Mizer model

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Loading library

Load the packages required to design mizer model and produce figures.

```
library(mizer)
library(mizerExperimental)
library(tidyverse)
```

Setting initial parameters

```
params <- newSingleSpeciesParams()
params_initial <- setResource(params,
                      resource_dynamics = "resource_semichemostat")
params_double <- params_initial
params_double <- setResource(params_double,
                             resource_level = 0.1)
initialN(params_double) <- 2*initialN(params_double)
initialNResource(params_double) <- initialNResource(params_double)/2
```

Implementing fishing gear

```
gear_params(params_double) <- data.frame(
  gear = "gear",
  species = "Target species",
  catchability = 0.3,
  sel_func = "sigmoid_weight",
  sigmoidal_weight = 15,
  sigmoidal_sigma = 5)
```

```r
params_double <- setFishing(params_double, gear_params = gear_params)

gear_params(params_double)
```

```
                     gear        species catchability       sel_func
Target species, gear gear Target species          0.3 sigmoid_weight
                     sigmoidal_weight sigmoidal_sigma
Target species, gear               15               5
```

Simulating ecosystem behaviour

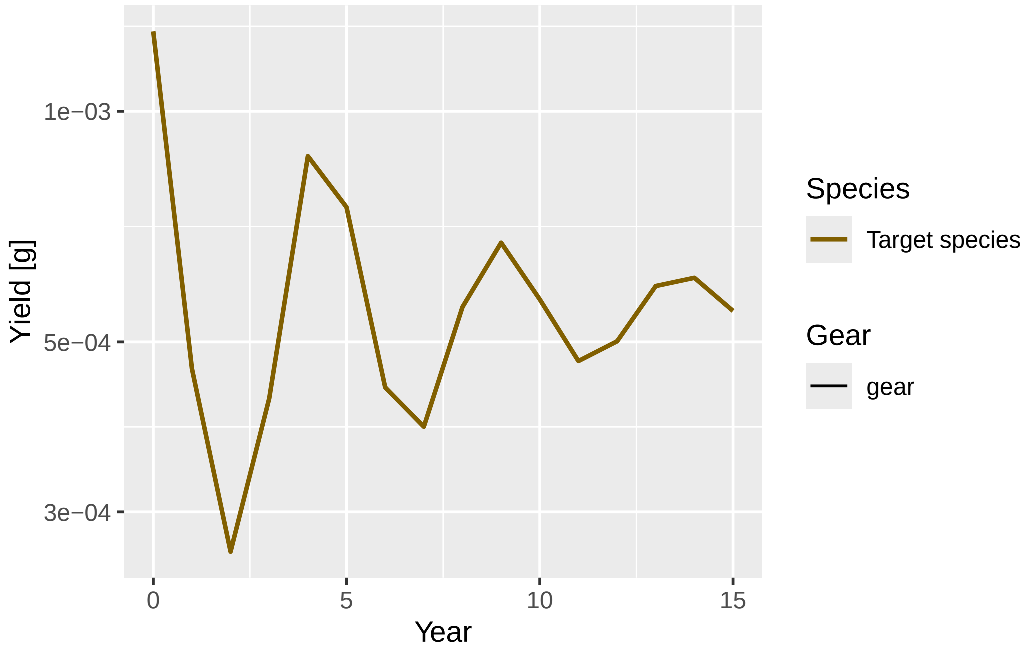
```r
sim_double <- project(params_double, t_max = 15, effort = 1)
```

Extract and plot yield

```r
getYieldGear(sim_double)
```

```
, , sp = Target species

    gear
time         gear
  0  0.0012712274
  1  0.0004614314
  2  0.0002662361
  3  0.0004220103
  4  0.0008738575
  5  0.0007496112
  6  0.0004361817
  7  0.0003875088
  8  0.0005553817
  9  0.0006736737
  10 0.0005680980
  11 0.0004720735
  12 0.0005009610
  13 0.0005914342
  14 0.0006062247
  15 0.0005487976
```

```r
plotYieldGear(sim_double)
```



