PGDM (RM) (16-18)

Statistics for Business Analysis

RM-103

Trimester – I, End-Term Examination: September 2016

Time allowed: 2 hrs 30 min

Max Marks: 50

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 out of 5 (Short Questions)	5 Marks each	3*5 = 15
B	2 out of 3 (Long Questions)	10 Marks each	2*10 = 20
C	Compulsory Case Study	15 Marks	15
		Total Marks	**50**

SECTION A

A1. Ship collisions in the Sethusamundram ship channel are rare. Suppose the number of collisions is poission distributed with mean of 1.2 collisions every four months.

a) What is the probability of having no collisions occur over a four- month period?
b) What is the probability of having exactly two collisions in a two- month period?
c) What is the probability of having one or fewer collisions in a six- month period?

A2. Smitty moyer knows that the probability that any one of the 20 individual floodlights in a light tower fails during a football game is 0.05. The individual floodlights in a tower fail independently of each other.

Using both the binomial and the poisson approximation, determine the probability that seven floodlight from a given tower will fail during the same game.

A3. A marketing research firm wants to conduct a survey to estimate the average amount spent on entertainment by each person visiting a popular resort. The people who plan the survey would like to determine the average amount spent by all people visiting the resort to within $120, with 95% confidence. From past operation of the resort, an estimate of the population standard deviation is s = $400. What is the minimum required sample size?

A4. The annual salaries of employees in a large company are approximately normally distributed with a mean of $50,000 and a standard deviation of $20,000.

a) What percent of people earn less than $40,000?

b) What percent of people earn between $45,000 and $65,000?

c) What percent of people earn more than $70,000?

A5. A national publication reported that a college student living away from home spends, on average, no more than Rs.15 per month on laundry. You believe this figure is too low and want to disprove this claim. To conduct the test, you randomly select 17 college students and ask them to keep track of the amount of money they spend during a given month for laundry. The sample produces an average expenditure on laundry of Rs.19.34, with a population standard deviation of Rs. 4.52. Use these sample data to conduct the hypothesis test. Assume you are willing to take a 10% risk of making a Type I error and that spending on laundary per month is normally distributed in the population.

SECTION B

B1. Accuracy in taking orders at a drive- through window is important feature for fast food chains. Each month QSR magazine publishes the results of its survey. Accuracy is measured as the percentage of orders consisting of a main item, side item and drink (but omitting one standard item, such as a pickle) that are filled correctly. In a recent month, suppose that the percentage of correct orders of this type filled at McDonald's was approximately 88%. If a sample of three order is taken, what are the mean and standard deviation of the binomial distribution for the numbers of orders filled accurately? Suppose you and two friends go to the drive through window at McDonald's, and each of you places an order of the type just mentioned. What are the probabilities that all three, that none of the three, and that at least two of the three orders will be filled accurately?

B2. Pepsi is studying the effect of its latest advertising campaign. People chosen at random were called and asked and asked how many cans of Pepsi they had bought in the past week and how many Pepsi advertisements they had either read or seen in the past week.

X (number of ads)	3	7	4	2	0	4	2	2
Y (cans purchased)	11	16	9	6	5	6	3	8

a) Develop an equation for the relationship between cans purchased and number of ads read or seen.

b) Interpret the slope of the regression line

c) Plot appropriate graphs for observed sales and estimated sales.

d) If a customer has seen or read 5 ads, how many Pepsi cans he is expected to purchase?

B3. The Department of transportation has mandated that the average speed of cars on interstate highway must be no more than 67 miles per hour in order for state highway department to retain their federal funding. North Carolina troopers in unmarked cars clocked a sample of 186 cars and found that the average speed was 66.3 miles per hour and standard deviation was 0.6 mph.

a) Find the standard error of mean

b) What is the interval around the sample mean that would contain the population mean 95 percent of time?

c) Can North Carolina truthfully report that the true mean speed on its highways is 67mph or less with 95 percent confidence?

SECTION C

Case # Frozen Pizza Targets Teens

McCain Foods Limited is one of the most recognizable and popular brand names. This company was founded in Florenceville, New Brunswick, in 1957, and today it is the world's leading producer of French fries and various frozen food items.

