Summary of Results

In all cases 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
- ScoreOpt: Score Optimisation by stochastic gradient descent.
- WLS: Weighted least squares using structural scaling.

Gaussian and Stationary DGP

The DGP has Gaussian residuals and all series are forced to be stationary.

ARIMA model

Recall that the true DGP is ARIMA

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	11.3712	11.9945	22.4364	17.8832	11.2119	11.2049	11.1714	10.9261	11.1097
independent	gaussian	11.3720	12.0131	22.3948	17.8905	11.2069	11.1998	11.1654	10.8925	11.0985
joint	bootstrap	11.1053	11.6482	22.4923	17.8471	10.9230	10.9150	10.8774	10.8774	10.8402

Summary of Nemenyi tests is below

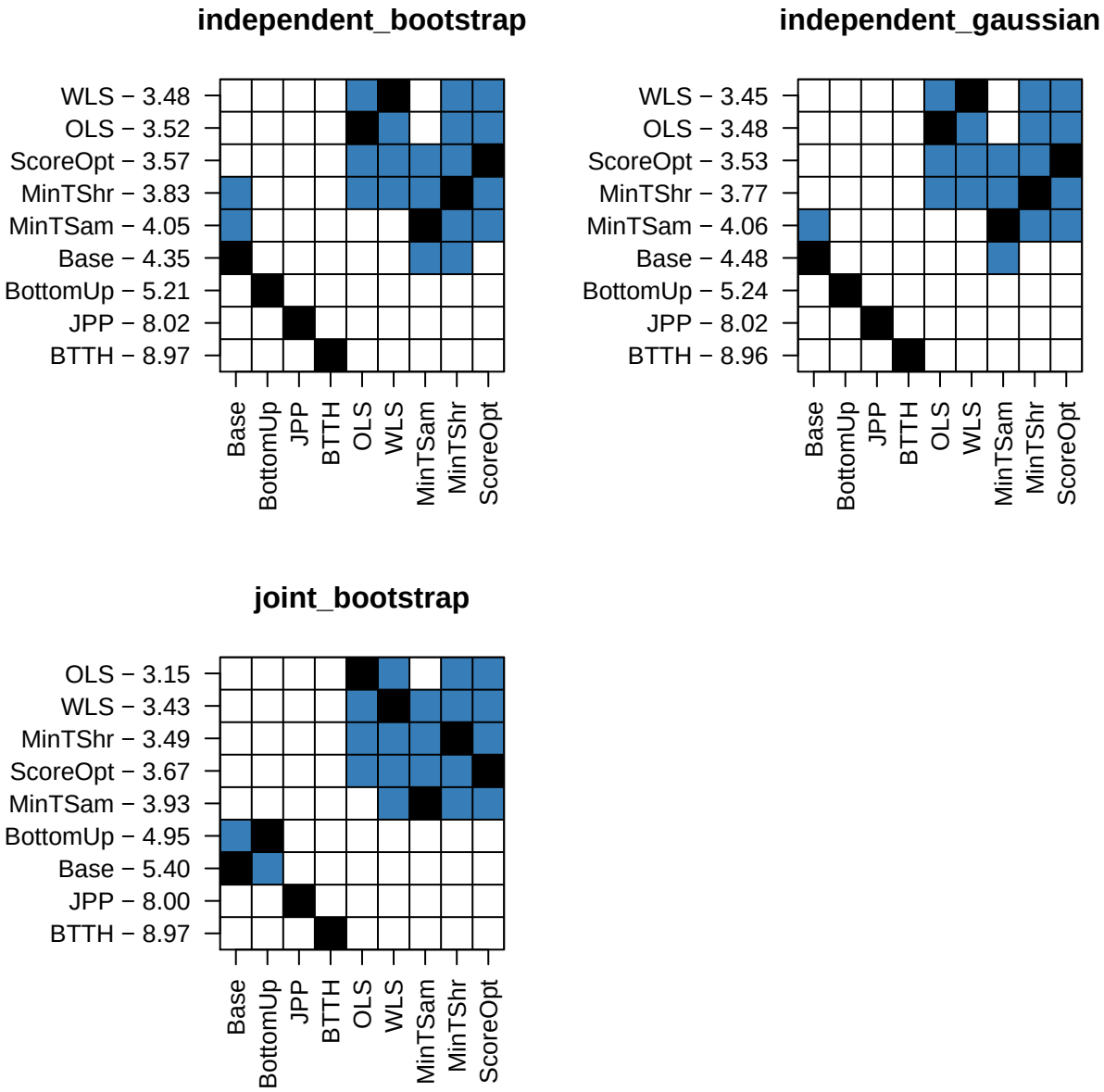

Figure 1: Results for arima modelling with a gaussian stationary DGP

ETS model

Recall that the true DGP is ARIMA so there is model misspecification here.

