INVESTMENTS
Lecture 1: Background

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- the players
- the assets
- security returns
- mean and variance of returns

Some of the Players (US Pension Fund Example)

• Plan Sponsor and Beneficiaries • Investment Manager • Custodian • Consultants	Buy side
• Issuers (e.g. companies, Treasury, municipalities) • Underwriters • Brokers and Dealers	Sell side
• Exchanges • Specialists	In between
• SEC, PBGC, Fed, Treasury, IRS	Regulation

A portfolio might contain:

- Cash
- Common Stock or Preferred Stock
- Treasury Bills, Bonds, Notes, STRIPs, and Tips
- Government Agency Issues
- Municipal Bonds
- Corporate Bonds
- Warrants or Rights
- Options and Futures
- Mortgage-Backed Securities or other Asset-Backed Securities
- Real estate and other illiquid assets
- Domestic or Foreign (all of the above)

Security Returns

The *rate of return* on a security is the natural extension of the notion of an interest rate to securities with randomness. The rate of return over some time period is the change in value divided by the value at the start of the period. For example, for a stock paying a dividend, the rate of return is

$$R_t = \frac{P_t + D_t - P_{t-1}}{P_{t-1}} = \left(\frac{P_t}{P_{t-1}} - 1\right) + \frac{D_t}{P_{t-1}}.$$

In the last expression, the first term is the *capital gain (loss)*, and the second term is the *income*. The rate of return is often stated in percent (also called points), or in basis points (100 basis points $=$ 1 percent). The obvious adjustment is made for stock splits or other distributions.

The term "total return" is sometimes used to refer to one plus the rate of return. The term "return" usually refers to the "rate of return" but can refer to the "total return" instead. Another useful term: the *ex-dividend day* is the first day the stock trades without a claim to the dividend.

notation: R-rate of return P-price D-dividend t-time

In-Class Exercise: Security Returns

Ursidae Corp's common stock was worth \$60/share at the end of December, \$54/share at the end of January, \$50/share at the end of February, and \$30/share at the end of March. There was a \$4 dividend paid in February, and a 2-for-1 stock split in March. Compute the three monthly rates of return for Ursidae Corp.

Adjusting for Inflation: Real Returns

Having your portfolio value in dollars increase by 10% does not leave you any better if there is inflation and the spending power of a dollar falls by 10% at the same time. If we have an inflation rate of 5% in a year, then it takes 5% more dollars to buy the same goods. In terms of spending power, we have that the value of your holding in an asset increases by a factor

$$1 + R_t^{\text{real}} = \frac{1 + R_t}{1 + I_t} \approx 1 + R_t - I_t$$

where I_t is the inflation rate over the same period as the return. The final approximation is due to the mathematical fact that

$$\frac{1 + x}{1 + y} \approx 1 + x - y \approx (1 + x)(1 - y)$$

when x and y are close to zero. This tells us that ignoring compounding (interest on interest) is not so important over short periods.

In-Class Exercise: Real Returns

If inflation is running at 1%/month, what are the real rates of return to Ursidae Corp for the three months examined in the previous in-class exercise?

Real Rates of Return: Discussion

Computed real rates of return do have some drawbacks. One is that the measures of inflation we normally use (for example the CPI or CPI-U in the US) try to give a single summary of much different inflation rates for different goods. Such a summary may be a good measure or a bad measure of the cost-of-living for an individual. For example, buying a house may hedge fairly precisely the housing costs of an individual, and therefore it is essentially riskless for the individual, but looks risky when viewed under the lens of the CPI.

Another difficulty with using real returns is that the CPI is not measured very frequently. We have daily and even intraday observations of stock prices, but the price level and inflation are only measured monthly. Even monthly inflation numbers are imprecise and are based not on prices at a point of time at the end of the month and rather on surveys of prices over time within a month.

Measures of Mean Return

The *arithmetic mean* (or just the mean) is what is relevant for thinking about the trade-off between risk and return:

$$mean = \frac{1}{T} \sum_{t=1}^{T} R_t$$

The *geometric mean* gives the equivalent constant return to a buy-and-hold strategy with reinvestment of dividends:

$$geometric\ mean = \left(\prod_{t=1}^{T} (1 + R_t) \right)^{1/T} - 1.$$

Over many short periods, the geometric mean is approximately the arithmetic mean minus half the variance.

Volatility of Returns

The *variance* is the average of the squared deviation from the mean, and the *standard deviation* is the square root of the variance. In a sample of returns, we measure the variance and standard deviation of returns as

$$variance = \frac{1}{T} \sum_{t=1}^{T} (R_t - mean)^2$$

and

$$standard\ deviation = \sqrt{variance}$$

Sometimes we divide by $T - 1$ instead of T in computing variance, to adjust for a tendency to understate the variance when the mean is unknown. If T is large, it obviously doesn't make much difference whether we divide by T or $T - 1$. For daily returns, the mean is much smaller (in absolute value) than a typical R_t, and it doesn't make much difference if we don't subtract the mean.

Practitioners commonly refer to volatility as "vol" for short.

In-Class Exercise: Mean Return and Volatility

In four years, a portfolio of common stocks has realized returns of 40%, 0%, -30%, and 10%. Compute the mean, variance, and standard deviation of returns. For this exercise, divide by T (not $T-1$) to compute the variance.

Properties of Stock Returns

- Market portfolio has a return of 8-10%/year over short Treasuries
- Market standard deviation around 20-25%/year
- Typical measured betas are between 0.5 and 1.5
- True betas are typically closer to 1 than measured betas
- Typical idiosyncratic noise standard deviation 30-40%/year
- Even over 10 years, luck dominates performance

Stock return anomalies

- small stock returns are abnormally high in Januaries
- stock returns are lower on average when interest rates are high
- stock returns are on average negative over the weekend
- large stock returns lead small stock returns
- data mining?
- spread?

International stocks

- very risky in dollar terms due to exchange risk
- move more with US stocks as capital markets become integrated
- for most countries, the history is too short to evaluate the mean
- sovereign risk
- conceptual issue: International diversification implies corresponding flows in real goods and services

Properties of Government Bonds

- Riskless in dollar terms *when held to maturity*
- Risky over other terms
- Short Treasuries Track inflation (Fisher equation)
- Treasury Bills are discount instruments
- Treasury Bonds and Notes offer Coupons
- STRIPs are individual cash flows from Treasuries
- TIPs are inflation-indexed Treasuries (like those in England and Israel)
- Recall that the yield is the interest rate at which the bond is fairly priced
- Interest is exempt from state taxes
- Agencies may be illiquid and/or not carry "full faith and credit" guarantee

Corporate Bonds

- Tend to be illiquid
- Risky debt has equity-like risk characteristics
- Often bundled with warrants or have conversion features
- These "equity kickers" keep yields reasonable

International Debt

- often dollar-denominated
- traditionally Euro = denominated in foreign currency
- for example, if Mexico issues bonds in Japanese yen, this is a "Euro-yen" issue
- now, the Euro is the new common European currency unit
- enforcement through vague incentives
- strongest economies generally issue in own currency

Some tax issues

- Tax code is complex
- Municipal bonds ("munis"): interest is not taxable (federal and usually state of issue)
- Treasury bonds ("T-Bonds"): interest is exempt from state and local taxes
- ordinary and capital gains/losses accounted separately
- accumulating tax-free is valuable
- it is usually beneficial to realize losses and defer gains
- "tax timing option" increases the value of some securities
- corporations are untaxed on all or part of dividends
- tax clienteles complicate valuation

Recent trends

- Portable alpha
- The new chartists
- Volatility models: ARCH, Stochastic Volatility (SV)