Experiment 5: To Analyse Log Normal Shadowing Model

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Aim:

To study the Log Normal Shadowing model and estimate the path loss

Problem statement 1:

Estimate the path loss using Log Normal Shadowing Model and plot distance Vs. Path loss.
Use the following values:

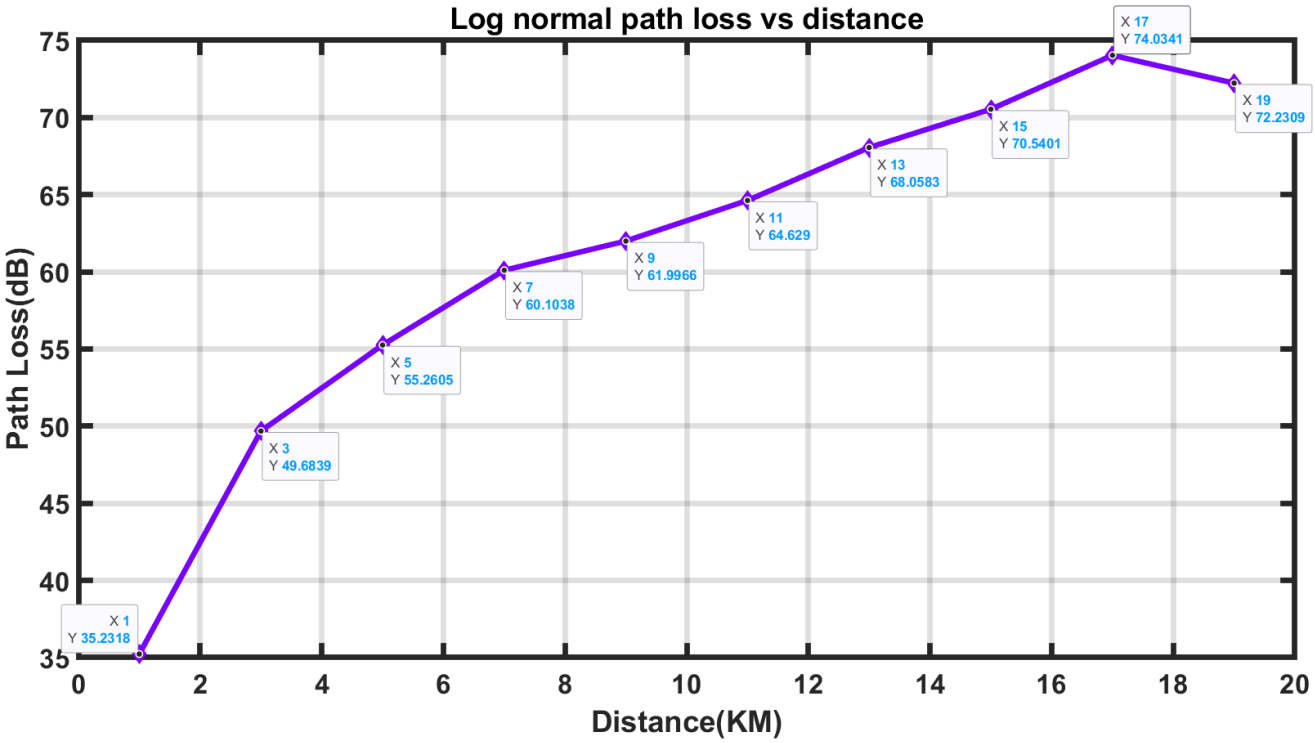
i. Reference distance do = 500m
ii. Frequency of operation f = 900 MHz
iii. N = 3

Find free space path loss (PLFS). Using PLFS, find path loss for log-normal model. Generate random normal variable 'Xm'. Plot the log-normal shadowing path loss vs distance, where d = 1 to 20 km, varying in steps of 2 km.

Code:

```
clc
clear all;
close all;
d0= 0.5;
f=900e6;
n=3;
d=1:2:20;
PLFS= 20*log10(d0)+20*log10(f)-147.56;
X=randn(size(d));
PL= PLFS + 10 * n .* log10(d/d0) + X;
figure(1)
plot(d,PL,'LineWidth',4,'Marker','diamond','color','#7700ff')
title('Log normal path loss vs
distance','FontSize',20,'LineWidth',4,'FontWeight','bold');
xlabel('Distance(KM)','FontSize',20,'LineWidth',4,'FontWeight','bold');
ylabel('Path Loss(dB)','FontSize',20,'LineWidth',4,'FontWeight','bold');
set(gca,'FontSize',20,'LineWidth',4,'FontWeight','bold');
grid on
```

Output:



Inference:

The Log-Normal path loss increases logarithmically and irregularly with increase in distance according to the random variable generated.

