Travel Forecasting for New Starts
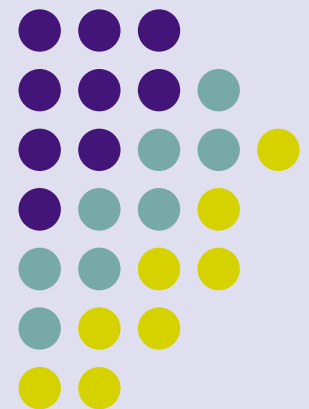
A Workshop Sponsored by

The Federal Transit Administration

March 23-25, 2009
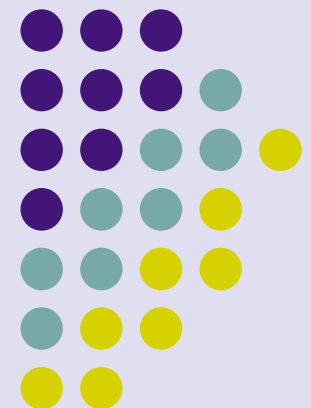
Tampa

Summit Tutorial – Welcome

Session 1

- FTA motivations
- Agenda for today

FTA Motivations for Summit

- FTA interest in analytical reporting of forecasts
  - FTA evaluation measures for New Starts
  - Quality control
  - Information for decision making
  - Cases for projects
- Summit – a tool for analytical reporting
- Other tools available
- Key is good reporting, not the reporting tool(s)

Agenda for Today

- Session 2: Summit
  - Files, control, reports
  - Interfaces with travel models
- Break
- Session 3: Sample problems
  - Prototypical questions
  - Conceptual approach to providing answers
  - Implementation of the approach in Summit
  - Results

Summit

Session 2

- Analytical reporting of travel forecasts
- Summit basics
- User benefits
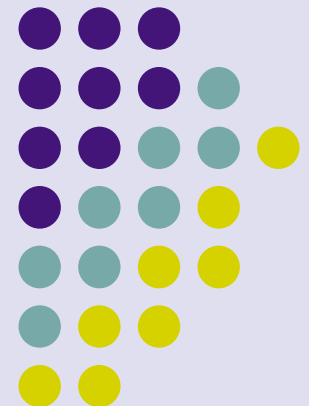
Analytical Reporting

- Information from travel forecasts
  - Trip tables
  - Impedance tables
  - Volumes on facilities
- Volumes routinely reported; tables less so
- Insights from trips tables & impedance tables
  - Relevant travel markets
  - Sources and impacts of errors
  - Causes and incidence of benefits

Analytical Reporting

- Trip tables
  - District-to-district summaries
  - District-to-district deltas and ratios
  - Row-percents and column-percents

Analytical Reporting

- Trip tables
  - Summary districts
  - Aggregation ("squeeze")

Urbanville

Summary Districts

5 miles
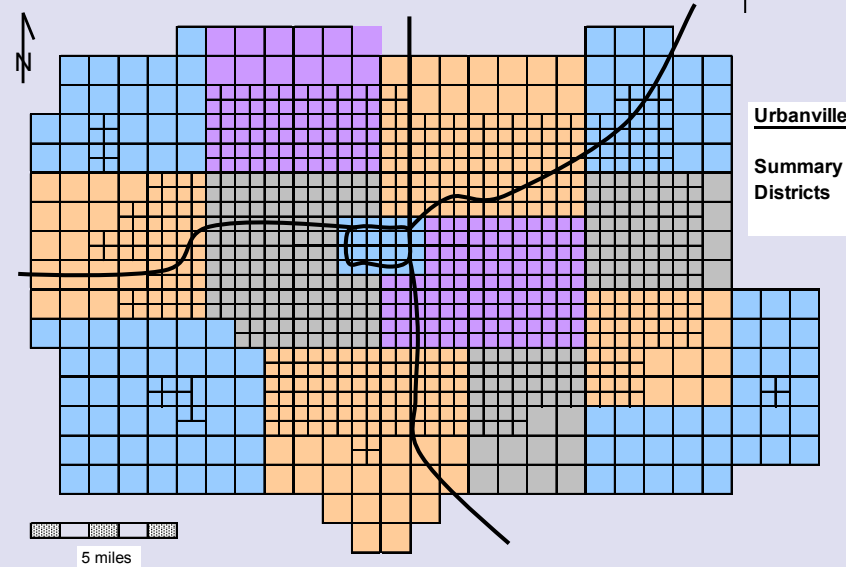
table 8

to
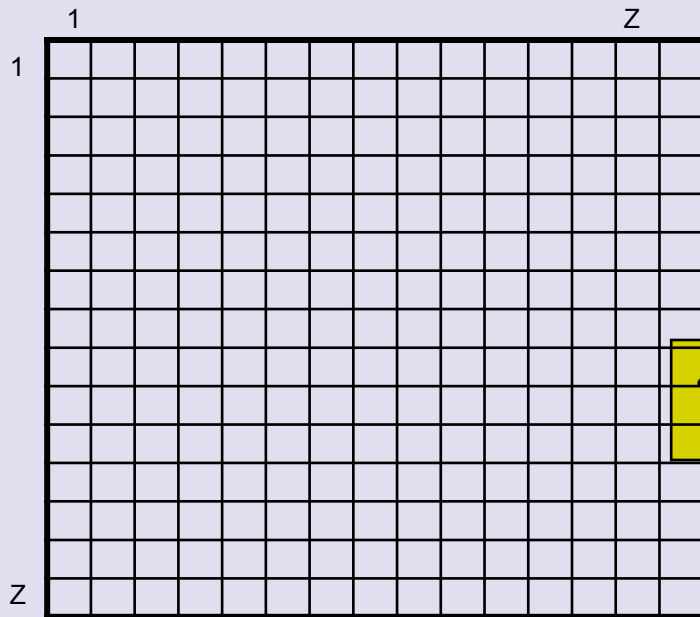
from

"squeeze"
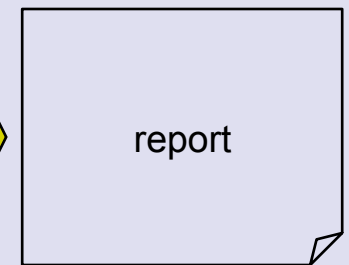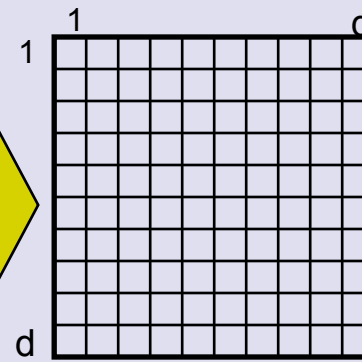
report

Analytical Reporting

- Trip tables – reports and applications
  - District-to-district totals, deltas, and ratios; e.g.:
    - Person-trip <u>flows</u> and person-trips <u>flows</u> by mode
    - <u>New</u> transit trips
    - Mode <u>shares</u>
    - <u>Average</u> auto-occupancies
  - Row-percents and column-percents
    - Calibration of trip-distribution models
    - Travel markets to the CBD and other activity centers

Analytical Reporting
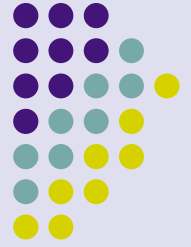
- Impedance tables – a whole new ballgame
  - Thematic maps
  - Trip length frequency distributions
  - Stratified tables

Analytical Reporting

- Impedances in thematic maps
  - i to all Z; all Z to j
  - Totals or deltas
  - No information on #trips

Table 11

ΔIVT

from

to
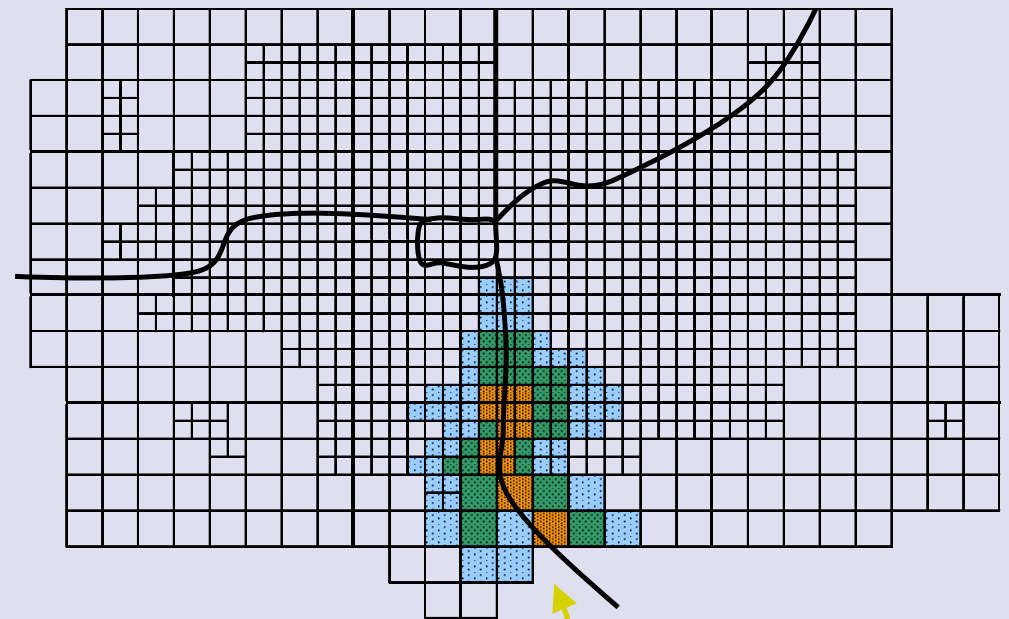
GIS thematic mapping

Analytical Reporting

- Impedances used in frequency distributions of trips
  - Trips summed by impedance increments
  - Total or delta impedance
  - Trips, but entirely aggregate: no geography, no flows

Trips to

Impeds to

I - J trips summed into appropriate interval

I - J impedance determines interval
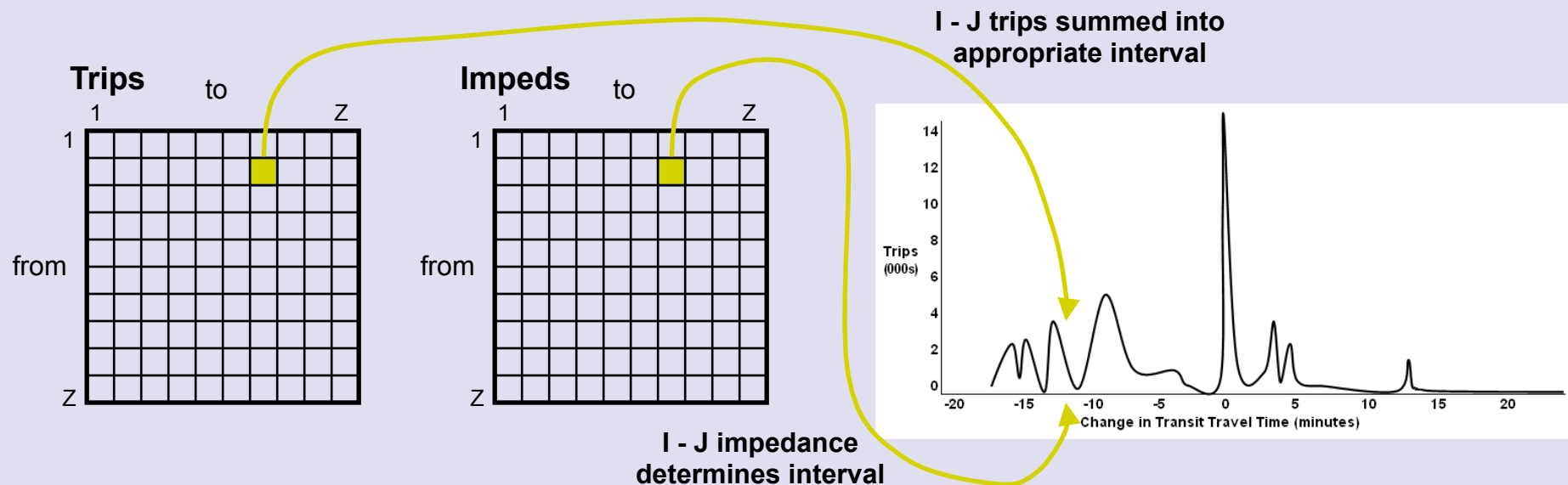
Analytical Reporting

- Impedances used to "stratify" trip-tables
  - Trip-table cells assigned to impedance-specific tables
  - Stratified tables available for various analyses including D-to-D aggregation, network assignment, mapping, etc.

trips **impedances** choose **Trips stratified by impedances**

Transit assignment

Imped range 1
Imped range 2
Imped range 3
Imped range 4
Imped range 5
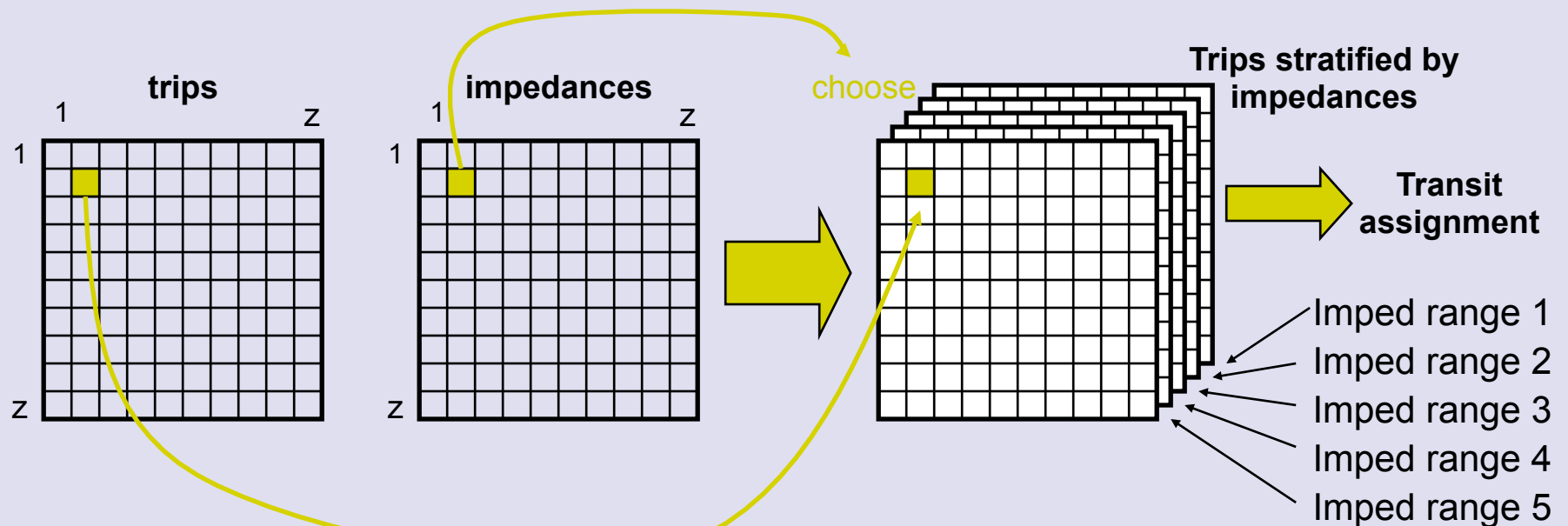
Analytical Reporting

