Department of Civil & Environmental Engineering • University of California Irvine

CEE 123 Transportation Systems III: Planning and Forecasting

Detailed Course Syllabus

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CEE 123 TRANSPORTATION SYSTEMS III: PLANNING & FORECASTING

This syllabus provides a detailed outline of the **Transportation Planning Process**, the continuous process under which all transportation planning, engineering, and analysis is performed. Also provided is a detailed outline of **Travel Demand Forecasting**, the modeling process by which alternate system designs identified in the Transportation Planning Process are analyzed and evaluated. Although the focus of CEE123 is the quantitative analysis of existing transportation systems and the design, performance forecasting, and evaluation of alternative future transportation systems, it is first necessary to understand the role of this analysis as an element of the continuous planning process.

I. THE URBAN TRANSPORTATION PLANNING PROCESS

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1. PROBLEM DEFINITION

1.1 Identification of Well-defined Problems
1.2 Define Regional Values
1.3 Formulation of Goals
1.4 Restatement as Achievable Objectives
1.5 Translation into Measurable Criteria
1.6 Examination of Constraints and Resources

2. SOLUTION GENERATION

2.1 Absence of a Generalized Approach
2.2 Bias in the Generation Process
2.3 The Base Case: "Do Nothing" Alternative
2.4 The Transportation Systems Management (TSM) Alternative
2.5 System Alternatives for the Horizon Year

a. Transportation Technologies and Alternate Plans
b. Non-Transportation Alternatives [Temporal Strategies, Telecommunications]
c. Activity System (Land Use) Alternatives

3. SOLUTION ANALYSIS

3.1 The Determinants of Urban Travel Demand
3.2 Underlying Economic Concepts

a. Travel as a Derived Demand
b. Consumer Travel Behavior
c. Land Markets and Land Use Economics
d. Equilibration of Demand and Supply

3.3 Data Management and Diagnosis

a. Sampling and Data Collection Techniques
b. Analysis of Errors: Sources and Impacts

3.4 The Role of Modeling

a. The Structure of Mathematical Models
b. Calibration, Validation, and Prediction

3.5 The Travel Forecasting Process

a. Pre-processing Data and Models
b. Model Development and Application
c. Post-processing Data and Models

4. EVALUATION AND CHOICE

4.1 Comparative Evaluation of Alternatives (Alternatives Analysis)

a. The Role of Decision-making
b. The EIR/AA Process

4.2 Technical Concepts Underlying Economic Evaluation

a. Measurement of Benefits and Costs
b. The Time Value of Money
c. Uncertainty in Evaluation
d. Distributional Effects

4.3 Alternate Economic Approaches to Evaluation

a. 4.3.1 Benefit Cost Analysis
b. 4.3.2 Cost Effectiveness
c. 4.3.3 Multi-objective Programming
d. 4.3.4 Alternative Evaluation Criteria

4.4 Apply to Stage 3, with Alternatives of Stage 2, using Goals of Stage 1
4.5 Feedback to Solution Generation and Problem Definition

5. SOLUTION IMPLEMENTATION

5.1 Legislative and Organizational Structure
5.2 Financial and Programming Considerations
5.3 Programming Improvements [TIP Regulations, Programming Process]
5.4 "Physic" Planning, Implementation, Construction, and Project Monitoring

II. TRAVEL DEMAND FORECASTING: PRE-PROCESSING [back to top]

1. INVENTORY

1.1 Spatial Considerations and the Study Area

a. System Closure and Regional Boundaries
b. Spatial Aggregation of Analysis Zones

1.2 Data Collection Techniques
1.3 Travel Surveys
1.4 Inventory and Analysis of Transportation Supply

a. Inventories of Transportation Facilities
b. Networks and Transportation Supply
c. Performance, Costs, and Capacities
d. Coding the Network

1.5 Land Use Surveys

a. Socioeconomic Data (population,employment,etc.)
b. Land Use and Zoning (General Plans)

2. LAND USE AND ACTIVITY FORECASTING

2.1 Basic Concepts

a. The **T**ransportation and **A**ctivity Systems
b. Land Use Markets and Land Use Economics
c. Transportation and Land Use Interactions
    - Forecasting the Inputs to the Travel Forecasting Process
    - Transportation Impacts on Activity Systems

2.2 Population Forecasting Models

a. Elementary Growth Models
    - Linear and Inherently Linear Trend Models
    - Asymptotic and Polynomial Growth Curves
b. Composite Population Forecasting Models

2.3 Economic (Employment) Forecasting Models

a. Economic Base
b. Input-Output Models
c. ShiftShare Analysis

2.4 Land Use Forecasting Models

a. Linear Models (regression)
b. Hansen's "Accessibility" Model
c. Non-analytical Methods

2.5 Comprehensive Models of Urban Development

a. Land Use Theories (von Thunen, Alonzo, etc.)
b. The Transportation/Land Use Interface
c. Economic Base and Spatial Interaction
d. The Lowry Model and its Derivatives
e. Mathematical Programming Approaches
f. Integrating Economics and Land Markets (Urbansim, PECAS)

II. TRAVEL DEMAND FORECASTING: FOUR STEP MODEL

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3. TRIP GENERATION (Trip frequency choice)

3.1 Purpose of Trip Generation
3.2 Classification of Trip Types

a. Disaggregation by Trip Types (Purposes)
    - Productions and Attractions
    - Origins and Destinations
b. Locational Characteristics
c. Market Segmentation

3.3 Cross Classification and Category Analysis
3.4 Multiple Regression Analysis as Applied to Trip Generation
3.5 Trip Rate Analysis (ITE Trip Generation)
3.6 Critique of Conventional Model Specifications
3.7 Quick Response and Site Impact Assessment

4. TRIP DISTRIBUTION (Destination Choice)

4.1 Purpose of Trip Distribution
4.2 Alternate Positions in the Planning Process

4.3 Simple Interaction Models
4.4 Spatial Interaction Models

a. The Gravity Model: Alternate Rationales and Behavioral Basis
b. Theoretical Underpinnings: Entropy and Information Theory
c. The Most Probable Distribution
d. Model Constraints
e. Growth Factor Models

4.5 The Gravity Model in Practice

a. Friction Factors and Model Calibration
b. Application in Forecasting

4.6 Alternate Approaches

a. Discrete Choice Models
b. Intervening Opportunities Model
c. Combined Models of TD/MC, TD/RA, and TD/MC/RA

4.7 Quick Response and Site Impact Assessment

5. MODE CHOICE

5.1 Purpose of Mode Choice
5.2 Trip-end versus Trip-interchange
5.3 Early Mode Split Models [Diversion Curves, Statistical Models, etc.]
5.4 Behavioral Travel Demand Models

a. Historical Development
b. Aggregate versus Disaggregate
c. Psychological and Economic Theories of Traveler Behavior
d. Discrete Choice Models (Logit, Probit, etc.)
e. The Multinomial Logit Model
    - Derivation
    - Cross and Direct Elasticities
    - Calibration
    - Alternate Model Structures
    - Specification Issues

5.5 Simplified Techniques
5.6 Critique, Discussion, and Summary

6. TIME-OF-DAY ANALYSIS (Departure time choice)

7. TRIP ASSIGNMENT (Route Choice)

7.1 Principles
7.2 Traffic Flow Characteristics and Link Performance Functions
7.3 Highway versus Transit Assignment
7.4 Path Specification Shortest Route Algorithms
7.5 Network Loading

a. All-or-Nothing
b. Capacity Restraint Procedures
c. Incremental Loading
d. Multipath and Probabilistic Assignment
e. Iterative Assignment

7.6 Network Equilibration: System Optimal vs User Equilibrium
7.7 Quick Response and Site Impact Assessment

7.8 Critique, Discussion, and Summary

8. FEEDBACK and SYSTEM EQUILIBRIUM

II. TRAVEL DEMAND FORECASTING: FOUR STEP MODEL [back to top]

9. PERFORMANCE ANALYSIS and ALTERNATIVE EVALUATION

10. CRITIQUE OF THE CONVENTIONAL 4-STEP PROCESS

10.1 The Transportation/Land Use Interface
10.2 Sequential versus Simultaneous Structure
10.3 Static Representation of Urban Systems
10.4 Analytical Problems with the Models
10.5 Treatment of Future Growth and Investment
10.6 Importance of Other Sectors of the Urban Economy
10.7 Absence of Feedback Mechanisms

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