

Innovative Safety Analysis Resources from the United States

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 **Safe Roads for a Safer Future**
Investment in roadway safety saves lives
<http://safety.fhwa.dot.gov>

“Road safety management is in transition. The transition is from action based on experience, intuition, judgment, tradition, and outdated methods to action based on empirical evidence, science, and technology...”

- Ezra Hauer



What is Safety?

- Principle evidence of lack of safety are crashes and the harm they cause
- Definition – number of crashes, or crash consequences, by kind & severity, **expected** to occur at a location during specified period of time

Measuring Safety

- Important distinction between directly observable & not observable
 - Directly observable = crash counts
 - Not observable = long-term averages

Crash Counts

- Count of crashes changes from one period to another even when there has been no change in any observable casual factor
- Useful definition of safety – Is in terms of the elusive mean (or average in the long run) that is behind the randomly fluctuating counts

Measure Safety

- The number of crashes by kind and severity, **expected to occur**, at a location during a specified period.
- Statistical methods used to estimate the expected number of crashes which increase the precision of estimates beyond what is possible when one is limited to the use of two-three year history of crashes, and correct for regression-to-the-mean bias.

Drawbacks of Older Safety Prediction

Methods

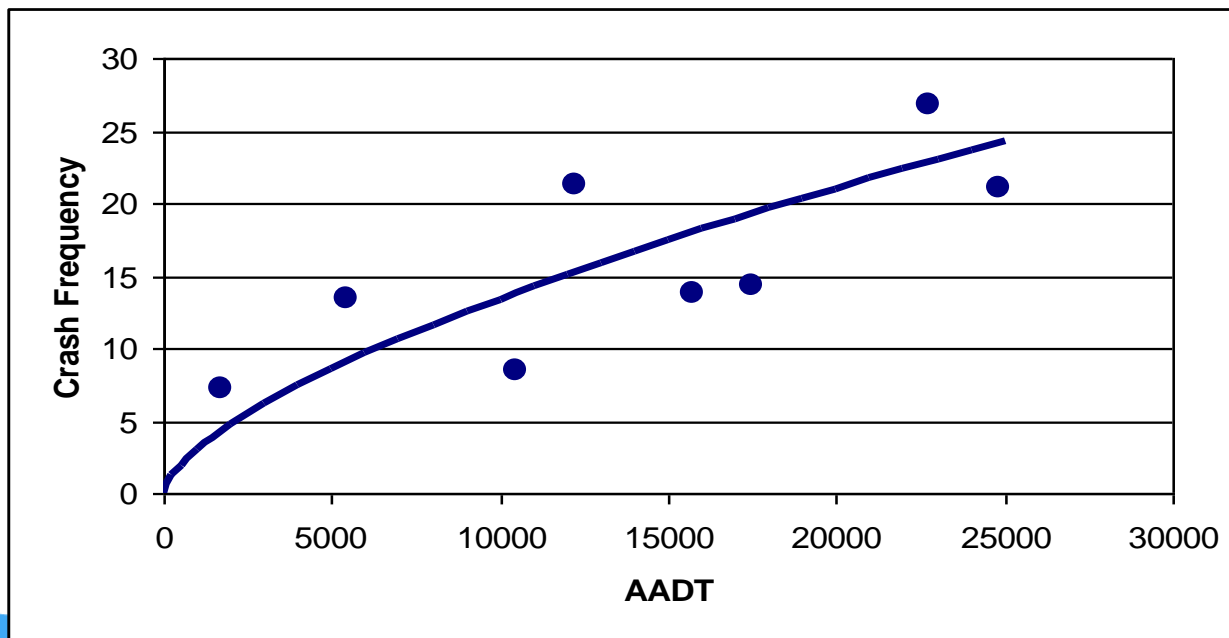
- Traditional regression modeling often used crash rate measures like crashes per million veh-mi of travel as the dependent variable
- This approach presumes a linear relationship between crash frequencies and exposure/traffic volume; what if the relationship is nonlinear?

