

Undergraduation in Finance
Money and Banking
Exam – 7 January 2026

1. Considering the information below about a portfolio of loans to be classified according to the original Altman Z-score model, being h_i the number of defaults during each year i and n_i the number of existing loans after defaults and redemptions in each maturity.

Maturity (Years from today)	h_i	n_i
1	0	100
2	0	90
3	2	85
4	3	82
5	2	80

- 1.1 Characterize the credit risk model mentioned, describing its variables, explaining in which sense does this model use information from the stock market and identifying the main differences to the Merton model. **(3,0/20)**

- The model was developed for listed companies, using 22 financial ratios from 66 companies between 1946 and 1965, evenly split between defaulting and non-defaulting companies:

where:

X_1 = working capital (net) / total assets; X_2 = retained earnings/ total assets

X_3 = EBIT / total assets; X_4 = market capitalization/book value of long-term liabilities

X_5 = sales/total assets

-The PD decreases with the Z-Score:

- $Z < 1,81$ – defaulting companies
- $Z > 2,99$ – non-defaulting companies

- The model uses market information through X_4 , but not using the option theory framework and stock prices, according to which the PD is the probability of the market value of assets being lower than the par value of debt at its redemption date.

- 1.2 Compute and compare the cumulative observed and Kaplan-Meier probabilities of default. **(3,0/20)**

- See spreadsheet

2. Considering the following information about the static marginal gaps of a bank operating in the Euro Area:

	<1week	1week-1month	1-3 months	3-6 months	6-12 months
Liquidity	100	300	-150	-500	200
Interest Rate	200	400	300	600	500

- 2.1. Characterize the types of risks mentioned and identify the major resulting fragilities. **(2,5/20)**

liquidity risk – the risk of losing the ability to have enough cash to keep operating smoothly, while the bank is solvent. Sometimes, it is also referred to as rollover risk. Stems from the mismatch between assets and liabilities involved in liquidity intermediation, by channeling savings to investment projects, through maturity transformation.

Interest rate risk – it is the risk of interest rate moves to impact on the NII and consequently on the NI of banks due to the difference repricing procedures of assets and liabilities

Main fragilities:

- liquidity risk - liquidity shortfall in 3-6 month horizon, as this is the time bucket where cumulative gaps become negative.
- interest rate risk – decrease in interest rates, as all marginal interest rate gaps are positive.

- 2.2. Characterize the main alternative indicators to assess liquidity risk. **(2,0/20)**

Besides gaps, we have the regulatory ratios (LCR and NSFR; to be detailed) and the level of eligible collaterals to obtain liquidity from the ECB, as a necessary condition to have access to ECB liquidity facilities is to comply with minimum capital requirements.

- 2.3. Explain how interest rate decreases occurred last year impacted on the Net Income, also characterizing its main components? **(2,0/20)**

With positive interest rate gaps, the decrease in interest rates impacted adversely on the NII and consequently on the NI.

Main components:

Gross Income = NII + Fees/Comissions and Results from Financial Operations

Operational Costs

Provisions for Impairments

3. Considering that the bank owns 1000 2-year Government bonds, valued at par, with a redemption value of 100 Euros and a coupon rate of 2,5%:

- 3.1. Compute the Duration and the Modified Duration of these bonds. **(2,5/20)**

- See spreadsheet

- 3.2. Characterize the interest rate risk of this portfolio and compare it to the interest rate risk approached in question 2. **(2,5/20)**

- the magnitude of the interest rate risk seems low, as the duration is below 2. This interest rate risk refers to debt securities priced according to market values, while the interest rate

risk assessed in question 2 refers to assets and liabilities not valued according to market prices

3.3. Present a duration hedging strategy for the interest rate faced by the bank and characterize the impact on duration of an increase in the coupon rate. **(2,5/20)**

- hold q units of the hedging instrument so that

$$dP + qdH = (qH'(y) + P'(y))dy = 0$$

- solution:

$$q = -\frac{P'(y)}{H'(y)} = -\frac{P \times D_P}{H \times D_H}$$

- An increase in the coupon rate increases the weight of intermediate cash-flows against the final cash-flow, bringing the duration downward.