**Solutions to Questions - Chapter 13**
**Risk Analysis**

**Question 13-1**

*What is meant by partitioning the internal rate of return? Why is this procedure meaningful?*

To illustrate what is meant by partitioning the IRR, remember that the IRR is made up of two components of cash flow:

1. cash flow from operations
2. cash flow from the sale of the investment

Partitioning is done to obtain some idea of the relative weights of these components of return and to get an idea of the timing of the receipt of the largest portion of that return.

Partitioning is meaningful because it helps the investor to determine how much of the return is from annual operating cash flow and how much is from the projected resale cash flow. Operating cash flow is generally more certain than projected resale cash flow. Therefore, the greater the proportion of resale cash flow versus operating cash flow, the greater the risk facing the investor. This could be useful in comparing multiple investments.

**Question 13-2**

*What is a risk premium? Why does such a premium exist between interest rates on mortgages and rates of return earned on equity invested in real estate?*

A risk premium is a higher expected rate of return paid to an investor as compensation for incurring additional risk on a higher risk investment. In general, investors are considered risk averse and must be compensated more for the higher risk of some investments.

This premium exists between mortgage interest rates and returns on equity invested in real estate because the equity investor is assuming more risk than the mortgage lender. The lender assumes less risk because a lender would have first claim on the property should there be a default. If this were not the case, the investor would be better off lending on real estate than investing in it.

**Question 13-3**

*What are some of the types of risk that should be considered when analyzing real estate and other categories of investment?*

Business Risk
Financial Risk
Liquidity Risk
Inflation Risk
Management Risk
Interest Rate Risk
Legislative Risk
Environmental Risk

**Question 13-4**

*What is the difference between business risk and financial risk?*

Business risk is the risk of loss due to fluctuations in economic activity that affect the variability of income produced by a property.

Financial risk (or debt financing referred to as financial leverage) magnifies the business risk. Financial risk increases as the amount of debt increases.

**Question 13-5**

*Why is the variance (or standard deviation) used as a measure of risk? What are the advantages and disadvantages of this risk measure?*

Lower variability in returns is considered by many analysts to be associated with lower risk and vice versa. Therefore, by using a statistical measure of variance, one has an indication of the extent risk is present in an investment. The standard deviation gives us a specific range over which we can expect the actual return for each investment to fall in relation to its expected return. It has the advantage of being relatively easy to calculate. It has the disadvantage of treating both higher than expected returns and lower than expected returns the same. It could be argued, however, that investors should be more concerned about returns being lower than expected or lower than some threshold return.

**Question 13-6**

*What is meant by a «real option'?*

A real option is an option related to investment in tangible assets like real estate that involves the option to wait to decide whether to invest additional capital based on future economic conditions. Land can be viewed as having the option to invest additional capital in the future to construct a building.

**Question 13-7**

*What is meant by the term 'overage' for retail space ?*

Overage refers to the rent that is paid above the minimum rent in the lease where the rent is based on a percentage of the tenant's sales once sales exceeds a specified breakpoint. The total rent is the minimum rent plus the overage rent.

**Question 13-8**

*How does the use of scenarios differ from sensitivity analysis ?*

Sensitivity analysis involves changing one variable at a time such as the market rent or the vacancy rate. Scenarios involve changing several variables at once for each scenario, e.g., a pessimistic, most likely, and optimistic scenario. For each scenario there might be a different assumption about market rents, vacancy rates, and the resale price because they are interrelated.

**Question 13-9**

*How does the use of Monte Carlo Simulation differ from using scenarios?*

Scenario analysis allows you to indicate the probability of a particular scenario occurring whereas Monte Carlo Simulation allows you to specify a probability distribution for inputs that are uncertain. Each iteration of the simulation can, in effect, result in a different scenario. By having a hundred or more interations in the Monte Carlo Simulation, the output is a probability distribution that indicates the liklihood of different scenarios occuring.

**Solutions to Problems - Chapter 13**
**Risk Analysis**

## INTRODUCTION

**Problem 13-1**

Investment A

| Year | BTCF | PV |
|---|---|---|
| 1 | $5,000 | $4,501 |
| 2 | 10,000 | 8,103 |
| 3 | 12,000 | 8,753 |
| 4 | 15,000 | 9,849 |
| 4 (sale) | 120,000 | 78,792 |
| | | $109,998* |

* Difference from $110,000 due to rounding of IRR.

The BTIRR for Investment A is 11.09 percent. This is used as the discount rate for calculating the present value.

Present value of $BTCF_O$ is $31,206

Present value of $BTCF_S$ is $78,792

Investment B

| Year | BTCF | PV |
|---|---|---|
| 1 | $2,000 | $1,774 |
| 2 | 4,000 | 3,145 |
| 3 | 1,000 | 697 |
| 4 | 5,000 | 3,092 |
| 4 (sale) | 180,000 | 111,301 |
| | | $120,009* |

* Difference from $120,000 due to rounding of IRR.

