

Transformed area-level model

Small introduction

The `fh` function allows for two transformations: `log` and `arcsin`.

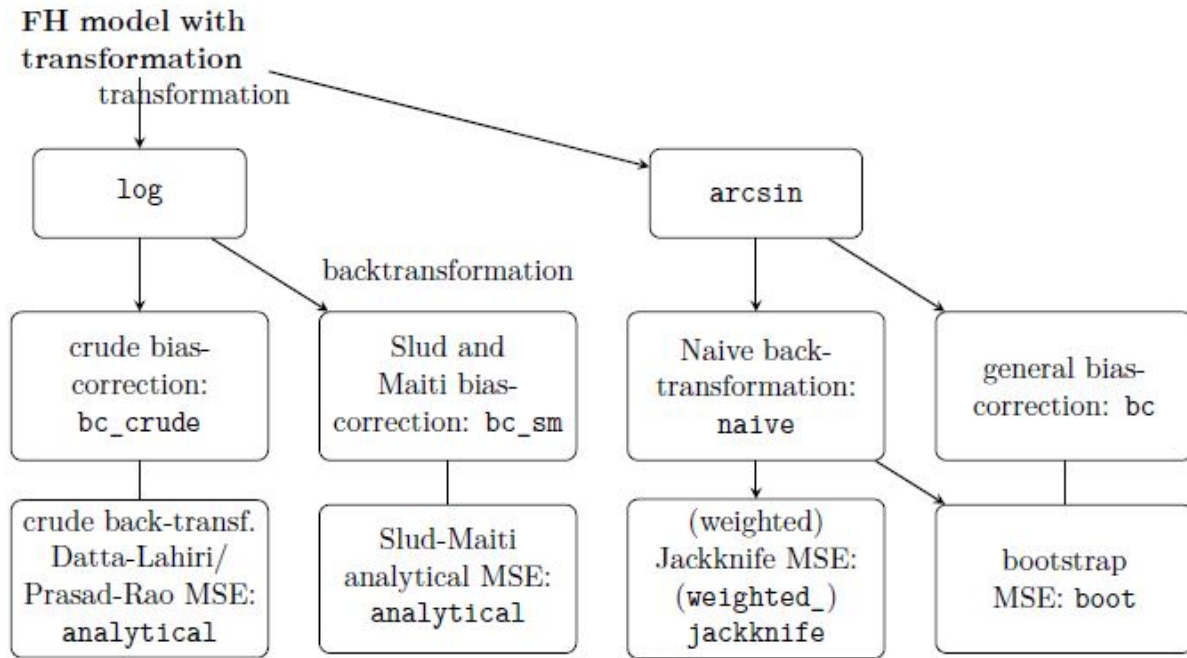


Figure 1: Estimation options for the transformed area-level model

Load package and data

```
library("emdi")

##
## Attaching package: 'emdi'
## The following object is masked from 'package:stats':
##
##     step
data("eusilcA_popAgg")
data("eusilcA_smpAgg")
```

Combine inout data

```
## Combine input data
combined_data <- combine_data(pop_data = eusilcA_popAgg,
                              pop_domains = "Domain",
                              smp_data = eusilcA_smpAgg,
                              smp_domains = "Domain")
```

Identify spatial structures

```
load_shapeaustria()
shape_austria_dis <- shape_austria_dis[order(shape_austria_dis$PB),]
austria_shape <- sp::merge(shape_austria_dis, eusilcA_smpAgg, by.x = "PB",
                           by.y = "Domain", all.x = F)
rel <- spdep::poly2nb(austria_shape, row.names = austria_shape$PB)
eusilcA_prox <- spdep::nb2mat(rel, style = "W", zero.policy = TRUE)

# Spatial correlation tests
spatialcor.tests(direct = combined_data$Mean,
                  corMatrix = eusilcA_prox)

##      Statistics      Value      p.value
## 1  Moran's I 0.2453677 5.607958e-05
## 2  Geary's C 0.6238681 2.473294e-03
```

Estimate EBLUPs and MSEs

```
fh_log <- fh(fixed = Mean ~ cash + self_empl,
             vardir = "Var_Mean", combined_data = combined_data,
             domains = "Domain", transformation = "log", method = 'ml',
             backtransformation = "bc_sm", eff_smpsize = "n", MSE = TRUE,
             mse_type = "analytical")
```

