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Improving the Elicitation of Professional Judgements for Use in Regulatory Benefits Analysis

Presentation for the Society for Benefit-Cost Analysis 2017 Annual Conference

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March 17, 2017

Why and When to Use A Streamlined Approach to Obtain Expert Judgements?

- U.S. Coast Guard (USCG) promulgates many smaller, less controversial regulations for which empirical data on effectiveness are not readily available.
- In these "lower stakes" rules, agencies often rely on expert judgments of the rule's likely effectiveness.
- The purpose of this effort was to develop a systematic approach for obtaining expert judgments, drawing on best practices for formal, structured expert elicitation, and tailored to USCG's needs for lower stakes rules.

Pilot Project – Generic Safety Regulation

- USCG identified a set of regulatory interventions designed to reduce fatalities and nonfatal injuries in the maritime environment.
- USCG staff reviewed the Marine Information for Safety and Law Enforcement (MISLE) database system to identify casualty reports for incidents occurring between 2002 and 2011 that might have been prevented or mitigated by the intervention.
- For each casualty report, IEc and USCG identified a "precipitating" event (e.g. equipment failure) that was the main cause of the ultimate fatality or injury.

Elicitation Steps

ELICITATION STEPS
Step 1. Develop background information and prepare for the elicitation.
Step 2. Identify and recruit experts.
Step 3. Conduct the elicitation.
Step 4. Apply the results.
Step 5. Document and verify the process.

Step 1. Develop background information and prepare for the elicitation.

- Define quantity to be estimated.
  - Used a disaggregated approach to help experts evaluate both the preventative and mitigation-oriented aspects of the regulatory intervention.
    - P(A) = the probability that the precipitating event occurs
    - P(B|A) = the probability that the fatality or nonfatal injury occurs IF the precipitating event occurs
    - P(A and B) = P(A)*P(B|A)
- Staff the project team.
  - Substantive expert: Internal USCG staff member
  - Normative experts: Henry Roman (IEc), with guidance from Dr. James Hammitt (Harvard University)

Step 1. Develop background information and prepare for the elicitation (continued).

- Develop briefing book.
  - Background documents.
  - Industry profile.
  - Information on historical incidents included in the elicitation.
- Develop the elicitation protocol.
  - Because we chose to have the experts answer the elicitation questions on their own, we developed an Excel-based elicitation tool.

Step 2. Identify and recruit experts.

- Ideal experts for this pilot would possess the following characteristics:
  - In-depth knowledge of the maritime activity subject to the intervention and relevant challenges.
  - Knowledge of current industry safety practices and the degree to which these practices are implemented across affected firms.
  - An understanding of how the changes required by the proposed intervention are likely to be implemented by affected firms and mariners.
  - Free of any conflicts of interest (COI).

Step 3. Conduct the elicitation.

- Training the experts.
  - Explained probability in general terms (probability wheel) and joint and conditional probabilities.
  - Discussed common heuristics and biases (anchoring, availability bias, motivational bias, and overconfidence) and strategies for minimizing their effects.
  - Reviewed the results of a training exercise sent to the experts prior to the workshop.

Step 3. Conduct the elicitation (continued).

- Eliciting judgements.
  - The experts engaged in collaborative thinking and discussion about the historical incidents during the pre-elicitation workshop.
  - Used an elicitation tool developed in Microsoft Excel, which the experts completed remotely and independently.

Step 4. Conduct the elicitation (continued).

