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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.

MR. MICHAEL E. HARTER: This session will begin with a review of the Course 220 syllabus followed by a more in-depth discussion of some of the topics and a review of one of last fall's exam questions. There are five sections to the current Course 220 syllabus. They are: macroeconomics, financial markets and asset definition, portfolio management and investment strategy, corporate finance, and asset management.

The first section is macroeconomics. The macroeconomics section is one study note and may be worth anywhere from 5% to 20% of the exam. The study material for the second section on financial markets and asset definition comes from two textbooks and one study note. The two textbooks are *The Handbook of Fixed Income Securities* (Fabozzi, J., T.D. Fabozzi, and T. Dessa, 4th ed, Burr Ridge, IL: Irwin Professional Publishers, 1994) and *Investments* (Bodie, Z., Kane, A., and Marcus, A., 2nd ed, Burr Ridge, IL: Irwin Professional Publishers, 1993). The study note topic is the Canadian bond market. The handbook is a well-known reference book for fixed-income securities. The investment textbook is on the chartered financial analyst's (CFA) syllabus and includes some past CFA exam questions. To me the CFA exam questions appeared easier than the past 220 questions.

The third section is portfolio management and investment strategy. This section includes more information from *Investments* as well as two study notes. The study notes are "Introduction to the Formation of Investment Strategy for Life Insurance Companies and Pension Plans" (Stapleford, Robert H. and Stewart, Kenneth W., SOA Study Note 24-91. Schaumburg, IL: Society of Actuaries, 1991) and the CIA's "Guidance Note: An Overview of the Investment Policy Statement in an Asset/Liability Management Context" (CIA, SOA Study Note 33-95. Schaumburg, IL: Society of Actuaries, 1995). Much of the information in this section pertains to equities portfolio management as opposed to fixed-income securities.

The fourth section is corporate finance and is probably the easiest part of the exam. It covers a textbook entitled *Analysis for Financial Management* (Higgins, Robert C., 4th ed, Burr Ridge, IL: Irwin Professional Publishers, 1994). It was useful, worthwhile information. The fifth and final section is on asset management. The material comes from the handbook and the study note written by Jim Tilly. He's an example of an actuary becoming very involved in investments. I believe he's currently the head of fixed-income research at Morgan Stanley as well as a managing director.

Now that we have a brief overview of Course 220 we can start to take a more in-depth look at some of the topics. The textbook for the corporate finance section covers five major areas and does that in five chapters. The first two chapters pertain to

understanding the company's current financial situation. The first chapter describes interpreting financial statement information. It covers income statements, balance sheets, cash flow statements. The second chapter covers ratio analysis, which is evaluating financial performance based on financial ratios like return on equity. The third chapter deals with forecasting techniques, especially pro forma financial statements, something we often use in life insurance pricing. It also covers cash flow forecasts and cash budgeting. The fourth chapter discussed the financial aspects of managing rapid growth. If you're working for a rapidly growing company, you might find this chapter particularly insightful. The last chapter of *Analysis for Financial Management* used in Course 220 discusses the financing decision and the implications of different capital structures, whether you will have a great deal of debt or want more equities, and so on.

The next topic I will cover is macroeconomics. The macroeconomics study note is very similar to an introductory course to macroeconomics. The author defines expressions like gross national product, consumer price index, and so on. Part of the study note addresses monetary policy and the tools used by the federal government to implement that policy. If you understand the study note really well, you can try to guess what Alan Greenspan is doing. Examples of these tools are discount rate, reserve requirements, and open market operations. In addition, fiscal policy is discussed, which is the impact of government spending and taxes on the economy.

