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INVESTING WITH PURPOSE

The Investor's Formula Reference

The core formulas of finance: valuation, risk, portfolios, and markets, in one clean, connected reference.

100 FORMULAS · **11 SECTIONS** · **iwpfinance.com**

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A quick-reference library of the formulas that matter most, grouped by theme. Tap any section to jump to it.

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01 Time Value of Money

The engine under everything else: moving cash forward and backward through time.

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Future value of a single sum

BEGINNER

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

where: PV = present value today, r = periodic rate, n = number of periods.

Present value of a single sum

BEGINNER

$$PV = \frac{FV}{(1 + r)^n}$$

Discounts a future amount back to today. FV = the future amount.

Compounding m times per year

INTERMEDIATE

$$FV = PV(1 + \frac{r}{m})^{mn}$$

m = compounding periods per year. Continuous compounding: FV = PV·e ^{rn}.

Effective annual rate

INTERMEDIATE

$$EAR = (1 + \frac{r}{m})^m - 1$$

The true annual rate once compounding is counted. Continuous: EAR = e^r − 1.

Rule of 72

BEGINNER

$$\text{years to double} \approx \frac{72}{r\ (\%)}$$

Quick mental estimate of how long money takes to double at rate r.

PV of an ordinary annuity

INTERMEDIATE

$$PV = PMT \cdot \frac{1 - (1 + r)^{-n}}{r}$$

where: PMT = level payment per period, paid at period end.

FV of an ordinary annuity

INTERMEDIATE

$$FV = PMT \cdot \frac{(1 + r)^n - 1}{r}$$

Future value of a stream of level end-of-period payments.

Annuity due

INTERMEDIATE

$$\text{value} = \text{ordinary annuity} \times (1 + r)$$

Use when payments occur at the start of each period instead of the end.

Perpetuity

BEGINNER

$$\text{PV} = \frac{\text{PMT}}{r}$$

A payment that never ends. Growing perpetuity: PV = PMT ÷ (r − g), where g = growth (needs r > g).

Net present value

INTERMEDIATE

$$\text{NPV} = -\text{CF}_0 + \Sigma \frac{\text{CF}_t}{(1 + r)^t}$$

where: CF_0 = initial outlay, CF_t = cash flow in period t. Accept when NPV > 0.

Internal rate of return

ADVANCED

$$0 = -\text{CF}_0 + \Sigma \frac{\text{CF}_t}{(1 + \text{IRR})^t}$$

The discount rate that makes NPV zero; compare it to your required return.

02 Returns & Performance

How a dollar or position actually grew, and how to compare growth fairly.

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Holding period return

BEGINNER

$$\text{HPR} = \frac{P_1 - P_0 + D_1}{P_0}$$

where: P_0, P_1 = start and end price, D_1 = income received.

Return components

BEGINNER

total return = price return + income yield

Splits total return into the capital gain and the dividend/coupon yield.

Arithmetic vs geometric mean

INTERMEDIATE

$$R_G = [\prod(1 + R_i)]^{1/n} - 1$$

The geometric mean is the true compound growth rate; it is never above the arithmetic mean.

Compound annual growth rate

INTERMEDIATE

$$\text{CAGR} = \left(\frac{\text{EV}}{\text{BV}}\right)^{1/n} - 1$$

where: EV, BV = ending and beginning value, n = years.

Annualizing a return

INTERMEDIATE

$$R_{\text{ann}} = (1 + R_{\text{period}})^{c} - 1$$

c = compounding periods per year (12 monthly, 252 daily).

Scaling volatility

INTERMEDIATE

$$\sigma_{\text{annual}} = \sigma_{\text{period}} \cdot \sqrt{c}$$

Volatility grows with the square root of time; c = periods per year.

Real (inflation-adjusted) return

INTERMEDIATE

$$1 + r_{\text{real}} = \frac{1 + r_{\text{nom}}}{1 + i}$$

where: r_{nom} = nominal return, i = inflation. Approximately $r_{real} \approx r_{nom} - i$.

Money- vs time-weighted

ADVANCED

MWR = IRR of the account's cash flows

MWR reflects deposit/withdrawal timing; the time-weighted return strips it out to judge the manager.

After-tax return

BEGINNER

$$R_{at} = R_{pre} \cdot (1 - t)$$

t = the tax rate applied to the return.

