

Extra Credit Homework Assignment #2 Answer Key

Is College Worth It?

Key Formulas

Formula Name	Formula	Variable Definitions
Compounding Interest	$P \times (1 + R/100)^Y = B$	P: Principle R: Interest Rate Y: # of Years invested B: Balance after Y years
Income from Interest	$\frac{P \times R}{100} = I$	P: Principle R: Interest Rate I: Income
Present Discounted Value	$PDV = \frac{V}{(1 + R/100)^Y}$	PDV: Present discounted value V: Value in Y years R: Interest Rate Y: # of Years
Savings with Interest and Yearly Contributions	$\frac{C}{R/100} \times [(1 + R/100)^{Y+1} - 1] = B$	C: Yearly Contribution R: Interest Rate Y: # of Years Invested B: Balance after Y years
Present Discounted Value with yearly costs or benefits	$PDV = \frac{B}{(1 + R/100)^Y}$	PDV: Present discounted value B: Balance computed from the "Savings with Interest and Yearly Contributions" equation R: Interest Rate Y: # of Years

We will be replicating the exercise we did in class for out of state students.

1. Computing the present discounted value of the tuition, room and board, books, and personal expenses for college.
 - a. Iowa State estimates the cost of tuition, room and board, books, and personal expenses for college, for a non-resident student, is \$31,470 per year. We will assume these costs do not go up, to make the calculations easier. As in class, assume the interest rate is 3.5%. Complete the following table, like we did in class:

Year	Carried Over	Additional	Total
0	0	\$31,470	\$31,470
1	\$31,470	$\$31,470/1.035 = \$30,405.80$	\$61,875.80
2	\$61,875.80	$\$31,470/1.035^2 = \$29,377.58$	\$91,253.38

3	\$91,253.38	$\$31,470/1.035^3 = \$28,384.14$	\$119,637.52

- b. Indicate on your table what the present discounted value of college tuition, room and board, books and personal expenses for college are.

\$119,637.52

- c. Show how you can use the formula for *Present Discounted Value with yearly costs or benefits* to obtain the same answer.

$$\text{Step one: } \frac{31470}{0.035} [1.035^{3+1} - 1] = 132,644.25 \quad \text{Step two: } \frac{132,644.25}{1.035^3} = 119,637.52$$

2. Factoring in opportunity costs

- a. In 2013, the median person without any college earned \$32,550 per year (if they worked 50 hours a week). Assume again that the interest rate is 3.5%. Compute the present discounted value of the opportunity cost of going to college, using either the table method from Part A of Question 1, or the formula for *Present Discounted Value with yearly costs or benefits*. Your final answer should be the same as we obtained in class. Show your work.

Either:

Year	Carried Over	Additional	Total
0	0	\$32,550	\$32,550
1	\$32,550	$\$32,550/1.035 = \$31,449.28$	\$63,999.28
2	\$63,999.28	$\$32,550/1.035^2 = \$30,385.77$	\$94,385.05
3	\$94,385.05	$\$32,550/1.035^3 = \$29,358.24$	\$123,743.29

Or

$$\text{Step one: } \frac{32550}{0.035} [1.035^{3+1} - 1] = 137,196.39 \quad \text{Step two: } \frac{137,196.39}{1.035^3} = 123,743.29$$

- b. What is the total opportunity cost of going to college for an out-of-state student?

$$123,743.29 + 119,637.52 = 243,380.80$$

3. In class, we showed the present discounted value of the benefits from going to college was \$459,234.75, if you graduate when you are 22 and work until the age of 65. Is it worth going to college if you have to come from out-of-state? Why?

Yes. The total benefits outweigh the total costs.

4. The median college graduate earned \$55,400 per year after graduating, if they work 50 weeks per year. What is the present discounted value of the benefits from going to college if you graduate when you are 23 instead of 22? Assume you work until age 65, and are 18 when you start college. Continue to assume a 3.5% interest rate.

$$\text{Step One: } \frac{55400 - 32550}{0.035} [1.035^{65-23+1} - 1] = 2,212,991.18 \quad \text{Step Two:}$$

$$\frac{2212991.18}{1.035^{65-18}} = 439,322.29$$

Or

$$459,234.75 - \frac{55400 - 32550}{1.035^4} = 439,322.29$$

5. Out-of-state students can establish residency (meaning they would pay *in-state* tuition) in Iowa by working as an independent here for one year. Suppose a student can earn the non-college wage of \$32,550 if they forgo college for one year.
- What is the benefit of establishing residency, in terms of reducing the cost of college? Explain intuitively and with a precise number.

