Exam #1 Answer Key

1. (a) 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.

   (b) 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. (a) The expected cost is $(.90)(0) + (.10)(\$20) = \$2$.

   (b) The city could increase the amount of the ticket from \$20 to \$200. This would mean that the expected value of risking it is still \$2: $(.99)(0) + (.01)(\$200) = \$2$.

3. (a) Plug \$100 and 5% into the perpetuity formula to get a present value of \$2000.

   (b) Plug \$84 and 5% into the perpetuity formula to get a present value of \$1680. Adding this to the \$400 you get from catching 400 fish today and you get a present value of \$2080, which is higher than the present value of the maximum sustainable yield policy.

   (c) 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 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. It turns out that maximum sustainable yield (MSY) is not the economically optimal policy because the *marginal* interest rate you get from investing in the fish is zero at MSY!

4. (a) Plug \$225 billion, .06, and 75 years into the annuity formula to get a present value of about \$3.7 trillion.

   (b) If we put \$3.7 trillion in the bank today at 6% interest, we can make the Social Security system solvent for the next 75 years.

   (c) Plugging \$600 billion and .06 into the present value of a perpetuity formula, we can see that the present value of an infinite stream of \$600 billion payments is \$10 trillion at a 6% interest rate.

5. (a) Plug the inflation rate (.03) into the future value formula to get a payment of \$1030 in one year, \$1060.90 in two years, and 1092.73 in three years.

(b) Use the nominal interest rate and the lump sum formula to get a present value of approximately

$$\$980.95 + \$962.27 + \$943.94 = \$2887.16.$$

(c) Plugging .05 and .03 into the true formula shows that the actual real interest rate is about 1.94%.

(d) Plug \$1000, .02, and 3 years into the annuity formula to get a present value of \$2883.88. This is very close to the answer from above! (If you use 1.94% as a better estimate of the real interest rate, the annuity formula gives you a present value of \$2887.26, which is very close indeed to the \$2887.16 figure above.) The punch line here is that you can use the real interest rate to determine the present value of inflation-adjusted annuities.