

I. Norwegian aid projects (weight 65 %)

Each sub-problem carries the same weight

In this problem, we are going to use data on Norwegian development aid projects. Data are taken from the API of the Norwegian agency for development cooperation (Norad) available at resultater.norad.no/microdata. Data for aid projects to Africa in the period 2010–2024 are available in the file [norad.csv](#).

Each row is a project-year-disbursement observation, i.e. there may be several rows per project-year. The variable [agreement_number](#) uniquely identifies projects.

a) Read the CSV file into a tibble [norad](#). How many rows do the data contain? What is the total number of projects? Find the number of projects per country (or regional group) as coded in the variable [recipient_country](#).

b) The variable [disbursements_1000_nok](#) gives the disbursement of the project (in 1000 NOK). The variable has some observations with values below 0. Report the number of negative values, and remove these from the tibble (keeping the same name).

c) Find the median value and the 25 and 75 percentiles of disbursements for every year. Show the values in a plot. Make sure to choose a suitable plot type for the data and to label all parts of the graph properly.

Hint: The quantile function can be used to compute percentiles.

d) Inspecting the variable [recipient_country](#) we notice that while many projects go to a country, some go to regional projects such as “Africa Regional” or “Western Africa regional”. All these projects are labelled with the term “regional” or “Regional” in the [recipient_country](#) variable. Construct a binary variable for each project which indicates regional projects. What is the fraction of projects that are regional? What is the median and mean disbursement for national and regional projects, respectively?

NB: For a full score, you need to use a generalizable code structure avoiding brute force when separating regional and national projects.

e) We want to plot total disbursement received by a country in 2024 in a map. We first need to prepare the data to plot. Compute the total disbursement per country in 2024. Add a column containing iso3c country codes using the [countrycode](#) package.

f) A world map can be found in the file [world_map.rda](#). Link your data from problem e) to the world map, matching the variable [iso_a3](#) to the iso3c code inserted above. Plot the map for the African continent showing levels of disbursement as the color of each country.

NB: If you did not manage to generate the ISO3 country codes in e), you can do an imperfect match linking the variable [recipient_country](#) to [admin](#) in the [world_map](#) data.

g) We want to compute the time trend in disbursements by country. For each country separately, regress total [annual disbursements](#) on the [year](#) variable. Keep the regression coefficient on the [year](#) variable. Plot the coefficient for each country in a map as for problem f).

II. Pork cycles (weight 35 %)

We want to study cyclicalities in the market for pork meat. Assume that the demand for pork is given by the demand function

$$D(p) = 100 - p$$

We will consider cases where there is a certain stock of pork that are ready for consumption. We assume that pork is eaten fresh and hence cannot be stored, so at any point in time supply is equal to the stock of pork.

a) (weight 5 %)

Write a function `price(stock)` that gives the equilibrium price for a certain stock of pork. Find the equilibrium price when the stock of pork is 50.

b) (weight 10 %)

Pork takes a while to produce, so the production decision must be based on past information. Assume that producers have adaptive expectations, so they make investment decisions based on prices in the previous period.

The cost of investing in and raising x piglets is given by the function $C(x) = \frac{1}{2}cx^2$ with $c = 1$.

Then profit maximization yields the following supply function:

$$p = C'(x) \Rightarrow x = \frac{p}{c}$$

Assume that at time 1, the stock of pigs is $x_1 = 30$. Write a loop that simulates the market for pork for $T = 10$ periods. Provide the produced volumes of pork for each period. Describe the behavior of production.

c) (weight 10 %)

Assume next that producers are somewhat more sophisticated, basing their investment decision on an expectation formed by taking the average price of the last two periods.

Simulate the behavior of the market using $x_1 = 30$, $x_2 = 40$ and $T = 10$ periods. Compare with your findings in problem b).

d) (weight 10 %)

Consider a version of this model where demand shocks arrive at random. Initially, the market is in equilibrium so $p_0 = x_0 = 50$. In each period $T \geq 3$, with probability π , a demand shock increasing demand by an amount of $\bar{D}$ occurs. Simulate the market with $\pi = 0.02$, $\bar{D} = 20$ and $T = 500$ periods. Show your result in a plot and comment on the shape.