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SANDAG Internal-External Models

ActivitySim Consortium Presentation

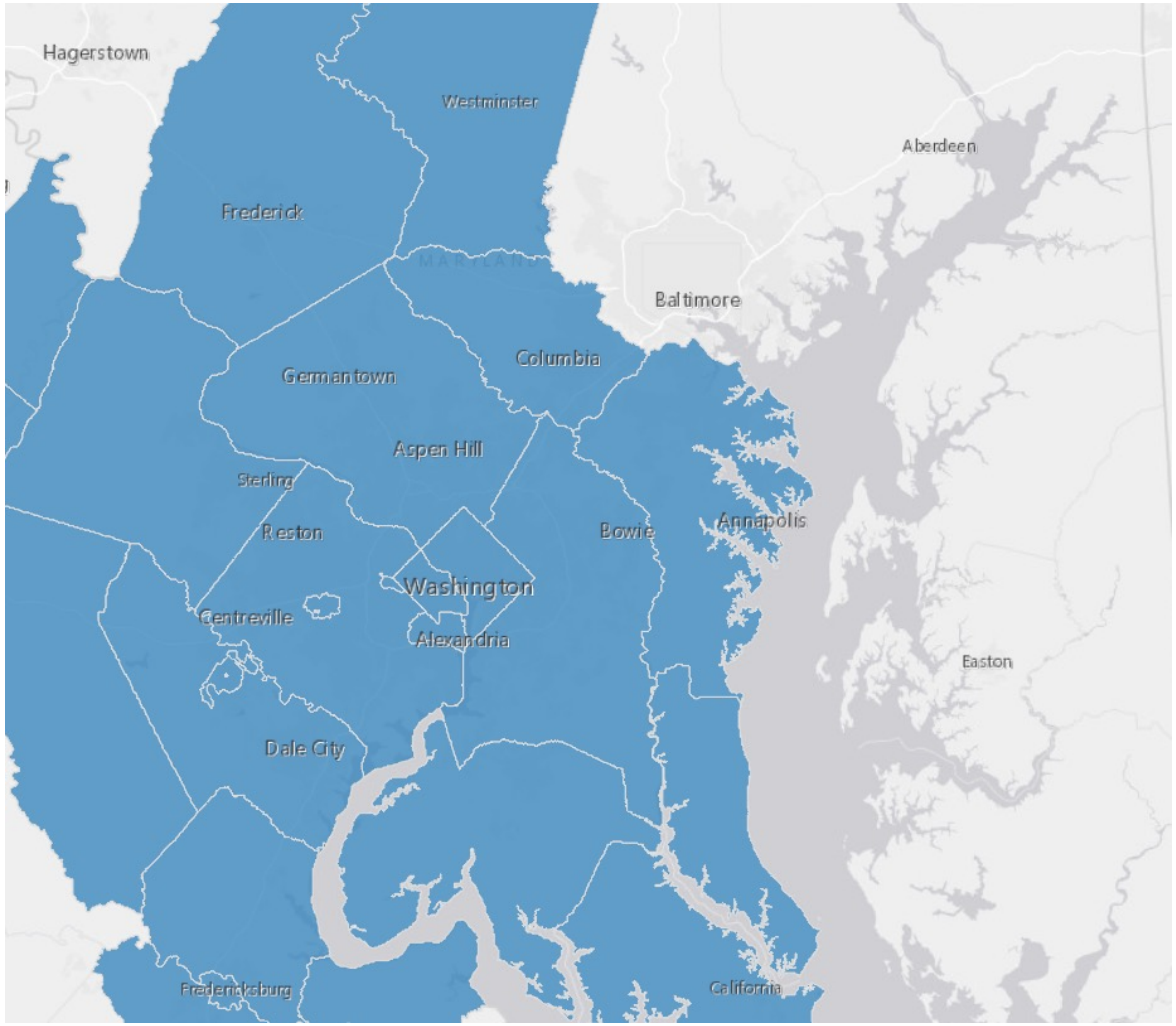
Feb 22, 2022

Purpose and Need

- ActivitySim currently only models travel to destinations internal to the modeling region
  - The model does not explicitly account for travel made by residents of the region to external stations
- Deploying activity-based models as a replacement for trip-based models often requires application of (or revision of) aggregate internal-external and external-internal trip tables
  - These are often modeled simultaneously with internal-internal trips, which can be tedious to reimplement as stand-alone models
  - Aggregate internal-external trip tables can lead to double-counting travel for internal residents
- Workers who commute outside region compete for internal jobs in shadow pricing

Does it matter?

- According to 2011-15 ACS, only about 3% of workers residing San Diego County have a regular workplace outside San Diego County (~44k workers)
- But some regions have much more significant interactions with their neighbors…



Source: Mapping Boundaries - TPB Modeled Area. GIS@MWCOG. TPB/COG GIS Team, Metropolitan Washington Council of Governments. Published April 19, 2016, Date updated November 14, 2017

Internal-External Travel in AB models is not a new concept

- SF-CHAMP model & DaySim
  - Specify percent of workers who work outside region by TAZ. Monte Carlo simulation used to select these workers and remove them from internal work location choice model.
  - Work tours not generated to external stations, and no mechanism for non-work travel. These are handled by the internal-external (aggregate) models
  - Also has an option to specify the percentage of jobs by TAZ taken by workers who work outside the region, to handle job competition. These are handled by the external-internal (aggregate) model.
- No explicit treatment in MTC\ARC CT-RAMP
  - Not sure about MAG\SCAG\Ohio versions?
- TourCast?

Current SANDAG Treatment of IE Travel

- Internal-external tours generated at a person level in the household mobility choice models, after transponder ownership, and right before the Coordinated Daily Activity Pattern model.
- Internal-external tour generation is a binary choice model.
  - The results of this model do not affect any downstream household choice models.
- InternalExternalModel generates exactly one external tour for each person with an external tour.
  - The departure and arrival time for the external tour is chosen by simulating from a probability distribution.
  - The choice set for destination is limited to an external station.
  - Two trips are generated for the tour.
  - A model is run to determine trip mode for each external trip.

Disadvantages of current IE model

- Work and school location choice assume all workers and students work or go to school in the region
  - Shadow pricing mechanism is unaffected by workers or students who commute outside the region.
- Can double-count travel for travelers who leave the region, since their internal travel is unaffected by whether they leave the region
- Requires maintenance of a code base and Utility Expression Calculator Files extraneous to the internal travel demand models

Proposed New Internal-External Model

We want IE travel to be integrated with ActivitySim

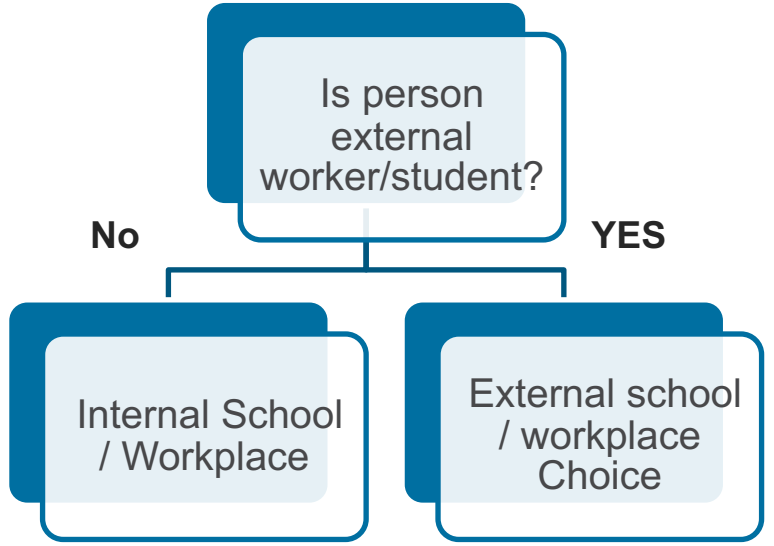
- Other models can run exactly the same (tour frequency, scheduling, mode choice, stop frequency, etc.)
  - No need to maintain separate codebase for handling of IE tours

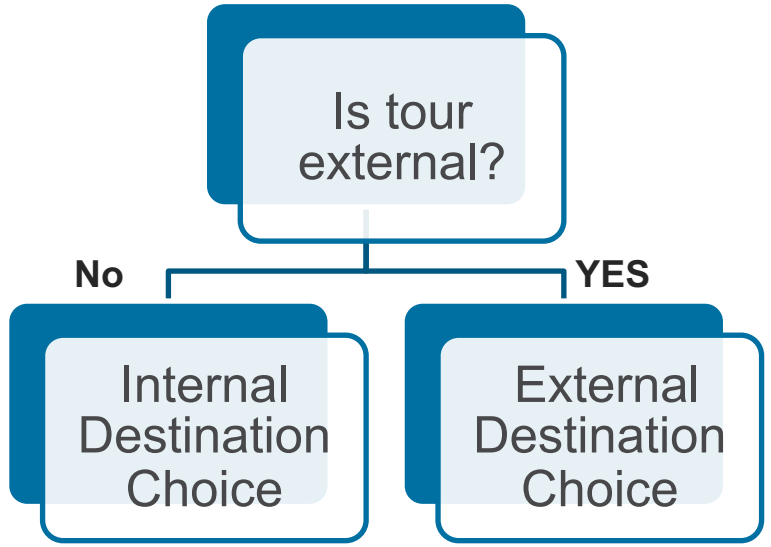
- Students and workers commuting outside the modeling region would be taken into account
  - Shadow pricing will correctly consider only those that work or go to school in the region

