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Discussion of
"Post-Financial Meltdown: What Do the Services Industries Need From Us Now?"
by Roger Hoerl and Ron Snee

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Hoerl and Snee have done three important things in their excellent paper. First of all they address the current work environment conditions head on, describing the facts about the 2008 economic melt down. Secondly they provide a retrospective about the role of Statistics and Statisticians in service industries, thus providing a context for their third contribution, which is to lay out a clear road map with specific recommendations.

This discussion paper expands their comments addressing the question they posed, namely "what do the service industries need from us now?". It will discuss some aspects of the causes of the economic meltdown and present some methodological implications. It will then take a wide angle view of the role of Statistics and Statisticians in business and industry and, finally, will revisit the recommendations of Hoerl and Snee with some add-ons and emphasis.

1. The Economic Meltdown

According to Taleb's terminology, the economic meltdown was a Black Swan (Taleb, 2007). A Black Swan is a highly improbable event with three principal characteristics: 1) It is unpredictable; 2) it carries a massive impact; and, 3) after the fact, we concoct an explanation that makes it appear less random, and more predictable, than it was. Why do we not acknowledge the phenomenon of Black Swans until after they occur? Part of the answer, according to Taleb, is that humans are hardwired to learn specifics when they should be focused on generalities. We concentrate on things we already know and time and time again fail to take into consideration what we don't know. We are, therefore, unable to truly estimate opportunities, too vulnerable to the impulse to simplify, narrate, and categorize, and not open enough to rewarding those who can imagine the "impossible". Taleb has studied how we fool ourselves into thinking we know more than we actually do. We restrict our thinking to the irrelevant and inconsequential, while large events continue to surprise us and shape our world. Taleb wrote about the potential for an economic meltdown well before it happened in 2008, indicating the limitations and dangers of statistical analysis. At this point in time Statisticians should consider his suggestions very carefully.

While the many ramifications of the economic meltdown described by Hoerl and Snee are still unfolding, it is evident that the process of financial reconstruction will necessarily be structural, inducing major changes in the manner in which the business of finance and, in particular, the management of complex financial institutions and financial transactions are made. These changes have been labeled "Intelligent Regulation" or "beyond Basel II" to indicate that the *Basel II Capital Accord on International Convergence of Capital Measurement and Capital Standards* needs to be reviewed.

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Statisticians can play a key role in instituting "Intelligent Regulation". New approaches for improved risk assessment, by combining qualitative and quantitative information in structured systematic systems, are now being developed. They combine natural language processing and ontology engineering in extracting semantic data with new analytic methods for providing combined risk scores (MUSING, 2006).

Taleb proposed a mapping of randomness and decision making into a quadrant with two classes of randomness and two types of decisions. Decisions referred to as “simple” or "binary" lead to data driven answers such as “very true" or "very false” or that a product is "fit for use" or "defective”. In these cases, statements of the type "true" or "false" can be stated with confidence intervals and P-values. A second type of decisions is more complex, emphasizing both its likelihood of occurrence and its consequences. The other dimensions of the Taleb quadrant characterize randomness. A first layer is based on “forecastable events”, implied in finite variance (and thus thin tail probability distributions). A second dimension relates to “unforecastable events”, defined by probability distributions with fat tails. In the first layer, exceptions occur without significant consequences since they are predictable. The traditional random walk, converging to Gaussian-Poisson processes, provides such an example. In the second domain, large consequential events are experienced but are also more difficult to predict. "Fractals" and infinite variance (Pareto-stable and chaotic) models provide such examples (see Kenett and Tapiero, 2009).

Statisticians should address these issues which combine mathematical and psychological abstractions. In fact, these aspects are key to effective Statistical Consulting and have traditionally not been well addressed by academia (see Kenett and Thyregod, 2006).

2. Services Computing

Services computing has become a cross-discipline domain that covers the science and technology of bridging the gap between business services and IT services. The underlying technology for it includes Web services and service-oriented architecture (SOA), cloud computing, business consulting methodology and utilities, business process modeling, transformation and integration. The scope of services computing covers the whole lifecycle of services innovation research and includes services modeling, services creation, services realization, services annotation, services deployment, services discovery, services composition, services delivery, service-to-service collaboration, services monitoring, services optimization and services management. The goal of services computing is to enable IT services and computing technology to perform business services more efficiently and effectively.

This challenging domain area requires inputs and contributions from Statisticians. Some examples where such contributions are needed include assessing usability of Web services (Harel et al, 2008), designing effective testing and control mechanisms (Bai and Kenett, 2009) and using data on "near misses" or incidents to predict events with consequence (Kenett and Salini, 2009).

