Excellence in Financial Management

Course 3: Capital Budgeting Analysis

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This course provides a concise overview of capital budgeting analysis. This course is recommended for 2 hours of Continuing Professional Education. In order to receive credit, you will need to pass a multiple choice exam which is administered over the internet at www.exinfm.com/training

A companion toll free course can be accessed by dialing 1-877-689-4097, option 3, ID 752.

Chapter

1

The Overall Process

Capital Expenditures

Whenever we make an expenditure that generates a cash flow benefit for more than one year, this is a capital expenditure. Examples include the purchase of new equipment, expansion of production facilities, buying another company, acquiring new technologies, launching a research & development program, etc., etc., etc. Capital expenditures often involve large cash outlays with major implications on the future values of the company. Additionally, once we commit to making a capital expenditure it is sometimes difficult to back-out. Therefore, we need to carefully analyze and evaluate proposed capital expenditures.
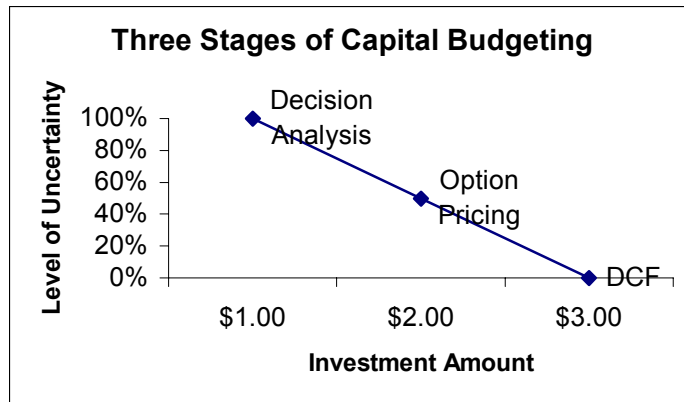
The Three Stages of Capital Budgeting Analysis

Capital Budgeting Analysis is a process of evaluating how we invest in capital assets; i.e. assets that provide cash flow benefits for more than one year. We are trying to answer the following question:

Will the future benefits of this project be large enough to justify the investment given the risk involved?

It has been said that how we spend our money today determines what our value will be tomorrow. Therefore, we will focus much of our attention on present values so that we can understand how expenditures today influence values in the future. A very popular approach to looking at present values of projects is *discounted cash flows or DCF*. However, we will learn that this approach is too narrow for properly evaluating a project. We will include three stages within Capital Budgeting Analysis:

▪ Decision Analysis for Knowledge Building

▪ Option Pricing to Establish Position

▪ Discounted Cash Flow (DCF) for making the Investment Decision

> KEY POINT → Do not force decisions to fit into Discounted Cash Flows! You need to go through a three-stage process: Decision Analysis, Option Pricing, and Discounted Cash Flow. This is one of the biggest mistakes made in financial management.

Three Stages of Capital Budgeting

Decision
Analysis

Option
Pricing

DCF

Level of Uncertainty: 100%, 80%, 60%, 40%, 20%, 0%

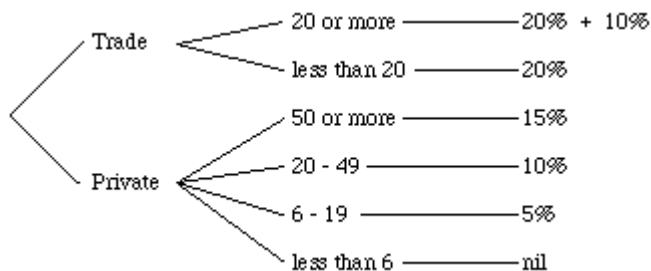Investment Amount: $1.00, $2.00, $3.00

Stage 1: Decision Analysis

Decision-making is increasingly more complex today because of uncertainty. Additionally, most capital projects will involve numerous variables and possible outcomes. For example, estimating cash flows associated with a project involves working capital requirements, project risk, tax considerations, expected rates of inflation, and disposal values. We have to understand existing markets to forecast project revenues, assess competitive impacts of the project, and determine the life cycle of the project. If our capital project involves production, we have to understand operating costs, additional overheads, capacity utilization, and start-up costs. Consequently, we can not manage capital projects by simply looking at the numbers; i.e. discounted cash flows. We must look at the entire decision and assess all relevant variables and outcomes within an analytical hierarchy.

