Author's response to reviews

Title: Decision Theory Applied to Image Quality Control in Radiology.

Authors:

Patrícia S Lessa (patlessa@hotmail.com)
Cristofer A Caous (cacaous@gmail.com)
Paula R Arantes (parantes@usp.br)
Edson Amaro Jr (edsonjr@einstein.br)
Fernando M Campello de Souza (fmcs@hotlink.com.br)

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# Reviewer 1

Minor revisions

I. “Correction of typos and incorrect word choice, particularly in Discussion section…”

The typos were corrected and many words substituted throughout the text.

II. “Method detail is good, but the section is too long; needs a brief overview of method used…”

The method section was revised according to the suggestion.

Discretionary revisions

I. “Figure 1 is not useful – too general. Perhaps it could be replaced with a flowchart detailing the specific method used in the paper.”

The authors thank the reviewer suggestion. A scheme was designed depicting the method used in this work.

II. “Justification for research is good but could be more clearly and strongly stated.”

The motive is clearly declared in the abstract and background sections.
I. “The proposed method is a direct application of decision theory in medical decision making. Substantial efforts are still required to clarify the details in the manuscript, please provide mathematical equations to facilitate the explanation. In addition, the manuscript has many typographical errors need to be corrected.”

The authors expect that all required details were clarified in the present manuscript. English written was properly revised. Some main equations were added to the text and typo errors corrected.

II. “I am confused about the example. On page 9, the authors mentioned the definition of states of nature. It seems to me that there is a quantitative way to define good vs. bad quality, why use x0-x7, where the variables look qualitative.”

In many situations, the state of nature can not be directly observed. The reasons are physical, technical or economical impossibilities. In addition, \( \theta \) value has not always a direct measure. In this case, it is possible to work with data stipulated from observations \((x0-x7)\) of another variable or a set of variables (film usage, film sensibility and spatial resolution) that have a relation with \( \theta \). The patient satisfaction level was mathematically considered as the probability of “yes” or “no”, “1” or “zero” measure. In addition this personal satisfaction level was not measured in the present study with specific questionnaires.

III. “Page 6, line 1, can you use mathematics to describe the content of this paragraph?”

Yes, mathematic was inserted to support the content of the paragraph.

IV. “Please make it clear the difference between consequence function, utility function and risk function.”

The utility function represents the decision-making preferences (payoffs values). The consequence function reflects the probability of having or not determined payoffs according to the state of nature (if state of nature is \( \theta_0 \) or \( \theta_1 \), the chosen action could be \( a_0 \) or \( a_1 \)). The risk function statistically represents the mean loss (mean loss function = - utility function) when the real state of nature is \( \theta \) and the decision-making was a determined decision (d); lower the risk better will be the decision rule.

V. “In results, what is the difference between film and film lot?”

Lots of films refer to boxes. Each box contains units of films. The quality control is based on a percentage of bad or good films from a film lot chosen arbitrarily.
VI. “Table 1, please replace comma with period”

The comma was replaced with period.

VII. “Page 9, line 4 please provide a short introduction to the behavioral randomized rule.”

A short introduction about this subject was already added to the background section (see page 6, last paragraph). The behavioral randomized rule equation was added to the text.

VIII. “I am very confused with the numbers in table 1 and 2, where did you get those?”

All values of probable observations were devised using hypothetical prediction based on previous information from real datasets. The referred database was supported by two tables of probabilistic results combining the dependency values. The dependency values include the inadequate or adequate parameters of application, sensibility and resolution, as well as, diagnostic, cost and satisfaction (not personal satisfaction levels). The present work is not a validation method process. There is not a specific dataset or database. The model used herein is hypothetical therefore it is not correct to have a new method validated through this work. In addition, no matter which acquisition data system, there will always be a likelihood function to the considered mathematical model.

IX. “Page 13, line 1. I assume the authors meant figure 2 and 3. They are not ROC plots.”

Both figures are actually ROC curves. The ROC curve axis depict risks not probabilities involving the preference concept of the decision making (von Neumann-Morgenstern function). The figures show a pair risk functions with a determined parametric parameter (risk sets r=4 and r=2 in figures 1 an 2, respectively) related to a perceptual discrimination (Peterson and Birdsall, 1950; Tanner and Swets, 1954). The main characteristics of the ROC curve are the convexly surface with a gradually decrement (Lusted, 1971; Mcneil et al., 1975). The ROC curve in terms of \( P \) (positive test| positive for disease) versus \( P \) (positive test| negative for disease) or sensibility versus false positive, \( P \) (altered exam| disease diagnostic) versus (altered exam| not disease diagnostic) could be one of the different ways to get a ROC curve. At the present, risks settings were used (good film| bad film).