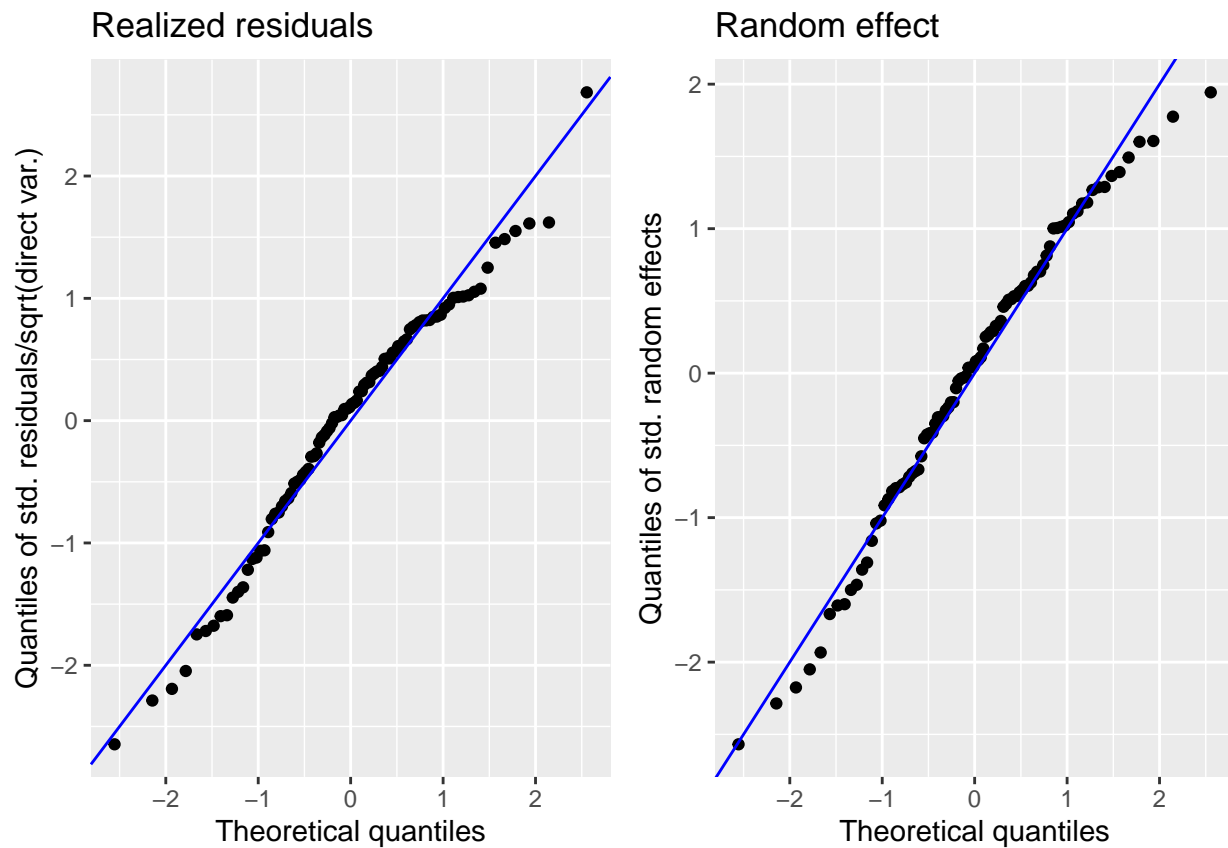
Assess the estimated model

```
summary(fh_log)

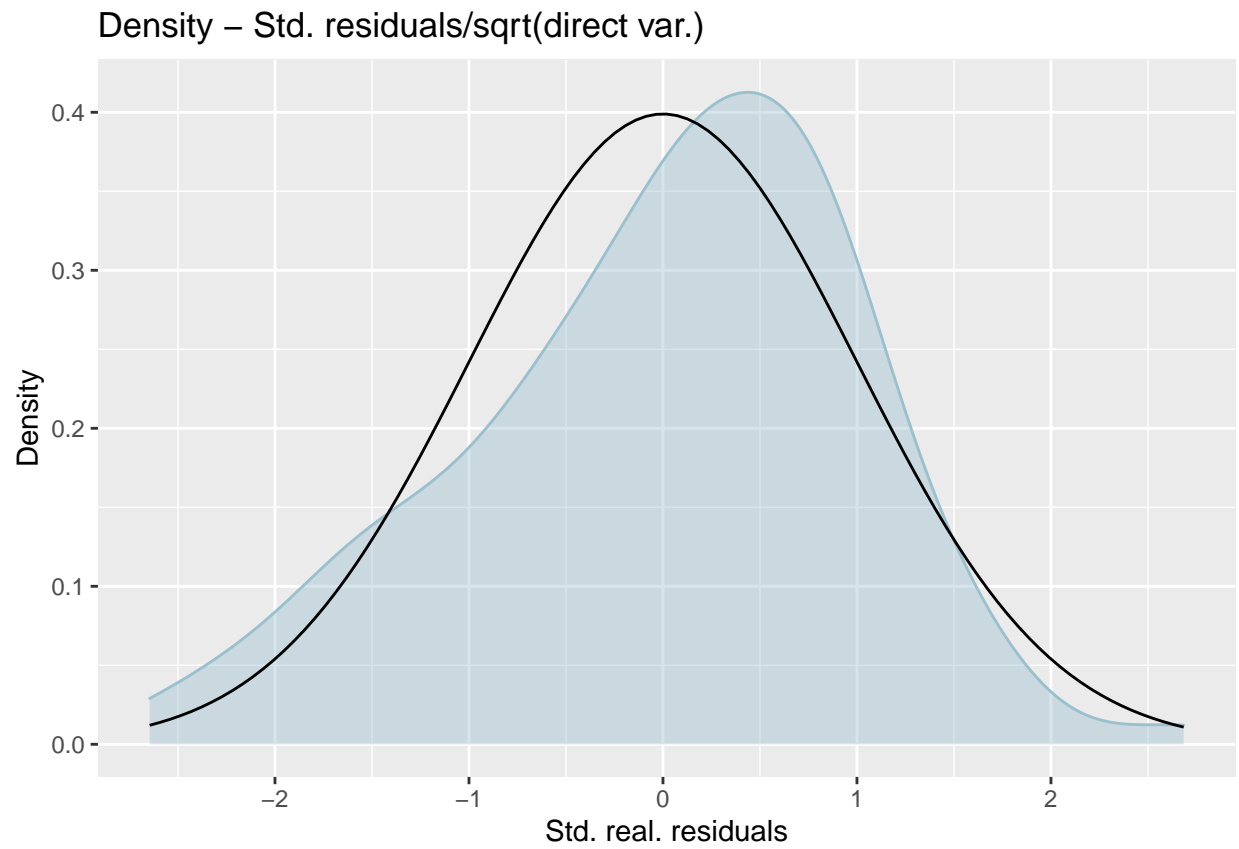
## Call:
## fh(fixed = Mean ~ cash + self_empl, vardir = "Var_Mean", combined_data = combined_data,
##     domains = "Domain", method = "ml", transformation = "log",
##     backtransformation = "bc_sm", eff_smpsize = "n", MSE = TRUE,
##     mse_type = "analytical")
##
## Out-of-sample domains: 0
## In-sample domains: 94
##
## Variance and MSE estimation:
## Variance estimation method: ml
## Estimated variance component(s): 0.008100964
## MSE method: slud-maiti
```

```
##
## Coefficients:
##      coefficients  std.error  t.value  p.value
## (Intercept)  8.9657e+00 4.1489e-02 216.0974 < 2.2e-16 ***
## cash        6.0137e-05 3.6984e-06 16.2602 < 2.2e-16 ***
## self_empl   6.1857e-05 6.5400e-06  9.4581 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Explanatory measures:
##      loglike      AIC      BIC      R2      AdjR2
## 1 60.66618 -113.3324 -103.1592 0.8745597 0.9223251
##
## Residual diagnostics:
##                               Skewness Kurtosis Shapiro_W Shapiro_p
## Standardized_Residuals -0.3940449 2.993990 0.9774171 0.1032109
## Random_effects          -0.3975579 2.645602 0.9812955 0.1985316
##
## Transformation:
##      Transformation Back_transformation
##              log              bc_sm
```