This is actually a very tricky question.

Perfect Answer: Establishing residency reduces tuition costs. The PDV of in-state tuition is \$71,923.97. Since we pay one year later, we need to discount this by 1.035, so that the cost, after establishing residency, is \$69,491.76. The PDV of out of state tuition is \$119,637.52. Thus the total benefits are \$119,637.52 - \$69,491.76 = \$50,145.76

Nearly Perfect Answer: Establishing residency reduces tuition costs. The PDV of in-state tuition is \$71,923.97. The PDV of out of state tuition is \$119,637.52. Thus the total benefits are \$119,637.52 - \$71,923.97 = \$47,713.55

- What is the cost of establishing residency, in terms of reducing the value of wage earnings? Explain intuitively and with a precise number.

This is also very tricky to get 100% correct.

Perfect Answer: The cost of establishing residency is the loss of earnings. If we graduate at age 23, the PDV of our future earnings is \$439,322.29. The PDV of future earnings if we do not establish residency is \$459,234.75, so the loss is \$19,912.46. To this, we should deduct the reduction of the opportunity cost of college, since we delay it by one year. This is \$123,743.29 - \$123,743.29/1.035 = \$4,184.56. Therefore, the total cost of establishing residency, in terms of reducing wage earnings, is \$19,912.46 - \$4,184.56 = \$15,727.90.

Nearly Perfect Answer: The cost of establishing residency is the loss of earnings. If we graduate at age 23, the PDV of our future earnings is \$439,322.29. The PDV of earnings if we do not establish residency is only \$459,234.75, so the loss in earnings is \$19,912.46.

- c. Is it worth establishing residency? Note: In the real world, there are a number of other factors to consider, such as the impact on parental dependence, the likelihood of finding a job paying the median salary if you will only be staying for a year and you are out of state, etc. Ignore these for the purposes of the homework.

Because the benefits outweigh the costs, its better to establish residency.

6. Now we'll calculate how long an out-of-state student should stay in school, like in class. Assume we continue to discount at 3.5%.

Degree	Annual Tuition Costs	Time to Complete	Yearly Salary If Complete
High School	0	0	\$32,550
Some college	\$31,470	2	\$38,850
College Degree	\$31,470	2	\$55,400
Master's Degree	\$33,380	2	\$66,450
Doctorate	\$33,380	5	\$81,150

Assuming you start school at age 18 and will work until you are 65, fill out the following table, as in class:

Degree	Marginal Benefit	Marginal Cost	Marginal Value
High School	0	0	0
Some College	\$138,180	$(31470 + 32550)(1 + 1/1.035) = 125,875.07$	+\$12,304.93
College Degree	\$356,309	$(31470 + 38850)(1 + 1/1.035) = 138,262.03$	+\$218,046.97
Master's Degree	\$233,116	$(33380 + 55400)(1 + 1/1.035) = 174,557.78$	+\$58,558.22
Doctorate	\$263,512	$(33380 + 66450) \sum_{t=0}^4 \left(\frac{1}{1.035}\right)^t = 466,513.50$	-\$203,001.50

How long should the student stay in school?

Stay until the master's program.

The marginal benefits can be calculated with the following two step procedure:

$$\text{Step One: } \frac{w1 - w2}{0.035} \left[1.035^{65-Y1+1} - 1 \right] = B \quad \text{Step Two: } \frac{B}{1.035^{65-Y0}}$$

Where

W1: Wage if current degree is completed

W2: wage if current degree not completed (one less)

Y1: Age at graduation – respectively 20 for “some college”, 22 for “college”, 24 for “master’s” and 29 for Doctorate

Y0: Age when degree is started – respectively 18 for “some college”, 20 for “college” 22 for “master’s”, and 24 for “Doctorate”

The Marginal Value column is simply marginal benefits minus marginal costs.