Syllabus

GIS in TRANSPORTATION GEOGRAPHY
GEOG 5130

Course Information and Requirements

Course Title: GIS in Transportation Geography (GEOG 5130)
Credits: 3 Credits
Prerequisites: GEOG 5500 Fundamentals of GIScience
University of Connecticut
Instructor: Natalia Vorotyntseva
E-mail: Natalia.Vorotyntseva@uconn.edu (After the first day of classes, students registered in the course should send all messages to the instructor via HuskyCT Messages tool.)
Office: 423 B Austin Building (formerly CLAS)
Office Hours: By email appointment, students may contact the instructor through Skype (account name is: natalia.vorotyntseva)
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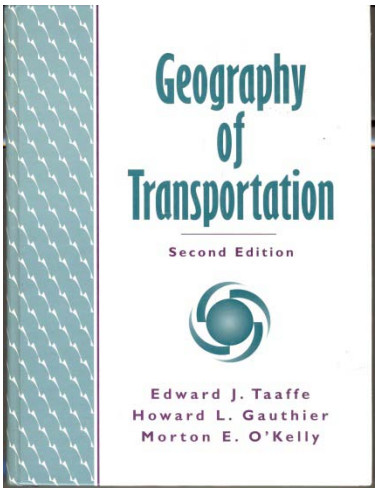
Minimum Technical Skills:
To be successful in this course, you will need the following technical skills:
A familiarity with ArcGIS 10 and higher.
Familiarity with the use of Microsoft Excel
Use of electronic mail with attachments.
Saving files in commonly used word processing program formats.
Copying and pasting text, graphics or hyperlinks.
Using presentation software to create and share information.
Working within two or more browser windows simultaneously.
Opening and accessing PDF files

Required Text:

You can purchase this book online as part of the course for $5.



Geography of Transportation, 2nd edition, 1996.
By E. J Taaffe, H. L. Gauthier, and M. E. O 'Kelly,

Prentice Hall, Upper Saddle River, NJ

ISBN 0-13-368572-1

The developer of this course is Dr. Jeffrey Osleeb, Professor in the Department of Geography at the University of Connecticut.

Course Goals and Objectives

After completing this course you will be able to:

Demonstrate knowledge of transportations systems: how they function, their importance to the space – economy and the policies that regulate and promote transportation.
Formulate and employ transportation models.
Visualize and analyze transportation systems using GIS tools.

Course Requirements: Activities, Grading and Examinations

The grade for the course will be based on the evaluation the student receives for completing each of the following required components:

Grading Criteria

Course Components	Final Grade %
10 Assignments	35
Midterm Examination	30
Final Problem	35
Total	100

Activities

Assignments are designed to connect the content areas associated with readings and lectures to different geographic methods, forms of spatial analysis, and GIS techniques.
You will also be asked to reflect on several major issues affecting transportation systems and economic development. In doing so, you will interpret spatial patterns and trends within and between regions and transport analysis zones in order to gain a better appreciation of transportation geography.

It is expected that this active learning approach to the modeling and study of transportation systems through the use of Geographical Information Science will enhance the student's analytical skill set and be a preparation for the job market.

Assignments

Ten assignments are associated with the 13 sessions that make up this course. The step-by-step instructions for the ten assignments are found at the end of a session. These 10 assignments require ArcGIS 10.1 as well as Microsoft Excel. In some cases the student will be asked to download data from the World Wide Web. In other cases data for the assignment will be furnished.

Examinations

There will be a mid-term examination. The mid-term examination has both a hand-on component as well as a written component. This test will consist of essay questions as well as problems that will have to be solved.

Final Problem

For the final problem the student will be given several data sets related to a specific transportation problem. The data will be analyzed with ArcGIS and the student is asked to write a final report describing the analysis undertaken and the conclusions reached.

