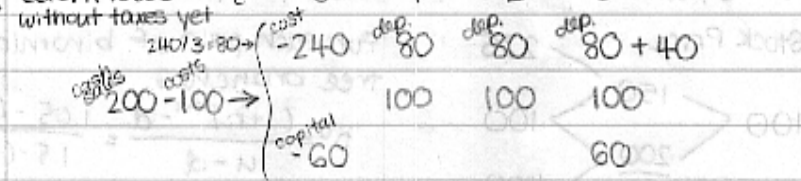


1. Cashflows $t = 0, 1, 2, 3$



$$NPV = PV - \text{Cost}$$

$$= \frac{(100-80)(1-0.4) + 80}{(1+0.08)} + \frac{(100-80)(1-0.4) + 80}{1.08^2}$$

$$+ \frac{(100+40-80)(1-0.4) + 80 + 60}{1.08^3} - (240+60)$$

$$\approx \boxed{3.77}$$

2. $V_L = V_U + PV(\text{debt tax shield})$

Taxable Income $t =$	1	2	3
before debt tax shield	20	20	60
after "potential worth"	0	0	35
			$\min(0, 20-25) \quad 60-25$

Debt Tax Shield $(20(0.4) \quad 20(0.4) \quad 25(0.4))$

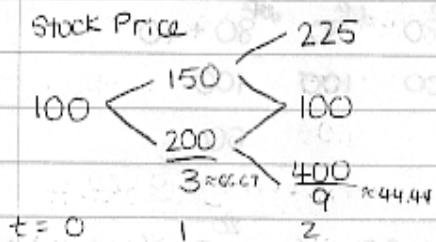
$$NPV \approx 3.77 + \left(\frac{20}{1.08} + \frac{20}{1.08^2} + \frac{25}{1.08^3} \right) 0.4 \approx \boxed{25.97}$$

same with NPV =

$$\frac{100}{1.08} + \frac{100}{1.08^2} + \frac{(100+40-80-25)(0.6) + 80 + 60 + 25}{1.08^3}$$

$$- 300 \approx 25.98 \checkmark$$

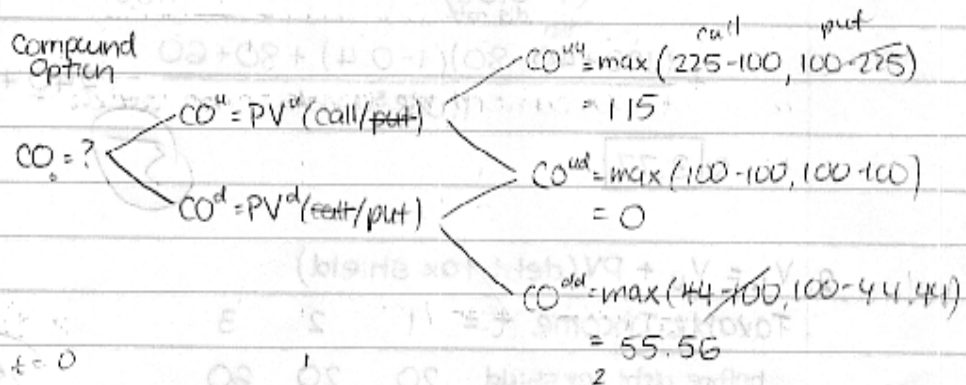
3. $u = 1.5$, $d = 1/1.5 \approx 0.67$; $r = 0.05$ per period



For each pair of binomial tree branches,

$$p^u = \frac{(1+r)^T - d}{u - d} = \frac{1.05 - (1/1.5)}{1.5 - (1/1.5)}$$

$$p^u = 0.46 \text{ (1's with #s in tree)}$$



$$CO^u = \frac{1}{1.05} (0.46(115) + 0) \approx 50.38095238$$

$$CO^d = \frac{1}{1.05} (0 + (1-0.46)(55.56)) \approx 28.57142857$$

$$CO_0 = \frac{1}{1.05} (0.46(50.38) + 0.54(28.57)) \approx \boxed{36.77}$$

4. $1000 \begin{cases} 1500 \\ 800 \end{cases}$ $1000 = \frac{1}{1.05} [p^4 1500 + (1-p^4) 800]$

$r = 5\%$ 100 shares

$$\frac{1500}{1.05} p^4 - \frac{800}{1.05} p^4 = 1000 - \frac{800}{1.05}$$

$D = 10$ E & C bonds
For one bond 1:1
 $p^4 = \frac{(1000 - 800)}{\left(\frac{1500}{1.05} - \frac{800}{1.05}\right)} \approx 0.357$

no free bond
 $B = \frac{1}{1+r} D - \frac{1}{1+r} E^* [\max(D - V, 0)] + \frac{1}{1+r} E^* [\max(\frac{V}{2} - D, 0)]$

