0.023877	0.025133	0.023425	0.025563
20	3	13	0.012773	0.017047	0.019421	0.021432	0.021386	0.022384	0.025568	0.024641
20	3	14	0.013477	0.016049	0.018451	0.019922	0.021991	0.022984	0.022401	0.024336
20	3	15	0.012816	0.016263	0.018243	0.020007	0.020868	0.021690	0.022985	0.023018
20	3	16	0.012887	0.015663	0.017838	0.019245	0.020457	0.021545	0.022058	0.022777
20	3	17	0.012659	0.015576	0.017514	0.018970	0.020056	0.020805	0.021554	0.022093
20	3	18	0.012564	0.015303	0.017198	0.018566	0.019594	0.020425	0.021054	0.021579
20	3	19	0.012444	0.015100	0.016920	0.018234	0.019224	0.019992	0.020610	0.021115
20	3	20	0.012339	0.014907	0.016659	0.017921	0.018870	0.019608	0.020198	0.020680
20	4	4	0.022443	0.030742	0.037029	0.041864	0.045667	0.048725	0.051231	0.053319
20	4	5	0.021385	0.028594	0.033950	0.038020	0.041197	0.043734	0.045807	0.047526
20	4	6	0.020579	0.026988	0.031675	0.035222	0.037954	0.040150	0.041906	0.043386
20	4	7	0.019906	0.025734	0.029956	0.033033	0.035479	0.037311	0.038952	0.040200
20	4	8	0.019459	0.024721	0.028474	0.031341	0.033493	0.035395	0.036595	0.037840
20	4	9	0.018841	0.023707	0.027237	0.029888	0.032041	0.033214	0.034570	0.035450
20	4	10	0.018532	0.023514	0.026748	0.028879	0.029999	0.031790	0.033675	0.034517
20	4	11	0.018646	0.021818	0.024791	0.027216	0.030479	0.031754	0.030286	0.031985
20	4	12	0.017307	0.022649	0.025507	0.027755	0.027137	0.028224	0.032680	0.031271
20	4	13	0.018309	0.020789	0.023674	0.025152	0.028702	0.029837	0.027350	0.031114
20	4	14	0.017025	0.021586	0.023726	0.025949	0.026076	0.027168	0.029867	0.028625
20	4	15	0.017395	0.020258	0.023047	0.024303	0.026156	0.027412	0.027368	0.028919
20	4	16	0.016937	0.020566	0.022586	0.024381	0.025461	0.026030	0.027125	0.027524
20	4	17	0.016865	0.019920	0.022125	0.023603	0.024732	0.025838	0.026397	0.027000
20	4	18	0.016665	0.019724	0.021758	0.023224	0.024326	0.025122	0.025830	0.026387
20	4	19	0.016521	0.019439	0.021393	0.022785	0.023823	0.024632	0.025272	0.025790
20	4	20	0.016379	0.019190	0.021066	0.022398	0.023391	0.024158	0.024769	0.025267
20	5	5	0.027083	0.035356	0.041398	0.045941	0.049461	0.052260	0.054536	0.056421
20	5	6	0.026064	0.033386	0.038654	0.042576	0.045600	0.047991	0.049933	0.051534
20	5	7	0.025252	0.031836	0.036517	0.039985	0.042638	0.044748	0.046419	0.047818
20	5	8	0.024552	0.030575	0.034800	0.037940	0.040292	0.042104	0.043653	0.044872
20	5	9	0.024050	0.029647	0.033509	0.036148	0.038227	0.040021	0.041434	0.042559
20	5	10	0.023603	0.028326	0.031924	0.034653	0.037153	0.038533	0.039045	0.040323
20	5	11	0.022748	0.028438	0.031591	0.033932	0.034427	0.035887	0.039022	0.038866
20	5	12	0.023236	0.026719	0.029799	0.031703	0.035178	0.036509	0.034559	0.037997
20	5	13	0.021920	0.027131	0.029840	0.032340	0.032091	0.033634	0.037108	0.034741
20	5	14	0.022251	0.025597	0.028750	0.029841	0.032804	0.033744	0.032872	0.036051
20	5	15	0.021709	0.026170	0.028054	0.030479	0.031175	0.031940	0.033488	0.033236
20	5	16	0.021608	0.024883	0.027585	0.029010	0.030457	0.031898	0.032342	0.033200
20	5	17	0.021322	0.024896	0.027067	0.028772	0.030001	0.030649	0.031583	0.032167

