Answers to Warm-Up Exercises

- E13-1. Breakeven analysis
- **Answer:** The operating breakeven point is the level of sales at which all fixed and variable operating costs are covered and EBIT is equal to \$0.

 $Q = FC \div (P - VC)$

Q =\$12,500 ÷ (\$25 - \$10) = 833.33, or 834 units

- E13-2. Changing costs and the operating breakeven point
- **Answer:** Calculate the breakeven point for the current process and the breakeven point for the new process, and compare the two.

Current breakeven: $Q_1 = \$15,000 \div (\$6.00 - \$2.50) = 4,286$ boxes

New breakeven:
$$Q_2 = \$16,500 \div (\$6.50 - \$2.50) = 4,125$$
 boxes

If Great Fish Taco Corporation makes the investment, it can lower its breakeven point by 161 boxes.

E13-3. Risk-adjusted discount rates

Answer: Use Equation 13.5 to find the DOL at 15,000 units.

Q = 15,000 P = \$20 VC = \$12FC = \$30,000

DOL at 15,000 units =
$$\frac{15,000 \times (\$20 - \$12)}{15,000 \times (\$20 - \$12) - \$30,000} = \frac{\$120,000}{\$90,000} = 1.33$$

- E13-4. DFL
- Answer: Substitute EBIT = 20,000, I = 3,000, PD = 4,000, and the tax rate (T = 0.38) into Equation 12.7.

DFL at \$20,000 EBIT = $\frac{\$20,000}{\$20,000 - \$3,000 - [\$4,000 \times (1 \div (1 - 0.38)]]}$ $= \frac{\$20,000}{\$10,548} = 1.90$

- E13-5. Net operating profits after taxes (NOPAT)
- **Answer:** Calculate EBIT, then NOPAT and the weighted average cost of capital (WACC) for Cobalt Industries.

EBIT = $(150,000 \times \$10) - \$250,000 - (150,000 \times \$5) = \$500,000$ NOPAT = EBIT × $(1 - T) = \$500,000 \times (1 - 0.38) = \$310,000$ Value of the firm $= \frac{\text{NOPAT}}{r_a} = \frac{\$310,000}{0.085} = \$3,647,059$

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Solutions to Problems

P13-1. Breakeven point—algebraic LG1; Basic

$$Q = \frac{FC}{(P - VC)}$$
$$Q = \frac{\$12,350}{(\$24.95 - \$15.45)} = 1,300$$

P13-2. Breakeven comparisons—algebraic LG 1; Basic

a.
$$Q = \frac{FC}{(P - VC)}$$

Firm F: $Q = \frac{\$45,000}{\$18.00 - \$6.75} = 4,000$ units
Firm G: $Q = \frac{\$30,000}{\$21.00 - \$13.50} = 4,000$ units
Firm H: $Q = \frac{\$90,000}{\$30.00 - \$12.00} = 5,000$ units

- b. From least risky to most risky: F and G are of equal risk, then H. It is important to recognize that operating leverage is only one measure of risk.
- P13-3. Breakeven point-algebraic and graphical

LG 1; Intermediate

a.
$$Q = FC \div (P - VC)$$

 $Q = $473,000 \div ($129 - $86)$
 $Q = 11,000$ units

b.





P13-4. Breakeven analysis

LG 1; Intermediate

- a. $Q = \frac{\$73,500}{\$13.98 \$10.48} = 21,000 \text{ CDs}$
- b. Total operating costs = $FC + (Q \times VC)$ Total operating costs = $\$73,500 + (21,000 \times \$10.48)$ Total operating costs = \$293,580
- c. $2,000 \times 12 = 24,000$ CDs per year. 2,000 records per month exceeds the operating breakeven by 3,000 records per year. Barry should go into the CD business.
- d. EBIT = $(P \times Q) FC (VC \times Q)$ EBIT = $(\$13.98 \times 24,000) - \$73,500 - (\$10.48 \times 24,000)$ EBIT = \$335,520 - \$73,500 - \$251,520EBIT = \$10,500
- P13-5. Personal finance: Breakeven analysis

LG 1; Easy

- a. Breakeven point in months = fixed cost \div (monthly benefit monthly variable costs) $500 \div (355 - 20) = 500 \div 15 = 33 \frac{1}{3}$ months
- b. Install the Geo-Tracker because the device pays for itself over 33.3 months, which is less than the 36 months that Paul is planning on owning the car.

P13-6. Breakeven point-changing costs/revenues

LG 1; Intermediate

a.	$Q = F \div (P - VC)$	$Q = $40,000 \div ($10 - $8)$	= 20,000 books
b.		$Q = $44,000 \div 2.00	= 22,000 books
c.		$Q = $40,000 \div 2.50	= 16,000 books
d.		$Q = $40,000 \div 1.50	= 26,667 books

e. The operating breakeven point is directly related to fixed and variable costs and inversely related to selling price. Increases in costs raise the operating breakeven point, while increases in price lower it.

