Preliminary communication
Претходно саопштење
UDC 681.51:004.42MATLAB
DOI: 10.7251/AGREN1801051H

University of Banjaluka, Faculty of Agriculture
Agro-knowledge Journal

The Evaluation of Master Theses in MATLAB Software Tool: Fuzzy Approach Makes Sense

Đurađ Hajder[1]

[1]*University of Banja Luka, Faculty of Agriculture, Republic of Srpska, BiH*

Abstract

The aim of conducted investigation was to evaluate defined objectives, presented materials and methods and interpretation of results in student's master theses in order to assess their scientific contribution. Firstly, evaluation was performed by using the traditional methodology and fuzzy evaluation was then conducted in a Fuzzy Logic Toolbox. Obtained values from two levels of evaluation were generally compared. Results indicate that fulfilment of defined criteria of evaluation is moderate. Evaluation mark in classical approach was higher in most cases but fuzzy approach showed some advantages. The criteria fulfilment for the logical-mathematical argumentation, as a prerequisite for the analysis of scientific results, showed its paramount importance in the process of classical and fuzzy evaluation as well.

Key words: scientific publishing, fuzzy mark, biometrics, fuzzy logic.

Introduction

The evaluation process consists of measuring the scientific contribution of an individual or an institution. Similarly, it is a process by which something is measured by comparing it with defined standards and criteria (Pavlović, 2016). In response to the methodology of classical evaluation, fuzzy logic has appeared as a tool for overcoming different types of uncertainty, imprecision, vagueness and approximative reasoning.

Fuzzy logic and fuzzy sets were introduced by Zadeh (1965). Different applications of a fuzzy logic in education comprise fuzzy educational grading systems and classification of students (Law, 1996; Fourali, 1997; Nolan, 1998; Nykänen, 2006; Daud et al., 2011; McLoone, 2012), fuzzy clustering (Wang & Bell, 1996), personnel selection (Petrović-Lazarević, 2001), soft computing (Chaudhari et al., 2012), and faculty performance evaluation (Guruprasad et al., 2016; Jyothi et al., 2014).

Contemporary studies are also oriented to evaluation of students' performance (Kharola et al., 2015; Surya et al., 2016; Varghese et al., 2017), faculty teachers' work (Pavlović, 2016) and general evaluation practices (Du Prel et al., 2009). It is important to note that main obstacles students are facing with in the process of preparing and writing master theses are the definition of research objectives, the methodology of data analysis and the argumentation of obtained data (results). It was reasonable to evaluate these sections from master theses based also on the fact emerging from related investigations (Mićić and Bosančić, 2013; Mićić et al., 2014a,b) that authors sometimes use incorrect or misleading methodology and fail to define research objectives or to interpret data properly.

By a two-level evaluation, the level of a scientific contribution and the relevance of descriptive statistics in master theses could be assessed. Accordingly, aim of this research was to evaluate the defined objectives, presented materials and methods and interpretation of results from master theses defended at the Faculty of Agriculture of University of Banja Luka.

Materials and Methods

For the analyses, 26 master theses defended at the Faculty of Agriculture of University of Banja Luka in the period 1994–2015 were used. In these theses mainly descriptive (defined as research based on statistical population or research using descriptive methods or measures) statistical approach was used. Two levels of evaluation were performed here: classical and fuzzy.

Classical evaluation consisted of assessment of following sections from master theses: 1) defined objective(s) and hypotheses (OB); 2) materials and methods (MM) and 3) logical-mathematical argumentation (LMA) based on specific evaluation criteria (like clarity of objectives for OB section, suitability of planned methods for MM or control of variation for LMA). It also comprised the analysis of fulfilment of these criteria and distribution of all theses at the Likert-type scale (ranging from 0 to 5).

