PROBLEM SET 3

6.2 a. Payback period = 6 + {1,000,000 – ($150,000*6)} / $150,000 = 6.67 years. Yes, the project should be adopted.

b. $\$150,000\ A^{11}_{0.10} = \$974,259$.
The discounted payback period = 11 + ($1,000,000 - $974,259) / ($1,50,000 / 1.1^{12}) = 11.54 years.

c. NPV = -$1,000,000 + $150,000 / 0.10 = $500,000

6.6 The IRR is the discount rate at which the NPV = 0.
$-\$3,000 + \$2,500 / (1 + IRR_A) + \$1,000 / (1 + IRR_A)^2 = 0$
By trial and error, $IRR_A = 12.87\%$
Since project B's cash flows are two times of those of project A,
the $IRR_B = IRR_A = 12.87\%$

6.7 a. IRR is 6.93%

b. Because the IRR of 6.93% is less than the discount rate of 8%, the project should not be adopted by CPC.

6.10 a. Project A:
$NPV = -\$5,000 + \$3,500 / (1 + r) + \$3,500 / (1 + r)^2 = 0$
IRR = r = 25.69%

Project B:
$NPV = -\$100,000 + \$65,000 / (1 + r) + \$65,000 / (1 + r)^2 = 0$
IRR = r = 19.43%

b. Choose project A because it has higher IRR.

c. The difference in scale is ignored.

d. Apply the incremental IRR method

e.

	C_O	C_1	C_2
B – A	-$95,000	$61,500	$61,500

$NPV = -\$95,000 + \$61,500 / (1 + r) + \$61,500 / (1 + r)^2 = 0$
Incremental IRR = r = 19.09%

f. If the discount rate is less than 19.09%, choose project B.

Otherwise, choose project A

g. NPV_A = -\$5,000 + \$3,500 / 1.15 + \$3,500 / 1.15^2 = \$689.98
NPV_B = -\$100,000 + \$65,000 / 1.15 + \$65,000 / 1.15^2 = \$5,671.08
Choose project B.

6.11 a. PV_A = {\$5,000 / (0.12 – 0.04)} / 1.12^2 = \$49,824.61
PV_B = (-\$6000 / 0.12) / 1.12 = -\$44,642.86

b. The IRR for project C must solve

$$\{\$5,000 / (x - 0.04)\} / (1 + x)^2 + (-\$6,000 / x) / (1 + x) = 0$$
$$\$5,000 / (x - 0.04) - \$6,000 (1 + x) / x = 0$$
$$25 x^2 + 3.17x - 1 = 0$$
$$x = \{-3.17 - (110.0489)^{0.5}\} / 50 \text{ or } \{-3.17 + (110.0489)^{0.5}\} / 50$$

The relevant positive root is IRR = x = 0.1464 = 14.64%

c. To arrive at the appropriate decision rule, we must graph the NPV as a function of the discount rate. At a discount rate of 14.64%, the NPV is zero. To determine if the graph is upward or downward sloping, check the NPV at another discount rate. At a discount rate of 10%, the NPV is \$14,325.07 [= \$68,870.52 - \$54,545.54]. Thus, the graph of the NPV is downward sloping. From the discussion in the text, if an NPV graph is downward sloping, the project is an investing project. The correct decision rule for an investing project is to accept the project if the discount rate is below 14.64%.

6.12 a. Generally, the statement is false. If the cash flows of B occur early and the cash flows of project A occur late, then for a low discount rate the NPV of A can exceed the NPV of B. Examples are easy to construct.

	C_0	C_1	C_2	IRR	NPV@ 0%
A:	-\$1,000,000	\$0	\$1,440,000	0.20	\$440,000
B:	-2,000,000	2,400,000	0	0.20	400,000

In one particular case, the statement is true for equally risky projects. If the lives of the two projects are equal, and in every time period the cash flows of the project B are twice the cash flows of project A, then the NPV of project B will be twice as great as the NPV of project A for any discount rate between 0% and 20%.

