

Instructor	A. Huang
Date of Exam	December 20, 2011
Duration of Exam	2.5 hours
Exam Type	Special Materials
Additional Materials Allowed	Calculator

Marking Scheme:

Question	Score	Question	Score
1	/20	5	/9
2	/15	6	/11
3	/18	7	/10
4	/8	8	/9
Total			/100

Instructions

1. The exam has 19 pages (including this page, the cover sheet, and the formula sheets). Verify that your copy of the exam is complete.
2. Answer all questions in the space provided. You can use the back of the page if space is not enough.
3. Show all of your calculations.
4. Unless specifically instructed otherwise, provide final answers involving percentage rates to four decimal places (e.g. 6.48% or .0648) and final answers involving dollar amounts to two decimal places (e.g. \$124.17).
5. Do not write any part of your answers on any of the formula sheets. You are not expected to hand in any of the formula sheets. You may detach the formula sheets from the rest of the exam if that makes it more convenient for you to consult them.

Question 1—Multiple choice (2 marks each, 20 marks in total): Circle one answer that is the best.

(1) You have been given this probability distribution for the holding period return for XYZ stock:

State of the Economy	Probability	HPR
Boom	0.30	18%
Normal growth	0.50	12%
Recession	0.20	-5%

What is the expected holding period return for XYZ stock?

- a) 11.67%
- b) 8.33%
- c) **10.4%**
- d) 12.4%
- e) 7.88%

(2) According to the mean-variance criterion, which of the statements below is correct concerning the following investments?

Investment	Expected return (%)	Standard Deviation (%)
A	10	5
B	21	11
C	18	23
D	24	16

- a) Investment B dominates Investment A.
- b) **Investment B dominates Investment C.**
- c) Investment D dominates all of the other investments.
- d) Investment D dominates only Investment B.
- e) Investment C dominates investment A.

(3) A company's current ratio is 2.0. If the company uses cash to retire notes payable due within one year, its current ratio would _____ and its asset turnover would _____.

- a) decrease; decrease
- b) decrease; increase
- c) increase; decrease
- d) **increase; increase**

(4) Assume a constant growth model. High Tech Chip Company is expected to have EPS in the coming year of \$2.50. The expected ROE is 14%. An appropriate required return on the stock is 11%. If the firm has a dividend payout ratio of 40%, the intrinsic value of the stock should be _____.

- a) \$22.73
- b) \$27.50
- c) \$28.57
- d) **\$38.46**
- e) none of these

(5) Management expense ratio (MER) of mutual funds may include the following expenses:

- a) front-end loads
- b) marketing costs
- c) trailer fees
- d) operating expenses
- e) all of the above
- f) **b), c) and d) only**

(6) On Dec. 30, you (as a Canadian investor) owned 1,000 shares of a mutual fund and the fund's NAV is \$10/share. On the same date, a redemption by institutional investor X forced the fund to sell assets and as result, the fund realized a 5% capital gains on its assets-under-management. The capital gain tax rate is 20%. You hold your 1,000 shares of the fund through year end. Your capital gain tax liabilities due to the redemption of institutional investor X are:

- a) zero since you hold your shares until year end and did not realize any capital gains.
- b) \$2,000.
- c) **\$100.**
- d) \$1,000.
- e) Cannot be determined.

(7) In technical analysis, the cross-over trading rule says that an investor should sell when a faster moving average crosses from above a slower moving average and should buy when a faster moving average crosses from below a slower moving average. Which of the following best describes the underlying rationale behind this rule?

- a) Stock price tends to display long-term reversal.
- b) **Stock price tends to display short-term momentum.**
- c) Stock price must satisfy the demand and supply equilibrium, and moving average cross-over is indicative of market breadth.
- d) People tend to overreact to unexpected and dramatic news events. Therefore, extreme movements in stock prices will be followed by subsequent price movements in the opposite direction.
- e) The former is usually accompanied by poor liquidity or lower volume, and the latter by better liquidity or larger volume.

(8) You wish to evaluate three mutual funds using the information ratio measure for performance evaluation. The risk-free return during the sample period is 6%, and the average return on the market portfolio is 19%. The average returns, residual standard deviations (i.e., idiosyncratic risks), and betas for the three funds are given below:

	Average Return	Residual Standard Deviation	Beta
Fund A	20%	4.00%	0.8
Fund B	21%	1.25%	1.0
Fund C	23%	1.20%	1.2

The fund with the highest information ratio measure is _____.

