P1.T3. Financial Markets & Products

Hull, Risk Management and Financial Institutions

Bionic Turtle FRM Study Notes

By David Harper, CFA FRM CIPM and Gaurav Bansal
www.bionicturtle.com

BIONIC TURTLE

Hull, Chapter 3 End of Chapter Questions & Answers

Hull, Chapter 4: Mutual Funds and Hedge Funds

Hull, Chapter 4 End of Chapter Questions & Answers

Hull, Chapter 2: Banks

Identify the major risks faced by a bank.

Evaluate the capital requirements for banks.

Distinguish between economic capital and regulatory capital.

Explain how deposit insurance gives rise to a moral hazard problem.

Describe investment banking financing arrangements including private placement, public offering, best efforts, firm commitment, and Dutch auction approaches.

Describe the potential conflicts of interest among commercial banking, securities services, and investment banking divisions of a bank and recommend solutions to the conflict of interest problems.

Describe the distinctions between the "banking book" and the "trading book" of a bank

Explain the originate-to-distribute model of a bank and discuss its benefits and drawbacks.

Identify the major risks faced by a bank.

Banks are in the business of risk, but their failure can be a threat to the financial system. Consequently, regulators require banks to hold a threshold amount of capital to maintain a low possibility of failure. The three major types of risk faced by a bank are:

- **Credit risk:** It is the risk that the bank's counterparties in loan transactions and derivatives transactions will default. This is one of the greatest risks facing a bank. To address credit risk, regulators require banks to hold the most amount of capital. For example, the capital is chosen so that the chance of unexpected losses exceeding the capital in a year is 0.1%. Normally, a one-year time horizon is used by regulators for determining losses from credit risks.

- **Market risk:** It is the risk associated with the probability that securities in a bank's trading book will decrease in value. It mainly emerges from the bank's trading operations. The regulatory time horizon for calculating losses from a market risk is usually much less than a year.

- **Operational risk:** It is the risk related to losses that a bank will face due to failure of internal systems or due to external events. This is also considered as one of the biggest risks facing the banks. Like in credit risk, regulators use a one-year time horizon to consider losses from operational risk.

Evaluate the capital requirements for banks.

Banks all over the world are subject to various regulations. The most important regulation amongst them is the capital requirement by the banks.

Banks have various kinds of risks like market risk, operational risk and credit risk. Thus, it is important for the banks to have adequate capital or there could be the chance of run on the bank (i.e. the depositors will decide to withdraw funds from the bank). Regulators have made several regulations to ensure that banks maintain adequate capital and classified the Equity Capital as "Tier I Capital" and subordinated long-term debt (These are bonds issued by the bank to investors that rank below deposits in the event of a liquidation) as "Tier 2 Capital".

Consider the following example for DLC bank which has a balance sheet as below:

Summary balance sheet of DLC Bank ($ Million)			
Assets		**Liabilities and Net worth**	
Cash	5	Depositors	90
Marketable Securities	10	Subordinated Long term Debt	5
Loans	80	Equity Capital	5
Fixed Assets	5		
Total	**100**	**Total**	**100**

The DLC bank has total assets of $100 million. Most of the assets (80% of the total) are loans made by the bank to private individuals and small corporations. Cash and marketable securities account for a further 15% of the assets. The remaining 5% of the assets are fixed assets (i.e., buildings, equipment, etc.). A total of 90% of the funding for the assets comes from deposits of one sort or another from the bank's customers. A further 5% is financed by subordinated long-term debt. The remaining 5% is financed by the bank's shareholders in the form of equity capital. The equity capital consists of the original cash investment of the shareholders and earnings retained in the bank.

Now consider the bank's income statement.

Summary Income Statement for DLC in 2018 ($ millions)	
Net Interest Income	3.00
Loan Losses	(0.80)
Non-Interest Income	0.90
Non-Interest Expense	(2.50)
Pre-tax operating income	**0.60**

The first item on the income statement is net interest income. This is the excess of the interest earned over the interest paid and is 3% of the total assets. It is important for the bank to be managed so that net interest income remains roughly constant regardless of movements in interest rates of different maturities.

The next item is loan losses. This is 0.8% of total assets. It is very important for management to quantify credit risks and manage them carefully. But however carefully a bank assesses the financial health of its clients before making a loan, it is inevitable that some borrowers will default which leads to loan losses. The percentage of loans that default will tend to fluctuate from year to year with economic conditions. It is likely that in some years default rates will be quite low, while in others they will be quite high.

The next item, non-interest income, consists of income from all the activities of the bank other than lending money. This includes fees for the services the bank provides for its clients. In the case of DLC non-interest income is 0.9% of assets.

The final item is non-interest expense and is 2.5% of assets. This consists of all expenses other than interest paid. It includes salaries, technology-related costs, and other overheads. Banks must try to avoid large losses from litigation, business disruption, employee fraud, and so on. The risk associated with these types of losses is known as operational risk.

The bank had pre-tax operating income of $0.60 million, thus, there will be no depletion in the capital as the bank is earning profit. However, if there are adverse conditions and the bank's loan losses rise to 4% next year. This would mean a pre-tax operating loss of $2.6 Mn and a after-tax loss of $1.8 Mn (considering 30% tax rate and assuming tax losses can be carried back to offset previous profits). In this case, since the bank has an equity capital of 5%, the after tax-loss of 1.8% can be absorbed. This would decrease the equity capital from 5% to 3.2%. Even, if the bank had the same scenario next year, it can absorb the losses and then the equity capital will be 1.4% and it will not be completely wiped off.

However, if the bank had an aggressive capital structure as shown in below figure, it would face a difficult financial situation.

Summary balance sheet of DLC Bank ($ Million)			
Assets		**Liabilities and Net worth**	
Cash	5	Depositors	94
Marketable Securities	10	Subordinated Long term Debt	5
Loans	80	Equity Capital	1
Fixed Assets	5		
Total	100	Total	100

Since, the bank had only 1% equity capital it will face financial difficulties and will have to raise additional capital. Its equity capital would be completely wiped off if it had 1.8% loss and there would be chances of a run on the bank and forced liquidation.

Thus, the regulators try to ensure that the banks have adequate capital that is sufficient to cover the risks taken by the bank.

Distinguish between economic capital and regulatory capital.

Regulatory capital **is the capital required to be held by banks as a requirement for meeting the central bank regulators objective of keeping the total capital of a bank adequately high, so that the chance of a bank failure is very low.**

For example, in the case of credit risk and operational risk that we discussed above, the amount of capital to be held by banks is determined such that the chance of unexpected losses exceeding the capital in a year is 0.1%.

Economic capital **is the capital that a bank thinks it requires in addition to regulatory capital, based on its own models rather than those prescribed by regulators.** The form of economic capital (equity, subordinated debt, etc.) to be held by the banks is decided by regulators though.

Economic capital is typically (or at least often) less than regulatory capital. Still banks should maintain their capital levels adequately above the regulatory minimum so as to avoid having to raise capital at short notice when required. For instance, when banks faced huge losses during the credit crisis in 2007-08, they had to raise new capital in a short time period. Particularly during that time, *sovereign wealth funds* (investment funds controlled by the government of a country) provided some relief by rendering capital to banks that faced heavy losses.

Explain how deposit insurance gives rise to a moral hazard problem.

Countries with a large number of small banks are susceptible to bank runs and the resultant panic created due to bank failures. **As a measure of restoring confidence in banks, government regulators in many countries often insure depositors for losses up to a certain level under their guaranty programs.** Also, under this program, banks are required by regulators to pay an insurance premium that is a percentage of their domestic deposits.

Typically, deposit insurance can lead to a problem called as moral hazard. **Moral hazard can be stated as the possibility that the existence of insurance changes the behavior of the insured party.** In this case, we can say that the existence of deposit insurance allowed banks to follow risky strategies that would not otherwise be feasible.

For example, banks could widen their deposit base by offering high rates of interest to depositors and use the funds to make risky loans. Without deposit insurance, such a scenario may not be possible as depositors would sense that the bank was too risky and withdraw their funds. However, with deposit insurance, depositors would be convinced that if the worst happens, they are protected under FDIC and so banks have an incentive to follow risky strategies. The introduction of risk-based deposit insurance premiums has reduced moral hazard to some extent.

For example, the United States which underwent a major recession during 1929 when nearly 10,000 banks failed between 1930 and 1933. **Consequently, in 1933, the US government formed the Federal Deposit Insurance Corporation (FDIC) to protect depositors**. At the time of its initiation, the maximum level of protection provided was $2,500. This amount increased over the years and its levels have reached $250,000 per depositor per bank in October 2008. Up until 1980, the system seemed to work well. However, between 1980 and 1990, bank failures in the United States reached over 1,000 (higher when compared to the whole 1933 to 1979 period). Amongst various other reasons cited for this failure, moral hazard was considered an important one. During that time, FDIC funds touched base levels

and consequently they had to borrow $30 billion from the U.S. Treasury. The Congress passed the FDIC Improvement Act in 1991 to prevent any possibility of the fund becoming insolvent in the future. Then, up to the year 2006, bank failures were rare but the funds held by FDIC depleted again when banks failed as a result of the credit crisis that began in 2007.

From 2007, the size of the premium required to be paid by banks has depended on the bank's capital and how safe it is considered to be by regulators. For well-capitalized banks, the premium might be less than 0.1% of the amount insured; for under-capitalized banks, it could be over 0.35% of the amount insured.

Describe investment banking financing arrangements including private placement, public offering, best efforts, firm commitment, and Dutch auction approaches.

The important function of investment banking is to raise finance for corporations or governments, in the form of debt, equity or hybrid instruments. This includes activities like originating the securities, underwriting them, and then placing them with investors.

Origination of securities involves comprehensive legal documentation listing the rights of the security holder. A prospectus indicating the company's past performance, future prospects and the major risks faced by the company is then created. The investment bank and company management market the securities to large fund managers in an event called "roadshow". The securities price is set and agreed upon by the investment bank and the firm. The bank is then responsible for the sale of the securities in the market.

There are various kinds of financing arrangement that exists between the investment bank and the corporation. They are described below.

Private placement: In private placement, the investment bank sells securities of the corporation to a small number of large institutional investors (like life insurance companies or pension funds) for a fee.

Public Offering: The securities of a corporation are offered to the general public through the investment bank. The two ways in which public offering may take place are distinguished based on a best effort or firm commitment basis.

- In a **best efforts public offering**, the investment bank does the best it can to place the securities with investors. Based mostly on its success, the bank receives a fee.

- In **a firm commitment public offering**, the investment bank buys the securities from the issuer at a particular price and sells it to the investors at slightly higher prices. The difference between the price at which it sells the securities and the price it pays the issuer is its profit. In case the investment bank is unable to sell the securities of the issuer, they tend to own it themselves.

These two types of public offerings can be explained by the example given here. A bank has agreed to underwrite an issue of 50 million shares by ABC Corporation. In negotiations between the bank and the corporation the target price to be received by the corporation has been set at $30 per share which means that corporation is expecting to raise $1.5 billion ($30 × 50 million shares = 1500 million dollars) in total. The bank can either offer the client a best efforts arrangement where it charges a fee of $0.30 per share or it can offer a firm commitment where it agrees to buy the shares from ABC Corporation for $30 per share.

The bank is confident that it will be able to sell the shares, but is uncertain about the price. As part of its procedures for assessing risk, it considers two alternative scenarios. Under the first scenario, it can obtain a price of $32 per share; under the second scenario, it is able to obtain only $29 per share.

- In a best-efforts deal, assuming all shares are sold, it obtains a total fee $15 million ($0.3 per share × 50 million shares) under both scenarios mentioned above.

- In a firm commitment deal, its profit depends on the price at which it can sell to the investors. If it sells the shares for $32, based on the price of $30 paid for acquiring the shares, we see it makes a profit of $100 million ((32 − 30) × 50 million shares). As per the second scenario if it can only sell the shares for $29 per share, it loses $50 million ((29-30) × 50million shares) because it still has to pay ABC Corporation $30 per share. The decision taken is likely to depend on the probabilities assigned by the bank to different outcomes and is referred to as its "risk appetite".

Scenarios	Profits - Best efforts	Profits - Firm commitment
Can sell at $29/share	+ $15 million	-50 million
Can sell at $32/share	+ $15 million	+100 million

Now we delve into the two types of public offerings.

- *Initial Public Offering*: When the company wishing to issue shares is not already publicly traded, the share issue is known as an initial public offering (IPO). They are mostly made on a best effort basis. The offering price may be difficult to determine. The bank's best estimate of the market price is its assessment of the company's value divided by the number of shares currently outstanding. Since the bank does not want to take a chance that the issue will not sell, the offering price may be set below this best estimate of the market price. The fee it would earn per share sold would still be the same regardless of the offering price.