ISSN 2250-3153

20	5	18	0.021149	0.024393	0.026576	0.028094	0.029214	0.030165	0.030817	0.031378
20	5	19	0.020944	0.024084	0.026153	0.027611	0.028694	0.029521	0.030184	0.030728
20	5	20	0.020769	0.023776	0.025748	0.027136	0.028164	0.028955	0.029583	0.030091
20	6	6	0.032132	0.040381	0.046233	0.050559	0.053871	0.056484	0.058594	0.060333
20	6	7	0.031134	0.038524	0.043704	0.047505	0.050399	0.052674	0.054508	0.056017
20	6	8	0.030317	0.037018	0.041671	0.045041	0.047626	0.049640	0.051263	0.052591
20	6	9	0.029608	0.035705	0.039942	0.043043	0.045399	0.047190	0.048569	0.049785
20	6	10	0.028954	0.034821	0.038629	0.041423	0.043274	0.044934	0.046637	0.047468
20	6	11	0.028726	0.033552	0.037259	0.039628	0.042129	0.043675	0.043749	0.045732
20	6	12	0.027741	0.033118	0.036344	0.039039	0.039972	0.041263	0.044007	0.042912
20	6	13	0.027802	0.031998	0.035225	0.037031	0.039777	0.040732	0.040309	0.043416
20	6	14	0.027259	0.031877	0.034463	0.037136	0.037635	0.039065	0.040827	0.039959
20	6	15	0.026910	0.030688	0.033760	0.035148	0.037179	0.038417	0.038933	0.040363
20	6	16	0.026609	0.030710	0.032981	0.035113	0.036301	0.036930	0.038023	0.038490
20	6	17	0.026354	0.029921	0.032434	0.034013	0.035261	0.036474	0.037067	0.037710
20	6	18	0.026082	0.029602	0.031870	0.033488	0.034683	0.035536	0.036303	0.036890
20	6	19	0.025852	0.029176	0.031335	0.032850	0.033965	0.034828	0.035508	0.036051
20	6	20	0.025630	0.028804	0.030860	0.032296	0.033353	0.034163	0.034804	0.035326
20	7	7	0.037749	0.045975	0.051678	0.055833	0.058984	0.061452	0.063437	0.065065
20	7	8	0.036757	0.044184	0.049282	0.052975	0.055764	0.057942	0.059688	0.061119
20	7	9	0.035917	0.042700	0.047302	0.050625	0.053106	0.055056	0.056633	0.057896
20	7	10	0.035223	0.041398	0.045625	0.048597	0.050927	0.052672	0.053965	0.055232
20	7	11	0.034489	0.040327	0.044156	0.046983	0.048905	0.050489	0.052124	0.052687
20	7	12	0.034132	0.039384	0.042935	0.045346	0.047504	0.048904	0.049581	0.051449
20	7	13	0.033495	0.038549	0.041800	0.044339	0.045648	0.047170	0.048694	0.048381
20	7	14	0.033035	0.037618	0.040789	0.042628	0.044838	0.045839	0.046754	0.048325
20	7	15	0.032683	0.037196	0.039873	0.042292	0.043424	0.044510	0.045534	0.045886
20	7	16	0.032305	0.036295	0.039205	0.040799	0.042347	0.043650	0.044363	0.045142
20	7	17	0.031965	0.035935	0.038371	0.040258	0.041560	0.042409	0.043336	0.043963
20	7	18	0.031655	0.035332	0.037727	0.039378	0.040591	0.041577	0.042283	0.042881
20	7	19	0.031370	0.034869	0.037123	0.038691	0.039843	0.040722	0.041419	0.041991
20	7	20	0.031106	0.034426	0.036553	0.038031	0.039115	0.039944	0.040599	0.041127
20	8	8	0.044113	0.052320	0.057898	0.061915	0.064937	0.067292	0.069176	0.070718
20	8	9	0.043115	0.050563	0.055585	0.059179	0.061878	0.063972	0.065644	0.067012
20	8	10	0.042250	0.049065	0.053620	0.056876	0.059299	0.061182	0.062697	0.063897
20	8	11	0.041517	0.047782	0.051951	0.054892	0.057110	0.058810	0.060119	0.061336
20	8	12	0.040820	0.046612	0.050464	0.053176	0.055128	0.056743	0.058038	0.058795
20	8	13	0.040250	0.045654	0.049150	0.051592	0.053611	0.054896	0.056026	0.057271
20	8	14	0.039730	0.044763	0.048004	0.050479	0.051948	0.053364	0.054291	0.054940
20	8	15	0.039241	0.043879	0.047022	0.048912	0.050671	0.051902	0.052902	0.053753
20	8	16	0.038797	0.043250	0.045964	0.048145	0.049515	0.050542	0.051496	0.052191
20	8	17	0.038390	0.042492	0.045197	0.046971	0.048339	0.049456	0.050200	0.050887
20	8	18	0.038026	0.041910	0.044396	0.046135	0.047406	0.048358	0.049147	0.049768
20	8	19	0.037680	0.041340	0.043674	0.045290	0.046475	0.047381	0.048095	0.048664
20	8	20	0.037362	0.040816	0.043012	0.044527	0.045635	0.046481	0.047146	0.047686
20	9	9	0.051453	0.059642	0.065117	0.069019	0.071935	0.074195	0.075997	0.077467
20	9	10	0.050435	0.057891	0.062839	0.066349	0.068964	0.070987	0.072596	0.073910
20	9	11	0.049543	0.056371	0.060874	0.064053	0.066415	0.068241	0.069693	0.070861
20	9	12	0.048761	0.055046	0.059157	0.062059	0.064221	0.065859	0.067178	0.068275
20	9	13	0.048055	0.053856	0.057648	0.060321	0.062238	0.063786	0.064946	0.065878
20	9	14	0.047429	0.052806	0.056310	0.058683	0.060544	0.061897	0.063047	0.063958
20	9	15	0.046844	0.051868	0.055046	0.057415	0.059005	0.060267	0.061245	0.062060
20	9	16	0.046331	0.050976	0.054032	0.056011	0.057576	0.058785	0.059667	0.060425
20	9	17	0.045858	0.050219	0.052973	0.054941	0.056350	0.057408	0.058306	0.058982
20	9	18	0.045406	0.049484	0.052078	0.053864	0.055176	0.056180	0.056957	0.057594
20	9	19	0.045003	0.048818	0.051237	0.052903	0.054120	0.055049	0.055779	0.056375
20	9	20	0.044624	0.048202	0.050459	0.052012	0.053144	0.054006	0.054684	0.055230
20	10	10	0.060071	0.068245	0.073631	0.077435	0.080262	0.082443	0.084176	0.085587
20	10	11	0.059020	0.066471	0.071349	0.074781	0.077324	0.079281	0.080835	0.082098
20	10	12	0.058089	0.064913	0.069354	0.072467	0.074765	0.076535	0.077935	0.079072
20	10	13	0.057259	0.063533	0.067592	0.070422	0.072520	0.074120	0.075399	0.076430
20	10	14	0.056508	0.062295	0.066012	0.068628	0.070521	0.071988	0.073129	0.074072
20	10	15	0.055837	0.061178	0.064626	0.066965	0.068727	0.070066	0.071122	0.071973
20	10	16	0.055212	0.060174	0.063309	0.065529	0.067123	0.068338	0.069325	0.070102
20	10	17	0.054643	0.059242	0.062169	0.064172	0.065648	0.066778	0.067644	0.068365
20	10	18	0.054126	0.058394	0.061096	0.062955	0.064312	0.065347	0.066166	0.066825
20	10	19	0.053639	0.057612	0.060113	0.061832	0.063084	0.064035	0.064784	0.065386
20	10	20	0.053190	0.056888	0.059207	0.060795	0.061949	0.062828	0.063517	0.064073
20	11	11	0.070391	0.078552	0.083861	0.087581	0.090330	0.092444	0.094118	0.095478
20	11	12	0.069292	0.076728	0.081537	0.084895	0.087370	0.089270	0.090773	0.091992
20	11	13	0.068308	0.075107	0.079480	0.082525	0.084763	0.086479	0.087833	0.088931
20	11	14	0.067423	0.073656	0.077648	0.080411	0.082445	0.083999	0.085227	0.086218
20	11	15	0.066618	0.072347	0.075991	0.078522	0.080369	0.081781	0.082896	0.083797
20	11	16	0.065885	0.071157	0.074504	0.076804	0.078492	0.079780	0.080785	0.081605
20	11	17	0.065214	0.070070	0.073136	0.075249	0.076789	0.077960	0.078889	0.079633
20	11	18	0.064591	0.069074	0.071890	0.073823	0.075231	0.076302	0.077142	0.077819
20	11	19	0.064018	0.068152	0.070741	0.072512	0.073800	0.074779	0.075548	0.076168
20	11	20	0.063484	0.067300	0.069679	0.071303	0.072482	0.073376	0.074077	0.074642
20	12	12	0.083029	0.091178	0.096419	0.100065	0.102748	0.104802	0.106427	0.107743
20	12	13	0.081863	0.089272	0.094012	0.097299	0.099712	0.101556	0.103012	0.104188
20	12	14	0.080811	0.087562	0.091860	0.094833	0.097009	0.098671	0.099980	0.101037
20	12	15	0.079855	0.086018	0.089924	0.092616	0.094585	0.096085	0.097265	0.098217
20	12	16	0.078983	0.084615	0.088168	0.090612	0.092394	0.093751	0.094819	0.095678
20	12	17	0.078181	0.083333	0.086568	0.088787	0.090403	0.091631	0.092594	0.093370
20	12	18	0.077444	0.082154	0.085101	0.087117	0.088582	0.089694	0.090567	0.091268
20	12	19	0.076759	0.081066	0.083750	0.085581	0.086909	0.087916	0.088704	0.089337
20	12	20	0.076123	0.080059	0.082500	0.084162	0.085365	0.086276	0.086988	0.087558
20	13	13	0.098922	0.107061	0.112241	0.115823	0.118446	0.120450	0.122029	0.123307
20	13	14	0.097666	0.105035	0.109702	0.112919	0.115269	0.117058	0.118462	0.119589
20	13	15	0.096523	0.103201	0.107412	0.110307	0.112417	0.114021	0.115278	0.116284
20	13	16	0.095479	0.101534	0.105336	0.107942	0.109838	0.111277	0.112402	0.113302
20	13	17	0.094519	0.100009	0.103441	0.105788	0.107492	0.108783	0.109791	0.110594
20	13	18	0.093634	0.098607	0.101703	0.103815	0.105345	0.106502	0.107404	0.108120

