

## CEE 770/870: Transportation Safety

Fall 2008, 3 credits, Tuesday & Thursday 5:45-7:00 PM

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### COURSE DESCRIPTION

This course focuses on major transportation safety issues. Approximately 40,000 to 45,000 people lose their lives in motor vehicle crashes every year (about 111 deaths per day) and over 3 million police reported injuries occur every year, with much less public or media interest than the loss of one airliner. The course examines how death, injury and property damage and the public perception of risk detract communities from achieving their goals. The specific issues relate to transportation safety goals, relevant frameworks, and the selection of safety countermeasures and their evaluation in terms of specific criteria. We will discuss the emerging concepts in safety such as "Safe Communities" and Intelligent Transportation Systems (ITS) countermeasures. The specific topics covered in the course will include:

- Identification of transportation safety goals and problems
- Transportation safety costs on various modes
- In-depth examination of motor vehicle safety
- Issues related to pedestrian safety
- Methodological issues and modeling of safety outcomes
- Factors that influence safety and analysis of safety data
- Response to accidents and behavioral issues in safety
- Planning, evaluating, and implementing safety countermeasures

**Course website:** You will find most of the readings at the course Blackboard website. Access the site with your ODU username and password.

**Students:** This course is for students in Engineering, and for other students interested in transportation-related crashes and injuries. Students should be interested in exploring and critically appraising transportation safety issues. They will be encouraged to work on transportation safety issues of their interest.

**Prerequisites:** Graduate standing.

**Credits and format:** This is 3-credit course. There will be lectures, class discussions, and student presentations and occasional guest speakers in the course.

**Requirements:** Student assignments will include readings to familiarize them with existing transportation safety issues and methods. A major effort will be devoted to doing a class project.

**Books:** The following books are recommended (on reserve in the Library).

- Hauer, E. *Observational Before-After Studies in Road Safety*, Pergamon Press, 2002.
- Evans, L. *Traffic Safety and the Driver*, Van Nostrand, 1991.

- Elvik, R. and T. Vaa, *Handbook of Road Safety Measures*, 2004.

Useful books for statistical methods are:

- Washington, S., M. Karlaftis, and F. Mannering. *Statistical & Econometric Methods for Transportation Data Analysis*. Chapman and Hall/CRC. Boca Raton, FL. 2003.
- Green, W. *Econometric Analysis*, Prentice Hall, 2003.

*Class Project:* For the class project, every student will conduct a three-phased effort aimed at identifying factors that influence the level of safety in urban/suburban or rural areas and treatments (counter-measures) which might decrease this risk.

Phase I will involve a review of the literature concerning a specific safety issue chosen by the student (e.g., effect of access control on urban street crashes; severity/frequency of heavy truck crashes on two-lane rural roads). The review will cover what is known about the issue in terms of both problem size and potential treatments/countermeasures. Students will be expected to identify sources of potential studies, conduct computer search of literature databases, and obtain and review relevant studies. Source material is available at the University library. Furthermore, the Internet provides a good source of transportation safety resources. Some of the relevant sites are:

*Transportation safety literature (refereed journal articles and research reports)*

- *Accident Analysis and Prevention and Transportation Research, Part C*, are journals that publish safety literature (there are others as well). You can access them by going to ODU libraries website. You are strongly encouraged to do a search on the topic of your interest.
- Journal of Transportation Research Board is another source of safety articles. You can see abstracts of the literature at TRIS-Transportation Research Information Services (<http://ntlsearch.bts.gov/tris/index.do>)
- The California PATH Database--A large bibliographic database pertaining to Intelligent Transportation Systems. Some of the research at this website contains new ideas for safety improvements. (<http://database.path.berkeley.edu/reports/index.cgi>)

*Transportation Safety literature (non-refereed)*

- TFHRC is the applied research facility of the Federal Highway Administration and they have a link to "safety" at their website. (<http://www.tfhrc.gov/>)
- The Insurance Institute for Highway Safety is dedicated to reducing highway crash deaths, injuries, and property damage losses. (<http://www.hwysafety.org/>)
- Advocates for Highway and Auto Safety is an alliance of consumer, health and safety groups and insurance companies and agents working together to make America's roads safer. (<http://www.saferoads.org/>)
- The HSRC website contains information on selected highway safety topics (<http://www.unc.edu/depts/hsrc/>)

*Transportation Safety Data*

- The HSIS is used by FHWA staff, contractors, university researchers, and others to study current highway safety issues, direct research efforts, and evaluate the effectiveness of accident countermeasures. (<http://www.hsisinfo.org/>)
- CARE is an on-line data analysis and reporting system designed to assist traffic safety professionals.