Locally reduce resource parameters

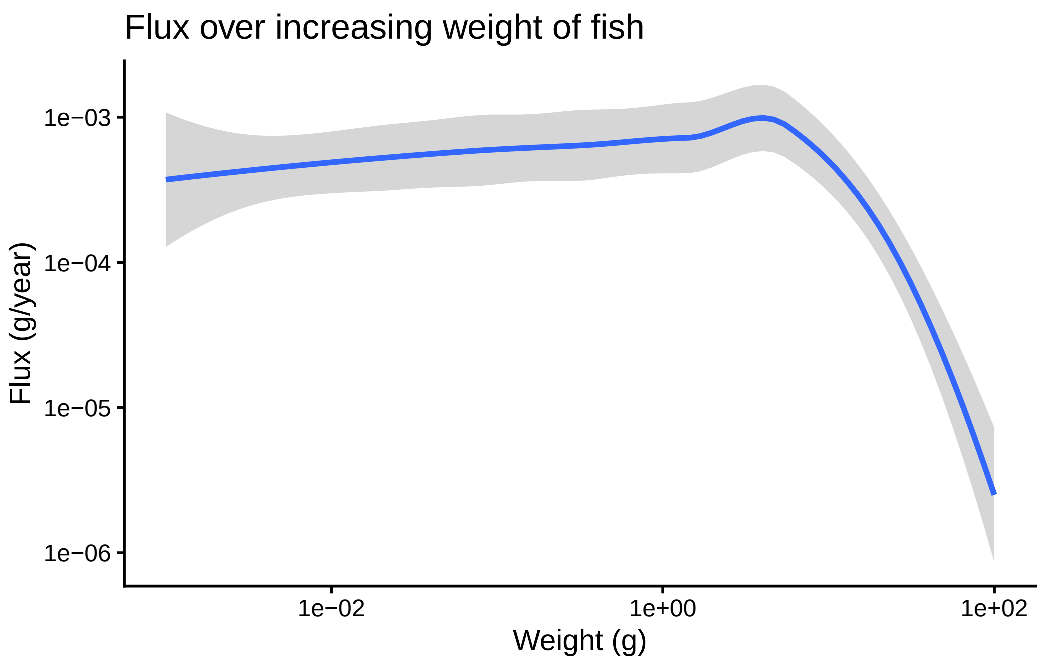
Calculate current flux

```r
N <- finalN(sim_double)["Target species", , drop = TRUE]
w <- w(params_double)

E_growth <- getEGrowth(params_double)["Target species", , drop = TRUE]
gr <- w * E_growth
flux <- gr * N
```

Plot initial flux without local reductions

```r
initial_flux_data <- data.frame(Weight = w,
                                Flux = flux)
initial_flux_plot <- ggplot(initial_flux_data,
                            aes(x = Weight, y = Flux)) +
  geom_smooth() +
```

```
  scale_x_log10() +
  scale_y_log10() +
  labs(
    x = paste0("Weight (g)"),
    y = paste0("Flux (g/year)"),
    title = "Flux over increasing weight of fish") +
  theme_classic()
initial_flux_plot
```

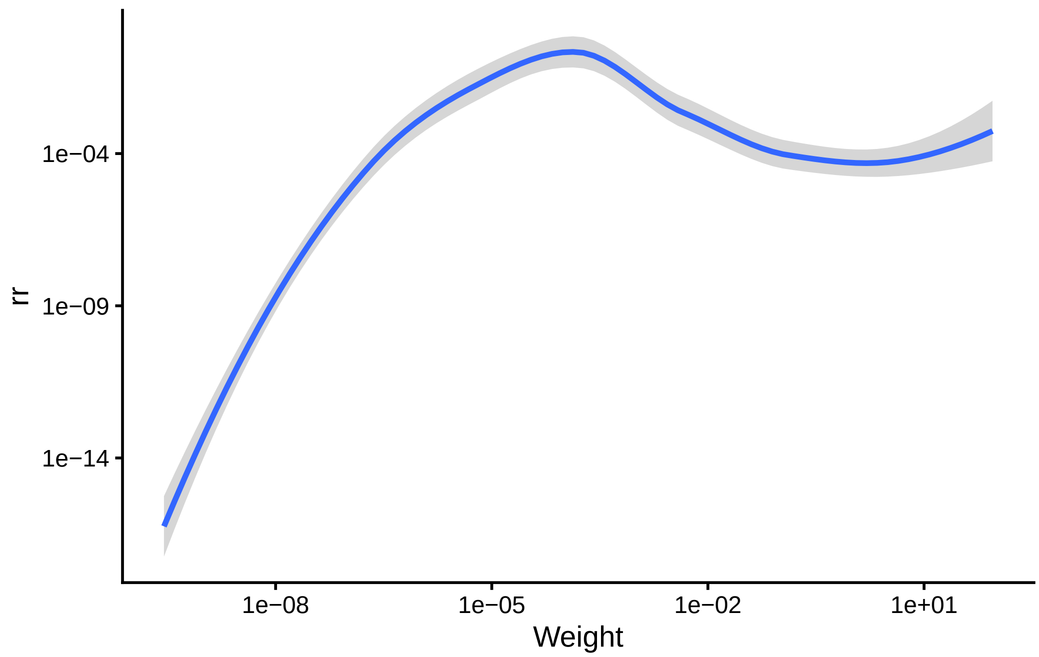


Locally reduce resource rate

```
rr <- resource_rate(params_double)
w_full <- w_full(params_double)
w_full[215:240]
```

```
 [1] 0.04466836 0.05011872 0.05623413 0.06309573 0.07079458 0.07943282
 [7] 0.08912509 0.10000000 0.11220185 0.12589254 0.14125375 0.15848932
[13] 0.17782794 0.19952623 0.22387211 0.25118864 0.28183829 0.31622777
[19] 0.35481339 0.39810717 0.44668359 0.50118723 0.56234133 0.63095734
[25] 0.70794578 0.79432823
```

```r
rr[215:240] <- rr[215:240] / 100000000

rr_data <- data.frame(
  Weight = params_double@w_full,
  rr = rr
)

rr_plot <- ggplot(rr_data,
                  aes(x = Weight, y = rr)) +
  geom_smooth() +
  scale_x_log10() +
  scale_y_log10() +
  theme_classic()
rr_plot
```



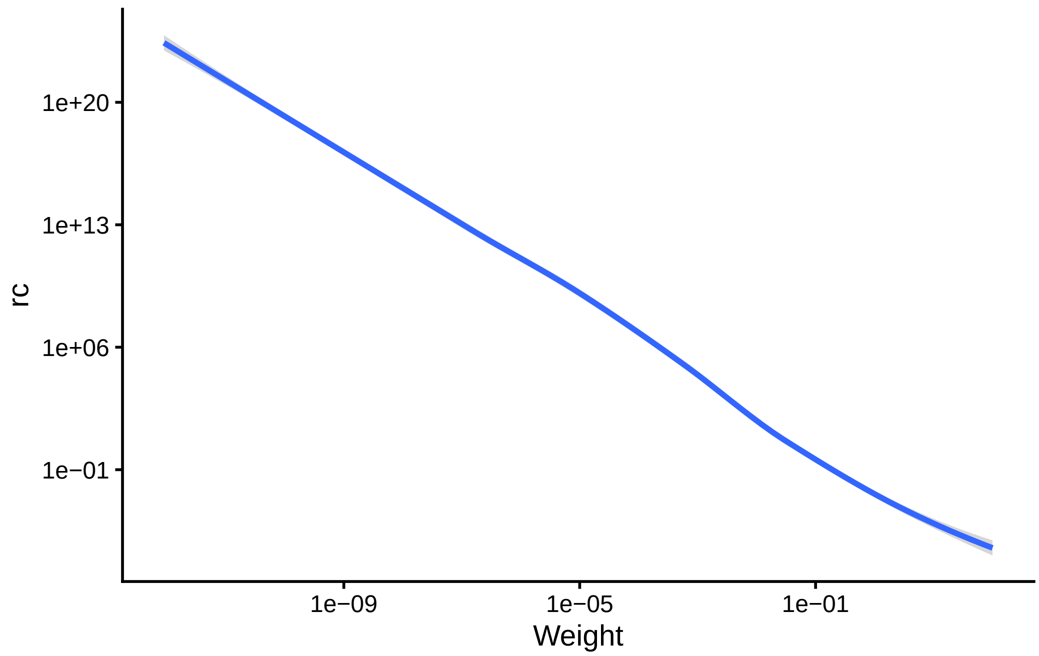
Locally reduce resource capacity

```r
rc <- resource_capacity(params_double)
w_full[215:240]
```

```
 [1] 0.04466836 0.05011872 0.05623413 0.06309573 0.07079458 0.07943282
```

```
 [7] 0.08912509 0.10000000 0.11220185 0.12589254 0.14125375 0.15848932
[13] 0.17782794 0.19952623 0.22387211 0.25118864 0.28183829 0.31622777
[19] 0.35481339 0.39810717 0.44668359 0.50118723 0.56234133 0.63095734
[25] 0.70794578 0.79432823
```

```
rc[215:240] <- rc[215:240] / 10000

rc_data <- data.frame(
  Weight = params_double@w_full,
  rc = rc
)

rc_plot <- ggplot(rc_data,
                  aes(x = Weight, y = rc)) +
  geom_smooth() +
  scale_x_log10() +
  scale_y_log10() +
  theme_classic()
rc_plot
```

