TOPIC		FORMULA	VARIABLES
QUANTITATIVE METHODS	Multiple regression model	$Y_i = b_0 + b_1X_{1,i} + b_2X_{2,i} + \cdots + b_kX_{k,i} + \epsilon_i$	Y_i = Dependent variable b_0 = Intercept term $b_1, b_2, \ldots, b_k$ = Slope coefficients $X_{1,i}, X_{2,i}, \ldots, X_{k,i}$ = Independent variables ϵ_i = Error term
	Coefficient of determination (R^2)	$R^2 = \frac{\text{Sum of regression squares}}{\text{Sum of squares total}} = \frac{\sum_{i=1}^{n}(\widehat{Y_i} - \overline{Y})^2}{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}$	n = Number of observations Y_i = Dependent variable observations $\widehat{Y_i}$ = Dependent variables predicted value to the independent variable $\overline{Y}$ = Dependent variable mean
	Adjusted R^2	$\overline{R^2} = 1 - \left[\left(\frac{n-1}{n-k-1}\right)(1 - R^2)\right]$	n = Number of observations R^2 = Coefficient of Determination k = Number of independent variables
	T-statistic	$t = \frac{\widehat{b_j} - b_{H0}}{S_{\widehat{b_j}}}$	$\widehat{b_j}$ = Estimated regression coefficient. b_{H0} = Hypothesized value $S_{\widehat{b_j}}$ = The standard error of the estimated coefficient
	F-statistic	$F = \frac{\left(\frac{RSS}{k}\right)}{\left(\frac{SSE}{n - (k + 1)}\right)}$ $= \frac{\text{Mean regression sum of squares (MSR)}}{\text{Mean squared error(MSE)}}$	RSS = Regression sum of squares SSE = Sum of squared errors n = Number of observations k = Number of independent variables
	Akaike's information criterion (AIC)	$AIC = n \ln\left[\frac{\text{Sum of squares error}}{n}\right] + 2(k + 1)$	n = Sample size k = Number of independent variables $2(k + 1)$ = The model is penalized when independent variables are included.

		Bayesian information criterion (BIC)	$BIC = n\ln\left[\frac{\text{Sum of squares error}}{n}\right] + \ln(n)(k+1)$	n = Sample size k = Number of independent variables
		BP chi-square test statistic	BP chi-square test statistic = $n \times R^2$	n = Number of observations. R^2 = Coefficient of determination from a regression of the squared residuals on the independent variables
		Durbin Watson statistic (DW)	$DW = 2(1 - r)$	r = The sample correlation between regression residuals from one period and the previous period
		Studentized residual	$t_i^* = \frac{e_{i^*}}{s(e^*)} = e_i\sqrt{\frac{n-k-1}{SSE(1-h_{ii}) - e_i^2}}$	e_{i^*} = The residual with the ith observation deleted s_e^* = The standard deviation of residuals k = The number of independent variables n = The total number of observations SSE = The sum of square errors of the original regression model h_{ii} = The leverage value for the ith observation
		Cook's distance	$D_i = \frac{(y_i - \hat{y}_i)^2}{k \times MSE}\left(\frac{h_{ii}}{(1-h_{ii})^2}\right)$ $D_i = \frac{e_i^2}{k \times MSE}\left(\frac{h_{ii}}{(1-h_{ii})^2}\right)$	e_i = The residual for observation i, K = The number of independent variables. MSE = The mean square error of the estimated regression model. h_{ii} = The leverage value for observation i.
		Value of the time series	$y_t = b_0 + b_1 t + \epsilon_t$	y_t = Value of the time series at time t. b_0 = Intercept term. b_1 = Trend coefficient. t = Time, the independent variable. t=1,2,..., T. ϵ_t = Random error term.

		Time series with exponential growth	$y_t = e^{b_0+b_1(t)}$	y_t = Value of the dependent variable at time t. b_0 = Intercept term. b_1 = Constant growth rate. t = time = 1,2,3,..., T.
		T-statistic	$t_{statistic} = \dfrac{\text{Residual autocorrelation}}{\frac{1}{\sqrt{T}}}$	$\frac{1}{\sqrt{T}}$ = Standard error
		Mean-reverting level	$X_t = \dfrac{b_0}{1-b_1}$	b_0 = Intercept term. b_1 = Lag 1.
		Simple random walk	$X_t = X_{t-1} + \epsilon_t$	X_t = Best prediction tomorrow. X_{t-1} = Best value today. ϵ_t = Random error term.
		Random walk with drift	$X_t = b_0 + b_1 X_{t-1} + \epsilon_t$	b_0 = Constant drift b_1 = 1
		Penalty term	$\lambda \sum_{k=1}^{K} \lvert \hat{b}_K \rvert$	
		Normalization	$X_{i(normalized)} = \dfrac{X_i - X_{Min}}{X_{Max} - X_{Min}}$	
		Standardization	$X_{i(Standardized)} = \dfrac{X_i - \mu}{\sigma}$	x = X value x = Observed value μ = Population mean σ = Standard deviation

		Precision (P)	$$\text{Precision (P)} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$	TP = True positive FP = False positive
		Recall/sensitivity	$$\text{Recall (R)} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$	TP = True positive FN = False negative
		Accuracy	$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{TN} + \text{FN}}$$	TP = True positive FP = False positive FN = False negative
		F1 score	$$\text{F1 score} = \frac{(2 \times \text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}}$$	
		False positive rate	$$\text{False positive rate (FPR)} = \frac{\text{FP}}{\text{TN} + \text{FP}}$$	TP = True positive TN = False negative
		True positive	$$\text{True positive rate (TPR)} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$	TP = True positive TN = False negative
		Root mean squared error	$$\text{RMSE} = \sqrt{\sum_{i=1}^{n} \frac{(\text{Predicted}_i - \text{Actual}_i)^2}{n}}$$	
		TF (collection level)	$$\text{TF} = \frac{\text{Total word count}}{\text{Total number of words in collection}}$$	
		TF at sentence level	$$\text{TF at Sentence Level} = \frac{\text{Word count in sentence}}{\text{Total words in sentence}}$$	

		Document frequency (DF)	$DF = \frac{\text{Sentence count with word}}{\text{Total number of sentences}}$	
		Inverse document frequency (IDF)	$IDF = \log\left(\frac{1}{DF}\right)$	
		TF-IDF	$TF\text{–}IDF = TF \times IDF$	
		Chi– square test statistic	$\chi^2_{n-1} = \frac{(n-1)s^2}{\sigma_0^2}$ $s^2 = \frac{\sum(X_i - \overline{X})^2}{n-1}$	Used to compare two population variances.
		F– statistic	$F = \frac{s_1^2}{s_2^2}$	
		Test of a correlation	$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$	r = Correlation coefficient n = Sample size

