MA374 Financial Engineering lab:11

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- **To execute my .py file**
  Run $python3 180123029_NamanGoyal.py on the terminal.

```
~/Desktop/IITG_SEMVI/FE_Labs/lab11
python3 180123029_NamanGoyal.py
------------------Q1------------------

The Term Structure upto 10 time units
The Yield v/s Maturity for upto 500 time units
------------------------------------------------------

------------------Q2------------------

The Term Structure upto 10 time units
The Yield v/s Maturity for upto 600 time units
------------------------------------------------------
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Ques.1

The Vasicek model has an affine term structure where

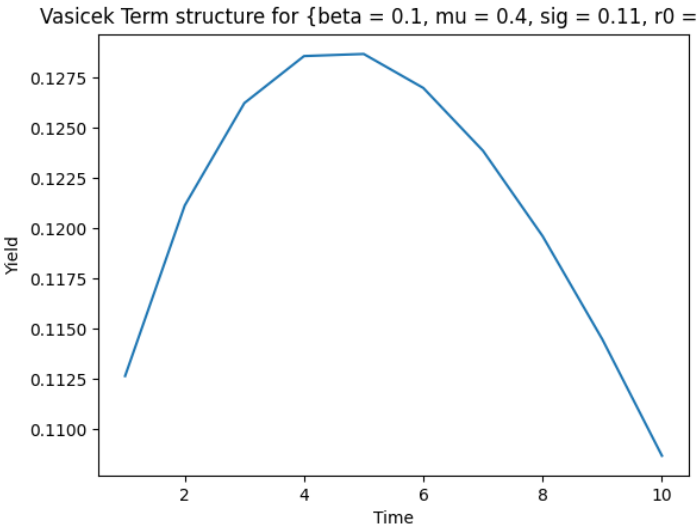
$$p(t,T) = e^{A(t,T)-B(t,T)r(t)}$$
$$B(t,T) = \frac{1}{a}\left(1 - e^{-a(T-t)}\right)$$
$$A(t,T) = \frac{(B(t,T) - T + t)(ab - \frac{1}{2}\sigma^2)}{a^2} - \frac{\sigma^2 B^2(t,T)}{4a}$$

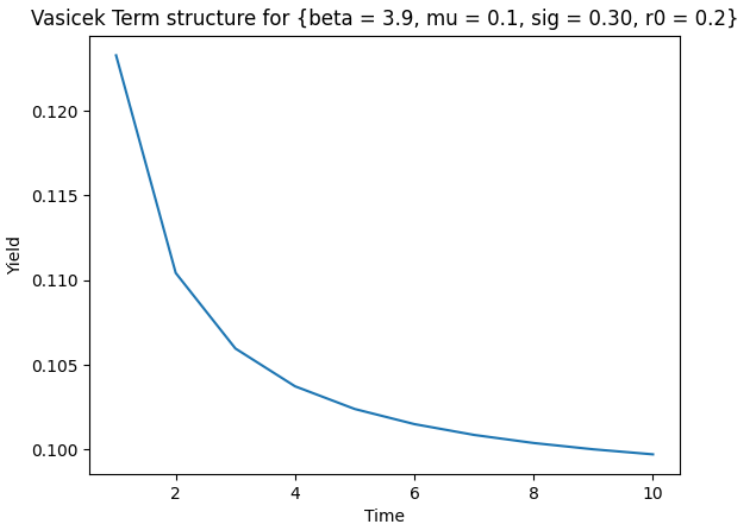
$$Here\ a\ =\ \beta\ and\ b\ =\beta\mu$$

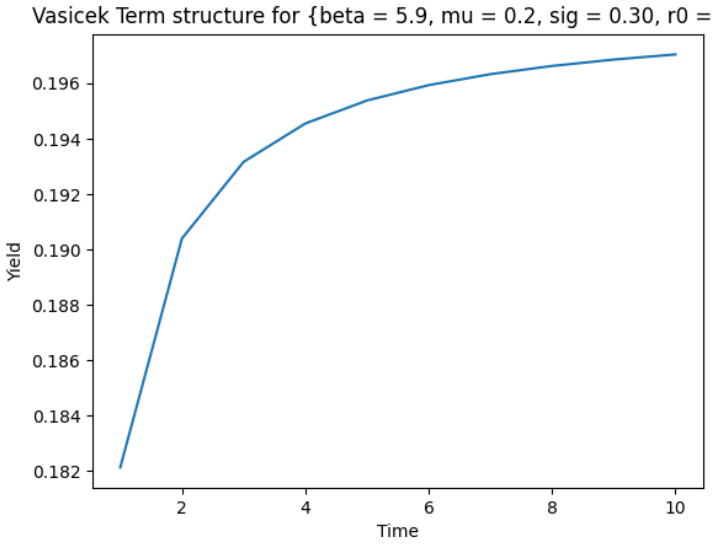
The yield is calculated using -

$$y = -\frac{\log(P(t,T))}{T-t}$$

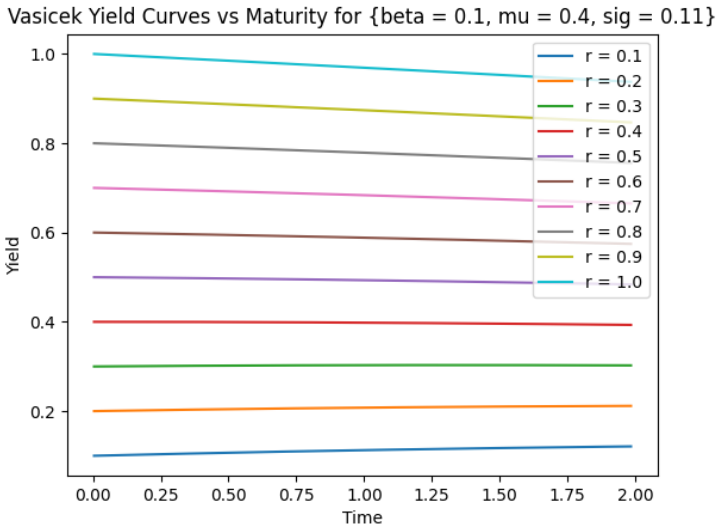
- The curves for **Term Structures** are given below:

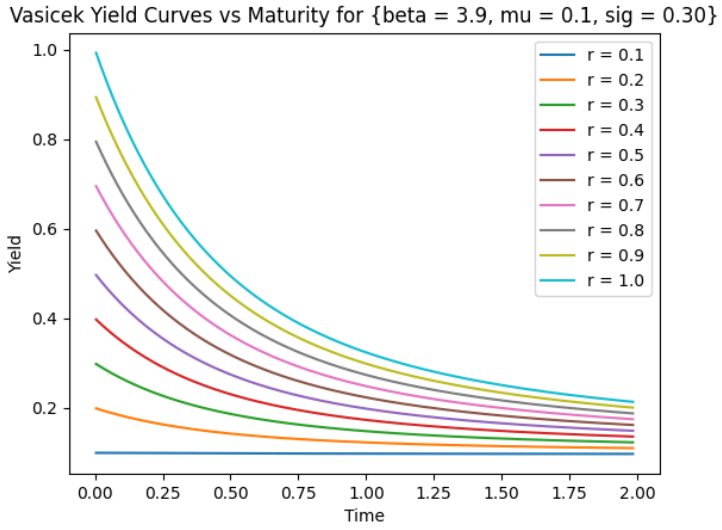


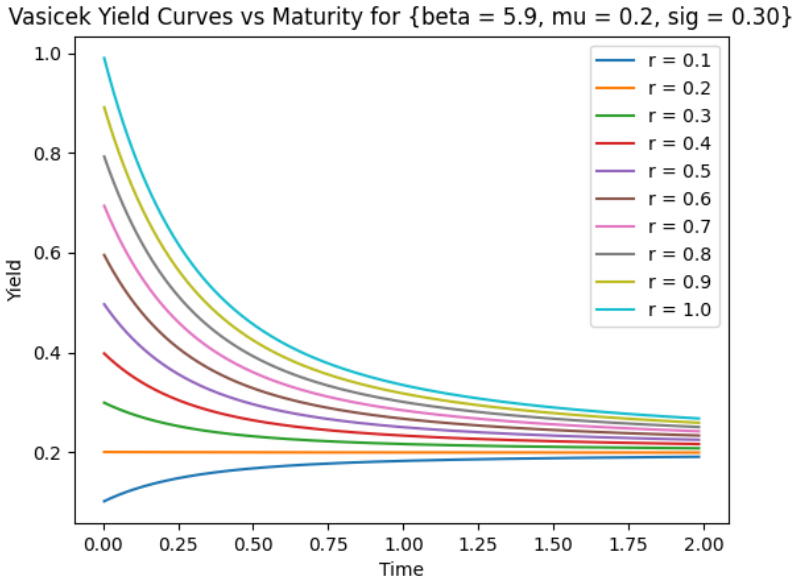




- The **Yields v/s Maturity** curves are plotted for different values of r = (0.1, 0.1, 1) : 10 values and are shown below:







Observations:

- As we can see from the plots of Yield Curves as values of Beta increases all the curves in the plot approximately converge to the same point.

Ques.2

In the Cox-Ingersoll-Ross model, the bond price is given by -

$$P(t,T) = A(t,T)\exp(-B(t,T)r_t)$$

where

$$A(t,T) = \left(\frac{2h\exp((a+h)(T-t)/2)}{2h+(a+h)(\exp((T-t)h)-1)}\right)^{2ab/\sigma^2}$$

$$B(t,T) = \frac{2(\exp((T-t)h)-1)}{2h+(a+h)(\exp((T-t)h)-1)}$$

