Solutions to Questions - Chapter 22
Real Estate Investment Performance and Portfolio Considerations

Question 22-1

What are some of the difficulties of obtaining data to measure real estate investment performance?
It is difficult obtaining data to measure real estate investment performance because properties do not sell frequently like stocks and bonds. Also, when properties do sell, the sale price is generally not publicly available. This makes it difficult to compare the investment performance with stocks and bonds.

Question 22-2

What are the distinguishing characteristics between REIT data and the NCREIF Property Index?
The NCREIF index measures the investment performance of real estate by using appraised values (rather than actual sale prices) for properties held by institutional investors that are members of the National Council of Real Estate Investment Fiduciaries (NCREIF). Because REITs are publicly traded, actual transactions prices are available for these stocks. Because REITs are operating companies, however, their value reflects both the performance of properties held by the REIT as well as the ability of the REIT's management to operate the company successfully.

Question 22-3

What is the d*ifference between arithmetic and geometric mean returns?*
The arithmetic mean adds the returns that occur over time and divides the sum by the total number of returns. The geometric mean is calculated by add one to each return and taking the product of the returns that occur over time. The geometric mean is the nth root of this product. The geometric mean is considered more appropriate in measuring the mean (i.e., average) of rates of return that occur over time.

Question 22-4

What statistical concept do many portfolio managers use to represent risk when considering investment performance?
The standard deviation (square root of the variance) of returns is typically used as a measure of risk.

Question 22-5

When NCREIF returns and REIT returns are compared, NCREIF returns exhibit a much lower pattern of variation. Why might this be the case?
NCREIF returns are based on using the quarterly appraised value of the properties as estimates for the value of the property, whereas REIT returns are based on actual transaction prices. The appraisal process tends to result in smoother changes in estimates of value over time as markets change, in part due to the fact that appraisers must rely on historical information.

Question 22-6

Mean returns for portfolios are calculated by taking the weighted average of the mean returns for each investment in the portfolio. Why won't this approach work to calculate the standard deviation of portfolio returns?
This approach would not take into consideration the way returns for different properties in the portfolio are correlated over time. The correlation of returns between each property and all other properties in the portfolio affects the standard deviation of the returns for the entire portfolio. The less returns are correlated between properties, the lower the portfolio standard deviation.

Question 22-7

What is the difference between covariance and correlation? Why are these concepts so important in portfolio analysis?
Correlation is calculated by dividing the covariance of two returns by the product of the standard deviation of the two returns. Both measure the degree to which returns move together over time. The advantage of the correlation coefficient is that it always ranges from -1 to +1 which makes it easier to compare for different investment alternatives.

Question 22-8

Results reported in the chapter showed that by including either REITs or the NCREIF Index in a portfolio containing S&P 500 securities, corporate bonds, and T bills, diversification benefits resulted. Why was this true? Did those benefits come about for the same reason for each category of real estate investment?

Diversification benefits resulted by including either REITs or the NCREIF Index in a portfolio because real estate investment returns are not highly correlated with returns for stocks, bonds and T bills. The diversification benefits come about for the same general reason for both REITs and the NCREIF Index although these two measures differ in the way they are calculated and what they measure as discussed in questions 2 and 5 above.

Question 22-9

Results presented in the chapter are based on historical data. Of what use are these results to a portfolio manager who may be making an investment decision today? Elaborate.

Results based on historical data suggest that real estate can add diversification benefits to a portfolio of stocks and bonds. This result in not likely to change since real estate returns should continue to be affected by different economic factors than stocks and bonds and thus returns between these categories of investments will not be highly correlated. The exact mix of assets in the portfolio, i.e., the percentage invested in real estate versus other assets, is likely to differ over time, however, so portfolio managers making decisions today should do their own analysis using the concepts presented in the chapter.

Question 22-10

Why should an investor consider investing globally?

Investors should consider investing globally because by doing so they can diversify portfolio risk and hence will be able to achieve a higher return for the same level of risk or same return with a lower level of risk.

Question 22-11

What are the risks of global investment?

Some of the risks associated with global investing are: government instability in host country, political issues, different rules and regulations, and change in exchange rates.

Question 22-12

How can a derivative security be used to hedge portfolio risk?

A derivative security can be used to hedge portfolio risk by taking an opposite position from what is taken in the underlying security. Say, for instance, if the investor takes a long position in a security it can hedge against the downside movement of prices by taking a long position in "puts". If the investor takes a short position in a security, it can hedge against the upward movement of prices by taking a long position in "calls".

Similarly, an opposite position in indexes can be taken for hedging risk for different securities constituting a portfolio.