Academic Misconduct

Academic misconduct in any form is in violation of The Student Code, which is incorporated into this document by reference, and will not be tolerated. This includes, but is not limited to, copying or sharing answers on tests or assignments, plagiarism, and having someone else do your academic work. Depending on the act, a student can receive an F grade on the test/assignment, F grade for the course, or can be suspended or expelled. Substantially similar submissions of an assignment from different students will be treated as an instance of academic misconduct by the students involved. The university takes plagiarism seriously. Anything taken in part, whole, or paraphrased from printed documents or the internet must be thoroughly cited using proper citation procedures. If you are unsure of how to recognize whether you are plagiarizing or wish to avid it click here.

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Students with Disabilities

Student with disabilities should contact the Center for Students with Disabilities as soon as possible and prior to the start of class, in order for appropriate accommodations to be provided in a timely manner.

General Course Outline

This course will be conducted totally online in 13 sessions. Each session is expected to take one week to complete including the accompanying assignment where applicable. Each session will include a lecture and accompanying readings.

Session 1 – Introduction to Transportation Geography Week 1

Session 01 Module 01 Spatial Organization
Session 01 Module 02 Transportation Linkages
Assignment 1: Regionalization

Session 2 – Geographic Information Systems Week2
Session 02 Module 01 Geographic Approach
Session 02 Module 02 TIGER
Session 02 Module 03 Types of GIS
Session 02 Module 04 GIS Data
Assignment 2: Using GTFS Files

Session 3 – Spatial Models Week 3
Session 03 Module 01 Highway Capacity Models
Session 03 Module 02 Other Uses of GIS
Session 03 Module 03 Spatial Decision Support System
Session 03 Module 04 Using Vector SDSS to Design a Bus Systems
Assignment 3: Calculating Vulnerable Populations

Session 4 –Transportation Geography Fundamentals Week4
Session 04 Module 01 Networks
Session 04 Module 02 Conditions for Movement
Session 04 Module 03 Transport Pricing
Session 04 Module 04 Intermodalism
Assignment 4: Network Deviousness
Assignment 5: Network Density\

Session 5 –Transportation Geography II Week 5
Session 05 Module 01 Transport Rates
Session 05 Module 02 Transportation Costs and the Location of Economic Activities
Session 05 Module 03 Trade

Session 6 –Transportation Geography and Spatial Analysis Week 6
Session 06 Module 01 More about Networks
Session 06 Module 02 Accessibility
Assignment 6: Calculating Network Accessibility

Session 7 –Advanced Network Analysis Week 7
Session 07 Module 01 Shortest Path Problem
Assignment 7: Calculating The Shortest Path

Session 8 –Allocation Models Week 8
Session 08 Module 01 The Transportation Problem Introduction
Session 08 Module 02 The Initial Feasible Solution Using the Northwest Corner Rule
Session 08 Module 03 The Dual Variables
Session 08 Module 04 Opportunity Cost
Session 08 Module 05 The Rule for The Reallocation of Flow
Session 08 Module 06 Additional Iterations

Assignment 8: The Transportation Problem

MIDTERM Examination End of Week 8

Session 9 – Allocation Models II: Advanced Topics in Allocation Modeling Weeks 9 -10
Session 9 Module 01 The Transshipment Problem
Session 9 Module 02 The Commodity Logistics System (COLS)
Session 9 Module 03 Data Requirements for the Commodity Logistics System
Session 9 Module 04 Commodity Logistics System Results
Session 9 Module 05 Commodity Logistics System Model
Session 9 Module 06 The COLS Model
Session 9 Module 07 The Interperiod Network Storage Location Allocation (INSLA) Model
Session 9 Module 08 Biofuels Distribution
Session 9 Module 09 The INSLA Model
Session 9 Module 10 INSLA Results

Session 10 –Transportation Options Week 11
Session 10 Module 01 Urban Transportation Options
Session 10 Module 02 The Problem

Session 11 –Location and Land Use and Transportation Interaction Week 12
Session 11 Module 01 Regional Implications of Transit Stations to the Residential Rental Market
Session 11 Module 02 Characteristics of Transit Riders A Comparison of Washington Metro and Atlanta MARTA
Session 11 Module 03 The Role of Politics in Economic Decision-Making A Case Study of the East Aurora Expressway
Assignment 9: Transportation and Land Use

Session 12 – The Urban Transportation Planning System Week 13
Session 12 Module 01 Urban Transportation Planning System
Session 12 Module 02 Trip Generation
Session 12 Module 03 The Urban Land Use Model
Session 12 Module 04 Other Models of Urban Land Use
Session 12 Module 05 The Herbert-Stevens Residential Model

Session 13 – The Urban Transportation Planning System Week 14
Session 13 Module 01 Trip Generation II
Session 13 Module 02 The Gravity Model
Session 13 Module 03 Trip Distribution
Session 13 Module 04 Modal Split
Assignment 10: Trip Generation

Assignment 11: End of Term Assignment: High School Bus Routing Problem Week 15

Detailed course outline

Session 1 – Introduction to Transportation Geography

Session Objectives
Upon successful completion of this module you should be able to:
Understand the meaning of Spatial Organization
Conceptualize the importance of transportation to spatial structure
Understand the role of GIS in transportation geography
Understand the role of transport linkages in economic development

Session Outline:
Spatial Organization
Transportation Linkages

Session 1 Lectures
Session 01 Module 01 Spatial Organization
Session 01 Module 02 Transportation Linkages

Readings
Read the following articles that can be found under the *Library Resources* menu item:
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapter 1 and 5.
Lakshmanan, T.R., "The broader economic consequences of transport infrastructure investments," Journal of Transport Geography 19 (2011) 1–12.

Assignment
Assignment 1: Regionalization

Session 2 – Geographic Information Systems

Session Objectives
Upon successful completion of this module you should be able to:
Understand the geographical approach.
Know what GIS implies.
Distinguish between base map information and attribute information.
Determine the uses of GIS for transportation.

Session Outline:
The Geographical Approach
The TIGER File
Types of GIS
GIS Data

Session 2 Lectures

Session 02 Module 01 Geographic Approach
Session 02 Module 02 TIGER
Session 02 Module 03 Types of GIS
Session 02 Module 04 GIS Data

Readings
Read the following articles that can be found under the *Library Resources* menu item:
Aronoff, S. "Geographical Information Systems: A Management Perspective", WDL Publications, Ottawa, Canada. 1993.
O'Neill, W and Harper, E. "Location Translation Within a GIS" 1998 pp. 1-25.
Sutton, John. "Role of Geographic Information Systems in Regional Transportation Planning" Transportation Research Record 1518, TRB, National Research Council, Washington, D.C., pp. 25-31. 1996.
Nyerges, Timothy, " Locational Referencing and Highway Segmentation in a Geographic Information System," ITE Journal. (1990), pp. 27 - 31

Assignment
Assignment 2: Using GTFS Files

Session 3 – Spatial Models

Session Objectives
Upon successful completion of this module you should be able to:
Highway capacities and how GIS can be used to visualize capacities.
Understand how GIS is used to solve spatial problems
Understand the corridor siting process.

Session Outline:
Highway Capacity Models
Other Uses of GIS
Spatial Decisions Support Systems (SDSS)
Using SDSS to Design Bus Systems

Session 3 Lectures
Session 03 Module 01 Highway Capacity Models
Session 03 Module 02 Other Uses of GIS
Session 03 Module 03 Spatial Decision Support System
Session 03 Module 04 Using Vector SDSS to Design a Bus Systems

Readings
Read the following articles that can be found under the *Library Resources* menu item:
J. Osleeb and S. Kahn "Integration of Geographic Information" in Tools to Aid Environmental Decision-makers, edited by M. English and V. Dale, National Center for Environmental Decision-making Research, Springer Verlog, 1999, pp. 161-189.

Yakov Smotritsky and Jeffrey P. Osleeb, “Reduction of Construction Costs for Oil And Gas Pipelines With New Technology Components During The Corridor Siting Process,” The National Science Foundation, 1996.
Moellering, H., H. Gauthier, J. Osleeb. “An Interactive Graphic Transit Planning System Based on Individuals,” Urban Systems, 2, pp. 93 –103, 1977
Zhang, C., T. Zhaob, W. Lic, and J. Osleeb, “Towards logic-based geospatial feature discovery and integration using web feature service and geospatial semantic web,” International Journal of Geographical Information Science, Vol. 24, No. 6, June 2010, 903–923.

