Name:

Student number:

Section:

Date:

AP/ADMS 4540 Financial Management
Summer 2014

Mid-term Exam for All Sections A, B, C, D

Time Limit: 2 hours

Instructions: Answer all 6 questions of this exam in the spaces provided on the question sheets. (If necessary, you may write on the back of the sheet). Any resemblance to actual or TV characters is purely coincidental and although the stories may appear "plausibly real", they are fictitious. You have 2 hours to work. The marks for each question are given. Please provide the marker with the greatest opportunity to give you credit by showing all calculations clearly. Answers without clear calculations will be penalized. Only normal writing instruments, a calculator and one 8.5"x11" or letter-size page list of hand-written formulas may be used to write this test. <u>This formula sheet must be submitted with the test; otherwise you will automatically receive a mark of zero (0).</u>

Question 1 – Duration (11 points)

1a. You are thinking about investing in some bonds. Your financial advisor presents to you a $1,000 face value 3 year semi-annual bond A with 8% coupon per annum and a yield to maturity of 8%. What is the **annualized** Macaulay duration of the bond? **(5 points)**

<u>**Solution**</u>

T	PMT	PV	RV=PV/Bond Price	WV=RV*t
1	40.00	38.4615	0.038462	0.038462
2	40.00	36.9822	0.036982	0.073964
3	40.00	35.5599	0.035560	0.106680
4	40.00	34.1922	0.034192	0.136769
5	40.00	32.8771	0.032877	0.164385
6	1,040.00	821.9271	0.821927	4.931563
		1,000.0000	1.000000	5.451822

(4 points)
Semi-annual duration = 5.451822 semi-annual periods
Annualized duration = 5.451822/2 = 2.725911 years **(1 point)**

<u>**OR**</u>

$$\text{Macaulay duration} = \frac{\sum_{t=1}^{n} \frac{tC}{(1+y)^t} + \frac{nM}{(1+y)^n}}{P}$$

Because yield to maturity equals to coupon rate, the market price of bond B is $1,000.

Semi-annual duration = $(1\times40/1.04 + 2\times40/1.04^2 + 3\times40/1.04^3 + 4\times40/1.04^4 + 5\times40/1.04^5 + 6\times40/1.04^6 + 6\times1{,}000/1.04^6)/1{,}000$ = 5.451822 semi-annual periods **(4 points)**

Annualized duration = 5.451822/2 = 2.725911 years **(1 point)**

<u>**OR**</u>

$$\text{Par Value Bond Duration} = \frac{1+\text{YTM}/2}{\text{YTM}}\left[1-\frac{1}{(1+\text{YTM}/2)^{2M}}\right]$$

Annualized duration = 2.7259 years **(5 points)**

1b. Bond B has the following characteristics:

Par Value	$1,000
Life	5 years
Coupon rate (annual coupons)	10 %
Yield to maturity	12 %
Market Price	$927.90
Macaulay duration	4.135462 years

When the yield to maturity falls by 40 basis points, calculate the new price of bond B using modified duration or volatility. **(4 points)**

Solution
Volatility = v = −D/(1+r) = −4.135462/1.12 = −3.692377% **(1 point)**
Price change=3.692377% × 0.4 × 927.90 = $13.70 **(2 points)**
New price = 927.90 +13.70 = $941.61 **(1 point)**

OR
Volatility = v = −D/(1+r) = −4.135462/1.12 = −3.692377% **(1 point)**
New Price = (100% + 3.692377%× 0.4) × 927.90 = $941.61 **(3 points)**

1c. It is expected that the Bank of Canada's recent policy moves are going to push interest rates up. You are considering keeping only one of the four annual coupon bonds in your portfolio. You know that bond C has duration of 4.3328 years, bond D has duration of 3.2056 years, bond E has 3.7812 years, and bond F has 4.0023 years. Which one of the four bonds should you keep and why? **(2 points)**

Solution
Because interest rates are expected to go up and bond prices are expected to go down, you should hold on to the bond with the shortest duration. **(1 point)**
In this case, that would be Bond D. **(1 point)**

Question 2 – Bond Refunding (15 points)
Korean Petroleum Corporation (KPC) is considering whether to refund an old issue of $60 million, 8 percent annual coupon, 10-year bonds that were sold 6 years ago. A new issue of $70 million, 4-year bonds can be sold with an annual coupon rate of 4 percent. A call premium of 10 percent will be required to retire the old bonds and floatation costs of $3.2 million will apply to the new issue. The tax rate applicable is 30 percent and KPC expects that there will be a two-month overlap during which any funds can be invested in T-bills yielding 1.5 percent. The additional $10 million from the new bond issue could be invested in a 4-year project with an expected NPV of $2.1 million. Should KPC refund the old issue of $60 million bonds? Note: Show all four working steps clearly.

