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Meta Discussion / 01
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Financial Computations with Formulas, Spreadsheets and Generative Artificial Intelligence

Quantitative Finance Exam for Solicitors[1]

1 - Simple Interest Regime

A debt, contracted at a quarterly interest rate of 2%, will be settled through three payments of principal and interest: €14,000 in 10 months, €12,000 in 15 months, and €16,000 in 20 months. Simple interest regime. Calendar base 30/360. Calculate:

a) The present value of the debt (at time 0) using the internal discount method.
b) The present value of the debt (at time 0) using the external discount method.

A: a) EUR 38,151.74 and b) EUR 37,733.33

2 - Compound Interest Regime

Consider an investment of €50,000 for 1 year with the following characteristics:

- Net interest capitalized quarterly (28% income withholding tax)
- Variable annual nominal gross interest rate convertible quarterly indexed to 3M EURIBOR, with a subtractive spread of 0.25%
- Cumulative quarterly permanence premium of 0.25%, starting from the second semester of the investment, applicable to the gross annual nominal rate in force each quarter
- 3M EURIBOR applicable successively in the four semesters of the investment: 2.75%, 2.50%, 2.25%, 2.00%.
- Compound interest regime and the calendar base is 30/360

Calculate the value obtained from this financial application at the end of the 1st year.
A: EUR 50,837.71

3 – Annuities

You contracted a financial application with a bank where you must deposit €200 at the end of each month for 4 years, which will earn interest at an effective annual interest rate of 2% for the first two years and an effective annual interest rate of 4% for the last two years. Determine the value of the financial application at the end of the 4 years.

4 – Loans

An entrepreneur took out a loan of EUR 80,000 today, to be amortized annually in arrears, over 4 years, based on an APR of 7%, convertible quadrimesterly (calendar base 30/360), with the first payment occurring within 1 year. The agreed amortization method was the Hamburg method. In the first year, there is a grace period for the principal. Prepare the amortization table .

k	Rk-1	jk	Jk	m	Tk	M_k	R_k

[1] I am not the author of the exam.

Solutions to Problem 1 - Simple Interest Regime

Excel Solution

Interest Rate	Paym	Amount	Months	Internal D.	External D.
2%	1º	14000	10	13125.00	13066.67
	2º	12000	15	10909.09	10800.00
	3º	16000	20	14117.65	13866.67
	Total			38151.74	37733.33

Generative AI Solutions

ChatGPT-4o

- Logic: Correct
- Formulas/Equations: Correct
- Replacing formula parameters with problem data: Correct
- Computations: Correct
- Overall: Correct

Claude 3.5 Sonnet

- Logic: Correct
- Formulas/Equations: Correct
- Replacing formula parameters with problem data: Correct
- Computations: Incorrect
- Overall: Incorrect
- Able to correct error when prompted: No

[Claude 3.5 Sonnet]

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Formula: PV = P / (1 + i * n), where PV is the present value, P is the payment, i is the quarterly interest rate, and n is the number of quarters.
  • 1st payment: 14,000 / (1 + 0.02 * 3.3333) = 13,066.67€     << Error
  • 2nd payment: 12,000 / (1 + 0.02 * 5) = 10,909.09€
  • 3rd payment: 16,000 / (1 + 0.02 * 6.6667) = 13.195,88€.    << Error
Total present value (internal discount) = 13,066.67 + 10,909.09 + 13,195.88 = 37,171.64€

This calculation sums up the present values of all three payments to get the total present value of the debt using the internal discount method.
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Solutions to Problem 2 - Compound Interest Regime

Excel Solution

C_0	Tax Rate	n	3M EURIBOR	Spread	Nominal Interest Rate	PP	Net Nominal Interest Rate	Net Quartely Effective Rate	BOP Capital	Interest	EOP Capital
50000	28%	1	2.75%	-0.25%	2.50%		1.80%	0.450%	50000.00	225.00	50225.00
		2	2.50%	-0.25%	2.25%		1.62%	0.405%	50225.00	203.41	50428.41
		3	2.25%	-0.25%	2.00%	0.25%	1.62%	0.405%	50428.41	204.24	50632.65
		4	2.00%	-0.25%	1.75%	0.50%	1.62%	0.405%	50632.65	205.06	50837.71

Generative AI Solutions

ChatGPT-4o

- Logic: Incorrect.
  Didn't take into account that there is a quarterly loyalty premium after the second quarter that is <u>cumulative</u>
- Formulas/Equations: Correct
- Replacing formula parameters with problem data: Correct
- Computations: Correct
- Overall: Incorrect
- Able to correct error when prompted: Yes

[ChatGPT-4o]

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4th Quarter (with loyalty premium):

- EURIBOR 3M: 2.00% per annum.
- Subtract the spread: 2.00% - 0.25% = 1.75% per annum.
- Add loyalty premium: 1.75% + <u>**0.25%**</u> = 2.00% per annum. << Error
- Convert to quarterly rate: 2.00% / 4 = 0.50% per quarter.
- Gross interest for 4th quarter: = 50,632.65 x 0.005 = 253.16
- After 28% retention, net interest = 253.16 x (1 - 0.28) = 182.27
- New balance = 50,632.65 + 182.27 = 50,814.92

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[Human] Notice that the quarterly loyalty premium of 0.25%, starting from the second half of the investment is CUMULATIVE! Perhaps one should take this into account to compute the final value?

[ChatGPT-4o] You're absolutely correct that the cumulative quarterly loyalty premium starting from the second half of the investment needs to be considered. Since the loyalty premium of 0.25% applies cumulatively, it will be added to the interest rate for the third and fourth quarters.

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Let's walk through the updated calculations step by step, taking this into account:
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Step 2: Calculate the interest rates with the spread and cumulative premium
   ◦ 1st Quarter: 2.75% - 0.25% = 2.50%
   ◦ 2nd Quarter: 2.50% - 0.25% = 2.25%
   ◦ 3rd Quarter: 2.25% - 0.25% + 0.25% (loyalty) = 2.25%
   ◦ 4th Quarter: 2.00% - 0.25% + (0.25% + 0.25% loyalty cumulative)
     = 2.25%
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<< Correct

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Claude 3.5 Sonnet

- Logic: Incorrect.
  Didn't take into account that there is a quarterly loyalty premium after the second quarter that is cumulative
- Formulas/Equations: Correct
- Replacing formula parameters with problem data: Correct
- Computations: Correct
- Overall: Incorrect
- Able to correct error when prompted: Yes

[Claude 3.5 Sonnet]

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4th Quarter:

- Gross annual nominal rate: (2,00% - 0,25%) + **0,25%** = 2,00) << Error
- Quarterly rate: 2,00% / 4 = 0,50%
- Gross interest: 50.632,65 * 0,50% = 253,16€
- Net interest: 253,16 * (1 - 0,28) = 182,28€
- Capital at end of quarter: 50.632,65 + 182,28 = 50.814,93€

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Therefore, the final value of this financial investment at the end of the 1st year is 50.814,93€.

[Human] Notice that the quarterly loyalty premium of 0.25%, starting from the second half of the investment is CUMULATIVE! Perhaps one should take this into account to compute the final value?

[Claude 3.5 Sonnet] You're absolutely right, and I apologize for missing that crucial detail. Thank you for pointing it out. The cumulative nature of the loyalty premium indeed changes our calculations. Let's recalculate with this important factor in mind.

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Quarter 4:

- Gross annual nominal rate: (2.00% - 0.25%) + (0.25% * 2) = 2.25% (includes cumulative loyalty premium) << Correct
- Quarterly rate: 2.25% / 4 = 0.5625%
- Gross interest: 50,632.65 * 0.5625% = 284.81€

- Net interest: 284.81 * (1 - 0.28) = 205.06€
- Capital at end of quarter: 50,632.65 + 205.06 = 50,837.71€

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Therefore, the final value of this financial investment at the end of the 1st year is 50,837.71€.

This updated calculation correctly accounts for the cumulative nature of the loyalty premium. The main differences are:
1. In the 3rd quarter, we add a 0.25% loyalty premium.
2. In the 4th quarter, we add a 0.50% loyalty premium (0.25% * 2), as it's cumulative.

Thank you again for catching this important detail. It's a great reminder of how crucial it is to carefully consider all aspects of financial products, especially when they involve cumulative benefits or changing rates over time.