所別：營建管理研究所碩士班 一般生 科目：工程經濟與統計

第一部份：工程統計（共五十分）

1. Short answer questions:（6 pts each, totally 18 pts）
   a. What is the meaning of R^2 in regression analysis?
   b. Explain the relationship between 'Central Limit Theory' and PERT.
   c. What is the statistical theory behind the 'Control Chart' method of quality control?

2. A highway tunnel is under construction using the D&B method. The total length of the tunnel is 240m. The progressing cycle is set to be 1 m. So far, 20 progressing cycles have been completed. Their respective cycle times are listed in the table below.

Unit: hour

10.8	10.2	9.8	11.4
10.6	8.6	10.6	9.2
11.8	11.4	45.5	10.2
34.0	11.6	10.2	12.8
10.2	12.0	10.4	11.2

   a. Calculate the Mean, Mode, Median and Standard deviation of the cycle time. (12 pts)
   b. With 95% confidence interval, how much more time is needed to complete the work? (8 pts)

3. 甲工地由信賴預拌廠供應 210 kgf/cm² 混凝土，下表為其抽樣試體之抗壓強度，妳（你）會考慮在妳（你）所負責的工地使用信賴預拌廠？為什麼？（12 分）

No.	取樣日期	樣品代號	平均抗壓強度（兩個試體）	No.	取樣日期	樣品代號	平均抗壓強度（兩個試體）
1	85.7.1	P5-1	246	7	85.7.2	P4-1	284
2	85.7.1	P5-2	260	8	85.7.2	P4-2	225
3	85.7.1	P7-1	255	9	85.7.3	P6-1	310
4	85.7.1	P7-2	294	10	85.7.3	P6-2	198
5	85.7.1	P3-1	305	11	85.7.3	P1-1	205
6	85.7.2	P3-2	276	12	85.7.3	P1-2	236

第二部份：工程經濟（共五十分）

1. An engineering consultant firm would like to raise funds needed for 4 anticipated engineering projects, thus resulting in only two choices for the firm: requesting bank's loan or selling a bond. The following information presents the details for these two choices:

   i. According to the creditworthiness of the corporate, the maximum amount of the best loan collected from a commercial bank reaches 1 billion dollars. This loan offers a lump sum amount one time ONLY and no more loans are available from all banks in 4 years if taking the loan. This loan has details of: 4-year loan for 1 billion dollars at the interest rate of 4%.

   ii. B-Class Bond: 10-year bond for 1 billion dollars at the interest rate of 7% paid on annual basis to the bondholders. Each bond face value is $10,000 and will be projected to sell for $12,000 in the future market. Additionally, the assisting bank charges 1% for the face value of sold bond plus 2% of the annual interest expense on the bond. The annual after-tax cost of capital for a bond can be estimated:
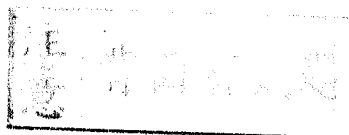
$$C_B = \frac{[Zr + (Z - P + S_e)/N + A_e](1-t)}{(Z + P - S_e)/2}$$

Where Z = face value of bond; r = bond rate (nominal interest) per year;　N = number of years until the bond is redeemed; Se = initial selling expenses associated with the bond; P = actual selling price of the bond (if P < Z, the bond sold at a discount, and if P > Z, the bond sold at a premium.) Ae = annual administrative expenses associated with the bond; t = effective (marginal) income-tax rate.

(a) Calculate <u>after-tax cost of capital of the loan</u> (5pts) and <u>bond</u> (5 pts). Assume that the tax rate is 25%.

(b) Under certain circumstances, short-term financing exhibits relatively higher risk for the firm. Financiers predict that the risk premiums for the short-term financing and bond are 2.82 % and 1.41% respectively within 10 years. The after-tax cost of capital for both choices will be affected according to the equations of:

$$c_{risk\text{-}adjusted\_Loan} = c_L + \text{risk premium}$$

$$c_{risk\text{-}adjusted\_Bond} = c_B + \text{risk premium}$$

where c is cost of capital, L stands for loan, and B stands for bond.

Determine the <u>adjusted after-tax cost of capital of the loan and bond</u> and <u>select the better choice</u> (10 pts).

2. By referring to the Question 1 mentioning the engineering projects, there are 4 anticipated projects (A, B, C, and D) exhibiting the interrelationship and cash flows as follow: i. A and C are mutually exclusive; ii. B and C are mutually exclusive; iii. At least 2 projects must be selected; iv. C is dependent on the acceptance of D.

Project	Cash flow (million dollars) for end of year k				
	0	1	2	3	4
A	-300	200	100	100	100
B	-300	300	200	100	0
C	-600	100	100	400	600
D	-500	100	200	300	400

(a) Determine <u>all possible combinations</u>. (5 pts)

(b) Using the selected cost of capital obtained in Question 1-(b), determine the <u>best capital amount allocation</u> among the combinations by utilizing the PW method. (10 pts)

(c) Assume that the general price inflation rate and the total price escalation rate are projected to be 2% and 3% respectively for the following 4 years. Using the selected cost of capital obtained in Question 1-(b), conduct the <u>actual dollar analysis</u> and <u>real dollar analysis</u> <u>for the best combination</u> (15 pts) obtained in Question 2-(b).