Detailed Results in the Paper "Branch-and-Price for the Capacitated Autonomous Vehicle Assisted Delivery Problem"

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1. Results When Driving Is Not Slower Than Walking

In this section, we present the detailed results regarding instance-set 1, which contains 350 instances, and driving is not slower than walking. We conduct experiments with four settings. The first one is referred to as "RCT2", where we implement all of the model improvements in Reed et al. (2022, Section 4), including service set reduction, variable reduction, and valid inequalities. We include "RCT2" because RCT2 is a valid formulation when driving is not slower than walking, as shown in Lemma 2 in Zhang (2024). The second and third settings are called "IP1" and "IP2", where we test the performance of IP1 and IP2 after applying service set reduction and variable reduction like "RCT2". We note that in our implementation of IP2, the CAVADP-strengthened subtour elimination constraints are implemented as user cuts in Gurobi. The last setting is referred to as "BP", where we apply the proposed branch-and-price approach. Specifically, we combine the solution approach in Section 3 and Section 4 of Zhang (2024) because the 350 instances satisfy the assumption that driving is not slower than walking.

	RCT2						IP1				
	$q=1$	$q=2$	$q=3$	$q=4$	$q=5$		$q=1$	$q=2$	$q=3$	$q=4$	$q=5$
Cook_2	3.2	4.3	12.0	86.2	292.9	Cook_2	5.2	9.0	31.6	245.2	1805.7
Cook_3	2.7	8.5	7.3	15.7	90.1	Cook_3	5.2	13.2	21.2	63.3	177.1
Cook_6	1.8	9.8	10.9	34.9	103.2	Cook_6	2.0	6.1	35.9	147.4	1027.9
Cook_9	1.7	2.2	4.2	15.5	74.4	Cook_9	3.0	7.6	31.7	49.5	114.0
Cook_10	1.6	2.7	1.8	16.8	303.0	Cook_10	2.1	11.5	14.7	53.0	727.8
Winnebago_2	30.9	27.7	41.0	116.9	3029.6	Winnebago_2	105.2	162.2	20.6	186.5	1878.43
Winnebago_3	3.0	6.5	8.6	7.4	21.6	Winnebago_3	5.0	7.7	10.9	11.2	15.67
Winnebago_4	1.8	4.1	10.1	10.6	8.5	Winnebago_4	2.8	3.7	14.2	23.3	12.86
Winnebago_6	3.4	12.3	4.2	7.7	10.7	Winnebago_6	2.3	17.3	9.0	30.0	23.35
Winnebago_7	3.4	2.7	2.8	3.9	3.7	Winnebago_7	4.7	8.9	6.6	6.2	10.22
Winnebago_8	3.6	7.5	5.9	8.4	26.0	Winnebago_8	4.5	9.3	15.7	25.4	56.22
Winnebago_9	1.1	1.5	2.1	2.3	7.7	Winnebago_9	2.1	4.1	4.3	3.90	24.60
Winnebago_10	2.1	4.8	4.2	7.3	19.9	Winnebago_10	4.5	6.5	8.1	16.52	59.86
Champaign_1	123.0	49.8	34.1	144.1	630.5	Champaign_1	15.4	23.5	35.2	148.4	703.4
Champaign_3	6.9	8.2	24.0	25.7	105.4	Champaign_3	6.1	2.5	27.7	15.5	246.0
Champaign_4	105.1	35.2	41.6	3016.2	16601.1	Champaign_4	138.0	38.7	60.6	769.7	3429.5
Champaign_5	6.3	9.0	29.9	27.7	124.4	Champaign_5	7.0	7.1	24.3	22.9	103.2

