

FA Module 7: Financial analysis techniques – practice problems

(The attached PDF file has better formatting.)

Exercise 7.1: Turnover ratios

A firm's financial statements show

	<i>Calendar Year 20X1</i>	<i>Calendar Year 20X2</i>
Net revenue	520	540
Cost of goods sold	220	260
Net income	120	100
	<i>December 31, 20X1</i>	<i>December 31, 20X2</i>
Accounts receivable	55	65
Inventory	125	135
Accounts payable	50	58

All purchases and sales are on credit.

- A. What is the receivables turnover in 20X2?
- B. What is the number of days of sales outstanding (DSO) in 20X2?
- C. What is the inventory turnover in 20X2?
- D. What is the number of days of inventory on hand (DOH) in 20X2?
- E. What is the payables turnover in 20X2?
- F. What is the number of days of payables in 20X2?
- G. What is the cash conversion cycle in 20X2?

Part A: The problem says all sales are on credit, so net revenue = credit sales.

$$\text{Receivables turnover} = \text{net revenue} / \text{average receivables} = 540 / ((55 + 65) / 2) = 9.00$$

Part B: The number of days of sales outstanding (DSO) = $365 / 9 = 40.5556$

Part C: Inventory turnover = cost of goods sold / average inventory = $260 / ((125 + 135) / 2) = 2.00$

Part D: The number of days of inventory on hand (DOH) = $365 / 2 = 182.50$

Part E: The payables turnover is purchases divided by average accounts payable. We derive purchases from the cost of goods sold and the inventory at the beginning and end of the year.

The cost of goods sold is 260, and the inventory increased by $65 - 55 = 10$, so the purchases were $260 + 10 = 270$. The payables turnover is $270 / ((50 + 58) / 2) = 5.00$

Part F: The number of days of payables is $365 / 5 = 73.00$

Part G: The cash conversion cycle is

$$\begin{aligned} & \text{days sales outstanding} \\ + & \text{days inventory on hand} \\ - & \text{days of payables} \end{aligned}$$

$$= 40.5556 + 182.50 - 73 = 150.06$$

Exercise 7.2: Turnover ratios

A firm's financial statements show

	<i>Calendar Year 20X1</i>	<i>Calendar Year 20X2</i>
Cost of goods sold	220	260
General expenses	140	120
Depreciation expenses	62	66
Interest expenses	20	20
Tax expense	81	84
	<i>December 31, 20X1</i>	<i>December 31, 20X2</i>
Accounts receivable	55	65
Inventory	125	135
Accounts payable	50	58
Cash	20	30
Marketable securities	60	50
Deferred revenue	42	44

- What are the cash expenses the firm had in 20X2 that must be paid even if it is financially troubled?
- What are daily cash expenditures?
- What are the average quick assets in 20X2?
- What is the defensive interval ratio in 20X2?

Part A: The firm's pre-tax cash expenses in 20X2 are $260 + 120 + 20 = 400$.

Depreciation is a non-cash expense. The firm needs cash to replace fixed assets as they wear out, but this need is a long-term consideration, not a short term liquidity need.

Taxes are not included in liquidity ratios. If the firm does not have the money to pay its expenses, it probably has negative income (or very low income) and is not paying taxes.

Part B: The daily cash expenditures are $400 / 365 = 1.0959$

Part C: The firm's average quick assets for 20X2 are

$$(55 + 65) / 2 + (20 + 30) / 2 + (60 + 50) / 2 = 140.00$$

Question: Why do we use quick assets instead of current assets?

Answer: The defensive interval ratio evaluates whether the firm has the money to pay cash expenses even if it is financially distressed. If it is distressed, its sales may be zero or low, and it is not converting inventory into cash.

Part D: The defensive interval ratio is the quick assets divided by daily cash expenditures =

$$140 / 1.0959 = 127.7489 \approx 128 \text{ days.}$$

Question: Why do we use calendar days instead of business days?

