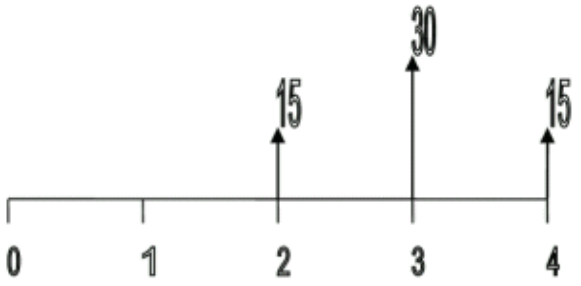
MSCI 261 Practice Problems, Chapters 2 – 5, Spring 2015.

Problem 1.

A student deposits now $10,000 in a saving account that pays 10% interest. Starting 2 years later from now, he expects to withdraw all the money in 4 equal-size amounts every 2 years. How much will the student get in each withdrawal?

Problem 2. Given the following cash flow diagram:



The following formulas are intended to define its present worth equivalent at time zero, but there is one small error in each formula. Find the error in each formula, and rewrite the correct formula, changing only one thing.

a) [15(F/P,i,2)+30(F/P,i,1)+15](P/F,i,3)
b) 15(P/F,i,2)+30(F/P,i,3)+15(P/F,i,4)
c) [15(P/A,i,3)+15(P/F,i,3)](P/F,i,1)

Problem 3. If you want to make an investment of $100,000 for a period of 1 year, which of the following options is the best? Show your work.

a) 10% interest rate compounded daily
b) 10.05% interest rate compounded monthly
c) 10.1% interest rate compounded quarterly
d) 10.15% interest rate compounded semiannually

Problem 4. A machine costs $1,200,000 and will provide savings of $ 200,000 a year. It has a useful life of 10 years with a scrap value of $50,000. Assume a MARR=10%.

a) Should the machine be purchased?
b) Suppose that the company that purchases the machine requires a seven-year payback period for any investment. Is the purchase of the equipment acceptable by this criterion?

Problem 5. A company is analyzing two mutually exclusive proposed investments, labelled A and B. Both proposals have an excess profit over the required MARR, i.e., present worth greater than zero. Proposal B has a greater excess profit. Indicate (all) the correct statement(s) below.

a) the present worth of the incremental investment in B over A is positive
b) the IRR of project A is greater than the MARR of the company
c) if the same projects are evaluated with the Annual Worth method, then project B will have a smaller excess profit than that of project A
d) none of the above

1. a) $i = 10\%$

$$i_e = (1+10\%)^2 - 1 = 1.1^2 - 1 = 0.21$$

$$A = 10000\,(A/P, i_e, N)$$

$$= 10000\,(A/P, 0.21, 4)$$

$$= 10000\left[0.21\,\frac{(1+0.21)^4}{[(1+0.21)^4-1]}\right]$$

$$= 3936.32$$

2. a) $[15(F/P, i, 2) + 30(F/P, i, 1) + 15](P/F, i, 4)$

b) $15(P/F, i, 2) + 30(F/P, i, 3) + 15(P/F, i, 4)$

($F/P \rightarrow P/F$; $4 \rightarrow 4$)

c) $[15(P/A, i, 3) + 15(P/F, i, 3)][P/F, i, 1]$

($3 \rightarrow 2$)

