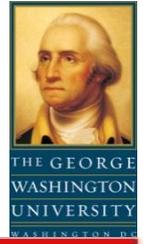


The Competition and the Opportunity: An Overview of Expert Elicitation Methods and Applications for the Last Few Years

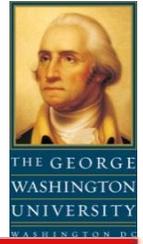
Thomas A. Mazzuchi
**Department of Engineering Management and
Systems Engineering**
George Washington University

How to Use Expert Judgement



- **Martin et al, Conserv Biology, 2011**
 - Conservation Science
- **O'Hagan, Metrologia, 2014**
 - Metrology
- **World Health Organization, Risk Analysis, 2016**
 - Global Health Risks
- **Kuhnet et al, Ecology Letters, 2010**
 - Ecology
- **Pilat, Nuclear Technology, 2012**
 - Nuclear Energy
- **Hadorn et al, Int J of Tech assessment in Healthcare, 2014**
 - Health Economic Decision Models

Similarities and Differences

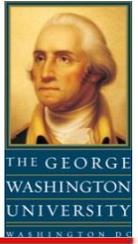


- **Similarities**

- Good overview of expert judgement citing one of the major sources
- Protocols for expert selection, eliminating bias, elicitation fatigue

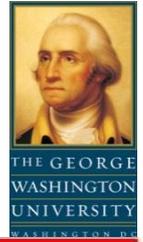
- **Differences**

- Research Areas
- Elicited Quantities - uncertainty distributions, 1-5 rating, 1-10 rating
- Weighting – mostly equal but some ranks based on expert evaluations
- Uses – exploring importance to determining priors
- Number of respondents



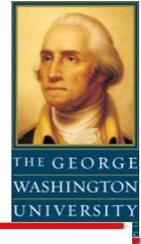
ENERGY

Energy Economic Models



- **Usher et al, Energy Policy, 2013**

- **Objective:** Determine values and uncertainty for key energy parameters (oil price, gnp, etc) for energy economic models
- **Number of Respondents:** 25
- **Delivery:** One-on-One Interviews
- **Questions:**
 - Min, max median and upper and lower quartile for each specified parameter
 - Text reasoning for their answers
 - Single calibration question
- **Used to determine uncertainty distributions and evaluation of expert weighting**

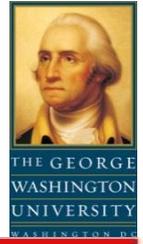


Wind Energy Costs

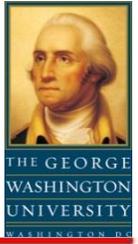
- **Wiser et al, Nature Energy, 2016**

- **Objective:** Gain insight into the possible magnitude of future wind energy cost reductions and to identify the sources of enabling conditions for those reductions.
- **Number of Respondents:** 163
- **Delivery:** Web Survey
- **Questions:**
 - Probabilistic estimates for the (10th, 50th, 90th %-ile) for Levelized Cost Energy of a 'typical' project, defined as the median project in a future scenario for 3 wind apps.
 - Impacts of technology advancement and resource depletion on 5 factors of LCOE
 - Market and technology characteristics and drivers most likely to impact LCOE trends
- **Used to generate uncertainty distributions, drivers impact**

Biofuels

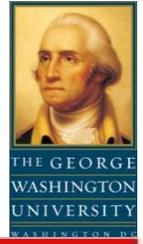


- **Edlmann et al, Int J of Greenhouse Gas Cntrl, 2016**
 - **Objective:** Identify, assess, and rank potential CO₂ leakage scenarios from depleted hydrocarbon resevoirs for guidance and support of decision making processes
 - **Number of Respondents:** 12
 - **Delivery:** In Person Survey
 - **Questions:**
 - Severity and immediacy assessment on a 5-point Likert scale for several leakage scenarios
 - Assessment of expertise for each scenario on 5 point scale
 - **Used to rank scenarios by importance on a PID**

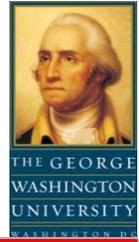


CONSERVATION STUDIES

Coastal Management



- **Ward, Ocean and Coastal Management, 2010**
 - **Objective:** provide a synthesis of the conditions and pressures on the intrinsic assets and values of the Australian marine environment.
 - **Number of Respondents:** 40
 - **Delivery:** Survey
 - **Questions:**
 - 10 point grading scale (mode and 90% credibility interval) for habitats, species changes in ecological processes, influence of pests, effects of environmental pressures (181) – conditions and 3 point trend scale
 - **Used to explore impressions of maritime environment through simple averaging**



Endangered Species

- **Mata et al, Austral Ecology, 2012**

- **Objective:** Determine conservation-orientated management solutions for a listed 'critically endangered' data-deficient insect species (sun-moth) that coincides with human populations.

- **Number of Respondents:** 5

- **Delivery:** Face to Face

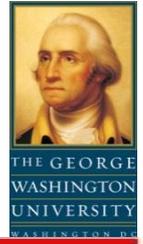
- **Questions:**

- Jointly facilitated BBN development

- Separately provided conditional probability distributions for the BBN. Expert distributions were combined via simple averaging

- **Used to develop sensitivity of species population to level input and developing a distribution for species population change under various scenarios**

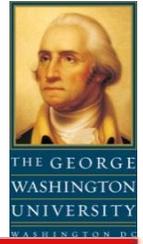
Environment Conservation



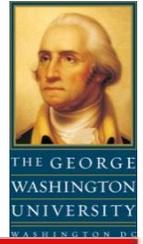
- **Rehr et al, Coastal Management, 2014**

- **Objective:** determine functional relationships between the type and magnitude of stressors and seagrass cover to identify how single or multiple management actions influence the cover of seagrass in Puget Sound
- **Number of Respondents:** 19
- **Delivery:** On line Questionnaire with email and phone contact
- **Questions:**
 - How eelgrass cover would respond to incremental changes in management action on stressors ranging from complete removal to doubling on a 5 point Likert scale
 - Indication of confidence on a 10-point scale
- **Used to determine OrReg analysis of mang. impact**

Endangered Species



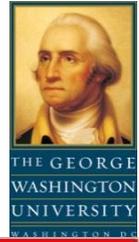
- **Odekoen et al, End Spec Res, 2015**
 - **Objective:** to improve the accuracy of priors in future Bayes models of the abundances and movements of right whales through the mid-Atlantic region.
 - **Number of Respondents:** 10
 - **Delivery:** Survey followed by in person Delphi process
 - **Questions:**
 - Min, max, and mode for number of whales in the region per month (season) and per sex
 - Confidence in each answer as a percent value
 - **Used to develop prior distribution for population study**



Conservation

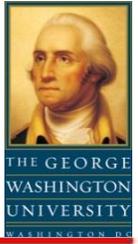
- **Swan et al, Fauna and Flora International, 2016**

- **Objective:** Gauge knowledge for understanding large-scale patterns of wildlife harvest, trade and consumption.
- **Number of Respondents:** 24
- **Delivery:** Questionnaire
- **Questions:**
 - Rate on a Likert scale for agreement statements related to relevant topics and knowledge gaps identified including: occurrence and drivers of caiman harvesting and trade, characteristics of harvesters, fraudulent meat substitution, and use of caiman meat as fish bait.
 - Text rationale for their responses
 - information on their employment role and the area or municipality from which their experience was derived.
- **Used to get simple averages of opinions per region**



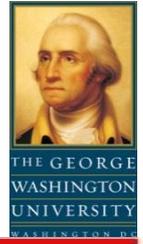
Invasive Species

- **Johnson et al, Ecological Economics, 2017**
 - **Objective:** Determine key demographic parameters of the tegu lizard population in southern Florida.
 - **Number of Respondents:** 10
 - **Delivery:** Face to Face with Delphi process
 - **Questions:**
 - Best guess (median) and its 95% confidence interval for egg, hatchling, 1, 2, and 3+ year survival rates and lifespan, clutch size, and 2008 population
 - **Used to determine rates in a Markov population model to explore mitigation measures. Uncertainty distribution used to calculate EVPI for management action model**

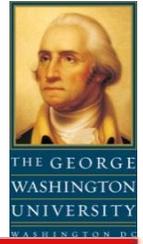


EARTH SCIENCE

Climate Forecasting



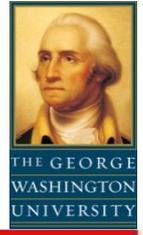
- **Soares et al, Climate Risk Management, 2015**
 - **Objective:** Elicit knowledge and experiences from experts working at the interface between the production and users of Seasonal Climate Forecast (SCF) to better understand its use
 - **Number of Respondents:** 24
 - **Delivery:** Face to Face Group Facilitated
 - **Questions:**
 - Identify and describe Seasonal Climate Forecast (SCF) users in Europe
 - Assign each user to a prediction lead time vs specific use potential matrix
 - Describe known chains of SCF provision and identify commonalities and linkages
 - Identify barriers to use and methods for overcoming them
 - **Used only as brainstorming lists**



Glaciology

- **As et al, Frontiers in Earth Science, 2016**

- **Objective:** Identify the most crucial topics in meltwater retention
- **Number of Respondents:** 34
- **Delivery:** Mail out questionnaire
- **Questions:**
 - Rate each of 18 topics on snow/firn processes and properties in terms of importance to meltwater retention, difficulty level in measuring with accuracy, and difficulty level in modeling with accuracy
 - Rate “the importance of the change in meltwater retention in snow and firn in a warming climate on decadal time scales for mass loss from” (1) Antarctica, (2) Greenland, and (3) other glaciated regions
 - 4 self Assessment ratings for expert weighting
- **Simple averaging used to determine areas for research**



Environment

- **Sebok et al, Water Recourses Research, 2016**

- **Objective:** To quantify catchment water balances and their uncertainty

- **Number of Respondents:** 35 (not all in each phase)

- **Delivery:** Face to Face individual and group assessment

- **Questions:**

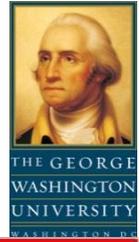
- Sources of uncertainties underlying each method used to estimate the given water balance component at each of the five sites

- The values of the average annual water balance components that belong to the 1, 99, 50, 33, and 66 %-iles

- Distribute %age of fitted variance over uncertainty sources

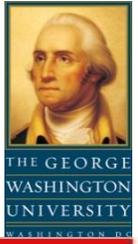
- **Used to obtain uncertainty distributions for water balance components and methods so as to establish water balance and evaluation (ranks) of uncertainty effects**

Greenhouse Gas Emissions



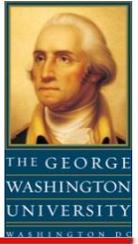
- **McKellar et al, Energy Policy, 2017**

- **Objective:** investigate expected changes in GHG emissions from Canada's oil sands over the period 2013–2033.
- **Number of Respondents:** 15
- **Delivery:** Web Based Survey
- **Questions:**
 - Min, max, 25th, 50th, and 75th %-ile for potential i) emissions intensity reductions due to technology, ii) emissions intensity reductions due to improvements to current processes, iii) emissions intensity increases and iv) drivers of emissions intensity changes for the three primary areas of oil sands activity
 - Text on rationale
 - rank a set of factors wrt impact on emissions intensities
- **Used for uncertainty distribution for quantities and ranked factor lists**

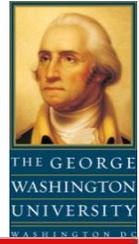


Climate Effects on Crops

- **Martinez-Cruiz et al, Ecological Economics, 2017**
 - **Objective:** Determine the impacts from climate change on crop yields and the effectiveness of specific irrigation techniques in mitigating their impacts
 - **Number of Respondents:** 12
 - **Delivery:** Face to Face
 - **Questions:**
 - Average crop yield given farming condition/irrigation, scenario
 - Given various climate change scenarios would crop yield change by specified %
 - **Used in statistical analysis (ordinal least squares) of crop yield model**



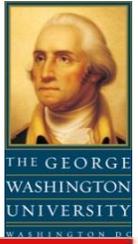
HEALTH



Air Pollution

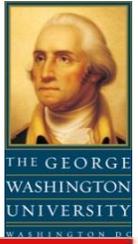
- **Roman et al, Risk Analysis, 2012**

- **Objective:** Determine quantitative probabilistic representations of uncertainty in Value per Statistical Life for air pollution policy assessment
- **Number of Respondents:** 3
- **Delivery:** Personal Interview
- **Questions:**
 - Min, 5%, 25%, 50%, 75%, 95% and mx, VSL mean values for a base case and adjusted cases for influencing factors such as age, income, health status, risk attitude, etc
- **Used to create uncertainty distributions**



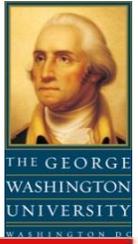
Poverty Assessment

- **Cohen et al, J of Development Studies, 2014**
 - **Objective:** Developing the Multidimensional Poverty Assessment Tool (MPAT) survey instrument and weights for category combination
 - **Number of Respondents:** 39
 - **Delivery:** Survey
 - **Questions: (for weighting scheme)**
 - Allocate % values of as weights for MPAT attributes
 - **Used for determining category weights by simple averaging and exploring uncertainty via expert variance**



Medicine

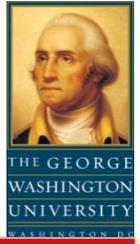
- **Pibouleao et al, Int J of Tech Assess in Healthcare, 2014**
 - **Objective:** Determine success rate of the Neoform stent
 - **Number of Respondents:** 19
 - **Delivery:** Computer-based Survey Method
 - **Questions:**
 - range of number of successes out of 100 patients
 - Mode of number of successes out of 100 patients
 - Distanc between each extreme and the mode was divided by two and experts were asked to specify probability as weight of belief for each interval to obtain a histogram
 - **Used to develop a prior distribution for success rate for a Bayes Hierarchical Model for new release**



Pharmacology

- **Reitbergen et al, Journal of Mixed Methods Research, 2016**
 - **Objective:** Reach consensus among a panel of experts with respect to the elicited study weights
 - **Number of Respondents:** 4
 - **Delivery:** Delphi Method
 - **Questions:** Experts were asked to read the five drug study reports one current and four past studies and
 - rank each of the previous studies wrt relevance for the current study
 - weight each previous study expressed as the percentage of the information captured in the auxiliary study willing to include in the analysis of the current study
 - Text indicating motivation for weights
 - **Used to determine appropriateness of method in establishing weights**

Foodborne Disease Transmission



- **Vally et al, Epidemiol. Infect., 2016**
 - **Objective:** Estimate the proportion of transmission that was foodborne, person-to-person or environmental for each relevant pathogen
 - **Number of Respondents:** 10
 - **Delivery:** Updated Survey
 - **Questions:**
 - Best guess and 90% credibility interval for transmission proportion for several pathogens
 - 1-10 rating on expertise per pathogen
 - 1-5 rating on influence of data
 - 1-5 rating on change of distribution given data
 - **Used to establish uncertainty distribution**