"It'll be alright by Friday"

Traffic Response to Capacity Reduction

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Introduction

- This paper considers what happens to traffic when the capacity of a road has been reduced by examining a real-life study.
- The data is analysed to look at how the flow of traffic changes when the capacity of the road is reduced.
- The title refers to an engineering rule of thumb:

"It'll be alright by Friday"

If a change to a road system looks like the consequences are bad when the change is introduced on Monday morning then leave it in place on the assumption that it'll be alright by Friday.

- A statistical model is fitted to the data and shows evidence of the "It'll be alright by Friday" effect.

Outline

Previous Research

- Cairns et al (1998) reported on road-capacity reduction. One conclusion was that often a transient response was reported.
- Batley and Clegg (2001) summarised evidence and models on driver responses to capacity reduction.
- This paper can be considered as a sequel to Clegg (2005) which studied day-to-day variability by analysing the same data.
- The previous paper looked at recurrence from day-to-day and found evidence for a day of the week effect.
- The data in this paper is also analysed in Clegg (2004).

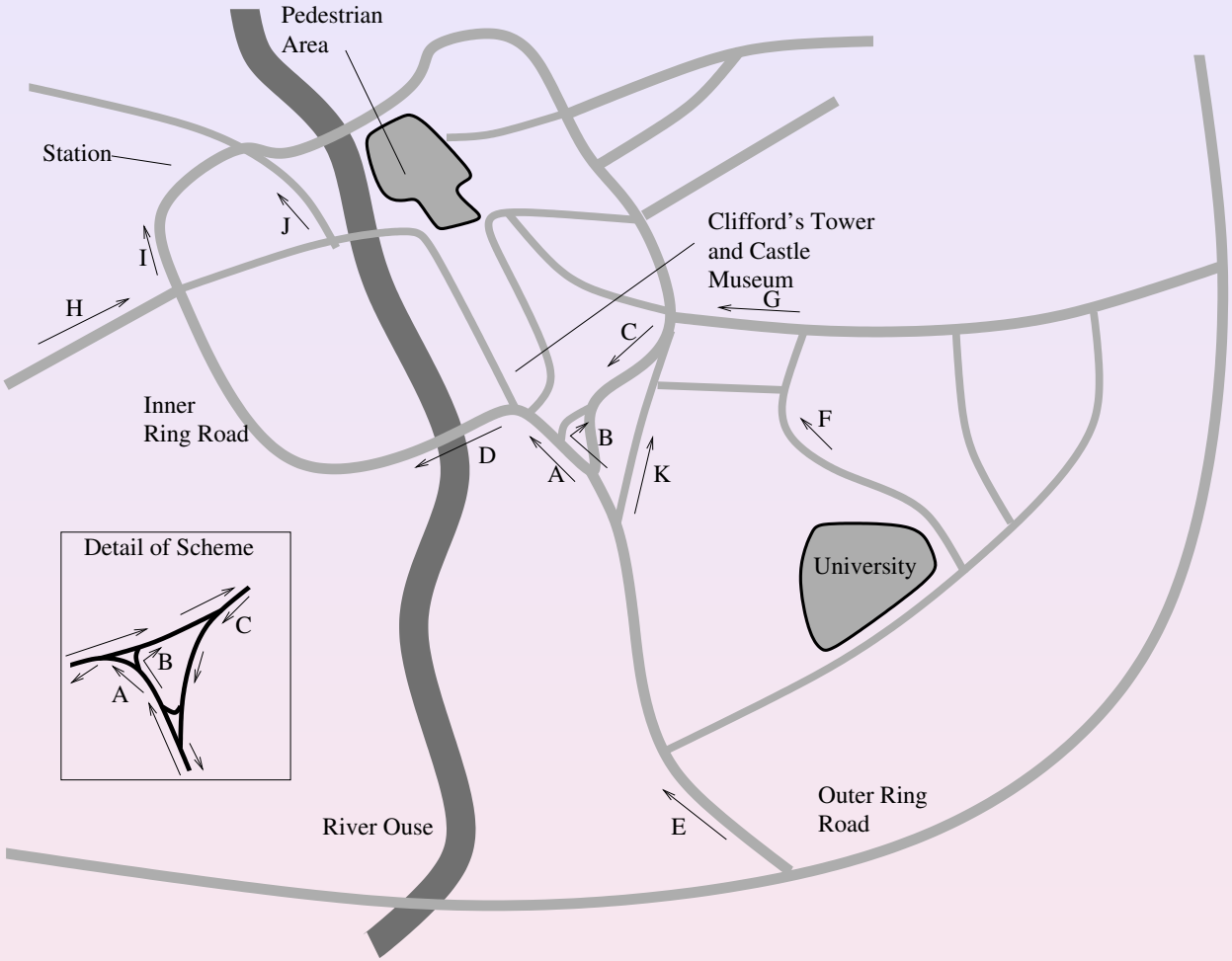
Fishergate Survey Overview

- Manual partial number plate survey — 11 sites, 14 days.
- Based around a lane closure in one direction at Fishergate (inner ring road).
- Survey several before days to establish ambient variability. Survey several during days to attempt to capture the dynamics of the situation.
- Plate matching allows partial routes to be inferred. Sites chosen to try to find three point matches for vehicles.
- Sites chosen for surveying which are directly affected and which are potential reroutings.

Practical Details

- Morning rush hour chosen for survey as this has most traffic in York.
- Surveys are taken between 7:45 and 9:15 to catch the peak hour and fifteen minutes either side.
- At sites A, I and J survey is between 8:00 and 9:30 to increase matches found.
- Some data is missing where surveyors were absent or arrived late.
- Partial plate survey (old style UK plates) of year letter and three digits.
- Obviously such data is prone to errors and false matches, a considerable challenge to investigate.

