FOUNDATIONS OF FINANCE
Fall 2018
Final Exam Formula Sheet

Time value of money:

$$FV = PV(1+r)^t \quad PV = \frac{FV}{(1+r)^t} \quad t = \frac{\ln\left(FV/PV\right)}{\ln(1+r)} \quad r = \left(\frac{FV}{PV}\right)^{1/t} - 1$$

$$FV = PV\,e^{rt} \quad PV = FV\,e^{-rt} \quad t = \frac{\ln\left(FV/PV\right)}{r} \quad r = \frac{\ln\left(FV/PV\right)}{t}$$

$$V(\text{annuity}) = C\left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right] \quad V(\text{perpetuity}) = \frac{C}{r} \quad \text{annualized HPR} = \left(\frac{V_t}{V_0}\right)^{1/t} - 1 \quad \sum_{t=0}^{T}\frac{C_t}{(1+IRR)^t} = 0$$

$$EAR = \left(1 + APR/m\right)^m - 1 \quad APR = m[(1+EAR)^{1/m} - 1] \quad APR = (\text{rate per period})(\text{\# of periods per year})$$

$$EAR = e^{APR} - 1 \quad APR = \ln(1+EAR)$$

$$\bar{r} = \frac{1}{T}\sum_{t=1}^{T} r_t \quad (\text{arithmetic average}) \qquad \mathrm{r} = \left(\prod_{t=1}^{T}(1+r_t)\right)^{1/T} - 1 \quad (\text{geometric average})$$

Portfolio theory (statistics):

$$E[r_i] = \sum_{s=1}^{S} p(s) r_i(s) \quad \text{var}[r_i] = \sigma_i^2 = E[(r_i(s) - E[r_i])^2] = \sum_{s=1}^{S} p(s)(r_i(s) - E[r_i])^2$$

$$\text{cov}(r_i, r_j) = E[(r_i - E[r_i])(r_j - E[r_j])] = \sum_{s=1}^{S} p(s)(r_i(s) - E[r_i])(r_j(s) - E[r_j]) \quad \text{corr}[r_i, r_j] = \rho_{ij} = \frac{\text{cov}[r_i, r_j]}{\sigma_i \sigma_j}$$

$$r_p = w r_1 + (1-w) r_2 \quad E[r_p] = wE[r_1] + (1-w)E[r_2] \quad w = \frac{E[r_p] - E[r_2]}{E[r_1] - E[r_2]}$$

$$\sigma_p^2 = w^2\sigma_1^2 + (1-w)^2\sigma_2^2 + 2w(1-w)\rho_{12}\sigma_1\sigma_2 \quad \sigma_p = \sqrt{\sigma_p^2} \quad w_{MVP} = \frac{\sigma_2^2 - \rho_{12}\sigma_1\sigma_2}{\sigma_1^2 + \sigma_2^2 - 2\rho_{12}\sigma_1\sigma_2}$$

$$\sigma_p = w\sigma_1 + (1-w)\sigma_2 \quad (\rho_{12} = 1) \quad \sigma_p = | w\sigma_1 - (1-w)\sigma_2 | \quad (\rho_{12} = -1)$$

$$\text{cov}[wr_1 + (1-w)r_2, vr_1 + (1-v)r_2] = wv\sigma_1^2 + (1-w)(1-v)\sigma_2^2 + [w(1-v) + (1-w)v]\rho_{12}\sigma_1\sigma_2 \quad (2\,\text{assets})$$

$$r_p = \sum_{i=1}^{N} w_i r_i \quad E[r_p] = \sum_{i=1}^{N} w_i E[r_i] \quad \sigma_p^2 = \sum_{i=1}^{N} w_i^2\sigma_i^2 + 2\sum_{i=1}^{N}\sum_{j>i}^{N} w_i w_j \rho_{ij}\sigma_i\sigma_j \quad \sum_{i=1}^{N} w_i = 1 \quad (\text{N assets})$$

$$\text{CAL}: E[r_p] = r_f + SR_i\sigma_p \quad SR_i = \frac{E[r_i] - r_f}{\sigma_i} \quad \mathrm{E}[\mathrm{r_p}] = \mathrm{r_f} + w\,\mathrm{E}[\mathrm{r_i} - \mathrm{r_f}] \quad \sigma_p = |w|\,\sigma_i$$

