



AZ-SMART

Arizona's Socioeconomic Modeling, Analysis and Reporting Tool Box

MAG POPTAC
June 23, 2009



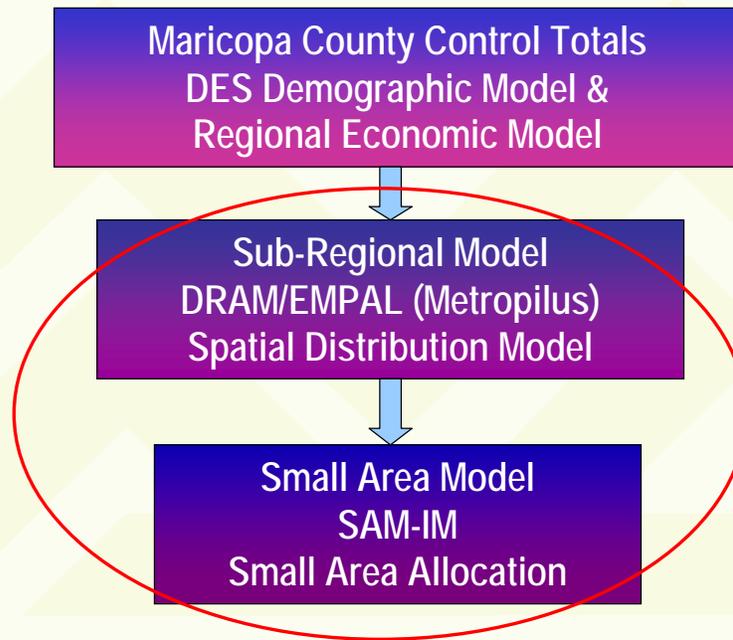
Socioeconomic Projections at MAG

- Prepared every five years or as needed
- 2005 to 2035 in 5-year intervals
- Variables projected:
 - Population in households
 - Population in group quarters
 - Total housing units
 - Occupied housing units
 - Employment
- Population Technical Advisory Committee reviews all data, assumptions and results and recommends approval
- Management Committee recommends approval of Municipal Planning Area (MPA) and Regional Analysis Zone (RAZ) numbers
- Regional Council approves at MPA and RAZ level





Current Modeling Process



Why AZ-SMART?



- Current platform
 - Old technology
 - New questions
- Current buzzwords
 - Agent based modeling
 - Behavioral models
 - Activity models
- UrbanSim the National Standard
 - Funded by EPA/NSF/FHWA
 - Developed by Paul Waddell @ University of Washington
 - Similar to SAM-IM



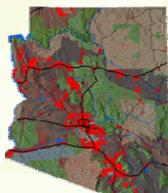
AZ-SMART

- A framework for creating, editing and managing software tools
- Suite of tools to model, analyze, summarize, visualize
- Applications able to project land use, population, employment, other socioeconomic variables in GIS environment
- Customizable
- Scalable system – new modules can be added



Phase I

- Best of SAM-IM and UrbanSim
- Contract with UW: Dec. 2006 to July 2008
- Current version includes all features developed under AZ-SMART contract
- Key additions to UrbanSim:
 - Addition of the GUI
 - New Real Estate Development model
 - Sub-Regional Control totals
 - New model types
 - GIS capabilities
 - User Documentation





