

Cost/Benefit Analysis

A Methodology for Sound Decision Making

Student Lesson Document

Essential Question: Is it worth it?

Context: We ask ourselves this question all the time, don't we? When we are out shopping and find an item of interest, we all ask ourselves the same questions:

1. What does it cost?
2. Is it worth it?

At times, this answer is evident; yet, sometimes, it is not as obvious.

Directions: Picture the following scenario.

You are walking around the grocery store and you suddenly have a craving for a thick, juicy rib eye steak. Without a second thought, you find your way to the fresh meat aisle. The rib eye steaks look delicious; one in particular seems to have your name written on it. The package reads, "Rib Eye \$11.99/lb." This particular steak is \$15.45.

Do you buy it?

The answer you give will depend on your subjective opinion about steak:

- If you are a steak lover and you can already imagine sinking your teeth into this bad boy, \$15.45 would not deter you at all.
- If the price tag gives you cause to pause, you might decide to look for a more economical steak to purchase.
- If steak is a food that you can take or leave, you will probably find yourself strolling down a different aisle.

This example defines Cost/Benefit Analysis. It can be subjective, and the ultimate decision depends on the individual making it.

Discussion #1:

Let's try again with an example that's a bit more clear-cut.

Again, you are going grocery shopping. You park your car in front of the drugstore, which is located next to the grocery store. In order to walk into the grocery store, you must pass by the drugstore's window. While in the grocery store, you read the following display: ***Soda pop 12-packs - Buy 3 for \$14.00 and get 1 FREE!*** Quickly, you do the math and determine that you will get four packs for \$14.00, which works out to \$3.50 per 12-pack.

Prior to checkout, you remember the sign that appeared in the drugstore's window: *Soda pop 12-packs - \$2.50 each*. Again, you use math to calculate that this would be a savings of \$1.00 per 12-pack; this would add up to a savings of \$4.00 if you purchase four 12-packs!

Ask yourself: Is it worth it to make an extra trip into the drugstore in order to save \$4.00 instead of purchasing the soda at the grocery store?

Presumably, \$4.00 is a significant enough savings for exactly the same item. In fact, many people would decide to get their soda pop at the drugstore. Heck, at this price, you could buy a fifth 12-pack and still save \$1.50 over the grocery store purchase!

Discussion #2:

Cost/Benefit Analysis is a practice that most of us use all the time when making decisions, even when we do not realize we are utilizing the tactic. So, let's define what it is.

Cost/Benefit Analysis (CBA) - a comparative analysis of estimates of the costs and the benefits of undertaking a particular action in order to determine if taking the action is worthwhile.

The procedure to complete an effective Cost/Benefit Analysis is a four-step process:

1. Try to determine all of the **costs** associated with taking a particular action.
Try to determine all of the **benefits** associated with taking that action.
2. Try to estimate the monetary value of each **cost** and total them.
3. Try to estimate the monetary value of each **benefit** and total them.
4. Finally, compare the **total costs** versus the **total benefits** to determine if the action is worth taking.

Note: These are seemingly simple steps; however, things are rarely as simple as they seem. The more accurate the monetary estimates of the costs and benefits are, the easier it will be to make a decision. Also, the greater the difference between the totals of the costs and the benefits, the easier the decision will be. Yet, when the costs and benefits totals are closer together, the decision becomes more subjective.

Also, while the monetary value of costs may be a relatively easy thing to estimate, many times there are benefits that cannot be ignored and are difficult, if not impossible, to value in monetary terms. Again, this can make a decision subjective.

Explanation: In the example of purchasing soda pop 12-packs, the difference in prices between the grocery store and the drugstore was substantial enough to make it a seemingly easy decision regarding where to purchase the soda. However, what if the difference in price per 12-pack was only a nickel instead of a dollar? The savings on purchasing four 12-packs would be merely

\$0.20. Depending on the individual shopper, this might not be a significant enough savings to make the trip into the drugstore. The decision on where to purchase the soda pop might be different because the CBA results changed the shopper's mind.

Would a \$0.20 savings difference, instead of a \$4.00 savings, change your mind?

