IEGR 350: Engineering Economy
Spring 2016
M. Salimian **Your Name:**

Test 3 (100 Points)

Time: 100 Minutes (+ 10 if you request to complete your calculations)

Read instructions carefully. Explain and show your work. No use of computer or cell phone allowed. Use of printed formula sheet and table for 8%, 12% and 15% is allowed. Non-digital textbook for use of the 3 tables (not the formula) is allowed. Write your name on sheets of paper you have (including table and formula sheets) and turn them in at the end of the test time.

Use of EXCEL: There are 2 computers assigned to be used with EXCEL for rate of return calculation only. Any Internet access attempt or use of EXCEL for problems not eligible for spreadsheet use would cause in immediate disqualification and a grade of zero on overall test. Use of the computer is limited to 5 minutes per person at a time. No file should be saved, only the results copied. EXCEL should be closed after the use and relaunched for the next user. You must have the cash flow that you are planning to enter ready and show it to the instructor before you are allowed to use the spreadsheet.

PROBLEM 1:

Calculate a project's PW with estimated costs of $40,000 now and $8000 per year for 5 years beginning 1 year from now with increases of 10% per year thereafter for the next 8 years. Use a real interest rate of 15% per year to make the calculations (a) without an adjustment for inflation (10 pts) and (b) considering inflation at a rate of 11% per year for the first 5 years and 13% for the years after that (25 pts). (No use of EXCEL)

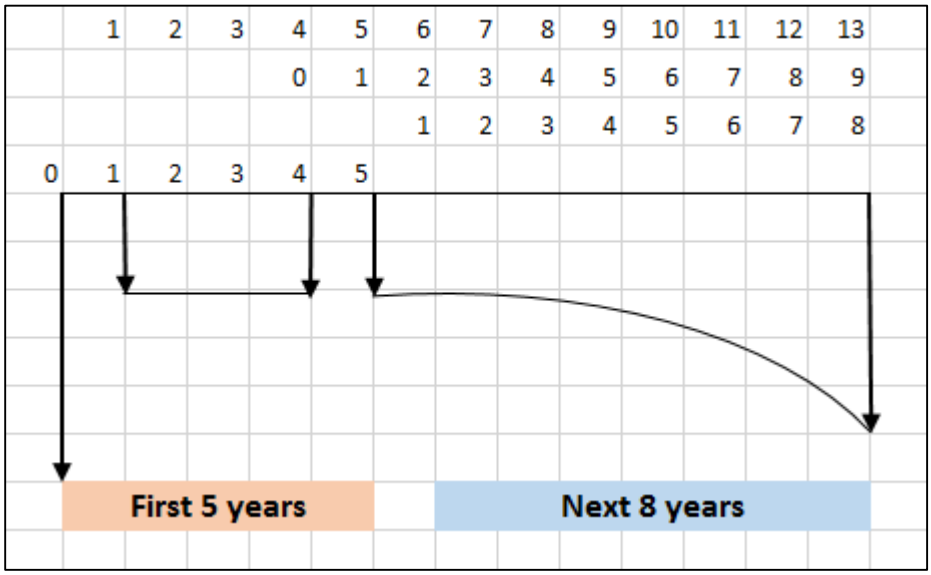
Solution

(a) Figure below presents the cash flows. The PW without an adjustment for inflation is found using i = 15% A = 8000 for the equal annual payment series, g = 10% and A1 of either 8000 or 8800 depending on how to separate two joint series for the geometric gradient series. In the solution below, I have assigned the 8000 payment in year 5 to the geometric series in part (a) and to the equal annual series in part (b). Thus the equal amount payment for the first 5 years is now for 4 years. **Important:** Note that the "first five years" and "the next 8 years actually make the project life 13 years. Also not that the equal payment series present worth happens at year 0 using the formula but the geometric series happens at year 4 using the formula and must be multiplied by (P/F, 15%, 4) to find the equivalent at year 0.

