

Modelling cycling rates to 2050

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What could happen if we get serious about cycling

Current expectations:



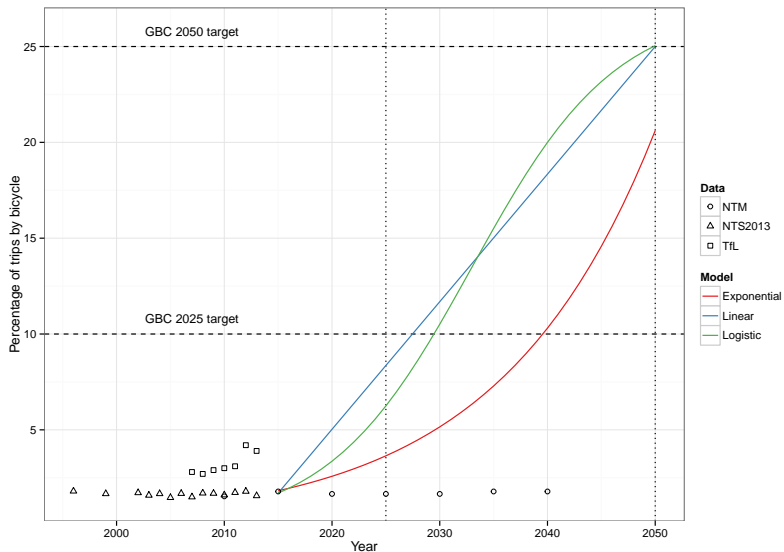
The kind of thing that's needed:



Policy context

- ▶ GBC report published spring 2013 with ambitious plan for cycling
- ▶ Since then there has been little commitment to cycling from main political parties of DfT
- ▶ Parliamentary Question tabled by CTC revealed complete lack of ambition for cycling the the National Transport Model
- ▶ DfT is currently updating its handling of cycling, but it will likely fall short of the vision needed to transform cycling in UK
- ▶ This research provides detail in space, time and demographics of how the shift to cycling could look in the coming years

Context: in graphics



The approach

- ▶ Occam's razor approach used: start simple, add complexity (distance, mode, spatial and temporal variables)
- ▶ Avoids distinction between 'cyclists' and 'non-cyclists'
- ▶ Scenarios are 'top down' overall but assignment 'bottom up'
- ▶ Focus on stages
- ▶ Outputs: increase in km cycled per person by place and time; concomitant decrease in driving

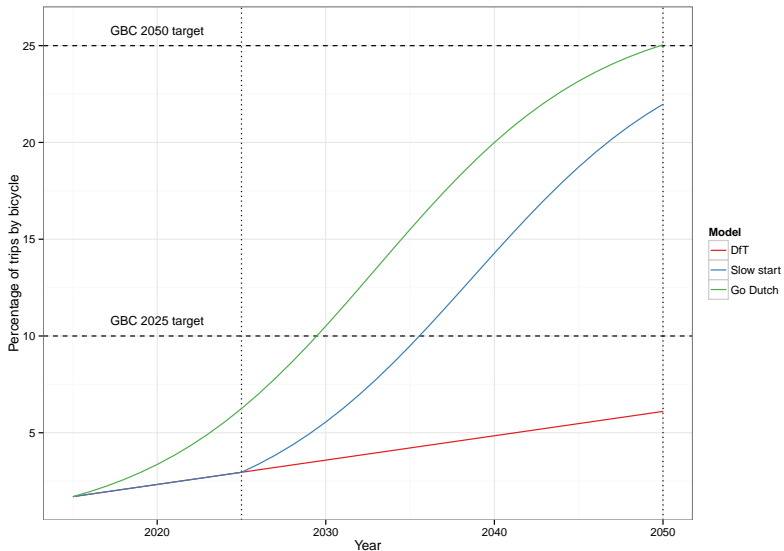
Modelling stages

1. Scenario development - overall % stages by bicycle nationwide
2. Allocation of stages to individuals depending on distance, mode and socio-demographic variables
3. Disaggregate by Local Authority
4. Output results into format useable by health and transport economists to estimate monetary savings

4 scenarios of change

- ▶ DfT: doubling in *number* (+74%) of stages made by bicycle to 2026
- ▶ Slow start: DfT until 2026 and acceleration to meet GBC by 2050
- ▶ 'Go Dutch': cycling uptake in a car-dominated world
- ▶ 'Ecotechnic': demand restraint and active travel

