■ Solutions to Problems

P10-1. LG 1: Concept of cost of capital

Basic

a. The firm is basing its decision on the cost to finance a particular project rather than the firm's combined cost of capital. This decision-making method may lead to erroneous accept/reject decisions.

b. $r_a = w_d r_d + w_e r_e$

$r_a = 0.04(7\%)+0.60(16\%)$

$r_a = 2.8\% + 9.6\%$

$r_a = 12.4\%$

c. Reject project 263. Accept project 264.

d. Opposite conclusions were drawn using the two decision criteria. The overall cost of capital as a criterion provides better decisions because it takes into consideration the long-run interrelationship of financing decisions.

P10-2. LG 2: Cost of debt using both methods

Intermediate

a. Net proceeds: $N_d = \$1{,}010 - \$30$

$$N_d = \$980$$

b.

Cash flows:

T	CF
0	$ 980
1–15	–120
15	–1,000

c. Cost to maturity:

$$B_0 = \left[\sum_{t=1}^{n} \frac{I}{(1+r)^t}\right] + \left[\frac{M}{(1+r)^n}\right]$$

$$\$980 = \left[\sum_{t=1}^{15} \frac{-\$120}{(1+r)^t}\right] + \left[\frac{-\$1{,}000}{(1+r)^{15}}\right]$$

Step 1: Try 12%

$V = 120 \times (6.811) + 1{,}000 \times (0.183)$

$V = 817.32 + 183$

$V = \$1{,}000.32$

(Due to rounding of the PVIF table values, the value of the bond is 32 cents greater than expected. At the coupon rate, the value of a $1,000 face value bond is $1,000.)

Try 13%:

$V = 120 \times (6.462) + 1{,}000 \times (0.160)$

$V = 775.44 + 160$

$V = \$935.44$

The cost to maturity is between 12% and 13%.

Step 2: $1,000.32 – $935.44 = $64.88

Step 3: $1,000.32 – $980.00 = $20.32

Step 4: $20.32 ÷ $64.88 = 0.31

Step 5: 12 + 0.31 = 12.31% = before-tax cost of debt

12.31(1 – 0.40) = 7.39% = after-tax cost of debt

Calculator solution: 12.30%

d. Approximate before-tax cost of debt

$$r_d = \frac{\dfrac{\$1{,}000 - N_d}{n}}{\dfrac{N_d + \$1{,}000}{2}}$$

$$r_d = \frac{\$120 + \dfrac{(\$1{,}000 - \$980)}{15}}{\dfrac{(\$980 + \$1{,}000)}{2}} \qquad r_d = \frac{I + \dfrac{\$1{,}000 - N_d}{n}}{\dfrac{N_d + \$1{,}000}{2}}$$

$$r_d = \$12.33 \div \$990{,}00$$

$$r_d = 12.26\%$$

$$r_d = \frac{\$120 + \dfrac{(\$1{,}000 - \$980)}{15}}{\dfrac{(\$980 + \$1{,}000)}{2}}$$

Approximate after-tax cost of debt = 12.26% × (1 − 0.4) = 7.36%

e. The interpolated cost of debt is closer to the actual cost (12.2983%) than using the approximating equation. However, the short cut approximation is fairly accurate and expedient in the absence of a financial calculator.

P10-3. LG2: Before-tax cost of debt and after-tax cost of debt

Easy

a. Use the model: PV = $ annual coupon interest (PVIFA) + par value (PVIF)
Solving for the discount rate
N = 10, PV = – 930 (an expenditure),
PMT = 0.6(1000) = 60, FV = 1000

b. Use the model: After-tax cost of debt = before-tax cost of debt × (1 – tax bracket)
7.0% (1 – 0.2) = 5.6%

P10-4. LG 2: Cost of debt–using the approximation formula:

Basic

$$r_d = \frac{I + \dfrac{\$1{,}000 - N_d}{n}}{\dfrac{N_d + \$1{,}000}{2}} \qquad r_i = r_d \times (1 - T)$$

