

MS Module 22: χ^2 tests (overview)

(The attached PDF file has better formatting.)

Reading §13.1 Goodness-of-Fit Tests When Category Probabilities Are Completely Specified

This module covers χ^2 tests, along with related p values.

The null hypotheses may specify the probabilities or a relation among the probabilities. If the study examines the probabilities of dominant and recessive alleles (versions of genes), we may test whether the dominant allele has a specified probability or simply whether the alleles follow Mendel's laws.

Binomial experiments use the statistical tests for proportions in earlier modules. Multinomial experiments use χ^2 tests, explained in this module.

The textbook uses illustrations from biology and from sports. Actuarial science also offers many illustrations.

- If mortality rates follow a mathematical curve, the percentage of deaths by age track the expected.
- If accident frequencies follow a mathematical curve, the number of annual accidents track the expected.

A χ^2 test helps decide if differences of actual from expected are random fluctuations or if the expected values are incorrect.

Reading §13.2: Goodness-of-Fit Tests for Composite Hypotheses (until the end of example 13.5 on human blood types)

This section covers χ^2 tests when observed probabilities are functions of other parameters. The probabilities may be phenotypes, and the parameter may be the percentage of alleles of a certain type in the population.

Pricing actuaries use χ^2 tests to judge whether accident frequency has a Poisson distribution or whether risk classifications are homogeneous. The actuary is not testing a specific Poisson distribution, but only testing whether a Poisson distribution is a reasonable model for accident frequency. In general, Poisson distributions are reasonable only for homogeneous classes, so the actuary is testing whether the class is homogeneous.

The final exam problems use allele probabilities, for which the arithmetic can be done without a computer. The examples using Poisson distributions and professional sports playoff games cannot be done by pencil and paper.