3. Management Consulting

In order to achieve significant impact on business and industry, Statisticians like Deming and Juran became management consultants. Deming made many contributions to survey methodology, Juran was very much affected by Shewhart's work and was a prime contributor to the deployment of Statistical Process Control in the Hawthorn plant of AT&T's Western Electric (Godfrey and Kenett, 2007). The main point of this remark is that, in order to effectively promote the contribution of Statistical Methods, one has to address management issues.

Hoerl and Snee refer to this point by mentioning the need to reinvigorate Six Sigma initiatives in service organizations. Such a recommendation needs to be substantiated in the language of management. Six Sigma has focused on specific improvements which permit an effective evaluation of Return On Investment . A more general approach, suggesting that increasing the management maturity level in an organization produces more effective and efficient results from a business perspective, has been labeled the *Statistical Efficiency Conjecture* (Kenett et al, 2008). The maturity level of the management of industrial organizations can be summarized and classified using a four-step Quality Ladder (Kenett and Zacks, 1998). The four maturity levels of management are (a) fire fighting, (b) inspection, (c) process improvement and control, and (d) quality by design. The *Statistical Efficiency Conjecture* states that organizations with management maturity levels higher up on the Quality Ladder, achieve higher impact in problem solving and improvement initiatives incorporating Statistical Methods.

The suggestion here is that Statisticians who want to increase their impact, in and on an organization, should also work on getting their management to go up the Quality Ladder and move from fire fighting to process control and quality by design. The challenge is to turn numbers into information and knowledge, and this requires a context (see Kenett, 2008). There are of course many other areas of management where Statistics can play an important operational role. One example is the wide spread Annual Performance Appraisal System where employees are appraised by their managers, in an organizational development effort. This exercise is generally considered problematic and ineffective, mostly because of misattribution to the employee of system related problems. In order to resolve such issues, control charts have been proposed as tools for discerning employees whose performance is beyond expectations, within expectations or below expectations (Waldman and Kenett, 1990, Kenett et al, 1994). In another application Statisticians can contribute to map cause and effect relationships between measurements collected in different parts of the organization. For an example of such an integrated analysis, combining the Voice of the Customer with the Voice of the Process and the Voice of the Workforce, see Godfrey and Kenett, 2007.

4. Quality by Design

As mentioned by Hoerl and Snee, health care offers unique opportunities for Statisticians. In considering this application domain, one should distinguish between the development of new pharmaceutical products and treatments, the manufacturing of these products and the delivery of health care.

Recently the Food and Drug Administration (FDA) has launched a Quality by Design (QbD) initiative. It encourages new drug applications to include a Design Space and risk based control strategies. The basic idea is that drug product developers should study the behavior of Critical Quality Attributes (CQA) in their proposed new products, under variations in the raw material and process control parameters. This area of application is beyond the traditional role of Biostatisticians in clinical trials (see Peterson, 2009, Kenett and Kenett, 2008). Moreover, the application of simulation experiments, Bayesian adaptive designs and data mining techniques in the critical path of research investigating efficacy and safety of new drug products is also encouraged by the FDA. These recent developments have created new opportunities for Statisticians who can now play a key role throughout the life cycle of health care services (see Woodall, 2006 and also chapters 10-13 in Kenett and Zacks, 1998).

In sum, I would like to congratulate Roger Hoerl and Ron Snee for their paper. It addresses a situation we are all facing and presents directions on how Statisticians can find opportunities for contributing to organizations, businesses and industries. My main point is that these contributions should be considered beyond focused process improvement and lean sigma initiatives.

Specifically, some open questions follow:

1. The restructuring of financial services poses challenges and opportunities for Statisticians in Business and Academia. Are the Taleb quadrants well enough addressed by current statistical technology?

2. The growing impact of Web services, and services computing in general, requires support from the Statistical community. Are Statisticians going to be involved in developing solutions for such systems?

3. The role of statisticians in organizations has significantly evolved in the last 50 years. Will Statisticians take a more proactive role in developing methods and tools with important organizational impact? (for a pragmatic and comprehensive list of examples see Hahn and Doganaksoy, 2008).

4. Quality by Design has been recently promoted by the FDA. Similar initiatives might be relevant in other domains such as aviation where development and production is followed by operations and maintenance. Will Statisticians play a lead role in such Quality by Design initiatives?

Responses to these questions should be developed by academia, business and industry. They require new mathematical constructs, improved technological systems and effective methodologies borrowing on management and psychology. Like in any other discipline, this will require leadership and collaboration from Statisticians in key positions. Hopefully the paper by Hoerl and Snee will motivate Statisticians to address these questions.

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