- a) Fund A
- b) **Fund B**
- c) Fund C
- d) Funds A and B are tied for highest
- e) Funds A and C are tied for highest

(9) Barber and Odean (2000) ranked portfolios by turnover and report that the difference in return between the highest and lowest turnover portfolios is 7% per year. They attribute this to _____.

- a) **overconfidence**
- b) framing
- c) regret avoidance
- d) mental accounting
- e) all of the above

(10) Assume CAPM, the market risk premium is 6%, and the riskfree rate is 3%. Firm ABC's beta is 1.5. It has an expected earnings per share of \$12 next year and an ROE of 20%. Currently its dividend payout ratio is 60%. What is the percentage of its present value of growth opportunities in its stock price?

- a) 33.33%
- b) 66.67%
- c) **44.44%**
- d) 55.56%
- e) 40%

Question 2: 15 marks. This question spans this and the next page. Sub-questions (a) and (b) are independent.

(a) (9 marks) The table below shows the historical performance of three mutual funds from 1990 to 2010. You believe that these return metrics are good indicators of future fund performance.

Fund	SR	M^2 (%)	IR	Treynor
Fidelity	0.35	0.03	0.35	0.34
Putnam	0.50	2.35	0.25	0.55
Vanguard	0.15	-1.25	-0.45	0.29

(i) Briefly explain what is the M^2 ratio (2 marks). Which fund performs the best according to M^2 (1 mark)?

Key: The M^2 ratio of portfolio P shows the difference of return between a derived portfolio of P and the market portfolio. The derived portfolio must satisfy two criteria: (1) it is a mix of portfolio P and risk-free asset so that the mixed portfolio has the same Sharpe ratio as P ; (2) the mixed portfolio has the same volatility as the market. The higher the M^2 the more desirable the portfolio. Therefore, choose Putnam.

(ii) (3 marks) Your existing portfolio is currently composed solely of holdings in the market index fund. If you are looking to buy a fund to add to your existing portfolio, what would be your choice and why?

Key: In this case, you should choose information ratio (IR). Fidelity has the highest IR therefore choose it. (Note that you're not shorting; otherwise Vanguard would be your choice.)

(iii) (3 marks) Assume instead that you're currently holding a well diversified portfolio (not the market). If you are looking to buy a fund to add a small amount to your existing portfolio, what would be your choice and why?

Key: In this case, you should choose Treynor ratio. Putname has the highest TR therefore choose it.

(b) (6 marks) You're evaluating the performance of a mutual fund manager based on 20-day fund flows and NAVs, outlined in the following table (a positive number indicates inflow, a negative number indicates outflow, and "NA" indicates no flow):

Day	End-of-the-day NAV	
	prior to in/out-flow	In/out-flow
0	\$100	NA
5	\$102	\$5
10	\$106	\$ - 10
15	\$100	\$10
20	\$108	NA

What is the effective annual return of the fund manager (using 365 days a year)?

Key:

Day	NAV	Flow	Return	New base
0	100			
5	102	5	$(102-100)/100 = 0.02$	$=102+5=107$
10	106	-10	$(106-107)/107=-0.0093$	$=106-10=96$
15	100	10	$(100-96)/96 =0.0417$	$=100+10=110$
20	108		$(108-110)/108 =-0.0182$	

Cumulative return over 20-days:

$$(1 + 0.02)(1 - 0.0093)(1 + 0.0417)(1 - 0.0182) = 1.0334$$

EAR:

$$1.0334^{365/20} - 1 = 0.8224$$

Question 3: 18 marks. This question spans this, the next page, and the page after the next.

Below are Sundcai's 2009 and 2010 Financial Statements (in million \$).

Income statement	2009	2010
Revenue	500.00	600.00
Depreciation	30.00	40.00
Other operating costs	350.00	420.00
Interest expenditure	10.00	11.00
Income before taxes	110.00	129.00
Taxes	33.00	38.70
Net Income	77.00	90.30
Dividends	23.10	27.09
Shares outstanding (millions)	80.00	80.00

Balance Sheet	2009	2010
Current assets	250.00	328.21
Net property, plant and equipment	500.00	550.00
Total assets	750.00	878.21
Current liabilities	60.00	120.00
Long-term debt	150.00	155.00
Total liabilities	210.00	275.00
Shareholders equity	540.00	603.21
Total liabilities and equity	750.00	878.21
Capital expenditures	60.00	80.00

(a) (4 marks) Christie Johnson, CFA, has been assigned to analyze Sundanci using the constant dividend growth price/earnings (P/E) ratio model. Johnson estimates that Sundaci's cost of equity is 11% based on past 10 years' returns, estimates that Sundaci's dividend payout ratio will remain the same as the average level of 2009 and 2010, and uses industry growth rate of 9% as the estimate of Sundaci's future constant growth rate of both earnings and dividends. What is Johnson's estimate of the forward P/E ratio based on this information?

