Australian and New Zealand College of Veterinary Scientists

Fellowship Examination

June 2021

Veterinary Epidemiology

Paper 1

Perusal time: **Twenty (20)** minutes

Time allowed: **Four (4)** hours after perusal

Answer **ALL** <u>**FOUR (4)**</u> questions

All four questions are of equal value.

Answer **FOUR (4)** questions each worth 60 marks.....................................total 240 marks

Paper 1: Veterinary Epidemiology

Answer all four (4) questions

1.   A new treatment for mastitis is assessed in a group of 20 first-calf dairy heifers within one herd which have been diagnosed as affected by subclinical *Streptococcus agalactiae* mastitis. A field intervention trial is used in which treatments are randomized to heifers in this group. Note that at the time of this trial, there were only 20 heifers in this herd eligible for inclusion in the trial. There are 10 heifers with mastitis that are treated, and of these, 9 recovered. The remaining 10 heifers are treated with an industry-standard treatment, and one heifer recovers. Recovery is assessed using standard mastitis diagnostics (somatic cell count), which are undertaken blinded to treatment status. Other than treatment received, all 20 heifers in this trial are managed in the same way.

Describe how to evaluate these empirical observations with reference to the null hypothesis to be tested and type I and II errors, and provide advice (with a justification) to the manufacturer about whether further development of their new treatment for subclinical *Streptococcus agalactiae* mastitis in first-calf heifers is worthwhile.   *(60 marks)*

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2.   A colleague is conducting a case-control study to investigate whether neuter status is associated with open fractures in dogs following trauma. After systematically reviewing published studies, the project principal investigator has laid out the following causal assumptions regarding study variables:

1.   Bodyweight is a determinant of open fractures.

2.   Confinement of dogs is a determinant of open fractures.

3.   Sex of dogs is associated with bodyweight and neuter status.

4.   Age of dogs is associated with bodyweight, neuter status and confinement, and is a determinant of open fractures.

5.   Breed of dogs is associated with bodyweight and confinement.

6.   Neuter status influences bodyweight.

Construct a causal diagram (directed acyclic graph, DAG) depicting these causal assumptions of your colleague. Note that you will have to decide on the direction of arrows based on your own stated assumptions and biological knowledge and provide justification for those decisions. Use your causal diagram to identify a sufficient set of confounders that would need to be controlled when analysing the data from this study. Ensure that the process and assumptions that you have used is demonstrated throughout your response.   *(60 marks)*

3.   Consider a state transition model of infectious disease spread in the form of:

susceptible → infectious → resistant (recovered)
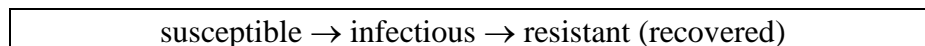
i.e. an SIR model of disease spread.

Answer **both** parts of this question:

a) Modelling time as a continuous function, write the differential equations which define this model. All variables and parameters should be defined. Assume that all births in the population are susceptible, only infectious individuals die, and that recovered individuals can become re-infected.   *(20 marks)*

b) For each parameter identified in question 3 a), describe options for parameterization, and the advantages and disadvantages of these options.
(40 marks)

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4. Consider the following statement:

> *Animal health economics is a discipline, which does not belong to the core of veterinary science but is becoming more and more important as an aid to decision making on animal interventions at various levels. The growing importance of animal health economics can be explained by the dramatic changes, which have occurred in the global socio-economic environment over the past 20 years.*

There is an endemic disease agent in livestock populations, which might have a zoonotic risk. Compare and contrast the animal health economics principles that would guide decision making at the level of the relevant national government authority versus that of the national livestock representative body. Provide examples of the evidence needed to guide the decision-making process of both government and industry that is based on animal health economics theory. *(60 marks)*

End of paper

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Paper 2

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Answer **ALL** <u>**FOUR (4)**</u> questions

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Answer **FOUR (4)** questions each worth 60 marks.....................................total 240 marks

Paper 2: Veterinary Epidemiology

Answer all four (4) questions

1. Infection with *E. canis* (ehrlichiosis) was confirmed for the first time in Australian dogs in May 2020 in the Kimberley region of Western Australia and June 2020 in the Northern Territory. The disease has also been detected in a small number of dogs in the Gascoyne and Pilbara. It is not known how the disease entered Australia, or when this occurred.