It contains crash data from states and the FARS system, and table-generating tools.  
(<http://care.cs.ua.edu>)

- NASS. NHTSA crash investigations (<http://www-nass.nhtsa.dot.gov/nass/>)
- FARS. Fatal Accidents Reporting System (<http://www-fars.nhtsa.dot.gov/www/main.html>)
- The Large Truck Crash Causation Study-LTCCS <http://ai.fmcsa.dot.gov/lccs/default.asp>
- Bureau of Transportation Statistics.  
[http://www.bts.gov/publications/national\\_transportation\\_statistics/](http://www.bts.gov/publications/national_transportation_statistics/)

Instructor will provide guidance in planning and conducting this review. The student will present the results of the review *informally* in class. They will also provide a summary of their review not to exceed 5 pages (12 point times roman font, with 1 inch margins).

Topics of interest can include analyzing the impacts of:

- Roadway factors such as road type, geometry and traffic flow on injury severity and harm.
- Environmental factors such as visibility and weather.
- Crash characteristics such as crash type and number of vehicles involved.
- Vehicle characteristics such as type, size and weight of vehicles involved and truck-involved crashes.

Students may want to further focus on a specific sub-area, such as pedestrian safety. Below are some of the research ideas:

- Explore innovative pedestrian treatments, e.g., traffic calming measures (roundabouts and speed tables), automatic pedestrian detectors, flashing crosswalks, variable message signs and road diets.
- Evaluate ADA-related design treatments, e.g., curb ramp tactile warning devices, audible and tactile pedestrian signals, talking signs, street crossing signs and markings.
- Understand the vehicle speeding problem in urban areas and impacts on pedestrian safety (“Kill your speed...not a child” campaign).
- Study Jaywalking and other dangerous behaviors and their implications.
- Analyze the effect of public information and awareness campaigns regarding pedestrian safety.
- Study the effect of neighborhood/spatial factors on pedestrian crashes (using GIS) or examine severity/frequency of pedestrian crashes.

Phase II will involve a detailed and critical review of one refereed journal paper that the student selects (related to the topic of interest, identified in Phase I). Instructions on how to review research papers are available at:

<http://www.trb.org/meeting/2009/PDFs/PaperReviewInstructions.pdf>

Phase III will involve conducting statistical analysis including developing models which predict crash risk as a function of various factors with emphasis on the issue chosen earlier. We prefer that students focus on factors such as roadway design features and because these factors are transportation policy sensitive, that is, they can be changed relatively easily through transportation policies.

**A paper that is no longer than 7500 words, following guidelines from the Transportation Research Board, will be prepared and a 10-minute formal presentation will be made to the class, including slides/overheads/visuals. For more information, you are encouraged to access the TRB website at:**

<http://www.trb.org/guidelines/authors.pdf>

The criteria for evaluation of the class project (paper and presentations) will include:

- Problem definition: Is it clear to both the reader and writer? Is it logical? Is it complete? Is it manageable? Is the topic of the paper original and timely? (Weight=1)
- Approach and analysis: Is there a clear methodology? Is the methodology logical, feasible, comprehensive and manageable? Is the study design valid? Are conceptual framework and hypotheses well developed? Are the data valid? Is the study population representative (if applicable)? Are the correct analysis techniques applied? Are the major analysis issues overlooked? Is the study internally and externally valid? Are biases (if present) explicitly addressed? Is the coverage of the subject complete? (Weight=4)
- Connection to the course: Is there logical use of course content? Is there evidence that the writer has learned from the course? (Weight=1)
- Connection between problem and solutions: Was the review of the problem (risk assessment) and solutions (safety treatments) comprehensive? If appropriate, do the treatments recommended relate to the context/risk factors? (Weight=1)
- Conclusions and recommendations: Are the conclusions valid and properly supported? Are the conclusions generalizable? Do they make sense? Will they work? Are they defensible and defended? Is the paper useful to practitioners/researchers? Is the work a significant contribution to the state-of-the-art or practice? (Weight=2)
- Presentation quality: Are the style, grammar, and format adequate? Is it written in simple, concise, and effective language? Is the paper free of sensitive/advocacy statements and special interests? Does the abstract convey the meaning of the paper? (Weight=1)

*Evaluation weights:* Students are expected to do the assigned readings before class. The requirements for this course include:

- Readings, active participation in class (10% of grade).
- Literature review, 30% of grade
- Class project (Paper - 50% of grade, Presentation - 10% of grade).