ISSN 2250-3153

20	13	19	0.092813	0.097312	0.100101	0.101999	0.103371	0.104407	0.105212	0.105849
20	13	20	0.092050	0.096111	0.098619	0.100321	0.101549	0.102473	0.103188	0.103751
20	14	14	0.119578	0.127708	0.132834	0.136358	0.138929	0.140886	0.142427	0.143670
20	14	15	0.118199	0.125509	0.130097	0.133237	0.135516	0.137233	0.138561	0.139599
20	14	16	0.116935	0.123506	0.127611	0.130415	0.132443	0.133968	0.135141	0.136053
20	14	17	0.115774	0.121672	0.125342	0.127841	0.129644	0.130996	0.132031	0.132828
20	14	18	0.114701	0.119984	0.123259	0.125482	0.127081	0.128276	0.129185	0.129876
20	14	19	0.113706	0.118425	0.121337	0.123309	0.124723	0.125773	0.126565	0.127159
20	14	20	0.112780	0.116978	0.119558	0.121298	0.122540	0.123456	0.124136	0.124632
20	15	15	0.147586	0.155708	0.160785	0.164257	0.166781	0.168698	0.170203	0.171416
20	15	16	0.146034	0.153257	0.157739	0.160770	0.162923	0.164486	0.165616	0.166399
20	15	17	0.144606	0.151015	0.154975	0.157640	0.159523	0.160875	0.161833	0.162469
20	15	18	0.143285	0.148950	0.152433	0.154767	0.156403	0.157562	0.158359	0.158855
20	15	19	0.142059	0.147039	0.150087	0.152116	0.153524	0.154500	0.155143	0.155500
20	15	20	0.140917	0.145265	0.147909	0.149654	0.150844	0.151638	0.152115	0.152309
20	16	16	0.187801	0.195916	0.200949	0.204374	0.206855	0.208735	0.210208	0.211394
20	16	17	0.185982	0.193032	0.197291	0.200025	0.201774	0.202791	0.203203	0.203070
20	16	18	0.184316	0.190438	0.194104	0.196417	0.197842	0.198590	0.198763	0.198403
20	16	19	0.182766	0.188033	0.191149	0.193068	0.194179	0.194657	0.194574	0.193959
20	16	20	0.181319	0.185788	0.188382	0.189909	0.190686	0.190842	0.190426	0.189443
20	17	17	0.250503	0.258611	0.263603	0.266985	0.269428	0.271274	0.272719	0.273880
20	17	18	0.248043	0.254449	0.257753	0.259131	0.259052	0.257721	0.255230	0.251626
20	17	19	0.245988	0.251245	0.253768	0.254526	0.253889	0.252007	0.248941	0.244716
20	17	20	0.244037	0.248174	0.249873	0.249897	0.248512	0.245812	0.241821	0.236539
20	18	18	0.361803	0.369906	0.374861	0.378203	0.380610	0.382426	0.383845	0.384984
20	18	19	0.355213	0.357370	0.354819	0.348695	0.339504	0.327533	0.312983	0.296016
20	18	20	0.351871	0.351815	0.347198	0.338883	0.327259	0.312560	0.294965	0.274637
20	19	19	0.611981	0.620080	0.625000	0.628306	0.630681	0.632469	0.633863	0.634982
20	19	20	0.550267	0.516451	0.472497	0.420706	0.362544	0.299082	0.231159	0.159457
20	20	20	1.612150	1.620244	1.625133	1.628406	1.630750	1.632512	1.633884	1.634984