		Test of independence (categorical data)	$X^2 = \sum_{i=1}^{m} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$	$E_{ij} = \frac{(\text{Total row i}) \times (\text{Total column j})}{\text{Overall total}}$
		Estimated variance of the prediction error	$s_f^2 = s^2 * \left[1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{(n-1)s_x^2}\right]$	s^2 = Squared standard error of estimate n = Number of observations X = Value of the independent variable $\bar{X}$ = Estimated mean s^2 = Variance, s^2 of the independent variable
		Sum of squares total (SST) or the total sum of squares (Variation of Y)	$\sum_{i=1}^{N} (Y_i - \bar{Y})^2$	Y_i = Particular observation of variable Y $\bar{Y}$ = Mean value of Y
		Slope coefficient	$\hat{b}_1 = \frac{\text{Covairance of Y and X}}{\text{Variance of X}}$ $\hat{b}_1 = \frac{\sum_{i=1}^{N}(Y_i - \bar{Y})(X_i - \bar{X})}{\sum_{i=1}^{N} (X_i - \bar{X})^2}$	Y_i = Particular observation of variable Y $\bar{Y}$ = Mean value of Y X_i = Particular observation of variable X $\bar{X}$ = Mean value of X n = Sample size
		Total sum of squares (SST)	$\sum_{i=1}^{N} (Y_i - \bar{Y})^2$	
		Regression sum of squares (RSS)	$\sum_{i=1}^{N} (\hat{Y}_i - \bar{Y})^2$	

		Sum of squared errors or residuals (SSE)	$\sum_{i=1}^{N}(Y_i - \widehat{Y}_i)^2$	
		Coefficient of determination	$R^2 = \frac{\text{Explained variation}}{\text{Total variation}}$ $R^2 = \frac{\text{Regression sum of squares (RSS)}}{\text{Sum of squares total (SST)}}$	
		F– statistic	$F = \frac{\frac{RSS}{k}}{\frac{SSE}{n-(k+1)}}$ $F = \frac{\text{Mean square regression}}{\text{Mean square error}}$ $F = \frac{MSR}{MSE}$	n = Total number of observations (n) k = Total number of independent variables RSS = Regression sum of squares SSE = Sum of squared errors or residuals
		Standard error of estimate (SEE)	$\sqrt{MSE}$	Used to compare two population variances.
		Standard error of the slope coefficient	$s_{\widehat{b}_1} = \frac{SEE}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}}$ $s_{\widehat{b}_1} = \frac{\text{Model's standard error of the estimate}}{\text{Square root of the variation of the independent variable}}$	

		Standard error of the intercept	$s_{\widehat{b_0}} = \sqrt{\frac{1}{n} + \frac{\bar{X}^2}{\sum_{i=1}^{n}(X_i - \bar{X})^2}}$	s^2 = The squared standard error of estimate n = Number of observations X = Value of the independent variable $\bar{X}$ = Estimated mean s^2 = Variance of the independent variable
		Estimated variance of the prediction error	$s_f^2 = s^2 * \left[1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{(n-1)s_x^2}\right]$	s^2 = The squared standard error of estimate n = Number of observations X = Value of the independent variable $\bar{X}$ = Estimated mean s^2 = Variance of the independent variable
		Log–lin model	$\ln Y_i = b_0 + b_1 X$	Y_i = Dependent variable b_0 = Intercept b_1 = Slope coefficient X_i = Independent variable
		Lin–log model	$Y_i = b_0 + b_1 \ln X_i$	Y_i = Dependent variable b_0 = Intercept b_1 = Slope coefficient X_i = Independent variable
		Log–log model	$\ln Y_i = b_0 + b_1 \ln X_i$	Y_i = Dependent variable b_0 = Intercept b_1 = Slope coefficient X_i = Independent variable

ECONOMICS	Forward rate	$F_{f/d} = S_{f/d}\left(\frac{1 + i_f\left[\frac{Actual}{360}\right]}{1 + i_d\left[\frac{Actual}{360}\right]}\right)$	i_d = The interest rate in the base currency (domestic country) i_f = The interest rate in the foreign currency or the quoted currency $S_{f/d}$ = The current spot exchange rate $F_{f/d}$ = The forward foreign exchange rate $\frac{Actual}{360}$ = Libor) day count convention
	Forward premium/discount	$F_{f/d} - S_{f/d} = S_{f/d}\left(\frac{\left[\frac{Actual}{360}\right]}{1 + i_d\left[\frac{Actual}{360}\right]}\right)(i_f - i_d)$	i_d = The interest rate in the base currency (domestic country) i_f = The interest rate in the foreign currency or the quoted currency $S_{f/d}$ = The current spot exchange rate $F_{f/d}$ = The forward foreign exchange rate $\frac{Actual}{360}$ = London Interbank Offered Rate (Libor) day count convention
	Uncovered interest parity	$\%\Delta S^e_{f/d} = i_f - i_d$	$\%\Delta S^e_{f/d}$ = percentage change of future change in the spot rate.
	Absolute purchasing power parity	$P_f = S_{f/d} \times P_d$	P_f = The price level of the foreign country. P_d = The price level of the domestic country $S_{f/d}$ = Nominal exchange rate
	Relative purchasing power parity	$\%\Delta S_{f/d} \approx \pi_f - \pi_d$	$\%\Delta S_{f/d}$ = Change in the spot exchange rate π_f = Foreign inflation rate π_d = Domestic inflation rate
	Ex ante purchasing power parity	$\%\Delta S^e_{f/d} \approx \pi^e_f - \pi^e_d$	1% significance level (0.5% in each tail)

	Total price of equity	$$P_{ag} = GDP\left(\frac{E_{ag}}{GDP}\right)\left(\frac{P_{ag}}{E_{ag}}\right)$$	P_{ag} = Total price of the equities E_{ag} = The aggregate earnings GDP = Gross Domestic Product
	Cobb Douglas function	$$Y = f(K, L) = K^{\alpha}L^{1-\alpha}$$	Y = Aggregate output in the economy L = Quantity of labor K = Capital α = Proportion of output paid by the companies to capital.
	Steady state growth rate of labor productivity	$$\frac{\Delta y}{y} = \frac{\Delta k}{k} = \frac{\theta}{1-\alpha}$$	$y = \frac{Y}{L}$ $k = \frac{K}{L}$ $\theta = \theta = \frac{\Delta A}{A}$
	The growth rate of output	$$\frac{\Delta Y}{Y} = \frac{\theta}{1-\alpha} + n$$	$n = \frac{\Delta L}{L}$ = Labor supply growth
	Equilibrium output-to-capital ratio	$$\Psi = \frac{Y}{K} = \frac{1}{s}\left[\left(\frac{\theta}{1-\alpha}\right) + \delta + n\right]$$	Ψ = Equilibrium output-to-capital ratio S = Saving rate Δ = Constant depreciation rate Y = Aggregate output in the economy $n = \frac{\Delta L}{L}$ = Labor supply growth
	The growth rate in the endogenous growth theory	$$\frac{\Delta y_e}{y_e} = sc - \delta - n$$	y_e = Output per worker (proportional to capital per worker) sc = Constant marginal product of capital in the whole economy δ = Constant depreciation rate $n = \frac{\Delta L}{L}$ = Labor supply growth

FINANCIAL REPORTING	Projected benefit obligation (PBO) at the end of the year	PBO at the end of year = PBO at the start of the year + Current service cost+ Interest cost + / (-) Actuarial gains / (losses) + Plan amendments - Benefits paid	
	Projected benefit obligation (PBO) at the beginning of the year	$\frac{\text{Benefits earned in prior years}}{(1 + \text{Discount rate})^{\text{Years until retirement}}}$	
	Gross profit	$\text{Gross Profit} = \text{Revenue} - \text{COGS}$	COGS = Cost of goods sold
	Operating profit	$\text{Operating profit} = \text{EBIT} = \text{Revenue} - \text{COGS} - \text{Operating expenses}$	EBIT = Earnings before income and taxes COGS = Cost of goods sold
	Annual depreciation expense	$\frac{\text{Cost} - \text{Residual value}}{\text{Estimated useful life}}$	
	Basic EPS	$\text{Basic EPS} = \frac{\text{Net income} - \text{preferred dividends}}{\text{Weighted average shares outstanding}}$	EPS = Earnings per share
	Diluted EPS (preference dividends converted)	$\frac{\text{Net income}}{\text{Weighted average shares outstanding} + \text{New common shares}}$	EPS = Earnings per share