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Real Estate Investment Performance and Portfolio Considerations

Problem 22-1

	ET&T			MREAF	
	Common Stock Fund			Real Estate Fund	
Period Ending	Unit Value	Quarterly Dividend		Unit Value	Quarterly Dividend
1	701.00	8.28		70.00	2.17
2	752.50	8.11		80.05	2.14
3	850.52	10.30		90.80	2.01
4	953.75	9.81		100.50	2.01
5	1,047.57	12.05		99.14	1.87
6	1,221.70	14.17		95.50	1.81
7	1,443.90	17.18		93.77	1.79
8	1,263.31	14.91		80.31	1.54
9	1,258.56	13.84		77.34	1.49
10	1,526.72	18.32		76.53	1.44
11	1,616.81	19.73		78.42	1.51
12	1,624.08	19.98		79.01	1.53
13	1,560.25	18.88		81.75	1.55

(a) Calculate the HPR for each investment

The formula to be used is $((P_t - P_{t-1}) + D_t) \div P_{t-1}$ where D_t = Dividends or cash distributions in time period t

P_t	=	Price in time period t
P_{t-1}	=	Price in time period t-1

Period	(a) Common Stock Fund	(b) Real Estate Fund
1	NA	NA
2	8.50%	17.41%
3	14.39%	15.94%
4	13.29%	12.90%
5	11.10%	0.51%
6	17.97%	-1.85%
7	19.59%	0.06%
8	-11.47%	-12.71%
9	.72%	-1.84%
10	22.76%	0.81%
11	7.19%	4.44%
12	1.69%	2.70%
13	-2.77%	5.43%
Total	102.98%	43.81%

(b) Calculate Arithmetic Mean return

Mean HPR for Common Stock Fund	=	102.98% ÷ 12	=	8.58%
Mean HPR for Real Estate Fund	=	43.81% ÷ 12	=	3.65%

Calculate the Standard Deviation

	Stock Fund		Real Estate fund	
Period	(HPRa - HPRa)	(HPRa - HPRa)	(HPRb - HPRb)	(HPRb - HPRb)
1				
2	-0.0008	0.0000	0.1376	0.0189
3	0.0581	0.0034	0.1229	0.0151
4	0.0471	0.0022	0.0925	0.0085
5	0.0252	0.0006	-0.0314	0.0010
6	0.0939	0.0088	-0.0550	0.0030
7	0.1101	0.0121	-0.0359	0.0013
8	-0.2006	0.0402	-0.1636	0.0268
9	-0.0786	0.0062	-0.0549	0.0030
10	0.1418	0.0201	-0.0284	0.0008
11	-0.0139	0.0002	0.0079	0.0001
12	-0.0690	0.0048	-0.0095	0.0001
13	-0.1135	0.0129	0.0178	0.0003
Total		0.1115		0.0790

Variance of Common Stock Fund	=	0.1115 ÷ 12	=	0.0093		
Standard Deviation	=	0.0066				
Variance of Real Estate Fund	=	0.0790 ÷ 12	=	0.0066		
Standard Deviation	=	0.0811				

Calculate the Geometric Mean

	Stock Fund	Real Estate Fund
Period	(1 + HPRa)	(1 + HPRb)
1		
2	1.0850	1.1741
3	1.1439	1.1594
4	1.1329	1.1290
5	1.1110	1.0051
6	1.1797	0.9815
7	1.1959	1.0006
8	0.8853	0.8729
9	1.0072	0.9816
10	1.2276	1.0081
11	1.0719	1.0444
12	1.0169	1.0270
13	.9723	1.0543

Geometric Mean of Stock Fund	=	0.0814
Geometric Mean of Real Estate Fund	=	0.0333

(c) Correlation between Common Stock Fund and Real Estate Fund

Correlation between Stock Fund and Real Estate Fund = [COVab] ÷ [Std. Dev. (a) x Std. Dev. (b)]

COVab   =   [HPRa - HPRa] x [HPRb - HPRb] ÷ N

Period	(HPRa - HPRa)	(HPRb - HPRb)	[HPRa - HPRa] * [HPRb - HPRb]
1			
2	-0.0008	0.1376	-0.0001
3	0.0581	0.1229	0.0071
4	0.0471	0.0925	0.0044
5	0.0252	-0.0314	-0.0008
6	0.0939	-0.0550	-0.0052
7	0.1101	-0.0359	-0.0040
8	-0.2006	-0.1636	0.0328
9	-0.0786	-0.0549	0.0043
10	0.1418	-0.0284	-1.0040
11	-0.0139	0.0079	-0.0001
12	-0.0690	-0.0095	0.0007
13	-0.1135	0.0178	-0.0020
Total			0.0331

Covariance between Stock Fund and Real Estate Fund   =   0.0331 ÷ 12.00   =   0.0028
Correlation between Stock Fund and Real Estate Fund   =   0.0028 ÷ (.096 x .081)   =   0.3530

(d) In order for a portfolio of assets to provide diversification, the standard deviation of the portfolio must be less than the weighted average standard deviations of the individual assets.

