若 PV 是售價，則 r 為 YTM；若 r 為 annual interest rate，則 PV 為理論價。

$$PV = \sum_{i=1}^{n} \frac{C}{\left(1+\frac{r}{m}\right)^{i}} + \frac{F}{\left(1+\frac{r}{m}\right)^{n}} = C\frac{1-\left(1+\frac{r}{m}\right)^{-n}}{\frac{r}{m}} + \frac{F}{\left(1+\frac{r}{m}\right)^{n}},$$

where n is the number of cash flows, m is the number of payments per year, and r is the annual interest rate compounded m times per annum. Note that $C = Fc/m$ when c is the annual coupon rate.

既然是投資，那 r 就不應該比定存的利率還低才對。
否則就放定存就好，何必承擔風險？

一、計算 YTM:

利用輸入的外生變數:F, C, r, m ,n 求得理論價格 PV，再透過迴圈逆算公式，以 PV 逼近 P 的情況下求得輸入當期價價格 P 之下的殖利率。

As stated above, spot rate is the yield on a zero-coupon bond. It can be calculated from (bond with nominal value 1. If y_t is the yield, then the equation can be written as follows:-

$$P_t = \frac{1}{(1+y_t)^t}$$

$$\Rightarrow P_t^{\frac{-1}{t}} = (1+y_t)$$

$$\Rightarrow y_t = P_t^{\frac{-1}{t}} - 1$$

Where, P_t is the price of an $n-year$ unit zero coupon bond.

二、計算 Spot Rate:

將距離年數與當期價格代入 spot rate 公式後，將結果儲存於一個陣列中

Forward Rates

- When S(i, j) equals

$$f(i,j) \triangleq \left[\frac{(1+S(j))^{j}}{(1+S(i))^{i}}\right]^{1/(j-i)} - 1$$

- f(i, j) are called the (implied) forward rates.

三、使用二維陣列儲存 Forward Rate:

將上一題中得到的 spot rate 陣列透過雙重迴圈的方式經過 forward rate 的公式計算後儲存進入矩陣中，最後再將結果用二維陣列的表格印出