

Module 1 Lesson 4: Video Transcriptions

1. Why Finance?

So anyway, the course I'm going to teach is called financial theory and I'm going to teach an actual class. I'm going to spend the first half of the class talking about the course and why you might be interested in it, and then I'm going to start with the course. There's not that many lectures available in the semester so I'm not going to waste this one. So the first half of the class is going to be about why to study it and the mechanics of the course, and the second half of the lecture is going to be the first part of the course. It will give you an idea of whether you will find the course interesting too. So, you should know that finance was not taught until 10 years ago at Yale. It was regarded by the deans and the classically minded faculty, the arts and sciences, as a vocational subject not worthy of being taught to Yale undergraduates. It was growing more and more famous however in the world, and there was a band of business school professors (Fisher Black, Robert Merton, William Sharp, Steve Ross, Myron Scholls, Merton Miller) who had a huge following in business schools teaching the subject, and whose students went off to Wall Street and more or less dominated the investment banking parts of wall street and became extremely successful. Finance became the most highly paid profession; it became the most highly paid faculty in the university, although they were all in business schools. There are more physics PHD's working in finance than there are working in Physics. So this merry band of financial theory professors didn't really believe in regulation. They believe markets left unfettered worked best of all. They believed in what they called efficient markets and the idea that aciprices reflect all the available possible information. So the implication of that is if you want to find out whether a company is doing well or not, you don't have to take the trouble to read all of their financial reports, just look at their stock price. If you want to know whether a country's is doing well or not, you don't have to study its entire political system and current events, just look at the general stock market of the country and that will tell you. They believed that you could make as good of returns in the market as a lay person as you could as an expert because all of the experts were competing to try to get the best possible price and so the price itself reflected all of their knowledge, wisdom, and opinions and so the lay person could take advantage of that by buying stocks. Everybody should be an investor they felt, a monkey throwing darts at a dartboard would do as well as any of the greatest experts. Now their own theory was basically contradicted by their own experiences because all of them seemed to go out into the world and invest and all most all of them made extraordinary returns and made a huge amount of money, all which made them even less popular in the faculty of arts and sciences. So, a critical part of their theory was that the markets were so efficient, driven by people like them who are competing to exploit every advantage and therefore compete away every advantage and by doing that, they put all the information they have into the prices. The implication of that theory is that there's an extraordinarily clever way of computing the value of most investment assets and about deciding when a financial decision is a good thing to do or not. That was the heart of what they taught in these business schools, these alga rhythms for valuing assets and making optimal financial decisions. One striking thing is that the people they studied, the business people and the investment bankers they studied, adopted their language. So, this had never happened in academia before. Anthropologists study primitive tribes and different kinds of people all the time, and not one of them I venture to say has ever taken over all of the language invented by anthropologists to behave themselves in their own societies. But the business people that these professors were studying

ended up using exactly the language created in academia. Now Yale was very different, there was no divide between economists and finance people. At Yale, the greatest economists in Yale's history were actually very interested in finance. Maybe they were financial economists to begin with. So the greatest Yale economists of the first half of the 20th century was Irving Fisher, who you'll hear a lot about. He wrote possibly the first economics PHD at Yale. There was no economist to teach him, so he had to write his PHD with Gibbs, maybe the greatest American physicist at the time. There's a building as you know on science hill named after Gibbs and you'll hear more about his dissertation in the 1890's, but he was a mathematical economist and an econometrician, but he invented almost all of his economics in order to study finance. The most famous Yale economist of the second half of the 20th century was James Tobin, a famous macroeconomist, and the most famous macroeconomist of the second half of the 20th century, after Cains. But he got the Nobel Prize for work he did on finance and economics; finance was incredibly interesting him. So, Bob Scholar and I went to Yale and basically said to the deans, "There's a long tradition of finance and economics hand in hand at Yale. And so it's not a vocational subject, it's actually central to economics and central to understanding the economy and central to understanding the global economy. So, we'd like to teach it to Yale undergraduates, and we believe a few of the will actually take the course." And so they agreed to let us do it, and so we've been teaching it now for the last ten years. So as you know, Scholar has been very critical of the business efficient market's tradition. He feels that these finance professors left something essential out of the whole story. What they left out was psychology. They left out the idea of fads, rumors, and narratives, which he thinks has a bigger effect on prices as the hard information on profits that the business schools imagined drove profits. I myself have been quite critical of the financial theory. I started off as a straight pure mathematical economist. To me, economics was almost a branch of logic and philosophy that happened to tell you something about the world. So I got my PHD with Ken Arrow, which you'll hear a lot about very shortly, I came back to Yale, and I joined the Khol's foundation. The Khol's foundation model was basically, can we make economics more mathematical? Economics as a social science ought to be amenable to mathematical analysis, just like physics and chemistry is. People didn't believe this at first and the Khol's foundation, which you'll hear a lot about in these lectures, lead the revolution in economics transforming it from a verbal subject, political economy, into a mathematical subject. Well, I decided around 1989 that since I did mathematical economics and there are all these finance people doing mathematical things on Wall Street and doing it very successfully, I thought I would just check out what they were doing. So it might be fun to see what they were up to. So I went to Wall Street and most professors that I knew in "Golden Sacs." A famous financial professor, named Fisher Black, was there at the time and he attracted a lot of people that was the traditional thing to do. But I decided to go to a littler firm called "Kidder Peabody." It was the 7th biggest investment firm at the time, and one thing lead to another and they wanted to reorganize their research department and fixed income. Since I was a professor there and I did mathematics economics, and since I was there for a year, someone in the income department said, "Why don't you take charge of it and hire a new fixed income department for me." So I did, and ultimately there were 75 people in the department and after 5 years, Kidder Peabody even through it was 135 years old, formed by a famous family, it closed down after 135 years, 5 years after I got there. I had to invite the 75 people that I had hired into my office and say, "you're fired." And then I went next door to the office next to mine and the guy there said, "You're fired." So, that was my first taste of Wall Street, and after that 6 of us founded a hedge fund called Ellington Capital Management, which was a mortgage hedge fund and