03 Risk & Statistics

Measuring dispersion, co-movement, and reward earned per unit of risk.

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Variance & standard deviation

INTERMEDIATE

$$\sigma^2 = \frac{\Sigma(R_i - \bar{R})^2}{n - 1}, \quad \sigma = \sqrt{\sigma^2}$$

where: $\bar{R}$ = mean return. Use n − 1 for a sample, n for a full population.

Covariance

INTERMEDIATE

$$\mathrm{Cov}(a,b) = \frac{\Sigma(R_a - \bar{R}_a)(R_b - \bar{R}_b)}{n - 1}$$

The direction two assets move together (units make it hard to read directly).

Correlation

INTERMEDIATE

$$\rho_{a,b} = \frac{\mathrm{Cov}(a,b)}{\sigma_a \, \sigma_b}$$

Covariance rescaled to a clean −1 to +1 range.

Beta

INTERMEDIATE

$$\beta_i = \frac{\mathrm{Cov}(i,m)}{\sigma^2_m} = \rho_{i,m} \frac{\sigma_i}{\sigma_m}$$

where: m = the market. Sensitivity of an asset to overall market moves.

Coefficient of variation

BEGINNER

$$\mathrm{CV} = \frac{\sigma}{\mathrm{mean}}$$

Risk per unit of return; a scale-free way to compare dispersion.

Standard error of the mean

INTERMEDIATE

$$\mathrm{SEM} = \frac{\sigma}{\sqrt{n}}$$

where: n = sample size. How much a sample average is expected to wander from the true mean.

Sharpe ratio

INTERMEDIATE

$$S = \frac{R_p - R_f}{\sigma_p}$$

where: R_p = portfolio return, R_f = risk-free rate. Excess return per unit of total risk.

Sortino ratio

INTERMEDIATE

$$\text{Sortino} = \frac{R_p - R_f}{\sigma_{\text{down}}}$$

Like Sharpe, but σ_{down} counts only downside (harmful) volatility.

Treynor ratio

ADVANCED

$$T = \frac{R_p - R_f}{\beta_p}$$

Excess return per unit of systematic (market) risk.

Information ratio

ADVANCED

$$IR = \frac{R_p - R_b}{TE}$$

where: R_b = benchmark, TE = tracking error (σ of active return).

Jensen's alpha

ADVANCED

$$\alpha = R_p - [R_f + \beta_p(R_m - R_f)]$$

Return earned above what CAPM predicts for the risk taken.

Maximum drawdown

INTERMEDIATE

$$\text{MDD} = \frac{\text{trough} - \text{peak}}{\text{peak}}$$

The worst peak-to-trough decline over a period.

Parametric value at risk

ADVANCED

$$\text{VaR} = (\mu - z \cdot \sigma) \cdot V$$

where: μ = mean, z = 1.65 (95%) or 2.33 (99%), V = portfolio value.

04 Portfolio Theory & CAPM

Combining assets, and pricing the risk that cannot be diversified away.

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Portfolio return

BEGINNER

$$R_p = \Sigma\, w_i\, R_i$$

where: w_i = weight of asset i. A weighted average of returns.

Two-asset portfolio variance

INTERMEDIATE

$$\sigma^2_p = w^2_a\sigma^2_a + w^2_b\sigma^2_b + 2w_a w_b \rho \sigma_a \sigma_b$$

where: w = weights, σ = std devs, ρ = correlation. Lower ρ means more diversification.

Minimum-variance weight (2 assets)

ADVANCED

$$w_a = \frac{\sigma^2_b - \rho\sigma_a\sigma_b}{\sigma^2_a + \sigma^2_b - 2\rho\sigma_a\sigma_b}$$

The weight in asset a that gives the lowest-risk two-asset portfolio.

Portfolio beta

BEGINNER

$$\beta_p = \Sigma\, w_i\, \beta_i$$

Weighted average of the component betas.

CAPM (expected return)

INTERMEDIATE

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

where: R_f = risk-free rate, $[E(R_m) - R_f]$ = market risk premium.

Capital market line

ADVANCED

$$E(R_p) = R_f + \frac{E(R_m) - R_f}{\sigma_m} \cdot \sigma_p$$

The risk-return line for efficient portfolios that mix the market and the risk-free asset.