In financial management, we refer to this analytical hierarchy as the Multiple Attribute Decision Model (MADM). Multiple attributes are involved in capital projects and each attribute in the decision needs to be weighed differently. We will use an analytical hierarchy to structure the decision and derive the importance of attributes in relation to one another. We can think of MADM as a *decision tree* which breaks down a complex decision into component parts. This decision tree approach offers several advantages:

- We systematically consider both financial and non-financial criteria.

- Judgements and assumptions are included within the decision based on expected values.

- We focus more of our attention on those parts of the decision that are important.

- We include the opinions and ideas of others into the decision. Group or team decision making is usually much better than one person analyzing the decision.

Therefore, our first real step in capital budgeting is to obtain knowledge about the project and organize this knowledge into a decision tree. We can use software programs such as Expert Choice or Decision Pro to help us build a decision tree.

Simple Example of a Decision Tree:

Trade	— 20 or more ——————— 20% + 10%		
	— less than 20 ——————— 20%		
Private	— 50 or more ——————— 15%		
	— 20 - 49 ——————— 10%		
	— 6 - 19 ——————— 5%		
	— less than 6 ——————— nil		

Stage 2: Option Pricing

The uncertainty about our project is first reduced by obtaining knowledge and working the decision through a decision tree. The second stage in this process is to consider all options or choices we have or should have for the project. Therefore, before we proceed to discounted cash flows we need to build a set of options into our project for managing unexpected changes.

In financial management, consideration of options within capital budgeting is called contingent claims analysis or option pricing. For example, suppose you have a choice between two boiler units for your factory. Boiler A uses oil and Boiler B can use either oil or natural gas. Based on traditional approaches to capital budgeting, the least costs boiler was selected for purchase, namely Boiler A. However, if we consider option pricing Boiler B may be the best choice because we have a choice or option on what fuel we can use. Suppose we expect rising oil prices in the next five years. This will result in higher operating costs for Boiler A, but Boiler B can switch to a second fuel to better control operating costs. Consequently, we want to assess the options of capital projects.

Options can take many forms; ability to delay, defer, postpone, alter, change, etc. These options give us more opportunities for creating value within capital projects. We need to think of capital projects as a bundle of options. Three common sources of options are:

1. Timing Options: The ability to delay our investment in the project.

2. Abandonment Options: The ability to abandon or get out of a project that has gone bad.

3. Growth Options: The ability of a project to provide long-term growth despite negative values. For example, a new research program may appear negative, but it might lead to new product innovations and market growth. We need to consider the growth options of projects.

Option pricing is the additional value that we recognize within a project because it has flexibilities over similar projects. These flexibilities help us manage capital projects and therefore, failure to recognize option values can result in an under-valuation of a project.

Stage 3: Discounted Cash Flows

So we have completed the first two stages of capital budgeting analysis: (1) Build and organize knowledge within a decision tree and (2) Recognize and build options within our capital projects. We can now make an investment decision based on Discounted Cash Flows or DCF.

Unlike accounting, financial management is concerned with the values of assets today; i.e. present values. Since capital projects provide benefits into the future and since we want to determine the present value of the project, we will discount the future cash flows of a project to the present.

Discounting refers to taking a future amount and finding its value today. Future values differ from present values because of the time value of money. Financial management recognizes the time value of money because:

1. **Inflation** reduces values over time; i.e. $ 1,000 today will have less value five years from now due to rising prices (inflation).

2. **Uncertainty** in the future; i.e. we think we will receive $ 1,000 five years from now, but a lot can happen over the next five years.

3. **Opportunity Costs** of money; $ 1,000 today is worth more to us than $ 1,000 five years from now because we can invest $ 1,000 today and earn a return.

Present values are calculated by referring to tables or we can use calculators and spreadsheets for discounting. The discount rate we will use is the opportunity costs of the investment; i.e. the rate of return we require on any other project with similar risks.

Exhibit 1 — Present Value of $ 1.00, year = n, rate = k

Year (n)	k = 10%	k = 11%	k = 12%
1	.909	.901	.893
2	.826	.812	.797
3	.751	.731	.712
4	.683	.659	.636
5	.621	.593	.567

Example 1 — Calculate the Present Value of Cash Flows

You will receive $ 500 at the end of next year. If you could invest the $ 500 today, you estimate that you could earn 12%. What is the Present Value of this future cash inflow?

$ 500 x .893 (Exhibit 1) = $ 446.50

If we were to receive the same cash flows year after year into the future, then we could use the present value tables for an annuity.