Fuzzy evaluation was carried out in Matlab Fuzzy Logic Toolbox software (R2016a 9.0 version). The fuzzy methodology included definition of variables, fuzzification, fuzzy inference, defuzzification and interpretation. Fuzzy inputs were 1. objectives (OB), 2. material and methods (MM) and 3. logical-mathematical argumentation (LMA). Single fuzzy output was defined as fuzzy evaluation value (FEV). Fuzzy linguistic variable was "master thesis quality". Fuzzy labels were sufficient (S), desirable (D) and outstanding (O) for three fuzzy inputs and adequate (A), good (G), very good (VG), excellent (E) and remarkable (R) for single fuzzy output.

For all inputs a trapezoidal mf was used. For the output (FEV) a combination of triangular and trapezoidal mf was used. A total of 27 rules were defined in the fuzzy rule base. For the obtained 26 numerical values, the fuzzy degree of membership $\mu_A(x)$ to fuzzy output (FEV) labels was calculated. Then, a comparison between fuzzy and classical marks was presented.

Results and Discussion

All 26 master theses were distributed into the range from 0 to 5. Evaluation marks ranged from 1.50 to 4.37 (OB section), from 0.93 to 4.70 (MM section) and from 1.13 to 4.50 (LMA section), respectively.

For the 26 numeric values, named as fuzzy evaluation values (FEV) a fuzzy degree of membership $\mu_A(x)$ to different fuzzy output labels was calculated. A 12 out of 26 master theses obtained the fuzzy degree of membership $\mu_A(x) = 1$ belonging to fuzzy output label *very good* (VG). Remaining theses had different fuzzy degrees of membership with $\mu_A(x)$ ranging from 0 to 1.

Classical marks were in all cases (except thesis 4) higher that FEV marks and this difference varied from 0.09 (thesis 13) to 1.38 (thesis 8).

Where low mark was present in OB section, authors defined their objectives too theoretically and some OB criteria were partly fulfilled. Here, a clear link between objectives and interpretation of results is very important. Some MM criteria were also moderately fulfilled and where low mark was present, authors used different statistical software incorrectly, which was assumed by McMillan (2000), who claimed that there is a danger that technology will contribute to the mindless use of new resources. Nevertheless, authors of theses were here missing to define a fundamental statistical concepts like biometrical unit of research, population size etc.

The fulfilment of LMA criteria was moderate. This result could be much better in order to improve the scientific contribution and the relevance of statistics in each thesis.

It can be done by performing following steps: establishing a clear connection between defined objectives and presented results, detecting and explaining high coefficients of variation, and also establishing a compatibility between defined objectives and MM/LMA sections from master theses. It is critical that all educators understand concepts like standard error of measurement, reliability coefficients, confidence intervals, and standard setting (McMillan, 2000). For example, performing *t*–test statistics with very low or very high coefficients of variation lead a researcher to fallacious conclusions (Mićić and Bosančić, 2012; Mićić and Bosančić, 2013; Mićić et al., 2014a,b).

In defuzzification the average experts' marks produced 26 crisp values (FEV), which had different $\mu_A(x)$ to fuzzy output labels. The $\mu_A(x) = 1$ for the fuzzy output label *very good* (VG) was achieved in 46.15% of cases (or 12 out of 26 master theses). These grouping of FEV values is a consequence of fuzzy input values, as well as the fuzzy scale, the specific range, type and shape of fuzzy *mf* and a fuzzy rule base design.

The comparison between classical and fuzzy evaluation indicated that only in thesis 4 there is no difference between two levels of evaluation. More important, 96.15% of master theses obtained higher classical mark, similar to results obtained in Kharola et al. (2015), Guruprasad et al. (2016) and Surya et al. (2016) who found higher classical mark in faculty performance evaluation. The advantage of a fuzzy approach is a possibility of modelling the level of severity of evaluation criteria by changing fuzzy methodology. Therefore, fuzzy approach can in some cases produce higher evaluation marks (McLoone, 2012; Daud et al., 2011; Chaudhari et al., 2012; Sakthivel et al., 2013; Jyothi et al., 2014).

