Varying thresholds for poverty mapping

Poverty mapping with emdi based on the empirical best prediction

The ebp function in package emdi returns ten different indicators by default. These include the head count ratio and the poverty gap. Both indicators makes use of a threshold or a poverty line. This threshold could be a fixed value or based on the indicator of interst, e.g., 60% of the median income. In the latter case, the poverty line needs to be calculated in each bootstrap iteration for the estimation of the uncertainty measure. Thus, it should be given as a function to the threshold argument in the ebp function.

Load package and data

The emdi package loaded here is the emdi package published on CRAN. The installation is explained in installEmdiExtensions.

For the data, unit-level survey and population data is loaded.

```
# Load package
library(emdi)
```

```
## Registered S3 method overwritten by 'MuMIn':
##   method         from
##   predict.merMod lme4
```

```
# Load aggregated data
data("eusilcA_pop")
data("eusilcA_smp")
```

One fixed poverty line

One way to add a poverty line is a fixed value. This could be, e.g., 10885.33.

For an application, the bootstrap iterations should be increased but due to computational reasons B is set to 2.

```
emdi_model <- ebp(fixed = eqIncome ~ gender + eqsize + cash + self_empl +
                    unempl_ben + age_ben + surv_ben + sick_ben + dis_ben + rent +
                    fam_allow + house_allow + cap_inv + tax_adj, pop_data = eusilcA_pop,
                  pop_domains = "district", smp_data = eusilcA_smp,
                  smp_domains = "district", threshold = 10885.33, MSE = TRUE,
                  B = 2)
```

```
##
 Bootstrap started
 Bootstrap completed
```

```
head(estimators(emdi_model))
```

```
##                Domain     Mean Head_Count Poverty_Gap      Gini
## 1 Eisenstadt-Umgebung 27509.02 0.03252174 0.006666679 0.2214688
## 2  Eisenstadt (Stadt) 53654.42 0.02918919 0.007225508 0.2872751
## 3             GÃ¼ssing 17189.34 0.15459459 0.034668361 0.1906263
## 4         Jennersdorf 13402.65 0.35877551 0.099130465 0.2098103
## 5         Mattersburg 21260.09 0.07908257 0.015634492 0.2091353
```

```
## 6     Neusiedl am See 19004.31 0.09316129 0.017250369 0.1865026
##   Quintile_Share Quantile_10 Quantile_25   Median Quantile_75 Quantile_90
## 1       3.103951   15481.824    19666.60 25414.07    33103.73    42172.95
## 2       4.877317   21672.724    36944.85 49274.84    62454.44    81651.59
## 3       2.718871   10177.998    13020.24 16718.13    20793.97    24807.80
## 4       3.093279    7521.495    10003.88 12869.55    16258.26    19788.91
## 5       2.941532   12184.216    15530.70 20102.09    25825.74    31543.47
## 6       2.624643   11436.229    14539.34 18386.83    22720.16    27271.89
```

Poverty line as a function of y

Another way to add a poverty line is a function of y. For instance, the EU countries use 60% of the median equvalized disposable income. In emdi, a function of y that calculates 60% of the median of y could be used as a threshold. This also enables the calculation of a poverty line in each bootstrap iteration for the uncertainty measure.

For an application, the bootstrap iterations should be increased but due to computational reasons B is set to 2.

```
emdi_model <- ebp(fixed = eqIncome ~ gender + eqsize + cash + self_empl +
                    unempl_ben + age_ben + surv_ben + sick_ben + dis_ben + rent +
                    fam_allow + house_allow + cap_inv + tax_adj, pop_data = eusilcA_pop,
                  pop_domains = "district", smp_data = eusilcA_smp,
                  smp_domains = "district", threshold = function(y){0.6 * median(y)},
                  MSE = TRUE, B = 2)
```

```
##
 Bootstrap started
 Bootstrap completed
```

```
head(estimators(emdi_model))
```

```
##                Domain     Mean Head_Count Poverty_Gap      Gini
## 1 Eisenstadt-Umgebung 27509.02 0.03304348 0.006760087 0.2214688
## 2  Eisenstadt (Stadt) 53654.42 0.02972973 0.007304474 0.2872751
## 3             GÃ¼ssing 17189.34 0.15648649 0.035100220 0.1906263
## 4         Jennersdorf 13402.65 0.36081633 0.100061464 0.2098103
## 5         Mattersburg 21260.09 0.07963303 0.015862168 0.2091353
## 6     Neusiedl am See 19004.31 0.09445161 0.017523417 0.1865026
##   Quintile_Share Quantile_10 Quantile_25   Median Quantile_75 Quantile_90
## 1       3.103951   15481.824    19666.60 25414.07    33103.73    42172.95
## 2       4.877317   21672.724    36944.85 49274.84    62454.44    81651.59
## 3       2.718871   10177.998    13020.24 16718.13    20793.97    24807.80
## 4       3.093279    7521.495    10003.88 12869.55    16258.26    19788.91
## 5       2.941532   12184.216    15530.70 20102.09    25825.74    31543.47
## 6       2.624643   11436.229    14539.34 18386.83    22720.16    27271.89
```

