

**RE 618/890 – Real Estate Investment Analysis
Fall 2001**

Final Exam – Suggested Solutions

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T-Th 8:00-9:15*

This exam is due into the FREDS department office no later than close of business, Monday December 10. As usual, I've tried to eliminate any ambiguity about how to interpret the questions on the exam. Nevertheless, if you make any assumptions not explicitly stated in the questions make sure you write them down so I can see what you are doing. Similarly, tell me what keystrokes you are entering into your calculator.

Note that on some problems I've given you more information than you need. Don't simply incorporate a figure into your analysis just because I've given it to you. Your job is to figure out which information is relevant and use only that. Because this is a take-home exam, please take advantage of your opportunity to present your answers in a clear, concise format. Typing your answers would be nice, but is not required. The easier it is for me to understand what you've done, the more likely I am to give partial credit for incorrect answers. Please read over the entire exam before you begin. This will help you organize your presentation and avoid doing unnecessary work.

Although this is a take-home exam, I expect your work on this to be entirely your own. You may use your textbook, class notes, and other sources in completing the exam, but you may not consult with other people (other than me).

Finally, I would like you to **print out and hand in** a hard copy of any spreadsheets you use, and also to **e-mail** me a copy of your spreadsheet files. Thus, if in doing a sensitivity analysis you consider three different scenarios, please print a copy of the spreadsheet for each scenario, clearly labeling which is which. Remember, make your spreadsheets clear and readable if you want full credit for your answers. The electronic copy will only be used to help me figure out what you've done if I can't decipher it from the printed version. Thus, I would appreciate both a hard copy and an electronic copy of your spreadsheets.

- 1) You are the general partner for WU-Shock Investments Group, a limited partnership that invests in real estate in the Wichita area. You would like to expand your holdings and have narrowed your search to the following two investments.

Office/Warehouse (Light Industrial) Property – The first property is a Class A office/warehouse building in Southwest Wichita. This building has 30,400 square feet gross leasable area (gla). The current owner is asking \$1,200,000, but you believe you will be able to purchase the property for \$1,125,000.

The building is currently leased to a highly-creditworthy tenant at \$4.20 per square foot (psf), triple net. There are 4 years remaining on the term of the lease, at which time you expect to be able to re-sign the current tenant to a new 10-year lease at \$4.40 psf, triple net.

The Sedgwick County Appraiser's office currently has the property appraised at \$505,540, of which \$104,600 is attributable to the land. According to the Appraiser's Office, the total property tax bill for this property was \$17,109 last year. Property taxes in Wichita are expected to increase by about 4% per year for the indefinite future.

Last year, electric, gas, water, sewer, and trash bills for the property totaled approximately \$25,000, while general repairs and maintenance ran about \$10,000. These costs are expected to increase by the general inflation rate each year.

You believe you can obtain 10-year balloon loan on this property with a 7.375% interest rate, monthly payments, a 25-year amortization schedule, and 1.25 points. The lender's maximum loan amount is limited to a maximum 75% LTV ratio and a minimum 1.2 DCR (calculated incorporating a 7.5% vacancy allowance and a 10% operating expense ratio).

The market cap rate for light industrial properties like this in Southwest Wichita is currently 12%, as it has been for the last several years. You expect this continue into the indefinite future.

Downtown Office Building – The second property is a 35,000 square foot Class B commercial office building downtown. It has 35,000 square feet gla, with 1,028 square feet currently vacant. The current asking price is \$1,300,000, and this seems to be a firm price.

The building has the following leases. A title company occupies 15,000 square feet at \$8.75 psf gross. Every other year, beginning with next year, the rent is scheduled to escalate by \$0.25 psf, and the lease is set to expire in 6 years.

An additional 7,500 square feet is being leased by a small law office at \$9.50 psf gross. This lease has 2 more years before it expires, at which time you expect to be able to increase the rent to \$10.50 psf.

