PGDM 2014 - 16

Research Methodology

Subject Code- DM-206

Trimester – II, End-Term Examination: December 2014

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.

Section A

Attempt ANY three questions in this section. Each question carries 5 marks. *(3 x 5)*

A1. Identify process steps for conducting a marketing research. Highlight the measures that need to be taken at each step to minimize errors.

A2. For a marketing research explain 'Validity' and 'Reliability'.

A3.

(a) Detail the steps of constructing a questionnaire

(b) List at least 10 *local controls* in a research design to find out if three different teachers of BRM are equally effective.

A4. Compare and contrast the following

(a) Informal and Formal research design

(b) Factorial design and Latin Square design

A5. Comment on the size of the sample in cases of Exploratory, Descriptive and Causal researches.

Section B

Attempt ANY two questions in this section. Each question carries 10 marks. *(2 x 10)*

B1. A continuous production plant of chemicals is considering changing the design of the workstation at the main control room to increase the productivity of staff. The management feels that the existing workstation is not ergonomically designed and it can be substantially improved. Three vendors have offered their models: Magnum, Classic and Exotica. The vendor offering Classic is charging more than the other two brands. He claims that the tests have shown that the average time taken by workers, when 6 workers were randomly allocated to each machine, is less on his model.

Workstation Designs					
	Magnum		Classic		Exotica
Worker 1	59	Worker 7	58	Worker 13	63
Worker 2	56	Worker 8	55	Worker 14	60
Worker 3	60	Worker 9	54	Worker 15	58
Worker 4	52	Worker 10	54	Worker 16	60
Worker 5	54	Worker 11	50	Worker 17	57
Worker 6	58	Worker 12	52	Worker 18	60
Count	6		6		6
Mean	56.50		53.83		59.67
Std Dev	3.08		2.71		2.07

If above data set is analyzed with One Way ANOVA, following table is obtained:

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Between Groups	102.33				3.68
Within Groups	105.66				
Total	208				

Management feels that the way test has been conducted is wrong. The test was repeated by noting the time taken by the same worker for the same job when performed on three different models.

Workstation Designs					
	Magnum	Classic	Exotica	Mean	Std Dev
Worker 1	55	55	54	54.67	0.58
Worker 2	56	55	57	56.00	1.00
Worker 3	58	54	53	55.00	2.65
Worker 4	52	54	57	54.33	2.52
Worker 5	54	50	54	52.67	2.31
Worker 6	51	52	53	52.00	1.00
Count	6	6	6		
Mean	54.33	53.33	54.67		
Std Dev	2.58	1.97	1.86		

(a) Help management analyze this data and draw conclusion.

(b) Is the vendor justified to charge higher price for Classic? Explain why?

B2. The owner of a small movie hall used multiple linear regression on past eight weeks sample data to predict weekly gross revenue (y) as a function of television advertising (x_1) and news paper advertising (x_2):

$$\hat{y} = 83.2 + 2.29\ x_1 + 1.30\ x_2$$

The computer solution provided SST = 25.5 and SSR = 23.435.
The Standard Errors of the coefficients of x_1 and x_2 are 0.304 and 0.321 respectively.

(a) Compute R^2 and R_a^2.
(b) Is there significant correlation among population elements?
(c) When television advertisement was only independent variable, $R^2 = 0.653$ and $R_a^2 = 0.595$. Do you prefer multiple regression results? Explain.
(d) Use $\alpha = 0.01$ to test the hypotheses

$H_0 : \beta_1 = \beta_2 = 0$
$H_a : \beta_1\ and / or \beta_2$ is not equal to 0

(e) Use $\alpha = 0.05$ to test the significance of β_2. Should x_2 be dropped from the model?

B3.
(a) What is the conceptual framework of factor analysis? Under what circumstances a researcher should apply factor analysis?
(b) Describe the steps followed in performing Factor Analysis by SPSS. For every step explain how the outcome of the step can be used by the researcher in interpreting the result.

SECTION C

This section is compulsory and carries 15 marks. (1 x 15)

C1. A firm engaged in floriculture wishes to select proper combination of type of seed, moisture level and fertilizer used to influence the growth of rose plant and hence yield of flowers.

