

Simulation Results

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Population Size = 400 stations True values: SIGMA2X = 3 BETA1 = 2

SIMULATION FOR PHI-X = 0.2

```
PHIX <- 0.2
```

Sample Size: 120

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.2 and SAMPLE SIZE= 120"
## [1] "Summary of results (median):"
##           X5           X3           X1           X0
## beta0      4.53540254  4.37466124  3.469662867  -1.56939400
## beta1      0.10084145  0.09148439  0.041614947  -0.25901323
## sigma2     9.20021375  8.77747152 116.600080647 1995.54512791
## phi        0.06005716  0.04491344  0.017226531  0.01873918
## variogsigma2 19.24861565 17.75921189 259.351422619 525472.95978089
## variogphi    0.38327432  0.22812566  0.009225806  43.77766133
## [1] "Estimates without Sampling:"
##           no_samp
## beta0      1.351462967
## beta1     -0.021787853
## sigma2     5.915568869
## phi        0.001934719
## variogsigma2 11.597431638
## variogphi    0.000000000
## [1] "Bias on the estimates"
##           X5           X3           X1           X0
## beta0  3.18393957  3.02319827  2.11819990  -2.92085697
## beta1  0.12262931  0.11327224  0.06340280  -0.23722538
## sigma2 3.28464488  2.86190265 110.68451178 1989.62955904
## phi    0.05812244  0.04297872  0.01529181  0.01680446
```

Sample Size: 200

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.2 and SAMPLE SIZE= 200"
## [1] "Summary of results (median):"
```

```

##           X5           X3           X1           X0
## beta0      3.31795674    3.13753359    2.17791515    -1.0261813
## beta1      0.07406536    0.08874798    0.24711302    -0.2517185
## sigma2     49.71908522   122.31864029   455.80774796   2403.4397851
## phi        0.07128974    0.06199261    0.02535692     0.0123768
## variogsigma2 91.45808124 1003.51049172 1162.68877294 263257.1348364
## variogphi    0.41973607    0.41367116    0.10440782     38.5882343
## [1] "Estimates without Sampling:"
##           no_samp
## beta0      1.351462967
## beta1     -0.021787853
## sigma2      5.915568869
## phi        0.001934719
## variogsigma2 11.597431638
## variogphi    0.000000000
## [1] "Bias on the estimates"
##           X5           X3           X1           X0
## beta0     1.96649377    1.7860706    0.8264522    -2.37764431
## beta1     0.09585321    0.1105358    0.2689009    -0.22993063
## sigma2   43.80351635   116.4030714  449.8921791  2397.52421622
## phi      0.06935503    0.0600579    0.0234222     0.01044208

```

Sample Size: 280

```

## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.2 and SAMPLE SIZE= 280"
## [1] "Summary of results (median):"
##           X5           X3           X1           X0
## beta0      1.83696249    1.74052261    1.32914305    -4.06595684
## beta1      0.08136243    0.10423747    0.30557261     0.40105269
## sigma2     736.28987637  747.13505917  836.43931110  4314.21070640
## phi        0.06279368    0.05957422    0.03476236     0.04088976
## variogsigma2 432362.69849547 1900.40647169 2178.67383494 697577.89469873
## variogphi    85.34643017    0.71935381    0.31152078    140.75604393
## [1] "Estimates without Sampling:"
##           no_samp
## beta0      1.351462967
## beta1     -0.021787853
## sigma2      5.915568869
## phi        0.001934719
## variogsigma2 11.597431638
## variogphi    0.000000000
## [1] "Bias on the estimates"
##           X5           X3           X1           X0
## beta0     0.48549952    0.3890596   -0.02231992   -5.41741981
## beta1     0.10315028    0.1260253    0.32736046    0.42284054
## sigma2   730.37430750  741.2194903  830.52374224  4308.29513754
## phi      0.06085896    0.0576395    0.03282764    0.03895504