it started after the Kidder closing as a rather small hedge fund but it grew into a bigger hedge fund. In fact, it's the biggest mortgage hedge fund in the country, although recently we found out that practically anybody that trades mortgages are hedge funds, so it doesn't mean anything anymore to say that you are a big mortgage hedge fund. Anyways, we almost went out of business in '98 and then we just suffered thorough this disastrous last year or two, but we're still here. So these experiences have colored my understanding of Wall Street and my approach to the subject. So I took on in my theoretical work finance and economical theory in it's own terms. I didn't think like Scholar to introduce psychology into economics, I just take it on in its own mathematical terms, and what I've found is that there are 2 things missing in the standard theory. One is that it implicitly assumes you can buy insurance for everything, it's the assumption called complete markets. And secondly, it leaves out collateral entirely. In every textbook you'll almost never see the idea of collateral or leverage. The idea that you can't always get insurance and that you need collateral. You have to be able to convince somebody that you can pay them back and collateral is a way of persuading them that they're going to get paid back. Those two things were missing from the standard theory. So, I built a theory around incomplete markets and leverage, which is a critique of the standard theory. So in a way, Scholar and I have been vindicated by the crash. So let me just show you a picture here of how bad the crash was. Let's look at the dow Jones. The Dow Jones is an average of 30 stocks and what their value's, we'll talk more about it later. But here it is in 1913 it's moving up and up, but look what happened lately. The Dow Jones was up at 14,000 and it dropped to 6500, more than a 50% drop, and now it's gone 50% up again. So if you believe these finance professors, you will have to say that everybody realized that the future profits in America were going to be less than half what they thought they were going to be before and that's why the stock market dropped. So when it hit a bottom, everyone thought, oh my gosh we misunderstood things, it's not nearly that bad and now we're 50% higher because people think profits were gonna drop 50% but they really only dropped 25%. That would be the only way according to the old theory that it would happen. Now Scholar would just say that everybody is crazy and that they have in their head that the world is great and that it all just started so high and the narrative changed and they thought things were terrible. That's his story, I'm not sure how he gets it to go up again, they changed their mind again. By the way, it's a little better to look at the dow correcting for inflation, and then you see that the 1929 crash is on a log scale. Remember that the great depression was so low and it's grown so much, it's hard to see any change on this scale, so going up two of these is multiplying by 10. So in the early thirties, the stock market fell, it looks almost two things like it's 80 or 90%. This time the drop was much smaller; it looks like only about 50%, so it's a whole thing down but not 2 things down. Well it actually less than that maybe only a half-thing down, so the depression actual percentage drop was a whole lot worse than it is now. So these numbers are very interesting, if you're mathematical then these numbers are something you should pay attention to. So these efficient markets guys looked at the change in price every month. So there's a lot to say, they said "look it goes up and down randomly." We'll see that there's all kinds of tests where you can see if it's going to go up or down tomorrow on the basis of how it did yesterday. And the answer is no, it's very difficult to predict whether the stock market is going to go up or down, it seems to be random. Well, it's random and it used to be that people thought it was randomly distributed, but it's hard because you never get these gigantic outliers if things are normally distributed, it's way too unlikely to happen. So Mandell, a retired professor who wasn't when he was there, was the inventor of fractile, he said this couldn't possibly be a random walk because you