  IPOs are considered attractive buys by many investors because many a times, soon after shares are sold in an IPO there may be substantial price increases (as high as 40%). With the hopes of increasing their business, banks mostly offer IPOs to the fund managers that are their best customers. They also place it to senior executives of large companies and in this case, it is known as "spinning" and is looked down upon by regulators.

- *Secondary offerings*: If the company is already publicly traded and additional equity financing has to be raised, then as a guide to the issue price, the investment bank looks at the prices at which the company's shares are trading a few days before the issue is to be sold. It is most likely that new shares will be issued at a target price slightly below the current price. This may lead to a possibility that the price of the company's shares will show a substantial decline before the new shares are sold.

Dutch Auction Process:

The IPOs of few companies may be launched by a specific process called Dutch auction approach. A prospectus is issued and there is usually a road show just like any other regular IPO. In the subsequent auction process, investors bid for the quantity of shares they are likely to purchase at a particular price. Shares are offered to investors in the order of the highest to the lowest bid till all the shares are sold. The price paid by all successful bidders is the lowest bid that leads to a share allocation.

For example, consider a company which wants to sell one million shares in an IPO through the Dutch auction approach. From the table, based on the bid price as seen from the highest to the lowest, shares are allocated to C, F, E, H, and A, in that order. At this point, 800,000 shares have been allocated and only 200,000 remain unallocated. The next highest bidder is D who has bid for 300,000 shares. Since only 200,000 shares are available now, D's order is only filled up to two-thirds of his quantity bid. The price paid by others investors like A, C, D, E, F, and H is equal to the price bid by the lowest bidder D ($29.00), among whom the shares are allocated

Bidder	Number of Shares	Price
A	100,000	$30.00
B	200,000	$28.00
C	50,000	$33.00
D	300,000	$29.00
E	150,000	$30.50
F	300,000	$31.50
G	400,000	$25.00
H	200,000	$30.25

Dutch auctions have two advantages over that of a traditional IPO.

- Firstly, the price that clears the market ($29.00 in the example) becomes the market price in the bidding process.

- Secondly, because it is an auction process, any potential investor and not only the favored clients of investment banker can obtain the shares.

Describe the potential conflicts of interest among commercial banking, securities services, and investment banking divisions of a bank and recommend solutions to the conflict of interest problems.

When a bank conducts activities in commercial banking, securities services, and investment banking, in the name of a single corporate entity, many potential conflicts of interest arise. Some of the situations that arise are described in the examples below:

- While selling advisory services to investors, a bank may promote securities that its investment banking division is trying to sell. Also, when a bank has the fiduciary responsibility (when it can trade on behalf of its client) it is possible for the bank to allocate the difficult-to-sell securities in to this account.

- The confidential information obtained about the company to which a bank lends may be misused. This may be done by way of sharing information with its mergers and acquisitions arm so as to render advice to another one of its clients on potential takeover opportunities.

- The research side of the securities division might be enticed to rate a company's share as a "buy", so as to please the company's management and get more investment banking business.

- Consider a case where a commercial bank no longer wants to hold a loan it has offered to a company on its books based on confidential information of increased chance of bankruptcy of that company. In such a situation, its investment banking division may be forced to organize a bond issue for the company, whose proceeds will be used to pay off the loan. This action of replacing the loan of the company which is about to go bankrupt with loan made by investors who have less information about the bankruptcy, may make the bank safer but puts the investors at risk.

Possible solutions to handle potential conflicts of interest

The aforementioned potential conflicts of interest results in degradation of a bank's reputation and may lead to fines and lawsuits. **One of the ways in which these types of conflicts can be addressed is by separating the commercial banking division from investment banking.** For this, internal barriers known as Chinese walls can be set up. This prohibits the transfer of information from one part of the bank to another when this is not in the best interests of the bank's customers.

The Glass-Steagall Act of 1933 in the United States limited the ability of commercial banks and investment banks to engage in each other's activities in areas such as public offerings. Also, investment banks were not allowed to take deposits and make commercial loans.

In the later years, these rules were relaxed slowly over a period of time and in 1999, under the Financial Services Modernization Act all restrictions on the operations of banks, insurance companies, and securities firms were effectively eliminated.

Now, although investment banks and commercial banks may be held by the same entity, banks are required to keep the financial transactions of their commercial banking activities separate so that they are not affected by losses in investment banking.

Describe the distinctions between the "banking book" and the "trading book" of a bank

The accounting of various banking activities can be segregated into two important types as:

Trading book:

- Trading book includes all the assets and liabilities the bank has as a result of its trading operations; i.e., instruments the bank intends to trade.

- The values of these assets and liabilities are *marked to market* daily

    o This means that the value of the book is adjusted daily to reflect changes in market prices. For example, if a bank buys an asset for $100 on one day and the price falls to $60 the next day, it records an immediate loss of $40, even though it may not be selling the asset in the immediate future.

    o Sometimes it becomes difficult to estimate the value of a security or contract when market prices of comparable transactions may not be available. Even during these circumstances, often a model has to be assumed by the bank. This process of coming up with a "market price" is then knows as *marking to model*.

Banking book

- Banking book includes loans made to corporations and individuals.

- These loans are not marked to market.

  - When a borrower makes principal and interest payments of a loan on time, the loan is recorded in the bank's books at the principal amount owed plus accrued interest.

  - If payments due from the borrower are more than 90 days past due, the loan is usually classified as a non-performing loan. In this case the bank does not then accrue interest on the loan when calculating its profit.

  - When it becomes likely that principal of the loan will not be repaid, the loan is classified as a loan loss.

- Actual loan losses are charged against reserves which means that there is a charge against the income statement for an estimate of the loan losses that will be incurred.

  - The reserve may be increased or decreased over time.

  - A bank can also smooth out its income from one year to the next by overestimating reserves in good years and underestimating them in bad years.

  - Sometimes, a bank may resort to tactics like debt rescheduling to avoid the recognition of loan losses. In debt rescheduling, more money is lent to the borrower so that the payments on the old loans can be kept up to date. It allows interest on the loans to be accrued and defers the recognition of loan losses.

Explain the originate-to-distribute model of a bank and discuss its benefits and drawbacks.

Normally a bank operates by accepting deposits and using those deposits to finance loans. The loans are reflected in its book of accounts. **In another approach known as the originate-to-distribute model the bank originates the loans but does not keep the loans in its books. Instead portfolios of loans are packaged into tranches which are then sold to investors.** This model is also termed securitization as securities are created from cash flow streams originated by the bank. The originate-to-distribute model has been used for various types of bank lending including student loans, commercial loans, commercial mortgages, residential mortgages, and credit card receivables

Three government sponsored entities exist in the United States to facilitate this originate-to-distribute model for mortgages. They are Government National Mortgage Association (GNMA) or "Ginnie Mae," the Federal National Mortgage Association (FNMA) or "Fannie Mae," and the Federal Home Loan Mortgage Corporation (FHLMC) or "Freddie Mac." They buy pools of mortgages from banks and other mortgage originators, guarantee the timely repayment of interest and principal, and then package the cash flow streams and sell them to investors.

Benefits

The loan-to-distribute model is considered attractive because of the following reasons.

- By securitizing loans, the banks can keep them off their balance sheet which frees up funds to enable it to make more loans.

- Securitization also frees up capital that can be used to cover risks being taken elsewhere in the bank. This is particularly attractive if the bank feels that the capital required by regulators for a loan is too high.

- A bank earns a fee for originating a loan and a further fee if it services the loan after it has been sold.

Drawbacks

One of the major drawbacks of the loan-to-distribute model is given below.

- When the loans are packaged and sold, it transfers the prepayment risk from the bank to the investors. This is the risk that interest rates will decrease and mortgages will be paid off earlier than expected. When mortgages are guaranteed by GNMA, FNMA, or FHLMC credit risk faced by investors may be avoided but in many cases where there is no such guarantee, investors bear the credit risk

  The originate-to-distribute models were not effective during the 2000- 2006 period when banks relaxed their mortgage lending standards and the credit quality of the securities originated diminished greatly. This resulted in a severe credit crisis later, due to which the model could not be used by banks as investors had lost confidence in the securities created.

Hull, Chapter 2 End of Chapter Questions & Answers

Question 2.1

How did concentration in the U.S. banking system change between 1984 and 2014?

Answer:

The banking system became more concentrated, with large banks having a bigger share of the market. The total number of banks reduced from 14,483 to 5,809.

Question 2.2

What government policies led to the large number of small community banks in the United States?

Answer:

In the early twentieth century, many states passed laws restricting banks from opening more than one branch. The McFadden Act of 1927 restricted banks from opening branches in more than one state.

Question 2.3

What risks does a bank take if it funds long-term loans with short-term deposits?

Answer:

The main risk is that interest rates will rise so that, when deposits are rolled over, the bank has to pay a higher rate of interest. The rate received on loans will not change. The result will be a reduction in the bank's net interest income.

Question 2.4

Suppose that an out-of-control trader working for DLC bank (see Tables 2.2and 2.3) loses $7 million trading foreign exchange. What do you think would happen?

Answer:

DLC's loss is more than its equity capital, and it would probably be liquidated. The subordinated long-term debt holders would incur losses on their $5 million investment. The depositors should get their money back.

Question 2.5

What is meant by net interest income?

Answer

The net interest income of a bank is interest received minus interest paid.

Question 2.6

Which items on the income statement of DLC bank in Section 2.2 are most likely to be affected by (a) credit risk, (b) market risk, and (c) operational risk?

Answer:

Credit risk primarily affects loan losses. Non-interest income includes trading gains and losses. Market risk therefore affects non-interest income. It also affects net interest income if assets and liabilities are not matched. Operational risk primarily affects non-interest expense.

Question 2.7

Explain the terms "private placement" and "public offering." What is the difference between "best efforts" and "firm commitment" for a public offering?

Answer:

A private placement is a new issue of securities that is sold to a small number of large institutional investors. A public offering is a new issue of securities that is offered to the general public. In a best efforts deal, the investment bank does as well as it can to place securities with investors, but does not guarantee that they can be sold. In a firm commitment deal, the investment bank agrees to buy the securities from the issuing company for a particular price and attempts to sell them in the market for a higher price.

Question 2.8

The bidders in a Dutch auction are as follows:

Bidder	Number of Shares	Price
A	20,000	$100.00
B	30,000	$93.00
C	50,000	$110.00
D	70,000	$88.00
E	60,000	$80.00
F	10,000	$105.00
G	90,000	$70.00
H	80,000	$125.00

The number of shares being auctioned is 150,000. What is the price paid by investors? How many shares does each investor receive?

Answer:

The bidders when ranked from the highest price bid to the lowest are: H, C, F, A, B, D, E, and G. Bidders H, C, and F have bid for 140,000 shares. A has bid for 20,000. The price that clears the market is the price that was bid by A or $100. H, C, and F get their orders filled at this price. Half of A's order is filled at this price.

Question 2.9

What is the attraction of a Dutch auction over the normal procedure for an IPO? In what ways was Google's IPO different from a standard Dutch auction?

Answer:

A Dutch auction potentially attracts a wide range of bidders. If all interested market participants bid, the price paid should be close to the market price immediately after the IPO. The usual IPO situation where the price turns out to be well below the market price should therefore be avoided. Also, investment banks are not able to restrict purchasers to their best current and potential clients. The Google IPO was different from a standard Dutch auction in that Google reserved the right to choose the number of shares that would be issued, and the percentage allocated to each bidder, when it saw the bids.

Question 2.10

Management sometimes argues that poison pills are in the best interests of shareholders because they enable management to extract a higher price from would-be acquirers. Discuss this argument.

Answer:

Poison pills can give management a negotiation tool, particularly if the board has the right to overturn a poison pill or make it ineffective. When it is confronted with a potential acquirer, the poison pill can buy the company time to bargain for a better purchase price or find other bidders. However, there is the danger that the poison pill will discourage potential buyers from approaching the company in the first place.

Question 2.11

Give three examples of the conflicts of interest in a large bank. How are conflicts of interest handled?

Answer:

The brokerage subsidiary of a bank might recommend securities that the investment banking subsidiary is trying to sell. The commercial banking subsidiary might pass confidential information about its clients to the investment banking subsidiary. When a bank does business with a company (or wants to do business with the company), it might persuade the brokerage subsidiary to recommend the company's shares as a "buy." The commercial banking subsidiary might persuade a company to which it has lent money to do a bond issue because it is worried about its exposure to the client. (It wants the investment banking subsidiary to persuade its clients to take on the credit risk.) These conflicts of interest are handled by what are known as Chinese walls. They prevent the flow of information from one part of the bank to another.

Question 2.12

A loan for $10 million that pays 8% interest is classified as nonperforming. What is the impact of this on the income statement?

Answer:

The interest is no longer accrued. The before-tax income will be reduced by 8% of $10 million or $800,000 per year.

Question 2.13

Explain how the loan loss provision account works.

Answer:

The provision for loan losses reflects the losses the bank expects in the future. It is updated periodically. When the provision is increased in a year byX, there is a charge to the income statement of X. Actual loan losses, when they are recognized, are charged against the balance in the loan loss provision account.

Question 2.14

What is the originate-to-distribute model?

Answer:

In the originate-to-distribute model, a bank originates loans and then securitizes them so that they are passed on to investors. This was done extensively with household mortgages during the seven-year period leading up to July 2007. In July 2007, investors lost confidence in the securitized products, and banks were forced to abandon the originate-to-distribute model, at least temporarily.

Question 2.15

Regulators calculate that DLC bank (see Section 2.2) will report a profit that is normally distributed with a mean of $0.6 million and a standard deviation of $2.0 million. How much equity capital in addition to that in Table 2.2 should regulators require for there to be a 99.9% chance of the capital not being wiped out by losses?

TABLE 2.2   Summary Balance Sheet for DLC at End of 2015 ($ millions)

Assets		Liabilities and Net Worth	
Cash	5	Deposits	90
Marketable Securities	10	Subordinated Long-Term Debt	5
Loans	80	Equity Capital	5
Fixed Assets	5		
Total	100	Total	100

Answer:

There is a 99.9% chance that the profit will not be worse than 0.6 − 3.090 × 2.0 = −$5.58 million. Regulators will require $0.58 million of additional capital.

Question 2.16

Explain the moral hazard problems with deposit insurance. How can they be overcome?

Answer:

Deposit insurance makes depositors less concerned about the financial health of a bank. As a result, banks may be able to take more risk without being in danger of losing deposits. This is an example of moral hazard. (The existence of the insurance changes the behavior of the parties involved with the result that the expected payout on the insurance contract is higher.) Regulatory requirements that banks keep sufficient capital for the risks they are taking reduce their incentive to take risks. One approach (used in the U.S.) to avoiding the moral hazard problem is to make the premiums that banks have to pay for deposit insurance dependent on an assessment of the risks they are taking.

Question 2.17

The bidders in a Dutch auction are as follows:

Bidder	Number of shares	Price
A	60,000	$50.00
B	20,000	$80.00
C	30,000	$55.00
D	40,000	$38.00
E	40,000	$42.00
F	40,000	$42.00
G	50,000	$35.00
H	50,000	$60.00

The number of shares being auctioned is 210,000. What is the price paid by investors? How many shares does each investor receive?

Answer:

When ranked from highest to lowest the bidders are B, H, C, A, E and F, D, and G. Individuals B, H, C, and A bid for 160, 000 shares in total. Individuals E and F bid for a further 80,000 shares. The price paid by the investors is therefore the price bid by E and F (i.e., $42). Individuals B, H, C, and A get the whole amount of the shares they bid for. Individuals E and F gets 25,000 shares each.

Question 2.18

An investment bank has been asked to underwrite an issue of 10 million shares by a company. It is trying to decide between a firm commitment where it buys the shares for $10 per share and a "best efforts" where it charges a fee of 20 cents for each share sold. Explain the pros and cons of the two alternatives.

Answer:

If it succeeds in selling all 10 million shares in a best efforts arrangement, its fee will be $2 million. If it is able to sell the shares for $10.20, this will also be its profit in a firm commitment arrangement. The decision is likely to hinge on a) an estimate of the probability of selling the shares for more than $10.20 and b) the investment banks appetite for risk. For example, if the bank is 95% certain that it will be able to sell the shares for more than $10.20, it is likely to choose a firm commitment. But if assesses the probability of this to be only 50% or 60% it is likely to choose a best efforts arrangement.

BIONIC TURTLE

Hull, Chapter 3: Insurance Companies and Pension Plans

Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies.

Describe the use of mortality table and calculate premium payment and the expected payout for a policy holder.

Calculate and interpret loss ratio, expense ratio, combined ratio, and operating ratio for a property casualty insurance company.

Describe moral hazard and adverse selection risks facing insurance companies, provide examples of each, and describe how to overcome the problems.

Distinguish between mortality risk and longevity risk and describe how to hedge these risks.

Evaluate the capital requirements for life insurance and property-casualty insurance companies.

Compare the guaranty system and the regulatory requirements for insurance companies with those for banks.

Describe a defined benefit plan and a defined contribution plan for a pension fund and explain the differences between them.

Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies.

Insurance companies may be classified under two main categories. **They are *life insurance* or *nonlife insurance* (also known as *property-casualty insurance*) firms.** Health insurance is considered to be a separate category. A pension plan is also a form of insurance arranged by a company for its employees.

Irrespective of the type of insurance company, the main feature of an insurance company is that policy holders make regular premium payments in exchange for the promise of receiving contingent payout(s) which triggered by well-defined (contractual) events.

Life insurance companies

Life insurance companies offer a number of products that provide a payoff when the life of a policyholder is at risk which implies the event of death of a policyholder. The contracts they offer are usually for a long term. Some of the main contracts these companies offer are:

- **Term life insurance (aka, temporary life insurance):** pays only if policyholder dies during a certain period.

- **Whole life insurance:** this policy provides protection for the life of the policyholder, so it provides a payoff on the death of the insured, regardless of when it happens. The portion of the premium not required to meet expected payouts in the early years of the policy is invested, and used to finance expected payouts in later years indicating the savings benefit available in this process. Also, whole life insurance policies usually give rise to tax benefits, because the present value of the tax paid is less than it would be if the investor had chosen to invest funds directly rather than through the insurance company.

- **Variable Life Insurance**: a variation on (form of) whole life insurance where the surplus premiums are invested in a fund chosen by the policyholder; e.g., equity, bond, or money market fund. A minimum guaranteed payout on death is usually specified, but the payout can be more if the fund outperforms.

- **Universal Life**: a variation on (form of) whole life insurance where the policyholder can reduce the premium down to a specified minimum without a lapse in coverage.

- **Variable-Universal Life Insurance**: this policy blends the features found in variable life insurance and universal life insurance. The policyholder can choose between a number of alternatives for the investment of surplus premiums. The insurance company guarantees a certain minimum death benefit and interest on the investments can sometimes be applied toward premiums. Premiums can be reduced down to a specified minimum without the policy lapsing.

- **Endowment Life Insurance**: this policy lasts for a specified period and pays a lump sum either when the policyholder dies or at the end of the period, whichever is first. There are many different types of endowment life insurance contracts. The amount that is paid out can be specified in advance as the same regardless of whether the policyholder dies or survives to the end of the policy. Sometimes the payout is also made if the policyholder has a critical illness.

- **Group Life Insurance**: this policy covers several people under a single policy and is often purchased by a company for its employees. The policy may be contributory, where the premium payments are shared by the employer and employee, or noncontributory, where the employer pays the whole of the cost. There are economies of scale in group life insurance.

- Annuity contracts: In exchange for an upfront lump sum payment by the policyholder, an annuity provides the policyholder with an annual income starting from a certain future date for the rest of his or her life. In some instances, the annuity starts immediately after the lump sum payment by the policyholder. But more typically, the lump sum payment is made by the policyholder several years ahead of the time when the annuity is to start and the insurance company invests the funds to create the annuity. (This is called a *deferred annuity.*)

Property-casualty insurance companies

Property-casualty insurance companies can be subdivided based on their concentration of activities in either property insurance and casualty insurance.

- Property insurance provide protection against loss of or damage to property from accidents, fire, theft, water damage, etc.

- Casualty insurance provides protection to individuals and companies against legal liability exposures (from, for example, injuries caused to third parties).

Their contracts usually last for a year although they may be renewed every year. The premiums collected by property-casualty insurance companies may change, that is, they may increase when overall costs of providing protection increases. The contracts whose payouts are most difficult to predict are those where a specific event is liable to trigger claims by many policyholders around the same time. They include events that cause natural disasters such as hurricanes or earthquakes. A property-casualty insurance company must typically keep more equity capital as a percent of total assets, than a life insurance company.

Health insurance companies

Health insurance companies are sometimes considered to be in a totally separate category from the first two types discussed above. They have some properties which are similar to the life insurance companies and some properties like that of property-casualty insurance companies.

Health insurance premiums resemble life insurance premiums when changes to the company's assessment of the risk of a payout do not lead to an increase in premiums. For example, when the health of the policy holder deteriorates, the premiums do not change. Sometimes, similar to premiums in a property-casualty insurance company, the premiums of a health insurance company may increase when the overall costs of providing health care increases.

Companies providing pension plan

Many companies provide insurance to employees in the form of a guaranteed income for the rest of their lives once they have retired. Usually, both the company and its employees make regular monthly contributions to the plan and the funds in the plan are invested to provide income for retirees.

Risks facing insurance companies

The reserves held by the insurance companies to meet the payouts as required by the claims of policyholders may fall short of their estimation. This is the biggest risk faced by the insurance companies.

Another risk faced by insurance companies is that they mostly invest in corporate bonds and when defaults on corporate bonds increase, it takes a toll on the profitability of the insurance company. They face liquidity risks associated with their investments. Illiquid bonds give higher yields but they cannot be readily converted into cash to meet high claims when they are not anticipated beforehand. Since insurance companies enter into transactions with banks and reinsurance companies, they are also exposed to credit risk. Finally, like banks, insurance companies are also exposed to operational risks and business risks.

Describe the use of mortality table and calculate premium payment and the expected payout for a policy holder.

Mortality tables are used to value life insurance contracts. The table on the next page shows mortality rates estimated by the U.S. Department of Social Security for the year 2013 (these are slightly different than Hull's because we retrieved more recent data from https://www.ssa.gov/oact/). To interpret the table, consider the row corresponding to age 6.

- The second column shows that the probability of a male aged 6 dying (highlighted among blue rows) within the next year is 0.000146 (or 0.0146%).

- The third column shows that the probability of that male surviving to age 6 is 0.992193 (or 99.219%).

- The fourth column shows the remaining life expectancy of 70.88 years for a 6-year old male. This means than on average this male will live to age 76.88 = 6 +70.88. Likewise, the statistics for a woman can be interpreted. The probability of a 6-year old female dying within one year is 0.000109 (0.0109%), the probability of that female surviving to age 6 is 0.993615 (99.361%), and the remaining life expectancy for that 6-year old female is 75.57 years, meaning that she on an average will live up to 81.57 years = 6+75.57.

On further analysis, it can be observed that the probability of death in the following year decreases with age up to 10 years of life and then starts to increase.

- It can be noticed that probability of death in the next year for a 90-year old man (highlighted among green rows) is 16.72%, for a 100-year old man is 35.35% and for a 110-year old man is 57.59%.

- For women, the probabilities of death in the next year are 13.22%, 30.47%, and 54.56%, respectively for ages 90, 100 and 110.

- This reveals that the mortality statistics are slightly more favorable for women than for men.

Some numbers in the table can be deduced from the others. The third column shows that the (cumulative) probability of a man surviving for up to age 90 is 0.177348. The probability of a man surviving up to age 91 is given as 0.147679. The **unconditional** probability of a man dying between his 90th and 91st birthday will then be the difference between these numbers, which is 0.029669 = 0.177348 − 0.147679.