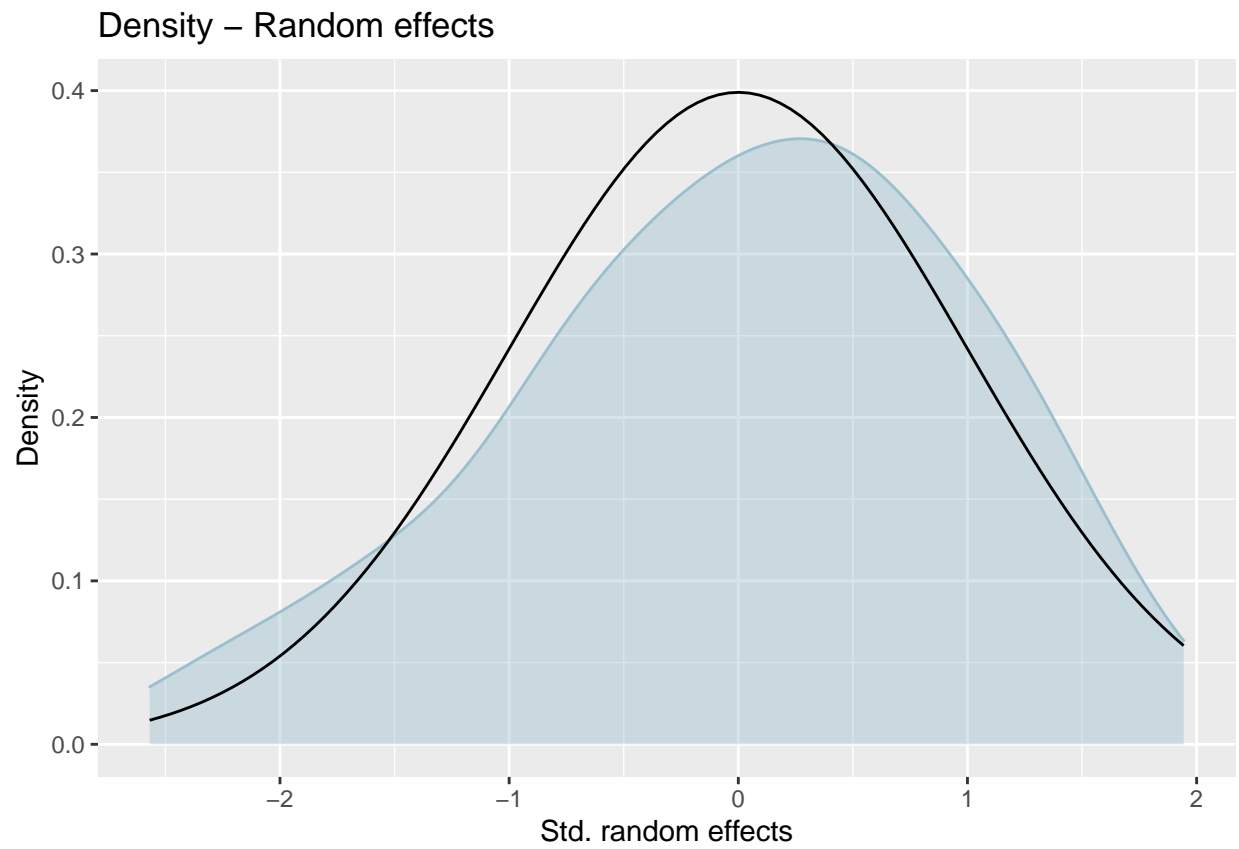
```
plot(fh_log)
```



```
## Press [enter] to continue
```

