MA374 : Financial Engineering Laboratory
Lab 11

Name : Harsh **Roll No. 200123022**

Question 1:

➢ In the Vasicek Model the risk neutral dynamics of r can be expressed as -

$$dr = (b - ar)dt + \sigma dW$$

➢ On comparing with the model we get $a = \beta \; and \; b = \beta u$.

➢ Price of the bond is calculated using following formulae -

$$B(t,T) = \frac{1 - e^{-a(T-t)}}{a}$$

$$A(t,T) = \frac{(B(t,T) - T + t)(ab - \frac{\sigma^2}{2})}{a^2} - \frac{\sigma^2 B^2(t,T)}{4a}$$

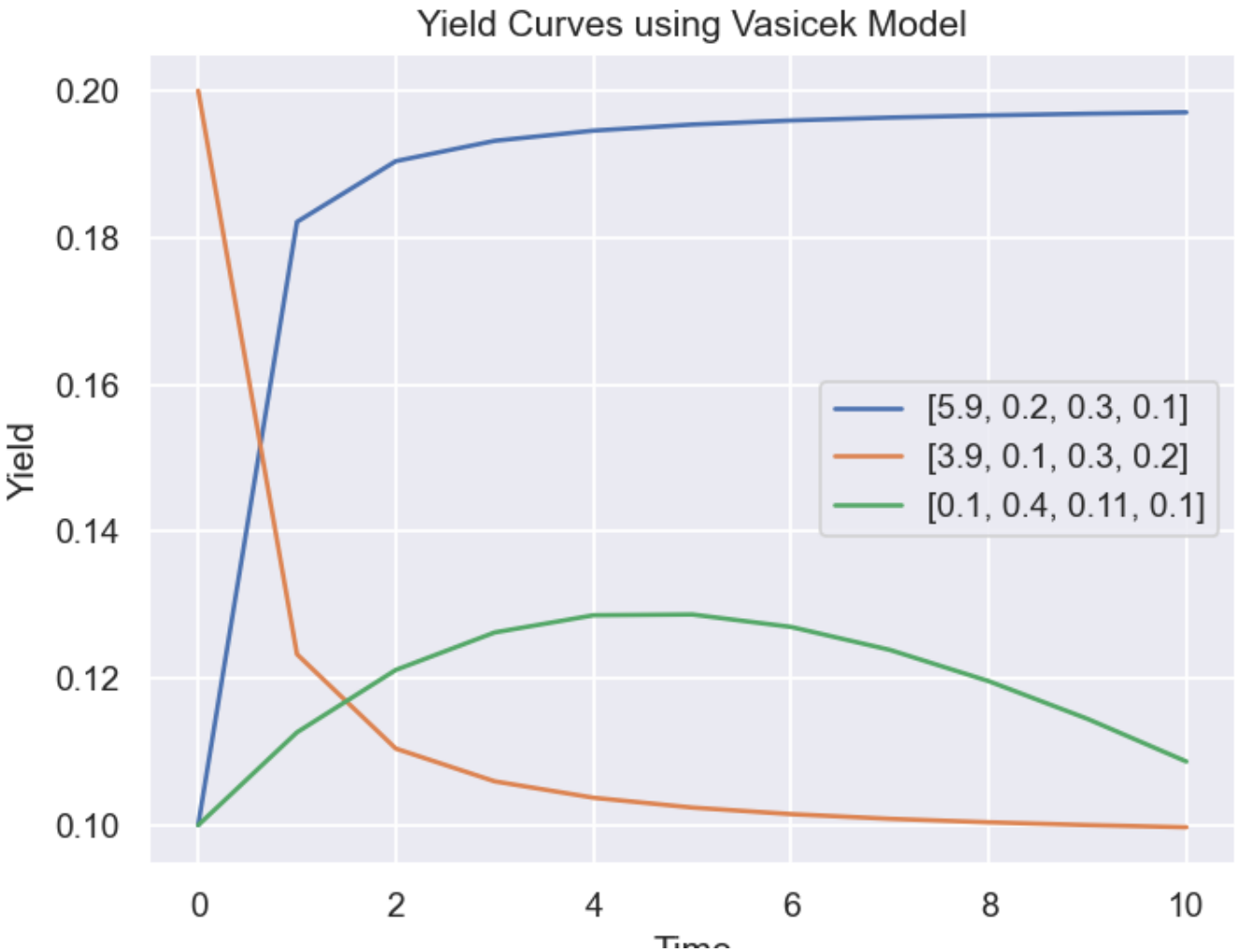
$$_{\rho}(t,T) = e^{A(t,T) - B(t,T)r(t)}$$

