



**RAJARATA UNIVERSITY OF SRI LANKA  
FACULTY OF APPLIED SCIENCES**

**B.Sc. (General) Degree in Applied Sciences  
First Year Semester I Examination – September/October 2019**

**MAA 1302 – PROBABILITY AND STATISTICS I**

**Time: 03 hours**

Name: \_\_\_\_\_

Registration Number: \_\_\_\_\_

Index Number: \_\_\_\_\_

CN number: \_\_\_\_\_

Instruction: Answer all question in the allocated space.

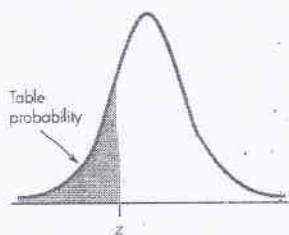
*Your exam paper should have 13 single sided pages with 14 problems.*

Calculators, Statistical distribution tables are will be provided.

Following table can be used if needed.

**Chi-square Distribution Table**

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
22	8.04	8.94	10.98	12.34	14.04	30.81	33.92	36.78	40.29
24	8.89	10.86	12.40	13.85	15.66	33.20	36.42	39.36	42.98
26	11.16	12.20	14.84	15.38	17.29	35.56	38.89	41.93	45.64
28	12.46	13.56	15.31	16.93	18.94	37.92	41.34	44.46	48.28
30	13.79	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89
32	15.13	16.36	18.29	20.07	22.27	42.58	46.19	49.48	53.49
34	16.50	17.79	19.81	21.66	23.95	44.90	48.60	51.97	56.06
36	17.99	19.29	21.33	23.20	25.59	47.15	50.99	54.28	58.56
38	19.29	20.69	22.88	24.88	27.34	49.51	53.38	56.90	61.16
40	20.71	22.16	24.43	26.55	29.19	51.80	55.76	59.34	63.69
42	22.14	23.65	26.00	28.14	30.77	54.09	58.12	61.78	66.21
44	23.60	25.16	27.58	29.78	32.35	56.34	60.48	64.19	68.71
46	25.01	26.66	29.16	31.41	34.22	58.64	62.83	66.62	71.20
50	27.99	29.71	32.36	34.76	37.69	63.17	67.50	71.42	76.15
55	31.73	33.57	36.40	38.96	42.06	68.80	73.31	77.38	82.29
60	35.53	37.48	40.48	43.19	46.46	74.40	79.08	83.30	88.38
65	39.38	41.44	44.60	47.45	50.88	79.97	84.82	89.18	94.42
70	43.28	45.41	48.76	51.71	55.33	85.53	90.53	95.02	100.43
75	47.21	49.48	52.94	56.05	59.79	91.06	96.22	100.84	106.39
80	51.17	53.54	57.15	60.39	64.28	96.58	101.88	106.63	112.33
85	55.17	57.63	61.39	64.75	68.78	102.08	107.52	112.39	118.21
90	59.20	61.75	65.65	69.13	73.29	107.57	113.15	118.14	124.12
95	63.25	65.90	69.92	73.52	77.82	113.04	118.75	123.86	129.97
100	67.33	70.06	74.22	77.93	82.36	118.50	124.34	129.56	135.81

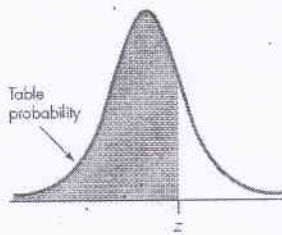
Table A.1 Standard Normal Probabilities (for  $z \leq 0$ )

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0076	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0126	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0263	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

In the Extreme (for  $z < 0$ )

$z$	-3.09	-3.72	-4.26	-4.75	-5.20	-5.61	-6.00
Probability	.001	.0001	.00001	.000001	.0000001	.00000001	.000000001

S-PLUS was used to determine information for the "In the Extreme" portion of the table

Table A.1 Standard Normal Probabilities (for  $z \geq 0$ )

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.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

In the Extreme (for  $z > 0$ )

$z$	3.09	3.72	4.26	4.75	5.20	5.61	6.00
Probability	.999	.9999	.99999	.999999	.9999999	.99999999	.999999999

S-PLUS was used to determine information for the "In the Extreme" portion of the table.