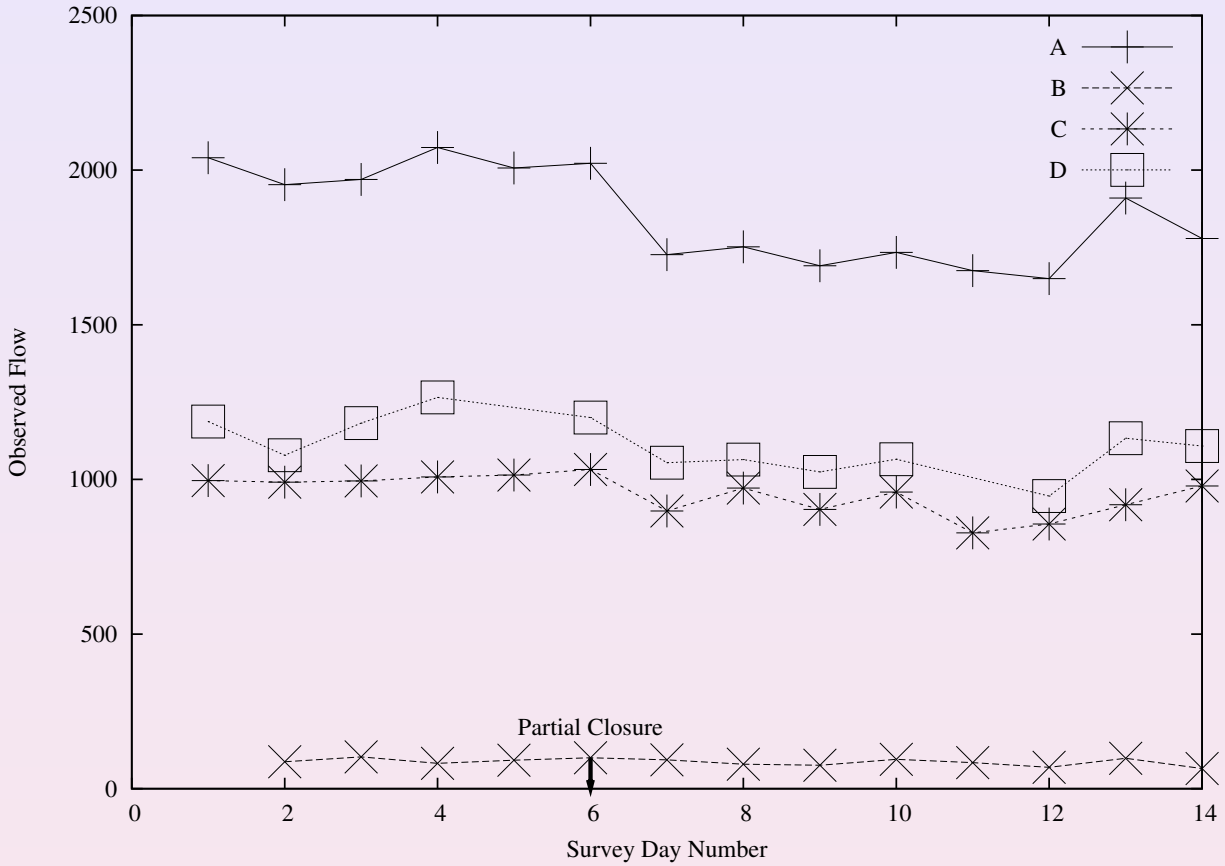
Fishergate Map



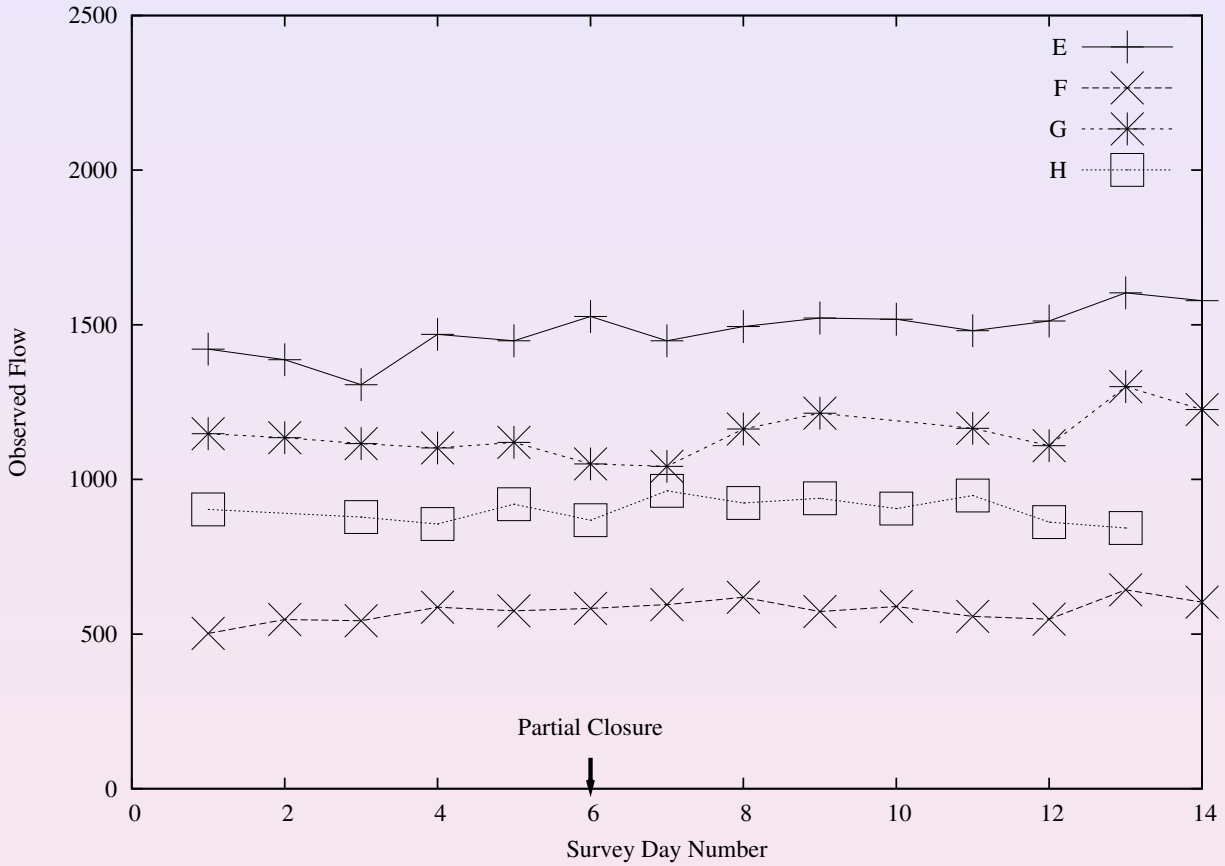
Fishergate Description

Day	Survey	Comment
25th June 2001	Before survey	
26th June 2001	Before survey	
27th June 2001	Before survey	
28th June 2001	Before survey	
29th June 2001	Before survey	
2nd July 2001	Before survey	Partial closure occurred at 9:15 and should not affect the data collected.
3rd July 2001	During survey	First day of partial closure.
4th July 2001	During survey	
5th July 2001	During survey	
6th July 2001	During survey	
11th July 2001	During survey	
12th July 2001	During survey	
13th July 2001	After survey	Road works removed to ease traffic for a race meeting in York. This can be considered to be an after survey day.
16th July 2001	During Survey	Road works put back in place.

