Transformed area-level model

Small introduction

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

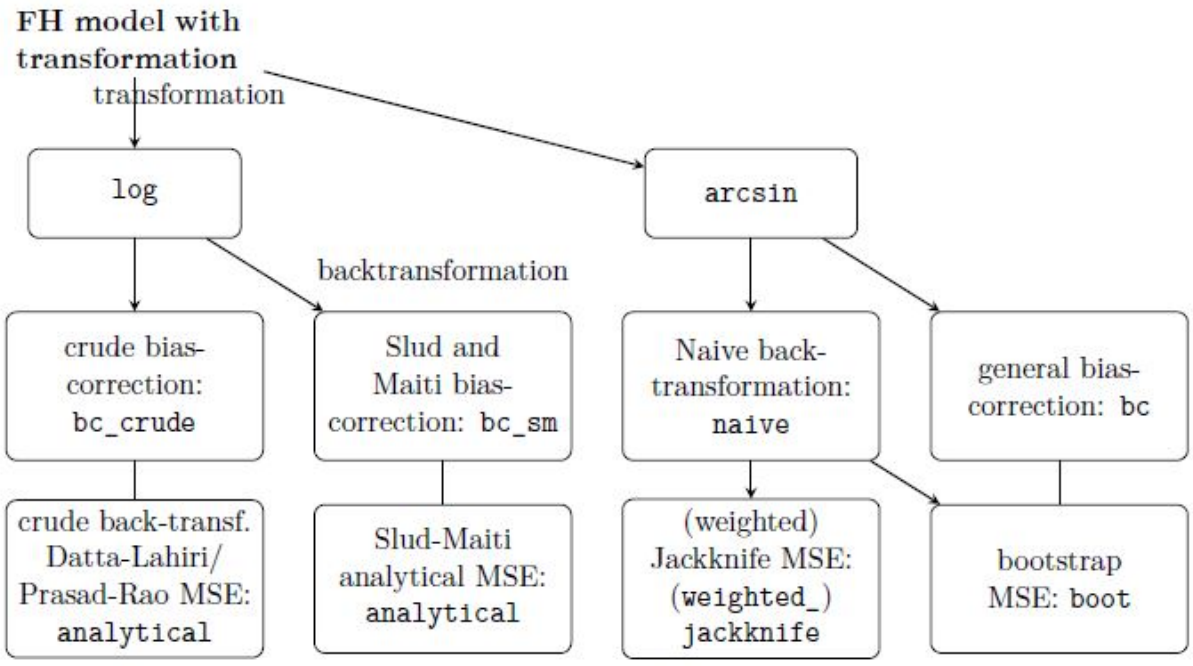


Figure 1: Estimation options for the transformed area-level model

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")
```

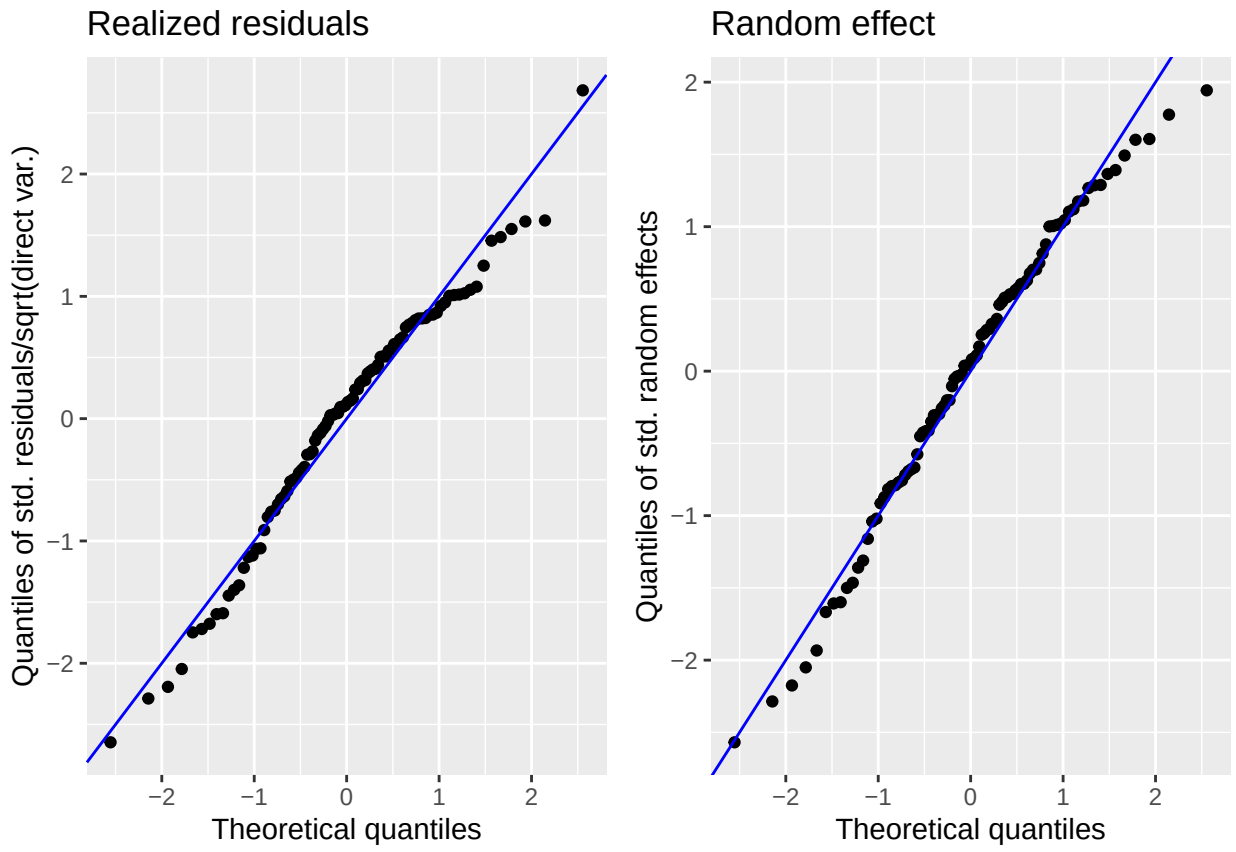
Assess the estimated model