Discussion #3:

As previously stated, assigning a monetary value to some benefits may be difficult, if not impossible, to do. Let's take a look at an example that still produces a reasonably clear-cut result.

Example: A small community, located in the vicinity of your neighborhood, is host to a troublesome intersection. Most of the time, it seems to be quite busy. Not only does heavy traffic move through the intersection, but it is also frequented by many people, especially small children. Perhaps it is even a school bus drop-off site? In any case, the intersection is clogged with vehicular and pedestrian traffic. It appears to be an accident waiting to happen. Residents continually petition the village council to install a traffic control device. A traffic light is preferred to control the flow of traffic and to help keep pedestrians safe.

The village council has agreed and does a Cost/Benefit Analysis on installing the traffic light at this intersection.

The costs are straightforward.

- \$8,500 for the traffic light and equipment needed to control it.
- \$2,500 for installation.
- \$1,000 per year to maintain the light and pay for the electricity to run it.

Total costs = \$11,000 + \$1,000 annually

The benefits are also straightforward, but assigning a monetary value to them is more difficult.

- A traffic light would almost certainly prevent injury or worse to pedestrians.
- **How does one put a monetary value on a human life?**

Note: The village council would be hard pressed to find anyone who would disagree with the fact that if the traffic light saved even one life, the \$11,000 cost would be well worth the expense. Placing a monetary value on a human life would be difficult, if not impossible, to do; yet, almost everyone would agree that whatever the monetary value of that life is, it is much greater than \$11,000. Therefore, the project should be completed.

Do you agree?

Discussion #4:

Remember, step #1 of conducting a CBA is to:

1. Try to determine all of the **costs** associated with taking a particular action.
Try to determine all of the **benefits** associated with taking that action.

It can be difficult to assign monetary values to benefits; yet, those benefits cannot and should not be ignored. In addition, there may be some obscure costs involved that should also be taken into account.

Opportunity Costs

Opportunity costs are real and are usually a part of the decision-making process; yet, they are easily missed when completing a CBA. What are Opportunity Costs?

Opportunity cost - the cost associated with forgoing the benefit of making a different decision. If there are two choices, Option A and Option B, but only one option can be selected, then the opportunity cost of choosing one option is the benefit of choosing the other option.

Example:

It's Friday night and you are looking forward to having a nice dinner at your favorite restaurant. Then, some friends contact you to invite to a movie tonight. Sounds like a blast! However, you only have enough money for dinner OR a movie, not both. So, you must make a choice: dinner OR a movie with your friends?

Option A: If you choose to go to dinner, you will miss out on going to the movies.

Option B: If you choose to go to the movies, you will miss out on dinner at your favorite restaurant.

Explanation: The *opportunity cost* of choosing dinner is the movie with friends. The *opportunity cost* of choosing the movie is dinner at your favorite restaurant.

Opportunity costs can be thought of as the consequences of selecting one action over another. In most CBAs, these opportunity costs are real and should always be taken into account.

What would you decide to do?

Discussion #5:

Reflect back to the CBA completed based on the traffic light scenario. What if there is an opportunity cost wrinkle?

As the village council works on the CBA to decide if installing the traffic light project should move forward, the council determines that the funds would need to come from a previously

approved project. The community park's equipment is in disrepair and needs to be fixed and/or replaced. The jungle gyms, swing sets, etc. have all seen better days and \$11,000 has already been approved and allocated to repair and upgrade the park. The current state of the equipment also presents a potential safety hazard to the people who frequent the park.

The park upgrade project and the traffic light project are two choices. The council, however, is aware that there is only enough money to fund one. The *opportunity cost* of installing the traffic light is that the park upgrade would have to wait. The *opportunity cost* of upgrading the park is that the traffic light would have to wait. Both costs deal with the value of a human life or injury. The decision to install the traffic light is no longer so clear.

Exercise: In order to solve this dilemma, use the four-step CBA process and include the opportunity costs of each choice.

