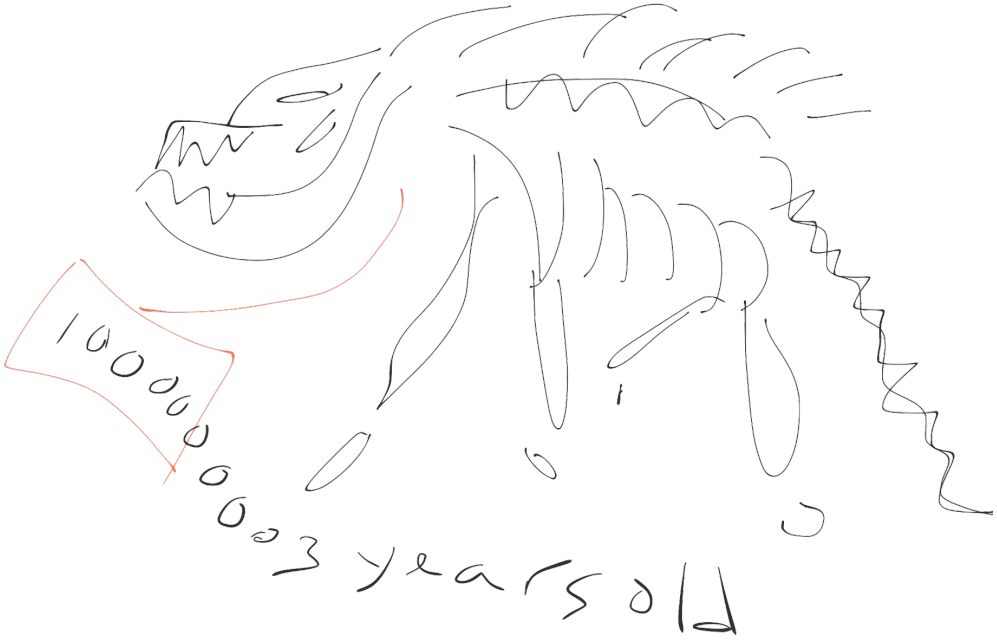
European Commission

SIGNIFICANT DIGITS

Responsible Use of Quantitative Information



@Brussels, Fondation Universitaire
9-10 June 2015

D. Albrecht, V. Šucha, J. Ravetz, J. van der Sluijs,
M. Giampietro, D. Dankel, P. Stark, Z. Kovacic,
A. Saltelli, J. Kay

Editor: A. Perira

Report EUR 27387 EN

Joint Research Centre

European Commission
Joint Research Centre
DDG01 Econometrics and Applied Statistics

Contact information
JRC STS
Address: Joint Research Centre, Via E. Fermi, 2749 21027 I-Ispra (VA)
E-mail: jrc-sts@jrc.ec.europa.eu
Tel.: +39 0332785340

JRC Science Hub
https://ec.europa.eu/jrc

JRC96441

EUR 27387 EN

ISBN 978-92-79-50344-3
ISSN 1831-9424

doi:10.2760/555227

Luxembourg: Publications Office of the European Union, 2015

Abstract
We live in an age when good policies are assumed to be evidence-based. And that evidential base is assumed to be at its best when expressed in numbers. The digital information may be derived from quantitative data organised in statistics, or from qualitative data organised in indicators. Either way, evidence in digital form provides the accepted foundation of policy arguments over a very broad range of issues.
In the policy realm there are frequent debates over particular policy issues and their associated evidence. But only rarely is the nature of the evidence called into question. Such a faith in numbers can be dangerous. Policies in economic and financial policy, based on numbers whose significance was less than assumed, recently turned out to be quite disastrously wrong. Other examples can easily be cited. The decades-long period of blaming dietary fats for heart disease, rather than sugar, is a notable recent case. We are concerned here with the systemic problem: whether we are regularly placing too much of an evidentiary burden on quantitative sciences whose strength and maturity are inherently inadequate. The harm that has been done to those sciences, as well as to the policy process, should be recognised. Only in that way can future errors be avoided.