Champaign_7	6.9	13.2	23.0	53.9	51.4	Champaign_7	5.7	11.6	23.7	31.3	29.8
Champaign_9	5.1	7.7	11.1	15.1	9.4	Champaign_9	5.1	11.0	12.8	20.5	18.1
Champaign_10	117.4	32.7	480.2	2824.3	2221.9	Champaign_10	124.6	62.6	223.0	1263.9	20187.2
LaSalle_1	2.6	3.8	5.5	10.5	9.4	LaSalle_1	4.7	10.0	5.2	16.7	7.9
LaSalle_2	2.4	14.4	11.8	7.8	7.3	LaSalle_2	4.6	12.8	21.5	27.1	17.0
LaSalle_3	54.1	28.2	77.1	82.8	179.8	LaSalle_3	45.1	44.1	139.6	64.4	49.9
LaSalle_4	3.0	3.9	3.3	2.7	3.3	LaSalle_4	8.0	14.6	8.5	5.9	11.9
LaSalle_5	1.7	1.7	7.0	10.7	22.9	LaSalle_5	2.1	2.5	2.8	7.1	17.1
LaSalle_8	8.4	12.2	15.6	24.8	59.3	LaSalle_8	5.8	8.4	9.8	17.9	28.4
LaSalle_9	11.0	43.0	29.8	52.6	44.0	LaSalle_9	18.1	40.5	26.1	60.5	89.0
LaSalle_10	101.0	44.2	33.3	541.0	1126.3	LaSalle_10	190.8	34.2	122.1	104.5	315.2
Adams_1	2.6	2.1	2.8	2.7	3.2	Adams_1	2.6	6.5	7.3	6.2	5.6
Adams_3	6.6	9.8	20.1	81.8	29.2	Adams_3	10.9	7.2	24.1	19.3	27.3
Adams_4	80.8	26.8	454.4	1084.6	957.3	Adams_4	1994.9	15.6	3136.1	204.8	605.8
Adams_5	32.8	24.5	107.7	704.5	1454.5	Adams_5	17.6	29.2	282.8	197.5	169.8
Adams_7	14.3	17.0	253.2	726.2	656.4	Adams_7	7.2	15.3	110.0	289.7	506.6
Adams_8	1.8	3.2	3.5	9.6	7.2	Adams_8	4.1	2.3	3.2	12.5	7.3
Adams_9	2.4	3.1	3.1	3.4	3.8	Adams_9	3.3	8.2	4.1	9.3	8.4
Adams_10	18.4	7.4	10.7	8.6	12.7	Adams_10	7.5	7.5	6.3	7.6	10.9
Fulton_1	12.0	4.3	5.4	4.4	10.4	Fulton_1	8.5	3.6	7.2	6.8	22.3
Fulton_2	24.5	16.4	41.8	99.2	189.5	Fulton_2	9.3	11.9	15.4	112.7	79.0
Fulton_3	59.2	76.4	266.1	1683.4	2076.9	Fulton_3	9.2	53.1	450.1	451.9	1207.6
Fulton_4	3.2	6.2	9.9	47.0	515.0	Fulton_4	2.6	8.0	21.6	34.2	207.8
Fulton_5	2.0	2.1	2.0	2.9	3.3	Fulton_5	3.3	3.7	2.4	3.5	3.4
Fulton_6	30.3	30.8	383.4	110.9	455.3	Fulton_6	19.4	13.2	109.9	122.3	150.9
Fulton_7	2.1	3.2	3.6	5.7	9.5	Fulton_7	2.1	2.9	3.6	6.3	17.2
Fulton_8	6.0	7.0	4.2	7.4	10.8	Fulton_8	7.4	8.1	16.9	21.8	24.7
Fulton_9	24.1	10.8	28.0	27.2	60.3	Fulton_9	6.1	10.4	15.3	26.0	42.2
Fulton_10	1.8	3.2	5.2	5.5	8.9	Fulton_10	2.4	2.3	2.8	8.3	8.7
Jefferson_1	7.6	21.3	21.9	51.8	30.1	Jefferson_1	8.0	14.7	17.4	33.5	18.1
Jefferson_2	1.6	1.2	2.1	2.5	9.2	Jefferson_2	1.0	1.6	2.1	2.6	7.4
Jefferson_3	8.1	10.6	21.1	6.9	15.6	Jefferson_3	9.2	10.7	15.2	19.8	27.0
Jefferson_4	5.6	9.3	12.6	7.8	42.2	Jefferson_4	6.2	8.2	11.3	12.7	21.9
Jefferson_5	2.3	2.2	1.7	1.5	1.8	Jefferson_5	1.8	2.5	3.5	5.6	3.1
Jefferson_6	14.1	22.5	15.9	24.3	9.1	Jefferson_6	7.6	14.6	5.5	15.5	15.7
Jefferson_7	41.2	28.2	101.5	304.2	742.7	Jefferson_7	39.8	18.8	76.4	180.3	125.1
Jefferson_8	7.1	6.5	13.9	5.5	7.5	Jefferson_8	5.4	9.3	14.7	14.5	10.4
Johnson_1	1.9	1.9	3.0	5.9	18.0	Johnson_1	2.2	3.1	9.4	7.2	20.4
Johnson_3	146.7	45.6	71.1	2840.1	881.1	Johnson_3	15.1	20.6	246.7	344.9	452.4
Johnson_4	103.3	30.4	150.7	379.5	301.8	Johnson_4	93.3	85.0	5938.6	343.9	226.1
Johnson_5	9.5	6.2	16.6	7.0	9.8	Johnson_5	7.0	10.4	14.4	11.1	26.5
Johnson_6	5.5	14.0	34.5	10.5	11.1	Johnson_6	5.5	8.5	25.0	15.8	13.4
Johnson_9	29.9	28.2	54.9	82.2	1439.4	Johnson_9	41.0	23.1	111.4	86.2	447.4
Johnson_10	8.7	16.7	132.8	211.2	1335.4	Johnson_10	9.0	75.3	98.7	245.1	219.5
Cumberland_2	3.0	4.2	16.2	16.5	30.1	Cumberland_2	4.9	7.8	10.6	7.2	17.8
Cumberland_3	5.1	14.5	17.2	33.0	60.2	Cumberland_3	5.5	7.6	14.3	16.4	48.1
Cumberland_4	3.3	8.2	5.1	4.5	5.6	Cumberland_4	4.7	4.5	5.1	5.9	8.4
Cumberland_5	2.0	2.6	2.8	2.3	2.4	Cumberland_5	2.4	3.2	3.0	2.4	3.3
Cumberland_6	5.0	7.8	3.5	5.0	10.1	Cumberland_6	5.0	5.8	6.0	7.4	7.7
Cumberland_7	2.8	8.6	4.7	3.6	6.6	Cumberland_7	7.4	7.4	7.3	9.9	6.9
Cumberland_8	7.5	9.3	4.0	5.2	9.0	Cumberland_8	5.3	4.4	5.0	13.8	13.5
Cumberland_9	10.4	14.8	15.2	14.3	17.6	Cumberland_9	12.7	18.8	15.9	21.5	22.6
Cumberland_10	25.3	25.8	58.1	112.5	753.7	Cumberland_10	16.9	33.8	75.8	38.3	136.0

Table 1: Run Times (in Seconds) of RCT2 and IP1 on Instance-Set 1.

	IP2						BP				
	$q=1$	$q=2$	$q=3$	$q=4$	$q=5$		$q=1$	$q=2$	$q=3$	$q=4$	$q=5$
Cook_2	2.0	2.0	6.8	98.3	153.8	Cook_2	8.6	13.9	37.4	141.0	183.9
Cook_3	1.2	3.6	5.2	15.1	42.8	Cook_3	9.6	16.8	29.2	73.1	92.8
Cook_6	1.4	2.1	12.4	41.2	102.2	Cook_6	8.1	13.6	51.6	97.3	214.5
Cook_9	2.4	1.6	14.9	27.9	42.5	Cook_9	8.8	13.6	37.3	96.5	108.3
Cook_10	1.9	3.5	7.9	24.0	200.6	Cook_10	9.5	14.5	23.9	73.5	376.4
Winnebago_2	2.1	2.8	15.0	55.1	243.8	Winnebago_2	10.0	33.4	57.8	169.5	342.3
Winnebago_3	1.9	1.3	4.5	6.4	9.1	Winnebago_3	8.4	15.8	31.3	68.1	72.0
Winnebago_4	1.4	1.8	7.6	12.7	8.5	Winnebago_4	8.8	14.3	29.6	57.3	176.0
Winnebago_6	1.2	3.8	8.7	13.0	20.3	Winnebago_6	8.0	23.0	32.3	80.4	78.6
Winnebago_7	1.2	2.0	3.4	7.6	9.4	Winnebago_7	8.3	15.0	28.7	61.3	86.3
Winnebago_8	1.7	2.2	4.7	8.2	10.8	Winnebago_8	8.8	12.2	25.0	79.1	81.6
Winnebago_9	0.9	1.0	3.7	5.5	8.9	Winnebago_9	7.9	17.5	21.2	65.9	97.6
Winnebago_10	1.3	2.6	5.4	8.9	25.6	Winnebago_10	8.5	13.8	26.7	94.9	66.7
Champaign_1	3.3	2.8	10.6	23.3	85.0	Champaign_1	10.5	22.3	40.8	99.5	154.3
Champaign_3	1.9	1.9	10.8	8.9	37.2	Champaign_3	8.6	19.5	35.6	104.6	127.9
Champaign_4	2.8	2.7	24.1	79.3	394.1	Champaign_4	9.8	18.2	45.5	242.8	841.4
Champaign_5	1.8	1.6	5.8	12.8	21.6	Champaign_5	8.6	15.0	27.7	47.4	90.4
Champaign_7	2.4	1.8	7.2	12.9	10.7	Champaign_7	7.8	12.6	29.8	42.5	58.6
Champaign_9	4.9	4.7	6.8	10.5	11.0	Champaign_9	10.6	14.2	23.3	51.7	47.3
Champaign_10	3.1	2.9	50.1	319.0	2922.5	Champaign_10	9.9	46.8	133.1	1349.1	1113.2
LaSalle_1	1.2	1.5	3.7	6.0	6.2	LaSalle_1	8.1	13.7	29.4	67.4	116.2
LaSalle_2	2.6	2.7	4.6	7.7	5.4	LaSalle_2	11.5	25.4	29.4	56.4	69.3
LaSalle_3	2.4	2.1	20.6	12.8	22.6	LaSalle_3	9.5	28.9	50.0	134.8	141.4
LaSalle_4	2.6	3.3	5.5	2.9	4.1	LaSalle_4	9.6	21.3	27.9	52.0	31.2
LaSalle_5	1.0	2.2	2.7	6.5	17.5	LaSalle_5	8.3	12.4	25.7	95.1	66.5
LaSalle_8	2.1	1.9	5.1	8.5	12.7	LaSalle_8	9.4	22.7	35.8	54.7	185.6
LaSalle_9	6.2	7.3	37.9	35.2	17.1	LaSalle_9	14.6	45.6	50.3	125.3	138.9
LaSalle_10	3.2	3.6	13.2	49.8	38.2	LaSalle_10	9.9	22.4	43.0	90.6	122.4
Adams_1	1.4	1.8	4.0	6.1	6.2	Adams_1	8.3	14.2	28.7	61.5	81.2
Adams_3	1.8	1.8	7.4	8.6	22.4	Adams_3	9.4	15.1	42.8	57.9	90.8
Adams_4	11.9	3.3	61.6	27.3	35.9	Adams_4	13.3	67.1	86.0	114.0	283.6
Adams_5	3.0	2.0	6.4	26.9	147.6	Adams_5	9.4	17.7	79.9	85.8	147.5
Adams_7	2.6	2.4	34.2	63.6	50.6	Adams_7	9.5	25.4	104.7	147.0	250.3
Adams_8	1.6	2.0	5.0	7.4	6.9	Adams_8	7.9	15.2	31.3	60.8	88.6
Adams_9	3.1	1.6	6.3	5.4	4.8	Adams_9	9.8	14.7	34.2	26.2	46.3
Adams_10	2.4	1.7	3.1	6.5	3.5	Adams_10	8.3	18.7	33.4	42.8	72.2
Fulton_1	1.9	2.2	4.9	4.3	9.5	Fulton_1	10.0	15.6	31.9	45.8	87.7
Fulton_2	2.1	2.3	7.9	14.5	55.5	Fulton_2	9.6	20.6	46.0	81.7	162.6
Fulton_3	2.4	3.8	34.5	138.6	211.2	Fulton_3	9.6	73.2	93.6	148.0	514.2
Fulton_4	2.2	2.1	5.7	13.3	416.6	Fulton_4	9.2	24.4	133.8	155.5	343.8
Fulton_5	2.1	1.7	4.0	7.0	4.6	Fulton_5	9.6	14.5	32.2	59.7	46.5
Fulton_6	2.7	3.4	7.1	14.4	17.0	Fulton_6	9.1	23.8	51.3	67.3	143.7
Fulton_7	1.0	1.4	2.2	7.9	7.1	Fulton_7	13.4	13.5	42.4	88.4	117.1
Fulton_8	1.6	2.7	4.9	4.7	6.4	Fulton_8	8.9	12.5	31.6	53.4	63.5
Fulton_9	2.4	2.0	6.1	5.3	10.0	Fulton_9	9.5	16.6	36.0	70.6	94.3
Fulton_10	1.1	2.0	4.3	5.9	5.8	Fulton_10	8.3	19.6	51.2	66.7	168.7
Jefferson_1	2.0	2.3	5.1	7.4	11.7	Jefferson_1	9.0	20.4	41.7	70.1	122.6
Jefferson_2	1.0	0.9	2.3	2.2	5.1	Jefferson_2	7.9	24.5	32.3	88.5	135.7
Jefferson_3	2.7	2.6	6.5	5.1	12.8	Jefferson_3	10.1	13.3	59.6	58.4	78.5
Jefferson_4	1.9	2.5	10.0	11.5	11.8	Jefferson_4	8.9	21.1	52.0	93.4	125.7
Jefferson_5	1.2	1.4	2.9	2.7	3.8	Jefferson_5	8.6	12.3	25.6	64.7	82.7
Jefferson_6	2.1	1.6	3.0	6.9	5.0	Jefferson_6	8.8	17.3	30.1	62.6	88.5
Jefferson_7	2.6	3.8	31.3	15.8	60.6	Jefferson_7	9.9	46.8	49.5	89.1	136.0
Jefferson_8	2.2	2.1	3.6	4.2	5.3	Jefferson_8	9.5	11.8	29.4	35.4	42.0
Johnson_1	1.1	1.7	10.4	9.7	15.1	Johnson_1	7.8	11.8	51.8	62.0	95.1
Johnson_3	3.6	4.7	12.7	38.6	67.0	Johnson_3	10.7	58.3	215.8	313.0	402.7
Johnson_4	3.7	3.3	26.3	25.0	30.0	Johnson_4	9.6	41.7	88.4	74.4	173.8
Johnson_5	2.1	2.3	7.3	5.8	11.6	Johnson_5	10.5	19.7	50.8	74.6	119.9
Johnson_6	1.6	2.1	5.8	5.7	6.8	Johnson_6	9.5	14.9	40.9	60.5	65.4
Johnson_9	2.3	3.2	14.2	14.1	74.2	Johnson_9	7.8	56.0	60.8	97.7	195.0
Johnson_10	2.3	4.6	15.4	39.2	316.0	Johnson_10	8.8	77.7	179.4	214.5	762.5
Cumberland_2	1.9	2.7	8.0	6.0	6.6	Cumberland_2	7.3	30.0	116.8	165.5	312.4

Cumberland_3	2.0	1.9	6.1	8.9	19.9	Cumberland_3	7.4	16.8	63.3	55.3	226.1
Cumberland_4	1.9	1.8	4.9	2.9	4.2	Cumberland_4	7.3	14.6	35.3	50.1	75.3
Cumberland_5	1.3	1.6	3.7	3.0	3.8	Cumberland_5	8.0	13.1	37.1	63.9	71.7
Cumberland_6	1.6	2.0	3.3	3.7	4.6	Cumberland_6	8.4	15.2	63.2	45.2	93.3
Cumberland_7	2.3	2.7	3.0	4.4	4.6	Cumberland_7	8.2	16.4	43.2	68.4	113.7
Cumberland_8	2.3	2.0	3.8	6.2	14.0	Cumberland_8	7.5	16.2	41.3	80.9	118.1
Cumberland_9	3.6	3.4	5.8	8.6	16.4	Cumberland_9	10.5	25.8	43.8	74.9	78.6
Cumberland_10	2.7	2.2	7.4	7.2	38.2	Cumberland_10	9.8	27.6	156.0	55.2	154.4

Table 2: Run Times (in Seconds) of IP2 and BP on Instance-Set 1.

	IP1, IP2, and RCT2						BP				
	$q=1$	$q=2$	$q=3$	$q=4$	$q=5$		$q=1$	$q=2$	$q=3$	$q=4$	$q=5$
Cook_2	172.91	119.96	103.16	98.63	90.59	Cook_2	172.91	119.96	103.16	98.77	90.65
Cook_3	159.60	105.11	91.42	81.87	77.52	Cook_3	159.60	105.11	91.42	82.30	77.98
Cook_6	166.83	118.07	102.36	95.81	90.06	Cook_6	166.83	118.07	102.36	96.36	90.12
Cook_9	156.72	109.97	95.21	89.54	85.46	Cook_9	156.72	109.97	95.21	90.06	85.68
Cook_10	163.71	121.52	106.06	101.26	98.05	Cook_10	163.71	121.52	106.06	101.56	98.54
Winnebago_2	147.61	93.35	72.19	63.89	58.36	Winnebago_2	147.61	93.35	72.19	63.94	58.36
Winnebago_3	196.51	160.35	152.20	146.53	143.47	Winnebago_3	196.51	160.35	152.20	146.53	144.88
Winnebago_4	159.16	115.47	104.57	98.57	93.21	Winnebago_4	159.16	115.47	104.57	98.58	93.94
Winnebago_6	163.65	123.38	107.03	104.52	99.65	Winnebago_6	163.65	123.38	107.03	105.10	99.96
Winnebago_7	169.79	129.86	120.57	116.69	112.50	Winnebago_7	169.79	129.86	120.57	116.69	112.64
Winnebago_8	179.39	139.86	125.60	123.09	120.40	Winnebago_8	179.39	139.86	125.60	123.09	120.59
Winnebago_9	160.74	118.85	108.34	104.01	101.18	Winnebago_9	160.74	118.85	108.34	104.01	101.18
Winnebago_10	167.16	125.17	110.89	108.19	105.54	Winnebago_10	167.16	125.17	110.90	108.37	105.55
Champaign_1	156.76	104.36	84.37	77.58	71.26	Champaign_1	156.76	104.36	84.37	78.72	71.39
Champaign_3	155.01	102.45	85.42	76.59	71.58	Champaign_3	155.01	102.45	85.42	77.62	74.26
Champaign_4	156.40	99.79	80.11	71.38	67.36	Champaign_4	156.40	99.79	80.11	72.71	68.95
Champaign_5	155.98	102.17	86.14	75.80	72.49	Champaign_5	155.98	102.17	86.14	75.91	73.80
Champaign_7	191.55	160.59	148.39	145.09	142.61	Champaign_7	191.55	160.59	148.39	145.58	142.61
Champaign_9	190.37	158.55	152.39	149.90	148.79	Champaign_9	190.37	158.55	152.39	150.11	149.00
Champaign_10	161.18	105.27	88.78	80.00	74.98	Champaign_10	161.18	105.27	88.78	80.76	75.50