- Impedance tables – summary
  - Thematic maps (for totals and for deltas)
    - Impedances to/from individual zones
    - Lots of detail but individual focus and nothing on trips
  - Trip length frequency distributions (for Σs and Δs)
    - Useful summary of impedances and trips
    - No geography
  - Stratified tables (largely for deltas)
    - Lots of detail and opportunity for further analysis
    - Powerful differentiation of trips by impedance ranges

Summit Basics

- Topics
  - Overview
  - Inputs
  - Controls
  - Outputs

A forecast is not useful until you **Summ**_arize_**it**

Summit Basics

- Overview
  - Two functions
    - Analytical reporting of forecasts
    - Calculation and reporting of user benefits
  - Philosophy
    - Embedded reporting step in model-application stream
    - Summit computations → no change to applications
    - Less reporting effort → more time for QC and insights

Summit Basics

- Overview (continued)
  - General software characteristics
    - PC operating system (Windows); DOS based
    - Written in Fortran
    - Fluent in the native matrix-file formats of:

      - EMME/2   - Tranplan   - Voyager

      - MinUTP   - TransCAD   - text

      - TP+   - (VISUM)
    - Upcoming release
      - Software: Version 1.0
      - Documentation: Version 1.0   July 2009

Summit Basics

● Overview (continued) -- information flow with Summit

Summit

ftable1	
ftable2	
ftable3	
ftable4	
ftable5	
ftable6	
⋮	
ftable9	

Working table calculations

Tnn

Reporting functions

Analysis functions

control

fequiv

report file

| ftlfs |
| frcsums |
| frcvals |
| fstrats |
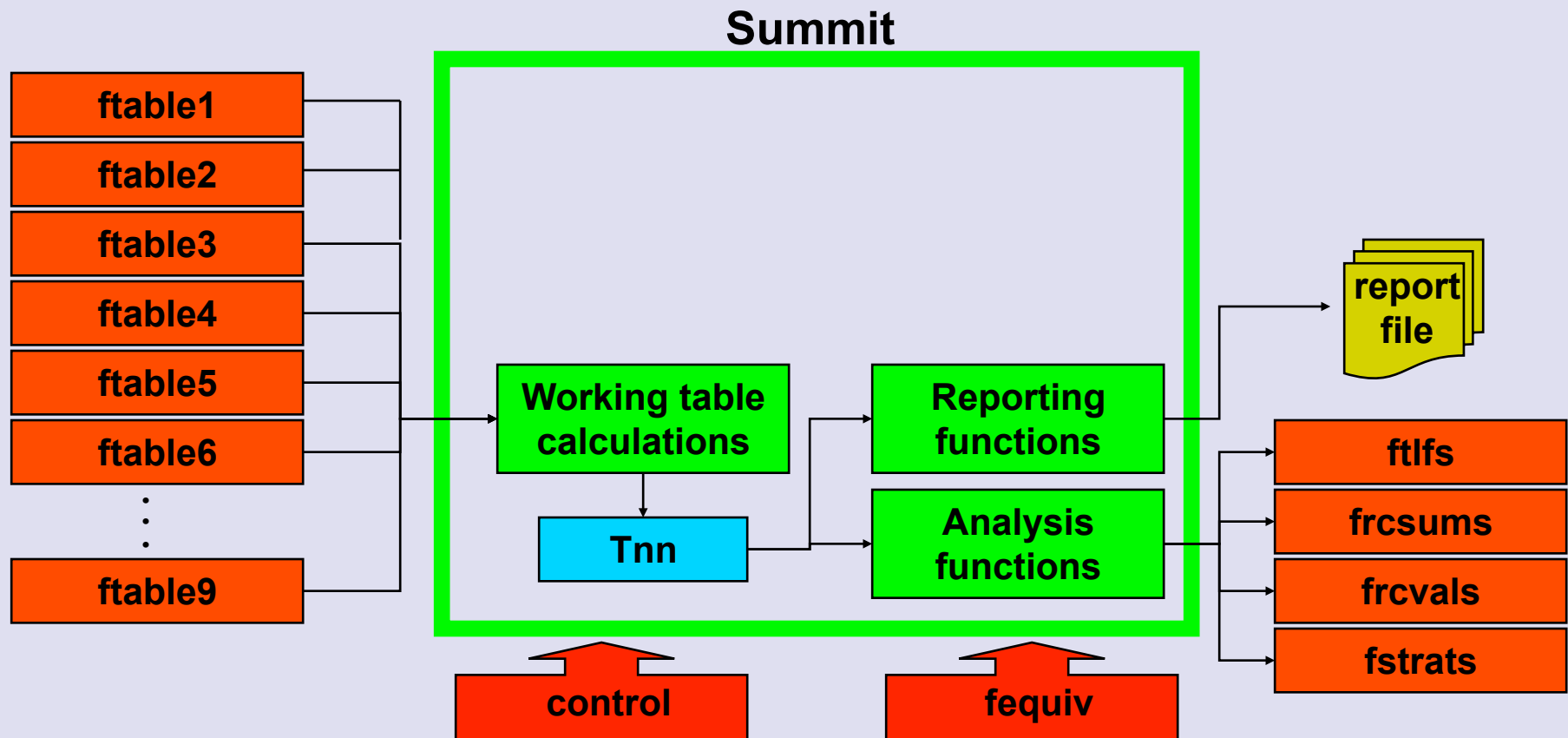
Summit Basics

- Control file
  - Keyword groups (namelists)
    - fnames   - names for all files
    - params   - #zones, #districts, software platform,
      - output file format
    - tables   - calculation specs for "working" tables
    - trpt   - settings for one table report
    - analysis   - frequency distributions, stratified tables
      - row|column values, rowsums|colsums
    - pages   - pagination of D-to-D reports the report file
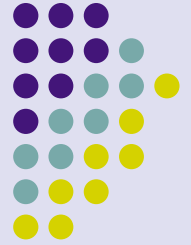
Summit Basics

- Control file (continued)
  - Syntax for table specifications
    - Table references
      - tfnnn
        - t = table indicator
        - f = file number; omitted for working tables
        - nnn or nn = table number
      - t203 = 3rd table of ftable2
      - t12 = 12th internal "working" table

Summit Basics

- Control file (continued)
  - Operators for table specifications
    - + – *   for add, subtract, multiply
    - /   for divide (district-level tables only)
    - > = <   for 1 if true, 0 if false
    - y M x   for maximum value of x and y
    - y m x   for minimum value of x and y
      where x and y are both tables or one is a table and one is a real number

Summit Basics

- ## Control file (continued)

  - ### Sample specifications for working tables

    - t1 = 't101 + t102 + t103'   !person trips by mode

    - t2 = 't101 / t1'   !transit share

    - t3 = 't201 + 2.5*t202 + 2.0*t203'   !impedance

    - t4 = 't201 > 0'   !got a transit path

    - t5 = 't101 * t3'   !transit expenditure

    - t9 = 't3 m t7'   !minimum impedance

| Specifications must be in single quotes |
| No parentheses or mixed operations |

| Comments begin with |
| exclamation marks |

Summit Basics

- ## Control file (continued)
  - ### Analysis
    - Freq distributions   tlf1 = 21,31   !trips,impeds
      intvltlf = 5   !5-min intervals

    - Stratified tables   tstrats = 21,31   !trips,impeds
      bpstrats = -15,-5,5,15   !breakpoints

    - Row|col values   trcvals = 21,31   !tables
      izvals = 600,634,651   !rows
      jzvals = 12,66,247   !columns

    - Row|col sums   trcsums=21,22   !tables

Summit Basics

- Output files
  - Report – control playback & D-to-D reports
  - Plain D-to-D reports (interior cell values only)
  - Frequency-distribution
  - Row-and-column cell values
  - Rowsums-and-colsums
  - Stratified z-to-z trip tables

Summit Basics

- ## Output files (continued)
  - frpt: reports of district-to-district s

```
                            Report S-3
           Transit Person-Trips in the TSM Alternative
                    All Transit-Access Markets
                        All Trip Purposes

Production                                  Attraction District
District    |    1     2     3     4     5     6     7      8      9     10      11      12     13   14 |   Total
------------+------------------------------------------------------------------------------------------+--------
 1 Perris   | 1692  3269    31    88   505    39   286    383    287    130      98     348      0    0 |   7156
 2 CityRiv  | 1133 26433   341    36    71   191  2613   4886   2166    961    1234    3092      1    0 |  43158
 3 Norco    |   40  2087   805     2     5    24  1367    570    230    233     336    1289      1    0 |   6989
 4 Hemet    |  651  1383    10  3739   616   201   144    132    136      9      20     161      0    0 |   7202
 5 Temecula |  319   725    10    14  3853    16   254    460    522    142     135     619      0    0 |   7069
 6 CVAG     |  183  1158     9    40    16  8530  1231    129     91     29      53     338      0    0 |  11807
 7 SBD      |  108  3568   229    19    28   295 75886   3115   1150   4409    3581   18887      6    0 | 111281
 8 OC North |    9   535    12     2     8     4   478 105543  36716   2680    8771   15720      3    0 | 170481
 9 OC South |    4   153     2     0     2     0   172  11045  34648   1516    1415    3159      0    0 |  52116
10 LA CBD   |    0     4     0     0     0     0    32     56      6   3414    3340    4637     12    0 |  11501
11 LA Corr  |    3   185     6     0     2     0   742  12182   2592  26659  159969  159500    287    0 | 362127
12 LA Rest  |   34   520    37     4     9    17  8133  13873   4833  54253  135949  893730   6753    0 |1118145
13 Ventura  |    0     1     0     0     0     0    33     44     10   1786    1204   10544  16294    0 |  29916
14 Pseudo   |    0     0     0     0     0     0     0      0      0      0       0       0      0    0 |      0
------------+------------------------------------------------------------------------------------------+--------
   Total    | 4176        1492        5115       91371        83387         316105         23357       |1938948
            |       40021        3944        9317       152418          96221        1112024         0 |
```

Summit Basics

- ## Output files (continued)
  - ftlfs – frequency distributions

```
tlf1<=v   t21:31   tlf2<=v  t22:32   tlf3<=v   t23:33   tlf4<=v  t24:34   tlf5<=v   t25:35
 -50.0        0                      -15.0        0                       -10.0        0
 -45.0     1041                      -10.0       49                        -5.0       89
 -40.0      134                       -5.0      460                        +.0   161359
 -35.0      216                       +.0   102509                         0.0    33032
 -30.0      188                       0.0    26511                         5.0   443973
 -25.0      382                       5.0   231246                        10.0      141
 -20.0      371                      10.0     2010                        15.0        0
 -15.0      547                      15.0       50
 -10.0      733                      20.0       11
  -5.0     1615                      25.0        0
   0.0    11788
   +.0    18242
   5.0    21185
  10.0     6904
  15.0     3735          t21:t31    > trips in table 21 classed by impedances in table 31
  20.0     2329
  25.0     1961                     > 1st column  = upper bound of impedance interval
  30.0     1590
  35.0     1100                     > 2nd column = number of trips in this impedance interval
  40.0     1058
  45.0     5970
  50.0        0
```

Summit Basics

- ## Output files (continued)
  - frcvals – cell values from selected rows/columns of selected tables

zone	r060001	r060005	r063401	r063405	r064101	r064105	c006601	c006605	c047201	c047205	c047501	c047505
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	41.00	12.30	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	1.00	2.38	11.00	5.58	0.00	0.00	0.00	0.00
4	1.00	23.58	1.00	2.45	1.00	25.02	25.00	8.76	0.00	0.00	1.00	8.05
5	0.00	0.00	0.00	0.00	0.00	0.00	16.00	19.20	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	31.00	50.92	0.00	0.00	1.00	0.45
7	1.00	2.95	0.00	0.00	0.00	0.00	33.00	37.79	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	8.00	8.07	0.00	0.00	0.00	0.00
9	1.00	5.34	0.00	0.00	0.00	0.00	13.00	18.38	0.00	0.00	0.00	0.00
10	0.00	0.00	2.00	20.93	1.00	5.41	19.00	35.03	1.00	−0.94	0.00	0.00
..	....	....	....	....	....	....	....	.....	....	.....	.....	....
..	....	....	....	....	....	....	....	.....	....	.....	.....	....
..	....	....	....	....	....	....	....	.....	....	.....	.....	....

r060001 > **r** = row values   **c047505** > **c** = column values
           > **0600** = izone 600   > **0475** = jzone 475
           > **01** = working table 01   > **05** = working table 05

Summit Basics

- ## Output files (continued)
  - frcsums – row and column sums from selected tables

zone	rs3	rs5	cs3	cs5
1	0	0	0	0
2	376	377	57	298
3	103	83	16	119
4	295	300	51	455
5	189	371	24	128
6	549	898	130	278
7	427	510	57	194
8	94	84	3	0
..	...	...	..	...
..	...	...	..	...
..	...	...	..	...
..	...	...	..	...
..	...	...	..	...
761	1261	2914	568	1977
762	936	339	3171	34758
763	1011	20666	857	4761
764	655	21008	267	2679

rs3   > **rs** = row sums
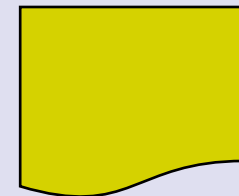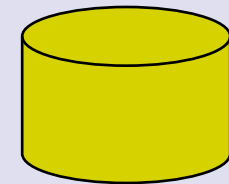> **3** = working table 03

cs5   > **cs** = column sums
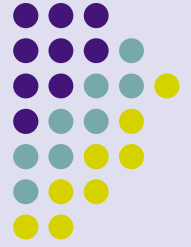> **5** = working table 05