Answer: Actuaries work during business days only. Banks and many professionals work similar hours. But the world does not close down on weekends. Supermarkets, restaurants, many retail stores, transportation firms, and leisure firms are open on weekends

Exercise 7.3: Accounts receivable

- In 20X1, a firm has credit sales of 300 and days of sales outstanding = 25 days.
- In 20X2, a firm has credit sales of 400 and days of sales outstanding = 20 days.
- On December 31, 20X0, accounts receivable are 18.

- A. What is the receivables turnover for 20X1?
- B. What are accounts receivable on December 31, 20X1?
- C. What is the receivables turnover for 20X2?
- D. What are accounts receivable on December 31, 20X2?

Part A: Days of sales outstanding = days in the year / receivables turnover \Rightarrow

Receivables turnover = days in the year / days of sales outstanding = $365 / 25 = 14.6000$.

Question: Do we always use days in the year? When should we use days in the quarter?

Answer: We use days in the accounting period. If the problem uses annual periods, such as 20X1 and 20X2, use 365 days. If the problem uses quarters of a year, such as "first quarter of 20X1," use the number of days in the quarter.

Part B: Receivables turnover = credit sales / average accounts receivable \Rightarrow

average accounts receivable = credit sales / receivables turnover = $300 / 14.6 = 20.5479$

Accounts receivable are 18 at the beginning of the year, so they are $2 \times 20.5479 - 18 = 23.0958$ at the end of the year.

Part C: Days of sales outstanding = days in the year / receivables turnover \Rightarrow

Receivables turnover = days in the year / days of sales outstanding = $365 / 20 = 18.2500$

Part D: Receivables turnover = credit sales / average accounts receivable \Rightarrow

average accounts receivable = credit sales / receivables turnover = $400 / 18.25 = 21.9178$

Accounts receivable are 23.0958 at the beginning of the year, so they are $2 \times 21.9178 - 23.0958 = 20.7398$ at the end of the year.

We verify the figures. Accounts receivable are

- December 31, 20X0: 18
- December 31, 20X1: 23.0958
- December 31, 20X2: 20.7398

Average accounts receivable are

- 20X1: $(18 + 23.0958) / 2 = 20.5479$
- 20X2: $(23.0958 + 20.7398) / 2 = 21.9178$

The receivables turnover ratios are

- 20X1: $300 / 20.5479 = 14.6000$
- 20X2: $400 / 21.9178 = 18.2500$

The days of sales outstanding are

- 20X1: $365 / 14.6 = 25.0000$
- 20X2: $365 / 18.25 = 20.0000$

Exercise 7.4: Interest coverage and fixed charge coverage ratios

A firm's financial statements show

	<i>Calendar Year 20X1</i>	<i>Calendar Year 20X2</i>
Net revenue	520	540
Cost of goods sold	220	260
Lease expense	8	10
Interest expense	12	16
Tax expense	10	14
Net income	100	120
	<i>December 31, 20X1</i>	<i>December 31, 20X2</i>
Long-term debt	255	235
Shareholders' equity	465	485
Accrued interest	2	3

- A. What are earnings before interest and taxes for 20X2?
- B. What is the interest coverage ratio for 20X2?
- C. What is the fixed charge coverage ratio for 20X2?
- D. If the firm had issued 80 more debt at a 7.5% coupon rate on January 1, 20X2, and bought back 80 of common stock, what would its interest coverage ratio have been in 20X2?

Part A: Earnings before interest and taxes (EBIT) = net income + interest expense + tax expense =
 $120 + 16 + 14 = 150$.

Part B: The interest coverage ratio is $\text{EBIT} / \text{interest expense} = 150 / 16 = 9.3750$.

Part C: The fixed charge coverage ratio is $(\text{EBIT} + \text{lease expenses}) / (\text{interest and lease expenses}) =$
 $(150 + 10) / (16 + 10) = 6.1538$

Part D: EBIT would have remained 150, and interest expense would have been $7.5\% \times 80 = 6.00$ higher. The interest coverage ratio would have been $150 / (16 + 6) = 6.8182$.

Question: Why do we add tax expense, interest expense, and lease expense to net income for the numerator?