Mixed indicator based on two poverty lines

In some applications, it is of interest to use different poverty lines for, e.g., rural and urban areas. Since it is only possible to add one poverty line to function ebp, following workaround is possible.

In the following, two poverty lines 10885.33 and 8885.33 are used to estimate two head count ratios using the two poverty lines, respectively. The first one is the automatically returned head count ratio. The second will be defined as a custom indicator which will be the future mixed indicator.

```
emdi_model <- ebp(fixed = eqIncome ~ gender + eqsize + cash + self_empl +
                    unempl_ben + age_ben + surv_ben + sick_ben + dis_ben + rent +
                    fam_allow + house_allow + cap_inv + tax_adj, pop_data = eusilcA_pop,
                  pop_domains = "district", smp_data = eusilcA_smp,
                  smp_domains = "district", threshold = 10885.33,
                  MSE = TRUE, B = 2,
                  custom_indicator = list(mixed_hcr = function(y, threshold){mean(y < 8885.33)}))
```

```
##
 Bootstrap started
 Bootstrap completed
```

```
head(estimators(emdi_model))
```

```
##                Domain     Mean Head_Count Poverty_Gap      Gini
## 1 Eisenstadt-Umgebung 27509.02 0.03252174 0.006666679 0.2214688
## 2  Eisenstadt (Stadt) 53654.42 0.02918919 0.007225508 0.2872751
## 3             GÃ¼ssing 17189.34 0.15459459 0.034668361 0.1906263
## 4         Jennersdorf 13402.65 0.35877551 0.099130465 0.2098103
## 5         Mattersburg 21260.09 0.07908257 0.015634492 0.2091353
## 6     Neusiedl am See 19004.31 0.09316129 0.017250369 0.1865026
##   Quintile_Share Quantile_10 Quantile_25   Median Quantile_75 Quantile_90
## 1       3.103951   15481.824    19666.60 25414.07    33103.73    42172.95
## 2       4.877317   21672.724    36944.85 49274.84    62454.44    81651.59
## 3       2.718871   10177.998    13020.24 16718.13    20793.97    24807.80
## 4       3.093279    7521.495    10003.88 12869.55    16258.26    19788.91
## 5       2.941532   12184.216    15530.70 20102.09    25825.74    31543.47
## 6       2.624643   11436.229    14539.34 18386.83    22720.16    27271.89
##    mixed_hcr
## 1 0.01495652
## 2 0.01621622
## 3 0.07972973
## 4 0.21714286
## 5 0.03266055
## 6 0.03922581
```

This emdi_model object returns the Head_Count with the poverty line 10885.33 and the mixed_hcr with the poverty line 8885.33. Assuming, that the poverty line 10885.33 applies to the first 20 domains and the poverty line 8885.33 otherwise, the mixed_hcr indicator can be updated as follows.

```
first20 <- rep(FALSE, 94)
first20[1:20] <- TRUE

emdi_model$ind$mixed_hcr[first20] <- emdi_model$ind$Head_Count[first20]
emdi_model$MSE$mixed_hcr[first20] <- emdi_model$MSE$Head_Count[first20]
head(estimators(emdi_model))
```

```
##                Domain     Mean Head_Count Poverty_Gap      Gini
## 1 Eisenstadt-Umgebung 27509.02 0.03252174 0.006666679 0.2214688
## 2  Eisenstadt (Stadt) 53654.42 0.02918919 0.007225508 0.2872751
## 3             GÃ¼ssing 17189.34 0.15459459 0.034668361 0.1906263
## 4         Jennersdorf 13402.65 0.35877551 0.099130465 0.2098103
## 5         Mattersburg 21260.09 0.07908257 0.015634492 0.2091353
## 6     Neusiedl am See 19004.31 0.09316129 0.017250369 0.1865026
##   Quintile_Share Quantile_10 Quantile_25   Median Quantile_75 Quantile_90
## 1       3.103951   15481.824    19666.60 25414.07    33103.73    42172.95
```

