1811 FRM Part I

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金融市场与产品

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Financial Market and Products

Key Point: Bond Pricing

- **Bond Pricing**

$$P=\frac{C_1}{1+y}+\frac{C_2}{(1+y)^2}+\cdots+\frac{C_T}{(1+y)^T}=\sum_{t=1}^{T}\frac{C_t}{(1+y)^t}$$

- **Perpetual Bond**

$$P=\frac{cF}{1+y}+\frac{cF}{(1+y)^2}+\cdots=\sum_{t=1}^{+\infty}\frac{cF}{(1+y)^t}=\frac{cF}{y}$$

- **Clean Price & Dirty Price**

Dirty price = clean price + accrued price

1. Given a one-year and a three-year zero coupon bonds price of 95.18 and 83.75 respectively, what should be the price of a two year zero coupon bond using linear interpolation on zero rates (semiannual compounding)?
   - A. 95.18
   - B. 89.47
   - C. 89.72
   - D. 83.75

Answer: C

Step 1: Compute semiannual zero rates for the 1-and 3-year bonds.

1-year bond: FV = 100; N = 2; PMT = 0, PV = -95.18, CPT: I/Y = 2.5008 × 2 = 5.0%

3-year bond: FV = 100; N = 6; PMT = 0, PV = -83.75, CPT: I/Y = 3 × 2 = 6%

Step 2: Use linear interpolation on zero rates for 2-year bond

(6% – 5%)/2 = 0.5%, zero rates for 2-year bonds = 5% + 0.5% = 5.5%

Step3: Compute 2-year bond price

FV = I00; N = 4; PMT = 0, I/Y = 2.75(5.5/2), CPT: PV = -89.72

2. You have been asked to check for arbitrage opportunities in the Treasury bond market by comparing the cash flows of selected bonds with the cash flows of combinations of other bonds. If a 1-year zero-coupon bond is priced at USD 96.12 and a 1-year bond paying a 10% coupon semi-annually is priced at USD 106.20, what should be the price of a 1-year Treasury bond that pays a coupon of 8% semiannually?
   - A. USD 98.10
   - B. USD 101.23
   - C. USD 103.35
   - D. USD 104.18

Answer: D

The solution is to replicate the 1 year 8% bond using the other two treasury bonds. In order to replicate the cash flows of the 8% bond, you could solve a system of equations to determine the weight factors, F_1 and F_2, which correspond to the proportion of the zero and the 10% bond to be held, respectively.

The two equations are as follows:

$(100 \times F_1) + (105 \times F_2) = 104$ (replicating the cash flow including principal and interest payments at the end of 1 year), and $(5 \times F_2) = 4$ (replicating the cash flow from the coupon payment in 6 months.)

Solving the two equations gives us $F_1 = 0.2$ and $F_2 = 0.8$. Thus the price of the 8% bond should be 0.2 (96.12) + 0.8 (106.2) = 104.18.

3. A two-year zero-coupon bond issued by corporate XYZ is currently rated A. One year from now XYZ is expected to remain at A with 85% probability, upgraded to AA with 5% probability, and downgraded to BBB with 10% probability. The risk free rate is flat at 4%. The credit spreads are flat at 40, 80, and 150 basis points for AA, A, and BBB rated issuers, respectively. All rates are compounded annually. Estimate the expected value of the zero-coupon bond one year from now (for USD 100 face amount).

   A. USD 92.59

   B. USD 95.33

   C. USD 95.37

   D. USD 95.42

Answer: C

The expected value of the zero coupon bond one year from now is given by:

$$5\% \times \frac{100}{1+(4\%+0.004)} + 85\% \times \frac{100}{1+(4\%+0.008)} + 10\% \times \frac{100}{1+(4\%+0.015)} = 95.35$$

4. A \$1,000 par corporate bond carries a coupon rate of 6%, pays coupons semiannually, and has ten coupon payments remaining to maturity. Market rates are currently 5%. There are 90 days between settlement and the next coupon payment. The dirty and clean prices of the bond, respectively, are closest to:

   A. \$1,043.76, \$1,013.76

   B. \$1,043.76, \$1,028.76

   C. \$1,056.73, \$1,041.73

   D. \$1,069.70, \$1,054.70

Answer: C

The dirty price of the bond 90 days ago is calculated as N = 10, I/Y = 2.5, PMT = 30, FV = 1,000;

CPT→PV = 1,043.76. Adjusting the PV for the fact that there are only 90 days until the receipt of the first coupon, then the dirty price now is 1,043.76 × $1.025^{(90/180)}$ = 1056.73. Clean price = dirty price – accrued interest = 1056.73 – 30 × (90/180) = 1041.73.

5. The table below gives coupon rates and mid-market price for three U.S. Treasury bonds for settlement on (as of) May 31, 2013

Coupon	**Maturity**	**Price**
2 7/8	11/30/2013	$100.62600
2 1/2	5/31/2014	$99.45250
4 3/4	11/30/2014	$100.38000

Which of the following is nearest to the implied discount function (set of discount factors) assuming semi-annual compounding?

A. d(0.5) = 0.9370, d(1.0) = 0.8667, d(1.5) = 0.9210

B. d(0.5) = 0.9920, d(1.0) = 0.9700, d(1.5) = 0.9350

C. d(0.5) = 0.9999, d(1.0) = 0.7455, d(1.5) = 0.8018

D. d(0.5) = 1.0350, d(1.0) = 1.1175, d(1.5) = 0.6487

Answer: B

The future value of $1 invested for time t is 1/d(t).

$$d(0.5)=\frac{100.62600}{(100+2.875/2)}=0.992$$

$$d(1)=\frac{(99.45250-1.25d(0.5))}{101.25}=0.9700$$

$$d(1.5)=\frac{(100.3800-2.375d(0.5)-2.375d(1))}{102.375}=0.9350$$

6. The following table gives the prices of two out of three US Treasury notes for settlement on August 30, 2008. All three notes will mature exactly one year later on August 30, 2009. Assume annual coupon payments and that all three bonds have the same coupon payment date.

Coupon	**Price**
2 7/8	94.40
4 1/2	?
6 1/4	101.30

Approximately what would be the price of the 4 1/2 US Treasury note?

A. 99.20

B. 99.40

C. 97.71

D. 100.20

Answer: C

$$\left(2\frac{7}{8}+100\right)X_1+\left(6\frac{1}{4}+100\right)(1-X_2)=\left(4\frac{1}{2}+100\right)$$

$$X_1=0.52$$

$$\text{Price}=0.52\times 94.40+(1-0.52)\times 101.30=97.71$$

Key Point: Corporate Bonds

7. As it relates to the bond indenture, the corporate trustee acts in a fiduciary capacity for:

   I. bond investors

   II. bond issuers

   III. bond underwriters

   IV. regulators

   A. I only

   B. II only

   C. I and IV

   D. II and III

Answer: A

The promises of corporate bond issuers and the rights of investors who buy them are set forth in great detail in contracts generally called indentures. The indenture is made out to the corporate trustee as a representative of the interests of bondholders; that is, the trustee acts in a fiduciary capacity for investors who own the bond issue.

8. Relative to coupon-bearing bonds of same maturity, zero-coupon bonds are NOT subject to which type of risk?

   A. Interest rate risk

   B. Credit risk

   C. Reinvestment risk

   D. Liquidity risk

Answer: C

Since zero-coupon bonds have no coupons, there is nothing to reinvest. They are subject to all of the other risks listed, however.

9. Which of the following statements regarding the trustee named in a corporate bond indenture is correct?

   A. The trustee has the authority to declare a default if the issuer misses a payment.

   B. The trustee may take action beyond the indenture to protect bondholders.

   C. The trustee must act at the request of a sufficient number of bondholders.

D. The trustee is paid by the bondholders or their representatives.

Answer: A

According to the Trust Indenture Act, if a corporate issuer fails to pay interest or principal, the trustee may declare a default and take such action as may be necessary to protect the rights of bondholders. Trustees can only perform the actions indicated in the indenture, but are typically under no obligation to exercise the powers granted by the indenture even at the request of bondholders. The trustee is paid by the debt issuer, not by bond holders or their representatives.

Key Point: Exchange VS. Over the Counter Market

10. Which of the following statements is an advantage of an exchange trading system? On an exchange system:
    A. Terms are not specified.
    B. Trades are made in such a way as to reduce credit risk.
    C. Participants have flexibility to negotiate.
    D. In the event of a misunderstanding, calls are recorded between parties.

Answer: B

Key Point: Forward Interest Rate

Forward rates are interest rates implied by the spot curve for a specified future period. The forward rate between T_1 and T_2 can be calculated as:

$$(1+Z_1)^{T_1}(1+F_{1,2})^{(T_2-T_1)}=(1+Z_2)^{T_2}$$

$$e^{Z_1T_1}\times e^{F_{1,2}(T_2-T_1)}=e^{Z_2T_2}\Rightarrow F_{1,2}=\frac{Z_2T_2-Z_1T_1}{T_2-T_1}$$

11. The zero rate of three years is 4.6%, the zero rate of four years is 5.0%. Please calculate the 1-year forward rate three years from today.
    A. 6.2%
    B. 6.0%
    C. 5.5%
    D. 4.8%

Answer: A

$$R_{forward}=\frac{R_2T_2-R_1T_1}{T_2-T_1}=\frac{5.0\%\times4-4.6\%\times3}{4-3}=6.2\%$$

12. The interest rate for a 1-year period is 5% and the rate for a 2-year period is 6%. Assuming continuous compounding, what is the forward rate for the period from the end of the first year to the second year?
    A. 6.9991%

B. 7.0000%

C. 7.0009%

D. 8.0000%

Answer: B

$$e^{5\%} \times e^{F_{1,2}} = e^{6\% \times 2}$$

$5\% + F_{1,2} = 6\% \times 2$，$F_{1,2} = 7\%$

13. Given the following bonds and forward rates:

Maturity	YTM	Coupon	Price
1 year	4.5%	0%	95.694
2 years	7%	0%	87.344
3 years	9%	0%	77.218

- 1-year forward rate one year from today = 9.56%
- 1-year forward rate two years from today = 10.77%
- 2-year forward rate one year from today = 11.32%

Which of the following statements about the forward rates, based on the bond prices, is true?

A. The 1-year forward rate one year from today is too low.

B. The 2-year forward rate one year from today is too high.

C. The 1-year forward rate two years from today is too low.

D. The forward rates and bond prices provide no opportunities for arbitrage.

Answer: C

1-year forward rate one year from today = $1.07^2/1.045 - 1 = 9.56\%$

1-year forward rate two years from today = $1.09^3/1.07^2 - 1 = 13.11\%$

2-year forward rate one year from today = $(1.09^3/1.045)^{0.5} - 1 = 11.32\%$

14. Below is a table of term structure of swap rates:

Maturity in Years	Swap Rate
1	2.50%
2	3.00%
3	3.50%
4	4.00%
5	4.50%

The 2-year forward swap rate starting in three years is closest to:

A. 3.50%

B. 4,50%

C. 5.51%

D. 6.02%

Answer: D

Computing the 2-year forward swap rate starting in three years:

$$(1+4.50\%)^5 = (1+3.50\%)^3 \times (1+r)^2$$

$$r = 6.02\%$$

Key Point: Forward Rate Agreement (FRA)

A long FRA position benefits from an increase in rates. A short FRA positions similar to a long position in a bond.

15. A long position in a FRA 2 × 5 is equivalent to the following positions in the spot market:

    A. Borrowing in two months to finance a five-month investment.

    B. Borrowing in five months to finance a two-month investment.

    C. Borrowing half a loan amount at two months and the remainder at five months.

    D. Borrowing in two months to finance a three-month investment.

Answer: B

An FRA defined as $t_1 \times t_2$ involves a forward rate starting at time t_1 and ending at time t_2. The buyer of this FRA locks in a borrowing rate for months 3 to 5.This is equivalent to borrowing for five months and reinvesting the funds for the first two months.

