EQUATION SHEET
Principles of Finance
Make-Up Exam

FINANCIAL STATEMENT ANALYSIS

Net cash flow = Net income + Depreciation and amortization

Net working capital = NWC = Current assets – Current liabilities

$$\begin{matrix}\text{Net operating}\\ \text{working}\end{matrix} = \text{NOWC} = \begin{pmatrix}\text{Current assets}\\ \text{required for operations}\end{pmatrix} - \begin{pmatrix}\text{Non} - \text{interest} - \text{bearing}\\ \text{current liabilities}\end{pmatrix}$$

Operating cash flow = NOI(1 – Tax rate) + Depreciation and amortization

Free cash flow = FCF = Operating cash flow – Investments
= Operating cash flow – (Δ in fixed assets + Δ NOWC)

Economic value added = EVA = NOI(1- Tax rate) – [(Invested capital) x (After-tax cost of capital)]

$$\text{DuPont equation -- ROA} = \text{Net profit margin} \times \text{Total assets turnover}$$
$$= \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total assets}}$$

TIME VALUE OF MONEY

Lump-sum (single) payments:

$$FV_n = PV(1+r)^n$$

$$PV = \frac{FV_n}{(1+r)^n} = FV_n\left[\frac{1}{(1+r)^n}\right]$$

Annuity payments:

$$FVA_n = PMT\left[\sum_{t=0}^{n-1}(1+r)^t\right] = PMT\left[\frac{(1+r)^n - 1}{r}\right]$$

$$FVA(DUE)_n = PMT\left[\sum_{t=1}^{n}(1+r)^t\right] = PMT\left[\left\{\frac{(1+r)^n - 1}{r}\right\}\times(1+r)\right]$$

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

$$PVA(DUE)_n = PMT\left[\left\{\frac{1 - \frac{1}{(1+r)^n}}{r}\right\}\times(1+r)\right]$$

Perpetuities:

$$\text{Present value of a perpetuity} = \text{PVP} = \frac{\text{Payment}}{\text{Interest rate}} = \frac{\text{PMT}}{r}$$

Uneven cash flow streams:

$$\text{PV} = CF_1\left[\frac{1}{(1+r)^1}\right] + \ldots + CF_n\left[\frac{1}{(1+r)^n}\right] = \sum_{t=1}^{n} CF_t\left[\frac{1}{(1+r)^t}\right]$$

$$FV_n = CF_1(1+r)^{n-1} + \ldots + CF_n(1+r)^0 = \sum_{t=0}^{n-1} CF_t(1+r)^t$$

Interest rates (yields):

$$\text{Periodic rate} = r_{PER} = \frac{\text{Stated annual interest rate}}{\text{Number of interest payments per year}} = \frac{r_{SIMPLE}}{m}$$

$$\begin{matrix}\text{Number of} \\ \text{interest periods}\end{matrix} = n_{PER} = \begin{pmatrix}\text{Number} \\ \text{of years}\end{pmatrix} \times \begin{pmatrix}\text{Number of interest} \\ \text{payments per year}\end{pmatrix} = n_{YRS} \times m$$

$$\begin{matrix}\text{Effective} \\ \text{annual rate}\end{matrix} = \text{EAR} = r_{EAR} = \left(1 + \frac{r_{SIMPLE}}{m}\right)^m - 1.0 = (1 + r_{PER})^m - 1.0$$

Annual percentage rate = APR = r_{PER} x m

COST OF MONEY

Dollar return = (Dollar income) + (Capital gains)
= (Dollar income) + (Ending value – Beginning value)

$$\text{Yield} = \frac{\text{Dollar return}}{\text{Beginning value}} = \frac{\text{Dollar income} + \text{Capital gains}}{\text{Beginning value}}$$

$$= \frac{\text{Dollar income} + (\text{Ending value} - \text{Beginning value})}{\text{Beginning value}}$$

Rate of return = r = Risk-free rate + Risk premium

Rate of return = r = r_{RF} + RP = r_{RF} + [DRP + LP + MRP]
= [r* + IP] + [DRP + LP + MRP]

$r_{Treasury}$ = r_{RF} + MRP = [r* + IP] + MRP

$$\begin{matrix}\text{Yield on a} \\ \text{2-year bond}\end{matrix} = \frac{\begin{pmatrix}\text{Interest rate} \\ \text{in Year 1}\end{pmatrix} + \begin{pmatrix}\text{Interest rate} \\ \text{in Year 2}\end{pmatrix}}{2} = \frac{R_1 + R_2}{2}$$