P13-7. Breakeven analysis

LG 1; Challenge

a.	$Q = \frac{FC}{(P - VC)} = \frac{\$4,000}{\$8.00 - \$6.00} =$	2,000 figurines
b.	Sales	\$10,000
	Less:	
	Fixed costs	4,000
	Variable costs ($$6 \times 1,500$)	9,000
	EBIT	<u>-\$3,000</u>
c.	Sales	\$15,000
	Less:	
	Fixed costs	4,000

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	Variable costs (\$6	6 × 1,500)	9,000	
	EBIT		\$2,000	
d.	$Q = \frac{\text{EBIT} + FC}{P - VC} = \frac{\$4}{2}$	$\frac{4,000 + \$4,000}{\$8 - \$6}$	$=\frac{\$8,000}{\$2}=4,000$	0 units

e. One alternative is to price the units differently based on the variable cost of the unit. Those more costly to produce will have higher prices than the less expensive production models. If they wish to maintain the same price for all units they may need to reduce the selection from the 15 types currently available to a smaller number that includes only those that have an average variable cost below \$5.33 (\$8 - \$4,000/1,500 units).

P13-8. EBIT sensitivity

LG 2; Intermediate

a. and b.

	8,000 Units	10,000 Units	12,000 Units
Sales	\$72,000	\$90,000	\$108,000
Less: Variable costs	40,000	50,000	60,000
Less: Fixed costs	20,000	20,000	20,000
EBIT	\$12,000	\$20,000	\$ 28,000

c.

Unit Sales	8,000	10,000	12,000
Percentage	$(8,000 - 10,000) \div 10,000$		(12,000 - 10,000) ÷ 10,000
Change in unit sales	=-20%	0	=+20%
Percentage Change in	$(12,000 - 20,000) \div 20,000$		$(28,000 - 20,000) \div 20,000$
EBIT	=-40%	0	=+40%

d. EBIT is more sensitive to changing sales levels; it increases/decreases twice as much as sales.

P13-9. DOL

LG 2; Intermediate

a. $Q = \frac{FC}{(P - VC)} = \frac{\$380,000}{\$63.50 - \$16.00} = 8,000$ units

9,000 Units	10,000 Units	11,000 Units
\$571,500	\$635,000	\$698,500
144,000	160,000	176,000
380,000	380,000	380,000
<u>\$ 47,500</u>	<u>\$ 95,000</u>	<u>\$142,500</u>
-1,000	0	+1,000
$-1,000 \div 10,000 =$	0	$1,000 \div 10,000 = +10\%$
-10%		
-\$47,500	0	+\$47,500
$-$47,500 \div 95,000 = -50\%$	0	\$47,500 ÷ 95,000 =
		+50%
$-50 \div -10 = 5$		$50 \div 10 = 5$
	9,000 Units 571,500 144,000 380,000 47,500 $-1,000 \div 10,000 =$ -10% -\$47,500 $-$47,500 \div 95,000 = -50\%$ $-50 \div -10 = 5$	9,000 Units10,000 Units\$571,500\$635,000144,000160,000 $380,000$ $380,000$ $$47,500$ $$95,000$ $-1,000 \div 10,000 =$ 0 -10% 0 $-$47,500$ 0 $-$47,500 \div 95,000 = -50\%$ 0 $-50 \div -10 = 5$

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e.
$$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$
$$DOL = \frac{[10,000 \times (\$63.50 - \$16.00)]}{[10,000 \times (\$63.50 - \$16.00) - \$380,000]}$$
$$DOL = \frac{\$475,000}{\$95,000} = 5.00$$

P13-10. DOL-graphic

LG 2; Intermediate

a.
$$Q = \frac{FC}{(P - VC)} = \frac{\$72,000}{\$9.75 - \$6.75} = 24,000 \text{ units}$$

b.
$$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$
$$DOL = \frac{[25,000 \times (\$9.75 - \$6.75)]}{[25,000 \times (\$9.75 - \$6.75)] - \$72,000} = 25.0$$
$$DOL = \frac{[30,000 \times (\$9.75 - \$6.75)]}{[30,000 \times (\$9.75 - \$6.75)] - \$72,000} = 5.0$$
$$DOL = \frac{[40,000 \times (\$9.75 - \$6.75)]}{[40,000 \times (\$9.75 - \$6.75)] - \$72,000} = 2.5$$







d. DOL = $\frac{[24,000 \times (\$9.75 - \$6.75)]}{[24,000 \times (\$9.75 - \$6.75)] - \$72,000} = \infty$

At the operating breakeven point, the DOL is infinite.

e. DOL decreases as the firm expands beyond the operating breakeven point.

P13-11. EPS calculations

LG 2; Intermediate

	(a)	(b)	(c)
EBIT	\$24,600	\$30,600	\$35,000
Less: Interest	9,600	9,600	9,600
Net profits before taxes	\$15,000	\$21,000	\$25,400
Less: Taxes	6,000	8,400	10,160
Net profit after taxes	\$ 9,000	\$12,600	\$15,240
Less: Preferred dividends	7,500	7,500	7,500
Earnings available to common shareholders	\$ 1,500	\$ 5,100	\$ 7,740
EPS (4,000 shares)	\$ 0.375	\$ 1.275	\$ 1.935

P13-12. Degree of financial leverage

LG 2; Intermediate

a.			
	EBIT	\$80,000	\$120,000
	Less: Interest	40,000	40,000
	Net profits before taxes	\$40,000	\$ 80,000
	Less: Taxes (40%)	16,000	32,000
	Net profit after taxes	\$24,000	\$ 48,000
	EPS (2,000 shares)	\$ 12.00	\$ 24.00

b. DFL =
$$\frac{\text{EBIT}}{\left[\text{EBIT} - I - \left(PD \times \frac{1}{(1-T)}\right)\right]}$$
$$\text{DFL} = \frac{\$80,000}{\left[\$80,000 - \$40,000 - 0\right]} = 2$$

c.

