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(一) 選擇題：單選題，每題 5%

1. Classifying students in a statistics course by their gender and height are an example of what scale of measurements?
   (A) Nominal, ordinal **(B)** Ordinal, interval **(C)** Nominal, ratio **(D)** Ordinal , ratio

2. A statistics instructor informed her class that the median exam score was 80 and the mean was 68. What might the smoothed histogram of scores look like? （直方圖大概的曲線為何？）
   (A) Skewed right **(B)** Skewed left **(C)** Symmetric and bell-shape **(D)** Two peaks

3. Which of the following will increase the width of a confidence interval (assuming that everything else remains constant)?
   (A) Decreasing the confidence level
   (B) Increasing the sample size
   (C) A decrease in the standard deviation
   (D) Decreasing the sample size

4. The time required to prepare a dry cappuccino using whole milk （只有奶泡的卡布奇諾）at a Coffee House is uniformly distributed between 25 and 35 seconds. Assuming a customer has just ordered a whole-milk dry cappuccino, what is the probability that the preparation time will be more than 32 seconds?
   (A) 0.5 **(B)** 0.4 **(C)** 0.3 **(D)** 0.7

5. A manufacturing firm has two suppliers for an electrical component used in its process: one in Mexico and one in China. The supplier in Mexico ships 68% of all the electrical components used by the firm and has a defect rate of 6%, the Chinese supplier ships 32% of the electrical components used by the firm and has defect rate of 4%. Calculate the probability that an electrical component is defective?
   (A) 0.1768 **(B)** 0.1920 **(C)** 0.0152 **(D)** 0.10

6. Suppose the number of cars that arrive at a car wash （洗車場）is descried be a Poisson distribution with a mean of 10 cars/hour. What is the probability that there are two or less cars arrive within half hour?
   (A) 0.1247 **(B)** 0.0067 **(C)** 0.0335 **(D)** 0.0842

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(二) 計算題。

1. (10%) A report indicates that 30% of all home buyers will do some remodeling (整修) to their home within the first five years of home ownership. Assuming this is true, use the binomial distribution to determine the probability that in a random sample of 100 homeowners, fewer than 25 will remodel their homes.

2. (10%) A minor league baseball team expects an average of 50 paying customers (願意買票的觀眾) on a rainy game day, 150 on a cloudy day, 300 on a fair day and 500 on a sunny day. According to the weather bureau (氣象局), the probabilities of weather during the baseball season are:

Weather	Rainy	Cloudy	Fair	Sunny
Probability	0.05	0.25	0.3	0.4

(A) Find the mean and standard deviation of the number of patrons (支持者) per day.

(B) If admission is $5 per head, what is the expected value of revenue per day from admissions?

3. (15%) Shown below is a portion of a computer output for regression analysis relating Y (dependent variable) and X (independent variable).

ANOVA

	df	SS
Regression	1	110
Residual	8	74
Total	9	184

	Coefficients	Standard Error
Intercept	39.222	5.943
X	-0.5556	0.1611

(A) Perform a t-test and determine whether or not X and Y are related. Let $\alpha = 0.05$.

(B) Perform an F test and determine whether or not X and Y are related. Let $\alpha = 0.05$.

(C) Compute the coefficient of determination and interpret its meaning.

4. (20%) An experiment was conducted to determine the effect of various degrees of stress on performance. Five persons were taught a simple task, and then each person was asked to perform the task under the following conditions, in random order:

A: no stress   B: mild stress   C: severe stress

The time in seconds to perform the task was recorded. Is there sufficient evidence to say that stress conditions affect the performance of this task? Let $\alpha = 0.05$.
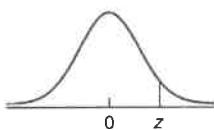
	Person				
Condition	1	2	3	4	5
A	3	10	6	9	6
B	7	10	9	13	9
C	10	14	14	16	15

5. (15%) A company packages powdered soap in 6-pound boxes. The sample mean and standard deviation of the soap in these boxes are currently 6.09 and 0.02 pounds. Adjustments were made in the filling equipment, but it can be assumed that the standard deviation remains unchanged.

(A) How large a sample is needed so that the maximum error of the estimate of the new μ is 0.001 with 90% confidence?

(B) A random sample of size $n = 1219$ yielded $\bar{x} = 6.048$ and s = 0.022. Calculate a 90% confidence interval for μ.

(C) Estimate the proportion of boxes that will now weigh less than six pounds.

TABLE II (cont.)
Areas under the standard normal curve
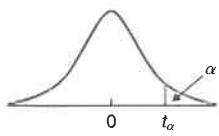
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000†									

† For $z \geq 3.90$, the areas are 1.0000 to four decimal places.

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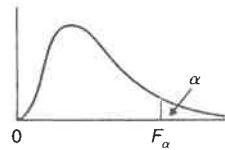
TABLE IV
Values of t_α

df	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	df
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
30	1.310	1.697	2.042	2.457	2.750	30
31	1.309	1.696	2.040	2.453	2.744	31
32	1.309	1.694	2.037	2.449	2.738	32
33	1.308	1.692	2.035	2.445	2.733	33
34	1.307	1.691	2.032	2.441	2.728	34
35	1.306	1.690	2.030	2.438	2.724	35
36	1.306	1.688	2.028	2.434	2.719	36
37	1.305	1.687	2.026	2.431	2.715	37
38	1.304	1.686	2.024	2.429	2.712	38
39	1.304	1.685	2.023	2.426	2.708	39
40	1.303	1.684	2.021	2.423	2.704	40
41	1.303	1.683	2.020	2.421	2.701	41
42	1.302	1.682	2.018	2.418	2.698	42
43	1.302	1.681	2.017	2.416	2.695	43
44	1.301	1.680	2.015	2.414	2.692	44
45	1.301	1.679	2.014	2.412	2.690	45
46	1.300	1.679	2.013	2.410	2.687	46
47	1.300	1.678	2.012	2.408	2.685	47
48	1.299	1.677	2.011	2.407	2.682	48
49	1.299	1.677	2.010	2.405	2.680	49

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TABLE VIII
Values of F_α

dfd	α	1	2	3	4	5	6	7	8	9
						dfn				
1	0.10	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86
	0.05	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54
	0.025	647.79	799.50	864.16	899.58	921.85	937.11	948.22	956.66	963.28
	0.01	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1	6022.5
	0.005	16211	20000	21615	22500	23056	23437	23715	23925	24091
2	0.10	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38
	0.05	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
	0.025	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39
	0.01	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39
	0.005	198.50	199.00	199.17	199.25	199.30	199.33	199.36	199.37	199.39
3	0.10	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24
	0.05	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
	0.025	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47
	0.01	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35
	0.005	55.55	49.80	47.47	46.19	45.39	44.84	44.43	44.13	43.88
4	0.10	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94
	0.05	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
	0.025	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98	8.90
	0.01	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66
	0.005	31.33	26.28	24.26	23.15	22.46	21.97	21.62	21.35	21.14
5	0.10	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32
	0.05	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
	0.025	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68
	0.01	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16
	0.005	22.78	18.31	16.53	15.56	14.94	14.51	14.20	13.96	13.77
6	0.10	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96
	0.05	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
	0.025	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52
	0.01	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98
	0.005	18.63	14.54	12.92	12.03	11.46	11.07	10.79	10.57	10.39
7	0.10	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72
	0.05	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
	0.025	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82
	0.01	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
	0.005	16.24	12.40	10.88	10.05	9.52	9.16	8.89	8.68	8.51
8	0.10	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56
	0.05	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
	0.025	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.43	4.36
	0.01	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
	0.005	14.69	11.04	9.60	8.81	8.30	7.95	7.69	7.50	7.34