BEST AVAILABLE APPROACH:

- Use crash frequency as the dependent variable and explicitly model exposure/traffic volume effects

Safety Performance Functions

SPF = Mathematical relationship between crash frequency per unit of time (and road length) and traffic volumes



Drawbacks of Older Safety Prediction

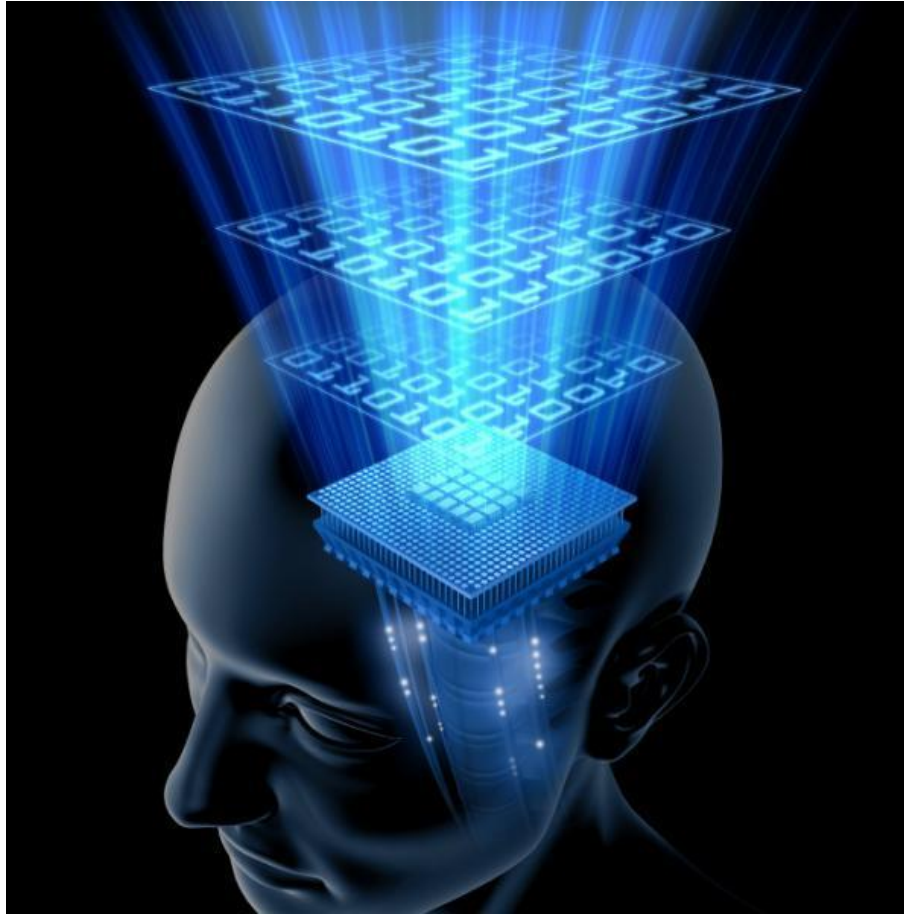
Methods

- Traditional methods treat observed crash history data as if they were exact safety measures
- Observed crash frequencies are random observations from a population whose true mean (and variance) are unknown
- Crash frequencies are highly variable from year to year
- As a result, crash frequencies are strongly subject to regression to the mean

