

# Appendix for New Large-Scale Data Instances for CARP and New Variations of CARP

Lone Kiilerich and Sanne Wøhlk

Cluster for Operations Research And Logistics,

Department of Economics and Business Economics, Aarhus University, Denmark

## Data instances for the C-CARP

This appendix provides information on the data for the C-CARP. Tables 1 through 5 first state the name of the graphs, number of nodes, edges, and required edges. Next, the tables state the number of edges requiring service of only one fraction ( $\pi_1$ ), of two different fractions ( $\pi_2$ ), of three different fractions ( $\pi_3$ ), etc. These numbers relate to the amount of coordination needed. The 5th column from the right states the average number of fractions required at each required edge.

For each of the two vehicle files assigned to each graph, the last four columns of the tables state the id of the vehicle file (VF) and a lower bound on the number of vehicles needed ( $\hat{K}$ ). The latter is determined as the sum of the number of vehicles needed for each fraction, where the number of vehicles needed for a fraction is determined such that serviced demand is evenly spread over time.

	$ \mathcal{N} $	$ \mathcal{E} $	$ \mathcal{E}_R $	$\pi_1$	$\pi_2$	$\frac{\sum_{f \in \mathcal{F}}  \mathcal{E}_R^f }{ \mathcal{E}_R }$	VF	$\hat{K}$	VF	$\hat{K}$
C-CARP_F1_A	812	1124	783	58	725	1.9	A5	11	A9	13
C-CARP_F10_A	415	565	377	30	347	1.9	A4	6	A8	6
C-CARP_F11_A	191	267	174	15	159	1.9	A3	3	A7	6
C-CARP_F12_A	80	110	72	7	65	1.9	A2	3	A6	4
C-CARP_F13_A	26	33	19	2	17	1.9	A2	2		
C-CARP_K1_A	11656	12691	8584	3219	5365	1.6	A5	8	A9	9
C-CARP_K10_A	5102	5518	3744	1404	2340	1.6	A4	5	A8	6
C-CARP_K11_A	3114	3361	2281	977	1304	1.6	A4	3	A8	2
C-CARP_K12_A	1132	1221	803	359	444	1.6	A2	3	A6	3
C-CARP_K13_A	394	422	283	104	179	1.6	A1	2		
C-CARP_N1_A	8573	9761	6377	1577	4800	1.8	A4	10	A8	10
C-CARP_N10_A	3698	4187	2802	804	1998	1.7	A4	4	A8	4
C-CARP_N11_A	2142	2419	1606	188	1418	1.9	A3	3	A7	6
C-CARP_N12_A	930	1040	702	52	650	1.9	A1	5		
C-CARP_N13_A	454	502	366	28	338	1.9	A2	2		
C-CARP_O1_A	10352	11943	8651	501	8150	1.9	A5	16	A9	23
C-CARP_O10_A	5882	6982	4827	352	4475	1.9	A5	11	A9	16
C-CARP_O11_A	2822	3281	2132	168	1964	1.9	A4	6	A8	6
C-CARP_O12_A	761	852	535	37	498	1.9	A2	4	A6	4
C-CARP_O13_A	228	247	170	10	160	1.9	A1	2		
C-CARP_S1_A	6149	7110	3797	1904	1893	1.5	A3	5	A7	13
C-CARP_S10_A	3404	3921	2221	1141	1080	1.5	A3	4	A7	7
C-CARP_S11_A	1564	1805	961	464	497	1.5	A1	5	A6	4
C-CARP_S12_A	755	866	407	158	249	1.6	A1	3		
C-CARP_S13_A	322	374	176	43	133	1.8	A2	2		

Table 1: C-CARP graph and vehicle information for set A.

