Chapter 27

27-1
The cost of capital of Genzyme is 15(0.9)+(0.1)(4) = 13.9%. The present value of the drug if it were developed immediately for commercial production would be the present value of an annuity of \$ 100 million growing at 5% a year for 14 years - \$ 802 million. Since the costs of immediate development are \$1 billion, the net present value of immediate development is positive, and equals -\$198 million. However, it might be worth more to wait.

The inputs to the option to wait are as follows: S = \$802; K = 1000; t = 14; Standard deviation = 50%; r = 5%; y = Dividend Yield = 1/Project Life = 1/14 = 0.0714286. The value of the option is $Se^{-yt}N(d_1) - Ke^{-rt}N(d_2)$, where $d_1 = \frac{\ln(S/K) + (r - y + \sigma^2/2)t}{\sigma\sqrt{t}}$,

$d_2 = d_1 - \sigma\sqrt{t}$. The option value can be written as
$802\ e^{-14(0.0714286)}\ N(1.1261) - 1000e^{-14(0.05)}N(-1.5197)$. Since $N(d_1) = 0.8699$; $N(d_2) = 0.0643$, the option value is \$ 224.74 million.

27-2
S = PV of \$25 million a year for 20 years at 16% = \$148.22 million
K = Cost of Taking Project = \$300 million
t = 10 years
Standard Deviation = 20%
r = 12%
y = Dividend Yield = 1/ Project Life = 10%

27-3
Using put-call parity, we can value a call with K = 50 and a 1-year life,
Call - Put = S - Ke^{-rt} = \$12.00 + \$45 - \$50 $e^{-(.1)}$ = \$11.76
We can also value of call with a strike price of \$75,
Call = \$31 + \$45 - \$75 e-(.1) = \$8.14
The value of the executive package can be estimated as follows:
Guaranteed Payment = \$500,000
Value of Bonus Package:
10,000 *(\$11.76-\$8.14) = \$36,200
(This is a capped call, since the executive bonus is capped off at \$75.)

27-4
a. NPV of Project = -\$5,000,000 + \$500,000 (PVA,15%,10) + \$5,000,000/1.15^{10} = -\$1,254,692

b. Value the option to abandon (per square foot)

S = \$50	Standard Deviation = Standard Deviation in Price/SqF
K = \$50	= 46.84%
t = 5 years	Riskless Rate = 6%

Value per put option = \$11.54 (for 1 square foot)
Value for 100,000 square feet = 100,000 * \$11.54 = \$1,154,000

27-5
a. True. Equity investors cannot lose more than their equity investment.
b. False. They can make equity more valuable, not the firm.
c. True. It transfers wealth to the bondholders.
d. True. This is the equivalent of the life of the option.
e. True. There is a transfer of wealth to bondholders.

27-6
a. Reinvestment rate = g/ROC = 5%/10% = 50%
Value of the firm = 40(1.05)(1-.5)(1-0.4)/(.10-.05) = \$252 million

b.
The value of the equity is computed as a call option on the value of the firm, using the call option pricing formula, $SN(d_1) - Ke^{-rt}N(d_2)$, where $d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)t}{\sigma\sqrt{t}}$,

$d_2 = d_1 - \sigma\sqrt{t}$.
S = \$252
K = \$500
t = 5 years
r = 5%
s = 0.125
The equity or call option value can be written as 252 N(-1.4172) -500 $e^{-0.25}$ N(-1.6967).
Since $N(d_1) = 0.0782$; $N(d_2) = 0.0449$, the option value is \$2.23 million.
Value of Call (Equity) = \$2.23 million

c. Value of Debt = \$252 - \$2.23 = \$249.77 million
Appropriate Interest Rate = $(500/249.77)^{1/5} - 1 = 14.89\%$

27-7
a. Free cash flows to the firm equal \$850 + 400 – 400 = \$850. Firm Value =

$$\frac{\$850(0.6)(1.20)\left[1-\frac{1.20^5}{1.10^5}\right]}{(0.10-0.20)} + \frac{\$850(0.6)(1.20)^5(1.05)}{(0.10-0.05)(1.1)^5} = \$19,883$$

b. Standard Deviation of Firm = $(0.67)^2(0.35)^2 + (0.33)^2(0.15)^2 + 2(0.67)(0.33)(.5)(.35)(.15) = 0.2619$
S = 19,883.21
r = 5%
K = FV of Debt = 10,000
Variance = $0.2619^2 = 0.07$
t = Average Duration of Debt = 3
Dividend Yield = 0

d1 = 2.07 N(d1) = 0.98
d2 = 1.62 N(d2) = 0.95
Value of Call (Equity) = $11,350

c. Market Value of Equity = $12,200 Implied Variance = 0.25
Implied Standard Deviation = 0.5 (Trial and Error)

d. Market Value of Debt = $8,534

27-8

a. PV of Inflows = 400,000 * 0.85 * (1 - $1.04^{25}/1.07^{25}$)/(.07 - .04) -400,000 * 0.40 * (1 - $1.03^{25}/1.07^{25}$)/(.07 - .03) = $3,309,756
Fixed Costs associated with opening = -3,000,000
NPV = 3,309,756 -3,000,000 = $309,756

b.
S = 3,309,756
K = 3,000,000
t = 25
r = 7%
σ = 0.25
y = 1/25 = 4%

Value of the Call Option = $828,674

c. The latter considers the option characteristics of owning the mine, i.e., that copper prices may go up, and is higher.

27-9

Current Value of Developed Reserve = 10,000,000 * ($20 - $6) = $140,000,000
Exercise Price = Cost of Developing Reserve = $120,000,000
t = 20 years
r = 7%
s = 20%
y = 4%
Value of Call (Natural Resource Reserve) = $37,360,435

27-10

a. NPV of Project = $250 - $200 = $50 million

b. The option has the following characteristics:
S = 250
K = 200
r = 8%
t = 5
Variance = 0.04
Dividend Yield = 12.5/250 = 5%

Value of Call (Project Rights) = $68.68

c. The latter captures the value of delaying the project. The difference between the two values will increase as the variance in the project cash flows increases.

27-11
a. S = PV of Cash Inflows on Project = 250
K = Cost of Taking Project = 500
t = 10 years
r = 6%
s = 0.6
y = 10/250 = 4%
Value of Call (Product Patent) = $95 million

b. It is an increasing function of the variance in project cash flows. This analysis suggests that the rights to products in technologically volatile areas are likely to be worth a great deal, even though the products may not be viable now.