Conclusion

The two-level evaluation showed that scientific contribution and the relevance of descriptive statistics of master theses is moderate in average, while 25 out of 26 analysed master theses obtained higher classical mark.

Study implications

Findings indicate a great gap between main sections from master theses i.e. OB, MM and LMA sections must be interconnected closely. Also, the opportunity to overcome disadvantages of a traditional evaluation (like uncertainty, subjectivity and sharp boundaries between classes) is provided by a fuzzy logic.

Fuzzy logic bears the potential for changing the severity of established evaluation criteria by adapting fuzzy methodology, instead of introducing new evaluators and/or criteria.

Main limitations of this study

Generalizations can be done only for master theses with descriptive statistical measures or tests. Some other theses' sections could be included in evaluation. Limitations also emerge in the design of fuzzy rules and fuzzy *mf*. Here, fuzzy methodology (with accent on the design of a fuzzy rule base) should be unconditionally grounded in expert knowledge for a specific field of research.

Future directions

Future directions should be aimed at a) designing different statistical courses for improving students' knowledge in statistics, b) evaluation of scientific publications' general structure and c) adjustments of a fuzzy methodology. One should also bear in mind that logical-mathematical argumentation (LMA) plays a key role in different study designs and data analyses.

Acknowledgments

My very special thanks go to Prof. Nikola Mićić, PhD for mentoring this research as well as for his unreserved support, time, effort and encouragement.

References

Chaudhari, O. K., Khot, P. G., & Deshmukh, K. C. (2012). Soft computing model for academic performance of teachers using fuzzy logic. *British Journal of Applied Science & Technology*, *2*(2), 213–226.

Daud, W. S. W., Aziz, K. A. A., & Sakib, E. (2011). An evaluation of students' performance in oral presentation using fuzzy approach. *Proceedings of the 10th International Annual Symposium (UMTAS 2011), Terengganu, Malaysia*, 157–162. Retrieved at https://www.researchgate.net/publication/277776194_An_Evaluation_of_Students%27_Performance_in_Oral_Presentation_Using_Fuzzy_Approach.

Du Prel, J. B., Röhrig, B., & Blettner, M. (2009). Critical appraisal of scientific articles. *Deutsches Arzteblatt International*, *106*(7), 100–105.

Fourali, C. (1997). Using fuzzy logic in educational measurement: the case of portfolio assessment. *Evaluation and Research in Education, 11*(3), 129–148.

Guruprasad, M., Sridhar, R., & Balasubramanian, S. (2016). Fuzzy logic as a tool for evaluation of performance appraisal of faculty in higher education institutions. *SHS Web of Conferences, 26*(2016), 1–7.

Jyothi, G., Parvathi, C., Srinivas, P., & Rahaman, S. A. (2014). Fuzzy expert model for evaluation of faculty performance in technical educational institutions. *International Journal of Engineering Research and Applications, 4*(5), 41–50.

Kharola, A., Kunwar, S., & Choudhury, G. B. (2015). Students' performance evaluation: a fuzzy logic reasoning approach. *PM World Journal, 9*(10), 1–11.

Law, C. K. (1996). Using fuzzy numbers in educational grading system. *Fuzzy Sets and Systems, 83*(3), 311–323.

McLoone, S. C. (2012, June). *On using fuzzy logic for grading highly subjective assessment material – a case study*. Paper presented at the IET Irish Signals and Systems Conference, Maynooth, Ireland. Retrieved at http://dx.doi.org/10.1049/ic.2012.0171

McMillan, J. H. (2000). Fundamental assessment principles for teachers and school administrators. *Practical Assessment, Research & Evaluation, 7*(8), 1–5.

Mićić, N., Bosančić, B. (2012): Varijabilitet i koeficijenti varijacije u biološkim i poljoprivrednim istraživanjima. *Agroznanje*, 13(3), 331–342.