Answer: The ratios test whether the firm has enough money to pay interest expense and lease expenses. Interest expense and lease expenses are tax deductible, so we use income before the firm pays interest, lease, and tax expenses.

Question: Why not use shareholders' equity divided by interest expense and lease expenses?

Answer: Shareholders' equity is the value of the firm's net assets, not the cash held by the firm. If the firm must sell its assets to pay interest expense, it has a cash flow problem, which this ratio tests.

Exercise 7.5: Interest coverage and fixed charge coverage ratios

In 20X2, a firm has

- an effective tax rate of 20%
- an interest coverage ratio of 5
- a fixed charge coverage ratio of 4
- net income of 100.

- A. What is the firm's tax expense in 20X2?
B. What is the firm's interest expense in 20X2?
C. What are the firm's other fixed charges in 20X2?

Part A: The effective tax rate = $1 - \text{net income} / \text{pre-tax income} \Rightarrow$

$\text{net income} / (\text{net income} + \text{tax expense}) = 1 - \text{effective tax rate} \Rightarrow$

$\text{tax expense} = \text{net income} / (1 - \text{effective tax rate}) - \text{net income} = 100 / (1 - 0.20) - 100 = 25.00.$

Part B: $\text{EBIT} = \text{net income} + \text{tax expense} + \text{interest expense} \Rightarrow$

$(125 + \text{interest expense}) / \text{interest expense} = 5 \Rightarrow$

$4 \times \text{interest expense} = 125 \Rightarrow$

$\text{interest expense} = 125 / 4 = 31.25$

We verify: $(125 + 31.25) / 31.25 = 5.00$

Part C: We add other fixed charges (mostly lease expenses) to the numerator and denominator:

$(125 + \text{interest expense} + \text{other fixed charges}) / (\text{interest expense} + \text{other fixed charges}) = 4$

$\Rightarrow 4 \times (\text{interest expense} + \text{other fixed charges}) = 125 + \text{interest expense} + \text{other fixed charges}$

$\Rightarrow 4 \times (31.25 + \text{other fixed charged}) = 125 + 31.25 + \text{other fixed charges}$

$\Rightarrow 3 \times \text{other fixed charges} = 125 + 31.25 - 4 \times 31.25$

$\Rightarrow \text{other fixed charges} = (125 + 31.25 - 4 \times 31.25) / 3 = 10.4167$

We verify: $(125 + 31.25 + 10.4167) / (31.25 + 10.4167) = 4.00$

Exercise 7.6: DuPont analysis

A firm has

- an effective tax rate of 20%
- an interest coverage ratio of 4
- an EBIT margin of 40%
- total asset turnover of 0.4
- financial leverage of 2

- A. What is the firm's tax burden?
- B. What is the firm's interest burden?
- C. What is the firm's net income margin?
- D. What is the firm's return on assets?
- E. What is the firm's return on equity?

Solution 7.6: $ROE = \text{tax burden} \times \text{interest burden} \times \text{EBIT margin} \times \text{total asset turnover} \times \text{leverage}$, or

$$\begin{aligned} & \text{net income} / \text{EBT} \\ \times & \text{EBT} / \text{EBIT} \\ \times & \text{EBIT} / \text{revenue} \\ \times & \text{revenue} / \text{average total assets} \\ \times & \text{average total assets} / \text{average shareholders' equity} \\ = & \text{net income} / \text{average shareholders' equity} \end{aligned}$$

Part A: The tax burden is $\text{net income} / \text{earnings before tax}$, and the effective tax rate is $1 - \text{net income} / \text{earnings before tax}$, so the tax burden $= 1 - \text{the effective tax rate} = 1 - 20\% = 80\%$.

The tax burden is the percentage of earnings before tax remaining after tax $= 1 - \text{the effective tax rate}$.

Part B: The interest coverage ratio is $\text{EBIT} / \text{interest expense}$. The interest burden $= \text{EBT} / \text{EBIT} =$

$$(\text{EBIT} - \text{interest expense}) / \text{EBIT} = 1 - 1 / \text{interest coverage ratio} = 1 - 1 / 4 = 75\%.$$

The interest burden is the percentage of EBIT remaining after interest expense.