The remaining leased space is occupied by sales office for \$8.50 psf gross. This office has struggled in recent years, and you do not expect it to renew its lease when it expires after next year. Given that the space this firm occupies is on the back side of the building, you believe that the current \$8.50 psf is the most you will be able to obtain from this space when you attempt to re-lease it.

The space currently vacant is retail space with street access, and the present owner has it listed at \$11.25 psf. Nevertheless, it has remained vacant for several years.

The Sedgwick County Appraiser's office currently has the property appraised at \$833,700, of which \$52,200 is attributable to the land. According to the Appraiser's Office, the total property tax bill for this property was \$25,833 last year. As mentioned above, property taxes in Wichita are expected to increase by about 4% per year for the indefinite future.

Last year, electric, gas, water, sewer, and trash bills for the property totaled approximately \$52,000, general repairs and maintenance ran about \$24,000, and security and cleaning for common areas ran \$28,400. These costs are expected to increase by the general inflation rate each year. In addition, you expect management expenses to run about 6% of effective gross income.

Financing for this property is obtainable through a 20-year, fixed-rate mortgage at 7.5% with monthly payments and 0.5 points. This lender requires an 80% LTV ratio and a 1.25 DCR (calculated incorporating a 15% vacancy allowance and assuming that management fees will be 10% of effective gross income).

The market cap rate for Class B office buildings in Downtown Wichita is currently 10%, as it has been for the last several years. You expect this continue into the indefinite future.

Other Information

Regardless of the project you choose, you expect total due diligence to cost about 4% of the purchase price, and your costs upon the sale of the property will be approximately 9% of the sale price.

Recently, actual inflation has been running about 2%, although current inflation expectations for the future are 2.75%.

Current market vacancy rates for different property types and locations in Wichita can be derived from the attached survey results from J.P. Weigand's Forecast 2001. Note that in this survey, CBD stands for "central business district," or the downtown area.

All of your investors are in the 35% marginal income tax bracket, and none have other passive income against which to offset losses. In addition, the appropriate capital gains tax rate is 20%, while the depreciation recapture rate is 25%.

For either property your expected holding period is 5 years. Any property purchased will be put into service on January 1 of next year and will be taken out of service on December 5, 2007.

Assignment

- a) Prepare a pro-forma operating statement for each of the properties above. Calculate the cap rate, the cash-on-cash return, the operating expense ratio, the debt-coverage ratio, the breakeven ratio, the gross income multiplier, and the net income multiplier for these properties.

Office/Warehouse Property:

See the accompanying spreadsheet RE618_2001Fall_FinalS_Problem1a.xls.

Net operating income in this spreadsheet is calculated using the current lease terms and the expected renewal rate. Because the tenant is a credit tenant and the lease is triple net, no operating expenses or vacancy allowances are included.

Based on the LTV ratio, the maximum loan is $\$1,125,000 \times 0.75 = 843,750$. The loan amount based on the DCR is calculated as follows:

PGI	\$127,680
<u>- V&C (7.5%)</u>	<u>9,576</u>
EGI	118,104
<u>- OE¹</u>	<u>11,810</u>
NOI	\$106,294

¹ This assumes the lender's required 10% management fees and a triple net lease on the building.

Thus, the maximum ADS = $\$106,294 / 1.2 = \$88,578$, and the maximum MDS = $\$7,382$. Entering PMT = $-\$7,382$, $N = 25 \times 12 = 300$, $I = 7.375\%$, and $FV = 0$ allows us to solve for $PV = \$1,010,016$. This is more than the maximum loan using the LTV ratio. Consequently, the maximum loan amount is $\$843,750$.

As shown on the accompanying spreadsheet, first-year NOI is expected to be $\$127,680$, reflecting the triple-net lease with a credit tenant.

- Cap rate = $\$127,680 / 1,125,000 = 11.35\%$.
- Cash-on-cash return = $(\$127,680 - \$74,002) / (\$1,125,000 - \$843,750) = \$53,678 / \$281,250 = 19.09\%$.
- OER = 0% .
- DCR = $\$127,680 / \$74,002 = 1.73$.
- BER = $(\$74,002 + 0) / \$127,680 = 57.96\%$.
- GIM = $\$1,125,000 / \$127,680 = 8.81$.
- NIM = $\$1,125,000 / \$127,680 = 8.81$.