3) $100000\left(1 + \frac{i}{\#\text{ time compound}}\right)^{\#}$

a) $100000\left(1 + \frac{0.1}{365}\right)^{365} = \$110516$

b) $100000\left(1 + \frac{0.1005}{12}\right)^{12} = \$110526$

c) $100000\left(1 + \frac{0.101}{4}\right)^{4} = \$110489$

d) $100000\left(1 + \frac{0.1015}{2}\right)^{2} = \$110407.6$

4. a) $PW = -1200000 + 200000(P/A, 10\%, 10) + 50000(P/F, 10\%, 10)$

$= \$49,392$

b) $\frac{1200000}{200000} = 6 \quad 6 < 7$

5. a) $PW_{B-A} = PW_B - PW_A > 0$ ✓

b) $IRR_A > MARR$ ✓

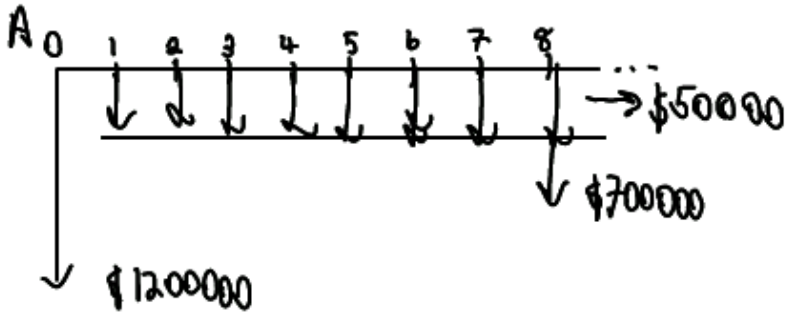
$\Leftrightarrow PW_A > 0$

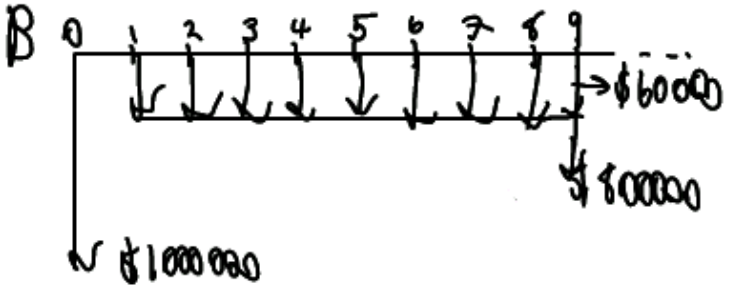
$\Leftrightarrow$ Excess profit over required MARR

c) $AW_A = PW_A \times (A/P, MARR, N)$

$AW_B = PW_B \times (A/P, MARR, N)$ ✗

6. a)





b) $A = 1200000(A/P, 10\%, \infty) \rightarrow FC$

$+ 700000(A/F, 10\%, 8) \rightarrow$ Resurfacing

$+ 50000 \rightarrow$ Maintenance

$= \$231\,210.81$

$B = 1000000(A/P, 10\%, \infty) + 800000(A/F, 10\%, 9) + 60000$

$= \$218,912.43$ $\quad A > \boxed{B}$

7. MARR = 10%

$PW = -100000 - 20000(P/F, i, 1) - 16000(P/F, i, 2) - 18000(P/F, i, 3)$

$= -\$144102.B$

$AW = 144102.13 \times (A/P, i, 3)$

$= 144102.13 * 0.40211$

$= \$59944.90$

per unit $= \frac{59944.90}{80000}$

$= \$0.72$/battery

8.

option #	Combination	Total Cost	Availability
1	A	30k	Y
2	B	60k	Y
3	C	50k	Y
4	D	20K	N
5	A-B	90K	Y
6	A-C	80 K	Y
7	A-D	50 k	N

opt	comb	TC	Aval
8	B-C	110k > 100k	N
9	B-D	60k	N
10	C-D	70k	Y
11	A-B-C	140k > 100k	N
12	A-B-D	110k > 100k	N
13	A-C-D	100k	Y
14	B-C-D	130k > 100	N
15	A-B-C-D	160k > 10k	N
16	do nothing	0	Y

Problem 6. The city of Waterloo is analyzing a proposed improvement to a connecting section between the city and a highway. Two options of road surface have been proposed.

	A	B
First cost (it includes first surfacing)	$1,200,000	$1,000,000
Annual maintenance	$50,000	$60,000
Resurfacing cost	$700,000	$800,000
Resurfacing period	every 8 years	every 9 years

a) Draw a cash flow diagram for each option.

b) Because the financial burden is expected to last forever, it is required to estimate the annual cost of this improvement. Which option should the city choose? Assume the city uses a MARR=10%.

Problem 7. A manufacturing plant is analyzing a special order of batteries. To implement the production line of this temporary order, the manager of the plant has estimated the following cash flow:

		Year 1	Year 2	Year 3
First cost	$100,000			
Annual production cost		$20,000	$15,000	$18,000
Annual production of batteries		80,000 units	80,000 units	80,000 units

a) What should be the minimum selling price per battery? The MARR is 10%.

b) If the customer has offered a purchase price of $1 a battery, should the offer be accepted?

