
Unit 1

Basic Concepts in Benefit-Cost Analysis (BCA)

Welcome and Introductions



Unit 1: Basic Concepts in Benefit-Cost Analysis (BCA)

Visual 1: Unit 1 - Basic Concepts in Benefit-Cost Analysis (BCA)

Welcome to Unit 1 of the Introduction to Benefit-Cost Analysis (BCA) course. This unit focuses on basic concepts in BCA.

The Student Manual is needed for this unit.

Unit 1 Overview

Unit 1 Overview

- Introduce students to the basic concepts behind Benefit-Cost Analysis (BCA).
- Introduce students to the role of the BCA in Hazard Mitigation Assistance (HMA) grants.
- Introduce students to the basic terms used when discussing BCA.

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Visual 2: Unit 1 Overview

Unit 1 will cover several topics:

- Introduce students to the basic concepts behind Benefit-Cost Analysis (BCA).
- Introduce students to the role of the BCA in Hazard Mitigation Assistance (HMA) grants.
- Introduce students to the basic terms used when discussing BCA.

Unit 1 Objectives

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- Students should be able to describe the basic terms used in Benefit-Cost Analysis (BCA).
- Students should be able to explain how to determine when to do a BCA and when it will be cost effective.

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Visual 3: Unit 1 Objectives

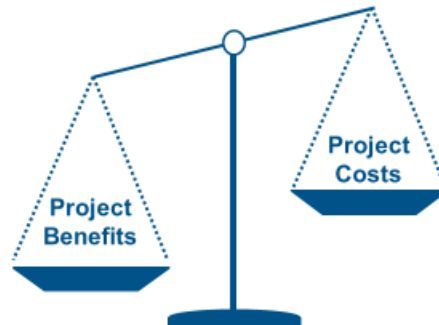
The purpose of this unit is for students to become familiar with the basic concepts behind Benefit-Cost Analysis (BCA). Once the unit is complete, students should be able to:

- Describe the basic terms used in Benefit-Cost Analysis (BCA).
- Explain how to determine when to do a BCA and when it will be cost effective.

What is Benefit-Cost Analysis (BCA)?

What is Benefit-Cost Analysis (BCA)?

- **Benefit-Cost Analysis (BCA)** is the process of quantifying the advantages (benefits) of an action and comparing it to its drawbacks (costs).



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Visual 4: What is Benefit-Cost Analysis (BCA)?

Benefit-Cost Analysis (BCA) is the process of comparing the advantages of an action to its costs.

We'll discuss BCA in relation to hazard mitigation projects more in Unit 3. For now, let's focus on learning the basic concepts behind BCA.

What is Benefit-Cost Analysis (BCA)?

What is Benefit-Cost Analysis (BCA)?

Although BCA may seem like a difficult concept, you probably already practice it almost every day.

- Examples:
 - Is a warehouse club membership worth it?
 - Should I fix that leaky toilet in my house?
 - Should I buy or rent a house?
- What factors go into your decision?

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Visual 5: What is Benefit-Cost Analysis (BCA)?

Although BCA may seem like a difficult concept, you probably already practice it in your everyday life.

For example, have you ever considered questions like the following?

- Is a warehouse club membership worth it?
- Should I fix that leaky toilet in my house?
- Should I buy or rent a house?

Can you think of other examples where you practice BCA in your life?

Benefits and costs

Benefits and costs

We'll discuss benefits and costs in relation to hazard mitigation projects more in Unit 3, but for now let's consider the example of the leaky toilet.

- What are the **benefits** of replacing it? How would I quantify these benefits?
- What are the **costs** of replacing it?

Visual 6: Benefits and costs

We will discuss benefits and costs specific to hazard mitigation projects more in Unit 3. For now, let's consider the example of the leaky toilet.

What are some benefits of replacing it? Are these benefits quantifiable (that is, able to be put into dollar terms)?

What are the costs of replacing it?

