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	MinTShr	OLS	ScoreOpt
independent	bootstrap	11.3202	11.9667	21.7753	22.8613	10.8894	11.1249	10.8021
independent	gaussian	11.3221	11.9607	21.7736	22.8933	10.8935	11.1215	10.8308
joint	bootstrap	11.0698	11.6468	21.8542	22.8590	10.7524	10.8433	10.8486

Summary of Nemenyi tests is below

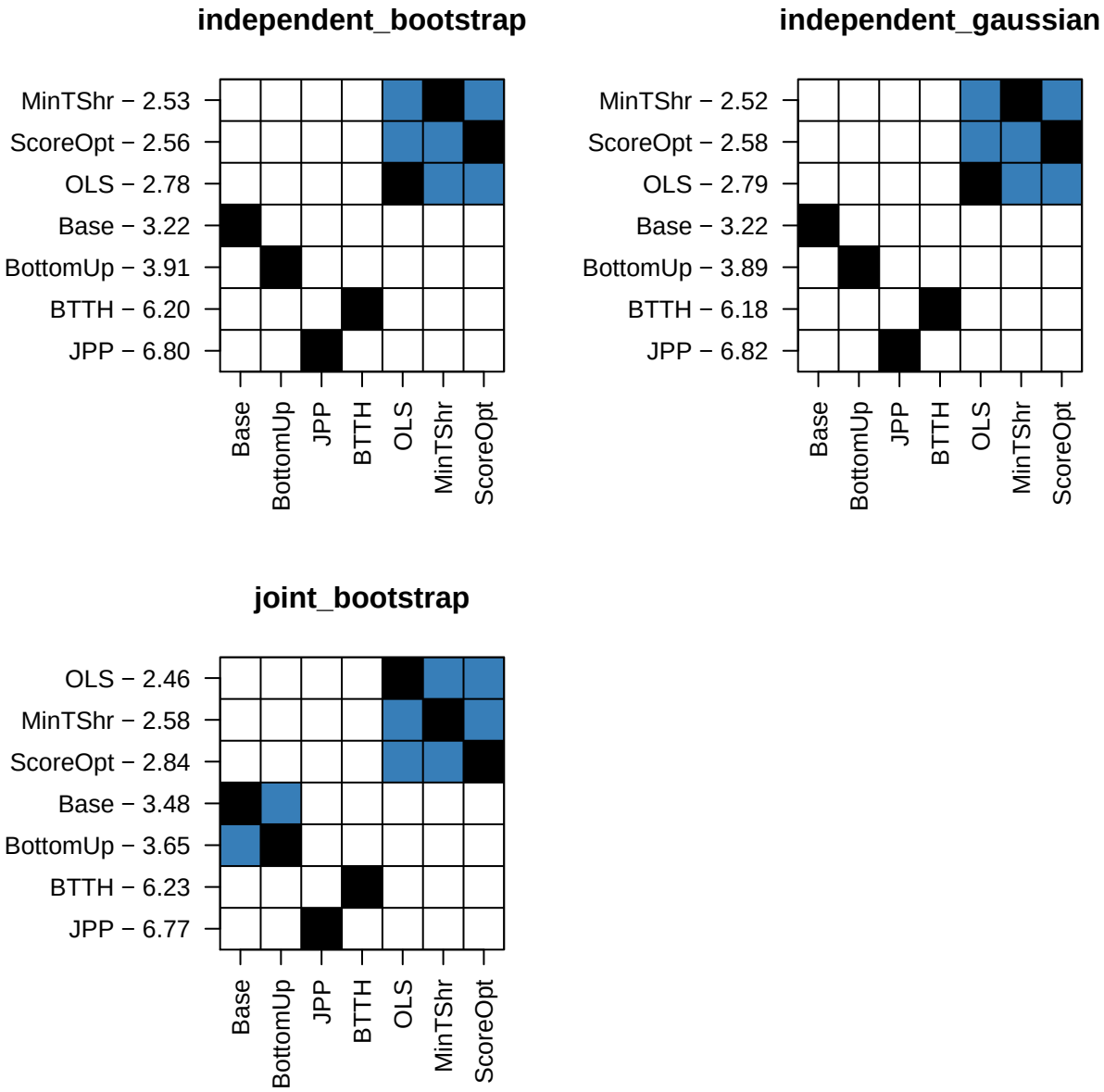

Figure 1: Results for arima modelling with a gaussian stationary DGP

ETS model

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

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTShr	OLS	ScoreOpt
independent	bootstrap	11.8017	12.4572	23.9298	23.4025	10.9487	11.1766	10.8365
independent	gaussian	11.7975	12.4653	23.9567	23.4430	10.9458	11.1704	10.8350
joint	bootstrap	11.6027	12.2055	23.9996	23.3915	10.7940	10.9321	10.8670

Summary of Nemenyi test below

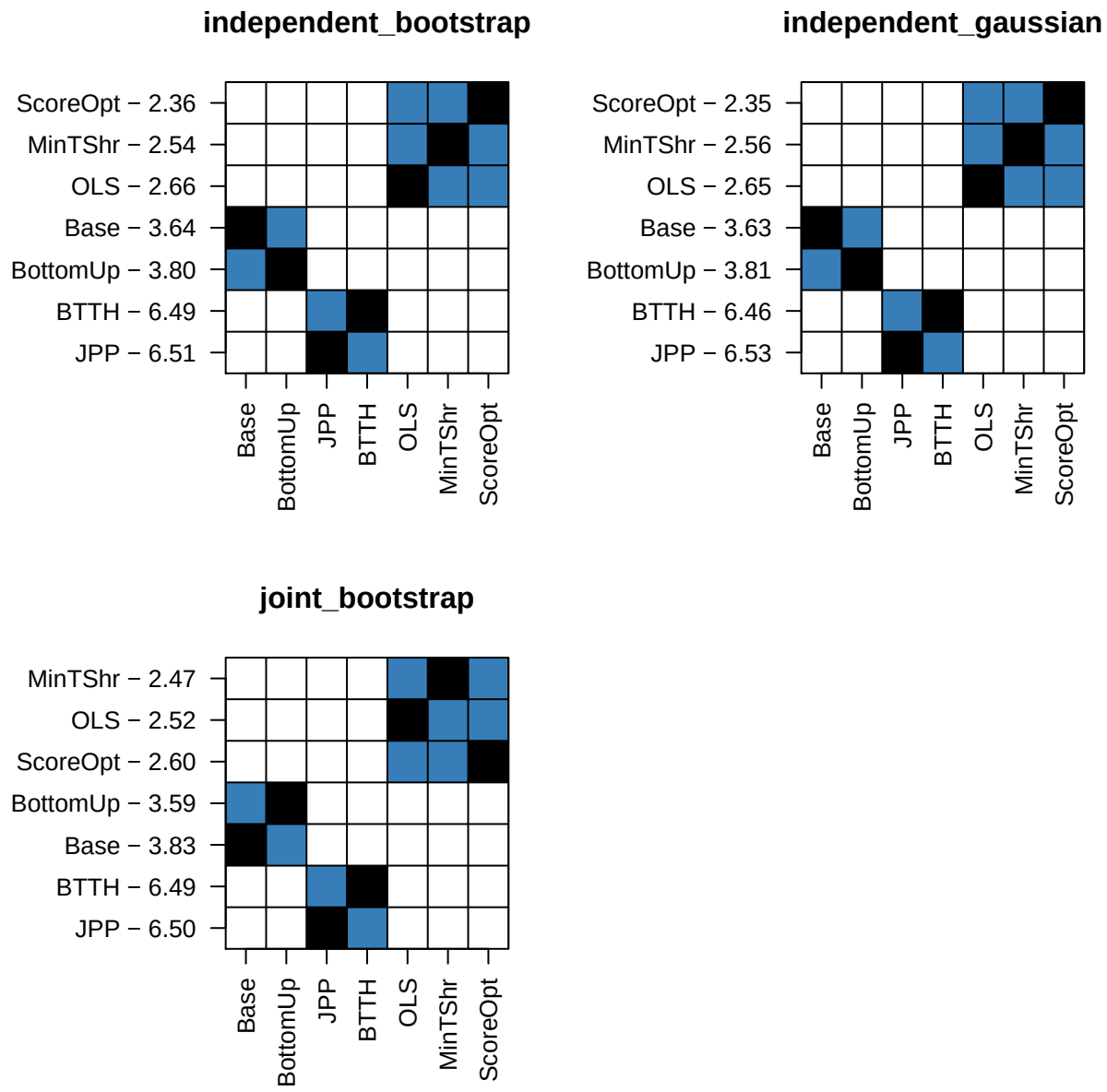

Figure 2: Results for ets modelling with a gaussian stationary DGP

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	MinTShr	OLS	ScoreOpt
independent	bootstrap	1.4165	1.5061	2.7706	2.8796	1.3512	1.3640	1.3385
independent	gaussian	1.4242	1.5299	2.9286	2.9735	1.3505	1.3635	1.3380
joint	bootstrap	1.3844	1.4654	2.7850	2.8783	1.3292	1.3402	1.3380

Summary of Nemenyi tests is below

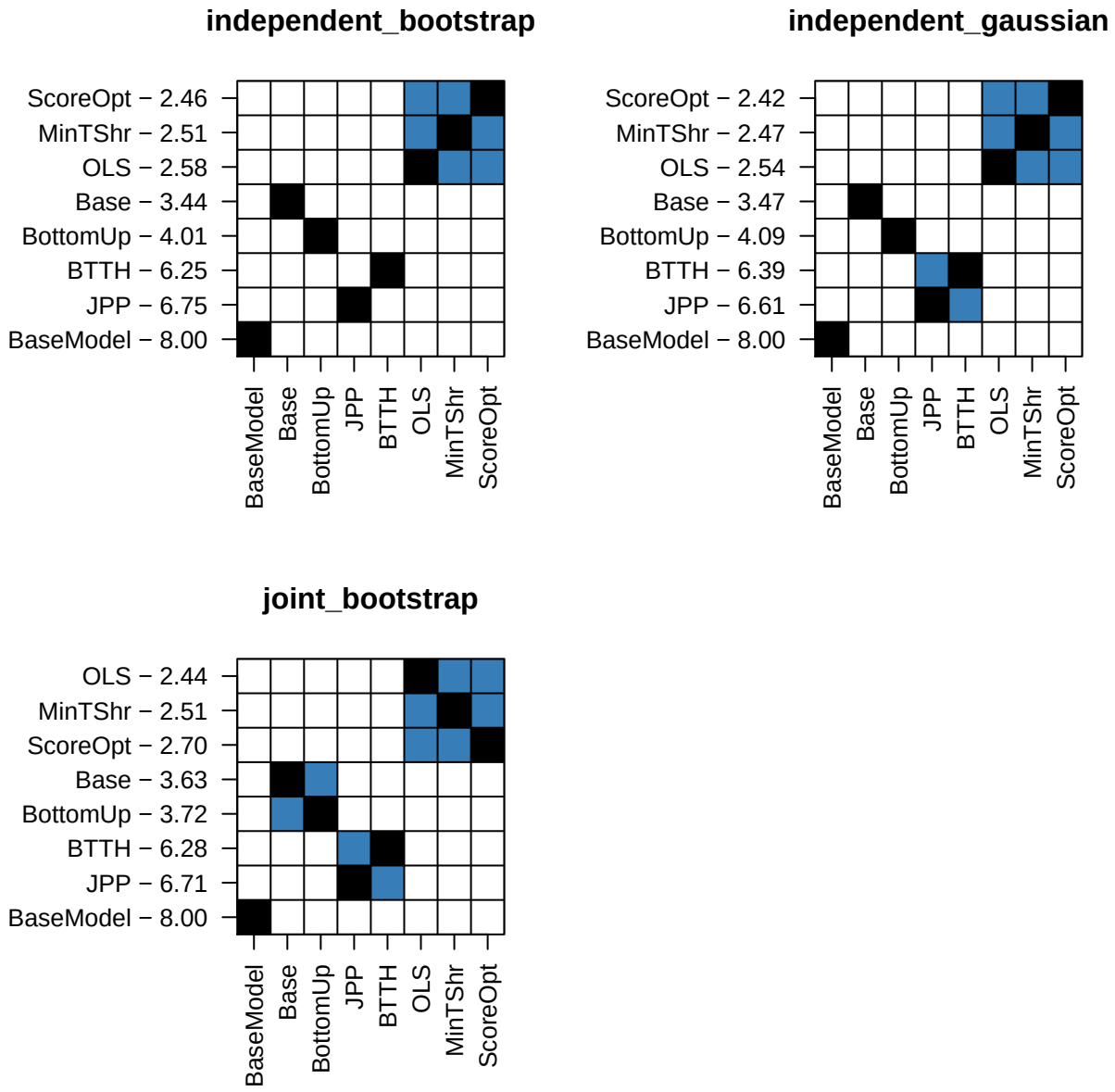

Figure 3: Results for arima modelling with a nongaussian stationary DGP

ETS model

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

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTShr	OLS	ScoreOpt
independent	bootstrap	1.4343	1.5216	2.8330	2.8967	1.3722	1.3706	1.3348
independent	gaussian	1.4410	1.5449	2.9995	3.0004	1.3699	1.3687	1.3347
joint	bootstrap	1.4046	1.4856	2.8412	2.8948	1.3551	1.3464	1.3350

Summary of Nemenyi test below

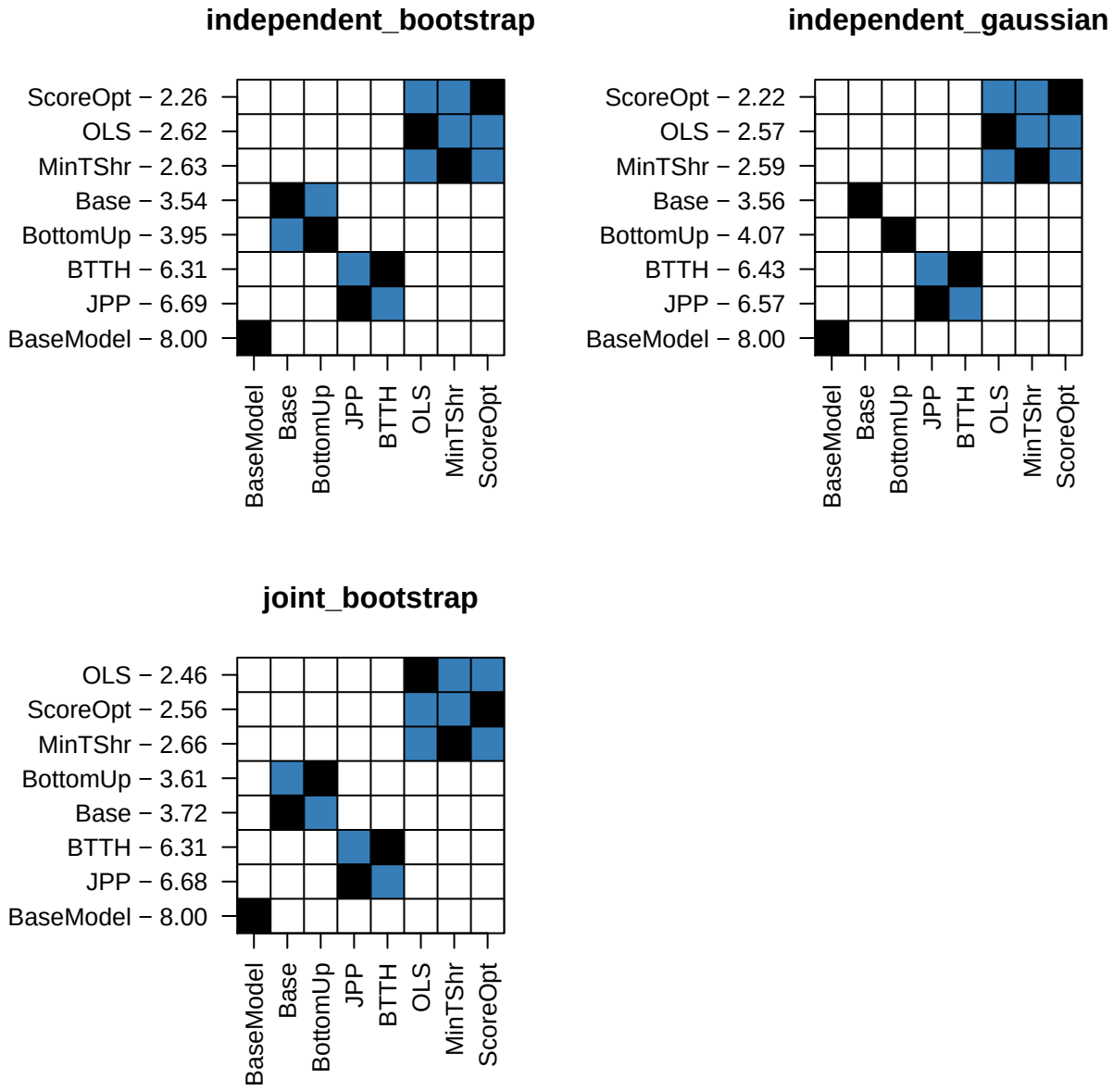

Figure 4: Results for ets modelling with a nongaussian stationary DGP

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	MinTShr	OLS	ScoreOpt
independent	bootstrap	12.9308	14.8323	26.6189	26.0954	11.5693	12.3616	11.9865
independent	gaussian	12.9043	14.7851	26.6134	26.1020	11.5468	12.3282	11.9715
joint	bootstrap	12.6602	14.5837	26.7386	26.0823	11.3499	12.0414	11.8860

Summary of Nemenyi tests is below

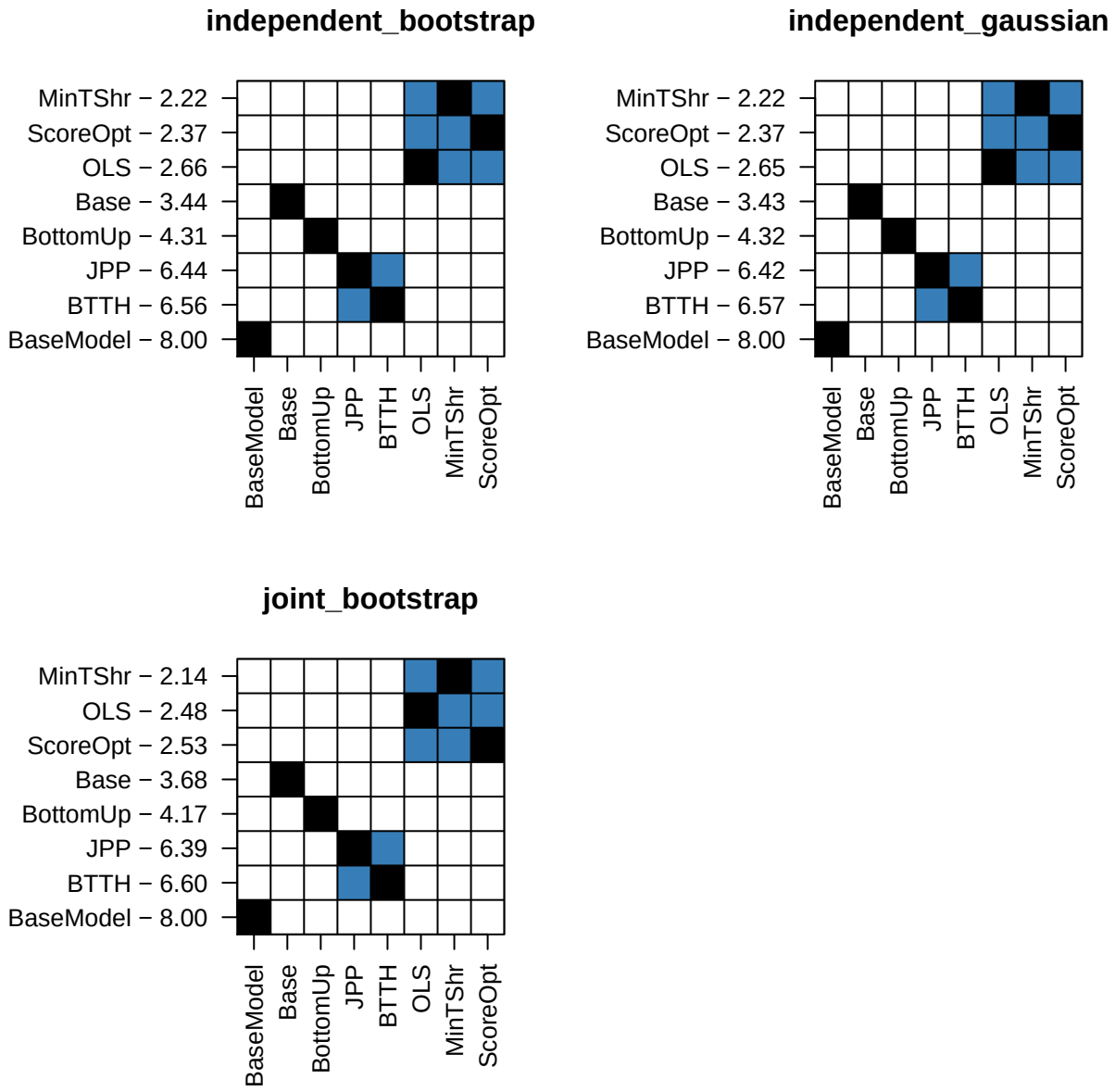

Figure 5: Results for arima modelling with a gaussian nonstationary DGP

ETS model

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

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTShr	OLS	ScoreOpt
independent	bootstrap	12.8670	15.0290	27.4175	26.0296	11.4709	12.1449	11.9159
independent	gaussian	12.8412	14.9802	27.4295	26.0309	11.4587	12.1180	11.8706
joint	bootstrap	12.6147	14.8145	27.4574	26.0068	11.2493	11.8588	11.7391

Summary of Nemenyi test below

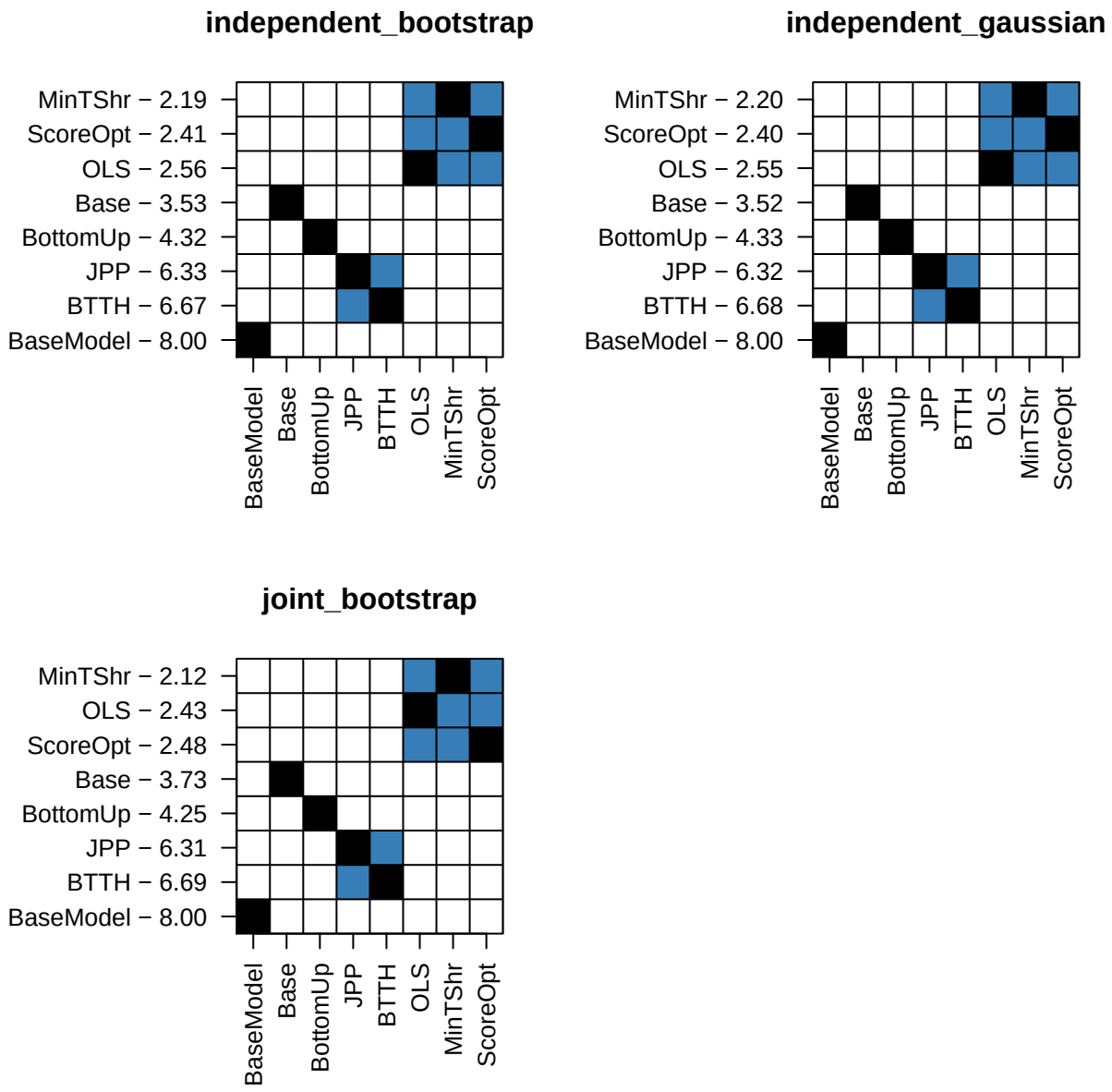

Figure 6: Results for ets modelling with a gaussian nonstationary DGP

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	MinTShr	OLS	ScoreOpt
independent	bootstrap	1.5718	1.7421	3.2292	3.1983	1.4420	1.4927	1.5219
independent	gaussian	1.5735	1.7454	3.2711	3.2316	1.4432	1.4926	1.5205
joint	bootstrap	1.5356	1.7185	3.2425	3.1972	1.4118	1.4628	1.4992

Summary of Nemenyi tests is below

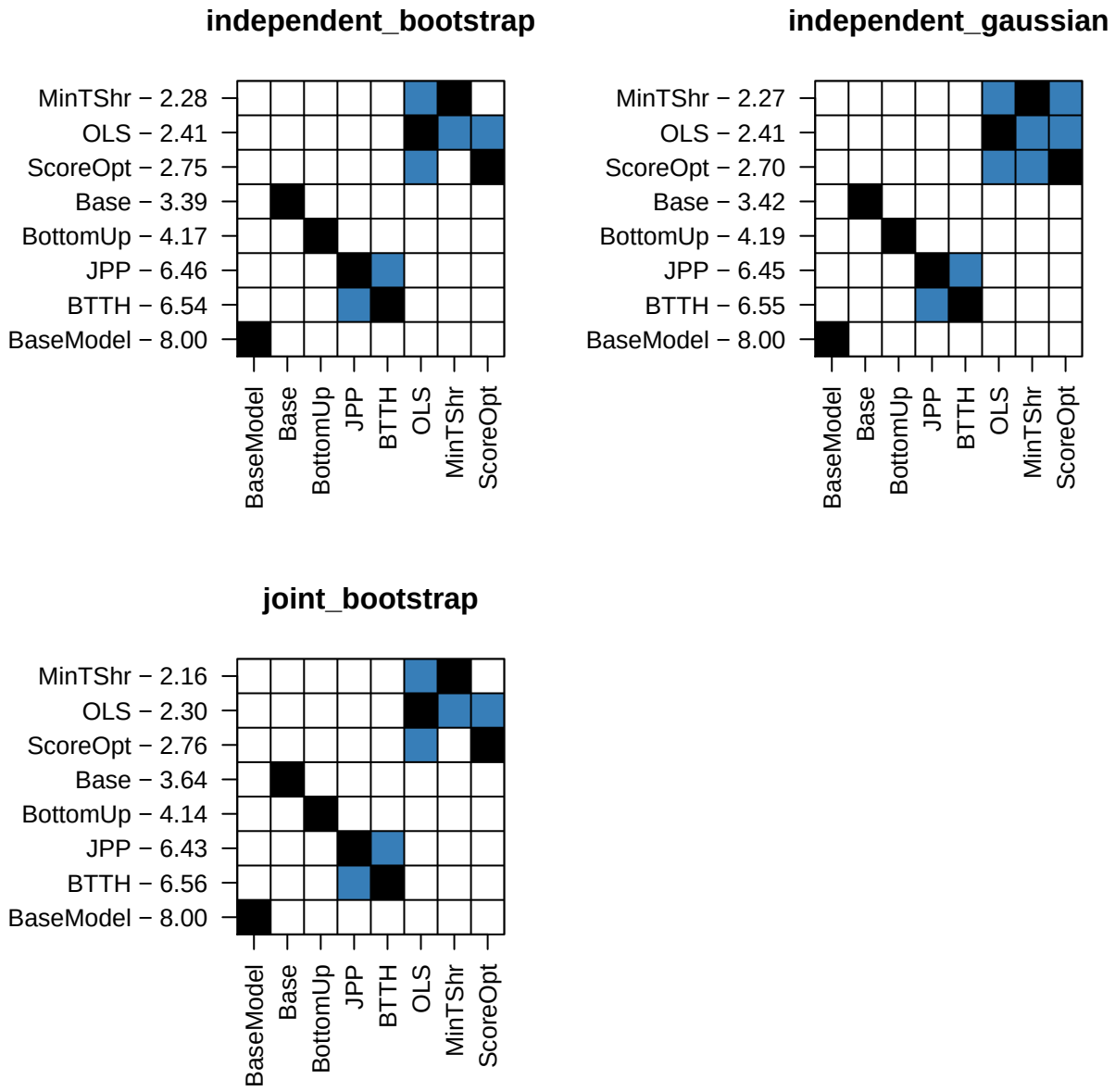

Figure 7: Results for arima modelling with a nongaussian nonstationary DGP

ETS model

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

BaseDependence	BaseDistribution	Base	BottomUp	BTTH	JPP	MinTShr	OLS	ScoreOpt
independent	bootstrap	1.5832	1.7601	3.2982	3.2016	1.4554	1.4847	1.5377
independent	gaussian	1.5835	1.7634	3.3411	3.2452	1.4547	1.4825	1.5371

Summary of Nemenyi test below

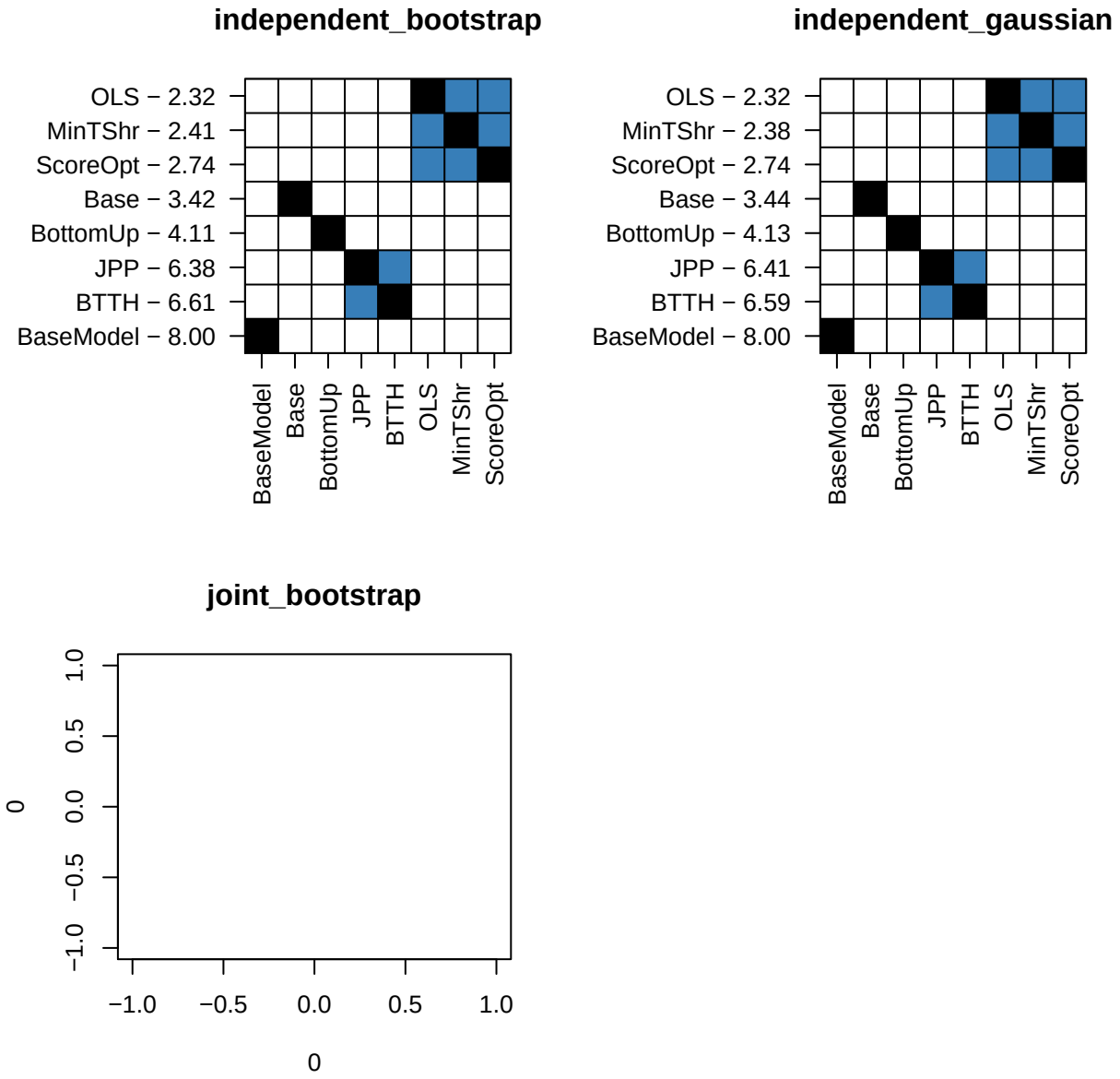

Figure 8: Results for ets modelling with a nongaussian nonstationary DGP