# IS MY HYPOTHESIS STATISTICALLY SIGNIFICANT—PART I

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Dear Reader,

In our previous letters on data analysis we explained how data are summarized through descriptive statistics. We also explored the basic elements of hypothesis testing. In this letter we are going to discuss some selected tests of statistical significance used when inferential statistics are appropriate.

"Could you further elaborate on this?"

We need to know which test of significance is appropriate to your data. The choice of a test depends on the type of data available, the nature of population, manner of sampling (e.g. purposive and non-purposive), sample size and hypothesis to be tested. In order to make an objective decision as to whether or not a particular hypothesis can be rejected or accepted, one has to proceed in a systematic way.

### Stating the Null Hypothesis

"I am ready. How should I begin".

The first step is to state the null hypothesis, sometimes noted by "Ho". In our previous letter we said that the null hypothesis is the hypothesis of "no difference" and that it is stated in this way for the purpose of statistical testing.

For example, you have collected data on deliveries conducted by traditional birth attendants and trained health workers from two villages under your health centre. The health centre is situated within eight kilometers of village B, whereas the distance is more than three kilometers in the case of village A. Now you want to know whether or not the distance of the health centre from these villages (where the trained health workers live) makes any difference in villagers' preference for the services of trained health workers. The research hypothesis may be stated as

"Significantly more women of village B will prefer the services of trained health workers than women of village A for deliveries".

"Let me state the conventional null hypothesis required for hypothesis testing"

"There is no difference in preference of services of trained health workers for deliveries by women in villages A and B".

"Good, you have got it. Let's look at this example shown in Table 1".

**Table 1: Home Deliveries by Type of Health Care Personnel**

| Villages | Home Deliveries by Trained Health Workers No. | % | Traditional Birth Attendants No. | % | Total |
|---|---|---|---|---|---|
| A | 4 | 19.05 | 17 | 80.95 | 21 |
| B | 16 | 46.00 | 19 | 24.00 | 35 |
| Totals | 20 | | 36 | | 56 |

Table 1 shows that there is a relative difference between the use of trained health workers in village A and B. In village B, 46% of women used the trained health workers whereas in Village A, only 19.05% utilized them. The test of significance would assess whether this difference is a true difference at a pre-determined level of significance (e.g., .01 or .05 or any other) or has it occurred by chance only.

### Choosing the appropriate test

"Now we have completed the first step—what do you do next?"

The next task is to select the appropriate test. There are several reasons for selecting a specific test, and we will discuss a few of them.

#### 1. Nature of Population

Earlier we have said that one consideration is the nature of the population. The population values are called "parameters". Parametric

statistics refer to the statistical techniques where it is assumed that scores are drawn from a normally distributed population. That means, if we plot the scores of the sample it would form a normal curve.

"Does this mean that in non-parametric statistics we do not assume that the sample is drawn from a population having normal distribution?"

Yes, we may draw a random sample but find that the distribution is skewed. In such cases, we use non-parametric statistics.

**2. Type of Data**

Another consideration for selecting an appropriate test is the type of measurement or the level of data you are using. When we have continuous scores, such as internal and ratio level data, both parametric and non-parametric statistical methods may be used. One such parametric test is called the t-test, which will be discussed later on in this letter.

"How do I analyse the ordinal or nominal level data?"

When the data are in the form of categories, say, on a five point scale or a two-point scale of "Yes—No" or in the form of ranks, non-parametric statistics are used. One such example is Chi-square.

**3. Size of the Sample**

Another consideration in choosing a test is to consider the size of the sample. For example Critical Ratio is applied to determine a significant difference between two sample means when the sample size is large, whereas the t-test is used for the same purpose when the sample size is small.

**4. Hypothesis to be Tested**

"Even after knowing the level data, population and size of sample, how do you determine which parametric or non-parametric statistics to apply?"

It depends upon hypothesis to be tested. When the data contain frequencies based upon categorization (ordinal level data), a **Chi-square** ($Chi^2$ or $\chi^2$) test is generally used to study the association.

**The Chi-square**

The $Chi^2$ test allows the rejection or non-rejection of the hypothesis of "no association" (the appropriate null hypothesis) that is, there is no degree of association between two categories variables.

"In correlation tests also we assess relationships, then in what way is chi-square different from correlation?"

