A hypothetical study using fake data to map K10 psychological distress and SOFAS functioning measures toAQoL-6D health utility using data from a sample of young people presenting to primary mental health services

Catalogue of models

Alejandra R Scienceace[1,2,*] Fionn S Researchchamp[3,2]

June 30, 2023

Contents

1 CHU9D generalised linear mixed model with Gaussian distribution and log link 2

2 CHU9D linear mixed model with complementary log log transformation 12

3 CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link 22

4 CHU9D with K10 linear mixed model with complementary log log transformation 34

[1] Awesome University, Shanghai
[2] August Institution, London
[3] Highly Ranked Uni, Montreal

[*] Correspondence: Alejandra R Scienceace <fake_email@fake_institute.com>

This algorithm authored report summarises a number of longitudinal models for predicting AQOL-6D (weighted total) at two time-points. The descriptions of each model included in the report detail model predictor variables, parameter values and predictive performance. Report figures graphically illustrate the predictive performance of models when mean or sampled parameter values are used, with and without transformation of model outputs to enforce within range predictions. A number of these plots compare the performance of predictions when the original R model object (of class *brmsfit*) is used or when predictions are made from a summary table of model coefficients. Each model description also includes a catalogue reference number that is useful for retrieving the model data required to make predictions.

1 CHU9D generalised linear mixed model with Gaussian distribution and log link

This model predicts values at two timepoints for AQOL-6D (weighted total). The predictor variables are baseline values and subsequent changes in CHU9D (Child Health Utility (9 Dimension) total score). The catalogue reference for this model is `CHU9D_1_GLM_GSN_LOG`.

Table 1: CHU9D generalised linear mixed model with Gaussian distribution and log link

Parameter	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Group-Level Effects:							
fkClientID (Number of levels: 3965)							
sd(Intercept)	0.03	0.02	0.00	0.08	1.01	338	717
Population-Level Effects:							
Intercept	-1.38	0.02	-1.41	-1.34	1.00	8 337	5 710
CHU9D	1.30	0.02	1.25	1.34	1.00	9 638	6 299
Family Specific Parameters:							
sigma	0.17	0.00	0.16	0.17	1.01	809	1 003

Formula: AQOL6D ~CHU9D + (1 | fkClientID)
Family: gaussian
Links: mu = log; sigma = identity
Data: NULL (Number of observations: 3963)
Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
total post-warmup draws = 8000
Draws were sampled using sample(hmc). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

Table 2: CHU9D generalised linear mixed model with Gaussian distribution and log link model performance parameters

Parameter*	Estimate	SE	95CI
R2	0.45	0.01	0.424 , 0.482
RMSE	0.24	0.00	0.238 , 0.242

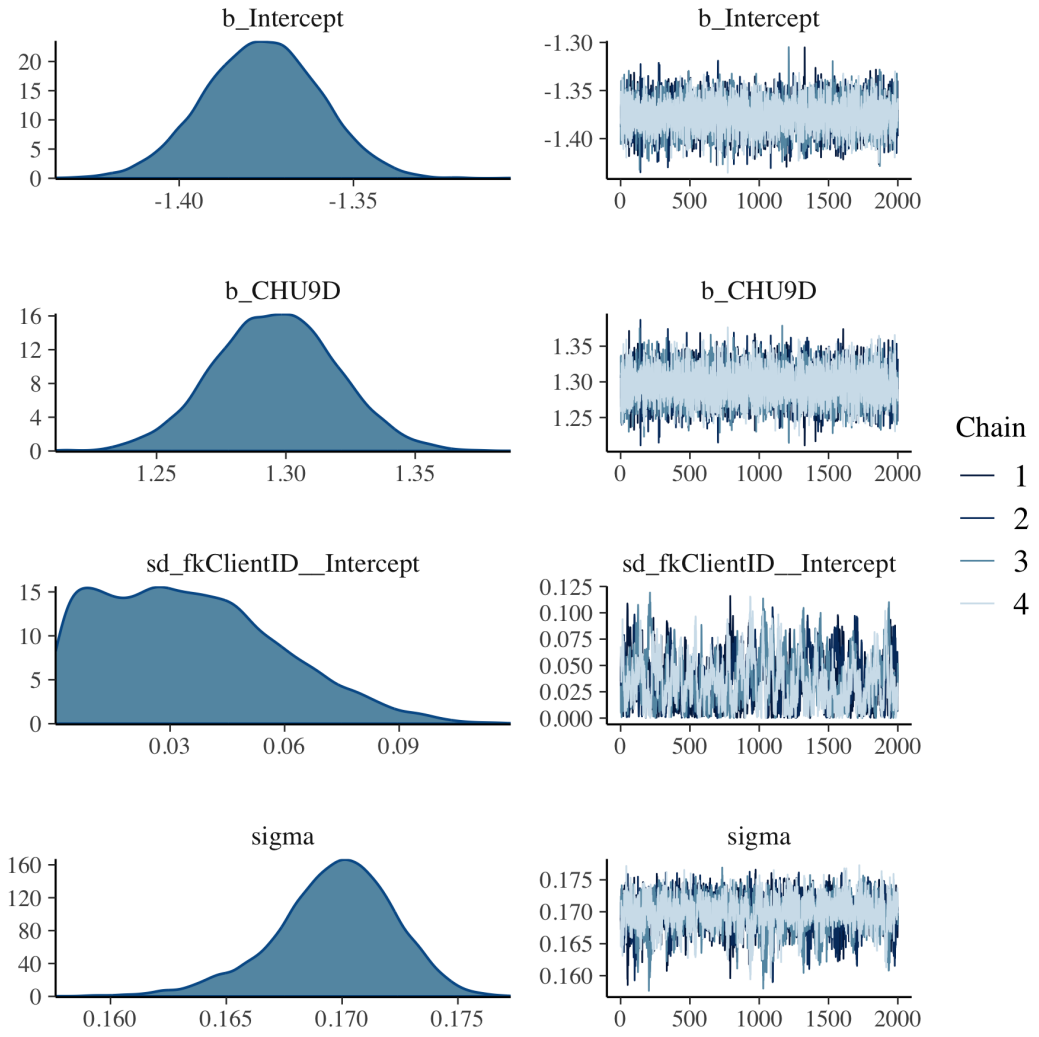

Figure 1: CHU9D generalised linear mixed model with Gaussian distribution and log link population and group level effects

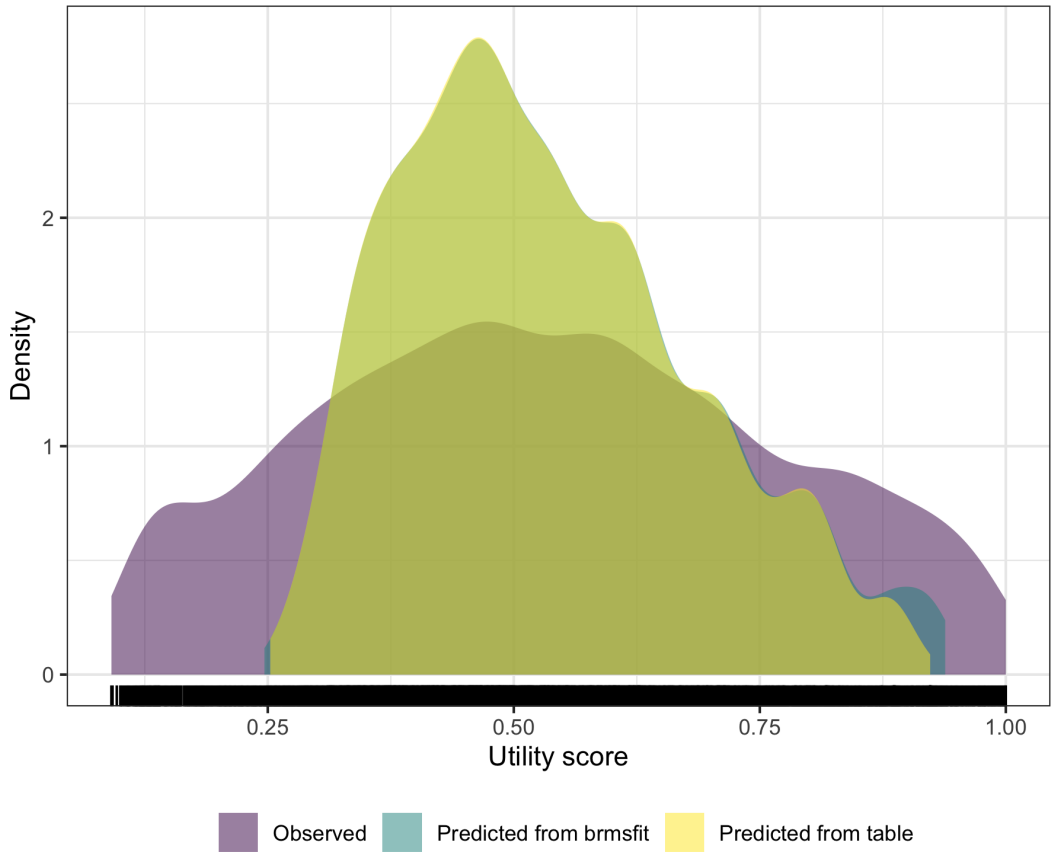

Figure 2: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using mean model parameter values

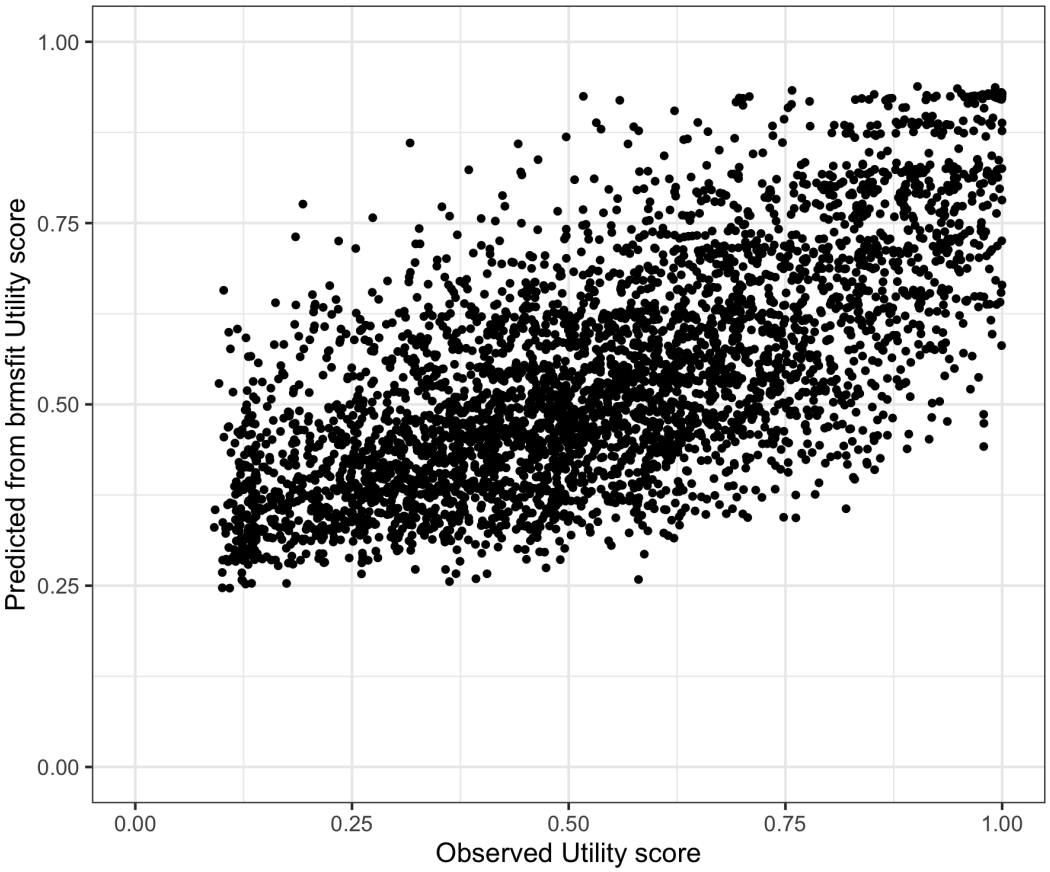

Figure 3: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using mean model parameter values

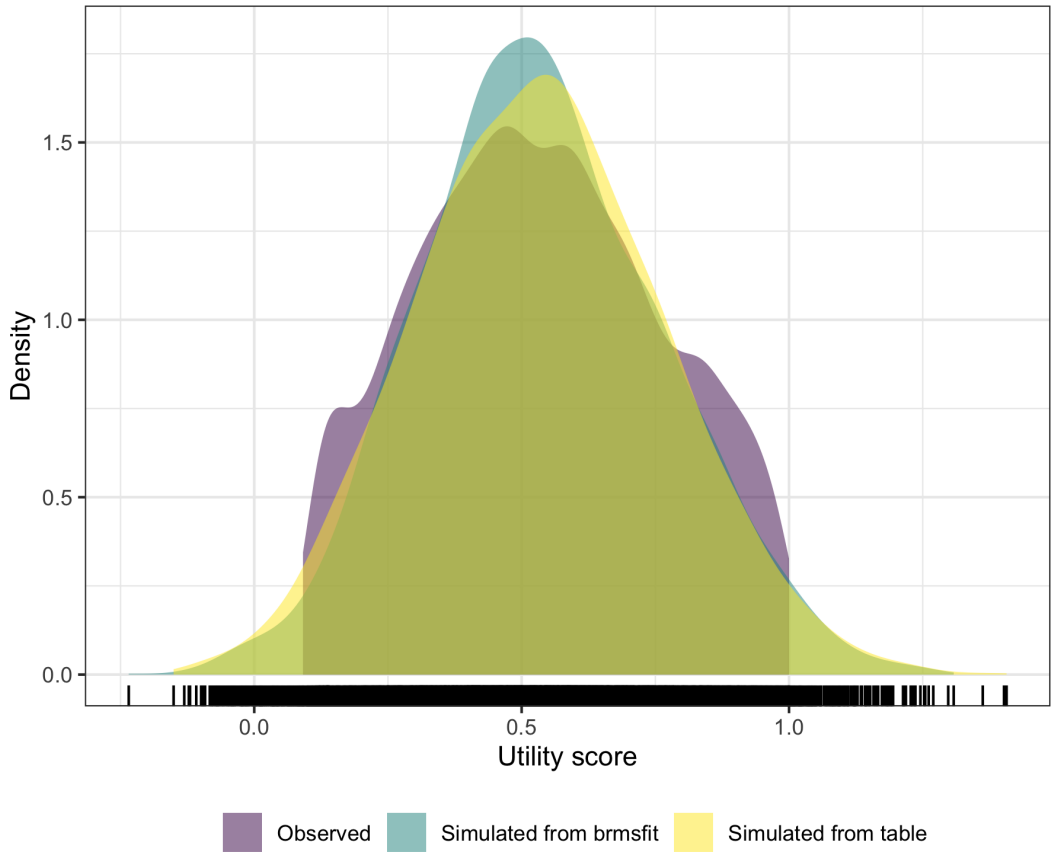

Figure 4: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using sampled model parameter values

