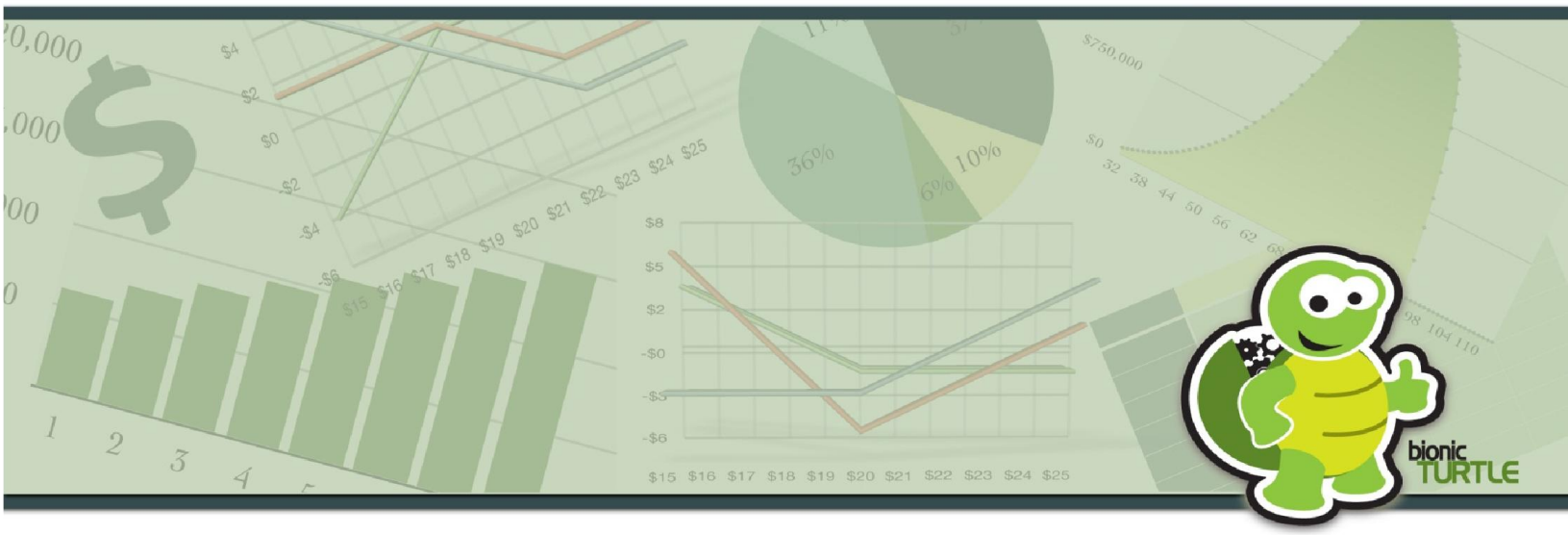

Bionic Turtle FRM Practice Questions

P1.T3. Financial Markets and Products

John Hull, Risk Management and Financial Institutions

By David Harper, CFA FRM CIPM
www.bionicturtle.com

Hull, Chapter 2: Banks

P1.T3.700. Major risks faced by banks
P1.T3.701. Basic bank functions and definitions

P1.T3.700. Major risks faced by banks

Learning Objectives: Identify the major risks faced by a bank. Distinguish between economic capital and regulatory capital.

700.1. Below is a hypothetical summary income statement for Deposits and Loans Corporation (DLC):

Summary Income Statement for Deposits and Loans Corp (DLC) in 2016	(millions)
Net interest income	$4.50
Loan losses	($1.20)
Non-interest income	$1.35
Non-interest expense	($3.75)
Pre-tax operating income	$0.90

Risks can affect any line in the income statement, but according to Hull, each major risk category tends to be primarily associated with certain activities as they manifest on the financial statements. In regard to this association between a major risk type and its primary income statement impact, each of the following statements is true **EXCEPT** which is inaccurate?

a) Credit risk primarily affects loan losses
b) Liquidity risk primary affects non-interest expense
c) Operational risk primarily affects non-interest expense
d) Market risk affects net interest income and/or non-interest income

700.2. Below are a summary balance sheet and income statement for Deposits and Loans Corporation (DLC):

Balance Sheet for DLC at End of 2016			
Assets		**Liabilities and Net Worth**	
Cash	$15.00	Deposits	$270.00
Marketable Securities	$30.00	Sub Long term debt	$15.00
Loans	$240.00	Equity Capital	$15.00
Fixed Assets	$15.00		
Total	$300.00	***Total***	$300.00

Summary Income Statement for DLC in 2016	
	(millions)
Net interest income	$9.00
Loan losses	($2.40)
Non-interest income	$2.70
Non-interest expense	($7.50)
Pre-tax Oper. income	$1.80
Tax rate	**30.0%**

Each of the following statements is true **EXCEPT** which is false?

a) Before-tax return on equity (ROE) is 12.0%
b) Leverage is 19.0 or 20.0 (depending on our definition of leverage)
c) If loan losses jump to 6.0% of assets next year, and nothing else changes, this will completely wipe out the equity shareholders
d) If DLC had borrowed $10 million (+$10.0 to Sub Long term debt) to buyback shares (-$10.0 equity) during 2016, its ROE would triple (3x)

700.3. Banks must manage both economic capital and regulatory capital. Each of the following statements is true **EXCEPT** which is false?

a) If corporations rated "AA" have a one-year default probability of 0.03%, then a reasonable economic capital confidence level is 99.97% for a financial institution with an objective of maintaining a "AA" rating
b) Economic capital is also called risk capital and can be regarded as a sort of "currency" for risk-taking within a financial institution; a business unit can take a certain risk only when it is allocated the appropriate economic capital for that risk.
c) Because sharing information about regulatory capital among divisions of the bank is a conflict of interest, banks construct a so-called Chinese Wall to keep the regulatory capital separate from the economic capital each division, and to separate economic capital among divisions within the bank
d) Economic capital is often less than regulatory capital, but it is also different than regulatory capital (which is prescribed by regulators); banks have no choice but to maintain their capital above the regulatory capital level, although in order to avoid having to raise capital at short notice, banks often maintain capital comfortably above the regulatory minimum

Answers:

700.1. B. False. Liquidity risk is generally a balance sheet phenomenon, which certainly impacts the income statement but it most likely to manifest "above" the non-interest expense line.

In regard to (A), (C) and (D), each is TRUE.

Hull: "2.8 THE RISKS FACING BANKS: A bank's operations give rise to many risks. Much of the rest of this book is devoted to considering these risks in detail. Central bank regulators require banks to hold capital for the risks they are bearing. In 1988, international standards were developed for the determination of this capital. These standards and the way they have evolved since 1988 are discussed in Chapters 15, 16, and 17. Capital is now required for three types of risk: credit risk, market risk, and operational risk.

Credit risk is the risk that counterparties in loan transactions and derivatives transactions will default. This has traditionally been the greatest risk facing a bank and is usually the one for which the most regulatory capital is required. ***Market risk*** arises primarily from the bank's trading operations. It is the risk relating to the possibility that instruments in the bank's trading book will decline in value. ***Operational risk***, which is often considered to be the biggest risk facing banks, is the risk that losses are made because internal systems fail to work as they are supposed to or because of external events. The time horizon used by regulators for considering losses from credit risks and operational risks is one year, whereas the time horizon for considering losses from market risks is usually much shorter. The objective of regulators is to keep the total capital of a bank sufficiently high that the chance of a bank failure is very low. For example, in the case of credit risk and operational risk, the capital is chosen so that the chance of unexpected losses exceeding the capital in a year is 0.1%."

Further, Hull's end-of-chapter Question #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."

700.2. C. False. 6.0% implies loan losses of $18.00 and pretax operating income of -$13.80 which is a pre-tax operating loss of -4.60%, but an after-tax loss of -3.22%; not enough to wipe out the 5.0% equity buffer.

In regard to (A), (B) and (D) each is TRUE.

- ***In regard to true (A)*****,** ROE = pretax operating income/equity = $1.80/$15.0 = 12.0%
- ***In regard to true (B)*****,** leverage can be defined as assets/equity or debt/equity; in this case, assets/equity = 300.0/15.0 = 20, and debt/equity = (270.0 deposits + 15.0 debt)/15.0 = 19.0
- ***In regard to true (D),*** the recapitalization leads to $1.80/5.0 = 36.0%

700.3. C. False. Conflicts of interest pertain to completely different issues (for example, the bank generally wants to aggregate economic capital such that privacy or conflicts simply do not pertain here).

In regard to (A), (B) and (D), each is TRUE.

Hull on the difference between economic and regulatory capital (**emphasis ours**): "In addition to calculating regulatory capital, most large banks have systems in place for calculating what is termed **economic capital (see Chapter 26). This is the capital that the bank, using its own models rather than those prescribed by regulators, thinks it needs. Economic capital is often less than regulatory capital. However, banks have no choice but to maintain their capital above the regulatory capital level.** The form the capital can take (equity, subordinated debt, etc.) is prescribed by regulators. To avoid having to raise capital at short notice, banks try to keep their capital comfortably above the regulatory minimum. When banks announced huge losses on their subprime mortgage portfolios in 2007 and 2008, many had to raise new equity capital in a hurry. Sovereign wealth funds, which are investment funds controlled by the government of a country, have provided some of this capital. For example, Citigroup, which reported losses in the region of $40 billion, raised $7.5 billion in equity from the Abu Dhabi Investment Authority in November 2007 and $14.5 billion from investors that included the governments of Singapore and Kuwait in January 2008. Later, Citigroup and many other banks required capital injections from their own governments to survive."

In regard to **conflicts of interest**, Hull gives several examples including

1. "When asked for advice by an investor, a bank might be tempted to recommend securities that the investment banking part of its organization is trying to sell. When it has a fiduciary account (i.e., a customer account where the bank can choose trades for the customer), the bank can “stuff” difficult-to-sell securities into the account.
2. A bank, when it lends money to a company, often obtains confidential information about the company. It might be tempted to pass that information to the mergers and acquisitions arm of the investment bank to help it provide advice to one of its clients on potential takeover opportunities.
3. The research end of the securities business might be tempted to recommend a company's share as a “buy” in order to please the company's management and obtain investment banking business.
4. Suppose a commercial bank no longer wants a loan it has made to a company on its books because the confidential information it has obtained from the company leads it to believe that there is an increased chance of bankruptcy. It might be tempted to ask the investment bank to arrange a bond issue for the company, with the proceeds being used to pay off the loan. This would have the effect of replacing its loan with a loan made by investors who were less well-informed.

... How are the conflicts of interest [above] handled? **There are internal barriers known as Chinese walls.** These internal barriers prohibit the transfer of information from one part of the bank to another when this is not in the best interests of one or more of the bank's customers. There have been some well-publicized violations of conflict-of-interest rules by large banks. These have led to hefty fines and lawsuits. Top management has a big incentive to enforce Chinese walls. This is not only because of the fines and lawsuits. A bank's reputation is its most valuable asset. The adverse publicity associated with conflict-of-interest violations can lead to a loss of confidence in the bank and business being lost in many different areas."

Discuss here in forum: https://www.bionicturtle.com/forum/threads/p1-t3-700-major-risks-faced-by-banks-hull.10232/

P1.T3.701. Basic bank functions and definitions

Learning objectives: 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.

701.1. Below are displayed the loans account in the Balance Sheet of Deposits and Loans Corporation (DLC) for the year ending December 31st, 2016. Also shown is the breakdown of the *Allowance for loan losses*. (Please note this format is realistic and mimics the presentation given by, for example, Bank of America's annual report).

Selected from DLC's BALANCE SHEET ending Dec 31st, 2016	2016 (millions)	2015 (millions)
Assets		
Loans, measured at fair value	**$12,900.0**	**$12,800.0**
Allowance for loan losses	**$448.6**	**$153.6**
Loans, net of allowance	**$12,451.4**	**$12,646.4**

FOOTNOTE to DLC's balance sheet ending Dec 31st, 2016		2016
Allowance for loan losses, Jan 1st		**$153.6**
Loans charged off (during year)	**$195.0**	
Recoveries of previously charged off	**$20.0**	
Net charge-offs (during year)		**$175.0**
Provision for loan losses		**$120.0**
Allowance for loan losses, Dec 31st		**$448.6**

About these accounts, each of the following statements is true **EXCEPT** which is false?

a) The actual (not expected) loan losses for DLC during 2016 were $195.0 million before netting any recoveries
b) The book value (aka, carrying value) of loans which contributes to DLC's reported Total Assets is $12,451.4 million
c) The most direct impact on DLC's 2016 Income Statement is "Net Charge Offs" which reduced DLC's reported Pre-tax Operating Income by $175.0 million
d) If the 2016 "Provision for loan losses" had increased from $120.0 million to $200.0 million (i.e., nearer to loans charged off) then reported Assets and Equity (as of December 31st, 2016) would have both decreased

701.2. Regulators estimate that Deposits and Loans Corporation (DLC) will report a profit that is normally distributed with a mean of $1.30 million and a standard deviation of $3.0 million. Below is displayed the summary Balance Sheet for DLC:

Balance Sheet for DLC at End of 2016

Assets (millions)		**Liabilities and Net Worth (mm)**	
Cash	$5.00	Deposits	$90.00
Marketable Securities	$10.00	Sub Long term debt	$6.00
Loans	$80.00		
Fixed Assets	$5.00	Equity Capital	$4.00
Total	$100.00	***Total***	$100.00

