

Department of Animal Sciences

ANSC 241: Quantitative Genetics and Animal Breeding

Special/Re-sit examination

Instructions:

1. Attempt ALL questions
2. Show your working

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1. Differentiate between the following concepts:
 - a) Selection differential and response to selection
 - b) Genotype and breeding value
 - c) Phenotype and trait
 - d) Inbreeding and breeding objective [16 marks]
 2. In a population the mean body weight of 1 month old juveniles is 1.95 kg. σ_P and σ_A for this trait are 3.5 and 1.5, respectively.
 - a) Determine the heritability for this trait. [2 marks]
 - b) Calculate the breeding value for a rabbit whose body weight at 1 month is 1.2 kg. [2 marks]
 - c) Determine the accuracy of the estimated breeding value for the rabbit in Question 2b above [2 marks]
 - d) If a male rabbit weighing 2.2 kg is mated to a female rabbit weighing 1.8 kg month, what is the expected weight of their offspring? [4 marks]
 3. The following parameters relate to a population of dairy cattle. Use the information to answer the questions that follow.
$$\sigma_A^2 = 30,000 \text{ kg}^2; \sigma_P^2 = 70,000 \text{ kg}^2; \mu = 3,400 \text{ kg}$$
 - a. Determine the estimate breeding value ($\hat{A}$) for an individual with phenotypic measure of 4,200 kg. [2 marks]
 - b. What is the accuracy with which $\hat{A}$ is estimated? [2 marks]
 4. A breeding program was designed to improve the growth rate from birth to weaning. Rams are evaluated based on the performance records of 10 progenies and ewes are evaluated based on own performance. The intensities of selection in males and females are 1.703 and 0.645, respectively. Heritability of the trait is 0.10. The phenotypic standard deviation for the trait is 10 g/day. Determine the response to selection for males and females per generation. [20 marks]
 5. In a population of 5,000 animals it was determined that the proportion of R allele was 0.65.
 - a. State the factors that cause changes in gene frequencies in a population [5 marks]

- b. Assuming this population is in Hardy-Weinberg equilibrium determine the frequencies of the heterozygotes and both homozygotes. [3 marks]
- c. If 2,000 individuals in this population are heterozygous, determine the proportion of individuals with genotypes RR and rr at the locus. [10 marks]
- d. Is this population in Hardy-Weinberg equilibrium? Explain your answer. [2 marks]

6. Genetic relationships are important in Animal Breeding.

- a. Determine the additive genetic relationship between a sire and its offspring [5 marks]
- b. Determine the genetic covariance between a sire and its offspring [5 marks]
- c. Differentiate between pleiotropy and linkage disequilibrium [5 marks]
- d. Write short notes on heterosis [5 marks]