Summit Basics

- ## Output files (continued)

  - fstrats – zone-to-zone tables from table stratification in specified software format

  - frpt – district-to-district summaries of the stratified tables

```
                    Report 2-1: Rail trips xfersBLD > xfersTSM by BLD-TSM Wtd Time
                              For Impedance Values Less Than     -0.01

Origin                                               Destination District
District    |   1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18 |  Total
------------+-------------------------------------------------------------------------------------------+-------
 1 Waianae  |   0    0    0   15   28   94   20   82  140   26   30   65  451   56   36  192  116   38 |  1389
 2 Makakilo |   0    0    0   16   10   48    3   29   67   10   36   41  247   32   20  237   56   18 |   870
 3 Kapolei  |   0    0    0   14   10   94   11   70   47   18   28   18  111   17   13  139   33   15 |   638
 4 Ewa      |   2    2   34   11   11   23   17  131  126   31   57   46  317   58   42  372   82   36 |  1398
 5 NCentVall|   9   12  151   35    0   84    0  201  303  128  142  142  906  210  246  375  209   72 |  3225
 6 Waipahu  |   0    9  141    1    4    3   36  154  120   41   31   55  319   78  148  639   93   37 |  1909
 7 Waiawa   |   0    2  107    2    0   18    0   58   35   17    8   26  113   24   51  210   29    7 |   707
 8 PrlCtyAiea|  0    4   75    0    0    9    1    2   40  189   47   25  157   39   23   59   31   39 |   740
 9 AirportPH|   1    0    3    0    1    2    0    3    0    4    2    6   19   11    1    9    2    1 |    65
10 SltLk Klwa|  0    0   12    1   16   12    3  235    0   18   28   76   88   69   22   60   35   17 |   692
11 Iwilei   |   0    0    2    2    0    6    0   11   10   37    2    2   22   70    2   86   12    6 |   270
12 Klhi Nnu |   0    0    0    2    4    3    0   20   30   44    6    1   62   77   30  120   25    0 |   424
13 Core     |   0    0    7    1    7    8    0   43   25   40    9    7   57   44   36  161   19    0 |   464
14 Makiki   |   0    0    3    0    0    4    0   26   53   65   56   35  208    0    0    0    0    1 |   451
15 Manoa    |   0    0    1    0    1    4    1   21    8    8    2    0   22    0    0    0    0    0 |    68
16 Waikiki  |   0    0    2    0    3    1    0   18    0   16   20    0    3    0    0    0    0    0 |    63
17 EHonolulu|   0    0    6    3    4    4    1   22   29   54   47   28   85    0    0    0    0    0 |   283
18 Windward |   0    0    8    3    5   12    2   38   56    4    0    5   11   37  141  236   18    0 |   576
------------+-------------------------------------------------------------------------------------------+-------
   Totals   |  12        552       104        95       1089       551       3198       811       760    | 14232
            |       29        106       429       1164       750       578       822       2895      287 |
```

User Benefits

- Topics
  - Definition
  - Calculation
  - Transit-access markets
  - Implementation with conventional models
  - Application

User Benefits

- Definition (for New Starts project evaluation)
  - User benefits are the changes in travel expenditures for fixed set of trips that are:
    - caused by changes in the attributes of a travel mode (or several modes);
    - measured in hours of travel time; and
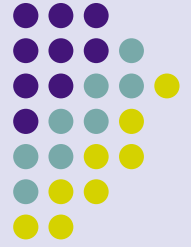   - summed over all travelers and all zone-to-zone interchanges.

User Benefits

- Calculation

  - $UB_{ij} = PTrips_{ij} \times dP_{ij}$

  - where

    - UB_{ij} = user benefits for travelers from zone i to zone j
    - $PTrips_{ij}$ = person trips from i to j in the base alternative
    - dP_{ij} = change in the <u>overall</u> price of travel from i to j considering all modes together

User Benefits

- Calculation (continued)
  - LogSum as the <u>overall</u> price of travel
    - All travelers / all travel options / all attributes
    - Reflects importance (share) of each mode
    - Decreases with improvements to options
    - Decreases with addition of a new option
    - Increases with loss of an option
    - Amenable to market segmentation across socio-economic class (income, autos)
    - Mode-choice denominator!

User Benefits

- Calculation (continued)
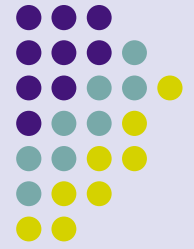
  - dP_{ij} = change in the price of travel from i to j

    $$= \{ \ln[\textstyle\sum_m \exp(U_m^{B})] \; - \; \ln[\textstyle\sum_m \exp(U_m^{b})] \} / C_{ivt}$$

  - where

    - C_{ivt} = coefficient on in-vehicle time
    - $\ln[\textstyle\sum_m \exp(U_m^{A})]$ = inclusive price for alternative A
    - B and b = Build and base alternatives
    - m is the set of available modes: transit and "other"

  See spreadsheet and narrative in Discussion #11 at:

  http://www.fta.dot.gov/planning/newstarts/planning_environment_5402.html

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User Benefits

- Calculation of capped user benefits
  - dPt_{ij} = change in the price of <u>transit</u>
    $$= \{ \ln[\exp(U_t^B)] - \ln[\exp(U_t^b)] \} / C_{ivt}$$
    - where $\ln[\exp(U_t^A)]$ = inclusive transit price for alt. A
    - Isolates the mode-specific contributions of UBs
  - Caps on the transit dPt_{ij}
    - Where $dPt_{ij} < (-45)$
      - Reset $Pt_{ij}^B = Pt_{ij}^b - 45$
      - Recompute dP_{ij} with reset value of Pt_{ij}

> (1) also applies to dPt > 45
>
> (2) purpose is to salvage shaky UB forecasts
>
> (3) default cap of 45 minutes can be lifted
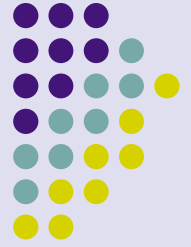
User Benefits

- Transit-access markets
  - Motivations
    - Avoidance of aggregation error with large dP variations
    - Detection of large coverage differences
  - Markets
    - Can walk (and may or may not be able to PnR or KnR)
    - Must drive
    - No transit
  - <u>Joint</u> distributions by base <u>and</u> build segmentations

User Benefits

- ## Transit-access markets (continued)
  - ### Calculation of user benefits
  - ### For each Z-to-Z cell

ALTERNATIVE

		can walk	must drive	no transit	
B	can walk	**dP(cw,cw) x PTrips(cw,cw) (-1-)**	**dP(cw,md) x PTrips(cw,md) (-2-)**	**dP(cw,nt) x PTrips(cw,nt) (-3-)**	**sum = user benefits i to j**
A **S**	must drive	**dP(md,cw) x PTrips(md,cw) (-4-)**	**dP(md,md) x PTrips(md,md) (-5-)**	**dP(md,nt) x PTrips(md,nt) (-6-)**	
E	no transit	**dP(nt,cw) x PTrips(nt,cw) (-7-)**	**dP(nt,md) x PTrips(nt,md) (-8-)**	**dP(nt,nt) x PTrips(nt,nt) (-9-)**	

Caps on dPt apply only to cells 1, 5, and 9 to avoid masking coverage differences

User Benefits

- Implementation within Summit

Summit

ftable1 *		User benefit calculations			fddub
ftable2 *					frcub

Usnn

Working table calculations → Reporting functions → report file

Tnn → Analysis functions

ftable3, ftable4, ftable5, ftable6, ... ftable9

control   fequiv

ftlfs
frcsums
frcvals
fstrats
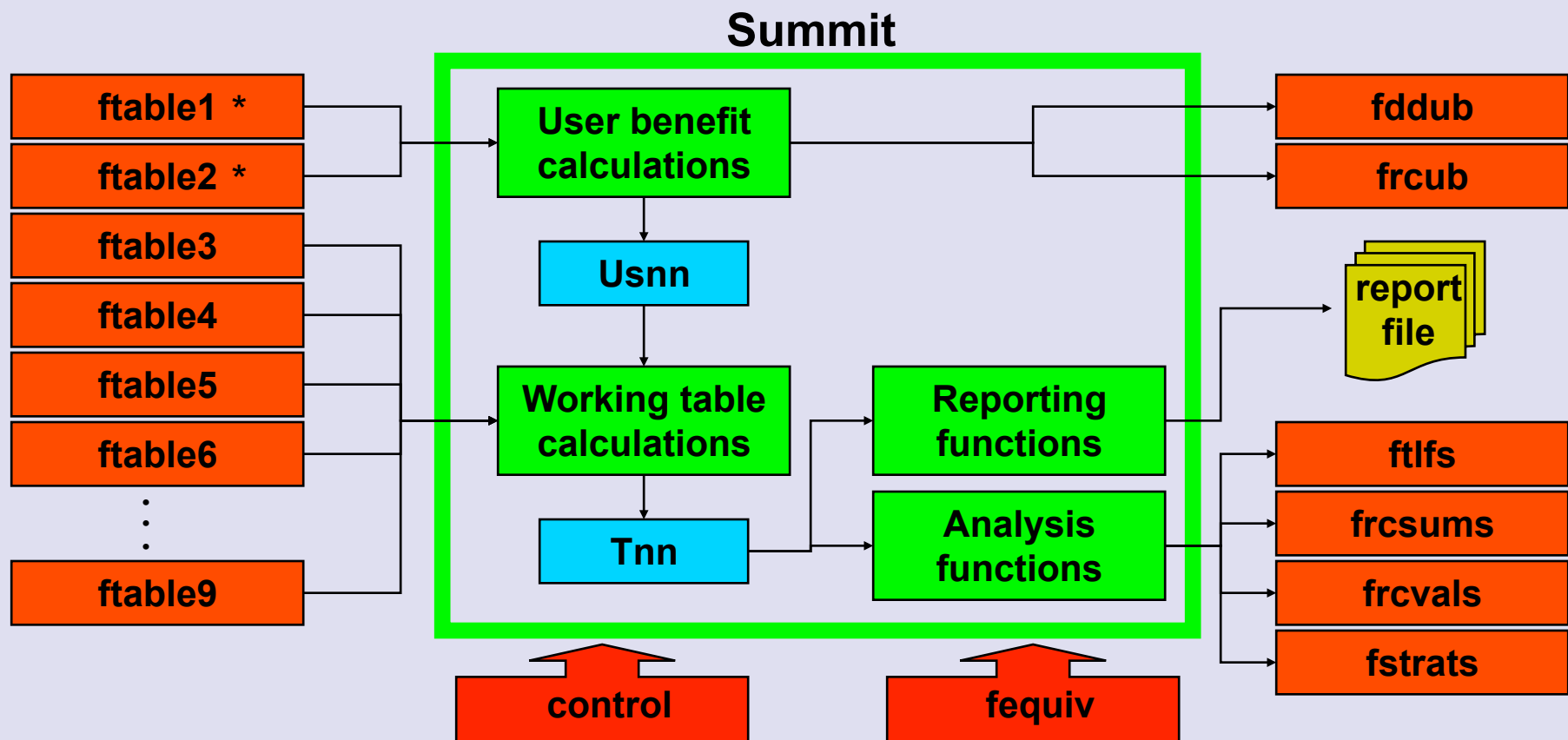
User Benefits

- ## Implementation within Summit (continued)

  - ### Syntax for table references to user-benefits results

    - #### Usnn

      - U = user-benefits table

      - s = socio-economic segment number

      - nn = user-benefits table number

      - For sum over all socio-economic segments,   s = # segments + 1

User Benefits

- ## Implementation within Summit (continued)

  - ### Contents of the Us<u>nn</u> array of user-benefits results

<u>Table groups</u>

   1-10: Base person trips

11-20: Alt person trips

21-30: Base transit trips

31-40: Alt transit trips

41-50: User benefits – total

51-60: User benefits – auto

61-70: User benefits – transit

71-80: User benefits – trip table

81-89: User-benefits/trip – transit

91-99: User-benefits/trip – total

<u>Tables</u>

1: CW-CW

2: CW-MD

3: CW-NT

4: MD-CW

5: MD-MD

6: MD-NT

7: NT-CW

8: NT-MD

9: NT-NT

10: sum of 1 through 9

User Benefits

- Implementation within Summit (continued)
  - <u>Additional</u> keywords related to user benefits
    - fnames – names for additional output files, as needed
      - fddub – D-to-D aggregations of standard user benefits tables
      - frcub – rowsums|colsums of zone-level user benefits tables
    - params
      - PQfiles – pointers to special binary files from mode choice
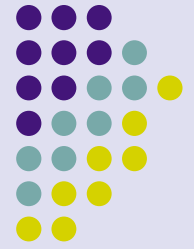
User Benefits

- Integration with local travel models
  - Items required from mode-choice calculations for each i-j and socio-economic class in the model
    1. Total person trips
    2. (Motorized person trips)
    3. Exponentiated utility of "non-transit" modes
    4. Can-walk market fraction
    5. Can-walk transit share
    6. Must-drive market fraction
    7. Must-drive transit share

Details follow

User Benefits

- ## Integration with local travel models (continued)

  #3: Computation of the exponentiated utility of non-transit modes for each access-market segment

$$= \exp(U_{auto}) + \exp(U_{walk})$$

auto   walk   transit

HOV   SOV   trn/wlk   trn/drv

2-occ   3+occ   bus   rail   bus   rail
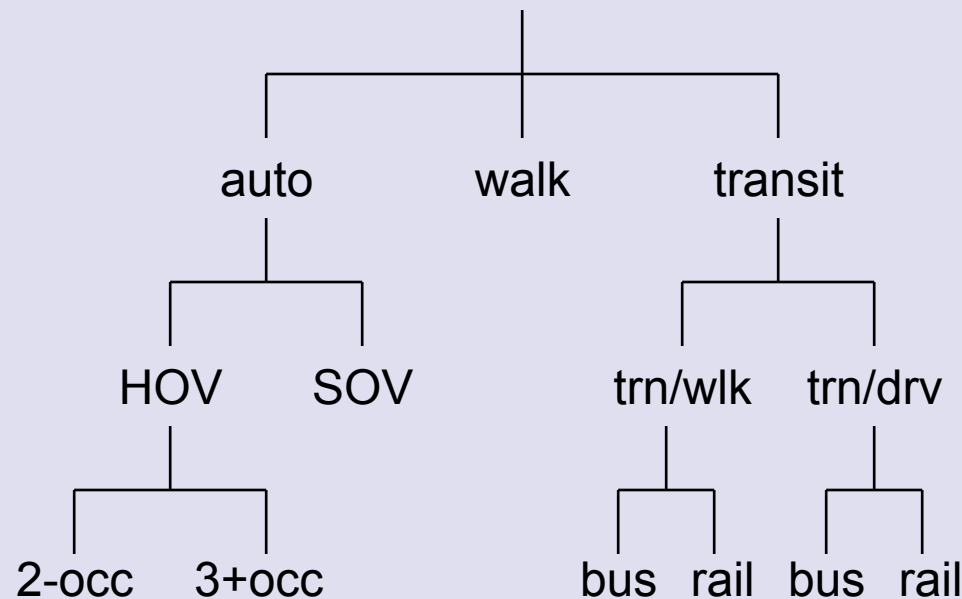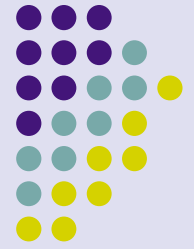
User Benefits

