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COURSE 220 "LITE": A "LESS FILLING" OVERVIEW OF THE FELLOWSHIP EXAM ON INTRODUCTION TO ASSET MANAGEMENT AND CORPORATE FINANCE

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During the past several years, the Fellowship syllabus has been strengthened with a number of exams on investment and finance topics. This teaching session will introduce Course 220 to "seasoned" actuaries who missed the opportunity to study this material on their road to Fellowship. Topics include: macroeconomics, financial markets and asset definition, portfolio management, and investment strategies. Given the time frame, the focus of this session will be to expose the various subjects covered, identify reading materials, and highlight a few topics. No pop quizzes, we promise!

MR. CHRISTOPHER J. FIEVOLI: The format of our session will be as follows: I'll start off with a review of what is on the syllabus for Course 220. Then, both Tom and I will go into more depth on a few subjects. Finally, we'll wrap up with a review of an actual exam question.

There are five sections to the syllabus. They are: (1) macroeconomics, (2) financial markets and asset definition, (3) portfolio management and investment strategy, (4) corporate finance, and (5) asset management.

The first section is on macroeconomics, and there's only one study note. It's intended to be an introduction to the subject so we don't go into a lot of detail. The note is by Paul Wachtel. The macroeconomics section covers anywhere from 5% to 20% of the syllabus. As we move to the subjects of financial markets and asset definition, we have two very good textbooks that we draw on for this section. They are the *Investments* textbook by Z. Bodie, A. Kane, and A. Marcus (Burr Ridge, IL: Richard D. Irwin, Inc., 1993), and the F.J. Fabozzi, T.D. Fabozzi, and I.M. Pollack *Handbook of Fixed Income Securities* (Burr Ridge, IL: Richard D. Irwin, Inc., 1993). I think both of these textbooks are on the Chartered Financial Analyst (CFA) course of study. We also include a study note (220-21-93, *Inside the Canadian Bond Market*) that looks at the Canadian bond market. That's published by Scotia/McLeod. Together this makes anywhere from 25% to 45% of the syllabus.

The next section is on portfolio management and investment strategy. Again, we turn to the *Investments* textbook, and there is a more practical study note. Much of the material on this exam is geared towards investment professionals and not necessarily actuaries or actuarial students, so we have a couple of study notes that bring in some practical applications, and this is one of them. It looks at investment strategy for life insurance companies and pension plans.

The next section is on corporate finance. There is one textbook here, titled *Analysis For Financial Management* by Robert C. Higgins. This textbook is really geared to nonfinancial executives and business students, but we found it provides a good background on corporate finance for actuarial students as well, so we've included it on the syllabus.

Finally, there's a section on asset management. Again, we take some material from the Fabozzi textbook. We also have a study note which is, again, an application study note. It looks at modern techniques for investment on insurance and pension funds, and that's written by Tilley.

That's basically the syllabus the way it looked in the Fall of 1994. I think there are some minor changes in setting the syllabus this year, but the general character of it will be basically the same. I'll turn things over to Tom now. He will give some details on a few topics that are on the syllabus.

MR. THOMAS C. GUAY: I'm interested in how many of members of the audience have not yet taken 220? I see about five hands. How many have taken the Investments exam since it has been renamed 220? Looks like roughly the same number of people. Finally, how many of you go back to the old Part 8 days or earlier? Your replies indicate that we have a fairly good mix.

What I want to do first is take roughly one-half of the syllabus and describe some of the major topics that are covered. And as Chris said, I will then go into a bit more detail on one of those subjects.

First, let's discuss corporate finance. Five major areas are covered in the Higgins textbook *Analysis for Financial Management.* The first two get at assessing the financial health of a firm. One chapter describes how we can interpret financial statement information. It covers the income statement, balance sheet, cash-flow statement, and what types of information you can learn by analyzing these financial statements. The second chapter covers ratio analysis—evaluating financial performance by looking primarily at the return-on-equity ratio. Earnings-to-equity can be divided into several pieces and each of those pieces can give you a feel for the strengths and weaknesses in a given firm.

In the next two chapters, the author focuses on planning for the future. One chapter is on financial forecasting techniques. For example, pro forma financial statements, cash-flow forecasts, and cash budgets are discussed. Also, there's a chapter on managing growth. The author first defines "sustainable growth." As a financial manager, you can compare actual growth to sustainable growth. If the two aren't in balance, there are certain techniques that you can follow to get them back in balance.

The final corporate finance chapter on the syllabus covers the decision of whether to finance with debt versus equity and on the debt side, how to establish your maturity structure—short-term versus long-term bonds. Macroeconomics is another major topic on the syllabus. I divided the study note into five main areas. In the first section on macroeconomic measurement, the author defines gross national product and indices like the consumer price index (CPI), before talking about business cycles and what occurs at various stages of the business cycle. A large portion of the study note covers supply/demand models, building from a simplistic model to a more complex and a complete total supply/demand model. It describes how the economy in general moves toward equilibrium. Also, inflation and its causes are discussed, in addition to the relationship that's often studied between the inflation rate and the unemployment rate. In the final two sections, the author discusses tools that organizations can use to impact the economy. The monetary policy section first defines money and the role of banks. The author also discusses the Federal Reserve and some of the tools that it can use.

Examples include changing the discount rate or changing the reserve requirements. Finally, the note covers fiscal policy. The government also has certain tools such as taxation and expenditures that can impact the economy. The author also touches on trade deficits and federal deficits, and the impact that each has on the economy.

As Chris mentioned, there's a study note on the syllabus, *Formation of Investment Strategy*, that has some very direct applications to actuaries. Specifically, it covers different considerations in developing an investment strategy, touching very briefly on a wide range of topics. For example, what are the risks that we face in the investment arena? Examples include C-1 risk, C-3 risk, and currency risk.

The note briefly goes into how the regulatory environment will impact your strategy. For example, it may limit the exposure you have to a certain asset class. The note then just bounces along to many other investment considerations. Examples include the importance of diversification, the role of having a certain amount of your portfolio in liquid assets, the decision of how you might distribute your portfolio among different asset classes, and the considerations in deciding whether you'll be more of a passive investor versus an active investor.

The final section of the study note covers asset/liability management techniques. The concept is to manage risk by knowing the relationship between your liability cash flows and the asset cash flows that back them. And in that way, it goes into some examples of different products and the characteristics of the underlying liabilities, such as universal life and single-premium deferred annuities (SPDAs). By describing the characteristics, the note gives some ideas about the possible types of assets you might use to back up the liabilities.

