Introduction to Statistics and Data Science using *eStat*

Chapter 11 Testing Hypothesis for Categorical Data

11.2.2 Homogeneity Test

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11.1 Goodness of Fit Test

11.1.1 Goodness of Fit Test for Categorical Data
11.1.2 Goodness of Fit Test for Continuous Data

11.2 Testing Hypothesis for Contingency Table

11.2.1 Independence Test
11.2.2 Homogeneity Test

11.2 Testing Hypothesis for Contingency Table

11.2.2 Homogeneity Test

- **Hypothesis:**
  H_0 : Several population distributions are homogeneous
  H_1 : Several population distributions are not homogeneous
- **Decision Rule:**

  'If $\chi^2_{obs} = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij}-E_{ij})^2}{E_{ij}} > \chi^2_{(r-1)(c-1);\,\alpha}$, reject H_0'

  where r is the number of attributes of categorical variable
  and c is the number of populations

11.2 Testing Hypothesis for Contingency Table

[Example 11.2.3] In order to investigate whether viewers of TV programs are different by age for three programs (A, B and C), 200, 100 and 100 samples were taken separately from the population of young people(20s), middle-aged people (30s and 40s), and older people (50s and over) respectively. Their preference of the program were summarized as follows. Test whether TV program preferences vary by age group at the significance level of 5%.

		Young	Middle Aged	Older	Total
TV Program	A	120	10	10	140
	B	30	75	30	135
	C	50	15	60	125
Total		200	100	100	400

11.2 Testing Hypothesis for Contingency Table

<Answer of Example 11.2.3>

- Hypothesis

  H_0 : TV program preferences for age groups are homogeneous.

  H_1 : TV program preferences for age groups are not homogeneous.

- Test Statistic

$$\chi^2_{obs} = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij}-E_{ij})^2}{E_{ij}} = \frac{(120-70)^2}{70} + \frac{(10-35)^2}{35} + \cdots + \frac{(60-31.25)^2}{31.25} = 180.495$$

- Decision Rule

  'If $\chi^2_{obs} > \chi^2_{(r-1)(c-1);\,\alpha}$, reject H_0'

  Since $\chi^2_{(3-1)(3-1);\,0.05} = 9.488$, H_0 is rejected.

Thank you