General Characteristics

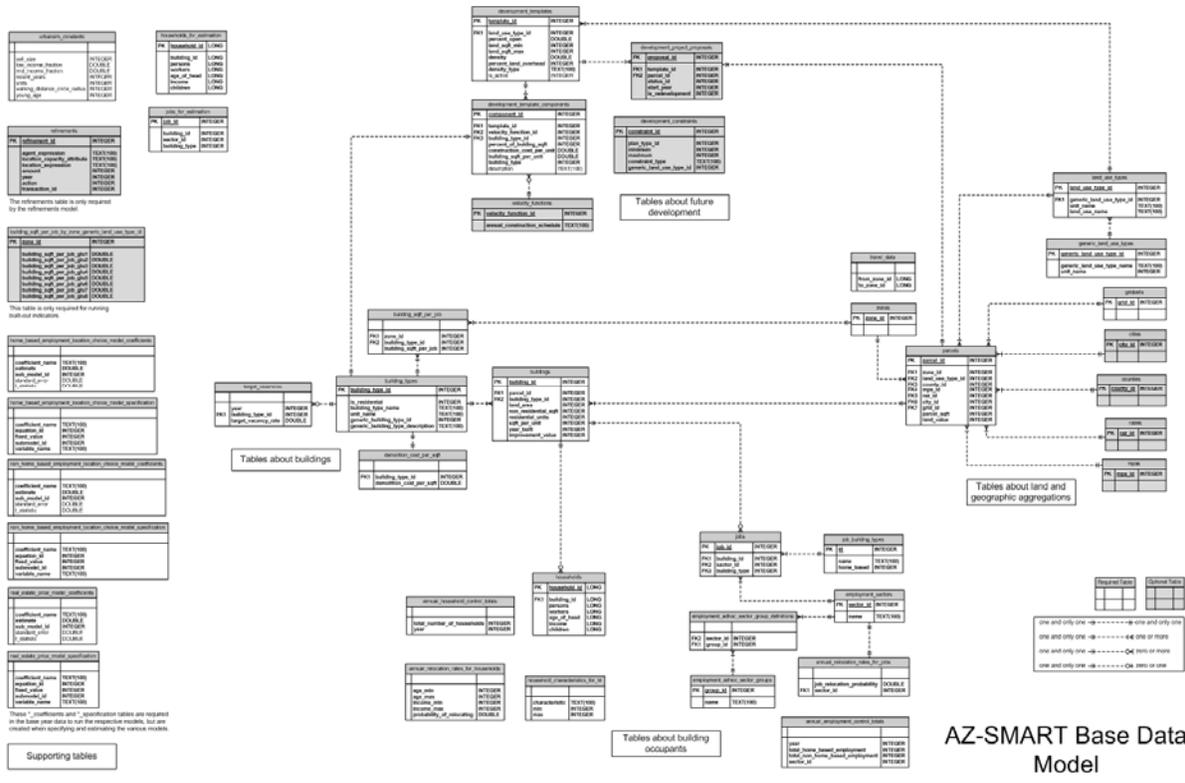
- UrbanSim
 - Set of socioeconomic, land use, and real estate development models
 - Implemented on the **OPUS** (Open Platform for Urban Simulation) platform, designed from the ground up for integrated land use and transportation modeling
 - Models run for every year in projection series
- Fully disaggregate micro-simulation of individual decision making **agents** – behavioral modeling
 - Households and persons
 - Development agents (developers)
 - Businesses and jobs
- Ability to test policy scenarios in an integrated land use and transportation context.



Model System Types

- Gridcell-based
 - Land is divided into gridcells
 - Well tested, in use worldwide
- Parcel-based
 - Explicit parcel-building-job\household representation
 - New real estate development model
- Zone-based
 - Newly developed aggregate model
 - Individual models derived from parcel-based
 - Designed to be fast running and less data intensive

AZ-SMART Data Model



AZ-SMART Base Data Model

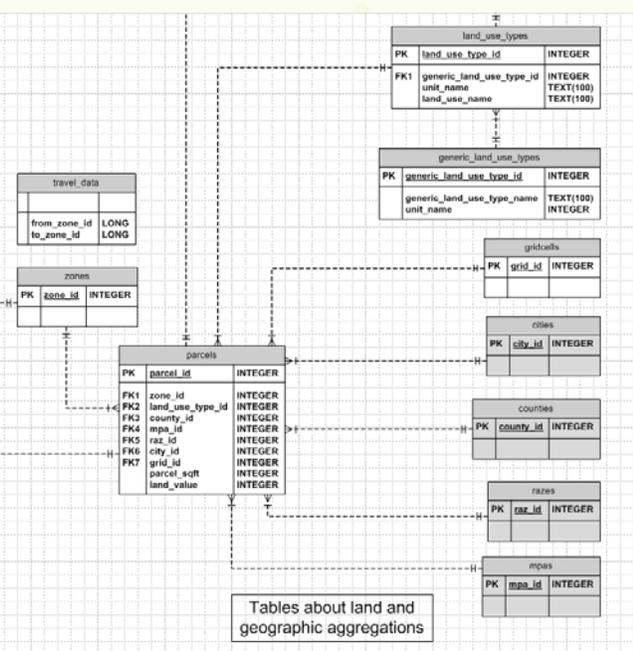
INFORMATION SERVICES

Socioeconomic Modeling



Land and Geographies

- Parcels are the base for analysis - everything eventually attaches to a parcel
- Parcel geography does not change in a simulation
- Any number of variables can be attached to parcels for use in the model system
- Parcels may be aggregated to any geography

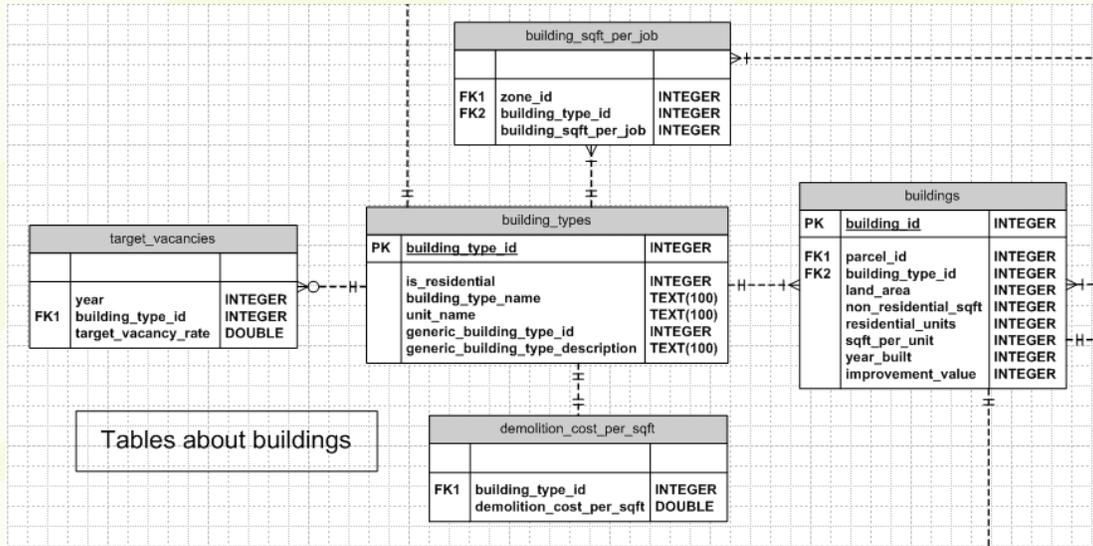


Tables about land and geographic aggregations



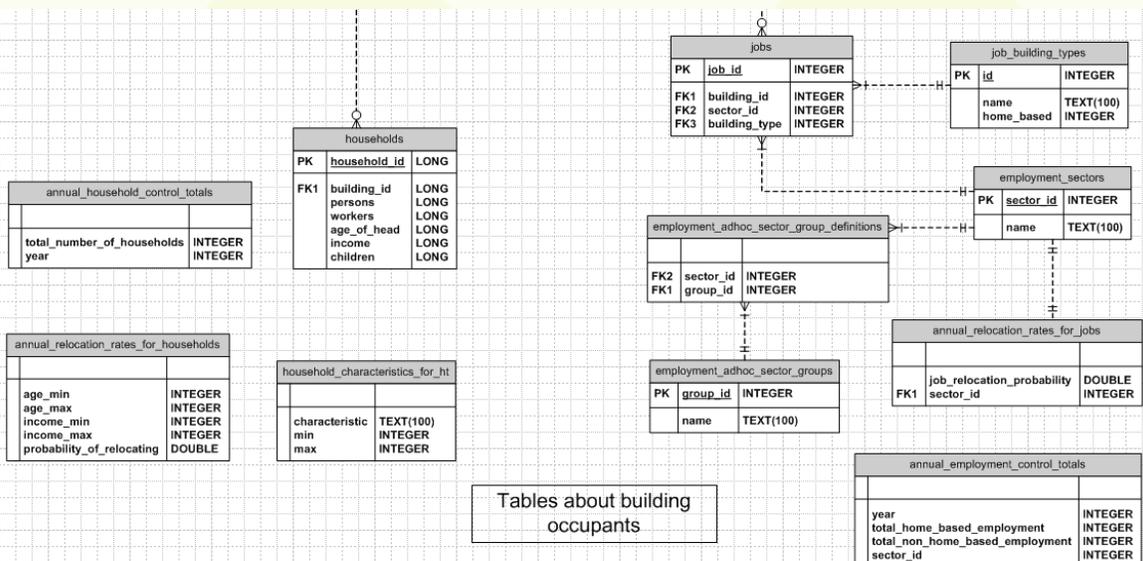
Built space

- Parcels can have built space (“buildings”)
- Flexible representation of built space, including mixed-use



Built space occupants

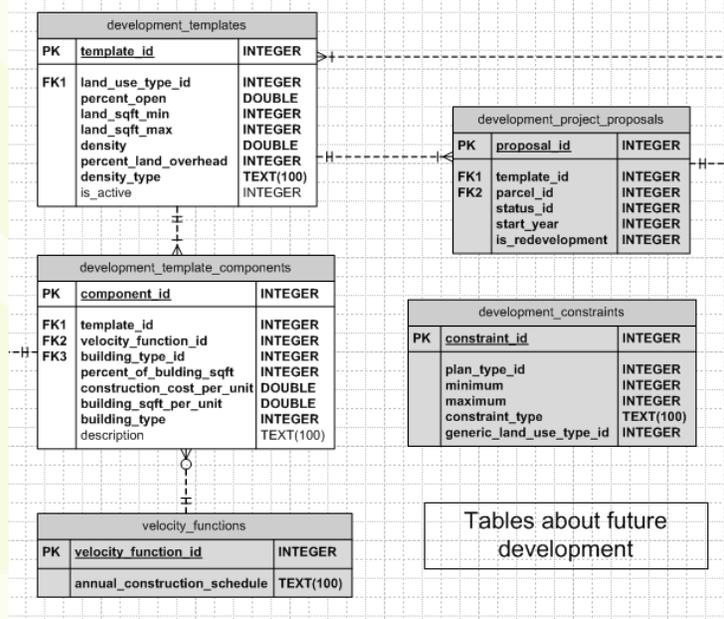
- Jobs and Households are located in a specific built space





Future Development

- Parcels have development constraints based on the General Plan
- Development proposals are known developments and/or development created by the model system
- Velocity functions define the time horizon for a development once it begins

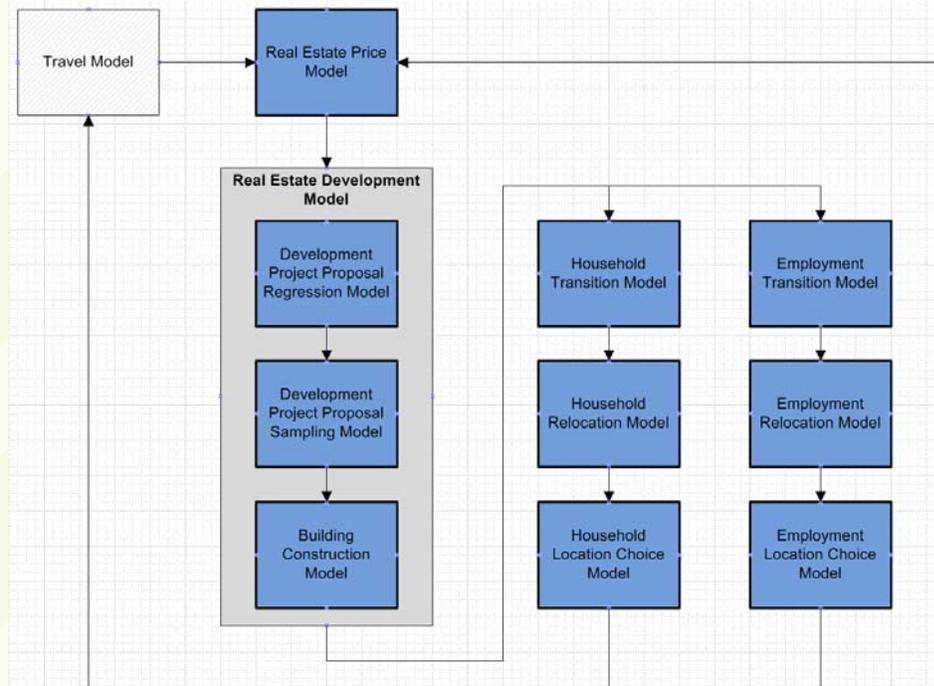


Model Types

- Choice model
 - Discrete choice (binary or multinomial logit)
 - e.g. Household and Employment location choice
- Regression model
 - Any prediction of a continuous variable
 - e.g. Real Estate Price Model
- Simple model
 - Calculates a variable using an equation
 - e.g. Age (N+1) = Current Age + 1
- Allocation model
 - Allocates variables based on weights
 - Accounts for capacity
 - e.g. Seasonal population model

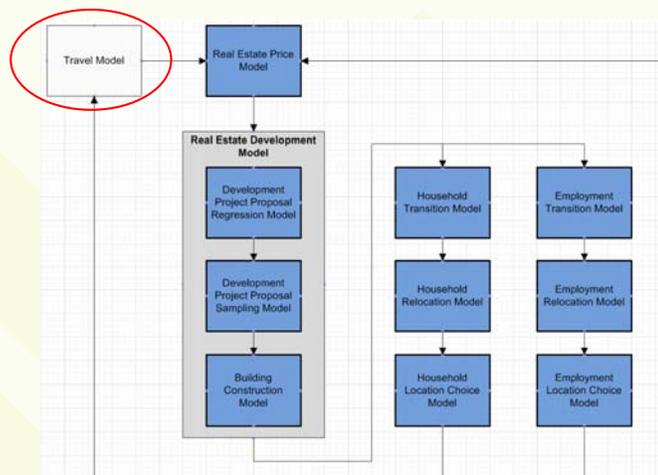


Current Parcel-based model system



Step 0: Travel Model

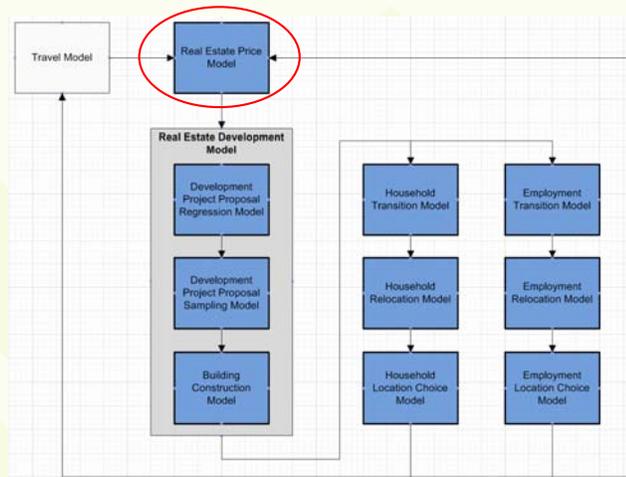
- Provides zone to zone travel times by mode and time of day
- Travel time used as independent variable in models
- External to UrbanSim
- Run for pre-defined years





Step 1: Real Estate Price Model

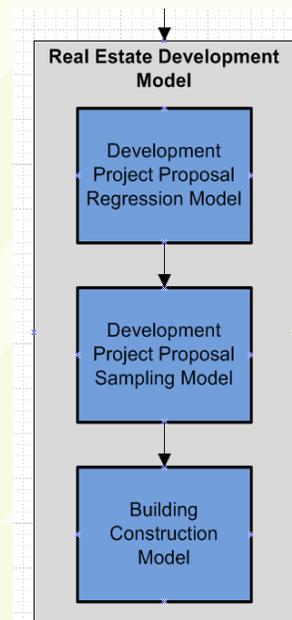
- Predicts the price of current development
 - Price per sqft.
 - For each type of development
 - Land + Improvement
- Price variables are input to the Real Estate Development Model (Step 2)
- Explanatory variables such as:
 - Location
 - Travel time
 - Density
- Standard regression model



Step 2: Real Estate Development Model

AGENT – Real Estate Developer

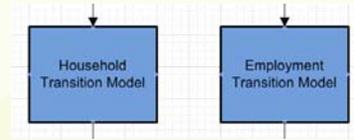
- Evaluate real estate needs from last model year
- For every developable parcel, produce development proposals conforming to known development projects or future land use
- One parcel may have more than one proposal
- Known development projects scheduled to start follow a velocity curve
- Predict an expected sale price for new proposals
- Calculate a ROI for new proposals using sale price and costs
- Select proposals based on ROI and start building real estate





Step 3: Annual Transition Models

- Evaluate Control Totals
 - Job totals by sector (NAICS or land use)
 - Household stratified by type (income groups, tenure, size, etc.)
 - For the County or subarea (RAZ)
- Model keeps tables for every household, person, and job
- Adds new unplaced households and jobs to the region or subarea



annual_household_control_totals	
total_number_of_households	INTEGER
year	INTEGER

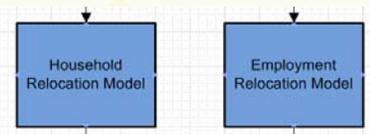
annual_employment_control_totals	
year	INTEGER
total_home_based_employment	INTEGER
total_non_home_based_employment	INTEGER
sector_id	INTEGER



Step 4: Relocation Models

AGENT – Households and Jobs

- Households move from one location to another and people change jobs
- Model uses a probability for relocation from current location
- Relocation rate calculated from surveys and local knowledge
- Un-places households and jobs based on probability



annual_relocation_rates_for_jobs		
FK1	job_relocation_probability	DOUBLE
	sector_id	INTEGER

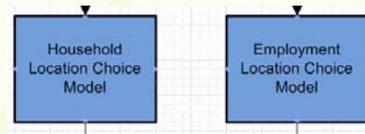
annual_relocation_rates_for_households	
age_min	INTEGER
age_max	INTEGER
income_min	INTEGER
income_max	INTEGER
probability_of_relocating	DOUBLE



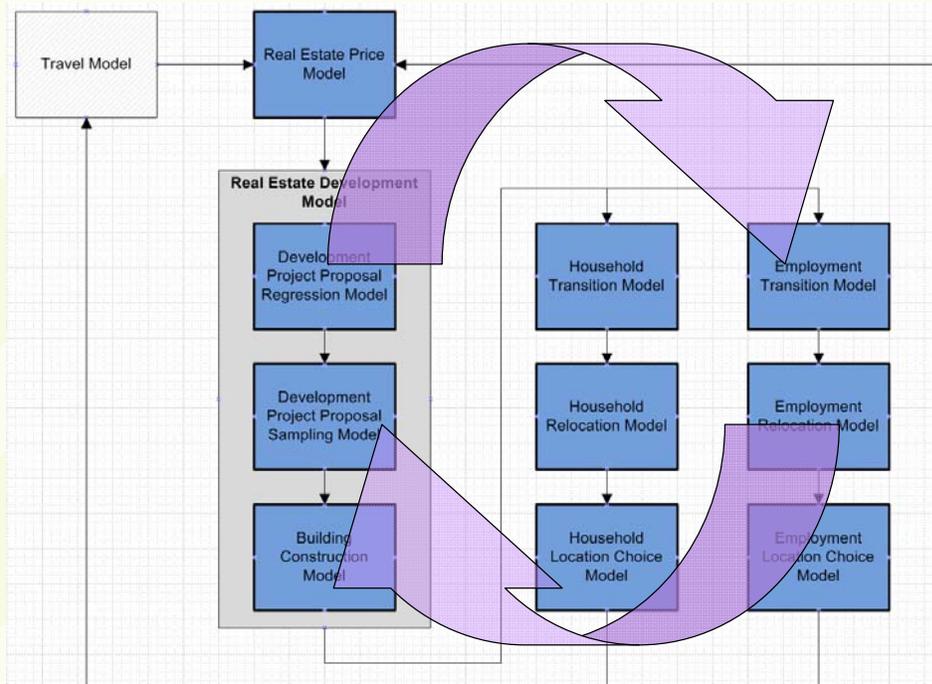
Step 5: Location Choice Models

AGENT – Households and Jobs

- Predict specific buildings where unplaced households and jobs are located
- Households and Jobs stratified into multiple location choice models:
 - specifications by employment sectors
 - specifications by types of households
- Typical explanatory variables include:
 - Travel times
 - Densities (e.g. nearby population, similar industry concentration, housing unit densities)
 - Nearby population characteristics (estimates of disposable income, number of children, etc.)
 - Distances (nearest freeway, CBD, arterial)



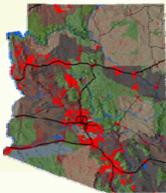
Model runs for every year





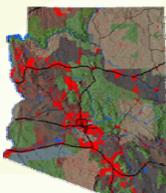
July 2008 - present

- AZ-SMART implemented using:
 - Polygon based data (pseudo-parcels)
 - Land use types matching with SAM-IM:
 - Residential: Single family, Multi family
 - Employment: Retail, Office, Industrial, Other
 - Simple model estimations
 - Starting from simple – working towards end-state models
 - Control at County and sub-regions
- Constant interaction with CUSPA and COG/MPO User group
 - Identify future improvements
- Completed the modeling team - finally
 - Hanyi Li
 - Jesse Ayers



Next steps

- Data – more detailed data
 - Parcels
 - Development_constraints dataset – applied to parcels from General Plan
 - Evaluate zoning data set
 - Adding all known development projects – aligned with parcels
 - Enhance datasets
 - Built space
 - HH
 - jobs
 - Evaluate other sources of data
- Estimation by household and job type
- Testing and evaluation of results
- Final system ready for 2012 Projections





Questions?