### **Administrative Issues**

*Registration:* Students must register for CEE Transportation Safety. Students with special registration problems should email the instructor.

*Class Meeting Schedule changes:* The dates of classes as planned are shown in this handout. The class is scheduled to meet generally at the regularly scheduled time in the afternoon. If it is necessary to reschedule a class, I will use Blackboard to convey the information. If you miss a class, please be sure to check Blackboard for any announcements.

*Office Hours:* The schedule of office hours will be announced in class. Dr. Khattak will usually be on campus the day before the class. However, the easiest way to meet me is by fixing an appointment (Tel: Dr. Khattak 683-6701, akhattak@odu.edu).

## OVERVIEW OF COURSE SCHEDULE AND CONTENT

Dates	Topic	Assignment
Week 1: Aug 26.	Intro & overview: Why safety is important?	
	Costs of safety	
Week 2: Sept 2.	Safety of roadways: Basics	Assignment 1 GIVEN
	Which mode is safer? Perceptions vs. reality	Term paper discussion
Week 3: Sept. 9	Highway harm data: Sources and structure	
	Details of highway harm by road & crash type	
Week 4: Sept. 16.	Analysis techniques: Crash rates	
	Analysis techniques: Hazardous sites	
Week 5: Sept. 23	Student presentation of literature review	Assignment 1 DUE (lit review)
	Safety models: Ordered probability	
Week 6: Sept. 30	Safety models: Poisson and negbin	
	Safety models: Poisson and negbin	
Week 7: Oct 7.	Guest lecture: TBA	Assignment 2 DUE (critical rev)
	Guest lecture: TBA	
Week 8: Oct 14.	No class—Fall break	
	No class—Fall break	
Week 9: Oct. 21.	Safety models: Empirical Bayes Approach	
	Safety models: Advanced modeling	
Week 10: Oct. 28.	Applications: SUV safety	Statistical analysis due
	Applications: Work zone safety	
Week 11: Nov 4.	Applications: Truck safety	
	Applications: Truck safety	
Week 12: Nov. 11.	Applications: Pedestrian safety	Results and conclusions due
	Applications: GIS in safety	
Week 13: Nov. 18.	Countermeasure identification	
	Evaluation of safety outcomes	
Week 14: Nov. 25.	Review	
	Discussion of class project issues	
Week 15: Dec 2	Last class: Student Presentations	Powerpoint presentation
	Last class: Student Presentations	Powerpoint presentation
Week 16: Dec 9.		<i>Final class project due at 5:00 PM in my office</i>

## OVERVIEW OF TRANSPORTATION SAFETY COURSE

### Week 1 (Part 1).

A. Introduction to course.

B. Overview of course and discussion of why safety is important to the engineer/planner?

- OPTIONAL-BTS, Transportation statistics annual report, Bureau of Transportation Statistics, US Department of Transportation, Washington, D.C. 2007. [See Safety portion.]

**Week 1 (Part 2).**

- A. Topics: Information on costs of accidents; comparison of accident costs with costs of other health hazards

Readings:

- Miller T. D. Lestina, & R. Spicer, Highway Crash Costs in the United States By Driver Age, Blood Alcohol Level, Victim Age, and Restraint Use, *Accident Analysis & Prevention*, Vol. 30, No. 2, pp. 137-150, 1998.
- Zaloshnja, E., & T. Miller Costs of large truck-involved crashes in the United States, *Accident Analysis & Prevention*, Volume 36, Issue 5, September 2004, Pages 801-808.
- Council, F., Eduard Zaloshnja, Ted Miller, Bhagwant Persaud, Crash Cost Estimates by Maximum Police-Reported Injury Severity Within Selected Crash Geometries, PUBLICATION NO. FHWA-HRT-05-051, USDOT, 2005. (Also in *Accident Analysis and Prevention*.)
- Evans, L. *Traffic Safety and the Driver*, pp. 1-17, 1991, pp. 358-361.
- Kniesner, T. Evaluating risk reduction programs. *Risk in Perspective*. (Harvard Center for Risk Analysis) Vol. 5, Issue 12. 1997, (2 pages).

- B. How would the engineer/planner use safety information in his/her efforts?

**Week 2 (Part 1 & 2).** Does the public perceive level of safety correctly on roadways or in other modes of transportation? Why does it matter?

