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	11.3198	11.9653	21.7530	22.8610	10.8853	11.1254	10.8004
independent	gaussian	11.3228	11.9714	21.8103	22.8917	10.8931	11.1240	10.8297
joint	bootstrap	11.0659	11.6429	21.9083	22.8561	10.7481	10.8395	10.8421

Summary of Nemenyi tests is below

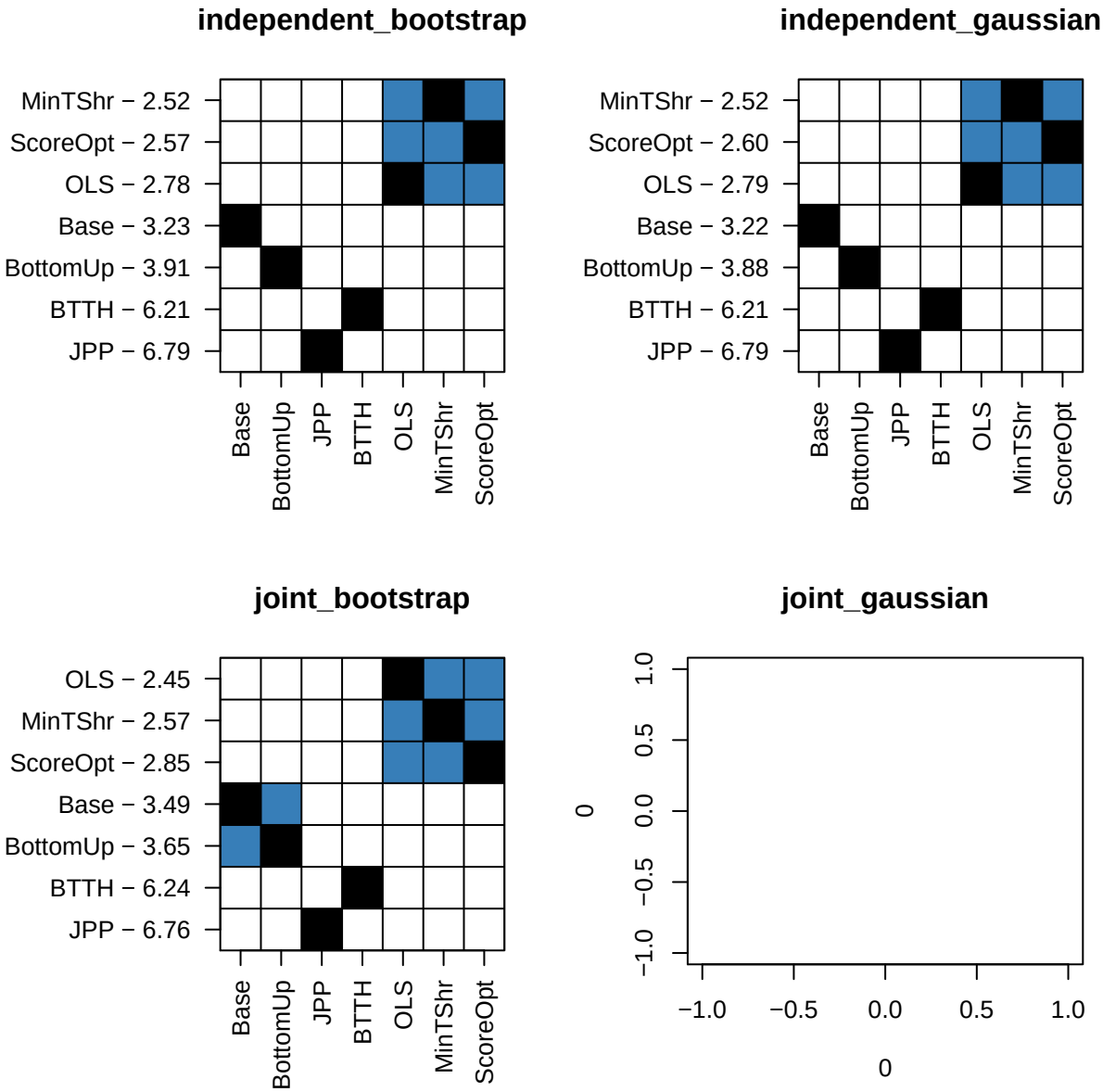

Figure 1: Results for arima modelling with a gaussian stationary DGP

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	11.8054	12.4678	23.9173	23.4083	10.9542	11.1781	10.8485
independent	gaussian	11.7950	12.4602	23.9651	23.4454	10.9452	11.1674	10.8290
joint	bootstrap	11.6022	12.2073	23.9699	23.3868	10.7901	10.9310	10.8624

Summary of Nemenyi test below

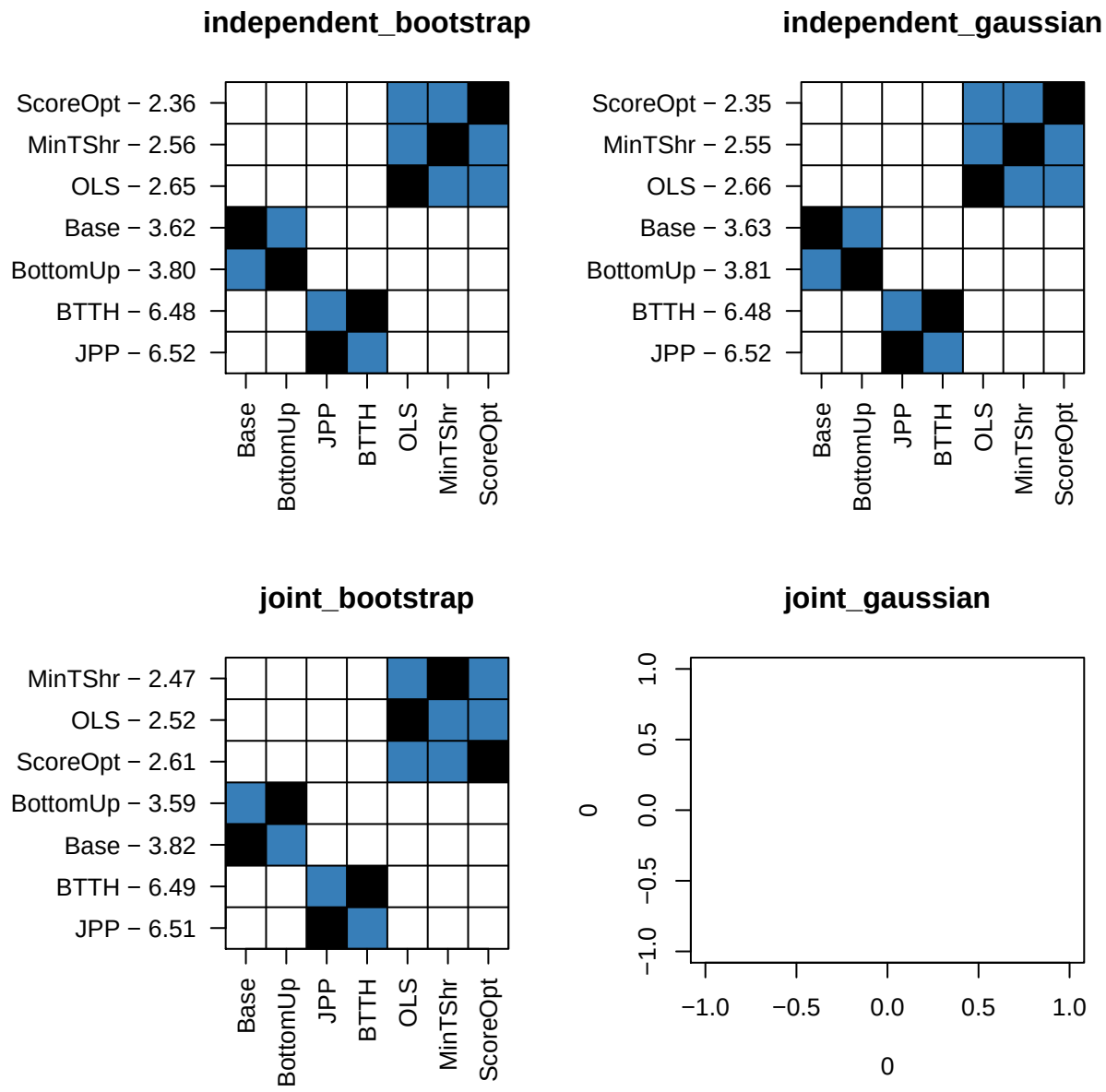

Figure 2: Results for ets modelling with a gaussian stationary DGP

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	1.4158	1.5050	2.7698	2.8792	1.3506	1.3633	1.3378
independent	gaussian	1.4249	1.5314	2.9269	2.9736	1.3512	1.3641	1.3393
joint	bootstrap	1.3833	1.4643	2.7827	2.8766	1.3279	1.3392	1.3366