    The Chief Veterinary Officer of the Northern Territory has requested you to design a survey to determine the extent of infection. Cost is an issue. Although the indirect immunofluorescence antibody (IFA) test for anti-*E. canis* IgG antibodies is considered the serological 'gold standard', indicating exposure due to *E. canis*, a commercially available dot-ELISA kit is available and much cheaper. Using the IFA test as the gold standard, this ELISA has a sensitivity of 90% and specificity of 99%.

    Answer **all** parts of this question:

    a) Describe the key epidemiologic features of *E. canis* that need to be considered when designing this survey, and briefly outline a survey design that takes into account these key epidemiologic features.   *(25 marks)*

    b) For this survey, define the source population, target population and study population. Propose an approach to creating a sampling frame – given that one does not already exist. Based on this sampling frame, describe how well it will capture the source population, and what follow-up studies might be necessary to meet the survey objective.   *(20 marks)*

    c) Outline how the available diagnostic test (dot-ELISA) should be effectively applied in the survey if the aim is to maximise detection of *E. canis* exposure in dogs and communities.   *(15 marks)*

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2.   You are a regional government veterinary office working in the Riverina area. Since pig production is a major animal industry within your region, you have been following the alarming spread of African swine fever throughout Asia. You have undertaken training to clinically recognise this disease.

A private veterinarian reports a disease situation in a backyard production system in your region. Clinical signs include sudden death, inappetance, and hyperaemia of the skin, as well as a range of other signs.

Answer **all** parts of this question:

a) Your Chief Veterinary Officer has asked you to lead the investigation of what is now considered a suspect outbreak of African swine fever. Using an established framework for outbreak investigations, describe how the investigation would be conducted.   *(20 marks)*

b) The outbreak investigation you undertook has ruled out African swine fever, or any other infectious disease, as the cause of the outbreak. A new hypothesis is that the outbreak was caused by an issue with the commercial feed being used in this backyard operation, since there have been some anecdotal reports of a similar disease (although more subtle) at some other sites. Briefly present an appropriate study design to test this idea. Consider that you are now one month on from the initial outbreak and no feed samples are available for laboratory analysis.
(20 marks)

c) As part of your follow-up study of this syndrome, you want to create a map to show the spatial pattern of occurrence. What data do you need to collect, and what type(s) of maps might you create?   *(20 marks)*

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3.   In 2017 an incursion of *Mycoplasma bovis* was detected in New Zealand. It spread throughout both the North Island and the South Island. A disease eradication program commenced in 2018. This is based on testing, culling and movement control.

Answer **both** parts of this question:

a) Describe the information needed to facilitate the decision about whether to attempt to eradicate an infectious disease or not in a livestock industry.   *(30 marks)*

b) List and describe the key stages that a successful disease eradication campaign might follow. Where relevant, include context from the New Zealand situation.
(30 marks)

4.   Hendra virus continues to be an issue for the Australian equine industries. Outbreaks can occur sporadically, or apparently clustered in time (and sometimes in space). Surveillance is passive, with cases usually reported to private practitioners, and then to government animal health services.

Consider that one equine industry, the Thoroughbred breeding industry, proposes Hendra virus zoning to primarily facilitate its export trade.

Discuss in detail the concept of zoning for animal diseases, and describe the approach you would propose if you were hired by the industry as a consultant. Your aim is to have this proposal adopted at the national animal health level, so include a discussion of 'selling points' in your response, as well as identifying challenges in such a proposal and their potential solutions.   *(60 marks)*

End of paper