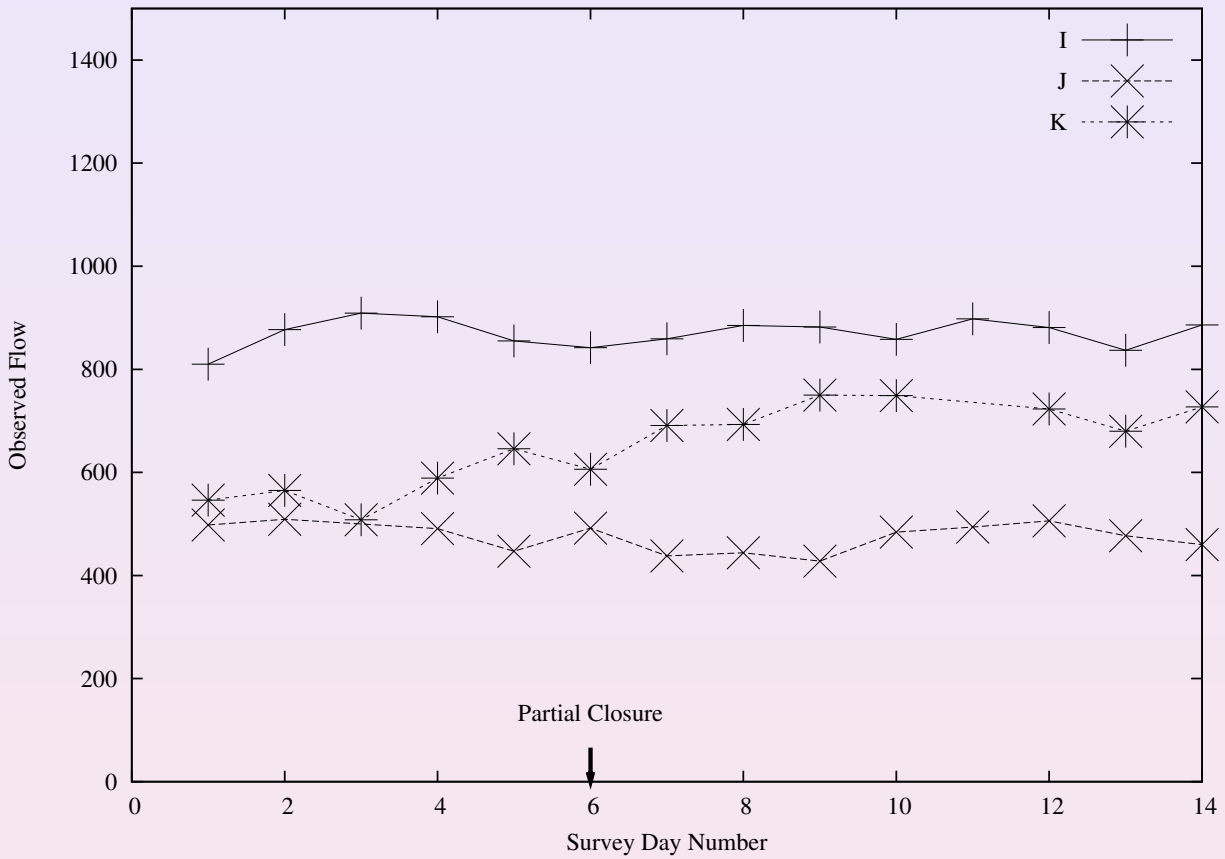
Fishergate Flow Data, sites A, B, C and D



Fishergate Flow Data, sites E, F, G and H



Fishergate Flow Data, sites I, J and K



Modelling Change of Flow

- An obvious question is: Does the flow increase or decrease as a result of the closure?
- Some flows are much larger at some sites. Normalise so each site has a mean flow 1.
- Define $F(i,s) = \frac{n(s)f(i,s)}{\sum_i f(i,s)}$ where $f(i,s)$ is raw flow at site s day i, $n(s)$ is no. days obs at site s and $F(i,s)$ is the normalised flow.
- F_o is the mean normalised flow with no closure F_c with closure.
- $F_c = 1.0060$ and $F_o = 0.9976$ but t-test gives a p-value of 0.63.

A GLM Rerouting Model

- Split sites into sites with less flow expected (A, C, D) and rerouting (F, G, K). Site B omitted due to very low flow.
- Fit a General Linear Model (GLM) to the data to test this. (It would be cheating to try lots of tests like this.)

Rerouting Model

$$\mathrm{E}[F] = \beta_0 + \beta_1 I_c + \beta_2 I_r,$$

where F is the proportional flow, I_c is one if A, C or D and the closure is in place, I_r is one if F, G or K and the closure is in place.