4 scenarios of change, visualised



NTS: foundation of future scenarios

- ▶ Travel in the UK's National Travel Survey (NTS) is measured in stages and trips.
- ▶ Data in the NTS is contains information on households, vehicles, individuals, trips and stages.
- ▶ The NTS is the basis of the future scenarios produced by the Department for Transport (DfT) and in this study.
- ▶ We therefore begin with current data from the NTS and move forward
- ▶ Sample of individuals taken from NTS forms basis of weekly activity patterns, to be translated into health impacts

National trip rates and modelling change

- ▶ Stages are the atomic elements of the NTS (7.8 vs 9.1 miles)
- ▶ A logical basis against which to model modal shift.
- ▶ DfT projects **doubling** in the number of stages by bicycle by 2025.
- ▶ Assume (for now) that stage distances and total number remain constant

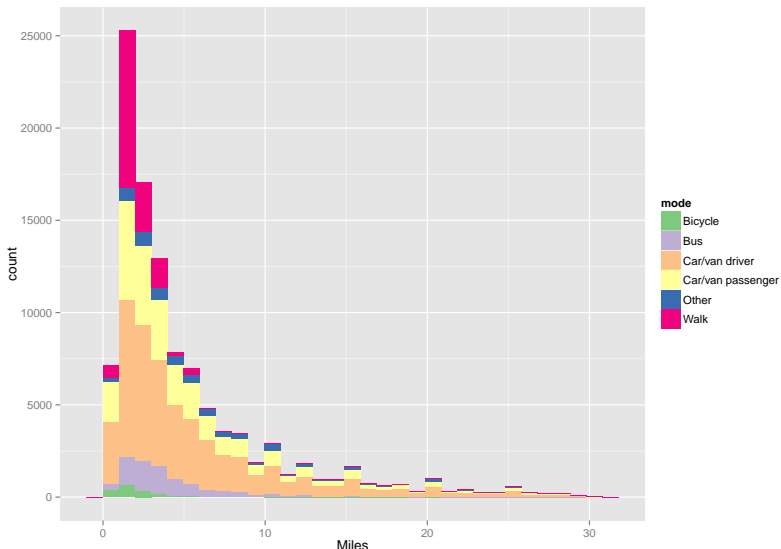
Proportion of trips made by bicycle

- ▶ Currently cycling accounts for just under 2% of all stages, commuting taking up disproportionate share of cycle trips:

	Shopping	Commuting	Visiting.friends	Other	
All_modes	18.6	17.4	16.2	47.8	
Bicycle	12.0	32.9	13.6	41.5	
Bus	26.4	20.6	13.9	39.0	
Car/van driver	19.7	22.0	13.4	44.9	
Car/van passenger	17.8	6.8	23.5	51.9	
Walk	16.8	11.9	13.4	57.9	

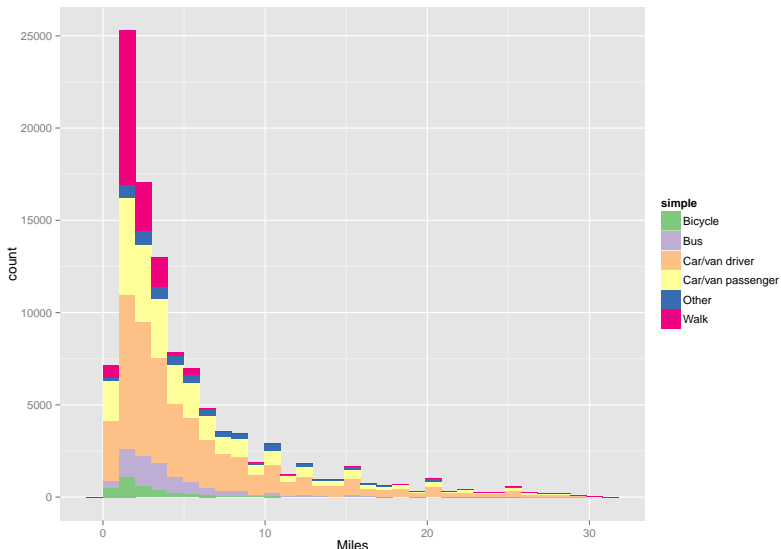
Distance distribution of stages

- ▶ Network distance and mode are the most important parameters for determining probability of shifting mode