Exhibit 2 — Present Value of Annuity for $ 1.00, year = n, rate = k

Year (n)	k = 10%	k = 11%	k = 12%
1	.909	.901	.893
2	1.736	1.713	1.690
3	2.487	2.444	2.402
4	3.170	3.102	3.037
5	3.791	3.696	3.605

Example 2 — Calculate the Present Value of Annuity Type Cash Flows

You will receive $ 500 each year for the next five years. Your opportunity costs for this investment is 10%. What is the present value of this investment?

$ 500 x 3.791 (Exhibit 2) = $ 1,895.50

We now understand discounting of cash flows (DCF) and the three reasons why we discount future cash flows: Inflation, Uncertainty, and Opportunity Costs.

Chapter

2

Calculating the Discounted Cash Flows of Projects

In capital budgeting analysis we want to determine the after tax cash flows associated with capital projects. We are concerned with all relevant changes or differences to cash flows once we invest in the project.

Understanding "Relevancy"

One question that we must ask in capital budgeting is what is relevant. Here are some examples of what is relevant to project cash flows:

1. <u>Depreciation</u>: Capital assets are subject to depreciation and we need to account for depreciation twice in our calculations of cash flows. We deduct depreciation once to calculate the taxes we pay on project revenues and we add back depreciation to arrive at cash flows because depreciation is a non-cash item.

2. <u>Working Capital</u>: Major investments may require increases to working capital. For example, new production facilities often require more inventories and higher salaries payable. Therefore, we need to consider the net change in working capital associated with our project. Changes in net working capital will sometimes reverse themselves at the end of the project.

3. <u>Overhead</u>: Many capital projects can result in increases to allocated overheads, such as computer support services. However, the subjective nature of overhead allocations may not make any difference at all. Therefore, you need to assess the impact of your capital project on overhead and determine if these costs are relevant.

4. <u>Financing Costs</u>: If we plan on financing a capital project, this will involve additional cash flows to investors. The best way to account for financing costs is to include them within our discount rate. This eliminates the possibility of double-counting the financing costs by deducting them in our cash flows and discounting at our cost of capital which also includes our financing costs.

We also need to ignore costs that are sunk; i.e. costs that will not change if we invest in the project. For example, a new product line may require some preliminary marketing research. This research is done regardless of the project and thus, it is sunk. The concept of sunk costs and relevant costs applies to all types of financing decisions.

Example 3 — Make or Buy Decision

You have the option to manufacture your own parts or purchase them from outside suppliers. If we purchase the parts, it will cost $ 50.00 per part. Our factory is operating at 70% of capacity and our total costs to manufacture parts is:

Direct Materials	$ 15.00 / part
Direct Labor	$ 19.00 / part
Overhead - Variable	$ 14.00 / part
Overhead - Fixed	$ 12.00 / part
Total Costs	$ 60.00 / part

Since we are operating at 70% capacity, we do not expect an increase in fixed overhead; this is a sunk cost. We would manufacture the parts since it is $ 2.00 / part cheaper:
Purchase $ 50.00 vs. Manufacture $ 48.00 ($ 15.00 + $ 19.00 + $ 14.00)

So far, we have covered present values and relevancy within capital budgeting. We now can proceed to calculate the present value of relevant cash flows. Once we have determined the present value of cash flows, we will have a basis for comparing our initial investment. Both values (future cash flows and initial investment) will be expressed in current values. The net of these two amounts will tell us how much value we will create or destroy by investing in a project.

maintenance. The new machine will require $ 750 each year for technical support. We will depreciate the machine over 5 years under the straight-line method of depreciation with an expected salvage value of $ 5,000. The effective tax rate is 35%.

Annual Savings in Operating Costs	$ 7,000
Annual Savings in Maintenance	500
Annual Costs for Technical Support	(750)
Annual Depreciation	(4,000) *
Revenues	$ 2,750
Taxes @ 35%	(962)
Net Project Income	1,788
Add Back Depreciation (noncash item)	4,000
Relevant Project Cash Flow	**$ 5,788**

* $ 25,000 - $ 5,000 / 5 years = $ 4,000

We will receive $ 5,788 of cash flow each year by investing in this new assembly machine. Since we have a salvage value, we have a terminal cash flow associated with this project.

