**Problem Statement 1:**

Blood glucose levels for obese patients have a mean of 100 with a standard deviation of 15. A researcher thinks that a diet high in raw cornstarch will have a positive effect on blood glucose levels. A sample of 36 patients who have tried the raw cornstarch diet have a mean glucose level of 108. Test the hypothesis that the raw cornstarch had an effect or not.

**Solution:**

H0 => the raw cornstarch had an effect.

H1 => the raw cornstarch had no effect.

$\mu = 100$, $x = 108$, $SD = 15$, $n = 36$

$Z = x - \mu / (SD/n)^{0.5}$

$Z = 108 – 100 / (15/36)^{0.5} = 3.2$

$Z(test) = 3.2$

P-value(z) = 0.0014

Thus we accept the H0 null hypothesis.

**Problem Statement 2:**

In one state, 52% of the voters are Republicans, and 48% are Democrats. In a second state, 47% of the voters are Republicans, and 53% are Democrats. Suppose a simple random sample of 100 voters are surveyed from each state. What is the probability that the survey will show a greater percentage of Republican voters in the second state than in the first state?

**Solution:**

$p1=0.52$, $p2 = 0.47$, $n = 100$

Difference between means = $\mu = p1 - p2 = 0.52 - 0.47 = 0.05$

$S.D = ((p1(1 – p1)/n) + (p2(1 – p2) / n))^{0.5}$

$S.D = ((0.52 * 0.48 / 100) + (0.47 * 0.53 / 100))^{0.5}$

$S.D = 0.0706$

$Z = x - \mu / S.D = 0 – 0.05 / 0.0706$

$Z = -0.7082$

Probability(Z) = 0.48 for two tailed

The probability that the survey will show a greater percentage of Republican voters in the second state than in the first state is 0.48/2 = 0.24

**Problem Statement 3:**

You take the SAT and score 1100. The mean score for the SAT is 1026 and the standard deviation is 209. How well did you score on the test compared to the average test taker?

**Solution:**

x= 1100, μ = 1026, SD = 209

Z = x - μ / SD

Z = 1100 – 1026 / 209

Z = 0.354

Z(0.354) = 0.6368

Thus I scored 63.68% compared to the average test taker.

**Problem 1**

Is gender independent of education level? A random sample of 395 people were surveyed and each person was asked to report the highest education level they obtained. The data that resulted from the survey is summarized in the following table:

| | High School | Bachelors | Masters | Ph.d. | Total |
|---|---|---|---|---|---|
| Female | 60 | 54 | 46 | 41 | 201 |
| Male | 40 | 44 | 53 | 57 | 194 |
| Total | 100 | 98 | 99 | 98 | 395 |

Question: Are gender and education level dependent at 5% level of significance? In other words, given the data collected above, is there a relationship between the gender of an individual and the level of education that they have obtained?

**Solution:**

Expected values

| | High School | Bachelors | Masters | Ph.d. | Total |
|---|---|---|---|---|---|
| Female | 50.886 | 49.868 | 50.377 | 49.868 | 201 |
| Male | 49.114 | 48.132 | 48.623 | 48.132 | 194 |
| Total | 100 | 98 | 99 | 98 | 395 |

So, working this out,

$$x^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}} = 1.632 + 1.691 + 0.342 + 0.354 + 0.380 + 0.394 + 1.576 + 1.633$$

$x^2 = 8.006$

The critical value of with 3 degree of freedom is 7.815. Since 8.006 > 7.815, we reject the null hypothesis and conclude that the education level depends on gender at a 5% level of significance.

**Problem Statement 2:**

Using the following data, perform a oneway analysis of variance using α=.05. Write up the results in APA format.

[Group1: 51, 45, 33, 45, 67]

[Group2: 23, 43, 23, 43, 45]

[Group3: 56, 76, 74, 87, 56]

**Solution:**

Group 1

| Value | Mean | SD | SD^2 |
|---|---|---|---|
| 51 | 48.2 | 2.8 | 7.84 |
| 45 | 48.2 | -3.2 | 10.24 |
| 33 | 48.2 | -15.2 | 231.04 |
| 45 | 48.2 | -3.2 | 10.24 |
| 67 | 48.2 | 18.8 | 353.44 |
| Sum | | | 612.8 |

Group 2

| Value | Mean | SD | SD^2 |
|---|---|---|---|
| 23 | 35.4 | -12.4 | 153.76 |
| 43 | 35.4 | 7.6 | 57.76 |
| 23 | 35.4 | -12.4 | 153.76 |
| 43 | 35.4 | 7.6 | 57.76 |
| 45 | 35.4 | 9.6 | 92.16 |
| Sum | | | 512.2 |

Group 3

| Value | Mean | SD | SD^2 |
|---|---|---|---|
| 56 | 69.8 | -13.8 | 190.44 |
| 76 | 69.4 | 6.2 | 38.44 |
| 74 | 69.4 | 4.2 | 17.64 |
| 87 | 69.4 | 17.2 | 295.84 |
| 56 | 69.4 | -13.8 | 190.44 |
| Sum | | | 732.8 |

$Var1=612.8 / 5-1=153.2$

$Var2=515.2 / 5-1=128.8$

$Var3=732.8/ 5-1=183.2$

$MS_{error} =153.2+128.8+183.23=155.07$

$Df_{error} =15-3=12$

$SS_{error} = (155.07)(15-3)=1860.8$

Grand mean ($\bar{x}_{grand}$) = $48.2+35.4+69.83=51.13$

| Group mean | Grand Mean | SD | SD^2 |
|---|---|---|---|
| 48.2 | 51.13 | -2.93 | 8.58 |
| 35.4 | 51.13 | -15.73 | 247.43 |
| 69.83 | 51.13 | 18.67 | 348.57 |

Sum of squares ($SS_{means}$) = 604.58

$Var_{means}=604.583-1=302.29$

$MS_{between} = (302.29)(5)=1511.45$

Calculating the remaining between (or group) terms of the ANOVA table:

$Df_{groups} = 3-1=2$

$SS_{group}= (1511.45)(3-1)=3022.9$

Test statistic and critical value

$F=1511.45/155.07=9.75$

$Fcritical(2,12)=3.89$

Reject H0 null hypothesis.

| Source | SS | Df | MS | F |
|---|---|---|---|---|
| Group | 3022.9 | 2 | 1511.45 | 9.75 |
| Error | 1860.8 | 12 | 155.07 | |
| Total | 4883.7 | | | |

Effect size

$\eta 2=3022.9/4883.7=0.62$

APA

$F(2, 12)=9.75$, $p <0.05$, $\eta 2=0.62$.