

Weeks 6-7: Human Capital

- I. Present Discounted Value (PDV)
 - A. What determines the sale value today of a future payment - positive or negative?
 1. Ex: If you issue a certificate that pays \$1, 10 years in the future, what could you sell it for today?
 2. Clearly the answer is not \$1! No one would pay \$1, because they are foregoing 10 years worth of interest.
 - B. But how much less? Just figure: "How much money would I have to put in the bank today in order to have \$1, 10 years from now?" With a constant interest rate, that comes out to: $\$1/(1+n)^{10}$. If e.g. the interest rate is 10%, then you would need $\$1/(1.1)^{10} = \$1/2.59 = \$0.386$. \$0.386 is what economists call this asset's **present discounted value** (PDV).
 - C. Similarly, a future cost is less harmful than it seems on its face. If you learn you will need a \$1000 operation 30 years from now, ask: "How much money must I put in the bank today in order to have \$1000 three decades from now?" If the interest rate is 5%, then the answer is $\$1000/(1.05)^{30} = \231.38 .
 - D. One step harder: What is the total amount people will pay for a whole set, or "bundle," of future benefits and costs? Just add up what they would pay for each item separately. That sum is the *income stream's* PDV.
 - E. In the real world, people have to make educated *guesses* about both future payments and future interest rates. We can think of something's current market price as its *expected* PDV.
 1. Important: When economists say people "maximize profits," what they actually mean is that they are maximizing PDV. (For 1 period, they are equivalent).
 - F. You can apply the PDV formula to virtually anything: houses, land, buildings, stock, bonds, animals, etc. E.g. what is the PDV of a chicken?
 - G. General rule: The lower the interest rate, the more the future counts.
- II. Rate of Return on Investment
 - A. Once you know an asset's PDV, you can calculate your rate of return on this investment.
 - B. Ex: If you get \$100 in dividends from a stock worth \$10,000, and the stock's value doesn't change, what was your rate of return? 1%. If you get \$100 in dividends from a stock worth \$10, what would your rate of return be then? 1000%.

- C. Ex: If you get no dividends from a stock but it rises in price from \$400 to \$500, what was your rate of return? 25%.
 - D. In general, the rate of return for a year is:

$$\frac{\text{net income} + \text{change in asset price}}{\text{initial asset price}}$$
 - E. Basic economic logic suggests that equally risky assets must have the **same expected** rate of return. Otherwise, people would sell the asset with the lower rate of return and buy the asset with the higher rate of return, until their rates of return are equal.
 - F. Of course, two gambles can have the same expected return, even though one turns out to pay much more than the other. For example, it is not surprising that some people win at blackjack and others lose. But if there are two casinos next to each other, and one gives better odds, something strange is going on.
- III. Slaves As Investments
- A. What slave-owners like about owning slaves is that the slave can't easily say "no." The owner can threaten violence or death to make the slave do as he is told.
 - B. But the slave owner still can't give the slave nothing. In order to take advantage of the slave, it is still necessary to provide the slave with his "subsistence" (food, shelter, etc.).
 - C. They must also pay some costs of "enforcement" - guarding and monitoring the slave.
 - D. So what is the most a slave-owner would pay to buy a slave? The logic of PDV directly applies: The sale price will equal the PDV of the slave's lifetime earnings, minus the PDV of his subsistence, minus the PDV of enforcement.
 - E. Similarly, suppose a slave-owner is weighing whether to train his slave to be a metal smith. This means foregone earnings - the slave could have been working instead of training. But it also means higher earnings for the master in the future. The profit-maximizing slave-owner will pick the level of training that maximizes the slave's PDV.
 - F. Or suppose that a slave-owner is deciding whether to allow his slaves to have children (who are also legally slaves). If a slave has a child, the mother will bring in less income for a while, and the enslaved child will have little productive value for many years; but eventually the master will have two slaves instead of one. The profit-maximizing slave-owner picks whichever PDV is higher.
 - G. What is the rate of return on a slave? If a slave sells for \$3000, produces \$300 in net income, and falls to \$2850 in value, the rate of return is $(300-150)/3000=5\%$.
 - H. In an economy with slavery, you would expect investments in slaves would earn the same typical return as anything else.
- IV. You As An Investment: Human Capital Theory