- Travel patterns will be internally consistent, likely leading to more accurate travel forecasts at external stations
  - Travel will not be double counted between the resident model and the Internal-External model

Proposed Revised Internal-External Model

- A model would be run before mandatory location choice for each worker and student to predict whether they work/go to school inside or outside region
  - If outside region, an external destination choice model would be run to predict which external station is the primary destination
  - These workers/students would not be considered in shadow pricing
- Similar model run before non-mandatory tour location choice
- External tour identifier can be used as explanatory variable in time-of-day, mode choice, stop frequency, etc.
- Stop frequency on external tours will be modeled as internal stops only
- *No double counting of travel, no extra code base, no competition in shadow pricing*





Internal-External Model Implementation

```
models:
  - initialize_landuse
  - initialize_households
  - compute_accessibility
  - initialize_los
  - initialize_tvpb
  # ---
  - external_student_identification
  - external_worker_identification
  - external_school_location
  - external_workplace_location
  - school_location
  - workplace_location
  - auto_ownership_simulate
```

ActivitySim Settings.yaml

Determines *is_student_external*, *is_student_internal*

Determines *is_worker_external*, *is_worker_internal*

Only has external stations allowed for sampling

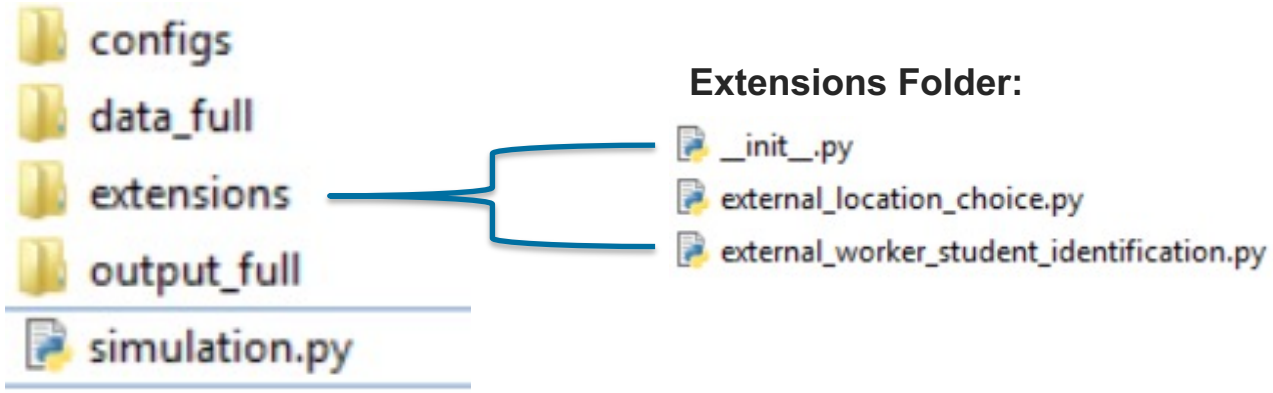
Regular school and work location models

Final Output: Each worker and student have a workplace and school location zone_id in the person table and subsequent models run normally

How the code works

Internal-External code development is separate from core ActivitySim code via an extensions folder

Run Directory:



ActivitySim Run Command:
python simulation.py –c configs –d data_full –o output_full

simulation.py:

```
from activitysim.cli.run import add_run_args, run

import extensions

if __name__ == '__main__':

    parser = argparse.ArgumentParser()
    add_run_args(parser)
    args = parser.parse_args()

    os.environ['MKL_NUM_THREADS'] = '1'

    sys.exit(run(args))
```

Internal-External Model Development status

- Basic functionality is implemented for
  - External worker and student identification
  - External school and workplace location choice
  - Internal models are not running for external workers & students

- Models are currently using placeholder utility expressions
  - Will create new utility expressions that include terms like distance to nearest external station, worker status, etc. that will be estimated later

- Still need to integrate external station data to use as location choice size terms in external models

`EXTERNALINTERNALCONTROLTOTALSBYYEAR.CSV`

Column Name	Description
Taz	External TAZ station
Work	Number of work vehicle trips
Nonwork	Number of non-work vehicle trips

Questions and Discussion

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