The next study note is "Introduction to the Formation of Investment Strategy for Life Insurance Companies and Pension Plans," a fairly small but concise study note with much practical information. It identifies different types of risk, some that people don't necessarily think of often like liquidity risk, regulation risk, and of course asset/liability risk and default risk. The study note also addresses active and passive investment strategies. In addition to "The Formation of Investment Strategy for Life Insurance Companies and Pension Plans" study note, the textbook, *Investments*, is part of the portfolio management and investment strategy section. Six chapters are covered for the portfolio management investment strategy. The first three chapters deal with utility theory. Some of the study material here looks fixed-rate like the study material in Course 151, which is risk theory. You graph utility functions and to find out where your neutral points are in terms of risk and reward. *Investments* takes the view that investments are random variables. In general it describes investments in terms of expected returns, variances, and covariances. This can lead to developing a useful conceptual framework. However, it can also lead people toward making intricate financial models of securities based on past price behavior. Such models may be nothing more than demonstrations of data overfitting.

The next topic is capital asset pricing model (CAPM). CAPM provides a specific statement about the risk of an asset given its expected return. It assumes that assets behave like well-defined random variables. CAPM also assumes that for each particular investment all investors have the same opinion as to the expected return, variance, and covariance of that particular investment. Although the assumptions behind this model are gross oversimplifications, the implications of the model are interesting, namely that expected returns and standard deviation provide an incomplete picture of risk and rewards for investments. In Course 151, the utility theory models, just look at risk and reward on an investment by itself as opposed to looking at how that investment behaves relative to other investments. With CAPM you really take into account

correlations between different investments. For example, if you have one investment that has a really high expected return and a high standard deviation, and another one that has a really high expected return and a really high standard deviation, if you have a negative correlation between those two investments you can put them together. The end result is that you have one investment with very little standard deviation, and a high expected return. So you're really looking at sort of a formal discussion of the value of diversification.

There's another concept that's discussed called market efficiency. The weak form efficiency model states that past price data provides no useful information for obtaining better than market returns. Another way of saying this is that technical analysis has no value, saying that you can't simply go back and look at past price behavior and get any kind of useful prediction as to future price behavior. Technical analysis continues to be fairly popular in commodities markets.

We can also look at market efficiency in terms of a semistrong form of market efficiency which states that all publicly available information is already reflected in the price of a security. As such, publicly available information cannot be used to obtain better than market returns. The implication of this model is that you may want to buy an index fund as opposed to hiring someone to manage funds for a pension. If you really believe the semistrong form, you may be inclined not to pay someone investment management fees.

The next form is the strong form. It states that no information, public or private, will allow an investor to earn above-market returns. There should be a problem with the strong form. It implies that insider information isn't useful, in which case, if the SEC believed that, insider trading wouldn't be illegal. So I don't think anyone puts much stock in the strong form. But as far as the weak form, that would suggest technical analysis isn't worthwhile and the semistrong form would suggest securities analysis isn't worthwhile.

The Handbook of Fixed Income Securities, as I mentioned before, is an excellent reference book. It's an excellent source of information. This book is used in the financial markets and asset definition, and asset management sections of the exam. Let me provide a quick rundown of the information contained in the chapters that are on the syllabus. You can think of fixed-income securities in terms of three broad categories: bonds, preferred stocks, and mortgages. The first chapter provides an overview of the types and features of fixed-income securities. The second chapter discusses risks associated with fixed-income securities. This discussion is a bit more in-depth than the discussion of investment risk that is in the "Introduction to the Formation of Investment Strategy for Life Insurance Companies and Pension Plans" study note. In addition to talking about C-1 risk, which is the risk of default, and C-3 risk, which is risk related to changes in interest rates, the book discusses liquidity risk, political risk, and other risks.

The next chapter deals with fixed income securities price volatility attributable to interest rate changes. If we think of the price of a bond as a function of an interest rate, then we can differentiate the price of the bond with respect to that interest rate. If we take the first derivative of price with respect to an interest rate, divide it by the initial price and multiply it by -100, we'll get the modified duration. The duration is

an approximation for the percentage decrease in the price of the bond given a 1% increase in interest rates. Since bond prices are not linear functions of interest rates, the second derivative can also be useful, if we use the second derivative to calculate convexity. We can think of the convexity as the decrease in duration as interest rates increase. Duration is obviously a very popular measure and in some respects probably an overused measure, because asset/liability values generally are not linear with respect to interest rates. So you can basically have durations that don't convey interest rate risk very well if you have a great deal of convexity; that is your duration changes a great deal as interest rates change.