Assignment
Assignment 3: Calculating Vulnerable Populations

Session 4 –Transportation Geography Fundamentals

Session Objectives
Upon successful completion of this module you should be able to:
Understand transportation networks
Determine the conditions that allow commodities to be transported
Understand the components of transportation costs

Session Outline:
The Network Characterization of Transportation Infrastructure
Ullman’s Conditions for Movement
The Determination of Transport Prices
The Role of Containerization ion US Transportation

Session 4 Lectures
Session 04 Module 01 Networks
Session 04 Module 02 Conditions for Movement
Session 04 Module 03 Transport Pricing
Session 04 Module 04 Intermodalism

Readings
Read the following articles that can be found under the *Library Resources* menu item:
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapter 2 and 4 .
Cutter, S. M. Ji, "Trends in US Hazardous Materials Transportation Spills," The Professional Geographer, 49, pp 318 -331, 1997.
Grubesic ,T, T. Matisziw, “A spatial analysis of air transport access and the essential air service program in the United States,” Journal of Transport Geography 19 (2011) 93–105
Kuby, M. and N. Reid, "Technological Change and the Concentration of the US General Port System: 1970-88," Economic Geography, 68, pp. 272 -289, 1992.

Assignment
Assignment 4: Network Deviousness
Assignment 5: Network Density

Session 5 –Transportation Geography II

Session Objectives
Upon successful completion of this module you should be able to:
Understand how transportation costs are determined
Understand the impact of transportation costs on the locations of firms
Understand regional trade

Session Outline:
The Determination of Transport Rates
The Impacts of Transportation Costs on the Location of Economic Activities
How Transport Costs Impact Interregional Trade

Session 5 Lectures
Session 05 Module 01 Transport Rates
Session 05 Module 02 Transportation Costs and the Location of Economic Activities
Session 05 Module 03 Trade

Readings
Read the following articles that can be found under the *Library Resources* menu item:
Jenelius, E. "Network structure and travel patterns: explaining the geographical disparities of road network vulnerability," Journal of Transport Geography 17 (2009) 234–244.
Samuelson, P. "Spatial Price Equilibrium and Linear Programming," American Economic Review, (1952) pp. 283 – 303.

Session 6 –Transportation Geography and Spatial Analysis

Session Objectives
Upon successful completion of this module you should be able to:
Transform a network into a matrix representation
Determine properties of the network
Learn to power a matrix to determine accessibility

Session Outline:
Matrix Operations for Network Analysis
The Determination of Network Accessibility

Session 6 Lectures
Session 06 Module 01 More about Networks
Session 06 Module 02 Accessibility

Readings
Read the following articles that can be found under the *Library Resources* menu item:
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapters 6 and 9.

Assignment
Assignment 6: Calculating Network Accessibility

Session 7 –Advanced Network Analysis

Session Objectives

Upon successful completion of this module you should be able to:

Understand the shortest problem

Solve the shortest path problem

Session Outline:

Understanding and Solving The Shortest Path Problem

Session 7 Lectures

Session 07 Module 01 Shortest Path Problem

Readings

Read the following articles that can be found under the *Library Resources* menu item:

“Network Flow Programming Methods”

http://www.me.utexas.edu/~jensen/methods/net.pdf/netshp.pdf

Assignment

Assignment 7: Calculating The Shortest Path

Session 8 –Allocation Models

Session Objectives

Upon successful completion of this module you should be able to:
Understand the formulation of the Transportation Problem
Solve the Transportation Problem

Session Outline:

Understanding and Solving The Transportation Problem
Finding the Initial Feasible Solution Using the Northwest Corner Rule
Understanding Dual Variables
Opportunity Costs
The Rule for the Reallocation of Flow While Maintaining the Constraints
Iterations and Optimal Solution

