SJIF 2013 = 1.795
An International Peer Reviewed & Referred
Scholarly Research Journal for Humanity Science & English Language

TESTING OF HYPOTHESIS Parametric Test (T, Z, F) Chi-Square

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Abstract

This article tries to explore the meaning of testing of hypothesis and find out its effect on research work. It aimed at to describe the process of different statistical test followed for the testing of hypothesis. Hypothesis is a most important tool of research. After formulation of hypothesis the researcher goes for its testing. For this purpose he goes step by step. First, he deduces its consequences, then conducts experiment or collect evidence to show that the consequences actually occur, and then tests, i.e., proves or disproves the hypothesis by applying some statically test in case of experimental researcher using internal-external criticism, sain case of historical research or critically analyzing the data in case of qualitative research.

INTRODUCTION

Hypothesis is usually considered as the principal instrument in research. Its main function is to suggest new experiment and observation. Before we explain how hypothesis are tested through different tests meant for the purpose, It will appropriate to explain clearly the meaning of the hypothesis and the related concept for better understanding of the hypothesis testing techniques.

WHAT IS A HYPOTHESIS?

The word hypothesis consist of two words

HYPO+ THESIS

'HYPO' means tentative and 'THESIS' means statement about solution of problem

Importance of Hypothesis

Hypothesis is a very important to do research. The formation of the Hypothesis is a central key step in a good research and In fact it guides a researcher in executing his work.

BAISC CONCEPTS CONCERNING TESTING OF HYPOTHESIS

In the context of statistical analysis, we often talk about null hypothesis and alternative hypothesis. If we are to compare, method A with method B about its superiority and if we proceed on the assumption that both methods are equally good, then this assumption is termed as the null hypothesis, As against this, we may think that the method A is superior or the method B is inferior, we are then stating that is termed as alternative hypothesis. To test a hypothesis means to tell (on the basis of the data the researcher has collected) whether or not the hypothesis seems to be valid. In hypothesis testing the main question is : whether to accept the null hypothesis or not to accept the null hypothesis

Levels of Significance

This is a very important concept in the context of hypothesis testing. Having set up the hypothesis, the next task is to test the validity of the hypothesis. It is a always some percentage (usually 5%) which should be chosen with great care, The researcher has to decide in advance about the level at which he plans to test the hypothesis. It is common convention to adopt 0.05(5/100) and 0.01 or (1/100) as two arbitrary probability standards called levels of significance. In case we take the significance level at 5 per cent, then this implies that hypothesis will be rejected when the sampling result (i.e., observed evidence) has a less than 0.05 probability.

PROCEDURE FOR HYPOTHESIS TESTING

The researcher uses appropriate test procedure. By proper administration of reliable and valid measures, scoring, organization of data and use of appropriate statistical techniques, the researcher arrives at generalization by testing the hypothesis.

STATISTICAL PROCEDURE

Having chosen the problem and completed the collection of data the next step is the analysis of data. The data are of various kinds and are obtained in various ways. They cannot be always analyzed just in one uniform way. There are different ways and techniques in which they can be treated and analyzed. But one thing which is common to all of them is that they all are analyzed statistically. There are a large number of statistical tool and techniques which can be used. The researcher job is ti identify and choose the one which is most relevant in view of the nature of the problem and objectives to be achieved. The test of significance or

hypothesis testing always calls for some kind of statistical model to be used (Statistical procedure can be developed by simplifying the large quantitative of numerical data and thus to assist in the task of obtaining meaning from them) For example, if the significance of difference between two means is to be tested, t-test is used. Now, in this case the model of statically test used is the model of t- distribution. Similarly, model of variance distribution (f-test) is used when there are more than two groups be compared. Like that there are a large number of statistical models or tests which are used in different situations. This raise a problem: how to choose an appropriate model of statistical test when alternative models are available. The most important principal to be followed in this context is that only that model should be selected which is more powerful, i.e., which has a small probability of incorrect rejection of the null hypothesis but a large probability of correct rejection of the null hypothesis. This is the definition of the power of this statistical test. Hence, one consideration in the choice of a statistical model is its power. Other consideration include the method of sampling used, nature of the population, kind of measurement or scaling used for obtaining observation. Related to these aspects each statistical test has certain assumptions or conditions which should be satisfied before it is chosen to be used. From the point of view of the power and inherent assumptions there are two types of models of statistical tests: parametric and non- parametric tests. Parametric test includes tests like t-test and the F-test. They carry with them the most extensive assumptions, hence, are most powerful. On the other hand non-parametric test do not make any assumptions about the distribution of measures to be obtained and analyzed such as normally. Hence, they are known as distribution free tests of significance.

