

## Problem 1

### Solution:

Suppose State tax rate is  $x\%$  and Federal Tax rate is  $y\%$ . Income is  $Z$ .

Case 1: the State tax is deductible from the Federal tax:

$$\text{State income tax} = x\% \cdot Z$$

$$\text{Federal taxable income} = Z - x\% \cdot Z$$

$$\text{Federal tax} = y\%(Z - x\% \cdot Z)$$

$$\rightarrow \text{Total tax burden} = x\% \cdot Z + y\%(Z - x\% \cdot Z) = x\% \cdot Z + y\% \cdot Z - x\% \cdot y\% \cdot Z$$

Case 2: Federal tax is deductible from the State tax

$$\text{Federal tax} = y\% \cdot Z$$

$$\text{State taxable income} = Z - y\% \cdot Z$$

$$\text{State tax} = x\% \cdot (Z - y\% \cdot Z)$$

$$\rightarrow \text{Total tax burden} = y\% \cdot Z + x\% \cdot (Z - y\% \cdot Z) = x\% \cdot Z + y\% \cdot Z - x\% \cdot y\% \cdot Z$$

$\rightarrow$  From above we can see the total tax burden are the same for these two cases.

2. List the various ways that changing the depreciation method can affect the NPV of an investment opportunity.
  - a. Depreciation results in a deduction in taxable income. If the marginal tax rate is unchanged, then taking this reduction earlier will result in a lower tax burden earlier in the project (investment) resulting in a higher NPV. Recall that depreciation is not a cash expense, so in of itself it does not affect the NPV.
  - b. Depreciation can change the tax marginal tax rate. Thus taking too much at one time could cause tax rate to go down. Whereas delaying the deduction would mean a higher tax savings. This means that taxing the depreciation earlier may lower the NPV of a project.
  - c. Taking too much depreciation early can cause a company to lose money, meaning that there is no tax savings from the depreciation. Actually this is not quite true, but the details are beyond the level of this course.

\$100,000 asset

$$\text{rate} = 2 * 100 / 12 = 16.666667$$

twelve year straight line

	rate	depreciation
1	8.333333	8333.333
2	8.333333	8333.333
3	8.333333	8333.333
4	8.333333	8333.333
5	8.333333	8333.333
6	8.333333	8333.333
7	8.333333	8333.333
8	8.333333	8333.333
9	8.333333	8333.333
10	8.333333	8333.333
11	8.333333	8333.333
12	8.333333	8333.333

twelve year DDB

	start BV	Deprec.	end BV
1	100,000	16,666.67	83,333.33
2	83,333	13,888.89	69,444.44
3	69,444	11,574.07	57,870.37
4	57,870	9,645.06	48,225.31
5	48,225	8,037.55	40,187.76
6	40,188	6,697.96	33,489.80
7	33,490	5,581.63	27,908.16
8	27,908	4,651.36	23,256.80
9	23,257	3,876.13	19,380.67
10	19,381	3,230.11	16,150.56
11	16,151	2,691.76	13,458.80
12	13,459	2,243.13	11,215.67

Question 4:

Cost	444000							
	MACRS 12 years		SL 12 years		MACRS 8 years		SL 8 years	
Year	%	Depr.	%	Depr.	%	Depr.	%	Depr.
1	10.00%	44400	5%	22200	10.00%	44400	5%	22200
2	18.00%	79920	10%	44400	18.00%	79920	10%	44400
3	14.40%	63936	10%	44400	14.40%	63936	10%	44400
4	11.52%	51148.8	10%	44400	11.52%	51148.8	10%	44400
5	9.22%	40936.8	10%	44400	9.22%	40936.8	10%	44400
6	7.37%	32722.8	10%	44400	7.37%	32722.8	10%	44400
7	6.55%	29082	10%	44400	6.55%	29082	10%	44400
8	6.55%	29082	10%	44400	3.28%	14541	5%	22200
9	6.56%	29126.4	10%	44400				
10	6.55%	29082	10%	44400				
11	3.28%	14563.2	5%	22200				
	100.00%	444000	100.00%	444000	80.34%	356687.4	75.00%	310800

### Question 5

Sale of asset in year 12 for \$44,000. The book value under both depreciation methods is zero and thus the net cash proceeds are  $44,000 - (0.35)44,000 = \$28,600$ .

