

27/11/2012

Report on the GUM Online Survey

(conducted 2 February – 15 June, 2012)

Walter Bich, JCGM-WG1 convener

Introduction

The “Guide to the expression of uncertainty in measurement” (GUM) was first published in 1993 and reprinted in 1995. The current document ([JCGM100:2008](#)) is essentially the 1995 GUM with minor corrections. For a number of reasons [1], working group 1 of the JCGM proposed to the JCGM to start a revision of the GUM, which was accepted. A “motivation and scope” supporting document had been prepared for the JCGM consideration. Subsequently, in order to gain as much feedback as possible in the early stages of drafting the revised GUM, an online questionnaire was prepared, based on that “motivation and scope” document. The questionnaire was uploaded on the joint BIPM and OIML web portal, and widely advertised. The present report gives the essentials of the opinions that have emerged from the survey. A pdf file containing the questionnaire, summary information about the responses to each of the questions and the [collated responses](#) to each of the open questions has been uploaded on the JCGM-WG1 website. The file was also sent to those survey respondents who provided their email addresses.

Summary of Survey Results

- The online survey was accessed by 200 persons, of which 130 provided name and contact information and 8 skipped all the questions. Notable respondents included the presidential Office of PTB, the future Director of the BIPM, and several metrologists, mostly from NIST and NPL.
- The three most represented professional categories were metrologists (36 %), other scientists (23 %) and engineers (22 %).
- 35 % of the respondents said they have a “good” degree of knowledge of the GUM, followed by 32 % who said that their degree of knowledge is “sufficient for my needs”, whereas 13 % claimed an excellent knowledge.
- The GUM is used “regularly” in metrology by 35 % of the respondents, in research by 28 % of them, in teaching/education by 29 % and in industrial practice by 21%. These data are delicate to interpret since the categories were not mutually exclusive. The majority of respondents appear to be involved in more than one application, a situation that is well known, at least to metrologists.
- The typical number of useful replies to open questions was about 60. This comparatively modest fraction of people daring to express opinions on the subject compared to people interested in it, or needing to use it, might be a representative sample of the whole population of GUM users.

Analysis of open questions

The most interesting outcome from the survey are the opinions expressed about the open questions. In the following, I will attempt to give a qualitative evaluation for these opinions.

The first set of open questions concerns the reasons why it was decided to revise the GUM. The reader was asked to express her/his opinion on the validity of each reason.

27/11/2012

The first reason was

Internal inconsistency: Conflicting (frequentist and Bayesian) views of probability, which cause a number of problems, especially in the evaluation of a coverage interval.

Opinions vary, of course. A good number of respondents either confess insufficient knowledge or are unaware of the problem, or do not care, or, while recognizing the problem, think that this is not of practical concern. However, about 20 % recognize the existence of a consistency problem and the need for its solution.

The second reason was

Internal inconsistency: Conflicting use of terminology, such as for the term “value”

This is better analyzed in conjunction with the fourth reason

External inconsistency: With respect to the VIM 3,

because many misunderstood Q2 or, in replying to it, involved also VIM3.

Many (perhaps 50 %) do not see any practical problem. The others are in favour of consistency, both internal and with VIM3. Five think that the VIM3 should be aligned with the GUM, rather than the opposite.

The third reason was

External inconsistency: With respect to Supplements 1 and 2 and the other documents being developed according to a consistent conceptual framework.

Many are unable to detect inconsistencies, or do not care. One does not see any of them, claiming that the GUM *is* intrinsically Bayesian. Most do agree, either showing awareness of the problem or simply recognising the value of consistency.

The fifth reason was

Inadequacy: Since its publication, the need to evaluate measurement uncertainty has been recognised in an increasing number of scientific disciplines, for which the present GUM does not provide sufficient guidance.

There was more interest in this specific issue, as expected (73 responses). Many think that the GUM is inadequate in their specific field. In this respect, there is a lot of suggestions that should be carefully considered in the revision. Guidance is requested in optics, acoustics, accelerometry, mass calibration and chemistry, biology, frequency-dependent quantities, laboratory medicine and medical physics, ionizing radiation, repeated measurements (!), social sciences, microbiological enumeration.

Some recognize the risk of a document addressing all and each of these issues, most think that examples are the good way to give guidance. One points to the fact that “*There are increasing number of disciplines using the top down approach to uncertainty rather than GUM and these have been accepted by accreditation bodies. In addition there are papers appearing in journals questioning the relevance of GUM to chemical testing in particular and emphasising the usefulness of PT and collaborative testing.*”

A representative reply is “*Yes, the scope of GUM (in context of different scientific disciplines) is too narrow.*”

27/11/2012

Replies here are also interesting in that they indirectly restate the good overall balance of the existing GUM. Some people find it too difficult, some others too simple for real applications, thus preferring to use its Supplements.

Reason 6 was

Inadequacy: The present GUM is focused mainly on the situation of a physical quantity which "...can be characterized by an essentially unique value". This has probably inhibited the wide use of the GUM in some scientific disciplines, such as chemistry and biology, in which a definition of the measurand according to the requirements of the present GUM can be impossible.

One "*would add the measurement of quantities which are function of time*". Another feels that "*Application to qualitative testing requires more support*". A third points to "*CFU or colony forming units*" as a potentially problematic measurand. Another writes "*I do not know of any measurement that is not related to a measurand*". However, a further one (a chemist) says "*At the moment, this is one of the largest shortcomings of the GUM*". My feeling is that those dealing with physical quantities do not see problems of adequacy in this respect, whereas those involved with chemistry, biology and similar disciplines do.

The next reason was

Ambiguities: Notational and terminological

Most think that this is not a major issue, although "*Of course ambiguity should be avoided where possible*."

I sympathize very much with the following reply:

"These will always be present and over zealous attempts to overcome them can lead to an unreadable document".

The questionnaire then went on by enumerating the lines along which it is intended to carry out the revision. The first of these was

Clarity of presentation

While all praise clarity, of course, there is no consensus on whether the present GUM is sufficiently clear or there are margins for improvement, with a slight majority for the former option.

Notable comments:

"Yes. It is very important that, although derived documents for the different sectors are provided by different organizations, GUM, as the common source, should be as clear as possible, while being comprehensive, unambiguous and deep enough."

"Many people find the GUM difficult to read."

"I think the GUM is pretty well written, and is more practical than I expected it to be."

The next, less obvious, was

Structure as close as possible to that of the present GUM.

The vast majority agrees with this principle.

An interesting suggestion is

"Would like to see the appendices folded into the chapters"

The next was

27/11/2012

Level of presentation comparable to that of the present GUM.

Also in this case there are people thinking that the present level is too high, others judge it too low, most think that the present balance is good.

The following was

Better specification of the conditions of applicability.

This question was largely misunderstood, so that *a posteriori* it can be concluded that it was ill-posed. While the question was intended as referred to the law of propagation of uncertainty, many indeed interpreted it in a broader sense, so that one can find replies such as

"The best specification should be GUM to be applied at all times and in all places." ,

or

"Yes, but be careful not to make a situation where unscrupulous people can point at it and claim an exemption."

Those who understood correctly were in favour.

Increased guidance in the evaluation of standard uncertainties associated with input estimates.

Of course, most do agree. Again, emphasis is given to more examples.

A delicate issue was

Bayesian approach extended to Type A evaluations of uncertainty.

Only a part of respondents (about 25 %) showed adequate awareness of the problem and the proposed solution. Almost all these were in favour of the proposed solution, one or two proposing the opposite.

Representative comments are

"O.K., even though this means to knock at an open door. Besides, I would recommend eliminating the concepts of "type-A evaluation" and "type-B evaluation" as confusing."

"It 's the main point for revision of present GUM."

Increased number of examples, with applications taken from biology, chemistry etc.

There is almost general agreement on this point.

"Definitely a need in the field of Laboratory Medicine."

"More emphasis needs to be given in testing"

"Even the "easier" areas of dimensional metrology would benefit from increased examples."

"A standard set of examples, especially for verifying and benchmarking computation software for GUM problems, would be very useful."

"I find that having more, simple, examples is better than fewer, complicated ones"

"Excellent - and should include rationale of why applicable to clinical lab testing/measurement - which is poorly accepted in my circles."

27/11/2012

Links to GUM Supplements where appropriate.

Of course, there is general agreement. A pleasant comment is
"I have found the electronic links inserted in the 104 supplement really useful."

What is your view on this timescale?

Realistic, adequate, desirable and the like balanced almost perfectly with *unrealistic, aggressive, ambitious* etc.

This is the end of the survey. If you have any additional remarks, please provide them here:

It is not easy to summarize the additional remarks. Many thank us for having been asked to comment, others re-state their fear that the document is to be changed too deeply, others also are not sure that a revision is needed at all. One points at an inconsistency in example H1, that needs to be considered. A few wish us good luck, which I find is a good way to conclude this review.

Conclusion

One should clearly bear in mind that a sample of about sixty persons is not sufficiently representative of the audience of the GUM at large. This said, and even trying to be as unbiased as possible, I feel that the overall outcome of the Survey is encouraging. The lines along which the revision is being carried out are largely shared by commenters, so that no drastic changes are necessary and we can confidently progress as planned. Apart from two well-known opposers, the comments were mostly positive and many useful suggestions were collected. The challenge for JCGM-WG1 will be that of being able to implement these suggestions and in general to meet the very high expectation surrounding our job.

References

[1] W Bich *et al.* "Revision of the "Guide to the Expression of Uncertainty in Measurement", [2012 Metrologia 49 702](#).