Answers to Warm-Up Exercises

E9-1. Weighted average cost of capital

Answer: N = 10, PV = \$20,000 (1 – 0.02) = \$19,600, PMT = –0.08 × \$20,000 = –\$1,600, FV = –\$20,000

Solve for I = 8.30%

E9-2. Cost of preferred stock

Answer: The cost of preferred stock is the ratio of the preferred stock dividend to the firm's net proceeds from the sale of the preferred stock.

$r_p = D_p \div N_p$

$r_p = (0.15 \times \$35) \div (\$35 - \$3)$

$r_p = \$5.25 \div \$32 = 16.4\%$

E9-3. Cost of common stock equity

Answer: The cost of common stock equity can be found by dividing the dividend expected at the end of year 1 by the current price of the stock and adding the expected growth rate.

$r_s = (D_1 \div P_0) + g$

$r_s = (\$6.50 \div \$78) + 7\% = 15.33\%$

E9-4. Weighted average cost of capital

Answer: $r_a = (0.35 \times 0.08) + (0.65 \times 0.13) = 0.0280 + 0.0845 = 11.25\%$

E9-5. Weighted average cost of capital

Answer: $r_a = (0.55 \times 0.067) + (0.10 \times 0.092) + (0.35 \times 0.106) = 0.0832 = 8.32\%$

Solutions to Problems

P9-1. Concept of cost of capital

LG 1; 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. $r_a = w_d r_d + w_e r_e$

$r_a = 0.40\ (7\%) + 0.60(16\%)$

$r_a = 2.8\% + 9.6\%$

$r_a = 12.4\%$

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.

P9-2. Cost of debt using both methods

LG 3; 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:

N = 15, P = 980, PMT = –120, FV = –1,000

Solve for I: 12.30%

After-tax cost: 12.30% (1 – 0.4) = 7.38%

d. Approximate before-tax cost of debt

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

r_d = \$121.33 ÷ \$990,000

r_d = 12.26%

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

e. The advantages of the calculator method are evident. There are fewer keypunching strokes and one gets the actual cost of debt financing. However, the approximation formula is fairly accurate and expedient in the absence of a financial calculator.

P9-3. Before-tax cost of debt and after-tax cost of debt

LG 3; Easy

a. N = 10, PV = – 930 (an expenditure), PMT = 0.6(1,000) = 60, FV = 1,000
Solving for I = 7.00%

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

P9-4. Cost of debt using the approximation formula:

LG 3; Basic

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

Bond A

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

r_i = 9.44% × (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

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

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

P9-5. Cost of debt using the approximation formula

LG 3; Intermediate

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

Alternative A

$$r_d = \frac{\$90 + \frac{\$1{,}000 - \$1{,}220}{16}}{\frac{\$1{,}220 + \$1{,}000}{2}} = \frac{\$76.25}{\$1{,}110} = 6.87\%$$

$r_i = 6.87\% \times (1 - 0.40) = 4.12\%$

Calculator: N = 16, PV = $1,220, PMT = –$90, FV = –$1,000

Solve for I: 6.71%

After-tax cost of debt: 4.03%

Alternative B

$$r_d = \frac{\$70 + \frac{\$1{,}000 - \$1{,}020}{5}}{\frac{\$1{,}020 + \$1{,}000}{2}} = \frac{\$66.00}{\$1{,}010} = 6.54\%$$

$r_i = 6.54\% \times (1 - 0.40) = 3.92\%$

Calculator: N = 5, PV = $1,020, PMT = –$70, FV = –$1,000

Solve for I: 6.52%

After-tax cost of debt: 3.91%

Alternative C

$$r_d = \frac{\$60 + \frac{\$1{,}000 - \$970}{7}}{\frac{\$970 + \$1{,}000}{2}} = \frac{\$64.29}{\$985} = 6.53\%$$

