

Choosing a Master's or Ph.D.? A Financial Comparison

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Abstract

We provide a financial comparison of obtaining a Master's degree in a mathematical science versus a Ph.D. We compare the average salaries obtained in nine industries with a master's degree to salaries obtained with a Ph.D. The opportunity cost of the additional years to obtain a Ph.D. is included, and all salary figures are discounted to the present value.

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Introduction

This analysis looks at a typical recipient of a Master's degree in a mathematical or science discipline and explores various career options and those salaries. We took the average salaries of popular mathematical and scientific professions such as, statisticians, mathematicians, mechanical engineering, electrical engineering, economists, biologists, material science engineers, chemists, and physicists. These salaries are obtained from the Department of Labor: Bureau of Labor Statistics 2001 survey [1]. The salary is expected to increase over the years to commensurate with experience. Since the data includes salary figures at different percentiles, we can expect one's salary to increase within a given field according to the distribution. For example the 90% percentile of salaries is included in the data and so it is unlikely that that a salary will grow much beyond that figure.

It can often be overlooked when considering graduate school choices but there are major financial implications in one's choice. Of course the struggles of obtaining a Ph.D. will be rewarded, but the Master's degree may be more financially beneficial. This paper analyses the opportunity cost of taking four additional years to complete graduate school (the average duration to complete the Ph.D. work beyond a Master's) and compares average salaries in industry and the growth of those salaries. You would expect a higher degree would warrant a higher salary; if so is it enough to make up the lost salary while staying in school?

Data and Assumptions

We assumed the opportunity cost of going an extra four years of graduate school is the potential earnings in industry minus the stipend received as a graduate research or teaching assistant.

All potential earnings in the future are also trended to mimic inflation. According to the Department of labor the Consumer Price Index has grown at an average annual rate of 5.082% over the past 40 years [1]. Therefore all future salaries will be developed to keep with inflation accordingly. All future figures will also be discounted to the present value. We use varying discount rates to compute these figures. From the Department of the Treasury we took the forward rate on a 1 year, 2 year, 3 year, 5 year, 7 year, 10 year, and 20 year T-Bill to obtain a true measure of the discount rate [2]. Finally the expected present value of a particular salary will be computed according to the following formula.

$$PV = \frac{FE}{e^{rt}} \quad [3].$$

The expected future earnings is denoted as FE , inflation is i , the discount rate is r , and the time since completion of the Master's degree is t . The final analysis will take the sum of all the present value earnings for a worker with a Master's degree and compare it to the sum of all the earnings of a Ph.D.

Experiment and Procedure

Tables 1 through 9 display the expected earnings in various industries based on the particular degree acquired. Each table represents a distinct profession, and the way of evaluation is the same for each table. To perform the calculations we have used Microsoft Excel spread sheets.

The method of evaluation is as follows. The first column of Table 1 is the number of years from graduation (for the Master's), at age 24, or the beginning of the Ph.D. until retirement, at age 65. In our calculations we used 41 years, since this is the average number of years employees work in the selected professions [4].

The second and third columns of Table 1 are used for the computation of the discounted cash flow analysis of the Master's degree. The second column is the yearly projected income (obtained from [2]) taking into account an average increase in salary of about 3% a year inflated by e^{it} where t is the number of years since our present time and i is the average yearly inflation rate.

The third column used the inflated yearly income and discounted back to its present value by a factor of e^{-rt} , where again, t is the number of years from present time and r is the discount rate.

The fourth, fifth and sixth columns represent the cash flow analysis for the Ph.D.'s. The fourth and sixth columns are the same as the second and third described above, of course with different values for salaries. The fifth column is the cost of obtaining the Ph.D. This cost is the opportunity cost which is the yearly income lost by not working in industry. These same calculations are identically performed for the other professions in Tables 2 through 9.

The second part of Table 1 (on the right) is the values of the rates used in our computations. Starting with the discount rates for the different terms where we used the forward rate from U.S. Treasury Bills. In the next line we noted the inflation rate used in our calculations, where we used the average of the past four decades. After noting the inflation rate the table consists of the average income for each degree, the Master's and the Ph.D. at different stages of a career. The line before the end denotes the average pay increase per year (above and beyond the inflation rate) and lastly the difference between the net cash flow obtained from having a Master's degree or a Ph.D. degree.

Results

Our spreadsheet model results are observed in Tables 1 through 9. The number labeled “difference” determines the whether the Ph.D. is financially advantageous. In all of the examined professions except economics the “difference” number is positive, which indicates that a Ph.D. is not worthwhile to pursue. The positive values range from \$65,000 to \$402,000, indicating the extra money earned over the 41 years. This is significant because it is approximately the amount of money to put 2 or 3 children through college, which will ensure another generation of educational opportunity and financial security.

Observing the right hand side of each table, we see the approximate income level of a Master’s and Ph.D. at entry level, after 5 years, and after ten years experience. For all the careers after 10 years of experience the difference in pay between that of a Ph.D. and a Master’s falls between \$10,000 and \$16,000. The only exception is for economists, where the discrepancy is more than \$26,000. This large difference is what is responsible for making the Ph.D. for economists financially worthwhile. It is necessary that there to be a significant pay difference after 10 years of working with a firm in order for the Ph.D. payoff. The majority of math and science vocations do not differentiate these pay scales enough. The sum of the net present value of the lifetime earnings are displayed below in Figure 1. Again the sum of the lifetime earnings of a Master’s recipient is greater in all professions except for an economist.