Problem 8. Chatham Automotive has $100, 000 to invest in internal projects. The choices are:

Project	Cost
1. New manual tester	$30,000
2. New automatic tester	$60,000
3. Overhauling press	$50,000
4. Line improvements	$20,000

Each option can be chosen just once, and only if the press is chosen can the line improvements be made. What mutually exclusive combinations are available?

Problem 9. An unusual investment opportunity would have the following net cash flow series.

Year	0	1	2	3
Net Cash Flow	+ $ 10,000	- $ 4000	- $ 4000	- $ 4000

Sketch the graph of the present worth versus interest rate, for non-negative values of the interest rate. Be sure to label any important numerical values on the present worth axis. State whether or not there is a real, positive solution to the equation that sets present worth equal to zero.

Problem 10. Multiple Choice Problems: for each problem below, circle the letter for the one correct answer.

10.1 Suppose that a company has some equity for investment and some debt for investment.

(a) The minimum return required for equity is greater than the weighted cost of capital.

(b) The current ratio divided by the equity ratio always equals the return on total assets.

(c) The MARR is normally less than the interest on debt.

(d) The MARR is normally less than or equal to the weighted cost of capital.

(e) none of the above.

10.2 Three mutually exclusive proposed investments are labelled A, B and C. Proposal A has the smallest first cost, C has the largest, and B's first cost is between A's and C's. Each has a present worth that is greater than zero, i.e. $PW_A>0$, $PW_B>0$ and $PW_C>0$. B has the largest present worth.

(a) The present worth of the incremental investment in C over B exceeds zero.

(b) $PW_A/PW_B<1$.

(c) The present worth of the incremental investment in B over A is less than zero.

(d) $PW_A + PW_B + PW_C$ exceeds the weighted cost of capital.

(e) none of the above.

10.3 A present amount P is equivalent to an annuity series of N payments each of size A (with the first payment one period after P), and both are equivalent to a future amount F at the same time as the Nth payment in the annuity series. The interest rate is i, and $i>0$.

(a) $F = \lim_{N\to\infty} A\left(\frac{(1+i)^N - 1}{i(1+i)^N}\right)$.

(b) $F < NA$.

(c) $A = P/N + iP$.

(d) $P > NA$.

(e) none of the above.

Problem 11.

a) John plans to deposit $400 into a retirement savings account at the end of every second month, for two years. The interest rate is 6% per year, compounded monthly. Write an expression for the total amount in the account, just after the last deposit. Your expression must include at least one interest factor symbol (e.g. (P/A,i,N), etc.), with the proper values for i and N in any interest factor symbol.

b) Maintenance on a machine is expected to cost $1000 at the end of its first year and the same amount again at the end of its second year of use. At the end of the third year, maintenance is expected to be $1250 and after that, it will continue to increase by $250 per year each year over the previous year. It will be used for a total of 10 years, with no maintenance expenditure at the end of the tenth year. The machine will be purchased now, so the first maintenance payment will be one year from now. How much money should be placed *now* in an account earning 6% per year so that the maintenance costs can be paid by withdrawals from the account, leaving a zero balance after the last withdrawal? Start your answer with a cash flow diagram. You may use the attached interest tables for acceptable accuracy, if you wish; or you may evaluate formulas on your calculator.

Problem 12. Multiple Choice Problems: for each problem below, circle the letter for the one correct answer.

12.1 A company decides on proposed investments by the present worth method, with the MARR as the weighted average cost of capital calculated as $w_d i_d + w_e i_e$. A proposed investment has a present worth PW>0.

(a) Normally, MARR < $w_d i_d + w_e i_e$.

(b) Normally, $w_d i_d$ < PW < $w_e i_e$.

(c) Normally, $i_e > i_d$.

(d) Normally, MARR > i_e .

(e) none of the above.

12.2 Your friend has just started his first term at Waterloo and plans to invest some money that will reach maturity within 5 years, returning the initial capital with all interest payments on February 28, 2013. For the interest payment, he can choose among the following four options. Which one shall he choose to maximize his total savings?

a) Monthly compounded interest at nominal annual rate of 12% .
b) Daily compounded interest at effective annual rate of 12% .
c) Single interest payment of 80% on February 28, 2013 .
d) Continuously compounded interest at 11% .
e) Annual simple interest of 16% .

Problem 13.

(a) You wish to borrow some money to help you purchase a car. You have found a bank that will loan money at 7% interest, compounded monthly, over 5 years of monthly repayments. Because you expect to be able to afford larger monthly payments in the future than you can now, the bank will let you increase your monthly payments at a steady rate. If you can afford to pay $200 in repayment in the first month, and to increase this by $5 per month thereafter, write out an expression that would calculate the size of a loan that you could get from the bank. ***Do not evaluate your expression, as it would take too long.*** Your expressions must use interest factor symbols (e.g. (P/A,i,N)), from the attached List of Formulas, wherever possible, and it should also include the correct numbers for any of the data.

(b) An interest rate is 0.5% per month, with monthly compounding.

(i) Calculate the effective interest rate per year, to the nearest hundredth of a percent.

(ii) Calculate the nominal interest rate per year.

Problem 14. A company is considering whether to build a factory to produce electric cars. The factory would be so large that it would take two years to build, and the first cars would be sold two years from now. The first cost would be $200,000,000 this year (now), followed by $350,000,000 next year. In the first year of production, output is expected to be 1500 cars, and in later years, the output is expected to increase by 200 cars each year compared to the previous year, as they become more popular and sales increase. The selling price will be $25,000 per car. Annual fixed costs will be $15,000,000 per year, and the variable costs will be $9,000 per car. Production and sales are planned to last for 15 years, with a salvage value of $200,000,000 on the buildings and equipment at the end of the 15th year. The MARR = 10%.

Draw a cash flow diagram. Calculate the present worth of the proposed investment and state whether the investment is economically acceptable. Show your work, including any relevant interest factor symbols (e.g. (P/A, i, N)) with the correct values of interest rate and number of periods filled in. You may use the attached interest tables for acceptable accuracy, if you wish; or you may evaluate formulas on your calculator.

Problem 15 Meghan plans to develop study software for her "Engineering Economics" course. It will be based on the textbook's current edition and implement interactive video lessons, example problems and sample test databases. She estimates an initial development and licensing cost of $74,000 plus additional annual expenses of $12,000 for advertising, distribution, maintenance and support. She is confident to sell 1,400 copies during the first year, but she expects a steady rate of decrease by 250 copies per year in each of the following years due to software piracy. After 5 years, when a new edition of the textbook will appear, she expects to sell her code for its initial cost to the textbook's publisher.

Considering that she could alternatively invest her capital at 6% interest, compute the levelized cost of each copy of her software. Show your work, including any relevant interest factor symbols (e.g. (P/A, i, N)) with the correct values of interest rate and number of periods filled in. You may use the attached interest tables for acceptable accuracy, if you wish; or you may evaluate formulas on your calculator.

Problem 16. MBD Inc. develops properties into shopping plazas and office buildings. There are four development proposals for this year, labelled A, B, C, and D, with first costs as shown in the table below.

Proposal	First Cost (millions of dollars)
A	3.7
B	5.8
C	6.2
D	1.4

Proposals A and B are for the same city property, so at most one of them can be done. Proposal D can be done only if C is also done because D is an addition of a parking garage to C. There is an overall limit of $11 million on the total of all first costs, due to budgetary limits this year.

Prepare a list of mutually exclusive, feasible combinations of proposals. Start your answer with all combinations and remove the infeasible ones.

Problem 17. Burning Money Corp (BMC) is looking to replace or repair its old furnace. There are three different alternatives: Repair, replace with a Small furnace, replace with a Big furnace. Each option has its own expected life, initial cost, salvage value and savings per year as given in the following table. Assume the MARR of BCM is 10%

	life	salvage value	Initial cost	savings per year
	(years)	(1000 $)	(1000 $)	(1000 $)
Repair	5	0	150	60
Small	10	20	300	100
Big	20	100	800	160

a. Compute the Annual worth of each option. Which option is the best by the Annual worth method? You may use the interest tables for acceptable accuracy, or you may evaluate formulas on your calculator.

b. Compute the payback period of each option. Which option is the best according to the payback method?

c. Assume BCM realizes that the installation costs of option BIG were miscalculated, and actually the initial costs for this option are 930 (1000's $) instead of 800 (1000's of $). What are the new annual worth and payback period for option BIG? Based on all calculations in parts a and b, and the revised calculations for BIG in part c, what option is the best?