	$ \mathcal{N} $	$ \mathcal{E} $	$ \mathcal{E}_R $	$\pi_1$	$\pi_2$	$\pi_3$	$\frac{\sum_{f \in \mathcal{F}}  \mathcal{E}_R^f }{ \mathcal{E}_R }$	VF	$\hat{K}$	VF	$\hat{K}$
C-CARP_F1_B	812	1124	783	46	70	667	2.8	B5	16	B8	23
C-CARP_F10_B	415	565	377	27	42	308	2.7	B4	9	B7	23
C-CARP_F11_B	191	267	174	13	19	142	2.7	B3	4	B6	11
C-CARP_F12_B	80	110	72	6	6	60	2.8	B2	4		
C-CARP_F13_B	26	33	19	2	0	17	2.8	B2	3		
C-CARP_K1_B	11656	12691	8584	18	3201	5365	2.6	B5	18	B8	22
C-CARP_K10_B	5102	5518	3744	9	1395	2340	2.6	B4	11	B7	24
C-CARP_K11_B	3114	3361	2281	5	972	1304	2.6	B4	7	B6	16
C-CARP_K12_B	1132	1221	803	1	358	444	2.6	B2	3		
C-CARP_K13_B	394	422	283	1	103	179	2.6	B1	3		
C-CARP_N1_B	8573	9761	6377	38	1539	4800	2.7	B4	16	B8	16
C-CARP_N10_B	3698	4187	2802	12	792	1998	2.7	B4	7	B6	16
C-CARP_N11_B	2142	2419	1606	7	181	1418	2.9	B3	5	B6	11
C-CARP_N12_B	930	1040	702	4	48	650	2.9	B1	7		
C-CARP_N13_B	454	502	366	2	26	338	2.9	B2	3		
C-CARP_O1_B	10352	11943	8651	70	431	8150	2.9	B5	34	B8	45
C-CARP_O10_B	5882	6982	4827	36	316	4475	2.9	B5	23	B8	30
C-CARP_O11_B	2822	3281	2132	25	143	1964	2.9	B4	10	B7	23
C-CARP_O12_B	761	852	535	0	37	498	2.9	B2	5		
C-CARP_O13_B	228	247	170	0	10	160	2.9	B1	3		
C-CARP_S1_B	6149	7110	3797	0	1904	1893	2.5	B3	10	B7	22
C-CARP_S10_B	3404	3921	2221		1141	1080	2.5	B3	7	B6	14
C-CARP_S11_B	1564	1805	961	0	464	497	2.5	B1	7		
C-CARP_S12_B	755	866	407	0	158	249	2.6	B1	3		
C-CARP_S13_B	322	374	176	0	43	133	2.8	B2	3		

Table 2: C-CARP Set B

	$ \mathcal{N} $	$ \mathcal{E} $	$ \mathcal{E}_R $	$\pi_1$	$\pi_2$	$\pi_3$	$\frac{\sum_{f \in \mathcal{F}}  \mathcal{E}_R^f }{ \mathcal{E}_R }$	VF	$\hat{K}$	VF	$\hat{K}$
C-CARP_F1_C	812	1124	783	46	70	667	2.8	C5	16	C8	23
C-CARP_F10_C	415	565	377	27	42	308	2.7	C4	9	C7	24
C-CARP_F11_C	191	267	174	13	19	142	2.7	C3	4	C6	11
C-CARP_F12_C	80	110	72	6	6	60	2.8	C2	4		
C-CARP_F13_C	26	33	19	2	0	17	2.8	C2	3		
C-CARP_K1_C	11656	12691	8584	18	3201	5365	2.6	C5	18	C8	21
C-CARP_K10_C	5102	5518	3744	9	1395	2340	2.6	C4	11	C7	25
C-CARP_K11_C	3114	3361	2281	5	972	1304	2.6	C4	7	C6	16
C-CARP_K12_C	1132	1221	803	1	358	444	2.6	C2	3		
C-CARP_K13_C	394	422	283	1	103	179	2.6	C1	3		
C-CARP_N1_C	8573	9761	6377	38	1539	4800	2.7	C4	16	C7	40
C-CARP_N10_C	3698	4187	2802	12	792	1998	2.7	C4	7	C6	16
C-CARP_N11_C	2142	2419	1606	7	181	1418	2.9	C3	5	C6	11
C-CARP_N12_C	930	1040	702	4	48	650	2.9	C1	7		
C-CARP_N13_C	454	502	366	2	26	338	2.9	C2	3		
C-CARP_O1_C	10352	11943	8651	70	431	8150	2.9	C5	34	C8	44
C-CARP_O10_C	5882	6982	4827	36	316	4475	2.9	C5	23	C8	30
C-CARP_O11_C	2822	3281	2132	25	143	1964	2.9	C4	10	C7	24
C-CARP_O12_C	761	852	535	0	37	498	2.9	C2	5		
C-CARP_O13_C	228	247	170	0	10	160	2.9	C1	3		
C-CARP_S1_C	6149	7110	3797		1904	1893	2.5	C3	10	C7	23
C-CARP_S10_C	3404	3921	2221	0	1141	1080	2.5	C3	7	C6	14
C-CARP_S11_C	1564	1805	961	0	464	497	2.5	C1	7		
C-CARP_S12_C	755	866	407	0	158	249	2.6	C1	3		
C-CARP_S13_C	322	374	176	0	43	133	2.8	C2	3		

Table 3: C-CARP graph and vehicle information for set C.