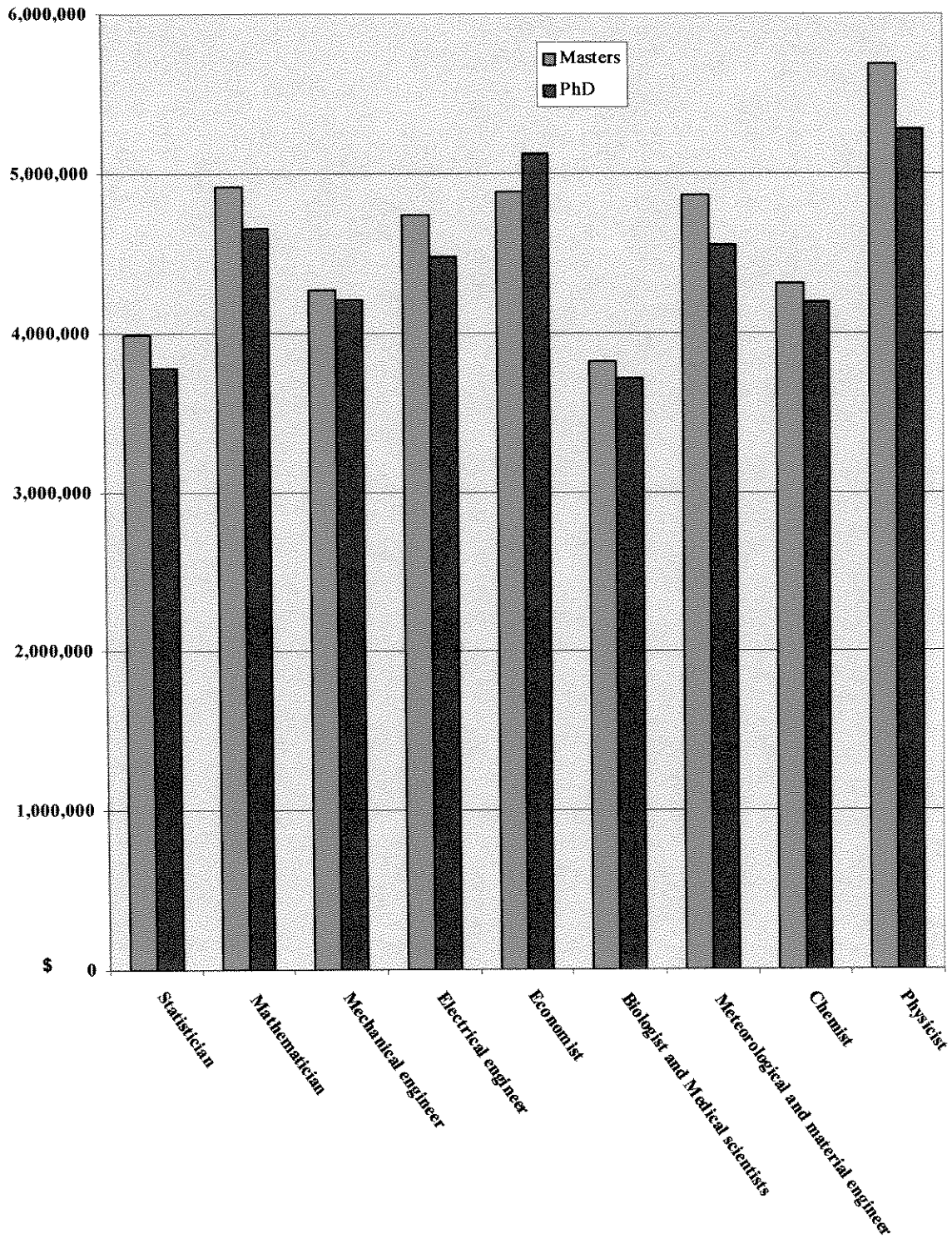


Figure 1. Net Present Value of Lifetime Earnings

Discussion

The results we have found are surprising; especially for the thousands of graduate students that continue to get a Ph.D. and assume that they will be justly compensated for their efforts and time. Such an assumption would have appropriate fifty or even twenty years ago. Now, however, that is not the case. With the Bachelor's degree trivialized and the increased number of Ph.D. graduates in recent years, the Ph.D. status has eroded and so has the pay.

The future work of this project would involve refining the model as new data becomes available. Variables of inflation, T-bills, number of years of work, yearly pay increases can be refined and updated to better model reality. Trends in certain professions may lead to decreased (or increased) pay differentiations between the Master's and Ph.D. employees. As science advances new professions may bubble up and need to be considered in our analysis. The university educational system for both Master's and Ph.D. students may change. Most immediately the model can also be expanded to include more professions.

Summary

We have conducted an investigative study of the financial value of obtaining a Ph.D. in a math and science related field. With our obtained data on salaries of nine professions we used life cycle savings analysis to determine the present value of ones lifetime pay. This involved considering various factors such as expected inflation rates, pay raises both yearly, and upon seniority status, and T-bill discount percents. The following conclusions are supported by the results of this study

- In the professions of Statistician, Mathematician, Mechanical Engineer, electrical engineer, biologist, material science engineer, chemist, and physicist, pursuing a Ph.D. is not financially worthwhile.
- In the profession of economist a Ph.D. is financially worthwhile.

References

[1] Department of Labor: Bureau of Labor and Statistics website,
<http://www.bls.gov/oco/ocos033.htm>.