Valuation Concepts

General valuation model:

$$V_0 = \text{PV of CF} = \frac{\hat{CF}_1}{(1+r)^1} + \ldots + \frac{\hat{CF}_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\hat{CF}_t}{(1+r)^t}$$

Bond Valuation:

$$V_d = \frac{INT}{(1+r_d)^1} + \ldots + \frac{INT}{(1+r_d)^N} + \frac{M}{(1+r_d)^N} = INT\left[\frac{1 - \frac{1}{(1+r_d)^N}}{r_d}\right] + M\left[\frac{1}{(1+r_d)^N}\right]$$

$$V_d = \frac{INT}{(1+YTM)^1} + \ldots + \frac{INT}{(1+YTM)^N} + \frac{M}{(1+YTM)^N}$$ YTM = Yield to maturity

$$V_d = \frac{INT}{(1+YTC)^1} + \ldots + \frac{INT}{(1+YTC)^N} + \frac{M}{(1+YTC)^N}$$ YTC = Yield to call

$$\text{Approximate yield to maturity} = \frac{INT + \left[\frac{M - V_B}{N}\right]}{\left[\frac{2(V_B) + M}{3}\right]}$$

To approximate YTC, substitute the call price for M and the time to call for N

$$YTM = \text{Bond yield} = \text{Current yield} + \text{Capital gains yield} = \left[\frac{INT}{V_{d0}}\right] + \left[\frac{V_{d1} - V_{d0}}{V_{d0}}\right]$$

Stock Valuation:

$$V_s = P_0 = \frac{\hat{D}_1}{(1+r_s)^1} + \ldots + \frac{\hat{D}_\infty}{(1+r_s)^\infty} = \sum_{t=1}^{\infty} \frac{\hat{D}_t}{(1+r_s)^t}$$

$$\text{Constant growth stock}: = P_0 = \frac{D_0(1+g)}{r_s - g} = \frac{\hat{D}_1}{r_s - g}$$

$$\text{Nonconstant growth stock} = P_0 = \frac{\hat{D}_1}{(1+r_s)^1} + \frac{\hat{D}_2}{(1+r_s)^2} + \cdots + \frac{\hat{D}_n + \hat{P}_n}{(1+r_s)^n}$$ where $\hat{P}_n = \frac{\hat{D}_n(1+g_{norm})}{r_s - g_{norm}}$

g_{norm} = normal, or constant growth

$$r_s = \text{Stock yield} = \left(\text{Dividend yield}\right) + \left(\text{Capital gains yield}\right) = \left(\frac{\hat{D}_1}{P_0}\right) + \left(\frac{\hat{P}_1 - P_0}{P_0}\right)$$

Risk and Rates of Return

$$\text{Expected rate of return} = \hat{r} = Pr_1 r_1 + Pr_2 r_2 + \ldots + Pr_n r_n = \sum_{i=1}^{n} Pr_i r_i$$

$$\text{Variance} = \sigma^2 = \sum_{i=1}^{n} (r_i - \hat{r})^2 Pr_i r_i$$

$$\text{Standard deviation} = \sigma = \sqrt{\sigma^2} = \sqrt{\sum_{i=1}^{n} (r_i - \hat{r})^2 Pr_i}$$

$$\text{Coefficient of variation} = CV = \frac{\text{Risk}}{\text{Return}} = \frac{\sigma}{\hat{r}}$$

$$\hat{r}_P = w_1\hat{r}_1 + w_2\hat{r}_2 + \ldots + w_N\hat{r}_N = \sum_{j=1}^{N} w_j\hat{r}_j$$

$$\beta_P = w_1\beta_1 + w_2\beta_2 + \ldots + w_N\beta_N = \sum_{j=1}^{N} w_j\beta_j$$

$$\text{Return} = \text{Risk-free return} + \text{Risk Premium} = r_{RF} + RP$$

$$RP = \text{Return} - r_{RF}$$

$$RP_{Investment} = RP_M \times \beta_{Investment}$$

$$\begin{aligned} r_{Investment} &= r_{RF} + RP_{Investment} \\ &= r_{RF} + (RP_M)\beta_{Investment} \\ &= r_{RF} + (r_M - r_{RF})\beta_{Investment} \end{aligned}$$

Capital Budgeting

Evaluation techniques:

$$\text{Payback} = \left(\begin{array}{c}\text{Number of years before} \\ \text{full recovery of} \\ \text{original investment}\end{array}\right) + \left(\frac{\begin{array}{c}\text{Unrecovered cost at start} \\ \text{of full-recovery year}\end{array}}{\begin{array}{c}\text{Total cash flow during} \\ \text{full-recovery year}\end{array}}\right)$$