One of McCain's most well-known and well-liked frozen food product is its frozen pizza. In 1998, McCain introduced Crescendo Rising Crust Pizza, its first rising crust pizza. The concept of a rising crust pizza was developed in order to replicate as much as possible the

taste and look of takeout pizza. However, sales for this pizza were not as McCain originally anticipated. This was due to the fact that just a few months after the Crescendo introduction, Kraft introduced its Delissio frozen pizza, and with extensive advertising, Delissio became the brand leader while McCain's Crescendo followed in second place.

In 2004, McCain's research experts concluded that the main reason for Crescendo's lagging leadership in its field was its lack of appeal and absence of a "cool factor" with the teenage market. Teenagers were not able to relate to the Crescendo Rising Crust Pizza because they did not see it as a cool and trendy product. As such, McCain needed to change its image in order to attract the important teenage market. Research conducted in the year 2000 found that 66% of teenagers purchase a product that reflects their style and image as "hip" and trendy; therefore portraying Crescendo as "cool" would make the product more desirable to teens. At the time, McCain was focused on attracting teens, since research showed that they represented a significant growth factor in the food product industry and were the main consumers of frozen pizzas.

In order for McCain to attract teens, it had to change its advertising strategy. The first change that McCain made was to introduce more creative advertisements specifically targeted at the teenage population. These advertisements included "The Tan Lines" campaign. This was a fun and innovative ad that focused on young people and how intriguing Crescendo could be. The desired effect of the advertising was to capture sufficient interest that in turn would distract the teenagers sufficiently and make them unaware of anything else around them. Featuring young people in the advertisements was very important to McCain so that the teenage population could easily relate to the characters portrayed. Research also indicated that television was the most powerful form of media; therefore McCain chose to advertise on both English and French channels.

McCain went even further and used outdoor billboards in busy areas such as Toronto, Ottawa, Montreal, and Vancouver.

As a result of this research, McCain was able to launch its new advertisements in December 2004. Its new ads were very successful. Within the first six months of the new advertising campaign, McCain was able to double its sales goal of a 15% increase for the Crescendo Rising Crust Pizza to a 34% year-over-year increase in ex-factory sales.

Discussion

In the research process for McCain Foods Limited, many different numerical questions were raised regarding advertising techniques and purchase patterns among teenagers. In each of these areas, statistics, in particular hypothesis testing plays a central role. Using the case information and the concepts of hypothesis testing, discuss the following:

a. The case information stated that 66% of teenagers purchase products that reflect their style and image as being hip and trendy. How would you test the appropriateness and validity of that percentage? In a test where 900 teens are randomly selected across Canada, 625 state that they purchase products that reflect their style and image as being hip and trendy. Test the claim made in the case regarding the purchase of products by teenagers reflecting their style and image. Assume normality.

b. Historically, it has been verified that 72% of all teens that ate frozen pizza were girls. Due to apparent changes in gender tastes, it is believed that more teen boys are now eating frozen pizzas. From a random sample of 653 teens that eat frozen pizza, 513 are girls. Does this sample result provide sufficient evidence to conclude that a higher proportion of teenage girls than before eat frozen pizza? Assume normality.

c. McCain is interested in knowing the average age of the teenage consumer of the Crescendo Rising Crust Pizza? Suppose that initial beliefs indicate that the mean age is 15. Is this figure really correct? To test whether it is, a researcher randomly contacts 30 teenage consumers of Crescendo Rising Crust Pizza, for this sample mean is 16.92 and variance is 30.2963.

Determine whether the mean age exceeds 15. Let α be 0.01. Assume normality.

Some important Formulae

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

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

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

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

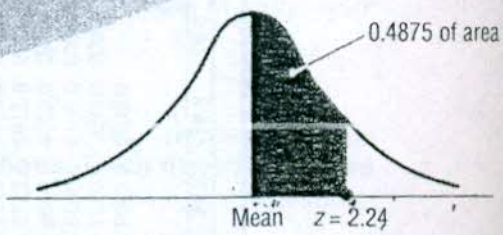
$$\bar{x} \pm z\alpha/2 \frac{\sigma}{\sqrt{n}} \qquad \bar{X} \pm t_{(\frac{\alpha}{2}, n-1)} \frac{s}{\sqrt{n}} \qquad n = \frac{(z\alpha/2)^2 \sigma^2}{E^2}$$

