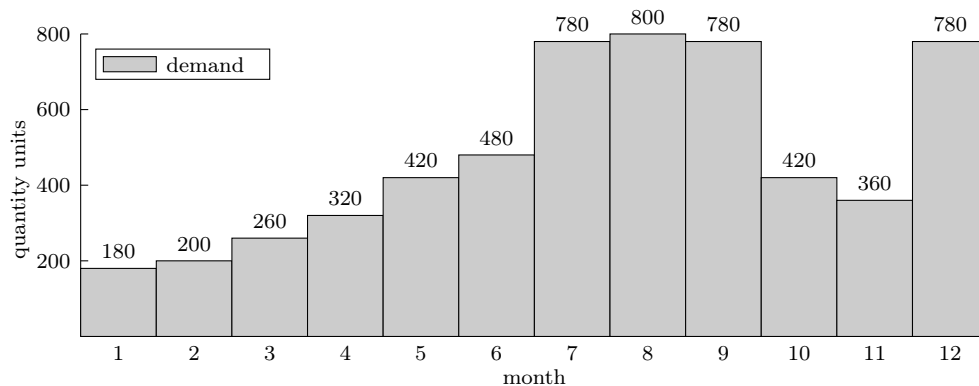# Optimization for Non-Mathematicians

Sheet 14

Exercise 33: Time variable demand

We consider again Sheet 9, Exercise 21 with some modifications:

A producer of icecream is planning his production for the coming year. From experience one expects the following demand in the several months:

The following aspects are important for the planning:

- **Production output:** The production costs for the production output of one month is given by the function $k(x) = (300x + 0.3x^2)$ € (x in quantity units, 1 QU = 1000 kg).

- **Storage:** Up to 600 QU can be stored. But this storage costs 30 € per month and QU.

Find a production plan for one trading year (including production output per month, storage) which minimizes the overall costs.

(a) Which constraints exist?

(b) What is the objective function?

(c) Solve the problem using `fmincon`.

(d) Generate a bar plot containing demand, production and stock.

(e) How would the total costs change if the demand in a certain month is increasing?

Exercise 34: Covering of a point set

In the two dimensional number plane a point set $M = \{(x_1, y_1), \ldots, (x_n, y_n)\}$ shall be covered by a circle with minimal radius.

(a) Formulate an optimization problem without constraints. Solve this problem using `fminunc`.

(b) This problem leads to difficulties when it is solved with `fminunc`. What could be the reason? In order to improve this, we introduce the radius as an additional optimization variable. Which are the objective and the constraints to obtain a smooth optimization problem?

(c) Solve this minimization problem using `fmincon` for a randomly generated point set M.

(d) Plot the point set M and the covering circle.