How to elicit opinions from experts

Flavie GOUTARD – UR AGIRs, CIRAD
goutard@cirad.fr

Risk Analysis training course
NIHE, Hanoi, Vietnam, 4-5 May 2016

What is expert-opinion elicitation?

- A method to address uncertainties, to explore vague and unknown issues
- a "heuristic" process: an experience-based technique, gathering and using readily available information for problem solving
- Heuristic ≠ scientific: when exhaustive scientific search is not available
- Not a substitute to scientific, rigorous analytical research

Fields of 'expert opinion'

- Widely used in a variety of fields :
  - design and management of large complex engineering projects such as nuclear installations,
  - in meteorology for extreme values analysis,
  - process of complex decision-making in business, finances or in medicine (diagnosis and treatment decisions, clinical trials…)
- In veterinary field, used in risk assessment (Gale et al., 2009, Greiner et al., 2007…), disease prioritisation, multi-criteria decision analysis etc.

When can we use expert opinion?

- Need to perform an initial screening of problems (i.e., what is known and how well it is known) and document that information.
- To address uncertainties:
  - Data on new, rare, complex, or poorly understood problems are sparse or difficult to obtain.
  - Data are too costly to obtain.
  - Data are open to different interpretations. Results are variable/uncertain.
  - Models to analyse risks are not available; or are very data intensive.
- Expert opinion not relevant in case of "recognized ignorance" (or only to establish ignorance)

Eliciting an expert opinion?

- **Elicitation** is used to obtain a formal expression of the expert's knowledge regarding an uncertain quantity. There are a number of methods used to elicit EO: individual expert vs expert panels, interviews or questionnaire or interactive software, etc. E.g. **modified Delphi approach**, Nominal group technique, conjoint analysis….
- Elicited probabilities may suffer from biases and non-coherence in practice, but the goal of elicitation is to represent the expert's knowledge and judgments as accurately as possible

Expert elicitation process in summary

- Characterization of uncertainties (**Target variables)**.
- Scope and format of elicitation
- Identification and selection of experts.
- Design of the elicitation protocol
- Preparation of the elicitation session
- Elicitation of expert opinion/judgment
- Summary, aggregation and reporting of the results

(Seven-step approach – Knol et al., 2010)

Characterization of uncertainties, format of elicitation

- Why is elicitation needed:
  - Usually, elicitation about model parameters (but could also be about hazards, pathways, scenarios, etc.)
  - Due to incomplete knowledge / intrinsic to system studied
  - Value diversity among experts
- => Definition of target variable, format of information needed (estimates, scenarios)

Who is your expert?

- An **expert** is a key person who:
  - has important knowledge about the field of interest;
  - has a background in the field of interest;
  - is recognized (such as by his colleagues) as qualified to address problems in the subject area;
  - has familiarity with probability assessments (not at any price: this can be given by training).

- Expert opinion can be viewed as a representation of an expert's state of knowledge at the time of response to the technical question. Thus, expert opinion should change through time as the expert receives new information.

Experts and their opinions

Expert's opinion needs to be:

- credible
- transparent
- science-based
- justifiable

So the expert must be

- experienced
- recognised

And a group of experts *(collective noun = ?)*

- diverse
- representative

Expert selection

- objective, defensible
- criteria defined, stated in the methodology
- selection process outlined
- reasons for selection/rejection of candidates

Group of experts tend to provide more accurate answers than the average individual expert.

Criteria for experts selection

- Tangible evidence of expertise (e.g. degrees, publications, positions)
- Reputation
- Availability and willingness to participate
- Understanding of the general problem area
- Impartiality
- Lack of an economic or personal stake in the potential findings

When not possible to satisfy the last two criteria, important to record any potential conflict of interest that an expert may have.

