

# **Evaluating the accuracy of actual workload questionnaire with ordinal response category: Bootstrap sampling for reliability**

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# Introduction

Within the European Higher Education Area (EHEA) framework, the student workload is set through the European Credit Transfer and Accumulation System (ECTS), which is a numerical descriptive value of the total in-class and independent unstructured work required to pass a particular lecture and it is used to determine the number of academic credits that should be assigned to a specific lecture or activity.

In the accreditation process, student workload is often used as a measure of the rigor and quality of the education provided by an institution or program.

Accrediting bodies often look at the number of hours that students are expected to spend on coursework and other activities, as well as the types of assignments and assessments they are required to complete.

Student workload questionnaire result is major evidence for Institutional Accreditation Program (IAP) in accreditation process to measure student engagement, rigor and overall satisfaction with the lecture or program.

It is typically used to gather information about how much time and effort students spend on their coursework, as well as to gather feedback on the quality of the lecture or program.

In the last two years, 23 institutions have been accredited by The Higher Education Quality Council of Turkey with the IAP system. While 13 of them received full accreditation, 10 received conditional accreditation.

When the reports of 13 institutions were assessed, applying student workload questionnaires and the evaluating of the results systematically were marked as areas open for improvement in the reports of 5 (38%) institutions. In 9 out of 10 conditionally accredited institutions (90%), the evidence regarding the actual workload was found to be insufficient.

In order for this evidence to be satisfactory, measuring the number of hours a student is expected to allocate for a lecture with open-ended questions, should be conducted by the lecture or program instructor for each lecture in every semester.

*Q1. How many hours per week did you spend on average outside of class hours in this course?*

*Q2. How many hours did you spend on average for the midterm exam preparation in this course?*

*Q3. How many hours did you spend on average for the final exam preparation in this course?*

Due to the workload instructors, it is essential to develop mechanisms that assist them with this process.

Most of the student information systems used by Turkish universities are available for administering multiple choice questionnaires to all students simultaneously.

AYBU student workload questionnaire applied for each lecture in the student information system every semester



## ECTS STUDENT WORKLOAD FORM

This form is carried out in order to reveal your working hours outside of your participation in classes and to calculate the total student load for the relevant course. In this way, real ECTS values for your course will be obtained. Thank you for your participation.

QUESTIONS	None.	1-3 hours	4-6 hours	7-9 hours	10-12 hours	13 hours and more
1. How many hours per week did you spend on average for this course outside of class hours? (article-book-magazine reading, quiz, homework, project, library work, internet research, etc.)						
2. How many hours did you spend on average for the preparation of the midterm exam in a semester for this course?						
3. How many hours did you spend on average for the final exam preparation in a semester for this course?						

## ***Research question***

Does the multiple choice actual workload survey conducted through the student information system replace the gold standard?

We aimed to check the level of correspondence between the answers taken from 3 short multiple-choice questions and the open-ended answers to determine the actual workload for any lecture.

If we could achieve this, we would be able to quickly calculate the student workload in each semester through the student information system and obtain the current ECTS calculation of the relevant course.

# Method

QUESTIONS	None.	1-3 hours	4-6 hours	7-9 hours	10-12 hours	13 hours and more
1. How many hours per week did you spend on average for this course outside of class hours? (article-book-magazine reading, quiz, homework, project, library work, internet research, etc.)						

	<b>Real (open-ended)</b>	<b>Converted (category)</b>
<b>How many hours per week did you spend on average outside of class hours in this course?</b>	6	5

The students' workload and the ECTS were calculated by the equations given below.

**Total hours of instruction=**

the scheduled hours (the semester lasts approximately 14 weeks\*2 hours/week) + the average time for midterm and final exams (2 hours)

**Total hours out-of-class independent study=**

(the semester lasts approximately 14 weeks \*response to Q1) + response to Q2 + response to Q3

**The students' workload =** total hours of instruction + hours out-of-class independent study hours

As one ECTS credit represents a workload of 25-30 hours the ECTS of a course was calculated by dividing the total workload by 30.

**The ECTS of course=** The students' workload / 30

The concordance between the ECTS values obtained from the open-ended version (“*Real*”) and over their categorical equivalents (“*Converted*”) was evaluated by intraclass correlation coefficient (ICC, two-way mixed model, agreement, single).

We measured the uncertainty in the concordance by the calculated statistics of the bootstrap sampling method.

The bootstrap statistic is a nonparametric resampling method which makes no distributional assumptions and used for estimation.

The basic steps of the bootstrap method used in this study are as follows:

1. We took a random sample with replacement from the original dataset. This sample is called a bootstrap sample.
2. We calculated the statistics of interest for the bootstrap sample. The main two statistics are median of ECTS for each lecture and ICC of “*Converted*” and “*Real*” values.
3. We repeated steps 1 and 2 10000 times to generate a large number of bootstrap samples and corresponding statistics.
4. The mean, bias, and the root mean square residuals (RMSR) of the statistic values based on the 10000 ordinary nonparametric bootstrap replicates was determined.

$$MEAN = \frac{\sum_{i:1}^R t_i}{R} \quad BIAS = \frac{\sum_{i:1}^n (t_i - t)}{R} \quad RMSR = \sqrt{\frac{\sum_{i:1}^R (t_i - t)^2}{R}}$$

$t_i$ : the estimated statistic value of sample based on the  $i^{\text{th}}$  bootstrap replicate

R: the number of nonparametric bootstrap replicates

$t$ : the statistic value from the original study sample

Accuracy of statistical significance of median and ICC estimates were quantified by the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles within the sorted distribution of the estimated parameters as the lower and upper limits of the bootstrap confidence intervals.