would never get these big outliers, but he offered no explanation of why it might be there. I don't know if Scholar has an explanation either. Is it that one-day people get shocked one day and then the next day they change their mind and things aren't so bad after all? But, you'll see that the theory of collateral and margins does explain these kinds of things. Now, let's look at the SMP 500. So, the SMP 500 looks very similar to the dow, except we have longer history back to 1871. So, I just want to point out more thing in the SMP500. So this is an average of 500 stocks instead of 30, but it's more or less the same. Let's look at the same thing, taking the logarithm and checking for inflation. So you see here that there are these 4 cycles, things seem low in 1971 then you've got an up and a down then another up and down, 4 times the same thing has happened. This could be just meaningless accidents, but it will turn out that the demography of the country, the baby boom cycle, we haven't had just one we've had four of them. So this cycle of stock crisis happens to correspond with the different baby boomer cycles and age distribution of the population. Another theory of the stock market that wouldn't have been entertained by the original financial theorists is that demography has something to do with the stock market; not information about profits and returns, but the distribution of ages in the population. So, I'm not saying this theory is correct, although I was one of the proponents of it, but it shows that there's room in finance for economic things, for demography and leverage to matter, and not just for expectations about future products. So, let me show you another picture. This is a 2nd way Scholar became famous, he looked at the housing prices, the House scholar Market Index. He became famous because he had the idea of collecting housing prices. So, you know it's quite amazing every town has to record in the town directory what every price is of every house, it's all publicly available on the public internet, and nobody thought to gather all the information and take the average and write down the index until scholar did it, so here's the Scholar index. So you can see that housing prices were stable throughout the 80's, and then in the 2000's they started taking off, this is when the stock market started taking off too. So Scholar thinks this was irrational exuberance, people just went crazy, they think things can never go down and they just keep buying because they think things are going to go up. Eventually a new narrative is going to start and somebody is going to say, "Oh it's being going up so long, things can't continue to go up, it has to go down," and things did go down. Now, I think there's something to psychology, so there was something missing in the original finance story. The finance guys would say, "well the rise is not very surprising, look at the interest rate you have to pay to get a mortgage." There's been a incredible decline of mortgage rates over the years, so it's less costly to buy housing. If you take the present values o your expenditures, you just have to pay less. So that's why you pay over a long period of time and so the interest rate is less and the value of the houses is worth more because you are discounting the future benefits at a lower rate. You'll hear about discounting later, so there's no mystery. On the other hand, nothing happened to interest rates, they kept getting lower, so there's no reason the market should have crashed, which again is an indication for Scholar. Now, it also is an indication for my theory, which is non-psychological. So I'm somewhat distrustful of Psychology because it can be anything although I agree it's important. So my theory is when you take a loan, you have to negotiate two things, the interest rate, and how much collateral you put up. Who's going to trust you to pay back? When you buy a house, they say, "we can't just trust you to borrow the whole value of the house, make a down payment then and borrow 80% of the value of the house." And so what I say is instead of paying all your attention on the interest rate, think about the collateral rate and why is it 20% that you have to put down? Maybe it should be 10% or 40%. Well in fact, that number changes all the time. So here what I've

done is that pink line from 2000 to the future is Scholar's housing index inverted. So you'll notice the housing prices but I've inverted it. And on the left, I have the down payment percentage. These are non-agency loans. But what you see is that from 2000's onward the down payments people had to make to buy their house got lower and lower to 3%. You could put down 3% of the value of the house and borrow the other 97% to buy it. So, amazingly the prices go down just with the leverage. Why is it called leverage? Because the amount of cash you put down payment say 10%, you can lever it up and own an asset that's worth 100, even though you put down \$10. So your leverage is 10:1. If you put down \$3 and you can get a \$100 house, you've leveraged it 30:1, that's why it's called leverage. So anyways the point is that the leverage went way up, the margins kept going down and just as the peak of the housing cycle, that's when collaterals started getting tougher. People started asking for more money down again and sure enough the prices turned around. So if you look at the prices of mortgages, again the inverse on the right, and you look at the margins on the left, not for buying houses but for buying securities. The blue line is for buying securities. So '98 is a big crisis, the margins spike up. Now from 2007-2009 you see the margins are spiking up. So to buy a toxic mortgage security, investors don't pay cash, they borrow part of the money to buy it. They used to have to put down 5% to buy it, now they have to put down 70% to buy it. Well what happened to prices? The inverse of prices in 2007, started to collapse. Once again the tougher margins means lower prices. As the margins came down recently, the prices went up recently. So, it's an alternative theory. So, it doesn't mean that the standard financial theory is wrong. After all, I helped run a hedge fund, 6 of us founded it and we've been in business for 15 years. We must believe in standard financial theory, because that's how we've been making a lot of our money. We exploit all of those alga-rhythms so it's very important to teach you that again today. But there's more to the theory than just that. I want to show you one more thing in the SMP that I forgot to mention. Where was the peak of the dow? It was right over here on October 1, 2007, so that's when people started to realize that something was wrong with the world and things headed down. Until then nothing bad seemed to be happening in the world, but suppose you looked at the subprime mortgage index. You'll see it's 100, 100 means nobody thinks there's going to be a default. Over here January 10, 2007, that's 10 months before the stock market hits its peak, it's still going up there. A month later, April 2007, the subprime index starts to collapse; you see it goes from 100 to 60, we're already in February or March 2007. So that means those experts trading mortgages already realized there was a calamity about to happen. This was long before anybody else perceived anything happening or the stock market moved or the government did anything to correct the problem. So, Justice Financial Theory says, "if you pay attention to the prices you can learn a lot about the world." The people trading those things, their life depends on fixing the right prices. Probably they know stuff that you don't know, the prices are going to reflect their opinion. If the price collapsed, part of the reasons it collapsed was because they knew something bad was happening. So for two and a half years, we've known there's going to be a major catastrophe in the mortgage market. It would go from 100 to 60 to 20 is a total calamity. So you know there's 1.7 million people who have already been thrown out of their houses, another 3.5 million aren't paying their debts, probably all of them will be thrown out of their houses, and another 4 or 5 million after them might default and have to be thrown out of their houses. So it's a major catastrophe and the market told us and warned us about it two and a half years ago and nobody's done anything about it basically until now. So it's not that I think that standard financial theory is wrong, I think it's incredibly useful, I just think it has to be supplemented by a more general, richer theory. By the

