EQUATION SHEET
Principles of Finance
Final Exam

FINANCIAL STATEMENT ANALYSIS

Net cash flow = Net income + Depreciation and amortization

DuPont equation: ROA = Net profit margin × Total assets turnover

$$= \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total assets}}$$

DuPont equation: ROE = ROA × Equity multiplier

$$= \frac{\text{Net income}}{\text{Total assets}} \times \frac{\text{Total assets}}{\text{Common equity}}$$

$$= \left[\begin{matrix}\text{Profit}\\ \text{margin}\end{matrix} \times \begin{matrix}\text{Total assets}\\ \text{turnover}\end{matrix}\right] \times \begin{matrix}\text{Equity}\\ \text{multiplier}\end{matrix}$$

$$= \left[\frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total assets}}\right] \times \frac{\text{Total assets}}{\text{Common equity}}$$

THE FINANCIAL ENVIRONMENT

Net proceeds from issue = Amount of issue – Flotation costs
= (Amount of issue) x (1 – Flotation costs)

$$\text{Amount of issue} = \frac{\text{Amount needed}}{(1-\text{Flotation costs})} = \frac{(\text{Net proceeds}) + (\text{Other costs})}{(1-\text{Flotation costs})}$$

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:

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

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

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

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

Perpetuities:

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

Uneven cash flow streams:

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

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

Interest rates (yields):

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

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

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

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

COST OF MONEY

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

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

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

Rate of return = r = Risk-free rate + Risk premium = r = r_{RF} + RP

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

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

Valuation Concepts

General valuation model:

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

Bond Valuation:

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

Adjust r_d, N, and INT if interest is paid more than once per year.

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

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

$$r_d = YTM = \text{Bond yield} = \text{Current yield} + \text{Capital gains yield} = \frac{INT}{V_{d0}} + \frac{V_{d1} - V_{d0}}{V_{d0}}$$

Stock Valuation:

$$\text{Stock value} = V_s = \hat{P}_0 = \frac{\hat{D}_1}{(1+r_s)^1} + \cdots + \frac{\hat{D}_\infty}{(1+r_s)^\infty} = \sum_{t=1}^{\infty} \frac{\hat{D}_t}{(1+r_s)^t}$$

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

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

g_{norm} = normal, or constant growth

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

$$\text{Economic value added} = EVA = EBIT(1-T) - \left[\left(\text{Average cost of funds}\right) \times \left(\text{Invested capital}\right)\right]$$

Risk and Rates of Return

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

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

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

$$\text{Estimated } \sigma = s = \sqrt{\frac{\sum_{t=1}^{n} (\ddot{r}_t - \bar{r})^2 Pr_t}{n-1}}$$

$$\bar{r} = \frac{\ddot{r}_1 + \ddot{r}_2 + \cdots + \ddot{r}_n}{n} = \frac{\sum_{t=1}^{n} \ddot{r}_t}{n}$$

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

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

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

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

$$\begin{aligned} RP &= \text{Return} - r_{RF} \\ RP_{\text{Investment}} &= RP_M \times \beta_{\text{Investment}} \end{aligned}$$

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

Capital Budgeting

Evaluation techniques:

$$\text{Payback} = \begin{pmatrix} \text{Number of years just} \\ \text{before full recovery of} \\ \text{original investment} \end{pmatrix} + \left(\frac{\text{Amount of the initial investment that is unrecovered at the start of therecovery year}}{\text{Total cash flow generated during the recovery year}} \right)$$

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

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

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

IRR = internal rate of return

$$\text{MIRR: PV of cash outflows} = \frac{\text{FV of cash inflows}}{(1+MIRR)^n} = \frac{TV}{(1+MIRR)^n} \quad ; \qquad \sum_{t=0}^{n} \frac{COF_t}{(1+r)^t} = \frac{\sum_{t=0}^{n} CIF_t (1+r)^t}{(1+MIRR)^n}$$

Cash Flow Estimation

Net cash flow = Net income + Depreciation = Return *on* capital + Return *of* capital

$$\text{Supplemental operating cash flow}_t = \Delta\text{Cash revenues}_t - \Delta\text{Cash expenses}_t - \Delta\text{Taxes}_t$$

$$= \Delta\text{NOI}_t \times (1-T) + \Delta\text{Depr}_t$$

$$= (\Delta\text{NOI}_t + \Delta\text{Depr}_t) \times (1-T) + T(\Delta\text{Depr}_t)$$

Cost of Capital

$$\begin{matrix}\text{After-tax component}\\ \text{cost of debt}\end{matrix} = \begin{pmatrix}\text{Bondholders' required}\\ \text{rate of return}\end{pmatrix} - \begin{pmatrix}\text{Tax savings}\\ \text{associated with debt}\end{pmatrix} = r_d - r_d \times T = r_d(1-T) = \text{YTM}(1-T)$$

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

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

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

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

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

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

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

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

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

$$Q_{OpBE} = \frac{F}{P-V} = \frac{F}{\text{Contribution margin}}$$

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

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

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

Financial Breakeven Analysis

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

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

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

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

$$\text{Financial BEP} = I + \frac{Dps}{(1 - T)}$$

$$DFL = \frac{EBIT}{EBIT - I}$$

When there is no preferred stock.

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

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

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

When there is no preferred stock.