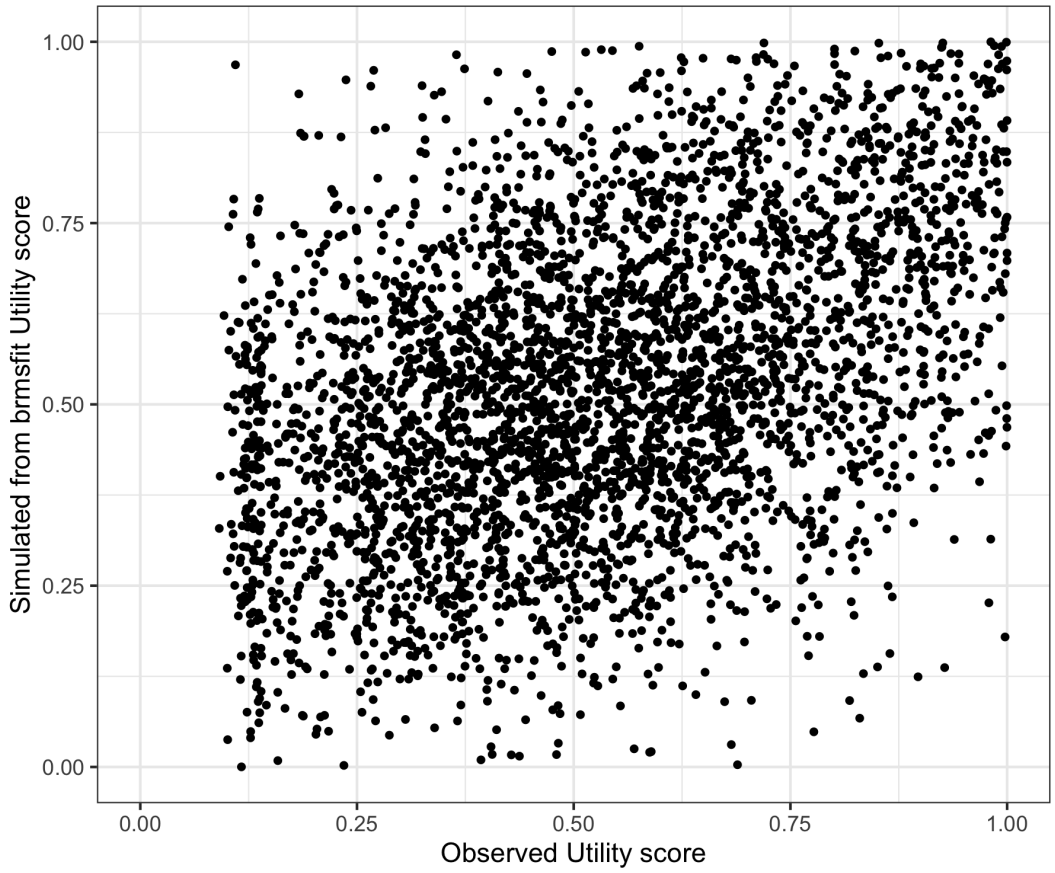

Figure 5: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using sampled model parameter values

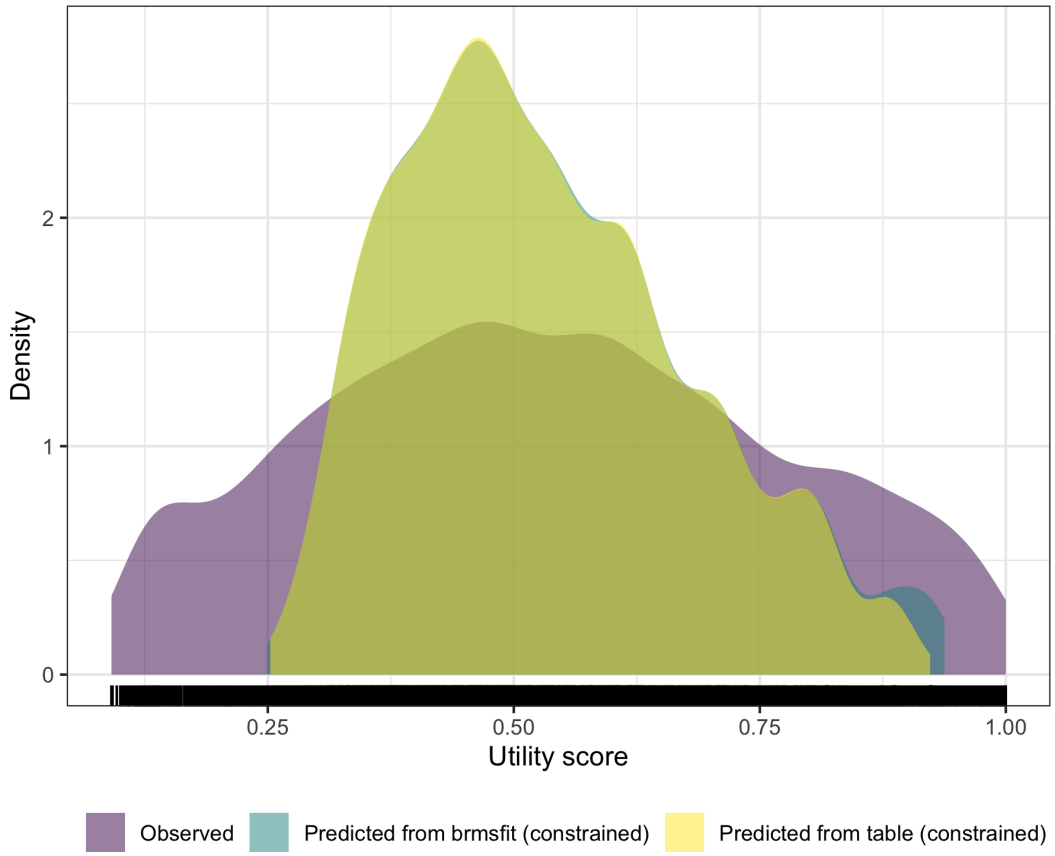

Figure 6: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

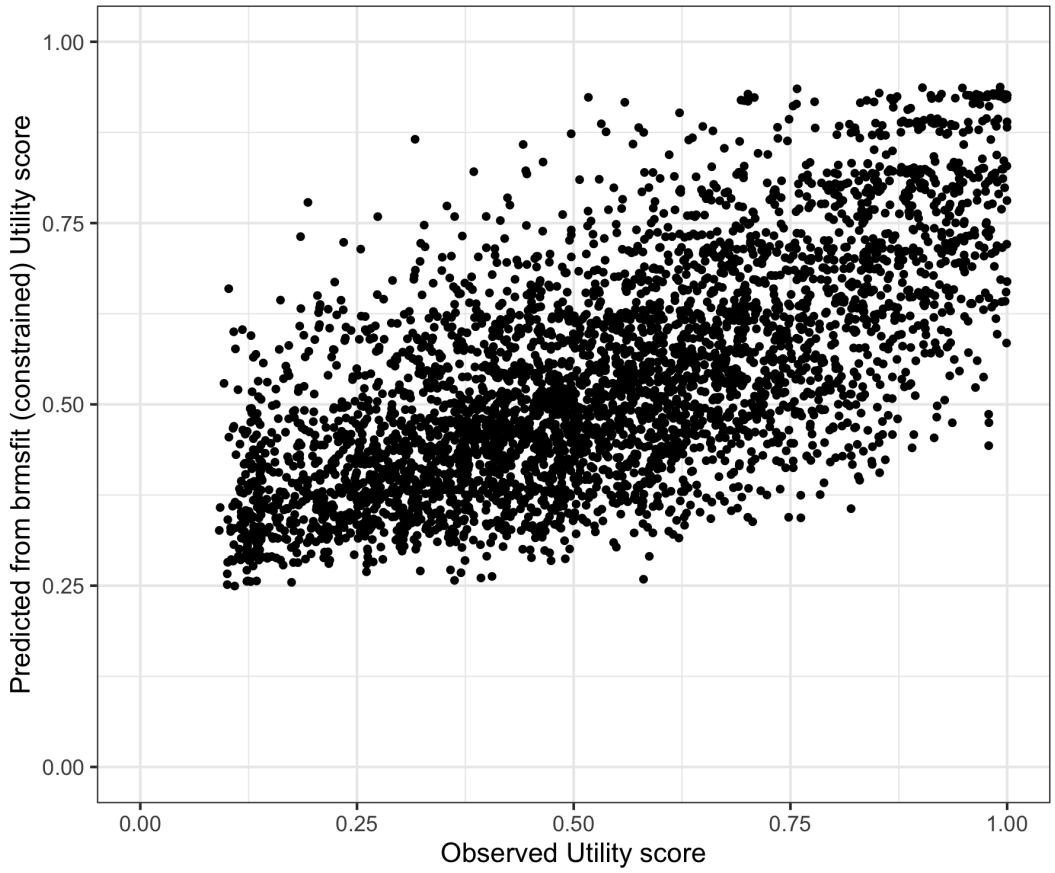

Figure 7: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

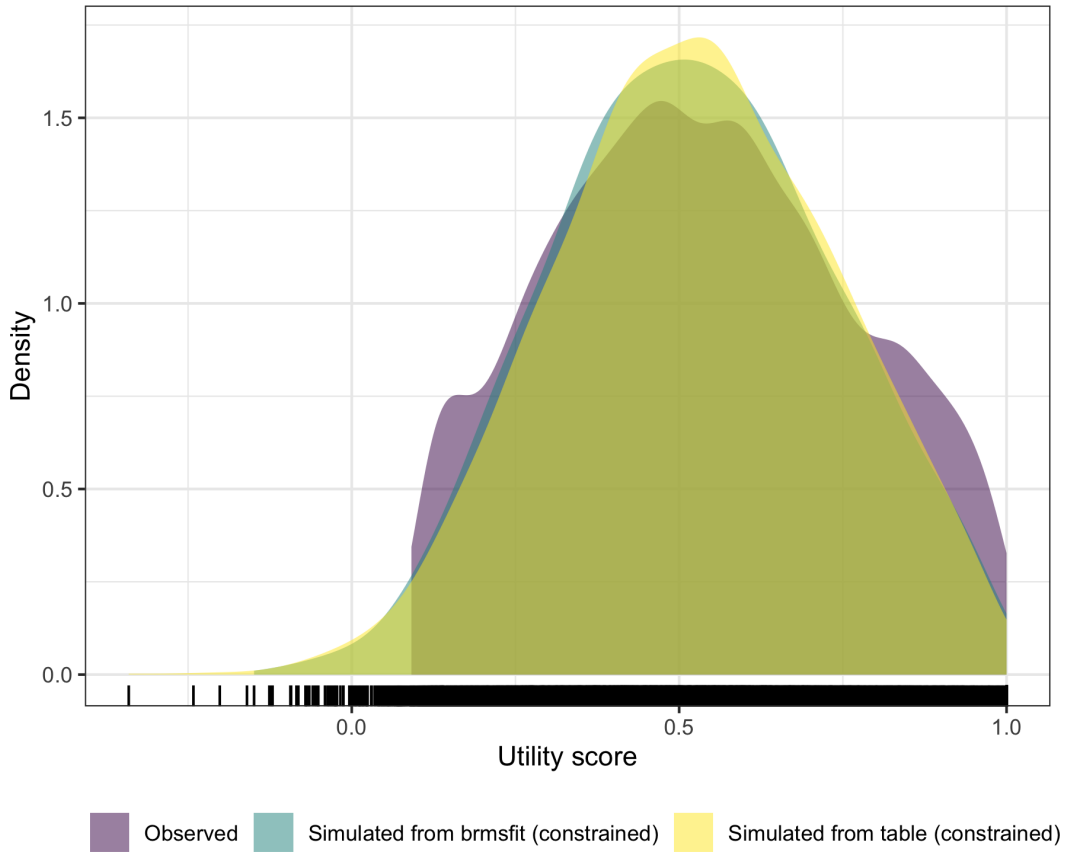

Figure 8: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

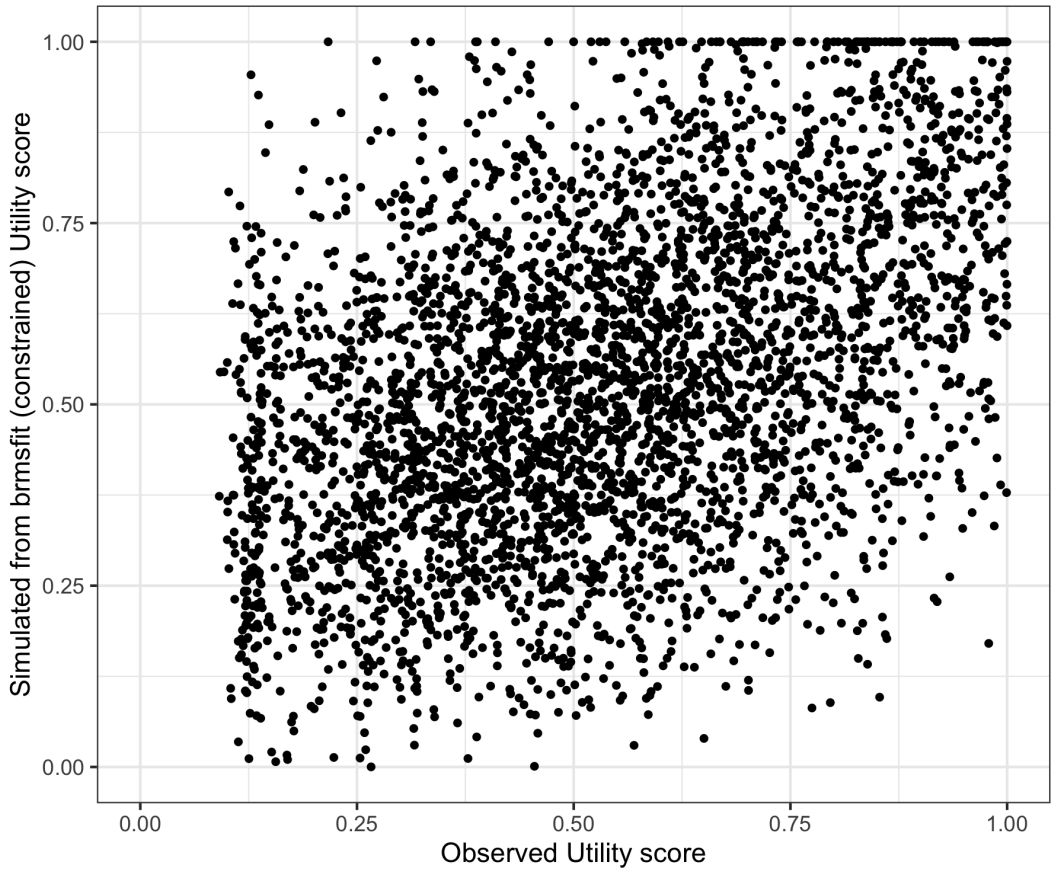

Figure 9: CHU9D generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

2 CHU9D linear mixed model with complementary log log transformation

This model predicts values at two timepoints for AQOL-6D (weighted total). The predictor variables are baseline values and subsequent changes in CHU9D (Child Health Utility (9 Dimension) total score). The catalogue reference for this model is `CHU9D_1_OLS_CLL`.

```
Warning: Parts of the model have not converged (some Rhats are > 1.05). Be careful when analysing the results! We recommend running more i
```

```
Warning: There were 210 divergent transitions after warmup. Increasing adapt_delta above 0.99 may help. See http://mc-stan.org/misc/warnin
```

Table 3: CHU9D linear mixed model with complementary log log transformation

Parameter	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Group-Level Effects:							
fkClientID (Number of levels: 3965)							
sd(Intercept)	0.23	0.13	0.01	0.46	1.21	14	18
Population-Level Effects:							
Intercept	-1.64	0.03	-1.69	-1.59	1.00	9 404	5 392
CHU9D	2.42	0.04	2.34	2.51	1.00	9 652	5 090
Family Specific Parameters:							
sigma	0.53	0.07	0.37	0.60	1.20	14	21

Formula: AQOL6D_CLL ~CHU9D + (1 | fkClientID)
Family: gaussian
Links: mu = identity; sigma = identity
Data: NULL (Number of observations: 3963)
Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
total post-warmup draws = 8000
Draws were sampled using sample(hmc). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

Table 4: CHU9D linear mixed model with complementary log log transformation model performance parameters

