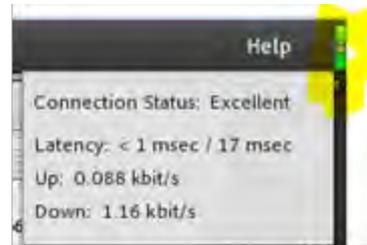


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- **Close** all unnecessary programs running on their computer
- **Do not** use VPN or VDI. Connect directly to the room URL
- **Check** their connections status on the top right hand side of the screen



- **The** webinar is being live close-captioned for the hearing impaired.

More Administrative Items

- **The** session will be recorded. The recorded webinar is available after the session via GovDelivery and <http://www.fhwa.dot.gov/planning/tmip/community/webinars/summaries/index.cfm>.
- **All** participant phone lines are muted.
- **A** Q&A pod window is displayed on your screen and you can enter your questions there anytime. The presenters will answer them during the Q&A session.
- **Please** answer the polls to help us improve future webinars.
- **This** webinar will last approximately two hour.

MSA to TAZ

Assembling a Metropolitan
Transportation Model 1993-2016

Planning and modeling the transportation future in the Little Rock region

INTRODUCTION

Jonathan Lupton AICP

- BA (History) Kalamazoo College 1982
- MA (Geography) University of Chicago 1987
- MS Community and Regional Planning University of Texas-Austin 1990
- Started out at Metroplan in 1993



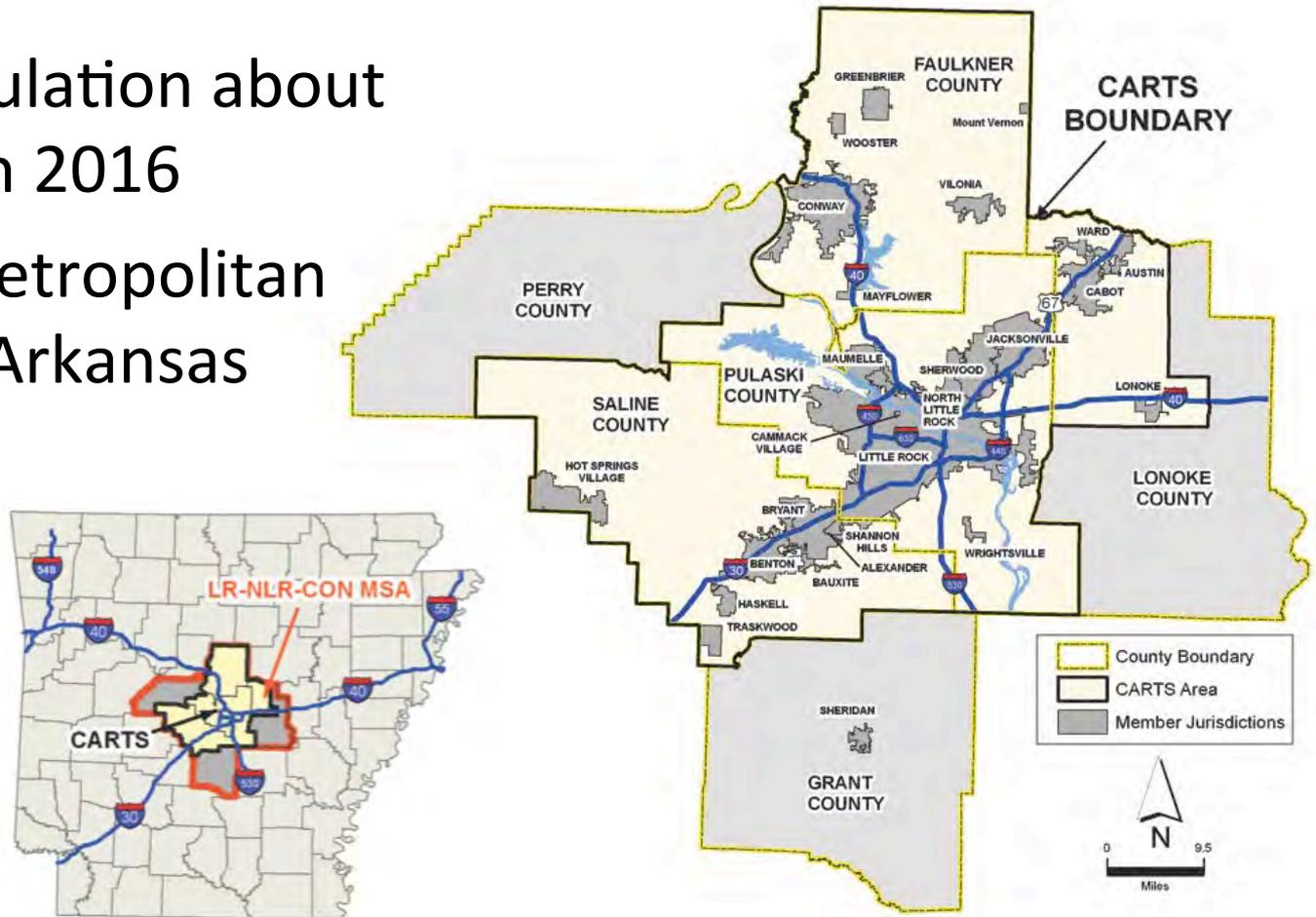
Metroplan

- Metroplan is the MPO for Central Arkansas
- A state capital region, geographically and economically central



Little Rock MSA

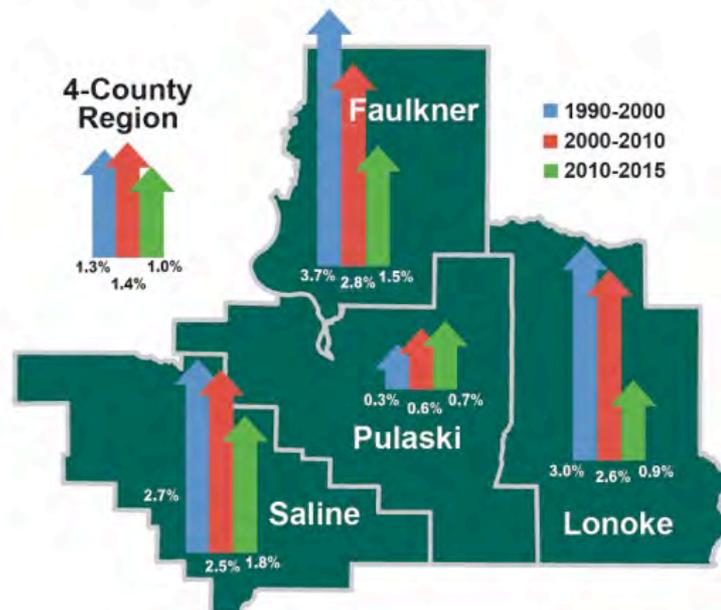
- Total population about 737,000 in 2016
- Largest metropolitan region in Arkansas



Recent Trends

- Regional population growth slightly above U.S. average, suburban counties growing faster than central (Pulaski) county

Annualized Population Growth Rates Four-County Region
1990 to 2015



Suburban Region With High-Density Core

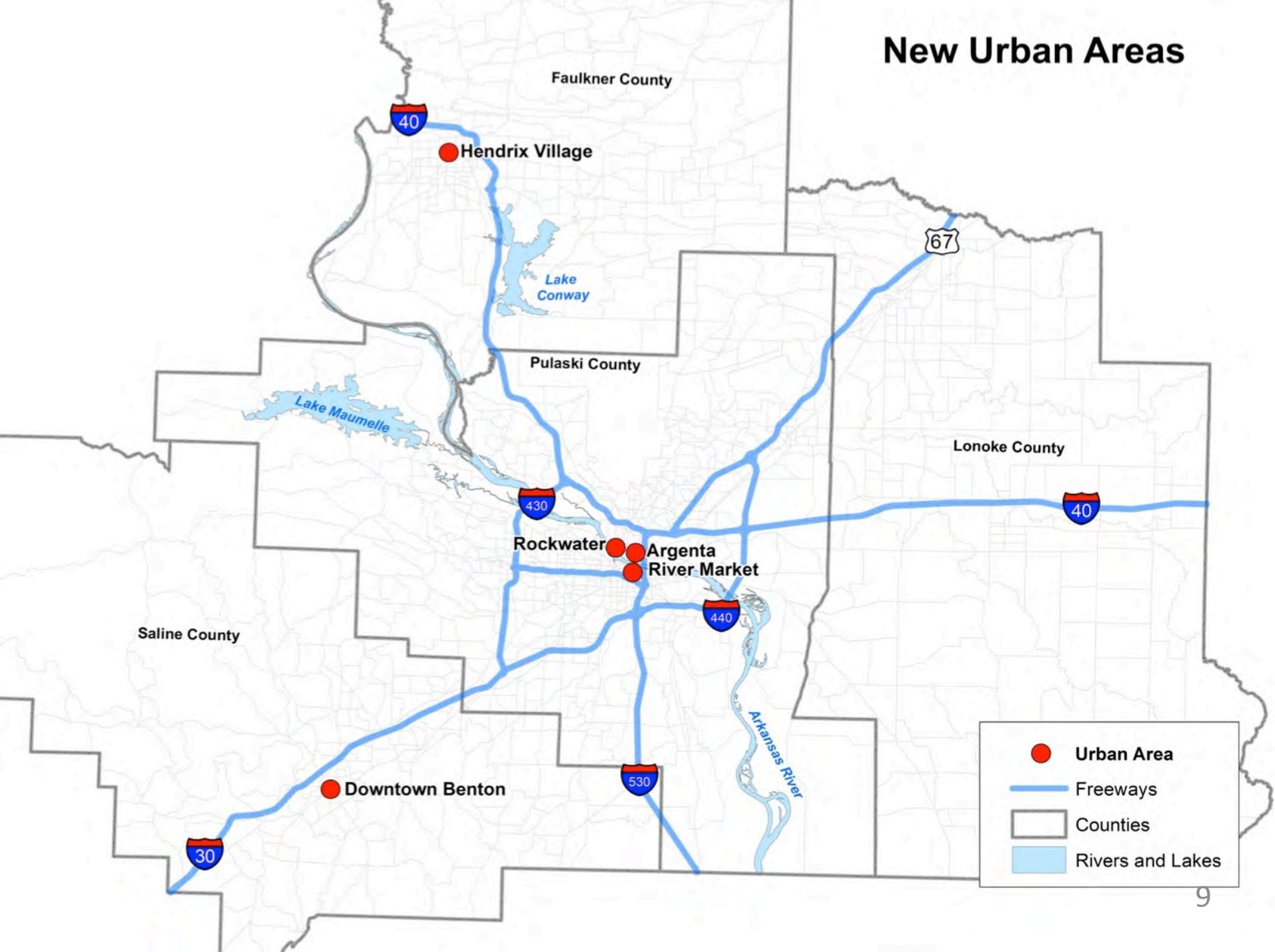
- Downtown core in Little Rock...



River Market, Creative Corridor



New Urban Areas



New Urbanism Springing Up

- Pockets of urban revival in downtown North Little Rock, Hendrix Village near downtown Conway, beginning in Benton



Multi-Family Rising in Importance



Region has three RCAPs (Racially concentrated areas of Poverty)



Ample Long-Term Water Supplies



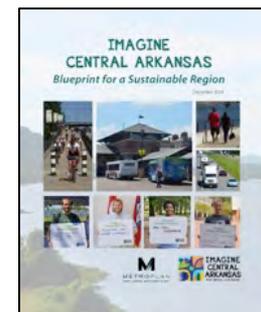
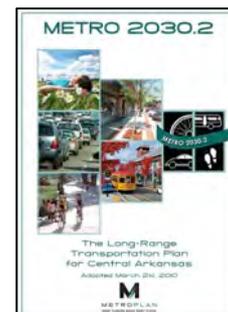
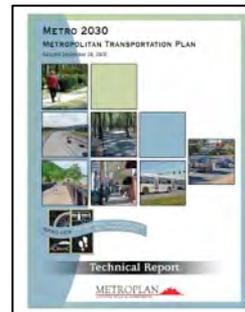
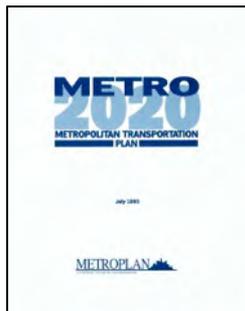
Low-Density Region