- Total cost of installing a traffic light
- Opportunity cost of installing a traffic light
- Total cost of park repair
- Opportunity cost of park repair

- Benefits of installing a traffic light
- Benefits of repairing the park

Respond: How would you rationalize your decision?

Discussion #6:

Future Value

Not all opportunity costs of a decision are subjective and/or difficult to value in monetary terms. Some can have hard and fast monetary values that can be easily calculated if we remember to include them.

Example - Mr. and Mrs. Jones have been planning necessary renovations/upgrades to their home for quite a while and have been saving to make them happen. They did their homework and determined the cost for the materials and the manual labor to be \$2,700. They have also determined that the upgrades would have a useful life of 10 years. The benefits they perceive are entirely subjective, but the pride in their home and the increased comfort they will enjoy for the 10-year period far outweigh the \$2,700 price tag.

Fair enough.

There is an opportunity cost the Jones family is missing. This should be calculated and taken into account. This is what we call the **future value** of the \$2,700 if they decided not to renovate. The \$2,700 they have set aside for the upgrade could alternatively be placed in a safe investment over

the same 10-year period. When the 10 years is up, the original \$2,700 investment will have grown.

By choosing the renovation, Mr. and Mrs. Jones will be giving up the \$2,700 *and* the value of their \$2,700 after 10 years of growth. So, the true cost of their renovations is not only the \$2,700 for materials and labor, but also the opportunity cost of the investment growth of the \$2,700.

Their upgrade will cost them substantially more than \$2,700 if they include this cost. But, the question remains, how much more?

To accurately determine the future value of their \$2,700, we turn to a formula called the **Future Value Formula**, also known as the **Compound Interest Formula**.

It looks like this: $F = P*(1 + r)^n$

Where:

F = the future value of an investment

P = the present value

r = the interest rate

n = the time frame (in years)

Example: What is the future value of \$1,000 invested at 6% for 8 years?

F= Future Value **P**= \$1,000 **r** = 6% or .06 **n** = 8

$$F = P*(1 + r)^n$$

$$F = 1000*(1 + .06)^8$$

$$F = 1000*(1.593848)$$

$$F = 1,593.85$$

Hands-on Activity #1

Now you try. Calculate the Future Value of the Jones family's \$2,700 if Mr. and Mrs. Jones decide not to renovate their home and instead invest in a fixed, 10-year safe investment paying 2.5%.

If Mr. and Mrs. Jones renovate, they will pay \$2,700 and enjoy the upgrade for 10 years but will have \$0.00 in 10 years.

Question: If they choose to invest, instead of renovate, how much will their investment be worth 10 years from now?

This amount should be added to the \$2,700 as an opportunity cost of finishing the renovations.

Hands-on Activity #2

CBA Activity

Tom and Patty Conley purchased their dream home 10 years ago.

They both work, so with two incomes and excellent credit, they qualified for and received a \$200,000 mortgage to purchase their dream home. Now, 10 years later, economic times have changed. The U.S. economy has suffered through tough economic challenges, including a severe housing market collapse. As a result, interest rates on today's mortgages are lower than when the Conleys purchased their house. The Conleys are considering **refinancing** their mortgage to take advantage of these low interest rates. They believe refinancing will give them a lower monthly payment, which will give them more of their money to use for other things. The refinancing will save lots of interest over the long term.

CBA can be used to help the Conleys analyze their opportunity.

First, it would be a good idea to define a couple of terms.

Refinancing a mortgage means to pay off an existing mortgage with a new one, usually because the terms of the new mortgage are more favorable than the old one.

Monthly Mortgage Payment is the amount of money paid each month to pay back a mortgage loan. The pure monthly mortgage payment consists of **principal** (the money borrowed) and **interest** (the price paid for borrowing the money), or **P & I**.

Some monthly mortgage payments consist of P & I, plus another amount called escrow, which is an estimate of the property taxes and property insurance that will be needed to be paid on the home. Some lenders require the annual insurance and property tax estimates to be totaled and divided by 12 (monthly amount), then added to the monthly mortgage payment as a payment into an **escrow account** that the lender will use to pay the insurance and taxes when they become due.

