PGDM (IB) & (RM), 2021-23

Statistics for Business Analysis

IB-111 & RM-108

Trimester – I, End-Term Examination: October 2021

Time allowed: 2 hrs 30 min

Max Marks: 30

Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means.** In case of rough work please use answer sheet.

Sections	No. of Questions to attempt	Marks	Marks
A	3 questions with internal choices and CILO covered	05 Marks each	3*5 = 15
B	Compulsory Case Study	20 Marks	15
		Total Marks	**30**

SECTION A

A1. (CILO 1)

I. The mayor of a large city is concerned that a large number of people drawing unemployment cheques are secretly employed. The mayor's assistants estimate that 40% of unemployment beneficiaries' fall in this category, but the mayor is not convinced and asks one of his aides to conduct an investigation of 10 randomly selected unemployment beneficiaries.

a) If the mayor's assistants are correct, what is the probability that more than 8 of the individuals investigated have jobs? (2.5 marks)

b) If the mayor's assistants are correct, what is the probability that only 3 of the individuals investigated have jobs? (2.5 marks)

OR

II. Customer arrivals at a bank are random and independent; the probability of an arrival in any one – minute period is the same as the probability of an arrival in any other one-

minute period. Answer the following questions, assuming a mean arrival rate of three customers per minute.

a) What is the probability of exactly three arrivals in a one-minute period? (2.5 marks)

b) What is the probability of at least three arrivals in a half minute period? (2.5 marks)

A2. (CILO 3)

I. A production line operation is designed to fill cartons with laundry detergent to a mean weight of 32 ounces. A sample of cartons is periodically selected and weighed to determine whether underflling or overfilling is occurring. If the sample data lead to a conclusion of underfilling or overfilling, the production line will be shut down and adjusted to obtain proper filling. Formulate the null and alternative hypotheses that will help in deciding whether to shut down and adjust the production line. (5 marks)

OR

II. The mean number of hours of flying time for pilots at Continental Airlines is 49 hours per month. Assume that this mean was based on actual flying times for a sample of 100 Continental pilots and that the sample standard deviation was 8.5 hours.

a. At 95% confidence what is the margin error? (2.5 marks)

b. What is the 95% confidence interval estimate of the population mean flying time for the pilots? (2.5 marks)

A3 (CILO 3)

I. A packaging device is set to fill detergent powder packets with a mean weight of 3 kg, with a standard deviation of 0.21 kg. The weight of packets can be assumed to be normally distributed. The weight of packets is known to drift upwards over a period of time due to machine fault which is no tolerable. A sample of 100 packets is taken and weighed. This sample has a mean weight of 5.03 kg. Can we conclude that the mean weight produced by the machine has increased? Use a 5 % level of significance. (5 marks)

OR

II. According to the U.S. Bureau of Labor Statistics, the average weekly earnings of a production worker in 1997 were $424.20. Suppose a labor researcher wants to test to

determine whether this figure is still accurate today. The researcher randomly selects 54 production workers from across the United States and obtains a representative earning statement for one week from each. The resulting sample average is $432.69, with a standard deviation of $33.90. Use these data and hypotheses- testing techniques along with a 5% level of significance to determine whether the mean weekly earnings of a production worker have changed. (5 marks)

SECTION B

Case: Boom in the Indian Cement Industry: ACC's Role (CILO 2)

Introduction

The Indian cement industry was delicensed in 1991. After China, India is the second largest producer of cement. The estimated demand for cement is 265 million metric tonnes by 2114--2115.The Indian cement industry saw a growth of 11.6% in 2006. The financial year 2007 also witnessed a muted growth of 7.1 %. In order to meet the increasing demand, several manufacturers have embarked on significant capacity expansion plans.

ACC-A Pioneer in the Indian Cement Industry

Associated Cement Companies Ltd (ACC) came into existence in 1936, after the merger of 10 companies belonging to four important business groups: Tatas, Khataus, Killick Nixon and F E Dinshaw. The Tata group was associated with ACC since its inception. It sold 14.45% of its share to Gujarat Arnbuja Cements Ltd between 1999 and 2000. After this strategic alliance, Gujarat Ambuja Cements Ltd became the largest single stakeholder in ACC. In 2005, ACC entered into a strategic relationship with the Holcim group of Switzerland, a world leader in cement as well as a large supplier of concrete, aggregates, and certain construction related services. These global strategic alliances have strengthened the company.

ACC is India's foremost manufacturer of cement and concrete. The company has a wide range of operations with 14 modem cement factories, more than 30 ready mix concrete plants, 20 sales offices, and several zonal offices. ACC's research and development facility has a unique track record of innovative research, product development, and specialized consultancy services. ACC's brand name is synonymous with cement and it enjoys a high level of equity in the Indian market.

The Impact of Cartelization

Cartelization is one of the major problems in the cement industry. Cartelization takes place when dominant players of the industry join together to control prices and limit competition. In the Indian market, manufacturers have been known to enter into agreements to artificially limit the supply of cement so that the price remains high. When markets are not sufficiently regulated, large companies may be tempted to collude instead of competing with each other. For example, in May 2006, the Competition Council of Romania imposed a combined fine of 27 million Euros on France's Lafarge, Switzerland's Holcim, and Germany's Carpatcement for being involved in the cement cartel in the Romanian market. These three companies share 98% of Romanian cement capacity.' The government should take appropriate action to check acts of cartelization.

Escalating input and fuel costs have forced manufacturers to tap new sources of supply and increase the quest for alternative fuels and raw materials. The cement industry is faced with the challenge of optimizing the utilization of scare basic raw materials and fossil fuels while simultaneously protecting the environment and maintaining emission levels within acceptable limits. It is vital for the cement industry to achieve high levels of energy utilization efficiencies and to sustain them continuously. Table exhibits sales turnover and advertisement expenses of ACC from 1995 to 2007.

