

## CHAPTER 3

# Core Financial Statements with Claude

تحليل القوائم المالية الثلاث

 Level: Intermediate

### Learning Objectives

- Understand the structure, purpose, and key line items of the three core financial statements
- Build a fully linked 3-statement financial model using Claude, with all inter-statement linkages
- Perform comprehensive ratio analysis across profitability, liquidity, leverage, and efficiency
- Conduct common-size (vertical and horizontal) analysis to identify trends and anomalies
- Apply DuPont decomposition to isolate the drivers of return on equity
- Use cross-validation techniques to ensure model integrity and catch common errors

*DARE Framework Integration: Every prompt in this chapter follows the DARE structure from Chapter 2. The Define step sets the accounting standard and reporting period. The Analyze step specifies which statements and line items to examine. The Request step determines output format (table, JSON, or narrative). The Evaluate step instructs Claude to cross-validate its output against balance sheet identity and cash flow reconciliation.*

## **3.1 The Three Financial Statements: An Overview**

The three core financial statements—the Income Statement, the Balance Sheet, and the Cash Flow Statement—form the foundation of all financial analysis. Together, they provide a complete picture of a company’s financial performance, position, and cash generation. Every financial model, from a simple valuation to a complex LBO, is built on these three statements. Understanding their structure, their individual components, and how they link to each other is a prerequisite for effective AI-augmented financial modeling.

*Source: IFRS Foundation, IAS 1 “Presentation of Financial Statements,” ifrs.org*

### **The Income Statement (Statement of Profit or Loss)**

The Income Statement measures a company’s financial performance over a specific period (quarter, year). It answers the fundamental question: did the company make money during this period? The statement follows a top-down structure, starting with revenue and subtracting costs in a logical sequence to arrive at net income.

Key line items include Revenue (the total value of goods sold or services rendered), Cost of Goods Sold (COGS, the direct costs attributable to production), Gross Profit (Revenue minus COGS), Operating Expenses (SG&A, R&D, and other indirect costs), EBITDA (earnings before interest, taxes, depreciation, and amortization), EBIT (operating income, after D&A), Interest Expense, Tax Expense, and Net Income (the bottom line). Under IFRS, the statement may present expenses by nature (materials, employee costs, depreciation) or by function (COGS, selling, administrative).

The Income Statement is an accrual-based document: it records revenue when earned and expenses when incurred, regardless of when cash changes hands. This distinction between accrual and cash is precisely why the Cash Flow Statement exists.

## The Balance Sheet (Statement of Financial Position)

The Balance Sheet is a snapshot of a company's financial position at a single point in time. It is governed by the fundamental accounting equation:

$$\text{Assets} = \text{Liabilities} + \text{Shareholders' Equity}$$

Assets are divided into Current Assets (cash, accounts receivable, inventory—items expected to be converted to cash within 12 months) and Non-Current Assets (property, plant and equipment, intangible assets, goodwill). Liabilities are similarly divided into Current Liabilities (accounts payable, short-term debt, accrued expenses due within 12 months) and Non-Current Liabilities (long-term debt, deferred tax liabilities, pension obligations). Shareholders' Equity includes common stock, additional paid-in capital, retained earnings, and accumulated other comprehensive income.

*Source: IFRS Foundation, IAS 1 "Presentation of Financial Statements," ifrs.org*

## The Cash Flow Statement

The Cash Flow Statement reconciles the accrual-based Income Statement with actual cash movements during the period. It is divided into three sections, as defined by IAS 7:

**Operating Activities (CFO):** Cash generated from core business operations. Starts with net income and adjusts for non-cash items (D&A, stock-based compensation) and changes in working capital (receivables, inventory, payables).

**Investing Activities (CFI):** Cash used for long-term investments. Includes capital expenditures (CapEx), acquisitions, asset disposals, and purchases or sales of investment securities.

**Financing Activities (CFF):** Cash flows between the company and its capital providers. Includes debt issuance and repayment, equity issuance and buybacks, and dividend payments.

The sum of these three sections equals the net change in cash, which must reconcile with the change in the cash line item on the Balance Sheet between the beginning and end of the period.

