[Your Full Name Goes Here]

ECE 3512: Signals – Continuous and Discrete

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# Problem Statement

This assignment ask us to solve a light bulb production quality control problem from the text book by generating random number follow the Gaussian distribution, then find the mean of the data generated. As there are true mean and the estimated mean at the same time when we generate the data, we have to find if they are statically significant depends on the confidence level of the data. At the end we need to find out if the difference between the true mean and estimated mean is statistically significant.

# Approach and Results

For the first task, I created a function, which generates Gaussian distributed random numbers based on mean, standard deviation, and n numbers. The mean of the data generated

When n = 10, mean = 1600 and stdev = 120.

When n = 10 , n=100 n=1000



2.For n =100, with estimated mean equal to 1577.4,

At confidence level of 80%, the difference is **statistically significant**.

At confidence level of 90%, the difference is **statistically significant**.

At confidence level of 95% - 99.99%, the difference is **not statistically significant**.

**3.**For confidence level of 80%, the minimum value of n had to be to **47** for the difference to be statistically significant.

For 90%, n has to be **76**.

For 95%, n has to be **109**.

For 99%, n has to be **188**.

For 99.9%, n has to be **302**.

For 99.99%, n has to be **427**.

**4.**For standard deviation of 240

For n =100, with estimated mean equal to 1587.3,

At confidence level of 80%, the difference is **not** **statistically significant**.

At confidence level of 90% - 99.99%, the difference is **not statistically significant**.

**5.**For n = 10 with estimated mean of 1561.2

The maximum value of variance at 80% is **9.1885e+03**

At confidence level of 90%, value is **5.5973e+03**

At confidence level of 95%, value is **3.9188e+03**

At confidence level of 99%, value is **2.2616e+03**

At confidence level of 99.9%, value is **1.3908e+03**

At confidence level of 99.99%, value is **994.8652**

For n = 100 with estimated mean of 1577.4

At confidence level of 80%, value is **3.1174e+04**

At confidence level of 90%, value is **1.8990e+04**

At confidence level of 95%, value is **1.3296e+04**

At confidence level of 99%, value is **7.6732e+03**

At confidence level of 99.9%, value is **4.7187e+03**

At confidence level of 99.99%, value is **3.3753e+03**

For n = 1000 with estimated mean of 1601.3

At confidence level of 80%, value is **1.0315e+03**

At confidence level of 90%, value is **628.3462**

At confidence level of 95%, value is **439.9209**

At confidence level of 99%, value is **253.8910**

At confidence level of 99.9%, value is **156.1331**

At confidence level of 99.99%, value is **111.6831**

# MATLAB Code

This is the main section, where we compute all the results

clear; close all; clc;

% Create a function that generates n Gaussian distributed random variables

X = gen\_grv(1600,120,10);

% Compute the mean of X

ux = mean(X)

% Tests whether the difference between the true mean and

%the estimated mean are statistically significant

status = check\_significance(ux, 1600, 120, 100, 80);

% find n value

N = determine\_significance(ux, 1600, 120, 99.99);

% find max variance

max\_var = max\_variance(ux, 1600, 10, 80);

This section computes whether the difference between the means is statistically significant.

function [ status ] = check\_significance(mean1, mean2, stdev, n, confidence)

 status = abs((mean1 - mean2)/((stdev)/sqrt(n)));

k = confidence\_index(confidence);

 if status > k

 fprintf('\nStatistically significant\n');

 else

 fprintf('\nNot statistically significant\n');

 end

end

This section computes the minimum value of n for the difference between the means to be statistically significant.

function [ N ] = determine\_significance(mean1, mean2, stdev, confidence)

 k = confidence\_index(confidence);

 N = abs((((k\*stdev)/(mean1-mean2))^2))

end

This section computes the max variance

function [ max\_var ] = max\_variance(mean1, mean2, n, confidence)

 k = confidence\_index(confidence);

 max\_var = (((mean1-mean2)\*sqrt(n))/k)^2;

end

This section generates the Gaussian distribution

function [ X ] = gen\_grv(mean,stdev, n)

 X = mean+ stdev\*randn(n,1);

end

This section converts confidence into k value

function [ k ] = confidence\_index( confidence )

 if confidence == 99.99

 k = 3.89;

 elseif confidence == 99.9

 k = 3.29;

 elseif confidence == 99

 k = 2.58;

 elseif confidence == 95

 k = 1.96;

 elseif confidence == 90

 k = 1.64;

 elseif confidence == 80

 k = 1.28;

 else

 k = 0;

 end

end

# Conclusions

The difference between the estimated mean and the true mean increases when the data number n become larger. Because of the increasing of the sample size, the estimated mean become closer and closer to the true mean. At the same time, the probability of the estimated mean falling in the acceptance region increases as the confidence level increases resulting the minimum value of n increases. Nevertheless, the difference is smaller for higher standard deviation when comparing the 240 hours example to the 12 hours example. the higher the confidence level, the higher the probability of the difference between the means of falling in the acceptance region.