Final Review

With an initial investment of $6549.32 in a new machine, you will provide your company with $4000 more incoming dollars over the next four years. However, over those four years, the maintenance of the machine will cost $800. Also, in Year 2 a refit of the machine will cost $5,100.

What is the rate of return?

PWC = PWB
6549. 32 + 800(P/A, IRR, 4) + 5100(P/F, IRR, 2) = 4000(P/A, IRR, 4)
IRR = 0.06 = 6%

Calculate the interest rate that is required for accumulating $20,000 if $1517 per year will be saved over a 10-year period.

20k = 1517(F/A, IRR, 10)
IRR = 6%

(Newnan 7-76)

Option 1: Gas Station

- Capital cost $80,000, Annual property taxes=$3,000, Annual income=$11,000, Life= 20 years

Net annual benefit = 8000

Option 2: Ice cream stand

- Capital cost $120,000, Annual property taxes=$5,000, Annual income=$16,000, Life= 20 years

Net annual benefit = 11,000

MARR=6%

Which option?

Incremental analysis
PWC = PWB
(120k-80k) = (11k-8k)(P/A, IRR, 20)
> IRR = 4.7%
IRR < MARR, so **take lower cost option, Gas Station.**

(Newnan 7-82(a))

Buy or lease?

- To buy: Capital cost $480,000, Life= 10 years, Salvage value=50,000
- To lease: $70,000 per year.

Other info: Community interest rate=8%, Lease payments made at start of year.

What is interest rate for buying verses leasing and which is the best choice?

Year	A	B	A-B
0	480	70	410
1	0	70	-70
…	…	…	…
9	0	70	-70
10	-50	0	-50

Lease payments are made at the start of the year, so in year 10 there is no -70k.

410k = 50k(P/F, IRR, 10) + 70k(P/A, IRR, 9)
> IRR = 0.107 = 10.7%
IRR > MARR, so **keep greater cost option, buy**

EXAMPLE 8-1

The student engineering society is building a snack cart to raise money. Members must decide how many people the cart should be able to serve. To serve 100 customers an hour costs $10,310, and to serve 150 customers an hour costs $13,400. The 50% increase in capacity is less than 50% of $10,310 because of economies of scale, but the increase in net revenue will be less than 50% since the cart will not always be serving 150 customers an hour. The estimated net annual income for the lower capacity is $3,300; for the higher capacity it is $4,000. After five years the cart is expected to have no salvage value. The engineering society is not sure what interest rate to use for deciding on the capacity. Make a recommendation.

10310 = 3300(P/A, IRRa, 5) -> IRRa = 118%
13400 = 4000(P/A, IRRb, 5) -> IRRb = 15%
3090 = 700(P/A, dIRR, 5) -> dIRR = 4.3%

0 < i < dIRR	0 < i < 4.3%	higher cost choice
dIRR < I < max(IRRa, IRRb)	4.3 < i < 18%	lower cost choice
max(IRRa, IRRb) < i	18% < i	do nothing

EXAMPLE 8-4

A pressure vessel can be made out of brass, stainless steel, or titanium. The first cost and expected life for each material are as follows:

	Brass	Stainless Steel	Titanium
Cost	$100,000	$175,000	$300,000
Life, in years	4	10	25

The pressure vessel will be in the non-radioactive portion of a nuclear power plant that is expected to have a life of 50 to 75 years. The public utility commission and the power company have not yet agreed on the interest rate to be used for making decisions and setting rates. Build a choice table to determine the best alternative at each interest rate.

EXAMPLE 8-6

The following information is for five mutually exclusive alternatives that have 20-year useful lives. The decision maker may choose any one of the options or reject them all. Prepare a choice table.