Key:

$$\frac{P_0}{E_1} = \frac{1-b}{k-g} \text{ where } 1-b \text{ is dividend payout ratio.}$$

$$\text{2009 payout ratio: } 23.10/77.00 = .3$$

$$\text{2010 payout ratio: } 27.09/90.30 = .3$$

$$\text{Average payout ratio} = .3$$

$$\text{Plugging in } k = .11 \text{ and } g = .09, \frac{P_0}{E_1} = 15$$

(b) (5 marks) Continue with sub-question (a). Johnson wishes to carry out some sensitivity analysis on his conclusion. In particular, he wishes to know whether the forward P/E ratio will decrease or increase when the growth rate is reduced to 7%. He considers two cases: (1) maintain all of his current assumptions in (a) except just revising down the growth rate; (2) maintain the cost of equity and the retention ratio but use a new ROE that is 8 percentage points lower than the 2010 ROE to calculate the permanent growth rate. Explain your answer in each of these two cases (you do not need to show the final P/E numbers, but you need to explain the intuition of the results).

Key:

Case (1): Assumptions in (a) implies an $ROE = \frac{g}{b} = \frac{.09}{1-.3} = 0.13 > k$ of .11. When $ROE > k$, decreasing growth rate will reduce P/E. Therefore, the forward P/E ratio will **decrease** when the growth rate is reduced to 7%.

Case (2): 2010's $ROE = \frac{90.30}{\frac{540+603.21}{2}} = 15.80\%$

An 8 percentage points lower ROE means an ROE of 7.80%, which is $< k$ of .11. When $ROE < k$, decreasing growth rate will increase P/E. Therefore, the forward P/E ratio will **increase** when the growth rate is reduced to 7%.

(c) (4 marks) Net working capital can be calculated as: Current assets – Current liabilities. Based on this formula, what is the free cash flow to equity of Sundaci in 2010?

Key:

Net working capital in 2010: $328.21 - 120.00 = 208.21$

NWC in 2009: $250.00 - 60.00 = 190.00$

Increase in NWC in 2010 = $208.21 - 190.00 = 18.21$

New debt issued in 2010: $155 - 150 = 5$

FCFE = Net income – (Capital expenditures – Depreciation) – Increase in net working capital – (Principal repaid – new debt issued)
= $90.30 - (80.00 - 40.00) - 18.21 + 5.00 = 37.09$

(d) (5 marks) Continue with (c) and use two-staged discounted FCFE approach. Assume the following: (1) the first stage growth rate is the growth rate of net income in 2010, and it will last for 2 years; and (2) the second stage growth rate is 9%. The cost of equity is 11%. What is the intrinsic stock price per share?

Key:

The growth rate of net income in 2010: $\frac{90.30}{77.00} - 1 = 0.1727$

Intrinsic value of equity:

$$\frac{37.09(1.1727)}{1.11} + \frac{37.09(1.1727^2)}{1.11^2} + \left[\frac{37.09(1.1727^2)(1.09)}{.11 - 0.09} \right] / (1.11^2) = 2,336.91$$

Per share value:

$$2,336.91/80 = \$29.21$$

Question 4: 8 marks.

High-frequency traders commonly believe that there are a temporary price impact and a permanent price impact of trades. Assume that for each unit of time, a stock's market price follows:

$$S_t = S_{t-1} - g(v) + \varepsilon_t$$

where $g(v)$ is the permanent price impact, v is the trading volume, and ε is an IID random shock with mean zero and variance σ^2 . The temporary price impact is $h(v)$, which impacts the contemporaneous price received by the trader but not the market price of the next period. The following are the parameters concerning stock XYZ:

$$\begin{aligned} \text{Current (arrival) stock price} &= 80\$ \\ g(v) &= 0.005\$/share \times v \\ h(v) &= 0.003\$/share \times v \\ \sigma &= 0.3\$ \end{aligned}$$

You need to sell a total of 100 shares in times 1 and 2, and decide to sell 70 shares at time 1 and 30 shares at time 2.

(a) (5 marks) What is your total expected proceeds from this selling scheme?