EBIT	\$80,000	\$120,000
Less: Interest	16,000	16,000
Net profits before taxes	\$64,000	\$104,000
Less: Taxes (40%)	25,600	41,600
Net profit after taxes	\$38,400	\$ 62,400
EPS (3,000 shares)	\$ 12.80	\$ 20.80
DFL =	-=1.25	
$\begin{bmatrix} \$80,000 - \$16,000 - 0 \end{bmatrix}^{-1.23}$		

P13-13. Personal finance: Financial leverage

LG 2; Challenge

a.

Current DFL	Initial Values	Future Value	Percentage Change
Available for making loan payment	\$3,000	\$3,300	10.0%
Less: Loan payments	<u>\$1,000</u>	<u>\$1,000</u>	0.0%
Available after loan payments	\$2,000	\$2,300	15.0%
DFL		15%	$\div 10\% = 1.50$
Proposed DFL	Initial Values	Future Value	Percentage Change
Available for making loan payment	\$3,000	\$3,300	10.0%
Less: Loan payments	<u>\$1,350</u>	<u>\$1,350</u>	0.0%
Available after loan payments	\$1,650	\$1,950	18.2%
DFL		18.2%	$\div 10\% = 1.82$

b. Based on his calculations, the amount that Max will have available after loan payments with his current debt changes by 1.5% for every 1% change in the amount he will have available for making the loan payment. This is less responsive and therefore less risky than the 1.82% change in the amount available after making loan payments with the proposed \$350 in monthly debt payments. Although it appears that Max can afford the additional loan payments, he must decide if, given the variability of Max's income, he would feel comfortable with the increased financial leverage and risk.

P13-14. DFL and graphic display of financing plans



LG 2, 5; Challenge

c. DFL =
$$\frac{\$67,500}{\left[\$67,500 - \$22,500 - \frac{\$6,000}{0.6}\right]} = 1.93$$

d. See graph, which is based on the following equation and data points.

Financing	EBIT	EPS
Original financing	\$67,500	$\frac{(\$67,000 - \$22,500)(1 - 0.4)}{15,000} = \1.80
plan	\$17,500	$\frac{(\$67,000 - \$22,500)(1 - 0.4)}{15,000} = -\0.20
Revised	\$67,500	$\frac{(\$67,000 - \$22,500)(1 - 0.4) - 6,000}{15,000} = \1.40
plan	\$17,500	$\frac{(\$17,000 - \$22,500)(1 - 0.4) - 6,000}{15,000} = -\0.60

e. The lines representing the two financing plans are parallel since the number of shares of common stock outstanding is the same in each case. The financing plan, including the preferred stock, results in a higher financial breakeven point and a lower EPS at any EBIT level.

P13-15. Integrative—multiple leverage measures

LG 1, 2; Intermediate

a. Operating breakeven =
$$\frac{\$28,000}{\$0.16}$$
 = 175,000 units

b.
$$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$
$$DOL = \frac{[400,000 \times (\$1.00 - \$0.84)]}{[400,000 \times (\$1.00 - \$0.84)] - \$28,000} = \frac{\$64,000}{\$36,000} = 1.78$$

c. EBIT = $(P \times Q) - FC - (Q \times VC)$ EBIT = $(\$1.00 \times 400,000) - \$2\$,000 - (400,000 \times \$0.84)$ EBIT = \$400,000 - \$2\$,000 - \$336,000EBIT = \$36,000EBIT

$$DFL = \frac{1}{\left[EBIT - I - \left(PD \times \frac{1}{(1 - T)}\right)\right]}$$
$$DFL = \frac{\$36,000}{\left[\$36,000 - \$6,000 - \left(\frac{\$2,000}{(1 - 0.4)}\right)\right]} = 1.35$$

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d.
$$DTL^{*} = \frac{[Q \times (P - VC)]}{\left[Q \times (P - VC) - FC - I - \left(\frac{PD}{(1 - T)}\right)\right]}$$
$$DTL = \frac{[400,000 \times (\$1.00 - \$0.84)]}{\left[400,000 \times (\$1.00 - \$0.84) - \$28,000 - \$6,000 - \left(\frac{\$2,000}{(1 - 0.4)}\right)\right]}$$
$$DTL = \frac{\$64,000}{[\$64,000 - \$28,000 - \$9,333]} = \frac{\$64,000}{\$26,667} = 2.40$$
$$DTL = DOL \times DFL$$
$$DTL = 1.78 \times 1.35 = 2.40$$
The two formulas give the same result.
*Degree of total leverage.

P13-16. Integrative—leverage and risk

LG 2; Intermediate

a.
$$\text{DOL}_{R} = \frac{[100,000 \times (\$2.00 - \$1.70)]}{[100,000 \times (\$2.00 - \$1.70)] - \$6,000} = \frac{\$30,000}{\$24,000} = 1.25$$

 $\text{DFL}_{R} = \frac{\$24,000}{[\$24,000 - \$10,000]} = 1.71$
 $\text{DTL}_{R} = 1.25 \times 1.71 = 2.14$
b. $\text{DOL}_{W} = \frac{[100,000 \times (\$2.50 - \$1.00)]}{[100,000 \times (\$2.50 - \$1.00)] - \$62,500} = \frac{\$150,000}{\$87,500} = 1.71$
 $\text{DFL}_{W} = \frac{\$87,500}{[\$87,500 - \$17,500]} = 1.25$
 $\text{DTL}_{R} = 1.71 \times 1.25 = 2.14$

- c. Firm R has less operating (business) risk but more financial risk than Firm W.
- d. Two firms with differing operating and financial structures may be equally leveraged. Since total leverage is the product of operating and financial leverage, each firm may structure itself differently and still have the same amount of total risk.