Given that a man reaches the age 90, the probability that he will die during the following year can be calculated as seen below. In technical terms, this one-year conditional death probability (0.167291) is equal to the one-year unconditional death probability divided by the cumulative survival probability (0.177348):

$$\frac{0.029669}{0.177348} = 0.167291$$

Alternatively, the cumulative probability of a man surviving to aged 91 is the (cumulative) probability that he survives to aged 90 and then does not die in the first year (between ages 90 and 91). This is calculated tallies with third column corresponding to row 91:

$$0.177348 \times (1 - 0.167291) \times = 0.147679$$

Mortality Table

Exact age	Male Cond'l Death Prob (a)	Male Cumul Survival Prob (b)	Male Life Expect	Female Cond'l Death Prob (a)	Female Cumul Survival Prob (b)	Female Life Expect
0	0.006519	1.000000	76.28	0.005377	1.000000	81.05
1	0.000462	0.993481	75.78	0.000379	0.994623	80.49
2	0.000291	0.993022	74.82	0.000221	0.994246	79.52
3	0.000209	0.992733	73.84	0.000162	0.994026	78.54
4	0.000176	0.992526	72.85	0.000133	0.993865	77.55
5	0.000159	0.992351	71.87	0.000119	0.993733	76.56
6	0.000146	0.992193	70.88	0.000109	0.993615	75.57
7	0.000133	0.992048	69.89	0.000101	0.993507	74.58
8	0.000118	0.991916	68.90	0.000096	0.993406	73.58
9	0.000102	0.991799	67.90	0.000093	0.993311	72.59
10	0.000091	0.991698	66.91	0.000094	0.993218	71.60
11	0.000096	0.991608	65.92	0.000100	0.993125	70.60
12	0.000128	0.991513	64.92	0.000112	0.993026	69.61
13	0.000195	0.991386	63.93	0.000134	0.992915	68.62
14	0.000288	0.991192	62.94	0.000162	0.992782	67.63
...	...	...	...	...	...	...
89	0.151299	0.208964	4.34	0.118513	0.330175	5.17
90	0.167291	0.177348	4.03	0.132206	0.291045	4.80
91	0.184520	0.147679	3.74	0.147092	0.252567	4.45
92	0.202954	0.120430	3.47	0.163154	0.215416	4.13
93	0.222555	0.095988	3.23	0.180371	0.180270	3.84
94	0.243272	0.074625	3.01	0.198714	0.147755	3.57
95	0.263821	0.056471	2.82	0.217264	0.118394	3.34
96	0.283833	0.041573	2.64	0.235735	0.092671	3.12
97	0.302916	0.029773	2.49	0.253810	0.070825	2.93
98	0.320672	0.020754	2.36	0.271155	0.052849	2.76
99	0.336706	0.014099	2.24	0.287424	0.038519	2.60
100	0.353541	0.009352	2.12	0.304670	0.027448	2.45
101	0.371218	0.006046	2.01	0.322950	0.019085	2.30
102	0.389779	0.003801	1.90	0.342327	0.012922	2.17
103	0.409268	0.002320	1.80	0.362867	0.008498	2.03
104	0.429732	0.001370	1.70	0.384639	0.005414	1.91
105	0.451218	0.000781	1.60	0.407717	0.003332	1.78
106	0.473779	0.000429	1.51	0.432180	0.001973	1.67
107	0.497468	0.000226	1.42	0.458111	0.001121	1.56
108	0.522341	0.000113	1.34	0.485597	0.000607	1.45
109	0.548458	0.000054	1.26	0.514733	0.000312	1.35
110	0.575881	0.000024	1.18	0.545617	0.000152	1.26
111	0.604675	0.000010	1.11	0.578354	0.000069	1.17

(a) Conditional probability of dying within one year.
(b) Cumulative probability of survival up to the age

Calculating premium payment and expected payout for a policyholder

Example: If the interest rates for all maturities are given as 4% per annum (with semiannual compounding) and premiums are paid once a year at the beginning of the year, what is an insurance company's break-even premium for $100,000 of term life insurance for a man of average health aged 90?

If the term insurance lasts one year, **the expected payout is calculated as probability of death multiplied the insurance coverage**. For a man aged 90, from the mortality table, it is calculated to be $16,729 and is shown as: $0.167291 \times 100,000 = 16,729$

In case the payout happens in the middle of the year, then the premium discounted for six months (at the semiannual rate of 2%) is $16,421 and can be calculated as:

$$\frac{16,729}{1.02} = 16,401$$

Suppose if the term insurance lasts two years, the present value of expected payout in the first year is $16,729, same as before. The probability that the policyholder dies during the 2nd year is $(1 - 0.167291) \times 0.184520 = 0.153651$. So, the expected payout will be $15,365 and is calculated as: $0.153651 \times 100,000 = 15,365$

If the payout happens in the middle of the 2nd year (i.e. in 18 months), then the present value of the payout is $14,478, calculated as:

$$\frac{15,365}{(1.02^3)} = 14,478$$

So, the total present value of payouts is $30,880, which is calculated by adding the payout in the middle of the first and the middle of the second year: $16,401 + 14,478 = 30,880$

So far we have seen the calculation of the payouts made in the event of death. Now let us move on to calculate the premium payments. The first premium is required at time zero (age 90), so it is certain that this will be paid. The probability of the second premium payment being made at the beginning of the second year is the probability that the man does not die during the first year. It is calculated as: $(1 - 0.167291) = 0.832709$

If the premium is X dollars per year, the present value of the premium payments is given as:

$$X + \frac{0.832709X}{(1.02^2)} = 1.800374X$$

The break-even annual premium is calculated by finding the value of (X) by equating the present value of the expected premium payments to the present value of the expected payout: $1.800374X = 30,880$

Solving this, we get the value of X as: $\dfrac{30,880}{1.800374} = 17,151$

The break-even premium payment is therefore $17,151.

Calculate and interpret loss ratio, expense ratio, combined ratio, and operating ratio for a property casualty insurance company.

Loss ratio **is the ratio of payouts made to premiums earned in a year by an insurance company**. In the US, loss ratios are in the 60% to 80% range and have shown an increasing trend over time.

The *expense ratio* for an insurance company is the ratio of expenses to premiums earned in a year. Expense ratios in the US are in the 25% to 30% range and have shown a decreasing trend through time. The two major sources of expenses are

- Loss adjustment expenses which are those expenses related to assessing the validity of a claim and how much the policyholder should be paid.
- Selling expenses which include the commissions paid to brokers and other expenses related to acquisition of business.

The *combined ratio* is the sum of the loss ratio and the expense ratio. For example, for a particular category of policies in a particular year, if the loss ratio is 75% and the expense ratio is 30%, then the combined ratio is 105%.

To the combined ratio if the dividend paid to policyholders is added, we obtain what is known as the *combined ratio after dividends*. In our example, suppose a small dividend to the tune of 1% of premiums is paid to the policyholders, we get a combined ratio after dividends of 106%.

Premiums to insurance policies are usually paid by policyholders at the beginning of a year and payouts on claims are made during the year, or after the end of the year. Therefore, an insurance company earns an investment income from the interest on the premiums during the time that elapses between the receipt of premiums and payouts.

Operating ratio **is the ratio obtained when the investment income earned from premiums is reduced from the losses as represented by the combined ratio.**

Continuing with our example, our combined ratio after dividends was 106%, which means the insurance company makes a loss of 6% before tax on the policies being considered. Suppose if the investment income is 9% of premiums received. Then, the operating ratio would be 106 − 9 = 97%.

Example: Calculation of Operating Ratio for a Property-Casualty Insurance Company

Loss ratio	75%
Expense ratio	30%
Combined ratio	105%
Dividends	1%
Combined ratio after dividends	106%
Investment income	-9%
Operating ratio	97%

Describe moral hazard and adverse selection risks facing insurance companies, provide examples of each, and describe how to overcome the problems.

The two important risks facing insurance companies are moral hazard and adverse selection.

Moral hazard **is the risk that availability of insurance would cause the policyholders to behave differently than they would without the insurance. This difference in behavior increases the risks and the expected payouts of the insurance company.**

Examples moral hazard are:

- A car owner buys insurance to protect against the car being stolen. As a result of the insurance, he or she becomes less likely to lock the car.

- An individual purchases health insurance. As a result of the existence of the policy, more health care is demanded than previously.

- As a result of a government-sponsored deposit insurance plan, a bank takes more risks because it knows that it is less likely to lose depositors because of this strategy.

By aligning the interest of the policyholders more closely with those of the insurance company, moral hazard can be handled better, as explained by using the following methods:

- *Deductibles*: The policyholder is responsible for bearing the first part of any loss.

- *Co-insurance provision***:** The insurance company pays a predetermined percentage (less than 100%) of losses in excess of the deductible.

- *Policy limit:* An upper limit to the payout is set by the insurance company.

Adverse selection **occurs when an insurance company cannot distinguish between good and bad risks and as a result it offers the same price to everyone, thereby attracting more of the bad risks.**

Examples for adverse selection are:

- If an insurance company is not able to distinguish good drivers from bad drivers and offers the same auto insurance premium to both, it is likely to attract more bad drivers.

- If it is not able to distinguish healthy from unhealthy people and offers the same life insurance premiums to both, it is likely to attract more unhealthy people.

To reduce the impact of the problems created due to adverse selection, an insurance company tries to do more research about the policyholder before committing itself. For instance, before offering life insurance, it may require the policyholder to undergo a physical examination by an approved doctor. Before offering auto insurance to, it will collect as much information as possible about the driver's driving record. Also, in this particular case, it will continue to collect information on the driver's risk like number of accidents, number of speeding tickets, etc. so as to make year-to-year changes to the premium to reflect this.

Although insurance companies may take steps to reduce these two types of risk, these cannot be completely overcome.

Distinguish between mortality risk and longevity risk and describe how to hedge these risks.

Mortality risk

It is the risk that wars, epidemics such as AIDS, or pandemics such as Spanish flu will cause individuals to die sooner than expected.

- Increase in mortality adversely affects life insurance contracts because the insured amount may have to be paid earlier than expected. However, in case of annuity contracts, since the annuity is not paid out for as long when mortality increases, they may increase profitability of such contracts.

In calculating the impact of mortality risk, it is important to consider the age groups within the population that are likely to be most affected by a particular event.

Longevity risk

It is the risk that advances in the field of medicine and healthy lifestyle options will cause people to live longer.

- Increase in longevity causes the final payout to be either delayed or, in the case of term insurance, less likely to happen in case of life insurance contracts and so it mostly increases their profitability.

- Increases in longevity adversely affects the profitability of most types of annuity contracts as the annuity has to be paid for longer.

Life expectancy has been steadily increasing in most parts of the world although it varies from country to country.

Hedging mortality and longevity risk

Due to their offsetting nature, the longevity and mortality risks in the annuity side of an insurance company somewhat tend to neutralize those present in its regular life insurance contracts. When the net exposure of the insurance companies is large, the option of reinsurance is considered. Reinsurance is one way in which an insurance company can hedge itself against large losses by entering into contracts with another insurance company. By paying a premium, the company transfers some of its risks to the other insurer.

Insurance companies may enter in to a longevity derivative contract (called a longevity bond, or survivor bond) that provides payoffs favorable to them when they are concerned about their longevity exposure on annuity contracts. Here, a population group is defined and the coupon on the bond at any given time is defined as being proportional to the number of individuals in the population that are still alive. Speculators sell these kinds of bonds to the insurance companies. Speculators are willing to take this risk as these bond payments depend on how long people live which is largely uncorrelated with returns from the market.

Evaluate the capital requirements for life insurance and property-casualty insurance companies.

As noted earlier, the risks taken by life insurance and property-casualty insurance companies vary and is normally higher for a property-casualty insurance company due to the uncertain nature of the payouts required. As a result, reserves that must be set aside for future payouts are higher for the later and hence their balance sheets also appear different.

The table below shows the summary of the balance sheet for a life insurance company. Unlike a bank, the insurance company has exposure on the liability side of the balance sheet as well as on the asset side. The company's investments are most often in corporate bonds. The company ties to match the maturity of its assets with the maturity of liabilities. In this process, it takes on credit risk because the default rate on the bonds may be higher than expected.

Abbreviated Balance Sheet for Life Insurance Company

Assets		Liabilities and Net Worth	
Investments	90.0	Policy reserves	80.0
Other Assets	10.0	Subord Long-term Debt	10.0
		Equity Capital	10.0
Total	**$100.0**	**Total**	**$100.0**

The policy reserves (80% of assets in this case) are often conservative estimates of the present value of payouts on the policies that have been written. If the holders of life insurance policies die earlier than expected or the holders of annuity contracts live longer than expected, then actual payouts would be higher than the estimates. In such cases, the 10% equity capital which includes the original equity contributed and retained earnings provides a safety net. Suppose if payouts are greater than loss reserves by an amount equal to 5% of assets, equity will decline by the same percentage, but the life insurance company will survive.

The table below shows the summary of balance sheet for a property-casualty insurance company. The payouts required for these companies are uncertain and much less easy to predict than those for a life insurance company as they are influenced by for instance, natural disasters like hurricanes or liabilities related problems like factory injuries. Hence the risks associated with their business is higher. So, in turn, the equity required is higher here than that for life insurance companies as seen in the table.

Abbreviated Balance Sheet for Property-Casualty Insurance Company

Assets		Liabilities and Net Worth	
Investments	90.0	Policy reserves	45.0
Other Assets	10.0	Unearned premiums	15.0
		Subord Long-term Debt	10.0
		Equity Capital	30.0
Total	**$100.0**	**Total**	**$100.0**

The investments of property-casualty insurance company mostly consist of liquid bonds with shorter maturities when compared to the bonds of life insurance companies. Also, in this table, the unearned premiums item on the liability side represents premiums that have been received, but apply to future time periods.

Compare the guaranty system and the regulatory requirements for insurance companies with those for banks.

Guaranty system

In the United States, the policyholder is protected against an insurance company becoming insolvent (and therefore unable to make payouts on claims) by insurance guaranty associations. **An insurer is required to be a member of the guaranty association** in a state as a condition of being licensed to conduct business in the state. **When there is an insolvency** by another insurance company operating in the state, each insurance company operating in the state has to contribute an amount to the state guaranty fund that is dependent on the premium income it collects in the state. The fund is used to pay the small policyholders of the insolvent insurance company.