- Few external growth constraints

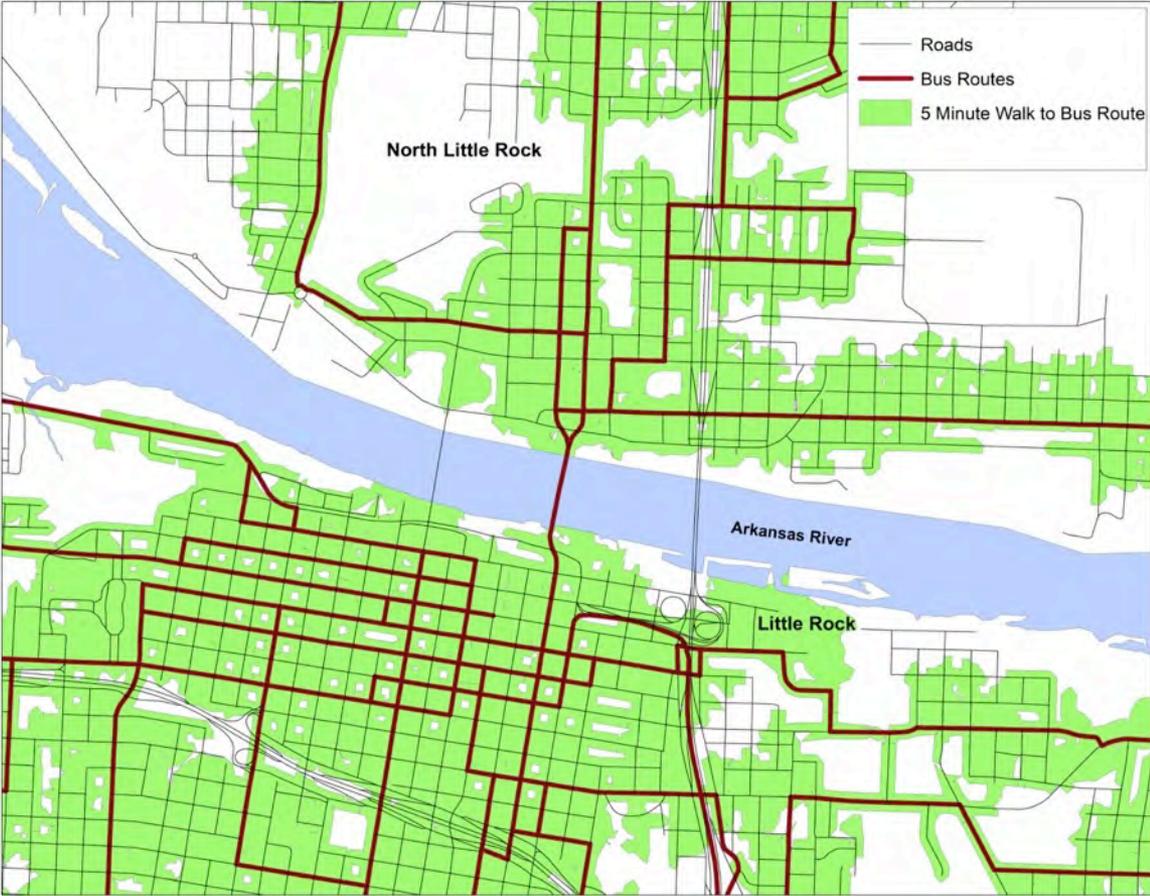


Four Models, Five Plans

- Metro 2020, completed in 1995
- Metro 2025, completed in 2000
- Metro 2030, completed in 2005
- Metro 2030.2, completed 2010 (not a model)
- Imagine Central Arkansas Plan (for year 2040), completed in 2014

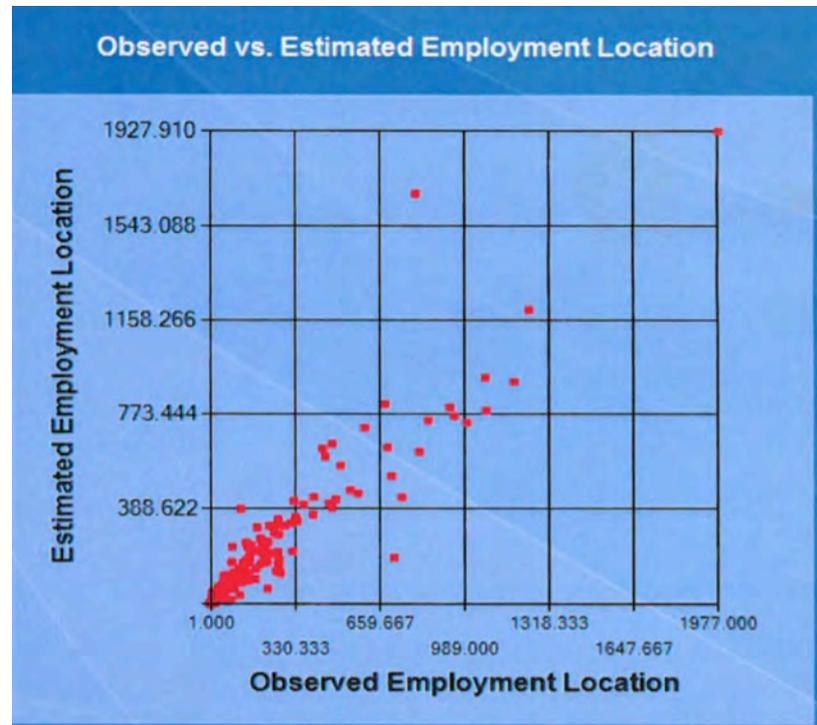


Metroplan is taking first steps into accessibility modeling



Land Use Modeling?

- TELUM –tantalizing, but outputs have been shaky



What-Where-When-Why

- This presentation is mainly about the “nuts and bolts” of designing socioeconomic projections
- Fast and good projection techniques facilitate more versions for scenario-testing

From Census data to building permits

DATA SOURCES

The Easy Part - Population Data

- Decennial Census 2010, SF-1. From overall totals to block-level, complete-count data.
- ACS. Accuracy varies
- Building permit data for updates



Demographic Analysis Data

- Department of Health MSA and county-level data on survivorship by age, sex and race
- Department of Health county-level data on births by age of mother by race



	A	B	C	D	E	F	G
59							
60	Age-specific Death Rate						
61	Arkansas, 2003 - 2007						
62	For Selected County/Countries						
63	For ICD9 Cause of Death Code(s) = "All Causes (000-799, E800-E999)"						
64	* Rows with less than 10 Population have been masked.						
65	SAS Version 9.1.3						
66							
67	Residence County	Age Group	Expected Population of Age Group*	Number of Selected Deaths	Actual Population of Age Group	Death Rate Per 100,000 Population	95% Confidence Interval
69	Faulkner County	< 1 Yr.	77	1	160	625	15.82 - 3482.28
70		1 to 4 Yrs.	308	0	532	0	0.00 - 0.00
71		5 to 14 Yrs.	809	0	1,168	0	0.00 - 0.00
72		15 to 24 Yrs.	771	1	1,263	79.18	2.00 - 441.14
73		25 to 34 Yrs.	754	1	1,020	98.04	2.48 - 546.24
74		35 to 44 Yrs.	904	0	734	0	0.00 - 0.00
75		45 to 54 Yrs.	750	1	338	295.86	7.49 - 1648.42
76		55 to 64 Yrs.	485	0	163	0	0.00 - 0.00
77		65 to 74 Yrs.	367	0	80	0	0.00 - 0.00
78		75 to 84 Yrs.	249	0	63	0	0.00 - 0.00
79		85+ Yrs.	86	0	39	0	0.00 - 0.00
80	Lonoke County	< 1 Yr.	44	0	88	0	0.00 - 0.00
81		1 to 4 Yrs.	176	0	319	0	0.00 - 0.00
82		5 to 14 Yrs.	463	0	820	0	0.00 - 0.00
83		15 to 24 Yrs.	441	0	481	0	0.00 - 0.00
84		25 to 34 Yrs.	431	0	509	0	0.00 - 0.00
85		35 to 44 Yrs.	517	0	502	0	0.00 - 0.00
86		45 to 54 Yrs.	429	0	225	0	0.00 - 0.00
87		55 to 64 Yrs.	277	0	122	0	0.00 - 0.00
88		65 to 74 Yrs.	210	0	51	0	0.00 - 0.00
89		75 to 84 Yrs.	143	0	41	0	0.00 - 0.00
90		85+ Yrs.	49	2	22	9090.91	1100.95 - 32839.5
91	Pulaski County	< 1 Yr.	423	5	1,260	396.83	128.85 - 926.06
92		1 to 4 Yrs.	1,694	1	3,903	25.62	0.65 - 142.75
93		5 to 14 Yrs.	4,157	1	5,500	17.00	0.15 - 99.00

Population in TAZs

- Pretty easy for GIS staff to convert block-level SF-1 data into TAZ geography
- Slight changes in block-level census geography can impact TAZs
- Group quarters population matters because *it is not household population*



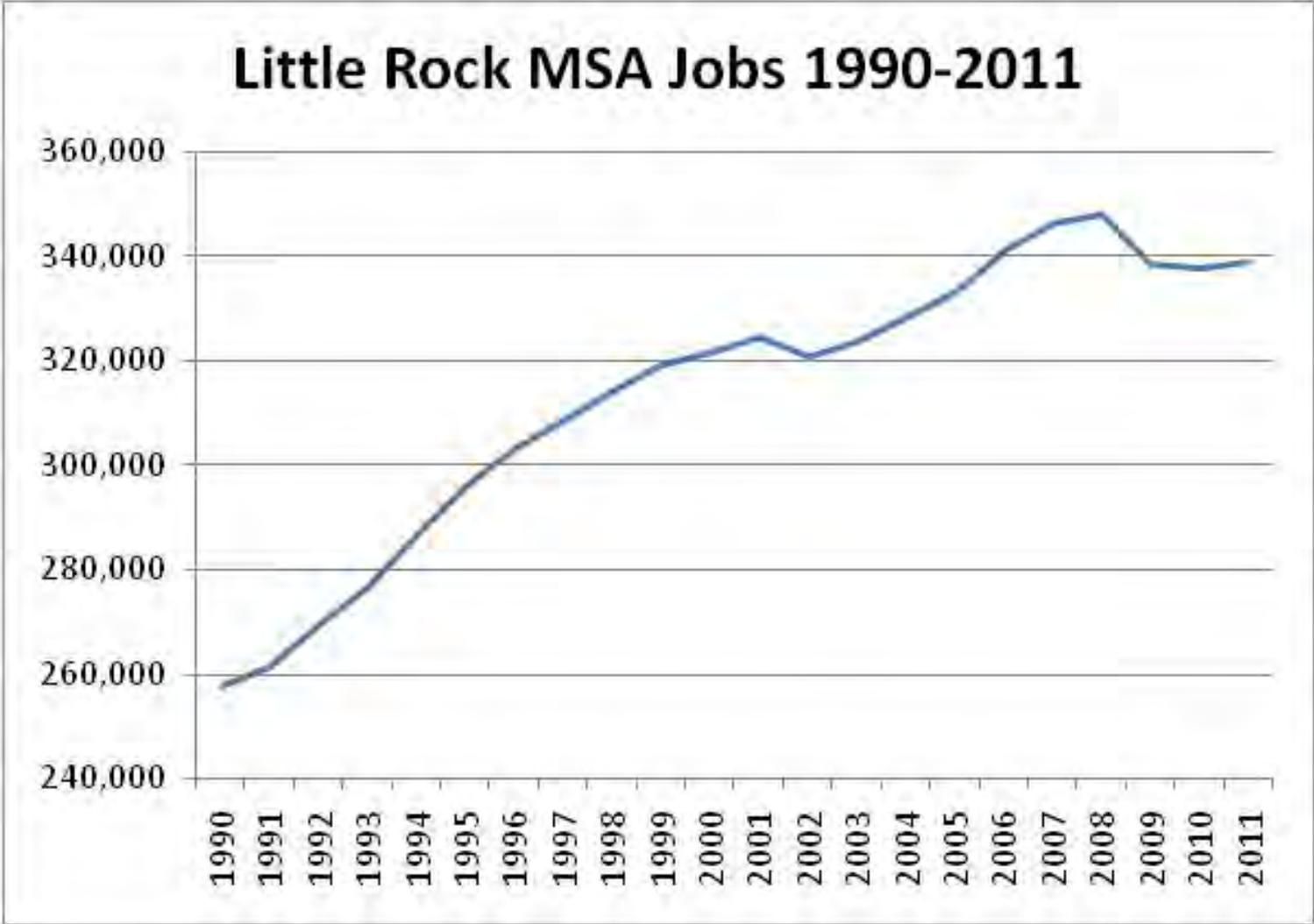
Library.uncfsu.edu/archives/history-of-fsu-campus-buildings

Employment Data (public sources)

- CTPP is valuable, but tends to arrive too late
- State and BLS Nonfarm payroll jobs data provides useful past trend-lines
- LEHD likely source for future plans
- *Psst....Synthesize your data to resolve differences*



BLS Nonfarm Payroll Job Series



Private Employment Data

- Best source for small (TAZ-level) data
- Dun and Bradstreet -v- InfoUSA
- Beware the difference, in retail especially

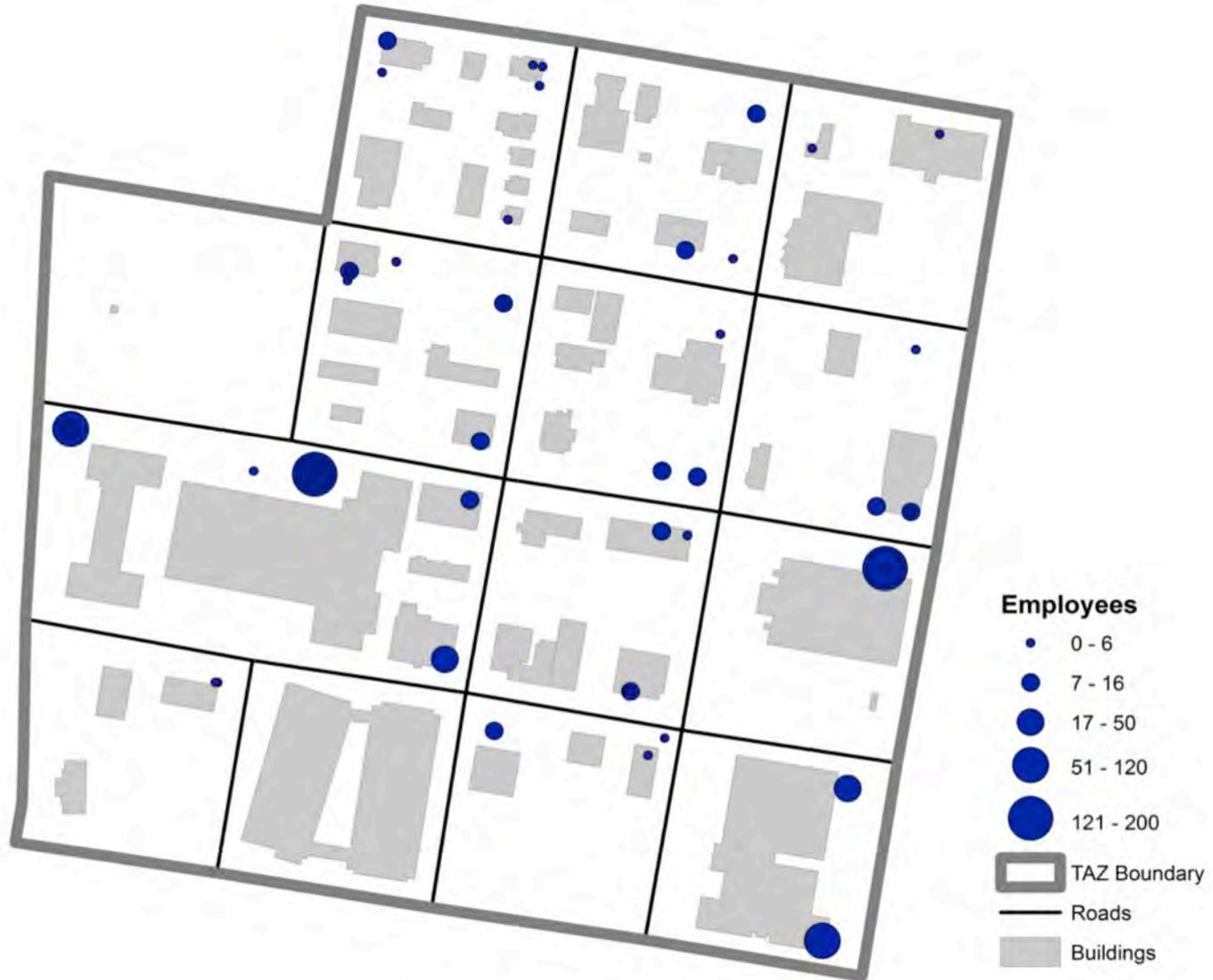


From Data to TAZ

- We were able to allocate about 99.5 percent of 300,000-odd jobs to TAZs
- Modest trouble with gap between addresses and actual place of work - HQs especially
- Small residuals – *know when to let go!*



From Geo-coded Jobs to TAZ



Three Main Categories

- **Basic**

(construction, mining, manufacturing, transportation and utilities)



- **Retail**

(critical for models, but not as clear-cut as NAICS codes look)



- **Service**

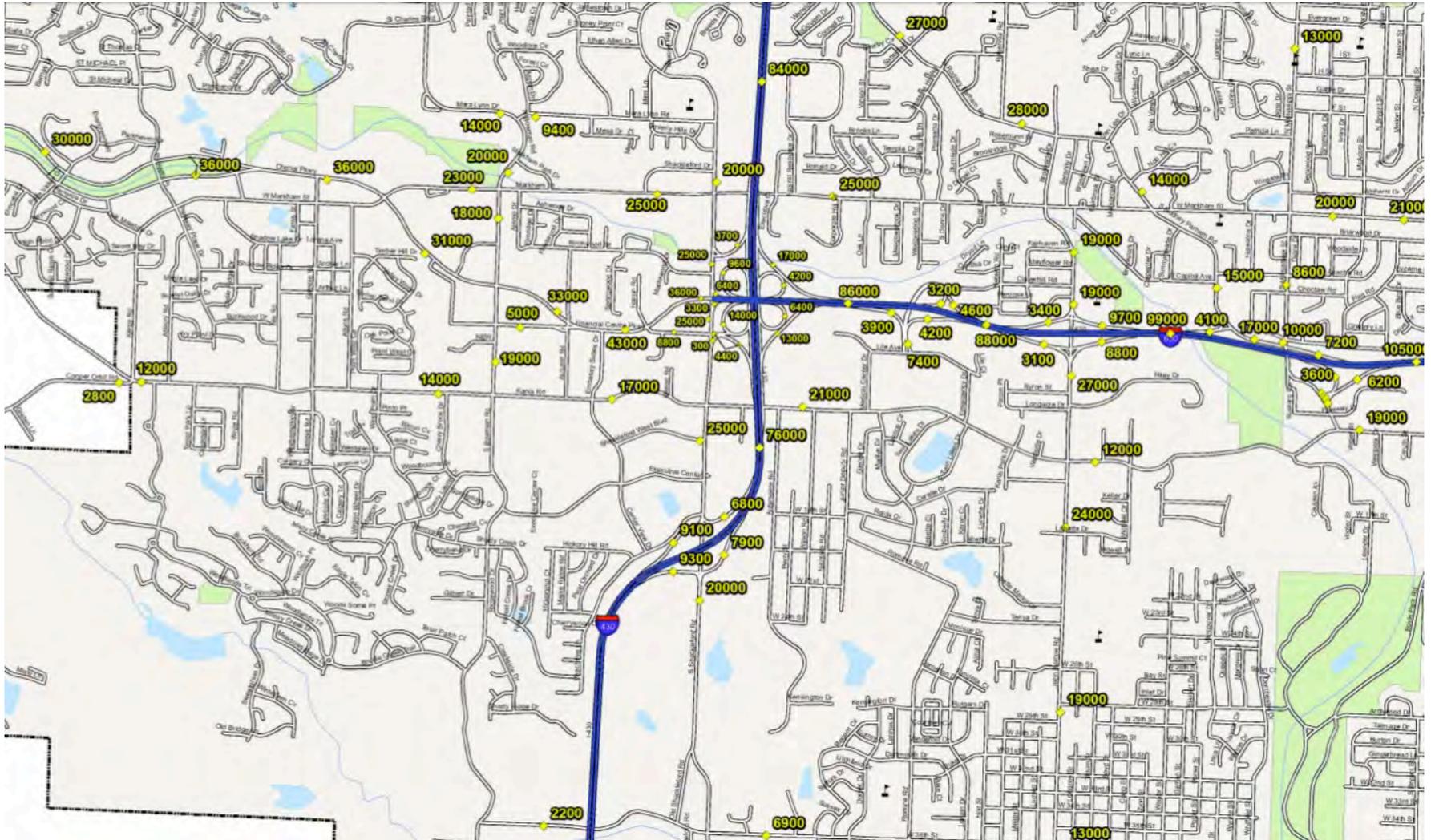
(everything else)



Transportation Data

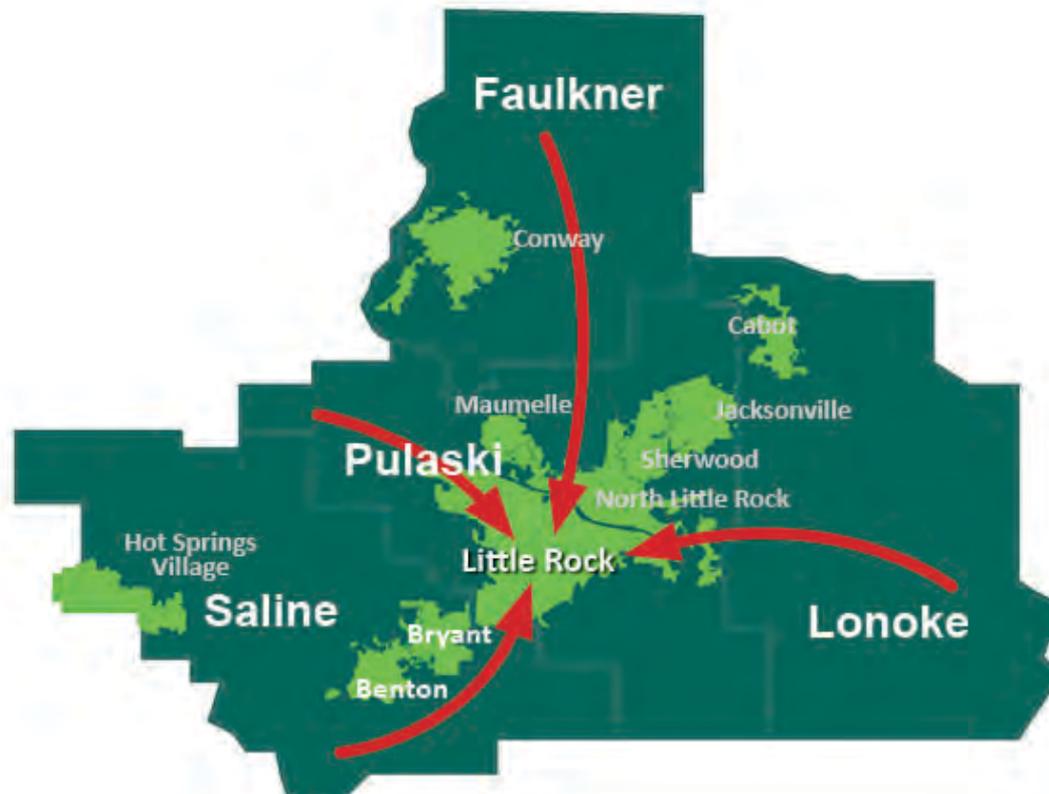
- Traffic counts
- Travel survey (last done in 2004)
- CTPP commuting flow data
- AirSage and related “Big Data” sources – on the horizon, but not yet used