Parameter*	Estimate	SE	95CI
R2	0.55	0.10	0.432 , 0.777
RMSE	1.09	0.02	1.08 , 1.107

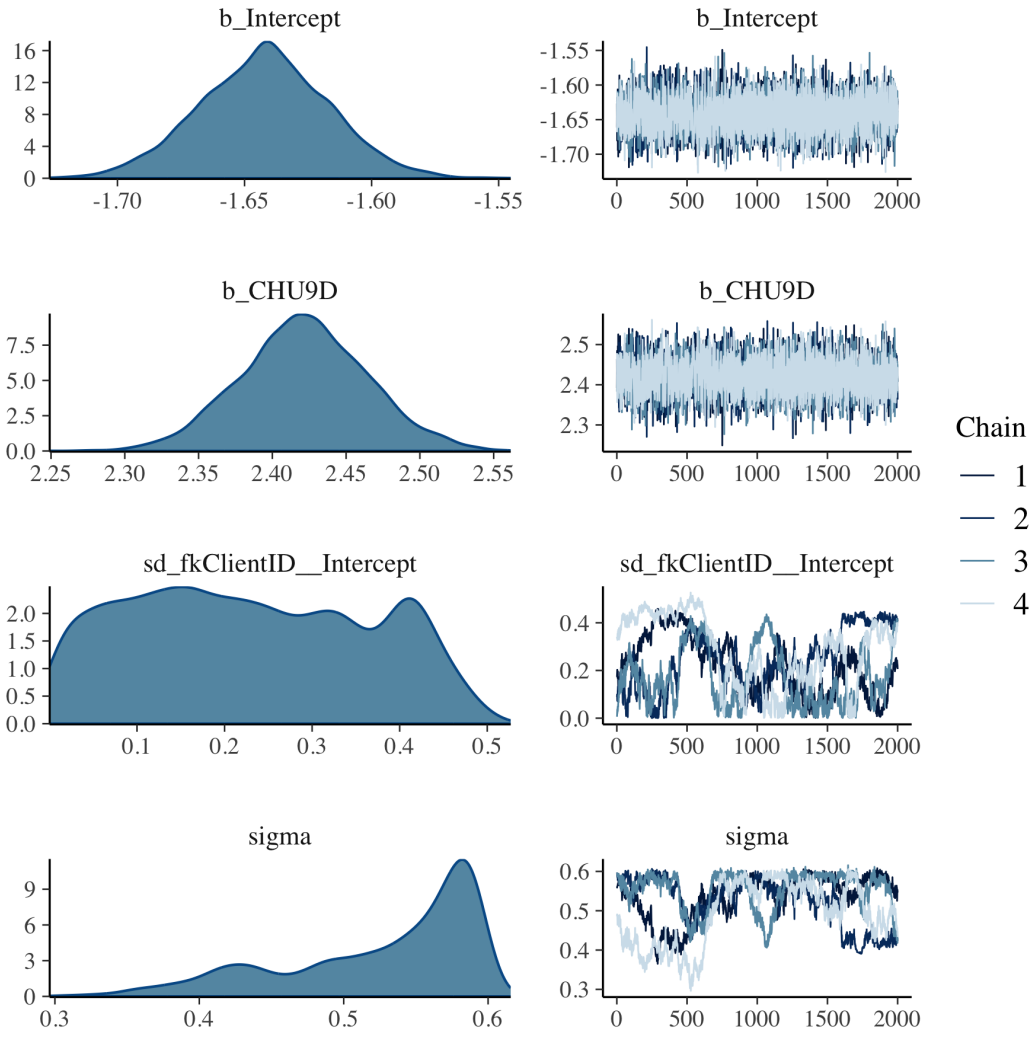

Figure 10: CHU9D linear mixed model with complementary log log transformation population and group level effects

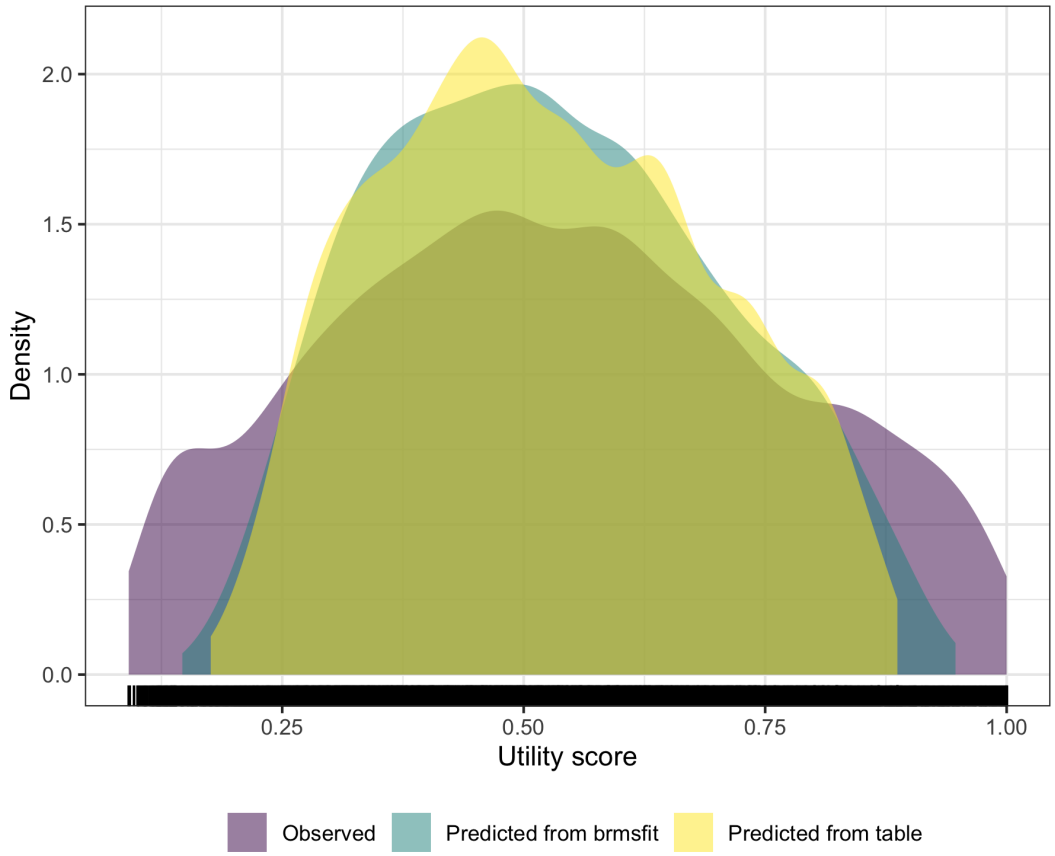

Figure 11: CHU9D linear mixed model with complementary log log transformation comparative densities of observed data and predictions using mean model parameter values

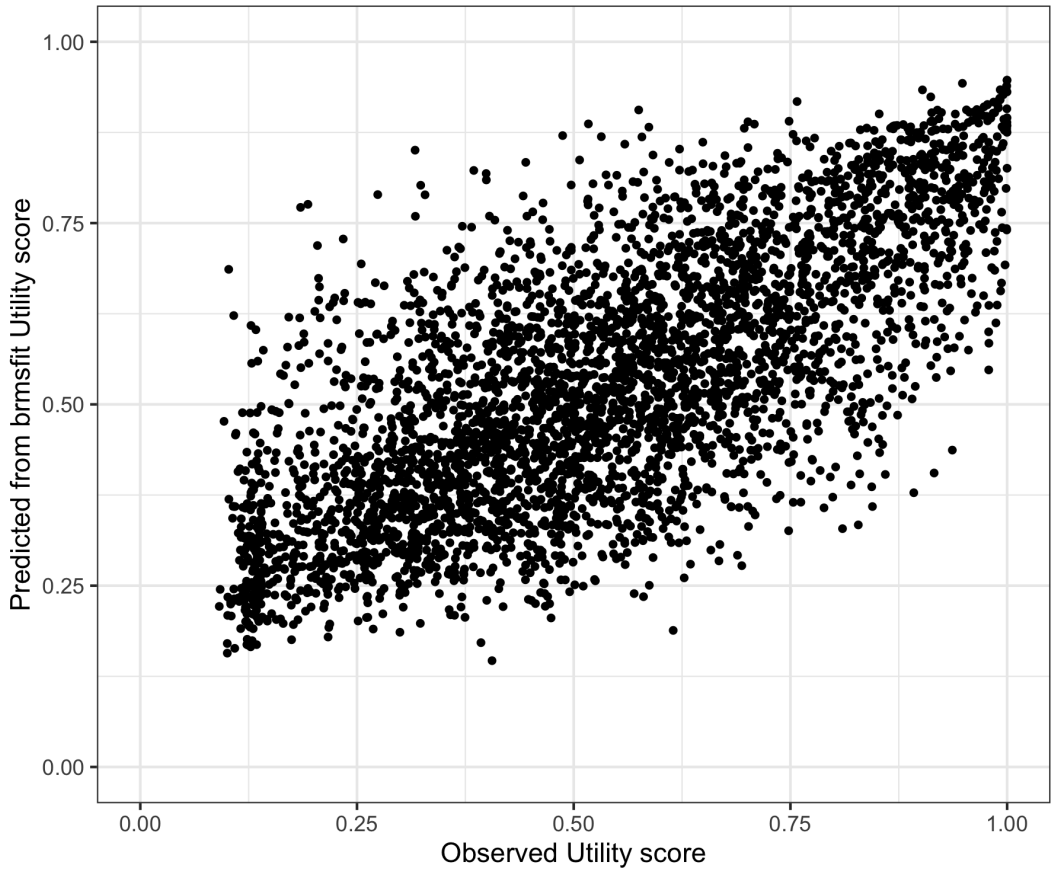

Figure 12: CHU9D linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using mean model parameter values

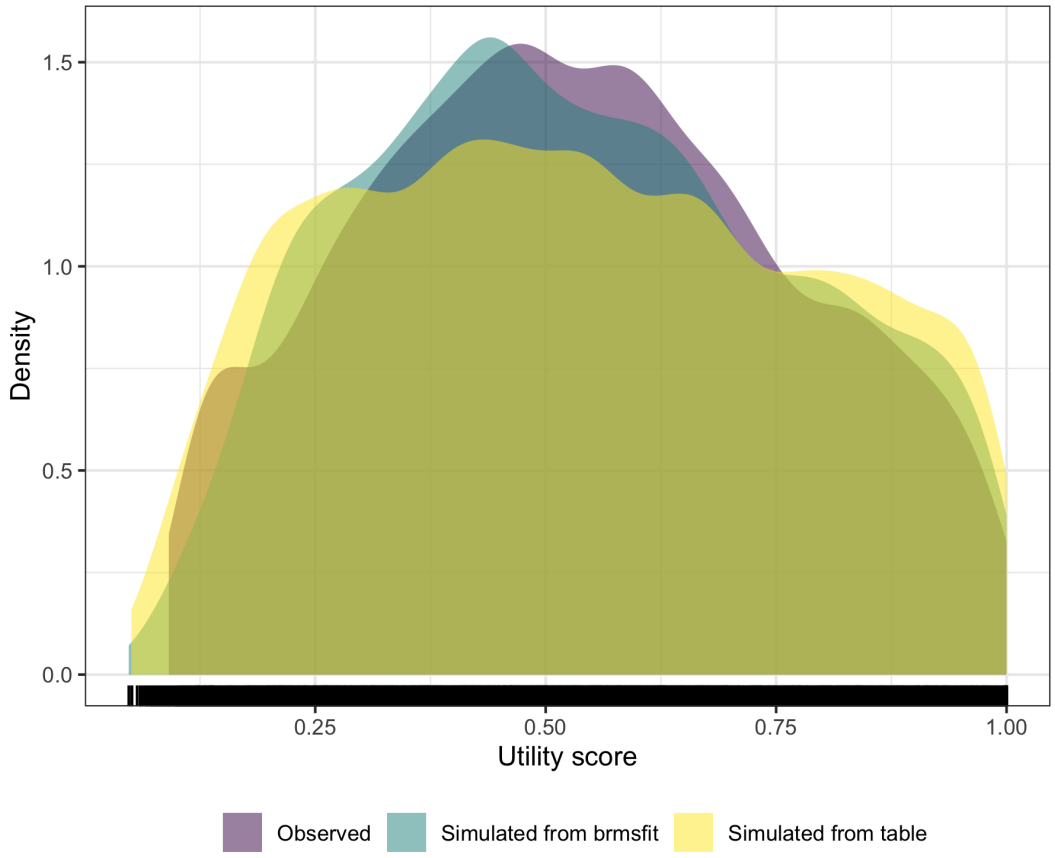

Figure 13: CHU9D linear mixed model with complementary log log transformation comparative densities of observed data and predictions using sampled model parameter values

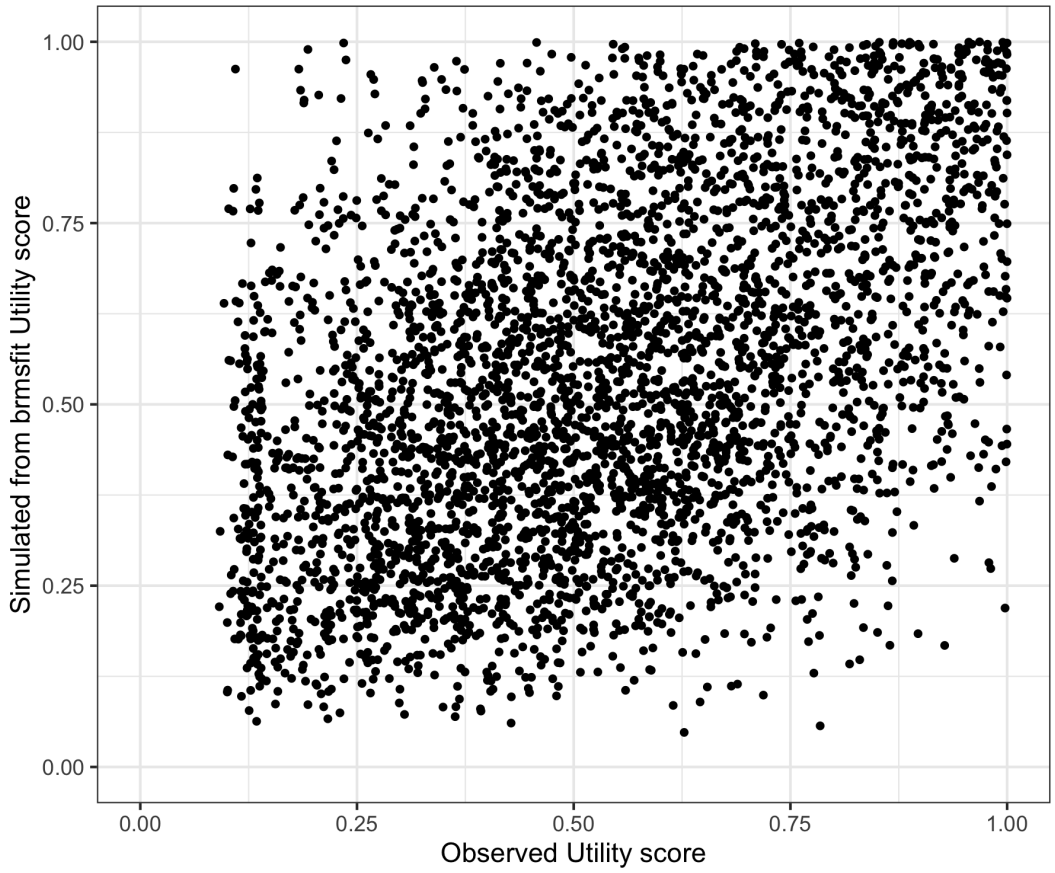

Figure 14: CHU9D linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using sampled model parameter values