*Source: IFRS Foundation, IAS 7 "Statement of Cash Flows," ifrs.org*

## Key Line Items by Statement

<b>Income Statement</b>	<b>Balance Sheet</b>	<b>Cash Flow Statement</b>
<b>Revenue</b>	Cash & Equivalents	Net Income
<b>COGS</b>	Accounts Receivable	D&A (add-back)
<b>Gross Profit</b>	Inventory	$\Delta$ Working Capital
<b>EBITDA</b>	PP&E (net)	CapEx
<b>EBIT / Operating Income</b>	Total Assets	Acquisitions
<b>Interest Expense</b>	Accounts Payable	Debt Issuance / Repayment
<b>Tax Expense</b>	Long-Term Debt	Dividends Paid
<b>Net Income</b>	Retained Earnings	Net Change in Cash

## 3.2 Building a Linked 3-Statement Model with Claude

A linked 3-statement model is the cornerstone of professional financial analysis. In such a model, the three financial statements are connected through a series of linkages that ensure internal consistency. When one assumption changes (e.g., revenue growth), the effect flows through all three statements automatically. Building this model correctly is essential; building it with Claude accelerates the process while maintaining rigor.

*Applying DARE: When building a linked model, the Define step is critical — specify whether the company uses IFRS or GAAP, as this affects lease treatment (IFRS 16 vs. ASC 842) and revenue recognition (IFRS 15 vs. ASC 606), both of which impact all three statements.*

### How the Three Statements Connect

The linkages between the three statements form a closed loop. Understanding these connections is critical for both building and validating financial models:

**Net Income → Retained Earnings → Balance Sheet:** Net Income from the Income Statement flows to Retained Earnings on the Balance Sheet ( $\text{Retained Earnings} = \text{Prior RE} + \text{Net Income} - \text{Dividends}$ ). This is the primary link from the IS to the BS.

**D&A → Cash Flow Statement → Balance Sheet:** Depreciation and Amortization is a non-cash expense on the IS. It is added back in the CFO section and reduces the net book value of PP&E on the BS ( $\text{Ending PP\&E} = \text{Beginning PP\&E} + \text{CapEx} - \text{D\&A}$ ).

**CapEx → Cash Flow Statement → Balance Sheet:** Capital Expenditures appear as a cash outflow in CFI and increase the gross PP&E balance on the BS.

**Debt → Balance Sheet → Cash Flow Statement → Income Statement:** Debt balances on the BS determine Interest Expense on the IS ( $\text{Interest} = \text{Avg Debt} \times \text{Interest Rate}$ ). Debt issuance and repayment flow through CFF. This creates the most common circular reference in financial models.

**Working Capital → Balance Sheet → Cash Flow Statement:** Changes in current assets and current liabilities (AR, Inventory, AP) flow as working capital adjustments in CFO. Increasing AR uses cash; increasing AP generates cash.

**Linkage Cycle: IS (Net Income) → BS (Retained Earnings) → CF (Operating Cash)  
→ BS (Cash Balance) → IS (Interest on Debt) → cycle repeats**

## **Step-by-Step Walkthrough: Using Claude to Build the Model**

The following walkthrough demonstrates how to use **Claude** to construct a fully linked 3-statement model from a set of assumptions. The process follows the CFMF framework: Prepare the inputs, Construct with **Claude**, Validate the output, and Deliver.

### ***[Demonstration Example — Hypothetical Data]***

**Step 1: Define Assumptions:** Establish the core operating assumptions: Revenue, margins, CapEx, D&A, debt structure, tax rate, and working capital days. These inputs drive every line item in the model.

**Step 2: Build the Income Statement:** Start from Revenue and cascade down through COGS, Gross Profit, OpEx, EBITDA, D&A, EBIT, Interest, Taxes, and Net Income. Each line is formula-driven from the assumptions.

**Step 3: Build the Cash Flow Statement:** Begin with Net Income from the IS. Add back non-cash items (D&A). Adjust for working capital changes. Subtract CapEx in CFI. Record debt and dividend flows in CFF.

**Step 4: Build the Balance Sheet:** Use the ending balances from the prior period as starting points. Update PP&E with CapEx and D&A. Update Retained Earnings with Net Income and Dividends. Update Debt for issuance and repayment. Cash is the plug that makes the BS balance.

**Step 5: Validate All Linkages:** Confirm that Total Assets = Total Liabilities + Equity in every period. Confirm that the change in the Cash line on the BS equals the Net Change in Cash from the CF Statement.