```

SIMULATION FOR $\text{PHI-X} = 0.5$

```
PHIX <- 0.5
```

Sample Size: 120

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 120"
## [1] "Summary of results (median):"
##
##           X5           X3           X1           X0
## beta0      3.34839933  3.42554752    2.25229149   -2.17004588
## beta1      0.32982908  0.29202361    0.19543065    0.20402836
## sigma2     7.46761585  6.94009402   495.33778457  1982.95232442
## phi        0.06586261  0.04709254    0.01515663    0.01795919
## variogsigma2 54.55429878 14.52732137 221884.57723886 7372598.78092527
## variogphi    3.65851657 0.10578137   19.95273093   616.43422683
## [1] "Estimates without Sampling:"
##
##           no_samp
## beta0      -7.6371370
## beta1       0.5199195
## sigma2    3610.1905571
## phi        0.0180671
## variogsigma2 12078.6355660
## variogphi    0.0000000
## [1] "Bias on the estimates"
##
##           X5           X3           X1           X0
## beta0     10.9855363    11.06268454    9.889428506    5.4670911410
## beta1     -0.1900904    -0.22789586   -0.324488818   -0.3158911113
## sigma2  -3602.7229412  -3603.25046308  -3114.852772528  -1627.2382326763
## phi       0.0477955     0.02902544   -0.002910471   -0.0001079107
```

Sample Size: 200

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 200"
## [1] "Summary of results (median):"
##
##           X5           X3           X1           X0
## beta0      1.55886389    1.95656205    1.24069996   -1.60094533
## beta1      0.79608228    0.49178610    0.24765591    0.23724680
## sigma2     389.44528123  193.14617959   960.83175086  2436.81193358
## phi        0.05281284    0.04100323    0.01613938    0.01148333
## variogsigma2 245413.74022728 120796.07705001 371182.18826363 83659.93669103
## variogphi    36.74808476   18.83649253    56.21903331   12.02290173
## [1] "Estimates without Sampling:"
##
##           no_samp
## beta0      -7.6371370
## beta1       0.5199195
## sigma2    3610.1905571
## phi        0.0180671
## variogsigma2 12078.6355660
## variogphi    0.0000000
## [1] "Bias on the estimates"
```

```
##           X5           X3           X1           X0
## beta0      9.19600091      9.59369907      8.877836980      6.036191692
## beta1      0.27616281     -0.02813337     -0.272263557     -0.282672672
## sigma2 -3220.74527586 -3417.04437751 -2649.358806239 -1173.378623517
## phi        0.03474573      0.02293613     -0.001927722     -0.006583772
```

Sample Size: 280

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 280"
## [1] "Summary of results (median):"
##           X5           X3           X1           X0
## beta0      -4.9396878     -0.18464364     -9.0734293     -4.29558378
## beta1       1.2833862      0.92624347      0.9103712      0.25876804
## sigma2    3542.8674374 1501.33634955 5443.6418010 4364.23340985
## phi        0.1112057      0.03789114      0.1670820      0.04349898
## variogsigma2 134921.8399401 87157.61164653 874317.8870439 19575070.72327057
## variogphi    28.0156171 17.57692013 182.6390664 4190.39941609
## [1] "Estimates without Sampling:"
##           no_samp
## beta0      -7.6371370
## beta1       0.5199195
## sigma2    3610.1905571
## phi        0.0180671
## variogsigma2 12078.6355660
## variogphi    0.0000000
## [1] "Bias on the estimates"
##           X5           X3           X1           X0
## beta0      2.6974492      7.45249338     -1.4362923      3.34155324
## beta1      0.7634667      0.40632400      0.3904517     -0.26115143
## sigma2 -67.3231197 -2108.85420755 1833.4512440 754.04285275
## phi        0.0931386      0.01982404      0.1490149      0.02543188
```

SIMULATION FOR $\text{PHI-X} = 1$