	Diluted EPS (bonds converted)	$\frac{\text{NI} + \text{Aftertax interest on convertible bond} - \text{Preferred dividends}}{\text{Average shares} + \text{New shares issued}}$		NI = Net income EPS = Earnings per share
	Diluted EPS (stock options for executives)	$\frac{\text{Net income} - \text{Preferred dividends}}{\text{Average shares} + (\text{New shares issued} - \text{Repurchased}) \times \text{Proportion of years instrument is outstanding}}$		EPS = Earnings per share
	Ratios	Profitability ratios	$\text{Net profit margin} = \frac{\text{Net income}}{\text{Revenue}}$	
			$\text{Gross profit margin} = \frac{\text{Gross profit}}{\text{Revenue}}$	
			$\text{Operating profit margin} = \frac{\text{EBIT}}{\text{Revenue}}$	EBIT = Earnings before income and taxes
		Liquidity ratios	$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$	
			$\text{Quick ratio} = \frac{\text{Cash} + \text{Marketable securities} + \text{Receivables}}{\text{Current liabilities}}$	
			$\text{Cash ratio} = \frac{\text{Cash} + \text{Marketable securities}}{\text{Current liabilities}}$	

		Operating Performance Turnover	$\text{Receivables turnover} = \frac{\text{Annual sales}}{\text{Average receivables}}$	
			$\text{Inventory turnover} = \frac{\text{COGS}}{\text{Average inventory}}$	COGS = Cost of Goods Sold
			$\text{Payables turnover} = \frac{\text{Purchases}}{\text{Average payables}}$	
			$\text{DOS outstanding} = \frac{365}{\text{Receivables turnover}}$	DOS = Days of sales outstanding
			$\text{DOI outstanding} = \frac{365}{\text{Inventory turnover}}$	DOI = Days of inventory outstanding
			$\text{DOP outstanding} = \frac{365}{\text{Payables turnover}}$	DOP = Days of payables outstanding
			$\text{Cash conversion cycle} = \text{DOS} + \text{DOI} - \text{DOP}$	DOS = Days of sales outstanding DOI = Days of inventory outstanding DOP = Days of payables outstanding
		Operating Performance Efficiency	$\text{Total asset turnover} = \frac{\text{Revenue}}{\text{Average total assets}}$	

			$\text{Fixed asset turnover} = \frac{\text{Revenue}}{\text{Average fixed assets}}$	
			$\text{Working capital turnover} = \frac{\text{Revenue}}{\text{Average working capital}}$	
		Returns	$\text{Return on total capital} = \frac{\text{EBIT}}{\text{Average total capital}}$	EBIT = Earnings before income and taxes
			$\text{Return on equity} = \frac{\text{Net income}}{\text{Average total equity}}$	
			$\text{Return on common equity} = \frac{\text{N.I} - \text{Preferred dividends}}{\text{Average common equity}}$	
		Interest coverage ratio	$\frac{\text{EBIT}}{\text{Interest payment}}$	EBIT = Earnings before income and taxes
		Fixed charge coverage ratio	$\frac{\text{EBIT} + \text{Lease payments}}{\text{Interest} + \text{Lease payments}}$	EBIT = Earnings before income and taxes
		DuPont analysis	**Traditional DuPont** $\text{ROE} = \frac{\text{Assets}}{\text{Equity}} \times \frac{\text{Revenue}}{\text{Assets}} \times \frac{\text{NI}}{\text{Revenues}}$ $= \text{Equity multiplier} \times \text{Asset turnover} \times \text{Net profit margin}$	ROE = Return on equity NI = Net income

			Extended DuPont Equation $$ROE = \frac{\text{Net income}}{\text{EBT}} \times \frac{\text{EBT}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Avg. Total Assets}} \times \frac{\text{Avg. Total Assets}}{\text{Avg. Equity}}$$ $$ROE = \text{Tax burden} \times \text{Interest burden} \times \text{EBIT margin} \times \text{Asset turnover} \times \text{Leverage}$$	EBIT = Earnings before income and taxes EBT = Earnings before tax
		Debt coverage ratio	$$\frac{\text{CFO}}{\text{Total debt}}$$	CFO = Cash flow from operating activities
		Financial leverage ratio	$$\frac{\text{Total debt}}{\text{Total equity}}$$	
		Free cash flow to the firm (FCFF)	FCFF = NI + NCC + Int(1 – Tax rate) – FCInv – WCInv FCFF = CFO + Int(1 – Tax rate) – FCInv	NI = Net income NCC = Non– cash charges (such as depreciation and amortisation) Int = Interest expense FCInv = Capital expenditures (fixed capital, such as equipment) WCInv = Working capital expenditures
		Free cash flow to equity (FCFE)	FCFE = CFO – FCInv + Net borrowing FCFE = CFO – FCInv – Net debt repayment	

		Estimated total useful life	Time elapsed since purchase (Age) + Estimated remaining life	
		Estimated total useful life	$\frac{\text{Historical cost}}{\text{Annual depreciation expense}}$	
		Historical cost	Accumulated depreciation + Net PPE	
	Deferred taxes	A DTA will occur if: Carrying Value of an Asset < Tax Base **OR** Carrying Value of a Liability > Tax Base A DTL will occur if: Carrying Value of a Liability < Tax Base **OR** Carrying Value of an Asset > Tax Base		DTA = Deferred tax asset DTL = Deferred tax liability
CORPORATE ISSUERS	WACC	$\text{WACC} = w_d r_d (1-t) + w_p r_p + w_e r_e$		WACC = Weighted average cost of capital W_d, W_p, W_e = Proportion of debt, preferred stock, and equity that the company uses when it raises new funds r_d = Before– tax marginal cost of debt $r_p r_e$ = Marginal cost of preferred stock, marginal cost of equity t = Company's marginal tax rate
	Weight of debt	$\frac{D}{E+D}$		D = Debt value E = Equity value
	Weight of equity	$\frac{E}{E+D}$		D = Debt value E = Equity value

	Cost of preferred stock	$r_p = \frac{D_p}{P}$	r_p= Cost of preferred stock D_p= Preferred stock dividend/share P = Preferred stock price
	Cost of equity	$r_e = \frac{D_1}{P_o} + g$	r_e= Required rate of return D_1= Dividends expected next period P_o= Market value of the equity market index g = The expected growth rate of dividends
	Expected dividend	Expected dividend = (Previous dividend) + [(Expected earnings) × (Target payout ratio) - (Previous dividend)] × (Adjustment factor)	
	Growth Rate	$g = b \times ROE$	g = Growth Rate b = Retention Rate ROE = Return on Equity
	Capital asset pricing model (CAPM) approach	$r_e = RFR + \beta\, [E(R_{mkt}) - RFR]$	r_e = Cost of equity RFR = Risk– free rate of an asset β = Sensitivity of a stock's return to changes in market return $E(R_{mkt})$ = Expected return on the market
	Bond yield plus risk premium method	r_e = bond yield + risk premium	r_0 = Cost of capital for a company financed only by equity and has zero debt r_d = Cost of debt r_e = Cost of equity D/E = Debt– to– equity ratio

	Estimating beta	$\beta_{asset} = \beta_{debt} w_d + \beta_{equity} w_e$ $\beta_{asset} = \beta_{equity} \{\frac{1}{1+(1-t)\frac{D}{E}}\}$ $\beta_{project} = \beta_{asset}\{1 + ((1 - t_{project})\frac{D_{project}}{E_{project}}$	W_d = Proportion of debt that the company uses when raising new capital W_e = Proportion of equity that the company uses when raising new capital D = Market value of debt E = Market value of equity t = Marginal tax rate
	Book value per share	$\text{Book value per share} = \frac{\text{Book value of equity}}{\text{Outstanding shares}}$	
	Dividend payout ratio	$\text{Dividend payout ratio} = \frac{\text{Dividend}}{\text{Net income}}$	
	EPS after repurchasing	$\text{EPS after repurchasing} = \frac{(\text{Earnings} - \text{After} - \text{tax cost of funds})}{\text{Shares outstanding after buyback}}$	
	Dividend coverage ratio	$\text{Dividend coverage ratio} = \frac{\text{Net income}}{\text{Dividend}}$	
	FCFE coverage ratio	$\text{FCFE coverage ratio} = \frac{\text{FCFE}}{(\text{Dividends+Share repurchases})}$	
	Gordon's growth model	$V_0 = \frac{D_1}{r_e - g}$	V_0 = Value of a stock. D_1= Year ahead dividend. r_e= Required return on Equity. g= Expected earnings growth rate.

	The forward-looking ERP estimate	$ERP = E\left(\frac{D_1}{V_0}\right) + E(g) - r_f$	V_0 = Value of a stock. D_1= Year ahead dividend. r_e= Required return on Equity. g= Expected earnings growth rate.
	Dividend discount model	$r_e = \frac{D_1}{P_0} + g$	D_1= Expected future dividend. P_0= Current share price. g = Expected growth rate in dividends.
	BYPRP	$r_e = r_d + RP$	r_d = The cost of debt of a company. RP = Risk premium.
	CAPM required return on equity	$r_e = r_f + \hat{\beta}(BRP)$	r_f = Risk-free rate. $\hat{\beta}$ = The sensitivity of a company's stock return to REP changes.
	Fama-French five factor required return on equity	$r_e = r_f + \beta_1 ERP + \beta_2 SMB + \beta_3 HML + \beta_4 RMW + \beta_5 CMA$	r_f = Risk-free rate SMB = Size premium. HML = Value premium RMW = Probability factor CMA = Investment factor
	International CAPM	$E(r_e) = r_f + \beta_G\left(E(r_{gm}) - r_f\right) + \beta_C(E(r_c) - r_f)$	r_f =The risk-free rate. β_G = The sensitivity to the global index. r_{gm} = The risk premium of a global index. β_C =The sensitivity to the foreign currency index.
	Takeover premium	$PRM = \frac{(DP - SP)}{SP}$	PRM = Takeover premium DP = Deal price per share of the target SP = Unaffected stock price of the target
EQUITY	Perceived mispricing	Perceived mispricing = True mispricing + Valuation error $V_E - P = (V - P) + (V_E - V)$	V_E = Estimated value P = Market price V = True intrinsic value

	Dividend discount model-single holding period	$V_0 = \frac{D_1}{(1+r)^1} + \frac{P_1}{(1+r)^1} = \frac{D_1 + P_1}{(1+r)^1}$	V_0 = The value of a shar e today, at t = 0 P_1 = The expected price per share at t = 1 D_1 = The expected dividends per share for the year to be paid at time t = 1 r = The required rate of return on the share
	Present value of growth opportunities	$V_0 = \frac{E_1}{r} + \mathrm{PVGO}$	E_1= Expected earnings at time, t = 1 r = Required rate of return
	Current/trailing P/E	$\frac{P_0}{E_0} = \frac{D_0(1+g)/E_0}{r-g} = \frac{(1-b)(1+g)}{r-g}$	b = Retention ratio (1 – b) = Dividend payout ratio
	Leading/forward P/E	$\frac{P_0}{E_1} = \frac{D_1/E_1}{r-g} = \frac{1-b}{r-g}$	b = Retention ratio (1 – b) = Dividend payout ratio
	The general two stage model	$V_0 = \sum_{t=1}^{n} \frac{D_0(1+g_S)^t}{(1+r)^t} + \frac{D_0(1+g_S)^n(1+g_L)}{(1+r)^n(r-g_{L)}}$	g_S = Short-term high growth rate g_L = Long-term sustainable growth rate r = Required rate of return n = Length of the high growth rate
	H-model	$V_0 = \frac{D_0(1+g_L) + D_0H(g_S - g_L)}{r - g_L}$	V_0 = Value per share at t = 0 D_0 = Current dividends r = Required rate of return on equity H = Half-life in years of the high-growth period g_S = Initial short term dividend growth rate g_L= Normal long-term dividend growth rate after the high growth period
	Present value of FCFF	$\text{Firm value} = \sum_{t=1}^{\infty} \frac{\mathrm{FCFF}_t}{(1+\mathrm{WACC})^t}$	

	Present value of FCFE	$\text{Equity value} = \sum_{t=1}^{\infty} \frac{\text{FCFE}_t}{(1+r)^t}$	
	Single-stage (constant growth) FCFF model	$\text{Firm value} = \frac{\text{FCFF}_1}{\text{WACC} - g} = \frac{\text{FCFF}_0(1+g)}{\text{WACC} - g}$	
	Single-stage (constant growth) FCFE model	$\text{Firm value} = \frac{\text{FCFE}_1}{r - g} = \frac{\text{FCFE}_0(1+g)}{r - g}$	
	Computing FCFF from cash flows from operation	$\text{FCFF} = \text{Cash flow from operations} + \text{Interest }(1 - \text{tax}) - \text{Fixed capital investments}$	
	Computing FCFF from EBIT	$\text{FCFF} = \text{EBIT}(1 - \text{Tax}) + \text{Depreciation} - \text{Fixed capital investments} = -\text{Working capital investments}$	
	Computing FCFF from EBITDA	$\text{FCFF} = \text{EBITDA}(1 - \text{Tax}) + \text{Depreciation}(\text{Tax}) - \text{Fixed capital investments} - \text{Working capital investments}$	
	Computing FCFE from EBIT	$\text{FCFE} = \text{EBIT}(1 - \text{Tax}) - \text{Interest }(1 - \text{Tax}) + \text{Depreciation} - \text{Fixed capital investment} - \text{Working capital investments} + \text{Net borrowing}$	

	Computing FCFE from EBITDA	$\text{FCFE} = \text{EBITDA}(1-\text{Tax}) - \text{Interest}(1-\text{Tax}) + \text{Depreciation}(\text{Tax}) - \text{Fixed capital investments} - \text{Working capital investments} + \text{Net borrowing}$	
	Computing FCFE from FCFF	$\text{FCFE} = \text{Free cash flow to the firm (FCFF)} - \text{Interest}(1-\text{tax}) + \text{Net borrowing}$	
	Computing FCFE from net income	$\text{FCFE} = \text{Net income} + \text{Noncash charges} - \text{Fixed capital investments} - \text{Working capital investments} + \text{Net borrowing}$	
	Computing FCFE from cash flow from operations	$\text{FCFE} = \text{Cash from operations} - \text{Fixed capital investments} + \text{Net borrowing}$	
	Two stage FCFF model	$\text{Firm value} = \sum_{t=1}^{n} \frac{\text{FCFF}_t}{(1+\text{WACC})^t} + \frac{\text{FCFF}_{n+1}}{(\text{WACC}-g)} \frac{1}{(1+\text{WACC})^n}$	
	Two stage FCFE	$\text{Equity value} = \sum_{t=1}^{n} \frac{\text{FCFE}_t}{(1+r)^t} + \frac{\text{FCFE}_{n+1}}{r-g} \frac{1}{(1+r)^n}$	
	Computing FCFF from net income	$\text{FCFF} = \text{Net income} + \text{Net noncash charges} + \text{Interest expense}(1-\text{tax rate}) - \text{Fixed capital investments} - \text{Working capital investments}$	
	Price to book ratio	$\frac{P_0}{B_0} = \frac{\text{ROE} - g}{r - g}$	ROE = Return on equity g = Growth rate
	P/E to growth ratio	$\text{PEG} = \frac{P/E}{g}$	P/E = Price to earnings ratio g = Growth rate

