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In [1]: import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as stats
from scipy.stats import norm
import math
```

```
In [2]: # vector = np.loadtxt('eng1.txt')
# print(vector[0:10])
file = open('eng1.txt')
datfile = file.readlines()
file.close()

vector = [float(x) for x in datfile]
vector = np.asarray(vector)
```

## Q1:: What are the null and alternative hypotheses, and what type of test can be used?

- using a z-test
- Null Hypothesis :: The Average Engagment of students who understand the material is 0.75
- Alternate Hypothesis :: The Average Engagment of students who understand the material is not 0.75

## Q2::

- the answer are in the code block output bellow

```

In [3]: #required data

#sample size
mu = 0.75
alphas = [0.1, 0.05, 0.01]
sample_size = vector.size
print(f"Sample Size :: {sample_size}")

sample_mean = np.mean(vector)
print("Sample Mean :: %0.5f"%(sample_mean))

sample_stdev = np.std(vector, ddof = 0)
sample_varience = sample_stdev/np.sqrt(sample_size)
print("Sample Varience :: %0.5f"%(sample_varience))

zscore = (sample_mean - mu)/sample_varience
print("\nSample Z-score :: %0.5f"%(zscore))

sample_prob = 2 * norm.cdf(-np.abs(zscore))
print("Sample Probability :: %0.5f"%(sample_prob))

for alpha in alphas:
    if sample_prob <= alpha:
        print("\nThe Null Hypothesis can be rejected because the sample probabili
ty of %0.3f is less than or equal to the alpha value of %0.3f"%(sample_prob, alph
a))
    else:
        print("\nThe Null Hypothesis can not be rejected because the sample proba
bility of %0.3f is greater than or equal to the alpha value of %0.3f"%(sample_pro
b, alpha))

```

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Sample Size :: 937
Sample Mean :: 0.74303
Sample Varience :: 0.00415

```

```

Sample Z-score :: -1.67909
Sample Probability :: 0.09313

```

The Null Hypothesis can be rejected because the sample probability of 0.093 is less than or equal to the alpha value of 0.100

The Null Hypothesis can not be rejected because the sample probability of 0.093 is greater than or equal to the alpha value of 0.050

The Null Hypothesis can not be rejected because the sample probability of 0.093 is greater than or equal to the alpha value of 0.010

## Q3::

- the answer are in the code block output bellow

```
In [4]: #lowest val
devs = 2 #0.05
zval = norm.ppf(0.05/2)
closestval = (sample_mean - mu)/zval
closestsize = np.square(sample_stdev/closestval)

print("associated zval for 0.05 :: %0.7f"%(zval))
print("The largest standard error to get a z-score of 2 (a = 0.05):: %0.7f"%(closestval))
print("The smallest sample size needed to get a z-score of 2 (a = 0.05) :: %d"%(closestsize))
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associated zval for 0.05 :: -1.9599640
The largest standard error to get a z-score of 2 (a = 0.05):: 0.0035560
The smallest sample size needed to get a z-score of 2 (a = 0.05) :: 1276
```

## Q4 :: What are the null and alternative hypotheses, and what type of test can be used?

- using a z-test
- Null Hypothesis :: The Average Engagment of students who understand and those that don't understand the material is not the same  $\mu_1 \neq \mu_2$
- Alternate Hypothesis :: The Average Engagment of students who understand and those that don't understand the material is the same  $\mu_1 = \mu_2$

```
In [5]: file = open('eng0.txt')
datfile = file.readlines()
file.close()
sample2_size = len(datfile)

vector2 = [float(x) for x in datfile]
```

```
In [6]: vector2 = np.asarray(vector2)
mu2 = 0.75
alphas2 = [0.1, 0.05, 0.01]

#print(f"Sample Size :: {sample2_size}")

sample2_mean = np.mean(vector2)
#print("Sample Mean :: %0.3f"%(sample2_mean))

sample2_stdev = np.std(vector2, ddof = 1)
sample2_varience = sample2_stdev/np.sqrt(sample2_size)
#print("Sample Variance :: %0.7f"%(sample2_varience))
```

## Q5 ::

- the answers can be found in the output of the code block below

```

In [7]: # 2 sample
double_mu = mu - mu2
double_mean = sample_mean - sample2_mean
print("Sample Variance :: %f"%(np.sqrt(np.square(sample_variance) + np.square(sample2_variance))))

double_stdev = np.sqrt(np.square(sample_variance) + np.square(sample2_variance))
double_zscore = double_mean/double_stdev
double_prob = 2 * norm.cdf(-np.abs(double_zscore))

print("2 Sample Mu :: %0.5f"%(double_mu))
print("2 Sample Mean :: %0.5f"%(double_mean))
print("2 Standard Deviation :: %0.5f"%(double_stdev))

print("\n2 Sample Z-score :: %0.5f"%(double_zscore))
print("2 Sample Prob :: %0.5f"%(double_prob))

for alpha in alphas:
    if double_prob <= alpha:
        print("\nThe Null Hypothesis can be rejected because the sample probability of %0.7f is less than or equal to the alpha value of %0.3f"%(double_prob, alpha))
    else:
        print("\nThe Null Hypothesis can not be rejected because the sample probability of %0.7f is greater than or equal to the alpha value of %0.3f"%(double_prob, alpha))

```

```

Sample Variance :: 0.007064
2 Sample Mu :: 0.00000
2 Sample Mean :: 0.10308
2 Standard Deviation :: 0.00706

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2 Sample Z-score :: 14.59147
2 Sample Prob :: 0.00000

```

The Null Hypothesis can be rejected because the sample probability of 0.0000000 is less than or equal to the alpha value of 0.100

The Null Hypothesis can be rejected because the sample probability of 0.0000000 is less than or equal to the alpha value of 0.050

The Null Hypothesis can be rejected because the sample probability of 0.0000000 is less than or equal to the alpha value of 0.010