Bond A

$$r_d = \frac{\$90 + \dfrac{\$1{,}000 - \$955}{20}}{\dfrac{\$955 + \$1{,}000}{2}} = \frac{\$92.25}{\$977.50} = 9.44\%$$

$r_i = 9.44\% \times (1 - 0.40) = 5.66\%$

Bond B

$$r_d = \frac{\$100 + \frac{\$1{,}000 - \$970}{16}}{\frac{\$970 + \$1{,}000}{2}} = \frac{\$101.88}{\$985} = 10.34\%$$

$$r_i = 10.34\% \times (1 - 0.40) = 6.20\%$$

Bond C

$$r_d = \frac{\$120 + \frac{\$1{,}000 - \$955}{15}}{\frac{\$955 + \$1{,}000}{2}} = \frac{\$123}{\$977.50} = 12.58\%$$

$$r_i = 12.58\% \times (1 - 0.40) = 7.55\%$$

Bond D

$$r_d = \frac{\$90 + \frac{\$1{,}000 - \$985}{25}}{\frac{\$985 + \$1{,}000}{2}} = \frac{\$90.60}{\$992.50} = 9.13\%$$

$$r_i = 9.13\% \times (1 - 0.40) = 5.48\%$$

Bond E

$$r_d = \frac{\$110 + \frac{\$1{,}000 - \$920}{22}}{\frac{\$920 + \$1{,}000}{2}} = \frac{\$113.64}{\$960} = 11.84\%$$

$$r_i = 11.84\% \times (1 - 0.40) = 7.10\%$$

P10-5. LG 2: After-tax cost of debt

Intermediate

a. Since the interest on the boat loan is not tax deductible, its after-tax cost equals its stated cost of 8%.

b. Since the interest on the second mortgage is tax deductible, its after-tax cost is found by multiplying the before-tax cost of debt by (1 – tax rate). Being in the 28% tax bracket, the after-tax cost of debt is 6.6% (9.2(1 – 0.28)).

c. Home equity loan has a lower after-tax cost. However, using the second home mortgage does put the Starks at risk of losing their home if they are unable to make the mortgage payments.

P10-6. LG 2: Cost of preferred stock: $r_p = D_p \div N_p$

Basic

a. $r_p = \frac{\$12.00}{\$95.00} = 12.63\%$

b. $r_p = \frac{\$10.00}{\$90.00} = 11.11\%$

P10-7. LG 2: Cost of preferred stock: $r_p = D_p \div N_p$

Basic

Preferred Stock	Calculation
A	$r_p = \$11.00 \div \$92.00 = 11.96\%$
B	$r_p = 3.20 \div 34.50 = 9.28\%$
C	$r_p = 5.00 \div 33.00 = 15.15\%$
D	$r_p = 3.00 \div 24.50 = 12.24\%$
E	$r_p = 1.80 \div 17.50 = 10.29\%$

P10-8. LG 3: Cost of common stock equity–capital asset pricing model (CAPM)

Intermediate

$r_s = R_F + [b \times (r_m - R_F)]$

$r_s = 6\% + 1.2 \times (11\% - 6\%)$

$r_s = 6\% + 6\%$

$r_s = 12\%$

a. Risk premium = 6%

b. Rate of return = 12%

c. After-tax cost of common equity using the CAPM = 12%

P10-9. LG 3: Cost of common stock equity: $k_n = \dfrac{D_1 + g}{N_n}$

Intermediate

a. $g = \dfrac{D_{2009}}{D_{2005}} = \text{FVIF}_{k\%,4}$

$g = \dfrac{\$3.10}{\$2.12} = 1.462$

From FVIF table, the factor closest to 1.462 occurs at 10% (i.e., 1.464 for 4 years).
Calculator solution: 9.97%

b. $N_n = \$52$ (given in the problem)