	Dividend yield	$\frac{D_0}{P_0} = \frac{r - g}{1 + g}$	g = Growth rate
	Earnings surprise	$UE_t = EPS_t - E(EPS_t)$	UE_t = Unexpected earnings for quarter t EPS_t = Reported earnings per share for quarter t $E(EPS_t)$ = Expected EPS for the quarter
	Simple harmonic mean	$X_H = \frac{n}{\sum_{i=1}^{n}(1/X_i)}$	
	Standardized unexpected earnings	$SUE_t = \frac{EPS_t - E(EPS_t)}{\sigma[EPS_t - E(EPS_t)]}$	EPS_t = Actual EPS at time t. $E(EPS_t)$ = Expected EPS at time t. $\sigma[EPS_t - E(EPS_t)]$ = Standard deviation of $EPS_t - E(EPS_t)$
	Weighted harmonic mean	$X_{WH} = \frac{1}{\sum_{i=1}^{n}(\omega_i/X_i)}$	ω_i = The portfolio value weights summing to 1.
	Residual income	$\text{Residual income} = \text{Net income} - \text{Equity charge}$	$\text{Equity charge} = \text{Cost of equity capital} \times \text{Equity capital}$
	Economic value added (EVA)	$EVA = NOPAT - (C\% \times TC)$	$NOPAT = EBIT - (EBIT \times Taxes)$ C% = Cost of capital TC = Total capital
	Market value added (MVA)	$MVA = \text{Market value of the company} - \text{Book value of total capital}$	
	Residual income	$RI_t = E_t - (r \times B_{t-1})$	B_t= Expected book value of equity at time t r = Required rate of return on equity E_t= Expected EPS for period t

	Intrinsic value of a common stock	$V_0 = B_0 + \sum_{t-1}^{\infty} \frac{RI_t}{(1+r)^t} = B_0 + \sum_{t-1}^{\infty} \frac{E_t - rB_{t-1}}{(1+r)^t}$	V_0 = Value of the share today B_0 = Current book value of equity per share B_t = Expected book value of equity at time t r = Required rate of return on equity E_t = Expected EPS for period t RI_t = Expected per share residual income
	Tobin's q	$\text{Tobin's q} = \frac{\text{Market value of debt and equity}}{\text{Replacement cost of total assets}}$	
	Capitalizing free cash flow to the firm	$V_f = \frac{FCFF_1}{(WACC - g_f)}$	V_f = Value of the firm $FCFF_1$ = Free cash flow to the firm for the next twelve months WACC = Weighted average cost of capital g_f = Sustainable growth rate of FCFF
	Capitalizing free cash flow for equity	$V_e = \frac{FCFE_1}{(r-g)}$	r = Required return on equity g = Sustainable growth rate of FCFE
	Discount for lack of control	$DLOC = 1 - \left[\frac{1}{1 + \text{Control premium}}\right]$	
FIXED INCOME	Discount factor	$DF_N = \frac{1}{(1+Z_N)^N}$	Zn = The spot rate
	The forward price of a discount bond filled at time A and maturing at time B	$DF_{A,B-A} = \frac{1}{[1 + f_{A,B-A}]^{B-A}}$	

	Forward rate model	$(1+Z_B)^B = (1+Z_A)^A(1+f_{A,B-A})^{B-A}$	Z_B = The spot rate for time B $F_{A,B-A}$ = The forward rate t years from now with a term to maturity of (B - A) years.
	Swap rate	$\sum_{t=1}^{T}\frac{\text{Swap Rate at time T}}{(1+S(t))^t}+\frac{1}{(1+S(T))^T}=1$	S(t) and S(T) are spot rates at t and T, respectively.
	Swap spread	$\text{Swap spread}_t = \text{Swap rate (Fixed interest rate)}_t - \text{Treasury bond yield}_t$	
	Ted spread	$\text{TED Spread} = (\text{Three}-\text{month LIBOR}) - (\text{Three}-\text{month T}-\text{bill rate})$	
	Libor-OIS spread	Libor-OIS Spread = Libor rate- overnight indexed swap (OIS) rate	
	Vasicek model	$dr = \alpha(\mu - r)dt + \sigma dw$	α = The speed of the mean reversion. μ = The mean level of the short-term rate. dr = An infinitely small increment in the short-term interest rate. dt = An infinitely small increment in time. σ = The volatility. It is a positive number, to ensure that r is mean reverting to the constant value μ dw = The stochastic process that models risk. $\alpha > 0$, $\mu > 0$ and, σ are constants

	Cir model	$dr = \alpha(\mu - r)dt + \sigma\sqrt{r}dw$	α = The speed of the mean reversion. μ = The mean level of the short-term rate. dr = An infinitely small increment in the short-term interest rate. dt = An infinitely small increment in time. σ = The volatility. It is a positive number, to ensure that r is mean reverting to the constant value μ dw = The stochastic process that models risk. $\alpha > 0$, $\mu > 0$ and, σ are constants
	Ho-lee model	$dr = \theta dt + \sigma dw$	dr = An infinitely small increment in the short-term interest rate. dt = An infinitely small increment in time. σ = The volatility. It is a positive number, to ensure that r is mean reverting to the constant value μ dw = The stochastic process that models risk. θ = The drift parameter.
	Arbitrage free value	$PV = \frac{PMT}{(1+S_1)^1} + \frac{PMT}{(1+S_2)^2} + \cdots + \frac{PMT+FV}{(1+S_N)^N}$	PMT = The periodic coupon, and FV is the face value S_1, S_2, and S_N = The spot rates for periods 1 to N
	The bond value at a node	$V = 0.5\left[\frac{Vu+C}{1+i} + \frac{Vd+C}{1+i}\right]$	Vu and Vd = The bond values if the higher and lower forward rates, respectively, are realized in one year i = The forward interest rate at a particular node C = The coupon rate independent of interest rates

	Value of a callable bond	$V_{Callable} = V_{Straight} - V_{Call}$	$V_{Straight}$ = Value of Straight Bond. V_{Call} = Value of Issuer Call Option. Value of issuer call option = Value of straight bond – Value of callable bond
	Value of a putable bond	$V_{Putable} = V_{Straight} + V_{Put}$	$V_{Straight}$ = Value of Straight Bond. V_{Put} = Value of Investor Put Option Value of investor put option = Value of putable bond – Value of straight bond
	Option adjusted spread (OAS)	$\text{OAS} = \text{Z} - \text{Spread} - \text{Option cost.}$	
	Effective duration	$\text{Effective duration} = \frac{P_i - P_{i+}}{2 \times P_0(\Delta\ \text{Curve})}$	P_i = Estimated price if interest is decreased by Δ Curve P_{i+} = Estimated value if interest is increased by Δ Curve P_0 = Current price (per $100 of par value) Δ Curve = The change in the interest rates used to calculate the new prices.
	Conversion ratio	$\text{Conversion Ratio} = \frac{\text{Issue price}}{\text{Conversion price}}$	
	Conversion value	Underlying share price × Conversion ratio	
	Minimum value of the convertible bond	Max(Conversion value, Straight value)	Straight value is the value of the underlying option-free bond.