Preamble

We live in an age when good policies are assumed to be evidence-based. And that evidential base is assumed to be at its best when expressed in numbers. The digital information may be derived from quantitative data organised in statistics, or from qualitative data organised in indicators. Either way, evidence in digital form provides the accepted foundation of policy arguments over a very broad range of issues.

In the policy realm there are frequent debates over particular policy issues and their associated evidence. But only rarely is the nature of the evidence called into question. Such a faith in numbers can be dangerous. Policies in economic and financial policy, based on numbers whose significance was less than assumed, recently turned out to be quite disastrously wrong. Other examples can easily be cited. The decades-long period of blaming dietary fats for heart disease, rather than sugar, is a notable recent case.

We are concerned here with the systemic problem: whether we are regularly placing too much of an evidentiary burden on quantitative sciences whose strength and maturity are inherently inadequate. The harm that has been done to those sciences, as well as to the policy process, should be recognised. Only in that way can future errors be avoided.

In this workshop we will review a seminal essay by Andrea Saltelli and Mario Giampietro, 'The Fallacy of Evidence Based Policy'. That paper contains positive recommendations for the development of a responsible quantification. The workshop will be devoted to the analysis and development of those ideas.

Jerome Ravetz

Agenda

@ Fondation Universitaire, Rue d'Egmont, 11, Brussels

June 9th

Fondation Universitaire, Room Felicien Cattier

10.00 Registration and coffee
11.00 Introduction by **Daniel Albrecht**, DDG01
11.05 **Vladimír Šucha**: Opening
11.30 **Jerome Ravetz**: 'The Significance of Digits'
12.30 **Jeroen van der Sluijs**: On the extinction of craft skills with numbers: the case of "Overall, 7.9% of species are predicted to become extinct from climate change"
13.30 - 14.30 Lunch buffet
14.30 **Mario Giampietro**: Quantitative story telling as a therapy for hypocognition
15.30 - 16.00 Coffee & tea break
16.00 **Dorothy Dankel**: Fisheries quota advice for management: Significant scripts and significant digits
17.00 General discussion
17.30 End of DAY 1

June 10th

Fondation Universitaire, Room A

09.00 Coffee & tea
09.15 Summary of First day
09.30 **Philip Stark**: Pay no attention to the model behind the curtain
10.30 **Zora Kovacic**: The simplification of complexity: challenges of sustainability science for governance
11.30 - 12.00 Coffee & tea break
12.00 **Andrea Saltelli**: Evidence based policy: handle with care
13.00 14.00 Lunch buffet
14.00 **John Kay**: Knowing what we don't know
15.00 Final Discussion
16.00 END

Abstracts

Significant Digits: Opening

Vladimír Šucha

European Commission, Director General of DG Joint Research Centre, Brussels, BE

Director General Vladimír Šucha will introduce the workshop, outlining the relevance of this endeavour in the broader context of the DG Joint Research Centre's work and its commitment to quality scientific advice to policy, *viz à viz* and with special relevance to the new regulations and advice frameworks recently proposed by the European Commission.

The Significance of Digits

Jerry Ravetz

Institute for Science, Innovation and Society, Univ. of Oxford, UK

Andrea Saltelli and Mario Giampietro[1] have shown us how to solve the crisis of 'evidence-based' policy, through an enriched conception of quality of science. Here I would like to use my historical perspective to suggest how the problem came to be. Its origins lie in a certain conception of knowledge, which can be summed up as a faith in digits as nuggets of truth. Since this is so deep in our modern scientific culture as to pass unnoticed, its exposure and correction will not be a quick or straightforward process. But we must start somewhere, and here we are.

The existence of a crisis is beyond doubt. Economics, the king of the sciences of society, has been exposed as vacuous in its main function, namely explaining and helping to guide the running of the economy. And economics has long prided itself on being the physics of society. In this it has ignored the actual state of physics for the last century, riven by uncertainty and paradox. For economists, and all the practitioners of social would-be technologies who have imitated it, the faith was simple. Given the reliance on numerical data and mathematical methods, what could possibly go wrong? The answer turned out to be 'everything'.

[1] See The fallacy of evidence based policy – Available at: http://www.andreasaltelli.eu/file/repository/PaperDraftPolicyCartesianDream_16c.pdf

This delusionary faith has complex roots, in traditions of philosophical thought and social practice. Here I focus on digits, as a core element and symptom of the pathology. Other colleagues here have analysed the misuse and abuse of numerical information at great depth. For brevity would like to use just two examples of the unnoticed, or rather suppressed, contradictions in numerical information.

One is a variant on the classic 'fossils joke', where we consider the calculation: 65,000,000 – 3 = 64,999,997. This illustrates the ambiguity in the zero, functioning as either counter or filler, and its meaning depending on context. Thus even in digital information semantics sometimes dominates over syntax. Who knew that? The other is the question, how many significant digits should we use in expressing an 'error-bar'? Is it really meaningful to say that we know that (say) the 95% upper limit of probability of an estimate is 3.65 and not 3.64 or 3.66? If not, is there a clear meaning there at all? My point is that a practice that depends on the concealment of its confusions and contradictions will be particularly vulnerable to misuse and abuse. I opened a discussion of these issues in the chapter on 'Obscurities at the Foundations of Theoretical Science' in my earlier book.

I offer two historical parallels. Descartes' classic denunciation of humanist teaching on ethics, as "towering and magnificent palaces with no better foundation than sand and mud" might now become applied to the mathematical policy sciences. And the understanding and practice of scripture-based religion in the West was transformed in modern times by the critical study of its sources. Will this present crisis provide the opportunity for science to reflect and catch up?

Since so many policy issues now involve quantities with 'not even one significant digit', we need an appropriate new arithmetical language, based on 'soft numbers' using 'sparse digits' and a dynamical graphical arithmetic of uncertainty and quality.

On the extinction of craft skills with numbers: the case of "Overall, 7.9% of species are predicted to become extinct from climate change"

Jeroen Van Der Sluijs

Centre for the Study of the Sciences & the Humanities, University of Bergen, Norway

Since the establishment in the 1980s of science-policy interfaces around

anthropogenic climate change attempts to quantify climate risks have produced various “magic numbers”. The classic example is the 1.5-4.5 °C range for the Earth’s climate sensitivity. Such numbers are produced in a particular way and within a particular context and are conditioned on a complex set of assumptions covering a wide range of scientific statuses ranging from crude speculation to well established knowledge. Once thrown over the disciplinary fence, important caveats tend to be ignored, uncertainties compressed and numbers used at face value. Poor practice in communication of uncertainty and the loss of what Jerome Ravetz calls “craft skills with numbers” has created a host of misunderstandings and miscommunication in quantitative information on climate change at the science policy and science society interfaces. This paper analyses the case of quantification of the risk that climate change poses to biodiversity. In 2004, Thomas *et al.* (doi:10.1038/nature02121) were the first to quantify extinction risks from climate change. On the basis of a highly aggregated species-area relationship model and climate projections of habitat loss, they predicted that by 2050 “15–37% of species in our sample of regions and taxa will be ‘committed to extinction’.”. Recently, based on a meta-analysis, Urban (2015 doi:10.1126/science.aaa4984) concluded that “overall, 7.9% of species are predicted to become extinct from climate change”. This paper will critically reflect on the meaning of the number “7.9%” and discuss the two papers from the viewpoint of craft skills with numbers and good practice in uncertainty communication.

Quantitative story telling as a therapy for hypocognition

Mario Giampietro

Institut de Ciència i Tecnologia Ambientals (ICTA) -Universitat Autonoma de Barcelona, Spain

Numbers in isolation do not carry meaning; they have to be always contextualised (examples of blunders and problematic formalizations using indicators). Numbers do not carry enough information for generating a robust integrated assessment - you need vectors and matrices (data arrays) and grammars in order to transfer information across levels and dimensions. Especially important is to be aware of the distinction between information referring to types and information referring to special instances.

