

Exercise 1 (6.1)

Empirical Data

CRNs with the (a + c) synchronization

delta = 10.0 avg = 55.84410000000003 var = 2113.079303120312

delta = 1.0 avg = 6.254299999999966 var = 38.38847035703572

delta = 0.1 avg = 0.643300000000003 var = 2.013266436643664

CRNs without synchronization

delta = 10.0 avg = 55.35869999999988 var = 3673.855819891997

delta = 1.0 avg = 5.370500000000023 var = 1902.058035535608

delta = 0.1 avg = 0.01150000000000265 var = 1946.5368214321438

IRNs (with B_i set to 1.0)

delta = 10.0 avg = 47.285200000000145 var = 2859.504211381143

delta = 1.0 avg = 5.932600000000001 var = 2941.1475719972022

delta = 0.1 avg = 1.0009000000000035 var = 2934.330532243232

IRNs

delta = 10.0 avg = 61.31770000000015 var = 56509.30329704001

delta = 1.0 avg = 8.670700000000007 var = 46397.589820491965

delta = 0.1 avg = 2.9493000000000125 var = 44282.17194670484

Conclusion

We want to compare the 4 types of synchronization tried.

First of all, as expected, the CRN (a+c) strategy worked best. This is the same conclusion as the one reached in the book (so it's also kind of unexpected, these simulations never seem to work out as expected).

Contrary to the result from the book, the variance of the CRN without synchronization didn't get so low for the small values of δ (for $\delta = 0.1$, the value from the book was 726, much smaller than 1946). This suggests that some implementation detail was different (not sure which one though).

The IRNs worked as expected, that is to say the variance was huge when B_i isn't fixed, as in the empirical observations in the book. When $B_i = 1.0$ for all B_i , the variance was much smaller, and this makes a lot of sense since one of the sources of variability has been disabled and we get its average. This practice (substituting a source of variability for the value of its mean) could make sense in some scenarios, depending on what parameter is observed, but would be horrible for example if we want to estimate some failure rate where the variability could provoke some system-wide changes).

As expected, as $\delta \rightarrow 0$, the difference gets harder to estimate and the noisier estimators (particularly IRNs) become pretty useless. The CRN (a+c) tend to keep up much better as it is supposed to do.

This is unfortunate, because the IRN simulations are much easier to implement. . .