- Integration with local travel models (continued)

  #4, #6: Computation of transit-access market fractions

bus

| 75% | 25% |

I-zone 25

40%

60%

bus

J-zone 1
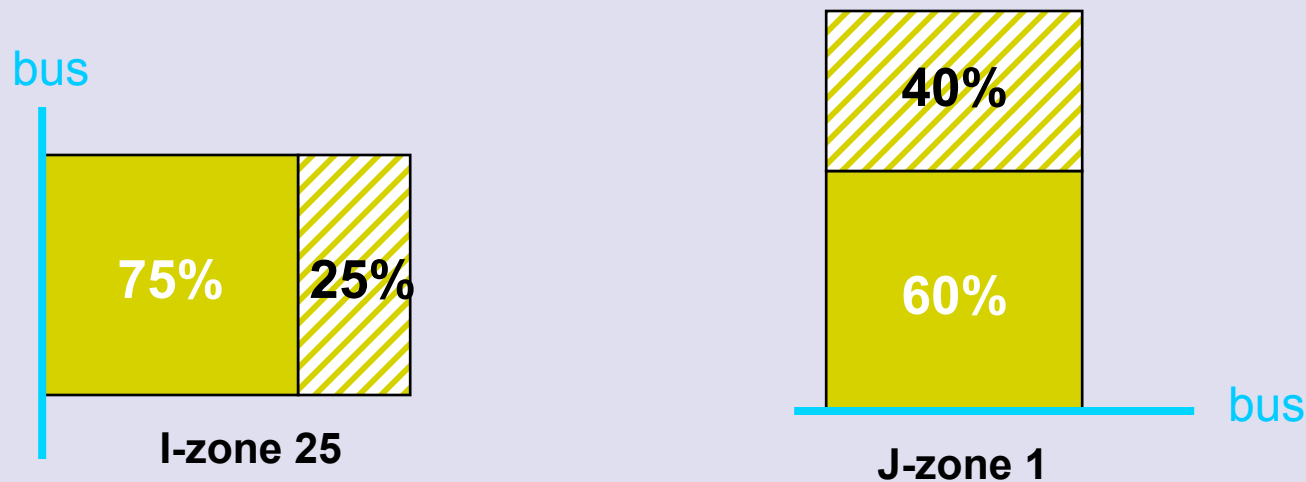
CW: Can walk (and maybe drive) to transit: 75 x 60 = 45.0%

MD: Must drive to transit: 25 x 60 = 15.0%

NT: No transit access: 40.0%

User Benefits

- Integration with local travel models (continued)

    #5, #7: Calculation of transit shares for access markets

$$\text{Transit market share}_{ij} = \frac{\text{Transit trips}_{ij} \text{ in the market}}{\text{person-trips}_{ij} \text{ in the market}}$$

    For the Can-Walk and Must-Drive transit markets

User Benefits

- Integration with local travel models (continued)
  - Options for mode-choice interface with Summit
    - Standard-content binary file from mode choice
      - Smaller output files and faster Summit runs
      - Modification of existing custom-written mode choice code
    - Native-format tables from mode choice
      - Useful with script-based mode choice applications
      - Useful with mode choice programs in commercial packages
  - Details in the Summit documentation

User Benefits

- Application
  - Fixed person-trip tables – <u>required</u>
    - Consistent with long-standing FTA approach
    - No-Build person-trip table used for all alternatives
    - Isolated from ~random differences between trip tables produced from doubly-constrained distribution models

User Benefits

- ## Application (continued)

  - ### Interface information for each transit alternative

HBW	HBO	NHB
TRIP GEN; TRIP DIST	**TRIP GEN; TRIP DIST**	**TRIP GEN; TRIP DIST**
MODE CHOICE → **HBW info**	**MODE CHOICE** → **HBO info**	**MODE CHOICE** → **NHB info**
TIME OF DAY	**TIME OF DAY**	**TIME OF DAY**

ASSIGNMENT
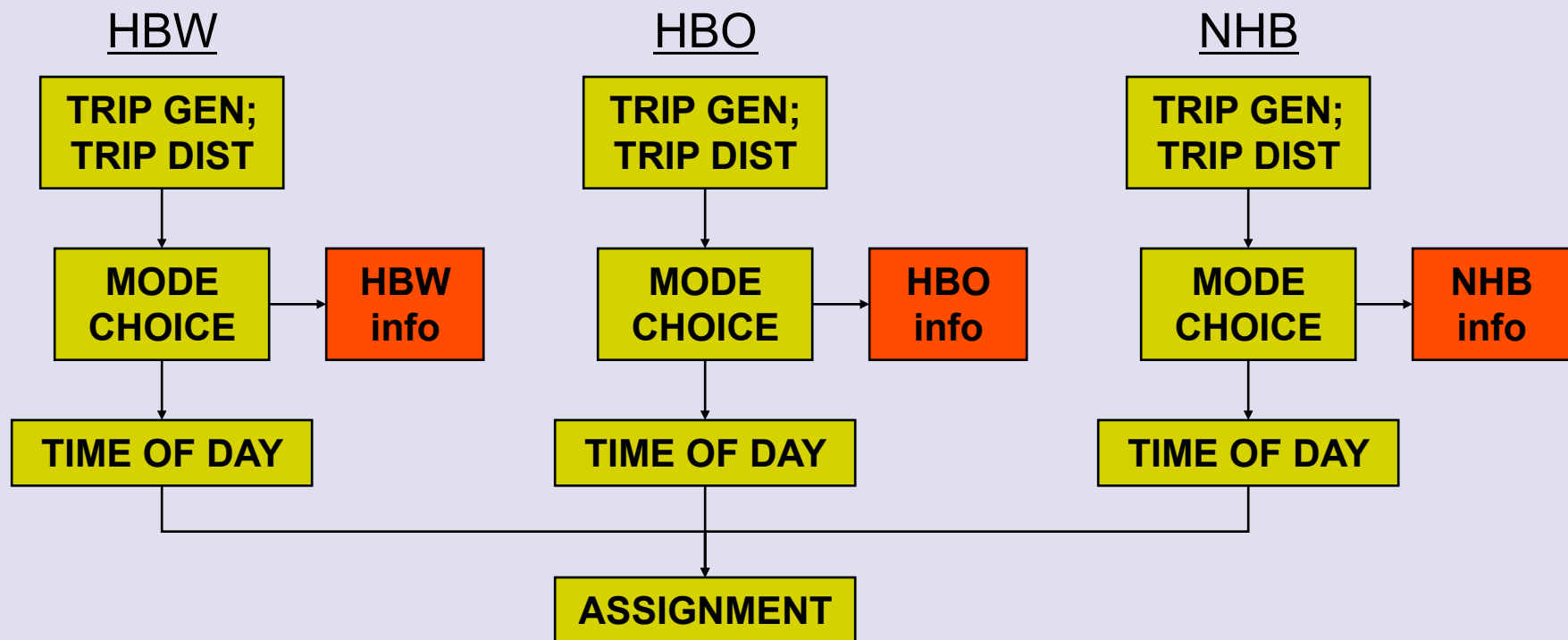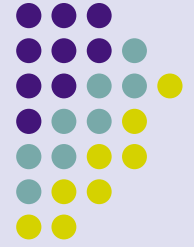
User Benefits

- ## Application (continued)
  - ### Summit calculations and reporting of forecasts

Alt HBW info		Summit		Alt HBO info		Summit		Alt NHB info		Summit
Base HBW info		User Bens: D-D & RCsum		Base HBO info		User Bens: D-D & RCsum		Base NHB info		User Bens: D-D & RCsum

Summit → reports
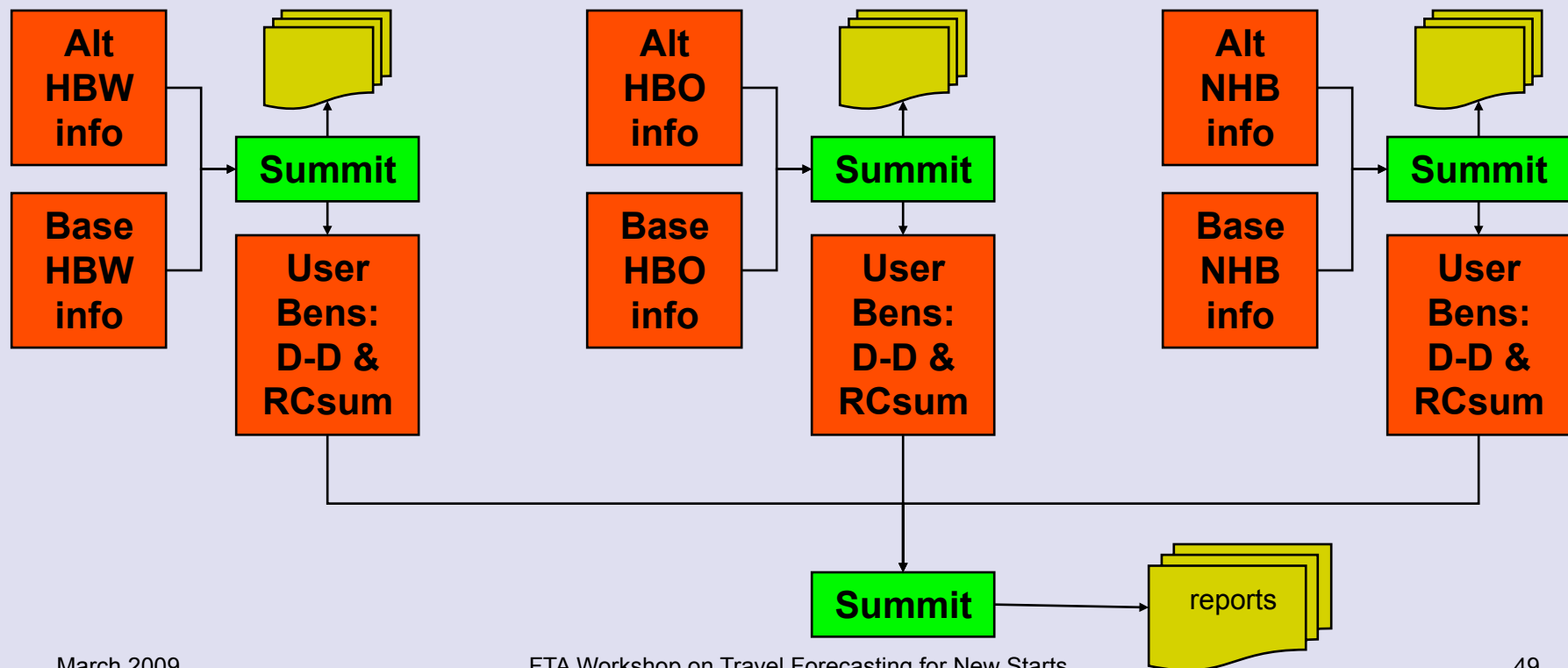
User Benefits

- ## Application (continued)

  - ### Additional report-file contents: UB table totals

37	trips	trn	ALT	NT-CW	294 trips
38	trips	trn	ALT	NT-MD	0 trips
39	trips	trn	ALT	NT-NT	0 trips
40	trips	trn	ALT	TOTAL	104734 trips
41	userbens	total		CW-CW	968132 minutes
42	userbens	total		CW-MD	0 minutes
43	userbens	total		CW-NT	-6954 minutes
44	userbens	total		MD-CW	0 minutes
45	userbens	total		MD-MD	0 minutes
46	userbens	total		MD-NT	0 minutes
47	userbens	total		NT-CW	13051 minutes
48	userbens	total		NT-MD	0 minutes
49	userbens	total		NT-NT	0 minutes
50	userbens	total		TOTAL	974229 minutes
51	userbens	auto		CW-CW	0 minutes
52	userbens	auto		CW-MD	0 minutes
53	userbens	auto		CW-NT	0 minutes

User Benefits

- ## Application (continued)

  - ### Additional report-file contents: capping effects

```
total expenditure         BASE          15385628 minutes
total expenditure         ALT           14297199 minutes
user benefits (d expnd)   BASE - ALT     1088429 minutes


Change in UBs from capped price changes (minutes)
Segment:    Total        1        2        3
          -------  -------  -------  -------
  CW-CW    -114199    -7410   -46377   -60413
  CW-MD          0        0        0        0
  CW-NT          0        0        0        0
  MD-CW          0        0        0        0
  MD-MD          0        0        0        0
  MD-NT          0        0        0        0
  NT-CW          0        0        0        0
  NT-MD          0        0        0        0
  NT-NT          0        0        0        0
  Totals  -114199    -7410   -46377   -60413
```