Key:

Trade	P_0	(Expected) Price at time	
		Expected price at 1	Expected price at 2
(70,30)	70	$= 80 - 70(.005) - 70(0.003) = 79.44$	$= 79.44 + 70(0.003) - 30(.005) - 30(0.003) = 79.41$

Expected proceeds:

$$70(\$79.44) + 30(\$79.41) = \$7,943.10$$

(b) (3 marks) Give one reason for the belief in the existence of a permanent price impact and one reason for a temporary price impact.

Key:

Permanent price impact: Market's response to information contained in an order (information-based). For example, in a buy order, informed agents with good news are more likely to buy.

Temporary price impact: price impact due to the depletion of limit orders in the order book. When the depth of limit order book is limited (i.e., there is not enough liquidity), price will temporary swing due to the depletion of limit orders. (You can also talk about something like bid-ask spread, general liquidity, trading volume.)

Question 5: 9 marks. This question spans this and the next page.

Consider the following information regarding the performance of a money manager in a recent month. The table represents the actual return of each asset class of the manager's portfolio in column 1, the fraction of the portfolio allocated to each class in column 2, the benchmark or neutral class allocations in column 3, and the returns of class indices in column 4.

	Actual return (%)	Actual weight	Bogey weight	Index return (%)
Equity	4.5	0.65	0.50	2.4 (S&P60)
Bond	0.5	0.30	0.40	0.7 (Scotia Capital)
Cash	0.25	0.05	0.10	0.25

(a) (3 marks) What's the manager's return in the month? What was her overperformance or underperformance?

Key:

Let's label:

$$\text{Actual return} = R_{P,i}$$

$$\text{Actual weight} = W_{P,i}$$

$$\text{Bogey return} = R_{B,i}$$

$$\text{Bogey index weight} = W_{B,i}$$

$$\text{Manager's return} = \sum_{i=1}^3 w_{P,i} R_{P,i} = 3.0875\%$$

$$\text{Bogey return} = \sum_{i=1}^3 w_{B,i} R_{B,i} = 1.505\%$$

$$\text{An overperformance of } 3.0875\% - 1.505\% = 1.5825\%$$

(b) (3 marks) What was the contribution of security selection to relative performance?

Key: The contribution of security selection is:

$$\sum_{i=1}^3 w_{P,i} (R_{P,i} - R_{B,i}) = [0.65(4.5 - 2.4) + 0.30(0.5 - 0.7) + 0.05(0.25 - 0.25)] / 100 = 1.305\%$$

(c) (3 marks) Within the Equity class, here is the fund's allocation vs. that of the benchmark:

	Actual return (%)	Actual weight	Bogey weight	Bogey Index return (%)
Sector 1	4.8	0.5	0.25	2.5
Sector 2	4.2	0.25	0.25	2.3
Sector 3	4.2	0.25	0.5	2.4

What was the contribution of **sector allocation** to its relative performance within the Equity class?

Key:

Let's label:

Actual return = $R_{P,j}$

Actual weight = $W_{P,j}$

Bogey return = $R_{B,j}$

Bogey index weight = $W_{B,j}$

The contribution of sector allocation is:

$$\sum_{i=1}^3 (w_{Pj} - w_{Bj})R_{Bj} = [(0.5 - 0.25)2.5 + (0.25 - 0.25)2.3 + (0.25 - 0.5)2.4] / 100 = 0.025\%$$

Question 6: 11 marks. Sub-questions (a), (b) and (c) are independent.

(a) (6 marks. **Please specify up to 5 decimal places.**) In months 1, 2 and 3, Mutual Fund X has a historical excess geometric return (as defined by Morningstar) of 2.0%, 0.5%, and -1.3%, respectively. Calculate its MRAR based on these returns. In your work, also show how large is the risk-adjustment of return at the monthly frequency of the fund imposed by Morningstar.

Key:

$$MRAR = \left\{ \frac{1}{T} \sum_{t=1}^T (1 + r_{G,t})^{-2} \right\}^{-\frac{1}{2} \times 12} - 1$$

Month	return	$(1 + r_{G,t})^{-2}$
1	0.02	0.96117
2	0.005	0.99007
3	-0.013	1.02652
Average	0.004	0.99259

$$MRAR = 0.99259^{-6} - 1 = 0.04566$$

$$\text{Certainty equivalent of monthly return: } 0.99259^{-1/2} - 1 = 0.00373$$

$$\text{Risk-adjustment} = 0.004 - 0.00373 = 0.00027$$

(b) (3 marks) Give and briefly explain three differences between hedge funds and mutual funds.

Key:

There are five major categories of differences between the two: transparency, investors, investment strategies, liquidity, and compensation structure. (Talk about any three give you full mark; you don't need to as wordy as I am.)

- Mutual funds are more highly regulated by the SEC and thus are required to be far more transparent. However, hedge funds provide only minimal information about portfolio composition or strategy.
- Investors in hedge funds differ in that investment minimums were traditionally set at \$250,000 to \$1,000,000. While newer hedge funds are starting to reduce the minimum investment to \$25,000, this minimum is outside the reach of many mutual fund investors.
- Mutual funds must provide an investment strategy and are restricted in the use of leverage, short selling, and in their use of derivatives. However, hedge funds are less restricted and frequently make large bets that can result in large losses over the short term.
- Mutual funds are liquid and investors can redeem shares at NAV and have proceeds within seven business days. Conversely, hedge funds often impose lock-up periods as long as several years and require redemption notices of several months even after the lock-up period is over. Thus, hedge funds are far less liquid.
- While mutual funds charge a management fee, hedge funds add an incentive fee as well. This incentive fee is similar to a call option and the portfolio manager receives a "performance" bonus if the portfolio outperforms the chosen benchmark.

(c) (2 marks) The Profitability Fund had NAV per share of \$17.50 on January 1, 2010. On December 31 of the same year the fund's NAV was \$19.47. The fund made two distributions during the year: an income distribution of \$0.75 and a capital gain distribution of \$1.00. Without considering taxes and transactions costs, what rate of return did an investor receive on the Profitability fund last year?

Key:

$$R = (\$19.47 - 17.50 + .75 + 1.00) / \$17.50 = 21.26\%$$

Question 7: 10 marks. Sub-question (c) is independent of sub-questions (a) and (b).

Consider a risky portfolio that offers an expected rate of return of 12% and a standard deviation of 18%. T-bills offer a risk-free 7% rate of return. Assume that an investor has the following utility function:

$$U(r) = E(r) - \frac{1}{2}A\sigma_r^2$$

where r is random return, A is the risk aversion coefficient, and σ_r^2 is the return variance.

(a) (3 marks) If the investor is considering to invest either the risky portfolio or the riskfree asset. Based on this utility function, what is the maximum level of risk aversion for which the risky portfolio is preferred to bills?

Key:

The utility from bills: 0.07

The utility from risky portfolio:

$$0.12 - 0.5A(0.18)^2 = 0.12 - 0.0162A$$

For the portfolio to be preferred to bills, the following inequality must hold:

$$0.12 - 0.0162A > 0.07$$

or $A < 3.09$. A must be less than 3.09 for the risky portfolio to be preferred to bills.

(b) (3 marks) Now set A to 3. What proportion of the total investment should be invested in the risky portfolio in the optimal combined portfolio?

Key: The optimal risky portfolio weight, y , in allocating between one risky and one riskfree asset is

$$\begin{aligned} y &= \frac{E(r_p) - r_f}{A\sigma_p^2} \\ &= \frac{0.12 - 0.07}{3 \times 0.18^2} = 0.5144 \end{aligned}$$

(c) (4 marks) Despite the poor empirical performance of the Capital Asset Pricing Model (CAPM), it is widely used in practice. Based on the course contents delivered throughout the term, give two examples of the poor performance of the CAPM (2 marks), and 2 examples where it is still widely used (2 marks).

Key: This is a relatively open-end question. Poor performance of CAPM: empirical failure (In CAPM testing, intercept tends to be greater than zero, and slope tends to be too flat; R-square too small); too many asset pricing anomalies to be explained by CAPM; etc.

Wide use: cost of equity calculation in valuations; cost of capital calculation; performance metrics in valuing mutual fund performance; evaluating mutual fund managers; mean-variance investment; etc.

Question 8: 9 marks.

Use arrow(s) to link the following six trading strategies with the corresponding anomaly(ies). There may be multiple links for a strategy.

Portfolio Manager	Anomaly
1. (Buffet) high book-to-market ratio	A. Size
2. (Buffet/Dreman) P/E below comparables	B. Value
3. (Dreman/Driehaus) High earnings growth	C. PEAD
4. (Driehaus) Price growth	D. Momentum
5. (Lynch) Firms with low analyst coverage	E. Liquidity
6. (Neff) Low P/E with high earnings growth	F. Reversal
	G. Neglected firm Effect

Key: Matchings:

- 1 with B
- 2 with B
- 3 with C
- 4 with D
- 5 with G
- 6 with B and C.

