Explanation of examination grade calculation by the ICLON for teaching staff and students

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1. Introduction

The Test and Examination Service of the ICLON (Leiden University Graduate School of Teaching) provides electronic processing of multiple choice examinations for various Leiden University study programmes.

The purpose of this explanation is to clarify the procedure of examination processing and grade determination for students and teaching staff. Several different methods of calculating examination grades are used within Leiden University. We have decided to give a concrete explanation of the basic concepts and to illustrate them with just a few examples that are often used in Leiden. The teacher or study programme's own method of grade calculation will then have to be added in the explanation for the students.

2. Procedure for electronic processing of multiple choice examinations

Students fill in their answers to the multiple choice questions on a specially printed multiple choice form. These forms are read digitally by the ICLON. On the basis of the results, the quality of the examination is analysed, after which the results are sent to the teacher / block coordinator. Based on the analysis of these provisional results, the teacher decides whether the results are definitive or whether adjustments are needed. For example, one or more questions can be excluded, or extra answer options can be counted as correct for one or more questions. This is then followed by a re-analysis (see § 6). In this context, the teacher can call upon the expertise of the Test and Examination Service staff.

In the next step, the teacher determines the pass threshold. Finally, the grades are calculated, either by the teacher him/herself or by the ICLON at the teacher's request. The teacher always has the final responsibility for releasing grades. The ICLON can advise, the teacher decides.

3. Concepts

<u>Score</u>: the number of points based on the number of correct answers.

<u>Pass threshold</u>: the lowest score that qualifies for a pass.

There are several possible methods for determining the pass threshold, which can be categorised as absolute, relative and compromise methods.[1] An example of the last category is the Cohen-Schotanus method, which is used in the Medicine study programme (see § 4.3). The decision about how the pass threshold is determined is made by the study programme, and in some cases by the teacher.

<u>Correct-guess probability</u>: there is a possibility that a student will choose the correct answer to a multiple choice question simply by guessing. This is known as the 'correct-guess probability'. The correct-guess probability is 1 divided by the number of answer options. That is to say: the correct-guess probability for a three-choice question is 1/3, for a four-choice question 1/4, for a five-choice question 1/5 and so on.

<u>Guess correction / guess score</u>: the number of points that theoretically can be obtained by guessing. The guess score is calculated by adding together the correct-guess probabilities of all the multiple choice questions. That is to say: if an examination has 60 four-choice questions, the guess score is $60 * \frac{1}{4} = 15$.

<u>Knowledge percentage</u>: the percentage of points (correct answers) that must be obtained on a test in order to pass, taking account of the guess correction. Many teachers apply the principle that to

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[1] For interested readers: an extensive quantity of literature has been published on this topic. For example: Dousma, T., Horsten, A. and Brants, J. (1997). *Tentamineren* [Examining]. HogerOnderwijs Reeks [Higher Education Series], Wolters Noordhoff; and Berkel, H. van and Bax, A. (eds.) (2002). *Toetsen in het hoger onderwijs* [Assessment in higher education]. Houten: Bohn Stafleu van Loghum.

qualify for a pass, the student must have demonstrated mastery of at least 50% of the material. This is known as the 'mastery level' or 'knowledge percentage'. In concrete terms, this means that the teachers use a fixed knowledge percentage, or fixed mastery level, of 50% correct answers, after guess correction. Some teachers, however, choose a different percentage, such as 55%. The knowledge percentage is used in determining the pass threshold.

<u>Weighting / weight</u>: if the questions differ in terms of how heavily they contribute to the score, they are given an individual 'weight' or multiplication factor. The greater the weight of a question, the more a correct answer contributes to the student's score.

4. How are the grades determined?

Within Leiden University, there is no uniform set of rules for determining grades. Even within a faculty, several different options are sometimes used. An explanation is given below of the three most frequently used methods.

4.1. An examination consists exclusively of multiple choice questions: questions with two or more answer categories from which a choice must be made.

Example: suppose that a test consists of 40 four-choice questions. From the statistical point of view, a student could answer 10 questions correctly by just guessing (that is: 25% of 40). In addition to these 10 questions that can be answered correctly by guessing, the student must answer half of the remaining 30 questions correctly in order to pass (knowledge percentage: 50%). That is to say: in this example, the student must answer 10 + (50% of 30) = 25 questions correctly in order to pass. We then say that the pass threshold is 25.

