This assignment has a theoretical part for individual work and a computational part ideally for group work (2 to 3 members). Let me know ASAP if you need assistance finding a group to work with.

**Theoretical portion.**

1. Let \( t < T_0 < \cdots < T_n \) be a given tenor. Consider a bond that pays a floating coupon of \( c_i = (T_i - T_{i-1}) L(T_{i-1}, T_i) \) at time \( T_i \) for each \( i = 1, \ldots, n \). By devising a replicating trading strategy, show that the time-\( t \) price of such a bond is \( p(t, T_0) \).

2. Suppose that, at time \( T_0 = 0 \), there are available in the market \( n - 1 \) zero-coupon bonds of maturities \( T_1, \ldots, T_{n-1} \) and a swap of maturity \( T_n \), payment dates \( T_1 < \cdots < T_n \), and reset times \( T_0 < \cdots < T_{n-1} \). Is it possible to create a synthetic zero-coupon bond of maturity \( T_n \) using the available bonds and the swap? If yes, illustrate how?

3. Consider a swap of an investor who receives a 10% fixed rate in semiannually paid coupons and pays the six-month LIBOR rate. The swap still have 9 months left to maturity.

   At the last resetting date, the six-month LIBOR was 6%, while the continuously compounded three-month and none-month rates are respectively 5% and 7%.

   Find the price of the just described swap position if the notional is 10,000.

4. The 1-year LIBOR rate is 10%. A bank trades swaps where a fixed rate of interest is exchanged for a 12-month LIBOR with payments being exchanged annually. The 2- and 3-year swap rates are 11% and 12% per annum. By using a Bootstrap-like method, determine the 2- and 3-year LIBOR rates.

**Computational portion.**

1. Perform the following tasks and write a concise but complete report that includes your code. Each code must specify the group member(s) that developed the code.

   (a) Collect current data from treasury bonds, LIBOR rates, swaps, and futures on bonds, **corresponding to the same day**. You need to explicitly indicate your sources and show the printout(s) of all your data. For instance, if you use Bloomberg terminal in Krannert’s library, you need to indicate the page used to obtain the data. If you use a website, you also need to indicate the link.

   (b) Write a program to strip the zero rates using bootstrap and interpolation as in Filipović’s notes (Section 4.1) and apply it to your collected data.

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1You can find further information about how to use the Bloomberg system to analyze swap data in the article of Nematnejad posted in the web site of the course.
(c) Find a smooth approximation of the zero-bond prices using any of the methods in the book "Interest Rate Modeling" by James & Weber (Chapter 15) and summarized in the notes "Interest rate models" by Filipović (Section 4.2) and in Section 7 of the course’s class notes. Possible methods include B-splines, Nelson and Siegel Curves, Kernel Methods, etc.

(d) Determine the instantaneous forward rate curve $f(t, T)$ using both methods (b) and (c) above. Compare your results.