Enhancing Local Search Algorithms for Job Shops with Min-sum Objectives by Approximate Move Evaluation

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A Detailed t-test results

This section provides detailed results of a Student's t-test, performed in order to answer the question whether the new estimation scheme is significantly better than the existing one according to Balas and Vazacopoulos. The t-test is based on a series of objective function values obtained during multiple runs of the ILS and TS method respectively. In fact it checks whether the average solution quality obtained by the new scheme is significantly lower than the one achieved by Balas' approach (one-sided t-test).

Table A.1: p-values originating from a one-sided Student's t-test (TWCT objective)

			FI ILS		BI ILS		FI TS		BI TS	
Inst.	n	m	ATC	Random	ATC	Random	ATC	Random	ATC	Random
LJB1	30	3	0.08	0.042	0.996	0.999	$1.12 \cdot 10^{-37}$	$9.95 \cdot 10^{-48}$	–	–
LJB2	30	3	0.395	0.462	0.977	0.999	0.274	0.567	–	0.381
LJB7	50	5-8	0.318	0.164	0.496	0.946	$1.22 \cdot 10^{-5}$	$2.45 \cdot 10^{-10}$	–	–
LJB9	50	5-8	0.5	0.491	0.582	0.628	0.003	0.989	–	–
LJB10	50	5-8	0.355	0.077	0.962	0.698	0.021	$7.21 \cdot 10^{-62}$	–	–
LJB12	50	5-8	0.5	0.258	0.003	0.135	–	$3.15 \cdot 10^{-53}$	–	–

Table A.2: p-values originating from a one-sided Student's t-test (TWT objective)

			FI ILS		BI ILS		FI TS		BI TS	
Inst.	n	m	ATC	Random	ATC	Random	ATC	Random	ATC	Random
la26	20	10	0.837	–	0.706	–	$1.97 \cdot 10^{-9}$	–	$2.48 \cdot 10^{-31}$	–
la27	20	10	0.071	–	0.945	–	$2.62 \cdot 10^{-15}$	–	$2.57 \cdot 10^{-25}$	–
la28	20	10	0.566	–	0.852	–	$1.75 \cdot 10^{-11}$	–	–	–
la29	20	10	0.373	–	0.003	–	$4.7 \cdot 10^{-13}$	–	–	–
la30	20	10	0.466	–	0.002	–	$5.7 \cdot 10^{-11}$	–	$2.12 \cdot 10^{-30}$	–
la31	30	10	0.215	–	0.483	–	$1.15 \cdot 10^{-18}$	–	$3.22 \cdot 10^{-53}$	–
la32	30	10	0.876	–	0.009	–	$1.27 \cdot 10^{-46}$	–	$1.69 \cdot 10^{-53}$	–
la33	30	10	0.053	–	0.003	–	$1.84 \cdot 10^{-29}$	–	$3.17 \cdot 10^{-34}$	–
la34	30	10	0.934	–	0.05	–	$1.76 \cdot 10^{-35}$	–	$1.15 \cdot 10^{-47}$	–
la35	30	10	0.309	–	0.975	–	$5.52 \cdot 10^{-36}$	–	$3.08 \cdot 10^{-34}$	–
LJB1	30	3	0.156	0.254	$1.56 \cdot 10^{-5}$	$1.95 \cdot 10^{-5}$	$1.11 \cdot 10^{-46}$	$2.04 \cdot 10^{-28}$	–	–
LJB2	30	3	0.5	0.442	0.998	0.97	0.716	0.05	–	–
LJB7	50	5-8	0.196	0.087	0.33	0.196	$2.28 \cdot 10^{-16}$	$5.19 \cdot 10^{-14}$	–	–
LJB9	50	5-8	0.5	0.474	0.637	0.056	$4.99 \cdot 10^{-12}$	0.571	–	$3.579 \cdot 10^{-4}$
LJB10	50	5-8	0.5	0.282	0.288	0.447	0.001	$1.46 \cdot 10^{-56}$	–	–
LJB12	50	5-8	0.5	0.153	$6.174 \cdot 10^{-4}$	0.593	0.041	$4.58 \cdot 10^{-37}$	–	–
swv11	50	10	0.914	–	0.014	–	$1.36 \cdot 10^{-9}$	–	$1.93 \cdot 10^{-31}$	–
swv12	50	10	0.956	–	0.169	–	$1.57 \cdot 10^{-16}$	–	$8.91 \cdot 10^{-23}$	–
swv13	50	10	0.989	–	0.686	–	$1.57 \cdot 10^{-18}$	–	$1.11 \cdot 10^{-33}$	–
swv14	50	10	0.949	–	0.204	–	$1.97 \cdot 10^{-8}$	–	$2.05 \cdot 10^{-18}$	–
swv15	50	10	0.962	–	0.424	–	$7.66 \cdot 10^{-7}$	–	$1.07 \cdot 10^{-7}$	–