CAPM:

$$\text{SML: } E[r_i] = r_f + \beta_i(E[r_M] - r_f) \quad \beta_i = \frac{\text{cov}[R_i, R_M]}{\sigma_M^2} = \frac{\text{cov}[r_i, r_M]}{\sigma_M^2} = \rho_{iM}\frac{\sigma_i}{\sigma_M} \quad R_i = r_i - r_f \quad \beta_p = \sum_{i=1}^{N} w_i \beta_i$$

$$r_i = r_f + \beta_i(r_M - r_f) + e_i \quad \text{E}[e_i] = 0 \quad \text{cov}[e_i, r_M] = 0 \quad \text{var}[r_i] = \beta_i^2\,\text{var}[r_M] + \text{var}[e_i]$$

$$\text{CML: } E[r_p] = r_f + \left(\frac{E[r_\text{M}] - r_f}{\sigma_\text{M}}\right)\sigma_p \quad \text{SCL: } r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{M,t} - r_{f,t}) + e_{i,t}$$

Equity valuation:

$$V_0 = \frac{E[D_1] + E[P_1]}{1+k} \quad k = \frac{E[D_1] + E[P_1]}{V_0} - 1 \quad E[HPR] = \frac{E[D_1] + E[P_1]}{P_0} - 1$$

$$\text{DDM}: \quad V_0 = \sum_{t=1}^{\infty}\frac{E[D_t]}{(1+k)^t} \quad V_0 = \frac{D_0}{k} \quad V_0 = \frac{D_0(1+g)}{k-g} = \frac{E[D_1]}{k-g} \quad PVGO = \text{P}_0 - \frac{E_1}{k}$$

$$\text{D}_0 = (1-b)E_0 \quad \frac{P_0}{E_0} = \frac{(1+g)(1-b)}{k-g} \quad g = b(ROE) \quad \frac{P_0}{E_1} = \frac{1-b}{k - b(ROE)} \quad \frac{\partial P_0/E_1}{\partial b} = \frac{ROE - k}{[k - b(ROE)]^2}$$

Fixed income:

$$\text{P}_0 = \sum_{t=1}^{T}\frac{\text{C}_\text{t}}{(1+r)^t} + \frac{\text{F}_\text{T}}{(1+r)^T} \quad YTM = r \text{ (annual pay)} \quad YTM = 2r \quad EAY = (1+r)^2 - 1 \text{ (semi-annual pay)}$$

$$f_n = \frac{P_{n-1}}{P_n} - 1 = \frac{(1+y_n)^n}{(1+y_{n-1})^{n-1}} - 1 \quad f_{n,t} \approx E_t[y_{1,t+n-1}] \quad 1 + y_{n,t} \approx \left(\prod_{i=0}^{n-1}(1 + E_t[y_{1,t+i}])\right)^{1/n} \text{ (EH)}$$

$$1 + y_{n,t} \approx \left(\prod_{i=0}^{n-1}(1 + E_t[y_{1,t+i}])\right)^{1/n} + \text{LP}_\text{n} \text{ (LPH)}$$

$$D = -\frac{dP}{dy}\frac{1+y}{P} = \sum_{1}^{T}\frac{PV(CF_t)}{P}\text{t} \quad D^* = \frac{D}{1+y} \quad \frac{\Delta P}{P} \cong -D^*\Delta y \quad D_p = \sum_i \omega_i D_i \quad D = \frac{1+y}{y} \text{ (perpetuity)}$$

Options/futures:

$$C_T = \max(0, S_T - X) \quad P_T = \max(0, X - S_T) \quad C_0 \geq \max(0, S_0 - Xe^{-rT}) \quad C_0 - P_0 + Xe^{-rT} = S_0$$

$$H = \frac{C_u - C_d}{S_u - S_d} \quad B = \frac{S_u H - C_u}{1 + r_f} \quad C = HS - B \quad H = \frac{P_u - P_d}{S_u - S_d} \quad B = \frac{S_u H - P_u}{1 + r_f} \quad P = HS - B$$

$$C = S\,N(d_1) - X\,e^{-rT}N(d_2) \quad P = X\,e^{-rT}[1 - N(d_2)] - S\,[1 - N(d_1)] \quad \frac{\partial C_0}{\partial S_0} = N(d_1) \quad \frac{\partial P_0}{\partial S_0} = -[1 - N(d_1)]$$

$$d_1 = \frac{\ln(S/X) + (r + \tfrac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} \quad d_2 = d_1 - \sigma\sqrt{T}$$

$$F_0 = S_0(1 + r_f - d)^T \quad F_0 = S_0\left[\frac{1 + r_\text{Aus}}{1 + r_\text{US}}\right]^T \quad F_0 \leq S_0(1 + r_f + s)^T \quad F_0 = S_0(1 + r_f - c)^T$$