```
summary(fh_log)
```

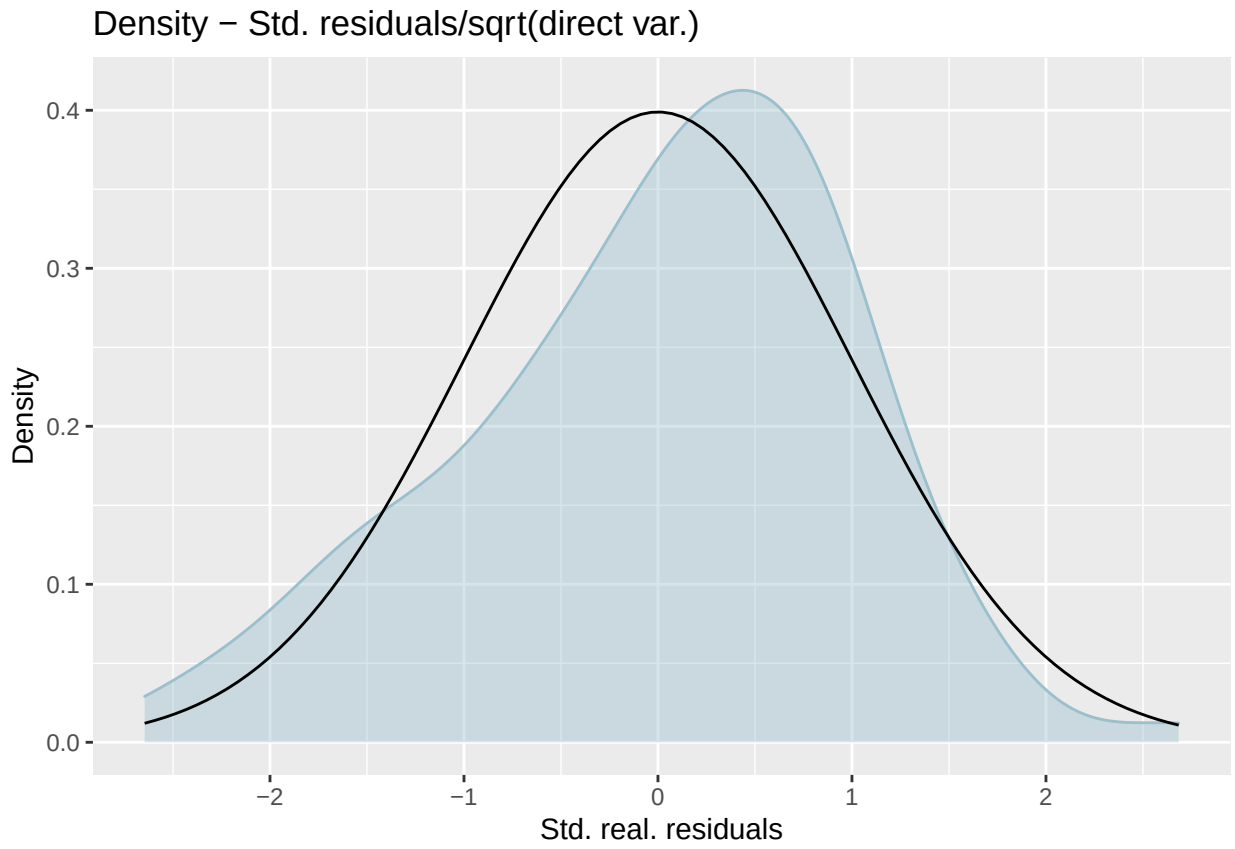
```
## Call:
##  fh(fixed = Mean ~ cash + self_empl, vardir = "Var_Mean", combined_data = combined_data,
##     domains = "Domain", method = "ml", transformation = "log",
##     backtransformation = "bc_sm", eff_smpsize = "n", MSE = TRUE,
##     mse_type = "analytical")
##
## Out-of-sample domains:  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
```

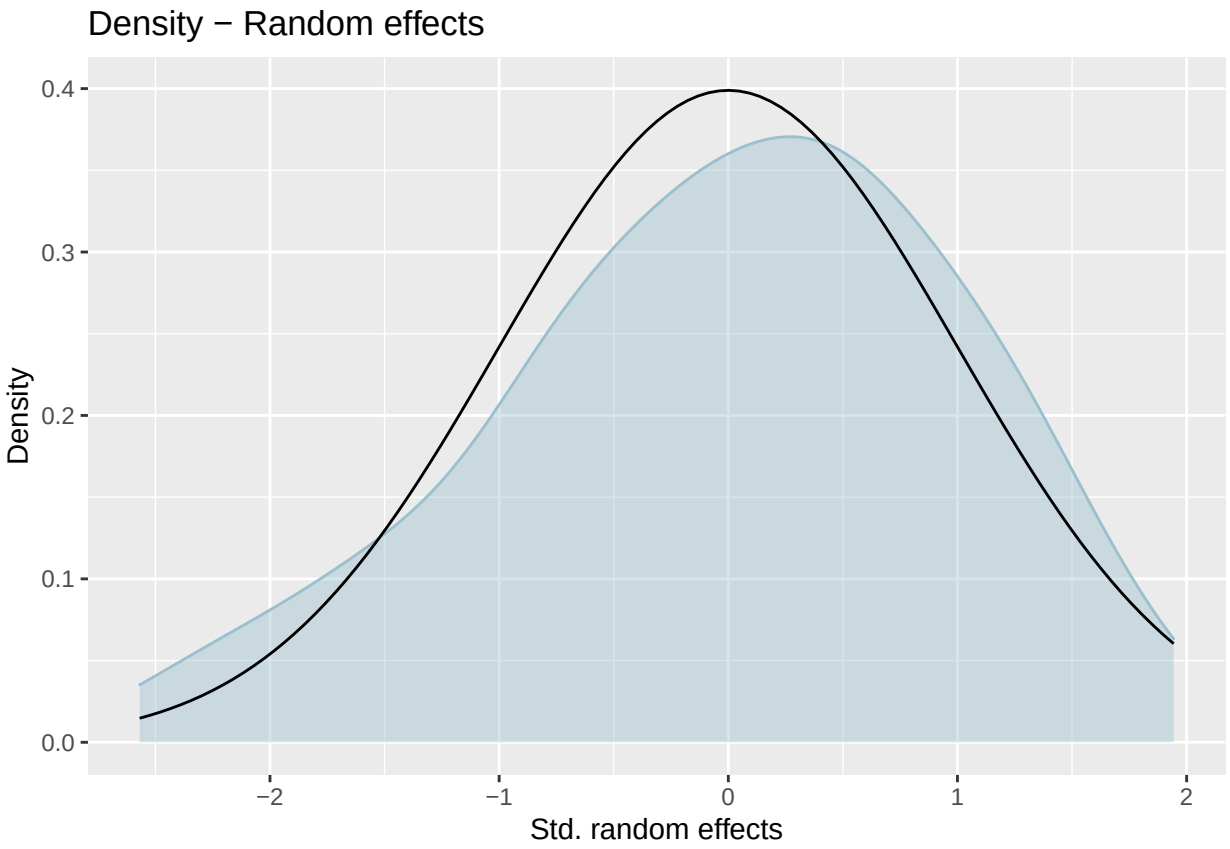
```
plot(fh_log)
```




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

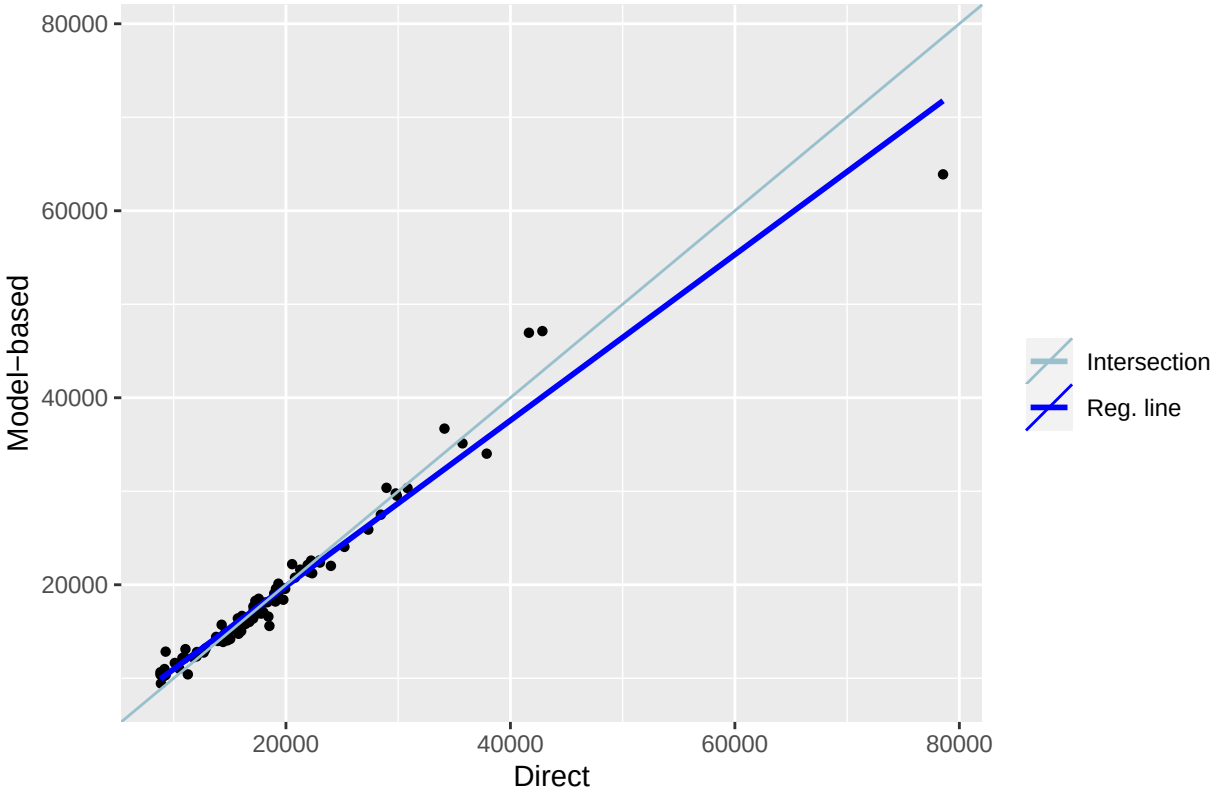



