# Derivatives Lab

## Session 4

### September 13, 2011

1. Consider a 10-year level coupon bond with an annual coupon rate of 8% compounded annually and a par value of EUR 1 000. Plot the price of the bond vs. the yield.

2. Plot price volatility vs. time to maturity for level coupon bonds with annual coupon rates of 2%, 6%, and 12% paid semiannually. Assume a yield of 6% and a par value of EUR 1 000. To see the different volatility behaviors, take a range from 0 up to 100 years to maturity.

3. Plot the bond value (forward value) of an 8% 15-year bond compounded semi-annually vs. years to maturity under three rate scenarios: (a) the interest rate decreases instantaneously to 6%, (b) the interest rate remains unchanged, and (c) the interest rate increases instantaneously to 10%.

4. Plot the future value of a 30-year bond at a coupon rate of 10% compounded annually after a 10-year horizon as a function of yield. Find the minimum of the horizon price numerically, e.g., using `scipy.optimize.brent`.

5. Write out a consistent set of expressions for the Macaulay duration and the immunization of a level coupon bond assuming continuous compounding of interest.