Making nurses familiar with data explanatory analysis and visualization

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Abstract

Purpose: The purpose of this paper is to provide our well-tried approach to develop statistic education based on the use of spreadsheets and then, to propose way of continuing evolution to Internet aided education in the introductory statistics for medical (nurses) students.

Material and methods: Paper expresses Author's personal opinions and was based on their experiences in preparing statistic textbook and spreadsheet's instructions, and then in using these in a computer room.

Results: In small groups, 10 to 20 students, the students quickly learned by hands-on experience to solve real-life problems following in exemplary solutions described in spreadsheet's instructions. Owing to restricted use of mathematics we obtain more time to discuss a practical interpretation of a research problem and for the student's presentations in the class.

Conclusions: The main goals of the presented approach was to familiarize students with the data explanatory analysis and visualization on the elementary level, giving them a good starting point to their nearest works in the matter and ability to recognize problems they were incapable of solving on their own. In our opinion the presented approach appeared useful to reach assumed goals.

Key words: statistic education, explanatory analysis, spreadsheet, interactive pages.

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Introduction

The patient's education and health promotion is getting more and more importance in nurses' daily duties. Some of the graduate nurses are engaged to active participation in research work. Nevertheless, all other professional roles need the continuous professional learning. Thus, the concept of education in computer science and statistics must be in advance adjusted to new challenges. We suspect there is general accord between educators that teaching computer sciences and statistics for medical students must substantially differ from teaching it for others, e.g. for engineers or statisticians. There a deep understanding of technical details and statistical methodology is not necessary but a more emphasis on the applied part is. The medical students should obtain a fairly clear picture of the activities associated with data analyses in practice. Moreover, they should be able to accurately formulate a question and they should distinguish practical task where they are and where they are not sufficiently experts. On the end, they should be able to successfully communicate the results to their intended audience. The Material & methods section of this paper describes our approach aimed to reach these goals, based on a set of the separate mini-tasks or entities which can be combined into the nets leading to solution. Section Results summarises our experiences in the matter. Section Discussion relates to some similar didactic approaches.

Material and methods

At Institute of Nursing on Jagiellonian University of Cracow from some years the statistic education based on small group cooperative learning approach [1]. This approach de-emphasized the traditional method-oriented approach, typically focusing on formulas and separated statistical tasks, and shift the focus to the looking for complete solutions to practical problems [2]. This approach allows students to supplement what they have heard and read about data analysis by actually doing analyses and then by giving oral presentations and discussing results. The

peer interactions, an atmosphere of cooperation and mutual helpfulness, and individual accountability fitted to individual mathematical and other abilities can change initial negative students' attitudes towards all mathematics [3,4].

From other hand, this approach requires a significant time and efforts necessary to implement all system, and then, a fitting amount of instructor's vigor and creativity at the class. Our first step as teaching coordinators was to design such structure of the statistics teaching resources which can be easy modifying, e.g. adopted to various statistics curses. Our second step was to choose the software, which keeps preparation time for instructors and for students as short as possible.

For software the best pragmatic advice is, if possible, do not design your own, use someone well-tried else's. Moreover, we have to provide software that students can easy use at home, at university, everywhere. Some years ago the seemly choice was the Excel spreadsheet program [5,6]. Excel has some advantages: first, it gives us opportunity to divide all didactic material into separate mini-tasks, each placed in separate spreadsheet. Next, the Excel spreadsheet program includes a lot of ready to use subroutines, named Excel functions and Excel procedures, in this as a minimum about 90 statistical functions and 17 procedures in special statistic add-in named Analysis Tools. Then, there every step in the solution is visible in the spreadsheet and easy to carry out by the students themselves. Alas, it is known that original Excel's help to statistics used strange terminology sometimes, moreover, it misconstrued some elementary statistical notions [7]. The Polish translation followed in this the English original. Thus, we are under necessity to write own explanations to each statistic mini-task. Our instruction to any mini-task points out how to prove if it can be applied (namely: which other mini-task use to do it) and then, where the results of this mini-task can be used. Moreover, there are suggestion what to do if necessary conditions (e.g. normality) was not fulfilled.

Working on set of statistic mini-task one may single out some Excel procedures ready at hand to our didactic purposes, in our opinion they are 8 following tasks: ANOVA – Single Factor, ANOVA – Two Factors without Replications, F-Test Two-Sample for Variances, Random Number Generation, Regression, t-Test Paired Two Sample for Means, Z-Test Two-Sample for Means, XY graph with options Trend. Than, 6 procedures needed a little extensions: Descriptive Statistics (there differences between mean and median and/or values of skew and curtosis should be used to discuss normality; then box-plot graphs need the explicit limits of the confidence interval), ANOVA – Two Factor with Replication (there graph of means makes evident an interaction if it occurs), Correlation (it needs some formulas to estimate a significance of correlation), t-Test Two-Sample Assuming Equal/Unequal Variances (there, except to more conservative F-test, some criterions is needed to use proper variant of t-test), Chi-square test (needed formulas to compute table of expected frequencies). Moreover, we recognised as indispensable 8 new own mini-tasks: Confidence interval for variance or standard deviation from normal distribution, Confidence interval for probability on the base of number of success in Bernoulli experiment, Confidence interval for odds ratio, Cronbach's alpha for questionnaires, histograms, Mann-Whitney test for medians (as nonparametric alternative for t-test), t-Test on the base of known sample means and variances (for data from literature). It makes 8+6+8=22 basic mini-tasks. Our textbook [8] includes description of 135 mini-tasks, in this about 40 intended for the introductory courses.