How much equity capital **IN ADDITION** to DLC's current equity position should regulators require for there to be a 99.9% chance of the capital not being wiped out by losses? (this is a variation on Hull's EOC Question 2.15)

a) None
b) About $1.50 million
c) About $3.97 million
d) About $14.46 million

701.3. Hull's Chapter 2 introduces several key banking definitions. Consider the definitions below:

I. **Moral hazard**: Moral hazard is the possibility that insurance itself motives the insured party to engage is riskier behavior
II. **Firm commitment IPO**: Faced with a choice between "firm commitment" versus "best efforts," an investment bank underwriting an initial public offering (IPO) is more likely to prefer the firm commitment if (i) the bank is more confident in obtaining a higher public sale price and (ii) the bank has a greater risk appetite
III. **Trading book**: Assets in the trading book are market to market daily, or if they do not have a market, marked according to a model ("marking to model"); but loans in the banking book are not marked to market, they are recorded in the books as principal amount owed plus accrued interest
IV. **Originate-to-distribute**: Originate-to-distribute refers to the business model that has the intention to securitize
V. **Poison pill**: An example of a poison pill is when a potential acquisition target grants to its key employees stock options that vest in the event of a takeover
VI. **Market maker:** A market maker facilitates trading by always being prepared to quote a bid (the price at which it is prepared to buy) and an offer (the price at which it is prepared to sell)

Which of the above definitions is **CORRECT**?

a) None of these definitions are correct
b) II., IV, and VI are accurate (but I., III., and V. are incorrect)
c) I., III., and V. are accurate (but II., IV, and VI. are incorrect)
d) All of these definitions are accurate

Answers:

701.1. C. False. Pre-tax Operating Income (on the income statement) is reduced by the "Provision for Loan Losses" which is an accounting expense, not charge-off (and recoveries) which impact the cash flow statement. In this way, loan loss provisions involve some degree of management discretion.

In regard to (A), (B) and (D), each is TRUE.

701.2. C. True. About $3.97 million: As 3.09 is the one-tailed normal deviation at 99.90% confidence, the worst expected loss is given by: μ 1.30 - 3.0 * 3.09 = - $7.97 which requires $3.97 in addition to the current equity of $4.0 million.

701.3. D. All of these definitions are accurate. Please consider the following notes by Hull (selected):

- **Moral hazard**: "Moral hazard is the possibility that insurance itself motives the insured party to engage is riskier behavior"
- **Firm commitment IPO**: "There are a number of different types of arrangement between the investment bank and the corporation. Sometimes the financing takes the form of a private placement in which the securities are sold to a small number of large institutional investors, such as life insurance companies or pension funds, and the investment bank receives a fee. On other occasions it takes the form of a public offering, where securities are offered to the general public. A public offering may be on a best efforts or firm commitment basis. In the case of a best efforts public offering, the investment bank does as well as it can to place the securities with investors and is paid a fee that depends, to some extent, on its success. In the case of a firm commitment public offering, the investment bank agrees to buy the securities from the issuer at a particular price and then attempts to sell them in the market for a slightly higher price. It makes a profit equal to the difference between the price at which it sells the securities and the price it pays the issuer. If for any reason it is unable to sell the securities, it ends up owning them itself. " [Please see Hull's Example 2.1 for an illustration]
- **Trading book**: "For other banking activities, there is an important distinction between the banking book and the trading book. As its name implies, the trading book includes all the assets and liabilities the bank has as a result of its trading operations. The values of these assets and liabilities are marked to market daily. This means that the value of the book is adjusted daily to reflect changes in market prices ... Often a model has to be assumed. The process of coming up with a market price is then sometimes termed marking to model. The banking book includes loans made to corporations and individuals. These are not marked to market. If a borrower is up-to-date on principal and interest payments on a loan, 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. The bank does not then accrue interest on the loan when calculating its profit. When problems with the loan become more serious and it becomes likely that principal will not be repaid, the loan is classified as a loan loss."

- **Originate-to-distribute**: "The originate-to-distribute model is also termed securitization because securities are created from cash flow streams originated by the bank. It is an attractive model for banks. By securitizing its loans it gets them off the balance sheet and frees up funds to enable it to make more loans. It also frees up capital that can be used to cover risks being taken elsewhere in the bank ... As we will explain in Chapter 6, the originate-to-distribute model got out of control during the 2000 to 2006 period. Banks relaxed their mortgage lending standards and the credit quality of the instruments being originated declined sharply. This led to a severe credit crisis and a period during which the originate-to-distribute model could not be used by banks because investors had lost confidence in the securities that had been created."
- **Poison pill**: "In addition to assisting companies with new issues of securities, investment banks offer advice to companies on mergers and acquisitions, investments, major corporate restructurings, and so on. They will assist in finding merger partners and takeover targets or help companies find buyers for divisions or subsidiaries of which they want to divest themselves. They will also advise the management of companies which are themselves merger or takeover targets. Sometimes they suggest steps they should take to avoid a merger or takeover. These are known as poison pills. Examples of poison pills are ..."
- **Market maker**: "A broker assists in the trading of securities by taking orders from clients and arranging for them to be carried out on an exchange. Some brokers operate nationally, and some serve only a particular region. Some, known as full-service brokers, offer investment research and advice. Others, known as discount brokers, charge lower commissions, but provide no advice. Some offer online services, and some, such as E* Trade, provide a platform for customers to trade without a broker. A **market maker** facilitates trading by always being prepared to quote a bid (the price at which it is prepared to buy) and an offer (the price at which it is prepared to sell). When providing a quote, it does not know whether the person requesting the quote wants to buy or sell. The market maker makes a profit from the spread between the bid and the offer, but takes the risk that it will be left with an unacceptably high exposure."

***Discuss here in forum**:* https://www.bionicturtle.com/forum/threads/p1-t3-701-basic-bank-functions-and-definitions-hull.10242/

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 2.2 and 2.3) loses $7 million trading foreign exchange. What do you think would happen?

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

TABLE 2.3 Summary Income Statement for DLC in 2015 ($ 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

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?

Answers:

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 Answers to Questions and Problems 631 $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 by X, 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 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?

Answer:

There is a 99.9% chance that the profit will not be worse than $0.6 - 3.090 \times 2.0 = -\$5.58\ million$. 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.

Hull, Chapter 3: Insurance Companies and Pension Plans

P1.T3.702. Life insurance products and mortality tables
P1.T3.703. Insurance company ratios
P1.T3.704. Insurance company regulations and pension funds

P1.T3.702. Life insurance products and mortality tables

Learning objective: Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies. Describe the use of mortality tables and calculate the premium payment for a policy holder.

702.1. Below is an extract (selected rows) from a mortality table:

Mortality Table

	Male			Female		
	Probability			Probability		
Age (Yrs)	Death w/n one year	Survival	Life Expect	Death w/n one year	Survival	Life Expect
0	0.006519	1.000000	76.280000	0.005377	1.000000	81.05
1	0.000462	0.993481	75.780000	0.000379	0.994623	80.49
2	0.000291	0.993022	74.820000	0.000221	0.994246	79.52
3	0.000209	0.992733	73.840000	0.000162	0.994026	78.54
...	...	...	...	...	...	...
79	0.053739	0.535041	8.730000	0.038920	0.664666	10.24
80	0.059403	0.506288	8.200000	0.043289	0.638797	9.64
81	0.065873	0.476213	7.680000	0.048356	0.611144	9.05
82	0.073082	0.444844	7.190000	0.054041	0.581592	8.48
83	0.081070	0.412334	6.720000	0.060384	0.550162	7.94

Which is **nearest** to the probability of a man aged 80 years old dying in the second year (between ages 81 and 82)?

a) 0.39%
b) 1.76%
c) 6.20%
d) 7.31%

702.2. Below is an extract from a mortality table (ages 30 to 34 for males and females):

Mortality Table						
	Male			Female		
	Probability			Probability		
Age (Yrs)	Death w/n one year	Survival	Life Expect	Death w/n one year	Survival	Life Expect
...	...	...	...	...	...	...
30	0.001467	0.975197	47.820000	0.000664	0.986345	52.01
31	0.001505	0.973766	46.890000	0.000705	0.985690	51.04
32	0.001541	0.972301	45.960000	0.000748	0.984995	50.08
33	0.001573	0.970802	45.030000	0.000794	0.984258	49.11
34	0.001606	0.969275	44.100000	0.000845	0.983477	48.15

Suppose a woman aged 30 years old buys a $1.0 million whole life insurance policy and she pays an annual premium of $6,000. What is approximately the surplus premium in the first year of the policy?

a) There is no surplus premium; i.e., zero
b) $5,336.00
c) $5,885.00
d) $5,919.00

702.3. There are many different life insurance products, including term, whole, variable, universal, variable-universal, and endowment. Each of the following definitions is correct **EXCEPT** which is false?

a) Whole life insurance lasts for the whole life of the policyholder, while term life insurance lasts a fixed period (e.g., five years or ten years)
b) Universal life insurance is a type of whole life insurance where the premium can be reduced to a specified minimum level without the policy lapsing
c) Variable life insurance is a type of term life insurance where the cash value grows at a variable interest rate; e.g., a variable index such as LIBOR plus a margin
d) Endowment life insurance lasts for a specified period and pays a lump sum either (i) when the policyholder dies or (ii) at the end of the period, whichever happens first

Answers:

702.1. C. 6.20%. This is the probability that he does not die in the first year multiplied by the probability that he does die in the second year, which is given by (1 - 0.0594030) * 0.0658730 = 0.0619599 = 6.19599%

702.2. B. $5,336.00. For a 30-year female, the conditional one-year probability of death is 0.000664 such that the surplus premium is equal to $6,000 - ($1,000,000 * 0.0006640) = $6,000 - $664 = $5,336.00

702.3. C. False. Variable life insurance is a type of 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.

In regard to (A), (B) and (D) each are true. To summarize:

- **Term Life Insurance** (aka, temporary life insurance) lasts a predetermined number of years. If the policyholder dies during the life of the policy, the insurance company makes a payment to the specified beneficiaries equal to the face amount of the policy. If the policyholder does not die during the term of the policy, no payments are made by the insurance company. The policyholder is required to make regular monthly or annual premium payments to the insurance company for the life of the policy or until the policyholder's death (whichever is earlier). The face amount of the policy typically stays the same or declines with the passage of time. A common motivation for term life is provide dependents with funds to pay off a mortgage in the event of the borrower's death.
- **Whole Life Insurance** (aka, permanent life insurance) provides protection for the life of the policyholder. The policyholder is required to make regular monthly or annual payments until his or her death. The face value of the policy is then paid to the designated beneficiary. In the case of term life insurance, there is no certainty that there will be a payout, but in the case of whole life insurance, a payout is certain to happen providing the policyholder continues to make the agreed premium payments. The only uncertainty is when the payout will occur. Whole life insurance requires considerably higher premiums than term life insurance policies. Usually, the payments and the face value of the policy both remain constant through time.
- **Variable Life Insurance**: as above
- **Universal Life** is a type of 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.
- **Variable-Universal Life Insurance** 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** 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.

***Discuss here in forum**:* https://www.bionicturtle.com/forum/threads/p1-t3-702-life-insurance-products-and-mortality-tables-hull.10259/

P1.T3.703. Insurance company ratios

Learning objective: 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.

703.1. In its annual report, Acehouse Property-Casualty presents a summary of selected key ratios (but where we've hidden four of the values):

Acehouse Property-Casualty (APC) An Insurance Company *X(D), X(C), X(I), X(O) represents hidden values*	
Loss ratio	75.0%
Expense ratio	30.0%
Combined ratio (before dividends)	105.0%
Dividends	X(D)
Combined ratio (after dividends)	X(C)
Investment income	X(I)
Operating ratio	X(O)

Each of the following statements it true **EXCEPT** which is false?

a) The Expense Ratio of 30.0% includes loss adjustment expenses
b) The Expense Ratio of 30.0% includes marketing expenses and commissions paid to brokers
c) Because its combined ratio is greater than 100.0%, Acehouse is NOT a profitable business
d) For each $1.00 in premiums received, Acehouse pays out (and/or reserves for payouts) about $0.75 in claims to its customers

703.2. Two of the key risks facing insurance companies are moral hazard and adverse selection. Three of the following examples are illustrations of moral hazard, but one is an example of adverse selection. Which is the example of adverse selection?

a) An individual buys health insurance and consequently increases their demand for health care services
b) A cell phone owner buys a "total equipment protection" insurance plan and, consequently, becomes more careless with the phone
c) Because it is backed by a government-sponsored deposit insurance plan, a bank is less worried about losing depositors and consequently it takes on more risks
d) A health insurance company is mandated by government to offer the same price (premium cost) to all new customers so that it cannot increase the relative price of riskier customers and consequently it attracts more high-risk customers

703.3. Catastrophe (CAT) bonds are a popular derivative instrument for hedging catastrophic risk. A CAT bond pays a higher-than-normal interest rate and is often issued by a subsidiary of an insurance company. Each of the following is TRUE about the features of a CAT bond **EXCEPT** which is false?

a) For an insurance company, issuing CAT bonds is an alternative to reinsurance: the interest or principal can be used to meet claims
b) CAT bonds tend to have little or no correlation to market returns such that their total risk can be diversified away in a large portfolio
c) A drawback of CAT bonds is the covered loss depends on a definition of "catastrophic loss" which is inevitably subjective and qualitative so that the issuer's basis risk is high
d) An inevitable feature of catastrophic risk is that the loss events are highly dependent on each other; the loss events are not independent and usually they are not even nearly independent

Answers:

703.1. C. False, as this ignores the insurance company's float (its investment income). In Hull's Table 3.2 (which is the basis for this question), Dividends equal 1.0% and Investment Income equals 9.0% such that the Combined ratio (after dividends) = 105% + 1% = 106% and the Operating ratio = 106% - 9% = 97% such that the firm is profitable. Here is Hull's actual Table 3.2:

Acehouse Property-Casualty (APC) An Insurance Company	
Hull's Actual Table 3.2	
Loss ratio	75.0%
Expense ratio	30.0%
Combined ratio (before dividends)	105.0%
Dividends	1.0%
Combined ratio (after dividends)	106.0%
Investment income	-9.0%
Operating ratio	97.0%

In regard to (A), (B) and (D), each is TRUE.

Hull: "Ratios Calculated by Property-Casualty Insurers: Insurance companies calculate a **loss ratio** for different types of insurance. This is the ratio of payouts made to premiums earned in a year. Loss ratios are typically in the 60% to 80% range. Statistics published by A. M. Best show that loss ratios in the United States have tended to increase through time.
The **expense ratio** for an insurance company is the ratio of expenses to premiums earned in a year. The two major sources of expenses are loss adjustment expenses and selling expenses. Loss adjustment expenses are those expenses related to determining the validity of a claim and how much the policyholder should be paid. Selling expenses include the commissions paid to brokers and other expenses concerned with the acquisition of business. Expense ratios in the United States are typically in the 25% to 30% range and have tended to decrease through time.

The **combined ratio is the sum of the loss ratio and the expense ratio.** Suppose that for a particular category of policies in a particular year the loss ratio is 75% and the expense ratio is 30%. The combined ratio is then 105%. Sometimes a small dividend is paid to policyholders. Suppose that this is 1% of premiums. When this is taken into account we obtain what is referred to as the combined ratio after dividends. This is 106% in our example. This number suggests that the insurance company has lost 6% before tax on the policies being considered. In fact, this may not be the case. Premiums are generally 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. T**he insurance company is therefore able to earn interest on the premiums during the time that elapses between the receipt of premiums and payouts [aka, float].** Suppose that, in our example, investment income is 9% of premiums received. When the investment income is taken into account, a ratio of 106 − 9 = 97% is obtained. This is referred to as the operating ratio."

703.2. D. This is an example of adverse selection, but (A), (B) and (C) are examples of moral hazard. Hull on the difference:

- "**Moral hazard** is the risk that the existence of insurance will cause the policyholder to behave differently than he or she would without the insurance. This different behavior increases the risks and the expected payouts of the insurance company ...
- **Adverse selection** describes the problems an insurance company has when it cannot distinguish between good and bad risks. It offers the same price to everyone and inadvertently attracts more of the bad risks. 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. "

Please note in regard to overcoming these problems:

- **To overcome moral hazard**, Hull says: "Typically there is a **deductible**. This means that the policyholder is responsible for bearing the first part of any loss. Sometimes there is a **co-insurance** provision in a policy. The insurance company then pays a predetermined percentage (less than 100%) of losses in excess of the deductible. In addition there is **nearly always a policy limit** (i.e., an upper limit to the payout). The effect of these provisions is to align the interests of the policyholder more closely with those of the insurance company. "
- **To overcome adverse selection**, Hull says: "To lessen the impact of adverse selection, an insurance company **tries to find out as much as possible about the policyholder** before committing itself. Before offering life insurance, it often requires the policyholder to undergo a physical examination by an approved doctor. Before offering auto insurance to an individual, it will try to obtain as much information as possible about the individual's driving record. In the case of auto insurance, it will continue to collect information on the driver's risk (number of accidents, number of speeding tickets, etc.) and make year-to-year changes to the premium to reflect this. Adverse selection can never be completely overcome. It is interesting that, in spite of the physical examinations that are required, individuals buying life insurance tend to die earlier than mortality tables would suggest. But individuals who purchase annuities tend to live longer than mortality tables would suggest."

703.3. C. False. The catastrophe loss is contractually defined an depends on the trigger which can be an indemnity trigger, an index (aka, industry) trigger, a parametric trigger, or a modeled trigger. None of these are subjective. In the case of an indemnity trigger, basis risk is low.

In regard to (A), (B) and (D), each is TRUE.

Hull on CAT Bonds: "The derivatives market has come up with a number of products for hedging catastrophic risk. The most popular is a catastrophe (CAT) bond. This is a bond issued by a subsidiary of an insurance company that pays a higher-than-normal interest rate. In exchange for the extra interest, the holder of the bond agrees to cover payouts on a particular type of catastrophic risk that are in a certain range. Depending on the terms of the CAT bond, the interest or principal (or both) can be used to meet claims.

Suppose an insurance company has a $70 million exposure to California earthquake losses and wants protection for losses over $40 million. The insurance company could issue CAT bonds with a total principal of $30 million. In the event that the insurance company's California earthquake losses exceeded $ 40 million, bondholders would lose some or all of their principal. As an alternative, the insurance company could cover the same losses by making a much bigger bond issue where only the bondholders' interest is at risk. Yet another alternative is to make three separate bond issues covering losses in the range $40 to $50 million, $50 to $60 million, and $60 to $70 million, respectively.

CAT bonds typically give a high probability of an above-normal rate of interest and a low-probability of a high loss. Why would investors be interested in such instruments? The answer is that the return on CAT bonds, like the longevity bonds considered earlier, have no statistically significant correlations with market returns. 2 CAT bonds are therefore an attractive addition to an investor's portfolio. Their total risk can be completely diversified away in a large portfolio. If a CAT bond's expected return is greater than the risk-free interest rate (and typically it is), it has the potential to improve risk-return trade-offs."

***Discuss here in forum**:* https://www.bionicturtle.com/forum/threads/p1-t3-703-insurance-company-ratios-hull.10267/

P1.T3.704. Insurance company regulations and pension funds

Learning objectives: 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.

704.1. A defined benefit pension fund is 50.0% invested in equities and 50.0% invested in bonds. If we assume the simplest possible balance sheet, which is **MOST LIKELY** to be the net effect of a scenario where equities are approximately flat but interest increase by 100 basis points? Please note this is a variation based on Hull's EOC Question 3.18, so it makes simplifying assumings such as (i) the rate increase is a parallel shift of both short- and long-term interest rates, (ii) durations are not managed, and (iii) the fund is not hedged.

a) Improvement in funded status because present value of liabilities decreases more than assets decrease
b) Improvement in funded status because present value of assets increases more than liabilities increase
c) Deterioration in funded status because present value of liabilities increases more than assets increase
d) Deterioration in funded status because present value of liabilities decreases more than assets decrease

704.2. In regard to these statements about insurance companies, each is generally true **EXCEPT** which is false?

a) Property-casualty insurance companies hold more capital than life insurance companies
b) Annuity contracts are exposed to longevity risk, but life insurance contracts are exposed to mortality risk
c) Basel II and Basel III determine the regulatory capital requirements for life insurance and property-casualty insurance companies in both the U.S. and European Union (EU)
d) In the U.S., the guaranty system for banks than for insurance companies: there is a permanent federal fund for banks, but there is insurance companies do not have a permanent fund

704.3. Suppose the following assumptions for a certain defined benefit pension plan:

- Employees work for 35.0 years earning wages that increase with inflation.
- They retire with a pension equal to 70.0% of their final salary.
- This pension also increases with inflation. The pension is received for 18.0 years.
- The pension fund's income is invested in bonds that earn the inflation rate.