	Market conversion price	$\frac{\text{Convertible bond price}}{\text{Conversion ratio}}$	
	Market conversion premium per share	$\text{Market conversion price} - \text{Underlying share price}$	
	Market conversion premium ratio	$\frac{\text{Market conversion premium per share}}{\text{Underlying share price}}$	
	Premium over straight value	$\frac{\text{Bond price}}{\text{Straight value}} - 1$	
	Value of convertible bond	$\text{Value}_{\text{convertible bond}} = \text{Value}_{\text{straight bond}} + \text{Value}_{\text{call option on the issuer's stock}}$	
	Conversion price	$\text{Conversion price} = \frac{\text{Issue price}}{\text{Conversion ratio}}$	
	Loss given default (LGD)	$\text{LGD} = \text{Loss severity} \times \text{Expected exposure}$	
	The Probability of Default	$\text{PD}_t = \text{PS}_{t-1} \times \text{Hazard rate}$	PD_t = The probability of default at any given year t PS_{t-1} = The survival probability for the previous year.

	Expected loss	$\text{Expected loss (\%)} = \text{LGD} \times \text{PD}$ $\text{Expected loss (\$)} = \text{Exposure} \times \text{PD} \times \text{LGD}$	PD = Probability of default LGD = Loss given default
	Present Value of Expected Loss	$\text{Present value of expected loss} = \text{LGD} \times \dfrac{\text{PD}}{(1+i)^t}$	PD = Probability of default LGD = Loss given default
	Probability of Survival	$\text{Probability of survival } (PS_t) = 1 - \text{Cumulative conditional probability of default}$	
	The expected percentage price change due to credit migration	$\Delta\%P = -\text{(Modified duration of the bond)} \times (\Delta \text{ Credit spread}).$	
	Expected return	$\text{Expected return} = \text{Yield to maturity (YTM)} + \Delta\%P$	
	Credit spread	$\text{Credit spread} = \text{YTM of the risky bond} - \text{Benchmark YTM}$	
	Credit valuation adjustment	$\text{CVA} = \sum_{t=1}^{n} \text{LGD} \times \dfrac{\text{PD}}{(1+i)^t}$ CVA = Price of a riskless bond - Price of the risky bond	
	PV (credit spread)	$\text{PV (Credit Spread)} = \text{Upfront premium} + \text{PV (Fixed Coupon)}$	

	Upfront premium	Upfront premium ≈ (Credit spread – Fixed coupon) × Duration	
	Protection buyer's profit	Protection buyer's profit = Δ spread (bps) × Duration × Notional	
	Percentage change of CDS price	% Δ CDS price = Δ spread (bps) × Duration	
DERIVATIVES	Value of forward $V_T(T)$	$V_T(T) = S_T + PV(\text{cost}) - PV(\text{benefit}) - \frac{F_0(T)}{(1 + r_f)^{T-t}}$	r_f = Risk– free rate T = Time to maturity PV = Present Value S_0 = Price of the underlying asset $F_0(T)$ = Forward Price
	The Value of a swap to the receiver of a fixed rate and payer of a floating rate	V_{Swap} = Value of fixed bond – Value of floating bond = $V_{FIX} - V_{FLT}$	Value of fixed bond (V_{FIX}) = $V_{FIX} = r_{FIX}\sum_{i=1}^{n} PV_i(1) + PV_n(1)$ r_{FIX} = Coupon payment for the fixed-rate bond PV_i = Appropriate present value factor for the i^{th} fixed cash flow.
	Fixed (swap) rate	$r_{FIX} = \frac{1 - PV_n(1)}{\sum_{i=1}^{n} PV_i(1)}$	
	The swap value to the receive fixed party	$V = NA(FS_0 - FS_t)\sum_{i=1}^{n'} PV_{t,t_i}$	

	The value of a fixed-to-fixed currency swap at some future point in time t	$$V_a = NA_a\left(r_{FIX,a}\sum_{i=1}^{n`} PV_i(1) + PV_n(1)\right) - S_t NA_b\left(r_{FIX,b}\sum_{i=1}^{n`} PV_i(1) + PV_n(1)\right)$$	
	Value of an equity swap	$$V_{EQ,t} = V_{FIX}(C_0) - \left(\frac{S_t}{S_{t-1}}\right) NA_E - PV(Par - NA_E)$$	$V_{FIX}(C_0)$ = The value at Time t of a fixed-rate bond initiated with coupon C_0 at Time 0 S_t= Current equity price S_{t-1}= Current equity price observed at the last reset date
	Risk neutral probability	$$q = \frac{(1+r) - d}{u - d}, \text{for an up} - \text{move}$$	
	One period binomial option values	European call: $c_0 = \frac{qc_u + (1-q)c_d}{1+r}$ European put: $p_0 = \frac{qp_u + (1-q)p_d}{1+r}$	$c_u = \max(0, S_0u - K)$ $c_d = \max(0, S_0d - K)$ $p_u = \max(0, K - S_0u)$ $p_d = \max(0, K - S_0d)$
	Two-period binomial option	Call option: $c_0 = \frac{q^2c_{uu} + 2q(1-q)c_{ud} + (1-q)^2c_{dd}}{(1+r)^2}$ Put option: $p_0 = \frac{q^2p_{uu} + 2q(1-q)p_{ud} + (1-q)^2p_{dd}}{(1+r)^2}$	$c_{uu} = \max(0, S_0u^2 - K)$ $C_{ud} = \max(0, S_0ud - K)$ $c_{dd} = \max(0, S_0d^2 - K)$
	Early exercise premium	Early exercise premium = American put value – European put value	

	Hedge ratios	Call option: $\phi = \frac{c_u - c_d}{S_0u - S_0d}$ Put option: $\phi = \frac{p_u - p_d}{S_0u - S_0d} \leq 0$	
	Option pricing using arbitrage-free pricing portfolio	$c_0 = \phi S_0 + PV(-\phi S_0 d + c_d)$ or $c_0 = \phi S_0 + PV(-\phi S_0 u + c_u)$ And $p = \phi S_0 + PV(-\phi S_0 d + p_d)$ or $p = \phi S_0 + PV(-\phi S_0 u + p_u)$	
	Interest rate options	Call option payoff $=$ Notional Amount $\times$ [Max (Current spot rate – Exercise rate, 0)] Put payoff $=$ Notional amount $\times$ [Max (Exercise rate – Current spot rate, 0)]	
	Black-Scholes-Merton (BSM) model: European call and European put	$c_0 = S_0N(d_1) - e^{-(rT)}KN(d_2)$ $p_0 = e^{-rT}KN(-d_2) - S_0N(-d_1)$	$d_1 = \frac{\ln \ln \left(\frac{S}{K}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$ $d_2 = d_1 - \sigma\sqrt{T}$ N(x) = standard normal cumulative distribution function N(−x) = 1 – N(x)

