Fixed_income_case3

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In [1]:
```
import math
import numpy as np
import pandas as pd
yield_yh = 0.08
yield_10 = 0.05
yield_1 = 0.0075
dur_yh = 0
conv_yh = 0
dur_10 = 0
conv_10 = 0
dur_1 = 0
conv_1 = 0
def bond_price(coupon,maturity,is_semi,r):
    price = 0
    if is_semi:
        for i in range(1,maturity * 2 + 1):
            price += coupon / 2 / math.pow(1 + r/2,i)
        price += 100 / (1 + r/2) ** (2 * maturity)

    else:
        for i in range(1, maturity + 1):
            price += coupon / math.pow(1 + r,i)
        price += 100 / (1 + r) ** maturity
    return  price
def inv_weight(yield1, yield2, yield3):
    dur_yh = 0
    conv_yh = 0
    dur_10 = 0
    conv_10 = 0
    dur_1 = 0
    conv_1 = 0
    price_yh = bond_price(11, 7, True, yield1)
    price_10 = bond_price(5,10,False,yield2)
    price_1 = 100 / (1 + yield3)
    for i in range(1,15):
        dur_yh += 5.5 * -i / 2 / math.pow(1 + yield1 / 2,i+1)
```

```
            conv_yh += 5.5 / 4 * i * (i + 1) / math.pow(1 + yield1 / 2, i+2)
        dur_yh += -14 * 100 / 2 / math.pow(1 + yield1 / 2, 15)
        conv_yh += 14 * 15 * 100 / 4 / math.pow(1 + yield1 / 2, 16)
        dur_yh = abs(dur_yh) / price_yh
        conv_yh = conv_yh / price_yh

        for i in range(1,11):
            dur_10 += 5 * -i / math.pow(1 + yield2, i + 1)
            conv_10 += 5 * i * (i + 1) / math.pow(1 + yield2, i + 2)
        dur_10 += -10 * 100 / math.pow(1 + yield2, 11)
        conv_10 += 10 * 11 * 100 / math.pow(1 + yield2, 12)
        dur_10 = abs(dur_10) / price_10
        conv_10 = conv_10 / price_10

        dur_1 = 100 / math.pow(1 + yield3,2) / price_1
        conv_1 = 2 * 100 / math.pow(1 + yield3, 3) / price_1
        solution = np.linalg.solve([[dur_10,dur_1],[conv_10,conv_1]],[dur_yh,conv_yh])
        solution = pd.Series({'T-notes':solution[0],'T-bill':solution[1]})
        return solution

    price_yh = bond_price(11, 7, True, yield_yh)
    price_10 = bond_price(5,10,False,yield_10)
    price_1 = 100 / (1 + yield_1)
    solution = inv_weight(yield_yh,yield_10,yield_1)
    print(solution)
```

```
T-notes    0.374823
T-bill     2.132244
dtype: float64
```

Yahoo should long 37.482% T-notes and long 213.224% T-bill as a percentage of the current market value of the Yahoo bond.

```
In [2]: units = [-1 / price_yh,solution['T-notes']/price_10,solution['T-bill']/price_1]
        delta_y = 0.01
        new_price_fell_yh = bond_price(11,7,True,yield_yh - delta_y)
        new_price_fell_10 = bond_price(5,10,False,yield_10 - delta_y)
        new_price_fell_1 = 100 / (1 + yield_1 - delta_y)
        capital_pnl = units[0] * (new_price_fell_yh - price_yh) +\
            units[1] * (new_price_fell_10 - price_10) + units[2] * (new_price_fell_1 - price_1
        print(capital_pnl)
```

```
1.5352675059029236e-05
```

If yields immediately fell by 100 basis points all along the term structure, the capital gain is 0.001535% as a percentage of the initial market value of high yield debt.

```
In [3]: new_price_rose_yh = bond_price(11,7,True,yield_yh + delta_y)
        new_price_rose_10 = bond_price(5,10,False,yield_10 + delta_y)
        new_price_rose_1 = 100 / (1 + yield_1 + delta_y)
        capital_pnl = units[0] * (new_price_rose_yh - price_yh) + \
            units[1] * (new_price_rose_10 - price_10) + units[2] * (new_price_rose_1 - price_1
        print(capital_pnl)

-1.373548776041969e-05
```

If yields immediately rose by 100 basis points all along the term structure, the capital loss is 0.0013735% as a percentage of the initial market value of high yield debt.

```
In [4]: inv_weight_fell = inv_weight(yield_yh - delta_y,
                                     yield_10 - delta_y, yield_1 - delta_y)
        inv_weight_fell = inv_weight_fell * (new_price_fell_yh / price_yh)
        rebalance_fell = pd.Series({'T-notes':inv_weight_fell['T-notes'] - solution['T-notes']
                'T-bill':inv_weight_fell['T-bill'] - solution['T-bill']})
        print(rebalance_fell)

T-notes    0.014770
T-bill     0.139502
dtype: float64
```

If yields immediately fell by 100 basis points all along the term structure, buy 1.477% T-notes and buy 13.95% T-bill as a percentage of the initial market value of high yield debt.

```
In [5]: inv_weight_inc = inv_weight(yield_yh + delta_y,
                                    yield_10 + delta_y, yield_1 + delta_y)
        inv_weight_inc = inv_weight_inc * (new_price_rose_yh / price_yh)
        rebalance_inc = pd.Series({'T-notes':inv_weight_inc['T-notes'] - solution['T-notes'],
                'T-bill':inv_weight_inc['T-bill'] - solution['T-bill']})
        print(rebalance_inc)

T-notes   -0.01394
T-bill    -0.13017
dtype: float64
```

If yields immediately rose by 100 basis points all along the term structure, sell 1.394% T-notes, and sell 13.017% T-bill as a percentage of the initial market value of high yield debt.