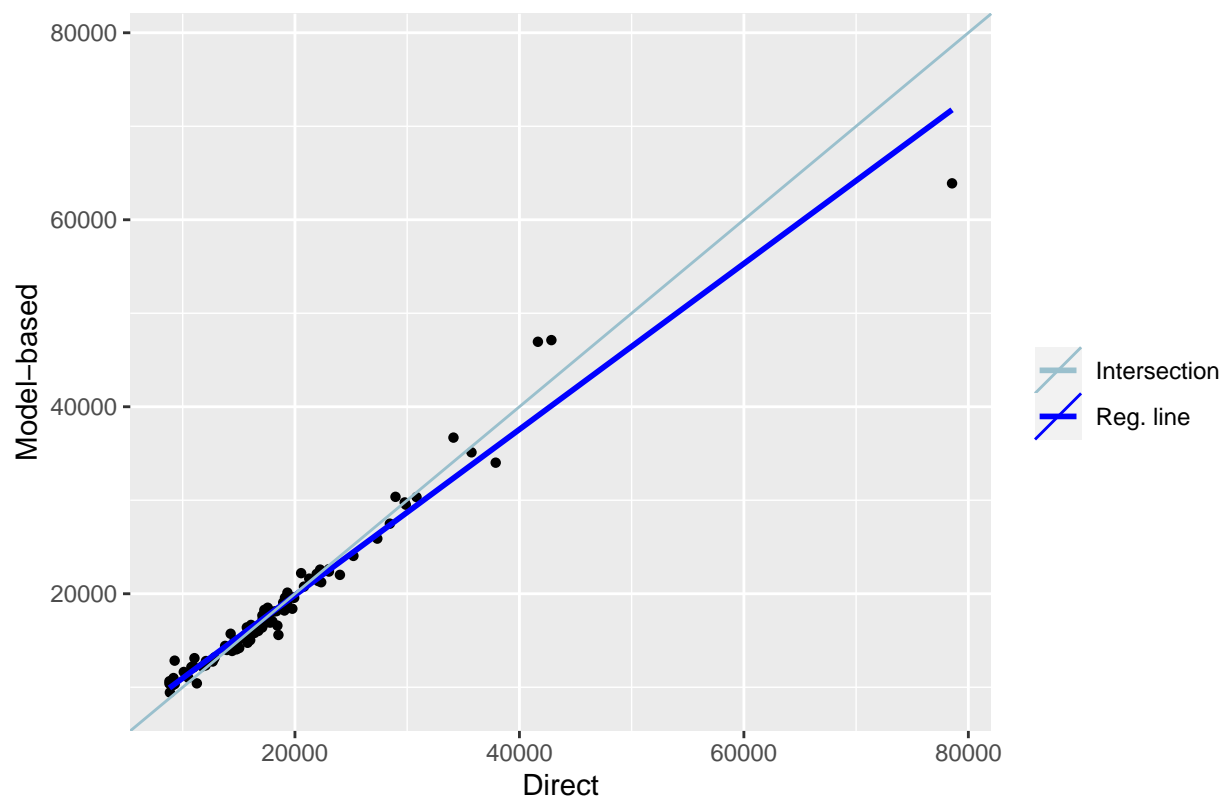


Press [enter] to continue

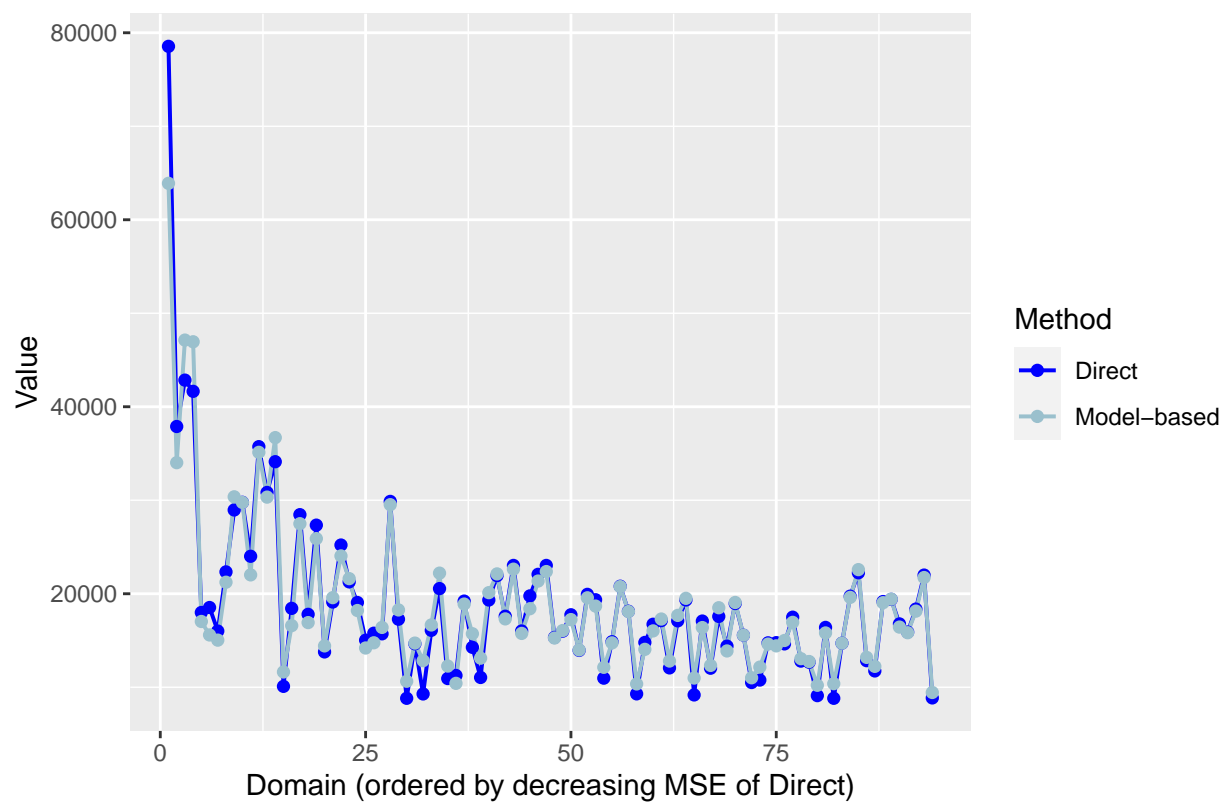


Compare results with direct estimates

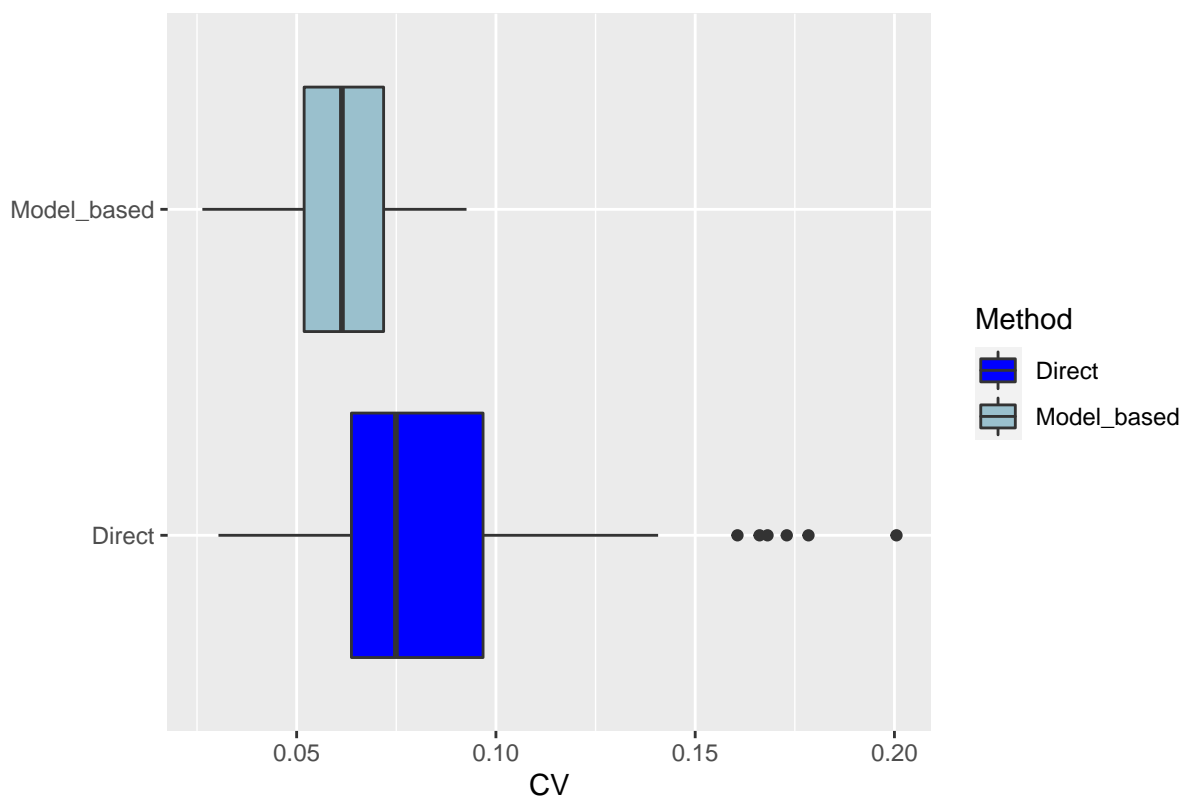
```
compare_plot(fh_log, CV = TRUE, label = "no_title")
```