```
## Press [enter] to continue
```

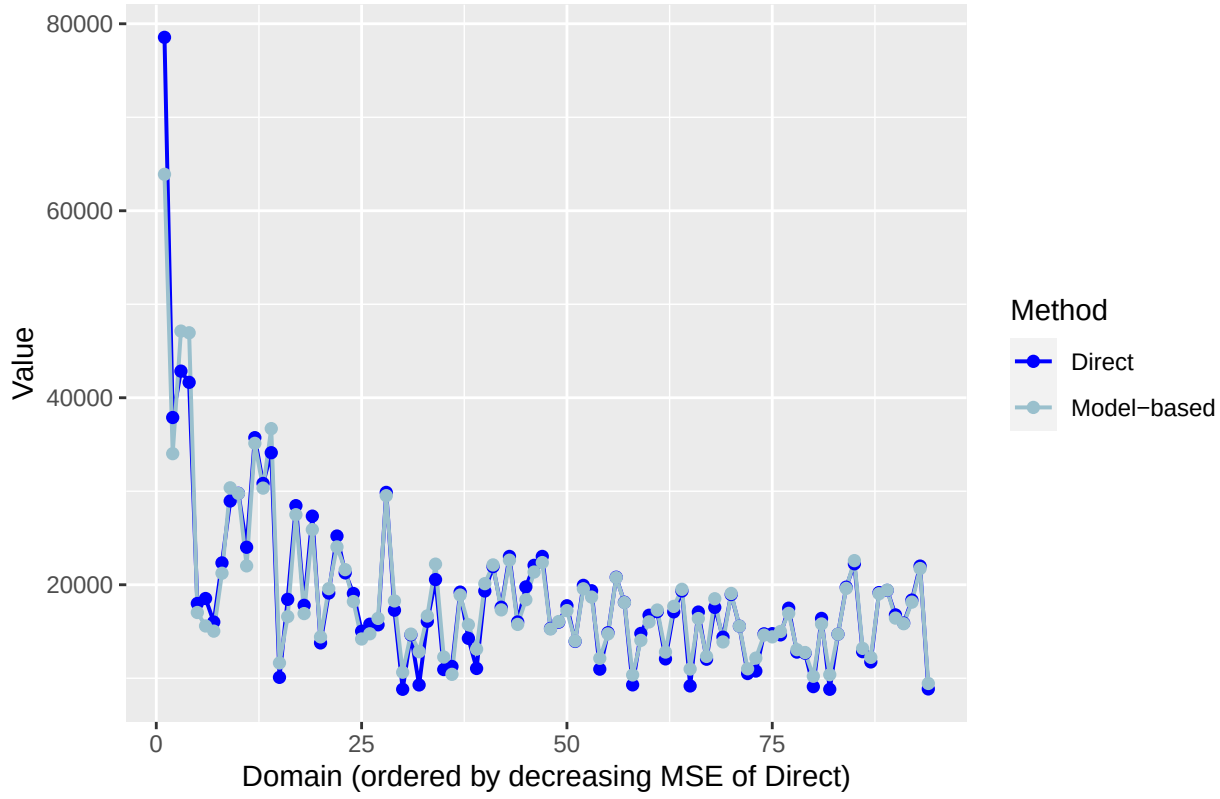


Compare results with direct estimates

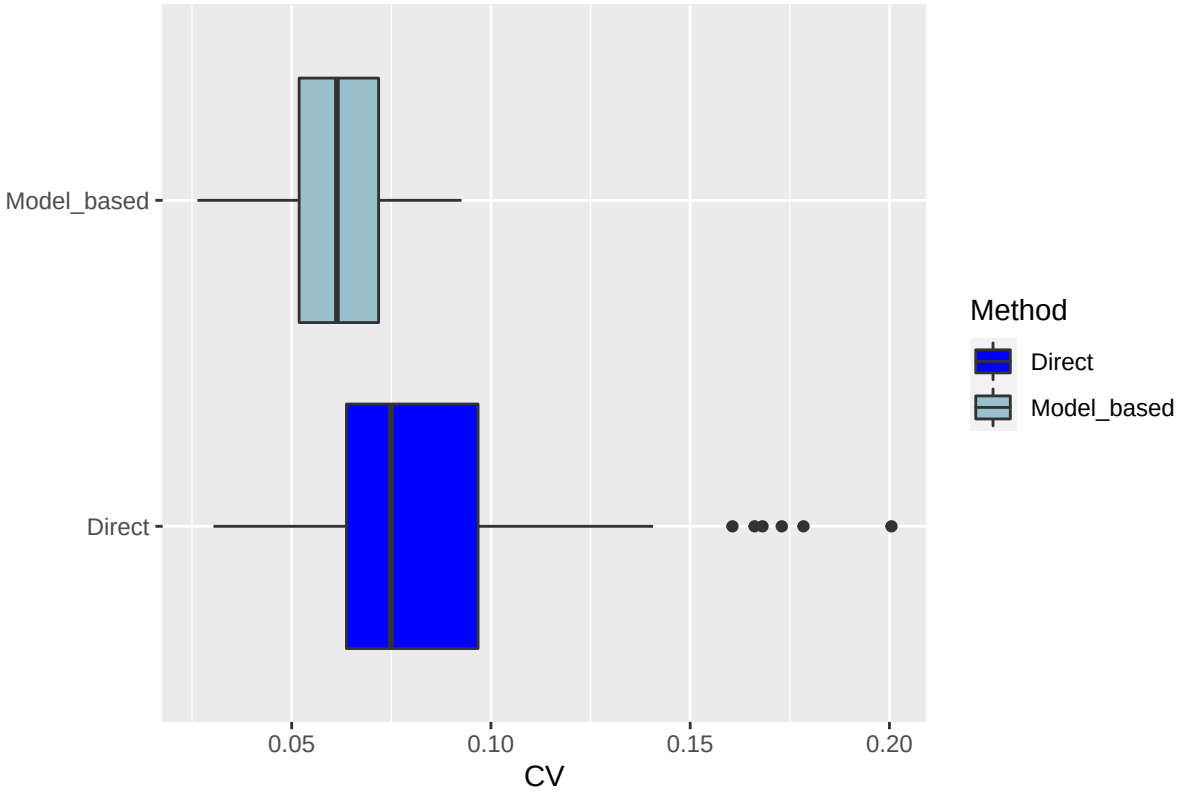
```
compare_plot(fh_log, CV = TRUE, label = "no_title")
```



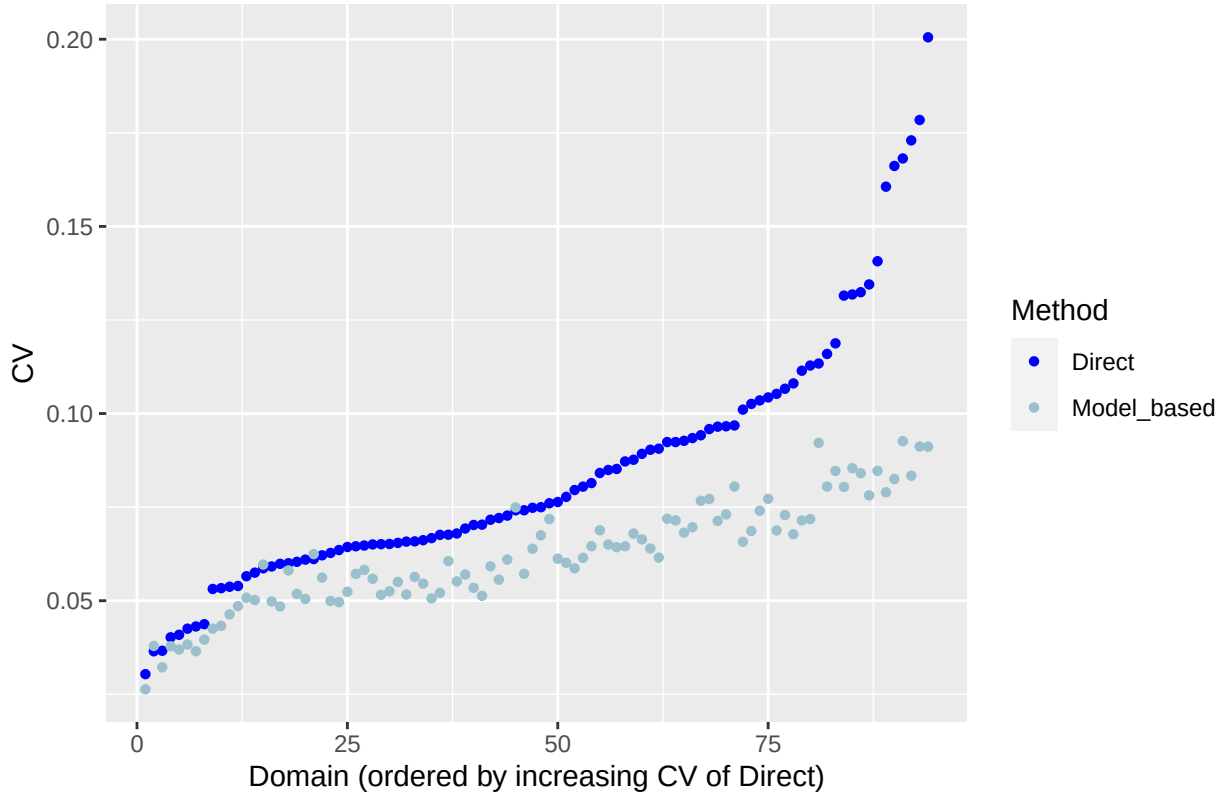