Downtown Office Building

See the accompanying spreadsheet RE618_2001Fall_FinalS_Problem1b.xls.

Several points are worth noting about this spreadsheet. First, the Annual Property Operating Data worksheet presents the prior year operating data, with the vacancy rate including only the currently vacant retail space. In contrast, the Cash Flow Analysis Worksheet assumes an overall 15% vacancy rate (consistent with the Weigand survey for Class B office space in the Central Business District). Market vacancy rates are assumed here because the leases do not lock premier credit tenants into long term leases.

In addition, the Cash Flow Analysis Worksheet assumes that the retail space in the building will rent for $\$8.75$ psf. The $\$8.75$ figure was chosen as the city-wide average asking rent for Class B retail space in Wichita according to the Weigand survey.

Other rent rates are based on the expectations listed in the problem.

Property taxes were based on the prior year figure, escalated 4% per year as stated in the problem. Management fees are 6% of the calculated gross operating income. Inflation for other operating expenses was based on the 2.75% expected inflation rate, not recent historical figures.

Using the LTV ratio, the maximum loan is $\$1,300,000 \times 0.80 = 1,040,000$. To determine the maximum loan amount based on the lender's minimum DCR, use the prior year actual rent figures (including the retail space asking rate), a 15% vacancy rate, and actual prior year operating expenses (with the exception of the 10% management fee). Using these inputs, you can obtain the following NOI estimate:

PGI	\$311,577
<u>– V&C</u>	<u>46,737</u>
EGI	264,840
<u>– OE²</u>	<u>156,717</u>
NOI	\$108,123

Thus, the maximum ADS = $\$108,123 / 1.25 = \$86,498$, and the maximum MDS = $\$7,208$. Entering PMT = $-\$6,973$, $N = 20 \times 12 = 240$, $I = 7.50\%$, and $FV = 0$ allows us to solve for $PV = \$894,744$. Since this is lower than the $\$1,040,000$ calculate above, this is the loan amount used in the spreadsheet.

- Cap rate = $\$115,756 / 1,300,000 = 8.90\%$.
- Cash-on-cash return = $(\$115,756 - \$86,496) / (\$1,300,000 - \$894,744) = \$29,260 / \$405,256 = 7.22\%$.
- OER = $\$150,088 / \$265,843 = 56.46\%$.
- DCR = $\$115,756 / \$86,496 = 1.34$. Notice that this does not equal 1.25 because the lender assumed a 10% management fee, whereas the spreadsheet assumes a 6% management fee. In addition, the lender used prior year operating expense data, whereas this figure is calculated using year-1 projected expenses.
- BER = $(\$150,088 + \$86,496) / \$265,843 = 88.99\%$.
- GIM = $\$1,300,000 / \$312,757 = 4.16$.
- NIM = $\$1,300,000 / \$115,756 = 11.23$.

- b) For each property indicate whether it exhibits positive or negative leverage. What is the significance of this fact?

The office/warehouse property has a mortgage constant of $\$74,002 / \$843,750 = 0.08771$, compared to a cap rate of 11.53%. Thus, it exhibits positive leverage. This is also evidenced by the fact that the cash-on-cash return is higher than the cap rate, indicating that the loan serves to magnify the investor's expected return.

In contrast, the office property exhibits negative leverage (a mortgage constant of $\$86,496 / \$894,744 = 0.09667$ compared with a 8.90% cap rate). Once again, this can also be seen through the fact that the cash-on-cash return is lower than the cap rate.

- c) Now derive a five-year forecasted operating statement for each property. Make sure that you clearly identify how you calculated each input in your analysis.

See the accompanying spreadsheets. The explanations for the inputs are given above.

- d) Calculate the before- and after-tax equity reversion you expect from each property. Once again, clearly explain where your figures came from.

See the accompanying spreadsheets.

² Calculated as follows: $\$25,833 + \$24,000 + \$52,000 + \$28,400 + 0.10 \times \$264,840 = \$156,717$.

- e) For each property, determine an appropriate discount rate and calculate both the before-tax and after-tax net present values and internal rates of return.

For each property, I use the market cap rates to determine a discount rate.

Office/Warehouse Property:

First calculate the equity discount rate:

- Market cap rate = 12%.
- Expected growth rate = 2.75% - 1.5% = 1.25%.
- Property discount rate = 12% + 1.25% = 13.25%.
- Loan-to-value ratio = $\$843,750 / \$1,125,000 = 75\%$.
- Equity discount rate = $(13.25\% - 7.375\% \times 0.75) / (1 - 0.75) = 30.875\% \approx 31\%$.

At this discount rate the before-tax NPV is – \$144,341, while the after-tax NPV is – \$136,101. Based on this, it appears that if you could negotiate a purchase price of just under \$1 million, you could come close to obtaining your required 31% rate of return.

The before-tax IRR on this investment is 11.75%, while the after-tax IRR is 7.24%.

Downtown Office Building:

- Market cap rate = 10%.
- Expected growth rate = 2.75% - 1.5% = 1.25%.
- Property discount rate = 10% + 1.25% = 11.25%.
- Loan-to-value ratio = $\$894,744 / \$1,300,000 = 68.83\%$.
- Equity discount rate = $(11.25\% - 7.50\% \times 0.6883) / (1 - 0.6883) = 19.53\% \approx 19.5\%$.

At this discount rate the before-tax NPV is – \$301,280, while the after-tax NPV is – 252,170. Once again, a purchase price of around \$1 million would allow you to obtain your required return on your investment.

The before-tax IRR for this property is – 8.00%, while the after-tax IRR is – 6.76%.

One point worth noting is that in both cases the after-tax NPV is *higher* (less negative) than the before-tax NPV. This is because in both cases the sale is expected to generate a capital loss (e.g., the sale price will be lower than the adjusted basis at the time of the sale; indeed, the sale price is expected to be lower than the purchase price). Once again, this reflects the questionable desirability of the investments at the current prices.

- f) Partition the present values of the after-tax cash flows from operations and sale of each property. Which inputs have the greatest impact on the outcomes of the projects? Which are most likely to vary over the life of the project? Which are most likely to vary together?

- g) Using the information from part (f), determine likely scenarios for each project and conduct a sensitivity analysis. (In doing so, please print off a separate spreadsheet printout for each scenario you consider, but limit yourself to no more than 3 or 4 likely scenarios.) For each investment opportunity, present a range of possible outcomes.
- h) Finally, prepare a short memo for your limited partners making an investment recommendation and providing an explanation of your reasoning. Assume that you can invest in only one of the two projects, but remember that you may recommend you're your partnership invest in neither.
- 2) Harold Beemer will be a non-material participant the following real estate investment. The property under consideration is a commercial office building that can be purchased for \$1,000,000, inclusive of transaction costs. Seventy-five percent financing is available at a 9.5% interest rate on a 15-year term with a 25-year amortization schedule (monthly payments), and 2 points. Eighty percent of the property's value is in improvements.
- The property is expected to generate the following NOI for the next 5 years: \$60,000, \$88,000, \$100,000, \$112,000, and \$124,000. Harold will hold this property for 5 years, after which time he expects to sell it at a 10% cap rate based on projected year 6 NOI of \$130,000. His transaction costs at the time of sale are expected to be 6% of the sale price.
- Harold is in the 35% tax bracket and although he has substantial active and portfolio income, he has no other passive income with which to offset any losses. Assume that capital gains are taxed at 20%, and depreciation recapture is taxed at the 25% rate.
- a) Calculate Harold's before and after-tax cash flows for the next 5 years, including cash flows from operations and cash flows from the sale of the property. What are the before- and after-tax internal rates of return on this investment?
- See the spreadsheet RE618_2001Fall_FinalS_Problem2a.xls.
- b) Now suppose that Harold *is* a material participant in this investment. Re-do your analysis accounting for this change. How do the before- and after-tax IRRs change? Explain any difference between your answers here and in part a.
- See the spreadsheet RE618_2001Fall_FinalS_Problem2b.xls.
- Note that the before-tax IRR does not change between the two parts of the problem. This is because the only change is in whether Harold can use passive losses to shield active income. In part a, Harold may not use these losses to shield active income, whereas in part b he may. Thus, his after-tax IRR is higher in the latter case.