[2] Department of the Treasury: Office of Debt Finances,
<http://www.ustreas.gov/offices/domestic-finance/debt-management/interest-rate/yield.html>.

[3] Charles R. MacCluer, *Industrial Mathematics: Modeling in Industry, Science and Government*, Prentice-Hall, Inc., Upper Saddle River, NJ, 2000, pp. 105 - 110

[4] W.F. Massy and C.A. Goldman, *The PhD Factory: Training and Employment of Science and Engineering Doctorates in the U.S.*, Anker, 2001, ch.7.

Table 1: Statisticians MS vs Phd

Year	Statistician				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	46,504.30	45,889.89	15,782.00	(45,889.89)	(30,316.40)
2	50,396.59	48,517.45	17,102.92	(48,517.45)	(32,052.25)
3	54,614.86	50,759.68	18,534.39	(50,759.68)	(33,533.55)
4	59,185.77	53,682.18	20,085.67	(53,682.18)	(35,464.25)
5	64,139.47	54,274.80	80,323.44	-	67,969.66
6	69,182.34	56,619.06	87,046.31	-	71,238.99
7	74,972.73	57,141.14	94,331.86	-	71,895.88
8	81,247.76	59,557.09	102,227.20	-	74,948.25
9	88,047.99	62,096.03	110,783.37	-	78,130.20
10	95,417.39	61,452.27	109,711.56	-	79,658.24
11	122,427.04	75,453.40	118,894.14	-	73,276.03
12	132,673.87	78,248.84	128,845.29	-	75,990.81
13	143,778.35	81,147.85	139,529.31	-	78,806.16
14	155,812.23	84,154.27	151,315.94	-	81,725.82
15	168,853.33	87,272.07	171,456.99	-	88,617.26
16	182,985.93	90,505.38	185,806.43	-	91,900.41
17	198,301.39	93,858.47	201,357.96	-	95,305.19
18	214,898.72	97,335.80	218,211.12	-	98,836.11
19	232,885.21	100,941.96	236,474.85	-	102,487.85
20	252,377.12	88,316.28	256,267.20	-	89,677.57
21	273,500.45	90,813.07	277,716.12	-	92,212.85
22	296,391.75	93,380.46	300,860.27	-	94,819.80
23	321,199.00	96,020.42	326,149.89	-	97,500.46
24	348,082.55	98,735.02	353,447.82	-	100,256.90
25	377,216.19	101,526.36	383,030.51	-	103,091.26
26	408,788.24	104,396.62	415,089.21	-	106,005.76
27	443,002.79	107,348.02	449,831.14	-	109,002.66
28	480,081.02	110,382.86	487,480.88	-	112,084.28
29	520,262.60	113,503.50	528,281.61	-	115,253.02
30	563,807.28	116,712.36	572,497.67	-	118,511.34
31	610,996.53	120,011.95	620,414.29	-	121,861.78
32	662,135.41	123,404.81	672,341.42	-	125,306.94
33	717,554.49	126,893.59	728,614.71	-	128,849.50
34	777,612.01	130,481.01	789,597.94	-	132,492.21
35	842,696.19	134,169.84	855,685.31	-	136,237.91
36	913,227.75	137,962.97	927,304.03	-	140,089.50
37	989,662.62	141,863.33	1,004,917.05	-	144,049.97
38	1,072,494.91	145,873.95	1,089,026.10	-	148,122.42
39	1,162,260.05	149,997.96	1,180,174.85	-	152,310.00
40	1,259,538.30	154,238.56	1,278,952.54	-	156,615.96
41	1,364,958.51	158,599.05	1,385,997.66	-	161,043.66

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate	0.05082	
	MS	PHD
Income beginning level	44,200.00	62,300.00
Income after 5 years	51,000.00	66,000.00
Income after 10 years	70,000.00	80,000.00
Rate of increase in salary per year	1.03	
Income during school		15,000.00
Total present worth	3,983,549.63	3,775,826.13
difference	207,723.50	

