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	11.3270	11.9845	22.2039	17.8592	11.1620	11.1576	11.1309	10.8062	11.0443
independent	gaussian	11.3163	11.9658	22.1806	17.8662	11.1489	11.1446	11.1189	10.8226	11.0343
joint	bootstrap	11.0636	11.6403	22.2983	17.8458	10.8724	10.8673	10.8369	10.8429	10.7792

Summary of Nemenyi tests is below

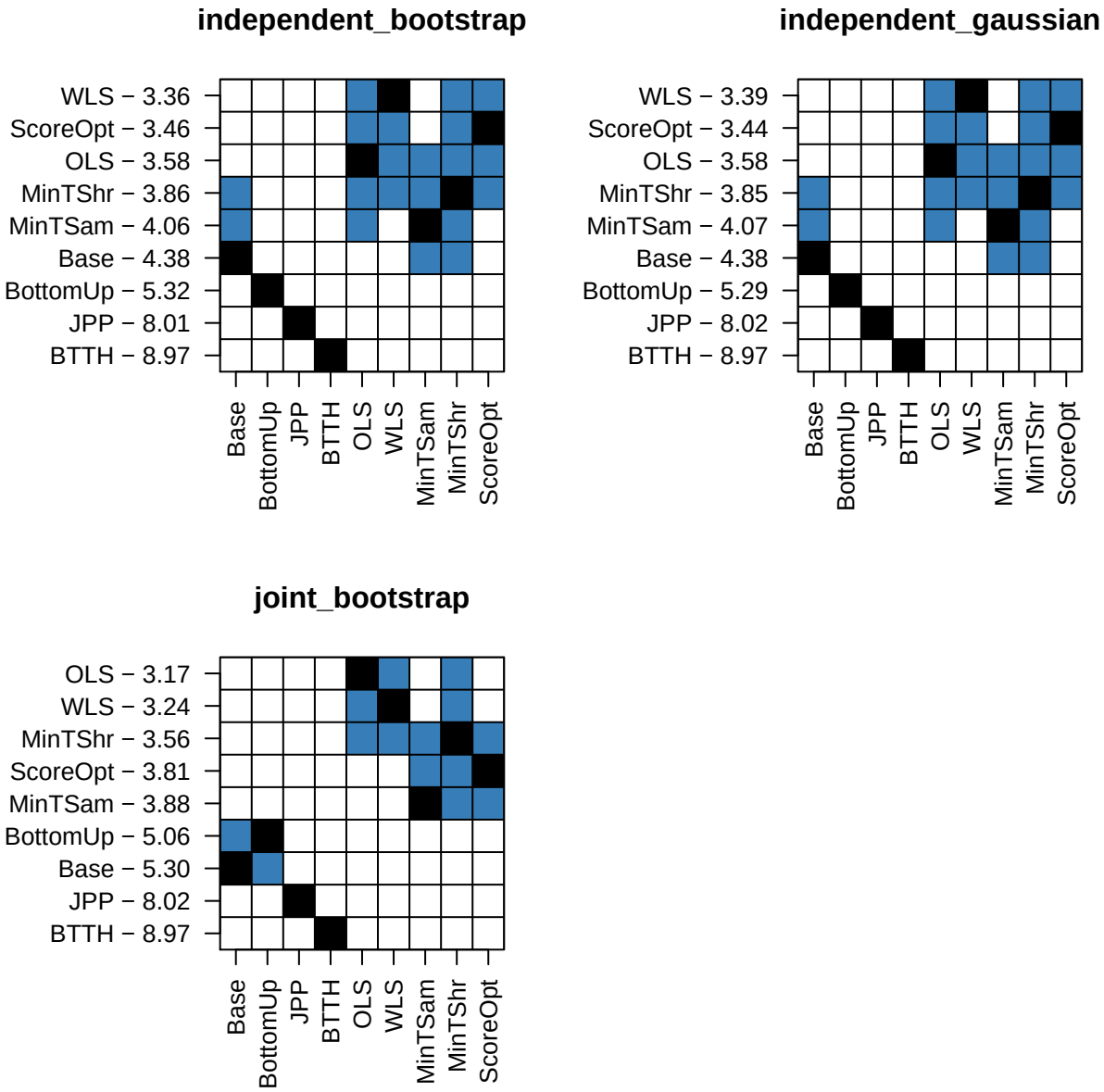

Figure 1: Results for arima modelling with a gaussian stationary DGP

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	11.7973	12.4577	23.6722	18.5009	11.2098	11.2021	11.1712	10.8325	11.2134
independent	gaussian	11.7911	12.4565	23.6915	18.5071	11.2024	11.1947	11.1636	10.8254	11.2045
joint	bootstrap	11.6058	12.2105	23.7762	18.4969	10.9759	10.9676	10.9339	10.8689	10.9977