Choice of elicitation format

- One expert vs group of experts
  - variability between experts
  - your uncertainty about how to deal with it.
- Interview vs questionnaire:
  - Face to face / telephone – single expert
  - Group of experts
  - Postal or internet-based questionnaire
- Aggregation of experts opinion:
  - Mathematical aggregation: variety of approaches
  - Behavioural aggregation: panel of experts define a single probability distribution representing their consensus

Size of expert panel

- Number of experts sought
  - factors to consider:
    - the type of problem for which expert judgment is being elicited;
    - the range of relevant expertise needed to assess the problem.
    - the nature and degree of uncertainty about the problem;
    - the existence of different views on the problem (value diversity);
    - resources available (time, money)
    - Use of results: critical for decision making, use in court decision, or preliminary study?
- Usually small expert panels (6-12)

Design of elicitation protocols

- Questions to be asked and format
  - Statistical estimates (e.g. probability density function, min/max/ML, mean and SD…)
  - Likelihood/qualitative estimates
- Wording of questions
  - issues of vagueness, context dependence, ambiguity and under-specificity
  - translation in case of international panel
- Uncertainty around estimates
  - Estimate, Unit, Uncertainty
  - NUSAP approach (qualitative assessment of uncertainty not captured in estimate)

Scoring opinion

- **Scoring rules** are rules to assess the performance and consistency of experts (reliability and quality). The scores from these rules can be used to determine weight factors for combining expert opinions (if necessary).
- Different types of scoring exist:
  - **Self scoring**: Each expert provides a self assessment in the form of a confidence level for each probability or answer provided for a subject.
  - **Collective scoring**: Each expert provides assessments of other experts, in the form of confidence levels.
  - **Entropy and information measures**: Scores for each expert are determined according to some rules of information reliability:
    - Calibration using seed variables
    - Asking for an outcome in 2 or more ways

Influencing factors of heuristic process

- **Availability:** Estimates are made according to the ease which similar events are called to mind (media coverage, recent occurrence, personal significance…) – overestimation of well-publicized events vs unglamorous events

