CS425A: Computer Networks

Assignment 1

Aditya Tanwar

200057

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Path Loss Exponent

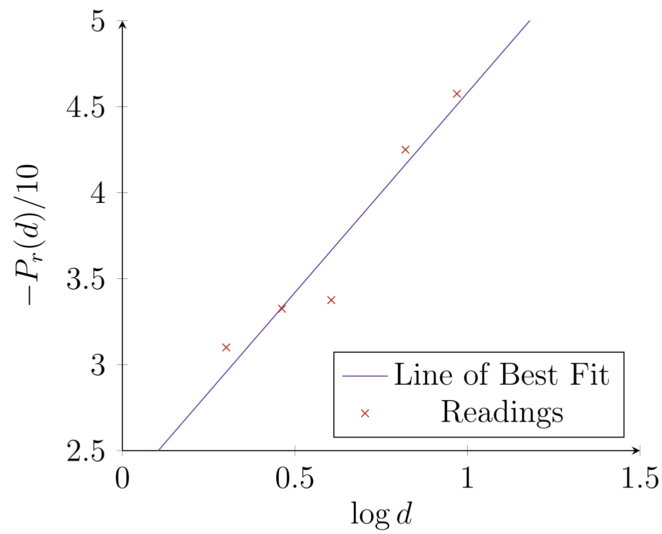
The following readings were taken using my phone and the router in my hostel wing:

Distance (m.)	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Average RSSI**
2	31	33	30	30	31
2.9	33	34	33	33	33.25
4.03	32	33	34	36	33.75
6.61	44	40	42	44	42.5
9.32	46	42	48	47	45.75

The distances are written in metres and the readings 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

$$y = 23.23\,x + 22.58$$

and the graph (scales re-adjusted for viewing purposes) is:



The variance is 2.31 units and the path loss exponent is 2.323.

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 -22.58 dBm. using the line of best fit (the equation has negative of RSSI). However, some readings were taken from the router at a distance of 1m. and the average value came out to be -24.75 dBm.
Afterwards, readings were taken for the following distances:

Actual Distance	Average Reading	Calculated Distance	Error (m.)
5.29	40	5.62	0.33
7.95	43.75	8.15	0.20
10.00	46.25	10.44	0.44
10.69	46.75	10.98	0.29
12.07	48	12.42	0.35

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 0.322 m.

Tools and Formulae

"MS Excel" was used for all the calculations, while "Wifi Analyzer (farproc)" was used to take all the readings.

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,

$$m = \frac{k \cdot \sum_{i=1}^{i=k} y_i x_i - (\sum_{i=1}^{i=k} y_i)(\sum_{i=1}^{i=k} x_i)}{k \cdot \sum_{i=1}^{i=k} x_i^2 - (\sum_{i=1}^{i=k} x_i)^2} \approx 23.23$$

$$c = \frac{k \cdot (\sum_{i=1}^{i=k} y_i)(\sum_{i=1}^{i=k} x_i^2) - (\sum_{i=1}^{i=k} x_i)(\sum_{i=1}^{i=k} y_i x_i)}{k \cdot \sum_{i=1}^{i=k} x_i^2 - (\sum_{i=1}^{i=k} x_i)^2} \approx 22.58$$

- The exponent, n, was found by dividing the slope, m, by 10, i.e.,

$$n = m/10 = 2.323$$

  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 finding the variance, σ^2, with respect to the line of best fit, firstly, the mean, μ, was found,

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

  And then the following formula was used to find the variance,

$$\sigma^2 = \frac{\sum_{i=1}^{i=k}(y_i - mx_i - c - \mu)^2}{k} \approx 2.31$$

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

$$d = d_0 \cdot 10^{(P_r - c)/m} = 10^{(P_r - c)/m}$$

  where P_r is the negative value of reading of RSSI taken.