6.18 Let project A represent New Sunday Early Edition; and let project B represent New Saturday Late Edition.

a. Payback period of project A = 2 + ($1,200 - $1,150) / $450 = 2.11 years.
   Payback period of project B = 2 + ($2,100 - $1,900) / $800 = 2.25 years.
   Based on the payback period rule, you should choose project A.

b. Project A:
   Average investment = ($1,200 + $0) / 2 = $600
   Depreciation = $400 / year
   Average income = [($600 - $400) + ($550 - $400) + ($450 - $400)] / 3
   = $133.33
   ARR = $133.33 / $600 = 22.22%

   Project B :
   Average investment = ($2,100 + $0) / 2 = $1,050
   Depreciation = $700 / year
   Average income = [($1,000 - $700) + ($900 - $700) + ($800 - $700)] / 3
   = $200
   ARR = $200 / $1,050 = 19.05%

c. IRR of project A :
   $-\$1,200 + \$600 / (1 + r) + \$550 / (1 + r)^2 + \$450 / (1 + r)^3 = 0$
   IRR = r = 16.76%

   IRR of project B :
   $-\$2,100 + \$1,000 / (1 + r) + \$900 / (1 + r)^2 + \$800 / (1 + r)^3 = 0$
   IRR = r = 14.29%

   Project A has greater IRR.

d. IRR of Project B – A:
   Incremental cash flows

Year	0	1	2	3
B – A	-$900	$400	$350	$350

   $-\$900 + \$400 / (1 + r) + \$350 / (1 + r)^2 + \$350 / (1 + r)^3 = 0$
   Incremental IRR = r = 11.02%

   If the required rate of return is greater than 11.02%, then choose Project A
   If the required rate of return is less than 11.02%, then choose Project B.

6.19 Let project A be Deepwater Fishing; let project B be New Submarine Ride.

a. Project A:

Year	Discounted CF	Cumulative CF
0	-$600,000	-$600,000
1	234,783	-365,217
2	264,650	-100,567
3	197,255	

Discounted payback period of project A = 2 + $100,567 / $197,255
= 2.51 years.

Project B:

Year	Discounted CF	Cumulative CF
0	-$1,800,000	-$1,800,000
1	869,565	-930,435
2	529,301	-401,134
3	591,765	

Discounted Payback period of project B = + $401,134 / $591,765
= 2.68 years

Project A should be chosen.

b. IRR of project A :

$-\$600{,}000 + \$270{,}000 / (1 + r) + \$350{,}000 / (1 + r)^2 + \$300{,}000 / (1 + r)^3 = 0$

IRR = r = 24.30%

IRR of project B :

$-\$1{,}800{,}000 + \$1{,}000{,}000 / (1 + r) + \$7000{,}000 / (1 + r)^2 + \$900{,}000 / (1 + r)^3 = 0$

IRR = r = 21.46%

Based on the IRR rule, project A should be chosen since it has greater IRR

c. Incremental IRR:

Year	0	1	2	3
B – A	-$1,200,00	730,000	$350,000	$600,000

$-\$1,200,000 + \$730,000 / (1 + r) + \$350,000 / (1 + r)^2 + \$600,000 / (1 + r)^3 = 0$
Incremental IRR = r = 19.92%.

Since the incremental IRR is greater than the required rate of return, 15%, choose project B.

d. $NPV_A = -\$600,000 + \$270,000 / 1.15 + \$350,000 / 1.15^2 + \$300,000 / 1.15^3$
$= \$96,687.76.$
$NPV_B = -\$1,800,000 + \$1,000,000 / 1.15 + \$700,000 / 1.15^2 + \$900,000 / 1.15^3$
$= \$190,630.39$

Since $NPV_B > NPV_A$, choose project B.
Yes, the NPV rule is consistent with the IRR rule.