Results Summary

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06 July, 2020

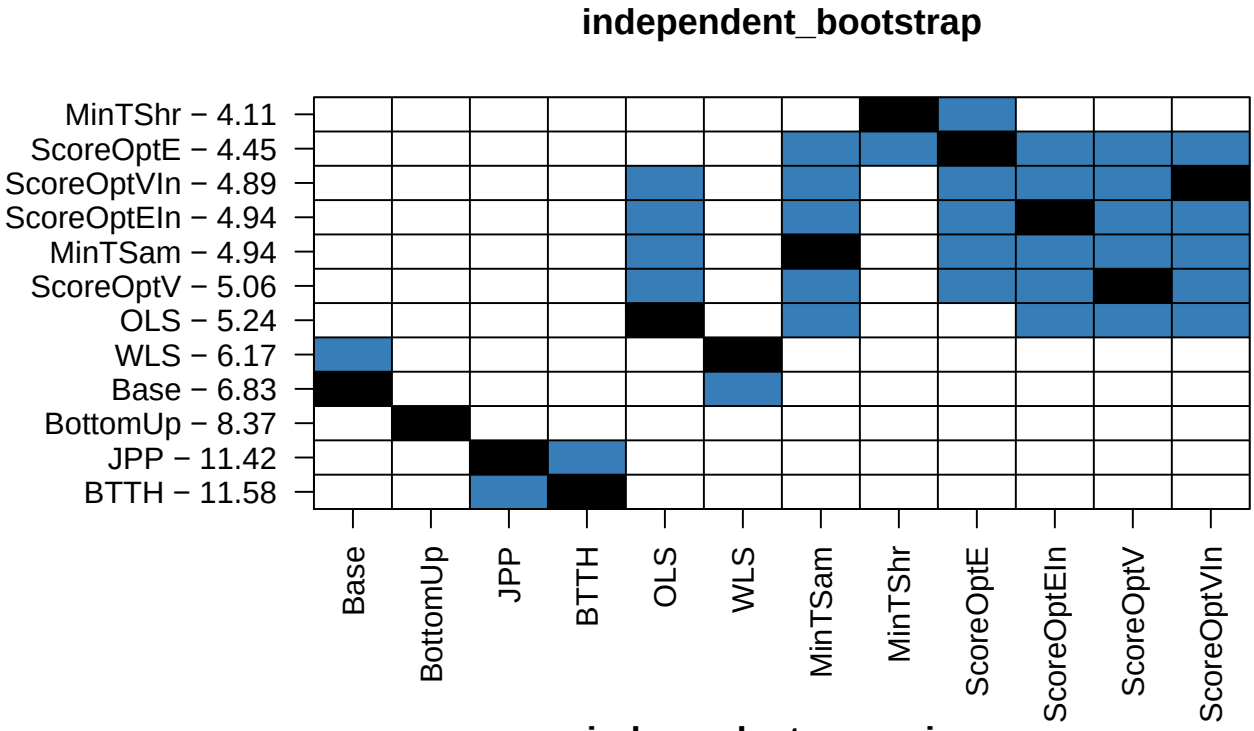
Four methods are used to generate base forecasts. Either base forecasts are drawn from an independent distribution or dependent distribution (all DGPs actually have dependence). Also base forecasts are Gaussian or use bootstrapping (the DGPs may be Gaussian or non-Gaussian). The following reconciliation methods are considered

