Model Description and Evaluation

The following questions are designed to classify a model for Dense Urban Areas (DUAs) within the framework created at ASU (attached). This document is self-contained, but more details and examples are reported in the framework description.

Please answer every question and provide comments for parts that are unclear. In the response fields, Shift+Enter inserts a new line and Up/Down arrows navigate between fields. Feedback about the questions is also welcome.

There are four main parts.

1. Information about the model
2. List of factors for which the model is applicable
3. Description of the model with respect to the framework
4. Evaluation of the model

I. INFORMATION ABOUT THE MODEL

1. Name of the model:  
   Hazus Flood Model
2. Name and contact info for the expert of the model:  
   Doug Plasencia, AMEC, Phoenix, AZ
3. Main references (manual, articles, tech. reports), relevant URLs:  
   https://www.fema.gov/media-library-data/20130726-1820-25045-8292/hzmh2\_1\_fl\_tm.pdf
4. Licensing (pricing, open source, free software):  
   Free, closed source
5. Hardware requirements (server-like, laptop, more detail if available):  
   Desktop systems sufficient; maximum assessed region size scales with computation power
6. Software requirements (e.g., Matlab, R):  
   N/A (Self-contained)
7. Community (reference users, tot number of users):  
   Extensively used in government; https://www.fema.gov/hazus-user-groups
8. Short description of the model (abstract-like, max 500 words, min 100):  
   The Hazus flood model is primarly a flood loss model, focusing on the effects of flooding on housing, infrastructure, and commericial or industrial properties, as well as the knock-on effects of that damage. Specifically, this model integrates both inundation depth, duration, and velocity to evaluate the effects of a particular event. Inputs are described in Appendix A of the reference listed above. One major consideration is that this model exists as a constituent component of the Hazus project, a GUI-based tool created by FEMA for disaster analytics. Therefore, integration or modification of this tool for use with other computation systems may not be possible, as the source has not been released. Four requests for the source code have been made by other researchers in the past, with no reponse thus far.
9. Feedback on the first part:  
   Click or tap here to enter text.

II. LIST OF DUA FACTORS FOR WHICH THE MODEL IS APPLICABLE

1. Does the model come with its own datasets or these must be provided?   
   Click or tap here to enter text.

An Excel file with physical and socio-cultural factors is attached.

If the model accepts data as input, please report the factors that are relevant (i.e., dataset that can feed the model) to support an instance (or execution) of the model.

Please report at least three examples in case the model can support different, heterogeneous instances. For example, one instance of the model describes the distribution of the water in a DUA, and another instance can model distribution of food.

1. The model is specific for a list of factors (it has a fixed input/output) and the factors are the following (copy the IDs from the spreadsheet and mark as input or output as appropriate):   
   Click or tap here to enter text.
2. The model can support different lists of factors (configurable input/output) and here are three example of factors (copy the IDs from the spreadsheet and mark as input or output as appropriate):  
   Click or tap here to enter text.
3. Feedback on the second part   
   Click or tap here to enter text.

III. DESCRIPTION OF THE MODEL WRT THE PROVIDED FRAMEWORK

1. What is the level the model operates?

- **Strategic**: Strategic planning is an organization's process of defining its *long term* strategy, or direction, and making decisions on allocating its resources to pursue this strategy.

- **Tactical**: Tactical planning is the process of outlining business plans for the *mid-term* (e.g., coming year).

- **Operational**: An operational plan is a work plan describing *short-term* strategies; it explains how a strategic plan will be put into operation (or what portion will be addressed) during a given operational period.  
Click or tap here to enter text.

2. What is the Goal of the model?

- **Prediction**: Estimate the value (quantitative or qualitative) of a system variable in a specified time period given knowledge of other system variables in the same time period

* + (who is going to be the influencer, assuming a static social network?)
  + (Whether a credit card customer is going to default on his outstanding payment)

**- Forecasting**: Estimate the value of a system variable in future time periods without knowledge of the values of other variables in those periods

* + (who is going to be the influencer, assuming a static social network?)

**- Describe**: Representing the system variables with visual abstractions, text summaries, keywords

* + (who is the influencer?)

**- Prescription/Planning**: Given a desired change in a variable, what are the action that I need to take

* + (how to make someone influencer)

**- Explain**: Show the causation for an event (change in a system variable)

* + (why are influencers?)

**- Discovery:** Identify (specified/unspecified) interesting system variables

Click or tap here to enter text.

3. What are the outcomes of the model?

- **Patterns**: A **pattern** is a series of data that repeats in a recognizable way

**- Trends**: **Upward trends** are characterized by a variable hitting a series of higher highs and lows, while downward **trends** are marked by lower highs and lows

**- Clusters**: Grouping relevant data and identifying meaningful information from the data.

**- Tipping points**: The point at which a series of small changes or incidents become significant enough to cause a larger, more important change.

**- Anomalies**: Deviations from normal observations, often identified as outliers.

**- Limits**: The min and max values that a variable can hold.

**- Ranges**: A sequence, series, or scale between limits.

**- Rankings**: The order of importance given to the features as a result.

**- Onsets**: The beginning of a signal (e.g., a high amplitude, short-duration sound at the beginning of a waveform for a sound)  
Click or tap here to enter text.

4. What are the scopes of the model?

**- Single/Multi-resolution:** If the model can handle different scopes or it is fixed to one scope. This can be tied to spatial, social, or temporal scope.  
Click or tap here to enter text.

**- Single/multi-aspects** : Modeling one real world object, but studying one or more of its aspects in the real world.  
Click or tap here to enter text.

