Part I. (50%)：Problems 1~20, Multiple Choice (2.5% for each problem)
(此部份請用電腦答案卡作答)

Problems 1~6. The **next six questions** refer to the following problem setting

The probability distribution for the medical condition of an automobile accident victim upon arrival at a particular hospital is:

Outcome	Condition	Probability
O1	Fair	0.1
O2	Guarded	0.3
O3	Serious	0.4
O4	Critical	0.2

Consider the events:

T = a doctor is immediately called to examine victim = {O3, O4}

U = victim is placed on life support = {O4}

V = Victim is admitted to the hospital = {O2, O3, O4}

W= Insurance forms are completed prior to treatment = {O1, O2}

Problem 1. An accident victim will be admitted to the hospital and will have insurance forms completed prior to treatment if his/her condition is:

A. fair only
B. guarded only
C. fair or guarded only
D. fair, guarded or serious only
E. serious or critical only

Problem 2. An accident victim will be placed on life support and a doctor will be immediately called if his/her condition is:

A. guarded, serious or critical only
B. serious or critical only
C. serious only
D. critical only
E. none of the above

Problem 3. Consider the three events, T, U and V. All three of these events will occur if the patient's condition is:

A. guarded, serious or critical only
B. serious or critical only
C. serious only
D. critical only
E. none of the above

Problem 4. What is the probability that a doctor will be called in immediately?

A. 0.2
B. 0.3
C. 0.4
D. 0.5
E. 0.6

Problem 5. What is the probability that an accident victim is placed on life support or that insurance forms for the victim are completed prior to admission?

A. 0.6
B. 0.7
C. 0.8
D. 0.9
E. 1.0

Problem 6. There are six pairs of events among events T, U, V and W. Which of the six pairs of events are mutually exclusive?

A. None of the pairs of events is mutually exclusive.
B. T and U are mutually exclusive.
C. T and U, T an V, and T and W are mutually exclusive.
D. All pairs of events are mutually exclusive.
E. None of the above.

Problems 7~11. The **next five questions** refer to the following problem setting.

The following bivariate probability distribution refers to two characteristics: age and traffic violations of residents in a western city.

Age	Violations last 12 months		
	None (F1)	One (F2)	Two or More (F3)
E1: Under 18	0.23	0.12	0.05
E2: 18 or older	0.45	0.14	0.01

Problem 7. The probability that a randomly selected resident had no traffic violations in the last 12 months given that he/she is 18 or older is:

A. 0.75
B. 0.60
C. 0.45
D. 0.66
E. None of the above.

Problem 8. The probability that a randomly selected resident had two or more violations in the last 12 months is:

A. 0.01
B. 0.05
C. 0.06
D. 0.40
E. 1.00.

Problem 9. $P(E_1 \cup F_2)$= ?

A. 0.12
B. 0.26
C. 0.54
D. 0.66
E. None of the above.

Problem 10. Let event A represent a randomly selected resident with less than two violations who is also under 18. P(A*)= __? A* is the complementary set of A.

A. 0.35
B. 0.65
C. 0.77
D. 0.88
E. 0.95

Problem 11. Given that a resident has two or more violations, the probability that he/she is under 18 is:

A. 0.010
B. 0.050
C. 0.125
D. 0.833
E. 0.916

Problems 12~13. The **next two questions** refer to the following problem setting.

An executive has fifteen suits, five of which are pin-striped. Suppose he selects a random sample of three suits to bring on a business trip.

Problem 12. The probability distribution of X, the number of pin-striped suits brought on this trip, has expected value $E\{X\}$ =___and variance $\sigma^2\{X\}$ =____:

A. 1.5; 0.667
B. 1.5; 0.571
C. 1.0; 0.667
D. 1.0; 0.571
E. None of the above

Problem 13. What is the probability that none of the suits brought on this trip are pin-striped?

A. 0.022
B. 0.220
C. 0.264
D. 0.494
E. None of the above

Problems 14~16. The **next three questions** refer to the following problem setting.
Consider random variables X and Y, and the following measures for these variables:
$E\{X\}=45.0$; $E\{Y\}=65.0$; $\sigma^2\{X\}=4.0$; $\sigma^2\{Y\}=16.0$; and $\sigma\{X,Y\}=3.0$

Problem 14. What is $E\{T\}$, where T is defined as the difference between X and Y; that is, $T=X-Y$.

A. -20.0
B. 0.0
C. 20.0
D. 45.0
E. 14.0

Problem 15. What is $\sigma^2\{T\}$, where T is defined as the difference between X and Y; that is, $T=X-Y$.

A. 14.0
B. 20.0
C. 23.0
D. 26.0
E. Cannot determine without additional information.

Problem 16. What is the coefficient of correlation between X and Y?

A. 0
B. 0.047
C. 0.250
D. 0.375
E. 0.500

Problems 17~19. The **next three questions** refer to the following problem setting.

The five homes on a certain cul-de-sac comprise a population. The property taxes paid on these homes last year were:

$X1 = \$560$; $X2 = \$425$; $X3 = \$520$; $X4 = \$460$; and $X5 = \$535$

Problem 17. The population mean is:

A. 500
B. 520
C. 567
D. 625
E. the population mean cannot be determined from the information given.

Problem 18. The population variance is:

A. 24.9
B. 50.0
C. 2,490.0
D. 3,112.5
E. 12,450.0

Problem 19. Suppose a simple random sample of n=2 homes is to be selected from this population of five homes. Which of the following statements concerning this sampling procedure is correct?

A. The resulting sample mean will be identical to the population mean.
B. The sampling procedure guarantees that the sample will not be comprised of two houses immediately next to one another on the cul-de-sac.
C. Homes with larger property taxes are relatively more likely to be selected than are homes with smaller property taxes.
D. The sample mean property taxes paid, $\bar{X}$, is certain to be no larger than \$547.5.
E. None of the above.

Problem 20. The number of collisions at sea in a year is Poisson distributed. Thus, the length of time between collisions follows:

A. a Poisson distribution also.
B. a normal distribution.
C. an exponential distribution.
D. a Bernoulli distribution.
E. None of the above.

Part II : Computations and Proof (50%) (此部份請用答案卷作答)

Problem 21. (15%) The following are the weekly losses of worker-hours due to accidents in 5 industrial plants before and after a certain safety program was put into operation.

Plant	1	2	3	4	5
Before	45	73	54	133	17
After	36	60	44	119	11

(A) Use the 0.05 level of significance to test whether the safety program is effective (10%)

(B) Find a 90% confidence interval for the mean improvement in lost worker-hours. (5%)

Problem 22. (15%) An experiment was designed to study the performance of 4 different detergents for cleaning fuel injectors. The following "cleanness" readings were obtained with specially designed equipment for 12 tanks of gas distributed over 3 different models of engines:

	Engine 1	Engine 2	Engine 3	*Totals*
Detergent A	45	43	51	139
Detergent B	47	46	52	145
Detergent C	48	50	55	153
Detergent D	42	37	49	128
Totals	182	176	207	565

Please obtain the appropriate analysis of variance table and test at the 0.01 level of significance whether there are differences in the detergents or in the engines.

Problem 23.(10%) For a simple linear regression model

$$Y_i = \alpha + \beta X_i + \varepsilon_i \qquad i = 1,2,.....,n$$

Where Y_i is the dependent variable in the i[th] case, X_i is the value of the independent variable in the i[th] case and assumed to be a known constant, α and β are parameters, and ε_i is the error term for the i[th] case.

(A) Please demonstrate that the regression line will pass the centroid of all observation cases, i.e., $\overline{Y} = \hat{\alpha} + \hat{\beta}\overline{X}$, where $\hat{\alpha}$ and $\hat{\beta}$ are the estimated values of α and β respectively by using least squares method., and $(\overline{X}, \overline{Y})$ is the centroid of all observation cases. (7%)

(B) Will the situation in (A) happen if the constant term α does not exist any more? This is, the simple regression model is formulated as $Y_i = \beta X_i + \varepsilon_i \qquad i = 1,2,.....,n$. (3%)

Problem 24.(10%) Please answer the following questions briefly

(A) What is the meaning of "Degree of Freedom" ? (4%)

(B) What is the Nonparametric Statistical Analysis? (3%)

(C) What is the meaning of "Regression to the Mean"? (3%)

Appendix A: Values of t_α :

Degree of freedom, ν	1	2	3	4	5	6	7	8
$\alpha = 0.10$	3.078	1.886	1.683	1.533	1.476	1.440	1.415	1.397
$\alpha = 0.05$	6.314	2.920	2.353	2.132	2.015	1.943	1.895	1.860
$\alpha = 0.025$	12.71	4.303	3.182	2.776	2.571	2.447	2.365	2.306
$\alpha = 0.01$	31.82	6.965	4.541	3.747	3.365	3.143	2.998	2.896
$\alpha = 0.005$	63.66	9.925	5.841	4.604	4.032	3.707	3.499	3.355

Appendix B: Values of $F_{\nu_1,\nu_2,0.01}$

ν_2 = Degrees of freedom for denominator	ν_1 = Degrees of freedom for numerator							
	1	2	3	4	5	6	7	8
1	4,052	5,000	5,403	5,625	5,764	5,859	5,928	5,982
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50