2014 Map Detail: West Little Rock Traffic Counts

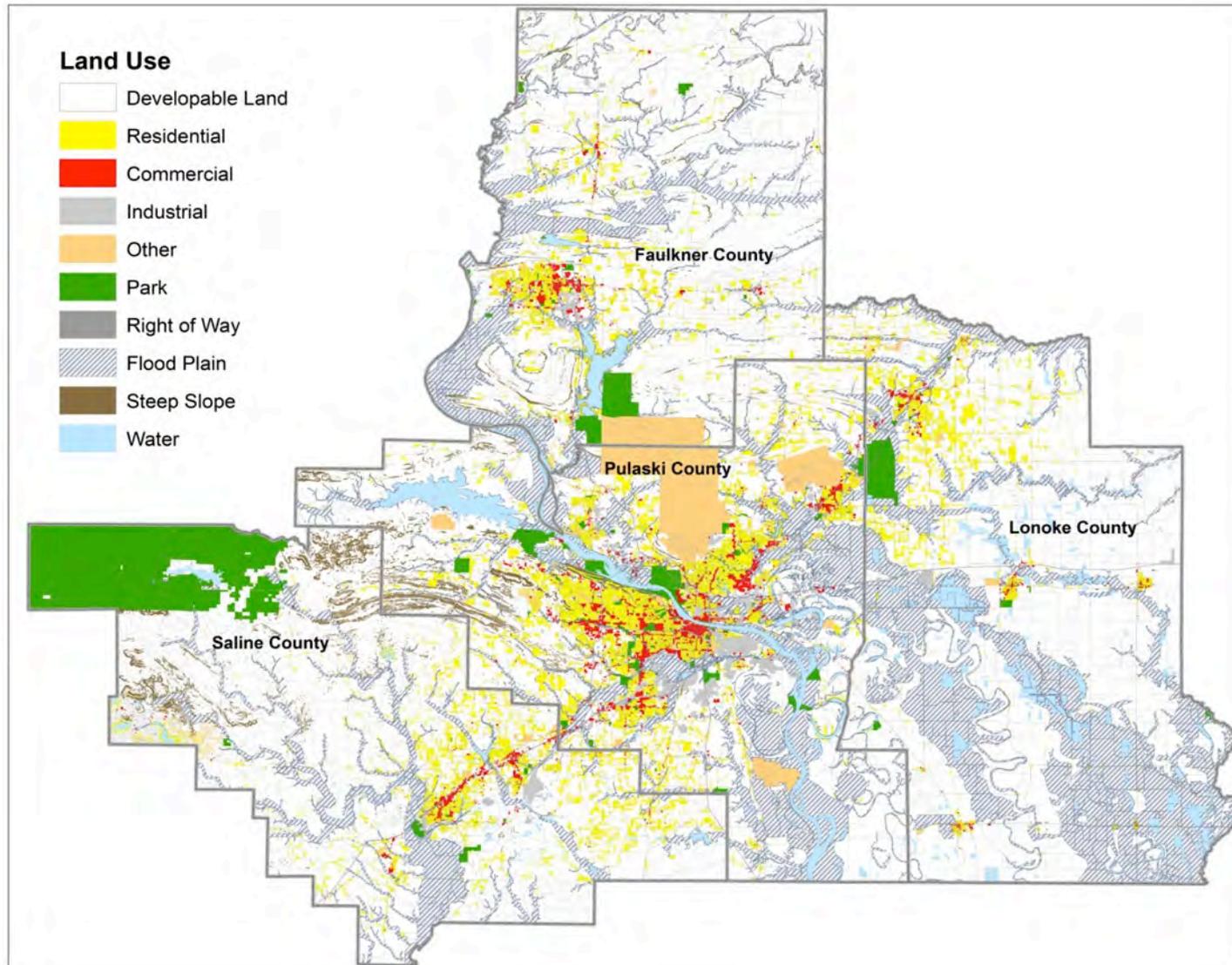


Regional Commuting Flows

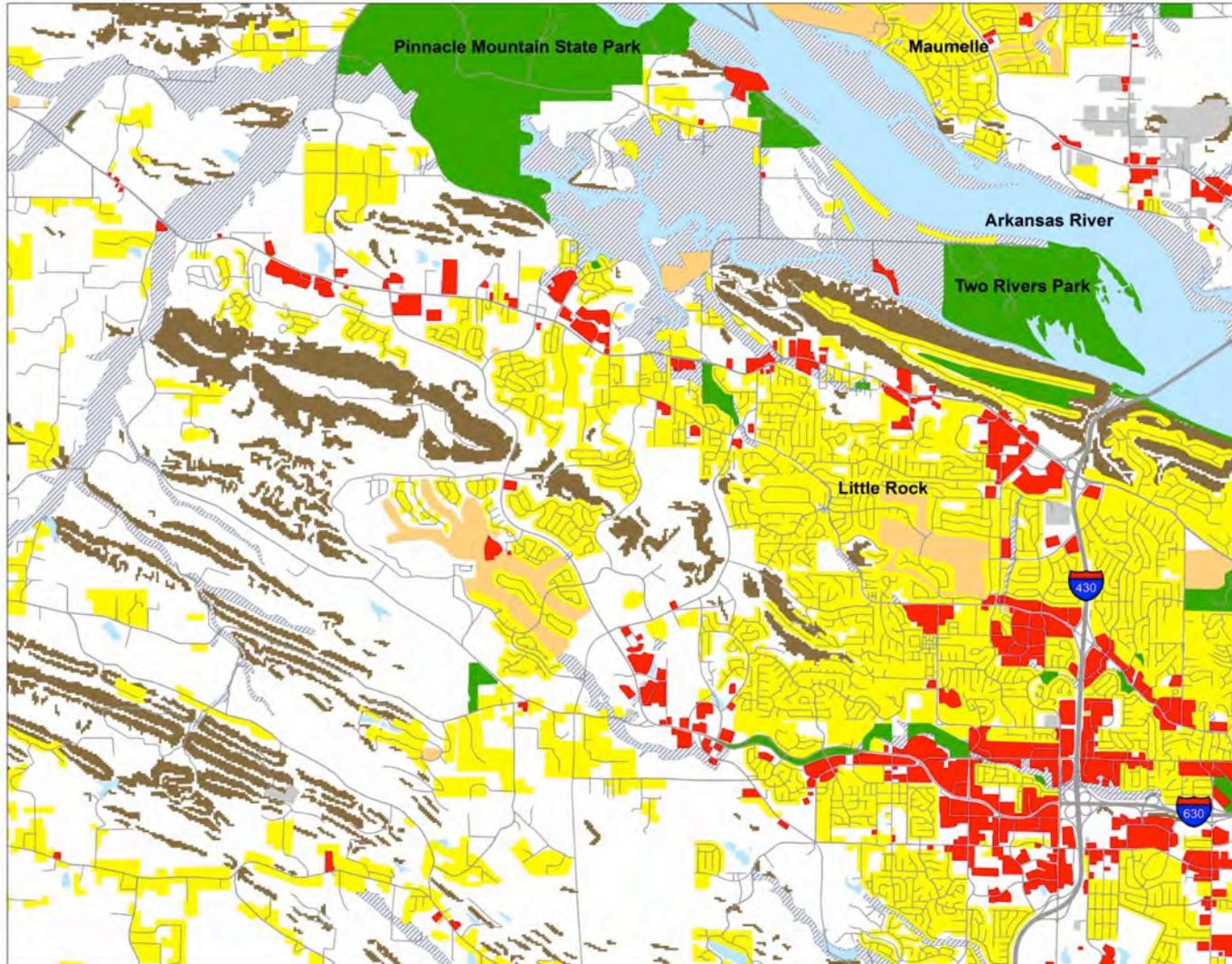
- CTPP main source for cross-check
- LEHD has value too



Land Use Satellite Data



Land Use (Closer View)



Excel and everything else...

TOOLS

Excel 1st, 2nd and 3rd

- Good for unstructured playing with data, a statistical “rough draft”
- Good basis for designing demographic and economic templates that help take the data “from MSA to TAZ,” i.e. from raw figures to data matched to TransCAD classifications

Halley

- This is a demographic program from the 1980s that can create life tables from 5-year census age-sex population data and age-specific mortality data
- It was designed for Lotus, but we copied a version into Excel circa 1998 and still use it
- Many states (including Arkansas) have county life-table data, but it's rarely adequately up-to-date

Halley Example 1 - Inputs

HalleyLifeTabCalcBlackNonHisp4CoRegion03-07 [Compatibility Mode]

	A	B	C	D	E	F	G	
4	4	***						
5	5	***						P
6	6	***	EXACT AGE	TOTAL	TOTAL	NUMBER OF	NUMBER OF	F
7	7	***	INTERVALS	NUMBER OF	NUMBER OF	FEMALES IN	MALES IN	P
8	8	***	x to x+n	FEMALE DEATHS	MALE DEATHS	EACH AGE GROUP	EACH AGE GROUP	E
9	9	***						
10	10	***						
11	11	***						
12	12	***	0-1	83	100	5781	5915	
13	13	***	1-4	15	31	23159	24050	
14	14	***	5-9	7	5	30430	30925	
15	15	***	10-14	8	6	31200	31050	
16	16	***	15-19	13	69	30530	30600	
17	17	***	20-24	20	94	33520	30100	
18	18	***	25-29	41	89	33485	27135	
19	19	***	30-34	45	96	28655	23130	
20	20	***	35-39	64	105	24925	20390	
21	21	***	40-44	80	135	27015	22290	
22	22	***	45-49	131	208	26900	22255	
23	23	***	50-54	167	245	23345	20055	
24	24	***	55-59	161	257	16310	14240	
25	25	***	60-64	165	240	10260	7845	
26	26	***	65-69	181	198	7730	5645	
27	27	***	70-74	204	208	6065	4235	
28	28	***	75-79	223	177	5420	2870	
29	29	***	80-84	272	217	4095	1910	
30	30	***	85+	626	278	3845	1390	
31	31	***						
32	32	***	TOTAL	2506	2758	372670	326030	
33								
34								
35								
36	A	B	C	D	E	F	G	

Navigation: HALLEY Current MIGRATE MALESTBL MALEPROP MALEFUTR LIFEEXP FEMSTABL FEMPROP FEMFUTUR BIRTHRAT

Halley Example 2 – Survivorship Rates

H	I	J	K	
PROPORTION OF FEMALE POPULATION IN EACH AGE GROUP	PROPORTION OF MALE POPULATION IN EACH AGE GROUP	AGE-SPECIFIC DEATH RATE FOR FEMALES AT AGE X MF(x)	AGE-SPECIFIC DEATH RATE FOR MALES AT AGE X MM(x)	PROBABILITY OF SURVIVAL FROM AGE X TO AGE X+1
-----	-----	-----	-----	-----
0.0155	0.0181	0.014358	0.016905	
0.0621	0.0738	0.000648	0.001289	
0.0817	0.0949	0.000230	0.000162	
0.0837	0.0952	0.000256	0.000193	
0.0819	0.0939	0.000426	0.002255	
0.0899	0.0923	0.000597	0.003123	
0.0899	0.0832	0.001224	0.003280	
0.0769	0.0709	0.001570	0.004150	
0.0669	0.0625	0.002568	0.005150	
0.0725	0.0684	0.002961	0.006057	
0.0722	0.0683	0.004870	0.009346	
0.0626	0.0615	0.007154	0.012216	
0.0438	0.0437	0.009871	0.018048	
0.0275	0.0241	0.016082	0.030593	
0.0207	0.0173	0.023415	0.035075	
0.0163	0.0130	0.033636	0.049115	
0.0145	0.0088	0.041144	0.061672	
0.0110	0.0059	0.066422	0.113613	
0.0103	0.0043	0.162809	0.200000	
-----	-----	-----	-----	-----
1.0000	1.0000	0.006724	0.008459	
		SEX-SPECIFIC DEATH RATES OF REAL POPULATION	SEX-SPECIFIC DEATH RATES OF REAL POPULATION	
-----	-----	-----	-----	-----

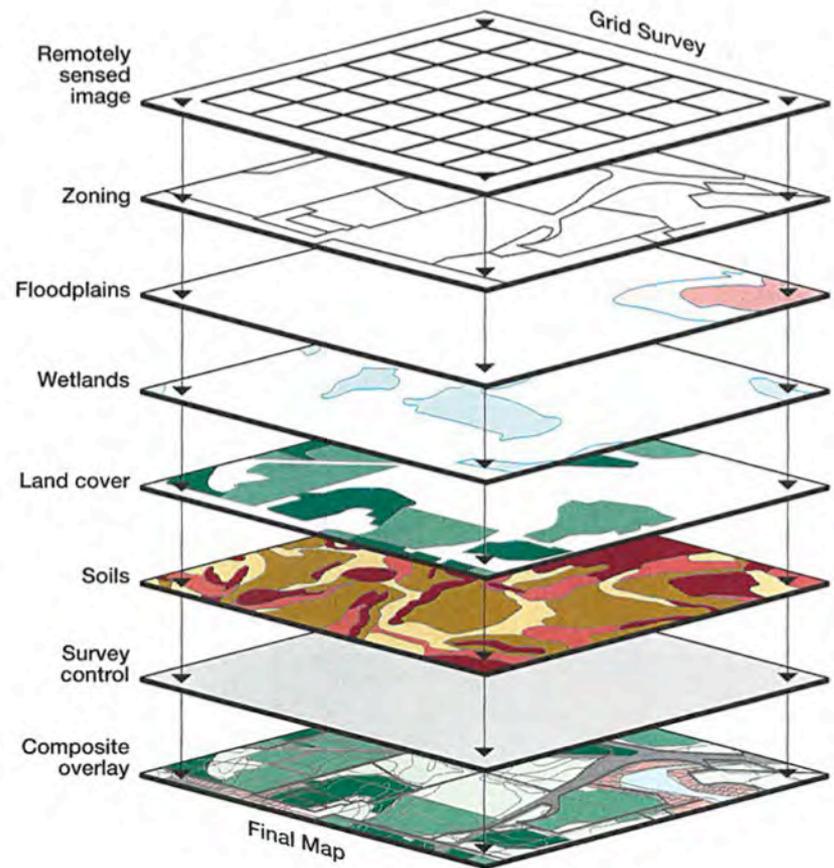
Microsoft Access

Two roles with modeling

1. Relational database capability that Excel lacks
– use of “key” fields allows matching of data sets of different sizes (where “sort” function won’t solve it)
2. Storage of model results for easy small-area access (good for small-scale travel studies)

GIS

- Indispensable at all levels
- Easy to take for granted
- Good if demographer/ economist can have his/ her own GIS
- Maptitude is compatible with TransCAD and capable of importing and exporting .shp files from ESRI software



McKnight, Tom L. *Physical Geography, A Landscape Appreciation*. Prentice Hall. 2008.

Figure 2-29. Much GIS work involves layers of spatial data superimposed upon one another.

GIS

- Visual appraisal of past trends
- Visual appraisal of projected trends
- Good for checking consistency, finding errors not obvious in a spreadsheet

Building Demographics

- Local mortality and fertility rates differ from national average
- Local demographics are therefore more accurate
- But demographic resources in a small state are limited...

A Few Demographic Templates

- Cohort-component population projection system can take inputs and spit out detailed population projections
- Develop 5-yr migration rates from latest decennial census, intercensal estimates by age/race/sex, and next-to-latest census
- Vehicle/household projection system

Cohort-Component Template 1st View

1	Regional Series D2 Tapered Projection		
2			
3	Category: Latino/Asian/Other		
4			MSA
5		Male 5-year	White
6		Survival Rate	Male IMR
7	0-4	0.99806	0.00776
8	5-9	0.99865	
9	10-14	0.99605	
10	15-19	0.9922	
11	20-24	0.99097	
12	25-29	0.99122	
13	30-34	0.98924	
14	35-39	0.98605	
15	40-44	0.97958	
16	45-49	0.96917	
17	50-54	0.95664	
18	55-59	0.9411	
19	60-64	0.91288	
20	65-69	0.86913	
21	70-74	0.80929	
22	75-79	0.68221	
23	80-84	0.60086	
24	85+		
25			MSA
26		Female 5-year	White