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TABLE VIII (cont.)
Values of F_α

dfd	α	dfn 1	2	3	4	5	6	7	8	9
	0.10	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44
	0.05	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
9	0.025	7.21	5.71	5.08	4.72	4.48	4.32	4.20	4.10	4.03
	0.01	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
	0.005	13.61	10.11	8.72	7.96	7.47	7.13	6.88	6.69	6.54
	0.10	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35
	0.05	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
10	0.025	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.85	3.78
	0.01	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
	0.005	12.83	9.43	8.08	7.34	6.87	6.54	6.30	6.12	5.97
	0.10	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27
	0.05	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
11	0.025	6.72	5.26	4.63	4.28	4.04	3.88	3.76	3.66	3.59
	0.01	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
	0.005	12.23	8.91	7.60	6.88	6.42	6.10	5.86	5.68	5.54
	0.10	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21
	0.05	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
12	0.025	6.55	5.10	4.47	4.12	3.89	3.73	3.61	3.51	3.44
	0.01	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
	0.005	11.75	8.51	7.23	6.52	6.07	5.76	5.52	5.35	5.20
	0.10	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16
	0.05	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
13	0.025	6.41	4.97	4.35	4.00	3.77	3.60	3.48	3.39	3.31
	0.01	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
	0.005	11.37	8.19	6.93	6.23	5.79	5.48	5.25	5.08	4.94
	0.10	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12
	0.05	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
14	0.025	6.30	4.86	4.24	3.89	3.66	3.50	3.38	3.29	3.21
	0.01	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03
	0.005	11.06	7.92	6.68	6.00	5.56	5.26	5.03	4.86	4.72
	0.10	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09
	0.05	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
15	0.025	6.20	4.77	4.15	3.80	3.58	3.41	3.29	3.20	3.12
	0.01	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
	0.005	10.80	7.70	6.48	5.80	5.37	5.07	4.85	4.67	4.54
	0.10	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06
	0.05	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
16	0.025	6.12	4.69	4.08	3.73	3.50	3.34	3.22	3.12	3.05
	0.01	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
	0.005	10.58	7.51	6.30	5.64	5.21	4.91	4.69	4.52	4.38

第一部分： 選擇題 (共七題，合計50分)

選擇題說明：

1. 選擇題共7題。3題單選題(題號：A-1至A-3)，4題複選題(題號：A-4至A-7)。
2. **單選題**每題6分(共18分)，**複選題**每題8分(共32分)。第一部分選擇題合計50分。
3. 單選題請以最接近的答案選答，複選題須完全答對該題才計分。

A-1 (單選題) 某公司一年的四季需求量呈現規則循環現象，且僅知第二季至第四季的季節指數，依序分別為：1.2、1.0、1.0。近幾年來，公司每年的年需求量均呈現直線的變化，去年整年的需求量為 2900，今年整年的需求量為 2650。試預測明年第一季的需求量為何?
(A)480　　(B)540　　(C)660　　(D)2400　　(E)2640

A-2 (單選題) 某汽車製造公司對於各種小型車種，均採用相同的剎車系統、配電系統、及傳動系統設計。該設計理念與下述何種觀念**最為接近**?
(A)Supply-Chain Based 設計
(B)Design for Recycling 設計
(C)Standardization 設計
(D)Global Manufacturing 設計
(E)Remanufacturing 設計