Summary of Nemenyi test below

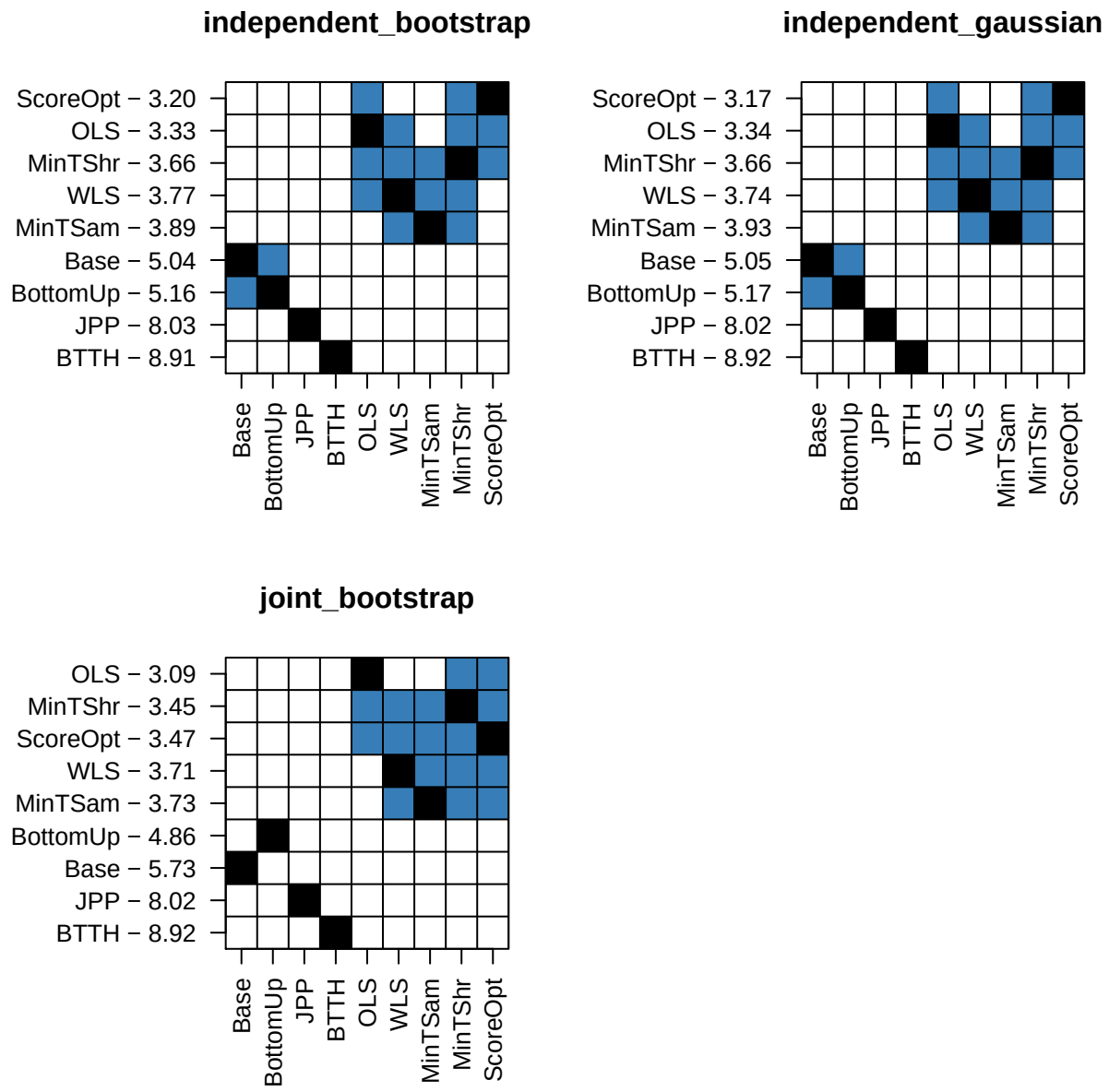

Figure 2: Results for ets modelling with a gaussian stationary DGP

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	1.4164	1.5056	2.8235	2.1919	1.3863	1.3743	1.3640	1.3379	1.3549
independent	gaussian	1.4251	1.5320	2.9860	2.1981	1.3877	1.3749	1.3640	1.3390	1.3556
joint	bootstrap	1.3846	1.4652	2.8414	2.1910	1.3640	1.3518	1.3405	1.3380	1.3339