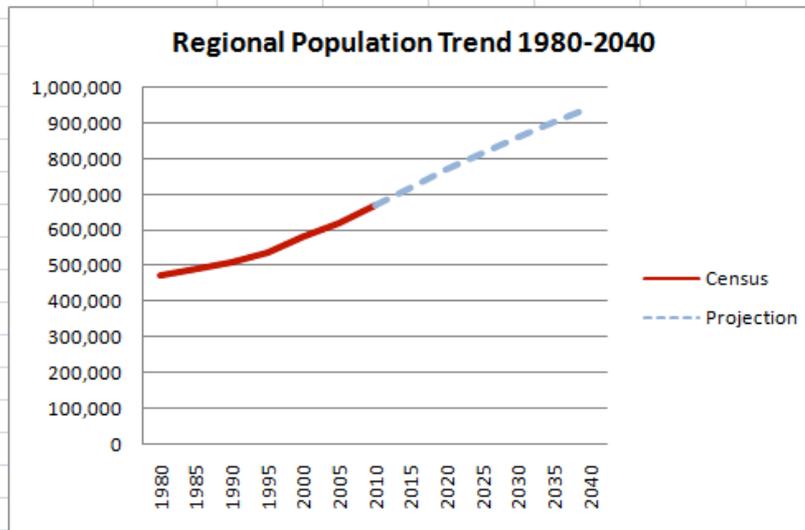
Population by Age and Sex 2000-2030				
	2010	2015	2020	2025
	Male	Male	Male	Male
0-4	3,567	3,799	4,212	4,776
5-9	2,974	3,560	4,951	5,105
10-14	2,413	2,970	3,733	5,118
15-19	2,347	2,403	3,435	4,138
20-24	3,143	2,329	2,919	3,943
25-29	3,131	3,115	3,849	4,246
30-34	2,804	3,104	4,281	4,848
35-39	2,354	2,774	3,785	4,925
40-44	1,810	2,321	3,132	4,112
45-49	1,417	1,773	2,596	3,373
50-54	1,192	1,373	1,875	2,677
55-59	830	1,140	1,423	1,898
60-64	686	781	1,099	1,361
65-69	332	626	740	1,029
70-74	226	289	512	616
75-79	141	183	241	424
80-84	98	96	125	165
85+	63	97	112	140

Cohort-Component Template 2nd View

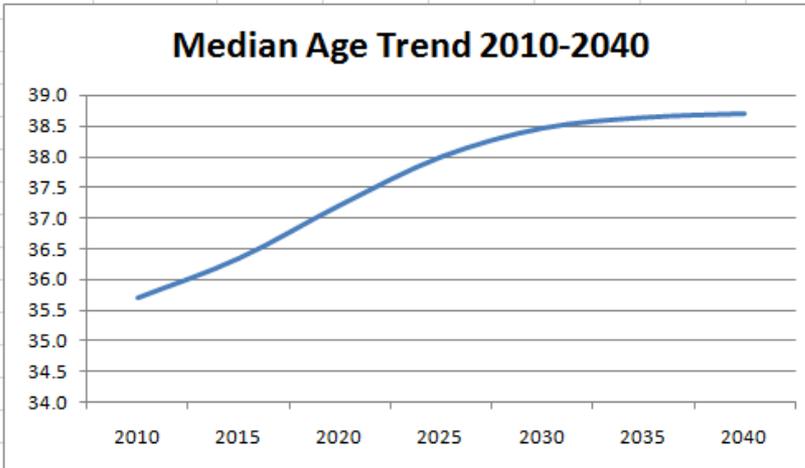
	V	W	X	Y	Z	AA	AB	AC	AD
1	Population by Age and Sex 2000-2030 With Migration								
2	Migration								
3	Adjustment:		0.5	0.35	0.3	0.3	0.25	0.25	
4									
5		2010	2015	2020	2025	2030	2035	2040	
6		Male							
7	0-4	3,567	4,961	5,114	5,653	5,981	6,097	7,358	
8	5-9	2,974	3,738	5,125	5,258	5,811	6,119	6,237	
9	10-14	2,413	3,449	4,154	5,613	5,759	6,271	6,603	
10	15-19	2,347	2,942	3,974	4,694	6,343	6,379	6,947	
11	20-24	3,143	3,884	4,284	5,524	6,525	8,395	8,443	
12	25-29	3,131	4,318	4,891	5,230	6,743	7,715	9,927	
13	30-34	2,804	3,826	4,978	5,525	5,909	7,462	8,538	
14	35-39	2,354	3,177	4,170	5,354	5,942	6,269	7,918	
15	40-44	1,810	2,650	3,443	4,461	5,728	6,274	6,620	
16	45-49	1,417	1,935	2,762	3,558	4,610	5,868	6,427	
17	50-54	1,192	1,487	1,984	2,810	3,620	4,653	5,923	
18	55-59	830	1,168	1,447	1,925	2,727	3,504	4,505	
19	60-64	686	810	1,128	1,392	1,853	2,615	3,360	
20	65-69	332	589	709	993	1,225	1,641	2,316	
21	70-74	226	298	524	628	880	1,082	1,450	
22	75-79	141	183	241	424	509	712	876	
23	80-84	98	100	129	169	297	355	497	
24	85+	63	86	104	130	168	264	352	
25									
26		2010	2015	2020	2025	2030	2035	2040	

Cohort-Component Output

	Census	Projection
1980	474,468	
1985	493,793	
1990	513,117	
1995	540,625	
2000	583,845	
2005	622,067	
2010	671,459	671,459
2015		722,365
2020		770,640
2025		817,325
2030		862,213
2035		902,516
2040		943,224



	Median Age
2010	35.7
2015	36.3
2020	37.2
2025	38.0
2030	38.5
2035	38.6
2040	38.7



From Population to Labor Force to Jobs

- Labor force participation model can take population-by-age-and-sex outputs from population projections, and spit out projections of future workforce by age and sex

Economic Templates

- Labor force participation projection, based on cohort-component outputs and participation rate trends
- Employment-by-Industry projections, using BLS projections (to 2020) with minimal industry-based extrapolations beyond that

Labor Force Participation Trends

1990-2010 With U.S. projections to 2020

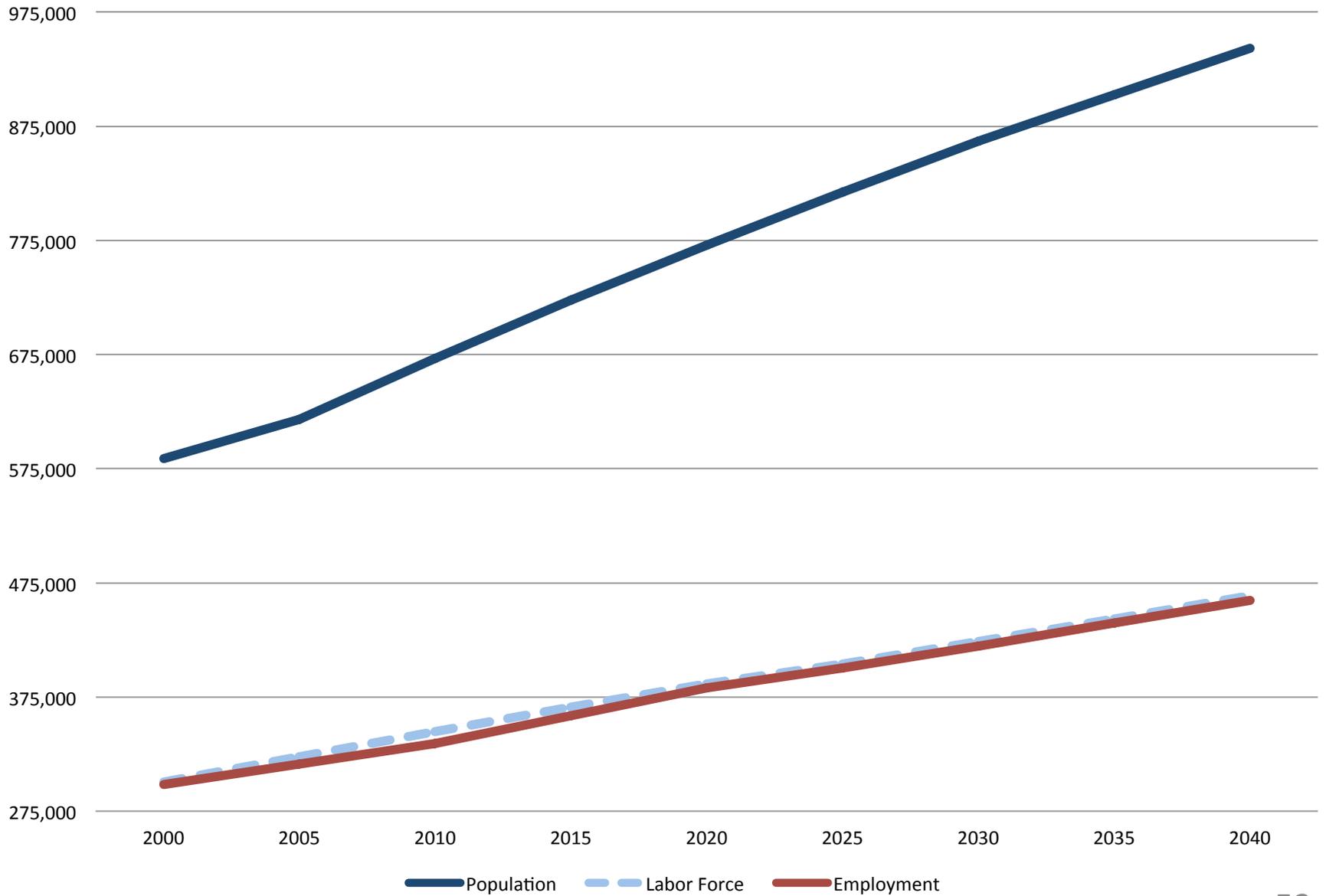
	U.S.A.				LR-NLR MSA (4)			
	1990	2000	2010	2020	1990	2000	2010	2020
Overall	66.5	67.1	64.7	62.5	66.8	66.6	65.7	63.6
16-24	67.3	65.4	55.2	48.2	65.0	65.7	63.1	60.0
25-54	83.5	84	82.2	81.3	84.3	81.6	81.0	80.3
55-64	55.9	59.3	64.9	68.8	53.9	59.1	62.9	66.2
65-74*	16.7	19.2	25.7	31	10.0	20.8	27.6	32.2
75+	4.3	5.3	7.4	10		5.4	5.0	5.3
Male	76.4	74.8	71.2	68.2	74.7	73.0	69.9	67.3
16-24	71.8	68.6	56.8	50.6	67.8	67.3	63.5	60.0
25-54	93.4	91.6	89.3	88.1	91.2	87.1	84.5	83.8
55-64	67.8	67.3	70	71.1	63.1	65.5	66.6	67.5
65-74*	21.4	24.6	30.4	35.1	14.7	26.7	32.0	37.0
75+	7.1	8.1	10.4	12.8		8.0	6.8	7.0
Female	57.5	59.9	58.6	57.1	59.8	60.8	61.9	60.1
16-24	62.9	63	53.6	45.7	62.4	64.0	62.7	60.0
25-54	74	76.7	75.2	74.6	77.8	76.4	77.7	77.0
55-64	45.2	51.9	60.2	66.6	46.1	53.4	59.5	65.0
65-74*	13	14.9	21.6	27.5	7.0	16.2	23.7	28.0
75+	2.7	3.6	5.3	8		4.0	3.9	4.1

U.S. projections 2020 from U.S. Bureau of Labor Statistics

Local Labor Force Participation Based on Population by Age/Sex

Working-Age Population 2010-2040 (Four-County Region)								
	2000	2010	2015	2020	2025	2030	2035	2040
Male Tot.	214,190	251,158	271,574	291,549	310,385	329,261	346,224	362,490
16-24	37,117	42,185	43,226	45,946	48,742	51,550	54,240	55,346
25-54	127,080	137,571	143,630	148,563	156,028	164,612	172,817	180,887
55-64	23,824	37,138	41,649	44,720	43,943	44,089	46,801	50,944
65-74	15,588	21,081	28,079	34,258	38,357	41,074	40,219	40,285
75+	10,581	13,183	14,990	18,061	23,316	27,937	32,147	35,027
Female Tot.	236,735	273,178	294,447	315,944	336,967	358,098	377,161	395,149
16-24	37,774	42,199	43,176	46,068	48,312	51,141	53,814	54,932
25-54	133,113	143,430	149,038	153,122	161,331	169,544	177,704	185,941
55-64	26,446	41,087	46,468	49,492	48,152	48,050	51,288	55,390
65-74	19,838	24,406	32,216	40,034	45,134	47,961	46,501	46,330
75+	19,564	22,056	23,549	27,228	34,038	41,403	47,854	52,556
Labor Force 2000-2040 (Four-County Region)								
	2000	2010	2015	2020	2025	2030	2035	2040
Male Tot.	156,302	175,932	186,491	196,190	205,482	215,787	226,086	236,536
16-24	24,996	26,800	26,692	27,568	29,245	30,930	32,544	33,208
25-54	110,704	116,732	121,152	124,496	130,751	137,944	144,820	151,583
55-64	15,595	24,750	27,925	30,186	29,661	29,760	31,591	34,388
65-74	4,161	6,750	9,687	12,676	14,192	15,198	14,881	14,906
75+	846	900	1,034	1,264	1,632	1,956	2,250	2,452
Female Tot.	144,002	168,493	179,742	190,040	198,544	207,593	217,440	227,265
16-24	24,181	26,473	26,488	27,641	28,987	30,685	32,288	32,959
25-54	101,690	110,953	115,057	117,904	124,225	130,549	136,832	143,175
55-64	14,129	24,427	28,926	32,170	31,299	31,233	33,337	36,003
65-74	3,210	5,790	8,328	11,210	12,637	13,429	13,020	12,972
75+	792	850	942	1,116	1,396	1,698	1,962	2,155

Population, Labor Force, and Employment



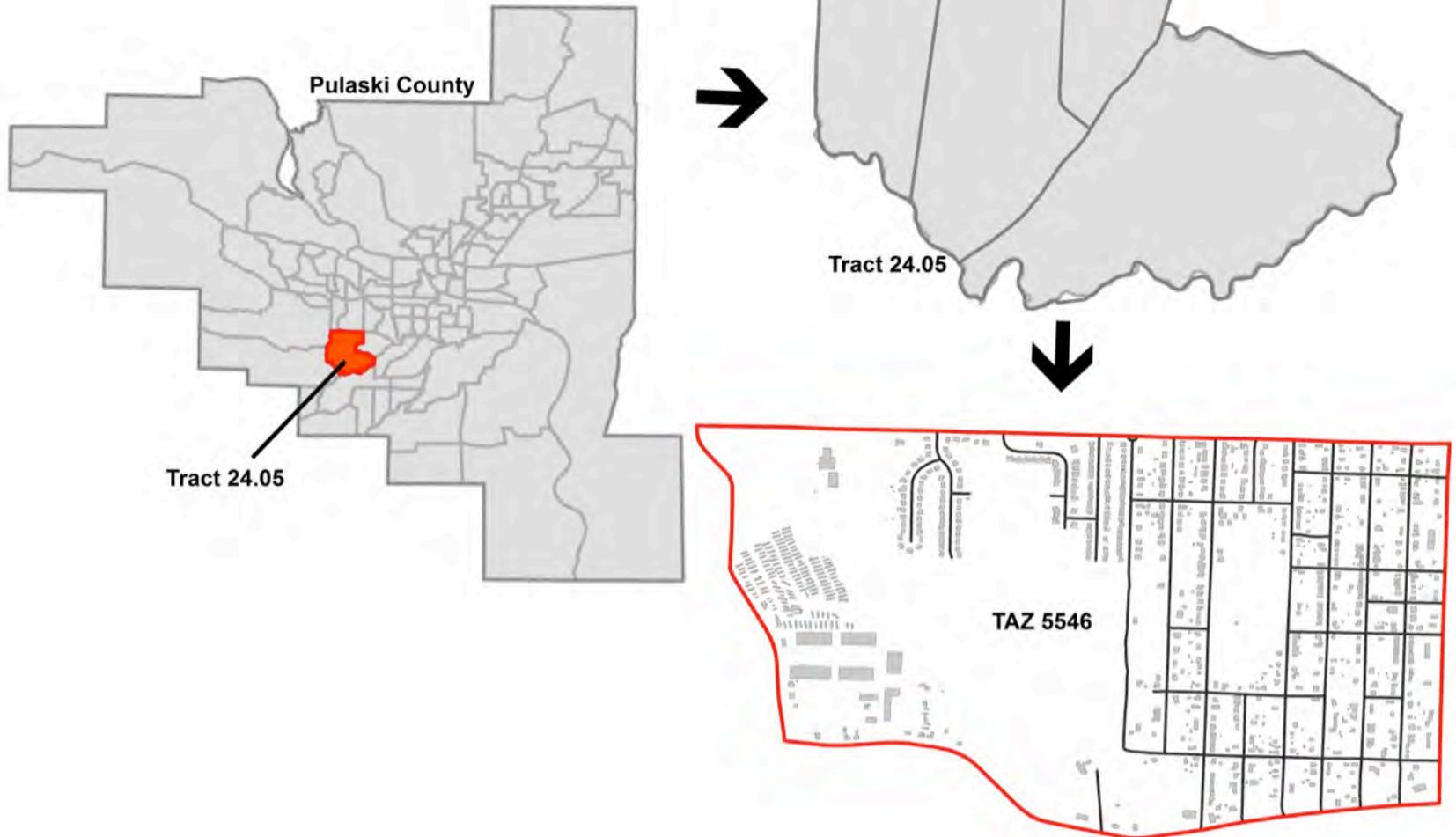
The nitty-gritty

CONCEPTS

Key Concepts

- Control total for population, employment and other data bits
- Geographic hierarchy

Hierarchy: County to Tract, Tract to TAZ



If-Then

- Simple, but vital
- Inferential reasoning

- If I walk my dog we'll both be glad
- If not...



Grade-school math +

- Multiplication and division
- Applied simple algebra



Multipliers

- You're looking for a number that allocates each characteristic in a way that's consistent with overall totals and totals by type
- That number is typically a multiplier

A little example

1	Lonoke County Extrapolations to Find Workers / Household in 2040									
2	by Tract (using County Control Totals)									
3										
4										
5										
6										
7	Tract	Pop10	HH10	HP10	HHwkr10		Pop40	HH40	HP40	HHwkr40
8	201.01	6,749	2,374	6,749	3,117		15,201	5,505	15,201	?
9	201.02	5,373	1,977	5,373	2,446		9,873	3,645	9,873	?
10	201.03	5,398	1,960	5,398	2,569		9,698	3,551	9,698	?
11	201.04	7,068	2,486	7,068	3,257		11,568	4,156	11,568	?
12	202.01	3,729	1,301	3,729	1,858		4,729	1,672	4,729	?
13	202.02	3,837	1,402	3,732	1,639		4,637	1,698	4,531	?
14	202.04	5,535	2,134	5,463	2,598		8,035	3,059	7,957	?
15	202.05	4,994	1,776	4,984	2,457		6,494	2,332	6,482	?
16	202.06	4,110	1,551	4,110	1,856		7,110	2,661	7,110	?
17	203.01	3,977	1,526	3,977	1,951		6,977	2,640	6,977	?
18	203.02	3,750	1,396	3,745	1,876		6,750	2,504	6,741	?
19	204	3,095	1,265	3,031	1,384		3,350	1,357	3,275	?
20	205	4,619	1,728	4,372	1,946		5,608	2,126	5,325	?
21	206	1,815	679	1,813	712		4,326	1,602	4,326	?
22	207	2,989	1,222	2,922	1,242		3,489	1,407	3,421	?
23	208	1,318	518	1,318	584		1,183	497	1,183	?
24										
25	Total	68,356	25,295	67,784	31,492		109,028	40,412	108,397	50,015
26										
27	Ratio Wkr / HH:				1.245		Projected Wkr / HH:			1.238
28										
29										
30										
31										
32										

Apply projected Wkr / HH ratio to all tracts, informed by current ratios but modified to reflect future changes.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Lonoke County Extrapolations to Find Workers / Household in 2040										Apply 2010 ratio				
2	by Tract (using County Control Totals)										of workers to				
3												households			
4															
5															
6												1st Draft			
7	Tract	Pop10	HH10	HP10	HHwkr10		Pop40	HH40	HP40	HHwkr40		HHwkr40			
8	201.01	6,749	2,374	6,749	3,117		15,201	5,505	15,201	?		7227.921			
9	201.02	5,373	1,977	5,373	2,446		9,873	3,645	9,873	?		4509.697			
10	201.03	5,398	1,960	5,398	2,569		9,698	3,551	9,698	?		4654.346			
11	201.04	7,068	2,486	7,068	3,257		11,568	4,156	11,568	?		5444.928			
12	202.01	3,729	1,301	3,729	1,858		4,729	1,672	4,729	?		2387.837			
13	202.02	3,837	1,402	3,732	1,639		4,637	1,698	4,531	?		1985.037			
14	202.04	5,535	2,134	5,463	2,598		8,035	3,059	7,957	?		3724.125			
15	202.05	4,994	1,776	4,984	2,457		6,494	2,332	6,482	?		3226.196			
16	202.06	4,110	1,551	4,110	1,856		7,110	2,661	7,110	?		3184.279			
17	203.01	3,977	1,526	3,977	1,951		6,977	2,640	6,977	?		3375.256			
18	203.02	3,750	1,396	3,745	1,876		6,750	2,504	6,741	?		3364.974			
19	204	3,095	1,265	3,031	1,384		3,350	1,357	3,275	?		1484.655			
20	205	4,619	1,728	4,372	1,946		5,608	2,126	5,325	?		2394.211			
21	206	1,815	679	1,813	712		4,326	1,602	4,326	?		1679.859			
22	207	2,989	1,222	2,922	1,242		3,489	1,407	3,421	?		1430.028			
23	208	1,318	518	1,318	584		1,183	497	1,183	?		560.3243			
24															
25	Total	68,356	25,295	67,784	31,492		109,028	40,412	108,397	50,015		50,634			
26															
27	Ratio Wkr / HH:				1.245		Projected Wkr / HH:			1.238		Formula for each tract:			
28												HH 2040 * (HHwkr 2010 / HH 2010)			
29							Apply projected Wkr / HH ratio to all								
30							tracts, informed by current ratios but								
31							modified to reflect future changes.								

1	Lonoke County Extrapolations to Find Workers / Household in 2040									Apply 2010 ratio	Multiplier rate				
2	by Tract (using County Control Totals)									of workers to	applied to adjust				
3										households	all cells to control				
4											total.				
5															
6										1st Draft	2nd Draft				
7	Tract	Pop10	HH10	HP10	HHwkr10	Pop40	HH40	HP40	HHwkr40	HHwkr40	HHwkr40				
8	201.01	6,749	2,374	6,749	3,117	15,201	5,505	15,201	?	7227.921	7139.606	Must use absolute value (\$) to apply multiplier to all cells.			
9	201.02	5,373	1,977	5,373	2,446	9,873	3,645	9,873	?	4509.697	4454.594				
10	201.03	5,398	1,960	5,398	2,569	9,698	3,551	9,698	?	4654.346	4597.477				
11	201.04	7,068	2,486	7,068	3,257	11,568	4,156	11,568	?	5444.928	5378.399				
12	202.01	3,729	1,301	3,729	1,858	4,729	1,672	4,729	?	2387.837	2358.661				
13	202.02	3,837	1,402	3,732	1,639	4,637	1,698	4,531	?	1985.037	1960.783				
14	202.04	5,535	2,134	5,463	2,598	8,035	3,059	7,957	?	3724.125	3678.621				
15	202.05	4,994	1,776	4,984	2,457	6,494	2,332	6,482	?	3226.196	3186.776				
16	202.06	4,110	1,551	4,110	1,856	7,110	2,661	7,110	?	3184.279	3145.371				
17	203.01	3,977	1,526	3,977	1,951	6,977	2,640	6,977	?	3375.256	3334.015				
18	203.02	3,750	1,396	3,745	1,876	6,750	2,504	6,741	?	3364.974	3323.859				
19	204	3,095	1,265	3,031	1,384	3,350	1,357	3,275	?	1484.655	1466.514				
20	205	4,619	1,728	4,372	1,946	5,608	2,126	5,325	?	2394.211	2364.957				
21	206	1,815	679	1,813	712	4,326	1,602	4,326	?	1679.859	1659.333				
22	207	2,989	1,222	2,922	1,242	3,489	1,407	3,421	?	1430.028	1412.555				
23	208	1,318	518	1,318	584	1,183	497	1,183	?	560.3243	553.478				
24															
25	Total	68,356	25,295	67,784	31,492	109,028	40,412	108,397	50,015	50,634	50,015				
26															
27	Ratio Wkr / HH:				1.245	Projected Wkr / HH:			1.238	Accumulated total is too high (50,634)					
28										Need a correction factor multiplier					
29						Apply projected Wkr / HH ratio to all									
30						tracts, informed by current ratios but									
31						modified to reflect future changes.				Multiplier is goal (50,015) divided by					
32										1st draft result (50,634)					
33															
34										Multiplier:					
35										0.987781					

1	Lonoke County Extrapolations to Find Workers / Household in 2040									Apply 2010 ratio	Multiplier rate			
2	by Tract (using County Control Totals)									of workers to	applied to adjust			
3										households	all cells to control			
4											total.		Rounding	
5														
6										1st Draft	2nd Draft		3rd Draft	
7	Tract	Pop10	HH10	HP10	HHwkr10	Pop40	HH40	HP40	HHwkr40	HHwkr40	HHwkr40	HHwkr40	HHwkr40	HHwkr40
8	201.01	6,749	2,374	6,749	3,117	15,201	5,505	15,201	?	7227.921	7139.606		7,140	
9	201.02	5,373	1,977	5,373	2,446	9,873	3,645	9,873	?	4509.697	4454.594		4,455	
10	201.03	5,398	1,960	5,398	2,569	9,698	3,551	9,698	?	4654.346	4597.477		4,597	
11	201.04	7,068	2,486	7,068	3,257	11,568	4,156	11,568	?	5444.928	5378.399		5,378	
12	202.01	3,729	1,301	3,729	1,858	4,729	1,672	4,729	?	2387.837	2358.661		2,359	
13	202.02	3,837	1,402	3,732	1,639	4,637	1,698	4,531	?	1985.037	1960.783		1,961	
14	202.04	5,535	2,134	5,463	2,598	8,035	3,059	7,957	?	3724.125	3678.621		3,679	
15	202.05	4,994	1,776	4,984	2,457	6,494	2,332	6,482	?	3226.196	3186.776		3,187	
16	202.06	4,110	1,551	4,110	1,856	7,110	2,661	7,110	?	3184.279	3145.371		3,145	
17	203.01	3,977	1,526	3,977	1,951	6,977	2,640	6,977	?	3375.256	3334.015		3,334	
18	203.02	3,750	1,396	3,745	1,876	6,750	2,504	6,741	?	3364.974	3323.859		3,324	
19	204	3,095	1,265	3,031	1,384	3,350	1,357	3,275	?	1484.655	1466.514		1,467	
20	205	4,619	1,728	4,372	1,946	5,608	2,126	5,325	?	2394.211	2364.957		2,365	
21	206	1,815	679	1,813	712	4,326	1,602	4,326	?	1679.859	1659.333		1,659	
22	207	2,989	1,222	2,922	1,242	3,489	1,407	3,421	?	1430.028	1412.555		1,413	
23	208	1,318	518	1,318	584	1,183	497	1,183	?	560.3243	553.478		553	
24														
25	Total	68,356	25,295	67,784	31,492	109,028	40,412	108,397	50,015	50,634	50,015		50,016	
26														
27	Ratio Wkr / HH:				1.245	Projected Wkr / HH:			1.238				Slight difference is acceptable.	
28														
29						Apply projected Wkr / HH ratio to all							Base allocation, more can be done.	
30						tracts, informed by current ratios but								
31						modified to reflect future changes.								