A-3 (單選題) 某公司採用 Center of Gravity 方法找尋物流中心倉庫的較佳位置，供貨及配送的協力廠商共有 n 個，其座標為 (a_i, b_i), $i = 1, 2, ..., n$，各協力廠商往來物流中心倉庫的運輸趟次為 W_i, $i = 1, 2, ..., n$，各協力廠商每單位距離的運送成本為 C_i, $i = 1, 2, ..., n$。則該物流中心倉庫較佳的位置座標(X, Y)為：
(A)$X = (\sum_{i=1}^{n} a_i)/n$, $Y = (\sum_{i=1}^{n} b_i)/n$
(B)$X = (\sum_{i=1}^{n} a_i W_i)/(\sum_{i=1}^{n} W_i)$, $Y = (\sum_{i=1}^{n} b_i W_i)/(\sum_{i=1}^{n} W_i)$
(C)$X = (\sum_{i=1}^{n} a_i W_i)/(\sum_{i=1}^{n} W_i C_i)$, $Y = (\sum_{i=1}^{n} b_i W_i)/(\sum_{i=1}^{n} W_i C_i)$
(D)$X = (\sum_{i=1}^{n} a_i W_i C_i)/(\sum_{i=1}^{n} W_i)$, $Y = (\sum_{i=1}^{n} b_i W_i C_i)/(\sum_{i=1}^{n} W_i)$
(E)$X = (\sum_{i=1}^{n} a_i W_i C_i)/(\sum_{i=1}^{n} W_i C_i)$, $Y = (\sum_{i=1}^{n} b_i W_i C_i)/(\sum_{i=1}^{n} W_i C_i)$

A-4 (複選題) 下列關於預測方法及其特性的敘述何者正確?
(A)若採簡單移動平均法，則較小的 n 值將會對預測值造成**較大的**波動
(B)若採加權移動平均法且 $n = 5$，則預測值**有可能**大於過去五期的實際值
(C)比較兩種漸減的直線方程式$(Y_1 = a + b_1 t$ 及 $Y_2 = a + b_2 t)$所做的預測值、已知 $b_1 > b_2$，則 Y_2 預測值有**較大的**波動
(D)以時間序列資料為基礎的各種預測方法，其預測值無法考慮未來事件的影響
(E)採指數平滑法預測時，若設定不同的初始預測值，則對最終的預測值必會造成差異，但隨著歷史資料量逐漸的增加，其差異將會逐漸減小

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　　　　　　　　　　　　科目：生產管理

A-5 (複選題) 某產品以 A 機器進行加工，標準工時為 Q (小時/件)，不良率為 p%。不良品需再經 B 機器進行修復，標準工時為 R (小時/件)，不良率為 q%。若修復成功則視為良品、若修復不成功則報廢。A 機器與 B 機器每年的有效產能均為 N (小時/年)，該產品年出貨量為 M (件/年)。下列有關該生產系統的敘述何者正確？

(A)系統產出率為：$1 - p\%q\%$

(B)該年報廢總量為：$(Mp\%q\%) / (1 - p\%q\%)$

(C) A 機器所需的機器數(理論值)為：$(MQ) / N$

(D) B 機器所需的機器數(理論值)為：$(MRp\%) / N(1 - p\%q\%)$

(E)達到出貨量需求之下，系統所需投入生產的數量為：$M / (1 - p\%q\%)$

A-6 (複選題) 下列有關整合規劃(Aggregate Planning)的敘述何者正確？

(A)以 Chase Demand 及 Level Output 兩策略做比較：若採用 Chase Demand 策略，則系統會產生較多的庫存

(B)以 Chase Demand 及 Level Output 兩策略做比較：若公司經常解雇及聘雇員工，則該公司較傾向 Chase Demand 策略

(C)增加臨時工(Part-time Worker)是屬於產能調整(Capacity Options)的選項

(D)採用延期交貨(Back Orders)是屬於需求調整(Demand Options)的選項

(E)整合規劃問題可以運用線性規劃(Linear Programming)模型以求解最小成本

A-7 (複選題) 生產線在原料充分供給下正常生產，有關生產線平衡的方法及生產線運作的現象，下列敘述何者正確？

(A) 各種生產線平衡技術所安排的生產線，均遵守先行作業要求並可達到期望的產出量

(B) 各種生產線平衡技術所安排的生產線，均可以達到理論上的最佳解

(C)指派作業單元(Task)時，必需確保該工作站的總作業時間不可超出規劃週期時間(Target Cycle Time)

