CEE 123 Transport Systems 3: Planning & Forecasting
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Homework #7 -- Trip Table Adjustments [S O L U T I O N S]

Homework 7 utilized data pertaining to a hypothetical five zone region. The data set included surveyed production, attractions, and activity system variables for 2020, as well as estimates of activity system variables for the year 2030.

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

In Homework 6, a HBW trip gravity model was calibrated for the region, and forecasts were completed for both trip generation and distribution (with assumed network and activity system changes). The following problems continue with the sequence of analysis.

Problem 6 [15 points]
Using the **base** 24-hour Home-based Work (HBW) person-trip production-attraction matrix in Table 1b and the Table 6 conversion factors, **produce** the corresponding (a) AM-peak, (b) PM-peak, and (c) off-peak period origin-destination matrices for HBW person-trips.

```
Table 6. Temporal Distribution of Trips by Purpose (PA-to-OD)
----------------------------------------------------------------------
                        --- HBW --     -- HBO --      -- NHB --
      Analysis Period    P-A   A-P     P-A   A-P      P-A   A-P
----------------------------------------------------------------------
  1. AM-peak (7-9:00am)  0.30  0.00    0.06  0.02     0.04  0.04
  2. PM-peak (4-7:00pm)  0.03  0.30    0.09  0.15     0.12  0.12
  3. Off-peak (other)    0.17  0.20    0.33  0.33     0.34  0.34
----------------------------------------------------------------------
```

Solution:
*Table 6a shows the results for AM-peak, PM-peak, and off-peak ODs for HBW trips only (due to round-off error, row and column sums may not exactly match O/D totals). **Note:** the "2-by-3" problem in PA format is a full "5-by-5" problem in OD format in the PM-peak and the off-peak since HBW trips exist in both directions (H-W and W-H). The sum of the 3 matrices yields the original matrix converted to O-D format by using P-A and A-P factors (PAF and APF) of 0.5 and 0.5 (column sums from Table 1). To convert PA trips to OD trips, use:*

$$T_{ij}^{OD} = PAFactor \cdot T_{ij}^{PA} + APFactor \cdot T_{ji}^{PA}$$

```
Table 6a. AM-peak, PM-peak, and Off-peak HBW O-D Matrices
----------------------------------------------------------------------
      ----- AM-peak -----      ----- PM-peak -----      ---- Off-peak -----
Fr\To  1   2   3   4   5   Fr\To  1   2   3   4   5   Fr/To  1   2   3   4   5
----------------------------------------------------------------------
  1    0   0   0   0   0     1    0   0  38   0  97     1    0   0  25   0  65
  2    0   0   0   0   0     2    0   0  37   0  38     2    0   0  25   0  25
  3   37  38   0  15   0     3    4   4   0   1   0     3   21  21   0   9   0
  4    0   0   0   0   0     4    0   0  15   0  75     4    0   0  10   0  50
  5   98  37   0  75   0     5   10   4   0   8   0     5   55  21   0  42   0
----------------------------------------------------------------------
    [PAF=0.30; APF=0.00]       [PAF=0.03; APF=0.30]       [PAF=0.17; APF=0.20]
----------------------------------------------------------------------


    Daily HBW in OD format [PAF=0.50; APF=0.50]
    ------------------------------------------
    O\D     1     2     3     4     5   O(i)
    ------------------------------------------
      1     0     0    63     0   162    225
      2     0     0    62     0    63    125
      3    62    63     0    25     0    150
      4     0     0    25     0   125    150
      5   163    62     0   125     0    350
    ------------------------------------------
    D(j)  225   125   150   150   350   1000
    ------------------------------------------
```

Problem 7 [5 points]

Convert the **2-hour AM-peak HBW O-D matrix of person-trips** (see Problem 1) to vehicle trips, using Table 2 parameters. **Report** in O-D matrix format.

```
Table 7. Base Year Vehicle Occupancy by Trip Purpose
-----------------------------------------------------------------
     Type         Trip purpose         Average Vehicle Occupancy
-----------------------------------------------------------------
  1. HBW          Home-based Work       1.10 persons/vehicle
  2. HBO          Home-based Other      1.40 persons/vehicle
  3. NHB          Non-home-based        1.20 persons/vehicle
-----------------------------------------------------------------
```

Solution: *Each element of the AM-peak HBW OD-matrix is divided by the HBW average vehicle occupancy (1.1 persons/vehicle) to obtain the number of vehicle-trips.*

```
Table 7a. AM-peak HBW Vehicle-trip O-D Matrix (AVO=1.1)
---------------------------------------------------------
    --- Person-trips ---        ------ Vehicle-trips ------
Fr\To  1   2   3   4   5   Fr\To  1   2   3   4   5   Tot
---------------------------------------------------------
  1    0   0   0   0   0     1    0   0   0   0   0     0
  2    0   0   0   0   0     2    0   0   0   0   0     0
  3   37  38   0  15   0     3   34  34   0  14   0    82
  4    0   0   0   0   0     4    0   0   0   0   0     0
  5   98  37   0  75   0     5   89  34   0  68   0   191
---------------------------------------------------------
                            Tot  123  68   0  82   0   273
---------------------------------------------------------
```

NOTE: HW 6, 7, and 8 provide a useful exercise which illustrates the sequential application of the four step model and, thus, serves as excellent preparation for the final exam.

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