a、

8、

① 0息債券：到期日才會有現金流入

→ 故存續期間 $\left(\frac{1}{p}\sum_{i=1}^{n}\frac{iC_i}{(1+y)^i}\right)$ = 到期年限 #

將 $i=n$ 代入：$\cancel{\frac{1}{p}}\left(\frac{n\cdot\cancel{C_n}}{\cancel{(1+y)^n}}\right)=n$ 得证

② coupon 的变化应和MD呈反向 #

- when coupon payment ↑：
  - 早期支付的金額較大（受利率影响↓）
  - ✓ time to maturity ↓ (∵較短时間就可收回)

  反向亦然！

- 根據程式：

  設期數 $n=6$，市場利率 $r=0.08$，$C_t=80$：

```
C:\Users\GameToGo\Desktop\財務工程\HW3\財工HW3.exe
Enter number of periods: 6
Enter Coupon of each period: 80
Enter Market yield: 0.08
CxDF=1000
CxDFxt=4992.71
Macaulay Duration:4.99271
```

• when $C_t=90$：

```
C:\Users\GameToGo\Desktop\財務工程\HW3\財工HW3.exe
Enter number of periods: 6
Enter Coupon of each period: 90
Enter Market yield: 0.08
CxDF=1046.23
CxDFxt=5144.17
Macaulay Duration:4.91687
```

MD↓

• when $C_t=70$:

```
C:\Users\GameToGo\Desktop\財務工程\HW3\財工HW3.exe
Enter number of periods: 6
Enter Coupon of each period: 70
Enter Market yield: 0.08
CxDF=953.771
CxDFxt=4841.25
Macaulay Duration:5.0759
```

MD↑

根據程式結果得証!

9. 已知 1. Modified Duration = Macaulay Duration $/(1+r)$

2. 一個 basis point = 0.01%

- 計算當殖利率提升一個 basis point 時,
  價格变动的百分比

  Modified Duration × 0.01 × (-1)

  ∵ r 和 Modified Duration 呈反比

- 根據程式:

  設期數 $n=6$, 市場利率 $r=0.08$, $C_t=80$:

```
C:\Users\GameToGo\Desktop\財務工程\HW3\財工HW3.exe
Enter number of periods: 6
Enter Coupon of each period: 80
Enter Market yield: 0.08
CxDF=1000
CxDFxt=4992.71
Macaulay Duration:4.99271
Modified Duration:4.62288
Price change when yield increase a basis point:-0.0462288%
Price change when yield decrease a basis point:0.0462288%

--------------------------------
Process exited after 12.68 seconds with return value 0
請按任意鍵繼續 . . .
```

b、根據FISD的資料

ISSUER_ ID	OFFERING_ DATE	OFFERING_ YIELD	OFFERING_ PRICE	MATURITY	INTEREST_ FREQUENCY	COUPON
1117	20100803	5.79816	99.320	20400815	2	5.750
1117	20100803	4.36422	99.082	20200815	2	4.250
1117	20120215	4.70958	99.864	20370315	2	4.700
1117	20120215	4.75951	99.853	20420315	2	4.750
1117	20121026	1.49800	99.768	20171115	2	1.450
1117	20150505	1.53184	99.907	20180508	2	1.500

知 $n = 20\ (10yr \times 2)$,

$r = 0.0436422/2 = 0.0218211$

$C_t = 1000 \times (0.0425/2) = 21.25$

C:\Users\GameToGo\Desktop\財務工程\HW3\財工HW3.exe

```
Enter number of periods: 20
Enter Coupon of each period: 21.25
Enter Market yield: 0.0218211
CxDF=990.823
CxDFxt=16328.5
Macaulay Duration:16.4797
Modified Duration:16.1278
Price change when yield increase a basis point:-0.161278%
Price change when yield decrease a basis point:0.161278%

--------------------------------
Process exited after 45.74 seconds with return value 0
請按任意鍵繼續 . . .
```