**1.**

P = 10,000

r = 6/10,000 = 0.0006

t = 365

m = 1

You have to pay V(t) = P\*(1 + r)t = or V(365) = 10,000 \* (1 + 0.0006)365 = 12,447.49527 dollars

The equivalent interest rate is R =100 \* (12,447.49527 – 10,000) / 10,000 = 24.47495267%

**2.**

A(0) = 100

A(T) = 110

S(0) = 90

S(T) = 115 with probability 0.70

S(T) = 70 with probability 0.30

Suppose we invest $14,000 in 100 shares of S and 50 shares of A.

V(T) = 115\*100 + 110\*50 = 17,000, if the stock goes up

V(T) = 70\*100 + 110\*50 = 12,500, if the stock goes down

KV = 100 \* (17,000 – 14,000) / 14,000 = 21.42857143%, if stock goes up

KV = 100 \* (12,500 – 14,000) / 14,000 = -10.71428571%, if stock goes down

Expected return:

E[*KV*] = 21.42857143% \* 0.70 + (-10.71428571%) \* 0.30 = 11.78571429%

**3.**

|  |  |
| --- | --- |
| **Forwards Contract** | **Futures Contract** |
| Private contract between two parties (traded in OTC markets) | Traded on an exchange |
| Not standardized | Standardized |
| Usually one specified delivery date | Range of delivery dates, e.g., the week following the maturity date |
| Settled at the end of contract | Settled daily |
| Delivery or final settlement usual Usually closed out prior to maturity. | Some credit risk Virtually no credit risk |

**4.**

**(a)**

Borrow $2000 to buy 20 certificates for $100 each.

▫ After six months sell the 20 certificates for $105 each, gaining $2100.

▫ Use the $2100 to buy 21 certificates for $100 each.

▫ After another six month, sell the 21 certificates for $105 each, gaining $2205.

▫ Clear the loan $2200 ($2000+10% interest).

▫ You earn $5!

**(b)**

The price of the certificate after six month is related to the interest rate under semi-annual compounding.

▫ If this interest rate is 𝑟, then the price will be (1 + 𝑟/2).

▫ Arbitrage will disappear if the growth factor (1 + 𝑟/2)2 over 1 year is equal to the growth factor 1.1 under annual compounding.

(1 + 𝑟/2)2 = 1.1

Solving the equation we get *r* ~ 0.09761769634

The certificate price after 6 month should be 100 \* (1 + 𝑟/2) ~ 104.8808848

What will happen if the certificate after six months is $104.8808848?

▫ After six months sell the 20 certificates for $104.8808848 each, gaining $2097.617696.

▫ Use the $2097.617696 to buy 20.97617696 certificates for $100 each.

▫ After another six month, sell the 20.8 certificates for $104.8808848 each, gaining $2199.999999.

▫ Clear the loan $2200 ($2000+10% interest).

▫ You earn ~ 0, so there is no arbitrage opportunity.

**5.**

**(a)**

Bond face value F = 100

Maturity T = 10

Coupon value C = 1

Coupon frequency Q = 0.25

Risk-free interest rate r = 1.3%

Bond value V(0) = 125.257722

**(b)**

Interest rate r1 = 1.3%, r2 = 1.45%

Bond value V(0) = 123.745157

**(c)**

Bond price V = 123.745157

Constant risk-free interest rate r = 1.44%

**(d)**

Bond price = Bond face value F = 100

Interest rate r1 = 1.3%, r2 = 1.45%

C = 38.44

**6.**

**(a)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***t*-days** | ***f*(*t, T*)** | **Cash Flow** | **Margin 1** | **Payment** | **Margin 2** |
| 0 | 150 | Opening | 0 | -15 | 15 |
| 1 | 154 | +4 | 19 | +4 | 15 |
| 2 | 155 | +1 | 16 | 0 | 16 |
| 3 | 150 | -5 | 11 | -4 | 15 |
| 4 | 148 | -2 | 13 | 0 | 13 |
|  |  | Closing | 13 | +13 | 0 |
|  |  |  | Total | -2 |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***t*-days** | ***f*(*t, T*)** | **Cash Flow** | **Margin 1** | **Payment** | **Margin 2** |
| 0 | 150 | Opening | 0 | -15 | 15 |
| 1 | 145 | -5 | 10 | -5 | 15 |
| 2 | 148 | +3 | 18 | +3 | 15 |
| 3 | 143 | -5 | 10 | -4 | 14 |
| 4 | 148 | +5 | 19 | +4 | 15 |
|  |  | Closing | 15 | +15 | 0 |
|  |  |  | Total | -2 |  |

**(b)**

The first scenario is preferable because in the day 1 and day 2, we can withdraw $4 and invest in risk-free rate and then, we have $4 \* (1 + 2%)2 = $4.1616. In the day 3, we have to pay $4 and our investment amount remains $0.1616. Next day, we have $0.1616 \* (1 + 0.02) = $0.164832.

For the second scenario, in day 1, we have to pay $5 and we do not have money to invest. Similarly, after day 2, day 3, and day 4, we have -$2, -$6, and -$2, respectively, so we also do not have money to invest.