Mićić, N., Bosančić, B. (2013): Zamke deskriptivnog i inferencijalnog statističkog pristupa u biološkim i poljoprivrednim naukama. *Agroznanje, 14*(4), 617–630.

Mićić, N., Đurić, G., Kurtović, M., Knezović, Z. (2014a): Biometrika kao metoda naučnog istraživanja u biološkim i poljoprivrednim naukama. *Radovi Poljoprivredno-prehrambenog fakulteta Univerziteta u Sarajevu*, LIX, 64/2, 169–177;

Mićić, N., Kurtović, M., Knezović, Z., Bosančić, B. (2014b): Cilj istraživanja i logičko-matematička argumentacija rezultata biometričkih analiza. *Radovi Poljoprivredno–prehrambenog fakulteta Univerziteta u Sarajev*u, LIX, 64/2, 151–160;

Nolan, J. R. (1998). A prototype application of fuzzy logic and expert systems in education assessment. *Proceedings of the Fifteenth National Conference on Artificial Intelligence (AAAI-98), Madison, Wisconsin,* 1134–1139. Retrieved at https://www.aaai.org/Papers/IAAI/1998/IAAI98-018.pdf

Nykänen, O. (2006). Inducing fuzzy models for student classification. *Educational Technology & Society, 9*(2), 223–234.

Pavlović, P. (2016). Evaluation of teachers' work in high education institutions of Serbia. *Ekonomika, 62*(2), 85–96.

Petrović–Lazarević, S. (2001). Personnel selection fuzzy model. *International Transactions in Operational Research*, *8*(1), 89–105.

Sakthivel, E., Senthamarai Kannan, K., & Arumugam, S. (2013). Optimized evaluation of students' performances using fuzzy logic. *International Journal of Scientific & Engineering Research*, *4*(9), 1128–1133.

Surya, A. A. Kurian, M. K., & Varghese, S. M. (2016). Overall performance evaluation of engineering students using fuzzy logic. *International Journal on Cybernetics & Informatics (IJCI)*, *5*(2), 71–78.

Varghese, A., Kolamban S., Shreedhar, J. P., & Nayaki, S. (2017). Outcome based assessment using fuzzy logic. *International Journal of Advanced Computer Science and Applications (IJACSA)*, *8*(1), 103–106.

Wang, H., & McCauley Bell, P. (1996). Fuzzy clustering analysis and multifactorial evaluation for students' imaginative power in physics problem solving. *Fuzzy Sets and Systems*, *78*(1), 95–105.

Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, *8*(3), 338–353.

Евалуација мастер теза у MATLAB софтверском пакету: оправданост фази приступа

Ђурађ Хајдер

Универзитет у Бањој Луци, Пољопривредни факултет, Република Српска, БиХ

Сажетак

Спроведено истраживање базирано је на евалуацији дефинисаних циљева, коришћених материјала и метода рада и интерпретације резултата у студентским магистарским и мастер радовима, у циљу оцјене научног доприноса ових радова. Први ниво евалуације спроведен је употребом класичних метода евалуације, док је у другом нивоу евалуације кориштена фази методологија у MATLAB Fuzzy Logic Toolbox софтверском пакету. Извршено је генерално поређење оцјена добијених у два нивоа евалуације. Резултати указују на осредњу испуњеност дефинисаних критеријума евалуације. Оцјена добијена примјеном класичних метода евалуације је била виша у већини случајева, међутим, фази приступ показао је одређене предности. Реализација критеријума евалуације за логичко–математичку аргументацију, као предуслова за анализу различитих научних резултата, била је изузетно значајна, како у класичној тако и у фази евалуацији.

Кључне ријечи: научне публикације, фази оцјена, биометрика, фази логика.

Đurađ Hajder
E-mail address: *djuradj.hajder@agro.unibl.org*

Received: January 2, 2018
Accepted: March 29, 2018