## 🗨 Chat — Build a Linked 3-Statement Model

Build a linked 3-statement model with the following assumptions:

Revenue: \$500M in Year 1, growing 8% annually

Gross margin: 40%

Operating expenses: 20% of revenue

Depreciation & Amortization: \$15M per year

Capital Expenditures: \$25M per year

Interest rate: 5% on \$200M of debt (no repayment)

Tax rate: 25%

Dividends: 30% of Net Income

Working capital: AR = 45 days of revenue, Inventory = 60 days of COGS, AP = 30 days of COGS

Project all three statements for 5 years (Year 1 through Year 5).

Show the complete Income Statement, Cash Flow Statement, and Balance Sheet.

For each linkage between statements, add a note explaining how the line item connects.

Use Cash as the balancing plug on the Balance Sheet.

Verify that the Balance Sheet balances in every year.

**Expected Output:** *Three fully populated financial statements for 5 years with linkage annotations. The Balance Sheet should balance (Assets = Liabilities + Equity) in each year. The change in Cash on the BS should equal Net Change in Cash from the CF Statement.*

**Refinement:** *Follow up with: "Now show me a sensitivity table: how does Year 5 Net Income change if revenue growth varies from 4% to 12% in 2% increments?"*

## 🌀 API — 3-Statement Model with JSON Output

```
import anthropic

client = anthropic.Anthropic()

message = client.messages.create(
    model="claude-sonnet-4-20250514",
    max_tokens=4096,
    temperature=0,
    system="You are a financial modeling expert. Output valid JSON only.
```

```
No markdown, no commentary outside the JSON structure.",
  messages=[{"role": "user", "content":
    "Build a linked 3-statement model. Revenue $500M growing 8%/yr,
    Gross margin 40%, OpEx 20% of revenue, D&A $15M, CapEx $25M, Interest 5%
    on $200M debt, Tax 25%, Dividends 30% of NI. Working capital: AR 45 days,
    Inv 60 days, AP 30 days. Return JSON with keys: assumptions{ },
    income_statement[{year, revenue, cogs, gross_profit, opex, ebitda, da,
    ebit, interest, ebt, tax, net_income}], cash_flow[{year, net_income, da,
    wc_change, cfo, capex, cfi, debt_change, dividends, cff,
    net_change_cash}], balance_sheet[{year, cash, ar, inventory, ppe_net,
    total_assets, ap, debt, total_liabilities, retained_earnings,
    total_equity, total_le}], validation{bs_balanced_all_years,
    cash_reconciles}"}]
  )
print(message.content[0].text)
```

**Expected Output:** *Parseable JSON containing all three statements with validation flags confirming the BS balances and cash reconciles in every projected year.*

### 3.3 Ratio Analysis with Claude

Financial ratios distill the information in the three statements into comparable, interpretable metrics. They allow analysts to assess performance, benchmark against peers, and identify trends over time. Ratios are typically grouped into four categories: profitability, liquidity, leverage, and efficiency.

*DARE Application: For ratio analysis, the Evaluate step is especially important — instruct Claude to compare calculated ratios against published industry benchmarks (Damodaran sector data, S&P Capital IQ) and flag any metric that deviates by more than one standard deviation from the sector median.*

*Source: CFA Institute, CFA Program Curriculum Level I, “Financial Reporting and Analysis,” cfainstitute.org*

#### Profitability Ratios

Profitability ratios measure a company’s ability to generate earnings relative to its revenue, assets, or equity. They answer the question: how effectively does the company convert activity into profit?

##### Gross Margin

*Formula:  $\text{Gross Profit} / \text{Revenue}$*

Measures production efficiency and pricing power. Higher margins indicate stronger competitive position or lower input costs.

##### EBITDA Margin

*Formula:  $\text{EBITDA} / \text{Revenue}$*

Measures core operating profitability before the effects of capital structure, tax jurisdiction, and asset age. Widely used for peer comparison.

##### Net Profit Margin

*Formula:  $\text{Net Income} / \text{Revenue}$*

Measures overall profitability after all costs, including interest and taxes. The bottom-line margin.

##### Return on Equity (ROE)

*Formula:  $\text{Net Income} / \text{Average Shareholders' Equity}$*

Measures the return generated on shareholders' investment. The single most watched return metric for equity investors.

### **Return on Assets (ROA)**

*Formula: Net Income / Average Total Assets*

Measures how efficiently the company uses its total asset base to generate profit. Useful for comparing capital-intensive vs. asset-light businesses.

### **Return on Invested Capital (ROIC)**

*Formula: NOPAT / Invested Capital, where NOPAT = EBIT × (1 – Tax Rate) and Invested Capital = Total Equity + Total Debt – Cash*

Measures the return on all capital deployed in the business, regardless of capital structure. The purest measure of operating efficiency.