A. Basics

- Hauer, E. *Observational Before-After Studies in Road Safety*, Pergamon Press, 2002. Chapter 3.
- Elvik, R. and T. Vaa, *Handbook of Road Safety Measures*, 2004. Chapter 4.

B. Safety of the roadways—public perception and true statistics.

Readings:

- Evans, L. "Individual Human Behavior-Risk Estimation", *Traffic Safety and the Driver*, 1991, pp. 342-345.
- Evans, L. "Driver's Perception of Risk", *Traffic Safety and the Driver*, 1991, pp. 322-325

C. Modal comparisons of safety—which mode is really safer?

Readings:

- NHTSA, *Traffic Safety Facts*, 2006.
- Evans, L., M. Frick and R. Schwing: Is it safer to fly or drive? *Risk Analysis* 10, 1982, pp. 239-246.
- Evans, L. *Traffic Safety and the Driver*, 1991, pp. 361-362.
- *National Safety Council* website has information on all unintentional injuries.

D. Why does perception matter?

- E. How will transportation engineers/planners be affected by current political/funding shifts?

**Week 3 (Parts 1 and 2).** Details of highway harm for motor vehicle users.

- A. In defining harm to motor vehicle users, what data do we use? Where does it come from? i. Accident

data, ii. Exposure information, iii. Data source for safety studies—Highway Safety Information System)

- Readings: HSIS Brochure (<http://www.hsisinfo.org/>)

B. Details of highway crash harm—types of collisions, roadway and traffic factors

Readings:

- Zegeer, C. and F. Council, Safety relationships associated with cross-sectional roadway elements. *Transportation Research Record* 1512, 1995, pp 29-36.
- Transportation Research Board. *Managing Speed: Review of Current Practice for Setting and Enforcing Speed Limits*. TRB, National Research Council, 1998. Chapter 2. Effects of Speed, “Summary” pp 71-73. Chapter 3. Managing Speeds: Speed Limits, “Effectiveness of Speed Limits” pp. 110-138.
- HSIS report. Safety effects of cross-section design on rural multilane highways, Publication No. FHWA-RD-97-027, 1997.

**Week 4 (Parts 1 and 2).** Analysis techniques used in transportation safety.

A. Equivalent PDO and its application to Hampton Roads

Readings:

- Samuel S. Belfield, Keith M. Nichols, Camelia Ravanbakht, Hampton Roads Regional Safety Study Part 3: Crash Analysis and Countermeasures, HRPDC, T04-02, 2004.
- OPTIONAL: Keith M. Nichols, Hampton Roads Rural Safety Study, HRPDC, T06-01, 2006.

B. Hazardous sites: Empirical Bayes

Readings:

- Bhagwant Persaud and Craig Lyon, Empirical Bayes before–after safety studies: Lessons learned from two decades of experience and future directions, *Accident Analysis & Prevention*, Volume 39, Issue 3, May 2007, Pages 546-555.
- Ezra Hauer, Douglas W. Harwood, Forrest M. Council, Michael S. Griffith, Estimating Safety by the Empirical Bayes Method: A Tutorial. TRB, 2002.
- Ezra Hauer, Back to the starting point: The empirical Bayes approach, Chapter 11, *Observational Before-After Studies in Road Safety*, 1997.
- OPTIONAL: Alicia L. Carriquiry and Michael Pawlovich, From empirical bayes to full bayes: methods for analyzing traffic safety data. 2004.
- OPTIONAL: Khattak Asad, Aemal Khattak, and F. Council, Effects of work zone presence on injury and non-injury crashes, *Accident Analysis and Prevention*, 34, Pergamon Press, pp. 19-29, 2002.

**Week 5 (Parts 1 and 2).** Analysis techniques used in transportation safety.

Part 1: Student presentations.

Part 2: Ordered probability models for injury severity

- Greene W., *Econometric Analysis*, McMillan, 2003.
  - Models for binary choice, pp. 665-668.
  - Ordered data, pp. 736-740.
- Khattak A., and Y. Fan, What exacerbates injury and harm in car-SUV collisions? *ASCE Journal of Transportation Engineering*, 134:2, 2008, pp. 93-104.
- Eluru, Naveen, Chandra R. Bhat, David A. Hensher, A mixed generalized ordered response model for examining pedestrian and bicyclist injury severity level in traffic crashes. *Accident Analysis and Prevention* 40 (2008) 1033–1054.
- C. J. O'Donnell and D. Connor, Predicting the severity of motor vehicle accident injuries using models of ordered multiple choice, *Accident Analysis and Prevention*, Vol. 28, No. 6, pp. 739-753, 1996.