R-program 2: R-code for computing the coefficients of the BLUEs of Location and Scale Parameters of GED

```
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-CODE COMPUTES COEFFICIENTS OF THE BLUEs OF LOCATION AND SCALE PARAMETERS OF GENERALIZED   @
# EXPONENTIAL DISTRIBUTION FOR A SPECIFIED VALUE OF SHAPE PARAMETER (alpha)  FOR A GIVEN COMPLETE   @
# SAMPLE OR RIGHT CENSORED OR LEFT CENSORED OR DOUBLY CENSORED SAMPLE FOR ANY SAMPLE SIZE UP TO 20 @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
cat("\n ENTER SHAPE PARAMETER OF STANDARD GE DISTRIBUTION (between 1.5 and 6.0)");
alpha=scan();
cat("\n ENTER SAMPLE SIZE (n between 2 and 20)");n=scan();
cat("\n ENTER No. observations LEFT  censored (r between 0 and n-2)");r=scan();
cat("\n ENTER No. observations RIGHT censored (s between 0 and n-2)");s=scan();
m=n-r-s;
I=rep(1,m);a=rep(0,m);B=a%*%t(a);
for (i in 1:m) a[i]=GEMOM1(n,r+i,alpha);
for (i in 1:m)
for (j in i:m) { if (i==j)  {B[i,i]=GEMOM2(n,r+i,alpha)-GEMOM1(n,r+i,alpha)**2;}
                 else  { B[i,j]=GEPM(n,r+i,r+j,alpha)-GEMOM1(n,r+i,alpha)*GEMOM1(n,r+j,alpha);}
                }
for (i in 1:(m-1)) for (j in (i+1):m) B[j,i]=B[i,j];
delta=sum(a*solve(B,a))*sum(I*solve(B,I))-sum(a*solve(B,I))**2;
BI=solve(B);
A=BI%*%(I%*%t(a)-a%*%t(I));
A=A%*%BI;
BLMUC=(-t(a)%*%A)/delta;
BLSIGC=(t(I)%*%A)/delta;
cat("\n\nCoefficients of the BLUE of Location parameter:\n","  ",format(round(BLMUC,4),nsmall=4));
cat("\n\nCoefficients of the BLUE of    Scale parameter:\n","  ",format(round(BLSIGC,4),nsmall=4));
vmu=sum(a*solve(B,a))/delta;
vsig=sum(I*solve(B,I))/delta;
cov=-sum(I*solve(B,a))/delta;
cat("\n\nVariances and covariance of the BLUEs: \n     ",
       format(round(vmu,4),nsmall=4),format(round(vsig,4),nsmall=4),format(round(cov,4),nsmall=4));
cat("\n");
cat("\n\n CHECKS ON BLUE COEFFICIENTS: \n ");
cat("\n SUM OF the BLUE COEFFICIENTS OF LOCATION= ", format(round(sum(BLMUC),6),nsmall=6));
cat("\n SUM OF the BLUE COEFFICIENTS OF    SCALE= ", format(round(sum(BLSIGC),6),nsmall=6));
cat("\n");


#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES MEAN OF R-th ORDER STATISTICS OF STANDARD GENERALIZED  @
# EXPONENTIAL DISTRIBUTION                                                        @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEMOM1=function(n,r,alpha){
GEMOM1=0;
for (i in 0:(n-r)) {
t=digamma((r+i)*alpha+1)+0.577215;
GEMOM1=GEMOM1+(-1)**i*comb(n-r,i)/(r+i)*t;
}
GEMOM1=GEMOM1/beta(r,n-r+1);
return(GEMOM1);
}

#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES SECOND ORDER MOMENT OF R-th ORDER STATISTIC OF STANDARD @
# GENERALIZED EXPONENTIAL DISTRIBUTION                                             @
```

ISSN 2250-3153

```
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEMOM2=function(n,r,alpha){
GEMOM2=0;
for (i in 0:(n-r)) {
t=(digamma((r+i)*alpha+1)+0.577215)**2-trigamma((r+i)*alpha+1)+pi**2/6;
GEMOM2=GEMOM2+(-1)**i*comb(n-r,i)/(r+i)*t;
}
GEMOM2=GEMOM2/beta(r,n-r+1);
return(GEMOM2);
}
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS R-FUNCTION COMPUTES PRODUCT MOMENTS BETWEEN R-th AND S-th ORDER STATISTICS OF STANDARD  @
# GENERALIZED EXPONENTIAL DISTRIBUTION                                                       @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
GEPM=function(n,r,s,alpha){
GEPM=0;
GEPM1=0;
crs=(factorial(n)/factorial(r-1)/factorial(s-r-1)/factorial(n-s));
for (i in 0:(n-s)) {
for (j in 0:(s-r-1)){
GEPM1=0;
for (k in 1:200)GEPM1=GEPM1+(digamma((s+i)*alpha+k+1)+0.5772157)/(k*((s+i)*alpha+k)*((r+j)*alpha+k));
GEPM=GEPM+((-1)**(i+j))*comb(s-r-1,j)*comb(n-s,i)*GEPM1;
}
}
GEPM=GEPM*(alpha**2)*crs;
return(GEPM);
}
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
# THIS FUNCTION COMPUTES COMBINOTORIAL(n,r)                       @
#@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
comb=function(n,r){
comb=1;
if (r==0) return(1);
for (i in 1:r) comb=comb*(n-i+1)/i;
return(comb);
}
```

Table 1: Coefficients to get BLUEs of Location and Scale parameters in Generalized Exponential Distribution from compete samples of sizes n=11(1)20 for shape parameter α =1.5(0.5)2.0(1.0)5.0.