Total vs systematic risk

BEGINNER

$$\text{total risk} = \text{systematic} + \text{unsystematic}$$

Only systematic (market) risk is rewarded; the rest is diversified away.

05 Equity Valuation

Turning growth, payout, and discount rates into a share price.

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Gordon growth (constant DDM)

INTERMEDIATE

$$V_0 = \frac{D_1}{r - g}$$

where: D_1 = next dividend, r = required return, g = growth (needs r > g).

Sustainable growth

INTERMEDIATE

$$g = b \cdot \text{ROE}$$

where: b = retention ratio = 1 – payout ratio.

Two-stage DDM

ADVANCED

$$V_0 = \Sigma \frac{D_t}{(1+r)^t} + \frac{V_n}{(1+r)^n}$$

High-growth dividends discounted individually, then a terminal value V_n for the stable phase.

Justified leading P/E

INTERMEDIATE

$$\frac{P_0}{E_1} = \frac{\text{payout ratio}}{r - g}$$

The fair forward P/E implied by payout, required return, and growth.

Justified P/B

ADVANCED

$$\frac{P_0}{B_0} = \frac{\text{ROE} - g}{r - g}$$

where: B_0 = book value. Ties price-to-book to profitability and growth.

PEG ratio

BEGINNER

$$\text{PEG} = \frac{P/E}{g\ (\%)}$$

P/E normalized by growth; a lower figure can flag better relative value.

Free cash flow

INTERMEDIATE

$$\text{FCFF} = \text{CFO} + \text{Int}(1 - t) - \text{CapEx}$$

where: CFO = operating cash flow. FCFE = FCFF − Int(1 − t) + net borrowing.

Terminal value

INTERMEDIATE

$$\mathrm{TV}_n = \frac{\mathrm{FCF}_n(1+g)}{r-g}$$

Perpetuity value of the cash flows beyond the explicit forecast.

DCF firm value

ADVANCED

$$V_0 = \Sigma \frac{\mathrm{FCFF}_t}{(1+\mathrm{WACC})^t} + \frac{\mathrm{TV}_n}{(1+\mathrm{WACC})^n}$$

Discount forecast cash flows plus terminal value at the WACC.

Residual income

ADVANCED

$$V_0 = B_0 + \Sigma \frac{\mathrm{RI}_t}{(1+r)^t}$$

where: RI = NI − (r · equity); B_0 = current book value.

Earnings & dividend yield

BEGINNER

$$\text{earnings yield} = \frac{E}{P} \;;\quad \text{dividend yield} = \frac{D}{P}$$

Income and earnings expressed as a return; earnings yield is the inverse P/E.

06 Fixed Income

Pricing bonds and measuring how their prices react to interest rates.

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Bond price

INTERMEDIATE

$$P = \Sigma \frac{C}{(1+y)^t} + \frac{F}{(1+y)^n}$$

where: C = coupon, F = face value, y = yield per period, n = periods.

Current yield

BEGINNER

$$\text{current yield} = \frac{\text{annual coupon}}{\text{price}}$$

Income return only; ignores any capital gain or loss to maturity.

Yield to maturity

BEGINNER

$$\text{YTM} = \text{discount rate where price} = \text{PV(all cash flows)}$$

The internal rate of return of a bond held to maturity.

Macaulay duration

ADVANCED

$$\text{MacDur} = \frac{\Sigma\, t \cdot \text{PV}(\text{CF}_t)}{\text{price}}$$

The cash-flow-weighted average time to receive a bond's payments, in years.

Modified duration

INTERMEDIATE

$$\text{ModDur} = \frac{\text{MacDur}}{1+y}$$

Approximate % price change for a 1% change in yield.

Effective duration

ADVANCED

$$\text{EffDur} = \frac{P_- - P_+}{2 \cdot P_0 \cdot \Delta y}$$

where: P_-, P_+ = repriced values after a yield drop/rise of Δy. Used for bonds with options.

Price change estimate

ADVANCED

$$\%\Delta P \approx -\text{ModDur} \cdot \Delta y + \frac{1}{2} \cdot \text{convexity} \cdot \Delta y^2$$

Duration is the straight-line estimate; convexity corrects for the curve.

DV01

INTERMEDIATE

$$\text{DV01} = \text{ModDur} \times \text{price} \times 0.0001$$

The dollar price change from a one-basis-point move in yield.

