Capital Markets and Asset Pricing
Goethe Business School
Summer Term 2022
Dr. Christoph Hambel
Retake Exam

- The exam is open book, i.e., any dead objects may be used.
- Any kind of communication with other persons will be considered cheating.
- The working time is 90 minutes.
- The exam consists of three problems. The maximum number of points in every problem is 30, so that the maximum number of total points in the exam is 90.
- There are two types of problems:

  1. Problems with a text entry field

     You are supposed to answer those questions by writing a text.

  2. Problems with a number input box

     Input box in LPlus for xx

     These boxes will be corrected automatically in LPlus. If your answer is correct, you will get the points. You will also have the opportunity, but not the obligation, to explain your calculations at the end of each problem. I will check your explanations only if your solution in the box is wrong. In this case, I can give you some points if your documentation is understandable and evident.

Problem 1 (Bond Pricing) There are three riskless Treasury bonds traded on the market. The first Treasury bond has a maturity of one year and an annual coupon of 1%, the second Treasury bond has a maturity of two years and an annual coupon of 2%, and the third bond has a maturity of three years and an annual coupon of 3%. All bonds have a notional of 100 euros. The Treasury bonds are currently traded at par.

(a) Calculate the continuously compounded zero rates for the Treasury bonds. What are the corresponding forward rates? (*8 credits*)

Input box in LPlus for $r(1)$:

Input box in LPlus for $r(2)$:

Input box in LPlus for $r(3)$:

Input box in LPlus for $f(0)$:

Input box in LPlus for $f(1)$:

Input box in LPlus for $f(2)$:

(b) Explain the term structure of interest rates in this particular market. Which other types of term structures exist in reality? (*4 credits*)

(c) The bonds in this problem are not affected by liquidity risk or credit risk. Explain carefully why and how these types of risks affect bond yields. (*6 credits*)

(d) Consider the two-year Treasury bond. Determine its

(i) Current yield *(2 credits)*

Input box in LPlus for $y_{current}$:

(ii) Simple redemption yield *(2 credits)*

Input box in LPlus for y_{simple}:

(iii) Discretely compounded yield-to-maturity *(2 credits)*

Input box in LPlus for y_d:

(iv) Continuously compounded yield-to-maturity *(2 credits)*

Input box in LPlus for y_c:

(e) The government has recently decided to emit a consol bond with an annual coupon payment of 60 euros. The consol bond is being traded at a price of 2000 euros. Determine its discretely compounded and continuously compounded yield-to-maturity, respectively. *(4 credits)*

Input box in LPlus for y_d:

Input box in LPlus for y_c:

Problem 2 (Option Pricing) We consider a one-period model where three securities are traded (stock, one-year Treasury bond with notional 1, and a call option with maturity 1 and strike price 100). The current stock price is 100 Euros, the current price of the zero-coupon Treasury bond is 0.99 Euros, and the call price is 5 Euros. At the end of the period, three states can occur (up, middle, down). The payoffs of the stock are 120, 100, and 80 Euros in the up, middle, and down state, respectively.

(a) What is the discretely compounded risk-free rate in this economy. (*2 credits*)

Input box in LPlus for r:

(b) Calculate the prices of the elementary securities. (*8 credits*)

Hint: In the first step, you should construct the payoff of the call option in $T = 1$. *If* you are unable to construct this payoff you may assume $C_u = 30$, $C_m = 10$, and $C_d = 0$.

Input box in LPlus for π_u:

Input box in LPlus for π_m:

Input box in LPlus for π_d:

(c) Determine the risk-neutral probabilities in every state. (*3 credits*)

Input box in LPlus for q_u:

Input box in LPlus for q_m:

Input box in LPlus for q_d:

(d) Is this market free of arbitrage? Explain carefully. (*3 credits*)

(e) Is this market complete? What would be different if the call option were not traded on the market? (*4 credits*)

(f) Determine the price of a put option with a strike price of 100 and maturity in one year. (*5 credits*)

Input box in LPlus for P:

(g) The current framework is very simplistic. A popular alternative is the Black-Scholes model. Elaborate on advantages and disadvantages of the Black-Scholes model. (*5 credits*)

Problem 3 (CAPM and APT)

(a) Are the following statements true or false? Explain your answers carefully.

(i) Suppose the CAPM holds. The systematic risk of an asset is always larger than its idiosyncratic risk. (*3 credits*)

(ii) Suppose the CAPM holds. An asset whose expected return is above the security market line is undervalued. (*3 credits*)

(iii) The CAPM can hardly be tested empirically. (*3 credits*)

(iv) Suppose the Fama-French 3-Factor model holds. Small stocks generate higher expected returns than large stocks if anything else is equal. (*3 credits*)

(v) The arbitrage pricing theory assumes that all investors are μ-σ-optimizers. (*3 credits*)

(b) Assume that the CAPM holds. Assume that the risk-free rate is 0.75% and the expected market return is $\mu_M = 7\%$. The volatility of market return is estimated to be 15%. An exchange-traded fund (ETF) has a beta of 1.25 with respect to the market portfolio and a volatility of 30%.

(i) Determine the systematic risk and the idiosyncratic risk of this fund. (*5 credits*)

Input box in LPlus for systematic risk:

Input box in LPlus for idiosyncratic risk:

(ii) Calculate the correlation between the fund and the market (*4 credits*)

Input box in LPlus for $\rho_{M,P}$:

(iii) Determine the expected return of the ETF? (*3 credits*)

Input box in LPlus for μ:

(iv) Determine the beta of an asset that generates an expected return of 5% (*3 credits*)

Input box in LPlus for β: