LEVEL 9: GROUP C

1. Batch 1: T = 0.25, K = 65, sig = 0.30, r = 0.08, S = 60 (then C = 2.13337, P = 5.84628)

|  |  |  |  |
| --- | --- | --- | --- |
| Time Interval | Number of Simulations | Price of Call Option | Price of Put Option |
| 100 | 1000 | 2.0741 | 5.84851 |
| 100 | 10000 | 2.1378 | 5.90807 |
| 100 | 50000 | 2.11675 | 5.87749 |
| 100 | 100000 | 2.13043 | 5.87321 |
| 100 | 500000 | 2.14037 | 5.84408 |
| 100 | 1000000 | 2.13271 | 5.85125 |
| 1000 | 500000 | 2.13279 | 5.84122 |
| 900 | 500000 | 2.13384 | 5.84152 |
| 800 | 500000 | 2.128 | 5.84487 |

Batch 2: T = 1.0, K = 100, sig = 0.2, r = 0.0, S = 100 (then C = 7.96557, P = 7.96557)

|  |  |  |  |
| --- | --- | --- | --- |
| Time Interval | Number of Simulations | Price of Call Option | Price of Put Option |
| 100 | 500000 | 7.98116 | 7.96006 |
| 500 | 500000 | 7.9418 | 7.97869 |
| 900 | 500000 | 7.96764 | 7.95589 |

Note: As mentioned below, the random sampling of Monte Carlo and the consistent presence of a certain amount is inevitable. It is even visible in the table above, where the actual prices of both put and call options are the same for Batch 2, yet the disparity in each scenario is present.

c. Batch 4: T = 30.0, K = 100.0, sig = 0.30, r = 0.08, S = 100.0 (C = 92.17570, P = 1.24750).

|  |  |  |  |
| --- | --- | --- | --- |
| Time Interval | Number of Simulations | Price of Call Option | Price of Put Option |
| 900 | 500000 | 92.089 | 1.25108 |
| 950 | 500000 | 92.3221 | 1.25167 |
| 800 | 100000 | 93.3143 | 1.24898 |
| 920 | 500000 | 92.1195 | 1.25051 |
| 800 | 50000 | 93.014 | 1.23868 |
| 1000 | 50000 | 93.5268 | 1.24091 |
| 1500 | 10000 | 92.1003 | 1.2548 |
| 3000 | 10000 | 94.6981 | 1.24411 |

Observations made from the simulations mentioned above-

* The greater the time interval, the longer the execution time
* Theoretically, Monte-Carlo Simulations work on the Law of large numbers, i.e. it is believed that as the no. of simulations is increased the value of error would diminish and ultimately coincide/converge to the actual value.
* However, since the process involved random sampling, converging to the decimal point is not permissible.
* It is observed that even though the simulations do not give the actual price, we reach quite close to the actual option price with quite minimal error, as the number of simulations are increased.
* From the above, we cannot infer that by purely increasing the time intervals, the error value decreases
* We also saw a difference in put and call option price error values, while certain combinations of time interval and no. of simulations work for put options, they do not work for call options.
* In conclusion, according to my understanding there are endless combinations of time intervals and no. of simulations that can lead to an overall minimal error (actual price -simulation price), this is due to the randomness and non-linear nature of the Monte-Carlo Model.

LEVEL 9: GROUP D

b. Batch 1: T = 0.25, K = 65, sig = 0.30, r = 0.08, S = 60 (then C = 2.13337, P = 5.84628)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time Interval | Number of Simulations | Standard Deviation (P) | Standard Error (P) | Standard Deviation (C) | Standard Error (C) |
| 100 | 1000 | 5.89612 | 0.186452 | 4.48768 | 0.141913 |
| 100 | 10000 | 6.0547 | 0.060547 | 4.54234 | 0.0454234 |
| 100 | 50000 | 6.06167 | 0.0271086 | 4.50473 | 0.0201457 |
| 100 | 100000 | 6.05775 | 0.0191563 | 4.51298 | 0.0142713 |
| 500 | 100000 | 6.05203 | 0.0191382 | 4.55354 | 0.0143996 |
| 750 | 100000 | 6.05264 | 0.0191401 | 4.54567 | 0.0143747 |
| 1000 | 100000 | 6.05915 | 0.0191607 | 4.55239 | 0.0143959 |

Batch 2: T = 1.0, K = 100, sig = 0.2, r = 0.0, S = 100 (then C = 7.96557, P = 7.96557)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time Interval | Number of Simulations | Standard Deviation (P) | Standard Error (P) | Standard Deviation (C) | Standard Error (C) |
| 1000 | 100 | 10.7928 | 1.07928 | 13.5847 | 1.35847 |
| 100 | 100000 | 10.4359 | 0.0330012 | 13.1477 | 0.0415767 |
| 500 | 5000 | 10.4458 | 0.147727 | 13.1874 | 0.186498 |
| 10 | 1000000 | 10.5321 | 0.0105321 | 13.0034 | 0.0130034 |

The observations made in Group C are further solidified in Group D.

* Standard Errors show a substantial decline as the number of simulations increases.
* Time does not have a visible effect on the standard error
* We have taken static time with increasing simulations and static simulations with increasing time intervals, which suggests the above.
* For batch 2, when the number of simulations were fewer and the time interval were on the higher end, a high error value was seen.
* And less time intervals with a higher number of simulations, show less error value.
* Thus, suggesting how an increase in the number of simulations still affects the error value in a rather positive way, while time intervals do not show much visible change in the error value