My First Four-Step Model

A simple and accessible introduction to travel demand modeling

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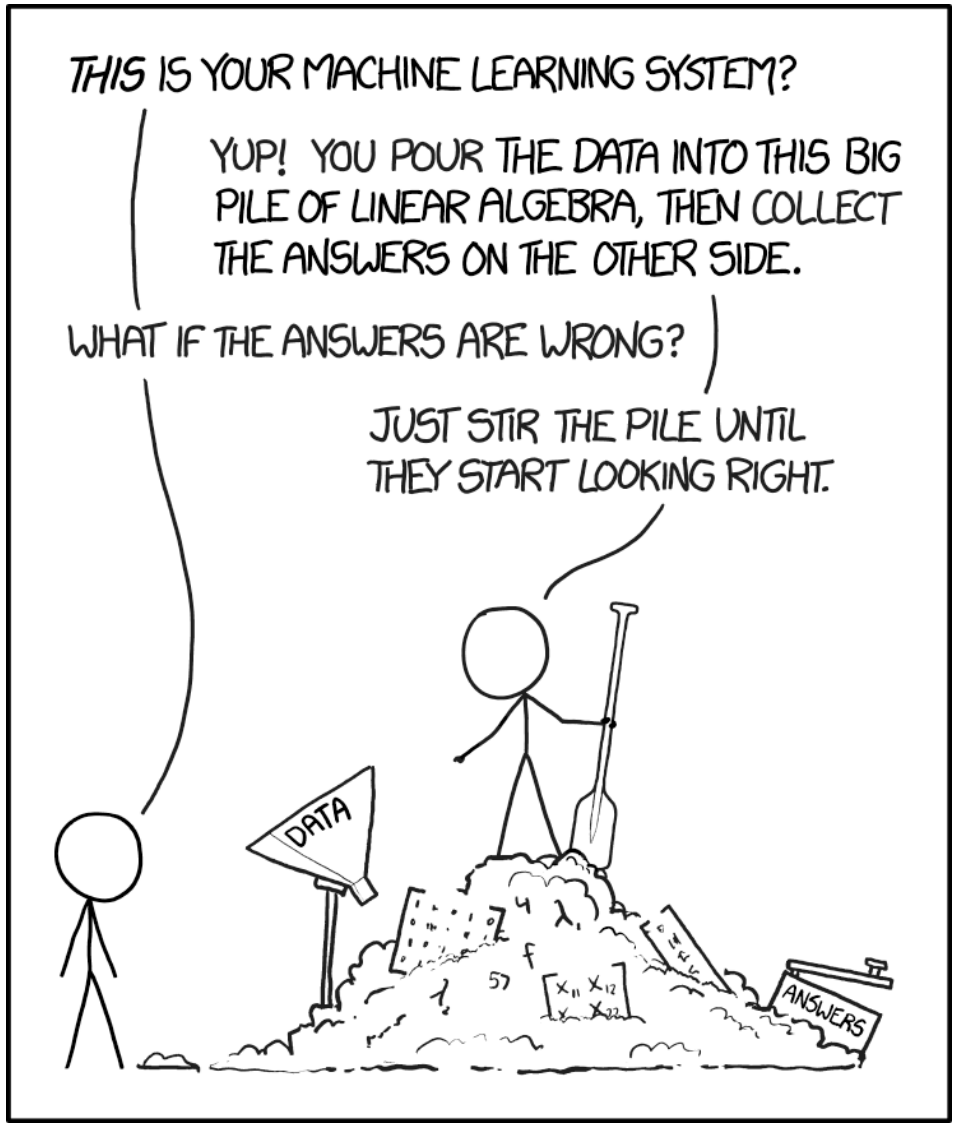
Why introduce modeling to planners?

- Most planners will never use a model directly
- However, most planners will be *consumers* of model output
- Giving planners more experience with modeling will improve communication with modelers
  - Provide a “healthy skepticism” of model results, but also
  - Understand what the model can and can’t do
  - Understand how the model can fit into planning processes
  - Think of novel ways to use models

Typical experience of planners with models



How we usually teach modeling

1. Take transportation planning
2. Take statistics
3. Take econometrics
4. Take choice modeling
5. Take GIS
6. Work with component models (mode choice, destination choice, etc.)
7. **Actually run a model**

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7. **Actually run a model** *(optional)*

An alternate approach

1. **Actually run a model**
2. Take transportation planning
3. Take statistics
4. Take econometrics *(optional)*
5. Take choice modeling *(optional)*
6. Take GIS *(optional)*
7. Work with component models (mode choice, destination choice, etc.) *(optional)*

How do you run a model first?

