



Australian College of Veterinary Scientists

## Membership Examination

June 2011

## Veterinary Epidemiology

### Paper 1

Perusal time: **Fifteen (15)** minutes

Time allowed: **Two (2)** hours after perusal

Answer **ALL** eight questions

In some questions, you must choose which subparts to answer

**EIGHT** questions each worth 15 marks.....total 120 marks

# Paper 1: Veterinary Epidemiology

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Answer **ALL** eight questions.

1. Answer **EITHER** subpart a) **OR** subpart b) of this question:

- a) Nominate an infectious disease of animals with which you are familiar. For that disease answer **all** subparts of this question:
- i. Describe the methods of spread of the infectious agent – both within herd and between herd. *(12 marks)*
  - ii. List any reservoirs of the infectious agent. *(3 marks)*

**OR**

b) Answer **all** subparts of this question:

- i. List the major strategies used for infectious disease control in animals. *(7 marks)*
- ii. Explain how **one (1)** of these strategies reduces disease frequency in the context of either basic epidemic theory or transmission and maintenance of infection. *(8 marks)*

2. In dairy cows, clinical ketosis (acetonæmia) occurs almost exclusively in lactating (ie 'milking') cows. Farm records indicate that there have been 24 cases of clinical ketosis (acetonæmia) in a dairy herd during the three-month period from March to May. The disease has been of concern to the farmer, especially because three cows have had two cases each. Over this time, 600 cows were milked. No cows calved and entered the milking herd (the herd of lactating cows) during the period but 25 cows were dried off and removed from the milking herd over this time.

Answer **all** subparts of this question:

- a) Calculate and explain the incidence risk of clinical ketosis in this herd for this three-month period, showing full details of your workings. Provided full details of your working are shown, if mathematical errors are made, partial marks will be awarded for otherwise correct responses. *(7 marks)*
- b) List possible causes of bias in this estimate. *(8 marks)*

**Examination continued on next page**

3. Answer **all** subparts of this question; for sub parts b) and c) assume all individuals are statistically independent of each other, other than the similarity of individuals due to being in the same group:
- a) Define and give examples of outcome variables of each major data type such as might be measured in an epidemiological study of your choice. (7 marks)
  - b) Describe a statistical approach for comparing the means of a continuous outcome variable between two groups. (4 marks)
  - c) Describe a statistical approach for comparing the distribution of a binary variable between two groups. (4 marks)
4. Counts of positive and negative test results are aggregated by government authorities for a selected set of diseases for particular time periods. These data may arise from disease case investigations or the screening of healthy animals.

Answer **all** subparts of this question:

- a) List and describe the major limitations to validity when using these data to measure prevalence or incidence of the diseases of interest. (9 marks)
  - b) List and describe some advantages of such passively collected data compared to actively collected data. (6 marks)
5. Answer **EITHER** subpart a) **OR** subpart b) of this question:
- a) List the major generic determinants of herd-level sensitivity; and for each of the determinants, note the direction of change in herd-level sensitivity following an increase in just that determinant. (15 marks)

**OR**

- b) List the major generic determinants of herd-level specificity; and for each of the determinants, note the direction of change in herd-level specificity following an increase in just that determinant. (15 marks)

**Examination continued on next page**

6. Answer **EITHER** subpart a) **OR** subpart b) of this question:

a) Using examples, briefly describe when partial farm budgets are an appropriate tool for economic evaluation of an intervention within a farm. *(15 marks)*

**OR**

b) Describe and briefly explain **one (1)** of the key measures used in cost-benefit analysis. *(15 marks)*

7. Briefly explain, with diagrams as appropriate, the purpose of risk analysis for the importation of animals into Australia or New Zealand, and steps involved in undertaking such a risk analysis. *(15 marks)*

8. Answer **all** subparts of this question:

a) List **three (3)** main applications of spatial analysis in veterinary epidemiology. *(3 marks)*

b) For **one (1)** of these applications, explain the objective of the analysis. *(6 marks)*

c) Describe an example of the use of spatial analysis for this application. *(6 marks)*

**End of paper**



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### Paper 2

Perusal time: **Fifteen (15)** minutes

Time allowed: **Two (2)** hours after perusal

Answer your choice of any **THREE (3)** questions from the five questions **ONLY**

**All** five (5) main questions are of equal value

Answer **ONE (1)** question **ONLY** from **SECTION A**

Answer **TWO (2)** questions **ONLY** from **SECTION B**

Answer **THREE** questions each worth 40 marks .....total 120 marks

# Paper 2: Veterinary Epidemiology

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## Section A

Answer ONE (1) question **ONLY** from SECTION A.

### 1. H5N1 Avian Influenza in village poultry

Vaccination is one of the key strategies for preventing deaths in village poultry due to H5N1 Avian Influenza virus infection in some countries in south-east Asia. At irregular intervals, all birds present in each household are vaccinated.

Suppose that outbreaks of deaths due to H5N1 Avian Influenza virus are occurring in ducks and so the effectiveness of vaccination in ducks under field conditions requires assessment. Also suppose that you have been asked to design a case-control study to assess the effectiveness of vaccination of ducks in preventing outbreaks of deaths in ducks due to H5N1 Avian Influenza virus. The study unit will be the individual household. Case households will be selected from those experiencing outbreaks of deaths in ducks that were reported to government officials that were attributed to H5N1 Avian Influenza virus. Control households will be selected from households not experiencing outbreaks of deaths in ducks. Vaccination history of each household will then be determined.