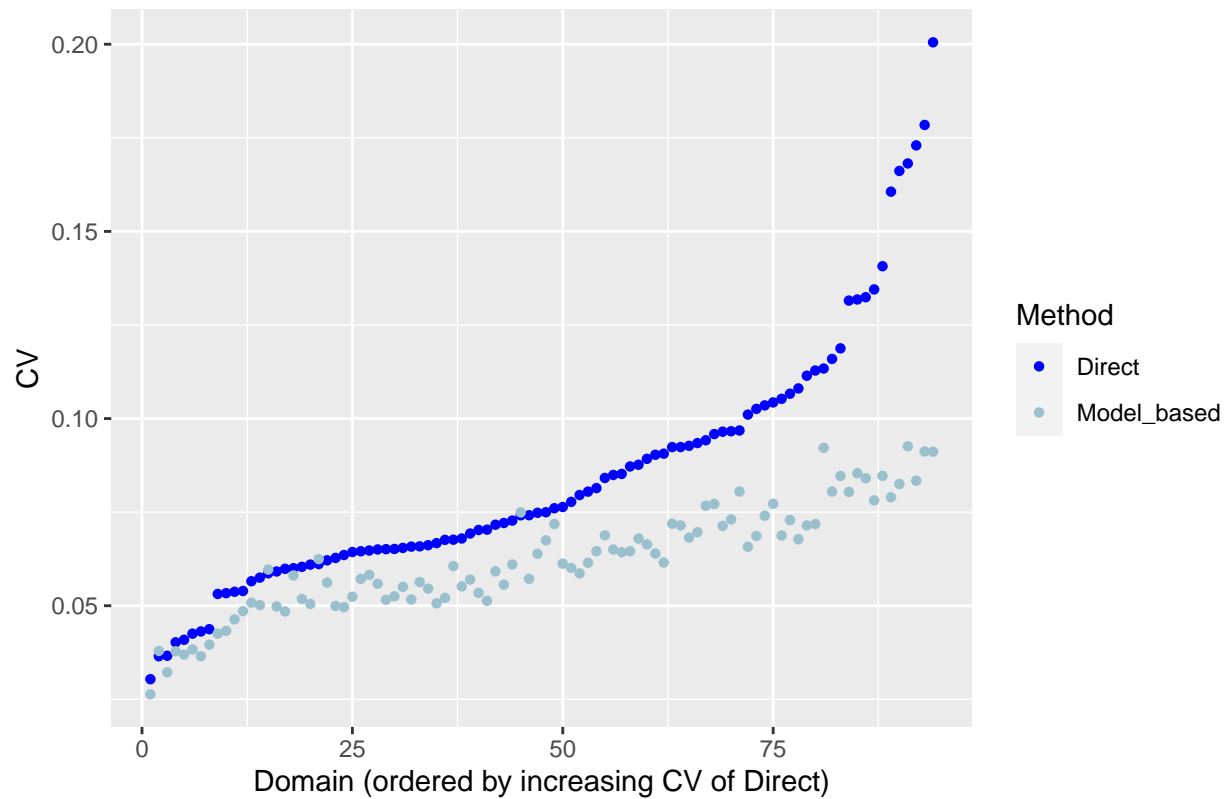
Press [enter] to continue



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```
compare(fh_log)
```

```
## Brown test
##
## Null hypothesis: EBLUP estimates do not differ significantly from the
##     direct estimates
##
##   W.value Df p.value
## 30.11971 94      1
##
## Correlation between synthetic part and direct estimator: 0.92
```

Extract and visualize the results

```
head(estimators(fh_log, MSE = TRUE))
```

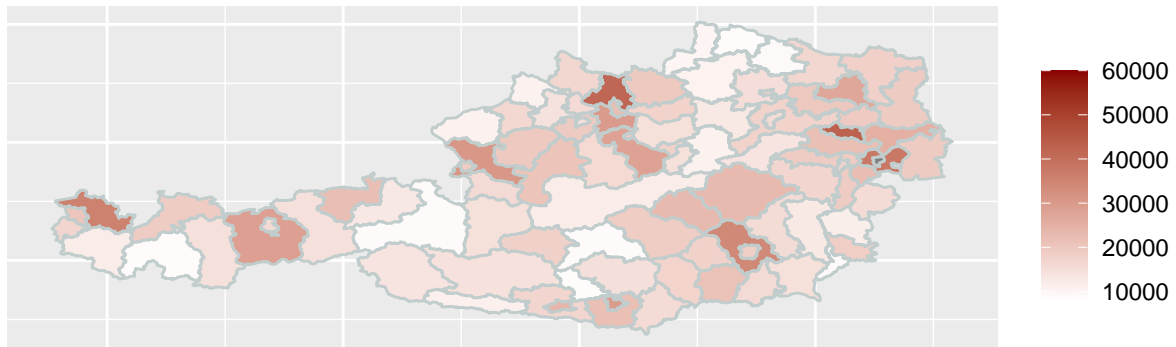
```
##           Domain   Direct Direct_MSE      FH    FH_MSE
## 1      Amstetten 14768.57   926167.4 14424.92 574061.1
## 2        Baden 21995.72  446534.3 21733.52 327640.8
## 3      Bludenz 12069.59 1243265.0 12801.89 847275.6
## 4 Braunau am Inn 10770.53 1029502.4 12154.04 869244.7
## 5      Bregenz 35731.20 4467316.4 35123.75 3060186.8
## 6 Bruck-Mürzzuschlag 23027.37 1971664.0 22628.23 1304465.0
```

Visualization of results on maps

```
# Load shape file
load_shapeaustria()

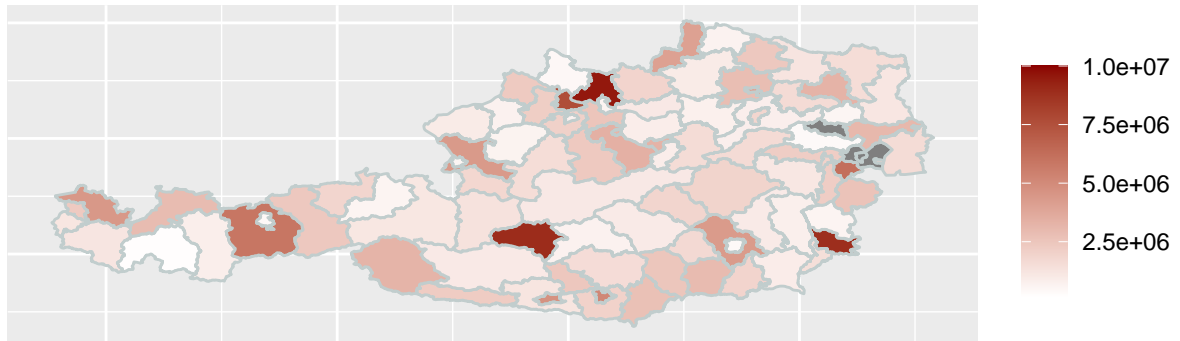
# Maps with adjusted scales
map_plot(object = fh_log, MSE = TRUE,
         map_obj = shape_austria_dis, map_dom_id = "PB",
         scale_points = list(Direct = list(ind = c(8000, 60000),
                                             MSE = c(200000, 10000000)),
                             FH = list(ind = c(8000, 60000),
                                         MSE = c(200000, 10000000))))
```

Direct



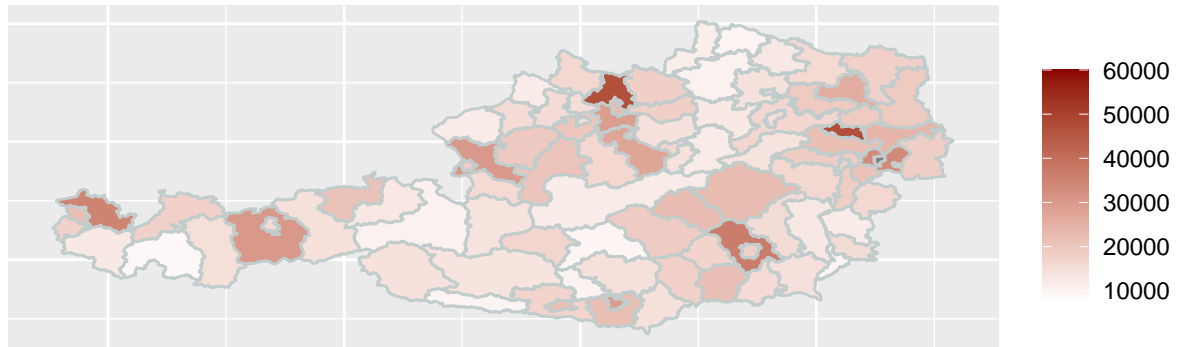
```
## Press [enter] to continue
```

Direct MSE



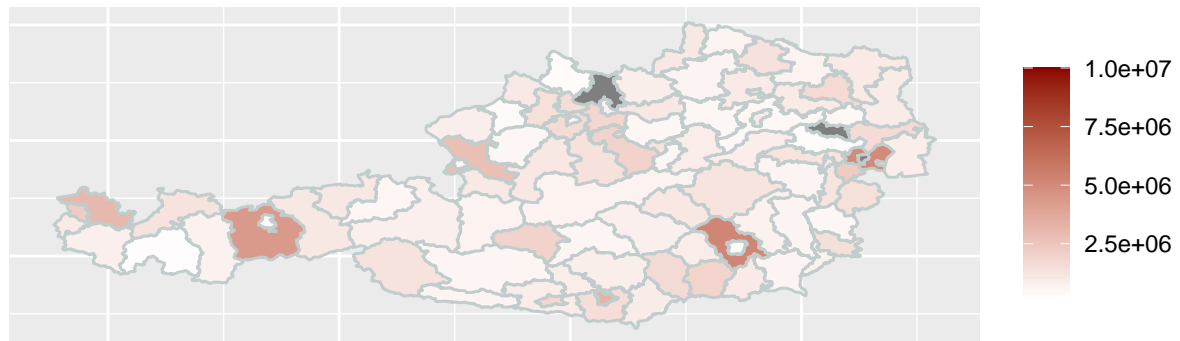
Press [enter] to continue

FH



Press [enter] to continue

FH MSE



Estimate EBLUPs and MSEs

```
fh_arcsin <- fh(fixed = MTMED ~ cash + age_ben + rent + house_allow,  
               vardir = "Var_MTMED", combined_data = combined_data,  
               domains = "Domain", transformation = "arcsin",  
               backtransformation = "bc", eff_smpsize = "n", MSE = TRUE,  
               mse_type = "boot")
```

```
## b =1  
## b =2  
## b =3  
## b =4  
## b =5  
## b =6  
## b =7  
## b =8  
## b =9  
## b =10  
## b =11
```

b =12
b =13
b =14
b =15
b =16
b =17
b =18
b =19
b =20
b =21
b =22
b =23
b =24
b =25
b =26
b =27
b =28
b =29
b =30
b =31
b =32
b =33
b =34
b =35
b =36
b =37
b =38
b =39
b =40
b =41
b =42
b =43
b =44
b =45
b =46
b =47

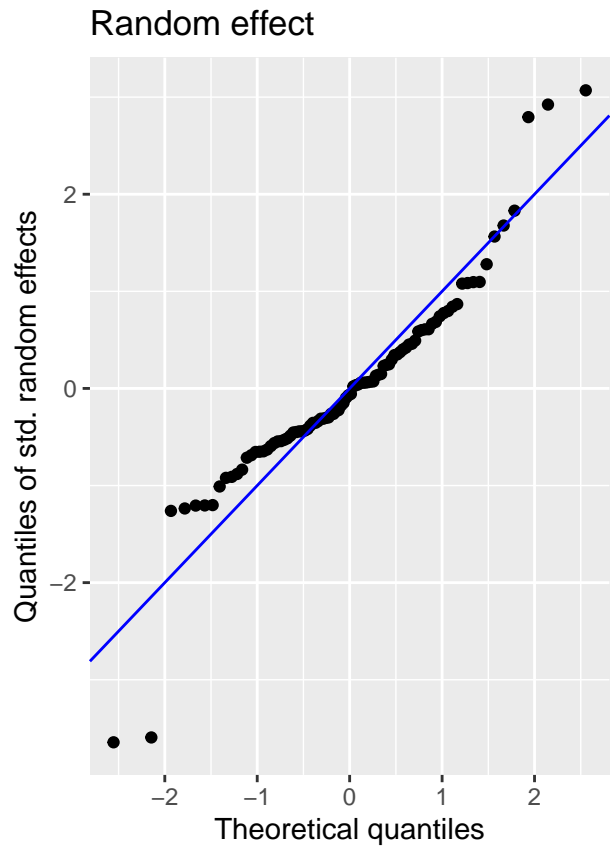
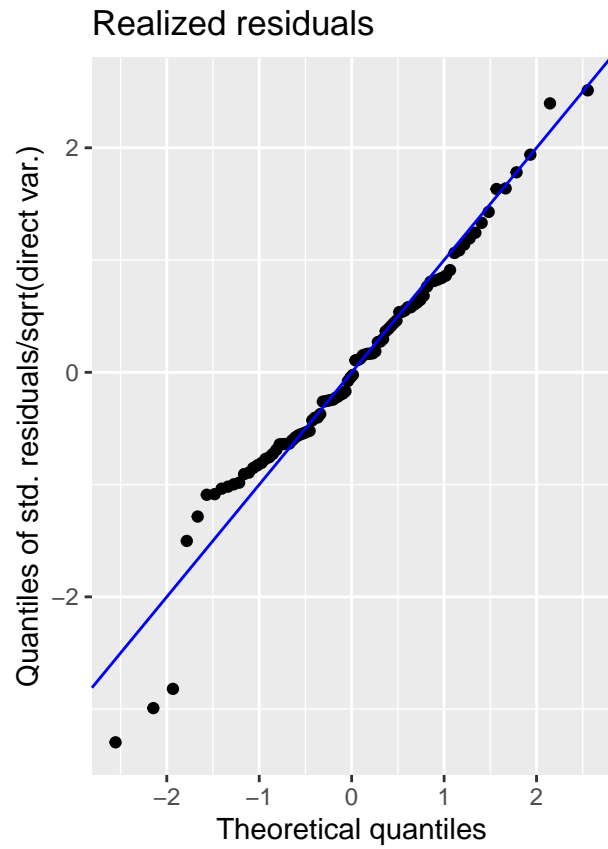
```
## b =48
## b =49
## b =50
```

Assess the estimated model

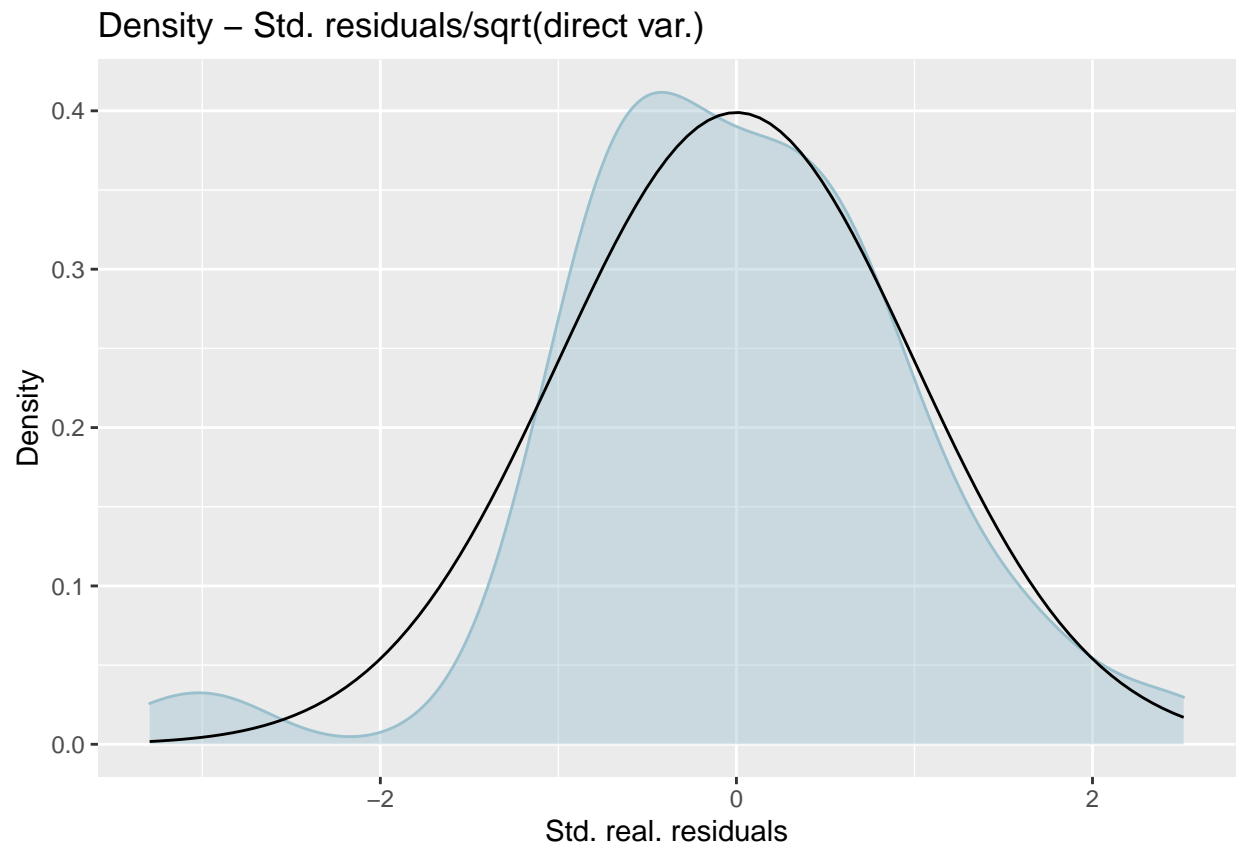
```
summary(fh_arcsin)
```