The next chapter covers the structure of interest rates. The chapter discusses interest rates in terms of components. For example, part of the interest rate is due to the time value of money and part is due to risks inherent in the investment. Another topic is term structure. The term structure of interest rates describes the differences in interest rates by maturity. Another way of looking at that is it's talking about the shape of the yield curve.

Specifically, this chapter discusses different theories of term structure. Theories of term structure generally aim at trying to estimate interest rate risk premiums by maturity. What I mean by that is what are your expectations in terms of earnings going from different maturities? Do you expect to earn more having a ten-year bond as opposed to a two-year bond? Term structure is sometimes discussed in terms of spot rates and forward rates. A good understanding of both of these measures of interest rates is essential for dealing with derivative securities. Chapter seven deals with treasury and agency securities. This generally includes T-bills, treasury notes, treasury bonds, and federal agency securities.

Moving to the private sector, there's a discussion of private money market instruments. Those would include commercial paper, bankers acceptance, and large denomination CDS. Then we go to corporate bonds. Key topics here are how the bond is secured, and call or sinking-fund provisions. Additionally the topic of bond ratings is discussed. A chapter on medium-term notes discusses the size and structure of the medium-term note market. When the term note is used instead of bond, it generally suggests that the maturity of the security at issue was less than ten years. The chapter on floating rate talks about bonds that have coupons that change as a function of interest rates. For example, you could have a bond with a 30-year maturity that resets coupons every six months based on the six-month treasury rate. This creates a long-term bond with a very short duration. If we were to make any distinction between floating rate bonds and adjustable rate bonds, it is that the coupon on floating rate bonds resets more frequently than once a year. The chapter on high-yield bonds covers the size of the market, past junk bonds, performance net of defaults, and the distribution of the markets in terms of industry.

The mortgage chapter is a basic review of the mortgage market. It talks about participants in the market, prepayment risk, different types of mortgages. The next chapter deals with pass-throughs or mortgage pass-throughs. These are securities created from large pools of mortgages. This securitization process is done by a number of institutions. Some of the better-known ones are the Government National Mortgage Association (GNMA), and the Federal National Mortgage Association (FNMA). This chapter gets into the cash flow and prepayment behavior of these securities.

More mortgage cash flow pipelines get discussed in the collateralized mortgage obligation (CMO) chapter. This chapter talks about CMO structures and their cash flow and price sensitivity. CMOs are created by segmenting different pieces of a mortgage pass-through's cash flow into individual securities. For example, we could take a mortgage pass-through which is just a large collection of mortgages and create two CMOs, one that gets all the cash flows except the last 20% of the principal cash flows, while the other gets the last 20% of principal. CMOs can be created that have reasonably stable and predictable cash flows. Additionally, CMOs can be created that have pathological cash flows. What I mean by pathological is that they're very hard to depict statistically. They're extremely sensitive to prepayment assumptions and prepayment assumptions are an estimate of future mortgage holders' behavior.

Regardless of how much statistical work is done in estimating prepayment functions, no one knows what they'll be in the future. The market in general grossly underestimated prepayment sensitivity about two or three years ago when the rates went down. As such, some of the CMOs, the ones that did better when prepayments were lower, had price behavior that people didn't anticipate.