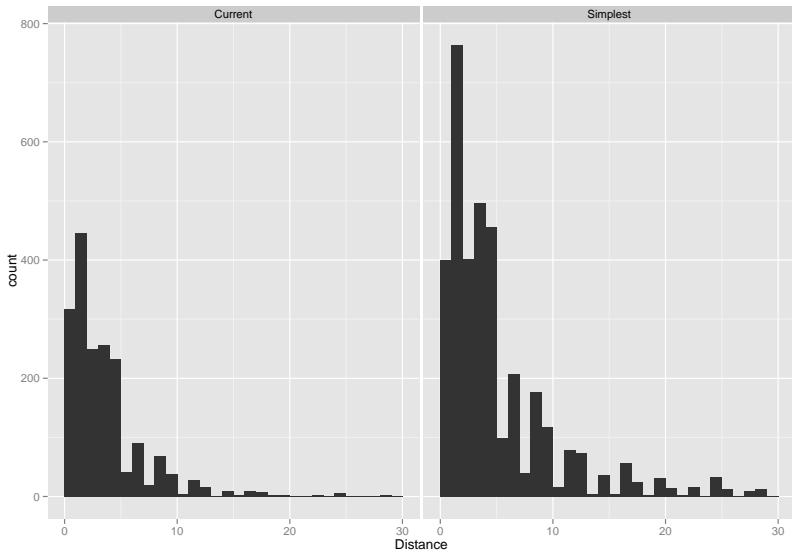
The simplest case

- ▶ In the simplest case, cycling trips double by swapping 1.7% of stages to cycling in every band:



A close up of cycling

- ▶ Distribution of **cycling** stages has grown, shifted to the right:



Incorporating distance

- ▶ Simplest example is unrealistically assumes equal proportion of trips shift for every distance band
- ▶ In practice it's more like an exponential decay (Iacono et al., 2011)
- ▶ Distance can be accounted for by setting probability of a shift as a function of distance

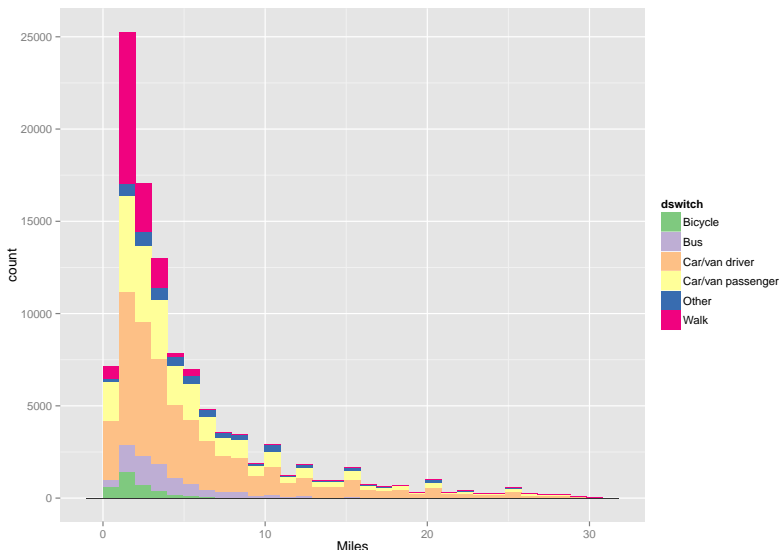
$$p = \alpha e^{-\beta d}$$

Incorporating distance II

- ▶ Values from Iacono et al. (2011) were used: $\alpha = 0.4$, $\beta = 0.2$ for bicycle trips
- ▶ These parameters can and should be updated with better evidence
- ▶ Distance decay, β is dependent on trip purpose, kept constant for now

Incorporating distance III

- ▶ The results look the same as for the simplest scenario yet they are subtly different

