ESF II project of the University of West Bohemia in Pilsen, reg. number: CZ.02.2.69/0.0/0.0/18_056/0013239

Example 4:

Efficient power distribution across multiple plants depending on consumer characteristics

(i.e. with respect to only the variable cost components)

Task:

Find the optimal power output for parallel cooperation of 2 power units with outputs of 5 MW and 8 MW, which have the consumption characteristics given in Tab. 1, and make its economical division between these blocks.

Tab. 1:

P_e [MW]	0	1	2	3	4	5	6	7	8
Q_1 [MW]	2,7	4,6	6,7	10,1	14,5	17,0			
Q_2 [MW]	5,1	6,7	8,1	10,4	13,7	15,8	18,2	21,2	24,7

Solution procedure:

1) Graphically we illustrate both of entered consumption characteristics (these are polynomials of the 2nd degree => do not connect the points, but interpolate them by curve).
2) We calculate and plot the sum of individual characteristics (on P-axis we consider P_{e1}) for 1 to 13 MW (in step of 1 MW).
3) We plot the minimum values of the individual sum characteristics always for the respective power output and interpolate them into the total sum characteristic (again as a polynomial of the 2nd degree).
4) We construct the tangent from the beginning of the coordinate system to the total sum characteristic, at the point of contact we find the optimal power output $P_{c\ opt}$ (by estimation, rounded to the nearest whole number), at which the power plants together have the highest efficiency.
5) From the graph of the sum characteristic for the determined optimal power output, we find the optimal P_{e1} for the minimum Q_c, then we obtain the optimal P_{e2} by subtracting P_{e1} from the $P_{c\ opt}$.

The individual sum characteristics for P_c are:

P_c=1 MW	P_{e1}	P_{e2}	Q_1	Q_2	Q_c
	0	1	2,7	6,7	9,4
	1	0	4,6	5,1	9,7

P_c=2 MW	P_{e1}	P_{e2}	Q_1	Q_2	Q_c
	0	2	2,7	8,1	10,8
	1	1	4,6	6,7	11,3
	2	0	6,7	5,1	11,8

P_c=3 MW	P_{e1}	P_{e2}	Q_1	Q_2	Q_c
	0	3	2,7	10,4	13,1
	1	2	4,6	8,1	12,7
	2	1	6,7	6,7	13,4
	3	0	10,1	5,1	15,2

etc. to

P_c=13 MW	P_{e1}	P_{e2}	Q_1	Q_2	Q_c
	5	8	17,0	24,7	41,7

Illustrative figur:

