Summary of Yield Measures

I. T-Bills

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

   The number of days to maturity equals \( x \).

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

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

   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 \( t \) 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** \( (t = \text{years to maturity}) \)

   a) Annual Compounding = \( \frac{t}{\sqrt[2]{P} - 1} \) or \( \left( \frac{F}{P} \right)^{\frac{1}{t}} - 1 \)

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

   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:
   
   \[ HPY = \sqrt[\frac{t'}{2}]{\frac{Final \ value \ of \ all \ cash \ flows}{Initial \ price}} - 1 \]

   Bodie Kane and Marcus call this the Realized Compound Yield
iii) If annual returns are given (HPY₁, HPY₂, ... ) and there are t' years, then you can use the following formula:

\[ HPY = \frac{1}{t'} \left( \frac{1}{(1 + HPY_1)(1 + HPY_2) \ldots (1 + HPY_{t'})} - 1 \right) \]

6. **Yield to Call**

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