Case Description

In this practical case, students are provided with a real database of **U.S. Treasury securities quotations**, obtained directly from a professional financial information platform. The dataset includes instruments of different nature:

- **Treasury Bills (T-Bills)**
- **Zero-coupon stripped bonds (STRIPS)**
- **Coupon-paying U.S. Treasury bonds**

The dataset includes, among others, the following columns:

- Instrument identifier (**RIC**)
- Asset name
- Coupon rate
- Maturity date
- Currency
- Market prices (**Bid** and **Ask**)
- Daily price change
- Instrument type
- Yields (**B Yield** and **A Yield**)

Quotation Formats and Market Conventions

A fundamental feature of this dataset is that **prices are NOT presented in a homogeneous format**:

1. STRIPS and Treasury Bills (0% coupon)

For these instruments, the **Bid and Ask columns are expressed in direct decimal format** (for example: 3.5625, 4.158, etc.). These values represent the market price in a numerical format that is immediately suitable for computational processing.

2. Coupon-paying U.S. Treasury Bonds

In this case, prices are quoted using the **traditional U.S. fixed-income market format based on points and thirty-seconds**. For example:

- 99*19⅝
- 98*28¾

- 97*13

This format represents a price expressed as:

- An **integer part** (for example, 99)
- A **fractional part in thirty-seconds** (for example, 19/32)
- In some cases, an additional refinement using **Unicode fractions** (⅛, ¼, ½, ¾, etc.)

Therefore, these prices are **NOT directly usable in financial calculations** without a prior conversion process into **decimal format**.

3. Distinction Between Prices and Interest Rates

Within the dataset, **market prices (Bid and Ask) and yields appear simultaneously**. Students must clearly understand that:

- **The price is the primary variable for valuation.**
- **The yield is a derived measure** that depends on the price, the coupon rate, and the maturity.
- In the context of **yield curve construction**, calculations should be performed **primarily using prices, not yields directly.**

Data Cleaning and Market Conventions

You must take into account the following:

- To estimate the prices of **short-term bonds** (i.e., maturities below one year), the market uses **simple compounding**.
- To estimate the **yield curve using the Nelson–Siegel model**, we will work in **continuous time**.
- **Coupon-paying bonds have semiannual coupon payments.**
- The yields of **zero-coupon bonds provide direct spot rates**.
- For **coupon-paying bonds**, the **Yield to Maturity (YTM)** will be used as a **proxy for the spot rates**.

Tasks

1. **Estimate the yield curve using the Nelson–Siegel method**, calibrating the curve with the **three methods studied in class**, and justify the selection of the preferred method.
2. **Determine the value of a bond** with:

- Face value: **1,000 US$**
- Semiannual coupon: **3.7%**
- Maturity: **15 years**

3. **Determine the return obtained if the bond is sold after two years**, assuming that the **term structure evolves according to the expectations implied by the ETTI**.

4. A financial institution has a **guaranteed future liability** of **1,000,000 US$** payable in **15 years**.
   Using the **ETTI**, determine an **immunized portfolio**.

5. **Analyze the impact of a parallel shift of +1 basis point (+1 bp)** in interest rates on the immunized portfolio.