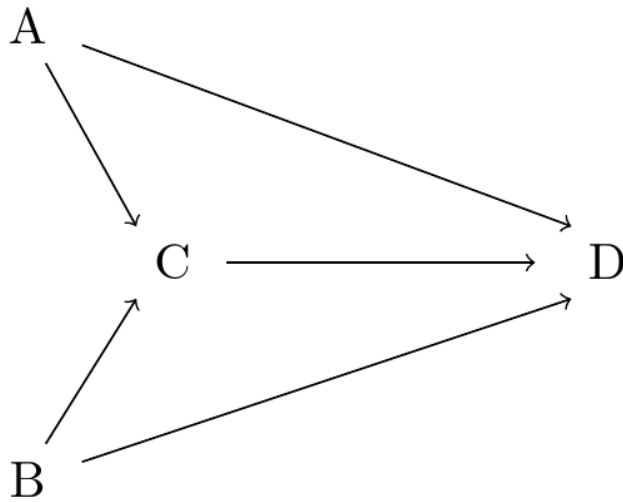


# Homework 5: Network Assignment and Validation

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Given a network of



and link travel time equations of

$$\begin{aligned}t_{AD} &= 20 + 0.01q_{AD} \\t_{AC} &= 10 + 0.005q_{AC} \\t_{CD} &= 12 + 0.005q_{CD} \\t_{BC} &= 7.25 + 0.005q_{BC} \\t_{BD} &= 20 + 0.01q_{BD},\end{aligned}$$

with 7000 trips from A to D and 500 from B to D:

## 5.1

We set up a matrix to solve the system of equations:

$$\begin{pmatrix} q_{AD} & q_{AC} & q_{CD} & q_{BC} & q_{BD} & t_{AD} & t_{AC} & t_{CD} & t_{BC} & t_{BD} & = \\ 0.01 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & -20 \\ 0 & 0.005 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & -10 \\ 0 & 0 & 0.005 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & -12 \\ 0 & 0 & 0 & 0.005 & 0 & 0 & 0 & 0 & -1 & 0 & -7.25 \\ 0 & 0 & 0 & 0 & 0.01 & 0 & 0 & 0 & 0 & -1 & -20 \\ 0 & 0 & 0 & 0 & 0 & -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & -1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 7000 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 5000 \\ 0 & 1 & -1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

The first about half of these rows come from the trip time equations. The remaining rows come from the following equations:

$$\begin{aligned} t_{AD} &= t_{AC} + t_{CD} \\ t_{BD} &= t_{BC} + t_{CD} \\ q_{AD} + q_{AC} &= 7000 \\ q_{BD} + q_{BC} &= 5000 \\ q_{CD} &= q_{AC} + q_{BC}. \end{aligned}$$

Solving this matrix gives us:

1	0	0	0	0	0	0	0	0	0	0	4050.00
0	1	0	0	0	0	0	0	0	0	0	2950.00
0	0	1	0	0	0	0	0	0	0	0	4750.00
0	0	0	1	0	0	0	0	0	0	0	1800.00
0	0	0	0	1	0	0	0	0	0	0	3200.00
0	0	0	0	0	1	0	0	0	0	0	60.50
0	0	0	0	0	0	1	0	0	0	0	24.75
0	0	0	0	0	0	0	1	0	0	0	35.75
0	0	0	0	0	0	0	0	1	0	0	16.25
0	0	0	0	0	0	0	0	0	1	0	52.00

or:

$q_{AD}$	$q_{AC}$	$q_{CD}$	$q_{BC}$	$q_{BD}$	$t_{AD}$	$t_{AC}$	$t_{CD}$	$t_{BC}$	$t_{BD}$
4050	2950	4750	1800	3200	60.5	24.75	35.75	16.25	52

## 5.2

All-or-nothing (AON) Averages

Iteration	qAD	qAC	qCD	qBC	qBD	tAD	tAC	tCD	tBC	tBD	TAD	TACD	TBD	TBCD
1	7000	0	5000	5000	0	90	10.0	37	32.25	20	90	47.0	20	69.25
2	0	7000	7000	0	5000	20	45.0	47	7.25	70	20	92.0	70	54.25
3	7000	0	5000	5000	0	90	10.0	37	32.25	20	90	47.0	20	69.25
4	0	7000	7000	0	5000	20	45.0	47	7.25	70	20	92.0	70	54.25
Average	3500	3500	6000	2500	2500	55	27.5	42	19.75	45	55	69.5	45	61.75

## 5.3

Incremental Assignment

Increment	qAD	qAC	qCD	qBC	qBD	tAD	tAC	tCD	tBC	tBD	TAD	TACD	TBD	TBCD
0.4	2800	0	2000	2000	0	48	10.0	22.0	17.25	20	48	32	20	39.25
0.3	2800	2100	4100	2000	1500	48	20.5	32.5	17.25	35	48	53	35	49.75
0.2	4200	2100	4100	2000	2500	62	20.5	32.5	17.25	45	62	53	45	49.75
0.1	4200	2800	4800	2000	3000	62	24.0	36.0	17.25	50	62	60	50	53.25
Final	4200	2800	4800	2000	3000	62	24.0	36.0	17.25	50	62	60	50	53.25

## 5.4

FHWA Successive Averages

$n$	$q_{AD}$	$q_{AC}$	$q_{CD}$	$q_{BC}$	$q_{BD}$	$t_{AD}$	$t_{AC}$	$t_{CD}$	$t_{BC}$	$t_{BD}$	$T_{AD}$	$T_{ACD}$	$T_{BD}$	$T_{BCD}$
0	0	0	0	0	0	20	10	12	7	20	20	22	20	19
1	7000	0	5000	5000	0	90	10	37	32	20	90	47	20	69
2	3500	3500	6000	2500	2500	55	28	42	20	45	55	70	45	62
3	4667	2333	4000	1667	3333	67	22	32	16	53	67	54	53	48
4	3500	3500	6000	2500	2500	55	28	42	20	45	55	70	45	62
5	4200	2800	4800	2000	3000	62	24	36	17	50	62	60	50	53
Final	4200	2800	4800	2000	3000	62	24	36	17	50	62	60	50	53