	Alternatives				
	A	B	C	D	E
Cost	$4,000	$2,000	$6,000	$1,000	$9,000
Uniform annual benefit	639	410	761	117	785

MARR is 5%

First order by lowest initial cost to highest

Do Nothing	D	B	A	C	E
0	1k	2k	4k	6k	9k
0	117	410	639	761	785

Start with lowest cost options, D-DN

1k = 117(P/A, IRR, 20)

- IRR = 9.94%

IRR > MARR, so keep greater cost option, D, and next best option B. B-D
(2k-1k) = (410-117)(P/A, IRR, 20)

- IRR = 29%

IRR > MARR, so keep greater cost option, B, and next best option A. A-B
(4k-2k) = (639-410)(P/A, IRR, 20)

- IRR = 9.6%

IRR > MARR, so keep greater cost option, A, and next best option C. C-A
(6k-4k) = (761-639(P/A, IRR, 20)

- IRR = 1.97%

IRR< MARR, so keep lower cost option A. **Use option A.**

Consider the alternatives below:

	Do Nothing	A	B	C	D
First cost	$0	$4000	$3000	$6000	$5000
Annual Benefit	0	$623	$531	$1020	$712
Life	10 years	10 years	10 years	10 years	10 years
Rate of Return	—	9%	12%	11%	7%

Select the one best alternative if MARR = 8%. Use incremental rate of return analysis.

DN	B	A	D	C
0	-3k	-4k	-5k	-6k
0	531	623	712	1020

Discard C immediately, because IRRd<MARR

B-DN	3k = 531(P/A, IRR, 10)	12%	>MARR, Keep B
A-B	4k-3k = (623-531)(P/A, IRR, 10)	-1.5%	<MARR, Keep B
C-B	6k-3k = (1020-531)(P/A, IRR, 10)	10%	>MARR, Keep C

No more options, so **keep C.**

The CROC Co. is considering a new milling machine. They have narrowed the choices down to three alternatives in addition to the "do nothing" alternative.

	Economy	Regular	Deluxe
First cost	$75,000	$125,000	$220,000
Annual Benefit	$28,000	$43,000	$79,000
M&O Costs	$8000	$13,000	$38,000
Salvage Value	$3000	$6900	$16,000

All machines have a life of 10 years. Using incremental rate of return analysis, which alternative should the company choose? Use a MARR of 15%.

E	R	D	
75	125	220	
20	30	41	

3	6.9	16	

E-DN
75k = 20k(P/A, IRR, 10) + 3k(P/F, IRR, 10)
IRR = 23.5%
IRR>MARR, so keep E

R-E
(125-75) = (30-20)(P/A, IRR, 10) + (6.9-3)(P/F, IRR, 10)
IRR = 15.6%
IRR<MARR, so keep R

D-R
(220-125) = (41-30)(P/A, IRR, 10) + (16-6.9)(P/F, IRR, 10)
IRR = 4%
IRR>MARR, so keep R

Get the regular.

A 25-year-old engineering graduate accepts employment at a starting salary of $50,000 per year. The engineer plans to work to age 65. During the period of employment, income is expected to increase by a gradient of 200 per year, starting the second year after beginning employment. Upon receiving his first paycheck, he notes that 7% has been deducted for his retirement plan. If an interest rate of 8% is used, what is the future worth of the engineer's contribution to the retirement plan during his career?

A = 50k
G = 200
n = 65 - 25 = 40
i = 8%

F = 0.07[50k(F/A, 8%, 40) + 200(A/G, 8%, 40)(F/A, 8%, 40)]
F = 0.07[13.5M] = **945k**

A transportation agency is considering a highway project that will cost $1.5 million. The annual benefits are expected to be $99,000 per year over a 20-year analysis period. Reusable material will be valued at $300,000 at the end of the useful life. If the discount rate is 8% per annum, should the project be constructed? Use benefit–cost analysis.

B/C = [99k(P/A, 8%, 20) + 300k(P/F, 8%, 20)]/1.5M = **0.69 < 1, so don't do the project**

EXAMPLE 9-11

Consider a project that may be constructed to full capacity now or may be constructed in two stages.

	Construction Costs
Two-stage construction	
Construct first stage now	$100,000
Construct second stage *n* years from now	120,000
Full-capacity construction	
Construct full capacity now	140,000

Other Factors

1. All facilities will last for 40 years regardless of when they are installed; after 40 years, they will have zero salvage value.
2. The annual cost of operation and maintenance is the same for both two-stage construction and full-capacity construction.
3. Assume an 8% interest rate.