01. Which graphical method is more informative to represent the following data. Give reasons.

(05 marks)

- a) Number of students received each grade in the recent MAA 1302 examination:

Grade	A	B	C	D
Number of Students	4	24	20	2

Graph:

Reasons:

- b) Student enrollment of three sports according to their gender.

Sport	Males	Females
Volleyball	30	28
Cricket	40	15
Swimming	10	15

Graph:

Reasons:

- c) Student waiting times at a Bank ATM

Waiting time in minutes	2.5, 1.5, 1.8, 2.2, 2.3, 1.9, 2.6, 2.8, 2.1, 2.4, 2.6, 1.6, 1.7, 1.9, 2.2, 2.7, 2.3, 1.9, 2.8 ..., etc.
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Graph:

Reasons:

02. Select the most appropriate central tendency measurement to represent the given data set below:

(05 marks)

- a) 34, 35, 35, 33, 36, 35, 35, 37, 35, 350

Measurement:

Reasons:

- b) 25, 35, 28, 29, 30, 32, 27, 28, 29, 280, 30, 26, 31

Measurement:

Reasons:

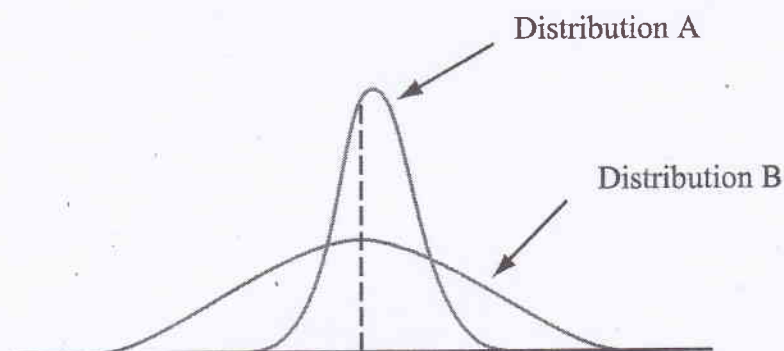
- c) 20, 24, 26, 28, 32, 27, 25, 35, 33, 22, 29, 31, 30

Measurement:

Reasons:

03. Explain the characteristics of the following two distributions, A and B

(05 marks)



04. For each of the following statistics, explain whether it would increase, decrease or remain the same after the outlier is corrected.

(05 marks)

Mean:

Median:

Standard deviation:

Range:

Standardized Scores:

05. The table below shows the opinions of 908 respondents in the General Social Survey to the question "Do you believe there is life after death?" The purpose of examining the data is to see if there is a gender difference in how people would respond to this question. State the hypotheses and statistically test it with 95% significant level.

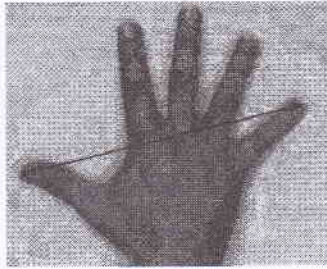
	Yes	No	Total
Male	282	109	391
Female	408	109	517
Total	690	218	908

(10 marks)



06.

Handspan



A researcher conducts a study to measure the relationship between left and right handspan of healthy people. The study considers the right handspan as an explanatory variable, and the left handspan as a response variable. Use the output obtained from Minitab software to answer the following questions.

Session					
The regression equation is					
LftSpan = 1.46 + 0.938 RtSpan					
Predictor	Coef	SE Coef	T	P	
Constant	1.4635	0.4792	3.05	0.003	
RtSpan	0.93830	0.02252	41.67	0.000	
S = 0.638615 R-Sq = 90.2% R-Sq(adj) = 90.2%					
Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	708.15	708.15	1736.38	0.000
Residual Error	188	76.67	0.41		

$p\text{-value} < 0.05$

Minitab regression results

(10 marks)

Regression equation: .....

Slope  $b_1$ : ..... Interpret  $b_1$ : .....

.....

Intercept  $b_0$ : ..... Interpret  $b_0$ : .....

.....

 $R^2$ : ..... Correlation coefficient  $r$ : .....Comment about the relationship using  $r$  and  $p\text{-value}$ :

07. Sri Lankan Indigenous Medical Association introduces a new herbal treatment for asthma patients. Suppose the truth is that the treatment actually will make 60% of those who receive treatment, healthy, and results are independent from one person to the other. The treatment is experimented on 3 people. Define  $X$  = number of people who become healthy due to the treatment.