The *Investments* textbook crosses over to a couple of areas that Chris will cover. I broke the text into five main areas. The first section included on the syllabus covers the many different types of instruments available to the investor such as stocks, bonds, and derivatives, and the way that the investments are bought and sold in the market, including the primary market as well as the secondary market. For example, the author discusses the security exchanges and the over-the-counter market.

There's also a chapter on the determinants of interest rates, including information on the difference between the real and the nominal interest rates, the role of taxation, and the impact of risk (how you can get to a risk-adjusted interest rate by starting with a risk-free rate and adding in a risk premium).

I will cover the third section on portfolio theory in more detail in just a moment. There is a large section on equilibrium in the capital markets. You've probably all heard something about, or studied the capital asset pricing model. It's a model that's used to explain how we get to equilibrium rates of return. Other models, such as the index models and the arbitrage pricing theory, are discussed as well.

Finally, the syllabus includes a short chapter on additional considerations when you invest internationally. One of our goals in this session was to pick a subject and go into a little more detail on that subject. When I was trying to come up with my topic, I happened to be (believe it or not) thinking about how I might want to reallocate my personal funds in my company's 401(k) plan.

My normal investment strategy has been to go on gut feelings. I remembered that on the 220 syllabus there are three or four chapters that outline a technique that I could use to determine how I might allocate investments among broad asset classes.

The technique is rooted in the concept of maximizing utility. So, I'll define what I mean by utility, and then go into capital allocation and asset allocation. What I mean by capital allocation is deciding what proportion of the money should flow to risk-free type assets versus risky assets. Then with asset allocation, I decide how much should go to broad classes like stocks or bonds given the amount I've allocated to risky assets. Security selection is the final step. Within each of these portfolios there's additional work that goes into picking the actual securities that make up that portfolio.

I'm going to assume that all of us are risk averse, rational people and that we would all attach higher utility to portfolios that have more attractive risk/return tradeoffs. The authors say, and I'm going to take their word for it, that financial theorists use the utility function below to describe how people pick portfolios. Utility is determined by expected returns, portfolio risk as measured by standard deviation of return, and the risk aversion of the investor. That risk aversion is represented by the letter A.

RISK AVERSION AND UTILITY

- Higher utility to portfolios with more attractive risk-return tradeoffs
- Common utility function:

$$U = E(r) - .005 \cdot A \cdot \sigma^2$$

Where:

U = Utility value
A = Index of investor's risk aversion
$E(r)$ = Expected portfolio return
σ^2 = Portfolio variance

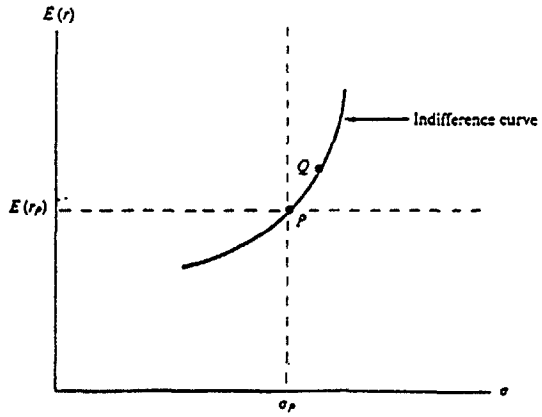
The authors go on to say that people's coefficient of risk aversion normally is somewhere between two and four, where the higher you go, the more risk averse you are. I will assume, since I'm not gutsy at all, that I have got a coefficient equal to four, which is at the upper end of that range. I might now go out and collect data on different portfolios that are available. Maybe there are four funds available in my 401K plan. Each of them has different expected rates of return as well as risk.

For example, portfolio one on Table 1 has an expected return at 10% and a standard deviation of 20. But when you plunk it into the utility function, you get a utility of two. Similarly, portfolio three has twice the expected return, but more risk. When you apply it to the utility function, you get the same level of utility. The author has defined something called an indifference curve, which would represent all portfolios that have different characteristics, but that gives you the same level of utility. You can graph this with expected return on the y-axis and risk on the x-axis, and all points along this curve will give you the same level of utility (Chart 1).

TABLE 1
INDIFFERENCE CURVE
(COEFFICIENT OF RISK AVERSION = 4)

Portfolio	Expected Return	Standard Deviation	$U = E(r) - .005 \cdot A \cdot \sigma^2$
1	10%	20.0%	$10 - .005 \cdot 4 \cdot 400 = 2$
2	15	25.5	$15 - .005 \cdot 4 \cdot 650 = 2$
3	20	30.0	$20 - .005 \cdot 4 \cdot 900 = 2$
4	25	33.9	$25 - .005 \cdot 4 \cdot 1{,}150 = 2$

CHART 1
INDIFFERENCE CURVE



Source: Reprinted with permission *Investments* by Bodie, Marcus, and Kane. 2nd Ed. (Burr Ridge, IL: Richard D. Irwin, Inc. Publisher, 1993). Page 149, Figure 5.2.

So far, we know the utility function we're going to use. We know my level of risk aversion is four. Since I'm going to talk along the way about mixing risky investments and risk-free investments, we probably should agree on what I mean by risk-free. I would assume that my risk-free asset would have the characteristics of being default free, short term and highly liquid. I'd argue you would also want it to be insensitive to things like changes in interest rates and inflation. Some candidates would be government bonds, T-Bills, CDs, or commercial paper. In the 401K example, it might be the money market fund. As I go along, I will use a money market or a T-Bill fund as my risk-free option.

Now let's get into the heart of it. In Table 2, let's make a simplified assumption that says I only have two assets I can pick from—a risk-free money-market-type fund and something I'll call the optimal risky portfolio (perhaps a balanced fund—a mix of stocks and bonds). What I'll call the complete portfolio is just a mix of these two assets.

TABLE 2
PORTFOLIO OF ONE RISKY
AND ONE RISK-FREE ASSET

- **Assume we've determined:**

Asset	Expected Return	Standard Deviation
Risk-free asset	$r_f = 7\%$	$\sigma_f = 0\%$
Optimal risky portfolio	$r_p = 15\%$	$\sigma_p = 22\%$

- **Complete portfolio (*C*)**

$$r(C) = y \cdot r_p + (1 - y) \cdot r_f$$
$$= 7 + 8 \cdot y$$
$$\sigma(C) = y\sigma_p$$

Expected return is a weighted average of each portfolio's return with weight Y equal to the exposure to the risky portfolio. We earn the 7% risk-free rate plus an extra 8% depending upon how much we decide to invest in the risky portfolio. Our standard deviation of this combination fund (because there's no risk in the risk-free asset) is just a function of the risk in the risky portfolio.

