"Simplicate and add Lightness"

NZMUGS Sept 2013

"Simplicate and Add Lightness"

- This quote appears to have originated in the aerospace industry
- Realisation that by removing complexity, things can be made to work better
  - Less complexity = Less weight and less things to go wrong
  - Less weight = Better performance
- Probably best associated with Colin Chapman of Lotus...
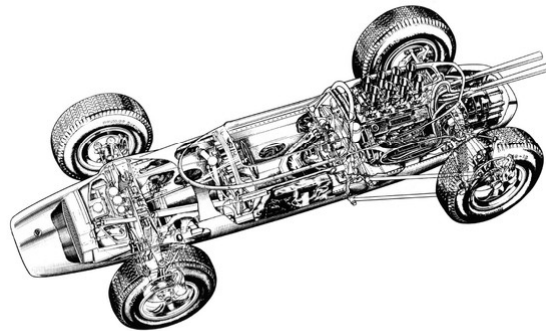
Epitomised by the Lotus 25 (1962)

Adding Lightness (Lotus)
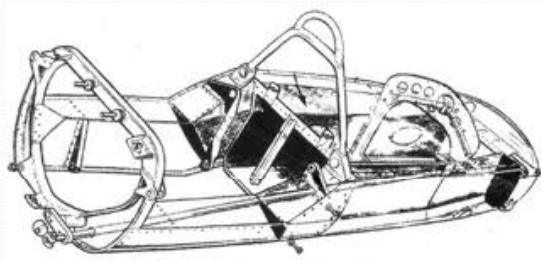
- The body was also the main structure

Adding Lightness (Lotus)

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- Half the weight and 3x rigidity of predecessor

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Adding Lightness (Lotus)

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- Rear suspension connected to engine block
- Todays F1 cars still use these basic principles

Pushing the Limits

- Chapman took "Add Lightness" to the extreme
- Achieved fantastic success (dominating GP)
- But also a fine line...

Relevance to Transport Modelling?

- Transport Demand Models have potential for simplification (within NZ context)

Relevance to Transport Modelling?

- Traffic Demand Models are generally:
  - Complicated (often with multiple sub-models)
  - Data intensive (to establish trip making relationships)
  - Computationally intensive
  - Expensive to set up and maintain
  - Limited to Main Centres in NZ
  - Probably not as good as some might expect

What is Desired

What can be Achieved

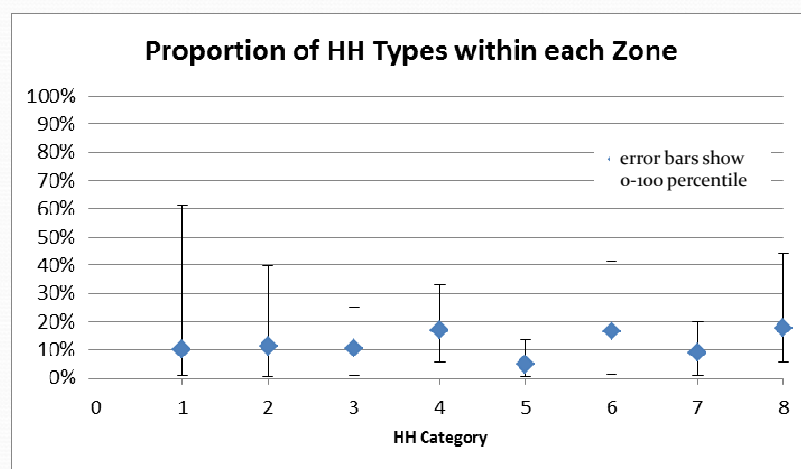*An Abstract Simplification of Reality*

How to Simplify?

