Adopting exploratory modelling in sensitivity analysis for a transportation infrastructure evaluation study

-- Burnaby Mountain Gondola Transit (BMGT)

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Team member

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BMGT Project

Project background

- Use the gondola to connect the SFU campus with the current Skytrain network
- Three proposed routes
- Regular point forecast using RTM for transportation metrics
- Sensitivity analysis

Sensitivity study using Exploratory Modelling

Goals

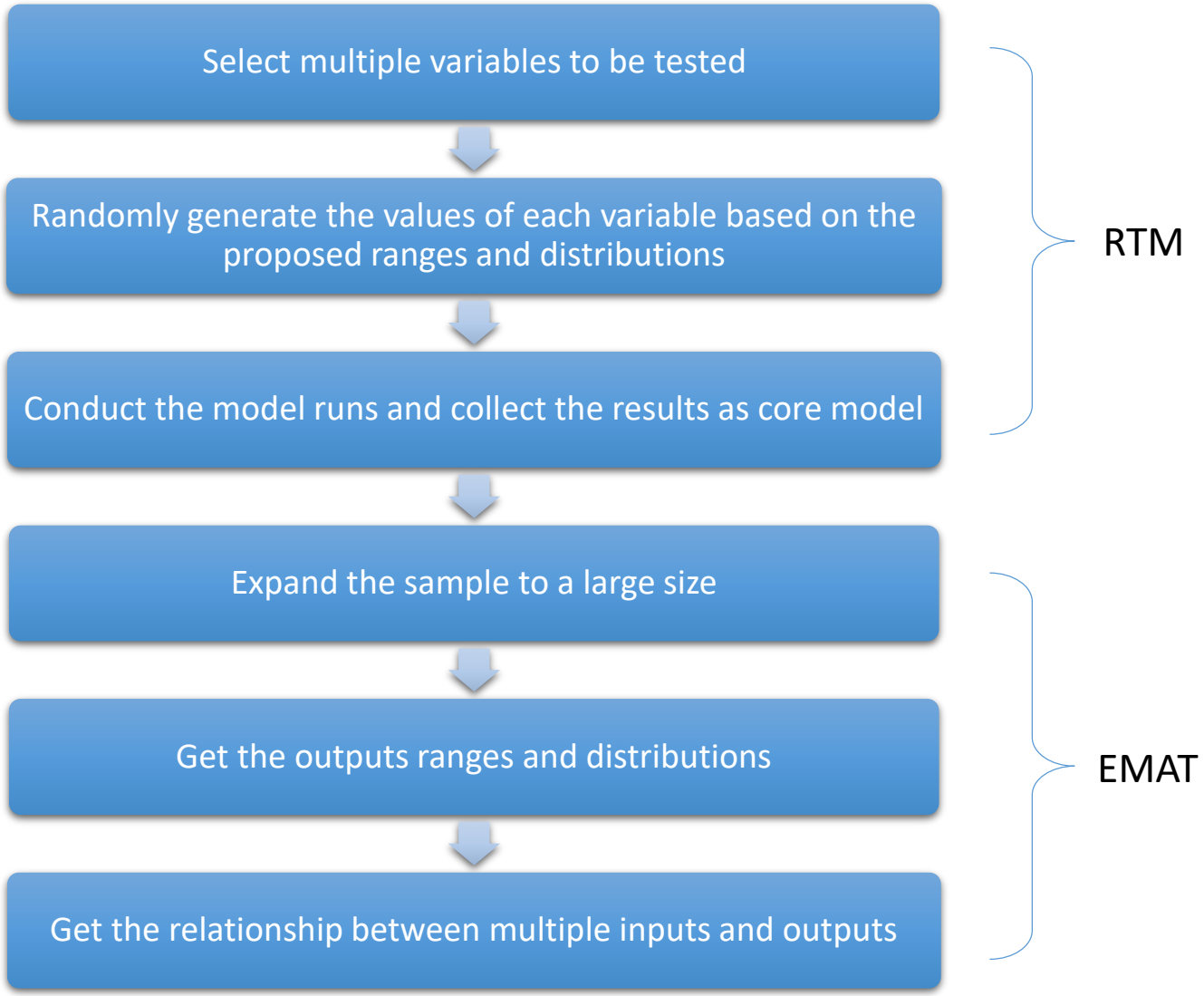
- Investigate the influence by different uncertainties and policies on gondola .
- Have a better idea of the gondola performance range in the long-term future.
- Help to understand the risk and benefit by the uncertainties.

Methodology

- The study used TransLink's new exploratory modeling.
- The model can simulate future scenarios with thousands of variable combinations.
- Then, use the statistical methods to discover the relationship between uncertainties/policies and performance indicators.
- The core model is based on the existing RTM. The full exploratory model is an expansion of the core model.

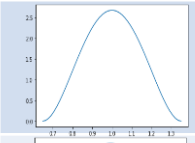
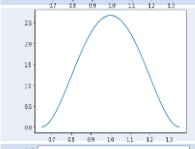
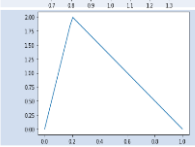
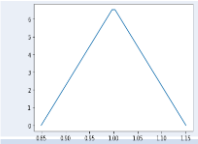
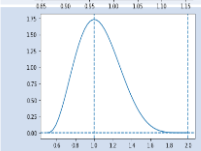
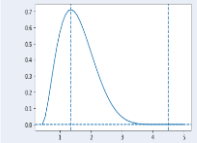
Proposed approach

- Using the exploratory modelling
- RTM runs the small sample as core model
- EMAT expands the sample size to a large size as the meta model.



The potential effected variables

A total of eight variables were identified, which may have a significant impact on the performance of the gondola.

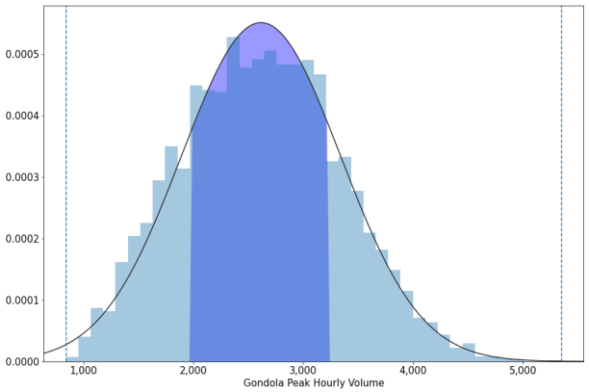
Variable	Range	Distribution	Correlate with	Comment
Enrolment Factor (enr_fac)	0.65 – 1.35, peak @ 1		emp_fac	A factor of 1 represents the projections provided by Metro Vancouver, SFU, etc.
Employment Factor (emp_fac)	0.65 – 1.35, peak @ 1		enr_fac	A factor of 1 represents the projections provided by Metro Vancouver, SFU, etc.
Work/Learn from Home (wfh_lfh)	0 – 1, peak @ 0.2		pref_private_vehicle	To simulate telecommuting. 0 represents pre-COVID. 1 and 0.2 represent 45% and 10% reduction of commute trips
Auto Propensity (pref_private_vehicle)	0.85 – 1.15, peak @ 1		wfh_lfh	This factor investigates the impact of potential increases/decreases in the desire to own cars
Gas Price (gas_prices)	0.43 – 4.5, peak @ 1.35 $/litre			The peak is at the current level of gas prices. The range of the factor is so wide because on the low end it reflects a world where the entire fleet is EVs, and on the high end it reflects high levels of RUC
Parking Cost Factor (park_fac)	0.5 – 2, peak @ 1			The factor applies to current parking cost at SFU campus
Route 143 Service (143_service)	Yes, No			
Options	Option 1,2,3			

