ESTIMATION OF FOREST ROAD NETWORK MAINTENANCE COST CONSIDERING COLLAPSE RISK: AN APPLICATION IN THE JAPAN MOUNTAINOUS REGION

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1. Introduction

The Known

- Recently in Japan, knowledge about the relationship between forest road installation conditions and its collapse risk have been accumulated

The Unknown

- How much exactly it will cost to maintain each forest road is uncertain
- Due especially to the complexity of the country's terrain and geology

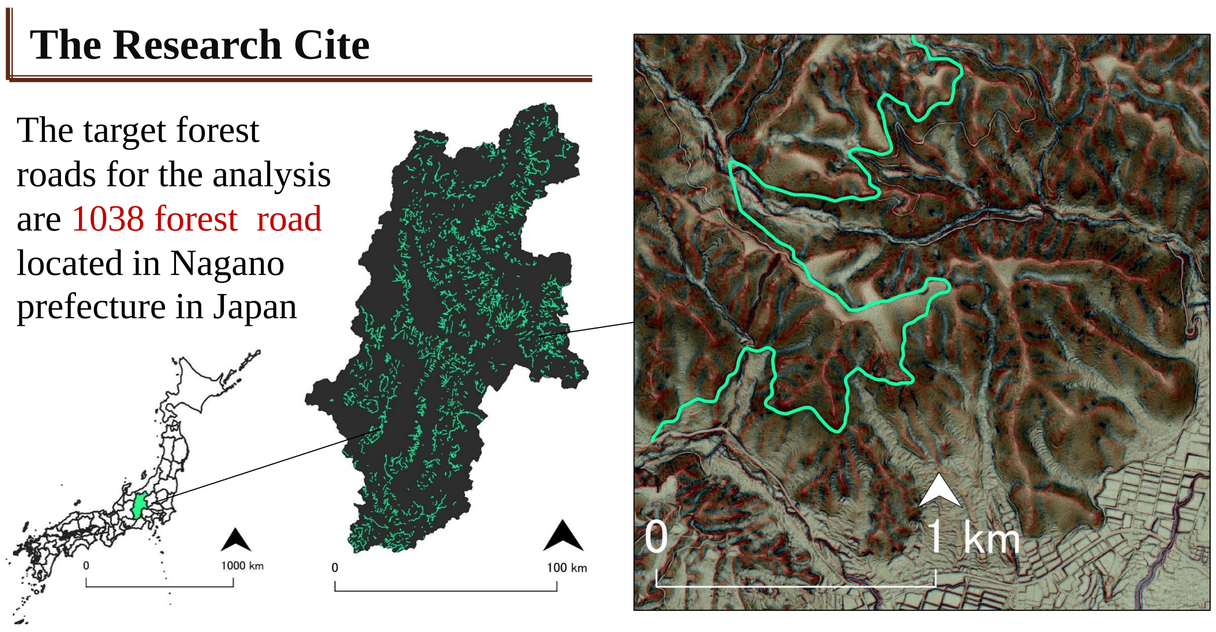
The Research Hypothesis

- To test the hypothesis that the recovery cost for a certain road is considerably affected by its collapse risk,
- We construct a predictive model of forest road recovery cost using recovery cost as a response variable and forest road feature values as predictor variables

2. Methods

The Research Cite

The target forest roads for the analysis are 1038 forest road located in Nagano prefecture in Japan



2. Methods

Tabulation of recovery unit cost

We converted the total recovery cost for each road into recovery cost per meter per year (hereinafter "recover unit cost (yen/(m year)"). Note that 1€≒120yen (1).

$$\frac{T}{\sum_{i=1}^{n}(d_i \times t_i)} \quad (1)$$

T: the total recovery cost (yen)
d_i: extension of i-th construction section
t_i: duration of i-th construction section

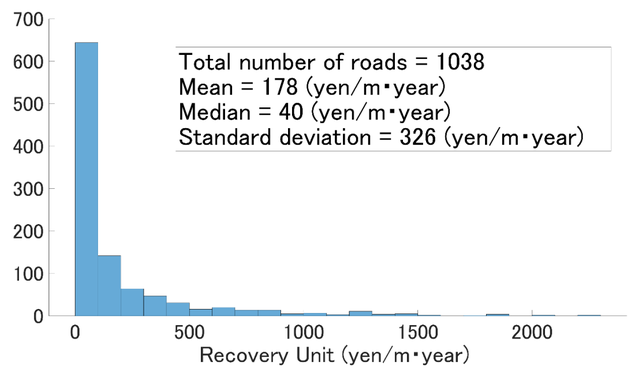
Acquisition of forest road features

Each 5 m segment	each road	Abbreviation	unit
Gradient	Mean	Gm	degrees
	Standard deviation	Gs	degrees
	Rate of segment that is greater than or equal to 30 degrees	Gr	%
Average curvature	Standard deviation	Hs	rad/m
	Rate of segment that is less than 0	Hr	rad/m
Dissection height	Mean	DISm	m
	Rate of segment that is greater than or equal to 3.5 m	DISr	%
Dissection rate	Mean	R	m
Cumulative flow	Mean	Am	Cell number
	Rate of segment that is greater than or equal to 2000 m²	Ar	%
Zero-order basin	Rate of segment that is determined as a zero-order basin (gradient ≧ 30 degrees and average curvature < 0 and dissection height ≧ 3.5 m)	Zr	%
Geological crosses	Per meter	ISG	number/m
Distance from geological boundary	Mean	DistGm	m
Fault crosses	Per meter	ISF	number/m
Distance from fault	Mean	DistFm	m
-	Standard	Standard	1, 2, 3

3. Results

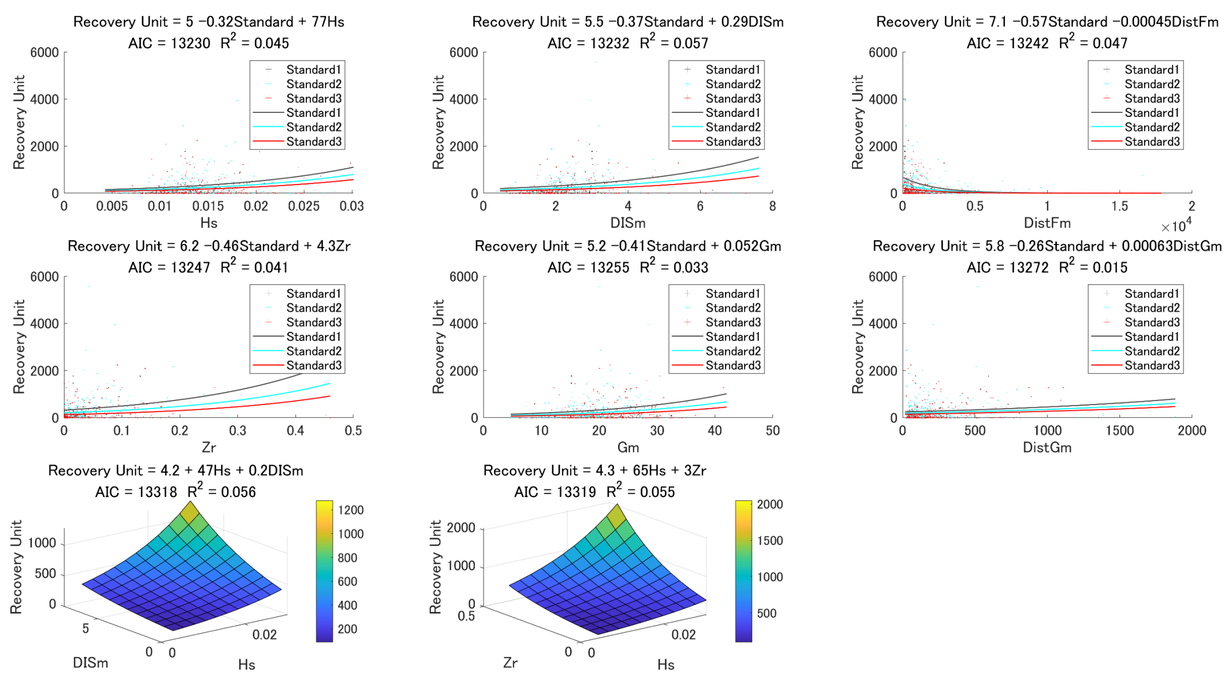
Distribution of recovery unit cost

- 394 road's recovery unit cost are 0 yen/m year
- Distribution of recovery unit cost biased tendency toward 0 to 100 yen/m year.