- A. Putting aside the moral repugnance of slavery, the same logic applies to *your* management of the person *you* own - yourself! This insight is known as **human capital** theory.
- B. There are various things you can do with your time. Which is the best investment? Compare PDV!
- C. Ex: Should you get another year of school? Add up the PDV of your foregone earnings during school and the extra income you expect to get after you've completed the schooling.
 - 1. Note: Since you forego earnings first, and get a raise afterwards, education makes less and less sense as interest rates rise.
- D. What else can you do for your career, and how do you decide if they are good investments?
 - 1. Plastic surgery
 - 2. Speech classes
 - 3. An Armani suit
 - 4. A fancy car to impress clients
- V. Application: The Rate of Return on Education
 - A. Are you wasting your time in college? Let's do PDV calculations to find out.
 - B. Assumption 1: One additional year of school will raise your average salary by \$2500/year during your working life; finishing four years of college gives you \$10,000 during your working life.
 - C. Assumption 2: You forego \$15,000 worth of labor income for each year of college.
 - D. Assumption 3: You have to pay \$10,000 for school and extra school-related expenses.
 - E. Assumption 4: The interest rate will be 8% during your lifetime.
 - F. Assumption 5: You are 18 years old now and will work until you are 68.
 - G. Conclusion: Putting all this into Excel, we find that going to college has a PDV of \$7136 more than the alternative.
 - H. What if:
 - 1. The interest rate rose to 9%? PDV falls to -\$3978. You'd be better off quitting school and putting your earnings and tuition in the stock market.
 - 2. Your wage without college rises to \$17,000 (but the marginal benefit of college stays the same)? PDV falls to -\$18.
 - 3. The benefit of college were \$10,000 for your first 20 years of work, but \$30,000 for all remaining years? PDV rises to \$41,241.
- VI. General Versus Firm-Specific Training
 - A. People get experience on-the-job, but there are two basic kinds:
 - 1. General
 - 2. Firm-specific

- B. General skills are skills that you can use in other firms or even other industries. Typing is a good example.
 - C. Firm-specific training, in contrast, really only has value in a specific firm. A good example is learning the names of your co-workers. You're more productive on that job, but if you quit this knowledge is valueless.
 - D. Will employers invest in general skills? At first glance, there seems to be little point. After they invest in you, you will be more productive in both your current and alternative jobs. They will have to give you a suitable raise to retain you.
 - E. On second thought, though, this only means that if you want general training from your firm, *you* will have to pay for it by working for less. Internships are a standard example.
 - F. What about firm-specific training? By definition, such skills won't help you get a better offer elsewhere. So if a firm gives you some firm-specific training, your productivity rises, but market forces don't force them to give you a corresponding raise. You are more likely to get firm-specific training without a dock in your pay.
 - G. However, the difference between general and firm-specific training may be weaker than it seems. Why? Firms have reputations for giving raises, and often even have formal pay scales. If one firm pays employees the full value of their firm-specific training, and another doesn't, the latter will not be able to attract employees in the first place.
 - 1. If this argument is right, then employees will have to accept lower pay for all costly training, but receive their full MVP wherever they work.
 - H. In the real world, firms often seem to initially overpay (you get your full salary even during the first few weeks or months when you are using up other employee's time by asking questions). Ideas?
- VII. Application: Understanding the Life Cycle
- A. Most people have a standard life pattern: get school when you're young, then work until retirement. (Alternate pattern involves taking breaks from the labor force to have children).
 - B. Human capital theory sheds considerable light on this pattern. Why don't people work for 20 years, then go to college, then go back to work for 20 more years?
 - 1. Because then they would only get to reap the benefits of education for 20 years instead of 40.
 - 2. Opportunity cost of time is lower when you're younger, so you give up less income.
 - C. Why retire? After a point, you become a less and less productive worker, and your wage will reflect that. It makes more sense to work doing your most productive years, and enjoy leisure when it's cheaper.

- D. Work-hour patterns fit this story too. People work the most hours during their peak-earning years (mid-40's to early 50's).
- VIII. Accounting for Compensating Differentials
 - A. But isn't there any difference between how you regard yourself and how a slave-owner regards a slave? Yes! As discussed earlier, a free worker can factor "fun" and discomfort into their calculations.
 - B. How can you quantify this? Simple. Ask yourself, "How much extra would someone have to pay me to do this unpleasant task rather than something else?" Or, "How much would I be willing to give up for the extra fun of this other job?"
 - C. Then, when you calculate PDV, add or subtract these numbers from your income in the appropriate time period.
 - D. For example, suppose you expect to suffer in an Internet start-up for five years. You figure it would take \$30,000/year to compensate you for your suffering. Afterwards, you earn \$10,000 extra for the next 20 years in an atmosphere with a normal fun level. With a 10% interest rate, the PDV is -\$39,627!
 - E. Or suppose you are considering relocating from Rochester, NY to Fairfax, VA. You figure that you would be willing to pay \$7000 to live in Fairfax rather than Rochester. If it costs \$10,000 to move, and you have to take a \$6000 pay cut for 10 years, should you move? No, sorry, the PDV of the move is -\$2855.
 - F. In sum, human capital theory does not say that workers care only about money income. Rather, it provides an accounting framework for managing your life.
 - G. Something to consider: Do you actively dislike school compared to work? Then you should count your "pain and suffering" as one of the costs of attending school.
- IX. Education Subsidies: The Failure of Externality Arguments
 - A. Externalities are *non-excludable* benefits and costs. The basic logic of selfishness then goes:
 - 1. If benefits are non-excludable, then each individual beneficiary gets them whether or not he pays for them.
 - 2. If beneficiaries get the benefits whether or not they pay for them, then they won't pay for them.
 - 3. If providers receive no pay for providing benefits, they won't provide them.
 - 4. Thus, due to non-excludability, potential social benefits don't materialize.
 - B. Even if a good is partly excludable, less than 100% of the potential social benefits will normally be realized.
 - 1. Caveat: Inframarginal externalities
 - C. It is easy to see why people see externalities of pollution clean-up. But where are the externalities of education?
 - D. Most externalities arguments for education amount to the absurdity that anything beneficial is an externality. "We all benefit from

