1. (a) Explain Yield to Maturity Model (YTM) with an example?

Ans: Yield to maturity (YTM) is the total return anticipated on a bond if the bond is held until it matures. Yield to maturity is considered a long-term bond yield but it is expressed as an annual rate. In other words, it is the internal rate of return (IRR) of an investment in a bond if the investor holds the bond until maturity, with all payments made as scheduled and reinvested at the same rate.

Yield to maturity is also referred to as “book yield” or “redemption yield.”

Yield to maturity is similar to current yield, which divides annual cash inflows from a bond by the market price of that bond to determine how much money one would make by buying a bond and holding it for one year. Yet, unlike current yield, YTM accounts for the present value of a bond’s future coupon payments. In other words, it factors in the time value of money, whereas a simple current yield calculation does not. As such, it is often considered a more thorough means of calculating the return from a bond.

The YTM of a discount bond that does not pay a coupon is a good starting place in order to understand some of the more complex issues with coupon bonds. The formula to calculate YTM of a discount bond is as follows:

\[
YTM = \sqrt[n]{\frac{\text{Face Value}}{\text{Current Price}}} - 1
\]

Where:
- \( n \) = number of years to maturity
- Face value = bond’s maturity value or par value
- Current price = the bond’s price today

Because yield to maturity is the interest rate an investor would earn by reinvesting every coupon payment from the bond at a constant interest rate until the bond’s maturity date, the present value of all the future cash flows equals the bond’s market price. An investor knows the current bond price, its coupon payments and its maturity value, but the discount rate cannot be calculated directly. However, there is a trial-and-error method for finding YTM with the following present value formula:

\[
\text{Bond Price} = \frac{\text{Coupon } 1}{(1 + YTM)^1} + \frac{\text{Coupon } 2}{(1 + YTM)^2} + \cdots + \frac{\text{Coupon } n}{(1 + YTM)^n} + \frac{\text{Face Value}}{(1 + YTM)^n}
\]

Or this formula:

\[
\text{Bond Price} = \left( \text{Coupon } x \frac{1}{1 + YTM} \right) + \left( \frac{\text{Face Value}}{(1 + YTM)^n} \right)
\]

Each one of the future cash flows of the bond is known, and because the bond’s current price is also known, a trial-and-error process can be applied to the YTM variable in the equation until the present value of the stream of payments equals the bond’s price.

Solving the equation by hand requires an understanding of the relationship between a bond's price and its yield, as well as of the different types of bond pricings. Bonds can be priced at a discount, at par or at a premium. When the bond is priced at par, the bond’s interest rate is equal to its coupon rate. A bond priced above par, called a premium bond, has a coupon rate higher than the realized interest rate, and a bond priced below par, called a discount bond, has a coupon rate lower than the realized interest rate. If an investor were calculating YTM on a bond priced below par, she would solve the equation by plugging in various annual interest rates that were higher than the coupon rate until finding a bond price close to the price of the bond in question.

Calculations of yield to maturity (YTM) assume that all coupon payments are reinvested at the same rate as the bond’s current yield and take into account the bond’s current market price, par value, coupon interest rate and term to maturity. The YTM is merely a snapshot of the return on a bond because coupon payments cannot always be reinvested at the same interest rate. As interest rates rise, the YTM will increase; as interest rates fall, the YTM will decrease.