

# MBG\*4030 - Animal Breeding Methods

## Fall 2009 - Midterm Exam

October 21, 2009

Write your name at the top of each page. There should be 9 pages. A blank answer gets 0 points. An answer that has wrong statements gets 1 point. If an answer is mostly correct but not complete gets 2 points. Totally correct answers get 3 points. There are a total of 105 points possible.

1. Two matrices are given below. Are they conformable for multiplication or addition, or both? Perform the valid operation(s).

$$\mathbf{A} = \begin{pmatrix} 3 & 2 \\ -1 & 0 \\ 2 & -4 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} -5 & 6 \\ 7 & -9 \end{pmatrix}.$$

2. List the necessary information to make genetic evaluations in a livestock species.

3. Give a guess-timate of the number of genes in a mammalian genome (a range).

4. List the assumptions of the Infinitesimal Model.

5. Draw a picture or explain the meaning of an epistatic genetic variance denoted by  $\sigma_{12}^2$

6. Give the elements of a basic Analysis of Variance table.
  
7. Which organization handles breed registrations and type classification programs in the dairy industry of Canada?
  
8. What beef breed dominates in Brazil?
  
9. List two contributions of Sir R. A. Fisher to animal breeding.
  
10. Describe the iteration method of solving equations.
  
11. If two individuals are inbred, does that mean their progeny will also be inbred? Explain.
  
12. What traits of animals tend to have high heritabilities (0.35 and higher)?
  
13. How are missing parents assigned to phantom parent groups?

14. Ostriches are raised for their meat, leather, and feathers. They have 40 pair of chromosomes. Males are ZZ genotype for the sex chromosome while females are ZW genotypes. Birds become sexually mature at 3 to 4 years of age. Ostriches have a breeding season starting in spring as day length is increasing. Males can only successfully mate with 1-3 females in a season, because fertility of the eggs decreases if more females are involved. Females will lay eggs every 2-3 days during the breeding season of which 10 to 95 % are fertile. In the wild, the male gathers the eggs of his females into one group and does the incubation and protection of the young. Under commercial conditions the eggs are incubated by the producer in machines that keep the eggs warm and turned several times a day. In the wild, about half of the eggs will hatch, and about half of the chicks will survive to a year of age. Under commercial conditions, fertility, hatchability, and survival can be improved with proper management, but genetic improvement is still possible. Incubation of the egg takes 42 days. Chicks that are grown for the meat market are slaughtered between 9 and 14 months at 20 to 50 kg of weight. The birds are known to live to be 50 yrs or more, but egg production is only for 30 to 40 years. Breeding and selection is the job for each producer because the Canadian Ostrich Association (in Alberta) does not keep pedigrees or perform genetic evaluations.

Fiona, an ostrich producer, has come to you to compute genetic evaluations on her birds so that she might construct an index to select future breeding males and females. Fiona's data includes data on her neighbor's farm who has bought some of Fiona's birds for breeding.

- (a) The main trait of importance to Fiona is growth rate (or weight at 7 months of age). Write a model (all three parts) that might be needed to analyze weight at 7 months of age for Fiona including her data and that of her neighbor. Data cover the last 5 years of production.

- (b) Fiona can identify the parents of all birds, but has not kept track of birthdates. Below are some animals (by wing clip number) with their parent identification. Order these animals chronologically.

Animal	Sire	Dam	Start	Pass 1	Pass 2	Pass 3
20	200	60	1			
200	100	70	1			
60	40		1			
40	100	70	1			
80	40	60	1			
120	200	30	1			
30	100	70	1			
100			1			
70			1			
50	20	80	1			

15. Given the following pedigrees, construct the additive relationship matrix for all animals in the table.

Animal	Sire	Dam
A		
B		
C	A	B
D	A	C
E	A	D
F	E	D

16. From the inbreeding coefficients in the previous question, compute the  $b_i$  values for animals A to F. ( $b_i = 0.5 - 0.25(F_{sire} + F_{dam})$  for both parents known,  $b_i = 0.75 - 0.25(F_{parent})$  for only one parent known,  $b_i = 1$  for parents unknown.)

Animal	Sire	Dam	Inbreeding	$b_i$
A				
B				
C	A	B		
D	A	C		
E	A	D		
F	E	D		

17. Using the  $b_i$  values construct  $\mathbf{A}^{-1}$  using Henderson's rules.

	animal	sire	dam
animal	x	-.5x	-.5x
sire	-.5x	.25x	.25x
dam	-.5x	.25x	.25x

18. Give an example R function(s) for performing the following tasks.
- (a) To read data from a large file, like `dped.d`.
  
  - (b) To analyze a linear model with two factors.
  
  - (c) To bind two or more rows of numbers together.
  
  - (d) To find out more information about an R function.
  
  - (e) To list the names of variables and functions in your workspace.
  
  - (f) To generate 200 random uniform variates between 0 and 1.
  
  - (g) To run a script file containing your library of R functions.
  
  - (h) To compute the standard deviation of records by age groups.

19. Set up a design matrix for the Age Group variable in the table below.

Animal	Age Group	Tank	Length(cm)
1	1	1	15.3
2	1	2	16.8
3	1	2	13.1
4	2	1	11.9
5	2	1	14.4
6	3	3	17.2
7	3	2	16.5
8	4	3	15.7
9	4	1	12.6
10	4	3	13.9

20. Given the Analysis of Variance table below, what factors would you retain in your final model.

Source	DF	F-value	$Pr(> F)$
Age	5	4.33	.0411
Season	3	1.54	.0972
Year	10	3.09	.0234
Herd-Year	1235	8.19	.0017
Litter	4872	5.88	.0005
Residual	13669		

21. Indicate how to simulate the true genetic value of two animals from a base population having a zero mean and genetic variance of 25.

22. Indicate how to simulate a progeny genetic value from the mating of the two animals in the previous question.



23. Indicate how to determine if the progeny should be a male or female in the simulation.
24. Write the Mixed Model Equations (in matrix notation) and explain what is in  $\mathbf{X}$ ,  $\mathbf{Z}$ , and  $\mathbf{y}$ .
25. Give an example situation where a repeated records animal model would be utilized.
26. Below are the relative EBVs of 3 male alpacas for wool quality, the reliabilities of the EBVs, and the cost to buy that male. Which male would you purchase, assuming you are the owner of many female alpacas, and why?

Male	EBV	Reliability	Cost
George	122	.75	\$8,710
Hugo	112	.95	\$6,160
Ivan	114	.82	\$7,270

27. In mink, the female can store the semen from successive matings to males in her reproductive tract. Thus, if the female mates with 3 different males during her ovulation cycle, the progeny in her litter could be from 3 different males. Some progeny in the litter would be full-sibs and others would be half-sibs to each other. Research using males of different coat colours has shown that the first mating accounts for 75% of the offspring, the second accounts for 10%, and the third accounts for 15% - ON AVERAGE. Construct the additive relationship table for the female, the 3 males and one progeny from the litter. (This is tricky so save until the end).