

MARKS:



AMERICAN INTERNATIONAL UNIVERSITY-
BANGLADESH (AIUB)

Data Communication Laboratory

LAB REPORT

ON

Study of Nyquist bit rate and Shannon capacity using MATLAB

Experiment No: 4

Section: [G]

Semester: Spring 20-21

Course Teacher: MD MEHEDI HASAN

Date of Performance: 16-Feb-21

Date of Submission: 23-Feb-21

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1. Working Procedure:

Given,

ID = **AB-CDEFG-H**

Now, my id = 19-40158-1

A=1, B=9, C=4, D=0, E=1, F=5, G=8, H=1

$$X = A1 \sin(2\pi(C*100)t) + A2 \cos(2\pi(G*100)t) + s*\text{randn}(\text{size}(t));$$

$$X = A1 \sin(2\pi(4*100)t) + A2 \cos(2\pi(8*100)t) + s*\text{randn}(\text{size}(t));$$

- (a) Select the value of the amplitudes as follows: let $A1 = AB$,
 $A2 = AF$ and $s = 0.AH$

Ans (a):

$$A1 = AB = 19;$$

$$A2 = AF = 15;$$

$$S = 0.AH = 0.11$$

$$\text{So, } x = A1 \sin(2\pi(\text{C}*100)t) + A2 \cos(2\pi(\text{G}*100)t) + s*\text{randn}(\text{size}(t));$$

$$X = A1 \sin(2\pi(4*100)t) + A2 \cos(2\pi(8*100)t) + s*\text{randn}(\text{size}(t));$$

(b) Calculate the SNR value of the composite signal.

Ans (b):

%% 19-40158-1 DEBORAJ ROY

close all;

clc;

fs = 40000;

t = 0:1/fs:1-1/fs;

A1=19;

A2=15;

s=0.11;

powfund = A2^2/2;

varnoise = s^2;

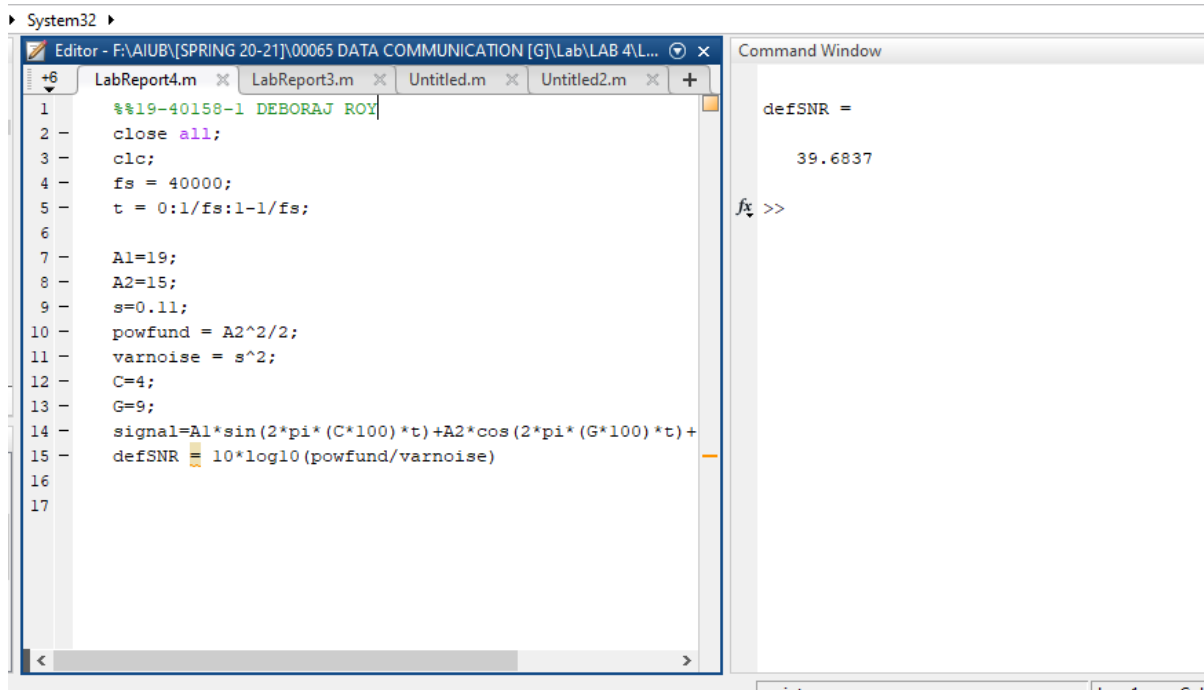
C=4;