During last years step by step the web on-line interactive pages become the main position in the student's statistical works. There are specialized Excel sheets like htttp://espse.ed.psu.edu/spsy/Watkins/software/ROCanalysis.xls for evaluating diagnostic performance on a clinical test under study. Besides, there are ready to us interactive pages like: http://members.aol.com/johnp71/javastat.html or http://home.clara.net/sisa/ that perform wide variety of statistical calculations. Currently, The Excel statistical instructions [8] are all time ready to use at our computer laboratory, but each of our mini-task has own web-based substitution, that can be freely applied by students.

Results

Our approach to statistic education was shown to be a working method that allowed students to enrich their statistical competencies. On the end of semester at the first glance there were no distinct differences in students knowledge and skills obtained with cooperative learning or by more traditional learning oriented on average student: about the same majority of the graduated students can carry out not more than 2-4 procedures practiced themselves and usually had some troubles with interpretation. Nevertheless, there are two measurable benefits. First, in the cooperative class some leaders appeared which could explain, compute and interpret many more tasks, because in the same time in a class divided into some working groups the students can to practice about three-four times more statistical procedures than a teacher can proceed and explain in a class working together (like chorus). The second advantage is that some years later students after cooperative learning are more eager to undertake statistical tasks, for example as an candidate for the master's degree.

Discussion

The cooperative learning in the statistical class can be carried out in many ways [9]. The commonly acknowledged great advantage is a class-room can be a not of a kind of a torture-room, neither for students nor for statisticians. It rather seldom pointed out that this approach can be very embarrassing for teachers at the preparatory stage and in the field, during lessons without fixed scenario [10,11]. It seems that our approach makes preparatory work distinctly easier.

Conclusions

Although Excel has a great deal to offer at the elementary level, it is of limited use to more professional data analysis, there is no many procedures offered by a good statistical package, like fitting maximum likelihood approach to regression and multi-factor analysis of variance, generalised linear models. Thus the

next step in practical course of statistics should base on some chosen statistical package that interfaces with Excel.

References

1. Górkiewicz M, Kołacz J. Medical statistics – practical approach with MS Excel. In Leaders for Health Care. Final Workshop of Tempus JEP 12 273/93. Ed Tempus, Kraków, 2001, s. 7.

2. Higgins JJ. Nonmathematical Statistics: A New Direction for the Undergraduate Discipline (with discussion). The American Statistician, 1999; 53: 1-28.

3. Carvalho C, Cesar M. Peer interaction and statistics learning. In Proceedings of 25th Conference of the International Group for the Psychology of Mathematics Education. Ed. Van den Heuvel-Panhuizen. Utrecht, the Netherlands: Freudendenthal Institute, Utrecht University 2001, v. 2: 217-24.

4. Magel R. Increasing Student Participation in Large Introductory Statistics Classes. The American Statistician, 1996; 50: 51-6.

5. Nash J, Quon T. Issues in Teaching Statistical Thinking With Spreadsheets. Journal of Statistics Education [Online], 1996; 4(1). http://www.amstat.org/publications/jse/v4n1/nash.html

6. Schuyten G, Dekeyser H. Computer-based and computer-aided learning of applied statistics at the department of psychology and educational sciences. [In:] Research on the role of technology in teaching and learning statistics. Eds JB Garfield, G Burril. Voorburg, the Netherlands: International Statistical Institute, 1997, s. 198-212

7. Callaert H. Spreadsheets and Statistics: The Formulas and the Words. In Chance, 1999; 12(2): 64.

8. Górkiewicz M, Kołacz J. 2001b. Statystyka Medyczna. Podejście praktyczne przy zastosowaniu programu MS Excel. 1st edition Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego. 333 p. ISBN 83-233-1461-6.

9. Garfield J. Teaching Statistics Using Small-Group Cooperative Learning. Journal of Statistics Education [Online], 1993; 1(1). http://www.amstat.org/publications/jse/v1n1/garfield.html

10. Giraud G. Cooperative Learning and Statistics Instruction. In Journal of Statistics Education, 1997; 5(3): 1-9, Online: <http://www.amstat.org/publications/jse/v5n3/garfield.html>

11. Keeler CM, Steinhorst RK. Using small groups to promote active learning in the Introductory Statistics Course: A report from the Field. [In:] Journal of Statistics Education, 1995, 5(3), 1-9, Online: <http://www.amstat.org/publications/jse/v3n2/keeler.html>