➢ Yield can be calculated from the price using following formula–

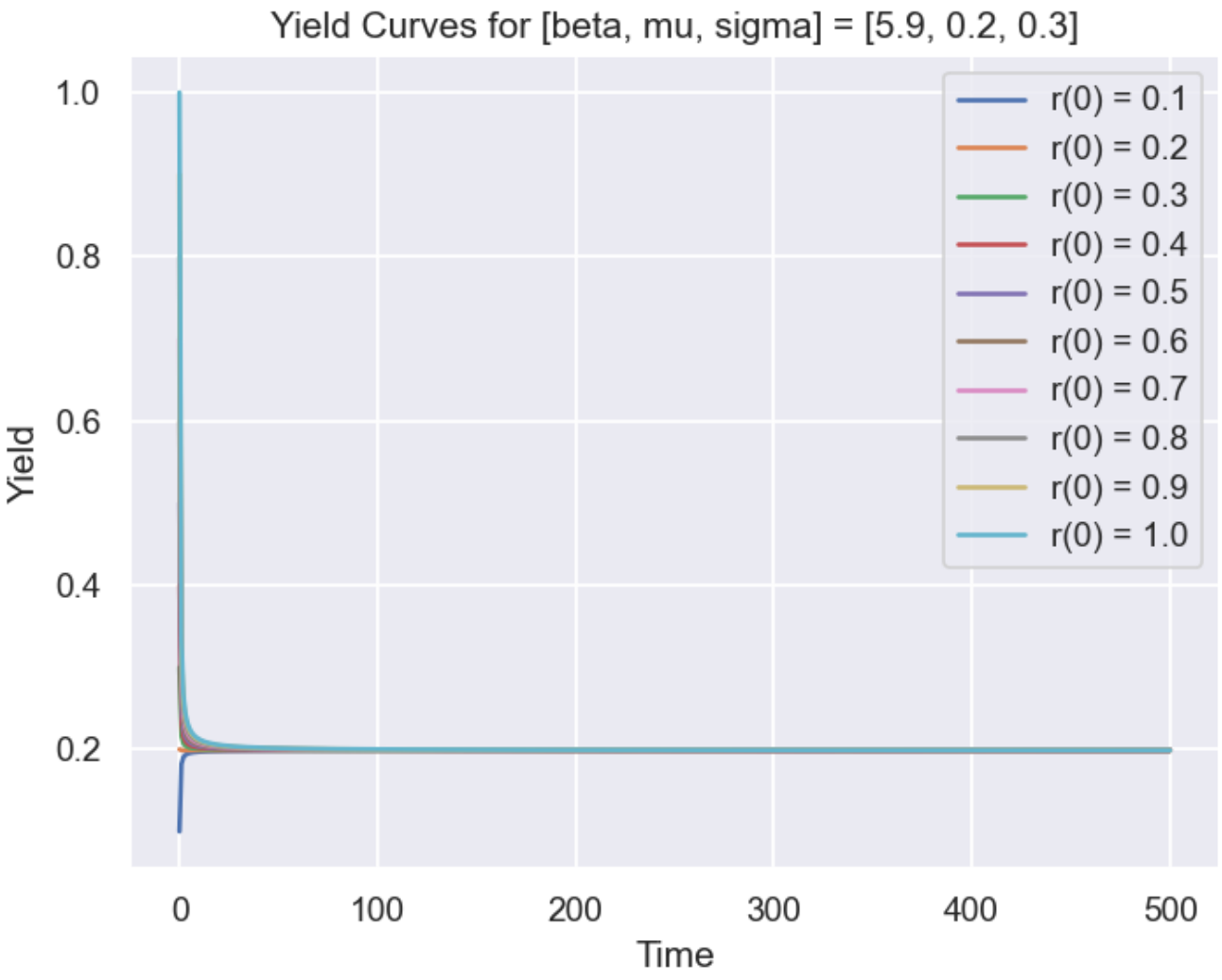
$$Yield = \frac{-log(p(t,T))}{T - t}$$

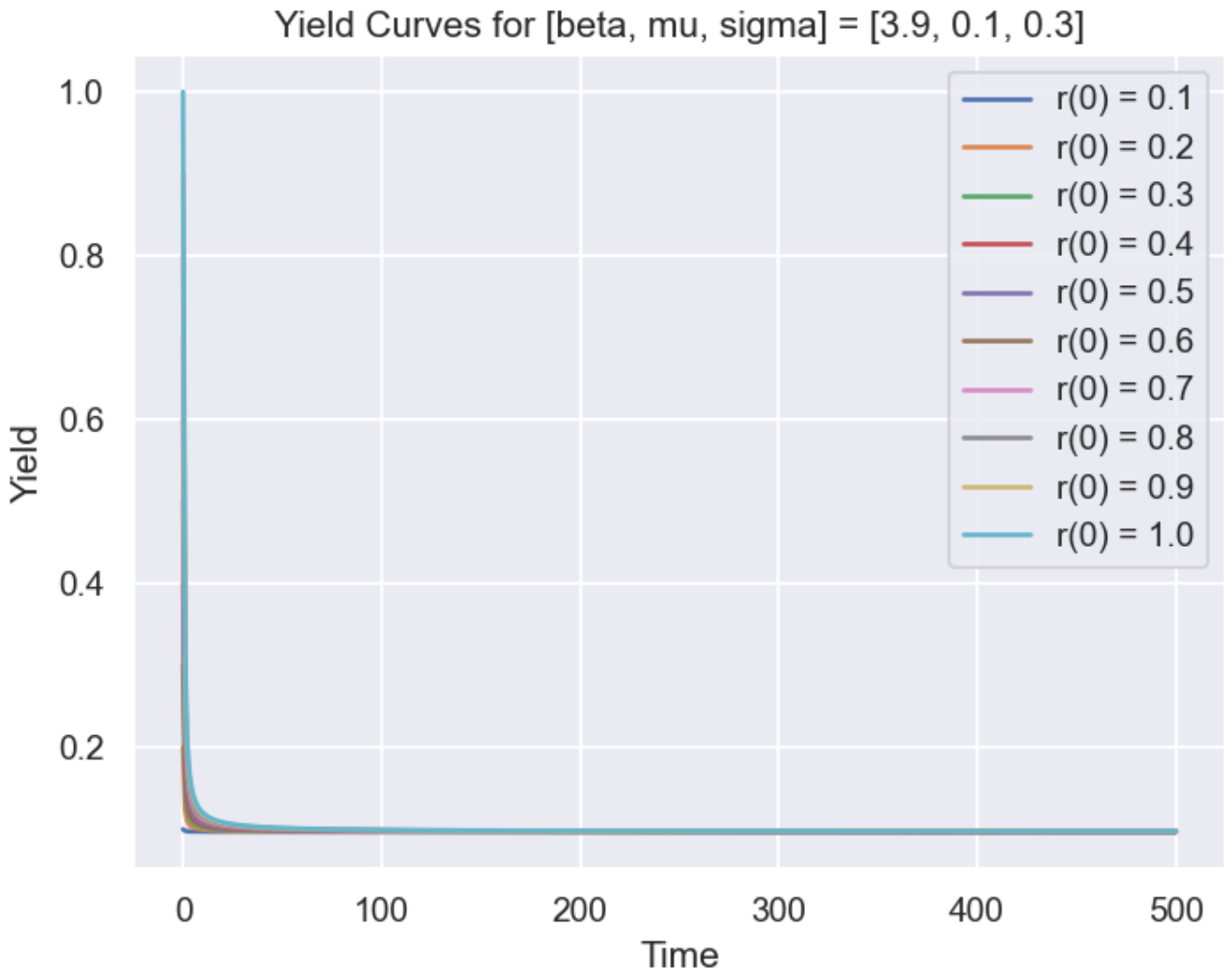
➢ t = 0 in our case

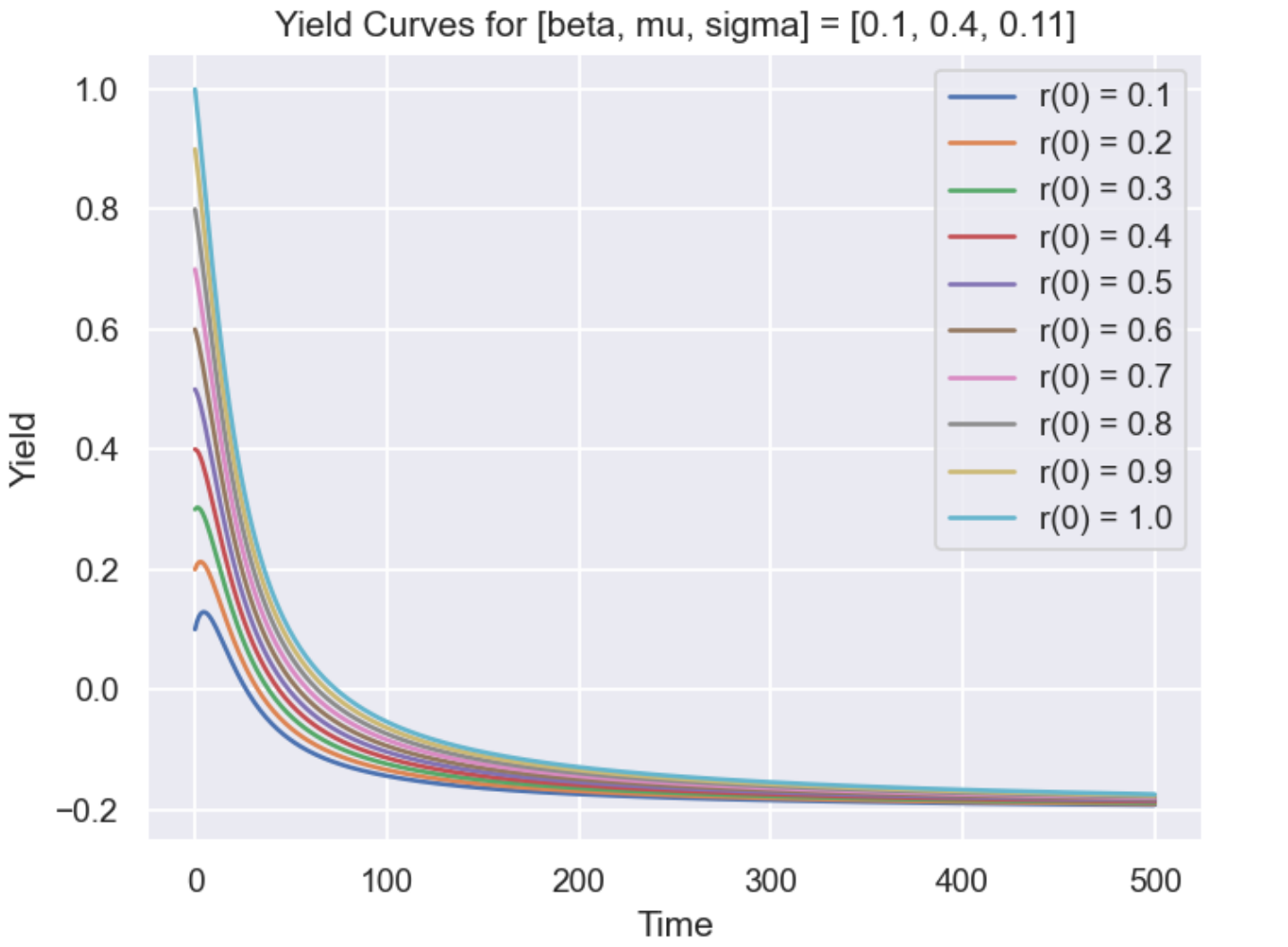
Term structure for the given parameters is plotted using 10 time units.



Now, yield curves versus maturity up to 500 time units for 10 different values of r(0) are plotted for all the three sets of parameters.


Yield Curves for [beta, mu, sigma] = [5.9, 0.2, 0.3]
r(0) = 0.1
r(0) = 0.2
r(0) = 0.3
r(0) = 0.4
r(0) = 0.5
r(0) = 0.6
r(0) = 0.7
r(0) = 0.8
r(0) = 0.9
r(0) = 1.0
Yield
1.0
0.8
0.6
0.4
0.2
0
100
200
300
400
500
Time


Yield Curves for [beta, mu, sigma] = [3.9, 0.1, 0.3]
1.0
0.8
0.6
0.4
0.2
Yield
0
100
200
300
400
500
Time
r(0) = 0.1
r(0) = 0.2
r(0) = 0.3
r(0) = 0.4
r(0) = 0.5
r(0) = 0.6
r(0) = 0.7
r(0) = 0.8
r(0) = 0.9
r(0) = 1.0



Observations :

- ➢ For higher r(0), yield is higher
- ➢ Yield converges to a limit for all the parameters.
- ➢ Yield can increase or decrease with time to maturity. It depends on the prediction made using the current parameters about the future interest rates.