Some insurance companies used many of those types of CMOs to back their assets, for example, interest-only (IO) CMOs. With an IO you will get just the interest off the pool of mortgages. As such, if interest rates go down and everyone prepays, the principal will come back in and there will be no further interest payments. This type of CMO was a significant factor in at least one insurance company insolvency. It had assumed the prepayment function would be much lower and react much less to lower interest rates, which was valid viewing only its statistical models. However, what the statistical models didn't incorporate was the fact that the refinancing market had changed a great deal. People who were selling refinancing services were actively seeking people to refinance their mortgages, calling them at home, advertising on TV, and so on. In general, taking a scientific or statistical approach to asset behavior can be deceptive when part of the behavior of the asset depends on future decisions that people will make in a new environment. The next chapter discusses theories of term structure and interest rates in greater detail than the previous discussion in chapter six.

I'll cover the last few chapters in more detail. They include: dedicated portfolios, an introduction to interest rate futures, options, and swaps. Dedicated bond portfolios aim at matching the cash flows of a set of liabilities with a bond portfolio. One of the points made in the chapter is that dedication strategies require predictable asset/liability cash flows. An asset/liability example that fits this criteria is pension liabilities in payout mode combined with noncallable high-grade corporate bonds. The benefits associated with the dedication are a reduction in C-3 or interest rate risk. If you literally match the cash flows, interest rate fluctuation isn't very significant; there are costs in terms of a reduced universe of potential investments. Namely, you will not be able to use securities that have strong call features or prepayment options.

An example of a segment of the fixed-income securities market that would not fit into a dedication strategy is mortgages. These securities would create reinvestment risk. Namely, if interest rates went down, the mortgage borrowers would repay their mortgages and the investor would have to reinvest at a lower interest rate, causing the ostensibly matched liabilities to be underfunded. The steps involved in creating a dedicated bond portfolio are modeling liabilities, developing portfolio constraints in

terms of quality sector diversification and company diversification, and then selecting a conservative reinvestment rate for future investments. The reinvestment assumption is only necessary to the extent that cash flows do not exactly match. The last step is to select an optimal portfolio, optimal in the sense of minimizing the cost of funding the liabilities. An optimization program may pick bonds by choosing a bond that has a final cash flow that matches the final liability cash flow and subtracting the earlier-period asset cash flows from the earlier-period liability cash flows. Then the process starts over again with the last unfunded liability cash flow. The asset portfolio can be reoptimized in the future if significant changes have occurred in the liabilities or in the securities market.

The next topic I will discuss is interest rate futures and options. A futures contract is an agreement between a buyer and an established futures exchange in which the buyer agrees to take delivery on a specific amount of a valued item such as a commodity, stock or bond at a specified price at a designated time. An agricultural example would be buying (going long) the March wheat futures at $3 per bushel. You're basically agreeing to pay $3 in March for a bushel of wheat. That idea can be extended to financial instruments. Financial futures can be classified as interest rate futures, stock index futures, and currency futures. The Course 220 syllabus covers interest rate futures only. Course 480, which is derivatives, also covers stock as well as currency futures. A forward contract is similar to a futures contract, the difference being with a forward contract you don't have an exchange backing the contract. What you have is another party out in the market backing the contract.

An option is a contract in which the seller of the option grants the buyer of the option either the right to purchase from or sell to the seller a designated instrument at a specified price within a specified time period. A call option on a ten-year Treasury bond would work something like this: You would have a time period like six months, and a particular strike price, let's say $1,000, and let's say you paid $5 for that option. In the event that the value of that bond exceeds $1,000, you may want to exercise your call option against the person or the exchange that sold it to you. At that point you would be able to buy the bond for $1,000 regardless of its current price.

We can think of interest rate futures as having three uses: hedging, speculation, and arbitrage. The use that we'll talk about is hedging. I previously mentioned duration and convexity and how they can be thought of as measures of a security's price sensitivity to interest rate changes. An interest rate futures contract can be thought of as an agreement to buy a bond at a future date. Five-year treasury futures are traded on the Chicago Board of Trade. They go out for about nine months. There's a September contract. Right now if I bought the September contract and interest rates went up after I bought that contract, the value of the bond that I would receive in September would decrease, so obviously I would have a losing position. If interest rates went down, the value of that bond would increase and I would have a winning position. The reason you'd buy a contract like that is if you wanted that type of interest rate price sensitivity. Interest rate futures are highly liquid markets that allow investors to change their overall interest rate exposure quickly and easily. If your asset duration is five and your liability duration is two, you can match asset/liability durations by taking short positions in a five-year treasury note future. A five-year treasury note has a duration of around four, but if you sell short the five-year treasury you're going to have a duration of about a negative four. You started out originally with an

asset duration of five and a liability duration of two. If you sell enough five-year treasury futures contracts, eventually you can get your asset/liability durations to match if that's your objective. Again the forward contract can be used to do the same thing. It's not as liquid and you don't have an exchange standing behind it. The value of a forward contract is that you could get more customization.

An interest rate option is an option on either an interest rate, a treasury bill, a treasury note, or a treasury bond. When an option writer grants the buyer the right to purchase the designated instrument, it is called a call option. A call option gives the purchaser the right to buy the specific item for a specific price any time in the next given time frame. When the option buyer has the right to sell the designated instrument to the writer, the option is called a put option. The buyer of an option is said to be long the option. The writer is said to be short the option. If you had a call option on a five-year treasury note and interest rates went down, you'd make a profit. If you had a put option on a five-year treasury note and interest rates went up, you'd make a profit also. In contrast to a futures contract, an option is a right to buy or sell something. If you spend $1,000 on an option, your total loss is limited to $1,000. A futures contract is an obligation. For example, if you are long a futures contract you are effectively obligated to purchase the underlying item at the predefined price. So you potentially can have a substantial loss.

Both futures and options can be used to alter interest rate risk exposure. If you have interest rate options embedded in your liabilities, purchasing interest rate options allows you to have a fixed cost associated with the interest rate options embedded in your liabilities. For example, if your liabilities are such that they have guaranteed floors like the guaranteed floors on cash value products, you can go out in the market and buy that guaranteed floor and up front limit your potential loss on that guarantee upfront. For example, if you have an annuity with a 4% floor guarantee on it, and if interest rates really dive down to 2%, you can potentially lose a large sum of money. But, if as you issued the annuities contracts you went out and bought a collection of floors, you could limit your potential loss to a specific amount, namely the amount that you had paid for the floors.

This is the last topic, interest rate swaps. An interest rate swap is a contract between two participants or counterparts in which interest payments are based on the notational principal amount which itself is never paid or received. By notational principal I mean you'll be swapping interest streams only, but the interest will be based on an amount of money. That amount is the notational principal. One party says, "I'm going to give you the five-year treasury coupon for the next five years on $1 million and you're going to give me the six month T-bill rate each six months for the next five years." The fixed-rate payment in a swap often called the fixed-rate coupon is made by the fixed-rate payer to the floating-rate payer. The floating-rate payment in the swap is made by the floating-rate payer or variable-rate payer to the fixed-rate payer. Like futures and options, swaps are vehicles for changing the structure of your interest rate risk. For example, if you own a five-year bond and you have a five-year liability that is crediting the new six-month treasury rate each six months, so effectively your liability is floating, you may want to enter into a swap. By entering into a swap you would exchange your fixed payments for floating ones and now both your assets and your liabilities would be floating. Futures, options and swaps are considered derivative instruments. They can be powerful vehicles for changing your exposure to risk.

Recent media coverage of derivatives has highlighted speculative uses of derivatives, even though they may not have been defined as speculative uses by the people using them. If you look at how they used them, they're clearly speculative. Orange County is one example. Speculation is just one use of derivatives. I think Course 220 provides very useful information in terms of understanding interest rate derivatives for a purpose that is 180 degrees different than speculation, namely hedging.