- In my introductory Planning Methods class, I do *one lecture* on modeling
- Then, every student uses a *very* simple model to evaluate a proposed housing development near UNC
  - Answer questions about the model, but more importantly about the context
  - Mean score 5.96 / 7, including 2 points extra credit

My First Four Step Model

- I implement this model using My First Four Step Model, an R package I developed
- Running the model only requires R and minimal computing power, so students can run it on their laptops
  - Even Chromebooks!
- The four steps of the model map directly onto four functions in the package

Running the model: setup

```
# installation steps, only needed first time
install.packages('MyFirstFourStepModel',
  repos = c('https://mattwigway.r-universe.dev', 'https://cloud.r-project.org'))

# model loading
library(MyFirstFourStepModel)
model = load_model("https://files.indicatrix.org/rdu_chatham.model")
```

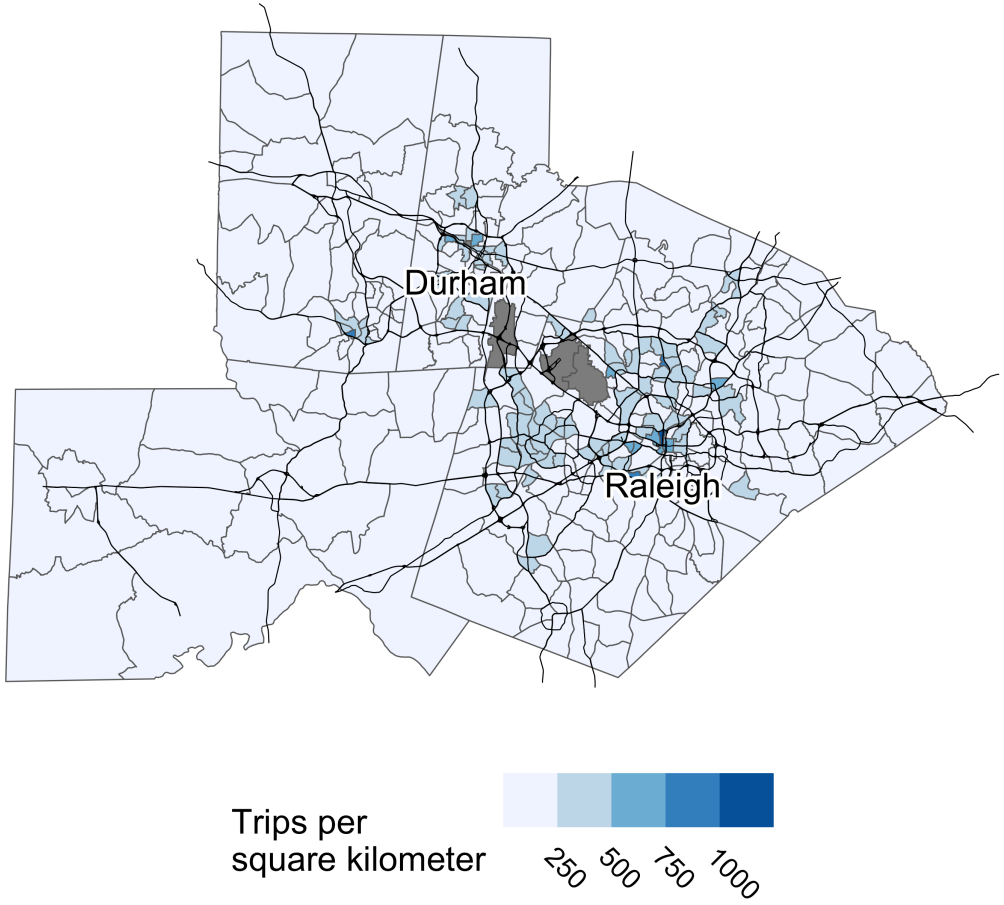
Running the model: trip generation

- The entire trip generation process happens with one function, `trip_generation`
- Trip generation uses a series of linear regression models, since my students are already familiar with them
- I have students interpret
  - coefficients in the regression models
  - maps of model output