Session 8 Lectures

Session 08 Module 01 The Transportation Problem Introduction
Session 08 Module 02 The Initial Feasible Solution Using the Northwest Corner Rule
Session 08 Module 03 The Dual Variables
Session 08 Module 04 Opportunity Cost
Session 08 Module 05 The Rule for The Reallocation of Flow
Session 08 Module 06 Additional Iterations

Readings

Read the following articles that can be found under the *Library Resources* menu item:
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapter 7, 10, 13

G. Hadley Linear Programming, Addison-Wesley Publishing Co. Inc. 1962 Chapter 9 pp.273 – 330.

Osleeb, J. and I. Sheskin. "Natural Gas: A Geographical Perspective," The Geographical Review, 67, pp. 71 –85, 1977.

B.Stevens "Linear Programming and Location Rent" Journal of Regional Science 1961, pp. 15 – 26

J. Osleeb "Excel Linear Programming Solver Tutorial"

Assignment:

Assignment 8: The Transportation Problem

Session 9 – Allocation Models II: Advanced Topics in Allocation Modeling

Session Objectives
Upon successful completion of this module you should be able to:
Be familiar advanced methods for modeling transportation logistics including the Commodity Logistics System (COLS)
Understand the data inputs of transportation logistics models.
Discuss verification techniques for large logistics models.
Discuss spatial-temporal models.

Session Outline:
Discussion of The Transshipment Problem
Discussion The Commodity Logistics System (COLS)
Discussion of The Interperiod Network Storage Location Allocation (INSLA) Model
Use of The Interperiod Network Storage Location Allocation (INSLA) Model to distribute Biofuels in the US

Session 9 Lectures
Session 9 Module 01 The Transshipment Problem
Session 9 Module 02 The Commodity Logistics System (COLS)
Session 9 Module 03 Data Requirements for the Commodity Logistics System
Session 9 Module 04 Commodity Logistics System Results
Session 9 Module 05 Commodity Logistics System Model
Session 9 Module 06 The COLS Model
Session 9 Module 07 The Interperiod Network Storage Location Allocation (INSLA) Model
Session 9 Module 08 Biofuels Distribution
Session 9 Module 09 The INSLA Model
Session 9 Module 10 INSLA Results

Readings
Osleeb, J. and S. Ratick. "The Impacts of Coal Conversions on the Ports of New England," Economic Geography, 59, pp. 35 –51, 1983.
Osleeb, J., S. Ratick, M. Kuby, H. Olson, L. Antle and A. Hawnn. "Coal Logistics System (COLS)," Transportation Research Record, No. 1222, pp. 6 –13, 1989.
Osleeb, J, S. Ratick, An Interperiod Network Storage Location–Allocation (INSLA) model for rail distribution of ethanol biofuels," Journal of Transport Geography 18 (2010) 729–737

Session 10 –Transportation Options

Session Objectives
Upon successful completion of this module you should be able to:
Be familiar with urban transportation options and how they are being employed in the US.
Understand the Urban Transportation Problem.
Discuss how different US cities attempt to solve the Urban Transportation Problem.

Session Outline:
Discussion of Urban Transportation Options
Presentation of the Urban Transportation Problem
Solutions to the Problem
Session 10 Lectures
Session 10 Module 01 Urban Transportation Options
Session 10 Module 02 The Problem

Readings
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapter 8.
Lee, K., W Jung, J. Park, and M.Y. Choi "Statistical analysis of the Metropolitan Seoul Subway System: Network structure and passenger flows," Physica A 387 (2008) 6231–6234
Golledge, R., M. Kwan and T. Garling. "Computational Process Modeling of Household Travel Decisions Using a Geographical Information System," Papers in Regional Science, 73, pp. 99 – 117, 1994.
Chen, S., J. Tan, C. Claramunt, C. Ray, "Multi-scale and multi-modal GIS-T data model," Journal of Transport Geography 19 (2011) 147–161.
Neutens, T., M. Versichele, T. Schwanen, "Arranging place and time: A GIS toolkit to assess person-based accessibility of urban opportunities," Applied Geography 30 (2010) 561–575.
Kirby, H., "Buffon's Needle and the Probability of Intercepting Short-Distance Trips by Multiple Screen-Line Surveys," Geographical Analysis, 29 pp.64 -71, 1997.