		Coefficient of											
α	n	$X_{1:n}$ / $X_{11:n}$	$X_{2:n}$ / $X_{12:n}$	$X_{3:n}$ / $X_{13:n}$	$X_{4:n}$ / $X_{14:n}$	$X_{5:n}$ / $X_{15:n}$	$X_{6:n}$ / $X_{16:n}$	$X_{7:n}$ / $X_{17:n}$	$X_{8:n}$ / $X_{18:n}$	$X_{9:n}$ / $X_{19:n}$	$X_{10:n}$ / $X_{20:n}$	$\frac{Var}{\sigma^2}$	$\frac{Cov(\mu^*,\sigma^*)}{\sigma^2}$
1.50	11	1.0505	0.0568	0.0173	0.0002	-0.0089	-0.0143	-0.0175	-0.0195	-0.0198	-0.0231		
		-0.0217										0.0265	
		-0.7711	0.0318	0.0628	0.0760	0.0824	0.0858	0.0873	0.0870	0.0830	0.0915		
		0.0836										0.0811	-0.0214
	12	1.0339	0.0595	0.0209	0.0039	-0.0050	-0.0104	-0.0137	-0.0159	-0.0171	-0.0171		
		-0.0202	-0.0188									0.0229	
		-0.7643	0.0233	0.0537	0.0668	0.0733	0.0769	0.0787	0.0795	0.0787	0.0744		
		0.0835	0.0756									0.0734	-0.0185
	13	1.0193	0.0615	0.0237	0.0069	-0.0019	-0.0073	-0.0106	-0.0129	-0.0144	-0.0152		
		-0.0149	-0.0179	-0.0165								0.0200	
		-0.7581	0.0163	0.0460	0.0592	0.0657	0.0694	0.0714	0.0725	0.0727	0.0716		
		0.0672	0.0770	0.0690								0.0670	-0.0162
	14	1.0064	0.0631	0.0259	0.0095	0.0006	-0.0047	-0.0081	-0.0104	-0.0119	-0.0131		
		-0.0135	-0.0132	-0.0161	-0.0146							0.0177	
		-0.7524	0.0104	0.0396	0.0527	0.0592	0.0630	0.0652	0.0664	0.0670	0.0670		
		0.0656	0.0612	0.0716	0.0635							0.0617	-0.0143
	15	0.9949	0.0642	0.0278	0.0115	0.0027	-0.0025	-0.0061	-0.0082	-0.0100	-0.0110		
		-0.0119	-0.0121	-0.0117	-0.0145	-0.0130						0.0158	
		-0.7472	0.0055	0.0340	0.0473	0.0537	0.0575	0.0599	0.0611	0.0620	0.0622		
		0.0620	0.0604	0.0560	0.0670	0.0587						0.0571	-0.0128
	16	0.9845	0.0653	0.0292	0.0132	0.0044	-0.0007	-0.0043	-0.0065	-0.0083	-0.0093		
		-0.0103	-0.0108	-0.0109	-0.0105	-0.0133	-0.0117					0.0142	
		-0.7424	0.0013	0.0292	0.0425	0.0489	0.0527	0.0552	0.0565	0.0575	0.0578		
		0.0580	0.0576	0.0558	0.0516	0.0630	0.0547					0.0531	-0.0115
	17	0.9750	0.0661	0.0304	0.0146	0.0057	0.0010	-0.0031	-0.0046	-0.0071	-0.0076		
		-0.0089	-0.0095	-0.0099	-0.0099	-0.0094	-0.0122	-0.0106				0.0129	
		-0.7379	-0.0023	0.0249	0.0385	0.0447	0.0484	0.0513	0.0522	0.0538	0.0538		
		0.0544	0.0542	0.0538	0.0518	0.0477	0.0596	0.0511				0.0496	-0.0104
	18	0.9665	0.0666	0.0315	0.0159	0.0069	0.0027	-0.0028	-0.0019	-0.0071	-0.0056		
		-0.0080	-0.0083	-0.0087	-0.0092	-0.0090	-0.0085	-0.0113	-0.0097			0.0118	
		-0.7338	-0.0052	0.0208	0.0351	0.0411	0.0444	0.0485	0.0474	0.0513	0.0497		
		0.0512	0.0510	0.0509	0.0504	0.0483	0.0443	0.0566	0.0480			0.0466	-0.0095
	19	0.9588	0.0665	0.0330	0.0165	0.0076	0.0056	-0.0051	0.0038	-0.0105	-0.0018		
		-0.0076	-0.0075	-0.0072	-0.0084	-0.0083	-0.0083	-0.0077	-0.0105	-0.0089		0.0108	
		-0.7302	-0.0071	0.0166	0.0323	0.0381	0.0397	0.0480	0.0404	0.0518	0.0444		
		0.0486	0.0485	0.0476	0.0482	0.0473	0.0451	0.0413	0.0540	0.0453		0.0439	-0.0087
	20	0.9534	0.0609	0.0430	0.0083	0.0138	0.0079	-0.0133	0.0189	-0.0214	0.0028		
		-0.0016	-0.0160	0.0017	-0.0119	-0.0058	-0.0084	-0.0074	-0.0071	-0.0098	-0.0082	0.0099	
		-0.7282	-0.0039	0.0051	0.0376	0.0304	0.0359	0.0526	0.0261	0.0586	0.0389		
		0.0410	0.0545	0.0376	0.0498	0.0436	0.0451	0.0421	0.0386	0.0516	0.0429	0.0415	-0.0080

2.00 11 1.0271 0.1069 0.0406 0.0094 -0.0080 -0.0187 -0.0254 -0.0294 -0.0300 -0.0380
-0.0345 0.0477
-0.6517 -0.0046 0.0407 0.0612 0.0720 0.0780 0.0810 0.0810 0.0760 0.0889
0.0775 0.0738 -0.0337
12 1.0034 0.1100 0.0456 0.0153 -0.0017 -0.0124 -0.0193 -0.0239 -0.0264 -0.0263
-0.0340 -0.0303 0.0419
-0.6411 -0.0125 0.0316 0.0518 0.0626 0.0689 0.0724 0.0740 0.0730 0.0679
0.0815 0.0700 0.0667 -0.0295
13 0.9825 0.1122 0.0496 0.0200 0.0032 -0.0072 -0.0143 -0.0190 -0.0223 -0.0238
-0.0233 -0.0308 -0.0270 0.0372
-0.6315 -0.0190 0.0241 0.0439 0.0548 0.0611 0.0650 0.0671 0.0679 0.0662
0.0611 0.0754 0.0638 0.0608 -0.0262
14 0.9639 0.1137 0.0528 0.0238 0.0073 -0.0030 -0.0101 -0.0148 -0.0183 -0.0206
-0.0215 -0.0208 -0.0281 -0.0242 0.0333
-0.6227 -0.0242 0.0178 0.0373 0.0482 0.0545 0.0586 0.0610 0.0623 0.0625
0.0604 0.0553 0.0703 0.0587 0.0559 -0.0235
15 0.9470 0.1149 0.0553 0.0269 0.0108 0.0004 -0.0064 -0.0114 -0.0149 -0.0174
-0.0191 -0.0195 -0.0187 -0.0259 -0.0219 0.0301
-0.6145 -0.0287 0.0125 0.0318 0.0424 0.0489 0.0530 0.0556 0.0572 0.0580
0.0578 0.0553 0.0504 0.0660 0.0543 0.0516 -0.0212
16 0.9317 0.1157 0.0573 0.0295 0.0135 0.0034 -0.0035 -0.0084 -0.0119 -0.0146
-0.0165 -0.0177 -0.0177 -0.0169 -0.0241 -0.0200 0.0274
-0.6070 -0.0325 0.0080 0.0269 0.0375 0.0439 0.0482 0.0509 0.0526 0.0537
0.0541 0.0537 0.0508 0.0463 0.0623 0.0506 0.0480 -0.0193
17 0.9178 0.1162 0.0590 0.0318 0.0158 0.0060 -0.0009 -0.0058 -0.0093 -0.0120
-0.0141 -0.0155 -0.0165 -0.0162 -0.0154 -0.0225 -0.0184 0.0251
-0.5999 -0.0357 0.0041 0.0226 0.0333 0.0396 0.0439 0.0467 0.0486 0.0498
0.0505 0.0507 0.0500 0.0468 0.0427 0.0591 0.0473 0.0448 -0.0177
18 0.9050 0.1166 0.0604 0.0335 0.0180 0.0081 0.0013 -0.0036 -0.0071 -0.0097
-0.0121 -0.0133 -0.0147 -0.0153 -0.0148 -0.0141 -0.0211 -0.0170 0.0232
-0.5934 -0.0385 0.0007 0.0189 0.0294 0.0359 0.0401 0.0431 0.0449 0.0462
0.0472 0.0474 0.0476 0.0467 0.0433 0.0395 0.0564 0.0445 0.0420 -0.0163
19 0.8931 0.1168 0.0617 0.0350 0.0197 0.0100 0.0033 -0.0017 -0.0053 -0.0073
-0.0107 -0.0111 -0.0131 -0.0138 -0.0143 -0.0136 -0.0129 -0.0199 -0.0158 0.0215
-0.5872 -0.0409 -0.0022 0.0157 0.0261 0.0325 0.0367 0.0398 0.0417 0.0428
0.0446 0.0442 0.0450 0.0447 0.0437 0.0401 0.0368 0.0540 0.0420 0.0395 -0.0151