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	11.6984	12.3632	23.6043	18.3601	11.1419	11.1386	11.1125	10.8040	11.1634
independent	gaussian	11.6856	12.3673	23.6331	18.3614	11.1206	11.1173	11.0911	10.7841	11.1402
joint	bootstrap	11.4701	12.0794	23.6688	18.3075	10.8812	10.8777	10.8501	10.8426	10.9207

Summary of Nemenyi test below

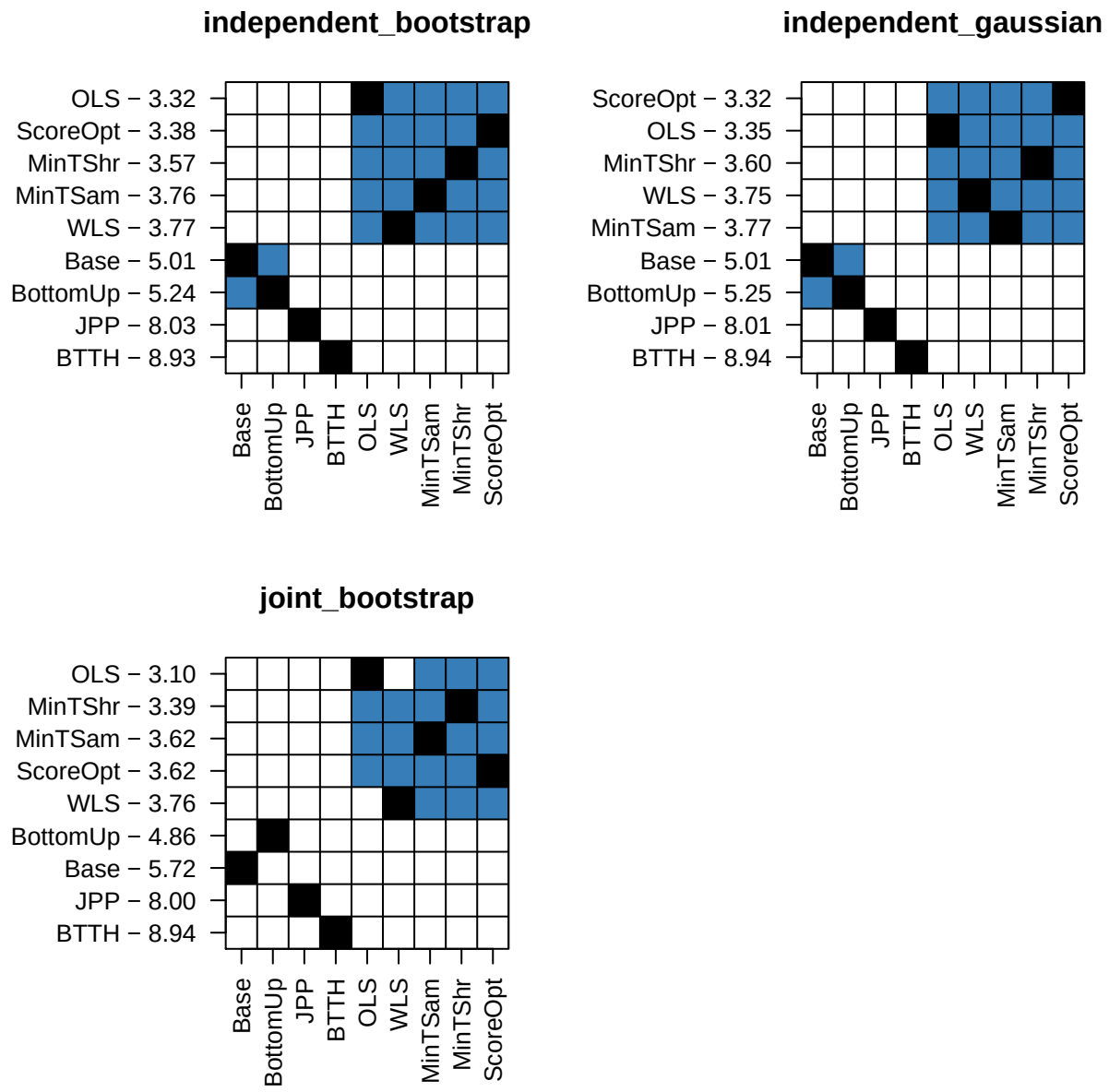

Figure 2: Results for ets modelling with a gaussian stationary DGP

Non Gaussian and Stationary DGP

The DGP has non-Gaussian residuals and all series are forced to be stationary.

