



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELLOR OF
SCIENCE IN FORENSIC SCIENCE
SBC 121: QUANTITATIVE GENETICS

DATE: Thursday 29th March 2012

TIME: 4.30p.m – 6.30p.m.

INSTRUCTIONS

SECTION A: Answer All Questions (1 mark each)

SECTION A: Answer ALL the questions (1 mark each:20 marks)

Question 1-10 : For each of the following definitions, give the appropriate term and spell it correctly. Terms are single words unless indicated otherwise.

1. The kind of phenotypic variation associated with quantitative traits. (One or two words.)
2. Environmental effect on current record (2 words)
3. Genetic loci that control quantitative traits (3 words)
4. A bell-shaped distribution of continuous phenotypic variation. (One or two words.)
5. A type of allelic interaction in which the phenotype of a heterozygote is outside the phenotypic limits of the corresponding homozygotes.
6. The proportion of the phenotypic variance of a trait that is attributable to gene effects.
7. A statistic expressing how much (on average) one sample variable may be expected to change per unit change in some other variable. (Two words.)
8. A statistical measurement of how closely two sets of sample data are associated, having limits ± 1 . (Two words.)
9. The mating of individuals that are more closely related than the average of the population to which they belong.
10. The superior phenotypic quality of heterozygotes relative to that of homozygotes.

Question 11-20 Choose the best answer

11. A correlation coefficient of zero describes
- A. a positive relationship between two variables
 - B. a negative relationship between two variables
 - C. the lack of a relationship between two variables
 - D. a perfect relationship between two variables
12. Heritability is a measurement that estimates the proportion of
- A. genetic variation in a group that can be attributed to phenotype.
 - B. phenotypic variation in an individual that can be attributed to genes.
 - C. phenotypic variation in a group that can be attributed to genes.
 - D. none of the above.
13. Siblings share ____% of their genes while fraternal twins share ____% and identical twins share ____% of their genes (on average).
- A. 50, 50, 50
 - B. 50, 100, 100
 - C. 100, 100, 100
 - D. 50, 50, 100
14. The most informative studies on how and to what degree heredity and the environment influence human traits have relied on data from
- A. adopted children.
 - B. monozygotic twins separated at birth.
 - C. dizygotic twins reared apart.
 - D. monozygotic twins and their biological parents.
15. A trait more often present in both members of MZ twin pairs than in both DZ twin pairs has a
- A. significant environmental component.
 - B. significant inherited component.
 - C. significant random component.
 - D. no conclusions can be drawn in this case.
16. Characteristics shared by adopted children and their biological parents are mostly ____ while their similarities with adoptive parents reflect ____ influences.
- A. environmental, heritable
 - B. genetic, environmental
 - C. genetic, heritable

- D. plastic, immutable
17. Assume that three pairs of alleles with no environmental modification control height in humans. In this model, each dominant allele contributes four inches to a base height of four feet. What is the range of heights possible in this population?
- A. 0 - 2 feet
 - B. 4 - 5 feet
 - C. 2 - 4 feet
 - D. 4 - 6 feet
18. Given that eye color is controlled by two pairs of genes, what are the genotypes of the lightest-eyed parents who could produce a child with medium brown eyes?
- A. AABB x aabb
 - B. AAbb x aaBB
 - C. AaBb x Aabb
 - D. Aabb x Aabb
19. The form of inheritance in which the heterozygous state is expressed as an intermediate is:
- A. polygenic inheritance.
 - B. sex-linked inheritance.
 - C. dominant-recessive inheritance.
 - D. incomplete dominance.
20. Transgressive variation-----
- A. cannot be explained by the additive polygene model
 - B. is when the phenotypic range of progeny exceed that of intermediate parents.
 - C. is a cross between two inbred lines which displays quantitative traits that exceed those of either parent.
 - D. is when particular combinations of alleles in a heterozygote cause a continuous variable to exceed that in either of the true-breeding parents.

SECTION B: Answer ALL the questions (5 Marks each; 30 Marks))

1. Outline the major applications of quantitative genetics.
2. List 5 differences between quantitative and qualitative inheritance.
3. What are the limitations of the twin study approach in studying the inheritance of quantitative traits in man?

4. Using appropriate examples and/or illustrations, distinguish between
 - a. Threshold traits and multiplicative traits (5 Marks)
 - b. Familial traits and (5 Marks)
5. Flower lengths were measured in two pure lines, and their F_1 and F_2 and backcross progenies. To eliminate multiplicative effects, logarithms of the measurements were used. The phenotypic variances were $P_1 = 48$, $P_2 = 32$, $F_1 = 46$, $F_2 = 130.5$, $B_1 (F_1 \times P_1) = 85.5$, and $B_2(F_1 \times P_2) = 98.5$.
 - a. Estimate the environmental variance (V_E), the additive genetic variance (V_A), and the dominance genetic variance (V_D). (3 Marks)
 - b. Calculate the degree of dominance. (1 Mark)
 - c. Estimate the narrow sense heritability of flower length in the F_2 . (1 mark)
6. A population of adult mice has a mean body weight of 30 g. The average weight of mice selected for breeding purposes is 34g. The progeny produced by random mating among the selected parents average 30.5g. Calculate
 - a. The selection differential (in grams) (2 Marks)
 - b. The genetic gain (in grams) (1 mark)
 - c. The heritability estimate for adult body weight in this population (2 Marks)

SECTION C: Answer TWO Questions (10 Marks each:20 Marks)

1. a) Describe the variance components of quantitative traits and express each of them mathematically. (8 Marks)
- b)What is the practical significance of studying these parameters in breeding? (2 Marks)
2. a) List the main features of heritability? (3 Marks)
- b)Define the following terms and express them mathematically:
 - i. Broad sense heritability (2 Mark)
 - ii. Narrow sense heritability (2 Marks)
 - iii. Realised heritability (1 Marks)
 - iv. Why are breeders more interested in (ii) than in (i)? (2 Marks)

c) A scientist wants to determine the narrow sense heritability of tail length in mice. He measures tail length among the mice of a population and finds a mean tail length of 9.7cm. He then selects the 10 mice in the population with the longest tails. Mean tail length in the selected mice is 14.3cm. He interbreeds the mice with the long tails and examines tail length in the progeny. The mean tail length in the F1 progeny of the selected mice is 13cm. Calculate the narrow sense heritability for tail length in these mice. (3 Marks)

3. a) On what assumptions is the polygenic model of inheritance based? (5 Marks)
- b) Explain the inheritance of a well studied quantitative trait in man whose inheritance supports the polygenic model of inheritance. (15 Marks)