# Statistics Assessment

# Question 1:

There is an assumption that there is no significant difference between boys and girls with respect to intelligence. Tests are conducted, and the following are the observations:

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Mean** | **Standard Deviation** | **Size** |
| **Girls** | 89 | 4 | 50 |
| **Boys** | 82 | 9 | 120 |

Validate the claim with 5% Level of Significance (LoS).

## Solution:

**Step 1: Set Hypotheses**

**Null Hypothesis (H₀): There is no significant difference between the intelligence of boys and girls (Mean difference = 0).  
Alternative Hypothesis (H₁): There is a significant difference between the intelligence of boys and girls (Mean difference ≠ 0).**

**Step 2: Calculate the Test Statistic (t-statistic)**

*Formula:  
t = (Mean₁ - Mean₂) / √((SD₁² / n₁) + (SD₂² / n₂))  
  
Substituting values:  
t = (89 - 82) / √((4²/50) + (9²/120))  
= 7 / √(0.32 + 0.675)  
= 7 / √0.995  
= 7 / 0.9975  
= 7.02*

**Step 3: Decision Rule**

**At 5% level of significance (two-tailed test), the critical value of t for large samples is approximately 1.96.  
Since 7.02 > 1.96, we reject the null hypothesis.**

**Step 4: Conclusion**

**There is a significant difference between the intelligence of boys and girls.**

# Question 2:

Analyze the below data and tell whether you can conclude that smoking causes cancer.

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Diagnosed as Cancer** | **Without Cancer** | **Total** |
| **Smokers** | 220 | 230 | 550 |
| **Non-Smokers** | 350 | 640 | 990 |
| **Total** | 680 | 910 | 1590 |

## Solution:

**Step 1: Set Hypotheses**

**Null Hypothesis (H₀): Smoking and cancer are independent (no association).  
Alternative Hypothesis (H₁): Smoking and cancer are not independent (smoking is associated with cancer).**

**Step 2: Calculate Expected Frequencies**

*Expected Smokers with Cancer = (550 × 680) / 1590 = 235.22  
Expected Smokers without Cancer = (550 × 910) / 1590 = 314.78  
Expected Non-Smokers with Cancer = (990 × 680) / 1590 = 444.78  
Expected Non-Smokers without Cancer = (990 × 910) / 1590 = 575.22*

**Step 3: Calculate Chi-Square Statistic**

*Formula:  
χ² = Σ((O - E)² / E)  
  
Calculations:  
For Smokers with Cancer: (220-235.22)²/235.22 = 0.984  
For Smokers without Cancer: (230-314.78)²/314.78 = 22.84  
For Non-Smokers with Cancer: (350-444.78)²/444.78 = 20.19  
For Non-Smokers without Cancer: (640-575.22)²/575.22 = 7.30  
  
Total χ² = 51.31*

**Step 4: Decision Rule**

**Degree of Freedom = (2-1)(2-1) = 1  
Critical value of Chi-Square at 5% significance level with 1 degree of freedom = 3.841  
Since 51.31 > 3.841, we reject the null hypothesis.**

**Step 5: Conclusion**

**There is strong evidence to conclude that smoking is associated with cancer.**