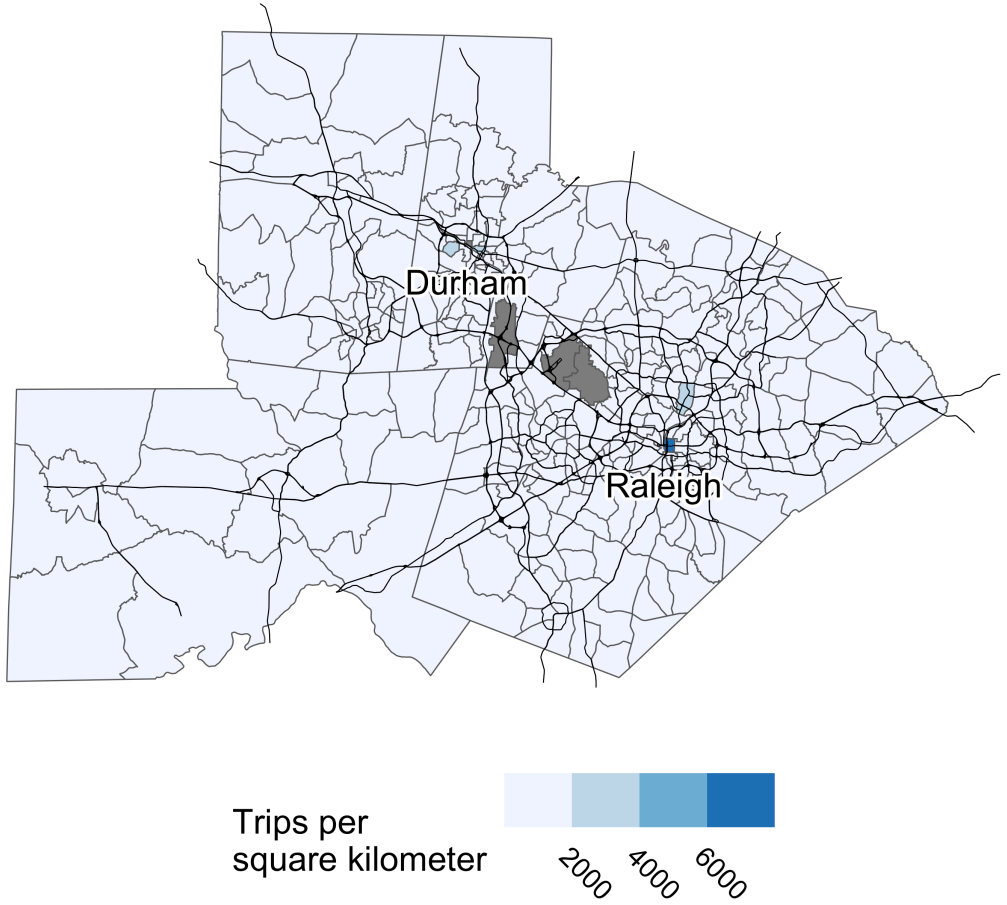
```
# Run trip generation
trip_ends = trip_generation(model, model$scenarios$baseline)
```

Trip generation results

HBW productions, AM Peak



HBW attractions, AM Peak

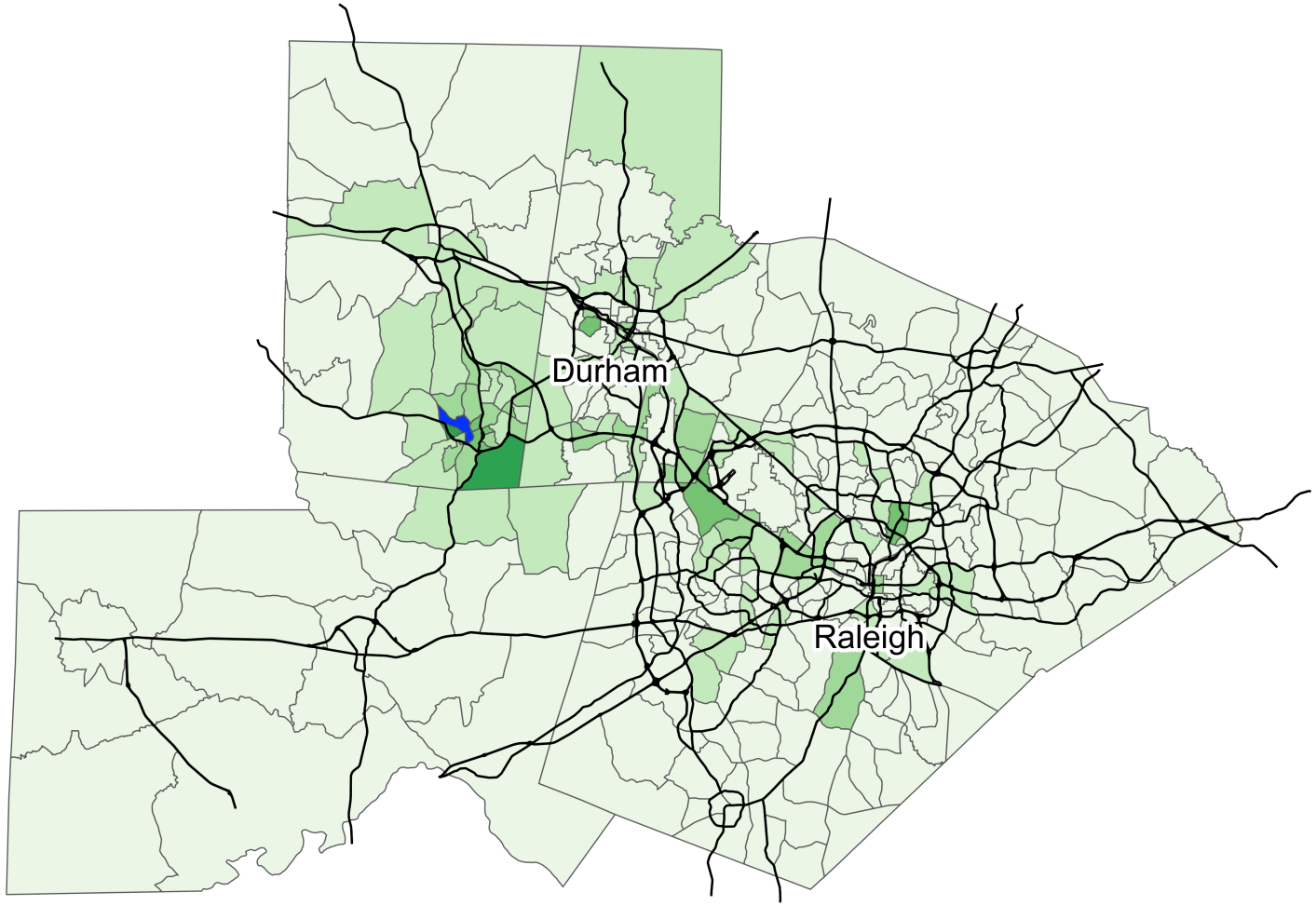


Running the model: trip distribution

- Trip distribution is likewise a single function
- I have students interpret
  - coefficients in the model
  - maps of trip destinations from a tract of their choice

```
1 flows = trip_distribution(model, model$scenarios$baseline, trip_ends)
```

HBW trips, AM Peak from tract 37135010705



Understanding mode choice

- Mode choice uses a multinomial logit model, which I explain *very* briefly, but do have students interpret
- I have students interpret the mode shares as well

```
1 flows_by_mode = mode_choice(model, model$scenarios$baseline, flows)
```

Car	Bike	Walk	Transit
0.92	0.01	0.05	0.03

Assignment

- Traffic assignment is also a single function, and we map the results

```
pm_network_flows = network_assignment(
    model,
    model$scenarios$baseline,
    model$networks$baseline,
    flows_by_mode,
    "PM Peak"
)
```

Forecast congestion, PM Peak

Scenarios

- Models are most useful to evaluate scenarios
- I have students evaluate a scenario based on the proposed Chatham Park developmend
  - Adding 20,000 households to Pittsboro, a bedroom community west of Raleigh

```
model$scenarios$future = model$scenarios$baseline |>
  add_households(
    "37037020801",
    tribble(
      ~hhsize, ~workers, ~vehicles, ~income, ~n,
      4,       2,        3,         150000,  10000,
      4,       2,        2,         75000,   10000
    )
  )
```

Chatham Park: network assignment output

Forecast congestion levels after adding 20,000 households, PM Peak

projects.indicatrix.org/MyFirstFourStepModel

Network scenarios

- I also have students evaluate the impacts of widening US 15-501, and use this to discuss induced demand

```
model$networks$widen = model$networks$baseline |>
  modify_ways(
    # US 15-501 between Pittsboro and Chapel Hill
    c(
      "16468788", "133051274", "16471803", "285898984",
      . . .
      "712336821", "712336826", "712336827", "998595932"
    ),
    lanes_per_direction=3,
    highway_type="motorway"
  )
```

Forecast congestion, PM Peak, with widened 15-501.

Colophon: Estimation

- The model can be estimated anywhere in the US
- Relies on NHTS, Census

Conclusion

All models are wrong, but some are useful.

More information, preprint, and instructions:

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- It is possible to get folks hands-on with a model within a few days
- This leads to more excitement and understanding about modeling

More information, preprint, and instructions: