AP/ADMS 3530 3.00 Finance

Final Exam Formula Sheet

Time Value of Money

$$\text{FV} = \text{Investment} \times (1+r)^t$$

$$\text{PV} = \frac{\text{Future Value}}{(1+r)^t}$$

$$\text{PV of a perpetuity} = \frac{C}{r}$$

$$\text{PV of a growing perpetuity} = \frac{C_1}{r-g}$$

$$\text{PV of an annuity} = C \times \left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$

$$= C \times \left[\frac{1-(1+r)^{-t}}{r}\right] \quad \text{(easier to calculate)}$$

$$\text{FV of an annuity} = C \times \left[\frac{(1+r)^t - 1}{r}\right]$$

$$\text{PV (Growing Annuity)} = \frac{C_1}{r-g} \times \left[1 - \left(\frac{1+g}{1+r}\right)^t\right]$$

$$\text{FV (Growing Annuity)} = \frac{C_1}{r-g} \times \left[(1+r)^t - (1+g)^t\right]$$

$$\text{Annuity factor} = \left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$

$$= \left[\frac{1-(1+r)^{-t}}{r}\right]$$

(lower version is easier to calculate)

PV (Annuity Due) = (1+r) x (PV of an annuity)

FV (Annuity Due) = (1+r) x (FV of an annuity)

$$1 + \text{Real rate} = \frac{1+\text{Nomimal rate}}{1+\text{Inflation rate}}$$

$$\text{APR} = \text{Period Rate} \times \text{m}$$

$$\text{EAR} = (1+\text{Period Rate})^m - 1$$

$$\text{Period Rate} = (1+\text{EAR})^{\frac{1}{m}} - 1$$

where m = number of periods per year

Bonds and Stocks

Price of a bond = PV (Coupons) + PV (Face Value) = $C \times \left[\frac{1}{r} - \frac{1}{r(1+r)^t} \right] + \frac{\text{Face Value}}{(1+r)^t}$

Current yield = $\frac{\text{Annual Coupon payment}}{\text{Bond price}}$

Yield to maturity (YTM) = interest rate for which the present value of the bond's payments equals the price

Rate of return = $\frac{\text{Coupon income} + \text{Price change}}{\text{Investment}}$

Dividend yield = $\frac{\text{Dividend payment}}{\text{Stock price}}$

Price earnings (P/E) ratio = $\frac{\text{Stock Price}}{\text{Earnings per share}}$

Sustainable growth rate g = ROE × Plowback ratio

<u>Dividend Discount Model</u>: $P_0 = \frac{\text{DIV}_1}{1+r} + \frac{\text{DIV}_2}{(1+r)^2} + \ldots + \frac{\text{DIV}_\text{H}}{(1+r)^H} + \frac{P_H}{(1+r)^H}$

where H is the horizon date, and P_H is the expected price of the stock at date H

<u>Constant-Growth Dividend Discount Model</u>: $P_0 = \frac{\text{DIV}_1}{r-g}$

<u>Expected Rate of Return Formula</u>: $r = \frac{\text{DIV}_1}{P_0} + g$ or $r = \frac{\text{DIV}_1}{P_0} + \frac{P_1 - P_0}{P_0}$

Net Present Value and Other Investment Criteria

Net Present Value: NPV = PV(Cash flows) – Initial Investment (C_0)

Payback = time periods it takes for the cash flows generated by the project to cover the initial investment (C_0)

Internal Rate of Return (IRR) = the discount rate at which project NPV is zero

Profitability Index: PI = $\dfrac{\text{NPV}}{\text{Initial Investment }(C_0)}$

Equivalent Annual Cost = $\dfrac{\text{PV of Costs}}{\text{Annuity Factor}}$

Capital Budgeting

Incremental cash flow = cash flow with project – cash flow without project

Total project cash flows = cash flow from investment in plant and equipment
+ cash flow from investment in working capital
+ cash flow from operations, including
- operating cash flows
- CCA tax shield

There are three equivalent ways to compute the cash flow from operations:

1) *Method 1*: Cash flow from operations = revenues – cash expenses – taxes paid

2) *Method 2*: Cash flow from operations = net profit + depreciation

3) *Method 3*: Cash flow from operations = (revenues – cash expenses) × (1 − tax rate)
+ (depreciation × tax rate)

Taxable income = revenues – expenses – CCA
CCA tax shield = CCA × tax rate

Present value of CCA tax shield with the half-year rule = $\left[\dfrac{CdT_c}{r+d}\right]\left[\dfrac{1+0.5r}{1+r}\right]-\left[\dfrac{SdT_c}{d+r}\right]\left[\dfrac{1}{(1+r)^t}\right]$

NPV = Total PV excluding CCA tax shield + PV of CCA tax shield

Accounting break-even level of revenues =

$$\frac{\text{Fixed costs} + \text{Depreciation}}{\text{Additional profit from each additional dollar of sales}}$$

NPV break-even level of sales = The sales level at which NPV is zero

The degree of operating leverage (DOL) = $\frac{\text{Percentage change in profits}}{\text{Percentage change in sales}}$

