

THE UNIVERSITY OF NEW ENGLAND
EXAMINER INFORMATION FORM

UNIT NAME : **GEST 325**

PAPER TITLE: **Quantitative Genetics and Statistics**

PAPER NUMBER: _____

TIME ALLOWED: **2 (two) hours**

**IS THIS PAPER TO BE WITHHELD FROM THE CANDIDATES AND
LIBRARY REFERENCE AFTER THE EXAMINATION ?**

YES

NUMBER OF PAGES IN PAPER: **4 (FOUR)**

NUMBER OF QUESTIONS ON PAPER: **16 (SIXTEEN)**

NUMBER OF QUESTIONS TO BE ANSWERED: **16 (SIXTEEN)**

Pocket calculators permitted : **YES** (Silent type)

Mathematical tables permitted: **NO**

Other aids required: **NIL**

TEXTBOOKS OR NOTES PERMITTED: **NO**

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SECTION A

30 marks

For each of the following questions write the single letter corresponding to your answer in your examination book. Each question is worth 3 marks. Answer all questions.

- 1 Which of the following depends on the population's gene frequencies?
 - A. The genotypic mean
 - B. The phenotypic value of a specified genotype
 - C. The breeding value of a specified genotype
 - D. A and C above.

- 2 The breeding value of an animal can best be described as:
 - A. Half the expected superiority of its parent
 - B. A measure of libido and fertility
 - C. Twice the expected superiority of its offspring
 - D. The total effect of the genes it carries
 - E. Both A and C above.

- 3 Genetic markers can be useful in animal breeding because:
 - A: They provide information about pieces of DNA which affect economically important traits.
 - B: They remove the need for pedigree and performance recording.
 - C: They can cheaply measure an animals' performance.
 - D: A as well as B.

- 4 Which is a correct description of the coefficient of inbreeding?
 - A. The probability of 2 alleles at a locus being genetically identical
 - B. The probability of 2 alleles at a locus being identical by descent
 - C. Half of the average of the inbreeding coefficient of the 2 parents
 - D. All of these.

5. Maternal effects can be estimated in breeding systems where
- A. Purebred mothers are crossed with terminal sires
 - B. Purebred mothers are mated with crossbred sires
 - C. Crossbred mothers as well as purebred mothers have progeny with data
 - D. Crossbred mothers as well as their offspring have a measurement
- 6 Which of the following describes the generation interval in a population?
- A. The average age of male parents when their progeny are born
 - B. The average age of female parents when their progeny are born
 - C. The average of A and B
 - D. The sum of A and B.
7. Which of the following crossing systems shows most direct heterosis?
- A. F_2 cross (F1 parents)
 - B. 2 breed rotation
 - C. back cross with purebred sire
 - D. F_1 cross. (purebred parents)
8. An estimated breeding values for a trait with a low heritability is expected to be most accurate when it is determined based on?
- A. An animals' individual performance
 - B. A BLUP breeding value, based on the animal's individual record
 - C. A BLUP breeding value based on all family information (information on parents, and 50 half sibs and 2 full sibs)
 - D. Performance records from 100 progeny
9. Progeny testing can be more valuable than mass selection because:
- A. Selection intensity can be increased
 - B. Generation interval can be increased
 - C. Accuracy of estimating breeding values can be increased
 - D. B and C above.
10. The relative economic value of a trait in the breeding objective depends on
- A. The extent to which differences for this trait determine profit
 - B. Whether the traits can be measured or not.
 - C. Whether the trait can be genetically changed easily
 - D. The price of a breeding animal.

SECTION B (40 marks)

Each question is worth as indicated. Answer all four questions.

B - 1. [10 marks]

A breeder is carrying out mass selection for body weight in a flock of sheep. S/he can rank animals on the average of two weighings taken a week apart, with no increase in generation interval. **What percentage extra selection response is the breeder expected to get over a policy of ranking animals on a single weighing alone?** Assume a repeatability of 0.9. Recall the following:

$$\text{Response with one measure} = R = i h^2 \sigma_P = i \frac{V_A}{V_P} \sigma_P = i \frac{\sigma_A}{\sigma_P} \sigma_A$$

$$\text{Variance of the mean of } n \text{ measures: } V_{P(n)} = \left(r + \frac{1-r}{n} \right) V_P$$

B- 2.[10 marks]

In a flock of sheep under selection for greasy fleece weight, the superiority of selected rams averages 0.9 kg and the superiority of selected ewes averages 0.3 kg. Give a reason for the latter figure being smaller. What is the expected response to selection per year if the generation interval is 3.25 years and heritability is 0.4?

B-3 [10 marks]

The age structure for a flock of sheep is shown below. Ages are given in years. The number of lambs weaned per breeding females is equal to 0.8. Assume the breeder practices progeny selection.

Age when progeny are dropped:	2	3	4	5	6	Total
Number of rams :	15	10				25
Number of ewes:	250	200	150	100	50	750

- a) Find the overall generation interval.
- b) What are the selected proportions for males and females?
- c) Explain how an increase in weaning rate would increase the rate of response to selection.

B-4 [10 marks]

Postweaning gain in cattle has been found to be essentially unaffected by maternal effects. Given this, predict the postweaning gain of animals in a 2 breed rotational cross (at equilibrium and averaged over years) derived from two breed rotation of breeds A and B. Use the results in the following table as a source of data. State any assumptions which you make.

GENOTYPE	POSTWEANING GAIN, grams/day
Breed A	900
Breed B	1200
A x B	1190

SECTION C

30 marks

Answer both questions, marks are as shown.

C – 1 [15 marks]

Assume two traits both with positive economic values. Explain with a diagram why optimal selection for two of such traits will be more sensitive to economic values when they are negatively correlated than when they are positively correlated. Use in the diagram the concepts of 'ellipse of all possible genetic responses' and 'iso-economic line'.

C - 2. [15 marks]

Briefly explain why in a breeding program direct markers are more useful than indirect genetic markers.