# CEE 123 Transport Systems 3: Planning & Forecasting

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## Homework #6 -- Trip Distribution [ Due: Friday 24 May 2024 ]

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The following base and future data pertain to a hypothetical five zone region. The data set includes surveyed production, attractions, and activity system variables for 2020, as well as estimates of activity system variables for the year 2030. Note that some zones are **strict** productions and others are **strict** attractions (hint!).

Table 1a. Travel Times ; HBW Ps & As ; Base and Future Demographics

| | -Base Travel Time- | | | | | -Base Trips- | | -Base Demo- | | -Future Demo- | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From\To | 1 | 2 | 3 | 4 | 5 | PROD | ATTR | WORK | EMPL | WORK | EMPL |
| 1 | 1 | 3 | 3 | 6 | 3 | 0 | 450 | 0 | 220 | 0 | 216 |
| 2 | 3 | 1 | 2 | 6 | 5 | 0 | 250 | 0 | 110 | 0 | 118 |
| 3 | 3 | 2 | 1 | 5 | 6 | 300 | 0 | 140 | 0 | 250 | 0 |
| 4 | 6 | 6 | 5 | 1 | 4 | 0 | 300 | 0 | 140 | 0 | 166 |
| 5 | 3 | 5 | 6 | 4 | 1 | 700 | 0 | 360 | 0 | 472 | 166 |
| Totals | | | | | | 1000 | 1000 | 500 | 470 | 722 | 666 |

Table 1b. Base HBW Trip Table

| FROM\TO | 1 | 2 | 4 | Prod |
|---|---|---|---|---|
| 3 | 125 | 125 | 50 | 300 |
| 5 | 325 | 125 | 250 | 700 |
| Attr | 450 | 250 | 300 | 1000 |

### Problem 1. Trip Generation (10 points)

Household HBW trip production and attraction models for the region have been estimated as functions of workers per zone (WORK) and employees per zone (EMPL), respectively:

$$P_i = 50.0 + 1.80\ WORK_i \qquad A_j = 30.0 + 1.90\ EMPL_j$$

a. **Estimate** a measure of goodness-of-fit for each of the above models using the base data. For example, compute the root mean square error, RMSE=sqrt[(Σ(est-obs)$^2$)/n]. **Comment** on the fit.
b. Use the demographic forecasts provided to **predict** future trip ends for the production and attraction models. These estimates will be used in the trip distribution forecast below. **Tabulate**.

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### Problem 2. Trip Distribution: Calibration (20 points)

By hand, **calibrate** a HBW singly-constrained gravity model for trip distribution for the base year data.

a. **Develop** the travel time frequency distribution based on one minute travel time intervals. Set all initial friction factors equal to one. **Complete** a minimum of 3 iterations, using a 5 percent convergence tolerance. **Apply** "Attraction Factoring" or "Column and Row Factoring" at each iteration. **Show** all work.
b. **How** close are the trip matrix cells to the base distribution? **How** could you adjust the cells for a better fit? **What** are the limitations of your adjustment process?
c. **Estimate** the mean trip length (time) for the base trip distribution results (note: these estimates do not reflect congested travel times).

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### Problem 3. Trip Distribution: Application (10 points)

Using future forecasts from the trip generation models in Problem 1 and an effective change in travel time to 2 minutes for Zone 3 to Zone 1, **estimate** the future trip distribution. **Estimate** the mean trip length (time) for the future distribution and compare to the base mean trip length.

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**• [cee223 only] Do Either Problem 4a or 4b •**

**Problem 4a. Trip Distribution: DCGM (10 points)**
Using the *calibrated* friction factors from the HBW Singly-Constrained Gravity Model of Problem 2, complete one iteration of a Doubly-Constrained Gravity Model application.

1. **Compute** the balancing terms ($a_i$ and $b_j$) and **estimate** the trip matrix.
2. **Determine** the corresponding Trip Length Frequency Distribution. Is the DCGM within the final convergence tolerance of the SCGM in Problem 2?

**Problem 4b. Trip Distribution: Growth Factors (10 points)**
Using future forecasts from the trip generation models in Problem 1, estimate future HBW trip distribution using the Furness growth factor model (Row and Column Factoring). Use a 5 percent convergence tolerance or a maximum of two iterations. Growth Factor Models cannot project growth in zones where no base activity exists, so ignore the added future employment in Zone 5. Hint: Simply use future productions and attractions to "column and row factor" the base trip matrix.

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**Problem 5. Travel Surveys (20 points)**
The spreadsheet provides 2020 household socio-economic and travel diary data for a sub-sample of Miasma Beach households. **Use only households 10 through 12 in this exercise**.

1. **Calculate** the trip travel time, activity duration, and trip purpose classification (HBW, HBO, or NHB) for each trip and append to the table. **Compute** the mean travel time by mode and mean activity duration by purpose. Submit a hardcopy (e-copy optional) of the updated spreadsheet.
2. **Plot** the travel patterns on a Miasma Beach network map. Label each trip end as a production (P) or attraction (A) and label the trip type (HBW, HBO, NHB). Use color and/or line types to distinguish individuals and/or trip types. You may need to plot households on separate maps.
3. **Calculate** the associated OD trip table and the PA trip table.

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Last Updated: 15 May 2024