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Short Communication

Testing the Experts

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Short Communication

In absence of reliable models and prevailing data paucity expert judgments constitute a valuable alternative for land degradation assessments. Yet, these qualitative expert opinions are branded as subjective and non-reproducible as tests for consistency are missing and qualitative classes remain difficult to interpret. This communication summarizes formal procedures to test expert judgment for consistency, reproducibility while correlation with quantitative data makes qualitative judgments interpretable.

Land Degradation

Devastating effects of land degradation on natural resource quality, landscape heritages and ecology have far reaching consequences for current and future human well-being [1]. The cry for action to curb the catastrophic effects of land degradation at national scale, the level where most decisions on land use take place, seem, therefore, justified [2]. Yet, assessing degradation processes at larger scale is not an easy task. Despite vast resources spent on development of degradation models there are hitherto no reliable quantitative assessment methods available to prioritize interventions at regional or national scale. The main reason is the chaotic [3] and highly unpredictable nature of the degradation process that is influenced by many factors, some of which are poorly understood [4]. Indeed absence of dense and long term monitoring networks impede explanation of the year-to-year variation of land degradation in its geographical dependence of natural resources and land use [5]. Instead land degradation assessments increasingly resort on qualitative expert opinions [6] that express the state of land degradation in ordered qualitative classes [7]; information that is easy to collect and inexpensive. Yet, principal criticism on uniformity, reproducibility and interpretability permeate these assessments and this communication aims to address these concerns and by introducing tests for consistency, formalizing the relationship between expert judgments and explanatory variables and quantifying boundaries of the qualitative assessments.

Consistency

Consistency can be tested by comparing expert judgments on land degradation for similar combinations of spatially explicit information on biophysical conditions, land use and where available socio-economic information. In practice, these attributes are categorized and spatially overlaid to identify map units (of analysis) that are unique in their combination of spatial attributes. The state of degradation for obtained combinations is assessed by experts. Reporting on consistency compares, for identical sites, the frequency of similar expert judgments and detailed specification on one or more class deviations [8].

Reproducibility

The relationship between expert assessments and a set of explanatory variables is formalized by estimating a qualitative response model. Land degradation is represented by an unknown continuous variable y and related to independent variables x.

Assuming additive error terms the underlying process is represented as:

$$y_i = \beta' x_i + \varepsilon_i, \qquad (1)$$

where i are observations, β the parameters to be estimated and ε_i the disturbance, independent across observations. Ordered land degradation classes are observed as z_i. Adjacent intervals of y_i correspond with qualitative information z_i, as follows:

$$z_i = 1 \quad \text{if } y_i < \mu_1,$$

$$z_i = 2 \quad \text{if } \mu_1 \le y_i < \mu, \qquad (2)$$

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$$z_i = n \quad \text{if } \mu_{n-1} \le y_i.$$

Disturbances ε_i of the probability model are assumed to possess a logistic distribution, leading to a cumulative logistic transformation function Λ, with explicit form: 1+ e−1 ($\mu_i - \beta$ X).

Parameters β and thresholds (μ_1,….., μ_{n-1}) are simultaneously estimated by maximizing probability of a correct classification by experts. Significance of estimated parameters is tested by Chi-square statistics while a likelihood ratio tests overall quality of the estimation. Accuracy of the estimated model is evaluated by a hit ratio, the percentage of correctly predicted observations, while a 10-fold cross-validation verifies model robustness for inclusion or exclusion of observations.

Interpretability

Boundaries of the ordered qualitative response models can be quantified by using real-valued process data [9] as independent variables in the above described estimation against expert classes as dependent variables. The estimation expresses qualitative class boundaries into quantitative values generated by the degradation process. Specifically, by default, cut- off points of expert classes is equal to the cumulative probability value of 0.5. Hence, we can define:

$$\frac{1}{1+e-(\mu i-\beta X)} = 0.5 \text{ and } x_\mu = \frac{\mu i}{B} \text{ where } x_\mu$$

Expresses threshold values μ_i in physical units of the degradation process.

Key Role

Formalizing expert assessments plays a key role in addressing land degradation hazard. Expert judgments can be collected fast and

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relatively cheap while formal test procedures can strengthen the expert capacity to ensure that assessments are applied with confidence.

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