Table 2: Mathematicians

Year	Mathematician				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	58,854.24	58,076.66	15,782.00	(58,076.66)	(42,503.17)
2	63,780.20	61,402.02	17,102.92	(61,402.02)	(44,936.82)
3	69,118.44	64,239.71	18,534.39	(64,239.71)	(47,013.57)
4	74,903.48	67,598.33	20,085.67	(67,938.33)	(49,720.39)
5	81,172.71	68,688.32	68,900.23	-	59,303.35
6	93,111.29	76,202.59	74,667.01	-	61,107.73
7	100,904.47	76,905.26	80,916.45	-	61,671.21
8	109,349.92	80,170.29	87,688.95	-	64,289.48
9	118,502.24	83,573.95	95,028.30	-	67,018.90
10	128,420.58	82,707.53	142,159.59	-	91,555.95
11	149,570.86	92,182.50	154,057.99	-	94,947.97
12	162,099.57	95,597.73	166,952.25	-	98,465.66
13	175,656.06	99,139.49	180,925.74	-	102,113.68
14	190,358.03	102,812.47	196,068.77	-	105,896.85
15	206,290.52	106,621.53	218,392.07	-	112,876.23
16	223,556.52	110,571.71	236,670.94	-	117,058.14
17	242,267.84	114,668.24	256,479.71	-	121,394.98
18	262,544.84	118,916.54	277,946.42	-	125,892.50
19	284,519.18	123,322.23	301,209.84	-	130,556.64
20	308,332.73	107,897.26	326,420.34	-	114,226.80
21	334,139.41	110,947.63	353,740.91	-	117,456.11
22	362,106.04	114,084.24	383,348.14	-	120,776.72
23	392,413.41	117,309.52	415,433.42	-	124,191.21
24	425,257.43	120,625.98	450,204.16	-	127,702.22
25	460,850.41	124,036.20	487,885.12	-	131,312.50
26	499,422.43	127,542.84	528,719.88	-	135,024.84
27	541,222.84	131,148.51	572,972.41	-	138,842.13
28	586,521.84	134,856.32	620,928.77	-	142,767.35
29	635,612.25	138,668.85	672,898.95	-	146,803.53
30	688,811.40	142,589.16	729,218.91	-	150,953.82
31	746,463.19	146,620.31	790,252.71	-	155,221.45
32	808,940.30	150,765.42	856,394.88	-	159,609.72
33	876,646.57	155,027.72	928,072.99	-	164,122.05
34	950,019.70	159,410.51	1,005,750.37	-	168,761.96
35	1,029,533.97	163,917.22	1,089,929.16	-	173,533.04
36	1,115,703.38	168,551.33	1,181,153.51	-	178,439.00
37	1,209,084.96	173,316.45	1,280,013.10	-	183,483.65
38	1,310,282.35	178,216.29	1,387,146.99	-	188,670.93
39	1,419,949.70	183,254.65	1,503,247.72	-	194,004.86
40	1,538,795.94	188,435.45	1,629,065.79	-	199,489.58
41	1,667,589.31	193,762.72	1,765,414.52	-	205,129.35

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate		0.05082
	MS	PHD
Income beginning level	55,938.00	53,440.00
Income after 5 years	68,640.00	85,520.00
Income after 10 years	85,520.00	101,900.00
Rate of increase in salary per year		1.03
Income during school		15,000.00
Total present worth	4,914,721.79	4,649,498.13
difference	265,223.66	

Table 3: Mechanical Engineer

Year	Mechanical Engineer				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	58,913.16	58,134.81	15,782.00	(58,134.81)	(42,661.31)
2	63,844.05	61,463.49	17,102.92	(61,463.49)	(44,998.29)
3	69,187.63	64,304.02	18,534.39	(64,304.02)	(47,077.88)
4	74,978.47	68,006.34	20,085.67	(68,006.34)	(49,788.40)
5	81,253.98	68,757.08	92,953.43	-	78,857.15
6	87,389.60	71,519.86	100,733.39	-	82,440.54
7	94,703.79	72,179.35	109,164.52	-	83,200.73
8	102,630.26	75,243.75	118,301.32	-	86,733.05
9	111,220.15	78,498.24	128,202.85	-	90,415.32
10	120,529.00	77,825.07	133,570.50	-	86,024.27
11	127,411.57	78,525.43	144,750.02	-	89,211.35
12	138,075.60	81,434.69	156,865.23	-	92,516.50
13	149,632.18	84,451.73	169,994.46	-	95,944.11
14	162,156.02	87,580.55	184,222.57	-	99,498.71
15	175,728.07	90,825.29	189,908.94	-	98,154.69
16	190,436.07	94,190.24	206,803.85	-	101,791.19
17	206,375.09	97,679.86	223,029.11	-	105,562.41
18	223,648.17	101,298.76	241,696.09	-	109,473.35
19	242,366.96	105,051.74	261,925.45	-	113,529.18
20	262,652.47	91,912.01	283,847.96	-	98,329.11
21	284,635.82	94,510.46	307,605.92	-	102,137.25
22	308,459.13	97,182.37	333,351.11	-	105,024.78
23	334,276.39	99,929.82	361,251.77	-	107,993.94
24	362,254.48	102,754.94	391,487.64	-	111,047.04
25	392,574.28	105,659.93	424,254.17	-	114,186.46
26	425,431.76	108,647.05	459,763.19	-	117,414.63
27	461,039.34	111,718.62	498,244.21	-	120,734.07
28	499,627.18	114,877.02	539,946.01	-	124,147.35
29	541,444.72	118,124.71	585,138.14	-	127,657.12
30	586,762.29	121,464.23	634,112.73	-	131,266.13
31	635,872.82	124,898.15	687,186.38	-	134,977.16
32	689,093.79	128,429.15	744,702.16	-	138,793.10
33	746,769.21	132,059.98	807,031.87	-	142,716.93
34	809,271.92	135,793.45	874,578.42	-	146,751.69
35	877,005.96	139,632.47	947,778.44	-	150,900.51
36	950,409.16	143,580.03	1,027,105.12	-	155,166.63
37	1,029,956.03	147,639.19	1,113,071.25	-	159,553.35
38	1,116,160.77	151,813.11	1,206,232.53	-	164,064.09
39	1,209,590.63	156,105.02	1,307,191.17	-	168,702.96
40	1,310,819.51	160,518.27	1,416,599.80	-	173,471.75
41	1,420,531.82	165,056.30	1,535,165.66	-	178,375.98

Data		
Discount rate 1 year:	0.0133	
Discount rate 2 years:	0.019	
Discount rate 3 years:	0.0244	
Discount rate 5 Years:	0.0334	
Discount rate 7 Years:	0.0388	
Discount rate 10 Years:	0.044	
Discount rate 20 Years:	0.0525	
Inflation rate	0.05082	
	MS	PHD
Income beginning level	55,994.00	72,096.00
Income after 5 years	64,422.00	80,353.00
Income after 10 years	72,850.00	88,610.00
Rate of increase in salary per year	1.03	
Income during school		15,000.00
Total present worth	4,269,016.57	4,203,138.11
difference	65,878.46	