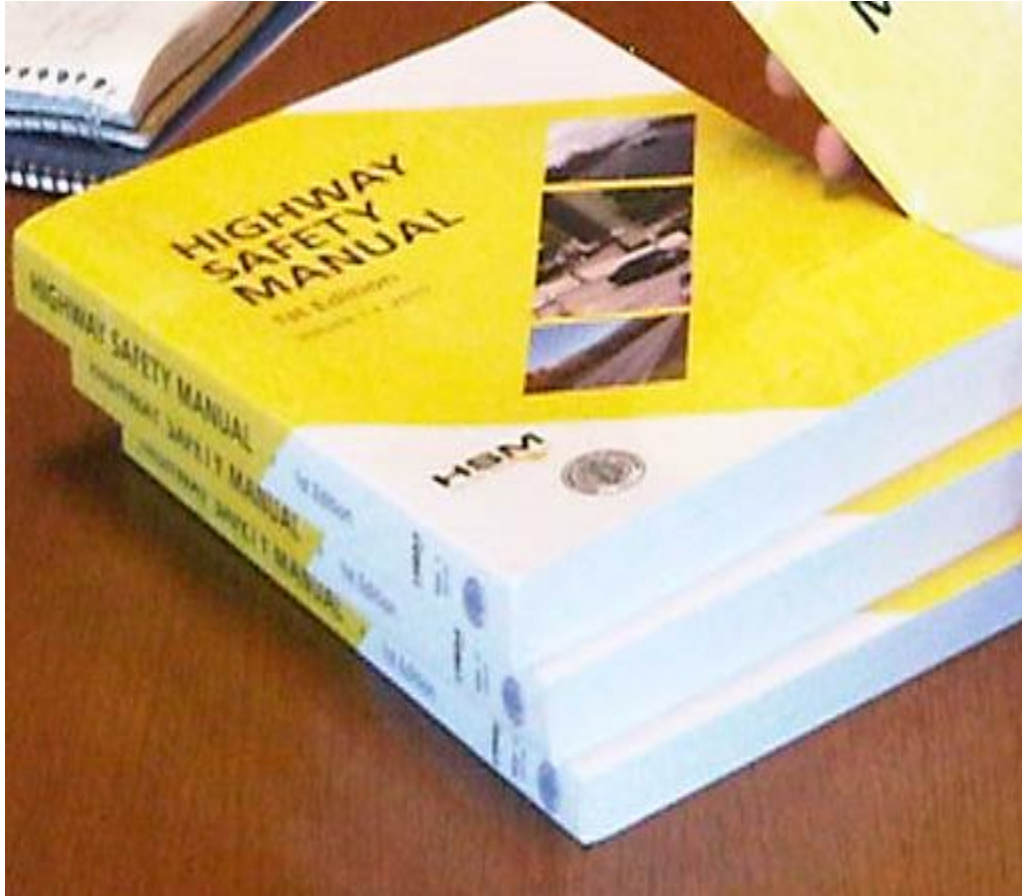
BEST AVAILABLE APPROACH

- The Empirical Bayes (EB) method combines the information available in both predictive models and observed data
- The EB method compensates for regression-to-the-mean

New Approach



Highway Safety Manual (HSM)



Part A - Introduction, Human Factors, and Fundamentals

- Chapter 1 – Introduction and Overview
- Chapter 2 – Human Factors
- Chapter 3 - Fundamentals

Part B - Roadway Safety Management Process

- Chapter 4 – Network Screening
- Chapter 5 – Diagnosis
- Chapter 6 – Select Countermeasures
- Chapter 7 – Economic Appraisal
- Chapter 8 – Prioritize Projects
- Chapter 9 – Safety Effectiveness Evaluation