## **Liquidity Ratios**

Liquidity ratios assess a company's ability to meet its short-term obligations. They answer the question: can the company pay its bills as they come due?

### **Current Ratio**

*Formula: Current Assets / Current Liabilities*

A ratio above 1.0 indicates the company has more current assets than current liabilities. A ratio below 1.0 may signal short-term liquidity risk, though this varies by industry.

### **Quick Ratio (Acid-Test)**

*Formula: (Current Assets – Inventory) / Current Liabilities*

A more conservative liquidity measure that excludes inventory, which may not be easily converted to cash. Particularly important for companies with slow-moving inventory.

## Leverage Ratios

Leverage ratios measure the extent to which a company relies on debt financing and its ability to service that debt. They answer the question: how much financial risk has the company taken on?

### Debt-to-Equity Ratio (D/E)

*Formula: Total Debt / Total Shareholders' Equity*

Measures the proportion of debt versus equity in the capital structure. Higher ratios indicate greater financial leverage and risk.

### Net Debt / EBITDA

*Formula: (Total Debt – Cash) / EBITDA*

Measures how many years of EBITDA it would take to repay net debt. A key covenant metric for lenders. Ratios above 3.0–4.0x are generally considered elevated.

### Interest Coverage Ratio

*Formula: EBIT / Interest Expense*

Measures the company's ability to pay interest from operating income. A ratio below 1.5x signals potential debt service difficulty.

## Efficiency Ratios

Efficiency ratios (also called activity ratios) measure how effectively a company manages its assets and liabilities. They are essential for working capital analysis and supply chain assessment.

### Asset Turnover

*Formula: Revenue / Average Total Assets*

Measures how efficiently the company generates revenue from its asset base. Higher turnover indicates more efficient asset utilization.

### Inventory Turnover

*Formula: COGS / Average Inventory*

Measures how many times inventory is sold and replaced during the period. Higher turnover generally indicates efficient inventory management.

### **Days Sales Outstanding (DSO)**

*Formula:  $(\text{Accounts Receivable} / \text{Revenue}) \times 365$*

Measures the average number of days it takes to collect payment after a sale. Lower DSO indicates faster collection.

### **Days Payable Outstanding (DPO)**

*Formula:  $(\text{Accounts Payable} / \text{COGS}) \times 365$*

Measures the average number of days the company takes to pay its suppliers. Higher DPO preserves cash but may strain supplier relationships.

### **Cash Conversion Cycle (CCC)**

*Formula:  $\text{DSO} + \text{DIO} - \text{DPO}$ , where  $\text{DIO} = (\text{Inventory} / \text{COGS}) \times 365$*

Measures the total number of days from paying for inventory to collecting cash from customers. A shorter CCC indicates more efficient working capital management.

## [Demonstration Example — Hypothetical Data]

### 🗨 Chat — Comprehensive Ratio Analysis

Calculate all key financial ratios from the following data:

Income Statement (FY2024):

Revenue: \$850M | COGS: \$510M | Operating Expenses: \$170M

D&A: \$30M | Interest Expense: \$25M | Tax Rate: 25%

Balance Sheet (FY2024):

Cash: \$80M | AR: \$120M | Inventory: \$95M | PP&E: \$400M | Total Assets: \$750M

AP: \$65M | Short-term Debt: \$50M | Long-term Debt: \$200M

Total Equity: \$380M

Balance Sheet (FY2023 for averages):

Total Assets: \$700M | Total Equity: \$350M | Inventory: \$85M

Calculate and present in a table:

1. Profitability: Gross Margin, EBITDA Margin, Net Margin, ROE, ROA, ROIC
2. Liquidity: Current Ratio, Quick Ratio
3. Leverage: D/E, Net Debt/EBITDA, Interest Coverage
4. Efficiency: Asset Turnover, Inventory Turnover, DSO, DPO, CCC

Show the formula, calculation, and result for each ratio.

Flag any ratio that may indicate a concern.

