this document is written by MOU(a.k.a MARKDOWN editor)

Principles of Financial Computing

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Environment

- c++ 4.2.1
- Apple LLVM 7.0.2

HW1 Modified Duration, Convexity(~3/23)

1. Files

```
.
+-- README      # documentation
|-- hw1.cpp     # source code
`-- a.out       # executable
```

2. TEST

```
# g++ hw1.cpp && ./a.out
```

INPUT

```
4                           # size of array(spot rates, cash flows)
0.053 0.051 0.049 0.047     # spot rates
3 2 3 102                   # cash flows
0.3                         # w
```

OUTPUT

```
2.998067 12.18047           # (modified duration, convexity)
```

Precision is 10e-5

3. Implementation

Modified Duration

Modified Duration = Macaulay Duration / (1 + Y)

1. Get Macaulay Duration & Y.
2. Macaulay Duration is trivial. Present Value is trivial too.
3. Calculate Y approximately using bisection method.

```
// hw1.cpp#L68

float start = 0;
float end = 1;
float y;

while(1) {
  y = (start + end) / 2;

  float p = 0;
  for(int i = 0; i < n; i++) {
    p += C[i] / pow(1 + y, W + i);
  }

  if(abs(pv - p) < MIN_ERR) {
    break;
  }

  if(p > pv) {
    start = y;
  } else {
    end = y;
  }
}
```

Convexity

Refer to p.17 of duration.pdf

1. Implentation.

```
// hw1.cpp#L108

float tConvx = 0;

for(int i = 0; i < n; i++) {
  tConvx += (C[i] * (W + i) * (W + i + 1)) / pow(1 + S[i], W + i);
}
tConvx /= (pv * pow(1 + y, 2));
```

4. Reference

- http://www.csie.ntu.edu.tw/~lyuu/finance1/2016/20160302.pdf
- http://www3.nd.edu/~jstiver/FIN462/Lecture%20Slides/Valuing%20Cash%20Flows.ppt
- http://educ.jmu.edu/~drakepp/FIN250/readings/duration.pdf