Table 1 (Continued)

Coefficient of

α n $X_{1:n}$ $X_{2:n}$ $X_{3:n}$ $X_{4:n}$ $X_{5:n}$ $X_{6:n}$ $X_{7:n}$ $X_{8:n}$ $X_{9:n}$ $X_{10:n}$ $\frac{Var}{\sigma^2}$ $\frac{Cov(\mu^*,\sigma^*)}{\sigma^2}$

$X_{11:n}$ $X_{12:n}$ $X_{13:n}$ $X_{14:n}$ $X_{15:n}$ $X_{16:n}$ $X_{17:n}$ $X_{18:n}$ $X_{19:n}$ $X_{20:n}$

2.00 20 0.8822 0.1164 0.0639 0.0344 0.0231 0.0106 0.0053 -0.0001 -0.0040 -0.0039
-0.0114 -0.0076 -0.0127 -0.0113 -0.0137 -0.0130 -0.0126 -0.0119 -0.0189 -0.0148 0.0200
-0.5814 -0.0427 -0.0057 0.0139 0.0221 0.0302 0.0331 0.0370 0.0391 0.0390
0.0432 0.0403 0.0435 0.0416 0.0427 0.0408 0.0372 0.0344 0.0518 0.0398 0.0373 -0.0141

3.00 11 1.0135 0.1742 0.0741 0.0235 -0.0066 -0.0259 -0.0384 -0.0444 -0.0454 -0.0678
-0.0568 0.0920
-0.5313 -0.0397 0.0169 0.0446 0.0602 0.0693 0.0741 0.0732 0.0680 0.0914
0.0734 0.0681 -0.0542
12 0.9806 0.1769 0.0812 0.0325 0.0033 -0.0157 -0.0286 -0.0370 -0.0402 -0.0403
-0.0621 -0.0507 0.0817
-0.5173 -0.0462 0.0081 0.0349 0.0504 0.0598 0.0654 0.0680 0.0655 0.0604
0.0845 0.0665 0.0615 -0.0481
13 0.9513 0.1785 0.0867 0.0396 0.0114 -0.0074 -0.0202 -0.0293 -0.0351 -0.0363
-0.0361 -0.0574 -0.0457 0.0733
-0.5045 -0.0514 0.0009 0.0270 0.0421 0.0517 0.0577 0.0613 0.0624 0.0587
0.0543 0.0789 0.0608 0.0560 -0.0432
14 0.9250 0.1794 0.0908 0.0454 0.0179 -0.0004 -0.0131 -0.0224 -0.0289 -0.0329
-0.0327 -0.0326 -0.0536 -0.0417 0.0664
-0.4928 -0.0556 -0.0050 0.0204 0.0353 0.0447 0.0509 0.0550 0.0573 0.0574
0.0528 0.0492 0.0743 0.0561 0.0514 -0.0391
15 0.9013 0.1796 0.0940 0.0500 0.0232 0.0053 -0.0072 -0.0164 -0.0232 -0.0281
-0.0308 -0.0295 -0.0298 -0.0503 -0.0383 0.0606
-0.4821 -0.0589 -0.0099 0.0148 0.0294 0.0388 0.0451 0.0493 0.0521 0.0535
0.0529 0.0475 0.0450 0.0703 0.0521 0.0474 -0.0357
16 0.8797 0.1795 0.0966 0.0538 0.0277 0.0103 -0.0022 -0.0113 -0.0181 -0.0233
-0.0270 -0.0287 -0.0265 -0.0274 -0.0476 -0.0355 0.0557
-0.4722 -0.0616 -0.0140 0.0101 0.0244 0.0336 0.0400 0.0443 0.0473 0.0492
0.0500 0.0488 0.0428 0.0415 0.0669 0.0488 0.0440 -0.0328
17 0.8599 0.1791 0.0986 0.0569 0.0315 0.0143 0.0022 -0.0068 -0.0137 -0.0189
-0.0230 -0.0257 -0.0267 -0.0239 -0.0254 -0.0452 -0.0331 0.0515
-0.4629 -0.0638 -0.0176 0.0060 0.0200 0.0292 0.0355 0.0399 0.0430 0.0452
0.0465 0.0468 0.0450 0.0386 0.0386 0.0640 0.0459 0.0411 -0.0303
18 0.8417 0.1784 0.1001 0.0595 0.0346 0.0179 0.0059 -0.0030 -0.0099 -0.0150
-0.0194 -0.0222 -0.0246 -0.0247 -0.0215 -0.0237 -0.0431 -0.0310 0.0478
-0.4543 -0.0656 -0.0206 0.0024 0.0162 0.0253 0.0315 0.0360 0.0392 0.0414
0.0431 0.0438 0.0439 0.0416 0.0348 0.0362 0.0615 0.0434 0.0385 -0.0281
19 0.8248 0.1776 0.1015 0.0617 0.0373 0.0209 0.0091 0.0008 -0.0075 -0.0103
-0.0173 -0.0180 -0.0223 -0.0230 -0.0230 -0.0192 -0.0224 -0.0414 -0.0293 0.0446
-0.4462 -0.0670 -0.0233 -0.0007 0.0130 0.0217 0.0280 0.0322 0.0363 0.0373
0.0407 0.0403 0.0419 0.0410 0.0385 0.0313 0.0342 0.0593 0.0412 0.0362 -0.0262
20 0.8096 0.1745 0.1068 0.0578 0.0447 0.0206 0.0122 0.0062 -0.0097 0.0012
-0.0245 -0.0068 -0.0241 -0.0185 -0.0230 -0.0210 -0.0173 -0.0213 -0.0398 -0.0277 0.0418
-0.4388 -0.0671 -0.0275 -0.0010 0.0080 0.0198 0.0248 0.0277 0.0363 0.0295
0.0432 0.0332 0.0417 0.0380 0.0392 0.0355 0.0282 0.0326 0.0574 0.0394 0.0341 -0.0245

