Sl. No. : 0007130 **IES/ISS EXAM 2016**

STATISTICS

Paper—IV

Time Allowed : Three Hours	Maximum Marks : 200

INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

There are FOURTEEN questions divided under SEVEN Sections.

Candidate has to choose any TWO Sections and attempt all the questions therein. All the Sections carry equal marks.

The number of marks carried by a question/part is indicated against it.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

All parts and sub-parts of a question are to be attempted together in the answer book.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly.

Any page or portion of the page left blank in the answer book must be clearly struck off.

Answers must be written in ENGLISH only.

Normal Distribution, *t*, *F*, Gamma and *cv* of Weibull Tables are attached with the question paper.

A graph paper sheet is attached to this question paper which may be carefully detached for answering graph-related question and then must be securely attached with the answer book.

Section—A

(Operations Research and Reliability)

1. (a) Solve the following two-person zero-sum game using graphical procedure : 10

$$\begin{bmatrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{bmatrix}$$

(b) If the demand for a certain product has a rectangular distribution between 4000 and 5000, then find the optimal order quantity if the storage cost is ₹ 1 per unit and the shortage cost is ₹ 7 per unit. 10

(c) A supermarket has two salesgirls at the counter. If the service time for each customer is exponential with mean 4 minutes and if people arrive in a Poisson fashion at 10 per hour, then find the expected percentage of idle time for each salesgirl. 10

(d) Find out ML estimators of the parameters in the density

$$\frac{c}{b} x^{c-1} e^{-\frac{x^c}{b}}, \quad x > 0,\ b, \quad c > 0$$

based on the following censored scheme :

$$X_{(1)}, X_{(2)}, \cdots, X_{(n-r)}$$

where n and r are respectively the sample size and number of censored observations. 10

(e) Defining a location-scale family, outline the procedure for obtaining the coefficient of BLUE's. 10

2. (a) A computer contains 10000 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is ₹ 1 only. If all the resistors are replaced at the same time, the cost per resistor comes down to 35 paise. The percent of surviving, $S(t)$, at the end of t-th month is

t	0	1	2	3	4	5	6
$S(t)$	100	97	90	70	32	15	0

Derive the optimum replacement plan. 25

(b) A random sample of 25 observations drawn from Weibull model (with shape parameter = 2 and scale parameter = 4) is given. Obtain the moment estimates of the parameters : 25

1·8487	0·3761	0·7500	3·0530	1·3545
1·8802	1·5700	1·7708	1·3592	3·0466
1·7961	1·5319	0·5903	0·6288	0·6461
1·6560	1·7172	1·9310	1·0509	1·6173
1·3162	0·7705	1·8889	1·8889	4·1505

Section—B

(Demography and Vital Statistics)

3. *(a)* Discuss the sources of demographic data in India and also point out the uses and limitations of these data. 10

(b) Explain the stationary and stable population models. Discuss the situation when stationary and stable populations are identical. 10

(c) Explain briefly the uses of life table. In usual notation, prove that

$$\frac{dL_x}{dx} = -d_x; \qquad \frac{dT_x}{dx} = -l_x$$

10

(d) Define crude death rate, specific death rate and standardized death rate. Interpret these rates. 10

(e) State the general procedure and steps for the construction of life tables. 10

4. *(a)* Explain an abridged life table and discuss its different columns. Discuss the King's method for its construction. 25

(b) What do you mean by fertility? Define crude birthrate, general fertility rate, specific fertility rate and age-specific fertility rate. How are these rates computed in practice? 25

Section—C

(Survival Analysis and Clinical Trials)

5. *(a)* Define hazard function and survival function. Obtain the same for an exponential distribution. 10

(b) If $f(t)$, $F(t)$ and $h(t)$ are the density, distribution and hazard functions of a random variable T, then show that

$$h(t) = \frac{f(t)}{\overline{F}(t)}, \quad \overline{F}(t) = 1 - F(t)$$

Also establish a suitable relationship between $h(t)$ and reliability function. 10

(c) If p_x is the probability that a person aged x will survive to age $x+1$, then show that ${}_n p_x + {}_n q_x = 1$, where

$${}_n p_x = \frac{l_{x+n}}{l_x}$$

10

(d) Discuss some specific situations in which it would be difficult or inefficient to perform clinical trials. 10

(e) What are the principles for ethical clinical trials? 10

6. (a) Define Type–I and Type–II censoring schemes. Obtain the maximum likelihood estimator of parameter θ in exponential distribution under the above censoring schemes. Also obtain the Fisher information for the parameter. 25

(b) Discuss various phases involved in a clinical trial. Also discuss the pros and cons of each phase. 25

Section—D

(Quality Control)

7. (a) Distinguish between process control and product control. Discuss the situations where they are used. 10

(b) Discuss various sources of assignable causes and random causes of variations. Also state how they are detected in a manufacturing process. 10

(c) Define the terms ASN, AOQ, ATI and ARL for an acceptance sampling plan. 10

(d) What is an acceptance sampling plan? Discuss a single sampling plan (n, c), where the sampling is carried out using a binomial model. Find P_a, if $n = 10$, $c = 3$ and $p = 0 \cdot 05$. 10

(e) State the importance of exponentially weighted moving average charts. How are these used in practical situations? 10

8. (a) Discuss the importance of control charts for variables. 5

(b) Obtain the control limits for $(\overline{X}, R)$ and $(\overline{X}, S)$ charts when standards are known and unknown. 20

(c) In usual notation, show that

$$C_2 = \sqrt{\frac{2}{n}}\,\frac{\Gamma(n/2)}{\Gamma((n-1)/2)}$$

where C_2 is a constant used for constructing control limits. 5

(d) Discuss in detail the double sampling plan (N, n_1, c_1, n_2, c_2) stating the assumptions followed in both the stages. Hence or otherwise, obtain the ASN function of this sampling procedure. 20

Section—E

(Multivariate Analysis)

9. (a) Define p-variate normal distribution and obtain its characteristic function. Assume mean vector μ and dispersion matrix Σ. 10

(b) Define Hotelling's T^2 and mention its application. Show that

$$T^2(p, m) = \frac{mp}{m-p+1} F_{p,\, m-p+1}$$ 10

(c) Explain the importance of principal components and discuss the method for extraction of principal components. 10

(d) Define Wishart distribution and obtain its characteristic function. 10

(e) Define canonical variates and canonical correlation. Give your interpretation. 10

10. (a) State the chief properties of Wishart distribution. If

$$A_i \sim W_p(\Sigma, n_i), \quad i = 1, 2, \cdots, k$$

then show that

$$A = \sum_{i=1}^{k} A_i$$

has the Wishart distribution with parameters Σ and n, where

$$n = \sum_{i=1}^{k} n_i$$

assuming the independence of A_i's. 25

(b) Define multiple correlation coefficient and obtain its non-null distribution. 25

Section—F

(Design and Analysis of Experiments)

11. *(a)* What are the basic principles of design of experiments? Explain them and their roles. 10

(b) Define completely randomized design, and mention its merits and demerits. Also give its statistical analysis. 10

(c) Define Latin square design with its applications, advantages and disadvantages. 10

(d) Explain analysis of covariance with its applications. Give an illustration for the use of analysis of covariance in identifying the response variable (y) and concomitant variable (x). 10

(e) Explain split-plot design and give some situations where split-plot design can be suitably adopted. 10

12. *(a)* What are factorial experiments? The following table gives the layout and the results of 2^3-factorial design laid out in four replicates. The purpose of the experiment is to determine the effect of different kinds of fertilizer, Nitrogen (N), Potash (K) and Phosphate (P) on potato crop yield :

Block 1

nk	*kp*	*p*	*np*
291	391	312	373
1	*k*	*n*	*nkp*
101	265	106	450

Block 2

kp	*p*	*k*	*nk*
407	324	272	306
n	*nkp*	*np*	1
89	449	338	106

Block 3

p	1	*np*	*kp*
323	87	324	423
nk	*k*	*n*	*nkp*
334	279	128	471

Block 4

np	*nk*	*n*	*p*
361	272	103	324
k	1	*nkp*	*kp*
302	131	437	435

Analyze the design and draw conclusions. 25

(b) What is confounding? A 2^3-factorial experiment is conducted in 2 blocks of size 4 each, in 3 replicates. The arrangements are as follows :

	Replicate 1	*Replicate 2*	*Replicate 3*
Key Block	(1), *c*, *ab*, *abc*	(1), *a*, *bc*, *abc*	(1), *b*, *ac*, *abc*

Identify the confounded effect in each replicate. 10

(c) Define a Randomized Block Design (RBD) specifying the statistical model associated with the design. Carry out a complete analysis of RBD with one missing observation. 15

Section—G

(Computing with C and R)

13. (a) Given a five-digit positive integer, write a C program to find the sum of individual digits.