Credit spread

BEGINNER

$$\text{spread} = \text{corporate yield} - \text{risk-free yield}$$

The extra yield demanded for default risk over a government benchmark.

Spot & forward rates

ADVANCED

$$(1 + s_2)^2 = (1 + s_1)(1 + {}_1f_1)$$

where: s = spot rate, ${}_1f_1$ = 1-year rate one year forward.

07 Financial Statement Analysis

The core ratios for liquidity, efficiency, solvency, and profitability.

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Liquidity

BEGINNER

$$\text{current} = \frac{\text{current assets}}{\text{current liabilities}} \; ; \quad \text{quick} = \frac{\text{CA} - \text{inventory}}{\text{CL}}$$

Ability to meet short-term obligations; the quick ratio excludes slow-moving inventory.

Activity / efficiency

INTERMEDIATE

$$\text{inventory turnover} = \frac{\text{COGS}}{\text{avg inventory}}$$

Receivables turnover = revenue ÷ avg receivables; DSO = 365 ÷ receivables turnover.

Cash conversion cycle

INTERMEDIATE

$$\text{CCC} = \text{DSO} + \text{DIO} - \text{DPO}$$

Days from paying suppliers to collecting from customers; lower is better.

Solvency

INTERMEDIATE

$$\text{D/E} = \frac{\text{total debt}}{\text{total equity}} \; ; \quad \text{interest coverage} = \frac{\text{EBIT}}{\text{interest}}$$

Leverage level and the earnings cushion to service debt.

Profitability margins

BEGINNER

$$\text{net margin} = \frac{\text{net income}}{\text{revenue}}$$

Gross, operating, and net margins measure profit left at each stage.

Return on equity / assets

BEGINNER

$$\text{ROE} = \frac{\text{net income}}{\text{avg equity}} \; ; \quad \text{ROA} = \frac{\text{net income}}{\text{avg assets}}$$

Profit generated per dollar of equity or of assets.

Return on invested capital

INTERMEDIATE

$$\text{ROIC} = \frac{\text{NOPAT}}{\text{invested capital}}$$

where: NOPAT = after-tax operating profit. Return on all capital put to work.

DuPont decomposition

INTERMEDIATE

ROE = net margin × asset turnover × equity multiplier

Breaks ROE into profitability, efficiency, and leverage.

08 Corporate Finance

The cost of capital, and how fixed costs and debt magnify results.

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WACC

INTERMEDIATE

$$\text{WACC} = \frac{E}{V} r_e + \frac{D}{V} r_d(1 - t)$$

where: E, D = market value of equity and debt, V = E + D, t = tax rate.

Cost of equity (CAPM)

INTERMEDIATE

$$r_e = R_f + \beta[E(R_m) - R_f]$$

The return shareholders require for the risk of the equity.

Cost of preferred

BEGINNER

$$r_p = \frac{D_p}{P_p}$$

where: D_p = preferred dividend, P_p = preferred price.

Degree of operating leverage

INTERMEDIATE

$$\text{DOL} = \frac{\%\Delta \text{ EBIT}}{\%\Delta \text{ sales}}$$

How fixed operating costs magnify a sales change into an EBIT change.

Degree of financial leverage

INTERMEDIATE

$$\text{DFL} = \frac{\%\Delta \text{ EPS}}{\%\Delta \text{ EBIT}}$$

How fixed financing costs magnify an EBIT change into an EPS change.

Total leverage

INTERMEDIATE

$$\text{DTL} = \text{DOL} \times \text{DFL}$$

Combined magnification from a change in sales all the way to EPS.

Payout & retention

BEGINNER

$$\text{payout} = D \div \text{EPS} \; ; \quad \text{retention } b = 1 - \text{payout}$$

How earnings split between dividends and reinvestment.

Breakeven quantity

BEGINNER

$$Q = \frac{\text{fixed costs}}{\text{price} - \text{variable cost}}$$

Units that must sell to cover all fixed and variable costs.

09 Derivatives & Options

Pricing forwards and the building blocks of option value.

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Forward price

INTERMEDIATE

$$F_0 = S_0(1 + r)^T$$

where: S_0 = spot price, T = time. Continuous: $F_0 = S_0 \cdot e^{rT}$.

Forward with carry/income

ADVANCED

$$F_0 = [S_0 - \text{PV(income)}](1 + r)^T$$

Adjusts the forward for dividends, coupons, or storage costs during the contract.

Option payoffs at expiry

BEGINNER

$$\text{call} = \max(S - K, 0)\ ; \quad \text{put} = \max(K - S, 0)$$

where: K = strike, S = underlying price at expiry.

Put-call parity

INTERMEDIATE

$$C + \frac{K}{(1 + r)^T} = P + S_0$$

Links a European call, put, strike PV, and spot into one no-arbitrage identity.

Option value split

BEGINNER

$$\text{option value} = \text{intrinsic value} + \text{time value}$$

Intrinsic = the in-the-money amount; time value erodes toward expiry.

The Greeks

INTERMEDIATE

$$\Delta \text{ price} \cdot \Gamma \text{ curvature} \cdot \Theta \text{ time} \cdot \nu \text{ volatility} \cdot \rho \text{ rate}$$

Delta, gamma, theta, vega, rho: how an option's price responds to each input.

Black-Scholes (call)

ADVANCED

$$C = S_0 N(d_1) - K e^{-rT} N(d_2)$$

where: N(·) = normal CDF. Values a European call under lognormal prices.

10 Foreign Exchange & International

Quoting currencies and the parity relationships that link rates.

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Bid-offer spread

BEGINNER

$$\text{spread} = \text{offer (ask)} - \text{bid}$$

The dealer's quoted difference between buying and selling a currency.

Forward premium / discount

INTERMEDIATE

$$\text{premium} = \frac{F - S}{S}$$

where: F = forward rate, S = spot rate. Positive means a forward premium.

Covered interest rate parity

ADVANCED

$$\frac{F}{S} = \frac{1 + i_d}{1 + i_f}$$

where: i_d, i_f = domestic and foreign rates. The no-arbitrage hedged forward.

Uncovered interest rate parity

ADVANCED

$$E(\%\Delta S) \approx i_d - i_f$$

Expected spot change should track the interest-rate differential.

Cross rate

BEGINNER

$$A/C = A/B \times B/C$$

Build a quote between two currencies through a common third one.

Triangular arbitrage

INTERMEDIATE

$$\text{profit exists if } A/C \neq A/B \times B/C$$

A mispricing among three cross rates that can be traded for riskless gain.

Purchasing power parity

INTERMEDIATE

$$E(\%\Delta S) \approx \text{inflation differential}$$

Currencies should adjust so identical goods cost the same across borders.

Real exchange rate

INTERMEDIATE

$$\text{RER} = S \cdot \frac{P_{\text{foreign}}}{P_{\text{domestic}}}$$

where: P = price levels. The nominal rate adjusted for relative prices.

11 Quantitative Methods

The regression and time-series relationships used across the toolkit.

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Expected value

BEGINNER

$$E(X) = \Sigma\, p_i\, x_i$$

where: p_i = probability of outcome x_i. The probability-weighted average of every possible result.

Simple linear regression

INTERMEDIATE

$$Y = b_0 + b_1 X + \varepsilon$$

where: $b_1 = \text{Cov}(X,Y) \div \text{Var}(X)$, $b_0 = \bar{Y} - b_1\bar{X}$, ε = error.

Coefficient of determination

INTERMEDIATE

$$R^2 = \frac{\text{explained variation}}{\text{total variation}}$$

The share of Y's variation explained by the model, from 0 to 1.

t-statistic of a coefficient

ADVANCED

$$t = \frac{b_1 - 0}{\text{SE}(b_1)}$$

where: SE = standard error. Tests whether a coefficient differs from zero.

Z-score (standardization)

BEGINNER

$$z = \frac{x - \mu}{\sigma}$$

How many standard deviations a value sits from the mean.

First-order autoregression

ADVANCED

$$x_t = b_0 + b_1 x_{t-1} + \varepsilon_t$$

Each observation modeled on the immediately prior one.

Mean-reverting level

ADVANCED

$$\bar{x} = \frac{b_0}{1 - b_1}$$

The long-run level an AR(1) series is pulled back toward.

Covariance from correlation

INTERMEDIATE

$$\mathrm{Cov}(a,b) = \rho \cdot \sigma_a \cdot \sigma_b$$

Recover covariance when you know the correlation and both volatilities.

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Understand what moves markets.

Every formula here is explained in plain English, with worked context, in the IWP knowledge base.

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