The pass threshold established in this way is an *absolute* pass threshold. The pass/fail boundary is determined independently of the students' scores. There are also teachers who opt for a higher knowledge percentage, and consider that students must correctly answer at least 55% (or even 60%) of the questions remaining after guess correction. The pass threshold in the above example would then become: 10+(55% of 30)=26.5. The first pass would then be awarded for 27 correct answers. The other scores are divided into grades at equal intervals upwards and downwards from the pass threshold (see also § 5).

4.2. An examination consists partly of multiple choice questions and partly of open-ended questions.

The multiple choice questions are processed by the ICLON, the open-ended questions by the teacher(s) of the course concerned. The grades can be calculated in two ways, possibly resulting in slightly different final grades, due to rounding differences.

4.2.1   The points obtained for the multiple choice questions and for the open-ended questions are added together. The grade is calculated over the total number of obtained points, after a guess correction has been applied to the multiple choice part.

Example: an examination consists of 40 four-choice questions (1 point per question) and 2 open-ended questions worth 10 points per question, which means that in total it is possible to obtain a maximum of 60 points. The guess correction is 10 (see § 4.1). In addition to these 10 questions, the student must obtain half of the remaining 50 points in order to pass (when the knowledge percentage is 50%). A student thus obtains the lowest pass grade (6) with a score of 10+(50% of 50)=35 points.

4.2.2   <u>Two separate grades</u> are calculated for the multiple choice part and the open-ended part. These two 'constituent grades' – after weighting (see § 3), if applicable – are then added together to obtain the final grade.

4.3. With the examples described above, one special situation in any event has to be mentioned.

In the Medicine study programme of the LUMC, the pass threshold is determined using the Cohen-Schotanus method. The Medicine study programme uses a pass threshold that is 60% of the average number of points obtained by the best 5% of the students, corrected for guessing.

Example: an examination consists of 60 four-choice questions, which means that a maximum of 60 points can be obtained and the guess score is 15 (25% of 60 questions). Suppose that the best 5% of the students obtain an average of 55 points; they have then correctly answered 55-15 = 40 questions, in addition to the guess score. In order to pass, the other students must then have correctly answered 60%[2] of the 40 questions = 24 questions, in addition to the guess score. The pass threshold is therefore 15 + 24 = 39 correct answers.

The pass threshold is thus calculated as follows: 60% *(average score of best 5% of students – guess score) + guess score = 60% *(55-15) + 15 = 39.

5.   Score – grade division

The range of scores (from 0 points to the maximum number of points that can be obtained in the test concerned) is divided into five equal score groups from the pass threshold downwards. In the same way, five equal groups are produced from the pass threshold upwards. A grade from 1 to 10 is assigned to each score group.

If 'constituent grades' are calculated before reaching a final grade, the constituent grades are determined to one decimal place. Only the final grade is rounded to whole or half numbers (depending on the rules within the study programme).

For rounding, the ICLON applies the usual rounding rules: 6.50 to 7.49 becomes 7; 7.50 to 8.49 becomes 8, etc. Rounding only takes place once (that is to say: it is not the case that 7.49 becomes 7.5, which then becomes 8).

At Leiden University, half grades may not be given between 5 and 6. This means that 5.49 becomes 5, and 5.50 becomes 6.

This is described in more detail in ICLON Report 152 by G. van Duijn, MA (May 2010).

6.   Re-analysis

The ICLON analyses both the individual examination questions and the examination as a whole in terms of several factors, including difficulty level and reliability. This analysis sometimes reveals that there is cause to adjust the examination. For instance, it can be found in retrospect that a question was not clearly formulated, or relates to material that was not covered in the lectures. As a result, the teacher can decide to exclude that question. The teacher can also decide, on further reflection, to count another answer option as correct, in addition to the correct option.

Adjustments of this kind are followed by a re-analysis: after adjustment based on the teacher's instructions, all the calculations are repeated and all the key figures and scores are recalculated, after which the teacher receives a new set of results.

For more information, please see our Handleiding itemtelling (Manual for *Itemtelling*, an 'item counting' programme).

The text Toetsing en toetsanalyse (Assessment and test analysis) by Dr. D.N.M. de Gruijter (November 2008) discusses the construction and processing of examinations in greater depth.

7.   Contacts at the ICLON Test and Examination Service:

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[2] The knowledge percentage set by the LUMC is 60%.