When dealing with the analysis of complex systems it is impossible to adopt a contextualisation "one size fits all" so, the more we try to formalise complex

problems, the more we generate *hypocognition*.

The way out is an integration of different quantitative types of analysis properly contextualized that have to be handled simultaneously using semantic relations. But if one decides to adopt this solution one has to acknowledge the arbitrariness of the choice of your stories. The talk concludes with examples of quantitative story-telling information systems.

Fisheries quota advice for management: Significant scripts and significant digits

Dorothy J. Dankel

Centre for the Study of the Sciences & the Humanities, University of Bergen, Norway

The oldest and most prominent of scientific institutions in Europe with a mandate to provide advice on ecosystem-based management of the Ocean is the International Council for the Exploration of the Sea (ICES). ICES is made up of over 1000 scientists who are active in annual Expert Groups and produce annual reports with annual advice delivered as the "Total Allowable Catch" (TAC). The well-oiled TAC-machine does its job as dictated by ICES' clients, but here I problematize the perception that TAC advice should be given as a single number. Often, a single and conclusive scientific answer will never be available for complex systems such as fisheries and marine ecosystems. In such cases, more research does not lead to less uncertainty, but can lead instead to unforeseen complexities (Van der Sluijs et al., 2005a, 2005b, 2010). Values are in dispute when the potential impacts of decisions based on uncertain models have very large biological and/or social consequences. Among ICES' goals in its new Strategic Plan (2014-2018) is increased transparency and better and increased dialogue with stakeholders, however we still observe stakeholder reluctance to develop alternative ways of delivering advice. Furthermore, I use the term "scripts" as a reference to Goffmann (Giddens, 1998) to describe the changing roles of ICES scientists the last decade. We observe a shift from passive scientific reviews to active science that increasingly is in dialogue with stakeholders in the development of new management strategies. However, the plurality of roles of single scientists is not arbitrary, and I argue that scripts and digits are inevitably intertwined. I conclude by introducing a method, the "Confidence Level Harvest Control Rule" for fisheries advice that potentially remedies both the script-juggling problem of scientists and the significant digit/significant model problem for society.

"Roles specify generalized expectations to which an individual has more or less closely to conform when in a particular situated context. […]. The self consists in an awareness of identity which simultaneously transcends specific roles and provides an integrating means of relating them to personal biography: and a set of dispositions for managing the transactions between motives and the expectations 'scripted' by particular roles"

(Giddens, 1988) [p. 258-259).

References:

Giddens, A. 1988. *Goffman as a systematic social theorist*. *In* Erving Goffman: Exploring the interaction order, pp. 250-279. Ed. by P. Drew, and A. Wootton. Polity Press.

Van der Sluijs, J. P. 2005a. Uncertainty as a monster in the science policy interface: four coping strategies. Water Science and Technology, 52: 87 – 92.

Van der Sluijs J.P.; Craye, M.; Funtowicz, S.; Kloprogge, P.; Ravetz, J.; and Risbey, J. 2005b. Combining Quantitative and Qualitative Measures of Uncertainty in Model based Environmental Assessment: the NUSAP System. Risk Analysis 25 (2) 481-492.

Van der Sluijs, J. P., van Est, R., and Riphagen, M. 2010. Beyond con-sensus: reflections from a democratic perspective on the interaction between climate politics and science. Current Opinion in Environmental Sustainability, 2: 409 – 415.

Pay no attention to the model behind the curtain

Philip B. Stark

Univ. of California, Berkeley, USA

Watch me pull a probability out of my model ... Presto! Typical attempts to quantify risk for policy makers involve inventing a stochastic model for a phenomenon; fitting some parameters in that model to data; then declaring that features of the fitted model, called "probabilities" within the model, magically apply to the real world. Pulling this probability rabbit from the analyst's hat generally involves several statistical and philosophical sleights of hand: confusing the map (the model) with the territory (the phenomenon), confusing rates with probabilities, and distracting attention from the moment that probability entered the hat (i.e., the moment the stochastic model was assumed to have generated the data). Bedazzling the

onlookers with a sparkly array of Greek symbols, heroic high-performance computing, and superficial attempts to quantify the uncertainty renders the show all the more dramatic.

