

**Carleton University**  
**Department of Civil and Environmental Engineering**  
**Engineering Economics (ECOR 3800A)**

**ASSIGNMENT # 2**

**Issued May 30, 2015 Due Date: June 09, 2015 at 2:00 PM**

Drop off location: Filing cabinet near the entrance to the Civil and Environmental  
Engineering office.

The cabinet located to the right of room 3424 ME.

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**Question (1) (20 marks)**

**(A)**

The Cadillac Motor Car Company is advertising a 20 month lease of a Cadillac DeVille for \$720, payable at the beginning of each month. The lease requires a \$3500 down payment, plus a \$500 refundable security deposit. As an alternative, the company offers a 24-month lease with a single up-front payment of \$15660, plus a \$600 refundable security deposit. The security deposit will be refunded at the end of the 20-month lease. Assuming an interest rate of 6.3%, compounded monthly, which lease is proffered one?

**(B)**

How many years will it take an investment to triple if the interest rate is 3% compounded  
(a) Quarterly?      (b) Monthly?      (c) Continuously?

**(C)**

You have a habit of drinking a cup of Starbucks coffee (\$1.8 a cup) on the way to work every morning. If, instead, you put the money in the bank for 25 years, how much would you have at the end of that time, assuming that your account earns 6% interest compounded daily? Assume also that you drink a cup of coffee every day, including weekends.

**Question (2) (20 marks)**

(A) Consider the following cash flows and compute the equivalent annual worth at  $i = 7\%$ ,

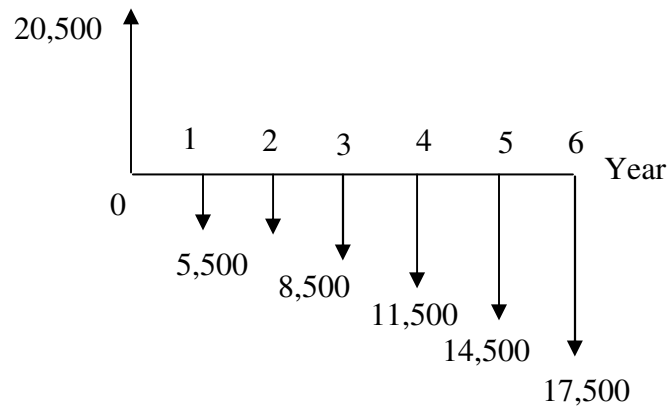
$A_n$		
n	Investment	Revenue
0	-10,000	
1		3000
2		3000
3		4000
4		4000
5		2000
6	+2000	200

**(B)**

Georgi Rostov deposits \$15,000 in a saving account that pays 4% interest compounded monthly. Three years later, he deposits \$14,000. Two years after the \$14,000 deposit, he makes another deposit in the amount of \$12,500. Four years after the \$12,500 deposit, half of the accumulated funds is transferred to a fund that pays 5% interest compounded quarterly. How much money will be in each account six years after the transfer?

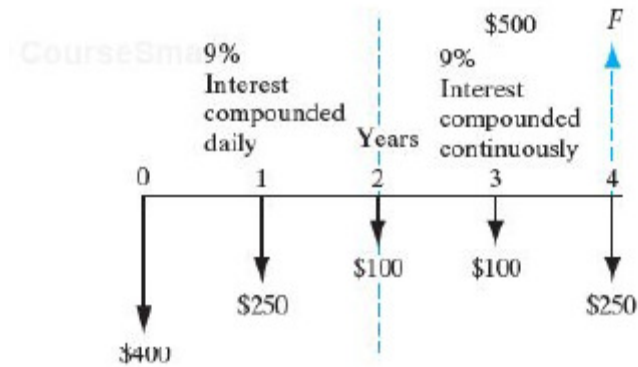
**(C)**

Consider the cash flow diagram. Compute the equivalent annual worth at  $i = 11\%$



**Question (3) (20 marks)****(A)**

Compute the future worth of the cash flows with different interest rates specified. The cash flows occur at the end of each year over four years.

**(B)**

Consider the following cash flows:

$n$	Project's Cash Flow (\$)			
	A	B	C	D
0	-\$2500	-\$3000	-\$5500	-\$4000
1	300	2000	2000	5000
2	300	1500	2000	-3000
3	300	1500	2000	-2500
4	300	500	5000	1000
5	300	500	5000	1000
6	300	1500		2000
7	300			3000
8	300			

- Calculate the payback period for each project.
- Determine whether it is meaningful to calculate a payback period for project D.
- Assuming that  $i=9\%$ , calculate the discounted payback period for each project.

