Marginal Benefit Versus Marginal Cost

1. Kalin Lucas is the point guard on the MSU basketball team. He is a very good basketball player with an NBA career in his future. Kalin is deciding whether to enter the 2010 NBA draft or play another year at MSU and then enter the 2011 NBA draft. The NBA draft occurs every year at the end of June. Suppose Kalin believes that if he enters the 2010 NBA draft, he will agree to a 5 year contract that pays him a guaranteed $4M ($4,000,000) a year starting in 2010. (For simplicity, assume that Kalin would receive the first $4M payment in June of 2010 and the last in June of 2014.) If Kalin plays next year at MSU and then enters the 2011 NBA draft, he believes he will sign a 5 year contract for a guaranteed $4.7M per year. (For simplicity, assume that Kalin would receive the first $4.7M payment in June of 2011 and the last in June of 2015.) If Kalin decides to play for MSU next year, he will purchase an insurance policy in June of 2010 because of the risk of a career ending injury. Suppose the insurance policy stipulates that if Kalin has a career ending injury while playing for MSU, he will receive insurance payments equivalent to those associated with the NBA contract he would have signed in 2011 (basically 5 annual payments of $4.7M starting in June of 2011 with the last being in June of 2015). Suppose this insurance policy will cost Kalin $1M to be paid in June of 2010. Assume that Kalin’s annual interest rate is 10%.

a. If Kalin expects not to work after his NBA career or if he collects the insurance payments, should Kalin enter the 2010 NBA draft or stay at MSU next year and enter the 2011 NBA draft? Assume that this decision is strictly based on monetary considerations. Show your calculations.

PDV of payoff if enter 2010 NBA Draft:
\[4 + \frac{4}{1.1} + \frac{4}{(1.1)^2} + \frac{4}{(1.1)^3} + \frac{4}{(1.1)^4} + \frac{1}{(1.1)^5} = 16.68 \text{ M}\]

PDV of payoff if stay at MSU next year and enter 2011 NBA Draft:
\[-1 + \frac{4.7}{1.1} + \frac{4.7}{(1.1)^2} + \frac{4.7}{(1.1)^3} + \frac{4.7}{(1.1)^4} + \frac{4.7}{(1.1)^5} + 0.1\left[1 + \frac{1}{1.1} + \frac{1}{(1.1)^2} + \frac{1}{(1.1)^3} + \frac{1}{(1.1)^4} + \frac{1}{(1.1)^5}\right] = 16.82 \text{ M}\]

Therefore, Kalin should stay at MSU for the year and enter 2011 NBA Draft.

b. Now suppose that after his 5-year NBA career, Kalin expects to take over for Tom Izzo as MSU men’s basketball head coach. If he plays for MSU next year, is injured, and collects his insurance payments, Kalin expects to become the head coach at MSU starting in June of 2011. For simplicity, assume that this probability of Kalin getting injured is .10. Suppose Kalin expects his compensation as head coach to be $1M per year and this payment is collected in June of each year. He also expects to retire at age 65 no matter what. If this is the case, should Kalin enter the 2010 NBA draft or stay at MSU next year and enter the 2011 NBA draft? As in part a), assume that this decision is strictly based on monetary considerations. Show your calculations.

PDV of payoff if enter 2010 NBA Draft:
\[4 + \frac{4}{1.1} + \frac{4}{(1.1)^2} + \frac{4}{(1.1)^3} + \frac{4}{(1.1)^4} + \frac{1}{(1.1)^5} = 17.30 \text{ M}\]

PDV of payoff if stay at MSU next year and enter 2011 NBA Draft:
\[-1 + \frac{4.7}{1.1} + \frac{4.7}{(1.1)^2} + \frac{4.7}{(1.1)^3} + \frac{4.7}{(1.1)^4} + \frac{4.7}{(1.1)^5} + 0.1\left[1 + \frac{1}{1.1} + \frac{1}{(1.1)^2} + \frac{1}{(1.1)^3} + \frac{1}{(1.1)^4} + \frac{1}{(1.1)^5}\right] = 17.20 \text{ M}\]

Therefore, Kalin should enter the 2010 NBA draft.