```
## Press [enter] to continue
```




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




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




```
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
```

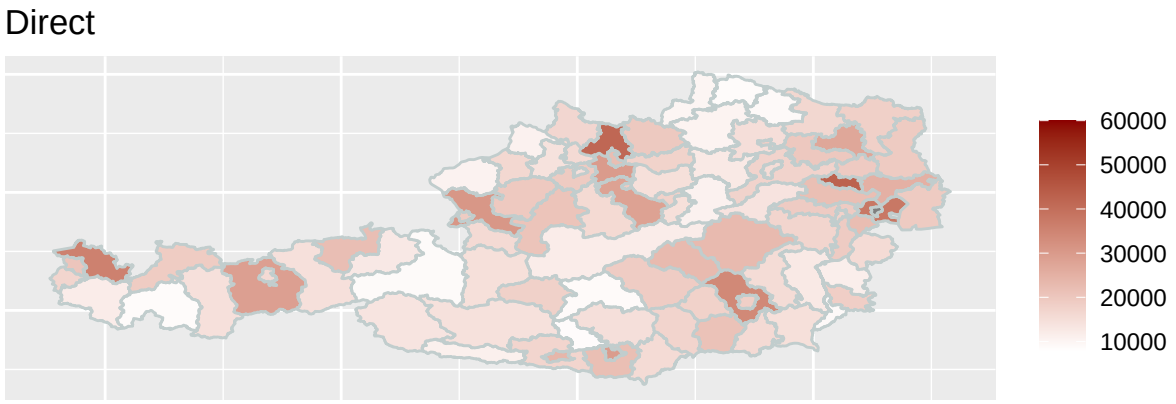
Extract and visualize the results

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

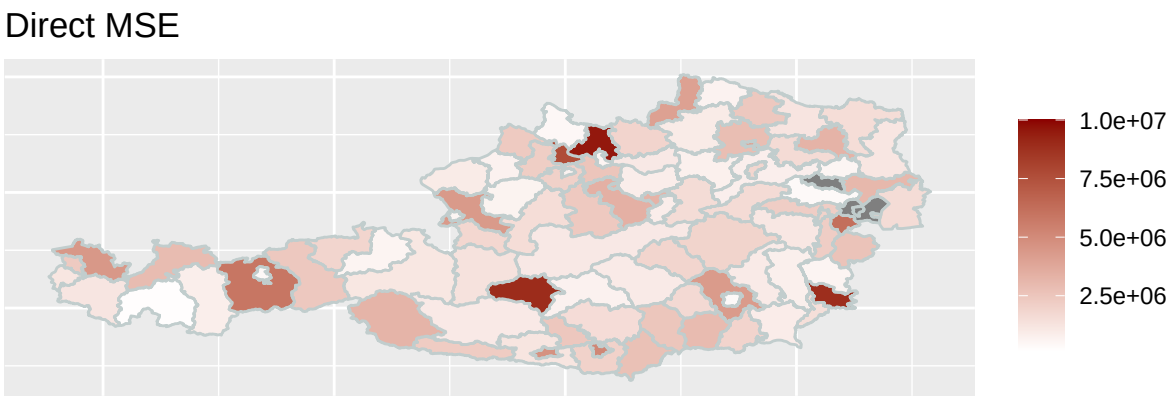
```
##                Domain   Direct Direct_MSE       FH    FH_MSE
## 1          Amstetten 14768.57   926167.4 14424.92  574061.1
## 2              Baden 21995.72   446534.3 21733.52  327640.8
## 3            Bludenz 12069.59  1243265.0 12801.89  847275.6
## 4     Braunau am Inn 10770.53  1029502.4 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

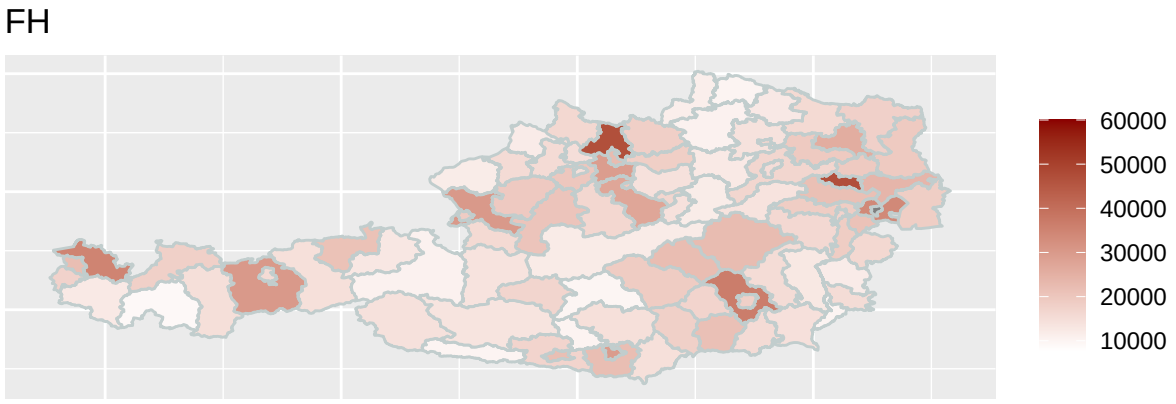
```
# Load shape file
load_shapeaustria()

# 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))))
```