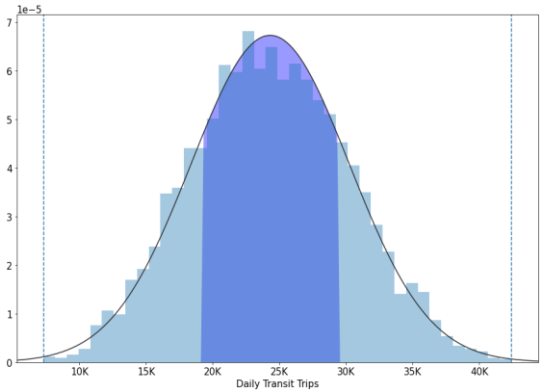
Output values and ranges

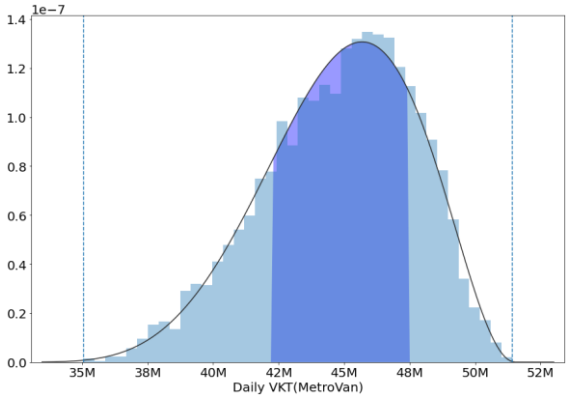
Total four outputs were captured.

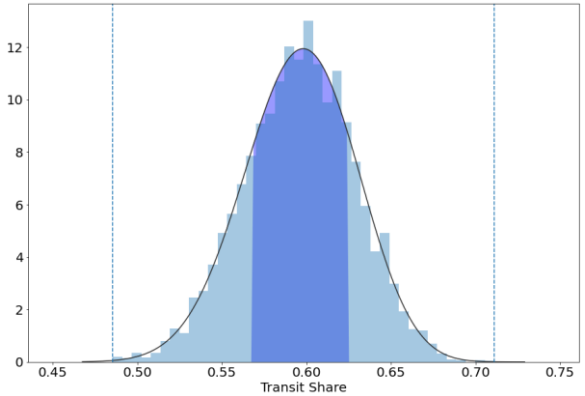
- Gondola AM NB volume
- Gondola daily trips
- Daily VKT
- Transit Share

Output Summary	Min	Mean	Max	Median	80% tile
Gondola AM NB Volume	840	2620	5350	2610	3230
Daily Gondola Trips	7300	24320	42420	24220	29490
Daily VKT(Metro Van)	35,060,600	44,822,940	51,413,250	45,138,320	47,450,580
Transit Share	0.49	0.59	0.71	0.60	0.62



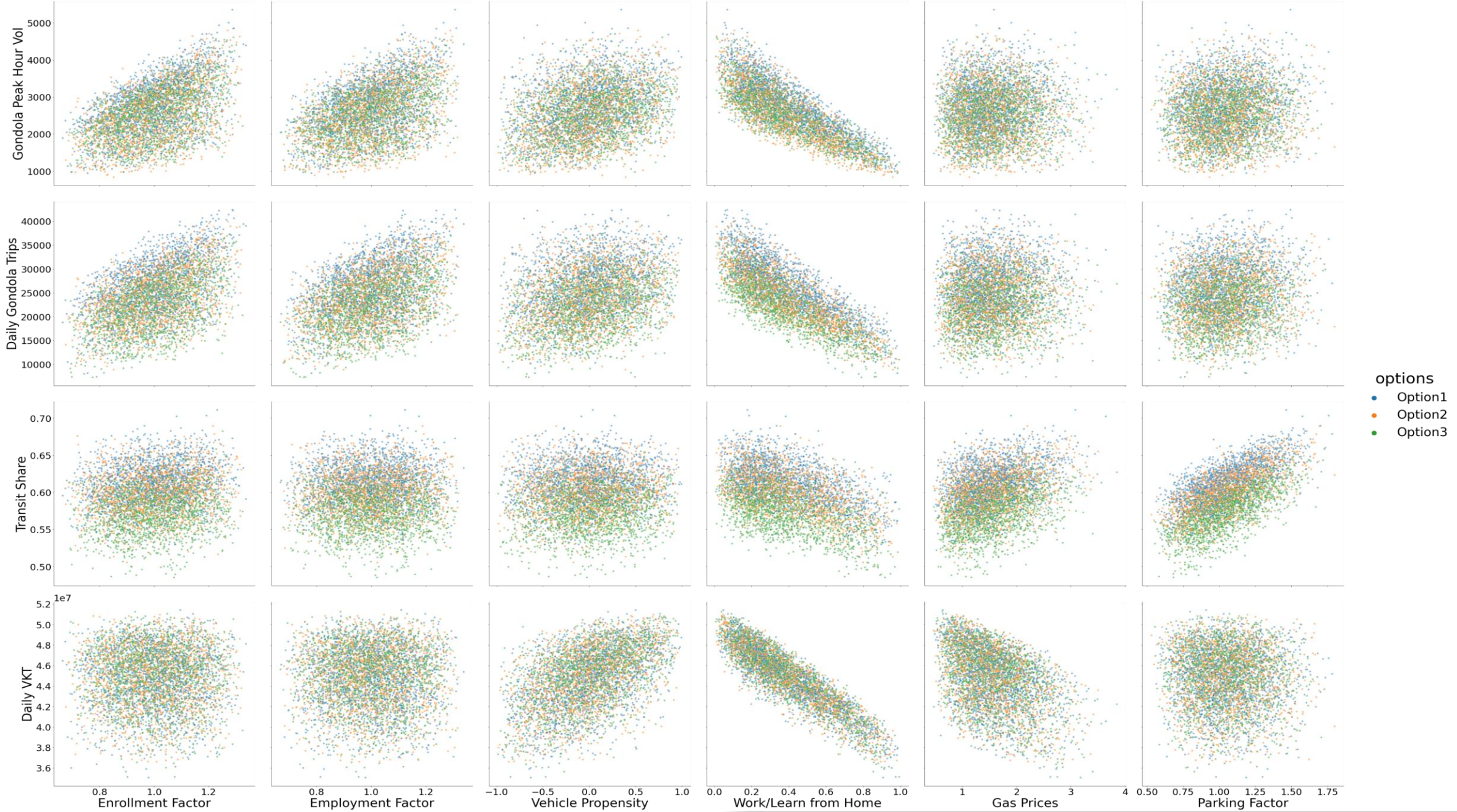






Findings

- The maximum gondola peak hour volume is around 5000 pphpd. However, the probability that the volume is less than 3200 pphpd is 80%, which is close to the “design capacity”(3000pphpd).
- The gondola peak hour ridership has a higher chance of being between 1900-3200.


Gondola Peak Hour Vol
Daily Gondola Trips
Transit Share
Daily VKT
1e7
Enrollment Factor
Employment Factor
Vehicle Propensity
Work/Learn from Home
Gas Prices
Parking Factor
options
Option1
Option2
Option3

Influence Score

The score can identify which input has the greatest impact on the output.

Influence Score (+ positive impact; - negative impact)		Input Variables							
		Enrollment Factor	Employment Factor	Auto Propensity	Work/Learn from Home	Gas Prices	Parking Prices	Route 143 Service	Options
Output Variables	Gondola AM NB Volume	+17	+16	+5	-47	+4	+4	3	4
	Daily Gondola Trips	+14	+15	+5	-42	+4	+5	6	8
	Transit Share	+6	+5	+6	-22	+10	+25	3	22
	Daily VKT	+5	+4	+12	-55	-15	+4	2	3

Conclusion

- The new approach can efficiently analysis the sensitivity by multiple factors.
- Takes the correlation of the two or more variables into account.
- Tested variable can be continuous or discrete.
- Easily to identify the influence level of each factor.
- The outputs can better reveal the likelihood of the project's performance.