Summary of Nemenyi tests is below

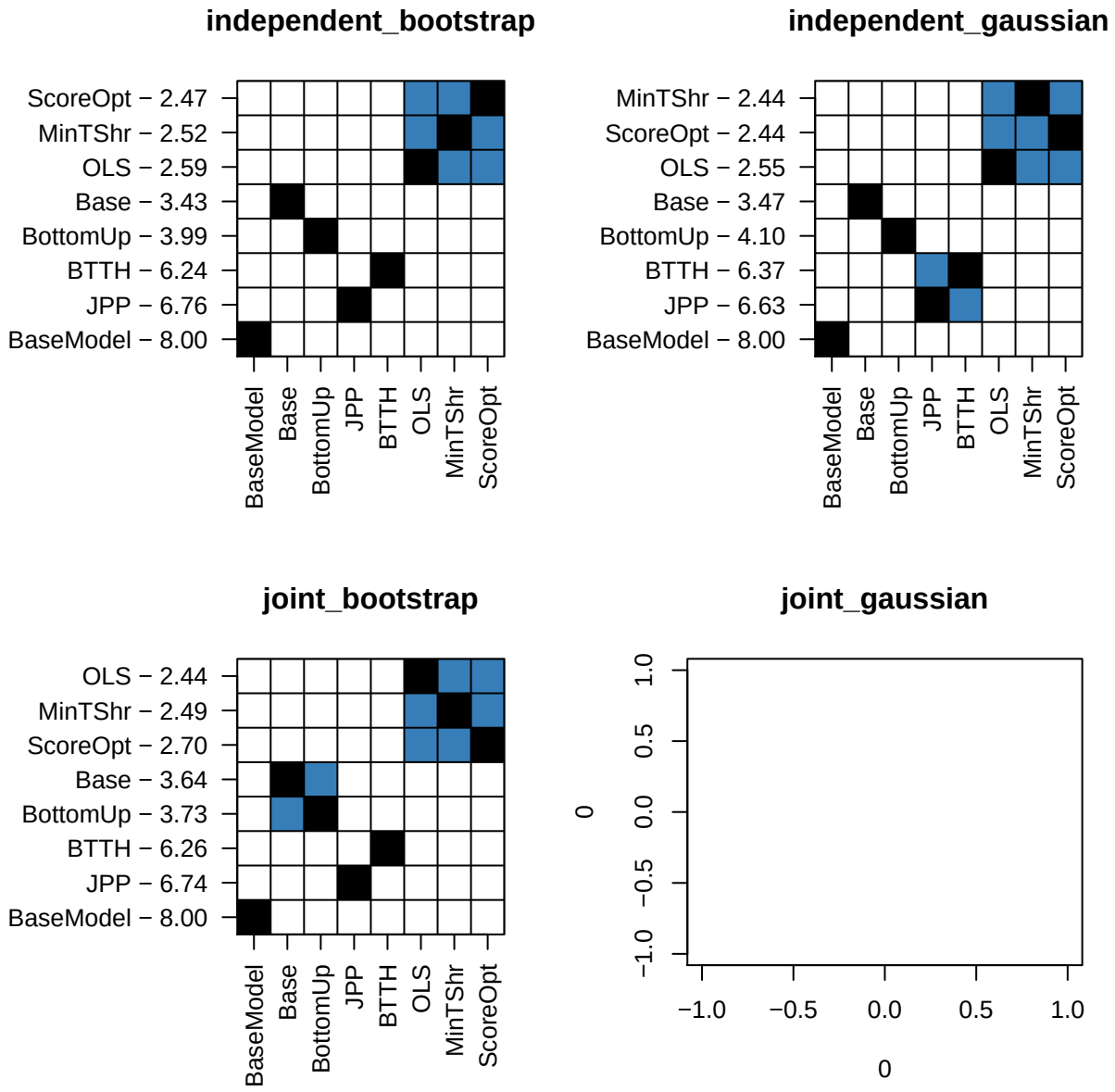

Figure 3: Results for arima modelling with a nongaussian stationary DGP

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	1.4338	1.5211	2.8347	2.8965	1.3717	1.3702	1.3339
independent	gaussian	1.4408	1.5441	3.0057	3.0005	1.3695	1.3682	1.3343
joint	bootstrap	1.4055	1.4866	2.8424	2.8959	1.3559	1.3474	1.3360

Summary of Nemenyi test below

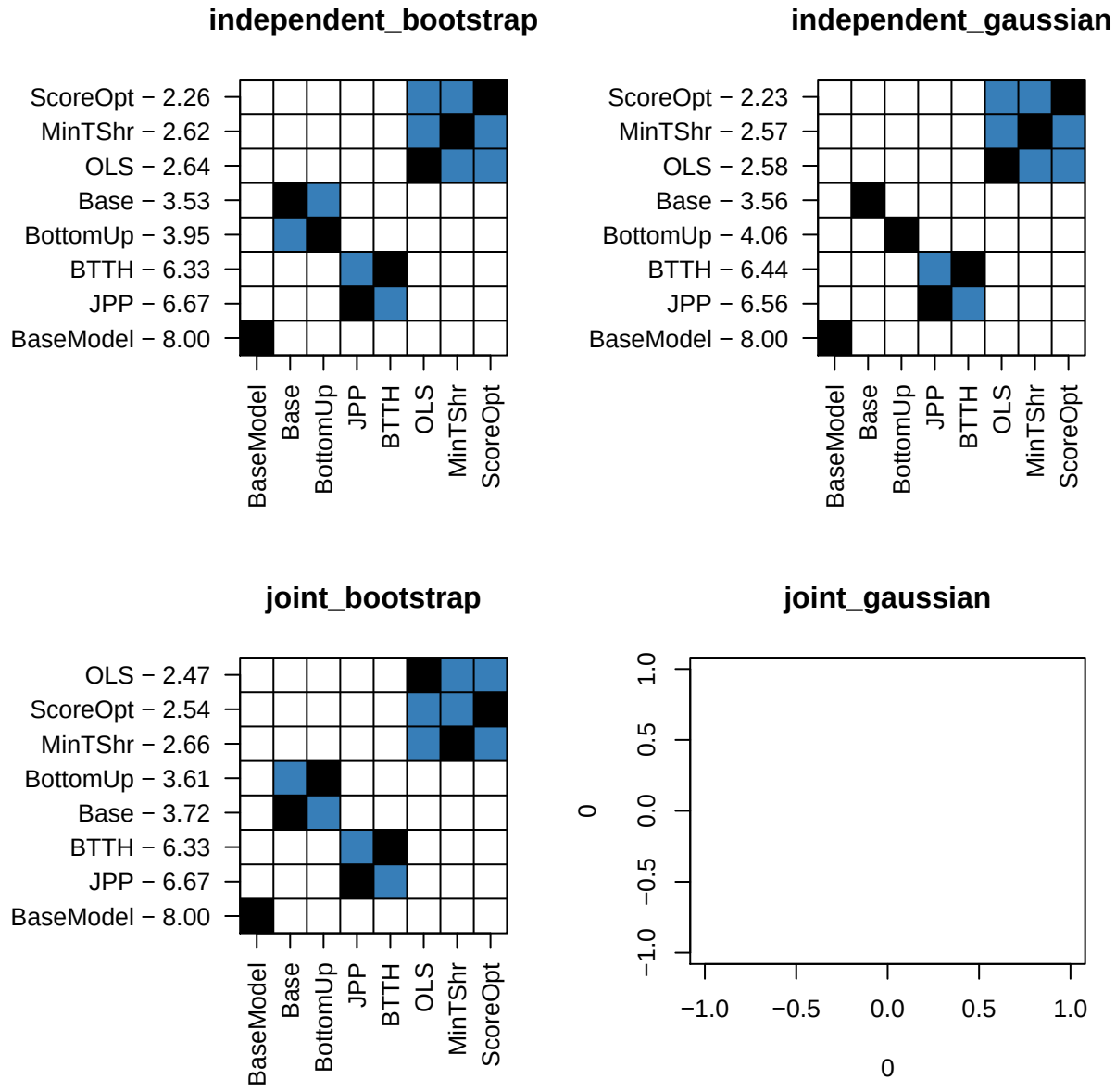

Figure 4: Results for ets modelling with a nongaussian stationary DGP

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	12.9274	14.8285	26.6718	26.0948	11.5767	12.3583	11.9854
independent	gaussian	12.9090	14.7911	26.6238	26.1049	11.5570	12.3350	11.9793
joint	bootstrap	12.6589	14.5769	26.6975	26.0793	11.3523	12.0411	11.8884