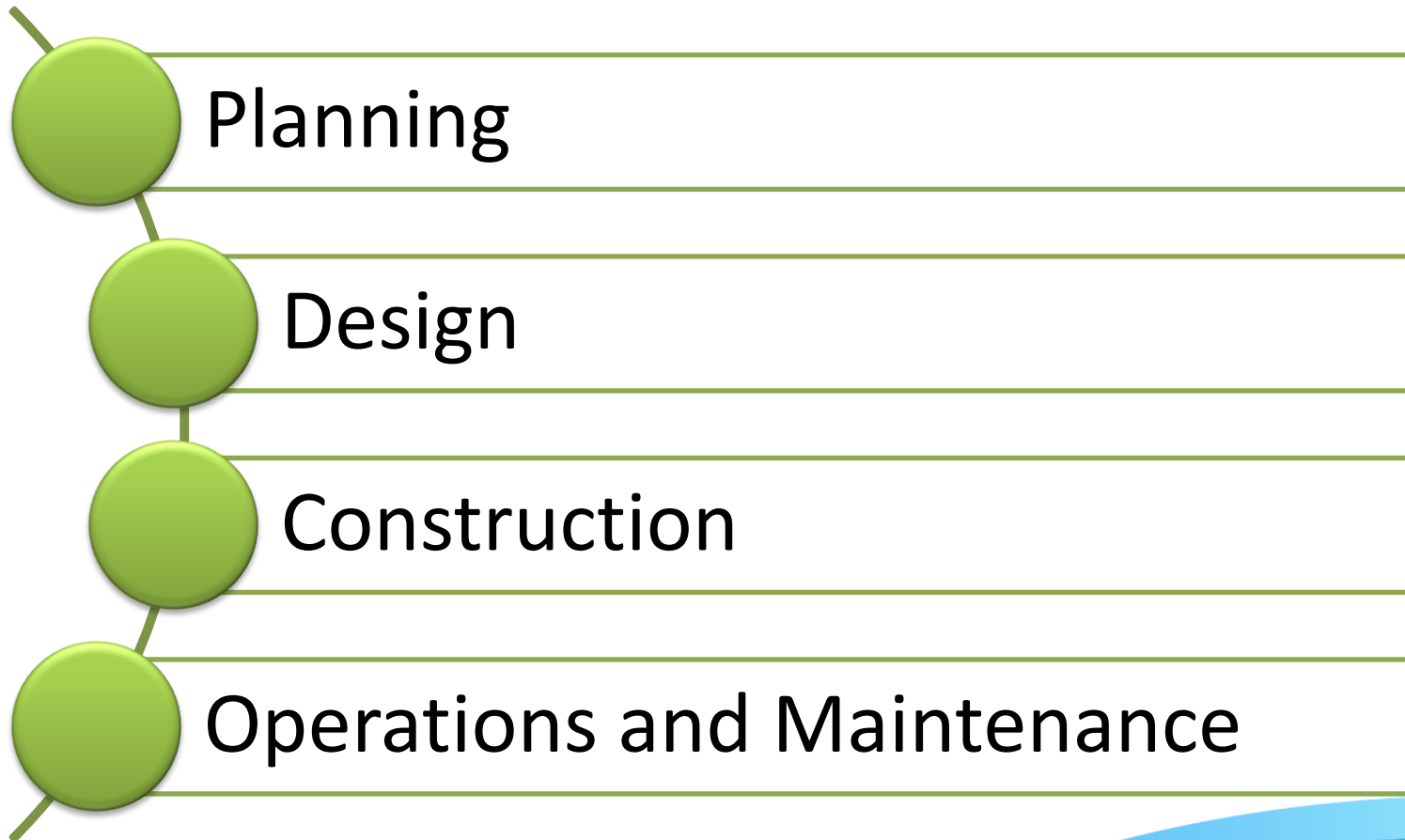
Part C - Predictive Method

- Chapter 10 – Rural Two-Lane Roads
- Chapter 11 – Rural Multilane Highways
- Chapter 12 – Urban and Suburban Arterials

Part D - Crash Modification Factors

- Chapter 13 – Roadway Segments
- Chapter 14 – Intersections
- Chapter 15 – Interchanges
- Chapter 16 – Special Facilities
- Chapter 17 – Road Networks

Incorporating safety in the project development decision-making process at all levels in an quantitative manner



Safety Trade-Offs?



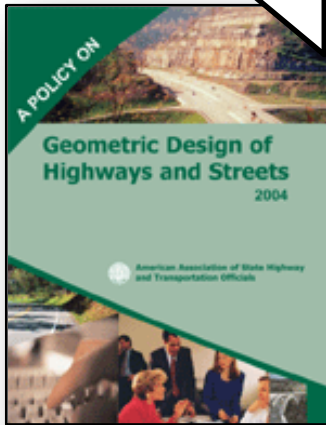
What Do You Do?

*Nominal
Safety*

*Substantive
Safety*

HSM
Highway Safety Manual
AASHTO

Examined in
reference to
compliance with
standards,
warrants, guidelines
and design
procedures



The expected or actual
crash frequency and
severity for a highway or
roadway

Part A: Introduction, Human Factors and Fundamentals

Part
A

Part
B

Part
C

Part
D

- **Part A:**
- **Introduction and Overview (Ch. 1)**
- **Human Factors (Ch. 2)**
- **Fundamentals (Ch. 3)**

Part B: Road Safety Management Process

**Part
A**

Network Screening (Ch. 4)

**Part
B**

**Diagnosis and Countermeasure Selection
(Ch. 5 & 6)**

**Part
C**

**Economic Appraisal and Prioritization
(Ch. 7 & 8)**

**Part
D**

Safety Effectiveness Evaluation (Ch. 9)



Part C: Predictive Methods

Part
A

Part
B

Part
C

Part
D

- **Crash Prediction Methodology**
 - Safety Performance Functions
 - Crash Modification Factors
 - Calibration
- **Applications**
- **Example problems**
- **References**

Part D: Crash Modification Factors

Part
A

- Roadway segments (Ch. 13)
- Intersections (Ch. 14)

Part
B

- Interchanges (Ch. 15)
- Special facilities and geometric situations (Ch. 16)

Part
C

- Road Networks (Ch. 17)


Part
D

CMFs

What kinds of HSM tools are available?