That completes my summary of the material in Course 220. Now let's move on to an example problem. The following is a paraphrased version of a past 220 exam problem:

> Recently, XYZ Company entered into the group pension business and, so far, has sold one guaranteed investment contract (GIC) to a pension fund. XYZ invested the proceeds of the GIC into 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, XYZ will repay the original $1 million plus interest less previous payments.
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> On July 1, 1994, XYZ invested the $1 million it received from the pension fund into a five-year mortgage. 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 five years later, the borrower will repay to XYZ the original $1 million minus the total of any previous principal repayments. Describe the problems that the insurance company may have with this investment strategy. More specifically, does the strategy contain embedded options?

MR. ANDREW PICKENS JOHNSON: As a naive practitioner who has not read the study notes, I would wonder whether the word embedded was described in the study notes or was the question not read as it was stated?

MR. HARTER: Both the actual question and at least one study note use the expression "embedded option." The study note is "An Introduction to the Formation of Investment Strategy for Life Insurance Companies and Pension Plans."

You could say that a put option has been granted to the pension fund. If interest rates go up by a large amount, the value of the mortgage backing the GIC investment is decreased, but the pension fund is still able to take money out of that GIC without having a market-value adjustment. In effect, the pension funds have a put option on the GIC's value, and we have a call option to the mortgage borrower. If interest rates go down, the value of that mortgage goes up. However, the insurance company may not realize that value because the mortgage will probably pay off very quickly. The problem we have is that the initial spread is 25 basis points, but it can become negative if interest rates move enough in either direction. We have sort of a double mismatch. The product and investment strategy combine to create a highly speculative position known as a short straddle, which is a position where you sell both call and put options;

the insurance company is done that at this point. For 25 basis points, it has granted both put and call options. If we started to look at this investment and incorporate the cost or value of those put and call options at day one, the 25-basis-point spread between the 6.25% mortgage and the 6.0% GIC would dissolve completely.

FROM THE FLOOR: I take it that the answer then is embedded in the nonmarket value-adjusted withdrawals and prepayments. We talked about those two options.

MR. HARTER: Exactly. They're not explicit. We're not calling them options, but there are features within the mortgage and the way the pension can take money out of the GIC that create options. When the option's embedded, sometimes no one really accounts for it. Certainly in this strategy someone should have accounted for the fact that there is going to be a problem in the event that interest rates either go up or down.

MR. DONALD A. MCISAAC: We arrived at the same analysis you did, but what's the solution?

MR. HARTER: The embedded put option stems from the fact that the pension fund can take money out of the GIC, and when the value of the GIC goes down, the pension can take money out without a market-value adjustment. So effectively the pension has a limited downside which acts like a put option. Then the embedded call is the prepayment feature on the mortgage. When interest rates go down, you have an incentive to refinance. You can go and refinance at a lower rate someplace else. We can look at that another way. As interest rates go down, the value of a mortgage, if you couldn't refinance, would go up like any other type of bond, when interest rates come down. But the value of that change, when interest rates go down, flows to the mortgage borrower. So we're going to let the mortgage borrower have most of the appreciation of that mortgage in the event that interest rates go down. So effectively they have a call on that mortgage. They have a call at the initial price of the mortgage.

MR. MCISAAC: My question was not so much along those lines. I think we arrived at the same analysis. The problem is now you're faced with this and I thought what you would be asking a student in session 220 is when you have this mess on your balance sheet, what can you do to protect the company or what do you do to meet the problem? For example, there are such things as interest rate futures. Can you arrange futures contracts that would insulate the company against the potential shock that can occur under either a rising or falling interest scenario?

MR. HARTER: Course 220, although it did a good job of identifying different options, futures contracts, and that type of thing, didn't go into any detail in terms of application. But there are later exams like Course 230 that start to get more involved in terms of application. Course 230 touches on option-adjusted pricing, in which case you'd be running over a great many scenarios and, obviously, this strategy is falling apart if interest rates go up enough or down enough. Then you will get an average value that reflects that. In terms of using hedging strategies, Course 480 gets more involved with calculating hedge ratios. Course 595 would also address hedging. The company has put and call options that can be exercised against it. If the company wants to be protected from the exercise of those options, it will need to purchase similar options.