

## A Online Appendix: Numerical Results

This section contains a detailed statistical summary of the numerical results gathered during the experimental analysis in Section ???. Because of space restrictions, we omit results for lookahead durations  $D \in \{180, 240, 300, 420, 480, 540\}$  minutes and only list results for  $D \in \{0, 60, 120, 360, 600\}$  minutes. For each problem, we give three tables:

- The first table subsumes in one line per algorithm and lookahead level the key figures with respect to the objective values incurred over the set of sampled input instances.
- The second table subsumes in one line per algorithm and lookahead level the key figures with respect to the performance ratio relative to an optimal offline algorithm if available, or relative to the best offline algorithm applied.
- The third table subsumes in one line per algorithm and lookahead level the key figures with respect to the performance ratio relative to an online algorithm from the same class of algorithms.

The following key figures were calculated from the samples of random input instances:

$\mu$  Average of objective value or performance ratio

$CV$  Coefficient of variation of objective value or performance ratio

**95 % CI** 95 % confidence interval of objective value or performance ratio

**min** Minimum objective value or performance ratio

**max** Maximum objective value or performance ratio

$q_{0.01}$  First percentile of objective value or performance ratio counting distribution

$q_{0.5}$  Median of objective value or performance ratio counting distribution

$q_{0.99}$  99th percentile of objective value or performance ratio counting distribution

**% det.** Fraction of samples with deterioration in the objective value when compared to the same algorithm with the lookahead level preceding the algorithm's lookahead level

$F(1)$  Fraction of samples with performance ratio smaller than 1 relative to the optimal offline algorithm if available, or relative to a best possible offline algorithm among those offline algorithms which terminated

$1 - F(1)$  Fraction of samples with performance ratio larger than 1 relative to an online algorithm from the same class of algorithms



Makespan for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>60</sub>	562.53	0.05	[554.57, 570.49]	546.2	693	546.2	556.3	693	0.04
LS,RET <sub>120</sub>	530	0.08	[518, 542]	490.8	725.7	490.8	523.4	725.7	0.06
LS,RET <sub>360</sub>	491.63	0.12	[474.94, 508.32]	406.2	669.5	406.2	481.4	669.5	0.29
LS,RET <sub>600</sub>	492.09	0.12	[475.38, 508.8]	407.8	669.5	407.8	487.9	669.5	0.2
LS,S <sub>0</sub>	621.5	0.05	[612.71, 630.29]	608.7	741	608.7	613.3	741	
LS,S <sub>60</sub>	557.83	0.03	[553.1, 562.56]	547.2	657.6	547.2	554.1	657.6	0.02
LS,S <sub>120</sub>	528.88	0.08	[516.91, 540.85]	488.6	725.7	488.6	525.7	725.7	0.06
LS,S <sub>360</sub>	467.4	0.12	[451.53, 483.27]	379	664.9	379	463.3	664.9	0.33
LS,S <sub>600</sub>	464.93	0.12	[449.15, 480.71]	357.7	664.9	357.7	462.8	664.9	0.33
LS,GAP <sub>0</sub>	622.76	0.05	[613.95, 631.57]	608.6	741	608.6	614.3	741	
LS,GAP <sub>60</sub>	562.47	0.05	[554.51, 570.43]	547.8	712.5	547.8	554.5	712.5	0
LS,GAP <sub>120</sub>	532.31	0.09	[518.76, 545.86]	491.6	725.7	491.6	523.3	725.7	0.08
LS,GAP <sub>360</sub>	484.77	0.11	[469.68, 499.86]	404.6	664.9	404.6	480.5	664.9	0.24
LS,GAP <sub>600</sub>	487.55	0.11	[472.38, 502.72]	403.5	664.9	403.5	481	664.9	0.31
LS,OPT <sub>0</sub>	617.52	0.03	[612.28, 622.76]	607.6	725.7	607.6	613	725.7	
LS,OPT <sub>60</sub>	562.69	0.05	[554.73, 570.65]	548.4	712.5	548.4	554.4	712.5	0.04
LS,OPT <sub>120</sub>	528.22	0.08	[516.27, 540.17]	489.7	725.7	489.7	520.4	725.7	0.08
LS,OPT <sub>360</sub>	467.18	0.12	[451.32, 483.04]	373.3	664.9	373.3	462.7	664.9	0.31
LS,OPT <sub>600</sub>	472.86	0.12	[456.81, 488.91]	392.7	664.9	392.7	472	664.9	0.2
Ts,RET <sub>0</sub>	619.58	0.03	[614.32, 624.84]	608.2	725.7	608.2	615	725.7	
Ts,RET <sub>60</sub>	567.43	0.06	[557.8, 577.06]	547.6	712.5	547.6	556.3	712.5	0.08
Ts,RET <sub>120</sub>	530.88	0.08	[518.87, 542.89]	493.8	725.7	493.8	523.4	725.7	0.1
Ts,RET <sub>360</sub>	489.94	0.12	[473.31, 506.57]	411.7	669.5	411.7	484.4	669.5	0.29
Ts,RET <sub>600</sub>	487.26	0.1	[473.48, 501.04]	411	664.9	411	485.7	664.9	0.33
Ts,S <sub>0</sub>	622.39	0.05	[613.59, 631.19]	608.5	742.6	608.5	613.6	742.6	
Ts,S <sub>60</sub>	559.28	0.04	[552.95, 565.61]	549	698.5	549	554.8	698.5	0
Ts,S <sub>120</sub>	527.52	0.08	[515.58, 539.46]	488.4	725.7	488.4	523.8	725.7	0.06
Ts,S <sub>360</sub>	469.72	0.13	[452.45, 486.99]	371.6	669.5	371.6	462.8	669.5	0.29
Ts,S <sub>600</sub>	466.62	0.12	[450.78, 482.46]	372.1	664.9	372.1	462.8	664.9	0.27
Ts,GAP <sub>0</sub>	621.1	0.04	[614.07, 628.13]	608.3	742.6	608.3	614.4	742.6	
Ts,GAP <sub>60</sub>	563.89	0.06	[554.32, 573.46]	548.1	712.5	548.1	556.4	712.5	0.06
Ts,GAP <sub>120</sub>	532.84	0.09	[519.27, 546.41]	488.7	725.7	488.7	525.1	725.7	0.1
Ts,GAP <sub>360</sub>	489.69	0.12	[473.07, 506.31]	405.7	669.5	405.7	481.6	669.5	0.39
Ts,GAP <sub>600</sub>	488.31	0.12	[471.73, 504.89]	414.3	669.5	414.3	476.4	669.5	0.35
Ts,OPT <sub>0</sub>	614.88	0.03	[609.66, 620.1]	606.6	725.7	606.6	612.5	725.7	
Ts,OPT <sub>60</sub>	561.7	0.05	[553.75, 569.65]	547.4	712.5	547.4	554.2	712.5	0.04
Ts,OPT <sub>120</sub>	531.77	0.09	[518.23, 545.31]	488	725.7	488	526.3	725.7	0.08
Ts,OPT <sub>360</sub>	474.58	0.14	[455.78, 493.38]	357.4	669.5	357.4	469.1	669.5	0.31
Ts,OPT <sub>600</sub>	469.68	0.13	[452.41, 486.95]	376.9	669.5	376.9	464.9	669.5	0.31
OPT,OPT <sub>0</sub>	615.99	0.06	[605.53, 626.45]	507.7	741	507.7	613.3	741	
OPT,OPT <sub>60</sub>	566.2	0.06	[556.59, 575.81]	507.7	712.5	507.7	554.5	712.5	0.08
OPT,OPT <sub>120</sub>	533.08	0.08	[521.02, 545.14]	489.9	725.7	489.9	525	725.7	0.14
OPT,OPT <sub>360</sub>	513.23	0.09	[500.16, 526.3]	434.4	669.5	434.4	510.8	669.5	0.31
OPT,OPT <sub>600</sub>	507.97	0.08	[496.47, 519.47]	436.3	664.9	436.3	509.7	664.9	0.27

Table 1: Makespans in the order picking system.



Performance ratios of makespan relative to Ts,OPT <sub>600</sub> for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	1.05	0.12	[1.01, 1.09]	0.99	1.61	0.99	1	1.61	0.1
LS,RET <sub>600</sub>	1.06	0.12	[1.02, 1.1]	0.98	1.61	0.98	1.01	1.61	0.12
LS,S <sub>0</sub>	1.35	0.13	[1.3, 1.4]	0.92	1.67	0.92	1.36	1.67	0.04
LS,S <sub>60</sub>	1.21	0.13	[1.17, 1.25]	0.83	1.49	0.83	1.19	1.49	0.04
LS,S <sub>120</sub>	1.14	0.14	[1.09, 1.19]	0.74	1.66	0.74	1.06	1.66	0.04
LS,S <sub>360</sub>	1	0.04	[0.99, 1.01]	0.74	1.07	0.74	1	1.07	0.27
LS,S <sub>600</sub>	0.99	0.05	[0.98, 1]	0.73	1.02	0.73	1	1.02	0.31
LS,GAP <sub>0</sub>	1.35	0.13	[1.3, 1.4]	0.92	1.66	0.92	1.39	1.66	0.04
LS,GAP <sub>60</sub>	1.22	0.13	[1.18, 1.26]	0.85	1.53	0.85	1.23	1.53	0.04
LS,GAP <sub>120</sub>	1.15	0.13	[1.11, 1.19]	0.98	1.66	0.98	1.06	1.66	0.02
LS,GAP <sub>360</sub>	1.04	0.12	[1, 1.08]	0.73	1.61	0.73	1	1.61	0.12
LS,GAP <sub>600</sub>	1.05	0.13	[1.01, 1.09]	0.73	1.61	0.73	1	1.61	0.16
LS,OPT <sub>0</sub>	1.34	0.13	[1.29, 1.39]	0.91	1.67	0.91	1.32	1.67	0.04
LS,OPT <sub>60</sub>	1.22	0.13	[1.18, 1.26]	0.85	1.54	0.85	1.23	1.54	0.04
LS,OPT <sub>120</sub>	1.14	0.14	[1.09, 1.19]	0.74	1.66	0.74	1.07	1.66	0.04
LS,OPT <sub>360</sub>	1	0.04	[0.99, 1.01]	0.73	1.03	0.73	1	1.03	0.27
LS,OPT <sub>600</sub>	1.01	0.1	[0.98, 1.04]	0.73	1.61	0.73	1	1.61	0.24
Ts,RET <sub>0</sub>	1.34	0.13	[1.29, 1.39]	0.92	1.66	0.92	1.33	1.66	0.04
Ts,RET <sub>60</sub>	1.23	0.15	[1.18, 1.28]	0.83	1.68	0.83	1.2	1.68	0.04
Ts,RET <sub>120</sub>	1.15	0.14	[1.1, 1.2]	0.75	1.66	0.75	1.12	1.66	0.04
Ts,RET <sub>360</sub>	1.05	0.12	[1.01, 1.09]	0.99	1.61	0.99	1.01	1.61	0.08
Ts,RET <sub>600</sub>	1.05	0.12	[1.01, 1.09]	0.73	1.61	0.73	1.01	1.61	0.08
Ts,S <sub>0</sub>	1.35	0.13	[1.3, 1.4]	0.91	1.67	0.91	1.36	1.67	0.04
Ts,S <sub>60</sub>	1.21	0.13	[1.17, 1.25]	0.83	1.49	0.83	1.19	1.49	0.04
Ts,S <sub>120</sub>	1.14	0.14	[1.09, 1.19]	0.74	1.66	0.74	1.07	1.66	0.04
Ts,S <sub>360</sub>	1	0.01	[1, 1]	0.97	1.02	0.97	1	1.02	0.24
Ts,S <sub>600</sub>	1	0.04	[0.99, 1.01]	0.73	1.07	0.73	1	1.07	0.31
Ts,GAP <sub>0</sub>	1.34	0.13	[1.29, 1.39]	0.92	1.66	0.92	1.37	1.66	0.04
Ts,GAP <sub>60</sub>	1.22	0.14	[1.17, 1.27]	0.83	1.67	0.83	1.2	1.67	0.04
Ts,GAP <sub>120</sub>	1.15	0.13	[1.11, 1.19]	0.99	1.66	0.99	1.08	1.66	0.02
Ts,GAP <sub>360</sub>	1.05	0.12	[1.01, 1.09]	0.99	1.61	0.99	1	1.61	0.14
Ts,GAP <sub>600</sub>	1.05	0.11	[1.02, 1.08]	0.97	1.61	0.97	1	1.61	0.12
Ts,OPT <sub>0</sub>	1.33	0.13	[1.28, 1.38]	0.91	1.66	0.91	1.32	1.66	0.04
Ts,OPT <sub>60</sub>	1.22	0.14	[1.17, 1.27]	0.82	1.68	0.82	1.2	1.68	0.04
Ts,OPT <sub>120</sub>	1.15	0.13	[1.11, 1.19]	0.98	1.66	0.98	1.07	1.66	0.02
Ts,OPT <sub>360</sub>	1.01	0.09	[0.98, 1.04]	0.83	1.61	0.83	1	1.61	0.31
Ts,OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>0</sub>	1.33	0.13	[1.28, 1.38]	0.92	1.73	0.92	1.32	1.73	0.02
OPT,OPT <sub>60</sub>	1.23	0.15	[1.18, 1.28]	0.85	1.68	0.85	1.24	1.68	0.06
OPT,OPT <sub>120</sub>	1.15	0.13	[1.11, 1.19]	0.92	1.66	0.92	1.11	1.66	0.04
OPT,OPT <sub>360</sub>	1.11	0.13	[1.07, 1.15]	0.99	1.61	0.99	1.02	1.61	0.04
OPT,OPT <sub>600</sub>	1.1	0.13	[1.06, 1.14]	0.74	1.61	0.74	1.03	1.61	0.04