Example 7 — Calculate Terminal Cash Flow for Capital Project

Estimated Salvage Amount in 5 Years	$ 5,000
Less Taxes	(1,750)
Terminal Cash Flow	**$ 3,250**

Calculating the Present Value of Cash Flows

Our next step is to calculate present values of our two cash flow streams. We will use our cost of capital to discount the cash flows. We will assume that our cost of capital is 12%. We will use the present value tables in Exhibits 1 and 2 for finding the appropriate discount factor per the life of our cash streams and the 12% cost of capital.

Example 8 — Calculate Present Value of Cash Flows

Annual Project Cash Flows	$ 5,788	
Discount Factor per Exhibit 2	x 3.605 (1)	
Present Value of Annual Flows		$ 20,866
Terminal Cash Flow	$ 3,250	
Discount Factor per Exhibit 1	x .567 (2)	
Present Value of Terminal Flow		1,843
Total Present Value		**$ 22,709**

(1): We use the Annuity Table since we have the same cash flows each year for the next 5 years. If we look at Exhibit 2 for n = 5 years and 12%, we find 3.605
(2): We need to discount the terminal cash flow received five years from now to the present by using the Present Value Table in Exhibit 1.

Calculating Net Investment

Now that we have the current value of $ 22,709 for our cash flows, we need to compare this to our investment amount. Our investment is the total cash outlay we must make today and it includes:

- All cash paid out to invest in the project and place it into service, such as installation, transportation, etc.

- Net proceeds from the disposal of any old equipment that will be replaced by the new equipment.

- Any taxes paid and/or tax benefits received from making the investment.

Example 9 — Calculate Net Investment

Referring back to Example 6, we can calculate our Net Investment. We will also assume that an existing machine can be sold for $ 6,000.

Acquisition Costs		$ 25,000
Installation Costs		2,000
Increase in Working Capital		1,000
Proceeds from Sale	$ 6,000	
Less Taxes @ 35%	(2,100)	
Net Proceeds from Sale		(3,900)
Net Investment		**$ 24,100**

So we now have a current value for our cash flows of $ 22,709 and a total net investment of $ 24,100. These amounts are derived by looking at three different types of cash flows:

1. Relevant cash flows during the life of the project.

2. Terminal cash flows at the end of the project.

3. Initial cash flows (net investment).

Three Economic Criteria for Evaluating Capital Projects

We have completed our three main stages of capital budgeting analysis, including the calculation of discounted cash flows. The next step is to apply some economic criteria for evaluating the project. We will use three criteria: Net Present Value, Modified Internal Rate of Return, and Discounted Payback Period.

Net Present Value

The first criterion we will use to evaluate capital projects is Net Present Value. Net Present Value (NPV) is the total net present value of the project. It represents the total value added or subtracted from the organization if we invest in this project. We can refer back to our previous example and calculate Net Present Value.

> Example 10 — Calculate Net Present Value
>
> | | |
> |---|---|
> | Net Investment Outflow (Example 9) | $ (24,100) |
> | Present Value of Inflows (Example 8) | 22,709 |
> | **Net Present Value** | **$ (1,391)** |

If the Net Present Value is positive, we should proceed and make the investment. If the Net Present Value is negative (as is the case in Example 10), then we would not make the investment.

Modified Internal Rate of Return

Besides determining the Net Present Value of a project, we can calculate the rate of return earned by the project. This is called the Internal Rate of Return. Internal Rate of Return (IRR) is one of the most popular economic criteria for evaluating capital projects since managers can identify with rates of return. Internal Rate of Return is calculating by finding the discount rate whereby the Net Investment amount equals the total present value of all cash inflows; i.e. Net Present Value = 0. If we have equal cash inflows each year, we can solve for IRR easily.

Example 11 — Calculate Internal Rate of Return

Referring back Example 6, we would solve for IRR as follows:

$ 5,788 x discount factor = $ 24,100 or $ 24,100 / $ 5,788 = 4.164.
If we look in the Present Value Tables for n = 5 years, we want to find a present value factor nearest to 4.164. By referring to published present value tables, we find the following:

At 6%, n = 5	4.2124	4.2124
As Calculated	4.1640	
At 7%, n = 5		4.1002
Difference	.0484	.1122

.06 + (.0484 / .1122) x (.07 - .06) = .0643

Internal Rate of Return = 6.43%

If the Internal Rate of Return were higher than our cost of capital, then we would accept this project. In our example, the IRR (6.43%) is less than our cost of capital (12%). Therefore, we would not invest in this project.

One of the problems with IRR is the so-called reinvestment rate assumption. IRR makes the assumption that every year you will be able to earn the IRR each time you reinvest your cash inflows. This assumption can result in some major distortions between Net Present Value and Internal Rate of Return. We will correct this distortion by modifying our IRR calculation.