$r_i = 6.53\% \times (1 - 0.40) = 3.92\%$

Calculator: N = 7, PV = $970, PMT = –$60, FV = –$1,000

Solve for I: 6.55%

After-tax cost of debt: 3.93%

Alternative D

$$r_d = \frac{\$50 + \frac{\$1{,}000 - \$895}{10}}{\frac{\$895 + \$1{,}000}{2}} = \frac{\$60.50}{\$947.50} = 6.39\%$$

$r_i = 6.39\% \times (1 - 0.40) = 3.83\%$

Calculator: N = 10, PV = $895, PMT = –$50, FV = –$1,000

Solve for I: 6.46%

After-tax cost of debt: 3.87%

P9-6. After-tax cost of debt

LG 3; 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.

P9-7. Cost of preferred stock: $r_p = D_p \div N_p$

LG 2; Basic

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

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

P9-8. Cost of preferred stock: $r_p = D_p \div N_p$

LG 4; Basic

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

P9-9. Cost of common stock equity—capital asset pricing model (CAPM)

LG 5; 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%

P9-10. Cost of common stock equity: $k_n = \frac{D_1 + g}{N_n}$

LG 5; Intermediate

a. N = 4 (2012 − 2008), PV (initial value) = −\$2.12, FV (terminal value) = \$3.10
Solve for I (growth rate): 9.97%

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

c. r_r = (Next Dividend ÷ Current Price) + growth rate
r_r = (\$3.40 ÷ \$57.50) + 0.0997
r_r = 0.0591 + 0.0997 = 0.1588 or 15.88%

d. r_r = (\$3.40 ÷ \$52) + 0.0997
r_r = 0.0654 + 0.0997 = 0.1651 or 16.51%

P9-11. Retained earnings versus new common stock

LG 5; Intermediate

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

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%

P9-12. Effect of tax rate on WACC

LG 3, 4, 5, 6; Intermediate

a. WACC = (0.30)(11%)(1 − 0.40) + (0.10)(9%) + (0.60)(14%)
WACC = 1.98% + 0.9% + 8.4%
WACC = 11.28%

b. WACC = (0.30)(11%)(1 − 0.35) + (0.10)(9%) + (0.60)(14%)
WACC = 2.15% + 0.9% + 8.4%
WACC = 11.45%

c. WACC = (0.30)(11%)(1 − 0.25) + (0.10)(9%) + (0.60)(14%)
WACC = 2.48% + 0.9% + 8.4%
WACC = 11.78%

d. As the tax rate decreases, the WACC increases due to the reduced tax shield from the tax-deductible interest on debt.

P9-13. WACC—book values

LG 6; 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.

P9-14. WACC—book weights and market weights

LG 6; 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.

P9-15. WACC and target weights

LG 6; 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 expensive long-term debt and the lower-costing preferred stock.

P9-16. Cost of capital

LG 3, 4, 5, 6; Challenge

a. Cost of retained earnings

$$r_r = \frac{\$1.26(1+0.06)}{\$40.00} + 0.06 = \frac{\$1.34}{\$40.00} = 3.35\% + 6\% = 9.35\%$$

b. Cost of new common stock

$$r_s = \frac{\$1.26(1+0.06)}{\$40.00-\$7.00} + 0.06 = \frac{\$1.34}{\$33.00} = 4.06\% + 6\% = 10.06\%$$

c. Cost of preferred stock

$$r_p = \frac{\$2.00}{\$25.00-\$3.00} = \frac{\$2.00}{\$22.00} = 9.09\%$$

d. $$r_d = \frac{\$100 + \frac{\$1,000-\$1,175}{5}}{\frac{\$1,175+\$1,000}{2}} = \frac{\$65.00}{\$1,087.50} = 5.98\%$$

$r_i = 5.98\% \times (1 - 0.40) = 3.59\%$

e. WACC = (0.40)(3.59%) + (0.10)(9.09%) + (0.50)(9.35%)
WACC = 1.436 + 0.909 + 4.675
WACC = 7.02%

P9-17. Calculation of individual costs, WACC, and WMCC

LG 3, 4, 5, 6; Challenge

a. After-tax cost of debt

Approximate Approach

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

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

$r_i = 10.77 \times (1 - 0.40)$
$r_i = 6.46\%$

Calculator approach

N = 10, PV = $950, PMT = –$100, FV = –$1,000
Solve for I: 10.84%
After-tax cost of debt: 10.84 (1 – 0.40) = 6.51%

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

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

c. Cost of new common stock equity:
Solve for g:
N = 4, PV = –$2.85, FV = $3.75
Solve for I: 7.10%
Net Proceeds: Current price – Price adjustment – Floatation cost
$50 – $5 – $3 = $42

r_n = $4.00 ÷ $42.00 + 0.0710 = 0.0952 + 0.0710 = 0.1662 = $16.62%

d.

WACC:	L-T debt	0.40 × 6.51%	=	2.60%
	Preferred stock	0.10 × 12.70%	=	1.27%
	Common stock	0.50 × 16.62%	=	8.31%
	WACC		=	12.18%

P9-18. Weighted-average cost of capital

LG 6; 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.

P9-19. Calculation of individual costs and WACC

LG 3, 4, 5, 6; Challenge

a. After-tax cost of debt
Approximate approach

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

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

$r_i = rd \times (1 - t)$
$r_i = 8.56\% \times (1 - 0.40)$
$r_i = 5.14\%$
Calculator approach
N = 20, PV = $940, PMT = –$80, FV = –$1,000
Solve for I: 8.64%
After-tax cost of debt: 8.64% (1 –0.40) = 5.18%

b. Preferred stock:

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

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

c. Retained earnings:

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

= ($7.00 ÷ $90) + 0.06 = 0.0778 + 0.0600 = 0.1378 or 13.78%

New common stock:

$$r_n = \frac{D_1}{N_n} + g$$

= [$7.00 ÷ ($90 – $7 – $5)] + 0.06

= [$7.00 ÷ $78] + 0.06 = 0.0897 + 0.0600 = 0.1497 or 14.97%

	Type of Capital	Target Capital Structure %	Cost of Capital Source	Weighted Cost
2.	With retained earnings			
	Long-term debt	0.30	5.18%	1.55%
	Preferred stock	0.20	8.44%	1.69%
	Common stock equity	0.50	13.78%	6.89%
				WACC = 10.13%
3.	With new common stock			
	Long-term debt	0.30	5.18%	1.55%
	Preferred stock	0.20	8.44%	1.69%
	Common stock equity	0.50	14.97%	7.48%
				WACC = 10.72%

P9-20. Weighted-average cost of capital

LG 6; Intermediate

a. WACC = 0.50 (0.06) + 0.50 (0.12) = 0.03 + 0.06 = 0.09 or 9.0%

b. WACC = 0.70 (0.06) + 0.30 (0.12) = 0.042 + 0.036 = 0.078 or 7.8%

c. They are affected, because under the revised capital structure there is more debt financing. Bond holders represent a prior, legal claim to the firm's operating income. A larger interest expense must be paid prior to any dividend payment. There is also a greater chance of bankruptcy, because the firm's operating income may be insufficiently large to accommodate the larger interest expense.

d. WACC = 0.70 (0.06) + 0.30 (0.16) = 0.042 + 0.048 = 0.09, or 9%

e. Increasing the percentage of debt financing increases the risk of the company not being able to make its interest payments. Bankruptcy would have negative consequences to both bondholders and stockholders. As shown in part d, if stockholders increase their required rate of return, the cost of capital may not decline. In fact, if the bondholders required a higher return also, the cost of capital would actually rise in this scenario.

P9-21. Ethics problem

LG 1; Intermediate

GE’s long string of good earnings reports made the company seem less risky, so it's cost of capital would be lower (e.g., the AAA credit rating mentioned in the chapter opener is evidence of

this). If investors learn that GE is really more risky than it seems, then the cost of capital will go up and GE's value will fall.