Question 2:

- In the CIR(Cox-Ingersoll-Ross) model the risk neutral dynamics of r can be expressed as –

$$dr = a(b - r)dt + \sigma\sqrt{r}dW$$

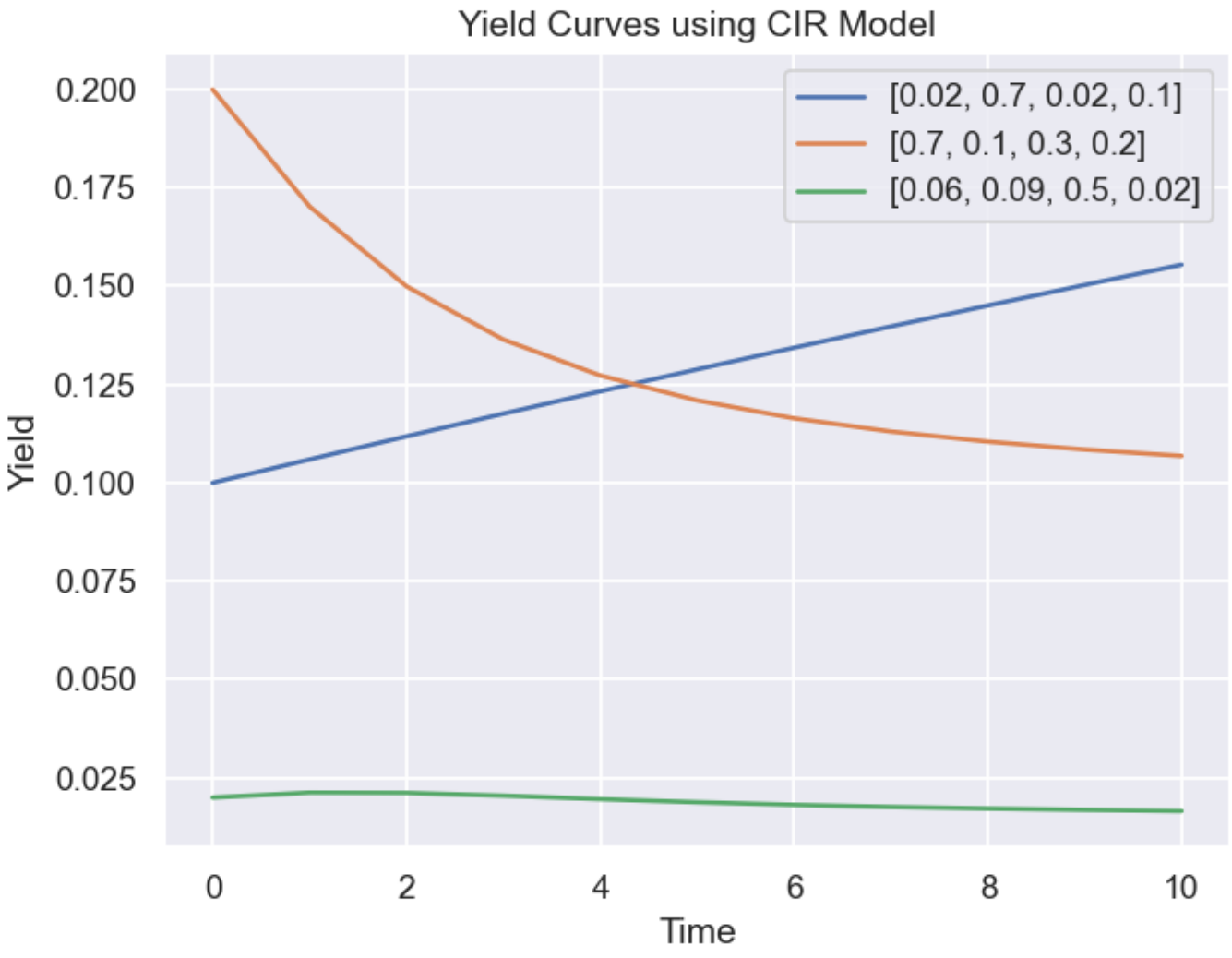
- On comparing with the model we get a = β and b = μ.
- Price of the bond is calculated using following formulas –