Summary of Nemenyi tests is below

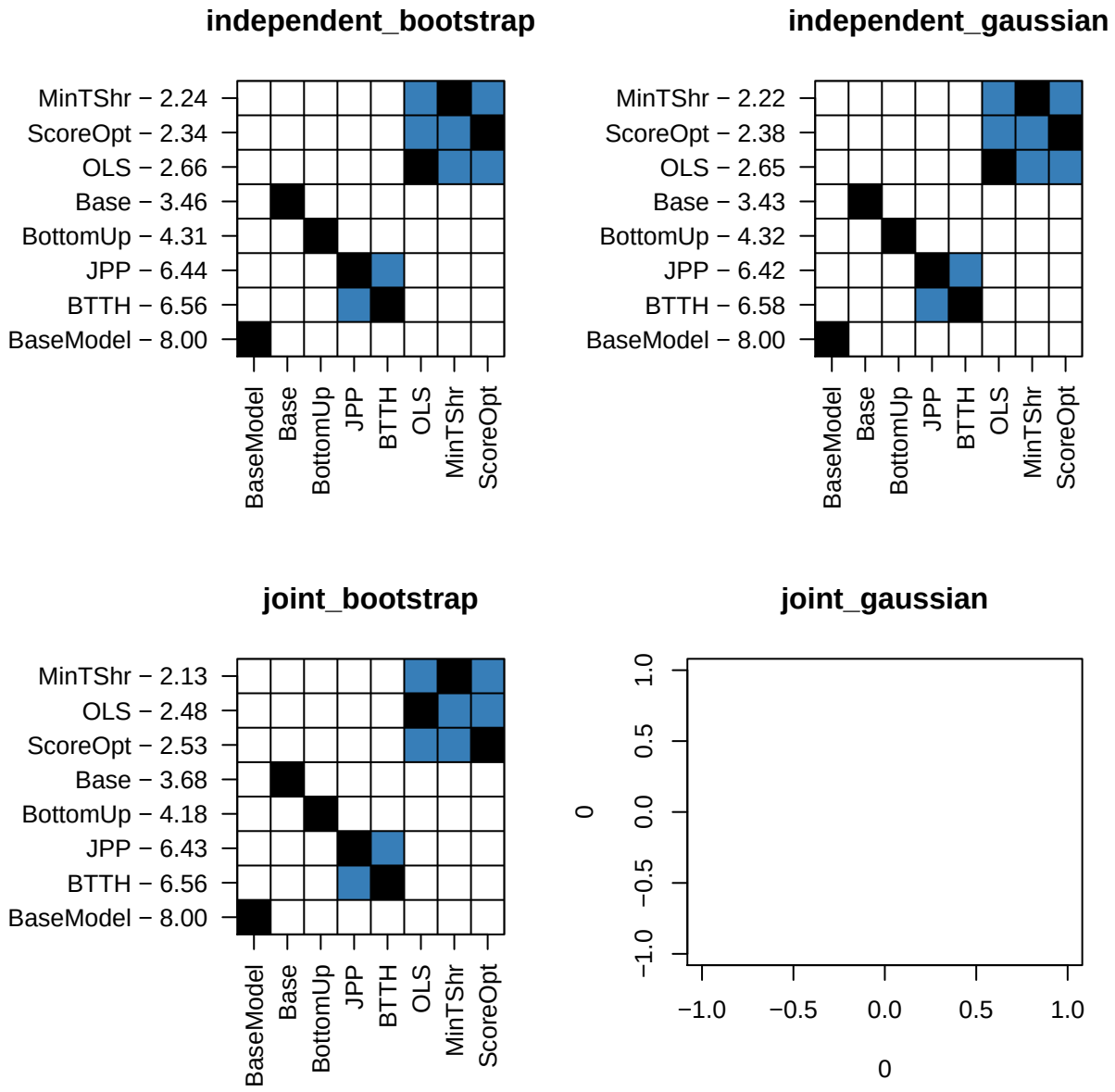

Figure 5: Results for arima modelling with a gaussian nonstationary DGP

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	12.8717	15.0342	27.4453	26.0369	11.4756	12.1508	11.9195
independent	gaussian	12.8443	14.9750	27.4370	26.0310	11.4633	12.1221	11.8731
joint	bootstrap	12.6267	14.8252	27.5146	26.0266	11.2597	11.8708	11.7509