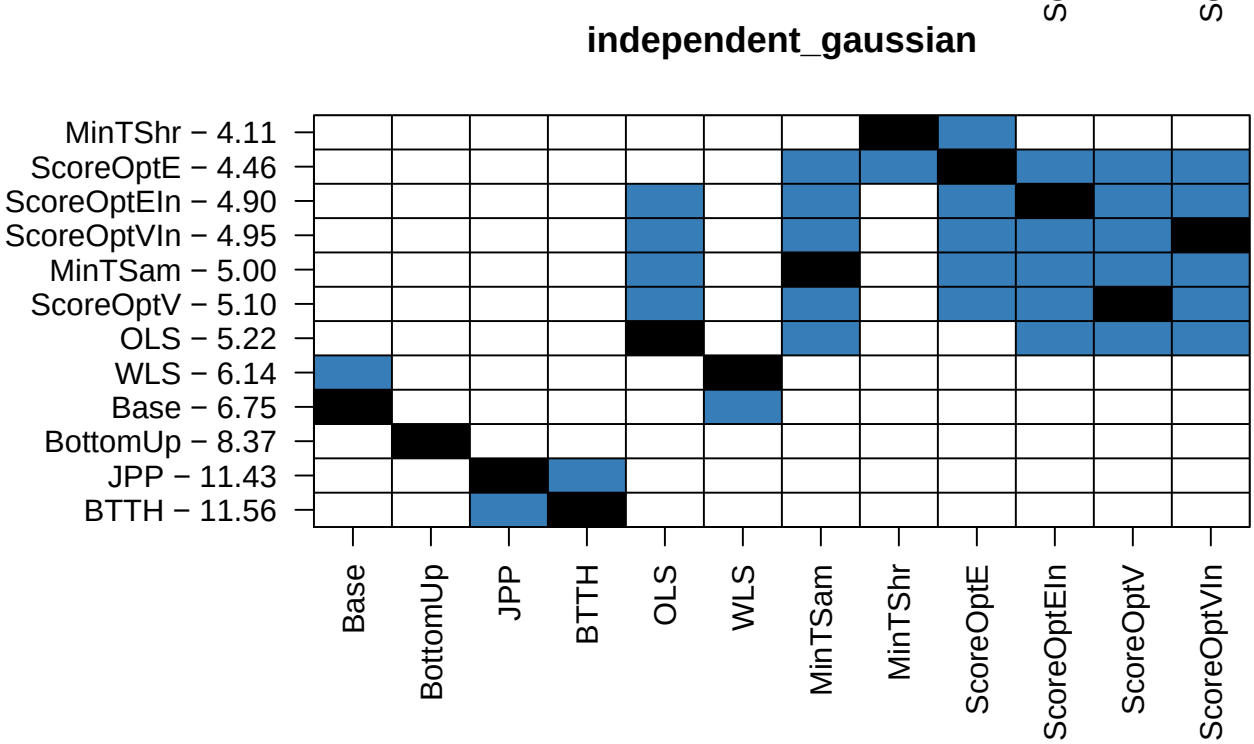
- Base: Not a reconciliation method, just the base forecasts.
- BottomUp: Bottom up
- BTTH: Ben Taieb, Taylor Hyndman (2020). This is like bottom up but reorders a sample from probabilistic forecast to match the empirical copula. Also the mean is adjusted to be the same as that from MinT reconciliation.
- JPP: Jeon Panagiotelis Petropoulos (2019). This reorders a sample from the probabilistic forecast to be perfectly dependent, i.e. it reconciles quantiles. Reconciliation is done by WLS (structural)
- MinTSam: MinT with the usual sample covariance estimator
- MinTShr: MinT with shrinkage covariance estimator
- OLS: OLS reconciliation
- ScoreOptE: Energy score Optimisation by stochastic gradient descent.
- ScoreOptEIn: Energy score Optimisation by stochastic gradient descent but with predicted values (in-sample) used instead of rolling window forecasts.
- ScoreOptV: Variogram score Optimisation by stochastic gradient descent.
- ScoreOptVIn: Variogram score Optimisation by stochastic gradient descent but with predicted values (in-sample) used instead of rolling window forecasts.
- WLS: Weighted least squares using structural scaling.

