Solution of question xl-65.2023

Sameer kendal - EE22BTECH11044

Question: The frequencies for autosomal alleles A and a are $p = 0.5$ and $q = 0.5$, respectively, where A is dominant over a. Under the assumption of random mating, the mating frequency among dominant parents is.

Solution: Given: A and a are two alleles where A is dominant one.

Parameter	Value	Description
n	2	number of Alleles
p	0.5	frequency of dominant one
q	0.5	frquency of recessive one
$\mu = np$	1	mean of the distribution
$\sigma^2 = npq$	0.5	variance of the distribution
Y	0,1,2	Number of dominant allele in zygote

1) Gaussian:

$$Y \sim \mathcal{N}\left(\mu, \sigma^2\right) \tag{1}$$

The CDF of Y:

$$F_Y(y) = 1 - \Pr\left(Y > y\right) \tag{2}$$

$$= 1 - \Pr\left(\frac{Y-\mu}{\sigma} > \frac{y-\mu}{\sigma}\right) \tag{3}$$

But,

$$\frac{Y-\mu}{\sigma} \sim \mathcal{N}\left(0, 1\right) \tag{4}$$

$$\tag{5}$$

the Q-function is defined as:

$$Q\left(x\right) = \Pr\left(Y > x\right) \; \forall x \in Y \sim \mathcal{N}(0, 1) \tag{6}$$

therefore the cdf will be:

$$F_Y\left(y\right) = \begin{cases} 1 - Q\left(\frac{y-\mu}{\sigma}\right), & y > \mu \\ Q\left(\frac{\mu-y}{\sigma}\right), & y < \mu \end{cases} \tag{7}$$

For the mating frquency among the dominant parents, both parents must have atleast one dominant allele. The probability of getting atleast 1 dominant allele in parent zygote :
considering 0.1 as correction term:

$$\Pr\left(Y > 1.1\right) = 1 - F_Y\left(1.1\right) \tag{8}$$

$$= Q\left(\frac{1.1-\mu}{\sigma}\right) \tag{9}$$

$$= Q\left(\frac{0.1}{\sqrt{0.5}}\right) \tag{10}$$

$$= Q\left(0.141\right) \tag{11}$$

$$= 0.4439 \tag{12}$$

Gaussian vs Binomial

Number of domiannt allele in zygote	Binomial	Gaussian
Atleast 1	0.75	0.4439