**# Lesson 10 :Hypothesis Testing**

**# Example 1: Hypo Test - Population Mean - Upper Tailed Test**

**# Kurkure claims that maximum saturated fat content in chip packet is 2 grams with std dev = 0.25**

**# A test on a sample of 35 packets reveal that mean saturated fat is 2.1 grams**

**# Should the claim of Kurkure be rejected?**

**# Let’s test the null hypothesis at the significance level of 5%.**

**# Step 1:**

**# Set up null hypothesis and alternative hypothesis**

**H0 = mu <= 2 # Null Hypothesis**

**H1 = mu > 2 # Alternative Hypothesis - Upper tailed test**

**# level of significance**

**α = 0.05**

**# Step 2: Compute Test Statistics**

**# Sample size id more than 30. So, need to calculate Z statistics**

**mu = 2 # Population mean**

**Xbar = 2.1 # Sample mean**

**sigma = 0.25 # Population Std Dev**

**n = 35 # Sample Size**

**SE = sigma/sqrt(n) # Sample std deviation: 0.0422**

**Z = (Xbar - mu)/SE # Z score**

**Z # 2.36 std dev away from the mean**

**# Step 3: Compute critical value for significance level = 0.05 or Confidence Interval = 95%**

**Zα = qnorm(1-α)**

**Zα # Critical value for 95% confidence**

**# Step 4: Compare Test statistic with critical value and conclude the test**

**# Decision**

**# if | Z |< Zα, Z is not significant and the null hypothesis may, therefore, be accepted.**

**# if | Z |≥ Zα, Z is significant and the null hypothesis is rejected**

**Z > Zα**

**# Conclusion**

**# With 95% confidence the claim of at most 2 grams of saturated fat in a chips packet should be rejected**

**# Critical Region**

**qnorm(.90) # 10% level**

**qnorm(.95) # 5% level**

**qnorm(.99) # 1 % level**

**# Example 2: Hypo Test - Population Mean - Lower Tailed Test**

**# An automatic machine fills an aerated drink in 2000 cc bottles.**

**# A tester needs to test Ho that the average amount being filled in a bottle is at least 2000 cc**

**# He selects a random sample of 40 bottles and records the exact content of the bottles and finds the sample mean to be 1999.6 cc**

**# Considers the population standard deviation as 1.30 cc**

**# Let’s test the null hypothesis at the significance level of 5%.**

**# Solution**

**# Step 1:**

**# Set up null hypothesis and alternative hypothesis**

**# H0 = μ >= 2000 # Null Hypothesis**

**# H1 = μ < 2000 # Alternative Hypothesis - Lower tailed test**

**α = 0.05 # level of significance**

**n = 40 # Sample Size**

**# Step 2: Compute Test Statistics**

**# Sample size id more than 30. So, need to calculate Z statistics**

**μ = 2000 # Population mean**

**Xbar = 1999.6 # Sample mean**

**sigma = 1.3 # Population Std Dev**

**SE = sigma/sqrt(n) # Sample std deviation: 0.0422**

**Z = (Xbar - μ)/SE # Z score**

**Z # -1.96 std dev away from the mean**

**# Step 3: Compute critical value for significance level = 0.05 or Confidence Interval = 95%**

**Zα = qnorm(1-α, lower.tail = FALSE)**

**Zα # Critical value for 95% confidence- -1.64**

**# Step 4: Compare Test statistic with critical value and conclude the test**

**# Decision**

**# if | Z |< Zα, Z is not significant and the null hypothesis may, therefore, be accepted.**

**# if | Z |≥ Zα, Z is significant and the null hypothesis is rejected**

**# Example 3: Hypo Test - Population Mean - Two Tailed Test**

**# For an insurance company the average liability insurance for each board seat is $2000.**

**# Significance level is 0.01.**

**# Population std dev = 947**

**# Let’s test this hypothesis using the Growth Resources, Inc. survey data.**

**# Sample : n = 100,sample mean = 2700**

**# Solution**

**# Step 1:**

**# Set up null hypothesis and alternative hypothesis**

**# H0 = μ = 2000 # Null Hypothesis**

**# H1 = μ != 2000 # Alternative Hypothesis - Lower tailed test**

**α = 0.01 # level of significance**

**n = 100 # Sample Size**

**# Step 2: Compute Test Statistics**

**Z = (2700 -2000)/(947/sqrt(100))**

**Z**

**# Step 3: Compute critical value for significance level = 0.05 or Confidence Interval = 95%**

**Zα1 = qnorm(1-α, lower.tail = FALSE)**

**Zα2 = qnorm(1-α, lower.tail = TRUE)**

**Zα1**

**Zα2**

**# Step 4: Compare Test statistic with critical value and conclude the test**

**# Conclusion - the test statistic falls in the upper rejection region; therefore,**

**# Ho is rejected and the average insurance liability is more than $2000**

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**# Example 4: Hypo Test - Population Proportion - Right Tailed Test**

**# The manager considers a random sample of 200 consumers, which shows the acceptance rate as 32%.**

**# Assuming the level of significance a of 0.05, let’s perform hypothesis testing to conclude an action.**

**# SOlution**

**# Step 1:**

**# Set up null hypothesis and alternative hypothesis**

**# H0 = P <= 0.3 # Null Hypothesis**

**# H1 = P > 0.3 # Alternative Hypothesis - Upper tailed test**

**α = 0.05 # level of significance**

**n = 200 # Sample Size**

**p = 0.32**

**P = 0.3**

**# Step 2: Compute Test Statistics**

**Z = (p-P)/sqrt((P\*(1-P))/n)**

**Z**

**# Step 3: Compute critical value for significance level = 0.05 or Confidence Interval = 95%**

**Zα = qnorm(1-α, lower.tail = FALSE)**

**Zα**

**# Step 4: Compare Test statistic with critical value and conclude the test**

**# Since |Z| = O.62 < Zα = 1.645**

**# Accept Ho at 5% level of significance.**

**# Recommended Action: Manager should not introduce the new product in the market.**