Workflow example with R2BEAT

Scenario 1

Only a sampling frame containing the units of the population of reference is available, no previous round of the sampling survey to be planned

In [1]:
```r
# Install last version of R2BEAT
#devtools::install_github("barcaroli/R2BEAT",dependencies = FALSE)
library(R2BEAT)
```

Caricamento del pacchetto richiesto: plyr

Caricamento del pacchetto richiesto: devtools

Caricamento del pacchetto richiesto: usethis

Caricamento del pacchetto richiesto: sampling

Caricamento del pacchetto richiesto: SamplingStrata

Caricamento del pacchetto richiesto: memoise

Caricamento del pacchetto richiesto: doParallel

Caricamento del pacchetto richiesto: foreach

Caricamento del pacchetto richiesto: iterators

Caricamento del pacchetto richiesto: parallel

Caricamento del pacchetto richiesto: pbapply

Caricamento del pacchetto richiesto: formattable

Caricamento del pacchetto richiesto: SamplingBigData

Report issues at https://github.com/barcaroli/SamplingStrata/issues

Get a complete documentation on https://barcaroli.github.io/SamplingStrata

In [2]:
```r
packageVersion("R2BEAT")
```

[1] '1.0.4'

In [3]:
```r
## Sampling frame
load("pop.RData")
```

Precision constraints

In [6]:
```r
cv <- as.data.frame(list(DOM=c("DOM1","DOM2"),
                         CV1=c(0.02,0.03),
                         CV2=c(0.03,0.06),
                         CV3=c(0.03,0.06),
```

```
                              CV4=c(0.03,0.06)))
     cv
```

A data.frame: 2 × 5

DOM	CV1	CV2	CV3	CV4
<chr>	<dbl>	<dbl>	<dbl>	<dbl>
DOM1	0.02	0.03	0.03	0.03
DOM2	0.03	0.06	0.06	0.06

Sensitivity analysis

Deff

In [7]:
```
deff_sens <- sensitivity(samp_frame=pop,
              errors=cv,
              id_PSU="municipality",
              id_SSU="id_ind",
              strata_var="stratum",
              target_vars=c("income_hh","active","inactive","unemployed"),
              deff_var="stratum",
              domain_var="region",
              minimum=50,
              delta=1,
              f=0.05,
              search=c("deff"),
              min=1,
              max=2,
              plot=TRUE)
```

```
 1
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0        0         0           0 13554
2         1       43       131         174 13554

 2
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0        0         0           0 13554
2         1       43       131         174 13873

 3
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0        0         0           0 13554
2         1       43       131         174 14183
3         2       46       137         183 14175

 4
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0        0         0           0 13554
2         1       43       131         174 14482
```

```
3         2     49      138        187 14464
```

 5
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 14782
3	2	49	143	192 14755

 6
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 15074
3	2	52	144	196 15025

 7
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 15360
3	2	52	148	200 15300

 8
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 15643
3	2	53	151	204 15573

 9
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 15923
3	2	56	151	207 15814

 10
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 16203
3	2	58	153	211 16062

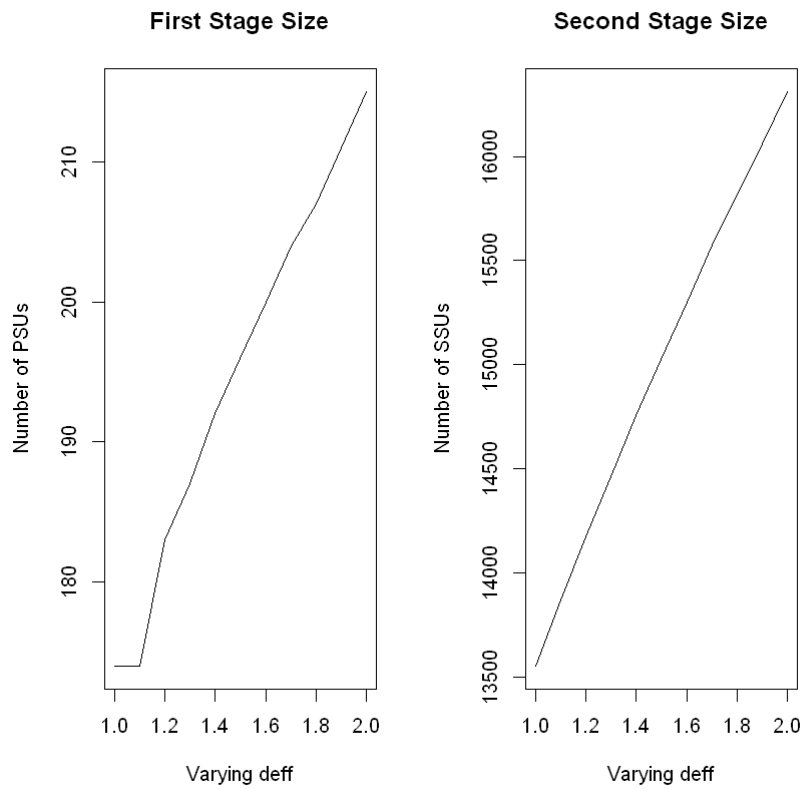 11
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0 13554
2	1	43	131	174 16471
3	2	59	156	215 16311

First Stage Size

Second Stage Size

In [29]:
```r
plot.sens(deff_sens,search="deff",min=1,max=2)
```

First Stage Size

Second Stage Size

Minimum

In [8]:
```r
deff_min <- sensitivity (samp_frame=pop,
            errors=cv,
            id_PSU="municipality",
            id_SSU="id_ind",
            strata_var="stratum",
```

```
              target_vars=c("income_hh","active","inactive","unemployed"),
              deff_var="stratum",
              domain_var="region",
              delta=1,
              f=0.05,
              deff_sugg=1.5,
              search=c("min_SSU"),
              min=30,
              max=80,
              plot=TRUE)
```

