[1] **[15 Marks]**

Bat cave gates: Group 1 = No gate (NG); Group 2 = Straight entrance gate (SE); Group 3 = Angled entrance gate (AE); Group 4 = Straight dark zone gate (SD), and Group 5 = Angled dark zone gate (AD). Hypothetical data for bat flight speed with various gate arrangements. FS= Flight speed; sd = standard deviation. Assume dF=4. Calculate: (i) between SS; (ii) within SS; (iii) between MS; (iv) within MS; (v) F-ratio, and (vi) your comment about rejecting or accepting the null hypothesis.

Group # i	Gate Type	Mean FS (m/s)	Sd FS(m/s)	n_i
1	NG	5.6	0.93	150
2	SE	3.8	1.05	150
3	AE	4.7	0.97	150
4	SD	4.2	1.23	137
5	AD	5.1	1.03	143

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[2] **[15 Marks]**

ICs Corporation has the capability of producing four types of products. Each product must be subjected to three processes: injection, packing and inspection. The plant manager desires to maximize the profit during the next month. During the upcoming thirty days, he has 800 machine hours available on the injection, 1000 hours on the packing and 340 man-hours of inspection time. The problem is formulated as follows: Use the simplex method to maximize $8\times X_1 + 14\times X_2 + 30\times X_3 + 50\times X_4$. Subject to:

$$X_1 + 2\times X_2 + 10\times X_3 + 16\times X_4 <= 800$$

$$1.5\times X_1 + 2\times X_2 + 3\times X_3 + 5\times X_4 <= 1000$$

$$0.5\times X_1 + 0.6\times X_2 + X_3 + 2\times X_4 <= 340$$

where X_i is the production level of the ith product; i = 1, 2, 3, 4.

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[3] **[15 Marks]**

a. Work out the covariance between x and y dimensions in the following 2 dimensional data set, and describe what the result indicates about the data:

Item Number	1	2	3	4	5
x	10	39	19	23	28
y	43	13	32	21	20

b. If X is a real valued p×n matrix; where n is the number of observations. Find the orthonormal P such that Y=P×X with Cov(Y) diagonalized.

c. Draw a flow chart of an algorithm to compute: PCA and ICA.

d. Drive mathematical expressions for the whitening process.

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[4] **[20 Marks]**

a. What are the limitations of Fourier transform.

b. Explain Hilbert transform; with the aid of mathematical expressions.

c. What are the limitations of Hilbert transform.

d. What are the properties of intrinsic mode functions?

e. State an algorithm of the sifting process.

f. Give short notes about Hilbert-Huang transform.

g. Explain the basics of Radon Transform.

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[5] **[20 Marks]**

a. We have a population of potential workers. We know that 45% are grade school graduates (G), 40% are high school grads (H), & 15% are college grads (C). In addition, 10% of the grade school grads are unemployed (U), 5% of the high school grads are unemployed (U), & 2% of the college grads are unemployed (U). Then determine the probability that a randomly selected unemployed person is a college graduate, that is, Pr(C|U).

b. Suppose $Y = X^2$ & the distribution of X is as given below. Determine the mean of Y=g(X) using two different techniques:

x	-3	-2	-1	1	2	3
P(x)	0.1	0.2	0.1	0.2	0.3	0.1

c. Given the joint distribution below, calculate E(X), E(Y), E(XY), and the correlation coefficient.

		Y		
		2	4	6
X	4	0.05	0.05	0.10
	8	0.10	0.50	0.20