ARIMA model

Recall that the true DGP is ARIMA

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	1.3711	1.4308	2.6948	2.1302	1.3412	1.3359	1.3295	1.2988	1.3273
independent	gaussian	1.3777	1.4494	2.8171	2.1402	1.3417	1.3361	1.3291	1.3021	1.3277
joint	bootstrap	1.3349	1.3755	2.7009	2.1266	1.3137	1.3086	1.3014	1.2935	1.3013

Summary of Nemenyi tests is below

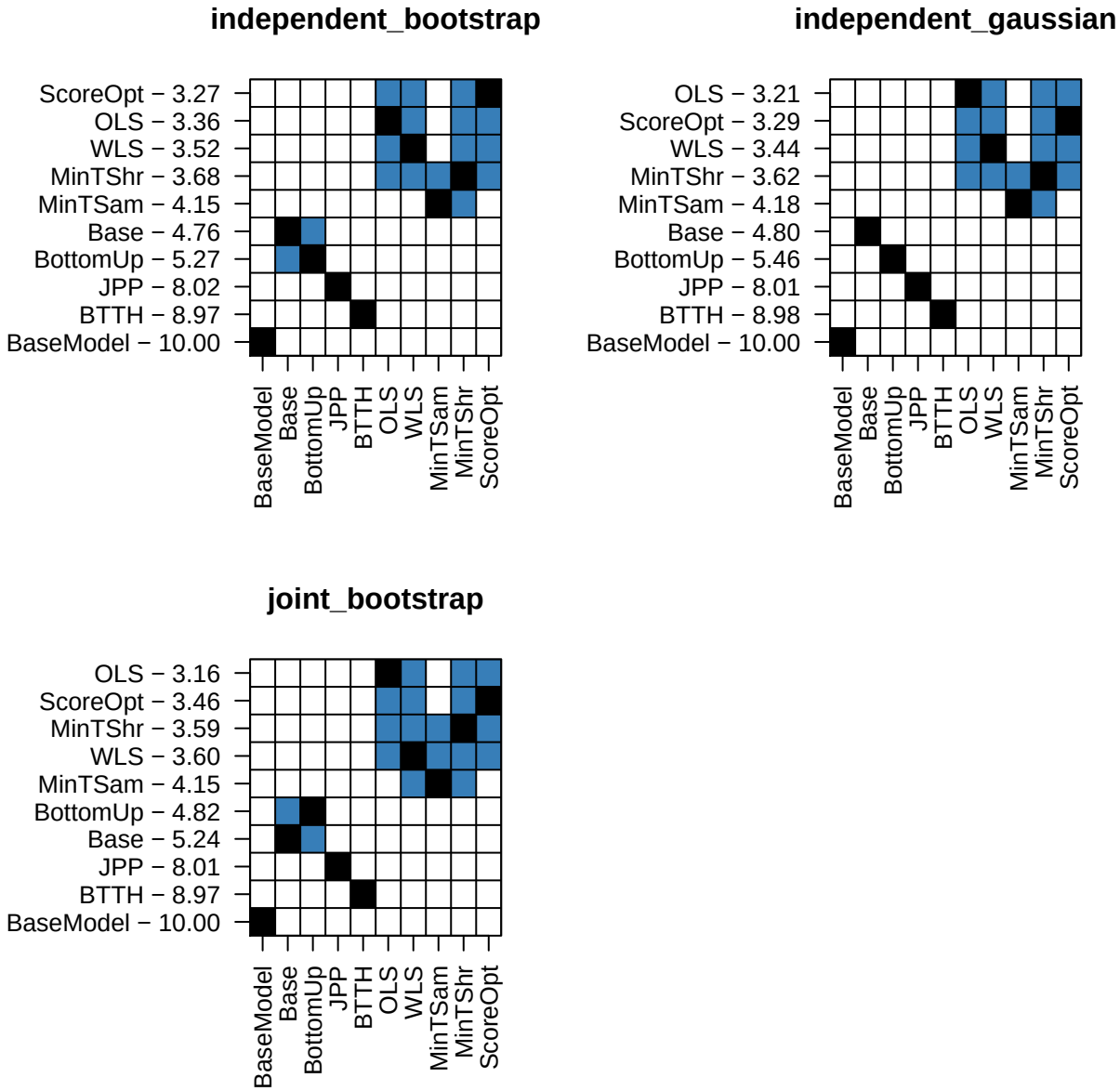

Figure 3: Results for arima modelling with a nongaussian stationary DGP

ETS model

Recall that the true DGP is ARIMA so there is model misspecification here.