16. ABC, Inc., entered a forward rate agreement (FRA) to receive a rate of 3.75% with continuous compounding on a principal of USD 1 million between the end of year 1 and the end of year 2. The zero rates are 3.25% and 3.50% for one and two years. What is the value of the FRA when the deal is just entered?

    A. USD 35,629

    B. USD 34,965

    C. USD 664

    D. USD 0

Answer: D

The market-implied forward rate is given by

$$e^{-R_2\times 2} = e^{-R_2\times 1 - F_{1,2}\times 1}$$

or 3.75%. Given that this is exactly equal to the quoted rate, the value must be zero. If instead this rate was 3.50%, for example, the value would be: V = \$1,000,000 × (3.75% – 3.50%) × (2 – 1) × e (-3.5% × 2) = 2,331

Key Point: Margin

- **Initial Margin**

✧ Must be deposited when contract is initiated

- **Marking to Market**

✧ At the end of each trading day, margin account is adjusted to reflect gains or losses.

- **Maintenance Margin**

✧ Investor can withdraw funds in the margin account in excess of the initial margin. A maintenance margin guarantees that the balance in the margin account never gets negative (the maintenance margin is lower than the initial margin).

- **Margin Call**

✧ When the balance in the margin account falls below the maintenance margin, broker executes a margin call. The next day, the investor needs to "top up" the margin account back to the initial margin level.

- **Variation margin**

✧ Extra funds deposited by the investor after receiving a margin call.

✧ Variation margin = initial margin – margin account balance

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17. To utilize the cash position of assets under management, a portfolio manager enters into a long futures position on the S&P 500 index with a multiplier of 250. The cash position is $15 million with the current futures value of 1000, which requires the manager to long 60 contracts. If the current initial margin is $12500 per contract, and the current maintenance margin is $10000 per contract, what variation margin does the portfolio manager have to advance if the futures contract value falls to $995 at the end of the first day of the position being placed?

    A. $30,000

    B. $0

    C. $300,000

    D. $75,000

Answer: B

Step 1: Initial margin $12,500 × 60 = $750,000; Maintenance margin$10,000 × 60 = $600,000

Step 2: The first day lose = (1,000 – 995) × 250 × 60 = $75,000,

So the first day value = $750,000 – $75,000 = $675,000>$600,000

It will not require a variation margin to bring the position to the proper margin level.

18. In late June, John purchased two December gold futures contracts. Each contract size is 5,000 ounces of silver and the futures price on the date of purchase was USD 18.62 per ounce. The required initial margin is USD 6,000 and a maintenance margin of USD 4,500. You are given the following price history for the December silver futures:

Day	Futures Price	Daily Gain
June 29	18.62	0

June 30	18.69	700
July 1	18.03	-6600
July 2	17.72	-3100
July 6	18.00	2800
July 7	17.70	-3000
July 8	17.60	-1000

On which days did John receive a margin call?

A. July 1 only

B. July 1 and July 2 only

C. July 1, July 2 and July 7 only

D. July 1, July 2 and July 8 only

Answer: B

19. Assume you enter into 5 long futures contracts to buy July gold for $1,400 per ounce. A gold futures contract size is 100 troy ounces. The initial margin is $14,000 per contract and the maintenance margin is 75% of the initial margin. What change in the futures price of gold will lead to a margin call?

A. $35 drop

B. $70 drop

C. $175 drop

D. $350 drop

Answer: A

The maintance margin = 75% × $14,000 = $10,500 per contract;the margin call occurs when the loss is $3,500 per contract or $35 per ounce.

That is, if gold drops from $1,400 to $1,365 then value of margin account,per contract,drop $3,500 ($35 × 100) which is 25% of the initial margin.

Key Point: Order Types

- **Market Order**

✧ The market order is a simple (the simplest) request to execute the trade immediately at the best available price.

- **Limit Order**

✧ A limit order specifies a particular price. The order can be executed only at this price or at one more favorable to the investor.

- **Stop Loss**

✧ The order is executed at the best available price once a bid or offer is made at that particular price or a less-favorable price.

- **Stop-Limit**

✧ The order becomes a limit order as soon as a bid or offer is made at a price equal to or less favorable than the stop price.

- **Market-if-Touched**

✧ A market-if-touched (MIT) order is executed at the best available price after a trade occurs at a specified price or at a price more favorable than the specified price.

- **Discretionary**

✧ A market order except that execution may be delayed at the broker's discretion in an attempt to get a better price.

20. Assume you have a long position in a stock with a current market price of $35. You have two goals. First, to retain ownership as long as the stock continues to go up. Second, to exit the position completely if the stock drops below $30. Which order best meets your dual objectives?

    A. Sell market order

    B. Sell limit order at $37

    C. Stop-loss sell order at $30

    D. Stop-and-limit sell order at $30

Answer: C

In regard to (A), a market order sells immediately and does not meet the first objective.

In regard to (B), a sell limit will try to execute if the price rises to $37 and does not meet the first objective.

In regard to (C), the stop-loss becomes a market order once the stock drops to $30 and therefore best meets the second objective.

In regard to (D), the stop becomes a limit at $30 and risks not being filled so does not meet the second objective as well as the stop-loss.

21. An investor with a long position in a futures contract wants to issue instructions to close out the position. A market-if-touched order would be used if the investor wants to:

    A. Execute at the best available price once a trade occurs at the specified or better price.

    B. Execute at the best available price once a bid/offer occurs at the specified or worse price.

    C. Allow a broker to delay execution of the order to get a better price.

    D. Execute the order immediately or not at all.

Answer: A

A market-if-touched order executes at the best available price once a trade occurs at the specified or better price. A stop order executes at the best available price once a bid/offer occurs at the specified or worse price. A discretionary order allows a broker to delay execution of the order to get a better price. A fill-or-kill order executes the order immediately or not at all.

Key Point: T-bond futures, CTD bond

- In a T-bond futures contract, any government bond with more than 15 years to maturity on the first of the delivery month (and not callable within 15 years) is deliverable on the contract.
- The procedure to determine which bond is the cheapest-to-deliver (CTD) is as follows:

  $$\text{Cash received by the short} = (QFP \times CF) + AI$$

  $$\text{Cost to purchase bond} = QBP + AI$$

  Where:

  QFP = quoted futures price

  CF = conversion factor

  QBP = quoted bond price
- The CTD is the bond that minimizes the following: QBP – (QFP × CF). This formula calculates the cost of delivering the bond.

22. The yield curve is upward sloping. You have a short T-bond futures position. The following bonds are eligible for delivery:

Bond	**A**	**B**	**C**
Spot price	102-14/32	106-19/32	98-12/32
Coupon	4%	5%	3%
Conversion factor	0.98	1.03	0.952

The futures price is 103-17/32 and the maturity date of the contract is September 1. The bonds pay their coupon semiannually on June 30 and December 31. The cheapest to deliver bond is:

A. Bond A

B. Bond B

C. Bond C

D. Insufficient information

Answer: C

Cost of bond A: (102-14/32) – (103-17/32) × 0.98 = 0.9769

Cost of bond B: (106-19/32) – (103-17/32) × 1.03 = -0.0435

Cost of bond C: (98-12/32) – (103-17/32) × 0.952 = -0.1868

23. A German housing corporation needs to hedge against rising interest rates. It has chosen to use futures on 10-year German government bonds. Which position in the futures should the corporation take, and why?

A. Take a long position in the futures because rising interest rates lead to rising futures prices.

B. Take a short position in the futures because rising interest rates lead to rising futures prices.

C. Take a short position in the futures because rising interest rates lead to declining futures prices.

D. Take a long position in the futures because rising interest rates lead to declining futures prices.

Answer: C

Government bond futures decline in value when interest rates rise, so the housing corporation should short futures to hedge against rising interest rates.

Key Point: Eurodollar Futures

- This contract settles in cash and the minimum price change is one “tick”, which is a price change of one basis point, or $25 per $1 million contract.
- The interest rate underlying this contract is essentially the 3-month (90-day) forward LIBOR. If Z is the quoted price for a Eurodollar futures contract, the contract price is:

  $$\text{Eurodollar futures price} = \$10,000[100 - (0.25)(100 - Z)] = 10,000[100 - 0.25F_t]$$
- Convexity adjustment: The daily marking to market aspect of the futures contract can result in differences between actual forward rates and those implied by futures contracts.

$$\text{Forward rate} = \text{Futures rate} - 0.5 \times \sigma^2 \times T_1 \times T_2$$

24. Consider an FRA (forward rate agreement) with the same maturity and compounding frequency as a Eurodollar futures contract. The FRA has labor underlying. Which of the following statements are true about the relationship between the forward rate and the futures rate?

    A. The forward rate is normally higher than the futures rate.

    B. They have no fixed relationship.

    C. The forward rate is normally lower than the futures rate.

    D. They should be exactly the same.

Answer: C

Futures rate exceeds the forward rate.

25. The four-year Eurodollar futures quote is 97.00. The volatility of the short-term interest rate (LIBOR) is 1.0%, expressed with continuous compounding. What is the equivalent forward rate, adjusted for convexity, given in ACT/360 day count with continuous compounding (i.e., the Eurodollar futures contract gives LIBOR in quarterly compounding ACT/360, so convert to continuous but a day count conversion is not needed)?

    A. 2.90%

    B. 2.95%

    C. 2.99%

D. 3.00%

Answer: A

$$\text{futures rate} = \text{forward rate} + (1/2)\sigma^2 t_1 t_2$$

$$\text{futures rate (annual)} = (100 - 97)\% = 3\%$$

$$\text{futures rate (quarterly)} = 3\% \times \frac{90}{360} = 0.75\%$$

$$\text{futures rate (continuous)} = \ln(1.0075) \times \frac{360}{90} = 2.99\%$$

$$\text{forward rate} = 2.99\% - (1/2)(1\%^2)(4)(4.25) = 2.90\%$$

Key Point: Cost-of-Carry Model

- Forward price when underlying asset does not have cash flows: $F_0 = S_0e^{rT}$
- Forward price when underlying asset has cash flows: $F_0 = (S_0 - I)e^{rT}$
- Forward price with continuous dividend yield (q): $F_0 = S_0e^{(r-q)T}$
- Forward price with storage costs: $F_0 = (S_0 + U)e^{rT}$ or $F_0 = S_0e^{(r+u)T}$
- Forward price with convenience yield: $F_0 = S_0e^{(r-c)T}$
- Arbitrage: Remember to buy low, sell high.
  - ✧ If $F_0 > S_0e^{rT}$, borrow, buy spot, sell forward today; deliver asset, repay loan at end.
  - ✧ If $F_0 < S_0e^{rT}$, short spot, invest, buy forward today; collect loan, buy asset under futures contract, deliver to cover short sale.
- Interest Rate Parity

$$F_0 = S_0e^{(r-r_f)T}$$

26. A stock index is valued at USD 750 and pays a continuous dividend at the rate of 2% per annum. The 6-month futures contract on that index is trading at USD 757. The risk free rate is 3.50% continuously compounded. There are no transaction costs or taxes. Is the futures contract priced so that there is an arbitrage opportunity? If yes, which of the following numbers comes closest to the arbitrage profit you could realize by taking a position in one futures contract?

A. 4.18

B. 1.35

C. 12.60

D. There is no arbitrage opportunity.

Answer: B

The formula for computing the forward price on a financial asset is:

$$F_{0,T} = S_0e^{(r-\delta)T}$$

Where S_0 is the spot price of the asset, r is the continuously compounded interest rate, and δ is the continuous dividend yield on the asset.

The no-arbitrage futures price is computed as follows:

$750 \times e^{(0.035-0.02)*0.5} = 755.65$

Since the market price of the futures contract is higher than this price, there is an arbitrage opportunity. The futures contract could be sold and the index purchased.

27. A trader in the arbitrage unit of a multinational bank finds that an asset is trading at USD 1,000, the price of a 1-year futures contract on that asset is USD 1,010, and the price of a 2-year futures contract is USD 1,025. Assume that there are no cash flows from the asset for 2 years. If the term structure of interest rates is flat at 1% per year, which of the following is an appropriate arbitrage strategy?
    A. Short 2-year futures and long 1-year futures
    B. Short 1-year futures and long 2-year futures
    C. Short 2-year futures and long the underlying asset funded by borrowing for 2 years
    D. Short 1-year futures and long the underlying asset funded by borrowing for 1 year

Answer: C

The 1-year futures price should be $1,000 \times e^{0.01} = 1,010.05$

The 2-year futures price should be $1,000 \times e^{0.01 \times 2} = 1,020.20$

The current 2-year futures price in the market is overvalued compared to the theoretical price. To lock in a profit, you would short the 2 year futures, borrow USD 1,000 at 1%, and buy the underlying asset. At the end of the 2nd years, you will sell the asset at USD 1,025 and return the borrowed money with interest, which would be $1,000 \times e^{0.01 \times 2} = 1,020.20$, resulting in a USD 4.80 gain.

28. A risk manager is deciding between buying a futures contract on an exchange and buying a forward contract directly from a counterparty on the same underlying asset. Both contracts would have the same maturity and delivery specifications. The manager finds that the futures price is less than the forward price. Assuming no arbitrage opportunity exists, what single factor acting alone would be a realistic explanation for this price difference?
    A. The futures contract is more liquid and easier to trade.
    B. The forward contract counterparty is more likely to default.
    C. The asset is strongly negatively correlated with interest rates.
    D. The transaction costs on the futures contract are less than on the forward contract.

Answer: C

When an asset is strongly negatively correlated with interest rates, futures prices will tend to be slightly lower than forward prices. When the underlying asset increases in price, the immediate gain arising from the daily futures settlement will tend to be invested at a lower than average rate of interest due to the negative correlation. In this case futures would sell for slightly less than forward contracts, which are not affected by interest rate movements in the same manner since forward contracts do not have a daily settlement feature.

The other three choices would all most likely result in the futures price being higher than the forward price.

29. A 15-month futures contract on an equity index is currently trading at USD 3,767.52. The underlying index is currently valued at USD 3,625 and has a continuously-compounded dividend yield of 2% per year. The continuously compounded risk-free rate is 5% per year. Assuming no transactions costs, what is the potential arbitrage profit per contract and the appropriate strategy?

    A. USD 189, buy the futures contract and sell the underlying.

    B. USD 4, buy the futures contract and sell the underlying.

    C. USD 189, sell the futures contract and buy the underlying.

    D. USD 4, sell the futures contract and buy the underlying.

Answer: D

This is an example of index arbitrage. The no-arbitrage value of the futures contract can be calculated as the future value of the spot price: $S_0 * e^{(\text{Risk Free Rate} - \text{Dividend Yield}) * t}$, where S_0 equals the current spot price and t equals the time in years.

Future value of the spot price = $S_0 * e^{(\text{Risk Free Rate} - \text{Dividend Yield}) * t} = 3{,}625 * e^{(5\% - 2\%) * 1.25} = 3{,}763.52$

Since this value is different from the current futures contract price, a potential arbitrage situation exists.

Since the futures price is higher than the future value of the spot price in this case, one can short sell the higher priced futures contract, and buy the underlying stocks in the index at the current price. The arbitrage profit would equal 3,767.52 - 3,763.52 = USD 4.

30. A risk analyst at a commodities trading firm is examining the supply and demand conditions for various commodities and is concerned about the volatility of the forward prices for silver in the medium term. Currently, silver is trading at a spot price of USD 20.35 per troy ounce and the six-month forward price is quoted at USD 20.50 per troy ounce. Assuming that after six months the lease rate rises above the continuously compounded interest rate, which of the following statements is correct about the shape of the silver forward curve after six months?

    A. The forward curve will be downward sloping.

    B. The forward curve will be upward sloping.

    C. The forward curve will be flat.

    D. The forward curve will be humped.

Answer: A

A is correct. The forward price is computed as:$F = Se^{(r+\lambda-c)*T}$

And the commodity lease rate (δ) is computed as $\delta = c - \lambda$.*So*, the forward price can alternatively be expressed in terms of lease rate and risk-free rate as: $F = Se^{(r-\delta)*T}$

Therefore, as the risk-free rate falls below the lease rate ($r < \delta = c - \lambda$), we can see from the forward price formula above that F < S, and the forward curve will be in backwardation.

31. Current spot CHF/USD rate: 1.3680 (1.3680CHF = 1USD)

    3-month USD interest rates: 1.05%

    3-month Swiss interest rates: 0.35%

    (Assume continuous compounding)

    A currency trader notices that the 3-month future price is USD 0.7350. In order to arbitrage, the trader should investment:

    A. Borrow CHF, buy USD spot, go long CHF futures

    B. Borrow CHF, sell CHF spot, go short CHF futures

    C. Borrow USD, buy CHF spot, go short CHF futures

    D. Borrow USD, sell USD spot, go long CHF futures

Answer: C

Step 1. The spot is quoted in terms of Swiss Francs per USD, theoretical future price of USD = $1.368 \times e^{(0.35\% - 1.05\%) \times 3/12} = 1.368 \times 0.99825 = 1.36561$ CHF

Step 2. 3-month future price is USD 0.7350 → 1/0.7350 = 1.3054 CHF

Step 3. 1.36561 CHF > 1.3054 CHF → USD future contract is undervalued

Step 4. Arbitrage strategies: borrow USD (buy CHF) spot, buy USD (short CHF) future.