LaSalle_1	156.04	103.18	84.00	79.05	73.42	LaSalle_1	156.04	103.17	84.00	79.74	74.65
LaSalle_2	200.82	168.65	154.73	151.58	150.88	LaSalle_2	200.82	168.65	154.73	152.07	151.37
LaSalle_3	154.73	106.03	88.74	83.00	77.81	LaSalle_3	154.72	106.03	88.74	83.02	77.81
LaSalle_4	190.13	157.60	145.54	144.34	143.61	LaSalle_4	190.13	157.60	145.54	144.67	143.90
LaSalle_5	159.19	108.46	96.47	88.63	83.88	LaSalle_5	159.19	108.46	96.47	89.01	84.66
LaSalle_8	213.47	166.12	152.10	144.01	141.40	LaSalle_8	213.48	166.12	152.10	144.56	141.99
LaSalle_9	160.93	108.51	93.53	83.66	77.84	LaSalle_9	160.93	108.51	93.53	84.07	80.10
LaSalle_10	157.05	105.85	88.71	81.72	75.30	LaSalle_10	157.05	105.85	88.71	81.72	75.30
Adams_1	160.55	109.85	101.03	92.23	91.11	Adams_1	160.55	109.85	101.03	92.82	92.80
Adams_3	160.01	107.93	94.32	85.75	83.18	Adams_3	160.01	107.93	94.32	87.55	83.28
Adams_4	200.15	149.76	131.57	121.80	115.27	Adams_4	200.15	149.76	131.57	122.13	116.24
Adams_5	185.84	137.33	121.01	115.00	108.68	Adams_5	185.85	137.33	121.01	115.92	109.43
Adams_7	169.76	118.71	103.24	93.29	89.49	Adams_7	169.76	118.71	103.24	93.67	89.98
Adams_8	174.19	124.11	110.76	105.40	98.79	Adams_8	174.19	124.11	110.76	105.44	98.79
Adams_9	186.91	167.22	160.31	158.91	158.57	Adams_9	186.91	167.22	160.31	160.36	159.52
Adams_10	191.01	150.41	138.77	136.02	134.04	Adams_10	191.01	150.41	138.77	136.10	134.36
Fulton_1	189.95	148.13	134.17	128.02	126.81	Fulton_1	189.95	148.13	134.17	130.14	128.25
Fulton_2	176.19	124.31	111.39	105.27	100.28	Fulton_2	176.19	124.31	111.39	105.47	100.39
Fulton_3	176.58	129.94	110.87	106.86	103.46	Fulton_3	176.58	129.94	110.87	107.41	104.83
Fulton_4	167.44	116.20	96.96	89.73	87.70	Fulton_4	167.44	116.20	96.96	91.09	88.77
Fulton_5	216.02	195.22	189.36	188.58	186.56	Fulton_5	216.02	195.22	189.36	188.58	186.56
Fulton_6	209.98	165.73	152.23	146.64	140.59	Fulton_6	209.98	165.73	152.23	146.75	140.59
Fulton_7	169.55	117.19	103.91	95.35	90.74	Fulton_7	169.55	117.19	103.91	95.35	91.73
Fulton_8	207.68	175.01	167.61	166.11	163.00	Fulton_8	207.68	175.01	167.61	166.11	163.30
Fulton_9	174.71	125.45	111.64	102.17	101.10	Fulton_9	174.71	125.45	111.64	102.73	102.07
Fulton_10	175.15	128.48	114.54	109.72	104.25	Fulton_10	175.15	128.48	114.54	110.05	104.58
Jefferson_1	163.97	118.78	107.66	99.14	93.06	Jefferson_1	163.97	118.78	107.66	99.42	94.27
Jefferson_2	158.01	112.74	99.88	94.22	92.06	Jefferson_2	158.01	112.73	99.88	95.31	92.10

