HW1
FE620
Hrishi Menta

1.1) No-arb forward: $F^* = S_0 e^{rT} = 5050 \cdot e^{0.035 \cdot 1}$

$F^* \approx 5230.88$

i) $5200 < 5230.88$ → underpriced → arb ✓

Arb:

1) Short sell 1 oz gold, get +5050

2) Invest 5050 @ r for 1 yr → grows to $5050 e^{0.035}$

3) Go long 1Y forward @ $F_0 = 5200$

4) @ maturity use forward to buy 1 oz for 5200, return to cover short

Profit: $\Pi = 5230.88 - 5200 = \boxed{30.88}$

ii) $5300 > 5230.88$ => forward overpriced

Arb: 1) Borrow 5050 @ r

2) Buy 1 unit gold

3) Short forward @ 5300

4) Deliver gold @ maturity / repay loan

Cash Flow: Forward = 5300, Loan Repayment = $5050 e^{0.035} = 5230.88$

profit: $\Pi = 5300 - 5230.88 = \boxed{69.12}$

1-2) Nominal = 3.25%, $n = 2$

$EAR = (1 + 0.0325/2)^2 - 1 = 0.03276406$

i) $\boxed{3.276\%}$

ii) $(1 + R_4/4)^4 = (1.01625)^2 \Rightarrow (1.01625)^{1/2} = \sqrt{1.01625}$

$R_4 = 4((1.01625)^{1/2} - 1) \approx \boxed{3.2369\%}$

iii) $R_c = m \ln(1 + R_m/m)$

$R_c = 2 \ln(1 + 0.0325/2) = 2 \ln(1.01625) \approx \boxed{3.224\%}$

$B_0 = 10000$

ARR = 17.15% = 0.1715

Daily

1.3)

$r_d = 0.1715 / 365 = 0.000469863013699$

$B_{30} = 10000\left(1 + \frac{0.1715}{365}\right)^{30} \approx \boxed{10141.9}$

Interest = $10141.9 - 10000 = \boxed{141.92}$

1.4)

1) B_1: 2Y, 5% semiannually

Cashflows:	Discount factors:
$t = 0.5$: 2.5 ($R = 3\%$)	$D(0.5) = e^{-0.03(0.5)}$
$t = 1.0$: 2.5 ($R = 3\%$)	$D(1) = e^{-0.03}$
$t = 1.5$: 2.5 ($R = 3.5\%$)	$D(1.5) = e^{-0.035(1.5)}$
$t = 2.0$: 102.5 ($R = 3.5\%$)	$D(2) = e^{-0.035(2)}$

Price: $B_1 = 2.5D(0.5) + 2.5D(1) + 2.5D(1.5) + 102.5D(2)$

$\boxed{B_1 \approx 102.83}$

2) Half yr coupon: 3, Last cashflow @ 10Y is 103

Payment: 0.5, 1, ..., 10 (20 total)

$B_2 = \sum_{i=1}^{19} 3e^{-R(t_i)t_i} + 103e^{-R(10)(10)} \approx \boxed{111.84}$

3) B_1 yield y_1: $102.83 = 2.5e^{-y_1(0.5)} + 2.5e^{-y_1(1)} + 2.5e^{-y_1(1.5)} + 102.5e^{-y_1(2)}$

$y_1 \approx 0.034911 \Rightarrow \boxed{3.491\%}$

B_2 yield y_2: $111.84 = \sum_{i=1}^{19} 3e^{-y_2 t_i} + 103e^{-y_2(10)}$

$y_2 \approx 0.044965 \Rightarrow \boxed{4.496\%}$

1.5)

Pay $N = 1{,}000{,}000$ in 6 months (1/2 yr)

Long EUR, mat 6M, $F = 1.150$ USD/EUR

$X_0 = 1.1$, $X_T = 1.175$, $T = 0.5$

i) Payoff $= (X_T - F)N = (1.175 - 1.15) \cdot 1000000$

$= \boxed{25{,}000 \text{ USD}}$

ii) $F = X_0 e^{(r_{USD} - r_{EUR})T} \Rightarrow$

$(r_{USD} - r_{EUR}) = 1/T \ln(F/X_0) = 1/0.5 \ln\left(\frac{1.15}{1.1}\right)$

$= 2\ln(1.04545) \approx 0.088904$

$\boxed{r_{USD} - r_{EUR} \approx 8.89\% \text{ p/yr}}$