- Look at each step in turn
  - Trip Generation
  - Trip Distribution
  - Mode Choice
- Identify key issues
- Propose alternative simplistic approach
- Using a real world example (Christchurch)
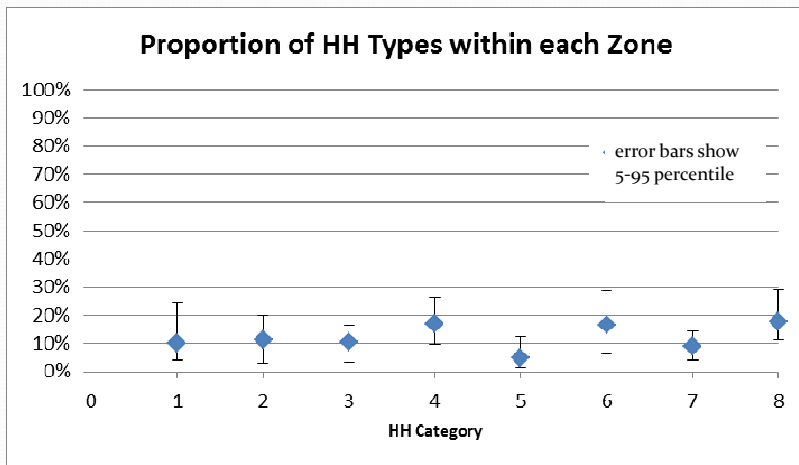- Attempt to find that 'fine line'!

Trip Generation - Issues

- A lot of data from HIS – very tempting to use as much as possible
- But need to consider future year independent variables (especially at TZ level)
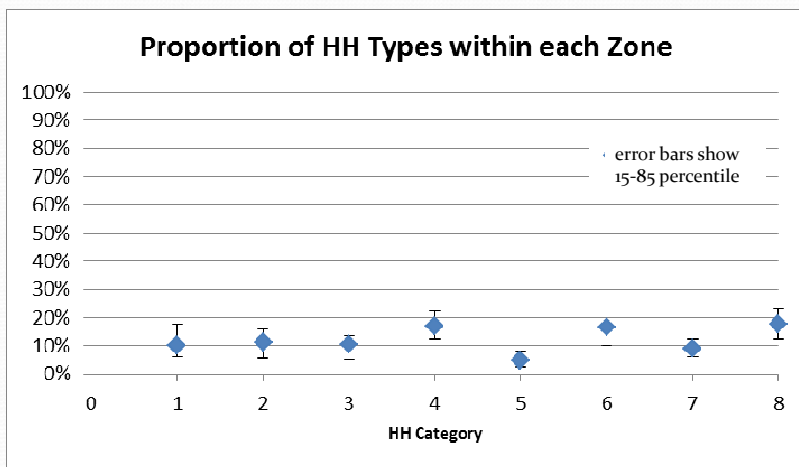- Estimating HH's by up to 32 classes is fanciful

Trip Generation - Issues

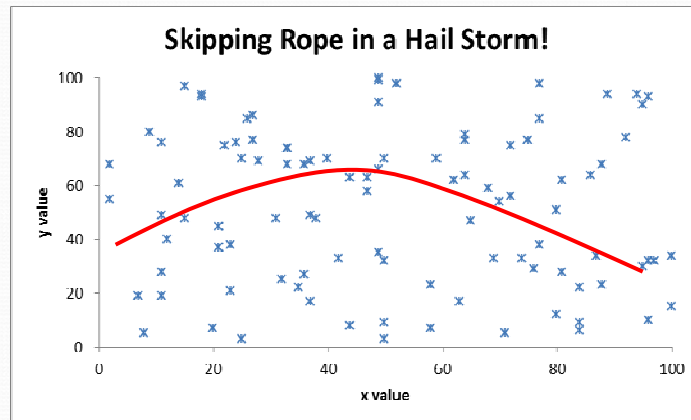**Proportion of HH Types within each Zone**

error bars show
0-100 percentile

HH Category

Trip Generation - Issues

Proportion of HH Types within each Zone

error bars show
5-95 percentile

HH Category

Trip Generation - Issues

Proportion of HH Types within each Zone

error bars show
15-85 percentile

HH Category

Trip Generation - Issues

- Robustness of Data and Relationships Implied

Skipping Rope in a Hail Storm!

Trip Distribution - Issues

- Obtaining robust data to calibrate against
- Calibrated parameters tied to base year only
- Grouping of trip purposes
- Generalised Cost is an input (but is also dependant on Trip Assignment)
- Origins and Destinations free to 'float'
- NZ generally has small cities – anywhere to anywhere in about 15min

Mode Split - Issues

- For many NZ cities/towns, differences in GC between modes are significant, so models unresponsive
- For PT, special care required for walk access
- Calibration is tied to existing use (if it exists!)
- How to handle significant stepwise change
- Most model applications relate to congested network performance (where private car and HCVs are the most significant factor)
- Modelling separate modes is important, but perhaps best handled by separate model(s).

A Simplistic Demand Model

- For most modelling tasks (small city/town), the following minimum specification could suffice:
  - Trip ends (Ps and As) estimated by simple trip rates or linear regression. Minimal trip purposes.
  - Trip Distribution by Gravity model (-ve exp deterrence)
  - No mode split. Separate models for each mode.

Simplified Model Performance

- So how does such a model perform?
- Need to compare against a comprehensive model
- Christchurch Transport Model (CTM) as benchmark
  - Assigned using CTM networks and parameters
  - Compare trip ends at TZ level
  - Compare trip length frequency
  - Compare SLA and SLZ
  - Compare Model Validation (Screenlines & GEH)
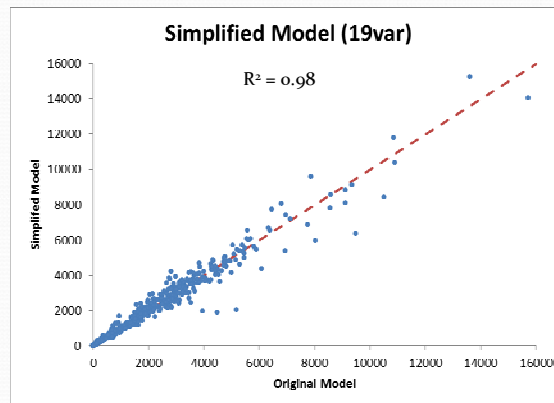 - Compare Sector to Sector trips

Trip Generation Simplified

- Simple two variable model (P's and A's)
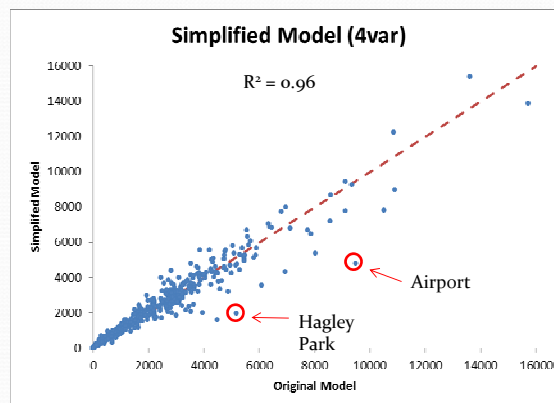 - TotHHs, Tot Jobs
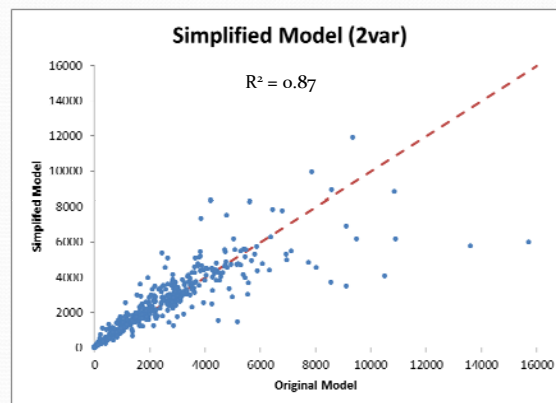
Trip Generation Simplified