I only consider the PDV of payments until 2015 because the PDV of payments after 2015 is the same no matter what Kalin decides.
2. Suppose you own a food distributorship that is located in East Lansing and you serve the southern Michigan area. The revenue you earn as a food distributor is five percent of the merchandise you sell. (For example, suppose you sell a truckload of shrimp to a grocery chain for $200,000, then the revenue generated for your company from this sale is $10,000 – so $190,000 goes to the shrimp company that provided and delivered the shrimp to the grocery store.)

The offices in East Lansing are able to serve southern Michigan but you are thinking of expanding into the Chicagoland area. In order to do this, you would have to establish a satellite office in Chicago and hire five salespeople, along with an office administrator. The office administrator will be paid $70,000 annually and office supplies would cost $30,000 annually in the Chicago office. Each salesperson would be compensated strictly on a commission basis. For each dollar of product they sell, they would earn three cents (i.e., have a three percent commission rate). You would purchase a small office building in Chicago which will cost $400,000 and can be sold after two years for $500,000. You plan to liquidate the food distributorship in two years and retire.

What is the minimum amount of annual sales the Chicago office must generate in order for you to expand in the Chicagoland area? Assume that the Chicago office obtains the same amount of annual sales each year. For simplicity, also assume all revenue is received at the beginning of each year, salaries are paid at the beginning of each year and supplies are purchased at the beginning of each year. Let the interest rate be 10%. Show calculations.

\[
\text{Marginal Benefit of Chicago Office} = 0.02 \times \text{Sales} + 0.02 \times \text{Sales}/1.1 + 500/1.1^2
\]

\[
\text{Marginal Cost of Chicago Office} = 400 + (70 + 30) + ((70 + 30)/1.1)
\]

\[
\text{MB} > \text{MC} \text{ if} 0.02 \times \text{Sales} + 0.02 \times \text{Sales}/1.1 + 500/1.1^2 > 400 + (70 + 30) + ((70 + 30)/1.1) \text{ or when Sales > 4,654,000}
\]

3. Charlie turns 9 years old in a month. As a birthday gift, his father Mike is deciding between season tickets for Michigan State football or a three year subscription to Direct TV (so that they will be able to spend quality time together watching football games). Suppose season tickets for Michigan State football cost $800 (which is to be paid today). The three year subscription to Direct TV costs $300 per year. Assume that the payment for each year occurs at the start of the year. (Therefore, the first payment is due today.) Also assume that the interest rate is 15%. If Mike selects the gift which costs him the least, will Mike buy Charlie season tickets for Michigan State football or the three year subscription to Direct TV? Show calculations and provide explanation.

\[
\text{The present value of MSU season tickets} = 800
\]

\[
\text{The present value of Direct TV for the next three years} = 300 + 300/1.15 + 300/(1+.15)^2 = 788
\]

Mike would buy him Direct TV since 788 < 800.

4. Sue currently works as a salesperson but is considering becoming a manager. To become a manager, she needs to go full-time to business school. Tuition and fees are $20,000 per year and her salary as a salesperson is $18,000 per year. The salary of a manager is $42,000 per year. The annual interest rate is 10%. Salaries are paid at the beginning of the year, as is tuition and fees. Suppose business school takes 2 years and she does not have time to work while going to school. What is the minimum number of years Sue must plan to work in order for her to quit her current job and attend
school? (Assume that Sue is indifferent between going to school, working as a salesperson and working as a manager. Therefore, she strictly makes the decision of whether to attend school based solely on monetary issues.) Show your calculations.

The easiest way to determine the minimum number of years Sue must plan to work in order for her to quit her current job and attend school is by trial and error. To make it not as tedious, you can just use excel to do the present value calculations. You can determine the minimum number of years in one of two ways.

i) The first is to compare the marginal benefit versus the marginal cost of going to school

Comparing marginal benefit with marginal cost if Sue plans to work for 4 years after attending school for two.
Marginal benefit of attending school is \( \frac{42000-18000}{1.1^2} + \frac{42000-18000}{1.1^3} + \frac{42000-18000}{1.1^4} + \frac{42000-18000}{1.1^5} = 69,161 \)
Marginal cost of attending school is \( 38000 + \frac{38000}{1.1} = 72,545 \).
Since marginal benefit is less than marginal cost, Sue should not go to school if she only plans to work for 4 years after attending school.

