CE 380

Highway and Traffic Engineering

Lec-12

Transportation Demand

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Transportation Planning

- Definition of Science: Transportation planning is a part of science which deals with ***Transport Systems*** considering their design, plan and evaluation.

- ***Transport System*** is any system used in transporting individuals or goods from an Origin to a Destination.

Transport System

- Examples




- Components:
  - Vehicle
  - Route
  - Operating System
  - Maintenance

You are Transport System user, but now you will be a planar

What problem does Transportation planning solve ?

Congestion

Delays

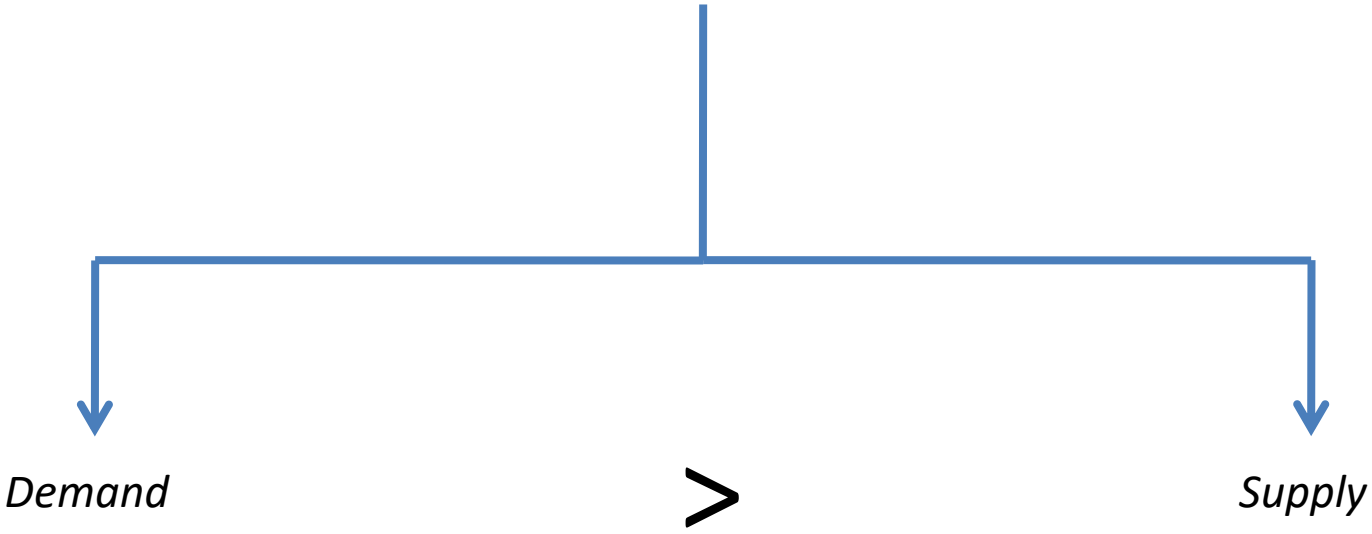
Pollution

Noise

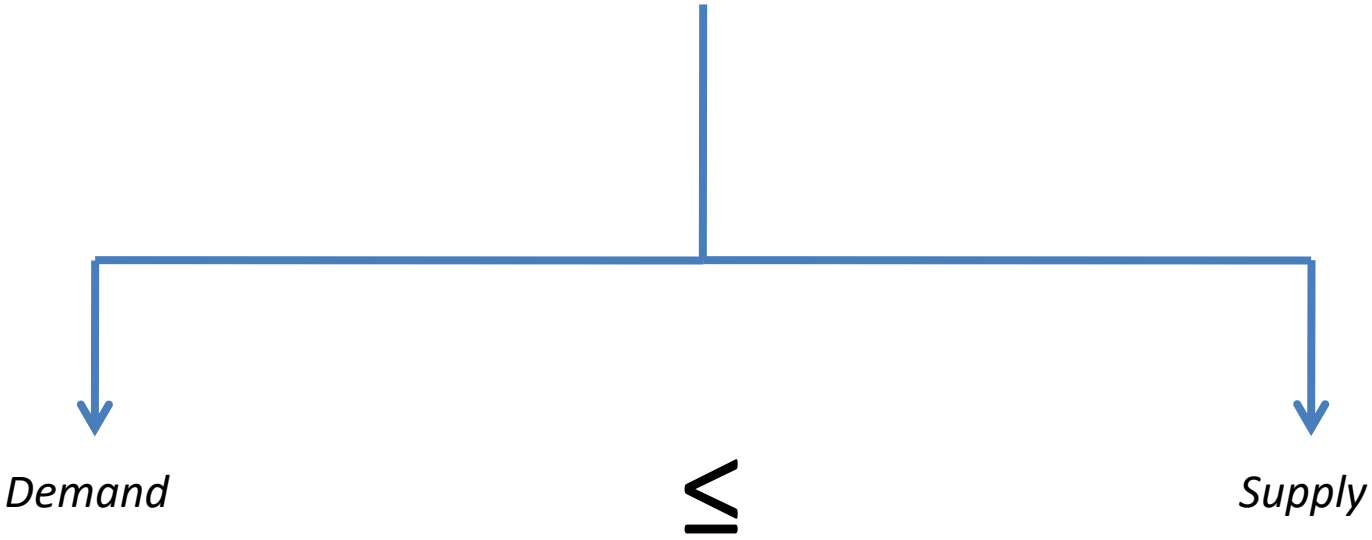
Fuel consumption

Safety problems

Transportation Planning role



Transportation Planning role



Examples of Supply

Present Demand

Predicting demand is a hard task

Future Demand

Unpredictable human behavior