 1
Computations are being done on population data

Number of strata: 24
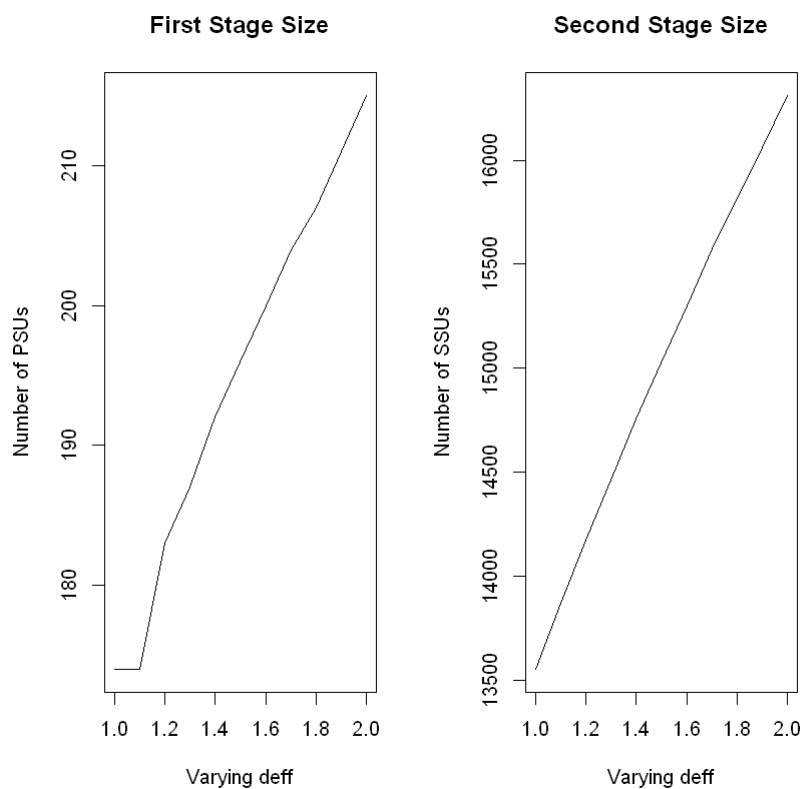... of which with only one unit: 0   iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0	13554
2	1	43	131	174	70035
3	2	385	86	471	18910
4	3	64	195	259	66634
5	4	372	93	465	19552
6	5	66	203	269	66481
7	6	372	92	464	19552
8	7	66	203	269	66481
9	8	372	92	464	19552
10	9	66	203	269	66481
11	10	372	92	464	19552
12	11	66	203	269	66481
13	12	372	92	464	19552
14	13	66	203	269	66481
15	14	372	92	464	19552
16	15	66	203	269	66481

 2
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0   iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0	13554
2	1	43	131	174	78024
3	2	416	65	481	17815
4	3	54	187	241	75890
5	4	405	74	479	18351
6	5	57	193	250	75513
7	6	405	73	478	18351
8	7	57	193	250	75513
9	8	405	73	478	18351
10	9	57	193	250	75513
11	10	405	73	478	18351
12	11	57	193	250	75513
13	12	405	73	478	18351
14	13	57	193	250	75513
15	14	405	73	478	18351
16	15	57	193	250	75513

 3
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0   iterations PSU_SR PSU NSR PSU Total   SSU

1	0	0	0	0	13554
2	1	43	131	174	85746
3	2	434	54	488	17229
4	3	52	180	232	83551
5	4	427	60	487	17693
6	5	52	187	239	83548
7	6	427	60	487	17693
8	7	52	187	239	83548

```
9          8     427    60       487 17693
10         9      52   187       239 83548
11        10     427    60       487 17693
12        11      52   187       239 83548
13        12     427    60       487 17693
14        13      52   187       239 83548
15        14     427    60       487 17693
16        15      52   187       239 83548

 4
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total   SSU
1          0      0     0         0 13554
2          1     43   131       174 93223
3          2    454    39       493 16287
4          3     52   165       217 90768
5          4    448    44       492 16601
6          5     52   170       222 90771
7          6    448    44       492 16602
8          7     52   170       222 90771
9          8    448    44       492 16602
10         9     52   170       222 90771
11        10    448    44       492 16602
12        11     52   170       222 90771
13        12    448    44       492 16602
14        13     52   170       222 90771
15        14    448    44       492 16602
16        15     52   170       222 90771

 5
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total   SSU
1          0      0     0         0  13554
2          1     43   131       174 100485
3          2    461    35       496  16054
4          3     50   164       214  98476
5          4    461    34       495  16051
6          5     50   164       214  98481
7          6    461    34       495  16051
8          7     50   164       214  98481
9          8    461    34       495  16051
10         9     50   164       214  98481
11        10    461    34       495  16051
12        11     50   164       214  98481
13        12    461    34       495  16051
14        13     50   164       214  98481
15        14    461    34       495  16051
16        15     50   164       214  98481

 6
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total   SSU
1          0      0     0         0  13554
2          1     43   131       174 107544
3          2    465    34       499  16047
4          3     50   164       214 105352
5          4    463    35       498  16161
6          5     50   166       216 105354
7          6    463    35       498  16161
8          7     50   166       216 105354
9          8    463    35       498  16161
10         9     50   166       216 105354
11        10    463    35       498  16161
```

```
12           11     50     166        216 105354
13           12    463      35        498  16161
14           13     50     166        216 105354
15           14    463      35        498  16161
16           15     50     166        216 105354

 7
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total    SSU
1            0      0       0          0  13554
2            1     43     131        174 114411
3            2    474      27        501  15728
4            3     51     157        208 111430
5            4    471      29        500  15877
6            5     51     160        211 111433
7            6    471      29        500  15877
8            7     51     160        211 111433
9            8    471      29        500  15877
10           9     51     160        211 111433
11          10    471      29        500  15877
12          11     51     160        211 111433
13          12    471      29        500  15877
14          13     51     160        211 111433
15          14    471      29        500  15877
16          15     51     160        211 111433

 8
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total    SSU
1            0      0       0          0  13554
2            1     43     131        174 121105
3            2    482      21        503  15298
4            3     50     152        202 118560
5            4    478      24        502  15629
6            5     51     156        207 117902
7            6    478      24        502  15627
8            7     51     156        207 117902
9            8    478      24        502  15627
10           9     51     156        207 117902
11          10    478      24        502  15627
12          11     51     156        207 117902
13          12    478      24        502  15627
14          13     51     156        207 117902
15          14    478      24        502  15627
16          15     51     156        207 117902

 9
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total    SSU
1            0      0       0          0  13554
2            1     43     131        174 127633
3            2    486      18        504  15106
4            3     50     149        199 124919
5            4    485      18        503  15166
6            5     50     150        200 124924
7            6    485      18        503  15166
8            7     50     150        200 124924
9            8    485      18        503  15166
10           9     50     150        200 124924
11          10    485      18        503  15166
12          11     50     150        200 124924
13          12    485      18        503  15166
14          13     50     150        200 124924
```

```
15         14      485      18        503  15166
16         15       50     150        200 124924

 10
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0   iterations PSU_SR PSU NSR PSU Total     SSU
1          0        0        0         0  13554
2          1       43      131        174 134002
3          2      488       17        505  15089
4          3       49      150        199 131368
5          4      487       17        504  15149
6          5       49      151        200 131373
7          6      487       17        504  15149
8          7       49      151        200 131373
9          8      487       17        504  15149
10         9       49      151        200 131373
11        10      487       17        504  15149
12        11       49      151        200 131373
13        12      487       17        504  15149
14        13       49      151        200 131373
15        14      487       17        504  15149
16        15       49      151        200 131373

 11
Computations are being done on population data

Number of strata:  24
... of which with only one unit:  0    iterations PSU_SR PSU NSR PSU Total     SSU
1          0        0        0         0  13554
2          1       43      131        174 140224
3          2      491       15        506  14895
4          3       49      146        195 137825
5          4      491       14        505  14893
6          5       49      146        195 137827
7          6      491       14        505  14893
8          7       49      146        195 137827
9          8      491       14        505  14893
10         9       49      146        195 137827
11        10      491       14        505  14893
12        11       49      146        195 137827
13        12      491       14        505  14893
14        13       49      146        195 137827
15        14      491       14        505  14893
16        15       49      146        195 137827
```
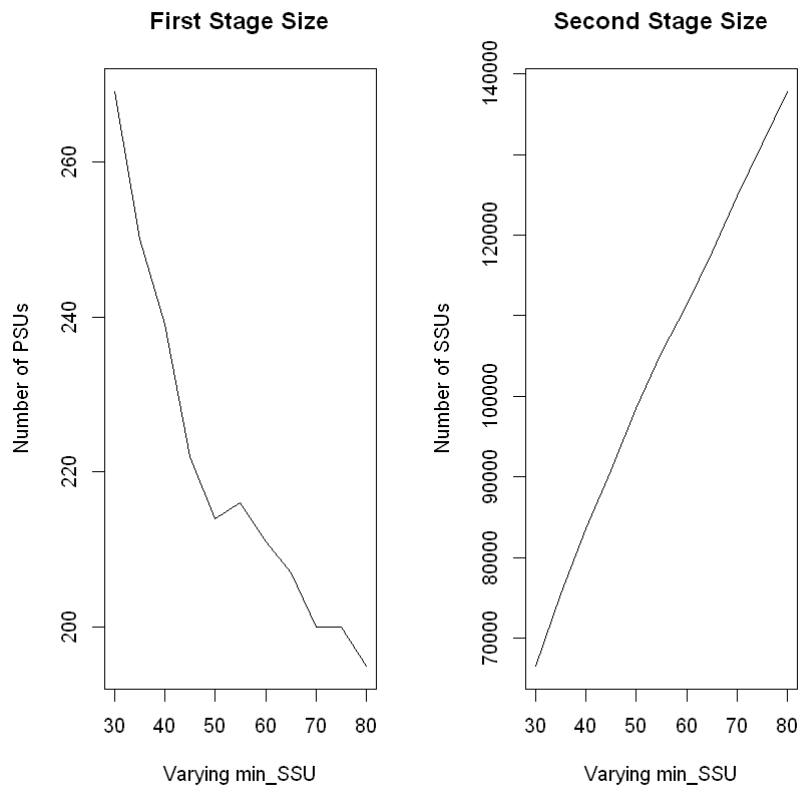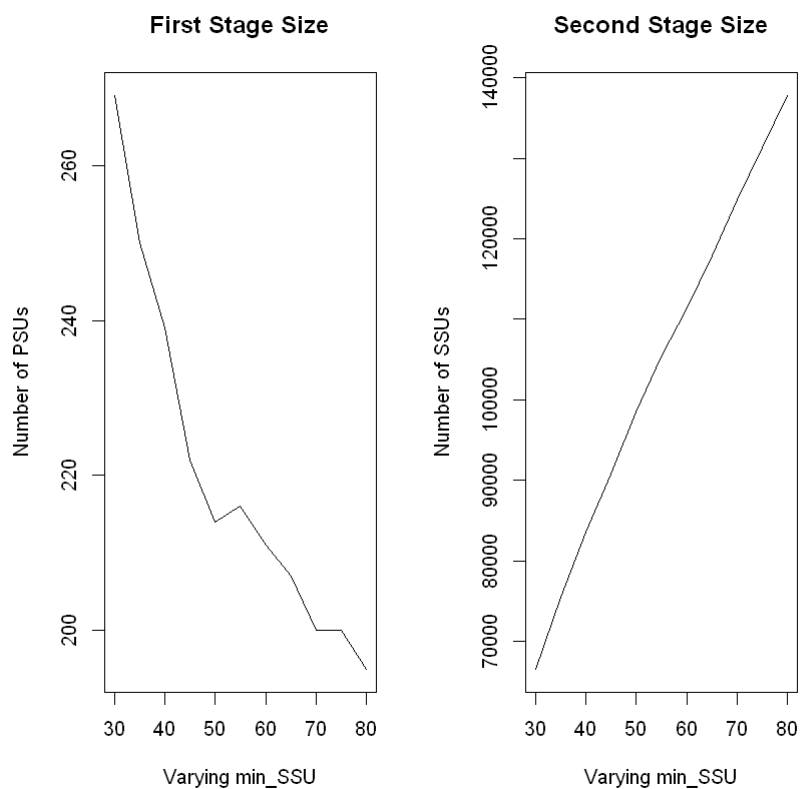
First Stage Size

