In each of the following situations, state whether it is a correctly stated hypothesis

testing problem and why?

1.H0: μ = 25, H1: μ ≠ 25

**Ans** : It is correct.The Null hypothesis is always opposite to Alternate hypothesis.

2. H0: σ > 10, H1: σ = 10

Ans : It is not correct.Becuase,H1 : should be σ <= 10

3. H0: x = 50, H1: x 50

Ans : It is correct.Because, hypothesis is opposite to Alternate hypothesis.

4. H0: p = 0.1, H1: p = 0.5

Ans : It is not correct.Because,the the proportions are not equal to 1.

5. H0: s = 30, H1: s > 30

Ans : It is not correct.Because,H1 should be s ≠ 30

**Problem Statement 2:**

The college bookstore tells prospective students that the average cost of its

textbooks is Rs. 52 with a standard deviation of Rs. 4.50. A group of smart statistics

students thinks that the average cost is higher. To test the bookstore’s claim against

their alternative, the students will select a random sample of size 100. Assume that

the mean from their random sample is Rs. 52.80. Perform a hypothesis test at the

5% level of significance and state your decision.

**Ans:**

H0: μ = 52, H1: μ ≠ 52

S=4.50

Sample size(n)=100

Sample mean(x)=52.80

Test statistic(z)=(x-u)/S/sqrt(n)

=(52.80-52)/4.50/sqrt(100)

=0.8/0.45

**Test statistic =1.78**

The critical value for the level of significance(0.05) is **1.96**

**Conclusion :**

Since the Test statistic =**1.78 falls below 1.96**,the **Null hypothesis is correct**.

The average cost of its textbooks is Rs. 52

**Problem Statement 3:**

A certain chemical pollutant in the Genesee River has been constant for several

years with mean μ = 34 ppm (parts per million) and standard deviation σ = 8 ppm. A

group of factory representatives whose companies discharge liquids into the river is

now claiming that they have lowered the average with improved filtration devices. A

group of environmentalists will test to see if this is true at the 1% level of

significance. Assume \ that their sample of size 50 gives a mean of 32.5 ppm.

Perform a hypothesis test at the 1% level of significance and state your decision.

**Ans :**

H0: μ = 34, H1: μ ≠ 34

S = 8 ppm

Sample size(n)=50

Sample mean(x)=32.5

Significance level=1%

Test statistic(z)=(x-u)/S/sqrt(n)

=(32.5-34)/8/sqrt(50)

=-1.5/1.13**=-1.33**

The critical value for significance level 1% is **-2.58**

**Conclusion:**

Since Test statistic **=-1.33** falls in Acceptance region i.e not falls in **-2.58**,the **Null hypothesis is accepted**.

**Problem Statement 4:**

Based on population figures and other general information on the U.S. population,

suppose it has been estimated that, on average, a family of four in the U.S. spends

about $1135 annually on dental expenditures. Suppose further that a regional dental

association wants to test to determine if this figure is accurate for their area of

country. To test this, 22 families of 4 are randomly selected from the population in

that area of the country and a log is kept of the family’s dental expenditure for one

year. The resulting data are given below. Assuming, that dental expenditure is

normally distributed in the population, use the data and an alpha of 0.5 to test the

dental association’s hypothesis.

1008, 812, 1117, 1323, 1308, 1415, 831, 1021, 1287, 851, 930, 730, 699,

872, 913, 944, 954, 987, 1695, 995, 1003, 994

**Ans :**

H0: μ = 1135, H1: μ ≠ 1135

S = 240.37

Sample size(n)=22

Sample mean(x)=1031.32

Significance level=5%

Test statistic(z)=(x-u)/S/sqrt(n)

=(1031.32-1123)/240.37/sqrt(22)

**Test statistic=-2.02**

Critical value at **5 % is -1.96 or 1.96**

**Conclusion :**

Since the Test statistic falls in the rejection region,the **Null hypothesis is rejected.**

**Problem Statement 5:**

In a report prepared by the Economic Research Department of a major bank the

Department manager maintains that the average annual family income on Metropolis

is $48,432. What do you conclude about the validity of the report if a random sample

of 400 families shows and average income of $48,574 with a standard deviation of

2000?

**Ans:**

H0: μ = 4832, H1: μ ≠ 4832

S = 2000

Sample size(n)=400

Sample mean(x)=48574

Significance level=10%

Test statistic(z)=(x-u)/S/sqrt(n)

=(48574-4832)/2000/sqrt(400)

**Test statistic=1.42**

Critical value at 10 % =-**1.645 or 1.645**

**Conclusion:**

Since **1.42 falls in acceptance region, the Null Hypothesis is Accepted.**

**Problem Statement 6:**

Suppose that in past years the average price per square foot for warehouses in the

United States has been $32.28. A national real estate investor wants to determine

whether that figure has changed now. The investor hires a researcher who randomly

samples 19 warehouses that are for sale across the United States and finds that the

mean price per square foot is $31.67, with a standard deviation of $1.29. assume

that the prices of warehouse footage are normally distributed in population. If the

researcher uses a 5% level of significance, what statistical conclusion can be

reached? What are the hypotheses?

**Ans:**

H0: μ = 32.28, H1: μ ≠ 32.28

s = 1.29

Sample size(n)=19

Sample mean(x)=31.67

Significance level=5%

Test statistic(z)=(x-u)/s/sqrt(n)

=(31.67-32.28)/1.29/sqrt(19)

**Test statistic=-2.1**

Critical value at **5% is -1.96 or 1.96**

**Conclusion :**

Since Test statistic falls in the rejection region,the **Null hypothesis is rejected.**

**Problem Statement 8:**

Find the t-score for a sample size of 16 taken from a population with mean 10 when

the sample mean is 12 and the sample standard deviation is 1.5.