Mean

Mean is the basic statistics tool which no researcher can afford to ignore. It is used to give concise description of the whole group. When the scores are distributed systematically around a central point i.e. when the distribution is not badly skewed. The mean is the centre of gravity in the distribution and each scores contributes for finding the mean.

Let us suppose that six students receive grades of 50, 55, 58,75,66,68, respectively, on an examination. The mean grade will be :

The mean for a distribution is the sum of scores divided by the number of scores.

$$\text{Mean} = \frac{\Sigma fd}{n} = \frac{50+55+58+75+66+68}{6} = 372$$

Let us suppose that we are going to conduct study about occupational stress in relation of emotional intelligence among teacher trainees. Then we can formulate the hypothesis:

1. There exists no difference between emotional intelligence of male and female teacher trainees
2. There exists no difference between occupational stress of male and female teacher trainees After that we can take a sample of 160 people further divided into 80 male and 80 female teacher trainees

Arithmetical mean (step deviation method)

C.I (E.I)	f (No. of female)	Mid point (m)	D=m-A	fd
50-60	5	55	20	100
40-50	18	45	10	180
30-40	20	35	0	0
20-30	15	25	-10	-150
10-20	12	15	-20	-240
0-10	10	5	-30	-300
	N=80			∑fd=-410

f= frequency of each class

N= Total frequency

M= mid-point of various classes

A= Assumed mean (select the assumed mean A, preferably the mid-value of a class which is the centre of distribution.

d = Deviation of mid- points from assumed mean i.e. (m-A)

∑fd =multiply the step-deviation of d' with the respective frequencies of the various classes and find out the sum of the products ∑fd.

The formula used in calculation of Arithmetic mean by Step d=Deviation method is:

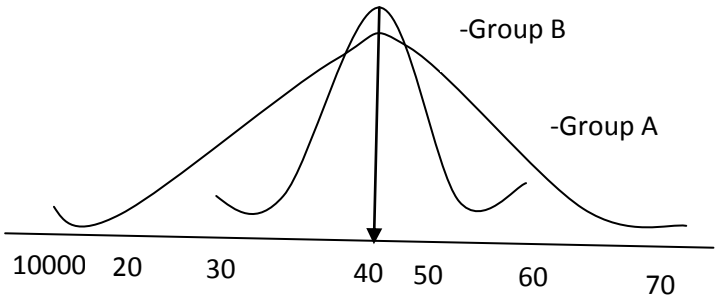
$$\bar{x} = A + \frac{\Sigma fd}{n} \text{ x } i$$

$$35 + \left(\frac{-410}{80}\right) \text{x} 10 = 16.25$$

Standard Deviation

Central Tendency gives overall picture of the performance of the group, whereas measures of variability like standard deviation represent the distribution. It also tells the degree in which the scores are clustered around the mean.

Let us take an example:



There are two frequency distributions of the same area and same mean 40, but of very different variability. Group A ranges from 10 to 70 and group B from 30 to 50. Group A is three times as variable as group B. Thus we observe that measures of central tendency alone are not enough, we should also know how the individual scores are clustered or scattered away from the central value. This property of distribution is called variability.

CALCULATE THE STANDARD DEVIATION FROM THE DATA GIVEN BELOW:

C.I	F(No.ofstudents)	Mid point (m)	D=m-A	fd	fd^2
50-60	5	55	20	100	2000
40-50	18	45	10	180	1800
30-40	20	35	0	0	0
20-30	15	25	-10	-150	1500
10-20	12	15	-20	-240	4800
0-10	10	5	-30	-300	9000
	N=80			$\sum fd$=-410	$\sum fd^2$=24000

$\sum fd$ =multiply the step-deviation of d' with the respective frequencies of the various classes and find out the sum of the products $\sum fd$.

$\sum fd^2$ – sum of the square of the deviation measured from mean

N-total number of items

This following formula has been used.

