Pabna University of Science and Technology

Faculty of Engineering and Technology

Department of Information and Communication Engineering

Assignment on: Exact Test for 2×2 Tables and Test for r×c Tables.

Course Code: **STAT-2201**

Course title: Engineering Statistics

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<u>Name of Assignment</u>: **Exact Test for 2×2 Tables and Test for r×c Tables.**

(i) For Exact Test for 2×2 Tables (Fisher's Exact Test):

To determine if there is a significant association between two categorical variables arranged in a 2×2 format. Fisher's Exact Test is used when we have a **2×2 contingency table** with small sample sizes. It is especially useful when the expected frequencies in the cells are very small (usually less than 5), where the chi-square test may not be valid.

For example:

	Outcome 1	Outcome 2	Total
Group A	a	b	a + b
Group B	c	d	c + d
Total	a + c	b + d	N

Fisher's Exact Test calculates the exact probability of getting the observed arrangement of data, or one more extreme, assuming the null hypothesis (no association) is true. It uses the hypergeometric distribution to compute the p-value.

- If the p-value is less than the significance level (e.g., 0.05), we reject the null hypothesis and conclude that there is a significant association.
- If the p-value is greater, we fail to reject the null hypothesis.

(ii) Test for r×c Tables (Chi-square Test of Independence)

To test whether two categorical variables are independent . The Chi-square Test of Independence is used for larger tables (r×c) where $r \geq 2$ and $c \geq 2$. It is applicable when sample sizes are sufficiently large and expected frequencies are generally 5 or more in each cell.

Procedure

1. Calculate expected frequencies for each cell:

$$E_{ij} = (\text{Row Total})_i * (\text{Column Total})_j / \text{Grand Total}$$

2. Compute the Chi-square statistic:

$$\chi^2 = \sum (O_{ij} - E_{ij})^2 / E_{ij}$$

3. Degrees of freedom:

$$(r-1)(c-1)$$

4. Compare the calculated Chi-square value with the critical value or compute the p-value.

Comparison Table:

Feature	Fisher's Exact Test (2×2)	Chi-square Test (r×c)
Table Type	2×2 only	Any size (r×c)
Sample Size	Small	Large
Statistical Basis	Exact (Hypergeometric)	Approximation
Output	Exact p-value	Approximate p-value
Use Case	Low expected frequencies	High expected frequencies