User Benefits

- ## Application (continued)
  - ### Additional row|col-sum file user benefits → GIS
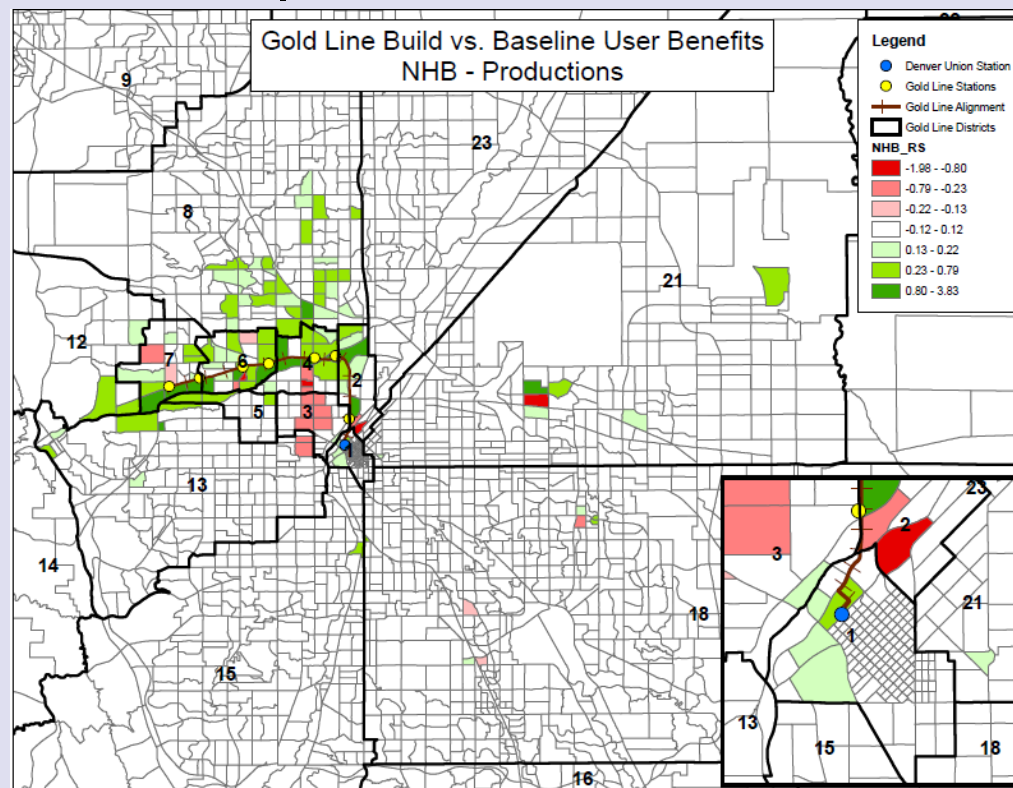
Summit Examples

Session 3

- Question on travel forecasts

- Analytical approach to an answer

- Implementation in Summit

- Results and insights
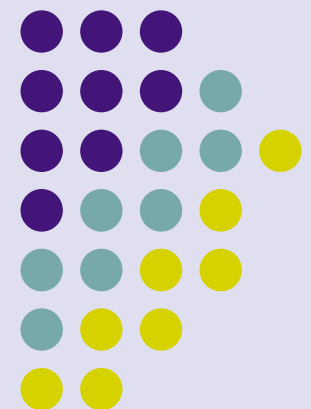
Notes on the Examples

- Honolulu test-bench constructed by FTA
- FTA analyses for illustrative purposes only
  - Not exactly the Honolulu travel models
  - Not exactly the Honolulu rapid transit project
  - Not the Honolulu project forecasts
- Thanks to:

  The Department of Transportation Services

  City and County of Honolulu

Problem #1

- Your colleague asks:

  I'm here from the mainland to write the case for the project and it's due at FTA tomorrow. I don't have anything on highway congestion changes between today and 2030. Can you help me?

- An approach

  - Compute the %Δ peak SOV times, '05→'30
    - Relative change: useful; absolute change: not
    - Cell weighted; could weight by trips (either '05 <u>or</u> '30)
  - Report district-to-district results

Problem #1 (Continued)

```
Hway-TT.CTL
  District-to-District reports for Peak Highway Travel Times
  through SOV paths

&fnames
  freport = 'Hway-TT.rpt'                  !report file
  fequiv = '764to18.eqv'                   !zone-district equivalence file
  ftable1 = '..\..\A30COM\skpkxxo1.b05'    !Today - highway skim file
  ftable2 = '..\..\A30COM\skpkxxo1.tno'    !2030 NB - highway skim file
&END

&PARAMS
  ndists   = 18                            !18 districts (maximum district number)
  nzones   = 764                           !764 zones   (maximum zone number)
  softtabi = 'minutp'                      !input table files in minutp format
  prteqv   = f                             !do not print zone-district equivalence table
&END

&PAGES
  pageh  = 59                              !page height for CourierNew, size 8
  pagew  = 149                             !page width  for CourierNew, size 8
&END

&TABLES
  t1='t101'                                !Today - pk period highway (SOV) travel time
  t2='t201-t101'                           !Delta highway travel time (2030 NB - Today)
  t3='t2/t1'                               !Relative IVT
&END

&ANALYSIS
&END

&TRPT
  t=3                                      !report table 3
  scale=100                                !to make percent
  tline4='Table 1: % Change PK H'way travel time'
&END
```

Problem #1 (Continued)

	District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
	Percent Change Highway Travel Time (2030 No-Build - Today), Peak Period																			
1	Waianae	-4	-31	-31	-29	-38	-27	-25	-13	-8	-7	-5	-5	-5	-5	-4	-4	-4	-8	-11
2	Makakilo	-17	-27	-26	-24	-6	-17	-6	0	4	4	6	5	5	5	5	5	5	3	2
3	Kapolei	-6	-13	-16	-15	1	-6	2	7	9	10	11	10	10	9	9	9	9	7	7
4	Ewa	-11	-19	-21	-21	-8	-15	-7	-3	1	2	4	3	3	3	4	4	3	1	0
5	NCentVall	-26	0	-2	-8	1	-6	-12	2	6	7	8	8	7	7	7	7	7	5	4
6	Waipahu	2	12	11	3	8	9	15	13	13	14	15	14	13	12	12	12	11	10	11
7	Waiawa	-5	4	1	-6	5	-3	-4	3	8	9	10	9	9	8	9	8	8	6	7
8	PrlCtyAiea	0	4	2	-3	9	-3	9	11	12	14	15	13	12	11	11	10	9	7	9
9	AirportPH	-2	2	0	-6	2	-6	1	3	4	4	10	7	7	6	6	6	5	3	3
10	SltLk Hlwa	-2	2	0	-6	1	-6	0	3	2	3	7	4	4	4	4	5	3	2	2
11	Iwilei	-2	2	0	-7	1	-7	-1	4	5	5	7	7	7	5	7	5	3	2	1
12	Klhi Nnu	-2	1	-1	-7	0	-7	-1	3	2	4	7	5	7	5	6	6	2	1	1
13	Core	-1	2	0	-6	1	-6	0	3	4	4	4	3	4	3	4	3	-1	1	0
14	Makiki	-1	2	1	-4	2	-4	1	4	4	5	4	6	2	2	5	4	3	4	2
15	Manoa	-1	2	1	-4	2	-4	1	4	4	5	8	7	5	4	3	4	0	3	2
16	Waikiki	-1	2	1	-4	1	-3	1	3	4	4	3	5	2	1	4	1	1	3	1
17	EHonolulu	0	3	1	-3	2	-2	2	4	4	5	6	5	5	4	5	4	3	3	2
18	Windward	-2	1	0	-4	0	-4	0	2	3	3	3	2	3	3	3	3	2	-1	1
	Totals	-4	0	-2	0	-1	0	-2	0	4	0	6	0	6	0	6	0	4	0	2
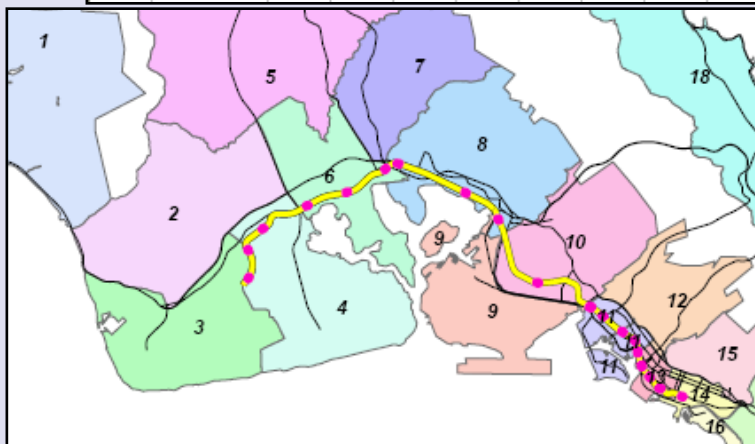
Observations

- Roadway improvements?
  - Growing areas of SW Oahu
  - To/from Waianae coast
- More congestion?
  - East of Pearl Harbor

Problem #1 (Continued)

- Your colleague returns:

  Um, I need something about current congestion too.

- A revised approach
  - For 2005
    - Compute peak delay vs. offpeak highway times
    - Compute percent peak delay
  - While we are at it, do that for 2030 too
  - Compute percent change in peak delay, 2005-2030
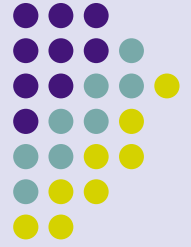
Problem #2

- Your colleague asks:

  Your Visine maps are all green; so all of your impacts seem to be positive. Have you ever checked for negative impacts that are hiding behind the positives?

- An approach

  - Flag z-to-z cells with +UBs & -UBs
  - Develop separate z-to-z tables for +UBs & -UBs
  - Report them for presenting frequency distribution and thematic maps.

Problem #2 (Continued)

```
&FNAMES
  ftable1='..\..\tsm-new\s4mc\userbwk.TSM'    !TSM - P&Q file from MC model
  ftable2='..\..\bld-new\s4mc\userbwk.MSL'    !BLD - P&Q file from MC model
  frcsums='prob#2-t.rcs'                      !row/col sums
  pqfiles=1,2                                 !ftable1 & ftable2 are P&Q files
&END
&TABLES
  t2='u441>0'                                 !Boolean positive Z-Z CW-CW UBs
  t3='u441<0'                                 !Boolean negative Z-Z CW-CW UBs
  t4='u441*t2'                                !Positive CW-CW UBs
  t5='u441*t3'                                !Negative CW-CW UBs
  t11='u141'                                  !Base CW-CW UBs,0-Car HH
  t12='u241'                                  !Base CW-CW UBs,1-Car HH
  t13='u341'                                  !Base CW-CW UBs,2-Car HH
  t21='u181'                                  !delta transit UBs/trip,0-Car HH
  t22='u281'                                  !delta transit UBs/trip,1-Car HH
  t23='u381'                                  !delta transit UBs/trip,2-Car HH
&END
&ANALYSIS
  tlf1=11,21                                  !TLF: user benefits by UBs/trip,0-Car HH
  tlf2=12,22                                  !TLF: user benefits by UBs/trip,1-Car HH
  tlf3=13,23                                  !TLF: unit benefits by UBs/trip,2-Car HH
  intvltlf=5.0                                !5-minute intervals for the TLF
  trcsums=4,5                                 !row/col sums tables 4 & 5
&END
&TRPT                         &TRP
  t=4                           t=5
  places=5                      places=5
  scale=0.016667                scale=0.016667
  tline4='Report 1-1: HBW +UBs(hrs)'  tline4='Report 1-2: HBW -UBs(hrs)'
&END
```

Problem #2 (Continued)

Results

Total UBs=25,382 hrs.

+ UBs=27,821 hrs

- UBs=2,439 hrs
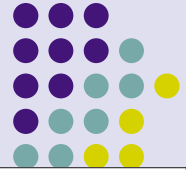
Report 1-1: Total + UBs (hrs), HBW

Origin District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1 Waianae	39	19	91	24	38	57	21	106	185	206	180	77	571	245	264	183	111	28	2444
2 Makakilo	14	25	168	51	24	45	11	68	68	93	197	37	255	110	125	169	57	19	1538
3 Kapolei	27	38	243	85	39	84	23	101	93	108	226	50	364	141	149	251	67	21	2110
4 Ewa	9	43	442	224	71	111	37	188	212	277	644	114	769	336	380	498	164	46	4566
5 NCentVall	22	31	275	103	446	289	151	372	276	381	321	139	898	405	427	284	182	53	5053
6 Waipahu	3	16	138	71	73	74	46	194	115	187	148	62	394	268	189	363	79	21	2440
7 Waiawa	7	17	167	54	96	137	14	146	78	135	103	40	304	188	113	292	54	18	1962
8 PrlCtyAiea	3	6	65	16	26	78	44	60	43	292	154	49	335	109	78	73	39	27	1494
9 AirportPH	1	0	2	1	1	12	7	24	14	71	10	5	21	7	3	3	1	1	184
10 SltLk Hlwa	1	3	29	9	18	49	26	291	157	211	243	75	350	94	36	52	24	23	1691
11 Iwilei	0	0	4	0	3	6	3	29	6	97	14	9	85	66	9	24	8	4	367
12 Klhi Nnu	1	0	9	3	6	15	6	81	34	176	73	8	171	112	18	44	10	2	771
13 Core	0	0	7	2	8	10	5	47	29	174	126	31	48	70	21	45	24	1	647
14 Makiki	0	0	6	1	4	5	2	26	23	77	95	13	150	14	9	3	11	1	442
15 Manoa	0	0	5	1	3	4	1	19	13	62	55	7	49	11	5	6	8	1	248
16 Waikiki	0	0	2	0	1	1	1	8	1	30	17	1	9	2	4	2	24	0	102
17 EHonolulu	1	1	13	5	3	12	4	42	22	83	58	14	107	61	28	70	45	5	574
18 Windward	1	2	26	9	14	28	14	116	69	212	114	16	132	155	97	137	24	21	1189
Totals	128	204	1691	659	875	1017	415	1918	1438	2872	2776	746	5011	2395	1955	2498	933	292	27821

Report 1-2: Total − UBs (hrs), HBW

Origin District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1 Waianae	-10	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-12
2 Makakilo	0	0	-4	-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-11
3 Kapolei	-2	0	-10	-9	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	-21
4 Ewa	-8	-13	-122	-90	-1	-19	-1	0	0	0	0	0	0	0	0	0	0	0	-253
5 NCentVall	-1	0	-2	-4	-143	-21	-15	-6	-1	0	0	0	0	0	0	0	0	0	-193
6 Waipahu	-2	-3	-36	-46	-22	-37	-6	-2	0	0	0	0	0	0	0	0	0	0	-156
7 Waiawa	-1	-1	-7	-12	-60	-38	-5	-5	-3	0	0	0	-1	0	0	0	0	0	-132
8 PrlCtyAiea	-2	0	-4	-11	-3	-19	-2	-49	-55	-10	-1	0	-1	0	0	0	0	-1	-158
9 AirportPH	0	0	0	0	1	-2	-1	-16	-35	-7	-14	-2	-2	0	0	0	0	0	-79
10 SltLk Hlwa	0	0	0	0	0	0	0	-9	-18	-31	-2	0	-2	0	0	0	-1	0	-64
11 Iwilei	0	0	0	0	-1	0	-1	-7	-55	-15	-7	-1	-9	-4	-1	-3	-3	-1	-108
12 Klhi Nnu	0	0	0	0	-1	0	-1	-11	-53	-6	-22	-1	-25	-9	-1	-3	-3	0	-137
13 Core	0	0	0	0	-3	0	-1	-10	-51	-6	-20	-9	-50	-22	-3	-21	-20	-4	-219
14 Makiki	0	0	0	0	-3	0	-1	-5	-19	-3	-20	-16	-88	-10	-3	-16	-17	-4	-205
15 Manoa	0	0	0	0	-2	0	0	-3	-16	-3	-12	-7	-29	-4	-1	-1	-3	0	-81
16 Waikiki	0	0	0	0	-1	-1	0	-2	-10	-1	-13	-14	-151	-34	-3	-10	-8	-2	-252
17 EHonolulu	-1	0	0	0	-2	0	-1	-4	-19	-5	-24	-8	-94	-23	-4	-14	-23	-2	-222
18 Windward	-1	0	0	-1	-3	0	-1	-9	-29	-5	-14	-3	-51	-8	-1	-2	-5	-4	-136
Totals	-27	-17	-187	-181	-246	-137	-36	-136	-363	-92	-148	-63	-504	-113	-18	-69	-82	-19	-2439

Problem #2 (Continued)

- Observations
  - Positive totals can include lots of negatives
    - Thematic maps
    - D-to-D reports
    - Separation of positives and negatives
    - Frequency distribution to check for significant numbers
    - Thematic maps and D-to-D reports to follow up, if magnitude of negatives is worrisome

Problem #2 (Continued)

- By the way, what happened with Δ <u>transit trips</u>?

  Summary of delta transit trips between mode choice output Minutp files for build and base alternatives

Report 1-1: Delta WA transit trips (BLD-TSM)

Production District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1 Waianae	22	17	63	23	47	55	25	92	175	187	150	63	468	193	222	163	97	34	2096
2 Makakilo	10	27	159	39	27	34	10	55	51	84	124	27	227	77	93	187	50	21	1302
3 Kapolei	15	29	177	50	42	69	12	89	75	91	137	42	251	95	103	210	64	23	1574
4 Ewa	-6	13	208	129	80	60	27	149	173	228	395	81	604	233	287	467	121	47	3296
5 NCentVall	20	38	282	84	323	241	137	336	277	347	270	129	796	312	354	264	159	54	4423
6 Waipahu	1	16	71	21	30	9	33	148	92	164	108	53	282	203	149	368	73	22	1843
7 Waiawa	5	12	134	31	25	54	2	104	58	119	74	31	214	141	83	284	40	19	1430
8 PrlCtyAiea	4	8	58	2	9	39	27	-15	-39	234	135	36	243	83	63	64	41	21	1013
9 AirportPH	2	0	3	2	1	7	5	-1	-38	59	-3	-1	12	4	3	0	3	-1	57
10 SltLk Hlwa	0	4	28	7	22	47	22	228	107	183	224	71	274	75	37	50	17	24	1420
11 Iwilei	0	2	5	0	3	9	-4	21	-36	76	7	8	82	51	4	18	2	-1	247
12 Klhi Nnu	1	2	8	3	9	4	8	60	-17	187	59	6	129	89	17	30	20	-5	610
13 Core	0	0	17	-2	-3	8	-2	21	-26	143	108	20	5	46	14	17	6	1	373
14 Makiki	0	-1	4	-1	4	12	3	15	3	61	60	1	62	8	1	-16	-3	-1	212
15 Manoa	0	0	3	1	5	5	3	10	-1	61	39	4	10	1	12	2	11	-4	162
16 Waikiki	0	0	1	-3	-1	1	2	10	-9	26	1	-8	-121	-44	6	-5	13	-3	-134
17 EHonolulu	-1	2	9	6	-1	16	4	35	22	65	41	-5	4	19	40	55	13	2	326
18 Windward	2	-1	30	9	16	21	17	122	42	227	88	12	66	131	88	134	15	-2	1017

```
 Totals  |   75     1260      638      331      909     2017     3608     1576      742   | 21267
         |       168      401      691     1479     2542      570     1717     2292     251 |
```

Problem #2 (Continued)

Report 1-2: Positive Delta transit trips

Production District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1 Waianae	51	33	141	55	63	83	30	110	181	194	188	88	545	226	237	184	130	45	2584
2 Makakilo	26	30	198	67	35	52	13	63	54	89	138	38	255	100	102	196	61	24	1541
3 Kapolei	48	53	279	120	56	117	24	108	85	96	168	53	312	112	110	228	71	32	2072
4 Ewa	30	57	456	297	113	149	43	177	191	240	439	113	698	276	316	507	170	67	4339
5 NCentVall	35	42	358	130	658	344	204	416	293	371	324	169	949	382	385	298	214	88	5660
6 Waipahu	21	41	222	132	151	136	75	219	112	179	139	68	400	247	160	422	96	34	2854
7 Waiawa	19	23	181	68	131	127	18	154	68	125	93	44	266	168	91	298	59	29	1962
8 PrlCtyAiea	9	15	140	53	76	139	76	195	63	288	194	82	396	117	76	88	61	53	2121
9 AirportPH	2	0	4	2	5	20	12	40	12	72	22	8	51	8	6	8	6	3	281
10 SltLk Hlwa	0	5	35	11	33	62	32	291	136	237	274	113	368	105	45	69	44	40	1900
11 Iwilei	0	2	12	3	7	19	6	70	27	125	69	78	257	135	31	64	34	24	963
12 Klhi Nnu	2	3	15	7	16	21	16	147	67	246	234	89	483	202	73	101	75	47	1844
13 Core	0	0	27	3	11	21	6	86	50	204	292	155	313	257	96	159	138	47	1865
14 Makiki	0	0	14	1	13	15	5	63	63	130	217	123	551	148	115	134	213	22	1827
15 Manoa	0	0	8	4	10	15	6	46	32	93	140	101	289	165	69	97	128	25	1228
16 Waikiki	0	0	5	0	3	7	3	26	24	47	66	39	161	76	57	49	114	12	689
17 EHonolulu	3	3	21	9	7	22	10	94	79	156	229	157	604	416	225	272	385	39	2731
18 Windward	5	3	55	18	33	45	32	229	141	326	301	192	578	281	149	263	112	193	2956
Totals	251	310	2171	980	1421	1394	611	2534	1678	3218	3527	1710	7476	3421	2343	3437	2111	824	39417

Report 1-3: Negative Delta Transit Trips

Production District	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1 Waianae	-29	-16	-78	-32	-16	-28	-5	-18	-6	-7	-38	-25	-77	-33	-15	-21	-33	-11	-488
2 Makakilo	-16	-3	-39	-28	-8	-18	-3	-8	-3	-5	-14	-11	-28	-23	-9	-9	-11	-3	-239
3 Kapolei	-33	-24	-102	-70	-14	-48	-12	-19	-10	-5	-31	-11	-61	-17	-7	-18	-7	-9	-498
4 Ewa	-36	-44	-248	-168	-33	-89	-16	-28	-18	-12	-44	-32	-94	-43	-29	-40	-49	-20	-1043
5 NCentVall	-15	-4	-76	-46	-335	-103	-67	-80	-16	-24	-54	-40	-153	-70	-31	-34	-55	-34	-1237
6 Waipahu	-20	-25	-151	-111	-121	-127	-42	-71	-20	-15	-31	-15	-118	-44	-11	-54	-23	-12	-1011
7 Waiawa	-14	-11	-47	-37	-106	-73	-16	-50	-10	-6	-19	-13	-52	-27	-8	-14	-19	-10	-532
8 PrlCtyAiea	-5	-7	-82	-51	-67	-100	-49	-210	-102	-54	-59	-46	-153	-34	-13	-24	-20	-32	-1108
9 AirportPH	0	0	-1	0	-4	-13	-7	-41	-50	-13	-25	-9	-39	-4	-3	-8	-3	-4	-224
10 SltLk Hlwa	0	-1	-7	-4	-11	-15	-10	-63	-29	-54	-50	-42	-94	-30	-8	-19	-27	-16	-480
11 Iwilei	0	0	-7	-3	-4	-10	-10	-49	-63	-49	-62	-70	-175	-84	-27	-46	-32	-25	-716
12 Klhi Nnu	-1	-1	-7	-4	-7	-17	-8	-87	-84	-59	-175	-83	-354	-113	-56	-71	-55	-52	-1234
13 Core	0	0	-10	-5	-14	-13	-8	-65	-76	-61	-184	-135	-308	-211	-82	-142	-132	-46	-1492
14 Makiki	0	-1	-10	-2	-9	-3	-2	-48	-60	-69	-157	-122	-489	-140	-114	-150	-216	-23	-1615
15 Manoa	0	0	-5	-3	-5	-10	-3	-36	-33	-32	-101	-97	-279	-164	-57	-95	-117	-29	-1066
16 Waikiki	0	0	-4	-3	-4	-6	-1	-16	-33	-21	-65	-47	-282	-120	-51	-54	-101	-15	-823
17 EHonolulu	-4	-1	-12	-3	-8	-6	-6	-59	-57	-91	-188	-162	-600	-397	-185	-217	-372	-37	-2405
18 Windward	-3	-4	-25	-9	-17	-24	-15	-107	-99	-99	-213	-180	-512	-150	-61	-129	-97	-195	-1939
Totals	-176	-142	-911	-579	-783	-703	-280	-1055	-769	-676	-1510	-1140	-3868	-1704	-767	-1145	-1369	-573	-18150

Problem #2 (Continued)

- Symptoms of odd delta-transit-trip results
  - 21,267 net gain = 39,417 gain – 18,150 loss
  - Checked MinUTP set-ups for errors → none
  - Checked Summit set-up for errors → none
  - Checked networks for bad service changes → few
  - What's happening? Answer: _____
- Moral(s) of the story
  - Forecasts are like a box of chocolates: you never know what you're going to get, <u>so you must look!</u>

Problem #3

- ## Your colleague asks:

  You sure changed the bus system a lot in the rail alternative. Are you sure that the user benefits are from the project and not from the bus changes?

- ## An approach

  - Identify z-to-z pairs with a rail-involved path
  - Identify z-to-z pairs without rail-involved path
  - Sum the UBs for the rail-involved pairs
  - Sum the UBs for the no-rail-involved pairs
  - Separate the +UBs from -UBs

Problem #3 (Continued)

```
&FNAMES
  ftable1='..\..\tsm-new\s4mc\userbwk.TSM'      !TSM - P&Q file from MC model
  ftable2='..\..\bld-new\s4mc\userbwk.MSL'      !BLD - P&Q file from MC model
  ftable3='..\..\bld-new\s3tpth\skamxxfg.MSL'   !BLD - Transit Skim file
  fddub='Prob#3.d2d'                            !District-to-District values for sum
  frcub='Prob#3.rcu'                            !Standard user benefit tables
  pqfiles=1,2
&END
&TABLES
  t1='u450'                                     !Total UBs
  t2='t304>0'                                   !Boolean, Rail in path
  t3='t304=0'                                   !Boolean, rail not in path
  t4='t1>0'                                     !Boolean, + UBs
  t5='t1<0'                                     !Boolean, - UBs
  t11='t1*t4'                                   !+ UBS
  t12='t1*t5'                                   !- UBs
  t13='t2*t11'                                  !+ UBS w/ rail in path
  t14='t2*t12'                                  !- UBs w/ rail in path
  t15='t11-t13'                                 !+UBs wo rail in path
  t16='t12-t14'                                 !-UBs wo rail in path
  t21='t13/t11'                                 !% +Rail UBs
  t22='t14/t12'                                 !% -Rail UBs
&END
```

Problem #3 (Continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	39	18	91	6	-	-	-	-	-	-	-	-	-					
2	12	24	153	13	-	-	-	-	-	-	-	-	-					
3	27	38	243	40	-	-	-	-	-	-	-	-	-					
4	2	19	221	163	-	18	-	-	-	-	-	-	-					
5	-	-	1	1	437	36	136	47	-	-	-	-	-					
6	1	-	3	22	28	15	1	1						-	-	-	-	-
7	-	-	-	3	94	7	14	4						-	-	-	-	-
8	-	-	-	1	22	7	4	12	9	4				-	-	-	-	-
9	-	-	-	-	-	1	-	19	14	47	1			-	-	-	-	-
10	-	-	-	-	-	-	14	151	150	7	6			-	-	-	-	-
11	-	-	-	-	1	-	-	-	24	1	1	4	-	1	-	-	-	
12	-	-	-	-	1	-	-	-	2	59	3	3	17	-	1	-	2	2
13	-	-	-	-	-	-	-	-	1	26	1	2	9	1	2	3	6	1
14	-	-	-	-	-	-	-	-	6	-	1	6	14	9	3	11	-	
15	-	-	-	-	-	-	-	-	10	1	2	4	7	5	4	8	1	
16	-	-	-	-	-	-	-	-	7	-	-	1	2	4	2	24	-	
17	-	-	-	-	-	-	-	1	4	8	7	7	29	61	28	70	45	5
18	-	-	-	-	2	-	-	1	4	28	6	9	13	2	1	1	5	21

Legends
- NonRail +UB =0
- NonRail +UB =1-75 hrs
- NonRail +UBs=75-150 hrs
- NonRail +UBs >150 hrs

Results

+ Rail UBs = 24,441 hrs
- Rail UBs = -2,413 hrs
+ Non-rail UBs = 3,119 hrs
- Non-rail UBs = -2,219 hrs
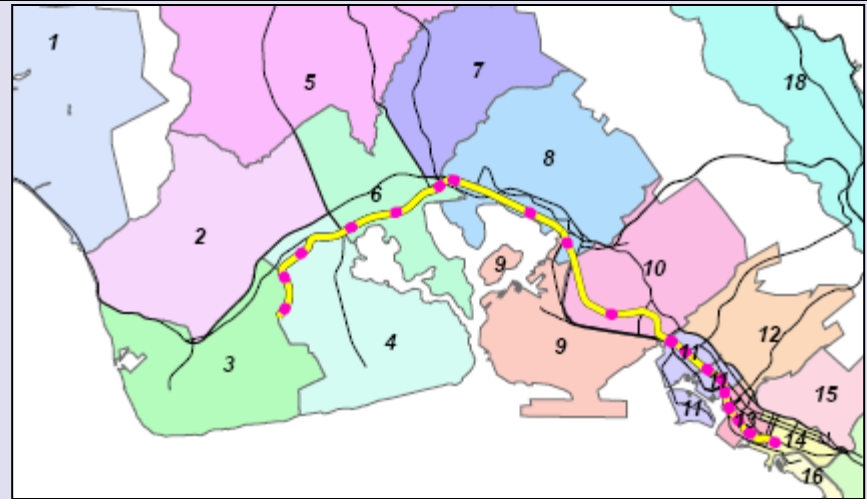
Observations

- Feeder buses to rail terminal?
- Long-distance buses from the Central Valley (district #5)
- Better bus (feeder bus?) connections between districts 10 and 9

Problem #3 (Continued)

- Your colleague continues:

  Just because you have a rail-involved path for a zone-pair, that does not mean it is actually causing the benefits. The benefits could be from the bus path.

