Last Name: _____ **First Name:** _____ **Student ID#:** _____

University of Guelph
Department of Population Medicine

Midterm #2 Examination
POPM*3240
November 1st, 2013

This is exam is out of **25 marks (10 multiple choice, 15 short answer)** and is worth 20% of the total course grade.

VERSION B

INSTRUCTIONS:

1. Write your name & ID number on the top of EVERY page of the exam AND on the Computer Test Scoring sheet.
2. Communication with anyone other than the instructors or invigilators during the exam is not permitted.
3. Scientific or desk calculators may be used, but cannot be shared.
4. The use of other electronic devices like computers, cell phones and PDAs is NOT permitted. Cells phones must be turned off during the exam.
5. **All** pages of the exam AND the Computer Test Scoring sheet must be handed in at the end of the exam period. Please remove the formulae sheet from your exam.
6. **PART A: MULTIPLE CHOICE QUESTIONS (MCQ)**
   - Fill in the personal information on the Computer Test Scoring sheet
   - Each question is worth one (1) mark
   - There is only one correct answer for each MCQ - choose the most correct answer and circle on the exam page
   - Enter the correct answer for each MCQ on the Computer Test Scoring sheet
   - Use only an HB #2 pencil to fill in the Computer Test Scoring sheet. Make heavy black marks that fill the circle completely. Erase cleanly any answer you wish to change. Make no stray marks on the answer sheet.
7. **PART B: SHORT ANSWER QUESTIONS**
   - Answer ALL questions in the space provided on the (front of the) exam pages
     - DO NOT WRITE ON THE BACK OF THE EXAM PAGES!
   - Please write legibly (we cannot mark things we cannot read)

Multiple Choice (10 marks total)

1.) Based on our lecture on infection control, what tool(s) is/are used and advocated for in Canadian healthcare settings to protect patients and healthcare professionals and to reduce the spread of infections?

a) Sterilization of medical equipment
b) Hand-hygiene
c) Hospital-specific and provincial policies and health promotion campaigns (e.g. from the Ministry of Health and Long Term Care)
d) A and B only
e) All of the above

2.) What is one reason why you would choose a cross-sectional study design over another observational study design?

a) You want to investigate the potential association between several exposures and diseases
b) In general, cross-sectional studies are less prone to bias than cohort studies
c) You want to study a rare exposure
d) You want to be able to establish a temporal sequence between the exposure and outcome
e) You want to estimate the population attributable rate

3.) In 1922, two researchers from the University of Toronto, Fredrick Banting and John Macleod, discovered insulin and subsequently won the Nobel Prize. Although it is not a cure, insulin is used to effectively manage diabetes, which is fatal if left untreated. However, several years after insulin became widely available in Canada it was observed that the prevalence of diabetes had dramatically increased. What can explain this?

a) The incidence risk increased due to insulin exposure.
b) The incidence rate for diabetes increased as a result of more new cases.
c) The incidence rate is less than the mortality rate for diabetes.
d) The duration of disease increased with availability of insulin.
e) The number of new cases increased as the population increased.

4.) Which of the follow statements is TRUE about observational study designs?

a) A well-designed cohort study does not need a follow-up period.
b) In cross-sectional studies, exposed and non-exposed individuals are often matched.
c) Cross-sectional studies are best suited for permanent exposures.
d) Case-control studies can measure prevalence and odds ratios.
e) Of all observational studies, case-control studies provide the strongest evidence for causation.

5.) A researcher is studying whether consuming unpasteurized milk is a significant source of *E. coli* O157:H7 infections for Canadians. His findings demonstrate that the population attributable fraction (PAF) is 0.15 in Canada. How is this value interpreted?

a) 15% of Canadians who consume unpasteurized milk had an *E. coli* O157:H7 infection due to consuming unpasteurized milk.
b) 15% of *E. coli* O157:H7 infections in Canada are due to consuming unpasteurized milk.
c) The risk of *E. coli* O157:H7 infections for Canadians who consume unpasteurized milk is 0.15 times the risk of *E. coli* O157:H7 infections for Canadians who do not consume unpasteurized milk.
d) For every 100 Canadians who consume unpasteurized milk, 15 were infected with *E. coli* O157:H7 due to consuming unpasteurized milk.
e) None of the above.

6.) Please select the option below that best represents the objective(s) of a journal article critique or critical appraisal?

a) Assess accountability
b) Assess internal validity
c) Assess external validity
d) Two of the above
e) All of the above

7.) A researcher is interested in understanding the etiology of Parkinson`s disease. The researcher is studying a number of genetic and environmental exposures within her study. She knows that to do that, she must use a case-control study design. The researcher has decided to enroll patients from a referral hospital where she can enroll incident cases over the course of one year, and select 2 controls each Friday for the course of the year. The researcher is working with a _____ population, with _____ population dynamics and using a(n) _____ control selection method.

a) Primary study base, open, steady state rate based
b) Primary study base, closed, incidence density rate based
c) Secondary study base, open, steady state rate based
d) Secondary study base, open, incidence density rate based
e) Secondary study base, closed, risk based