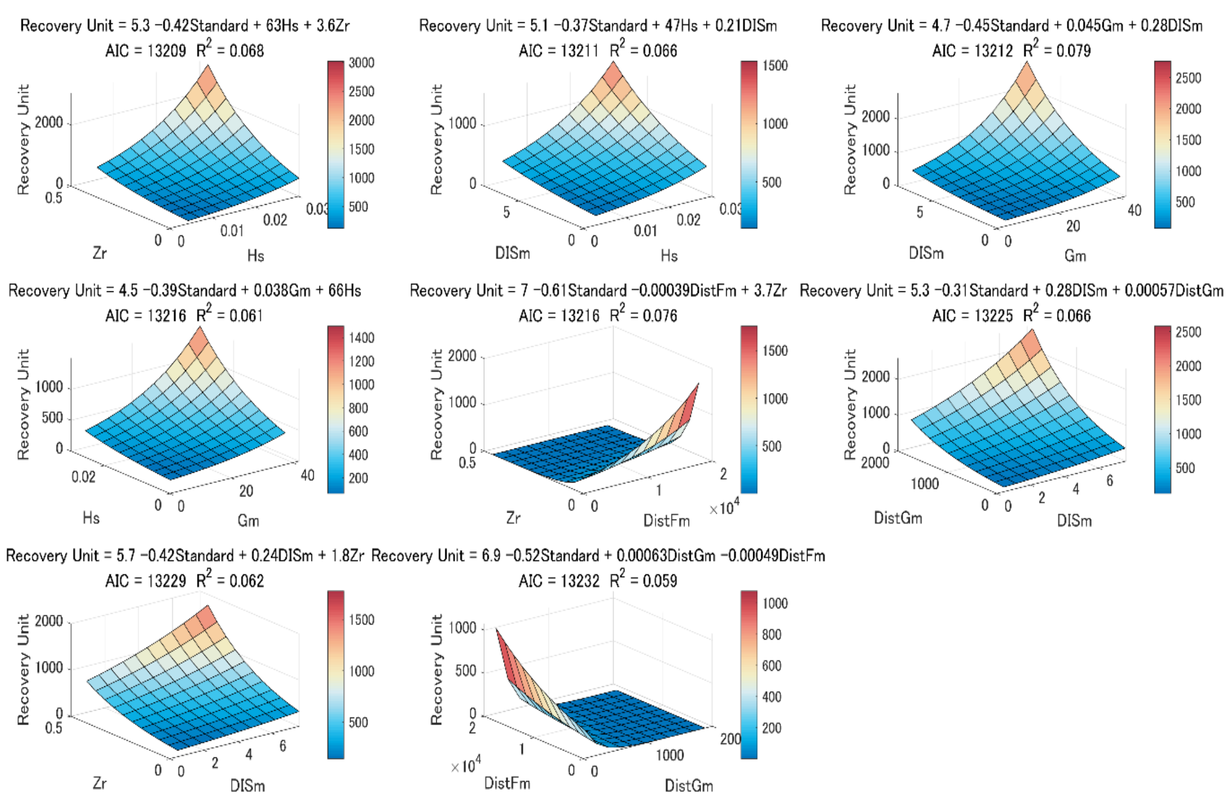


GLM

Considering practicability of prediction model, the number of predictor variables was up to three and interaction was not studied. On constructing the GLM, the normal distribution was specified as the distribution, and the log function was specified as the link function.



Models depended constant term and two predictor variables



Models depended constant term and three predictor variables

Since all model include Standard as predictor value, these figures display prediction on condition Standard＝2

4. Discussion

- ☐ Some of forest road features generally showed the same relationship between features and recovery unit with relationship between features and collapse risk.
- ☐ While we confirmed that trend from these results, all models show low determining factors.
- ☐ We recommend further study to convert geomorphic quantities into forest road features and improve the prediction method itself.

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