Jingxia Zhu
IE 523 Financial Computing
10/19/2018

Please see the following for the output that I got in Xcode.

Output from input1:

```
Input File Name:input1.dms
Input File: input1.dms
We owe 1790.85 in 10 years
Number of Cash Flows: 5
-----------------------------------------------------
Cash Flow #1
Price = 1131.27
Maturity = 10
Percentage of Face Value that would meet the obligation = 0.892239
Yield to Maturity = 0.0499999
Duration = 7.7587
Duration (to be used in LP-formulation below) = 8.69576
(Note) 7.7587 = 8.69576 x 0.892239
Convexity = 70.4264
Convexity (to be used in LP-formulation below) = 78.9322
(Note) 70.4264 = 78.9322 x 0.892239
-----------------------------------------------------
Cash Flow #2
Price = 1069.88
Maturity = 15
Percentage of Face Value that would meet the obligation = 0.943436
Yield to Maturity = 0.0625639
Duration = 9.93582
Duration (to be used in LP-formulation below) = 10.5315
(Note) 9.93582 = 10.5315 x 0.943436
Convexity = 119.831
Convexity (to be used in LP-formulation below) = 127.016
(Note) 119.831 = 127.016 x 0.943436
-----------------------------------------------------
Cash Flow #3
Price = 863.5
Maturity = 30
Percentage of Face Value that would meet the obligation = 1.16892
Yield to Maturity = 0.07
Duration = 13.6774
Duration (to be used in LP-formulation below) = 11.7009
(Note) 13.6774 = 11.7009 x 1.16892
Convexity = 262.769
Convexity (to be used in LP-formulation below) = 224.796
(Note) 262.769 = 224.796 x 1.16892
-----------------------------------------------------
Cash Flow #4
Price = 1148.75
Maturity = 12
Percentage of Face Value that would meet the obligation = 0.878662
Yield to Maturity = 0.0574999
Duration = 8.58082
```

```
Duration (to be used in LP-formulation below) = 9.76578
(Note) 8.58082 = 9.76578 x 0.878662
Convexity = 87.6798
Convexity (to be used in LP-formulation below) = 99.7879
(Note) 87.6798 = 99.7879 x 0.878662
-----------------------------------------------------------
Cash Flow #5
Price = 1121.39
Maturity = 11
Percentage of Face Value that would meet the obligation = 0.9001
Yield to Maturity = 0.0549998
Duration = 8.20531
Duration (to be used in LP-formulation below) = 9.116
(Note) 8.20531 = 9.116 x 0.9001
Convexity = 79.1966
Convexity (to be used in LP-formulation below) = 87.9864
(Note) 79.1966 = 87.9864 x 0.9001
*******************************************************
Average YTM (which I use to compute PV of Debt = 0.0590127
Present value of debt = 1009.36
*******************************************************
Model name:
               C1       C2       C3       C4       C5
Minimize  -78.9322 -127.016 -224.796 -99.7879 -87.9864
R1         1131.27  1069.88    863.5  1148.75  1121.39  =  1009.36
R2         8.69576  10.5315  11.7009  9.76578    9.116  =       10
Type          Real     Real     Real     Real     Real
upbo           Inf      Inf      Inf      Inf      Inf
lowbo            0        0        0        0        0
Largest convexiry we can get is: 143.262
Optimal portfolio:
%Cash Flow:1  0.554367
%Cash Flow:2  0
%Cash Flow:3  0.442645
%Cash Flow:4  0
%Cash Flow:5  0

That is, buy
$627.139 of Cash Flow#1
$382.224 of Cash Flow#3
Program ended with exit code: 0
```

Output from input2:

```
Input File Name:input2.dms
Input File: input2.dms
We owe 1790.85 in 10 years
Number of Cash Flows: 3
--------------------------------------------------------
Cash Flow #1
Price = 1131.27
Maturity = 10
Percentage of Face Value that would meet the obligation = 0.934116
Yield to Maturity = 0.0499999
Duration = 7.7587
Duration (to be used in LP-formulation below) = 8.30593
(Note) 7.7587 = 8.30593 x 0.934116
Convexity = 70.4264
Convexity (to be used in LP-formulation below) = 75.3936
(Note) 70.4264 = 75.3936 x 0.934116
--------------------------------------------------------
Cash Flow #2
Price = 1121.39
Maturity = 11
Percentage of Face Value that would meet the obligation = 0.942346
Yield to Maturity = 0.0549998
Duration = 8.20531
Duration (to be used in LP-formulation below) = 8.70733
(Note) 8.20531 = 8.70733 x 0.942346
Convexity = 79.1966
Convexity (to be used in LP-formulation below) = 84.042
(Note) 79.1966 = 84.042 x 0.942346
--------------------------------------------------------
Cash Flow #3
Price = 1148.75
Maturity = 12
Percentage of Face Value that would meet the obligation = 0.919902
Yield to Maturity = 0.0574999
Duration = 8.58082
Duration (to be used in LP-formulation below) = 9.32798
(Note) 8.58082 = 9.32798 x 0.919902
Convexity = 87.6798
Convexity (to be used in LP-formulation below) = 95.3144
(Note) 87.6798 = 95.3144 x 0.919902
***************************************************
Average YTM (which I use to compute PV of Debt = 0.0541665
Present value of debt = 1056.74
***************************************************
Model name:
                C1       C2       C3
Minimize  -75.3936  -84.042 -95.3144
R1         1131.27  1121.39  1148.75  =  1056.74
R2         8.30593  8.70733  9.32798  =      10
Type          Real     Real     Real
upbo           Inf      Inf      Inf
lowbo            0        0        0
There is no portfolio that meets the duration constraint of 10 years
Program ended with exit code: 0
```

Output from inpt3:

```
Input File Name:input3.dms
Input File: input3.dms
We owe 1790.85 in 10 years
Number of Cash Flows: 3
------------------------------------------------------
Cash Flow #1
Price = 1051.52
Maturity = 10
Percentage of Face Value that would meet the obligation = 0.951007
Yield to Maturity = 0.0600001
Duration = 7.6655
Duration (to be used in LP-formulation below) = 8.0604
(Note) 7.6655 = 8.0604 x 0.951007
Convexity = 67.9958
Convexity (to be used in LP-formulation below) = 71.4987
(Note) 67.9958 = 71.4987 x 0.951007
------------------------------------------------------
Cash Flow #2
Price = 1095.96
Maturity = 15
Percentage of Face Value that would meet the obligation = 0.912445
Yield to Maturity = 0.0599997
Duration = 10
Duration (to be used in LP-formulation below) = 10.9596
(Note) 10 = 10.9596 x 0.912445
Convexity = 121.484
Convexity (to be used in LP-formulation below) = 133.142
(Note) 121.484 = 133.142 x 0.912445
------------------------------------------------------
Cash Flow #3
Price = 986.24
Maturity = 30
Percentage of Face Value that would meet the obligation = 1.01396
Yield to Maturity = 0.0599996
Duration = 14.6361
Duration (to be used in LP-formulation below) = 14.4347
(Note) 14.6361 = 14.4347 x 1.01396
Convexity = 296.143
Convexity (to be used in LP-formulation below) = 292.067
(Note) 296.143 = 292.067 x 1.01396
****************************************************
Average YTM (which I use to compute PV of Debt = 0.0599998
Present value of debt = 1000
****************************************************
```

```
Model name:
             C1        C2        C3
Minimize  -71.4987  -133.142  -292.067
R1         1051.52   1095.96    986.24   =      1000
R2          8.0604   10.9596   14.4347   =        10
Type          Real      Real      Real
upbo           Inf       Inf       Inf
lowbo            0         0         0
Largest convexiry we can get is: 144.404
Optimal portfolio:
%Cash Flow:1  0.632508
%Cash Flow:2  0
%Cash Flow:3  0.339581

That is, buy
$665.095 of Cash Flow#1
$334.908 of Cash Flow#3
Program ended with exit code: 0
```