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**Phase-II, Hayatabad, Peshawar**

**Khyber Pukhtunkhwa**

**Paper : Statistical Inference**

**Subject : Business Administration**

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 **PART A (Objectives)**

**Choose the best answer. (10)**

 **i) C**hi square distribution is

 **a. Normal (Answer)** b. Uniform c. Asymmetrical d. None

 **ii) A** hypothesis is a claim about

 a. Sample statistic **b. population parameter (Answer)** c. A study d. all

 **iii)** Type 1 error in hypothesis testing is related to

 **a. Rejecting a true null hypothesis (Answer)**

 b. Accepting a true null hypothesis

 c. Accepting a false alternate hypothesis

 d. P value approach.

**Part IV) and v) are related to following condition**

A manufacturer of fluorescent light bulbs claims that the mean life of these bulbs is 2500 years. A consumer agency wanted to check whether or not this claim is true. The agency took a random sample of 36 such bulbs and tested them. The mean life for the sample was found to be 2447 hours with a standard deviation of 180 hours.

**iv)** The null and alternative hypotheses are:

1. 
2. **(Answer)**
3. 
4. 

 **v)** The test statistic is:

1. z =1.76
2. **z = -1.76 (Answer)**
3. t = -0.29
4. t =0.29

**vi)**  f distribution is associated with

 a. Population mean

 b. Population proportion

 c. One population variance

 **d. Two population variance. (Answer)**

**vii)** If p-value is greater than , we will

 **a. Accept the null hypothesis (Answer)**

 b. Reject the null hypothesis

 c. No effect on decision

 d. Accept the alternate hypothesis

**viii)** If value of  i.e. the level of significance isn’t specified, then we take it at…….. .

**Answer: 0.05 or 5%**

 **ix)** Acceptance and rejection region in the critical region approach is associated with……….. hypothesis.

**Answer: Null-Hypothesis**

 **x) ………….** test is used when  is unknown.

**Answer: T – Test (t-statistics)**

 **PART B**

**Q1: (a)** For each of the following statements if tested, write the null and alternate hypothesis. **(5)**

1. The normal person has an average IQ of 100.
2. More than 65% of cola drinkers prefer Coke to Pepsi.
3. Waiting time to place an order has changed from the mean time of 4.5 min.

**Answer:**

**1:** $H\_{0}:μ=100$

$ H\_{0}:μ\ne 100$

**2:** $H\_{0}:π\leq 0.65$

$H\_{1}:π>0.65$

**3:** $H\_{0}:μ=4.5$

$H\_{0}:μ\ne 4.5$

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**(b)** If following are the results for hypothesis testing, analyze whether you will accept or reject null hypothesis. **(5)**

**Value of test statistic Value for critical region Type of test**

-1.57 -3.06 Left tail

 4.9 3.2 Two tail

 1.8 0.8 Right tail

**Answer:**

**1: -3.06 lies in Rejection region.**

**2: 3.06 lies in Acceptance region.**

**3: 0.8 lies in Acceptance region.**

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**Q2: (a)** John wants to send packages by courier and determine the variability in charges. A random sample of 18 packages give the standard deviation $1.22.Construct 80% and 98% confidence interval for the variance in charges of packets.. **(6)**

**Answer:**

**Data:**

N = 18

Std. Dev. = $1.22

**Required:**

Construct 80% and 98% confidence interval in charges =?

**Solution:**

**For 80% confidence level:**

CL = 100 – 80 $⇒ \frac{20}{100} $

 α= 0.2 $\frac{α}{2}=0.1$

$\frac{\left(n-1\right) S^{2}}{x^{2} ^{∝}/\_{2}} \leq ϑ^{2}\leq \frac{\left(n-1\right)s^{2}}{x^{2}(1-^{∝}/\_{2}}$

$\frac{\left(18-1\right)(1.22^{2})}{24.769}\leq ϑ^{2}\leq \frac{(18-1)(1.22^{2})}{10.085}$