First Stage Size

Number of PSUs

Varying min_SSU

Second Stage Size

Second Stage Size

Number of SSUs

Varying min_SSU

```
In [30]:   plot.sens(deff_min,search="min_SSU",min=30,max=80)
```

First Stage Size

Number of PSUs

Varying min_SSU

Second Stage Size

Number of SSUs

Varying min_SSU

Sampling fraction

```
In [9]:   deff_sf <- sensitivity (samp_frame=pop,
                  errors=cv,
                  id_PSU="municipality",
                  id_SSU="id_ind",
                  strata_var="stratum",
```

```
                target_vars=c("income_hh","active","inactive","unemployed"),
                deff_var="stratum",
                domain_var="region",
                delta=1,
                minimum=50,
                deff_sugg=1.5,
                search=c("sample_fraction"),
                min=0.01,
                max=0.10,
                plot=TRUE)
```

 1
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11606
3   2   32   114   146 11461

 2
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11630
3   2   32   114   146 11487

 3
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11649
3   2   32   115   147 11511

 4
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11617
3   2   32   114   146 11477

 5
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11559
3   2   32   113   145 11424

 6
Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0 iterations PSU_SR PSU NSR PSU Total   SSU
1   0   0   0   0 13554
2   1   43   131   174 11590
3   2   32   114   146 11455

 7
Computations are being done on population data

```
Number of strata:   24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0         0         0          0 13554
2         1        43       131        174 11618
3         2        32       114        146 11484

 8
Computations are being done on population data

Number of strata:   24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0         0         0          0 13554
2         1        43       131        174 11647
3         2        32       115        147 11508

 9
Computations are being done on population data

Number of strata:   24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0         0         0          0 13554
2         1        43       131        174 11670
3         2        32       115        147 11536

 10
Computations are being done on population data

Number of strata:   24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0         0         0          0 13554
2         1        43       131        174 11697
3         2        32       115        147 11566

 11
Computations are being done on population data

Number of strata:   24
... of which with only one unit:  0  iterations PSU_SR PSU NSR PSU Total    SSU
1         0         0         0          0 13554
2         1        43       131        174 11717
3         2        32       116        148 11587
```
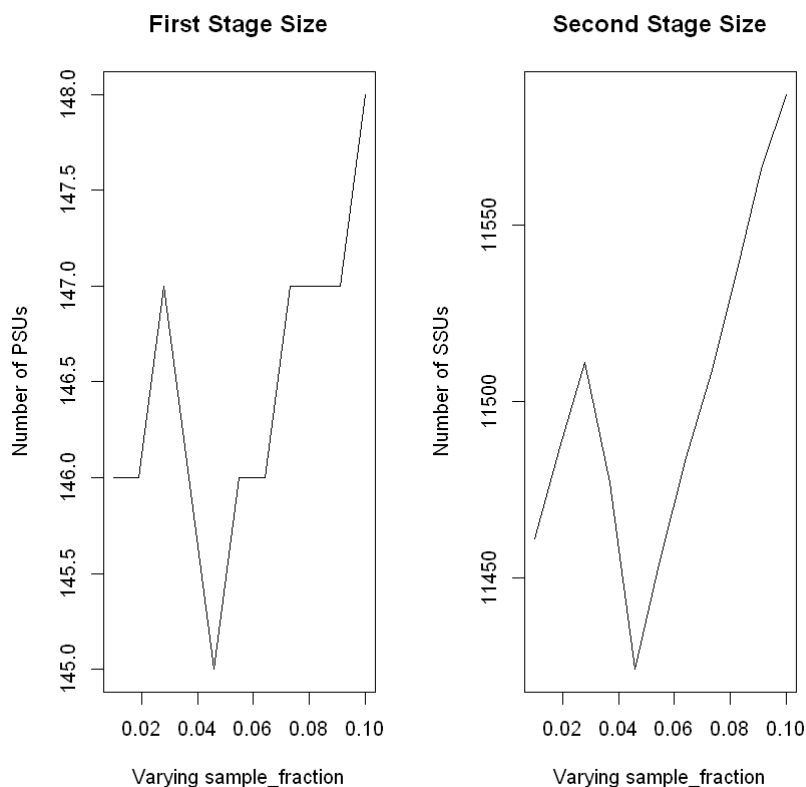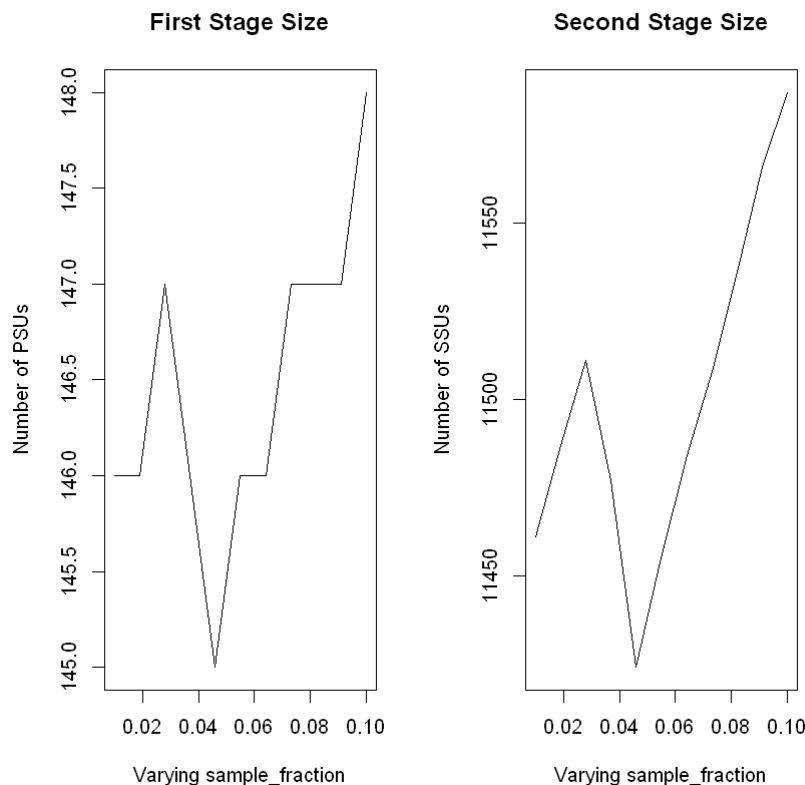
First Stage Size   **Second Stage Size**

```
plot.sens(deff_sf,search="sample_fraction",min=0.01,max=0.10)
```

First Stage Size

Second Stage Size

Number of PSUs — 145.0, 145.5, 146.0, 146.5, 147.0, 147.5, 148.0

Varying sample_fraction — 0.02 0.04 0.06 0.08 0.10

Number of SSUs — 11450, 11500, 11550

Varying sample_fraction — 0.02 0.04 0.06 0.08 0.10

Preparation of inputs for allocation steps

```
## Preparation of inputs for allocation steps
samp_frame <- pop
samp_frame$one <- 1
id_PSU <- "municipality"
id_SSU <- "id_ind"
strata_var <- "stratum"
target_vars <- c("income_hh","active","inactive","unemployed")
deff_var <- "stratum"
domain_var <- "region"
delta = 1        # households = survey units
minimum <- 50    # minimum number of SSUs to be interviewed in each selected PSU
f = 0.05         # suggestion for the sampling fraction
deff_sugg <- 1.5 # suggestion for the deff value

inp <- prepareInputToAllocation1(samp_frame,
                                 id_PSU,
                                 id_SSU,
                                 strata_var,
                                 target_vars,
                                 deff_var,
                                 domain_var,
                                 minimum,
                                 delta,
                                 f,
                                 deff_sugg)
```

Computations are being done on population data

Number of strata: 24
... of which with only one unit: 0

```
In [13]:  head(inp$strata)
```

A data.frame: 6 × 14

	N	M1	M2	M3	M4	S1	S2	S3	S4
	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1000	197007	23959.87	0.6650322	0.2285807	0.10638708	22179.08	0.4719792	0.4199185	0.3083324
2000	261456	20966.65	0.6709886	0.2297519	0.09925953	19624.65	0.4698541	0.4206732	0.2990102
3000	115813	19814.73	0.6644591	0.2315975	0.10394343	14754.88	0.4721792	0.4218532	0.3051871
4000	17241	18732.72	0.6273418	0.2499275	0.12273070	13462.74	0.4835122	0.4329708	0.3281278
5000	101067	22070.31	0.6134445	0.2338845	0.15267100	17187.98	0.4869603	0.4232996	0.3596701
6000	47218	21069.07	0.6135796	0.2348469	0.15157355	17342.74	0.4869288	0.4239031	0.3586070

```
In [11]:  head(inp$deff)
```

A data.frame: 6 × 7

	stratum	STRATUM	DEFF1	DEFF2	DEFF3	DEFF4	b_nar
	<fct>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	1000	1000	1.002141	1.003487	1.018508	0.998091	254.50000
2	10000	10000	1.019820	1.029362	1.010320	1.000982	178.83333
3	11000	11000	1.128662	1.036882	1.002039	1.115932	52.07500
4	12000	12000	3.233942	0.978419	1.202842	0.639357	49.42857
5	13000	13000	1.063373	1.056811	1.015756	1.048938	1285.00000
6	14000	14000	1.018801	1.003173	1.002272	1.013573	263.50000

```
In [6]:  head(inp$effst)
```

A data.frame: 6 × 5

	STRATUM	EFFST1	EFFST2	EFFST3	EFFST4
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>
1	1000	1	1	1	1
2	2000	1	1	1	1
3	3000	1	1	1	1
4	4000	1	1	1	1
5	5000	1	1	1	1
6	6000	1	1	1	1

```
In [7]:  head(inp$rho)
```