Example 12 — IRR Distortions from Reinvestment Rate Assumption

A summary of four simple projects with IRR and NPV:

		Cash Inflows			
Project	Investment	Year-1	Year-2	IRR	NPV
A	$ 2,000	$ - 0 -	$ 4,500	50%	$ 3,130
B	2,000	1,500	2,250	50%	2,810
C	2,000	2,450	1,000	55%	2,640
D	2,000	- 0 -	4,210	45%	2,940

If we use IRR, we would select Project C, but if we go by NPV, we would select Project A.

In order to eliminate the reinvestment rate assumption, we will modify the Internal Rate of Return so that the reinvestment rate is our cost of capital. This will give us a more accurate IRR for our project. Fortunately, we can use spreadsheets like Microsoft Excel to calculate Modified Internal Rate of Return.

Example 13 — Calculate Modified IRR Using Microsoft Excel

Referring back to Example 6, we have the following:
$ 5,788 annual project cash inflows
$ 24,100 net investment amount
12% cost of capital

The formula for calculating Modified IRR in a Microsoft Excel Spreadheet is:
@MIRR(A1:An, k%, r%)
A1:An is the cell range for entering our data. We always enter the net investment in the first cell and the cash inflows in each cell thereafter. k% refers to our cost of capital and r% is the rate we believe we can earn when we reinvest cash inflows.

If we assume that we can earn our cost of capital on reinvested cash flows, then we would enter the following from our example:

Cell	Input	Output
A1	-24,100	
A2	5,788	
A3	5,788	
A4	5,788	
A5	5,788	
A6	5,788	
B1	@MIRR(A1:A6, 12%, 12%)	9%

The Modified IRR on our project is 9%.

Discounted Payback Period

The final economic criteria we will use is the Discounted Payback Period. Payback refers to the number of years it takes to recover our net investment. In our previous example (Example 6), we could use a simple payback calculation as follows:

$ 24,100 / $ 5,788 = 4.2 years

However, this method does not recognize the time value of money and as we previously indicated, we must consider the time value of money because of inflation, uncertainty, and opportunity costs. Therefore, we will use the discounted cash flows to calculate the payback period (discounted payback period).

Example 14 — Calculate Discounted Payback Period

Referring back to Example 6, we can calculate the discounted payback period as follows:

Year	Cash Flow x	P.V. Factor =	P.V. Cash Flow	Total to Date
1	$ 5,788	.893	$ 5,169	$ 5,169
2	5,788	.797	4,613	9,782
3	5,788	.712	4,121	13,903
4	5,788	.636	3,681	17,584
5	5,788	.567	3,282	20,866
5	3,250	.567	1,843	22,709

Under the Discounted Payback Period, we would never receive a payback on our project; i.e. the total to date present cash flows never reached $ 24,100 (net investment). If we had relied on the regular payback calculation, we would falsely assume that this project does payback in the fourth year.

In summary, we use economic criteria that have realistic economic assumptions about capital investments. Three economic criteria that meet this test are:

- Net Present Value

- Modified Internal Rate of Return

- Discounted Payback Period

Additional Considerations in Capital Budgeting Analysis

Whenever we analyze a capital project, we must consider unique factors. A discussion of all of these factors is beyond the scope of this course. However, three common factors to consider are:

- Compensating for different levels of risks between projects.

- Recognizing risks that are specific to foreign projects.

- Making adjustments to capital budgeting analysis by looking at the actual results.

Adjusting for Risk

We previously learned that we can manage uncertainty by initiating decision analysis and building options into our projects. We now want to turn our attention to managing risks. It is worth noting that uncertainty and risk are not the same thing. Uncertainty is where you have no basis for a decision. Risk is where you do have a basis for a decision, but you have the possibility of several outcomes. The wider the variation of outcomes, the higher the risk.

In our previous example (Example 6), we used the cost of capital for discounting cash flows. Our example involved the replacement of equipment and carried a low level of risk since the expected outcome was reasonably certain. Suppose we have a project involving a new product line. Would we still use our cost of capital to discount these cash flows? The answer is no since this project could have a much wider variation in outcomes. We can adjust for higher levels of risk by increasing the discount rate. A higher discount rate reflects a higher rate of return that we require whenever we have higher levels of risk.