Which of the following is **nearest** to an estimate of 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. (Please note this is based on Hull's EOC Question 3.15)

a) 9.0%
b) 18.0%
c) 36.0%
d) 72.0%

Answers:

704.1. A. TRUE. Improvement in funded status because present value of liabilities decreases more than assets decrease

An increase in the interest rate implies an increase in the *discount rate used to value the liabilities*; this decreases the present value of the liabilities. An increase in the interest should affect a *decrease in the value of the bonds (on the asset site)* per the typical inverse relationship between bond prices and yields. However, bonds are only 50% of the asset mix so that the liability impact should be greater than the asset impact, for a net positive effect on the pension's funded status.

Hull on pension plans and please note the interesting Perfect Storm example: "Estimating the present value of the liabilities in defined benefit plans is not easy. An important issue is the discount rate used. The higher the discount rate, the lower the present value of the pension plan liabilities. It used to be common to use the average rate of return on the assets of the pension plan as the discount rate. This encourages the pension plan to invest in equities because the average return on equities is higher than the average return on bonds, making the value of the liabilities look low. Accounting standards now recognize that the liabilities of pension plans are obligations similar to bonds and require the liabilities of the pension plans of private companies to be discounted at AA-rated bond yields. The difference between the value of the assets of a defined benefit plan and that of its liabilities must be recorded as an asset or liability on the balance sheet of the company. Thus, if a company's defined benefit plan is underfunded, the company's shareholder equity is reduced. A perfect storm is created when the assets of a defined benefits pension plan decline sharply in value and the discount rate for its liabilities decreases sharply.

Business Snapshot (3.2) A **Perfect Storm**: "During the period from December 31, 1999 to December 31, 2002, the S&P 500 declined by about 40% from 1469.25 to 879.82 and 20-year Treasury rates in the United States declined by 200 basis points from 6.83% to 4.83%. The impact of the first of these events was that the market value of the assets of defined benefit pension plans declined sharply. The impact of the second of the two events was that the discount rate used by defined benefit plans for their liabilities decreased so that the fair value of the liabilities calculated by actuaries increased. This created a perfect storm for the pension plans. Many funds that had been overfunded became underfunded. Funds that had been slightly underfunded became much more seriously underfunded. When a company has a defined benefit plan, the value of its equity is adjusted to reflect the amount by which the plan is overfunded or underfunded. It is not surprising that many companies have tried to replace defined benefit pension plans with defined contribution plans to avoid the risk of equity being eroded by a perfect storm. "

And for further reference, this question is based on Hull's end-of-chapter (EOC) question 3.18:

- Hull's EOC Question 3.18 **Question**: 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."

704.2. C. False. In the EU, Solvency II is the major directive (https://en.wikipedia.org/wiki/Solvency_II_Directive_2009) which determines the regulatory capital requirements for insurance companies. In the US, as Hull discusses, insurance companies are regulated at the state level.

In regard to (A), (B) and (D), each is TRUE.

- ***In regard to true (A)*** that "Property-casualty insurance companies hold more capital than life insurance companies", Hull asks in Question 3.12, "Why do property-casualty insurance companies hold more capital than life insurance companies?" and the answer is "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."
- ***In regard to true (B)*** that "Annuity contracts are exposed to longevity risk, but life insurance contracts are exposed to mortality risk" Hull explains "**Longevity risk** is the risk that advances in medical sciences and lifestyle changes will lead to people living longer. Increases in longevity adversely affect the profitability of most types of annuity contracts (because the annuity has to be paid for longer), but increases the profitability of most life insurance contracts (because the final payout is either delayed or, in the case of term insurance, less likely to happen). Life expectancy has been steadily increasing in most parts of the world. Average life expectancy of a child born in the United States in 2009 is estimated to be about 20 years higher than for a child born in 1929. Life expectancy varies from country to country. **Mortality risk** is the risk that wars, epidemics such as AIDS, or pandemics such as Spanish flu will lead to people living not as long as expected. This adversely affects the payouts on most types of life insurance contracts (because the insured amount has to be paid earlier than expected), but should increase the profitability of annuity contracts (because the annuity is not paid out for as long). 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."
- ***In regard to true (D)*** that "In the U.S., the guaranty system for banks than for insurance companies: there is a permanent federal fund for banks, but there is insurance companies do not have a permanent fund," Hull explains "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. Regulating insurance companies at the state level is unsatisfactory in some respects ... The Dodd-Frank Act of 2010 set up the Federal Insurance Office (FIO), which is housed in the Department of the Treasury. It is tasked with monitoring the insurance industry and identifying gaps in regulation ... The FIO submitted its report in December 2013.3 It identified changes necessary to improve the U.S. system of insurance regulation. It seems likely 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. "

704.3. C. 36.0%

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 0.70*X. The real return earned is zero. Because employees work for 35.0 years, the present value of the contributions made by one employee is 35.0*X*R where R is the contribution rate as a percentage of the employee's wages. The present value of the benefits is 18 * 70% = 12.6 * X. The value of R that is necessary to adequately fund the plan must therefore satisfy: 35.0*X*R = 12.6 * X, so that R = 12.6/35.0 = 36.0%.

Discuss here in forum: https://www.bionicturtle.com/forum/threads/p1-t3-704-insurance-company-regulations-and-pension-funds-hull.10277/

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 prespecified 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

	Male			Female		
Age (Years)	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 $0.003559 \times (1 - 0.003289) = 0.003547$. 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.

Question 3.6

From Table 3.1, 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 prespecified 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 20×0.75X=15X. The value of R that is necessary to adequately fund the plan must therefore satisfy

$$40XR = 15X$$

The solution to this equation isR=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).

Answers:

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) × 0.011835 = 0.011704

Year 3: (1−0.011046) × (1−0.011835) × 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 by the insurance company are entirely nonsystematic.) The one-year risk-free rate is 5% per annum with annual compounding. Estimate the cost of the following:

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

$$\frac{90}{1.05} = 87.51$$

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. This calculation confirms the point made in Section 3.12 that defined benefit plans require higher contribution rates that those that exist in practice.

Chapter 4: Mutual Funds and Hedge Funds

P1.T3.705. Mutual funds
P1.T3.706 Hedge funds

P1.T3.705. Mutual funds

Learning Objectives: 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. Explain the key differences between hedge funds and mutual funds.

