

Summary of Yield Measures

I. T-Bills

1. (Bank) Discount Yield = $\left(\frac{F-P}{F}\right) / t, \quad \left(t = \frac{x}{360}\right)$

The number of days to maturity equals x.

Problems: (i) Uses F in denominator
(ii) Uses 360 days

2. Bond Yield Equivalent = $\left(\frac{F-P}{P}\right) / t, \quad \left(t = \frac{x}{365}\right)$

Problems: Uses simple interest to annualize (this is the so-called Annual Percentage Rate (APR) procedure, which takes the periodic rate and multiplies by the number of periods per year, where 1 It equals the number of periods per year).

3. Effective Annual Rate = $(1 + bye \cdot t)^{\frac{1}{t}} - 1$

Problems: Although the EAR properly accounts for compounding within a year, it still has the implicit reinvestment assumption of all yield to maturity type measures.

II. Zeros

1. Yield to Maturity (t = years to maturity)

a) Annual Compounding = $\sqrt[t]{\frac{F}{P}} - 1$ or $\left(\frac{F}{P}\right)^{\frac{1}{t}} - 1$

b) Semi-annual compounding = $2\left(\sqrt[2t]{\frac{F}{P}} - 1\right)$ or $2\left(\left(\frac{F}{P}\right)^{\frac{1}{2t}} - 1\right)$

c) Effective Annual Rate = $\left(1 + \frac{\text{semi-annual YTM}}{2}\right)^2 - 1$

2. Holding Period Yield

Same as 1(a), (b) and (c) except selling price replaces F and years held replaces t.

III. Coupon Bonds

1. Coupon Rate = C/F

Problems: When a bond sells at par, this equals yield to maturity, otherwise it ignores the effect of price paid differing from F.

2. Current Yield = C/P

Problems: Although it improves on C/F by replacing F with P, it ignores the capital appreciation or depreciation associated with P moving to F at maturity.

3. Yield to Maturity = internal rate of return.
Implicitly includes all effects of P, C, and F on yields.
- a) Annual pay bonds
IRR using number of periods = number of years
- b) Semi-annual pay bonds
Double IRR using number of periods = twice the number of years to maturity

4. Effective Annual Rate

a) Annual pay bonds = Yield to maturity

b) Semi-annual pay bonds = $\left(1 + \frac{YTM}{2}\right)^2 - 1$

5. Holding Period Yield = Return per annum

a) When coupon is at end (for annual pay bond), and P' is the selling price at the end of one year:

$$HPY = \frac{P' - P + C}{P}$$

b) When coupon payments occur throughout holding period:

i) $HPY = YTM$ only if annual coupon payments are reinvested at YTM (this assumes the bond is held to maturity).

ii) If coupons are reinvested at some other rate, and/or if the bond is a semi-annual pay bond, and if t' is years held, then you must calculate the final value of all cash flows and then solve as follows:

$$HPY = \sqrt[t']{\frac{\text{Final value of all cash flows}}{\text{Initial price}}} - 1$$

Bodie Kane and Marcus call this the Realized Compound Yield

iii) If annual returns are given (HPY_1, HPY_2, \dots) and there are t years, then you can use the following formula:

$$HPY = \sqrt[t]{(1 + HPY_1)(1 + HPY_2) \cdots (1 + HPY_t)} - 1$$

6. Yield to Call

Same as yield to maturity except call price replaces face value and number of periods equals periods to call date