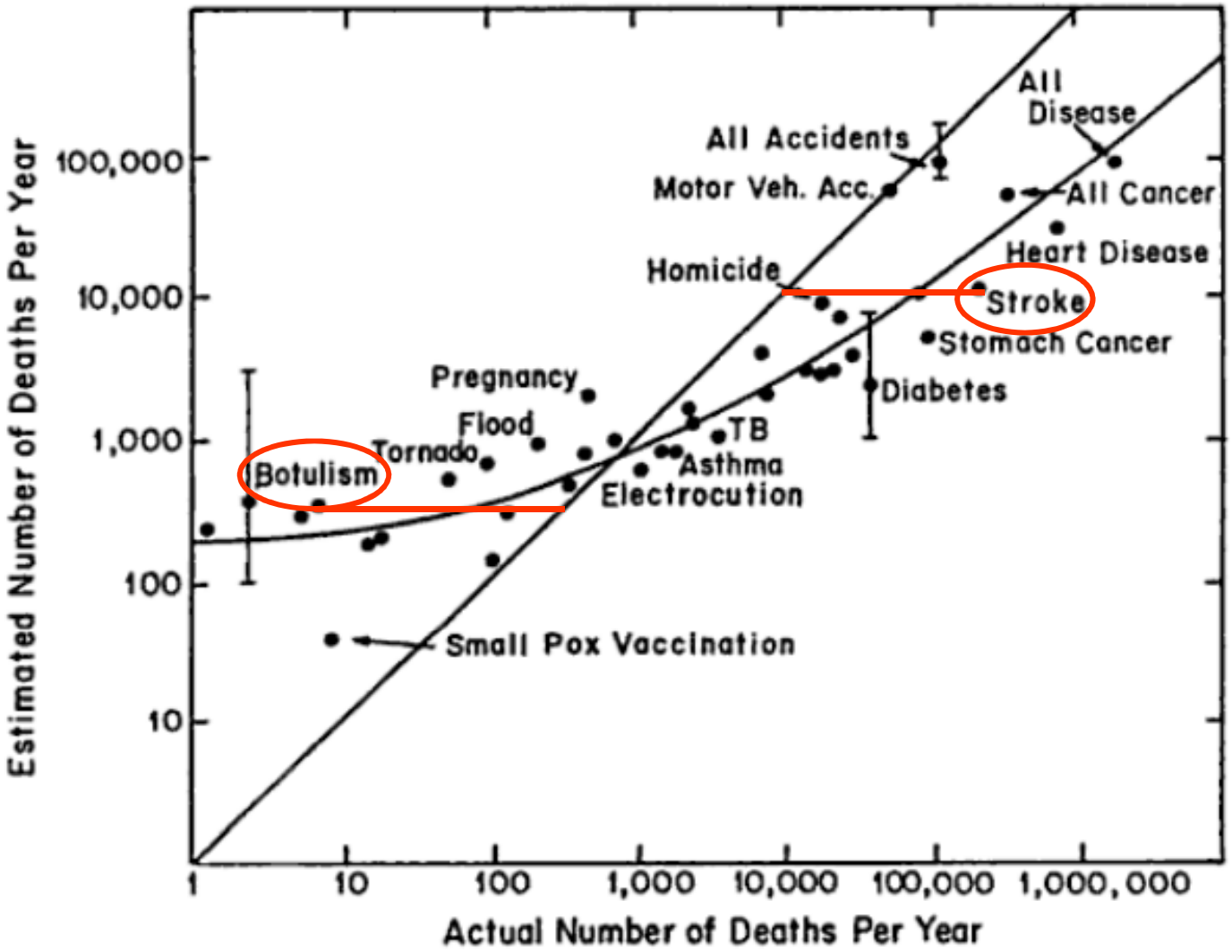


Figure 6.1. Plot showing the geometric mean of people's estimates of the annual numbers of deaths from a variety of causes (vertical axis) versus the actual numbers of deaths (horizontal axis). In general, the occurrence of frequent causes of deaths is underestimated and that of less frequent causes is overestimated. The operation of bias from the heuristic of availability is clearly illustrated by the points for stroke and botulism. Much of the "scatter" of the points is not noise but can be reproduced. The figure is redrawn from Lichtenstein et al. (1978).

Influencing factors of heuristic process

- **Anchoring-and-adjusting:** individuals or experts, tend to start with an initial estimate and correct it to the issue at hand. (most likely, min, max /or when considering a series of related questions)

- Is the population of Paris more or less than 1.5 million? Estimate the population.
- Is the population of Paris more or less than 4 million? Estimate the population.
- The first question gave Paris a smaller population.

Influencing factors of heuristic process

- Incoherence in probability assessment (lack of representativeness)
  - Ex: Karen is smart, she has study law in London, and has participated in some demonstration against violence on women
    - Tick the most likely alternative:
      - She is a lawyer
      - She is a lawyer and a feminist

- If I toss a coin 6 times which sequences is more likely to happen:
  - HHHTTT
  - HTTHTH

Other biases associated with EO

- **Base-rate fallacy:**
  - The base-rate fallacy arises as a result of using misguided, or misinformed subjects. A subject might rely on recent or popular information and unintentionally ignore the historic rate for an event of interest.
- **Overconfidence:**
  - Especially common in assessing confidence intervals on an estimated value. Subjects tend to provide narrower confidence intervals compared to real.
  - May also be a problem in expert panels (to reach consensus)

Other biases associated with EO

- **Unpacking principle:** providing a hypothesis that gives a more detailed description of an event generally increases its judged probabilities
  - Ex: How many people die from natural causes in a year < adding how many from heart diseases + cancers + other natural causes
- **Description of events:**
  - Sweden beats Russia vs Sweden fail to win against Russia
- **Motivational biases:** answer influence by personal belief, professional responsibility, peer credibility…

Communication to selected experts

- Motivating experts:
  - Explaining why their judgements are required and how it can be used
  - Reassure expert that uncertainty is natural
- Presenting the study:
  - Background information: nature of problem and uncertainty, (key literature – increase availability bias!)
  - Elicitation procedure, heuristics and biases
- Training with practices are sometimes necessary (e.g. when estimate to provide is probability density function)

Running the elicitation: key points

- After presentation of the study and of the elicitation process:
  - Optional training on estimates requested and elicitation format (probabilities, comparison matrices, etc.)
  - Training questions (to allow experts to practice, test the devices such as voting remotes, etc.)
  - Elicitation per se, incl. discussions to check that result reflect experts thoughts, understand differences, clear remaining ambiguities/vagueness and reduce biases
  - Ensure anonymity of answers throughout process (less peer pressure, motivational bias, etc.)
  - Provide feedback (instantaneous such as in Delphi – but beware of effect on revised answers or shortly after elicitation)

Delphi Method

- The **Delphi method** was developed during the early 1950s, and was the first structured method for eliciting and combining expert opinion. The Delphi Method is a procedure for arriving at a group decision or set of opinions which does not involve a face-to-face meeting but where the group members respond to a written questionnaire survey in several rounds.