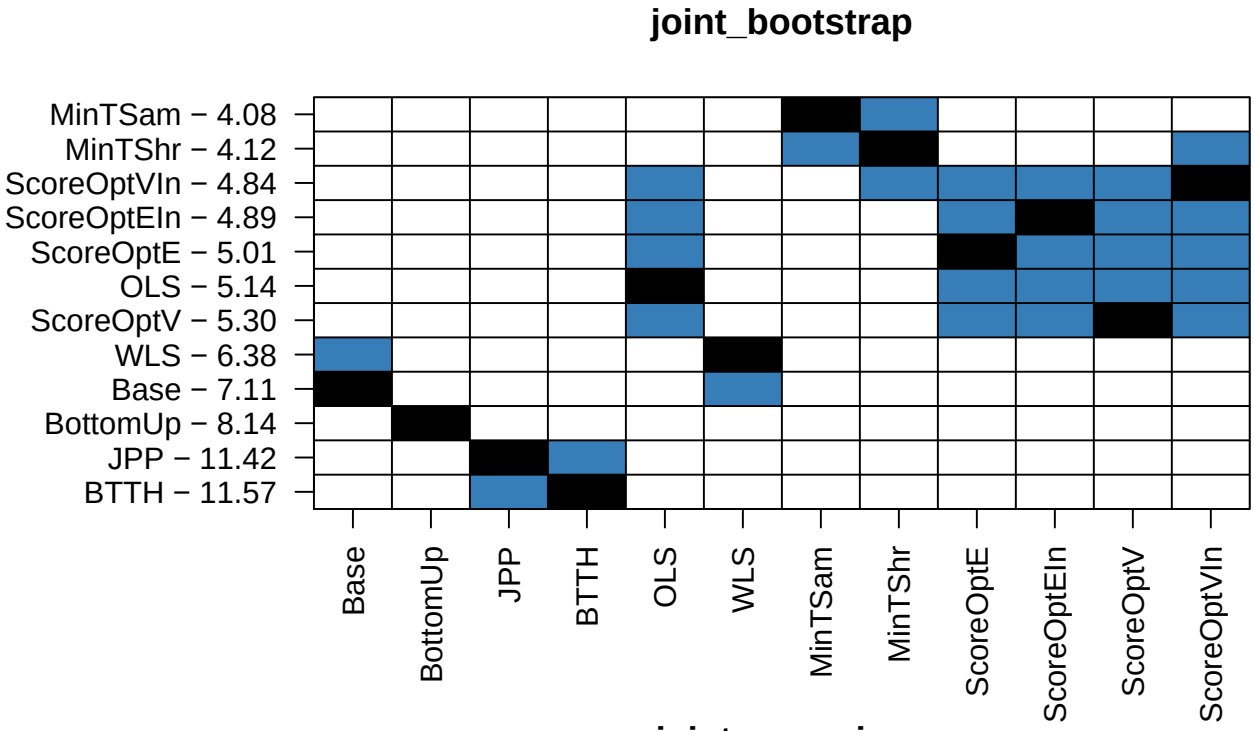
The first table and first four figures all correspond to forecasts evaluated using the energy score. The second table and last four figures correspond to using the variogram score. This report is for arima modelling with a gaussian nonstationary DGP.

Table 1: Mean energy score for arima modelling with a gaussian nonstationary DGP

Method	independent_bootstrap	independent_gaussian	joint_bootstrap	joint_gaussian
Base	12.9296	12.9088	12.6596	12.6343
BottomUp	14.8316	14.7876	14.5805	14.5193
BTTH	26.6312	26.6452	26.7293	26.6734
JPP	26.0974	26.0948	26.0729	26.0434
MinTSam	11.7378	11.7270	11.3241	11.3013
MinTShr	11.5728	11.5590	11.3500	11.3301
OLS	12.3557	12.3356	12.0399	12.0197
ScoreOptE	11.9843	11.9742	11.8872	11.8986
ScoreOptEIn	12.2031	12.1661	11.9113	11.8994
ScoreOptV	12.1742	12.1714	12.0074	12.0067
ScoreOptVIn	12.2000	12.1846	11.9028	11.9136
WLS	12.7755	12.7489	12.5279	12.4986


independent_bootstrap
MinTShr − 4.11
ScoreOptE − 4.45
ScoreOptVIn − 4.89
ScoreOptEIn − 4.94
MinTSam − 4.94
ScoreOptV − 5.06
OLS − 5.24
WLS − 6.17
Base − 6.83
BottomUp − 8.37
JPP − 11.42
BTTH − 11.58
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn


independent_gaussian
MinTShr − 4.11
ScoreOptE − 4.46
ScoreOptEIn − 4.90
ScoreOptVIn − 4.95
MinTSam − 5.00
ScoreOptV − 5.10
OLS − 5.22
WLS − 6.14
Base − 6.75
BottomUp − 8.37
JPP − 11.43
BTTH − 11.56
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn


joint_bootstrap
MinTSam − 4.08
MinTShr − 4.12
ScoreOptVIn − 4.84
ScoreOptEIn − 4.89
ScoreOptE − 5.01
OLS − 5.14
ScoreOptV − 5.30
WLS − 6.38
Base − 7.11
BottomUp − 8.14
JPP − 11.42
BTTH − 11.57
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn

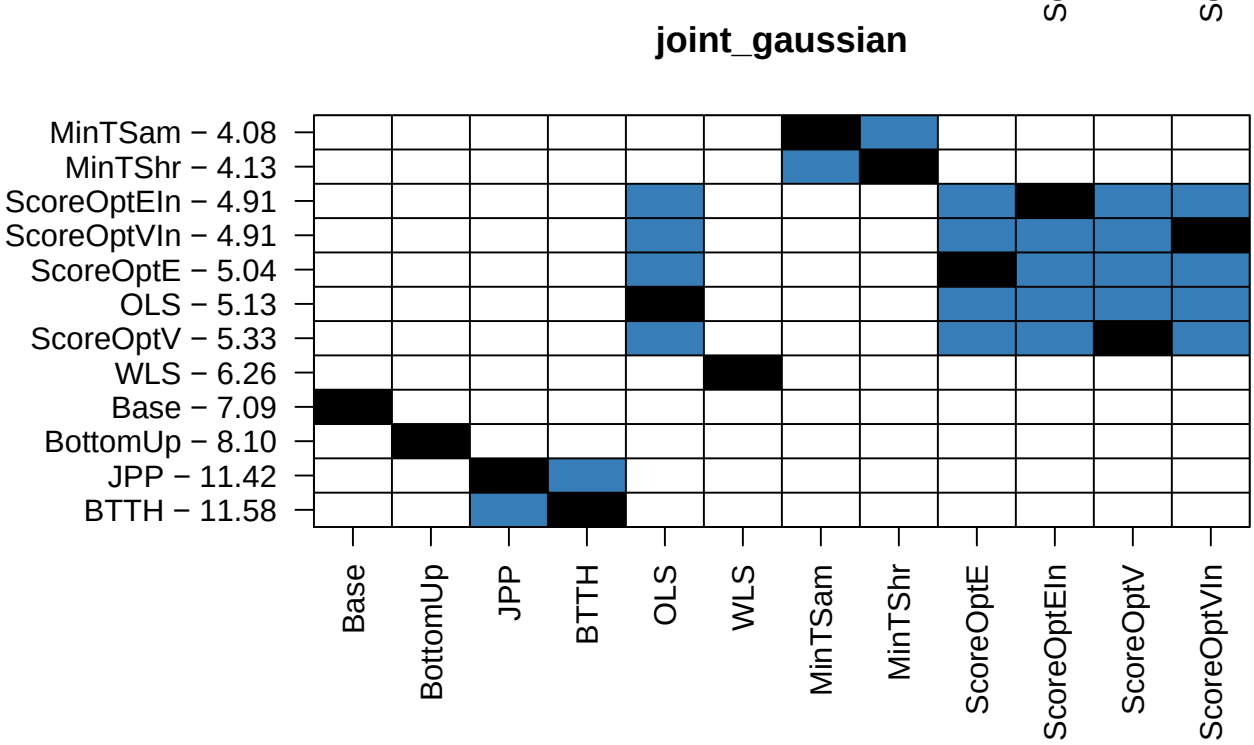
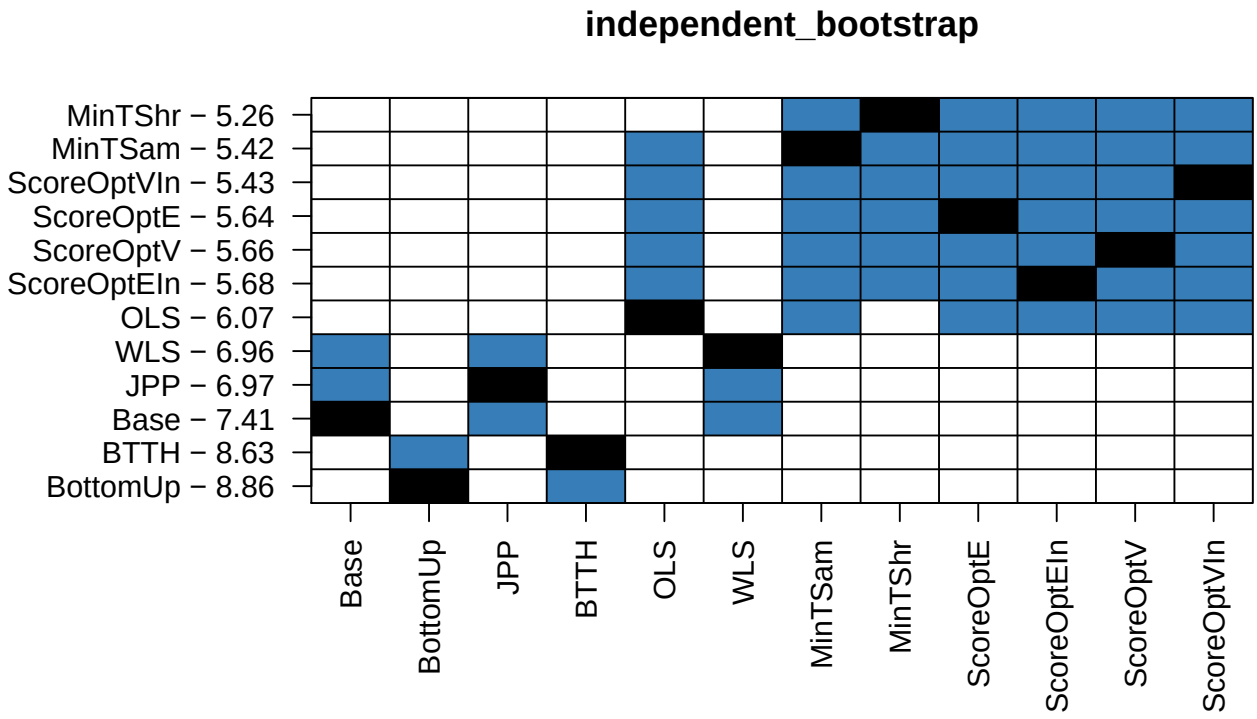
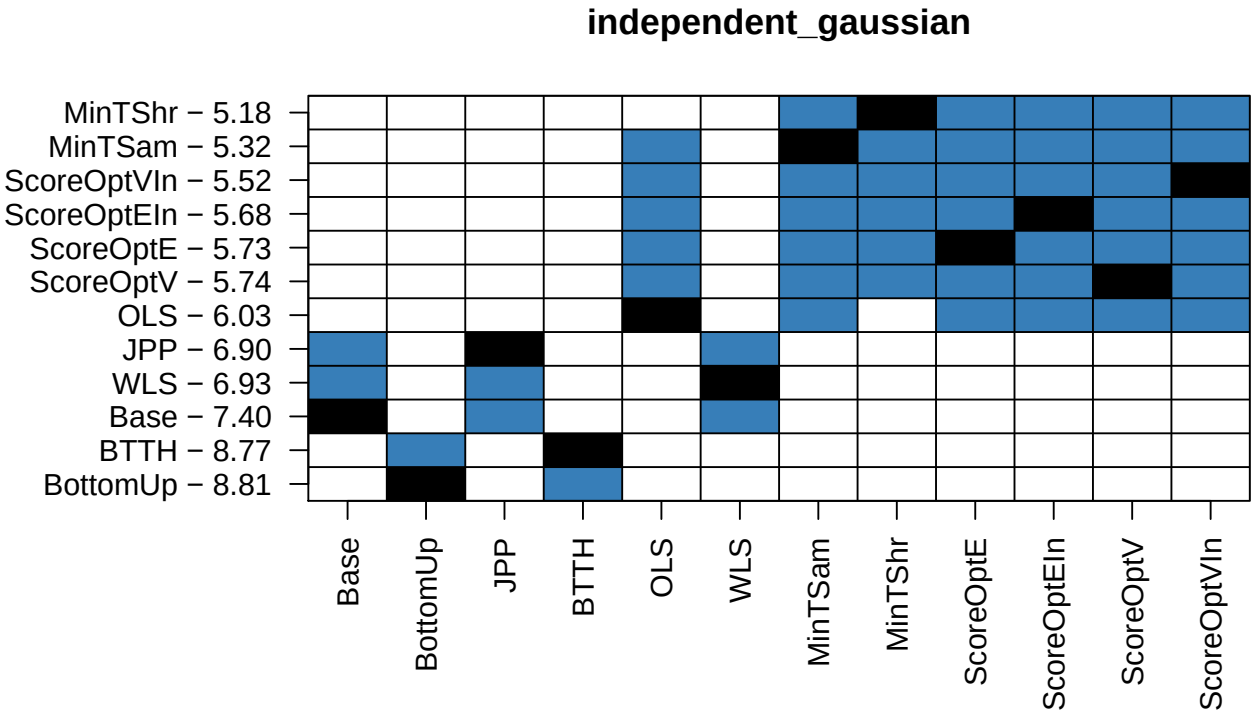
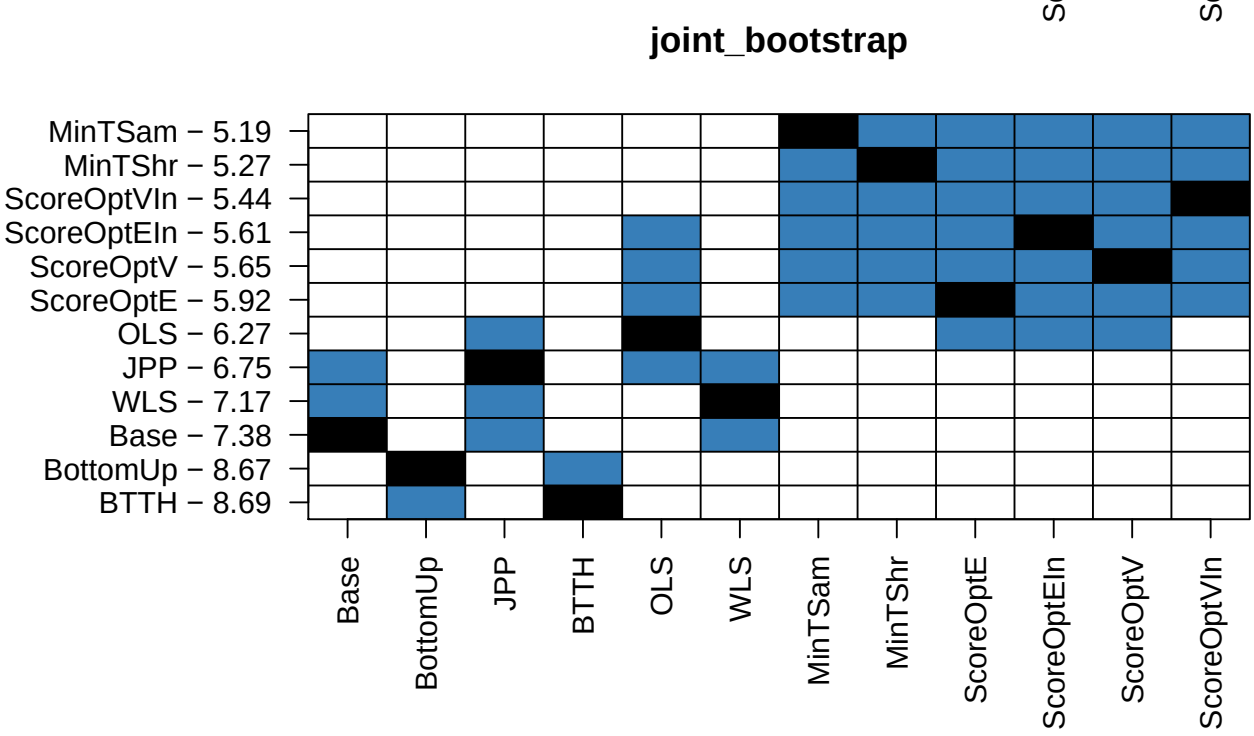