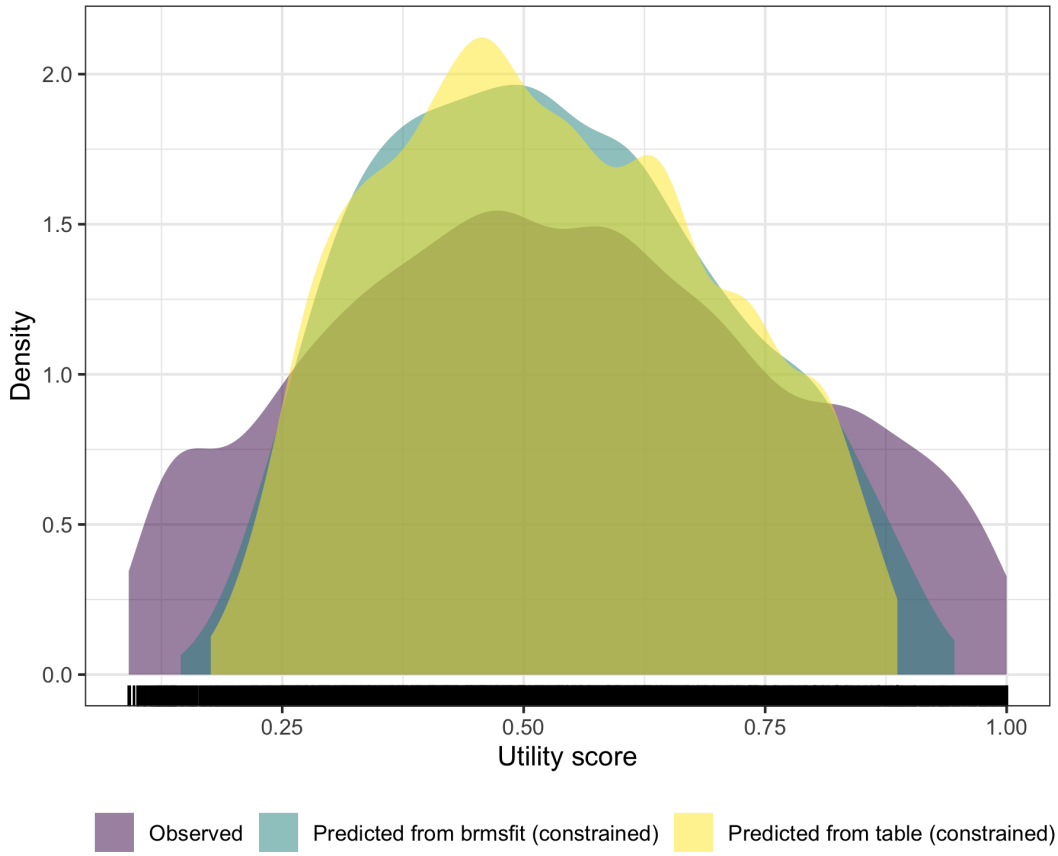

Figure 15: CHU9D linear mixed model with complementary log log transformation comparative densities of observed data and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

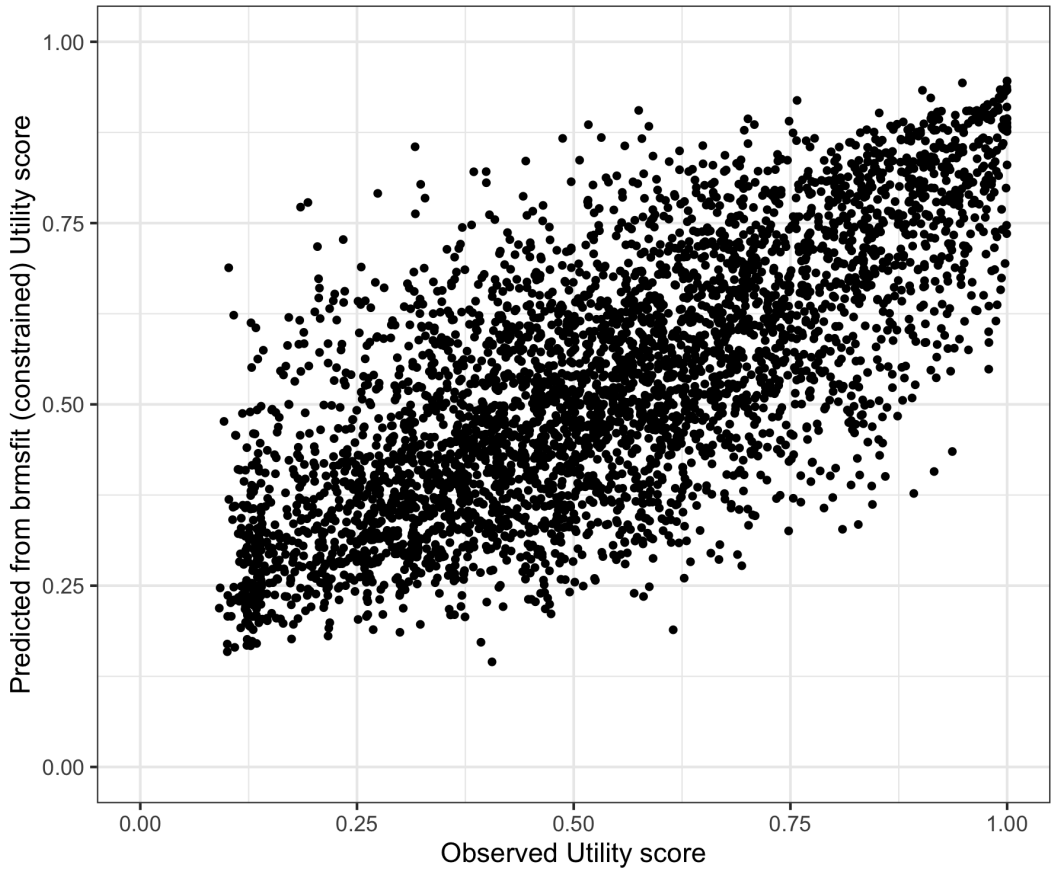

Figure 16: CHU9D linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

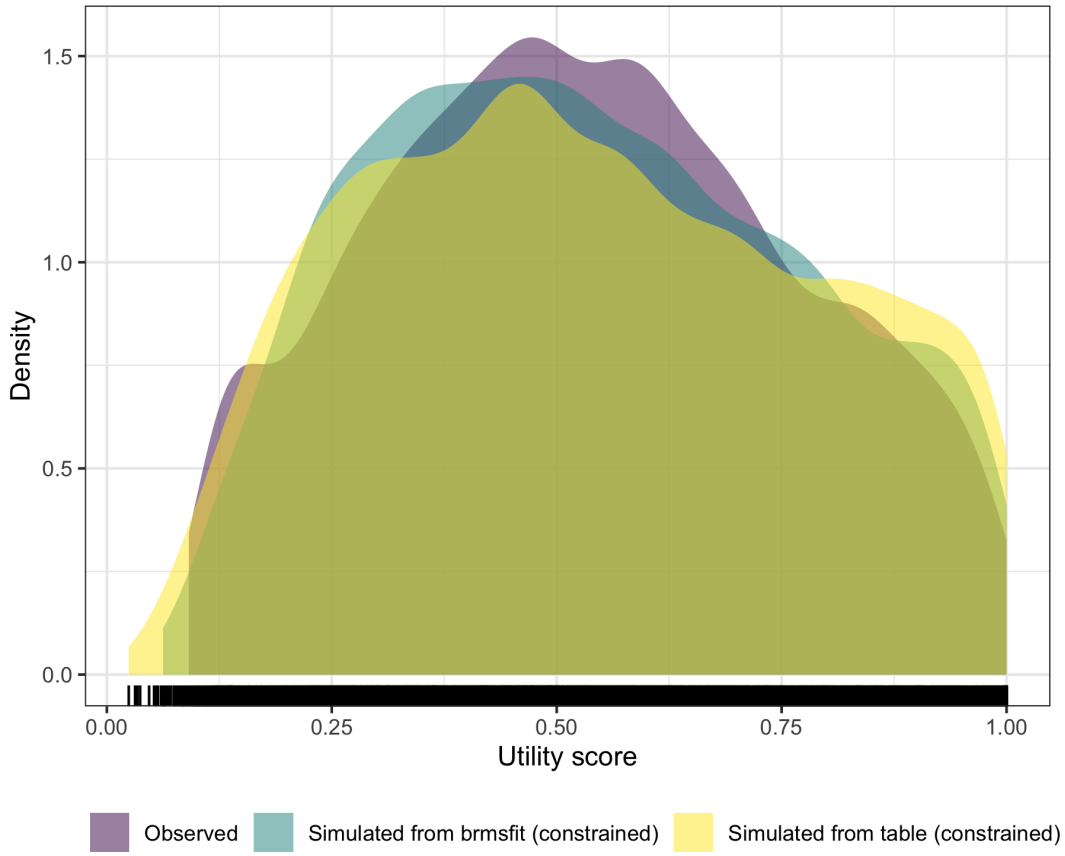

Figure 17: CHU9D linear mixed model with complementary log log transformation comparative densities of observed data and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

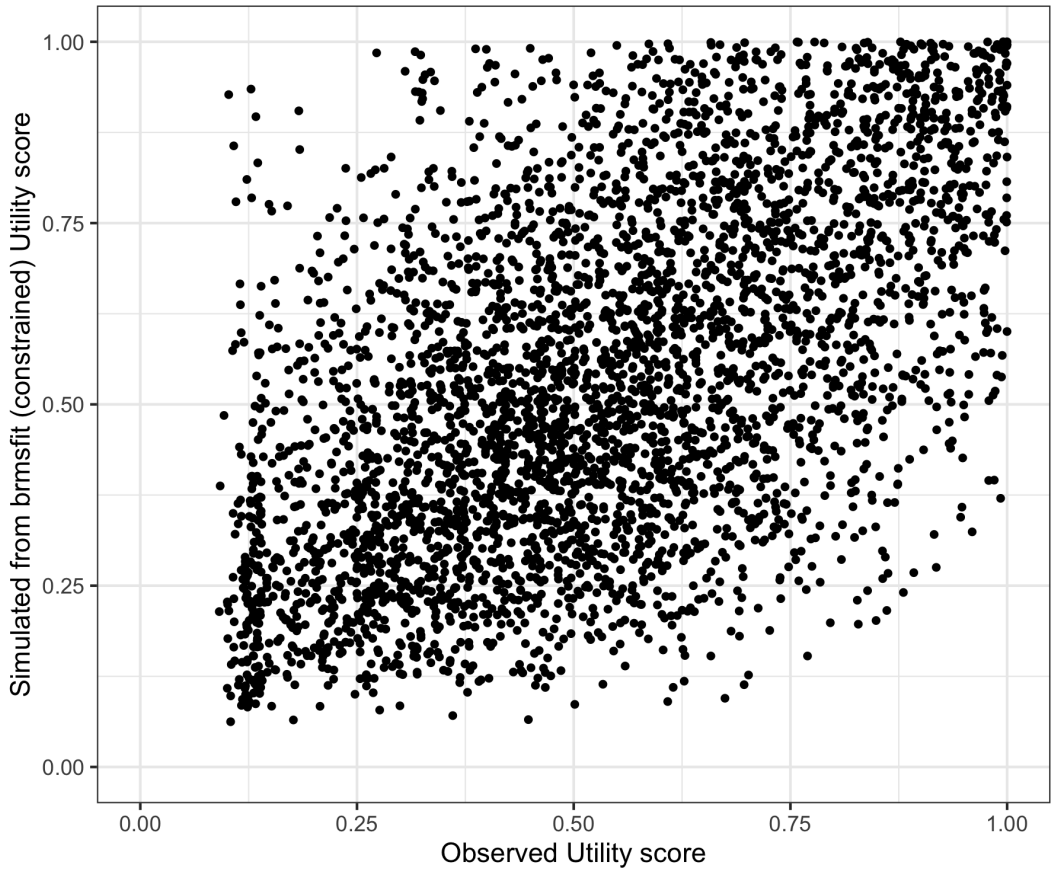

Figure 18: CHU9D linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

3 CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link

This model predicts values at two timepoints for AQOL-6D (weighted total). The predictor variables are baseline values and subsequent changes in - CHU9D (Child Health Utility (9 Dimension) total score); - K10 (Kessler Psychological Distress Scale (10 Item) (multiplied by 0.01)); - dage (age); - dgenderMale (); and - dgenderOther (). The catalogue reference for this model is `CHU9D_K10_1_GLM_GSN_LOG`.

Table 5: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link

Parameter	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Group-Level Effects:							
fkClientID (Number of levels: 3963)							
sd(Intercept)	0.03	0.02	0.00	0.06	1.00	574	1 116
Population-Level Effects:							
Intercept	-0.50	0.04	-0.58	-0.43	1.00	9 105	6 739
CHU9D	0.79	0.03	0.74	0.84	1.00	9 299	6 209
K10_scaled	-1.92	0.07	-2.06	-1.79	1.00	9 237	5 684
dage	-0.00	0.00	-0.01	-0.00	1.00	9 328	5 851
dgenderMale	0.01	0.01	-0.01	0.03	1.00	16 675	5 550
dgenderOther	-0.00	0.03	-0.07	0.06	1.00	13 690	5 745
Family Specific Parameters:							
sigma	0.16	0.00	0.15	0.16	1.00	1 477	1 885

Formula: AQOL6D ~CHU9D + K10_scaled + dage + dgender + (1 | fkClientID)
Family: gaussian
Links: mu = log; sigma = identity
Data: NULL (Number of observations: 3963)
Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
total post-warmup draws = 8000
Draws were sampled using sample(hmc). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

Table 6: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link model performance parameters

Parameter*	Estimate	SE	95CI
R2	0.53	0.01	0.513 , 0.552
RMSE	0.22	0.00	0.218 , 0.222

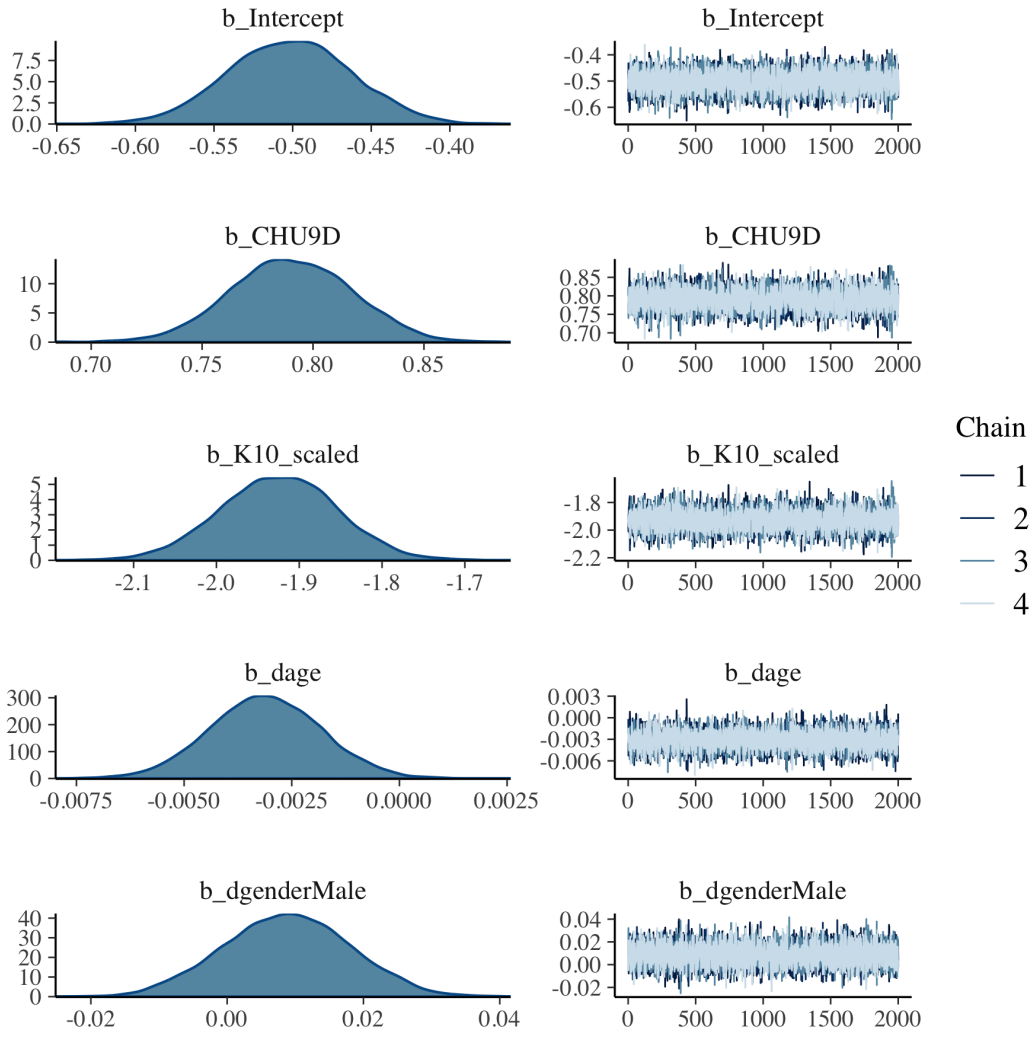

Figure 19: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link population level effects