TABLE: Sales turnover and advertisement expenditure of ACC from 1995-2007

Year	Sales (in millions Rs.)	Advertisement (in million Rs.)
1995	20	2
1996	22	3
1997	24	4
1998	23	2
1999	25	6
2000	26	4
2001	29	5
2002	32	6
2003	34	10
2004	39	13
2005	45	13

Turn Over

2006	40	11
2007	44	12

B1 Develop an appropriate regression model to predict sales from advertisement. (10 marks)

B2 Predict the sales when advertisement is Rs 500 million. (5 marks)

Some important Formulae

$$P(x) = \binom{n}{x} p^x q^{(n-x)} = \frac{n!}{x!(n-x)!} p^x q^{(n-x)} \qquad ; \mu = np \quad ; \sigma^2 = npq$$

$$P(x) = \frac{\mu^x e^{-\mu}}{x!} \text{ for } x = 1,2,3,... \qquad ; \qquad z = \frac{x - \mu}{\sigma}$$

$$\frac{\bar{X} - \mu}{\sigma/\sqrt{n}} \qquad \frac{\bar{X} - \mu}{s/\sqrt{n}} \qquad \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$$

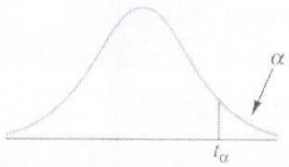
$$\frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}} \qquad \frac{\bar{X} - \mu_0}{s/\sqrt{n}} \qquad \frac{(\hat{p} - p_0)}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

$$\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \qquad \bar{X} \pm t_{(\frac{\alpha}{2}, n-1)} \frac{s}{\sqrt{n}} \qquad n = \frac{(z_{\alpha/2})^2 \sigma^2}{E^2}$$

$$Y_i = b_0 + b_1 X \qquad b_0 = \bar{y} - b_1 \bar{x}$$

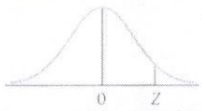
$$b_1 = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}} \qquad b_1 = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

x	e^{-x}	x	e^{-x}	x	e^{-x}	x	e^{-x}
0.0	1.0000	3.0	0.0498	6.0	0.00248	9.0	0.00012
0.1	0.9048	3.1	0.0450	6.1	0.00224	9.1	0.00011
0.2	0.8187	3.2	0.0408	6.2	0.00203	9.2	0.00010
0.3	0.7408	3.3	0.0369	6.3	0.00184	9.3	0.00009
0.4	0.6703	3.4	0.0334	6.4	0.00166	9.4	0.00008
0.5	0.6065	3.5	0.0302	6.5	0.00150	9.5	0.00007
0.6	0.5488	3.6	0.0273	6.6	0.00136	9.6	0.00007
0.7	0.4966	3.7	0.0247	6.7	0.00123	9.7	0.00006
0.8	0.4493	3.8	0.0224	6.8	0.00111	9.8	0.00006
0.9	0.4066	3.9	0.0202	6.9	0.00101	9.9	0.00005
1.0	0.3679	4.0	0.0183	7.0	0.00091	10.0	0.00005
1.1	0.3329	4.1	0.0166	7.1	0.00083		
1.2	0.3012	4.2	0.0150	7.2	0.00075		
1.3	0.2725	4.3	0.0136	7.3	0.00068		
1.4	0.2466	4.4	0.0123	7.4	0.00061		
1.5	0.2231	4.5	0.0111	7.5	0.00055		
1.6	0.2019	4.6	0.0101	7.6	0.00050		
1.7	0.1827	4.7	0.0091	7.7	0.00045		
1.8	0.1653	4.8	0.0082	7.8	0.00041		
1.9	0.1496	4.9	0.0074	7.9	0.00037		
2.0	0.1353	5.0	0.0067	8.0	0.00034		
2.1	0.1225	5.1	0.0061	8.1	0.00030		
2.2	0.1108	5.2	0.0055	8.2	0.00027		
2.3	0.1003	5.3	0.0050	8.3	0.00025		
2.4	0.0907	5.4	0.0045	8.4	0.00022		
2.5	0.0821	5.5	0.0041	8.5	0.00020		
2.6	0.0743	5.6	0.0037	8.6	0.00018		
2.7	0.0672	5.7	0.0033	8.7	0.00017		
2.8	0.0608	5.8	0.0030	8.8	0.00015		
2.9	0.0550	5.9	0.0027	8.9	0.00014		



Values of α for one-tailed test and $\alpha/2$ for two-tailed test						
df	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.001}$
1	3.078	6.314	12.706	31.821	63.656	318.289
2	1.886	2.920	4.303	6.965	9.925	22.328
3	1.638	2.353	3.182	4.541	5.841	10.214
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.894
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.610
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
40	1.303	1.684	2.021	2.423	2.704	3.307
50	1.299	1.676	2.009	2.403	2.678	3.261
60	1.296	1.671	2.000	2.390	2.660	3.232
70	1.294	1.667	1.994	2.381	2.648	3.211
80	1.292	1.664	1.990	2.374	2.639	3.195
90	1.291	1.662	1.987	2.368	2.632	3.183
100	1.290	1.660	1.984	2.364	2.626	3.174
150	1.287	1.655	1.976	2.351	2.609	3.145
200	1.286	1.653	1.972	2.345	2.601	3.131
∞	1.282	1.645	1.960	2.326	2.576	3.090

Turn Over



The entries in this table are the probabilities that a standard normal random variable is between 0 and z (the shaded area).

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998									
4.0	.49997									
4.5	.499997									
5.0	.4999997									
6.0	.499999999									