

CONGESTION STUDIES

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Congestion Mitigation

1. Supply measures

- Add capacity to the system
- Make the system operate more efficiently
- The focus is on the transportation system

2. Demand measures

- It focuses on motorists and travelers
- It attempts to modify their trip making behaviour

Supply measures

1. Development of Infrastructure

- New projects (new freeways, transit lines etc.)
- Road widening
- Bridge replacement
- Technology conversions(ITS)

2. Small scale capacity and efficiency improvement

- Signal system upgrade and coordination
- Freeway ramp metering
- Relocation of bus stops

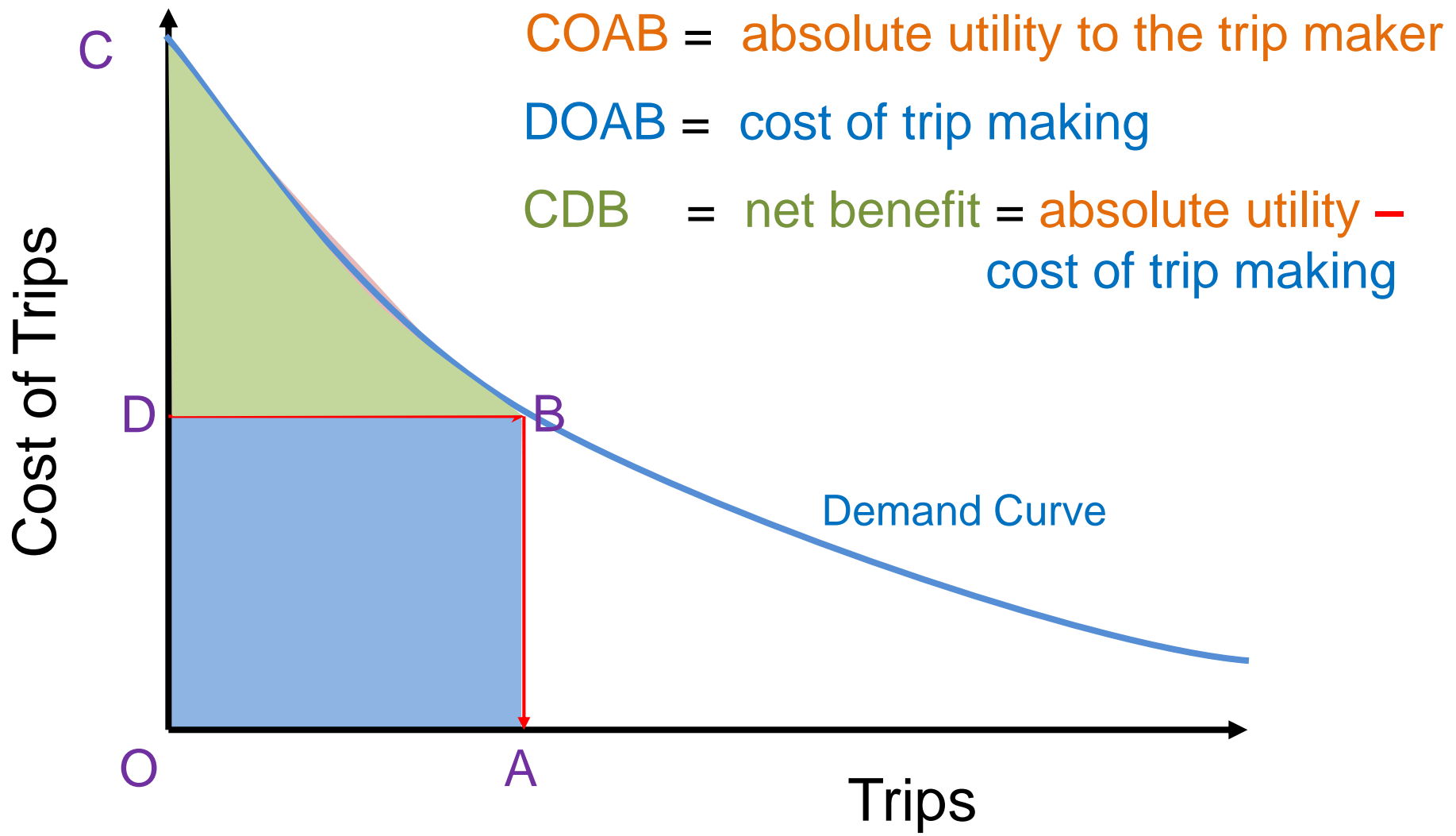
Demand measures

1. Congestion pricing
2. Parking pricing
 - It discourages the use of private vehicles to specific areas
3. Restrictions on vehicle ownership and use
 - Heavy import duties, fuel taxes, etc.
 - Separate licensing requirement
 - Restrain private vehicle acquisition and use

Congestion Pricing

1. A method of road user taxation, charging the users of congested roads according to the time spent or distance travelled
2. Principle: Those who cause congestion or use road in congested period should be charged
3. Gives the road user the choice of whether to make a journey or not

