Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	MANAGEMENT SCIENCE II
COURSE CODE	:	BPB 20603
PROGRAMME CODE	:	BPA
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK** 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) A dairy company makes cheese to supply to stores in its area. The dairy can make 250 kg of cheese per day (365 days per year), and the demand at area stores is 180 kg per day. Each time the dairy makes cheese, it costs RM125 to set up the production process. The annual cost of carrying a pound of cheese in a refrigerated storage area is RM12.

(i) Calculate the production lot size.

(3 marks)

(ii) Compute the minimum total annual inventory cost.

(3 marks)

(b) A large distributor of oil-well drilling equipment operated over the past two years with EOQ policies based on an annual holding cost rate of 22%. Under the EOQ policy, a particular product has been ordered with a $Q^* = 80$. A recent evaluation of holding costs shows that because of an increase in the interest rate associated with bank loans, the annual holding cost rate should be 27%.

Determine the new economic order quantity for the product.

(4 marks)

(c) A city manager and the chief of police agreed on the size of the police force necessary for normal daily operations. However, they need assistance in determining the number of additional police officers needed to cover daily absences due to injuries, sickness, vacations, and personal leave. Records over the past three years show that the daily demand for additional police officers is normally distributed with a mean of 50 officers and a standard deviation of 10 officers. The cost of an additional police officer is based on the average pay rate of $150 per day. If the daily demand for additional police officers exceeds the number of additional officers available, the excess demand will be covered by overtime at the pay rate of $240 per day for each overtime office

(i) If the number of additional police officers available is greater than demand, the city will have to pay for more additional police officers than needed.

Find the cost of overestimating demand.

(2 marks)

(ii) If the number of additional police officers available is less than demand, the city will have to use overtime to meet the demand.

Find the cost of underestimating demand.

(2 marks)

(iii) Determine optimal number of additional police officers that should be included in the police force.

(6 marks)

Q2 Rocky's TV Productions is considering producing a pilot for a comedy series in the hope of selling it to a major television network. The network may decide to reject the series, but it may also decide to purchase the rights to the series for either one or two years. At this point in time, Rocky may either produce the pilot and wait for the network's decision or transfer the rights for the pilot and series to a competitor for RM100,000. **Table Q2** shows Rocky's decision alternatives and profits (in thousands of ringgit Malaysia).

Table Q2: Payoff table of Rocky's TV Productions

	State of Nature		
Decision Alternative	Reject, s_1	1 year, s_2	2 years, s_3
Produce pilot, d_1	-100	50	150
Sell to competitor, d_2	-100	100	100

The probabilities for the states of nature are $P(s_1) = 0.20, P(s_2) = 0.30$ and $P(s_3) = 0.50$. For a consulting fee of \$5000, an agency will review the plans for the comedy series and indicate the overall chances of a favorable network reaction to the series. Assume that the agency review will result in a favorable (F) or an unfavorable (U) review and that the following probabilities are relevant:

$$P(F) = 0.69 \qquad P(s_1 \mid F) = 0.09 \qquad P(s_1 \mid U) = 0.45$$
$$P(U) = 0.31 \qquad P(s_2 \mid F) = 0.26 \qquad P(s_2 \mid U) = 0.39$$
$$P(s_3 \mid F) = 0.65 \qquad P(s_3 \mid U) = 0.16$$

(a) Construct a decision tree for this problem.

(2 marks)

(b) Determine the recommended decision if the agency opinion is not used.

(3 marks)

(c) Compute the expected value of perfect information

(2 marks)

(d) Determine Rocky's optimal decision strategy assuming the agency's information is used.

(8 marks)

(e) Calculate the expected value of the agency's information.

(2 mark)

(f) Find the maximum fee that Rocky should pay for the agency's information.

(1 mark)

(g) Determine the final recommended decision for Rocky's TV Production.

