Exam #1 Answer Key

1. No: the R&D expenditure is a sunk cost. If it spent twice as much or half as much to discover the drug, it should still charge the same price, because that's the price that maximizes profit. The only time that R&D costs affect the company's behavior is *before* they're sunk: when the company is thinking about spending money on R&D, it has to determine whether or not it's going to be profitable to make that investment given their estimate of how much they'll be able to charge for the pill. Once they do the R&D, however, it's a sunk cost and will no longer influence their profit-maximizing decisions.

2. To maximize your present value you need to compare the return you'll get from "investing in the fish" (or the trees, or the oil) with the return you'll get from investing in the bank. Investing in the bank means catching the fish, cutting down the trees, or selling the oil and putting the proceeds in the bank. Investing in the fish means letting the fish grow and reproduce so there will be more fish next year; investing in the trees means letting the trees grow so there will be more lumber next year; investing in the oil means keeping the oil in the hopes that the price will go up next year.

3. (a) The expected value of guessing randomly is $\frac{1}{6}(1) + \frac{5}{6}(0) = \frac{1}{6}$.

   (b) If an incorrect answer is worth x, the expected value from guessing randomly is $\frac{1}{6}(1) + \frac{5}{6}(x) = \frac{1+5x}{6}$. If the teacher wants this expected value to equal zero, she must set $x = -\frac{1}{5}$.

   (c) If you can't eliminate any answers, the expected value of guessing randomly is $\frac{1}{6}(1) + \frac{5}{6}\left(-\frac{1}{4}\right) = -\frac{1}{24}$. If you can eliminate one answer, you have a 1 in 5 chance of getting the right answer if you guess randomly, so your expected value if you can eliminate one answer is $\frac{1}{5}(1) + \frac{4}{5}\left(-\frac{1}{4}\right) = 0$. If you can eliminate two answers, you have a 1 in 4 chance of getting the right answer if you guess randomly, so your expected value if you can eliminate two answers is $\frac{1}{4}(1) + \frac{3}{4}\left(-\frac{1}{4}\right) = \frac{1}{16}$. So you need to eliminate at least two answers in order to make random guessing yield an expected value greater than zero.

4. (a) Higher interest rates favor the lump sum payment ("money today") because higher interest rates make the future less important: you need to put less money in the bank today in order to get $20 in 10 years if the interest rate goes up from 7% to 10%.

   (b) No: you can use the bank to transfer money between time periods. If the annuity has a higher value, you should choose the annuity and then borrow against it (or sell it) in order to have access to mondy today.

5. (a) Put $100 and 6% in the future value formula to get about $1028.57.

   (b) No: inflation means that you'll have 10 times more money, but not 10 times more purchasing power.

(c) Plug \$1 and 4% into the future value formula to get a price of about \$4.80. With \$1028.57, you'll be able to buy about 214 ice cream bars.

(d) The rule of thumb says that the real interest rate is approximately $6-4 = 2\%$. The true formula gives us $r = \frac{1+n}{1+i} - 1 = \frac{1.06}{1.04} - 1 \approx .019$, i.e., about 1.9%.

(e) Plug \$100 and 1.92% into the future value formula to get a future value of about \$214. This equals the answer from question 5c.

6. (a) The present value of \$56,499 one year ago is $(\$56,499)(1.08) = \$61,018.92$. The present value of \$56,499 today is simply that: \$56,499. And the perpetuity formula tells us that the present value of the payments in the future is $\frac{\$56,499}{.08} = \$706,237.50$. Add them together and you get \$823,755.42. The elegant alternative is to put yourself two years in the past, calculate the present value of the forthcoming stream of payments *from that perspective* to be \$706,237.50, and then translate this into today's money using the future value formula: $(\$706,237.50)(1.08)^2 = \$823,755.42$.

(b) The present value of $-\$30,000$ one year ago is $(-\$30,000)(1.08) = -\$32,400$. The present value of $-\$30,000$ today is simply that: $-\$30,000$. And the perpetuity formula tells us that the present value of the payments in the future is $\frac{\$77,147}{.08} = \$964,337.50$. Add them together and you get \$901,937.50.

(c) The perpetuity formula tells us that the present value of the infinite stream of payments is \$964,337.50. The annuity formula tells us that the present value of 40 years' worth of payments is

$$\$77,147 \left[\frac{1 - \frac{1}{(1.08)^40}}{.08} \right] \approx \$919,948.14.$$

Subtracting one from the other gives us a difference of \$44,389.36, which isn't really all that much. The elegant alternative approach, incidentally, is to notice that the difference between payments lasting forever and payments lasting 40 years is payments lasting forever starting at the end of year 40; we have already calculated the present value of these payments *from the perspective of year 40* to be \$964,337.50, so all we have to do is discount this amount back to today by using the lump sum formula: $\frac{\$964,337.50}{(1.08)^{40}} \approx \$44,389.36$.

(d) Put that amount of money in the bank at 8% interest and at the end of every year you can "live off the interest", an amount that equals $(\$964,337.50)(.08) = \$77,147$.

(e) This is calculated above to be approximately \$44,389.36.

(f) We need x such that $(.7)(\$100,000) + (.3)(\$x) = \$77,147$. Solving for x gives $x \approx 23,823.33$.

(g) The present value of \$56,499 one year ago is still

$$(\$56,499)(1.08) = \$61,018.92.$$

Adjusting today's payment for inflation yields

$$(\$56,499)(1.04) = \$58,758.96,$$

and its present value is exactly that: \$58,758.96. The present value of future payments can be calculated using \$58,758.96 and the *real interest rate*, which turns out to be $\frac{1}{26}$, or about 3.846%. Plugging this into the perpetuity formula gives us $\$1,527,732.96 \approx \frac{\$58,758.96}{.03846}$. (The number to the left of the equal sign is actually the precise number using $\frac{1}{26}$ rather than .03846.) Add them together and you get \$1,647,510.84. The elegant alternative is to put yourself two years in the past, when the inflation-adjusted wage was $\frac{\$56,499}{1.04} = \$54,325.96154$; use the *real* interest rate to calculate the present value of the forthcoming stream of payments *from that perspective* to be $\$1,412,475.00 \approx \frac{\$54,325.96}{.03846}$; and then translate this into today's money using the future value formula and the *nominal* interest rate: $(\$1,412,475.00)(1.08)^2 = \$1,647,510.84$.