Solutions to Selected Computer Lab Problems and Exercises in Chapter 3 of *Statistics and Data Analysis for Financial Engineering, 2nd ed.* by David Ruppert and David S. Matteson

Problem 3. The yield is 0.0324:

```
> bondvalue = function(c, T, r, par)
+ {
+   #       Computes bv = bond values (current prices) corresponding
+   #       to all values of yield to maturity in the
+   #       input vector r
+   #
+   #       INPUT
+   #        c = coupon payment (semiannual)
+   #        T = time to maturity (in years)
+   #        r = vector of yields to maturity (semiannual rates)
+   #        par = par value
+   #
+   bv = c / r + (par - c / r) * (1 + r)^(-2 * T)
+   bv
+ }
>
> T = 30
> C = 40
> par = 1000
> price = 1200
> options(digits = 3)
> uniroot(function(r) bondvalue(C,T,r,par) - price, c(0.001,.1))
$root
[1] 0.0324

$f.root
[1] -0.333

$iter
[1] 6

$init.it
[1] NA

$estim.prec
[1] 6.1e-05
```

Problem 6. The coupon payment is $29:

```
> T = 5
> par = 1000
> price = 950.1
> r = 0.035
> options(digits = 3)
> uniroot(function(C) bondvalue(C,T,r,par) - price, c(20,60))
$root
[1] 29

$f.root
[1] 0

$iter
[1] 1

$init.it
[1] NA

$estim.prec
[1] 31
```

Exercise 1. (a) $y_{20} = 0.028 + (0.00042)(20)/2 = 0.0322$.

(b) Price is $1000 \exp\{-[(15)(0.028) + (0.00042)(15^2)/2]\} = \$626.72$.

3. (a) It is selling above par because the current yield is below the coupon rate. The current yield is based on the price while the coupon rate is based on par.

(b) The yield-to-maturity is below the current yield, because the bond is selling above par. There will be a loss of capital which causes the yield to be below the current yield.

Exercise 4. (a) The 5-year spot rate (= yield) is 0.0362. The following `R` code computes the answers to parts (a) and (b).

```
> T=5
> yield = 0.032 + 0.001*T/2 + 0.0002* T^2/3
> round(yield,4)
[1] 0.0362
> price = 1000*exp(-T*yield)
> round(price,2)
[1] 834.6
```

(b) \$834.60

Exercise 5. The price is \$ 1067.00.

```
> yields = c(0.025,0.028,0.032,0.033)
> T = seq(0.5,2,by=0.5)
> cashflows = c(35,35,35,1035)
>
> prices = cashflows * exp(-T*yields)
>
> round(sum(prices),2)
[1] 1067
```

Exercise 12.

$$\text{return} = \frac{\exp\{-[(0.04)(8) + (0.001)(8^2)/2]\}}{\exp\{-[(0.03)(7.5) + (0.0013)(7.5^2)/2]\}} - 1 = -0.0865.$$

Exercise 16. (a) The price is \$606.53 and is calculated below

```
> T1 = 10
> yield1 = 0.04 + 0.001*T1
> price1 = 1000*exp(-T1*yield1)
> round(price1,2)
[1] 606.53
```

(b)

The returns is 0.0419

```
> T2 = 9
> yield2 = 0.042 + 0.001*T2
> price2 = 1000*exp(-T2*yield2)
> price2
[1] 631.9152
>
> netReturn = price2/price1 - 1
> round(netReturn,4)
[1] 0.0419
```

Exercise 19. The price is \$ 1067.00.

```
> yields = c(0.025,0.029,0.031,0.035)
> T = seq(0.5,2,by=0.5)
> cashflows = c(35,35,35,1035)
>
> prices = cashflows * exp(-T*yields)
>
> round(sum(prices),2)
[1] 1067
```

Exercise 22. (a) The price is \$1100.87 and is found by the following `R` program.

```
> T = seq(1/2,4,by=1/2)
> y = 0.022 + 0.005*T/2 - (0.004* T^2)/3 + (0.0003*T^3)/4
> D = exp(-y*T)
> C = c(rep(21,7),1021)
> prices = C*D
> options(digits=6)
> sum(prices)
[1] 1100.87
```

(b) The duration is 3.741 years and is computed by:

```
> duration = sum(T*prices) / sum(prices)
> round(duration,3)
[1] 3.741
```