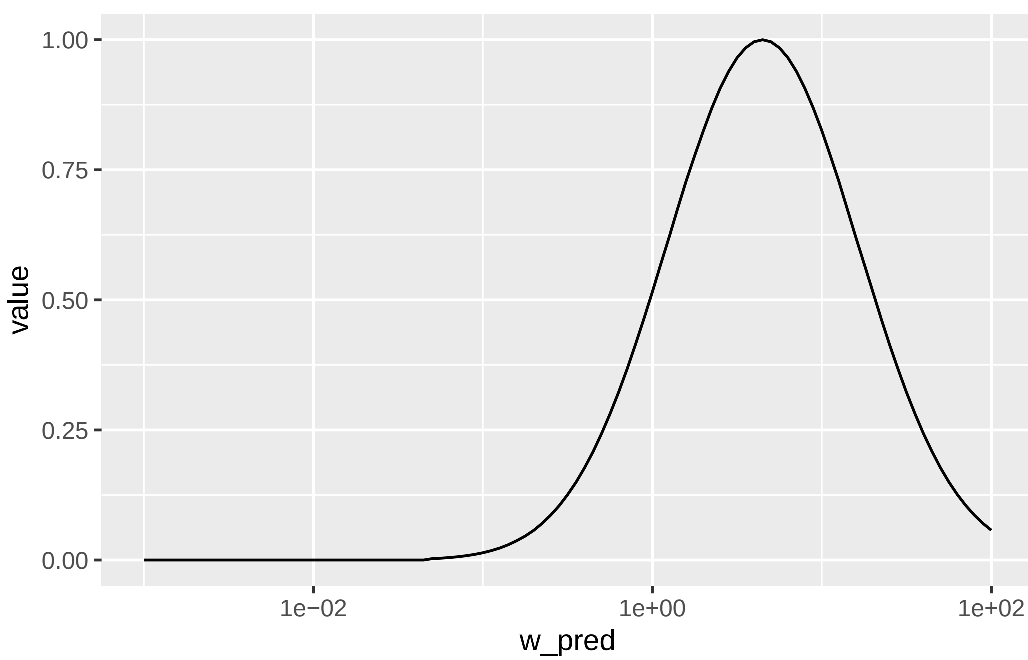


Set new parameters with local resource parameter reductions

```r
params_reduced <- setResource(params_double,
                              resource_capacity = rc,
                              resource_rate = rr,
                              balance =  FALSE)
```