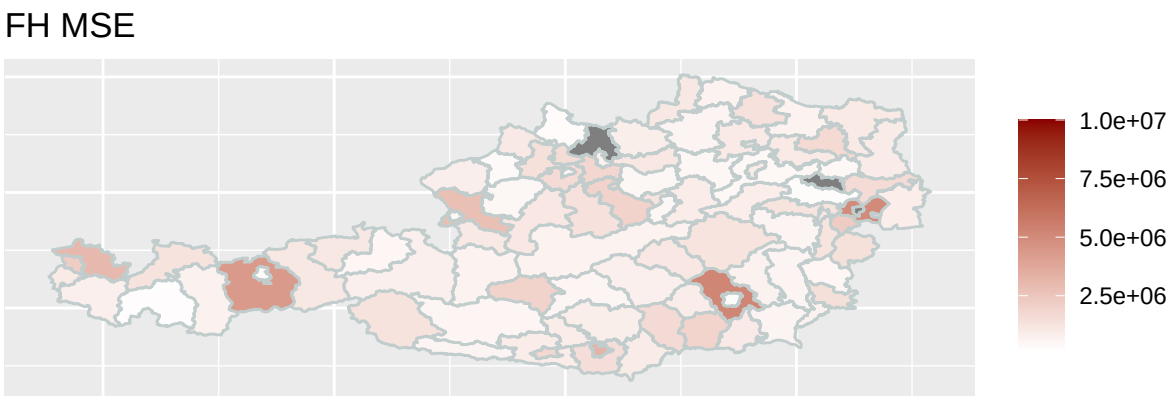

```
## Press [enter] to continue
```




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




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



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
```

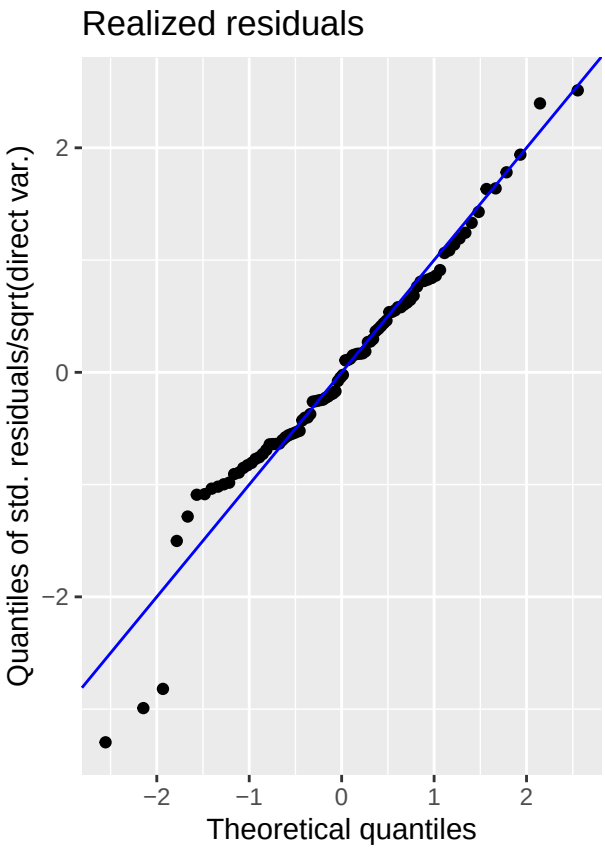
```
## b =48
## b =49
## b =50
```

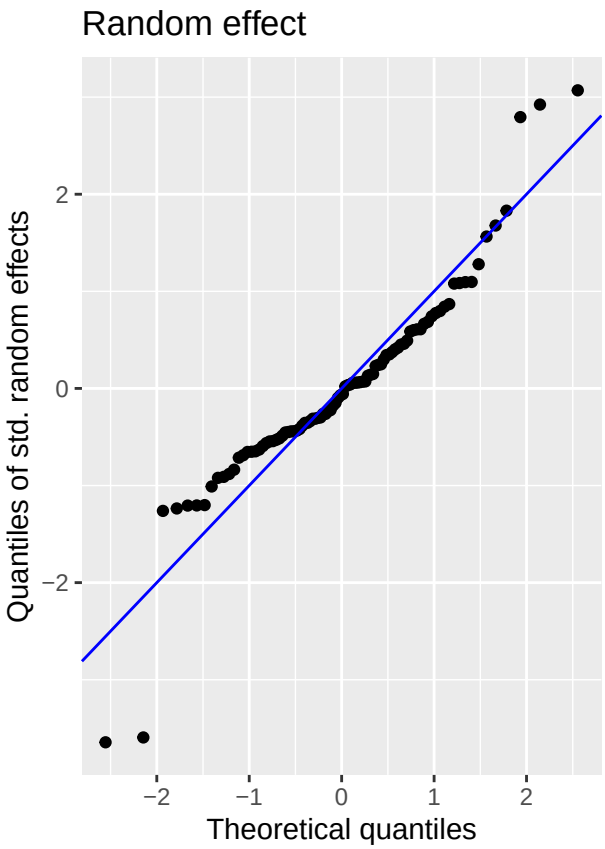
Assess the estimated model