	$ \mathcal{N} $	$ \mathcal{E} $	$ \mathcal{E}_R $	$\pi_1$	$\pi_2$	$\pi_3$	$\pi_4$	$\frac{\sum_{f \in \mathcal{F}}  \mathcal{E}_R^f }{ \mathcal{E}_R }$	VF	$\hat{K}$	VF	$\hat{K}$
C-CARP_F1_D	812	1124	783	46	46	428	263	3.2	D4	18	D8	29
C-CARP_F10_D	415	565	377	27	25	162	163	3.2	D3	10	D7	27
C-CARP_F11_D	191	267	174	13	8	72	81	3.3	D2	10	D6	14
C-CARP_F12_D	80	110	72	6	4	23	39	3.3	D1	6		
C-CARP_F13_D	26	33	19	2	0	5	12	3.4	D1	4		
C-CARP_K1_D	11656	12691	8584	18	0	3201	5365	3.6	D4	27	D8	38
C-CARP_K10_D	5102	5518	3744	9	0	1395	2340	3.6	D3	15	D7	29
C-CARP_K11_D	3114	3361	2281	5	0	972	1304	3.6	D2	15	D5	22
C-CARP_K12_D	1132	1221	803	1	0	358	444	3.6	D1	5		
C-CARP_K13_D	394	422	283	1	0	103	179	3.6	D1	4		
C-CARP_N1_D	8573	9761	6377	38	0	1539	4800	3.7	D3	22	D7	46
C-CARP_N10_D	3698	4187	2802	12	0	792	1998	3.7	D3	9	D5	22
C-CARP_N11_D	2142	2419	1606	7	0	181	1418	3.9	D2	10	D5	15
C-CARP_N12_D	930	1040	702	4	0	48	650	3.9	D1	8		
C-CARP_N13_D	454	502	366	2	0	26	338	3.9	D1	5		
C-CARP_O1_D	10352	11943	8651	70	0	431	8150	3.9	D4	50	D8	82
C-CARP_O10_D	5882	6982	4827		0	316	4475	3.9	D4	34	D8	55
C-CARP_O11_D	2822	3281	2132	25	0	143	1964	3.9	D3	15	D7	27
C-CARP_O12_D	761	852	535	0	0	37	498	3.9	D2	7		
C-CARP_O13_D	228	247	170	0	0	10	160	3.9	D1	4		
C-CARP_S1_D	6149	7110	3797	0	0	1904	1893	3.5	D2	23	D7	28
C-CARP_S10_D	3404	3921	2221	0	0	1141	1080	3.5	D2	14	D5	20
C-CARP_S11_D	1564	1805	961	0	0	464	497	3.5	D1	8		
C-CARP_S12_D	755	866	407	0	0	158	249	3.6	D1	4		
C-CARP_S13_D	322	374	176	0	0	43	133	3.8	D1	4		

Table 4: C-CARP graph and vehicle information for set D.

	$ \mathcal{N} $	$ \mathcal{E} $	$ \mathcal{E}_R $	$\pi_1$	$\pi_2$	$\pi_3$	$\pi_4$	$\frac{\sum_{f \in \mathcal{F}}  \mathcal{E}_R^f }{ \mathcal{E}_R }$	VF	$\hat{K}$	VF	$\hat{K}$
C-CARP_F1_E	812	1124	783	46	46	428	263	3.2	E4	18	E8	32
C-CARP_F10_E	415	565	377	27	25	162	163	3.2	E3	10	E7	27
C-CARP_F11_E	191	267	174	13	8	72	81	3.3	E2	10	E6	15
C-CARP_F12_E	80	110	72	6	4	23	39	3.3	E1	6		
C-CARP_F13_E	26	33	19	2	0	5	12	3.4	E1	4		
C-CARP_K1_E	11656	12691	8584	18	0	3201	5365	3.6	E4	27	E8	39
C-CARP_K10_E	5102	5518	3744	9	0	1395	2340	3.6	E3	15	E7	29
C-CARP_K11_E	3114	3361	2281	5	0	972	1304	3.6	E2	15	E5	22
C-CARP_K12_E	1132	1221	803	1	0	358	444	3.6	E1	5		
C-CARP_K13_E	394	422	283	1	0	103	179	3.6	E1	4		
C-CARP_N1_E	8573	9761	6377	38	0	1539	4800	3.7	E3	22	E7	46
C-CARP_N10_E	3698	4187	2802	12	0	792	1998	3.7	E3	9	E5	22
C-CARP_N11_E	2142	2419	1606	7	0	181	1418	3.9	E2	10	E5	15
C-CARP_N12_E	930	1040	702	4	0	48	650	3.9	E1	8		
C-CARP_N13_E	454	502	366	2	0	26	338	3.9	E1	5		
C-CARP_O1_E	10352	11943	8651	70	0	431	8150	3.9	E4	50	E8	86
C-CARP_O10_E	5882	6982	4827		0	316	4475	3.9	E4	34	E8	57
C-CARP_O11_E	2822	3281	2132	25	0	143	1964	3.9	E3	15	E7	27
C-CARP_O12_E	761	852	535	0	0	37	498	3.9	E2	7		
C-CARP_O13_E	228	247	170	0	0	10	160	3.9	E1	4		
C-CARP_S1_E	6149	7110	3797	0	0	1904	1893	3.5	E2	23	E7	28
C-CARP_S10_E	3404	3921	2221	0	0	1141	1080	3.5	E2	14	E5	20
C-CARP_S11_E	1564	1805	961	0	0	464	497	3.5	E1	8		
C-CARP_S12_E	755	866	407	0	0	158	249	3.6	E1	4		
C-CARP_S13_E	322	374	176	0	0	43	133	3.8	E1	4		

Table 5: C-CARP graph and vehicle information for set E.