Summary of Nemenyi tests is below

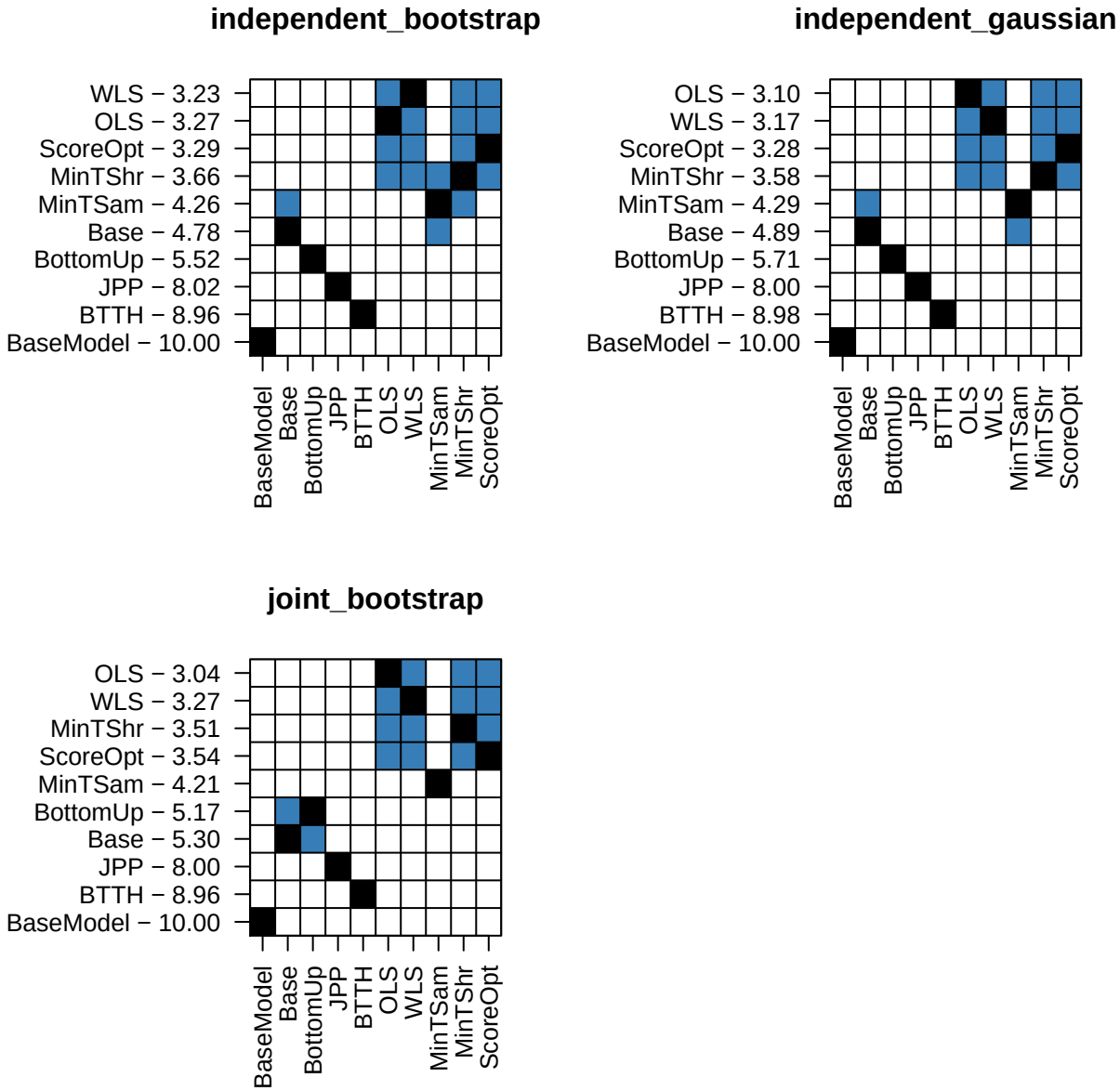

Figure 3: Results for arima modelling with a nongaussian stationary DGP

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	1.4345	1.5216	2.8646	2.2187	1.3967	1.3787	1.3709	1.3340	1.3604
independent	gaussian	1.4408	1.5437	3.0392	2.2202	1.3974	1.3786	1.3686	1.3340	1.3592
joint	bootstrap	1.4050	1.4856	2.8784	2.2177	1.3742	1.3563	1.3469	1.3355	1.3392

