SS2857 Probability and Statistics 1
Fall 2024

Lecture 6

Revised 30/09/24

Activity

Please take two tickets from the desk at the front of the room. You may choose:

- Two Brown
- Two Blue
- One Brown and one Blue

Activity

- Move about the room.
- When I say "stop" trade one ticket with someone close to you.
- You should end up with one old ticket and one new ticket.
- Return to your seat.

Chapter 2 Summary Exercise

Hardy-Weinberg Equilibrium

Background: Genotypes and Phenotypes

https://www.youtube.com/watch?v=ZmE0Q4no5Pk

Background: Eye Colour

Alleles:

- A – brown eyes (dominant)
- a – blue eyes (recessive)

Background: Eye Colour

Your genotype is determined by the pair of alleles you have and your phenotype is your eye-colour.

	Phenotype	
Genotype	Brown	Blue
AA	X	
Aa	X	
aa		X

Question 1

Suppose that a population contains only homozygotes:

- n_{AA} is the numbers of people with genotype AA, and
- n_{aa} is the numbers of people with genotype aa.

The total population size is

$$n = n_{AA} + n_{aa}.$$

Suppose that an offspring is formed from two randomly selected parents. What is the probability that the offspring has each of the genotypes?

Question 2

Suppose that the population is large so that n_{AA}, n_{Aa}, and n_{aa} are all much bigger than 1.

Show that

$$P(G_{AA}) \approx p^2, \quad P(G_{Aa)} = 2p(1-p), \quad P(G_{aa)} = (1-p)^2$$

where p is the proportion of the allele A in the parent population.

Question 3

Suppose now that the population contains all three genotypes:

- n_{AA} is the numbers of people with genotype AA,
- n_{Aa} is the numbers of people with genotype Aa, and
- n_{aa} is the numbers of people with genotype aa.

The total population size is

$$n = n_{AA} + n_{Aa} + n_{aa}.$$

Suppose that an offspring is formed from two randomly selected parents. Show that the same result occurs.

Hardy-Weinberg Equilibrium

A population is said to undergo random mating if:

1) the two alleles an offspring inherits from each parent are independent, and
2) the probability that each allele takes a specific form is equal to the proportion of that allele in the parent population.

In this case, the genotype frequencies of a gene with one dominant and one recessive allele will remain close to p, $2p(1-p)$, and $(1-p)^2$ where p is the frequence of the dominant allele.

Question 4

Suppose that a population in Hardy-Weinberg equilibrium contains n_B people with brown eyes and $n_b = n - n_B$ people with blues.

What is the probability that a randomly selected person has each of the possible genotypes?

Question 5

Suppose that a population in Hardy-Weinberg equilibrium contains n_B people with brown eyes and $n_b = n - n_B$ people with blues.

What is the probability that a randomly selected person has each of the possible genotypes given that they have brown eyes?

Question 6

Suppose that a population in Hardy-Weinberg equilibrium contains n_B people with brown eyes and $n_b = n - n_B$ people with blues.

What is the probability that a randomly selected person has each of the possible genotypes given that they have brown eyes?

Questions?