Problem statement 2:

Use the following values:

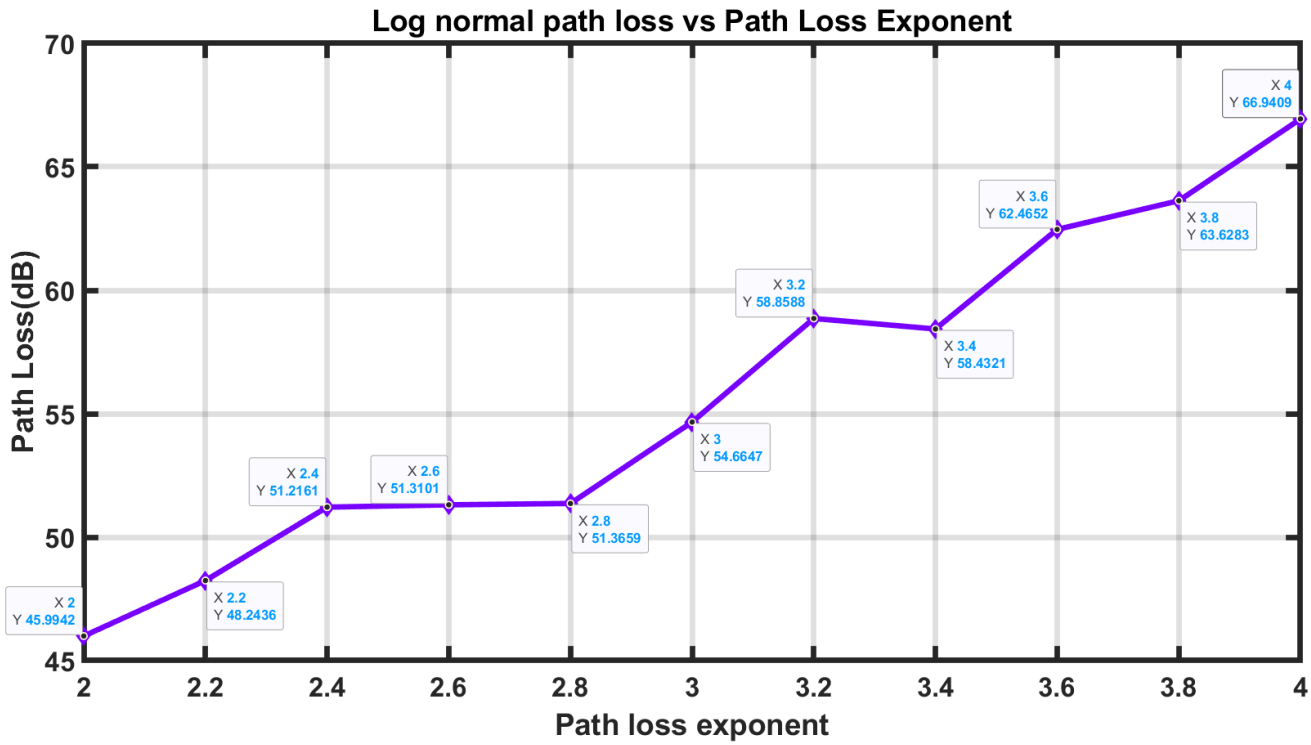
i. Reference distance do = 500m
ii. Frequency of operation f = 900 MHz
iii. d = 5km

Find free space path loss (PLFS). Using PLFS, find path loss for log-normal model. Generate random normal variable 'Xm'. Plot the log-normal shadowing path loss vs loss exponent, where n = 2 to 4, varying in steps of 0.2.

Code:

```
clc
clear all;
close all;
d0= 0.5;
f=900e6;
PLFS= 20*log10(d0)+20*log10(f)-147.56;
d=5;
n=2:0.2:4;
X1=randn(size(n));
PL1= PLFS + 10 .* n .* log10(d/d0) + X1;
plot(n,PL1,'LineWidth',4,'Marker','diamond','color','#7700ff')
title('Log normal path loss vs Path Loss
Exponent','FontSize',20,'LineWidth',4,'FontWeight','bold');
xlabel('Path loss exponent','FontSize',20,'LineWidth',4,'FontWeight','bold');
ylabel('Path Loss(dB)','FontSize',20,'LineWidth',4,'FontWeight','bold');
set(gca,'FontSize',20,'LineWidth',4,'FontWeight','bold');
grid on
```