**Question (4) (20 Marks)****(A)**

Your firm is considering purchasing an old office building with an estimated remaining service life of 25 years. Recently, the tenants signed long-term leases, which leads you to believe that the current rental income of \$150,000 per year will remain constant for the first 5 years. Then the rental income will increase by 10% for every 5-year interval over the remaining life of the asset. For example, the annual rental income would be \$165,000 for years 6 through 10, \$181,500 for years 11 through 15, \$199,650 for years 16 through 20, and \$219,615 for years 21 through 25. You estimate that operating expenses, including income taxes, will be \$45,000 for the first year and that they will increase by \$3000 each year thereafter. You also estimate that razing the building and selling the lot on which it stands will realize a net amount of \$50,000 at the end of the 25-year period. If you had the opportunity to invest your money elsewhere and thereby earn interest at the rate of 12% per annum, what would be the maximum amount you would be willing to pay for the building and lot at the present time?

**(B)**

A large food-processing corporation is considering using laser technology to speed up and eliminate waste in the potato-peeling process. To implement the system, the company anticipates needing \$2.5 million to purchase the industrial-strength lasers. The systems will save \$1,200,000 per year in labor and materials. However, it will require an additional operating and maintenance cost of \$275,000. Annual income taxes will also increase by \$145,000. The system is expected to have a 10-year service life and will have a salvage value of about \$225,000. If the company's MARR is 10%, justify the economics of the project based on:

- (a) PE method
- (b) FE method
- (c) AE method

**Question (5) (20 Marks)****(A)**

Consider the following project balances for a typical investment project with a service life of 4 years:

N	$A_n$	Project Balance
0	-1000	-1000
1	( )	-1100
2	( )	-800
3	460	-500
4	( )	0

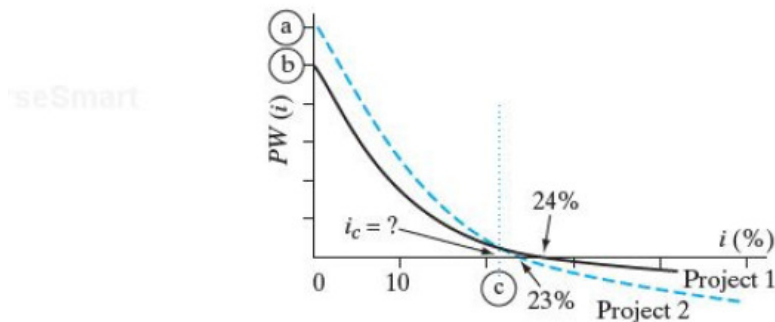
- Construct the original cash flows of the project.
- Determine the interest rate in computing the project balance.
- At  $i = 15\%$ , would this project be acceptable?

**(B)**

Consider the following cash flows and present-worth profile:

Year	Net Cash Flows (\$)	
	Project 1	Project 2
0	-\$1000	-\$1000
1	400	300
2	800	Y
3	X	800

- Determine the values of  $X$  and  $Y$ .
- Calculate the terminal project balance of project 1 at  $MARR = 24\%$ .
- Find the values of  $a$ ,  $b$ , and  $c$  in the NPW plot.



**Question (6) (20 Marks)****(A)**

An electric motor is rated at 10 horsepower (HP) and costs \$835. Its full load efficiency is specified to be 85%. A newly designed, high-efficiency motor of the same size has an efficiency of 90%, but costs \$1300. It is estimated that the motors will operate at a rated 10 HP output for 1500 hours a year, and the cost of energy will be \$0.07 per kilowatt-hour. Each motor is expected to have a 15-year life. At the end of 15 years, the first motor will have a salvage value of \$75. Consider the MARR to be 7%. (Note: 1HP = 0.7457 kW.)

- Determine which motor should be installed based on the PE criterion.
- In (a), what if the motors operated 2500 hours a year instead of 1500 hours a year? Would the same motor in (a) be the choice?

**(B)**

Consider the following investment projects:

$n$	Project's Cash Flow				
	A	B	C	D	E
0	-\$1,800	-\$5,200	-\$3,800	-\$4,000	-\$6,500
1	-500	2,500	0	500	1,000
2	900	-4,000	0	2,000	3,600
3	1,300	5,000	4,000	3,000	2,400
4	2,200	6,000	7,000	4,000	
5	-700	3,000	12,000	1,250	

- Compute the future worth at the end of life for each project at  $i = 12\%$ .
- Determine the acceptability of each project.