Tradtional payback—unadjusted cash flows are used
Discounted payback—discounted cash flows, or present values, are used

$$NPV = CF_0 + \frac{\hat{CF}_1}{(1+r)^1} + \ldots + \frac{\hat{CF}_2}{(1+r)^n} = \sum_{t=0}^{n} \frac{\hat{CF}_2}{(1+r)^t}$$

$$CF_0 + \frac{\hat{CF}_1}{(1+IRR)^1} + \frac{\hat{CF}_2}{(1+IRR)^2} + \ldots + \frac{\hat{CF}_n}{(1+IRR)^n} = CF_0 + \sum_{t=1}^{n} \frac{\hat{CF}_t}{(1+IRR)^t} = 0$$

IRR = internal rate of return

$$\text{MIRR: PV of cash outflow} = \frac{TV}{(1+MIRR)^n}$$

$$\sum_{t=0}^{n} \frac{COF_t}{(1+r)^t} = \frac{\sum_{t=0}^{n} CIF_t (1+r)^{n-t}}{(1+MIRR)^n}$$

Cash Flow Estimation

$$\begin{aligned} \text{Incremental operating cash flow}_t &= \Delta\text{Cash revenues}_t - \Delta\text{Cash expenses}_t - \Delta\text{Taxes}_t \\ &= (\Delta\text{Cash revenues}_t - \Delta\text{Cash expenses}_t)(1 - T) + \Delta\text{Depreciation}_t(T) \\ &= \Delta NI_t + \Delta\text{Depreciation}_t = \Delta EBT_t(1 - T) + \Delta\text{Depreciation}_t \end{aligned}$$

Cost of Capital

$$\begin{matrix}\text{After} - \text{tax component} \\ \text{cost of debt}\end{matrix} = \begin{pmatrix}\text{Bondholders' required} \\ \text{rate of return}\end{pmatrix} - \begin{pmatrix}\text{Tax savings} \\ \text{associated with debt}\end{pmatrix}$$

$$= r_d - r_d \times T = r_d(1 - T)$$

$$\begin{matrix}\text{Component cost} \\ \text{of preferred stock}\end{matrix} = r_{ps} = \frac{D_{ps}}{P_0(1 - F)} = \frac{D_{ps}}{NP_0}$$

$$\begin{matrix}\text{Component cost} \\ \text{of retained earnings}\end{matrix} = r_s = r_{RF} + (r_M - r_{RF})\beta = \frac{\hat{D}_1}{P_0} + g = \hat{r}_s$$

$$\begin{matrix}\text{Component cost} \\ \text{of new equity}\end{matrix} = r_e = \frac{\hat{D}_1}{P_0(1 - F)} + g = \frac{\hat{D}_1}{NP} + g$$

$$\text{WACC} = \left[\begin{pmatrix}\text{Proportion} \\ \text{of} \\ \text{debt}\end{pmatrix} x \begin{pmatrix}\text{After-tax} \\ \text{cost of} \\ \text{debt}\end{pmatrix}\right] + \left[\begin{pmatrix}\text{Proportion} \\ \text{of preferred} \\ \text{stock}\end{pmatrix} x \begin{pmatrix}\text{Cost of} \\ \text{preferred} \\ \text{stock}\end{pmatrix}\right] + \left[\begin{pmatrix}\text{Proportion} \\ \text{of common} \\ \text{equity}\end{pmatrix} x \begin{pmatrix}\text{Cost of} \\ \text{common} \\ \text{equity}\end{pmatrix}\right]$$

$$= w_{dT} r_{dT} + w_{ps} r_{ps} + w_s (r_s \text{ or } r_e)$$

$$\begin{matrix}\text{WACC} \\ \text{Break Point}\end{matrix} = \frac{\text{Total dollar amount of lower cost of capital of a given type}}{\text{Proportion of this type of capital in the capital structure}}$$