Sale of asset in year 8 for \$144,000 using MARCS. The \$444,000 asset has been depreciated \$356687.4 and thus its book value is \$87312.6. The profit on the sale is thus  $144,000 - 87312.6 = \$56687.4$ . The tax is thus  $(0.35) 56687.4 = \$19840.59$ . Thus the net cash proceeds are  $144,000 - 19840.59 = \$124,159.41$

Sale of asset in year 8 for \$144,000 using SL-MARCS. The \$444,000 asset has been depreciated \$310800 and thus its book value is \$133200. The profit on the sale is thus  $144,000 - 133200 = \$10800$ . The tax is thus  $(0.35) 10800 = \$3780$ . Thus the net cash proceeds are  $144,000 - 3780 = \$140,220$ .

Purchase Cost	444000	Salvage Value	44000	N	10			
SL		SYD			DB 200%			
		sum of year digits is 55		rate = 2*100/10 = 20%				
year	%	Dep	Digits %	Dep	begin BV	dep	End BV	
1	10	40000	10 0.181818182	72727.27	444000	88800	355200	
2	10	40000	9 0.163636364	65454.55	355200	71040	284160	
3	10	40000	8 0.145454545	58181.82	284160	56832	227328	
4	10	40000	7 0.127272727	50909.09	227328	45465.6	181862.4	
5	10	40000	6 0.109090909	43636.36	181862.4	36372.5	145489.9	
6	10	40000	5 0.090909091	36363.64	145489.9	29098	116391.9	
7	10	40000	4 0.072727273	29090.91	116391.9	23278.4	93113.55	
8	10	40000	3 0.054545455	21818.18	93113.55	18622.7	74490.84	
9	10	40000	2 0.036363636	14545.45	74490.84	14898.2	59592.67	
10	10	40000	1 0.018181818	7272.727	59592.67	11918.5	47674.14	
Sums	100	400000	55	1 400000	400000			

7. For equal principal payments, the principal payment each year is 444,000/10. The interest payment is then computed yearly based on the previous loan balance. For equal total payments, one must compute the total annual payment as  $(\text{Amount borrowed})(A/P, i, N)$ . Then, one computes interest payment based on the previous loan balance, and the left over money is used for the principal payment. The logic is the same year to year, and the difference is which column is computed initially and which ones are computed year-by-year. [Calculations were done with a spreadsheet using greater accuracy than what is displayed here.] Comparing these two repayment methods involves concepts covered in the graduate course; if you are interested, contact the instructor for additional reading materials.

	Loan amount=444000		444000					
	rate	0.12	N	10	$(i+i)^N$	3.1058	A/P	0.177
		Equal principal payments				Equal total payments		
	interest payment	principal payment	Total payment	New loan balance	interest payment	principal payment	Total payment	New loan balance
time								
1	53280	44400	97680	399600	53280	25308	78588	418692
2	47952	44400	92352	355200	50243	28345	78588	390347
3	42624	44400	87024	310800	46842	31746	78588	358601
4	37296	44400	81696	266400	43032	35556	78588	323045
5	31968	44400	76368	222000	38765	39823	78588	283222
6	26640	44400	71040	177600	33987	44601	78588	238621
7	21312	44400	65712	133200	28634	49954	78588	188667
8	15984	44400	60384	88800	22640	55948	78588	132719
9	10656	44400	55056	44400	15926	62662	78588	70058
10	5328	44400	49728	0	8407	70058	78588	0

Question 8:

time	Asset cost = 444,000		Marginal tax rate = 0.35		Profit	Cash flow
	Optg. cash (Cash flow before taxes)	Eqpt. deprec.	Taxable income	Income tax	after tax	after tax
0						-444000
1	257000	44400	212600	74410	138190	182590
2	269000	79920	189080	66178	122902	202822
3	311000	63936	247064	86472	160592	224528
4	325000	51148.8	273851.2	95848	178003	229152
5	340000	40936.8	299063.2	104672	194391	235328
6	350000	32722.8	317277.2	111047	206230	238953
7	325000	29082	295918	103571	192347	221429
8	310000	29082	280918	98321	182597	211679
9	282000	29126.4	252873.6	88506	164368	193494
10	190000	29082	160918	56321	104597	133679
11	130000	14563.2	115436.8	40403	75034	89597



[illegible]

- 10 A company expects the following revenues and expenses during the next year. The state income tax rate is a flat 6% rate, and state taxes are a deductible item for federal tax calculations. Use the federal tax rate information from lecture, see slide 11 on the second page of the pdf file of the lecture notes.

Revenues	444,000
Expenses	
Labor	72,000
Equipment Depreciation	40,000
Materials	12,000
Supplies	33,000
Rent	76,000
Insurance	21,000

- a. If state income taxes were **zero**, what would be the **amount** of federal income tax?  
**Total expenses:  $72,000 + 40,000 + 12,000 + 33,000 + 76,000 + 21,000 = 254,000$**   
**Taxable income:  $(444,000 - 254,000) = 190,000$**   
**This is in range 4 of the federal corporate income tax table,**  
**Income tax is  $22,250 + 0.39(190,000 - 100,000) = 57,350$**
- b. If state income taxes were **zero**, what would be the **effective (average)** federal income tax **rate** for this company?  
**The effective or average rate is  $57,350/190,000 = 0.302$  or **30.2%****
- c. If state income taxes were **zero**, what would be the **marginal** federal income tax **rate**?  
**The marginal tax rate applies to the next additional dollar of taxable income.**  
**In this case it is 39%.**
- d. With state income taxes at the **flat rate** given above, what is the **amount** of state income tax?  
**The taxable income is the same as in part a, 190,000**  
**State income tax is  $(0.06)(190,000) = 11,400$ .**
- e. With state taxes at the **flat rate** given above, what is the **amount** of federal income tax?  
**The taxable income changes from that computed in part a, to  $190,000 - 11,400 = 178,600$**   
**This is still in range 4 of the federal income tax table.**  
**So the federal income tax is  $22,250 + 0.39(178,600 - 100,000) = 52,904$**
- Note that state income tax is a deductible expense on the federal tax return. The accountant would first prepare the state income tax return, ignoring federal income tax, and then prepare the federal income tax return.
- f. What is the **effective (average)** total tax rate (federal and state taxes combined) for this company?  
**The effective or average rate is  $(11,400 + 52,904)/190,000 = 0.338$  or **33.8%****
- g. What is the **marginal** tax rate (federal and state combined) for this company?  
**The marginal rate for state taxes is 6%; these are deductible on the federal return.**  
**The marginal rate for federal taxes is 39%, for range 4.**  
**The combined marginal rate is  $(0.06)(1 - 0.39) + 0.39 = 0.427$  or **42****

11.

First determine the loan repayment schedule for years 1, 2, and 3:

Annual loan payment is  $(3,000,000)(A/P, 11\%, 15) = (3,000,000)(0.139065) = 417,195.72$

The interest payment in 2013 is  $(3,000,000)(0.11) = 330,000$

so the principal payment in 2013 is  $(417,195.72 - 330,000) = 87,195.72$

This reduces the loan balance at time 1, end of year 2003, to  $(3,000,000 - 87,195.72) = 2,912,804.28$

The interest payment in 2014 is  $(2,912,804.28)(0.11) = 320,408.47$

so the principal payment in 2014 is  $(417,195.72 - 320,408.47) = 96,787.25$

This reduces the loan balance at time 2, end of year 2014, to  $(2,912,804.28 - 96,787.25) = 2,816,017.035$

The interest payment in 2015 is  $(2,816,017.035)(0.11) = 309,761.87$  or 309,762

so the principal payment in 2015 is  $(417,195.72 - 309,761.87) = 107,433.84$  or 107,434

The total tax-deductible expenses include the interest payment in 2015, so the total is 622,762,

which gives a taxable income of  $(880,000 - 622,762) = 257,238$ .

The income tax is based on the marginal rate for this division of a large corporation:

Income tax =  $(0.35)(257,238) = 90,033$

The final after-tax cash flow reflects the adjustments made to profit after tax of the depreciation expense and the loan principal payment:

Tax-deductible expenses are:  $(166,000 + \dots + 11,000) + 309,762 = 622,762$

So the taxable income is  $(800,000 - 622,762) = 257,238$

The income tax is  $(257,238)(0.35) = 90,033$

The after-tax profit is  $(257,238 - 90,033) = 167,205$

Adjustments to obtain final cash flow:

Undo the subtract operation for depreciation expense, which is not a cash flow: + 44,000

Reflect the loan principal payment, which is not tax-deductible: - 107,434

The final cash flow is:  $167,205 + 44,000 - 107,434 = 103,771$