education." How is that different from "We all benefit from steel." Yes, there's a benefit, but doesn't the market pay people to provide that benefit?!

- E. The sophisticated externality arguments focus on non-job-related aspects: crime ("Uneducated youth turn to crime,") and political culture ("An educated electorate votes better,") are probably the leading contenders.
 - F. The crime argument is again weak. We could just as easily increase the severity of punishment. (More on this later!)
 - G. The political education argument is stronger; there is no clear way to pay people for being smart voters. But you certainly could just restrict the franchise to people with a certain education level! Same effect, and no subsidy needed.
- X. Education Subsidies and Credit Market Imperfections
- A. A quite different argument concedes that education is a private good, but focuses on "credit market imperfections." In essence, the problem is that it is difficult to credibly promise to repay an educational loan. With a house, they can repossess the house if you default. But they can't repossess your brain if you default on a student loan.
 - B. Still, the problem is less serious than it sounds. The IRS doesn't take excuses for failure to pay taxes; why couldn't lenders be given a comparable level of legal authority to attach your wages if you default?
 - C. Even under the current legal regime, your parents or other relatives or an employer could cosign for you. Or schools might loan you money themselves, and refuse to release transcripts for former students who default.
 - D. Economists who take credit market imperfections seriously normally point to the measured rate of return to education. They say that it is unusually large, indicating a failure of credit markets to equalize rates of return on different investments.
 - E. If you assume that foregone earnings are the *only* cost of education, then on NLSY data the rate of return to education is 12.6% (controlling for no other variables).
 - F. But this number is surely too high:
 - 1. It costs resources to educate people. Counting these costs would definitely reduce the rate of return.
 - 2. This is an estimate of the average, not the marginal rate of return. (The marginal rate would be lower. Can you explain why?)
 - 3. It does not control for intelligence, which is highly correlated with education.
 - G. (There's another big problem with return-to-education estimates we'll deal with after the midterm).
- XI. Intelligence and Human Capital

- A. We all have an intuitive notion of what it means to be "intelligent." Empirical research on intelligence is one of the best-developed areas of psychology.
- B. In practical terms, researchers usually measure intelligence with IQ (Intelligence Quotient) or related tests. These tests have come under angry attack on a number of grounds. We'll briefly consider each in turn:
 - 1. Cultural bias
 - 2. "There is no one thing that constitutes 'intelligence.'"
 - 3. Imperfection
- C. Complaint #1: "Cultural bias." There are large group differences in performance on IQ tests. Jews do about 1 SD better than average, blacks about 1.2 SDs worse. Critics blame this on cultural bias - supposedly, the tests measure familiarity with middle-class lifestyles rather than ability. Unfortunately for this argument, it has been carefully tested and shown to be wrong. If you use IQ tests to predict performance on practical tasks - like ability to drive a tank through an obstacle course - IQ tests actually *overstate* the performance of members of groups with low average IQs.
- D. Complaint #2: "There is no one thing that constitutes 'intelligence.'" Everyone is good at some things and bad at others, or so the claim goes. Still, the fact is that for a wide range of mental problems, people who are good at some are usually (not always) good at all of them, and vice versa. Think about the SAT Verbal versus Math scores. There are some people who are great at Verbal and terrible at Math, but there are a lot more who are great at both or terrible at both.
- E. Complaint #3: Imperfection. There are several varieties of this complaint. One is that the same person has received very different test scores at different times. Another is that world-renowned geniuses (Feynman is a common example) got low IQ scores. All this may be true, but it's irrelevant. IQ scores are more reliable than anything else, and if you tested 100 geniuses their average score would be very high.
- F. Intelligence is a lot like "strength." There is some ambiguity, but at root we know what we mean, we know there are real differences, and we know that people who are strong by one measure are usually strong by other measures, too.
- G. There is a second debate about the extent to which IQ is hereditary or environmental. There is no time to resolve this here, but evidence from carefully-constructed twin and adoption studies finds that the variance is about 80% genetic. Unclear where the remaining 20% comes from - it doesn't seem to be family environment.
- H. Why do I bring all this up? Because controlling for IQ sharply reduces the measured return to education to a mere 7.5%. (1 extra

percentile of IQ bumps you up .7%; a year of education is thus worth about as much as 11 percentiles of IQ).