Benefits and costs

Benefits and costs

- Benefits:
 - Lower water bills
 - Reduced damage to floor
 - Less worry about damage?
 - Reduced time spent fixing leak or cleaning up mess?
 - Costs:
 - Cost of new toilet + materials
 - Pay someone to install toilet
 - Take time off work to supervise installation of toilet
 - Maintenance?
-

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Visual 7: Benefits and costs

Some benefits of replacing the toilet may include:

- Lower water bills
- Reduced damage to floor
- Less worry about damage?
- Reduced time spent fixing leak or cleaning up mess?

Can we quantify all these benefits? If not, should we include them in our BCA?

Some costs of replacing the toilet may include:

- The cost of the new toilet plus any materials
- The cost to pay someone to install the toilet
- Time taken away from other activities to do it yourself
- Potential maintenance costs with new toilet

How do we know if something is worth the investment?

How do we know if something is “worth it”?

- If an action’s benefits are greater than its costs, then it is considered **cost-effective**.
- Once we add up the benefits for an action, we divide that value by the costs, which gives us the **Benefit-Cost Ratio (BCR)**.

$$\frac{\text{Benefits}}{\text{Costs}} = \text{BCR}$$

If the BCR is greater than or equal to 1.0, then the action is cost-effective.

Visual 8: Cost-effectiveness

If an action’s benefits are greater than its costs, then it is considered to be cost-effective.

Once we add up the benefits of an action, we divide that value by the costs. This gives us the Benefit-Cost Ratio (BCR).

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If the BCR is greater than 1.0, then the action is considered cost-effective.

How do we know if something is worth the investment?

How do we know if something is “worth it”?

• Is it worth \$1 million to:

1. Protect one vacation home?
2. Protect one government building that floods infrequently?
3. Protect a flood-prone hospital or wastewater treatment plant?
4. Protect 150 flood-prone houses?

	Probably	Probably Not
1. Protect one vacation home?		
2. Protect one government building that floods infrequently?		
3. Protect a flood-prone hospital or wastewater treatment plant?		
4. Protect 150 flood-prone houses?		

Visual 9: Cost-effectiveness exercise

Do you think it is worth \$1 million to protect these structures from flooding? Why or why not? Fill out the table below.

	Probably	Probably Not
1. Protect one vacation home?		
2. Protect one government building that floods infrequently?		
3. Protect a flood-prone hospital or wastewater treatment plant?		
4. Protect 150 flood-prone houses?		

How do we know if something is worth the investment?

How do we know if something is “worth it”?

• Is it worth \$1 million to:

1. Protect one vacation home?
2. Protect one government building that floods infrequently?
3. Protect a flood-prone hospital or wastewater treatment plant?
4. Protect 150 flood-prone houses?

	Probably	Probably Not
1. Protect one vacation home?		<input checked="" type="checkbox"/>
2. Protect one government building that floods infrequently?		<input checked="" type="checkbox"/>
3. Protect a flood-prone hospital or wastewater treatment plant?	<input checked="" type="checkbox"/>	
4. Protect 150 flood-prone houses?	<input checked="" type="checkbox"/>	

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Visual 10: Results of Cost-effectiveness exercise

Intuitively, we know that a million-dollar mitigation project to protect one vacation home or a building that doesn't flood frequently is probably not a good investment.

On the other hand, a million-dollar mitigation project to protect a large number of flood-prone houses or important buildings is probably a worthwhile investment.

- Cost is always a key determinant of cost-effectiveness. Protecting a hospital may be cost-effective at \$500,000 but not if the mitigation project costs \$5,000,000.

Why are the last two projects worth doing, while the first two are not?

Applications of BCA

Applications of BCA

- BCA can be used to determine if a single action is cost-effective in comparison to the status quo:
 - Should I replace that leaky toilet, or leave it as-is?
- Or it can be used to determine the most cost-effective option out of several:
 - Should I (1) replace the leaky toilet, (2) try to repair it, or (3) remodel my entire bathroom?
- For hazard mitigation projects, we are usually doing the first way, since we do not require applicants to show that they are choosing the most cost-effective option.

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Visual 11: Applications of BCA

BCA can be used multiple ways. For one, it can be used to determine if a single action is cost-effective in comparison to the status quo:

- For example: Should I replace that leaky toilet, or leave it as-is?

Or, it can be used to determine the most cost-effective option out of several.