joint_gaussian
MinTSam − 4.08
MinTShr − 4.13
ScoreOptEIn − 4.91
ScoreOptVIn − 4.91
ScoreOptE − 5.04
OLS − 5.13
ScoreOptV − 5.33
WLS − 6.26
Base − 7.09
BottomUp − 8.10
JPP − 11.42
BTTH − 11.58
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn

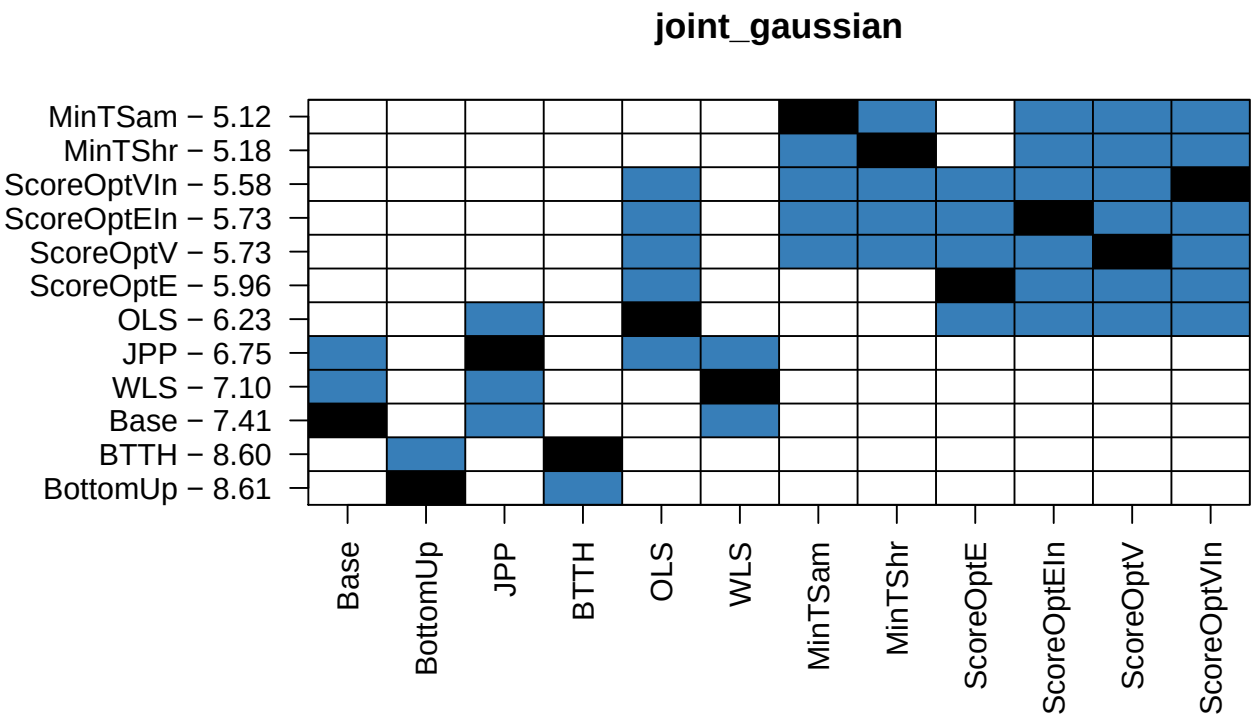
Table 2: Mean variogram score for arima modelling with a gaussian nonstationary DGP