The process:

- Each expert gives his independent opinion on a list of questions.
- The opinions of each expert are collated. Extreme opinions are discarded, and an initial view (consensus) is formulated.
- The initial view is circulated to the experts for their further comments, and depending on how they respond, the initial view might be changed.
- The process will continue until a prediction for the future has been made, which has the acceptance of all/most of the panel of experts

Modified Delphi technique

- Variation where group discussion is encouraged by a facilitator, so anonymity is lost.
- Enhanced consensus : information is discussed openly, ambiguities are clarified and feedback is provided directly and in real time.
- Better synthesis and analysis of knowledge
- Success of group interactions depends on the ability of the facilitator to encourage the sharing of knowledge and recognition of expertise.
- Consensus is not necessarily achieved using the modified Delphi technique, further mathematical combination is needed after the interactive process.

Managing group judgments

- Most important:
  - Role of facilitators – Experienced analysts
- Control the process and structure the group interaction – No contribution to the content of discussion
- Methods:
  - Delaying commitment of the group
  - Spreading power among the group
  - Encouraging conflict among members

Analysis and aggregation

- Much of the literature on expert elicitation focuses on how to aggregate expert judgment to generate estimates of parameters or distributions of interest.
- Several approaches:
  - Delphi processes are a widely used behavioural approach to aggregation that use highly structured, iterative group processes to reach consensus among experts.
  - Several alternative means of aggregating expert judgment through weighting expert judgments have been developed – but no consensus on methods.

Behavioural approaches

- A consensus combination of opinion is arrived at through a facilitated discussion among the experts to some agreeable common values with perhaps a confidence interval or outer quartile values.
- **Biases resulting from group interactions:**
  - Group pressures to conform (group think) or strong personalities that dominant.
  - Less confident members of the group may not participate as readily.
  - Effects of hidden agendas (motivational bias).
  - Tendency to reach a decision prematurely.
  - New ideas may be discouraged
  - Group polarization = tendency of group to adopt more extreme positions than would individual members

Example (1)

EXPERT OPINION WORKSHOP

INTRODUCTION

The aim of MedReoNet Work-Package 5 is to develop a Risk Assessment model to allow us to estimate the risk of BT, AHS & EHD introduction into the different countries.
Even though the first idea was to build up a qualitative model, we thought that attempting to develop a quantitative model was worth a try.
Quantitative models require incredible amounts of quantitative data. Most of these parameters are obtained from published literature. However, often quantitative data on some parameters are not available, or if available, are unreliable or not applicable. In such cases, expert opinion is the only way to complete the required knowledge. Expert data elicited under rigorous methodological rules is increasingly recognised as a valuable asset in many fields, including veterinary science.

THE METHOD

The method (Workshop Method), developed jointly by the VLA and FAO, has to be carried out on 2 stages:
Stage 1: The questionnaire, designed to elicit the information needed for the model, will be sent by e-mail to a panel of selected experts. This questionnaire has to be answered individually and without referring to any literature.
Stage 2: The answers will be analysed and the results presented on the "expert opinion workshop" in the next MedReoNet meeting. As the results of the different questions are presented a facilitated discussion has to take place. Finally, the experts have to individually answer the questionnaire again, having the opportunity to amend their answers if necessary.

From S. Napp(2007, CRESA)

Example (1)

AREA OF EXPERTISE

1- Please indicate your working background:

Entomology	☐	Veterinary services	☐
Epidemiology	☐	Virology	☐
Laboratory diagnostic	☐	Other (indicate)	☐