Capital Structure

$$\begin{matrix}\text{Degree of} \\ \text{operating leverage}\end{matrix} = \text{DOL} = \frac{\text{Percentage change in NOI}}{\text{Percentage change in sales}} = \frac{\left(\frac{\Delta \text{NOI}}{\text{NOI}}\right)}{\left(\frac{\Delta \text{Sales}}{\text{Sales}}\right)} = \frac{\left(\frac{\Delta \text{EBIT}}{\text{EBIT}}\right)}{\left(\frac{\Delta \text{Sales}}{\text{Sales}}\right)} = \frac{\left(\frac{\Delta \text{EBIT}}{\text{EBIT}}\right)}{\left(\frac{\Delta Q}{Q}\right)}$$

$$\text{DOL} = \frac{(Q \times P) - (Q \times V)}{(Q \times P) - (Q \times V) - F} = \frac{S - VC}{S - VC - F} = \frac{\text{Gross profit}}{\text{EBIT}}$$

$$\begin{matrix}\text{Degree of} \\ \text{financial leverage}\end{matrix} = \text{DFL} = \frac{\text{Percent change in EPS}}{\text{Percent change in EBIT}} = \frac{\left(\frac{\Delta \text{EPS}}{\text{EPS}}\right)}{\left(\frac{\Delta \text{EBIT}}{\text{EBIT}}\right)}$$

$$\text{DFL} = \frac{\text{EBIT}}{\text{EBIT} - I} = \frac{\text{EBIT}}{\text{EBIT} - [\text{Financial BEP}]}$$

When there is no preferred stock.

$$\begin{matrix}\text{Degree of} \\ \text{total leverage}\end{matrix} = \text{DTL} = \frac{\left(\frac{\Delta \text{EPS}}{\text{EPS}}\right)}{\left(\frac{\Delta \text{Sales}}{\text{Sales}}\right)} = \frac{\left(\frac{\Delta \text{EBIT}}{\text{EBIT}}\right)}{\left(\frac{\Delta \text{Sales}}{\text{Sales}}\right)} x \frac{\left(\frac{\Delta \text{EPS}}{\text{EPS}}\right)}{\left(\frac{\Delta \text{EBIT}}{\text{EBIT}}\right)} = \text{DOL x DFL}$$

$$\text{DTL} = \frac{\text{Gross Profit}}{\text{EBIT}} \text{ x } \frac{\text{EBIT}}{\text{EBIT - [Financial BEP]}} = \frac{\text{Gross Profit}}{\text{EBIT - [Financial BEP]}}$$

$$= \frac{\text{S - VC}}{\text{EBIT - I}} = \frac{\text{Q(P - V)}}{\text{[Q(P - V) - F] - I}}$$

Dividend Policy

$$\begin{matrix}\text{Dollars transferred from} \\ \text{retained earnings}\end{matrix} = \left[\begin{pmatrix}\text{Number of shares} \\ \text{outstanding}\end{pmatrix} \times \begin{pmatrix}\text{Percent stock dividend} \\ \text{stated as a decimal}\end{pmatrix}\right] \times \begin{pmatrix}\text{Market price} \\ \text{of the stock}\end{pmatrix}$$

Planning and Control

$$\text{Full capacity sales} = \frac{\text{Sales level}}{\begin{pmatrix}\text{Percent of capacity used} \\ \text{to generate sales level}\end{pmatrix}}$$

Operating Breakeven Analysis

$$\begin{matrix}\text{Sales} \\ \text{revenues}\end{matrix} = \begin{matrix}\text{Total operating} \\ \text{costs}\end{matrix} = \begin{matrix}\text{Total} \\ \text{variable costs}\end{matrix} + \begin{matrix}\text{Total} \\ \text{fixed costs}\end{matrix}$$

$$(P \times Q) = TOC = (V \times Q) + F$$

$$Q_{OpBE} = \frac{F}{P - V} = \frac{F}{\text{Contribution margin}} \qquad S_{OpBE} = \frac{F}{1 - \left(\frac{V}{P}\right)} = \frac{F}{\text{Gross profit margin}}$$

Degree of operating leverage—see the equations in the capital structure section

Financial Breakeven Analysis

$$\text{EPS} = \frac{\text{Earnings available to common stockholders}}{\text{Number of common shares outstanding}} = \frac{(\text{EBIT} - I)(1 - T) - D_{ps}}{\text{Shrs}_C} = 0$$

$$\text{EBIT}_{FinBE} = I + \frac{D_{ps}}{(1 - T)}$$

Degree of financial leverage—see the equations in the capital structure section

Degree of total leverage—see the equations in the capital structure section

Rates/Taxes

$$\begin{matrix}\text{Equivalent pretax yield} \\ \text{on a taxable investment}\end{matrix} = \frac{\text{Yield on tax-free investment}}{\text{1 - Marginal tax rate}}$$

$$\begin{matrix}\text{Equivalent yield on} \\ \text{tax-free investment}\end{matrix} = \begin{matrix}\text{After-tax yield on a} \\ \text{taxable investment}\end{matrix} = \begin{pmatrix}\text{Pretax yield on} \\ \text{taxable investment}\end{pmatrix} \times \text{(1 - Marginal tax Rate)}$$