That is a good question. The $Chi^2$ test does not satisfactorily estimate the actual degree of the association as you find in correlation coefficient. Moreover, correlation coefficient is derived from continuous data and looks only at two variables at a time. $Chi^2$ can be applied to ordinal level data as well as data belonging to two or more sets of categories obtained from the same sample as shown in Table 2.

**Table 2: Nutritional Status of 200 School Children**

| | | Beginning of Year Ratings | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | Totals |
| End of year ratings | A | 16 | 08 | 05 | 01 | 30 |
| | B | 08 | 38 | 10 | 04 | 60 |
| | C | 08 | 20 | 22 | 20 | 70 |
| | D | 02 | 10 | 15 | 13 | 40 |
| Totals | | 34 | 76 | 52 | 38 | 200 |

Two hundred school children were examined for nutritional status at the beginning and at the end of the school year. You are interested in the relationship between these two ratings. For the purpose of statistical calculation, the data as given in Table 2 are called "observed frequencies".

"What do these columns and rows indicated?"

The column totals (vertical) show the total number of children at the beginning of the year placed in particular categories, e.g., 34 children were found to have a particular nutritional or "A" Status as of the beginning of the school year. The row totals (horizontal) give the total number of children in each category at the end of the school year. The Table also indicates that 20 children who got "B" nutritional status in the beginning of the year got "C" at the end of the year and so on.

"But, what's the logic behind this test?"

Let's go back to our previous example of villages A and B. Here data are arranged in a

2×2 table as shown now in Table 3.

**Table 3: Home Deliveries by Type of Health Care Personnel—Observed Frequencies**

| Villages | Home Deliveries by | |
|---|---|---|
| | Trained Health Workers | Traditional Birth Attendants |
| A | 4 | 17 |
| B | 16 | 19 |

Suppose, "if" women of villages A and B had no difference in their preference for having trained health workers for deliveries the data would have shown equal preference. The expected data are given in Table 4. These data are called "expected frequencies". The null hypothesis is stated with the assumption of "if".

**Table 4: Home Deliveries by Type of Health Care Personnel—Expected Frequencies**

| Villages | Home Deliveries by | | Total |
|---|---|---|---|
| | Trained Health Workers | Traditional birth attendant | |
| A | 10 | 18 | 28 |
| B | 10 | 18 | 28 |
| Total | 20 | 36 | 56 |

The Chi-square test of significance has to demonstrate that our obtained frequencies as given in Table 3 are different from the expected frequencies as given in Table 4 if there is a real difference between the women of villages A and B using trained health personnel for deliveries.

"When you say 'real difference', do you mean that in terms of level of significance?"

Exactly so! The level of significance of .01 means that the probability that your obtained difference due to a sampling error is less than 1%.

Now let us put both the frequencies together. The expected frequency is noted as "fe" and the observed frequency is written as "fo". Look at Table 5. The difference between fo—fe are noted in each cell.

**Table 5: Home Deliveries by Type of Health Care Personnel**

| Villages | Trained Health Worker | | Traditional attendant | | Total |
|---|---|---|---|---|---|
| | $f_o$ | $f_e$ | $f_o$ | $f_e$ | |
| A | $(f_o - f_e^4 = -6)$ | 10 | $(f_o - f_e^{17} = -1)$ | 18 | 28 |
| B | $(f_o - f_e^{10} = 6)$ | 10 | $(f_o - f_e^{19} = 1)$ | 18 | 28 |
| | 20 | 20 | 36 | 36 | 56 |

The formula for $= \sum \frac{(f_o - f_e)^2}{f_o}$

If you look at the formula carefully you can see that the larger is the deviation, i.e., fo—fe the greater is the Chi-square value.


REFERENCES

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# APPEAL TO LIFE MEMBERS

TNAI has been facing the financial difficulties and is running under deficit due to hike in prices of all goods and high cost of production of Nursing Journal. The association has been supplying the NURSING JOURNAL OF INDIA to its members free as well as meeting all other expenses like affiliations, welfare activities and scholarships etc. without putting any burden on the members.

In the last meeting, the Council of the TNAI has given a considerable thought to this big problem of meeting the deficit and it was decided to APPEAL TO ALL THE LIFE MEMBERS TO CONTRIBUTE GENEROUSLY TOWARDS GENERAL FUND TO MEET THE DEFICIT and help the association grow from strength to strength to safeguard the social and economic welfare of nurses in our country.

Secretary, TNAI.