Alternatively: $\text{DOL} = 1 + \frac{\text{Fixed Costs} + \text{Depreciation}}{\text{Pretax Profits}}$

Risk and Return

Rate of return on any security = interest rate on Treasury bills + security risk premium

Expected market return = interest rate on Treasury bills + normal market risk premium

Mean (or expected) return = probability-weighted average of possible returns

Variance = σ^2 = probability-weighted average of squared deviations around the mean

Sample variance = σ^2 = sum of squared deviations around the average return, divided by the number of observations minus 1

Standard deviation = σ = $\sqrt{\text{Variance}}$

Suppose a portfolio consists of only **two** assets:

1) Portfolio rate of return = $r_P = x_1 r_1 + x_2 r_2$,
where x_1 and x_2 are fractions of the portfolio in the first and second assets, respectively, and r_1 and r_2 are the realized rates of return on the first and second assets, respectively.

2) Portfolio expected rate of return $= r_P = x_1 r_1 + x_2 r_2$,
where x_1 and x_2 are fractions of the portfolio in the first and second assets, respectively, and r_1 and r_2 are the expected rates of return on the first and second assets, respectively.

3) Portfolio standard deviation $= \sigma_P = \sqrt{x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2\rho\sigma_1\sigma_2}$,
where x_1 and x_2 are fractions of the portfolio in the first and second assets, respectively, σ_1 and σ_2 are standard deviations of the returns on the first and second assets, respectively, and ρ is the correlation coefficient between the two assets.

Correlation: $\rho_{j,m} = \frac{\text{Cov}(r_j, r_m)}{\sigma_j \sigma_m}$

Covariance: $\text{Cov}(r_j, r_m) = \rho_{j,m}\sigma_j\sigma_m$

Covariance: the probability-weighted average of cross-products of the deviations from the respective means

Beta of stock *j*: $\beta_j = \frac{\rho_{j,m}\sigma_j}{\sigma_m} = \frac{\text{Cov}(r_j, r_m)}{\sigma_m^2}$

The capital asset pricing model (CAPM):

Expected return = Risk-free rate + Asset risk premium ➔ $r = r_f + \beta(r_m - r_f)$.

Cost of Capital

After-tax cost of debt = pretax cost of debt × (1 – tax rate) = $r_{\text{debt}} \times (1 - T_c)$

WACC = $[\frac{D}{V} \times (1 - T_c) r_{\text{debt}}] + [\frac{E}{V} \times r_{\text{equity}}]$, where $V = D + E$.

If firm has a third type of securities, e.g. preferred stocks, in its capital structure,

WACC = $[\frac{D}{V} \times (1 - T_c) \times r_{\text{debt}}] + [\frac{P}{V} \times r_{\text{preferred}}] + [\frac{E}{V} \times r_{\text{equity}}]$, where $V = D + P + E$.

$r_{\text{equity}} = r_f + \beta(r_m - r_f)$; or $r_{\text{equity}} = \frac{\text{DIV}_1}{P_0} + g$.

$r_{\text{preferred}} = \frac{\text{Dividend}}{\text{Price of preferred}}$

Working Capital Management and Short-Term Financial Decisions

Cash conversion cycle = (inventory period + trade receivables period) – trade payables period

Inventory period = $\frac{\text{Average inventory}}{\text{Annual cost of sales}/365}$

Trade receivables period = $\frac{\text{Average trade receivables}}{\text{Annual sales}/365}$

Trade payables period = $\frac{\text{Average trade payables}}{\text{Annual cost of goods sold}/365}$

For bank loans (where *m* is the number of periods per year):

1) Simple interest:

$$\text{Effective annual rate} = (1+\frac{\text{quoted annual interest rate}}{m})^m - 1.$$

2) Discount interest:

$$\text{Effective annual rate} = \left(\frac{1}{1-\frac{\text{quoted annual interest rate}}{m}}\right)^m - 1.$$

3) Interest with compensating balances:

$$\text{Effective annual rate} = (1+\frac{\text{actual interest paid}}{\text{borrowed funds available}})^m - 1.$$

For inventories, total costs = order costs + carrying costs

$$\text{Economic order quantity (EOQ)} = \sqrt{\frac{2\times\text{annual sales}\times\text{cost per order}}{\text{carrying cost}}}$$

$$\text{Initial cash balance} = \sqrt{\frac{2\times\text{annual cash outflows}\times\text{cost per sale of securities}}{\text{interest rate}}}$$

$$\text{For trade credit, effective annual rate} = (1+\frac{\text{discount}}{\text{discounted price}})^{\frac{365}{\text{extra days credit}}} - 1.$$

The break-even probability of collection is the probability p that makes the expected profit from granting credit, $p\times\text{PV(REV} - \text{COST)} - (1-p)\times\text{PV(COST)}$, equal to zero.

When there is **no** possibility of repeat order, break-even probability of collection $= p = \frac{\text{PV(COST)}}{\text{PV(REV)}}$.