- I. This is actually the central argument of the much-maligned book *The Bell Curve* by Charles Murray and Richard Herrnstein: The market pays a lot for intelligence. Intelligence isn't the whole story, but it is on par with education in explanatory power.
- XII. Personality, Culture, and Human Capital
 - A. Another well-developed field in psychology is the study of *personality*. To my knowledge, unfortunately, there is little cross-over between this literature and labor economics.
 - B. My hypothesis: What the main personality tests call Conscientiousness is probably another important determinant of income. Ignoring it probably leads us to over-state the effect of education. (In contrast, IQ and Conscientiousness are roughly unrelated).
 1. Note for the curious: In the popular Myers-Briggs personality test, Conscientiousness is captured by the Judging-Perceiving axis.
 - C. Curious about your personality? You can take the Myers-Briggs test at: <http://www.keirsey.com/cgi-bin/keirsey/newkts.cgi> and the Five-Factor test at: <http://cac.psu.edu/~j5j/test/ipipneo1.htm>
 - D. Sowell presents a great deal of historical evidence on the economic importance of culture. This is a complicated issue, though, because culture is hard to measure. Many leap to the conclusion that unexplained group differences must stem from "discrimination."
 - E. We'll deal with discrimination later. But: Let us suppose, as I guess most Americans do, that *religious* discrimination is no longer important in the U.S.
 - F. What are the labor income differences for different religions, controlling for education, experience, and intelligence?

Religious Background	Earnings Residual
None	0
Protestant	232
Baptist	-615
Episcopalian	2,388
Lutheran	-97
Methodist	-912
Presbyterian	-1,572
Roman Catholic	1,588
Jewish	11,939
Other	-483

- G. Maybe this reveals massive discrimination in favor of Jews, mild discrimination in favor of Episcopalians and Catholics, and mild discrimination against Presbyterians and Methodists, but I doubt it. Rather, I'd say that much of

this represents various cultural differences that have made some denominations more economically prosperous than others.

	A	B	C	D	E	F	G	H
1	Age	Period	Net Flow	PDV		Net Flow	PDV	Dif
2	18	0	0	0	1.12559052	15000	15000	-15000
3	19	1	0	0		15000	13326.3383	-13326.34
4	20	2	0	0		15000	11839.4195	-11839.42
5	21	3	0	0		15000	10518.4072	-10518.41
6	22	4	24112.6433	15021.8385		15000	9344.7902	5677.049
7	23	5	24112.6433	13345.741		15000	8302.12235	5043.619
8	24	6	24112.6433	11856.6573		15000	7375.79272	4480.865
9	25	7	24112.6433	10533.7217		15000	6552.82059	3980.901
10	26	8	24112.6433	9358.3959		15000	5821.67359	3536.722
11	27	9	24112.6433	8314.20996		15000	5172.1061	3142.104
12	28	10	24112.6433	7386.53163		15000	4595.0157	2791.516
13	29	11	24112.6433	6562.36128		15000	4082.31557	2480.046
14	30	12	24112.6433	5830.14975		15000	3626.82122	2203.329
15	31	13	24112.6433	5179.63652		15000	3222.14976	1957.487
16	32	14	24112.6433	4601.70589		15000	2862.63051	1739.075
17	33	15	24112.6433	4088.25929		15000	2543.2255	1545.034
18	34	16	24112.6433	3632.10175		15000	2259.45889	1372.643
19	35	17	24112.6433	3226.8411		15000	2007.35423	1219.487
20	36	18	24112.6433	2866.79841		15000	1783.37877	1083.42
21	37	19	24112.6433	2546.92836		15000	1584.39392	962.5344
22	38	20	24112.6433	2262.74859		15000	1407.61129	855.1373
23	39	21	24112.6433	2010.27687		15000	1250.55361	759.7233
24	40	22	24112.6433	1785.97531		15000	1111.02003	674.9553
25	41	23	24112.6433	1586.70074		15000	987.05525	599.6455
26	42	24	24112.6433	1409.66072		15000	876.922144	532.7386
27	43	25	24112.6433	1252.37438		15000	779.077408	473.297
28	44	26	24112.6433	1112.63764		15000	692.149939	420.4877
29	45	27	24112.6433	988.492369		15000	614.921615	373.5708
30	46	28	24112.6433	878.198913		15000	546.31023	331.8887
31	47	29	24112.6433	780.211719		15000	485.354329	294.8574
32	48	30	24112.6433	693.157686		15000	431.199731	261.958
33	49	31	24112.6433	615.81692		15000	383.087565	232.7294
34	50	32	24112.6433	547.10564		15000	340.343632	206.762
35	51	33	24112.6433	486.060988		15000	302.368958	183.692
36	52	34	24112.6433	431.827543		15000	268.631401	163.1961
37	53	35	24112.6433	383.645328		15000	238.658195	144.9871
38	54	36	24112.6433	340.839161		15000	212.029323	128.8098
39	55	37	24112.6433	302.809197		15000	188.371632	114.4376
40	56	38	24112.6433	269.02252		15000	167.353606	101.6689
41	57	39	24112.6433	239.005673		15000	148.680717	90.32496
42	58	40	24112.6433	212.33803		15000	132.091302	80.24673
43	59	41	24112.6433	188.645895		15000	117.352892	71.293
44	60	42	24112.6433	167.597267		15000	104.258956	63.33831
45	61	43	24112.6433	148.897192		15000	92.6260074	56.27118
46	62	44	24112.6433	132.283623		15000	82.2910338	49.99259
47	63	45	24112.6433	117.523754		15000	73.1092102	44.41454
48	64	46	24112.6433	104.410753		15000	64.9518711	39.45888
49	65	47	24112.6433	92.7608677		15000	57.704707	35.05616
50	66	48	24112.6433	82.4108468		15000	51.2661631	31.14468
51	67	49	24112.6433	73.2156548		15000	45.5460154	27.66964
52	68	50	24112.6433	65.0464388		15000	40.4641072	24.58233
53	Total PDV			134113.577			134113.577	2.49E-07

	A	B	C	D	E	F	G	H
1	Age	Period	Net Flow	PDV		Net Flow	PDV	Dif
2	18	0	-15000	-15000	1.06537277	15000	15000	-30000
3	19	1	-15000	-14079.5789		15000	14079.5789	-28159.16
4	20	2	-15000	-13215.6361		15000	13215.6361	-26431.27
5	21	3	-15000	-12404.7061		15000	12404.7061	-24809.41
6	22	4	24112.6433	18717.0952		15000	11643.5359	7073.559
7	23	5	24112.6433	17568.5879		15000	10929.0722	6639.516
8	24	6	24112.6433	16490.5546		15000	10258.4489	6232.106
9	25	7	24112.6433	15478.671		15000	9628.97605	5849.695
10	26	8	24112.6433	14528.878		15000	9038.12854	5490.749
11	27	9	24112.6433	13637.3656		15000	8483.53626	5153.829
12	28	10	24112.6433	12800.5576		15000	7962.97454	4837.583
13	29	11	24112.6433	12015.0974		15000	7474.35522	4540.742
14	30	12	24112.6433	11277.8341		15000	7015.71827	4262.116
15	31	13	24112.6433	10585.8104		15000	6585.22393	4000.586
16	32	14	24112.6433	9936.25014		15000	6181.14532	3755.105
17	33	15	24112.6433	9326.54786		15000	5801.86155	3524.686
18	34	16	24112.6433	8754.25776		15000	5445.85116	3308.407
19	35	17	24112.6433	8217.08419		15000	5111.68608	3105.398
20	36	18	24112.6433	7712.87235		15000	4798.02583	2914.847
21	37	19	24112.6433	7239.59965		15000	4503.61221	2735.987
22	38	20	24112.6433	6795.36763		15000	4227.26423	2568.103
23	39	21	24112.6433	6378.39431		15000	3967.87335	2410.521
24	40	22	24112.6433	5987.00707		15000	3724.39906	2262.608
25	41	23	24112.6433	5619.63589		15000	3495.8647	2123.771
26	42	24	24112.6433	5274.80713		15000	3281.35352	1993.454
27	43	25	24112.6433	4951.13754		15000	3080.00505	1871.132
28	44	26	24112.6433	4647.32878		15000	2891.01161	1756.317
29	45	27	24112.6433	4362.16215		15000	2713.61507	1648.547
30	46	28	24112.6433	4094.49374		15000	2547.10383	1547.39
31	47	29	24112.6433	3843.24984		15000	2390.80996	1452.44
32	48	30	24112.6433	3607.42263		15000	2244.1065	1363.316
33	49	31	24112.6433	3386.0661		15000	2106.40497	1279.661
34	50	32	24112.6433	3178.29232		15000	1977.15299	1201.139
35	51	33	24112.6433	2983.26783		15000	1855.8321	1127.436
36	52	34	24112.6433	2800.21032		15000	1741.95564	1058.255
37	53	35	24112.6433	2628.38548		15000	1635.06679	993.3187
38	54	36	24112.6433	2467.10405		15000	1534.73679	932.3673
39	55	37	24112.6433	2315.71907		15000	1440.56318	875.1559
40	56	38	24112.6433	2173.62329		15000	1352.1682	821.4551
41	57	39	24112.6433	2040.24671		15000	1269.19726	771.0495
42	58	40	24112.6433	1915.0543		15000	1191.31753	723.7368
43	59	41	24112.6433	1797.54388		15000	1118.21661	679.3273
44	60	42	24112.6433	1687.24406		15000	1049.60126	637.6428
45	61	43	24112.6433	1583.71239		15000	985.196253	598.5161
46	62	44	24112.6433	1486.53357		15000	924.743225	561.7903
47	63	45	24112.6433	1395.31778		15000	867.99968	527.3181
48	64	46	24112.6433	1309.69911		15000	814.737999	494.9611
49	65	47	24112.6433	1229.33413		15000	764.744529	464.5896
50	66	48	24112.6433	1153.90046		15000	717.818729	436.0817
51	67	49	24112.6433	1083.09551		15000	673.772362	409.3231
52	68	50	24112.6433	1016.63524		15000	632.428742	384.2065
53	Total PDV			234779.135			234779.135	-1.14E-07

