



The New Methodology for Calculating the Lives Saved by Safety Belts and Air Bags

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Your Most Important Travel Companions

In the U.S. in 2002:

- Safety belts saved 14,000 lives.
- Air bags saved 2,000.
- 7,000 people died because they did not buckle up.



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Lives Saved by Belts & Bags, 1991-2000





Financial Consequences

 Belts save the nation \$50 billion each year in medical care, productivity, and other societal costs.

Conversely, belt nonuse costs the nation \$26 billion annually.





Purpose of This Talk

How does one estimate lives saved & savable?

– Improvements we made







- The general theory
- Applying this to belts and bags
 - Special complications
 - Our changes and their effect



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The General Theory

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Quantifying the Benefits of a Device

- Suppose the "benefit" is "survival".
- Will explain the process for a single device.
- Will outline complications for multiple devices.





The Process for a Single Device

Suppose that a device A is the sole safety device for a certain setting.

E.g. suppose belts were the only safety device for vehicle crashes.





Potential Fatalities

<u>Potential fatalities</u> are the people in instances of the setting who would die without A.

-E.g. people in crashes sufficiently severe that they would die unbelted



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Effectiveness

The <u>effectiveness</u> *e* of A is the percent of potential fatalities that would live using A.







Lives Saved

A person is <u>saved</u> by A if they use A, survive, and would have died without A.



 $e \times 100\%$ of PFs who use A are **saved**_by A.

 $(1-e) \times 100\%$ of PFs who use A die.





Formula for Lives Saved If *F* people die using A: -*F*/(1-*e*) potential fatalities used A. -*eF*/(1-*e*) lives are saved.







Formula for Lives Savable

To calculate lives saved if more people used A: –Determine how many PFs Pc would use A. –ePc would be saved.







The Process for Multiple Devices

E.g. for devices A and B:

- Potential fatalities are those that would die if they had neither A nor B.
- Effectiveness ratings:
 - Effectiveness of A without B ("individual" effectiveness)
 - Effectiveness of A with B ("joint" effectiveness)
 - Effectiveness of A on those not saved by B ("residual" effectiveness)



Multiple Devices, Continued

- Applying the single device process to A, to B, and to A+B gives the total saved by A and B.
- Attribution is complex for those using A and B.
 - Some needed A and B to live.
 - Some needed A but not B (or B but not A).
 - Some would have lived with either.
- On savability, some people newly using A will have been saved by B.





Applying The Theory to Belts and Bags

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Several Safety Devices

Safety devices in passenger vehicles to protect people in crashes:

- Safety belts
- Air bags
- Crumple zones
- Reinforced passenger compartments
- Padded dashboards

etc



Reasonably Considered a Two-Device Scenario

What happens when we ignore other safety devices?

- Some people who needed e.g. their belt and crumple zone to live will be "saved by their belt".
- Reasonable since nearly all of today's motorists are protected by crumple zones.





Source of Fatality Data

Fatality Analysis Reporting System (FARS)

- Census of people who die within 30 days of the crash of a vehicle in transport on a public road in the U.S.
- Compiled from police reports, hospital records, death certificates, and other state documents.

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Total Lives Saved by Belts and Bags

- This is straightforward.
- Several effectiveness ratings:
 - Different belts, and belt-bag systems, have different effectiveness in different vehicles and seating positions.



Total Lives Savable by Belts and Bags

<u>Main complication</u>: Need to determine the # of PFs that will buckle up if more motorists do.

- Fewer PFs will buckle up (risk takers, drunks, etc).
 - Model use among PFs as a regression on general use.
- Not all PFs have belt access (e.g. pickup truck bed).
 - Remove unbelted fatalities without belt access from calculation.





Attributing to Belts and Bags

- Want to divide, e.g., total saved into "saved by belts" and "saved by bags".
 - Want only two categories for communicability.
 - Those that needed both or would have lived with either will have to be attributed to one or the other.





Attributions Considered

Method	Saved by Belts	Saved by Bags
Belt-favoring	Belts were sufficient for survival.	Bags were necessary.
Restraint-neutral	Apportion unknown cases according to the individual effectiveness ratings.	
Bag-favoring	Belts were necessary.	Bags were sufficient.



Attribution Method for Lives Saved

- All are reasonable.
- Viewing one restraint as supplementing another suggests belt- or bag-favoring.
- Regarding neither as supplementing the other suggests restraint-neutral.
- Classical benefits analysis suggests belt-favoring.
- Have used belt-favoring in the past.

Decision: Belt-favoring





Attribution Method for Savable

– Have used bag-favoring in the past.

 Additional complication: Not wanting to reattribute lives saved suggests bag-favoring.

Decision: Bag-favoring

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Changes Made

- Refined the determination of which fatalities could have buckled up.
- Corrected oversights.
- Revisited attribution decisions.
- Updated effectiveness ratings.
- Updated regression model for savability calculations.
- Changed the calculation of lives savable at 100% belt use to be consistent with other savable calculations.





Lives Lost from Failure to Use Belts

- Our nationwide belt use survey (National Occupant Protection Use Survey) observes use in the front seat during daytime.
 - So "100% Use" means "100% use in front seat during daytime".
- <u>Problem</u>: Not all PFs will buckle up when daytime front seat use is 100%.
 - Discontinuity in savability at 100% use.
- <u>Solution</u>: Use "100% daytime front seat use" for savability at 100% use.





Effect of the Changes

• Lives saved decrease by 6-9%.

• Lives savable increase by 10-25%.

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Implementation

• Full implementation in 2002.

• Restate cumulative lives saved during 1991-2001, smoothing in new method.

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Published and Revised Estimates



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For Further Information

- Glassbrenner, "Improving the Calculations of the Lives Saved and Savable by Safety Belts and Air Bags", NHTSA Technical Report, DOT HS 809 xxx, 2003
- Kahane, "Fatality Reduction by Safety Belts for Front Seat Occupants of Cars and Light Trucks", NHTSA Technical Report, DOT HS 809 199, 2000