

Urban Growth Modeling

[Start Assignment](#)

- Due Saturday by 11:59pm
- Points 25
- Submitting a file upload
- Available Apr 9 at 12am - May 15 at 11:59pm

In anticipation of the region's next large-scale comprehensive planning process, the local Metropolitan Planning Organization (MPO) has asked you to create a spatial forecast of urban development in 2031. You will build a forecast that incorporates the effect of proposed transportation infrastructure and offer several recommendations based on your analysis of the forecast's outputs.

Your task is to find an MSA region of interest^[1], gather land cover data from the USGS^[2] and population/development data from federal (census), state and local open data websites.

You will then train a binary logistic regression model that predicts change in development during an observed time period - from approximately 2011 (t1) to 2021 (t2). Available data will inform a model that predicts the likelihood a given "cell" of land will change in 2021. You can assess accuracy and generalizability because we *have* the data for 2021. You must employ the same goodness of fit metrics that we've used for binary models this semester.

Use the Houston Urban Growth Modeling markdown as your template for this assignment - *everything you need is in there*. You can do the model entirely in R as seen in the markdown *or* do the data wrangling in ArcGIS and bring data into R for modeling.

You will then put the model into practice - use t2 inputs (e.g. the exact same variables that are in your t1-t2 model) and predict change for 2031 (t3). Assume the role of Lead Land Use Planner. Put the model into practice to support your recommendations for growth management in the following scenario:

You will "plan" a new large-scale infrastructure project, like a new highway or public transportation line. Your model will use transportation proximity as a predictor of land use change from t1 to t2 – what happens when you input new infrastructure into your model and then predict the location of new development using these new inputs? If you want to use transit in addition to highways - you will need to incorporate distance to transit as a predictor in your model (it is not used as a feature in the example markdown).

Draw this new transport shape in ArcGIS or the `mapedit` package and incorporate it into your feature development workflow as the basis for your transportation-related predictor(s) in year t2.

Describe the nature of this new infrastructure (What is it? What kind of new demand do you expect it to generate?). Please be creative in how you design/describe your intervention.

To summarize, the modeling procedure is as follows:

1. Wrangle data for time t1 land use, infrastructure, census etc., (e.g. 2011)
2. Wrangle same data for time t2 (e.g. 2021)
3. Use t1 data to create a model ("the model") to predict the probability that a grid cell will convert from undeveloped to developed in t2.
4. Feed t2 data (including the hypothetical transport features) to the model to project for t3 (e.g. 2031) in the context of scenario specified in the assignment

You will then assess the impacts associated with forecasted growth - and make a few key planning recommendations.

Logistics

You will do this project in teams of 2. This team must be different than your team for any previous homework.

[Sign up here](#) 

(https://docs.google.com/spreadsheets/d/1nWWvzl0xkXAMsP2hEVD74HS5gd9YQdj_9f879eLpKzw/edit?usp=sharing).

If you cannot find a partner, contact the TA for help.

Deliverables:

- **Prepare a planning memo of no more than 1000 words *to your professor, playing the role of the technically savvy head of the planning commission* communicating the following:**
 - The planning rationale of the project and the nature of your scenario-based forecast
 - Exploratory maps/tables of current land cover and relevant predictors
 - The feature engineering process
 - Model results (summary), threshold selection, and validation (confusion matrix and exploration of errors)
 - Assessment of impact - where is development likely to occur? Are sensitive lands at risk? Where?
 - Key recommendations - use your planning expertise acquired through readings and lectures - give *three key recommendations* about growth allocation and management implications given the results of your forecast. This *requires you* to do some desk research about population and employment forecasts for your region (these are published by local MPOs) or about important local growth management issues.

You will be **judged on your ability to communicate your analysis and recommendations to me - your audience**. The best approach is to relate ideas like development demand and allocation in a way that planners will understand. Please show your work (regression tables, confusion matrices /maps, etc.).

This document can be an html markdown or a pdf document with graphics interspersed.

[1] Find a region that isn't totally built out. Make sure there is room for sprawl.

[2] Since we don't always have data on exactly 10-year intervals for land cover, and our most recent land data are 2021 - use the next best thing for the ancestral time period. You should use data from 2008 or 2011, and from the most recent surveys in 2019 or 2021. You can calculate change on that interval using raster calculator or map algebra in R. Find the data here: <https://www.mrlc.gov/data?f%5B0%5D=category%3ALand%20Cover>

Some Rubric (1)		
Criteria	Ratings	Pts
Completeness Is it on time? Is it in the format specified and at the length specified? Were you able to run the full workflow and output predictions?		5 pts
Planning Rationale Did you frame the analysis for the specified reader, discussing the purpose and methods in the context of the assignment? Do you describe the scenario being forecast? Have you clearly understood the task presented?		5 pts
Exploratory Analysis and Feature Engineering Do you describe and visualize important features being used in the model? Do you use charts and tables as appropriate? Is the process rational and properly executed? Do you annotate it with text to explain what's going on?		5 pts
Models and Validation Do you present the model summary and annotate it? Do you present error metrics as appropriate (a confusion matrix, tabular and/or graphic exploration of errors)? Do you specify a logical model threshold? Do you discuss accuracy and generalizability?		5 pts
Forecast, Assessment and Recommendations Do you appropriately make a forecast for your new transportation scenario? Do you assess impacts across space and land cover types? Do you interpret the impacts in a planning or environmental context in your text? Do you make three key recommendations about growth allocation and management?		5 pts
Total Points: 25		