8.) A recent study claims that 30 million Americans are overweight. What measure of disease is this?

a) Rate
b) Proportion
c) Ratio
d) Count
e) None of the above

9.) For exposure X and outcome Y, it is determined that the relative risk (RR) is 0.89 (95% CI: 0.78-1.03). This indicates that the exposure and the outcome are _____ associated and that this association is _____.

a) Positively; Not Statistically Significant
b) Negatively; Not Statistically Significant
c) Positively; Statistically Significant
d) Negatively; Statistically Significant
e) None of the above

10.) Which of the following is FALSE about the potential for bias in cohort studies?

a) The quality of information for each exposure group may differ leading to confounding bias
b) Matching and analytical control can be used to address confounding bias in prospective cohort studies
c) Generally, prospective cohort studies do not suffer from recall bias
d) Prospective cohort studies and retrospective cohort studies can differ in terms of the potential for bias
e) Diagnostic methods may change over the follow-up period, which can contribute to information bias in prospective cohort studies

Short Answer (15 marks total)

October is breast cancer awareness month. We will discuss two possible tests that are available to help determine if someone has breast cancer: a mammogram (68% specificity, 86% sensitivity) and a breast tissue biopsy (92% sensitivity, 82% specificity). Current treatments for breast cancer include a mastectomy (removal of the breast) and chemotherapy (strong drugs are given to kill cancerous cells with many side effects including hair and nail loss), which are physically invasive and can cause emotional, mental and social distress. Initial research has highlighted a potential link between exposure to and infection with Human Papilloma Virus Type 16 (HPV16) and the disease outcome of breast cancer. Eight hundred individuals are randomly selected and initially screened for enrollment in a study. At baseline, 10% of these people already had breast cancer according to the gold standard test. The remaining individuals are followed for three years; the prevalence of HPV at baseline was 50%. At the three-year follow-up, 7.5% of the remaining cohort had developed breast cancer (n=30). The prevalence of HPV amongst people who developed breast cancer after three years was 92% and the prevalence of HPV amongst people who remained free of breast cancer after three years was 48%.

11.) Please state the type of observational study design used (be specific, 1 mark) as well as one benefit (0.5 marks) of using this study design.

Prospective (**0.5 marks**) cohort study (**0.5 marks**)
0.5 marks for one logical benefit of design stated (even if study design is wrong).

12.) What measure(s) of association is/are available for this kind of study design? List all that apply. (1 mark)

Relative risk, odds ratio, and incident rate ratio
1 mark for all three (**0.33 marks for each MoA listed**)
If other measures listed (e.g. measures of effect), maximum 0.5 marks total

13.) Please use a single word to fill in each blank below. (0.5 marks x 5 = 2.5 marks total)

Treatment for breast cancer is a TERTIARY intervention, while screening for breast cancer is a SECONDARY intervention. Given the impact of breast cancer diagnosis and treatment, it would be best to combine the two screening tests (biopsy and mammogram) in SERIES (choose either: parallel or series), which would increase net SPECIFICITY and thus increase the likelihood of true NEGATIVES.

5.0

14.) Please **choose one** of the available measures of association (answer to Question #12 on the previous page) to calculate and **appropriately interpret** based on the 3-year follow-up assessment done at the end of the study period. (3.5 marks)

0.5 marks for stating n=400 @ 3-year follow-up
1 mark for correct formula of RR / OR / IRR
1 mark for correct calculation of RR / OR / IRR (only if value is correct)
1 mark for full sentence with proper interpretation (even if value is wrong)

Calculate the number of the people left at the end of the study period:
Proportion D+ = cases / n
N = cases/proportion D+ = 30/0.075 = 400

	D+	D-		*Person-years*
E+	27.6 (28)	177.6 (178)	205.2 (206)	NAR=0.5[(720*0.5) + (177.6)]= 269 269*3 = 807 person-years
E-	2.4 (2)	192.4 (192)	194.8 (194)	NAR = 0.5[(720*0.5) + (192.4)]= 276 276*3 = 828 person-years
	30	370	n=400	

OR = (a*d)/(b*c) = (27.6*192.4)/(177.6*2.4) = 12.46
or = 15.1 (if 2x2 table values were rounded)
The odds of breast cancer is 12.46 times greater in people who have HPV than the odds of breast cancer in people who do not have HPV.

RR = (a/a+b) / (c/c+d) = (27.6/205.2)/(2.4/194.8) = 10.92
or = 13.2 (if 2x2 table values were rounded)
The risk of breast cancer is 10.92 times greater in people who have HPV than the risk of breast cancer in people who do not have HPV.

IRR = (a/NAR*t) / (c/NAR*t) = (27.6/807) / (2.4/828) = 11.8
or = 14.4 (if 2x2 table values were rounded)
The incidence rate of breast cancer is 11.8 times greater in people who have HPV than the incidence rate of breast cancer in people who do not have HPV.

