12.1 (L14.1) (A callable bond) Construct a short rate lattice for periods (years) 0 through 9 with an initial rate of 6% and with successive rates determined by a multiplicative factor of either $u = 1.2$ or $d = 0.9$. Assign the risk-neutral probabilities to be 0.5.
a) Using this lattice, find the value of a 10-year 6% bond.
b) Suppose this bond can be called by the issuing party at any time after 5 years. (When the bond is called, the face value plus the currently due coupon are paid at that time and the bond is cancelled.) What is the fair value of this bond?

12.2 (L14.8) (Swaps) Consider a plain vanilla interest rate swap where party A agrees to make six yearly payments to party B of a fixed rate of interest on a notional principal of 10 M€and in exchange party B will make six yearly payments to party A at the floating short rate on the same notional principal. Assume that the short rate process is described by the lattice of Exercise 1.
a) Set up a lattice that gives the value of the floating rate cash flow stream at every short rate node, and thereby determine the initial value of this stream.
b) What rate of interest would equalize the present values of the cash flows on both sides of the swap?

12.3 (L14.9) (Swaption pricing) A swaption is an option to enter a swap arrangement in the future. Suppose that company B has debt of 10 M€ financed over 6 years at a fixed rate of 6.69%. Company A offers to sell company B a swaption to swap the fixed rate obligation for a floating rate obligation, with payments equal to the short rate, with the same principal and the same termination date. The swaption can be exercised at the beginning of year 2 (just after the payment for the previous year and when the short rate for the coming year is known). Assuming that the short rate process is that of Exercise 1, how much is this swaption worth?

12.4 (L14.2) (General adjustable formula) Let V_{ks} be the value of an adjustable-rate loan initiated at period k and state s with initial principal of 100. The loan is to be fully paid at period n. The interest rate charged each period is the short rate of that period plus a premium p. The loan payment for a period is the amount that would be required to amortize the loan at the charged interest rate equally over the remaining periods. Write an explicit backward recursion formula for V_{ks} as a function of k and s.