32. You are examining the exchange rate between the U.S. dollar and the Euro and have the following information:

    - Current USD/EUR exchange rate is 1.25.
    - Current USD-denominated 1-year risk-free interest rate is 4% per year.
    - Current EUR-denominated 1-year risk-free interest rate is 7% per year.

    According to the interest rate parity theorem, what is the 1-year forward USD/EUR exchange rate?

    A. 0.78

    B. 0.82

    C. 1.21

    D. 1.29

Answer: C

The forward rate, F_t, is given by the interest rate parity equation:

$$F_t = S_0 \times e^{(r-r_f)\times t}$$

where S_0 is the spot exchange rate, r is the domestic (USD) risk-free rate, and r_f is the foreign (EUR) risk-free rate, t is the time to delivery.

Substituting the values in the equation:

$$F_t = 1.25 \times e^{(0.04-0.07)\times 1} = 1.21$$

Key Point: Contango and Backwardation

- **Backwardation**
  - ✧ Refers to a situation where the futures price is below the spot price. For this to occur, there must be a significant benefit to holding the asset.
- **Contango**
  - ✧ Refers to a situation where the futures price is above the spot price. If there are no benefits to holding the asset (e.g., dividends, coupons, or convenience yield), contango will occur because the futures price will be greater than the spot price.

33. The current price of Commodity X in the spot market is $42.47. Forward contracts for delivery of Commodity X in one year are trading at a price of $43.11. If the current continuously compounded annual risk-free interest rate is 7.0%, calculate the implicit lease rate for Commodity X. Holding the calculated implicit lease rate constant, would the forward market for Commodity X be in backwardation or contango if the continuously compounded annual risk-free rate immediately fell to 5.0%?

    A. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.

    B. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.

    C. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.

    D. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.

Answer: B

Step1: Calculate implicit lease rate = 0.07 – 0.0150 = 5.5%.

Step2: The forward price ($43.11) is higher than the spot price ($42.47), the market for Commodity X is currently in contango.

Step 3: If annual risk-free rate immediately fell to 5.0%, holding the lease rate constant, forward price 42.487($se^{(r - \delta)t} = 42.47e^{(0.05 - 0.055)}$) is lower than the spot price ($42.47) the market would be in backwardation.

34. In commodity markets, the complex relationships between spot and forward prices are embodied in the commodity price curve. Which of the following statements is true?
    A. In a backwardation market, the discount in forward prices relative to the spot price represents a positive yield for the commodity supplier.
    B. In a backwardation market, the discount in forward prices relative to the spot price represents a positive yield for the commodity consumer.
    C. In a contango market, the discount in forward prices relative to the spot price represents a positive yield for the commodity supplier.
    D. In a contango market, the discount in forward prices relative to the spot price represents a positive yield for the commodity consumer.

Answer: B

When forward prices are as a discount to spot prices, a backwardation market is said to exist. The relatively high spot price represents a convenience yield to the consumer that holds the commodity for immediate consumption.

35. A commodities trader observes quotes for futures contracts as follow:

Spot Price	321
July, 2014	312
October, 2014	310
December, 2014	309

This commodity is trading:
    A. As a normal futures market since the futures prices are consistent with the commodity's seasonality.
    B. As an inverted futures market since more distant delivery contracts are trading at lower prices than nearer-term ones.
    C. As a normal futures market because it is typical for more distant delivery contracts to trade lower than nearer-term delivery contracts.
    D. Consistently with convergence as futures prices will rise when the delivery period nears.

Answer: B

Key Point: Forward Contract Value

36. Three months ago a company entered in a one-year forward contract to buy 100 ounces of gold. At the time, the one-year forward price was USD 1,000 per ounce. The nine-month forward

price of gold is now USD 1,050 per ounce. The continuously-compounded risk-free rate is 4% per year for all maturities and there are no storage costs. Which of the following is closest to the value of the contract?

A. USD5,000

B. USD 4,852

C. USD 7,955

D. USD1,897

Answer: B

The forward price is computed as follows:

$$F_0 = 100 \times (F_0 - K)e^{-rT} = 100 \times (1050 - 1000)e^{-4\% \times 0.75} = 4,852$$

37. A French bank enters into a 6-month forward contract with an importer to sell GBP 40 million in 6 months at a rate of EUR 0.80 per GBP. If in 6 months the exchange rate is EUR 0.85 per GBP, what is the payoff for the bank from the forward contract?

A. EUR -2,941,176

B. EUR -2,000,000

C. EUR 2,000,000

D. EUR 2,941,176

Answer: B

The value of the contract for the bank at expiration: 40,000,000 GBP × 0.80 EUR/GBP

The cost to close out the contract for the bank at expiration: 40,000,000 GBP × 0.85 EUR/GBP

Therefore, the final payoff in EUR to the bank can be calculated as: 40,000,000 × (0.80 – 0.85) = -2,000,000 EUR.

38. Company XYZ operates in the U.S. On April 1, 2009, it has a net trade receivable of EUR 5,000,000 from an export contract to Germany. The company expects to receive this amount on Oct. 1, 2009. The CFO of XYZ wants to protect the value of this receivable. On April 1, 2009, the EUR spot rate is 1.34, and the 6-month EUR forward rate is 1.33. The CFO can lock in an exchange rate by taking a position in the forward contract. Alternatively, he can sell a 6-month EUR 5,000,000 call option with strike price of 1.34. The CFO thinks that selling an option is better than taking a forward position because if the EUR goes up, XYZ can take delivery of the USD at 1.34, which is better than the outright forward rate of 1.33. If the EUR goes down, the contract will not be exercised. So, XYZ will pocket the premium obtained from selling the call option.

What can be concluded about the CFO's analysis?