```
## Call:
## fh(fixed = MTMED ~ cash + age_ben + rent + house_allow, vardir = "Var_MTMED",
##     combined_data = combined_data, domains = "Domain", transformation = "arcsin",
##     backtransformation = "bc", eff_smpsize = "n", MSE = TRUE,
##     mse_type = "boot")
##
## Out-of-sample domains:  0
## In-sample domains:   94
##
## Variance and MSE estimation:
## Variance estimation method:  reml
## Estimated variance component(s):  0.0001874598
## MSE method:  bootstrap
##
## Coefficients:
##              coefficients  std.error t.value  p.value
## (Intercept) -2.4830e-01  5.5744e-02 -4.4544 8.414e-06 ***
## cash         5.7334e-05  3.4693e-06 16.5263 < 2.2e-16 ***
## age_ben      4.9484e-05  1.1052e-05  4.4773 7.560e-06 ***
## rent         1.7314e-05  4.5992e-06  3.7646 0.0001668 ***
## house_allow  3.8655e-04  3.6580e-04  1.0567 0.2906342
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Explanatory measures:
##      loglike      AIC      BIC      R2      AdjR2
## 1 82.30149 -152.603 -137.3432 0.9041989 0.9864738
##
## Residual diagnostics:
##              Skewness Kurtosis Shapiro_W  Shapiro_p
## Standardized_Residuals -0.36732735 4.494575 0.9629906 9.246963e-03
## Random_effects         -0.09832158 6.734578 0.9080185 6.259135e-06
##
## Transformation:
## Transformation Back_transformation
##              arcsin              bc
```

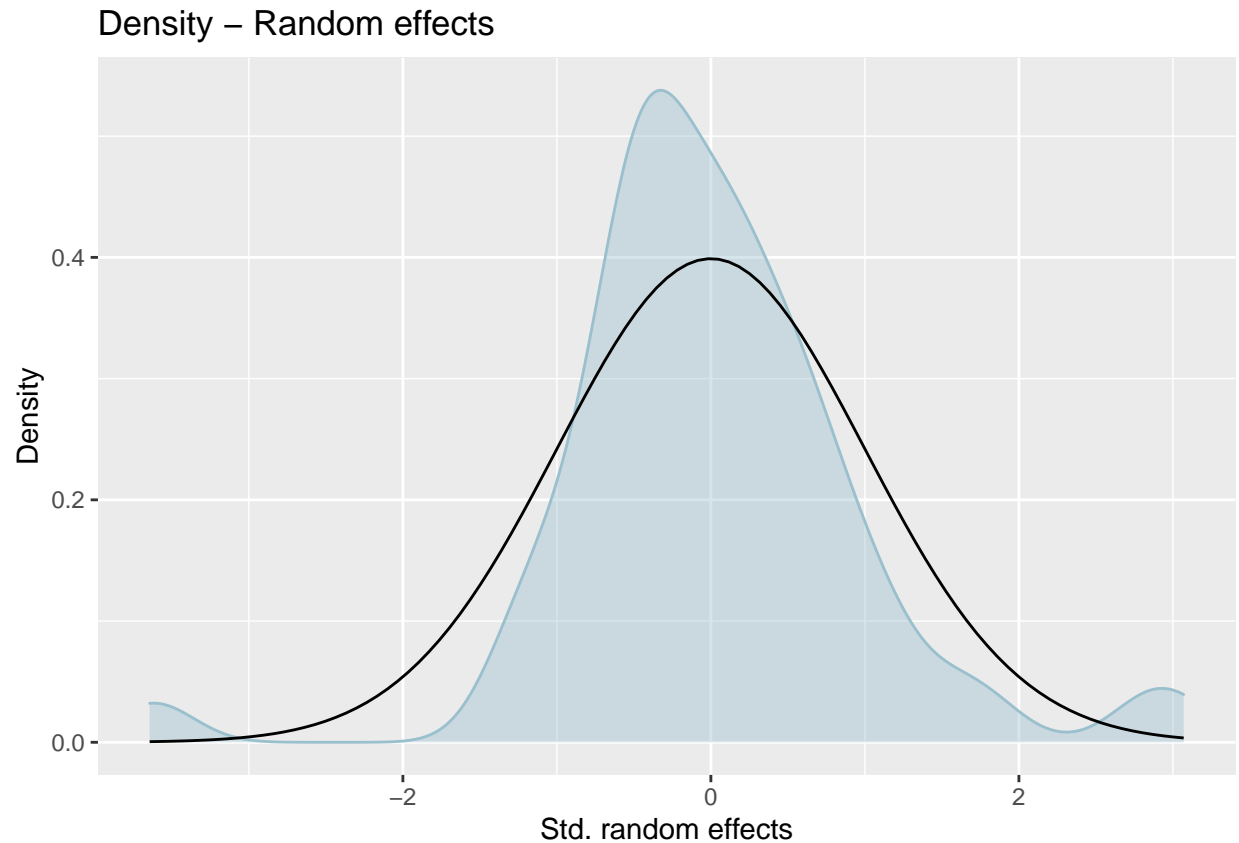
```
plot(fh_arcsin)
```



Press [enter] to continue



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Extract and visualize the results