G=9;

signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)+s*randn(size(t));

defSNR = 10*log10(powfund/varnoise)

So, value of SNR = 39.6837 ;



```
%%19-40158-1 DEBORAJ ROY
close all;
clc;
fs = 40000;
t = 0:1/fs:1-1/fs;

A1=19;
A2=15;
s=0.11;
powfund = A2^2/2;
varnoise = s^2;
C=4;
G=9;
signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)+
defSNR = 10*log10(powfund/varnoise)
```

```
defSNR =
    39.6837

fx >>
```

(c) Find the bandwidth of the signal and calculate the maximum capacity of the channel.

Ans (c):

%%19-40158-1 DEBORAJ ROY

close all;

clc;

fs = 40000;

t = 0:1/fs:1-1/fs;

A1=19;

A2=15;

s=0.11;

powfund = A2^2/2;

varnoise = s^2;

C=4;

G=9;

signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)+s*randn(size(t));

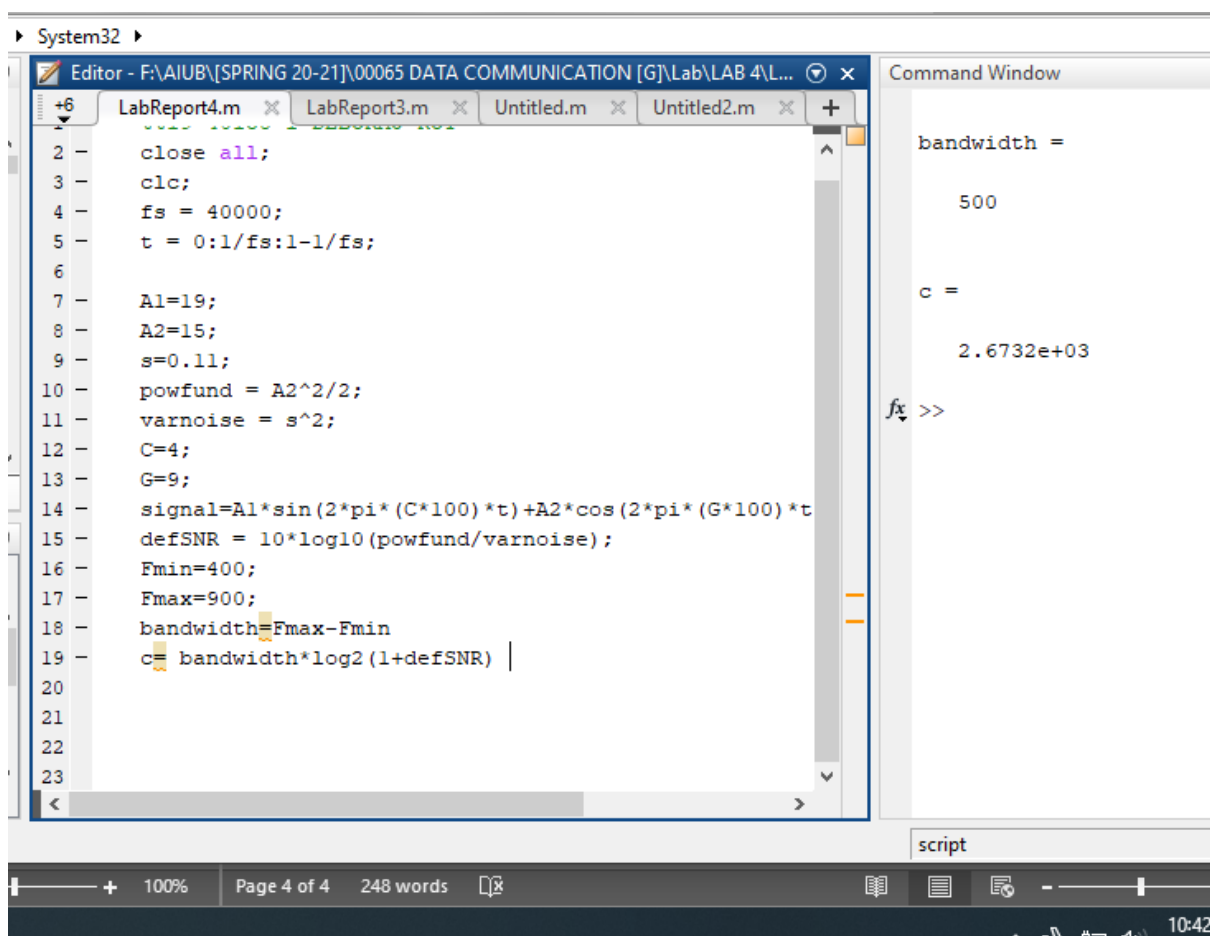
defSNR = 10*log10(powfund/varnoise);

```

Fmin=400;
Fmax=900;
bandwidth=Fmax-Fmin
c= bandwidth*log2(1+defSNR) %capacity

