

Exercise 6.1.

Consider a generating unit with a maximum and minimum output of 150 MW and 50 MW, respectively. The production cost is 20 €/MWh. The uncertain electricity pool price for the next 7 time periods is characterized by 10 scenarios, with the same probability of occurrence, provided in the following table:

Pool prices (€/MWh)							
Scenario	t1	t2	t3	t4	t5	t6	t7
w1	29,8	32,3	30,4	31,3	29,8	31,5	30,2
w2	30,6	29,1	29,7	32,5	29,4	32,1	31,0
w3	36,4	39,8	36,0	39,1	39,2	39,4	36,3
w4	41,4	43,3	40,4	40,7	40,3	40,2	43,2
w5	45,4	44,5	43,4	44,1	43,6	42,3	43,0
w6	31,6	30,1	33,6	33,7	31,9	31,9	31,3
w7	39,7	38,1	37,5	38,1	36,9	37,1	40,3
w8	36,0	36,5	38,3	35,1	35,2	35,7	37,6
w9	30,4	29,4	31,2	28,9	30,9	28,9	29,7
w10	36,8	36,2	35,0	34,8	34,8	34,3	35,1

Moreover, the generating unit can also sell its production through the following forward contracts spanning the whole study horizon:

Contract #	Price (€/MWh)	Max Power (MW)
c1	31	20
c2	32	20
c3	33	20
c4	34	20
c5	35	20
c6	36	20

The generating unit has to determine the optimal number of forward contracts to be signed without knowing the realization of the electricity pool prices throughout the study horizon.

- Determine the first-stage decisions, second-stage decision, and uncertain parameters involved in the problem.
- Write the formulation to maximize the expected profit of the power producer.
- Write the formulation to maximize the Conditional Value-at-Risk of the producer's profit distribution.
- Fill in the following table and comment the results. The total power sold through forward contracts (PC) and the CVaR is computed solving the model c). The expected profit is determined by solving the model b) with the power sold through forward contracts fixed to those obtained in c).

FOR = 0%			
α	PC (MW)	CVaR	Expected Profit
0			
0.1			
0.2			
0.3			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			

- e) Fill in the following table assuming that there is a 20% chance that the generating unit is offline during the 7 time periods. Note that forward contracts decisions need to be made without knowing the availability of the unit during the study horizon.

FOR = 20%			
α	PC (MW)	CVaR	Expected Profit
0			
0.1			
0.2			
0.3			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			

- f) Compare the results obtained in d) and e)