- For example: Should I (1) replace the leaky toilet, (2) try to repair it, or (3) remodel my entire bathroom?
- It is important to note that the last option, remodeling the bathroom, could very well be cost-effective when compared to the status quo. But it is unlikely to be the **most** cost-effective option.

For hazard mitigation projects, we are usually doing the first way, since we do not require applicants to show that they are choosing the **most** cost-effective option.

Remember that the BCA is only one component subapplicants must consider when determining which project is their preferred option. The other components are discussed briefly in Unit 3 and in more detail in E0212.

Why should I do a BCA?

Why should I do a BCA?

- Required component for HMA projects
- Required for some 406 (Public Assistance) mitigation projects
- Helps communities and subapplicants make informed decisions about their risks and money and prioritize projects

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Visual 12: Why should I do a BCA?

There are several reasons you should do a BCA. They include:

- A BCA is a required component of most HMA project applications
- A BCA is required for some 406 (Public Assistance) mitigation projects
- BCAs help communities and subapplicants make informed decisions about their risks and money and prioritize projects

We'll discuss the statutory and regulatory requirement for BCA in the next unit.

For those of you who've taken the 212 course, HMA: Developing Quality Application Elements, you should know why you need to conduct a Benefit-Cost Analysis. For those who haven't taken the 212 course, it's important to know that a Benefit-Cost Analysis is a required component of a complete Hazard Mitigation Assistance project subapplication.

Other common BCA terms

Other common BCA terms

- Discount rate
- Net present value

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Visual 13: Other Common BCA terms

Now let's discuss a couple of other terms commonly used in BCA:

- Discount rate
- Net present value

Discount rate

Discount rate

- If I offered you \$100 today, or \$100 one year from now, which would you choose? Why?
 - \$100 invested today might result in \$106 one year from now.
 - \$100 one year from now might only buy \$97 worth of goods.
- Because benefits are worth more if they are experienced sooner, future benefits must be discounted. The rate at which benefits decline in value each year is the **discount rate**.
 - Federally-funded mitigation projects must use a discount rate of 7%, which is set by the U.S. Office of Management and Budget (OMB). We'll discuss this more in Unit 3.

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Visual 14: Discount rate

If I offered you \$100 today, or \$100 one year from now, which would you choose? Why?

You'd probably choose to have \$100 today because:

- \$100 invested today might result in \$106 one year from now.
- \$100 one year from now might only buy \$97 worth of goods.

Because benefits are worth more if they are experienced sooner, future benefits must be discounted. The rate at which benefits decline in value each year is the discount rate.

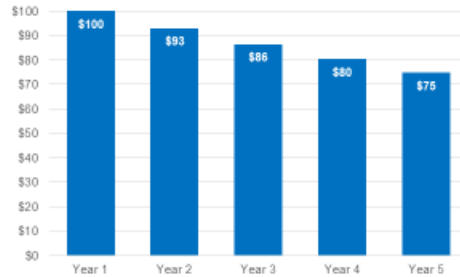
Federally-funded mitigation projects must use a discount rate of 7%, which is set by the U.S. Office of Management and Budget (OMB). We'll discuss this more in Unit 3.

How do you think using a higher or lower discount rate for a mitigation project would affect the BCR?

Discount rate

Discount rate

- Example: Let's say I have a mitigation project with \$100 in benefits in Year 1. With a discount rate of 7%, my annual benefits would be as follows:



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Visual 15: Discount rate example

Let's say I have a mitigation project with \$100 in benefits in Year 1. With a discount rate of 7%, my annual benefits would be as follows:

	Annual benefits
Year 1	\$100
Year 2	\$93
Year 3	\$86
Year 4	\$80
Year 5	\$75

As you can see, the benefits are reduced by 7% each year.

Net present value

Net present value

- **Net present value (NPV)** is the value today of benefits that you will receive in the future, minus the value today of costs that you will incur in the future.
- A positive NPV indicates that something is a good investment.

$$\begin{array}{r} \text{Future benefits} \\ \text{(in today's} \\ \text{dollars)} \end{array} - \begin{array}{r} \text{Costs} \\ \text{(in today's} \\ \text{dollars)} \end{array} = \begin{array}{r} \text{Net Present} \\ \text{Value (NPV)} \end{array}$$

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Visual 16: Net Present Value

Net present value (NPV) is the value today of benefits that you will receive in the future, minus the value today of costs that you will incur in the future.

$$\text{Future benefits (in today's dollars)} - \text{Costs (in today's dollars)} = \text{Net Present Value (NPV)}$$

A positive NPV indicates that something is a good investment.

