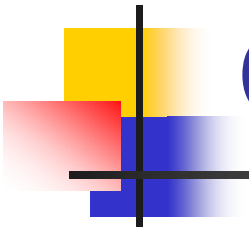
Portfolio Management – Performance Measurement



Overview

- Measuring Profitability
- Equity Curve Measures
- Portfolio Performance Measures

Measuring Profitability

- Net returns
- Buy and hold test
- Distance from the ideal

Net Returns

- Test of investment strategy
  - Long positions when expected returns are positive
  - Short positions when expected returns are negative

$$r = \sum_{t=1}^{n} p_t (y_{t+1} - y_t)$$

$$p_t = \begin{cases} 1 \quad if \ (f_{t+1} - y_t) > 0 \\ -1 \, if \ (f_{t+1} - y_t) < 0 \\ 0 \quad if \ (f_{t+1} - y_t) = 0 \end{cases}$$

Buy and Hold Test

- Benchmark to quantify excess returns
  - Tests whether profitability is due to predictive ability or just general market conditions

$$r = \frac{c + (y_{t+n} - y_t)}{y_t}$$

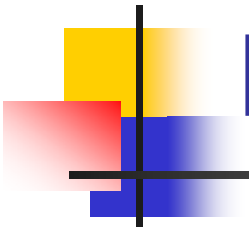
  - C is stock dividend or bond coupon

Distance From the Ideal

- Measures returns from trading system against perfect predictor d

$$r_d = \frac{\sum_{t=1}^{n} p_t (y_{t+1} - y_t)}{\sum_{t=1}^{n} | y_{t+1} - y_t |}$$

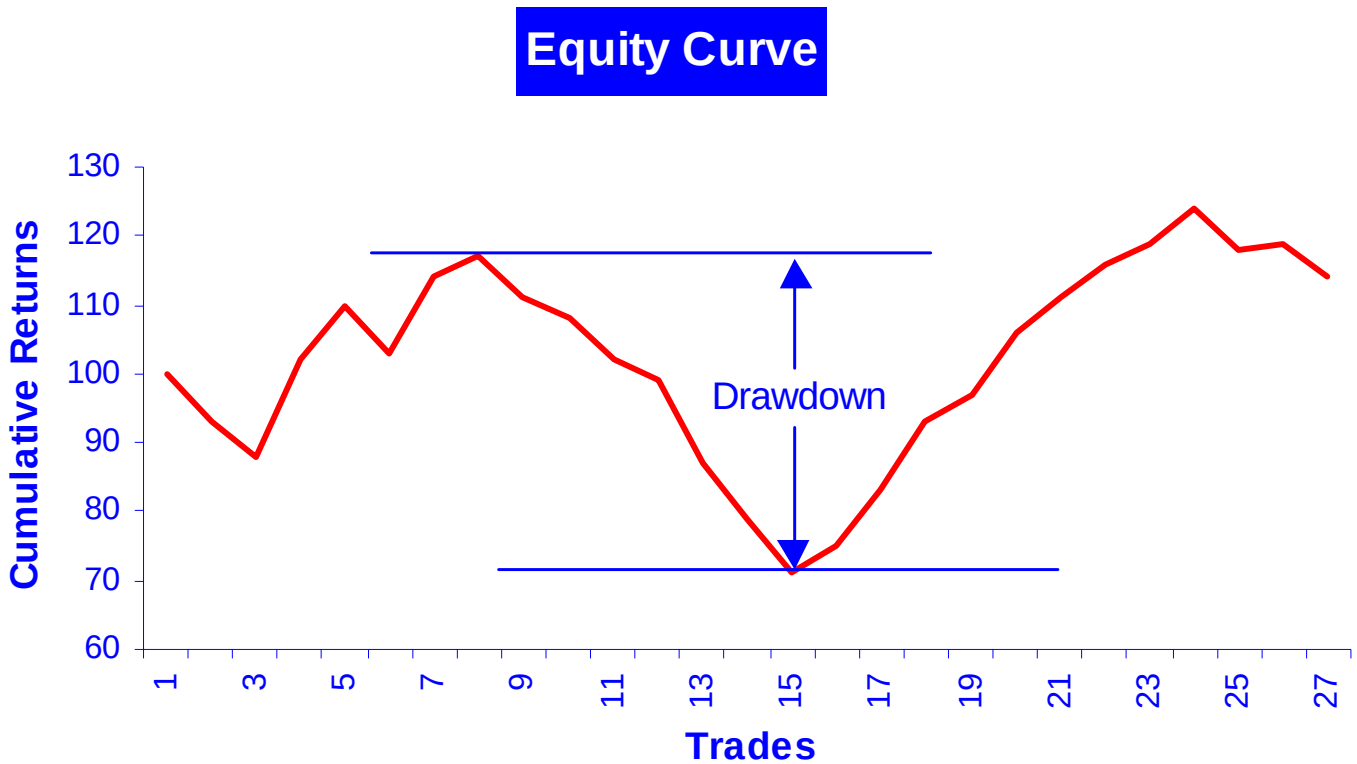
  - P_t as previously defined

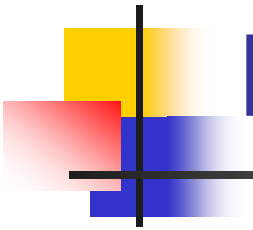


Equity Curve Measures

- Drawdown
- Luck coefficient
- Stirling ratio
- Risk of ruin

Drawdown


Equity Curve
Cumulative Returns
130
120
110
100
90
80
70
60
Drawdown
1
3
5
7
9
11
13
15
17
19
21
23
25
27
Trades