Solution

Step 1: Find appropriate after tax discount rate r. r = (1-0.30) × 4% = 2.8% **(2 points)**

Step 2: Find costs of refunding.
Call premium costs = 10% × 60m =$6,000,000
Net Flotation Costs:
Flotation costs = $ 3,200,000
PV of future tax savings = (3,200,000/4yrs) ×0.3×PVIFA (4yrs, 2.8%) =$896,387 **(2 points)**
Net Flotation Costs = 3,200,000 – 896,387 = $2,303,613 **(1 point)**
Net Additional Interest
After tax additional interest paid on old bonds = (1-0.3) ×8%×2/12×60m = $560,000
After tax additional interest received on T-bills = (1-0.3) ×1.5%×2/12×70m = $122,500
Net Additional Interest = 560,000 - 122,500 = $437,500 **(2 points)**
Total costs of refunding = Call premium costs + Net Flotation Costs + Net Additional Interest
= 6,000,000 + 2,303, 613 + 437,500 = $8,741,113 **(2 points)**

Step 3: Find benefits of refunding
Yearly interest savings = (60m x 8%) – (70m x 4%) =$2,000,000 **(2 points)**
After-tax PV of yearly savings = 2,000,000×(1-0.3)×PVIFA(4 yrs,2.8%) = $5,228,923 **(2 points)**

Step 4: Find NPV of refunding
NPV = Total Benefits - Total Costs = After-tax PV of yearly savings + NPV of additional funds from refunding invested in new project - total costs of refunding = 5,228,923 + 2,100,000 – 8,741,113 = ($1,412,190) **(1point)**

Since NPV < 0, KPC should not refund the old issue of $60m bonds. **(1 point)**

Question3 – ODA (15 points)

Canada is one of 24 donor countries that are members of the Organization for Economic Co-operation and Development's (OECD) Development Assistance Committee (DAC). Bilateral aid programs account for just over half of Canada's overall assistance money – 53 percent, or roughly $1.5 billion. Afghanistan is one of the official development assistance (ODA) recipients of Canada, and Canada has been involved in Afghanistan for decades. Suppose that the government of Canada was considering a loan of $20 million for Afghanistan. To qualify as official development assistance, development loans must have a grant element of at least 25 percent, calculated using a stated annual interest rate of 10 percent. During the grace period of 5 years only interest would be paid **semi-annually**. After that the loan has to be amortized in 12 years with 24 **semi-annual payments**. This loan would charge interest at a stated annual rate of 7 percent.

3a. Determine whether or not this loan would be qualified as ODA. **(7 points)**
3b. Calculate the maximum interest rate that could be charged for this loan to qualify as ODA? Show all working steps clearly. **(8 points)**

Solution
3a. Status of the loan:
Grace Period:
Payment during grace period = ($20,000,000 x 7%)/2 = $700,000 **(1 point)**
PV of the payments at time 0 = $700,000 x PVIFA(5%, 10) = $ 5,405,214 **(1 point)**
Amortization Period:
Payment to amortize the loan with 24 payments = ($20,000,000)/PVIFA(3.5%, 24)
= $ 1,245,456 **(1 point)**
PV of these CFs at the end of year 5 = $ 1,245,456 x PVIFA(5%, 24) = $17,185,610 **(1 point)**
PV of $17,185,610 at time 0 = ($17,185,610)/ $(1+.05)^{10}$ = $10,550,473 **(1 point)**
Calculation of GE:
Total PV = $ 5,405,214 + $10,550,473=$15,955,687
Grant element = ($20,000,000 - $15,955,687)/ $20,000,000 = 20.2216% **(1 point)**
Since the grant element is less than 25%, this loan would not be qualified as ODA. **(1 point)**

3b. Maximum Interest Rate:
Since, at 7% the loan is not qualified, the interest should be lower than 7%. **(1 point)**
Say the interest rate = 6%
Grace Period:
Payment during grace period = ($20,000,000 x 6%)/2 = $600,000
PV of the payments at time 0 = $600,000 x PVIFA(5%, 10) = $ 4,633,040 **(1 point)**
Amortization Period:
Payment to amortize the loan with 24 payments = ($20,000,000)/PVIFA(3%, 24)
= $ 1,180,948 **(1 point)**
PV of these CFs at the end of year 5 = $ 1,180,948x PVIFA(5%, 24) = $16,295,478 **(1 point)**
PV of $17,185,610 at time 0 = ($16,295,478)/ $(1+.05)^{10}$ = $10,004,010 **(1 point)**
Calculation of GE:
Total PV = $ 4,633,040+ $10,004,013=$14,637,053
Grant element = ($20,000,000 - $14,637,053)/ $20,000,000 = 26.8147%
Since the grant element is more than 25%, this loan would be qualified as ODA. **(1 point)**

OR

Using Interpolation:

Interest Rate	PV of total payments
6%	$14,637,053
r	20m*75%= $ 15,000,000
7%	$15,955,687

(r – 7%)/(6% - 7%) = (15,000,000 – 15,955,687) / (14,637,053 – 15,955,687)

r = 6.2752 %, the maximum interest to qualify the loan as ODA. (**2 Points)**

Using Interpolation:

Interest Rate	Grant Element
6%	26.8147%
r	25%
7%	20.2216%

(r – 7%)/(6% - 7%) = (25% – 20.2216%) / (26.8147%– 20.2216%)

r = 6.2752 %, the maximum interest to qualify the loan as ODA. (**2 Points**)

Question 4 – Canadian Tradition/APT (15 points)

4a. Assume portfolio returns in the BRIC markets can be described by a 2-factor model with intercept (3 factors including intercept). You are asked to determine the equation that describes the equilibrium returns for the following portfolios in the BRIC markets. You want the weights to be greater than or equal to zero. (**8 Points**)

Portfolio	Expected Return (%)	$\beta i1$	$\beta i2$
A	16.2	1.4	0.8
B	20.9	1.8	1.1
C	29.3	2.6	1.5

4b. Construct a portfolio D with $\beta D1 = 2.36$. The weights need to be greater than or equal to 0. What is the equilibrium return on portfolio D? What is the sensitivity of portfolio D to factor 2? (**4 Points**)

4c. Suppose there is another portfolio E with the following characteristics: Actual Return =12.74 %; $\beta E1 = 0.85$ and $\beta E2 = 0.67$. Would you recommend investment in portfolio E? Why? Show all the working steps clearly. (**3 Points**)

Solution

4a.

$0.162 = \lambda 0 + 1.4\,\lambda 1 + 0.8\,\lambda 2$ (1)
$0.209 = \lambda 0 + 1.8\,\lambda 1 + 1.1\,\lambda 2$ (2)
$0.293 = \lambda 0 + 2.6\,\lambda 1 + 1.5\,\lambda 2$ (3) **(1 point)**

(2) - (1): $0.047 = 0.4\,\lambda 1 + 0.3\,\lambda 2$ (4)
(3) - (1): $0.131 = 1.2\,\lambda 1 + 0.7\,\lambda 2$ (5)

(4) × 3 – (5): $0.01 = 0.2\lambda 2$ which implies that $\lambda 2 = 0.05$ **(2 point)**
Substituting $\lambda 2 = 0.05$ into (4) yields:
$0.047 = 0.4\,\lambda 1 + 0.3 \times 0.05$
$0.032 = 0.4\,\lambda 1$ which implies that $\lambda 1 = 0.08$ **(2 point)**
Substituting $\lambda 1 = 0.08$ and $\lambda 2 = 0.05$ into (1) yields:
$0.162 = \lambda 0 + 1.4 \times 0.08 + 0.8 \times 0.05$ which implies that $\lambda 0 = 0.01$ **(2 point)**
Therefore, the equation for APT is $E(ri) = 0.01 + 0.08\beta i1 + 0.05\beta i2$ **(1 point)**

4b.

Let the proportion of portfolio B in the portfolio D $= W_B$
The proportion of portfolio C in the portfolio D $= W_C$
$W_B + W_C = 1$ $1.8 \times W_B + 2.6 \times W_C = 2.36$ **(1 point)**
$1.8 \times W_B + 2.6 \times (1 - W_B) = 2.36$ which yields that $W_B = 0.3$ and $Wc = 0.7$ **(1 point)**
The equilibrium return on portfolio D = 0.3 × 20.9% + 0.7 × 29.3% =26.78% **(1 point)**
$\beta D2 = 0.3 \times 1.1 + 0.7 \times 1.5 = 1.38$ **(1 point)**

4c.

$E(ri) = 0.01 + 0.08\beta i1 + 0.05\beta i2$
$E(r_E) = 0.01 + 0.08 \times 0.85 + 0.05 \times 0.67 = 11.15\%$ **(1 point)**
Since the actual return is 12.74%, the portfolio E has overperformed. So portfolio E is underpriced and should be recommended. **(2 points)**

Question 5 – Risk and Return (24 points)

The following parts of the question are NOT related.

5a. You are a stock analyst in charge of valuing mining firms, and you are expected to come out with buy-sell recommendations for your clients. You are currently analyzing the Latin American Minerals Corporation (LAM). The firm is not currently profitable even though you believe it will be in the future. Your projections are that the firm will pay no dividends for the next four years. Five years from now, you expect the firm will pay its first dividend of $2 per share. You expect dividends to increase at a rate of 25 percent per year for the next ten years after that. At that point, the industry will start to mature and slow down; dividends will continue to grow but only at a rate of 7.5 percent per year thereafter.

LAM stock is currently trading at $20.15 per share. If you believe that the required rate of return on a stock of this type is 18 percent, what is your estimate of the value of the stock, and should you issue a recommendation to buy or to sell? **(6 points)**

Solution

Calculate the value of the stock at the end of year 5, just after the first dividend was paid. This is from the two-stage growth model, but we are at year 5 instead of year 0.

P_5 = [$2(1.25)/ (0.18 – 0.25)] [1 – $(1.25/1.18)^{10}$]
+ $[(1 + 0.25)/ (1 + 0.18)]^{10}$[$2(1.075)/(0.18 – 0.075)]
= $64.27 **(3 points)**

Now bring this back to year 0, remembering to include D_5

$P_0 = [D_5 + P_5]/ (1.18)^5$ = [$2 + 64.27]/ $(1.18)^5$ = $28.97 **(2 points)**

The stock should be worth $28.97, which is much higher than the current price of $20.15. It is underpriced. Recommendation: Buy. **(1 point)**

OR

$$P_0 = \frac{P_t}{(1+r)^t} + D_1[\frac{1-(\frac{1+g}{1+r})^t}{r-g}]$$

$P_0 = [2(1.25)^{10}(1.075)/(0.18-0.075)]/(1.18)^{15}$
$+ 2.50[1-(1.25/1.18)^{10}/(0.18-0.25)]/(1.18)^5 + 2/(1.18)^5$
= 15.9265 + 12.1677 + 0.8742
= $28.97 **(5 points)**

The stock should be worth $28.97, which is much higher than the current price of $20.15. It is underpriced. Recommendation: Buy. **(1 point)**

5b. You are provided with the following table which gives some characteristics of two risky assets – stock fund and bond fund. Also shown are weights in the market portfolio P, which is assumed to be mean variance efficient, i.e., it provides the highest expected return for its level of variance

Risky Asset	Weight in Market Portfolio P	Expected Return	Standard Deviation	Correlation with Stock fund	Correlation with Bond fund
Stock fund	0.75	?	0.36	1.00	-0.80
Bond fund	0.25	?	0.18	-0.80	1.00

If the expected return on the market portfolio P, E(rp) is equal to 16 percent, what are the expected returns on stocks and bonds? Assume the T-bills rate is equal to 4 percent. Show all calculations clearly. **(7 points)**

Solution

P is the market portfolio and therefore a tangency portfolio. E(rs) = rf + [E(rp) – rf] βsp, where

$$\beta_{sp} = \frac{Cov(s,p)}{\sigma_p^2} = \frac{\sigma_{sp}}{\sigma_p^2}$$

and [E(rp) – rf] is the tangent portfolio's expected excess return.

As we are given E(rp) = 16% and rf = 4%, we just need to calculate the covariance (cov (s,p)) and variance σ_p^2 to get E(rs).