Method	independent_bootstrap	independent_gaussian	joint_bootstrap	joint_gaussian
Base	2189.881	2185.971	2192.167	2186.695
BottomUp	2500.336	2491.643	2483.079	2471.410
BTTH	2551.970	2559.825	2561.673	2547.267
JPP	2183.414	2177.689	2185.833	2178.963
MinTSam	1942.943	1937.218	1940.730	1932.175
MinTShr	1944.402	1939.244	1949.074	1941.579
OLS	2120.249	2115.503	2130.916	2124.982
ScoreOptE	2058.315	2054.715	2083.572	2088.127
ScoreOptEIn	2069.807	2058.099	2071.461	2066.162
ScoreOptV	2051.818	2049.494	2053.978	2054.862
ScoreOptVIn	2043.521	2038.511	2045.796	2048.471
WLS	2171.291	2165.583	2181.849	2174.784




independent_gaussian
MinTShr − 5.18
MinTSam − 5.32
ScoreOptVIn − 5.52
ScoreOptEIn − 5.68
ScoreOptE − 5.73
ScoreOptV − 5.74
OLS − 6.03
JPP − 6.90
WLS − 6.93
Base − 7.40
BTTH − 8.77
BottomUp − 8.81
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn


joint_bootstrap
MinTSam − 5.19
MinTShr − 5.27
ScoreOptVIn − 5.44
ScoreOptEIn − 5.61
ScoreOptV − 5.65
ScoreOptE − 5.92
OLS − 6.27
JPP − 6.75
WLS − 7.17
Base − 7.38
BottomUp − 8.67
BTTH − 8.69
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn


joint_gaussian
MinTSam − 5.12
MinTShr − 5.18
ScoreOptVIn − 5.58
ScoreOptEIn − 5.73
ScoreOptV − 5.73
ScoreOptE − 5.96
OLS − 6.23
JPP − 6.75
WLS − 7.10
Base − 7.41
BTTH − 8.60
BottomUp − 8.61
Base
BottomUp
JPP
BTTH
OLS
WLS
MinTSam
MinTShr
ScoreOptE
ScoreOptEIn
ScoreOptV
ScoreOptVIn