c. $r_r = \dfrac{D_{2010}}{P_0} + g$

$r_r = \dfrac{\$3.40}{\$57.50} + 0.10 = 15.91\%$

d. $r_r = \dfrac{D_{2010}}{N_n} + g$

$r_r = \dfrac{\$3.40}{\$52.00} + 0.10 = 16.54\%$

P10-10. LG 3: Retained earnings versus new common stock

Intermediate

$$r_r = \frac{D_1}{P_0} + g \qquad r_n = \frac{D_1}{N_n} + g$$

Firm	Calculation
A	r_r = ($2.25 ÷ $50.00) + 8% = 12.50%
	r_n = ($2.25 ÷ $47.00) + 8% = 12.79%
B	r_r = ($1.00 ÷ $20.00) + 4% = 9.00%
	r_n = ($1.00 ÷$18.00) + 4% = 9.56%
C	r_r = ($2.00 ÷ $42.50) + 6% = 10.71%
	r_n = ($2.00 ÷ $39.50) + 6% = 11.06%
D	r_r = ($2.10 ÷ $19.00) + 2% = 13.05%
	r_n = ($2.10 ÷ $16.00) + 2% = 15.13%

P10-11. LG 4: WACC–book weights

Basic

a.

Type of Capital	Book Value	Weight	Cost	Weighted Cost
L-T debt	$ 700,000	0.500	5.3%	2.650%
Preferred stock	50,000	0.036	12.0%	0.432%
Common stock	650,000	0.464	16.0%	7.424%
	$1,400,000	1.000		10.506%

b. The WACC is the rate of return that the firm must receive on long-term projects to maintain the value of the firm. The cost of capital can be compared to the return for a project to determine whether the project is acceptable.

P10-12. LG 4: WACC–book weights and market weights

Intermediate

a. Book value weights:

Type of Capital	Book Value	Weight	Cost	Weighted Cost
L-T debt	$4,000,000	0.784	6.00%	4.704%
Preferred stock	40,000	0.008	13.00%	0.104%
Common stock	1,060,000	0.208	17.00%	3.536%
	$5,100,000			8.344%

b. Market value weights:

Type of Capital	Market Value	Weight	Cost	Weighted Cost
L-T debt	$3,840,000	0.557	6.00%	3.342%
Preferred stock	60,000	0.009	13.00%	0.117%
Common stock	3,000,000	0.435	17.00%	7.395%
	$6,900,000			10.854%

c. The difference lies in the two different value bases. The market value approach yields the better value since the costs of the components of the capital structure are calculated using the prevailing market prices. Since the common stock is selling at a higher value than its book value, the cost of capital is much higher when using the market value weights. Notice that the book value weights give the firm a much greater leverage position than when the market value weights are used.

P10-13. LG 4: WACC and target weights

Intermediate

a. Historical market weights:

Type of Capital	Weight	Cost	Weighted Cost
L-T debt	0.25	7.20%	1.80%
Preferred stock	0.10	13.50%	1.35%
Common stock	0.65	16.00%	10.40%
			13.55%

b. Target market weights:

Type of Capital	Weight	Cost	Weighted Cost
L-T debt	0.30	7.20%	2.160%
Preferred stock	0.15	13.50%	2.025%
Common stock	0.55	16.00%	8.800%
			12.985%

c. Using the historical weights the firm has a higher cost of capital due to the weighting of the more expensive common stock component (0.65) versus the target weight of (0.55). This over-weighting in common stock leads to a smaller proportion of financing coming from the significantly less expense L-T debt and the lower costing preferred stock.

P10-14. LG 2, 3, 4, 5: Calculation of specific costs, WACC, and WMCC

Challenge

a. Cost of debt: (approximate)

$$r_d = \frac{I + \frac{(\$1{,}000 - N_d)}{n}}{\frac{(N_d + \$1{,}000)}{2}}$$

$$r_d = \frac{\$100 + \frac{(\$1{,}000 - \$950)}{10}}{\frac{(\$950 + \$1{,}000)}{2}} = \frac{\$100 + \$5}{\$975} = 10.77\%$$

$r_i = 10.77 \times (1 - 0.40)$

$r_i = 6.46\%$

Cost of preferred stock: $r_p = \frac{D_p}{N_p}$

$$r_p = \frac{\$8}{\$63} = 12.70\%$$

Cost of common stock equity: $r_s = \frac{D_1}{P_0} + g$

$$g = \frac{D_{2009}}{D_{2005}} = \text{FVIF}_{k\%,4}$$

$$g = \frac{\$3.75}{\$2.85} = 1.316$$

From FVIF table, the factor closest to 1.316 occurs at 7% (i.e., 1.311 for 4 years).
Calculator solution: 7.10%

$$r_r = \frac{\$4.00}{\$50.00} + 0.07 = 15.00\%$$

Cost of new common stock equity:

$$r_n = \frac{\$4.00}{\$42.00} + 0.07 = 16.52\%$$

b. Breaking point = $\frac{\text{AF}_j}{W_j}$

$$\text{BP}_{\text{common equity}} = \frac{[\$7{,}000{,}000 \times (1 - 0.6^*)]}{0.50} = \$5{,}600{,}000$$

Between \$0 and \$5,600,000, the cost of common stock equity is 15% because all common stock equity comes from retained earnings. Above \$5,600,000, the cost of common stock equity is 16.52%. It is higher due to the flotation costs associated with a new issue of common stock.

*The firm expects to pay 60% of all earnings available to common shareholders as dividends.

c. WACC—$0 to $5,600,000:

L-T debt	0.40 × 6.46%	=	2.58%
Preferred stock	0.10 × 12.70%	=	1.27%
Common stock	0.50 × 15.00%	=	7.50%
		WACC =	11.35%

d. WACC—above $5,600,000:

L-T debt	0.40 × 6.46%	=	2.58%
Preferred stock	0.10 × 12.70%	=	1.27%
Common stock	0.50 × 16.52%	=	8.26%
		WACC =	12.11%

P10-15. LG 4: Weighted-average cost of capital

Intermediate

	Rate [1]	Outstanding Loan Balance [2]	Weight [2] ÷ 64,000 = [3]	WACC [1] × [3]
Loan 1	6.00%	$20,000	31.25%	1.88%
Loan 2	9.00%	$12,000	18.75%	1.69%
Loan 3	5.00%	$32,000	50.00%	2.50%
Total		$64,000		6.06%

John Dough should not consolidate his college loans because their weighted cost is less than the 7.2% offered by his bank.

P10-16. LG 2, 3, 4, 5: Calculation of specific costs, WACC, and WMCC

Challenge

a. Debt: (approximate)

$$r_d = \frac{I + \frac{(\$1{,}000 - N_d)}{n}}{\frac{(N_d + \$1{,}000)}{2}}$$

$$r_d = \frac{\$80 + \frac{(\$1{,}000 - \$940)}{20}}{\frac{(\$940 + \$1{,}000)}{2}} = \frac{\$80 + \$3}{\$970} = 8.56\%$$

$$r_i = r_d \times (1 - t)$$

$$r_i = 8.56\% \times (1 - 0.40)$$

$$r_i = 5.14\%$$

Preferred stock:

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

$$r_p = \frac{\$7.60}{\$90} = 8.44\%$$

Common stock:

$$r_n = \frac{D_j}{N_n} + g$$

$$r_p = \frac{\$7.00}{\$78} = 0.06 = 0.1497 = 14.97\%$$

Retained earnings:

$$r_r = \frac{D_1}{P_0} + g$$

$$r_p = \frac{\$7.00}{\$90} + 0.06 = 0.1378 = 13.78\%$$

b. Breaking point = $\frac{AF_j}{W_i}$

1. $\text{BP}_{\text{common equity}} = \frac{[\$100{,}000\ ]}{0.50} = \$200{,}000$

	Type of Capital	Target Capital Structure%	Cost of Capital Source	Weighted Cost
2.	WACC equal to or below $200,000 BP:			
	Long-term debt	0.30	5.1%	1.53%
	Preferred stock	0.20	8.4%	1.68%
	Common stock equity	0.50	13.8%	6.90%
				WACC = 10.11%
3.	WACC above $200,000 BP:			
	Long-term debt	0.30	5.1%	1.53%
	Preferred stock	0.20	8.4%	1.68%
	Common stock equity	0.50	15.0%	7.50%
				WACC = 10.71%

P10-17. LG 4, 5, 6: Integrative–WACC, WMCC, and IOS

Challenge

a. **Breaking points and ranges:**

Source of Capital	Cost%	Range of New Financing	Breaking Point	Range of Total New Financing
Long-term debt	6	$0–$320,000	$320,000 ÷ 0.40 = $800,000	$0–$800,000
	8	$320,001 and above		Greater than $800,000
Preferred stock	17	$0 and above		Greater than $0
Common stock	20	$0–$200,000	$200,000 ÷ 0.40 = $500,000	$0–$500,000
equity	24	$200,001		Greater than

and above	$500,000

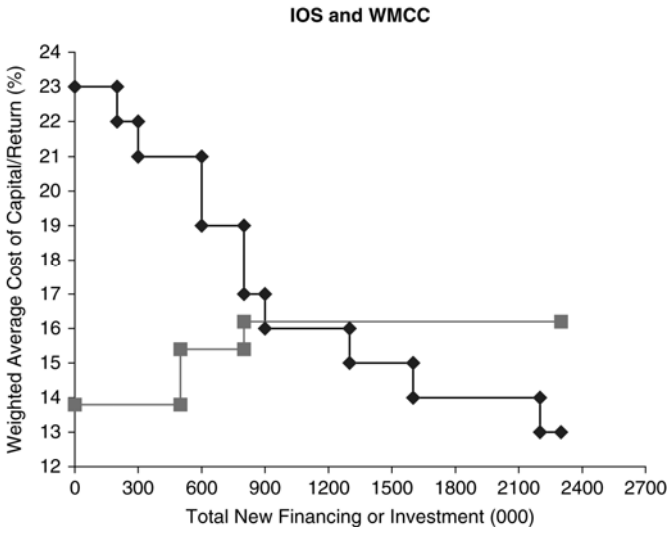
b. WACC will change at $500,000 and $800,000.

c. **WACC**

Range of Total New Financing	Source of Capital (1)	Target Proportion (2)	Cost% (3)	Weighted Cost (2) × (3) (4)
$0 – $500,000	Debt	0.40	6	2.40%
	Preferred	0.20	17	3.40%
	Common	0.40	20	8.00%
				WACC = 13.80%
$500,000 – $800,000	Debt	0.40	6%	2.40%
	Preferred	0.20	17%	3.40%
	Common	0.40	24%	9.60%
				WACC = 15.40%
Greater than $800,000	Debt	0.40	8%	3.20%
	Preferred	0.20	17%	3.40%
	Common	0.40	24	9.60%
				WACC = 16.20%

d. **IOS data for graph**

Investment	IRR	Initial Investment	Cumulative Investment
E	23%	$200,000	$ 200,000
C	22	100,000	300,000
G	21	300,000	600,000
A	19	200,000	800,000
H	17	100,000	900,000
I	16	400,000	1,300,000
B	15	300,000	1,600,000
D	14	600,000	2,200,000
F	13	100,000	2,300,000



e. The firm should accept Investments E, C, G, A, and H, since for each of these, the IRR on the marginal investment exceeds the WMCC. The next project (i.e., *I*) cannot be accepted since its return of 16% is below the weighted marginal cost of the available funds of 16.2%.

P10-18. Ethics problem

Intermediate

The company would likely try to deny the claim on the basis that no damages have been sustained or proven by the claimant. The claimant would argue that the company might not be around to pay damages when the symptoms emerge and that the damage has already been done even if the symptoms are not present.

■ Case

Making Star Products' Financing/Investment Decision

The Chapter 10 case, Star Products, is an exercise in evaluating the cost of capital and available investment opportunities. The student must calculate the component costs of financing, long-term debt, preferred stock, and common stock equity; determine the breaking points associated with each source; and calculate the WACC. Finally, the student must decide which investments to recommend to Star Products.

1. Cost of financing sources

Debt:

Below $450,000:

$$r_d = \frac{I + \frac{(\$1{,}000 - N_d)}{n}}{\frac{(N_d + \$1{,}000)}{2}}$$

$$r_d = \frac{\$90 + \frac{(\$1{,}000 - \$960)}{15}}{\frac{(\$960 + \$1{,}000)}{2}}$$

$$r_d = \frac{\$92.67}{\$980} = 0.0946 = 9.46\%$$

$$r_i = r_d \times (1 - t)$$

$$r_i = 9.46 \times (1 - 0.4)$$

$$r_i = 5.68\%$$

Above \$450,000: $r_i = r_d \times (1 - t)$

$$r_i = 13.0 \times (1 - 0.4)$$

$$r_i = 7.8\%$$

Preferred stock:

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

$$r_p = \frac{\$9.80}{\$65} = 0.1508 = 15.08\%$$

Common stock equity:

\$0–\$1,500,000:

$$r_r = \frac{D_i}{P_0} + g$$

$$r_r = \frac{\$0.96}{\$12} + 0.11 = 19\%$$

Above \$1,500,000:

$$r_r = \frac{D_i}{N_n} + g$$

$$r_r = \frac{\$0.96}{\$9} + 0.11 = 21.67\%$$

2. **Breaking points**

$$\text{Breaking point} = \frac{\text{AF}_j}{W_i}$$

$$\text{BP}_{\text{Long-term debt}} = \frac{\$450,000}{0.30} = \$1,500,000$$

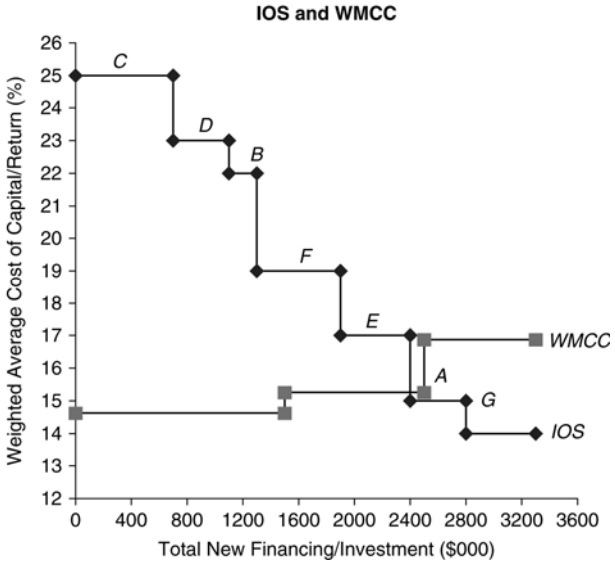
$$\text{BP}_{\text{common equity}} = \frac{\$1,500,000}{0.60} = \$2,500,000$$

3. **Weighted average cost of capital:**

	Type of Capital	Target Capital Structure %	Cost of Capital Source	Weighted Cost
1.	From \$0 to \$1,500,000:			
	Long-term debt	0.30	5.7%	1.71%
	Preferred stock	0.10	15.1%	1.51%
	Common stock equity	0.60	19.0%	11.40%

	1.00		WACC = 14.62%
2. From $1,500,000 to $2,500,000:			
Long-term debt	0.30	7.8%	2.34%
Preferred stock	0.10	15.1%	1.51%
Common stock equity	0.60	19.0%	11.40%
	1.00		WACC = 15.25%
3. Above $2,500,000:			
Long-term debt	0.30	7.8%	2.34%
Preferred stock	0.10	15.1%	1.51%
Common stock equity	0.60	21.7%	13.02%
	1.00		WACC = 16.87%

4.



5. Projects C, D, B, F, and E should be accepted, because each has an IRR greater than the WACC. These projects will require $2,400,000 in new financing.

■ Spreadsheet Exercise

The answer to Chapter 10's measurement of the cost of capital at Nova Corporation spreadsheet problem is located in the Instructor's Resource Center at *www.prenhall.com/irc*.

■ A Note on Web Exercises

A series of chapter-relevant assignments requiring Internet access can be found at the book's Companion Website at *http://www.prenhall.com/gitman*. In the course of completing the assignments students access information about a firm, its industry, and the macro economy, and conduct analyses consistent with those found in each respective chapter.