Table 4: Electrical Engineer

Year	Electrical Engineer				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	67,138.74	66,251.71	15,782.00	(66,251.71)	(50,678.22)
2	72,758.09	70,045.15	17,102.92	(70,045.15)	(53,579.95)
3	78,847.76	73,282.28	18,534.39	(73,282.28)	(56,056.15)
4	85,447.12	77,501.53	20,085.67	(77,501.53)	(58,283.59)
5	92,598.83	80,161.48	102,165.48	-	86,452.39
6	97,948.63	80,161.48	110,716.47	-	90,610.73
7	106,146.68	80,900.66	119,983.17	-	91,446.26
8	115,030.90	84,335.32	130,025.46	-	95,328.64
9	124,658.69	87,915.80	140,908.26	-	99,375.84
10	135,092.31	87,004.37	144,396.21	-	92,996.42
11	140,965.99	86,879.20	156,481.81	-	96,441.80
12	152,764.49	90,097.95	169,578.94	-	100,014.84
13	165,550.49	93,435.96	183,772.27	-	103,720.25
14	179,406.66	96,897.63	199,153.55	-	107,562.94
15	194,422.55	100,487.55	202,510.96	-	104,668.06
16	210,695.23	104,210.48	219,460.62	-	108,545.87
17	228,329.89	108,071.33	237,828.93	-	112,567.34
18	247,440.53	112,075.22	257,734.61	-	116,737.80
19	268,150.68	116,227.45	279,306.35	-	121,062.78
20	290,594.22	101,689.89	302,683.60	-	105,920.42
21	314,916.23	104,564.77	328,017.45	-	108,914.80
22	341,273.93	107,520.92	355,471.69	-	111,994.04
23	369,837.71	110,560.65	385,223.79	-	115,160.23
24	400,792.20	113,686.32	417,466.05	-	118,415.93
25	434,337.50	116,900.35	452,406.92	-	121,763.67
26	470,690.46	120,205.25	490,272.24	-	125,206.06
27	510,086.07	123,603.58	531,306.80	-	128,745.76
28	552,779.00	127,097.98	575,775.85	-	132,385.54
29	599,045.22	130,691.17	623,866.85	-	136,128.22
30	649,183.81	134,385.95	676,191.31	-	139,976.71
31	703,518.87	138,185.18	732,786.83	-	143,934.00
32	762,401.63	142,091.82	794,119.26	-	148,003.16
33	826,212.74	146,108.91	860,585.05	-	152,187.37
34	895,364.68	150,239.56	932,613.87	-	156,489.87
35	970,304.46	154,486.99	1,010,671.31	-	160,914.00
36	1,051,516.52	158,854.50	1,095,261.97	-	165,463.21
37	1,139,525.82	163,345.49	1,186,932.66	-	170,141.03
38	1,234,901.28	167,963.44	1,286,275.96	-	174,951.08
39	1,338,259.43	172,711.94	1,393,934.03	-	179,897.14
40	1,450,268.39	177,594.69	1,510,602.81	-	184,983.03
41	1,571,652.22	182,615.48	1,637,036.49	-	190,212.69

Data		
Discount rate 1 year:	0.0133	
Discount rate 2 years:	0.019	
Discount rate 3 years:	0.0244	
Discount rate 5 Years:	0.0388	
Discount rate 7 Years:	0.0388	
Discount rate 10 Years:	0.044	
Discount rate 20 Years:	0.0525	
Inflation rate	0.05082	
	MS	PHD
Income beginning level	63,812.00	79,241.00
Income after 5 years	72,206.00	86,865.50
Income after 10 years	80,600.00	94,490.00
Rate of increase in salary per year	1.03	
Income during school	15,000.00	
Total present worth	4,739,243.00	4,479,722.07
difference	259,520.93	

Table 5: Economists

Year	Economists				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	35,036.05	34,573.15	15,782.00	(34,573.15)	(18,999.66)
2	37,968.47	36,552.74	17,102.92	(36,552.74)	(20,087.54)
3	41,146.34	38,242.02	18,534.39	(38,242.02)	(21,015.89)
4	44,590.19	40,443.82	20,085.67	(40,443.82)	(22,225.88)
5	48,322.27	40,890.29	51,829.89	-	43,858.43
6	87,942.96	71,972.81	56,167.92	-	45,968.01
7	95,303.57	72,636.48	60,869.04	-	46,391.89
8	103,280.24	75,720.28	65,963.62	-	48,361.47
9	111,924.54	78,935.01	71,484.61	-	50,414.67
10	121,292.34	78,116.68	128,645.12	-	82,652.14
11	153,715.89	94,737.13	139,412.39	-	85,921.70
12	166,581.59	98,247.01	151,080.86	-	89,104.98
13	180,523.98	101,866.93	163,725.95	-	92,406.19
14	195,633.39	105,661.70	177,429.40	-	95,829.71
15	212,007.41	109,576.31	245,567.85	-	126,922.07
16	229,751.90	113,635.96	266,121.26	-	131,624.36
17	248,981.56	117,846.02	288,394.94	-	136,500.85
18	269,820.70	122,212.05	312,532.88	-	141,558.02
19	292,404.01	126,739.84	338,691.10	-	146,802.55
20	316,877.50	110,867.40	367,036.70	-	128,440.69
21	343,399.35	114,022.30	397,758.92	-	132,071.85
22	372,141.02	117,245.83	431,050.34	-	135,805.66
23	403,288.29	120,560.49	467,126.18	-	139,645.03
24	437,042.51	123,968.87	506,225.64	-	143,592.94
25	473,621.87	127,473.60	548,595.45	-	147,652.46
26	513,262.84	131,077.41	594,511.52	-	151,826.75
27	556,221.65	134,783.11	644,270.65	-	156,119.06
28	602,776.01	138,593.57	698,194.49	-	160,532.71
29	653,226.85	142,511.75	756,631.62	-	165,071.13
30	707,900.31	146,540.71	819,959.79	-	169,737.87
31	767,149.79	150,683.57	888,588.37	-	174,536.54
32	831,358.31	154,943.55	962,960.99	-	179,470.87
33	900,940.92	159,323.97	1,043,558.42	-	184,544.70
34	976,347.42	163,828.23	1,130,901.65	-	189,761.97
35	1,058,065.25	168,459.82	1,225,555.28	-	195,126.74
36	1,146,622.67	173,222.36	1,328,131.19	-	200,643.16
37	1,242,592.11	178,119.54	1,439,292.45	-	206,315.56
38	1,346,593.96	183,155.17	1,559,757.63	-	212,148.33
39	1,459,300.51	188,333.15	1,690,305.44	-	218,145.99
40	1,581,440.31	193,667.53	1,831,779.77	-	224,313.21
41	1,713,802.90	199,132.43	1,985,095.15	-	230,654.78

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate	0.05082	
	MS	PHD
Income beginning level	33,300.00	40,200.00
Income after 5 years	64,830.00	77,390.00
Income after 10 years	87,890.00	114,580.00
Rate of increase in salary per year	1.03	
Income during school		15,000.00
Total present worth	4,879,150.61	5,128,346.11
difference	(249,195.50)	

Table 6: Biologists and Medical Scientists

Year	Biological & Med Scientists				
	Masters Degree		Ph D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	37,526.45	37,030.65	15,782.00	(37,030.65)	(21,457.16)
2	40,667.31	39,150.95	17,102.92	(39,150.95)	(22,685.75)
3	44,071.07	40,960.31	18,534.39	(40,960.31)	(23,734.17)
4	47,759.71	43,318.61	20,085.67	(43,318.61)	(25,100.67)
5	51,757.07	43,796.82	55,109.87	-	46,633.95
6	66,793.51	54,664.03	59,722.43	-	48,877.03
7	72,383.96	55,168.09	64,721.05	-	49,327.73
8	78,442.32	57,510.27	70,138.04	-	51,421.96
9	85,007.75	59,951.89	76,008.41	-	53,605.09
10	92,122.68	59,330.36	98,052.21	-	63,149.20
11	118,839.93	73,242.62	106,258.94	-	65,488.79
12	128,786.53	75,956.15	115,152.55	-	67,915.05
13	139,565.64	78,770.22	124,790.53	-	70,431.21
14	151,246.93	81,688.55	135,235.18	-	73,040.59
15	163,905.92	84,715.00	174,458.62	-	90,169.17
16	177,624.44	87,853.57	189,090.37	-	93,509.61
17	192,491.16	91,108.42	204,884.25	-	96,974.22
18	208,602.19	94,483.86	222,032.54	-	100,566.98
19	226,061.67	97,984.36	240,616.11	-	104,292.85
20	244,982.47	85,728.61	260,755.08	-	91,248.05
21	265,486.69	88,152.25	282,579.63	-	93,827.72
22	287,707.47	90,644.41	306,230.83	-	96,480.33
23	311,787.87	93,207.02	331,861.59	-	99,207.93
24	337,883.73	95,842.08	359,637.57	-	102,012.65
25	366,163.76	98,551.64	389,738.34	-	104,896.65
26	396,810.75	101,337.80	422,358.46	-	107,862.19
27	430,022.81	104,202.72	457,708.80	-	110,911.57
28	466,014.65	107,148.64	496,017.89	-	114,047.15
29	505,018.90	110,177.85	537,533.34	-	117,271.39
30	547,287.72	113,292.69	582,523.54	-	120,686.77
31	593,094.34	116,495.60	631,279.30	-	123,995.89
32	642,734.85	119,789.05	684,115.80	-	127,501.38
33	696,530.15	123,175.61	741,374.58	-	131,105.98
34	754,827.97	126,657.92	803,425.77	-	134,812.48
35	818,005.19	130,238.67	870,670.50	-	138,623.77
36	886,470.17	133,920.65	943,543.44	-	142,542.81
37	960,665.51	137,706.73	1,022,515.66	-	146,572.65
38	1,041,070.81	141,599.84	1,108,097.67	-	150,718.41
39	1,128,205.83	145,603.02	1,200,842.67	-	154,977.32
40	1,222,633.83	149,719.37	1,301,350.19	-	159,358.70
41	1,324,965.22	153,952.10	1,410,269.95	-	163,863.93

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate		0.05082
	MS	PHD
Income beginning level	35,667.00	42,744.00
Income after 5 years	49,239.00	58,986.00
Income after 10 years	67,948.00	81,401.00
Rate of increase in salary per year		1.03
Income during school		15,000.00
Total present worth	3,823,829.00	3,714,849.61
difference	108,979.39	