(For example, if the given number is 96785, the required sum is $9+6+7+8+5=35$) 10

(b) Write a C program to pick up the largest tender from a set of tenders assuming that Tender-id and Tender-value for each tender are specified. 10

(c) Express $(A-B)*C$ in infix and postfix forms. 10

(d) Write a program in R to plot Q–Q plot assuming that the two samples

$$(X_i,\ i=1,\ 2,\ \cdots,\ 25 \text{ and } Y_i,\ i=1,\ 2,\ \cdots,\ 250)$$

are drawn from normal population. 10

(e) Given n positive integers, write R code to find their ranks. 10

14. *(a)* Illustrate call by value and call by reference, and advantages as well as disadvantages of each method. Write a C function to evaluate the series without using a built-in function : 25

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots \infty$$

(b) Given $X \sim N(\mu, \sigma^2)$, where μ and σ^2 are specified, write a C program to compute

$$P(X > t) = \int_t^\infty \text{Density of } N(\mu, \sigma^2)\, dx$$ 25

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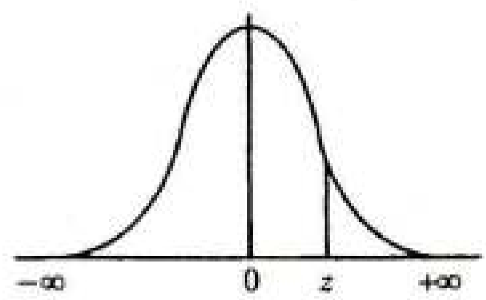
Normal Distribution Table



	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	**0.50**	**0.25**	**0.20**	**0.15**	**0.10**	**0.05**	**0.025**	**0.01**	**0.005**	**0.001**	**0.0005**
two-tail	**1.00**	**0.50**	**0.40**	**0.30**	**0.20**	**0.10**	**0.05**	**0.02**	**0.01**	**0.002**	**0.001**
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
					Confidence Level						

Table of *F* Distribution

Critical values of F for the 0·01 significance level :

	1	2	3	4	5	6	7	8	9	10
1	4052.19	4999.52	5403.34	5624.62	5763.65	5858.97	5928.33	5981.10	6022.50	6055.85
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05
6	13.75	10.93	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10
14	8.86	6.52	5.56	5.04	4.70	4.46	4.28	4.14	4.03	3.94
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.90	3.81
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69
17	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79	3.68	3.59
18	8.29	6.01	5.09	4.58	4.25	4.02	3.84	3.71	3.60	3.51
19	8.19	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26
23	7.88	5.66	4.77	4.26	3.94	3.71	3.54	3.41	3.30	3.21
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17
25	7.77	5.57	4.68	4.18	3.86	3.63	3.46	3.32	3.22	3.13
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09
27	7.68	5.49	4.60	4.11	3.79	3.56	3.39	3.26	3.15	3.06
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03
29	7.60	5.42	4.54	4.05	3.73	3.50	3.33	3.20	3.09	3.01
30	7.56	5.39	4.51	4.02	3.70	3.47	3.31	3.17	3.07	2.98
31	7.53	5.36	4.48	3.99	3.68	3.45	3.28	3.15	3.04	2.96
32	7.50	5.34	4.46	3.97	3.65	3.43	3.26	3.13	3.02	2.93

Table of *F* Distribution

Critical values of F for the 0·05 significance level :

	1	2	3	4	5	6	7	8	9	10
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.39	19.40
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14
10	4.97	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.10	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.97	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.56	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35
21	4.33	3.47	3.07	2.84	2.69	2.57	2.49	2.42	2.37	2.32
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.38	2.32	2.28
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.26
25	4.24	3.39	2.99	2.76	2.60	2.49	2.41	2.34	2.28	2.24
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.17
31	4.16	3.31	2.91	2.68	2.52	2.41	2.32	2.26	2.20	2.15
32	4.15	3.30	2.90	2.67	2.51	2.40	2.31	2.24	2.19	2.14
33	4.14	3.29	2.89	2.66	2.50	2.39	2.30	2.24	2.18	2.13
34	4.13	3.28	2.88	2.65	2.49	2.38	2.29	2.23	2.17	2.12
35	4.12	3.27	2.87	2.64	2.49	2.37	2.29	2.22	2.16	2.11