Finite Correction Factor : $\sqrt{\frac{N-n}{N-1}}$ $\qquad N\bar{X} \pm N\left(t_{\alpha/2, n-1}\right)\frac{S}{\sqrt{n}}\sqrt{\frac{(N-n)}{(N-1)}}$

$$Y_i = b_0 + b_1 X$$

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

Appendix Tables



EXAMPLE: TO FIND THE AREA UNDER THE CURVE BETWEEN THE MEAN AND A POINT 2.24 STANDARD DEVIATIONS TO THE RIGHT OF THE MEAN, LOOK UP THE VALUE OPPOSITE 2.2 AND UNDER 0.04 IN THE TABLE; 0.4875 OF THE AREA UNDER THE CURVE LIES BETWEEN THE MEAN AND A z VALUE OF 2.24.

APPENDIX TABLE 1 AREAS UNDER THE STANDARD NORMAL PROBABILITY DISTRIBUTION BETWEEN THE MEAN AND POSITIVE VALUES OF z

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

APPENDIX TABLE 3 BIONOMIAL PROBABILITIES

FOR A GIVEN COMBINATION OF n AND p, ENTRY INDICATES THE PROBABILITY OF OBTAINING A SPECIFIED VALUE OF r. TO LOCATE ENTRY: WHEN $p \leq 0.50$, READ p ACROSS THE TOP AND BOTH n AND r DOWN THE LEFT MARGIN; **WHEN** $p \geq 0.50$, READ p ACROSS THE BOTTOM AND BOTH n AND r UP THE RIGHT MARGIN.