way, maybe I should show you how my hedge fund has done so you don't think I'm a total failure. So Kidder Peabody went out of business in 1994, there was a tremendous crash in the market, a low leverage cycle. The purple is Ellington hedge fund, you'll see that these are other investment opportunities. The SMP 500 is the green thing, emerging markets is the blue one, and high yield is the green one and then there are a bunch of other things like treasuries and libewar, which is what banks loan to each other. So this says that if you put your money into any of those strategies, like lending your money to a bank each month and seeing what interest you accumulate, or putting your money in Ellington and looking at the purple, or putting your dollar into the stock market and seeing what happens with the SMP 500, is what happens. So, you see this was a crash here, so we start Ellington and then all these years we're doing great. Then in '98, there's a huge crash and we lost a huge amount of money and almost went out of business. Long-term capital, which was run by two Nobel prize winners, Myron Schols and Robert Merton, two of the guys I mentioned as leaders bankrupted their company and went out of business. Why did they go out of business? Because they weren't aware of the leverage cycle, so the prices collapsed. Then look, the returns shoot up again and the market seems to be going great. Then there's another crisis in 2007, everything plummets and now everything's going up again. It's hard to see this and live through that. I remember in '98 for example, when there was a margin call. Our lenders called and said, "We want more money. We don't believe that the assets are worth as much as they were and so the lateral's not covering the loan anymore." And we said, "You can't make a margin call. It's not legal, you promised not to change the margins on us for 6 months, you can't make a margin call." And they said, "Well, blah blah blah we don't really know about that. We're making a margin call." So we called up Warren Buffet and we said, "This is terrible they're making a margin call, they can't do this. We have great bonds, there's nothing wrong with the bond, they just want us to sell all the bonds and pay all the money. How can they force us to do that? They shouldn't force us to do it. We've got great bonds, it's a great business and company, and they're going to throw us out of business. You can't let this happen Buffet, why don't you buy part of the company and save us. You'll get rich and it will be great." And he said, "Say that again." And we said, "Well, they're going to force us to sell all of the bonds on Tuesday to meet their margin call and we will get terrible prices for the bonds and be driven out of business even though they're great bonds, just because they're making a margin call. You can't let this happen to us. Buy part of the business, and save us and you'll get rich and own part of a great company. He said, "it sounds like I should just show up on Tuesday and buy the bonds." I'll tell you more about what we did, but we survived that thanks to Warren Buffet and then we survived the last crashes. But the fact is thing go up and then crash again. Could it all be my fault? I decided it can't be all my fault, there's got to be something more basic at work and that's why I'm going to tell you about the leverage cycle. Now of course I realize my pet theories may not be right, so I'm not going to spend a huge portion of the class just talking about my pet theories. I recognize that I have to teach partly what's standard. So I'm going to divide it in the following way, I'm going to talk about the standard no-arbitrage financial theory theoretically and mathematically, and from a practical point of view, because to run a hedge fund, lots of the things that I'll be teaching, we actually confronted in the hedge fund. So you'll get the standard financial theory course taught from a hedge fund perspective, both theoretically and from a practical point of view. On the other hand, I've lived through 3 mortgage crises, so it seems silly for me not to describe how the mortgage market works, even though you'll find almost none of that in a standard finance textbook, how the mortgage market works and what's going on and what happened in the crises,