	A	B	C	D	E	F	G	H
1	Age	Period	Net Flow	PDV		Net Flow	PDV	Dif
2	18	0	-15000	-15000	1.03016849	15000	15000	-30000
3	19	1	-15000	-14560.7249		15000	14560.7249	-29121.45
4	20	2	-15000	-14134.314		15000	14134.314	-28268.63
5	21	3	-15000	-13720.3905		15000	13720.3905	-27440.78
6	22	4	20032.0371	17786.5644		15000	13318.5888	4467.976
7	23	5	20032.0371	17265.6847		15000	12928.5539	4337.131
8	24	6	20032.0371	16760.059		15000	12549.9411	4210.118
9	25	7	20032.0371	16269.2406		15000	12182.416	4086.825
10	26	8	20032.0371	15792.7958		15000	11825.6539	3967.142
11	27	9	20032.0371	15330.3037		15000	11479.3395	3850.964
12	28	10	20032.0371	14881.3557		15000	11143.167	3738.189
13	29	11	20032.0371	14445.5551		15000	10816.8393	3628.716
14	30	12	20032.0371	14022.5169		15000	10500.0681	3522.449
15	31	13	20032.0371	13611.8674		15000	10192.5735	3419.294
16	32	14	20032.0371	13213.2438		15000	9894.08395	3319.16
17	33	15	20032.0371	12826.2939		15000	9604.33565	3221.958
18	34	16	20032.0371	12450.6758		15000	9323.07262	3127.603
19	35	17	20032.0371	12086.0577		15000	9050.04639	3036.011
20	36	18	20032.0371	11732.1174		15000	8785.01572	2947.102
21	37	19	20032.0371	11388.5423		15000	8527.74649	2860.796
22	38	20	20032.0371	11055.0287		15000	8278.01138	2777.017
23	39	21	20032.0371	10731.2822		15000	8035.58977	2695.692
24	40	22	20032.0371	10417.0165		15000	7800.26748	2616.749
25	41	23	20032.0371	10111.9541		15000	7571.8366	2540.118
26	42	24	20032.0371	9815.82548		15000	7350.09532	2465.73
27	43	25	20032.0371	9528.36897		15000	7134.84773	2393.521
28	44	26	20032.0371	9249.33063		15000	6925.90368	2323.427
29	45	27	20032.0371	8978.46393		15000	6723.07855	2255.385
30	46	28	20032.0371	8715.52956		15000	6526.19315	2189.336
31	47	29	20032.0371	8460.29523		15000	6335.07355	2125.222
32	48	30	20032.0371	8212.53543		15000	6149.55088	2062.985
33	49	31	20032.0371	7972.03128		15000	5969.46125	2002.57
34	50	32	20032.0371	7738.5703		15000	5794.64554	1943.925
35	51	33	20032.0371	7511.94622		15000	5624.94931	1886.997
36	52	34	20032.0371	7291.95884		15000	5460.22264	1831.736
37	53	35	20032.0371	7078.41378		15000	5300.31999	1778.094
38	54	36	20032.0371	6871.12239		15000	5145.10009	1726.022
39	55	37	20032.0371	6669.90153		15000	4994.4258	1675.476
40	56	38	20032.0371	6474.57342		15000	4848.16401	1626.409
41	57	39	20032.0371	6284.9655		15000	4706.1855	1578.78
42	58	40	20032.0371	6100.91025		15000	4568.36483	1532.545
43	59	41	20032.0371	5922.24506		15000	4434.58024	1487.665
44	60	42	20032.0371	5748.81208		15000	4304.71353	1444.099
45	61	43	20032.0371	5580.45808		15000	4178.64997	1401.808
46	62	44	20032.0371	5417.03434		15000	4056.27818	1360.756
47	63	45	20032.0371	5258.39645		15000	3937.49005	1320.906
48	64	46	20032.0371	5104.40428		15000	3822.18063	1282.224
49	65	47	20032.0371	4954.92177		15000	3710.24805	1244.674
50	66	48	20032.0371	4809.81686		15000	3601.59341	1208.223
51	67	49	20032.0371	4668.96135		15000	3496.12073	1172.841
52	68	50	20032.0371	4532.23079		15000	3393.73681	1138.494
53	Total PDV			399714.75			399714.75	2.31E-06

