系所組別： 土木工程學系丙、戊組

考試科目： 工程統計

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. Each front tire on a particular vehicle is supposed to be filled to a pressure of 26 psi. Suppose the actual air pressure in each tire is a random variable – X for the right tire and Y for the left tire, with joint pdf: (4 points each)

$$f(x,y)=\begin{cases} k\cdot(x^2+y^2), & 20\le x\le 30,\ \ 20\le y\le 30 \\ 0, & \text{otherwise} \end{cases}$$

(1) What is k value?

(2) What is the probability that both tires are underfilled?

(3) What is probability that the difference in air pressure between the two tires is at most 2 psi?

(4) Determine the marginal distribution of air pressure in the right tire alone.

(5) Are X and Y independent random variables?

Values Provided for Your Calculations

z	-1.00	1.67	1.64	1.96	$t_{0.025,24}$	$t_{0.025,25}$	$t_{0.025,26}$	$t_{0.025,27}$	$F_{0.05,4,26}$	$F_{0.05,4,25}$	$F_{0.05,5,26}$
Φ(z)	0.1587	.9525	0.95	0.975	2.064	2.060	2.048	2.045	2.55	2.76	2.60

2. Suppose the strength of a particular material is normally distributed with mean 70 MPa and standard deviation 3 MPa. (4 points each)

(1) If a specimen is only acceptable only if its strength is between 67 and 75, what is the probability that a randomly selected specimen has an acceptable strength?

(2) If the acceptable range of strength is (70 – c, 70 + c), for what value of c would 95% of all specimens have acceptable strength?

(3) If the acceptance range is as in part (1) and the strength of each of ten randomly selected specimens is independent determined, what is the expected number of acceptable specimens among the ten?

3. Let X_1, X_2, X_3, X_4 and X_5 represent the time necessary to perform a construction job for each of five groups consisting of six workers. The average time (hour) required to finish the job is listed as follows:

$\bar{x}_{1\bullet}=2.58$, $\bar{x}_{2\bullet}=2.63$, $\bar{x}_{3\bullet}=2.13$, $\bar{x}_{4\bullet}=2.41$ and $\bar{x}_{5\bullet}=2.49$. Assuming that $\sum\sum x_{ij}^2=183.4$ and $\sum x_{i\bullet}^2=1084.26$.

(1) Construct an analysis of variance (ANOVA) table. (8 points)

(2) State your null hypothesis, and test the hypothesis using a 0.05 level of significance. (2 points)

(3) Construct a 95% confidence interval (CI) for $\theta=\mu_1-(\mu_2+\mu_3+\mu_4+\mu_5)/4$. (4 points)

(4) Following (3), what conclusion would you make regarding the difference between the average time for group 1 and the combined average for the four other groups? Why? (2 points)

4. Two distinct materials (i.e., A and B) are evaluated for their tensile strength for a construction job. The strength data are shown on the next page. Do the accompanying data support the research hypothesis that the mean strength is higher for A than for B? Test the appropriate hypothesis using a 0.05 significance level. (7 points)

(背面仍有題目,請繼續作答)

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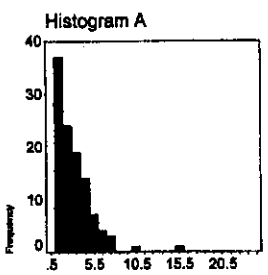
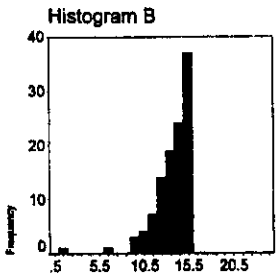
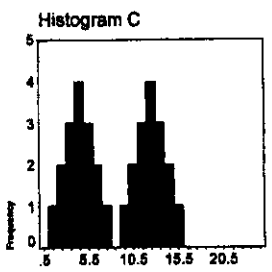
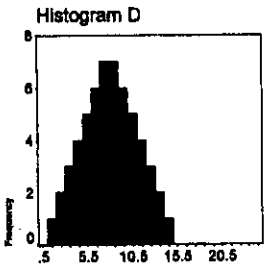
Type	Sample size	Sample mean (MPa)	Sample SD (MPa)
A	97	10.40	4.83
B	148	9.26	4.68

5. Find the best answer for each question. (3 points each)







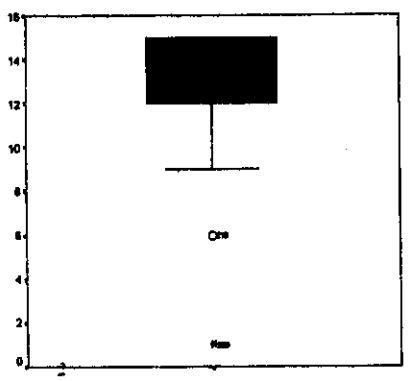


Use the above histograms to answer the next three problems

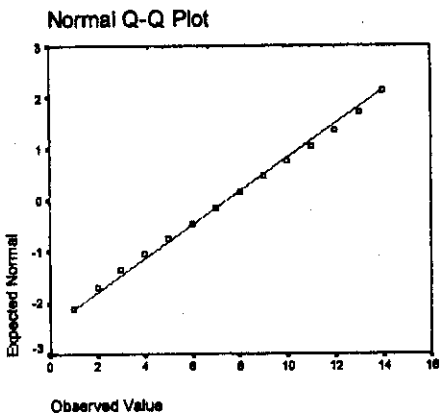
(1) Which of the histograms matches the box plot given below?

(2) Which of the histograms matches the normal plot given below?