**Table 2:** Performance ratios of makespan relative to Ts,OPT<sub>600</sub> in the order picking system.



Performance ratios of makespan relative to online version for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
Ls,RET <sub>360</sub>	0.79	0.13	[0.76, 0.82]	0.6	1.09	0.6	0.78	1.09	0.04
Ls,RET <sub>600</sub>	0.79	0.13	[0.76, 0.82]	0.61	1.09	0.61	0.78	1.09	0.04
Ls,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,S <sub>60</sub>	0.9	0.05	[0.89, 0.91]	0.75	1.07	0.75	0.9	1.07	0.02
Ls,S <sub>120</sub>	0.85	0.08	[0.83, 0.87]	0.67	1.08	0.67	0.86	1.08	0.02
Ls,S <sub>360</sub>	0.75	0.13	[0.72, 0.78]	0.59	1.08	0.59	0.74	1.08	0.02
Ls,S <sub>600</sub>	0.75	0.13	[0.72, 0.78]	0.59	1.08	0.59	0.73	1.08	0.02
Ls,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,GAP <sub>60</sub>	0.9	0.04	[0.89, 0.91]	0.75	1	0.75	0.9	1	0
Ls,GAP <sub>120</sub>	0.86	0.09	[0.84, 0.88]	0.67	1.09	0.67	0.85	1.09	0.04
Ls,GAP <sub>360</sub>	0.78	0.12	[0.75, 0.81]	0.61	1.08	0.61	0.78	1.08	0.02
Ls,GAP <sub>600</sub>	0.78	0.12	[0.75, 0.81]	0.59	1.08	0.59	0.78	1.08	0.02
Ls,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,OPT <sub>60</sub>	0.91	0.06	[0.89, 0.93]	0.78	1.16	0.78	0.9	1.16	0.04
Ls,OPT <sub>120</sub>	0.86	0.07	[0.84, 0.88]	0.75	1.08	0.75	0.85	1.08	0.02
Ls,OPT <sub>360</sub>	0.76	0.12	[0.73, 0.79]	0.6	1.08	0.6	0.76	1.08	0.02
Ls,OPT <sub>600</sub>	0.77	0.13	[0.74, 0.8]	0.59	1.08	0.59	0.77	1.08	0.02
Ts,RET <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,RET <sub>60</sub>	0.92	0.07	[0.9, 0.94]	0.78	1.16	0.78	0.9	1.16	0.08
Ts,RET <sub>120</sub>	0.86	0.07	[0.84, 0.88]	0.71	1.08	0.71	0.85	1.08	0.02
Ts,RET <sub>360</sub>	0.79	0.12	[0.76, 0.82]	0.6	1.09	0.6	0.78	1.09	0.04
Ts,RET <sub>600</sub>	0.79	0.11	[0.77, 0.81]	0.6	1.08	0.6	0.79	1.08	0.02
Ts,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,S <sub>60</sub>	0.9	0.04	[0.89, 0.91]	0.75	1	0.75	0.9	1	0
Ts,S <sub>120</sub>	0.85	0.07	[0.83, 0.87]	0.69	1.09	0.69	0.85	1.09	0.02
Ts,S <sub>360</sub>	0.76	0.14	[0.73, 0.79]	0.58	1.09	0.58	0.75	1.09	0.04
Ts,S <sub>600</sub>	0.75	0.13	[0.72, 0.78]	0.59	1.09	0.59	0.74	1.09	0.02
Ts,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,GAP <sub>60</sub>	0.91	0.07	[0.89, 0.93]	0.74	1.16	0.74	0.9	1.16	0.06
Ts,GAP <sub>120</sub>	0.86	0.08	[0.84, 0.88]	0.69	1.09	0.69	0.86	1.09	0.04
Ts,GAP <sub>360</sub>	0.79	0.12	[0.76, 0.82]	0.6	1.09	0.6	0.78	1.09	0.04
Ts,GAP <sub>600</sub>	0.79	0.12	[0.76, 0.82]	0.6	1.09	0.6	0.77	1.09	0.04
Ts,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,OPT <sub>60</sub>	0.91	0.06	[0.89, 0.93]	0.78	1.17	0.78	0.9	1.17	0.04
Ts,OPT <sub>120</sub>	0.86	0.07	[0.84, 0.88]	0.8	1.09	0.8	0.86	1.09	0.04
Ts,OPT <sub>360</sub>	0.77	0.14	[0.74, 0.8]	0.59	1.09	0.59	0.77	1.09	0.04
Ts,OPT <sub>600</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.76	1.09	0.04
OPT,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>60</sub>	0.92	0.08	[0.9, 0.94]	0.76	1.16	0.76	0.9	1.16	0.08
OPT,OPT <sub>120</sub>	0.87	0.07	[0.85, 0.89]	0.67	1	0.67	0.86	1	0.02
OPT,OPT <sub>360</sub>	0.84	0.11	[0.81, 0.87]	0.59	1.09	0.59	0.84	1.09	0.04
OPT,OPT <sub>600</sub>	0.83	0.09	[0.81, 0.85]	0.6	1	0.6	0.84	1	0.02

**Table 3:** Performance ratios of makespan relative to the online version of an algorithm in the order picking system.





Distance for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	66.09	0.02	[65.72, 66.46]	63.7	68.7	63.7	66.1	68.7	0.45
LS,RET <sub>600</sub>	65.97	0.02	[65.6, 66.34]	63.8	68.6	63.8	65.9	68.6	0.37
LS,S <sub>0</sub>	83.17	0.02	[82.7, 83.64]	79.3	87.2	79.3	83	87.2	
LS,S <sub>60</sub>	78.13	0.02	[77.69, 78.57]	74.3	81.6	74.3	78.1	81.6	0
LS,S <sub>120</sub>	71.87	0.02	[71.46, 72.28]	68.4	75.2	68.4	72	75.2	0
LS,S <sub>360</sub>	58.4	0.02	[58.07, 58.73]	55.5	60.8	55.5	58.4	60.8	0.37
LS,S <sub>600</sub>	58.42	0.02	[58.09, 58.75]	56.2	60.7	56.2	58.5	60.7	0.45
LS,GAP <sub>0</sub>	81.22	0.02	[80.76, 81.68]	76.8	85	76.8	81.1	85	
LS,GAP <sub>60</sub>	76.74	0.02	[76.31, 77.17]	72.9	79.9	72.9	76.8	79.9	0
LS,GAP <sub>120</sub>	70.63	0.03	[70.03, 71.23]	66.4	74.5	66.4	70.7	74.5	0
LS,GAP <sub>360</sub>	59.8	0.02	[59.46, 60.14]	57	62.4	57	59.8	62.4	0.35
LS,GAP <sub>600</sub>	59.89	0.02	[59.55, 60.23]	56.8	62.2	56.8	59.8	62.2	0.47
LS,OPT <sub>0</sub>	73.6	0.02	[73.18, 74.02]	70.3	76.4	70.3	73.8	76.4	
LS,OPT <sub>60</sub>	70.86	0.02	[70.46, 71.26]	68.1	73.3	68.1	71.1	73.3	0.02
LS,OPT <sub>120</sub>	66.92	0.02	[66.54, 67.3]	64.3	69.3	64.3	67	69.3	0
LS,OPT <sub>360</sub>	58.26	0.02	[57.93, 58.59]	55.5	60.6	55.5	58.2	60.6	0.24
LS,OPT <sub>600</sub>	58.36	0.02	[58.03, 58.69]	55.7	60.4	55.7	58.2	60.4	0.49
TS,RET <sub>0</sub>	93.23	0.03	[92.44, 94.02]	85.9	98.6	85.9	93.3	98.6	
TS,RET <sub>60</sub>	87.51	0.03	[86.77, 88.25]	82.9	92.3	82.9	87.2	92.3	0
TS,RET <sub>120</sub>	80.27	0.03	[79.59, 80.95]	75.9	86.2	75.9	80.3	86.2	0
TS,RET <sub>360</sub>	66.01	0.02	[65.64, 66.38]	63.3	68.6	63.3	66.1	68.6	0.39
TS,RET <sub>600</sub>	65.99	0.02	[65.62, 66.36]	63.8	68.5	63.8	65.9	68.5	0.51
TS,S <sub>0</sub>	83.48	0.03	[82.77, 84.19]	78.8	87.6	78.8	83.6	87.6	
TS,S <sub>60</sub>	78.54	0.02	[78.1, 78.98]	75.1	82.3	75.1	78.7	82.3	0.02
TS,S <sub>120</sub>	72.38	0.03	[71.77, 72.99]	67.6	76.6	67.6	72.2	76.6	0.02
TS,S <sub>360</sub>	58.38	0.02	[58.05, 58.71]	56	60.6	56	58.4	60.6	0.37
TS,S <sub>600</sub>	58.36	0.02	[58.03, 58.69]	56.1	60.4	56.1	58.3	60.4	0.35
TS,GAP <sub>0</sub>	81.98	0.02	[81.52, 82.44]	77.3	86	77.3	81.9	86	
TS,GAP <sub>60</sub>	77.41	0.02	[76.97, 77.85]	74.6	80.7	74.6	77.3	80.7	0
TS,GAP <sub>120</sub>	70.95	0.02	[70.55, 71.35]	67.5	74.9	67.5	71.2	74.9	0
TS,GAP <sub>360</sub>	59.28	0.02	[58.94, 59.62]	57	62.1	57	59.2	62.1	0.35
TS,GAP <sub>600</sub>	59.46	0.02	[59.12, 59.8]	56.9	61.8	56.9	59.4	61.8	0.43
TS,OPT <sub>0</sub>	74.12	0.02	[73.7, 74.54]	70.4	76.6	70.4	74.1	76.6	
TS,OPT <sub>60</sub>	71.24	0.02	[70.84, 71.64]	68.7	73.8	68.7	71.4	73.8	0.02
TS,OPT <sub>120</sub>	67.17	0.02	[66.79, 67.55]	63.8	70.6	63.8	67.1	70.6	0
TS,OPT <sub>360</sub>	57.69	0.02	[57.36, 58.02]	55.3	60	55.3	57.9	60	0.41
TS,OPT <sub>600</sub>	57.77	0.02	[57.44, 58.1]	55	60.5	55	57.8	60.5	0.35
OPT,OPT <sub>0</sub>	75	0.02	[74.58, 75.42]	69.3	78.2	69.3	75.1	78.2	
OPT,OPT <sub>60</sub>	73.66	0.02	[73.24, 74.08]	69.3	76.2	69.3	73.7	76.2	0.14
OPT,OPT <sub>120</sub>	69.94	0.02	[69.54, 70.34]	67	74.6	67	69.8	74.6	0.06
OPT,OPT <sub>360</sub>	63.37	0.02	[63.01, 63.73]	61	66	61	63.3	66	0.33
OPT,OPT <sub>600</sub>	63.39	0.02	[63.03, 63.75]	60.3	65.6	60.3	63.4	65.6	0.51

Table 4: Distances in the order picking system.



Performance ratios of distance relative to Ts,OPT <sub>600</sub> for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	1.14	0.01	[1.14, 1.14]	1.12	1.17	1.12	1.14	1.17	0
LS,RET <sub>600</sub>	1.14	0.01	[1.14, 1.14]	1.12	1.17	1.12	1.14	1.17	0
LS,S <sub>0</sub>	1.44	0.02	[1.43, 1.45]	1.37	1.5	1.37	1.44	1.5	0
LS,S <sub>60</sub>	1.35	0.03	[1.34, 1.36]	1.28	1.44	1.28	1.35	1.44	0
LS,S <sub>120</sub>	1.24	0.03	[1.23, 1.25]	1.16	1.32	1.16	1.24	1.32	0
LS,S <sub>360</sub>	1.01	0.01	[1.01, 1.01]	0.99	1.03	0.99	1.01	1.03	0.08
LS,S <sub>600</sub>	1.01	0.01	[1.01, 1.01]	1	1.03	1	1.01	1.03	0.06
LS,GAP <sub>0</sub>	1.41	0.02	[1.4, 1.42]	1.33	1.46	1.33	1.41	1.46	0
LS,GAP <sub>60</sub>	1.33	0.02	[1.32, 1.34]	1.26	1.41	1.26	1.33	1.41	0
LS,GAP <sub>120</sub>	1.22	0.03	[1.21, 1.23]	1.13	1.29	1.13	1.22	1.29	0
LS,GAP <sub>360</sub>	1.04	0.01	[1.04, 1.04]	1.01	1.06	1.01	1.04	1.06	0
LS,GAP <sub>600</sub>	1.04	0.01	[1.04, 1.04]	1.02	1.06	1.02	1.04	1.06	0
LS,OPT <sub>0</sub>	1.27	0.02	[1.26, 1.28]	1.21	1.31	1.21	1.28	1.31	0
LS,OPT <sub>60</sub>	1.23	0.02	[1.22, 1.24]	1.18	1.27	1.18	1.23	1.27	0
LS,OPT <sub>120</sub>	1.16	0.02	[1.15, 1.17]	1.1	1.2	1.1	1.16	1.2	0
LS,OPT <sub>360</sub>	1.01	0.01	[1.01, 1.01]	0.99	1.04	0.99	1.01	1.04	0.2
LS,OPT <sub>600</sub>	1.01	0.01	[1.01, 1.01]	0.99	1.03	0.99	1.01	1.03	0.08
Ts,RET <sub>0</sub>	1.61	0.02	[1.6, 1.62]	1.48	1.69	1.48	1.61	1.69	0
Ts,RET <sub>60</sub>	1.52	0.03	[1.51, 1.53]	1.43	1.61	1.43	1.52	1.61	0
Ts,RET <sub>120</sub>	1.39	0.03	[1.38, 1.4]	1.3	1.48	1.3	1.39	1.48	0
Ts,RET <sub>360</sub>	1.14	0.01	[1.14, 1.14]	1.12	1.17	1.12	1.14	1.17	0
Ts,RET <sub>600</sub>	1.14	0.01	[1.14, 1.14]	1.12	1.17	1.12	1.14	1.17	0
Ts,S <sub>0</sub>	1.45	0.03	[1.44, 1.46]	1.37	1.51	1.37	1.45	1.51	0
Ts,S <sub>60</sub>	1.36	0.03	[1.35, 1.37]	1.28	1.44	1.28	1.36	1.44	0
Ts,S <sub>120</sub>	1.25	0.03	[1.24, 1.26]	1.15	1.35	1.15	1.25	1.35	0
Ts,S <sub>360</sub>	1.01	0.01	[1.01, 1.01]	0.99	1.03	0.99	1.01	1.03	0.1
Ts,S <sub>600</sub>	1.01	0.01	[1.01, 1.01]	0.99	1.03	0.99	1.01	1.03	0.1
Ts,GAP <sub>0</sub>	1.42	0.02	[1.41, 1.43]	1.35	1.47	1.35	1.43	1.47	0
Ts,GAP <sub>60</sub>	1.34	0.02	[1.33, 1.35]	1.29	1.4	1.29	1.34	1.4	0
Ts,GAP <sub>120</sub>	1.23	0.03	[1.22, 1.24]	1.15	1.31	1.15	1.22	1.31	0
Ts,GAP <sub>360</sub>	1.03	0.01	[1.03, 1.03]	1	1.05	1	1.03	1.05	0.02
Ts,GAP <sub>600</sub>	1.03	0.01	[1.03, 1.03]	1.02	1.04	1.02	1.03	1.04	0
Ts,OPT <sub>0</sub>	1.28	0.02	[1.27, 1.29]	1.23	1.32	1.23	1.29	1.32	0
Ts,OPT <sub>60</sub>	1.23	0.02	[1.22, 1.24]	1.17	1.27	1.17	1.23	1.27	0
Ts,OPT <sub>120</sub>	1.16	0.02	[1.15, 1.17]	1.08	1.21	1.08	1.17	1.21	0
Ts,OPT <sub>360</sub>	1	0.01	[1, 1]	0.98	1.01	0.98	1	1.01	0.51
Ts,OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>0</sub>	1.3	0.02	[1.29, 1.31]	1.19	1.39	1.19	1.3	1.39	0
OPT,OPT <sub>60</sub>	1.28	0.02	[1.27, 1.29]	1.19	1.33	1.19	1.28	1.33	0
OPT,OPT <sub>120</sub>	1.21	0.03	[1.2, 1.22]	1.13	1.3	1.13	1.21	1.3	0
OPT,OPT <sub>360</sub>	1.1	0.01	[1.1, 1.1]	1.07	1.12	1.07	1.1	1.12	0
OPT,OPT <sub>600</sub>	1.1	0.01	[1.1, 1.1]	1.08	1.12	1.08	1.1	1.12	0