Part C: The net income margin $= \text{the EBIT margin} \times \text{the interest burden} \times \text{the tax burden}$

$$= 40\% \times 75\% \times 80\% = 24.00\%$$

To verify these figures, suppose net revenue is 100.

- $\text{EBIT} = 100 \times 40\% = 40$.
- $\text{EBT} = 40 \times 75\% = 30$, so interest expense $= 10$.
- The interest coverage ratio $= 40 / 10 = 4$.
- The effective tax rate is 20%, so tax expense $= 30 \times 20\% = 6$, and net income $= 30 - 6 = 24$.

Part D: Total assets $= \text{net revenue} / \text{the turnover ratio}$, so

$$\text{the return on assets} = \text{the net income margin} \times \text{the turnover ratio} = 24\% \times 0.4 = 9.60\%$$

Part E: The return on equity $= \text{the return on assets} \times \text{the financial leverage ratio} = 9.6\% \times 2 = 19.20\%$.

To verify the figures, suppose shareholders' equity $= 100$.

- Total assets = $100 \times 2 = 200$
- Net revenue = $200 \times 0.4 = 80$
- EBIT = $80 \times 40\% = 32.00$
- EBT = $32 \times 75\% = 24.00$
- Net income = $24 \times (1 - 20\%) = 19.20$
- Return on equity = $19.20 / 100 = 19.20\%$

Exercise 7.7: Sustainable growth rate

A firm has 100 common shares outstanding and 25 preferred shares outstanding, with market values of 20 per common share and 5 per preferred share on December 31, 20X2.

In 20X2, a firm has net income of 300, ROE of 15%, and it pays dividends of 1 per common share and 2 per preferred share.

- A. What is the net income attributable to common shareholders in 20X2?
- B. What is the dividend payout ratio in 20X2?
- C. What is the dividend retention rate in 20X2?
- D. What is the sustainable growth rate in 20X2?

Part A: Preferred dividends take precedence over common dividends. Preferred dividends are contractual and often cumulative, and they must be paid before dividends on common share are paid.

- The 20X2 dividends on preferred shares are $2 \times 25 = 50$ in this practice problem.
- The net income attributable to common shares is $300 - 50 = 250$.

Question: What does cumulative mean with regard to preferred dividends?

Answer: If the preferred dividends were not paid 20X2, the firm must pay in 20X3 the preferred dividends for both 20X2 and 20X3 before it can pay common dividends.

Question: Debt takes precedence over both preferred dividends and common dividends. Why don't we subtract interest expense as well?

Answer: Interest expense is subtracted from EBIT to get earnings before tax; tax expense is then subtracted to get net income. Preferred dividends and common dividends are included in net income.

Part B: The dividend payout ratio is common share dividends / net income attributable to common shares

$$= (1 \times 100) / (300 - 2 \times 25) = 0.4000.$$

The net income attributable to common shares is net income – preferred dividends.

Part C: The retention rate = $1 - \text{dividend payout ratio} = 1 - 0.40 = 0.60$

Part D: The sustainable growth rate = the retention rate \times ROE = $0.60 \times 15\% = 9\%$.

Exercise 7.8: Debt-to-equity ratio

In 20X1, a financial analyst is preparing pro-forma financial statements for 20X2:

- With no changes in debt or shares, the expected debt-to-equity ratio = 2.0 and the expected return on equity = 10%.
 - If the firm issues 100 of additional debt at 8% coupon rates on December 31, 20X1, and repurchases 100 of stock on the same day, the expected return on equity = 12%.
- A. With no changes in debt or shares, what is the expected net income in 20X2?
B. With the additional debt, what is the expected net income in 20X2?
C. With the additional debt, what is the expected shareholders' equity in 20X2?
D. With no changes in debt or shares, what is the expected shareholders' equity in 20X2?
E. With no changes in debt or shares, what is the expected debt in 20X2?
F. With the additional debt, what is expected debt-to-equity ratio?