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	1.3872	1.4455	2.7454	2.1625	1.3435	1.3415	1.3375	1.2982	1.3332
independent	gaussian	1.3936	1.4648	2.8627	2.1690	1.3445	1.3423	1.3379	1.3010	1.3344
joint	bootstrap	1.3555	1.3948	2.7552	2.1593	1.3213	1.3193	1.3145	1.3030	1.3125

Summary of Nemenyi test below

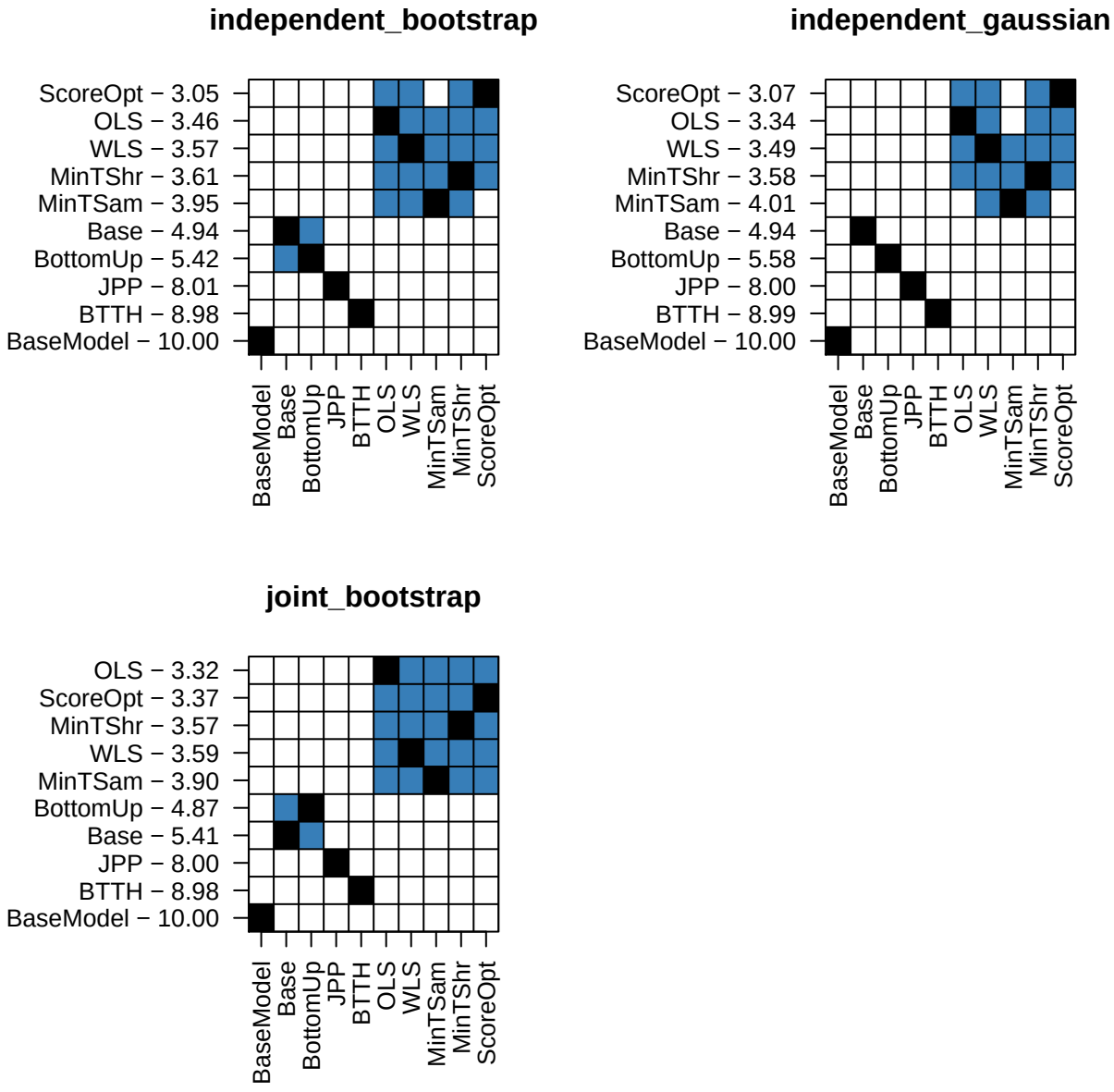

Figure 4: Results for ets modelling with a nongaussian stationary DGP

Gaussian and non-Stationary DGP

The DGP has Gaussian residuals and some series are non stationary.

ARIMA model

Recall that the true DGP is ARIMA

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	12.9145	14.7159	28.6161	19.0026	12.6829	12.6735	12.3198	12.6147	12.1877
independent	gaussian	12.8836	14.6643	28.5873	19.0009	12.6465	12.6372	12.2838	12.5822	12.1535
joint	bootstrap	12.6493	14.4312	28.7179	18.9601	12.4078	12.3981	12.0089	12.4496	11.8702

Summary of Nemenyi tests is below

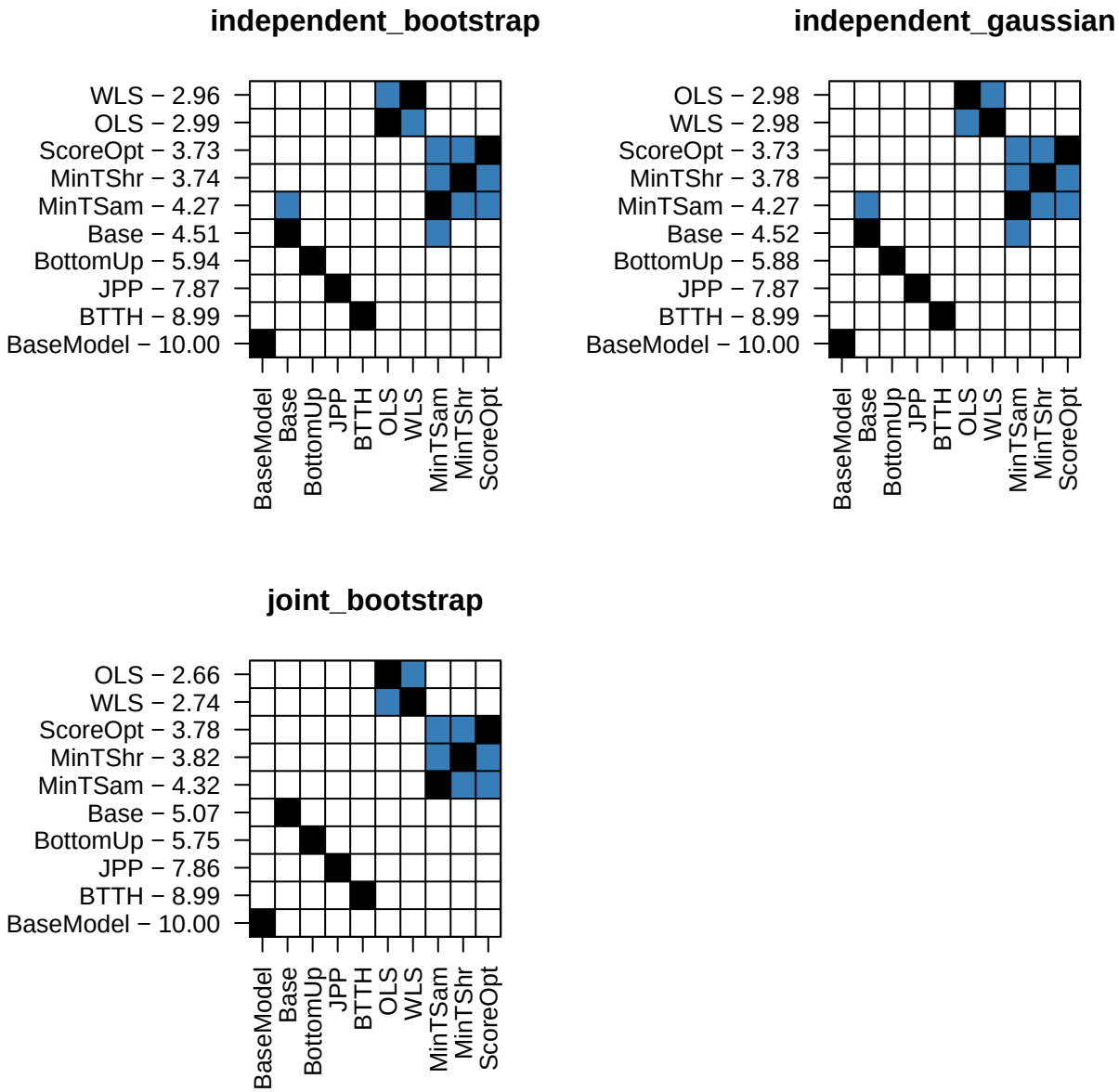

Figure 5: Results for arima modelling with a gaussian nonstationary DGP

ETS model

Recall that the true DGP is ARIMA so there is model misspecification here.

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	12.8955	14.8749	29.3070	18.8970	12.5974	12.5854	12.1747	12.4369	12.0488
independent	gaussian	12.8826	14.8254	29.2771	18.8937	12.5736	12.5617	12.1560	12.3943	12.0317
joint	bootstrap	12.6595	14.6266	29.3885	18.8647	12.3602	12.3478	11.9038	12.2873	11.7709

Summary of Nemenyi test below

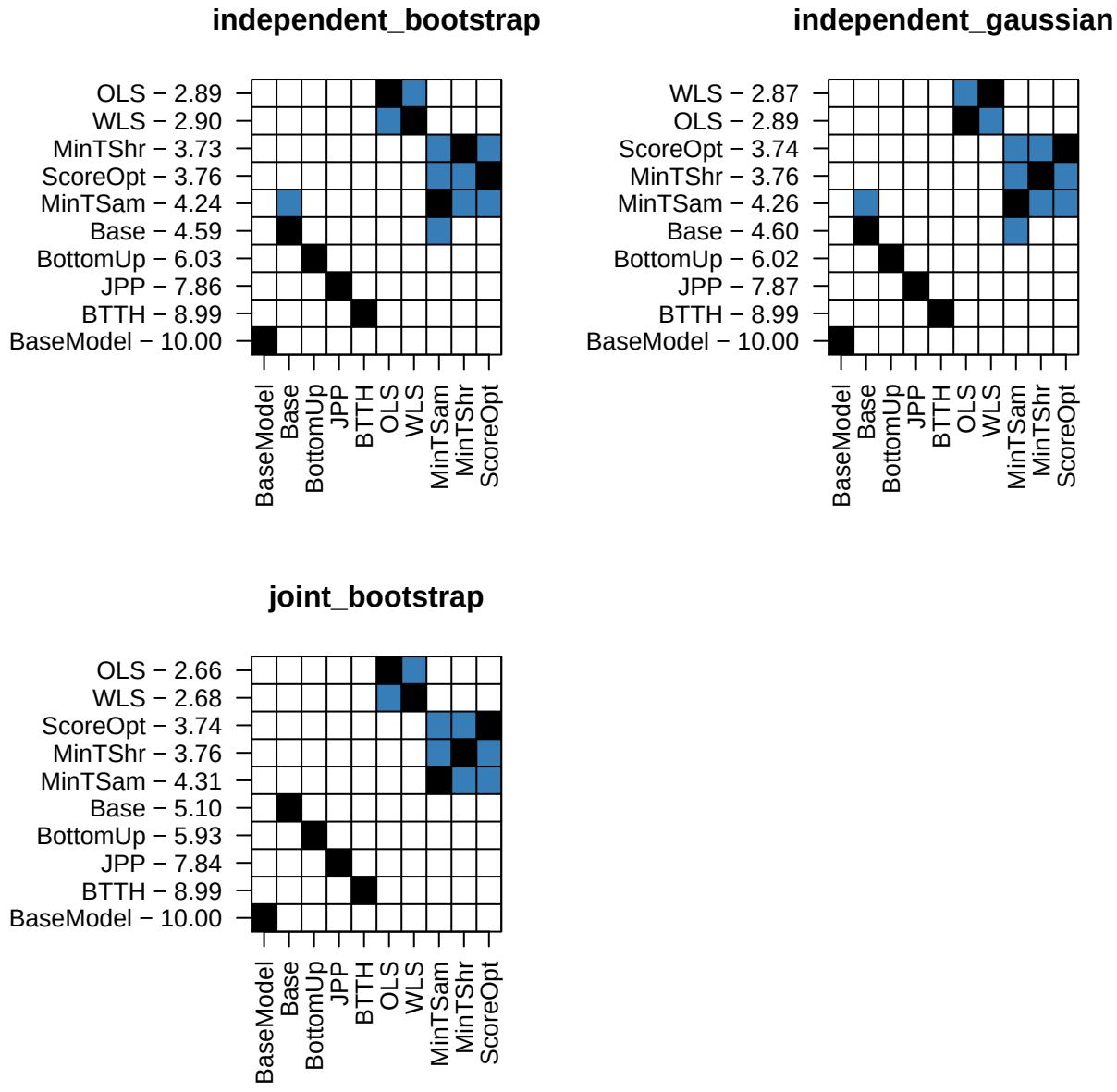

Figure 6: Results for ets modelling with a gaussian nonstationary DGP

Non Gaussian and non Stationary DGP

The DGP has non-Gaussian residuals and some series are non-stationary.