PW0 = - 40000
PW1 = - 8000 (P/A, 15%, 4) = -8000 (2.8550) = -22840
PW2 = - {8000 [1 – $(1.10/1.15)^9$] / (0.15 – 0.10)} (P/F, 15%, 4)
PW2 = - 8000 (6.5949) (0.5718) = - 30167.70

PW = PW0 + PW1 +PW2 = - 40000 – 22840 – 30167.70 = - 93,007.70

(10 points)



(b) – To adjust for inflation, calculate the inflated interest rate and use it to calculate PW.

For the first 5 years the inflation rate is 11%:

$i_f = i + f + (i)(f) = 0.15 + 0.11 + (0.15)(0.11) = 0.2765$ or 27.65%

For the remaining years the inflation rate is 13%:

$i_f = i + f + (i)(f) = 0.15 + 0.13 + (0.15)(0.13) = 0.2995$ or 29.95%

PW0 = - 40000
PW1 = - 8000 (P/A, 27.65%, 5) = -8000 (2.5495) = -20396
PW2 = - {8800 $[1 - (1.10/1.2995)^8]$ / (0.2995 – 0.10)} (P/F, 27.65%, 5)
PW2 = - 8800 (3.6913) (0.2951) = - 9585.86

PW = PW0 + PW1 +PW2 = - 40000 – 20396 – 9585.86 = - 69,981.90

(15 points)

 Your Name:

PROBLEM 2:

A company has purchased a new industrial processing unit for $90,000. The unit has an anticipated life of 7 years and a salvage value of $12,000. Using the DB, DDB, SYD, and DDB-to-SL from year 4 depreciation methods, what are the book values and depreciation for the last three years of each method? (20 pts) (No use of EXCEL)

Solution

For DB, depreciation rate is calculated by:

$d = 1 - (12{,}000/90{,}000)^{1/7} = 0.250121$

For DDB, depreciation rate is calculated by:

$d = 2/n = 2/7 = 0.285814$

Note that for the last year of DDB we cannot exceed the BV.

D_t and BV_t Values for DB and DDB Depreciation

	Declining Balance, $		Double Declining Balance, $	
Year t	D_t	BV_t	D_t	BV_t
0	---	90,000.00	---	90,000.00
1	22,510.89	67,489.11	25,714.29	64,285.71
2	16,880.44	50,608.67	18,367.35	45,918.37
3	12,658.29	37,950.38	13,119.53	32,798.83
4	9,492.19	28,458.19	9,371.10	23,427.74
5	7,117.99	21,340.20	6,693.64	16,734.10
6	5,337.63	16,002.57	4,781.17	11,952.93
7	4,002.57	12,000.00	47.07	12,000.00

For SYD method:

Sum of the years' digits = 1+2+3+4+5+6+7 = 28
Year 1 depreciation = (7/28) (90,000 – 12,000) = 19,500
Year 2 depreciation = (6/28) (90,000 – 12,000) = 19,500
…
…
Year 1 depreciation = (1/28) (90,000 – 12,000) = 2,875.81

For DDB-to-SL method:

Book value at the end of year 3 is 32,798.73 and salvage value is 12,000. Thus, the SL depreciation rate is (32,798.83 – 12,000) / 4 = 5,199.71

D_t and BV_t Values for SYD and DDB-to-SL Depreciation

	SYD, $			DDB-to-SL, $	
Year t	D_t	BV_t		D_t	BV_t
0	---	90,000.00		---	90,000.00
1	19,500.00	70,500.00		25,714.29	64,285.71
2	16,714.29	53,785.71	DDB	18,367.35	45,918.37
3	13,928.57	39,857.14		13,119.53	32,798.83
4	11,142.86	28,714.29		5,199.71	27,599.13
5	8,357.14	20,357.14		5,199.71	22,399.42
6	5,571.43	14,785.71	SL	5,199.71	17,199.71
7	2,785.71	12,000.00		5,199.71	12,000.00

PROBLEM 3:
A company has a new contract for which it plans to purchase additional equipment for use in the 6-year contract. The equipment is expected to cost $600,000 and have a resale value of $180,000 after 6 years. Use of the new equipment will increase contract revenue by $220,000 per year and require an additional M&O expense of $90,000 per year. MACRS depreciation allows recovery in 5 years, and the effective corporate tax rate is 30% per year. Tabulate and plot CFBT and CFAT series (15 pts). What is the rate of return of this project? (10 pts) (EXCELL eligible) – screen capture your EXCEL sheet, place it in word document, save it to your flash drive and AFTER the TEST email it.

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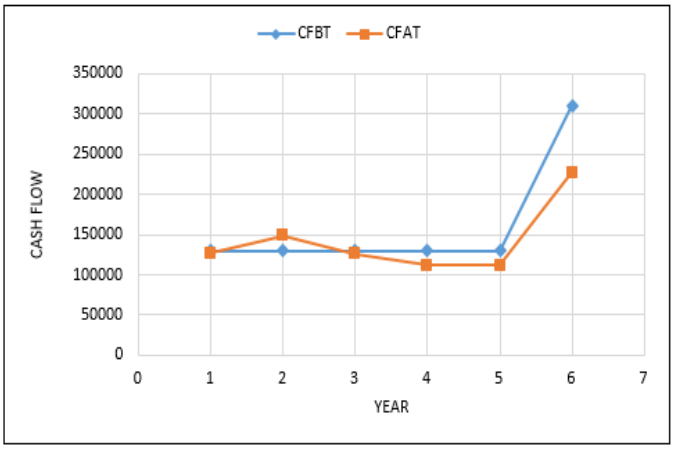
Solution

Table below represent the work on spreadsheet. Depreciation is calculated using MACRS for 5 years (20%, 32%, 19.20%, 11.52%, 11.52%, 5.76%). Also note that taxable income in year 2 is negative which indicates no taxes should be paid. If this was the only work of the company during the year, then it would make sense to declare the TI for that year as 0. However, companies generally have several other projects during a year. In this case, the negative taxes are calculated for this project meaning when combined income is reported for the company at the end of the year, these savings are applied to other projects that owe taxes during that year and create less overall taxes for the company. Either way that you calculated during the test, is acceptable.

Year	GI	OE	P and S	CFBT	D	TI	Taxes	CFAT
0			-600000	-600000		0	0	-600000
1	220000	-90000		130000	120000	10000	3000	127000
2	220000	-90000		130000	192000	-62000	-18600	148600
3	220000	-90000		130000	115200	14800	4440	125560
4	220000	-90000		130000	69120	60880	18264	111736
5	220000	-90000		130000	69120	60880	18264	111736
6	220000	-90000	180000	310000	34560	275440	82632	227368
				13.32% ROR				10.36% ROR



PROBLEM 4:

For a 2 year project the following transactions are noted:

Initial investment	$5000
Net revenues (Year 1):	
End of month 2	$1300
End of Week 11	$1400
End of month 7	$1500
End of Week 39	$1600
End of month 11	$1500
End of Year 1	-$2000
Net revenues (Year 2):	
End of month 3	$500
End of Week 22	$300
End of Day 200	$600
End of Day 250	$1000
End of month 10	$500
End of Year 2	$600

Calculate PW at 12% interest rate compounding annually. Do the same with compounding weekly. What is the equivalent of this investment in in AW if interest rate were compounding quarterly? (30 pts)

Solution

Let's calculate some of the effective interest rates:

Nominal: 12%, (WC) weekly compounding
$r = (1 + i/n)^n - 1 = (1+0.12/52)^{52} - 1 = 1.1273 - 1 = 0.1273$ or 12.73%

Nominal: 12%, (QC) seasonal (Quarterly) compounding
$r = (1 + i/n)^n - 1 = (1+0.12/4)^4 - 1 = 1.1255 - 1 = 0.1255$ or 12.55%

Interest rate for each season = 0.1255/4 = 0.0314 or 3.14% per season

Interest rate for each week = 0.12/52 = 0.0023 or 0.23% per week

<u>Calculating PW at 12% interest rate compounding annually</u>:

Because compounding is annually, all transactions during the year are combined as end of the year values. So, during the first and second year total revenues are:

Year 1 → 1300 + 1400 + 1500 + 1600 + 1500 = $7,300
Year 2 → 500 + 300 + 600 + 1000 + 500 + 600 = $3,500

At the end of year 1 we have another investment of $2,000 which would reduce end of the year 1 by that amount or, 7300 – 2000 = 5300. Thus the PW is:

PW = - 5000 +5300 (P/F, 12%, 1) + 3500 (P/F, 12%, 2)
PW = - 5000 +5300 (0.8929) + 3500 (0.797 2) = 2522.57

Calculating PW at 12% interest rate compounding weekly:

In this case all payments during days of the week will be combined at the end of the week they are happening:

Initial investment $5000
Net revenues (Year 1):
End of month 2 $1300 → end of week 9
End of Week 11 $1400 → end of week 11
End of month 7 $1500 → end of week 30
End of Week 39 $1600 → end of week 39
End of month 11 $1500 → end of week 48
End of Year 1 -$2000 → end of week 52
Net revenues (Year 2):
End of month 3 $500 → end of week 65
End of Week 22 $300 → end of week 74
End of Day 200 $600 → end of week 81
End of Day 250 $1000 → end of week 88
End of month 10 $500 → end of week 95
End of Year 2 $600 → end of week 104

Therefore, PW is calculated as:

PW = - 5000
+ 1300 (P/F, 0.23%, 9) + 1400 (P/F, 0.23%, 11) + 1500 (P/F, 0.23%, 30)
+ 1600 (P/F, 0.23%, 39) + 1500 (P/F, 0.23%, 48) - 2000 (P/F, 0.23%, 52)
+ 500 (P/F, 0.23%, 65) + 300 (P/F, 0.23%, 74) + 600 (P/F, 0.23%, 81)
+ 1000 (P/F, 0.23%, 88) + 500 (P/F, 0.23%, 95) + 600 (P/F, 0.23%, 104)

PW = $2,943.30

Calculating PW at 12% interest rate compounding quarterly:

In this case all payments during days of a quarter will be combined at the end of that quarter (remember that every 52/4=13 weeks is one quarter):

Initial investment $5000
Net revenues (Year 1):
End of month 2 $1300 → end of quarter 1
End of Week 11 $1400 → end of quarter 1
End of month 7 $1500 → end of quarter 3

End of Week 39 $1600 → end of quarter 3
End of month 11 $1500 → end of quarter 4
End of Year 1 -$2000 → end of quarter 4
Net revenues (Year 2):
End of month 3 $500 → end of quarter 5
End of Week 22 $300 → end of quarter 6
End of Day 200 $600 → end of quarter 7
End of Day 250 $1000 → end of quarter 7
End of month 10 $500 → end of quarter 8
End of Year 2 $600 → end of quarter 8

Which is re-written as:

End of quarter 1 $2700 → 1300+1400
End of quarter 2 $0
End of quarter 3 $3100 → 1500+1600
End of quarter 4 $-500 → 1500 - 2000
End of quarter 5 $500
End of quarter 6 $300
End of quarter 7 $1600 → 600+1000
End of quarter 8 $1100 → 500+600

Therefore, PW is calculated as:

$$PW = -5000 + 2700(P/F, 3.14\%, 1) + 3100(P/F, 3.14\%, 3) - 500(P/F, 3.14\%, 4) + 500(P/F, 3.14\%, 5) + 300(P/F, 3.14\%, 6) + 1600(P/F, 3.14\%, 7) + 1100(P/F, 3.14\%, 8)$$

$$PW = -5000 + 2700(0.9696) + 3100(0.9114) - 500(0.8837) + 500(0.8568) + 300(0.8307) + 1600(0.8054) + 1100(0.7809)$$

$$PW = \$2826.65$$

$$AW = 2826.65(A/P, 3.14\%, 8) = 2826.65(0.1433) = 405.06$$