```
summary(fh_arcsin)
```

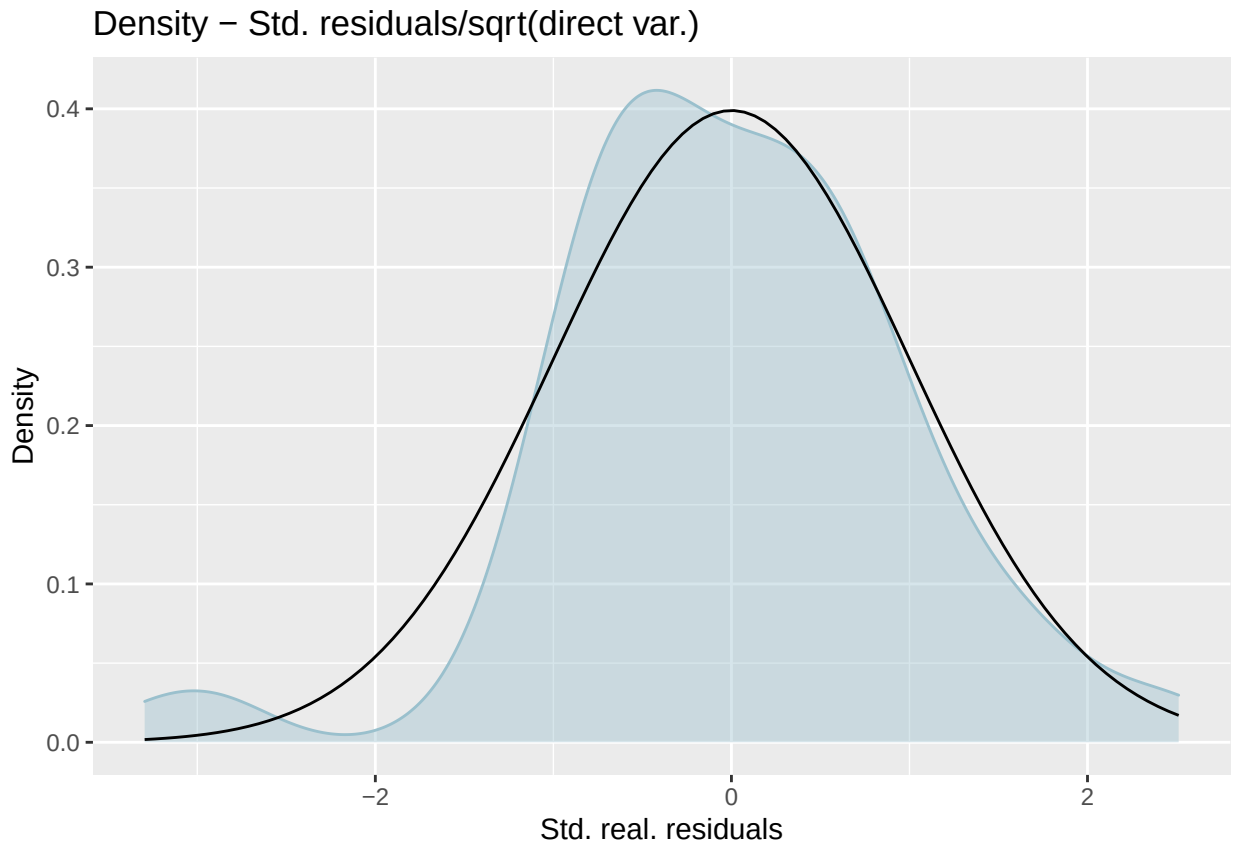
```
## Call:
##  fh(fixed = MTMED ~ cash + age_ben + rent + house_allow, vardir = "Var_MTMED",
##     combined_data = combined_data, domains = "Domain", transformation = "arcsin",
##     backtransformation = "bc", eff_smpsize = "n", MSE = TRUE,
##     mse_type = "boot")
##
## Out-of-sample domains:  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)
```

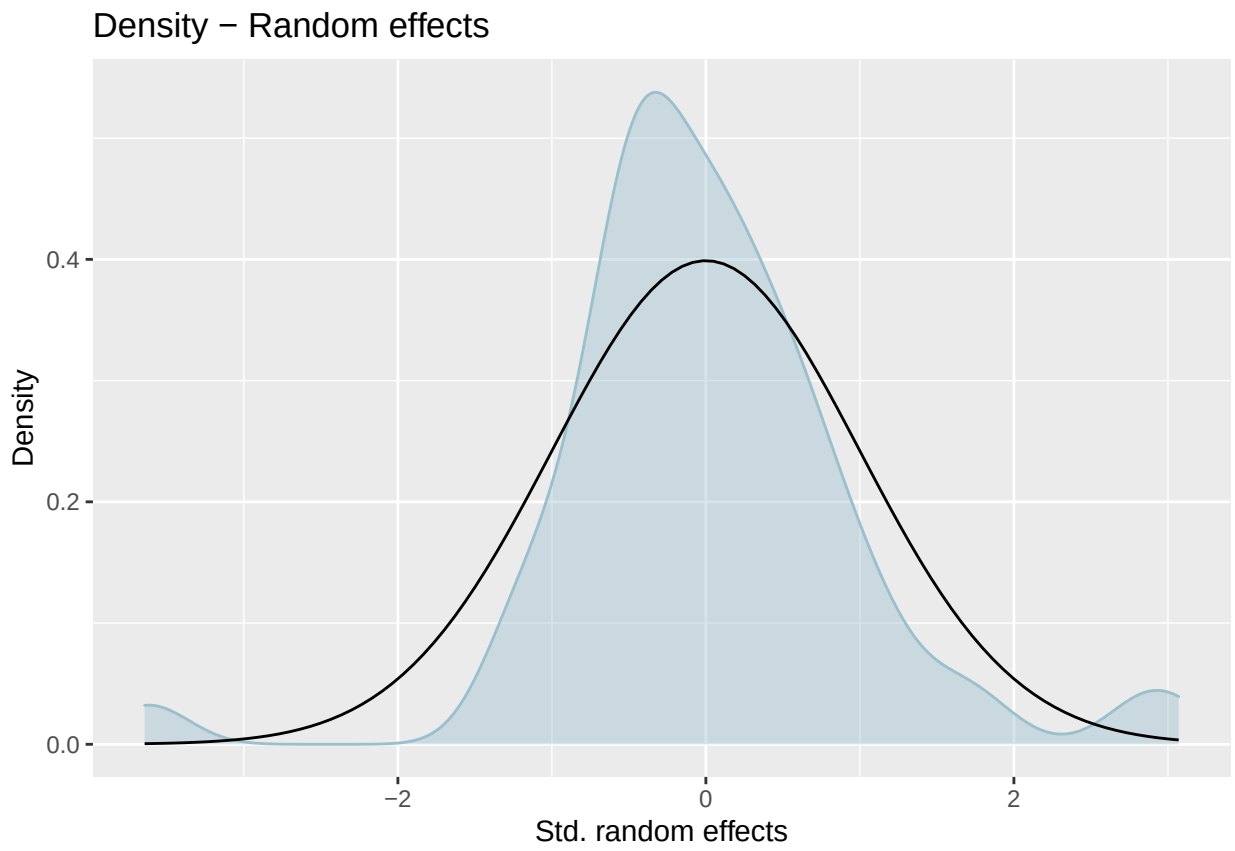