705.1 America's Best Fund (Class A) is an open-ended mutual fund with 1.20 million shares outstanding. Currently, it is 10 am U.S. eastern standard time (EST) in the morning and the fund owns the following:

- $9.30 million in large cap equities,
- $1.0 million in short-term U.S. Treasury bills; aka, the risk-free asset, and
- $500,000 in cash

Which of the following statements is **TRUE**?

a) The fund's net asset value (NAV) is about $7.75 per share
b) If the fund reinvests dividends earned on the equities, the fund's investors are not taxed on these reinvested dividends
c) An immediate order to buy shares, at 10 am, can specify the total dollar amount but will know neither the exact NAV nor exact number of shares purchased
d) Unless and until the fund issues additional shares in a secondary offering or initiates a share buyback, the number of shares outstanding will remain fixed at 1.20 million

705.2. The Investment Committee at your endowment just analyzed the historical performance of its asset allocation to hedge funds, which was 20.0% of the fund. It has determined that net of fees these hedge funds did not outperform the S&P 500 on a risk-adjusted basis. Consequently, the Committee wants to re-allocate this portion to a fund that tracks the S&P 500 index; and the Committee is comfortable mirroring the index with minimum tracking error. An outside consultant proposes an exchange-traded fund (ETF) such as the "Spider" (ticker SPY), but some members want to compare the ETF to an open-ended or closed-ended mutual fund that tracks the S&P 500.

In addition to highlighting the fact that the expense ratios tend to be lower for ETFs than mutual funds, the consultant offers the following arguments in favor of an ETF:

I. In contrast to an open-ended mutual fund, advantage of the SPDR ETF can be traded at any time, can be shorted, and does not have to be partially liquidated to accommodate redemptions

II. II. In contrast to a closed-ended mutual fund whose price tends to trade at a discount to its fair market value, there is never any appreciable difference between the traded price of the SPDR EFT and its fair market value.

Which of the consultant's argument(s) is (are) **TRUE**?

a) Neither is true
b) Only I. is true, but II. is false
c) Only II. is true, but I. is false
d) Both are true.

705.3 Quadholding Mutual is a mutual fund in the United States who reports the following sequence of per annum returns over the last five years: +7.0%, +15.0%, +20.0%, +5.0%, +18.0%. Quadholding Mutual charges a back-end load of 2.0%. Each of the following statements about this mutual fund is true **EXCEPT** which is false?

a) Quadholding's five-year geometric mean must be less than 13.0%
b) Unlike a hedge fund, Quadholding must disclose its investment policies, must limit it its use of leverage, must calculate NAV daily, and must make its shares redeemable at any time
c) When purchasing shares in Quadholding, a 2.0% fee will be charged to the investor; and if the shares are held for five years then subsequently sold, then the total expense ratio amortizes to about 40 basis points per year
d) Quadholding is heavily regulated primarily by the Securities and Exchange Commission (SEC) who does not permit the illegal practice of "late trading;" although investors can legally engage in "market timing" or "front running" the fund but only if such trades are based on publicly available information

Answers:

705.1. C. TRUE: An immediate order to buy shares, at 10 am, can specify the total dollar amount but will know neither the exact NAV nor exact number of shares purchased.

Hull: "An investor in a long-term mutual fund owns a certain number of shares in the fund. The most common type of mutual fund is an open-end fund. This means that the total number of shares outstanding goes up as investors buy more shares and down as shares are redeemed. Mutual funds are valued at 4 P.M. each day. This involves the mutual fund manager calculating the market value of each asset in the portfolio so that the total value of the fund is determined. This total value is divided by the number of shares outstanding to obtain the value of each share. The latter is referred to as the net asset value (NAV) of the fund. Shares in the fund can be bought from the fund or sold back to the fund at any time. When an investor issues instructions to buy or sell shares, it is the next-calculated NAV that applies to the transaction. For example, if an investor decides to buy at 2 P.M. on a particular business day, the NAV at 4 P.M. on that day determines the amount paid by the investor.

The investor usually pays tax as though he or she owned the securities in which the fund has invested. Thus, when the fund receives a dividend, an investor in the fund has to pay tax on the investor's share of the dividend, even if the dividend is reinvested in the fund for the investor. When the fund sells securities, the investor is deemed to have realized an immediate capital gain or loss, even if the investor has not sold any of his or her shares in the fund. "

In regard to (A), (B) and (D), each is FALSE. In regard to false (A), the fund's NAV is about ($9.30 + 0.50 + 1.0)/1.20 mm = $9.00 but it will fluctuate throughout the day.

705.2. D. Both [statements] are true.

Hull on ETFs: "Exchange-traded funds (ETFs) have existed in the United States since 1993 and in Europe since 1999. They often track an index and so are an alternative to an index mutual fund for investors who are comfortable earning a return that is designed to mirror the index. One of the most widely known ETFs, called the Spider, tracks the S& P 500 and trades under the symbol SPY. In a survey of investment professionals conducted in March 2008, 67% called ETFs the most innovative investment vehicle of the previous two decades and 60% reported that ETFs have fundamentally changed the way they construct investment portfolios. In 2008, the SEC in the United States authorized the creation of actively managed ETFs.

ETFs are created by institutional investors. Typically, an institutional investor deposits a block of securities with the ETF and obtains shares in the ETF (known as creation units) in return. Some or all of the shares in the ETF are then traded on a stock exchange. This gives ETFs the characteristics of a closed-end fund rather than an open-end fund. However, a key feature of ETFs is that institutional investors can exchange large blocks of shares in the ETF for the assets underlying the shares at that time. They can give up shares they hold in the ETF and receive the assets or they can deposit new assets and receive new shares. This ensures that there is never any appreciable difference between the price at which shares in the ETF are trading on the stock exchange and their fair market value. This is a key difference between ETFs and closed-end funds and makes ETFs more attractive to investors than closed-end funds.

ETFs have a number of advantages over open-end mutual funds. ETFs can be bought or sold at any time of the day. They can be shorted in the same way that shares in any stock are shorted. (See Chapter 5 for a discussion of short selling.) ETF holdings are disclosed twice a day, giving investors full knowledge of the assets underlying the fund. Mutual funds by contrast only have to disclose their holdings relatively infrequently. When shares in a mutual fund are sold, managers often have to sell the stocks in which the fund has invested to raise the cash that is paid to the investor. When shares in the ETF are sold, this is not necessary as another investor is providing the cash. This means that transactions costs are saved and there are less unplanned capital gains and losses passed on to shareholders. Finally, the expense ratios of ETFs tend to be less than those of mutual funds. "

705.3. C. False. The front-end load fee is charged when the investor first buys the fund, and the total expense ratio is the total annual fee which includes at least management expenses and distribution costs.

In regard to (A), (B) and (D), each is TRUE.

- ***In regard to true (A)***, the geometric mean is 12.841%, which is less than the arithmetic mean by about one-half the variance of the series
- ***In regard to true (B),*** Hull: "4.2 Hedge funds: Hedge funds are different from mutual funds in that they are subject to very little regulation. This is because they accept funds only from financially sophisticated individuals and organizations. Examples of the regulations that affect mutual funds are the requirements that: 1. Shares be redeemable at any time, 2. NAV be calculated daily, 3. Investment policies be disclosed, and 4. The use of leverage be limited. Hedge funds are largely free from these regulations. This gives them a great deal of freedom to develop sophisticated, unconventional, and proprietary investment strategies. Hedge funds are sometimes referred to as alternative investments. "
- ***In regard to true (D),*** see Hull's Regulation and Mutual fund Scandals.

Discuss here in forum: *https://www.bionicturtle.com/forum/threads/p1-t3-705-mutual-funds-hull.10282/*

P1.T3.706 Hedge funds

Learning Objectives: 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.

706.1. A fund of funds divides its money *equally* between four hedge funds who earn –3.0%, +1.0%, +11.0%, and +21.0% before fees in a particular year. The fund of funds charges "1% plus 10%" and the hedge funds charge "1% plus 20%" (due to competitive pressures this is reduced from "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 and incentive fees) average return of the hedge funds in which it invests and after its own management fee has been subtracted. Which is **nearest** to the return to investors in the fund of funds? (please note this is variation on Hull's EOC Question 4.17)

a) 1.40%
b) 3.60%
c) 5.00%
d) 7.50%

706.2. Hedge fund fees are notoriously high, although recently the traditional "2 and 20" fee structure has been under much pressure. Clauses in fee structure agreements can help make the incentive fees more palatable for clients. In regard to these fee structure agreement clauses, each of the following is a true description **EXCEPT** which is inaccurate?

a) Hurdle rate is the minimum return necessary for an incentive fee to be applicable
b) High-water market requires previous losses to be recouped before an incentive fee is applicable
c) Clawback refers to investors being able to use some (or all) previous incentive fees, held in a recovery account, to offset current losses
d) Proportional adjustment clause allows the hedge fund manager, in the event of style drift, to replace the fund's benchmark, ex post, in order to reduce the funds reported tracking error

706.3. In regard to various hedge fund strategies, each of the following statements is generally true **EXCEPT** which statement is false?

a) Although prior to 2009, hedge fund returns lagged the S&P 500, since 2009 hedge funds have outperformed the S&P 500
b) A Distressed Securities hedge fund investor is more likely to earn an illiquidity risk premium than a typical Global Macro manager
c) A Merger Arbitrage (aka, risk arb) hedge fund investors should have a lower correlation to the broad equity markets than a typical Long/Short Equity manager
d) A Systematic Managed Futures hedge fund investor is more likely to employ technical analysis than an Emerging Markets manager

Answers:

706.1. B. 3.60%. Please see the calculations below, in particular:

- Gross return = (-3.0% + 1.0% + 11.0% + 21.0%)/4 = 7.50%
- Total hedge fund fees = 1.0% management fee + 1.50% (average) performance fee = 2.50%
- Fund of fund fees = 1.0% management + 0.40% performance = 1.40%
- Return to investor = 7.50% - 2.50% - 1.40% = 3.60%

	Hedge Funds					
	Gross Returns	Mgmt Fee	Return after Fee	Perform Fee	Total Fee	Net Return
	(A)			20%	(B)	(A-B)
1	-3.0%	1.0%	-4.0%	0.0000%	1.00%	-4.00%
2	1.0%	1.0%	0.0%	0.0000%	1.00%	0.00%
3	11.0%	1.0%	10.0%	2.0000%	3.00%	8.00%
4	21.0%	1.0%	20.0%	4.0000%	5.00%	16.00%
Avg	7.50%	1.000%		1.500%	2.500%	5.000%

Fund of Funds	
Management fee	1.000%
+ 10% Peformance fee	0.400%
*= 10% * (5.00% - 1.00%)*	
Total FOF fees	1.400%
Return earned by hedge funds	7.500%
Fees to hedge funds	2.500%
Fees to fund of funds	1.400%
Return to investor	3.600%

706.2. D. False. A proportional adjustment clause is related to a high-water mark. In regard to (A), (B) and (C), each is TRUE. Hull: "The agreements offered by hedge funds may include clauses that make the incentive fees more palatable. For example:

- There is sometimes a **hurdle rate**. This is the minimum return necessary for the incentive fee to be applicable.
- There is sometimes a high-water mark clause. This states that any previous losses must be recouped by new profits before an incentive fee applies. Because different investors place money with the fund at different times, the high-water mark is not necessarily the same for all investors. There may be a proportional adjustment clause stating that, if funds are withdrawn by investors, the amount of previous losses that has to be recouped is adjusted proportionally. Suppose a fund worth $ 200 million loses $ 40 million and $ 80 million of funds are withdrawn. The high-water mark clause on its own would require $ 40 million of profits on the remaining $ 80 million to be achieved before the incentive fee applied. The proportional adjustment clause would reduce this to $ 20 million because the fund is only half as big as it was when the loss was incurred.
- There is sometimes a clawback clause that 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. This account is used to compensate investors for a percentage of any future losses."

706.3. A. False. Prior to 2009, hedge fund returns generally beat the S&P 500, but since 2009 hedge funds have generally lagged behind the S&P 500

In regard to (B), (C) and (D), each is TRUE.

- ***In regard to true (B)***, Distressed Securities an an event-driven strategy that typically requires high level of skill making investments that lack liquidity; i.e., alpha and illiquidity risk premiums. On the other hand, Global Macro tends to make directional bets in highly efficient markets.
- ***In regard to true (C)***, Merger Arbitrage is an event-driven strategy but Long/Short Equity is directional with market exposure; please note the difference between long/short equity and equity market neutral.
- ***In regard to true (D)***, Managed Futures classically divided into discretionary versus systematic (albeit with blurring lines recently) where the Systematic Managed Futures strategy tends to be highly technical. Emerging Markets, on the other hand, tends to require more fundamental analysis. Writes Hull about Managed Futures: "Managed Futures Hedge fund managers that use managed futures strategies attempt to predict future movements in commodity prices. Some rely on the manager's judgment; others use computer programs to generate trades. Some managers base their trading on technical analysis, which analyzes past price patterns to predict the future. Others use fundamental analysis, which involves calculating a fair value for the commodity from economic, political, and other relevant factors. When technical analysis is used, trading rules are usually first tested on historical data. This is known as back-testing. If (as is often the case) a trading rule has come from an analysis of past data, trading rules should be tested out of sample (that is, on data that are different from the data used to generate the rules). Analysts should be aware of the perils of data mining. Suppose thousands of different trading rules are generated and then tested on historical data. Just by chance a few of the trading rules will perform very well— but this does not mean that they will perform well in the future. "

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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 openend 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?

Answers:

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 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 fund 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:

The plot is shown in the chart 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%.