and why we survived and other people didn't. I'll talk about the leverage cycle. I'll also spend some time on the mathematical logic of the invisible hand argument, that's the most important argument in economics. The free market does good for the economy and a huge number of people believe it and part of that hazy knowledge of that argument is what drives resistance to a lot of government programs. "The government can only screw things up" is what people generally believe. Is that a prejudice or an actual argument? Well I want to go over that argument and show you precisely how it works and how it doesn't work in the financial sphere. And then I want to talk about social security. That's one more program, that's the biggest program in the budget, it's as big as defense and the two of those are vastly bigger than anything else in the budget. So I want to talk about social security and should it be prioritized or reformed. It's also a mathematical problem because SS critically involves the belief that things will go on forever, so there's an infinity in it. In each generation the young are paying for the old, nobody would do that if they thought they were going to be the last generation paying for the old, and when they got old no one would help them. So SS rests on the world going on forever, which makes it mathematically interesting. So I got interested in it from a theoretical point of view and then I got put in all of these national academy panels on SS and privatizing. And so, since I know a lot about it, I might as well talk about something I know about. Alright so, I will just give you a few examples here of things from the standard financial theory. So I'll give you 10 examples. So, these are things that I'm guessing you'll have trouble figuring out now, but by the end of the course, they should be totally obvious to you. So suppose you win the lottery, 100 million dollars and they give you a choice, do you want to take 5 million dollars a year over 20 years or just get 40 million dollars right now. Which would you choose and how do you think about what to do? Ok so now you get tenure at Yale at the age of 50, you're making \$100,000 a year and you think it's gonna go up with the rate of inflation for the next 20 years until you retire, and then you're going to live another 20 years making nothing. So much of the \$150,000, let's say inflation is 3% and so you would like to consume the same amount after you retire. So how much of the \$150,000 should you spend this year and how much should you save? Now president Levin wrote that the crisis was bad and that Yale would lever it, but that Yale had lost 25% of its endowment, that's \$5 billion, so how much should he choose to cut in spending every year? The total spending right now is a little over 2 billion. So if the endowment goes down by 5 billion, what cut should you take to the budget? Should faculty salaries be cut, should you cut the number of TA's? How big of a cut should you take? The same cut faced Yale in 1996, the previous president, Dr. Schmit suddenly noticed that there was differed maintenance. A billion dollars to fix the Yale building. They decided a billion dollars every year had to be spent. The whole endowment was \$3 billion differed maintenance problem. The budget was about \$1 Billion then. So how much should you cut the Yale budget at that time? So, Schmit said I'm firing 15% of the faculty, it was on the front page of the NY Times. Well did he make the right decision? Rick Levin took over as president 3 months later so probably not. What mistake did he make in his calculations? What should he have done? What was the right response? Now, let's take a slightly more complicated one. You're a bookie and the World Series is coming up. The Yankees are playing the Dodgers. You know that the teams are evenly matched and you have a bunch of friends who you know will be willing to evenly bet on either side. One of your customers comes to you as Yankees fan, and says he's willing to put up \$300,000. So if the Yankees win he gets \$200,000, but if the Yankees lose, he loses \$300,000. Well you say this guy is sort of a sucker here, I can take a big advantage of him. On the other hand, that's a lot of money I might lose if I have to pay off and the Yankees win. So even

though my expected profit is positive, the fact that it's such a big number worries me, so what can you do? You've got these friends who are willing to bet at even odds each game by game. Presumably one of the first nights, you're gonna bet with one your friends, you take the customer's \$300,000, you promise to deliver him back \$500 if the Yankees win and to keep it if the Yankees loose. So who should you bet for with your friends and how much should you bet? There's a way to skillfully betting with your friends and not betting \$200 or \$300,000, you can bet a different number and you can figure that out, so that if you keep betting through the course of the World Series you can never loose a penny. But how do you know how much that is? That's the kind of clever thing these financial guys invented that you're going to know how to do. So let's do another example like that. Suppose there's a deck of cards, 26 red cards and 26 black cards, they say if you pick a card and it's black, then I will give you a dollar, but if it's red then you give me a dollar. The guy says by the way you can quit whenever you want. There's an even chance of wining or loosing. You pick your first card; it's black so you win a dollar. Now the guy says do you want to do it again? You do it again it's black, so now the deck is stacked against you. Should you pick another card? Well it doesn't sound like you should pick a card, but you should pick another card. In fact, I can tell you how many cards to pick. You should keep picking cards. Even if you keep getting blacks you should keep piking and picking. So how can that be? It's very shocking and it's going to turn out to be very simple for you to solve halfway through the course. So let's suppose that there are 30-year mortgages now you can get for 5.75% interest, there are 15 year mortgages you can get for like 5.3%. Should you take the 15 year mortgage or the 30 year mortgage? Why do they offer one at a lower price than the other? Suppose you're a bank and you hold a bunch mortgages, that means the people in the houses, you've lent them that money. They're promising to pay you back and you value all those mortgages at a million dollar, the interest rate goes down, half choose to refinance. They pay you back what they owe and then refinance as a new mortgage. So half the people are left, is that shrunken pool half the original pool, is that worth 50 million, half of what it was worth before? Or is that 50 million half of what it was before or more than 50 million or less than 50 million. How would you decide that? It's again puzzling, but actually you should be able to get that, today even. We'll start analyzing. So that's what mortgage traders have to do, they see interest rates went down, the people who are left in the pool are different than the people who started in the pool. Now we've got to revalue everything and rethink it all. So we're thinking how should we do that? Okay, let' say you're on a hedge fund and the investors comes to you and says, " Ugh things are terrible, look at all the money you lost from me last year. I know you're doing great and you've got back the money you lost last year, but I don't wan to run that risk. So I'm going to give you my money, \$1 Billion, I want to get these superior returns you seem to earn but you have to guarantee that you don't loose me a penny. I don't want any risk. I want a principal guarantee that when I give you my \$100, you'll always return my \$100 and hopefully make more. So is there any way to do that? You know that you've got a great strategy but of course it's risky, you could loose, you've lost before. So how can you guarantee the guy that all of is money back but still have room to run your strategy. It sounds like you can't do it, but a lot of people wan to run their business that way so there must be a way to do it. So, you'll figure out how to do that. There's three more. A scientist discovers a cure for AIDS, if it works, he's gonna make a fortune, if it doesn't work he's gonna make 0. You calculate, let's say your calculation that the expected profits, the probability of it working x's the profit=the profit of all of General Electric. Should his company be worth more than General Electric, the same as General Electric, or less than General Electric? Since it's got the same

expected profits. I can tell you the answer to this one because first you'd think well maybe it's the same, then you'd think this AIDS thing is so risky, it's either going to be way up here or nothing. It's so risky and General Electric is so solid, probably General Electric is worth more. But the answer is the AIDS company's worth more. So how could that be? I've got another question, so suppose you believe in the sufficient market stuff, and you rank all the stocks at the end of this year from top to bottom of which stock had the highest return of 2010 of year. Now, suppose you did the same thing in 2011 with the same stocks. Would you expect to get the same order, or the reverse order, or random order? Now again, if you believe in efficient markets and the markets are really functioning and the prices are fair and all, I'll bet most of you would say it should be random the next time because the firms only did better by luck, but that's not right either. So, you're going to be able to answer that by the end of the class. One last one, the Yale endowment over the last 15 years had gotten 15% annualized return, a hedge fund has gotten 11% over the last 15 years. So, is it obvious that Yale endowment has done better than the hedge fund? Would you say that the Yale manager is better because the fund got 15% and the hedge fund only got 11%? I'm asking the question and I would say that David Swinson would think about it the same way that I would think about it. So suppose I told you that the Yale endowment had lower volatility than the hedge fund, which it surely does. Would that convince you now that the Yale endowment had been managed better than the hedge fund? Well, we're going to answer this question again, and you're going to see that this answer is a bit surprising. But anyway that's the kind of thing that in finance you're going to think about. So, the crisis of 2007, which we're going to spend a lot of time talking about. So those lists of questions were the kinds of things that I used to teach for years before I was confident of my theory of crises. And those are kinds of questions you have to face with hedge funds, decisions you have to make, things you have to tell investors, and so that's the basic part of the course. But I want to say more about the crisis of 2007 and 2009; it started as a mortgage crisis. Okay but how could it be that everything goes wrong in mortgages? They're 4,000 years old. The Babylonians invented mortgages. What is a mortgage? You lend somebody money, they put up collateral, they don't pay so you take the house or the guy's life. It's the same thing you put down money and the guy promises you can confiscate something if he doesn't pay, 4,000 years and we screwed it up. How can that be? And why would a screw up in the mortgage office be closed to the economy? And how did we get out of the crises? How did people say this is the worst crash since the depression and then things have been turned around? We're not there yet, but things are a lot better than they were a year ago, so what is it that government did to turn things around? It didn't do nearly enough I think, but it did something just exactly what did it do? Now Sholar would talk about how the whole thing was irrational exuberance, now I think the whole thing is all the leverage cycle. But anyways, that's the mortgage cycle. Are free markets good? I want to talk about the argument was first made by Adam Smith the modern mathematical hand is Ken Arrow, my thesis advisor. Of course it's that monopoly and pollution and things like that interfere with the free market and they have to be regulated. But the financial market says there's no monopoly. As long as there's no monopoly and no pollution, shouldn't the free market function there? I wanna go over that argument and show you what was missing as I said before, and then lastly we're going to talk about social security and how could that system be going bankrupt? It just seems shocking, there's a 2 trillion dollar trust fund going out in 2024 and then after that the system will be broke. So how did it happen? Why is it broke? How do we fix it? So George Busch says, "Well its terrible, even if we manage to get the trust fund rehabilitated people like you are going to get a 2% return. If you put

