1. A feeder supplies power first increasing at *r* %/a for the first 10 years and later on remains the same. The calculation period is 25 a, the interest rate is 8 %, the cost of losses 0.05 €/kWh and the utilization time for losses is 1500 h/a. U = 20 kV. Make a table showing the most favourable areas of use. The variables are the initial supplied power and annual growth percentage.

	r Ω/km	*x* Ω/km	Price k€/km	Ampacity (A)
Raven	0,537	0,362	11	280
Al 132	0,219	0,342	14	459

Is the capacity sufficient after 10 years if the growth percentage is 4 %/a starting from the year 0 power at the break-even point (1.64 MVA). Calculate the max lengths when the allowed voltage drop is 4 % (cos φ = 0,95).

2. A factory needs a new medium voltage (20 kV) feeder of length 5 km. The supplied max power of the feeder will be for the first 20 a, 1,5 MVA, $\cos\varphi = 0{,}9$. The interest rate is 8 %, the cost of losses 0.05 €/kWh and the utilization time for losses is 1500 h/a. The feeder type will be Raven or Al 132. How big is the error if the wrong feeder type is chosen? Also calculate the possible error when the max power is 2,0 MVA or 2,5 MVA. The assessment time, T = 20 years.

3. Revisit ED&M_Exercise02 Question 3, and assuming a lifetime of 20 years and a load growth of 3%/a and an interest rate of 4%/a, **calculate the NPV for the lifetime cost of losses**. C_{losses} = 5e-5 €/Wh and T_{losses} = 3000 h/a based on 1st year demand ($\boldsymbol{P_{max,0}}$ and $\boldsymbol{Q_{max,0}}$)

You need the following formulae:

$$\gamma = \frac{(1+r)}{(1+p)}, \quad \gamma_1 = \frac{(1+r)^2}{(1+p)} \text{ and } \gamma_2 = \frac{1}{1+p}$$

(1), (2) and (3)

$$\kappa_{losses} = \gamma_1 \frac{\gamma_1^{t'} - 1}{\gamma_1 - 1} + \frac{(1+r)^{2t'}}{(1+p)^{t'}} \gamma_2 \frac{\gamma_2^{T-t'} - 1}{\gamma_2 - 1}$$

(4)

$$\kappa_{load} = \gamma \frac{\gamma^{t'} - 1}{\gamma - 1} + \frac{(1+r)^{t'}}{(1+p)^{t'}} \gamma_2 \frac{\gamma_2^{T-t'} - 1}{\gamma_2 - 1}$$

(5)

where

r is load growth
p is interest rate
T is review period and

t' is load growth period.