Session 11 –Location and Land Use and Transportation Interaction

Session Objectives
Upon successful completion of this module you should be able to:
Understand how network configuration impacts transit ridership.
Discuss the implications of transit and residential housing costs.
Discuss how planning decisions may be made for political expediency.

Session Outline:
Discussion of Urban Transportation Options
Presentation of the Urban Transportation Problem
Solutions to the problem

Session 11 Lectures
Session 11 Module 01 Regional Implications of Transit Stations to the Residential Rental Market
Session 11 Module 02 Characteristics of Transit Riders A Comparison of Washington Metro and Atlanta MARTA
Session 11 Module 03 The Role of Politics in Economic Decision-Making A Case Study of the East Aurora Expressway

Readings
Yeates, M. "Some Factors Affecting the Spatial Distribution of Chicago Land Values, 1910 – 1960," Economic Geography, 41, pp. 57 –70, 1965.
McLafferty, S. and V. Preston. "Spatial Mismatch and Labor Market Segmentation for African-American and Latina Women" Economic Geography, Vol. 68, No. 4, Local Labor Markets (Oct., 1992), pp. 406-431.
Atkinson-Palombo, C., M. Kuby, "The geography of advance transit-oriented development in metropolitan Phoenix, Arizona, 2000–2007," Journal of Transport Geography, 2011, 19 (2), 189-199 .

Assignment
Assignment 9: Transportation and Land Use

Session 12 – The Urban Transportation Planning System

Session Objectives
Upon successful completion of this module you should be able to:
Be familiar with Urban Transportation Planning System.
Understand urban land use models.
Discuss the Herbert-Stevens Residential Model.

Session Outline:
Discussion of the Urban Transportation Planning System
Urban Land Use Models

The Herbert-Stevens Residential Model

Session 12 Lectures
Session 12 Module 01 Urban Transportation Planning System
Session 12 Module 02 Trip Generation
Session 12 Module 03 The Urban Land Use Model
Session 12 Module 04 Other Models of Urban Land Use
Session 12 Module 05 The Herbert-Stevens Residential Model

Readings
Osleeb, J., D. Lam. "A Geographic Information System to Support the New York City Employee Commute Options Program," URISA Proceedings, pp. 209 –221, 1996.
J. Herbert and B. Stevens, A model for the distribution of residential activities in urban areas, Journal of Regional Science, 2, 22 36 (1960)

Session 13 – The Urban Transportation Planning System

Session Objectives
Upon successful completion of this module you should be able to:
Be able to discuss the components of the Urban Transportation Planning System.

Session Outline:
Discussion of the Components of the Urban Transportation Planning System
Specification of Trip Generation
Specification of the Gravity Model
Specification of Trip Distribution
Specification of Modal Split

Session 13 Lectures
Session 13 Module 01 Trip Generation II
Session 13 Module 02 The Gravity Model
Session 13 Module 03 Trip Distribution
Session 13 Module 04 Modal Split

Readings
Taaffe, E. J. and H. L. Gauthier, and M. E. O 'Kelly, Geography of Transportation, Chapters 11, 12 and Statistical Appendix.
Gitlesen, J., G. Kleppe, Thorsen, I.,"An Empirically Based Implementation and Evaluation of a Hierarchical Model for Commuting Flows," Geographical Analysis 42 (2010) 267–287.
Makigami, Y., L. Woodie. "Freeway Travel Time Evaluation Technique, "Highway Research Record, No. 321, pp. 33 –45, 1970.
Thill, J., J. Horowitz, "Travel-Time Constraints on Destination-Choice Sets," Geographical Analysis, 29 pp.108 -123, 1997.
Mikkonen, K., M. Luoma, "The parameters of the gravity model are changing ± how and why?," Journal of Transport Geography 7 (1999) 277-283.

Assignment
Assignment 10: Trip Generation
Assignment 11: End of Term Assignment: High School Bus Routing Problem