Computational experiments

Data generation

We randomly generate input parameters for the three-model ROQCP problem using the following procedure:

- The lead times l_i and capacities c_i are uniformly distributed in the range $[10,50]$ for $i=1,\dots,n$.
- The bounds for the modification of lead times and capacities are initialized as follows: $\bar{x}_i$ is uniformly distributed in $[1,10]$ for $i=1,\dots,n$; $\bar{y}_i$ is dependent on l_i and randomly generated in $[1,c_i-1]$ to ensure that $c_i-\bar{y}_i>1$.
- The lead time adjustment cost λ_i follows a uniform distribution in the range $[5,10]$, while the capacity adjustment cost μ_i is randomly chosen from the interval $[1,150]$.
- The budgets are randomly generated using the following formulas: $B^1=\sum_{i=1}^{n}(\lambda_i\bar{x}i+\mu_i)$, $B^2=\sum_{i=1}^{n}(\lambda_i+\mu_i)$ and $B^3=\sum_{i=1}^{n}\mu_i$.

Computational results

We implemented the described algorithm using Python 3 on a personal PC (Intel Core i7 2.80Ghz, 32 GB RAM). With the input data provided above, we perform runtime tests for the algorithm using different values of σ and B. For each combination of σ and B, the algorithms are executed 50 times with randomly generated data for each run. The average time taken is recorded and presented in Table 1.

Table 1: Result for the RQOCP[1]

n	$\sigma=50$			$\sigma=100$			$\sigma=500$			$\sigma=1000$		
	$\frac{1}{100}B^1$	$\frac{1}{50}B^1$	$\frac{1}{10}B^1$	$\frac{1}{100}B^1$	$\frac{1}{50}B^1$	$\frac{1}{10}B^1$	$\frac{1}{100}B^1$	$\frac{1}{50}B^1$	$\frac{1}{10}B^1$	$\frac{1}{100}B^1$	$\frac{1}{50}B^1$	$\frac{1}{10}B^1$
50	0.0019	0.0025	0.0031	0.0013	0.0021	0.0040	0.0035	0.0035	0.0038	0.0033	0.0041	0.0043
100	0.0060	0.0050	0.0045	0.0055	0.0054	0.0069	0.0067	0.0059	0.0071	0.0086	0.0085	0.0087
500	0.0354	0.0342	0.0397	0.0426	0.0374	0.0383	0.0436	0.0423	0.0420	0.0432	0.0501	0.0512
1000	0.0845	0.0931	0.0825	0.0855	0.0852	0.0837	0.1010	0.1001	0.1002	0.1032	0.1159	0.1028
5000	0.5864	0.5845	0.5158	0.6883	0.6251	0.6599	0.7092	0.6322	0.7072	0.7113	0.7092	0.6439
10000	1.4297	1.5935	1.4256	1.5153	1.3381	1.3314	1.5298	1.6988	1.3646	1.5810	1.7446	1.5718
50000	13.3954	13.1759	13.1608	15.6273	12.6039	12.5037	15.1767	14.0848	13.9814	14.4228	14.7154	13.3739

Table 2: Result for the RQOCP^2

n	$\sigma = 50$			$\sigma = 100$			$\sigma = 500$			$\sigma = 1000$		
	$\frac{1}{100}B^2$	$\frac{1}{50}B^2$	$\frac{1}{10}B^2$	$\frac{1}{100}B^2$	$\frac{1}{50}B^2$	$\frac{1}{10}B^2$	$\frac{1}{100}B^2$	$\frac{1}{50}B^2$	$\frac{1}{10}B^2$	$\frac{1}{100}B^2$	$\frac{1}{50}B^2$	$\frac{1}{10}B^2$
50	0.0010	0.0013	0.0011	0.0014	0.0011	0.0010	0.0016	0.0015	0.0010	0.0014	0.0012	0.0017
100	0.0028	0.0025	0.0016	0.0028	0.0027	0.0023	0.0031	0.0038	0.0026	0.0037	0.0034	0.0033
500	0.0147	0.0124	0.0142	0.0163	0.0153	0.0154	0.0182	0.0183	0.0186	0.0192	0.0215	0.0195
1000	0.0353	0.0263	0.0339	0.0368	0.0281	0.0373	0.0488	0.0380	0.0434	0.0399	0.0403	0.0458
5000	0.2168	0.2163	0.2181	0.2341	0.2351	0.2071	0.3002	0.2715	0.2745	0.2836	0.2890	0.2806
10000	0.5301	0.5394	0.5279	0.5761	0.5734	0.5674	0.5973	0.6205	0.7024	0.7003	0.6309	0.6328
50000	5.8542	5.3506	5.3906	5.4949	5.6476	5.5581	5.6383	6.2490	6.2591	6.0853	6.6894	6.6670

Table 3: Result for the RQOCP^3

n	$\sigma = 100$			$\sigma = 500$			$\sigma = 1000$		
	$\frac{1}{100}B^3$	$\frac{1}{50}B^3$	$\frac{1}{10}B^3$	$\frac{1}{100}B^3$	$\frac{1}{50}B^3$	$\frac{1}{10}B^3$	$\frac{1}{100}B^3$	$\frac{1}{50}B^3$	$\frac{1}{10}B^3$
50	8.7×10^{-5}	9.2×10^{-5}	9.8×10^{-5}	9.1×10^{-5}	8.7×10^{-5}	0.00011	9.1×10^{-5}	0.00010	0.00010
100	9.7×10^{-5}	0.00012	0.00011	0.00010	0.00010	0.00012	0.00012	0.00011	0.00014
500	9.3×10^{-5}	0.00010	0.00012	0.00011	0.00013	0.00013	0.00017	0.00013	0.00012
1000	0.00010	0.00013	0.00014	0.00013	0.00015	0.00018	0.00015	0.00014	0.00019
5000	0.00017	0.00016	0.00016	0.00025	0.00023	0.00021	0.00070	0.00022	0.00025
10000	0.00023	0.00024	0.00030	0.00027	0.00018	0.00024	0.00131	0.00132	0.00139
50000	0.00077	0.00061	0.00089	0.00861	0.00878	0.00875	0.00799	0.00871	0.00852
100000	0.00141	0.00147	0.00161	0.01889	0.01910	0.01833	0.01869	0.01850	0.01881