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Problem 1.1

Assume that the spot price of gold is $5,050 per ounce. Suppose that the market quotes a forward contract on gold with delivery in 1 year at $5,200.00. The risk-free interest rate is r = 3.5%.

i) Is there an arbitrage opportunity? If yes, describe the steps required to realize the arbitrage. What is the profit we can expect to make?

Fair forward price: $ 5,229.88 =5050*EXP(0.035)

Yes, there is an arbitrage opportunity as the 1 year forward contract value of $5,200 is less than the fair forward value.

Strategy: At t=0, you should short 1 oz of gold and receive $5,050. This money should be invested at the risk-free rate of 3.5%. You should also long the $5,200 forward contract.
At t=1, your investment will have grown to about $5,229.88. You should buy gold via the forward for $5,200 and use it to close your short position.
This strategy will result in a profit of about $29.88 per ounce.

ii) Consider now the case when the forward price is $5,300.00. Is there an arbitrage opportunity? If yes, describe the steps required to realize the arbitrage.

Once again, there is an arbitrage opportunity as the forward price of $5,300 exceeds the fair value of $5,229.88.

Strategy: At t=0, you should borrow $5,050 at the risk-free rate and purchase 1 oz of gold. You should also short the $5,300 forward contract.
At t=1, you should supply the gold for the forward contract and receive $5,300. You should use this money to repay your loan and interest of $5,229.88.
This will result in a profit of $70.12 per ounce.

Problem 1.2		
Assume that an interest rate is quoted as 3.25% with semi-annual compounding. What is the rate when expressed with:		
i) annual compounding.		
Risk-Free Rate:	3.25%	
Annual Rate:	3.2764%	=(1+(B5/2))^2-1
ii) quarterly compounding.		
Quarterly Rate:	3.2369%	=(((1+B6)^(1/4))-1)*4
iii) continuous compounding.		
Continuous Rate:	3.2239%	=LN(1+B6)

Problem 1.3

Credit card companies quote the APR on the outstanding balance. APR means Annual Percentage Rate and is the interest rate with annualized compounding. Typical APRs are shown in the Table below. However, credit card interest rate is compounded daily, for 365 days a year.

Suppose the balance on a credit card is $10,000. Compute the total balance including interest after 30 days, if the customer has Excellent Credit?

Initial Balance:	$ 10,000	
Excellent Credit Rate:	17.15%	
Daily Interest Rate:	0.0470%	=B10/365
30 Day Growth:	101.4192%	=(1+B12)^30
Total Balance:	$ 10,141.92	=B9*B13

Problem 1.4

We are given the zero rates R(T) for several maturities in Table 2. These zero rates apply for all maturities in the ranges shown.

1) Price a bond B1 with annual coupon 5.0% paid twice a year with maturity 2Y.

B_1 Price: $2.5e^{-0.03(0.5)} + 2.5e^{-0.03} + 2.5e^{-0.035(1.5)} + 102.5^{-0.035(2)}$

$= \$102.83$

2) Price a bond B2 with annual coupon 6.0% paid twice a year, with maturity 10Y.

B2 Price: $\sum_{t=1}^{2} 3e^{-0.03(0.5t)} + \sum_{t=3}^{4} 3e^{-0.035(0.5t)} + \sum_{t=5}^{9} 3e^{-0.0425(0.5t)} + \sum_{t=10}^{19} 3e^{-0.045(0.5t)} + 103e^{-0.045(10)}$

$= 5.687 + 5.597 + 12.551 + 21.436 + 65.676$

$\approx \$111.13$

3) Compute the bond yields of the two bonds in points 1) and 2).

B1 Yield: $102.8314 = 2.5e^{-x_1(0.5)} + 2.5^{-x_1} + 2.5^{-x_1(1.5)} + 102.5^{-x_1(2)}$

$x_1 \approx 3.49\%$

B2 Yield: $111.127 = \sum_{t=1}^{19} 3e^{-x_2(0.5t)} + 103e^{-x_2(10)}$

$x_2 \approx 4.49\%$

Problem 1.5

A US company is due to make a payment of 1.0m Euros in 6 months. They plan to hedge this payment by taking a long position in a forward contract for 1.0m Euros with maturity 6 months, at a forward exchange rate 1.150. The current EUR/USD rate is X0 = 1.100, and the actual exchange rate realized at maturity is X(6M) = 1.175.

i) What is the gain or loss of the company at maturity?

Need to Pay:	$ 1,000,000	
Hedge:	1.15	
Spot Today:	1.1	
Spot at Maturity:	1.175	
Unhedged Cost:	$ 1,175,000	=B9*B12
Hedged Cost:	$ 1,150,000	=B9*B10
Gain:	$ 25,000	=B14-B15

ii) What is the interest rate differential rU SD − rEU R for maturity 6M implied by the quoted forward FX rate?

Forward / Spot Ratio:	1.0455	=B10/B11
Rate Differential:	8.89%	=LN(B20)/0.5