46750 - Optimization in Modern Energy Systems
Exercise 9

Name:

Student Number:

1. **Optimal offering strategy of price-taker wind producer**

   We consider a **price-taker** wind producer (W_1) with a capacity of $\overline{W}^{nom} = 150$ (MW) participating in the day-ahead electricity market and balancing market. Its marginal production cost is $c_{W_1}^G = 15 EUR/MWh$. Before deciding on the production to offer in the day-ahead market, the day-head λ^{DA} and balancing λ^B market prices, and the available wind production $\overline{P}_{W_1}$ are still uncertain. Once its production offered to the day-ahead market has been decided, and all sources of uncertainty have been revealed, the wind producer must settle any remaining imbalance. We consider that the wind producer only has access to (independent) forecasts of the realizations of the day-ahead and balancing prices and available wind production, such that:

   - $\lambda^{DA} = 20 EUR/MWh$ with a probability 1 (perfectly known for simplicity)
   - $\lambda^B \in \{0, 7, 10, 15, 24, 26, 35, 40, 43, 50\}$ (EUR/MWh) with equal probabilities (0.1)
   - $\overline{P}_{W_1} \in \{75, 125\}$ (MWh) with equal probability (0.5)

   (a) Considering that the wind producer aims at maximizing its expected profit, formulate and solve its optimal offering strategy problem with a one-price balancing scheme. Report and analyse the most relevant results.

   (b) Considering that the wind producer is risk-averse, and aims at finding an optimal trade-off between the expected profit and CVaR$_\alpha$ for the confidence level $\alpha = 0.95$, formulate and solve its optimal offering strategy problem with a one-price balancing scheme. Report and analyse the most relevant results for varying values of the *risk-preference parameter* $\beta \in [0, 1]$.