ARIMA model

Recall that the true DGP is ARIMA

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	1.5704	1.6955	3.3022	2.3566	1.5428	1.5388	1.5085	1.5256	1.4894
independent	gaussian	1.5732	1.6985	3.3273	2.3773	1.5448	1.5407	1.5101	1.5324	1.4904
joint	bootstrap	1.5292	1.6620	3.3018	2.3515	1.5074	1.5034	1.4703	1.4977	1.4558

Summary of Nemenyi tests is below

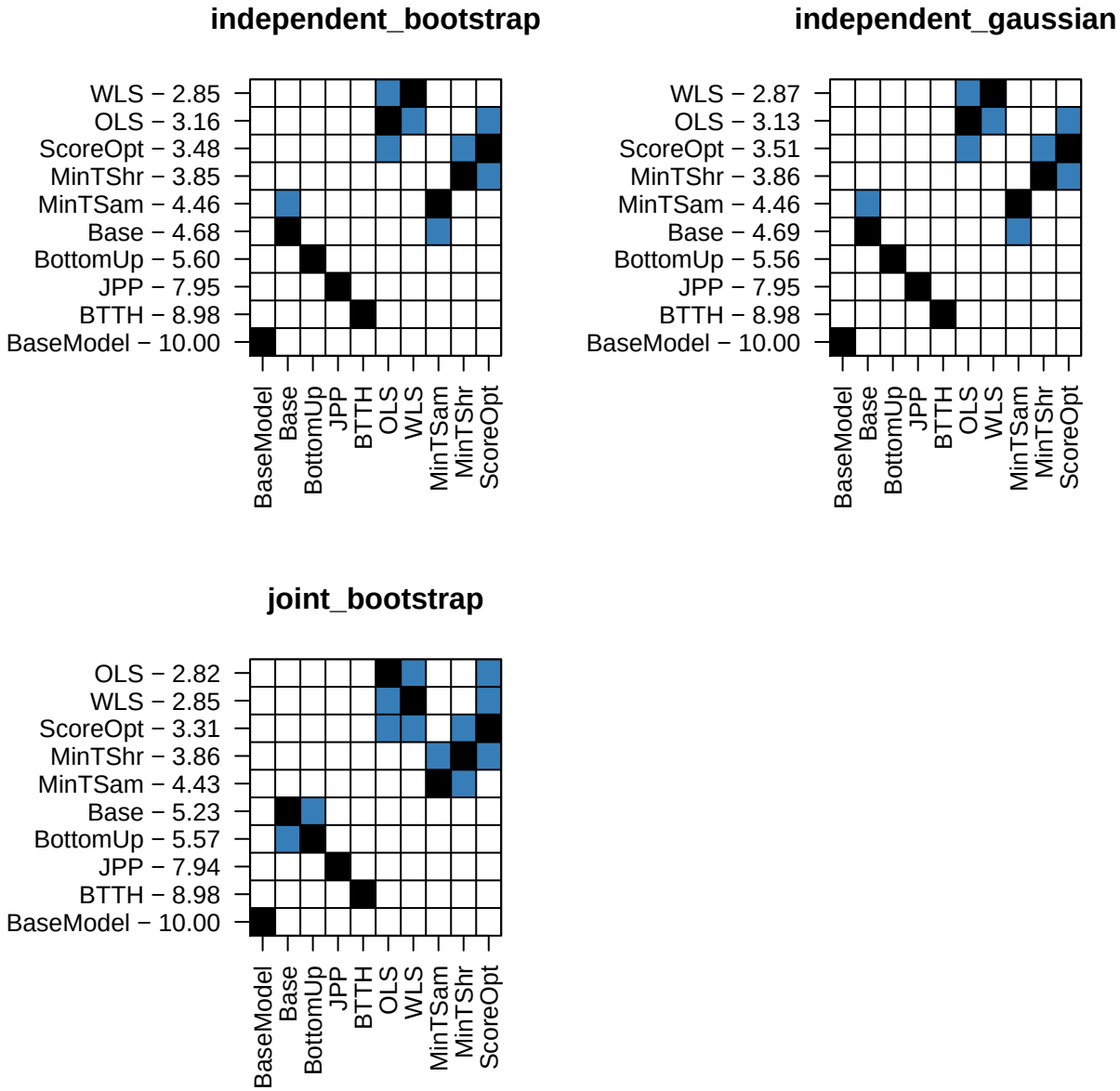

Figure 7: Results for arima modelling with a nongaussian nonstationary DGP

ETS model

Recall that the true DGP is ARIMA so there is model misspecification here.