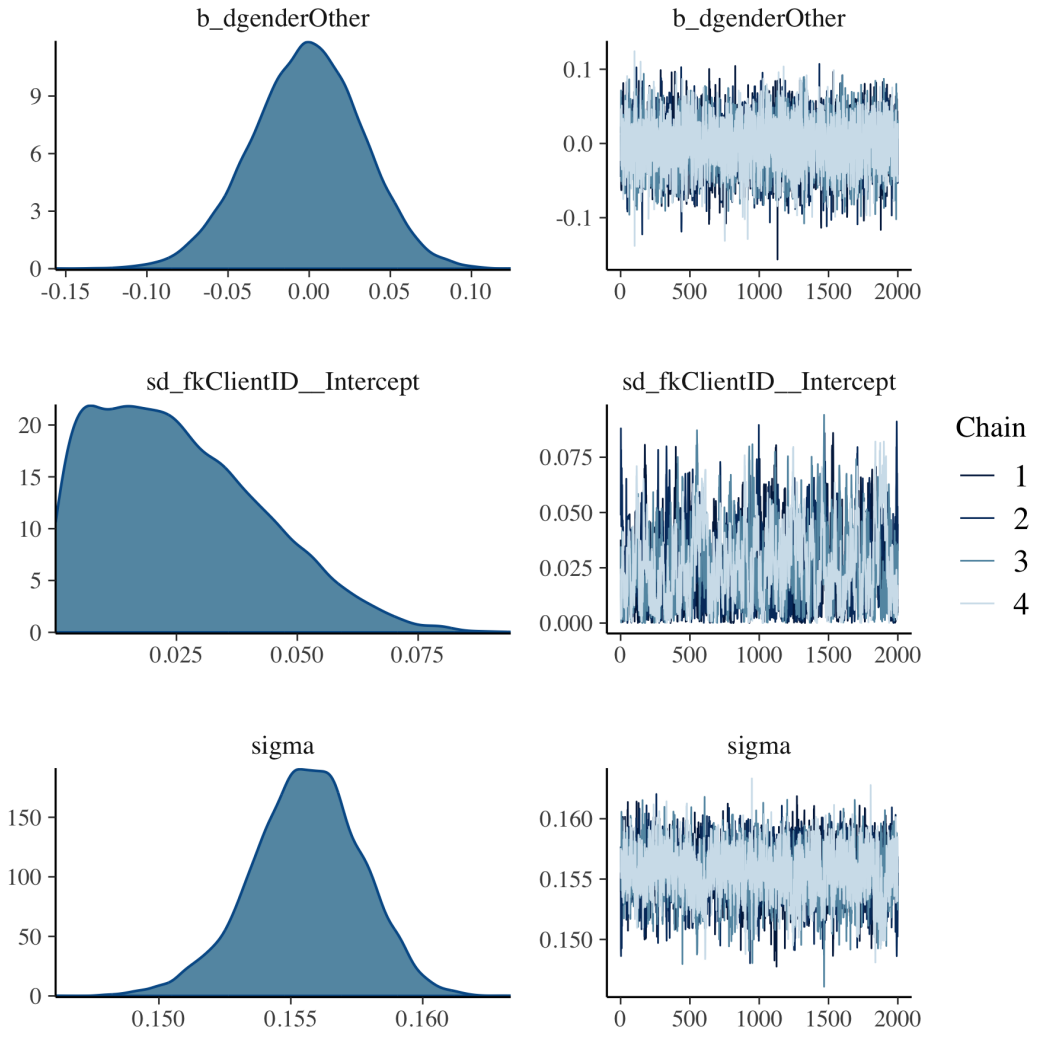

Figure 20: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link group level effects

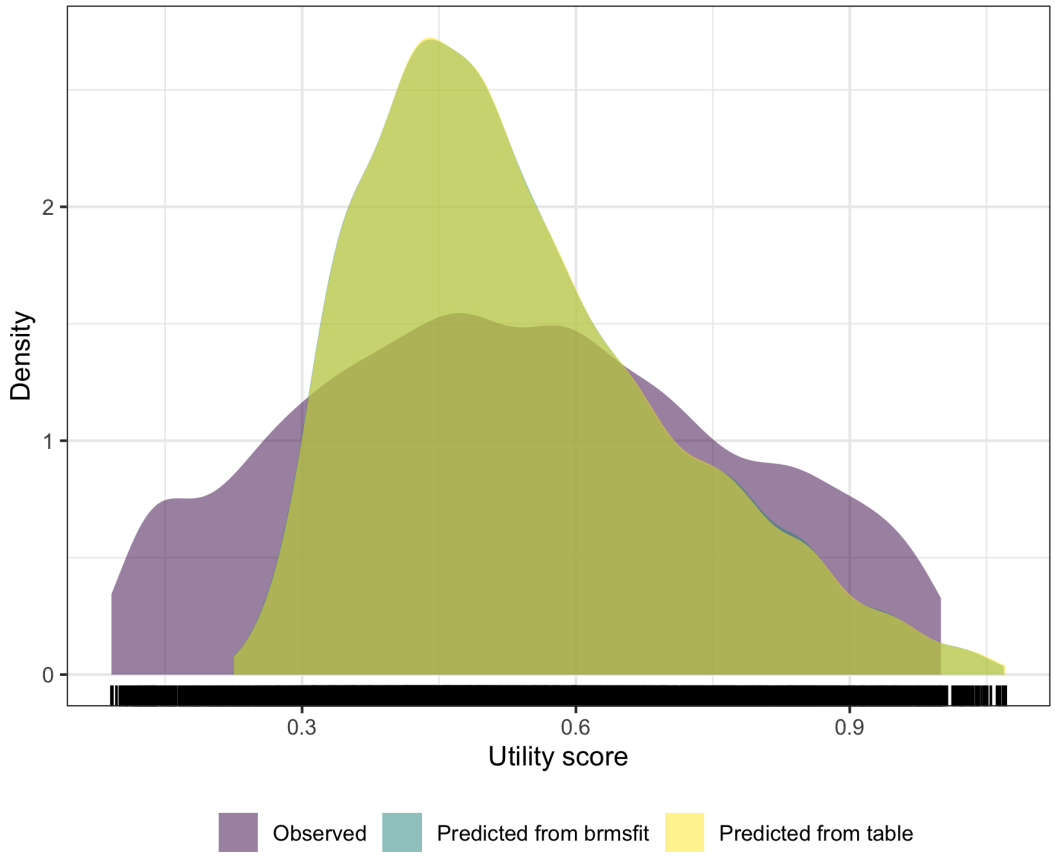

Figure 21: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using mean model parameter values

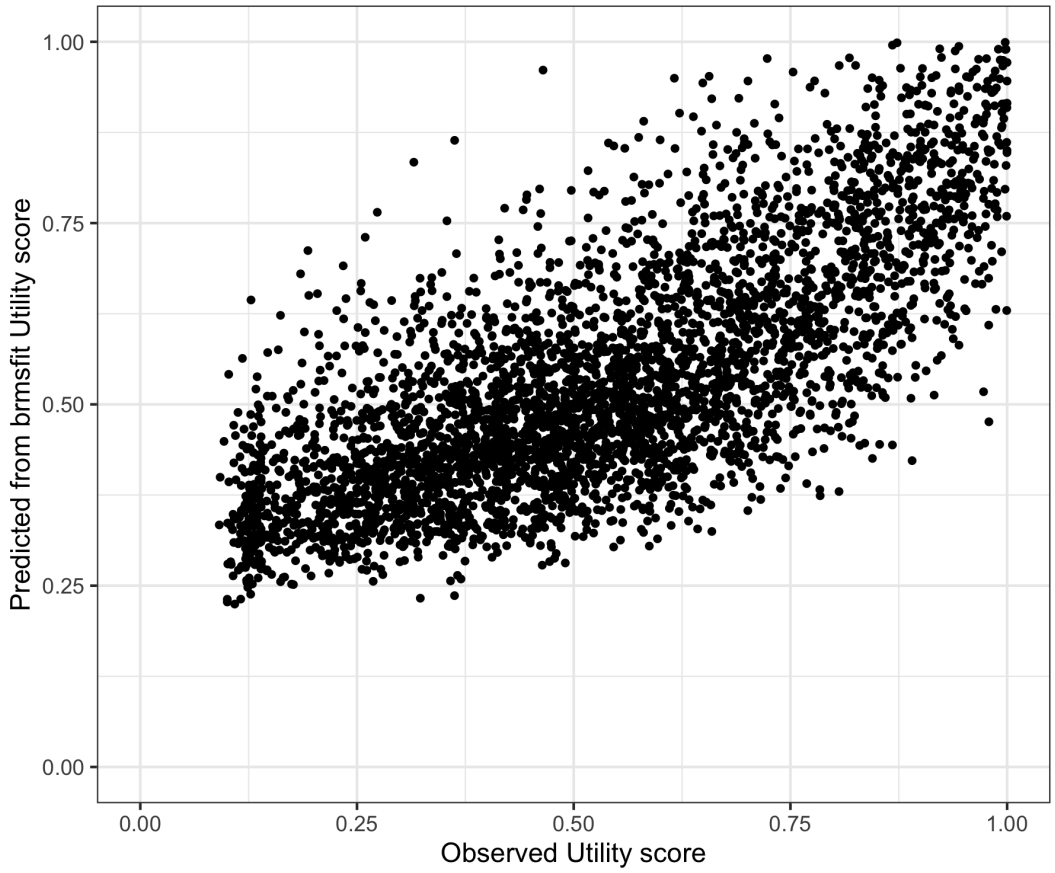

Figure 22: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using mean model parameter values

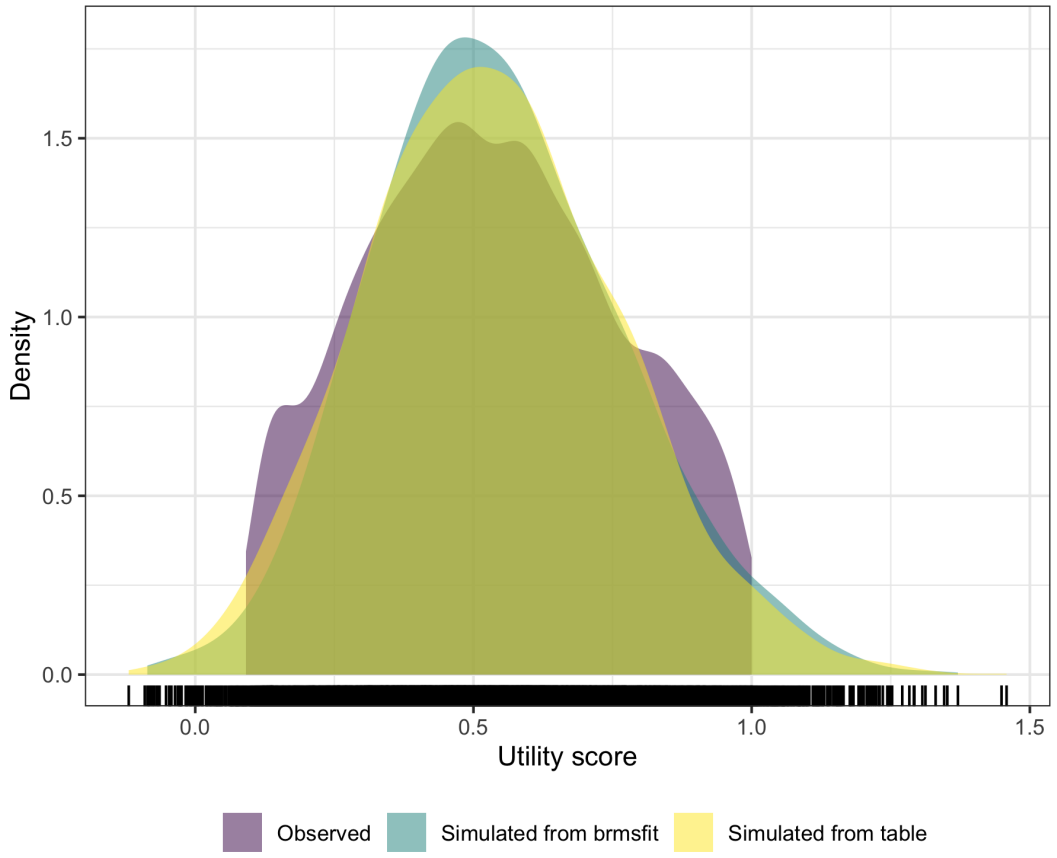

Figure 23: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using sampled model parameter values

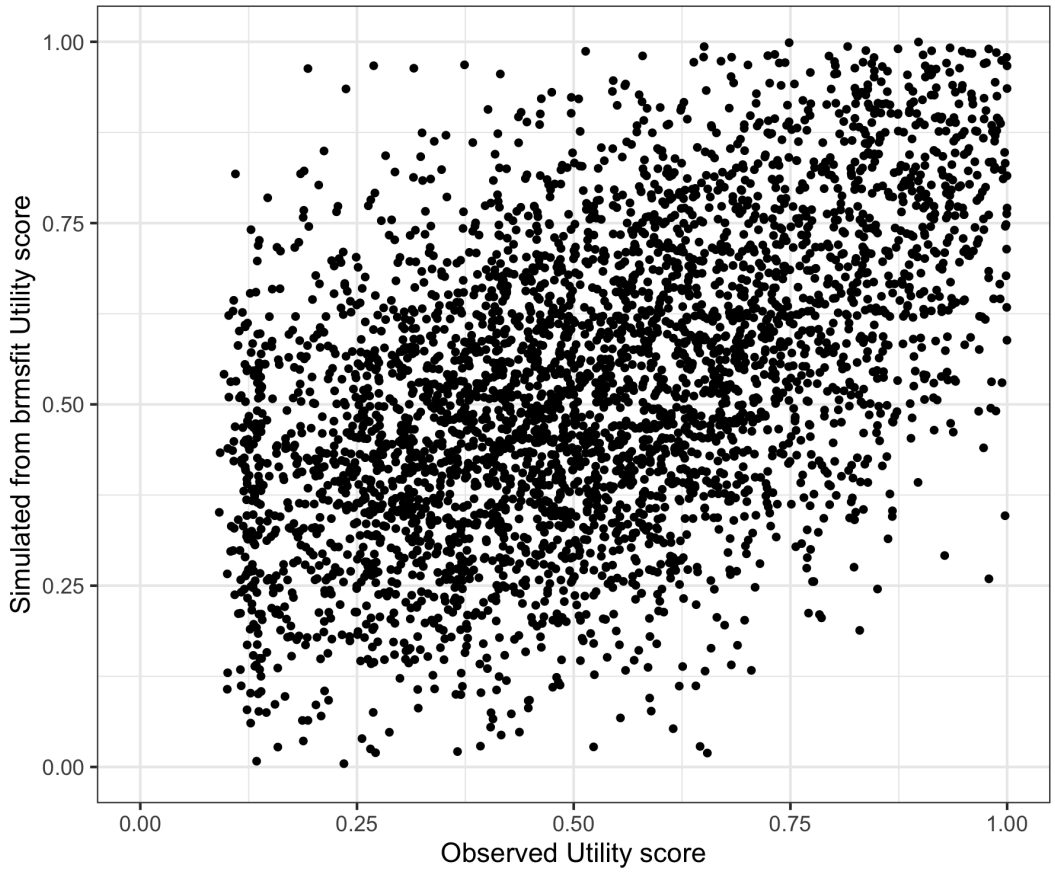

Figure 24: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using sampled model parameter values

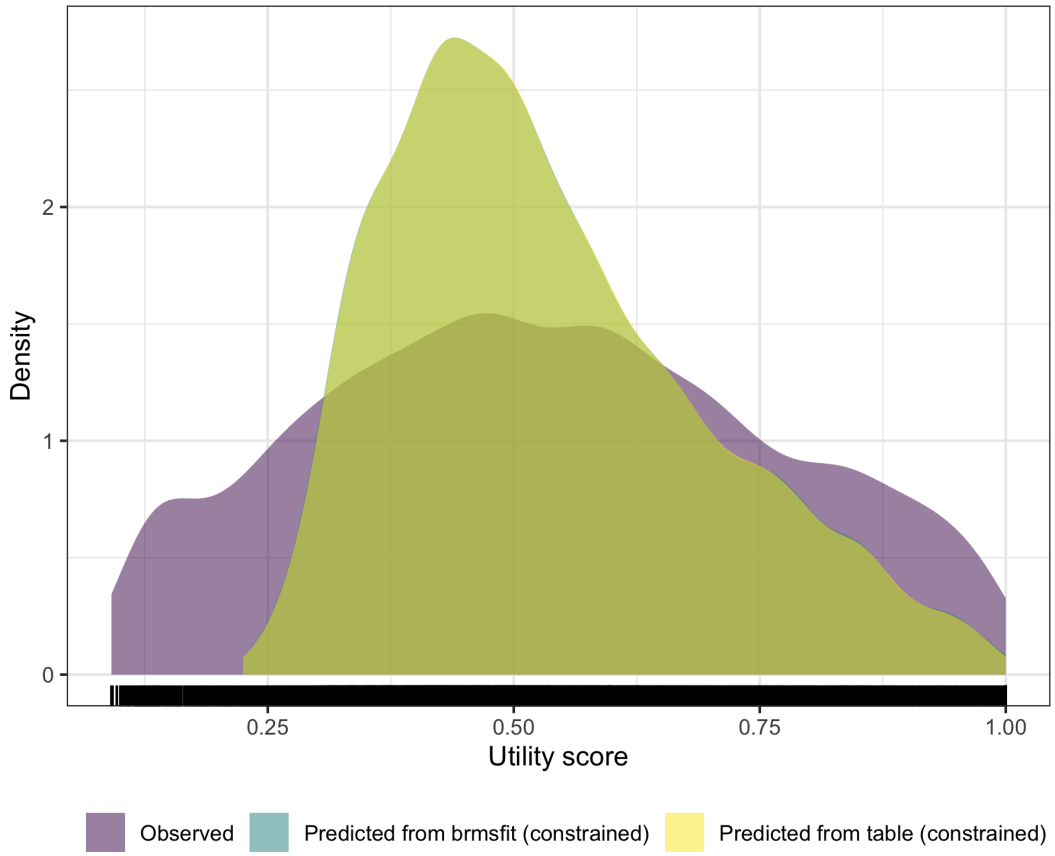

Figure 25: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

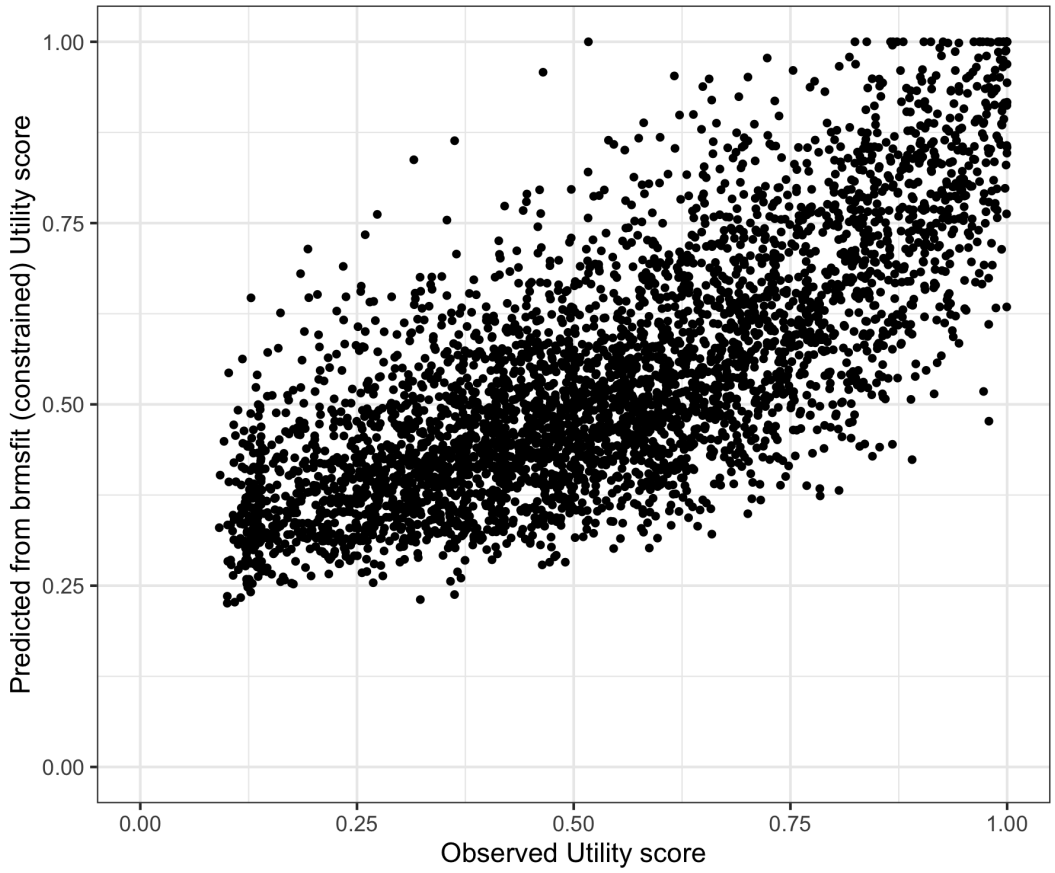

Figure 26: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

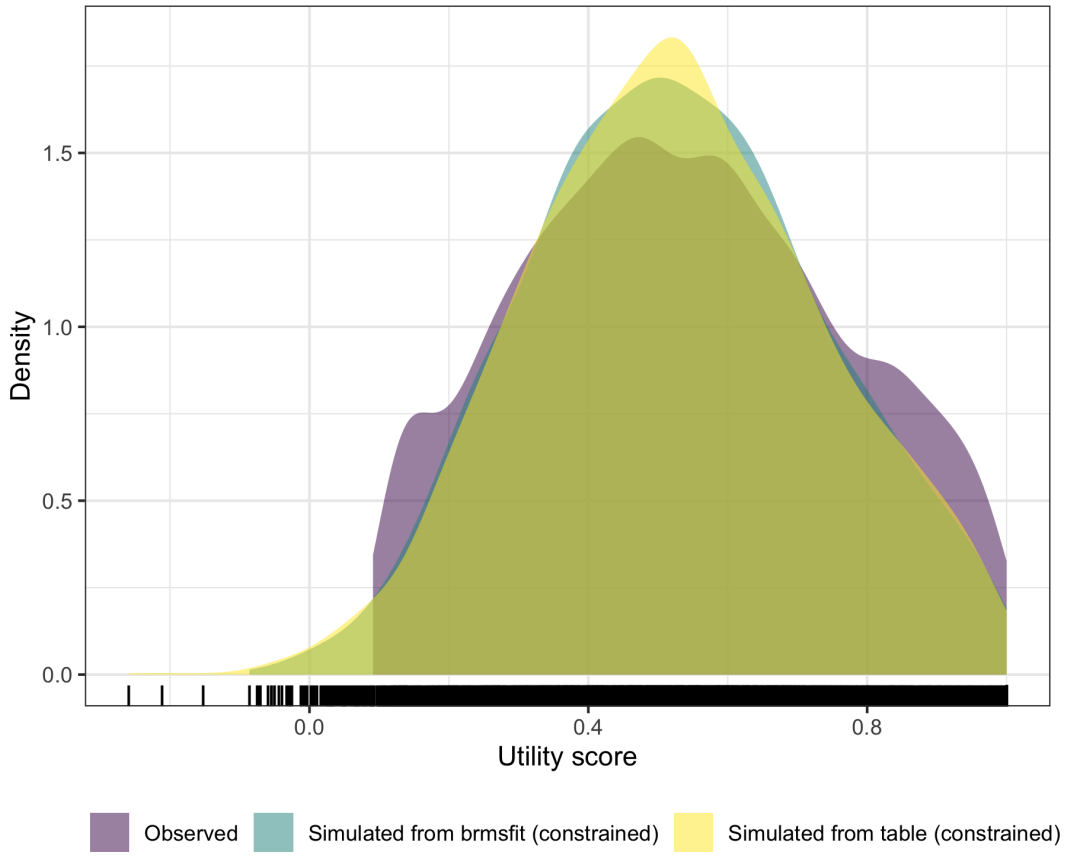

Figure 27: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative densities of observed data and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

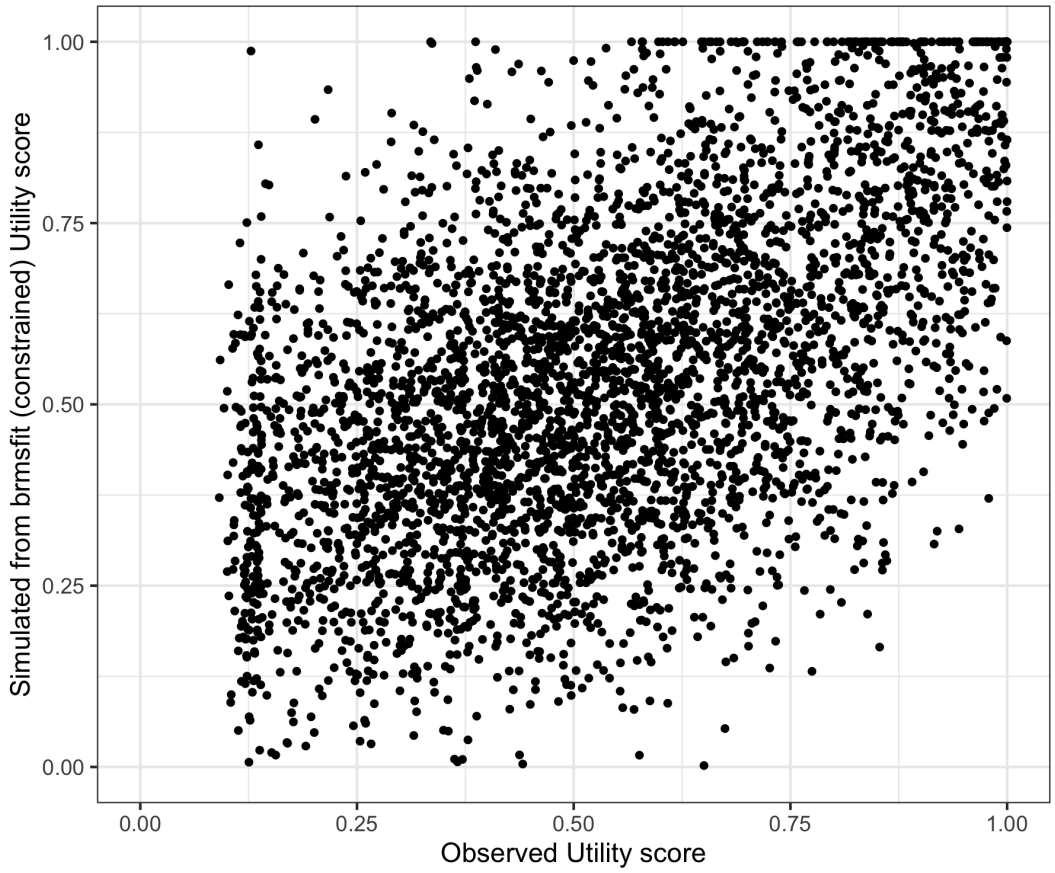

Figure 28: CHU9D with K10 generalised linear mixed model with Gaussian distribution and log link comparative scatter plot of observed and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

4 CHU9D with K10 linear mixed model with complementary log log transformation

This model predicts values at two timepoints for AQOL-6D (weighted total). The predictor variables are baseline values and subsequent changes in - CHU9D (Child Health Utility (9 Dimension) total score); - K10 (Kessler Psychological Distress Scale (10 Item) (multiplied by 0.01)); - dage (age); - dgenderMale (); and - dgenderOther (). The catalogue reference for this model is `CHU9D_K10_1_OLS_CLL`.

```
Warning: Parts of the model have not converged (some Rhats are > 1.05). Be careful when analysing the results! We recommend running more i
```

```
Warning: There were 121 divergent transitions after warmup. Increasing adapt_delta above 0.99 may help. See http://mc-stan.org/misc/warnin
```

Table 7: CHU9D with K10 linear mixed model with complementary log log transformation

Parameter	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Group-Level Effects:							
fkClientID (Number of levels: 3963)							
sd(Intercept)	0.30	0.15	0.02	0.48	1.53	7	65
Population-Level Effects:							
Intercept	0.04	0.07	-0.10	0.19	1.00	5 152	6 034
CHU9D	1.54	0.05	1.44	1.64	1.00	4 979	5 203
K10_scaled	-3.60	0.13	-3.85	-3.34	1.00	5 043	5 727
dage	-0.01	0.00	-0.02	-0.01	1.00	6 650	5 772
dgenderMale	0.04	0.02	0.01	0.08	1.00	5 736	5 500
dgenderOther	0.03	0.06	-0.08	0.14	1.00	5 685	5 279
Family Specific Parameters:							
sigma	0.42	0.10	0.24	0.54	1.52	7	61

Formula: AQOL6D_CLL ~CHU9D + K10_scaled + dage + dgender + (1 | fkClientID)
Family: gaussian
Links: mu = identity; sigma = identity
Data: NULL (Number of observations: 3963)
Draws: 4 chains, each with iter = 4000; warmup = 2000; thin = 1;
total post-warmup draws = 8000
Draws were sampled using sample(hmc). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).