The covariance is:

cov (rs, rp)= cov (rs, wsrs + wbrb) = cov (rs,wsrs) + cov (rs,wbrb)

cov (rs, rp) = cov (rs, 0.75 rs + 0.25rb) = cov (rs , 0.75rs) + cov (rb , 0.25 rb)
= 0.75cov (rs, rs) + 0.25cov(rs, rb)
= 0.75 var(rs) + 0.25cov (rs, rb)
= $0.75 (0.36)^2$ + 0.25 (0.36)(0.18)(-0.8) = 0.0972 - 0.0130 = 0.0842 **(2 points)**

The variance is:

$\sigma_P^2 = (w_B\sigma_B)^2 + (w_S\sigma_S)^2 + 2(w_B\sigma_B)(w_S\sigma_S)\rho_{BS}$
= $(0.25 * 0.18)^2 + (0.75 * 0.36)^2$ + 2(0.25 * 0.18) (0.75 * 0.36)-0.8
= 0.0020 + 0.0729 - 0.0194 = 0.0555 (**2 points**)

βsp = 0.0842/0.0555 =1.5171 (**1 point**)

E(rs) = rf + [E(rp) – rf] βsp = 4% + (16% - 4%) * 1.5171 = 22.2052% **(1 point)**

Since $0.75E(r_s) + 0.25E(r_b) = E(r_p)$, we have 0.75(22.2052%) + 0.25E(rb) = 16%, which yields $E(r_b)$ = -2.6156% **(1 point)**

5c. You are provided with the following information.

Economic Growth	Probability of Growth	Return If Growth Occurs (%)	
		Stock X	Stock Y
Strong	0.60	30	55
Poor	?	-15	-30

(i) Calculate the expected return and standard deviation of the returns on each stock. **(4 points)**

(ii) What are the direction and strength of the relationship between expected return on Stock X and the expected return on Stock Y? You must support your answer with the calculation of the appropriate statistical measures. **(3 points)**

Solution

(i) $E(_{rx}) = (0.6*30\%) + (0.4*-15\%) = 12\%$ **(1 point)**
$E(_{ry}) = (0.6*55\%) + (0.4*-30\%) = 21\%$ **(1 point)**
$\sigma^2(_{rx}) = [(0.6)*(0.30-0.12)^2 + (0.4)*(-0.15-0.12)^2 = 0.0486$
$\sigma(_{rx}) = (0.0486)^{½} = 0.2204$ or 22.04% **(1 point)**
$\sigma^2(_{ry}) = [(0.6)*(0.55-0.21)^2 + (0.4)*(-0.30-0.21)^2 = 0.1734$
$\sigma(_{ry}) = (0.1734)^{½} = 0.4165$ or 41.65% **(1 point)**

(ii) $cov(_{rx,\ ry}) = 0.6(0.18*0.34) + 0.4(-0.27*-0.51) = 0.0918$ **(1 point)**
$corr(_{rx,\ ry}) = 0.0918/(0.2204*0.4165) = 1.00$ **(1 point)**
A correlation of +1 implies a perfect positive relationship **(1 point)**

5d. There are many stocks in the market and Stocks A and B are characterized as follows:

Stock	Expected Return	Standard Deviation	Correlation with Stock A	Correlation with Stock B
A	10%	6%	1.00	−1.00
B	18%	14%	−1.00	1.00

If there is no arbitrage opportunity, what will be the value of the risk free rate? Note: *You must show working steps from the equation for portfolio variance to receive full credit.* **(4 Points)**

Solution

$\sigma_P^2=(w_A\sigma_A)^2+ (w_B\sigma_B)^2 +2\, w_A\sigma_A\, w_B\sigma_B\, \rho_{A,B}$

$0=(w_A\sigma_A)^2+ (w_B\sigma_B)^2 -2\, w_A\sigma_A\, w_B\sigma_B =(w_A\sigma_A - w_B\sigma_B)^2$

$w_A\sigma_A - w_B\sigma_B = 0$

$w_A + w_B = 1 \Rightarrow w_B = 1 - w_A$

$w_A\sigma_A - (1 - w_A)\, \sigma_B = 0 \qquad \Rightarrow w_A = \sigma_B / (\sigma_A + \sigma_B) = 14\%/(6\% + 14\%) =0.7$ **(2 points)**

The expected rate of return on this risk-free portfolio is:
$E(r_p) = 0.7 \times 10\% + (1\text{-}0.7) \times 18\% = 12.4\%$

If there is no arbitrage opportunity, the risk free rate will be 12.4%. **(2 points)**

Question 6 – Capital Budgeting (20 points)

6a. Matin Patwa is evaluating two different kinds of water heating systems. The WH 20XC costs $290,000, has a three-year life, and has pre-tax operating costs of $67,000 per year. The WH 30XD costs $510,000, has a five-year life, and has pre-tax operating costs of $35,000 per year. Both systems are in a class with CCA rate of 20 percent per year. Though the systems vary greatly in price, Patwa is expecting a salvage value of $40,000 for both of the systems. If the tax rate is 35 percent and Patwa's firm uses a discount rate of 10 percent, compute the EAC for both systems. Which system Patwa should prefer and why? **(11 Points)**

