PB HLTH 250C: Final Exam

Due by 6pm, Friday 15 May 2020

This final exam is take-home and there are 9 questions. You may use any PB HLTH 250C class materials from <u>this semester</u> (e.g. notes, readings, previous homework assignments), any PB HLTH 252 materials, or any published materials (books, journal articles) but **you must not discuss this exam with anyone except the course instructor and GSI.** This includes, <u>but is not limited to</u> communications in-person, *via* phone, Skype, Zoom, text messaging, internet bulletin board, social media, Owl Post, Floo Network, etc. . . <u>You are also specifically not allowed to access exams from previous offerings of PB HLTH 250C.</u> If you have any questions regarding this please see the GSI or course instructor.
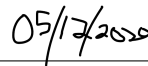
After you have submitted your exam do not discuss it amongst your peers until after grades are posted.

Read all questions carefully before answering. Please <u>maintain numbering on sub-questions</u>, type your responses, **do not submit unformatted computer output or code** and **please keep answers brief.** Report measures of association to **two** decimal places. Submit a pdf to Gradescope with the following statement at the beginning, and sign below it:

On my honor, I have neither given nor received any assistance in the taking of this exam, as stipulated above, and that I will refrain from discussing it until grades are posted.

_____ _____

05/17/2020

Signature Date

Questions

Bias analysis

Answer the following **TRUE/FALSE** questions regarding bias analysis in general **and provide a 1-2 sentence justification** (please read carefully). **(5 points each)**

1. *Deterministic bias analysis* incorporates uncertainty in the bias parameters into your analysis.
2. *Probabilistic bias analysis* yields a range of bias-corrected measures of association.
3. *The gamma distribution* is a good choice for the distribution of the bias parameter for a proportion/prevalence/probability.
4. *The normal distribution* is a good choice for the distribution of the bias parameter for a log-relative risk.
5. One reason quantitative bias analysis is important is that *systematic errors can be larger than random errors.*

Paper Evaluation

A paper by Keil *et al.* (2014) in *Environmental Health* examined the association between exposure to imidacloprid (a common flea and tick medication for pets) and autisum spectrum disorder (ASD) among children. Read the accompanying paper, paying particular attention to the methods and results sections, and answer the following questions regarding the methodological approach and presentation of results (**please keep answers brief**):

6. The authors mention using *'3 jointly estimated models to simultaneously model the "true" exposure and estimate its association with ASD.'* For the analysis in this paper, write out each of these models as described by the authors.[1] Consider only the non-differential misclassification scenario (group 2). Give definitions for each of the covariates and parameters in your models. Specify any distributional assumptions for the outcomes on the models, but here you do not need to specify the priors on the model parameters: *Hint: refer to misclassification example from the Bayesian Bias Analysis lecture*

    a. The exposure model **(10 points)**.
    b. The measurement model **(10 points)**.
    c. The outcome model **(10 points)**.

7. The authors describe a sequence of analyses where each one treats the sensitivity and false positive rate (1-specificity) as fixed. In the case of non-differential misclassification (group 2), sensitivity ranges from 0.70-0.95 and false positive probability (1-specificity) from 0.00-0.20 for both cases (ASD) and controls (TD). Instead of specific fixed scenarios, describe one possible set of prior distributions for sensitivity and specificity that would be consistent with these ranges of values (**5 points**) *Hint: Assume there is no prior probability outside of the stated ranges. You should specify two reasonable distributions of your choice (one for each bias parameter), and include specific values for the hyperparameters.*

8. The model above assumes non-differential exposure misclassification.

    a. Modify and present the approopriate sub-model from question 6 to accommodate *differential* misclassification (this will only involve one of (a), (b), or (c)). Make sure to define each of the necessary bias parameters in this new sub-model. (**5 points**)

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[1]Note correction at top of page 3. Text should read: 'probability of <u>reported</u> exposure, given <u>"true"</u> exposure and case/control status...'

b. Assuming this modification, specify the necessary prior distributions for the bias parameters consistent with the **group 3** scenario (see Figure 2). (**5 points**)

Analytic Plan

9. Given the analysis and methodological issue that you outlined on the midterm, **briefly** outline an plan for the analysis. Consider writing this in the format you would for a MPH capstone proposal or dissertatoin prospectus. Be specific about 1) target parameter, 2) modeling forms, 3) covariates included, and 4) how you will inform any priors (e.g. for Bayesian analysis or probabilistic bias analysis). Include an expression for the model form (you can denote sets of covariates in vector notation for brevity). (**30 points**) **LIMIT YOUR ANSWER TO ONE PAGE OR LESS** (points will be deduced for exceeding the word limit)

BONUS (3 points) Include (with your answers here) documentation that you have completed the online course evaluation for PBHLTH 250C. (And thank you!) (Please do not include any information on your responses to the questions.)