Table A.3: p-values originating from a one-sided Student's t-test (TWT objective, contd.)

			FI ILS		BI ILS		FI TS		BI TS	
Inst.	n	m	ATC	Random	ATC	Random	ATC	Random	ATC	Random
ta51	50	15	0.113	–	0.957	–	$3.24 \cdot 10^{-49}$	–	–	–
ta52	50	15	0.155	–	0.811	–	$3.54 \cdot 10^{-19}$	–	–	–
ta53	50	15	0.166	–	0.909	–	$1.2 \cdot 10^{-54}$	–	$4.38 \cdot 10^{-50}$	–
ta54	50	15	0.54	–	0.999	–	$1.17 \cdot 10^{-23}$	–	$8.28 \cdot 10^{-64}$	–
ta55	50	15	0.442	–	0.973	–	$5.81 \cdot 10^{-28}$	–	$3.98 \cdot 10^{-54}$	–
ta71	100	20	0.209	–	0.999	–	$1.08 \cdot 10^{-51}$	–	–	–
ta72	100	20	0.044	–	–	–	$1.18 \cdot 10^{-45}$	–	$6.21 \cdot 10^{-50}$	–
ta73	100	20	0.537	–	0.999	–	$9.91 \cdot 10^{-51}$	–	$1.98 \cdot 10^{-51}$	–
ta74	100	20	0.122	–	–	–	$2.71 \cdot 10^{-50}$	–	–	–
ta75	100	20	0.007	–	0.999	–	$3.56 \cdot 10^{-44}$	–	–	–

Table A.4: p-values originating from a one-sided Student's t-test ($\sum_i w_i U_i$ objective)

			FI ILS		BI ILS		FI TS		BI TS	
Inst.	n	m	ATC	Random	ATC	Random	ATC	Random	ATC	Random
LJB1	30	3	0.197	0.136	0.57	0.092	$4.14 \cdot 10^{-17}$	$1.62 \cdot 10^{-17}$	$8.37 \cdot 10^{-9}$	$6.33 \cdot 10^{-8}$
LJB2	30	3	0.426	0.46	0.35	0.616	0.998	0.564	0.131	0.118
LJB7	50	5-8	0.133	0.052	0.012	0.018	$5.94 \cdot 10^{-12}$	$1.68 \cdot 10^{-18}$	$5.74 \cdot 10^{-35}$	$1.97 \cdot 10^{-50}$
LJB9	50	5-8	0.394	0.478	0.493	0.802	0.732	0.976	0.001	0.056
LJB10	50	5-8	0.45	0.495	0.287	0.183	0.33	0.006	0.013	$1.79 \cdot 10^{-7}$
LJB12	50	5-8	0.1	0.346	0.454	0.564	$3.24 \cdot 10^{-14}$	$3.85 \cdot 10^{-14}$	$2.52 \cdot 10^{-38}$	$3.43 \cdot 10^{-43}$