It was assumed that the remission time follows exponential distribution with parameters λ_1 and λ_2 respectively under the two therapies. Test whether the two therapies are significantly different using the likelihood ratio test. (Use $\chi^2_{1,0.05} = 3.84$)

(6,7)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 10368 **K**

Unique Paper Code : 2373010017

Name of the Paper : Advanced Theory of Biostatistics (DSE)

Name of the Course : **B.Sc. (H) Statistics**

Semester : VII

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Attempt any **five** questions from the remaining seven questions.
4. Use of scientific non-programmable calculator is allowed.
5. Please mention null and alternative hypotheses wherever applicable.

1. Attempt any **five** parts :

(a) Fill in the blanks

(i) In Mantel-Haenzel test, the data are stratified by _____ variable.

(ii) Thoman and Bain suggested the test statistic G = _____ to test for equality of scale parameters λ_1 and λ_2 of the two Weibull distributions respectively.

(iii) The log-likelihood ratio test statistics χ_L = _____ is used to test the equality of the parameters when all the parameters are unknown.

(iv) Hawthorne effect is a disadvantage in _____ study.

(v) _____ study is not suitable for assessment of sensitivity and specificity.

following times to relapse (in months) were recorded:

Drug A: 15, 18+, 18+, 19+, 20+

Drug B: 23+, 16, 18, 20, 24

Apply the log-rank test to check whether drug B is more effective than drug A at 5% level of significance. (6,7)

7. (a) Discuss Cox's F parametric test for comparing the two exponential distributions with parameters λ_1 and λ_2 respectively.

(b) Twelve patients were randomised to receive either therapy 1 or therapy 2 to control the progression of diabetes. The remission times of the patients (in weeks) were obtained as follows:

Therapy 1	15, 18, 19, 19, 20, 17
Therapy 2	23, 16+, 18+, 20+, 24, 26

5. (a) Explain a simple stochastic epidemic model with its components. Suppose there are n susceptible and one infective at time t = 0. Derive the expression for the probability that there are (n-1) susceptible at time t.

(b) Explain carrier-borne epidemic model. Obtain the expected number of susceptible at time t, i.e. m(t). (8,5)

6. (a) Discuss the log likelihood ratio test for comparing two survival distributions with p parameters when a subset of the parameters of the distribution is known. In particular, discuss the test when we compare two Weibull distributions with parameters (λ_1, v_1) and (λ_2, v_2) respectively where v_1 and v_2 are unknown.

(b) Ten patients suffering from hypertension were randomly allocated either drug A or drug B. The

(b) In a class, there are 15 healthy students and 1 infected student. The infection rate of the disease is 0.05 per hour. Obtain the probability that all 15 students remain healthy after two hours.

(c) Define a general stochastic epidemic model. State the initial conditions and possible transitions in time (t, t + h).

(d) How do you compare Gehan's Wilcoxon test with the Cox-Mantel test for comparing the two survival distributions?

(e) Discuss the test for testing the null hypothesis H_0: RR = 1 against H_1: RR $\neq$ 1 for independent samples. Also, obtain 95% confidence interval for the relative risk (RR).

(f) Discuss the main differences between retrospective and cross-sectional studies, giving an appropriate example for each.

(5×5=25)

P.T.O.

2. Suppose (Y_1, Y_2) represent the lifetimes associated with two dependent competing risks R_1 and R_2 following a bivariate Normal distribution BVN(μ_1, μ_2, σ_1^2, σ_2^2, ρ) with $\rho\sigma_2 = \sigma_1$. Derive the expression for the death density function for death due to a specific cause R_1. (13)

3. (a) Using the data provided below, calculate the LR+, LR–, positive predictivity and negative predictivity of the TMT test performed on 600 subjects suffering from prolonged acute chest pain. Interpret the results in terms of the diagnostic accuracy of the TMT test.

TMT	Myocardial infarction	
	Present	Absent
Positive	370	8
Negative	75	147

(b) Using the data given below, calculate the Odds ratio and interpret the value obtained. Also, apply the Z-test and Chi-Square test to test whether the antecedent (Smoking) has a significant

effect on the outcome (cardiovascular disease). (Use $\chi^2_{1,0.05} = 3.84$)

Cardiovascular disease	Smoking	
	Yes	No
Yes	61	35
No	23	77

(5,8)

4. Explain the Cox-Mantel non-parametric test to compare two survival distributions. Ten patients with cardiovascular disease are randomized to receive two different treatments. The following relapse times (in months) are recorded:

Treatment A: 30, 23+, 27+, 25+, 34+

Treatment B: 19, 27, 25, 26, 26, 25

Test whether treatment A is more effective than treatment B using Cox-Mantel test at 5% level of significance. Also, explain the steps of the test clearly. (13)

P.T.O.