	Replicating strategy cost	Replicating strategy cost $= n_S S + n_B B$	Where for call options: $n_S = N(d_1) > 0$ $n_B = -N(d_2) < 0$ And for put options: $n_S = -N(-d_1) < 0$ $n_B = N(-d_2) > 0$
	BSM valuation for equities	European call: $c_0 = S_0 e^{-\delta T} N(d_1) - e^{-rT} K N(d_2)$ European put: $p_0 = e^{-rT} K N(-d_2) - S_0 e^{-\delta T} N(-d_1)$	$\delta =$ Continously paid dividend yield $d_1 = \ln\left(\frac{S_0}{K}\right) + \frac{\left(r - r^f + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$ $d_2 = d_1 - \sigma\sqrt{T}$ $r^f =$ Foreign risk − free rate
	Black option valuation model	European call: $c_0 = e^{-rT}[F_0(T)N(d_1) - KN(d_2)]$ European put: $p_0 = e^{-rT}[KN(-d_2) - F_0(T)N(-d_1)]$	$d_1 = \frac{\ln \ln \left(\frac{F_0(T)}{K}\right) + \frac{\sigma^2}{2}T}{\sigma\sqrt{T}}$ $d_2 = d_1 - \sigma\sqrt{T}$ $F_0(T) =$ Futures price at time 0 that expires at time T $\sigma =$ Volatility of returns on the futures price
	Delta hedging	$N_H = -\frac{\text{Portfolio delta}}{\text{Delta}_H}$	
ALTERNATIVE INVESTMENTS	Management fee	$NAV_{new} \times$ fee %	NAV = Net Asset Value
	Capital return	$\frac{\text{NOI} - \text{Capital expenditures} + (\text{Ending market value} - \text{Beginning mark}}{\text{Beginning market value}}$	

	Capitalization rate (CR)	$\text{Capitalization Rate (CR)} = \frac{\text{Net operating income}}{\text{Property cost}}$	
	The value of property	$\text{The value of property} = \frac{\text{NOI}}{(r-g)}$	r = Discount rate g = Growth rate for income
	Debt service coverage ratio (DSCR)	$\text{DSCR} = \frac{\text{Year one NOI}}{\text{Debt service}}$	
	Loan to value (LTV)	$\text{LVT} = \frac{\text{Amount of loan}}{\text{Value appraisal}}$	
	Revenue per available room	$\text{RevPAR} = \frac{\text{Average daily room rate}}{\text{Occupancy rate}}$	
	Operating property value	$\text{Operating property value} = \frac{\text{Estimated next 12} - \text{month NOI}}{\text{Cap rate}}$	
	Net asset value per share	$\text{NVPS} = \frac{\text{Net asset value}}{\text{Shares outstanding}}$	
	Funds for operation per share	$\text{FFO per share} = \frac{\text{Total FFO}}{\text{Outstanding shares}}$	

	NAV per share	$\text{NAV per Share} = \frac{\text{NAV}}{\text{Shares outstanding}}$	
	Paid -in-capital (PIC)	$\text{PIC} = \frac{\text{Paid} - \text{in} - \text{capital to date}}{\text{The capital committed}}$	
	Post money valuation	$\text{Post money valuation} = \frac{\text{Value of equity at exit}}{\text{ROI}}$	
	Distributed to Paid-in-capital (DPI)	$\text{DPI} = \frac{\text{Cumulative distributions paid to the LPs}}{\text{Cumulative capital invested}}$	
	Residual to paid-in-capital (RVPI)	$\text{RVPI} = \frac{\text{Value of LP's holdings in the fund}}{\text{Cumulative capital invested}}$	
	Total value to paid in capital (TVPI)	$\text{TVPI} = \text{DPI} + \text{RVPI}$	
	Futures price	$\text{Futures price} = \text{Spot price of the physical commodity} + \text{Direct storage costs} - \text{Convenience yield}$	
	Price return	$\text{Price return} = \frac{\text{Current price} - \text{Previous price}}{\text{Previous price}}$	

	Roll return	$\frac{\text{Near} - \text{term futures contract closing price} - \text{Farther} - \text{term futures co}}{\text{Near} - \text{term futures contract closing price}}$ $\times$ % futures contract position being rolled	
	Total return	Total return $=$ Price return $+$ Roll return $+$ Collateral return	
PORTFOLIO MANAGEMENT	End of day premium or discount (%)	$\text{End of day premium or discount}(\%) = \frac{\text{ETF price} - \text{NAV per share}}{\text{NAV per share}}$	
	Intraday EFT premium or discount (%)	$\text{Intraday ETF premium or discount}(\%) = \frac{\text{ETF price} - \text{iNAV per share}}{\text{iNAV per share}}$	
	Round-trip trading cost (%)	Round-trip trading cost (%) = $(\text{one} - \text{way commission } \% \times 2) + \left(\frac{1}{2}\text{Bid} - \text{ask spread } \% \times 2\right)$	
	Holding period cost (%)	Holding period cost (%) = Round-trip trade cost (%) + Management fee for period (%).	
	The arbitrage pricing theory (APT)	$E(R_i) = E(R_Z) + \beta_{i1}\lambda_1 + \cdots + \beta_{iK}\lambda_K$	$E(R_i)$ = The expected return on a well-diversified portfolio i; β_{ij} = The sensitivity for a portfolio i relative to factor j; $E(R_Z)$ = The expected rate of return on a portfolio with zero betas (such as risk-free rate of return); λ_j = The risk premium relative to factor j.

	Single factor model	$R_i = E(R_i) + \beta_i F + \varepsilon_i$	$E(R_i)$ = The expected return on stock i; R_i = The return for stock i; F = The macroeconomic factor; B_i = The factor-beta; ε_i = The surprise return.
	Macroeconomic factor model	$R_i = E(R_i) + b_{i1}F_1 + b_{i2}F_2 + \cdots + b_{ik}F_k + \varepsilon_i$	R_i = The return for asset i; $E(R_i)$ = The expected return for asset i; F_i's = The surprises in the factors; b_{ij}'s = The surprise sensitivities of asset i; and ε_i = The firm-specific surprise, which is unrelated to the macro factors.
	Fundamental factor model	$R_i = \alpha_i + \beta_{i1}F_1 + \beta_{i2}F_2 + \cdots + \beta_{ik}F_k + \varepsilon_i$	R_i = The return for stock i; β_{ij}'s = The standardized sensitivities for stock i to factor j; F_j's = The returns for factor j; α_i = The intercept; ε_i = The portion of stock i return that may not be explained by the factor model.
	The Standard sensitivity of factor F_1	$\beta_{A1} = \dfrac{F_{A1} - \overline{F_1}}{\sigma_{F_1}}$	F_{A1} = The F_1-the factor for stock A; $\overline{F_1}$ = The average of F_1 calculated across all stocks; σ_{F_1} = The standard deviation of F_1 ratios across all stocks.
	Active return	$\text{Active return} = R_P - R_b$	R_P = The return of the portfolio R_b = The benchmark return
	Active risk	$\text{Active risk} = \text{Tracking error (TE)} = s(R_P - R_b)$	S = The sample standard deviation R_P = The return of the portfolio R_b = The benchmark return
	Information risk (IR)	$IR = \dfrac{\overline{R_p} - \overline{R_b}}{S(R_P - R_b)}$	$\overline{R_p}$ = The average of the portfolio returns for the chosen periods; $\overline{R_b}$ = The average of the benchmark returns for the chosen periods;