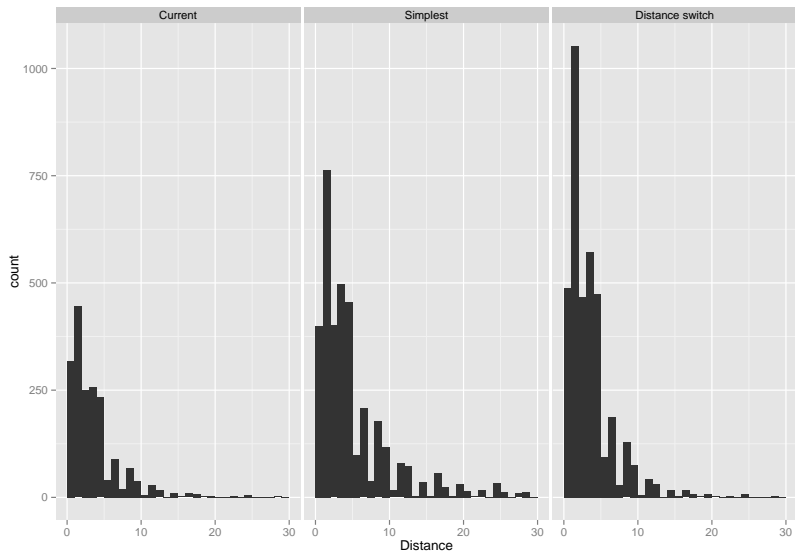


Comparing 'distance switch' with simplest scenario

- ▶ The purpose of the distance-dependent probability of switch was to provide more realistic switching
- ▶ Proportion of trips > 10 miles by bike:
- ▶ Overcomes issue of unrealistic % of long trips by bike in simplest scenario

Current	Simplest case	Distance-decay
1.8	7.2	1.2

Comparing the scenarios II



Including mode of travel

With the per-trip probabilistic modelling framework set-up, driven by prior knowledge of the number/proportion of stages to be made by bicycle, it is easy to refine.

- ▶ Evidence suggests bicycle uptake disproportionately replaces walking and bus travel than car journeys
- ▶ To include this subtlety, we simply assign a relative weight to each mode of travel, indicating how much more likely it is to be replaced by bicycle trips than the others
- ▶ If a car we set at 0.5 and bus at 1, for example, half the number of car journeys, on average, would be replaced by bicycle trips than would bus stages
- ▶ The absolute probabilities do not matter, as these are determined by the sample size in R's `sample` function (as long as $p < 1$)

Altering mode-specific probabilities

Bus	Car.d	Car.p	Other	Walk
1	0.5	0.6	0.5	1

- ▶ Possible issue of double counting
- ▶ Comparison of modes that were replaced by new bicycle trips
- ▶ Outcome is policy dependent: e.g. congestion charges
- ▶ E.g. cuts to bus services -> more bus journeys replaced

The impact of mode-specific probabilities:

% trips replaced by bicycle in different scenarios:

	Bicycle	Bus	Car/van driver	Car/van passenger
Distance	0	6.8	42.9	25.8
Distance + Modes	0	11.2	32.8	21.9

- ▶ No strong evidence on likely distribution
- ▶ Just distance scenarios used at present for 'policy neutrality'

Including trip purpose

	Shopping	Commuting	Visiting.friends	Other
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- ▶ Current preferences may not reflect future change
- ▶ Low % could represent aversion to cycling for shopping. Or growth potential...
- ▶ Probabilities of switch by purpose is highly policy dependent

