Deacon's Challenge

No 143 - Answer

The distribution of genotypes seen in Chemist's Disease is as shown. Calculate the frequency of the two alleles CCR-5 and ccr-5, and state whether these frequencies accord with the Hardy-Weinberg equilibrium.

Genotype	Number of individuals
CCR-5/CCR-5	568
CCR-5/ccr-5	134
ccr-5/ccr-5	2
Total	704

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No of CCR-5 alleles = (2 x CCR-5/CCR-5) + CCR-5/ccr-5 = (2 x 568) + 134 = 1270

No of ccr-5 alleles = (2 x ccr-5/ccr-5) + CCR-5/ccr-5 = (2 x 2) + 134 = 138

Total alleles = 1270 + 138 = 1408 (i.e. same as 2 x 704)

Frequency of CCR-5 allele = $\frac{\text{CCR-5 alleles}}{\text{Total alleles}} = \frac{1270}{1408} =$ **0.902** (i.e. 90.2%)

Frequency of ccr-5 allele = $\frac{\text{ccr-5 alleles}}{\text{Total alleles}} = \frac{138}{1408} =$ **0.098** (i.e. 9.8%)

Next calculate the expected numbers of the three genotypes (using these frequencies) if the Hardy-Weinberg equilibrium applies (rounded to whole numbers):

Expected CCR-5/CCR-5 = CCR-5 frequency^2 x Total = 0.902^2 x 704 = 573

Expected CCR-5/ccr-5 = 2 x CCR-5 frequency x ccr-5 frequency x Total

= 2 x 0.902 x 0.098 x 704 = 124

Expected ccr-5/ccr-5 = ccr-5 frequency^2 x Total = 0.098^2 x 704 = 7

Finally carry out a chi-squared test to compare the numbers of expected *(E)* and observed *(O)* genotypes:

Chi-squared = $\Sigma\ (O - E)^2/E$

Genotype	Observed *(O)*	Expected *(E)*	*(O - E)*	$(O - E)^2/E$
CCR-5/CCR-5	568	573	-5	0.0436
CCR-5/ccr-5	134	124	10	0.8065
ccr-5/ccr-5	2	7	-5	3.5714
			Total (chi-squared) =	4.4215

Normally the degrees of freedom would be $n - 1 = 3 - 1 = 2$. However, since the observed values were used to calculate the gene frequencies which in turn were used to calculate the expected values, a further degree of freedom is lost leaving only one.

From tables the probability (*P*-value) of obtaining a chi-squared value of 4.42 if there was no real difference between the observed and expected values (i.e. the observed data obeyed the Hardy-Weinberg equilibrium) is between 0.01 and 0.05. **Therefore at the 5% level of probability the observed frequencies are NOT in accord with the Hardy-Weinberg equilibrium.**

Question 144

You are provided with brief details of a method to measure peptide-X. If the mean result of assaying a redissolved extract of peptide-X gives a result of 8 fmol/tube, calculate the concentration of peptide-X in the original sample, expressing the answer in appropriate units.

Immunoassay method for peptide-X:
Extract 1 mL of serum with 5 mL of methanol.
Evaporate methanol to dryness under nitrogen, and redissolve residue in 250 µL of assay buffer.
Assay aliquots (100 µL) of this solution by immunoassay in duplicate.
Calibrate the assay against non-extracted standards to give a result in terms of femtomoles (fmol) per assay tube.

Average expected recovery for peptide-X extraction is 80%.

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