	A	B	C	D	E	F	G	H
1	Age	Period	Net Flow	PDV		Net Flow	PDV	Dif
2	18	0	-15000	-15000	0.94485672	15000	15000	-30000
3	19	1	-15000	-15875.423		15000	15875.423	-31750.85
4	20	2	-15000	-16801.937		15000	16801.937	-33603.87
5	21	3	-15000	-17782.5237		15000	17782.5237	-35565.05
6	22	4	15455.0879	19391.3329		15000	18820.339	570.9939
7	23	5	15455.0879	20523.0407		15000	19918.7228	604.3179
8	24	6	15455.0879	21720.7968		15000	21081.21	639.5868
9	25	7	15455.0879	22988.4558		15000	22311.5417	676.9141
10	26	8	15455.0879	24330.0972		15000	23613.6774	716.4199
11	27	9	15455.0879	25750.039		15000	24991.8077	758.2312
12	28	10	15455.0879	27252.8507		15000	26450.3679	802.4828
13	29	11	15455.0879	28843.3687		15000	27994.0519	849.3169
14	30	12	15455.0879	30526.7119		15000	29627.8276	898.8843
15	31	13	15455.0879	32308.2975		15000	31356.953	951.3446
16	32	14	15455.0879	34193.8593		15000	33186.9927	1006.867
17	33	15	15455.0879	36189.4652		15000	35123.8365	1065.629
18	34	16	15455.0879	38301.5378		15000	37173.7173	1127.82
19	35	17	15455.0879	40536.8742		15000	39343.2324	1193.642
20	36	18	15455.0879	42902.6682		15000	41639.3636	1263.305
21	37	19	15455.0879	45406.5336		15000	44069.5006	1337.033
22	38	20	15455.0879	48056.5284		15000	46641.4642	1415.064
23	39	21	15455.0879	50961.181		15000	49363.5314	1497.65
24	40	22	15455.0879	53829.5174		15000	52244.4627	1585.055
25	41	23	15455.0879	56971.0904		15000	55293.5295	1677.561
26	42	24	15455.0879	60296.0105		15000	58520.5445	1775.466
27	43	25	15455.0879	63814.978		15000	61935.8931	1879.085
28	44	26	15455.0879	67539.3178		15000	65550.5666	1988.751
29	45	27	15455.0879	71481.0158		15000	69376.1981	2104.818
30	46	28	15455.0879	75652.7573		15000	73425.0992	2227.658
31	47	29	15455.0879	80067.968		15000	77710.3004	2357.668
32	48	30	15455.0879	84740.8572		15000	82245.5925	2495.265
33	49	31	15455.0879	89686.4633		15000	87045.5712	2640.892
34	50	32	15455.0879	94920.7026		15000	92125.6839	2795.019
35	51	33	15455.0879	100460.42		15000	97502.2799	2958.14
36	52	34	15455.0879	106323.444		15000	103192.662	3130.782
37	53	35	15455.0879	112528.643		15000	109215.144	3313.499
38	54	36	15455.0879	119095.987		15000	115589.107	3506.88
39	55	37	15455.0879	126046.611		15000	122335.064	3711.547
40	56	38	15455.0879	133402.884		15000	129474.726	3928.158
41	57	39	15455.0879	141188.481		15000	137031.069	4157.412
42	58	40	15455.0879	149428.457		15000	145028.412	4400.045
43	59	41	15455.0879	158149.33		15000	153492.492	4656.838
44	60	42	15455.0879	167379.167		15000	162450.549	4928.618
45	61	43	15455.0879	177147.672		15000	171931.412	5216.26
46	62	44	15455.0879	187486.281		15000	181965.592	5520.689
47	63	45	15455.0879	198428.267		15000	192585.383	5842.885
48	64	46	15455.0879	210008.845		15000	203824.96	6183.884
49	65	47	15455.0879	222265.282		15000	215720.497	6544.785
50	66	48	15455.0879	235237.024		15000	228310.276	6926.749
51	67	49	15455.0879	248965.817		15000	241634.813	7331.005
52	68	50	15455.0879	263495.844		15000	255736.99	7758.853
53	Total PDV			4380662.89			4380662.89	-0.000477

