Transport Project Assessment

Geography 490 - Spring, 2008

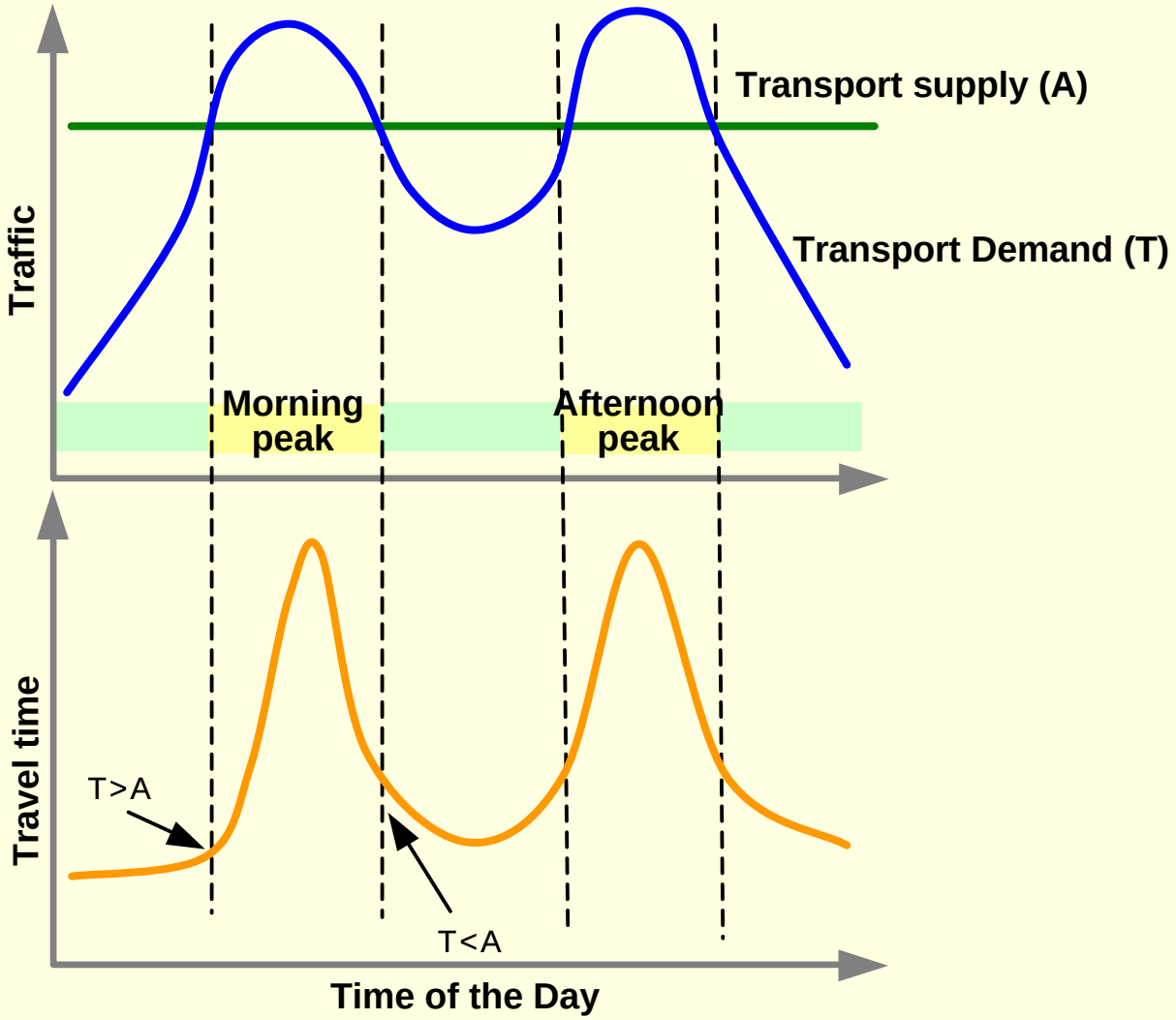
Difficulties in Transport Project Assessment

- Multiple criteria: many different and often contradictory goals
- Wide-ranging economic and social consequences
- Impact spread over long time span
- Projects typically are inter-related, yet assessed individually
  - E.g. individual transit expansion lines are seen as separate projects, yet cannot be viewed in isolation
  - Transportation projects affect and are affected by land-use decisions, but assessment often does not encompass land-use options
- Difficult to reconcile groups who bear costs and groups who gain benefits
- Fundamentally a political process

Transport Supply Capacity Issues

- Transport services can't be stored – unused transport capacity is lost.
  - Similar to time services – e.g., a consultant can't store unused time to sell in the future.
- Demand for transport follows temporal cycles
  - Diurnal: commuting, business, shopping, etc.
  - Weekly: working days vs. weekend
  - Seasonal: tourism, freight (agricultural products)
- Cyclical variations often are very large
- Attempts to shift demand to unused-capacity periods of great importance
  - For example: flex-time spreads commuting demand
- TDM tools, such as congestion charging, can be an important aspect of improving utilization of existing capacity as opposed to increasing peak capacity