```

So, bandwidth= 500 and capacity = 2.6732e+03



The screenshot shows the MATLAB environment. The Editor window displays a script with the following code:

```

1 - close all;
2 - clc;
3 - fs = 40000;
4 - t = 0:1/fs:1-1/fs;
5 -
6 -
7 - A1=19;
8 - A2=15;
9 - s=0.11;
10 - powfund = A2^2/2;
11 - varnoise = s^2;
12 - C=4;
13 - G=9;
14 - signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t);
15 - defSNR = 10*log10(powfund/varnoise);
16 - Fmin=400;
17 - Fmax=900;
18 - bandwidth=Fmax-Fmin
19 - c= bandwidth*log2(1+defSNR)
20 -
21 -
22 -
23 -

```

The Command Window shows the results of the execution:

```

bandwidth =
    500

c =
    2.6732e+03

fx >>

```

The status bar at the bottom indicates the script is on Page 4 of 4, containing 248 words, and the current time is 10:42.

(d) What will be the signal level to achieve the data rate?

Ans (d):

%%19-40158-1 DEBORAJ ROY

```

close all;
clc;
fs = 40000;

```

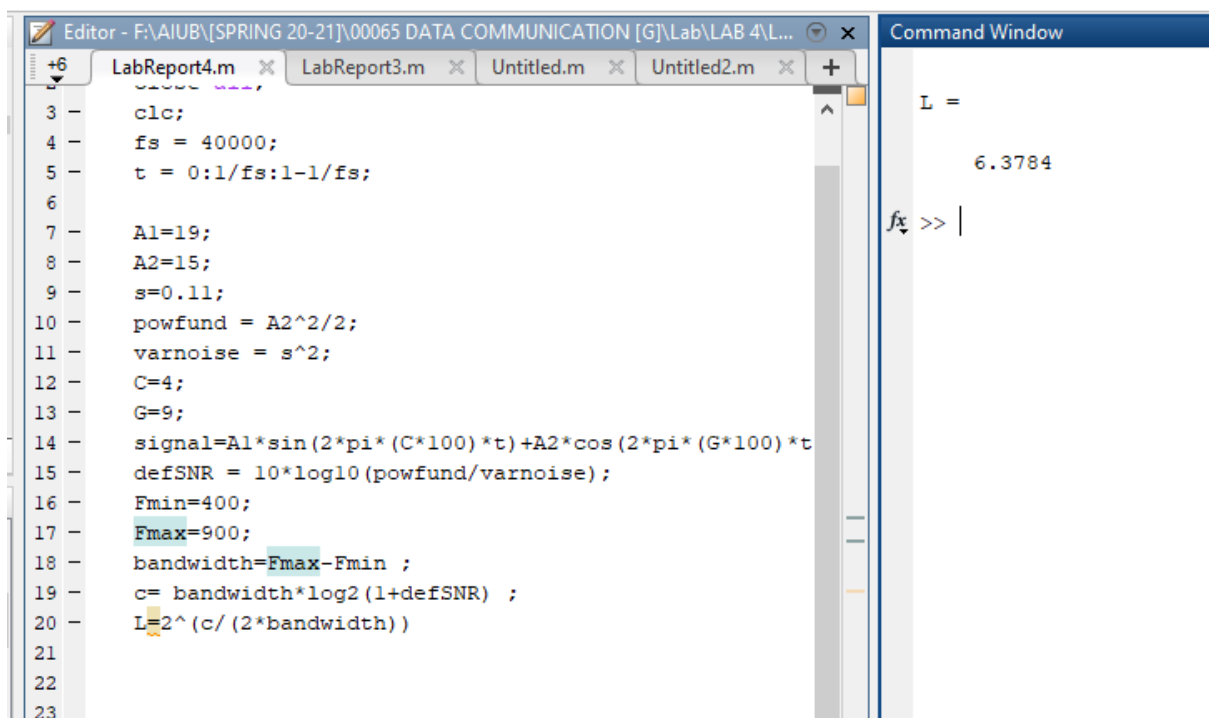
```

t = 0:1/fs:1-1/fs;

A1=19;
A2=15;
s=0.11;
powfund = A2^2/2;
varnoise = s^2;
C=4;
G=9;
signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)+s*randn(
size(t));
defSNR = 10*log10(powfund/varnoise);
Fmin=400;
Fmax=900;
bandwidth=Fmax-Fmin ;
c= bandwidth*log2(1+defSNR) ;
L=2^(c/(2*bandwidth))

```

So, signal level = 6.3784 ,



