Student User Guide

Smart Business Writer - how to use each tile and capability

Build 1.162 | 2026-11-12 | Global edition - all examples in USD

About this guide

This guide walks you through every tile and capability in Smart Business Writer, in plain language. It is written for college and graduate students. Each tile says what it is for, when to use it, what you need before you start, the steps in the workbench, how to read the result, the most common mistakes, and its limits.

Every number in the product is computed by code, not by an AI assistant, and every result can be re-performed from the inputs you declare. This guide tells you how to supply those inputs and how to interpret the output.

How to read a tile entry

What it's for. The business question the tile answers.

When to use it. The situations it fits, and when to choose something else.

What you need. The inputs you must declare before running.

Steps. What to click or enter in the workbench.

Read the result. What the number or chart means in plain words.

Common mistakes. The errors that cost marks, and how to avoid them.

Limit. What the tile does not do, so you do not rely on it beyond its design.

Global conventions used throughout the product

* **All examples are in USD.** The product is global: it names no home exchange, home country, or home-currency example.
* **Rates are decimals.** Enter 6% as 0.06, not 6.
* **Cash flows are end-of-period.** The first cash flow (normally a negative outlay) is period 0 or t = 0, unless a method states otherwise.
* **Time is in years or periods** as the method asks; do not mix annual and monthly inputs.
* **One currency per file or engagement.** Do not mix currencies in the same table.
* **The tool computes; you supply and judge.** The AI never writes a number, never chooses a treatment, and never audits your answer.

Where things live. Start at **Home** to describe a case and open the chat. Open a **subject** from the left rail to run a tool (tile). Use the **Business Calculator** for a standalone figure. Use **Charts** to turn a data file into a visual. Each subject tile is its own small computation with its own inputs and checks.

Getting started - five steps

* **Open Home.** Describe your case in the composer box and press Enter (or the arrow). The chat infers the framework from what you write.
* **Confirm the plan.** Review the selected computations and capabilities, then confirm. A frozen plan is recorded so every number can be re-performed later.
* **Declare your figures.** Fill in the inputs each tile asks for. Rates go in as decimals; currencies stay consistent.
* **Run and review.** Each result shows its declared inputs, the computed value, and its limits. Reject anything that does not match your case.
* **Export.** Download Word, Excel, PowerPoint (project plans), PDF (Chrome), or a ZIP bundle. Export stays blocked until every required field and block is complete.

Export gate. The download button stays hidden until the paper is complete - every required field and every selected computation block must be supplied. If export is refused, the message names exactly what is missing.

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Accounting

Ledger, statements, ratios and the cost-volume-profit questions built on them.

How to start. Work from the accounting question. If you already have a journal and a trial balance, start by checking them against each other. If you are building the records, start with the management accounts: the chart, the opening balances and the entries. Then read the statements with the ratios and the common-size trend, and use the cost tools when the question is about volume, activity or a sales variance.

Tiles in this subject

Tile	What it's for	Method / level
Management accounts (accounts)	Run the double-entry engagement, confirm the account mapping and produce the statements.	management_accounts - intermediate
Check a trial balance (tbcheck)	Compare your own trial balance with the one your journal rebuilds to, and see every line that differs or is missing.	trial_balance_check - intro
Financial statement ratios (ratios)	Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.	ratio_analysis - intro
Standard-cost variances (scv)	Material price and usage, labour rate and efficiency, and overhead variances for the output produced.	standard_cost_variances - intermediate
Activity-based costing (abc)	Activity rates, each product's allocation and its unit cost from the drivers it consumes.	abc_costing - intermediate
Sales price, mix and yield variances (salesvar)	Reconcile the revenue change into price, mix and yield, per product and in total.	sales_variances - intermediate
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Working capital and EOQ (workingcapital)	Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.	working_capital - intro
Loan amortization (loan)	Find the level payment, total interest and first-payment split on a fixed-rate loan.	loan_amortization - intro
Common-size and trend (trendanalysis)	Several years of income-statement figures as common-size percentages, an index and compound growth.	trend_analysis - intro
Tax on declared rates (tax)	Income tax, VAT payable and deferred tax from the rates you declare, with the total charge.	tax_declared - intro

How to use each tile

Management accounts - method: management_accounts | level: intermediate

What it's for. Run the double-entry engagement, confirm the account mapping and produce the statements.

Steps. Declare the period, the currency and the chart of accounts. Enter the opening balances and every transaction as a dated, balanced entry. Confirm the account mapping when the engine asks; nothing is posted before you do. Read the trial balance, the statements, the cash flow and the closing entries, then check that they agree.

Rule. Every entry keeps debits equal to credits; assets = liabilities + equity, and net income closes to retained earnings.

Check a trial balance - method: trial_balance_check | level: intro

What it's for. Compare your own trial balance with the one your journal rebuilds to, and see every line that differs or is missing.

Steps. Paste the trial balance you prepared. Paste the journal it came from, one dated balanced entry at a time. Read every line that agrees, differs or has no counterpart. Fix the entry the hint points to, not the total.

Rule. A trial balance balances when total debits equal total credits; the check compares each line with the one your own journal rebuilds.

Financial statement ratios - method: ratio_analysis | level: intro

What it's for. Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.

Steps. Enter the statement figures you have; missing figures leave ratios uncomputed. Read each ratio with its declared formula and the figures it used. Compare only with a stated benchmark or prior period. Check the balance-sheet identity where the figures allow it.

Rule. Current ratio = current assets / current liabilities; margins divide profit by revenue; turnover divides revenue by the balance.

Standard-cost variances - method: standard_cost_variances | level: intermediate

What it's for. Material price and usage, labour rate and efficiency, and overhead variances for the output produced.

Steps. Enter the actual output and the standard quantity and price (or hours and rate) per unit. Enter the actual quantity or hours and the actual price or rate. Read each variance and its total; positive means actual cost exceeded the standard. If you declare overhead, read the spending and efficiency (or volume) variances too.

Rule. Price = AQ(AP - SP); usage = SP(AQ - SQ); rate = AH(AR - SR); efficiency = SR(AH - SH); a positive variance is unfavourable.

Activity-based costing - method: abc_costing | level: intermediate

What it's for. Activity rates, each product's allocation and its unit cost from the drivers it consumes.

Steps. List the activity pools and their costs. List the products and their units. For each activity and product, declare the driver quantity consumed. Read the rates, the allocations and the unit costs; every pool is allocated in full.

Rule. Rate = pool cost / driver total; product allocation = sum of driver quantity x rate; unit cost = allocation / units.

Sales price, mix and yield variances - method: sales_variances | level: intermediate

What it's for. Reconcile the revenue change into price, mix and yield, per product and in total.

Steps. Enter budget and actual units and prices for two or more products. Read the price, mix and yield variances per product and in total. Check that they reconstruct the total revenue change. Explain the movements from evidence outside the numbers, not from the variances alone.

Rule. Price = actual units x (actual price - budget price); mix = budget price x (actual units - standard-mix units); yield = budget price x (standard-mix units - budget units).

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Working capital and EOQ - method: working_capital | level: intro

What it's for. Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.

Steps. Enter revenue, cost of sales and the three working-capital balances. Read DSO, DIO, DPO and the cash conversion cycle. Enter annual demand, order cost and holding cost for the order quantity. Read the reorder point and the annualised cost of forgoing the trade discount.

Rule. CCC = DSO + DIO - DPO; EOQ = square root of (2 x annual demand x order cost / holding cost per unit).

Loan amortization - method: loan_amortization | level: intro

What it's for. Find the level payment, total interest and first-payment split on a fixed-rate loan.

Steps. Enter the principal, the nominal annual rate, the term and the payment frequency. Convert the annual rate and the term to the payment period. Read the level payment, then total paid and total interest. Check the first payment's interest and principal split.

Rule. PMT = P x r / (1 - (1 + r)^-n), where r is the annual rate divided by payments per year and n is years x payments per year.

Common-size and trend - method: trend_analysis | level: intro

What it's for. Several years of income-statement figures as common-size percentages, an index and compound growth.

Steps. Enter the periods in order, starting with the base year. Enter revenue, cost of sales, operating expenses and net income for every period. Read each line as a share of revenue in the latest period. Read the index against the base year and the compound growth across the whole span.

Rule. Common-size % = line / revenue; index = period value / base value x 100; CAGR = (end / start)^(1 / periods) - 1.

Tax on declared rates - method: tax_declared | level: intro

What it's for. Income tax, VAT payable and deferred tax from the rates you declare, with the total charge.

Steps. Enter the taxable income you are declaring and the income tax rate as a decimal. If the assignment includes VAT, enter the output and input tax. If it includes deferred tax, enter the temporary difference and the rate. Read the current tax, the VAT payable, the deferred tax and the total charge.

Rule. Income tax = positive taxable income x declared rate; VAT payable = output tax - input tax; deferred tax = temporary difference x declared rate; total charge = income tax + deferred tax.

Limits - what this subject does not do

* It does not file a tax return or apply a jurisdiction's tax law; tax is a declared-rate calculation.
* It does not choose the accounting policy, audit the figures or certify the statements.
* It does not invent a missing balance or plug an unbalanced trial balance.

Finance

Corporate finance, valuation and the investments, debt, risk and international tools a finance student needs.

How to start. Start with the question, not the tool. Instrument: time value, a loan or a bond. Project: NPV, IRR and discounted payback, then rank it. Company: WACC, DCF, then the equity bridge. Investment or risk: CAPM, the portfolio, VaR, options. International: the parity and currency tools. Every rate, price and cash flow is yours to declare.

Tiles in this subject

Tile	What it's for	Method / level
Time value of money (tvm)	Grow a lump sum and a level payment to a future value, and show the effective annual rate behind them.	time_value - intro
Loan amortization (loan)	Find the level payment, total interest and first-payment split on a fixed-rate loan.	loan_amortization - intro
DuPont analysis (dupont)	Break return on equity into margin, turnover and leverage, with five-step, common-size and prior-period growth.	dupont_analysis - intro
Common-size and trend (trendanalysis)	Several years of income-statement figures as common-size percentages, an index and compound growth.	trend_analysis - intro
Working capital and EOQ (workingcapital)	Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.	working_capital - intro
Financial statement ratios (ratios)	Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.	ratio_analysis - intro
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro
Net present value (npv)	Discount a project's cash flows at a declared rate and record the NPV with its checks.	npv - intro
Internal rate of return (irr)	Find the rate at which the project's NPV is zero, with the declared search bounds.	irr - intro
Discounted payback (dpayback)	Record how long the discounted cash flows take to repay the investment.	discounted_payback - intro
Project ranking metrics (projectmetrics)	Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.	project_metrics - intermediate
Weighted average cost of capital (wacc)	Record the WACC from the declared capital structure and component costs.	wacc - intermediate
CAPM and beta (capm)	Estimate beta from returns and turn it into a cost of equity, with Hamada relevering.	capm - intermediate
Leverage, EPS and Altman Z (leverage)	EPS, financial leverage, interest cover, tax shield, EBIT-EPS indifference and the Z-score.	leverage_analysis - intermediate
Scenario analysis (scenario)	Recompute NPV at a low and high discount rate and find the decision-flip rate.	scenario_analysis - intro
Compare strategic options (case_decision)	Compare alternatives by NPV and record the crossover rate that flips the decision.	case_decision - intermediate
DCF valuation (year-end) (dcf)	Value a business or project from forecast free cash flows and a declared discount rate.	dcf_valuation - intermediate

Tile	What it's for	Method / level
DCF valuation (mid-year) (dcfmid)	The same DCF with mid-year discounting, recorded separately so the assumption is visible.	dcf_valuation - intermediate
Equity bridge (equitybridge)	Move from enterprise value to equity value through net debt and other declared claims.	equity_bridge - intermediate
Comparable multiples (multiples)	Apply peer multiples to your own earnings, EBITDA, sales or book value.	multiples_valuation - intermediate
Portfolio valuation (portfolioval)	Value a dated portfolio from holdings, prices and cash: NAV, weights and concentration.	portfolio_valuation - intro
Time-weighted return (portfolioperf)	Chain dated period returns, net of flows, and compare them with a declared benchmark.	portfolio_performance - intro
Bond price and duration (bond)	Price a fixed-coupon bond or solve its yield, with duration, convexity and DV01.	bond_analysis - intermediate
Portfolio return and risk (portfolio)	Two-asset return and risk, correlation, Sharpe, beta, Treynor and Jensen's alpha.	portfolio_analysis - intermediate
Pearson correlation (pearson)	Record the linear association between two variables with its sample size and checks.	pearson - intermediate
Linear regression (ols)	Fit a declared linear model and record coefficients, fit and diagnostics.	ols - advanced
Linear regression (HC3) (ols_robust)	The same regression with heteroskedasticity-robust standard errors.	ols_robust - advanced
Value at risk (risk)	Parametric and historical VaR and expected shortfall from a declared return series.	risk_metrics - intermediate
Option pricing (options)	Black-Scholes price and Greeks for a European call or put, with a binomial cross-check.	option_pricing - advanced
FX and interest parity (fx)	Implied forward, expected spot, forward premium and real rates, plus a one-forward hedge comparison.	fx_parity - intermediate
Currency conversion (currency)	Convert an amount at a rate you declare; the rate and its source are recorded.	currency_convert - intro

How to use each tile

Time value of money - method: time_value | level: intro

What it's for. Grow a lump sum and a level payment to a future value, and show the effective annual rate behind them.

Steps. Enter today's amount, the level payment and the nominal annual rate. Divide the annual rate by the compounding frequency to get the periodic rate. Multiply the years by the frequency to get the number of periods. Read the future value, the present value of the payments and the effective annual rate together.

Rule. FV = PV(1 + r)^n + PMT[((1 + r)^n - 1) / r]; the effective annual rate is (1 + r)^m - 1.

Loan amortization - method: loan_amortization | level: intro

What it's for. Find the level payment, total interest and first-payment split on a fixed-rate loan.

Steps. Enter the principal, the nominal annual rate, the term and the payment frequency. Convert the annual rate and the term to the payment period. Read the level payment, then total paid and total interest. Check the first payment's interest and principal split.

Rule. PMT = P x r / (1 - (1 + r)^-n), where r is the annual rate divided by payments per year and n is years x payments per year.

DuPont analysis - method: dupont_analysis | level: intro

What it's for. Break return on equity into margin, turnover and leverage, with five-step, common-size and prior-period growth.

Steps. Enter revenue, net income, total assets and equity. Read the three components and their product. If you have EBIT, pre-tax income and tax, read the five-step decomposition. Declare the prior period to see common-size ratios and growth.

Rule. ROE = net margin x asset turnover x equity multiplier; the five-step form adds tax and interest burdens.

Common-size and trend - method: trend_analysis | level: intro

What it's for. Several years of income-statement figures as common-size percentages, an index and compound growth.

Steps. Enter the periods in order, starting with the base year. Enter revenue, cost of sales, operating expenses and net income for every period. Read each line as a share of revenue in the latest period. Read the index against the base year and the compound growth across the whole span.

Rule. Common-size % = line / revenue; index = period value / base value x 100; CAGR = (end / start)^(1 / periods) - 1.

Working capital and EOQ - method: working_capital | level: intro

What it's for. Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.

Steps. Enter revenue, cost of sales and the three working-capital balances. Read DSO, DIO, DPO and the cash conversion cycle. Enter annual demand, order cost and holding cost for the order quantity. Read the reorder point and the annualised cost of forgoing the trade discount.

Rule. CCC = DSO + DIO - DPO; EOQ = square root of (2 x annual demand x order cost / holding cost per unit).

Financial statement ratios - method: ratio_analysis | level: intro

What it's for. Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.

Steps. Enter the statement figures you have; missing figures leave ratios uncomputed. Read each ratio with its declared formula and the figures it used. Compare only with a stated benchmark or prior period. Check the balance-sheet identity where the figures allow it.

Rule. Current ratio = current assets / current liabilities; margins divide profit by revenue; turnover divides revenue by the balance.

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Net present value - method: npv | level: intro

What it's for. Discount a project's cash flows at a declared rate and record the NPV with its checks.

What you need. the outlay, the later cash flows, and the hurdle rate you will justify

Steps. List the cash flows in order, starting with the negative outlay at t = 0. Choose the discount rate that matches the project's risk. Discount each flow and add them. Compare the result with zero; a positive NPV clears the hurdle at that rate.

Rule. NPV = sum of CF_t / (1 + r)^t, with the first cash flow at t = 0 and undiscounted.

Internal rate of return - method: irr | level: intro

What it's for. Find the rate at which the project's NPV is zero, with the declared search bounds.

What you need. the same cash flows; the method refuses more than one sign change

Steps. Write the cash flows with the outlay at t = 0. Solve for the rate that makes the present value zero. Compare the IRR with the cost of capital. Use it with NPV, not instead of it, when projects differ in scale or life.

Rule. The IRR is the rate r at which NPV = 0: sum of CF_t / (1 + r)^t = 0.

Discounted payback - method: discounted_payback | level: intro

What it's for. Record how long the discounted cash flows take to repay the investment.

What you need. the cash flows and the discount rate

Steps. Discount each cash flow at the declared rate. Add the discounted flows year by year. Find the year in which the cumulative total crosses zero. Interpolate within that year for the fractional period.

Rule. Cumulate the discounted cash flows until they turn positive; interpolate inside the recovering period.

Project ranking metrics - method: project_metrics | level: intermediate

What it's for. Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.

What you need. the cash flows, the hurdle rate and a finance rate

Steps. Start from the same cash flows and rate as the NPV. Compute the profitability index from the present values of inflows and outflows. Reinvest positive flows at the finance rate and finance negative flows at the cost of capital for MIRR. Spread the NPV over the project's life for the equivalent annual annuity.

Rule. PI = PV(inflows) / |PV(outflows)|; MIRR reinvests positive flows at the finance rate; EAA = NPV x r / (1 - (1 + r)^-n).

Weighted average cost of capital - method: wacc | level: intermediate

What it's for. Record the WACC from the declared capital structure and component costs.

Steps. Enter the market value of equity and interest-bearing debt. Enter the cost of equity and the AFTER-TAX cost of debt. Compute the weights from market values. Multiply each cost by its weight and add.

Rule. WACC = (E / V) x ke + (D / V) x kd(after tax), where V = E + D.

CAPM and beta - method: capm | level: intermediate

What it's for. Estimate beta from returns and turn it into a cost of equity, with Hamada relevering.

Steps. Enter the risk-free rate and the expected market return. Enter beta, or supply both return series and let the method estimate it. Multiply beta by the market risk premium and add the risk-free rate. If you declare debt-to-equity and a tax rate, read the unlevered and relevered beta.

Rule. ke = rf + beta x (rm - rf); beta = covariance(asset, market) / variance(market).

Leverage, EPS and Altman Z - method: leverage_analysis | level: intermediate

What it's for. EPS, financial leverage, interest cover, tax shield, EBIT-EPS indifference and the Z-score.

Steps. Enter EBIT, interest, tax and the share count. Read EPS, the degree of financial leverage and interest cover. For the Z-score, also enter the six balance-sheet and market figures. For EBIT-EPS indifference, declare the alternative plan's interest and share count.

Rule. EPS = (EBIT - interest)(1 - tax) / shares; DFL = EBIT / (EBIT - interest); Z = 1.2WC/TA + 1.4RE/TA + 3.3EBIT/TA + 0.6MVE/TL + Sales/TA.

Scenario analysis - method: scenario_analysis | level: intro

What it's for. Recompute NPV at a low and high discount rate and find the decision-flip rate.

What you need. the cash flows, a base rate and a low/high range

Steps. Enter the project's cash flows and the base discount rate. Declare the optimistic (low) and pessimistic (high) rates. Read the three NPVs, the swing and the decision-flip rate. Say which single input changed and which did not.

Rule. Recompute NPV at the low and high discount rates; the break-even rate is the IRR of the same cash flows.

Compare strategic options - method: case_decision | level: intermediate

What it's for. Compare alternatives by NPV and record the crossover rate that flips the decision.

What you need. the facts, the alternatives, their cash flows and provenance

Steps. Enter two to five alternatives, each with its own cash flows. Read each alternative's NPV and the crossover rate between pairs. Say which alternative wins at the decision rate and where the ranking flips. Keep non-financial criteria visible beside the numbers.

Rule. Compare each alternative's NPV at the declared rate; the crossover rate is where two alternatives' NPVs are equal.

DCF valuation (year-end) - method: dcf_valuation | level: intermediate

What it's for. Value a business or project from forecast free cash flows and a declared discount rate.

Steps. Enter the free cash flows for the explicit forecast. Enter the discount rate that matches the cash flows. If the business continues, declare a terminal growth rate below the discount rate. Read the explicit present value, the terminal present value and their sum.

Rule. EV = sum of FCF_t / (1 + r)^t + TV / (1 + r)^n; TV = FCF_n(1 + g) / (r - g).

DCF valuation (mid-year) - method: dcf_valuation | level: intermediate

What it's for. The same DCF with mid-year discounting, recorded separately so the assumption is visible.

Steps. Use the same cash flows and rate as the year-end DCF. Declare the mid-year timing convention. Discount each flow and the terminal value one half-period earlier. Compare the result with the year-end value; mid-year raises it.

Rule. The same DCF, with every flow discounted at exponent t - 0.5 instead of t.

Equity bridge - method: equity_bridge | level: intermediate

What it's for. Move from enterprise value to equity value through net debt and other declared claims.

Steps. Start from the enterprise value the DCF or a multiple implies. Subtract debt and add cash for net debt. Subtract minority interest and preferred equity if they are claims on the enterprise. Divide by shares outstanding only if you want a per-share value.

Rule. Equity value = enterprise value - net debt - minority interest - preferred equity; per share = equity value / shares.

Comparable multiples - method: multiples_valuation | level: intermediate

What it's for. Apply peer multiples to your own earnings, EBITDA, sales or book value.

Steps. Choose the metric: earnings and book value are equity multiples, EBITDA and sales are enterprise multiples. Enter the subject's metric and the peer multiples. Read the mean, median, minimum and maximum multiple. Bridge enterprise value to equity value with net debt if the multiple is an EV multiple.

Rule. Implied value = subject metric x peer multiple; EV multiples bridge to equity through net debt.

Portfolio valuation - method: portfolio_valuation | level: intro

What it's for. Value a dated portfolio from holdings, prices and cash: NAV, weights and concentration.

Steps. Enter each holding's symbol, shares and price in one base currency. Enter the cash balance. Read NAV, invested value, cash share and each holding's weight. Check the largest holding and the top-three concentration before using the snapshot.

Rule. NAV = sum(shares x price) + cash; weight = value / NAV; top-three concentration = sum of the three largest weights.

Time-weighted return - method: portfolio_performance | level: intro

What it's for. Chain dated period returns, net of flows, and compare them with a declared benchmark.

Steps. Record the NAV at the start and end of each period. Record any contribution or withdrawal as that period's flow. Chain the period returns to get the time-weighted return. If you use a benchmark, record its level on each date.

Rule. period return = (end NAV - start NAV - flow) / (start NAV + flow); TWR = product(1 + period return) - 1.

Bond price and duration - method: bond_analysis | level: intermediate

What it's for. Price a fixed-coupon bond or solve its yield, with duration, convexity and DV01.

Steps. Divide the annual coupon and the annual yield by the payment frequency. Discount every coupon and the face value at the periodic yield. Add the present values for the price. Weight each cash flow's time by its present value and divide by the price for duration.

Rule. Price = sum of coupon / (1 + y)^t + face / (1 + y)^n; Macaulay duration is the present-value-weighted time to each cash flow.

Portfolio return and risk - method: portfolio_analysis | level: intermediate

What it's for. Two-asset return and risk, correlation, Sharpe, beta, Treynor and Jensen's alpha.

Steps. Enter the two return series for the same periods. Declare the weight in the first asset and the risk-free rate for that period. Read each asset's mean and standard deviation, their covariance and correlation. Read the portfolio return and risk, then the Sharpe, beta, Treynor and Jensen measures.

Rule. Rp = wRa + (1 - w)Rb; sigma_p^2 = w^2 sa^2 + (1 - w)^2 sb^2 + 2w(1 - w)cov; Sharpe = (Rp - rf) / sigma_p.

Pearson correlation - method: pearson | level: intermediate

What it's for. Record the linear association between two variables with its sample size and checks.

What you need. the two numeric variables you are relating, and the pairs you observed

Steps. Check both variables are numeric and paired. Read r between minus one and one. Inspect the scatter plot before trusting a linear summary.

Rule. r = covariance(x, y) / (standard deviation of x x standard deviation of y).

Linear regression - method: ols | level: advanced

What it's for. Fit a declared linear model and record coefficients, fit and diagnostics.

What you need. the outcome, the predictors, and the observations you have for each

Steps. Check the sample size and missing values. Read each coefficient with its standard error. Check the fit and residual diagnostics. State the assumptions and the claim ceiling.

Rule. y = intercept + coefficient x x + error; the coefficients minimise the sum of squared errors.

Linear regression (HC3) - method: ols_robust | level: advanced

What it's for. The same regression with heteroskedasticity-robust standard errors.

Steps. Fit the same model as OLS. Read the robust standard errors and their tests. Compare with the ordinary OLS errors to see whether heteroskedasticity mattered. Keep the model specification fixed when comparing.

Rule. The same OLS coefficients with HC3 heteroskedasticity-robust standard errors.

Value at risk - method: risk_metrics | level: intermediate

What it's for. Parametric and historical VaR and expected shortfall from a declared return series.

Steps. Enter a representative series of periodic returns. Declare the confidence level, portfolio value and horizon. Read the parametric and historical VaR side by side. Read the expected shortfall to see how bad the tail beyond VaR is.

Rule. Parametric VaR = -(mu + z x sigma) at the declared confidence; historical VaR is the matching return quantile; CVaR is the average loss beyond it.

Option pricing - method: option_pricing | level: advanced

What it's for. Black-Scholes price and Greeks for a European call or put, with a binomial cross-check.

Steps. Enter the spot price, strike, annual volatility, risk-free rate and time to expiry in years. Choose call or put and declare the dividend yield if any. Read the price, intrinsic and time value, and the Greeks. Use the binomial cross-check and the parity gap to see that the arithmetic is consistent.

Rule. Black-Scholes: C = S e^(-qT) N(d1) - K e^(-rT) N(d2); put-call parity: C - P = S e^(-qT) - K e^(-rT).

FX and interest parity - method: fx_parity | level: intermediate

What it's for. Implied forward, expected spot, forward premium and real rates, plus a one-forward hedge comparison.

Steps. Quote the spot rate as domestic currency per one unit of foreign currency. Enter the domestic and foreign interest and inflation rates. Read the parity forward, the PPP expected spot and the forward premium. If you declare an exposure, compare the hedged and unhedged domestic amounts.

Rule. Covered parity: F = S(1 + rd)^T / (1 + rf)^T; relative PPP: E[S_T] = S(1 + inflation_d)^T / (1 + inflation_f)^T.

Currency conversion - method: currency_convert | level: intro

What it's for. Convert an amount at a rate you declare; the rate and its source are recorded.

Steps. Enter the amount, the source currency and the target currency. Declare the rate and where it came from. Read the converted amount and the recorded rate. Keep the rate date with the result.

Rule. Converted amount = amount x rate, with the rate's provenance recorded.

Limits - what this subject does not do

* It does not retrieve market prices, yields, exchange rates or peer multiples; you declare them.
* It does not choose the discount rate, the peer set or the risk appetite for you.
* It does not model tax, American exercise, liquidity risk or a full portfolio optimisation.

Economics

The quantitative economics core: micro, macro, welfare, international, development, behavioural, game theory and impact evaluation.

How to start. Start with the level you are working at. Intro tools cover the first principles: demand and supply, elasticity, tax incidence, price controls and market concentration. Intermediate tools cover welfare, policy, international trade and behavioural questions. Advanced tools are econometrics and game theory; use them only when you have the data and the design. Every curve, rate and income is one you declare.

Tiles in this subject

Tile	What it's for	Method / level
Market equilibrium (equilibrium)	Find the equilibrium price and quantity from declared linear demand and supply, with consumer and producer surplus.	demand_supply_equilibrium - intro
Price elasticity of demand (elasticity)	Measure the arc elasticity between two price-quantity observations and see what happens to revenue.	elasticity - intro
Tax incidence and deadweight loss (taxincidence)	Split a per-unit tax between buyers and sellers and record the revenue and deadweight loss.	tax_incidence - intro
Price ceilings and floors (pricecontrol)	See the shortage, surplus and deadweight loss created by a declared price control.	price_control - intro
Market concentration (HHI) (concentration)	Compute HHI, CR4 and the equivalent number of firms from declared firm revenues.	market_concentration - intro
Cost curves (costcurves)	Average, average variable, average fixed and marginal cost at a declared quantity, with profit and a shutdown test if you supply a price.	cost_curves - intro
Profit maximisation (profitmax)	Find the output and price where marginal revenue equals marginal cost, with profit, markup and the Lerner index.	profit_maximization - intro
Markup and Lerner index (marketpower)	Measure the markup and Lerner index from a price and marginal cost, and the implied demand elasticity.	market_power - intro
Price discrimination (pricediscrimination)	Set third-degree prices and quantities in two separated markets.	price_discrimination - advanced
Cournot duopoly (cournot)	Find the two-firm Cournot quantities, price and profits.	cournot_duopoly - advanced
Nash equilibrium (2x2) (nash)	Find the pure-strategy Nash equilibria of a declared 2x2 game.	nash_equilibrium - advanced
Panel fixed effects (panel)	Estimate the within-entity slope from a balanced panel with entity fixed effects.	panel_regression - advanced
Instrumental variables (iv)	Estimate a just-identified IV slope from one endogenous regressor and one excluded instrument.	instrumental_variables - advanced
Regression discontinuity (rdd)	Estimate the jump at a cutoff with a local linear fit on each side.	regression_discontinuity - advanced
Probit model (probit)	Fit a binary probit with one predictor and read the marginal effect at the mean.	probit - advanced
GDP and national income (nationalincome)	Build GDP by the expenditure approach, then GNP, NNP, net exports, GDP per capita and real GDP.	national_income - intro
Growth rate and CAGR (growth)	Compute total growth, the compound annual growth rate and the rule-of-72 doubling time.	growth_rate - intro
Inflation and real interest (inflation)	Compute inflation from two CPI values, the exact and approximate real interest rate, and real wage growth.	inflation_cpi - intro
Unemployment and participation (unemployment)	Compute the unemployment rate, labour-force participation rate and employment-population ratio.	unemployment_rate - intro
Money multiplier (moneymultiplier)	Compute the simple and currency-adjusted money multipliers and the implied money supply.	money_multiplier - intro

Tile	What it's for	Method / level
Fiscal multipliers (fiscal)	Compute the government-spending, tax and balanced-budget multipliers and the output change from a declared fiscal package.	fiscal_multiplier - intro
Budget balance and debt (budgetdebt)	Compute the overall and primary balances, the debt-to-GDP ratio and the debt-ratio change.	budget_debt - intro
Output gap and Okun's law (okun)	Compute the output gap and the unemployment change implied by a declared Okun coefficient.	output_gap_okun - intermediate
Externalities and Pigouvian tax (externality)	Compare the private market with the social optimum and record the Pigouvian tax and deadweight loss.	externality_pigouvian - intermediate
Public goods (publicgood)	Find the efficient provision of a public good from two benefit schedules and a cost schedule.	public_good - intermediate
Social welfare functions (socialwelfare)	Compare utilitarian, Rawlsian and Nash welfare for the same incomes.	social_welfare - intermediate
Gini coefficient (gini)	Measure inequality from declared incomes, with the poorest and richest shares.	gini_coefficient - intermediate
Poverty measures (poverty)	Compute the headcount, poverty gap and squared gap against a declared poverty line.	poverty_measures - intermediate
Tax progressivity (taxprogressivity)	Compare the top quartile's income share with its tax share.	tax_progressivity - intermediate
Optimal pollution (optimalpollution)	Find the emission level where marginal damage equals marginal abatement cost, with the pollution tax.	optimal_pollution - intermediate
Comparative advantage (comparative)	Find opportunity costs and comparative advantage from two countries' unit labour requirements.	comparative_advantage - intermediate
Tariff welfare (tariff)	Compute the domestic price, imports, tariff revenue and deadweight loss of a small-country tariff.	tariff_welfare - intermediate
Purchasing-power parity (ppp)	Compare a nominal exchange rate with PPP and record the real rate and expected depreciation.	exchange_rate_ppp - intermediate
Interest-rate parity (irp)	Compute the covered-interest-parity forward rate and forward premium from two interest rates.	interest_rate_parity - intermediate
Balance of payments (bop)	Check the current, capital and financial accounts against the balance-of-payments identity.	balance_of_payments - intermediate
Human Development Index (hdi)	Compute the HDI from life expectancy, schooling and GNI per capita using the UNDP goalposts.	hdi - intermediate
Expected utility (expectedutility)	Compute expected value, expected utility, the certainty equivalent and the risk premium.	expected_utility - intermediate
Prospect theory (prospect)	Value a gamble around a reference point with loss aversion and probability weighting.	prospect_theory - intermediate
Real wage and labour market (labour)	Compute the real wage, wage share of productivity and labour-market tightness.	labour_market - intermediate
Difference-in-differences (did)	Estimate a two-group, two-period treatment effect from four declared means.	difference_in_differences - advanced
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Currency conversion (currency)	Convert an amount at a rate you declare; the rate and its source are recorded.	currency_convert - intro
Pricing rules (pricing)	Cost-plus, target-margin, break-even and target-return prices from your cost, volume and rate.	pricing_decision - intro
Demand line and revenue-max price (demandcurve)	Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.	demand_curve - intermediate
Cost-benefit analysis (cba)	Compare the present value of programme costs and benefits under declared assumptions.	cost_benefit - intermediate

Tile	What it's for	Method / level
Cost-effectiveness analysis (cea)	Compare cost per unit of effect across options, with the effect measure declared.	cost_effectiveness - intermediate
Social return on investment (sroi)	Record the SROI ratio from declared social value, investment and attribution assumptions.	sroi - intermediate
Net present value (npv)	Discount a project's cash flows at a declared rate and record the NPV with its checks.	npv - intro
DCF valuation (year-end) (dcf)	Value a business or project from forecast free cash flows and a declared discount rate.	dcf_valuation - intermediate
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro
Pearson correlation (pearson)	Record the linear association between two variables with its sample size and checks.	pearson - intermediate
Linear regression (ols)	Fit a declared linear model and record coefficients, fit and diagnostics.	ols - advanced
Welch two-sample t-test (welch)	Compare two group means without assuming equal variances.	welch_t - advanced
One-way ANOVA (anova)	Compare three or more group means and record the effect size and checks.	anova - advanced
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced

How to use each tile

Market equilibrium - method: demand_supply_equilibrium | level: intro

What it's for. Find the equilibrium price and quantity from declared linear demand and supply, with consumer and producer surplus.

Steps. Write demand as Qd = a - bP and supply as Qs = c + dP. Set Qd = Qs and solve for the equilibrium price P*. Substitute P* into either curve to get the equilibrium quantity Q*. Consumer surplus is the triangle below demand and above P*; producer surplus is the triangle above supply and below P*.

Rule. Qd = a - bP and Qs = c + dP; set Qd = Qs to find P*, then Q* = a - bP*.

Price elasticity of demand - method: elasticity | level: intro

What it's for. Measure the arc elasticity between two price-quantity observations and see what happens to revenue.

Steps. Compute the change in quantity divided by the average quantity. Compute the change in price divided by the average price. Divide the first percentage change by the second. Compare the absolute value with one and read the revenue change.

Rule. E = (% change in Q) / (% change in P), using the midpoint (arc) formula.

Tax incidence and deadweight loss - method: tax_incidence | level: intro

What it's for. Split a per-unit tax between buyers and sellers and record the revenue and deadweight loss.

Steps. Find the no-tax equilibrium first. Shift the supply curve up by the per-unit tax. Read the new consumer price and producer price. Split the tax between the two sides, then compute revenue and deadweight loss.

Rule. Consumer price Pc and producer price Ps satisfy Pc - Ps = t; the burden split follows the slopes.

Price ceilings and floors - method: price_control | level: intro

What it's for. See the shortage, surplus and deadweight loss created by a declared price control.

Steps. Find the free-market equilibrium. Decide whether the ceiling is below it or the floor is above it. At the control price, compute quantity demanded and quantity supplied. Report the shortage or surplus, the quantity traded and the deadweight loss.

Rule. At the control price, compare quantity demanded with quantity supplied; the short side determines quantity traded.

Market concentration (HHI) - method: market_concentration | level: intro

What it's for. Compute HHI, CR4 and the equivalent number of firms from declared firm revenues.

Steps. Add the declared revenues to get the market total. Divide each firm's revenue by the total and multiply by one hundred. Square each share and add them for the HHI. Add the four largest shares for CR4; the equivalent number of firms is 10,000 divided by the HHI.

Rule. HHI = sum of squared percentage market shares; CR4 = sum of the four largest shares.

Cost curves - method: cost_curves | level: intro

What it's for. Average, average variable, average fixed and marginal cost at a declared quantity, with profit and a shutdown test if you supply a price.

Steps. Enter fixed cost and the linear and quadratic variable-cost terms. Choose the quantity at which to evaluate the costs. Read AC, AVC, AFC and MC together; MC crosses AC at the minimum of AC. If you supply a price, compare it with the minimum AVC to test shutdown.

Rule. TC = FC + bQ + cQ^2; AC = TC / Q; MC = b + 2cQ.

Profit maximisation - method: profit_maximization | level: intro

What it's for. Find the output and price where marginal revenue equals marginal cost, with profit, markup and the Lerner index.

Steps. Write demand as P = a - bQ, so marginal revenue is a - 2bQ. Write marginal cost from the cost function as c + 2dQ. Set MR = MC and solve for Q. Substitute Q back into demand for P, then compute revenue, cost and profit.

Rule. Set MR = MC: a - 2bQ = c + 2dQ, then P = a - bQ.

Markup and Lerner index - method: market_power | level: intro

What it's for. Measure the markup and Lerner index from a price and marginal cost, and the implied demand elasticity.

Steps. Enter the price and the marginal cost at the same quantity. Subtract marginal cost from price for the markup. Divide the markup by price for the Lerner index. If the index is positive, take its inverse for the implied demand elasticity.

Rule. Lerner index = (P - MC) / P; markup = P - MC; implied elasticity = 1 / Lerner.

Price discrimination - method: price_discrimination | level: advanced

What it's for. Set third-degree prices and quantities in two separated markets.

Steps. Write each market's linear demand. Set MR = MC in each market for its quantity. Substitute back for each price. Add revenues and profits across the two markets.

Rule. Set marginal revenue equal to marginal cost separately in each market.

Cournot duopoly - method: cournot_duopoly | level: advanced

What it's for. Find the two-firm Cournot quantities, price and profits.

Steps. Write each firm's best response to the other's quantity. Solve the two best responses simultaneously. Substitute the quantities into demand for the price. Compute each firm's profit.

Rule. q1 = (a - 2c1 + c2) / (3b); q2 = (a - 2c2 + c1) / (3b); P = a - b(q1 + q2).

Nash equilibrium (2x2) - method: nash_equilibrium | level: advanced

What it's for. Find the pure-strategy Nash equilibria of a declared 2x2 game.

Steps. Enter each player's four payoffs in the declared cell order. For each cell, check the row player's alternative and the column player's alternative. Flag the cells where neither can gain. Read the number of pure-strategy equilibria.

Rule. A cell is a Nash equilibrium when neither player can gain by switching strategy alone.

Panel fixed effects - method: panel_regression | level: advanced

What it's for. Estimate the within-entity slope from a balanced panel with entity fixed effects.

Steps. Check the panel is balanced: every entity has the same periods. Subtract each entity's mean from its x and y. Regress the demeaned y on the demeaned x. Read the within R-squared and degrees of freedom.

Rule. Within slope = sum of within-entity (x - entity mean x)(y - entity mean y) / sum of within-entity (x - entity mean x)^2.

Instrumental variables - method: instrumental_variables | level: advanced

What it's for. Estimate a just-identified IV slope from one endogenous regressor and one excluded instrument.

Steps. Check the instrument varies and is correlated with the endogenous regressor. Compute the covariance ratio for the IV slope. Read the first-stage slope and the OLS slope for comparison. State the exclusion restriction explicitly.

Rule. Just-identified IV slope = cov(z, y) / cov(z, x); first stage = cov(z, x) / var(z).

Regression discontinuity - method: regression_discontinuity | level: advanced

What it's for. Estimate the jump at a cutoff with a local linear fit on each side.

Steps. Choose the cutoff and a bandwidth. Keep observations within the bandwidth on each side. Fit a separate local linear line on each side. Read the jump in intercepts at the cutoff.

Rule. RDD estimate = right-side intercept at the cutoff - left-side intercept at the cutoff.

Probit model - method: probit | level: advanced

What it's for. Fit a binary probit with one predictor and read the marginal effect at the mean.

Steps. Check the outcome is binary and both outcomes occur. Fit the latent-index probit by maximum likelihood. Read the slope and intercept on the latent scale. Evaluate the marginal effect at the mean of the predictor.

Rule. P(y = 1) = Phi(intercept + slope x x); the marginal effect at the mean is phi(intercept + slope x mean x) x slope.

GDP and national income - method: national_income | level: intro

What it's for. Build GDP by the expenditure approach, then GNP, NNP, net exports, GDP per capita and real GDP.

Steps. Add household consumption, investment and government spending. Add exports and subtract imports. Add net factor income for GNP, then subtract depreciation for NNP. If you supply a population or deflator, read GDP per capita or real GDP.

Rule. GDP = C + I + G + X - M; GNP = GDP + net factor income; NNP = GNP - depreciation.

Growth rate and CAGR - method: growth_rate | level: intro

What it's for. Compute total growth, the compound annual growth rate and the rule-of-72 doubling time.

Steps. Enter the start value, end value and number of periods. Read total growth as the proportional change. Read CAGR as the constant rate that compounds the start to the end. Use the rule of 72 only as an approximation for the doubling time.

Rule. CAGR = (end / start)^(1 / periods) - 1; doubling time is about 72 / (CAGR x 100).

Inflation and real interest - method: inflation_cpi | level: intro

What it's for. Compute inflation from two CPI values, the exact and approximate real interest rate, and real wage growth.

Steps. Enter the two CPI values. Divide their difference by the starting CPI for inflation. If you have a nominal interest rate, apply the Fisher relation for the real rate. If you have wages, compare their growth with inflation for real wage growth.

Rule. Inflation = (CPI end - CPI start) / CPI start; real interest = (1 + nominal) / (1 + inflation) - 1.

Unemployment and participation - method: unemployment_rate | level: intro

What it's for. Compute the unemployment rate, labour-force participation rate and employment-population ratio.

Steps. Enter the labour force, the number employed and the working-age population. Subtract employment from the labour force for the unemployed. Divide the unemployed by the labour force for the unemployment rate. Use the working-age population for participation and the employment ratio.

Rule. Unemployment rate = unemployed / labour force; LFPR = labour force / working-age population.

Money multiplier - method: money_multiplier | level: intro

What it's for. Compute the simple and currency-adjusted money multipliers and the implied money supply.

Steps. Enter the monetary base and the reserve ratio. Compute the simple multiplier as the inverse of the reserve ratio. Add the currency drain for the extended multiplier. Multiply the base by the multiplier for the implied money supply.

Rule. Simple multiplier = 1 / reserve ratio; extended = (1 + currency drain) / (reserve ratio + currency drain).

Fiscal multipliers - method: fiscal_multiplier | level: intro

What it's for. Compute the government-spending, tax and balanced-budget multipliers and the output change from a declared fiscal package.

Steps. Enter the marginal propensity to consume and the proportional tax rate. Compute the denominator 1 - MPC(1 - t). Read the government-spending, tax and balanced-budget multipliers. Apply the declared spending and tax changes to get the output change.

Rule. Government multiplier = 1 / (1 - MPC(1 - t)); tax multiplier = -MPC / (1 - MPC(1 - t)).

Budget balance and debt - method: budget_debt | level: intro

What it's for. Compute the overall and primary balances, the debt-to-GDP ratio and the debt-ratio change.

Steps. Enter revenue, primary spending, interest, debt and GDP. Add interest to primary spending for total spending. Subtract total spending from revenue for the overall balance. Divide debt by GDP for the debt ratio and apply the interest-growth-primary identity for its change.

Rule. Overall balance = revenue - spending - interest; debt ratio = debt / GDP.

Output gap and Okun's law - method: output_gap_okun | level: intermediate

What it's for. Compute the output gap and the unemployment change implied by a declared Okun coefficient.

Steps. Enter actual and potential GDP on the same basis. Compute the proportional output gap. Apply the declared Okun coefficient for the unemployment change in percentage points. Add the change to the current unemployment rate.

Rule. Output gap = (actual GDP - potential GDP) / potential GDP; unemployment change = -Okun coefficient x gap.

Externalities and Pigouvian tax - method: externality_pigouvian | level: intermediate

What it's for. Compare the private market with the social optimum and record the Pigouvian tax and deadweight loss.

Steps. Find the private market equilibrium first. Add the external cost to private supply to get the social cost. Solve for the social quantity and compare it with the market quantity. Read the Pigouvian tax and the deadweight-loss triangle.

Rule. Social optimum: demand = private supply + marginal external cost; Pigouvian tax = marginal external cost; DWL = 1/2 x tax x (market quantity - social quantity).

Public goods - method: public_good | level: intermediate

What it's for. Find the efficient provision of a public good from two benefit schedules and a cost schedule.

Steps. Write each person's marginal benefit as a linear schedule. Add the schedules vertically to get social marginal benefit. Set it equal to marginal cost and solve for the efficient quantity. Compare total benefit with total cost.

Rule. Sum the marginal benefits vertically; set social marginal benefit equal to marginal cost.

Social welfare functions - method: social_welfare | level: intermediate

What it's for. Compare utilitarian, Rawlsian and Nash welfare for the same incomes.

Steps. Enter the incomes and choose the welfare function. Read all three welfare values alongside the selected one. Compare how a transfer changes each criterion.

Rule. Utilitarian = sum of incomes; Rawlsian = minimum income; Nash = geometric mean.

Gini coefficient - method: gini_coefficient | level: intermediate

What it's for. Measure inequality from declared incomes, with the poorest and richest shares.

Steps. Sort the incomes from lowest to highest. Compute the mean and the rank-weighted sum. Apply the Gini formula; zero means perfect equality. Read the poorest and richest shares for context.

Rule. Gini = (2 x sum of rank-weighted incomes - (n + 1) x total income) / (n x total income).

Poverty measures - method: poverty_measures | level: intermediate

What it's for. Compute the headcount, poverty gap and squared gap against a declared poverty line.

Steps. Choose and declare the poverty line. Count the incomes below it for the headcount. Average the normalised shortfall for the gap, and square it for the squared gap. Read the total shortfall in currency.

Rule. Headcount = share below the line; poverty gap = average normalised shortfall over the population.

Tax progressivity - method: tax_progressivity | level: intermediate

What it's for. Compare the top quartile's income share with its tax share.

Steps. Enter each person's income and tax. Rank by income and take the top quartile. Compare its tax share with its income share. A positive gap means the top pays proportionally more.

Rule. Progressivity gap = top-quartile tax share - top-quartile income share.

Optimal pollution - method: optimal_pollution | level: intermediate

What it's for. Find the emission level where marginal damage equals marginal abatement cost, with the pollution tax.

Steps. Write marginal damage as rising with emissions. Write marginal abatement cost as falling with emissions. Set them equal and solve for optimal emissions. Read the tax and the total damage.

Rule. Set marginal damage equal to marginal abatement cost; the pollution tax equals marginal damage at the optimum.

Comparative advantage - method: comparative_advantage | level: intermediate

What it's for. Find opportunity costs and comparative advantage from two countries' unit labour requirements.

Steps. Enter each country's unit labour requirements for both goods. Compute the opportunity cost of each good in each country. The lower opportunity cost identifies comparative advantage. Check that the two countries specialise in different goods.

Rule. Opportunity cost of good one = hours per unit of good one / hours per unit of good two.

Tariff welfare - method: tariff_welfare | level: intermediate

What it's for. Compute the domestic price, imports, tariff revenue and deadweight loss of a small-country tariff.

Steps. Find free-trade imports at the world price. Add the tariff to get the domestic price. Compute the new imports and tariff revenue. Add the production and consumption deadweight-loss triangles.

Rule. Domestic price = world price + tariff; imports = quantity demanded - quantity supplied.

Purchasing-power parity - method: exchange_rate_ppp | level: intermediate

What it's for. Compare a nominal exchange rate with PPP and record the real rate and expected depreciation.

Steps. Enter the two price levels and the nominal rate as domestic per foreign. Compute the PPP rate and the real rate. Read the misalignment: zero means the nominal rate is at PPP. If inflation rates are supplied, read expected depreciation.

Rule. PPP rate = domestic price / foreign price; real exchange rate = nominal x foreign price / domestic price.

Interest-rate parity - method: interest_rate_parity | level: intermediate

What it's for. Compute the covered-interest-parity forward rate and forward premium from two interest rates.

Steps. Enter the spot rate, the two interest rates and the horizon. Compute the parity forward rate. Read the forward premium as the interest differential. If a forward is declared, compare it with parity.

Rule. Forward = spot x [(1 + domestic rate) / (1 + foreign rate)]^T.

Balance of payments - method: balance_of_payments | level: intermediate

What it's for. Check the current, capital and financial accounts against the balance-of-payments identity.

Steps. Enter the three account balances on one sign convention. Add them, including declared errors and omissions. A zero net balance closes the identity. Read the current-account-to-GDP ratio if GDP is supplied.

Rule. Current account + capital account + financial account + errors and omissions = 0.

Human Development Index - method: hdi | level: intermediate

What it's for. Compute the HDI from life expectancy, schooling and GNI per capita using the UNDP goalposts.

Steps. Enter life expectancy, expected and mean schooling, and GNI per capita. Scale each dimension against the UNDP goalposts. Take the geometric mean of the three indices. Read each dimension index to see what drives the result.

Rule. HDI = geometric mean of the life, education and income indices.

Expected utility - method: expected_utility | level: intermediate

What it's for. Compute expected value, expected utility, the certainty equivalent and the risk premium.

Steps. Enter the outcomes and probabilities. Compute the expected value. Apply the declared utility function for expected utility. Invert the utility for the certainty equivalent and risk premium.

Rule. EV = sum of probability x outcome; EU = sum of probability x utility; the certainty equivalent is the certain amount with the same utility.

Prospect theory - method: prospect_theory | level: intermediate

What it's for. Value a gamble around a reference point with loss aversion and probability weighting.

Steps. Choose the reference point. Enter outcomes and probabilities. Evaluate gains and losses relative to the reference. Apply the declared loss aversion, curvature and weighting.

Rule. v(gain) = gain^alpha; v(loss) = -loss aversion x loss^beta; probabilities are weighted.

Real wage and labour market - method: labour_market | level: intermediate

What it's for. Compute the real wage, wage share of productivity and labour-market tightness.

Steps. Enter the nominal wage, CPI and productivity. Deflate the nominal wage by the price index. Divide the real wage by productivity for the wage share. If vacancies and unemployment are supplied, read tightness.

Rule. Real wage = nominal wage / (CPI / 100); wage share = real wage / labour productivity.

Difference-in-differences - method: difference_in_differences | level: advanced

What it's for. Estimate a two-group, two-period treatment effect from four declared means.

Steps. Enter the four group-period means. Compute the treated change and the control change. Subtract the control change from the treated change. State the parallel-trends assumption explicitly.

Rule. DiD = (treated post - treated pre) - (control post - control pre).

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Currency conversion - method: currency_convert | level: intro

What it's for. Convert an amount at a rate you declare; the rate and its source are recorded.

Steps. Enter the amount, the source currency and the target currency. Declare the rate and where it came from. Read the converted amount and the recorded rate. Keep the rate date with the result.

Rule. Converted amount = amount x rate, with the rate's provenance recorded.

Pricing rules - method: pricing_decision | level: intro

What it's for. Cost-plus, target-margin, break-even and target-return prices from your cost, volume and rate.

Steps. Enter the variable cost per unit and the fixed cost for the period. Enter the volume you expect to sell. Read the cost-plus price at your markup, then the margin price and the break-even price. Compare them with what customers in your market actually pay; the method cannot do that part.

Rule. Cost-plus price = unit cost x (1 + markup); margin price = unit cost / (1 - margin); break-even price = total cost / expected units.

Demand line and revenue-max price - method: demand_curve | level: intermediate

What it's for. Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.

Steps. Collect price-quantity pairs from the same market and period basis. Enter the prices and the quantity demanded at each price. Read the slope, the R-squared and the elasticity at the mean price. If the slope is negative, read the revenue-maximising price on the fitted line.

Rule. q = a + b p, fitted by least squares; elasticity at the mean = b x (mean price / mean quantity).

Cost-benefit analysis - method: cost_benefit | level: intermediate

What it's for. Compare the present value of programme costs and benefits under declared assumptions.

Steps. Discount each period's costs and benefits at the declared rate. Subtract present-value costs from present-value benefits. Divide benefits by costs for the benefit-cost ratio.

Rule. NPV = PV(benefits) - PV(costs); BCR = PV(benefits) / PV(costs).

Cost-effectiveness analysis - method: cost_effectiveness | level: intermediate

What it's for. Compare cost per unit of effect across options, with the effect measure declared.

Steps. Name the comparator first. Compute the incremental cost and the incremental effect for each other option. Divide the cost difference by the effect difference.

Rule. ICER = (cost of option - cost of comparator) / (effect of option - effect of comparator).

Social return on investment - method: sroi | level: intermediate

What it's for. Record the SROI ratio from declared social value, investment and attribution assumptions.

Steps. Discount the declared social benefits. Divide their present value by the declared investment. State the attribution and deadweight assumptions explicitly.

Rule. SROI = PV(social benefits) / investment.

Net present value - method: npv | level: intro

What it's for. Discount a project's cash flows at a declared rate and record the NPV with its checks.

What you need. the outlay, the later cash flows, and the hurdle rate you will justify

Steps. List the cash flows in order, starting with the negative outlay at t = 0. Choose the discount rate that matches the project's risk. Discount each flow and add them. Compare the result with zero; a positive NPV clears the hurdle at that rate.

Rule. NPV = sum of CF_t / (1 + r)^t, with the first cash flow at t = 0 and undiscounted.

DCF valuation (year-end) - method: dcf_valuation | level: intermediate

What it's for. Value a business or project from forecast free cash flows and a declared discount rate.

Steps. Enter the free cash flows for the explicit forecast. Enter the discount rate that matches the cash flows. If the business continues, declare a terminal growth rate below the discount rate. Read the explicit present value, the terminal present value and their sum.

Rule. EV = sum of FCF_t / (1 + r)^t + TV / (1 + r)^n; TV = FCF_n(1 + g) / (r - g).

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Pearson correlation - method: pearson | level: intermediate

What it's for. Record the linear association between two variables with its sample size and checks.

What you need. the two numeric variables you are relating, and the pairs you observed

Steps. Check both variables are numeric and paired. Read r between minus one and one. Inspect the scatter plot before trusting a linear summary.

Rule. r = covariance(x, y) / (standard deviation of x x standard deviation of y).

Linear regression - method: ols | level: advanced

What it's for. Fit a declared linear model and record coefficients, fit and diagnostics.

What you need. the outcome, the predictors, and the observations you have for each

Steps. Check the sample size and missing values. Read each coefficient with its standard error. Check the fit and residual diagnostics. State the assumptions and the claim ceiling.

Rule. y = intercept + coefficient x x + error; the coefficients minimise the sum of squared errors.

Welch two-sample t-test - method: welch_t | level: advanced

What it's for. Compare two group means without assuming equal variances.

Steps. Check the two groups are independent. Read the difference, the interval and the p-value together. Report the effect size, not only significance.

Rule. t = (mean A - mean B) / standard error of the difference, without assuming equal variances.

One-way ANOVA - method: anova | level: advanced

What it's for. Compare three or more group means and record the effect size and checks.

Steps. Check the groups are independent. Read the F test and the effect size. Use a post-hoc test before naming which groups differ.

Rule. F = between-group variance / within-group variance.

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Limits - what this subject does not do

* It does not retrieve GDP, CPI, market or household data; you declare every input.
* It does not estimate a demand curve, a model or a causal effect from raw data.
* It does not make a policy recommendation or prove that one policy is better.

Management & strategy

Structure the evidence on a competitive position, then compare the options that follow.

How to start. Start with the worksheet that answers your question. Every worksheet is structure plus an evidence audit: you supply the evidence, the worksheet places it and names the gaps, and nothing is scored. The records below are the frameworks and methods that have no worksheet yet, followed by the theories to read alongside the analysis. Those theories are reading lenses, not templates to fill in.

Tiles in this subject

Tile	What it's for	Method / level
Compare strategic options (case_decision)	Compare alternatives by NPV and record the crossover rate that flips the decision.	case_decision - intermediate

How to use each tile

Compare strategic options - method: case_decision | level: intermediate

What it's for. Compare alternatives by NPV and record the crossover rate that flips the decision.

What you need. the facts, the alternatives, their cash flows and provenance

Steps. Enter two to five alternatives, each with its own cash flows. Read each alternative's NPV and the crossover rate between pairs. Say which alternative wins at the decision rate and where the ranking flips. Keep non-financial criteria visible beside the numbers.

Rule. Compare each alternative's NPV at the declared rate; the crossover rate is where two alternatives' NPVs are equal.

Limits - what this subject does not do

* It does not generate evidence or fill a blank quadrant or cell.
* It does not score or rank the frameworks.
* It does not choose the strategy for you.

Project management

Govern a project, record the documents that deliver it, appraise its business case, compare the options, and plan and control the schedule.

How to start. This shelf follows the project lifecycle an assignment usually asks for, and it is laid out in tiles you meet in that order. The three worksheet tiles come first, because the documents a project needs are written before it is appraised or scheduled. Governance holds the four frameworks that say how the project is steered and judged: the balanced scorecard, the strategy map, the KPI tree and the OKRs. Delivery documents hold the charter, the work breakdown structure and the risk register. People and governance roles hold the RACI, the stakeholder engagement plan and the lessons learned. Then the calculators: start with the business case, discounting the project's cash flows (NPV), finding the rate it earns (IRR), seeing when it pays back, and ranking it on profitability index, MIRR and equivalent annual annuity; compare options under different assumptions and find the assumption the decision turns on; project the costs and benefits you will report; plan the delivery with the critical path and PERT; and track it with earned value - schedule and cost variances, SPI and CPI, and the estimate at completion. You supply and confirm every figure; the engine returns the calculation with its checks, and you can export the result as your submission. Ten of the frameworks on this shelf are completing worksheets: you fill them in and they audit what you wrote, naming the empty cells rather than filling them. Six more - Scrum, Kanban, COBIT, ITIL, DeLone-McLean and the TOE framework - stay read-only records, catalogued and held off the page for now: they give you the structure and the evidence each one needs, but there is no worksheet to complete them in yet.

Tiles in this subject

Tile	What it's for	Method / level
Net present value (npv)	Discount a project's cash flows at a declared rate and record the NPV with its checks.	npv - intro
Internal rate of return (irr)	Find the rate at which the project's NPV is zero, with the declared search bounds.	irr - intro
Discounted payback (dpayback)	Record how long the discounted cash flows take to repay the investment.	discounted_payback - intro
Project ranking metrics (projectmetrics)	Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.	project_metrics - intermediate
Scenario analysis (scenario)	Recompute NPV at a low and high discount rate and find the decision-flip rate.	scenario_analysis - intro
Compare strategic options (case_decision)	Compare alternatives by NPV and record the crossover rate that flips the decision.	case_decision - intermediate
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Critical path and PERT (cpm)	Early and late dates, total float, the critical path and the project duration, with optional three-point estimates.	cpm_schedule - intermediate
Earned value (evm)	Schedule and cost variances, SPI and CPI, and the estimate and variance at completion.	earned_value - intermediate
Resource levelling (leveling)	Delay work until each declared resource is within capacity, and compare the levelled plan with the unconstrained one.	resource_leveling - intermediate
Project crashing (crashing)	Buy duration on the critical path to reach a target, and read the crash periods, final durations and total cost.	project_crashing - advanced
Calendar schedule (calendar)	Schedule activities over a declared working calendar, skipping non-working periods, with dates, float and the critical path.	calendar_schedule - intermediate
Multi-project scheduling (multiproject)	Sequence several projects that share resources by declared priority, and read each project's finish and delay.	multi_project_schedule - advanced
Schedule risk (Monte Carlo) (schedrisk)	Run seeded PERT simulations for the mean, P50/P80/P90 duration, the chance of meeting a target and each activity's criticality.	schedule_risk - advanced

Tile	What it's for	Method / level
Decision tree (decisiontree)	Roll back your own decision tree: expected value, best alternative, loss probability and the best and worst terminal value.	decision_tree - intermediate
Real option valuation (realoption)	Value a call or put on a declared project value with a binomial lattice, including intrinsic value and delta.	real_option - advanced
Weighted decision matrix (mcda)	Score alternatives against your criteria and weights, with weighted totals and ranks.	multi_criteria - intro
Monte Carlo simulation (montecarlo)	Simulate NPV from uncertain cash flows or profit from uncertain price, cost and volume, with seeded percentiles and the share of positive outcomes.	monte_carlo - advanced

How to use each tile

Net present value - method: npv | level: intro

What it's for. Discount a project's cash flows at a declared rate and record the NPV with its checks.

What you need. the outlay, the later cash flows, and the hurdle rate you will justify

Steps. List the cash flows in order, starting with the negative outlay at t = 0. Choose the discount rate that matches the project's risk. Discount each flow and add them. Compare the result with zero; a positive NPV clears the hurdle at that rate.

Rule. NPV = sum of CF_t / (1 + r)^t, with the first cash flow at t = 0 and undiscounted.

Internal rate of return - method: irr | level: intro

What it's for. Find the rate at which the project's NPV is zero, with the declared search bounds.

What you need. the same cash flows; the method refuses more than one sign change

Steps. Write the cash flows with the outlay at t = 0. Solve for the rate that makes the present value zero. Compare the IRR with the cost of capital. Use it with NPV, not instead of it, when projects differ in scale or life.

Rule. The IRR is the rate r at which NPV = 0: sum of CF_t / (1 + r)^t = 0.

Discounted payback - method: discounted_payback | level: intro

What it's for. Record how long the discounted cash flows take to repay the investment.

What you need. the cash flows and the discount rate

Steps. Discount each cash flow at the declared rate. Add the discounted flows year by year. Find the year in which the cumulative total crosses zero. Interpolate within that year for the fractional period.

Rule. Cumulate the discounted cash flows until they turn positive; interpolate inside the recovering period.

Project ranking metrics - method: project_metrics | level: intermediate

What it's for. Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.

What you need. the cash flows, the hurdle rate and a finance rate

Steps. Start from the same cash flows and rate as the NPV. Compute the profitability index from the present values of inflows and outflows. Reinvest positive flows at the finance rate and finance negative flows at the cost of capital for MIRR. Spread the NPV over the project's life for the equivalent annual annuity.

Rule. PI = PV(inflows) / |PV(outflows)|; MIRR reinvests positive flows at the finance rate; EAA = NPV x r / (1 - (1 + r)^-n).

Scenario analysis - method: scenario_analysis | level: intro

What it's for. Recompute NPV at a low and high discount rate and find the decision-flip rate.

What you need. the cash flows, a base rate and a low/high range

Steps. Enter the project's cash flows and the base discount rate. Declare the optimistic (low) and pessimistic (high) rates. Read the three NPVs, the swing and the decision-flip rate. Say which single input changed and which did not.

Rule. Recompute NPV at the low and high discount rates; the break-even rate is the IRR of the same cash flows.

Compare strategic options - method: case_decision | level: intermediate

What it's for. Compare alternatives by NPV and record the crossover rate that flips the decision.

What you need. the facts, the alternatives, their cash flows and provenance

Steps. Enter two to five alternatives, each with its own cash flows. Read each alternative's NPV and the crossover rate between pairs. Say which alternative wins at the decision rate and where the ranking flips. Keep non-financial criteria visible beside the numbers.

Rule. Compare each alternative's NPV at the declared rate; the crossover rate is where two alternatives' NPVs are equal.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Critical path and PERT - method: cpm_schedule | level: intermediate

What it's for. Early and late dates, total float, the critical path and the project duration, with optional three-point estimates.

What you need. a list of activities, their durations and which must finish first

Steps. List each activity with its duration and its predecessors. Read the early dates from the forward pass and the late dates from the backward pass. The activities with zero total float are the critical path; the project ends at the latest early finish. For a PERT estimate, enter optimistic, most likely and pessimistic times and read the expected duration and variance.

Rule. Forward pass: ES = latest predecessor EF, EF = ES + duration. Backward pass: LF = earliest successor LS, LS = LF - duration. Float = LS - ES. PERT: (O + 4M + P) / 6.

Earned value - method: earned_value | level: intermediate

What it's for. Schedule and cost variances, SPI and CPI, and the estimate and variance at completion.

What you need. planned, earned and actual cost at one status date, plus the budget

Steps. Take the cumulative planned value, earned value and actual cost at one status date. Divide earned value by planned value for the schedule index and by actual cost for the cost index. Read the variances: negative SV is behind schedule, negative CV is over cost. Choose the declared EAC convention and read ETC, VAC and TCPI.

Rule. SV = EV - PV; CV = EV - AC; SPI = EV/PV; CPI = EV/AC; EAC = BAC/CPI (or AC + (BAC - EV)); VAC = BAC - EAC.

Resource levelling - method: resource_leveling | level: intermediate

What it's for. Delay work until each declared resource is within capacity, and compare the levelled plan with the unconstrained one.

What you need. activities, their resource and demand, and each resource's capacity

Steps. Run CPM without resource limits to get the early dates. List each resource capacity and each activity's resource and demand. Schedule in early-start order, delaying an activity until its resource has room for every period it occupies. Compare the levelled duration and delay with the unconstrained plan, and read the over-capacity periods before and after.

Rule. Serial scheduling: earliest = max(CPM early start, predecessor finish); delay one period until the resource load in every occupied period is at or below capacity.

Project crashing - method: project_crashing | level: advanced

What it's for. Buy duration on the critical path to reach a target, and read the crash periods, final durations and total cost.

What you need. normal and crash durations, crash costs and a target duration

Steps. Enter each activity's normal and crash durations, its total crash cost and its predecessors. Set the target duration; it must be at least the fully crashed duration. Crash one period at a time on the cheapest available critical activity, recomputing the critical path after each step. Read the crash periods, final durations and total cost, and check the target is met.

Rule. Cost per period = crash cost / (normal duration - crash duration); at each step crash the cheapest critical activity by one period and recompute the network.

Calendar schedule - method: calendar_schedule | level: intermediate

What it's for. Schedule activities over a declared working calendar, skipping non-working periods, with dates, float and the critical path.

What you need. the working period numbers and the activities

Steps. Declare the working period numbers, for example 0,1,2,5,6,7. List each activity with its duration in working periods and its predecessors. Run the forward pass over the working periods, then the backward pass for late dates. Read the dates, float and critical path; a zero-duration milestone sits on the first working period.

Rule. Start at the first working period at or after the constraint; an activity occupies its declared number of working periods; EF is the period after the last occupied one; float is LS - ES in calendar periods.

Multi-project scheduling - method: multi_project_schedule | level: advanced

What it's for. Sequence several projects that share resources by declared priority, and read each project's finish and delay.

What you need. each project's priority, activities, shared resources and capacities

Steps. Declare the shared resources and their capacities. List each project with a priority and its activities, resource, demand and predecessors. Schedule the higher-priority project first, then the next, delaying work only when a shared resource is full. Read each project's finish and its delay against its own unconstrained CPM, and the overall finish.

Rule. Order projects by declared priority, then schedule each activity serially at its earliest start that keeps every shared resource within capacity.

Schedule risk (Monte Carlo) - method: schedule_risk | level: advanced

What it's for. Run seeded PERT simulations for the mean, P50/P80/P90 duration, the chance of meeting a target and each activity's criticality.

What you need. optimistic, most likely and pessimistic durations, a seed and a target

Steps. Enter optimistic, most likely and pessimistic durations for each activity, with its predecessors. Declare the number of iterations and a seed; keep the seed in the report. Run the simulation and read the mean, P50, P80 and P90 durations and the target probability. Read each activity's criticality index as the share of runs in which it had zero float.

Rule. Sample each duration from a triangular distribution between optimistic and pessimistic with the most likely as the mode; run CPM; report the mean, P50/P80/P90, the share within a target and the criticality index.

Decision tree - method: decision_tree | level: intermediate

What it's for. Roll back your own decision tree: expected value, best alternative, loss probability and the best and worst terminal value.

What you need. the alternatives, chance probabilities and terminal values

Steps. Draw the decision as alternatives, then chance branches, then terminal values. Give every chance branch a probability; the branches at one node must sum to one. Roll back from the terminals: weight each child by its branch probability and take the best alternative at each decision. Read the expected value, the loss probability and the best and worst terminal value.

Rule. Chance node: EV = sum(probability x child EV); decision node: EV = maximum alternative EV; terminal node: its declared value.

Real option valuation - method: real_option | level: advanced

What it's for. Value a call or put on a declared project value with a binomial lattice, including intrinsic value and delta.

What you need. the project value, investment, volatility and risk-free rate

Steps. Declare the project value, the investment or strike, the volatility, the risk-free rate and the horizon. Choose the number of lattice steps and whether the option is a call or a put, European or American. Roll back the terminal payoffs with the risk-neutral probability and the discount factor. Read the option value, intrinsic value and delta.

Rule. u = exp(sigma x sqrt(dt)); d = 1/u; p = (exp(r x dt) - d) / (u - d); discount = exp(-r x dt); roll back the payoff, taking the intrinsic value at each node for an American option.

Weighted decision matrix - method: multi_criteria | level: intro

What it's for. Score alternatives against your criteria and weights, with weighted totals and ranks.

What you need. the criteria, their weights, and a score for every alternative

Steps. Declare the criteria and their weights; the weights must sum to one. Set a common score scale and score every alternative on every criterion, higher meaning better. Read the weighted totals and the ranks. Check whether a small change in a weight would change the order before relying on it.

Rule. Weighted total = sum(weight x score); weights sum to one; the alternative with the highest total ranks first.

Monte Carlo simulation - method: monte_carlo | level: advanced

What it's for. Simulate NPV from uncertain cash flows or profit from uncertain price, cost and volume, with seeded percentiles and the share of positive outcomes.

What you need. the uncertain figures and a low, most likely and high value for each

Steps. Choose the NPV or profit model and declare the distribution of every uncertain input. Set the iteration count and a seed; keep the seed in the report. Run the simulation and read the mean, median, tenth and ninetieth percentiles, the range and the positive share. Change the seed or an input to see how much the sample moves before relying on a percentile.

Rule. Draw each uncertain input from its declared fixed, uniform or triangular distribution; compute NPV = sum(cf / (1 + r)^t) or profit = (price - variable cost) x volume - fixed cost; report the mean, P10/P50/P90 and the share of positive outcomes.

Limits - what this subject does not do

* It does not invent durations, probabilities, weights, owners or terminal values; you declare them.
* It does not choose the project or the option for you beyond the declared rule.
* It does not level resources optimally, level across calendars or simulate correlated risks.
* It does not score, weight or rank your objectives, measures or risks; an empty cell is named, never filled.

Entrepreneurship

Test a venture idea: market size, price, break-even, cash and the capital it needs.

How to start. This shelf follows the sections of a business plan. Size the market, set a price and find break-even, plan the cash and the capital you must raise, then appraise the return. Each tile opens one published method; nothing is calculated until you supply and confirm your own figures, and every result can be exported as an assignment submission.

Tiles in this subject

Tile	What it's for	Method / level
Market size (TAM, SAM, SOM) (marketsize)	Size the whole market, the part you can serve and the part you can win from a population, an annual spend and two shares you declare.	market_sizing - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Demand line and revenue-max price (demandcurve)	Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.	demand_curve - intermediate
Purchase intent (purchaseintent)	Turn weighted survey answers into an expected buying rate, projected buyers and projected revenue.	purchase_intent - intro
Sales funnel and conversion (funnel)	Enter how many people reached each stage and read the conversion, the drop-off and the cost of winning a customer.	sales_funnel - intro
Cohort retention (cohort)	Follow groups of customers who started together and read retention, churn and the average customer life.	cohort_retention - intermediate
Market concentration (HHI) (concentration)	Compute HHI, CR4 and the equivalent number of firms from declared firm revenues.	market_concentration - intro
Price elasticity of demand (elasticity)	Measure the arc elasticity between two price-quantity observations and see what happens to revenue.	elasticity - intro
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced
Pricing rules (pricing)	Cost-plus, target-margin, break-even and target-return prices from your cost, volume and rate.	pricing_decision - intro
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Cost curves (costcurves)	Average, average variable, average fixed and marginal cost at a declared quantity, with profit and a shutdown test if you supply a price.	cost_curves - intro
Markup and Lerner index (marketpower)	Measure the markup and Lerner index from a price and marginal cost, and the implied demand elasticity.	market_power - intro
Capacity and bottleneck (capacity)	Capacity per resource, the bottleneck and the utilisation at your declared demand.	capacity_analysis - intro
Order quantity and reorder point (inventory)	Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.	inventory_policy - intro
Sales from market share (frommarket)	Target revenue and units from a declared market size, share and price.	sales_from_market - intro

Tile	What it's for	Method / level
Projected statements (proforma)	Projected income statement, cash flow and balance sheet from your declared drivers, with the balance check.	proforma_statements - intermediate
Price and volume sensitivity (sensitivity)	Profit across declared price and volume changes, with the base case.	sensitivity_table - intermediate
Financial statement ratios (ratios)	Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.	ratio_analysis - intro
Depreciation schedule (depreciation)	The period charge, accumulated depreciation and carrying amount, straight line or declining balance.	depreciation_schedule - intro
Sales and profit projection (salesprojection)	Project volume, revenue, costs and profit period by period from a starting volume and a growth rate.	sales_projection - intro
Start-up capital and amount to raise (startupcapital)	Add set-up costs, working capital and a contingency, subtract what is already committed, and record the funding gap.	startup_capital - intro
Cash runway and funding gap (cashrunway)	Months of cash left at a declared monthly burn, the lowest balance and the cash needed over your horizon.	cash_runway - intermediate
Return on investment (roi)	ROI and the annualised return from a declared investment and net gain.	return_on_investment - intro
Tax on declared rates (tax)	Income tax, VAT payable and deferred tax from the rates you declare, with the total charge.	tax_declared - intro
Net present value (npv)	Discount a project's cash flows at a declared rate and record the NPV with its checks.	npv - intro
Internal rate of return (irr)	Find the rate at which the project's NPV is zero, with the declared search bounds.	irr - intro
Discounted payback (dpayback)	Record how long the discounted cash flows take to repay the investment.	discounted_payback - intro
Project ranking metrics (projectmetrics)	Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.	project_metrics - intermediate
Scenario analysis (scenario)	Recompute NPV at a low and high discount rate and find the decision-flip rate.	scenario_analysis - intro
Common-size and trend (trendanalysis)	Several years of income-statement figures as common-size percentages, an index and compound growth.	trend_analysis - intro
Working capital and EOQ (workingcapital)	Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.	working_capital - intro
Cap table and dilution (captable)	Post-money value, price per share, new shares, investor and founder percentages and dilution for one round.	cap_table_round - intermediate
Loan amortization (loan)	Find the level payment, total interest and first-payment split on a fixed-rate loan.	loan_amortization - intro
DCF valuation (year-end) (dcf)	Value a business or project from forecast free cash flows and a declared discount rate.	dcf_valuation - intermediate
Comparable multiples (multiples)	Apply peer multiples to your own earnings, EBITDA, sales or book value.	multiples_valuation - intermediate
Equity bridge (equitybridge)	Move from enterprise value to equity value through net debt and other declared claims.	equity_bridge - intermediate
Currency conversion (currency)	Convert an amount at a rate you declare; the rate and its source are recorded.	currency_convert - intro
Social return on investment (sroi)	Record the SROI ratio from declared social value, investment and attribution assumptions.	sroi - intermediate
Cost-benefit analysis (cba)	Compare the present value of programme costs and benefits under declared assumptions.	cost_benefit - intermediate
Cost per unit of impact (costeffectiveness)	Compare your options' incremental cost per unit of effect, with the effect measure declared.	cost_effectiveness - intermediate

Tile	What it's for	Method / level
Compare strategic options (case_decision)	Compare alternatives by NPV and record the crossover rate that flips the decision.	case_decision - intermediate

How to use each tile

Market size (TAM, SAM, SOM) - method: market_sizing | level: intro

What it's for. Size the whole market, the part you can serve and the part you can win from a population, an annual spend and two shares you declare.

Steps. Count the customers in the market you are describing, or use a population and a spend figure you can defend. Multiply by the average annual spend for the total addressable market. Apply the share of that market you can physically serve, then the share of that market you can win. Check that each share is below one and that SOM is smaller than SAM, which is smaller than TAM.

Rule. TAM = customers x annual spend; SAM = TAM x serviceable share; SOM = SAM x obtainable share.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Demand line and revenue-max price - method: demand_curve | level: intermediate

What it's for. Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.

Steps. Collect price-quantity pairs from the same market and period basis. Enter the prices and the quantity demanded at each price. Read the slope, the R-squared and the elasticity at the mean price. If the slope is negative, read the revenue-maximising price on the fitted line.

Rule. q = a + b p, fitted by least squares; elasticity at the mean = b x (mean price / mean quantity).

Purchase intent - method: purchase_intent | level: intro

What it's for. Turn weighted survey answers into an expected buying rate, projected buyers and projected revenue.

Steps. Enter how many respondents gave each answer. Declare the weight each answer carries, or use the stated defaults. Read the weighted intent rate. If you declare the population and the price, read projected buyers and projected revenue.

Rule. Intent rate = (definitely x w1 + probably x w2 + maybe x w3 + never x w4) / respondents; projected buyers = population x intent rate.

Sales funnel and conversion - method: sales_funnel | level: intro

What it's for. Enter how many people reached each stage and read the conversion, the drop-off and the cost of winning a customer.

Steps. List the stages in the order a customer meets them. Enter how many people reached each stage in the same period. Read each stage's conversion, the overall conversion and the drop-off. If you declare the spend, read the acquisition cost per customer.

Rule. Stage conversion = count at the next stage / count at this stage; overall conversion = last count / first count.

Cohort retention - method: cohort_retention | level: intermediate

What it's for. Follow groups of customers who started together and read retention, churn and the average customer life.

Steps. Enter the number of customers in each cohort when it started. Enter how many of each cohort were still buying in each later period. Keep every cohort's row the same length; leave out a period a cohort has not reached. Read the pooled retention curve, the churn and the average lifetime.

Rule. Period retention = retained customers in that period / starting customers, pooled across cohorts; average lifetime = the sum of the period retention rates.

Market concentration (HHI) - method: market_concentration | level: intro

What it's for. Compute HHI, CR4 and the equivalent number of firms from declared firm revenues.

Steps. Add the declared revenues to get the market total. Divide each firm's revenue by the total and multiply by one hundred. Square each share and add them for the HHI. Add the four largest shares for CR4; the equivalent number of firms is 10,000 divided by the HHI.

Rule. HHI = sum of squared percentage market shares; CR4 = sum of the four largest shares.

Price elasticity of demand - method: elasticity | level: intro

What it's for. Measure the arc elasticity between two price-quantity observations and see what happens to revenue.

Steps. Compute the change in quantity divided by the average quantity. Compute the change in price divided by the average price. Divide the first percentage change by the second. Compare the absolute value with one and read the revenue change.

Rule. E = (% change in Q) / (% change in P), using the midpoint (arc) formula.

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Pricing rules - method: pricing_decision | level: intro

What it's for. Cost-plus, target-margin, break-even and target-return prices from your cost, volume and rate.

Steps. Enter the variable cost per unit and the fixed cost for the period. Enter the volume you expect to sell. Read the cost-plus price at your markup, then the margin price and the break-even price. Compare them with what customers in your market actually pay; the method cannot do that part.

Rule. Cost-plus price = unit cost x (1 + markup); margin price = unit cost / (1 - margin); break-even price = total cost / expected units.

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Cost curves - method: cost_curves | level: intro

What it's for. Average, average variable, average fixed and marginal cost at a declared quantity, with profit and a shutdown test if you supply a price.

Steps. Enter fixed cost and the linear and quadratic variable-cost terms. Choose the quantity at which to evaluate the costs. Read AC, AVC, AFC and MC together; MC crosses AC at the minimum of AC. If you supply a price, compare it with the minimum AVC to test shutdown.

Rule. TC = FC + bQ + cQ^2; AC = TC / Q; MC = b + 2cQ.

Markup and Lerner index - method: market_power | level: intro

What it's for. Measure the markup and Lerner index from a price and marginal cost, and the implied demand elasticity.

Steps. Enter the price and the marginal cost at the same quantity. Subtract marginal cost from price for the markup. Divide the markup by price for the Lerner index. If the index is positive, take its inverse for the implied demand elasticity.

Rule. Lerner index = (P - MC) / P; markup = P - MC; implied elasticity = 1 / Lerner.

Capacity and bottleneck - method: capacity_analysis | level: intro

What it's for. Capacity per resource, the bottleneck and the utilisation at your declared demand.

Steps. List each resource, the hours it is available and the minutes it needs per unit. Read each resource's capacity and the bottleneck. If you declare demand, read each resource's utilisation and the capacity gap. Improve the bottleneck first; extra capacity elsewhere adds nothing.

Rule. Capacity = available minutes / minutes per unit; process capacity is the smallest resource capacity.

Order quantity and reorder point - method: inventory_policy | level: intro

What it's for. Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.

Steps. Enter annual demand, the cost of one order and the cost of holding one unit for a year. Enter the lead time in days. If you know the service level and the daily demand variability, enter both to get safety stock. Read the order quantity, the reorder point and the total ordering and holding cost.

Rule. EOQ = sqrt(2 x annual demand x order cost / holding cost); safety stock = z x demand SD x sqrt(lead time).

Sales from market share - method: sales_from_market | level: intro

What it's for. Target revenue and units from a declared market size, share and price.

Steps. Enter the annual market size in your currency. Declare the share you plan to win as a fraction. Enter your price per unit. Read the target revenue and units; carry them into the sales projection.

Rule. Target revenue = market size x target share; target units = revenue / price.

Projected statements - method: proforma_statements | level: intermediate

What it's for. Projected income statement, cash flow and balance sheet from your declared drivers, with the balance check.

Steps. Enter revenue for each period and the gross margin. Enter operating costs, depreciation, interest and principal repayment. Enter tax, working-capital days and the opening balance sheet. Read the income statement, cash flow and balance sheet; fix any period that does not balance.

Rule. Net income = revenue x margin - operating costs - depreciation - interest - tax; cash = opening + operating + investing + financing flows; assets = liabilities + equity.

Price and volume sensitivity - method: sensitivity_table | level: intermediate

What it's for. Profit across declared price and volume changes, with the base case.

Steps. Enter the base price, units, unit variable cost and fixed cost. Declare one to five price changes and volume changes as fractions. Read the base profit and each cell. Use the table to show how much the result moves, not to choose a scenario.

Rule. Profit = (price x (1 + price change) - unit cost) x units x (1 + volume change) - fixed cost.

Financial statement ratios - method: ratio_analysis | level: intro

What it's for. Compute the declared liquidity, profitability, solvency and efficiency ratios from supplied statements.

Steps. Enter the statement figures you have; missing figures leave ratios uncomputed. Read each ratio with its declared formula and the figures it used. Compare only with a stated benchmark or prior period. Check the balance-sheet identity where the figures allow it.

Rule. Current ratio = current assets / current liabilities; margins divide profit by revenue; turnover divides revenue by the balance.

Depreciation schedule - method: depreciation_schedule | level: intro

What it's for. The period charge, accumulated depreciation and carrying amount, straight line or declining balance.

Steps. Enter the asset's cost, its expected salvage value and the useful life. Choose straight line or declining balance. Read each period's charge, the accumulated depreciation and the carrying amount. Use the period charges in the projected statements.

Rule. Straight line: (cost - salvage) / life each period. Declining balance: carrying amount x rate, with the final period plugged to salvage.

Sales and profit projection - method: sales_projection | level: intro

What it's for. Project volume, revenue, costs and profit period by period from a starting volume and a growth rate.

