MOBILITY MANAGEMENT & TRANSPORTATION SYSTEM MODELING

Lauren Lee Stuart
Center for Energy Studies
Louisiana State University
lstuar3@lsu.edu

Overview

- Transportation Economics
- Mobility Demand Management
  - Definitions
  - Examples
  - Applications
- LSU Case Study
  - Background
  - Survey Results
  - Supply and Demand Findings
  - Mode Choice Forecasting
  - Optimum Investment Allocations
  - Energy and Environmental Impacts

Traffic Congestion: A Negative Externality?

- Engineers collect traffic counts to rate roads according to the *Level of Service*
- Economists can calculate *Pareto Efficiency* to estimate optimum level of vehicular activity

Transportation Economics

- PRINCIPLE ASSUMPTIONS
  - Roads as Public Goods
  - Operated as Monopoly Markets
  - Consumer Prices:
    - » Fuel, parking, tolls, vehicle ownership, fares, etc.
  - Producer Costs:
    - » Construction, maintenance, law enforcement, etc.
  - Social Costs:
    - » Congestion, accidents, emissions, etc.
- APPLICATIONS
  - PUBLIC WORKS FINANCING
  - ALTERNATIVE ASESSMENTS
  - EMISSION MITIGATIONS

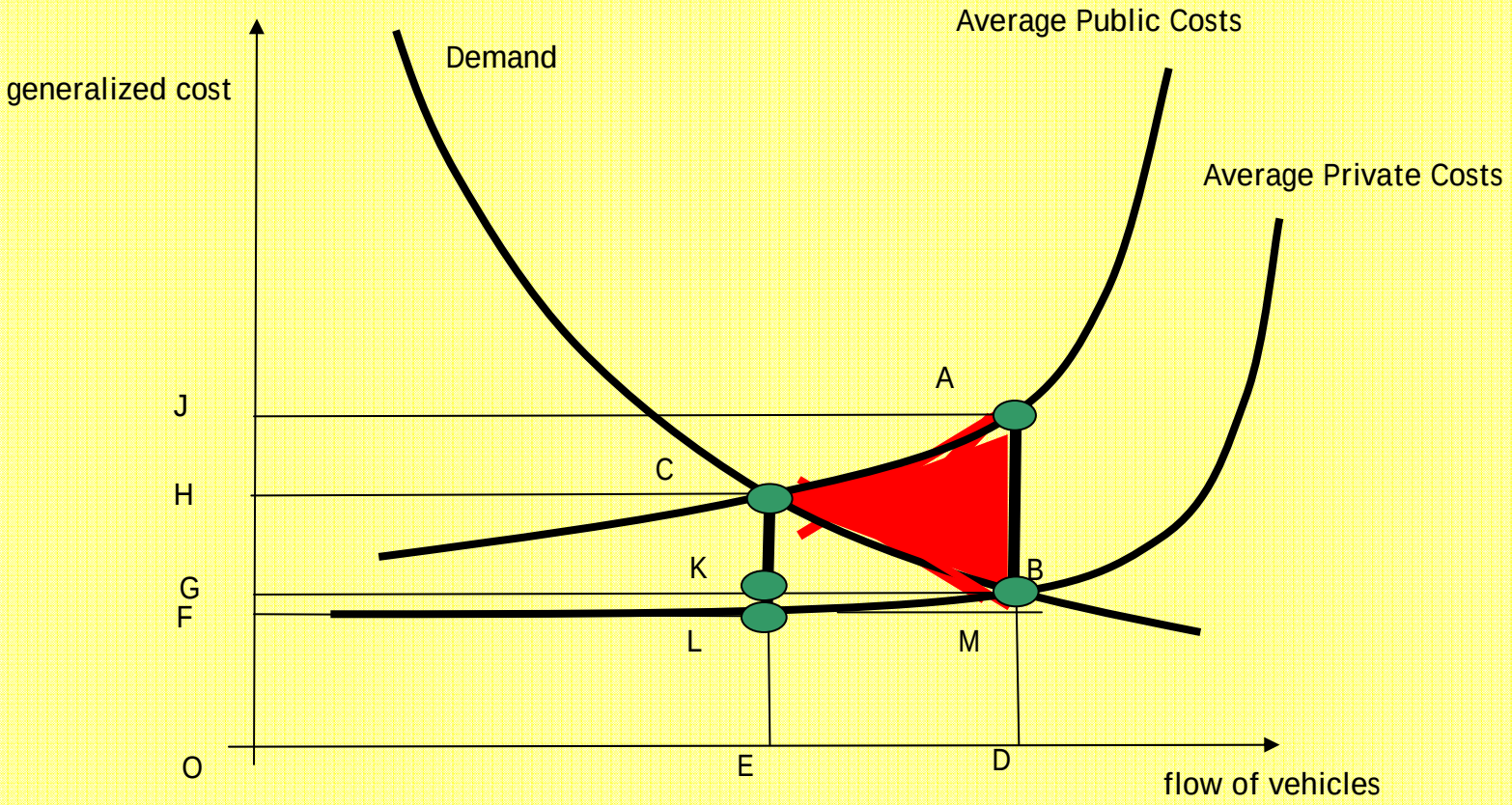
Mobility Demand Management

System Intervention	Market Based	Policy Based	Structural
Example	Gas tax, parking pricing, toll roads	Commuter Services, ITS, Inspection& Maintenance	Auto Restriction, Bike Paths, Park-and-Ride, Transit
Implementation Strategy	Revenue neutral cost distribution	Idling limitations, telecommuting	Construction + Awareness
Description	Incorporate the *price mechanism*	Influence *decision making*	Offer *mode-choice*

Examples

- Edmonton, Canada
  - Deadweight loss of $1,300/day from emissions and congestion
  - Road and parking pricing funded expansion of alternate modes
- Kamloops, British Columbia
  - Road expenditures reduced from $120 million to $14 million
  - Annual energy consumption decrease from 128 to 125 gigajoules per capita
  - Carbon monoxide decrease from 116 to 111 kg/capita/year, and carbon dioxide from 7,200 to 7,000 kg/capita/year
- Stockholm, Sweden
  - Congestion charge included expansion of transit and park-and-ride
  - Significant NOx, CO, PM10, VOC, & CO2 emission reductions
- Atlanta, Georgia USA
  - Carpool, vanpool, and transit saved 94,460,789 VMT/yr

Transportation Economics



– Presented by J.D. Hunt, et.al at the 11th TRB National Transportation Planning Applications Conference; Daytona Beach, FL; May 8, 2007

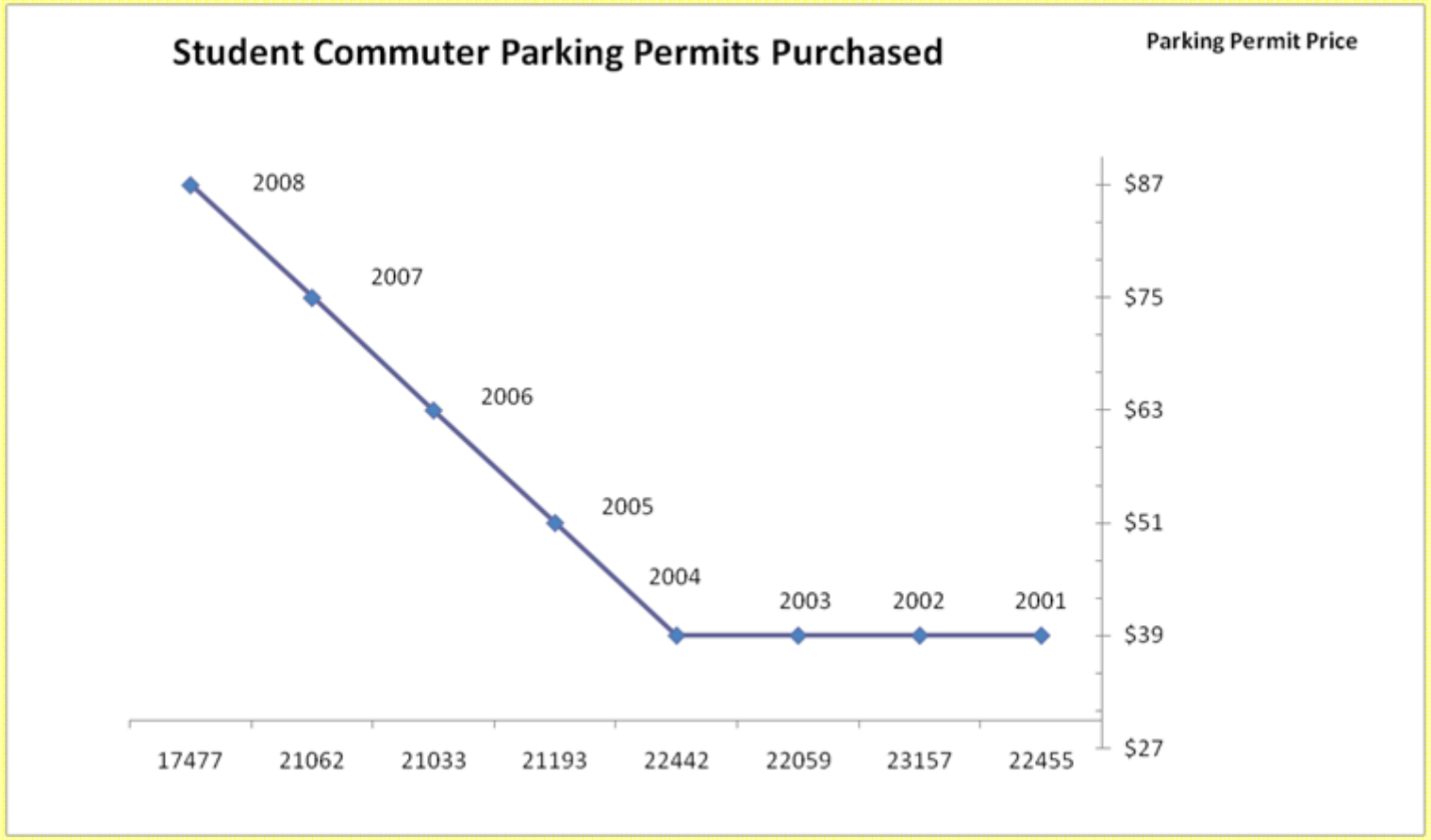
Louisiana State University

- LSU is located on more than 2,000 acres of land in the southern part of Baton Rouge, bordered on the west by the Mississippi River.
- ~30,000 students, an average of 92% commute in personal vehicle
- Traffic congestion and air quality serious problems in the area
- 2007 Road closure implemented, called “Easy Streets”
  - Phase one of the Master Plan goal of a “car-free campus”
  - Parking permit prices increased incrementally (arbitrarily)
- Controversial, although stated impact was 62% reduction in number of cars on campus

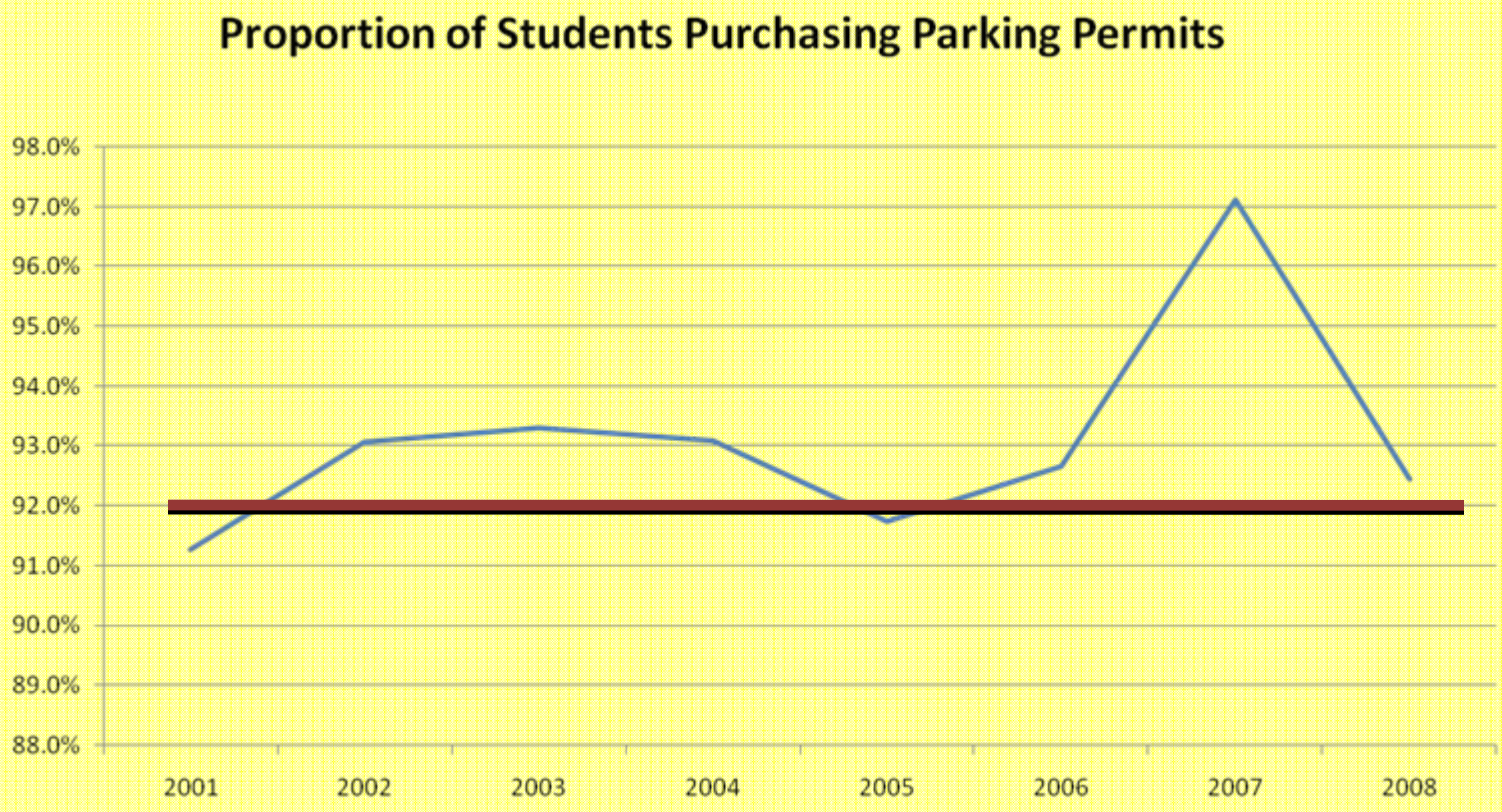
LSU Mobility Case Study

WALKER
PARKING CONSULTANTS

Demand for Driving

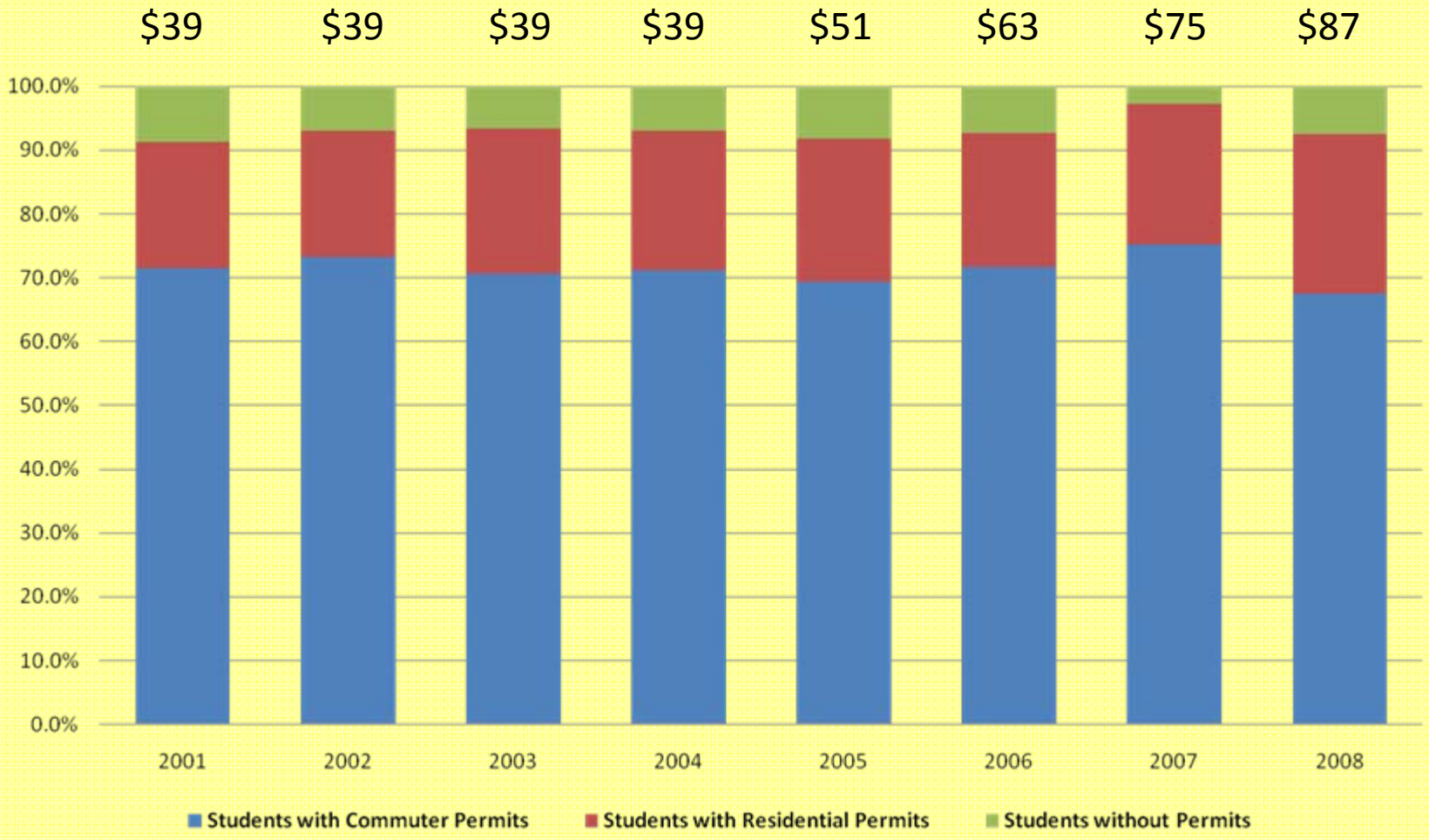


Demand for Driving



*Average = 92%

Demand for Driving



Driving Demand is Price Inelastic

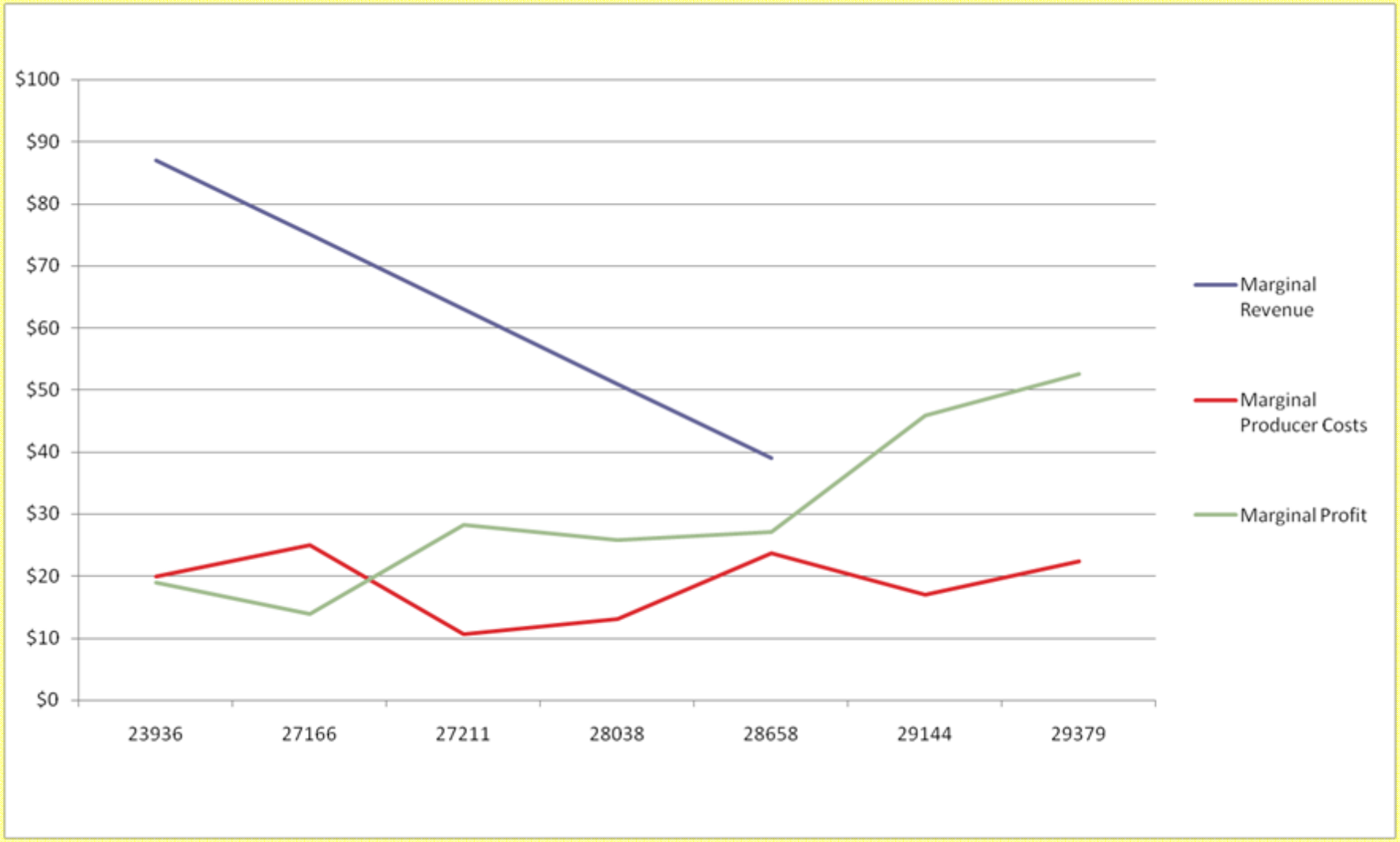
$$E_d = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}} = \frac{\Delta Q_d / Q_d}{\Delta P_d / P_d}$$

E_d(Commuters) = -.11

E_d(Total) = -.22

PARKING PERMITS ARE A SUNK COST

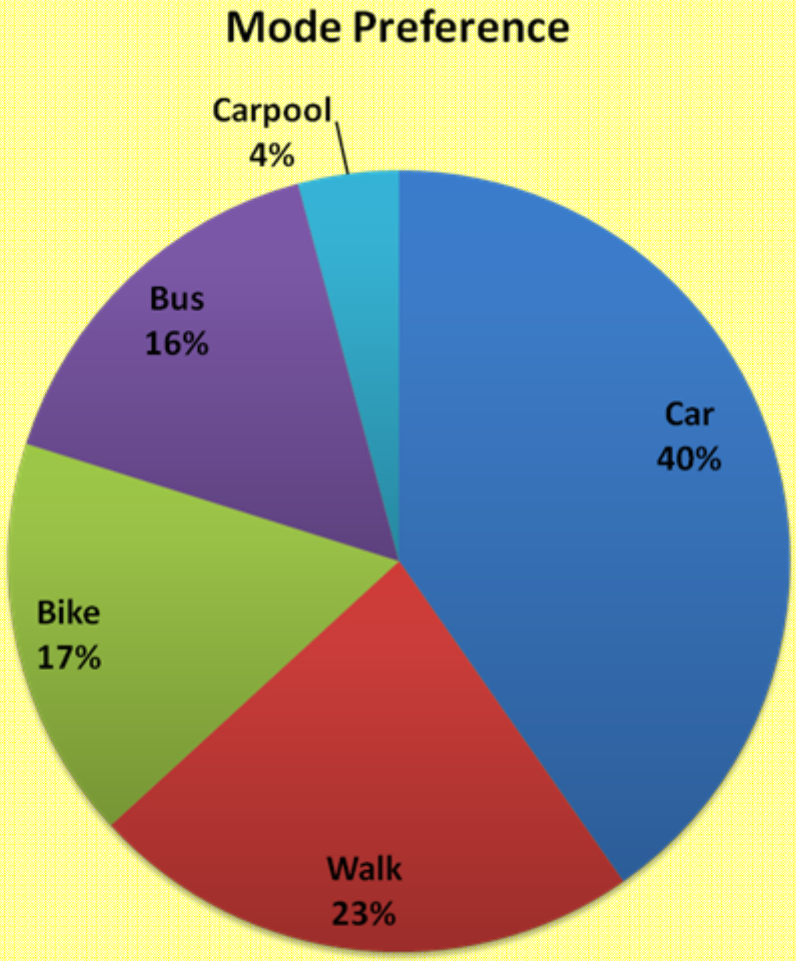
Parking Supply



Producer Surplus

- Profit = Total Revenue – Total Cost
  - $565,431.36 / year
- Average Marginal Revenue = $54
- Average Marginal Cost = $19
  - Deadweight Loss = ½ x (MR=AC) x (MR=MC)
  - $282,715.68 / year
  - Traffic Congestion: Time, fuel, emissions, etc.

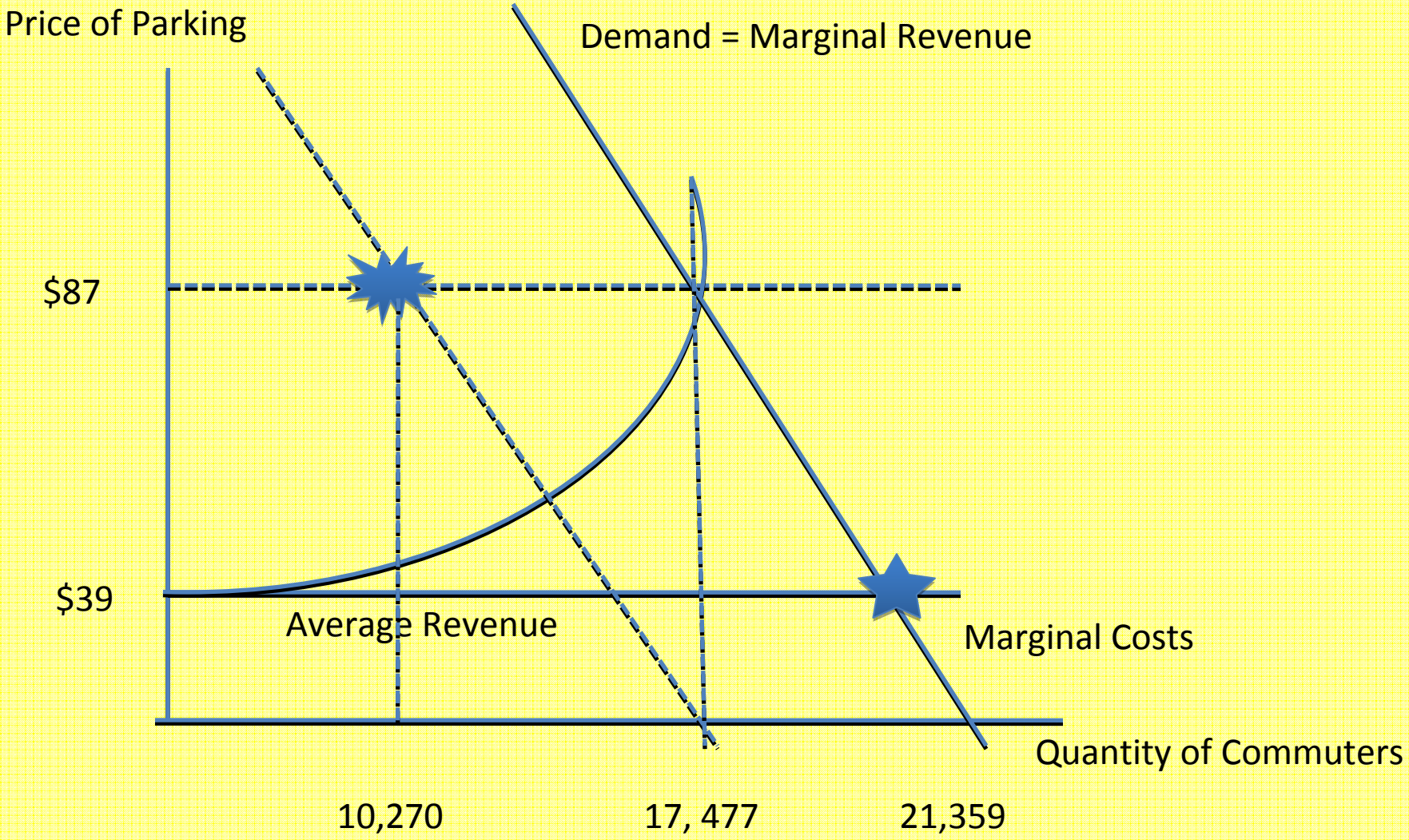
Student Transportation Survey



Factors:

- Convenience, Reliability, Safety
- Accessibility, Affordability
- Cost, Benefits

Supply and Demand Findings



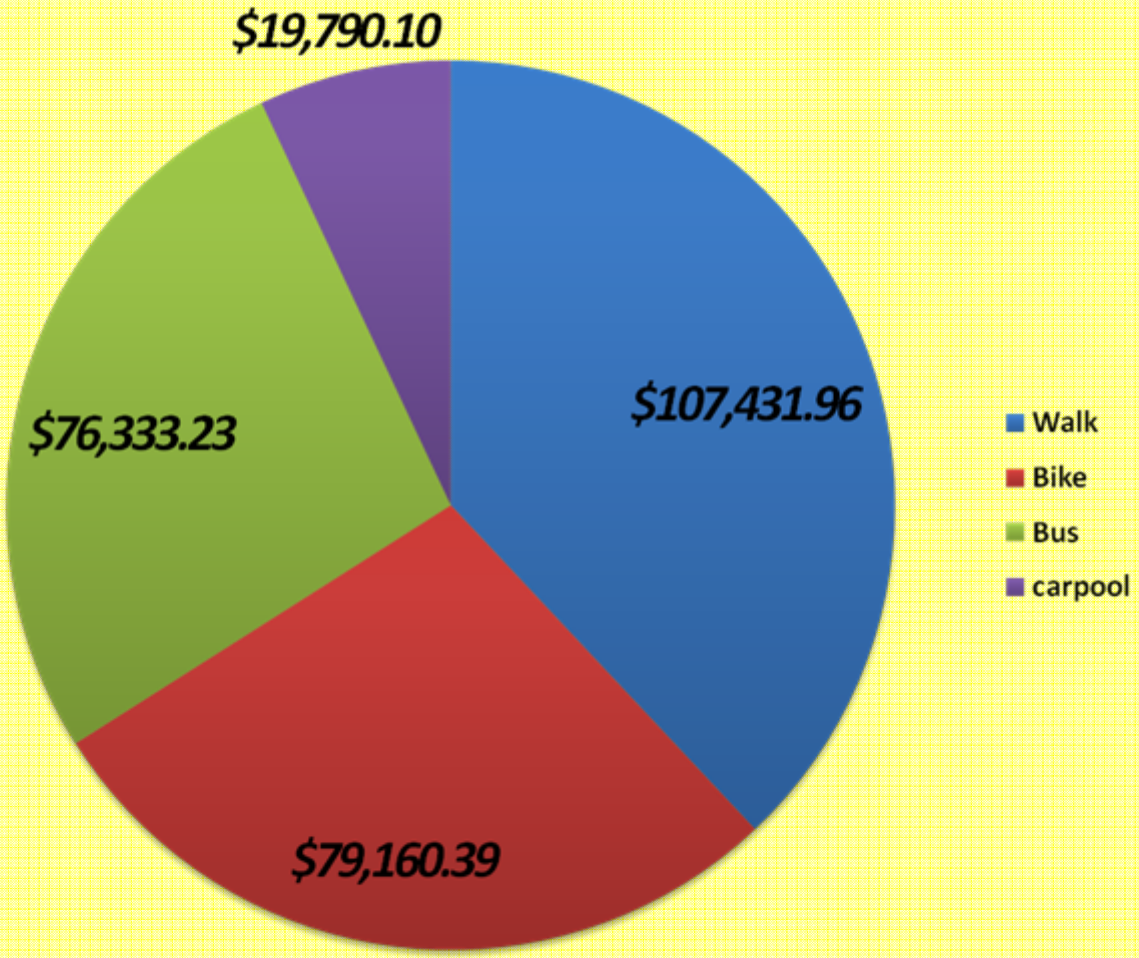
Mode Choice Forecasting

	Enrollment	Commuter	Residential	Walking	Bike	Bus	Carpool
Average	30234.1	21359.8	6506.0	900.0	663.1	639.5	165.8
2008 Actual	28194.0	17477.0	6459.0	1618.0	1192.2	1149.7	298.1
Equilibrium	**30000.0**	**10270.8**	**4500.0**	**5843.8**	**4250.0**	**4072.9**	**1062.5**
Percent Change		-0.41	-0.30	2.61	2.56	2.54	2.56

PARETO OPTIMALITY

Optimum Investment Allocation

Alternate Mode	Share of Total
Walk	38%
Bike	28%
Bus	27%
Carpool	7%



Energy and Environmental Impacts

- 21,359 – 10,270 = 11,089 fewer vehicles
- 26 weeks/year x 5 days/week x 2 miles/day
  = 160 miles/year fewer (per vehicle)
- 1,774,240 VMT reduction
- 64,517 gallons of gasoline less (@27.5 mpg)
- 1,251,645 lbs of CO_2 saved (@ 19.4 lbs/gal)

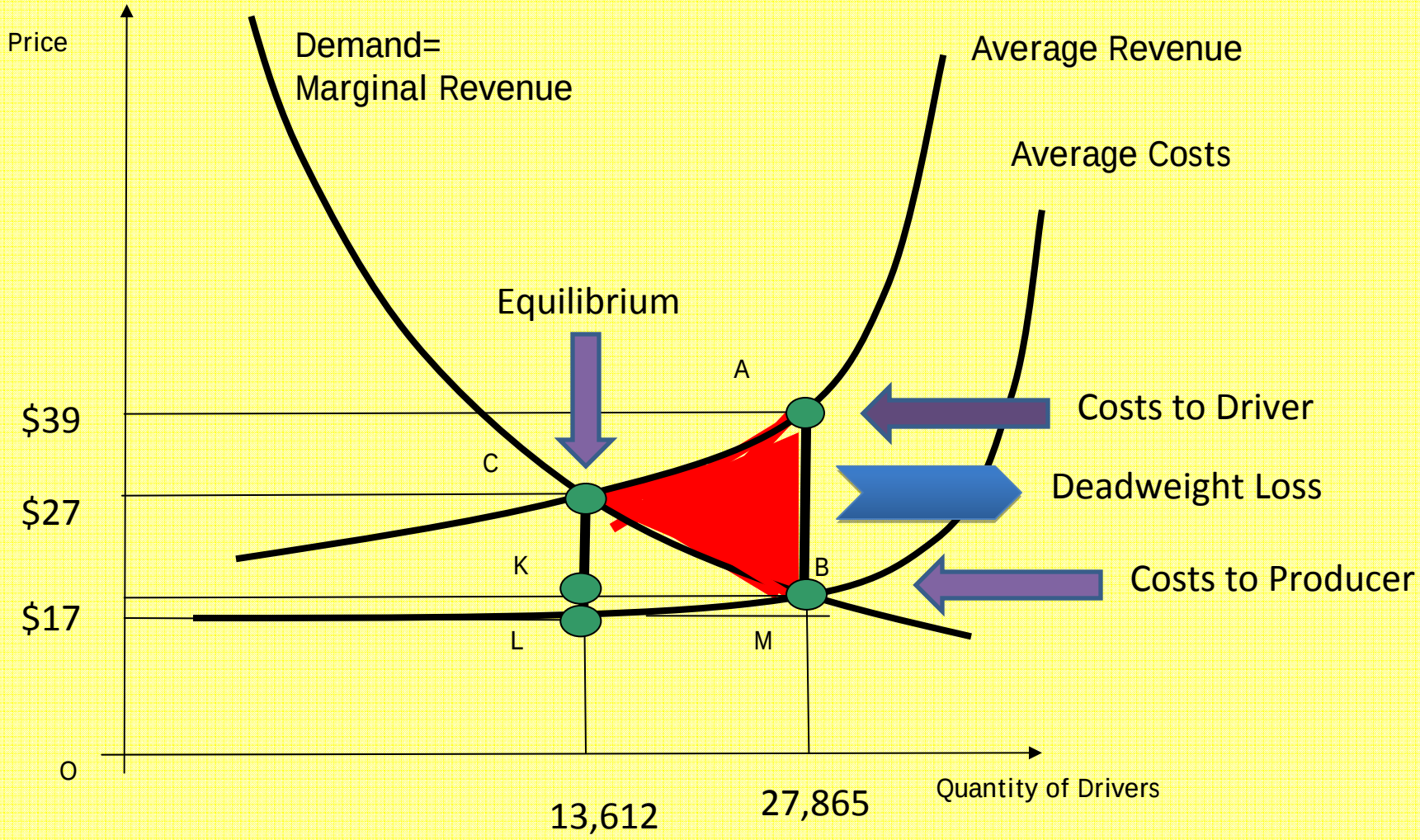
Questions? Comments?

Lauren Lee Stuart
Center for Energy Studies
Louisiana State University
lstuar3@lsu.edu

Transportation, Energy, and Climate Change

Mode	Passenger-mile/Gallon	CO_2/passenger-mile
Single Occupancy Vehicle	27.7	371
Transit Bus	32.5	299
2-Person Carpool	55.4	185
Van Pool	101.9	101

Monopoly Inefficiency



Driving Demand

	Parking Permit Price	Student Enrollment	Student Permits Purchased	Commuter Permits Purchased	Residential Permits	Students Purchasing Permits	Students with Commuter Permits	Students with Residential Permits	Students without Permits	Percent Change in Commuter Permits Purchased	Percent Change in Price	Price Elasticity of Demand
2001	$39	31402	28658	22455	6203	91.3%	71.5%	19.8%	8.7%	n/a	n/a	
2002	$39	31582	29394	23157	6237	93.1%	73.3%	19.7%	6.9%	3.1%	n/a	
2003	$39	31234	29144	22059	7085	93.3%	70.6%	22.7%	6.7%	-4.9%	n/a	
2004	$39	31561	29379	22442	6937	93.1%	71.1%	22.0%	6.9%	1.7%	n/a	
2005	$51	30564	28038	21193	6845	91.7%	69.3%	22.4%	8.3%	-5.7%	26.67%	-0.214678584
2006	$63	29317	27166	21033	6133	92.7%	71.7%	20.9%	7.3%	-0.8%	21.05%	-0.035996779
2007	$75	28019	27211	21062	6149	97.1%	75.2%	21.9%	2.9%	0.1%	17.39%	0.007922556
2008	$87	28,194	23936	17477	6459	84.9%	62.0%	22.9%	15.1%	-18.6%	14.81%	-1.255805807
AVG	$54	30234.125	27865.75	21359.75	6506	92.14%	70.60%	21.5%	7.9%	-3.57%	19.98%	-0.374639653

Parking Supply

	Parking Permit Price	Student Permits Purchased	Commuter Permits Purchased	Total Revenue	Revenue-Commuter	Expenditures	Average Producer Costs	Profit	Average Profit
2001	$39	28658	22455	$1,117,662	$875,745.00	$572,233.00	$19.97	$545,429.00	$19.03
2002	$39	29394	23157	$1,146,366	$903,123.00	$737,079.00	$25.08	$409,287.00	$13.92
2003	$39	29144	22059	$1,136,616	$860,301.00	$310,576.00	$10.66	$826,040.00	$28.34
2004	$39	29379	22442	$1,145,781	$875,238.00	$384,415.00	$13.08	$761,366.00	$25.92
2005	$51	28038	21193	$1,429,938	$1,080,843.00	$666,915.00	$23.79	$763,023.00	$27.21
2006	$63	27166	21033	$1,711,458	$1,325,079.00	$463,565.00	$17.06	$1,247,893.00	$45.94
2007	$75	27211	21062	$2,040,825	$1,579,650.00	$609,547.00	$22.40	$1,431,278.00	$52.60
2008	$87	23936	17477	$2,082,432	$1,520,499.00				
AVG	$54	27,865.75	21359.75	$1,504,751	$1,153,426.50	$534,904.29	$18.86	$854,902.29	$30.42