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AGEC 609
HW #1

1. Find the internal rate of return, net present value, benefit-cost ratio, and annual equivalent of the NPV over 12 years for the following cash flows assuming an 8% interest rate. Treat negative values in the table as costs and positive values as benefits. (Treat each column—A, B, and C—as a separate project. Note also that the project lifetimes are different—4 years for A, 8 for B, and 12 for C.

Year	A	B	C
1	–5,000	–6,000	–15,000
2	1,200	500	5,000
3	2,000	700	4,000
4	3,000	1,000	–4,000
5		2,000	4,000
6		2,000	5,000
7		2,000	–4,000
8		2,000	6,000
9			5,000
10			–2,000
11			6,000
12			6,000

	A	B	C
IRR	10%	12%	13%
NPV	$191.93	$1,032.9	$3,949.68
BCR	1.12	1.28	1.10
AE	$61.28	$179.72	$523.45

2. You need to purchase a new car. You want the car with the lowest lifetime total net present value cost. You have narrowed the decision down to two vehicles, A and B, that are identical in features and styling except that:

- Car A has a purchase price of $22,000 and fuel economy of 20 miles per gallon (mpg) and
- Car B has a purchase price of $28,000 and fuel economy of 40 mpg.

Gasoline costs $2.50 today (beginning of year 1) and you expect it to go up 3% per year in nominal terms. Use a 6% nominal borrowing rate, and assume that you can finance 85% of the purchase price of the vehicle and must make a down payment of 15%. (Purchase is at the beginning of year 1 and annual payments start at the end of year 1.) Repayment is over 4 years. You expect the vehicle to last 11 years and you will drive 12,000 miles per year. Your personal discount rate is 8%.

(a) Which vehicle has the lowest total cost over the course of its life?

Car A = $ 42,874.69

Car B = $ 38,117.93 → Car B

(b) What is the annualized total cost per mile for each vehicle? (Note: this question is not asking you to calculate the discounted unit cost we talked about in lecture; just calculate the annualized total cost and divide by miles driven per year.)

Car A = 0.36 Car B = 0.34

(c) What personal nominal discount rate makes you indifferent between the two vehicles?

Break even: $\sum_{t=1}^{N} \frac{B_t - C_t}{(1+r)^t} = 0$ ← NPV

↳ solve w/ goal seek

$\sum\left[\frac{C_A}{(1+r^*)^t}\right] = \sum\left[\frac{C_B}{(1+r^*)^t}\right]$

answer: 0.197061

calculating NPV is w/ this DR →

Both NPVs ≈ $22K.

(d) What rate of gasoline price increase makes you indifferent between the two vehicles?

Using goal seek → answer = $1.87

(e) What is the breakeven purchase price of the more fuel efficient car? Car B

Using goal seek → answer = $30,009

3. A proposed farm project has a three-year development period during which farmers borrow \$4000/year (real) at the beginning of each year. At the beginning of year 1, real and nominal values are the same. The inflation rate is expected to be 3% per year over the entire loan and repayment period. The nominal interest rate is 8%. Calculate the NPV of the nominal and real repayments of interest and principal over the borrowing and repayment years for the following three repayment schemes:

   (a) Interest on the outstanding principal is paid at the end of each year of the development period. The debt is repaid over six years in equal annual installments beginning at the end of year four.

Nominal NPV = \$11,453
Real NPV = \$11,453

   (b) Interest during project development is capitalized (i.e., added to the principal and not paid during the development period), and repayment is over six years in equal annual installments beginning at the end of year four.

Nominal NPV = \$11,453
Real NPV = \$11,453

   (c) No interest is charged during the development period. Repayment is on the basis of equal amounts of principal repaid each year over a period of six years beginning at the end of vear four.

Nominal NPV = \$9,815
Real NPV = \$9,815

4. The central electricity authority is considering building electric generating plants using coal, gas, nuclear energy, or wind. The capital costs of each option (in $000) are as follows:

Year	Coal	Gas	Nuclear	Wind
1	30	20	40	60
2	30	25	40	
3	25		50	
4	30		60	
5	40		70	
6			80	
7			50	

Each plant begins full operation the year following completion of construction. All four plants operate for 25 years, so the total project life is different for each plant. Other data for the problem are as follows:

- Coal fuel cost: $20/megawatt
- Gas fuel cost: $27/megawatt
- Nuclear fuel cost: $4/megawatt
- Coal capacity: 500 megawatts
- Gas capacity: 200 megawatts
- Nuclear capacity: 800 megawatts
- Wind capacity: 100 megawatts
- Other coal operating cost: $5,000/year
- Other gas operating cost: $3,000/year
- Other nuclear operating cost: $4,000/year
- Other wind operating cost: $300/year
- Social discount rate: 10%

What is the discounted unit cost of producing electricity from each plant?

Breakeven Price = Disc. unit cost

$$= \frac{PV(\text{Total cost})}{(\text{production} * Ar_{1N})}$$

↓ 10% ↘ 5

	discounted unit cost
coal	$25.58 per mgw
gas	$33.43 per mgw
nuclear	$26.33 per mgw
wind	$61.38 per mgw

5. Suppose you manage an excavation company. You purchase a new backhoe for $125,000 (real). You anticipate that you will use the backhoe for a total of 300 hours per year. You intend to keep the backhoe for 10 years, at which point you will replace it with an identical model. Assume the cost of a backhoe stays constant over time in real terms. The opportunity cost of your funds (i.e., your discount rate) in real terms is 5%.

   (a) For now, assume there are no annual maintenance or other costs, the backhoe is worthless at the end of the ten-year ownership period, and you ignore inflation. What hourly rate do you need to charge to recoup the cost of the backhoe?

   (b) Recalculate the breakeven hourly rate assuming you can sell the backhoe at the end of the ten-year ownership period for a salvage value equal to 20% of its initial sale price.

   (c) Recalculate the breakeven hourly rate given the salvage value from (b) and an estimate of annual operating costs (e.g., fuel, lubrication, and other maintenance) equal to 10% of the backhoe's initial purchase price.

   (d) Recalculate the breakeven hourly rate each year given the salvage value from (b) and the operating costs from (c), but now assume that inflation is 3% per year. (N.B. <u>All</u> cash flows will increase at this inflation rate.)

	wage ($/hour)
part (a)	$ 54
part (b)	$ 47
part (c)	$ 44
part (d)	$ 97