Table 8: CHU9D with K10 linear mixed model with complementary log log transformation model performance parameters

Parameter*	Estimate	SE	95CI
R2	0.71	0.13	0.531 , 0.905
RMSE	1.07	0.02	1.045 , 1.087

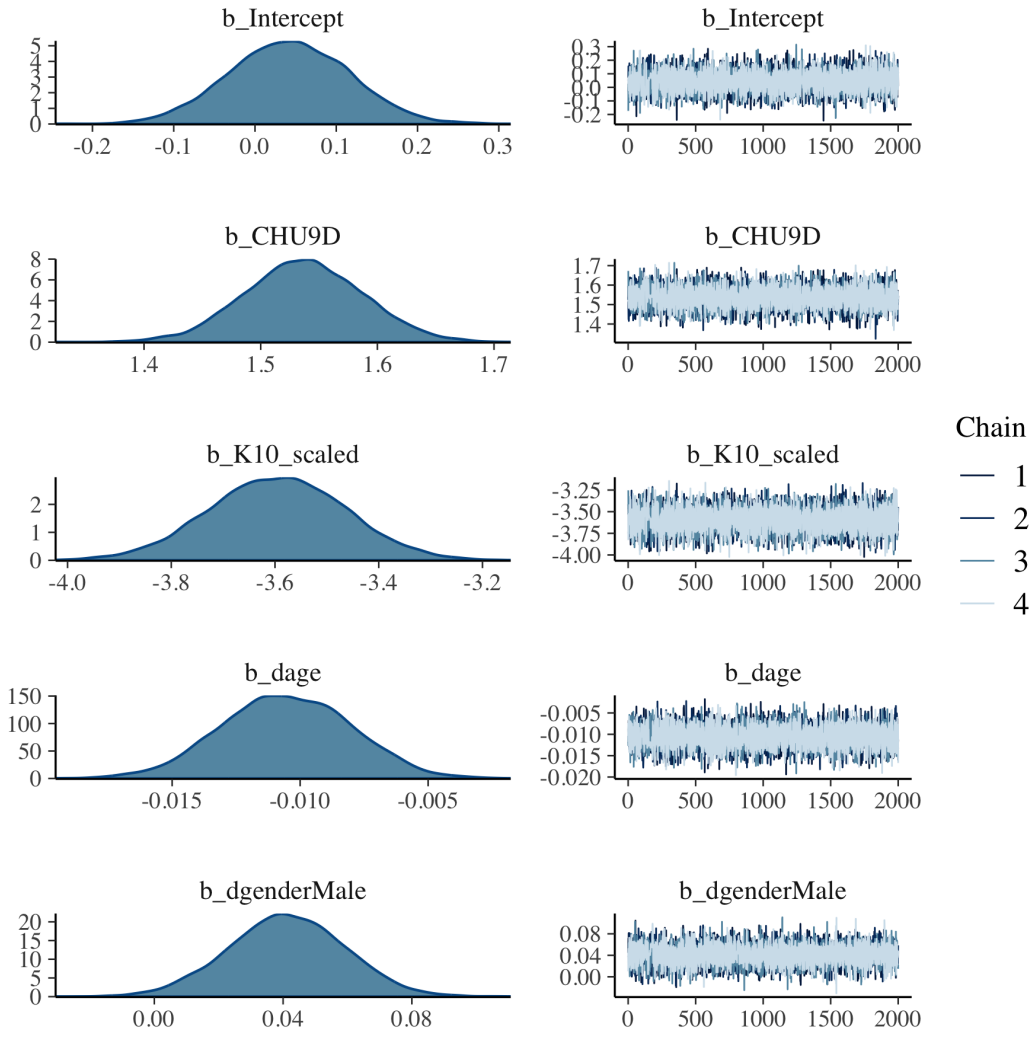

Figure 29: CHU9D with K10 linear mixed model with complementary log log transformation population level effects

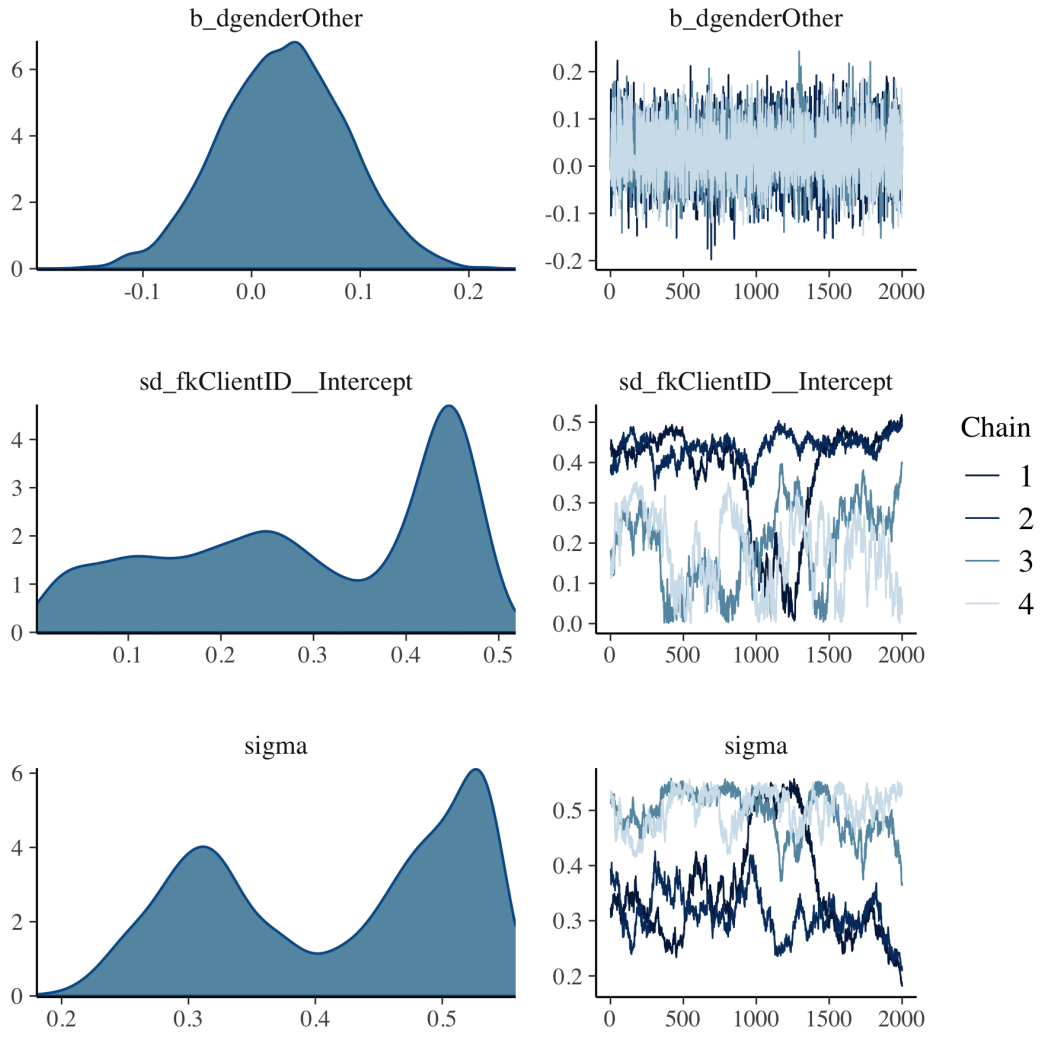

Figure 30: CHU9D with K10 linear mixed model with complementary log log transformation group level effects

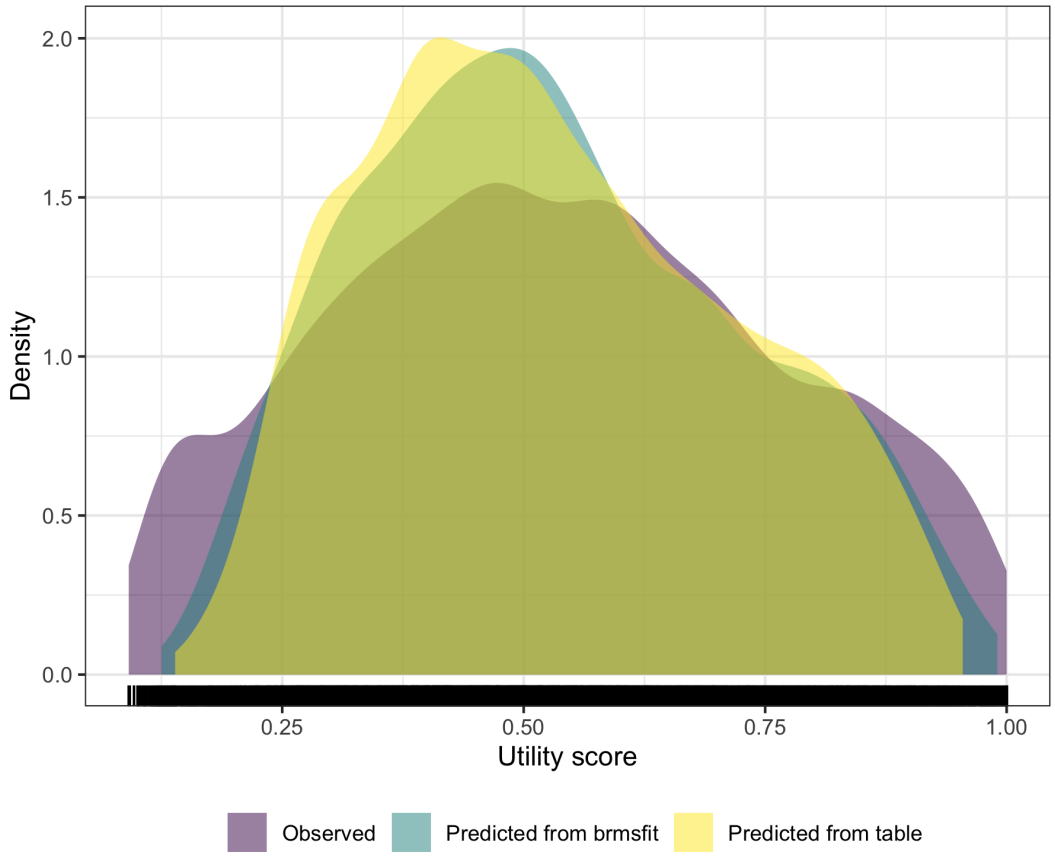

Figure 31: CHU9D with K10 linear mixed model with complementary log log transformation comparative densities of observed data and predictions using mean model parameter values

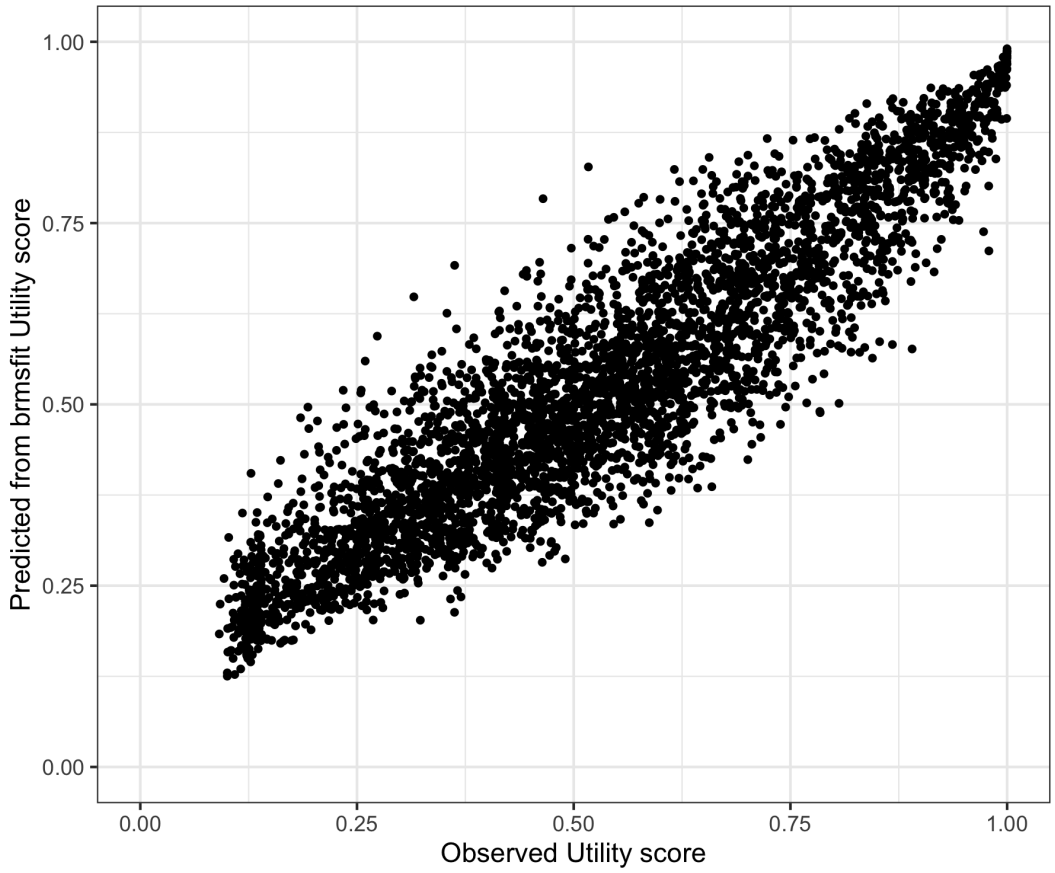

Figure 32: CHU9D with K10 linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using mean model parameter values

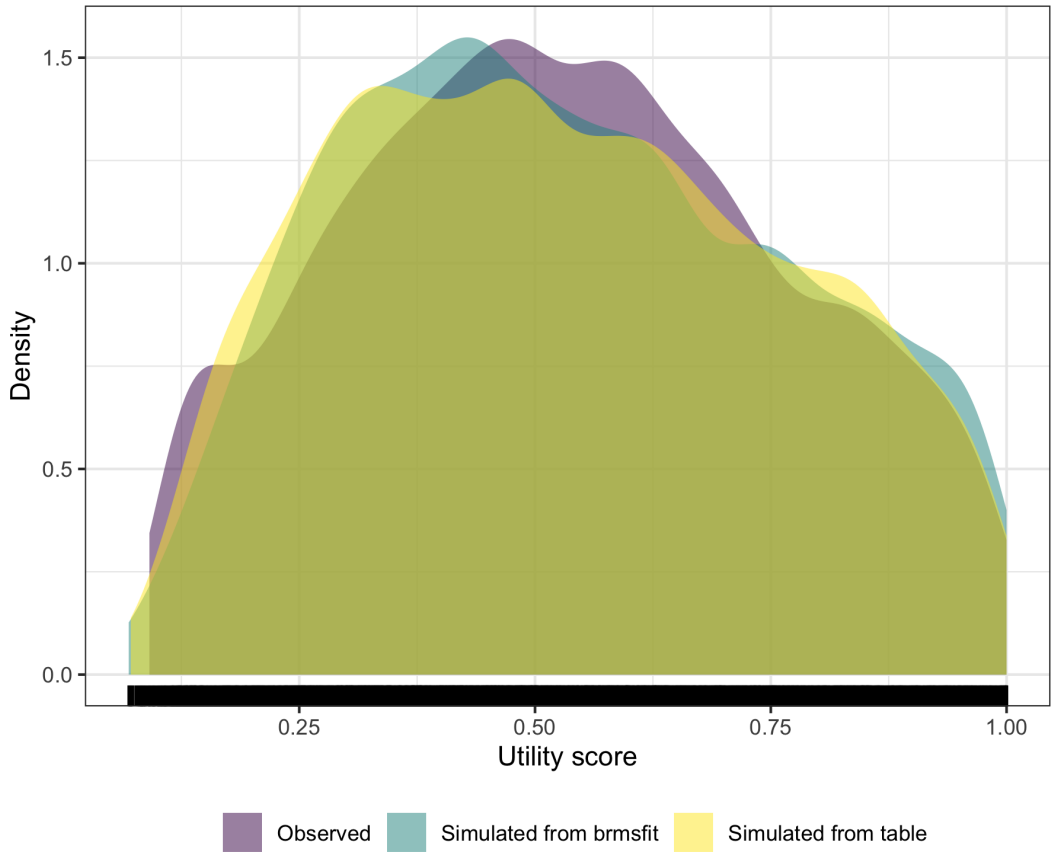

Figure 33: CHU9D with K10 linear mixed model with complementary log log transformation comparative densities of observed data and predictions using sampled model parameter values