There may be a cap on the amount the insurance company has to contribute to the state guaranty fund in a year. This can lead to the policyholder having to wait several years before the guaranty fund is in a position to make a full payout on its claims. In the case of life insurance, where policies last for many years, the policyholders of insolvent companies are usually taken over by other insurance companies. However, there may be some change to the terms of the policy so that the policyholder is somewhat worse off than before.

The guaranty system for insurance companies in the United States is therefore different from that for banks. **In the case of banks, there is a permanent fund created from premiums paid by banks to the FDIC to protect depositors. In the case of insurance companies, there is no permanent fund. Insurance companies have to make contributions after an insolvency has occurred.** An exception to this is property-casualty companies in New York State, where a permanent fund does exist.

Regulatory requirements

In the United States, insurance companies are regulated at the state level rather than at the federal level whereas banks are regulated at the federal level. The state level regulators are involved with issues such as the solvency of insurance companies, their ability to satisfy policyholders' claims and also their business conduct which deals with how premiums are set, advertising, contract terms, the licensing of insurance agents and brokers etc.

Insurance companies file detailed annual financial statements with state regulators, and the state regulators conduct periodic on-site reviews. Capital requirements are determined by state regulators using risk-based capital standards determined by the National Association of Insurance Commissioners (NAIC) which is an organization consisting of the chief insurance regulatory officials from all 50 states. The NAIC acts as national forum for insurance regulators to discuss common issues and interests.

Regulation of insurance companies at the state level faces some shortcomings as mentioned below.

- Regulations tend to vary across different states. For instance, a large insurance company that operates throughout the country has to deal with a large number of different regulatory authorities.

- Some insurance companies trade derivatives in the same way as banks, but are not subject to the same regulations as banks which can lead to some serious issues. For example, in 2008, the American International Group (AIG), had incurred huge losses trading credit derivatives and was eventually rescued by the federal government.

The Dodd–Frank Act of 2010 in the US resulted in the formation of Federal Insurance Office (FIO) which monitors the insurance industry and identifies gaps in regulation. According to a report submitted by the FIO to the Congress in 2013 to improve the US insurance regulation, it was suggested that the United States will either (a) move to a system where regulations are determined federally and administered at the state level or (b) move to a system where regulations are set federally and administered federally.

In the European Union, insurance companies are regulated centrally implying similar regulatory framework across all member countries. This framework known as Solvency I was based on research which showed that, with a capital equal to 4% of policy provisions, life insurance companies have a 95% chance of surviving. Solvency I does not consider investment risks, and to overcome such weaknesses the European Union is working on Solvency II. Solvency II assigns capital for a wider set of risks than Solvency I and is expected to be implemented in 2016.

Describe a defined benefit plan and a defined contribution plan for a pension fund and explain the differences between them.

Companies set up pension plans for their employees with regular contributions from both the employer and the employee while the employee is working. This serves as a source of income for the employees after they retire until the time of their death. There are two types of pension plans which are as described below.

Defined benefit plan

In a defined benefit plan, regular contributions are required up to a certain age and then lifetime pensions are provided. Here the pension to be received by the employee after retirement is defined by a plan. That is, the pension is calculated by a formula which is based on the number of years of employment and the employee's salary. For example, the pension per year might equal to 2% of the employee's average earnings per year during the last three years of employment times the number of years of employment.

The employee's spouse may continue to receive a reduced pension if the employee dies earlier than the spouse. When an employee dies while still in employment, a lump sum is payable to dependents and a monthly income may be payable to a spouse or dependent children. Sometimes by what is known as indexation, the defined benefit plans are adjusted for inflation. For instance, the indexation in a defined benefit plan might lead to pensions being increased each year by 75% of the increase in the consumer price index. A typical defined benefit plan provides the employee with about 70% of final salary as a pension and includes some indexation for inflation.

Defined contribution plan

In a defined contribution plan, the contributions to the plan are defined, and the employer and employee contributions are invested on behalf of the employee. When employees retire, the final value of the contributions invested so far can be converted to a lifetime annuity or received as a lump sum.

In case of both defined benefit and defined contribution plans no taxes are payable on money contributed to the plan by the employee and also contributions by a company are deductible. This means that taxes can be deferred to the time when pension income is received. Probably by the time the employee retires, the marginal tax rate may become relatively low. Thus, pension plans are designed to have tax advantages.

Differences between a defined benefit and a defined contribution plan

- In a defined benefit plan, the final benefits to be received by the employee are defined whereas, in a defined contribution plan, the monthly contributions to be made by the employees and employers to the pension plan are defined.

- In a defined benefit plan, the contributions to the pension fund are all pooled and payments to retirees are made out of the pool. For instance, pension plans that are sponsored by governments like Social Security in the US are similar to defined benefit plans. Instead, in a defined contribution plan, the funds are identified with individual employees which means that for each employee a separate account is set up and the pension is calculated only from the funds contributed to that account. For example, in the US, a 401(k) plan is a form of defined contribution plan.

- **The most important difference between the two plans is that while the responsibility of the defined benefit plans lies with the employer, the responsibility of the performance of a defined contribution plan is left in the hands of the employee.**

  To explain further, employers are seen to face the most risk and are responsible for paying the promised benefits in case of a defined benefit plan. For example, if the assets of a defined benefit plan total $100 million and the present value of the obligations are calculated to be $120 million, then the shortfall of $20 million falls as a burden on the employers. This means that eventually the company's shareholders bear the cost. If the company declares bankruptcy, government may fund as a means of insurance. In either case, there is a transfer of wealth to retirees from the next generation.

  This problem does not occur in the case of defined contribution plans. Here the employee is responsible for and bears the cost of the performance of the plans. This is because both the employers and employees have to only make the contributions as defined and the final benefits to be received by the plan is not a problem of the employer but is the onus of the employee.

Hull, Chapter 3 End of Chapter Questions & Answers

Question 3.1

What is the difference between term life insurance and whole life insurance?

Answer:

Term life insurance lasts a fixed period (e.g., five years or ten years). The policyholder pays premiums. If the policyholder dies during the life of the policy, the policyholder's beneficiaries receive a payout equal to the principal amount of the policy. Whole life insurance lasts for the whole life of the policyholder. The policyholder pays premiums (usually the same each year), and the policyholder's beneficiaries receive a payout equal to the principal amount of the policy when the policyholder dies. There is an investment element to whole life insurance because the premiums in early years are high relative to the expected payout in those years. (The reverse is true in later years.)

Question 3.2

Explain the meaning of variable life insurance and universal life insurance.

Answer:

Variable life insurance is whole life insurance where the policyholder can specify how the funds generated in early years (the excess of the premiums over the actuarial cost of the insurance) are invested. There is a minimum payout on death, but the payout can be more than the minimum if the investments do well. Universal life insurance is whole life insurance where the premium can be reduced to a specified minimum level without the policy lapsing. The insurance company chooses the investments (generally fixed income) and guarantees a minimum return. If the investments do well, the return provided on the policyholder's death may be greater than the guaranteed minimum.

Question 3.3

A life insurance company offers whole life and annuity contracts. In which contracts does it have exposure to (a) longevity risk, (b) mortality risk?

Answer:

Annuity contracts have exposure to longevity risk. Life insurance contracts have exposure to mortality risk.

Question 3.4

"Equitable Life gave its policyholders a free option." Explain the nature of the option.

Answer:

The lifetime annuity created from an accumulated value was calculated using an interest rate that was the greater of (a) the market interest rate and (b) a pre-specified minimum interest rate.

Question 3.5

Use Table 3.1 to calculate the minimum premium an insurance company should charge for a $1 million two-year term life insurance policy issued to a woman aged 50. Assume that the premium is paid at the beginning of each year and that the interest rate is zero.

TABLE 3.1 Mortality Table

Age (Years)	Male			Female		
	Probability of Death within 1 Year	Survival Probability	Life Expectancy	Probability of Death within 1 Year	Survival Probability	Life Expectancy
0	0.006990	1.00000	75.90	0.005728	1.00000	80.81
1	0.000447	0.99301	75.43	0.000373	0.99427	80.28
2	0.000301	0.99257	74.46	0.000241	0.99390	79.31
3	0.000233	0.99227	73.48	0.000186	0.99366	78.32
...	...	...	...	...	...	...
30	0.001419	0.97372	47.52	0.000662	0.98551	51.82
31	0.001445	0.97234	46.59	0.000699	0.98486	50.86
32	0.001478	0.97093	45.65	0.000739	0.98417	49.89
33	0.001519	0.96950	44.72	0.000780	0.98344	48.93
...	...	...	...	...	...	...
40	0.002234	0.95770	38.23	0.001345	0.97679	42.24
41	0.002420	0.95556	37.31	0.001477	0.97547	41.29
42	0.002628	0.95325	36.40	0.001624	0.97403	40.35
43	0.002860	0.95074	35.50	0.001789	0.97245	39.42
...	...	...	...	...	...	...
50	0.005347	0.92588	29.35	0.003289	0.95633	33.02
51	0.005838	0.92093	28.50	0.003559	0.95319	32.13
52	0.006337	0.91555	27.66	0.003819	0.94980	31.24
53	0.006837	0.90975	26.84	0.004059	0.94617	30.36
...	...	...	...	...	...	...
60	0.011046	0.85673	21.27	0.006696	0.91375	24.30
61	0.011835	0.84726	20.50	0.007315	0.90763	23.46
62	0.012728	0.83724	19.74	0.007976	0.90099	22.63
63	0.013743	0.82658	18.99	0.008676	0.89380	21.81
...	...	...	...	...	...	...
70	0.024488	0.72875	14.03	0.016440	0.82424	16.33
71	0.026747	0.71090	13.37	0.018162	0.81069	15.59
72	0.029212	0.69189	12.72	0.020019	0.79597	14.87
73	0.031885	0.67168	12.09	0.022003	0.78003	14.16
...	...	...	...	...	...	...
80	0.061620	0.49421	8.10	0.043899	0.62957	9.65
81	0.068153	0.46376	7.60	0.048807	0.60194	9.07
82	0.075349	0.43215	7.12	0.054374	0.57256	8.51
83	0.083230	0.39959	6.66	0.060661	0.54142	7.97
...	...	...	...	...	...	...
90	0.168352	0.16969	4.02	0.131146	0.28649	4.85
91	0.185486	0.14112	3.73	0.145585	0.24892	4.50
92	0.203817	0.11495	3.46	0.161175	0.21268	4.19
93	0.223298	0.09152	3.22	0.177910	0.17840	3.89

Answer:

The probability that the woman will die during the first year is 0.003289. The probability that the woman will die during the second year is 0.003559×(1− 0.003289)=0.003547. Suppose that the break-even premium is X. We must have

$$1{,}000{,}000 \times (0.003289 + 0.003547) = X + (1 - 0.003289)X$$

so that X = 3,424. The break-even premium is therefore $3,424.

BIONIC TURTLE

Question 3.6

From Table 3.1 above, what is the probability that a man aged 30 will live to 90? What is the same probability for a woman aged 30?

Answer:

The probability of a male surviving to 30 is 0.97372. The probability of a male surviving to 90 is 0.16969. The probability of a male surviving to 90 conditional that 30 is reached is therefore $0.16969 / 0.97372 = 0.17427$. The probability of a female surviving to 90 conditional that 30 is reached is $0.28649 / 0.98551 = 0.29070$.

Question 3.7

What features of the policies written by a property-casualty insurance company give rise to the most risk?

Answer:

The biggest risks are those arising from catastrophes such as earthquakes and hurricanes and those arising from liability insurance (e.g., claims related to asbestos in the United States). This is because there is no "law of large numbers" working in the insurance company's favor. Either the event happens and there are big payouts or the event does not happen and there are no payouts.

Question 3.8

Explain how CAT bonds work.

Answer:

CAT bonds (catastrophe bonds) are an alternative to reinsurance for an insurance company that has taken on a certain catastrophic risk (e.g., the risk of a hurricane or an earthquake) and wants to get rid of it. CAT bonds are issued by the insurance company. They provide a higher rate of interest than risk-free bonds. However, the bondholders agree to forgo interest, and possibly principal, to meet any claims against the insurance company that are within a pre-specified range.

Question 3.9

Consider two bonds that have the same coupon, time to maturity, and price. One is a B-rated corporate bond. The other is a CAT bond. An analysis based on historical data shows that the expected losses on the two bonds in each year of their life is the same. Which bond would you advise a portfolio manager to buy and why?

Answer:

The CAT bond has very little systematic risk. Whether a particular type of catastrophe occurs is independent of the return on the market. The risks in the CAT bond are to some extent diversified away by the other investments in the portfolio. A B-rated bond does have systematic risk so that less of its risks are diversified away. It is likely therefore that the CAT bond is a better addition to the portfolio.

Question 3.10

How does health insurance in the United States differ from that in Canada and the United Kingdom?

