

國立成功大學

113學年度碩士班招生考試試題

編 號：100

系 所：土木工程學系

科 目：工程統計

日 期：0201

節 次：第 3 節

備 註：可使用計算機

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. The probability mass function for X = the number of major additives in a randomly selected sample of cement concrete is as follows: (5 points each)

X	0	1	2
$P(x)$	0.3	0.4	0.3

- (1) Compute $E(X)$, $E(X^2)$, and $V(X)$.
 - (2) If the price of a concrete sample containing major additives X is $(20X-5)$, what is the expected price paid by the customer?
 - (3) What is the variance of the price $(20X-5)$ paid by the customer?
 - (4) The actual strength of a concrete sample is $(X-0.01X^2)$. What is the expected strength?
2. Let X be a continuous random variable with the probability density function (pdf) below. (5 points each)

$$f(x) = \begin{cases} e^x & \text{for } 0 < x < k \\ 0 & \text{otherwise} \end{cases}$$

- (1) Find the value of k .
 - (2) Find the cumulative density function, $F(x)$.
 - (3) Find $P(X \leq 0.1)$.
 - (4) Find the median of the distribution of X .
3. Assume that the helium porosity (in percentage) of coal samples taken from any particular seam is normally distributed with true standard deviation 0.75. (5 points each)
- (1) Compute a 95% confidence interval (CI) for the true average porosity of a certain seam if the average porosity for 20 specimens from the seam was 4.85.
 - (2) Compute a 98% CI for true average porosity of another seam based on 16 specimens with a sample average porosity of 4.56.
 - (3) How large a sample size is necessary if the width of the 95% interval is to be 0.40?
 - (4) What sample size is necessary to estimate true average porosity to within 0.2 with 99% confidence?

Values Provided for Your Calculations

z	1.96	2.06	2.33	2.58	$t_{0.025, 4}$	$t_{0.05, 5}$	$F_{0.05, 2, 10}$	$F_{0.05, 1, 10}$	$F_{0.05, 1, 9}$	$F_{0.05, 3, 22}$	$F_{0.05, 2, 22}$	$F_{0.05, 2, 21}$
$\Phi(z)$	0.975	0.98	0.99	0.995	2.776	2.015	4.10	4.96	5.12	3.02	3.44	3.47

4. In a laboratory experiment, the compressive strength of a certain material when it was mixed with three different types of additives was measured. Eight specimens were tested for each type of additive. A higher strength implies that the additive is better. An ANOVA table is obtained as follows:

Source	SS	DF	MS	F
Between	56	b=?	e=?	g=?
Within	a=?	c=?	f=?	
Total	119	d=?		

- (1) Complete the ANOVA table. (14 points)
 - (2) State the null and the alternative hypothesis for the ANOVA table. (3 points)
 - (3) What is the conclusion based on the ANOVA table using the F-statistic and $\alpha=0.05$. (3 points)
5. A study was undertaken to relate the viscosity (y) to the filler content (x) for a particular material. A total of 11 pairs of values were measured. A simple linear regression model of the form $y = \beta_0 + \beta_1 x + \varepsilon$ was first fitted to the data. An ANOVA table is obtained for this regression model as follows:

Source	SS	DF	MS	F
Regression	a=?	b=?	e=?	g=?
Error	0.27	c=?	f=?	
Total	1.41	d=?		

- (1) Complete the ANOVA table for this regression model. (14 points)
- (2) Using the ANOVA table for this regression model, make your conclusion at $\alpha = 0.05$. Make sure to include in your answer the null and alternative hypotheses. (3 points)
- (3) What percent of the observed variation in the viscosity can be attributed to the linear relationship between viscosity and filler content? (3 points)