$\frac{17(1.4884)}{24.769}\leq $ $ϑ^{2}\leq \frac{17(1.488)}{10.085}$

$$\frac{25.3028}{24769}\leq ϑ^{2}\leq \frac{25.3028}{10.085}$$

$1.021 \leq θ^{2}\leq 2.5089$ **(Answer)**

**For 98% confidence level:**

$100-98=^{2}/\_{100} =\gg ∝=0.02$

$\frac{∝}{2}=\frac{0.02}{2} ^{∝}/\_{2}=0.01 $

$\frac{\left(n-1\right) S^{2}}{x^{2} ^{∝}/\_{2}} \leq ϑ^{2}\leq \frac{\left(n-1\right)s^{2}}{x^{2}(1-^{∝}/\_{2}}$

$\frac{\left(18-1\right)(1.22^{2})}{32.00}\leq ϑ^{2}\leq \frac{(18-1)(1.22^{2})}{6.408}$

$\frac{17(1.4884)}{32.00}\leq $ $ϑ^{2}\leq \frac{17(1.488)}{6.408}$

$$\frac{25.3028}{32.00}\leq ϑ^{2}\leq \frac{25.3028}{6.408}$$

 $0.7907\leq θ^{2}\leq 3.9486$**(Answer)**

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 **(b)** Write the table values for the following. **(4)**

* **n= 12  = 1 %** Write t value and chi square value
* n1= 25 , n2 = 5  = 0.01 Write f value
* z = -2.22 Write z table value.

**Answer:**

**1)**

 n = 12

 α = 0.005

 **t-value is** **3.1058**

 **Now for chi square value,**

 n = 12

 α = 1%

 $\frac{α}{2}$ = 0.005

 $π^{2}= \frac{α}{2}=26.757$

**2)** n1 = 25

 n2 = 5

 α = 0.01

 For $v\_{1}⇒n1-1$

 $25-1=24$

 For $v\_{2}⇒n2-1$

 $5-1=4$

 **f-table value is 13.93**

**3)**  -2.22 value in z-table **0.0132**

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**Q3(b) :( a) A** machine is used to dispense liquid dressing on salad. The mean dispense was 8 ounce with a standard deviation of 0.15 ounce. A sample of 50 bottles taken show the mean content dispensed was 7.955. Test at 1% level of significance that the mean content dispensed is not 8 ounce. Also find the p value.

**(b)** The following information is available for two samples taken from two populations.

* n1 = 16 and n2 = 13
* Std. deviation of 1st sample = 6.88 and std. deviation for 2nd sample = 6.04

 Construct 95% confidence interval for two population variances. **(3)**

 **Part: A**

**Answer:**

$ϑ=0.15$

$n=50$

$μ=8$

$x=7.955$

$∝=1\%$

$p=?$

**Step 1:**

$H\_{0}: μ=8$

$H\_{1}: μ\ne 8$

**Step 2:**

**Z – Test**

$Z=\frac{x-μ}{\frac{ϑ}{\sqrt{n}}}$

**Step 3:**

Z = $\frac{7.955-8}{0.15/\sqrt{50}}=\frac{-0.045}{0.15/7.07} =\frac{-0.045}{0.021} =- 2.14$

**Now P – value;**

P (Z > 2.14) = 0.9838

1 – 0.9838 = 0.0162

P (Z < - 2.14) = 0.0162

P = 0.0162 + 0.0162

= 0.0324

* + P is less than α and we reject H0 and accept HA.

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**Part: B**

**Answer:**

n1=16 n2=13 S1=6.88 S2=6.04

C.I=95%

V1= n1-1 =16-1

V2=n2-1=13-1

V1=15

V2=12

 $∝=1\% , ^{1}/\_{100}$

 $∝=0.01 , ^{∝}/\_{2}=^{0.01}/\_{2}$,$^{∝}/\_{2}=0.005$

$$0.4080<\frac{\sqrt{σ}}{\sqrt{σ}}<3.839$$

**We are 95% confident that the true ratio of population variance is conatained by the above interval.**

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**Q4:** Differentiate between. **(3+ 4+3)**

* One tail and two tail test with an example
* Z test and t test
* Null and alternate hypothesis.