P13-17. Integrative—multiple leverage measures and prediction

LG 1, 2; Challenge

a.	$Q = FC \div (P - VC)$	Q = \$50,000 ÷ (\$6 - \$3.50) = 20,000 latches
b.	Sales (\$6 × 30,000)	\$180,000
	Less:	
	Fixed costs	50,000
	Variable costs (\$3.5)	0 × 30,000) <u>105,000</u>
	EBIT	25,000
	Less interest expense	13,000
	EBT	12,000
	Less taxes (40%)	4,800
	Net profits	<u>\$ 7,200</u>

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c.
$$DOL = \frac{[Q \times (P - VC)]}{[Q \times (P - VC)] - FC}$$

 $DOL = \frac{[30,000 \times (\$6.00 - \$3.50)]}{[30,000 \times (\$6.00 - \$3.50)] - \$50,000} = \frac{\$75,000}{\$25,000} = 3.0$
d. $DFL = \frac{EBIT}{\left[EBIT - I - \left(PD \times \frac{1}{(1 - T)}\right)\right]}$
 $DFL = \frac{\$25,000}{\$25,000 - \$13,000 - [\$7,000 \times (1 \div 0.6)]} = \frac{\$25,000}{\$333.33} = 75.00$
e. $DTL = DOL \times DFL = 3 \times 75.00 = 225 \text{ (or } 22,500\%)$
f. Change in sales $= \frac{15,000}{30,000} = 50\%$

Percentage change in EBIT = % change in sales × DOL = $50\% \times 3 = 150\%$ New EBIT = $$25,000 + ($25,000 \times 150\%) = $62,500$ Percentage change in earnings available for common = % change_{sales} × DTL = $50\% \times 225\% = 11,250\%$ New earnings available for common = $$200 + ($200 \times 11,250\%) = $22,700,064$

P13-18. Capital structures

LG 3; Intermediate

- a. Monthly mortgage payment \div Monthly gross income = $\$1,100 \div \$4,500 = 24.44\%$ Kirsten's ratio is less than the bank maximum of 28%.
- b. Total monthly installment payment \div Monthly gross income = $(\$375 + \$1,100) \div \$4,500 = 32.8\%$.

Kirsten's ratio is less than the bank maximum of 37.0%. Since Kirsten's debt-related expenses as a percentage of her monthly gross income are less than bank-specified maximums, her loan application should be accepted.

P13-19. Various capital structures

LG 3; Basic

Debt Ratio	Debt	Equity
10%	\$100,000	\$900,000
20%	\$200,000	\$800,000
30%	\$300,000	\$700,000
40%	\$400,000	\$600,000
50%	\$500,000	\$500,000
60%	\$600,000	\$400,000
90%	\$900,000	\$100,000

Theoretically, the debt ratio cannot exceed 100%. Practically, few creditors would extend loans to companies with exceedingly high debt ratios (>70%).

P13-20. Debt and financial risk

LG 3; Challenge

EBIT Calculation a.

Probability	0.20	0.60	0.20
Sales	\$200,000	\$300,000	\$400,000
Less: Variable costs (70%)	140,000	210,000	280,000
Less: Fixed costs	75,000	75,000	75,000
EBIT	\$(15,000)	\$ 15,000	\$ 45,000
Less: Interest	12,000	12,000	12,000
Earnings before taxes	\$(27,000)	\$ 3,000	\$ 33,000
Less: Taxes	(10,800)	1,200	13,200
Earnings after taxes	\$(16,200)	\$ 1,800	\$ 19,800

Earnings after taxes \$(16,200) \$ 1,800 \$ 19,800 Number of shares 10,000 10,000 10,000 EPS \$ (1.62) \$ 0.18 \$ 1.98

Expected EPS = $\sum_{i=1}^{n} EPS_i \times Pr_i$

Expected EPS = $(-\$1.62 \times 0.20) + (\$0.18 \times 0.60) + (\$1.98 \times 0.20)$

Expected EPS = -\$0.324 + \$0.108 + \$0.396

Expected EPS = \$0.18

$$\sigma_{\text{EPS}} = \sqrt{\sum_{i=1}^{n} (\text{EPS}_{i} - \text{EPS})^{2} \times \text{Pr}_{i}}$$

$$EPS = \int_{-\infty}^{n} (EPS) -$$

 $\sigma_{\text{EPS}} = \sqrt{[(-\$1.62 - \$0.18)^2 \times 0.20] + [(\$0.18 - \$0.18)^2 \times 0.60] + [(\$1.98 - \$0.18)^2 \times 0.20]}$ $\sigma_{\rm EPS} = \sqrt{(\$3.24 \times 0.20) + 0 + (\$3.24 \times 0.20)}$

 $\sigma_{\text{EPS}} = \sqrt{\$0.648 + \$0.648}$

 $\sigma_{\text{EPS}} = \sqrt{\$1.296} = \$1.138$

$$CV_{\text{EPS}} = \frac{\sigma_{\text{EPS}}}{\text{Expected EPS}} = \frac{1.138}{0.18} = 6.32$$

c.

b.

EBIT *	\$(15,000)	\$15,000	\$45,000
Less: Interest	0	0	0
Net profit before taxes	\$(15,000)	\$15,000	\$45,000
Less: Taxes	(6,000)	6,000	18,000
Net profits after taxes	\$ (9,000)	\$ 9,000	\$27,000
EPS (15,000 shares)	\$ (0.60)	\$ 0.60	\$ 1.80

*From part a

Expected EPS =
$$(-\$0.60 \times 0.20) + (\$0.60 \times 0.60) + (\$1.80 \times 0.20) = \$0.60$$

 $\sigma_{\text{EPS}} = \sqrt{[(-\$0.60 - \$0.60)^2 \times 0.20] + [(\$0.60 - \$0.60)^2 \times 0.60] + [(\$1.80 - \$0.60)^2 \times 0.20]}$
 $\sigma_{\text{EPS}} = \sqrt{(\$1.44 \times 0.20) + 0 + (\$1.44 \times 0.20)}$
 $\sigma_{\text{EPS}} = \sqrt{\$0.576} = \$0.759$
 $CV_{\text{EPS}} = \frac{\$0.759}{0.60} = 1.265$

d. Summary statistics

	With Debt	All Equity
Expected EPS	\$0.180	\$0.600
$\sigma_{ m EPS}$	\$1.138	\$0.759
$CV_{\rm EPS}$	6.320	1.265

Including debt in Tower Interiors' capital structure results in a lower expected EPS, a higher standard deviation, and a much higher coefficient of variation than the all-equity structure. Eliminating debt from the firm's capital structure greatly reduces financial risk, which is measured by the coefficient of variation.

P13-21. EPS and optimal debt ratio

LG 4; Intermediate



Maximum EPS appears to be at 60% debt ratio, with \$3.95 per share earnings.

b.
$$CV_{\text{EPS}} = \frac{\sigma_{\text{EPS}}}{\text{EPS}}$$

Debt Ratio	CV
0%	0.5
20	0.6
40	0.8
60	1.0
80	1.5



P13-22. EBIT-EPS and capital structure

LG 5; Intermediate

a. Using \$50,000 and \$60,000 EBIT:

	Structure A		Structure B		
EBIT	\$50,000	\$60,000	\$50,000	\$60,000	
Less: Interest	16,000	16,000	34,000	34,000	
Net profits before taxes	\$34,000	\$44,000	\$16,000	\$26,000	
Less: Taxes	13,600	17,600	6,400	10,400	
Net profit after taxes	\$20,400	\$26,400	\$ 9,600	\$15,600	
EPS (4,000 shares)	\$ 5.10	\$ 6.60			
EPS (2,000 shares)			\$ 4.80	\$ 7.80	

Financial breakeven points:

Structure A	Structure B
\$16,000	\$34,000

b.



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- c. If EBIT is expected to be below \$52,000, Structure A is preferred. If EBIT is expected to be above \$52,000, Structure B is preferred.
- d. Structure A has less risk and promises lower returns as EBIT increases. B is more risky since it has a higher financial breakeven point. The steeper slope of the line for Structure B also indicates greater financial leverage.
- e. If EBIT is greater than \$75,000, Structure B is recommended since changes in EPS are much greater for given values of EBIT.

P13-23. EBIT-EPS and preferred stock

LG 5: Intermediate

a.

	Structu	ure A	Structu	re B
EBIT	\$30,000	\$50,000	\$30,000	\$50,000
Less: Interest	12,000	12,000	7,500	7,500
Net profits before taxes	\$18,000	\$38,000	\$22,500	\$42,500
Less: Taxes	7,200	15,200	9,000	17,000
Net profit after taxes	\$10,800	\$22,800	\$13,500	\$25,500
Less: Preferred dividends	1,800	1,800	2,700	2,700
Earnings available for common shareholders	\$ 9,000	\$21,000	\$10,800	\$22,800
EPS (8,000 shares)	\$ 1.125	\$ 2.625		
EPS (10,000 shares)			\$ 1.08	\$ 2.28



Comparison of Capital Structures



- c. Structure A has greater financial leverage, hence greater financial risk.
- d. If EBIT is expected to be below \$27,000, Structure B is preferred. If EBIT is expected to be above \$27,000, Structure A is preferred.
- e. If EBIT is expected to be \$35,000, Structure A is recommended since changes in EPS are much greater for given values of EBIT.

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P13-24. Integrative-optimal capital structure

LG 3, 4, 6; Intermediate

a.

Debt Ratio	0%	15%	30%	45%	60%
EBIT	\$2,000,000	\$2,000,000	\$2,000,000	\$2,000,000	\$2,000,000
Less: Interest	0	120,000	270,000	540,000	900,000
EBT	\$2,000,000	\$1,880,000	1,730,000	\$1,460,000	\$1,100,000
Taxes @40%	800,000	752,000	692,000	584,000	440,000
Net profit	\$1,200,000	\$1,128,000	\$1,038,000	\$ 876,000	\$ 660,000
Less: Preferred dividends	200,000	200,000	200,000	200,000	200,000
Profits available to common stock	<u>\$1,000,000</u>	<u>\$ 928,000</u>	<u>\$ 838,000</u>	<u>\$ 676,000</u>	<u>\$ 460,000</u>
# shares outstanding	200,000	170,000	140,000	110,000	80,000
EPS	\$ 5.00	\$ 5.46	\$ 5.99	\$ 6.15	\$ 5.75

b. $P_0 = \frac{\text{EPS}}{r_s}$ **Debt: 0%** $P_0 = \frac{\$5.00}{1.00} = \41.67

0 0.12
Debt: 30%

$$P_0 = \frac{\$5.99}{0.14} = \$42.79$$

Debt: 15% $P_0 = \frac{\$5.46}{0.13} = \42.00 **Debt: 45%** $P_0 = \frac{\$6.15}{0.16} = \38.44

Debt: 60%

$$P_0 = \frac{\$5.75}{0.20} = \$28.75$$

c. The optimal capital structure would be 30% debt and 70% equity because this is the debt/equity mix that maximizes the price of the common stock.

P13-25. Integrative—Optimal capital structures

LG 3, 4, 6; Challenge

a. 0% debt ratio

		Probability	
	0.20	0.60	0.20
Sales	\$200,000	\$300,000	\$400,000
Less: Variable costs (40%)	80,000	120,000	160,000
Less: Fixed costs	100,000	100,000	100,000
EBIT	\$ 20,000	\$ 80,000	\$140,000
Less: Interest	0	0	0
Earnings before taxes	\$ 20,000	\$ 80,000	\$140,000
Less: Taxes	8,000	32,000	56,000
Earnings after taxes	\$ 12,000	\$ 48,000	\$ 84,000
EPS (25,000 shares)	\$ 0.48	\$ 1.92	\$ 3.36

20% debt ratio:

Total capital = $$250,000 (100\% \text{ equity})$	= 25,000 shares \times \$10 book value)
Amount of debt = $20\% \times $250,000$	= \$50,000
Amount of equity = $80\% \times 250,000$	= \$200,000
Number of shares = $200,000 \div 10$ book value	= 20,000 shares

		Probability	
	0.20	0.60	0.20
EBIT	\$20,000	\$80,000	\$140,000
Less: Interest	5,000	5,000	5,000
Earnings before taxes	\$15,000	\$75,000	\$135,000
Less: Taxes	6,000	30,000	54,000
Earnings after taxes	\$ 9,000	\$45,000	\$ 81,000
EPS (20,000 shares)	\$ 0.45	\$ 2.25	\$ 4.05

40% debt ratio:

Amount of debt $= 40\% \times \$250,000 = total debt capital = \$100,000$ Number of shares= \$150,000 equity $\div \$10$ book value= 15,000 shares

	Probability		
	0.20	0.60	0.20
EBIT	\$20,000	\$80,000	\$140,000
Less: Interest	12,000	12,000	12,000
Earnings before taxes	\$ 8,000	\$68,000	\$128,000
Less: Taxes	3,200	27,200	51,200
Earnings after taxes	\$ 4,800	\$40,800	\$ 76,800
EPS (15,000 shares)	\$ 0.32	\$ 2.72	\$ 5.12

60% debt ratio:

Amount of debt $= 60\% \times \$250,000 = total debt capital = \$150,000$ Number of shares = \$100,000 equity \div \$10 book value = 10,000 shares

	Probability		
	0.20	0.60	0.20
EBIT	\$20,000	\$80,000	\$140,000
Less: Interest	21,000	21,000	21,000
Earnings before taxes	\$ (1,000)	\$59,000	\$119,000
Less: Taxes	(400)	23,600	47,600
Earnings after taxes	\$ (600)	\$35,400	\$ 71,400
EPS (10,000 shares)	\$ (0.06)	\$ 3.54	\$ 7.14

Debt Ratio	E(EPS)	σ (EPS)	CV (EPS)	Number of Common Shares	Dollar Amount of Debt	Share Price [*]
0%	\$1.92	0.9107	0.4743	25,000	0	\$1.92/0.16 = \$12.00
20%	\$2.25	1.1384	0.5060	20,000	\$ 50,000	\$2.25/0.17 = \$13.24
40%	\$2.72	1.5179	0.5581	15,000	\$100,000	\$2.72/0.18 = \$15.11
60%	\$3.54	2.2768	0.6432	10,000	\$150,000	\$3.54/0.24 = \$14.75

*Share price: E(EPS) ÷ required return for *CV* for E(EPS), from table in problem.

b.	(1) Optimal capital structure to maximize EPS:	60% debt
		40% equity
	(2) Optimal capital structure to maximize share price:	40% debt
		60% equity

c.





LG 3, 4, 5, 6; Challenge

a.

% Debt	Total Assets	\$ Debt	\$ Equity	No. of Shares @ \$25
0	\$40,000,000	\$ 0	\$40,000,000	1,600,000
10	40,000,000	4,000,000	36,000,000	1,440,000
20	40,000,000	8,000,000	32,000,000	1,280,000
30	40,000,000	12,000,000	28,000,000	1,120,000
40	40,000,000	16,000,000	24,000,000	960,000
50	40,000,000	20,000,000	20,000,000	800,000

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b.

% Debt	\$ Total Debt	Before Tax Cost of Debt, k_d	\$ Interest Expense
0	\$ 0	0.0%	\$ 0
10	4,000,000	7.5	300,000
20	8,000,000	8.0	640,000
30	12,000,000	9.0	1,080,000
40	16,000,000	11.0	1,760,000
50	20,000,000	12.5	2,500,000
60	24,000,000	15.5	3,720,000

c.