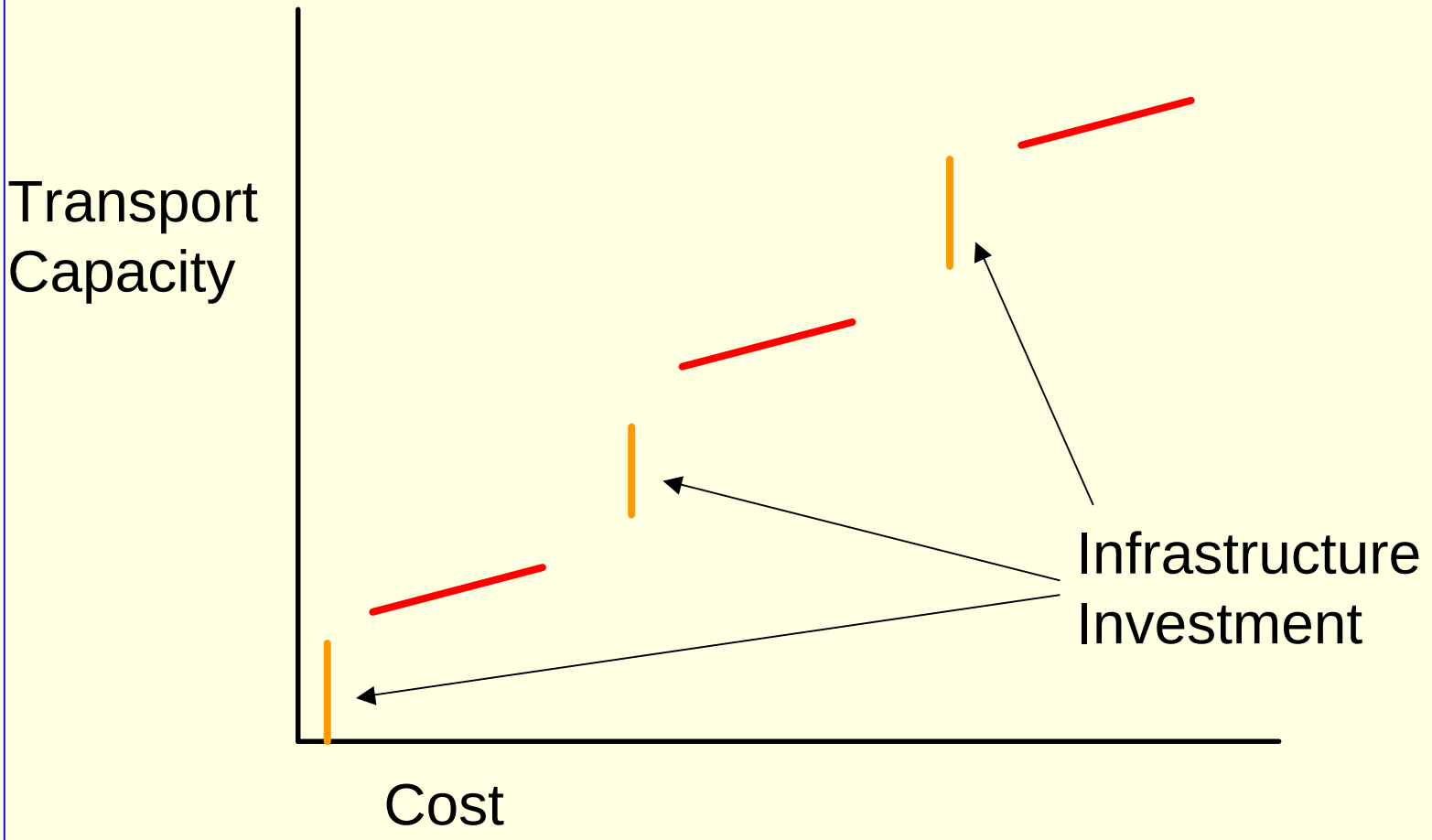
Transport Supply, Demand and Travel Time



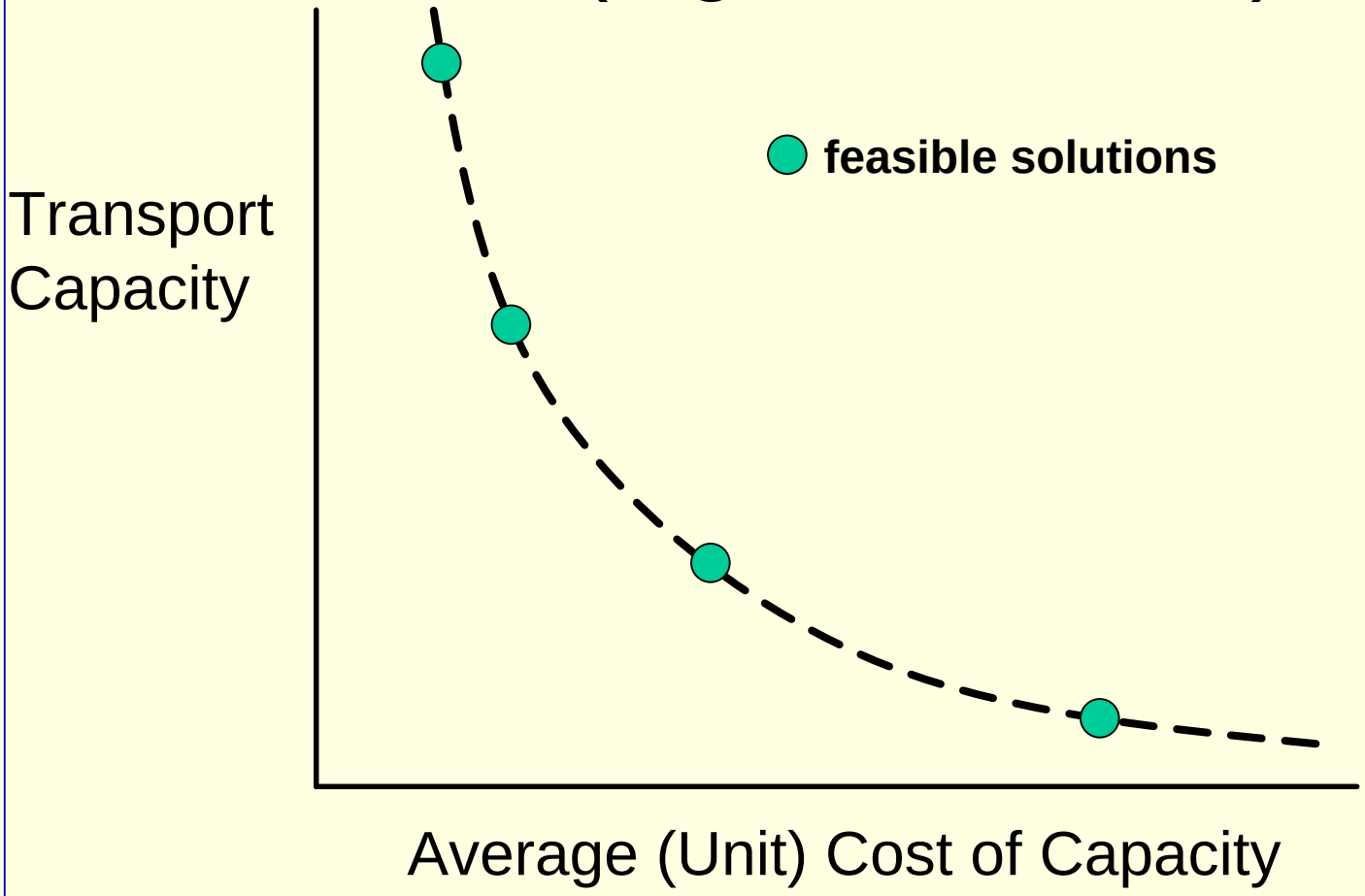
Discrete Provision of Transport Supply

- Transportation supply typically cannot be increased incrementally
- E.g., minimal increase in road capacity is 1 lane
- Result: Cost advantages in building for long-term future demand rather than for current or near-term demand
- Lumpiness in providing increased capacity for high-demand periods results in regular over-demand / under-demand cycles.
- New transport projects often supply too much current capacity, leading to induced demand through land-use changes.

Lumpiness of Transport Supply



Lumpiness of Transport Supply: Capacity Levels Discrete, not Continuous (e.g., road lanes)



Evaluation Framework for Assessment

Specifies basic structure of analysis for clear and consistent evaluation and comparison

Factors:

- Evaluation method
    - Cost-Benefit, Cost Effectiveness, Multiple Criteria, etc.
- Evaluation criteria: factors and impacts to be considered
    - Objectives (benefits)
    - Problems (costs)
- Modeling techniques – method of predicting impacts and measuring resulting benefits and costs

Evaluation Framework for Assessment

Factors:

- Base case: what would happen without the proposed change
- Base year and discount rate
- Perspective and scope:
- Geographic range, etc.
- Approach to Uncertainty: eg., sensitivity analysis

Cost-Benefit Analysis (CBA)

- Primary method of assessing a transport project
- Basic concept:
  - Sum up all costs
  - Sum up all benefits
  - Calculate net benefit
  - Compare net benefit with project alternatives
  - Select project with highest net benefit
- Need for a common metric for all costs and benefits: monetary valuation
  - Without a common metric, CBA cannot be applied

CBA and Welfare Economics

- Welfare economics: a branch of economics concerned with the overall well-being of society as a whole, based on the allocation of scarce resources
- Pareto improvement: a project is an overall efficiency improvement if it benefits one group without harming any other group
- Kaldor-Hicks improvement: a project is an overall efficiency improvement if the willingness to pay of those benefiting is greater than the willingness to pay of those harmed
  - In principle, if gains exceed losses those benefiting could compensate those harmed and still come out ahead
  - Theoretical basis of CBA

CBA: Basic Cost Categories

- Construction related:
  - Land assembly
  - Materials
  - labour
- Equipment
  - Vehicle (or rolling) stock: train cars, buses, etc.
- Operating
  - Labour, administration, etc.
- Maintenance
  - Ongoing upkeep and replacement costs
- Externalities (mainly environmental effects)
  - Pollution
  - Noise
  - Disruption of other activities
  - View impairment
  - Impairment of ecologically sensitive or archeologically significant sites

CBA: Basic Benefit Categories

- Project revenue stream (eg., transit fares, tolls)
- Local economy
  - Economic activity in addition to what would otherwise take place
  - Employment, tax revenue, materials from local suppliers, etc.
  - Due to:
    - Construction and operation activities
    - Accessibility improvements
- Transportation (travel) benefits
  - Flow increase: direct and indirect effects
    - route/mode effects
  - Time/Cost of travel reduced
  - Other: safety, comfort, reliability, etc.
- Accessibility and Land-use
  - Induced effects
  - Reflected in land values and property tax base

Valuation Methods: Benefits to Local Economy

Economic Base Theory

- Primary (Base) Activity
  - Output for export (from the region)
  - Goods or services (financial, distribution, tourism, etc.)
- Local (Service) Activity
  - Output of goods or services for either
    - intermediate input to primary activities (including labour)
    - support of labour for both primary and local activities
- Base activities are ‘engine’ of local economy: ‘multiplier effect’
- By definition base activities involve links outside the region
- Major transportation nodes (eg., ports, airports) facilitate base activities
  - Trans-shipment nodes are themselves base activities

Valuation Methods: Travel Time Savings

- Valuation of Travel Time Saving
  - The major benefit of most transport improvements is a reduction in travel time
  - If the reduction is for goods movement, valuation is relatively straightforward – market exists to determine value of time reduction
  - If the reduction benefits people, valuation is difficult as there often is no market – for example, commuting travel

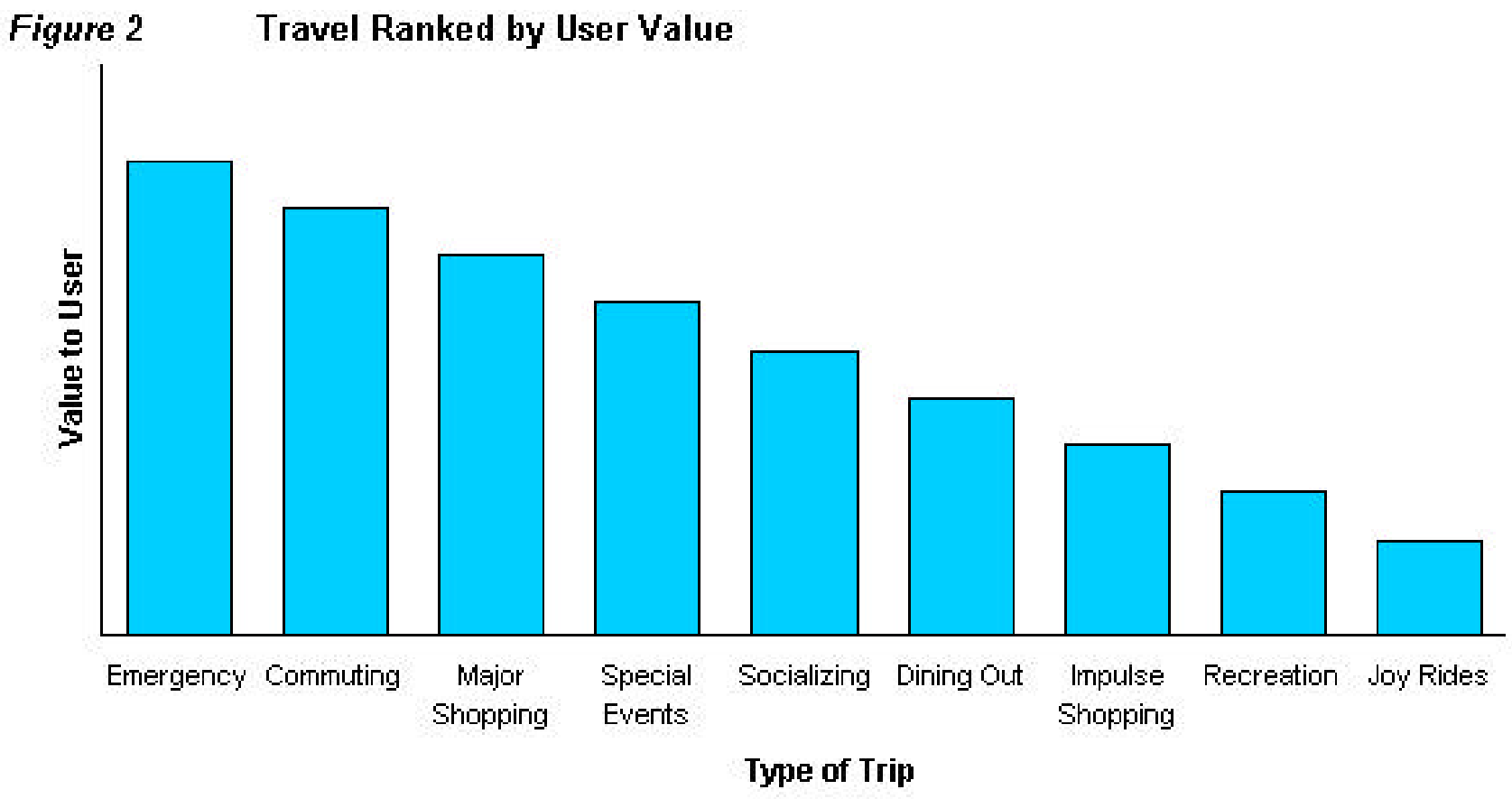
Time as an Element of Transport Cost

- The purchase of transport services involves a monetary expenditure and a time expenditure.
- A major benefit of many investments in transport infrastructure is a decrease in the time required to make a given trip (in-transit time, waiting time, etc.)
- The question is how to value the decrease in time.
- Issues:
  - Alternative use of time saved
  - Duration of time-saving
  - Income effect
- Valuation is often inferred by estimating the elasticity of demand

Assigning Monetary Value To Travel Time

- 'Time is money' – but how much?
- Standard approach: base time value on wage
  - Hourly wage rate is amount of money a person is willing to trade 1 hour of time for
  - But work also involves more than just time – physical labour, responsibility, boredom, etc.
  - Travel time value is for time only – not other aspects of discomfort, etc. of the trip
- So, a fraction of wage rate is used to value travel time
  - Commonly, 50% of wage rate is used to value commuting time
  - Shopping/recreational travel time is valued lower (around 20%-25%)

Value of Travel by Trip Purpose



Assigning Monetary Value To Travel Time

- Is all time spent on a trip worth the same?
- General answer is ‘No’
- Studies have found that people value trip time spent not actually traveling as more valuable
  - i.e., greater disutility of time spent getting to the vehicle and waiting for the vehicle
- Common factors used for transit trips:
  - In-vehicle time factor = 1
  - Wait time (standing at the bus stop) factor = 2
  - Travel to node (walking to bus stop) factor = 1.5

Assigning Monetary Value To Travel Time

Example:

20 min. commute by bus, 7 min. walk to origin stop, 5 min. walk from origin stop, 10 min. wait for bus

- Time value =

  value of a min. of time * (1 * 20) + (2 * 10) + (1.5 * 12)
- Total = 58 * value of a minute of time

  (Total trip time = 42 minutes, but valued at 58 min.)
- If the average wage = $20, then

  a minute of time = ($20 * .5) / 60 = $0.17
- Value of trip time = 58 * $0.17 = $9.67

Value of Variability in Travel Time

- One of the costs of congestion is the variability in trip times
  - i.e., a trip-maker cannot reliably predict how long the trip will take
- A common approach to handling this issue is to add the standard deviation of the trip time to the mean trip time:
- Trip Time = mean time + st. dev. of time

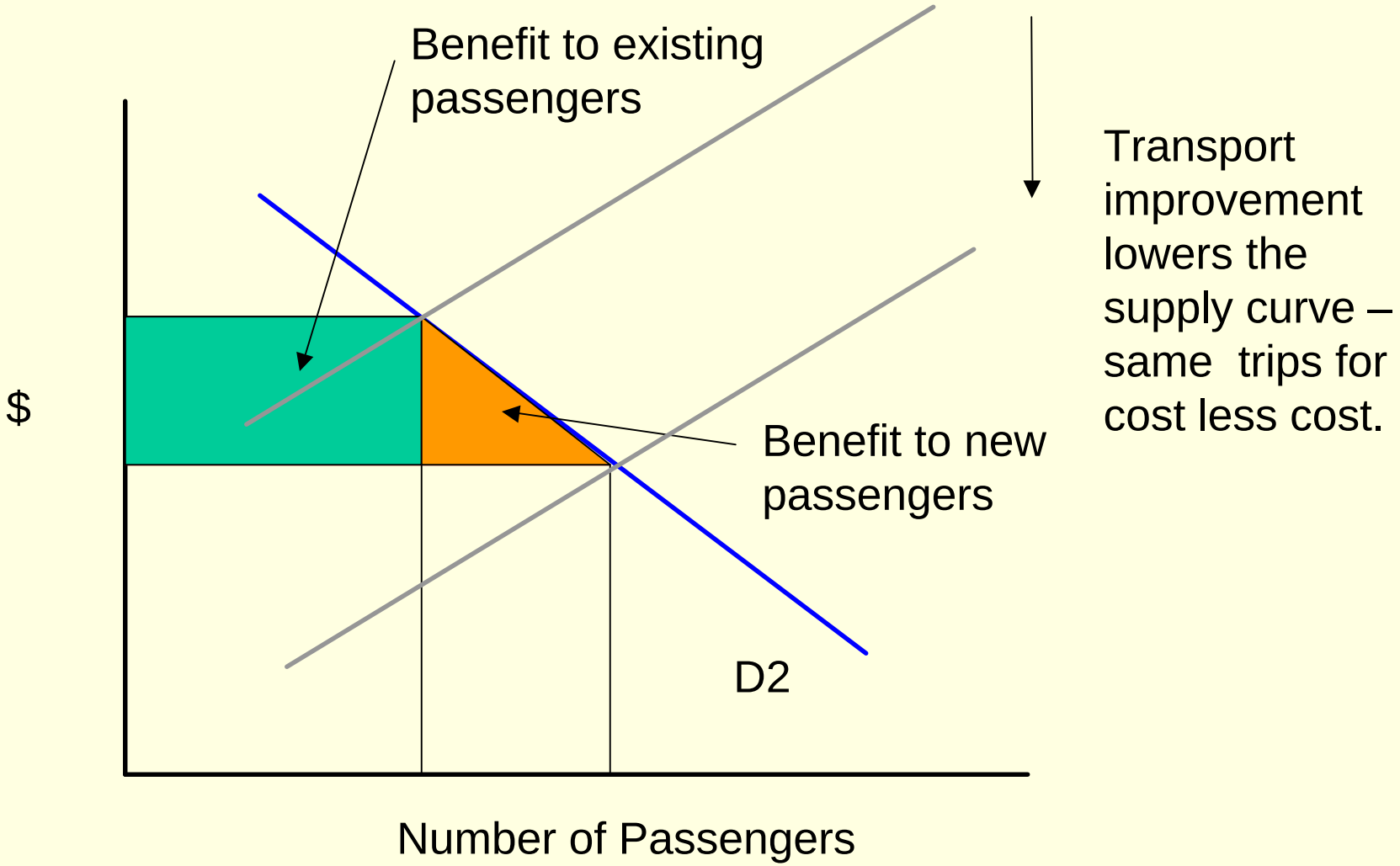
  (Note: if trip time is normally distributed, +/- 1 st. dev. From the mean covers 68% of all trips.)
  - Example: a trip takes on average 25 minutes, with a standard deviation of 5 minutes

    Trip time for valuation purposes is 30 minutes

Time Savings: Current and New Travelers

- There is a difference in the value of time saved due to a transport improvement gained by:
  - a) current travelers (direct effect)
  - b) New travelers (indirect and induced effect)
- This difference is handled by application of the ‘rule of a half’:

Benefits of a Transport Improvement



Valuation Methods: Externalities

- A common approach to valuing external effects is based on the concept of ‘willingness to pay’

Example: Airport runway expansion

- Changes the noise envelope around the airport
- Effect on nearby residents
- Cost established by comparing housing prices in areas currently affected by airport noise with areas not affected
- Price differences used to estimate the amount people are willing to pay for no noise

Markets for Externalities

- Willingness to Pay estimates require a market mechanism
- In absence of a market (for example, air pollution) cost of remediating harmful effects or costs of direct effects can be used – for example:
  - cost of health services for increase in disease resulting from air pollution
  - valuation of premature deaths
- Much current interest in developing markets for externalities – for example, transferable air pollution credits, carbon tax

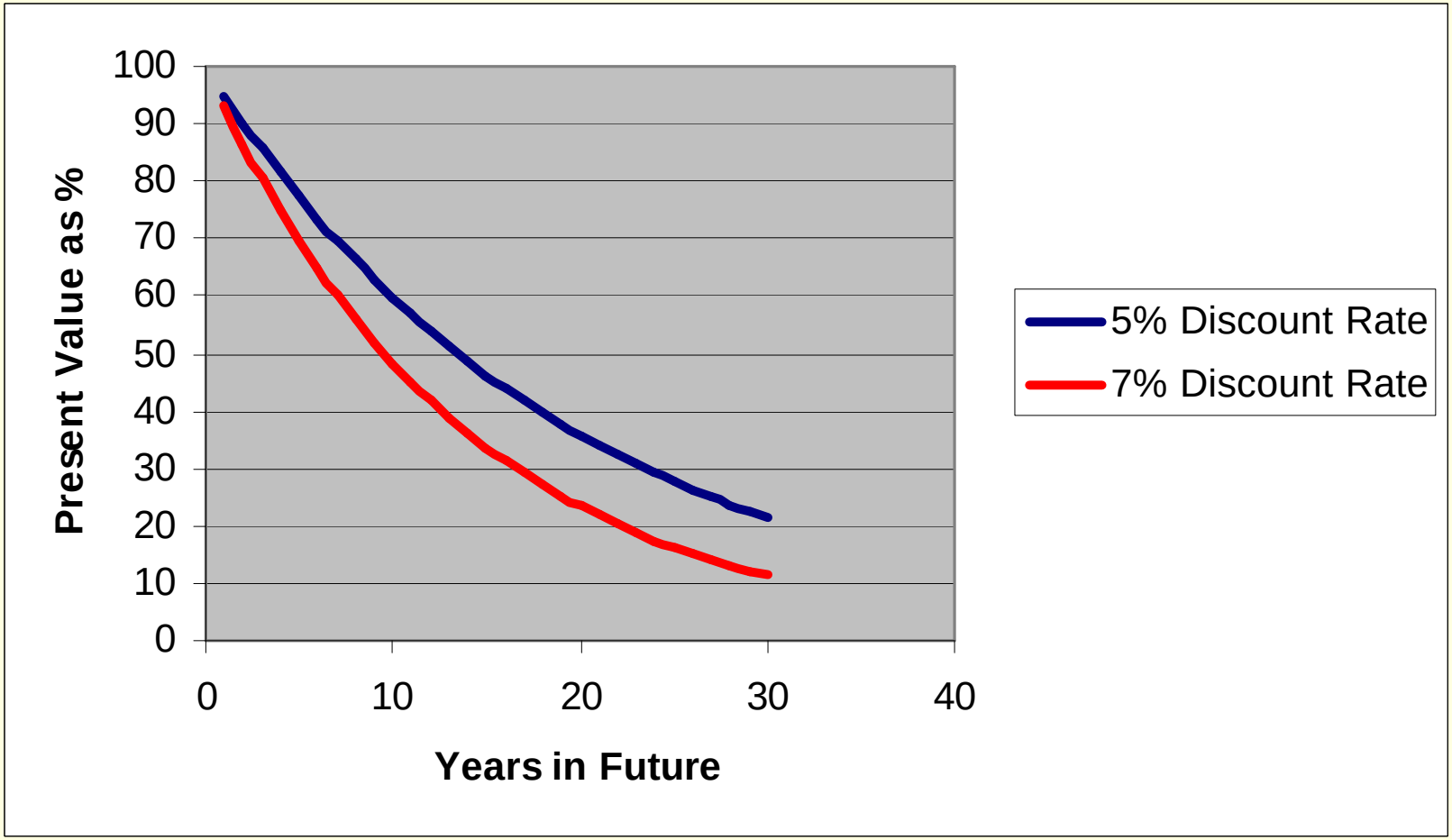
Valuing Deaths: VSL

- One method of valuing a premature death is called the Value of a Statistical Life (VSL)
- This valuation is based on the concept that people often make valuations of reducing the likelihood of dying prematurely (through accidents)
- For example, there are markets in reducing the likelihood of dying prematurely by some percentage (e.g., safety equipment in cars, etc.)
- From this market, the value of decreasing the probability of dying prematurely to 0 is calculated.
- Common figure used = $5 million / death

‘Present Value’ Method of Handling Timing of Costs and Benefits

- Costs and benefits occur in a time stream
- Necessary to evaluate them at a standardized time point
- Standard method is to discount future costs/benefits to establish the net present value of a project
- Theoretically, the net present value (NPV) of a project can be used to compare it to any other allocation of resources
  - The theory is that all projects should be evaluated in terms of their NPV in order to select those that will do the most to improve the overall well-being of society

Present Value



Present value as % of nominal value received at specified future time

CBA: All future costs and benefits are discounted so they can be directly compared – selection of a discount rate is very important.

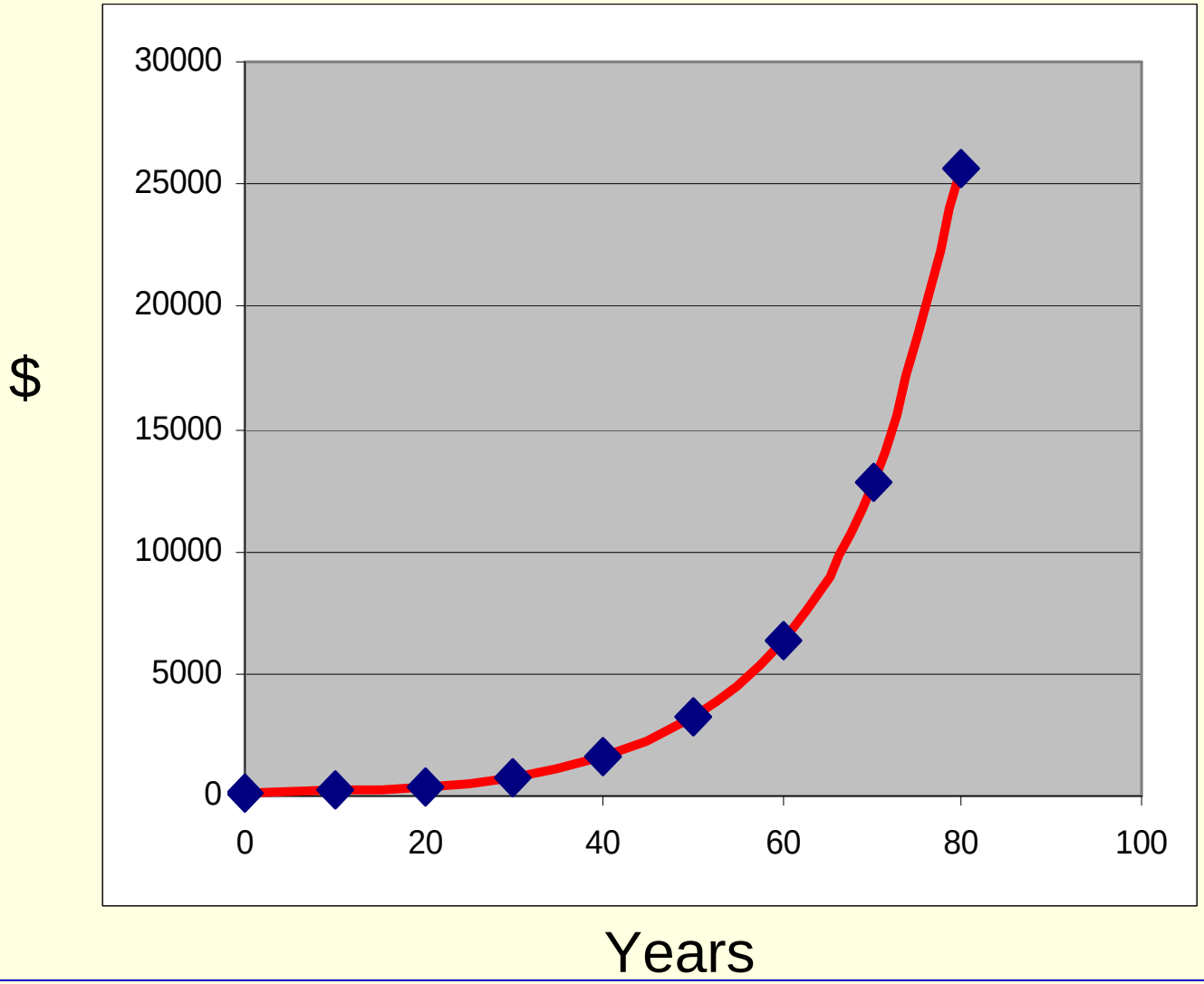
Problems with Net Present Value

- Present value de-emphasizes importance of costs and benefits occurring in the future
- Cross-generational issue: using present value calculation, little concern with impact of a project on succeeding generations
- Longer term effects (such as induced land-use changes) cannot be handled properly
- A tendency to over-emphasize the benefits derived from immediate flow improvement

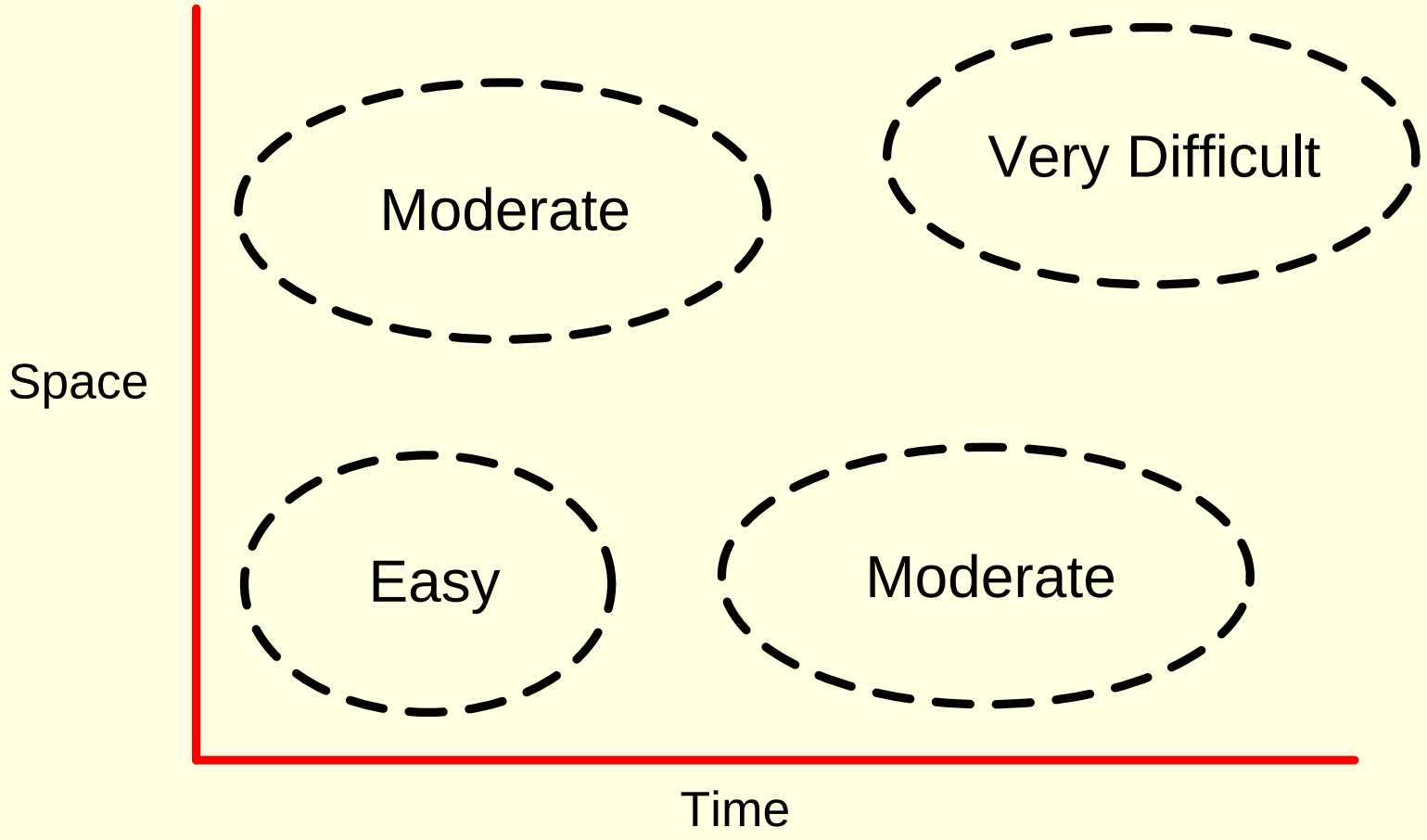
Current Value of Future Impact

What future cost/benefit would be worth $100 today?

Example: 7% Discount Rate



Dealing With Externality Impacts



- Impacts occuring more distant in time and space become much more difficult to value and to avoid or mitigate

Other Techniques

- Difficulties with CBA has resulted in other techniques being applied:
- Cost Effectiveness Analysis: what is the most cost effective method of achieving a given set of goals
  - Useful if the range of goals are not contradictory
  - Negative impacts usually handled in terms of minimum acceptance levels rather than valuation
- Mutiple Criteria Analysis (MCA): Ranking of alternatives based on ability to achieve threshold performance
  - A more subjective approach
  - Conceptually useful but in practice difficult to reconcile positive and negative impacts of alternatives