A data.frame: 6 × 9

	STRATUM	RHO_AR1	RHO_NAR1	RHO_AR2	RHO_NAR2	RHO_AR3	RHO_NAR3	RHO_AR4

	STRATUM	RHO_dAR1	RHO_NAR1	RHO_dAR2	RHO_NAR2	RHO_dAR3	RHO_NAR3	RHO_dAR4
	<fct>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	1000	1	0.0001015399	1	0.0001015399	1	0.0001015399	
12	2000	1	0.0004977105	1	0.0004977105	1	0.0004977105	
18	3000	1	0.0022551239	1	0.0022551239	1	0.0022551239	
19	4000	1	0.0106628754	1	0.0106628754	1	0.0106628754	
20	5000	1	0.0001979669	1	0.0001979669	1	0.0001979669	
21	6000	1	0.0006361593	1	0.0006361593	1	0.0006361593	

In [8]:
```r
head(inp$psu_file)
```

A data.frame: 6 × 3

	PSU_ID	STRATUM	PSU_MOS
	<dbl>	<fct>	<dbl>
1	1	12000	1546
2	2	12000	936
3	3	12000	367
4	4	10000	13032
5	5	12000	678
6	6	11000	3193

In [9]:
```r
head(inp$des_file)
```

A data.frame: 6 × 4

	STRATUM	STRAT_MOS	DELTA	MINIMUM
	<fct>	<dbl>	<dbl>	<dbl>
1	1000	197007	1	50
2	2000	261456	1	50
3	3000	115813	1	50
4	4000	17241	1	50
5	5000	101067	1	50
6	6000	47218	1	50

Allocation

In [14]:
```r
## Precision constraints
cv <- as.data.frame(list(DOM=c("DOM1","DOM2"),
                         CV1=c(0.02,0.03),
                         CV2=c(0.03,0.06),
                         CV3=c(0.03,0.06),
```

```
              CV4=c(0.03,0.06)))
 cv
```

A data.frame: 2 × 5

DOM	CV1	CV2	CV3	CV4
<chr>	<dbl>	<dbl>	<dbl>	<dbl>
DOM1	0.02	0.03	0.03	0.03
DOM2	0.03	0.06	0.06	0.06

In [15]:
```r
alloc <- beat.2st(stratif = inp$strata,
                  errors = cv,
                  des_file = inp$des_file,
                  psu_file = inp$psu_file,
                  rho = inp$rho,
                  deft_start = NULL,
                  effst = inp$effst,
                  epsilon1 = 5,
                  mmdiff_deft = 1,
                  maxi = 15,
                  epsilon = 10^(-11),
                  minnumstrat = 2,
                  maxiter = 200,
                  maxiter1 = 25)
```

```
  iterations PSU_SR PSU NSR PSU Total   SSU
1          0      0       0         0 13554
2          1     43     131       174 15074
3          2     52     144       196 15025
```

Selection of PSUs (I stage)

In [16]:
```r
allocat <- alloc$alloc[-nrow(alloc$alloc),]
set.seed(1234)
sample_2st <- StratSel(dataPop= inp$psu_file,
                       idpsu= ~ PSU_ID,
                       dom= ~ STRATUM,
                       final_pop= ~ PSU_MOS,
                       size= ~ PSU_MOS,
                       PSUsamplestratum= 1,
                       min_sample= minimum,
                       min_sample_index= FALSE,
                       dataAll=allocat,
                       domAll= ~ factor(STRATUM),
                       f_sample= ~ ALLOC,
                       planned_min_sample= NULL,
                       launch= F)
```

In [17]:
```r
sample_2st[[2]]
```

A data.frame: 26 × 6

Domain	SRdom	nSRdom	SRdom+nSRdom	SR_PSU_final_sample_unit	NSR_PSU_final_sample_unit
<chr>	<chr>	<chr>	<chr>	<chr>	<chr>
1000	2	0	2	509	0
2000	9	2	11	525	132

Domain	SRdom	nSRdom	SRdom+nSRdom	SR_PSU_final_sample_unit	NSR_PSU_final_sample_unit
<chr>	<chr>	<chr>	<chr>	<chr>	<chr>
3000	0	6	6	0	312
4000	0	1	1	0	59
5000	2	0	2	305	0
6000	3	0	3	143	0
7000	0	2	2	0	97
8000	0	2	2	0	99
9000	1	0	1	1018	0
10000	6	0	6	1073	0
11000	21	19	40	1028	1055
12000	0	14	14	0	692
13000	1	0	1	1285	0
14000	4	0	4	1054	0
15000	28	10	38	1629	627
16000	0	34	34	0	1705
17000	1	0	1	170	0
18000	2	2	4	84	137
19000	0	9	9	0	462
20000	0	5	5	0	229
21000	1	0	1	160	0
22000	3	0	3	137	0
23000	0	5	5	0	247
24000	0	1	1	0	47
Total	84	112	196	9120	5900
Mean				380	246

In [18]:
```r
## Plot of allocation (PSUs and SSUs)
des <- sample_2st[[2]]
des2 <- NULL
des2$strata <- c(des$Domain[1:24],des$Domain[1:24])
des2$SR <- c(rep("SR",24),rep("nSR",24))
des2$PSU <- as.numeric(c(des$SRdom[1:24],des$nSRdom[1:24]))
des2$SSU <- as.numeric(c(des$SR_PSU_final_sample_unit[1:24],des$NSR_PSU_final_sample
des2 <- as.data.frame(des2)
des2$strata <- as.numeric(des2$strata)
par(mfrow=c(2, 1))
barplot(PSU~SR+strata, data=des2,
        main = "PSUs by strata",
        xlab = "strata", ylab = "PSUs",
        col = c("black", "grey"),
        # beside = TRUE,
        las=2,
        cex.names=0.7)
```

```
legend("topright",
       legend = c("Non Self Representative","Self Representative"),cex = 0.7,
       fill = c("black", "grey"))
barplot(SSU~SR+strata, data=des2,
        main = "SSUs by strata",
        xlab = "strata", ylab = "PSUs",
        col = c("black", "grey"),
        # beside = TRUE,
        las=2,
        cex.names=0.7)
legend("topright",
       legend = c("Non Self Representative","Self Representative"),cex = 0.7,
       fill = c("black", "grey"))
```
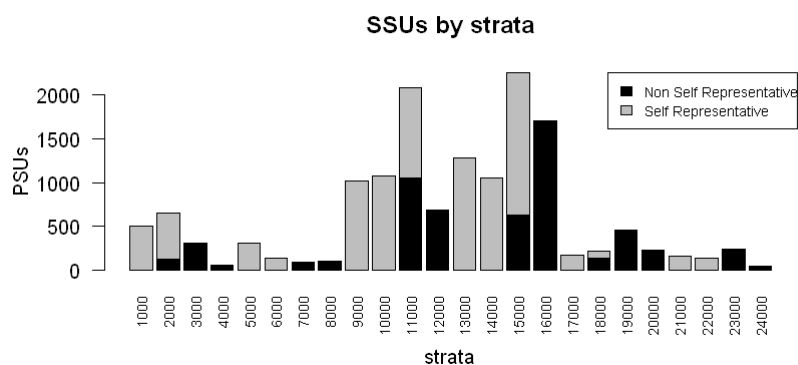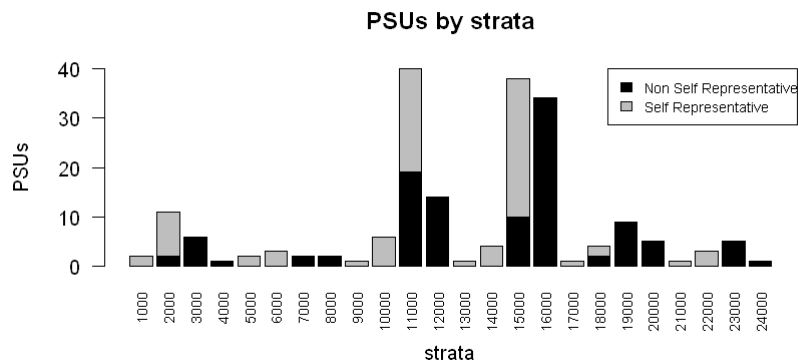