**Expected Output:** *A structured table with four ratio categories, each showing formula, numerical calculation, result, and a flag/comment for any metric outside normal ranges.*

**Refinement:** *Follow up: "Compare these ratios to typical manufacturing industry benchmarks. Which ratios suggest the company is outperforming or underperforming its peers?"*

### 🌀 API — Ratio Analysis with JSON Output

```
user="Calculate all financial ratios from this data: Revenue $850M, COGS $510M, OpEx $170M, D&A $30M, Interest $25M, Tax 25%. BS: Cash $80M, AR $120M, Inv $95M, PPE $400M, TA $750M, AP $65M, ST Debt $50M, LT Debt $200M, Equity $380M. Prior year: TA $700M, Equity $350M, Inv $85M. Return JSON: {profitability: {gross_margin, ebitda_margin, net_margin, roe, roa,
```

```
roic}, liquidity: {current_ratio, quick_ratio}, leverage: {de_ratio,  
net_debt_ebitda, interest_coverage}, efficiency: {asset_turnover,  
inventory_turnover, dso, dpo, ccc}, flags: [{ratio, value, concern}]}"
```

**Expected Output:** *Parseable JSON with all ratio values and automated flags for any metric outside normal ranges.*

## 3.4 Common-Size Analysis

Common-size analysis transforms raw financial data into percentages, making it possible to compare companies of different sizes and identify trends within a single company over time. There are two primary forms: vertical analysis and horizontal analysis.

### Vertical Analysis

Vertical analysis expresses each line item as a percentage of a base item within the same period. For the Income Statement, the base is Revenue (every line item is expressed as a percentage of Revenue). For the Balance Sheet, the base is Total Assets (every line item is expressed as a percentage of Total Assets).

This approach immediately reveals the cost structure of a business. If COGS is 60% of Revenue, the gross margin is 40%. If SG&A is 15% of Revenue and R&D is 8%, the analyst can quickly see where the company's costs are concentrated and how they compare to peers.

#### *[Demonstration Example — Hypothetical Data]*

Line Item	FY2022 (\$M)	FY2022 (% Rev)	Interpretation
Revenue	500	100.0%	Base
COGS	(300)	60.0%	Cost structure
Gross Profit	200	40.0%	Gross margin
SG&A	(75)	15.0%	Selling & admin costs
R&D	(25)	5.0%	Innovation investment
EBITDA	100	20.0%	Core profitability
Net Income	52	10.4%	Bottom-line margin

### Horizontal Analysis

Horizontal analysis compares each line item across periods, calculating the year-over-year percentage change. This technique reveals growth trends, cost escalation patterns, and potential anomalies. For example, if revenue grows 8% but COGS grows 12%, the

gross margin is contracting—a trend that vertical analysis confirms but horizontal analysis explains.

$$\text{Year-over-Year \% Change} = (\text{Current Period} - \text{Prior Period}) / \text{Prior Period} \times 100$$

When performing horizontal analysis, flag any line item whose year-over-year change deviates by more than 2 percentage points from the overall revenue growth rate. Such deviations signal structural changes in the cost profile that warrant investigation.

### 🗨 Chat — Common-Size Analysis

Perform common-size analysis of this 3-year income statement:

[Demonstration Example – Hypothetical Data]

	FY2022	FY2023	FY2024
Revenue	\$500M	\$540M	\$583M
COGS	(\$300M)	(\$330M)	(\$362M)
Gross Profit	\$200M	\$210M	\$221M
SG&A	(\$75M)	(\$84M)	(\$94M)
R&D	(\$25M)	(\$27M)	(\$29M)
EBITDA	\$100M	\$99M	\$98M
D&A	(\$20M)	(\$22M)	(\$24M)
EBIT	\$80M	\$77M	\$74M
Interest	(\$15M)	(\$18M)	(\$20M)
EBT	\$65M	\$59M	\$54M
Tax (25%)	(\$16M)	(\$15M)	(\$14M)
Net Income	\$49M	\$44M	\$41M

1. Vertical analysis: Express each line as % of revenue for all 3 years
2. Horizontal analysis: Calculate YoY % change for each line item
3. Flag any line item where the YoY % change deviates >2pp from revenue growth
4. Summarize the key trend: is profitability improving or deteriorating, and why?

**Expected Output:** Two tables (vertical and horizontal analysis) with flagged anomalies. A summary paragraph identifying that SG&A is growing faster than revenue (margin compression) while gross margin is also declining slightly, causing EBITDA margin erosion.

**Refinement:** *Follow up: “What specific actions could management take to reverse the EBITDA margin decline?”*

## 3.5 DuPont Decomposition

DuPont analysis breaks down Return on Equity (ROE) into its component drivers, revealing whether a company's ROE is driven by profitability, efficiency, or leverage. This decomposition is one of the most powerful diagnostic tools in financial analysis, and it is named after the DuPont Corporation, which popularized the approach in the 1920s.

### 3-Factor DuPont Decomposition

The classic 3-factor decomposition expresses ROE as the product of three components:

$$\text{ROE} = \text{Net Profit Margin} \times \text{Asset Turnover} \times \text{Equity Multiplier}$$

$$(\text{Net Income} / \text{Revenue}) \times (\text{Revenue} / \text{Average Total Assets}) \times (\text{Average Total Assets} / \text{Average Equity})$$

**Net Profit Margin = Net Income / Revenue:** Measures profitability. How much of each dollar of revenue becomes profit?

**Asset Turnover = Revenue / Average Total Assets:** Measures efficiency. How effectively does the company use its assets to generate revenue?

**Equity Multiplier = Average Total Assets / Average Shareholders' Equity:** Measures leverage. How much of the asset base is funded by debt versus equity? Higher multiplier = more debt.

### 5-Factor DuPont Decomposition

The extended 5-factor decomposition provides even more granular insight by separating the effects of tax policy and capital structure from operating performance:

$$\text{ROE} = \text{Tax Burden} \times \text{Interest Burden} \times \text{Operating Margin} \times \text{Asset Turnover} \times \text{Equity Multiplier}$$

$$(\text{NI/EBT}) \times (\text{EBT/EBIT}) \times (\text{EBIT/Revenue}) \times (\text{Revenue/Avg Assets}) \times (\text{Avg Assets/Avg Equity})$$

**Tax Burden = Net Income / EBT:** Measures the proportion of pre-tax profit retained after taxes. A value of 0.75 means the effective tax rate is 25%.

**Interest Burden = EBT / EBIT:** Measures how much operating income is consumed by interest expense. A value of 1.0 means no interest expense; lower values indicate higher debt costs.

**Operating Margin = EBIT / Revenue:** Measures core operating profitability, independent of tax and capital structure.

**Asset Turnover = Revenue / Average Total Assets:** Same as in the 3-factor model: measures asset utilization efficiency.

**Equity Multiplier = Average Total Assets / Average Equity:** Same as in the 3-factor model: measures financial leverage.

## [Demonstration Example — Hypothetical Data]

### Chat — DuPont Decomposition Analysis

Perform both 3-factor and 5-factor DuPont decomposition for the following company over 2 years:

[Demonstration Example – Hypothetical Data]

FY2023: Revenue \$780M, EBIT \$94M, EBT \$72M, Net Income \$54M

Avg Total Assets: \$1,200M, Avg Equity: \$500M

FY2024: Revenue \$850M, EBIT \$115M, EBT \$90M, Net Income \$68M

Avg Total Assets: \$1,350M, Avg Equity: \$560M

For each year, calculate:

1. 3-Factor DuPont:  $\text{Net Margin} \times \text{Asset Turnover} \times \text{Equity Multiplier} = \text{ROE}$
2. 5-Factor DuPont:  $\text{Tax Burden} \times \text{Interest Burden} \times \text{Op Margin} \times \text{Asset Turnover} \times \text{Leverage} = \text{ROE}$
3. Identify which factor drove the largest change in ROE from FY2023 to FY2024
4. Present results in a comparison table

**Expected Output:** *A table showing each DuPont factor for both years with year-over-year change. A clear identification of the primary ROE driver (e.g., margin improvement vs. leverage increase).*

**Refinement:** *Follow up: “If management wants to increase ROE by 200 basis points without increasing leverage, which factor should they focus on and what specific improvements would be needed?”*

### API — DuPont Analysis with JSON Output

```
user="Perform 3-factor and 5-factor DuPont for FY2023 and FY2024. FY2023: Rev $780M, EBIT $94M, EBT $72M, NI $54M, Avg TA $1200M, Avg Eq $500M. FY2024: Rev $850M, EBIT $115M, EBT $90M, NI $68M, Avg TA $1350M, Avg Eq $560M. Return JSON: {fy2023: {three_factor: {net_margin, asset_turnover, equity_multiplier, roe}, five_factor: {tax_burden, interest_burden, op_margin, asset_turnover, equity_multiplier, roe}}, fy2024: {same structure}, yoy_change: {each factor delta}, primary_driver: string, recommendation: string}"
```

**Expected Output:** *Structured JSON with both decompositions, year-over-year deltas, and an identified primary driver.*

## 3.6 Cross-Validation Techniques

Cross-validation is the process of verifying that a financial model is internally consistent and that its outputs are reasonable. In a linked 3-statement model, errors in one statement can cascade through the entire model. A rigorous validation process catches these errors before they reach a client deliverable or investment decision.

*The DARE Evaluate Step in Practice: Cross-validation is the Evaluate component of DARE applied systematically. Every model built with Claude should end with an explicit validation prompt that checks balance sheet identity, cash flow reconciliation, and ratio reasonableness.*

### The Validation Checklist

Every 3-statement model should pass the following validation checks before being considered complete:

**Balance Sheet Balance:** Total Assets = Total Liabilities + Shareholders' Equity in every period. This is the most fundamental check. If the BS does not balance, there is a structural error in the model.

**Cash Flow Reconciliation:** The Net Change in Cash from the Cash Flow Statement must equal the change in the Cash line on the Balance Sheet (Ending Cash – Beginning Cash = Net Change in Cash).

**Retained Earnings Continuity:** Ending Retained Earnings = Beginning RE + Net Income – Dividends. This check confirms the IS-to-BS linkage.

**PP&E Roll-Forward:** Ending PP&E = Beginning PP&E + CapEx – D&A (– Disposals). This confirms the CF-to-BS linkage for fixed assets.

**Debt Roll-Forward:** Ending Debt = Beginning Debt + New Issuance – Repayments. This confirms the CFF-to-BS linkage.

**Interest Expense Reasonability:** Interest Expense should approximately equal Average Debt × Interest Rate. A significant deviation suggests a formula error.

**Growth Rate Reasonability:** Revenue growth should be compared to historical rates and industry averages. Projected growth significantly above GDP growth for mature companies should be flagged.

**Margin Trajectory:** Margins should follow logical patterns. Sudden jumps or drops without a structural explanation (acquisition, divestiture) indicate a modeling error.

## Claude Self-Check Prompt

One of **Claude**'s most valuable capabilities is its ability to review and validate its own output. By providing a structured validation request, you can have **Claude** perform many of the checks that a senior analyst would perform during a peer review.

### Chat — Comprehensive Model Validation

Review the 3-statement model you just built and perform the following validation checks. Present results in a table with columns: Check | Status (Pass/Fail/Warning) | Details.

1. Balance Sheet Balance: Does  $\text{Total Assets} = \text{Total Liabilities} + \text{Equity}$  in every year?
2. Cash Reconciliation: Does the change in Cash on the BS equal Net Change in Cash from the CFS?
3. Retained Earnings: Does  $\text{Ending RE} = \text{Beginning RE} + \text{Net Income} - \text{Dividends}$  in every year?
4. PP&E Roll-Forward: Does  $\text{Ending PP\&E} = \text{Beginning PP\&E} + \text{CapEx} - \text{D\&A}$ ?
5. Debt Roll-Forward: Does  $\text{Ending Debt} = \text{Beginning Debt} + \text{Issuance} - \text{Repayments}$ ?
6. Interest Check: Does  $\text{Interest Expense} \approx \text{Average Debt Balance} \times \text{Stated Rate}$ ?
7. Growth Rates: Are revenue growth rates between 0% and 20% (flag if outside)?
8. Margin Logic: Are margins stable or trending logically? Flag abrupt changes >3pp.

If any check fails, identify the root cause and suggest the specific fix.

**Expected Output:** *A validation table with 8 rows showing pass/fail status. For any failures, a specific explanation of the error and a recommended correction.*

**Refinement:** *If any check fails, follow up: "Fix [specific issue] and regenerate only the affected statement(s). Then re-run validation to confirm the fix."*

## Common Errors and How to Fix Them

### Error: Balance Sheet Does Not Balance

**Cause:** The most common cause is a missing linkage—typically the cash plug is not properly configured, or retained earnings is not updating from net income. Another frequent cause is an asset or liability that is hardcoded rather than formula-driven.

**Fix:** Verify that  $\text{Cash} = \text{Prior Cash} + \text{Net Change in Cash (from CFS)}$ . Verify that  $\text{Retained Earnings} = \text{Prior RE} + \text{Net Income} - \text{Dividends}$ . Ensure no line items are hardcoded.

### Error: Circular Reference in Interest Expense

**Cause:** Interest expense depends on debt balance, which depends on cash flow (after interest), which depends on interest expense. This is the most common circular reference in financial modeling. In Excel, this requires iterative calculation enabled. In Claude, this requires explicit instructions to break the circularity.

**Fix:** Use beginning-of-period debt balance (not average) for interest calculation, or instruct Claude to use an iterative approach: calculate interest on prior-period debt, then adjust if the resulting debt balance changes materially.

### Error: Working Capital Signs Reversed

**Cause:** An increase in Accounts Receivable uses cash (negative in CFO), but it is sometimes incorrectly entered as positive. Similarly, an increase in Accounts Payable generates cash (positive in CFO) but may be reversed.

**Fix:** Establish a clear sign convention: on the CFS, an increase in a current asset is a cash outflow (negative), and an increase in a current liability is a cash inflow (positive). Instruct Claude to state its sign convention explicitly.

### Error: Tax Expense Not Linked to EBT

**Cause:** Tax expense should equal  $\text{EBT} \times \text{Tax Rate}$ . A common error is using a fixed tax amount rather than a formula-driven calculation, causing tax to remain constant even as EBT changes.

**Fix:** Ensure  $\text{Tax} = \text{EBT} \times \text{Tax Rate}$ . If EBT is negative, tax should be zero (or a tax benefit, depending on the model's assumptions). Instruct Claude to handle negative EBT cases.

### Chat — Error Diagnosis and Correction

My 3-statement model has the following issue: the Balance Sheet does not balance in Year 3. Total Assets are \$1,250M but Total Liabilities + Equity is \$1,237M (difference of \$13M).

The model assumptions are:

- Revenue growing 8% annually from \$500M base
- CapEx \$25M/year, D&A \$15M/year
- Debt constant at \$200M, interest rate 5%
- Tax rate 25%, Dividends 30% of NI
- Working capital: AR 45 days, Inventory 60 days, AP 30 days

Diagnose the \$13M imbalance. Walk through each BS line item to identify where the error originates. Then provide the corrected Year 3 Balance Sheet.

**Expected Output:** *A step-by-step diagnostic tracing the \$13M difference to a specific line item (likely a working capital calculation error or a missing cash plug adjustment). A corrected Balance Sheet that balances.*

**Refinement:** *Follow up: "Now re-validate all 5 years to confirm the fix did not introduce new errors in other periods."*

## Key Takeaways

- The three financial statements—Income Statement, Balance Sheet, and Cash Flow Statement—are interconnected through linkages that must remain consistent in any financial model.
- In a linked 3-statement model, Net Income flows to Retained Earnings (IS→BS), D&A and CapEx flow through the Cash Flow Statement to PP&E (CF→BS), and Debt drives Interest Expense (BS→IS), creating a closed loop.
- Financial ratios across four categories—profitability, liquidity, leverage, and efficiency—provide a comprehensive diagnostic toolkit. Every ratio must use the textbook-accurate formula.
- Common-size analysis (vertical and horizontal) reveals cost structure and trend patterns that raw dollar amounts obscure. Flag any line item whose growth deviates more than 2pp from revenue growth.
- DuPont decomposition (3-factor and 5-factor) identifies whether ROE is driven by margin, efficiency, or leverage—critical for diagnosing the quality of a company's returns.
- Cross-validation is non-negotiable: the Balance Sheet must balance, cash must reconcile, and all roll-forwards (RE, PP&E, Debt) must tie. Claude can perform these checks, but the analyst must verify the results.
- The most common modeling errors—unbalanced BS, circular interest references, reversed working capital signs—can be systematically diagnosed and corrected using structured prompts.

## تحليل القوائم المالية الثلاث

Income Statement — قائمة الدخل

Balance Sheet — الميزانية العمومية

Cash Flow Statement — قائمة التدفقات النقدية

Revenue — الإيرادات

Cost of Goods Sold (COGS) — تكلفة البضائع المباعة

Gross Profit — الربح الإجمالي

EBITDA — الأرباح قبل الفوائد والضرائب والإهلاك

Net Income — صافي الدخل

Retained Earnings — الأرباح المحتجزة

Depreciation & Amortization — الإهلاك والإطفاء

Capital Expenditures (CapEx) — النفقات الرأسمالية

Working Capital — رأس المال العامل

Current Ratio — نسبة التداول

Quick Ratio — نسبة السيولة السريعة

Debt-to-Equity Ratio — نسبة الدين إلى حقوق الملكية

Return on Equity (ROE) — العائد على حقوق الملكية

Return on Invested Capital (ROIC) — العائد على رأس المال المستثمر

DuPont Analysis — تحليل ديوبون

Common-Size Analysis — التحليل النسبي (الحجم الموحد)

Cross-Validation — التحقق المتقاطع

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