R-lab: Fixed Income Securities

Statistical Methods in Finance

Computing Yield to Maturity

- Yield to maturity is an implicit function which is not easy to compute by hand. Nevertheless, the calculation could be done using R.
- First, we need to specify the price-yield relationship of a bond with a user-defined function in R.

```
bondprice = function(C, T, r, F)
{
P = C / r + (F - C / r) * (1 + r)^(-2 * T)
P
}
```

- C = coupon payment (semiannual)
- T = time to maturity (in years)
- r = **vector** of yields to maturity (semiannual rates)
- F = face value / par value
- P = bond prices corresponding to all values of yield to maturity in the input vector r

Using Interpolation

- Suppose we need to compute the yield to maturity for a 30-year par \$1,000 bond with coupon payments of \$40 selling at \$1,200.
- We could calculate the bond prices for a grid of interest rates using the previous function.
- The price-yield function is then interpolated to find the yield to maturity when the price is \$1,200.

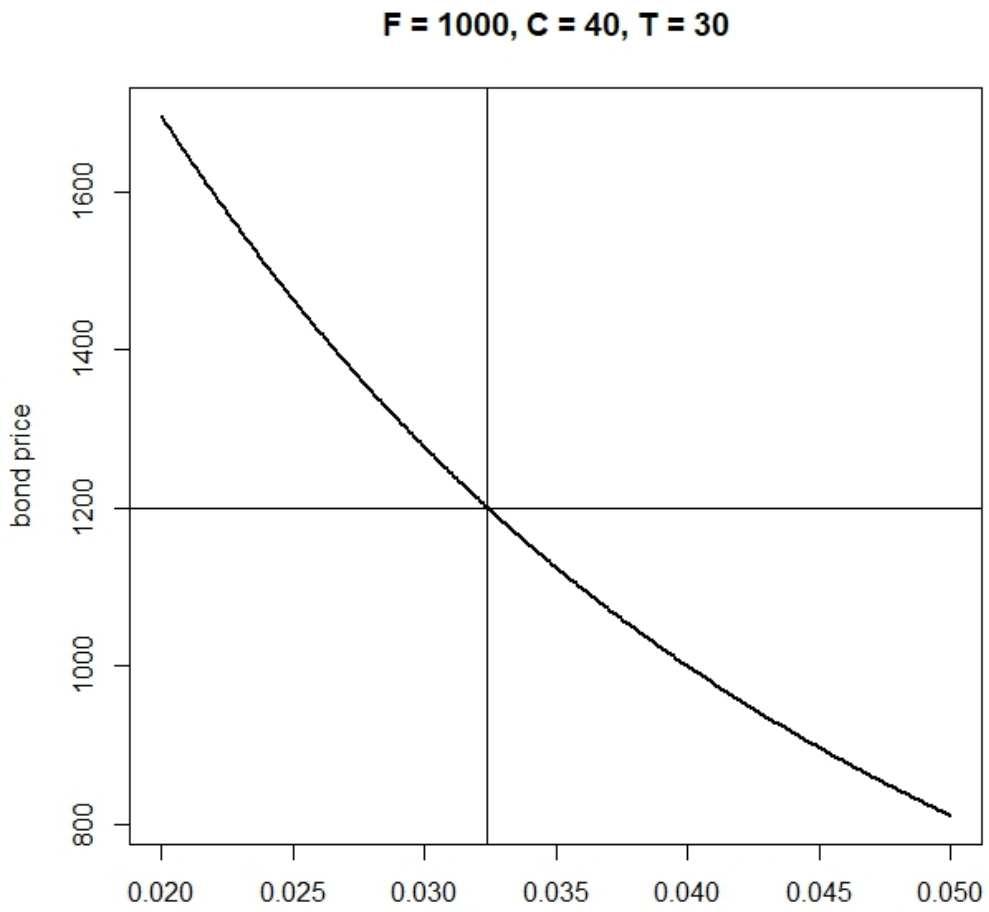
```
P = 1200   # current price of the bond
C = 40   # coupon payment
T = 30   # time to maturity
F = 1000   # par value of the bond

r = seq(0.02, 0.05, length = 300)   # grid of interest rates
value = bondprice(C, T, r, F)
yield2M = spline(value, r, xout = P)   # spline interpolation

[1] 0.03239813   # yield to maturity
```

Graphical Representation

```
plot(r, value, xlab = "yield to maturity", ylab = "bond price",
type = "l", main = "F = 1000, C = 40, T = 30", lwd = 2)
abline(h = 1200)
abline(v = yield2M)
```



Using Equation Solver

- As an alternative, R has a built-in nonlinear root finder **uniroot()**, which can be used to solve the yield to maturity directly.
- **uniroot()** solves for the root where the equation equals zero.
- In the above example, it is equivalent to solve for the root of r when the difference of the bond price function and the current price is 0.

```
uniroot(function(r) bondprice(C,T,r,F)-P, c(.02,.05))
```

```
[1] 0.03238059   # yield to maturity
```

- Note that in the first argument, the function has to solely depend on r. And we have to specify the range where the root lies inside in the second argument.