The BTIRR for Investment B is 12.77 percent. This is used as the discount rate for calculating the present value.

Present value of $BTCF_O$ is $8,708
Present value of $BTCF_S$ is $111,301

(a)
The BTIRR for investment A is 11.09% and the BTIRR for investment B is 12.77%.

(b)
For investment A $PVATCF_O$ is $31,206 / $110,000 or 28% and $PVATCF_S$ is $78,792 / $110,000 or 72%.
For investment B $PVATCF_O$ is $8,708 / $120,000 or 7% (rounded) and $PVATCF_S$ is $111,301 / $120,000 or 93%.

(c)
Investment B is much more dependent on the reversion. It might be considered more risky because there is often more uncertainty about the estimated resale price than the cash flow from operations -- especially when there are leases on the property.

**Problem 13-2**

INVESTMENT I

| | (1) Estimated BTIRR | (2) Expected Return | (3) Deviation (1) - (2) | (4) Squared Deviation | (5) Probability | (6) Product (4) x (5) |
|---|---|---|---|---|---|---|
| Optimistic | 15.00 | 10.00 | 5.00 | 25.00 | 0.20 | 5.00 |
| Most Likely | 10.00 | 10.00 | 0.00 | 0.00 | 0.60 | 0.00 |
| Pessimistic | 5.00 | 10.00 | -5.00 | 25.00 | 0.20 | 5.00 |
| | | | | | Variance | 10.00 |
| | | | | | Std Deviation | 3.16 |

INVESTMENT II

| | (1) Estimated BTIRR | (2) Expected Return | (3) Deviation (1) - (2) | (4) Squared Deviation | (5) Probability | (6) Product (4) x (5) |
|---|---|---|---|---|---|---|
| Optimistic | 20.00 | 14.00 | 6.00 | 36.00 | 0.20 | 7.20 |
| Most Likely | 15.00 | 14.00 | 1.00 | 1.00 | 0.60 | 0.60 |
| Pessimistic | 5.00 | 14.00 | -9.00 | 81.00 | 0.20 | 16.20 |
| | | | | | Variance | 24.00 |
| | | | | | Std Deviation | 4.90 |

The expected BTIRR and standard deviation of the BTIRR are calculated above for Investment I and II. The expected BTIRR is higher for Investment II (15% vs. 10% ) but the standard deviation is also higher for investment II vs. investment I

(4.47% vs. 2.24% ). Thus, based on this criteria, Investment II has a higher expected BTIRR but is also riskier. We can not say that one is better than the other. IT depends on whether Mike Riskless feels that the higher expected BTIRR for Investment II is sufficient to compensate him for the extra risk.

**Additional Comment:**
It is interesting to note that for any of the three scenarios (growth, stability and decline), Investment II never has a lower return than Investment I. Thus, it could be said that Investment II dominates Investment I. This is a slightly different way of evaluating the risk (referred to as stochastic dominance). In this case, it leads to a different conclusion than if only the variance or standard deviation is evaluated.

**Problem 13-3**
(REFER TO TEMPLATE 13_3.XLS)

ASSUMPTIONS:

| | Pessimistic | Most-Likely | Optimistic |
|---|---|---|---|
| **Scenario Probability** | 30% | 40% | 30% |
| **NOI** | $200,000 | $200,000 | $200,000 |
| **Change in NOI** | -2.00% | 0.00% | 3.00% |
| **Sale Price** | $1,800,000 | $2,000,000 | $2,200,000 |
| **Asking Price** | $2,000,000 | | |

(a)

**Pessimistic Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | (2,000,000) | 200,000 | 196,000 | 192,080 | 188,238 | 184,474 |
| Resale | | | | | | 1,800,000 |
| Total | (2,000,000) | 200,000 | 196,000 | 192,080 | 188,238 | 1,984,474 |
| **IRR** | **7.93%** | | | | | |

**Most-Likely Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | (2,000,000) | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 |
| Resale | | | | | | 2,000,000 |
| Total | (2,000,000) | 200,000 | 200,000 | 200,000 | 200,000 | 2,200,000 |
| **IRR** | **10.00%** | | | | | |

**Optimistic Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | (2,000,000) | 200,000 | 206,000 | 212,180 | 218,545 | 225,102 |
| Resale | | | | | | 2,200,000 |
| Total | (2,000,000) | 200,000 | 206,000 | 212,180 | 218,545 | 2,425,102 |
| **IRR** | **12.12%** | | | | | |

(b)

**Expected IRR**

| | IRR | Probability | IRR x Prob. |
|---|---|---|---|
| Pessimistic | 7.93% | 30.00% | 2.38% |
| Most-likely | 10.00% | 40.00% | 4.00% |
| Optimistic | 12.12% | 30.00% | 3.64% |
| **Total (Expected IRR)** | | | **10.01%** |

(c)

**Variance & Standard Deviation**

| | Square of IRR -Expected IRR | Probability | IRR x Prob. |
|---|---|---|---|
| Pessimistic | 0.04% | 30.00% | 0.01% |
| Most-likely | 0.00% | 40.00% | 0.00% |
| Optimistic | 0.04% | 30.00% | 0.01% |
| **Variance** | | | **0.0263%** |
| **Std. Dev.** | | | **1.62%** |

(d)

We can't tell. Although the IRR is higher, the standard deviation is higher, as well. The decision would be up to the risk averseness of the investor. The investor would need to decide if the higher return is enough to compensate for the extra risk.

**Problem 13-4**

(REFER TO TEMPLATE 13_4.XLS)

ASSUMPTIONS:

| | Pessimistic | Most-Likely | Optimistic |
|---|---|---|---|
| **Scenario Probability** | 30% | 40% | 30% |
| **NOI** | 200,000 | 200,000 | 200,000 |
| **Change in NOI** | -2.00% | 0.00% | 3.00% |
| **Sale Price** | 1,800,000 | 2,000,000 | 2,200,000 |
| | | | |
| **Holding Period** | 5 | | |
| **Asking Price** | 2,000,000 | | |
| **Loan Amount** | 1,500,000 | | |
| **Loan Term** | 15 years | | |
| **Loan Interest Rate** | 10.00% | | |
| **Payments per Year** | 12 | | |

| | | | |
|---|---|---|---|
| Equity | 500,000 | | |
| Annual Debt Service | 193,429 | | |
| Mortgage Balance | 1,219,749 | end of year | 5 |

(a) IRR AND STANDARD DEVIATION OF RETURN ON EQUITY:

**Pessimistic Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | | 200,000 | 196,000 | 192,080 | 188,238 | 184,474 |
| Debt Service | | 193,429 | 193,429 | 193,429 | 193,429 | 193,429 |
| BTCF | | 6,571 | 2,571 | (1,349) | (5,191) | (8,955) |
| Resale | (500,000) | | | | | 580,251 |
| Total | (500,000) | 6,571 | 2,571 | (1,349) | (5,191) | 571,295 |
| **IRR** | **2.82%** | | | | | |

**Most-Likely Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 |
| Debt Service | | 193,429 | 193,429 | 193,429 | 193,429 | 193,429 |
| BTCF | | 6,571 | 6,571 | 6,571 | 6,571 | 6,571 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Resale | (500,000) | | | | | 780,251 |
| Total | (500,000) | 6,571 | 6,571 | 6,571 | 6,571 | 786,822 |
| **IRR** | **10.42%** | | | | | |

**Optimistic Scenario**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| NOI | | 200,000 | 206,000 | 212,180 | 218,545 | 225,102 |
| Debt Service | | 193,429 | 193,429 | 193,429 | 193,429 | 193,429 |
| BTCF | | 6,571 | 12,571 | 18,751 | 25,116 | 31,673 |
| Resale | (500,000) | | | | | 980,251 |
| Total | (500,000) | 6,571 | 12,571 | 18,751 | 25,116 | 1,011,924 |
| **IRR** | **17.07%** | | | | | |

Expected IRR

| | IRR | Probability | IRR x Prob. |
|---|---|---|---|
| Pessimistic | 2.82% | 30.00% | 0.85% |
| Most-likely | 10.42% | 40.00% | 4.17% |
| Optimistic | 17.07% | 30.00% | 5.12% |
| **Total (Expected IRR)** | | | **10.14%** |

Variance & Standard Deviation

| | Square of IRR -Expected IRR | Probability | IRR x Prob. |
|---|---|---|---|
| Pessimistic | 0.53% | 30.00% | 0.16% |
| Most-likely | 0.00% | 40.00% | 0.00% |
| Optimistic | 0.48% | 30.00% | 0.14% |
| **Variance** | | | **0.3050%** |
| **Std. Dev.** | | | **5.52%** |

(b)
The IRR has only increased slightly (from 10.01% to 10.14%). However, the standard deviation has increased from 1.62% to 5.52%. The return does not appear to have increased sufficiently to justify the additional risk.

It should be noted that the standard deviation (and thus the risk) will always increase with more debt. Whether or not the expected IRR increases depends on the degree of leverage. In this case, leverage is only marginally positive.

**Problem 13-5**

The value of the land at the end of the year if the NOI is $150,000 is as follows:

Property Value = NOI / (Discount rate – growth rate)
Property Value = $150,000 / (.12 - .02) = $1,500,000

Land value = Property Value – Construction Cost
Land value = $1,500,000 - $1,000,000 = $500,000

The value of the land at the end of the year if NOI is $75,000 is as follows:

Property Value = NOI / (Discount rate – growth rate)
Property Value = $75,000 / (.12 - .02) = $750,000

Land value = Property Value – Construction Cost
Land value = $750,000 - $1,000,000
Land value = 0 since it would not be developed because the property value if constructed is less than the construction cost

The expected land value in one year is therefore (.60 x $500,000) + (.40 x $0) = $300,000.

The value today is found by discounting the expected value in one year by the 12% discount rate.

Land value - $300,000 / 1.12 = $267,857.