Table 7: Metallurgical and Materials Engineer

Year	Metallurgical & Materials Engineer				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	52,606.67	51,911.64	15,782.00	(51,911.64)	(36,338.15)
2	57,069.72	54,884.00	17,102.92	(54,884.00)	(38,418.80)
3	61,781.29	57,420.46	18,534.39	(57,420.46)	(40,194.32)
4	66,952.23	60,726.45	20,085.67	(60,726.45)	(42,508.52)
5	72,555.97	61,396.83	74,779.44	-	63,278.33
6	92,141.38	75,408.81	81,038.29	-	66,322.01
7	99,853.38	76,104.16	87,821.00	-	66,933.57
8	108,210.86	79,335.19	95,171.39	-	69,775.25
9	117,267.84	82,703.39	103,137.00	-	72,737.58
10	127,082.87	81,845.99	120,794.09	-	77,795.79
11	149,011.19	91,837.57	130,904.25	-	80,678.02
12	161,483.06	95,240.02	141,860.61	-	83,667.03
13	174,998.79	98,768.53	153,733.99	-	86,766.77
14	189,645.75	102,427.77	166,601.14	-	89,981.36
15	205,518.62	106,222.57	214,319.99	-	110,771.57
16	222,720.02	110,157.97	232,258.04	-	114,875.51
17	241,361.12	114,239.17	251,637.45	-	119,131.48
18	261,562.44	118,471.57	272,763.99	-	123,545.14
19	283,454.57	122,860.78	295,593.56	-	128,122.32
20	307,179.00	107,493.53	320,334.00	-	112,096.95
21	332,889.12	110,532.48	347,145.15	-	115,266.06
22	360,751.10	113,657.35	378,200.33	-	118,524.75
23	390,945.07	116,870.57	407,687.36	-	121,875.57
24	423,666.19	120,174.62	441,809.77	-	125,321.12
25	459,125.99	123,572.08	478,788.14	-	128,864.08
26	497,553.69	127,065.60	518,861.51	-	132,507.20
27	539,187.69	130,657.88	562,288.92	-	136,253.32
28	584,327.18	134,351.71	609,351.10	-	140,105.35
29	633,233.91	138,149.98	660,352.26	-	144,066.27
30	686,234.00	142,055.62	715,622.09	-	148,139.18
31	743,670.07	146,071.68	775,517.87	-	152,327.23
32	805,913.39	150,201.28	840,426.77	-	156,633.68
33	873,366.32	154,447.63	910,768.39	-	161,061.88
34	946,464.90	158,814.03	986,997.42	-	165,615.27
35	1,025,681.64	163,303.87	1,069,606.64	-	170,297.38
36	1,111,528.63	167,920.64	1,159,130.04	-	175,111.87
37	1,204,560.79	172,667.93	1,256,146.32	-	180,062.47
38	1,305,379.52	177,549.44	1,361,282.62	-	185,153.02
39	1,414,636.51	182,568.95	1,475,218.57	-	190,387.49
40	1,533,038.05	187,730.36	1,598,690.67	-	195,769.95
41	1,661,349.50	193,037.70	1,732,497.08	-	201,304.57

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate		0.05082
	MS	PHD
Income beginning level	50,000.00	58,000.00
Income after 5 years	67,925.00	72,667.00
Income after 10 years	85,200.00	100,000.00
Rate of increase in salary per year		1.03
Income during school		15,000.00
Total present worth	4,860,857.81	4,553,666.64
difference	307,191.18	

Table 8: Chemists

Year	Chemists				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	46,399.09	45,786.06	15,782.00	(45,786.06)	(30,212.57)
2	50,282.57	48,407.69	17,102.92	(48,407.69)	(31,942.49)
3	54,491.10	50,644.84	18,534.39	(50,644.84)	(33,418.71)
4	59,051.87	53,560.73	20,085.67	(53,560.73)	(35,342.80)
5	63,994.36	54,152.00	83,159.90	-	70,369.87
6	88,173.57	72,161.54	90,120.17	-	73,754.65
7	95,553.48	72,826.95	97,663.01	-	74,434.74
8	103,551.07	75,918.84	105,837.15	-	77,594.89
9	112,218.03	79,142.00	114,695.46	-	80,889.21
10	121,610.40	78,321.53	136,640.76	-	88,001.63
11	131,171.83	80,842.93	148,077.25	-	91,261.96
12	142,190.58	83,838.05	160,470.95	-	94,543.09
13	154,048.23	86,944.13	173,901.96	-	98,149.49
14	166,941.68	90,165.29	188,457.12	-	101,785.79
15	180,914.28	93,505.79	188,665.89	-	97,512.22
16	196,056.35	96,970.05	204,456.75	-	101,124.91
17	212,465.78	100,562.65	221,569.27	-	104,871.45
18	230,248.63	104,288.36	240,114.06	-	108,756.79
19	249,519.87	108,152.10	260,211.01	-	112,786.07
20	270,404.05	94,624.59	281,990.02	-	98,678.95
21	293,036.20	97,299.72	305,591.88	-	101,468.71
22	317,562.59	100,050.49	331,169.15	-	104,337.34
23	344,141.79	102,879.02	358,887.18	-	107,287.06
24	372,945.59	105,787.52	388,925.14	-	110,320.18
25	404,160.20	108,778.24	421,477.20	-	113,439.05
26	437,987.40	111,853.52	456,753.79	-	116,646.09
27	474,645.85	115,015.74	494,982.94	-	119,943.80
28	514,372.52	118,267.35	536,411.77	-	123,334.74
29	557,424.21	121,610.89	581,308.09	-	126,821.54
30	604,079.22	125,048.96	629,962.13	-	130,406.92
31	654,639.14	128,584.23	682,688.38	-	134,093.66
32	709,430.80	132,219.44	739,827.69	-	137,884.63
33	768,808.38	135,957.42	801,749.41	-	141,782.77
34	833,155.72	139,801.08	868,853.83	-	145,791.12
35	902,888.77	143,753.41	941,574.72	-	149,912.79
36	978,458.30	147,817.47	1,020,382.17	-	154,150.98
37	1,060,352.81	151,996.42	1,105,785.60	-	158,508.99
38	1,149,101.89	156,293.52	1,198,337.09	-	162,990.21
39	1,245,278.62	160,712.10	1,298,634.91	-	167,598.11
40	1,349,505.33	165,255.60	1,407,327.40	-	172,336.29
41	1,462,455.54	169,927.55	1,525,117.16	-	177,208.41

