Mathematical Computation:

A0: Café shop at location 0 and the cost per coffee is $4

B0: Café shop at location 10 and the cost per coffee is $5

Score of coffee shop = (10 – (distance from customer to location of coffee shop)) + 3 * (6- price of one cup of coffee)

score(A0) = (10 – (distance from customer to L(A0)) + 3*(6 – C(A0))

= (10 - (10 - 5) + 3*(6 – 4)

= 5 + 3 *2

= 11

score(B0) = (10 – (distance from customer to L(B0)) + 3*(6 – C(B0))

= (10 - (10 - 5) + 3* (6 - 5)

= 5 + 3 * 1

= 8

Total Score= score(A0) + score(B0) = 11 + 8 = 19

Probability for A0 =11 /19 = 0.58

Probability for B0 = 8 / 19 = 0.42

This implies that the customers had higher probabilities of choosing our café (A0) since A0 had a higher score than B0 and thus had a probability of 0.58 while B0 only has a probability of 0.42. When the customers are at x=5, they are more likely to choose A0 than B0, based on our computation.

The profit of shop = number of total customer that we simulate * the probability of shop that people choose the cafe * (the price of one cup of coffee - the cost of one cup of coffee)

The profit of A0 = (11/19) * (4 – 2) = 22/19 = 1.16

The profit of B0 = (8/19) * (5 – 2) = 24/19 = 1.26

The above calculation reflects that the profit of B0 will be higher than A0 because the cost of one cup of coffee in shop B0 is higher than A0, which increases the gap between the profit of B0 and A0. B0 priced the coffee at a much higher cost, so even when there is a higher probability for customers to choose A0, B0 will earn more profit from each coffee that they sold after deducting the initial cost to make the coffee ($2), compared to A0. Therefore, although A0 had a higher probability, we earn a lower profit earn for each cup of coffee due to our price.

After simulation:

Through our 50000 trial of Excel simulation, we found that the profit of A0 and B0 that we obtained from our mathematical calculation aligned with the average profit in our simulation. The average profit of A0 in Excel simulation is 1.15452, which is relatively close to 1.16 that we calculated in our math. We assumed that the reason why the profit doesn't completely match and slightly off is because the random generation of the customers' location and selection, while we hardcoded the average location of the customers as 5 when we calculated our math. Correspondingly, the average profit of B0 in Excel simulation is 1.26816, which is again very closed to 1.26 in our mathematical calculation that we make. As a result, the general conclusion that we draw using our simulation is although the average profit didn't fully match up, our calculation is relatively close to the excel simulation, which validates our calculation and prove that we correctly predict the average profit using our calculation. Both the excel simulation and the mathematical calculation prove that A0 (our café shop) will lose to B0 (our competitor) if both locations are being put in the extreme situation.