Investment Formula with Descriptions

Dividend Discount Model Formula (DDM) or Constant Growth Model

$$V = \frac{D_1}{r - g}$$

- use this formula when the question asks to solve for the intrinsic value of a stock; they must give you the dividend and dividend growth rate (g)
- use decimals for percentages
  e.g. 8% should be entered as .08
- If no dividend given, use P/E x EPS

V = Value (or price) of the stock
D_1 = next year's dividend
Rewrite $D_1 \rightarrow D_0 (1 + g)$
r = investor's required rate of return (you may need to solve for **r** using the SML formula)
g = dividend growth rate

Required Rate of Return formula

$$r = \frac{D_1}{P} + g$$

- use this formula when the question asks to solve for the required rate of return; they must give you the dividend, dividend growth rate (g), and price of stock (P)
- use decimals for percentages
  e.g. 8% should be entered as .08

Note: this formula is the same as the DDM formula…it's just rearranged to solve for r

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Covariance

$$COV_{ij} = \rho_{ij}\sigma_i\sigma_j$$

- use this formula when the question asks to solve for covariance or correlation coefficient (ρ)
- if solving for ρ then rearrange the formula to:
  $\rho = cov \div (\sigma_i \sigma_j)$
- if solving for σ_i then rearrange the formula to:
  $\sigma_I = cov \div (\rho \sigma_j)$

cov = covariance
ρ = correlation coefficient (this is the Greek letter "rho")
σ_i = standard deviation of a stock "i"(this is the Greek letter "sigma")
σ_j = standard deviation of a stock "j"(this is the Greek letter "sigma")

Standard Deviation of Two Assets (based on weighting)

$$\sigma_p = \sqrt{W_i^2\sigma_i^2 + W_j^2\sigma_j^2 + 2W_iW_jCOV_{ij}}$$

- use this formula when the question asks to solve for standard deviation of a portfolio when given the weighting of two different stocks
- use decimals for percentages
  e.g. 50% is entered as .50

σ_p = standard deviation of the portfolio
w_i = weight of stock "i", expressed as a percentage
w_j = weight of stock "j", expressed as a percentage
cov = covariance

Beta

$$\beta_i = \frac{COV_{im}}{\sigma_m^2} = \frac{\rho_{im}\sigma_i}{\sigma_m}$$

- use this formula when the question asks to solve for beta (risk) of a stock
- if cov is given, then use the first part of the formula; don't forget to square the σ_m
- if the correlation coefficient is given, then use the second part of the formula

β_I = Beta (risk) of stock "i"
cov = covariance
σ_m = the standard deviation of the market
σ_i = the standard deviation of stock "i"
ρ_{im} = correlation coefficient between stock "i" and the market

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Required (or Expected) Rate of Return (Security Market Line—or SML)

$$r_i = r_f + (r_m - r_f)\beta_i$$

- use this formula when the question asks to solve for the (investor's) required rate of return
- use whole numbers when given percentages
  e.g. 9% should be entered as 9
- sometimes the exam will give you the market premium or the stock premium; be aware!
- you may need to solve for "r" and plug into the DDM formula

r_i = investor's required return (or expected return)
r_f = risk-free rate (could be given as the 3 month T-bill rate)
r_m = return of the market
β_i = the beta (or risk) of stock "i"
$(r_m - r_f)$ = the market premium
$(r_m - r_f)\beta_i$ = the stock premium

Alpha (Jensen)

$$\alpha_p = \overline{r_p} - \left[\overline{r_f} + \left(\overline{r_m} - \overline{r_f}\right)\beta_p\right]$$

- use this formula when the question asks to solve for portfolio manager's return; positive alpha means the manager has added value (desirable); negative alpha means the portfolio manager has subtracted value (undesirable)
- when $R^2 > 60$, use alpha to determine which fund to select; choose the highest *positive* alpha, **not highest R^2**
- use whole numbers when given percentages
  e.g. 9% should be entered as 9
- sometimes the exam will give you the market premium or the stock premium; be aware!

α_p = alpha of the portfolio (this measures how much value the portfolio manager has added or subtracted in relation to the expected return of the portfolio)
r_p = return of the portfolio (i.e the portfolio manager's return)
r_i = investor's required return (or expected return)
r_f = risk-free rate (could be given as the 3 month T-bill rate)
r_m = return of the market
β_i = the beta (or risk) of stock "i"
$(r_m - r_f)$ = the market premium
$(r_m - r_f)\beta_i$ = the stock premium

Treynor ratio

$$T_p = \frac{\overline{r_p} - \overline{r_f}}{\beta_p}$$

- use this formula when the question asks to solve for Treynor ratio
- when $R^2 > 60$, use Treynor ratio only if alpha is not given; choose the higher Treynor ratio to determine which fund to select
- use whole numbers when given percentages
  e.g. 9% should be entered as 9

T_p = Treynor Ratio
r_p = return of the portfolio
r_f = risk-free rate (could be given as the 3 month T-bill rate)
β_p = the beta (or risk) of portfolio "p"

Change in Price of a Bond

$$\frac{\Delta P}{P} = -D\left[\frac{\Delta y}{1+y}\right]$$

- use this formula when the question asks for change in percentage or price of a bond when interest rates rise or fall
- note the formula is **percentage change**; if the question asks for the change in price, multiply the percentage by the FMV of the bond
- use decimals for percentages
  e.g. 8% should be entered as .08
- a decrease in interest rates is a negative Δy
- note the **negative sign** in front of Duration!

$\frac{\Delta P}{P}$ = percentage change in the price of a bond
D = duration of the bond
Δy = the change in interest rate
y = Yield to maturity (YTM)

Tax-Equivalent Yield

$$TEY = r/(1\text{-}t)$$

- use this formula when the question asks for the Tax Equivalent Yield of a Municipal (or federal) bond
- in the denominator, I like "t" as "taxes you don't pay"
- use decimals for percentages
  e.g. 8% should be entered as .08
- note: out-of-state municipal bonds will pay in-state tax
- since federal bonds (e.g T-bills, T-bonds) pay federal taxes, the TEY will be close to the interest rate of the federal bond

TEY = Tax Equivalent Yield
r = the interest rate of the municipal (or Federal) bond
t = tax rate

Sharpe Ratio

$$S_p = \frac{\overline{r_p} - \overline{r_f}}{\sigma_p}$$

- use this formula when the question asks to solve for Sharpe ratio
- when $R^2 < 60$, use Sharpe ratio; choose the higher Sharpe ratio to determine which fund to select
- use whole numbers when given percentages
  e.g. 9% should be entered as 9

S_p = Sharpe Ratio
r_p = return of the portfolio
r_f = risk-free rate (could be given as the 3 month T-bill rate)
σ_p = the standard deviation of the portfolio
