AP STATISTICS • EXERCISE SHEET

8.6 Carrying Out a Chi-Square Test for Homogeneity or Independence

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on **carrying out a chi-square test for homogeneity or independence**.

You must be able to:

- compute χ^2 from a two-way table and find the **p-value**
- compare it to α and reach a decision
- state a conclusion about association in context

1 Worked examples

Study these first. Each one shows the method for a question type used later.

The procedure

1. State the hypotheses; check conditions (expected counts ≥ 5).
2. Compute the expected counts, then $\chi^2 = \sum \dfrac{(O-E)^2}{E}$, with $\text{df} = (r-1)(c-1)$.
3. Find the **p-value**.
4. Compare to α: a **small** p-value $\rightarrow$ **reject** H_0 $\rightarrow$ the variables are **associated**.

Finding an expected count

Each expected count is $\dfrac{\text{row total} \times \text{column total}}{\text{grand total}}$. For a cell whose row totals 40 and column totals 50, with grand total 200:

$$E = \frac{40 \times 50}{200} = 10.$$

Compute every E, then sum $\dfrac{(O-E)^2}{E}$.

2 Practice

2.1 State the steps to carry out a chi-square test for a two-way table. [2]

2.2 State what a small p-value indicates about the two variables. [1]

2.3 A test of independence gives a p-value of 0.02 at $\alpha = 0.05$. State the decision. [1]

3 Exam-style questions

3.1 A chi-square test of independence with a small p-value suggests the variables are [1]

- **A** independent
- **B** associated
- **C** exactly equal
- **D** unrelated

3.2 A chi-square test rejects H_0 when the p-value is [1]

- **A** above α
- **B** below α
- **C** exactly zero
- **D** exactly one

3.3 A test of independence gives $\chi^2 = 10$, df $= 2$, p-value 0.007 at $\alpha = 0.05$.

(a) State the decision. [1]

(b) State whether the variables are associated. [1]

(c) State the conclusion in context. [1]

4 Go further

- work through the **8.6 Carrying Out a Chi-Square Test for Homogeneity or Independence** lesson on the **Learn** page;
- read the **Inference for Categorical Data: Chi-Square** section of the AP Statistics handout on the **Know** page.

Solutions

2.1 state hypotheses and check conditions; compute expected counts and χ^2; find the p-value; compare to α and conclude.

2.2 the two variables are associated (not independent).

2.3 reject H_0 ($0.02 < 0.05$).

3.1 B.

3.2 B.

3.3 (a) reject H_0. (b) yes, they are associated. (c) there is convincing evidence of an association between the two variables.