- A revised approach

  - Include the mode choice output trip table
  - Test for rail share of transit trips > 50%
  - Test whether results change significantly with 30%, 70%

Problem #4

- Your colleague whines:

  Gee, you've got benefits everywhere. I'm trying to focus on the important stuff. Can't you highlight the travelers whose lives would be significantly changed by the project?

- An approach

  - Flag z-to-z cells with UB/trip outside of ±30 minutes.
  - Use flags to separate out UBs caused by ±30 min. Δs
  - Report and compare large UBs with the total UBs.

Problem #4 (Continued)

```
&FNAMES
  ftable1='..\..\tsm-new\s4mc\userbwk.TSM'        !P&Q file from MC model
  ftable2='..\..\bld-new\s4mc\userbwk.MSL'        !P&Q file from MC model
&END
&TABLES
  t1='u441'                                       !CWCW UBs - total
  t2='u141'                                       !CWCW UBs - 0-Car HH
  t3='u241'                                       !CWCW UBs - 1-Car HH
  t4='u341'                                       !CWCW UBs - 2-Car HH
  t5='u181'                                       !delta transit UB/trips/0-Car HH
  t6='u281'                                       !delta transit UB/trips/1-Car HH
  t7='u381'                                       !delta transit UB/trips/2-Car HH
  t11='t13>30'                                    !booleans, UB/trips >30 mins. 0-car HH
  t12='t13<-30'                                   !booleans, UB/trips <-30 mins. 0-car HH
  t13='t10*t21'                                   !UBs for trips saving >30 mins. 0-car HH
  t14='t10*t22'                                   !UBs for trips saving <-30 mins. 0-car HH
  t15='t23+t24'                                   !UBs for trips >30 & <-30 min savings
  t21='t14>30'                                    !booleans, UB/trips >30 mins. 1-car HH
  t22='t14<-30'                                   !booleans, UB/trips <-30 mins. 1-car HH
  t23='t11*t31'                                   !UBs for trips saving >30 mins. 1-car HH
  t24='t11*t32'                                   !UBs for trips saving <-30 mins. 1-car HH
  t25='t33+t34'                                   !UBs for trips >30 & <-30 min savings
  t31='t15>30'                                    !booleans, UB/trips >30 mins. 2-car HH
  t32='t15<-30'                                   !booleans, UB/trips <-30 mins.2-car HH
  t33='t12*t41'                                   !UBs for trips saving >30 mins.2-car HH
  t34='t12*t42'                                   !UBs for trips saving <-30 mins.2-car HH
  t35='t43+t44'                                   !UBs for trips >30 & <-30 min savings
  t51='t15+t25+t35'                               !UBs for trips >30 & <-30 min savings for all trips
  t52='t51/t1'                                    !ratio of UBs
&END
&ANALYSIS
  trcsums=51
&END
```
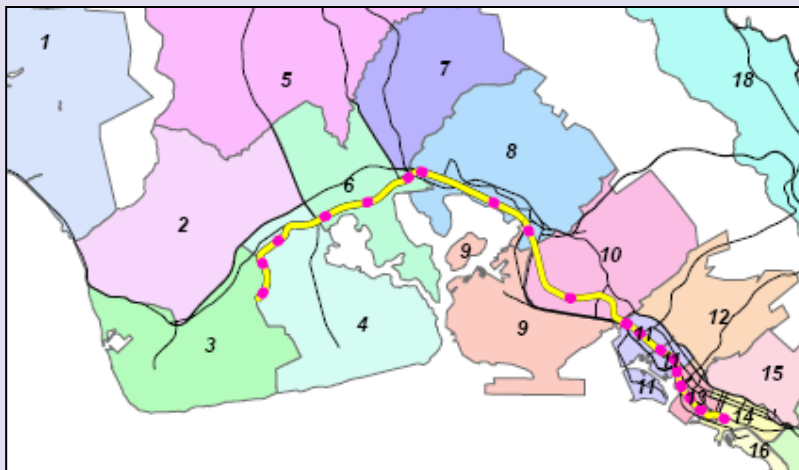
Problem #4 (Continued)

Results

TOTAL CW-CW User Benefits

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	25	18	82	18	16	36	15	65	124	88	112	50	395	154	121	126	66	16
2	11	24	147	40	13	37	9	49	58	50	150	31	212	85	65	135	38	11
3	24	38	229	71	21	74	16	71	77	55	176	37	300	103	77	179	46	13
4	-1	40	395	167	37	94	27	135	162	136	466	79	626	238	193	384	107	29
5	11	20	157	58	325	184	123	231	181	173	209	95	678	268	251	198	115	31
6	-1	13	60	18	28	29	34	147	107	106	120	52	376	226	121	345	64	14
7	1	14	106	27	33	75	6	70	53	76	59	23	171	102	65	153	27	7
8	-2	5	33	1	16	44	23		-18	225	113	42	302	92	59	65	27	14
9	0	0	2	1	0	8	4	6	-20	49	-8	2	12	4	2	2	1	
10	1	2	17	5	6	32	15	185	114	113	146	49	244	64	25	38	14	10
11	0	0	4	0	1	5	1	11		62	5	6	71	51	8	21	3	
12	0	0	6	1	3	10	3	26		112	13	3	76	53	12	25	4	
13	0	0	7	1	1	9	3	23		125	57	16	4	38	18	24	4	-3
14	0	0	5	1	-2	4	1	11	-1	50	31	-7	37	3	6	-13	-6	-4
15	0	0	3	1	-1	4	1	11	-3	47	27	-2	20	6	5	5	5	0
16	0	0	2	0	0	0	1	5	-10	23	1	-13			1	-7	16	-2
17	-1	1	6	3	-1	5	0	14	-11	41	1	1	-12	32	19	49	18	
18	-1	1	13	4	2	18	4	41	-5	98	27	6	17	61	61	63	6	

CW-CW UBs for >30 minutes savings

|	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	12	59	8	9	8	12	52	108	84	92	45	328	148	117	126	61	11
2	7	10	79	29	8	15	6	46	57	50	148	31	208	83	64	135	38	11
3	0	7	25	32	13	34	11	61	72	54	166	37	294	102	76	179	46	12
4	-1	14	106	92	27	36	21	107	150	135	444	71	529	223	187	332	96	23
5	7	16	115	42	158	131	80	160	155	167	163	79	519	235	236	194	95	21
6	0	6	24	27	13	31	14	49	77	103	109	44	266	213	114	283	53	5
7	0	9	49	20	-1	11	0	13	25	70	41	14	109	71	55	89	18	5
8	0	2	8	5	12	12	1	-6	0	100	27	13	170	68	51	53	18	5
9	0	0	1	1	-1	6	2	-6	1	35	-3	0	5	1	2	1	0	0
10	0	1	15	4	4	23	9	54	18	34	26	14	132	38	20	25	8	4
11	0	0	1	0	0	2	1	-1	-4	29	0	1	1	0	2	0	1	0
12	0	0	3	0	1	4	2	-3	0	38	0	0	1	0	1	0	0	
13	0	0	1	1	-1	2	3	-2	1	66	1	0	0	0	0	0	1	0
14	0	0	1	1	-1	2	1	-2	0	25	0	0	0	1	0	0	0	0
15	0	0	1	0	0	2	0	0	0	22	1	0	0	0	0	0	0	0
16	0	0	1	0	0	0	1	-1	0	9	0	0	0	0	0	0	0	
17	0	0	2	2	0	3	0	0	0	24	0	0	0	0	0	0	0	
18	0	1	4	2	2	12	3	13	1	46	3	1	10	18	17	10	3	0

Observations

- UBs from significant time changes
  - 69% of total UBs
  - Wow!
- Negative UBs
  - Apparently few from ±30 minutes
  - Need to do TLF to check

Problem #4 (Continued)

CW-CW UBs (Total)

CW-CW UBs (|ΔUBs/trip|>30 min)
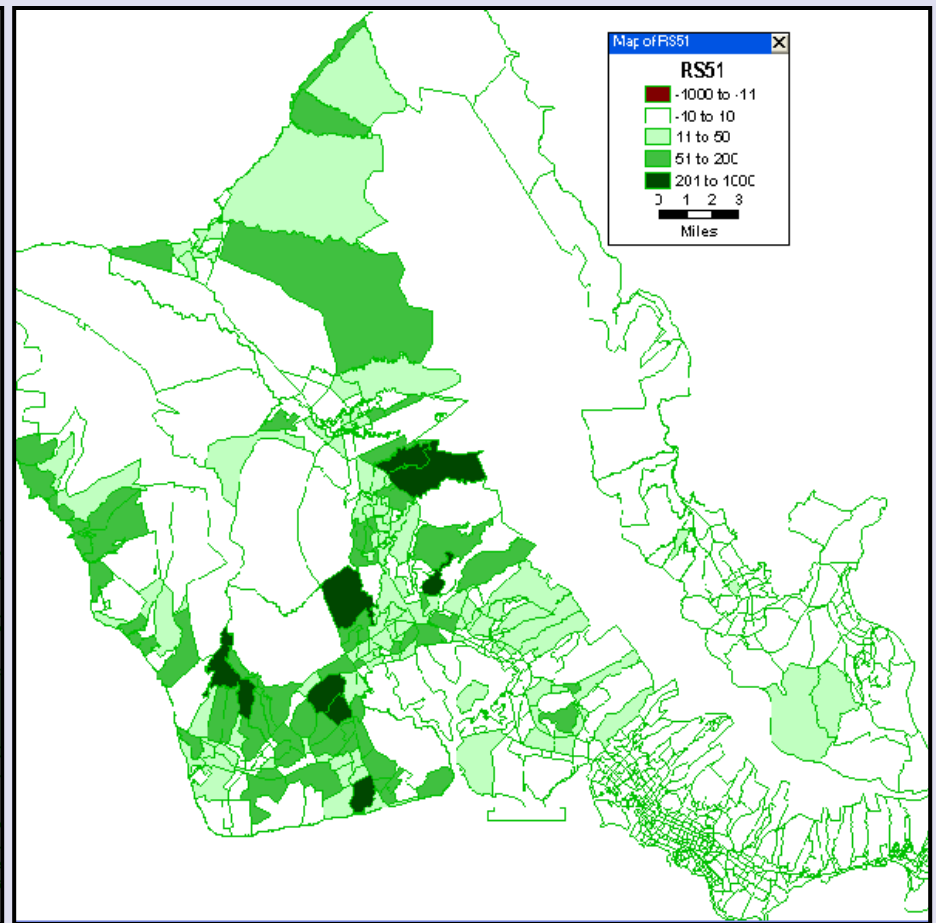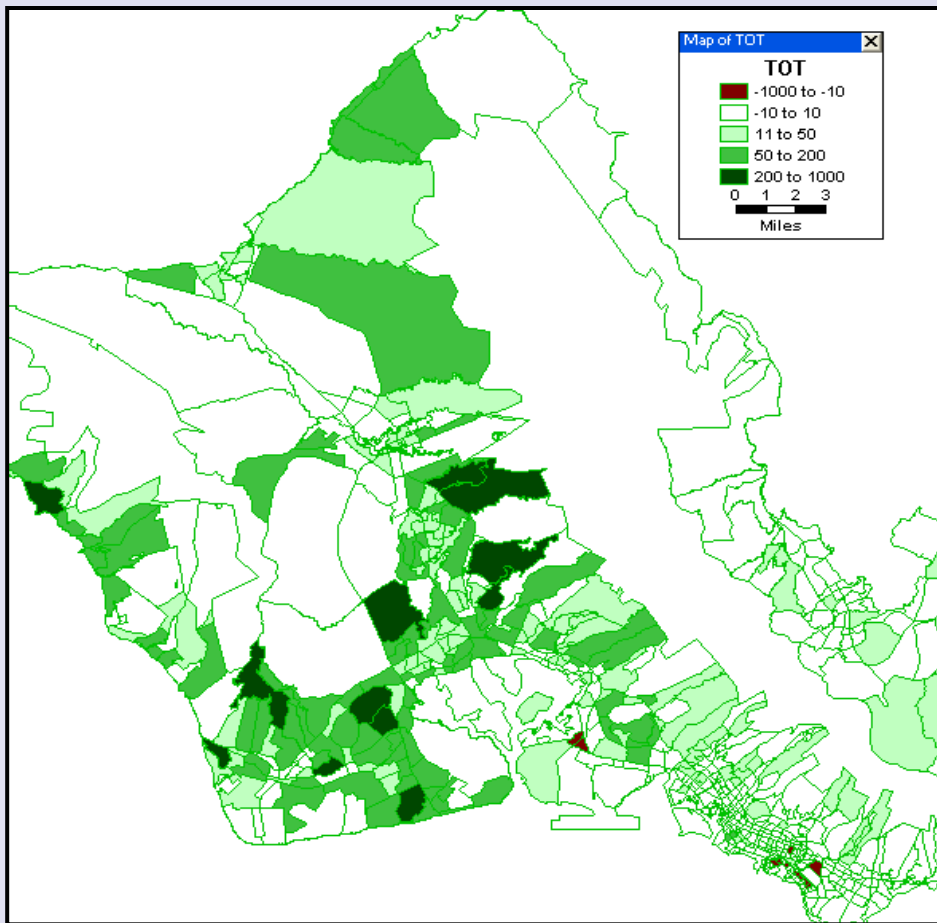
Problem #5

- Your colleague observes:

  You sure were aggressive in eliminating competitive bus services in the rail alternative. Do you think that some of those cuts may cause an uproar and not ever happen?