```
PHIX <- 0.5
```

Sample Size: 120

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 120"
## [1] "Summary of results (median):"
##           X5           X3           X1           X0
## beta0      3.34839933 3.42554752 2.25229149 -2.17004588
## beta1      0.32982908 0.29202361 0.19543065 0.20402836
## sigma2      7.46761585 6.94009402 495.33778457 1982.95232442
## phi        0.06586261 0.04709254 0.01515663 0.01795919
## variogsigma2 54.55429878 14.52732137 221884.57723886 7372598.78092527
## variogphi    3.65851657 0.10578137 19.95273093 616.43422683
## [1] "Estimates without Sampling:"
##           no_samp
```

```
## beta0          -7.6371370
## beta1           0.5199195
## sigma2         3610.1905571
## phi            0.0180671
## variogsigma2 12078.6355660
## variogphi       0.0000000
## [1] "Bias on the estimates"
##              X5              X3              X1              X0
## beta0      10.9855363    11.06268454    9.889428506    5.4670911410
## beta1      -0.1900904    -0.22789586    -0.324488818    -0.3158911113
## sigma2 -3602.7229412 -3603.25046308 -3114.852772528 -1627.2382326763
## phi        0.0477955     0.02902544    -0.002910471    -0.0001079107
```

Sample Size: 200

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 200"
## [1] "Summary of results (median):"
##              X5              X3              X1              X0
## beta0      1.55886389    1.95656205    1.24069996    -1.60094533
## beta1      0.79608228    0.49178610    0.24765591    0.23724680
## sigma2    389.44528123   193.14617959   960.83175086   2436.81193358
## phi        0.05281284    0.04100323    0.01613938    0.01148333
## variogsigma2 245413.74022728 120796.07705001 371182.18826363 83659.93669103
## variogphi   36.74808476   18.83649253    56.21903331   12.02290173
## [1] "Estimates without Sampling:"
##              no_samp
## beta0      -7.6371370
## beta1       0.5199195
## sigma2     3610.1905571
## phi        0.0180671
## variogsigma2 12078.6355660
## variogphi    0.0000000
## [1] "Bias on the estimates"
##              X5              X3              X1              X0
## beta0      9.19600091    9.59369907    8.877836980    6.036191692
## beta1      0.27616281    -0.02813337    -0.272263557    -0.282672672
## sigma2 -3220.74527586 -3417.04437751 -2649.358806239 -1173.378623517
## phi        0.03474573     0.02293613    -0.001927722    -0.006583772
```

Sample Size: 280

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 0.5 and SAMPLE SIZE= 280"
## [1] "Summary of results (median):"
##              X5              X3              X1              X0
## beta0      -4.9396878    -0.18464364    -9.0734293     -4.29558378
## beta1       1.2833862     0.92624347     0.9103712      0.25876804
## sigma2    3542.8674374 1501.33634955 5443.6418010   4364.23340985
## phi        0.1112057     0.03789114     0.1670820      0.04349898
## variogsigma2 134921.8399401 87157.61164653 874317.8870439 19575070.72327057
## variogphi   28.0156171   17.57692013   182.6390664    4190.39941609
## [1] "Estimates without Sampling:"
```

```
##          no_samp
## beta0      -7.6371370
## beta1       0.5199195
## sigma2     3610.1905571
## phi        0.0180671
## variogsigma2 12078.6355660
## variogphi   0.0000000
## [1] "Bias on the estimates"
##          X5          X3          X1          X0
## beta0    2.6974492    7.45249338   -1.4362923    3.34155324
## beta1    0.7634667    0.40632400    0.3904517   -0.26115143
## sigma2  -67.3231197  -2108.85420755  1833.4512440  754.04285275
## phi      0.0931386    0.01982404    0.1490149    0.02543188
```