Table for Gamma Function

$$\Gamma(n) = \int_0^\infty e^{-x} x^{n-1} dx, \; 1 \le n \le 2$$

n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$
1.00	1.00000	1.25	0.90640	1.50	0.88623	1.75	0.91906
1.01	0.99433	1.26	0.90440	1.51	0.88659	1.76	0.92137
1.02	0.98884	1.27	0.90250	1.52	0.88704	1.77	0.92376
1.03	0.98355	1.28	0.90072	1.53	0.88757	1.78	0.92623
1.04	0.97844	1.29	0.89904	1.54	0.88818	1.79	0.92877
1.05	0.97350	1.30	0.89747	1.55	0.88887	1.80	0.93138
1.06	0.96874	1.31	0.89600	1.56	0.88964	1.81	0.93408
1.07	0.96415	1.32	0.89464	1.57	0.89049	1.82	0.93685
1.08	0.95973	1.33	0.89338	1.58	0.89142	1.83	0.93969
1.09	0.95546	1.34	0.89222	1.59	0.89243	1.84	0.94261
1.10	0.95135	1.35	0.89115	1.60	0.89352	1.85	0.94561
1.11	0.94739	1.36	0.89018	1.61	0.89468	1.86	0.94869
1.12	0.94359	1.37	0.88931	1.62	0.89592	1.87	0.95184
1.13	0.93993	1.38	0.88854	1.63	0.89724	1.88	0.95507
1.14	0.93642	1.39	0.88785	1.64	0.89864	1.89	0.95838
1.15	0.93304	1.40	0.88726	1.65	0.90012	1.90	0.96177
1.16	0.92980	1.41	0.88676	1.66	0.90167	1.91	0.96523
1.17	0.92670	1.42	0.88636	1.67	0.90330	1.92	0.96878
1.18	0.92373	1.43	0.88604	1.68	0.90500	1.93	0.97240
1.19	0.92088	1.44	0.88580	1.69	0.90678	1.94	0.97610
1.20	0.91817	1.45	0.88565	1.70	0.90864	1.95	0.97988
1.21	0.91558	1.46	0.88560	1.71	0.91057	1.96	0.98374
1.22	0.91311	1.47	0.88563	1.72	0.91258	1.97	0.98768
1.23	0.91075	1.48	0.88575	1.73	0.91466	1.98	0.99171
1.24	0.90852	1.49	0.88595	1.74	0.91683	1.99	0.99581
						2.00	1.00000

Shape Parameter *c* Corresponding to the Population Coefficient of Variation *cv* of Weibull Distribution

cv	*c*	*cv*	*c*	*cv*	*c*
429.8314	0.10	0.7238	1.40	0.3994	2.70
47.0366	0.15	0.7006	1.45	0.3929	2.75
15.8430	0.20	0.6790	1.50	0.3866	2.80
8.3066	0.25	0.6588	1.55	0.3805	2.85
5.4077	0.30	0.6399	1.60	0.3747	2.90
3.9721	0.35	0.6222	1.65	0.3690	3.00
3.1409	0.40	0.6055	1.70	0.3634	3.05
2.6064	0.45	0.5897	1.75	0.3581	3.10
2.2361	0.50	0.5749	1.80	0.3529	3.15
1.9650	0.55	0.5608	1.85	0.3479	3.20
1.7581	0.60	0.5474	1.90	0.3430	3.25
1.5948	0.65	0.5348	1.95	0.3383	3.30
1.4624	0.70	0.5227	2.00	0.3336	3.35
1.3529	0.75	0.5112	2.05	0.3292	3.40
1.2605	0.80	0.5003	2.10	0.3248	3.45
1.1815	0.85	0.4898	2.15	0.3206	3.50
1.1130	0.90	0.4798	2.20	0.3165	3.55
1.0530	9.95	0.4703	2.25	0.3124	3.60
1.0000	1.00	0.4611	2.30	0.3085	3.65
0.9527	1.05	0.4523	2.35	0.3047	3.70
0.9102	1.10	0.4438	2.40	0.3010	3.75
0.8718	1.15	0.4341	2.45	0.2974	3.80
0.8369	1.20	0.4279	2.50	0.2938	3.85
0.8050	1.25	0.4204	2.55	0.2904	3.90
0.7757	1.30	0.4131	2.60	0.2870	3.95
0.7487	1.35	0.4062	2.65	0.2838	4.00

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