	Factor return	$\text{Factor return} = \sum_{i=1}^{k}(\beta_{pi} - \beta_{bi})\lambda_i$	β_{pi} = The factor sensitivity for factor i in the active portfolio β_{bi} = The factor sensitivity for the factor i in the benchmark portfolio λ_i = The factor risk premium for factor i.
	Active specific risk	$\text{Active specific risk} = \sum_{i=1}^{n}(w_{pi} - w_{bi})^2\sigma_{\varepsilon i}^2$	w_{pi} = The ith security in the active portfolio w_{bi} = The ith security in the active benchmark $\sigma_{\varepsilon i}^2$ = The residual risk in the ith asset
	Value at risk	$\text{VaR}(X) = -t \text{ where } P(X < t) = p$	
	Estimated VaR of a portfolio	$\text{VaR}_p = \mu - \alpha_p\sigma$	VaR_p = The estimated VaR of portfolio p; μ = The mean of the portfolio or the expected return of the portfolio;? σ = The standard deviation of the portfolio or the volatility of the portfolio; and α_p = The determined by the confidence interval and the chosen theoretical distribution.
	Delta	$\Delta = \frac{\delta P_o}{\delta P_a}$	δP_o = The change in price change of the option; and δP_a = The change in the price of the underlying asset.
	Gamma	$\Gamma = \frac{\delta\Delta}{\delta P_a}$	$\delta\Delta$ = The change in Δ; and δP_a = The change in the price of the underlying asset.

	Vega	$\nu = \frac{\delta P_o}{\delta\sigma}$	δP_o = The change in the price of the option; and $\delta\sigma$ = The change in volatility of the underlying asset.
	Change in call price	Change in call price = $\Delta(\delta P) + \frac{1}{2}\Gamma(\delta P_a)^2 + \nu(\delta\sigma)$	δP_a = The change in the price of the underlying asset; and $\delta\sigma$ = The change in the expected volatility.
	Discounted cash flow model	$P_t^i = \sum_{s=1}^{N} \frac{E_t[\widetilde{CF}_{t+s}^i]}{(1 + l_{t,s} + \theta_{t,s} + P_{t,s}^i)^s}$	P_t^i = Value of asset i at time t. N = Number of cash flows in the life of the asset. $\widetilde{CF}_{t+s}^i$ = The uncertain, nominal cash flow paid s periods in the future. E_t = Expectation at time t. $l_{t,s}$ = Yield to maturity on a real default-free investment at time t, which pays one unit of currency s periods in the future. $\theta_{t,s}$ = Expected inflation rate between t and t+s. $P_{t,s}^i$ = Risk premium required at time t to pay investors for the risk taken in the cash flow of asset i, s periods in the future.
	Intertemporal rate of substitution	$m_t = \frac{u_t}{u_0}$	u_t = The marginal utility of consumption after t periods; and u_0 = The marginal utility of consumption today.
	Taylor's rule	$Pr_t = l_t + l_t + 0.5(l_t - l_t^*) + 0.5(y_t - y_t^*)$	Pr_t =The policy rate at time t. l_t = The real short-term interest rates. l_t = The rate of inflation. l_t^* = The target rate of inflation. y_t = The logarithmic level of actual GDP. y_t^* = The logarithmic level of potential real GDP.

	Break-even inflation (BEI) rate	$\text{BEI} = \theta + \pi$	θ = The expected inflation π = The compensation for the uncertainty of future inflation
	Sharpe ratio	$\frac{E(R_p) - R_f}{\sigma_p}$	$E(R_p)$ = Expected return of the portfolio R_f = Risk–free rate of interest σ_p = Return volatility (standard deviation of returns) of the portfolio
	Ex-ante Sharpe ratio	$SR_p = \frac{E(R_P - R_F)}{\sigma(R_P)}$	$E(R_p)$ = Expected return of the portfolio R_f = Risk–free rate of interest $\sigma(R_P)$ = The sample standard of the portfolio return.
	Ex-post Sharpe ratio	$SR_p = \frac{R_P - R_F}{\sigma(R_P)}$	R_P = The average realized portfolio return; R_F = The average riskless rate of interest; and $\sigma(R_P)$ = The sample standard of the portfolio return.
	The value added	$R_A = R_P - R_B$	R_A = The value added; R_P = The investor's return; and R_B = The benchmark portfolio return.
	Return of the benchmark	$R_B = \sum_{i=1}^{n} w_{b,i} \times R_i$	$w_{b,i}$ = The benchmark weight of security i R_i = The return on security i
	Return of the managed portfolio	$R_P = \sum_{i=1}^{n} w_{p,i} \times R_i$	$w_{p,i}$ = The portfolio weight of security i
	Weights between managed portfolio and benchmark portfolio	$R_A = \sum_{i=1}^{n} \Delta w_i R_i$	Δw_i (active weight) = $w_{p,i} - w_{b,i}$

	Optimal risk	$\sigma_P^* = \frac{IR}{SR_B} \times \sigma_B$	σ_P^* = The optimal risk; IR = The information ratio of the active portfolio; SR_B = The Sharpe ratio of the benchmark. σ_B = The volatility of the benchmark return.
	Weight active strategy	$w_P = \frac{\sigma_P^*}{\sigma_P}$	σ_P^* = The optimal amount of active risk σ_P = The total active risk of the active portfolio
	Expected active return	$\text{Expected active return} = \text{IR} \times \text{Optimal active risk}$	IR = Information Ratio
	Breadth (BR)	$BR = \frac{N}{1 + (N-1)\rho}$	N = The number of decisions; and ρ = The same correlation between the decisions.
	Expected value added by active management	$E(R_A)^* = IC \times \sqrt{BR} \times \sigma_A$	IC = Information coefficient BR = breadth
	Transfer coefficient	$TC = CORR\left(\frac{\mu_i}{\sigma_i}, \Delta w_i \sigma_i\right) = CORR(\Delta w_i \times \sigma_i, \Delta w_i \sigma_i)$	μ_i= The ex-ante active return for security i
	Realized active portfolio risk	$\sigma_A = \sigma_{IC}\sqrt{N}\sigma_{RM}$	σ_A = The realized active portfolio risk; σ_{RM} = The benchmark tracking risk predicted by the risk model; and σ_{IC} = The additional risk induced by the uncertainty of the information coefficient.
	Noise	$\text{Noise} = R_A - E(R_A \mid IC_R)$	R_A = The actual active return. $E(R_A \mid IC_R)$ = The expected value added, given the investor's realized skill

	Effective spread transaction cost for buy orders	Effective spread transaction cost estimate = $\text{Trade size} \times \left(\text{Trade price} - \left(\text{Bid} + \frac{\text{Ask}}{2}\right)\right)$	
	Effective spread transaction for sell orders	Effective spread transaction $= \text{Trade size} \times \left(\left(\text{Bid} + \frac{\text{Ask}}{2}\right) - \text{Trade price}\right)$	
	VWAP transaction cost estimate for buy orders	VWAP transaction cost estimate = $\text{Trade size} \times (\text{Trade VWAP} - \text{VWAP benchmark})$	$\text{VWAP} = \frac{\sum(\text{Price} \times \text{Volume})}{\sum\text{Volume}}$
	VWAP transaction cost estimate for sell orders	VWAP transaction cost estimate $= \text{Trade size} \times (\text{VWAP benchmark} - \text{Trade VWAP})$	
	Implementation shortfall	Implementation shortfall = Actual price − Expected price	

Disclaimer: **The formula sheet includes only the most important formulas from current and past CFA® exam practice materials. The list is not exhaustive.**