

IND 511 Advanced Engineering Economy
Homework #2[†]

- (15p) 1. Fred has \$2200 to invest over the next five years. At the beginning of each year he can invest money in one-year or two-year time deposits. The bank pays 8 percent interest on one-year time deposits and 17 percent (total) on two-year time deposits. In addition, West World Limited will offer three-year certificates of deposit starting at the beginning of the third year. These certificates will return 27 percent (total). If Fred reinvests his money available every year, formulate a linear program to show him how to maximize his total cash on hand at the end of the fifth year.
- (20p) 2. It is desired to determine the most economical thickness of insulation for a large cold-storage room. Insulation is expected to cost \$150 per 1,000 sq ft of wall area per in. of thickness installed and to require annual property taxes and insurance of 5% of first cost. It is expected to have negligible net salvage value after a 20-year life. The following are estimates of the heat loss per 1,000 sq ft of wall area for several thicknesses:

Insulation (in.)	Heat loss (Btu per hr)
3	4,400
4	3,400
5	2,800
6	2,400
7	2,000
8	1,800

The cost of heat removal is estimated at \$0.01 per 1,000 Btu per hr. The minimum required yield on investment is 20%. Assuming continuous operation throughout the year, which thickness is the most economical?

- (25p) 3. A taxpayer has the option of using either straight line or 200 % declining balance depreciation (If DB is used, there will be no shift to straight line.). Let P = initial cost. The depreciable life is 5 years; the salvage value is zero in either case. Cash flows for taxes occur at the end of each tax year. The tax rate is monotone increasing as given below:

$$t_j = 0.20 + 0.05(j-1), 1 \leq j \leq 5$$

Any gain (or loss) in disposal will be treated as ordinary income (or loss). Determine the range of discount rates such that declining balance would be preferred to straight line. Assume that the property is placed in service at the start of the tax year.

[†] Problem 5 is adapted from “Luenberger, D. G., *Investment Science*, Oxford University Pres, 1998”.

- (20p) 4. Given the following mutually exclusive projects and assuming $N = \infty$, which investment should be selected if the company's MARR is 25%? Use the IRR method.

	A	B	C	D	E	F
Investment	\$30,000	\$60,000	\$75,000	\$50,000	\$55,000	\$70,000
Annual savings	10,000	18,000	21,500	14,000	16,000	20,500

- (20p) 5. A company has identified 7 promising project alternatives, as indicated in the table given below. The cash flows for the first 2 years are negative for all projects. The cash flows in later years are positive, and the net present value of each project is shown. The company managers have decided that they can allocate up to \$250,000 in each of the first 2 years to fund these projects. If less than \$250,000 is used the first year, the balance can be invested at 10% and used to augment the next year's budget. Formulate the mathematical programming model and determine the projects to be funded using LINDO (or another solver).

Project	Cash flow		NPV
	Year 1	Year 2	
1	-90	-58	150
2	-80	-80	200
3	-50	-100	100
4	-20	-64	100
5	-40	-50	120
6	-80	-20	150
7	-80	-100	240