Jefferson_3	171.22	130.57	113.97	108.19	106.26	Jefferson_3	171.22	130.57	113.97	108.78	106.87
Jefferson_4	173.47	125.76	115.92	104.97	103.29	Jefferson_4	173.47	125.76	115.92	105.31	103.53
Jefferson_5	158.68	110.30	95.06	87.64	85.99	Jefferson_5	158.68	110.30	95.06	89.56	87.28
Jefferson_6	163.35	120.03	104.39	101.27	98.23	Jefferson_6	163.35	120.03	104.39	102.68	99.84
Jefferson_7	174.61	123.41	108.11	102.62	98.57	Jefferson_7	174.61	123.41	108.11	103.26	99.03
Jefferson_8	194.14	161.89	153.30	149.81	149.14	Jefferson_8	194.14	161.89	153.30	150.22	150.05
Johnson_1	170.31	120.44	104.79	98.23	94.52	Johnson_1	170.31	120.44	104.79	99.81	94.63
Johnson_3	211.49	163.80	144.62	137.76	134.62	Johnson_3	211.49	163.80	144.62	139.00	136.79
Johnson_4	179.69	130.44	114.47	109.54	103.27	Johnson_4	179.69	130.44	114.47	109.56	103.34
Johnson_5	181.24	135.78	126.83	118.12	117.24	Johnson_5	181.24	135.80	126.83	118.31	119.53
Johnson_6	177.68	139.56	127.00	118.41	115.44	Johnson_6	177.68	139.56	127.00	118.43	117.37
Johnson_9	195.53	148.75	136.20	128.65	126.51	Johnson_9	195.53	148.75	136.20	129.80	128.03
Johnson_10	186.96	137.10	121.15	116.81	115.14	Johnson_10	186.96	137.10	121.15	117.49	115.56
Cumberland_2	179.69	129.89	119.72	109.46	109.24	Cumberland_2	179.69	129.89	119.72	109.46	109.96
Cumberland_3	206.33	160.04	143.67	136.27	135.16	Cumberland_3	206.33	160.04	143.67	136.72	135.76
Cumberland_4	190.82	153.45	141.49	136.56	136.55	Cumberland_4	190.82	153.45	141.49	138.08	138.47
Cumberland_5	165.02	124.46	108.75	102.40	100.02	Cumberland_5	165.02	124.46	108.75	103.68	101.12
Cumberland_6	171.18	120.74	105.51	100.74	99.15	Cumberland_6	171.18	120.74	105.51	100.87	99.98
Cumberland_7	172.27	134.19	122.14	115.86	114.21	Cumberland_7	172.27	134.19	122.14	117.27	115.58
Cumberland_8	163.09	123.52	110.01	105.66	103.98	Cumberland_8	163.09	123.52	110.01	106.67	104.11
Cumberland_9	202.86	160.62	149.85	147.12	145.98	Cumberland_9	202.86	160.62	149.85	147.23	145.98
Cumberland_10	209.58	163.49	155.98	147.72	147.72	Cumberland_10	209.59	163.49	155.98	147.72	148.44

Table 3: Objective Values of IP1, IP2, RCT2, and BP on Instance-Set 1.

2. Results When Driving Could Be Slower Than Walking

This section presents the results on instance-set 2, which contains 100 instances. Instead of four settings, we conduct experiments with two settings, IP1 and BP, because RCT2 and IP2 are not valid for instances in this set due to the fact that driving could be slower than walking.