What we might do is plot something I will call the capital allocation line (Chart 2). All points along this line represent a combination portfolio of these two assets. For example, at point F, we have a Y value (exposure to the risky fund) of zero. Here we have 100% in the risk-free asset with an expected return of 7% and no risk. At point P, our Y value is one (100% in the risky portfolio) with an expected return of 15%. Perhaps the more interesting points are somewhere along that line between points F and P where we're combining the two assets. I should note that we're not confined to points between F and P. We could decide to sell our money market fund short to buy additional shares in the balanced fund. From our capital allocation line, we can see the amount of reward we're getting for any level of risk.

Now how do we decide which combination of assets to select? We know our utility function. We know I'm quite risk averse when it comes to investing. We've identified our risk-free asset, and we know we have only one risky asset available. Under the author's approach, we maximize my level of utility among various investments that are available. This is an old Part 1 or Course 100 optimization problem. We want to maximize our utility function with respect to Y (our exposure to the risky asset).

OPTIMAL PORTFOLIO—STEP 1

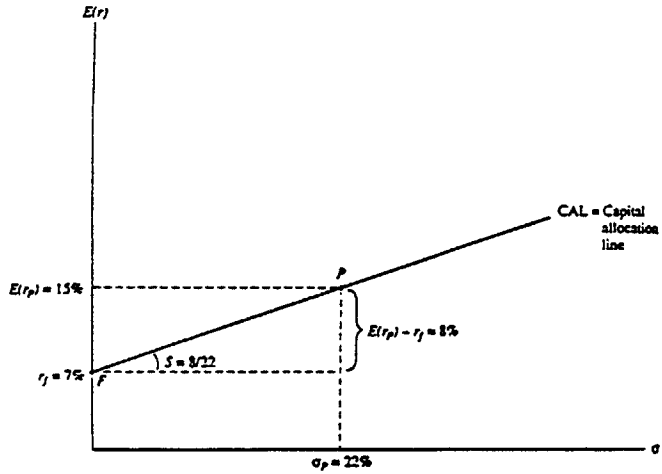
- Re-introduce utility function:
  $U = E(r) - .005 \cdot A \cdot \sigma^2$
- Goal is to maximize utility

$$\frac{Max\,U}{y} = r_f + y \cdot [E(r_p) - r_f] - .005 \cdot y^2 \cdot A \cdot \sigma_p^2$$

Take derivative; set equal to zero; solve for y.

$$y^* = \frac{E(r_p) - r_f}{.01 \cdot A \cdot \sigma_p^2}$$

CHART 2
CAPITAL ALLOCATION LINE



Source: Reprinted with permission *Investments* by Bodie, Marcus, and Kane. 2nd ed. (Burr Ridge, IL: Richard D. Irwin, Inc., 1993): page 180, figure 6.3.

You may recall that to solve an optimization problem, we take the derivative, set it equal to zero and solve for the *Y* value. I will not go through the algebra for you. Trust me that the expression shown above gives the correct solution. Our optimal exposure to the risky portfolio is directly proportional to the risk premium. The more extra return I get from the risky portfolio, the larger my *Y* value. And *Y* is inversely proportional to the risk in the risky portfolio. The more risk in this portfolio, the more likely I'll be to go with the risk-free alternative.

So given the numbers that I've assumed in my example, this technique would tell me that every pay period when my money is allocated to my 401K plan, I should direct 41% of it to the balanced fund. Fifty-nine percent of it would go to my money market fund. The

expected return and standard deviation of the combination portfolio are 10.28% and 9.02%, respectively.

OPTIMAL PORTFOLIO
EXAMPLE

- Suppose A = 4

$$y^* = \frac{15-7}{.01 \cdot 4 \cdot 22^2} = .41 \, (Risky\, assets)$$

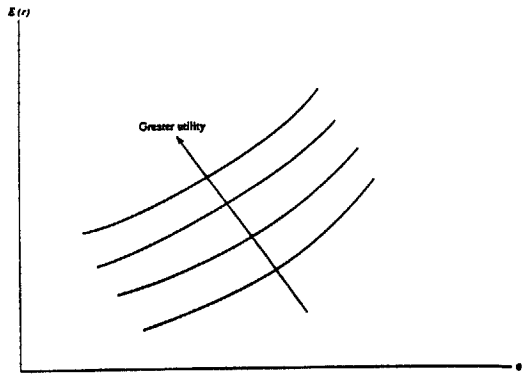
$$1 - y^* = .59 \text{ (Risk-free asset)}$$

- Complete portfolio

$$E(r_c) = 7 + 8y$$
$$= 10.28\%$$
$$\sigma_c = y\sigma_p$$
$$= .41 \cdot 22 = 9.02\%$$

We can show this process graphically (Chart 3) as well as algebraically. All of these lines represent different indifference curves. Remember each line has many different portfolios, each with the same level of utility. The higher up and to the left we go, the higher the level of utility. Thus, we'd want to have the highest possible line to maximize utility.

CHART 3
OPTIMAL PORTFOLIO



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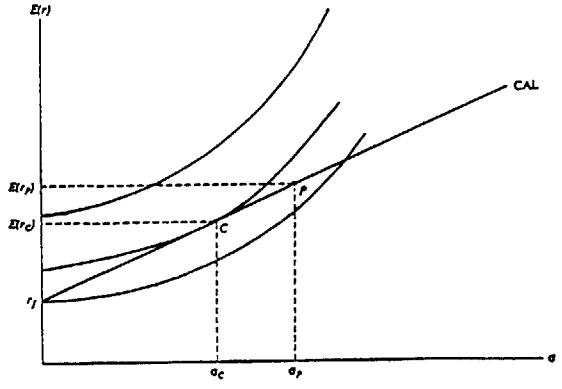
Now we can draw these utility curves along with our capital allocation line (Chart 4). Again, any point on the capital allocation line represents different available portfolios. The solution we reached to algebraically turns out to be the point where the capital allocation line is tangent to our highest possible indifference curve; this is where I receive the highest level of utility among the investments that are available to me.

CHART 4
UTILITY CURVE



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In Table 3, the authors switch gears by ignoring the risk-free asset. Let's say the only two investments available to me in my 401K plan are two risky investments—a stock fund and a bond fund. Again, assume I've gone out and collected some data. I've calculated the expected returns and standard derivations of the two funds. Also, these two funds will have some variability between them and I've also identified the covariance and correlation coefficient. Recall that the correlation coefficient can have values between one and negative one. In this case, we're assuming the two funds have some positive correlation, but are not perfectly positively correlated.

TABLE 3
OPTIMAL PORTFOLIO—STEP 2
PORTFOLIO OF TWO RISKY ASSETS

	Debt	Equity
Expected Return	8%	13%
Standard Deviation	12%	20%
Covariance	72	
Correlation Coefficient	.30	

$$E(r_p) = 8w_D + 13w_E$$
$$\sigma_p^2 = 12^2 w_D^2 + 20^2 w_E^2 + 2 \cdot 72 w_D w_E$$

We can express the expected return, which again is just the weighted average of returns. You may recall from your Part 2 or Course 110 days that the variance of this combination portfolio of stocks and bonds would be a function of not only the variances of the individual funds, but also the covariance term.

The authors get into the importance of diversification. In simple terms, we want to look at the standard deviation of this combined portfolio at different weights of stocks versus bonds (Table 4). If we're at 100% stocks, we know our standard deviation will be 20%. As we diversify into bonds, our standard deviation goes down. At a certain point, somewhere between a 75/25 mix and 100% bonds, we being to turn the corner and our standard deviation is going back up.

TABLE 4
PORTFOLIO STANDARD DEVIATION

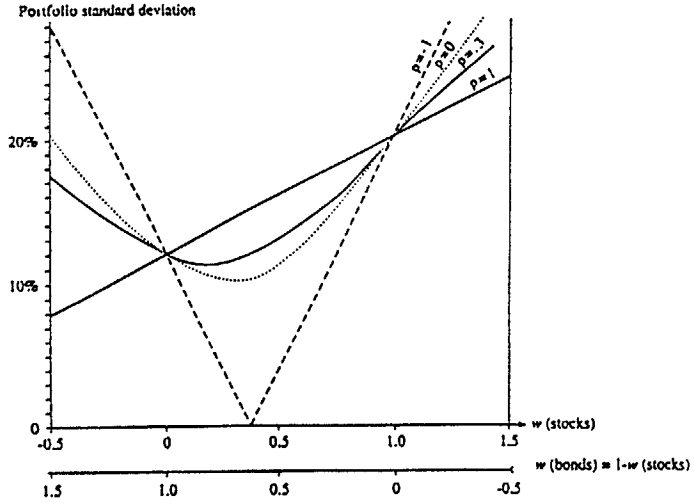
W_D	W_E	Standard Deviation (ρ = .3)
0.0	1.00	20.0 %
.25	.75	16.2
.50	.50	13.1
.75	.25	11.5
1.00	0.0	12.0
Minimum σ*		11.45
W_D at min		0.82

* $Min(VarP) = W_D^2\sigma_D^2 + (1-W_D)^2\,\sigma_E^2 + 2W_D(1-W_D)(Cov\ r_D, r_E)W_D$

- Take derivative
- Set equal to zero
- Solve for W_D

If we wanted to do an extremely difficult algebraic exercise, we would solve this optimization problem of minimizing the standard deviation—with respect to one of the weights. But I'd prefer to look at it more graphically (Chart 5). Focus on the darkest curved line which is our situation with the correlation coefficient equal to 0.3. We want to solve for the minimum point on the portfolio standard deviation curve. At that point (which happens in this case to be 82% bonds), we minimize the variance of our combination portfolio.

CHART 5
PORTFOLIO STANDARD DEVIATION



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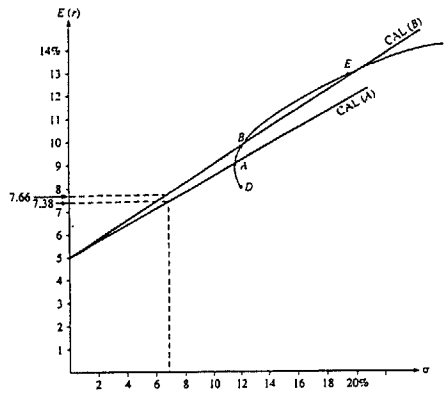
We started by maximizing utility with one risky and one risk-free asset. We then looked at only two risky assets and minimized our variance of the combination portfolio. The final step I want to cover is to bring all three assets into the picture. Now my alternatives in my 401K plan are the money market fund, or T-Bill fund (which is risk-free), a bond fund, and a stock fund. On Chart 6, the curved line represents all different combinations of stocks and bonds. We're ignoring, for just a second, the risk-free asset. Point *D* would represent 100% bonds. Point *E* would be 100% stocks.

CHART 6
THREE ASSETS



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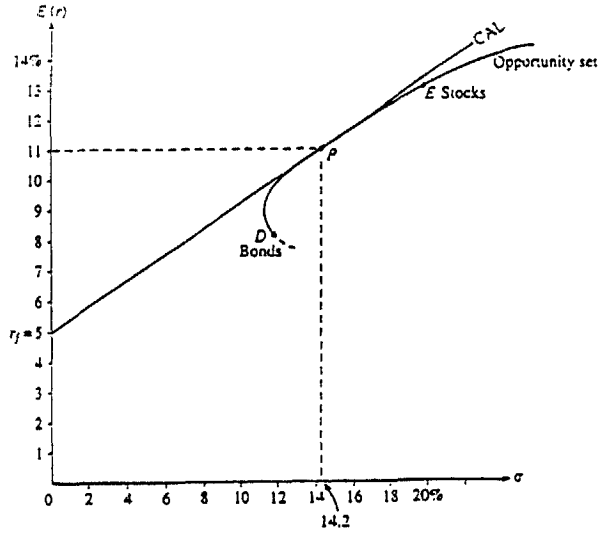
Now, in the exercise we just completed, we identified point *A*, the minimum variance portfolio. Note that it's closest to the *y*-axis, as we would expect. What we can do from any point (and we'll pick on point *A*) is draw a capital allocation line down to the *y*-axis which is 100% in the risk free asset with a rate of return of 5%. Any point between the *y*-axis and point *A* would represent a combination of the minimum variance risky portfolio A and the risk-free asset.

The point that the authors make is that we shouldn't stop at point *A*. If we move up to point *B*, another capital allocation line can be drawn. A steeper curve means that I will get more return for any level of risk with a combination of portfolio B and the risk-free asset than I will with portfolio A. But why stop there? The steepest possible capital allocation line I could draw is the one that's tangent to the portfolio opportunity set at portfolio P (Chart 7). This gives me the most reward for any level of risk among portfolios that are available to me.