4.00 11 1.0183 0.2173 0.0965 0.0329 -0.0061 -0.0315 -0.0475 -0.0526 -0.0557 -0.0966

-0.0751 0.1335
-0.4705 -0.0554 0.0049 0.0355 0.0534 0.0641 0.0692 0.0660 0.0629 0.0971
0.0728 0.0655 -0.0698
12 0.9792 0.2194 0.1048 0.0441 0.0067 -0.0184 -0.0355 -0.0459 -0.0468 -0.0501
-0.0897 -0.0677 0.1190
-0.4549 -0.0609 -0.0035 0.0259 0.0434 0.0544 0.0611 0.0633 0.0580 0.0563
0.0906 0.0662 0.0590 -0.0623
13 0.9445 0.2201 0.1110 0.0530 0.0168 -0.0076 -0.0248 -0.0368 -0.0433 -0.0414
-0.0456 -0.0840 -0.0618 0.1073
-0.4407 -0.0651 -0.0103 0.0181 0.0352 0.0461 0.0533 0.0575 0.0578 0.0509
0.0511 0.0853 0.0610 0.0537 -0.0561
14 0.9133 0.2200 0.1157 0.0600 0.0250 0.0013 -0.0156 -0.0280 -0.0366 -0.0404
-0.0364 -0.0421 -0.0793 -0.0569 0.0975
-0.4278 -0.0684 -0.0158 0.0116 0.0282 0.0391 0.0464 0.0512 0.0538 0.0526
0.0445 0.0470 0.0809 0.0566 0.0492 -0.0509
15 0.8850 0.2193 0.1192 0.0655 0.0319 0.0087 -0.0079 -0.0203 -0.0293 -0.0356
-0.0373 -0.0317 -0.0393 -0.0753 -0.0529 0.0893
-0.4159 -0.0708 -0.0204 0.0062 0.0223 0.0331 0.0404 0.0455 0.0488 0.0502
0.0478 0.0389 0.0438 0.0772 0.0530 0.0454 -0.0466
16 0.8593 0.2181 0.1219 0.0701 0.0374 0.0149 -0.0013 -0.0135 -0.0228 -0.0297
-0.0341 -0.0341 -0.0275 -0.0372 -0.0720 -0.0496 0.0823
-0.4048 -0.0727 -0.0241 0.0016 0.0173 0.0279 0.0351 0.0403 0.0440 0.0462
0.0467 0.0434 0.0338 0.0413 0.0740 0.0500 0.0421 -0.0429
17 0.8357 0.2167 0.1238 0.0738 0.0421 0.0202 0.0042 -0.0074 -0.0172 -0.0238
-0.0295 -0.0324 -0.0310 -0.0236 -0.0355 -0.0691 -0.0468 0.0762
-0.3945 -0.0741 -0.0272 -0.0024 0.0130 0.0233 0.0306 0.0357 0.0397 0.0421
0.0438 0.0434 0.0392 0.0292 0.0393 0.0714 0.0475 0.0392 -0.0397
18 0.8139 0.2150 0.1253 0.0767 0.0460 0.0248 0.0088 -0.0019 -0.0127 -0.0182
-0.0249 -0.0286 -0.0306 -0.0280 -0.0201 -0.0343 -0.0667 -0.0445 0.0709
-0.3849 -0.0752 -0.0298 -0.0057 0.0093 0.0193 0.0267 0.0314 0.0361 0.0380
0.0405 0.0412 0.0404 0.0352 0.0251 0.0379 0.0691 0.0454 0.0367 -0.0369

Table 1 (Continued)

Coefficient of

α n $X_{1:n}$ $X_{2:n}$ $X_{3:n}$ $X_{4:n}$ $X_{5:n}$ $X_{6:n}$ $X_{7:n}$ $X_{8:n}$ $X_{9:n}$ $X_{10:n}$ $\frac{Var}{\sigma^2}$ $\frac{Cov(\mu^*,\sigma^*)}{\sigma^2}$
$X_{11:n}$ $X_{12:n}$ $X_{13:n}$ $X_{14:n}$ $X_{15:n}$ $X_{16:n}$ $X_{17:n}$ $X_{18:n}$ $X_{19:n}$ $X_{20:n}$

4.00 19 0.7937 0.2131 0.1265 0.0789 0.0495 0.0288 0.0123 0.0041 -0.0101 -0.0122
-0.0208 -0.0250 -0.0272 -0.0291 -0.0249 -0.0169 -0.0335 -0.0647 -0.0425 0.0663
-0.3759 -0.0759 -0.0322 -0.0083 0.0059 0.0158 0.0236 0.0269 0.0336 0.0338
0.0374 0.0387 0.0386 0.0376 0.0314 0.0214 0.0369 0.0672 0.0436 0.0344 -0.0345

20 0.7757 0.2066 0.1384 0.0649 0.0663 0.0249 0.0157 0.0137 -0.0130 -0.0075
-0.0059 -0.0376 -0.0106 -0.0341 -0.0237 -0.0232 -0.0137 -0.0330 -0.0629 -0.0408 0.0622
-0.3677 -0.0743 -0.0395 -0.0029 -0.0036 0.0158 0.0206 0.0208 0.0337 0.0307
0.0288 0.0440 0.0299 0.0403 0.0331 0.0284 0.0179 0.0362 0.0657 0.0420 0.0324 -0.0323

