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In [1]: # 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.
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In [1]: import math
Sample_count = 36
Sample_Mean = 108
Population_Mean = 100
Population_sigma = 15 #(Standard deviation)

# The population mean is 100 so we have define our hypotheses based on that.
#Null Hypothesis is H0:Mean=100
#Alternative Hypothesis is H1:≠100
#There is no information provided about the significance level or confidence interval, so lets assume it to be 0.05 or 95%
#which is commonly used.

#Lets calculate Z score
z=(Sample_Mean - Population_Mean)/(Population_sigma/math.sqrt(Sample_count))
print('The z score is' ,z)
print('By looking this value up in z table, we get a value of 0.9993')
print('Which implies the probability of having value less than 108 is 99.93% and more than or equals to 108 is 0.007')
print('It is less than 0.05 so we will reject the Null hypothesis i.e. there is raw cornstarch effect')
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The z score is 3.2

By looking this value up in z table, we get a value of 0.9993

Which implies the probability of having value less than 108 is 99.93% and more than or equals to 108 is 0.007

It is less than 0.05 so we will reject the Null hypothesis i.e. there is raw cornstarch effect

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In [24]: # 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?
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In [26]: #Let :-
#P1 = Proportion of Republican voters in the first state
#P2 = Proportion of Republican voters in the second state
#P_1 = Proportion of Republican voters in the sample from the first state
#P_2 = Proportion of Republican voters in the sample from the second state.

#N1 = The number of voters sampled from the first state
N1 = 100
#N2=The number of voters sampled from the second state
N2 = 100

P1 = 0.52
#Q1=(1 - P1), the proportion on non republican voters in first state
Q1 = 0.48
P2 = 0.47
#Q2=(1 - P2), the proportion on non republican voters in second state
Q2 = 0.53

#The mean of the difference in sample proportions or the expected value  $E[P_1 - P_2]$ 
mu = P1 - P2

#The standard deviation of the difference (Std)
std = math.sqrt(((P1 * Q1) / N1) + ((P2 * Q2) / N2))
print("Mu : ",mu,"Std : ",std)

#This problem requires us to find the probability that  $P_1$  is less than  $P_2$ 
#This is equivalent to finding the probability that  $P_1 - P_2 < 0$ 
x = 0
#To find this probability, we need to transform the random variable ( $P_1 - P_2$ ) into a z-score.
#Z= Z_score(P_1,P_2)
#That transformation appears below.
Z = (x - mu)/std

print("Z_score(P_1,P_2):",Z)

#From Z table we find that the probability of a z-score being -0.7082 or less is 0.24.

print('The probability that the survey will show a greater percentage of Republican voters in the second state than in the first state is 0.24.')

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Mu : 0.050000000000000044 Std : 0.07061869440877536
Z_score(P_1,P_2): -0.7080278164104213
The probability that the survey will show a greater percentage of Republican voters in the second state than in the first state is 0.24.

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In [28]: # 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?

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In [31]: #The z score tells you how many standard deviations from the mean your score is
#My score =x
x = 1100
#Population Mean =mu
mu = 1026
#population standard deviation =sd
sd = 209
z = ( x - mu)/sd
print("Z Score : ",z)
print('The above calculation shows that my score is 0.35 standard deviations above the mean')
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Z Score : 0.35406698564593303

The above calculation shows that my score is 0.35 standard deviations above the mean