1. Let X_1, X_2 and X_3 represent the times necessary to perform three successive repair tasks at a mix plant. Suppose they are independent, normal random variables with expected values μ_1, μ_2, and μ_3 and variances σ_1^2, σ_2^2, and σ_3^2, respectively. (4 points each)

   (1) If $\mu_1=\mu_2=\mu_3= 60$ and $\sigma_1^2=\sigma_2^2=\sigma_3^2=15$, calculate $P(X_1+X_2+X_3 \le 200)$ and $P(150 \le X_1+X_2+X_3 \le 200)$.

   (2) Using the μ_i's and σ_i's given in part (a), calculate $P(55 \le \bar{X})$ and $P(58 \le \bar{X} \le 62)$.

   (3) Using the μ_i's and σ_i's given in part (a), calculate $P(-10 \le X_1-0.5X_2-0.5X_3 \le 5)$.

   (4) If $\mu_1=40$, $\mu_2=50$, $\mu_3=60$, $\sigma_1^2=10$, $\sigma_2^2=12$, and $\sigma_3^2=14$, calculate $P(X_1+X_2+X_3 \le 160)$ and $P(X_1+X_2 \ge 2X_3)$.

Values Provided for Your Calculations

z	-2.24	-2.11	-0.89	0.89	1.05	1.67	2.98	3.40	$Q_{0.05,3,9}$	$Q_{0.05,4,8}$
Φ(z)	0.0125	0.0174	0.1867	0.8133	0.8531	0.9525	0.9986	0.9997	3.95	4.53

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

Sample #	A	B	C	Overall average
1	1	3	4	
2	2	2	3	
3	2	4	5	
4	1	2	3	
Average	1.5	2.75	3.75	8/3

   (1) Complete the following ANOVA table: (9 points)

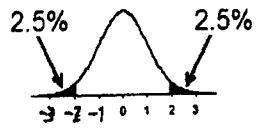
Source	SS	df	MS	F	Table F
SSTR	(a)	(d)	(g)	(i)	4.26
SSE	(b)	(e)	(h)		
SSTO	(c)	(f)			

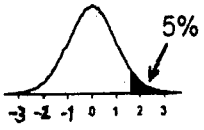
   (2) Perform the test H_o: $\mu_A = \mu_B = \mu_C$ *vs.* H_1: not all μ_A, μ_B and μ_C equal zero at the level of confident 95%. What is your conclusion? (5 points)

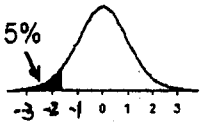
   (3) Using the Tukey's procedure to construct the simultaneous confidence intervals (CI) for the matched-pair difference $\mu_A-\mu_B$, $\mu_A-\mu_C$, $\mu_B-\mu_C$ at the level of confident 95%. (5 points) Hint: $(\bar{x}_{i\bullet}-\bar{x}_{j\bullet}) \pm Q_{\alpha,I,I(J-1)}\sqrt{\frac{MSE}{J}}$

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

3. Match the following hypotheses to the correct α=0.05 rejection region. You answer will be either A, B, or C.

A. 

B. 

C. 

(1) H_o: $\mu \le 0.01$ vs H_a: $\mu > 0.01$, (2) H_o: $\mu = 0.50$ vs H_a: $\mu \ne 0.50$, (3) H_o: $\mu \ge 0.05$ vs H_a: $\mu < 0.05$, (4) H_o: $\mu = 200$ vs H_a: $\mu \ne 200$, (5) H_o: $\mu \le 300$ vs H_a: $\mu > 300$ (2 points each)

（背面仍有題目,請繼續作答）

4. Researchers wish to study the effect of working hour (X) on productivity level (Y) in men. Following data are obtained:

X (hr)	1	1	2	2	3	3	$\bar{X}=2$	$s_x=0.89$
Y	3	4	5	7	9	8	$\bar{Y}=6$	$s_y=2.37$

(1) Find the straight line that best describes the effect of working hour on mean productivity level. (3 points)

(2) Based on this model, what mean productivity level would you predict for men whose working hour is (a) 2 hr? (b) 16 hr? (3 points)

(3) Complete the ANOVA Table for the regression model. (9 points)

(4) Calculate the standard deviation of productivity level for men whose working hour is (a) 2 hr? (b) 3 hr? (2 points)

(5) What percentage of the variation in productivity level is explained by working hour? (Hint: think about R^2 value) (3 points)

5. Find the best answer for each question. (2 points each)

Let X be a continuous random variable with the legitimate probability density function (pdf),

$$f(x)=\begin{cases} k\cdot x, & 0\le x\le 4 \\ 0, & \text{otherwise} \end{cases}$$

Answer questions (1) to (6) using this information.

(1) What is k that will make f(x) a legitimate probability density function?

(2) What is the value for the cumulative distribution function of X using the legitimate pdf when x >4?