(15 marks)

- a) Calculate the probability that  $X = 0$ ?

- b) Define the two events  $A$  and  $B$ :

$A$  = the first person is helped by the treatment

$B$  = the second person is helped by the treatment

Check off the answer for these questions: Yes / No

- i. Are  $A$  and  $B$  independent? .....
  - ii. Are  $A$  and  $B$  mutually exclusive? .....
  - iii. Are  $A$  and  $B$  complement? .....
- c) Event  $A$  is defined in the previous part as “the first person is helped by the treatment.” Explain in words the event  $A^C$  and give the probability  $P(A^C)$ .
- d) State whether or not  $X$  is a binomial random variable. If so, specify parameters  $n$  and  $p$ . If not, specify which condition is not met.



08. Consider the experiment of tossing a fair coin for five times.

(10 marks)

- a) Which of the following sequence is most likely to happen? If not justify your answer.

HHHHH

HTHHT

HHHTT

- b) Consider that the random variable  $X$  is the number of heads occur in the above experiment. Write down the probability mass/density function of  $X$ .

- c) Hence find the mean and variance of  $X$ .

09. Specify whether each of the following applies to binomial, uniform and/or normal random variables. Write the answers as **yes** or **no**.

(10 marks)

- a) 68% of possible values are in the range  $\mu \pm \sigma$ .

Binomial? ..... Uniform? ..... Normal? .....

- b)  $\mu = np$  or  $E(X) = np$

Binomial? ..... Uniform? ..... Normal? .....

- c) The pdf is constant for all values in the range of possibilities.

Binomial? ..... Uniform? ..... Normal? .....

- d) Continuous random variable.

Binomial? ..... Uniform? ..... Normal? .....

- e) Discrete random variable.

Binomial? ..... Uniform? ..... Normal? .....

10. The relative humidity  $Y$ , when measured at a location, has a probability density function given by

$$f(y) = \begin{cases} k y^3 (1 - y)^2, & 0 \leq y \leq 1 \\ 0, & \text{elsewhere} \end{cases}$$

Find the value of  $k$  that makes  $f(y)$  a density function.

(05 marks)

11. Suppose that weights ( $X$ ) of the girls in a certain age group follow a normal distribution with mean  $\mu = 80$  pounds and standard deviation  $\sigma = 12$  pounds.

Find  $P(X \leq 92)$  = probability of the weight of a randomly selected girl is less than or equal to 92 pounds.

**(05 marks)**

12. Assume that the total raw marks the MAA 1302 class follow a normal distribution with mean  $\mu = 515$  and standard deviation  $\sigma = 100$ .

**(15 marks)**

- a) Calculate the probability that a randomly selected student has a score less than or equal to 600?
- b) Calculate the probability that a randomly selected student has a score more than 600?
- c) Calculate the probability that a randomly selected student has a score between 515 and 600?
- d) Calculate the probability that the score of a randomly selected student is more than 85 points from the mean in either direction?

13. A researcher conducted a survey to explore the number of adults prone to allergies. He surveyed 883 randomly selected adults. According to the data he collected, 36% of the sample answered "yes" to the question "Are you allergic to anything?".

(15 marks)

- a) Calculate the sample statistic of who said "yes"?
- b) Hence, estimate the 95% confidence interval of the population parameter.  
(Hint: multiplier = 2 can be used to achieve the 95% confidence.)
- c) There is a claim that 45% of the adults have allergies. State the null and alternative hypotheses and use the above confidence interval to validate the claim.

14. Suppose that 26% of over weighted adults and 18% of normal weighted adults have high blood pressure.

Note: For each of the following, fill in the first blank with *appropriate notation*, and the second blank with *a number* for the requested value.

(15 marks)

- a) The difference in population proportions with high blood pressure is:

..... = .....

- b) Random samples of 500 overweight and 500 normal weight adults are considered, and the proportions with high blood pressure are found. The mean of the sampling distribution of the difference in proportions that is found when the samples are taken is:

..... = .....

- c) Random sample of 500 are considered, and 125 of the over weighted adults and 100 of the normal weighted adults have high blood pressure. The point estimate for the difference in population proportions is:

..... = .....

... END...