Solution 7.8: Let Eq = shareholders' equity next year with no changes in debt or shares. We first solve the exercise in terms of Eq and then solve for Eq at the end.

Part A: Return on equity = net income / shareholders' equity \Rightarrow net income = return on equity \times shareholders' equity = $10\% \times Eq$

Part B: The firm issues debt and buys back shares; its total capital and its operating activities do not change. Net income includes interest expense but not dividends to shareholders, so net income decreases by the new debt costs, which are $8\% \times 100 = 8$. The net income with the additional debt = $10\% \times Eq - 8$.

Part C: The shareholders' equity in this practice problem decreases by the amount of the additional debt, so the revised shareholders' equity = $Eq - 100$.

Part D: The expected return on equity with the additional debt is 12% \Rightarrow

$$(10\% \times Eq - 8) / (Eq - 100) = 12\% \Rightarrow$$

$$0.10 \times Eq - 8 = 0.12 \times (Eq - 100) \Rightarrow$$

$$12 - 8 = 0.02 \times Eq \Rightarrow Eq = 4 / 0.02 = 200$$

Part E: The debt-to-equity ratio with no additional debt is 2.0, so the debt = $2.0 \times 200 = 400$.

Part F: With the additional debt and repurchase of shares:

- debt = $400 + 100 = 500$
- shareholders' equity = $200 - 100 = 100$

The revised debt-to-equity ratio is $500 / 100 = 5.0$

Question: Common shares on the balance sheet are reported at book values, not market values. The market value of a share differs greatly from the book value on the balance sheet. Yet this practice problem adjusts shareholders' equity by the market value of the shares sold.

Answer: The book value of common shares equals the market value on the date of sale or repurchase. The market value then changes as the stock price changes; the book value remains fixed.

Question: The common share has a price listed on it (often one dollar in the United States) which is not the market price even on the date of sale.

Answer: The price listed on the share is the par value. The book value is the par value plus the additional paid-in capital, which is the sale price minus the par value.

Question: Suppose a firm sells 100 shares in 20X0 with par values of 1 and sales prices of 5, and rebuys 20 shares in 20X6 when the market price is 10. How are these transactions reported on the balance sheet?

Answer: The balance sheet entries for 20X0 are

- credit common stock 100
- credit additional paid-in capital 400
- debit cash 500

The balance sheet entries for 20X6 are equivalent to

- debit common stock 20
- debit additional paid-in capital 180
- credit cash 200

The repurchase of shares is shown as an addition to Treasury stock, not as a decrease in common stock. Treasury stock is a contra-equity, so increasing Treasury stock is the same as decreasing common stock. The shares repurchased by the firm are no longer outstanding, but they are still authorized, so we do not decrease the number of shares.

Exercise 7.9: Financial ratios

A firm's current assets are cash, marketable securities, accounts receivable, and inventory.

All balance sheet entries are the same at the beginning and at the end of the year and all sales are on credit.

- Cash and marketable securities = 6
- Non-current assets = 90
- Total liabilities = 40
- Shareholders' equity = 140
- Net revenue = 420

Financial ratios are

- Current ratio = 2.50
 - Quick ratio = 1.00
 - Gross profit margin = 30%
- A. What are total assets on the balance sheet?
B. What are current assets on the balance sheet?
C. What are current liabilities on the balance sheet?
D. What are quick assets on the balance sheet?
E. What is inventory during the year?
F. What is the cost of goods sold?
G. What is the inventory turnover ratio?
H. What is the days of inventory on hand?
I. What are accounts receivable on the balance sheet?
J. What is the receivables turnover ratio?
K. What is the days of sales outstanding?

Part A: Total assets = total liabilities + shareholders' equity = $140 + 40 = 180$.

Part B: Current assets = total assets – non-current assets = $180 - 90 = 90$.

