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1.

The Basics of Capital Budgeting: Introduction

Firms use **capital budgeting** for their long-term asset investment decisions. Capital budgeting is important because fixed asset investment decisions chart a company's course for the future. Capital budgeting is similar in principle to _____ in which future cash flows are estimated, risks are appraised and reflected in a cost of capital discount rate, and all cash flows are evaluated on a _____ value basis. The primary methods used in this process are: Net present value, Internal rate of return, Modified internal rate of return, and Payback. Projects that firms consider are either **independent** or **mutually exclusive**. In addition, projects may have **normal cash flows** or **nonnormal cash flows**. Whether a project is independent or mutually exclusive will impact the firm's capital budgeting analysis as we will see when we discuss the different decision rules.

2.

The Basics of Capital Budgeting: NPV

NPV

The net present value (NPV) method estimates how much a potential project will contribute to _____ , and it is the best selection criterion. The _____ the NPV, the more value the project adds; and added value means a _____ stock price. In equation form, the NPV is defined as:

$$NPV = CF_0 + \frac{CF_1}{\left(1+r\right)^1} + \frac{CF_2}{\left(1+r\right)^2} + ... + \frac{CF_N}{\left(1+r\right)^N} = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

CF_t is the expected cash flow at Time t, r is the project's risk-adjusted cost of capital, and N is its life, and cash outflows are treated as negative cash flows. The NPV calculation assumes that cash inflows can be reinvested at the project's risk-adjusted _____ . When the firm is considering independent projects, if the project's NPV exceeds zero the firm should _____ the project. When the firm is considering mutually exclusive projects, the firm should accept the project with the _____ NPV.

Quantitative Problem: Bellinger Industries is considering two projects for inclusion in its capital budget, and you have been asked to do the analysis. Both projects' after-tax cash flows are shown on the time line below. Depreciation, salvage values, net operating working capital requirements, and tax effects are all included in these cash flows. Both projects have 4-year lives, and they have risk characteristics similar to the firm's average project. Bellinger's WACC is 7%.

	0	1	2	3	4
Project A	-1130	680	335	240	290
Project B	-1130	280	270	390	740

What is Project A's NPV? Round your answer to the nearest cent. Do not round your intermediate calculations.

$ _____

What is Project B's NPV? Round your answer to the nearest cent. Do not round your intermediate calculations.

$ _____

If the projects were independent, which project(s) would be accepted?

_____

If the projects were mutually exclusive, which project(s) would be accepted?

_____

3.

The Basics of Capital Budgeting: IRR

IRR

A project's internal rate of return (IRR) is the _____ that forces the PV of its inflows to equal its cost. The IRR is an estimate of the project's rate of return, and it is comparable to the _____ on a bond. The equation for calculating the IRR is:

$$NPV = CF_0 + \frac{CF_1}{\left(1 + \text{IRR}\right)^1} + \frac{CF_2}{\left(1 + \text{IRR}\right)^2} + \ldots + \frac{CF_N}{\left(1 + \text{IRR}\right)^N} = 0$$

$$0 = \sum_{t=1}^{N} \frac{\text{CF}_t}{(1 + \text{IRR})^t}$$

CF_t is the expected cash flow in Period t and cash outflows are treated as negative cash flows. There must be a change in cash flow signs to calculate the IRR. The IRR equation is simply the NPV equation solved for the particular discount rate that causes NPV to equal _____ .

The IRR calculation assumes that cash flows are reinvested at the _____ . If the IRR is _____ than the project's risk-adjusted cost of capital, then the project should be accepted; however, if the IRR is less than the project's risk-adjusted cost of capital, then the project should be _____ . Because of the IRR reinvestment rate assumption, when _____ projects are evaluated the IRR approach can lead to conflicting results from the NPV method. Two basic conditions can lead to conflicts between NPV and IRR: _____ differences (earlier cash flows in one project vs. later cash flows in the other project) and project size (the cost of one project is larger than the other). When mutually exclusive projects are considered, then the _____ method should be used to evaluate projects.

Quantitative Problem: Bellinger Industries is considering two projects for inclusion in its capital budget, and you have been asked to do the analysis. Both projects' after-tax cash flows are shown on the time line below. Depreciation, salvage values, net operating working capital requirements, and tax effects are all included in these cash flows. Both projects have 4-year lives, and they have risk characteristics similar to the firm's average project. Bellinger's WACC is 11%.

	0	1	2	3	4
Project A	-1250	730	360	270	315
Project B	-1250	330	295	420	765

What is Project A's IRR? Do not round intermediate calculations. Round your answer to two decimal places.

_____ %

What is Project B's IRR? Do not round intermediate calculations. Round your answer to two decimal places.

_____ %

If the projects were independent, which project(s) would be accepted according to the IRR method?

_____

If the projects were mutually exclusive, which project(s) would be accepted according to the IRR method?

_____

Could there be a conflict with project acceptance between the NPV and IRR approaches when projects are mutually exclusive?

_____

The reason is _____

Reinvestment at the _____ is the superior assumption, so when mutually exclusive projects are evaluated the _____ approach should be used for the capital budgeting decision.

4.

The Basics of Capital Budgeting: Payback Period

Payback Period

Payback period was the earliest _____ selection criterion. The _____ is a "break-even" calculation in the sense that if a project's cash flows come in at the expected rate, the project will break even. The equation is:

$$\text{Payback} = \begin{matrix}\text{Number of}\\ \text{years prior to}\\ \text{full recovery}\end{matrix} + \frac{\text{Unrecovered cost at start of year}}{\text{Cash flow during full recovery year}}$$

The _____ a project's payback, the better the project is. However, payback has 3 main disadvantages: (1) All dollars received in different years are given _____ weight. (2) Cash flows beyond the payback year are ignored. (3) The payback merely indicates when a project's investment will be recovered. There is no necessary relationship between a given payback and investor wealth maximization.

A variant of the regular payback is the **discounted payback**. Unlike regular payback, the discounted payback considers _____ costs. However, the discounted payback still disregards cash flows _____ the payback year. In addition, there is no specific payback rule to justify project acceptance. Both methods provide information about _____ and risk.

Quantitative Problem: Bellinger Industries is considering two projects for inclusion in its capital budget, and you have been asked to do the analysis. Both projects' after-tax cash flows are shown on the time line below. Depreciation, salvage values, net operating working capital requirements, and tax effects are all included in these cash flows. Both projects have 4-year lives, and they have risk characteristics similar to the firm's average project. Bellinger's WACC is 7%.

	0	1	2	3	4
Project A	-950	600	450	250	300
Project B	-950	200	385	400	750

What is Project A's payback? Round your answer to four decimal places. Do not round your intermediate calculations.

_____ years

What is Project A's discounted payback? Round your answer to four decimal places. Do not round your intermediate calculations.

_____ years

What is Project B's payback? Round your answer to four decimal places. Do not round your intermediate calculations.

_____ years

What is Project B's discounted payback? Round your answer to four decimal places. Do not round your intermediate calculations.

_____ years

5.

NPV

Project L costs $35000, its expected cash inflows are $8000 per year for 7 years, and its WACC is 12%. What is the project's NPV? Round your answer to the nearest cent. Do not round your intermediate calculations.

$ _____

6.

IRR

Project L costs $44964.46, its expected cash inflows are $10000 per year for 9 years, and its WACC is 10%. What is the project's IRR? Round your answer to two decimal places.

_____ %

7.

PAYBACK PERIOD

Project L costs $45000, its expected cash inflows are $13000 per year for 9 years, and its WACC is 9%. What is the project's payback? Round your answer to two decimal places.

_____ years

8.

DISCOUNTED PAYBACK

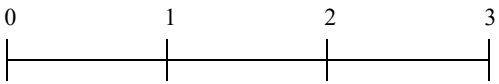
Project L costs $60000, its expected cash inflows are $14000 per year for 8 years, and its WACC is 13%. What is the project's discounted payback? Round your answer to two decimal places.

_____ years

9.

NPV

Your division is considering two projects with the following cash flows (in millions):



Project A	-$27	$13	$17	$8
Project B	-$25	$14	$11	$2

a. What are the projects' NPVs assuming the WACC is 5%? Round your answer to two decimal places. Do not round your intermediate calculations. Enter your answer in millions. For example, an answer of $10,550,000 should be entered as 10.55. Negative value should be indicated by a minus sign.

Project A $ _____ million

Project B $ _____ million

What are the projects' NPVs assuming the WACC is 10%? Round your answer to two decimal places. Do not round your intermediate calculations. Enter your answer in millions. For example, an answer of $10,550,000 should be entered as 10.55. Negative value should be indicated by a minus sign.

Project A $ _____ million

Project B $ _____ million

What are the projects' NPVs assuming the WACC is 15%? Round your answer to two decimal places. Do not round your intermediate calculations. Enter your answer in millions. For example, an answer of $10,550,000 should be entered as 10.55. Negative value should be indicated by a minus sign.

Project A $ _____ million

Project B $ _____ million

b. What are the projects' IRRs assuming the WACC is 5%? Round your answer to two decimal places. Do not round your intermediate calculations.

Project A _____ %

Project B _____ %

What are the projects' IRRs assuming the WACC is 10%? Round your answer to two decimal places. Do not round your intermediate calculations.

Project A _____ %

Project B _____ %

What are the projects' IRRs assuming the WACC is 15%? Round your answer to two decimal places. Do not round your intermediate calculations.

Project A _____ %

Project B _____ %

c. If the WACC was 5% and A and B were mutually exclusive, which project would you choose? (*Hint*: The crossover rate is 90.37%.)

_____

If the WACC was 10% and A and B were mutually exclusive, which project would you choose? (*Hint*: The crossover rate is 90.37%.)

_____

If the WACC was 15% and A and B were mutually exclusive, which project would you choose? (*Hint*: The crossover rate is 90.37%.)

_____

10.

CAPITAL BUDGETING CRITERIA: ETHICAL CONSIDERATIONS

A mining company is considering a new project. Because the mine has received a permit, the project would be legal; but it would cause significant harm to a nearby river. The firm could spend an additional $9.66 million at Year 0 to mitigate the environmental Problem, but it would not be required to do so. Developing the mine (without mitigation) would cost $57 million, and the expected cash inflows would be $19 million per year for 5 years. If the firm does invest in mitigation, the annual inflows would be $20 million. The risk-adjusted WACC is 11%.

a. Calculate the NPV and IRR with mitigation. Round your answers to two decimal places. Do not round your intermediate calculations. Enter your answer for NPV in millions. For example, an answer of $10,550,000 should be entered as 10.55.

NPV $ _____ million

IRR _____ %

Calculate the NPV and IRR without mitigation. Round your answers to two decimal places. Do not round your intermediate calculations. Enter your answer for NPV in millions. For example, an answer of $10,550,000 should be entered as 10.55.

NPV $ _____ million

IRR _____ %

b. How should the environmental effects be dealt with when this project is evaluated?

I. The environmental effects if not mitigated would result in additional cash flows. Therefore, since the mine is legal without mitigation, there are no benefits to performing a "no mitigation" analysis.

II. The environmental effects should be treated as a remote possibility and should only be considered at the time in which they actually occur.

III. The environmental effects if not mitigated could result in additional loss of cash flows and/or fines and penalties due to ill will among customers, community, etc. Therefore, even though the mine is legal without mitigation, the company needs to make sure that they have anticipated all costs in the "no mitigation" analysis from not doing the environmental mitigation.

IV. The environmental effects should be ignored since the mine is legal without mitigation.

V. The environmental effects should be treated as a sunk cost and therefore ignored.

_____

c. Should this project be undertaken?

_____

If so, should the firm do the mitigation?

I. Under the assumption that all costs have been considered, the company would not mitigate for the environmental impact of the project since its NPV without mitigation is greater than its NPV when mitigation costs are included in the analysis.

II. Under the assumption that all costs have been considered, the company would mitigate for the environmental impact of the project since its IRR with mitigation is greater than its IRR when mitigation costs are not included in the analysis.

III. Under the assumption that all costs have been considered, the company would not mitigate for the environmental impact of the project since its NPV with mitigation is greater than its NPV when mitigation costs are not included in the analysis.

IV. Under the assumption that all costs have been considered, the company would not mitigate for the environmental impact of the project since its IRR without mitigation is greater than its IRR when mitigation costs are included in the analysis.

V. Under the assumption that all costs have been considered, the company would mitigate for the environmental impact of the project since its NPV with mitigation is greater than its NPV when mitigation costs are not included in the analysis.

_____

11.

CAPITAL BUDGETING CRITERIA: ETHICAL CONSIDERATIONS

An electric utility is considering a new power plant in northern Arizona. Power from the plant would be sold in the Phoenix area, where it is badly needed. Because the firm has received a permit, the plant would be legal; but it would cause some air pollution. The company could spend an additional $40 million at Year 0 to mitigate the environmental problem, but it would not be required to do so. The plant without mitigation would cost $240.09 million, and the expected cash inflows would be $80 million per year for 5 years. If the firm does invest in mitigation, the annual inflows would be $84.75 million. Unemployment in the area where the plant would be built is high, and the plant would provide about 350 good jobs. The risk adjusted WACC is 18%.

a. Calculate the NPV and IRR with mitigation. Round your answers to two decimal places. Enter your answer for NPV in millions. Do not round your intermediate calculations. For example, an answer of $10,550,000 should be entered as 10.55. Negative value should be indicated by a minus sign.

NPV $ _____ million

IRR _____ %

Calculate the NPV and IRR without mitigation. Round your answers to two decimal places. Enter your answer for NPV in millions. Do not round your intermediate calculations. For example, an answer of $10,550,000 should be entered as 10.55.

NPV $ _____ million

IRR _____ %

b. How should the environmental effects be dealt with when evaluating this project?

I. If the utility mitigates for the environmental effects, the project is not acceptable. However, before the company chooses to do the project without mitigation, it needs to make sure that any costs of "ill will" for not mitigating for the environmental effects have been considered in the original analysis.

II. The environmental effects should be treated as a remote possibility and should only be considered at the time in which they actually occur.

III. The environmental effects if not mitigated would result in additional cash flows. Therefore, since the plant is legal without mitigation, there are no benefits to performing a "no mitigation" analysis.

IV. The environmental effects should be ignored since the plant is legal without mitigation.

V. The environmental effects should be treated as a sunk cost and therefore ignored.

_____

c. Should this project be undertaken?

I. The project should be undertaken since the IRR is positive under both the "mitigation" and "no mitigation" assumptions.

II. The project should be undertaken since the NPV is positive under both the "mitigation" and "no mitigation" assumptions.

III. Even when no mitigation is considered the project has a negative NPV, so it should not be undertaken.

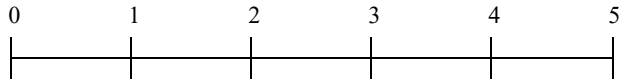
IV. The project should be undertaken only if they do not mitigate for the environmental effects. However, they want to make sure that they've done the analysis properly due to any "ill will" and additional "costs" that might result from undertaking the project without concern for the environmental impacts.

V. The project should be undertaken only under the "mitigation" assumption.

12.

CAPITAL BUDGETING CRITERIA: MUTUALLY EXCLUSIVE PROJECTS

A firm with a WACC of 10% is considering the following mutually exclusive projects:



Project 1	-$400	$80	$80	$80	$230	$230
Project 2	-$700	$250	$250	$50	$50	$50

Which project would you recommend?

- a. Project 1, since the $NPV_1 > NPV_2$.
- b. Neither Project 1 nor 2, since each project's NPV < 0.
- c. Both Projects 1 and 2, since both projects have IRR's > 0.
- d. Project 2, since the $NPV_2 > NPV_1$.
- e. Both Projects 1 and 2, since both projects have NPV's > 0.

13.

CAPITAL BUDGETING CRITERIA: MUTUALLY EXCLUSIVE PROJECTS

Project S costs $10000 and its expected cash flows would be $4500 per year for 5 years. Mutually exclusive Project L costs $37500 and its expected cash flows would be $11100 per year for 5 years. If both projects have a WACC of 15%, which project would you recommend?

- a. Neither Project S nor L, since each project's NPV < 0.
- b. Project S, since the $NPV_S > NPV_L$.
- c. Project L, since the $NPV_L > NPV_S$.
- d. Both Projects S and L, since both projects have IRR's > 0.
- e. Both Projects S and L, since both projects have NPV's > 0.

14.

Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through Problem Walk-Through

IRR AND NPV

A company is analyzing two mutually exclusive projects, S and L, with the following cash flows:

	0	1	2	3	4
Project S	-$1000	$895.69	$240	$10	$15
Project L	-$1000	$10	$260	$380	$775.74

The company's WACC is 10.0%. What is the IRR of the better project? (*Hint*: The better project may or may not be the one with the higher IRR.) Round your answer to two decimal places.

_____ %

15.

NPV PROFILES: TIMING DIFFERENCES

An oil-drilling company must choose between two mutually exclusive extraction projects, and each costs $12.6 million. Under Plan A, all the oil would be extracted in 1 year, producing a cash flow at t = 1 of $15.12 million. Under Plan B, cash flows would be $2.2389 million per year for 20 years. The firm's WACC is 12.3%.

a. Construct NPV profiles for Plans A and B. Round your answers to two decimal places. Do not round your intermediate calculations. Enter your answers in millions. For example, an answer of $10,550,000 should be entered as 10.55. If an amount is zero enter "0". Negative value should be indicated by a minus sign.

Discount Rate	NPV Plan A	NPV Plan B
0%	$ _____ million	$ _____ million
5	_____ million	_____ million
10	_____ million	_____ million
12	_____ million	_____ million
15	_____ million	_____ million
17	_____ million	_____ million
20	_____ million	_____ million

Identify each project's IRR. Round your answers to two decimal places. Do not round your intermediate calculations.

Project A _____ %

Project B _____ %

Find the crossover rate. Round your answer to two decimal places. Do not round your intermediate calculations.

_____ %

b. Is it logical to assume that the firm would take on all available independent, average-risk projects with returns greater than 12.3%?

_____

If all available projects with returns greater than 12.3% have been undertaken, does this mean that cash flows from past investments have an opportunity cost of only 12.3%, because all the company can do with these cash flows is to replace money that has a cost of 12.3%?

_____

Does this imply that the WACC is the correct reinvestment rate assumption for a project's cash flows?

_____

16.

NPV

A project has annual cash flows of $7500 for the next 10 years and then $11000 each year for the following 10 years. The IRR of this 20-year project is 11.25%. If the firm's WACC is 9%, what is the project's NPV? Round your answer to the nearest cent. Do not round your intermediate calculations.

$ _____

17.

The Basics of Capital Budgeting: NPV Profile

NPV Profile

A project's NPV profile graph intersects the Y-axis at 0% cost of capital and intersects the X-axis at the project's _____ (where NPV = 0). The Y-axis intersection point represents the project's undiscounted NPV. The point at which 2 projects' profiles cross one another is the **crossover rate**. The crossover rate can be found by calculating the _____ of the differences in the projects' cash flows (Project Delta). A _____ NPV profile indicates that increases in the cost of capital lead to large declines in NPV. If a project has most of its cash flows coming in later years, its NPV will _____ sharply if the cost of capital increases; but a project whose cash flows come earlier will not be severely penalized by high capital costs. The significance of the crossover rate is that at any cost of capital _____ than the crossover rate, the NPV and IRR methods will provide the same conclusion for evaluating mutually exclusive projects. However, at any cost of capital _____ than the crossover rate, the NPV and IRR methods' conclusions will conflict. In that situation, the _____ method will always provide the correct project acceptance result.

Quantitative Problem: Bellinger Industries is considering two projects for inclusion in its capital budget, and you have been asked to do the analysis. Both projects' after-tax cash flows are shown on the time line below. Depreciation, salvage values, net operating working capital requirements, and tax effects are all included in these cash flows. Both projects have 4-year lives, and they have risk characteristics similar to the firm's average project. Bellinger's WACC is 10%.

	0	1	2	3	4
Project A	-1100	590	360	220	280
Project B	-1100	270	280	390	770

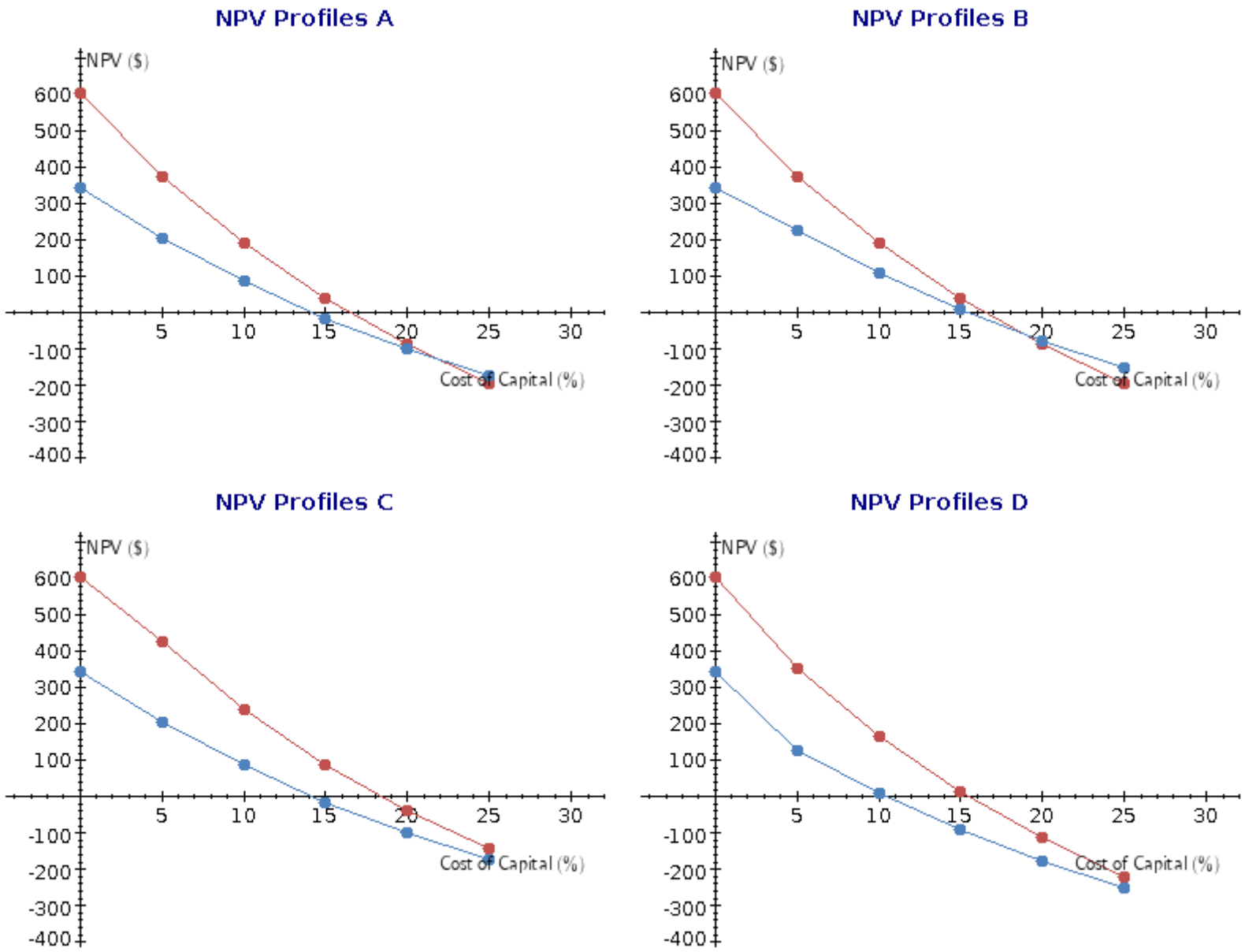
What is Project Delta's IRR? Do not round intermediate calculations. Round your answer to two decimal places.

_____ %

What is the significance of this IRR?

It is the _____ , after this point when mutually exclusive projects are considered there is no conflict in project acceptance between the NPV and IRR approaches.

Review the graphs below. Select the graph that correctly represents the correct NPV profile for Projects A and B by using the following drop down menu.



PAGE 1 (First Page)

PAGE 1 (Subsequent Pages)

ANSWER KEY

Copy of Copy of Copy (2) of Module 6 Homework

1

security valuation
present

2

shareholders' wealth
larger
higher
WACC
accept
highest positive
215.27; **215.28**; **215.29**; **215.30**; **215.26**; **215.25**; **215.24**

250.41; **250.42**; **250.43**; **250.44**; **250.40**; **250.39**; **250.38**

Both projects A and B
Project B

3

discount rate
YTM
zero
IRR
greater
rejected
mutually exclusive
timing
NPV
15.70

14.10

Both projects A and B
Project A
Yes
the NPV and IRR approaches use different reinvestment rate assumptions so there can be a conflict in project acceptance when mutually exclusive projects are considered.

WACC
NPV

4

capital budgeting
payback
shorter
equal
capital
beyond
liquidity
1.7778; **1.7779**; **1.7777**

1.9903

2.9125

3.1753

5 1510.05
6 16.70
7 3.46
8 6.66; 6.67; 6.65; 6.68; 6.69; 6.67
9 7.71; 7.70
0.04; 0.00
4.88; 4.80
−1.68; −1.70
2.42; 2.50
−3.19; −3.20
20.67; 20.68; 20.66
5.10; 5.11; 5.09
20.67; 20.68; 20.66
5.10; 5.11; 5.09
20.67; 20.68; 20.66
5.10; 5.11; 5.09
Project A
Project A
Project A
10 7.25
15.24
13.22
19.86
III
Even when mitigation is considered the project has a positive NPV, so it should be undertaken.
I

11 −15.06
15.60; 15.65; 15.55
10.08
19.84; 19.89; 19.79
I
IV
12 a
13 b
14 11.30; 11.29; 11.31
15 2.52
32.18
1.80
15.30
1.15
6.46
0.90
4.12
0.55
1.41
0.32
0.00
0.00
−1.70
20.00; 20.01; 19.99
17.00; 17.01; 16.99
16.41; 16.42; 16.40
Yes
Yes
Yes
16 12166.60
17

IRR
IRR
steep
decline
greater
less
NPV
21.81

crossover rate
A