(2 marks)

Q3 Sunrise Bakery has decided to bake 20 loaves of its famous sourdough bread every day. Each loaf costs Sunrise RM1.50 and can be sold for RM3.00. Sunrise can sell any unsold loaves for RM0.75 the next day. The store has determined that daily demand will follow the distribution as shown in **Table Q3(a)**:

Table Q3(a): Demand probability distribution

Daily Demand	Probability
5	0.08
10	0.12
15	0.25
20	0.20
25	0.20
30	0.15

Table Q3(b) shows ten random numbers:

Table Q3(b): Random numbers

No.	Random number
1	0.8689
2	0.7369
3	0.7235
4	0.2098
5	0.1132
6	0.3762
7	0.9505
8	0.1591
9	0.4832
10	0.4834

(a) Construct intervals of random numbers.

(2 marks)

(b) Simulate 10 days demand by using the results in **Q3(a)** and **Table Q3(b)**.

(2 marks)

(c) Calculate Sunrise Bakery's total profit for 10 days using the results in **Q3(b)**.

(16 marks)

Q4 (a) A teacher has breakfast at a restaurant every morning. He either orders a coffee or a tea. He never orders coffee on two consecutive days, but if he does order tea one day, then the next day he can order tea or coffee with equal probability.

Tabulate the matrix of transition probabilities.

(4 marks)

(b) **Table Q4(b)** shows the transition matrix for switching political parties in an election year, where Democrats, Republicans, and Independents are denoted by the letters D, R, and I, respectively.

Table Q4(b): Transition matrix for switching political parties

	Next election		
This election	D	R	I
D	0.6	0.3	0.1
R	0.3	0.6	0.1
I	0.2	0.2	0.6

Find the probability of a Democrat voting Republican in the second election.

(6 marks)

(c) A survey of Asian car buyers indicates that if a person buys a Honda, there is a 60% chance that their next purchase will be a Honda, while owners of a Mazda will buy a Mazda again with a probability of 0.80. **Table Q4(c)** shows the transition matrix of the buying habits of these consumers

Table Q4(c): Transition matrix buying habits

	Next purchase	
Present purchase	Honda	Mazda
Honda	0.6	0.4
Mazda	0.2	0.8

Compute the steady-state probabilities.

(10 marks)

Q5 A company producing torches is negotiating with a company for the supply of torch bulbs. The bulb company therefore needs to plan its production to meet the needs of the torch company and thus uses that company's quarterly demand over the past three years to forecast future demand. **Table Q5** shows the sales figures of 2019 to 2021.

Table Q5: Quarterly sales figures of 2019-2021 (in thousands)

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2019	349	295	196	389
2020	447	418	324	456
2021	550	528	415	615

Calculate the forecasted demand for four quarters of 2022 using trend regression line and seasonal variation factors through moving average technique.

(20 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

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Forecasting

Let

$$S_{xy} = \sum_{i=1}^{n} x_i y_i - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right), \quad S_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2 \text{ and } S_{yy} = \sum_{i=1}^{n} y_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} y_i\right)^2$$

Simple linear regression model

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$$

where

$$\hat{\beta}_1 = \frac{S_{xy}}{S_{xx}}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

Coefficient of Determination

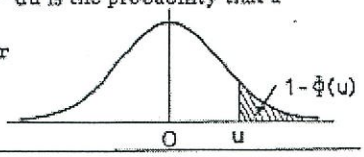
$$r^2 = \frac{\left(S_{xy}\right)^2}{S_{xx} \cdot S_{yy}}$$

Coefficient of Pearson Correlation

$$r = \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$$

AREAS IN TAIL OF THE NORMAL DISTRIBUTION

The function tabulated is $1 - \Phi(u)$ where $\Phi(u)$ is the cumulative distribution function of a standardised Normal variable u. Thus $1 - \Phi(u) = \frac{1}{\sqrt{2\pi}} \int_u^\infty e^{-u^2/2}\, du$ is the probability that a standardised Normal variable selected at random will be greater than a value of u $\left(= \frac{x-\mu}{\sigma}\right)$



$\frac{(x-\mu)}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
3.0	.00135									
3.1	.00097									
3.2	.00069									
3.3	.00048									
3.4	.00034									
3.5	.00023									
3.6	.00016									
3.7	.00011									
3.8	.00007									
3.9	.00005									
4.0	.00003									