$\sigma = \sqrt{\sum fd^2/n - (\sum fd/n)^2}$

$\sigma = \sqrt{24000/80 - (410/80)^2}$ =16.544

STANARD ERROR OF MEAN

The standard error of mean is the standard deviation of sampling distribution. The stability depends upon the standard deviation of sampling distribution. The sampling distribution reflects the fluctuations in mean from sample to sample. Suppose that we have administered an intelligence test to 60($8^{th\ class}$) students. The mean and standard deviation of each sample will be different from one another due to sampling fluctuations. The standard deviation or error of each sample of population will be known as standard error. The standard error of mean, therefore, depends upon (1) error of measurement, and (2) sampling fluctuations.

Let us take an example:

S.no.	Sample	N	Mean	S.D(σ)	$S.E_D$
1	E.I of male t.t	80	121.44	12.78	?
2	E.I of female t.t	80	123.03	10.30	

The standard error was found by the following formula

$$S.E_D = \sqrt{\frac{\sigma 1}{n1} + \frac{\sigma 2}{n2}}$$

$$SE_D = \sqrt{\frac{12.78}{80} + \frac{10.30}{80}} \quad = 1.83$$

T-test and Z-test

To determine the significance of difference between any two selected means, we must compute a t- ratio by dividing the mean difference by its $SE_{D.}$ When the N's of the two samples are large (more than 30) the distribution of CR's(Z) is known to be normal around the true differences between the population means. 't' is defined in a similar manner as we have defined Z. " It is the ratio of deviation from the mean or other parameter in a distribution of a sample statistics to the standard error of the distribution." WE get sampling distribution in case of both t and Z. The frequency distribution either for t and Z is formed when we calculate the ratio for every sample drawn from the same population. The obvious distinction between the Z and t as discussed earlier is that Z is normally distributed and is applied when sample are large, whereas t is applied when sample are small. It is so because as when N increases t approaches the normal distribution. The t may be applied regardless of the size of sample, whereas the function of Z is restricted only to large sample. The value of every t for significance a 0.05 and 0.01 level changes with respect to chance in N which further brings in the shape of distribution. The level of significance of Z test at 0.05=1.96 and 0.01=2.58 and its never change. There is no need to look the table in Z- test.

t-ratio $\frac{m1-m2}{SE_D}$ $\frac{121.44-123.03}{1.83}$ = 0.87

S.No	Sample	N	Mean	S.D(σ)	$S.E_D$	t-ratio
1	E.I of male t.t	80	121.44	12.78	1.83	?
2	E.I of female t.t	80	123.03	10.30		

The t is = 0.87 and the degree of freedom to be used (n1+n2-2) in testing this t are 80+80-2 or158.

Entering table D with 158 df, we find that our t of 0.87 is smaller than 2.62 the 0.1 and 1.98 the 0.5 , which is insignificant at both level , this signifies that male and female teacher trainees do not differ in emotional intelligence.

The reason may be that both male and female get equal environment problems. It is observed that both male and female teacher trainees can properly adjust and handle their problems effectively. Both remain balance emotionally and use their emotions appropriately even in adverse situations of life.

Therefore the hypothesis 1, "There exists no difference between emotional intelligence of male and female teacher trainees", is accepted.

S.no.	Sample	N	Mean	S.D(σ)	S.ED	t-ratio
1	E.I of male t.t	80	121.44	12.78	1.83	0.86 (insignificant)
2	E.I of female t.t	80	123.03	10.30		

Analysis of variance (ANOVAs)

The statistical method known as the t- test is applied to a situation in which they are two conditions or treatments of the independent variable and, hence there are only two groups to be compared on the dependent variable. But experiments are not confined to only two treatments or groups. In many situations an independent variable is required to be varied in more than two ways. In this case, then there are more than two groups to be compared. For example, in studying the relationship between the level of motivation and exploratory behavior of young children the researcher may be like to vary the independent variable, motivation, in three ways such as highly motivated, ordinary motivated and poorly motivated and may like to compare them on exploratory behavior measures. The t-test , through applicable, is not appropriate method in this situation. the method which is used in such situations is called the analysis of variance original developed by the late Sir Ronald A. Fisher Instead of the difference between the two means, it is the various components of the total variance which form the basis of comparison in the case of analysis of variance. It is shortly written as ANOVAs

Let us take an example

In this table X is our independent variable which has three treatment condition or levels, X_1

X_1	X_2	X_3
6	4	6
2	2	5
3	5	4
5	1	4
4	3	6
∑ =20	15	25 =60

X_2 X_3 . The analysis of variance will involve the following steps:

1. Correction Term (C) =(∑X)2 /N

   (60)2/15 = 240.0

2. SS_T = Total Sum of squares –C

   = $(6^2 + 2^2 \ldots\ldots\ldots 4^2 \ldots\ldots\ldots\ldots 6^2)$ - 240.0 = 34.0

3. Sum of square among means of $\sum X_1, \sum X_2, \sum x_3$

$$ss_A = \frac{(\sum X_1)2+(\sum X_2)2+(\sum X_3)2}{N} \text{ -C}$$

$$ss_A = \frac{(20)^2 + (15)^2+(25)^2}{5} - 240.0 = 10.0$$

4. Sum of square with in condition X_1, X_2, X_3,

$$s_W = sS_T - sS_A = 34.0 - 10.0 = 24.00$$

SUMARRY: ANALYSIS OF VARIENCE

Source of variation	Df	Sum of square	Variance
Among the means of conditions	(a-1)=(3-1)=2	10.0	5
With in condition	(n-a)=12	24.0	2

F $= \frac{5}{2} = 2.50$

From Table F for

$Df_1 = 2$ and $df_2 = 12$

f at .05=3.88 and f at .01 =6.93

Conclusion: treatments are not significantly different from one another with regard to their effects upon dependent variable.

Chi-square test

There is one more method to test the hypothesis; this is known by chi square. It is invented by Karl Pearson and this is derived from geek word.

T-test and ANOVAs are used when the populations are normally distributed and have equal variance. But a chi square test can often be used when the data do not met these assumptions. Instead of using the measurement to calculate a mean, we simply use them to categorize

individual observations e.g. As high, average and low or above and below or agree, undecided, disagree etc. Choice of categories of course depends on the researcher's theory and type of problem. The chi-square test represents a useful method of comparing experimental obtained results with those to be expected theoretically on some hypothesis.

Let us take an example.

An investigator wanted to know, whether educated ladies in general, like to be employed. To test this 48 educated ladies have been selected and asked each of them to report whether they are 1.prefering 2 not preferring or 3.Indifferent choices

Let us have a null hypothesis i.e. there is no difference in the opinion (opinion is equal).

The researcher got the frequency of each response as follows

F	preferred	Not preferred	indifferent	Total
Observed (F_o)	24	12	12	48
Expected (F_e)	16	16	16	48
F_o-F_e	8	4	4	
$(F_o-F_e)^2$	64	16	16	
$(F_o-F_e)^2/F_e$	4	1	1	6 =x^2 value

$$x^2 = \sum (F_o-F_e)^2/F_e$$

In the above example chi-square value for each cell has been calculated and then they all have summed up. The total chi-square value comes to be 6, this has to be taste for significance. For this purpose we use the chi-square table in the same way as is done in case of t-test. We see the chi- square value in table for given degrees of freedom at a predecided level of significance. For calculating the degrees of freedom we use the formula (r-1)(k-1) in which r means number of rows and k means number of groups. In the present example there are two rows and three groups .Hence, df =(2-1)(3-1) =2. For 2df at0.5level chi square value=5.991.(table D) Hence, at . 05 level the null hypothesis "that there is no n difference between the obtained and expected distribution" is rejected. (when df is equal to or less than table value at previously decided level of significance than hypothesis should be accepted. If not, hypothesis should be rejected. In other words if obtained chi-square is greater than or equal to the table chi-square value, the hypothesis is rejected. 0therwise it is accepted.

Conclusion

The hypothesis is the most important tool in research .After formulating a hypothesis the researchers goes to test the hypothesis. To achieve this purpose the researcher goes step by step. First, he deduces its consequences, than conducts experiment or collects evidence to show that the consequences actually occur, and then tests. There are a large number of statistical tools and techniques which can be use .The researcher's job is to identify and

choose the one which is most relevant in view of the nature of the problem and objectives to be achieved

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