MA374 – Financial Engineering Laboratory

Lab – 10

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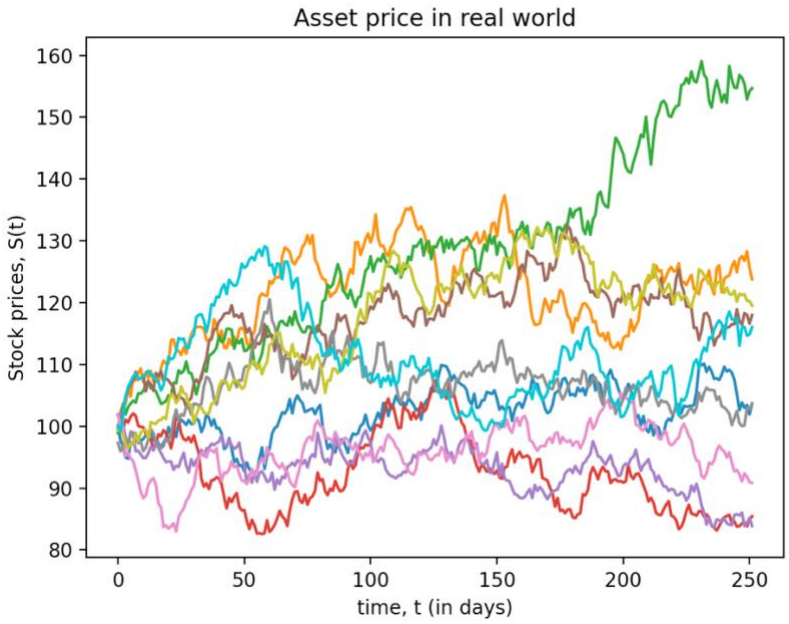
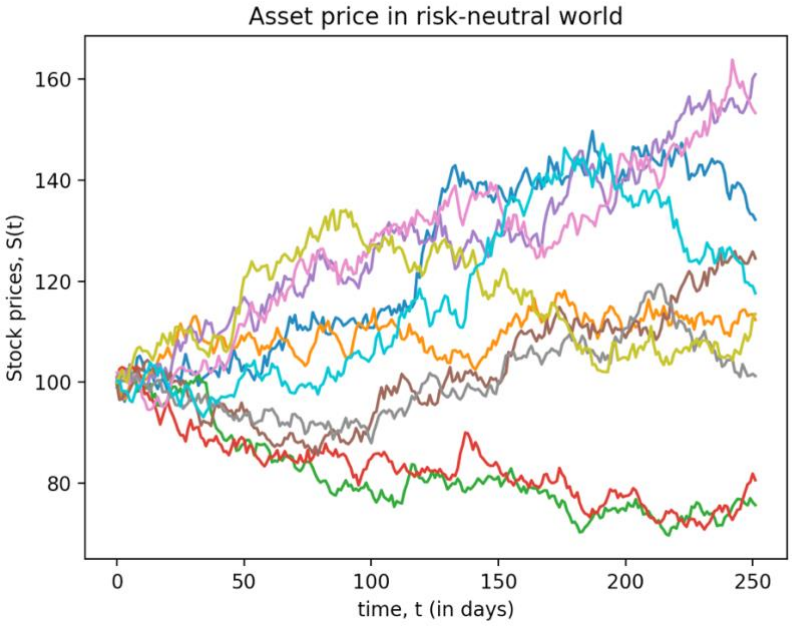
Ques – 1

a. 10 different asset price paths based on GBM Model in real world.



b. 10 different asset price paths based on GBM Model in risk-neutral world.



The prices of a six-month fixed-strike Asian option with various strike prices are: -

```
************** For K = 90 **************
Asian call option price                  = 10.719871273979782
Variance in Asian call option price      = 55.060998883934985

Asian put option price                   = 0.30945530614003863
Variance in Asian put option price       = 1.6971352911726028


************** For K = 105 **************
Asian call option price                  = 1.7288990250447622
Variance in Asian call option price      = 14.94283097874346

Asian put option price                   = 5.923788318090797
Variance in Asian put option price       = 34.844648532841575


************** For K = 110 **************
Asian call option price                  = 0.6365947396617387
Variance in Asian call option price      = 5.985861785195261

Asian put option price                   = 9.72560976851764
Variance in Asian put option price       = 47.648977059924206
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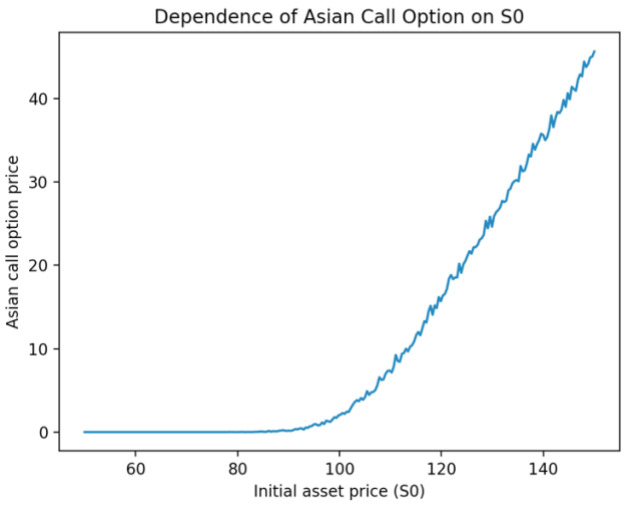
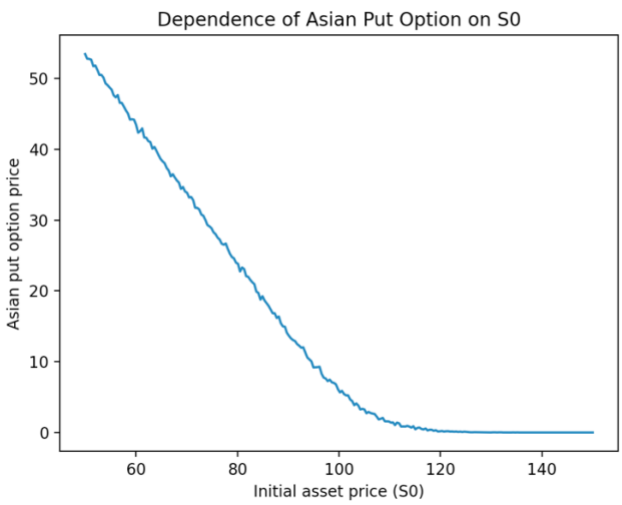
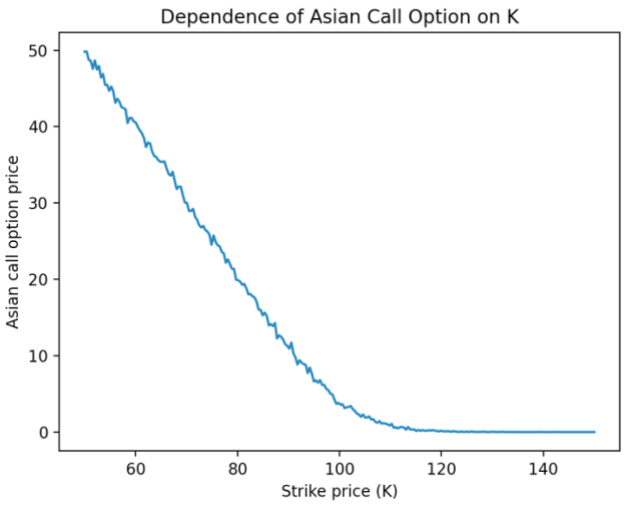
Sensitivity Analysis: -

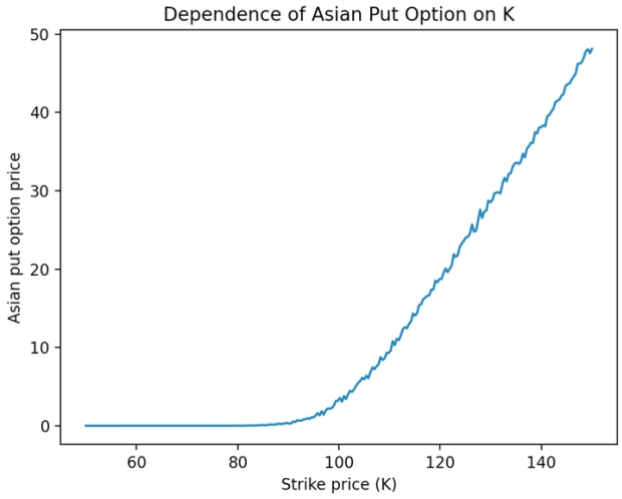
1. Variation with S_0: -



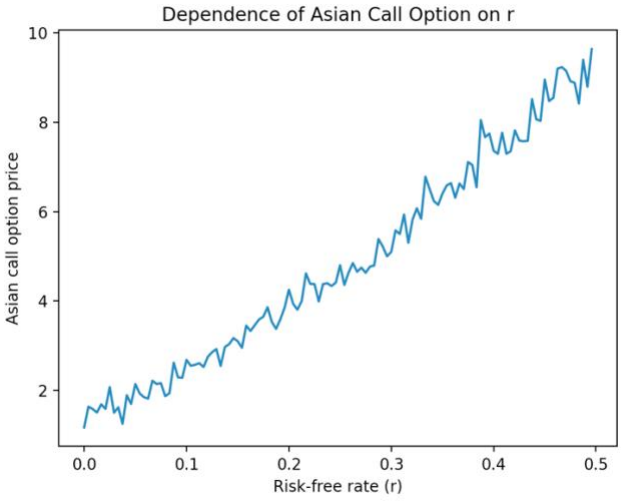


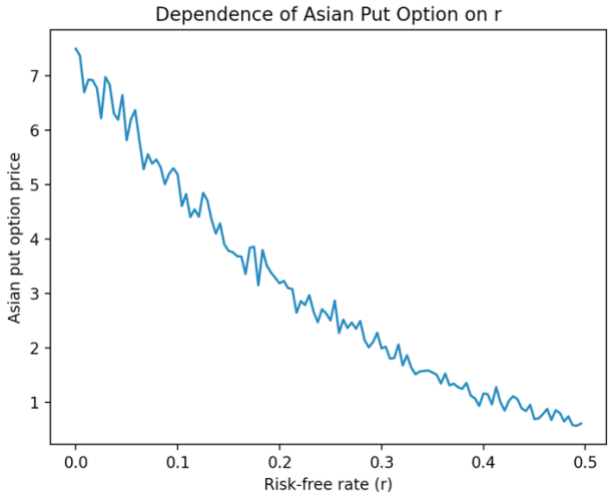
2. Variation with K: -



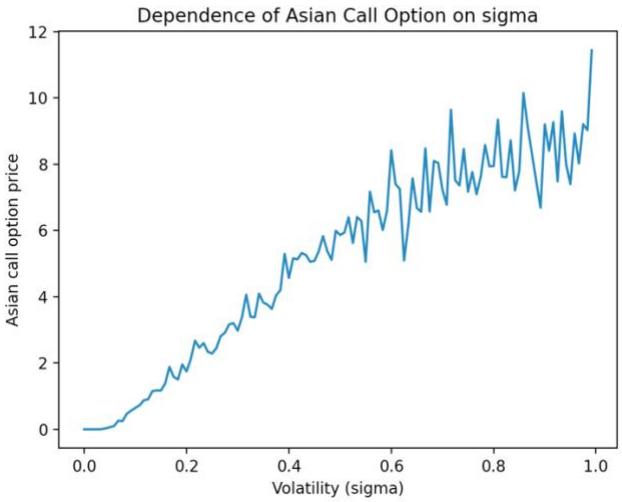


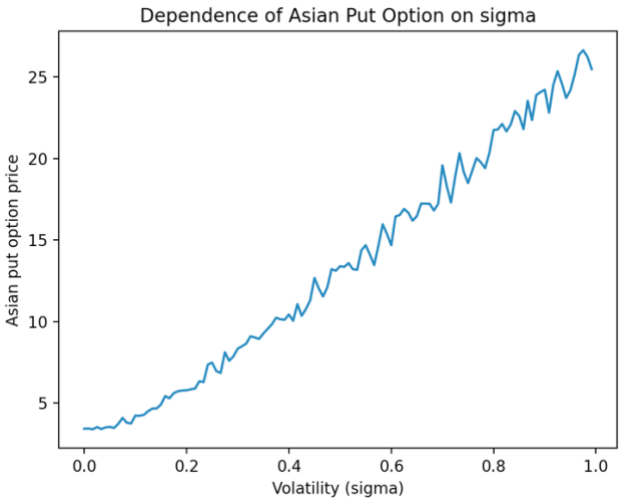
3. Variation with r: -





4. Variation with sigma: -





Observations: -

1. The price of the call option increases while that of the put option decreases, with an increase in the initial asset price, S0.
2. The price of the call option decreases while that of the put option increases, with an increase in the strike prices, K.
3. The price of the call option increases while that of the put option decreases, with an increase in the risk-free interest, r.
4. The price of both call and put option increases with an increase in sigma.

Ques – 2

The prices of a six-month fixed-strike Asian option with various strike prices, after performing variance reduction are: -