your money in the stock over the long haul the returns have been 6% so it's terrible social security something's wrong with the system, we should privatize it and let young people like you all put your money in stocks instead." Well Gore, said, "You can't do that because then the old people that are expecting their money can't get paid." It was all the baby boomers' fault, people like me buy too many stocks. That's the conventional wisdom, all those things are wrong so we're going to find out why. So in summary, the new system, which is really apart of the economic system, is to make informed choices. Is privatizing social security a good or bad thing? Is regulation of financial markets a good thing? The language you will learn is the language created on Wall Street by professors. For me, it's incredibly fun. I think money is just a way of keeping score to figure out what something's worth in the end and if you get it right, you get the puzzle right. And it will help you make good financial decisions in a potential career. That's the standard reason to take finance. Now, the prerequisites of the course, I want to make this clear, you don't really need Econ 115, it is helpful because the logic of the free market being good or bad, that was already started in Econ 115. So anyways, what you really need is mathematical self-confidence. It's not going to be hard math, it's going to be simple math, but it's relentless over and over again. Ad I can tell you that every year there's 5% of you that are just going to get bored there's maybe 10 % don't have that much experience doing it and just don't have much confidence doing it. Those people stop coming to class and then they have no idea what's going on. So my sister is probably much smarter than I am but she doesn't like math, so I wouldn't recommend this course. So, if you're not confident doing little mathematical problems, just don't take the course. I don't know how to say this any better, I'll warn you not to do it. It's easy math but it never stops, every week there's going to be a problem set. The exam has problem sets; the exam is doing problems just like the problem set. But if you don't like that, to me finance is a quantitative subject. What's so beautiful about it and one aspect I really like is that you have complicated things you have to weigh, but at the end, you have to come up with one number. What is the price you are willing to come up for something concrete. I might take advantage of the concreteness by turning every question into a number. So, if you don't like numbers it's not a good course to take. What are the kinds of things you have to know? You have to understand the distributive law of arhythmic and that's not to easy to understand. Then you have to understand the function of contingent plan, simultaneous equations, what we do for equilibrium and arbitrage, taking a derivative, that's margin utility, the idea of diminishing marginality, concave function, that's risk aversion, bankers invent exponential means, you have to know what taking loga rhythms means, and you have to understand how to take probability weight averages of things. We're going to use Excel for a lot of the problems which will teach you and then you'll be better at it than I am. So, my office hours are 4-6, my secretary assistant is Rende Wilson, she just started 3 days ago, but I'm sure she'll be great. There's a TA in every session. So every Tuesday, they'll be a problem set, it'll start this Tuesday, due the next Tuesday. There will be 2 mid-terms with stuff to learn, and so I've found that everyone agrees whose taken the course, if you take the midterm, it will focus your mind and make it a lot easier. So you'll have two of them, which makes it easier to study. I recognize that some of you will have problems with the first midterm, and if you do vastly worse on one exam than the rest, I tend to ignore that. But most people don't do vastly worse on one than the rest. The final is 40%, the problem set is 20%, and the rest is 20%. All the TA sessions are on Thursdays. So they're gonna start next Thursday. So the TA's are going to meet there and the same moment in the class. There are all these textbooks you can buy any one of them, but I have my own lecture notes because I am teaching a slightly unconventional course. And there's a

list of books on crisis, they're all interesting and fun and so those are some you can look at. I mean it's never been a more fun time to read this stuff now. So that's it, are there any questions about how the course runs or how I run it or whether you think you should take the course or whether you are prepared? So if you haven't taken Econ 115, it's okay, but you've got to be confident that you can solve problems. Otherwise, don't do it. Any questions? Yes.... Yeah, so next Tuesday, it's going to be due the Tuesday after. I know that's early but I know you probably already know if you're going to take the course or not. Yes? Will I teach this next year? I probably won't because I'm going to go on leave, but I might but probably not. But someone else will teach it. I don't really suggest, they're all good, the books are trying to sell copies, so they're pitched at a low level, but they're very good. Any one of them is good, Miller's book, Merton's book, Steve Ross's book, any one of those is very good, but they're not at the same mathematical level as this because they're trying to send thousands of books and they stick pretty closely to the financial view of the world that everything's efficient. Yes? That's a good question, no they're shaking their heads so it won't be in time for you but it will be back in your old age. The lecture notes are already posted for the class, so the first 12 are there. I'm changing them each year so there will be some changes. Last year's 12 were there, so there might be some change a little bit, but you can already get an idea of what they're about. This first lecture is not on, but the rest of them are. Any other questions? Yes? Oh you should be signing up now, you can sign up now. So what you do is you pick your sections, we might add another section if all of you stay, but you probably won't, but if you do we will add another TA section. The grade distribution is the standard Yale junior level course grade distribution. When I was Yale things were much tougher, but it's the standard distribution. I'll tell you all about the distribution of the midterm. There will be a midterm before you have a chance to drop the course, and then there will be another midterm right at the end of the course. Yes? Okay I was trying to say that, I'm glad you're making me go over that again. So the things you have to know, you have to be able to take the derivative of that, you have to be able to solve simultaneous equations. So that's the kind of thing you have to do, and you have to be able to do it quickly and with total confidence that you're doing it right. You know, for many of you that's not problem, but for some of you who are even smarter than everybody else, that's a problem. So, you'll have to judge yourself in whether you can do that comfortably so that you don't have to worry about the mechanics, you can think conceptually about what the question is asking. Alright, I want to end with one experiment. This is something we're not going to have time to figure out the answer to. So, I need 16 volunteers, how about the first two rows, you can volunteer and just do it. Okay, so I'm going to an auction. So please stand up and 8 of you come over here. That's okay, I know you're reluctant to do this, I only need 16 Bege help me count them. Ok you guys have to come the other way, the TA's aren't going to participate. Okay they're 8, mix these up, they're going to be 8 sellers and 8 buyers, so shuffle them up and give one to each. We've got 8 sellers and 8 buyers, so each seller knows what his football ticket is worth to her. So say it's \$15, if she can sell it for more than \$15, she's gonna do it so she can make a profit. If she sells it for less than \$15 she's not a very good trader, she's not gonna do that. She's gonna say if I can get more for the ticket, I'm gonna do it, if I can't get more than it's worth I'm not going to sell it. She everyone knows what the ticket is worth herself. All these guys know what it's worth for them. So say I think it's worth \$30, if I can get it for \$15, then I'll get a profit, if I can only get it for \$40, I'm not going to do that because it's more than I think it's worth. Reservation value yourself, you don't want to pay for more than it's worth because then you're losing money, and they don't want to sell it for less than it's worth because then want to

