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## Online Supplement to “The Surgical Patient Routing Problem: A Central Planner Approach”

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**Table 5** Performance of the branch-and-price method under different algorithmic strategies. The reported solution times are in seconds.

Class	Instance	SCD			MCD			SCH			MCH		
		Nodes	Depth	Time	Nodes	Depth	Time	Nodes	Depth	Time	Nodes	Depth	Time
P1	1	1	1	1.95	1	1	3.47	1	1	3.99	1	1	<b>0.85</b>
	2	32	7	25.57	10	4	12.63	<b>17</b>	<b>5</b>	<b>9.61</b>	21	8	9.87
	3	5	3	5.70	13	7	20.65	7	4	5.54	<b>5</b>	<b>3</b>	<b>4.06</b>
	4	3	2	1.43	3	2	2.08	5	3	3.46	<b>3</b>	<b>2</b>	<b>0.70</b>
	5	1	1	2.11	1	1	5.99	1	1	5.23	<b>1</b>	<b>1</b>	<b>1.70</b>
	Average	8.40	2.80	7.35	5.60	3.00	8.96	6.20	2.80	5.57	6.20	3.00	3.44
P2	1	1	1	15.79	1	1	10.35	1	1	6.63	<b>1</b>	<b>1</b>	<b>4.38</b>
	2	27	7	121.93	23	7	58.89	<b>27</b>	<b>7</b>	<b>44.42</b>	65	9	184.37
	3	35	11	153.23	33	7	100.98	<b>25</b>	<b>6</b>	<b>41.56</b>	29	7	84.92
	4	1	1	21.14	1	1	13.15	1	1	9.39	<b>1</b>	<b>1</b>	<b>7.94</b>
	5	1	1	18.04	1	1	9.24	<b>1</b>	<b>1</b>	<b>7.38</b>	1	1	8.15
	Average	13.00	4.20	66.03	11.80	3.40	38.52	11.00	3.20	21.88	19.40	3.80	57.95
P3	1	23	7	273.26	<b>15</b>	<b>5</b>	<b>151.63</b>	35	9	200.50	19	7	180.34
	2	16	5	247.18	21	6	231.58	27	7	187.64	<b>13</b>	<b>5</b>	<b>138.38</b>
	3	1	1	34.29	1	1	32.14	1	1	12.52	<b>1</b>	<b>1</b>	<b>10.21</b>
	4	9	4	164.24	13	5	139.10	<b>9</b>	<b>4</b>	<b>44.84</b>	13	5	133.17
	5	61	11	555.59	37	8	275.01	<b>53</b>	<b>9</b>	<b>183.46</b>	49	11	341.22
	Average	22.00	5.60	254.91	17.40	5.00	165.89	25.00	6.00	125.79	19.00	5.80	160.66
P4	1	1	1	2.61	1	1	4.42	1	1	3.97	<b>1</b>	<b>1</b>	<b>2.06</b>
	2	75	9	50.84	131	12	129.39	95	10	59.38	<b>91</b>	<b>8</b>	<b>50.61</b>
	3	49	7	35.83	79	14	82.79	<b>47</b>	<b>14</b>	<b>21.58</b>	42	11	26.80
	4	9	5	8.71	43	9	53.29	<b>15</b>	<b>7</b>	<b>13.77</b>	73	10	46.86
	5	55	11	44.72	39	11	64.57	47	10	45.04	<b>49</b>	<b>13</b>	<b>21.78</b>
	Average	37.80	6.60	28.54	58.60	9.40	66.89	41.00	8.40	28.75	51.20	8.60	29.62
P5	1	1	1	20.78	1	1	15.92	1	1	7.29	<b>1</b>	<b>1</b>	<b>6.26</b>
	2	1	1	31.19	1	1	24.22	1	1	12.28	<b>1</b>	<b>1</b>	<b>12.10</b>
	3	1	1	18.62	1	1	15.16	1	1	8.19	<b>1</b>	<b>1</b>	<b>7.34</b>
	4	83	12	269.55	215	13	675.60	<b>33</b>	<b>7</b>	<b>51.68</b>	57	7	142.77
	5	267	16	985.47	233	17	816.57	253	17	474.07	<b>91</b>	<b>11</b>	<b>271.28</b>
	Average	70.60	6.20	265.12	90.20	6.60	309.49	57.80	5.40	110.70	30.20	4.20	87.95
P6	1	41	7	438.07	55	9	815.41	73	10	522.48	<b>47</b>	<b>8</b>	<b>447.29</b>
	2	93	13	732.35	29	8	334.04	<b>61</b>	<b>9</b>	<b>331.95</b>	93	13	589.90
	3	27	9	242.91	47	8	415.68	28	9	202.65	<b>21</b>	<b>6</b>	<b>189.98</b>
	4	93	10	951.64	75	9	1028.71	<b>87</b>	<b>9</b>	<b>588.34</b>	73	10	621.13
	5	43	8	313.62	179	17	2047.19	49	10	274.96	<b>27</b>	<b>7</b>	<b>135.10</b>
	Average	59.40	9.40	535.72	77.00	10.20	928.21	59.60	9.40	384.08	52.20	8.80	396.68
P7	1	45	7	31.37	54	8	75.20	57	8	36.35	<b>43</b>	<b>7</b>	<b>26.41</b>
	2	1	1	3.64	1	1	8.07	1	1	5.27	<b>1</b>	<b>1</b>	<b>1.36</b>
	3	5	3	6.37	5	3	13.16	5	3	7.29	<b>5</b>	<b>3</b>	<b>3.32</b>
	4	5	3	4.30	7	4	12.27	7	4	7.99	<b>5</b>	<b>3</b>	<b>2.78</b>
	5	231	11	177.82	253	11	328.88	<b>145</b>	<b>10</b>	<b>96.20</b>	177	11	117.95
	Average	57.40	5.00	44.70	64.00	5.40	87.52	43.00	5.20	30.62	46.20	5.00	30.36
P8	1	443	15	1857.66	453	19	2393.41	<b>350</b>	<b>21</b>	<b>1087.66</b>	391	14	1492.91
	2	3	2	26.49	11	4	70.34	11	6	32.39	<b>5</b>	<b>3</b>	<b>24.48</b>
	3	133	14	570.90	67	11	310.63	<b>61</b>	<b>8</b>	<b>160.67</b>	231	17	952.05
	4	109	12	489.55	55	8	327.99	<b>49</b>	<b>9</b>	<b>153.84</b>	84	10	397.89
	5	1	1	25.16	1	1	39.04	1	1	22.43	<b>1</b>	<b>1</b>	<b>14.11</b>
	Average	137.80	8.80	593.95	117.40	8.60	628.28	94.40	9.00	325.79	142.40	9.00	576.29
P9	1	1	1	51.16	1	1	94.92	1	1	29.51	<b>1</b>	<b>1</b>	<b>17.93</b>
	2	5	3	73.06	5	3	164.48	5	3	50.24	<b>5</b>	<b>3</b>	<b>44.25</b>
	3	19	6	133.93	13	4	178.53	17	5	103.98	<b>7</b>	<b>4</b>	<b>44.93</b>
	4	52	11	449.28	69	8	1007.76	129	10	1095.67	<b>43</b>	<b>8</b>	<b>376.70</b>
	5	240	17	1661.62	312	30	1780.65	350	22	1855.94	<b>230</b>	<b>21</b>	<b>1459.78</b>
	Average	63.40	7.60	473.81	80.00	9.20	645.27	100.40	8.20	627.07	57.20	7.40	388.72

**Table 6 Comparing objective function values of BSPRP when using branch and price (it finds optimal solutions in all instances) vs. TSP- and TRP-based routing methods with random assignments of patients to stages.**

Problem	Instance	B&P	TSP-based				TRP-based			
			Min	Max	Gap (%)	Avg. Gap (%)	Min	Max	Gap (%)	Avg. Gap (%)
P1	1	4414	5050	5614	21.26		4976	5570	18.71	
	2	4924	5286	5728	11.07		5268	5640	9.05	
	3	4776	5092	5784	13.02	15.50	5090	5610	10.37	13.07
	4	5116	5780	6280	17.46		5604	5912	13.69	
	5	4442	4866	5294	14.69		4862	5218	13.54	
P2	1	7083	7961	8557	17.73		7631	8391	14.20	
	2	7662	8612	9596	18.38		8352	9046	14.15	
	3	8704	9930	10554	18.79	17.26	9428	10338	14.48	13.56
	4	7242	7706	8650	14.56		7692	8360	11.33	
	5	8147	9229	9875	16.82		9045	9577	13.66	
P3	1	10726	12036	12888	15.78		11966	12260	13.07	
	2	11590	12884	13572	13.90		12840	13262	12.16	
	3	11368	12674	13404	15.65	15.56	12440	13070	12.61	12.72
	4	9688	10746	11540	14.84		10620	11114	12.02	
	5	11388	12888	14400	17.65		12796	13230	13.74	
P4	1	5378	6202	6824	20.83		6116	6492	17.21	
	2	6718	7222	7828	10.97		7194	7672	10.45	
	3	6066	6956	7564	19.42	18.34	6802	7336	16.41	15.66
	4	6418	7324	8242	21.18		7290	7918	16.97	
	5	6320	7166	7912	19.28		7102	7740	17.24	
P5	1	10017	11185	12119	15.61		11005	11585	12.89	
	2	9793	10937	12105	18.93		10887	11703	15.49	
	3	9326	10774	12018	22.57	19.11	10476	11296	16.61	15.40
	4	10404	11642	12770	17.87		11474	12316	14.56	
	5	9945	11771	12185	20.58		11505	12049	17.48	
P6	1	12846	14706	15600	17.23		14328	14862	13.43	
	2	12392	13930	14768	15.06		13470	14116	12.03	
	3	13368	14902	16700	18.77	18.75	14780	15746	14.28	14.42
	4	13520	14778	16568	17.71		14632	15712	13.32	
	5	14432	17270	18694	24.99		16650	17692	19.04	
P7	1	7196	8568	9052	21.96		8360	8712	18.86	
	2	7514	8584	9194	18.69		8416	8872	15.39	
	3	7228	8528	9390	23.44	19.57	8206	9078	20.37	16.92
	4	7022	7790	8350	14.87		7736	8158	13.00	
	5	7352	8452	9548	18.88		8338	8926	16.96	
P8	1	11290	13158	14304	22.82		13038	13962	19.28	
	2	10529	11921	12855	18.15		11797	12401	14.61	
	3	11860	13756	15756	25.42	21.94	13602	14710	20.04	17.59
	4	12805	14919	15859	20.00		14503	15253	16.13	
	5	11150	13440	14106	23.34		12778	13500	17.88	
P9	1	15816	18430	19762	20.86		18126	19012	17.57	
	2	15504	17326	18760	16.38		17102	17954	13.30	
	3	16036	18610	20482	22.42	19.34	18274	19378	17.60	15.30
	4	16064	18324	19410	17.20		17742	18514	13.51	
	5	14726	16734	18214	19.86		16490	17198	14.55	

**Table 7 Comparing objective function values of BSPRP when using branch and price (it finds optimal solutions in all instances) vs. the two-phase procedure with exact solution of each phase.**

K	$\kappa$	Patients	Instances	B&P	Two-Phase Procedure				Avg. Gap(%)	
					TSP-based	Gap (%)	TRP-based	Gap (%)	TSP-based	TRP-based
4	4	20	1	4459	5068	13.66	4950	11.01	15.60	13.41
			2	4523	5174	14.39	4976	10.02		
			3	4346	5066	16.57	4998	15.00		
			4	4743	5294	11.62	5218	10.01		
			5	4084	4972	21.74	4942	21.01		
4	5	25	1	6578	8010	21.77	7631	16.01	17.32	14.01
			2	7531	8129	7.94	8360	11.01		
			3	6562	8479	29.21	7875	20.01		
			4	7201	7961	10.55	7850	9.01		
			5	7175	8403	17.11	8180	14.01		
5	5	30	1	9756	10902	11.75	10732	10.00	18.14	15.21
			2	9592	10988	14.55	10936	14.01		
			3	8973	10774	20.07	10678	19.00		
			4	9015	11056	22.64	10887	20.77		
			5	9555	11626	21.67	10728	12.28		
5	6	35	1	11852	14372	21.26	13630	15.00	14.87	11.80
			2	12836	13930	8.52	13992	9.01		
			3	12425	14286	14.98	13792	11.00		
			4	12589	14040	11.53	13974	11.00		
			5	11920	14072	18.05	13470	13.00		
6	5	35	1	10923	11921	9.14	11797	8.00	18.47	15.21
			2	10180	12451	22.31	12115	19.01		
			3	9895	12445	25.77	11875	20.01		
			4	10898	12309	12.95	12097	11.00		
			5	10509	12841	22.19	12401	18.00		
6	6	40	1	15434	17846	15.63	16978	10.00	18.32	13.20
			2	13857	16976	22.51	16490	19.00		
			3	14625	17752	21.38	16966	16.01		
			4	15634	18124	15.93	17198	10.00		
			5	15232	17690	16.14	16908	11.00		