A six month long controlled experiment was conducted with six identical pieces of land in which three types of seeds (S1, S2 and S3) were used under three moisture levels (High, Medium and Low) and with three types of fertilizer (Organic, Synthetic and Nitrogenous). Average daily yield of flowers after twelve weeks onwards were tracked.

The firm wishes to know as to which combination of seed, moisture level and fertilizer may yield maximum flowers. In effect the firm wishes to know if choice of seed type, moisture levels and fertilizer type do affect the flower output.

Stage I

Initially a factorial design experiment was conducted as given below and daily outputs of flowers were recorded as given in Table 1:

TABLE 1	Seed 1	Seed 2	Seed 3
Moisture level High	142	156	136
Moisture level High	163	174	152
Moisture level High	149	185	163
Moisture level High	180	175	175
Moisture level Medium	144	159	170
Moisture level Medium	189	145	138
Moisture level Medium	112	119	145
Moisture level Medium	147	158	163
Moisture level Low	185	176	192
Moisture level Low	187	195	179
Moisture level Low	158	169	194
Moisture level Low	175	185	190

The analysis of two way ANOVA is displayed below with some missing values:

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample		2	____	____	0.00	3.35
Columns	238.39	2	____	____	0.67	3.35
Interaction	846.44	4	____	____	0.58	2.73
Within	7858.00					
Total	15552.89					

Stage II

Next a data collection plan has been developed as per the following table (Table 2) with three types of fertilizers as global hypothesis:

TABLE 2	Seed 1	Seed 2	Seed 3
Moisture level High	F-Org	F-Synth	F-Nitro
Moisture level High	F-Org	F-Synth	F-Nitro
Moisture level High	F-Org	F-Synth	F-Nitro
Moisture level High	F-Org	F-Synth	F-Nitro
Moisture level Medium	F-Nitro	F-Org	F-Synth
Moisture level Medium	F-Nitro	F-Org	F-Synth
Moisture level Medium	F-Nitro	F-Org	F-Synth
Moisture level Medium	F-Nitro	F-Org	F-Synth
Moisture level Low	F-Synth	F-Nitro	F-Org
Moisture level Low	F-Synth	F-Nitro	F-Org
Moisture level Low	F-Synth	F-Nitro	F-Org
Moisture level Low	F-Synth	F-Nitro	F-Org

The actual data collected as per the plan shown in table 2 is given in Table 3 below:

TABLE 3	**Seed 1**	**Seed 2**	**Seed 3**
Moisture level High	196	185	159
Moisture level High	189	169	157
Moisture level High	185	173	148
Moisture level High	189	188	163
Moisture level Medium	189	177	192
Moisture level Medium	167	149	183
Moisture level Medium	193	196	175
Moisture level Medium	185	153	149
Moisture level Low	176	189	168
Moisture level Low	187	195	172
Moisture level Low	198	169	196
Moisture level Low	176	156	190

The ANOVA table for the data in Table 3 is shown below:

Total	*Seed 1*	*Seed 2*	*Seed 3*
Count	12	12	12
Sum	2230	2099	2052
Average	185.8333	174.9167	171
Variance	80.33333	264.2652	274

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	255.17	2	127.58	0.67	0.52	3.35
Columns	1418.17	2	709.08	3.70	0.04	3.35
Interaction	1380.17	4	345.04	1.80	0.16	2.73
Within	5169.25	27	191.45			
Total	8222.75	35				

C1. After Stage I can the firm proceed to use Latin Square Design in this case to test three independent hypotheses? Explain. (Marks 4)

C2. State all three sets of hypotheses and interpret them. (Marks 6)

C3. What will be your recommendation to the firm? Explain. (Marks 5)

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-tails	**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					

F Values for $\alpha = 0.05$

d_2 (denominator) \ d_1 (Numerator)	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.3	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
inf	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

F Values for $\alpha = 0.05$

d_2 \ d_1	10	12	15	20	24	30	40	60	120	inf
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	19.4	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.5
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	1.91	1.83	1.75	1.66	1.10	1.55	1.50	1.43	1.35	1.25
inf	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

d_1 = Numerator

d_2 = Denominator