% Debt	\$ Interest Expense	ЕВТ	Taxes @40%	Net Income	# of Shares	EPS
0	\$ 0	\$8,000,000	\$3,200,000	\$4,800,000	1,600,000	\$3.00
10	300,000	7,700,000	3,080,000	4,620,000	1,440,000	3.21
20	640,000	7,360,000	2,944,000	4,416,000	1,280,000	3.45
30	1,080,000	6,920,000	2,768,000	4,152,000	1,120,000	3.71
40	1,760,000	6,240,000	2,496,000	3,744,000	960,000	3.90
50	2,500,000	5,500,000	2,200,000	3,300,000	800,000	4.13
60	3,720,000	4,280,000	1,712,000	2,568,000	640,000	4.01

d.

% Debt	EPS	r _s	P_0
0	\$3.00	10.0%	\$30.00
10	3.21	10.3	31.17
20	3.45	10.9	31.65
30	3.71	11.4	32.54
40	3.90	12.6	30.95
50	4.13	14.8	27.91
60	4.01	17.5	22.91

e. The optimal proportion of debt would be 30% with equity being 70%. This mix will maximize the price per share of the firm's common stock and thus maximize shareholders' wealth. Beyond the 30% level, the cost of capital increases to the point that it offsets the gain from the lower-costing debt financing.

P13-27. Integrative—optimal capital structure

LG 3, 4, 5, 6; Challenge

a.

	Probability		
	0.30	0.40	0.30
Sales	\$600,000	\$900,000	\$1,200,000
Less: Variable costs (40%)	240,000	360,000	480,000
Less: Fixed costs	300,000	300,000	300,000

EBIT

Debt Ratio	Amount of Debt	Amount of Equity	Number of Shares of Common Stock [*]
0%	\$ 0	\$1,000,000	40,000
15%	150,000	850,000	34,000
30%	300,000	700,000	28,000
45%	450,000	550,000	22,000
60%	600,000	400,000	16,000

* Dollar amount of equity \div \$25 per share = Number of shares of common stock.

c

Debt Ratio	Amount of Debt	Before Tax Cost of Debt	Annual Interest
0%	\$ 0	0.0%	\$ 0
15%	150,000	8.0	12,000
30%	300,000	10.0	30,000
45%	450,000	13.0	58,500
60%	600,000	17.0	102,000

d. $EPS = [(EBIT - interest) (1 - T)] \div number of common shares outstanding$

Debt Ratio	Calculation	EPS
0%	$(\$60,000 - \$0) \times (0.6) \div 40,000$ shares	= \$0.90
	$($240,000 - $0) \times (0.6) \div 40,000$ shares	= 3.60
	$($420,000 - $0) \times (0.6) \div 40,000$ shares	= 6.30
15%	$($60,000 - $12,000) \times (0.6) \div 34,000$ shares	= \$0.85
	$($240,000 - $12,000) \times (0.6) \div 34,000$ shares	= 4.02
	$($420,000 - $12,000) \times (0.6) \div 34,000$ shares	= 7.20
30%	$($60,000 - $30,000) \times (0.6) \div 28,000$ shares	= \$0.64
	$($240,000 - $30,000) \times (0.6) \div 28,000$ shares	= 4.50
	$($420,000 - $30,000) \times (0.6) \div 28,000$ shares	= 8.36
45%	$($60,000 - $58,500) \times (0.6) \div 22,000$ shares	= \$0.04
	$($240,000 - $58,500) \times (0.6) \div 22,000$ shares	= 4.95
	$($420,000 - $58,500) \times (0.6) \div 22,000$ shares	= 9.86
60%	$($60,000 - $102,000) \times (0.6) \div 16,000$ shares	=-\$1.58
	$($240,000 - $102,000) \times (0.6) \div 16,000$ shares	= 5.18
	$($420,000 - $102,000) \times (0.6) \div 16,000$ shares	= 11.93

b.

Debt Ratio	Debt Ratio Calculation		E(EPS)	
0%	$\begin{array}{c} 0.30 \times (0.90) + 0.40 \times (3.60) + 0.30 \times (6.30) \\ 0.27 + 1.44 + 1.89 \end{array}$	=	\$3.60	
15%	$\begin{array}{c} 0.30 \times (0.85) + 0.40 \times (4.02) + 0.30 \times (7.20) \\ 0.26 + 1.61 + 2.16 \end{array}$	=	\$4.03	
30%	$\begin{array}{c} 0.30 \times (0.64) + 0.40 \times (4.50) + 0.30 \times (8.36) \\ 0.19 + 1.80 + 2.51 \end{array}$	=	\$4.50	
45%	$\begin{array}{c} 0.30 \times (0.04) + 0.40 \times (4.95) + 0.30 \times (9.86) \\ 0.01 + 1.98 + 2.96 \end{array}$	=	\$4.95	
60%	$0.30 \times (-1.58) + 0.40 \times (5.18) + 0.30 \times (11.93) \\ -0.47 + 2.07 + 3.58$	=	\$5.18	

