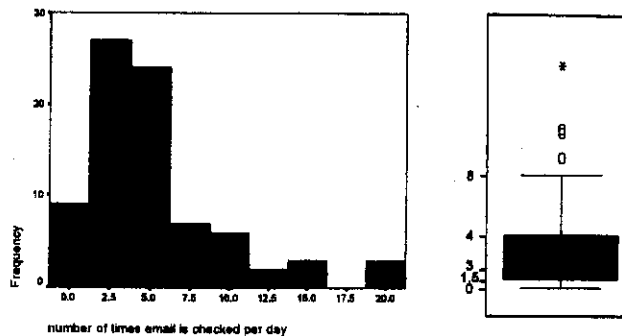編號：G 131　系所：土木工程學系丙組　　　科目：工程統計

137　　　　　　戊

本試題是否可以使用計算機：☑可使用 ， □不可使用　（請命題老師勾選）

1. A survey of 31 students was made to determine the number of times per week they checked their e-mail. Below are two of the charts from this survey. Use this to answer the following questions. (2 points each)

number of times email is checked per day

(a) What is the shape of the data? (Hint: symmetric, skewed right, or skewed left)

(b) Based on the plots, how would you rank the following three values from highest to lowest: mean ($\bar{X}$), median (m) and mode ($\hat{M}$)?

(c) Define the interquartile rage (IQR) as follows: IQR = Q_3 - Q_1. What is the value of the IQR? [Q_3=upper fourth, Q_1 =lower fourth]

(d) Use Q_3+1.5*IQR as a criteria to determine the outlier. How many outliers are there in the data?

2. Suppose the IQ's of students at Anycity College are normally distributed with standard deviation 15 and unknown mean. (2 points each)

(a) Suppose a random sample of 64 students is obtained. Find the probability that the average IQ of the students in the sample will be within 3 points of the overall mean.

(b) A sample of 64 students had a sample mean IQ of 115. Construct a 95% confidence interval for the overall mean IQ of students at Anycity College.

(c) What is the minimum sample size required if we want to estimate the overall mean IQ of students at Anycity College to within 3 points with 95% confidence?

(d) The dean boasts that the average IQ of students at Anycity College is at least 119. A sample of 64 students had a sample mean IQ of 115. Perform the appropriate test using a 5% level of significance. State your decision.

(e) Find the p-value of the test in part (d). State your decision (Fail to reject H_0 or Reject H_0 for α = 0.05.)

(f) Suppose that only 20% of the students at Anycity College have the IQ above 130. Find the overall average IQ of the students.

(g) Find the probability that the sample average IQ will be 115 or higher for a random sample of 64 students.

(h) Only students in the top 33% are allowed to join the science club. What is the

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minimum IQ required to be able to join the science club?

(i) What is the percentage of the students having IQ of 127 or above?

3. Professor Civil gives an exam in Engineering Statistics.   Professor Civil then groups the students by the number of missed lectures as follows: students missing no classes, students missing just a few classes, and students missing a lot of classes.   The results are shown below:

Lectures Missed	None	A Few	A Lot
Students' Scores	64, 57, 67, 70, 54, 62, 60	48, 59, 50, 55, 62	52, 45, 50, 57, 60, 54
n_i	7	5	6
$\bar{x}_{i\bullet}$	62	54.8	53
s_i^2	31	34.7	28

Do the data suggest that at the average scores for these three groups are not the same?

(a) State the null and alternative hypotheses. (2 points)

(b) Construct an ANOVA table. (14 points)

(c) State your conclusion at $\alpha = 0.05$. ($F_{0.05} = 3.68$) (2 points)

(d) State your conclusion at $\alpha = 0.01$. ($F_{0.01} = 6.63$) (2 points)

4. The midterm and final exam scores of 10 students in Engineering Statistics are collected.   We would like to explain the final score (Y) as a linear function of the midterm exam score (X).   For the data, $\bar{X} = 74.5$, $\bar{Y} = 86.8$; $S_{xx} = \sum(X - \bar{X})^2 = 414.5$; $S_{YY} = \sum(Y - \bar{Y})^2 = 607.6$ and $S_{XY} = \sum(X - \bar{X})(Y - \bar{Y}) = 421$. (4 points each)

(a) State the assumptions of the linear regression model.

(b) Estimate the coefficients of the regression model.

(c) Calculate an estimate of MSE (σ^2). (Hint: SSE $= S_{YY} - [(S_{XY})^2/S_{XX}]$)

(d) Complete the ANOVA table for this regression model.

(e) Using the ANOVA table, make your conclusion.   Make sure to include in your answer the null and alternative hypotheses. ($F_{0.05} = 5.32$)

5. A college professor never finishes his lecture before the bell rings to end the period and always finishes his lectures within 2 min after the bell rings.   Let X = the time that elapses between the bell and the end of the lecture and suppose the pdf of X is

$$f(x) = \begin{cases} k \cdot x^2, & 0 \leq x \leq 2 \\ 0, & \text{otherwise} \end{cases}$$ (2 points each, except (b) equal to 6 points)

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(a) Find the value of k which makes f(x) a legitimate pdf.

(b) Find the cumulative distribution function, F(X)? F(0)=?, F(1)=?, F(2)=?

(c) Find the 90th percentile of X

(d) Find the median of X

(e) Find the expected value of X

(f) Find the variance of X

6. Four different treatments are compared, and the test results are as follows:

Treatment	n_i = number of data	$\bar{x}_i$	s_i
1	100	10.5	1.5
2	90	10.0	1.3
3	100	10.1	1.8
4	120	10.7	1.6

Let μ_i = the true average after the ith treatment. Let $\theta = \frac{1}{3}(\mu_1 + \mu_2 + \mu_3) - \mu_4$ be the parameter to measure the difference in true average between overall treatments of 1, 2, 3, and treatment of 4. (5 points each)

(a) Compute the 95% confidence interval for the estimator $\hat{\theta}$, and

(b) According to your answer in (a), does there exits any significant difference between overall treatments of 1, 2, 3, and treatment of 4? Why?

7. In each of the following cases, decide whether the given function is intrinsically linear. Briefly explain your answer. (2 points each)

(a) $y = 1/(\alpha + \beta x)$,

(b) $y = 1/(1 + e^{\alpha + \beta x})$,

(c) $y = e^{\alpha + \beta x}$

(d) $y = \alpha + \beta e^{\lambda x}$

Values Provided for Your Calculations
Normal Distribution

z	-2.13	-1.28	0.44	0.64	0.84	1.6	1.64	1.96
$\Phi(z)$	0.0166	0.1003	0.67	0.7389	0.8	0.9452	0.95	0.975