A. CFO's analysis is correct. The company is better off whichever way the EUR rate goes.

B. CFO's analysis is not correct. The company will suffer if the EUR goes up sharply.

C. CFO's analysis is not correct. The company will suffer if the EUR moves within a narrow range.

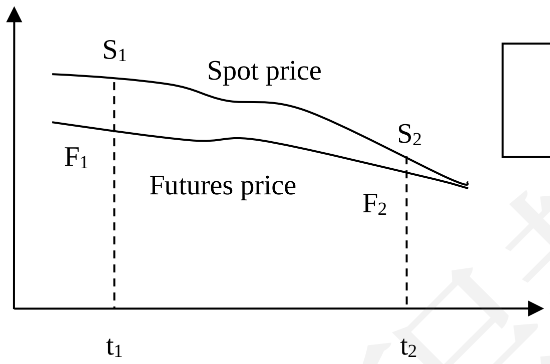
D. CFO's analysis is not correct. The company will suffer if the EUR goes down sharply.

Answer: D

The CFO's analysis is incorrect because there is unlimited downside risk. The option premium received is a fixed amount, and if the EUR declines sharply, the value of the underlying receivable goes down as well. If instead the EUR moves in a narrow range, that would be good, but there is no guarantee of course that this will occur.

Key Point: Basis and Basis Risk

Define the basis and the various sources of basis risk, and explain how basis risks arise when hedging with futures.



Basis: $b_1 = S_1 - F_1$
$b_2 = S_2 - F_2$

The profit on the futures position is $F_1 - F_2$.

The effective price that is obtained for the asset with hedging is therefore: $S_2 + F_1 - F_2 = F_1 + b_2$;

The value of F_1 is known at time t_1. If b_2 were also known at this time, a perfect hedge would result.

The hedging risk is the uncertainty associated with b_2 and is known as basis risk.

39. Which of the following statements are true with respect to basis risk?

I. Basis risk arises in cross-hedging strategies but there is no basis risk when the underlying asset and hedge asset are identical.

II. Short hedge position benefits from unexpected strengthening of basis.

III. Long hedge position benefits from unexpected strengthening of basis.

A. I and II

B. I and III

C. II only

D. III only

Answer: C

“II” is the only true statement. A short hedge position or a short forward contract benefits from any unexpected decline in future prices and subsequent strengthening of basis. An increase in basis is known as a strengthening of the basis. The payoff to the short hedge position is spot price at maturity (S_2) and the difference between futures price i.e., ($F_1 - F_2$). Thus, payoff = $S_2 + F_1 - F_2 = F_1 + b_2$, where b_2 is the basis.

Basis risk can also arise if underlying asset and hedge asset are identical. This can happen if the maturity of the hedge contract and the delivery date of asset do not match. A long hedge position benefits from weakening of basis.

40. A buffalo farmer is concerned that the price he can get for his buffalo herd will be less than he has forecasted. To protect himself from price declines in the herd, the farmer has decided to hedge with live cattle futures. Specifically, he has entered into the appropriate number of cattle future position for September delivery that he believes will help offset any buffalo price declines during the winter slaughter season. The appropriate position and the likely sources of basis risk in the hedge are, respectively:

    A. Short; choice of futures delivery date.

    B. Short; choice of futures asset.

    C. Short; choice of futures delivery date and asset.

    D. Long; choice of futures delivery date and asset.

Answer: C

The farmer needs to be short the futures contracts. The two sources of basis risk confronting the farmer will result from the fact that he is using a cattle contract to offset the price movement of his buffalo herd. Cattle prices and buffalo prices may not be perfectly positively correlated. As a result, the correlation between buffalo and cattle prices will have an impact on the basis of the cattle futures contract and spot buffalo meat. Also the delivery date is a problem in this situation, because the farmer’s hedge horizon is winter, which probability will not commence until December or January. In order to maintain a hedge during this period, the farmer will have to enter into another futures, which will introduce an additional source of basis risk.

41. You wish to hedge an investment in Zirconium using futures. Unfortunately, there are no futures that are based on this asset. To determine the best futures contract for you to hedge with, you run a regression of daily changes in the price of Zirconium against daily changes in the prices of similar assets which do have futures contracts associated with them. Based on your results, futures tied to which asset would likely introduce the least basis risk into your hedging position?

Change in price of Zirconium = α+ β (Change in price of Asset)			
Asset	**α**	**β**	**R^2**
A	1.25	1.03	0.62

B	0.67	1.57	0.81
C	0.01	0.86	0.35
D	4.56	2.30	0.45

A. Asset A

B. Asset B

C. Asset C

D. Asset D

Answer B

Futures on an asset whose price changes are most closely correlated with the asset you are looking to hedge will have the least basis risk. This is determined by examining the R^2 of the regressions and choosing the highest one. R^2 is the most applicable statistic in the above chart to determine correlation with the price of Zirconium.

42. Imagine a stack-and-roll hedge of monthly commodity deliveries that you continue for the next five years. Assume the hedge ratio is adjusted to take into effect the mistiming of cash flows but is not adjusted for the basis risk of the hedge. In which of the following situations is your calendar basis risk likely to be greatest?

A. Stack and roll in the front month in oil futures.

B. Stack and roll in the 12-month contract in natural gas futures.

C. Stack and roll in the 3-year contract in gold futures.

D. All four situations will have the same basis risk.

Answer: A

The oil term structure is highly volatile at the short end, making a front-month stack-and-roll hedge heavily exposed to basis fluctuations. In natural gas, much of the movement occurs at the front end, as well, so the 12-month contract won't move as much. In gold, the term structure rarely moves much at all and won't begin to compare with oil and gas.

43. Pear, Inc. is a manufacturer that is heavily dependent on plastic parts shipped from Malaysia. Pear wants to hedge its exposure to plastic price shocks over the next 7 ½ months. Futures contracts, however, are not readily available for plastic. After some research, Pear identifies futures contracts on other commodities whose prices are closely correlated to plastic prices. Futures on Commodity A have a correlation of 0.85 with the price of plastic, and futures on Commodity B have a correlation of 0.92 with the price of plastic. Futures on both Commodity A and Commodity B are available with 6-month and 9-month expirations. Ignoring liquidity considerations, which contract would be the best to minimize basis risk?