- 3) Suppose you've decided you would like to purchase Mr. Loveland's apartment complex, and have negotiated a purchase price of \$11,000,000. You have two different financing options to consider.

The first is a 75% LTV loan at 6.75% interest with 3 points, a 15-year term using a 20-year amortization schedule. The second is a 75% LTV loan with 7.125% interest, 1 point, and a 15-year term with a 30-year amortization schedule. Both loans have monthly payments.

- a) What is the effective borrowing cost of each assuming you hold the loan to term? Which is preferred?

Loan 1: First, solve for the monthly payment on the loan: $PV = \$8,250,000$, $N = 240$, $I = 6.75\% \Rightarrow PMT = -\$62,730$.

Next, calculate the balance due at the end of 15 years: $N = 180 \Rightarrow FV = -\$3,186,941$.

Finally, adjust the present value to account for the points paid and calculate the effective borrowing cost: $PV = \$8,250,000 \times 0.97 = \$8,002,500 \Rightarrow I = 7.16\%$.

Loan 2: First, solve for the monthly payment on the loan: $PV = \$8,250,000$, $N = 360$, $I = 7.125\% \Rightarrow PMT = -\$55,582$.

Next, calculate the balance due at the end of 15 years: $N = 180 \Rightarrow FV = -\$6,135,998$.

Finally, adjust the present value to account for the point paid and calculate the effective borrowing cost: $PV = \$8,250,000 \times 0.99 = \$8,167,500 \Rightarrow I = 7.24\%$.

Based on the effective borrowing cost of each, the first loan is preferred.

- b) What is the effective borrowing cost of each if you only hold the property for 5 years? In this case which is preferred?

Loan 1: With the information from part a entered into your calculator, calculate the balance due at the end of 5 years: $N = 60 \Rightarrow FV = -\$7,088,864$. Then calculate the effective borrowing cost given the three points paid for the loan: $PV = \$8,002,500 \Rightarrow I = 7.52\%$.

Loan 2: With the information from part a entered into your calculator, calculate the balance due at the end of 5 years: $N = 60 \Rightarrow FV = -\$7,776,141$. Then calculate the effective borrowing cost given the point paid for the loan: $PV = \$8,167,500 \Rightarrow I = 7.37\%$.

Based on the effective borrowing costs, the second loan is preferred when the holding period is only five years.

- 4) Margaret owns two properties in Kansas City. The first is a retail strip center with a fair market value of \$2.5 million (90% of the value is attributable to improvements), a \$1.25 million outstanding mortgage, and a \$900,000 tax basis. The second is an apartment complex worth \$3.2 million (75% of the value attributable to improvements) with a \$1.3 million outstanding mortgage and a \$1.2 million tax basis.

Margaret would like to exchange these properties with Andrew, who owns a commercial office building in Wichita worth \$7.3 million (80% of the value attributable to improvements), with an outstanding mortgage of \$4.5 million and a tax basis of \$3.75 million.

Both Margaret and Andrew are able to put up cash to balance the equities if necessary, and each will incur transaction costs equaling 8% of the fair market value of their current properties.

- a) For both Margaret and Andrew, calculate the realized, recognized, and deferred gains from this exchange.