**Table 5:** Performance ratios of distance relative to Ts,OPT<sub>600</sub> in the order picking system.



Performance ratios of distance relative to online version for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
Ls,RET <sub>360</sub>	0.71	0.02	[0.71, 0.71]	0.68	0.77	0.68	0.71	0.77	0
Ls,RET <sub>600</sub>	0.71	0.02	[0.71, 0.71]	0.69	0.77	0.69	0.71	0.77	0
Ls,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,S <sub>60</sub>	0.94	0.02	[0.93, 0.95]	0.88	0.98	0.88	0.94	0.98	0
Ls,S <sub>120</sub>	0.86	0.03	[0.85, 0.87]	0.81	0.92	0.81	0.86	0.92	0
Ls,S <sub>360</sub>	0.7	0.02	[0.7, 0.7]	0.68	0.74	0.68	0.7	0.74	0
Ls,S <sub>600</sub>	0.7	0.02	[0.7, 0.7]	0.68	0.74	0.68	0.7	0.74	0
Ls,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,GAP <sub>60</sub>	0.95	0.02	[0.94, 0.96]	0.89	1	0.89	0.94	1	0
Ls,GAP <sub>120</sub>	0.87	0.03	[0.86, 0.88]	0.81	0.94	0.81	0.87	0.94	0
Ls,GAP <sub>360</sub>	0.74	0.02	[0.74, 0.74]	0.71	0.78	0.71	0.74	0.78	0
Ls,GAP <sub>600</sub>	0.74	0.02	[0.74, 0.74]	0.71	0.77	0.71	0.74	0.77	0
Ls,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,OPT <sub>60</sub>	0.96	0.02	[0.95, 0.97]	0.91	1	0.91	0.96	1	0.02
Ls,OPT <sub>120</sub>	0.91	0.02	[0.9, 0.92]	0.87	0.96	0.87	0.91	0.96	0
Ls,OPT <sub>360</sub>	0.79	0.02	[0.79, 0.79]	0.76	0.83	0.76	0.79	0.83	0
Ls,OPT <sub>600</sub>	0.79	0.02	[0.79, 0.79]	0.77	0.83	0.77	0.79	0.83	0
Ts,RET <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,RET <sub>60</sub>	0.94	0.03	[0.93, 0.95]	0.88	1	0.88	0.94	1	0
Ts,RET <sub>120</sub>	0.86	0.03	[0.85, 0.87]	0.81	0.93	0.81	0.86	0.93	0
Ts,RET <sub>360</sub>	0.71	0.02	[0.71, 0.71]	0.68	0.76	0.68	0.7	0.76	0
Ts,RET <sub>600</sub>	0.71	0.02	[0.71, 0.71]	0.68	0.76	0.68	0.7	0.76	0
Ts,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,S <sub>60</sub>	0.94	0.03	[0.93, 0.95]	0.86	1	0.86	0.95	1	0.02
Ts,S <sub>120</sub>	0.87	0.04	[0.86, 0.88]	0.78	0.94	0.78	0.87	0.94	0
Ts,S <sub>360</sub>	0.7	0.02	[0.7, 0.7]	0.67	0.74	0.67	0.7	0.74	0
Ts,S <sub>600</sub>	0.7	0.02	[0.7, 0.7]	0.67	0.74	0.67	0.7	0.74	0
Ts,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,GAP <sub>60</sub>	0.94	0.02	[0.93, 0.95]	0.9	1	0.9	0.94	1	0
Ts,GAP <sub>120</sub>	0.87	0.03	[0.86, 0.88]	0.81	0.93	0.81	0.86	0.93	0
Ts,GAP <sub>360</sub>	0.72	0.02	[0.72, 0.72]	0.7	0.77	0.7	0.72	0.77	0
Ts,GAP <sub>600</sub>	0.73	0.02	[0.73, 0.73]	0.7	0.77	0.7	0.72	0.77	0
Ts,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,OPT <sub>60</sub>	0.96	0.02	[0.95, 0.97]	0.92	1	0.92	0.96	1	0.02
Ts,OPT <sub>120</sub>	0.91	0.02	[0.9, 0.92]	0.86	0.95	0.86	0.9	0.95	0
Ts,OPT <sub>360</sub>	0.78	0.02	[0.78, 0.78]	0.76	0.82	0.76	0.78	0.82	0
Ts,OPT <sub>600</sub>	0.78	0.02	[0.78, 0.78]	0.76	0.81	0.76	0.78	0.81	0
OPT,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>60</sub>	0.98	0.02	[0.97, 0.99]	0.93	1.02	0.93	0.98	1.02	0.14
OPT,OPT <sub>120</sub>	0.93	0.03	[0.92, 0.94]	0.86	1	0.86	0.93	1	0
OPT,OPT <sub>360</sub>	0.85	0.02	[0.85, 0.85]	0.8	0.93	0.8	0.84	0.93	0
OPT,OPT <sub>600</sub>	0.85	0.03	[0.84, 0.86]	0.79	0.94	0.79	0.84	0.94	0

**Table 6:** Performance ratios of distance relative to the online version of an algorithm in the order picking system.



Utilization for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Ls,RET <sub>360</sub>	0.88	0.12	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.02
Ls,RET <sub>600</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.08
Ls,S <sub>0</sub>	0.71	0.06	[0.7, 0.72]	0.6	0.8	0.6	0.7	0.8	
Ls,S <sub>60</sub>	0.8	0.04	[0.79, 0.81]	0.7	0.9	0.7	0.8	0.9	0
Ls,S <sub>120</sub>	0.83	0.08	[0.81, 0.85]	0.6	0.9	0.6	0.8	0.9	0.1
Ls,S <sub>360</sub>	0.89	0.12	[0.86, 0.92]	0.6	1	0.6	0.9	1	0.06
Ls,S <sub>600</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.04
Ls,GAP <sub>0</sub>	0.75	0.07	[0.74, 0.76]	0.6	0.8	0.6	0.8	0.8	
Ls,GAP <sub>60</sub>	0.8	0.05	[0.79, 0.81]	0.6	0.9	0.6	0.8	0.9	0.02
Ls,GAP <sub>120</sub>	0.84	0.08	[0.82, 0.86]	0.6	0.9	0.6	0.8	0.9	0.1
Ls,GAP <sub>360</sub>	0.89	0.13	[0.86, 0.92]	0.6	1	0.6	0.9	1	0.06
Ls,GAP <sub>600</sub>	0.88	0.12	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.08
Ls,OPT <sub>0</sub>	0.72	0.07	[0.71, 0.73]	0.6	0.8	0.6	0.7	0.8	
Ls,OPT <sub>60</sub>	0.79	0.07	[0.77, 0.81]	0.6	0.9	0.6	0.8	0.9	0.04
Ls,OPT <sub>120</sub>	0.82	0.09	[0.8, 0.84]	0.6	0.9	0.6	0.8	0.9	0.1
Ls,OPT <sub>360</sub>	0.89	0.12	[0.86, 0.92]	0.6	1	0.6	0.9	1	0.04
Ls,OPT <sub>600</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.04
Ts,RET <sub>0</sub>	0.78	0.05	[0.77, 0.79]	0.6	0.8	0.6	0.8	0.8	
Ts,RET <sub>60</sub>	0.84	0.07	[0.82, 0.86]	0.7	0.9	0.7	0.8	0.9	0.04
Ts,RET <sub>120</sub>	0.86	0.08	[0.84, 0.88]	0.6	1	0.6	0.9	1	0.16
Ts,RET <sub>360</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.06
Ts,RET <sub>600</sub>	0.88	0.12	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.06
Ts,S <sub>0</sub>	0.72	0.07	[0.71, 0.73]	0.6	0.8	0.6	0.7	0.8	
Ts,S <sub>60</sub>	0.8	0.05	[0.79, 0.81]	0.6	0.9	0.6	0.8	0.9	0.02
Ts,S <sub>120</sub>	0.84	0.08	[0.82, 0.86]	0.6	0.9	0.6	0.8	0.9	0.06
Ts,S <sub>360</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.06
Ts,S <sub>600</sub>	0.89	0.12	[0.86, 0.92]	0.6	1	0.6	0.9	1	0.02
Ts,GAP <sub>0</sub>	0.75	0.08	[0.73, 0.77]	0.6	0.8	0.6	0.8	0.8	
Ts,GAP <sub>60</sub>	0.8	0.06	[0.79, 0.81]	0.6	0.9	0.6	0.8	0.9	0.04
Ts,GAP <sub>120</sub>	0.84	0.09	[0.82, 0.86]	0.6	1	0.6	0.8	1	0.08
Ts,GAP <sub>360</sub>	0.87	0.13	[0.84, 0.9]	0.6	1	0.6	0.9	1	0.06
Ts,GAP <sub>600</sub>	0.89	0.12	[0.86, 0.92]	0.6	1	0.6	0.9	1	0.06
Ts,OPT <sub>0</sub>	0.71	0.06	[0.7, 0.72]	0.6	0.8	0.6	0.7	0.8	
Ts,OPT <sub>60</sub>	0.79	0.06	[0.78, 0.8]	0.6	0.9	0.6	0.8	0.9	0.04
Ts,OPT <sub>120</sub>	0.82	0.09	[0.8, 0.84]	0.6	0.9	0.6	0.8	0.9	0.12
Ts,OPT <sub>360</sub>	0.87	0.14	[0.84, 0.9]	0.6	1	0.6	0.9	1	0.08
Ts,OPT <sub>600</sub>	0.88	0.13	[0.85, 0.91]	0.6	1	0.6	0.9	1	0.04
OPT,OPT <sub>0</sub>	0.72	0.09	[0.7, 0.74]	0.6	0.9	0.6	0.7	0.9	
OPT,OPT <sub>60</sub>	0.79	0.07	[0.77, 0.81]	0.6	0.9	0.6	0.8	0.9	0.04
OPT,OPT <sub>120</sub>	0.86	0.09	[0.84, 0.88]	0.6	1	0.6	0.9	1	0.1
OPT,OPT <sub>360</sub>	0.91	0.1	[0.88, 0.94]	0.7	1	0.7	0.9	1	0.08
OPT,OPT <sub>600</sub>	0.92	0.09	[0.9, 0.94]	0.7	1	0.7	0.9	1	0.06

Table 7: Picker utilizations in the order picking system.





Performance ratios of utilization relative to Ts,OPT <sub>600</sub> for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	1.01	0.1	[0.98, 1.04]	0.7	1.25	0.7	1	1.25	0.29
LS,RET <sub>600</sub>	1	0.1	[0.97, 1.03]	0.6	1.17	0.6	1	1.17	0.24
LS,S <sub>0</sub>	0.82	0.16	[0.78, 0.86]	0.67	1.17	0.67	0.78	1.17	0.04
LS,S <sub>60</sub>	0.93	0.16	[0.89, 0.97]	0.7	1.33	0.7	0.89	1.33	0.16
LS,S <sub>120</sub>	0.96	0.16	[0.92, 1]	0.67	1.5	0.67	1	1.5	0.24
LS,S <sub>360</sub>	1.02	0.08	[1, 1.04]	0.87	1.5	0.87	1	1.5	0.1
LS,S <sub>600</sub>	1.01	0.09	[0.98, 1.04]	0.87	1.5	0.87	1	1.5	0.08
LS,GAP <sub>0</sub>	0.87	0.17	[0.83, 0.91]	0.67	1.33	0.67	0.87	1.33	0.1
LS,GAP <sub>60</sub>	0.93	0.17	[0.89, 0.97]	0.67	1.5	0.67	0.89	1.5	0.14
LS,GAP <sub>120</sub>	0.97	0.15	[0.93, 1.01]	0.67	1.17	0.67	1	1.17	0.35
LS,GAP <sub>360</sub>	1.02	0.13	[0.98, 1.06]	0.6	1.5	0.6	1	1.5	0.27
LS,GAP <sub>600</sub>	1.01	0.13	[0.97, 1.05]	0.6	1.5	0.6	1	1.5	0.27
LS,OPT <sub>0</sub>	0.84	0.19	[0.79, 0.89]	0.6	1.33	0.6	0.8	1.33	0.08
LS,OPT <sub>60</sub>	0.91	0.17	[0.87, 0.95]	0.67	1.33	0.67	0.89	1.33	0.12
LS,OPT <sub>120</sub>	0.95	0.17	[0.9, 1]	0.67	1.5	0.67	1	1.5	0.24
LS,OPT <sub>360</sub>	1.01	0.08	[0.99, 1.03]	0.89	1.5	0.89	1	1.5	0.08
LS,OPT <sub>600</sub>	1.01	0.1	[0.98, 1.04]	0.6	1.5	0.6	1	1.5	0.08
Ts,RET <sub>0</sub>	0.91	0.17	[0.87, 0.95]	0.67	1.33	0.67	0.89	1.33	0.12
Ts,RET <sub>60</sub>	0.98	0.18	[0.93, 1.03]	0.7	1.5	0.7	1	1.5	0.29
Ts,RET <sub>120</sub>	1	0.17	[0.95, 1.05]	0.67	1.67	0.67	1	1.67	0.37
Ts,RET <sub>360</sub>	1.01	0.1	[0.98, 1.04]	0.7	1.25	0.7	1	1.25	0.27
Ts,RET <sub>600</sub>	1.01	0.12	[0.98, 1.04]	0.6	1.5	0.6	1	1.5	0.24
Ts,S <sub>0</sub>	0.84	0.18	[0.8, 0.88]	0.67	1.33	0.67	0.78	1.33	0.08
Ts,S <sub>60</sub>	0.93	0.16	[0.89, 0.97]	0.67	1.33	0.67	0.89	1.33	0.14
Ts,S <sub>120</sub>	0.97	0.17	[0.92, 1.02]	0.67	1.5	0.67	1	1.5	0.31
Ts,S <sub>360</sub>	1.01	0.04	[1, 1.02]	0.9	1.13	0.9	1	1.13	0.08
Ts,S <sub>600</sub>	1.01	0.08	[0.99, 1.03]	0.87	1.5	0.87	1	1.5	0.08
Ts,GAP <sub>0</sub>	0.87	0.19	[0.82, 0.92]	0.67	1.33	0.67	0.87	1.33	0.12
Ts,GAP <sub>60</sub>	0.93	0.17	[0.89, 0.97]	0.67	1.5	0.67	0.89	1.5	0.16
Ts,GAP <sub>120</sub>	0.97	0.14	[0.93, 1.01]	0.67	1.17	0.67	1	1.17	0.35
Ts,GAP <sub>360</sub>	1	0.11	[0.97, 1.03]	0.6	1.25	0.6	1	1.25	0.18
Ts,GAP <sub>600</sub>	1.02	0.11	[0.99, 1.05]	0.6	1.17	0.6	1	1.17	0.33
Ts,OPT <sub>0</sub>	0.83	0.17	[0.79, 0.87]	0.67	1.33	0.67	0.78	1.33	0.04
Ts,OPT <sub>60</sub>	0.92	0.17	[0.88, 0.96]	0.6	1.33	0.6	0.89	1.33	0.14
Ts,OPT <sub>120</sub>	0.94	0.15	[0.9, 0.98]	0.67	1.17	0.67	1	1.17	0.22
Ts,OPT <sub>360</sub>	0.99	0.08	[0.97, 1.01]	0.6	1.25	0.6	1	1.25	0.06
Ts,OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>0</sub>	0.83	0.18	[0.79, 0.87]	0.67	1.33	0.67	0.78	1.33	0.06
OPT,OPT <sub>60</sub>	0.93	0.18	[0.88, 0.98]	0.6	1.5	0.6	0.89	1.5	0.16
OPT,OPT <sub>120</sub>	1	0.15	[0.96, 1.04]	0.67	1.33	0.67	1	1.33	0.41
OPT,OPT <sub>360</sub>	1.05	0.14	[1.01, 1.09]	0.7	1.29	0.7	1.11	1.29	0.59
OPT,OPT <sub>600</sub>	1.07	0.15	[1.02, 1.12]	0.7	1.67	0.7	1.11	1.67	0.59

**Table 8:** Performance ratios of picker utilization relative to Ts,OPT<sub>600</sub> in the order picking system.



Performance ratios of utilization relative to online version for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
LS,RET <sub>360</sub>	1.14	0.15	[1.09, 1.19]	0.75	1.67	0.75	1.13	1.67	0.12
LS,RET <sub>600</sub>	1.12	0.15	[1.07, 1.17]	0.75	1.5	0.75	1.13	1.5	0.12
LS,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
LS,S <sub>60</sub>	1.14	0.06	[1.12, 1.16]	1	1.33	1	1.14	1.33	0
LS,S <sub>120</sub>	1.17	0.1	[1.14, 1.2]	1	1.5	1	1.14	1.5	0
LS,S <sub>360</sub>	1.26	0.14	[1.21, 1.31]	0.86	1.5	0.86	1.29	1.5	0.02
LS,S <sub>600</sub>	1.25	0.14	[1.2, 1.3]	0.86	1.5	0.86	1.29	1.5	0.02
LS,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
LS,GAP <sub>60</sub>	1.07	0.08	[1.05, 1.09]	0.86	1.33	0.86	1	1.33	0.02
LS,GAP <sub>120</sub>	1.12	0.09	[1.09, 1.15]	0.87	1.29	0.87	1.13	1.29	0.02
LS,GAP <sub>360</sub>	1.19	0.15	[1.14, 1.24]	0.86	1.67	0.86	1.14	1.67	0.08
LS,GAP <sub>600</sub>	1.18	0.15	[1.13, 1.23]	0.86	1.67	0.86	1.14	1.67	0.06
LS,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
LS,OPT <sub>60</sub>	1.09	0.08	[1.07, 1.11]	0.86	1.33	0.86	1.14	1.33	0.04
LS,OPT <sub>120</sub>	1.14	0.1	[1.11, 1.17]	0.75	1.33	0.75	1.14	1.33	0.04
LS,OPT <sub>360</sub>	1.24	0.16	[1.18, 1.3]	0.75	1.67	0.75	1.25	1.67	0.06
LS,OPT <sub>600</sub>	1.22	0.16	[1.16, 1.28]	0.75	1.67	0.75	1.14	1.67	0.06
TS,RET <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS,RET <sub>60</sub>	1.07	0.08	[1.05, 1.09]	0.87	1.33	0.87	1.13	1.33	0.04
TS,RET <sub>120</sub>	1.1	0.08	[1.08, 1.12]	0.87	1.29	0.87	1.13	1.29	0.02
TS,RET <sub>360</sub>	1.13	0.15	[1.08, 1.18]	0.75	1.67	0.75	1.13	1.67	0.12
TS,RET <sub>600</sub>	1.13	0.14	[1.09, 1.17]	0.75	1.5	0.75	1.13	1.5	0.1
TS,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS,S <sub>60</sub>	1.11	0.07	[1.09, 1.13]	0.86	1.33	0.86	1.14	1.33	0.02
TS,S <sub>120</sub>	1.17	0.08	[1.14, 1.2]	1	1.5	1	1.14	1.5	0
TS,S <sub>360</sub>	1.23	0.16	[1.17, 1.29]	0.75	1.5	0.75	1.29	1.5	0.08
TS,S <sub>600</sub>	1.24	0.15	[1.19, 1.29]	0.86	1.5	0.86	1.29	1.5	0.04
TS,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS,GAP <sub>60</sub>	1.07	0.09	[1.04, 1.1]	0.86	1.33	0.86	1	1.33	0.04
TS,GAP <sub>120</sub>	1.12	0.12	[1.08, 1.16]	0.75	1.5	0.75	1.13	1.5	0.04
TS,GAP <sub>360</sub>	1.17	0.16	[1.12, 1.22]	0.75	1.5	0.75	1.14	1.5	0.12
TS,GAP <sub>600</sub>	1.19	0.16	[1.14, 1.24]	0.75	1.67	0.75	1.25	1.67	0.08
TS,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS,OPT <sub>60</sub>	1.11	0.07	[1.09, 1.13]	0.86	1.17	0.86	1.14	1.17	0.04
TS,OPT <sub>120</sub>	1.14	0.09	[1.11, 1.17]	0.75	1.29	0.75	1.14	1.29	0.02
TS,OPT <sub>360</sub>	1.22	0.16	[1.16, 1.28]	0.75	1.5	0.75	1.29	1.5	0.06
TS,OPT <sub>600</sub>	1.23	0.15	[1.18, 1.28]	0.75	1.5	0.75	1.29	1.5	0.04
OPT,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>60</sub>	1.11	0.1	[1.08, 1.14]	0.86	1.33	0.86	1.14	1.33	0.04
OPT,OPT <sub>120</sub>	1.21	0.1	[1.18, 1.24]	1	1.5	1	1.17	1.5	0
OPT,OPT <sub>360</sub>	1.28	0.12	[1.24, 1.32]	0.87	1.67	0.87	1.29	1.67	0.02
OPT,OPT <sub>600</sub>	1.29	0.11	[1.25, 1.33]	1	1.67	1	1.29	1.67	0

**Table 9:** Performance ratios of picker utilization relative to the online version of an algorithm in the order picking system.



Throughput for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	153.99	0.1	[149.63, 158.35]	109.6	181.4	109.6	154.9	181.4	0.29
LS,RET <sub>600</sub>	153.88	0.1	[149.53, 158.23]	109.6	181.1	109.6	153.7	181.1	0.18
LS,S <sub>0</sub>	120.62	0.05	[118.91, 122.33]	100.6	125.8	100.6	122.3	125.8	
LS,S <sub>60</sub>	134.21	0.03	[133.07, 135.35]	112.8	138.8	112.8	134.7	138.8	0.02
LS,S <sub>120</sub>	142.22	0.07	[139.4, 145.04]	101.4	154.1	101.4	143.7	154.1	0.06
LS,S <sub>360</sub>	162.22	0.11	[157.17, 167.27]	109.6	197.3	109.6	159.3	197.3	0.33
LS,S <sub>600</sub>	163.22	0.12	[157.68, 168.76]	109.6	204.2	109.6	159.1	204.2	0.31
LS,GAP <sub>0</sub>	120.38	0.05	[118.68, 122.08]	100.6	126	100.6	122.2	126	
LS,GAP <sub>60</sub>	133.34	0.05	[131.45, 135.23]	102.7	138.8	102.7	134.7	138.8	0
LS,GAP <sub>120</sub>	141.44	0.08	[138.24, 144.64]	101.4	153.9	101.4	142.7	153.9	0.08
LS,GAP <sub>360</sub>	155.96	0.1	[151.55, 160.37]	109.6	182.5	109.6	156.3	182.5	0.24
LS,GAP <sub>600</sub>	155	0.1	[150.62, 159.38]	109.6	183.2	109.6	156.4	183.2	0.31
LS,OPT <sub>0</sub>	121.27	0.03	[120.24, 122.3]	101.4	125.9	101.4	122.5	125.9	
LS,OPT <sub>60</sub>	133.29	0.05	[131.4, 135.18]	102.7	138.8	102.7	134.9	138.8	0.04
LS,OPT <sub>120</sub>	142.41	0.07	[139.59, 145.23]	101.4	153.9	101.4	143.7	153.9	0.08
LS,OPT <sub>360</sub>	162.2	0.11	[157.15, 167.25]	109.6	200.3	109.6	158.2	200.3	0.31
LS,OPT <sub>600</sub>	160.3	0.11	[155.31, 165.29]	109.6	189.8	109.6	157.3	189.8	0.2
TS,RET <sub>0</sub>	120.88	0.03	[119.85, 121.91]	101.4	125.8	101.4	122.1	125.8	
TS,RET <sub>60</sub>	132.31	0.06	[130.06, 134.56]	102.7	138.3	102.7	134.7	138.3	0.08
TS,RET <sub>120</sub>	141.67	0.07	[138.86, 144.48]	101.4	153.3	101.4	142.6	153.3	0.1
TS,RET <sub>360</sub>	154.57	0.1	[150.2, 158.94]	109.6	179	109.6	154.4	179	0.29
TS,RET <sub>600</sub>	155.05	0.1	[150.66, 159.44]	109.6	179.4	109.6	153.8	179.4	0.33
TS,S <sub>0</sub>	120.43	0.04	[119.07, 121.79]	101.4	125.9	101.4	122.1	125.9	
TS,S <sub>60</sub>	133.93	0.03	[132.79, 135.07]	107	138.8	107	134.7	138.8	0
TS,S <sub>120</sub>	142.58	0.07	[139.76, 145.4]	101.4	154.6	101.4	143.4	154.6	0.06
TS,S <sub>360</sub>	161.82	0.12	[156.33, 167.31]	109.6	201.2	109.6	158.7	201.2	0.29
TS,S <sub>600</sub>	162.57	0.11	[157.51, 167.63]	109.6	200.9	109.6	158.6	200.9	0.27
TS,GAP <sub>0</sub>	120.65	0.04	[119.28, 122.02]	101.4	125.8	101.4	121.8	125.8	
TS,GAP <sub>60</sub>	133.05	0.05	[131.17, 134.93]	102.7	139.3	102.7	135	139.3	0.06
TS,GAP <sub>120</sub>	141.32	0.08	[138.12, 144.52]	101.4	153.9	101.4	143	153.9	0.1
TS,GAP <sub>360</sub>	154.67	0.11	[149.86, 159.48]	109.6	183.3	109.6	155.1	183.3	0.37
TS,GAP <sub>600</sub>	155.08	0.1	[150.69, 159.47]	109.6	178.3	109.6	157.3	178.3	0.35
TS,OPT <sub>0</sub>	121.76	0.03	[120.73, 122.79]	101.4	126	101.4	122.6	126	
TS,OPT <sub>60</sub>	133.53	0.05	[131.64, 135.42]	102.7	139.3	102.7	135.2	139.3	0.04
TS,OPT <sub>120</sub>	141.61	0.08	[138.41, 144.81]	101.4	154.3	101.4	143.3	154.3	0.08
TS,OPT <sub>360</sub>	160.41	0.13	[154.51, 166.31]	109.6	204.3	109.6	159	204.3	0.31
TS,OPT <sub>600</sub>	161.83	0.12	[156.34, 167.32]	109.6	198.4	109.6	159.8	198.4	0.31
OPT,OPT <sub>0</sub>	121.91	0.06	[119.84, 123.98]	100.6	149.7	100.6	122.4	149.7	
OPT,OPT <sub>60</sub>	132.63	0.06	[130.38, 134.88]	102.7	149.7	102.7	134.3	149.7	0.06
OPT,OPT <sub>120</sub>	141.13	0.07	[138.34, 143.92]	101.4	153.6	101.4	143.2	153.6	0.16
OPT,OPT <sub>360</sub>	146.93	0.08	[143.6, 150.26]	109.6	170.1	109.6	147.6	170.1	0.33
OPT,OPT <sub>600</sub>	148.13	0.07	[145.2, 151.06]	109.6	168.9	109.6	148.4	168.9	0.24

Table 10: Box throughputs in the order picking system.



Performance ratios of throughput relative to Ts,OPT <sub>600</sub> for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
LS,RET <sub>360</sub>	0.96	0.09	[0.94, 0.98]	0.62	1.01	0.62	1	1.01	0.1
LS,RET <sub>600</sub>	0.96	0.09	[0.94, 0.98]	0.62	1.02	0.62	0.99	1.02	0.12
LS,S <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.73	1.09	0.04
LS,S <sub>60</sub>	0.84	0.14	[0.81, 0.87]	0.67	1.21	0.67	0.84	1.21	0.04
LS,S <sub>120</sub>	0.89	0.14	[0.85, 0.93]	0.6	1.35	0.6	0.94	1.35	0.04
LS,S <sub>360</sub>	1	0.05	[0.99, 1.01]	0.93	1.36	0.93	1	1.36	0.24
LS,S <sub>600</sub>	1.01	0.06	[0.99, 1.03]	0.98	1.37	0.98	1	1.37	0.31
LS,GAP <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.72	1.09	0.04
LS,GAP <sub>60</sub>	0.84	0.14	[0.81, 0.87]	0.65	1.18	0.65	0.81	1.18	0.04
LS,GAP <sub>120</sub>	0.88	0.12	[0.85, 0.91]	0.6	1.02	0.6	0.94	1.02	0.02
LS,GAP <sub>360</sub>	0.97	0.1	[0.94, 1]	0.62	1.36	0.62	1	1.36	0.12
LS,GAP <sub>600</sub>	0.97	0.1	[0.94, 1]	0.62	1.36	0.62	1	1.36	0.16
LS,OPT <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.76	1.09	0.04
LS,OPT <sub>60</sub>	0.84	0.14	[0.81, 0.87]	0.65	1.18	0.65	0.82	1.18	0.04
LS,OPT <sub>120</sub>	0.89	0.14	[0.85, 0.93]	0.6	1.36	0.6	0.94	1.36	0.04
LS,OPT <sub>360</sub>	1	0.05	[0.99, 1.01]	0.97	1.37	0.97	1	1.37	0.27
LS,OPT <sub>600</sub>	1	0.08	[0.98, 1.02]	0.62	1.37	0.62	1	1.37	0.24
Ts,RET <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.75	1.09	0.04
Ts,RET <sub>60</sub>	0.83	0.15	[0.79, 0.87]	0.59	1.21	0.59	0.83	1.21	0.04
Ts,RET <sub>120</sub>	0.89	0.14	[0.85, 0.93]	0.6	1.33	0.6	0.89	1.33	0.04
Ts,RET <sub>360</sub>	0.96	0.09	[0.94, 0.98]	0.62	1.01	0.62	0.99	1.01	0.08
Ts,RET <sub>600</sub>	0.97	0.1	[0.94, 1]	0.62	1.36	0.62	0.99	1.36	0.08
Ts,S <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.73	1.09	0.04
Ts,S <sub>60</sub>	0.84	0.14	[0.81, 0.87]	0.67	1.21	0.67	0.84	1.21	0.04
Ts,S <sub>120</sub>	0.89	0.14	[0.85, 0.93]	0.6	1.36	0.6	0.94	1.36	0.04
Ts,S <sub>360</sub>	1	0.01	[1, 1]	0.98	1.03	0.98	1	1.03	0.24
Ts,S <sub>600</sub>	1.01	0.05	[1, 1.02]	0.93	1.36	0.93	1	1.36	0.31
Ts,GAP <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.73	1.09	0.04
Ts,GAP <sub>60</sub>	0.84	0.15	[0.8, 0.88]	0.6	1.21	0.6	0.83	1.21	0.04
Ts,GAP <sub>120</sub>	0.88	0.12	[0.85, 0.91]	0.6	1.01	0.6	0.93	1.01	0.02
Ts,GAP <sub>360</sub>	0.96	0.09	[0.94, 0.98]	0.62	1.02	0.62	1	1.02	0.14
Ts,GAP <sub>600</sub>	0.96	0.08	[0.94, 0.98]	0.62	1.03	0.62	1	1.03	0.12
Ts,OPT <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.6	1.09	0.6	0.75	1.09	0.04
Ts,OPT <sub>60</sub>	0.84	0.14	[0.81, 0.87]	0.59	1.21	0.59	0.83	1.21	0.04
Ts,OPT <sub>120</sub>	0.89	0.12	[0.86, 0.92]	0.6	1.02	0.6	0.94	1.02	0.02
Ts,OPT <sub>360</sub>	0.99	0.07	[0.97, 1.01]	0.62	1.2	0.62	1	1.2	0.31
Ts,OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>0</sub>	0.76	0.14	[0.73, 0.79]	0.59	1.09	0.59	0.73	1.09	0.02
OPT,OPT <sub>60</sub>	0.83	0.15	[0.79, 0.87]	0.59	1.18	0.59	0.8	1.18	0.06
OPT,OPT <sub>120</sub>	0.88	0.12	[0.85, 0.91]	0.6	1.09	0.6	0.89	1.09	0.02
OPT,OPT <sub>360</sub>	0.92	0.11	[0.89, 0.95]	0.62	1.01	0.62	0.98	1.01	0.04
OPT,OPT <sub>600</sub>	0.93	0.12	[0.9, 0.96]	0.62	1.34	0.62	0.97	1.34	0.04

**Table 11:** Performance ratios of box throughput relative to Ts,OPT<sub>600</sub> in the order picking system.





Performance ratios of throughput relative to online version for $n = 625$ (50 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
Ls,RET <sub>360</sub>	1.28	0.12	[1.24, 1.32]	0.92	1.67	0.92	1.28	1.67	0.04
Ls,RET <sub>600</sub>	1.28	0.12	[1.24, 1.32]	0.92	1.65	0.92	1.28	1.65	0.04
Ls,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,S <sub>60</sub>	1.11	0.05	[1.09, 1.13]	0.94	1.34	0.94	1.11	1.34	0.02
Ls,S <sub>120</sub>	1.18	0.08	[1.15, 1.21]	0.92	1.5	0.92	1.17	1.5	0.02
Ls,S <sub>360</sub>	1.35	0.12	[1.3, 1.4]	0.92	1.69	0.92	1.35	1.69	0.02
Ls,S <sub>600</sub>	1.36	0.13	[1.31, 1.41]	0.92	1.7	0.92	1.36	1.7	0.02
Ls,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,GAP <sub>60</sub>	1.11	0.04	[1.1, 1.12]	1	1.33	1	1.11	1.33	0
Ls,GAP <sub>120</sub>	1.18	0.09	[1.15, 1.21]	0.92	1.49	0.92	1.17	1.49	0.04
Ls,GAP <sub>360</sub>	1.3	0.11	[1.26, 1.34]	0.92	1.65	0.92	1.28	1.65	0.02
Ls,GAP <sub>600</sub>	1.29	0.12	[1.25, 1.33]	0.92	1.69	0.92	1.28	1.69	0.02
Ls,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ls,OPT <sub>60</sub>	1.1	0.05	[1.08, 1.12]	0.86	1.27	0.86	1.11	1.27	0.04
Ls,OPT <sub>120</sub>	1.17	0.06	[1.15, 1.19]	0.92	1.33	0.92	1.18	1.33	0.02
Ls,OPT <sub>360</sub>	1.34	0.12	[1.29, 1.39]	0.92	1.68	0.92	1.32	1.68	0.02
Ls,OPT <sub>600</sub>	1.32	0.12	[1.28, 1.36]	0.92	1.69	0.92	1.29	1.69	0.02
Ts,RET <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,RET <sub>60</sub>	1.1	0.06	[1.08, 1.12]	0.86	1.28	0.86	1.11	1.28	0.08
Ts,RET <sub>120</sub>	1.17	0.07	[1.15, 1.19]	0.92	1.41	0.92	1.18	1.41	0.02
Ts,RET <sub>360</sub>	1.28	0.12	[1.24, 1.32]	0.92	1.68	0.92	1.28	1.68	0.04
Ts,RET <sub>600</sub>	1.28	0.11	[1.24, 1.32]	0.92	1.67	0.92	1.27	1.67	0.02
Ts,S <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,S <sub>60</sub>	1.11	0.04	[1.1, 1.12]	1	1.34	1	1.11	1.34	0
Ts,S <sub>120</sub>	1.19	0.07	[1.17, 1.21]	0.92	1.45	0.92	1.17	1.45	0.02
Ts,S <sub>360</sub>	1.35	0.13	[1.3, 1.4]	0.91	1.71	0.91	1.34	1.71	0.04
Ts,S <sub>600</sub>	1.35	0.12	[1.3, 1.4]	0.92	1.68	0.92	1.34	1.68	0.02
Ts,GAP <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,GAP <sub>60</sub>	1.1	0.06	[1.08, 1.12]	0.86	1.35	0.86	1.11	1.35	0.06
Ts,GAP <sub>120</sub>	1.17	0.08	[1.14, 1.2]	0.92	1.46	0.92	1.17	1.46	0.04
Ts,GAP <sub>360</sub>	1.28	0.12	[1.24, 1.32]	0.92	1.67	0.92	1.28	1.67	0.04
Ts,GAP <sub>600</sub>	1.29	0.11	[1.25, 1.33]	0.92	1.68	0.92	1.29	1.68	0.04
Ts,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
Ts,OPT <sub>60</sub>	1.1	0.05	[1.08, 1.12]	0.86	1.27	0.86	1.11	1.27	0.04
Ts,OPT <sub>120</sub>	1.16	0.06	[1.14, 1.18]	0.91	1.25	0.91	1.17	1.25	0.04
Ts,OPT <sub>360</sub>	1.32	0.13	[1.27, 1.37]	0.91	1.71	0.91	1.3	1.71	0.04
Ts,OPT <sub>600</sub>	1.33	0.13	[1.28, 1.38]	0.91	1.66	0.91	1.32	1.66	0.04
OPT,OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT,OPT <sub>60</sub>	1.09	0.07	[1.07, 1.11]	0.86	1.29	0.86	1.11	1.29	0.06
OPT,OPT <sub>120</sub>	1.16	0.08	[1.13, 1.19]	1	1.5	1	1.16	1.5	0.02
OPT,OPT <sub>360</sub>	1.21	0.11	[1.17, 1.25]	0.92	1.67	0.92	1.2	1.67	0.04
OPT,OPT <sub>600</sub>	1.22	0.1	[1.19, 1.25]	1	1.63	1	1.2	1.63	0.02

**Table 12:** Performance ratios of box throughput relative to the online version of an algorithm in the order picking system.

## A.2 Online Pickup and Delivery with Lookahead

Makespan for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	819.73	0.04	[813.27, 826.19]	753.3	943	755.8	814.8	928.55	
SRH <sub>60</sub>	819.73	0.04	[813.27, 826.19]	748.8	908.1	749.25	813.8	902.9	0.43
SRH <sub>120</sub>	814.83	0.04	[808.41, 821.25]	736.8	898.8	745.05	812.9	894.6	0.38
SRH <sub>360</sub>	815.41	0.04	[808.98, 821.84]	753.3	938.3	757.1	811.6	906.8	0.52
SRH <sub>600</sub>	813.69	0.04	[807.28, 820.1]	757.7	891.1	758.8	810.25	884.05	0.42
2OPT <sub>0</sub>	819.73	0.04	[813.27, 826.19]	753.3	943	755.8	814.8	928.55	
2OPT <sub>60</sub>	819.73	0.04	[813.27, 826.19]	748.8	908.1	749.25	813.8	902.9	0.43
2OPT <sub>120</sub>	814.83	0.04	[808.41, 821.25]	736.8	898.8	745.05	812.9	894.6	0.38
2OPT <sub>360</sub>	815.41	0.04	[808.98, 821.84]	753.3	938.3	757.1	811.6	906.8	0.52
2OPT <sub>600</sub>	813.69	0.04	[807.28, 820.1]	757.7	891.1	758.8	810.25	884.05	0.42
SA <sub>0</sub>	819.73	0.04	[813.27, 826.19]	753.3	943	755.8	814.8	928.55	
SA <sub>60</sub>	819.73	0.04	[813.27, 826.19]	748.8	908.1	749.25	813.8	902.9	0.43
SA <sub>120</sub>	814.83	0.04	[808.41, 821.25]	736.8	898.8	745.05	812.9	894.6	0.38
SA <sub>360</sub>	815.41	0.04	[808.98, 821.84]	753.3	938.3	757.1	811.6	906.8	0.52
SA <sub>600</sub>	813.69	0.04	[807.28, 820.1]	757.7	891.1	758.8	810.25	884.05	0.42
TS <sub>0</sub>	813.35	0.03	[808.54, 818.16]	743.9	883	750.25	810.6	878.9	
TS <sub>60</sub>	812.15	0.04	[805.75, 818.55]	752.4	919.2	753.35	808.9	905.55	0.48
TS <sub>120</sub>	812.46	0.03	[807.66, 817.26]	756.7	924.6	761.15	807.35	909.85	0.49
TS <sub>360</sub>	811.49	0.03	[806.69, 816.29]	735.7	870.4	749.25	810.1	864.75	0.45
TS <sub>600</sub>	813.64	0.03	[808.83, 818.45]	735.9	921.9	739.15	812.55	895.25	0.53
OPT <sub>0</sub>	819.12	0.03	[814.28, 823.96]	752.5	885.1	752.9	821.3	883.15	
OPT <sub>60</sub>	817.59	0.03	[812.76, 822.42]	750.6	894.4	758.5	812.9	889.8	0.48
OPT <sub>120</sub>	818.08	0.04	[811.63, 824.53]	749.2	897	749.95	819.6	895.1	0.5
OPT <sub>360</sub>	816.9	0.03	[812.07, 821.73]	727.6	879.1	743.3	814.85	876.95	0.56
OPT <sub>600</sub>	817.7	0.03	[812.87, 822.53]	745.1	910.8	746.9	816.5	906.65	0.46

Table 13: Makespans in the pickup and delivery service.

Performance ratios of makespan relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	1	0.04	[0.99, 1.01]	0.91	1.12	0.92	1	1.12	0.54
SRH <sub>60</sub>	1	0.04	[0.99, 1.01]	0.89	1.15	0.91	1	1.12	0.51
SRH <sub>120</sub>	1	0.04	[0.99, 1.01]	0.92	1.13	0.92	0.99	1.11	0.59
SRH <sub>360</sub>	1	0.03	[0.99, 1.01]	0.9	1.09	0.92	0.99	1.09	0.59
SRH <sub>600</sub>	1	0.03	[0.99, 1.01]	0.88	1.08	0.91	1	1.07	0.59
2OPT <sub>0</sub>	1	0.04	[0.99, 1.01]	0.91	1.12	0.92	1	1.12	0.54
2OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.89	1.15	0.91	1	1.12	0.51
2OPT <sub>120</sub>	1	0.04	[0.99, 1.01]	0.92	1.13	0.92	0.99	1.11	0.59
2OPT <sub>360</sub>	1	0.03	[0.99, 1.01]	0.9	1.09	0.92	0.99	1.09	0.59
2OPT <sub>600</sub>	1	0.03	[0.99, 1.01]	0.88	1.08	0.91	1	1.07	0.59
SA <sub>0</sub>	1	0.04	[0.99, 1.01]	0.91	1.12	0.92	1	1.12	0.54
SA <sub>60</sub>	1	0.04	[0.99, 1.01]	0.89	1.15	0.91	1	1.12	0.51
SA <sub>120</sub>	1	0.04	[0.99, 1.01]	0.92	1.13	0.92	0.99	1.11	0.59
SA <sub>360</sub>	1	0.03	[0.99, 1.01]	0.9	1.09	0.92	0.99	1.09	0.59
SA <sub>600</sub>	1	0.03	[0.99, 1.01]	0.88	1.08	0.91	1	1.07	0.59
TS <sub>0</sub>	1	0.03	[0.99, 1.01]	0.91	1.07	0.92	1	1.06	0.59
TS <sub>60</sub>	0.99	0.03	[0.98, 1]	0.89	1.14	0.9	0.99	1.11	0.61
TS <sub>120</sub>	0.99	0.04	[0.98, 1]	0.88	1.14	0.91	0.99	1.11	0.6
TS <sub>360</sub>	0.99	0.03	[0.98, 1]	0.89	1.05	0.91	0.99	1.05	0.64
TS <sub>600</sub>	1	0.02	[1, 1]	0.88	1.05	0.91	1	1.04	0.52
OPT <sub>0</sub>	1	0.03	[0.99, 1.01]	0.9	1.1	0.92	1	1.09	0.5
OPT <sub>60</sub>	1	0.03	[0.99, 1.01]	0.91	1.1	0.92	1	1.09	0.51
OPT <sub>120</sub>	1	0.05	[0.99, 1.01]	0.9	1.15	0.9	1	1.14	0.47
OPT <sub>360</sub>	1	0.03	[0.99, 1.01]	0.89	1.07	0.92	1	1.07	0.54
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

Table 14: Performance ratios of makespan relative to OPT in the pickup and delivery service.

Performance ratios of makespan relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	1	0.04	[0.99, 1.01]	0.91	1.09	0.92	1	1.09	0.43
SRH <sub>120</sub>	0.99	0.04	[0.98, 1]	0.89	1.1	0.9	1	1.09	0.39
SRH <sub>360</sub>	1	0.03	[0.99, 1.01]	0.89	1.1	0.9	1	1.09	0.42
SRH <sub>600</sub>	0.99	0.04	[0.98, 1]	0.91	1.07	0.91	1	1.07	0.39
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.91	1.09	0.92	1	1.09	0.43
2OPT <sub>120</sub>	0.99	0.04	[0.98, 1]	0.89	1.1	0.9	1	1.09	0.39
2OPT <sub>360</sub>	1	0.03	[0.99, 1.01]	0.89	1.1	0.9	1	1.09	0.42
2OPT <sub>600</sub>	0.99	0.04	[0.98, 1]	0.91	1.07	0.91	1	1.07	0.39
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	1	0.04	[0.99, 1.01]	0.91	1.09	0.92	1	1.09	0.43
SA <sub>120</sub>	0.99	0.04	[0.98, 1]	0.89	1.1	0.9	1	1.09	0.39
SA <sub>360</sub>	1	0.03	[0.99, 1.01]	0.89	1.1	0.9	1	1.09	0.42
SA <sub>600</sub>	0.99	0.04	[0.98, 1]	0.91	1.07	0.91	1	1.07	0.39
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1	0.03	[0.99, 1.01]	0.91	1.15	0.92	1	1.11	0.48
TS <sub>120</sub>	1	0.03	[0.99, 1.01]	0.92	1.17	0.93	1	1.14	0.45
TS <sub>360</sub>	1	0.03	[0.99, 1.01]	0.92	1.07	0.93	1	1.06	0.46
TS <sub>600</sub>	1	0.03	[0.99, 1.01]	0.94	1.08	0.94	1	1.07	0.51
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.92	1.1	0.92	1	1.09	0.48
OPT <sub>120</sub>	1	0.05	[0.99, 1.01]	0.87	1.13	0.88	1	1.12	0.51
OPT <sub>360</sub>	1	0.04	[0.99, 1.01]	0.91	1.1	0.91	1	1.09	0.47
OPT <sub>600</sub>	1	0.03	[0.99, 1.01]	0.91	1.11	0.92	1	1.08	0.5

**Table 15:** Performance ratios of makespan relative to the online version of an algorithm in the pickup and delivery service.