Summary of Nemenyi test below

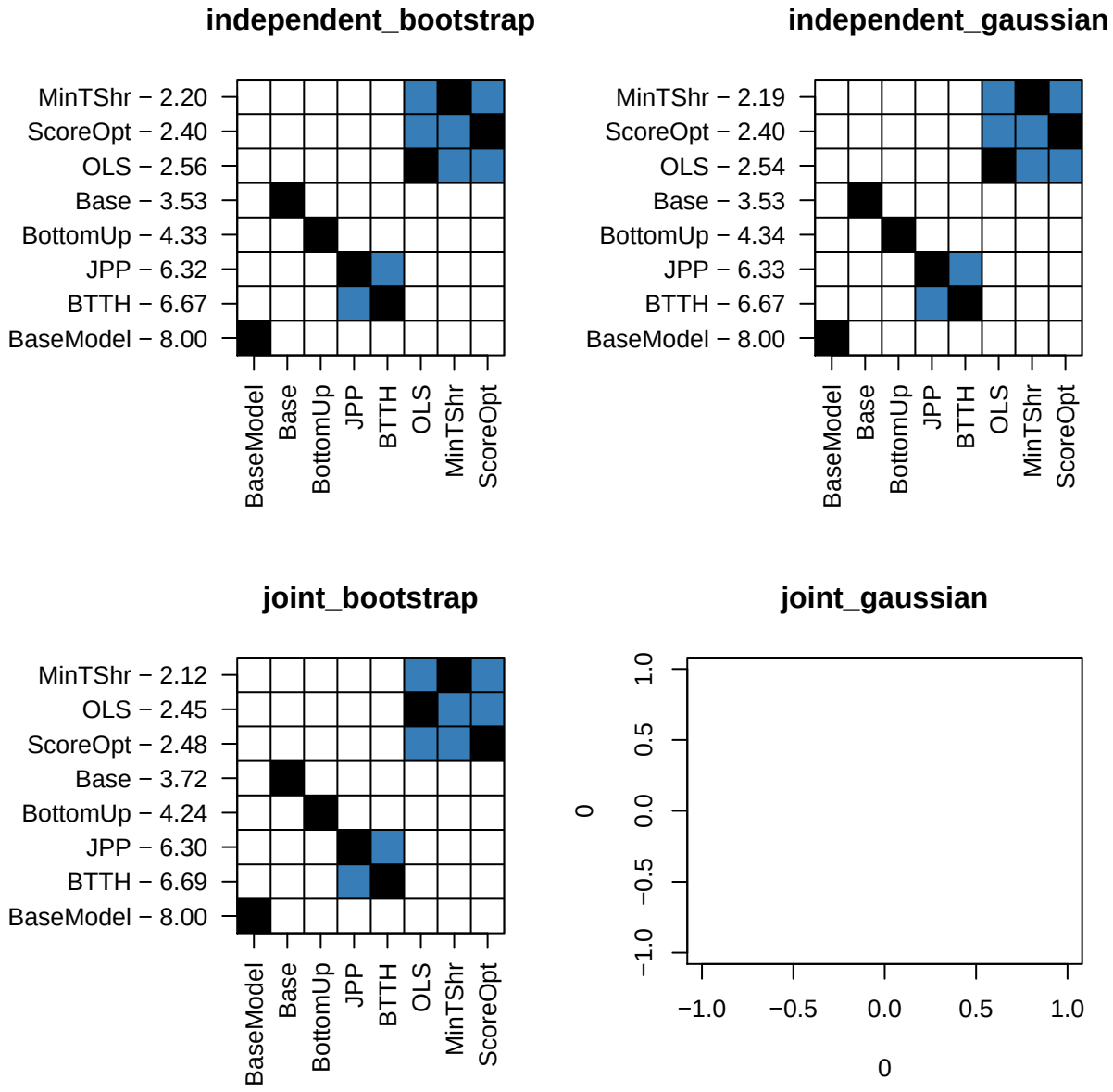

Figure 6: Results for ets modelling with a gaussian nonstationary DGP

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	1.5723	1.7416	3.2256	3.1986	1.4423	1.4933	1.5226
independent	gaussian	1.5737	1.7467	3.2733	3.2324	1.4437	1.4926	1.5205
joint	bootstrap	1.5343	1.7175	3.2423	3.1959	1.4104	1.4615	1.4980
joint	gaussian	1.5358	1.7200	3.2771	3.2237	1.4121	1.4632	1.4925