Comparing marginal benefit with marginal cost if Sue plans to work for 5 years after attending school for two.
Marginal benefit of attending school is \( \frac{42000-18000}{1.1^2} + \frac{42000-18000}{1.1^3} + \frac{42000-18000}{1.1^4} + \frac{42000-18000}{1.1^5} + \frac{42000-18000}{1.1^6} = 82,708 \)
Marginal cost of attending school is \( 38000 + \frac{38000}{1.1} = 72,545 \).
Since marginal benefit is greater than marginal cost, Sue should go to school if she only plans to work for at least 5 years after attending school.

ii) The second way is to calculate the present values of payoffs associated with going to school and not going to school.

Payoffs if Sue plans to work for 4 years after attending school for two.
Payoff from attending school is \( -20000 - \frac{20000}{1.1} + \frac{42000}{1.1^2} + \frac{42000}{1.1^3} + \frac{42000}{1.1^4} = 82,849 \)
Payoff from not attending school is \( 18000 + \frac{18000}{1.1} + \frac{18000}{1.1^2} + \frac{18000}{1.1^3} + \frac{18000}{1.1^4} = 86,234 \)

Payoffs if Sue plans to work for 5 years after attending school for two.
Payoff from attending school is \( -20000 - \frac{20000}{1.1} + \frac{42000}{1.1^2} + \frac{42000}{1.1^3} + \frac{42000}{1.1^4} + \frac{42000}{1.1^5} = 106,557 \)
Payoff from not attending school is \( 18000 + \frac{18000}{1.1} + \frac{18000}{1.1^2} + \frac{18000}{1.1^3} + \frac{18000}{1.1^4} + \frac{18000}{1.1^5} = 96,395 \)

Either way you do it, Sue should go to school only if she plans to work for at least 5 years after completing school.

5. Mike and Stacy just bought a house for $50,000. They plan to live in the house for three years and then sell it. They are deciding whether install new hardwood floors before moving into the house. The cost of the hardwood floors is $15,000. Suppose Mike and Stacy will sell the house in three years for $70,000 if they do not install hardwood floors and for $80,000 if they do install the hardwood floors. If Mike and Stacy decide to install the hardwood floors, what is the minimum amount Stacy and Mike would have to benefit in present value terms from living in a house with
The present discounted value of the $10,000 difference between the selling price with and without hardwood floors is $10,000/(1+.15)^3=6575$. If Mike and Stacy decide to install the hardwood floors, the minimum amount Stacy and Mike would have to benefit in present value terms from living in a house with hardwood floors for three years is $15000-6575=8425$.

6. Mike used to manage an asphalt plant for Barrett Paving. While employed at Barrett Paving, Mike did a cost-benefit analysis on whether to replace the burner that heated the asphalt liquid. Mike discovered that a new burner would cost $800,000 and calculated that it would burn more efficiently than the current burner. Mike expected the burner to last 5 years. This increased efficiency would result in fuel savings of $200,000 per year. For simplicity, assume that the cost savings were obtained at the start of each year. Let the annual interest rate be 15%. Should Mike advise Barrett Paving to purchase the burner? Show calculations. What simplifying assumptions are required to determine whether Mike should purchase the burner?

The marginal benefit of replacing the burner (compared to not replacing the burner for the next 5 years) is $200,000+200,000/1.15+200,000/1.15^2+200,000/1.15^3+200,000/1.15^4=770,996$. The marginal cost is $800,000$.

Since the marginal benefit is less than the marginal cost, Mike should not replace the burner.

There are a lot of simplifying assumptions being made in this word problem. For example, I am assuming that if Mike does not replace the burner this year, than Mike does not replace the burner for the next 5 years. I am also assuming that Mike could perfectly predict future fuel costs.