CHART 7
OPTIMAL RISKY PORTFOLIO



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That is what we'd call our optimal risky portfolio. In other words, the minimum variance portfolio isn't necessarily the one we'll want to mix with our money market fund. Rather, the portfolio to mix with that risk-free fund is the portfolio that maximizes our amount of return per unit of risk. Algebraically, we can again go through an optimization problem. When we solve the maximization problem, we find, in my case, that the optimal risky portfolio has 40% bonds and 60% stocks.

OPTIMAL RISKY PORTFOLIO

$$
\begin{aligned}
W_D^* &= .4 \\
W_E &= 1 - .4 = .6 \\
E(r_p) &= .4 \cdot 8 + .6 \cdot 13 \\
&= 11\% \\
\sigma_p &= 14.2\%
\end{aligned}
$$

Finally, we can mix that risky portfolio with the risk-free fund to get our complete portfolio. We know that given my level of utility, an all risky portfolio (60% stocks, 40% bonds) is likely not my optimal complete portfolio. Recall that the way we got to our optimal complete portfolio earlier was by maximizing utility (solving for the optimal exposure, denoted by letter *Y*).

COMPLETE PORTFOLIO

- Optimal risky portfolio is not necessarily optimal complete portfolio
- Recall that optimal weight in risky portfolio maximizes utility with respect to y:

$$y^* = \frac{E(r_p) - r_f}{.01 \cdot A \cdot \sigma_p^2}$$

$$\text{Where } U = E(r) - .005 \cdot A \cdot \sigma^2$$

Given the data, I solve for *Y* and get the following results. Every pay period when I allocate my investment dollars, now with three alternatives available, I'd have 75% or so go into the risky portfolio, of which I have a 60/40 mix between stocks and bonds. The other 25% or so goes into the risk-free fund. Overall, about 45% should go to stocks, 30% or so to bonds, and the rest to T-Bills. That would give me an expected rate of return of 9.5% and portfolio standard deviation of 10.56%. It can be shown that this portfolio has the maximum level of utility among all possible combinations of these three investments.

COMPLETE PORTFOLIO
(COEFFICIENT OF RISK = 4)

- $y^* = .744$
- Complete portfolio

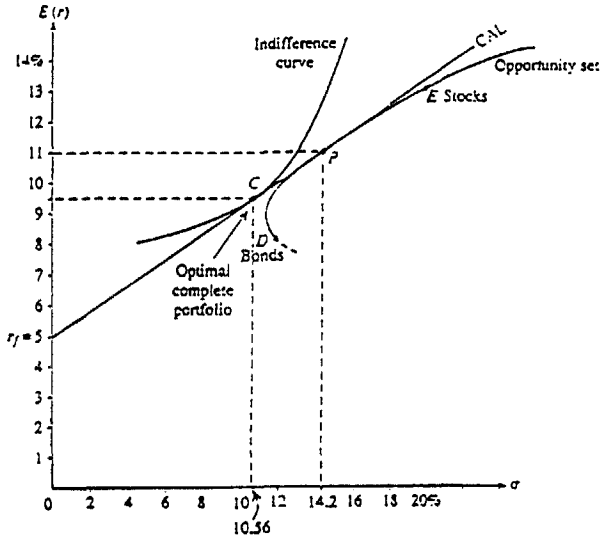
Asset	Portion of Complete Portfolio
Stocks	$.6 \cdot 744 = 44.6\%$
Bonds	$.4 \cdot 744 = 29.8\%$
T-Bills	25.6%
	100.0%

$$
\begin{aligned}
E(r_c) &= .446 \cdot 13\% + .298 \cdot 8\% + .256 \cdot 5\% \\
&= 9.5\% \\
\sigma_c &= y\,\sigma_p \\
&= .744 \cdot 14.2\% = 10.56\%
\end{aligned}
$$

To summarize, we started on Chart 8 at the upper right part of this curve and identified point *P* as the optimal risky portfolio. We drew a line down to the *y*-axis. Any points on

that line would be combinations of *P* and the risk-free asset. Given my amount of risk aversion and the utility curve assumed, we slid down to point *C*—our optimal complete portfolio.

CHART 8
OPTIMAL COMPLETE PORTFOLIO



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I've made some simplifying assumptions along the way that may not be realistic. For example, I've assumed I only have two risky investments available to me—stocks and bonds. Most of you with 401K plans have many more risky investments available. I've also assumed that the risk has been minimized within each of these funds by good asset management, including diversification and appropriate security selection. I've also assumed that the risk-free asset is available. A money market fund probably has most of the "risk-free" characteristics I discussed earlier.

I hope none of you come up to me after this session and want any investment advice because you will be asking the wrong person. What I hope I've done is give you an algorithm that an investor might use to determine their optimal mix of assets.

MR. FIEVOLI: My part of the discussion will focus on the *Handbook of Fixed Income Securities* by Fabozzi. There is a lot of material in this textbook, as it's one of the thickest textbooks we have on any of the exams. It's a very good reference book and I will go through the chapters that we have on the syllabus for exam 220, and give you a highlight of what's in each chapter, and then, as Tom did, take you a little bit more in depth on some subjects.

When we talk about fixed-income securities, there's really three general categories we can look at. Those are bonds, preferred stocks, and mortgages (including mortgage-related

securities such as mortgage pass-throughs and mortgage-backed securities). This first chapter provides a good overview of the types and features of fixed-income securities, and it focuses a lot on bonds. It talks about things like who the issuers are, how maturity is structured, and it defines coupon and principal. It looks at the various provisions that you can find in a bond issue such as calls, refunding, sinking-fund provisions, exchanges, and warrants.

If you want to talk about the risks associated with investing in fixed-income securities, there are quite a lot of them and they're detailed in chapter two of this textbook. I can give you just a brief overview of some of the risks that are included.

- Market risk, better known as interest rate risk or C-3 risk.
- Reinvestment risk. What happens if you reinvest at a lower rate than you assumed?
- Timing and call risk. What happens if your security is called by the issuer?
- Default risk. Your security really is only as good as the issuing company.
- Yield curve and maturity risk.
- Purchasing power risk. If you have a 10% bond, it will not do you much good if you're in a 20% inflation environment.
- Marketability risk. Many bonds are not readily marketable. They're not liquid. What do you do in that case?

Other risks include exchange rate and currency risk, volatility risk, political and legal risk, event risk, and sector risk. So there's quite a few of them, and most of them are detailed in this chapter.

When we talk about price volatility characteristics, what we're really getting at is how your security behaves when interest rates change. This chapter is really the first introduction to the concepts of duration and convexity, so it gets at how a bond behaves when you have changes in the prevailing interest environment.