**Ans :**

t-score= [ x - μ ] / [ s / sqrt( n ) ]

=(12-10)/(1.5/sqrt(16)

=2/(1.5/4)

**t-score =5.33**

**Problem Statement 20:**

Children of three ages are asked to indicate their preference for three photographs of

adults. Do the data suggest that there is a significant relationship between age and

photograph preference? What is wrong with this study? [Chi-Square = 29.6, with 4

df: p < 0.05].

**Ans :**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **photograph:** | | |  |
| **age of child:** | **A:** | | **B:** | **C:** | **row totals:** |
| **5-6 years** | **18** | | **22** | **20** | **60** |
| **7-8 years** | **2** | | **28** | **40** | **70** |
| **9-10 years** | **20** | | **10** | **40** | **70** |
| **column totals:** | **40** | | **60** | **100** | **200** |

                   (row total \* column total)

            E =           ----------------------------------------

                                      grand total

          For each cell of the above table, this gives us:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **O:** | **18** | **22** | **20** | **2** | **28** | **40** | **20** | **10** | **40** |
| **E:** | **12** | **18** | **30** | **14** | **21** | **35** | **14** | **21** | **35** |

Next, work out (O - E):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(O-E):** | **6** | **4** | **-10** | **-12** | **7** | **5** | **6** | **11** | **5** |

Square each of these, to get (O - E)2:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(O - E)2:** | **36** | **16** | **100** | **144** | **49** | **25** | **36** | **121** | **25** |

Divide each of the above numbers by E, to get  (O - E)2 / E:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(O - E)2**  **----------**  **E** | **3** | **0.89** | **3.33** | **10.29** | **2.33** | **0.71** | **2.57** | **5.76** | **0.71** |

Chi-squared is the sum of these:

            2 = **29.60**.

            d.f. = (rows - 1) \* (columns - 1) = 2 \* 2 = 4.

**Conclusion :**

            The critical value of Chi-Square in the table for a 0.001 significance level and 4 d.f. is 18.46. Our obtained Chi-Square value is bigger than this: therefore we have a Chi-Square value which is so large that it would occur by chance only about once in a thousand times. It seems more **reasonable to accept the alternative hypothesis**, that there is a significant relationship between age of child and photograph preference.

**Problem Statement 21:**

A study of conformity using the Asch paradigm involved two conditions: one where

one confederate supported the true judgement and another where no confederate

gave the correct response.

Is there a significant difference between the "support" and "no support" conditions in the

frequency with which individuals are likely to conform? [Chi-Square = 19.87, with 1 df:

p < 0.05].

|  |  |  |
| --- | --- | --- |
| **support** | **no support** | **row totals:** |
| **conform:** | **18** | **40** | **58** |
| **not conform:** | **32** | **10** | **42** |
| **column totals:** | **50** | **50** | **100** |

**Ans:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **O:** | **18** | **40** | **32** | **10** |
| **E:** | **29** | **29** | **21** | **21** |

Next, work out (O - E):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(|O-E|- 0.5):** | **10.5** | **10.5** | **10.5** | **10.5** |

Square each of these, to get (O - E)2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(|O-E|- 0.5)2:** | **110.25** | **110.25** | **110.25** | **110.25** |

Divide each of the above numbers by E, to get  (O - E)2 / E:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(O - E)2**  **-----------**  **E** | **3.80** | **3.80** | **5.25** | **5.25** |

Chi-squared is the sum of these:

            2 = **18.10.**

            d.f. = (rows - 1) \* (columns - 1) = 1 \* 1 = 1.

**Conclusion :**

            Our obtained value of Chi-Squared is bigger than the critical value of Chi-Squared for a 0.001 significance level. In other words, there is less than a one in a thousand chance of obtaining a Chi-Square value as big as our obtained one, merely by chance. **Therefore we can conclude that there is a significant difference between the "support" and "no support" conditions, in terms of the frequency with which individuals conformed.**

**Problem Statement 22:**

We want to test whether short people differ with respect to their leadership qualities

(Genghis Khan, Adolf Hitler and Napoleon were all stature-deprived, and how many midget

MP's are there?) The following table shows the frequencies with which 43 short people and

52 tall people were categorized as "leaders", "followers" or as "unclassifiable". Is there a

relationship between height and leadership qualities?

[Chi-Square = 10.71, with 2 df: p < 0.01].

**Ans:**

|  |  |  |
| --- | --- | --- |
| **short** | **tall** | **row totals:** |
| **leader:** | **12 (19.92)** | **32 (24.08)** | **44** |
| **follower:** | **22 (16.29)** | **14 (19.71)** | **36** |
| **unclassifiable:** | **9   (6.79)** | **6   (8.21)** | **15** |
| **column totals:** | **43** | **52** | **95** |

Chi-Square  = 3.146 + 2.602 + 1.998 + 1.652 + 0.720 + 0.595 = **10.712**, with 2 d.f.

**Conclusion :**

            10.712 is bigger than the tabulated value of Chi-Square at the 0.01 significance level. We would conclude that there seems to be a relationship between height and leadership qualities. Note that we can only say that there is a relationship between our two variables, not that once causes the other. There could be all kinds of explanations for such a relationship.