



AMREF INTERNATIONAL UNIVERSITY
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF COMMUNITY HEALTH
MASTER OF PUBLIC HEALTH
END OF SEMESTER EXAMINATION AUGUST 2023

UNIT CODE: MAP 717: STATISTICAL METHODS IN EPIDEMIOLOGY
DATE: APRIL, 2026
TIME: **Three Hours** **Start:** 1600 Hours **Finish** 1900 Hours

INSTRUCTIONS

1. This exam is marked out of 100 marks
2. This Examination comprises TWO Sections
Section A: Compulsory Questions (25 marks)
Section B: Long Answer Questions (75 marks)

SECTION A: COMPULSORY (25 Marks)

Short Answer Questions

1. Researchers conduct a study to compare the risk of hypoglycemia (low blood sugar) among patients with diabetes who initiate long-acting versus short-acting insulin therapy. They recruit 15 patients who recently initiated insulin treatment and have no previous history of hypoglycemic episodes. Participants are followed for up to 2 years to assess occurrences of hypoglycemia. Results are shown below.

Participant number	Insulin type	Follow-up time (years)	Hypoglycemic episode
1	Long-acting	1.3	No
2	Long-acting	1.1	Yes
3	Long-acting	0.8	No
4	Long-acting	1.6	No
5	Long-acting	1.4	Yes
6	Long-acting	1.9	No
7	Long-acting	1.7	No
8	Short-acting	0.6	No
9	Short-acting	1.9	No

10	Short-acting	1.1	No
11	Short-acting	0.8	Yes
12	Short-acting	0.4	No
13	Short-acting	1.3	Yes
14	Short-acting	0.7	No
15	Short-acting	1.4	No

- What is the study design? Give reasons for your answer. **(5 Marks)**
- Calculate the cumulative incidence and incidence rate of hypoglycemia in this study. Provide a brief interpretation of the measures you have calculated above explaining how they differ. **(5 Marks)**
- Calculate the relative risk and incidence rate ratio comparing hypoglycemic reaction among patients receiving long-acting insulin with those receiving short-acting insulin. Provide a brief interpretation of the measure you just calculated. **(10 Marks)**
- How do measures of disease frequency such as incidence differ from measures of association? **(5 Marks)**

SECTION B

ANSWER ANY THREE (3) QUESTIONS (75 Marks)

Long Answer Questions

- Define Type I (α) and Type II (β) errors, including their statistical implications and the concept of statistical power ($1-\beta$). **(6 marks)**
 - Provide one public health example each of Type I and Type II errors, clearly illustrating the null hypothesis scenario. **(6 marks)**
 - Discuss the potential impacts of Type I and Type II errors on public health decision-making and resource allocation, using appropriate examples from epidemiology. **(7 marks)**
 - In designing an epidemiological study (e.g., evaluating TB intervention efficacy), explain the trade-offs between controlling Type I and Type II errors. Describe at least three strategies to manage these trade-offs, including their advantages and limitations. **(6 marks)**
- Researchers conducted a case-control study examining paint exposure (latex/oil-based) and pulmonary fibrosis (30 HRCT-confirmed cases; 90 asymptomatic controls). In-person interviews assessed prior exposures.

 - Identify and define three potential sources of bias specific to this case-control design (e.g., selection, information, confounding). **(9 marks)**
 - For each bias identified in (a), explain its mechanism in this study using the paint exposure context. **(8 marks)**
 - Propose two specific measures to minimize each bias, including implementation details (e.g., matching, blinding). **(8 marks)**
- A medical researcher hypothesizes that smoking causes periorbital wrinkles. They recruited 50 age-matched smokers and 50 nonsmokers for an observational study. Blinded wrinkle scoring found 32 smokers and 20 nonsmokers had prominent wrinkles.

 - Identify the appropriate statistical test for comparing wrinkle frequency between groups. Justify based on study design and data type. **(4 marks)**

- b) State the null (H_0) and alternative (H_1) hypotheses in statistical and contextual terms. **(3 marks)**
- c) Construct the 2×2 contingency table and verify chi-square assumptions (expected frequencies). **(4 marks)**
- d) Outline steps to conduct the chi-square test. **(5 marks)**
- e) Calculate the chi-square statistic, df, p-value, and state conclusions with public health interpretation. **(9 marks)**
5. The 2×2 table below summarizes a longitudinal cohort study on diabetes (exposed) and all-cause mortality.
- a) Define attributable risk (AR), attributable risk percent (AR%), and population attributable risk percent (PAR%). Show formulas. **(6 marks)**
- b) Calculate incidence rates, risk ratio, attributable risk, attributable risk percent, and population attributable risk percent. Show workings. **(10 marks)**
- c) Interpret each measure in public health terms (diabetes-mortality context). **(5 marks)**
- d) Explain how these guide interventions (e.g., diabetes prevention prioritization). Discuss limitations (e.g., causality). **(4 marks)**

	Dead	Alive	Total
Diabetic	100	89	189
Non-diabetic	811	2340	3151
Total	911	2429	3340