		p																			
n	r	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	r	n
2	0	0.9801	0.9604	0.9409	0.9216	0.9025	0.8836	0.8649	0.8464	0.8281	0.8100	0.7921	0.7744	0.7569	0.7396	0.7225	0.7056	0.6889	0.6724	2	
	1	0.0198	0.0392	0.0582	0.0768	0.0950	0.1128	0.1302	0.1472	0.1638	0.1800	0.1958	0.2112	0.2262	0.2408	0.2550	0.2688	0.2822	0.2952	1	
	2	0.0001	0.0004	0.0009	0.0016	0.0025	0.0036	0.0049	0.0064	0.0081	0.0100	0.0121	0.0144	0.0169	0.0196	0.0225	0.0256	0.0289	0.0324	0	2
3	0	0.9703	0.9412	0.9127	0.8847	0.8574	0.8306	0.8044	0.7787	0.7536	0.7290	0.7050	0.6815	0.6585	0.6361	0.6141	0.5927	0.5718	0.5514	3	
	1	0.0294	0.0576	0.0847	0.1106	0.1354	0.1590	0.1816	0.2031	0.2236	0.2430	0.2614	0.2788	0.2952	0.3106	0.3251	0.3387	0.3513	0.3631	2	
	2	0.0003	0.0012	0.0026	0.0046	0.0071	0.0102	0.0137	0.0177	0.0221	0.0270	0.0323	0.0380	0.0441	0.0506	0.0574	0.0645	0.0720	0.0797	1	
	3	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003	0.0005	0.0007	0.0010	0.0013	0.0017	0.0022	0.0027	0.0034	0.0041	0.0049	0.0058	0	3
4	0	0.9606	0.9224	0.8853	0.8493	0.8145	0.7807	0.7481	0.7164	0.6857	0.6561	0.6274	0.5997	0.5729	0.5470	0.5220	0.4979	0.4746	0.4521	4	
	1	0.0388	0.0753	0.1095	0.1416	0.1715	0.1993	0.2252	0.2492	0.2713	0.2916	0.3102	0.3271	0.3424	0.3562	0.3685	0.3793	0.3888	0.3970	3	
	2	0.0006	0.0023	0.0051	0.0088	0.0135	0.0191	0.0254	0.0325	0.0402	0.0486	0.0575	0.0669	0.0767	0.0870	0.0975	0.1084	0.1195	0.1307	2	
	3	0.0000	0.0000	0.0001	0.0002	0.0005	0.0008	0.0013	0.0019	0.0027	0.0036	0.0047	0.0061	0.0076	0.0094	0.0115	0.0138	0.0163	0.0191	1	
	4	–	–	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002	0.0003	0.0004	0.0005	0.0007	0.0008	0.0010	0	4
5	0	0.9510	0.9039	0.8587	0.8154	0.7738	0.7339	0.6957	0.6591	0.6240	0.5905	0.5584	0.5277	0.4984	0.4704	0.4437	0.4182	0.3939	0.3707	5	
	1	0.0480	0.0922	0.1328	0.1699	0.2036	0.2342	0.2618	0.2866	0.3086	0.3280	0.3451	0.3598	0.3724	0.3829	0.3915	0.3983	0.4034	0.4069	4	
	2	0.0010	0.0038	0.0082	0.0142	0.0214	0.0299	0.0394	0.0498	0.0610	0.0729	0.0853	0.0981	0.1113	0.1247	0.1382	0.1517	0.1652	0.1786	3	
	3	0.0000	0.0001	0.0003	0.0006	0.0011	0.0019	0.0030	0.0043	0.0060	0.0081	0.0105	0.0134	0.0166	0.0203	0.0244	0.0289	0.0338	0.0392	2	
	4	–	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003	0.0004	0.0007	0.0009	0.0012	0.0017	0.0022	0.0028	0.0035	0.0043	1	
	5	–	–	–	–	–	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0002	0	5
6	0	0.9415	0.8858	0.8330	0.7828	0.7351	0.6899	0.6470	0.6064	0.5679	0.5314	0.4970	0.4644	0.4336	0.4046	0.3771	0.3513	0.3269	0.3040	6	
	1	0.0571	0.1085	0.1546	0.1957	0.2321	0.2642	0.2922	0.3164	0.3370	0.3543	0.3685	0.3800	0.3888	0.3952	0.3993	0.4015	0.4018	0.4004	5	
	2	0.0014	0.0055	0.0120	0.0204	0.0305	0.0422	0.0550	0.0688	0.0833	0.0984	0.1139	0.1295	0.1452	0.1608	0.1762	0.1912	0.2057	0.2197	4	
	3	0.0000	0.0002	0.0005	0.0011	0.0021	0.0036	0.0055	0.0080	0.0110	0.0146	0.0188	0.0236	0.0289	0.0349	0.0415	0.0486	0.0562	0.0643	3	
	4	–	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0005	0.0008	0.0012	0.0017	0.0024	0.0032	0.0043	0.0055	0.0069	0.0086	0.0106	2	
	5	–	–	–	–	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002	0.0003	0.0004	0.0005	0.0007	0.0009	1	
	6	–	–	–	–	–	–	–	–	–	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	6
7	0	0.9321	0.8681	0.8080	0.7514	0.6983	0.6485	0.6017	0.5578	0.5168	0.4783	0.4423	0.4087	0.3773	0.3479	0.3206	0.2951	0.2714	0.2493	7	
	1	0.0659	0.1240	0.1749	0.2192	0.2573	0.2897	0.3170	0.3396	0.3578	0.3720	0.3827	0.3901	0.3946	0.3965	0.3960	0.3935	0.3891	0.3830	6	
	2	0.0020	0.0076	0.0162	0.0274	0.0406	0.0555	0.0716	0.0886	0.1061	0.1240	0.1419	0.1596	0.1769	0.1936	0.2097	0.2248	0.2391	0.2523	5	
	3	0.0000	0.0003	0.0008	0.0019	0.0036	0.0059	0.0090	0.0128	0.0175	0.0230	0.0292	0.0363	0.0441	0.0525	0.0617	0.0714	0.0816	0.0923	4	
	4	–	0.0000	0.0000	0.0001	0.0002	0.0004	0.0007	0.0011	0.0017	0.0026	0.0036	0.0049	0.0066	0.0086	0.0109	0.0136	0.0167	0.0203	3	
	5	–	–	–	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003	0.0004	0.0006	0.0008	0.0012	0.0016	0.0021	0.0027	2	
	6	–	–	–	–	–	–	–	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002	1	
	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0000	0.0000	0.0000	0.0000	0	7
n	r	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	r	n
		p																			