Another way to adjust for risk is to understand the impact of risk on outcomes. Sensitivity Analysis and Simulation can be used to measure how changes to a project affect the outcome. Sensitivity analysis is used to determine the change in Net Present Value given a change in a specific variable, such as estimated project revenues. Simulation allows us to simulate the results of a project for a given distribution of variables. Both sensitivity analysis and simulation require a definition of all relevant variables associated with the project. It should be noted that sensitivity analysis is much easier to implement since sophisticated computer models are usually required for simulation.

International Projects

Capital investments in other countries can involve additional risks. Whenever we invest in a foreign project, we want to focus on the values that are added (or subtracted) to the Parent Company. This makes us consider all relevant risks of the project, such as exchange rate risk, political risk, hyper-inflation, etc. For example, the discounted cash flows of the project are the discounted cash flows of the project to the foreign subsidiary converted to the currency of the home country of the Parent Company at the current exchange rate. This forces us to take into account exchange rate risks and its impact to the Parent Company.

Post Analysis

One of the most important steps in capital budgeting analysis is to follow-up and compare your estimates to actual results. This post analysis or review can help identify bias and errors within the overall process. A formal tracking system of capital projects also keeps everyone honest. For example, if you were to announce to everyone that actual results will be tracked during the life of the project, you may find that people who submit estimates will be more careful. The purpose of post analysis and tracking is to collect information that will lead to improvements within the capital budgeting process.

Course Summary

The long-term investments we make today determines the value we will have tomorrow. Therefore, capital budgeting analysis is critical to creating value within financial management. And the only certainty within capital budgeting is *uncertainty*. Therefore, one of the biggest challenges in capital budgeting is to manage uncertainty. We deal with uncertainty through a three-stage process:

1. Build knowledge through decision analysis.

2. Recognize and encourage options within projects.

3. Invest based on economic criteria that have realistic economic assumptions.

Once we have completed the three-stage process (as outlined above), we evaluate capital projects using a mix of economic criteria that adheres to the principles of financial management. Three good economic criteria are Net Present Value, Modified Internal Rate of Return, and Discounted Payback.

Additionally, we need to manage project risk differently than we would manage uncertainty. We have several tools to help us manage risks, such as increasing the discount rate. Finally, we want to implement post analysis and tracking of projects after we have made the investment. This helps eliminate bias and errors in the capital budgeting process.

Final Exam

Select the best answer for each question. Exams are graded and administered over the internet at www.exinfm.com/training.

1. Capital budgeting analysis consists of three distinct stages. The first stage is:

    a. Discounted Cash Flows

    b. Simulation

    c. Decision Analysis

    d. Net Present Value

2. The ability to postpone, delay, alter or abandon a project adds value to the project. This value is referred to as:

    a. Relevant cash flows

    b. Attribute value

    c. Net Present Value

    d. Option Pricing

3. The time value of money is important for three reasons. These three reasons are:

    a. Inflation, uncertainty, and opportunity costs.

    b. Relevancy, stability, and consistency.

    c. Project returns, costs, and timing.

    d. Project options, positions, and variables.

4. Which of the following is relevant in determining the cash flows of a project?

    a. Sunk costs

    b. Depreciation

    c. Payback period

    d. Net Present Value

5. You are about to invest $ 15,000 into a project that will generate $ 5,500 of cash flows each year for the next 3 years. If your cost of capital is 11%, then the present value of future cash flows is: (refer to Exhibit 2 for present value tables)

   a. $ 23,218

   b. $ 13,442

   c. $ 11,612

   d. $ 10,808

6. Referring back to question 5, the Net Present Value of the project is:

   a. $ 6,418

   b. $ 8,218

   c. $ (1,558)

   d. $ (4,192)

7. You are considering investing in a new cotton-bailing machine. The purchase price of new bailer is $ 10,000. It will cost $ 750 to transport the bailer to your location. The old bailer will be sold for $ 2,000 and your tax rate is 40%. The net investment for this project is:

   a. $ 11,950

   b. $ 10,750

   c. $ 9,550

   d. $ 8,950

8. In addition to using Net Present Value to evaluate a project, another good economic criteria that can be used is:

   a. Accounting Rate of Return

   b. Modified Internal Rate of Return

   c. Simple Payback

   d. Return on Investment

9. One method for managing project risk is to use:

    a. Sensitivity Analysis

    b. Discounted Payback

    c. Net Investment

    d. Project Turnover

10. An additional risk usually associated with an international project is:

    a. Project payback

    b. Direct Labor Changes

    c. Installation Costs

    d. Foreign Exchange Rate Risk