Economic Principle of Road Pricing



Economic Principle of Road Pricing

Total private cost of a trip

$$c = a + \frac{b}{v}$$

a - fixed component and

b - variable part related to speed v

Speed of the vehicle

$$v = d - eq$$

d and e are constants and

q = flow in veh/hour

The total private cost is therefore,

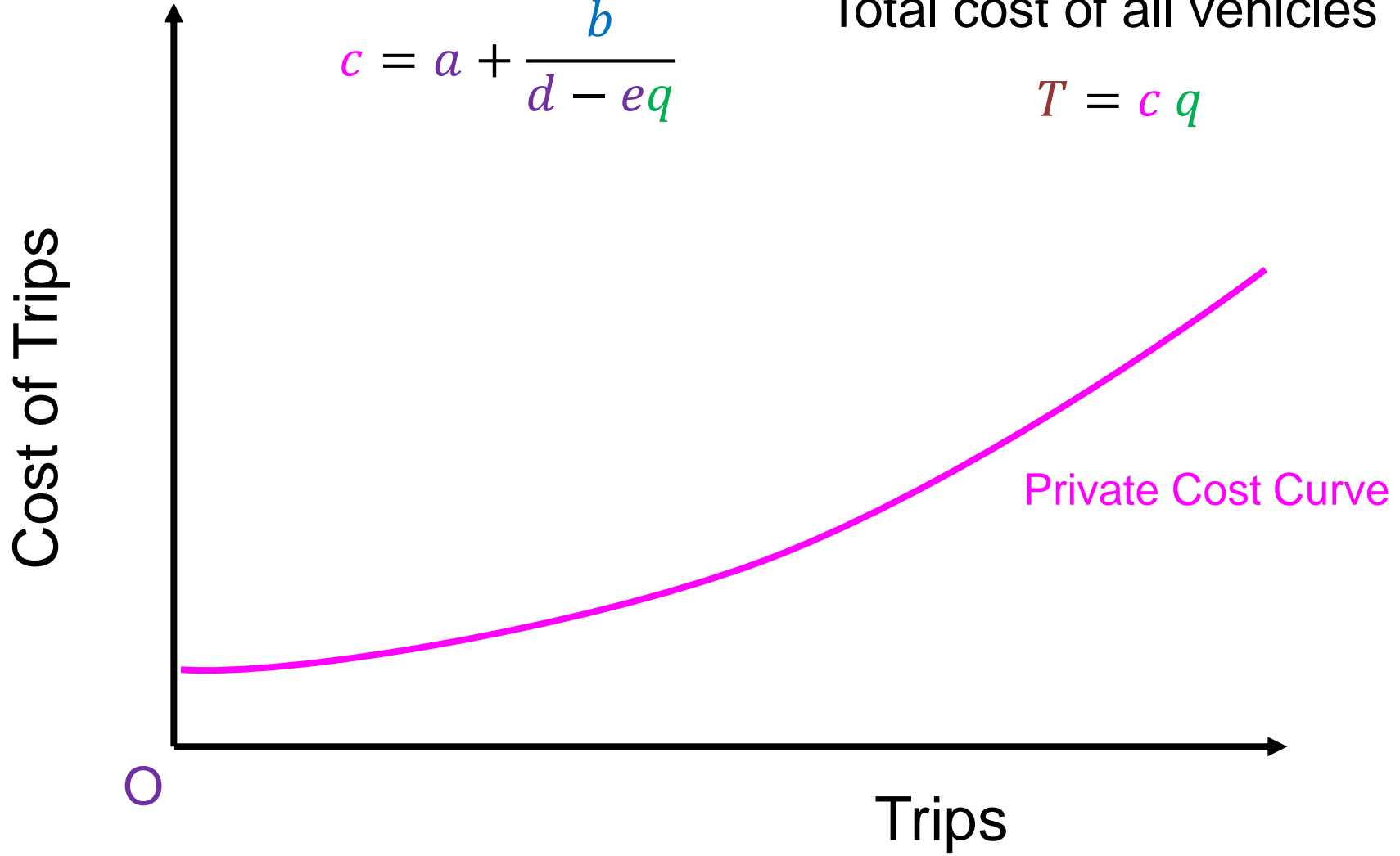
$$c = a + \frac{b}{d - eq}$$

Economic Principle of Road Pricing

$$c = a + \frac{b}{d - eq}$$

Total cost of all vehicles

$$T = c q$$



Economic Principle of Road Pricing

Marginal Cost

- *Additional cost of adding one extra vehicle*
- *This results in speed reduction and congestion*
- *Obtained by differentiating T w.r.to q*

Economic Principle of Road Pricing

Marginal cost

$$\begin{aligned} m &= \frac{dT}{dq} = \frac{d(cq)}{dq} \\ &= c + q \frac{dc}{dq} \end{aligned}$$

$$\begin{aligned} \frac{dc}{dq} &= \frac{dc(v)}{dq} \\ &= \frac{dc}{dv} \times \frac{dv}{dq} \\ &= \frac{d(a + \frac{b}{v})}{dv} \times \frac{d(d - eq)}{dq} \\ &= \frac{-b}{v^2} \times -e \\ &= \frac{b}{v^2} \times \frac{(d-v)}{q} \end{aligned}$$

$$c = a + \frac{b}{v} \quad v = d - eq$$

$$m = c + q \frac{b(d-v)}{v^2 q}$$

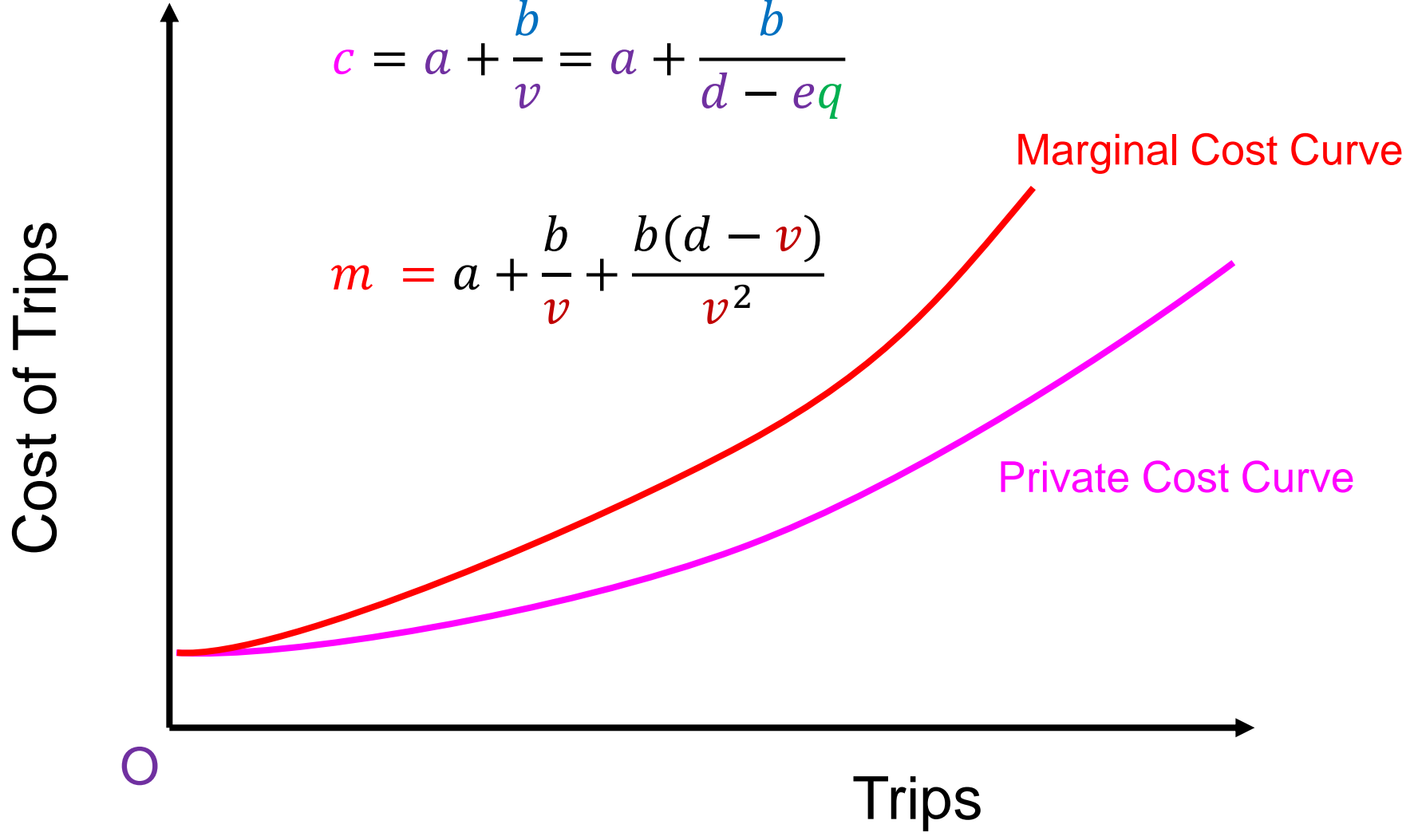
$$m = a + \frac{b}{v} + \frac{b(d-v)}{v^2}$$

$$m = f(v) = f(v(q))$$

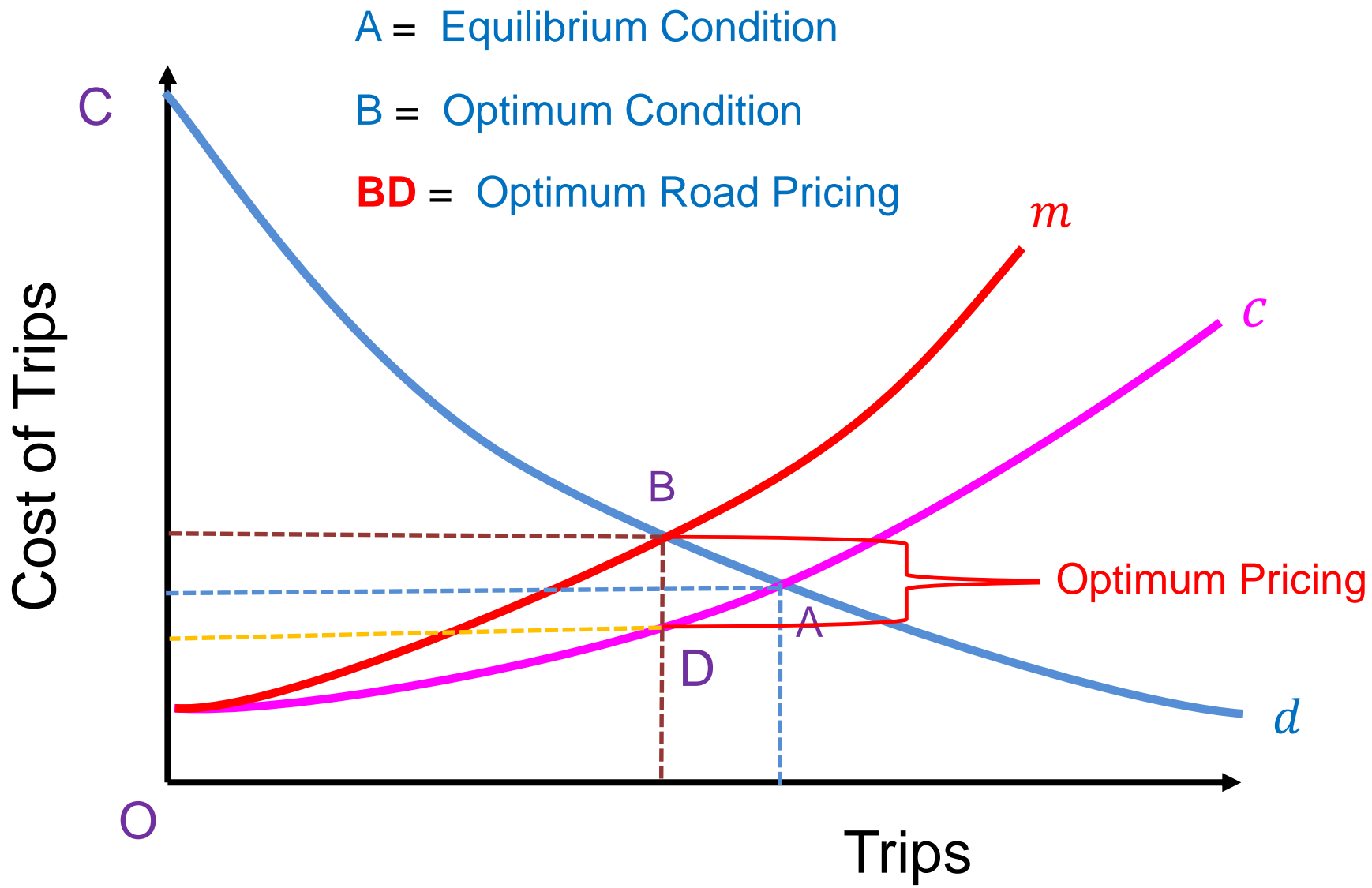
Economic Principle of Road Pricing

$$c = a + \frac{b}{v} = a + \frac{b}{d - eq}$$

$$m = a + \frac{b}{v} + \frac{b(d - v)}{v^2}$$



Economic Principle of Road Pricing



Benefits

- Congestion pricing can:
 - Divert travelers to other modes
 - Cause cancellation of non essential trips during peak hours
 - Collect sufficient fund for major upgrades of highways
 - Cross-subsidize public transport modes

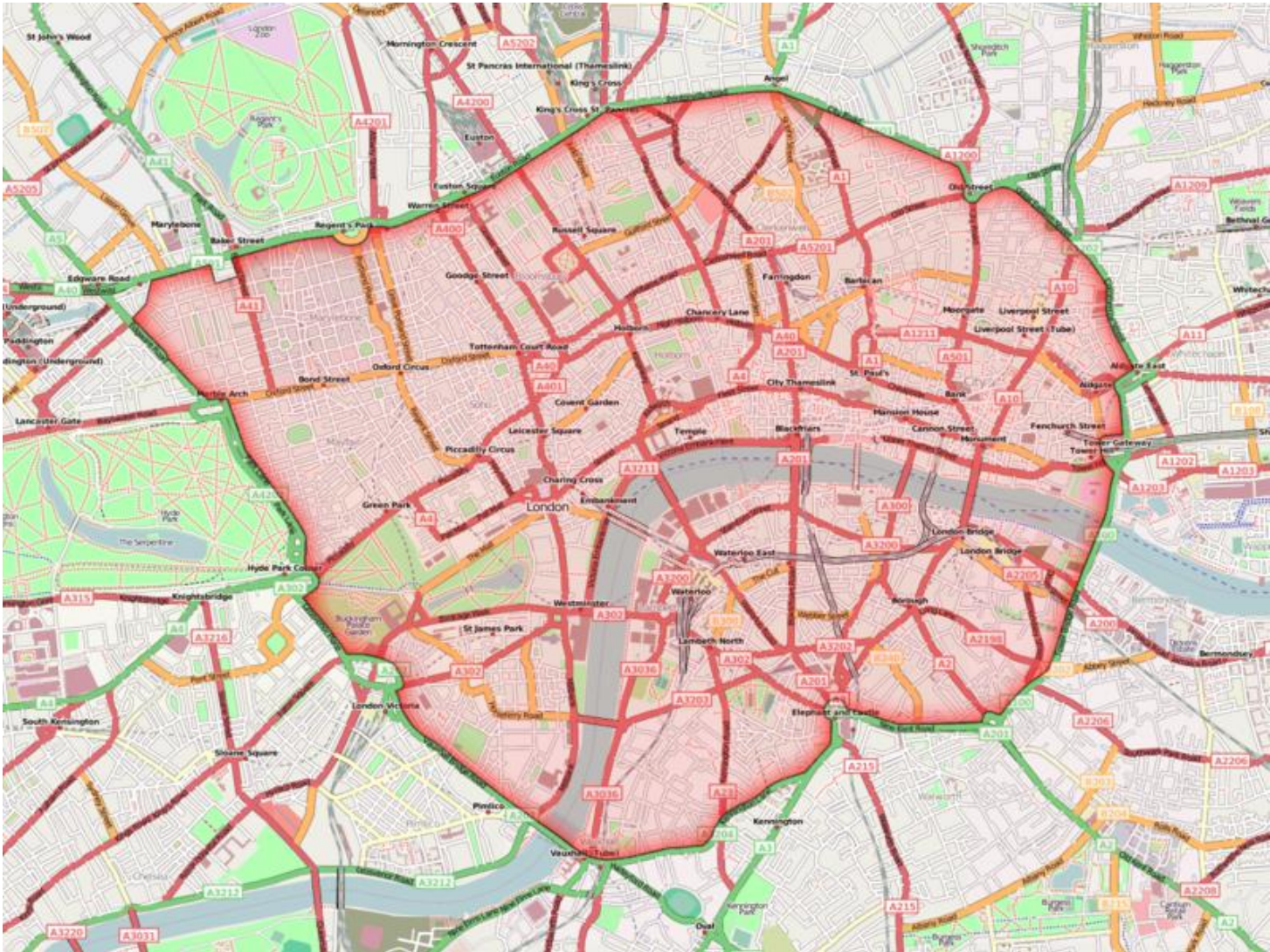
Requirements

- Requirements of a good pricing system:
 - Charges should be closely related to the amount of use made of roads
 - Price should be variable at different times of day/week/year or for different classes of vehicles
 - It should be stable and ascertainable by road users before commencement of journey
 - Method should be simple for road users to understand and police to enforce

Requirements

- Should be accepted by public as fair to all
- Payment in advance should be possible
- Should be reliable
- Should be free from fraud or evasion
- Should be capable of being applied to the whole country

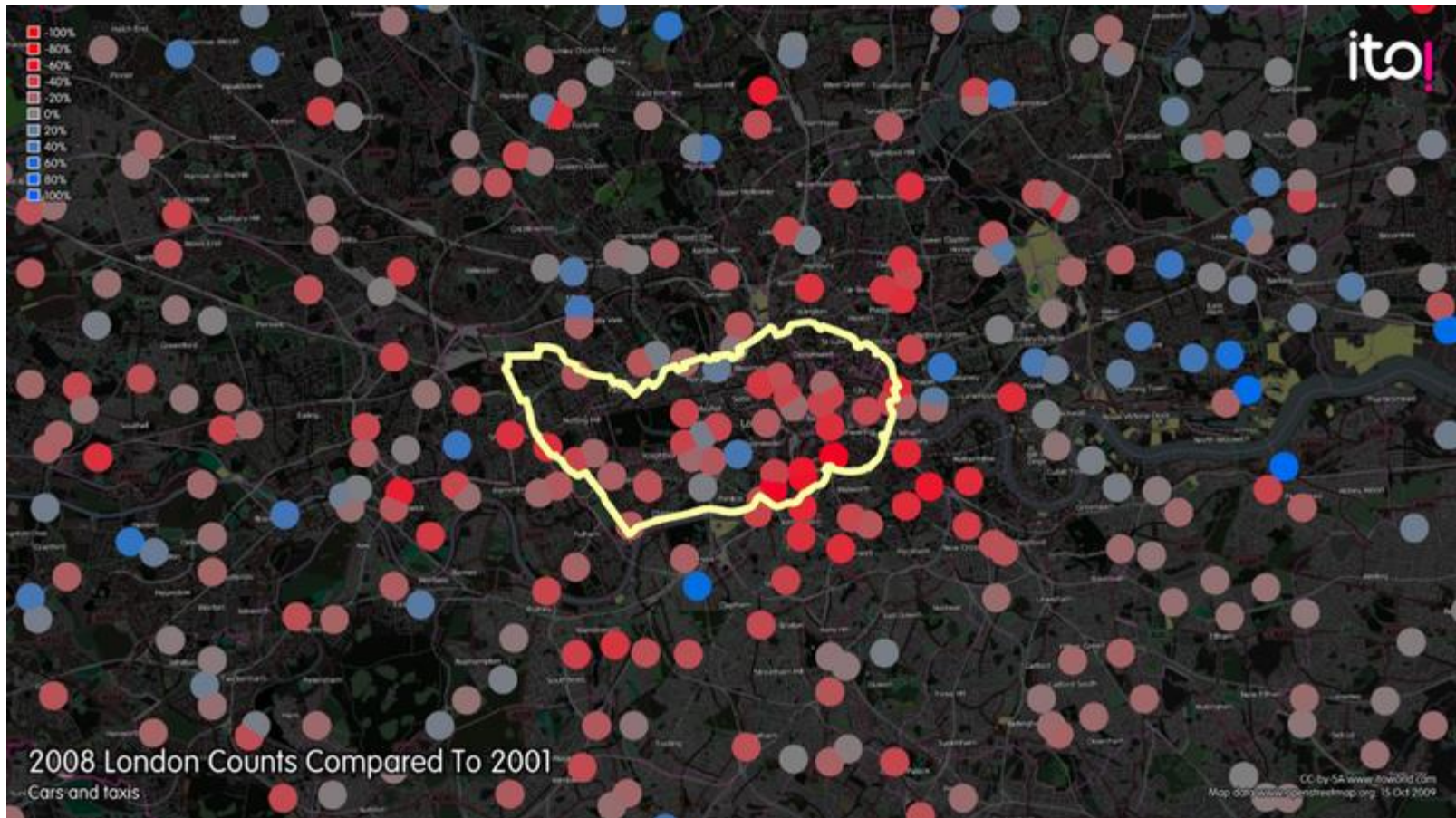
Case Study - London congestion charge



London congestion charge

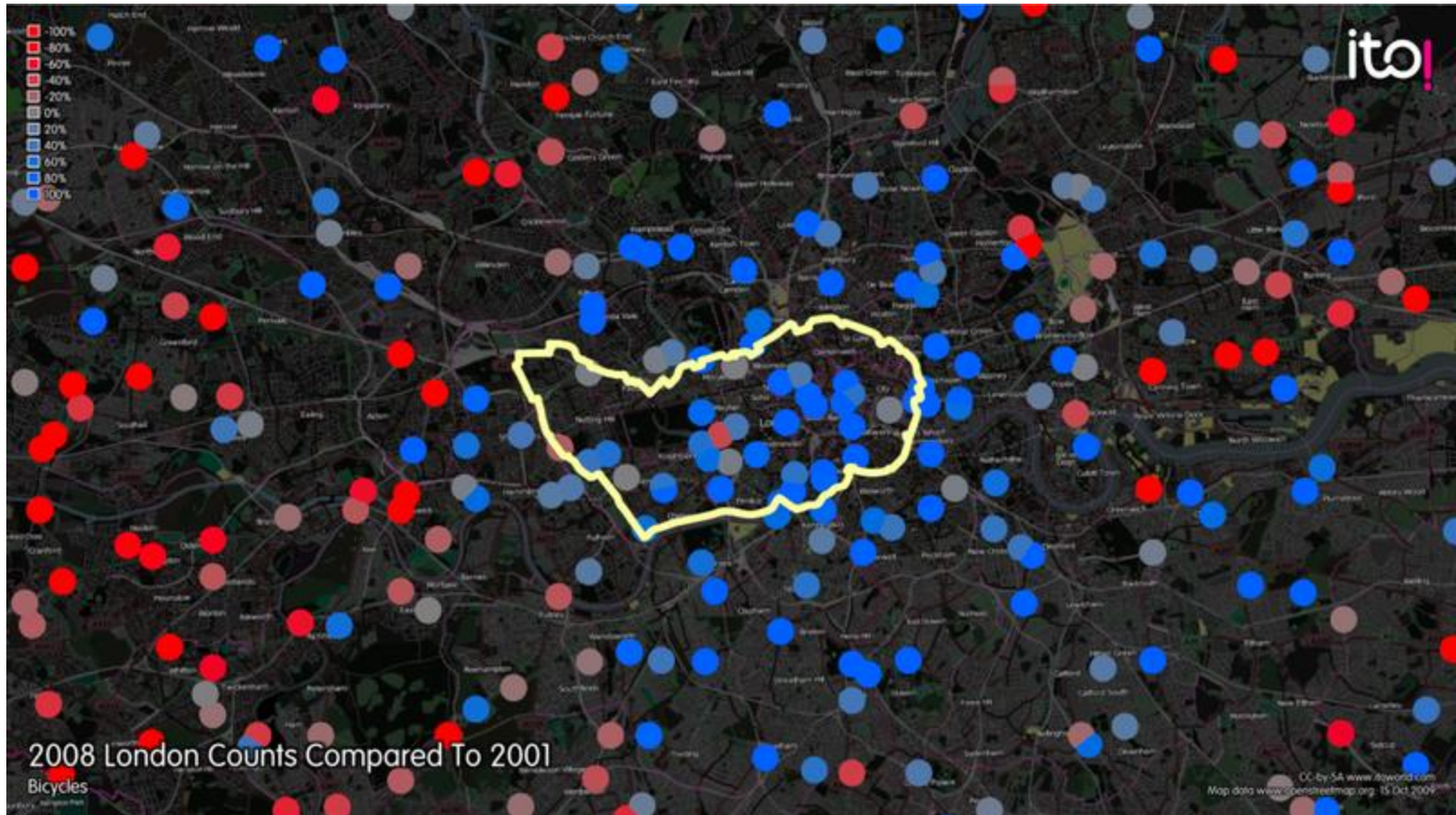


London congestion charge



Changes in the counts of cars and taxis in London at October 2008 compared to October 2001. Red dots show reductions and blue dots increases. The boundary of the congestion charge is shown in white.

London congestion charge



Changes in the counts of bicycles at October 2008 compared to October 2001. Red dots show reductions and blue dots increases.

Conclusion

1. Discussed about the causes and effects of congestion
2. How congestion can be defined and quantified
3. Measures to be taken in order to counteract congestion
4. Congestion Pricing
5. Advanced study on congestion can include improved measurement schemes and the combined travel demand modeling and route choice under congested conditions

Thankyou..