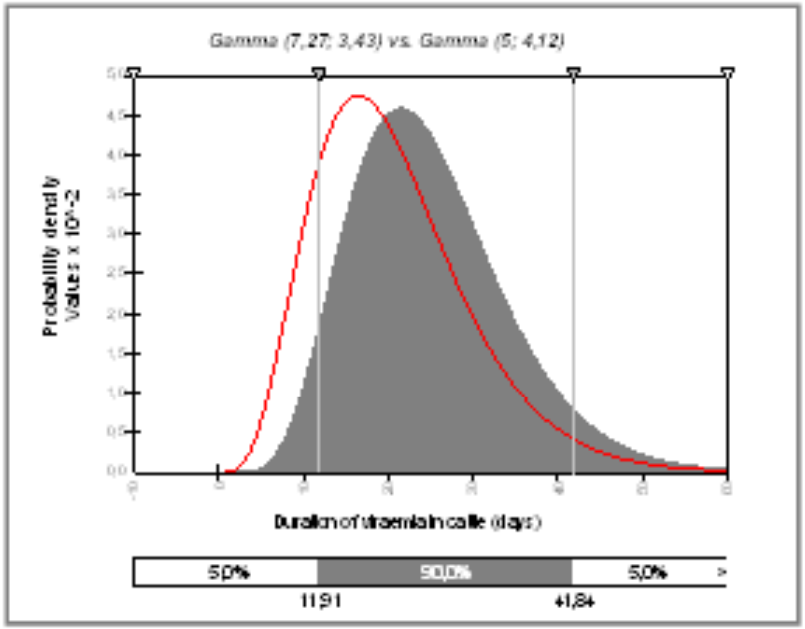
2- How many years have you been working with BT, AHS and/or EHD?

Years of expertise

From S. Napp(2007, CRESA)

Example (1)

* The x-axis represents the duration of viraemia in days and the y-axis the probability associated with this value



Please, tick on the appropriate box

Viraemia duration in cattle	
Singer and collaborators	Gubbins and collaborators
☐	☐

Confidence in your answer	Indicate how confident you are using a number from 1 to 5 (1= not confident; 5= very confident)	

From S. Napp(2007, CRESA)

Example (1)

Question 1: Means of transport/commodities worth to be assessed

Introduction: Potentially infected *Culicoides* may be transported in vehicles (cars, planes, boats..) or containers (transporting animals or plants) coming from countries where BTV is present.

The relative importance of these vehicles/commodities obviously depends on the country. For example, cars may be more important for Spain than for other countries, because of the volume of cars travelling between the South of Spain and Northern Africa, particularly on the summer when the vector is active. However, this question has to be answered globally (considering the situation in the different countries for which the risk has to be assessed).

Question: *Please, tick in the appropriate box:*

Means of transport /commodities	Is it worth to be assessed?					Confidence in your answer
	Not worth at all				Critical	Indicate how confident you are using a number from 1 to 5 (1= not confident; 5= very confident)
	1	2	3	4	5	
Cars	☐	☐	☐	☐	☐	
Planes	☐	☐	☐	☐	☐	
Boats	☐	☐	☐	☐	☐	
Transport of non-ruminant species	☐	☐	☐	☐	☐	
Commodities (for example plants)	☐	☐	☐	☐	☐	
Other (indicate)	☐	☐	☐	☐	☐	

From S. Napp(2007, CRESA)

Example (1)

Question 9: Vector preference for cattle compared to sheep

Question: *Given a farm with the same number of cattle and sheep (and no other species), what would be the proportion of vectors biting on cattle and on sheep?*

Vector preference for cattle compared to sheep	
Cattle (%)	Sheep (%)

Confidence in your answer	Indicate how confident you are using a number from 1 to 5 (1= not confident; 5= very confident)	

From S. Napp(2007, CRESA)

Example (2)

Example:
In a questionnaire on bird flu, you could have answered the following.

Consider 10 chickens from backyard farms. These animals have contact with a chicken from a neighbouring farm, infected with Avian Influenza. How many of these 10 chickens become infected with bird flu?

Minimum number of chickens	Maximum number of chickens	Most likely number of chickens
7	**10**	**9**

Confidence in your answer	Indicate, using a number from 1 to 5, how confident you are in your answer (1=not confident; 5=very confident)	**4**

From S. Costard (2006, RVC)

Introduction to risk assessment

Flavie GOUTARD – UR AGIRs, CIRAD
goutard@cirad.fr

Risk Analysis training course
NIHE, Hanoi, Vietnam, 4-5 May 2016