make money. Okay so nobody knows the value information. This is a famous experiment; this knowledge is distributed in the whole environment. We're going to see what happens when I start a chaotic interaction with these 16 people. You would think it would be total chaos and nothing sensible was going to happen, but what the efficient market would say, the market is going to discover what everyone thinks it's worth and figure out the best and right thing to do, and that's what's going to happen. It's hard to believe that with this preparation you've had, 0 training, 0 experience, with only 2 minutes to do this. With only 2 minutes of training, you're going to work everything out and it's going to seem like much more than 2 minutes. So here are the rules, I'm going to put you all together start inching your way to each other. You're going to start yelling out an offer. So if you're a seller and you think it's worth \$15, you're not gonna sell it for \$15, you're gonna say give me \$20 or give me \$30. You're going to try to get as much as you can and then the buyers are going to make their offers. When two of you see that there's a deal, you have to shake hands, exchange the football, and leave, and tell your numbers to Bege. So it has to be public outcry and all the other people can hear you. You've only got 2 minutes, now two minutes sounds like an incredibly short amount of time, which it is, but it's longer than you think. You shouldn't trade in the 1st 10 or 15 seconds. Two minutes, though it sounds short, is actually a very long period of time, so be patient, try to get the best possible price, and we'll see what happens. Any questions about what you're doing? Now, in the heat of the moment you might be so frustrated about what you're doing that you can't sell, I'm going to expose you if you do that. So keep track of what thing's worth. Alright any questions about what is going on? Okay, so you have two minutes, go!

Okay let's see what happened. 5 traded. Here's what happened, here were the numbers. All the buyers are in blue and the red ones were the sellers. For every buyer there's a seller underneath. So, you could have had 8 trades, but only 5 people traded and there were at least 3 slump pairs of people looking despondent, hopeless, unable to trade, worried they were on camera. So Bege name the buyers who bought, the prices. So here's what happened, Mr. seller 10 sold to 36 at a price of \$20. Mr. seller 6 sold to buyer 20 at a price of \$20. Buyer 14 sold to buyer 44 at a price \$20. Buyer 20 sold to Buyer 40 for \$22. Seller 24 sold to buyer 30 for \$25. Okay so 5 people traded 10, 6, 14, 24 and the five buyers were 36, 20, 44, 40, 30. So, if you look at it, it's not quite the way theory would have predicted it, but almost. If you just shuffle the orders and put the buyers from bottom to top, you get what looks like a demand curve and a supply curve. All these 5 people ended up selling, the price they sold for was between 20-25 and the buyers were 44, 40, 36, 30, 20. So, basically the theory of the free market says this chaotic situation because they only had 2 minutes to do it, could be analyzed when you put a demand curve with the supply curve and there was one price that they miraculously knew. Here it was 25, it turned out to be 20 or 22, that at that one price, you get all the trades happening. If that happens, people of the highest valuation buyers, get it, and people with the highest valuation sellers sell it. So the people that end up with the ticket are these people at the top. All the tickets go from the people who value the stuff least to the people who value it more. So the market has done extraordinary thing. What happened in 2 minutes, Mr. and Mrs. 20 got a very bad deal. So he didn't get any extra out of it. So 26 should have gotten it instead of 20. So it's a slight inefficiency. But basically, with no training, no background, these 16 undergraduates managed to reproduce and gathered all of the information and discovered who are the 8 people who value the tickets the most, and they ended up with all the tickets. For me to do it and sort it out would have taken longer. It solves a complicated problem and gets it incredibly quickly and puts it into the hands of the people who value it the most. The marginal value thought it

was valued as 20 and what the price turned out to be. So we will come back to this parable at the beginning of the next class.