1.

A concrete specification recognizes the statistic natural of quality control for two conditions:

(1) No more than 10 percent of samples tested may fall more than 10 percent below the specific strength

(2) No more than 25 percent of samples tested may fall below the specific strength.

Assume ten tests are conducted and coefficient of variation V = 20%. Please determine the design strength to satisfy the specific strength of 300 kg/cm^2. (10 points)

Values Provided for Your Calculations

Student t Distribution

DF	Upper-Tail Area α				
	0.025	0.05	0.1	0.125	0.25
10	2.228	1.812	1.372	1.117	0.689
9	2.262	1.833	1.383	1.129	0.703

Normal Distribution

z	0.8	1.28	1.64
Φ(z)	0.79	0.9	0.95

2.

Three types of construction machine (i.e., A, B and C) are evaluated for their performance on the same construction jobs. Their productivity is shown as follows:

Job #	A	B	C	
1	5	2	3	
2	4	2	2	
3	5	3	2	
4	4	2	2	
Average	4.5	2.25	2.25	Overall mean = 3

(1) You are asked to complete the following ANOVA table: (10 points)

Source	SS	DF	MS	F	Table F
SSTR	(a)	(d)	(g)	(i)	4.26
SSE	(b)	(e)	(h)		
SSTO	(c)	(f)			

(2) Please perform the test H_o: $\mu_A = \mu_B = \mu_C$ *vs.* H_1: not all μ_A, μ_B and μ_C equal zero at the level of confident 95%. What is your conclusion? (5 points)

(3) Please construct three confidence intervals (C.I.) for the matched-pair difference $\mu_A - \mu_B$, $\mu_A - \mu_C$, $\mu_B - \mu_C$ at the level of confident 95%. (5 points)

(4) What information is provided by above C.I.? You need to answer whether $\mu_A = \mu_B$, $\mu_A = \mu_C$, or $\mu_B = \mu_C$. (5 points)

3.

(1) Suppose the relationship between applied stress (X) and time-to-failure (Y) is described by a simple linear regression model. Please use the matrix approach to find the line of best fit, $Y = b_0 + b_1X$, for the following data: (5 points)

Y (sec) = 1 2 3

X (MPa) = 4 4 6

(2) Please calculate the variability of results, $s_{Y \cdot X}$. (5 points)

(3) What is the probability that time-to-failure (Y) exceeds 2.81 seconds when applied stress X = 5 MPa. (5 points)

(背面仍有題目,請繼續作答)

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4.

The safety of a building in an earthquake-prone area is under consideration. The past 100 years of data indicate that there were five strong earthquakes in the area. Also a detailed evaluation shows that during a strong earthquake, the probability that the building will suffer damage is 0.2. Assume that damage events for different earthquakes are statistically independent.

(1) Please use the Poisson distribution to determine the probability that there will be no strong earthquake in the area in 60 years. (5 points)

(2) What is the probability that there will be only 3 strong earthquakes in 60 years? (5 points)

(3) What is the probability that the building will suffer damage due to strong earthquakes in 60 years? (5 points)

Hint: Poisson Distribution : $P(x;\lambda,t)=P(X=x)=\frac{(\lambda t)^x e^{-\lambda t}}{x!}$ $x=0,1,2,...$

5.

(1) What are the correct statements? (a) A Poisson distribution is to deal with the number of occurrences of an event over a specific interval of time or space. (b) An exponential distribution is to deal with the occurring time between events. (c) The gamma distribution can provide wide class of specific distributions. (d) The *t* distribution has a thicker tail than the normal distribution. (e) The χ^2 distribution is positively skewed. (6 points)

(2) A regression line is as follows: $Y = a + b{\cdot}X$ with the coefficient of correlation r_1 and the variability of results $s_{Y{\cdot}X}$. For the same set of data, another regression line is found to be as follows: $X = c + d{\cdot}Y$ with r_2 and $s_{X{\cdot}Y}$. What are the correct statements? (a) $r_1 = r_2$, (b) $a = c/d$, (c) $b = -1/d$, (d) both lines pass the average point $(\overline{X}, \overline{Y})$, (e) $s_{Y{\cdot}X} = s_{X{\cdot}Y}$. (6 points)

(3) A multiple regression model was built to investigate the effect of an ingredient (X_1) on the yield (Y). An indicator variable (X_2) was used to represent the catalyst with 1 being present and 0 being absent. The following estimated multiple regression equation applied: $\hat{Y}=1+2X_1+3X_2+4X_1X_2$. When the catalyst is present, the yield regression is as follows: $\hat{Y}=$ __(i)__ + __(ii)__ X_1. Please find the answer for (i) and (ii) (6 points)

(4) To estimate the mean of a particular population with known standard deviation σ =32, an investigator takes a random sample and computes the 80% confidence interval, $97.22 \le \mu \le 102.56$. What sample size (n) should the investigator take? n = _____ (5 points)

(5) What are the correct statements regarding the statistical process control? (a) The spread for natural tolerance of a material is 4σ. (b) Products that are within control limits do not necessarily meet the specification limits. (c) The phrase of 'in-control' means that products are all made of good quality as long as they stay within 'in-control'. (d) Control charts are designed to identify the chance causes. (e) 'Good' control charts do not indicate that 'good' product. (6 points)

(6) Consider the following statements: (I) Acceptance of a null hypothesis implies that a hypothesis is true. (II) The null hypothesis is usually the one that researchers usually believe to be false. (III) A null hypothesis is a statement asserting no change, or no difference, or no effect. (IV) Most often, the null hypothesis is the one for which erroneous rejection is the more serious consequence. What are the true statements? (6 points)