The simplification of complexity: challenges of sustainability science for governance

Zora Kovavic

Institut de Ciència i Tecnologia Ambientals (ICTA) - Universitat Autònoma de Barcelona, Spain

The criticism to evidence based policy is a criticism to the idea that science can provide policy makers with all the information that is needed in order to decide for the common good (Funtowicz and Strand 2007). The assumption behind this model of science-policy is that (1) scientific information is a faithful representation of reality, whose interpretation and use are unequivocal, and that (2) policy decisions are based on the scientific information provided by the scientific community.

The first assumption is addressed by looking at instances of scientific information used to discuss policies. Based on the case of the indicators produced following the Beyond GDP Conference of 2007 and of the scientific evidence used in water management in Israel, I will give examples of the high level of ambiguity associated with scientific information and of the multiple representations of the same problem that can be produced by using different scales of analysis, different narratives and different time frames. The plurality of representations and perspectives that can be found in science suggest that scientific information reflects the normative stand of the analyst in relation to what is to be considered relevant in the framing of a problem – rather than a faithful representation of reality.

The second assumption is addressed by looking at the management of the financial crisis of 2008. In this case, policies seem to be irresponsive to the improvement of models, to more refined information, and to more data. In this situation, to what extent is it worth producing more accurate measurements, more quantitative information, and more indicators?

I argue that a better understanding of complexity can provide some of the tools needed to deal with uncertainty and pluralism. Complexity is defined as a systematic study of the way in which different perspectives are expressed in different pre-

analytical choices and in the resulting non-equivalent representations of the same problem. Complexity thus offers a way to assess the usefulness of the scientific information used in different policy contexts.

References:

Funtowicz, S.O. and Strand, R. 2007. Models of science and policy. In: Traavik, T. and Lim, L.C. (eds.). 2007. *Biosafety first: Holistic approaches to risk and uncertainty in genetic engineering and genetically modified organisms.* Trondheim: Tapir Academic Press.

Evidence based policy: handle with care

Andrea Saltelli

Centre for the Study of the Sciences & the Humanities, University of Bergen, Norway

The use of science for policy is at the core of a perfect storm generated by the insurgence of several concurrent crises: of science, of trust, of sustainability. The prevailing modern positivistic model of science for policy, known as 'evidence based policy', is based on dramatic simplifications and compressions of available perceptions of the state of affairs and possible explanations (*hypocognition*). Therefore this model can result in seriously flawed prescriptions.

The primacy of science to adjudicate political issues must pass through a serious assessment of the level of maturity and effectiveness of the various disciplines. The solution implies abandoning dreams of prediction, control and optimization obtained by relying on a limited set of simplified narratives to define a problem to be dealt with and move instead to an open exploration of a broader set of plausible and relevant stories.

We make examples of instrumental or otherwise vacuous use of evidence for policy. Computing climate's dollars are a case in point. We mention some strategies to spot problems and to tackle them.

Knowing what we don't know

John Kay

London School of Economics, UK

I review three model types – the cost benefit model (WEBTAG) used for assessing UK transport projects, the value for money models used to justify PFI (private finance initiative) schemes, and the value at risk (VAR) models widely employed in the financial sector. These have a common structure:

- write down the calculations you would make if the world were completely known
- since very little of it is in fact known, almost all the numbers in the cells of the spreadsheet are invented
- a standard template is applied to a widely varied class of problems.

I will analyse the deficiencies of these approaches and what might be done instead.