The next chapter deals with the structure of interest rates. It includes a number of different topics, one of which is what makes up an interest rate. The theory is that there is a base rate, which is a risk-free rate. The various rates of return we get on securities are made up of that risk-free rate plus risk premiums. Also, this chapter looks at the term structure of interest rates. It defines spot and forward rates so you can get an idea of what's referred to by those two terms. It also takes a fair amount of time to look at the shape of the yield curve. The normal yield curve is one that trends upwards, and there are a number of theories that attempt to explain why that happens. Some theories assert it has to do with liquidity; some theories claim that it has to do with purchasing power risk. So there's a number of different theories, and there's an introduction to them in this chapter. The textbook then starts to get into more practical applications of the various securities that are out there, for example, treasury and agency securities—that generally includes T-Bills, treasury notes, treasury bonds and federal agency securities.

Moving to the private sector, there's a discussion on private money-market instruments. Those would include commercial paper, bankers acceptances and large denomination CDs. With regard to corporate bonds, there's a lot of detail on this subject as corporate bonds make up a fair part of the market. One of the characteristics of corporate bonds that we have to talk about is security. Exactly what is securitizing the bond? Is it a collateral trust? An equipment trust? Is it a debenture? Other things we consider are payment provisions. We have to worry about call provisions on the bond. Are there any refund

provisions? It also gets into a discussion of redemptions, sinking funds and replacement funds. This chapter also gives us an introduction into the various bond-rating mechanisms and provides an overview of how the bond market itself operates.

Medium-term notes tend to occupy a position on the spectrum that is between the private money market instruments and the corporate bonds. This chapter just looks at the mechanics of the market and it talks about the behavior of medium-term notes. When we talk about floating-rate and adjustable-rate debt securities, we're looking at something like a bond, where the coupon is not fixed, but rather varies according to some published index. The only difference between these two is that floating-rate debt securities tend to be tied to a short-term index, and the adjustable-rate securities tend to tie into a longer term index.

There's a discussion of convertible securities. These are bonds that can be converted to the stock of the issuing company. This chapter looks at the pros and cons of this feature to both the issuer and the investor, and it discusses the various methods for analyzing and valuing these securities. Also, there's a discussion of the high-yield corporate bond market. I think this is generally referred to as the junk bond market, although the textbook very judiciously avoids that term. This chapter takes more of a macro approach to the market. There is some discussion of the types of junk bond issues, but then it gets to look at the dynamics of the market. It gets more into actual return experience and it looks at the default experience that we have seen on this type of security.

A few chapters get into mortgages. Chapter 23 is a basic review of mortgages. It talks about the participants in the market, prepayment risk, and some various alternative mortgage investments such as adjustable rate mortgages. Some of the more popular mortgage pass-through securities are the Fannie Maes and Ginnie Maes. This chapter gets into their cash flow and prepayment behavior. It looks at price and yield behavior and examines total holding period returns.

Chapter 25 is on collateralized mortgage obligations (CMOs). There is a great deal of information in this chapter, which makes it almost impossible to summarize. What it really gets into is the basic structure of CMOs and types of tranches. It also gets into valuation and some of the regulatory considerations.

There is also a chapter on the term structure of interest rates. This builds on the theories that were introduced in Chapter six. It looks at the theories in more detail and it looks at actual historical data as a way to try to evaluate the validity of these theories. I'll go into more detail on the last few chapters. They include dedicated bond portfolios, introduction to interest rate futures and option contracts, the basics of interest rate options, and interest rate swaps.

Let's start off with dedicated bond portfolios. As I mentioned earlier, much of the material in this exam isn't geared toward actuaries. However, this chapter does have a very definite actuarial application. In fact, the example they use is the funding of liabilities in a pension fund. The goal of the dedicated bond portfolio, quite simply, is that you want to match the cash flows from your underlying assets to your liabilities. This seems fairly straightforward. One of the overriding themes in this chapter is that being conservative will cost you money. If you have to use a lower rate of return in your assumptions, then you're not going to end up with a cheaper way to go about it.

So we can walk through the example of the pension fund. The first point is to determine the liabilities. As actuaries, we know that is our area of expertise, so there's really not much need to go into more detail on that. The important thing to remember is that you want to get a good handle on what your liability cash flows look like.

The next step in the process is to determine the constraints in your portfolio. You may not want to select from the entire universe of available bonds. In fact, you may want to put some restrictions on it. You might want to restrict the sector, the quality of the bond, the issuer and the lot size. What you really want to do here is try to optimize within those constraints. You may want to use mortgages in the equation, but then you have to worry about prepayment risk, so this example sticks with the bond portfolio.

The reinvestment rate is important here. The more conservative that you are with your reinvestment rate, the more you are forced towards a closer match in your portfolio. So if you have a reinvestment rate running around 9% or 10%, the value of the work that you do with the dedicated bond portfolio is lower.

Then what we get to is setting the optimal portfolio. What you want to do is pick assets from your defined universe and come up with an optimal portfolio that gives you the highest rate of return. There are some methods discussed in the textbook that are step-wise solutions, linear programming, or integer programming.

Then we talk about the cash-flow match. If you set your optimal portfolio, one of the key practices is to maintain a small surplus balance each year. A surplus balance would be the excess of your asset cash flow over your liability cash flow. The smaller your surplus, the less reinvestment risk you have. As you get to the longer tails of your liability, you may need to prefund more of them simply because there may not be many high-yielding, call-protected issues at the long end of the curve, and that can be a little more costly. So that's something that you have to look out for.

A comment on the pricing of the bonds in your portfolio. In many cases, it may not be a concern. If you have these bonds in your dedicated portfolio and something happens in the market that would affect the price of the bonds, that may not necessarily be a concern to you, because what you're really concerned with is getting the cash flows and the coupons from those bonds. So if you're getting that in your portfolio, your dedicated portfolio will still work.

As I said, the example in the textbook is looking at a pension plan. In this particular case, the initial assumption of 5% was modified using a dedicated portfolio, and they were able to raise their assumption to 7.8%. That resulted in an almost 25% reduction in the present value cost. There are also methods for reoptimizing your dedicated bond portfolio. You should not always assume that the dedicated portfolio will be managed passively. You can take some active management on it. For example, your yield curve may change. Your spreads may change. And over time, that may imply a new optimal portfolio exists for your liabilities.

There's also some discussion of techniques for active management of the dedicated portfolio. You may want to swap in and out of the various sectors. You may want to make calls on the direction of interest rates. This is a little more aggressive, but if you believe interest rates are going to rise in the short term, you may want to have a little

more surplus in your plan. And, conversely, if you think rates are falling, you may want to try to minimize your surplus. There may be opportunities along the way for you to upgrade the quality of your portfolio.

