Hardy-Weinberg Equation Assignment

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In a human population of 1000 members, the alleles I^A, I^B and I^O represent the blood groups. If the frequency of IB and I^O are 0.3 and 0.5 respectively,

Problem 1

Find out the frequency of I^A

Solution: Let the frequency of I^A be "p", frequency of I^B be "q" and frequency of I^O be "r".

According to the Allele frequencies equation:

$$\text{p} + \text{q} + \text{r} = 1$$
$$\text{q} = 0.3,\ \text{r} = 0.5$$
$$\implies \text{p} + 0.3 + 0.5 = 1$$
$$\text{p} + 0.8 = 1$$
$$\text{p} = 0.2$$

Therefore the frequency of I^A allele = p = 0.2 □

Problem 2

Find out the number of individuals with Homozygous A group.

Solution: The total genotype frequency is as follows:

$$(p + q + r)^2 = 1$$
$$p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1$$

For homozygous A group, the frequency is p^2

Therefore the number of individuals with Homozygous A group that is $I^A I^A$ is:

$$p^2 \times 1000$$
$$= 0.04 \times 1000$$
$$= 40$$

□

Problem 3

Find out the number of individuals with Heterozygous A group

Solution: The total genotype frequency is as follows:

$$(p + q + r)^2 = 1$$
$$p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1$$

For heterozygous A group, the frequency is $2pr$
Therefore the number of individuals with Heterozygous A group that is $I^A I^O$ is:

$$2pr \times 1000$$
$$= 0.2 \times 1000$$
$$= 200$$

$\square$

Problem 4

Find out the number of individuals with Homozygous B group

Solution: The total genotype frequency is as follows:

$$(p + q + r)^2 = 1$$
$$p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1$$

For homozygous B group, the frequency is q^2
Therefore the number of individuals with Homozygous B group that is $I^B I^B$ is:

$$q^2 \times 1000$$
$$= 0.09 \times 1000$$
$$= 90$$

$\square$

Problem 5

Find out the number of individuals with Heterozygous B group

Solution: The total genotype frequency is as follows:

$$(p + q + r)^2 = 1$$
$$p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1$$

For heterozygous B group, the frequency is $2qr$
Therefore the number of individuals with Heterozygous B group that is $I^B I^O$ is:

$$2qr \times 1000$$
$$= 0.3 \times 1000$$
$$= 300$$

$\square$

Problem 6

Find out the number of individuals with AB group and O group

Solution: The total genotype frequency is as follows:

$$(p + q + r)^2 = 1$$
$$p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1$$

For O group, the frequency is r^2
Therefore the number of individuals with O group that is $I^O I^O$ is:

$$r^2 \times 1000$$
$$= 0.25 \times 1000$$
$$= 250$$

For AB group, the frequency is $2pq$
Therefore the number of individuals with AB group that is $I^A I^B$ is:

$$2pq \times 1000$$
$$= 0.12 \times 1000$$
$$= 120$$

$\square$