Part C: Current ratio = current assets / current liabilities \Rightarrow

$$2.5 = 90 / \text{Current liabilities} \Rightarrow \\ \text{Current liabilities} = 36$$

Part D: The quick ratio = quick assets / current liabilities = 1.00 \Rightarrow quick assets = current liabilities = 36

Part E: In this practice problem, the only current asset that is not a quick asset is inventory, so

$$\text{Inventory} = 90 - 36 = 54$$

Part F: The net profit margin = $1 - \text{cost of goods sold} / \text{net revenue} \Rightarrow$

$$30\% = 1 - \text{cost of goods sold} / 420 \Rightarrow \\ \text{cost of goods sold} = (1 - 30\%) \times 420 = 294$$

Part G: The inventory turnover ratio = cost of goods sold / average inventory = $294 / 54 = 5.4444$

Part H: Days of inventory on hand = days in accounting period / inventory turnover ratio

$$= 365 / (294 / 54) = 67.0408$$

Part I: Accounts receivable = Quick current assets – (cash + marketable securities) = 36 – 6 = 30

Part J: Receivables turnover = net credit sales / average accounts receivable = 420 / 30 = 14

Part K: Days of sales outstanding = days in accounting period / receivables turnover ratio = 365 / 14 = 26.0714

Exercise 7.10: Liquidity ratios

On December 30, 20X1, a firm has net working capital of 300, a current ratio of 2.50, a quick ratio of 1.50, and a cash ratio of 1.00.

On December 31, 20X1, the firm sells for 100 (on credit) goods with inventory value of 50, buys new inventory for 40 (on credit), collects an account receivable of 20, pays an account payable of 30, pays accrued interest of 10, and borrows 60 from a bank for 90 days.

On December 30, 20X1:

- A. What are the current liabilities and the current assets?
- B. What are the quick assets?
- C. What is the inventory?
- D. What are cash and marketable securities?
- E. What are the accounts receivable?
- F. What are the accounting entries for the transactions on December 31?

On December 31, 20X1:

- G. What is the firm's net working capital?
- H. What is the firm's current ratio?
- I. What is the firm's quick ratio?
- J. What is the firm's cash ratio?

Part A: We work out the firm's current assets and liabilities on December 30.

Let Z = current liabilities. The net working capital is 300, so current assets = $Z + 300$. The current ratio is 2.50, so $(Z + 300) / Z = 2.50 \Rightarrow Z = 300 / (2.50 - 1) = 200$

- current liabilities = $Z = 200$.
- current assets = $Z + 300 = 500$.

Part B: The quick ratio = 1.50, so quick assets = $1.50 \times 200 = 300$.

Part C: Inventory = current assets – quick assets = 200.

Part D: The cash ratio = 1.00, so cash + marketable securities = $1.00 \times 200 = 200$.

Part E: Accounts receivable = quick assets – cash + marketable securities = $300 - 200 = 100$.

The accounting entries for the transactions on December 31 are

- A) sell for 100 (on credit) goods with inventory value of 50
 - debit accounts receivable (current asset) 100
 - credit inventory (current asset) 50
 - credit net revenue (income statement) 100
 - debit cost of goods sold (income statement) 50
- B) buy new inventory for 40 (on credit)
 - credit accounts payable (current liability) 40
 - debit inventory (current asset) 40
- C) collect an account receivable of 20
 - credit accounts receivable (current asset) 20
 - debit cash (current asset) 20
- D) pay an account payable of 30

- credit cash (current asset) 30
- debit accounts payable (current liability) 30
- E) pay accrued interest of 10
 - credit cash (current asset) 10
 - debit accrued interest (current liability) 10
- F) borrow 60 from a bank for 90 days.
 - debit cash (current asset) 60
 - credit short term loan (current liability) 10

These changes are

	<i>cash</i>	<i>accounts receivable</i>	<i>inventory</i>	<i>current liabilities</i>
	200	100	200	200
A		100	-50	
B			40	40
C	20	-20		
D	-30			-30
E	-10			-10
F	60			60
tot	240	180	190	260

Part G: Net working capital is $240 + 180 + 190 - 260 = 350$.

Part H: The current ratio is $(240 + 180 + 190) / 260 = 2.3462$

Part I: The quick ratio is $(240 + 180) / 260 = 1.6154$

Part J: The cash ratio is $240 / 260 = 0.9231$