- An approach
  - Search for really unhappy "existing" transit riders
    - Rail alternative compared to TSM alternative
    - Transit trips that must transfer more and travel longer
  - Identify geography and implicated TSM bus routes
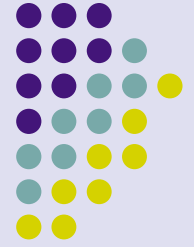
Problem #5 (Continued)

- Implementation in Summit
  - Use Boolean to find TSM trips with more xfers in BLD
  - Compute Δ weighted time (BLD minus TSM)
  - Get TLFD of TSM trips by Δ weighted time
  - Stratify TSM trip tables by Δ weighted time
  - Assign badly affected TSM trips to the TSM network

Problem #5 (Continued)

```
&FNAMES
  ftable1 = '..\..\tsm-new\s3tpth\skamxxwp.tsm'    !transit impedances   TSM
  ftable2 = '..\..\bld-new\s3tpth\skamxxfg.MSL'    !transit impedances   BLD
  ftable3 = '..\..\tsm-new\s4mc\ppxxwkmm.tsm'      !mode-choice output trip tables TSM
  ftlfd   = 'prob#5.tlf'                           !trip-length frequency distributions
  fstrats = 'prob#5.str'                           !stratified trip tables
&END

&TABLES
  t1 = 't206>t106'                                 !boolean:- more xfers in BLD than in TSM
  t2 = 't304+t305'                                 !sum of walk-local and walk-express TSM bus trips
  t3 = 't1*t2'                                      !bus trips with xfersBLD > xfersTSM
  t4='0.01*t103+0.02*t101+6.0*t106+0.02*t102'      !bus  weighted travel time           TSM
  ta4=103                                          !bus  availability based on total IVT  TSM
  t5='0.01*t203+0.02*t201+6.0*t206+0.02*t202'      !rail weighted travel time           BLD
  ta5=204                                          !rail availability based on rail  IVT  BLD
  t6='t5-t4'                                        !diff in wtd travel time, BLD minus TSM
&END

&ANALYSIS
  tlf1     = 3,6                                   !TLFD: bus trips in TSM by BLD-TSM wtd time
  intvltlf = 5.0                                   !5-minute intervals for the TLF

  tstrat=    3,6                                   !bus trips stratified by BLD-TSM wtd time
  bpstrats = -0.01,0.01                            !breakpoints for stratifications
  tline2   = 'Report 2-#
  tline3   = 'Bus trips with xfersBLD > xfersTSM'
  tline4   = 'Stratified by BLD-minus-TSM Weighted Time'
&END
```
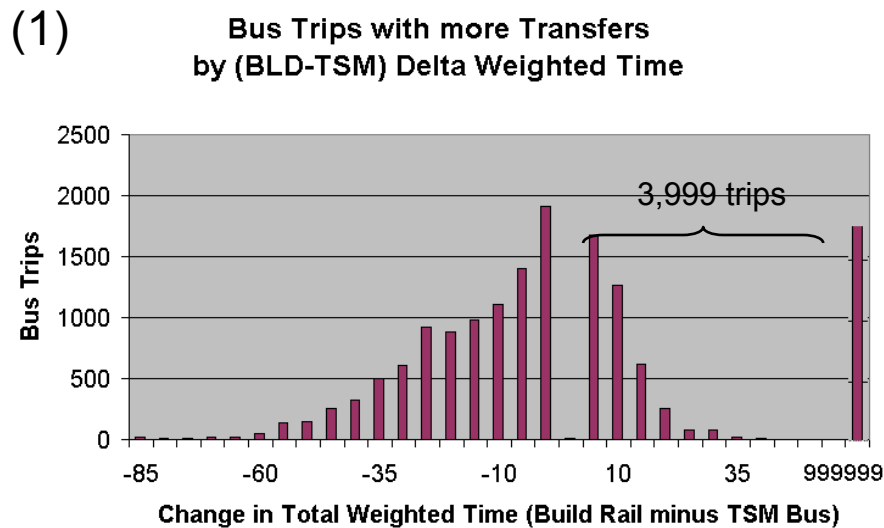
Problem #5 (Continued) Results

(1)

Bus Trips with more Transfers by (BLD-TSM) Delta Weighted Time — 3,999 trips
Bus Trips (y-axis) vs Change in Total Weighted Time (Build Rail minus TSM Bus) (x-axis)

Bus Trips xfers BLD>xfers TSM by BLD-TSM wtd time-impedance value > 0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
3	0	0	0	6	1	32	0	0	0	0	1	0	0	0	0	0	0	0	40
4	0	0	5	0	24	53	7	6	0	0	4	2	34	5	2	12	6	3	163
5	7	0	23	19	12	11	1	5	16	0	2	0	3	1	0	0	0	0	100
6	8	24	245	90	5	58	4	27	5	0	7	4	37	2	4	1	8	2	531
7	9	6	85	59	0	53	0	3	12	0	5	1	26	5	0	0	2	5	271
8	6	2	88	51	0	37	0	13	45	43	11	7	52	2	1	0	1	11	370
9	0	0	1	0	0	0	0	10	0	8	21	6	49	1	2	0	4	2	104
10	0	0	0	1	3	4	2	22	6	81	27	16	125	0	1	0	11	14	313
11	0	0	3	2	1	0	2	39	16	27	11	0	16	20	1	3	7	3	151
12	2	0	0	2	5	0	0	10	117	26	1	4	18	48	2	50	13	0	298
13	0	0	1	1	1	2	0	44	77	49	54	5	17	23	5	112	10	0	401
14	0	0	0	1	6	1	3	19	44	29	46	20	87	0	0	0	0	2	258
15	0	0	0	3	2	1	2	3	37	12	4	14	23	0	0	0	0	0	101
16	0	0	0	1	5	5	2	3	94	4	50	14	131	0	0	0	0	0	309
17	5	1	2	0	1	4	2	17	31	26	54	4	79	0	0	0	0	0	226
18	1	0	0	8	8	0	4	9	155	22	0	9	19	20	4	79	21	0	359
	38	33	453	244	74	261	29	230	655	327	302	106	716	127	22	257	83	42	3,999

(2) D-to-D cells of potential concern
-- 6 to 3;
-- 12,18 to 9
-- 10,16 to 13;
-- 13 to 16

(3) Bus lines of potential concern
-- Route 19AW (476 trips)
-- Route 50AE (383 trips)
-- Route 3AE (247 trips)
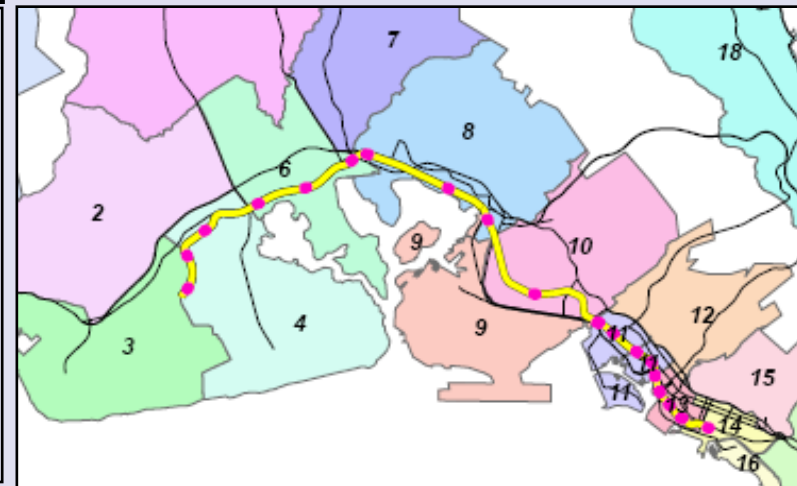
Problem #6

- Your colleague worries:

  I did not realize how narrow your rail corridor is geographically. Many bus routes will still run in the corridor – parallel to the rail line. Do you think that a lot of your rail riders might actually stay on the buses?

- An approach

  - Identify potentially grumpy rail riders (say, 2+ transfers)
  - Check for good alternative bus path
  - Identify riders with large +/- Δ weighted travel time

Problem #6 (Continued)

- ● Implementation in Summit
  - ● Use Boolean to find rail trips with 2+ xfers in BLD
  - ● Compute weighted times for all paths (LB, XB, rail)
  - ● Identify best_bus weighted time
  - ● Compute weighted time difference (rail minus best_bus)
  - ● Get TLFD of rail trips by weighted time difference
  - ● Stratify rail trip table by weighted time difference
  - ● Assign rail trips with competitive bus path to the bus-only network of the BLD alternative

Problem #6 (Continued)

```
&FNAMES
  ftable1='..\..\bld-new\s3tpth\skamxxwl.MSL'      !local bus impedances BLD
  ftable2='..\..\bld-new\s3tpth\skamxxwp.MSL'      !all Bus impedances BLD
  ftable3='..\..\bld-new\s3tpth\skamxxfg.MSL'      !guideway impedances BLD
  ftable4='..\..\bld-new\s4mc\ppxxwkmm.MSL'        !mode-choice output trip tables BLD
  ftlfd='Prob#6.tlf'                               !trip-length frequency file
  fstrats='Prob#6.str'                             !stratified trip tables
&END
&TABLES
  t1='t306>1'                                      !boolean: 2+ xfers in rail path
  t2='t406'                                        !walk to rail HBW trips, BLD
  t3='t1*t2'                                       !rail trips with 2+ transfers

  t11='0.01*t103+0.02*t101+6.0*t106+0.02*t102'     !LB only weighted travel time, BLD
  ta11=103                                         !LB availability indicated by LB IVT
  t12='0.01*t203+0.02*t201+6.0*t206+0.02*t202'     !all bus weighted travel time, BLD
  ta12=203                                         !all bus availability indicated by bus IVT
  t13='0.01*t303+0.02*t301+6.0*t306+0.02*t302'     !rail weighted travel time, BLD
  ta13=304                                         !rail availability indicated by rail IVT

  t14='t11 m t12'                                  !minimum of the LB and all-bus wtd times
  t15='t13-t14'                                    !delta wtd travel time (rail - best bus)
&END
&ANALYSIS
  tlf1     = 3,15                                  !TLFD: rail trips arrayed by delta wted time
  intvltlf = 5.0                                   !5-minute intervals for the TLF

  tstrat=    3,15                                  !rail trips stratified by delta wtd time
  bpstrats = -0.01,0.01                            !breakpoints for stratifications
  tline2 = 'Report 2-#'
  tline3 = 'Rail trips with xfersBLD => 2'
  tline4 = 'Stratified by (Rail-minus-Best Bus) Weighted Time'
&END
```
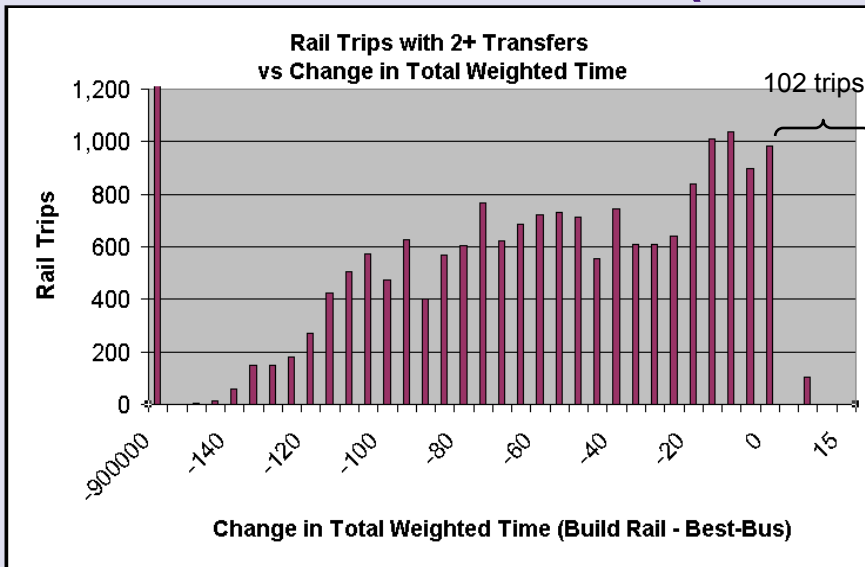
Problem #6 (Continued)

Rail Trips with 2+ Transfers vs Change in Total Weighted Time

102 trips

Y-axis: Rail Trips (0 to 1,200)
X-axis: Change in Total Weighted Time (Build Rail - Best-Bus)

Rail Trips xfers BLD =>2 by Rail-Bus wtd Time-Impedance value 0.0 to 10.0 min.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	3
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	7
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	4
12	0	0	0	0	0	0	0	2	0	3	1	0	0	2	0	25	5	0	38
13	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2
14	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	4
15	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	22
17	0	0	0	0	0	0	0	1	0	2	2	0	0	0	0	0	0	0	5
18	0	0	0	0	0	0	4	0	0	4	0	0	0	0	3	3	0	0	14
	1	0	5	0	0	1	5	7	22	12	4	1	2	2	4	28	5	3	102
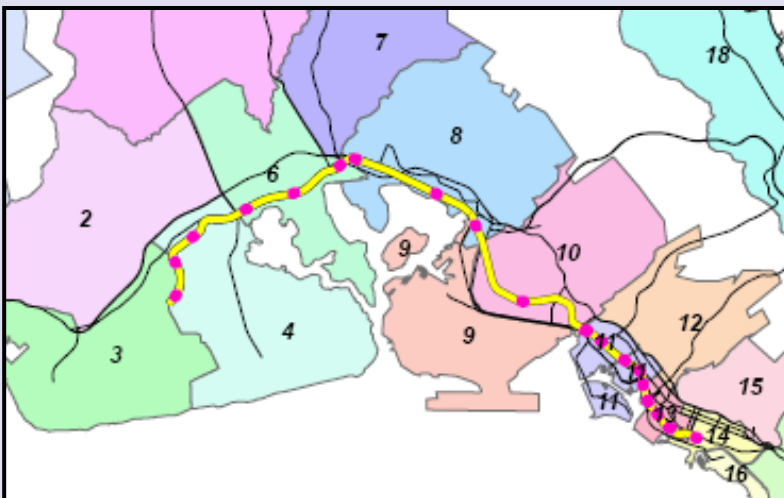
(2) D-to-D cells of (minor) concern
-- 16 to 9
-- 12 to 16

(3) Build bus lines of (minor) concern
19AW, 17BE, 8BE

Not much here; so risk of predicted rail riders actually staying on parallel buses seems very low.

Concluding Thoughts

- Roles of travel forecasts
  - Tradition: some grand totals but few insights
  - Better: answers to real-world questions
  - Best: information for decision-making
- Analytical reporting of forecasts
  - Quality control and quality assurance
  - Insights into problems, markets, impacts, benefits
  - Possible in <u>any</u> software setting
  - Possible <u>only</u> through analytical thinking