

نمذجة الحركة المرورية

Traffic Models

- Definitions

- Microscopic traffic characteristics
- Macroscopic traffic characteristics

الموديلات الميكروسكوبية:

Microscopic Models

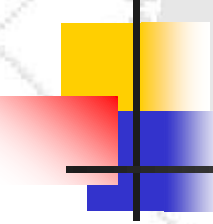
- تمثل هذه الموديلات خصائص وتفاعلات العربات المفردة، وينتج عنها مسارات العربات المتحركة عبر الشبكة. وتشمل العملية الخوارزميات والقواعد التي تصف حركة العربة وتفاعلها ضمن تيار المرور (التسارع، التباطؤ، تبديل الحارة المرورية والتجاوز).

الموديلات الميسوسكوبية: Mesoscopic Models

- تمثل هذه الموديلات العربات المفردة، ولكنها تصف أنشطة هذه العربات وتفاعلاتها على أساس العلاقات الميكروسكوبية، والاستخدام الأساسي لهذه الموديلات هو في تقييم أنظمة معلومات المسافرين (الركاب)، (traveler information systems) ، مثلاً يمكن تمثيل حركة عربة مفردة مزودة بنظام معلومات الزمن الحقيقي للرحلة، (real-time travel information system) حيث تحدد أزمدة الرحلة بناء على معدلات السرعة على الشبكة ، حيث يتم حساب معدلات السرعة هذه بناء علاقات السرعة – الغزارة.

الموديلات الماكروسكوبية: Macroscopic Models

- تمثل هذه الموديلات الجريان المروري وتأخذ بالاعتبار خصائص التيار المروري (السرعة، الغزارة والكثافة) وكذلك العلاقات بينها. تستخدم هذه الموديلات عادة معادلات تقليدية للجريان وحالة الاضطرابات التي تحصل ضمن النظام. تمكن من التنبؤ بالامتداد المكاني والزمني للازدحام المروري الذي قد ينجم عن الزيادة في الطلب المروري أو عن الحوادث التي تحصل على الشبكة، ولكن هذه الموديلات لا تمكن من نمذجة تفاعل العربات من أجل أشكال لتصاميم بديلة.



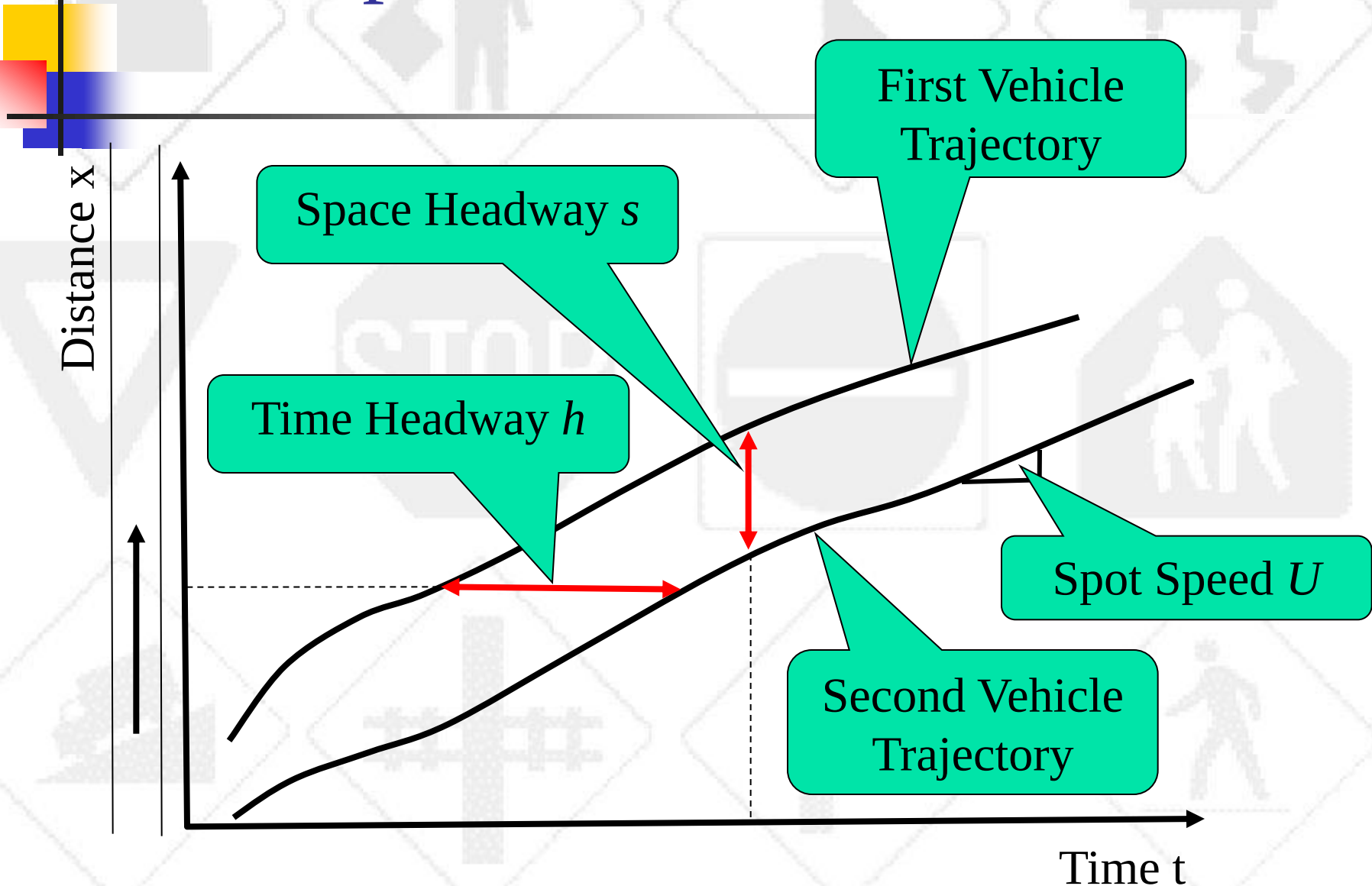
Microscopic Characteristics

Time headway h = time measured at a spot between two consecutive vehicles passages

Space headway s = distance between two consecutive vehicles at an instant

Speed U = instantaneous speed of a vehicle at a spot and at an instant

Microscopic Characteristics



Macroscopic Characteristics

Volume

■ N = number of vehicles counted at a spot during T seconds

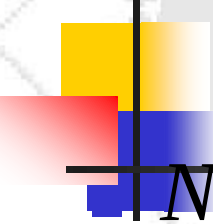
- $q = N/T$, flow rate or volume (veh/s)
- $q = 3600 \cdot N/T$ (veh/h)

Average time headway $\bar{h} = T/N$ (s), $1/\bar{h} = N/T$

$$q = \frac{1}{\bar{h}} \text{ (veh/s)} \quad \text{or} \quad q = \frac{3600}{\bar{h}} \text{ (veh/h)}$$

Macroscopic Characteristics

Density

 N = number of vehicles counted instantaneously along segment of L feet

- $k = N/L$, traffic density (veh/ft)
- $k = 5280 \cdot N/L$ (veh/mi)

Average space headway $\bar{s} = L/N$ (ft), $1/\bar{s} = N/L$

$$k = \frac{1}{\bar{s}} \text{ (veh/ft)} \quad \text{or} \quad k = \frac{5280}{\bar{s}} \text{ (veh/mi)}$$

Macroscopic Characteristics

Mean Speeds



Time-mean speed U_t

Average value of instantaneous speeds of vehicles passing a spot during some period of time (mi/h)

$$\bar{U}_t = \frac{\sum_{i=1}^N U_i}{N}$$

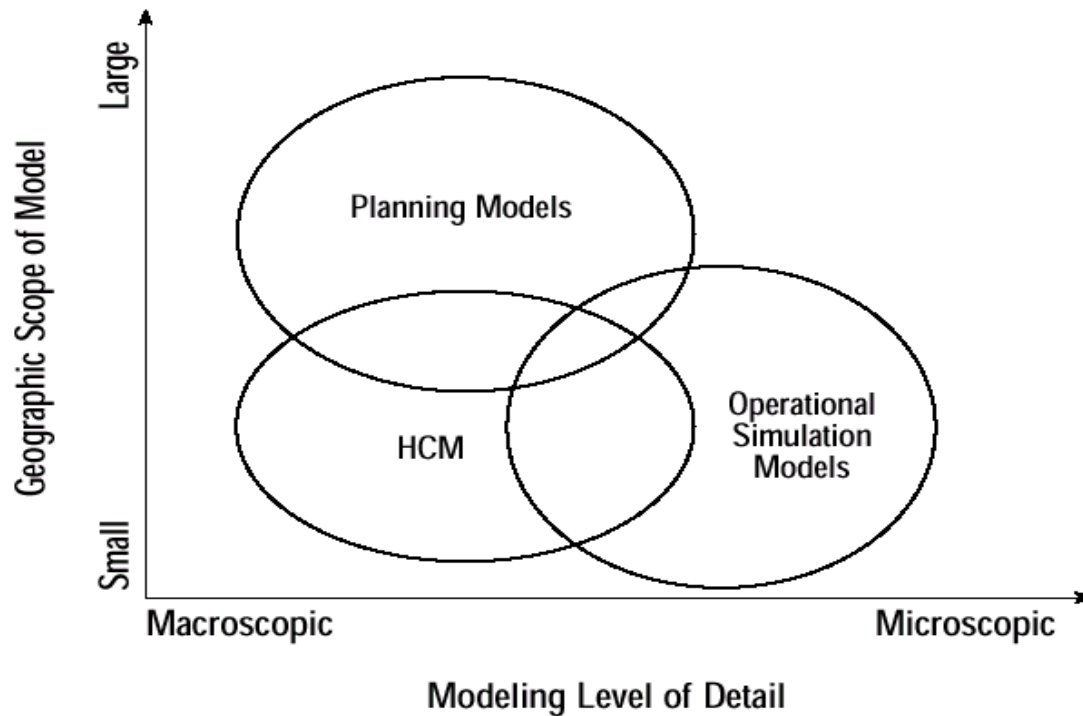
Space-mean speed U_s

Average value of instantaneous speeds of vehicles along a road at some instant (mi/h)

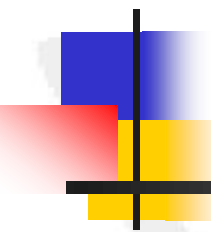
$$\bar{U}_s = \frac{\sum_{i=1}^N U_i}{N}$$

Simulation

■ Typology of Models

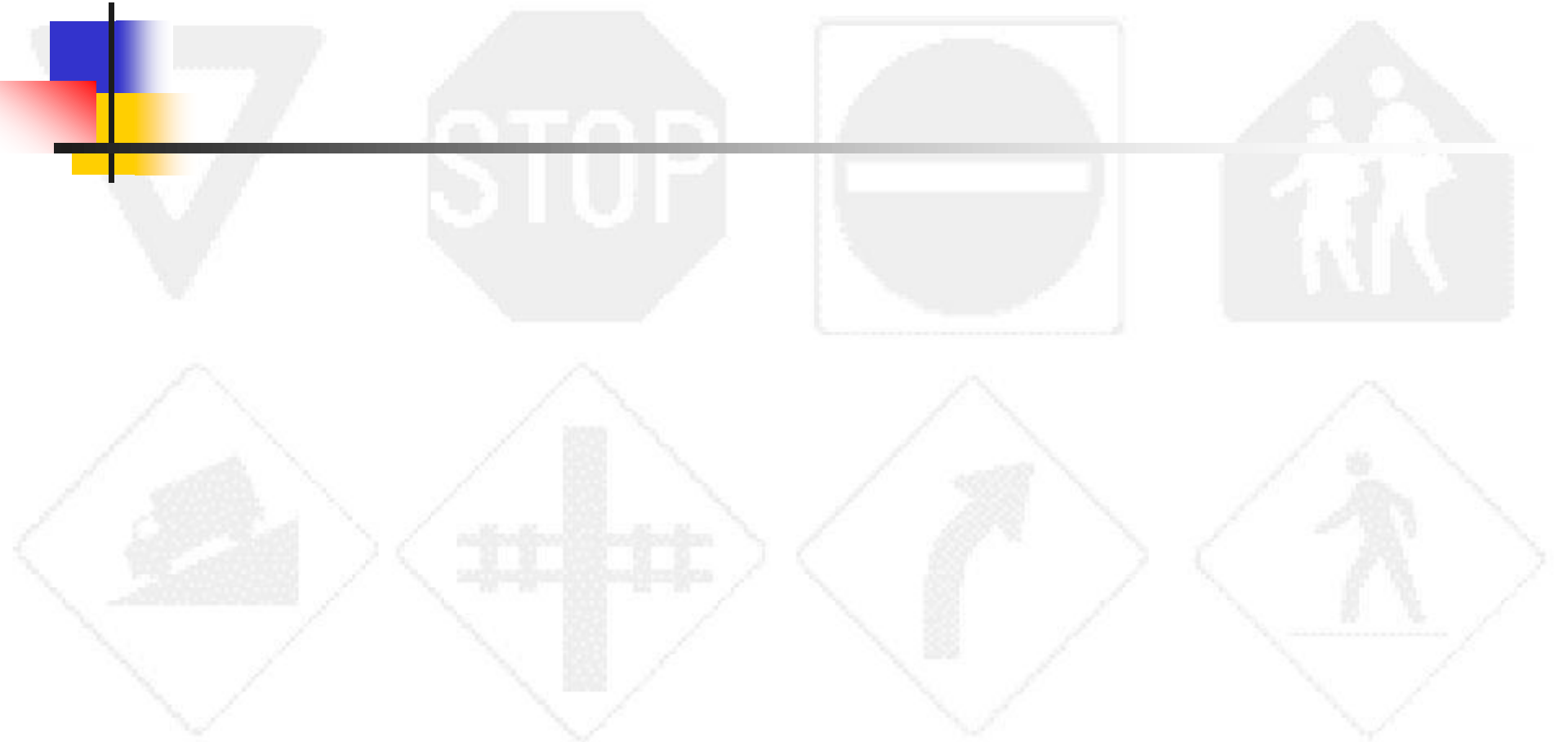


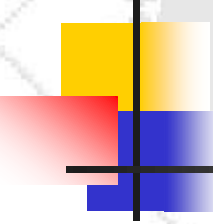
Travel Demand Modeling Overview



- Selecting a Model
- Model Capabilities
- Data Availability
- Ease of Use
- Past Performance
- Validation/Calibration

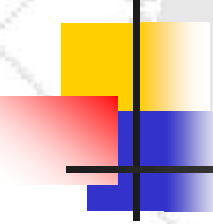
Travel Demand Modeling Overview





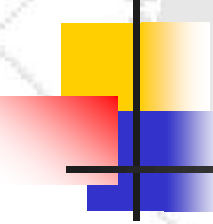
What is the Goal for Today?

