W1-2-60-1-6

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2023/2024

MASTER OF SCIENCE IN EPIDEMIOLOGY AND BIOSTATISTICS

PEH-3104: QUANTITATIVE EPIDEMIOLOGY

DATE: AUGUST 2024 **TIME: 3 HOURS**

INSTRUCTIONS: ANSWER ANY FOUR QUESTIONS

1) The Division of Disease Surveillance and Response at the Ministry of Health has been notified by their field staff of an outbreak of a disease in the Mukuru Slums in Nairobi characterized by severe watery (sometimes bloody) diarrhoea, general body weakness, fever, headache, abdominal pains and vomiting. They are convinced that the disease is Bacillary Dysentery. The Head of Division sends you to Mukuru slums as head of the disease control team. Briefly outline the steps you would follow to control the outbreak and to prevent future outbreaks of the same disease in this area. *(25 Marks)*

2) A study of people with HIV/AIDS undergoing highly active antiretroviral therapy (HAART) found that the probability of immune failure in the presence of oral candidiasis was 91% (*Gautan-Cepeda et. al. 2005*). Here are the results of the study's cross-sectional sample of patients with HIV/AIDS on HAART:

		Immune Failure		
		Yes	No	
Oral Candidiasis	Yes	31	3	**34**
	No	75	37	**112**
		106	**40**	**146**

(a) View the exam for oral candidiasis as a test for immune failure. Which of the test characteristics does the 91% figure represent? *(2 Marks)*

(b) What was the prevalence of immune failure in this sample? *(3 Marks)*

(c) What was the probability of immune failure in the absence of oral candidiasis? *(3 Marks)*

(d) What would you call this number ((c) above)? *(2 Marks)*

(e) Calculate the sensitivity of oral candidiasis for immune failure. *(5 Marks)*

(f) Calculate the specificity. *(5 Marks)*

(g) Do you agree with the authors that oral candidiasis is a good marker for immune failure in patients on HAART? *(5 Marks)*

3) In a chart review of patients presenting to the emergency department with epigastric pains, a subgroup of 240 patients were classified as either peptic ulcer disease (PUD) or atypical epigastric pains (no PUD) by two doctors, an accident and emergency (AE) doctor and a gastroenterologist (consultant).

		Gastroenterologist		
		PUD	No PUD	
AE Doctor	PUD	64	12	**76**
	No PUD	56	108	**164**
		120	**120**	**240**

(a) What proportion of the 240-patient sample was assigned to PUD group by the gastroenterologist? *(3 Marks)*

(b) What proportion was assigned to the PUD group by the AE doctor? *(3 Marks)*

(c) What is the actual agreement (concordance rate) between the two doctors? *(4 Marks)*

(d) What is the expected agreement? *(4 Marks)*

(e) Calculate the kappa statistic? *(6 Marks)*

(f) Are the disagreements balanced or unbalanced? How would this affect your interpretation of a study by the AE doctor on the incidence of PUD? (Assume for this problem that the main source of error in diagnosis is the distinction between PUD and atypical abdominal pain.) *(5 Marks)*

4) A prostate cancer screening program based on repeat free clinical prostatic examinations is implemented by the Ministry of Health for men aged 60 – 79 years. The program is open to all eligible men, but it is not compulsory.

(a) Do you expect the incidence of prostatic cancer among the men who take advantage of the program to be the same as the total eligible population? Why? *(7 Marks)*

In men who choose to take advantage of the program the average annual incident of previously undetected prostate cancer is found to be about 100 per 100,000 on follow up. In the first exam, point prevalence is found to be about 200 per 100,000. Assume that, after cases are confirmed by biopsy, no false negative go undetected.

(b) What is the average duration of the detectable pre-clinical phase in cases of prostate cancer detected at the first exam? *(3 Marks)*

(c) Define lead-time bias in the context of evaluation of the screening program or procedure. *(3 Marks)*

(d) How does lead-time bias affect the estimation of average survival time? *(4 Marks)*

(e) Estimate the average lead time for prevalent cases in this example and state the assumption underlying this estimation. *(4 Marks)*

(f) What is the tendency of the average lead-time for incident cases that are detected after initial screening, as the interval between screening exams becomes shorter? *(4 Marks)*

5) One of the screening tests frequently done in Kenyan hospitals in women with breast lumps is the mammography test. Doctors use this test frequently in combination with clinical presentation to predict Breast Cancer. The gold standard for breast cancer diagnosis is breast biopsy. You search in PUBMED and find a study done in Kenya which showed that the prevalence of undetected invasive breast cancer in previously unscreened women at age 50 years is about 5%. The sensitivity of the mammography test is about 94% and the specificity about 80%.

(a) Construct a 2×2 table using "Cancer" and "No Cancer" (by breast biopsy as the gold-standard) and "Mammography +" and "Mammography −" as the tests for a population of 1,000 50-year-old Women. *(10 Marks)*

(b) What is the posterior probability of breast cancer in a 50-year-old woman if the mammography test is positive? *(3 Marks)*

(c) What is the posterior probability of breast cancer in a 50-year-old woman if the mammography test is negative? *(3 Marks)*

(d) What is the likelihood ratio for a positive mammography test (LR+)? *(5 Marks)*

(e) Use the LR+ to calculate the posterior (post-test) probability of breast cancer for a 50-year-old woman if the mammography test is positive. *(4 Marks)*

6) For each of the following study descriptions, name and briefly explain the bias most likely to account for the results:

(a) A new policy at Kenyatta National Hospital requires all asthmatics to have a pCO_2 measured in the accident & emergency department, with automatic admission to the ICU rather than the ward if the pCO_2 is > 40. (A $pCO_2 > 40$ is an indication of increased severity.) Death rates from asthma in both the ICU and on the ward decline. *(5 Marks)*

(b) A study done in Kenya shows that PSA screening of prostate cancer in men above 50 years reduces Prostate cancer mortality by 70% compared to men who do not undergo screening. *(5 Marks)*

(c) One way to screen for colon cancer in Kenya is to have patients collect a small amount of stool on a Hemoccult® card that can be chemically tested for the presence of blood. A study of faecal occult blood screening finds a dose-response between the number of Hemoccult® cards returned and decreased risk of lung cancer death. *(5 Marks)*

(d) A study on early treatment of lupus-related kidney disease (nephritis) compared patients who had a kidney biopsy early in their clinical course to patients biopsied late in their course. The study measured time to renal failure from the time of the biopsy and found that those biopsied earlier had a longer time to renal failure. *(5 Marks)*

(e) A 2006 paper in the New England Journal of Medicine reported 88% estimated 10-year lung-cancer-specific survival among 412 patients with pathologically proven Stage I lung cancer detected by CT screening. They contrasted this with about 5% survival among lung cancer patients in general. *(5 Marks)*