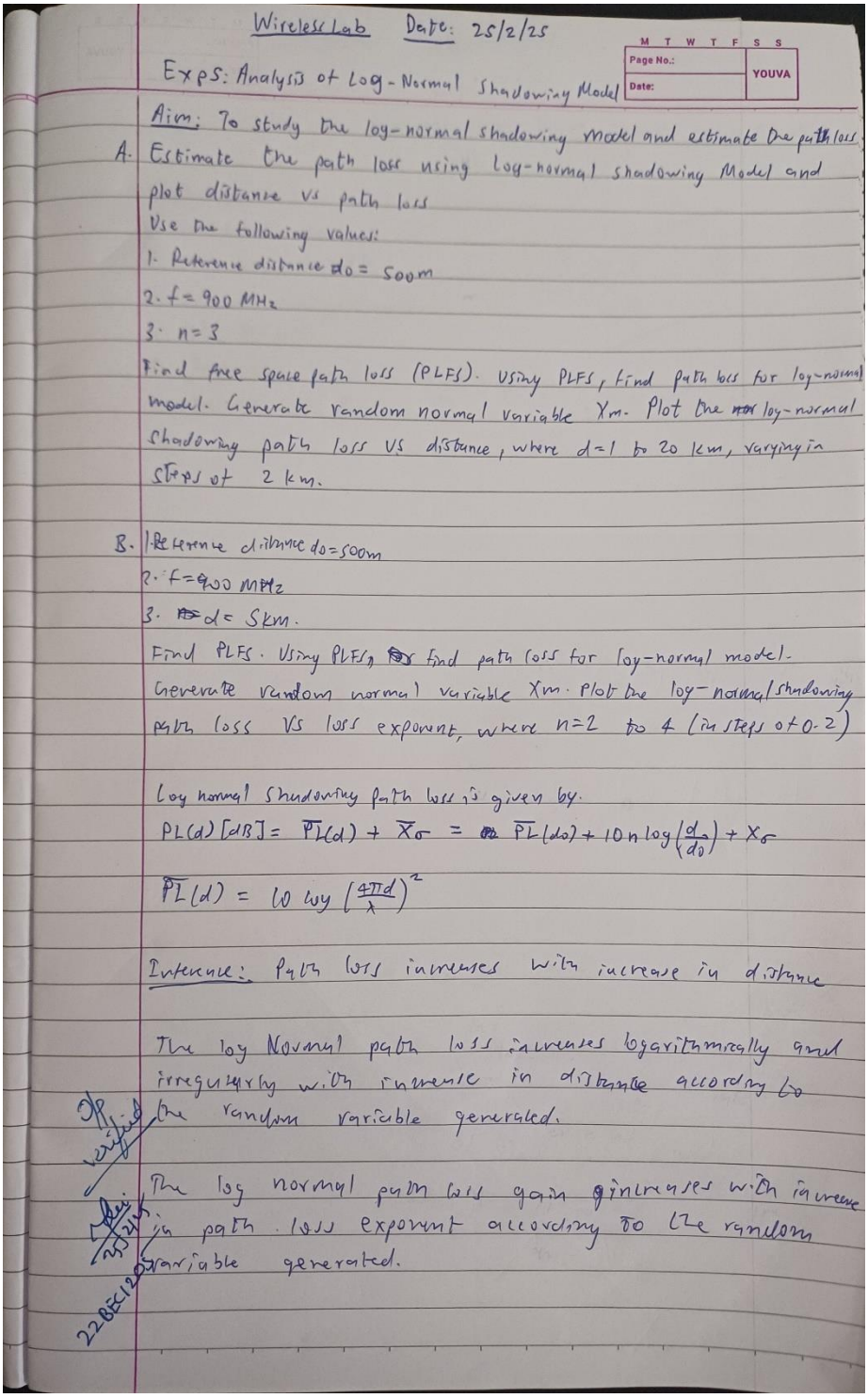
Output:



Inference:

The Log-Normal path loss increases with increase in path loss exponent according to the random variable generated.

Output Verification:



Wireless Lab Date: 25/2/25

Exp5: Analysis of Log-Normal Shadowing Model

Aim: To study the log-normal shadowing model and estimate the path loss

A. Estimate the path loss using log-normal shadowing Model and plot distance vs path loss

Use the following values:

1. Reference distance $d_0 = 500m$
2. $f = 900$ MHz
3. $n = 3$

Find free space path loss (PLFS). Using PLFS, find path loss for log-normal model. Generate random normal variable X_m. Plot the log-normal shadowing path loss vs distance, where $d = 1$ to 20 km, varying in steps of 2 km.

B. 1. Reference distance $d_0 = 500m$
2. $f = 900$ MHz
3. $d = 5km$.

Find PLFS. Using PLFS, find path loss for log-normal model. Generate random normal variable X_m. Plot the log-normal shadowing path loss vs loss exponent, where $n = 2$ to 4 (in steps of 0.2)

Log normal Shadowing path loss is given by.

$$PL(d)[dB] = \overline{PL}(d) + X_\sigma = \overline{PL}(d_0) + 10n \log\left(\frac{d}{d_0}\right) + X_\sigma$$

$$\overline{PL}(d) = 10 \log\left(\frac{4\pi d}{\lambda}\right)^2$$

Inference: Path loss increases with increase in distance

The log Normal path loss increases logarithmically and irregularly with increase in distance according to the random variable generated.

The log normal path loss gain increases with increase in path loss exponent according to the random variable generated.

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Observation and Result:

Hence, the graphs of path loss with respect to distance as well as path loss exponent were estimated, plotted and observed for the Log-Normal Shadowing model.