Assignment 1 (CS425)

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Path Loss Exponent

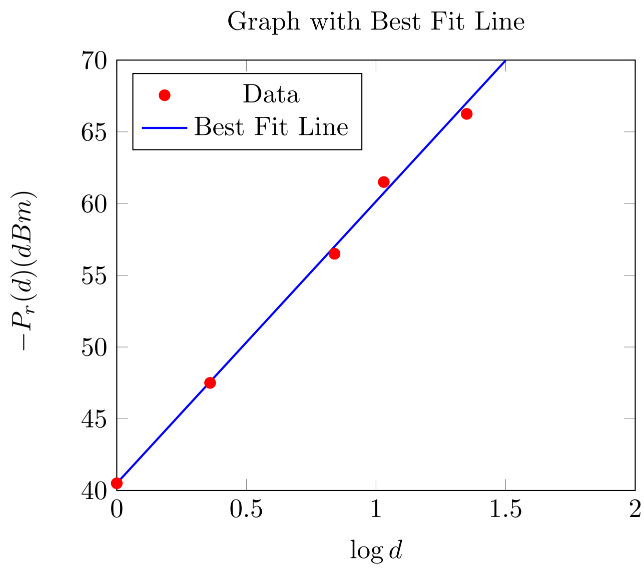
The following readings are taken from my phone and the router in my hostel wing:

Distance (m)	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Average RSSI**
1	41	40	42	39	40.5
2.3	47	49	46	48	47.5
6.9	57	58	57	54	56.5
10.7	60	61	61	63	61.5
20.65	66	67	64	68	66.25

The distances are written in meters, and the readings are in dBm. The sign of the readings has been flipped since they were all negative.

The line of best fit for this data, where x is the log of the distance from the WiFi AP, and y is the negative of the RSSI, comes out to be:

$$y = 19.65x + 40.5$$



The variance is 0.23 units and the path loss exponent is 1.965

• Note: The formulae used in the calculations have been mentioned towards the end of the document.

Range Estimation

The value of $P_r(d_0)$ is simply -40.5 dBm. using the line of best fit (the equation has negative of RSSI). readings were taken for the following distances:

Actual Distance (m)	**Average Reading**	**Calculated Distance**	**Error (m.)**
1.87	47.75	2.2	0.33
3.76	51.66	3.63	0.13
8.4	58.66	8.3	-0.1
13.05	62.5	13.18	0.13
16.73	64.66	16.59	-0.14

- Again, all the distances have been written in metres, while the RSSI readings have been written in dBm. with opposite sign. The average error is found to be 0.35 m.

Tools and Formulae

The formulae used are given below:

• Let y = mx + c be the line of best fit for the data $(x_i, y_i)_{i=1}^{i=k}$

Then, we have,

$$m = \frac{k.\sum_{i=1}^{i=k} y_i x_i - (\sum_{i=1}^{i=k} x_i)(\sum_{i=1}^{i=k} y_i)}{k.(\sum_{i=1}^{i=k} x_i^2) - (\sum_{i=1}^{i=k} x_i^2)}$$

$$c = \frac{k.(\sum_{i=1}^{i=k} y_i)(\sum_{i=1}^{i=k} x_i^2) - (\sum_{i=1}^{i=k} x_i)(\sum_{i=1}^{i=k} y_i x_i)}{k.\sum_{i=1}^{i=k} x_i^2 - (\sum_{i=1}^{i=k} x_i^2)}$$

- The mean μ:

$$\mu = \frac{1}{k}\sum_{i=1}^{k}(y_i - mx_i - c)$$

- The variance, σ^2, is :

$$\sigma^2 = \frac{1}{k}\sum_{i=1}^{k}(y_i - mx_i - c - \mu)^2$$

$$\sigma^2 = 0.23$$

- The exponent, n, was found by dividing the slope, m, by 10, i.e.,
  n = m/10 = 1.965
  Note: Instead of dividing the slope by -10, here it is divided by 10, since the minus sign has already been absorbed in using the negative of RSSI values in the line's equation.

- For calculating the distance, the following formula was used,

$$d = d_0.10^{(p_r - c)/m} = 10^{(p_r - c)/m}$$

where P_r is the negative value of reading of RSSI taken