Narrow predation kernel

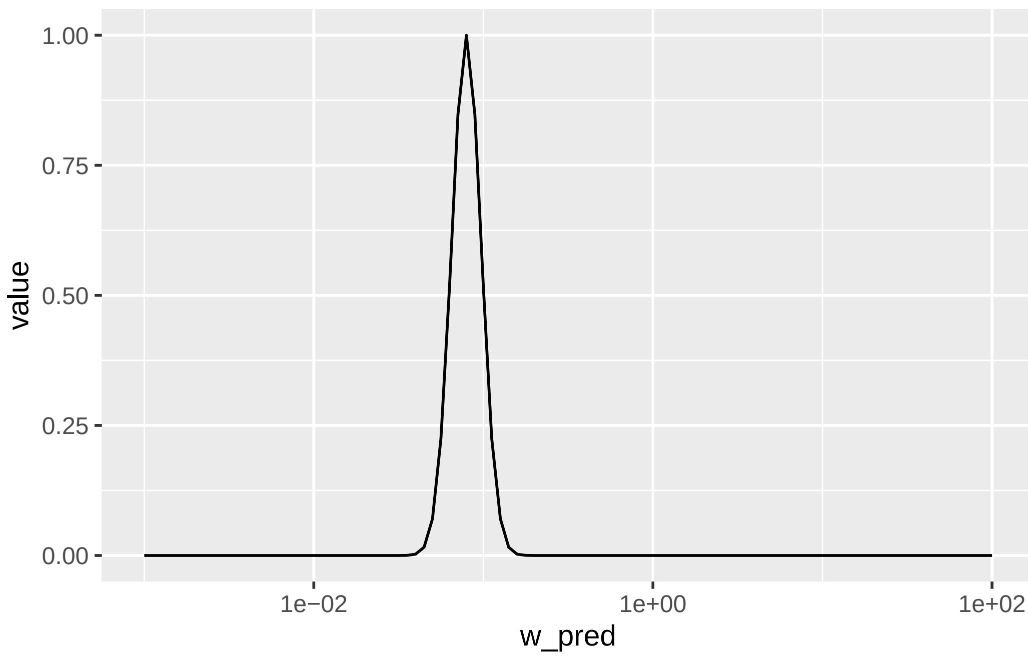
```r
pred_kernel <- getPredKernel(params_reduced)

pred_kernel_reduced <- pred_kernel[, , 215, drop = FALSE]

ggplot(melt(pred_kernel_reduced)) +
  geom_line(aes(x = w_pred, y = value)) +
  scale_x_log10()
```




```r
select(species_params(params_reduced), beta, sigma)
```

```
               beta sigma
Target species  100   1.3
```

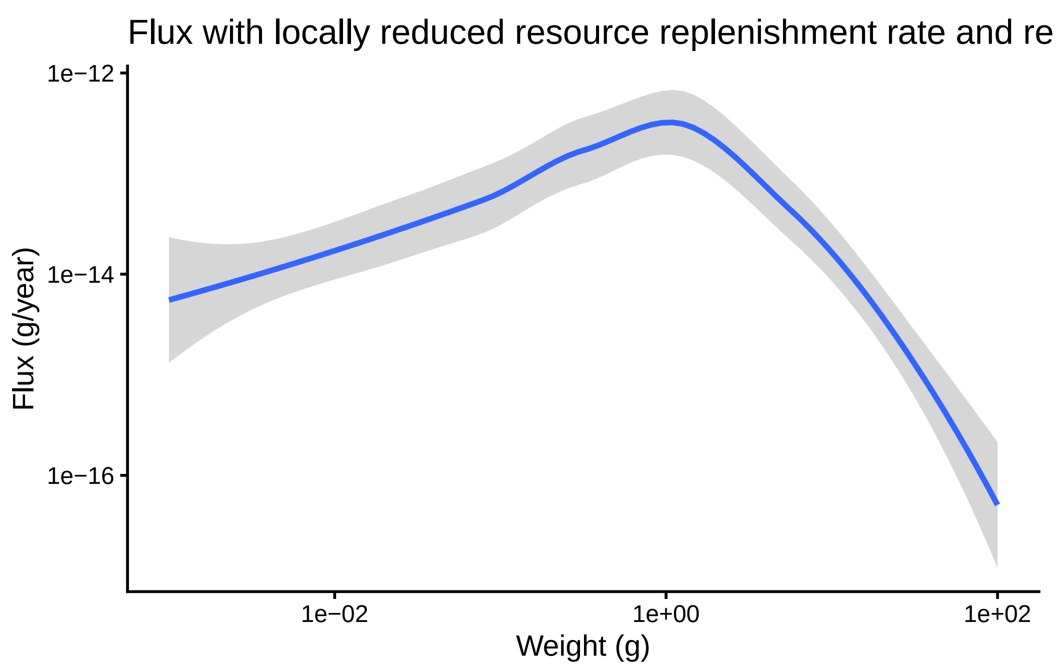
```r
given_species_params(params_reduced)$sigma <- 0.2
given_species_params(params_reduced)$beta <- 100

getPredKernel(params_reduced)[, , 180, drop = FALSE] %>%
  melt() %>%
  ggplot() +
  geom_line(aes(x = w_pred, y = value)) +
  scale_x_log10()
```



Calculate flux after local reductions in resource parameters

```r
sim_reduced <- project(params_reduced, t_max = 15, effort = 1)

N_reduced <- finalN(sim_reduced)["Target species", , drop = TRUE]
w <- w(params_reduced)

E_growth_reduced <- getEGrowth(params_reduced)["Target species", , drop = TRUE]
grr <- w * E_growth_reduced
flux_reduced <- grr * N_reduced
```

```
reduced_flux_data <- data.frame(Weight = w,
                                 Flux = flux_reduced)

reduced_flux_plot <- ggplot(reduced_flux_data,
                            aes(x = Weight, y = Flux)) +
  geom_smooth() +
  scale_x_log10() +
  scale_y_log10() +
  labs(
    x = paste0("Weight (g)"),
    y = paste0("Flux (g/year)"),
    title = "Flux with locally reduced resource replenishment rate and resource capacity") +
  theme_classic()

reduced_flux_plot
```

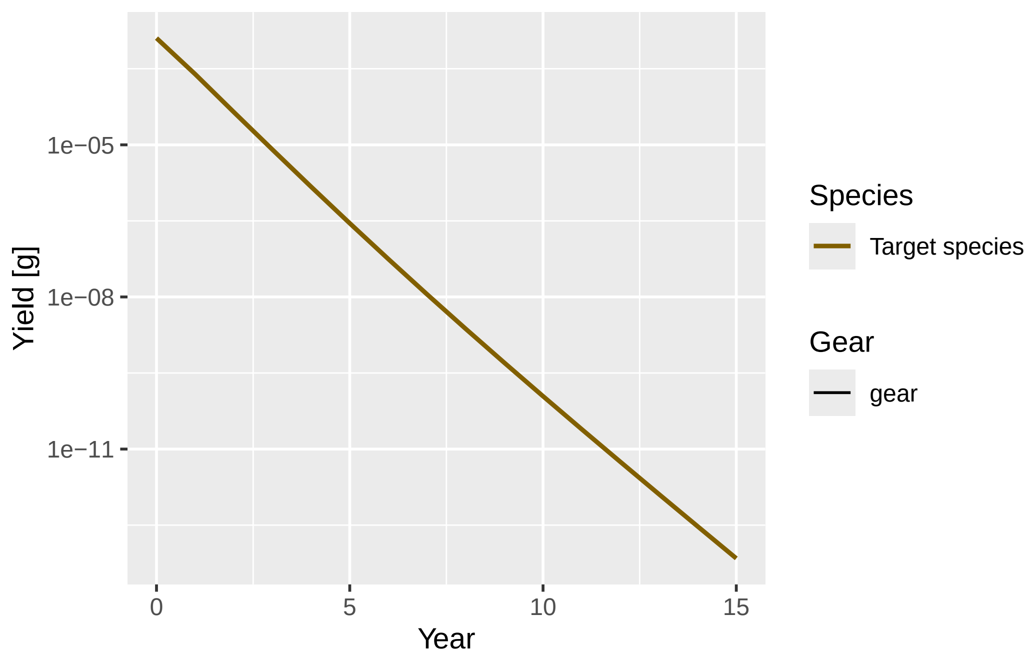


Extract yield

```
getYieldGear(sim_reduced)
```

```
, , sp = Target species

    gear
time         gear
  0  1.271227e-03
  1  2.474499e-04
  2  4.418470e-05
  3  8.029882e-06
  4  1.487549e-06
  5  2.835862e-07
  6  5.569605e-08
  7  1.126878e-08
  8  2.348460e-09
  9  5.029205e-10
  10 1.102644e-10
  11 2.464974e-11
  12 5.596909e-12
  13 1.286500e-12
  14 2.985719e-13
  15 6.981861e-14
```

```
plotYieldGear(sim_reduced)
```



Plot growth rate against weight

```r
growth_data <- data.frame(growth = E_growth_reduced,
                          weight = w)
growth_plot <- ggplot(growth_data,
       aes(x = weight,
           y = growth)) +
  geom_smooth() +
  scale_x_log10() +
  scale_y_log10() +
  labs(x = paste0("Weight (g)"),
       y = paste0("Growth Rate (g/year)"),
       title = "Growth rate of fish across increasing size classes") +
  theme_classic()
growth_plot
```

```
`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```