Summary of Nemenyi test below

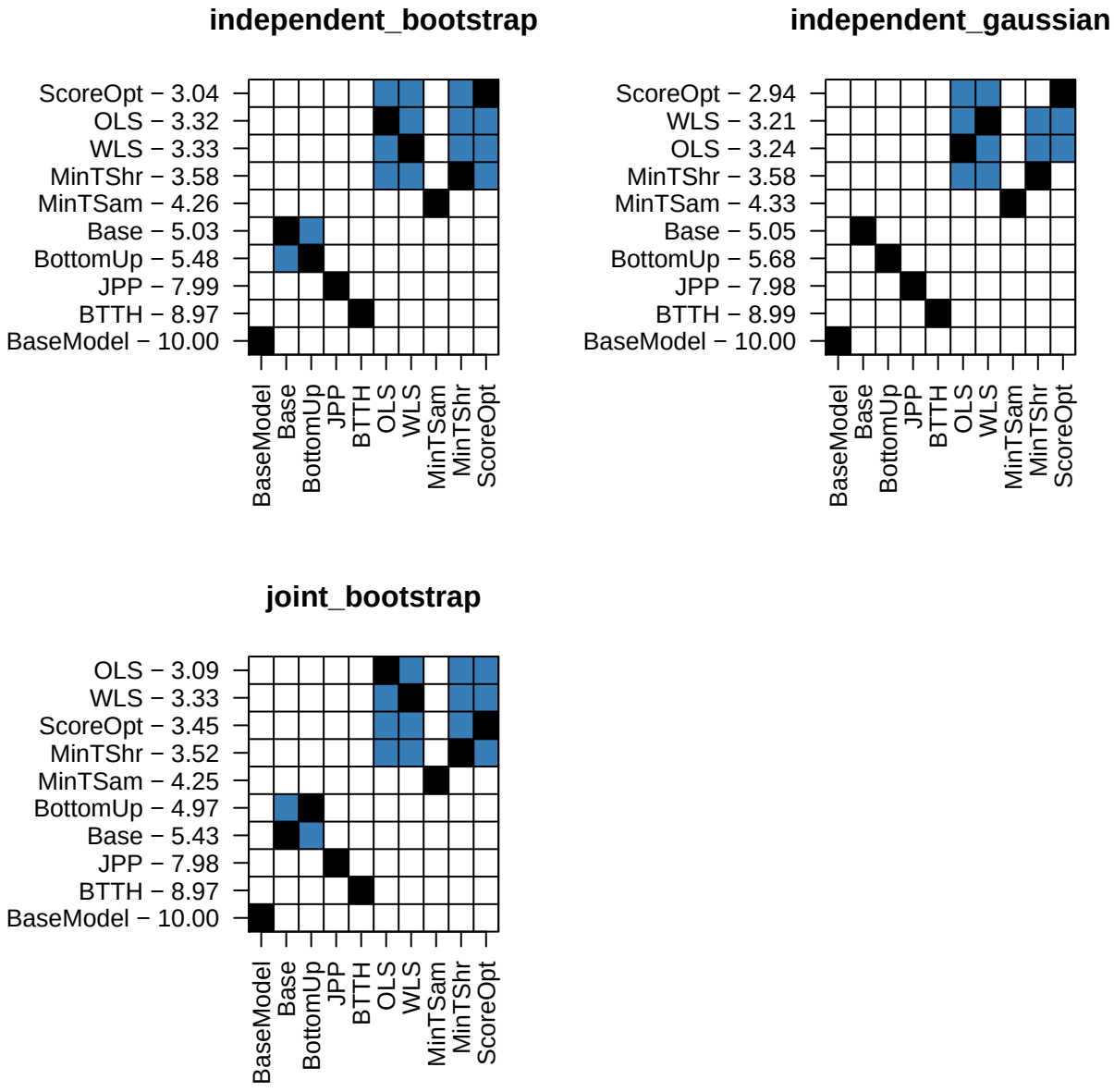

Figure 4: Results for ets modelling with a nongaussian stationary DGP

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	12.9342	14.8390	28.5539	19.1423	12.7263	12.7182	12.3619	11.9910	12.1846
independent	gaussian	12.9107	14.7847	28.5501	19.1442	12.6960	12.6879	12.3346	11.9759	12.1616
joint	bootstrap	12.6560	14.5721	28.6578	19.1251	12.4332	12.4248	12.0376	11.8868	11.8631

Summary of Nemenyi tests is below

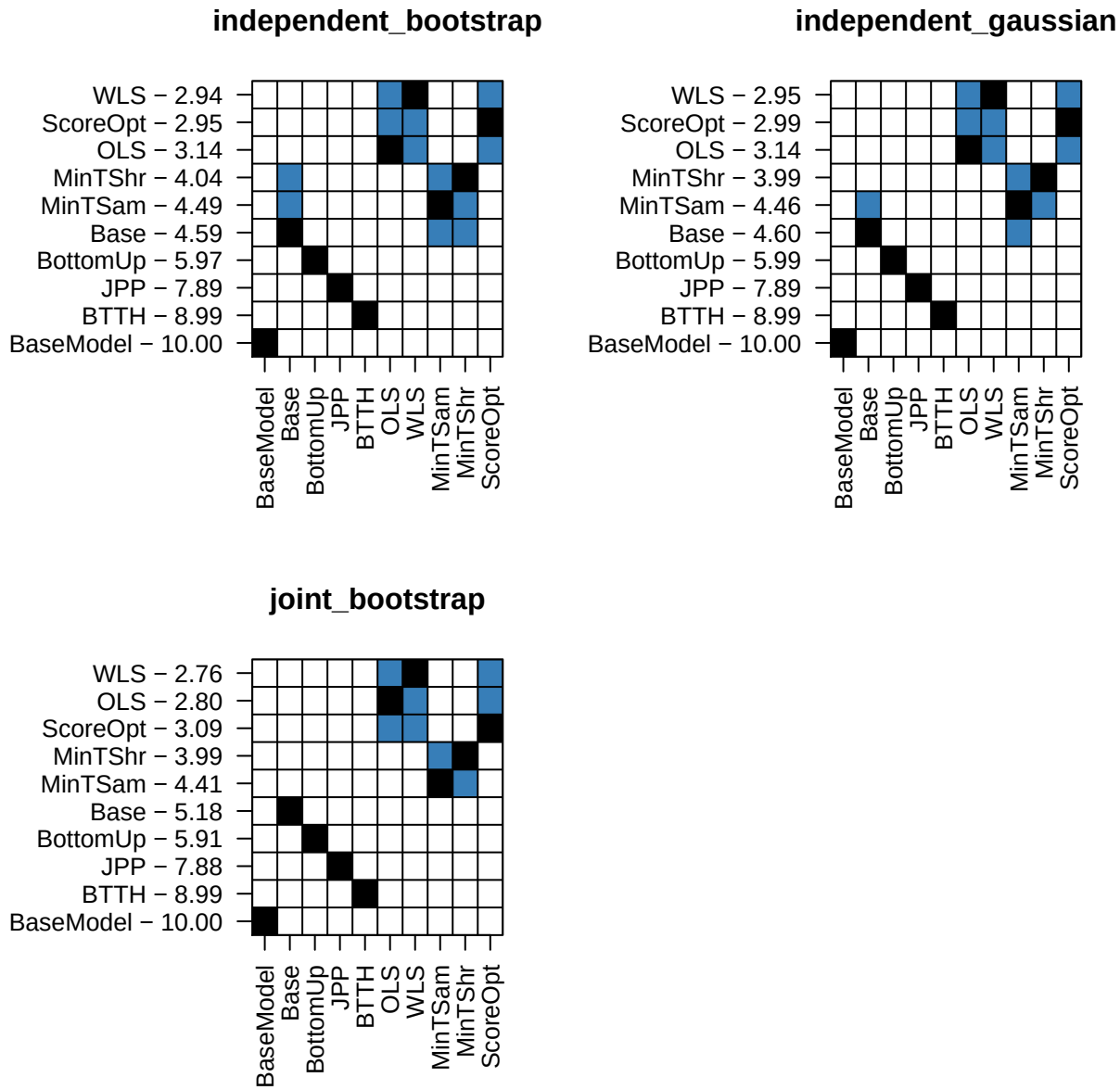

Figure 5: Results for arima modelling with a gaussian nonstationary DGP

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	12.8724	15.0326	29.4222	18.9678	12.5802	12.5713	12.1504	11.9171	11.9837
independent	gaussian	12.8430	14.9804	29.3870	18.9718	12.5432	12.5342	12.1186	11.8679	11.9551
joint	bootstrap	12.6219	14.8216	29.5338	18.9569	12.3241	12.3149	11.8657	11.7456	11.7005

Summary of Nemenyi test below

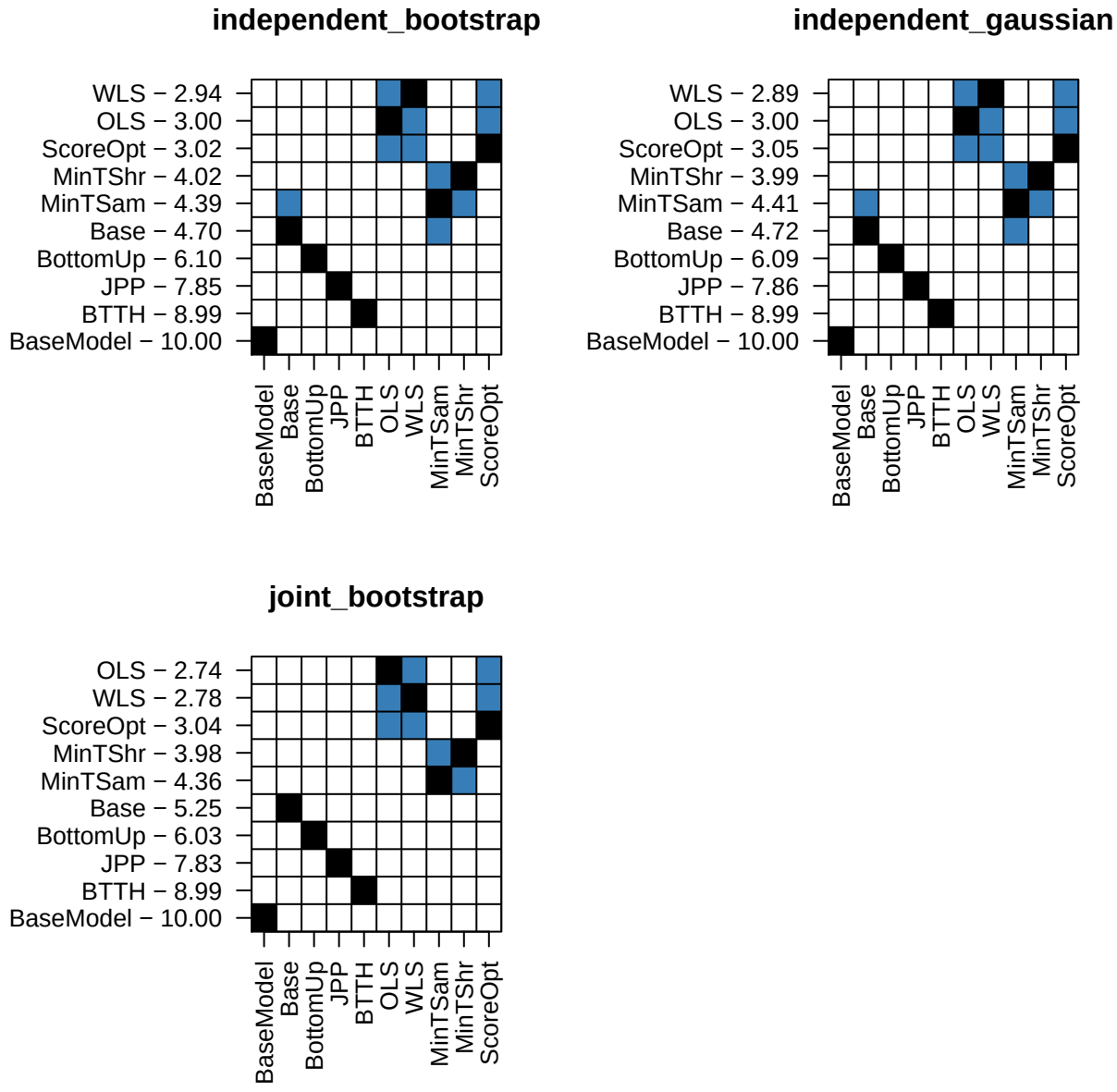

Figure 6: Results for ets modelling with a gaussian nonstationary DGP

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	1.5718	1.7422	3.4145	2.3504	1.5394	1.5344	1.4931	1.5224	1.4656
independent	gaussian	1.5731	1.7456	3.4527	2.3640	1.5388	1.5338	1.4920	1.5198	1.4645
joint	bootstrap	1.5353	1.7183	3.4289	2.3500	1.5117	1.5066	1.4625	1.4990	1.4393

Summary of Nemenyi tests is below

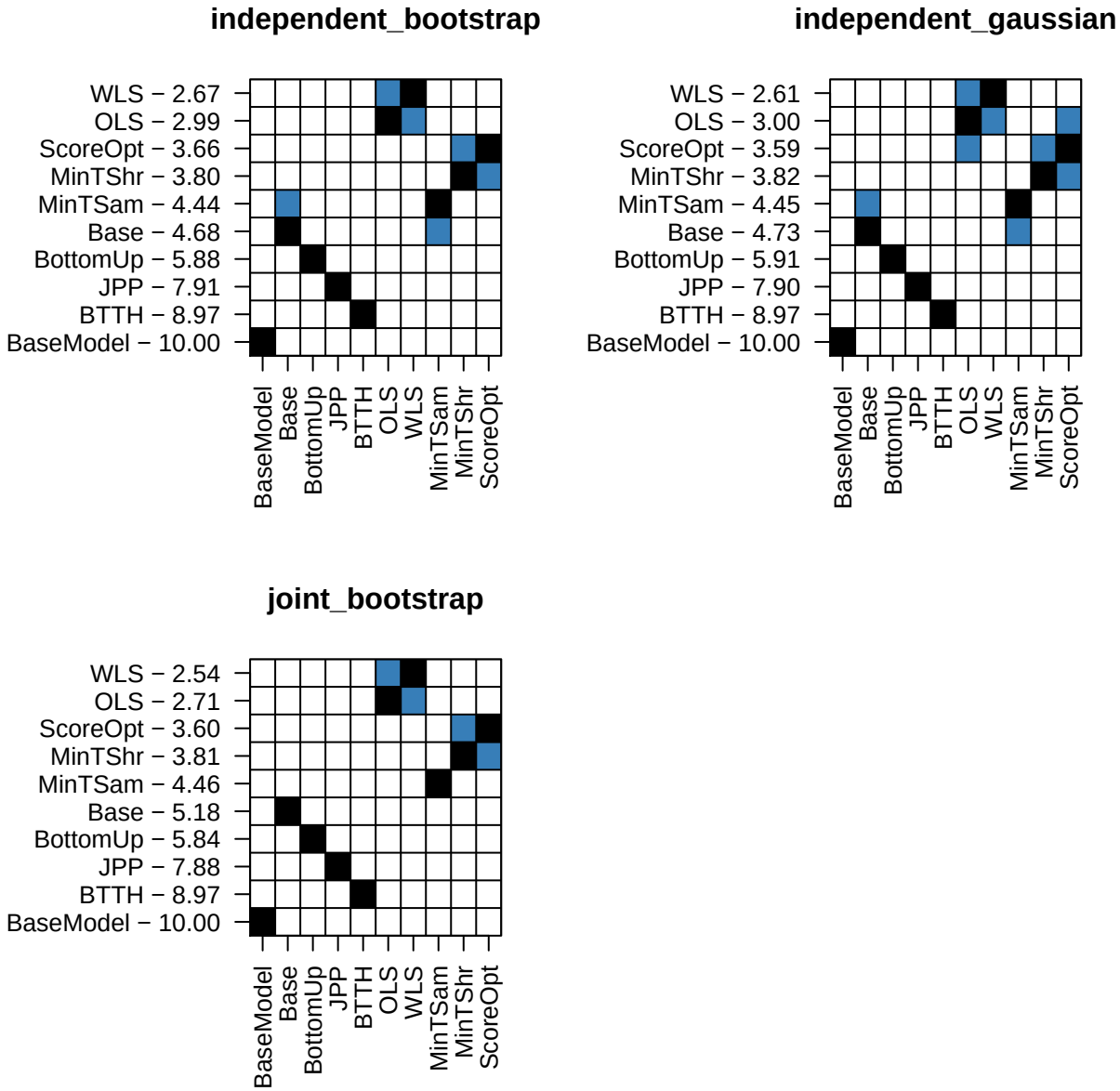

Figure 7: Results for arima modelling with a nongaussian nonstationary DGP

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	1.5829	1.7595	3.5126	2.3505	1.5650	1.5516	1.4845	1.5373	1.4637
independent	gaussian	1.5837	1.7631	3.5542	2.3794	1.5641	1.5507	1.4830	1.5377	1.4611

Summary of Nemenyi test below

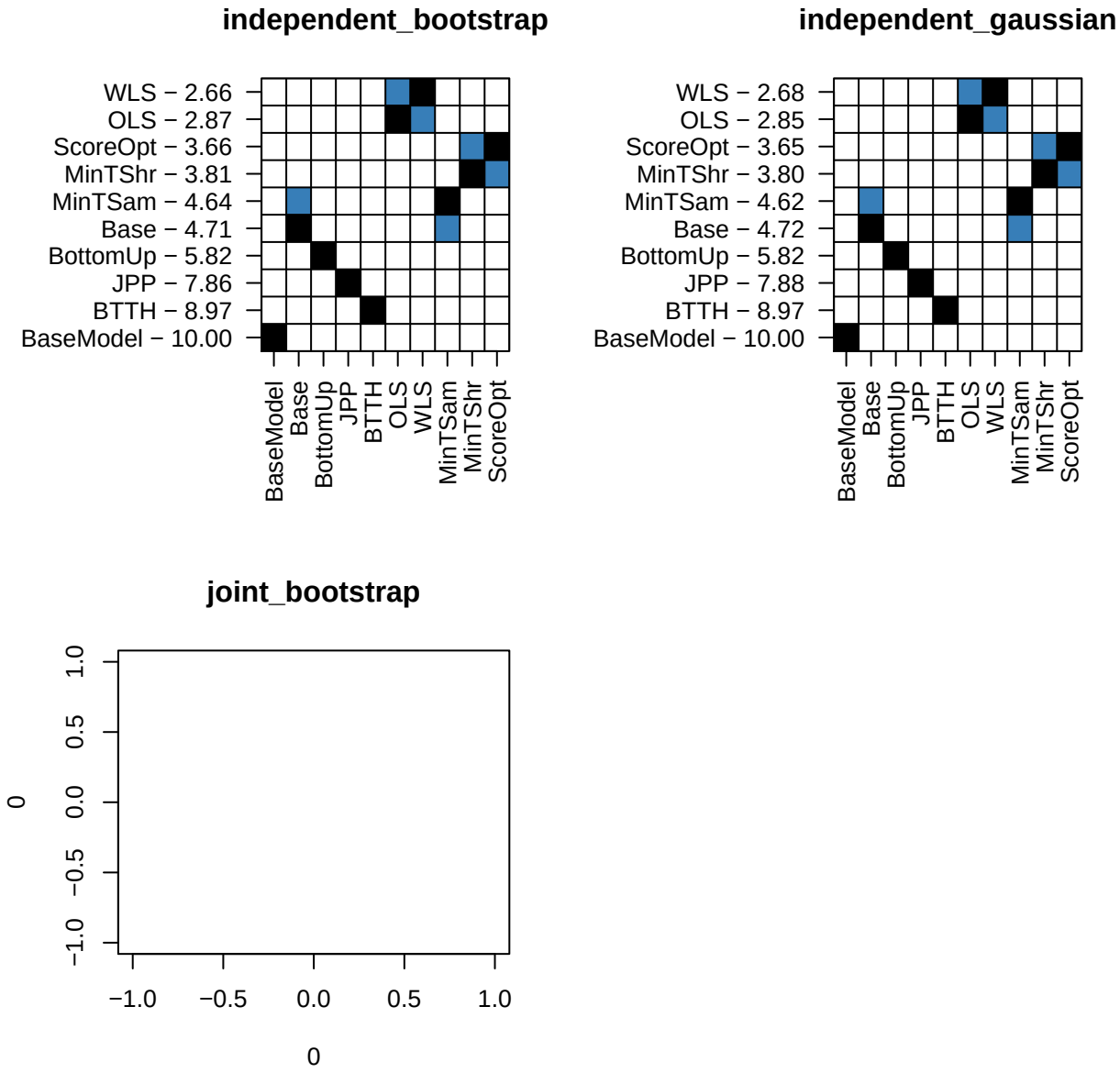

Figure 8: Results for ets modelling with a nongaussian nonstationary DGP