(3) For the variable being described by histogram A, is the mean value larger or smaller than the median value?



Question (1)



Question (2)

(4) Suppose that $2\hat{\theta}_1$, $\hat{\theta}_2/5$ and $\hat{\theta}_3/4$ are the unbiased estimators of the parameter θ. We know that $E(2\hat{\theta}_1)=E(\hat{\theta}_2/5)=E(\hat{\theta}_3/4)=\theta$, $Var(\hat{\theta}_1)=10$, $Var(\hat{\theta}_2)=12$ and $Var(\hat{\theta}_3)=16$. Which of the following is the minimum variance unbiased estimator for θ? (a) $\hat{\theta}_2/5$ (b) $\hat{\theta}_3/4$ (c) $\hat{\theta}_1/2$ (d) $2\hat{\theta}_1$ (e) $\hat{\theta}_2$

(5) Let $X_1, X_2, \ldots, X_{2n}$ be a random sample from a population with the mean μ and standard deviation σ. Which of the following is the $E\left(\frac{1}{2n}\sum_{i=1}^{2n}X_i\right)$? (a) $\mu/(2n)$ (b) $\mu/2$ (c) μ (d) 2μ (e) $2n\mu$

(6) Let $X_1, X_2, \ldots, X_{2n}$ be a random sample from a population with the mean μ and standard deviation σ. Which of the following is the $Var\left(\frac{1}{2n}\sum_{i=1}^{2n}X_i\right)$? (a) $\sigma 2/(2n)$ (b) $\sigma 2/n$ (c) $n\sigma 2$ (d) $2n\sigma 2$ (e) We need to know the covariance of X's to answer

(7) A sample of 10 NCKU students is randomly selected. Which of the following is NOT a discrete random variable? (a) V = the number of majors represented in the sample. (b) W = the number of CDs owned by members of the sample (c) X = the total number of textbooks purchased by the sample members this semester. (d) Y = the height of the tallest member of the sample. (e) Z = the number of girl (boy) friends associated with the sample

(8) A(n) _____ is computed from a sample whereas a(n) _____ is associated with a population. (a) parameter, statistic, (b) parameter, bias (c) bias, statistic (d) statistic, parameter (e) estimate, deviation (f) deviation, estimate.

(9) An engineer concludes that a difference in sample is statistically significant at the 1% level. What is the correct statement? (a) The p-value for H_0 is more than 1%. (b) The difference would not be statistically significant at the 5% level. (c) If there were no difference in the population means, the chance of getting such a difference in the sample mean is 1% or less. (d) Statistical significance does imply practical significance. (e) The p-value for H_0 is more than 5%.

(10) If the P-value is computed as 0.38 where α=0.05 and $\mu = 99$, for the hypothesis $H_0 : \mu \geq 100$ versus $H_a : \mu < 100$, what type of error you might have made? (a) Type I error (b) Type II error (c) No error

(11) The following choices list some changes that are made to the sample statistics. The null/alternative hypothesis pair is: Ho: $\mu < \theta$; Ha: $\mu > \theta$ where θ is some hypothesized value for the population average. Given the choices below, those that would certainly result in a decrease in the P-value is(are) (a) $\bar{x}$ increases, n remains the same, s remains the same. (b) $\bar{x}$ decreases, n increases, s remains the same, (c) $\bar{x}$ decreases, n remains the same, s increases, (d) The P- value would decrease in the situations described in A and B, (e) The P- value would decrease in situations A, B, and C

(12) What is the correct range of the p–value for testing H_0: μ = 17 vs. Ha: $\mu \neq 17$ given the three confidence intervals for μ below? 90%: (14.99, 16.61), 95%: (14.83, 16.77), 99%: (14.48, 17.12), (a) p–value > 0.10, (b) 0.10 > p–value > 0.05, (c) 0.05 > p–value > 0.01 (d) p–value < 0.01 (e) You need a test statistic value to determine the p–value

(13) Suppose W , X , Y are independent random variables, E(W) = 5, Var(W) = 4, E(X) = 4, Var(X) = 9, E(Y) = 7, SD(Y) = 4. Let U = 8 + 2 W – 5 X + 3 Y. Find E(U) and Var(U).

(14) The following 95% simultaneous confidence intervals (CI) are obtained on the 4 different temperatures in an experiment. Which of the following four statements do you think describes the relationship between μ1, μ2, μ3, and μ4? (a) μ3=μ4 . μ1 and μ2 differ from μ3 and μ4. (b) μ1=μ2=μ3, and μ4 differs from μ1, μ2, and μ3. (c) μ2=μ4. μ2 and μ4 differ from μ1 and μ3. (d) μ1=μ3=μ4, and μ2 differs from μ1, μ3, and μ4. (e) All four μ's are different from one another.

Difference	μ_1- μ_2	μ_1- μ_3	μ_1- μ_4	μ_2- μ_3	μ_2- μ_4	μ_3- μ_4
CI	(-0.5,-0.1)	(-0.3,-0.2)	(0.2, 0.5)	(0.1, 0.5)	(-0.1, -0.4)	(0.2, 0.4)

(15) A mail-order computer business has six telephone lines. Let X be the number of lines in use at a specified time. Which of the following can be a legitimate pmf for X?

x	0	1	2	3	4	5	6
(a): p(x)	0.1	0.2	0.2	0.1	0.05	0.2	0.15
(b): p(x)	0.3	0.2	0.05	0.05	0.20	0.10	0.15
(c): p(x)	0.10	0.25	0.20	-0.10	0.20	0.15	0.20