Solution
EAC for the systems:
Both cases: salvage value = $40,000

WH 20XC:
PV of after-tax operating costs = $67,000(1 – 0.35) (PVIFA10%,3) = $43,550(PVIFA10%,3)
= $108,302.40 (**1 Point**)
PV of S=40,000/1.10^3= $30,052.59 (**1 Point**)
PVCCATS = (290,000)(.35)(.20)(1.05)/[(.10 + .20)(1.10)]
– {[(40,000)(0.20)(0.35)/[0.10 + 0.20]] (1/1.10)^3}= $57,578.64 (1 **Point**)
PV(Costs) = -$290,000 –$108,302.40 + $30,052.59 + $57,578.64 = -$310,671.17 (**1 Point**)
EAC = -$310,671.17/ (PVIFA10%,3) = -$124,925.48 (**1 Point**)

WH 30XD:
PV of after-tax operating costs = $35,000(1 – 0.35) (PVIFA10%,5)= $22,750(PVIFA10%,5)
=$86,240.40 (**1 Point**)
PV of S=40,000/1.10^5= $24,836.85 (**1 Point**)
PVCCATS = (510,000)(.35)(.20)(1.05)/[(.10 + .20)(1.10)]
– {[(40,000)(0.20)(0.35)/[0.10 + 0.20]] (1/1.10)^5}= $107,795.64 (1 **Point**)
PV(Costs) = -$510,000 – $86,861.32 + $24,836.85 + 107,795.64 = -$463,607.90 (**1 Point**)
EAC = -$463,607.90/ (PVIFA10%,5) = -$122,298.60 (**1 Point**)

Decision: The two systems have unequal lives, so they can only be compared by expressing both on an equivalent annual basis which is what the EAC method does. Thus, Patwa should prefer the WH 30XD because it has the lower annual cost. (**1 Point**)

6b. Ian and Eric made a lot of money in Beijing and London and are looking for an investment opportunity. After they paid $6,450 to a marketing research firm to conduct research, they were interested in the idea of building a signature swim spa in Toronto.

An old Toronto retail building purchased a few years ago could be converted into the swim spa. The retail equipment was purchased four years ago, with a capital cost of $240,000. When purchased, the retail equipment was expected to last ten years with a salvage value of $28,000. Necessary equipment for the spa will cost $365,000, including installation costs. The new equipment is expected to last six years along with a salvage value of $107,000. The new business is expected to generate annual pre-tax revenues of $185,500 accompanied by annual pre-tax costs of $85,500 for six years. The old retail equipment could be sold for $110,000 at present. Both the old and new equipment fall into CCA asset class 8 and they follow the CRA requirement of using the declining balance method at a CCA rate of 20 percent. For simplicity, changes in net working capital will be ignored. Ian and Eric's weighted average cost of capital is 12% taking into account all opportunity costs. The corporate tax rate is 40%. Would you recommend Ian and Eric to open the signature swim spa on the basis of **NPV**? **(9 Points)**

Solution
The consulting fee $6,450 is sunk cost and therefore it shouldn't be taken into consideration the calculation of NPV.

Net addition to CCA asset pool = C = 365,000 – 110,000 = $255,000 **(2 points)**
Net salvage value in six years = S = 107,000 – 28,000 = $79,000 **(2 points)**

PV of S = = $40,024 **(1 point)**
PV of CCATS = $\frac{255{,}000 \times 0.2 \times 0.40}{(0.2+0.12)} \times \frac{(1+0.12/2)}{(1+0.12)} - \frac{79{,}000 \times 0.2 \times 0.40}{(0.2+0.12)} \times \frac{1}{1.12^6}$
= 60,335 – 10,006 = $50,329 **(1 point)**
PV of after-tax profits = (1– 0.40) × (185,500 – 85,500) × PVIFA (12%, 6)
= (1– 0.40) × (185,500 – 85,500) × 4.11141 = $246,684 **(1 point)**

NPV = – C + PV of S + PV of CCATS + PV of annual after-tax profits
= –255,000 + 40,024 + 50,329 + 246,684 = $ 82,037 **(1 point)**

On the basis of NPV, Ian and Eric should open a signature swim spa. **(1 point)**