	$q=1$		$q=2$		$q=3$		$q=4$		$q=5$	
	IP1	BP	IP1	BP	IP1	BP	IP1	BP	IP1	BP
Cook_1	3.8	19.9	13.3	36.1	505.8	225.8	9856.7	278.5	NA	329.6
Cook_4	1.0	23.0	10.5	42.9	164.0	94.4	6970.8	163.9	NA	311.8
Cook_5	1.5	20.0	12.0	66.6	76.2	201.0	1646.6	321.9	NA	642.9
Cook_7	4.3	22.5	13.5	71.3	77.6	121.8	2224.3	152.9	NA	257.6
Cook_8	2.8	21.2	16.0	50.4	425.7	189.1	10053.8	195.4	NA	412.6
Winnebago_1	3.4	20.1	10.3	49.3	196.2	84.7	8785.8	124.7	NA	315.1
Winnebago_5	1.6	18.7	5.8	52.4	44.6	54.7	1544.0	78.0	NA	170.4
Champaign_2	128.9	157.6	107.1	125.0	1779.8	473.0	NA	3661.9	NA	12687.5
Champaign_6	31.0	62.9	196.0	65.7	3198.7	170.8	20098.4	638.3	NA	1054.5
Champaign_8	3.8	21.2	5.4	55.5	70.7	79.9	3863.6	170.2	NA	196.1
LaSalle_6	38.5	54.6	232.4	221.7	1192.5	515.0	NA	274.8	NA	1703.9
LaSalle_7	3.1	22.8	14.9	39.1	497.7	110.1	10284.8	208.5	NA	223.6
Adams_2	3.9	33.1	17.9	93.5	214.2	187.0	9465.1	239.8	NA	698.2
Adams_6	1.7	30.3	3.8	46.4	73.7	103.6	3327.1	142.6	NA	689.2
Jefferson_9	15.9	33.3	258.6	102.5	1107.9	169.0	NA	364.3	NA	590.9
Jefferson_10	4.7	20.8	23.4	48.9	370.4	55.2	NA	259.4	NA	1151.5
Johnson_2	43.5	164.4	104.9	239.4	794.3	495.3	9309.8	489.1	NA	1044.5
Johnson_7	10.9	74.6	21.4	180.1	168.8	234.3	4245.2	376.3	NA	454.0
Johnson_8	7.0	168.8	33.1	341.9	272.5	535.7	1652.8	1261.0	NA	1965.2
Cumberland_1	3.9	28.1	21.1	93.9	222.8	144.4	8460.8	155.5	NA	321.0

Table 4 Run Times (in Seconds) of IP1 and BP on Instance-Set 2.

	$q=1$		$q=2$		$q=3$		$q=4$		$q=5$	
	IP1	BP	IP1	BP	IP1	BP	IP1	BP	IP1	BP
Cook_1	173.71	173.71	130.88	130.88	116.30	116.30	109.30	109.30	NA	104.70
Cook_4	159.16	159.16	112.00	112.00	97.71	97.71	89.66	89.66	NA	85.54
Cook_5	168.57	168.57	122.57	122.57	108.74	108.74	104.19	104.67	NA	100.05
Cook_7	165.18	165.18	115.38	115.38	102.17	102.17	93.03	93.03	NA	90.59
Cook_8	166.86	166.86	117.72	117.78	100.22	100.22	91.48	91.48	NA	87.69
Winnebago_1	165.17	165.17	114.20	114.20	97.44	97.80	90.55	90.55	NA	87.56
Winnebago_5	171.93	171.93	136.07	136.07	123.90	123.90	118.45	118.52	NA	117.54
Champaign_2	151.00	151.00	88.78	88.78	73.28	73.28	NA	64.28	NA	59.29
Champaign_6	215.42	215.97	170.92	171.49	151.49	154.14	142.03	146.03	NA	140.84
Champaign_8	200.03	200.03	166.07	166.07	158.84	158.84	156.20	156.20	NA	154.24
LaSalle_6	177.11*	177.57	130.59*	130.83	116.08	116.96	NA	108.20	NA	104.59
LaSalle_7	180.06	180.06	130.59	130.59	117.80	117.80	109.98	110.02	NA	107.09
Adams_2	204.36	204.94	158.70	158.70	141.71	141.71	136.95	137.11	NA	131.10
Adams_6	179.48	179.48	138.67	138.67	129.76	129.76	123.89	123.89	NA	121.42
Jefferson_9	184.13	184.24	135.61*	135.67	116.50	116.56	NA	111.35	NA	102.17
Jefferson_10	186.30	186.82	137.61	140.78	120.73	122.40	NA	116.58	NA	113.30
Johnson_2	196.77*	197.82	147.51*	147.51	130.28	130.28	123.59	123.59	NA	121.05
Johnson_7	191.22	191.22	143.01	143.01	127.59	127.59	120.91	120.91	NA	115.71
Johnson_8	285.90	285.90	240.60	240.60	229.76	229.76	224.89	225.23	NA	224.21
Cumberland_1	194.84	194.84	155.76	155.76	145.92	146.55	137.07	137.07	NA	136.07

Table 5 Objective Values of the Solutions of IP1 and BP on Instance-Set 2.

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Reed, S., Campbell, A. M., and Thomas, B. W. (2022). Impact of autonomous vehicle assisted last-mile delivery in urban to rural settings. *Transportation Science*, 56(6):1530–1548.

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