**Answer:**

* **One Tail and Two Tail Test:**

**Two-Tailed Hypothesis Tests**

Two-tailed hypothesis tests are also known as nondirectional and two-sided tests because we can test for effects in both directions. When we perform a two-tailed test, we split the significance level percentage between both tails of the distribution.

In a two-tailed test, the generic null and alternative hypotheses are the following:

* **Null**: The effect equals zero.
* **Alternative**:  The effect does not equal zero.

The specifics of the hypotheses depend on the type of test you perform because we might be assessing means, proportions, or rates.

**For example**, suppose we wish to compare the averages of two samples A and B. Before setting up the experiment and running the test, we expect that if a difference between the two averages is highlighted, we do not really know whether A would be higher than B or the opposite. This drives us to choose a two-tailed test, associated to the following alternative hypothesis: **Ha: average (A) ≠ average (B)**. Two-tailed tests are by far the **most commonly used**tests.

**One-Tailed Hypothesis Tests**

One-tailed hypothesis tests are also known as directional and one-sided tests because we can test for effects in only one direction. When we perform a one-tailed test, the entire significance level percentage goes into the extreme end of one tail of the distribution.

In a one-tailed test, we have two options for the null and alternative hypotheses, which correspond to where you place the critical region.

We can choose either of the following sets of generic hypotheses:

* **Null**: The effect is less than or equal to zero.
* **Alternative**: The effect is greater than zero.

 In the **example** described above, the alternative hypothesis related to a one-tailed test could be written as follows: **average (A) < average (B)** or **average (A) > average (B)**, depending on the expected direction of the difference.

* **Null and Alternate Hypothesis:**

**Null Hypothesis**

The null hypothesis reflects that there will be [no observed effect](https://www.thoughtco.com/null-hypothesis-examples-609097) in our experiment. In a mathematical formulation of the null hypothesis, there will typically be an equal sign. This hypothesis is denoted by *H*0.

The null hypothesis is what we attempt to find evidence against in our hypothesis test. We hope to obtain a small enough [p-value](https://www.thoughtco.com/the-difference-between-alpha-and-p-values-3126420) that it is lower than our level of significance alpha and we are justified in rejecting the null hypothesis. If our p-value is greater than alpha, then we [fail to reject](https://www.thoughtco.com/fail-to-reject-in-a-hypothesis-test-3126424) the null hypothesis.

If the null hypothesis is not rejected, then we must be careful to say what this means. The thinking on this is similar to a legal verdict. Just because a person has been declared "not guilty", it does not mean that he is innocent. In the same way, just because we failed to reject a null hypothesis it does not mean that the statement is true.

**The Alternative Hypothesis**

The alternative or experimental hypothesis reflects that there will be an observed effect for our experiment. In a mathematical formulation of the alternative hypothesis, there will typically be an inequality, or not equal to symbol. This hypothesis is denoted by either *H*a or by *H*1.

The alternative hypothesis is what we are attempting to demonstrate in an indirect way by the use of our hypothesis test. If the null hypothesis is rejected, then we accept the alternative hypothesis. If the null hypothesis is not rejected, then we do not accept the alternative hypothesis.

* **Z-Test and T-Test:**

**Z-Test**

* Z-test is kind of hypothesis test which ascertains if the averages of the 2 datasets are different from each other when standard deviation or variance is given.
* The Population variance or standard deviation is known here.
* The Sample size is large.
* All data points are independent.
* Normal Distribution for Z, with an average zero and variance = 1.
* It is based on Normal distribution.
* Z-test is also a univariate test which is based on a standard normal distribution.

**T-Test**

* The t-test can be referred to a univariate hypothesis test that is based on t-statistic, wherein the mean i.e. the average is known, and population variance i.e. standard deviation is approximated from the sample.
* The t-test can be referred to a kind of parametric test that is applied to an identity, how the averages of 2 sets of data differ from each other when the standard deviation or variance is not given.
* The Population variance or standard deviation is unknown here.
* The Sample Size is small.
* All the data points are dependent.
* Sample values are to be recorded and taken accurately.
* It is based on Student-t distribution.

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