- Yield can be calculated from the price using following formula –

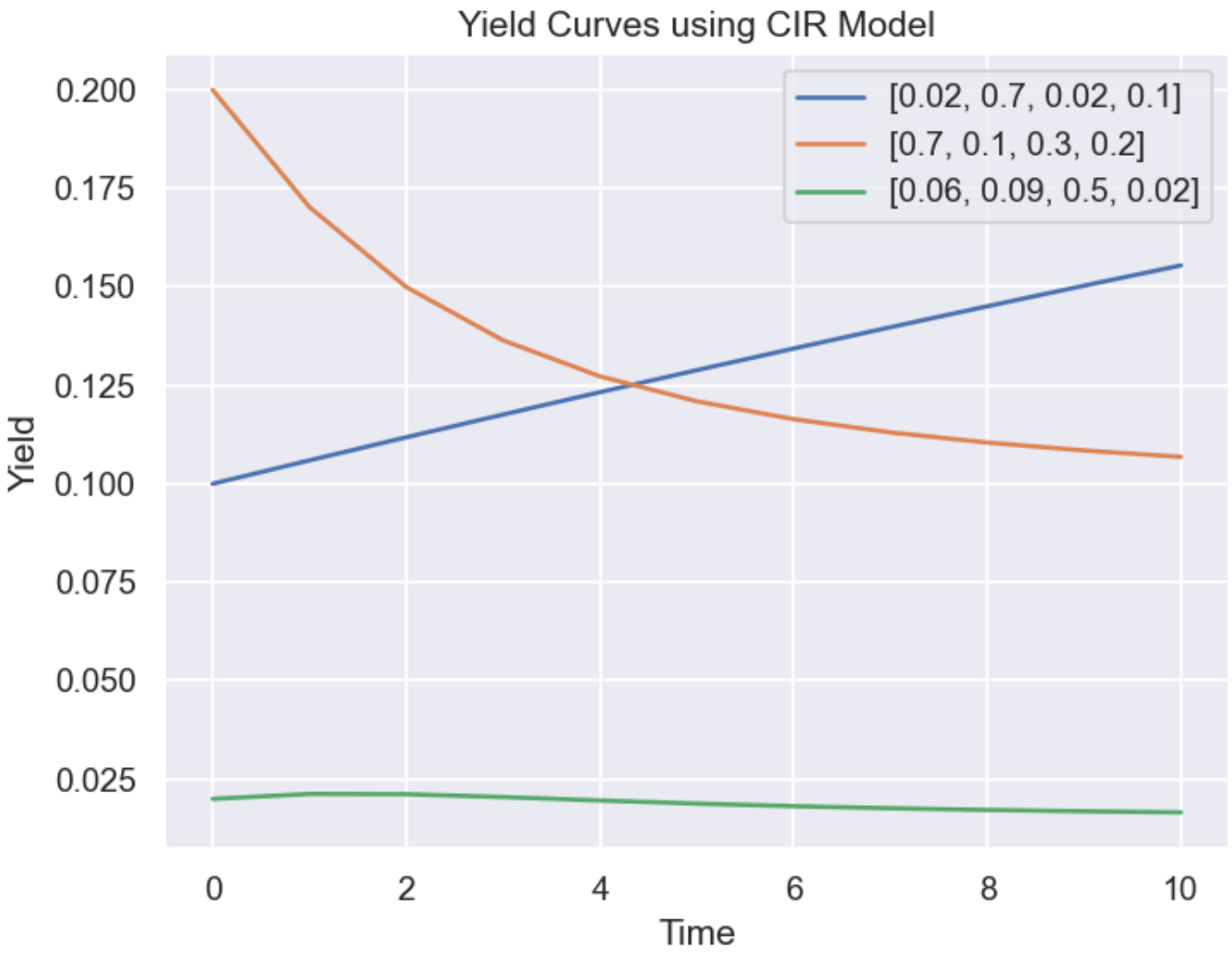
$$Yield = \frac{-log(p(t,T))}{T - t}$$

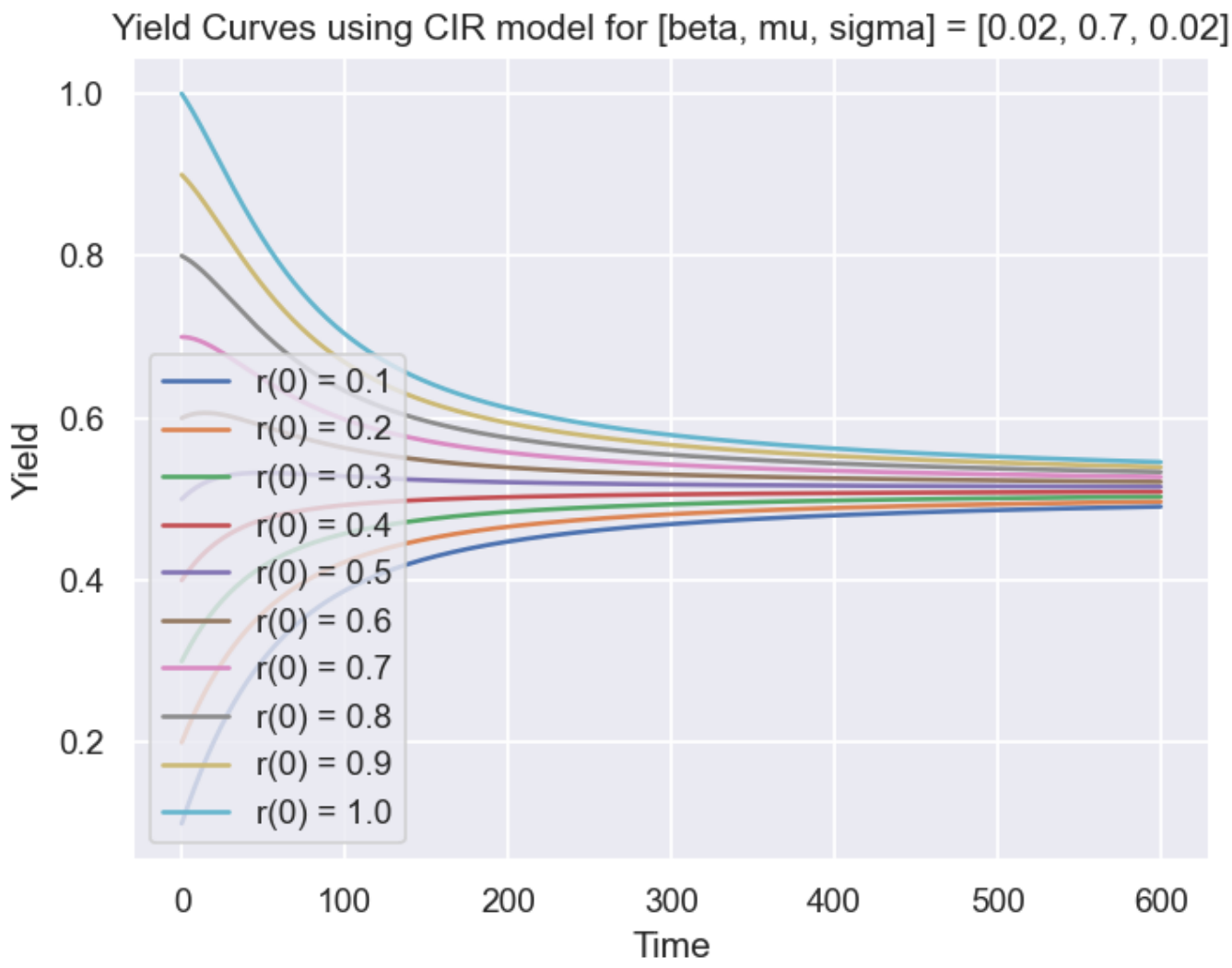
- t = 0 in our case.

Term structure for the given parameters is plotted using 10 time units.



Now, yield curves versus maturity up to 600 time units for r(0) = 0.1:0.1:1 is plotted for [beta, mu, sigma] = [0.02, 0.7, 0.02].





Observations :

- ➢ For higher r(0), yield is higher.
- ➢ Yield converges to a limit.
- ➢ Yield can increase or decrease with time to maturity. It depends on the prediction made using the current parameters about the future interest rates.