Selection of SSUs (II stage)

In [19]:
```
selected_PSU <- sample_2st[[4]]
selected_PSU <- selected_PSU[selected_PSU$PSU_final_sample_unit > 0,]
samp <- select_SSU(df=pop,
                   PSU_code="municipality",
                   SSU_code="id_ind",
                   PSU_sampled=selected_PSU[selected_PSU$Sampled_PSU==1,],
                   verbose=TRUE)
```

```
PSU =  1  *** Selected SSU =  132
PSU =  2  *** Selected SSU =  65
PSU =  3  *** Selected SSU =  55
PSU =  4  *** Selected SSU =  1018
PSU =  5  *** Selected SSU =  191
PSU =  6  *** Selected SSU =  145
PSU =  7  *** Selected SSU =  71
PSU =  8  *** Selected SSU =  50
PSU =  9  *** Selected SSU =  50
PSU =  10  *** Selected SSU =  21
PSU =  11  *** Selected SSU =  61
PSU =  12  *** Selected SSU =  47
```

```
PSU =   13  *** Selected SSU =    41
PSU =   14  *** Selected SSU =    46
PSU =   15  *** Selected SSU =    62
PSU =   16  *** Selected SSU =    47
PSU =   17  *** Selected SSU =    51
PSU =   18  *** Selected SSU =    48
PSU =   19  *** Selected SSU =    59
PSU =   20  *** Selected SSU =    47
PSU =   21  *** Selected SSU =    46
PSU =   22  *** Selected SSU =   158
PSU =   23  *** Selected SSU =   106
PSU =   24  *** Selected SSU =    36
PSU =   25  *** Selected SSU =    51
PSU =   26  *** Selected SSU =    46
PSU =   27  *** Selected SSU =    55
PSU =   28  *** Selected SSU =    53
PSU =   29  *** Selected SSU =   341
PSU =   30  *** Selected SSU =    46
PSU =   31  *** Selected SSU =    42
PSU =   32  *** Selected SSU =    52
PSU =   33  *** Selected SSU =    66
PSU =   34  *** Selected SSU =    44
PSU =   35  *** Selected SSU =    69
PSU =   36  *** Selected SSU =    61
PSU =   37  *** Selected SSU =    63
PSU =   38  *** Selected SSU =    41
PSU =   39  *** Selected SSU =    53
PSU =   40  *** Selected SSU =    71
PSU =   41  *** Selected SSU =    58
PSU =   42  *** Selected SSU =    36
PSU =   43  *** Selected SSU =    42
PSU =   44  *** Selected SSU =    64
PSU =   45  *** Selected SSU =    53
PSU =   46  *** Selected SSU =    47
PSU =   47  *** Selected SSU =    49
PSU =   48  *** Selected SSU =    54
PSU =   49  *** Selected SSU =    57
PSU =   50  *** Selected SSU =    40
PSU =   51  *** Selected SSU =    61
PSU =   52  *** Selected SSU =    44
PSU =   53  *** Selected SSU =    53
PSU =   54  *** Selected SSU =    56
PSU =   55  *** Selected SSU =    52
PSU =   56  *** Selected SSU =    55
PSU =   57  *** Selected SSU =    40
PSU =   58  *** Selected SSU =    50
PSU =   59  *** Selected SSU =    59
PSU =   60  *** Selected SSU =    43
PSU =   61  *** Selected SSU =    46
PSU =   62  *** Selected SSU =    97
PSU =   63  *** Selected SSU =    45
PSU =   64  *** Selected SSU =   196
PSU =   65  *** Selected SSU =    45
PSU =   66  *** Selected SSU =    55
PSU =   67  *** Selected SSU =    43
PSU =   68  *** Selected SSU =    57
PSU =   69  *** Selected SSU =    76
PSU =   70  *** Selected SSU =    43
PSU =   71  *** Selected SSU =    48
PSU =   72  *** Selected SSU =    59
PSU =   73  *** Selected SSU =    40
PSU =   74  *** Selected SSU =    44
PSU =   75  *** Selected SSU =    55
PSU =   76  *** Selected SSU =    45
PSU =   77  *** Selected SSU =    44
PSU =   78  *** Selected SSU =    75
PSU =   79  *** Selected SSU =    50
PSU =   80  *** Selected SSU =    47
PSU =   81  *** Selected SSU =    54
```

```
PSU =    82  *** Selected SSU =    53
PSU =    83  *** Selected SSU =    47
PSU =    84  *** Selected SSU =    72
PSU =    85  *** Selected SSU =    57
PSU =    86  *** Selected SSU =    50
PSU =    87  *** Selected SSU =    51
PSU =    88  *** Selected SSU =    96
PSU =    89  *** Selected SSU =    85
PSU =    90  *** Selected SSU =    48
PSU =    91  *** Selected SSU =    62
PSU =    92  *** Selected SSU =    58
PSU =    93  *** Selected SSU =    76
PSU =    94  *** Selected SSU =    61
PSU =    95  *** Selected SSU =    48
PSU =    96  *** Selected SSU =   106
PSU =    97  *** Selected SSU =    58
PSU =    98  *** Selected SSU =    50
PSU =    99  *** Selected SSU =    52
PSU =   100  *** Selected SSU =   237
PSU =   101  *** Selected SSU =    53
PSU =   102  *** Selected SSU =    50
PSU =   103  *** Selected SSU =   189
PSU =   104  *** Selected SSU =    61
PSU =   105  *** Selected SSU =    46
PSU =   106  *** Selected SSU =   432
PSU =   107  *** Selected SSU =    53
PSU =   108  *** Selected SSU =    53
PSU =   109  *** Selected SSU =    41
PSU =   110  *** Selected SSU =    43
PSU =   111  *** Selected SSU =    52
PSU =   112  *** Selected SSU =    56
PSU =   113  *** Selected SSU =    50
PSU =   114  *** Selected SSU =    43
PSU =   115  *** Selected SSU =    46
PSU =   116  *** Selected SSU =    65
PSU =   117  *** Selected SSU =    40
PSU =   118  *** Selected SSU =  1285
PSU =   119  *** Selected SSU =    50
PSU =   120  *** Selected SSU =    42
PSU =   121  *** Selected SSU =    70
PSU =   122  *** Selected SSU =    50
PSU =   123  *** Selected SSU =    32
PSU =   124  *** Selected SSU =    60
PSU =   125  *** Selected SSU =    72
PSU =   126  *** Selected SSU =    53
PSU =   127  *** Selected SSU =    42
PSU =   128  *** Selected SSU =    48
PSU =   129  *** Selected SSU =    55
PSU =   130  *** Selected SSU =    52
PSU =   131  *** Selected SSU =    25
PSU =   132  *** Selected SSU =    64
PSU =   133  *** Selected SSU =    59
PSU =   134  *** Selected SSU =    66
PSU =   135  *** Selected SSU =    55
PSU =   136  *** Selected SSU =    55
PSU =   137  *** Selected SSU =    38
PSU =   138  *** Selected SSU =    69
PSU =   139  *** Selected SSU =    62
PSU =   140  *** Selected SSU =    49
PSU =   141  *** Selected SSU =    49
PSU =   142  *** Selected SSU =    72
PSU =   143  *** Selected SSU =    91
PSU =   144  *** Selected SSU =    51
PSU =   145  *** Selected SSU =    47
PSU =   146  *** Selected SSU =   131
PSU =   147  *** Selected SSU =    35
PSU =   148  *** Selected SSU =    74
PSU =   149  *** Selected SSU =    60
PSU =   150  *** Selected SSU =    43
```

```
PSU =  151  *** Selected SSU =   57
PSU =  152  *** Selected SSU =  378
PSU =  153  *** Selected SSU =   59
PSU =  154  *** Selected SSU =   44
PSU =  155  *** Selected SSU =   86
PSU =  156  *** Selected SSU =   38
PSU =  157  *** Selected SSU =   55
PSU =  158  *** Selected SSU =   56
PSU =  159  *** Selected SSU =   54
PSU =  160  *** Selected SSU =   32
PSU =  161  *** Selected SSU =   52
PSU =  162  *** Selected SSU =   47
PSU =  163  *** Selected SSU =   54
PSU =  164  *** Selected SSU =   57
PSU =  165  *** Selected SSU =   6
PSU =  166  *** Selected SSU =   43
PSU =  167  *** Selected SSU =  299
PSU =  168  *** Selected SSU =   45
PSU =  169  *** Selected SSU =   64
PSU =  170  *** Selected SSU =   55
PSU =  171  *** Selected SSU =   47
PSU =  172  *** Selected SSU =   44
PSU =  173  *** Selected SSU =   46
PSU =  174  *** Selected SSU =   73
PSU =  175  *** Selected SSU =   46
PSU =  176  *** Selected SSU =   48
PSU =  177  *** Selected SSU =   48
PSU =  178  *** Selected SSU =   51
PSU =  179  *** Selected SSU =   58
PSU =  180  *** Selected SSU =  170
PSU =  181  *** Selected SSU =   54
PSU =  182  *** Selected SSU =   36
PSU =  183  *** Selected SSU =   52
PSU =  184  *** Selected SSU =   54
PSU =  185  *** Selected SSU =   43
PSU =  186  *** Selected SSU =   48
PSU =  187  *** Selected SSU =   47
PSU =  188  *** Selected SSU =   36
PSU =  189  *** Selected SSU =   58
PSU =  190  *** Selected SSU =   54
PSU =  191  *** Selected SSU =   45
PSU =  192  *** Selected SSU =  160
PSU =  193  *** Selected SSU =   45
PSU =  194  *** Selected SSU =   51
PSU =  195  *** Selected SSU =   50
PSU =  196  *** Selected SSU =   45
--------------------------------
Total PSU =  196
Total SSU =  15020
--------------------------------
```

In [20]:
```r
nrow(samp)
sum(allocat$ALLOC)
```

15020

15025

In [21]:
```r
nrow(pop)
sum(samp$weight)
```

2258507

2258507

In [22]:
```r
## Plot of weights distribution
par(mfrow=c(1, 2))
```

```r
boxplot(samp$weight,col="grey")
title("Weights distribution (total sample)",cex.main=0.7)
boxplot(weight ~ region, data=samp,col="grey")
title("Weights distribution by region",cex.main=0.7)
par(mfrow=c(1, 2))
boxplot(weight ~ province, data=samp,col="grey")
title("Weights distribution by province",cex.main=0.7)
boxplot(weight ~ stratum, data=samp,col="grey")
title("Weights distribution by stratum",cex.main=0.7)
```
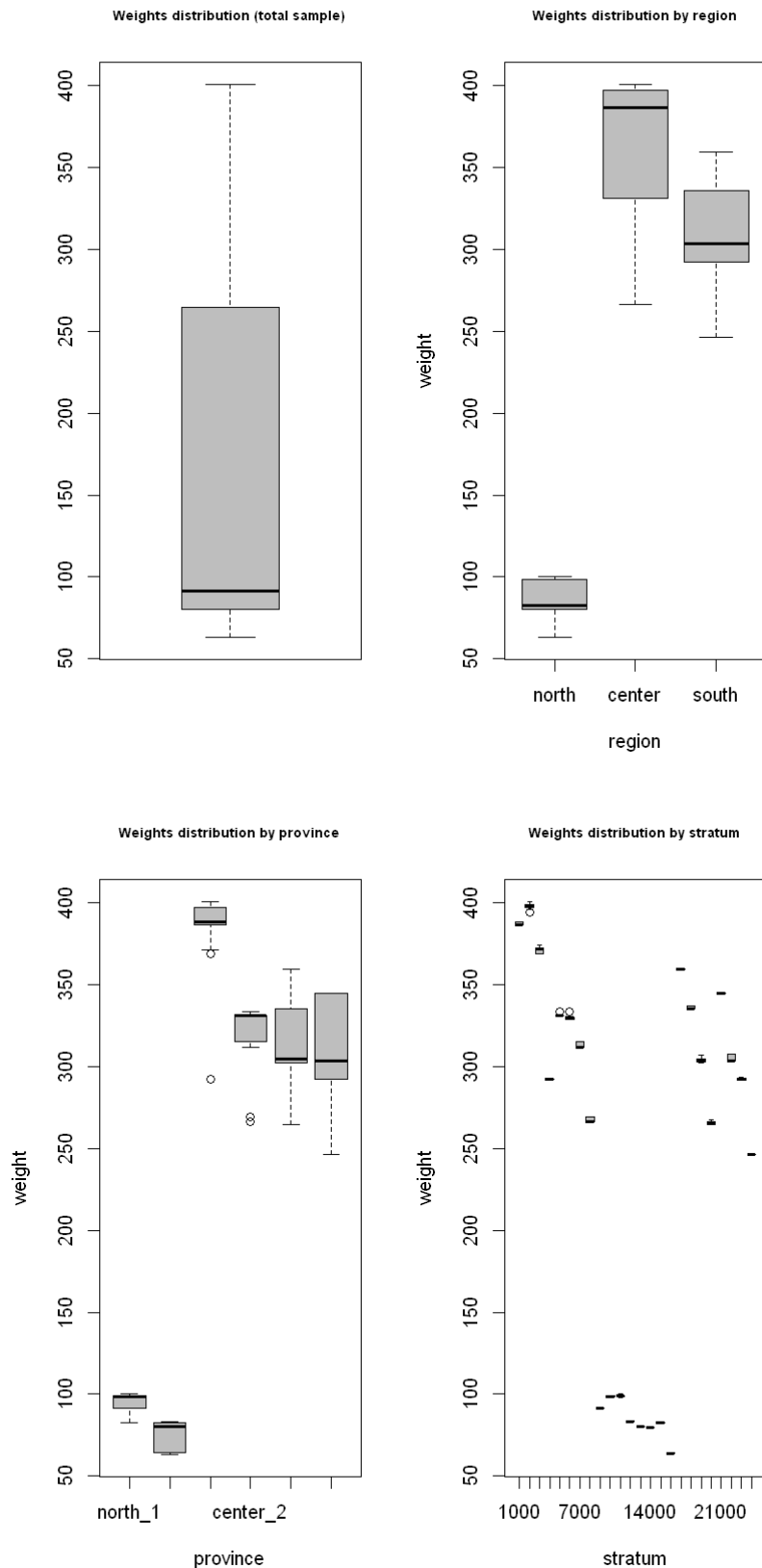
Precision constraints compliance control (by simulation)