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- Annuity: $PV = \frac{C}{r} \left(1 - \frac{1}{(1+r)^T} \right)$
- Covariance involving random variables X, Y, Z : $Cov(aX + bY, cZ) = acCov(X, Z) + bcCov(Y, Z)$
- CAPM:

$$- E(r_i) = r_f + \beta_i [E(r_m) - r_f], \quad \beta_i = \frac{Cov(r_i, r_m)}{\sigma_m^2}$$

$$- \text{Return realization: } r_i = r_f + \beta_i(r_m - r_f) + \varepsilon_i$$

- Linear factor models (including single-index model, CAPM, APT). In general, return can be written as:

$$E(r_i) = \alpha_i + \sum_{k=1}^K \beta_{i,k} E(F_k)$$

For example, Fama and French three-factor model:

$$r_i = r_f + \beta_i^M (r_M - r_f) + \beta_i^{SMB} SMB + \beta_i^{HML} HML + \varepsilon_i$$

- When the utility function is

$$U(r) = E(r) - \frac{1}{2} A \sigma_r^2$$

the optimal risky portfolio weight, y , in allocating between one risky and one riskfree asset is

$$y = \frac{E(r_p) - r_f}{A \sigma_p^2}$$

- Geometric mean: $\mu_{GEO} = [\prod_{i=1}^N (1 + r_i)]^{\frac{1}{N}} - 1$
- Trin statistic = $\frac{\text{volume declining}/\# \text{ declining}}{\text{volume advancing}/\# \text{ advancing}}$
- High-frequency traders' objective: $\min_x E(x) + \gamma Var(x)$, where $x \equiv \text{shortfall}$
- Financial statement and Dupont analysis:

$$- ROE = \frac{\text{Net Profit}}{\text{Pretax Profit}} \times \frac{\text{Pretax Profit}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}}$$

$$- EVA = (ROA - k) \times \text{Invested Capital}$$

$$- \text{Quick Ratio} = \frac{\text{Cash} + \text{Marketable securities} + \text{Receivables}}{\text{Current liabilities}} \quad (\text{two related terms: current ratio and cash ratio—equations on your own})$$

$$- \text{Total asset turnover} = \frac{\text{Sales}}{\text{Average total assets}}$$

$$- \text{Inventory turnover} = \frac{\text{COGS}}{\text{Average inventories}}$$

$$- \text{Interest coverage} = \frac{\text{EBIT}}{\text{Interest expense}}$$

$$- ROA = \frac{\text{EBIT}}{\text{Average total assets}}$$

$$- \text{Earnings Yield} = \frac{\text{EPS}}{\text{Price}}$$

- Security Analysis:

- $V_0 = \frac{CF_0(1+g)}{k-g}$
- $\beta_L \approx \beta_U [1 + (1-t)\frac{D}{E}]$
- FCFF = EBIT (1 - tax rate) - (Capital expenditures - Depreciation) - Increase in net working capital
- FCFE = Net income - (Capital expenditures - Depreciation) - Increase in net working capital - (Principal repaid - new debt issued)
- $V_0(\text{growth}) = \frac{CF_1}{k} + PVGO$
- $\frac{P_0}{E_1} = \frac{1-b}{k-g}$
- $\frac{P_0}{BV_0} = \frac{ROE-g}{k-g}$
- $\frac{P_0}{S_0} = \frac{\text{Profit Margin} \cdot (1-b)}{k-g}$

- Portfolio performance measures:

- Sharpe ratio: $SR_p = \mu_p^e / \sigma_p$
- M^2 : $M_p^2 = (SR_p - SR_m) \sigma_m$
- IR (or appraisal ratio): $IR_p = \frac{\alpha_p}{Std(\epsilon_{pt})}$
- TR: $TR_p = \frac{\mu_p^e}{\beta_p}$

- Morningstar's Risk-Adjusted Return:

$$MRAR(\gamma) = \left\{ \frac{1}{T} \sum_{t=1}^T (1 + r_{G,t})^{-\gamma} \right\}^{-\frac{1}{\gamma} \times 12} - 1$$

where γ is set to 2.

- Performance attribution:

Contribution from asset allocation	$(w_{Pi} - w_{Bi})R_{Bi}$
+ Contribution from security selection	$w_{Pi}(R_{pi} - R_{Bi})$
= Total contribution from asset class i	$w_{Pi}R_{Pi} - w_{Bi}R_{Bi}$