In the case of Mr. and Mrs. Conley, the lender did not require a monthly escrow payment and the Conleys are responsible for paying their insurance and taxes when they are due. Therefore, the Conleys' monthly mortgage payment consists only of P & I.

Amortization Table is a table showing the amount of interest and principal being applied to a mortgage loan each month.

There are 360 monthly payments due in a 30-year mortgage ($12 \times 30 = 360$ months).

Each payment is the same amount but how the funds are used changes each month. For each payment, the lender calculates the amount of interest the borrower owes on the money he/she has borrowed. The lender subtracts that interest amount from the mortgage payment. Whatever

money is left over, the lender applies to the outstanding balance, which reduces the amount the borrower now owes.

Next month then, when the lender calculates the amount of interest due, it will be a bit less because the borrower owes a bit less. So, the lender takes a smaller amount from the mortgage payment to pay for interest and applies a larger amount to pay back the amount owed. Each and every month then, the borrower owes a bit less than he/she did the previous month; therefore, more of the mortgage payment is being used to pay back the loan, and less of the payment is being used to pay interest. The exact breakdown of the amounts of interest and principal being used out of each payment is presented in a table called an **Amortization Table**.

Discussion #7:

To complete the calculations necessary for this activity, we will need the help of a mortgage loan calculator. There are plenty of fine calculators available on the web (any one of which would probably be fine to use). One calculator to use is found on BankRate.com.

Exercise:

Let's begin by identifying a couple of important numbers.

The Conleys' original mortgage loan was for \$200,000. It is a 30-year mortgage at 8.625% interest, and their monthly payment consists of only principal and interest.

Using the mortgage loan calculator, answer these questions:

- What is the Conleys' current **monthly mortgage payment**?
- If the Conleys keep their existing mortgage, how much **total interest** will they end up paying after 30 years?
- It has been exactly 10 years since the mortgage was taken out (120 months). How much do the Conleys **still owe** on their loan?
- How much **interest** have they **paid so far** over the 10 years?
- If they keep their existing mortgage, how much interest will they pay from now until the end?

Cost/Benefit Analysis(CBA) is a comparative analysis of estimates of the costs and the benefits of undertaking a particular action in order to determine if taking the action is worthwhile.

The procedure to do an effective Cost/Benefit analysis is a four-step process:

1. Try to determine all of the **costs** associated with taking a particular action.
Try to determine all of the **benefits** associated with taking that action.
2. Try to estimate the monetary value of each cost and total them.
3. Try to estimate the monetary value of each benefit and total them.
4. Finally, compare the total costs versus the total benefits to determine if the action is worth taking.

Step 1:

1. *Try to determine all of the **costs** associated with taking a particular action.
Try to determine all of the **benefits** associated with taking that action.*

Refinancing a mortgage means to pay off an existing mortgage with a new one, usually because the terms of the new mortgage are more favorable than the old one. There are costs associated with refinancing a mortgage.

The Conleys are considering refinancing their mortgage to take advantage of lower interest rates. They believe refinancing will give them a lower monthly payment, which will give them more of their money to use for other things. Refinancing will save lots of interest over the long term.

Step 2:

2. *Try to estimate the monetary value of each cost and total them.*

Refinancing costs vary from state to state and lender to lender. For our purposes, we will list costs typically found in any refinancing. Also, some of the costs are based on the amount borrowed and some are fixed amounts.

Cost	Explanation	Amount
Application fee	Initial cost of determining if a borrower qualifies for a loan. Can include fee for checking credit report.	\$125
Loan origination fee 1.5% of loan amount	Lender's fee for documenting and preparing the loan.	<input type="text"/>
Points 2 points	1 point = 1% of loan amount Bank's profit for establishing the loan	<input type="text"/>
Appraisal fee	A current appraisal of the home's value done by a licensed appraiser.	\$350

Inspection fee	Home inspection by a licensed inspector to determine the home's condition	\$200
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In the table that follows, we will fill in fixed costs and ask you to calculate those based on the loan amount. The **new loan amount** is the amount the Conleys still owe on their existing mortgage.

Costs of a refinance:

Bank attorney fee	Bank's attorney reviews and signs off on the loan agreement and may conduct the closing.	\$500
Conleys' attorney fee	Borrower's attorney reviews the documents to protect the borrower.	\$500
Title work	Searching the property's history to determine if the ownership is clear. Also, insures against future claims against ownership.	\$800
Survey	An updated survey of the property is required.	\$125
TOTAL COSTS	Total cost of the refinance	<input type="text"/>

Step 3:

3. *Try to estimate the monetary value of each benefit and total them.*

Look at the new loan.

How much do the Conleys owe on their existing loan?

(You answered this question earlier. This will be the new loan amount.)

The new loan will be a 30-year fixed rate mortgage at 4.75% interest.

What will the Conleys' new monthly mortgage payment be?

If the Conleys keep their new mortgage, how much **total interest** will they end up paying after 30 years?

Step 4:

4. *Finally, compare the total costs versus the total benefits to determine if the action is worth taking.*

- We have information about the existing 30-year mortgage loan.
- We have information about the cost to refinance this loan into a new loan.
- We have information about the new loan.

Now, analyze the information and determine what the benefit of refinancing the loan will be for Mr. and Mrs. Conley.

One benefit the Conleys anticipate from refinancing is a lower monthly mortgage payment. Will the refinanced mortgage free up money in their monthly budget for other things?

What is the Conleys' current monthly mortgage payment?

What will be the Conleys' new monthly mortgage payment?

Subtract
(if positive, this will be the Conleys' monthly savings):

Were Mr. and Mrs. Conley right? Is the monthly savings a substantial benefit?

Break-Even Period

The Conleys will be saving money on their mortgage each and every month. However, it cost them a substantial sum to refinance and get a new mortgage.

How many months of savings will it take before the Conleys recover the cost of refinancing the loan?

$$\frac{\text{Total Costs}}{\text{Monthly Savings}} = \frac{\text{[]}}{\text{[]}} \text{ equals } \text{[]} \text{ months}$$

Another benefit the Conleys expect is that refinancing will save them a substantial amount of interest over the long term. Will it?

If the Conleys keep their existing mortgage, how much **interest** do they still have left to pay?

$$\begin{array}{r} \text{[]} \\ \text{[]} \\ \hline \text{Subtract ...} \\ \text{[]} \end{array}$$

The difference here is how much interest they will save by refinancing.

Do you consider it substantial?

Answer: It appears the Conleys' expectations were correct. They will save a substantial amount of money each and every month on their mortgage payment. They will reimburse themselves for the cost of the refinance in a reasonable amount of time and will ultimately save a substantial amount of interest over the long term.

Note: You may have noticed that there is an **opportunity cost** missing from the analysis: the opportunity cost of investing the money they paid for the refinance, instead of spending it on refinancing.

Opportunity costs are the consequences of choosing one course of action over another. The Conleys needed to reduce monthly spending. Saving big on interest over the long term was not a choice, but a necessity. This calculation was not included in the calculation of costs.

But, they really should know what it would be, so...

Please calculate the Future Value of investing the Total Costs figure from the table above in a safe investment yielding 2.5% interest for 30 years.

Conclusion:

Cost/Benefit Analysis is a practice most of us use all the time when making decisions, even if we do not realize we are utilizing the tactic.

Cost/Benefit Analysis (CBA) is a comparative analysis of estimates of the costs and the benefits of undertaking a particular action in order to determine if taking the action is worthwhile.

- Just because you *can* do something, does not mean you *should* do it.
- Not every idea is a good one.
- Look before you leap.

This is good advice, wouldn't you say?

Following a particular course of action can sometimes *simply feel right*.

Subjective benefits can be difficult to quantify; therefore, these make it difficult to prove that feeling like the right thing to do *is* the right thing to do.

Extension Activities:

- Can you think of a situation where you just know what the right course of action is, but cannot prove that it is merely by reducing the action to dollars and cents?
- Can you think of a situation where what seems to be the right thing to do turns out to be the wrong thing to do?

Thank you for your attention.