(D)實際生產時，生產線瓶頸工作站之後的工作站，可能有閒置時間

(E)實際生產時，生產線中工時最長的工作站，其使用率有可能達 100%

第二部分： 共三題

1. 經濟生產批量模式(Economic Production Quantity, EPQ)中須考慮存貨持有成本 (holding cost)及準備作業成本(setup cost)，若年需求量 D，每次的準備作業成本為 S，每件存貨每年的持有成本為 H，每日產品的生產率(production rate)為 p，每日產品的需求率為 d，試問年存貨持有成本為何？年準備作業成本為何？請推導出經濟生產批量的計算公式。(20 分)

2. 有五個工作(job)都必須經由兩個工作站加工，且都須先經工作站 1 加工後，再經工作站 2 加工，作業時間如下表，試問最短完工時間為何？工作站 2 的閒置時間為何？(15 分)

工作(job)	A	B	C	D	E
工作站 1	2	4	4	5	6
工作站 2	3	5	3	5	6

3. 某專案的作業(Activity)、先行作業(Predecessor)、及作業時間(Duration)如下表所示，試劃出 AOA 圖，並找出關鍵路徑為何，並說明那些作業有寬裕時間(slackness)，其寬裕時間個為何？(15 分)

Activity	Predecessor	Duration
A	--	1
B	--	4
C	A	1
D	B	5
E	B	2
F	C,D,E	7
G	D	2
H	F,G	3
end		--

(You need to define and explain your notations clearly. Points are granted only if detail computations are presented.)

1. (25%) Consider the following problem:

$$\max \quad Z = 10\,x_1 + 15\,x_2$$
$$\text{s.t.} \quad 4\,x_1 + 8x_2 \le 32$$
$$x_1 - 2\,x_2 \ge 2$$
$$x_1, x_2 \ge 0.$$

(a) Formulate the corresponding dual problem. (5%)

(b) Compute all the complementary basic solutions of the primal and dual problems. (12%)

(c) Based on (b), what is the optimal solution by applying strong duality property. (8%)

2. (25%) A transportation company has to select the daily routes from six possible routes to serve the demand points (A~G). The company has only **three** vehicles available for the transportation and aim to minimize the total cost. Demand point F has to be served at least twice a day, but the remaining demand points ({A,B,$\cdots$,G}\F) have to be served at least once a day. The information of routes and the corresponding costs is as follows:

- Route 1: A→B→C→G, $12
- Route 2: B→D, $6
- Route 3: C→E, $8
- Route 4: D→E→F, $9
- Route 5: A→B→C→D→F→G, $15
- Route 6: E→F→G, $10

(a) Formulate this problem. (8%)

(b) When a route is selected, a setup cost $10 will incur. Explain how to modify the model in (a). (5%)

(c) If route 2 is selected, either route 5 or route 6 must be selected. Show how to modify the model in (a)? (5%)

(d) If route 3 is selected, route 5 and route 6 is not allowed to coexist. Show how to modify the model in (a)? (7%)

1

3. (20%) You are an umbrella seller. The number of umbrella you sold each day depends on the weather of that day. If it rains, you sell 100 umbrellas that day. If it does not rain, you sell 50 umbrella that day. Let us classify weather of a day as rainy (R) and not rainy (N). Let X_n be weather of day n. Assume that $\{ X_n, n=1,2,... \}$ is a Markov chain with the following transition probability matrix. Find the expected number of umbrellas you sell in a day in steady state.

$$\begin{bmatrix} & R & N \\ R & 2/5 & 3/5 \\ N & 1/2 & 1/2 \end{bmatrix}$$

4. (30%) Consider a M/M/2/4 queue with inter-arrival time being Exp(2) and service time being Exp(1).

   (a) Draw a transition rate diagram of this queue. (10%)

   (b) Find the expected number of jobs in the system (10%)

   (c) Find the expected time a job in the system (10%)

2