The Mother of All Data Problems

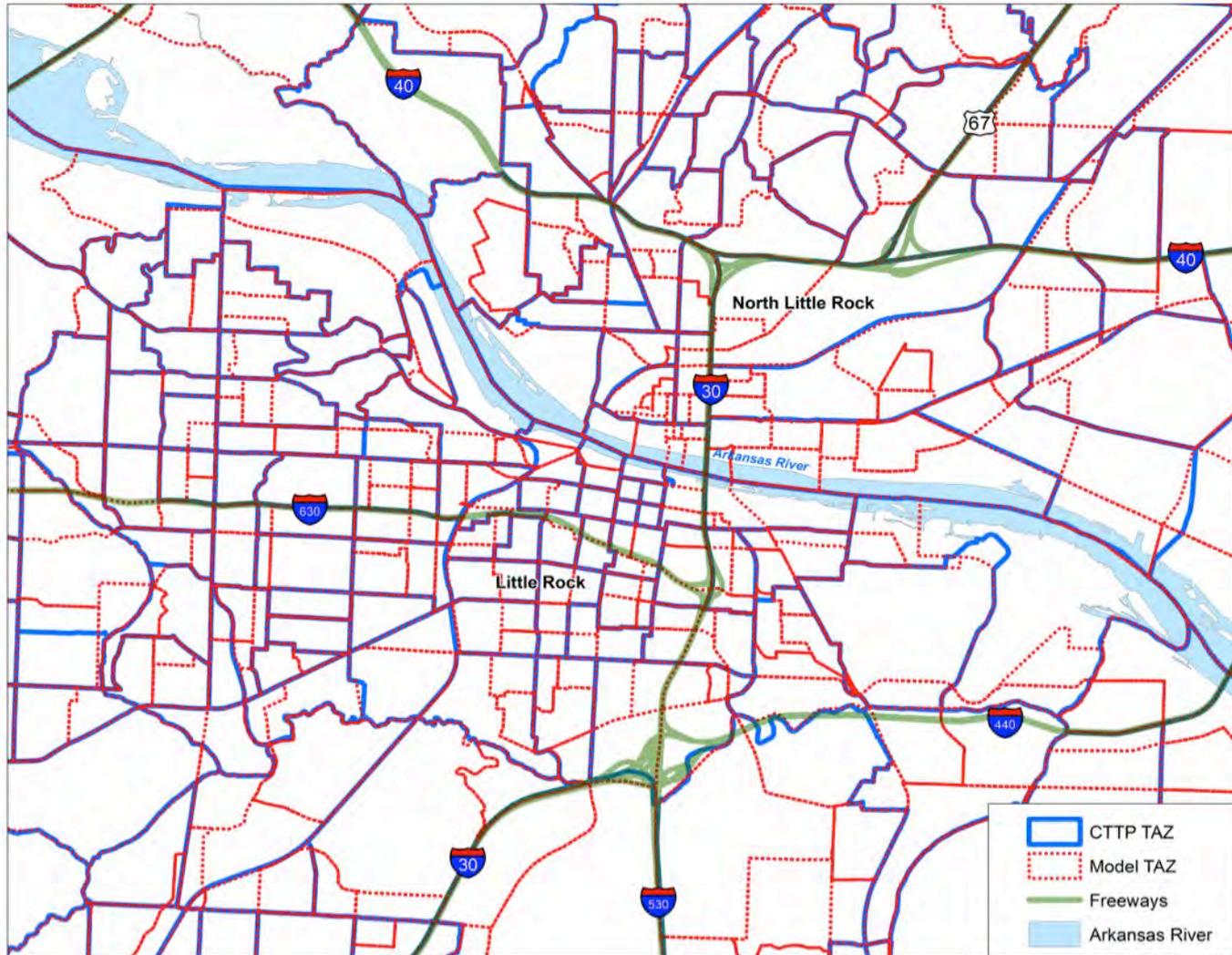
- Model demands 12 separate inputs for each TAZ, for 1,500 TAZs in ten-year increments
- That works out to 18,000 discrete data “bits” *per forecast year*, and 72,000 in all.



TAZs for CTPP 2006-2010 (center portion only)



Model TAZs in CTPP TAZs



The Nub of the Data Problem

- Each of 72,000 separate data bits must meet the following qualifications:
 1. They must be internally consistent (HH size, emp-by-industry, workers/HH)
 2. They must match control totals (or it's an exercise in pure fiction)
 3. They are subject to draft versions, map checks, and revisions

What do you do?



Excel VBA

- VBA = Visual Basic for Applications
- It's the internal programming language of Excel
- If you've ever generated a "macro," you've touched VBA
- Get started by designing a macro, then step into VBA and start tweaking it

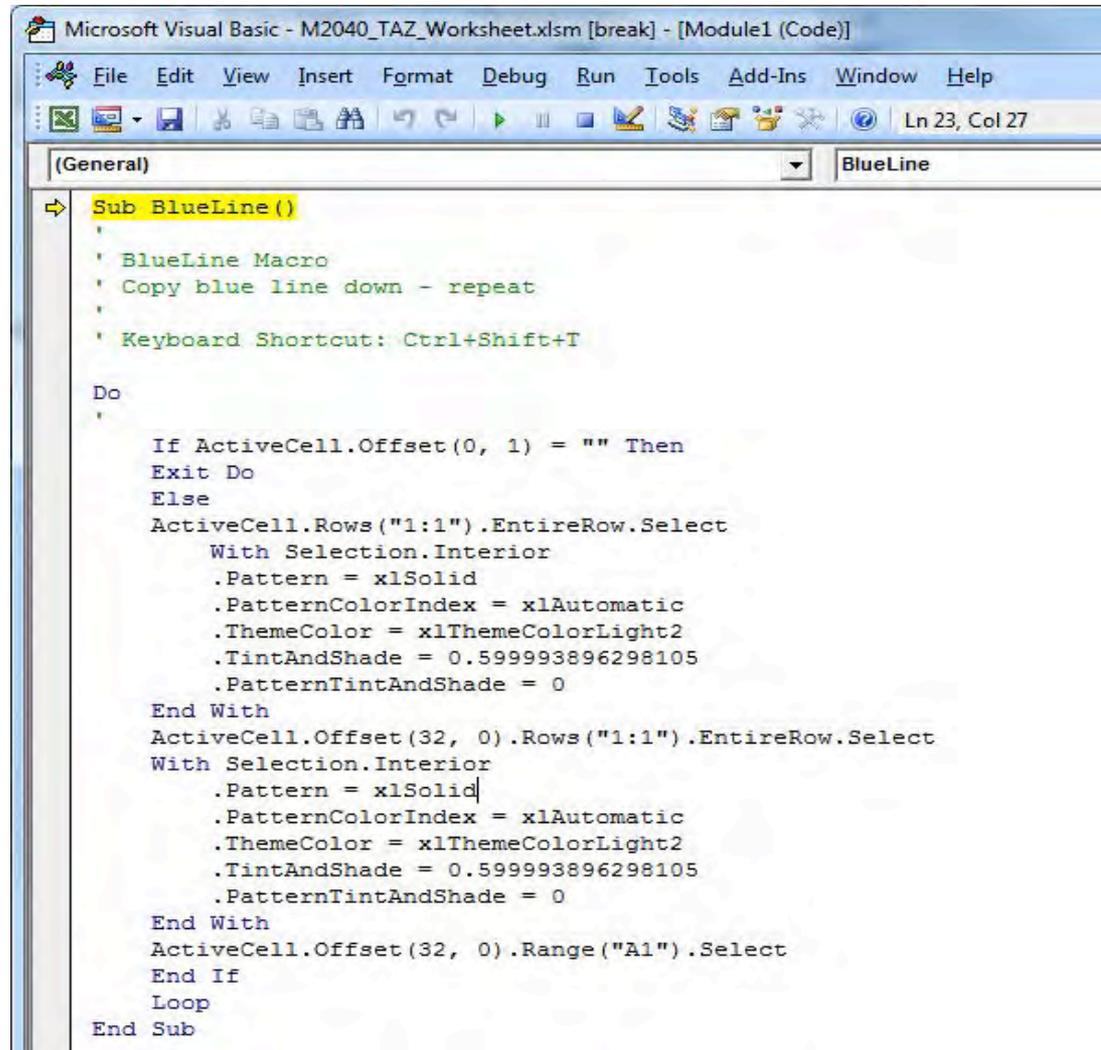
VBA On the Ground

- “On the Ground” is a useful analogy because the hierarchy of spatial geography is key
- County – tract – TAZ
- VBA best for tract – to – TAZ (the trenches)

VBA Examples

- One macro may conduct tract-to-TAZ calculations for all rows in a tract, then stop
- Once in the code you can copy it to do the same thing ten times
- With a “Do Loop” you can make it copy repeatedly until it meets a stopping criterion, possibly a simple blank space

Sample of VBA Code



```
Microsoft Visual Basic - M2040_TAZ_Worksheet.xlsm [break] - [Module1 (Code)]
File Edit View Insert Format Debug Run Tools Add-Ins Window Help
Ln 23, Col 27
(General) BlueLine
Sub BlueLine ()
'
' BlueLine Macro
' Copy blue line down - repeat
'
' Keyboard Shortcut: Ctrl+Shift+T

Do
'
    If ActiveCell.Offset(0, 1) = "" Then
    Exit Do
    Else
    ActiveCell.Rows("1:1").EntireRow.Select
        With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorLight2
        .TintAndShade = 0.599993896298105
        .PatternTintAndShade = 0
        End With
    ActiveCell.Offset(32, 0).Rows("1:1").EntireRow.Select
    With Selection.Interior
    .Pattern = xlSolid
    .PatternColorIndex = xlAutomatic
    .ThemeColor = xlThemeColorLight2
    .TintAndShade = 0.599993896298105
    .PatternTintAndShade = 0
    End With
    ActiveCell.Offset(32, 0).Range("A1").Select
    End If
    Loop
End Sub
```

Sample VBA Tract-TAZ Spreadsheet

TRACT TAZ	SERV300	BAS30P	RET30P	SERV30P	TOT30R	BAS30R	RET30R	SERV30R	BAS30S	RET30S	SERV30S	TOT30T	BAS30T	RET30T	SERV30T	BAS30U	RET30U	SERV30U	
1 301 4801	44	4	25	44	74	4	25	44	4	25	44	74	4	25	44	4	25	44	
2 301 4802	26	31	8	26	65	31	8	26	31	8	26	65	31	8	26	31	8	26	
3 301 4803	15	37	5	15	58	37	5	15	37	5	15	58	37	5	15	37	5	15	
4 301 4804	30	0	12	30	42	0	12	30	0	12	30	42	0	12	30	0	12	30	
5 301 4805	25	0	10	25	35	0	10	25	0	10	25	35	0	10	25	0	10	25	
6 301 4806	4	0	0	4	4	0	0	4	0	0	4	4	0	0	4	0	0	4	
7 301 4807	57	7	18	57	82	7	18	57	7	18	57	82	7	18	57	7	18	57	
8 301 4808	214	157	75	214	446	157	75	214	157	75	214	446	157	75	214	157	75	214	
9 301 4809	20	144	31	20	195	144	31	20	144	31	20	195	144	31	20	144	31	20	
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28		436	380	185	436	1,000	379	185	436	380	185	436	1,000	379	185	436	380	185	436
29						8							9						
30 1 301 4814	146	100	52	146	298	100	52	146	100	52	146	298	100	52	146	100	52	146	
31 2 301 4817	16	6	2	16	24	6	2	16	6	2	16	24	6	2	16	6	2	16	
32 3 301 4820	71	7	241	71	319	7	241	71	7	241	71	319	7	241	71	7	241	71	
33 4 301 4821	8	0	2	8	10	0	2	8	0	2	8	10	0	2	8	0	2	8	
34 5 301 4822	691	12	43	691	746	12	43	691	12	43	691	746	12	43	691	12	43	691	
35 6 301 4824	416	52	21	416	488	52	21	416	52	21	416	488	52	21	416	52	21	416	
36 7 301 4827	7	6	1	7	14	6	1	7	6	1	7	14	6	1	7	6	1	7	
37 8 301 4828	27	13	3	27	43	13	3	27	13	3	27	43	13	3	27	13	3	27	
38 9 301 4831	25	16	18	25	59	16	18	25	16	18	25	59	16	18	25	16	18	25	
39 10 301 4833	99	12	88	99	199	12	88	99	12	88	99	199	12	88	99	12	88	99	
40																			
41																			
42																			
43																			
44																			
45																			
46																			
47																			
48																			
49																			
50																			
51																			
52																			
53																			
54		1,505	224	471	1,505	2,200	224	471	1,505	224	471	1,505	2,200	224	471	1,505	224	471	1,505
55																			
56 1 301 4823	323	103	249	323	675	103	249	323	103	249	323	675	103	249	323	103	249	323	
57 2 301 4825	15	58	4	15	77	58	4	15	58	4	15	77	58	4	15	58	4	15	
58 3 301 4826	3	0	2	3	5	0	2	3	0	2	3	5	0	2	3	0	2	3	
59 4 301 4829	6	19	5	6	29	19	5	6	19	5	6	29	19	5	6	19	5	6	
60 5 301 4830	27	72	15	27	115	72	15	27	72	15	27	115	72	15	27	72	15	27	

Correction factors

- Once you've adjusted a set of numbers (for TAZs within a tract for example), you will probably violate the control total
- A correction factor can re-impose the same control total on adjusted values
- Values must remain reasonable, like PPH is rarely lower than 1.5 and rarely higher than 3
- You can set up if-then "flags" to draw your attention to violations

VBA Tips

- VBA can allow you to repeat a complex function
- VBA can meet “if-then” conditions, so to some extent a VBA program can walk through your spreadsheet thinking for itself
- VBA is fragile. Minor syntax errors will throw everything off
- VBA depends on consistent spacing, so you’ll do better if you’re spatially wasteful (but consistent) than if you’re stingy with rows and columns

A Sick Relationship

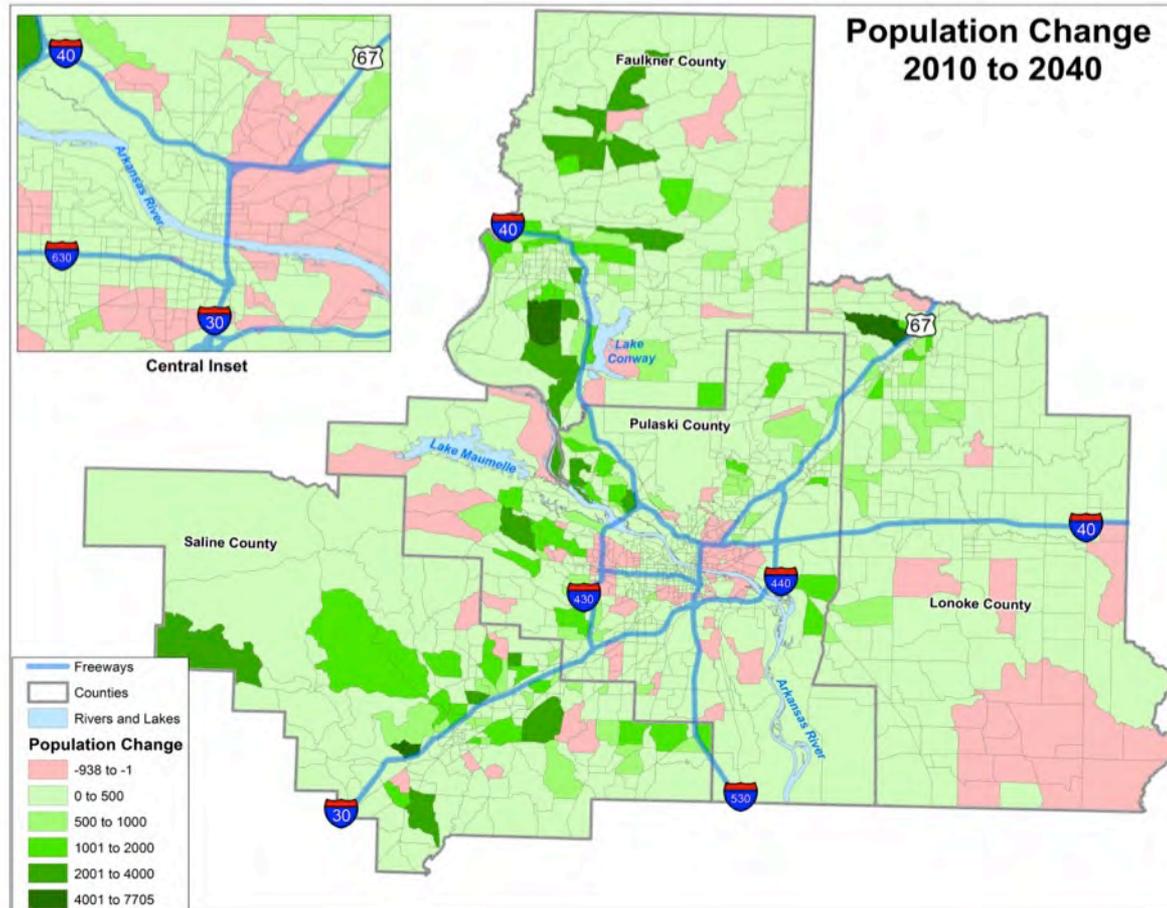
- When it's bad, it's really bad



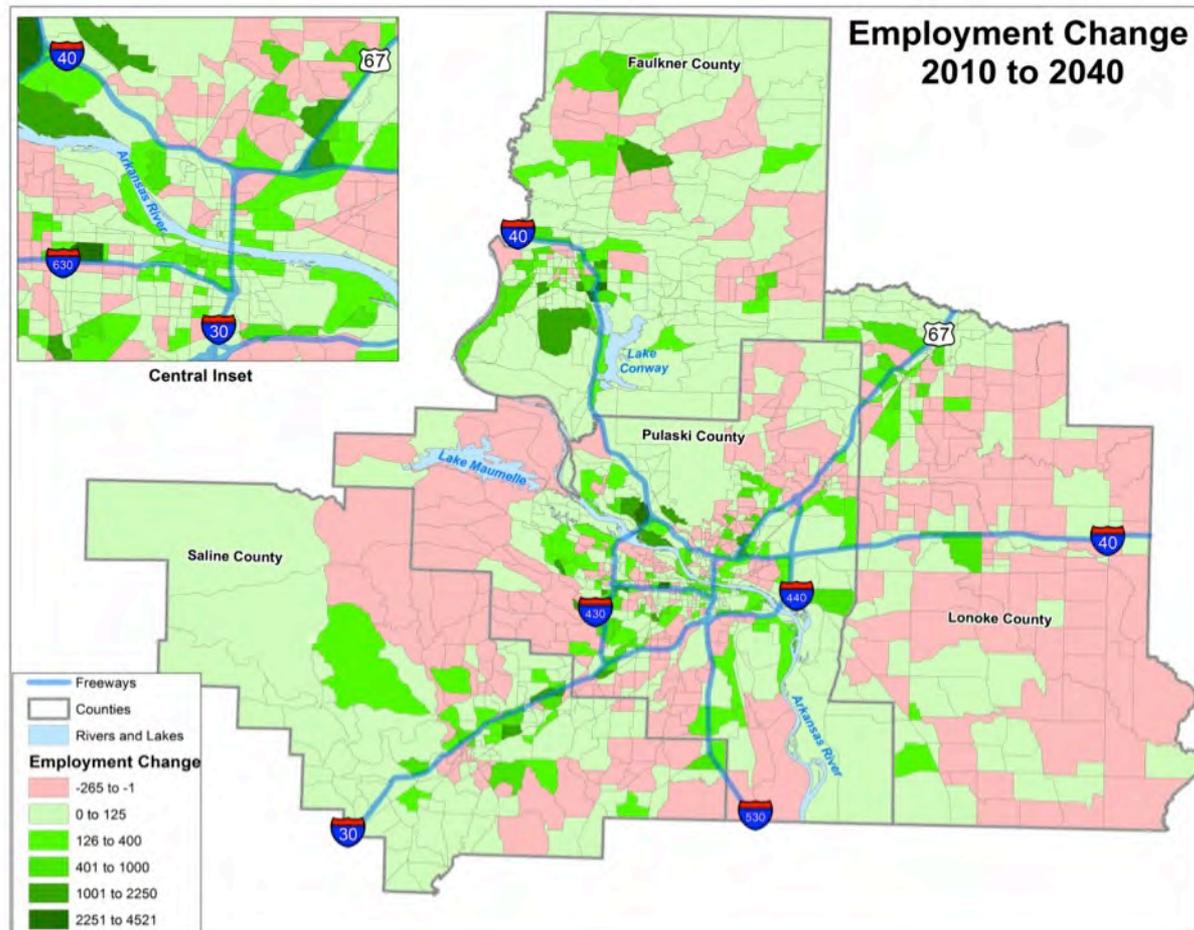
- It's mentally intensive, so it's okay – essential in fact – to take long walks, develop strange hobbies, chat with the receptionist, distract the GIS staff with your teenager troubles...



The Results – Population Change Projected (Trend Model)

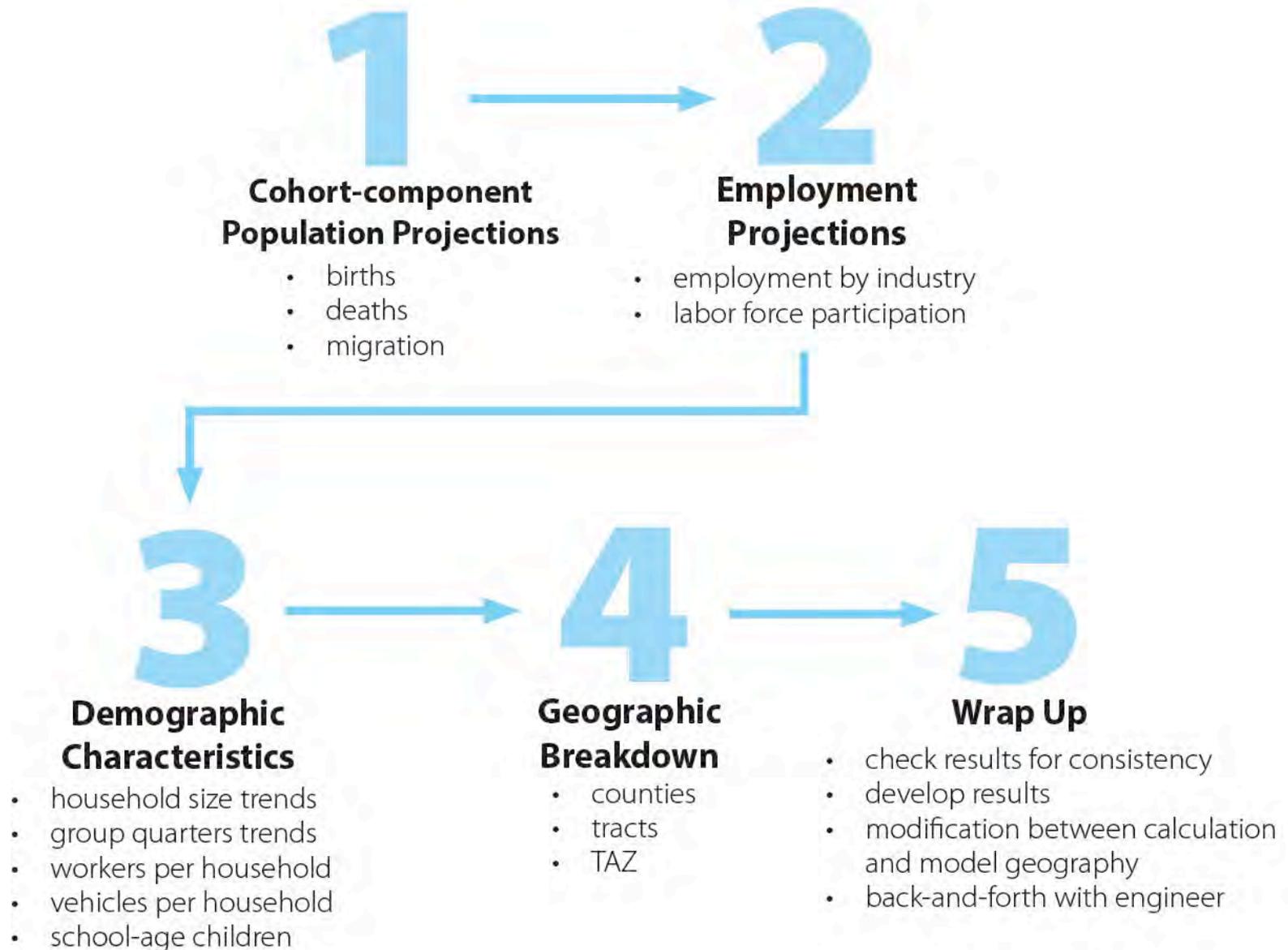


The Results – Employment Change (Trend Model)



How you get from MSA to TAZ

STEP-BY STEP SUMMARY



Human and Humor share the same first 3 letters

THE HUMAN FACTOR

Teamwork

- An office of “turfs” won’t get too far
- An office with a “sharing” culture will do well, and have fun, too



Teamwork

- Supervisors should allow people space and time to be creative. Work is complicated, coaching support is welcome
- Employees should keep the boss apprised. Supervisors have the big picture, and may be able to help in ways you don't recognize



Training / Aptitude

- Attitude is key
- Motivation matters more than raw ability
- Creativity can cut a lot of corners
- Mathematical genius not necessary, but...
- You'd better like numbers and statistics.

“Organization is the Enemy of Improvisation” – Lord Beaverbrook, 1940



Working with the Public

- The public is rarely interested and doesn't understand



Working with the Public

- Despite the obscurity of the work, it can make a big difference
- School-age population projections are a gold mine for school districts looking at facilities needs



Scenarios

- Since 1995, Metroplan has always done a “trend” scenario and a “vision” or “preferred policy” scenario
- “Trend” is defaulted to in practice
- “Trend” is not an “ugly plan” for this reason; it allows for shifting market and demographic forces

Final Thoughts

- “Anyone that can forecast land use twenty to thirty years out is a fool, a charlatan, or both”
– Dr. Stephen Putnam, 2003 -
- Projections try to help with anticipating trends, not exact results
- Sometimes they miss trends too
- A model is just a tool

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TMIP Contacts

If you have any questions or comments about today's presentation or TMIP, or if you are interested in sharing your experience, please contact me at:

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