Biographical Notes

Vladimír Šucha

Vladimir Šucha is Director-General of the Joint Research Centre of the European Commission, its in-house scientific service. He was Deputy Director-General of the JRC between 2012 and 2013. Prior to that, he spent 6 years in the position of director for culture and media in the Directorate-General for Education and Culture of the European Commission. Before joining the European Commission, he held various positions in the area of European and international affairs. Between 2005 and 2006, he was director of the Slovak Research and Development Agency, national body responsible for funding research. He was principal advisor for European affairs to the minister of education of the Slovak Republic (2004-2005). He worked at the Slovak Representation to the EU in Brussels as research, education and culture counselor (2000-2004). In parallel, he has followed a long-term academic and research career, being a full professor in Slovakia and visiting professor/scientist at different academic institutions in many countries. He published more than 100 scientific papers in peer-reviewed journals.

Jerome Ravetz

Jerome R. Ravetz was born in Philadelphia, and attended Central High School and Swarthmore College. He came to England on a Fulbright scholarship to Trinity College, Cambridge, where he did a Ph.D. in Pure Mathematics. He lectured in the History & Philosophy of Science at Leeds University. He is a leading authority on the social and methodological problems of contemporary science. With Silvio Funtowicz he created the NUSAP notational system for assessing the uncertainty and quality of scientific information, in *Uncertainty and Quality in Science for Policy*, and also the concept of Post-Normal Science, relevant when 'facts are uncertain, values in dispute, stakes high and decisions urgent'. His earlier seminal work *Scientific Knowledge and its Social Problems* (Oxford U.P. 1971, Transaction 1996) now has a smaller sequel, *The No-Nonsense Guide to Science* (*New Internationalist* 2006). His other publications include a collection of essays, *The Merger of Knowledge with Power* (Mansell 1990). He is now working on a 'New Arithmetical Language for Policy', based on 'soft numbers', employing sparse arithmetics and dynamical graphical methods.

Jeroen van der Sluijs

Jeroen P. van der Sluijs is professor in Theory of Science & Ethics of the Natural Sciences at the University of Bergen and associate professor in new and emerging risks at Utrecht University. His research focusses on scientific controversy on environmental and health risks in situations where scientific assessment is used as a basis for policymaking before conclusive scientific evidence is available on the causal relationships, the magnitude, and the probabilities of these risks. His work seeks to understand and improve the science-policy interface in a context of deep uncertainty by contributing and applying deliberative methods and tools for knowledge quality assessment. He has been working on contested science in the fields of climate change, pollinator decline, fish stock assessments, endocrine disruptors, electromagnetic fields, nanoparticles, underground storage of CO2, risk migration in sustainable technologies. Jeroen has published 78 articles in peer reviewed scientific journals and 27 peer reviewed book chapters.

Mario Giampietro

Mario Giampietro has BSc degrees in Chemical Engineering and Biological Sciences (Università la Sapienza, Rome), an MSc degree in Food System Economics, and a PhD in the Social Sciences (Wageningen University, the Netherlands). Currently he is ICREA Research Professor at the Institute of Environmental Science and Technology (ICTA) of the Autonomous University of Barcelona (UAB), Spain. He has (co)authored over 150 publications, including six books, in research themes such as multi-criteria analysis of sustainability; integrated assessment of scenarios and technological changes; alternative energy technologies (notably biofuel); energy analysis; biocomplexity and sustainability; multi-scale integrated analysis of societal and ecosystem metabolism; science for governance.

Dorothy Dankel

Dorothy J. Dankel was raised in Indiana, USA by newspaper reporters and graduated from Hillsdale College, a liberal arts school in Michigan, USA. Since 2001, she has been living in Norway where she earned master's and doctorate degrees in fisheries management. Dorothy's research spans two areas: bio-socio-economic integrated assessments of commercial fish stocks and the ethical, legal and social aspects of science and biotechnologies. Dorothy and her husband, a researcher on adipose tissue and obesity, are preparing their two daughters, ages 4 and 2, for a changing world.

Philip Stark

Philip B. Stark is Professor and Chair, Department of Statistics, University of California, Berkeley. His research centers on uncertainty quantification in physical, social, and life sciences. He was a Presidential Young Investigator and won the UC Berkeley Chancellor's Award for Research in the Public Interest. He consults for major corporations and for many branches of government, including the U.S. Department of Justice, the Federal Trade Commission, the U.S. Department of Agriculture, and the U.S. Census Bureau. He has testified to the U.S. House of Representatives, and the State of California Senate and Assembly. His CV is at www.stat.berkeley.edu/~stark/bio.pdf

Zora Kovacic

Zora Kovacic is a postdoctoral researcher at the Institute for Environmental Science and Technology (ICTA) of the Universitat Autònoma de Barcelona (UAB). She works on science for governance, with a focus on complexity theory and on the quality assessment of sustainability indicators. She is interested in the integration of participatory methods and quantitative analysis in support of decision-making processes. Zora holds a Bachelor degree in Economics and Development Studies from the School of Oriental and African Studies, and an MSc and PhD degree in Environmental Science and Technology from the Universitat Autònoma de Barcelona.

Andrea Saltelli

Andrea Saltelli has worked on physical chemistry, environmental sciences, applied statistics, impact assessment and science for policy. His main disciplinary focus is on sensitivity analysis of model output, a discipline where statistical tools are used to interpret the output from mathematical or computational models, and on sensitivity auditing, an extension of sensitivity analysis to the entire evidence-generating process in a policy context. A second focus is the construction of composite indicators or indices. Till February 2015 he led the Econometric and Applied Statistics Unit of the European Commission at the Joint Research Centre in Ispra (I), developing econometric and statistic applications, mostly in support to the services of the European Commission, in fields such as lifelong learning, inequality, employment, competitiveness and innovation. He participated to the training of European Commission staff on impact assessment. At present he is visiting

researcher at the Centre for the Study of the Sciences and the Humanities (SVT) - University of Bergen (UIB), and a host at the Institut de Ciència i Tecnologia Ambientals (ICTA) -Universitat Autonoma de Barcelona (UAB).

John Kay

John Kay is an economist whose career has spanned the academic world, business and public affairs. Currently, he is a visiting Professor of Economics at the London School of Economics, a Fellow of St John's College, Oxford. He is a Fellow of the British Academy and of the Royal Society of Edinburgh.
He is a director of several public companies and contributes a weekly column to the Financial Times. He recently chaired the Review of UK Equity Markets and Long-Term Decision-Making, which reported to the Secretary of State for Business, Innovation and Skills in July 2012. He is the author of many books, including *The Truth about Markets* (2003), *The Long and the Short of It: finance and investment for normally intelligent people who are not in the industry* (2009) and *Obliquity* (2010). His latest book, *Other People's Money* – towards a financial system for the needs of the economy rather than financial market participants –will be published by Profile Books and (in North America) by Public Affairs in September 2015.

Organisation

Organiser

European Commission - DG Joint Research Centre

Scientific Committee

Jerome Ravetz

Andrea Saltelli

JRC responsible

Ângela Guimarães Pereira

angela.pereira@jrc.ec.europa.eu

The Science and Technology Studies Project @ the JRC

https://ec.europa.eu/jrc/en/research-topic/science-and-technology-studies

Secretariat

Susanna Loffelhölz

Susanna.loffelholz@ec.europa.eu

Web

Science Hub

https://ec.europa.eu/jrc/en/event/conference/use-quantitative-information

email

jrc-sts@jrc.ec.europa.eu

Twitter

@JrcXstS

European Commission
EUR 27387 EN – Joint Research Centre – Deputy Director-General

Title: **Significant Digits**

Authors: D. Albrecht, V. Šucha, J. Ravetz, J. van der Sluijs,, M. Giampietro, D. Dankel, P. Stark, Z. Kovacic, A. Saltelli, J. Kay
Luxembourg: Publications Office of the European Union

2015 – 20 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424

ISBN 978-92-79-50344-3

doi:10.2760/555227

KJ-NA-27387-EN-N

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

doi:10.2760/555227

ISBN 978-92-79-50344-3

Publications Office