```
********** For K = 90 **********
Asian call option price                 = 11.142210238234185
Variance in Asian call option price     = 46.642947385475 94

Asian put option price                  = 0.24894605198791 94
Variance in Asian put option price      = 1.15975130667624


********** For K = 105 **********
Asian call option price                 = 1.67187322262748 44
Variance in Asian call option price     = 11.752896402273667

Asian put option price                  = 5.658644971053163
Variance in Asian put option price      = 24.762609678107157


********** For K = 110 **********
Asian call option price                 = 0.60159512999477 97
Variance in Asian call option price     = 4.044356770084273

Asian put option price                  = 9.96326441457935
Variance in Asian put option price      = 39.324083436338334
```

Observations: –

The price of both call and put options obtained using both with and without variance reduction, are comparable. The respective variances are compared in the following table:

i. **For Call Option: -**

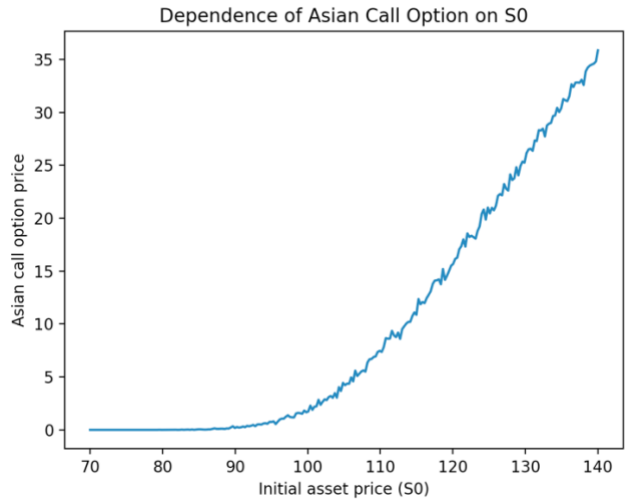
S No.	Strike Price (K)	Variance (without reduction)	Variance (with reduction)
1.	95	55.060998883934985	46.64294738547594
2.	105	14.94283097874346	11.752896402273667
3.	110	5.985861785195261	4.044356770084273

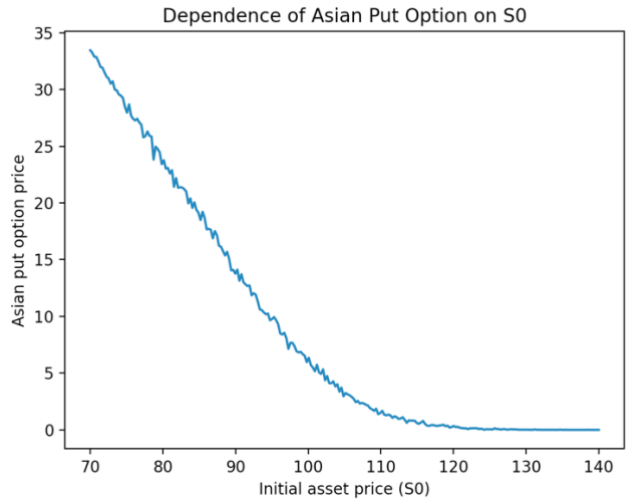
ii. **For Put Option: -**

S No.	Strike Price (K)	Variance (without reduction)	Variance (with reduction)
1.	95	1.6971352911726028	1.15975130667624
2.	105	34.844648532841575	24.762609678107157
3.	110	47.648977059924206	39.324083436338334

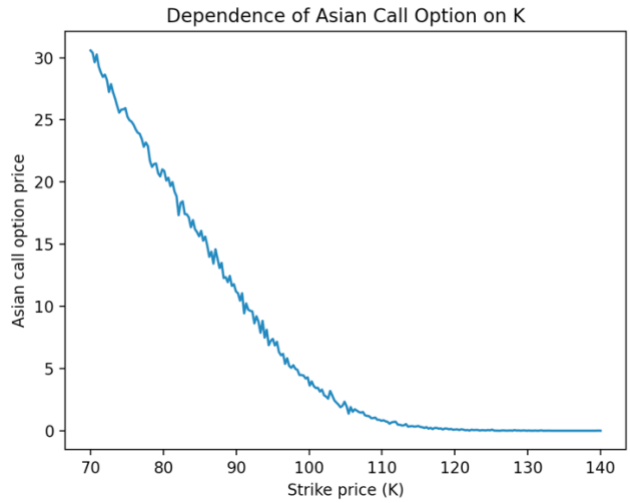
Sensitivity Analysis after performing Variance Reduction: –

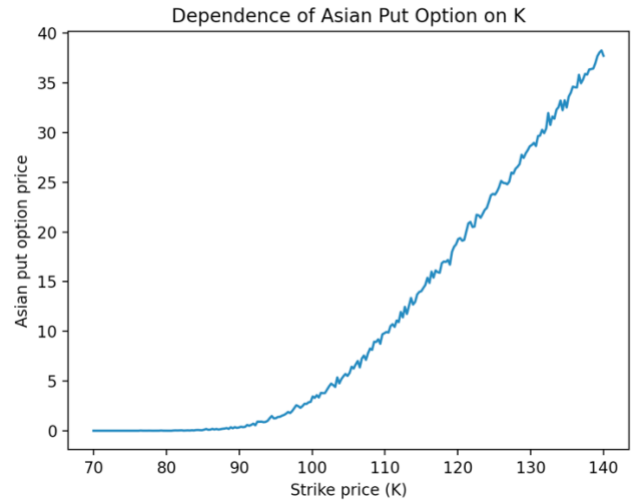
1. Variation with S_0: -



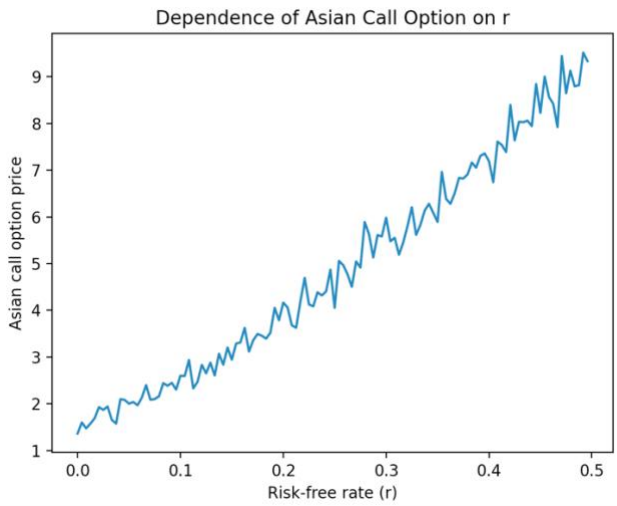


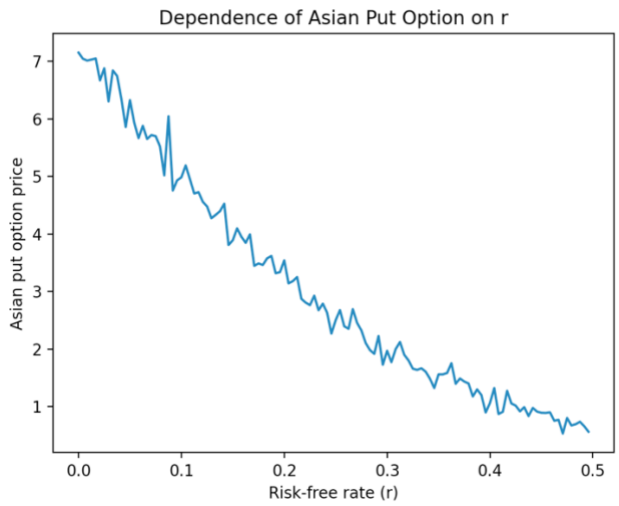
2. Variation with K: -



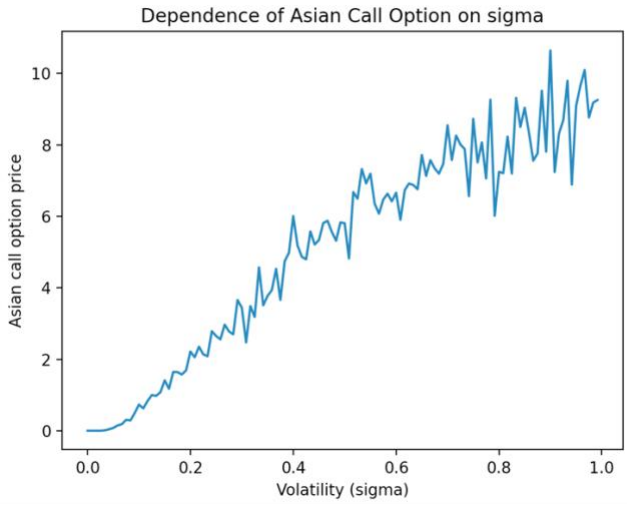


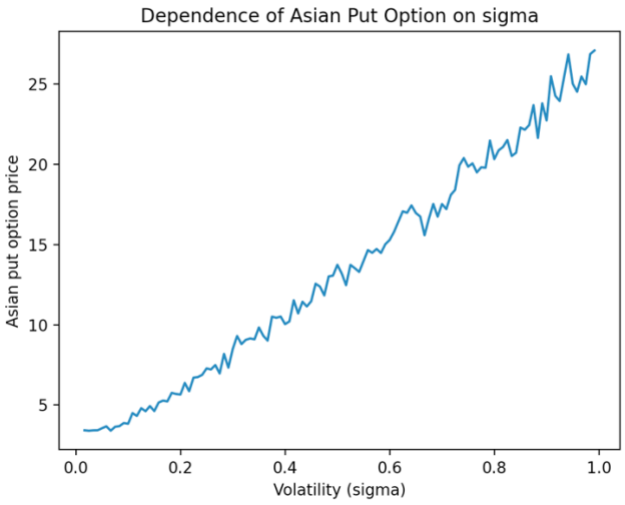
3. Variation with r: -





1. Variation with sigma: -





Observations: -

1. Earlier, we have quantitatively demonstrated that the variance reduction is achieved. This claim is even more supported by the constructed plots.
2. On careful analysis, the fluctuations in the plots seem to be less than the case when variance reduction was not applied. So, the scheme achieves its goal.
3. The nature of the plots is consistent with our expectations, which is explained in the last question.