# ESM232 - HwK5

Ruben Sanchez, Alex Millward and Mauricio Collado

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## 1. Objective

Implement a differential equation for growth rate incorporating carrying capacity. Then predict the population for the next 50 years employing the following set of parameters:

- Initial population of 1
- Intrinsic growth rate of 0.05
- Carrying capacity of 20

## 2. Change in population

We create a growth rate function with initial population (P), intrinsic growth (r), and carrying capacity (k) as parameters. The growth has the following form:

$$dP/dT = r * P * (1 - P/K)$$

```
#'  Population growth rate
#' @param T  period of growth
#' @param P initial population
#' @param parms$r - base growth rate
#' @param parms$k - carrying capacity
#' @return change in population
#'
dexpopk = function(time, P, parms) {

  # compute rate of change of population that includes carrying capacity
  dexpop = parms$r*P*(1-P/parms$k)

  return(list(dexpop))
}
```

## 3. Prediction for 50 years

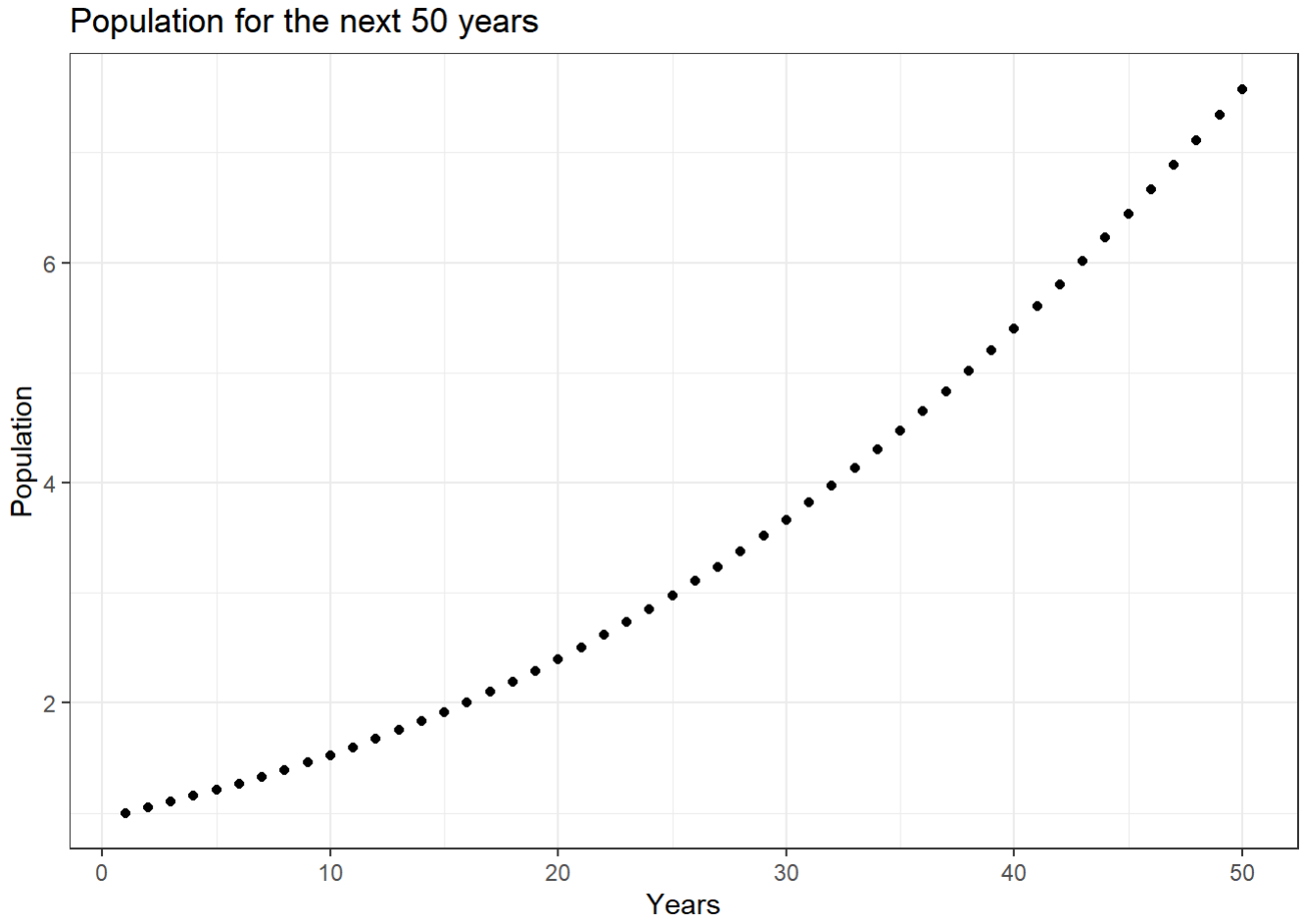
We predict the population for next 50 years with the following parameters:

- Initial population of 1
- Intrinsic growth rate of 0.05
- Carrying capacity of 20

```
# set parameters
initial_pop=1
params_rk = list(r=0.05, k=20) # same parameter names in function
years = seq(from=1, to=50)

# use solver and growth rate function
results=ode(initial_pop, years, dexpopk, params_rk)

# column names
colnames(results)=c("year","P")

# save results in a dataframe

results_df <- as.data.frame(results) # same result as propose as rachel
```

With the selected parameters, the population reachs a value 7.576973 in the year 50.

```
# plot
ggplot(results_df, aes(year,P))+
  geom_point()+
  labs(title="Population for the next 50 years",
       y="Population",
       x="Years")+
  theme_bw()
```



We do not reach the steady state on the year 50. We decided to test the model for 200 years, and we found out we reach the steady state after the year 150.

```
# test until the year 200
years = seq(from=1, to=200)

# use solver and growth rate function
results=ode(initial_pop, years, dexpopk, params_rk)

# column names
colnames(results)=c("year","P")

# save results in a dataframe

results_df <- as.data.frame(results)

# plot
ggplot(results_df, aes(year,P))+
  geom_point()+
  labs(title="Population for the next 200 years",
       y="Population",
       x="Years")+
  theme_bw()
```