We'll turn now to the introduction to interest rate futures and contract options. What we're going into here are really derivatives. Derivatives are a way that you can manage the interest rate sensitivity of your portfolio. There are three types of financial futures. They include stock index futures, currency futures and interest rate futures. We're going to talk about interest rate futures here. In this case, the underlying security is something like a bond or a treasury note, or something of that nature.

I think we are all fairly familiar with how we define a future. In a futures contract, the seller undertakes a commitment to deliver an instrument, usually a treasury note, to a buyer at a future date for an agreed-upon price. Very similar to these are forward contracts. There are few differences between forward contracts and futures contracts. Forward contracts are really more nonstandardized. They're traded over the counter, not on exchanges. Not very many futures contracts require the actual delivery of the underlying security. Most of them are settled in cash whereas with most forward contracts, the intent is to deliver the underlying security. Forward contracts are not typically marked to market. You don't have any interim cash flow. When you talk about forward contracts, you have to worry about credit risk in the trading of these contracts.

I will talk about options a little bit in the next chapter. An option is simply a right to buy or sell, as opposed to an obligation or a commitment to buy or sell. It doesn't have to be exercised. There's also a discussion of futures options. This gets to be a little more complicated. What you're doing in this case is you're buying an option on a futures contract. So the underlying security isn't necessarily a treasury note or a bond. It's a futures contract. It gets into a little bit more of a different analysis. You have a derivative on a derivative.

Let's talk a bit about interest rate options. The first discussion is how options work, and this chapter gives you a good introduction into this topic. When we talk about options, you hear the terms put and call. Quite simply, a put is a right to sell an instrument and a call is a right to buy the instrument.

There is some terminology when we get into options. One of them is strike price, which is the agreed-upon price. So if I have an option and the strike price is $1,000, I have the option to buy or sell the instrument at $1,000. The expiration date on an option, obviously, is the last day that you can exercise the option. After that date, the option is expired.

There's also a discussion of American options versus European options. The primary difference there is that a European option can only be exercised on the expiration date. So if I'm in a European option and the expiration date is July 1st, that is the only day that I can purchase the instrument whereas with an American option, I can exercise it any time between now and the expiration. So there's a little more flexibility there.

I want to get into a discussion of short and long positions. These terms are often used when you talk about options. Quite simply, a long position means that you bought a position, and a short position means that you sold it. So I'll just work through a couple of

examples here. Suppose we're talking about a long call. What that means is that I bought a call, which means that I bought a right to purchase an instrument. Now, when am I going to exercise that? Well, if my strike price is $1,000, I'm obviously going to exercise it when the price increases. If the market price is at $1,200 and I have the option to buy it for $1,000, I'm going to use the option. On the other hand, if the price in the market decreases, I'm content to let my option expire simply because I can buy the instrument for a much cheaper price.

If you have a long option position, you really minimize your downside risk. What happens is that my maximum loss is going to be the cost of the option and if I'm long in the position, I still have the opportunity to get some upside return.

Take a look at the other side of the equation. Suppose I have a short put position. That means I sold a put option to someone. I've given someone the right to sell an instrument to me. Again, let's assume the strike price is $1,000. Well, if the market rates increase and the price was up to $1,200, I think they'll let the option expire. They can get a better price from someone else. Or, if the price in the market decreases, then they're going to exercise their option. I may end up having to purchase the instrument at a rate higher than the market is asking at that time. So, in that case, if you're short an option, it's really like having the short end of the stick.

There is something called put and call parity. The whole concept behind it is that you're taking the profit and loss that we talked about and splitting it into two pieces. I'll work through a few examples just to give you an idea of what we're talking about. Suppose I have the long call that I discussed earlier and, on top of that, I have a short put. With the long call, I have the right to buy. I'm going to exercise that when market rates increase. I have the potential to gain when prices go up. If I have my short put, then the other party in the option is going to sell me the instrument when prices go down, and I stand to take a loss. So, I will gain when prices go up, and I will lose when prices go down. And that's exactly the same as being long on the security. It's the same as owning the underlying security.

Let's walk through the second example. If I'm long on the security and I add to that a long put, what I've done is I've added a right to sell, which means I've eliminated my risk when prices go down. If the prices go down, I can sell at the strike price. However, I still stand to gain when prices go up and that's equivalent to having a position that's equal to a long call.

Let's look at the third example. I'm short a security. That's a little bit different. That means that I stand to lose when prices go up, and I stand to gain when prices go down. I add to that a long call, which is my right to buy, and that means that I've neutralized my risk when prices go up. If you put the two of them together, that's the equivalent of being in a long put.

The point of this whole exercise is to show that by using this concept of the put and call parity, you can manufacture positions simply by writing options. In the first example, if I'm in the position where I have a short put, I write a long call on top of it, and I'm right back to owning the underlying security. That gives you a little bit of flexibility and provides a more practical use for options.

Let's talk about valuing an option, and I won't get into too much detail on this. There are just a few concepts that you need to know. With the intrinsic value of an option, what you are seeing here is how much the option is worth if you exercised it today. That doesn't make up the entire amount of the option. In addition to the intrinsic value, there is the time value of an option, and that represents the value you have considering the fact that you're not at the expiration date. There's two pieces—the value if you exercise today, and the value if you held onto it until the expiration. And, of course, like with any other instrument, the price of an option tends to increase the more volatile the underlying instrument tends to be.

Let's talk a little bit about interest rate swaps. This is another way to synthetically manage your interest rate exposure. The definition of a swap is having two counter-parties that agree to exchange payments that are based on a negotiable principal amount. What does that mean? Let's give you a real life example. Suppose that I have an asset for which I'm earning a floating rate of return. Say that it's tied to the 91-day T-Bill rate. I would like to use that asset to back a block of fixed rate GICs that I've written. There's a problem there. There's obviously a mismatch. There's no guarantee that the floating rate I earn is going to necessarily line up with the fixed rate that I'm paying on my liability.

So I have two options. One option is that I can liquidate the floating-rate asset, and purchase a fixed-rate asset and use that to back my liabilities. That's one option. The other one is that I can enter into an interest rate swap. What I have to do in that case is find a counter-party that's willing to swap cash flows with me. I will, in that case, take my floating rate, pay it to the counter-party, and it will pay me a fixed rate. Both the fixed rate and the floating rate will be based on the same principal amount.

So what I've done is taken this floating-rate asset that I own and converted it to a fixed-rate asset. I haven't had to liquidate the underlying security. I've synthetically managed the interest rate characteristics of my asset portfolio. And typically, interest rate swaps involve this sort of fixed-to-floating exchange. Usually the floating rate is based on published rates such as a 91-day T-Bill rate; and one that's often used is the London interbank offered rate (LIBOR).

To interpret the swap position, I will refer back to some of the topics we've already looked at. There are a couple of ways of interpreting it. If I'm involved in an interest rate swap, I've bought a package of forward contracts, or committed to a series of future payments. I will deliver these cash flows at some time in the future, and you can treat those cash flows as separate forward contracts. So I have this series of commitments extending into the future.

The other way to look at it is to consider it to be a package of cash-market instruments. So in this example, I've swapped out my floating rate and I'm getting a fixed rate back. What I've done here is purchased a fixed-rate asset and I'm financing it with a floating-rate debt.

There's a bit of terminology in the interest rate swap market and I'll just summarize a bit of it. The date when the trade occurs is also referred to as the commitment date—that's when you commit to the contract. The swap starts incurring interest at the effective date. The interest rate swap will stop at the maturity date, obviously, and you'll exchange your

cash flows at settlement dates along the way. A couple of more terms that you may hear refer to the fixed-rate payers in the interest rate swap. They're considered to be short in the bond market, or alternatively, they're considered to be long at the swap. And, on the other side, the floating-rate payer is long at the bond market, but short at the swap.

This chapter also gets into a few applications of interest rate swaps. The general theme seems to be that you're going to convert a floating-rate debt into a fixed-rate debt using swaps. And, of course, you can go the other way, by converting your fixed-rate debt into a floating-rate debt. In that case, they're generally referred to as reverse swaps.

That covers my summary of information on the Fabozzi textbook. I'd like to pass things back over to Tom, and he will look at an actual question that we had on the exam last year.

MR. GUAY: As we go through this next step, we will actually break out into smaller groups and talk about the question. It's the kind of question that we all should be able to understand even if we haven't thought about or worked with the investment arena in the recent past. Let me read it through before we break into groups. Recently, XYZ Company entered into the group pension business and so far has sold one GIC to a pension fund. XYZ invested the proceeds of the GIC in a commercial mortgage. For the GIC, on July 1, 1994, the pension fund deposited $1 million with XYZ for a five-year term. No further deposits are permitted. XYZ agrees to make annual interest payments on each contract anniversary at the guaranteed rate of 6%. In addition, the pension fund administrator can withdraw up to $200,000 of the principal each year. On July 1, 1999, five years later, XYZ will repay the original $1 million minus the total of any previous amounts that have been withdrawn.

XYZ insurance company, on July 1, 1994, advanced $1 million to a mortgage borrower for a five-year term. No further advances are made. The mortgage borrower agrees to make interest payments annually on each anniversary at the guaranteed rate of 6.25%. In addition, the mortgage borrower may repay up to $200,000 of the principal on each anniversary. And then five years later, the borrower will repay to XYZ the original million dollars minus the total of any previous principal repayments that were made.

This is a six-point question and the way it was broken down was, first, to describe the embedded options that are contained in the GIC as well as the mortgage. This will touch on some of the material that Chris covered as well as outlining the investment risks that are faced by the insurance company. Finally, we can comment on whether the mortgage is an appropriate investment to back up this GIC liability.

Let's break into groups and when we get back together, we'll have a representative from each group give a summary of their thoughts.

Now that we're back from our breakout sessions, I thought we'd take just a few minutes to summarize the response we were looking for on this question. On the first part, we were looking at the embedded options. There were two things we were looking for in particular. What XYZ has given to the pension fund is a put option. In the pension fund, they have the right to sell part of their investment at a fixed price even though the market price may decrease. For example, if interest rates go up, the pension fund can take money out at 6% and invest it at a higher rate.

In the mortgage, there's also an embedded option. It's a call option given to the mortgage borrower. They can buy back their debt at a fixed price even though its value may increase. We have a put option on one side and a call option on the other.

The second part is an overview of the risks faced by the insurance company. One would be the default risk by the mortgage borrower. Certainly, the borrower could default. Foreclosure would be costly. It's possible that the real estate value could decline, and you may not get the money back in foreclosure. There is interest rate risk as well. Foreclosure proceeds may not be able to be reinvested at a good rate.

Reinvestment risk is present since the insurance company isn't necessarily going to know what rate can be earned on any net positive cash flows. There also is prepayment risk. Prepayments will occur if interest rates drop because the borrower can refinance a part of the mortgage elsewhere at a lower rate. The insurance company may not be able to invest the $200,000 at a rate that would support the 6% GIC guarantee. They may lose money on the deal depending upon how much interest rates move.

Disintermediation risk is also present. If interest rates go up, the pension fund will take out as much as it can up to $200,000 a year and reinvest it more profitably elsewhere. The insurance company has an option to try to sell off the mortgage and it will be difficult to do so at a good price. In addition, there's not a real secondary market for mortgages. The borrower, on the other hand, would have no incentive to prepay. And if the insurance company decides to borrow, the cost of borrowing may be high—possibly higher than the 6.25% that they're earning on the mortgage.

MR. FIEVOLI: Now, we want to ask, how suitable is this structure for XYZ company? I think we know that it is not suitable. The key point here is that your asset and your liability will behave differently, and that will be to the company's disadvantage if interest rates move in either direction. So if rates increase, the pension fund has that bailout and that $200,000 a year will be invested somewhere else. On the other hand, if rates drop, the mortgage holder will prepay that $200,000 a year. One important point we want to make here is that they're working on a 25-basis-point spread between the asset and the liability. Without going into any deeper mathematics, that's not enough to cover all the risks that they're open to here.

I will jump ahead and talk about something that may be more appropriate for Exam 230. As you get into asset and liability matching, you'll realize what you have here is a problem, in that the behavior of the asset and liability as interest rates change is different. And that's when you get into concepts like duration matching and partial duration matching. What duration says is, "How does my price change when interest rates move a certain way?" So if you have the duration matched on the asset and liability, they will move the same way when interest rates move. They will behave the same way. You're not opening yourself up to any risk.

If you take that a step further, you get into the concept of partial duration, which may be more appropriate for the Exam 230 session. What you're trying to do is not only cover the odds of the interest rate curve moving in parallel one way or the other, but also cover it if you have a nonparallel shift. What if rates at the long end move faster than rates at the short end? This exam really forms the building blocks for you to go forward and get into a discussion of some of the more complex asset/liability matches and concerns.