- 19 variable model (P's and A's)
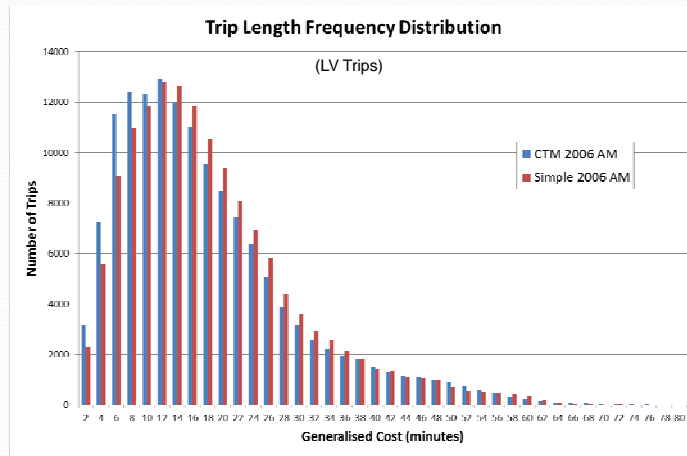 - HHs, School Roll and Jobs (by classification)

Simplified Model (19var)

$R^2 = 0.98$

Trip Generation Simplified

- Simple four variable model (P's and A's)
  - TotHHs, Retail Jobs, Education Jobs, Other Jobs

Simplified Model (4var)

$R^2 = 0.96$

Airport

Hagley Park

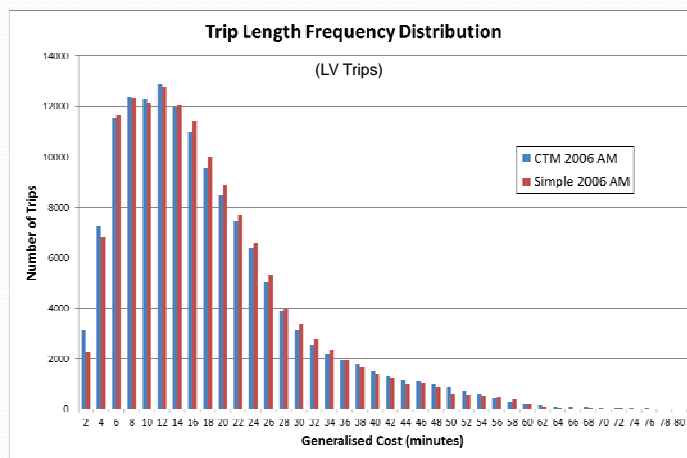# Trip Distribution Simplified

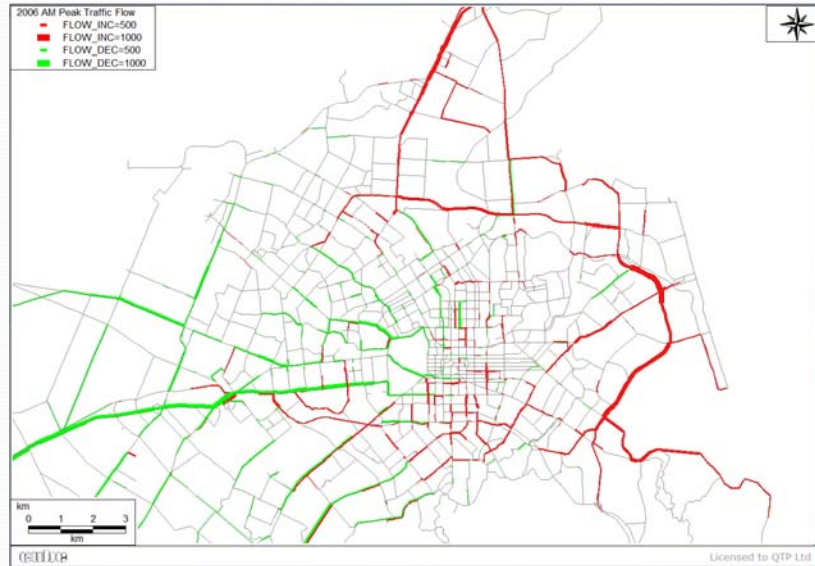- Gravity Model (-ve exp deterrence, λ = -0.09, int-int)

Trip Distribution Simplified

- With reduced deterrence for trips < 6mins
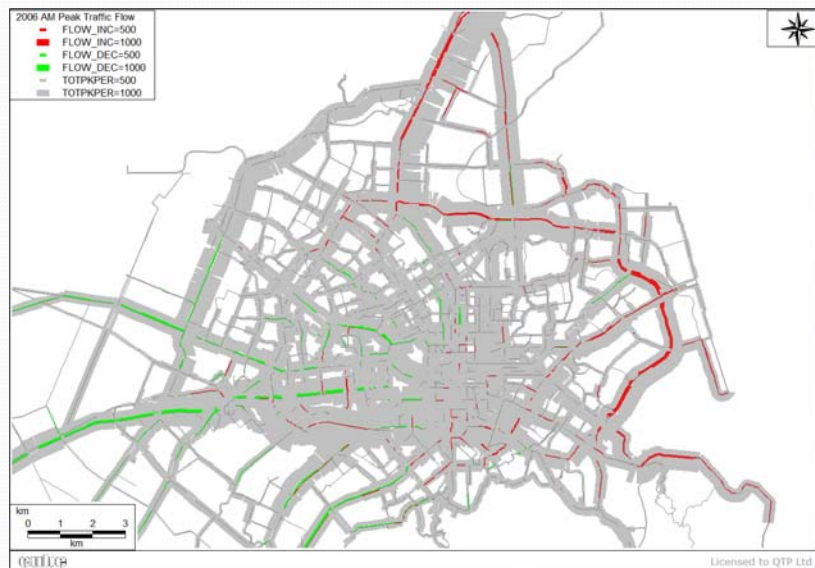
Compare Assigned Traffic

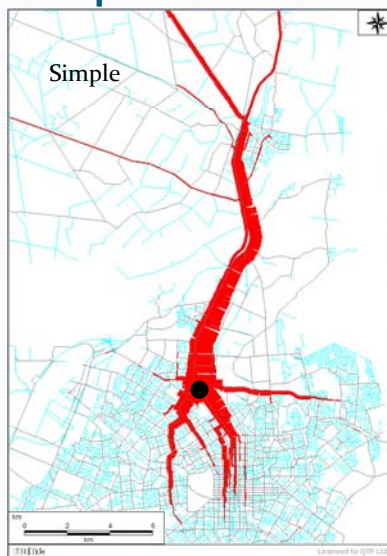Simple

CTM

Compare Assigned Traffic

Compare Assigned Traffic

Compare Assigned Traffic

Compare Select Zone Analysis

Simple CTM

Compare Select Link Analysis

Simple CTM

Compare Total Trips
Light Vehicles (0700-0900)

Description	CTM	Simple
Observed	295,353	295,353
Estimated	276,895	281,844
Abs. Diff	-18,458	-13,509
% Diff	-6%	-5%
%RMSE	30	32

Compare Screenlines
Light Vehicles (0700-0900)

Description	CTM	Simple
% Screenlines with Error <10%	(32 of 46) 69 %	(32 of 46) 69 %
% Screenlines with GEH <4	(26 of 46) 56 %	(24 of 46) 52 %
% Screenlines with GEH <10	(43 of 46) 93 %	(39 of 46) 84 %

Compare Link GEH
Light Vehicles (0700-0900)

Description	CTM	Simple
% Links with GEH < 12	94%	93%
% Links with GEH < 10	87%	88%
% Links with GEH < 5	58%	57%

Conclusions

- Traffic Models may not be as good as many expect
- But they don't need to be!
- Need to be pragmatic – abstract simplification of reality to understand key interactions
- Simplistic Models are feasible under many circumstances (NZ context)
- Demonstrated the concept – need to demonstrate transferability and tie in with other research
- Consistent with ITA approach/methodology (trip rate)
- Bang for buck – NZTA NZHHTS should suffice
- Bang for buck – Better Business Case

Questions?