(3) Which of the following is the 50th percentile of the random variable X using the legitimate pdf? (a) 0, (b) $1/k$ (c) $\sqrt{1/k}$ (d) $-1/k$, (e) 2

(4) Which of the following is the expected value of 3·X using the legitimate pdf? (a) k, (b) $8\cdot k$, (c) $64\cdot k/3$, (d) $24\cdot k$, (e) $64\cdot k$

(5) Is the data symmetric using the legitimate pdf ? (a)Yes, the median is the same as the mean value. (b) Yes, the median is the same as the variance. (c) No, the median is different from the mean value. (d) No, the mean value is the same as the median. (e)Hard to determine if k is unknown.

(6) What is the probability that X is at most 3 using the legitimate pdf? (a) $2\cdot k/9$, (b) $9\cdot k/2$, (c) $(2-9\cdot k)/2$, (d) $(9-2\cdot k)/2$, (e) $7\cdot k/2$

(7) What is the correct range of the p–value for testing H_0: $\mu = 17$ vs. H_a: $\mu \neq 17$ 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

(8) Which of the following are parameters? (a) $\bar{X}$, σ ; θ (b) $\bar{X}$, s, $\hat{\theta}$ (c) μ, σ, $\hat{\theta}$ (d) μ, s, θ (e) μ, σ, $\hat{\theta}$.

(9) If the P-value is 0.25, which of the following is correct? (a) Reject H_0 with α=0.10 (b) Fail to reject H_0 with α=0.30 (c) Reject H_0 with α=0.01 (d) Fail to reject H_0 with α=0.05 (e) Reject H_0 with α=0.05

(10) Is the mean height for all adult ROC males between the ages of 18 and 21 now over 175 cm? If the population of all adult ROC males between the ages of 18 and 21 has a mean height of μ cm and a standard deviation of σ cm, to answer this question one would test which of the following null and alternative hypotheses? Assuming our sample size is n. (a) $H_0 : \mu = 175$ v.s. $H_a : \mu > 175$, (b) $H_0 : \mu = 175$ v.s. $H_a : \mu < 175$, (c) $H_0 : \mu = 175$ v.s. $H_a : \mu \neq 175$, (d) $H_0 : \mu = 175$ v.s. $H_a : \mu = 175 \pm \bar{X}$, (e) $H_0 : \mu \leq 175$ v.s. $H_a : \mu > 175$

(11) Suppose you were testing H_0: μ= 5 vs H_a: μ > 5 and ended up with a p-value = 0.03. Which of the following is the best interpretation of the p-value? (a) 3% of the time we would get a rejection even though H_0 is true. (b) In repeated sampling, we would get p-values of 3% or more even though H_0 is true. (c) 3% of the time in repeated sampling, we would get sample means = 5 or more even though H_0 is true. (d) 3% of the time in repeated sampling, we would get sample means at least as large as the sample mean here even though H_0 is true. (e) none of above

(12) Which of the following BEST describes what 95% confidence means in a 95% confidence interval for μ of (7.8, 9.4)? (a) There is a 95% probability that μ is between 7.8 and 9.4. (b) In repeated sampling, μ will fall between 7.8 and 9.4 about 95% of the time. (c) In repeated sampling, about 95% of the observations will fall between 7.8 and 9.4. (d) In repeated sampling, the confidence intervals will contain μ about 95% of the time. (e) none of above

(13) In general, if you get a p-value of 0.06 and α = 0.05, which of the following will be your decision? (a) You would reject H_o (b) You would fail to reject H_o (c) You would accept H_a (d) You would accept H_o (e) You would fail to reject H_a

A study was to predict the strength of a material (y) from water percentage added to the mixture (x). The data are listed below.

Adj R-squared = 0.1966

Source	SS	df	MS	F	P
Model	654.81	1	654.81	3.20	0.111
Residual	1635.65	8	204.46		
Total	2290.50	9			

Answer questions (14) to (15) using the information above.

(14) What is the correct conclusion based on the output? (α=0.05) (a) The P-value is 0.111, so we can reject the H_0 and conclude that strength and water percentage are linearly related. (b) The P-value is 0.111, so we can fail to reject the H_0 and conclude that strength and water percentage are linearly related. (c) The P-value is 0.111, so we can reject the H_0 and conclude strength and water percentage are not linearly related. (d) The P-value is 0.111, so we can fail to reject the H_0 and conclude that strength and water percentage are not linearly related. (e) The P-value is 0.222, so we can fail reject the H_0 and conclude that strength and water percentage are not linearly related.

(15) What is the consequence of Type II error? (a) You claim that strength and water percentage are linearly related when they are not. (b) You claim strength and water percentage are not linearly related when they are not. (c) You claim strength and water percentage are linearly related when they are. (d) You claim strength and water percentage are not linearly related when they are. (e) There is no type II error.