Steps. Enter the units you expect in the first period, the price and the unit variable cost. Enter the fixed cost for one period and the growth you assume per period. Declare how many periods the plan covers. Read each period's units, revenue and profit, and the totals across the horizon.

Rule. Units_t = units_1 x (1 + g)^(t-1); revenue = units x price; profit = revenue - units x unit cost - fixed cost.

Start-up capital and amount to raise - method: startup_capital | level: intro

What it's for. Add set-up costs, working capital and a contingency, subtract what is already committed, and record the funding gap.

Steps. List the one-off costs to open: equipment, fit-out, permits, deposits and initial stock. Add the cash needed to operate before receipts cover the costs. Add a contingency you can justify, as a percentage of that base. Subtract the owner's cash and any loan already approved to get the amount still to raise.

Rule. Requirement = (set-up costs + working capital) x (1 + contingency rate); amount to raise = requirement - owner equity - loan.

Cash runway and funding gap - method: cash_runway | level: intermediate

What it's for. Months of cash left at a declared monthly burn, the lowest balance and the cash needed over your horizon.

Steps. Enter the cash you have now. Enter the monthly net cash flow: cash received minus cash paid. A loss is a negative number. If the flow changes each month, declare the monthly growth you assume. Read the runway in months, the lowest balance and the funding gap over your horizon.

Rule. Runway = opening cash / monthly burn (no growth); with growth g, runway = ln(1 - opening x g / burn) / ln(1 + g) for a negative flow.

Return on investment - method: return_on_investment | level: intro

What it's for. ROI and the annualised return from a declared investment and net gain.

Steps. Enter the total amount invested. Enter the total gain net of that investment over the whole holding period. Read the return, and the annualised return if you declare the years. Compare it with the return you could get elsewhere before you call it good.

Rule. ROI = net gain / total investment; annualised ROI = (1 + ROI)^(1/years) - 1.

Tax on declared rates - method: tax_declared | level: intro

What it's for. Income tax, VAT payable and deferred tax from the rates you declare, with the total charge.

Steps. Enter the taxable income you are declaring and the income tax rate as a decimal. If the assignment includes VAT, enter the output and input tax. If it includes deferred tax, enter the temporary difference and the rate. Read the current tax, the VAT payable, the deferred tax and the total charge.

Rule. Income tax = positive taxable income x declared rate; VAT payable = output tax - input tax; deferred tax = temporary difference x declared rate; total charge = income tax + deferred tax.

Net present value - method: npv | level: intro

What it's for. Discount a project's cash flows at a declared rate and record the NPV with its checks.

What you need. the outlay, the later cash flows, and the hurdle rate you will justify

Steps. List the cash flows in order, starting with the negative outlay at t = 0. Choose the discount rate that matches the project's risk. Discount each flow and add them. Compare the result with zero; a positive NPV clears the hurdle at that rate.

Rule. NPV = sum of CF_t / (1 + r)^t, with the first cash flow at t = 0 and undiscounted.

Internal rate of return - method: irr | level: intro

What it's for. Find the rate at which the project's NPV is zero, with the declared search bounds.

What you need. the same cash flows; the method refuses more than one sign change

Steps. Write the cash flows with the outlay at t = 0. Solve for the rate that makes the present value zero. Compare the IRR with the cost of capital. Use it with NPV, not instead of it, when projects differ in scale or life.

Rule. The IRR is the rate r at which NPV = 0: sum of CF_t / (1 + r)^t = 0.

Discounted payback - method: discounted_payback | level: intro

What it's for. Record how long the discounted cash flows take to repay the investment.

What you need. the cash flows and the discount rate

Steps. Discount each cash flow at the declared rate. Add the discounted flows year by year. Find the year in which the cumulative total crosses zero. Interpolate within that year for the fractional period.

Rule. Cumulate the discounted cash flows until they turn positive; interpolate inside the recovering period.

Project ranking metrics - method: project_metrics | level: intermediate

What it's for. Profitability index, MIRR, payback and equivalent annual annuity beside NPV and IRR.

What you need. the cash flows, the hurdle rate and a finance rate

Steps. Start from the same cash flows and rate as the NPV. Compute the profitability index from the present values of inflows and outflows. Reinvest positive flows at the finance rate and finance negative flows at the cost of capital for MIRR. Spread the NPV over the project's life for the equivalent annual annuity.

Rule. PI = PV(inflows) / |PV(outflows)|; MIRR reinvests positive flows at the finance rate; EAA = NPV x r / (1 - (1 + r)^-n).

Scenario analysis - method: scenario_analysis | level: intro

What it's for. Recompute NPV at a low and high discount rate and find the decision-flip rate.

What you need. the cash flows, a base rate and a low/high range

Steps. Enter the project's cash flows and the base discount rate. Declare the optimistic (low) and pessimistic (high) rates. Read the three NPVs, the swing and the decision-flip rate. Say which single input changed and which did not.

Rule. Recompute NPV at the low and high discount rates; the break-even rate is the IRR of the same cash flows.

Common-size and trend - method: trend_analysis | level: intro

What it's for. Several years of income-statement figures as common-size percentages, an index and compound growth.

Steps. Enter the periods in order, starting with the base year. Enter revenue, cost of sales, operating expenses and net income for every period. Read each line as a share of revenue in the latest period. Read the index against the base year and the compound growth across the whole span.

Rule. Common-size % = line / revenue; index = period value / base value x 100; CAGR = (end / start)^(1 / periods) - 1.

Working capital and EOQ - method: working_capital | level: intro

What it's for. Cash conversion cycle, order quantity, reorder point and the cost of forgoing a discount.

Steps. Enter revenue, cost of sales and the three working-capital balances. Read DSO, DIO, DPO and the cash conversion cycle. Enter annual demand, order cost and holding cost for the order quantity. Read the reorder point and the annualised cost of forgoing the trade discount.

Rule. CCC = DSO + DIO - DPO; EOQ = square root of (2 x annual demand x order cost / holding cost per unit).

Cap table and dilution - method: cap_table_round | level: intermediate

What it's for. Post-money value, price per share, new shares, investor and founder percentages and dilution for one round.

Steps. Enter the agreed pre-money valuation and the amount invested. Enter all shares outstanding before the round. If an option pool is part of the deal, declare it as a share of the fully diluted company. Read the post-money value, the price per share, the new shares and each holder's percentage.

Rule. Post-money = pre-money + investment; price per share = pre-money / existing shares; new shares = investment / price; investor % = new shares / fully diluted shares.

Loan amortization - method: loan_amortization | level: intro

What it's for. Find the level payment, total interest and first-payment split on a fixed-rate loan.

Steps. Enter the principal, the nominal annual rate, the term and the payment frequency. Convert the annual rate and the term to the payment period. Read the level payment, then total paid and total interest. Check the first payment's interest and principal split.

Rule. PMT = P x r / (1 - (1 + r)^-n), where r is the annual rate divided by payments per year and n is years x payments per year.

DCF valuation (year-end) - method: dcf_valuation | level: intermediate

What it's for. Value a business or project from forecast free cash flows and a declared discount rate.

Steps. Enter the free cash flows for the explicit forecast. Enter the discount rate that matches the cash flows. If the business continues, declare a terminal growth rate below the discount rate. Read the explicit present value, the terminal present value and their sum.

Rule. EV = sum of FCF_t / (1 + r)^t + TV / (1 + r)^n; TV = FCF_n(1 + g) / (r - g).

Comparable multiples - method: multiples_valuation | level: intermediate

What it's for. Apply peer multiples to your own earnings, EBITDA, sales or book value.

Steps. Choose the metric: earnings and book value are equity multiples, EBITDA and sales are enterprise multiples. Enter the subject's metric and the peer multiples. Read the mean, median, minimum and maximum multiple. Bridge enterprise value to equity value with net debt if the multiple is an EV multiple.

Rule. Implied value = subject metric x peer multiple; EV multiples bridge to equity through net debt.

Equity bridge - method: equity_bridge | level: intermediate

What it's for. Move from enterprise value to equity value through net debt and other declared claims.

Steps. Start from the enterprise value the DCF or a multiple implies. Subtract debt and add cash for net debt. Subtract minority interest and preferred equity if they are claims on the enterprise. Divide by shares outstanding only if you want a per-share value.

Rule. Equity value = enterprise value - net debt - minority interest - preferred equity; per share = equity value / shares.

Currency conversion - method: currency_convert | level: intro

What it's for. Convert an amount at a rate you declare; the rate and its source are recorded.

Steps. Enter the amount, the source currency and the target currency. Declare the rate and where it came from. Read the converted amount and the recorded rate. Keep the rate date with the result.

Rule. Converted amount = amount x rate, with the rate's provenance recorded.

Social return on investment - method: sroi | level: intermediate

What it's for. Record the SROI ratio from declared social value, investment and attribution assumptions.

Steps. Discount the declared social benefits. Divide their present value by the declared investment. State the attribution and deadweight assumptions explicitly.

Rule. SROI = PV(social benefits) / investment.

Cost-benefit analysis - method: cost_benefit | level: intermediate

What it's for. Compare the present value of programme costs and benefits under declared assumptions.

Steps. Discount each period's costs and benefits at the declared rate. Subtract present-value costs from present-value benefits. Divide benefits by costs for the benefit-cost ratio.

Rule. NPV = PV(benefits) - PV(costs); BCR = PV(benefits) / PV(costs).

Cost per unit of impact - method: cost_effectiveness | level: intermediate

What it's for. Compare your options' incremental cost per unit of effect, with the effect measure declared.

Steps. Enter each option's cost and its effect in one declared unit. Choose the comparator. Read the incremental cost per unit of effect. State what the effect measure is and what it leaves out.

Rule. ICER = (cost of the option - cost of the comparator) / (effect of the option - effect of the comparator).

Compare strategic options - method: case_decision | level: intermediate

What it's for. Compare alternatives by NPV and record the crossover rate that flips the decision.

What you need. the facts, the alternatives, their cash flows and provenance

Steps. Enter two to five alternatives, each with its own cash flows. Read each alternative's NPV and the crossover rate between pairs. Say which alternative wins at the decision rate and where the ranking flips. Keep non-financial criteria visible beside the numbers.

Rule. Compare each alternative's NPV at the declared rate; the crossover rate is where two alternatives' NPVs are equal.

Limits - what this subject does not do

* It does not invent a market size, price, cost or growth rate.
* It does not raise the capital, validate the idea or guarantee a return.
* It does not replace a customer interview or a real market test.

Operations management

Cost-volume-profit, process evidence and the statistics used to inspect a process.

How to start. Start with the process question: cost, capacity, flow, quality or inventory. The shelf is a set of declared-input calculations, not a plant simulation. Choose the tool that matches the question, enter the figures you have, and read the checks and limits before you use the answer.

Tiles in this subject

Tile	What it's for	Method / level
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Order quantity and reorder point (inventory)	Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.	inventory_policy - intro
Queue length and waiting time (queue)	Utilisation, customers waiting and the average wait for a single-server queue.	queue_analysis - intermediate
Capacity and bottleneck (capacity)	Capacity per resource, the bottleneck and the utilisation at your declared demand.	capacity_analysis - intro
Line balancing (linebalance)	Assign tasks to stations at a declared cycle time, with the lower bound, idle time and efficiency.	line_balancing - intermediate
Overall equipment effectiveness (oee)	Availability, performance, quality and OEE from planned time, downtime and unit counts.	oee_analysis - intro
Control chart and capability (spc)	I-MR control limits, out-of-control points and, with specification limits, Cp and Cpk.	process_control - intermediate
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced
Missing-data bounds (missing)	Bound how far the missing values could move the mean, without imputing them.	missing_data_bounds - intermediate
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro

How to use each tile

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Order quantity and reorder point - method: inventory_policy | level: intro

What it's for. Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.

Steps. Enter annual demand, the cost of one order and the cost of holding one unit for a year. Enter the lead time in days. If you know the service level and the daily demand variability, enter both to get safety stock. Read the order quantity, the reorder point and the total ordering and holding cost.

Rule. EOQ = sqrt(2 x annual demand x order cost / holding cost); safety stock = z x demand SD x sqrt(lead time).

Queue length and waiting time - method: queue_analysis | level: intermediate

What it's for. Utilisation, customers waiting and the average wait for a single-server queue.

Steps. Enter the average number of arrivals per period. Enter the average number the single server can serve per period. Check that arrivals are below service, or the queue never clears. Read utilisation, the average queue, the average wait and the probability the server is idle.

Rule. Utilisation = arrival rate / service rate; queue length = utilisation squared / (1 - utilisation); waits follow Little's law.

Capacity and bottleneck - method: capacity_analysis | level: intro

What it's for. Capacity per resource, the bottleneck and the utilisation at your declared demand.

Steps. List each resource, the hours it is available and the minutes it needs per unit. Read each resource's capacity and the bottleneck. If you declare demand, read each resource's utilisation and the capacity gap. Improve the bottleneck first; extra capacity elsewhere adds nothing.

Rule. Capacity = available minutes / minutes per unit; process capacity is the smallest resource capacity.

Line balancing - method: line_balancing | level: intermediate

What it's for. Assign tasks to stations at a declared cycle time, with the lower bound, idle time and efficiency.

Steps. List each task with its time and its immediate predecessors. Declare the cycle time the line must meet. Choose the heuristic: longest task time, or ranked positional weight. Read the stations used, each station's load, the idle time and the efficiency; compare with the lower bound.

Rule. Lower bound = ceil(total task time / cycle time); efficiency = total time / (stations x cycle time).

Overall equipment effectiveness - method: oee_analysis | level: intro

What it's for. Availability, performance, quality and OEE from planned time, downtime and unit counts.

Steps. Enter the planned production time and the downtime inside it. Enter the ideal cycle time and the units produced. Enter how many of those units were good. Read the three factors and their product; fix the largest loss first.

Rule. Availability = (planned time - downtime) / planned time; performance = ideal cycle x units / run time; quality = good units / units; OEE = the product.

Control chart and capability - method: process_control | level: intermediate

What it's for. I-MR control limits, out-of-control points and, with specification limits, Cp and Cpk.

Steps. Enter the observations in time order. Read the mean, the estimated sigma and the control limits. Check the points outside the limits and the longest run on one side of the mean. If you declare specification limits, read Cp and Cpk against them.

Rule. I-MR: sigma = average moving range / 1.128; limits = mean +/- 3 sigma; Cp = (USL - LSL) / (6 sigma); Cpk = min((USL - mean), (mean - LSL)) / (3 sigma).

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Missing-data bounds - method: missing_data_bounds | level: intermediate

What it's for. Bound how far the missing values could move the mean, without imputing them.

Steps. Enter the observations you have, leaving missing values blank or marking their codes. Declare the missing-data mechanism you believe applies; it is recorded, not verified. Read the complete-case mean and the worst-case bounds. Report the bound beside the estimate, not instead of it.

Rule. The mean is bounded by valuing every missing observation at the minimum and at the maximum observed value; the bound width shows how much the missing data could move it.

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Limits - what this subject does not do

* It does not retrieve production, time or quality data; you declare it.
* It does not optimise a full schedule, a shift plan or a stochastic process.
* It does not replace a plant visit or a direct process observation.

Supply chain & logistics

The same evidence tools as Operations, with the inventory and network gaps stated plainly.

How to start. This shelf is deliberately narrower than Operations. Start with inventory and the forecast, then use capacity and queueing for a bottleneck or service-level question. The network design, routing and supplier-retrieval gaps are stated rather than filled.

Tiles in this subject

Tile	What it's for	Method / level
Break-even point (breakeven)	Solve the break-even quantity from fixed cost, price and variable cost.	breakeven - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Order quantity and reorder point (inventory)	Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.	inventory_policy - intro
Queue length and waiting time (queue)	Utilisation, customers waiting and the average wait for a single-server queue.	queue_analysis - intermediate
Capacity and bottleneck (capacity)	Capacity per resource, the bottleneck and the utilisation at your declared demand.	capacity_analysis - intro
Missing-data bounds (missing)	Bound how far the missing values could move the mean, without imputing them.	missing_data_bounds - intermediate

How to use each tile

Break-even point - method: breakeven | level: intro

What it's for. Solve the break-even quantity from fixed cost, price and variable cost.

Steps. Subtract variable cost from price to get the unit contribution and the contribution-margin ratio. Divide fixed cost by the unit contribution for the break-even quantity. Multiply by the price for the break-even revenue. If you declare an expected volume, read the margin of safety; a profit target gives its volume.

Rule. Break-even quantity = fixed cost / (price - variable cost per unit); break-even revenue = quantity x price; margin of safety = expected units - break-even units.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Order quantity and reorder point - method: inventory_policy | level: intro

What it's for. Economic order quantity, safety stock, reorder point and the annual ordering and holding cost.

Steps. Enter annual demand, the cost of one order and the cost of holding one unit for a year. Enter the lead time in days. If you know the service level and the daily demand variability, enter both to get safety stock. Read the order quantity, the reorder point and the total ordering and holding cost.

Rule. EOQ = sqrt(2 x annual demand x order cost / holding cost); safety stock = z x demand SD x sqrt(lead time).

Queue length and waiting time - method: queue_analysis | level: intermediate

What it's for. Utilisation, customers waiting and the average wait for a single-server queue.

