Final, Financial Economics

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All questions must be answered on this test form. You must show your work

Question 1: Suppose there are three states at t=1 and two assets. The values of asset 1 in the three states are 10,2, and 4, respectively The values of asset 2 are 2,8,4. At t=0 the price of asset 1 is 6 Dollars and the price of asset 2 is 5 Dollars.

10 points

Denote state prices by q_1 , q_2 , and q_3 . Specify the two equations that q_1 , q_2 , and q_3 must satisfy. *Note: You do not have to solve the equations.*

Equation 1:

Equation 2:

Question 2: Suppose there are two states states s_1 , s_2 . Stock A has a return of 10% in state s_1 and 0% in state s_2 . Asset B has a riskless return of 2%.

Then the probabilities of states s_1 , s_2 that allow for risk neutral valuation are given by

12 points

 $\pi_1 =$, $\pi_2 =$

Recall that a put option on the stock gives the holder the right to sell the stock at t=1 for a price K, the strike price. Suppose that the price of the stock at t=0 is 20, and that the strike price is K=21. Determine the price of the option at t=0.

The price of the put option at t=0 is

The stock price at t=0 is again 20. A futures contract for the stock determines a price q (the futures price) at which the holder of the contract (the long position) must buy the stock at t=1, and the short position must sell - *no money changes hands at t=0*. The futures price q is determined by demand and supply. As a consequence, at the equilibrium q must be such that the value of the futures contract at t=0 is zero (else there would be an arbitrage as the next question indicates).

Therefore the futures price q=

Question 3: Suppose there are three states. The probabilities that allow risk-neutral valuation are given by $\pi_1=0.2$, $\pi_2=0.5$, $\pi_3=0.3$. The riskless rate is 5%. There is a stock with a value of 20, 70, or 10 in each of the three states at t=1. In addition, there is a call option on the stock with a strike price of 28 (this provides the right but not the obligation to buy the stock at t=1 for \$28).

10 points

At t=0 the price of the stock is	, and the price of the option is
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Now suppose there is a futures contract with futures price q=20. Recall that the payoff of someone who is long in futures contract is S-q, where S is the stock price at t=1 (the person must buy the stock at q and hence makes a profit of S-q). You can check that at this price E*[S-q] \neq 0, which as claimed in Question 2 means that there is an arbitrage.

An arbitrage portfolio is given by (denote long position by positive numbers and short positions by negative numbers. Scale the numbers such that they are all integers).

units of the riskless asset (Assume each unit is 1 Dollar of face value)
units of the stock
call options
future contracts

10 points

	А	В	С	D	Ε	F	G	Н	Ι
1	Date	CAT Stock Price	S&P 500	6 Month T-bill rate					
2	4/06/09	31.07	856.56	4.9%					
3	4/13/09	31.25	869.60	4.95%					
4	4/20/09	32.55	866.23	5.01%					
5	4/27/09	36.06	877.52	5.01%					
6	5/4/09	38.63	929.23	5.05%					

Question 4: The stock price of Caterpillar (CAT) and of the S&P500 are given below

You want to estimate alpha and beta using weekly data for one year for CAT. On the top is the beginning of your spreadsheet. Label the columns (you don't need to use all of them), fill in the missing entries above, and specify the Excel formula for column 3 in the boxes below.

E3:	
F3:	
G3:	
Н3:	
I3:	

In the regression the dependent variable (Y) is:

In the regression the explanatory variable(s) (X) is (are):

Question 5: Suppose there are two assets, A and B. Their mean returns are 0.09, and 0.27, respectively. The standard deviations are 0.15 and 0.30. The correlation between returns of A and B is -1.

Graph the set of all feasible portfolios by shading it. Also clearly indicate the efficient frontier. *12 points*



μ

Question 6: Suppose there are three assets A, B, C with mean returns 0.1, 0.15, and 0.23. The standard deviations of all assets are identical equal to 0.1 and the correlation is zero. Determine the MRP, i.e., the portfolio (a_1,a_2,a_3) with the lowest standard deviation (recall that $a_1+a_2+a_3=1$.) Specify and solve the Lagrangian.

The return of the MRP =

12 points

Question 7: Suppose the following Government bonds are traded. Face value is always \$100. All coupons are paid semiannually (if applicable).

- A) A Zero coupon bond that expires in 6 months. Current price \$99.00
- **B**) A Zero coupon bond that expires in 12 months. Current price \$97.50
- **C)** A bond with 4% coupon rate (next coupon payment in 6 months) that expires in 18 months. Current price \$101.50
- **D)** A bond with a 6% coupon rate (next coupon payment in 6 months) that expires in 2 years. Current price \$104.25

Then (report 3 digits after the period, i.e., up to 1/10 of a cent. Face value=100)

The price of a zero coupon bond that expires in 18 month is \$

The price of a zero coupon bond that expires in 2 years is \$

Determine the yield curve (i.e., the spot yield of zero coupon bonds with the indicated maturity)

maturity	6months	1 year	1 ½ years	2 years
yield (%)				

12 points

Question 8: Consider the following prices for zero coupon bonds

Maturity	aturity ¹ / ₂ year 1 year		1 ½ years	2 years	
Price	99.10	97.44	94.92	92.31	

Determine the price of a bond that pays semiannual coupons with a coupon rate of 6% and face value \$100 that matures in 2 years.

The price of the bond is \$

Determine the coupon rate of a bond with semiannual coupons and face value \$100 that sells at par and matures in 2 years (*report three digits after the period*).

The coupon rate is	%	
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Determine the forward rate on a zero coupon with maturity of one year, issued in one year (i.e., if you can enter a contract now that determines the yield to be paid on a zero coupon (issued in one year, maturing in the following year), what must the yield be in order for there not to be an arbitrage?

The forward rate	is	%
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12 points

Question 9: On May 5, 2010 the spread on credit default swaps (CDSs) for 5 year Greek governments bonds reached a record of 865 basis points. That is, suppose you buy a such a CDS and hold a 5 year Greek government bond with face value 100 Euro at the same time, then you must pay Euro 8.65 per year to the issuer of the CDS. In exchange for that, the issuer of the CDS will compensate you for any interest or principal payments that the Greek government defaults on. In other words, if you have a portfolio consisting of a CDS and the underlying bond, then this would be equivalent to holding a bond without default risk (because after paying the fee on the CDS you are promised to receive principal and interest either from the Greek government or the issuer of the CDS).

The German government is planning to provide a loan of 27 Billion Euro to Greece at an interest rate of 5% annually (one 5% coupon per year), with 5 year maturity. We want to determine the cost to the German government of providing the loan. One way to price the risk of default is to use CDSs. I.e., suppose you hold CDSs in addition to the loan to completely insure agains default risk. As a consequence, you pay the annual fee in years 1 to 5 of 8.65% of the principal of 27 Billion to the issuer of CDS in exchange for making the coupon and principal payments riskless.

In the first row of the table below, list the net payments Germany gets/makes in each year - negative numbers if Germany is a net payer, and positive, otherwise (assuming that the loan is completely insured via CDSs). The first number is already filled in. In the second row, determine the present value of each number in the row above, assuming a riskless rate of 3% (flat yield curve).

date	now	1 year	2 years	3 years	4 years	5 years
payment in Billions	-27					
present value in Billions	-27					

Thus, you can conclude that present value of the cost to the German government of providing the loans is

Billion Euro

Give that the population of Germany is 82 Million, the

per capita cost is Euro