Case 2 (2026): CDS Stripping

The following CDS spreads apply for counterparty "C", assuming annually compounded interest rates of 3% and a LGD (Loss Given Default) of 40%;

Maturity	CDS Rate (in bps)	Formula
1Y	100	$R(1)$
3Y	110	$R(3)$
5Y	120	$R(5)$
7Y	120	$R(7)$
10Y	125	$R(10)$

Exercise

Question 1: The "Simple" Model

Derive the CDS curve, where you assume continuous premium payments, and piece-wise constant hazard rates. To this end:

1. Calculate the Average Hazard rates using $\lambda_{Average}(T) = \frac{R(T)}{LGD}$.
2. From this calculate the cumulative default probability and forward hazard rates.

Please fill in the following table;

Maturity	CDS Rate (in bps)	(Average) Hazard Rate (see above "simple" definition)	Forward Hazard Rate (between T_{i-1} and T_i)	Default Probability (between T_{i-1} and T_i)
1Y	100			
3Y	110			
5Y	120			
7Y	120			
10Y	125			

Note:

- The simplified setup with continuous premium payments is a different procedure as the iterative stripping procedure which you are asked to apply in question 2.
- The main objective is to use the resulting hazard rates and default probabilities from this question and benchmark these outcomes against the results obtained from question 2.
- In Question 3 you are then asked to compare the results between question 1 and 2.

Question 2: The “Exact” Model (Iterative Stripping)

Strip the CDS curve assuming quarterly premiums including accrued premium at default, and piece-wise constant hazard rates. This entails iteratively solving for the Forward Hazard Rates using the following formulas:

- λ_1: $CDS(0,1,R(1),\mathrm{LGD};\{\lambda_1\}) = 0$
- λ_2: $CDS(0,3,R(3),\mathrm{LGD};\{\lambda_1,\lambda_2\}) = 0$
- λ_3: $CDS(0,5,R(5),\mathrm{LGD};\{\lambda_1,\lambda_2,\lambda_3\}) = 0$
- λ_4: $CDS(0,7,R(7),\mathrm{LGD};\{\lambda_1,\lambda_2,\lambda_3,\lambda_4\}) = 0$
- λ_5: $CDS(0,10,R(10),\mathrm{LGD};\{\lambda_1,\lambda_2,\lambda_3,\lambda_4,\lambda_5\}) = 0$

Where: $CDS\left(0,T,R(T),\mathrm{LGD};\bar{\boldsymbol{\lambda}}\right) =$

$$R(T)\cdot\left\{\sum_{i=1}^{N} e^{-r\cdot T_i}\cdot(T_i - T_{i-1})\cdot Q(\tau > T_i) + \sum_{i=1}^{N} e^{-r\cdot T_i^{Mid}}\cdot\left(Q(\tau > T_{i-1}) - Q(\tau > T_i)\right)\cdot\frac{(T_i - T_{i-1})}{2}\right\}$$

$$-LGD\cdot\sum_{i=1}^{N} e^{-r\cdot T_i^{Mid}}\cdot\left(Q(\tau > T_{i-1}) - Q(\tau > T_i)\right)$$

Where $T_i^{Mid} = \frac{(T_i+T_{i-1})}{2}$ and where in which the (forward) hazard rate is computed as:

$$\lambda(u) = \begin{cases} \lambda_1 \; if \; 0 \le u < 1 \\ \lambda_2 \; if 1 \le u < 3 \\ \lambda_3 \; if 3 \le u < 5 \\ \lambda_4 \; if 5 \le u < 7 \\ \lambda_5 \; if 7 \le u < 10 \end{cases}$$

Hint: to solve for the forward rates, you can use root finding procedures, which exists in many software packages (e.g. using SciPy in Python)

Please fill in the following table;

Maturity	CDS Rate (in bps)	(Average) Hazard Rate (defined as: $\frac{\int_0^{T_i}\lambda(u)du}{T_i}$)	Forward Hazard Rate (between T_{i-1} and T_i)	Forward Default Probability (between T_{i-1} and T_i)
1Y	100			
3Y	110			
5Y	120			
7Y	120			
10Y	125			

Implementation Requirement: You may use root-finding packages (e.g., scipy.optimize), but you may not use specific pricing libraries like QuantLib. You must implement the discretization loop yourself.

Question 3: Model Validation (Audit)

Perform the following checks to prove your code is correct.

Using the hazard rates derived in Question 2, explicitly calculate the present value of the Premium Leg and the Protection Leg for the 7Y CDS.

1. Report both values.
2. Confirm that their difference is effectively zero (within a tolerance of 10^{-6}.

Question 4: Analysis & Stress Testing

Compare the two models to understand their limitations.

1. Baseline Comparison: Compare the Hazard Rates from Q1 vs. Q2. Why is the "Simple" rate generally different from the "Exact" rate?
2. The "High Interest Rate" Scenario:
   a) Re-run both models assuming the interest rate rises from 3% to 10%.
   b) Crucial Check: Look at your results for the "Simple Model" (Q1) under the 10% scenario. Did they change compared to the 3% scenario? Why or why not?
   c) Based on this observation, explain why the spread between the Simple and Exact models widens when interest rates are high. Which model is more reliable in a high-rate environment?