**Homework Set 3**

**EGR 310**

 **(10 pts each problem)**

1. Compute the internal rate of return (IRR) for the following cash flows: (Chapter 7)

|  |  |
| --- | --- |
| Year | Alt A |
| 0 | -$2,033 |
| 1 | $0 |
| 2 | $0 |
| 3 | $500 |
| 4 | $700 |
| 5 | $900 |
| 6 | $1,100 |

 2033 = (500(P/A, i, 4) + 200(P/G, i, 4))\*(P/F, i, 2)

 Try 9%

 2033 = (500(3.240) + 200(4.511))\*(.8417)

 = 2123

Try 10%

 2033 = (500(3.170) + 200(4.378))\*(.8264)

 = 2033

10%

1. Compute the internal rate of return (IRR) for the following cash flows: (Chapter 7)

|  |  |
| --- | --- |
| Year | Alt A |
| 0 | $30,000 |
| 1 | -$8,071 |
| 2 | -$8,071 |
| 3 | -$8,071 |
| 4 | -$8,071 |

 30000 = 8071(P/A, i, 4)

 (P/A, i, 4) = 30000/8071 = 3.72

 From Appendix C, (P/A, 3%, 4) = 3.717

 i = 3%

1. A 20 year bond with a face value of $1,000 has an 8% coupon rate compounded quarterly. If the bond was purchased for $1,107 and held to maturity, what is the IRR of the bond? (Chapter 7)

Number of periods = 4 quarters \* 20 years = 80

Interest Payment per quarter = $1,000\*((.08)/4) = $20

$1,107 = 20\*(P/A, i, 80) + 1000(P/F, i, 80)

Try 2%

20\*(39.744) + 1,000(.2051) = 1,000

Try 1.75%

20\*(42.880) + 1,000(.2496) = 1,107

i = 1.75 /quarter

IRR = ((1 + .0175)^4) -1 = 7.19%

1. A $1,000 face value 10 year bond returns $50 semiannually. If the bond was purchased when issued for $1,011, and then sold after 6 years for $1,020, what ,was the IRR the purchaser received? (Chapter 7)

Number of periods = 2 \* 6 years = 12

1,011 = 50\*(P/A, i, 12) + 1020\*(P/F, i, 12)

Try 4.5%

50\*(9.119) + 1020\*(.5897) = 1024

Try 5%

50\*(8.863) + 1020\*(.5568) = 1011

IRR = ((1.05))^2 – 1 = 10.2%

1. A car dealer gives you 2 options to buy a $50,000 new car.

Option 1 is no money down, but pay back in equal monthly installments for 5 years at 0% interest.

The second option is to pay cash for the car and get a $6,895 rebate.

What is the IRR of the payment option? (Chapter 7)

Monthly payment = $50,000/60 = $833.33

Purchase price = $50,000 –$ 6895 = $43,105

Find monthly i

43,105 = 833.33\*(P/A, i, 60)

(P/A, i, 60) = 51.726

i = 0.5% monthly

IRR = ((1.005)^12) – 1 = 6.17%

1. Use incremental analysis to evaluate the 2 alternatives. Assume a seven year life and a MARR of 15%. (IRRs for each is given) Would picking the highest IRR give you the best investment decision? (Chapter 7)

|  |  |  |
| --- | --- | --- |
|   | **Alt A** | **Alt B** |
| **Initial Investment** | $21,000 | $16,000 |
| **O&M Costs** | $2000 | $3,000 |
| **Annual Benefit** | $8,000 | $7,500 |
| **Salvage Value** | $5,000 | $8,000 |
| **IRR** | 23.2% | 24.8% |

Solution

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **Alt A** | **Alt B** | **A-B** | **B-A** |
| **Initial Investment** | $21,000 | $16,000 | $5,000 | -$5,000 |
| **O&M Costs** | $2000 | $3,000 | -$1000 | -$1000 |
| **Annual Benefit** | $8,000 | $7,500 | $500 | -$500 |
| **Salvage Value** | $5,000 | $8,000 | $-3,000 | $3,000 |
| **IRR** | 23.2% | 24.8% |  |  |

 NPV of delta = -5000 + 1500(P/A, i, 7) - 3000(P/F, i, 7)

 Try MARR of 15%

 NPV = -5000 + 1500(4.160) - 3000(.3759) = 112.3

Since NPV using MARR is positive, IRR > MARR. Pick larger initial investment A.

Since IRR of A-B is > 15%, pick biggest initial investment A. Alt B has a higher IRR but the difference between A and B can also be invested to give a return greater than the MARR of 15%.

1. Use incremental challenger-defender analysis to determine the best of the 3 mutually exclusive alternatives. Assume a MARR of 7% and a 5 year life. (Chapter 8)

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Alt A** | **Alt B** | **Alt C** |
| **Initial Investment** | $5,000 | $3,000 | $4,000 |
| **O&M Costs** | $200 | $400 | $400 |
| **Annual Benefit** | $1,200 | $1,000 | $1,200 |
| **Salvage Value** | $1,300 | $700 | $1,200 |

Solution

First order lowest initial investment to highest initial investment:

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Alt B** | **Alt C** | **Alt A** |
| **Initial Investment** | $3,000 | $4,000 | $5,000 |
| **O&M Costs** | $400 | $400 | $200 |
| **Annual Benefit** | $1,000 | $1,200 | $1,200 |
| **Salvage Value** | $700 | $1,200 | $1,300 |

 Check to see if IRR of B is > MARR

 NPVB = -3000 + 600(P/A, i, 5) + 700(P/F, i, 5)

 At MARR = 7%. NPVB = -3000 + 600(4.100) + 700(.7130) = -40.9

 Since NPV is negative, IRR < MARR. Go to next largest investment C.

NPVc = -4000 + 800(P/A, i, 5) + 1200(P/F, i, 5)

 At MARR = 7%. NPVC = -4000 + 800(4.100) + 1200(.7130) = 135.6

 Since NPV is positive, IRR > MARR. C is the defender.

|  |  |  |
| --- | --- | --- |
| **Alt A** | **Alt C** | **A-C** |
| $5,000 | $4,000 | $1,000 |
| $200 | $400 | -$200 |
| $1,200 | $1,200 | $ 0 |
| $1,300 | $1,200 | $100 |

 NPVA-C = -1000 + 200(P/A, i, 5) + 100(P/F, i, 5)

 Try MARR of 10%. NPVA-C = -1000 + 200(4.100) + 100(.7130) = -108.7

 Since NPV is negative, IRR < MARR. C is the best decision.

1. A person is considering investing in a startup company. There are 3 possible outcomes being considered. Probability of the company failing within 2 years is 60%.The probability the company continues to grow after 2 years is 30%. The third possibility (the one the investor is hoping for), is the company will be bought within 2 years giving the investor a large profit. Construct a probability distribution table showing each possible outcome and the probability for each outcome. (Chapter 10)

|  |  |
| --- | --- |
|   | **Prob** |
| **Failing** | 60% |
| **Grows** | 30% |
| **Sold** | 10% |

1. An investment in a new product has 4 possible annual benefits and 2 possible annual costs with the probabilities of each shown in the following table. Construct a joint probability distribution table of benefits – costs. Which benefit – cost is most likely? Which is the highest benefit - cost. The lowest benefit - cost? What is the expected return (annual benefit – annual cost)? (Chapter 10)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Annual Benefits** | **Prob** |  | **Annual Costs** | **Prob** |
| $8,000 | 25% |  | $5,000 | 70% |
| $9,000 | 20% |  | $8,000 | 30% |
| $10,000 | 45% |  |  |  |
| $15,000 | 10% |  |  |  |

 Solution

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Annual Benefits** | **Prob** | **Annual Costs** | **Prob** | **Benefits - Costs** | **Joint Prob** | **Expected Value** |
| $8,000 | 25% | $5,000 | 70% | $3,000 | 17.5% | $525 |
| $9,000 | 20% | $5,000 | 70% | $4,000 | 14% | $560 |
| $10,000 | 45% | $5,000 | 70% | $5,000 | 31.5% | $1,575 |
| $15,000 | 10% | $5,000 | 70% | $10,000 | 7% | $700 |
| $8,000 | 25% | $8,000 | 30% | $0 | 7.5% | $0 |
| $9,000 | 20% | $8,000 | 30% | $1,000 | 6% | $60 |
| $10,000 | 45% | $8,000 | 30% | $2,000 | 13.5% | $270 |
| $15,000 | 10% | $8,000 | 30% | $7,000 | 3% | $210 |
|  |  |  |  |  | **Expected Return =**  | **$3,900** |

 Expected return is sum of (Benefits – costs)\* probability = $3900

1. An investment of 4 possible returns after 3 years as shown in the following table. What is the expected value of the return? Should the investment be made? (Chapter 10)

|  |  |
| --- | --- |
| **Return** | **Prob** |
| -$-6,000 | 10% |
| $0 | 35% |
| $1000 | 35% |
| $2000 | 20% |

 Solution:

|  |  |  |
| --- | --- | --- |
| **Return** | **Prob** |  |
| -$ 6,000 | 10% | -$600 |
| $0 | 35% | $0 |
| $1000 | 35% | $350 |
| $2,000 | 20% | $400 |
|  | 100% | $150 |

Investment should be made.