```
head(estimators(fh_arcsin, MSE = TRUE))
```

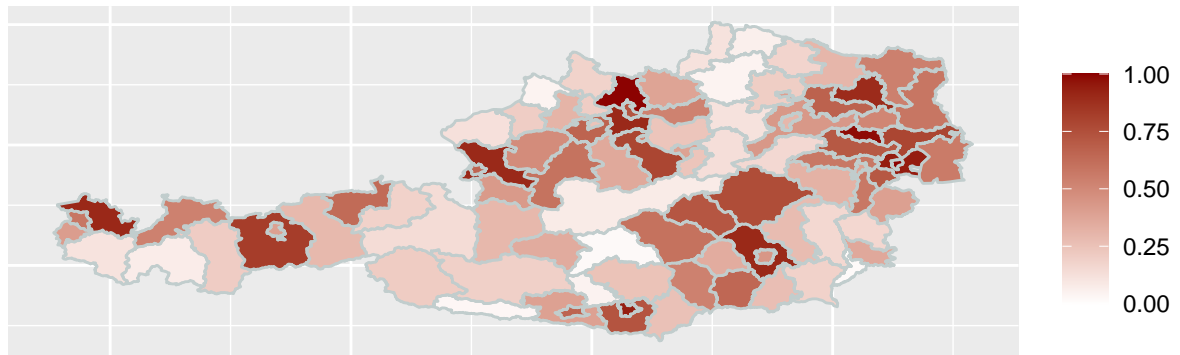
##	Domain	Direct	Direct_MSE	FH	FH_MSE
## 1	Amstetten	0.2429907	0.0005730411	0.2646767	0.0003942584
## 2	Baden	0.7110553	0.0005162203	0.6109119	0.0009669789
## 3	Bludenz	0.1172840	0.0006390644	0.1633053	0.0003273193
## 4	Braunau am Inn	0.1276596	0.0003949029	0.1782620	0.0004002151
## 5	Bregenz	0.9053254	0.0002535837	0.9492463	0.0003347779
## 6	Bruck-Mürzzuschlag	0.7622378	0.0006336761	0.6487685	0.0003246441

Visualization of results on maps

```
# Load shape file
load_shapeaustria()

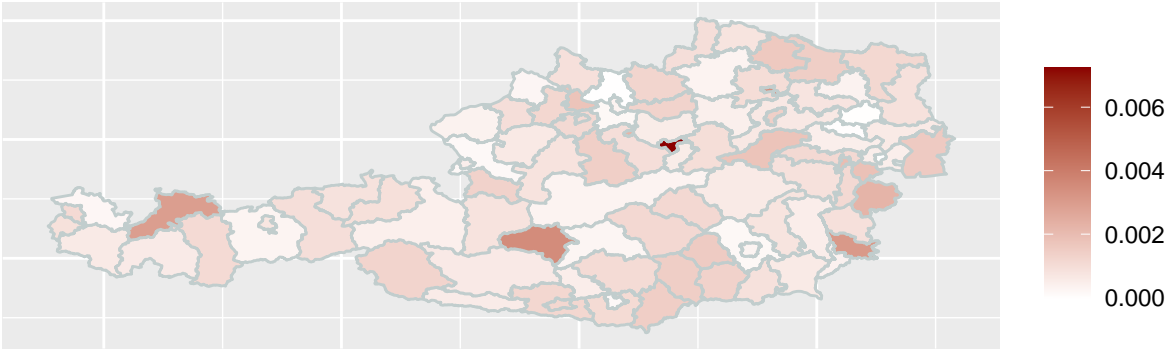
# Maps with adjusted scales
map_plot(object = fh_arcsin, MSE = TRUE,
          map_obj = shape_austria_dis, map_dom_id = "PB")
```

Direct



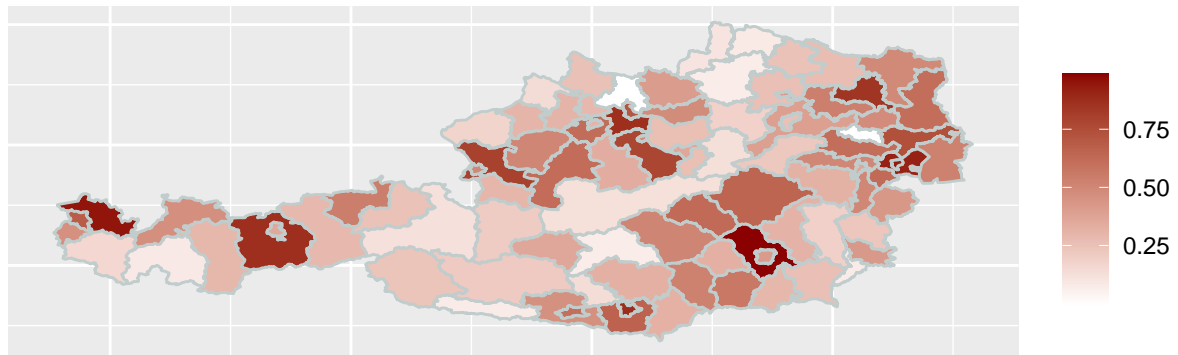
Press [enter] to continue

Direct MSE



Press [enter] to continue

FH



Press [enter] to continue

FH MSE