Different trip purposes

Land-use in future

Use complex mathematics

Using many models

Very difficult to predict

Predicting demand is a hard task

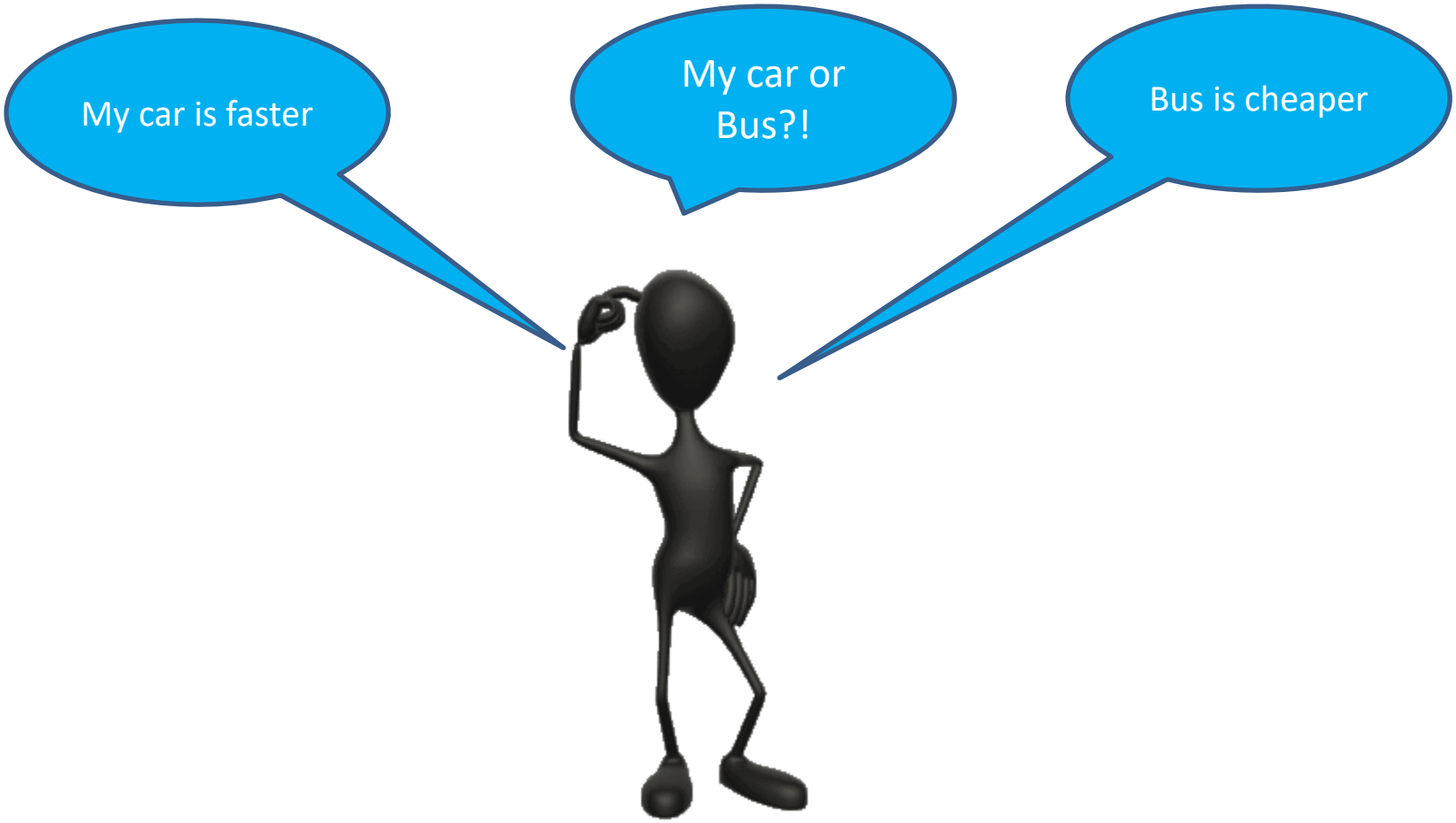
Four Basic Questions

How many people are willing to go?

Four Basic Questions

Where would they go?

Four Basic Questions

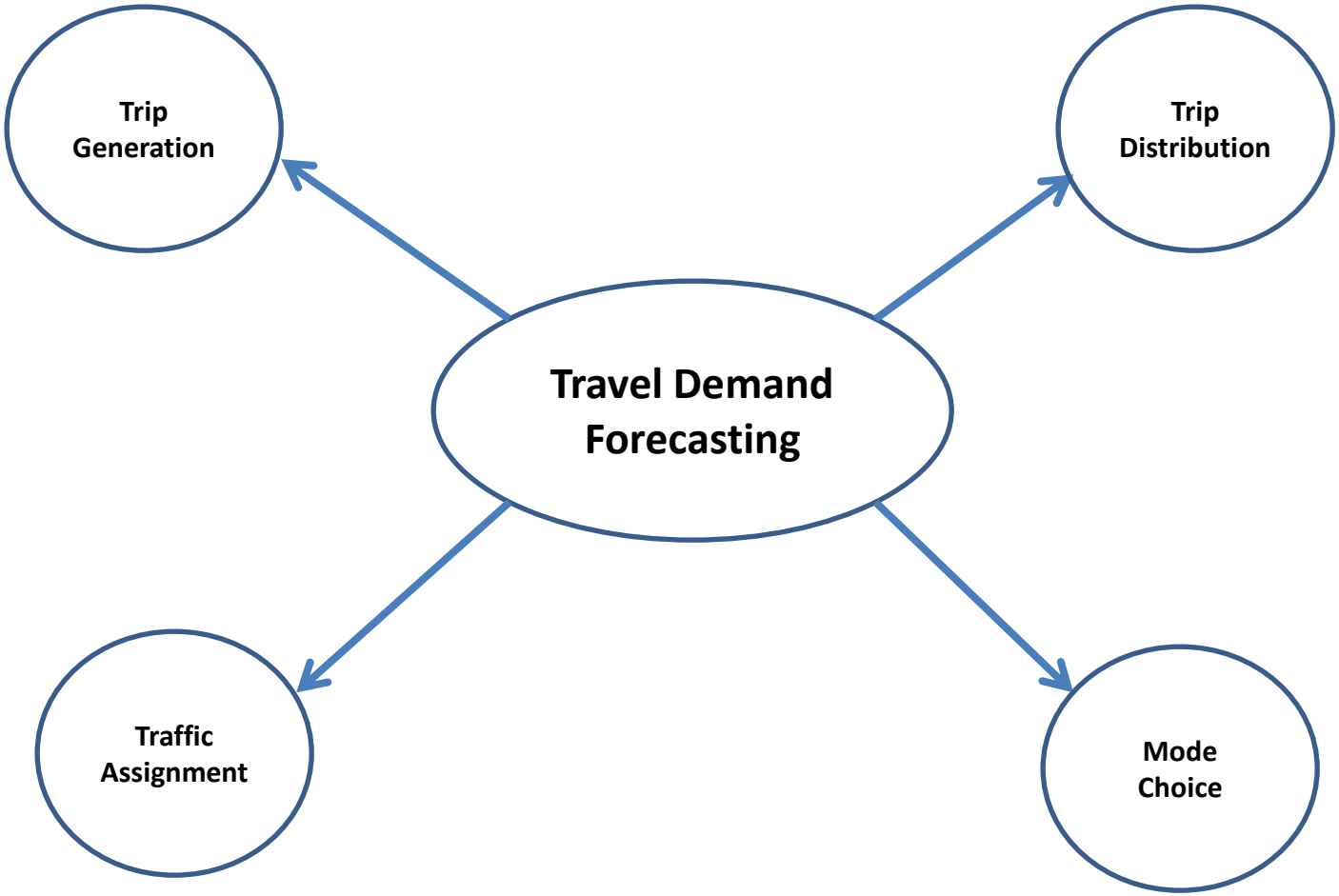


Which mode would they use?

Four Basic Questions

They lied to me that all routes lead to Rome

Which route would they use?


Trip Generation
Trip Distribution
Travel Demand Forecasting
Traffic Assignment
Mode Choice

Purpose of Travel Demand Model

- This process is important to be in transportation planning for:
  - provide new transportation system
  - improve the existing system
  - build highways, transit systems and other

- to determine the number of trips that will use the existing transportation system. trips taken in the form private vehicles and public transport

TRANSPORTATION PLANNING PERIOD

Long Term (≥ 5 years)

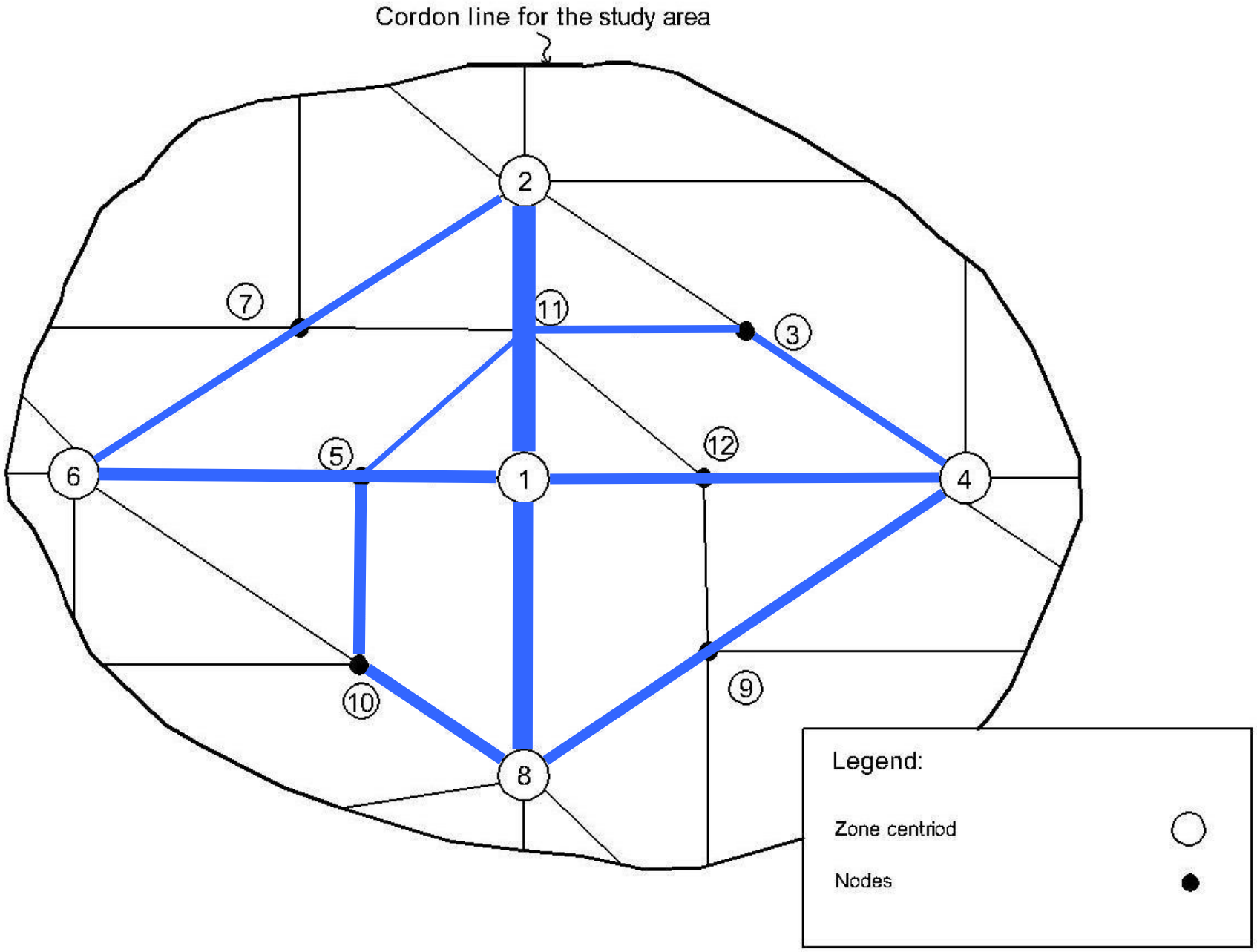
- This type of planning is more structured and complicated and it must be designed better than short term planning
- urban transportation planning process involves planning the next 20 to 25 year

PLANNING PROCESS

- Problem definition
- Surveying
- Design and Solution
- Evaluation of alternative
- Choice of project
- Specification and construction
- Feed Back

Study Area

- Clearly define the area under consideration
  - Where does one entity end?
  - May be defined by county boundaries or, town centers


Cordon line for the study area
2
7
11
3
6
5
12
1
4
10
9
8
Legend:
Zone centriod
Nodes

Study Area

- Links and nodes
- Simple representation of the geometry of the transportation systems (usually major roads or transportation routes)
- Links: sections of roadway (or railway)
- Nodes: intersection of 2+ links
- Centroids: center of TAZs
- Centroid connectors: centroid to roadway network where trips load onto the network

Travel Analysis Zones (TAZs)

- Homogenous urban activities (generate same types of trips)
    - Residential
    - Commercial
    - Industrial
- May be as small as one city block or as large as 10 sq. miles
- Natural boundaries --- major roads, rivers, airport boundaries
- Sized so only 10-15% of trips are intrazonal

Household Based

- Trips based on “households” rather than individual
- Individual too complex
- Theory assumes households with similar characteristics have similar trip making characteristics
- However
  - Concept of what constitutes a “household” (i.e. 2-parent family, kids, hamster) has changed dramatically
    - Domestic partnerships
    - Extended family arrangements
    - Single parents
    - Singles
    - roommates

Trip Purpose

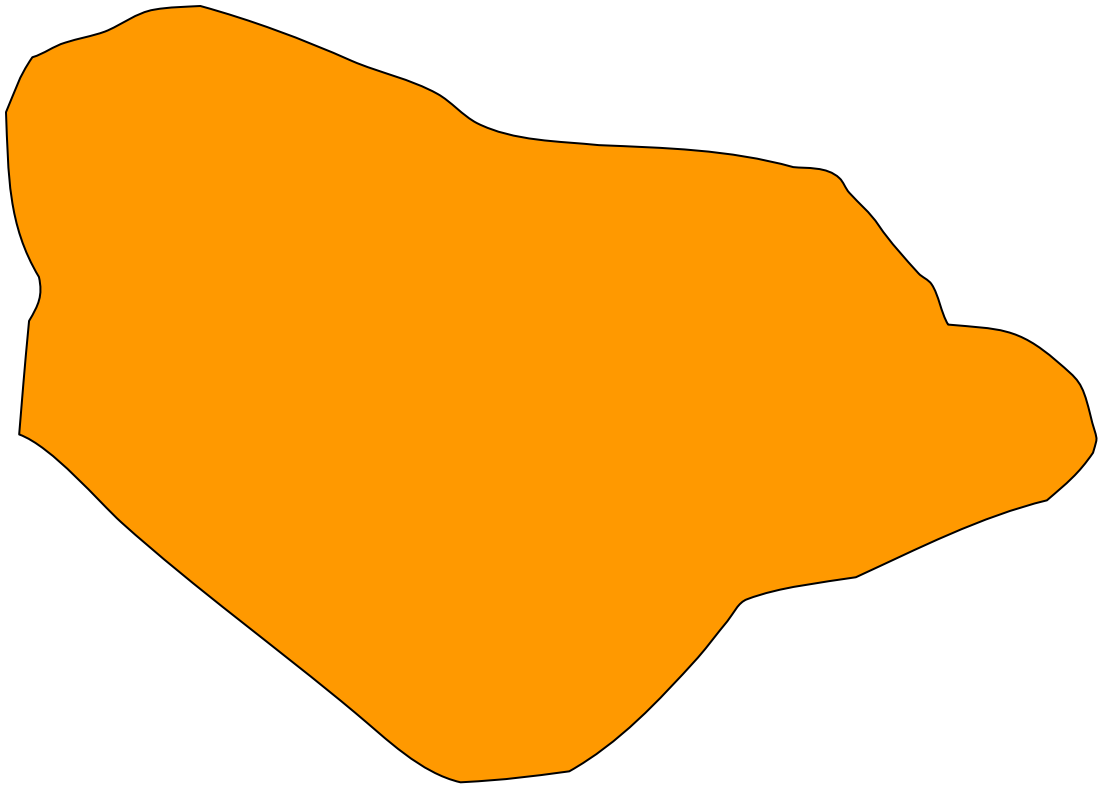
- Trips are estimated by purpose (categories)
  - Work
  - School
  - Shopping
  - Social or recreational
  - Others (medical)
- Travel behavior of trip-makers depends somewhat on trip purpose
  - Work trips
    - regular
    - Often during peak periods
    - Usually same origin/destination
  - School trips
    - Regular
    - Same origin/destination
  - Shopping recreational
    - Highly variable by origin and destination, number, and time of day

Trip Generation

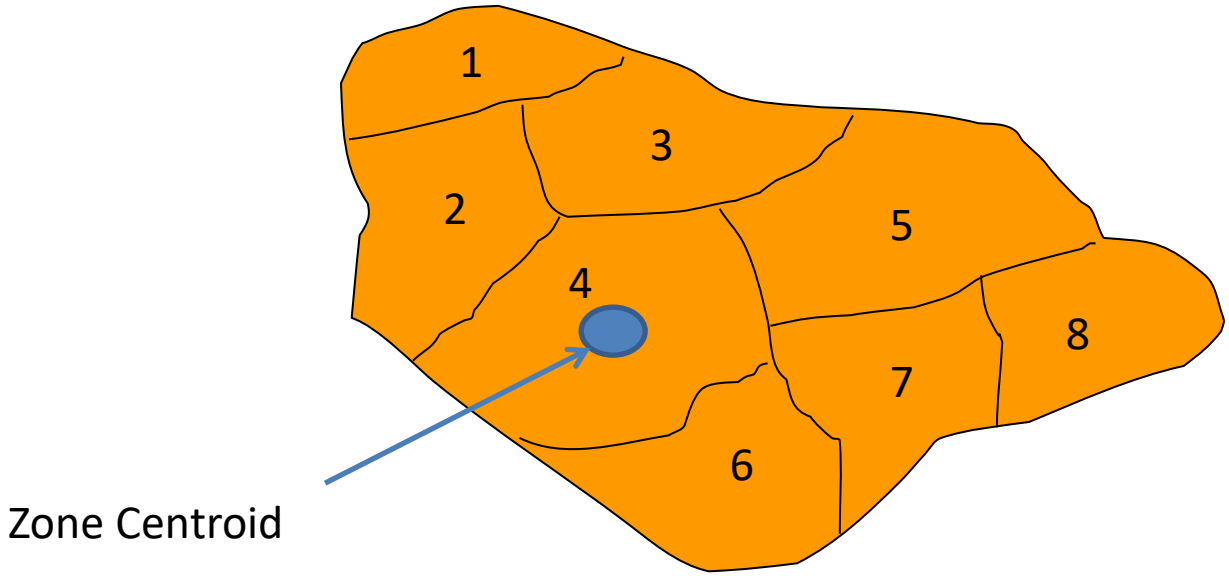
- Forecast the trips that produced or attracted by each TAZ for a “typical” day

- Attraction
  - Number and types of retail facilities
  - Number of employees
  - Land use
- Production
  - Car ownership
  - Income
  - Population (employment characteristics)

Study Area

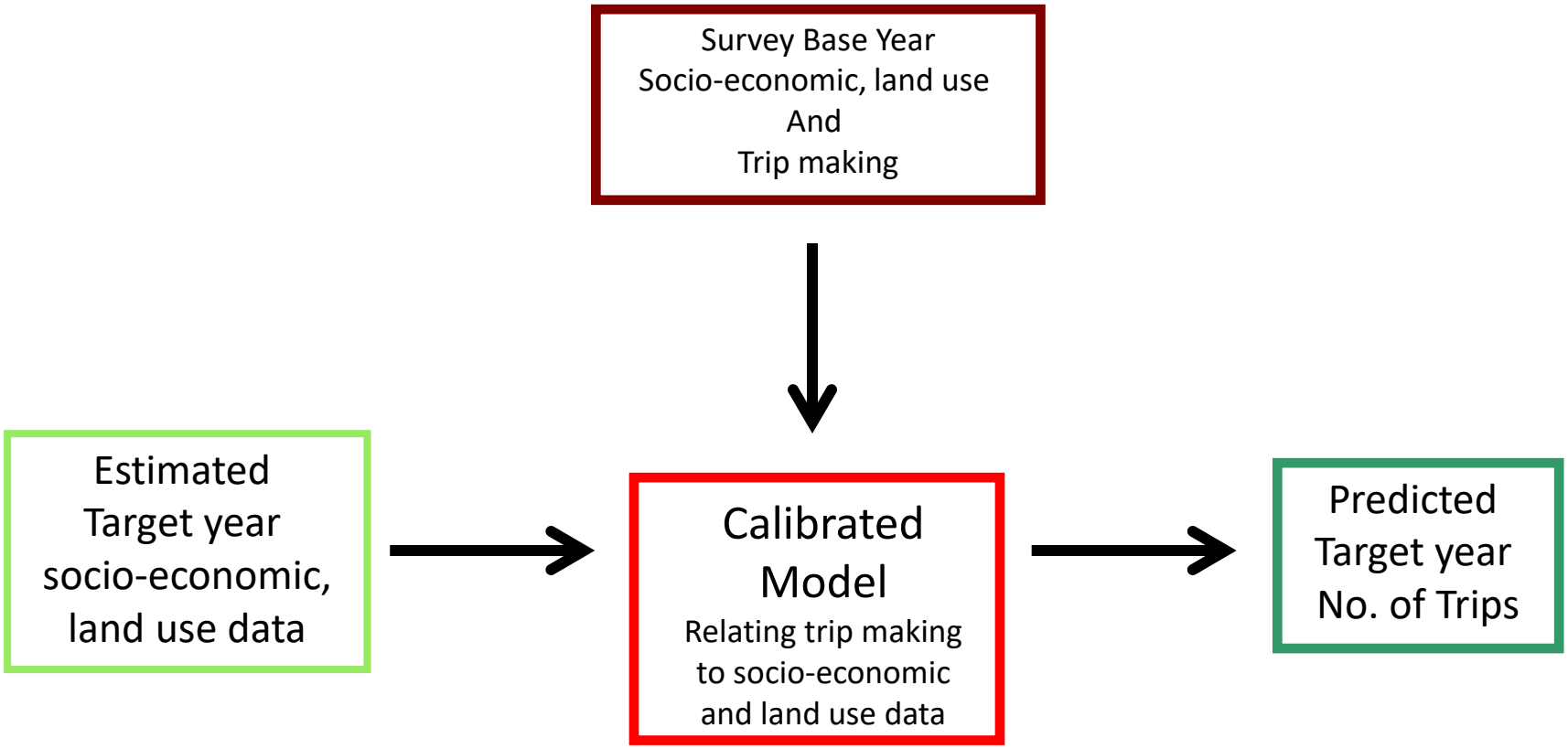


Zoning System



Trip Generation

Developing and Using the Model



Trip Generation

Developing and Using the Model

The trip generation model typically can take the form of

No. of trips/unit time/place = Function (pop, income, auto ownership rates)

The model is developed and calibrated using BASE year data

Trip Generation

Demographics and Trip Making Factors affected by Land Use

The land use pattern may affect

- **Car ownership rates**
- **Household size and composition**
- **Number of daily trips**
- **Mode of trips**
- **Length of trips**

Trip Generation

What is Predicted?

Trip generation models predict so called TRIP ENDS for each zone

The trip ends maybe classified as either

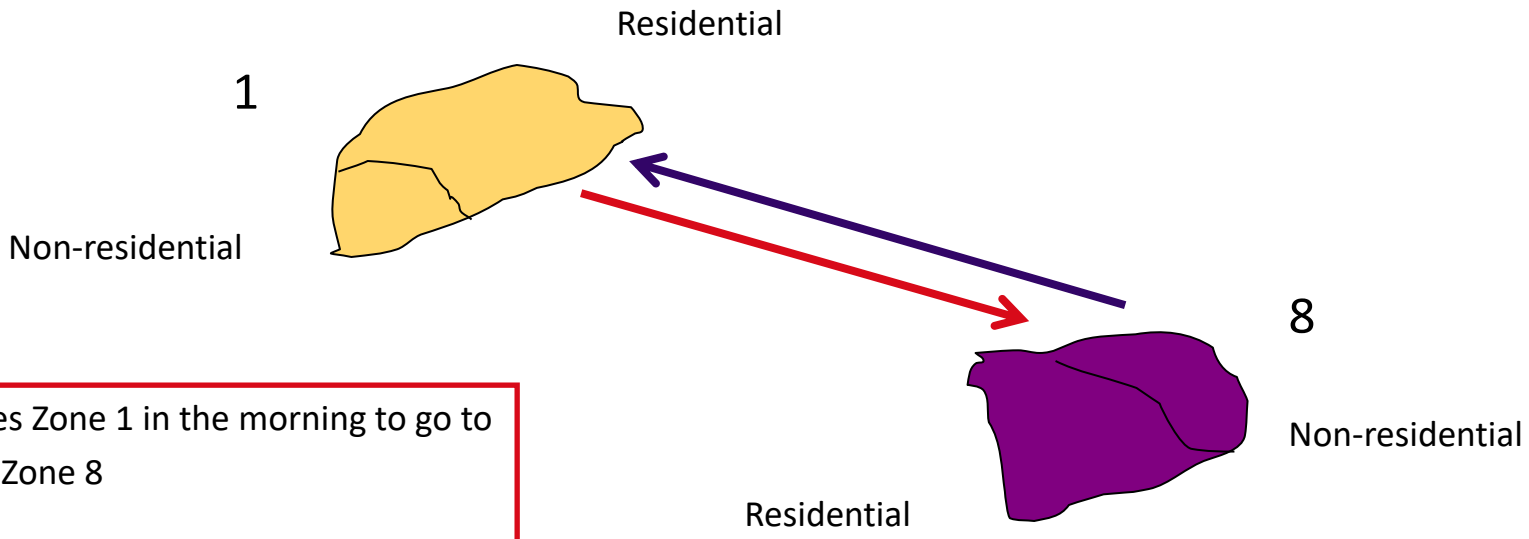
- ORIGINS and DESTINATIONS (O-D)

or

- PRODUCTIONS and ATTRACTIONS

The two sets of terms sound similar but there is a technical difference

Origins and Destinations



A worker leaves Zone 1 in the morning to go to work in Zone 8

This results in 2 trip ends:

- One Origin for Zone 1
- One Destination for Zone 8

When that same worker leaves Zone 8 in the evening to go to home to Zone 1

This results in another 2 trip ends:

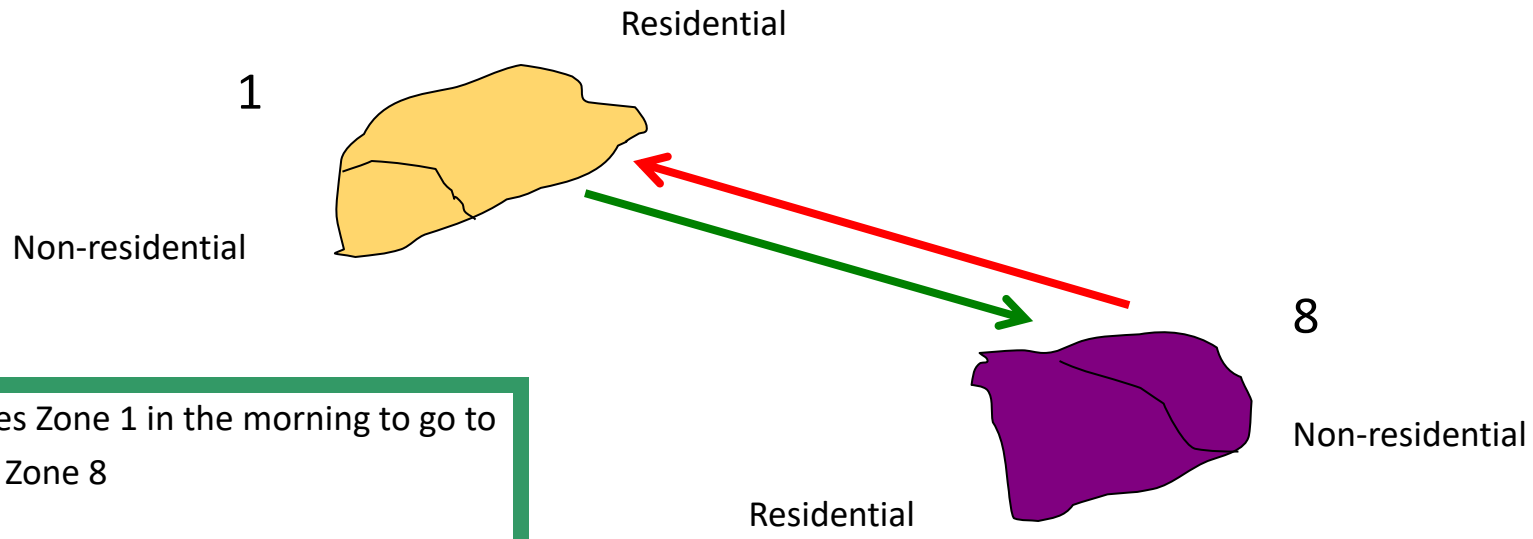
- One Destination for Zone 1
- One Origin for Zone 8

Total Number of Trip Ends

Zone 1: 2 Trip Ends (1 O, 1 D)

Zone 8: 2 Trip Ends (1 O, 1 D)

Productions and Attractions



A worker leaves Zone 1 in the morning to go to work in Zone 8

This results in 2 trip ends:

- One **Production** for Zone 1
- One **Attraction** for Zone 8

When that same worker leaves Zone 8 in the evening to go to home to Zone 1

This results in another 2 trip ends:

- One **Production** for Zone 1
- One **Attraction** for Zone 8

Total Number of Trip Ends

Zone 1: 2 Trip Ends (2 **Productions**)

Zone 8: 2 Trip Ends (2 **Attractions**)

Origins and Destinations??
Productions and Attractions??

Based on the convention of trip generation models

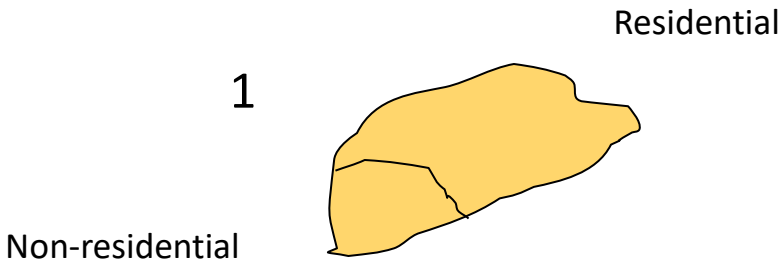
Origins and **Destinations** are defined in terms of the direction of the trip

Productions and **Attractions** are defined by the land use

Residential Land use **PRODUCES** trip ends
Non-residential land use **ATTRACTS** trip ends

This is a useful distinction because of how trip generation models are typically developed

Modeling Productions and Attractions



For example, Trip Ends for Zone 1 would be reported as

1. 1000 Production Trip Ends
2. 500 Attraction Trip Ends

Trip generation models typically model separately, i) residential trip production, ii) non-residential trip attractions

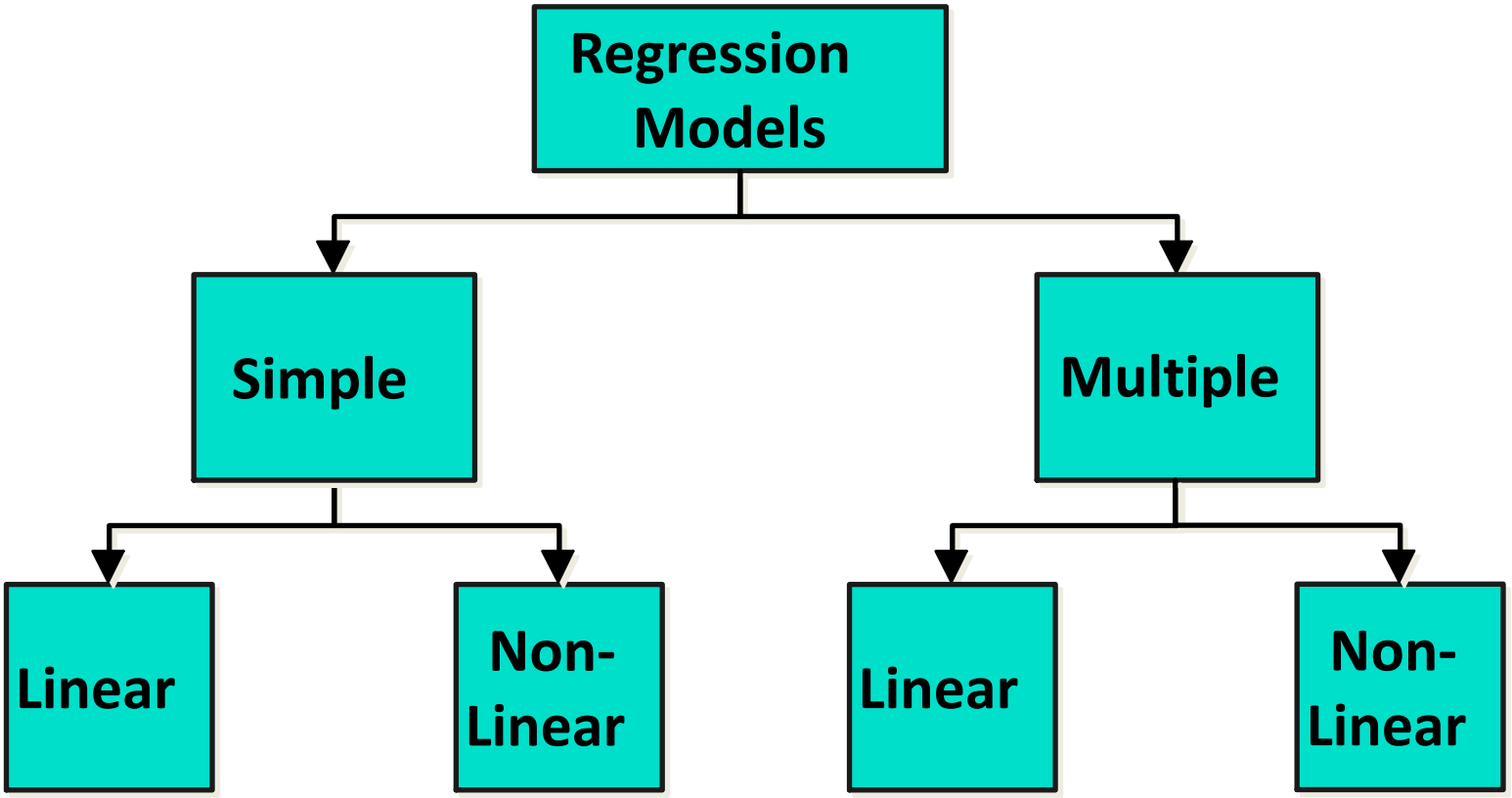
This approach works for home based trips (HB). But falls apart when we start to consider non-home based trips (NHB). Special techniques are developed to deal with the relatively small number of NHB that occurs.

Regression Analysis

Regression Modeling Steps

- Define problem or question
- Specify model
- Collect data
- Do descriptive data analysis
- Estimate unknown parameters
- Evaluate model
- Use model for prediction

Types of Regression Models



Goal

Develop a statistical model that can predict the values of a *dependent* (response) variable based upon the values of the *independent* (explanatory) variables.

Simple Regression

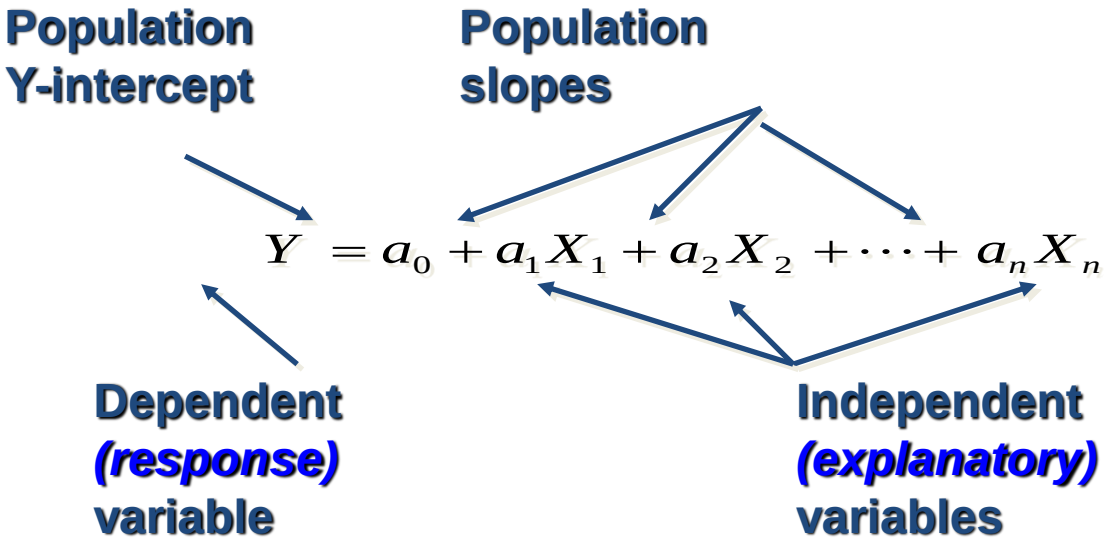
A statistical model that utilizes <u>one</u> *quantitative* *independent* variable "X" to predict the *quantitative* *dependent* variable "Y."

Multiple Regression

A statistical model that utilizes **two or more** *quantitative* and *qualitative* explanatory variables (x_1,..., x_p) to predict a ***quantitative*** dependent variable Y.

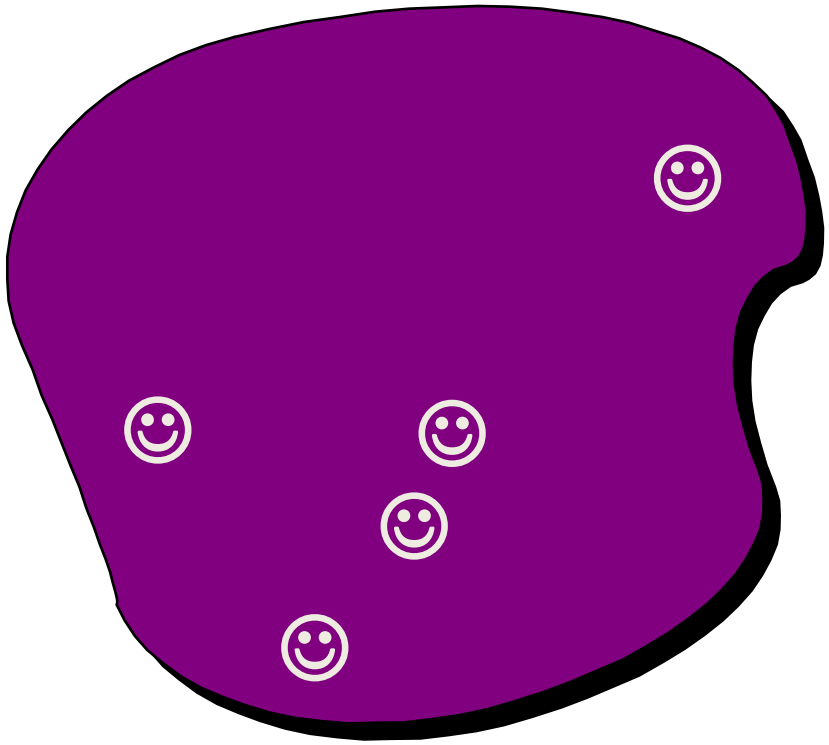
Linear Model

Relationship between one dependent & two or more independent variables is a linear function

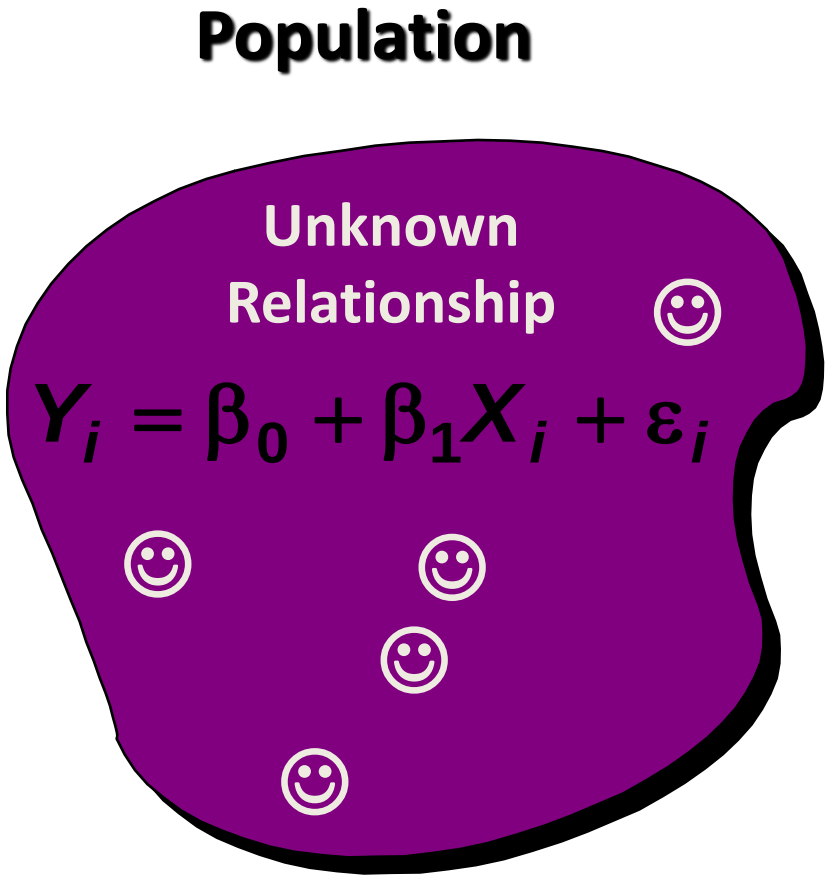


Population & Sample Regression Models

Population



Population & Sample Regression Models



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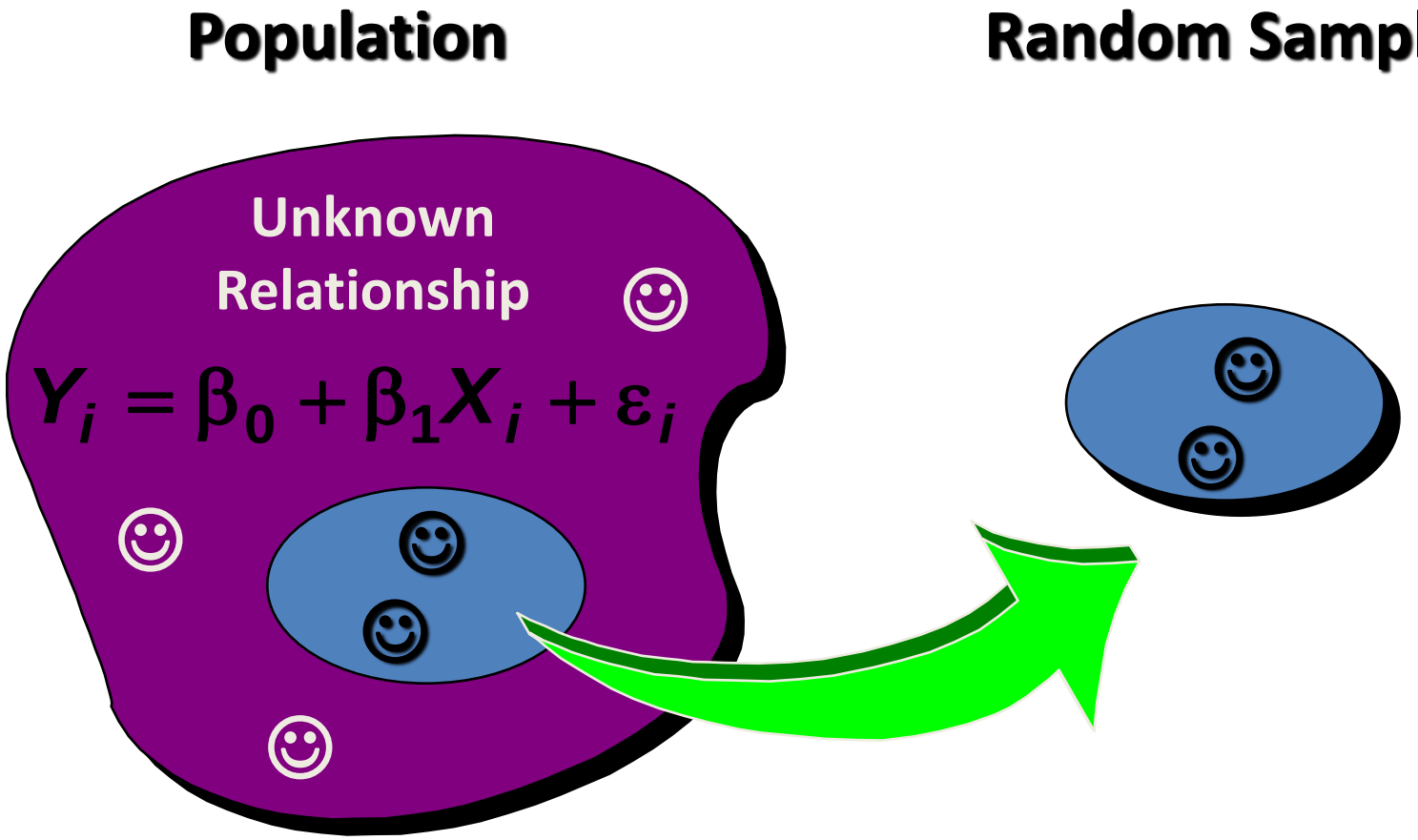

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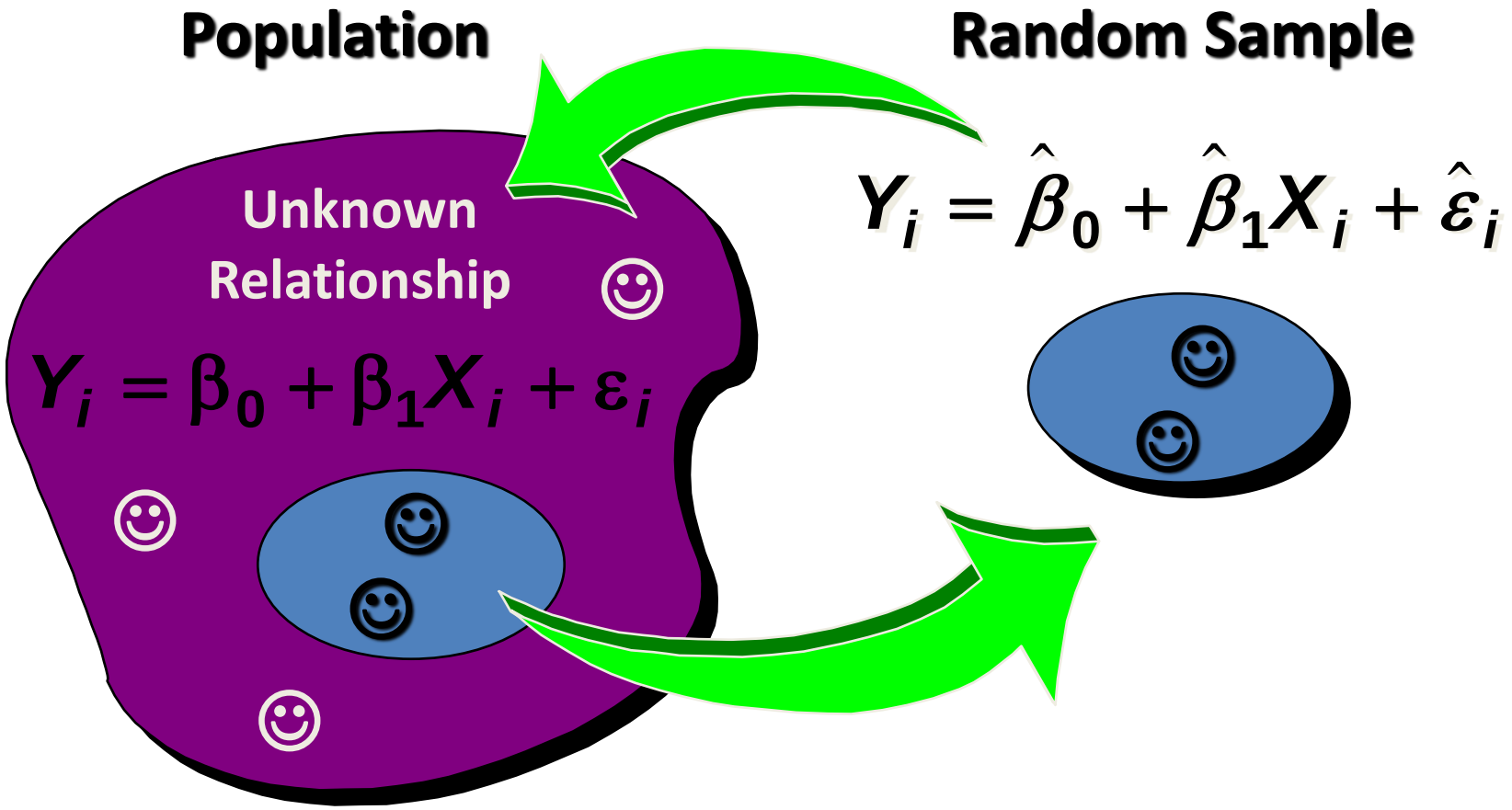
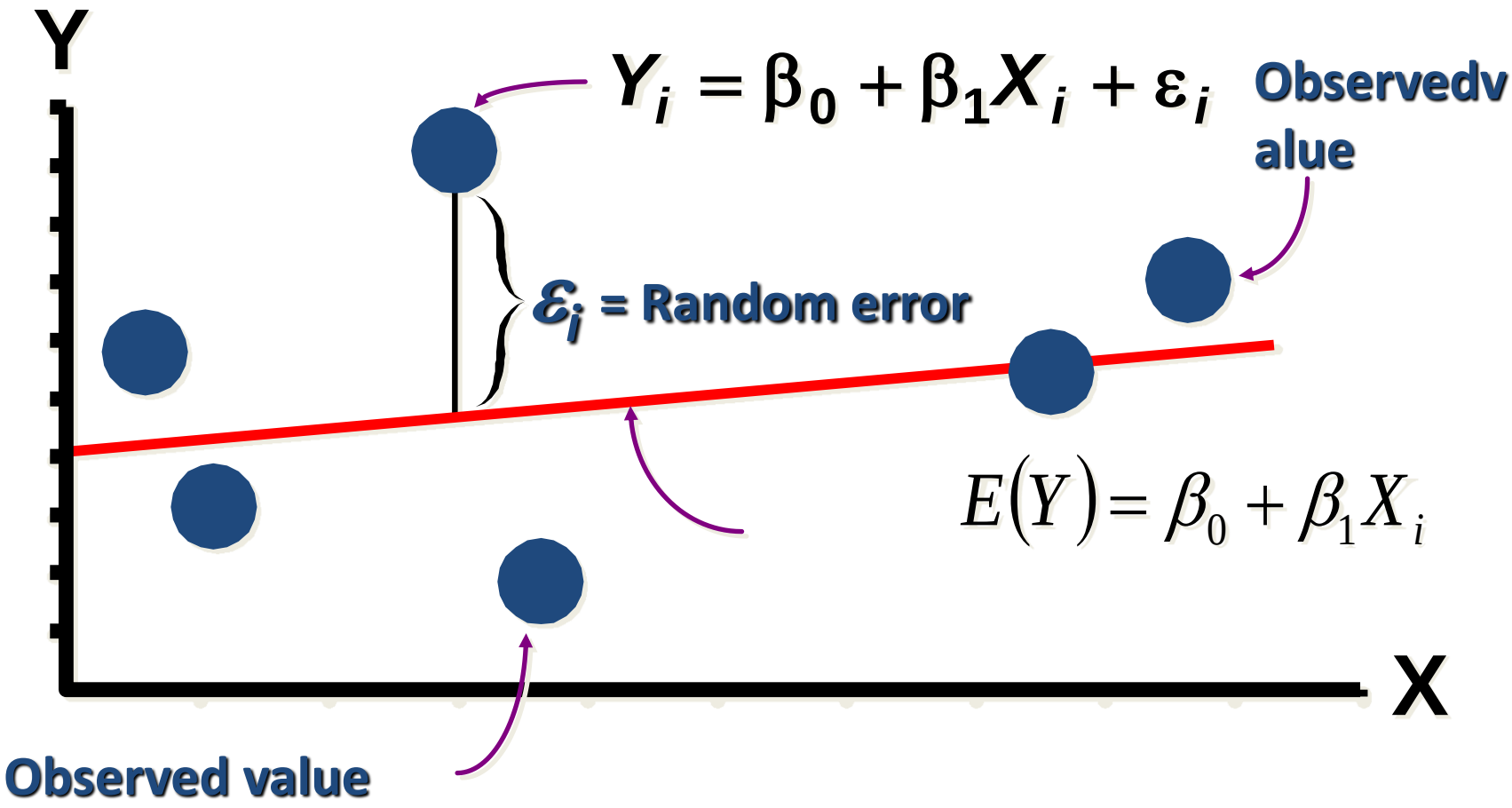


Population Linear Regression Model



Sample Linear Regression Model