First we balance the equities:

<u>Margaret Gives Up</u>		<u>Margaret Receives</u>	
Retail center	2,500,000	Office building	7,300,000
– Mortgage	1,250,000	– Mortgage	4,500,000
+ Apartment complex	3,200,000	Equity received	2,800,000
<u>– Mortgage</u>	<u>1,300,000</u>	<u>+ Cash boot received</u>	<u>350,000</u>
Equity given up	3,150,000	Total equity received	3,150,000

Calculate the net boot received for each party to the exchange:

<u>Boot Received by Margaret</u>		<u>Boot Received by Andrew</u>	
Cash boot received	350,000	Net mortgage relief	1,950,000
+ Net mortgage relief	– 0 –	– Cash boot paid	350,000
Total boot received	350,000	Net boot received	1,600,000
<u>– Transaction costs</u>	<u>456,000</u>	<u>– Transaction costs</u>	<u>584,000</u>
Recognized gain	– 0 –	Recognized gain	1,016,000

Next calculate the realized and deferred gain for each investor:

<u>Margaret’s Deferred Gain</u>		<u>Andrew’s Deferred Gain</u>	
Fair market value	5,700,000	Fair market value	7,300,000
– Basis	2,100,000	– Basis	3,750,000
<u>– Transaction costs</u>	<u>456,000</u>	<u>– Transaction costs</u>	<u>584,000</u>
Realized gain	3,144,000	Realized gain	2,966,000
<u>– Recognized gain</u>	<u>– 0 –</u>	<u>– Recognized gain</u>	<u>1,016,000</u>
Deferred gain	3,144,000	Deferred gain	1,950,000

- b) Calculate the substitute basis for each property.

First, note that Andrew has two properties, and his deferred gain must be allocated between the two. Since the retail center represents 43.86% of the fair market value of the properties he will receive (\$2.5 million ÷ \$5.7 million), we allocate \$855,270 of the deferred gain to the retail property.

<u>Margaret's Substitute Basis</u>		<u>Andrew's Substitute Bases</u>	
Fair market value	7,300,000	Retail property	2,500,000
– <u>Deferred gain</u>	<u>3,144,000</u>	– <u>Deferred gain</u>	<u>855,270</u>
Substitute basis	4,156,000	Substitute basis	1,644,730
		Apartment property	3,200,000
		– <u>Deferred gain</u>	<u>1,094,730</u>
		Substitute basis	2,105,270

- c) Calculate the depreciation allowance for each property during the first year of ownership, assuming that they will be placed in service during the month of April. What is the depreciation allowance for each property in subsequent years?

Commercial office building: The depreciable basis is $\$4,156,000 \times 0.80 = \$3,324,800$. In the first year the depreciation allowance will be $\$3,324,800 \times 0.01816 = \$60,378$. In future years the allowance will be $\$3,324,800 \times 0.02564 = \$85,248$.

Retail strip center: The depreciable basis for this property is $\$1,644,730 \times 0.90 = \$1,480,257$. In the first year the depreciation allowance will be $\$1,480,257 \times 0.01816 = \$26,881$. In future years the allowance will be $\$1,480,257 \times 0.02564 = \$38,131$.

Apartment property: The depreciable basis for this property is $\$2,105,270 \times 0.75 = \$1,578,953$. In the first year the depreciation allowance will be $\$1,578,953 \times 0.02576 = 40,674$ (note that this is a residential property). In subsequent years the depreciation allowance will be $\$1,578,953 \times 0.03636 = \$57,410$.

- 5) Damien is currently trying to sell an industrial building he owns in San Antonio. His current mortgage balance on this property is \$1.75 million, and his adjusted tax basis is \$1.25 million.

This week Damien's broker brought him two offers. The first is a cash offer for \$3 million. The second offer consists of \$750,000 cash, with the buyer assuming Damien's existing \$1.75 million mortgage, and asks Damien to carry a \$600,000 note with a 5-year term, 15-year amortization schedule, 8.5% interest, and monthly payments (and compounding).

Assume that Damien is in the 35% income tax bracket, capital gains are taxed at the 20% rate, and depreciation recapture is taxed at the 25% rate.

- a) What will the tax consequence be for Damien if he accepts the cash offer?

Note: This problem did not give you enough information, because it did not tell you the cumulative depreciation allowances Damien had taken. As a result, you cannot calculate the portion of the gain that is attributable depreciation recapture versus appreciation. To answer the problem, I will simply assume that all of the gain is due to appreciation.

Sale price	\$3,000,000
– Adjusted basis	<u>1,250,000</u>
Gain on sale	1,750,000
× Tax rate	<u>0.20</u>
Taxes due on sale	\$350,000
Sale price	\$3,000,000
– Mortgage balance	1,750,000
– Taxes due on sale	<u>350,000</u>
After-tax equity reversion	\$900,000

- b) What will the tax consequence be for Damien if he accepts the second offer?

The solution is presented in the accompanying spreadsheet RE618_2001Fall_FinalS_Problem5.xls.

Several points are worth noting on this spreadsheet. First, I have assumed that the sale took place in year 0, but that all loan payments are made in subsequent years.

Second, because the mortgage balance is greater than the adjusted tax basis, the contract price is adjusted to keep the profit ratio equal to 100%. We discussed this in class.

In addition, the excess of the mortgage balance and the adjusted basis is treated as a cash payment in the year of the sale for tax purposes. Thus, the total recognized gain at date zero is \$1,250,000 even though the actual cash income is only \$750,000.

Sorry, but we didn't discuss this one. Don't worry, I won't hold you responsible.

- c) Suppose that Damien can invest any funds he receives upon the sale of the property for five years at 7.5% (compounded annually), but that he must reinvest funds he receives at a later date at only 5% (compounded annually). Based on the (after-tax) capital Damien will accumulate by the end of the 5th year, which offer should he accept?

See the accompanying spreadsheet RE618_2001Fall_FinalS_Problem5.xls. Note that I have assumed that the investment returns are after-tax returns, so I do not have to calculate the taxes due on the interest earned from the cash flows that are reinvested at the 7.5% or 5% rates.

- 6) Consider the following two mutually exclusive projects:

Project A		Project B	
n	\$	n	\$
0	(180,000)	0	(105,000)
1	25,000	1	18,000
2	35,000	2	45,000
3	(10,000)	3	(20,000)
4	310,000	4	(25,000)
		5	235,000

- a) Calculate the NPV and IRR for each of these projects. Assume a 15% discount rate. Which project is preferred based on its NPV? Which is preferred based on its IRR?

$$NPV_A = \$38,873, IRR_A = 21.69\%$$

$$NPV_B = \$34,071, IRR_B = 23.35\%$$

- b) Use the capital accumulation method to compare these two projects, using a 15% reinvestment rate and a 5% safe rate.

Begin the capital accumulation method by eliminating any negative cash flows:

Project A	
n	\$
0	(180,000)
1	25,000
2	35,000
3	(10,000)
4	310,000

+ (9,524) = 25,476

←

Next, compound any positive cash flows to the terminal date:

Project A	
n	\$
0	(180,000)
1	25,000
2	25,476
3	0
4	310,000
5	0

356,500 + 38,746 + 43,725 = 438,971

This gives us the following cash flows for Project A:

Project A

n	\$
0	(180,000)
1	0
2	0
3	0
4	0
5	48,971

Now do the same for Project B:

Project B

n	\$
0	(105,000)
1	18,000
2	45,000
3	(20,000)
4	(25,000)
5	235,000

+ (19,048) + (22,676) = 3,276

Project B

n	\$
0	(105,000)
1	18,000
2	3,276
3	0
4	0
5	235,000

+ 4,982 + 31,482 = 271,464

Finally, we need to equalize the initial investment by adding investment to Project B:

Project B

n	\$
0	(105,000)
1	0
2	0
3	0
4	0
5	271,464

+ (75,000) = (180,000)

+ 150,852 = 422,316

This gives us the following comparisons:

Project A		Project B	
n	\$	n	\$
0	(180,000)	0	(180,000)
1	0	1	0
2	0	2	0
3	0	3	0
4	0	4	0
5	0	5	0
6	438,971	6	422,316

Thus, Project A is preferred because it will generate a higher total accumulation of capital by the end of year 5. The implicit return on this invested capital is 27.59%, compared to 26.13% for Project B.