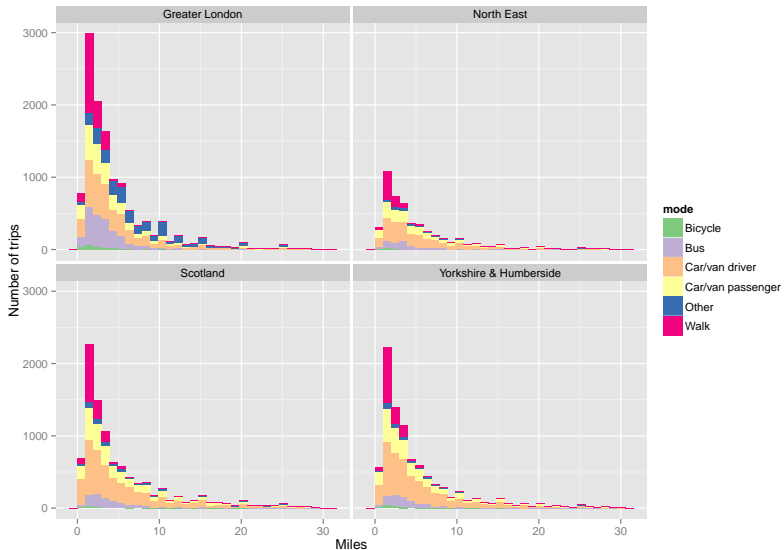
Including socio-demographics

- ▶ Not is inclined to cycle, especially in car-dominated settlements with poor cycle infrastructure
- ▶ Variability is a function of age: the young have been responsible for most growth in cycling in London and some elderly cannot cycle
- ▶ Large implications for health savings
- ▶ Strategy: modify probability of switching each stage to bicycle based on the age of the traveller

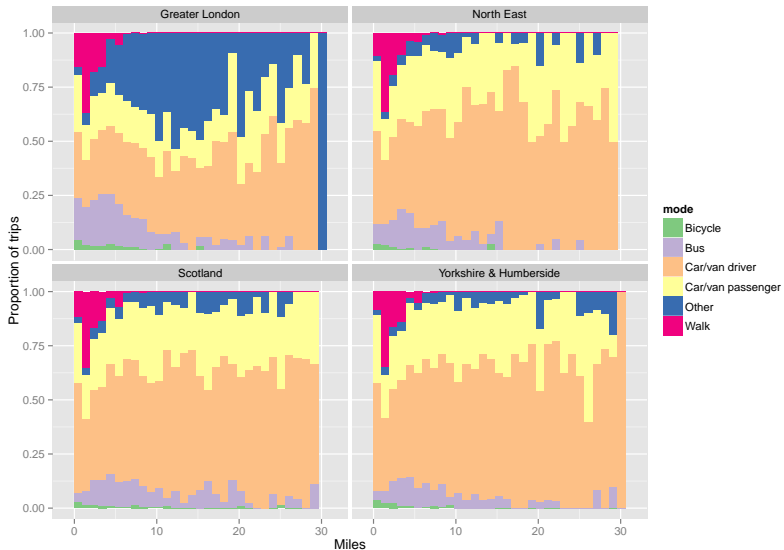
Including space

- ▶ To take account of space, we subset individuals by region (variable j58g)
- ▶ The characteristics of *current* trips in each region will then filter-down into probability of modal shift
- ▶ This will provide insight into how high growth rates will have to be in London for nationwide targets to be met

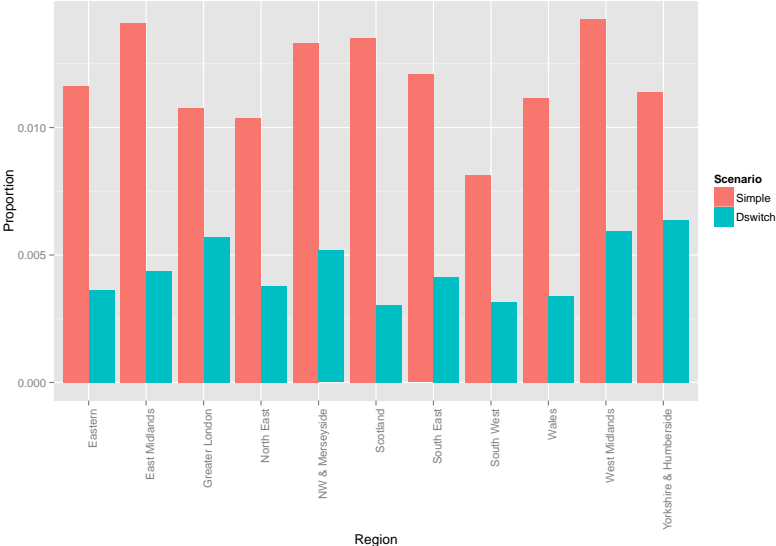
Trips distributions by region I



Trips distributions by region II



Energy savings by 2050



Discussion and conclusion

- ▶ Region -> LA -> individual -> trip -> stage level analysis
- ▶ Short-term GBC parliamentary debate, monetary valuation is needed
- ▶ Increased physical activity due to cycling will be an output
- ▶ Emissions savings: relatively straightforward
- ▶ Estimating congestion savings still a challenge
- ▶ Mid-term aim: use scenarios to update 2011 work: Energy implications of modal shift to cycling to 2050 in the UK