- Introduction/Overview: Travel Demand Modeling
 - Why do we model travel demand?
 - How do we model travel demand?
 - Who uses model output?
 - Get the “Big Picture”!
 - Don’t worry about remembering everything today.
 - Learn specifics as you go through the semester.
- Presentation designed to:
 - Educate MPO Policy and Technical Committee Members on the modeling process.



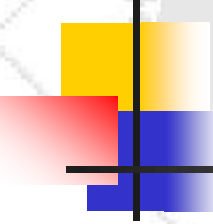
What Is a Traffic Model?

- Typical Definition:
 - A computer program that runs mathematical equations using input data to replicate travel choices that individuals make.
- The output is a measure of future travel demand that is expressed in terms of future traffic volumes.
- Simply: A forecast of future travel.
 - Where are people traveling to and from.
 - What routes are they choosing to get there.



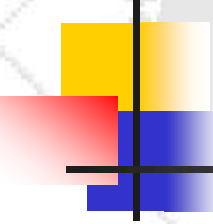
Why Are Models Important?

- Models are the heart of Transportation Planning.
- They help to guide the development of Long-Range Transportation Plans.
- They help us determine how much traffic will be on our roadways in the future.
- They help us to understand the impact that development has on our transportation system.
- They guide future investment strategies.
- Models allow us to make informed decisions.



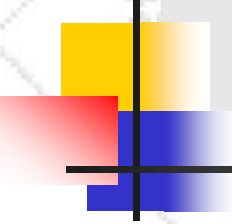
What Are Travel Models Used For?

- Provide Decision Makers the best possible information about future needs.
- Determining where congestion may be in the future.
- Determining what projects will alleviate or minimize that congestion.
- Scenario analyses. (What ifs).
- How many lanes are we going to need?
- Determine traffic impact due to land use changes.
- Important to most all transportation projects.



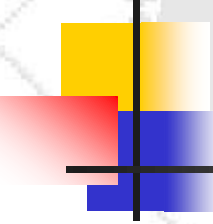
Example Scenario

- MPO Planner or Engineer
- Finite \$ in available funding
- Your job: ID what roadway projects will be in the MPO Transportation Improvement Program.
- Resources are limited.
- Choices need to be good ones.
- Public drives the roads every day and are ready to complain.
- How do you go about selecting solutions?
- Use the travel demand model to aid in determining how to address existing congestion problems.
 - Test various projects to determine effectiveness.
 - Measure in VMT and VHT savings



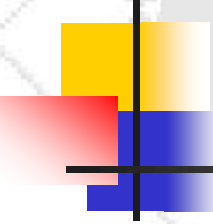
Building a Travel Demand Model

- What do we need to start?
- DATA!
 - Population (how many people do we have?)
 - Households (where do they live)
 - Employment (jobs, shopping, restaurants, recreation, etc.)
 - Schools (College locations)
 - **Roadway Network**
- What causes us to travel each day and how do we get there.



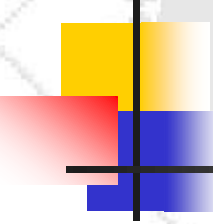
Data Organization

- Well organized data is critical!
- Before the data is collected a system to organize it needs to be set up.



How is our data organized?

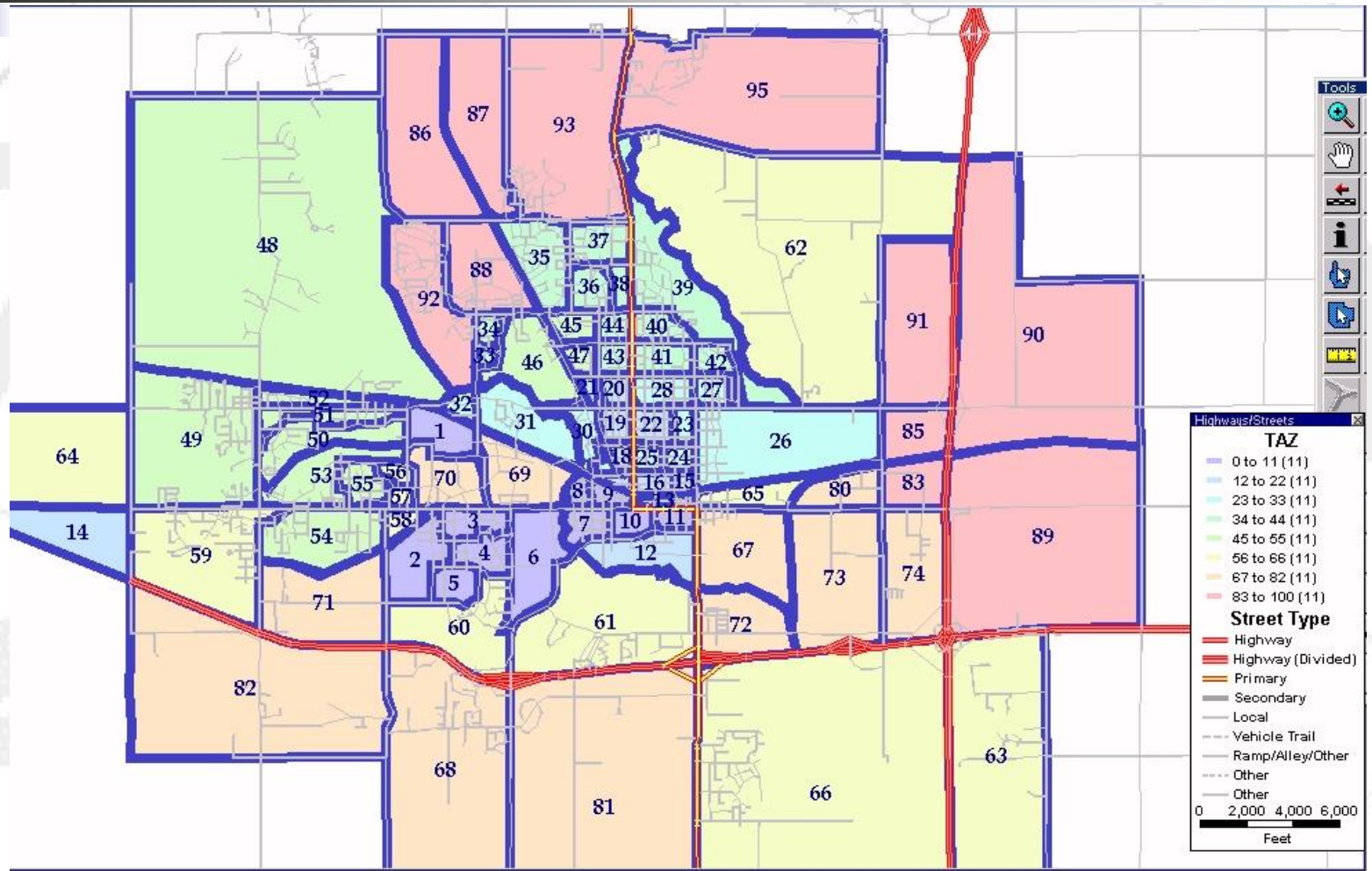
- It is subdivided into special zones commonly referred to as:
 - Traffic Analysis Zones
 - Zones (for short)
 - TAZs (for shorter)



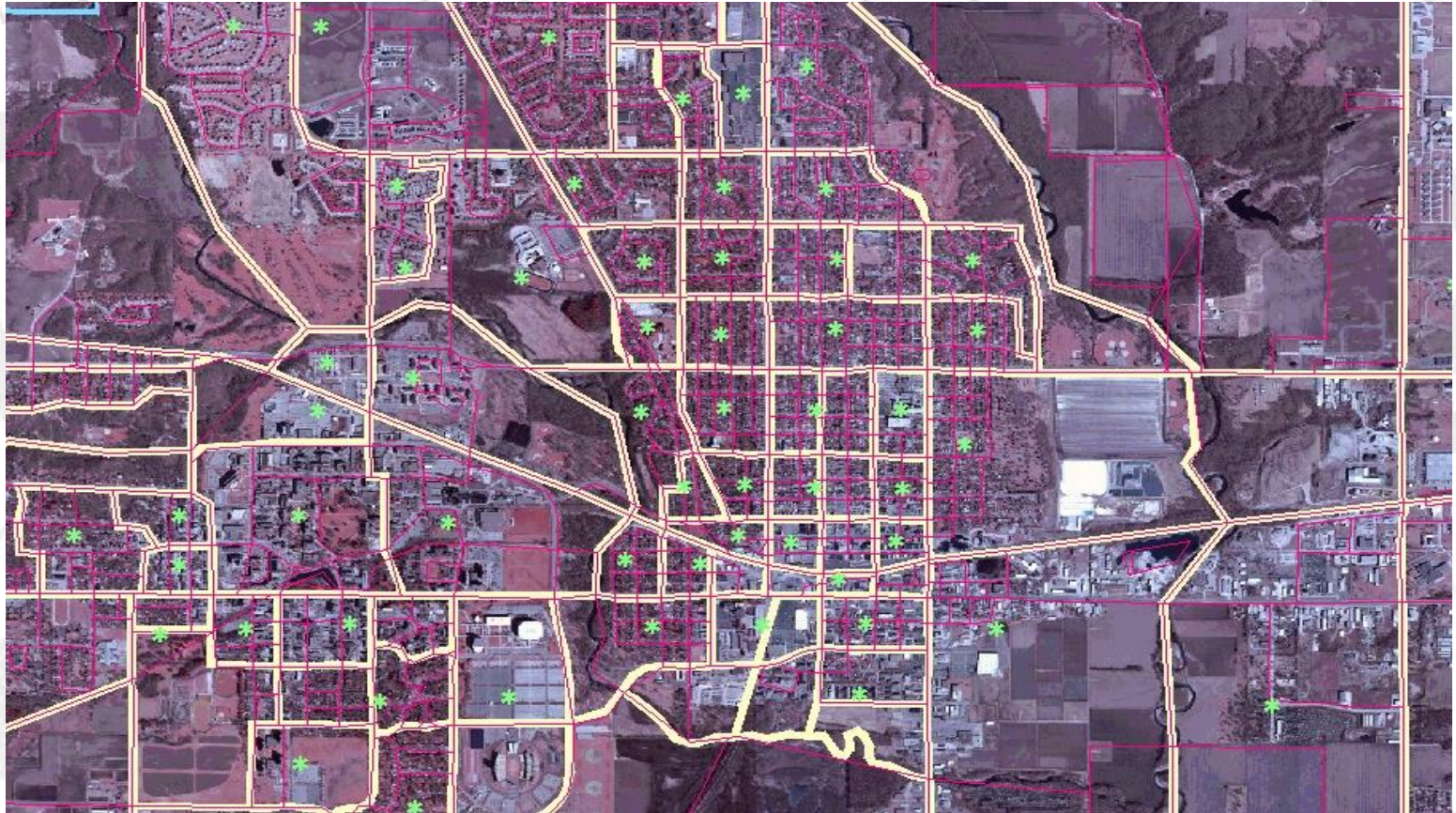
Traffic Analysis Zones (TAZ)

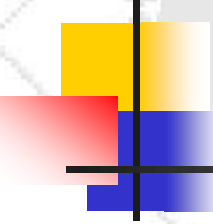
- What is a TAZ?
- Geographic Area where Data is Stored
 - Population, Employment, School Enrollment
- Similar to Census Geography (Aggregated)
 - Aggregated Census Blocks

Traffic Analysis Zones



Traffic Analysis Zones

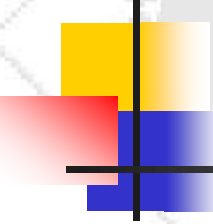




Traffic Analysis Zones (TAZ)

- TAZ Characteristics

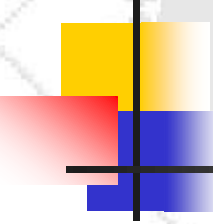
- Approximately equal in size (smaller in downtown but larger on the periphery of study area)
- **Homogeneous land use**
 - Residential, Retail, Industrial, etc.



Traffic Analysis Zones (TAZ)

- TAZ Characteristics

- TAZ boundaries are major roadways or physical barriers such as railroads, rivers, etc.
- Typically follow Census geography such as block or block group boundaries.
- Goal: replicate areas of **Origin** and **Destination** for trips being made.
 - Home to Work ; Home to Shopping ; Work to Shopping, etc.



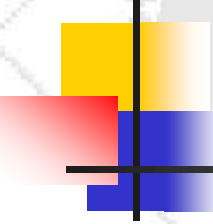
Model Input Data

■ Socio-Economic Data

- Population
- Households/Dwelling Units
- Employment
- School Enrollment
- Vehicle Ownership
- Income Levels
- Land Use Characteristics / Zoning

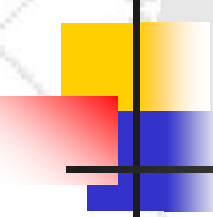
SE Data Table

	A	B	C	D	E	F	G	H
1	Socioeconomic Data			Year 2000				
2								
	TAZ	TOTAL	OCCUPIED	RETAIL	TOTAL	SERVICE		OTHER
3	2000	POP	DWELLING	EMPL	EMPL	EMPL		EMPL
4			UNITS					
5	1	0	0	1	526	525		0
6	2	2881	960	345	5552	5207		0
7	3	3032	1010	0	1447	1306		141
8	4	0	0	0	100	100		0
9	5	0	0	0	60	60		0
10	6	949	343	316	434	52		66
11	7	2667	422	189	362	93		80
12	8	822	251	0	27	26		1
13	9	2203	25	0	80	80		0
14	10	373	137	28	54	26		0
15	11	259	134	0	10	10		0
16	12	632	277	1	59	35		23
17	13	0	0	0	118	118		0
18	14	0	0	0	286	286		0
19	15	500	249	0	5	5		0
20	16	212	92	0	2	2		0
21	17	208	87	8	375	80		287
22	18	0	0	0	1114	30		1084
23	19	0	0	411	531	85		35
24	20	265	111	0	45	0		45
25	21	1408	768	269	433	45		119



Trip Generation

- Now that the data is collected and organized into TAZs what do we use it for?
- To determine how many trips will be generated for each TAZ in a typical day.



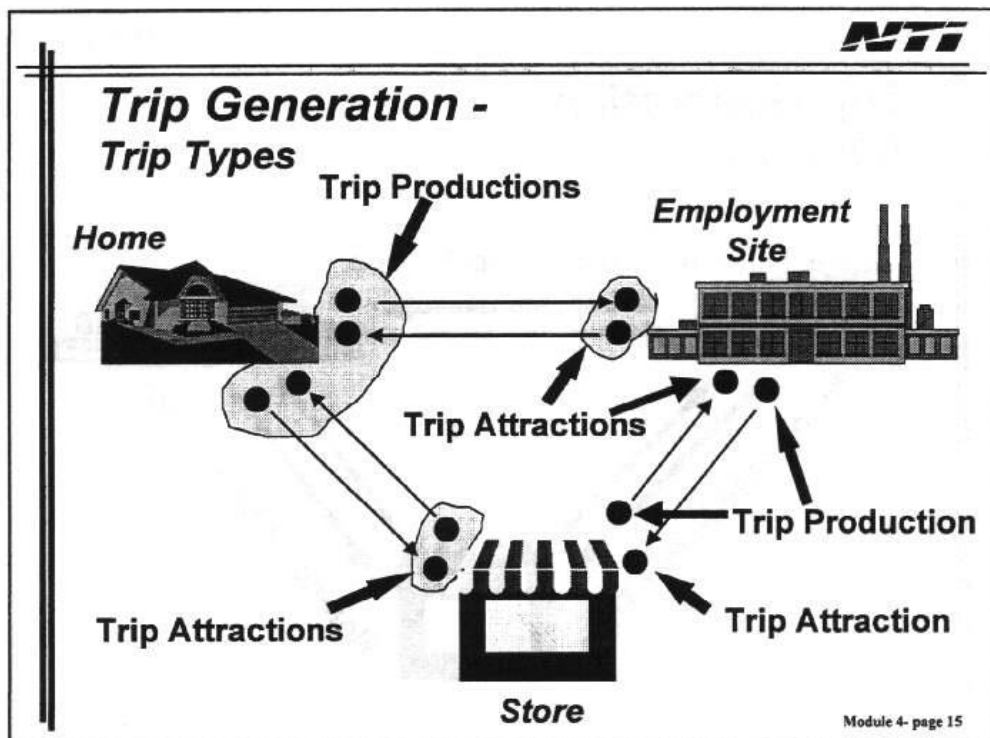
The Four Steps



- Trip Generation - How many trips?
- Trip Distribution - Where are they going?
- Mode Choices - By what mode?
- Trip Assignment - What path are they taking?

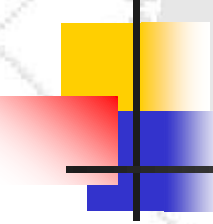
Trip Generation (1st Step)

- Determines how many trips are being **Produced** from and **Attracted** to each TAZ?



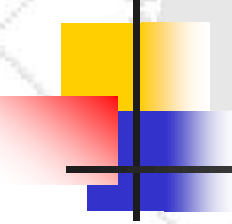
Productions and Attractions

Buzz phrase: **P**s and **A**s



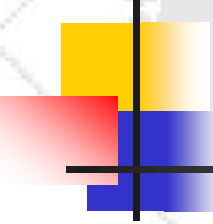
Trip Generation Methods

- Cross Classification
 - Used to determine trip productions by TAZ
 - Persons per Household and Auto's Available
- Trip Rates Based on Activity Units
 - ITE Trip Generation Manual
 - Hospitals, Fast Food Restaurants, etc.
- Regression Equations
 - Used to determine TAZ attractions
 - Based on previously observed data.



Special Generators

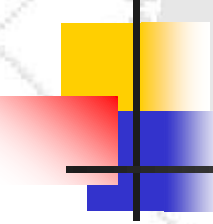
- Used for zones that have trip rates significantly different from standard trip rates.
 - Hospitals
 - Universities
 - Regional Malls
 - Military Bases
 - Etc.



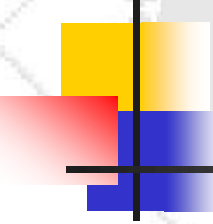
Trip Purposes

- Trips are stratified into purposes:
 - **Home-Based Work** – Trips between home and work.
 - **Home-Based Other** – Trips between home and other places such as shopping and recreation.
 - **Non-home Based** – Trips that do not involve the home.
 - **External Trips** – Trips that enter/leave or travel through the study area.

What Do We Get Out of Trip Generation?

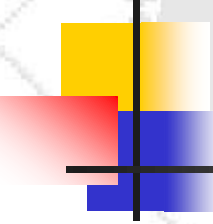


- Trip Productions and Trip Attractions
 - By Traffic Analysis Zone
 - By Trip Purpose



Trip Distribution

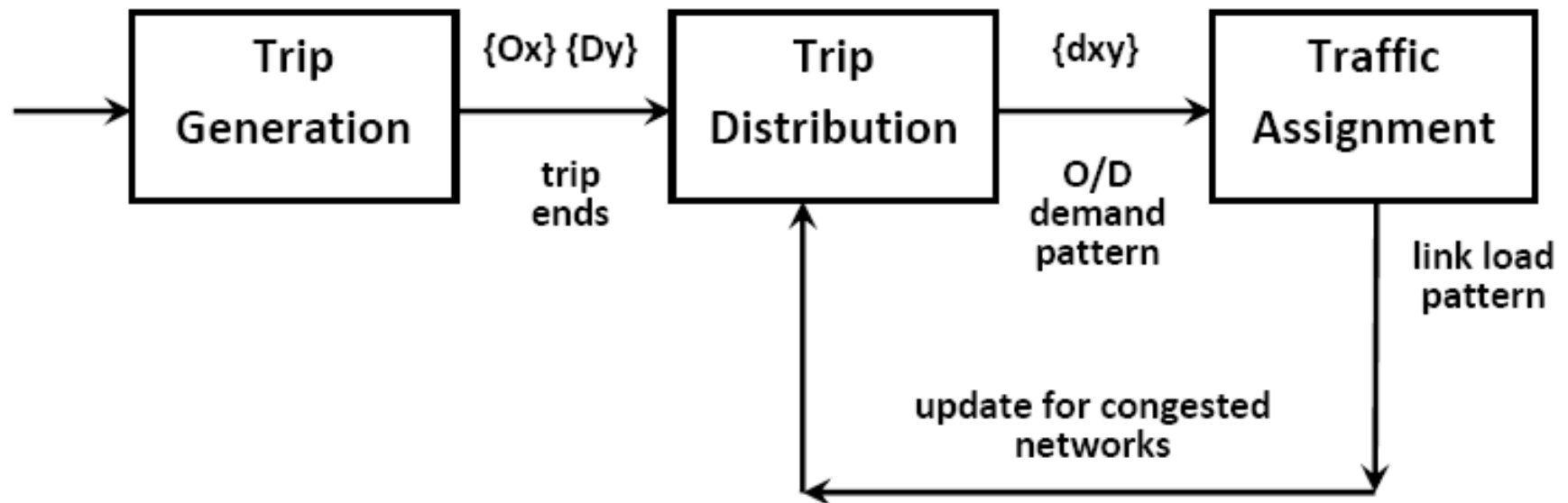
- Now we know how many trips are being produced from and attracted to each TAZ.
- But we don't yet know **where** the trips are going to or coming from.



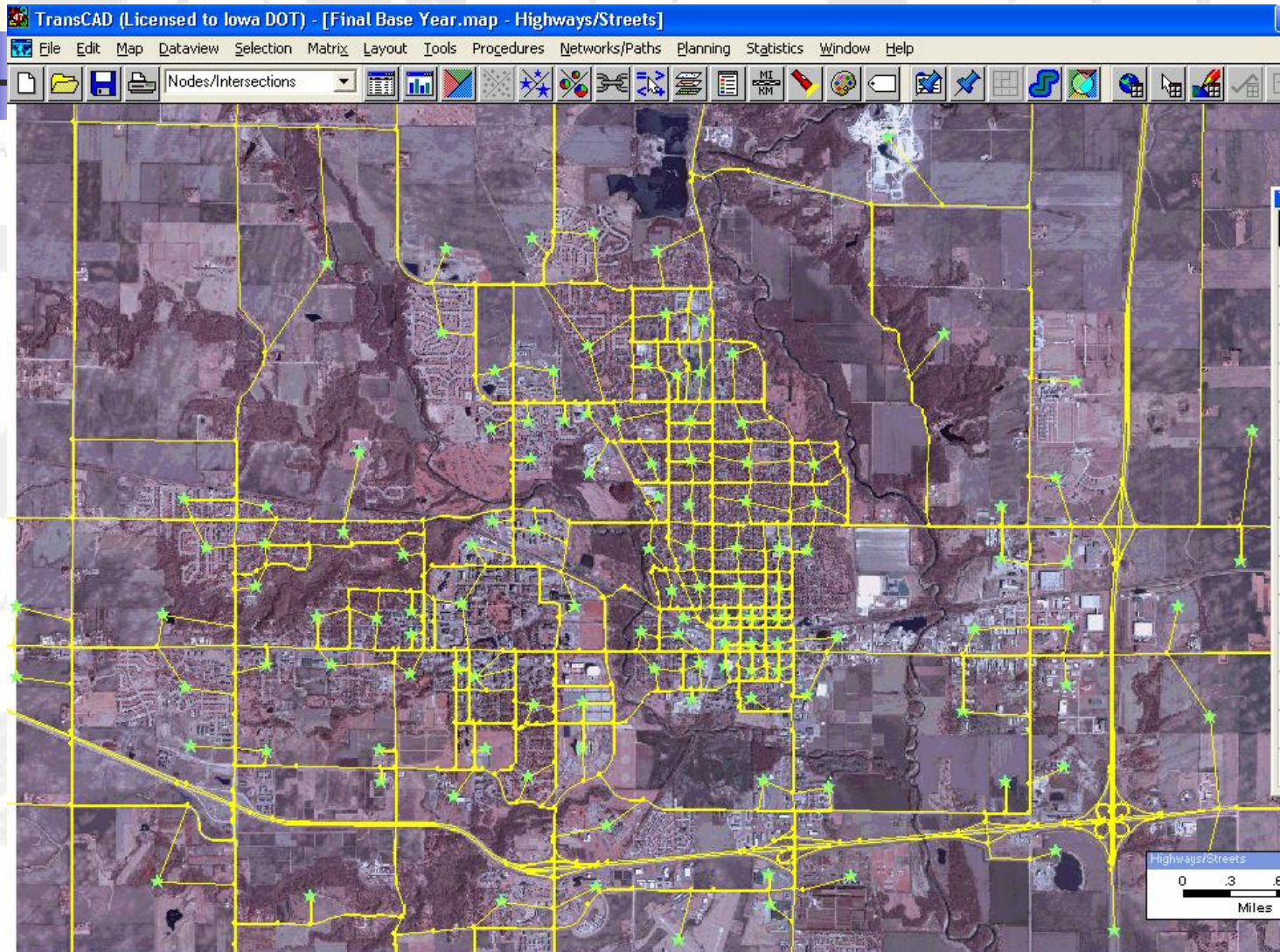
Roadway Network

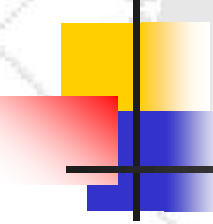
- Before we can figure out how the trips are distributed between TAZs, we need to know how the zones are connected.
- Zones are connected by a network of roads.

Three Stage Model for Transportation Planning.



Roadway Network

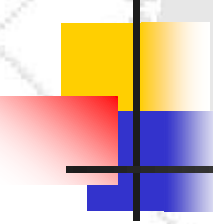




Roadway Network

A system of nodes, links, and centroids that describe a transportation system.

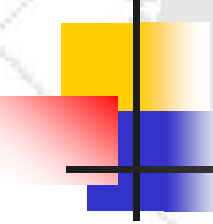
- 1. Node: intersections of roadway links.**
- 2. Links: Used to represent the street network (local roads are not included).**
- 3. Centroids: special node representing origin and destination of all trips for TAZ.**
- 4. Centroid connectors: special links that represent local roads and provide access between centroids and the network.**



Network Attributes

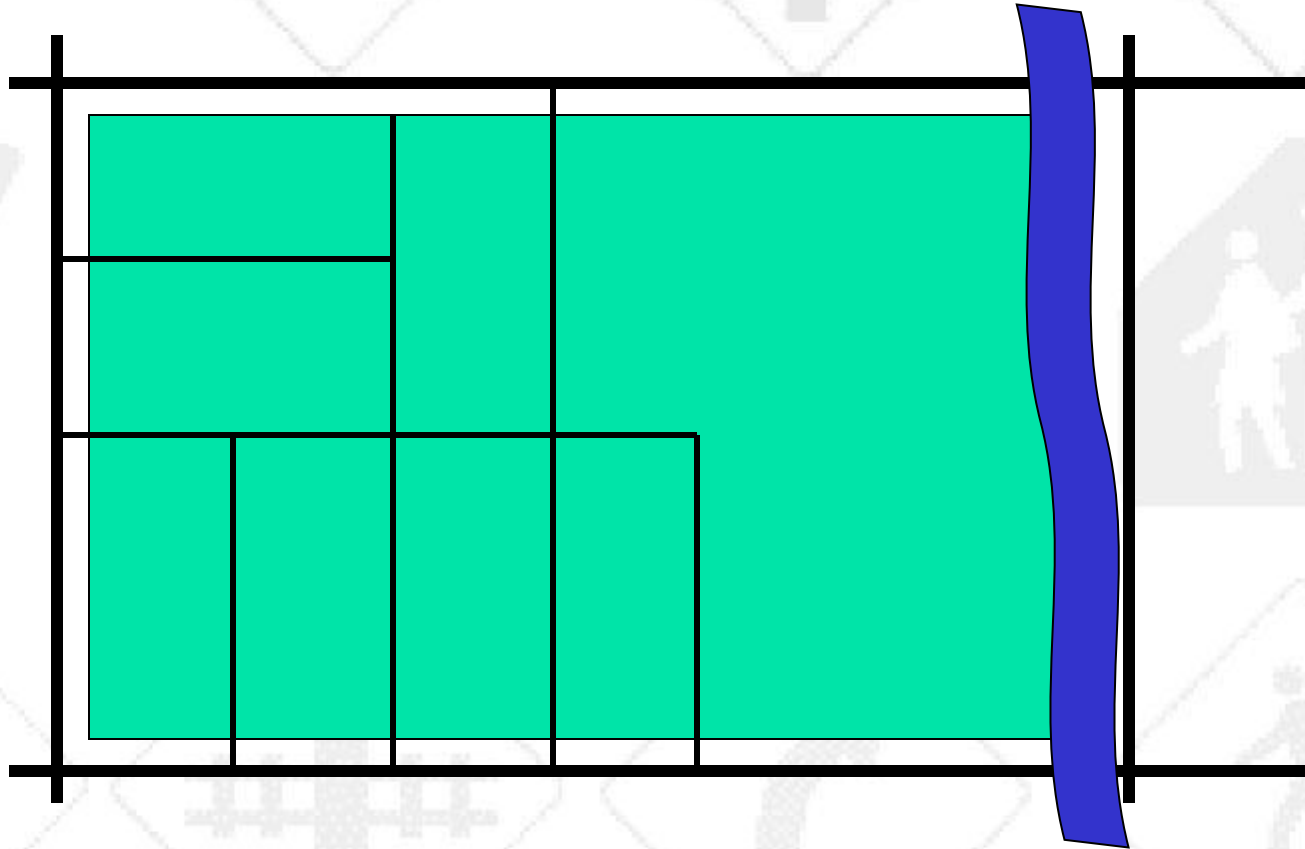
- Transportation System

- Speed
- Capacity
- Direction
- Travel Time
- Functional Classification
- Traffic Counts



Network Building

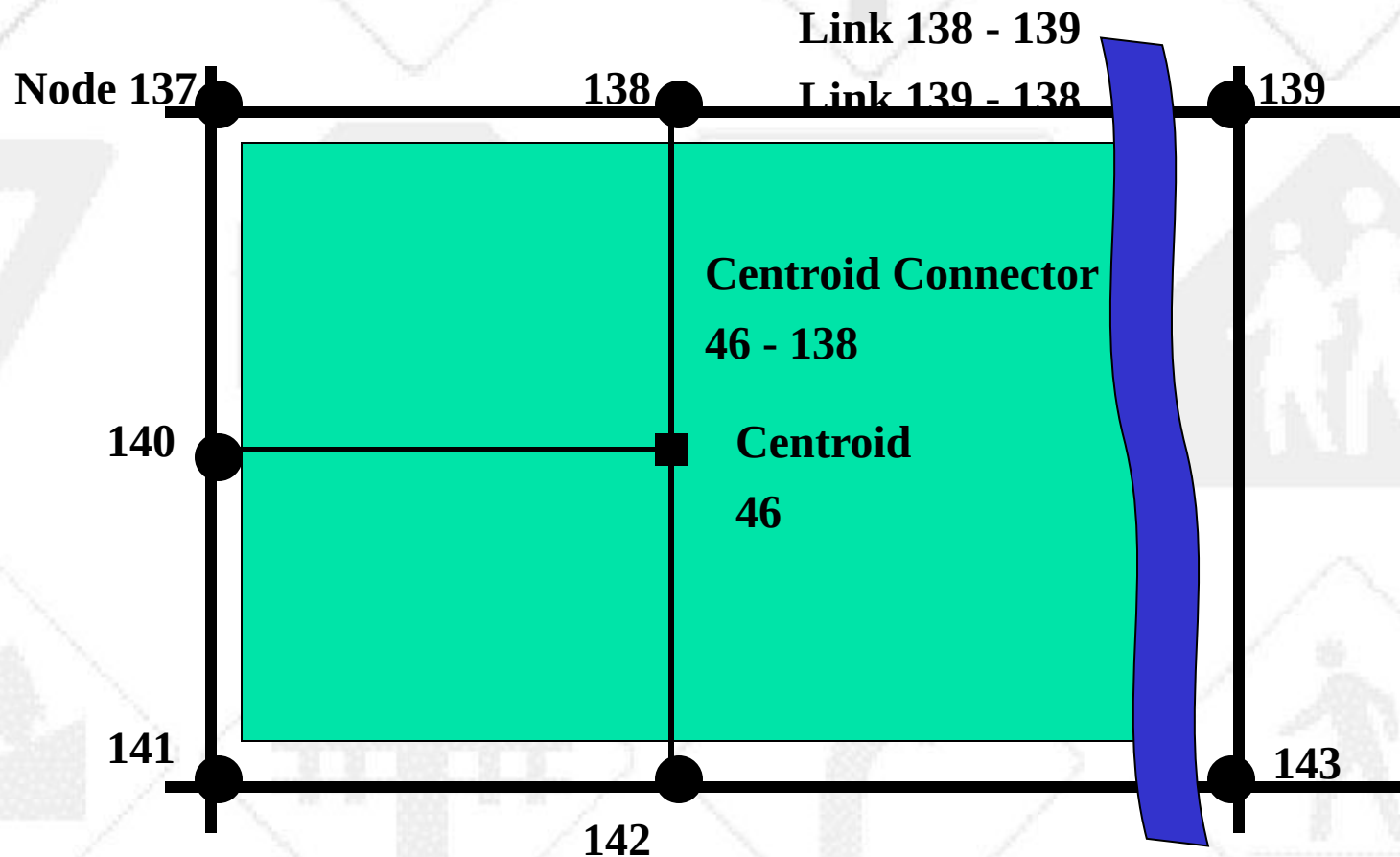
Actual Street System and River



Source: NTI

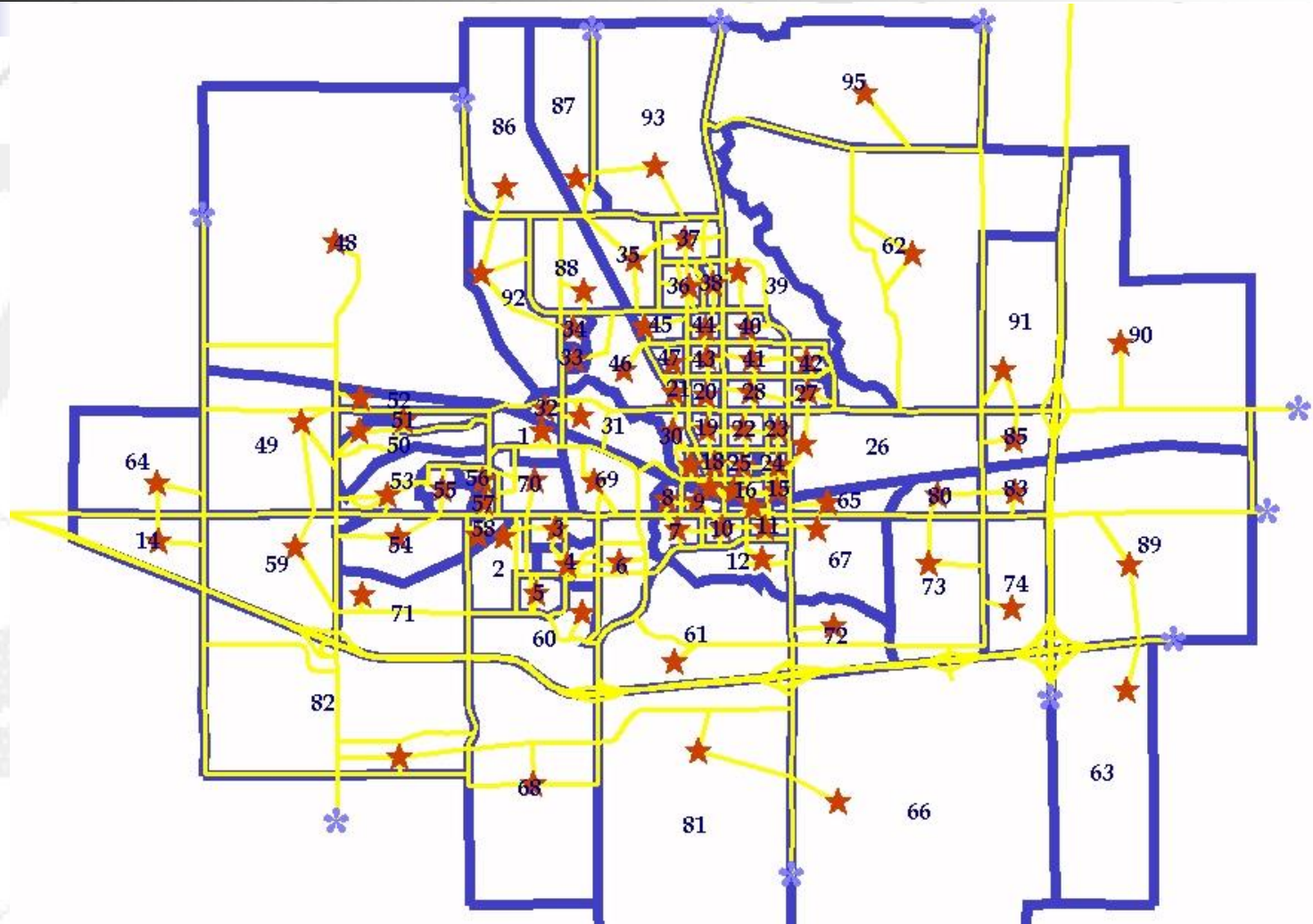
Network Building

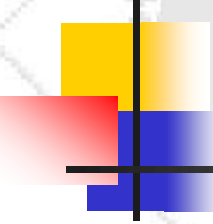
Computer Street System



Source: NTI

Centroids



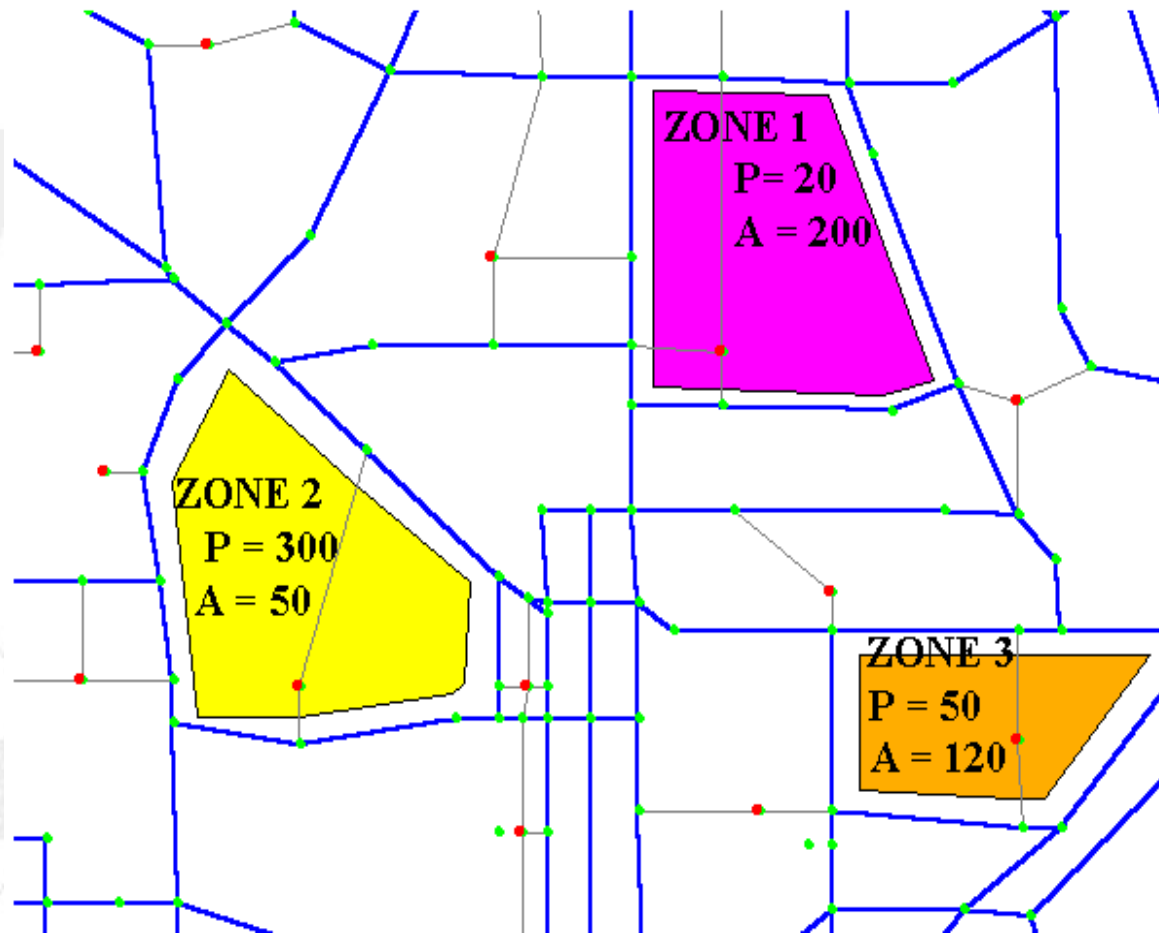


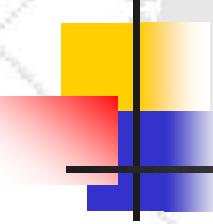
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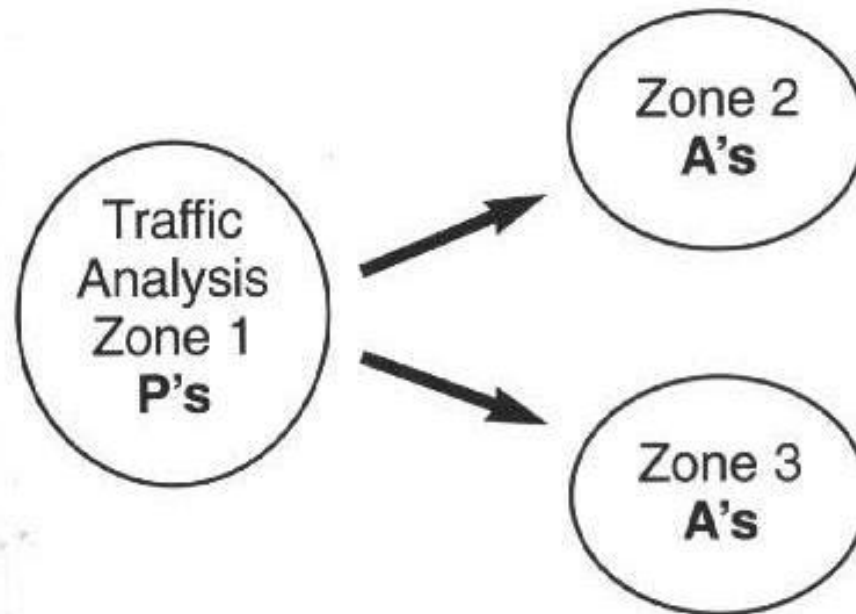
Trip Distribution (2nd Step)

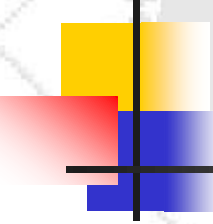




Trip Distribution

- Determines where trips are going to and coming from.

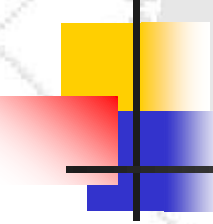




The Gravity Model

$$T_{ij} = P_i \times \left(\frac{A_j \times F_{ij} \times K_{ij}}{\sum_{j=1}^n A_j \times F_{ij} \times K_{ij}} \right)$$

Source: NTI

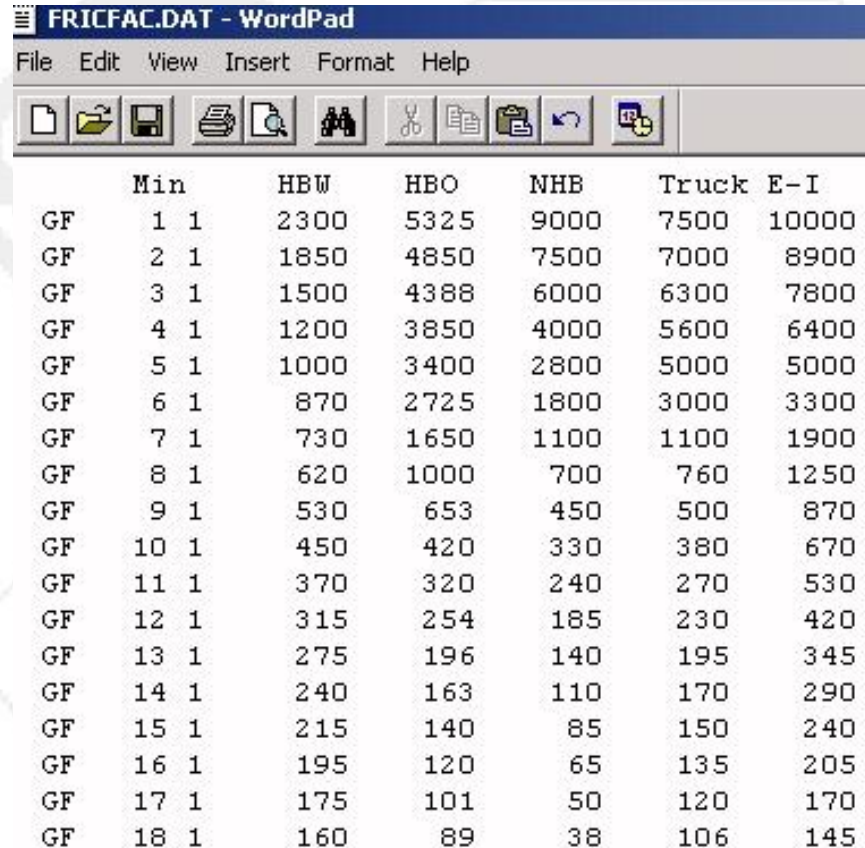


The Gravity Model

- Analogous to Newton's Law of Gravitation!
- The number of trips between zones are directly proportional to the number of productions at the origin zone and attractions at the destination zone and;
- Trips are inversely proportional to a function of the “friction” between zones measured in distance.

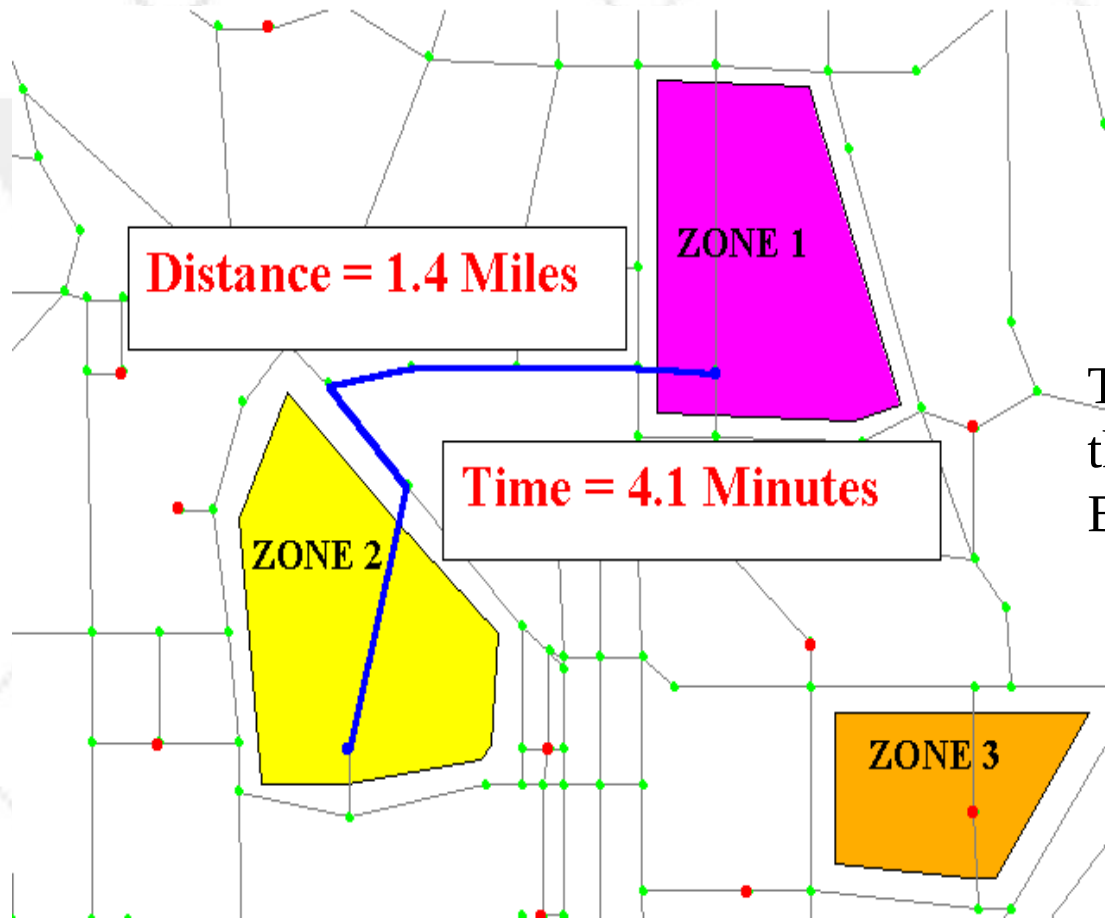
Friction or Impedance Factors

- FF Inversely Proportional Time



	Min	HBW	HBO	NHB	Truck	E-I
GF	1 1	2300	5325	9000	7500	10000
GF	2 1	1850	4850	7500	7000	8900
GF	3 1	1500	4388	6000	6300	7800
GF	4 1	1200	3850	4000	5600	6400
GF	5 1	1000	3400	2800	5000	5000
GF	6 1	870	2725	1800	3000	3300
GF	7 1	730	1650	1100	1100	1900
GF	8 1	620	1000	700	760	1250
GF	9 1	530	653	450	500	870
GF	10 1	450	420	330	380	670
GF	11 1	370	320	240	270	530
GF	12 1	315	254	185	230	420
GF	13 1	275	196	140	195	345
GF	14 1	240	163	110	170	290
GF	15 1	215	140	85	150	240
GF	16 1	195	120	65	135	205
GF	17 1	175	101	50	120	170
GF	18 1	160	89	38	106	145

Trip Distribution (Shortest Paths or Skim Trees)

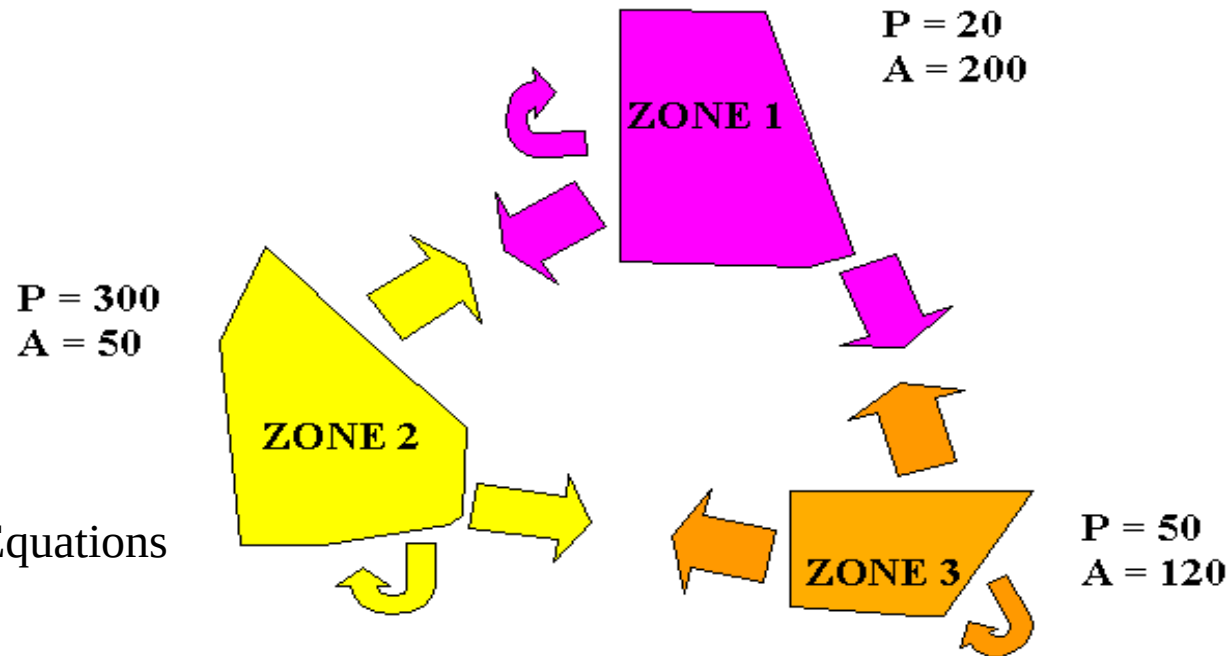


Travel Time (Minutes)	Distance Function $f(D)$
2.9	3.6
3.7	3.1
4.1	2.5
5.2	2.0

The Model Software Figures the Shortest Travel Time Paths Between All Zone Pairs

Trip Distribution

Example that plugs in the numbers to the Gravity Model

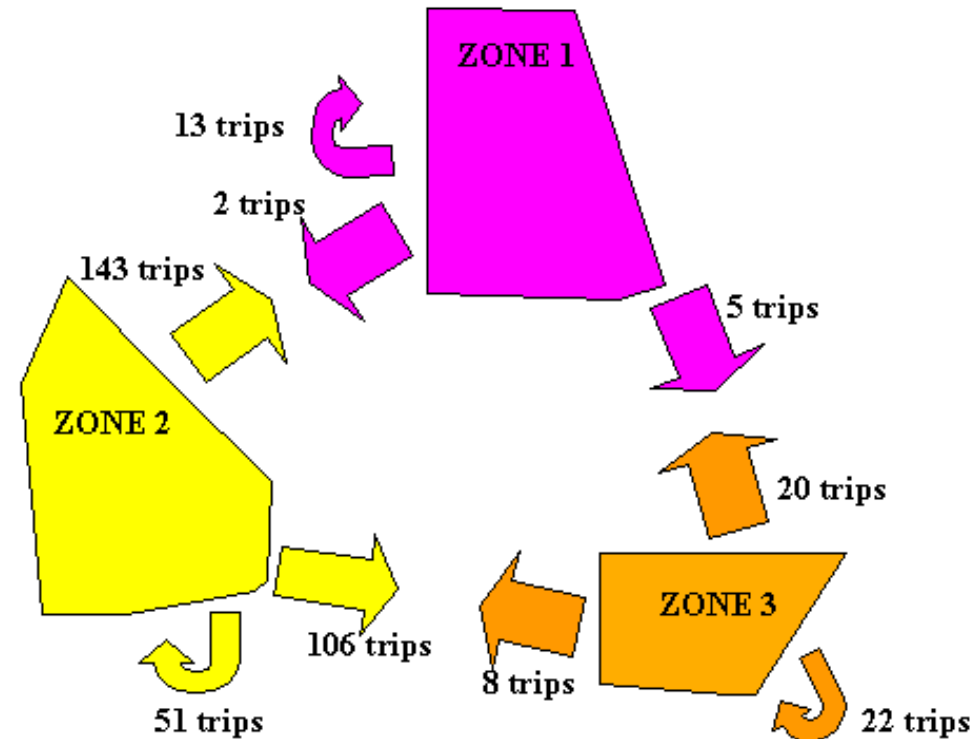


Gravity Model Equations

$$T_{1-1} = 20 * \frac{[200 * 3.6]}{[(200 * 3.6) + (50 * 2.5) + (120 * 2.0)]} = 13 \text{ trips}$$

$$T_{1-2} = 20 * \frac{[50 * 2.5]}{[(200 * 3.6) + (50 * 2.5) + (120 * 2.0)]} = 2 \text{ trips}$$

Trip Distribution



Example Trip Table

Trip Matrix	Zone 1	Zone 2	Zone 3	Total Productions
Zone 1	13	2	5	20
Zone 2	143	51	106	300
Zone 3	20	8	22	50

Trip Distribution: Trip Matrix

TransCAD (Licensed to Iowa DOT) - [Matrix1 - Output Matrix (QuickSum)]

File Edit Map Dataview Selection Matrix Layout Tools Procedures Networks/Paths Planning Statistics Window Help

QuickSum

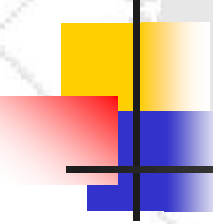
	1	2	4	5	6	7	8	9	10	11	12	15	
1	4.37	5.86	2.62	6.92	1.84	1.50	0.64	2.98	6.76	0.89	6.16	4.12	4.2
2	26.23	63.09	8.81	26.12	14.51	4.52	1.88	26.11	75.00	6.88	43.80	41.04	43.9
4	16.74	34.52	4.66	12.13	12.54	2.32	0.95	18.44	55.65	5.01	31.17	29.49	31.0
5	8.34	25.24	9.57	29.88	5.20	5.37	2.10	8.35	19.62	3.20	24.05	12.32	11.9
6	1.84	3.19	1.93	4.30	1.34	0.98	0.40	1.78	4.31	0.59	4.05	2.37	2.3
7	11.60	19.98	2.76	6.92	7.74	2.23	0.91	15.90	52.40	4.32	26.40	23.71	26.3
8	4.24	7.44	1.07	2.63	2.68	0.87	0.35	6.76	17.54	1.45	8.74	8.66	9.0
9	7.52	12.57	3.04	7.54	4.54	2.23	1.09	11.38	32.52	2.80	17.06	15.06	17.0
10	6.75	11.72	5.94	14.83	4.30	4.77	1.84	9.45	21.76	2.82	19.25	11.13	12.3
11	5.07	8.64	1.37	3.50	3.40	1.02	0.38	7.45	23.28	2.68	15.25	14.13	14.2
12	27.87	50.13	9.90	25.40	18.62	7.71	2.81	38.98	122.14	14.18	92.91	69.62	72.0
15	4.88	8.84	3.84	9.90	2.82	2.80	1.16	5.86	14.51	2.38	15.17	12.81	10.9
16	5.09	8.76	3.73	9.45	2.85	2.81	1.19	6.39	16.35	2.22	14.52	10.49	11.9
17	3.96	6.56	2.00	5.01	2.20	1.49	0.69	5.11	13.18	1.44	9.28	7.77	9.2
18	4.43	7.30	1.12	2.85	2.47	0.83	0.36	5.97	18.49	1.66	10.01	10.79	13.2
19	12.94	19.96	2.55	6.65	7.11	1.76	0.76	16.33	50.52	4.39	26.44	29.59	34.7
20	9.60	14.33	1.79	4.69	5.07	1.22	0.52	11.45	35.30	3.09	18.72	20.76	23.4
21	7.31	10.07	1.27	3.34	3.73	0.74	0.33	7.84	23.84	2.04	12.30	13.98	15.4
22	13.76	21.86	2.78	7.26	7.64	1.95	0.84	17.65	54.54	4.78	28.94	34.56	36.7
23	15.16	23.17	9.42	24.62	8.46	6.05	2.64	16.07	41.47	5.46	35.87	32.35	28.9
24	6.60	10.63	1.87	4.91	3.75	1.29	0.55	8.25	24.79	2.63	15.76	22.17	17.0
25	11.29	18.27	2.92	7.63	6.38	2.16	0.92	14.66	44.67	4.49	26.96	30.32	33.8
26	20.46	32.78	5.15	13.64	11.78	3.50	1.46	25.20	76.05	7.75	47.44	57.81	51.2
27	11.21	17.69	2.39	6.39	6.23	1.63	0.69	13.38	40.61	3.96	24.41	28.85	26.4
28	13.36	20.72	2.62	6.92	7.29	1.79	0.76	16.26	49.86	4.47	26.86	32.25	32.2
29	3.60	5.65	0.84	2.12	2.02	0.61	0.28	4.88	13.18	1.17	7.10	7.74	9.0
30	7.95	11.97	1.38	3.60	4.32	0.92	0.41	9.74	28.38	2.45	14.77	16.66	18.3
31	0.50	0.62	0.30	0.75	0.22	0.18	0.08	0.35	0.80	0.11	0.73	0.49	0.9
32	0.82	1.04	0.49	1.25	0.35	0.28	0.12	0.56	1.27	0.17	1.17	0.78	0.8
33	21.08	31.31	4.09	10.90	9.48	2.54	1.05	18.97	54.97	4.93	31.12	31.94	34.7
34	16.38	24.17	2.83	7.60	7.50	1.69	0.70	14.93	43.73	3.83	23.91	25.33	27.0
35	35.40	51.18	5.56	15.25	17.09	3.24	1.39	34.80	106.07	9.26	57.15	62.92	66.0
36	7.49	11.45	1.50	4.07	3.75	1.03	0.43	8.10	24.45	2.23	14.02	14.59	15.0
37	23.76	36.04	4.27	11.48	12.26	2.85	1.20	26.33	80.07	7.15	44.56	47.83	51.0

MatrixView: 143 rows by 143 columns

Network: d:\...ear\ames2000binarynetwork.net

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10:11 AM



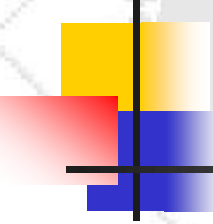
The Four Steps

- Trip Generation - How many trips?
- Trip Distribution - Where are they going?
- Mode Choices - By what mode?
- Trip Assignment - What path are they taking?



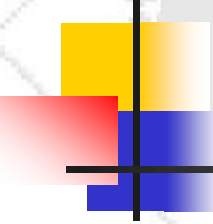
Mode Split (3rd Step)





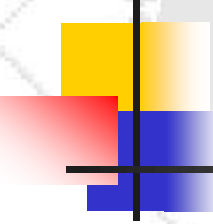
Mode Choice Models

- None used in Iowa at present
 - Typically Mode share is approximately 5% or less.
 - Ames and Iowa City higher due to Universities.
 - Significantly more work to add mode split to model.
 - Benefit/Cost Issue



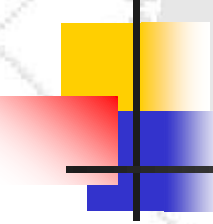
External Trip Estimation

- Good idea of internal travel (planning area)
- What about trips that leave the area?
- External Station Description
 - Somewhat similar to TAZ
 - Origin and Destination of Trips
- Two kinds of trips.
 - External to External
 - Internal to External or External to Internal



External Trip Estimation

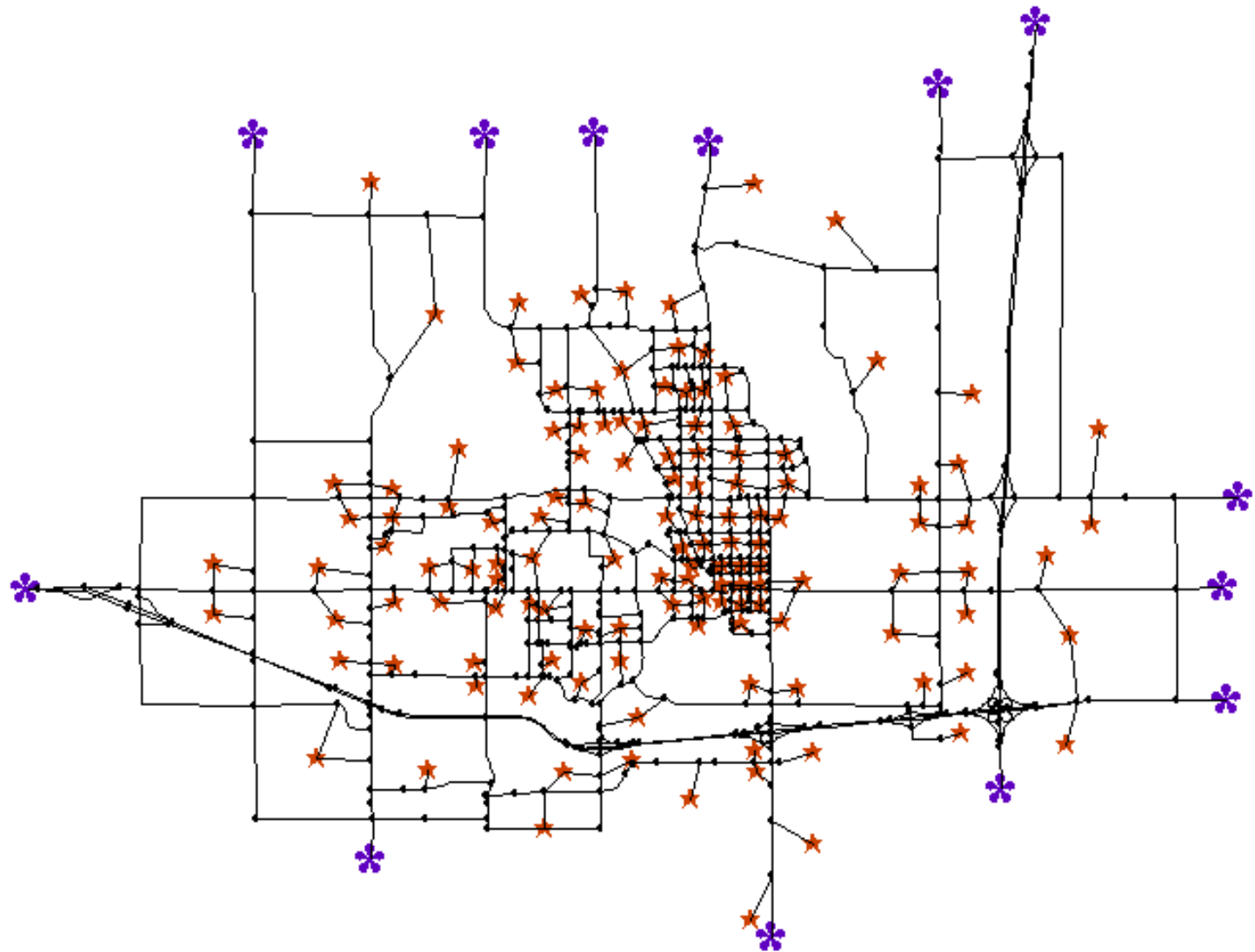
- NCHRP 365 Process
- Urban Areas approximately 50,000 in Pop.
- 1st Step: Determine Through Trip Percentages
 - Larger Urban Areas have more EI/IE
- Through trip % based on:
 - ADT (cordon volume)
 - Size of Area
 - Functional Class of Facility
 - Vehicle Makeup (% trucks) (propensity for through trip)

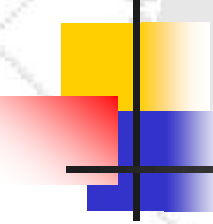


External Trip Estimation

- 2nd Step: Distribution of EE Trips
 - Modlin equations to accomplish this.
 - Discuss in detail later in the semester.
- Result is EE matrix
- 3rd Step: EI/IE Productions and Attractions
 - Involved process to be covered in detail later.
 - EI/IE trips get distributed with the Gravity Model. EE trip matrix already distributed.

External Stations

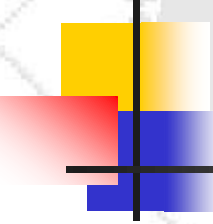




Traffic Assignment

- Now it is known how many trips are going between each zone pair.
- What are we missing?





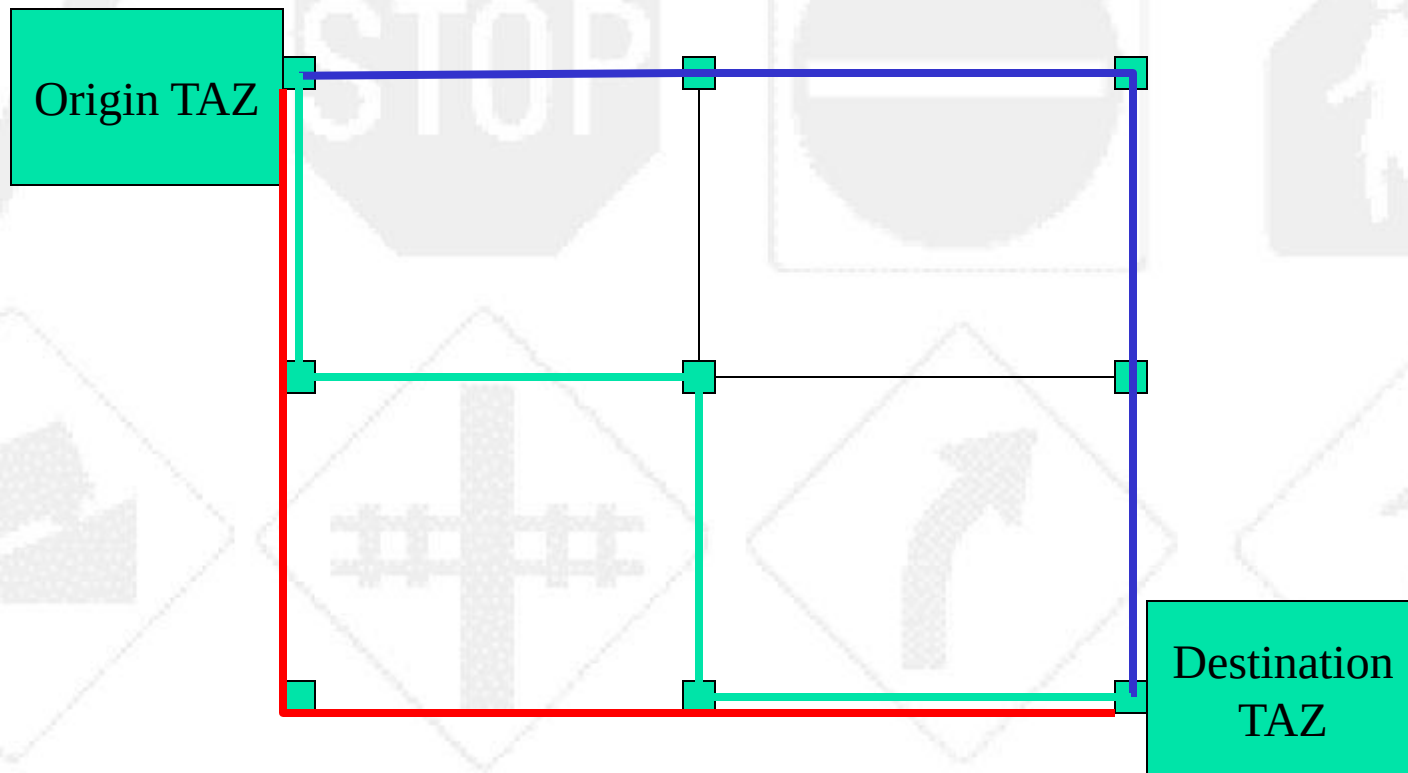
The Four Steps

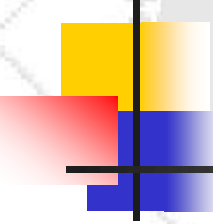
- Trip Generation - How many trips?
- Trip Distribution - Where are they going?
- Mode Choices - By what mode?
- Trip Assignment - What path are they taking?



Trip Assignment (4th Step)

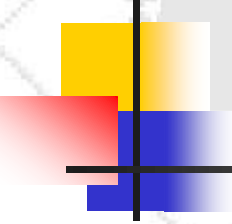
- Determining the path a trip will take between the origin and destination TAZ.





Traffic Assignment

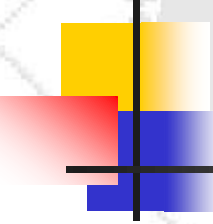
- Now we know how many trips there are, where they are going and the mode they are using, but not yet the path they will take.
- Several assignment methods available
 - Uncongested - Shortest Path
 - Human Behavior - Stochastic
 - Congestion – Capacity Restraint
 - Equilibrium – No trip can decrease its travel time by taking an alternate route.



Trip Assignment – Path Selection Criteria

The Path a Trip will most likely take between two zones is based on:

- Travel Time or Friction
- Congestion or V/C Ratio
- Turn Penalties & Prohibitions
 - 15 second penalty for left turns, no right turns, etc.

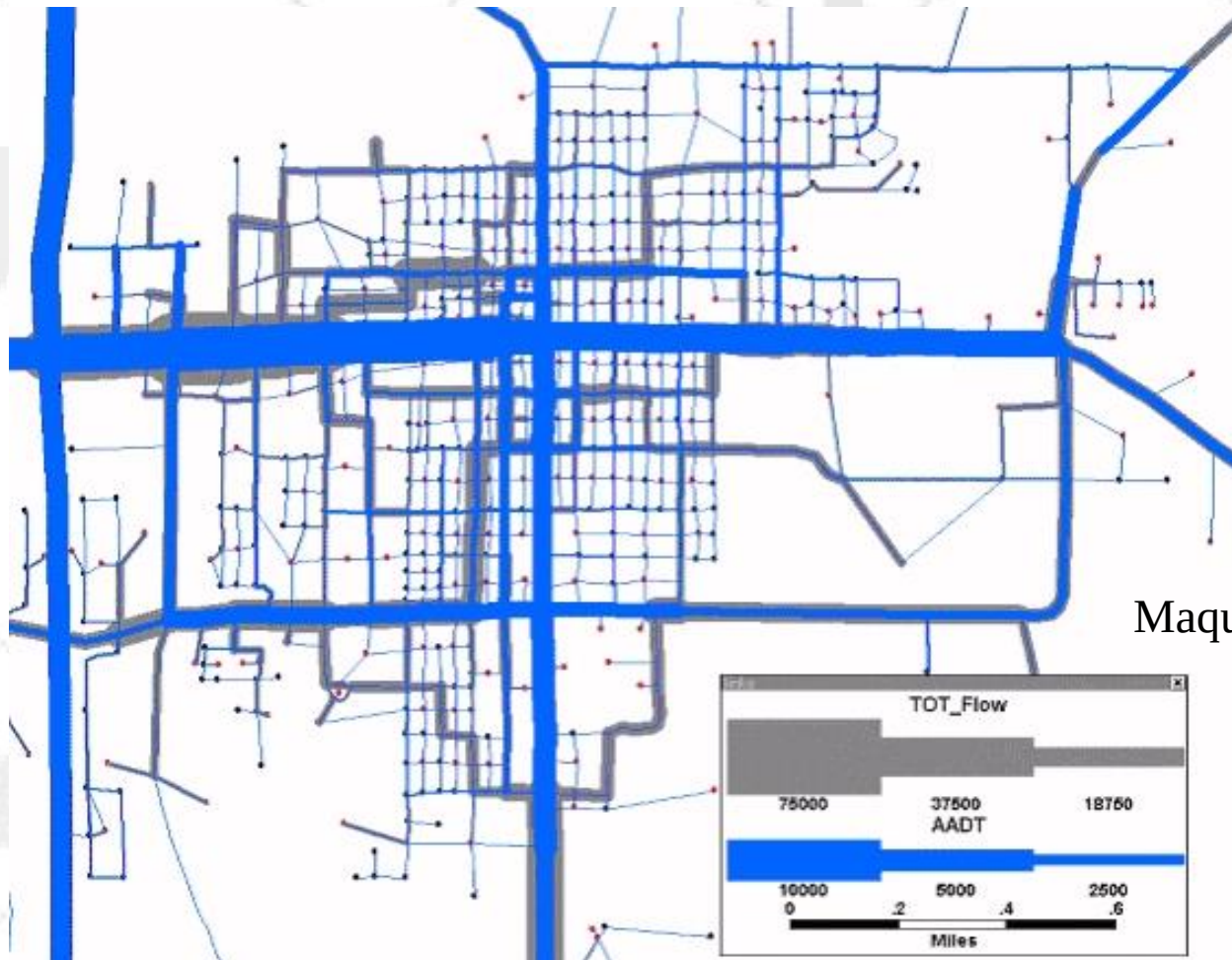


Traffic Assignment Outputs

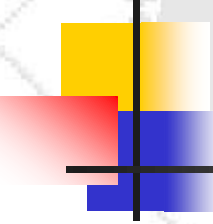
- Link volumes and speeds
- Turning movements at intersections
- Estimates of Regional VMT (vehicle miles traveled) and VHT (vehicle hours of travel)
- Congestion measures (V/C Ratio)

[illegible]

Loaded Network Flows

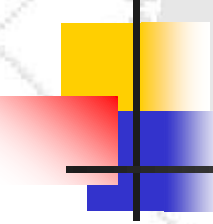


Maquoketa Example



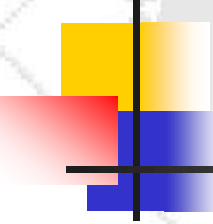
Validation and Model Errors

- Steps to Obtain a Reliable Model
 - Model Estimation
 - Model Calibration
 - Model Validation (Traffic Counts)
 - Model Application
 - Reasonableness Checks
 - Sensitivity Checks



Steps to Obtain a Reliable Model

- Model Estimation
 - Statistical estimation of model parameters
 - Trip Generation Rates
 - Trip Length Frequency Distribution
- Model Calibration
 - Adjustment of model parameters until predicted travel matches observed travel



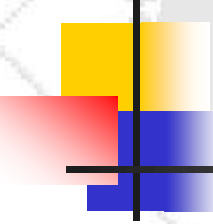
Steps to Obtain a Reliable Model

- Model Validation

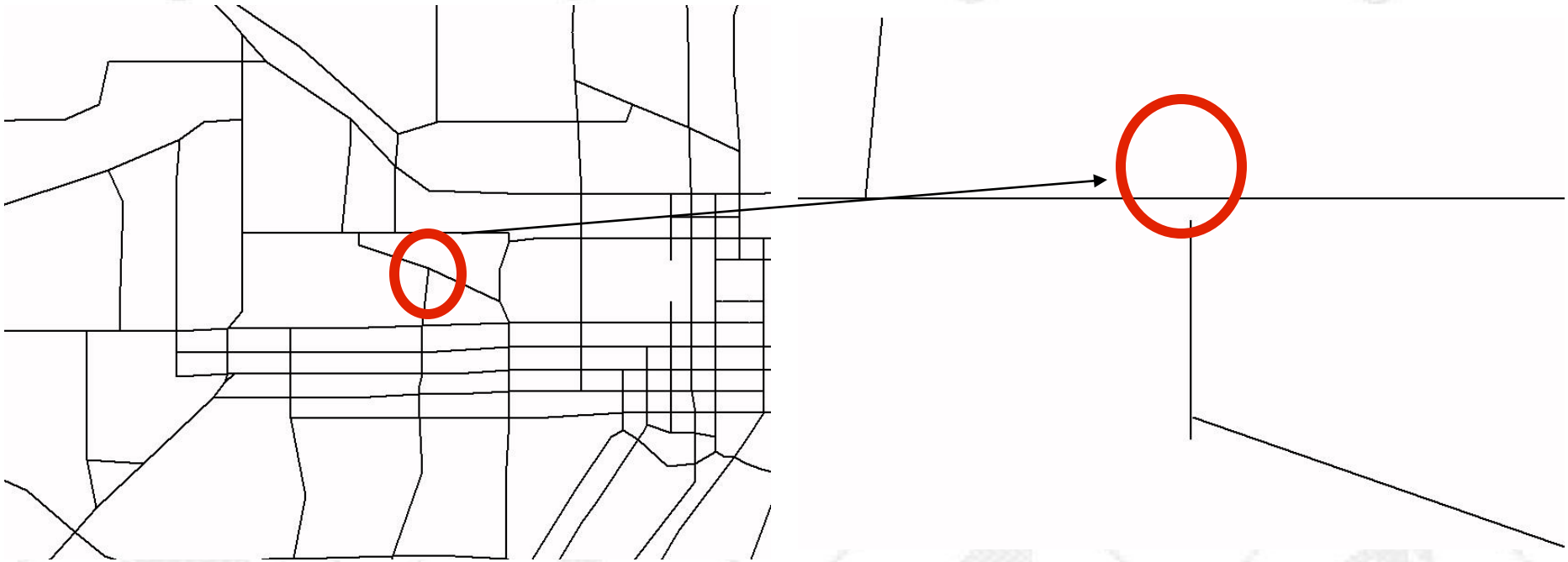
- Checking the model results against observed data and adjusting the parameters until model results fall within an acceptable range of error.

- Model Application

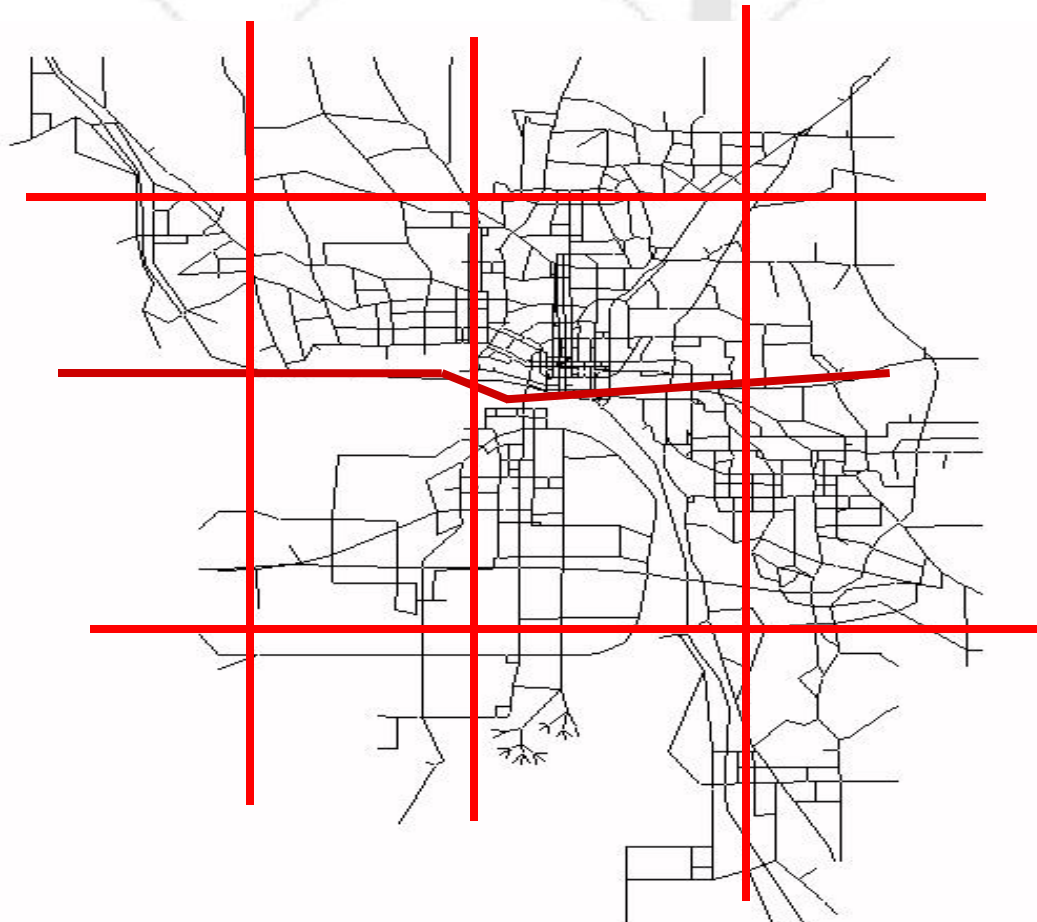
- Checking the reasonableness of future year traffic projections
- Testing the sensitivity of the model to system or policy changes

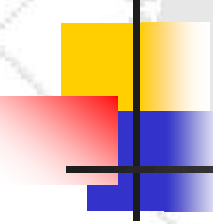


Network Connectivity Check

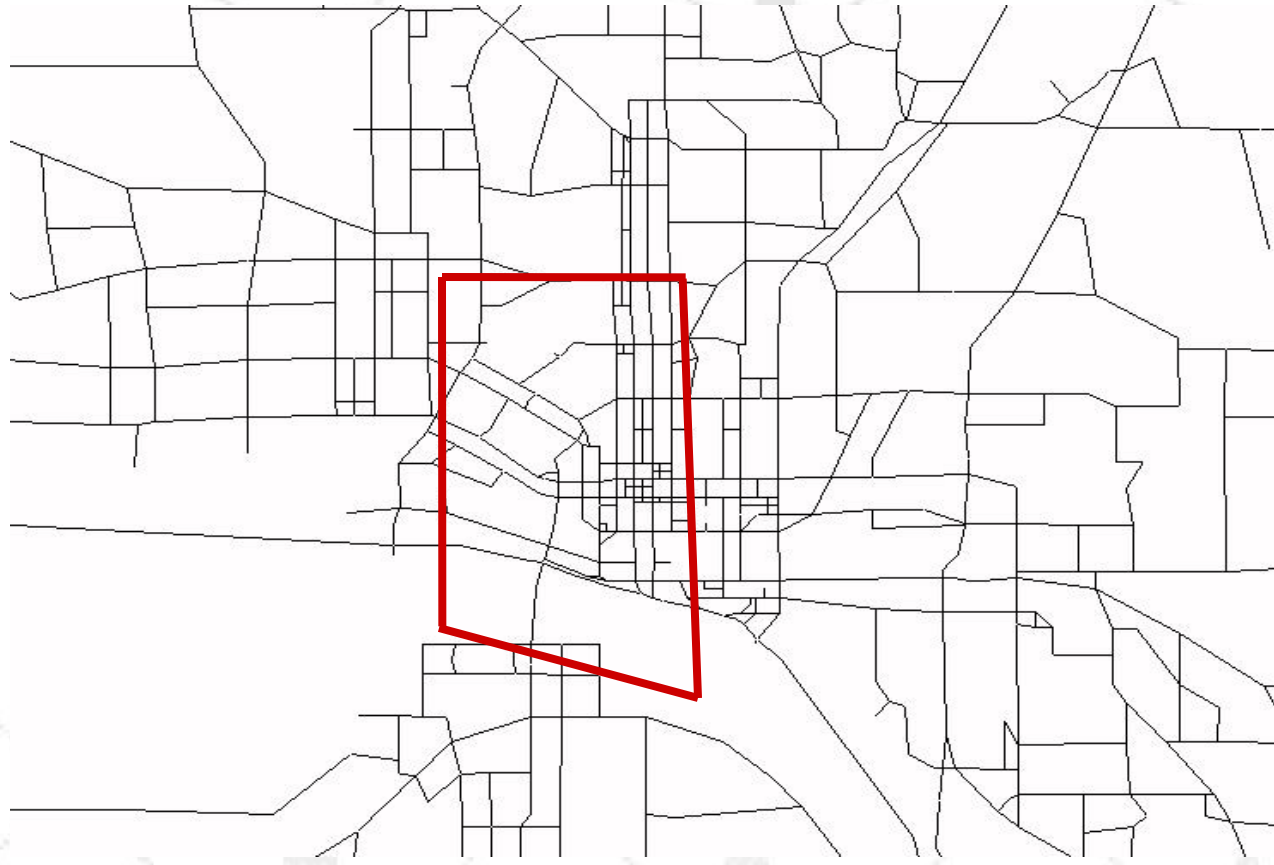


Screen Line

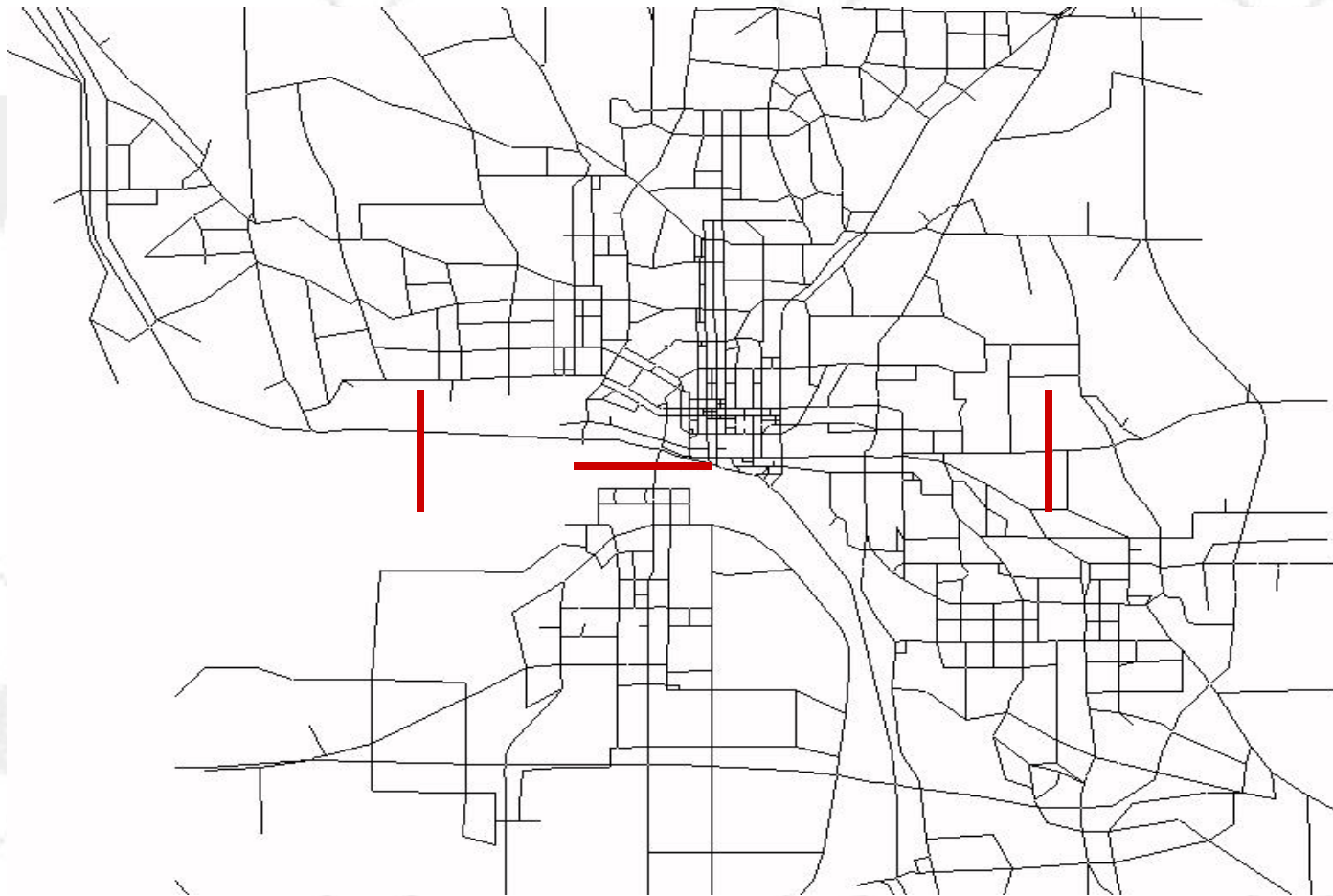




Cordon Line

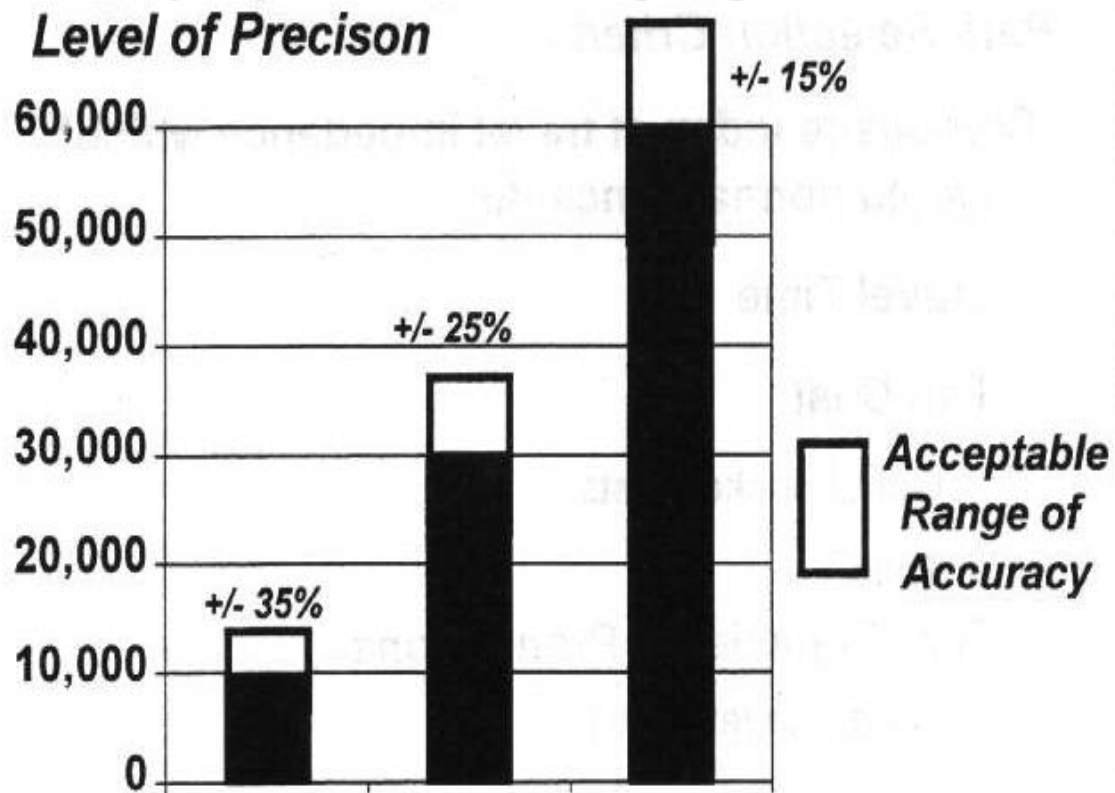


Cut Line

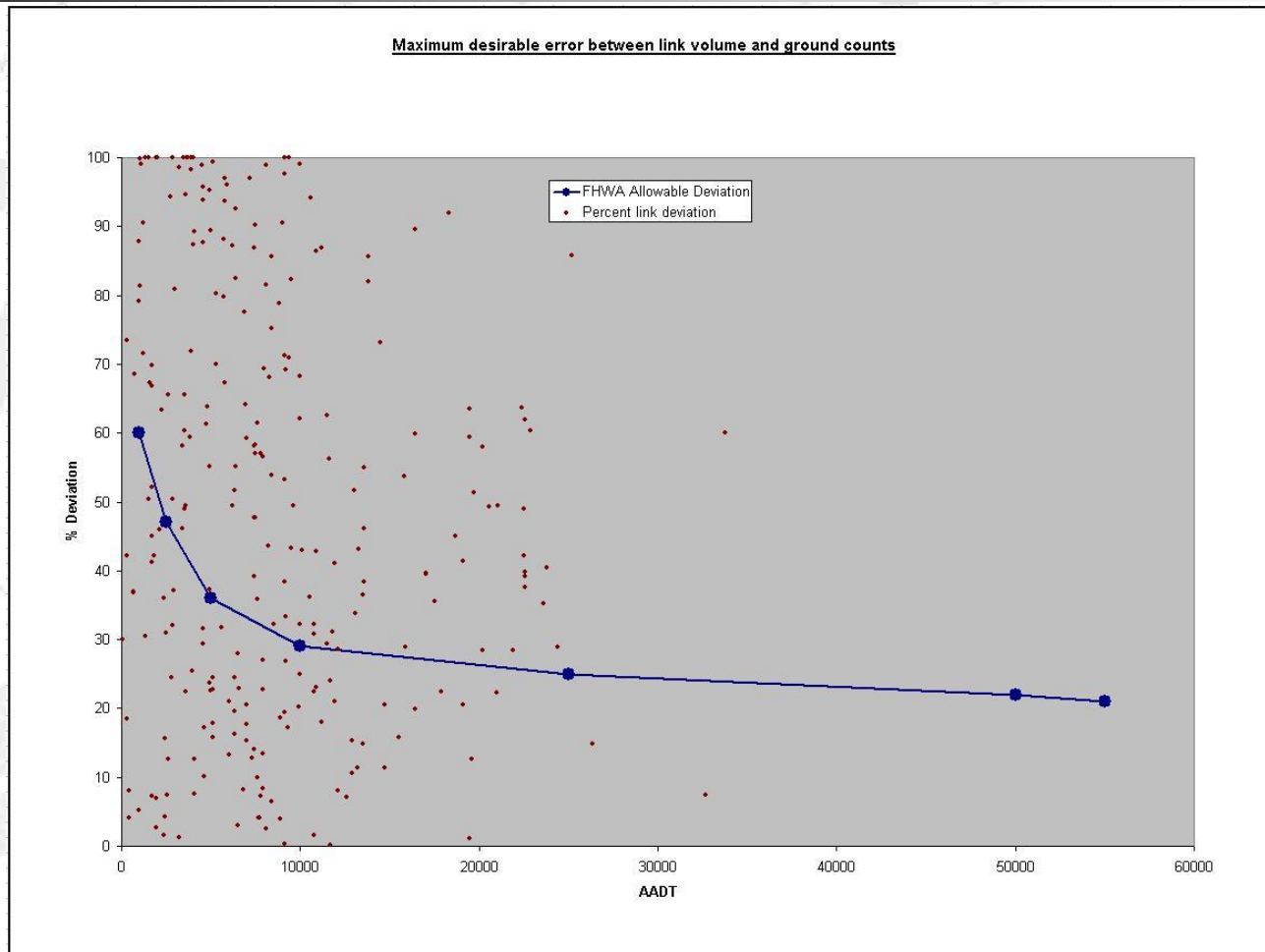


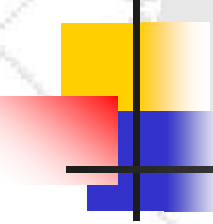
Acceptable Ranges of Error

ADT



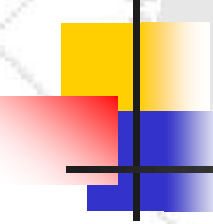
Acceptable Ranges of Error (% deviation)





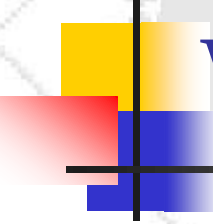
Two Models?

- Two Time Frames (Two Models)
 - Base Year
 - Forecast Year
- Base Year Model
 - Calibrated to Match Traffic Counts
 - Replicates Existing Conditions
 - Gives Confidence for Future Projections



Two Models?

- Forecast or Planning Horizon Year
 - At least 20 Years into the Future
 - Forecast Population, Employment, etc.
 - Includes Planned Roadways and Development
- Trend for Interim Year Scenarios
 - Base, 5, 10 and 20



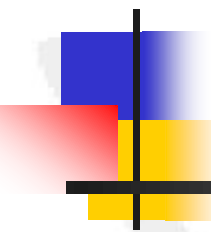
What Are Some Model Applications?

- What if no improvements were done to the roadway system for 20 years? Where would the congestion be and how much?
- What if a new mall was proposed on the east side of town? Will changes to the existing roadways need to be made?
- What if we built a bypass around the north east side of the Des Moines area? How will it impact nearby roadways?



What Are Some Model Applications?

- You have 30 new roadway construction projects to do and only money for 15. Which ones and in what order will you do them? (TIP Prioritization)
- A new interchange with an interstate is proposed. Will it negatively impact the interstate or connecting roadways?
- You are going to build a new bridge over the Mississippi River. How many lanes will be needed in the year 2035?



Questions?