BLP Simulation

Nutcha Wattanachit

12/2/2019

Ensemble/pooling Methods

TLP

Traditional linear pool finds optimal weights that maximmizes the likelihood of $f(y) = \sum_{i=1}^{k} w_i f_i(y)$.

BLP

BLP finds α, β, and weights that maximize the likelihood of

$$g_{\alpha,\beta} = (\sum_{i=1}^{k} w_i f_i(y)) b_{\alpha,\beta} (\sum_{i=1}^{k} w_i F_i(y)).$$

BLP Example: To obtain α, β, and the weights for all component models, train the BLP model on half of the data. Then, use α, β, and the weights from training to apply to the data held out for testing.

Bias-corrected TLP (bcTLP)

Bias-corrected BLP (bcBLP)

BLP with Non-central Parameter(nBLP)

nBLP finds α, β, non-central parameter λ, and weights that maximize the likelihood of

$g_{\alpha,\beta,\lambda} = (\sum_{i=1}^{k} w_i f_i(y)) b_{\alpha,\beta} (\sum_{i=1}^{k} w_i F_i(y)).$

nBLP process: To obtain α, β, λ, and the weights for all component models, train the nBLP model on half of the data. Then, use α, β, λ, and the weights from training to apply to the data held out for testing.

Component-wise BLP (cBLP)

This is the extension of the traditional BLP. We beta-transform each of the cumulative distribution functions of the component models. This is done by finding α and β that maximize the likelihood of

$$G_{i,\alpha_i,\beta_i} = B_{\alpha_i,\beta_i}[F_i(y)]$$
$$g_{i,\alpha_i,\beta_i} = f_i(y) \times b_{\alpha_i,\beta_i}[F_i(y)]$$

Then, to obtain α, β, and the weights for 21 models, we apply BLP on the beta-transformed components:

$$G_{\alpha,\beta} = B_{\alpha,\beta}\Big[\sum_{i=1}^{k} w_i B_{\alpha_i,\beta_i}(F_i(y))\Big]$$

$$g_{\alpha,\beta} = \Big(\sum_{i=1}^{k} w_i b_{i,\alpha_i,\beta_i}(F_i(y)) f_i(y)\Big) b_{\alpha,\beta}\Big(\sum_{i=1}^{k} w_i B_{i,\alpha_i,\beta_i}(F_i(y))\Big)$$

cBLP - Part 1: For each component model, train over all observations to get α_i and β_i. Then, apply α_i and β_i to beta-transform the CDF. This ends the component-wise part.

cBLP Part 2: Apply the usual BLP process on the beta-transformed component models to get the BLP ensemble.

Componentwise Bias-Corrected & Componentwise Recalibrated BLP (cbcBLP)