- Part B - SafetyAnalyst
- Part C - Interactive Highway Safety Design Model (IHSDM)
- Part D - CMF Clearinghouse

SafetyAnalyst

- Software tool to support safety management decision making by State and local highway agencies
 - State-of-the-art analytical methods for:
 - Module 1 Network Screening
 - Module 2 Diagnosis and Countermeasure Selection
 - Module 3 Economic Appraisal and Priority Ranking
 - Module 4 Evaluation of Implemented Countermeasures
- 

Objectives of *SafetyAnalyst*

- Effectiveness of decision making:

Automating state-of-the art analytical methods yields better information upon which to make better decisions in the programming of site-specific highway safety improvements

- Efficiency of decision support:

Integrating all parts of the safety management process in a single, modular software package streamlines work flow

Interactive Highway Safety Design Model (IHSDM)

A suite of software tools that support **project-level** geometric design decisions by providing **quantitative** information on the expected safety and operational performance

IHSDM Benefits

- IHSDM results help project developers make design decisions that improve the expected safety performance of designs
- IHSDM helps project planners, designers, and reviewers justify and defend geometric design decisions

Crash Modification Factor (CMF) Clearinghouse (www.cmfclearinghouse.org)

The screenshot shows the website interface for the Crash Modification Factors Clearinghouse. The browser window title is "Crash Modification Factors Clearinghouse - Windows Internet Explorer" and the address bar shows "http://www.cmfclearinghouse.org/".

Header: The logo features a stylized 'C' in a square followed by 'M' and 'F' in separate squares, with the text "CRASH MODIFICATION FACTORS CLEARINGHOUSE" below. Navigation links include "Skip to main content | Site Map | Notice | Sign Up for our e-Newsletter | Home". A secondary navigation bar contains "About CMFs | Find CMFs | Submit CMFs | Resources | Contact".

Quick Search: A search box with the placeholder "enter search term(s)" is followed by four dropdown menus: "narrow by countermeasure category", "narrow by crash type", "narrow by crash severity", and "narrow by roadway type". There are links for "Advanced Search" and "Need Help?", and a blue "Search CMFs" button.

Highway Safety Manual: A promotional banner for the "Highway Safety Manual" (1st Edition, March 19, 2008) by HBM and Axminster. The text states: "The first edition of the Highway Safety Manual is now available! Find out how to order a copy and see news related to the HSM." A small image of the manual cover is shown on the right, and a pagination bar with numbers 1, 2, 3, 4 is at the bottom.

Recently Added CMFs: A dark blue section with the heading "Recently Added CMFs". It lists three items:

- [Widen paved shoulder from 3 ft to 6 ft](#)
CMF: 0.93
- [Provide static combination horizontal alignment / advisory speed signs](#)
CMF: 0.36
- [Install chevron signs on horizontal curves](#)
CMF: 0.36

The Windows taskbar at the bottom shows the Start button, several application icons, and open windows including "Inbox - Microsoft O...", "K:\pptpoint", "Office of Safety PP...", "TRB CMF 1-20-11.pptx", and "Crash Modification...". The system tray shows "Internet", "100%", and the time "10:42 AM".

Resources

- Highway Safety Manual Website
www.highwaysafetymanual.org
- TRB Committee on Highway Safety Performance
www.safetyperformance.org
- Interactive Highway Safety Design Model
www.ihsdm.org
 - Technical Support, E-mail: IHSDM.Support@dot.gov
- *SafetyAnalyst*
www.safetyanalyst.org
- CMF Clearinghouse
www.cmfclearinghouse.org