The “*boot*” and “*irr*” packages in RStudio were used for the estimation of the median and ICC values, respectively.

The mean of estimations was obtained from the replicates.

# Findings

**Table 1.** The median ECTS values for each lecture

	<b>IMT218</b>	<b>IMT322</b>	<b>SBF102-Nutrition</b>	<b>SBF102-Physiotherapy</b>
<b>Real</b>	2.42	3.48	2.13	1.97
<b>Converted</b>	2.52	3.62	2.37	2.27

The ECTS median values obtained from the open-ended version (*real*) and ordinal response categories (*converted*) version were similar for these lectures.

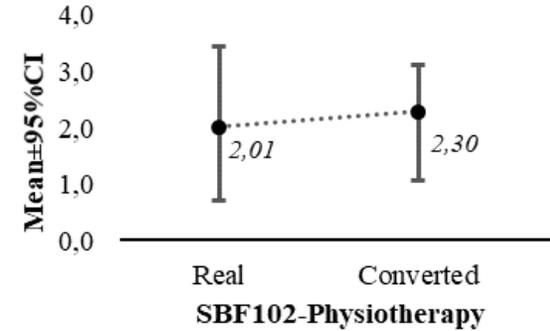
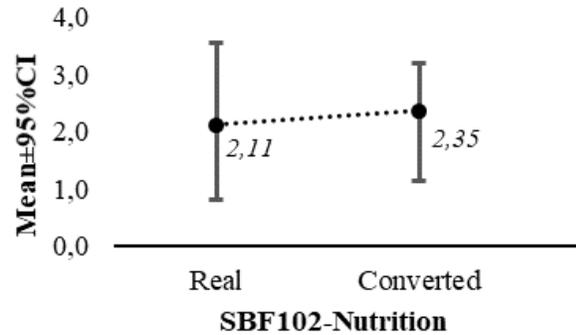
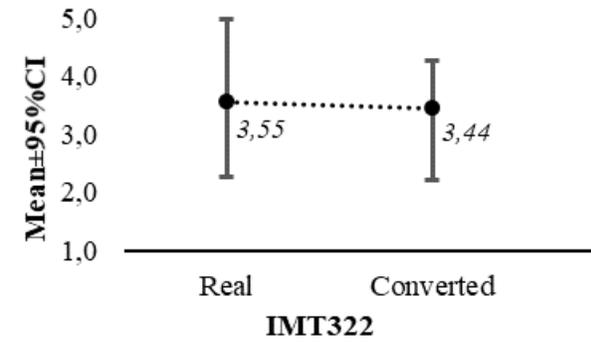
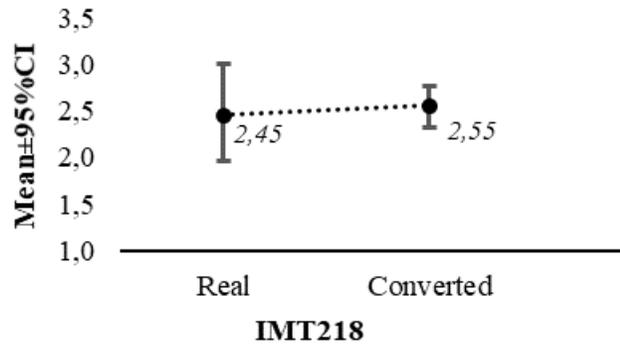
**Table 2.** The ICC between the Real and Converted ECTS values from the original study sample and the bootstrap samples.

	ICC (95% CI) from the original sample	ICC (95% CI) from the bootstrap samples
<b>IMT218</b>	0.97 (0.94 – 0.99)	0.97 (0.94 – 0.99)
<b>IMT322</b>	0.89 (0.68 – 0.97)	0.87 (0.71 – 0.97)
<b>SBF102-Nutrition</b>	0.69 (0.53 – 0.80)	0.74 (0.59 – 0.94)
<b>SBF102-Physiotherapy</b>	0.66 (0.47 – 0.79)	0.71 (0.57 – 0.87)

The ICC between the Real and Converted ECTS values were obtained from each bootstrap samples, and the mean of the 10000 ICC values were calculated.

The agreements between the Real and Converted ECTS values from the bootstrap samples were obtained as excellent (0.97), good (0.87) and moderate (0.74 and 0.71), respectively.

When the confidence intervals obtained from the bootstrap simulation were examined, it was observed that the lower limits of all confidence intervals were above 50%. This is a proof for the significance of the ICC mean values.



**Figure (a-d).** The mean and percentile 95% CIs of ECTS median values.

- ✓ CIs for ECTS estimates obtained from “Real” data included lower and upper bounds of the CIs obtained from “Converted” data.

## Conclusion

It is important to use fast and easy-to-use tools in order to carry out student workload calculation.

In calculating the student workload, the use of student information system, which provides access to all students simultaneously for all lectures, can be considered as the fastest and feasible method.

However, it is not always possible to make open-ended inquiries in these systems. Even with open-ended querying, systems often do not allow to get specific calculations from open-ended results.

In this study, it was investigated whether the student workload could be obtained reliably from the student information system.

Calculations can be made using the answers obtained with the multiple-choice questionnaire in student information systems that do not facilitate questioning with an open-ended questionnaire.

The strength of our study is that the bootstrap method was used for population generalization of the obtained estimates, considering that the number of students in the departments was low and the ECTS distribution calculated over the questions directed to the workload calculation was not known.

Indeed, including four lectures is a limitation for this study.

It is important to support the results by making similar evaluations for different lectures in different faculties and departments or design specific simulation process to answer this question taking various simulation conditions.

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Thank you...