Simulation studies
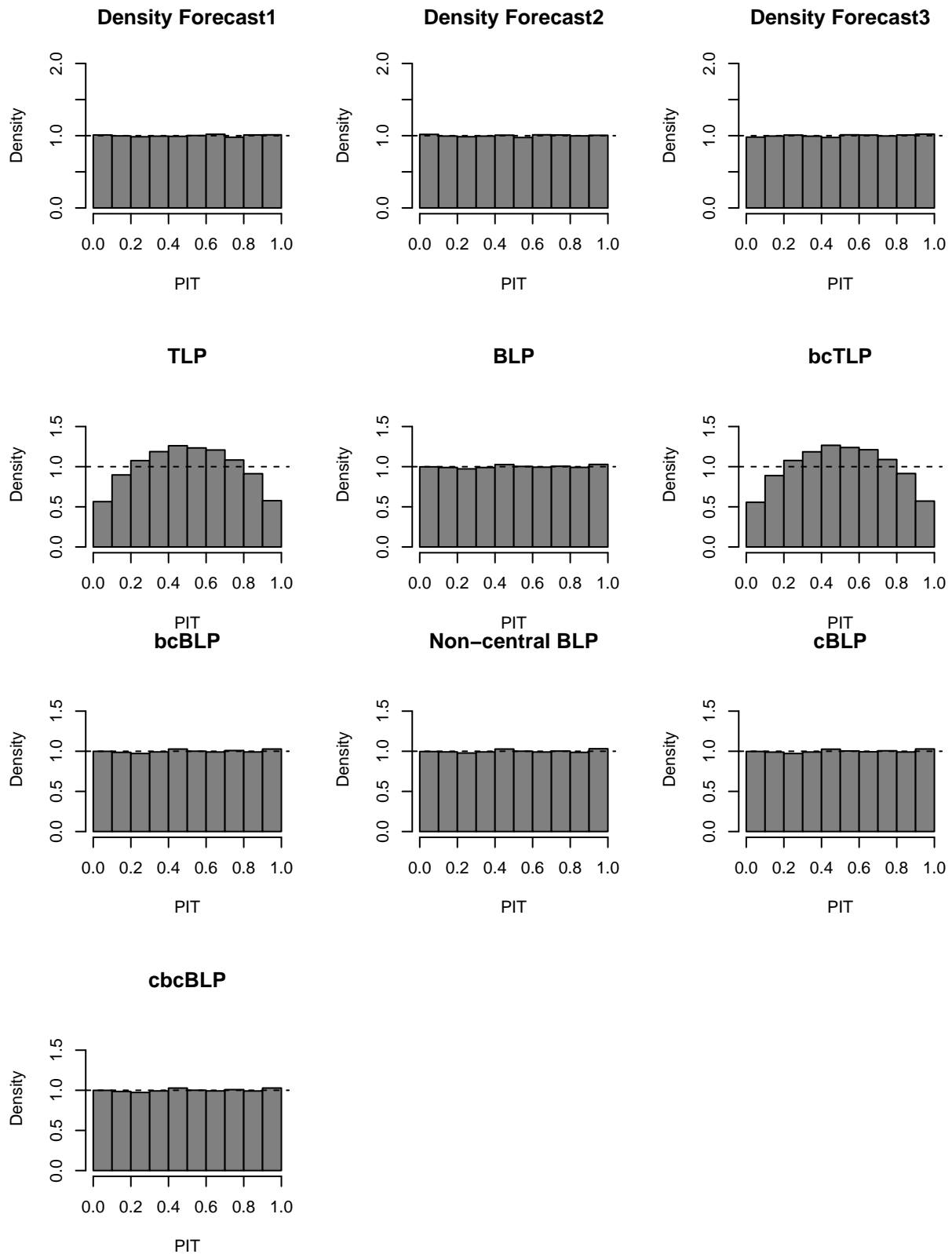
Scenario 1: calibrated components (Baseline scenario).

Density Forecast1

Density Forecast2

Density Forecast3

TLP

BLP

bcTLP

bcBLP

Non−central BLP

cBLP

cbcBLP

Table 1: Model Parameters and Log Score

	w1	w2	w3	alpha	beta	ncp		Training	Test
TLP	0.271	0.264	0.465	NA	NA	NA	f1	-1.998	-2.004
BLP	0.301	0.295	0.404	1.465	1.469	NA	f2	-1.999	-2.006
bcTLP	0.272	0.264	0.464	NA	NA	NA	f3	-1.965	-1.969
bcBLP	0.301	0.296	0.403	1.477	1.477	NA	TLP	-1.907	-1.912
nBLP	0.301	0.295	0.404	1.452	1.483	0.076	BLP	-1.864	-1.872
cBLP	0.300	0.296	0.405	1.459	1.460	NA	bcTLP	-1.906	-1.911
cbcBLP	0.301	0.296	0.403	1.469	1.469	NA	bcBLP	-1.861	-1.870
							nBLP	-1.864	-1.872
							cBLP	-1.864	-1.872
							cbcBLP	-1.862	-1.870

Scenario 2: Biased forecast scenario

Density Forecast1

Density Forecast2

Density Forecast3

TLP

BLP

bcTLP

bcBLP

Non−central BLP
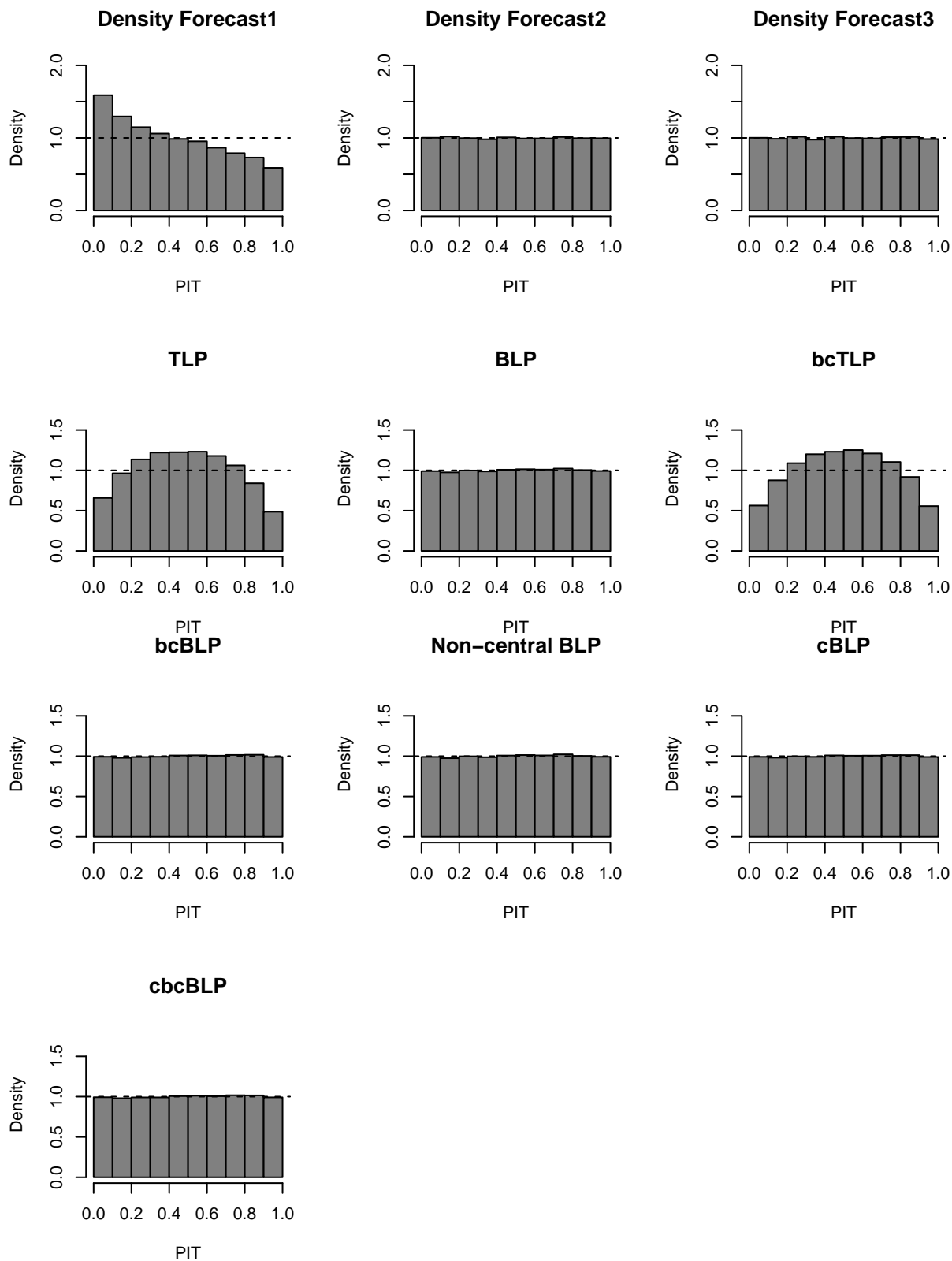
cBLP

cbcBLP

Table 2: Model Parameters and Log Score

	w1	w2	w3	alpha	beta	ncp		Training	Test
TLP	0.184	0.292	0.524	NA	NA	NA	f1	-2.040	-2.042
BLP	0.295	0.287	0.419	1.403	1.549	NA	f2	-2.005	-2.002
bcTLP	0.269	0.245	0.486	NA	NA	NA	f3	-1.962	-1.965
bcBLP	0.299	0.283	0.418	1.466	1.466	NA	TLP	-1.912	-1.912
nBLP	0.295	0.287	0.419	1.403	1.549	0.001	BLP	-1.867	-1.866
cBLP	0.290	0.296	0.415	1.455	1.458	NA	bcTLP	-1.907	-1.907
cbcBLP	0.299	0.286	0.415	1.460	1.461	NA	bcBLP	-1.864	-1.864
							nBLP	-1.867	-1.866
							cBLP	-1.872	-1.871
							cbcBLP	-1.865	-1.864

Scenario 3 : "incorrect" (high/increasing/decreasing) variance forecast scenario
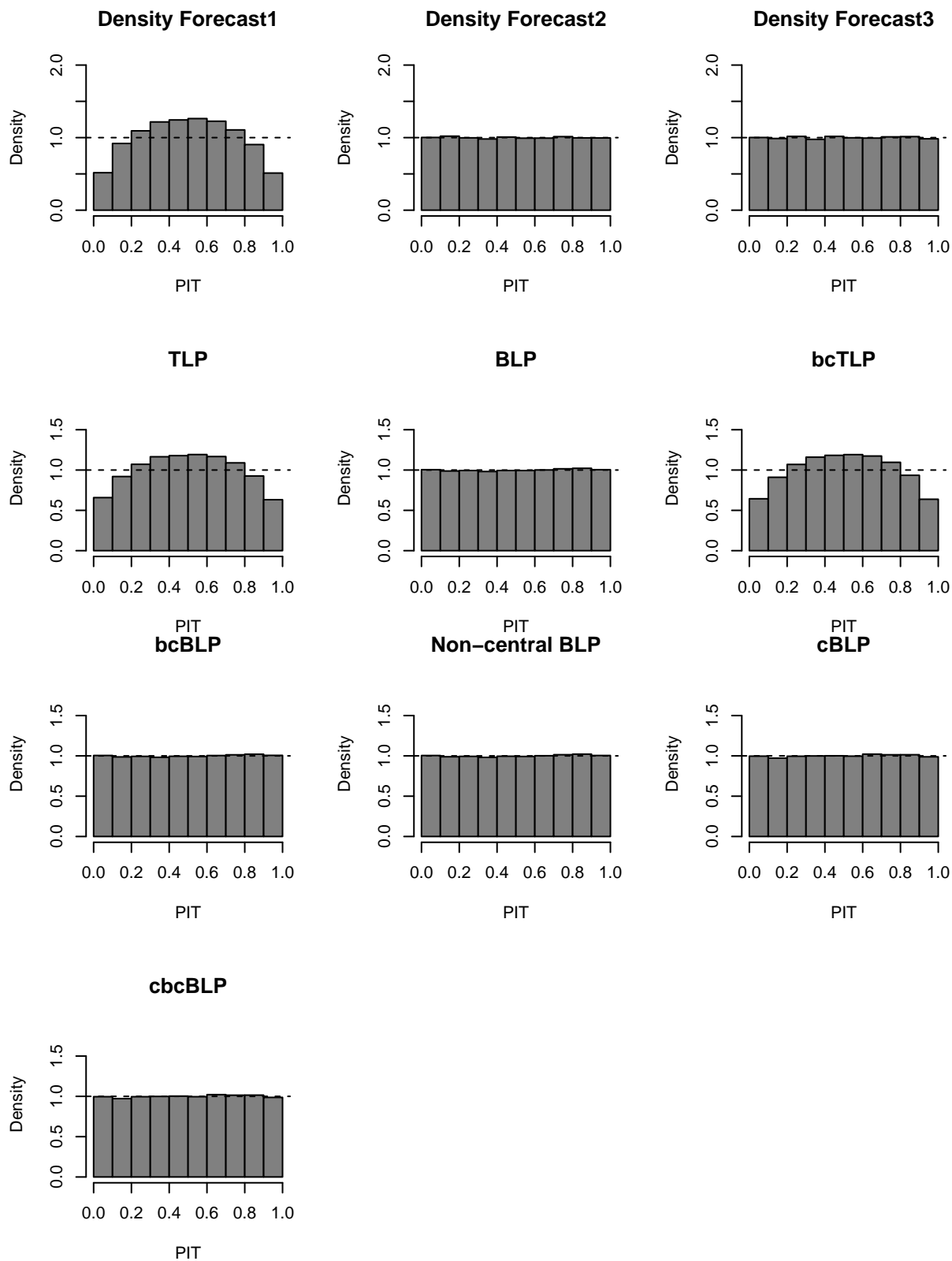
Table 3: Model Parameters and Log Score

	w1	w2	w3	alpha	beta	ncp		Training	Test
TLP	0.012	0.391	0.597	NA	NA	NA	f1	-2.051	-2.052
BLP	0.333	0.272	0.395	1.656	1.667	NA	f2	-2.005	-2.002
bcTLP	0.013	0.391	0.596	NA	NA	NA	f3	-1.962	-1.965
bcBLP	0.334	0.270	0.396	1.668	1.667	NA	TLP	-1.919	-1.918
nBLP	0.333	0.272	0.395	1.654	1.668	0.009	BLP	-1.865	-1.865
cBLP	0.207	0.343	0.449	1.441	1.442	NA	bcTLP	-1.918	-1.918
cbcBLP	0.209	0.342	0.449	1.446	1.447	NA	bcBLP	-1.864	-1.864
							nBLP	-1.865	-1.865
							cBLP	-1.868	-1.867
							cbcBLP	-1.867	-1.866

Scenario 4 Biased + "incorrect" variance forecast scenario

Density Forecast1

Density Forecast2

Density Forecast3

TLP

BLP

bcTLP

bcBLP

Non–central BLP
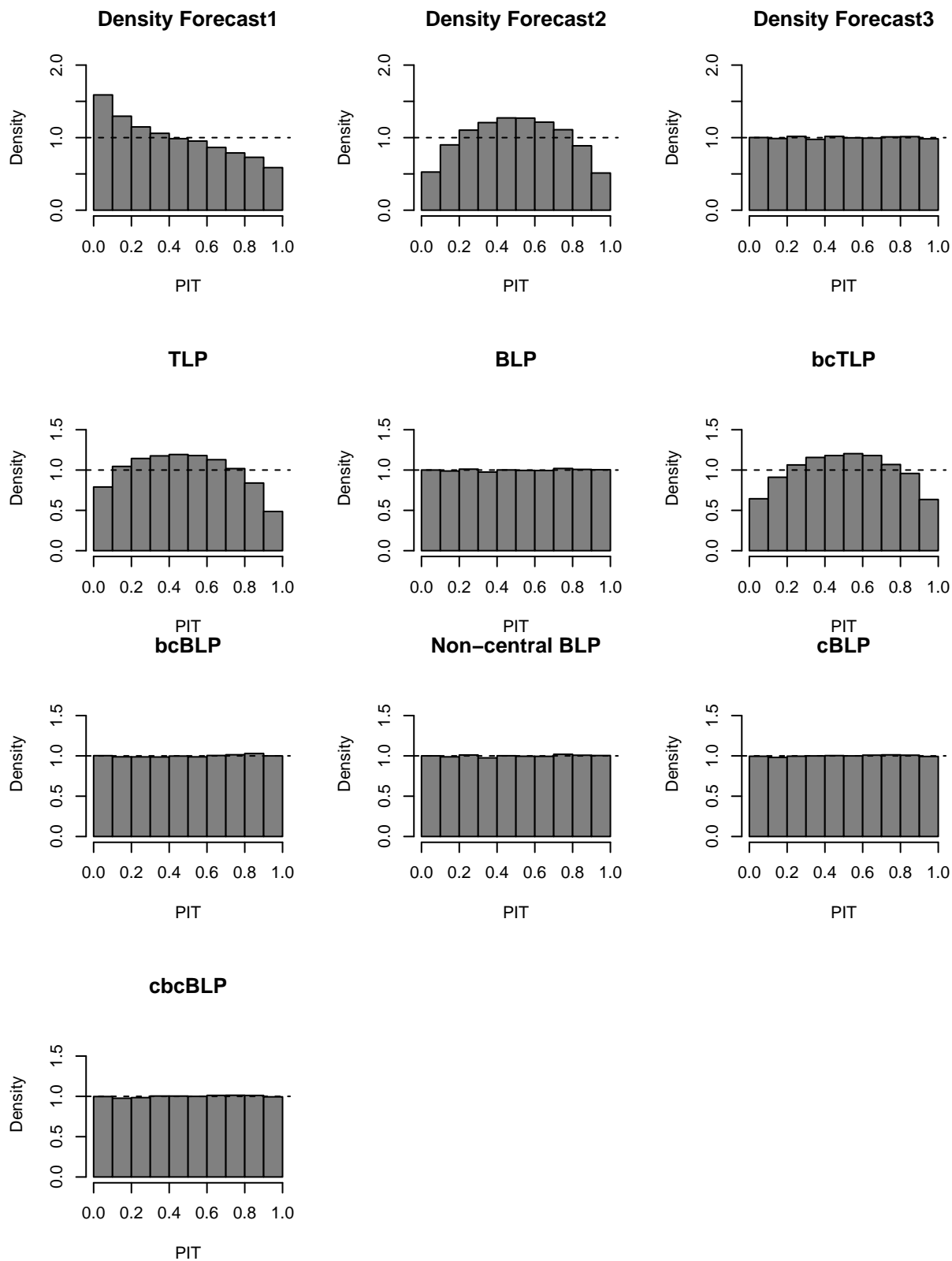
cBLP

cbcBLP

Table 4: Model Parameters and Log Score

	w1	w2	w3	alpha	beta	ncp		Training	Test
TLP	0.320	0.032	0.648	NA	NA	NA	f1	-2.040	-2.042
BLP	0.281	0.321	0.397	1.593	1.748	NA	f2	-2.054	-2.052
bcTLP	0.407	0.005	0.588	NA	NA	NA	f3	-1.962	-1.965
bcBLP	0.287	0.317	0.397	1.657	1.656	NA	TLP	-1.925	-1.926
nBLP	0.281	0.321	0.397	1.593	1.748	0	BLP	-1.866	-1.866
cBLP	0.339	0.209	0.451	1.441	1.444	NA	bcTLP	-1.917	-1.918
cbcBLP	0.353	0.198	0.448	1.445	1.446	NA	bcBLP	-1.864	-1.864
							nBLP	-1.866	-1.866
							cBLP	-1.874	-1.874
							cbcBLP	-1.865	-1.865