SACOG’s Regional Travel Demand Model Program

Workshop for Planners’ Committee
March 27, 2014
What is a travel demand model?

• You can’t “test build” a project or plan to see how it will perform…
• …so you do the next best thing: model it using computers
• Travel demand model has 3 basic inputs, all represented as digital databases
  – Population
  – Land Use
  – Transportation system (road, transit, bike, ped)
What is a TDM (cont’d)?

• The fourth “piece” of a TDM is mathematical sub-models which connect the population, land use and transportation system
  – Choice sub-models to estimate the amounts and types of travel which the activities of current or future residents will require
    • Activities generically defined: work, school, shopping, personal business, etc.
    • These models operate at person and household level
  – Aggregate sub-models to estimate the amounts and types of non-resident travel: commercial vehicle, external / through
    • These sub-models operate at zone level (currently)
SACOG’s TDM

- Sacramento Activity-Based Travel Simulation Model—a.k.a. SACSIM
- First “activity based” TDM to be used by an MPO for a statutory purpose (plan adoption, air quality conformity analysis)—2008 MTP, 2012 MTP/SCS
  - Others either doing so now, or in process (MTC, SCAG, SANDAG, etc.)
- Only large MPO TDM to use parcel-level land use and population data
- Development of model over time through combination of grant-funded consultant work, SACOG-funded staff work
Iterations of SACSIM

• Versions of SACSIM released every 4 years, with improvements / enhancements in each release
  – SACSIM07 = 2008 MTP, SACSIM11=2012 MTP / SCS. SACSIM15 to be used for 2016 MTP / SCS.

• Though developed by SACOG for use in MTP / SCS, model, data, programs, and documentation released to public agencies (or their consultants) for local use—more on this later.

• Development work governed by SACOG Overall Work Program
Unique Aspects of SACSIM

• Demand simulation for resident household-generated travel
  – NOT traffic simulation
  – Simulation is…
    • …unit of analysis is small (e.g. person)
    • …time is explicitly treated (i.e. a “clock”)
    • …randomness is “allowed”
  – Demand simulation in SACSIM is the DAYSIM sub-model
    • Activity-based (i.e. travel is an outcome of engaging in activities outside the home)
    • DAYSIM = open source software
Unique Aspects of SACSIM (cont’d)

- Advantages of demand simulation
  - Greater access to demographic factors (age, income, etc.)
    - Older models mush these factors together or miss them altogether
  - All household-generated travel “traceable” back to person/household
    - Older models lose track of about one-third of all travel which is “non-home-based” (i.e. generated by a resident, but for which neither trip end is at home)
Weekday Travel for 4-Person HH

- 16 person trips
- 11 vehicle trips
- 45 vehicle miles traveled
SACMET Representation of Travel

- Trips to/from TAZ, not HH
- Trip rates = averages
- Mode of trips unrelated
- Non-home-based trips disconnected

### HOME BASED TRIPS
- HH TAZ
  - 2.6 Trips
  - Work TAZ A
  - Work TAZ B

### NON-HOME BASED TRIPS
- HH TAZ
  - 2.6 Trips
  - School TAZ

- HH TAZ
  - 7.5 Trips
  - Shop, Other TAZ’s

- HH TAZ
  - 1.8 Trips
  - Other TAZ A

- HH TAZ
  - 1.8 Trips
  - Other TAZ B
SACSIM Representation of Travel

- People represented (1 FT worker, 1 PT worker, 2 school-age kids)
- “Tours” for each person generated
  - Tour = chain of trips beginning and ending at home
  - Tours defined by activities (work, school, shop, meal, etc)
- Mode prior mode choice affects later mode choice on tour
- Non-home-based travel “attached” to person
- Characteristics of people and place of residence retained through all activities and travel
SACSIM Representation of Travel (cont’d)

PERSON 1: Full Time Worker
Tour 1: Work Tour (Home-Work-Home) + 1 intermediate stop (Shop)
Tour 2: Escort Tour

PERSON 2: Part Time Worker
Tour 1: Work Tour (Home-Work-Home) + 2 intermediate stops (Escort Kids)
Tour 2: Work-Based Tour (Work-Work-Work)

PERSON 3: School Age Child
Tour 1: School Tour (Home-School-Home)
Tour 2: Soc/Red Tour (Home-Rec-Home)

PERSON 4: School Age Child
Tour 1: School Tour (Home-School-Home)
Not-so-unique Aspects of SACSIM

• Commercial vehicle sub-model
  – Simple “3-step” process
    • Trip generation (land use by zone)
    • Trip distribution (where to trips go)
    • Assignment to roadways (along with all other trips)

• External / through travel sub-model
  – External = trips with one end in region, other end outside region
  – Through trips pass through the region

• Vehicle trip assignment
  – How you get demand onto roadways
  – Add up parcel-level results to zones for assignment (800k parcels, 1534 zones)
Compare to Local Area Models

- Many jurisdictions have built their own TDM’s
- Vary widely, but some common threads:
  - Generally simpler in structure (e.g. no demand simulation, no parcel-level data)
  - Generally more detailed transportation network within jurisdiction (i.e. more roadways, smaller zones)
  - Generally actually used by consultants under contract, not by staff
  - Focused on vehicle traffic and peak periods or hours
What are TDM’s Used For?