Steps. Enter the average number of arrivals per period. Enter the average number the single server can serve per period. Check that arrivals are below service, or the queue never clears. Read utilisation, the average queue, the average wait and the probability the server is idle.

Rule. Utilisation = arrival rate / service rate; queue length = utilisation squared / (1 - utilisation); waits follow Little's law.

Capacity and bottleneck - method: capacity_analysis | level: intro

What it's for. Capacity per resource, the bottleneck and the utilisation at your declared demand.

Steps. List each resource, the hours it is available and the minutes it needs per unit. Read each resource's capacity and the bottleneck. If you declare demand, read each resource's utilisation and the capacity gap. Improve the bottleneck first; extra capacity elsewhere adds nothing.

Rule. Capacity = available minutes / minutes per unit; process capacity is the smallest resource capacity.

Missing-data bounds - method: missing_data_bounds | level: intermediate

What it's for. Bound how far the missing values could move the mean, without imputing them.

Steps. Enter the observations you have, leaving missing values blank or marking their codes. Declare the missing-data mechanism you believe applies; it is recorded, not verified. Read the complete-case mean and the worst-case bounds. Report the bound beside the estimate, not instead of it.

Rule. The mean is bounded by valuing every missing observation at the minimum and at the maximum observed value; the bound width shows how much the missing data could move it.

Limits - what this subject does not do

* It does not design a network, optimise routing or select a supplier.
* It does not retrieve freight, tariff or supplier data.
* It does not model disruption, multi-echelon inventory or a full logistics simulation.

Marketing & customers

Plan the marketing and then measure it: market size and demand, customer economics, campaign and channel performance, and the surveys and tests behind customer evidence.

How to start. Work down the page in the order a marketing plan is written. Size the market and test the demand first, then check whether a customer is worth acquiring, then measure the funnel and the digital channels that feed it, and finally test what you changed. Every figure is one you supply and confirm; the engine computes the arithmetic, runs its checks and states what it cannot tell you. It does not connect to an ad platform, estimate a missing number or recommend a budget.

Tiles in this subject

Tile	What it's for	Method / level
Market size (TAM, SAM, SOM) (marketsize)	Size the whole market, the part you can serve and the part you can win from a population, an annual spend and two shares you declare.	market_sizing - intro
Market share and penetration (marketshare)	Read the share of a declared market, its change from a prior period, penetration against a population and the relative share against a named competitor.	market_share - intro
Demand line and revenue-max price (demandcurve)	Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.	demand_curve - intermediate
Price elasticity of demand (elasticity)	Measure the arc elasticity between two price-quantity observations and see what happens to revenue.	elasticity - intro
Purchase intent (purchaseintent)	Turn weighted survey answers into an expected buying rate, projected buyers and projected revenue.	purchase_intent - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro
Unit economics (unitecon)	The margin per customer, the cost to win one, its payback and lifetime value.	unit_economics - intro
Multi-product break-even (multibreakeven)	Find the sales mix at which several products together cover their fixed costs.	multi_product_breakeven - intro
Cohort retention (cohort)	Follow groups of customers who started together and read retention, churn and the average customer life.	cohort_retention - intermediate
RFM segmentation (rfm)	Score every customer on recency, frequency and monetary value, then see how many fall in each named segment and what the average scores are.	rfm_scoring - intermediate
Customer lifetime value (clv)	Value a customer over a declared horizon with a churn and discount rate, and read the undiscounted value, the value per unit of acquisition cost and the payback period.	clv_model - intermediate
Customer profitability by segment (custprofit)	Enter revenue, direct cost and any allocated cost for each segment and read profit, margin, profit share and how few segments carry the profit.	customer_profitability - intermediate
Campaign efficiency (campaign)	Enter impressions, clicks, conversions, spend and revenue and read the click-through, cost per click and per thousand impressions, cost per acquisition, return on ad spend and the break-even return.	campaign_efficiency - intro
Attribution across channels (attribution)	Enter the credit each channel receives under first-click, last-click and linear rules and see how much the shares disagree.	attribution_split - intermediate
Channel economics (channelecon)	Give each channel its spend, new customers, margin and churn and read acquisition cost, payback, lifetime value and the blended acquisition cost.	channel_economics - intermediate
Email list health (email)	Read list growth, churn, open and click rates, click-to-open and revenue per subscriber from the counts you declare.	email_list_health - intro

Tile	What it's for	Method / level
Social reach and engagement (social)	Read engagement rate, frequency, cost per thousand impressions, cost per engagement and follower growth from the platform counts you declare.	social_engagement - intro
Web traffic and conversion by channel (web)	Compare sessions, conversions, conversion rate and revenue per session across your acquisition channels, with organic-search click-through when you declare it.	web_analytics - intro
Reach, frequency and rating points (mediaplan)	Enter the population and each vehicle's reach, insertions and cost and read rating points, cost per point, cost per thousand impressions and the combined reach under random duplication.	media_plan - intro
Sales funnel and conversion (funnel)	Enter how many people reached each stage and read the conversion, the drop-off and the cost of winning a customer.	sales_funnel - intro
A/B test result (abtest)	Enter the visitors and conversions for two variants and read the lift, the test result and the interval, plus how many visitors each arm needs for the effect you declare.	ab_test_two_proportion - intermediate
Reliability (Cronbach's alpha) (alpha)	Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.	reliability_alpha - intro
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced

How to use each tile

Market size (TAM, SAM, SOM) - method: market_sizing | level: intro

What it's for. Size the whole market, the part you can serve and the part you can win from a population, an annual spend and two shares you declare.

Steps. Count the customers in the market you are describing, or use a population and a spend figure you can defend. Multiply by the average annual spend for the total addressable market. Apply the share of that market you can physically serve, then the share of that market you can win. Check that each share is below one and that SOM is smaller than SAM, which is smaller than TAM.

Rule. TAM = customers x annual spend; SAM = TAM x serviceable share; SOM = SAM x obtainable share.

Market share and penetration - method: market_share | level: intro

What it's for. Read the share of a declared market, its change from a prior period, penetration against a population and the relative share against a named competitor.

Steps. Decide the market boundary and keep it identical for every figure. Enter the firm's sales and the whole market's sales for the same period and currency. Add a prior period only if you have both sides of it, so the share change is comparable. Add customers and population for penetration, and name the largest competitor for relative share.

Rule. Market share = firm sales / market sales; penetration = customers / target population; relative share = firm sales / largest competitor's sales.

Demand line and revenue-max price - method: demand_curve | level: intermediate

What it's for. Fit a line to your price and quantity pairs and read the slope, the elasticity and the price that maximises revenue.

Steps. Collect price-quantity pairs from the same market and period basis. Enter the prices and the quantity demanded at each price. Read the slope, the R-squared and the elasticity at the mean price. If the slope is negative, read the revenue-maximising price on the fitted line.

Rule. q = a + b p, fitted by least squares; elasticity at the mean = b x (mean price / mean quantity).

Price elasticity of demand - method: elasticity | level: intro

What it's for. Measure the arc elasticity between two price-quantity observations and see what happens to revenue.

Steps. Compute the change in quantity divided by the average quantity. Compute the change in price divided by the average price. Divide the first percentage change by the second. Compare the absolute value with one and read the revenue change.

Rule. E = (% change in Q) / (% change in P), using the midpoint (arc) formula.

Purchase intent - method: purchase_intent | level: intro

What it's for. Turn weighted survey answers into an expected buying rate, projected buyers and projected revenue.

Steps. Enter how many respondents gave each answer. Declare the weight each answer carries, or use the stated defaults. Read the weighted intent rate. If you declare the population and the price, read projected buyers and projected revenue.

Rule. Intent rate = (definitely x w1 + probably x w2 + maybe x w3 + never x w4) / respondents; projected buyers = population x intent rate.

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Unit economics - method: unit_economics | level: intro

What it's for. The margin per customer, the cost to win one, its payback and lifetime value.

Steps. Enter the price and the variable cost per unit or customer. Enter the acquisition cost and, if you know it, the churn rate. Read the margin, the payback period and the LTV/CAC ratio. Check that price and cost are for the same period.

Rule. Contribution margin = price - variable cost; LTV = margin / churn; CAC payback = acquisition cost / margin.

Multi-product break-even - method: multi_product_breakeven | level: intro

What it's for. Find the sales mix at which several products together cover their fixed costs.

Steps. Compute each product's unit contribution. Weight the contributions by the declared sales mix. Divide fixed cost by the weighted contribution. Split the break-even units back across the mix.

Rule. Weighted contribution = sum(mix weight x unit contribution); break-even units = fixed cost / weighted contribution.

Cohort retention - method: cohort_retention | level: intermediate

What it's for. Follow groups of customers who started together and read retention, churn and the average customer life.

Steps. Enter the number of customers in each cohort when it started. Enter how many of each cohort were still buying in each later period. Keep every cohort's row the same length; leave out a period a cohort has not reached. Read the pooled retention curve, the churn and the average lifetime.

Rule. Period retention = retained customers in that period / starting customers, pooled across cohorts; average lifetime = the sum of the period retention rates.

RFM segmentation - method: rfm_scoring | level: intermediate

What it's for. Score every customer on recency, frequency and monetary value, then see how many fall in each named segment and what the average scores are.

Steps. Decide what counts as a purchase and over what window, then take recency, frequency and monetary value from the same records. Give every customer a unique name so the rows can be checked back. Read the segment sizes before the averages: a small Champions group and a large At-risk group call for different actions. Say in your write-up that the bands are relative to this list, not an industry benchmark.

Rule. Rank customers inside the file, split the ranks into five equal-count bands, and score recency in reverse; the segment comes from the declared first-match rules on the three scores.

Customer lifetime value - method: clv_model | level: intermediate

What it's for. Value a customer over a declared horizon with a churn and discount rate, and read the undiscounted value, the value per unit of acquisition cost and the payback period.

Steps. Take the contribution margin the customer leaves in one period, not the revenue. Declare the churn rate and the discount rate as decimals, and state the horizon. Read the discounted value, then the undiscounted value, to see what time costs. Add an acquisition cost only if you want the value ratio and the payback period.

Rule. Value = sum over the horizon of margin x survival / (1 + discount rate)^period, where survival falls by the churn rate each period.

Customer profitability by segment - method: customer_profitability | level: intermediate

What it's for. Enter revenue, direct cost and any allocated cost for each segment and read profit, margin, profit share and how few segments carry the profit.

Steps. Decide what counts as a segment and keep the definition identical across rows. Enter revenue, direct cost and only the shared cost you can justify allocating. Read the profitable and unprofitable counts before the shares. Read the concentration count as a description of this snapshot, not a law.

Rule. Segment profit = revenue - direct cost - allocated cost; margin = profit / revenue; profit share = segment profit / total profit.

Campaign efficiency - method: campaign_efficiency | level: intro

What it's for. Enter impressions, clicks, conversions, spend and revenue and read the click-through, cost per click and per thousand impressions, cost per acquisition, return on ad spend and the break-even return.

Steps. Agree the campaign, the period and what counts as a conversion before you start. Enter impressions, clicks, conversions, spend and the revenue you attribute to the campaign. Declare the contribution margin if you want the break-even return and the profit after media. Compare the return on ad spend with the break-even figure, not with a rule of thumb.

Rule. Click-through rate = clicks / impressions; cost per click = spend / clicks; cost per acquisition = spend / conversions; return on ad spend = revenue / spend; break-even return = 1 / contribution margin rate.

Attribution across channels - method: attribution_split | level: intermediate

What it's for. Enter the credit each channel receives under first-click, last-click and linear rules and see how much the shares disagree.

Steps. Choose the rules you will compare and keep the conversion definition fixed across them. Enter each channel's credited conversions under first-click, last-click and linear. Check that each rule allocates every conversion in full. Read the largest spread as the channel whose apparent value depends most on the rule.

Rule. Each channel's share under a rule = its credited conversions / the total credited conversions under that rule; the spread is the largest share minus the smallest.

Channel economics - method: channel_economics | level: intermediate

What it's for. Give each channel its spend, new customers, margin and churn and read acquisition cost, payback, lifetime value and the blended acquisition cost.

Steps. Assign each customer to the one channel that won them, and keep shared spend separate. Enter each channel's spend, new customers, contribution margin per customer and period churn. Read payback first: it says how long the cash takes to come back. Read lifetime value and the ratio to acquisition cost second, against the same churn assumption.

Rule. Acquisition cost = spend / new customers; payback = acquisition cost / contribution margin; lifetime value = contribution margin / churn rate; blended acquisition cost = total spend / total new customers.

Email list health - method: email_list_health | level: intro

What it's for. Read list growth, churn, open and click rates, click-to-open and revenue per subscriber from the counts you declare.

Steps. Take the list size, the additions and the losses for the same period as the sends. Keep opens and clicks for the same set of sends. Read growth and churn together: a growing list can still be losing its most engaged readers. Read revenue per subscriber beside the send counts, not on its own.

Rule. List end = start + new - unsubscribes - bounces; open rate = opens / sends; click rate = clicks / sends; revenue per subscriber = revenue / list end.

Social reach and engagement - method: social_engagement | level: intro

What it's for. Read engagement rate, frequency, cost per thousand impressions, cost per engagement and follower growth from the platform counts you declare.

Steps. Decide one platform and one engagement definition, and keep them fixed. Enter impressions, reach, engagements, the starting audience, the net follower change and any spend. Read the engagement rate with the frequency beside it: the same person can be counted many times. Compare only with the same platform, definition and period.

Rule. Engagement rate = engagements / reach; frequency = impressions / reach; cost per thousand impressions = spend / impressions x 1,000; follower growth = net gain / starting followers.

Web traffic and conversion by channel - method: web_analytics | level: intro

What it's for. Compare sessions, conversions, conversion rate and revenue per session across your acquisition channels, with organic-search click-through when you declare it.

Steps. List every acquisition channel, including direct and unattributed traffic. Enter sessions, conversions and revenue for the same period and the same definition. Read the conversion rate and revenue per session side by side: they answer different questions. Add organic impressions and clicks only if you want the organic click-through.

Rule. Conversion rate = conversions / sessions; revenue per session = revenue / sessions; channel share = channel sessions / total sessions; blended rate pools every channel.

Reach, frequency and rating points - method: media_plan | level: intro

What it's for. Enter the population and each vehicle's reach, insertions and cost and read rating points, cost per point, cost per thousand impressions and the combined reach under random duplication.

Steps. Fix the target population and the period, then take each vehicle's reach, insertions and cost from the same plan. Enter one row per vehicle and keep the names distinct. Read the plan total in rating points, then the combined reach: points add up, reach does not. Treat the combined reach as an upper bound, because real audiences overlap more than chance.

Rule. Rating points = reach share x average frequency x 100; gross impressions = reach x frequency; cost per point = cost / rating points; combined reach = 1 - the product of (1 - each reach share).

Sales funnel and conversion - method: sales_funnel | level: intro

What it's for. Enter how many people reached each stage and read the conversion, the drop-off and the cost of winning a customer.

Steps. List the stages in the order a customer meets them. Enter how many people reached each stage in the same period. Read each stage's conversion, the overall conversion and the drop-off. If you declare the spend, read the acquisition cost per customer.

Rule. Stage conversion = count at the next stage / count at this stage; overall conversion = last count / first count.

A/B test result - method: ab_test_two_proportion | level: intermediate

What it's for. Enter the visitors and conversions for two variants and read the lift, the test result and the interval, plus how many visitors each arm needs for the effect you declare.

Steps. Decide the single metric and the smallest effect worth acting on before the test runs. Let both arms run over the same window and split traffic at random. Enter the visitors and conversions for each arm, then read the lift, the p-value and the interval. Read the interval as well as the p-value: it shows the range of effects the sample cannot rule out.

Rule. Absolute lift = rate B - rate A; pooled z = (rate B - rate A) / sqrt(p(1 - p)(1/nA + 1/nB)) with p the pooled rate; the interval for the difference uses unpooled standard errors.

Reliability (Cronbach's alpha) - method: reliability_alpha | level: intro

What it's for. Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.

What you need. the items of your scale and the people who answered it

Steps. List the answers for every respondent to every survey item, keeping the same scale direction. Check that higher scores mean the same thing on every item, reversing items where they do not. Read alpha with the number of items and respondents beside it. Report alpha as evidence about the instrument, not about the people who answered.

Rule. Cronbach's alpha = (k / (k - 1)) x (1 - sum of item variances / total variance), for k items.

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Limits - what this subject does not do

* It does not connect to an ad platform or retrieve campaign data.
* It does not recommend a budget, a bid or a segment.
* It does not estimate a missing number or invent a customer.

People & organisation

Design the job, develop the people who do it, and read the organisation they work in.

How to start. Start with the tile that matches the decision. Strategy and design covers how the organisation is set up and how a change is carried through it. Resourcing covers the job and the people in it. Development covers training and how teams work. Reward is empty by design: the catalogue holds no reward or job-evaluation framework, and the tile says so rather than hiding it. Engagement and culture covers why people perform and what the culture is. Analytics holds the calculators that work on declared figures.

Tiles in this subject

Tile	What it's for	Method / level
Reliability (Cronbach's alpha) (alpha)	Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.	reliability_alpha - intro
Weighted summary (weighted)	Summarise scores with the design weights you supply, stating the weighting rule.	weighted_summary - intro
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced
Pearson correlation (pearson)	Record the linear association between two variables with its sample size and checks.	pearson - intermediate
Linear regression (ols)	Fit a declared linear model and record coefficients, fit and diagnostics.	ols - advanced
Training ROI (trainingroi)	Work out what a training or development spend returned, from the investment you declare and the gain you declare.	return_on_investment - intermediate
Labour market tightness (labourtightness)	Read the real wage, the wage share of productivity and how tight the labour market is, from declared figures.	labour_market - advanced
People programme cost-effectiveness (programmecost)	Compare a people programme with a declared alternative on cost per unit of effect, with the effect you declare.	cost_effectiveness - advanced

How to use each tile

Reliability (Cronbach's alpha) - method: reliability_alpha | level: intro

What it's for. Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.

What you need. the items of your scale and the people who answered it

Steps. List the answers for every respondent to every survey item, keeping the same scale direction. Check that higher scores mean the same thing on every item, reversing items where they do not. Read alpha with the number of items and respondents beside it. Report alpha as evidence about the instrument, not about the people who answered.

Rule. Cronbach's alpha = (k / (k - 1)) x (1 - sum of item variances / total variance), for k items.

Weighted summary - method: weighted_summary | level: intro

What it's for. Summarise scores with the design weights you supply, stating the weighting rule.

What you need. the values you want to weigh and the weights you are declaring

Steps. Enter one value per line and one weight per line, in the same order. Declare the kind of weight: frequency, reliability or sampling. Read the weighted mean and the weighted standard deviation. Read the effective sample size: how many unweighted observations your weights are worth.

Rule. Weighted mean = sum(weight x value) / sum(weight); design effect = (n - 1) / (n_effective - 1).

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Pearson correlation - method: pearson | level: intermediate

What it's for. Record the linear association between two variables with its sample size and checks.

What you need. the two numeric variables you are relating, and the pairs you observed

Steps. Check both variables are numeric and paired. Read r between minus one and one. Inspect the scatter plot before trusting a linear summary.

Rule. r = covariance(x, y) / (standard deviation of x x standard deviation of y).

Linear regression - method: ols | level: advanced

What it's for. Fit a declared linear model and record coefficients, fit and diagnostics.

What you need. the outcome, the predictors, and the observations you have for each

Steps. Check the sample size and missing values. Read each coefficient with its standard error. Check the fit and residual diagnostics. State the assumptions and the claim ceiling.

Rule. y = intercept + coefficient x x + error; the coefficients minimise the sum of squared errors.

Training ROI - method: return_on_investment | level: intermediate

What it's for. Work out what a training or development spend returned, from the investment you declare and the gain you declare.

What you need. everything the training cost, and the gain it produced net of that cost

Steps. Enter everything the training cost: design, delivery, materials, cover, and the time people spend on it. Enter the gain the training produced, net of that cost, over the period you are judging. Declare the years only if the gain runs over more than one. Read the return, then say what the gain was measured on and how it was established.

Rule. ROI = net gain / total investment; annualised ROI = (1 + ROI)^(1/years) - 1.

Labour market tightness - method: labour_market | level: advanced

What it's for. Read the real wage, the wage share of productivity and how tight the labour market is, from declared figures.

What you need. the wage, the price index and productivity for one labour market, plus vacancies and unemployment

Steps. Enter the nominal wage, the CPI and labour productivity for the same period and the same population. Enter the vacancy count and the number of unemployed people for the labour market you are describing. Read the real wage, the wage share of productivity and how tight the market is. Say which labour market the figures describe: the method has no regional or sector breakdown.

Rule. Real wage = nominal wage / (CPI / 100); wage share = real wage / labour productivity; tightness = vacancies / unemployed.

People programme cost-effectiveness - method: cost_effectiveness | level: advanced

What it's for. Compare a people programme with a declared alternative on cost per unit of effect, with the effect you declare.

What you need. the options, their costs and their effect on one scale you declare

Steps. Enter the comparator option first: its name, its cost and its effect. Enter each other option on the same cost basis and the same effect scale. Declare the effect unit you use: people trained, roles filled, or any other single unit. Read the incremental cost per unit of effect for each option, and check the dominance flags.

Rule. ICER = (cost of the option - cost of the comparator) / (effect of the option - effect of the comparator).

Limits - what this subject does not do

* The reward tile is empty because no reward or job-evaluation framework is in the catalogue.

* It does not compute headcount, turnover, absence, cost per hire, time to hire, compa-ratio, span of control, diversity, engagement or a nine-box score: the frozen core has no such method, and a similar method is not a substitute for it.

* The frameworks here record and evidence a decision; they do not design the role, run the training, choose the intervention or predict who will succeed.

* A catalogue-only framework is something to read and cite. It is not a worksheet until the owner builds one.

Research & statistics

The cross-cutting method shelf: every statistical method the engine can run, linked from every subject.

How to start. This is the cross-cutting method shelf. Start with the design and the data shape, then choose the test. Every output states its assumptions, its checks and what it cannot establish; a significant result is not a causal claim.

Tiles in this subject

Tile	What it's for	Method / level
Descriptive statistics (descriptive)	Record the count, centre, spread and declared missing-value handling for one variable.	descriptive_stats - intro
Pearson correlation (pearson)	Record the linear association between two variables with its sample size and checks.	pearson - intermediate
Spearman rank correlation (spearman)	Record the rank association between two variables without assuming a linear shape.	spearman
Linear regression (ols)	Fit a declared linear model and record coefficients, fit and diagnostics.	ols - advanced
Linear regression (HC3) (ols_robust)	The same regression with heteroskedasticity-robust standard errors.	ols_robust - advanced
Welch two-sample t-test (welch)	Compare two group means without assuming equal variances.	welch_t - advanced
Mann-Whitney U test (mann_whitney)	Compare two groups by rank when the distributional assumption is not met.	mann_whitney
One-way ANOVA (anova)	Compare three or more group means and record the effect size and checks.	anova - advanced
Kruskal-Wallis test (kruskal_wallis)	Compare three or more groups by rank, the non-parametric alternative to ANOVA.	kruskal_wallis
Chi-square association (chi_square)	Test whether two categorical variables are associated, with the expected-count checks.	chi_square - advanced
Two-way ANOVA (factorial)	Record the two main effects and their interaction with the frozen checks.	two_way_anova
Post-hoc pairwise tests (posthoc)	Compare group pairs after a significant omnibus test, with the correction declared.	posthoc_pairwise
Multiple-comparison correction (multicomp)	Correct a declared family of tests and show the adjusted decisions.	multiple_comparison
Power and sample size (power)	Record the sample size or power implied by a declared effect and alpha.	power_analysis - advanced
Missing-data bounds (missing)	Bound how far the missing values could move the mean, without imputing them.	missing_data_bounds - intermediate
Paired t-test (paired)	Compare paired before/after measurements on the same units.	paired_t
One-sample t-test (onesample)	Compare a sample mean with a declared target.	one_sample_t
Logistic regression (logit)	Fit a declared binary-outcome model and record coefficients and fit checks.	logistic_regression
Reliability (Cronbach's alpha) (alpha)	Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.	reliability_alpha - intro
Weighted summary (weighted)	Summarise scores with the design weights you supply, stating the weighting rule.	weighted_summary - intro
Trend forecast (forecast)	Fit a trend to your own series and record the forecast periods and the range the result could fall in.	trend_forecast - intro

How to use each tile

Descriptive statistics - method: descriptive_stats | level: intro

What it's for. Record the count, centre, spread and declared missing-value handling for one variable.

What you need. the numbers you hold and the group they describe

Steps. Check the sample size and missing values. Read the centre and spread together. Look at the shape before using the mean alone.

Rule. Mean = sum of values / count; standard deviation measures typical distance from the mean.

Pearson correlation - method: pearson | level: intermediate

What it's for. Record the linear association between two variables with its sample size and checks.

What you need. the two numeric variables you are relating, and the pairs you observed

Steps. Check both variables are numeric and paired. Read r between minus one and one. Inspect the scatter plot before trusting a linear summary.

Rule. r = covariance(x, y) / (standard deviation of x x standard deviation of y).

Spearman rank correlation - method: spearman

What it's for. Record the rank association between two variables without assuming a linear shape.

Linear regression - method: ols | level: advanced

What it's for. Fit a declared linear model and record coefficients, fit and diagnostics.

What you need. the outcome, the predictors, and the observations you have for each

Steps. Check the sample size and missing values. Read each coefficient with its standard error. Check the fit and residual diagnostics. State the assumptions and the claim ceiling.

Rule. y = intercept + coefficient x x + error; the coefficients minimise the sum of squared errors.

Linear regression (HC3) - method: ols_robust | level: advanced

What it's for. The same regression with heteroskedasticity-robust standard errors.

Steps. Fit the same model as OLS. Read the robust standard errors and their tests. Compare with the ordinary OLS errors to see whether heteroskedasticity mattered. Keep the model specification fixed when comparing.

Rule. The same OLS coefficients with HC3 heteroskedasticity-robust standard errors.

Welch two-sample t-test - method: welch_t | level: advanced

What it's for. Compare two group means without assuming equal variances.

Steps. Check the two groups are independent. Read the difference, the interval and the p-value together. Report the effect size, not only significance.

Rule. t = (mean A - mean B) / standard error of the difference, without assuming equal variances.

Mann-Whitney U test - method: mann_whitney

What it's for. Compare two groups by rank when the distributional assumption is not met.

One-way ANOVA - method: anova | level: advanced

What it's for. Compare three or more group means and record the effect size and checks.

Steps. Check the groups are independent. Read the F test and the effect size. Use a post-hoc test before naming which groups differ.

Rule. F = between-group variance / within-group variance.

Kruskal-Wallis test - method: kruskal_wallis

What it's for. Compare three or more groups by rank, the non-parametric alternative to ANOVA.

Chi-square association - method: chi_square | level: advanced

What it's for. Test whether two categorical variables are associated, with the expected-count checks.

What you need. a two-way table of counts, and the categories in each direction

Steps. Build the contingency table. Check the expected counts. Read the p-value and the effect size.

Rule. Chi-square = sum of (observed - expected)^2 / expected.

Two-way ANOVA - method: two_way_anova

What it's for. Record the two main effects and their interaction with the frozen checks.

Post-hoc pairwise tests - method: posthoc_pairwise

What it's for. Compare group pairs after a significant omnibus test, with the correction declared.

Multiple-comparison correction - method: multiple_comparison

What it's for. Correct a declared family of tests and show the adjusted decisions.

Power and sample size - method: power_analysis | level: advanced

What it's for. Record the sample size or power implied by a declared effect and alpha.

What you need. the size of the effect you are looking for and the number of observations

Steps. Declare the effect size you care about. Choose alpha and the desired power. Read the required sample size or the detectable effect.

Rule. Power depends on the effect size, alpha, sample size and variability.

Missing-data bounds - method: missing_data_bounds | level: intermediate

What it's for. Bound how far the missing values could move the mean, without imputing them.

Steps. Enter the observations you have, leaving missing values blank or marking their codes. Declare the missing-data mechanism you believe applies; it is recorded, not verified. Read the complete-case mean and the worst-case bounds. Report the bound beside the estimate, not instead of it.

Rule. The mean is bounded by valuing every missing observation at the minimum and at the maximum observed value; the bound width shows how much the missing data could move it.

Paired t-test - method: paired_t

What it's for. Compare paired before/after measurements on the same units.

One-sample t-test - method: one_sample_t

What it's for. Compare a sample mean with a declared target.

Logistic regression - method: logistic_regression

What it's for. Fit a declared binary-outcome model and record coefficients and fit checks.

Reliability (Cronbach's alpha) - method: reliability_alpha | level: intro

What it's for. Check whether a set of survey items measures the same thing consistently, with the item and respondent counts stated.

What you need. the items of your scale and the people who answered it

Steps. List the answers for every respondent to every survey item, keeping the same scale direction. Check that higher scores mean the same thing on every item, reversing items where they do not. Read alpha with the number of items and respondents beside it. Report alpha as evidence about the instrument, not about the people who answered.

Rule. Cronbach's alpha = (k / (k - 1)) x (1 - sum of item variances / total variance), for k items.

Weighted summary - method: weighted_summary | level: intro

What it's for. Summarise scores with the design weights you supply, stating the weighting rule.

What you need. the values you want to weigh and the weights you are declaring

Steps. Enter one value per line and one weight per line, in the same order. Declare the kind of weight: frequency, reliability or sampling. Read the weighted mean and the weighted standard deviation. Read the effective sample size: how many unweighted observations your weights are worth.

Rule. Weighted mean = sum(weight x value) / sum(weight); design effect = (n - 1) / (n_effective - 1).

Trend forecast - method: trend_forecast | level: intro

What it's for. Fit a trend to your own series and record the forecast periods and the range the result could fall in.

What you need. a series in period order and the horizon

Steps. Enter the series in order, one value per period. Declare the horizon you want to forecast. Read the trend, the forecast values and the interval. Check the holdout error before trusting the extrapolation.

Rule. Fit y = a + bt to the series; the forecast extends the line and carries a prediction interval.

Limits - what this subject does not do

* It does not design the study, choose the hypothesis or clean the data for you.

* It does not prove causality from observational data.
* It does not replace a statistician for a complex or clustered design.

Charts and diagrams

The Chart window turns typed figures or a data file (CSV, TSV, XLSX, TXT) into a bar, line, pie, scatter, area, candlestick, Pareto, or other chart, or into a diagram (process, matrix, pyramid, funnel, tree, board, journey, WBS) or a project timeline. Before anything is drawn, the reader shows you an "I understood this" table - the points, columns, skipped lines and warnings - so you can correct it first.

What you need. A typed data file with figures in columns, or typed lines in the reader's format. Currency, thousands separators, decimal commas and parentheses for negatives are all accepted.

Rules to remember. A Pareto needs a running total you supply (it is never summed). A scatter needs an x value on every point. A candlestick refuses a high below its low, or an open/close outside the high-low range. A task that ends before it starts is refused.

Diagram labels stay text-only. Write "Marketing mix", not "4Ps".

Limit. A scanned PDF or a file with no figures is refused. The tool reads what you give it; it does not estimate missing figures.

Financial statements tile

The financial statements tile builds statements from a journal or trial balance, checks that they articulate (assets = liabilities + equity; cash movement matches the balance-sheet cash change), and produces depreciation and accrual schedules. The engine reads a trial balance and a transaction narrative with no model at all; you derive the adjustments (depreciation convention, prepaid amortisation, tax).

What you need. A period, a currency, a chart of accounts, opening balances, and dated journal entries (or an imported CSV/TSV/XLSX table). Every entry must keep debits equal to credits.

Limit. It does not file a tax return, apply a jurisdiction's tax law, choose accounting policy, audit figures, or certify statements. It does not invent a missing balance or plug an unbalanced trial balance - it names the equity that would balance it. PDFs and scans are not ingested as data tables.

Learning Guide (File 2)

The Learning Guide is an optional second file that travels with your paper. It is a student-facing explanation of the computation the paper records. File 1 (the paper) is written exactly as before; the guide joins the same download as a separate DOCX.

How it works. The guide quotes the computation record, never the paper's prose. Every figure is a placeholder filled from the record after an automated checker passes; the resolver never changes a number. A rate recorded as 0.075 is printed as 0.075, not rounded to 0.07.

Money. Quote before any model call; charge only when a guide is produced; the first guide of a paper is free; a stored guide for unchanged paper is reused with no second charge. Price: 25 credits.

Failure is free. If the checker or reviewer rejects a guide, File 1 still ships alone, nothing is stored, and no credits are taken.

Export and downloads

One download can bundle the Word document, an Excel workbook (Cover, Summary, Inputs, Working, Results, Notes, Record), a PowerPoint deck (project plans), and - with Chrome - a PDF. Project plans also export a ZIP with Charter, WBS, Schedule, Cost, RACI and Risks sheets.

Export is blocked when the paper is incomplete. The download stays hidden until every required field and block is complete; the refusal names exactly what is missing.

Saved cases. You can reopen a saved case from the case shelf. A case is your own object, not a subject workspace, so the subject mark does not carry into a saved case.

Troubleshooting - what to do when something is refused

Export says "missing ...". The export gate names exactly what is missing. Supply the named field or computation block and try again.

A figure was refused. The core's own message names the problem - wrong input type, an invalid figure, or a figure no selected computation takes. Correct the declared input and re-run.

The Learning Guide did not appear. The box appears only when the paper records a computation. A brief with no solved computation shows no box.

PDF export needs Chrome. Use the Word, Excel or PowerPoint download, or open the file in Chrome to print to PDF.

A scanned PDF will not load as data. Scanned PDFs and SPSS files are refused as data tables. Use CSV, TSV or XLSX for figures; a brief can be read from a PDF's text layer.

Support. Use the Contact us pill in the top bar. It opens a menu of categories plus Help & about. The message is composed in your own mail client (mailto:); the product sends no email and makes no response-time promise.