The image shows a MATLAB Editor window with a script named 'LabReport4.m' open. The script contains the same MATLAB code as shown in the previous block. The Command Window on the right displays the result of the calculation for 'L', which is 6.3784. The Command Window prompt is 'fx >> |'.

```

Editor - F:\AIUB\SPRING 20-21\00065 DATA COMMUNICATION [G]\Lab\LAB 4\L...
LabReport4.m  LabReport3.m  Untitled.m  Untitled2.m
3 -   clc;
4 -   fs = 40000;
5 -   t = 0:1/fs:1-1/fs;
6
7 -   A1=19;
8 -   A2=15;
9 -   s=0.11;
10 -  powfund = A2^2/2;
11 -  varnoise = s^2;
12 -  C=4;
13 -  G=9;
14 -  signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)+s*randn(
15 -  size(t));
16 -  defSNR = 10*log10(powfund/varnoise);
17 -  Fmin=400;
18 -  Fmax=900;
19 -  bandwidth=Fmax-Fmin ;
20 -  c= bandwidth*log2(1+defSNR) ;
21 -  L=2^(c/(2*bandwidth))
22
23
Command Window
L =
    6.3784
fx >> |

```

Editor - F:\AIUB\SPRING 20-21\00065 DATA COMMUNICATION [G]\Lab\LAB 4\L... Command Window

LabReport4.m LabReport3.m Untitled.m Untitled2.m

```
1 %%19-40158-1 DEBORAJ ROY
2 close all;
3 clc;
4 fs = 40000;
5 t = 0:1/fs:1-1/fs;
6
7 A1=19;
8 A2=15;
9 s=0.11;
10 powfund = A2^2/2;
11 varnoise = s^2;
12 C=4;
13 G=9;
14 signal=A1*sin(2*pi*(C*100)*t)+A2*cos(2*pi*(G*100)*t)
15 defSNR = 10*log10(powfund/varnoise)
16 Fmin=400;
17 Fmax=900;
18 bandwidth=Fmax-Fmin
19 c = bandwidth*log2(1+defSNR)
20 L=2^(c/(2*bandwidth))
21
22
```

defSNR =
39.6837

bandwidth =
500

c =
2.6732e+03

L =
6.3784

f_x >>