Parameter	β_0	β_1	β_2
Estimate	1.004	-0.063	0.037
Significance	0.1%	0.1%	5%
Statistic	R^2	R^2_a	p-value
Estimate	0.123	0.111	8.3×10^{-5}

A General Linear Model for the Effect

- Want to look at the effect of the closure on travel times and flows.
- To look at travel times we need to consider pairs of sites.
- Want to consider a transient effect and fit a GLM.

GLM for "It'll be Alright by Friday" effect

$$\mathrm{E}[F] = \beta_0 + \beta_1 I_c + \beta_2 D,$$

where F is the normalised flow (or time), I_c is one if the closure is in place and D is zero or the number of days since closure (not weekends).

Data Pre-processing

Because of the difficult nature of the data, a large amount of pre-processing is necessary.

1. Remove obviously erroneous or problematic data (missing days and site B with low flow).
2. Pick pairs of sites of most interest, those with greatest flow between them and which are on obvious routes of interest.
3. Correct for the problem of false matches — Watling (1994).
4. Trim the times considered to avoid the "early end" problem (is a reduction in flow really a reduction in flow or an increase in travel time).
5. Normalise flows and times so each site is mean zero unit variance.

GLM model travel times

Pair	β_0 (sig)	β_1 (sig)	β_2 (sig)	R^2	R_a^2	p-value
A – D	-0.58 (5%)	-0.32 (low)	0.24 (0.1%)	0.74	0.68	0.002
A – J	0.65 (low)	-0.54 (low)	-0.10 (low)	0.35	0.22	0.12
C – A	-0.67 (1%)	1.9 (0.1%)	-0.093 (10%)	0.76	0.71	0.00040
D – I	0.21 (low)	-1.11 (10%)	0.11 (low)	0.31	0.15	0.19
E – A	-0.37 (low)	1.65 (1%)	-0.14 (5%)	0.55	0.47	0.012
E – F	0.51 (low)	-0.92 (low)	-0.02 (low)	0.26	0.12	0.19
E – K	0.59 (low)	-0.49 (low)	-0.13 (low)	0.41	0.30	0.069
F – A	-0.44 (low)	1.41 (5%)	-0.08 (low)	0.40	0.30	0.058
F – G	0.56 (low)	-1.11 (10%)	-0.016 (low)	0.38	0.25	0.09
G – C	-0.78 (5%)	1.06 (5%)	-0.094 (low)	0.65	0.58	0.0054
H – I	-0.53 (low)	-0.25 (low)	0.20 (5%)	0.49	0.39	0.034

GLM model flows

Pair	β_0 (sig)	β_1 (sig)	β_2 (sig)	R^2	R_a^2	p-value
A – D	0.73 (5%)	-1.50 (1%)	0.0062 (low)	0.60	0.51	0.017
A – J	0.74 (5%)	-1.49 (1%)	0.017 (low)	0.55	0.47	0.018
C – A	0.68 (10%)	-0.51 (low)	0.067 (10%)	0.47	0.38	0.030
D – I	0.21 (low)	-1.45 (5%)	0.17 (5%)	0.57	0.47	0.023
E – A	-0.041 (low)	-0.047 (low)	0.020 (low)	0.0046	-0.18	0.97
E – F	-0.30 (low)	-0.43 (low)	0.17 (10%)	0.30	0.17	0.14
E – K	-0.65 (5%)	1.48 (1%)	-0.012(low)	0.56	0.48	0.016
F – A	0.33 (low)	0.03 (low)	-0.11(low)	0.17	0.017	0.36
F – G	-0.20 (low)	0.35 (low)	0.013 (low)	0.045	-0.15	0.79
G – C	0.27 (low)	-1.35 (5%)	0.11 (low)	0.37	0.24	0.10
H – I	-0.16 (low)	1.44 (1%)	-0.19 (5%)	0.60	0.51	0.02

Discussion of the Results

- Caution: Many models fitted — some will be significant by chance alone.
- Consider only models on pairs with two significant parameters.
- All such models have the return to normal effect in the right direction.
- An effect on flow does not necessarily imply and effect on travel time.
- $E - -K$ and $H - -I$ which show increased flow are rerouting sites.
- Pairs starting at A show reduced flow as would be expected — but returning to normal.

Conclusions and Further Work

- Data analysis showed a number of effects resulting from capacity reduction — none unexpected but experimental confirmation is good.
- Results here can tentatively confirm the "It'll be alright by Friday" effect as genuine.
- Both flows and times showed an initial transient effect followed by return to normal (obviously model only valid in short time scale).
- Data required considerable preprocessing and is only a single study. More and better data needed.

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