Pooling Expert Assessments

Antonio Possolo Pedro Espina

June 8th, 2010

1 Summary

In the course of the Plume Team telecon of Monday, June 7th, six experts produced estimates of the average number of barrels of oil leaked per day from all sources of leaks that had been evaluated. Applying a statistical procedure to reconcile assessments made by multiple experts produces an interval that, with 95 % confidence, should include the true value of that average: this interval ranges from 15 to 40 thousand barrels of oil per day.

2 Assessments

The following table summarizes the intervals (in thousands of barrels of oil per day) that six experts provided during the telecon, that each expert believes should include the true value that is sought (please let us know if any of the names or numbers are incorrect, or whether additional names and numbers ought to be included — we can rerun the analysis very quickly, if need be):

	LOW	HIGH
Alberto	20	30
Ira	20	34
Jim	20	30
Juan	20	30
Omer	25	40
Steve	15	34

3 Approach

We use probability distributions to model the uncertainty implied in each expert's assessment, and then apply a statistical method to reconcile these distributions that is due to Lindley [1983]. The result is a probability distribution that represents the group's collective state of knowledge about the spill.

Obviously, not all views held by team members are yet represented. In particular, and for the reasons that Pooji articulated in his eMail from yesterday at 9:40pm, we have not used his early assessment.

There also is an issue unresolved that Frank has brought up cogently: is the team estimating true average volume of oil spilled, or maximum volume? Listening to the discussion yesterday, it seems to us that all the experts but Frank are doing the former — that's why the preliminary results that Frank sent last evening are not included in the table above, or otherwise in this analysis.

4 Details

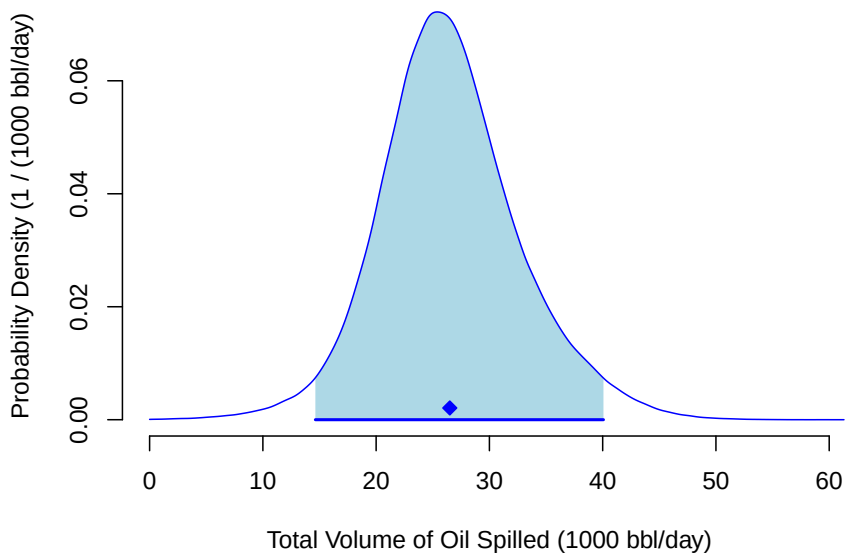
No one expressed quantitatively his level of confidence in the interval provided. Judging from the reaction our question prompted, when we asked if these might be more like 2σ confidence intervals or like 1σ intervals, or otherwise whether the experts were very confident in their results, it seems to us that we may fairly represent the sentiment of the majority by saying that these may represent assessments that the experts themselves consider *likely* to *very likely*.

According to the *Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties* that have been used by the Intergovernmental Panel on Climate Change in the preparation of their fourth assessment report [Solomon et al., 2007], *likely* is taken to mean confidence of at least 66 %, and *very likely* is taken to mean confidence of at least 90 %. We will use the geometric mean of these two values, and proceed on the tentative assumption that the intervals provided by the experts are like confidence intervals that cover their target with confidence level 77 %.

Further assuming that the confidence intervals purport to Gaussian situations, and using the confidence level just mentioned, we derived the means and standard deviations of the corresponding distributions: for example, for Juan's,

the implied mean is 25 000 bbl/day and the implied standard deviation is 4 159 bbl/day.

We produced a sample of size 500 000 by repeating the following steps this many times: select one expert uniformly at random; draw one value from the selected expert's distribution. The following figure is a smooth histogram of the results. The corresponding mean (dark blue diamond) is 26 500 bbl/day, and the standard deviation is 6 250 bbl/day. The shaded area comprises 95 % of the area under the curve: its projection onto the horizontal axis (thick, blue, horizontal line segment) is a 95 % confidence interval for the average total volume of oil spilled per day: it ranges from 15 000 bbl/day to 40 000 bbl/day.



References

D. V. Lindley. Reconciliation of probability distributions. *Operations Research*, 31(5):866–880, September-October 1983.

S. Solomon, D. Qin, M. Manning, M. Marquis, K. Averyt, M. M. B. Tignor, and H. L. Miller, editors. *Climate Change 2007 — The Physical Science Basis*. Cambridge University Press, New York, NY, 2007. Working Group I Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).