Exhibit 2. Sample Elicitation Questions and Aid

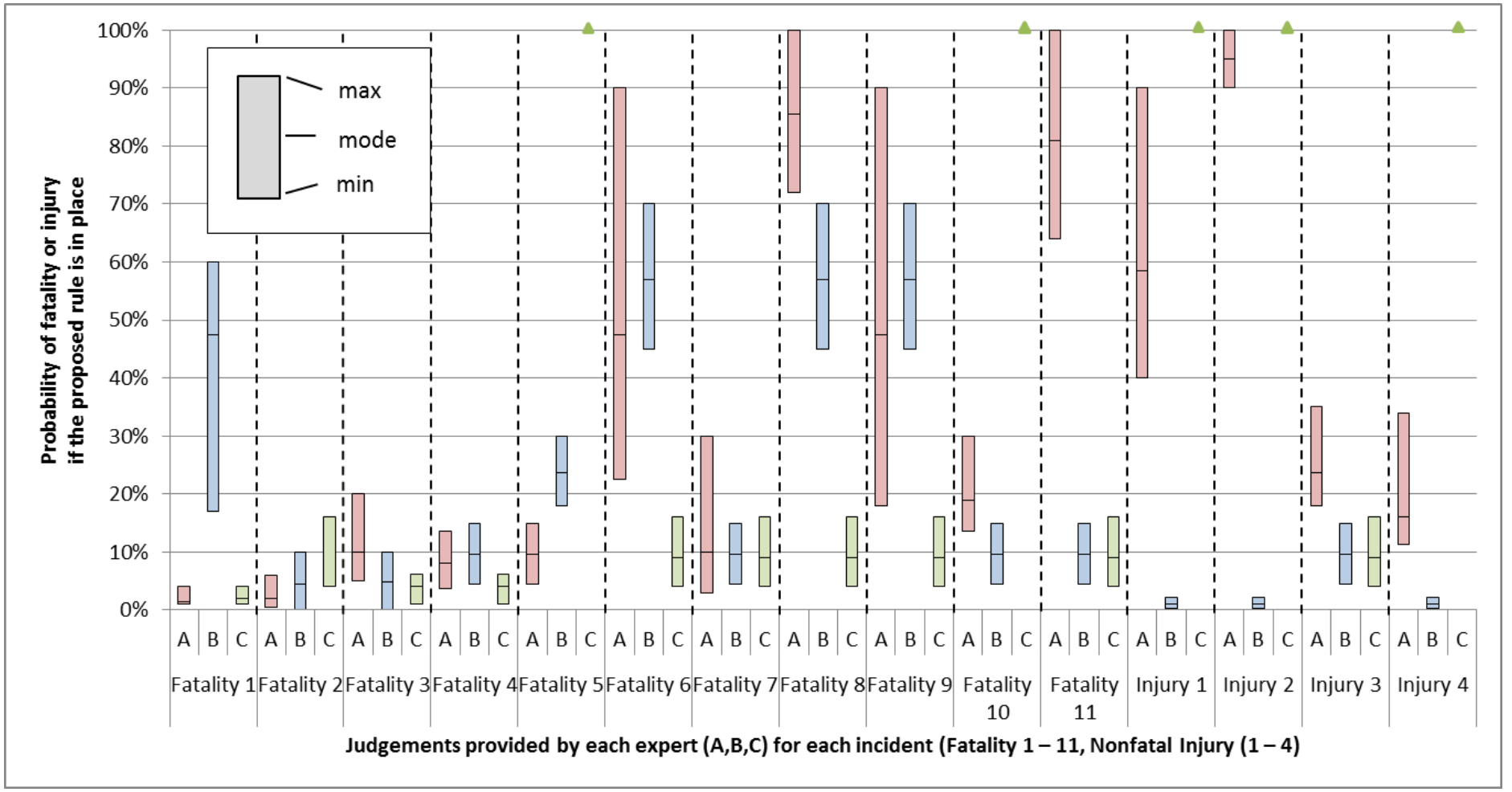
Likelihood of the Precipitating Event				
2. As agreed in the pre-elicitation workshop, the precipitating event for this incident was procedural and operator error. If a scenario identical to this one occurs in the future, absent a change in regulations, this precipitating event is 100% likely to occur. Now assume a scenario identical to this one occurs in the future, but with the proposed rule in place. How likely is it that this precipitating event will occur?				
	2a) The precipitating event is AT LEAST __% likely to occur.	0%	Implied maximum effectiveness of rule:	100%
	2b) The precipitating event is AT MOST __% likely to occur.	0%	Implied minimum effectiveness of rule:	100%
	2c) The precipitating event is MOST LIKELY __% likely to occur.	0%	Implied most likely effectiveness of rule:	100%
Likelihood of Fatality Given the Precipitating Event				
4. Assume that a scenario identical to this one occurs and that the precipitating event occurs. If the proposed rule is in place, what is the liklihood of a fatality?				
	4a) The fatality is AT LEAST __% likely to occur.	0%	Implied maximum effectiveness of rule:	100%
	4b) The fatality is AT MOST __% likely to occur.	0%	Implied minimum effectiveness of rule:	100%
	4c) The fatality is MOST LIKELY __% likely to occur.	0%	Implied most likely effectiveness of rule:	100%

Step 4. Applying the results.

- Preliminary review of the results.
  - Checked for logically inconsistent answers.
  - Graphed a subset to get a better sense of how they varied across experts.

Step 4. Applying the results (continued).

Exhibit 3. Sample Expert Elicitation Results



Step 4. Applying the results (continued).

- Combining the Judgments
  - Used Monte Carlo simulation to combine the probability distributions provided for (1) the likelihood that the intervention would prevent the incident in the first place and/or (2) the likelihood that the fatality or injury would be prevented if the incident occurs.
  - Aggregated judgments across experts using an equal weighting approach.
  - Reported the best estimate for each incident, as well as the minimum and maximum values for use in sensitivity analysis.
- Reviewing the Results with the Experts
  - Shared the results with the experts and gave them the opportunity to refine their initial answers. The experts also provided helpful insights regarding counter-intuitive or surprising results.

Step 4. Applying the results (continued).

Exhibit 4. Likely Number of Avoided Fatalities (10-year Timeframe)[a]

INCIDENT[b]	MIN	AVERAGE	MAX
Fatality 1	0.4	0.9	1.0
Fatality 2	0.9	1.0	1.0
Fatality 3	0.8	0.9	1.0
Fatality 4	0.9	0.9	1.0
Fatality 5	0.0	0.6	1.0
Fatality 6	0.1	0.6	1.0
Fatality 7	0.7	0.9	1.0
Fatality 8	0.0	0.5	1.0
Fatality 9	0.1	0.6	1.0
Fatality 10	0.0	0.6	1.0
Fatality 11	0.0	0.7	1.0
TOTAL[c]	**3.9**	**8.1**	**10.7**

Notes:
a. Note that these are not present or annualized values.
b. Incident data obtained from MISLE for years 2002 through 2011.
c. Totals may not sum due to rounding.

Conclusions and Recommendations

- Although it was streamlined in comparison to standard approaches for structured expert elicitation, the methodology used in this pilot provides many of the benefits of the more formal, rigorous process.
  - The problem was well-specified.
  - The elicitation team was appropriately staffed and the experts were adequately trained and prepared.
  - By decomposing the question, asking the experts for qualitative commentary, and following up, the results are more easily interpreted and transparent.
  - Eliciting judgments in the form of probability distributions, rather than point estimates, more accurately reflects uncertainty and provides opportunities for more rigorous sensitivity or uncertainty analysis.
- The pilot study demonstrates that, with only a modest increase in resources, USCG can achieve greater credibility and more transparent data. However, this type of streamlined approach may not be sufficient for high-stakes regulations.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