Answer:

In Canada and the United Kingdom, health care is provided by the government. In the United States, publicly funded health care is limited and most individuals buy private health care insurance of one sort or another. In the United Kingdom, a private health care system operates alongside the public system.

Question 3.11

An insurance company decides to offer individuals insurance against losing their jobs. What problems is it likely to encounter?

Answer:

Both moral hazard and adverse selection are potential problems. The insurance might lead to an individual not trying to keep a job as much as he or she otherwise would. Indeed, an individual might purposely lose his or her job to collect the insurance payout! Also, individuals who are most at risk for losing their jobs would be the ones who would choose to buy the insurance.

Question 3.12

Why do property-casualty insurance companies hold more capital than life insurance companies?

Answer:

The payouts of property–casualty insurers show more variability than the payouts of life insurers. This is because of the possibility of catastrophes such as earthquakes and hurricanes and liability insurance claims such as those related to asbestos in the United States.

Question 3.13

Explain what is meant by "loss ratio" and "expense ratio" for a property casualty insurance company. "If an insurance company is profitable, it must be the case that the loss ratio plus the expense ratio is less than 100%." Discuss this statement.

Answer:

The loss ratio is the ratio of payouts to premiums in a year. The expense ratio is the ratio of expenses (e.g., sales commissions and expenses incurred in validating losses) to premiums in a year. The statement is not true because investment income can be significant. Premiums are received at the beginning of a year, and payouts are made during the year or after the end of the year.

Question 3.14

What is the difference between a defined benefit and a defined contribution pension plan?

Answer:

A defined contribution plan is a plan where the contributions of each employee (together with contributions made by the employer for that employee) are kept in a separate account and invested for the employee. When retirement age is reached, the accumulated amount is usually converted into an annuity. In a defined benefit plan, all contributions for all employees are pooled and invested. Employees receive a pre-defined pension that is based on their years of employment and final salary. At any given time, a defined benefit plan may be in surplus or in deficit.

Question 3.15

Suppose that in a certain defined benefit pension plan

   a) Employees work for 40 years earning wages that increase with inflation.
   b) They retire with a pension equal to 75% of their final salary. This pension also increases with inflation.
   c) The pension is received for 20 years.
   d) The pension fund's income is invested in bonds that earn the inflation rate.

Estimate the percentage of an employee's salary that must be contributed to the pension plan if it is to remain solvent. (Hint: Do all calculations in real rather than nominal dollars.)

Answer:

The employee's wages are constant in real terms. Suppose that they are X per year. (The units for X do not matter for the purposes of our calculation.) The pension is 0.75X. The real return earned is zero. Because employees work for 40 years, the present value of the contributions made by one employee is 40XR where R is the contribution rate as a percentage of the employee's wages. The present value of the benefits is $20 \times 0.75X = 15X$. The value of R that is necessary to adequately fund the plan must therefore satisfy

$$40XR = 15X$$

The solution to this equation is $R = 0.375$. The total of the employee contributions (and employer contributions, if any) should therefore be 37.5% of salary.

Question 3.16

Use Table 3.1 to calculate the minimum premium an insurance company should charge for a $5 million three-year term life insurance contract issued to a man aged 60. Assume that the premium is paid at the beginning of each year and death always takes place halfway through a year. The risk-free interest rate is 6% per annum (with semiannual compounding).

Answer:

The unconditional probability of the man dying in years one, two, and three can be calculated from Table 3.1 as follows:

Year 1: 0.011046

Year 2: $(1 - 0.011046) \times 0.011835 = 0.011704$

Year 3: $(1 - 0.011046) \times (1 - 0.011835) \times 0.012728 = 0.012438$

The expected payouts at times 0.5, 1.5, 2.5 are therefore $55,230.00, $58,521.35, and $62,192.17. These have a present value of $160,824.20. The survival probability of the man is

Year 0: 1

Year 1: $1 - 0.011046 = 0.988594$

Year 2: $1 - 0.011046 - 0.011704 = 0.97725$

The present value of the premiums received per dollar of premium paid per year is therefore 2.800458. The minimum premium is

$$\frac{160,824.20}{2.800458} = 57,427.83$$

or $57,427.83.

Question 3.17

An insurance company's losses of a particular type per year are to a reasonable approximation normally distributed with a mean of $150 million and a standard deviation of $50 million. (Assume that the risks taken on by the insurance company are entirely non-systematic.) The one-year risk-free rate is 5% per annum with annual compounding. Estimate the cost of the following:

a) A contract that will pay in one-years' time 60% of the insurance company's costs on a pro rata basis
b) A contract that pays $100 million in one-years' time if losses exceed $200 million.

Answer:

a) The losses in millions of dollars are normally distributed with mean 150 and standard deviation 50. The payout from the reinsurance contract is therefore normally distributed with mean 90 and standard deviation 30. Assuming that the reinsurance company feels it can diversify away the risk, the minimum cost of reinsurance is

$$\frac{90}{1.05} = 85.71$$

or $85.71 million

b) The probability that losses will be greater than $200 million is the probability that a normally distributed variable is greater than one standard deviation above the mean. This is 0.1587. The expected payoff in millions of dollars is therefore 0.1587 × 100=15.87 and the value of the contract is

$$\frac{15.87}{1.05} = 15.11$$

or $15.11 million

Question 3.18

During a certain year, interest rates fall by 200 basis points (2%) and equity prices are flat. Discuss the effect of this on a defined benefit pension plan that is 60% invested in equities and 40% invested in bonds.

Answer:

The value of a bond increases when interest rates fall. The value of the bond portfolio should therefore increase. However, a lower discount rate will be used in determining the value of the pension fund liabilities. This will increase the value of the liabilities. The net effect on the pension plan is likely to be negative. This is because the interest rate decrease affects 100% of the liabilities and only 40% of the assets.

Question 3.19

Suppose that in a certain defined benefit pension plan

a) Employees work for 45 years earning wages that increase at a real rate of 2%
b) They retire with a pension equal to 70% of their final salary. This pension increases at the rate of inflation minus 1%.
c) The pension is received for 18 years.
d) The pension fund's income is invested in bonds which earn the inflation rate plus 1.5%.

Estimate the percentage of an employee's salary that must be contributed to the pension plan if it is to remain solvent. (Hint: Do all calculations in real rather than nominal dollars.)

Answer:

The salary of the employee makes no difference to the answer. (This is because it has the effect of scaling all numbers up or down.) If we assume the initial salary is $100,000 and that the real growth rate of 2% is annually compounded, the final salary at the end of 45 years is $239,005.31. The spreadsheet is used in conjunction with Solver to show that the required contribution rate is 25.02% (employee plus employer). The value of the contribution grows to $2,420,354.51 by the end of the 45 year working life. (This assumes that the real return of 1.5% is annually compounded.) This value reduces to zero over the following 18 years under the assumptions made.

Hull, Chapter 4: Mutual Funds and Hedge Funds

Differentiate among open-end mutual funds, closed-end mutual funds, and exchange-traded funds (ETFs).

Calculate the net asset value (NAV) of an open-end mutual fund.

Distinguish between active and passive management and define alpha.

Explain the key differences between hedge funds and mutual funds.

Calculate the return on a hedge fund investment and explain the incentive fee structure of a hedge fund including the terms hurdle rate, high-water mark, and clawback.

Describe various hedge fund strategies, including long/short equity, dedicated short, distressed securities, merger arbitrage, convertible arbitrage, fixed income arbitrage, emerging markets, global macro, and managed futures, and identify the risks faced by hedge funds.

Describe hedge fund performance and explain the effect of measurement biases on performance measurement.

Differentiate among open-end mutual funds, closed-end mutual funds, and exchange-traded funds (ETFs).

Open-End Mutual Funds

The number of shares outstanding varies from day to day as individuals choose to invest in the fund or redeem their shares. This means that the total number of shares outstanding goes up as investors buy more shares and goes down as shares are redeemed.

- Shares in the fund can be bought from the fund or sold back to the fund at any time.

- They are valued once a day, at 4 p.m. When an investor issues instructions to buy or sell shares, the value calculated at the end of the day is applied for the transaction made before that time during that day.

- The value of each share is calculated in terms of *net asset value*(NAV) of the fund which is equal to total value of the portfolio divided by the number of shares outstanding. The total value of the portfolio in turn is calculated as the sum of market values of each asset in the portfolio.

Closed-End Mutual Funds

- They have a fixed number of shares outstanding.

- Closed-end funds are like regular corporations and the shares of the fund are traded on a stock exchange which means they can be bought and sold during any time of the day.

- For closed-end funds, two NAVs can be calculated.
    - One is the price at which the shares of the fund are trading.
    - The other referred to as the fair market value is the market value of the fund's portfolio divided by the number of shares outstanding. Usually a closed-end fund's share price is less than its fair market value. Fees paid to fund managers are considered to be a reason for this.

ETFs

They are created to serve large institutional investors while mutual funds are created for small retail investors. They mostly track an index and are comparable to that of an index mutual fund.

Some or all of the shares in the ETF are traded on a stock exchange which makes it more like that of a closed end mutual fund. However, a major difference between ETFs and closed-end funds is that there is not much difference between the price at which shares in the ETF are trading on the stock exchange and their fair market value. This is because, in case of ETFs, institutional investors can easily exchange shares to receive assets or can deposit new assets to receive new shares so that the price of shares and their fair market value remain more or less same. In this aspect, ETFs more considered to be more attractive to investors than closed-end funds.

ETFs can be bought or sold at any time of the day unlike the open-ended mutual funds. They can be shorted just like a stock. ETF holdings are disclosed twice a day thereby providing investors with more information about assets underlying the fund unlike mutual funds which disclose their holdings relatively infrequently.

When shares in a mutual fund are sold, managers sell the stocks in which the fund has invested to raise the cash that is paid to the investor. In case of ETFs, since another investor is providing the cash, selling of stocks in order to raise cash is not necessary. This results in lower transactions costs for an ETF and ensures that only less amount of any unplanned capital gains and losses are passed on to shareholders. The expense ratios (fee charged per year, as a % of assets) of ETFs is usually lesser than those of mutual funds.

Calculate the net asset value (NAV) of an open-end mutual fund.

To obtain the value of each share for an open-end mutual fund, the mutual fund manager first calculates the market value of each asset in the portfolio so that the total value of the fund is determined. **This total value is then divided by the number of shares outstanding to find out the value per share called the *net asset value* (NAV) of the fund**. For example, if the total value of the all the assets in the fund is calculated to be $100 million and if the number of outstanding shares is 2 million, then the NAV is $50 per share (=100/2).

In an open-end mutual fund, the investor pays tax as though he owned the securities in which the fund has invested. When the fund receives a dividend, an investor has to pay tax on his share of the dividend, even if the dividend is reinvested in the fund for the investor. When the fund sells securities, the investor is made to realize an immediate capital gain or loss, even if the he has not sold any of his shares in the fund.

For example, an investor buys shares at $100 and the trading by the fund leads to a capital gain of $20 per share in the first tax year and a capital loss of $25 per share in the second tax year. The investor has to declare this capital gain of $20 in the first year and a loss of $25 in the second year. When the investor sells the shares, there is a capital gain or loss.

In order to avoid double counting, the purchase price of the shares is adjusted to reflect the capital gains and losses that have already accrued to the investor. Applying this in our example, if the investor sold shares in the fund during the second year, the purchase price is assumed to be $120 for the purpose of calculating capital gains or losses on the transaction during the second year. Similarly, if the investor sold the shares in the fund during the third year, the purchase price is assumed to be $95 for the purpose of calculating capital gains or losses on the transaction during the third year.

Distinguish between active and passive management and define alpha.

Investors have a choice to either invest in an actively managed fund or a passively managed fund.

- An **actively managed fund** relies on stock selection and timing skills of the fund manager. Actively managed funds usually have a higher expense ratio than a passively managed fund.

- A **passively managed fund** is designed such that it tracks the performance of an index such as S&P 500.

A study by Jensen (1969) shows that actively managed funds do not outperform the stock indices on average. Also, the study showed that the funds that outperformed the market in one year do not continue to do so. He performed tests on mutual fund performance using 10-year data and 115 funds. He calculated alpha of each fund.

Alpha is the excess return made on the investment portfolio than the return predicted by the Capital Asset pricing model. Alpha can be generated by superior portfolio management or just by good luck. An investor makes positive alpha on the expense of other investors who make a negative alpha. The weighted average alpha of all the investors is zero.

$$\alpha = R_P - R_F - \beta(R_M - R_F)$$

where,
R_P is the return on the investment portfolio
R_F is the risk free rate
R_M is the return on market portfolio
β is the sensitivity of the return on portfolio to the return on market portfolio

Jensen's study showed that the average alpha was close to zero before expenses were considered and it was negative after expenses are considered.