	A	B	C	D	E	F	G	H
1	Age	Period	Net Flow	PDV		Net Flow	PDV	Dif
2	18	0	-15000	-15000	0.9972718	15000	15000	-30000
3	19	1	-15000	-15041.035		15000	15041.035	-30082.07
4	20	2	-15000	-15082.1822		15000	15082.1822	-30164.36
5	21	3	-15000	-15123.442		15000	15123.442	-30246.88
6	22	4	17379.7562	17570.7188		15000	15164.8147	2405.904
7	23	5	17379.7562	17618.7864		15000	15206.3005	2412.486
8	24	6	17379.7562	17666.9855		15000	15247.8999	2419.086
9	25	7	17379.7562	17715.3165		15000	15289.613	2425.703
10	26	8	17379.7562	17763.7796		15000	15331.4403	2432.339
11	27	9	17379.7562	17812.3754		15000	15373.3819	2438.993
12	28	10	17379.7562	17861.1041		15000	15415.4384	2445.666
13	29	11	17379.7562	17909.9661		15000	15457.6098	2452.356
14	30	12	17379.7562	17958.9617		15000	15499.8967	2459.065
15	31	13	17379.7562	18008.0914		15000	15542.2992	2465.792
16	32	14	17379.7562	18057.3555		15000	15584.8177	2472.538
17	33	15	17379.7562	18106.7544		15000	15627.4526	2479.302
18	34	16	17379.7562	18156.2884		15000	15670.204	2486.084
19	35	17	17379.7562	18205.9579		15000	15713.0725	2492.885
20	36	18	17379.7562	18255.7633		15000	15756.0582	2499.705
21	37	19	17379.7562	18305.705		15000	15799.1615	2506.544
22	38	20	17379.7562	18355.7832		15000	15842.3827	2513.401
23	39	21	17379.7562	18405.9985		15000	15885.7221	2520.276
24	40	22	17379.7562	18456.3512		15000	15929.1801	2527.171
25	41	23	17379.7562	18506.8416		15000	15972.757	2534.085
26	42	24	17379.7562	18557.4701		15000	16016.4531	2541.017
27	43	25	17379.7562	18608.2371		15000	16060.2688	2547.968
28	44	26	17379.7562	18659.143		15000	16104.2043	2554.939
29	45	27	17379.7562	18710.1882		15000	16148.26	2561.928
30	46	28	17379.7562	18761.373		15000	16192.4362	2568.937
31	47	29	17379.7562	18812.6978		15000	16236.7333	2575.964
32	48	30	17379.7562	18864.163		15000	16281.1516	2583.011
33	49	31	17379.7562	18915.769		15000	16325.6913	2590.078
34	50	32	17379.7562	18967.5163		15000	16370.353	2597.163
35	51	33	17379.7562	19019.405		15000	16415.1368	2604.268
36	52	34	17379.7562	19071.4357		15000	16460.0431	2611.393
37	53	35	17379.7562	19123.6088		15000	16505.0722	2618.537
38	54	36	17379.7562	19175.9246		15000	16550.2246	2625.7
39	55	37	17379.7562	19228.3835		15000	16595.5004	2632.883
40	56	38	17379.7562	19280.9859		15000	16640.9002	2640.086
41	57	39	17379.7562	19333.7322		15000	16686.4241	2647.308
42	58	40	17379.7562	19386.6228		15000	16732.0726	2654.55
43	59	41	17379.7562	19439.6581		15000	16777.8459	2661.812
44	60	42	17379.7562	19492.8385		15000	16823.7445	2669.094
45	61	43	17379.7562	19546.1644		15000	16869.7686	2676.396
46	62	44	17379.7562	19599.6361		15000	16915.9186	2683.718
47	63	45	17379.7562	19653.2542		15000	16962.1949	2691.059
48	64	46	17379.7562	19707.0189		15000	17008.5978	2698.421
49	65	47	17379.7562	19760.9307		15000	17055.1276	2705.803
50	66	48	17379.7562	19814.99		15000	17101.7847	2713.205
51	67	49	17379.7562	19869.1972		15000	17148.5695	2720.628
52	68	50	17379.7562	19923.5526		15000	17195.4822	2728.07
53	Total PDV			819736.122			819736.122	0.00011