**- Stationary vs non stationary:** The identified scope must be stable or is allowed to vary (dynamic).   
Click or tap here to enter text.

**- Fixed/reconfigurable:** The scope of the model is fixed and cannot be modified later (e.g., it works only for a certain region or country). Reconfigurable if the scope can be altered later depending on the changes on the requirements.   
Click or tap here to enter text.

5. What type of data Granularity is handled by the model?

**Granularity** is the level of detail handled by a model. For example, a kilometer broken into centimeters has finer granularity than a kilometer broken into meters.

**- Spatial Granularity** (lumped / grid / continuous)

**- Temporal Granularity** (lumped / interval-based / continuous)

**- Social Granularity** (lumped / class / individual)  
Click or tap here to enter text.

6. What type of analysis or methods are used in the model?

**- Spatial**: Analysis based on topological, geometric or geographic properties.

**- Temporal**: Analysis based on the entities’ temporal properties.

**- Rule Based:** A set of rules that indirectly specifies a mathematical model.

**- Probabilistic**: Estimates the probability of an event occurrence based on past historical data.

**- Agent Based:** Simulates actions and interactions of agents with environments.

**- Game Theoretic:** A mathematical models of conflict and cooperation between intelligent rational decision-makers.

**- Graph based:** Dependence between variables is represented graphically.

**- Dynamic Systems:** Model in which a function describes the time dependence of a point in a geometrical space.

**- Factorization:**  decomposition of an object into a product of other objects, or factors

**- Neural networks**:  a network used to estimate or approximate functions that can depend on a large number of inputs that are generally unknown

[feel free to propose a new method if yours is not listed above]

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7. What inputs do the model take and what kind of output is expected from the model?

**- GUI**: Graphical User Interface allows users to interact with the model.  
Click or tap here to enter text.

**- Batch**: The processing of previously collected jobs in a single batch.  
Click or tap here to enter text.

**- Data Stream:** Processing of an ongoing sequence of instances that can be ready only once or a small number of times using limited computing and storage capabilities.   
Click or tap here to enter text.

**- Data Type Format**:

* + **Structured**: Data can be easily mapped into pre-designed fields of a database. A structure is enforced for storing the data.
  + **Semi Structured**: Data have organizational properties for easy analysis. It needs some processing to store them in relational database but semi structure exists to ease space, clarity or compute.
  + **Unstructured**: Data such as videos, photos, audios that can’t be stored in a structured format like in a databases.
  + **Boolean**: Data can only hold two values, True and False.

Click or tap here to enter text.

**- Interactive Data:** Accepting input (data or command) from a human during the execution.   
Click or tap here to enter text.

**- Interface Type**: If and how the model can be plugged to another model in a sequence.  
Click or tap here to enter text.

**- Driver**: if the model is process driven, data driven, or control signal driven.  
Click or tap here to enter text.

**- Support**: ability to use standard vs proprietary data and formats.  
Click or tap here to enter text.

8. Feedback on the third part:   
Click or tap here to enter text.

IV. EVALUATION OF THE MODEL

Each model should be evaluated for the following metrics before its execution. Given that the required datasets are available, please rate the quality of the model (with 5 being the best compared to the state-of-the-art) for every metric. If a metrics does not apply, please mark N.A. and explain why in the box below.

1. Correctness

(a) Including right elements and correct relations between them, correct statements about the domain; (b) Not violating rules and conventions.

(1)  (2)  (3)  (4)  (5)  N.A.

2. Completeness

Having all the necessary information that is relevant and being detailed enough according to the purpose of modeling

(1)  (2)  (3)  (4)  (5)  N.A.

3. Consistency

The level of contradictions involved in the model

(1)  (2)  (3)  (4)  (5)  N.A.

4. Comprehensibility

How well the model is understandable by the intended users

(1)  (2)  (3)  (4)  (5)  N.A.

5. Confinement

The level of agreement with the purpose of modeling and the type of system, being at the right abstraction level

(1)  (2)  (3)  (4)  (5)  N.A.

6. Changeability

How well the model is versatile to supporting changes or improvements evolving rapidly and continuously

(1)  (2)  (3)  (4)  (5)  N.A.

7. Specificity

The Proportion of true negatives that are correctly identified, also known as true negative rate.

(1)  (2)  (3)  (4)  (5)  N.A.

8. Precision

The fraction of retrieved instances that are relevant. Also known as sensitivity.

(1)  (2)  (3)  (4)  (5)  N.A.

9. User Level

The level of expertise needed to use the model.

(1)  (2)  (3)  (4)  (5)  N.A.

10. Freshness

The level of recent information the model has, with no outdated values.

(1)  (2)  (3)  (4)  (5)  N.A.

11. Reusability

Easiness in using the existing assets in some form within the model development process.

(1)  (2)  (3)  (4)  (5)  N.A.

12. Maintainability

The level of easiness with which the models can be restored after a failure.

(1)  (2)  (3)  (4)  (5)  N.A.

13. Resilience

The ability to absorb faults without suffering complete failure.

(1)  (2)  (3)  (4)  (5)  N.A.

14. Modularity

The Degree at which models can be separated in modules and recombined.

(1)  (2)  (3)  (4)  (5)  N.A.

15. Complexity

How hard it is to learn the model with limited data

(1)  (2)  (3)  (4)  (5)  N.A.

16. Conciseness

The minimization of components in the model

(1)  (2)  (3)  (4)  (5)  N.A.

17. Feedback on the fourth part:   
Click or tap here to enter text.