For **each** of the following types of bias, describe in detail specific strategies that could be used in this study to minimise that bias type:

- a) selection bias (12 marks)
- b) confounding due to daytime grazing access to rice fields. (In some households, all ducks are grazed on rice fields during the day. In other households, ducks are confined at home and fed grains etc.) (12 marks)
- c) misclassification bias. (16 marks)

For each strategy, be sure to describe specifically how they could be implemented in this particular study.

**Section A continued on next page**

2. **Evidence evaluation**

Attached as an appendix to this examination paper is a report describing a study of patterns of tobacco usage amongst veterinarians.

Assess the information available in the report, and critically evaluate the design of this study.

Your answer should include consideration of **each** of the following:

- a) research hypothesis(es) (6 marks)
- b) study type (6 marks)
- c) reference population and study population (6 marks)
- d) key outcome and explanatory variables (8 marks)
- e) key aspects of sampling (5 marks)
- f) possible bias in results, including selection bias, confounding, and bias due to measurement error or misclassification. (9 marks)

In your responses, explain any further information that you feel would have helped you to more fully evaluate the study.

Attachment: Smith *et al.* The latest endangered species in Australia: A tobacco smoking veterinarian. *Aust Vet J* 2010; 88(9):369-370.

**End of section A**

**Section B starts on next page**

## Section B

Answer **TWO (2)** questions **ONLY** from SECTION B.

### 3. **Respiratory disease vaccination in feedlot cattle**

In Australian feedlots, cattle from various sources are trucked to the feedlot, held for various periods of time in paddocks or pens and fed hay; then on a single day, are placed in groups of between 100 and 500 (depending on the physical size of the pen). They typically remain together in the same pen until removed for slaughter after 60 to 250 days. Each feedlot typically consists of between 10 and 100 pens. Most pens have other pens adjoining. Feedlot staff visually assess cattle each day and remove cattle thought to be unwell for detailed examination and treatment elsewhere.

Bovine respiratory disease is the most important disease in most large beef cattle feedlots. Cattle must have been infected with one or more of several infectious and contagious agents before clinical bovine respiratory disease develops. Three vaccines are available in Australia that target the pathogens thought to be contributors to clinical bovine respiratory disease; (all of these vaccines are killed and so are not transmitted between animals). You have been asked to design a controlled trial to assess the effectiveness of these under Australian conditions.

Managers of five feedlots have approved implementation of a controlled trial for this purpose in their feedlots.

Describe in detail the design of a controlled trial that will provide precise and unbiased estimates of the effectiveness of these three vaccines in preventing clinical bovine respiratory disease in feedlot cattle. Explain why each element of your design is important and necessary. *(40 marks)*

### 4. **Surveillance**

Select an infectious disease exotic to either Australia or New Zealand and of importance to that country.

Briefly describe surveillance activities that could be used to provide evidence that the infectious agent(s) necessary for occurrence of your selected disease is/are not present in animals in that country. *(12 marks)*

In your answer, considering the key determinants of degree of confidence that an infectious agent is not present in animals in a region, identify both the key aspects of the agent(s) and the key features of the surveillance activities that affect the degree of confidence of freedom. Explain how these affect degree of confidence of freedom.

*(28 marks)*

**Section B continued on next page**

5. **Diagnostic test validity and use**

Two diagnostic tests are being used during a major livestock disease eradication program for an infectious disease, a PCR (polymerase chain reaction) test for viral DNA, and an ELISA (enzyme-linked immunosorbent assay) for antibodies.

Test results are available for animals known to be infected (as demonstrated using a gold standard process), and animals in regions known to be free of the agent. Numbers of animals were as follows:

**Animals known to be infected  
(as demonstrated using a gold standard process)**

		ELISA	
		Positive	Negative
PCR	Positive	154	2
	Negative	23	7

**Animals in regions known to be free of the agent**

		ELISA	
		Positive	Negative
PCR	Positive	5	1
	Negative	39	263

Answer **all** subparts of this question:

- a) Based on these data, calculate **each** of the following:
  - i. sensitivity of the PCR (2 marks)
  - ii. specificity of the PCR (2 marks)
  - iii. sensitivity of the ELISA (2 marks)
  - iv. specificity of the ELISA (2 marks)
  - v. relative sensitivity of the ELISA (relative to the PCR) (2 marks)
  - vi. relative specificity of the ELISA (relative to the PCR) (2 marks)

Show full details of your working for each. Provided full details of your working are shown, if mathematical errors are made, partial marks will be awarded for otherwise correct responses.

- b) Describe in words the meaning of each of the six numbers calculated above in 5a).  
(2 marks each, total 12 marks)

**Question continued on next page**

- c) Assume an eradication program is about to commence and that the agent is very common in a region. If only one of these tests is to be used at any particular stage of the eradication program; based solely on the test sensitivities and specificities that you have calculated above, describe which test you would use in **each** of the following stages:
- i. early in the eradication program (5 marks)
  - ii. near the end of the eradication program (5 marks)
  - iii. to prove freedom to trading partners five years after the infectious agent was declared eradicated. (6 marks)

Briefly justify each of your answers.

**End of Paper**