Summary of Nemenyi tests is below

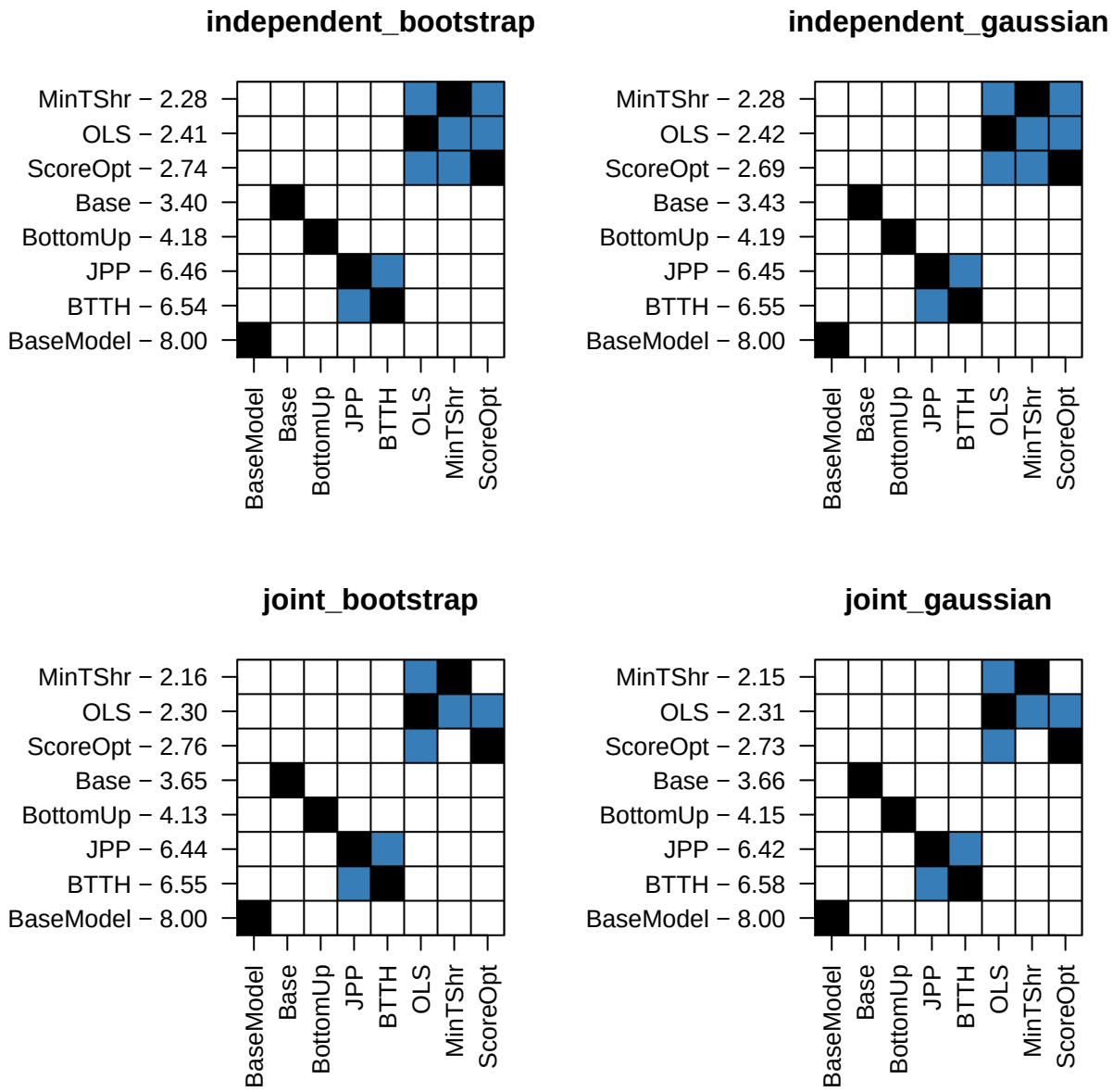

Figure 7: Results for arima modelling with a nongaussian nonstationary DGP

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	1.5836	1.7620	3.2958	3.2024	1.4559	1.4848	1.5378
independent	gaussian	1.5835	1.7636	3.3392	3.2452	1.4552	1.4828	1.5373
joint	bootstrap	1.5480	1.7390	3.3012	3.1998	1.4160	1.4550	1.4776

Summary of Nemenyi test below

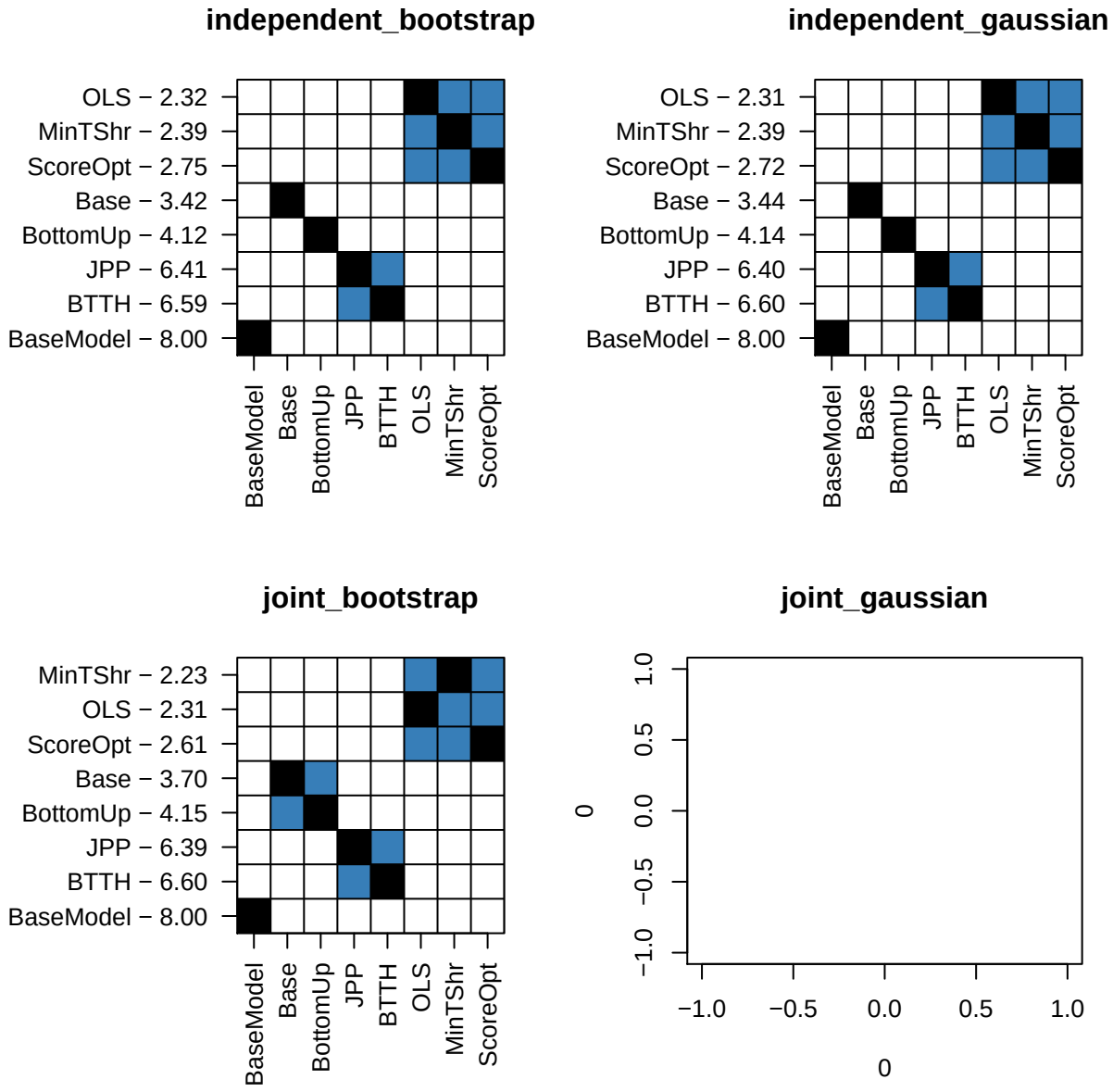

Figure 8: Results for ets modelling with a nongaussian nonstationary DGP