Plot "Age When Second Stage Is Constructed" versus "Costs for Both Alternatives." Mark the break-even point on your graph. What is the sensitivity of the decision to second-stage construction 16 or more years in the future?

PWa = 140k
PWb = 100k + 120k(P/F, 8%, n)

Break even where PWa = PWb

140k = 100k + 120k(P/F, 8%, n)

- **n = 14.27 years**

(Newnan 9-46)

Large project requires an investment of $200m. Construction takes 3 years: $30m in first year, $100m in second and $70m in third. MARR=10%

Two options:

- Option A: 10 years with expected net profit of $40m/yr
- Option B: 20 years with expected net profit of $32.5m/yr
- Calculate:
  - Payback periods for each alternative
  - Equivalent investment cost at end of construction
  - Equivalent uniform annual worth

PWC = 30M(P/F, 10%, 1) + 100M(P/F, 10%, 2) + 70M(P/F, 10%, 3) = 162.5M

FC a = 162.5M(F/P, 10%, 3) = **216M**

Payback A = PWC/UAWB = 216/40 = **5.4**
Payback B = 216/32.5 = **6.6**

EAUW a = 40M - 216M(A/P, 10%, 10) = **4.8M**
EAUW b = 32.5M - 216M(A/P, 10%, 20) = **7.1M**

(Newnan 9-69 and 9-77)

Property bought for $10,000. Income $1000 per annum. Interest rate =10%. Property sold after 5 years. What is selling price to break even? (Assume no opportunity cost)

- If property bought for $12,000?
- If yearly income is $925?
- If property sold after 7 years?
- If all of above occurs?

PWC = PWB

10k = 1k(P/A, 10%, 5) + Selling Price(P/F, 10%, 5)

- **Selling price = 10k**

The proposed projects have the potential uniform annual benefits and associated probability at occurrence shown below. Which project is more desirable based on these data?

Project A		Project B	
EUAB	**Probability**	**EUAB**	**Probability**
$1000	0.10	$1500	0.20
$2000	0.30	$2500	0.40
$3000	0.40	$3500	0.30
$4000	0.20	$4500	0.10

EVa = 1k(0.10) + 2k(0.30) + 3k(0.40) + 4k(0.20) = 2.7k

EBa = 1.5k(0.20) + 2.5k(0.40) + 3.5k(0.30) + 4.5k(0.10) = 2.8k

Project B has greater expected value, so it is preferable.

A city engineer has compiled the following data on a flood damage project. To control the flood, the construction of a small dam will cost $100,000. Based on the estimated damage data collected, determine if it is worth building a dam.

Damage Estimate	Probability
$200,000	0.30
$100,000	0.50
$50,000	0.10
$0	0.10

EV cost of damage = 200*0.3 + 100*0.5 + 50*0.1 + 0*0.1 = 115k

Cost to avoid damage < EV cost of damage, **so build the dam**

1) Given a MARR of 10%, use incremental analysis to determine which of the following alternatives should be selected (if any). Each has an expected life of 10 years. (10 points).

Plan	1	2	3	4	Null
First Cost	$220,000	$100,000	$265,000	$180,000	$0
Annual Benefit	39,000	15,000	51,000	26,000	0

DN	**2**	**4**	**1**	**3**
0	100k	180k	220k	265k
0	15k	26k	39k	51k

Start with DN and 2

2 - DN
(100k-0k) = (15k-0k)(P/A, IRR, 10)

- IRR = 8.11%

IRR < MARR, so keep lower cost DN

4-DN
(180k-0k) = (26k-0k)(P/A, IRR, 10)

- IRR = 7.3%

IRR < MARR, so keep lower cost DN

1-DN
(220k) = 39k(P/A, IRR, 10)

- IRR = 12%

IRR > MARR, so keep higher cost 1.

3-1
(265k-220k) = (51k-39k)(P/A, IRR, 10)

- IRR = 23.4%

IRR>MARR, so keep higher cost, 3.

All out of options. So go with **Plan 3**.

2) A corporation is considering spending $3 million for a new stamping machine that will save $550,000 per year (repairs, down time, etc.) over its 7–year life. At the end of 7 years, the machine could be sold for $1.8 million. An alternative is to spend $1 million on an overhaul of the existing machine. This would extend its life 7 more years and save $175,000 per year. The value at the end of Year 7 would be $750,000. Using benefit–cost ratio analysis, identify the best choice. Explain your reasoning. The MARR is 12%. (12 points).

i = MARR

Option 1

PWB/PWC = 550k(P/A, i, 7) + 1.8M(P/F, i, 7) / 3M = 1.108

Option 2

PWB/PWC
= 550k(P/A, i, 7) + 175k(P/A, i, 14) - 175k(P/A, i, 7) + 750k(P/F, i, 14) / 3M + 1M(P/F, i, 7)
= 0.942

Option 1 has a higher ratio, so choose **option 1**.

3) A major city has recently experienced a low growth period in housing prices. An investor in real estate has $1.5 million to invest in real estate now. The investor has a theory that housing prices follow 4-year cycles of return (low growth and high growth) and that for the next 4 years growth will remain slow. The investor expects to make $50,000 per year on his investment if housing prices stay in this low growth period for the next 4 years and there is a 60% chance that the investor is correct. There is a 25% chance that this will continue for another 4 years after that. However, if he is wrong and the real estate market moves into a high growth cycle in the first or second 4-year period (or for both of the next two 4 year periods), he will make $200,000 per year. Can the investor expect to make a return of 10% per year on his investment over 8 years based on a present worth analysis? (8 points)

PWC = 1.5M
PWB expected value = 0.6[50k(P/A, 10%, 4)] + 0.25[50k(P/A, 10%, 8)] + 0.35[200k(P/A, 10%, 8)] =
95.1k + 66.69k + 373.4k = 535.2k

PWB < PWC, so no, **he cannot expect to make a return**

4) Your company is considering the installation of a new material handling system that costs $150,000. This system is expected to save your company $32,000 per year in labour costs for the next 15 years. Maintenance costs are expected to average $8000 per year. Using straight line depreciation, $0 salvage value and a total income tax rate (ITR) of 40%, determine the after-tax rate of return for the this project. (10 points)

7) Two mutually exclusive projects are under consideration:

Year	Project A	Project B
0	-$5000	-$9000
1	2750	1000
2	2750	3000
3	2750	5000
4	2750	7000
5	2750	9000

a) Which project should be selected if the simple payback method is used to make the determination? (4 points)
b) Which project should be selected if NPV or NFV were used? (4 points)
c) Explain any differences in results. (4 points)

A. Project A would be selected based on payback because its payback is within 2 years whereas Project B's payback is after 3 years.

B. We don't have the interest rate so we can't do a full analysis. But doing a simple analysis assuming no interest, project B has a net worth of 16k, whereas project A has a net worth of 8750. So

Project B would be chosen.

C. Project A gets back higher quantities of money sooner and costs less, so it has a small payback. However, Project B's returns grow whereas Project A's remain constant. So Project B ends up resulting in more net income. And thus is selected based on NPV or NFV.

8) You have borrowed $60,000 from a bank at an interest rate of 10.25%, compounded monthly. You are to repay the loan and its interest charges in equal monthly payments over a 15–year period. The estimated annual inflation rate is 6%, compounded monthly.

a) What is the amount of your monthly payments? Round your answer to the nearest dollar. (4 points)
b) What is the bank's rate of return on this deal after taking inflation into account? Round your answer to the nearest 0.1%. (6 points)

9) a) Using Porter's five forces framework, carry out a competitive analysis of **one** of the following industries: (8 points)
(i) Foodtruck catering
(ii) Software development for mobile communications devices

b) Which resources and capabilities are most important for project based firms? Provide examples. (12 points)

c) Describe what is most important for technology based firms to maintain their competitive advantage. Provide examples. (12 points)