

## HWK 4 -- Solutions

1. **Path Loss Exponent:** To solve this problem, I simply entered all of the data into a spreadsheet:

R (m)	PL wrt 1m (dB)	$(10 \log_{10} R)^2$	$10 \log_{10} R \times PL$
10.0	31.3	100.0	313.0
10.0	33.4	100.0	334.0
10.0	31.3	100.0	313.0
10.0	32.4	100.0	324.0
10.0	25.9	100.0	259.0
11.0	33.7	108.4	350.9
11.0	27.3	108.4	284.3
12.0	31.8	116.5	343.2
12.0	32.1	116.5	346.4
13.0	32.0	124.1	356.5
13.0	32.0	124.1	356.5
18.0	42.5	157.6	533.5
15.0	40.1	138.3	471.6
15.0	45.8	138.3	538.6
13.0	39.6	124.1	441.1
15.0	41.6	138.3	489.3
18.0	51.2	157.6	642.7
16.0	46.7	145.0	562.3
16.0	43.7	145.0	526.2
19.0	51.9	163.5	663.7
20.0	57.7	169.3	750.7
15.0	44.4	138.3	522.2
17.0	51.2	151.4	630.0
18.0	51.7	157.6	649.0
18.0	46.6	157.6	585.0
16.0	40.6	145.0	488.9
21.0	40.2	174.8	531.5
21.0	29.8	174.8	394.0
21.0	45.0	174.8	595.0
21.0	33.0	174.8	436.3
21.0	51.4	174.8	679.6
21.0	48.5	174.8	641.3
21.0	52.6	174.8	695.5
21.0	50.7	174.8	670.4
22.0	51.3	180.2	688.7
22.0	51.0	180.2	684.6
22.0	54.4	180.2	730.3
22.0	57.9	180.2	777.3
23.0	53.6	185.4	729.9
23.0	56.5	185.4	769.4
		5915.1	21099.2

n= 3.6

Thus, the final path loss exponent is

$$n = \frac{\sum_{i=1}^N 10 \log_{10} R_i PL_i}{\sum_{i=1}^N (10 \log_{10} R_i)^2} = 3.6$$

which results in a standard deviation of 6.5 dB.

2. **Partition Propagation Model:** There is some subjectivity in this problem in judging distances and intervening partitions, so answers will vary slightly. Here is a copy of the data set I used in getting the following results:

PL (dB)	dist (m)	Ext. #	Int. #
38.9000	30.0000	0	0
33.5000	28.7500	0	0
34.2000	30.4167	0	0
29.8000	28.7500	0	0
38.1000	30.8333	0	0
35.6000	29.1667	0	0
37.6000	31.2500	0	0
37.3000	30.0000	0	0
38.9000	32.5000	0	0
37.2000	31.2500	0	0
40.8000	33.7778	0	0
41.4000	32.5000	0	0
50.3000	35.0000	1.0000	0
60.7000	35.0000	1.0000	0
49.4000	37.5000	1.0000	0
58.3000	37.9167	1.0000	1.0000
65.3000	37.5000	1.0000	2.0000
59.8000	38.7500	1.0000	1.0000
73.5000	41.2500	1.0000	3.0000
70.5000	43.3333	1.0000	4.0000
55.2000	42.5000	1.0000	0
58.4000	42.9167	1.0000	1.0000
71.6000	46.2500	1.0000	5.0000
56.8000	45.8333	1.0000	2.0000

This analysis produces 22.8 dB of loss per exterior wall, 3.7 dB of loss per interior wall with  $\sigma = 6.2$  dB.

3. **RFID Warehouse:** Maximum reader-tag separation distance is 4.1 meters.