Drawdown

- Systems with large drawdowns hard to trade
  - Requires lots of capital & confidence!
- Smooth equity curve is desirable
- Usually harder to obtain than high net return

Luck Coefficient

- How much of total profit was dependent on most profitable (k) trades(s)?

$$l(k) = \frac{Max_k\{r_0, r_1, \ldots, r_n\}}{\sum_{i=1}^{n} r_i}$$

- Large L indicates system success unlikely to be repeatable

Stirling Ratio

- Penalizes average returns for drawdown

$$s = \frac{\frac{1}{n}\sum_{i=1}^{n} r_i}{10 - d_i}$$

  - d_i is the i-period maximum drawdown.
- Can be too slow to change
  - Recalculate frequently

Risk of Ruin

- Probability that capital will be depleted
  - Depends on
    - Probabilkity of successful trade p
    - Payoff ratio (av. Win / av. Loss)
    - Fraction of capital exposed to trading
  - Assume:
    - Payoff ratio is 1
    - We risk all capital
    - K sequential trades
  - $R \sim [(1-p)/p]^k$

Portfolio Performance Measures

- Sharpe ratio: $(r_p - r_f) / \sigma_p$
  - Measures reward to total risk trade-off
- Treynor's measure: $(r_p - r_f) / \beta_p$
  - Excess return per unit of systematic risk
- Jensen's measure: $\alpha_P = r_p - [r_f + \beta_p(r_M - r_f)]$
  - The portfolio's alpha - abnormal return above that predicted by CAPM
- Appraisal ratio: $\alpha_P / \sigma(e_p)$
  - Abnormal return per unit of specific risk that could be diversified away using a market index portfolio

Which Measure to Use

- Suppose you have invested in a portfolio P
- Case 1: P is your entire investment fund
- Case 2: P is your active portfolio and:
  - You are also investing in the passive market index portfolio
- Case 3: P is one of many portfolios
  - Combined in a large investment fund
  - E.g. You are one of a number of portfolio managers

Case 1: P Is Your Entire Investment Fund

- Compare P's Sharpe ratio with other fund:
  - Passive index fund
  - Professionally managed active funds

Case 2: P Is Your Active Portfolio

- Recall: $S^2_C = S^2_M + [\alpha_P / \sigma(e_P)]^2$
  - S_C is the Sharpe ratio of the combined portfolio (M and P)
- "How much does your active portfolio P add to the Sharpe ratio S_M of your passive market index portfolio?"
- Use appraisal ratio: $[\alpha_P / \sigma(e_P)]$

Case 3: P Is One of Many Portfolios

- P's contribution to the entire diversified fund is α_P
- So could use Jensen's measure (portfolio alpha)
  - But this takes no account of risk
- Better to use Treynor's measure: $(r_p - r_f) / \beta_p$
  - Measure P's excess return against the systematic risk (beta) rather than the total diversifiable risk (s.d.)

Lab: Portfolio Performance Measurement

- Advise a client in choice of funds
  - Use different performance measures
- Excel lab: portfolio performance measurement
  - Complete worksheet
  - See solution worksheet
- See written notes and solution

Portfolio Performance Measurement - Solution

	Fund P	Fund Q	Benchmark M
Sharpe	0.43	0.49	0.19
Alpha (Jensen)	1.63%	5.26%	0.00%
Beta	0.70	1.40	1.00
Treynor	3.97	5.38	1.64
$\sigma(e)$	1.92%	9.35%	0
Appraisal ratio	0.85	0.56	0.00
R^2	91.12%	63.82%	100.00%

Portfolio Performance Measurement - Solution

- Both P & Q outperform M:
  - Higher Sharpe ratios, positive alphas
- Fund Q is preferred:
  - If this fund is the client's only investment
    - Higher Sharpe ratio than P
  - As one of a mix of portfolios
    - Higher Treynor measure than P
- P is preferred if used as an active fund
  - In conjunction with a passive index fund
    - Higher appraisal measure than Q

Summary: Performance Measurement

- Appropriate testing metric depends on application
  - Forecasting
  - Trading system development
  - Portfolio management
- Models unlikely to perform equally on every basis
  - E.g. with low R^2 may generate significant profits
  - Models with good statistical fit may trade badly
- Moral
  - Decide objective and testing strategy *before* modeling!