Rabnawaz_lab1

Question 1: Hardy–Weinberg equilibrium

part 1.1

Initially

$$total \;\; population = 2N$$

Frequency of genome

$$f_1(a) = q, \qquad f_1(A) = p, \qquad f_1(p+q) = 1$$

$$f_1(AA) = p^2, \qquad f_1(aa) = q^2, \qquad f_1(Aa) = 2pq$$

Proportions in offspring population:

$$(p+q)^2 = p^2 + q^2 + 2pq = 1$$

$$P(A) = f_1(AA) + \frac{1}{2} f_1(Aa)$$
$$= p^2 + \frac{1}{2}(2pq) = p^2 + pq$$

$$P(a) = f_1(aa) + \frac{1}{2} f_1(Aa)$$
$$= q^2 + \frac{1}{2}(2pq) = q^2 + pq$$

$$P(Aa \;\; or \;\; aA) = pq + pq = 2pq$$

For Second generation:

$$p(AA) = (p^2 + pq)^2 = p^4 + 2p^3q + p^2q^2 = p^2(p^2 + 2pq + q^2) = p^2$$

In the same way:

$$p(aa) = (q^2 + pq)^2 = q^2$$
$$p(Aa \text{ or } aA) = 2(p^2 + pq)(q^2 + pq) = 2(2p^2q^2 + pq^3 + p^3q) = 2pq(p^2 + 2pq + q^2) = 2pq$$

The proportions of the second generation are the same as in the first generation. No, a population in Hardy-Weinberg equilibrium cannot deviate from it with random mating.

part 1.2

```r
MM <- 357
MN <- 485
NN <- 158

p<-(MM+(1/2 * MN)) / sum( MM + MN + NN)
q<-(NN+(1/2 * MN)) / sum( MM + MN + NN)

r = chisq.test(c(MM,MN, NN), p = c(p^2, 2*p*q,q^2))

r$p.value
```

```
## [1] 0.951259
```

Pvalue is greater than 0.05 so population is in Hardy–Weinberg equilibrium.