SIMULATION FOR $\text{PHI-X} = 1$

```
PHIX <- 1
```

Sample Size: 120

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 1 and SAMPLE SIZE= 120"
## [1] "Summary of results (median):"
##          X5          X3          X1          X0
## beta0    -4.77195824   -5.67454747   -6.80633286   -0.45670098
## beta1     0.70327292   -0.20194004   -0.12731152    0.31642618
## sigma2   6636.19245679  7320.53532081  6343.73301731  1988.78414711
## phi       0.03692578    0.05221314    0.08658196    0.01926601
## variogsigma2 1321376.01077199 844442.22014005 127140.21901873 651464.90881477
## variogphi   91.43193619   60.34403919   10.11636991   58.28008510
## [1] "Estimates without Sampling:"
##          no_samp
## beta0    -13.103014358
## beta1     3.084428940
## sigma2   7097.373917731
## phi       0.002755511
## variogsigma2 11980.104735795
## variogphi   0.000000000
## [1] "Bias on the estimates"
##          X5          X3          X1          X0
## beta0     8.33105612    7.42846688    6.29668150   12.6463134
## beta1    -2.38115602   -3.28636898   -3.21174046   -2.7680028
## sigma2  -461.18146094  223.16140308  -753.64090042  -5108.5897706
## phi      0.03417027    0.04945763    0.08382645    0.0165105
```

Sample Size: 200

```
## [1] "Results for Simulation: \n"
## [1] "PHIX= 1 and SAMPLE SIZE= 200"
## [1] "Summary of results (median):"
##          X5          X3          X1          X0
```

```

## beta0          -2.71913416      -4.73584024      -12.8512298      0.56853466
## beta1          -0.30362479       0.43466521       -0.3643143      0.02058351
## sigma2        6517.80499209     7151.82582235     9691.1091616    2346.66446113
## phi           0.04553494       0.04963924       0.1478525      0.01217775
## variogsigma2  4195510.20316051  2188827.46606175  3633678.3229283  50716.09302876
## variogphi     604.60329858      295.03026596     451.7453919     7.17837462
## [1] "Estimates without Sampling:"
##               no_samp
## beta0         -13.103014358
## beta1          3.084428940
## sigma2        7097.373917731
## phi           0.002755511
## variogsigma2  11980.104735795
## variogphi     0.000000000
## [1] "Bias on the estimates"
##               X5          X3          X1          X0
## beta0    10.38388020  8.36717411  0.2517846  13.671549020
## beta1    -3.38805373 -2.64976373 -3.4487432 -3.063845433
## sigma2  -579.56892564  54.45190462  2593.7352439 -4750.709456606
## phi      0.04277943  0.04688373  0.1450970  0.009422238

```

Sample Size: 280

```

## [1] "Results for Simulation: \n"
## [1] "PHIX= 1 and SAMPLE SIZE= 280"
## [1] "Summary of results (median):"
##               X5          X3          X1
## beta0         -2.34440369      0.242571806     -0.095004216
## beta1          0.22631036      0.073192775     -0.067995308
## sigma2        5414.57534234    4284.472871319    4609.633087753
## phi           0.04057369      0.003117268      0.007393282
## variogsigma2  3419290.57974743  6060360.858650332  573090.878010020
## variogphi     666.02752083    1229.664564783    112.502175475
##               X0
## beta0         -1.55982131
## beta1         -0.24055594
## sigma2        4262.73983500
## phi           0.03991708
## variogsigma2  15256783.38649039
## variogphi     3299.64645758
## [1] "Estimates without Sampling:"
##               no_samp
## beta0         -13.103014358
## beta1          3.084428940
## sigma2        7097.373917731
## phi           0.002755511
## variogsigma2  11980.104735795
## variogphi     0.000000000
## [1] "Bias on the estimates"
##               X5          X3          X1          X0
## beta0    10.75861066  13.3455861637  13.008010142  11.54319305
## beta1    -2.85811858  -3.0112361643  -3.152424248  -3.32498488
## sigma2  -1682.79857540 -2812.9010464122 -2487.740829978 -2834.63408273

```

## phi	0.03781818	0.0003617575	0.004637771	0.03716157
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