A. Futures on Commodity A with 6 months to expiration

B. Futures on Commodity A with 9 months to expiration

C. Futures on Commodity B with 6 months to expiration

D. Futures on Commodity B with 9 months to expiration

Answer: D

In order to minimize basis risk, one should choose the futures contract with the highest correlation to price changes, and the one with the closest maturity, preferably expiring after the duration of the hedge.

Key Point: Hedging Strategy

- **Optimal Hedge Ratio**

$$h^* = \rho \frac{\sigma_S}{\sigma_F}$$

- **Hedge Effectiveness**

$$R^2 = h^{*2} \frac{\sigma_F^2}{\sigma_S^2}$$

- **Optimal Number of Futures Contracts**

$$N^* = \frac{h^* N_A}{Q_F}$$

- **Hedging with Stock Index Futures**

$$N^* = \beta \times \frac{P}{A}$$

- **Adjusting Portfolio Beta**

$$\text{\# of contracts} = (\text{target beta - portfolio beta}) \times \frac{\text{portfolio value}}{\text{underlying asset}}$$

- **Duration-Based Hedge Ratio**

$$\text{\# of contracts} = -\frac{\text{portfolio value} \times \text{duration}_p}{\text{futures value} \times \text{duration}_F}$$

44. The hedge ratio is the ratio of derivatives to a spot position (or vice versa that achieves an objective such as minimizing or eliminating risk. Suppose that the standard deviation of quarterly changes in the price of a commodity is 0.57, the standard deviation of quarterly changes in the price of a futures contract on the commodity is 0.85, and the correlation between the two changes is 0.3876. What is the optimal hedge ratio for a 3-month contract?

A. 0.1893

B. 0.2135

C. 0.2381

D. 0.2599

Answer: D

The optimal hedge ratio can be determined by the formula:

$$h = \rho_{s,f} \times \frac{\sigma_s}{\sigma_f} = 0.3876 \times \frac{0.57}{0.85} = 0.2599$$

45. On Nov 1, Jimmy Walton, a fund manager of a USD 60 million US medium-to-large cap equity portfolio, considers locking up the profit from the recent rally. The S&P 500 index and its futures with the multiplier of 250 are trading at 900 and 910, respectively. Instead of selling off his holdings, he would rather hedge two-thirds of his market exposure over the remaining 2 months. Given that the correlation between Jimmy's portfolio and the S&P 500 index futures is 0.89 and the volatilities of the equity fund and the futures are 0.51 and 0.48 per year respectively, what position should he take to achieve his objective?

A. Sell 250 futures contracts of S&P 500

B. Sell 169 futures contracts of S&P 500

C. Sell 167 futures contracts of S&P 500

D. Sell 148 futures contracts of S&P 500

Answer: C

The optimal hedge ratio is the product of the coefficient of correlation between the change in the spot price and the change in futures price, and the ratio of the volatility of the equity fund and the futures.

Two-thirds of the equity fund is worth USD 40 million. The optimal hedge ratio computed:

h = 0.89 × (0.51 / 0.48) = 0.945

Computing the number of futures contracts:

N = 0.945 × 40,000,000 / (910 × 250) = 166.26 ≈ 167, round up to nearest integer.

46. The current value of the S&P 500 index is 1457, and each S&P futures contract is for delivery of 250 times the index. A long-only equity portfolio with market value of USD 300,100,000 has beta of 1.1. To reduce the portfolio beta to 0.75, how many S&P futures contract should you sell?

A. 288 contracts

B. 618 contracts

C. 906 contracts

D. 574 contracts

Answer: A

This is as in the previous question, but the hedge is partial, i.e. for a change of 1.10 to 0.75. So,

$$N = (\beta_{new} - \beta_{old}) \times \frac{\text{size of spot position}}{\text{size of one futures contract}} = (0.75 - 1.1) \times \frac{300{,}100{,}000}{250 \times 1{,}457} = -288$$

47. A trader executes a $420 million 5-year pay fixed swap (duration 4.433) with one client and a $385 million 10 year receive fixed swap (duration 7.581) with another client shortly afterwards. Assuming that the 5-year rate is 4.15% and 10-year rate is 5.38% and that all contracts are transacted at par, how can the trader hedge his position?

   A. Buy 4,227 Eurodollar contracts

   B. Sell 4,227 Eurodollar contracts

   C. Buy 7,185 Eurodollar contracts

   D. Sell 7,185 Eurodollar contracts

Answer: B

Step1. First swap is equivalent to a short position in a bond with similar coupon characteristics and maturity offset by a long position in a floating-rate note.

Its $\text{DV01}=420 \times 4.433 \times 0.0001=0.186$.

Step2. Second swap is equivalent to a long position in a bond with similar coupon characteristics and maturity offset by a short position in a floating-rate note.

Its $\text{DV01}=385 \times 7.581 \times 0.0001=0.291$.

Step3. Net DV01 of portfolio = -0.186+ 0.291 = 0.105m = 105,683

Step4. The optimal number is $N^* = -\text{DV01}_S / \text{DV01}_F = -105{,}683 / 25 = -4{,}227$ (Note that the DVBP of the Eurodollar futures is about 25.)

48. A bronze producer will sell 1,000 mt (metric tons) of bronze in three months at the prevailing market price at that time. The standard deviation of the change in the price of bronze over a 3-month period is 2.6%. The company decided to use 3-month futures on copper to hedge the exposure. The copper futures contract is for 25mt of copper. The standard deviation of the futures price is 3.2%. The correlation between 3-month changes in the futures price and the price of bronze is 0.77. To hedge its price exposure, how many futures contracts should the company buy/sell?

   A. Sell 38 futures

   B. Buy 25 futures

   C. Buy 63 futures

   D. Sell 25 futures

Answer: D

To hedge the exposure, the company should sell futures and not buy.

The number of contracts to sell is: