BASIC STATISTICS IN MEDICAL PRACTICE

Pages with reference to book, From 119 To 120

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X^2(Chi-square) test

So far we have been dealing with the test of significance between two means but in actual practice there may be occasions when we may need to compare the characteristics of more than two groups. For example, we may be interested in comparing the proportions of vaccinated children, and to see whether the proportion attacked varies with the duration of time lapsed since vaccination. For problems like this the X -test was developed. However it is important to note that X2-test can only be carried out on the actual numbers. It cannot be done in percentages, proportions, means or others derived statistics.

2x2 Contingency table

Treatments	Death	Survivors	Total
Adrenalectomy	26(a)	53(c)	79 (a+c)
Hypophysectomy	13 (b)	57(d)	70 (b+c)
Total	39 (a+b)	110 (c+d)	149 (a+b+c+d)

The value of X^2 is calculated by the formula:

$$X^2 = \frac{(ad-bc)^2 (a+b+c+d)}{(a+b)(c+d)(a+c)(b+c)}$$

$$= \frac{(26x57 - 13x53)(149)}{39x110x79x70}$$

$$= 93698501/23723700$$

$= 3.95$ $P < 0.05$ (see Table-C) at d.f = 1

We therefore, reject the null hypothesis and may conclude that hypophysectomy is better treatment.

To illustrate the use and application of X2-test. Let us consider the following example which shows the distribution of intelligence quotients in a group of children.

	Intelligence Quotients				
Nutrition status	under80%	80-89%	90-99%	100%	Total
Satisfactory	245	228	177	219	869
Unsatisfactory	31	27	13	10	81

Solu: The X^2-test is carried out in the following steps:

$$X^2 = \sum \frac{(O-E)^2}{E}$$

1. For each observed number (O) and expected number (E) is found out.
   To calculate the expected number for each cell:
   E11 = 869x276/950; E12 = 869x255/950 ....
   E21 = 81x276/950; E22 = 81x255/950 .....
2. Find out the difference between the observed and expected entries (O-E).
3. Square the differences $(O-E)^2$.
4. Divide the squares so obtained for each cell of the table by the expected number of that cell $(O-E)^2/E$.
5. Find the sum of all $\sum (O-E)^2/E$ which is the required X^2.

Null hypothesis: Nutrition status and intelligence are not associated.

Solu:

		Intelligence Quotients				
Nutrition status	Under 80%		80-89%	90-99%	100%	Total
Satisfactory	(O)	245	228	177	219	869
	(E)	253	233	174	209	
Unsatisfactory	(O)	31	27	13	10	81
	(E)	23	22	16	20	

$$X^2 = 0.25 + 0.11 + 0.05 + 0.48 + 2.78 + 1.14 + 0.56 + 5.0$$

$= 10.37$ $P < 0.02$ (See in table-C) at degree of freedom $(c-1)(r-1) = 3$ where c is the number of columns and r is the number of rows.

Each intelligence group were clinically assessed as having normal or subnormal nutrition[1]. We may therefore say that our null hypothesis is wrong and we conclude that Nutritional status and intelligence are associated.

Further application of X^2:

Suppose we wish to compare two treatments; Adrenalectomy and hypophysectomy for patients with advanced breast cancer. A total of 149 patients were allocated at random to the treatment and comparison was made of patients who survived 3 months after the operation. 75 patients had Adrenalectomy, out of those 53 survived and 70 had Hypophysectomy and of these 57 survived. Solution: This data can be put in 2*2 contingency table with the null hypothesis that "Two treatments are equally effective".

REFERENCE

1. Siddiqui, M.A. Role of Statistics in Medical Research, Pakistan Medical Research Council, Minhas House Annexe PECHS, Karachi. pp 60-61.