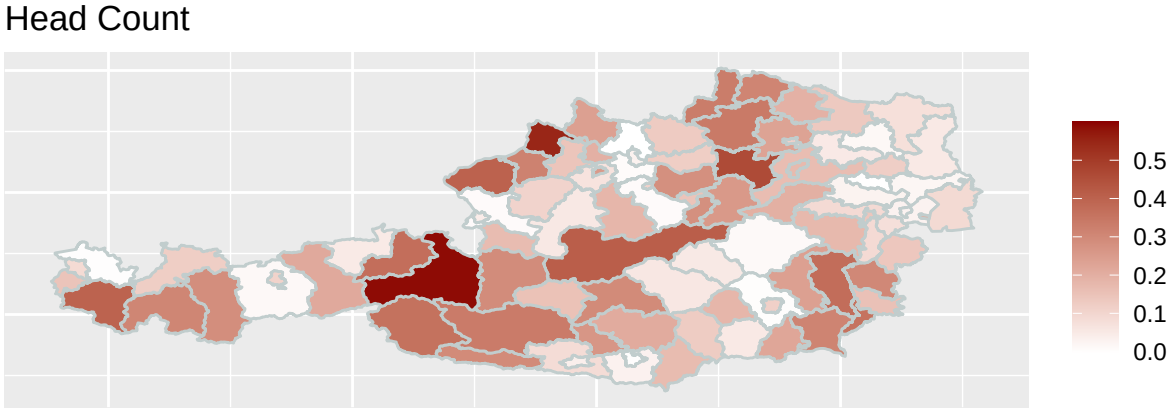
```
## 2       4.877317   21672.724    36944.85 49274.84    62454.44    81651.59
## 3       2.718871   10177.998    13020.24 16718.13    20793.97    24807.80
## 4       3.093279    7521.495    10003.88 12869.55    16258.26    19788.91
## 5       2.941532   12184.216    15530.70 20102.09    25825.74    31543.47
## 6       2.624643   11436.229    14539.34 18386.83    22720.16    27271.89
##    mixed_hcr
## 1 0.03252174
## 2 0.02918919
## 3 0.15459459
## 4 0.35877551
## 5 0.07908257
## 6 0.09316129
```

```
tail(estimators(emdi_model))
```

```
##       Domain     Mean  Head_Count  Poverty_Gap      Gini Quintile_Share
## 89    Reutte 18329.96 0.123333333 0.0288102093 0.1879845       2.698333
## 90    Schwaz 15305.26 0.216587678 0.0494003193 0.1977235       2.808239
## 91   Bludenz 12743.01 0.399506173 0.1132301861 0.2296274       3.385003
## 92   Bregenz 32269.58 0.004674556 0.0007006917 0.2095524       2.838061
## 93  Dornbirn 19794.00 0.090593607 0.0189277223 0.2117603       2.972636
## 94 Feldkirch 17397.89 0.149172932 0.0316361274 0.2069506       2.905127
##    Quantile_10 Quantile_25   Median Quantile_75 Quantile_90  mixed_hcr
## 89   11013.240   14080.345 17832.57    21854.47    26235.01 0.06166667
## 90    8746.890   11499.002 14852.48    18586.50    22427.77 0.11317536
## 91    6438.116    9001.094 12173.73    15907.58    19667.08 0.24617284
## 92   19354.513   23836.468 29597.87    36700.72    47143.60 0.00147929
## 93   11262.253   14475.086 18792.19    23670.02    29190.30 0.04365297
## 94    9835.191   12866.383 16610.01    21023.17    25603.85 0.07037594
```

All methods can be applied on this manipulated emdi_model object.

```
load_shapeaustria()
map_plot(emdi_model, indicator = c("Head_Count", "mixed_hcr"),
                                    map_obj = shape_austria_dis, map_dom_id = "PB",
         scale_points = c(0, 0.6))
```




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

mixed hcr