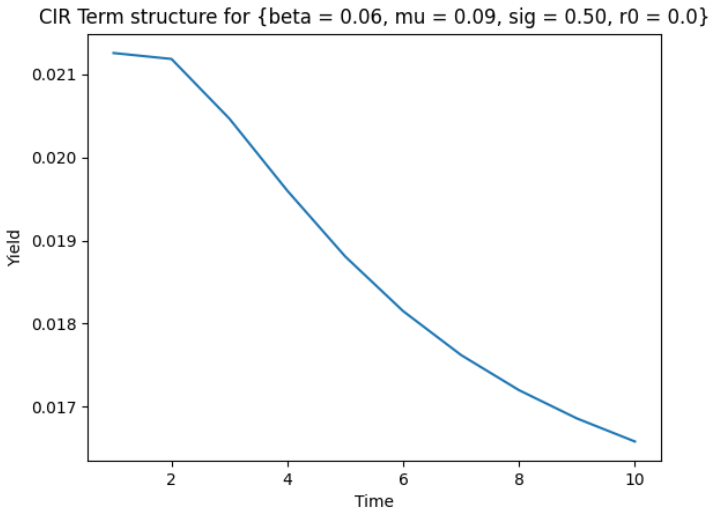
$$h = \sqrt{a^2+2\sigma^2}$$

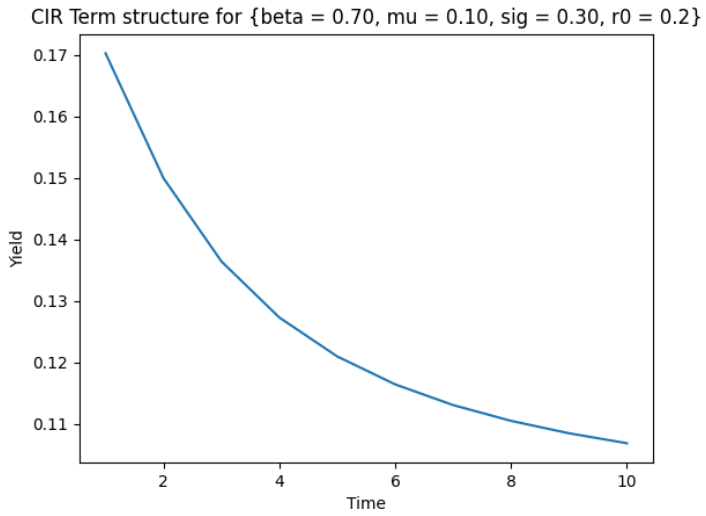
Here $a = \beta$ *and* $b = \mu$

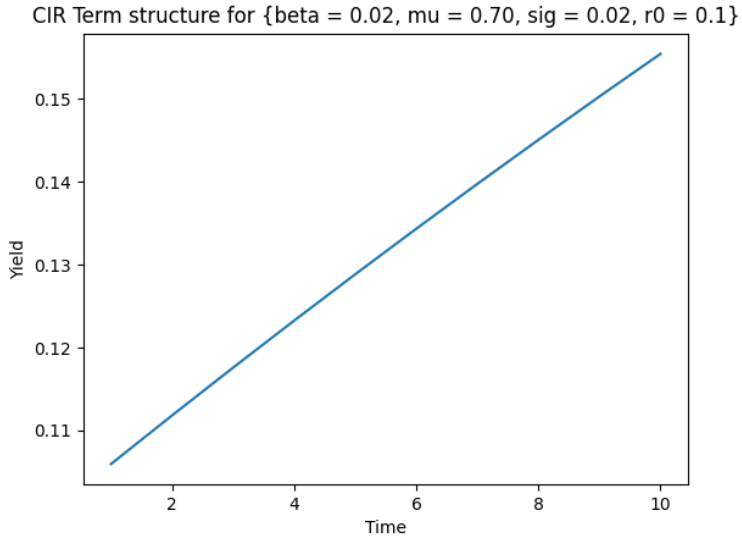
The yield is calculated using -

$$y = -\frac{\log(P(t,T))}{T-t}$$

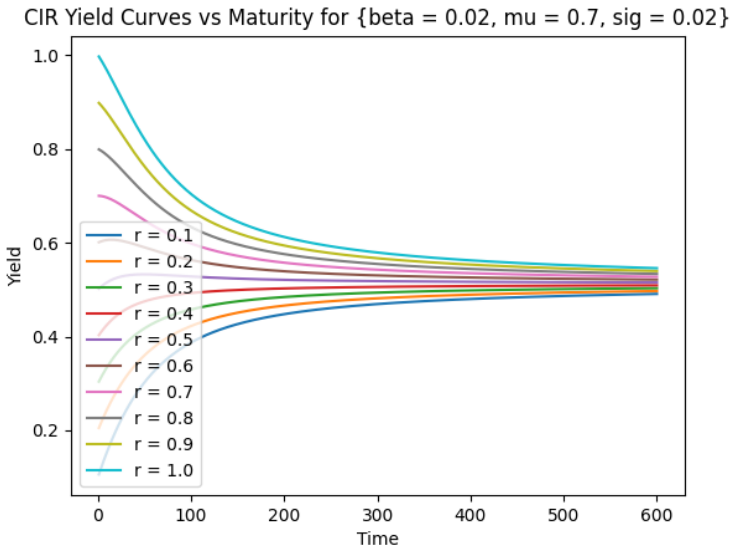
- The curves for **Term Structures** are given below:







- The **Yield v/s Maturity** curve is plotted for different values of r = (0.1, 0.1, 1) : 10 values and are shown below:



Observations:

- As we can again see from the plot of Yield Curve all the curves in the plot approximately converges to the same point.