Net present value

Net present value

- Example: Let's say I would like to rent out my basement. In order to make the space rentable, I will have to spend \$25,000 to renovate it and get a certificate of occupancy. The basement will rent for \$1,000 per month, and I plan to rent it out over a period of 3 years.
- Is this a good investment? How can I figure this out?

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Visual 17: Net Present Value example

Example: Let's say I would like to rent out my basement. In order to make the space rentable, I will have to spend \$25,000 to renovate it and get a certificate of occupancy. The basement will rent for \$1,000 per month, and I plan to rent it out over a period of 3 years.

Is this a good investment? How can I figure this out?

Note: This is a very simplified example and does not take inflation, rent increases, etc. into account.

Net present value

Net present value

$$\text{Future benefits (in today's dollars)} - \text{Costs (in today's dollars)} = \text{Net Present Value (NPV)}$$

- In Year 1, my benefits from renting out my basement are \$1,000 x 12 = \$12,000.
- What are my benefits in Year 2 if I assume a 7% discount rate? (Hint: The answer is not \$12,000.)

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Visual 18: Net Present Value example

First, let's figure out the first part of our equation: future benefits in today's dollars.

We calculate this by using the discount rate.

- In Year 1, my benefits from owning the rental property are \$1,000 x 12 = \$12,000.
- What are my benefits in Year 2? (Hint: It's not \$12,000.)

 Net present value

Net present value

$$\text{Future benefits (in today's dollars)} - \text{Costs (in today's dollars)} = \text{Net Present Value (NPV)}$$

Benefits are reduced by 7% each year over the 3-year period:



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Visual 19: Net Present Value example

Recall we have a discount rate of 7%.

Since my benefits are reduced by 7% each year, my total benefits over the 10-year period are:

	Annual benefits
Year 1	\$12,000
Year 2	\$11,520
Year 3	\$11,059
Sum:	\$33,539

Net present value

Net present value

$$\begin{array}{r} \text{Future benefits} \\ \text{(in today's} \\ \text{dollars)} \end{array} - \begin{array}{c} \text{Costs} \\ \text{(in today's} \\ \text{dollars)} \end{array} = \begin{array}{r} \text{Net Present} \\ \text{Value (NPV)} \end{array}$$

- In this very simplified example, my costs are my original investment:

\$25,000

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Visual 20: Net Present Value example

Now that we have calculated the value of our future benefits in today's dollars (\$33,539), let's determine the costs.

In this very simplified example, the costs are my original investment of \$25,000.

Net present value

Net present value

$$\begin{array}{r} \text{Future benefits} \\ \text{(in today's} \\ \text{dollars)} \end{array} - \begin{array}{r} \text{Costs} \\ \text{(in today's} \\ \text{dollars)} \end{array} = \text{Net Present} \\ \text{Value (NPV)}$$

- For this example:

$$\$33,539 - \$25,000 = \$8,539$$

- Did I make a good investment?

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Visual 21: Net Present Value example

My Net Present Value (NPV) is \$8,539, which is a positive number.

$$\$33,539 - \$25,000 = \$8,539$$

Answer: Yes, I have a positive NPV, so I made a good investment.

Unit 1 Review

Unit 1 Review

- Key terms:
 - **Benefit-Cost Analysis (BCA)**
 - **Benefit**
 - **Cost**
 - **Benefit-Cost Ratio (BCR)**
 - **Cost-effectiveness**
 - **Discount rate**
 - **Net present value (NPV)**

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Visual 22: Unit 1 Review

Let's review the concepts and terms we've discussed in this unit:

- Benefit-Cost Analysis (BCA)
- Benefit
- Cost
- Benefit-Cost Ratio (BCR)
- Cost-effectiveness
- Discount rate
- Net present value (NPV)