• Development / evaluation of projects
  – Transportation improvements
  – Land development projects
• Development / evaluation of plans
  – System-wide packages of transportation improvements
  – Area-wide changes in land use
• Filling in gaps in “real” data
  – No agency counts or surveys enough to empirically know what is going on for a system or a large area.
  – Models have been pressed into service to fill in this knowledge gap.
SACSIM Applications & Uses

- MTP / SCS analysis
  - Region and subarea estimates of travel outcomes
    - VMT
    - Congestion
    - Travel by different modes
  - Equity / environmental justice analysis
    - Unique subarea analysis of MTP / SCS outcomes
  - Clean Air Act analyses (a.k.a. air quality conformity)
    - SACSIM is the source of vehicle activities which are post-processed using EMFAC to estimate emissions
SB375 greenhouse gas analysis

– Does SCS meet regional GHG reduction targets?
  • Baseline = 2005 passenger vehicle CO2 per capita
  • 2020 target = 7 percent reduction from baseline
  • 2035 target = 16 percent reduction from baseline

– Similar to CAA / AQC analysis:
  • SACSIM forecasts vehicle activities
  • EMFAC used to estimate vehicle emissions

– Contrast to local agency CAP’s:
  • SB375 broad geography, but narrow GHG source
  • CAP’s narrow geography, but broad GHG sources
Examples of Applications

Figure 5B.1
Total Vehicle Miles Traveled in the SACOG Region, Historic Trends and Projected MTP/SCS


Source: SACOG, September 2011.
VMT per Capita--Graphed

Figure 5B.3
Weekday Household Vehicle Miles Traveled per Capita by Community Type in the SACOG Region¹

¹ Household-generated VMT as defined in this report is rolled up to place of residence, and then totaled to the Community Type of the place of residence.

Source: SACOG, September 2011.
Figure 5C.8
Transit, Bike and Walk Trips Per Capita by Community Type in the SACOG Region

Source: SACOG, September 2011.
Same Non-Auto Trip Data--Mapped
Roadway Congestion
Local Agency Use of SACSIM

• History:
  – Local agencies slowly engage with SACMET, but by about 2000, many based local models on SACMET

• Only 3 known applications of SACSIM by local agencies
  – I-5 Subregional Impact Fee (early work)
  – Sacramento County General Plan (smart growth sensitivity analysis)
  – Recent Sacramento County Jackson Highway Corridor Traffic Impact Study
Local Agency Use of SACSIM (cont’d)

- Reasons for slow transition
  - Normal learning curve
  - Consistency with existing analysis & studies—don’t want to “switch horses”
  - Data files (parcel file, population file) more difficult to create and manage
  - Model takes longer to run
SACOG TDM-Related Programs

• Model Development Program
  – Funds work to improve models over time
  – Priority on
    • Keeping model up to standards
    • Allowing for analysis capabilities to keep up with policy questions
    • Testing and documentation for current models

• Regional Forecasting Program
  – Provide technical assistance related to TDM to local agencies for their projects

• Regional Transportation Monitoring Program
  – Tracks changes to travel and key factors influencing travel
Model Development Program

- Key applicable guidelines & standards
  - General trend: federal guidelines & standards diminishing over time, state intensifying
  - CAA act includes many G & S on how models are used, but less on what models are
    - 2010 CTC guidelines are most significant for SACOG---SACOG an “E” class MPO (large)—most extensive requirements and recommendations
    - SB375 Regional Targets Advisory Committee—no G&S per se, but spotlighted “reasonable sensitivity to key factors” as an issue/deficiency among many MPO models
    - SB375 itself has G&S on transparency and public access
Model Development Program (cont’d)

• Key applicable guidelines & standards (cont’d)
  – 2010 CTC G&S
    • 15 specific TDM requirements, 53 recommendations
    • Most of the requirements are routine (validation to counts, feedback loops, etc).
    • Some of the recommendations are very difficult (sensitivity testing, details on treatment of transit sub-modes, etc.)

• FHWA References and Resources
  – Validation & Reasonableness Checking Manual
  – Travel Model Improvement Program—funds independent peer review
    • SACSIM subject of TMIP peer review 2008
    • Planned update of peer review 2015
Model Development Program (cont’d)

• SACSIM15 enhancements
  – DAYSIM software updated—bigger faster stronger
  – Additional time periods added (highway increased from 4 to 12, transit from 2 to 5)
  – Transit sub-modes added (LRT/rail, commuter bus, local bus—prior only one generic transit mode)
  – Highway networks move from “stick and ball” to GIS basis (more accurate distances, more attractive maps)
  – Operational June 2014, to be used for 2016 MTP / SCS update

• SACSIM19 enhancements in planning stage
Regional Forecasting Program

• TDM assistance to local agencies
  – Locally requested data extracts or analysis, based on MTP / SCS forecasts
  – Access to SACOG models, data—generally for their consultants
    • SACSIM training for consultants, staff
  – Work-sharing on using SACSIM:
    • SACOG prepares SACSIM parcel and population files, based on locally-generated project descriptions, provide to local agency for their use
    • Alleviates most labor-intensive & difficult step in using SACSIM from the consultant
Regional Forecasting Program (cont’d)

• Recent examples:
  – Woodland GP: SACOG took consultant prepared traffic zone shapefile, prepared SACMET-runnable base year data files
  – Jackson Highway Corridor TIS: SACOG prepared parcel and population files for 4 projects to County staff; training on SACSIM for consultant
  – Many requests for “background traffic” volumes for specific areas for small-scale TIS’s or negative declarations
Reg. Transportation Monitoring Program

- Not modeling per se, but organizing observed data on travel and key factors influencing travel
- Useful for:
  - Updating base year (4 year cycle)
  - Trend-tracking
  - Establishing reasonable ranges of key assumptions (e.g. fuel prices and auto operating costs)
  - Establishing reasonable ranges for TDM validation (traffic volumes, transit passenger volumes, VMT, etc.)
Total VMT per Capita
6-County SACOG Region
Transit Service Hours Provided, per Capita
All Operators in 6-County SACOG Region