e. (1) $E(EPS) = 0.30(EPS_1) + 0.40(EPS_2) + 0.30(EPS_3)$

(2) σ_{EPS}

Debt	Coloriation
Katio	Calculation
0%	$\sigma_{\rm EPS} = \sqrt{[(0.90 - 3.60)^2 \times 0.3] + [(3.60 - 3.60)^2 \times 0.4] + [(6.30 - 3.60)^2 \times 0.3]}$
	$\sigma_{\rm EPS} = \sqrt{2.187 + 0 + 2.187}$
	$\sigma_{\rm EPS} = \sqrt{4.374}$
	$\sigma_{\text{EPS}} = 2.091$
15%	$\sigma_{\rm EPS} = \sqrt{[(0.85 - 4.03)^2 \times 0.3] + [(4.03 - 4.03)^2 \times 0.4] + [(7.20 - 4.03)^2 \times 0.3]}$
	$\sigma_{\rm EPS} = \sqrt{3.034 + 0 + 3.034}$
	$\sigma_{\text{EPS}} = \sqrt{6.068}$
	$\sigma_{\rm EPS} = 2.463$
30%	$\sigma_{\rm EPS} = \sqrt{[(0.64 - 4.50)^2 \times 0.3] + [(4.50 - 4.50)^2 \times 0.4] + [(8.36 - 4.50)^2 \times 0.3]}$
	$\sigma_{\rm EPS} = \sqrt{4.470 + 0 + 4.470}$
	$\sigma_{\text{EPS}} = \sqrt{8.94}$
	$\sigma_{\text{EPS}} = 2.99$
45%	$\sigma_{\text{EPS}} = \sqrt{[(0.04 - 4.95)^2 \times 0.3] + [(4.95 - 4.95)^2 \times 0.4] + [(9.86 - 4.95)^2 \times 0.3]}$
	$\sigma_{\rm EPS} = \sqrt{7.232 + 0 + 7.187232}$
	$\sigma_{\rm EPS} = \sqrt{14.464}$
	$\sigma_{\text{EPS}} = 3.803$
60%	$\sigma_{\rm EPS} = \sqrt{[(-1.58 - 5.18)^2 \times 0.3] + [(5.18 - 5.18)^2 \times 0.4] + [(11.930 - 5.18)^2 \times 0.3]}$
	$\sigma_{\rm EPS} = \sqrt{13.669 + 0 + 13.669}$
	$\sigma_{\rm EPS} = \sqrt{27.338}$
	$\sigma_{\text{EPS}} = 5.299$

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(3)

Debt Ratio	$\sigma_{\rm EPS}$ ÷ $E({\rm EPS})$	=	CV
0%	2.091 ÷ 3.60	=	0.581
15%	$2.463 \div 4.03$	=	0.611
30%	2.990 ÷ 4.50	=	0.664
45%	3.803 ÷ 4.95	=	0.768
60%	5.229 ÷ 5.18	=	1.009

f. (1)





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The return, as measured by the E(EPS), as shown in part d, continually increases as the debt ratio increases, although at some point the rate of increase of the EPS begins to decline (the law of diminishing returns). The risk as measured by the CV also increases as the debt ratio increases, but at a more rapid rate.



The EBIT ranges over which each capital structure is preferred are as follows:

Debt Ratio	EBIT Range	
0%	\$0 - \$100,000	
30%	\$100,001 - \$198,000	
60%	above \$198,000	

To calculate the intersection points on the graphic representation of the EBIT-EPS approach to capital structure, the EBIT level which equates EPS for each capital structure must be found, using the formula in Footnote 22 of the text.

$$EPS = \frac{(1-T) \times (EBIT - I) - PD}{\text{number of common shares outstanding}}$$

Set EPS 0% = EPS 30%
EPS 30% = EPS 60%
The first calculation, EPS 0% = EPS 30%, is illustrated:
$$EPS_{0\%} = \frac{[(1-0.4)(EBIT - \$0) - 0]}{40,000 \text{ shares}}$$

$$EPS_{30\%} = \frac{[(1-0.4)(EBIT - \$30,000) - 0]}{28,000 \text{ shares}}$$

$$16,800 \text{ EBIT} = 24,000 \text{ EBIT} - 720,000,000$$

$$EBIT = \frac{720,000,000}{7,200} = \$100,000$$

The major problem with this approach is that is does not consider maximization of shareholder wealth (i.e., share price).

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h.

Debt Ratio	EPS ÷ r_s	Share Price
0%	\$3.60 ÷ 0.100	\$36.00
15%	\$4.03 ÷ 0.105	\$38.38
30%	\$4.50 ÷ 0.116	\$38.79
45%	\$4.95 ÷ 0.140	\$35.36
60%	\$5.18 ÷ 0.200	\$25.90

i. To maximize EPS, the 60% debt structure is preferred.

To maximize share value, the 30% debt structure is preferred.

A capital structure with 30% debt is recommended because it maximizes share value and satisfies the goal of maximization of shareholder wealth.

P13-28. Ethics problem

LG 3; Intermediate

Information asymmetry applies to situations in which one party has more and better information than the other interested party(ies). This appears to be exactly the situation in which managers overleverage or lead a buyout of the company. Existing bondholders and possibly stockholders are harmed by the financial risk of overleveraging, and existing stockholders are harmed if they accept a buyout price less than that warranted by accurate and incomplete information.

The board of directors has a fiduciary duty toward stockholders, and hopefully bears an ethical concern toward bondholders as well. The board can and should insist that management divulge all information it possesses on the future plans and risks the company faces (although caution to keep this out of the hands of competitors is warranted). The board should be cautious to select and retain chief executive officers (CEOs) with high integrity, and continue to emphasize an ethical tone "at the top." (Students will no doubt think of other creative mechanisms to deal with this situation.)