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTSam	MinTShr	OLS	ScoreOpt	WLS
independent	bootstrap	1.6011	1.7151	4.7381	2.3840	4.3207	3.6706	1.5391	1.6205	1.5247
independent	gaussian	1.5850	1.7032	4.8418	2.4016	4.3154	3.6663	1.5055	1.5947	1.4920

Summary of Nemenyi test below

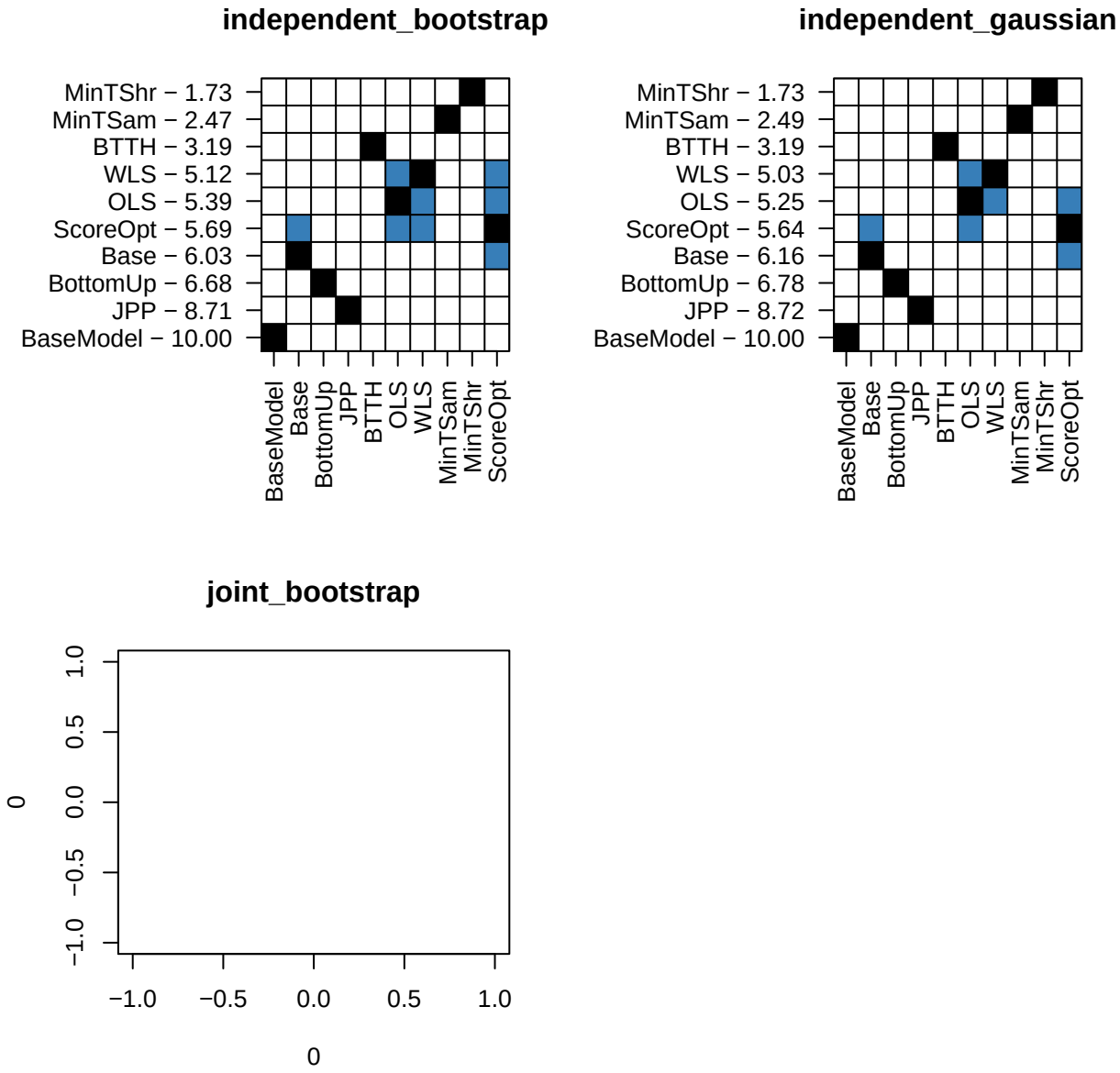

Figure 8: Results for ets modelling with a nongaussian nonstationary DGP