Module 4.2: Valuation Corporate Bonds
R Commentary

See module *Ch 4.2 Valuation Corporate Bonds*. The UST and corporate bond inputs are contained in *Bond Inputs.R* and various bond related functions are contained in *BOND Functions.R* and various LSC-related functions are contained in *SPREADS Functions.R*. The sample test program that calculates standard corporate bond calculations is in *Valuation Corporate Bonds Test.R*.

Valuation Bond Test.R (Selected Excerpts and Output)
All initial parameters are set in the file Bond Inputs.R. We provide information on a Xerox BB-rated bond with 4.6 years to maturity. The coupon payment frequency per year (`inputFrequency`), the coupon rate (`inputCouponRate`), the assume bond par value (`inputPar`), the yield to maturity (`inputYieldToMaturity`), and related settlement and maturity dates are illustrate here:

```
ActualBondPrice = 992890.00 # Dollars: Quoted price without accrued interest
inputFrequency = 2L         # Coupon frequency per year, 1, 2, 4, or 12
inputCouponRate = 3.8      # Percent
inputPar = 1000000.0        # Currency
inputYieldToMaturity = 3.970  # Percent
# Dollars: Quoted bond price without accrued interest (stubbed to -99)
inputBondPrice = -99
SettlementDateMonth = 10     # Integer: 1-12
SettlementDateDay = 7      # Integer: 1-31
SettlementDateYear = 2019   # Integer: 1-very high number
MaturityDateMonth = 5      # Integer: 1-12
MaturityDateDay = 15        # Integer: 1-31
MaturityDateYear = 2024     # Integer: 1-very high number
```

Once the particulars of an individual bond have been inputted, we can test our various functions. The bond illustrated here is a BB credit corporate bond and some preliminary results are presented here:

```
N = CouponsRemaining(BONDInputData)
# ElapsedOutput contains fraction, JLastDate, JNextDate, and JCurrentDate
ElapsedOutput = Elapsed(BONDInputData)
# Number of Total Days
NTD <- ElapsedOutput$NextDate - ElapsedOutput$LastDate
# Number of Accrued Days since last semi-annual coupon
NAD <- ElapsedOutput$Fraction * NTD
# Fraction of coupon period that has elapsed already
f <- ElapsedOutput$Fraction
# Bond maturity, in years
Mat <- TimeToMaturity(BONDInputData)
NAD; NTD; f; N; Mat
```

The results are as follows:

```
[1] 145
[1] 184
[1] 0.7880435
[1] 10
[1] 4.605978
```

In this particular case, we find NAD = 145 days have accrued since the last coupon, NTD = 184 days between the last coupon payment date and the next coupon payment date, f = 78.80% of the coupon period has elapsed, N = 10 coupons remaining, and Mat = 4.606 years to maturity.

Just like with UST, bond valuation calculations are considered next with the following lines of code.

```
MarketValueOfBond = BondValue(BONDInputData)
AccruedInterestAmount = AccruedInterest(BONDInputData)
QuotedBondPrice = MarketValueOfBond - AccruedInterestAmount
MarketValueOfBond; AccruedInterestAmount; QuotedBondPrice; ActualBondPrice
```

The results are as follows:

```
[1] 1007850
[1] 14972.83
[1] 992876.7
[1] 992890
```

Note that our model is only $13.3 off per $1 million par, well within rounding error on the yield to maturity. The analysis of yield to maturity results in a similar conclusion that our approach is accurate.

```
inputBondPrice = ActualBondPrice #Dollars:Quoted price w/o accrued interest
BONDInputData$BondPrice <- inputBondPrice
EstYieldToMaturity = YieldToMaturitySolver(BONDInputData)
EstYieldToMaturity; inputYieldToMaturity
[1] 3.969678
[1] 3.97
```

The results for this bond with initial bond price of $992,890 results in an estimated yield to maturity very close to the reported yield to maturity.

With the 2-factor model, we can estimate the various parameters for the particular Xerox BB-rated bond described earlier. The analytic results for this particular bond with the 2-factor LSC model is given here.

```
> QuotedBondPrice <- (BONDInputData$BondPrice/BONDInputData$Par)*100.0
> AccruedInterestAmount = AccruedInterest(BONDInputData)
> QuotedBondPriceEstYTM <- ((TestBondValue - AccruedInterestAmount) /
+   BONDInputData$Par)*100.0
> QuotedBondPriceEstLSC <- ((TestBondValueDF - AccruedInterestAmount) /
+   BONDInputData$Par)*100.0
> # Expect YTM-based difference to be rounding error
> PriceEstDiffYTM <- QuotedBondPriceEstYTM - QuotedBondPrice
> # Expect LSC-based difference to include spread over/under BB curve
> PriceEstDiffLSC <- QuotedBondPriceEstLSC - QuotedBondPrice
> # Just express as percent of bond price
> PriceEstDiffLSCPct <- ((QuotedBondPriceEstLSC - QuotedBondPrice) /
+   QuotedBondPrice)*100.0
> QuotedBondPrice; QuotedBondPriceEstYTM; QuotedBondPriceEstLSC
[1] 99.289
[1] 99.28767
[1] 99.13166
> PriceEstDiffYTM; PriceEstDiffLSC; PriceEstDiffLSCPct
[1] -0.001328109
[1] -0.1573414
[1] -0.1584681
```

Note that our analysis results in a 15 basis point spread under the BB 2-Factor LSC. We observe, however, that the fit was relatively poor in the near term. We now repeat this analysis with a 4-factor LSC model.

With the 4-factor model, we can again estimate the various parameters for the particular Xerox BB-rated bond described earlier. The analytic results for this particular bond with the 2-factor LSC model is given here.

```
> QuotedBondPrice <- (BONDInputData$BondPrice/BONDInputData$Par)*100.0
> AccruedInterestAmount = AccruedInterest(BONDInputData)
> QuotedBondPriceEstYTM <- ((TestBondValue - AccruedInterestAmount) /
+   BONDInputData$Par)*100.0
> QuotedBondPriceEstLSC <- ((TestBondValueDF - AccruedInterestAmount) /
+   BONDInputData$Par)*100.0
> # Expect YTM-based difference to be rounding error
> PriceEstDiffYTM <- QuotedBondPriceEstYTM - QuotedBondPrice
> # Expect LSC-based difference to include spread over/under BB curve
> PriceEstDiffLSC <- QuotedBondPriceEstLSC - QuotedBondPrice
> # Just express as percent of bond price
> PriceEstDiffLSCPct <- ((QuotedBondPriceEstLSC - QuotedBondPrice) /
+   QuotedBondPrice)*100.0
> QuotedBondPrice; QuotedBondPriceEstYTM; QuotedBondPriceEstLSC
[1] 99.289
[1] 99.28767
[1] 99.90041
> PriceEstDiffYTM; PriceEstDiffLSC; PriceEstDiffLSCPct
[1] -0.001328109
[1] 0.6114147
[1] 0.615793
```

Note that our analysis with a 4-factor LSC model results in a 61 basis point spread *over* the BB 4-Factor LSC. With these functions, it is straightforward to analyze any bonds and appraise their value relative to the BB curve. Remember, the more factors the more challenging is the resultant risk management.