Data		
Discount rate 1 year:	0.0133	
Discount rate 2 years:	0.019	
Discount rate 3 years:	0.0244	
Discount rate 5 Years:	0.0334	
Discount rate 7 Years:	0.0388	
Discount rate 10 Years:	0.044	
Discount rate 20 Years:	0.0525	
Inflation rate	0.05082	
	MS	PHD
Income beginning level	44,100.00	64,500.00
Income after 5 years	65,000.00	82,200.00
Income after 10 years	75,000.00	88,030.00
Rate of increase in salary per year	1.03	
Income during school		15,000.00
Total present worth	4,309,725.79	4,199,962.54
difference	109,763.25	

Table 9: Physicists

Year	Physicists				
	Masters Degree		Ph.D Degree		
	Income	Present worth	Income	First Cost	Present worth
0					
1	54,374.26	53,655.87	15,782.00	(53,655.87)	(38,082.39)
2	58,925.25	56,728.10	17,102.92	(56,728.10)	(40,262.90)
3	63,857.14	59,349.78	18,534.39	(59,349.78)	(42,123.65)
4	69,201.83	62,766.86	20,085.67	(62,766.86)	(44,548.53)
5	74,993.85	63,459.76	88,024.43	-	74,486.24
6	86,545.75	70,829.33	95,391.85	-	78,069.01
7	93,789.41	71,482.45	103,375.91	-	78,798.89
8	101,639.35	74,517.26	112,028.22	-	82,133.89
9	110,146.31	77,680.91	121,404.70	-	85,620.91
10	119,365.28	76,875.59	129,659.12	-	83,505.19
11	178,865.90	110,237.42	140,511.26	-	86,598.94
12	193,836.53	114,321.56	152,271.70	-	89,807.32
13	210,060.16	118,557.01	165,016.46	-	93,134.55
14	227,641.67	122,949.39	178,827.93	-	96,585.06
15	246,694.71	127,504.49	249,232.72	-	128,816.26
16	267,342.44	132,228.35	270,092.87	-	133,588.73
17	289,718.33	137,127.23	292,698.97	-	138,538.00
18	313,967.03	142,207.60	317,197.14	-	143,670.64
19	340,245.29	147,476.20	343,745.75	-	148,993.44
20	368,722.97	129,030.09	372,516.41	-	130,357.55
21	399,594.16	132,677.90	403,695.10	-	134,042.90
22	433,028.35	136,428.85	437,483.37	-	137,832.43
23	469,271.74	140,285.83	474,095.63	-	141,729.10
24	508,548.61	144,251.86	513,780.58	-	145,735.93
25	551,112.85	148,330.01	556,782.73	-	149,856.04
26	597,239.62	152,523.46	603,384.05	-	154,092.63
27	647,227.08	156,835.46	653,885.79	-	158,448.99
28	701,398.37	161,269.36	708,614.39	-	162,928.51
29	760,103.66	165,828.61	767,923.64	-	167,534.67
30	823,722.43	170,516.76	832,196.93	-	172,271.05
31	892,665.94	175,337.45	901,849.73	-	177,141.33
32	967,379.84	180,294.43	977,332.29	-	182,149.31
33	1,048,347.11	185,391.54	1,059,132.56	-	187,298.86
34	1,136,091.14	190,632.75	1,147,779.30	-	192,593.99
35	1,231,179.13	196,022.14	1,243,845.56	-	198,038.83
36	1,334,225.74	201,563.90	1,347,952.32	-	203,637.59
37	1,445,897.09	207,262.32	1,460,772.55	-	209,394.64
38	1,566,915.06	213,121.84	1,583,035.56	-	215,314.45
39	1,698,061.93	219,147.02	1,715,531.67	-	221,401.62
40	1,840,185.46	225,342.54	1,859,117.38	-	227,660.87
41	1,994,204.38	231,713.21	2,014,720.85	-	234,097.09

Data		
Discount rate 1 year:		0.0133
Discount rate 2 years:		0.019
Discount rate 3 years:		0.0244
Discount rate 5 Years:		0.0334
Discount rate 7 Years:		0.0388
Discount rate 10 Years:		0.044
Discount rate 20 Years:		0.0525
Inflation rate	0.05082	
	MS	PHD
Income beginning level	51,680.00	68,273.00
Income after 5 years	63,800.00	78,000.00
Income after 10 years	102,270.00	116,290.00
Rate of increase in salary per year	1.03	
Income during school		15,000.00
Total present worth	5,683,762.52	5,280,877.61
difference	402,884.91	