15.) What is the monthly rate at which breast cancer developed in this study? **Interpret appropriately** in a single sentence. (2.5 marks)

Incident rate with an approximate denominator
Rate = 30 new cases / ([720+370/2]*3 person-years) = 0.01923 / 12 months = 0.0016 = 1.6 cases per 1000 person-months

0.5 marks for choosing correct formula
0.5 marks for NAR(initial) = 720
0.5 marks for NAR(final) = 370 (400 at 3-yrs subtract 30 with disease)
0.5 marks for proper calculation (0.0016 cases per person-month or 0.019 cases per person-year)
0.5 mark for full sentence with proper interpretation in person-months (even if final value is wrong)

6.0

Scenario (repeated for convenience): October is breast cancer awareness month. We will discuss two possible tests that are available to help determine if someone has breast cancer: a mammogram (68% specificity, 86% sensitivity) and a breast tissue biopsy (92% sensitivity, 82% specificity). Current treatments for breast cancer include a mastectomy (removal of the breast) and chemotherapy (strong drugs are given to kill cancerous cells with many side effects including hair and nail loss), which are physically invasive and can cause emotional, mental and social distress. Initial research has highlighted a potential link between exposure to and infection with Human Papilloma Virus Type 16 (HPV16) and the disease outcome of breast cancer. Eight hundred individuals are randomly selected and initially screened for enrollment in a study. At baseline, 10% of these people already had breast cancer according to the gold standard test. The remaining individuals are followed for three years; the prevalence of HPV at baseline was 50%. At the three-year follow-up, 7.5% of the remaining cohort had developed breast cancer (n=30). The prevalence of HPV amongst people who developed breast cancer after three years was 92% and the prevalence of HPV amongst people who remained free of breast cancer after three years was 48%.

16.) What kind of selection bias should you be most concerned with (0.5 marks)? In a single sentence, explain how you would reduce the impact of this kind of bias (0.5 marks).

0.5 marks for stating "loss to follow-up" bias **(-0.25 if said "information bias)**
0.5 marks for stating one of the following: 1) that increasing incentives to encourage participants to return or 2) increase frequency of contact near beginning (not just baseline and then 3-year follow-up) or 3) other logical method to prevent loss to follow-up

17.) Considering the **initial screening** for inclusion into the study at baseline, what would be the likelihood that someone who receives a positive test result from a breast tissue biopsy truly had breast cancer at baseline? Please ensure you **appropriately interpret** your result in a single sentence. (3 marks)

	D+	D-	
Test +	74	130	204
Test -	6	590	596
	80	720	800

PPV = 74 / 204 = 0.3627 = 36%

There would be a 36% chance that a person who receives a positive biopsy result actually has breast cancer.

1 mark for correct 2x2 table (0.25 per cell, regardless of whether rounding was used or not)
0.5 marks for knowing to calculate PPV
0.5 marks for correct calculation of PPV (only if value is correct)
1 mark for full sentence with proper interpretation of PPV (even if value is wrong)

4.0

Last Name: _____ **First Name:** _____ **Student ID#:** _____

Provided Formulae

(please remove this sheet from your exam)

$$\text{Agreement}_{\text{Expected}} = [(a+b)*(a+c)/n + (c+d)*(b+d)/n] / n$$

$$\text{Kappa} = (\text{Agreement}_{\text{Obs}} - \text{Agreement}_{\text{Exp}}) / (1 - \text{Agreement}_{\text{Exp}})$$

Kappa values (degree of agreement):

<0.2 (slight) → 0.2-0.4 (fair) → 0.4-0.6 (moderate) → 0.6-0.8 (substantial) → >0.8 (excellent)

$$n = \frac{{Z_\alpha}^2 * \sigma^2}{L^2}$$

$$n = \frac{{Z_\alpha}^2 * p * q}{L^2}$$

$$n = \frac{\left(Z_\alpha\sqrt{2pq} - Z_\beta\sqrt{p_1q_1 + p_2q_2}\right)^2}{\left(p_1 - p_2\right)^2}$$

$$n = 2 * \left[\frac{\left(Z_\alpha - Z_\beta\right)^2 * \sigma^2}{\left(\mu_1 - \mu_2\right)^2}\right]$$

Measures of Disease Frequency:

Overall Morbidity Rate = # developing disease in time period / (average NAR * ITC)

AR = # individuals exposed who became ill / total # individuals exposed

CFR = # dying from disease Y / # sick from disease Y

Cause-specific mortality risk = # dying from disease Y during specified time period / (initial NAR – ½ withdrawals during that time period)

Incidence risk = # new cases in a population during specified time period / (initial NAR – ½ withdrawals during that time period)

Incidence rate (approximate denominator): # new cases in population during specified time period / (average NAR * ITC)

NAR = (initial NAR + final NAR) / 2

Measures of Effect:

RD = [a/(a+b)] – [c/(c+d)]
= P(D+ | E+) - P(D+ | E-)
= $I_1 - I_0$

AP = RD / P(D+ | E+)
= $(I_1 - I_0) / I_1$
= (RR-1) / RR *or* (OR-1)/OR)

PAR = p(D+) – p(D+ | E-)
= $I - I_0$

PAF = PAR / p(D+)
= [P(E+)*(RR-1) / [P(E+)*(RR-1)+1]]*100
= $(I - I_0) / I$ = AP(e) * P(E+ | D+) in C-C studies