In [23]:
```r
selected_PSU <- sample_2st[[4]]
df=pop
df$one <- 1
PSU_code="municipality"
SSU_code="id_ind"
PSU_sampled=selected_PSU[selected_PSU$Sampled_PSU==1,]
target_vars <- c("income_hh",
                 "active",
                 "inactive",
                 "unemployed")
PSU_sampled <- selected_PSU[selected_PSU$PSU_final_sample_unit > 0,]
```

In [24]:
```r
# Domain level = national
domain_var <- "one"
eval <- eval_2stage(df,
                    PSU_code,
                    SSU_code,
                    domain_var,
                    target_vars,
                    PSU_sampled,
                    nsampl=100,
                    writeFiles=FALSE,
                    progress=TRUE)
eval$coeff_var
```
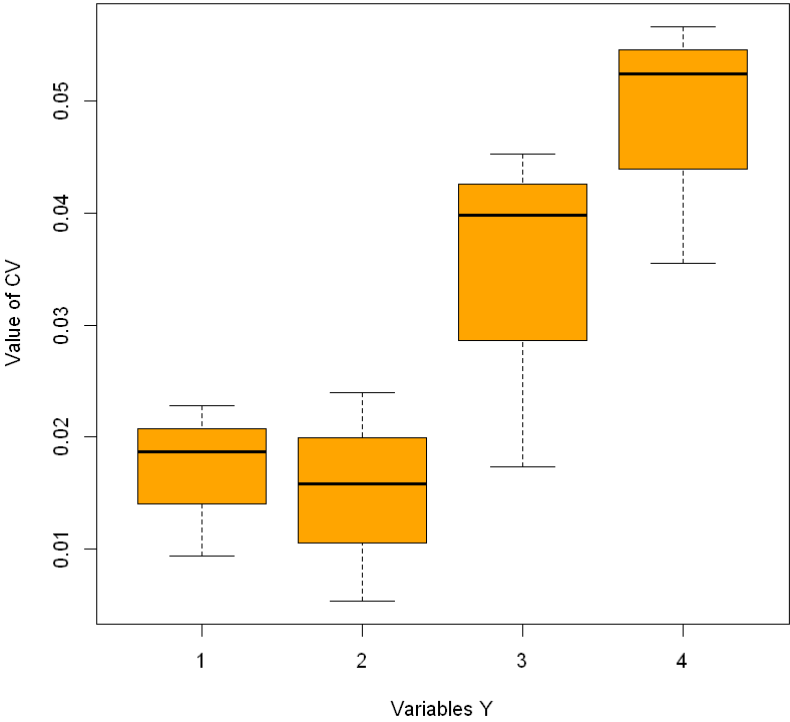
|==| 100%

A data.frame: 1 × 5

CV1	CV2	CV3	CV4	dom
<dbl>	<dbl>	<dbl>	<dbl>	<chr>
0.009	0.0074	0.0213	0.029	DOM1

In [25]:
```r
# Domain level = regional
domain_var <- "region"
set.seed(1234)
eval <- eval_2stage(df,
                    PSU_code,
                    SSU_code,
                    domain_var,
                    target_vars,
                    PSU_sampled,
                    nsampl=100,
                    writeFiles=FALSE,
                    progress=TRUE)
eval$coeff_var
```
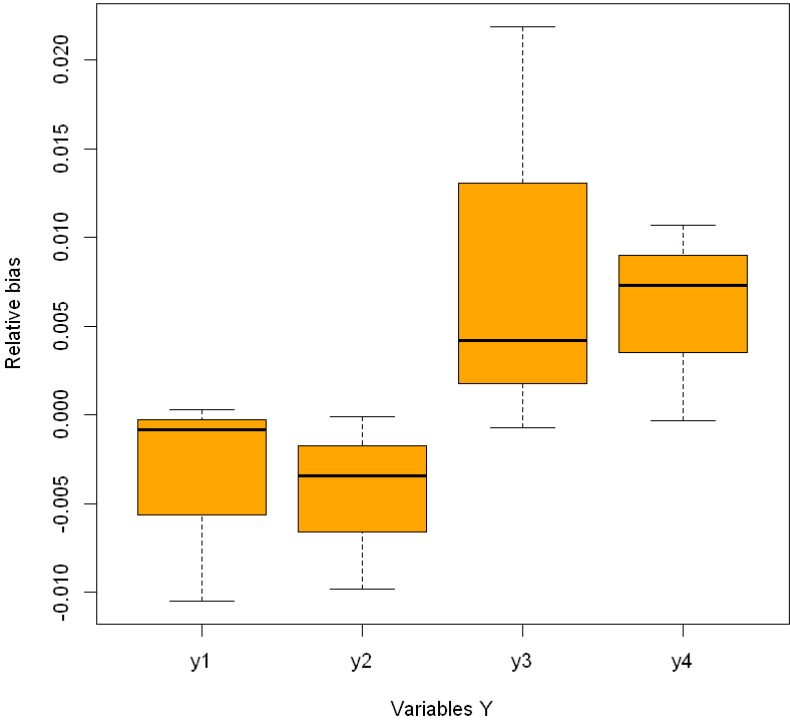
|==| 100%

Distribution of CV's in the domains

A data.frame: 3 × 5

CV1	CV2	CV3	CV4	dom
<dbl>	<dbl>	<dbl>	<dbl>	<chr>
0.0094	0.0053	0.0174	0.0566	DOM1
0.0187	0.0158	0.0398	0.0524	DOM2
0.0228	0.0240	0.0453	0.0355	DOM3

Distribution of relative bias in the domains

```
In [26]:  alloc$sensitivity
```

A data.frame: 4 × 6

	Type	Dom	V1	V2	V3	V4
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>
1	DOM1	1	1	1	1	628
5	DOM2	1	1	0	1	2214
9	DOM2	2	1	1	1	163
13	DOM2	3	1	1	1	1

```
In [ ]:
```