```
## Press [enter] to continue
```




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



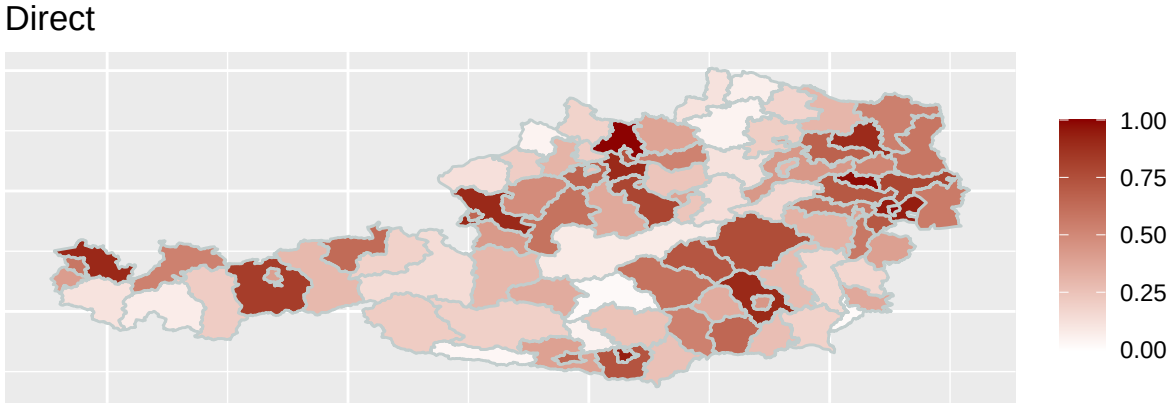
Extract and visualize the results

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

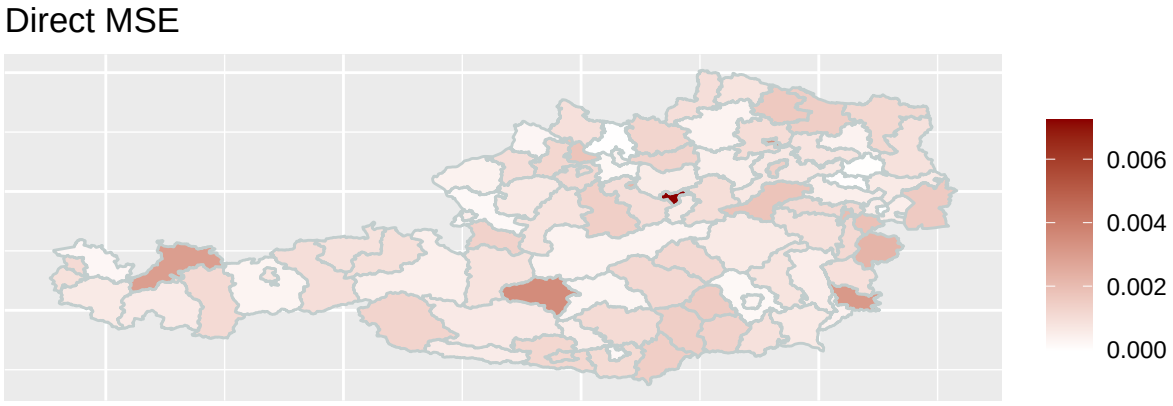
```
##               Domain    Direct   Direct_MSE        FH       FH_MSE
## 1          Amstetten 0.2429907 0.0005730411 0.2646767 0.0003942584
## 2              Baden 0.7110553 0.0005162203 0.6109119 0.0009669789
## 3            Bludenz 0.1172840 0.0006390644 0.1633053 0.0003273193
## 4     Braunau 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

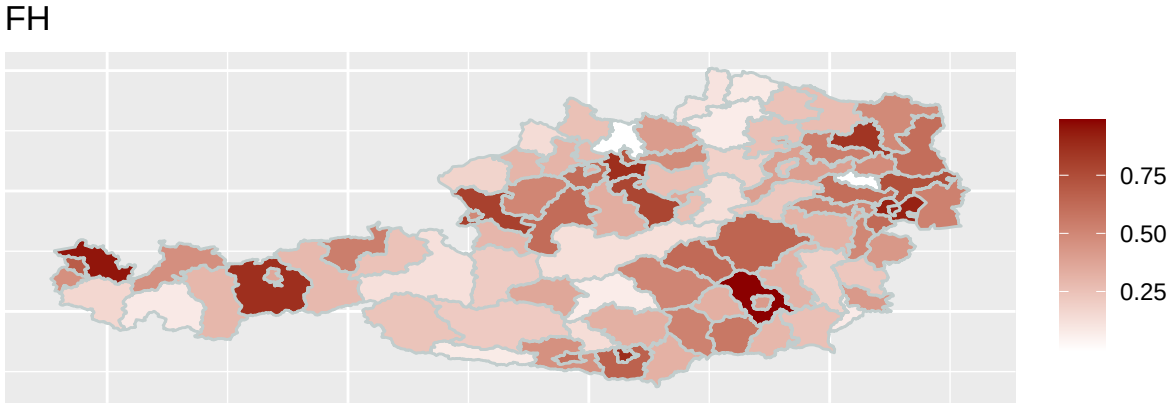
```
# Load shape file
load_shapeaustria()

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




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




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




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

FH MSE