Value of 100 convertible bonds = corporate debt B

$$\rightarrow \frac{1}{1.05} (100 \times 10) - \frac{1}{1.05} [(1 - 0.357)(1000 - 800) + (0.357) \cdot 0]$$

will not convert $\rightarrow \frac{1}{1.05} [0.357(0) + 0] \rightarrow 0$ b/c $1000 > \frac{1500}{2} = 750 > \frac{800}{2} = 400$

≈ 829.93

ONE C bond $\rightarrow \div 100 \approx 8.30$

$V = B + E ; E = V - B$

$E = 1000 - 829.93 = 170.07 = \frac{1}{1.05} [0.357(500) - 0]$

$B = 829.93$, one convertible bond ≈ 8.30
 $E = 170.07$, one share of equity = 1.70

5

* assume personal wealth includes stock value held

* Please see description of scenarios to see what I thought

5(a) Scenario ①: firm pays dividends, you ^{problem meant} keep all stocks

$$(27 \times 100) + (3 \times 100)(1 - 0.28) = 2,916$$

stock held dividends taxes, income

Scenario ②: firm does not pay div., you sell 10 shares

$$(30 \times 90) + (10 \cdot 30) - (10(30 - 20))(0.78) = 2,972$$

stock held stock sold capt. gains tax

div. paid: \$2,916

you sell 10 shares: \$2,972

✓

(b) ① $2700 + (300)(1 - 0.4) = 2880$

② $2700 + 300 - (100)(0.16) = 2984$

div. paid: \$2,880

you sell: \$2,984

✓

⑤

⑦

Q5 (Note: capital gains taxes are not paid and need not be taken into account until you realize them; in principle, you NEVER realize capital gains).

(a) Scenario 1:

$$300(1-0.28) + 100.27 = 2916$$

Scenario 2:

$$-(300-200)(0.28) + 300 + 90.30 = 2992$$

(b) Scenario 1:

$$300(1-0.40) + 100.27 = 2880$$

Scenario 2:

$$-(300-200)(0.16) + 300 + 90.30 = 2984$$

Q6 \$20. All the NPV goes to the shareholders.

Q7. Several possibilities:

(a) Firm A and B merge.

(b) Firm B takes over one division of Firm A with debt obligations in exchange of equity in Firm B.

(Note: issuing new debt is not an option, because the first coupon is not due until the future).

Q8 Over 1 year:

$$E(\ln W_1 - \ln W_0) = 0.15$$

$$V(\ln W_1 - \ln W_0) = 0.15^2 = 0.0225$$

Over 15 years:

$$E(\ln W_{15} - \ln W_0) = E\left(\sum_{t=1}^{15} \ln R_t\right)$$

$$= \sum_{t=1}^{15} E(\ln R_t)$$

$$= 15(0.15) = 2.25$$

$$V(\ln W_{15} - \ln W_0) = V\left(\sum_{t=1}^{15} \ln R_t\right)$$

$$= \sum_{t=1}^{15} V(\ln R_t) \quad (\text{independence!})$$

$$= 15(0.15^2) = 0.3375$$

Q9 (a) $P\left(\frac{W_1}{W_0} > 1\right) = P(\ln W_1 - \ln W_0 > 0)$

$$= P(\ln R_1 > 0)$$

$$= P\left(\frac{\ln R_1 - 0.15}{0.15} > -1\right)$$

$$\sim N(0, 1)$$

$$= 0.84$$

(b) $P\left(\frac{W_{15}}{W_0} > 1\right) = P(\ln W_{15} - \ln W_0 > 0)$

$$= P\left(\sum_{t=1}^{15} \ln R_t > 0\right)$$

$$= P\left(\frac{\sum_{t=1}^{15} \ln R_t - 2.25}{\sqrt{0.3375}} > -\frac{2.25}{\sqrt{0.3375}}\right)$$

$$\sim N(0, 1)$$

$$= -3.8730$$

$$= 0.9998$$

$$(b) > (a)$$

$$\begin{aligned} \text{q10 } (a) &= P\left(\frac{W_1}{W_0} < 0.15\right) = P\left(\frac{\ln R_1 - 0.15}{0.15} < \frac{\ln 0.15 - 0.15}{0.15}\right) \\ &= P\left(\frac{\ln R_1 - 0.15}{0.15} < -13.65\right) \end{aligned}$$

$$\begin{aligned} (b) &= P\left(\frac{W_{15}}{W_0} < 0.15\right) = P\left(\frac{\sum_{t=1}^{15} \ln R_t - 2.25}{\sqrt{0.3375}} < \frac{\ln 0.15 - 2.25}{\sqrt{0.3375}}\right) \\ &= P\left(\frac{\sum_{t=1}^{15} \ln R_t - 2.25}{\sqrt{0.3375}} < -7.139\right) \end{aligned}$$

$$\text{So, } (b) > (a)$$

(Note: (a) and (b) are small numbers, but don't be fooled - they matter, e.g. when you have logarithmic utility - as Bernoulli suggested!)