5.00 11 1.0278 0.2477 0.1125 0.0397 -0.0057 -0.0355 -0.0527 -0.0539 -0.0640 -0.1248
-0.0912 0.1707
-0.4323 -0.0635 -0.0022 0.0298 0.0488 0.0601 0.0643 0.0577 0.0601 0.1038
0.0735 0.0636 -0.0818
12 0.9839 0.2490 0.1217 0.0526 0.0090 -0.0204 -0.0403 -0.0503 -0.0464 -0.0589
-0.1169 -0.0830 0.1525
-0.4156 -0.0683 -0.0103 0.0203 0.0388 0.0506 0.0574 0.0582 0.0492 0.0547
0.0976 0.0674 0.0573 -0.0730
13 0.9448 0.2489 0.1284 0.0626 0.0208 -0.0078 -0.0281 -0.0416 -0.0466 -0.0392
-0.0551 -0.1105 -0.0765 0.1376
-0.4005 -0.0717 -0.0167 0.0126 0.0305 0.0423 0.0499 0.0539 0.0522 0.0415
0.0508 0.0925 0.0625 0.0520 -0.0658
14 0.9097 0.2478 0.1333 0.0704 0.0304 0.0026 -0.0174 -0.0319 -0.0411 -0.0423
-0.0326 -0.0524 -0.1053 -0.0713 0.1252
-0.3866 -0.0742 -0.0218 0.0063 0.0236 0.0352 0.0431 0.0482 0.0502 0.0465
0.0347 0.0480 0.0884 0.0586 0.0476 -0.0597
15 0.8778 0.2461 0.1368 0.0767 0.0382 0.0112 -0.0082 -0.0228 -0.0334 -0.0396
-0.0376 -0.0265 -0.0506 -0.1010 -0.0670 0.1147
-0.3738 -0.0759 -0.0259 0.0010 0.0178 0.0292 0.0370 0.0425 0.0459 0.0464
0.0409 0.0287 0.0460 0.0850 0.0554 0.0438 -0.0546
16 0.8487 0.2439 0.1393 0.0817 0.0445 0.0186 -0.0005 -0.0149 -0.0258 -0.0337
-0.0374 -0.0327 -0.0211 -0.0495 -0.0975 -0.0636 0.1057
-0.3619 -0.0771 -0.0292 -0.0034 0.0129 0.0239 0.0317 0.0373 0.0412 0.0433
0.0427 0.0355 0.0233 0.0447 0.0823 0.0528 0.0405 -0.0503
17 0.8218 0.2414 0.1411 0.0857 0.0498 0.0246 0.0062 -0.0079 -0.0191 -0.0272
-0.0332 -0.0348 -0.0277 -0.0163 -0.0489 -0.0946 -0.0608 0.0979
-0.3508 -0.0779 -0.0320 -0.0071 0.0087 0.0195 0.0271 0.0327 0.0368 0.0395
0.0408 0.0390 0.0303 0.0186 0.0439 0.0801 0.0508 0.0376 -0.0465
18 0.7970 0.2386 0.1422 0.0888 0.0543 0.0298 0.0117 -0.0015 -0.0136 -0.0206
-0.0284 -0.0318 -0.0321 -0.0226 -0.0120 -0.0488 -0.0924 -0.0586 0.0912
-0.3402 -0.0783 -0.0342 -0.0102 0.0050 0.0156 0.0231 0.0284 0.0331 0.0354
0.0380 0.0380 0.0355 0.0251 0.0144 0.0437 0.0784 0.0491 0.0351 -0.0432
19 0.7738 0.2355 0.1432 0.0911 0.0580 0.0346 0.0155 0.0060 -0.0114 -0.0116
-0.0262 -0.0258 -0.0313 -0.0289 -0.0174 -0.0083 -0.0491 -0.0907 -0.0568 0.0852
-0.3302 -0.0783 -0.0360 -0.0127 0.0019 0.0120 0.0201 0.0237 0.0310 0.0303
0.0361 0.0350 0.0359 0.0318 0.0201 0.0108 0.0437 0.0771 0.0478 0.0328 -0.0402
20 0.7531 0.2280 0.1513 0.0860 0.0637 0.0406 0.0139 0.0204 -0.0209 0.0085
-0.0329 -0.0155 -0.0290 -0.0300 -0.0249 -0.0125 -0.0050 -0.0498 -0.0895 -0.0555 0.0798
-0.3212 -0.0760 -0.0413 -0.0116 -0.0019 0.0076 0.0199 0.0158 0.0343 0.0200
0.0386 0.0293 0.0349 0.0333 0.0280 0.0152 0.0077 0.0442 0.0763 0.0468 0.0308 -0.0376

Note: Against each α and n the figures in the first two rows are corresponding to location parameter and the figures in the second two rows are corresponding to scale parameter.

REFERENCES

[1]. M. Z.Raqab and M. Ahsanullah, "Estimation of location and scale parameters of generalized exponential distribution based on order statistics". *J. Statist. Computat. Simul.*,vol. 69, 2001, pp.109-124.

[2]. R. D.Gupta and D.Kundu, "Generalized exponential distribution",*Austral. N. Z. Statist.*,vol. 41, 1999, pp.173-188.

[3]. E. H. Lloyd (1952), "Least squares estimation of location and scale parameters using order statistics",*Biometrika*,vol. 39, 1952, pp.88-95.

[4]. R. D.Gupta and D. Kundu, "Generalized exponential distributions: different methods of estimation", *J. Statist. Comput. Simul.*,vol. 69, 2001, pp.315-338.

[5]. M. Z.Raqab, "Inferences for generalized exponential based on record statistics". *J. Statist. Plann. Infer.*,vol.104, 2002, pp.339-350.

[6]. M. Z.Raqab, "Generalized Exponential Distribution: Moments of Order Statistics",*Statistics*, vol. 38, 2004, pp.29-41.

[7]. R. U.Khan and D. Kumar, "Exponential Distribution of Lower generalized Order Statistics from Generalized Exponential Distribution and a Characterization". *Mathematical methods of Statistics*, vol.20, 2011, pp.150-157.

[8]. M. Z.Raqab and M. T. Madi,"Bayesian inference for the generalized exponential distribution". *J. Statist. Computat. Simul.*,vol. 75, 2005, pp.541-852.

AUTHORS

First Author –Dr.A. Vasudeva Rao, M.Sc., M.Phil., Ph.D., Professor and Head, Department of Statistics, Acharya Nagarjuna University, Nagarjunanagar-522501, Guntur, Andhra Pradesh, India, Email: profavrao@gmail.com.

Second Author–S. Bhanu Prakash, M.Sc., Ph.D. student, Department of Statistics, Acharya Nagarjuna University, Nagarjunanagar-522501, Guntur,Andhra Pradesh, India, Email: prakash9293165890@gmail.com

Third Author– Sd. Jilani, M.Sc., Ph.D. student, BSR-RFSMS, Department of Statistics, Acharya Nagarjuna University, Nagarjunanagar-522501, Guntur, Andhra Pradesh, India, Email: jilanisyed1992@gmail.com

Correspondence Author–S. Bhanu Prakash, Email: prakash9293165890@gmail.com, contact number:9293165890.