Distances for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	1677.4	0.07	[1654.27, 1700.53]	1420.3	2120.7	1421.8	1688.25	2022.65	
SRH <sub>60</sub>	1645.6	0.07	[1622.91, 1668.29]	1318.2	2003.4	1353.65	1641.45	1953.05	0.35
SRH <sub>120</sub>	1610.23	0.08	[1584.85, 1635.61]	1342.6	1898.3	1351.55	1592.05	1885.85	0.34
SRH <sub>360</sub>	1611.39	0.07	[1589.17, 1633.61]	1364.6	1931.9	1369.95	1620.9	1930.6	0.51
SRH <sub>600</sub>	1612.54	0.07	[1590.3, 1634.78]	1328.9	1859.6	1350.65	1609.65	1838.1	0.41
2OPT <sub>0</sub>	1677.4	0.07	[1654.27, 1700.53]	1420.3	2120.7	1421.8	1688.25	2022.65	
2OPT <sub>60</sub>	1645.6	0.07	[1622.91, 1668.29]	1318.2	2003.4	1353.65	1641.45	1953.05	0.35
2OPT <sub>120</sub>	1610.23	0.08	[1584.85, 1635.61]	1342.6	1898.3	1351.55	1592.05	1885.85	0.34
2OPT <sub>360</sub>	1611.39	0.07	[1589.17, 1633.61]	1364.6	1931.9	1369.95	1620.9	1930.6	0.51
2OPT <sub>600</sub>	1612.54	0.07	[1590.3, 1634.78]	1328.9	1859.6	1350.65	1609.65	1838.1	0.41
SA <sub>0</sub>	1677.4	0.07	[1654.27, 1700.53]	1420.3	2120.7	1421.8	1688.25	2022.65	
SA <sub>60</sub>	1645.6	0.07	[1622.91, 1668.29]	1318.2	2003.4	1353.65	1641.45	1953.05	0.35
SA <sub>120</sub>	1610.23	0.08	[1584.85, 1635.61]	1342.6	1898.3	1351.55	1592.05	1885.85	0.34
SA <sub>360</sub>	1611.39	0.07	[1589.17, 1633.61]	1364.6	1931.9	1369.95	1620.9	1930.6	0.51
SA <sub>600</sub>	1612.54	0.07	[1590.3, 1634.78]	1328.9	1859.6	1350.65	1609.65	1838.1	0.41
TS <sub>0</sub>	1759.03	0.07	[1734.77, 1783.29]	1481.9	2059.4	1483.35	1753.5	2037.85	
TS <sub>60</sub>	1756.27	0.08	[1728.59, 1783.95]	1439	2090.4	1439.1	1752.2	2070.75	0.44
TS <sub>120</sub>	1745	0.1	[1710.63, 1779.37]	1409.4	2332.6	1414.4	1733.3	2241.65	0.42
TS <sub>360</sub>	1706.83	0.09	[1676.57, 1737.09]	1315.9	2110.7	1351.65	1693.5	2092.05	0.4
TS <sub>600</sub>	1698.68	0.08	[1671.91, 1725.45]	1363.9	2045	1401.85	1703.9	2044.15	0.5
OPT <sub>0</sub>	1637.32	0.08	[1611.52, 1663.12]	1332.3	2077	1334.2	1633.45	2012.35	
OPT <sub>60</sub>	1669.62	0.08	[1643.31, 1695.93]	1279.6	1972.8	1322.8	1672.4	1956.05	0.59
OPT <sub>120</sub>	1695.97	0.09	[1665.9, 1726.04]	1362.4	2134.7	1364.95	1688.15	2098.35	0.52
OPT <sub>360</sub>	1665.57	0.1	[1632.76, 1698.38]	1287.8	2035.5	1299.3	1648.2	2026.25	0.4
OPT <sub>600</sub>	1660.2	0.08	[1634.04, 1686.36]	1334.1	2024.4	1372.75	1665.1	1992.45	0.49

**Table 16:** Distances in the pickup and delivery service.

Performance ratios of distance relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	1.01	0.07	[1, 1.02]	0.86	1.23	0.86	1.01	1.22	0.46
SRH <sub>60</sub>	0.99	0.08	[0.97, 1.01]	0.78	1.17	0.81	0.98	1.16	0.57
SRH <sub>120</sub>	0.97	0.08	[0.95, 0.99]	0.72	1.16	0.77	0.98	1.14	0.62
SRH <sub>360</sub>	0.97	0.07	[0.96, 0.98]	0.8	1.14	0.8	0.97	1.14	0.69
SRH <sub>600</sub>	0.97	0.07	[0.96, 0.98]	0.82	1.19	0.82	0.98	1.16	0.66
2OPT <sub>0</sub>	1.01	0.07	[1, 1.02]	0.86	1.23	0.86	1.01	1.22	0.46
2OPT <sub>60</sub>	0.99	0.08	[0.97, 1.01]	0.78	1.17	0.81	0.98	1.16	0.57
2OPT <sub>120</sub>	0.97	0.08	[0.95, 0.99]	0.72	1.16	0.77	0.98	1.14	0.62
2OPT <sub>360</sub>	0.97	0.07	[0.96, 0.98]	0.8	1.14	0.8	0.97	1.14	0.69
2OPT <sub>600</sub>	0.97	0.07	[0.96, 0.98]	0.82	1.19	0.82	0.98	1.16	0.66
SA <sub>0</sub>	1.01	0.07	[1, 1.02]	0.86	1.23	0.86	1.01	1.22	0.46
SA <sub>60</sub>	0.99	0.08	[0.97, 1.01]	0.78	1.17	0.81	0.98	1.16	0.57
SA <sub>120</sub>	0.97	0.08	[0.95, 0.99]	0.72	1.16	0.77	0.98	1.14	0.62
SA <sub>360</sub>	0.97	0.07	[0.96, 0.98]	0.8	1.14	0.8	0.97	1.14	0.69
SA <sub>600</sub>	0.97	0.07	[0.96, 0.98]	0.82	1.19	0.82	0.98	1.16	0.66
TS <sub>0</sub>	1.06	0.07	[1.05, 1.07]	0.88	1.25	0.89	1.06	1.24	0.14
TS <sub>60</sub>	1.06	0.07	[1.05, 1.07]	0.84	1.24	0.85	1.05	1.24	0.18
TS <sub>120</sub>	1.05	0.08	[1.03, 1.07]	0.86	1.3	0.87	1.05	1.28	0.28
TS <sub>360</sub>	1.03	0.07	[1.02, 1.04]	0.9	1.22	0.9	1.02	1.21	0.39
TS <sub>600</sub>	1.02	0.02	[1.02, 1.02]	0.96	1.1	0.97	1.02	1.09	0.11
OPT <sub>0</sub>	0.99	0.07	[0.98, 1]	0.83	1.15	0.83	0.99	1.15	0.56
OPT <sub>60</sub>	1.01	0.08	[0.99, 1.03]	0.83	1.24	0.84	1.01	1.21	0.46
OPT <sub>120</sub>	1.03	0.1	[1.01, 1.05]	0.76	1.34	0.77	1.03	1.28	0.35
OPT <sub>360</sub>	1	0.07	[0.99, 1.01]	0.87	1.21	0.88	1	1.19	0.55
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

**Table 17:** Performance ratios of distance relative to OPT in the pickup and delivery service.

Performance ratios of distance relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	0.98	0.07	[0.97, 0.99]	0.84	1.19	0.85	0.97	1.15	0.35
SRH <sub>120</sub>	0.96	0.07	[0.95, 0.97]	0.78	1.17	0.8	0.96	1.14	0.27
SRH <sub>360</sub>	0.96	0.06	[0.95, 0.97]	0.8	1.17	0.81	0.96	1.12	0.26
SRH <sub>600</sub>	0.96	0.06	[0.95, 0.97]	0.82	1.09	0.83	0.96	1.09	0.35
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	0.98	0.07	[0.97, 0.99]	0.84	1.19	0.85	0.97	1.15	0.35
2OPT <sub>120</sub>	0.96	0.07	[0.95, 0.97]	0.78	1.17	0.8	0.96	1.14	0.27
2OPT <sub>360</sub>	0.96	0.06	[0.95, 0.97]	0.8	1.17	0.81	0.96	1.12	0.26
2OPT <sub>600</sub>	0.96	0.06	[0.95, 0.97]	0.82	1.09	0.83	0.96	1.09	0.35
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	0.98	0.07	[0.97, 0.99]	0.84	1.19	0.85	0.97	1.15	0.35
SA <sub>120</sub>	0.96	0.07	[0.95, 0.97]	0.78	1.17	0.8	0.96	1.14	0.27
SA <sub>360</sub>	0.96	0.06	[0.95, 0.97]	0.8	1.17	0.81	0.96	1.12	0.26
SA <sub>600</sub>	0.96	0.06	[0.95, 0.97]	0.82	1.09	0.83	0.96	1.09	0.35
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1	0.07	[0.99, 1.01]	0.86	1.17	0.87	0.99	1.16	0.44
TS <sub>120</sub>	0.99	0.09	[0.97, 1.01]	0.85	1.28	0.85	0.98	1.25	0.44
TS <sub>360</sub>	0.97	0.08	[0.95, 0.99]	0.82	1.21	0.82	0.96	1.19	0.32
TS <sub>600</sub>	0.97	0.07	[0.96, 0.98]	0.85	1.15	0.85	0.96	1.15	0.26
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	1.02	0.08	[1, 1.04]	0.76	1.27	0.81	1.01	1.27	0.59
OPT <sub>120</sub>	1.04	0.11	[1.02, 1.06]	0.75	1.44	0.78	1.04	1.41	0.6
OPT <sub>360</sub>	1.02	0.07	[1.01, 1.03]	0.83	1.19	0.84	1.01	1.18	0.62
OPT <sub>600</sub>	1.02	0.07	[1.01, 1.03]	0.87	1.21	0.87	1.01	1.2	0.56

**Table 18:** Performance ratios of distance relative to the online version of an algorithm in the pickup and delivery service.

Tardiness for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	25.8	0.48	[23.36, 28.24]	7	75.6	7.45	22.75	72.15	
SRH <sub>60</sub>	27.39	0.51	[24.64, 30.14]	6.8	76	7.35	24.2	72.55	0.53
SRH <sub>120</sub>	26.21	0.41	[24.09, 28.33]	10.4	54.7	10.9	23.4	54.55	0.45
SRH <sub>360</sub>	26.75	0.53	[23.96, 29.54]	8.3	120.9	9.15	24.85	93	0.54
SRH <sub>600</sub>	26.28	0.4	[24.21, 28.35]	6.8	62.4	6.9	25.05	60	0.4
2OPT <sub>0</sub>	25.8	0.48	[23.36, 28.24]	7	75.6	7.45	22.75	72.15	
2OPT <sub>60</sub>	27.39	0.51	[24.64, 30.14]	6.8	76	7.35	24.2	72.55	0.53
2OPT <sub>120</sub>	26.21	0.41	[24.09, 28.33]	10.4	54.7	10.9	23.4	54.55	0.45
2OPT <sub>360</sub>	26.75	0.53	[23.96, 29.54]	8.3	120.9	9.15	24.85	93	0.54
2OPT <sub>600</sub>	26.28	0.4	[24.21, 28.35]	6.8	62.4	6.9	25.05	60	0.4
SA <sub>0</sub>	25.8	0.48	[23.36, 28.24]	7	75.6	7.45	22.75	72.15	
SA <sub>60</sub>	27.39	0.51	[24.64, 30.14]	6.8	76	7.35	24.2	72.55	0.53
SA <sub>120</sub>	26.21	0.41	[24.09, 28.33]	10.4	54.7	10.9	23.4	54.55	0.45
SA <sub>360</sub>	26.75	0.53	[23.96, 29.54]	8.3	120.9	9.15	24.85	93	0.54
SA <sub>600</sub>	26.28	0.4	[24.21, 28.35]	6.8	62.4	6.9	25.05	60	0.4
TS <sub>0</sub>	21.08	0.43	[19.29, 22.87]	5.5	43.5	6.2	19.6	43.15	
TS <sub>60</sub>	21.77	0.39	[20.1, 23.44]	6.3	45.9	6.85	21.4	44.4	0.51
TS <sub>120</sub>	21.66	0.42	[19.87, 23.45]	7.9	58.8	8.2	19.6	56.5	0.5
TS <sub>360</sub>	21.04	0.4	[19.38, 22.7]	8.8	55.4	8.8	19.35	50.1	0.55
TS <sub>600</sub>	21.96	0.5	[19.8, 24.12]	3.9	59	4.3	19.75	57.15	0.44
OPT <sub>0</sub>	20.74	0.38	[19.19, 22.29]	7.3	48.8	7.6	20.05	43.65	
OPT <sub>60</sub>	20.81	0.43	[19.05, 22.57]	6.5	48.3	7	19.25	47.35	0.5
OPT <sub>120</sub>	21.75	0.41	[19.99, 23.51]	8.7	58.8	9.05	20.15	55.15	0.51
OPT <sub>360</sub>	21.52	0.4	[19.82, 23.22]	8.5	56.1	8.95	20.4	51.6	0.57
OPT <sub>600</sub>	22.33	0.49	[20.17, 24.49]	4.3	59.3	4.5	20.15	57.2	0.46

**Table 19:** Tardinesses in the pickup and delivery service.

Performance ratios of tardiness relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	1.32	0.52	[1.18, 1.46]	0.42	3.84	0.46	1.12	3.65	0.39
SRH <sub>60</sub>	1.44	0.61	[1.27, 1.61]	0.21	4.28	0.29	1.19	4.18	0.36
SRH <sub>120</sub>	1.4	0.64	[1.22, 1.58]	0.3	6.16	0.4	1.21	5.84	0.37
SRH <sub>360</sub>	1.34	0.49	[1.21, 1.47]	0.46	4.84	0.46	1.2	4.01	0.35
SRH <sub>600</sub>	1.4	0.65	[1.22, 1.58]	0.4	5.76	0.43	1.17	5.55	0.35
2OPT <sub>0</sub>	1.32	0.52	[1.18, 1.46]	0.42	3.84	0.46	1.12	3.65	0.39
2OPT <sub>60</sub>	1.44	0.61	[1.27, 1.61]	0.21	4.28	0.29	1.19	4.18	0.36
2OPT <sub>120</sub>	1.4	0.64	[1.22, 1.58]	0.3	6.16	0.4	1.21	5.84	0.37
2OPT <sub>360</sub>	1.34	0.49	[1.21, 1.47]	0.46	4.84	0.46	1.2	4.01	0.35
2OPT <sub>600</sub>	1.4	0.65	[1.22, 1.58]	0.4	5.76	0.43	1.17	5.55	0.35
SA <sub>0</sub>	1.32	0.52	[1.18, 1.46]	0.42	3.84	0.46	1.12	3.65	0.39
SA <sub>60</sub>	1.44	0.61	[1.27, 1.61]	0.21	4.28	0.29	1.19	4.18	0.36
SA <sub>120</sub>	1.4	0.64	[1.22, 1.58]	0.3	6.16	0.4	1.21	5.84	0.37
SA <sub>360</sub>	1.34	0.49	[1.21, 1.47]	0.46	4.84	0.46	1.2	4.01	0.35
SA <sub>600</sub>	1.4	0.65	[1.22, 1.58]	0.4	5.76	0.43	1.17	5.55	0.35
TS <sub>0</sub>	1.07	0.48	[0.97, 1.17]	0.33	2.68	0.33	0.94	2.53	0.57
TS <sub>60</sub>	1.11	0.46	[1.01, 1.21]	0.34	2.89	0.34	1.03	2.75	0.48
TS <sub>120</sub>	1.1	0.48	[1, 1.2]	0.4	3.98	0.41	0.97	3.2	0.54
TS <sub>360</sub>	1.1	0.6	[0.97, 1.23]	0.23	5.91	0.37	0.92	4.51	0.55
TS <sub>600</sub>	0.98	0.05	[0.97, 0.99]	0.74	1.07	0.76	0.99	1.06	0.63
OPT <sub>0</sub>	1.09	0.55	[0.97, 1.21]	0.19	4.3	0.26	0.95	3.81	0.52
OPT <sub>60</sub>	1.07	0.47	[0.97, 1.17]	0.12	3.38	0.16	0.94	2.9	0.54
OPT <sub>120</sub>	1.25	0.8	[1.05, 1.45]	0.16	8.57	0.22	1.01	6.33	0.47
OPT <sub>360</sub>	1.12	0.63	[0.98, 1.26]	0.25	6.4	0.38	0.96	4.86	0.53
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

**Table 20:** Performance ratios of tardiness relative to OPT in the pickup and delivery service.

Performance ratios of tardiness relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	1.22	0.6	[1.08, 1.36]	0.23	5.16	0.26	1.06	4.11	0.53
SRH <sub>120</sub>	1.17	0.49	[1.06, 1.28]	0.33	2.9	0.35	0.99	2.76	0.49
SRH <sub>360</sub>	1.14	0.46	[1.04, 1.24]	0.24	2.95	0.36	1.03	2.84	0.52
SRH <sub>600</sub>	1.16	0.48	[1.05, 1.27]	0.36	2.93	0.38	1.07	2.88	0.55
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	1.22	0.6	[1.08, 1.36]	0.23	5.16	0.26	1.06	4.11	0.53
2OPT <sub>120</sub>	1.17	0.49	[1.06, 1.28]	0.33	2.9	0.35	0.99	2.76	0.49
2OPT <sub>360</sub>	1.14	0.46	[1.04, 1.24]	0.24	2.95	0.36	1.03	2.84	0.52
2OPT <sub>600</sub>	1.16	0.48	[1.05, 1.27]	0.36	2.93	0.38	1.07	2.88	0.55
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	1.22	0.6	[1.08, 1.36]	0.23	5.16	0.26	1.06	4.11	0.53
SA <sub>120</sub>	1.17	0.49	[1.06, 1.28]	0.33	2.9	0.35	0.99	2.76	0.49
SA <sub>360</sub>	1.14	0.46	[1.04, 1.24]	0.24	2.95	0.36	1.03	2.84	0.52
SA <sub>600</sub>	1.16	0.48	[1.05, 1.27]	0.36	2.93	0.38	1.07	2.88	0.55
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1.15	0.48	[1.04, 1.26]	0.47	3.4	0.47	1.02	3.37	0.51
TS <sub>120</sub>	1.12	0.38	[1.04, 1.2]	0.42	2.25	0.44	1.04	2.17	0.53
TS <sub>360</sub>	1.12	0.41	[1.03, 1.21]	0.28	2.51	0.33	1.08	2.49	0.55
TS <sub>600</sub>	1.13	0.48	[1.02, 1.24]	0.37	3.06	0.38	1.04	3.04	0.53
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	1.07	0.43	[0.98, 1.16]	0.35	2.75	0.37	1	2.66	0.5
OPT <sub>120</sub>	1.2	0.58	[1.06, 1.34]	0.3	3.77	0.3	0.99	3.71	0.48
OPT <sub>360</sub>	1.12	0.39	[1.03, 1.21]	0.39	2.45	0.4	1.08	2.35	0.57
OPT <sub>600</sub>	1.16	0.56	[1.03, 1.29]	0.23	5.16	0.27	1.05	4.11	0.52

**Table 21:** Performance ratios of tardiness relative to the online version of an algorithm in the pickup and delivery service.

Maximum tardiness for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	172.29	0.33	[161.09, 183.49]	89	409.3	92.1	161.3	372.35	
SRH <sub>60</sub>	178.52	0.34	[166.56, 190.48]	88.3	342.6	88.4	163.9	334.6	0.56
SRH <sub>120</sub>	176.33	0.27	[166.95, 185.71]	94.4	316	96.4	174.25	305.5	0.51
SRH <sub>360</sub>	186.76	0.31	[175.36, 198.16]	87.3	401.8	88.7	179.4	389.5	0.56
SRH <sub>600</sub>	181.5	0.32	[170.06, 192.94]	82.5	351.2	82.7	164.05	345.55	0.43
2OPT <sub>0</sub>	172.29	0.33	[161.09, 183.49]	89	409.3	92.1	161.3	372.35	
2OPT <sub>60</sub>	178.52	0.34	[166.56, 190.48]	88.3	342.6	88.4	163.9	334.6	0.56
2OPT <sub>120</sub>	176.33	0.27	[166.95, 185.71]	94.4	316	96.4	174.25	305.5	0.51
2OPT <sub>360</sub>	186.76	0.31	[175.36, 198.16]	87.3	401.8	88.7	179.4	389.5	0.56
2OPT <sub>600</sub>	181.5	0.32	[170.06, 192.94]	82.5	351.2	82.7	164.05	345.55	0.43
SA <sub>0</sub>	172.29	0.33	[161.09, 183.49]	89	409.3	92.1	161.3	372.35	
SA <sub>60</sub>	178.52	0.34	[166.56, 190.48]	88.3	342.6	88.4	163.9	334.6	0.56
SA <sub>120</sub>	176.33	0.27	[166.95, 185.71]	94.4	316	96.4	174.25	305.5	0.51
SA <sub>360</sub>	186.76	0.31	[175.36, 198.16]	87.3	401.8	88.7	179.4	389.5	0.56
SA <sub>600</sub>	181.5	0.32	[170.06, 192.94]	82.5	351.2	82.7	164.05	345.55	0.43
TS <sub>0</sub>	139.76	0.29	[131.78, 147.74]	81.3	306.3	81.95	132.1	281.1	
TS <sub>60</sub>	142.93	0.24	[136.17, 149.69]	55.1	266.8	61.95	137.05	249.05	0.55
TS <sub>120</sub>	153.52	0.29	[144.75, 162.29]	82.6	298.4	83	145.75	280.95	0.59
TS <sub>360</sub>	144.71	0.29	[136.44, 152.98]	70.5	296.5	71.3	138.35	287.75	0.39
TS <sub>600</sub>	143.5	0.33	[134.17, 152.83]	51.5	353.9	52.55	133.45	307	0.42
OPT <sub>0</sub>	144.53	0.23	[137.98, 151.08]	78.4	251.2	84.1	139.7	242.3	
OPT <sub>60</sub>	136.93	0.26	[129.92, 143.94]	55.1	243.1	69.6	127.85	234.3	0.43
OPT <sub>120</sub>	149.16	0.3	[140.35, 157.97]	81.2	319.9	81.65	144	314.4	0.57
OPT <sub>360</sub>	148.55	0.3	[139.77, 157.33]	70.5	304.1	74.85	143.05	300.3	0.38
OPT <sub>600</sub>	145.55	0.32	[136.38, 154.72]	53.3	353.9	53.45	140.4	313.95	0.42

**Table 22:** Maximum tardinesses in the pickup and delivery service.

Performance ratios of maximum tardiness relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	1.28	0.4	[1.18, 1.38]	0.42	3.27	0.49	1.17	2.91	0.32
SRH <sub>60</sub>	1.34	0.43	[1.23, 1.45]	0.27	3.23	0.36	1.22	3.08	0.3
SRH <sub>120</sub>	1.35	0.52	[1.21, 1.49]	0.37	5.09	0.44	1.21	4.83	0.34
SRH <sub>360</sub>	1.39	0.4	[1.28, 1.5]	0.41	3.32	0.47	1.32	3.16	0.25
SRH <sub>600</sub>	1.39	0.56	[1.24, 1.54]	0.41	6.59	0.49	1.19	5.14	0.29
2OPT <sub>0</sub>	1.28	0.4	[1.18, 1.38]	0.42	3.27	0.49	1.17	2.91	0.32
2OPT <sub>60</sub>	1.34	0.43	[1.23, 1.45]	0.27	3.23	0.36	1.22	3.08	0.3
2OPT <sub>120</sub>	1.35	0.52	[1.21, 1.49]	0.37	5.09	0.44	1.21	4.83	0.34
2OPT <sub>360</sub>	1.39	0.4	[1.28, 1.5]	0.41	3.32	0.47	1.32	3.16	0.25
2OPT <sub>600</sub>	1.39	0.56	[1.24, 1.54]	0.41	6.59	0.49	1.19	5.14	0.29
SA <sub>0</sub>	1.28	0.4	[1.18, 1.38]	0.42	3.27	0.49	1.17	2.91	0.32
SA <sub>60</sub>	1.34	0.43	[1.23, 1.45]	0.27	3.23	0.36	1.22	3.08	0.3
SA <sub>120</sub>	1.35	0.52	[1.21, 1.49]	0.37	5.09	0.44	1.21	4.83	0.34
SA <sub>360</sub>	1.39	0.4	[1.28, 1.5]	0.41	3.32	0.47	1.32	3.16	0.25
SA <sub>600</sub>	1.39	0.56	[1.24, 1.54]	0.41	6.59	0.49	1.19	5.14	0.29
TS <sub>0</sub>	1.04	0.38	[0.96, 1.12]	0.31	2.9	0.4	0.97	2.7	0.53
TS <sub>60</sub>	1.07	0.43	[0.98, 1.16]	0.43	3.93	0.44	1	3.08	0.5
TS <sub>120</sub>	1.15	0.44	[1.05, 1.25]	0.26	4.57	0.37	1.06	3.49	0.44
TS <sub>360</sub>	1.09	0.54	[0.97, 1.21]	0.45	5.56	0.45	0.99	3.99	0.51
TS <sub>600</sub>	0.99	0.07	[0.98, 1]	0.68	1.28	0.69	1	1.22	0.2
OPT <sub>0</sub>	1.1	0.48	[1, 1.2]	0.26	4.71	0.39	0.99	3.79	0.51
OPT <sub>60</sub>	1.02	0.39	[0.94, 1.1]	0.44	3.1	0.45	0.93	2.88	0.58
OPT <sub>120</sub>	1.14	0.5	[1.03, 1.25]	0.4	4.57	0.42	1.05	3.95	0.44
OPT <sub>360</sub>	1.12	0.53	[1, 1.24]	0.45	5.56	0.45	1.02	4.02	0.49
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

**Table 23:** Performance ratios of maximum tardiness relative to OPT in the pickup and delivery service.

Performance ratios of maximum tardiness relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	1.12	0.4	[1.03, 1.21]	0.32	2.31	0.37	1.08	2.24	0.56
SRH <sub>120</sub>	1.11	0.39	[1.02, 1.2]	0.36	3.06	0.41	1.01	3.01	0.52
SRH <sub>360</sub>	1.16	0.35	[1.08, 1.24]	0.35	2.48	0.43	1.04	2.45	0.55
SRH <sub>600</sub>	1.15	0.43	[1.05, 1.25]	0.43	3.48	0.46	1.03	2.97	0.53
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	1.12	0.4	[1.03, 1.21]	0.32	2.31	0.37	1.08	2.24	0.56
2OPT <sub>120</sub>	1.11	0.39	[1.02, 1.2]	0.36	3.06	0.41	1.01	3.01	0.52
2OPT <sub>360</sub>	1.16	0.35	[1.08, 1.24]	0.35	2.48	0.43	1.04	2.45	0.55
2OPT <sub>600</sub>	1.15	0.43	[1.05, 1.25]	0.43	3.48	0.46	1.03	2.97	0.53
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	1.12	0.4	[1.03, 1.21]	0.32	2.31	0.37	1.08	2.24	0.56
SA <sub>120</sub>	1.11	0.39	[1.02, 1.2]	0.36	3.06	0.41	1.01	3.01	0.52
SA <sub>360</sub>	1.16	0.35	[1.08, 1.24]	0.35	2.48	0.43	1.04	2.45	0.55
SA <sub>600</sub>	1.15	0.43	[1.05, 1.25]	0.43	3.48	0.46	1.03	2.97	0.53
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1.08	0.32	[1.01, 1.15]	0.47	2.19	0.51	1.03	2.09	0.55
TS <sub>120</sub>	1.16	0.34	[1.08, 1.24]	0.45	2.52	0.48	1.11	2.45	0.63
TS <sub>360</sub>	1.1	0.36	[1.02, 1.18]	0.44	2.88	0.45	1.03	2.5	0.53
TS <sub>600</sub>	1.08	0.39	[1, 1.16]	0.34	3.27	0.37	0.98	2.64	0.5
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	0.99	0.31	[0.93, 1.05]	0.36	2.08	0.39	0.94	1.99	0.43
OPT <sub>120</sub>	1.08	0.35	[1.01, 1.15]	0.53	2.15	0.54	0.99	2.03	0.49
OPT <sub>360</sub>	1.07	0.34	[1, 1.14]	0.47	2.03	0.48	0.99	2.02	0.49
OPT <sub>600</sub>	1.06	0.41	[0.97, 1.15]	0.21	3.9	0.28	1.01	2.91	0.51

**Table 24:** Performance ratios of maximum tardiness relative to the online version of an algorithm in the pickup and delivery service.

Utilization for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	0.93	0.05	[0.92, 0.94]	0.9	1	0.9	0.9	1	
SRH <sub>60</sub>	0.98	0.04	[0.97, 0.99]	0.9	1	0.9	1	1	0.01
SRH <sub>120</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.05
SRH <sub>360</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.04
SRH <sub>600</sub>	0.99	0.04	[0.98, 1]	0.9	1	0.9	1	1	0.09
2OPT <sub>0</sub>	0.93	0.05	[0.92, 0.94]	0.9	1	0.9	0.9	1	
2OPT <sub>60</sub>	0.98	0.04	[0.97, 0.99]	0.9	1	0.9	1	1	0.01
2OPT <sub>120</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.05
2OPT <sub>360</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.04
2OPT <sub>600</sub>	0.99	0.04	[0.98, 1]	0.9	1	0.9	1	1	0.09
SA <sub>0</sub>	0.93	0.05	[0.92, 0.94]	0.9	1	0.9	0.9	1	
SA <sub>60</sub>	0.98	0.04	[0.97, 0.99]	0.9	1	0.9	1	1	0.01
SA <sub>120</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.05
SA <sub>360</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.04
SA <sub>600</sub>	0.99	0.04	[0.98, 1]	0.9	1	0.9	1	1	0.09
TS <sub>0</sub>	0.91	0.04	[0.9, 0.92]	0.8	1	0.85	0.9	1	
TS <sub>60</sub>	0.96	0.05	[0.95, 0.97]	0.9	1	0.9	1	1	0.04
TS <sub>120</sub>	0.98	0.04	[0.97, 0.99]	0.9	1	0.9	1	1	0.09
TS <sub>360</sub>	0.99	0.04	[0.98, 1]	0.9	1	0.9	1	1	0.07
TS <sub>600</sub>	0.99	0.03	[0.98, 1]	0.9	1	0.9	1	1	0.05
OPT <sub>0</sub>	0.88	0.05	[0.87, 0.89]	0.8	0.9	0.8	0.9	0.9	
OPT <sub>60</sub>	0.91	0.04	[0.9, 0.92]	0.8	1	0.8	0.9	1	0.01
OPT <sub>120</sub>	0.96	0.05	[0.95, 0.97]	0.9	1	0.9	1	1	0.02
OPT <sub>360</sub>	0.96	0.05	[0.95, 0.97]	0.9	1	0.9	1	1	0.26
OPT <sub>600</sub>	0.97	0.05	[0.96, 0.98]	0.9	1	0.9	1	1	0.13

**Table 25:** Vehicle utilizations in the pickup and delivery service.

Performance ratios of utilization relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	0.96	0.06	[0.95, 0.97]	0.9	1.11	0.9	1	1.11	0.04
SRH <sub>60</sub>	1.01	0.06	[1, 1.02]	0.9	1.11	0.9	1	1.11	0.2
SRH <sub>120</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.22
SRH <sub>360</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.24
SRH <sub>600</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.2
2OPT <sub>0</sub>	0.96	0.06	[0.95, 0.97]	0.9	1.11	0.9	1	1.11	0.04
2OPT <sub>60</sub>	1.01	0.06	[1, 1.02]	0.9	1.11	0.9	1	1.11	0.2
2OPT <sub>120</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.22
2OPT <sub>360</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.24
2OPT <sub>600</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.2
SA <sub>0</sub>	0.96	0.06	[0.95, 0.97]	0.9	1.11	0.9	1	1.11	0.04
SA <sub>60</sub>	1.01	0.06	[1, 1.02]	0.9	1.11	0.9	1	1.11	0.2
SA <sub>120</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.22
SA <sub>360</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.24
SA <sub>600</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.2
TS <sub>0</sub>	0.94	0.06	[0.93, 0.95]	0.8	1.11	0.85	0.9	1.11	0.03
TS <sub>60</sub>	0.99	0.06	[0.98, 1]	0.9	1.11	0.9	1	1.11	0.15
TS <sub>120</sub>	1.01	0.05	[1, 1.02]	0.9	1.11	0.9	1	1.11	0.19
TS <sub>360</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.21
TS <sub>600</sub>	1.02	0.05	[1.01, 1.03]	0.9	1.11	0.9	1	1.11	0.2
OPT <sub>0</sub>	0.91	0.07	[0.9, 0.92]	0.8	1	0.8	0.9	1	0
OPT <sub>60</sub>	0.94	0.06	[0.93, 0.95]	0.8	1.11	0.8	0.9	1.11	0.02
OPT <sub>120</sub>	0.99	0.07	[0.98, 1]	0.9	1.11	0.9	1	1.11	0.17
OPT <sub>360</sub>	0.99	0.06	[0.98, 1]	0.9	1.11	0.9	1	1.11	0.13
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

**Table 26:** Performance ratios of vehicle utilization relative to OPT in the pickup and delivery service.



Performance ratios of utilization relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	1.06	0.05	[1.05, 1.07]	0.9	1.11	0.95	1.11	1.11	0.01
SRH <sub>120</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
SRH <sub>360</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
SRH <sub>600</sub>	1.07	0.06	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.03
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	1.06	0.05	[1.05, 1.07]	0.9	1.11	0.95	1.11	1.11	0.01
2OPT <sub>120</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
2OPT <sub>360</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
2OPT <sub>600</sub>	1.07	0.06	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.03
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	1.06	0.05	[1.05, 1.07]	0.9	1.11	0.95	1.11	1.11	0.01
SA <sub>120</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
SA <sub>360</sub>	1.07	0.05	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.02
SA <sub>600</sub>	1.07	0.06	[1.06, 1.08]	0.9	1.11	0.9	1.11	1.11	0.03
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1.05	0.06	[1.04, 1.06]	0.9	1.13	0.9	1.11	1.12	0.04
TS <sub>120</sub>	1.08	0.05	[1.07, 1.09]	1	1.25	1	1.11	1.18	0
TS <sub>360</sub>	1.08	0.05	[1.07, 1.09]	1	1.25	1	1.11	1.18	0
TS <sub>600</sub>	1.08	0.05	[1.07, 1.09]	1	1.25	1	1.11	1.18	0
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	1.03	0.05	[1.02, 1.04]	0.89	1.13	0.94	1	1.13	0.01
OPT <sub>120</sub>	1.09	0.07	[1.07, 1.11]	1	1.25	1	1.11	1.25	0
OPT <sub>360</sub>	1.1	0.06	[1.09, 1.11]	1	1.25	1	1.11	1.25	0
OPT <sub>600</sub>	1.1	0.07	[1.08, 1.12]	1	1.25	1	1.11	1.25	0

**Table 27:** Performance ratios of vehicle utilization relative to the online version of an algorithm in the pickup and delivery service.

Throughput for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	% det.
SRH <sub>0</sub>	3.67	0.04	[3.64, 3.7]	3.2	4	3.25	3.7	4	
SRH <sub>60</sub>	3.66	0.04	[3.63, 3.69]	3.3	4	3.3	3.7	4	0.29
SRH <sub>120</sub>	3.68	0.04	[3.65, 3.71]	3.3	4.1	3.35	3.7	4.05	0.2
SRH <sub>360</sub>	3.69	0.04	[3.66, 3.72]	3.2	4	3.3	3.7	3.95	0.29
SRH <sub>600</sub>	3.69	0.04	[3.66, 3.72]	3.4	4	3.4	3.7	3.95	0.27
2OPT <sub>0</sub>	3.67	0.04	[3.64, 3.7]	3.2	4	3.25	3.7	4	
2OPT <sub>60</sub>	3.66	0.04	[3.63, 3.69]	3.3	4	3.3	3.7	4	0.29
2OPT <sub>120</sub>	3.68	0.04	[3.65, 3.71]	3.3	4.1	3.35	3.7	4.05	0.2
2OPT <sub>360</sub>	3.69	0.04	[3.66, 3.72]	3.2	4	3.3	3.7	3.95	0.29
2OPT <sub>600</sub>	3.69	0.04	[3.66, 3.72]	3.4	4	3.4	3.7	3.95	0.27
SA <sub>0</sub>	3.67	0.04	[3.64, 3.7]	3.2	4	3.25	3.7	4	
SA <sub>60</sub>	3.66	0.04	[3.63, 3.69]	3.3	4	3.3	3.7	4	0.29
SA <sub>120</sub>	3.68	0.04	[3.65, 3.71]	3.3	4.1	3.35	3.7	4.05	0.2
SA <sub>360</sub>	3.69	0.04	[3.66, 3.72]	3.2	4	3.3	3.7	3.95	0.29
SA <sub>600</sub>	3.69	0.04	[3.66, 3.72]	3.4	4	3.4	3.7	3.95	0.27
TS <sub>0</sub>	3.69	0.03	[3.67, 3.71]	3.4	4	3.4	3.7	4	
TS <sub>60</sub>	3.7	0.04	[3.67, 3.73]	3.3	4	3.35	3.7	4	0.29
TS <sub>120</sub>	3.7	0.04	[3.67, 3.73]	3.2	4	3.3	3.7	3.95	0.21
TS <sub>360</sub>	3.7	0.03	[3.68, 3.72]	3.4	4.1	3.45	3.7	4	0.28
TS <sub>600</sub>	3.69	0.03	[3.67, 3.71]	3.3	4.1	3.4	3.7	4.05	0.34
OPT <sub>0</sub>	3.67	0.03	[3.65, 3.69]	3.4	4	3.4	3.65	4	
OPT <sub>60</sub>	3.67	0.03	[3.65, 3.69]	3.4	4	3.4	3.7	3.95	0.36
OPT <sub>120</sub>	3.67	0.04	[3.64, 3.7]	3.3	4	3.35	3.7	4	0.35
OPT <sub>360</sub>	3.68	0.04	[3.65, 3.71]	3.4	4.1	3.4	3.7	4.05	0.39
OPT <sub>600</sub>	3.68	0.03	[3.66, 3.7]	3.3	4	3.3	3.7	4	0.3

**Table 28:** Job throughputs in the pickup and delivery service.

Performance ratios of throughput relative to OPT for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$F(1)$
SRH <sub>0</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.27
SRH <sub>60</sub>	1	0.04	[0.99, 1.01]	0.87	1.12	0.88	1	1.1	0.29
SRH <sub>120</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.37
SRH <sub>360</sub>	1	0.03	[0.99, 1.01]	0.91	1.12	0.92	1	1.09	0.37
SRH <sub>600</sub>	1	0.04	[0.99, 1.01]	0.92	1.15	0.93	1	1.12	0.35
2OPT <sub>0</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.27
2OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.87	1.12	0.88	1	1.1	0.29
2OPT <sub>120</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.37
2OPT <sub>360</sub>	1	0.03	[0.99, 1.01]	0.91	1.12	0.92	1	1.09	0.37
2OPT <sub>600</sub>	1	0.04	[0.99, 1.01]	0.92	1.15	0.93	1	1.12	0.35
SA <sub>0</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.27
SA <sub>60</sub>	1	0.04	[0.99, 1.01]	0.87	1.12	0.88	1	1.1	0.29
SA <sub>120</sub>	1	0.04	[0.99, 1.01]	0.89	1.09	0.89	1	1.09	0.37
SA <sub>360</sub>	1	0.03	[0.99, 1.01]	0.91	1.12	0.92	1	1.09	0.37
SA <sub>600</sub>	1	0.04	[0.99, 1.01]	0.92	1.15	0.93	1	1.12	0.35
TS <sub>0</sub>	1	0.03	[0.99, 1.01]	0.95	1.09	0.95	1	1.09	0.36
TS <sub>60</sub>	1.01	0.03	[1, 1.02]	0.89	1.12	0.91	1	1.1	0.36
TS <sub>120</sub>	1	0.04	[0.99, 1.01]	0.86	1.12	0.89	1	1.1	0.35
TS <sub>360</sub>	1.01	0.03	[1, 1.02]	0.95	1.12	0.95	1	1.11	0.41
TS <sub>600</sub>	1	0.03	[0.99, 1.01]	0.95	1.15	0.96	1	1.11	0.28
OPT <sub>0</sub>	1	0.03	[0.99, 1.01]	0.92	1.09	0.92	1	1.08	0.3
OPT <sub>60</sub>	1	0.03	[0.99, 1.01]	0.92	1.09	0.92	1	1.09	0.31
OPT <sub>120</sub>	1	0.05	[0.99, 1.01]	0.87	1.14	0.87	1	1.13	0.34
OPT <sub>360</sub>	1	0.03	[0.99, 1.01]	0.92	1.12	0.93	1	1.09	0.34
OPT <sub>600</sub>	1	0	[1, 1]	1	1	1	1	1	0

**Table 29:** Performance ratios of job throughput relative to OPT in the pickup and delivery service.

Performance ratios of throughput relative to online version for $n = 50$ (100 samples)									
Algorithm	$\mu$	$CV$	95% CI	min	max	$q_{0.01}$	$q_{0.5}$	$q_{0.99}$	$1 - F(1)$
SRH <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SRH <sub>60</sub>	1	0.04	[0.99, 1.01]	0.92	1.09	0.92	1	1.09	0.29
SRH <sub>120</sub>	1.01	0.04	[1, 1.02]	0.89	1.12	0.91	1	1.12	0.25
SRH <sub>360</sub>	1.01	0.03	[1, 1.02]	0.91	1.13	0.92	1	1.12	0.24
SRH <sub>600</sub>	1.01	0.04	[1, 1.02]	0.92	1.12	0.92	1	1.1	0.29
2OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
2OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.92	1.09	0.92	1	1.09	0.29
2OPT <sub>120</sub>	1.01	0.04	[1, 1.02]	0.89	1.12	0.91	1	1.12	0.25
2OPT <sub>360</sub>	1.01	0.03	[1, 1.02]	0.91	1.13	0.92	1	1.12	0.24
2OPT <sub>600</sub>	1.01	0.04	[1, 1.02]	0.92	1.12	0.92	1	1.1	0.29
SA <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
SA <sub>60</sub>	1	0.04	[0.99, 1.01]	0.92	1.09	0.92	1	1.09	0.29
SA <sub>120</sub>	1.01	0.04	[1, 1.02]	0.89	1.12	0.91	1	1.12	0.25
SA <sub>360</sub>	1.01	0.03	[1, 1.02]	0.91	1.13	0.92	1	1.12	0.24
SA <sub>600</sub>	1.01	0.04	[1, 1.02]	0.92	1.12	0.92	1	1.1	0.29
TS <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
TS <sub>60</sub>	1	0.03	[0.99, 1.01]	0.87	1.09	0.89	1	1.09	0.29
TS <sub>120</sub>	1	0.04	[0.99, 1.01]	0.84	1.09	0.88	1	1.09	0.3
TS <sub>360</sub>	1	0.03	[0.99, 1.01]	0.92	1.06	0.92	1	1.06	0.25
TS <sub>600</sub>	1	0.03	[0.99, 1.01]	0.92	1.06	0.93	1	1.06	0.29
OPT <sub>0</sub>	1	0	[1, 1]	1	1	1	1	1	0
OPT <sub>60</sub>	1	0.04	[0.99, 1.01]	0.92	1.11	0.92	1	1.1	0.36
OPT <sub>120</sub>	1	0.05	[0.99, 1.01]	0.88	1.14	0.89	1	1.13	0.38
OPT <sub>360</sub>	1	0.04	[0.99, 1.01]	0.89	1.11	0.91	1	1.1	0.29
OPT <sub>600</sub>	1	0.04	[0.99, 1.01]	0.92	1.09	0.93	1	1.09	0.3

**Table 30:** Performance ratios of job throughput relative to the online version of an algorithm in the pickup and delivery service.