Standard Deviation of Common Stock Fund   =   0.0964
Standard Deviation of Real Estate Fund   =   0.0811

The portfolio will be comprised of   50.00% Common Stock and
                                                       50.00% Real Estate Equities

| Period	Common Stock Fund	Real Estate Fund	Portfolio
1	NA	NA	NA
2	0.0850	0.1741	0.1296
3	0.1439	0.1594	0.1517
4	0.1329	0.1290	0.1309
5	0.1110	0.0051	0.0580
6	0.1797	-0.0185	0.0806
7	0.1959	0.0006	0.0983
8	-0.1147	-0.1271	-0.1209
9	0.0072	-0.0184	-0.0056
10	0.2276	0.0081	0.1179
11	0.0719	0.0444	0.0582
12	0.0169	0.0270	0.0219
13	-0.0277	0.0543	0.0133
	1.0298	0.4381	0.7339

Weighted Average Standard Deviation (each asset weighted 50%)   =   0.0888
Portfolio Standard Deviation   =   0.0731

Because the portfolio's standard deviation is less than the weighted average of the individual standard deviations, the portfolio does provide an element of diversification.

(e) Optional

Weight of Common Stock	Portfolio Return	Portfolio Risk
0%	3.65%	8.11%
10%	4.14%	7.69%
20%	4.64%	7.39%
30%	5.13%	7.22%
40%	5.62%	7.20%
50%	6.12%	7.31%
60%	6.61%	7.57%
70%	7.10%	7.94%
80%	7.60%	8.42%
90%	8.09%	8.99%
100%	8.58%	9.64%

(f) Based on the exhibit below, it would appear that substantial risk reduction occurs as more of the real estate fund is combined with the stock fund. However, mean returns on the portfolio increase sharply as more common stock is added. How much stock should be combined with real estate will depend on the degree of risk aversion of the portfolio manager, however, the trade off between risk and return can be clearly seen in the Exhibit.

Portfolio of Stocks and Real Estate
Return vs. Risk
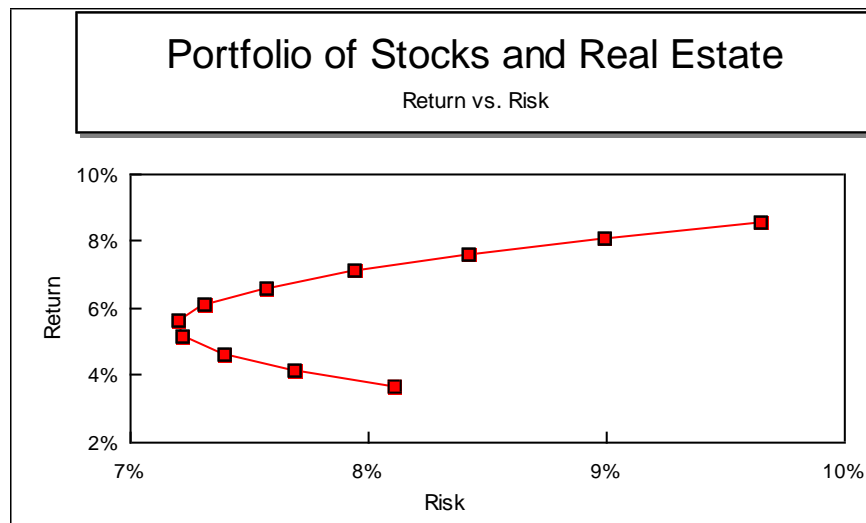
Problem 22-2

See below:

% S&P	% NCREIF	Portfolio Variance	Portfolio Stand. Dev	Return	Return x 100
0.00%	100.00%	0.03%	1.76%	2.32%	2.32
5.00%	95.00%	0.03%	1.64%	2.41%	2.41
10.00%	90.00%	0.03%	1.61%	2.50%	2.50
15.00%	85.00%	0.03%	1.68%	2.58%	2.58
20.00%	80.00%	0.03%	1.83%	2.67%	2.67
25.00%	75.00%	0.04%	2.05%	2.76%	2.76
30.00%	70.00%	0.05%	2.32%	2.84%	2.84
35.00%	65.00%	0.07%	2.62%	2.93%	2.93
40.00%	60.00%	0.09%	2.94%	3.02%	3.02
45.00%	55.00%	0.11%	3.28%	3.10%	3.10
50.00%	50.00%	0.13%	3.63%	3.19%	3.19
55.00%	45.00%	0.16%	3.99%	3.28%	3.28
60.00%	40.00%	0.19%	4.36%	3.36%	3.36
65.00%	35.00%	0.22%	4.73%	3.45%	3.45
70.00%	30.00%	0.26%	5.11%	3.54%	3.54
75.00%	25.00%	0.30%	5.49%	3.62%	3.62
80.00%	20.00%	0.34%	5.87%	3.71%	3.71
85.00%	15.00%	0.39%	6.25%	3.80%	3.80
90.00%	10.00%	0.44%	6.64%	3.88%	3.88
95.00%	5.00%	0.49%	7.02%	3.97%	3.97
100.00%	0.00%	0.55%	7.41%	4.06%	4.06

The standard deviation of the portfolio for 50% S&P and 50% NCREIF is 3.63% versus 3.76% before. The more negative the correlation the greater the diversification benefits and the lower the portfolio standard deviation.