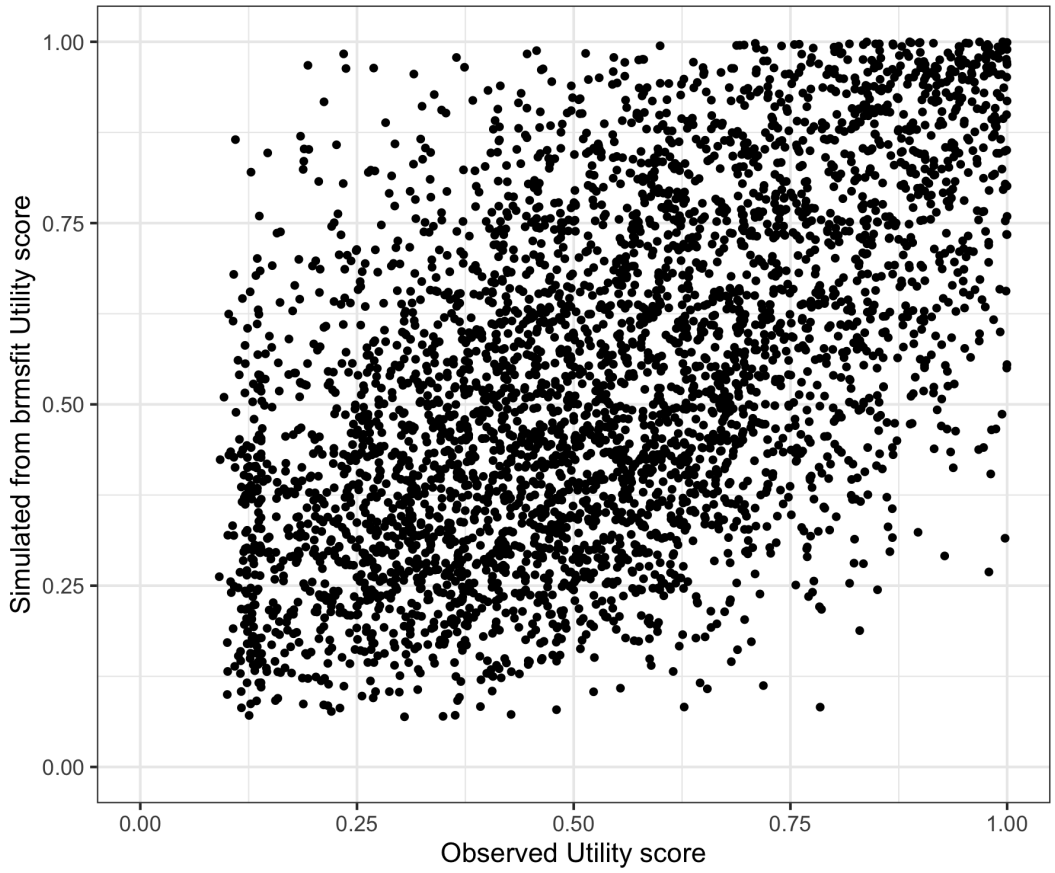

Figure 34: CHU9D with K10 linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using sampled model parameter values

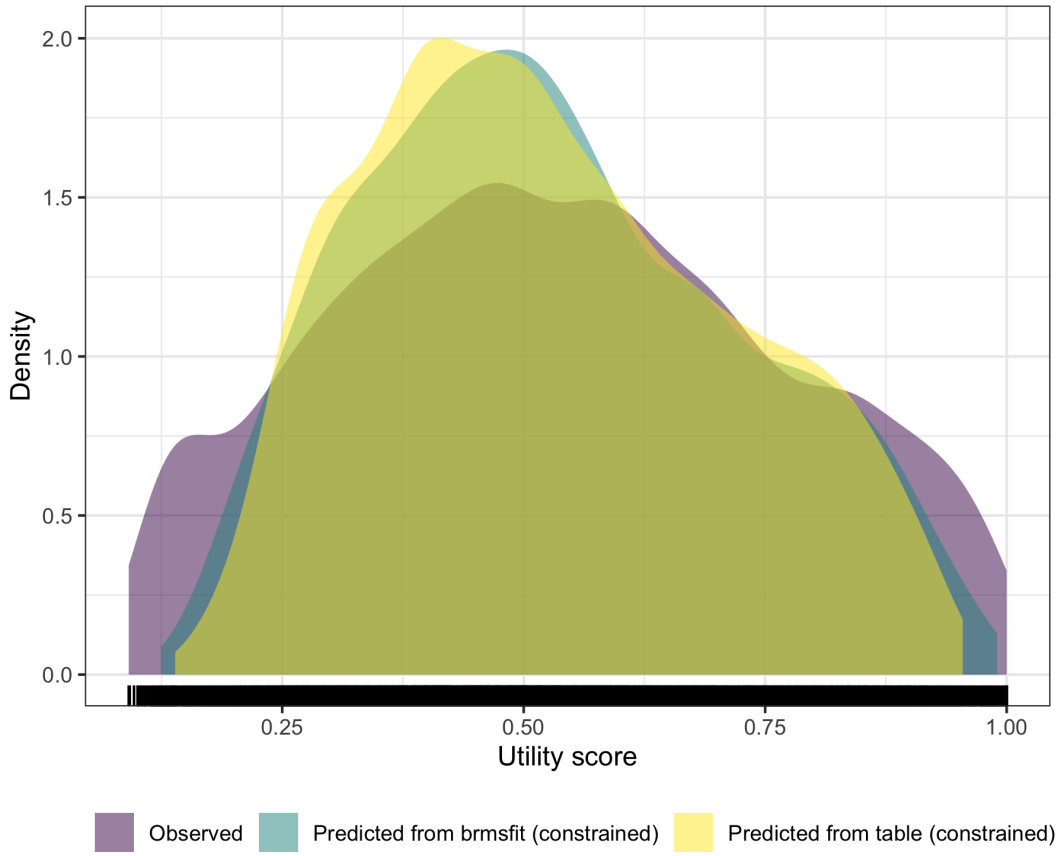

Figure 35: CHU9D with K10 linear mixed model with complementary log log transformation comparative densities of observed data and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

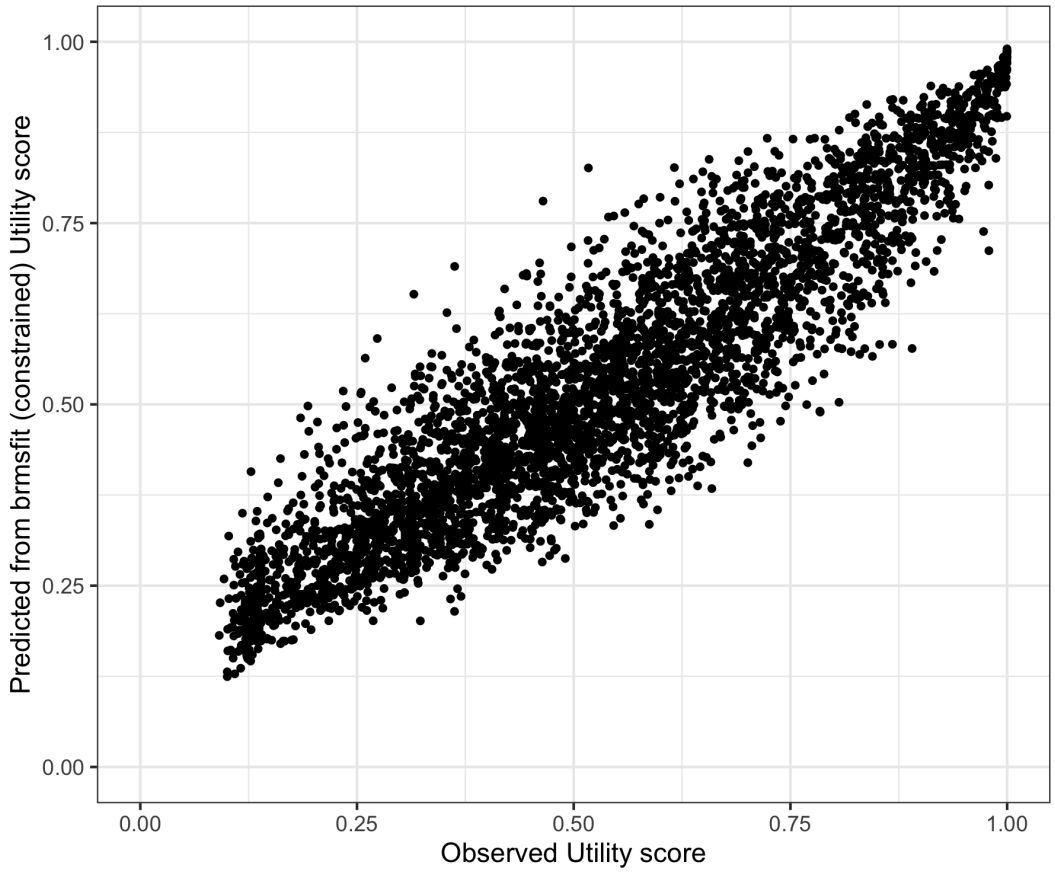

Figure 36: CHU9D with K10 linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using mean model parameter values and transformation of out of range predictions to upper and lower bounds

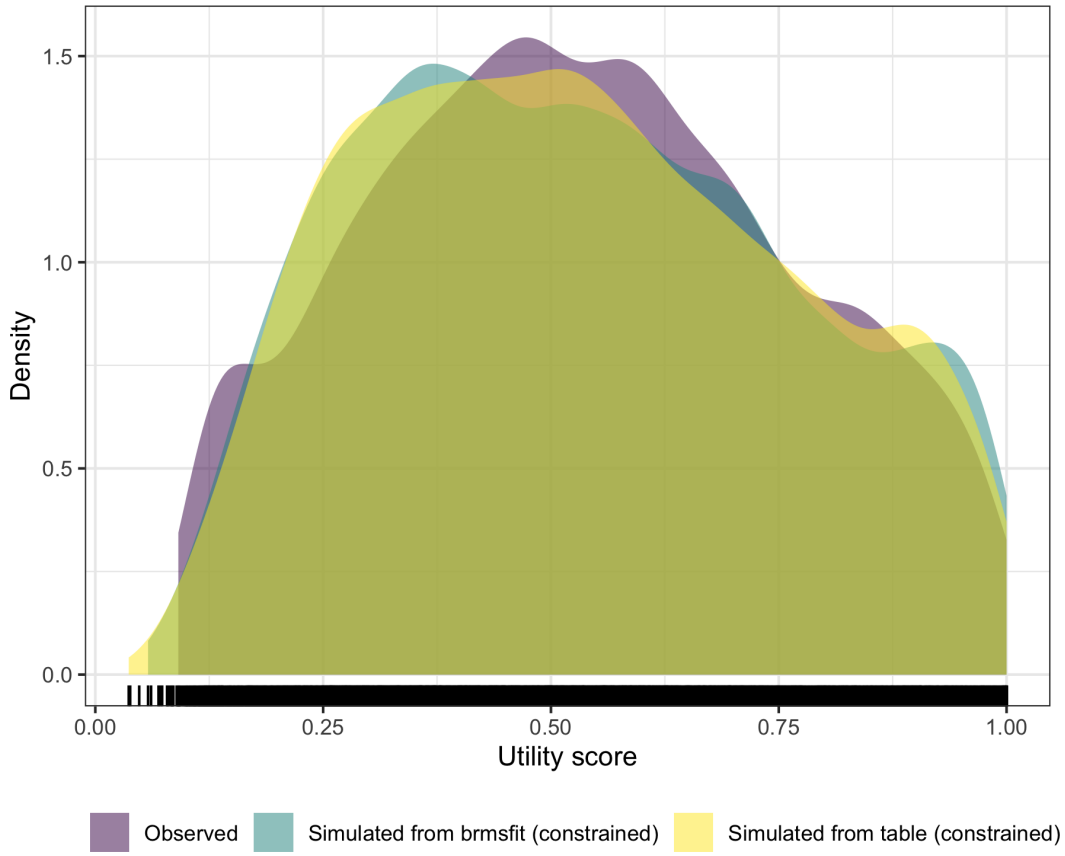

Figure 37: CHU9D with K10 linear mixed model with complementary log log transformation comparative densities of observed data and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds

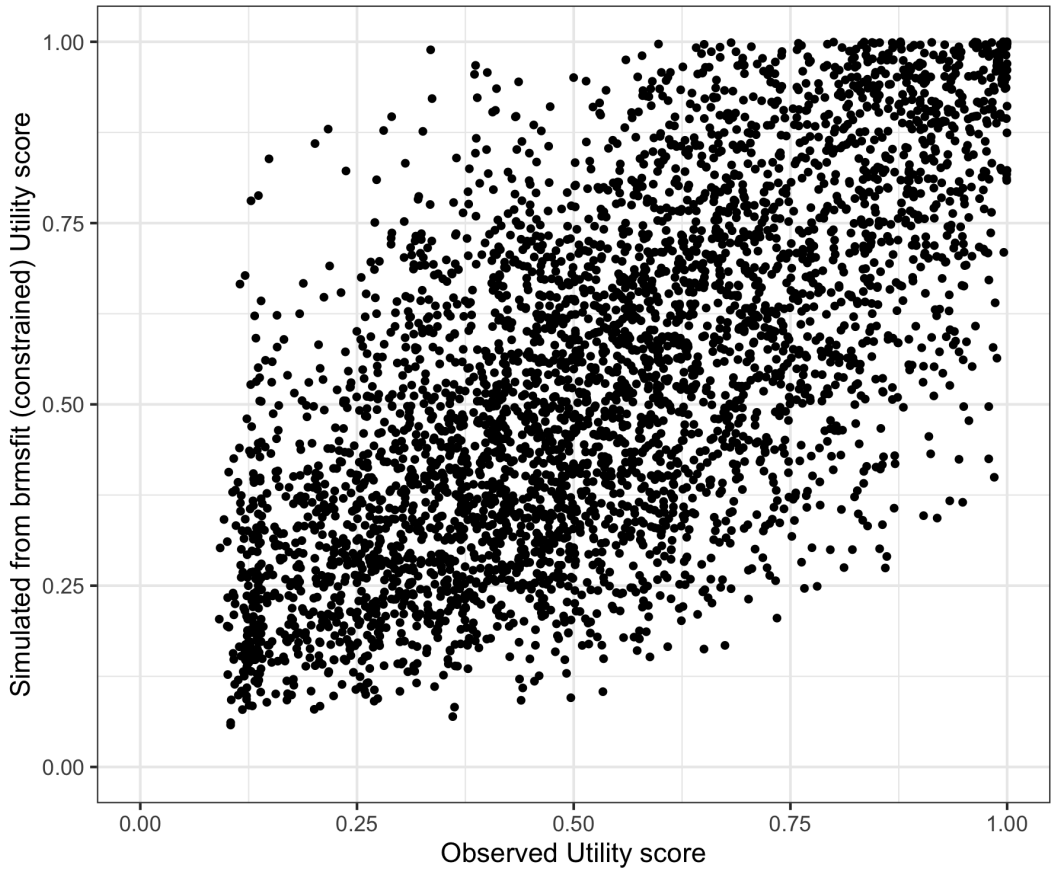

Figure 38: CHU9D with K10 linear mixed model with complementary log log transformation comparative scatter plot of observed and predictions using sampled model parameter values and transformation of out of range predictions to upper and lower bounds