His results (in the table below) showed that close to 50% observations had a positive alpha and out of these observations, 50.4% were followed by a year of another positive alpha.

Consistency of good performance by Mutual Funds		
Number of consecutive Years of Positive alpha	Number of observations	Percentage of Observations when next alpha is positive
1	574	50.4
2	312	52
3	161	53.4
4	79	55.8
5	41	46.4
6	17	35.3

The results show that a manager who has earned above average return in one year had 50% probability of achieving above average return in the next year as well. It suggests that the manager obtained positive alpha more due to luck than due to his skill. Some fund managers are consistent performers, but they are a very small percentage of the total. Recent studies have confirmed Jensen's conclusions that the fund managers do on beat the stock indices and the past performance is not a good guide to future performance on average.

Explain the key differences between hedge funds and mutual funds.

The key differences between the hedge funds and mutual funds are as described below.

- Mutual funds invest money on behalf of small investors, while hedge funds seek to attract funds from wealthy individuals and large investors such as pension funds.

- As mutual funds accept investments mainly from retail investors, they are subjected to higher level of regulation than hedge funds. Comparatively, hedge funds are largely free from regulations and are given more flexibility in terms of investment strategies compared to mutual funds.

  Some of the examples of regulations that affect mutual funds pertain to shares being redeemable at any time, daily calculation of NAV, disclosure of investment policies, limited use of leverage etc. Hedge funds are not subject to such regulations and they can include advanced, and alternative investment strategies.

- Another main feature that distinguishes them both is that the fees are relatively higher and dependent on performance for a hedge fund.

  o A typical hedge fund fee might be expressed as "2 plus 20%" indicating that the fund charges 2% per year of assets under management and 20% of net profit. On top of high fees there is usually a lock up period of at least one year during which invested funds cannot be withdrawn.

  o In case of a mutual fund, a front-end load is a fee charged by some funds when an investor first buys shares. In the United States, front-end loads are usually less than 8.5% of the investment. Back-end load is the fee charged by some funds when an investor sells shares. Normally, the back-end load declines with the length of time the shares in the fund have been held. Apart from these, all funds charge an annual fee which is expressed in terms of the total expense ratio (total of the annual fees charged per share divided by the value of the share).

Calculate the return on a hedge fund investment and explain the incentive fee structure of a hedge fund including the terms hurdle rate, high-water mark, and clawback.

Return on a hedge fund investment

For an investor of hedge funds, the fees paid can be high. For example, consider an investment that is divided equally between two funds, A and B and both funds charge "2 plus 20;" i.e., the traditional arrangement of 2.0% of assets under management (AUM) plus 20.0% of realized profits. Recently, fee pressure has forced many firms to offer 1.5% and 15.0%; startup funds may offer even better terms.

Assume in the first year, Fund A earns 20% and Fund B earns –10% such that the investor's average return on investment before fees is calculated as follows

- **Investor return before fees**: 0.5 × 20% + 0.5 × (−10%) = 5%.

Fees paid to the funds are:

- **Fund A fees**: 2% + 0.2 × (20 - 2)% = 5.6%.
- **Fund B fees**: only 2% since no profit is made.

The average fee paid on the investment in the hedge funds is: (5.6 + 2)/2 =3.8%. The investor is left with a return of: 5 - 3.8 = 1.2%

If the 2 plus 20% were applied to the overall return of 5%, then the fee paid would be: 2% + 0.2 (5 -2) % = 2.6%. In such a case the investor gets a return of: 5 - 2.6 = 2.4% which is double that of the return of 1.2% obtained when the fees are applied for each fund separately. This is shown in the table below.

Example: Calculation of Hedge fund return

	Fund A	Fund B	Average	Both funds
Returns before fees	20.0%	-10.0%	5.0%	5.0%
Fees paid	5.6%	2.0%	3.8%	2.6%
Return to investors after fees			1.2%	2.4%

In case of a fund of funds, the additional layer of fees reduces the investor's return further. A fund of hedge funds normally charges a fee 1% of assets under management plus 10% of the net profits (after management and incentive fees) of the hedge funds they invest in.

Consider an example where a fund of hedge funds divides its money equally between 10 hedge funds. All hedge funds charge 2 plus 20% and the fund of hedge funds charges 1 plus 10%. While it may seem that the investor pays 3 plus 30%, the actual fee can be even higher. Consider a scenario where five of the hedge funds lose 40% before fees and the other five make 40% before fees.

Each of the profitable hedge funds would collect an incentive fee of 20% of the profit of 38%: 0.2 × (40 − 2) = 7.6 %

The total incentive fee is (7.6% × 5)/10 = 3.8% of the funds invested.

Considering the 2% annual fee paid to the hedge funds and 1% annual fee paid to the fund of funds, the net return of the investor is −(3+ 3.8) = −6.8% of the amount invested. This means the return after fee is 6.8% less than the return on the underlying assets before fees.

Tot	$1,000,000		Hedge Funds				
			Mgmt	Return	Perform	Total	Net
		Returns	Fee	after Fee	Fee	Fee	Return
Fund #		(A)			20%	(B)	(A-B)
1	$100,000	-40.0%	2.0%	-42.0%	0.0000%	2.00%	-42.00%
2	$100,000	-40.0%	2.0%	-42.0%	0.0000%	2.00%	-42.00%
3	$100,000	-40.0%	2.0%	-42.0%	0.0000%	2.00%	-42.00%
4	$100,000	-40.0%	2.0%	-42.0%	0.0000%	2.00%	-42.00%
5	$100,000	-40.0%	2.0%	-42.0%	0.0000%	2.00%	-42.00%
6	$100,000	40.0%	2.0%	38.0%	7.6000%	9.60%	30.40%
7	$100,000	40.0%	2.0%	38.0%	7.6000%	9.60%	30.40%
8	$100,000	40.0%	2.0%	38.0%	7.6000%	9.60%	30.40%
9	$100,000	40.0%	2.0%	38.0%	7.6000%	9.60%	30.40%
10	$100,000	40.0%	2.0%	38.0%	7.6000%	9.60%	30.40%
Avg		0.00%	2.000%		3.800%	5.800%	-5.800%
Total			$20,000		$38,000	$58,000	

Fund of Funds	
Management fee	1.000%
+10% Peformance fee	0.000% = max[0, 10% * (-5.80% - 1.00%)]
Total FOF fees	1.000%
Return earned by hedge funds	0.000%
Fees to hedge funds	5.800%
Fees to fund of funds	1.000%
Return to investor	-6.800%

Incentives of Hedge Fund Managers

The fee structure of a hedge fund gives an incentive to the managers to make a profit as well as to take risks. The hedge fund manager has a call option on the assets of the fund. This means that the hedge fund manager can increase the value of the option by taking risks that increase the volatility of the fund's assets. This is an attractive strategy for the managers towards the end of the period over which the incentive fee is calculated and when the return to date is low or negative.

For example, consider there is a 0.40 probability of a 60% profit and a 0.60 probability of a 60% loss for a hedge fund that charges the industry standard fee of "2 plus 20%."

The expected return of the investment is calculated as:

0.4 × 60% + 0.6 × (−60%) = −12%.

Although the return is negative, the manager still earns a fee on it as calculated below.

- For a 60% profit the hedge fund's fee is 2 + 0.2 × 58 = 13.6%.
- For the 60% loss, the hedge fund's fee is 2%.
- The expected fee to the hedge fund is 0.4 × 13.6 + 0.6 × 2 = 6.64%

The fee is therefore, 6.64% of the funds under administration. The expected management fee is 2% and the expected incentive fee is 4.64%.

To the investors in the hedge fund, the expected return is negative as shown.

0.4 × (60 - 0.2 × 58 - 2) + 0.6 × (−60 − 2) = −18.64 %

The calculations are summarized in the table below.

Example: Returns of a high-risk investment where hedge fund fee is "2 plus 20"		
Returns	+60%	-60%
Probabilities	0.40	0.60
Expected return to hedge fund	**+6.64%**	
Expected return to investors	**-18.64%**	
Overall expected return	-12.00%	

This shows that the fee structure of a hedge fund gives its managers an incentive to take high risks even when expected returns are negative.

Arrangements (clauses) offered by hedge funds to make high fees more palatable

Since the incentive fee structure and the associated risk of the hedge fund is high, some agreements that include clauses are offered to make the incentive fees more acceptable. These clauses include the following.

- **Hurdle rate**: This is the minimum return that a hedge fund should produce in order for the incentive fee to be applicable.

- **High-water mark clause:** This clause indicates that any previous losses must be recouped by new profits before an incentive fee applies.

  As various investors place money with a hedge fund at different times, the high-water mark will vary among investors. A **proportional adjustment clause** states that if funds are withdrawn by investors, the amount of previous losses that has to be recouped is adjusted proportionally.

  For example, suppose a fund worth $200 million loses $40 million and $80 million of funds are withdrawn. The high-water mark clause by itself would require $40 million of profits on the remaining $80 million to be achieved before the incentive fee applied. Since the fund is now only half as big as it was when the loss incurred (it has reduced to 80 million from 160 million), according to the proportional adjustment clause it would require only $20 million profits (half of $40 million loss) to be achieved before the incentive fee is applied.

- **Clawback clause:** This clause allows investors to apply part or all of previous incentive fees to current losses. A portion of the incentive fees paid by the investor each year is then retained in a *recovery account* and used to compensate investors for a percentage of any future losses.

Describe various hedge fund strategies, including long/short equity, dedicated short, distressed securities, merger arbitrage, convertible arbitrage, fixed income arbitrage, emerging markets, global macro, and managed futures, and identify the risks faced by hedge funds.

Some of the strategies used by hedge funds are as described below.

Long/Short Equity

In this strategy, the hedge fund manager takes a long position in a group of stocks that are considered undervalued and short position in a group that are considered overvalued by the market. This strategy should give good returns in both bull and bear markets if the stocks are picked up after being well researched. The hedge fund manager may have a net long bias where the longs are of bigger size than the shorts or a net short bias where the short are bigger than the longs.

Some of the styles that can be created with this strategy include:

- An *equity-market-neutral* fund where longs and shorts are matched in some way.

- A *dollar-neutral* fund which is an equity-market-neutral fund where the dollar amount of the long position equals the dollar amount of the short position.

- A *beta-neutral* fund which is an equity-market-neutral fund where the weighted average beta of the shares in the long portfolio equals the weighted average beta of the shares in the short portfolio so that the overall beta of the portfolio is zero or totally insensitive to market movements.

- Funds with *sector neutrality* where long and short positions are balanced by industry sectors.

- Funds with *factor neutrality* where the exposure to factors like the price of oil, the level of interest rates, or the rate of inflation is neutralized.

Dedicated Short

Managers select extremely overvalued companies and sell them short. This strategy exploits the fact that brokers and analysts are hesitant to issue sell recommendations. Mostly, companies with weak financials, those that change their auditors regularly, those that delay filing reports with the SEC, companies in industries with overcapacity, companies attempting to silence their short sellers, etc. are chosen under this strategy.

Distressed Securities

This strategy deals with trades related to distressed securities by calculating a fair value for these securities considering possible future scenarios and their probabilities. For example, bonds with credit ratings of CCC are called as "distressed" and they sell at than the yield on Treasury bonds. Some of the points that can be made about distressed securities are:

- Distressed debt cannot be shorted and so managers usually look for a debt that is undervalued by the market.

- Managers must be well versed with bankruptcy proceedings (reorganization or liquidation), since distressed securities are highly susceptible to this condition

- Passive managers buy distressed debt when the price is below its fair value and wait while active managers might purchase a sufficiently large position in outstanding debt claims so that they have the right to influence a reorganization proposal.

Merger Arbitrage

Merger arbitrage is a bet that a merger or acquisition deal will take place after it has been announced. Merger-arbitrage hedge funds are generally observed to generate steady but not huge returns. There are two main types of deals, namely *cash deals* and *share-for-share exchanges* and are explained with help of examples below.

Consider a cash deal in which Company A announces that it would acquire all the shares of Company B for $30 per share. Suppose the shares Company B were trading at $20 earlier and immediately after the deal is announced its price jumps to $28. The price may not have risen as high as $30 because there is some chance that the deal will not go through and also it may take some time to factor into market prices. Merger-arbitrage hedge funds buy the shares in company B for $28 and wait, so that if acquisition happens at $30 or higher, the fund makes a profit of minimum $2 per share or more respectively. However, if deal does not go through, the hedge fund will take a loss.

Consider a share-for-share exchange in which Company A is willing to exchange one of its shares for four of Company B's shares. Assume that Company B's shares were earlier trading at 15% of the price of Company A's. After the announcement, Company B's share price might rise to 22% of Company A's share price. A hedge fund following a merger-arbitrage strategy would buy a certain amount of Company B's stock and at the same time short a quarter as much of Company A's stock to generates profits if the deal consummates.

Convertible Arbitrage

Convertible bonds are bonds that can be converted into the equity of the bond issuer at a specified times and price in the future. The convertible bond price depends on factors such as the price of the underlying equity, its volatility, the level of interest rates, and the chance of the issuer defaulting. A hedge fund using the convertible arbitrage strategy develops a complex model for valuing these convertible bonds so as to extract higher returns from it. Many convertible bonds trade at prices below their fair value, so hedge fund managers buy the bond and then hedge their risks by shorting the stock.

Fixed Income Arbitrage

- One of the strategies followed by hedge fund managers in relation to fixed income arbitrage is a *relative value* strategy, where they buy bonds that the zero-coupon yield curve indicates are undervalued by the market and sell bonds that it indicates are overvalued.

- *Market-neutral* strategies are similar to relative value strategies with the only condition that the fund has no exposure to interest rate movements.

- Some fixed-income hedge fund managers follow *directional* strategies where they take a position based on beliefs that certain spread between interest rates, or interest rates themselves, will move in a certain direction. Usually they have a lot of leverage and have to post collateral. The risk associated with this strategy is that although the strategy may work out well in the long term, in the short term if the market goes against it, loss has to be faced.

Emerging Markets

Emerging market strategies engage in investments in developing countries. This could include either equity or debt investments of the emerging markets.

- In case of equities, managers invest in securities trading on the local exchange, or through securities like American Depository Receipts (ADRs). ADRs are certificates backed by shares of a foreign company issued in the US and which can be traded on a U.S. exchange. ADRs may have better liquidity and lower transactions costs than the underlying foreign shares. Sometimes, the price discrepancies between ADRs and the underlying shares may give rise to arbitrage opportunities.

- In case of debt, hedge funds invest in either Eurobonds or local currency bonds. Eurobonds are bonds issued by the country and denominated in a hard currency such as the U.S. dollar or the euro. Local currency bonds are bonds denominated in the local currency. These can be risky because there are several incidents of emerging markets countries like Russia, Argentina, Brazil, and Venezuela having defaulted on their debt.

Global Macro

Global macro strategies are structured to carry out trades that reflect global macroeconomic trends. Hedge fund managers try to spot situations where markets have, moved away from equilibrium for whatsoever reason and place large bets that they will move back into equilibrium. Mostly these bets are on exchange rates and interest rates. For instance, bets could be placed for U.S. dollar to decline based on the huge deficit in U.S. balance of payments.

The main risk associated with the global macro funds is that they may be unaware of when equilibrium will be restored because world markets can be in disequilibrium for long periods of time.

Managed Futures

Hedge funds that follow managed futures strategies try to predict future movements in commodity prices based on manager's judgment or trading rules generated by computer programs.

Managers may use **technical analysis** which analyzes past price patterns to predict the future; or **fundamental analysis** which involves calculating a fair value for the commodity from fundamental factors such as market, economy etc. In the case of technical analysis, first, trading rules are tested on historical data; aka, back-testing. Then they are tested out-of-sample; i.e., on data that are different from the data used to generate the rules.

The risks involved in such a strategy include the problems of data mining. Due to data mining, out of the thousands of trading rules, few of the trading rules may perform well just because of chance and so there is no guarantee that they will perform well in the future.

Describe hedge fund performance and explain the effect of measurement biases on performance measurement.

Hedge fund performance is hard to truly evaluate as there exists no dataset that of *complete* return information for all hedge funds. The Credit Suisse hedge fund index is an asset-weighted index of hedge fund returns after fees. It has some potential biases due to unavailability of complete information on all hedge fund returns. The table below compares the returns given by this index with the returns of S&P 500.

Although hedge funds performed very well before 2008, in the same year they lost money on average. But they showed better performance than the S&P 500. From 2009 to 2013, the S&P 500 showed a higher return than the average hedge fund.

Table: Performance of Hedge funds

Year	Return on Hedge Fund Index (%)	S&P 500 Return including dividends (%)
2008	−15.66	−37.00
2009	18.57	26.46
2010	10.95	15.06
2011	−2.52	2.11
2012	7.67	16.00
2013	9.73	32.39

It is very common to see some hedge funds reporting good returns for a few years and then performing poorly all of a sudden only to close their business eventually. There is a general view that hedge fund returns are like the returns from writing out-of-the-money options: the options cost nothing, but occasionally they become very expensive.

Importantly, the Tass hedge funds database includes only hedge funds that report voluntarily. Small hedge funds and those with poor track records usually do not report their returns and are therefore not included in the data set. Also, when returns are reported by a hedge fund, the database is usually backfilled with the fund's previous returns. This creates a bias in the returns that are in the data set because, only the hedge funds that do well are likely to be the ones that disclose their return data. When this bias is removed, it is observed that hedge fund returns are no different from mutual fund returns, especially when their fees are taken into account.

Hull, Chapter 4 End of Chapter Questions & Answers

Question 4.1

What is the difference between an open-end and closed-end mutual fund?

Answer:

The number of shares of an open-end mutual fund increases as investments in the fund increase and decreases as investors withdraw their funds. A closed-end fund is like any other corporation with a fixed number of shares that trade.

Question 4.2

How is the NAV of an open-end mutual fund calculated? When is it calculated?

Answer:

The net asset value (NAV) of an open-end mutual fund is calculated at 4 p.m. each day as the value of the assets held by the fund divided by the number of shares outstanding.

Question 4.3

An investor buys 100 shares in a mutual fund on January 1, 2015, for $30 each. The fund makes capital gains in 2015 and 2016 of $3 per share and $1 per share, respectively, and earns no dividends. The investor sells the shares in the fund during 2017 for $32 per share. What capital gains or losses is the investor deemed to have made in 2015, 2016, and 2017?

Answer:

The investor is deemed to have made capital gains of $300 and $100 in 2015 and 2016, respectively. In 2017, the investor is deemed to have made a capital loss of $200.

Question 4.4

What is an index fund? How is it created?

Answer:

An index fund is a fund that is designed so that its value tracks the performance of an index such as the S&P 500. It can be created by buying all the stocks (or a representative subset of the stocks) that underlie the index. Sometimes futures contracts on the index are used.

Question 4.5

What is a mutual fund's (a) front-end load and (b) back-end load?

Answer:

The front-end load is the amount an investor pays, as a percentage of his or her investment, when shares of the fund are purchased. The back-end load is the amount an investor pays, as a percentage of his or her investment, when shares of the fund are redeemed.

Question 4.6

Explain how an exchange-traded fund that tracks an index works. What are the advantages of an exchange-traded fund over (a) an open-end mutual fund and (b) a closed-end mutual fund?

Answer:

An exchange-traded fund (ETF) that tracks an index is created when an institutional investor deposits a portfolio of shares that is designed to track the index and receives shares in the ETF. Institutional investors can at any time exchange shares in the ETF for the underlying shares held by the ETF, or vice versa. The advantages over an open-end mutual fund that tracks the index are that the fund can be traded at any time, the fund can be shorted, and the fund does not have to be partially liquidated to accommodate redemptions. The advantage over a closed-end mutual fund is that there is very little difference between the ETF share price and the net asset value per share of the fund.

Question 4.7

What is the difference between the geometric mean and the arithmetic mean of a set of numbers? Why is the difference relevant to the reporting of mutual fund returns?

Answer:

The arithmetic mean of a set of *n* numbers is the sum of the numbers divided by *n*. The geometric mean is the *nth* root of the product of the numbers. The arithmetic mean is always greater than or equal to the geometric mean. The return per year realized when an investment is held for several years is calculated using a geometric mean, not an arithmetic mean. (The procedure is to calculate the geometric mean of one plus the return in each year and then subtract one.)

Question 4.8

Explain the meaning of (a) late trading, (b) market timing, (c) front running, and (d) directed brokerage.

Answer:

Late trading is the illegal practice of putting in an order to buy or sell an open end mutual fund at the 4 p.m. price after 4 p.m. Market timing is a practice where favored clients are allowed to buy and sell a mutual fund frequently to take advantage of the fact that some prices used in the calculation of the 4 p.m. net asset value are stale. Front running is the practice of trading by individuals ahead of a large institutional trade that is expected to move the market. Directed brokerage describes the situation where a mutual fund uses a brokerage house for trades when the brokerage house recommends the fund to clients.

Question 4.9

Give three examples of the rules that apply to mutual funds, but not to hedge funds.

Answer:

Mutual funds must disclose their investment policies; their use of leverage is limited; they must calculate NAV daily; their shares must be redeemable at any time.

Question 4.10

"If 70% of convertible bond trading is by hedge funds, I would expect the profitability of that strategy to decline." Discuss this viewpoint.

Answer:

If a hedge fund is making money out of trading convertible bonds, it must be doing so at the expense of its counterparties. If most of the traders are hedge funds, they cannot all be making money.

Question 4.11

Explain the meanings of the terms hurdle rate, high-water mark clause, and clawback clause when used in connection with the incentive fees of hedge funds.

Answer:

Hurdle rate is the minimum return necessary for an incentive fee to be applicable. High-water mark refers to the previous losses that must be recouped before incentive fees are applicable. Clawback refers to investors being able to use some of the past incentive fees they have paid as an offset to current losses.

Question 4.12

A hedge fund charges 2 plus 20%. Investors want a return after fees of 20%. How much does the hedge fund have to earn, before fees, to provide investors with this return? Assume that the incentive fee is paid on the net return after management fees have been subtracted.

Answer:

If the return is $X (> 2\%)$, the investors pay $0.02 + 0.2(X - 0.02)$ in fees. It must therefore be the case that

$$X - 0.02 - 0.2(X - 0.02) = 0.2$$

so that $0.8X = 0.216$ or $X = 0.27$. A return of 27% is necessary.

Question 4.13

"It is important for a hedge fund to be right in the long term. Short-term gains and losses do not matter." Discuss this statement.

Answer:

Short-term gains and losses do matter if the hedge fund is highly levered. Short term losses can lead to margin calls that destroy the hedge fund.

Question 4.14

"The risks that hedge funds take are regulated by their prime brokers." Discuss this statement.

Answer:

The leverage a hedge fund is allowed to take is limited by its prime broker. This in turn influences the risks that the hedge fund can take.

Question 4.15

An investor buys 100 shares in a mutual fund on January 1, 2015, for $50 each. The fund earns dividends of $2 and $3 per share during 2015 and 2016. These are reinvested in the fund. The fund's realized capital gains in 2015 and 2016 are $5 per share and $3 per share, respectively. The investor sells the shares in the fund during 2017 for $59 per share. Explain how the investor is taxed.

Answer:

The investor pays tax on dividends of $200 and $300 in year 2015 and 2016, respectively. The investor also has to pay tax on realized capital gains by the fund. This means tax will be paid on capital gains of $500 and $300 in year 2015 and 2016, respectively. The result of all this is that the basis for the shares increases from $50 to $63. The sale at $59 in year 2017 leads to a capital loss of $4 per share or $400 in total.

Question 4.16

Good years are followed by equally bad years for a mutual fund. It earns +8%, −8%, +12%, −12% in successive years. What is the investor's overall return for the four years?

Answer:

The investors overall return is

$$1.08 \times 0.92 \times 1.12 \times 0.88 - 1 = -0.0207$$

or − 2.07% for the four years.

Question 4.17

A fund of funds divides its money between five hedge funds that earn –5%, 1%, 10%, 15%, and 20% before fees in a particular year. The fund of funds charges 1 plus 10% and the hedge funds charge 2 plus 20%. The hedge funds' incentive fees are calculated on the return after management fees. The fund of funds incentive fee is calculated on the net (after management fees and incentive fees) average return of the hedge funds in which it invests and after its own management fee has been subtracted. What is the overall return on the investments? How is it divided between the fund of funds, the hedge funds, and investors in the fund of funds?

Answer:

The overall return on the investments is the average of −5%, 1%, 10%, 15%, and 20% or 8.2%. The hedge fund fees are 2%, 2%, 3.6%, 4.6%, and 5.6%. These average 3.56%. The returns earned by the fund of funds after hedge fund fees are therefore −7%, −1%, 6.4%, 10.4%, and 14.4%. These average 4.64%. The fund of funds fee is 1% + 0.364% or 1.364% leaving 3.276% for the investor. The return earned is therefore divided as shown in the table below.

Return earned by hedge funds	8.200%
Fees to hedge funds	3.560%
Fees to fund of funds	1.364%
Return to investor	3.276%

Question 4.18

A hedge funds charges 2 plus 20%. A pension fund invests in the hedge fund. Plot the return to the pension fund as a function of the return to the hedge fund.

Answer:

Plot shown below. If the hedge fund return is less than 2%, the pension fund return is 2% less than the hedge fund return. If it is greater than 2%, the pension fund return is less than the hedge fund return by 2% plus 20% of the excess of the return above 2%.