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ABSTRACT Students' evaluations of teacher performance (SETs) are increasingly used by universities. However, in their current format SET-scores are controversial mainly due to two issues: (1) questionnaire items are relegated to the status of being of equal importance, and (2) the feedback to the teachers is rather vague and limited. This paper proposes a tailored version of Data Envelopment Analysis to construct SET-scores. One part of this method's appeal stems from overcoming the two aforementioned criticisms. In particular, DEA accounts for different values and interpretations that teachers attach to 'good teaching' and teacher performances are put into a relative perspective to be optimally evaluated. Second, if available, expert opinion on the relative importance of teaching aspects can be easily incorporated into the evaluation. The identification of teachers' relative strengths and weaknesses is a third advantage. The method is illustrated using data collected at the Hogeschool Universiteit Brussel.

Keywords: student evaluations of teaching; Data Envelopment Analysis; higher education; Benefit of the doubt; weight restrictions
JEL-Classification: C14, C61, I21

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Introduction

While still controversial, student evaluations of teaching (hereafter, SETs) have become an important and frequently used method of assessment, its rationale being that students, and only students, are constant observers of what happens during the lectures. While the plethora of research has been devoted to establishing the validity, reliability, stability and usefulness of student evaluations (see, among others, Abrami *et al.*, 1990; Centra, 1994; De Jong *et al.*, 2001; Feldman, 1996, 1997; Marsh, 1982, 1984, 1987; Marsh *et al.*, 1993, 1997; McKeachie, 1997; etc.), only limited attention has been paid to how the student questionnaires should be processed and translated into useful insights and messages for faculty self-improvement. The common practice is to provide the teachers with average ratings on questionnaire items and, eventually, a SET score that is just a weighted average of these ratings. Formally,

$$SET_j = \sum_{i=1}^{q} w_i \bar{y}_{j,i} \qquad (1)$$

where we assume n teachers in the sample of observations, SET_j the teacher evaluation score for instructor j (j=1,…n), $\bar{y}_{j,i}$ the class-average student rating for instructor j on questionnaire item i (i=1,…,q), and w_i the weight assigned to this item i. Note that there is w_i and not $w_{j,i}$ as weights are fixed over evaluated teacher performances. In situations where SET scores are computed as the arithmetic average, weights are equal $(w_i = 1/q)$ across all questionnaire items i.

Several points can be made here. First of all, when using an arithmetic average all questionnaire items (measuring different aspects of teacher performance) are relegated to the status of being of equal importance. Whether or not such equal weights and, in general, any set of fixed weights are appropriate is questionable. Indeed, there are some indications suggesting that equality of weights across teaching aspects and/or over teachers is undesirably

restrictive. As an illustration of the latter, one frequently observes that teachers value teaching aspects differently in the definition and, thus, the evaluation of excellent teaching (Pritchard et al., 1998 p.32).[1] These differences are not surprising given the different personalities and abilities of teachers. Hence, using fixed weights in the build-up of SET scores may be somewhat counterintuitive. Pritchard et al. (1998, p. 32) put it even stronger: "*If an evaluation system is to be valid, differences in importance [of teaching aspects] need to be captured when effective teaching is measured. If responses to items are averaged, differences in importance are lost…. Therefore, some method of weighting importance must be used so that measures can be combined into a single index in a way that preserves the differential importance of the components.*" Moreover, in the absence of a consensus on how teaching aspects exactly interrelate, any choice of fixed weights will be subjective to some extent. The use of fixed weights can also introduce unfairness in teacher evaluations. Indeed, fixed weights may favour teachers who perform well on aspects that receive high weights, while disfavouring teachers who excel on aspects with low assigned weights. Teachers may invoke this subjectivity in weight choice to undermine the credibility of the SET scores. Last but not least, teachers only get limited information out of such a weighted average, the essential reason being that it is not at all clear what scores precisely imply. At what value does a score become an indication of good overall teaching performance? Very often, scores are compared to some standard fixed norm (i.e., external benchmark) to check whether the teacher performance is of proper quality. The question remains whether the norm itself is suitable. For instance, how reliable is such a fixed norm if a large majority of the teachers perform better (something that is frequently observed in practice)? A similar reasoning applies to the identification of the teacher's principal strengths and weaknesses. When is a rating on a questionnaire item high (low) enough for this item to be considered as a strength (weakness)?

[1] Illustrative are the strong inter-individual disagreements observed in the opinion of teachers and students on the appropriate weights in our current study (see Table 1).

For a teacher, a SET score becomes much more meaningful when it is constructed and interpreted in a relative perspective to the performances of colleagues. These considerations are a central theme of the current paper.

The main purpose of this study is to present a specially tailored version of the Data Envelopment Analysis methodology (DEA, hereafter) as a well-suited approach to construct meaningful SET scores based on questionnaire data. The DEA model has been developed by Charnes *et al.* (1978) as a non-parametric (i.e., it does not assume any *a priori* assumption on the production frontier) technique to estimate efficiency of observations. In the current paper, we do not apply the original DEA model, but rather an alternative approach which originates from DEA. This so-called 'benefit of the doubt' (BoD) model exploits the characteristic of DEA that it, thanks to its linear programming formulation, allows for an endogenous weighting of multiple outputs/achievements (Melyn and Moesen, 1991). This approach has several advantages over the currently employed methodologies. Firstly, SET scores are no longer computed by just averaging the class ratings over the several questionnaire items. Instead, for each teacher performance under evaluation, weights are chosen endogenously in a relative perspective to the performances of other teachers such that an optimal SET score is realized. Therefore, teachers with performances receiving low SET scores can no longer blame their poor evaluation to unfair weights. Second, DEA is a non-parametric technique which implies that only limited assumptions are required on how the different teaching aspects interrelate. This approach is justifiable in the complex setting of constructing SET scores where "*one knows what the characteristics of good teaching are, but one doesn't know how they relate to each other"* (Weimer, 1990 p. 13). Third, DEA is flexible to incorporate stakeholder opinion (e.g. teachers, students, practitioners, pedagogical experts, etc.) in the construction of the SET scores. Clearly, this involvement is beneficial for the credibility and

acceptance of the evaluation results. Finally, DEA provides a summarizing picture of the teacher's overall performance together with additional information on the most important relative strengths and weaknesses (observed for each subject lectured by the teacher as well as more general). This is a practical advantage as the overall score can be used for summative purposes (i.e., tenure, promotion, etc.) while the information on relative strengths and weaknesses can be used for normative purposes (i.e., improving teacher performance). During the paper, each of these advantages will be discussed more in detail.

The paper is laid out as follows. The next section briefly describes the questionnaire data collected at the Hogeschool Universiteit Brussel (HUB) during the academic years 2005-2006 and 2006-2007. A section then follows which presents the DEA for a non-specialist audience. Doing so, I will stress some fundamental intuitions and show some basic formulas, focusing less on the technical and computational aspects of DEA (these are treated at length in various surveys: e.g. Cooper et al. 2004, or Zhu, 2003). The basic DEA model is adjusted to the specific context of constructing a composite SET score based on only performance indicators (i.e., the questionnaire items). The ensuing section discusses the methodological as well as practical importance of incorporating the opinions of stakeholders (i.e., students and lecturers) as weight restrictions to ensure that a proper weighting scheme is established. This section will also demonstrate the importance of such restrictions in establishing relative strengths and weaknesses. This is followed by a section that proposes a format for an individual lecturer report. In the subsequent section we illustrate how all individual teacher evaluations can be easily summarized in a faculty evaluation report. The paper ends with a summary of the conclusion reached and a discussion of some limitations that could be addressed in future research.

Student questionnaire

The purpose is to estimate teacher performance as measured by the performance of a teacher on a specific course. In particular, the present study explores a detailed sample on 530 college courses j $(j = 1,\ldots,530)$ taught by 148 different teachers. Teachers who lecture several courses will therefore have several teacher performance scores (SET-scores), i.e. one for each evaluated course. These courses were taught in the Commercial Sciences and Commercial Engineering programs at the Hogeschool Universiteit Brussel (HUB) in the first and second semester of the academic years 2005-2006 and 2006-2007. During the last two weeks of these semesters, in total, 30.098 responses were elicited from the students using a questionnaire. Note that a student could have been asked to express his appreciation of multiple courses. The questionnaire comprised 16 statements to evaluate the multiple aspects of teacher performance. Students were asked to rate a lecturer's performance on all statements on a five-point Likert scale that corresponds to a coding rule ranging from 1 (I completely disagree) to 5 (I completely agree). To facilitate the users' understanding of the 'underlying structure' in teacher performance, statements focussing on similar aspects of the teaching activity were grouped into key dimensions: 'Learning & Value', 'Examinations & Assignments', 'Lecture Organization', and 'Individual Lecturer Report' (see Appendix 1). The development of the questionnaire as well as the categorization of the items into these key dimensions were largely based on a study of the content of effective teaching, the specific intentions of the evaluation instrument, and reviews of previous research and feedback (e.g. Marsh, 1982, 1984, 1987, 1989 and 1991; Marsh *et al.*, 1991, 1992, 1993 and 1997; etc.). Based on a literature review, Marsh *et al.* (1992, p. 146) conclude that this approach is more commonly used than statistical techniques such as factor analysis or multitrait-multimethod analysis. The individual course was the unit of analysis, rather than the individual student. For each course j $(j = 1,\ldots,530)$,

this entails computing an average student rating $\bar{y}_{j,i}$ for each questionnaire item i (i = item 1,…, item 16):

$$\bar{y}_{j,i} = \frac{1}{S} \sum_{s \in course\ j} y_{j,i,s} \qquad (2)$$

with $y_{j,i,s}$ the appreciation of student s for the teacher lecturing course j on item i. The $s \in course\ j$ indicates that all S students registered for course j and present during the administration of the questionnaires are considered in the computation of the class mean rating on the items $\bar{y}_{j,i}$ $(i = 1,\ldots,16)$. Note that this value of S can be lower than the number of students enrolled for the course j (i.e., official class size) as students may be absent during this administration. Among others, Cranton *et al.* (1990), Aiken (1996) and Thorndike *et al.* (1991), Yunker (1983) and Marsh (1987) argued in favour of using the class as the unit of analysis and not the individual student. In essence, all arguments in favour of the use of class-level data boil down to the same idea, namely that the process of averaging across the individual ratings produces a more reliable and balanced picture of the teacher's complete performance. For instance, Yunker (1983) emphasized that aggregating student ratings at the class level has the advantage of lessening the influence of extraneous student variables (e.g. academic ability, his personal intention when rating the lecturer) and errors (e.g. inaccuracies in the data collection) on the results.

Methodology

The methodology to construct SET scores is rooted in DEA, a performance measurement technique originally developed by Farrell (1957) and put into practice by Charnes *et al.* (1978). In essence, DEA is a linear programming tool for evaluating the relative efficiency of a set of similar entities (e.g., firms, individuals, etc.) given observations on (possibly multiple)

inputs and outputs and, often, no reliable information on prices, in a setting where one has no (exact) knowledge about the 'functional form' of the production or cost function. However broad, one immediately appreciates the conceptual similarity between that problem and the one of constructing SET scores based on a large array of single-dimensional performance indicators i $(i=1,\ldots,q)$ (i.e., the q average class ratings $\bar{y}_{j,i}$ collected using a carefully constructed questionnaire) and no precise understanding on the exact importance of each of these indicators. In fact, in comparison to DEA, the only difference is that the build-up of SET scores only requires a look at achievements (without explicitly taking into account the input dimension). Formally, in the DEA setting, all evaluated entities are assumed to have a 'dummy input' equal to one. The intuitive interpretation (see, amongst others, Lovell *et al.* 1995 and Cook, 2004) for this focus may be obtained by simply looking upon this specific version of the DEA-model as a tool for summarizing performances on the several components of the evaluated phenomenon, without explicit reference to the inputs that are used for achieving such performances. Melyn *et al.* (1991) were the first to adjust DEA to such a setting. They labelled the resulting model 'Benefit of the Doubt' (BoD), a label that originates from one of the features of DEA: the use of an endogenous weight selection procedure in the aggregation. For a presentation of the BoD-formula in a stepwise fashion, see Cherchye *et al.* (2007b).

The main conceptual starting point of DEA is that, in the absence of any detailed knowledge on the correct weights, information on the appropriate weights can be retrieved from the observed data themselves (i.e., a posteriori). In particular, the basic idea is to put each teacher performance on a specific course c (as measured by the $\bar{y}_{c,i}$'s) in a relative perspective to the other teacher performances (the $\bar{y}_{j,i}$'s with $j=1,...,n$) included in the comparison set Υ and look for relative strengths and weaknesses. A good relative performance of a teacher on a

specific item i indicates that this teacher considers this aspect as relatively important. Accordingly, this aspect should weigh more heavily in the performance evaluation. As a result, a large weight is assigned. The opposite reasoning holds for the teaching aspects on which a teacher performs weak compared to the other colleagues in the comparison set (i.e., low weights are assigned to such items). In other words, for each evaluated teacher performance on a specific course c separately, DEA looks for the weights that maximize the impact of the teacher's relative strengths and minimize the influence of the relative weaknesses. As a result, BoD-weights $w_{c,i}$ are optimal in the sense that they are chosen in such a way as to maximize the teacher's SET score SET_c.[2] Formally, this point is covered by the general max operator in the following basic DEA problem (adjusted for the 'Benefit of the Doubt' context of constructing a composite SET score based on achievements only, see also Cherchye *et al.*, 2007b):[3]

$$SET_c = \max_{w_{c,i}} \sum_{i=1}^{q} w_{c,i} \bar{y}_{c,i} \qquad (3)$$

s.t.

$$\sum_{i=1}^{q} w_{c,i} \bar{y}_{j,i} \leq 1 \qquad j = 1,...,n \quad (all\ n \in \mathrm{Y}) \qquad (3a)$$

$$w_{c,i} \geq 0 \qquad i = 1,...q \qquad (3b)$$

Thus, in the absence of any detailed information on the 'true' weights, DEA assumes that representative weights can be inferred from looking at the relative strengths and weaknesses. This indeed means that the each teacher is granted the benefit-of-the-doubt when it comes to assigning weights in the build-up of his/her SET_c's (i.e., one for each evaluated course). This quality explains a major of the appeal of the DEA-based SET_c's: teachers can no longer blame a low SET score on damaging or unfair weights.

[2] For completeness, we mention that DEA alternatively allows for a 'worst-case' perspective in which entities receive their worst set of weights, hence, high (low) weights on performance indicators on which they perform relative weak (strong) (Zhou *et al.*, 2007).

[3] As mentioned above, this adjusted model is formally tantamount to the original input oriented CCR-DEA model of Charnes *et al.* (1978), with all questionnaire items considered as outputs and a dummy input equal to one for all observations.

In basic DEA, teachers are granted considerable leeway in the definition of their most favourable weights $w_{c,i}$. In fact, optimal weights only need to satisfy two constraints: the normalization constraint $(3a)$ and the non-negativity constraint $(3b)$. The first restriction imposes that no other teacher performance present in the sample Υ can have a SET score higher than unity when applying the optimal weights $w_{c,i}$ of the teacher performance c under evaluation. The second constraint states that weights should be non-negative. Hence, SET_c is a non-decreasing function of the performances on the several statements i. Apart from these restrictions, the formal model $(3)-(3b)$ allows weights to be freely estimated in order to maximize SET_c.[4]

From restriction $(3a)$, one can deduce that, for all evaluated teacher performances SET_c $(c=1,\ldots,n)$, SET_c will lie between 0 and 1 with higher values indicating a better relative teacher performance. In fact, this constraint highlights the benchmarking idea of DEA: the most favourable weights for the evaluated teacher performance are always applied to all n performances in the comparison set Υ. One is in that way effectively looking which of the teacher performances in this sample are worse, similar or better. If $SET_c=1$, the teacher lectures the course, relative to the other evaluated courses, in the best way (i.e., he/she acts as his/her own benchmark). That is, it is not outperformed by other observations j $(j=1,\ldots,c,\ldots,n)$ when applying his/her best possible weights $w_{c,i}$. On the other hand, a

[4] It is important to stress that the DEA-approach effectively allows one to impose a common (endogenously selected) set of weights by imposing further restrictions on the weights. In particular, it is possible to reduce (or even eliminate) the dispersion of weight values over evaluated performances pertaining to the same teacher or, even more general, over all evaluated teacher performances. For an application of this idea on country-level data, see Cherchye *et al.* (2007a) and Kao *et al.*, (2005). I will refrain from pursuing this further in this paper. As will be discussed in the next sections, I prefer granting some limited flexibility in the definition of the weights (the flexibility being limited by the weigh restrictions as retrieved from the stakeholders). Doing so, I bear in mind the common observation that while the possibility of arriving at a stakeholder consensus on a unique set of weights is rather unlikely, agreement on weight bounds is much simpler to obtain.

$SET_c \leq 1$ reveals that there is at least one observation in the sample who realizes a higher SET score when applying the most favourable weights $w_{c,i}$ for the teacher performance under evaluation (weights which are surely less favourable than the own optimal DEA weights). In such situations, clearly, a strong case can be made for the notion that this teacher performance is 'outperformed'. Such an outperforming performance may be conceived as a suitable benchmark for the evaluated performance. More generally, the SET_c-value reveals the degree of superior performance. The closer is SET_c to unity, the closer is the evaluated performance to the benchmark performance. Note that this interpretation is intuitive and straightforward to convey to the target audience: "The SET-scores of other teacher performances in the comparison set Υ, constructed with your optimal weights, may indeed be higher than the SET-score for your own evaluated performance. From point of view of improving your own teaching performance, focus specifically on those teacher performances who realize the highest SET-values when using your optimal weights."

Up to now, only the teacher performances on individual courses have been evaluated. To get an impression of a teacher's overall performance, it is valuable to combine his or her multiple course evaluations into an overall quantitative score. To get to such an overall index of teaching quality, TQ_T, the administrator of the questionnaires at HUB proposed to aggregate all k SET scores pertaining to a teacher using a measure of the course importance. Specifically, the administrator at HUB made explicit to weigh the SET score of each course with the number of contact hours h_c:

$$TQ_T = \frac{h_c}{\sum_{c \in Lecturer\,T} h_c} SET_c \qquad (4)$$

The rational for using contact hours is that, in general, courses with a higher contact hour ask more preparation, organization, etc., and, therefore, should weigh more heavily in the

evaluation of that teacher's overall performance. Note that this is merely a proposal reflecting the preference of the administrator of the SETs at the Hogeschool Universiteit Brussel. Other universities may prefer the use of alternative aggregation weights (e.g.: class size as an indication of the number of students who expressed their appreciation on the evaluated teacher performance). As all SET scores of each individual teacher T are optimal, TQ_T is optimal too (and this irrespective of the aggregation weights used).

Stakeholder opinion and weight restrictions

DEA clearly marks a deviation from the common fixed/equal weighting practice in that it grants teachers considerable leeway in the definition of their most favourable weights $w_{c,i}$. In fact, apart from the two minor constraints $(3a)$ and $(3b)$ in the basic model, DEA allows weights to be freely estimated in order to maximize an individual's SET score. This large freedom in weight choice can be seen as an advantage as it enables teachers to put themselves in the best possible light relative to their colleagues. Disillusioned teachers can no longer blame a low SET score on a harmful or unfair weighting scheme. Any other weighting scheme than the one specified by DEA would worsen the SET score. However, this flexibility also carries some potential disadvantages as it may allow a teacher to appear as a brilliant performer in a manner that is hard to justify. For instance, there is nothing that keeps model $(3)-(3b)$ from assigning zero or quasi-zero weights to questionnaire items on which the teacher performs poorly compared to the colleagues, thereby neglecting those aspects in his or her assessment. For example, in an extreme scenario, all the relative weight could be assigned to only a few items, which would then completely determine the SET score. One thus faces the risk of basing an evaluation on only a subset of all (judiciously selected and defined) questionnaire items. Further, there is the potential problem that DEA may select weights that

contradict prior stakeholder views (e.g. students, lecturers, pedagogic experts, faculty board, etc.). Questionnaire items that experts judge to be of only secondary importance may receive very high weights in basic DEA analysis. Or, conversely, in its basic version, DEA may assign a low weight to items which experts judge to be of crucial importance. To avoid zero or unrealistic weights, additional weight restrictions are needed in the basic model. Formally, the constraint $(3c)$ is added to the model, with W denoting the set of permissible weight values defined based upon the opinion of selected stakeholders $e \in E$.

$$w_{c,i} \in W_e \qquad i = 1,...,q \ \ and \ \ e \in E \qquad (3c)$$

In our application, we gathered opinion on appropriate weights of the two parties most involved in the teaching process (i.e., students and teachers).[5] In total, 16 students and 16 teachers were invited to complete five Budget Allocation analyses (BA, hereafter). Such a Budget Allocation analysis is a participatory methodology in which stakeholders have to distribute 100 points over the items allocating more to what they regard to be the more important items. Four of these BA-analyses where performed within the four key dimensions of teaching where the stakeholders were asked to express their opinion on the relative importance of the constituting questionnaire items. One BA-analysis pertained to the general teaching level. In this analysis, teachers and students had to distribute 100 points over the four dimensions, giving more to those dimensions whose importance he/she wanted to stress. Summary information (i.e., average, the minimum and maximum BA-weights) about the distribution of the points so-obtained is provided in Table 1. As one notices, there are strong inter-individual disagreements about the precise value of the weights (i.e., large difference between the maximum and the minimum assigned weights). Not a single pair of stakeholders shared a similar proposal. In addition, nobody in the panel proposed to weigh all dimensions

[5] Weight restrictions are the result of stakeholder opinions and thus introduce subjectivity into the evaluation system. Although this subjectivity is at times considered as less acceptable than objectivity, in the current application this is not regarded as an issue. In fact, subjectivity of this type is both desirable and essential as it helps identifying how teachers should be more or less performing to be viewed as good teachers. Further, stakeholder participation is a critical way to promote acceptance of the evaluation tool.

and questionnaire items equally, in contrast with the common practice. The question to be taken up in the remainder of this section is how stakeholder opinions can be incorporated when calculating SET scores.

Different types of weight restrictions have been proposed to introduce additional information in the basic DEA model (e.g., Wong *et al.*, 1990; Thompson *et al.*, 1990; etc.). Cherchye *et al.* (2007b) argued in favour of using proportional virtual weight restrictions when opinions have been collected by a BA-approach. The stated 'weights' (which actually are budget shares) are then very easy to incorporate. Formally,

$$\alpha_i \leq \frac{w_{c,i}\overline{y}_{c,i}}{\sum_{i=1}^{q} w_{c,i}\overline{y}_{c,i}} \leq \beta_i \qquad (5)$$

An interesting feature about this type of restrictions is that the interpretation of the bounds remains invariant to changes in the Likert scale. In the DEA literature, this feature is also known as 'unit invariance'. While not providing a formal proof of this statement here (see e.g. Cooper *et al.*, 2000, pp. 39), the underlying intuition is quite straightforward: the original scale of the questionnaire item (4-point, 5-point, 6-point, etc.) has no influence on the interpretation of the proportional virtual weight restriction.

[Table 1 About Here]

The only difficulty is the how to specify the bounds, given the diversity over individual stakeholders. The idea is to grant DEA more leeway in the definition of the relative importance of the items (i.e., relative to the key dimensions they belong to) while allowing only a limited amount of flexibility in the definition of the relative importance of the key dimensions to the overall SET score. In terms of the proportional virtual weight restrictions

pertaining to the items, the lower and upper bound are respectively the minimum and maximum weight as specified by the stakeholders (the columns 'Min' and 'Max' in Table 1).

For example, in the dimension 'Lecture Organization' the weight of the questionnaire item 'The lecturer takes into account my knowledge and skills' is allowed to vary between 5% and 30%:

$$5.00\% \leq \frac{w_{c,know}\bar{y}_{c,know}}{\sum_{i \in Lect.Org.} w_{c,i}\bar{y}_{c,i}} \leq 30.00\% \qquad (6)$$

The lower and upper bound pertaining to the key dimensions are centered around the dimension-specific average BA-weights as specified by the experts (the column 'Average' in Table 1). A certain amount of variation is allowed, viz. minus 25% (lower bound) and plus 25% (upper bound) of this average weight. In the example of the key dimension 'Lecture Organization', for instance, this would yield $\alpha_i = 0.2207 \times 0.75 = 0.1655$ and $\beta_i = 0.2207 \times 1.25 = 0.2759$. Formally,

$$0.1655 \leq \frac{\sum_{i \in Lect.Org.} w_{c,i}\bar{y}_{j,i}}{\sum_{i=1}^{q} w_{c,i}\bar{y}_{j,i}} \leq 0.2759 \qquad (7)$$

Similar proportional virtual weight restrictions are also imposed on the other key dimensions: 'Learning & Value' (lower bound: 0.2390; upper bound: 0.3984), Examinations & Assignments' (lower bound: 0.1777; upper bound: 0.2961), and 'Individual Lecturer Characteristics' (lower bound: 0.1678; upper bound: 0.2796).

Individual teacher results

We first examine the individual course evaluations as computed by $(3)-(3b)$ and the proportional virtual weight restrictions as in (6) and (7). Table 2 displays some results. The first five columns provide some administrative information, the last four columns present the

SET-scores following different evaluation approaches. The 'EW'-column provides the commonly-used arithmetic average SET score. Somewhat similarly, the column 'BA FW' displays a weighted average using the average specified BA-weights (cf. Table 1). Note that both these approaches are just two specific cases of fixed weighting. Compare, for instance, the SET scores for the courses 'Micro Economics A' (8673) and 'Bank & Stock A' (8522). Using equal weights, the latter is evaluated to be of higher quality. The opposite holds when applying the average BA-weights in the aggregation. It is obvious that one may invoke this dependency to question the credibility and the use of SET scores. Indeed, a SET-score is not very meaningful when the resulting ordering depends solely on the preferences of merely one or a few stakeholder(s). In practice, however, all SET scores constructed using fixed weights are prone to precisely this deficiency. Removing the requirement for administrators to fix a set of weights would eliminate this dependency and, thus, an important criticism. As noted above, SET scores constructed using DEA (column 'DEA') are less vulnerable to this criticism as weights are chosen endogenously and, thus, objectively based on the observed data themselves. Further, the optimality of the DEA weights may well tone down some of the negative feelings of teachers towards evaluations.

[Table 2 About Here]

As argued above, in its full flexibility version, DEA still suffers from the problem of allowing inappropriate (zero or extreme) weights. In fact, in the current example of constructing SET scores, if one would use DEA without any additional restrictions, the majority of the weights would be equal to zero (cf. Appendix 2). More precisely, SET scores constructed using full flexibility DEA comprise on average only 3.72 of the 16 statements. There would be even 74 SET-scores (approximately 14% of all SET scores) which just comprise one single statement. Clearly, this abolishes the original desideratum of SET scores portraying a multidimensional

phenomenon (see, for instance, Feldman, 1996, 1997; and Marsh, 1984). As already discussed, we handle this issue by incorporating stakeholder opinion in the analysis by adding weight restrictions. The result is a restricted DEA-model (column 'DEA_R') which provides a balance between, on the one hand, freedom in the definition of optimal weights and, on the other hand, conformity to some general specifications on the appropriate values of these weights. For that reason, it seems save to say that both theoretically as well as intuitively, SET scores constructed using restricted DEA are the least open to criticism.

While Table 2 generates some valuable insights into the quality of the evaluated teaching practices, a single number is far too shallow a basis for learning about the multiple factors causing a certain teaching performance. Evidently, plausible explanations of observed teaching performance require detailed analyses indicating what strengths and weaknesses are at the origin of these performances. In this respect, DEA enables an in-depth analyses as Table 3a and Table 3b illustrate for the evaluated courses of Professor C. Table 3a shows the absolute contributions (i.e., $w_{c,i}\overline{y}_{j,i}$) of the 16 statements for each of the seven courses evaluated for Professor C. Note two things. First, within each key dimension, contributions of questionnaire-items sum up to exact contribution of that dimension. Second, absolute contributions of all four key dimensions sum up to the SET scores. Somewhat trivially, absolute contributions of all 16 statements sum up to that same SET-score. Besides that, Table 3a doesn't reveal much useful information.

[Table 3a About Here]

[Table 3b About Here]

More findings can be retrieved from Table 3b, which displays the percentage contributions of the key dimensions and questionnaire statements. One can readily note that all tabulated percentage contributions are in accordance with the added weight restrictions as retrieved from the stakeholder group (cf. Table 1). Further remark that, even without violating these restrictions, DEA-obtained percentage contributions can still be quite diverse. Third and more importantly, this table shows an interesting side-effect of such restrictions: binding restrictions reveal relative strengths and weaknesses. This side-effect results from the relative perspective and the endogenous weight selection which enables DEA to assign higher (lower) weights to those statements for which the evaluated teacher performs relatively best (worst). With these features of DEA in mind, it is straightforward to see that binding proportional virtual weight restrictions as in (6) and (7) reveal statements on which DEA was limited in the definition of optimal weights. To be more precise, binding restrictions in upward (downward) direction indicate the accordance of the maximum (minimum) allowed importance and, thus, relative strengths (weaknesses). In fact, if not for the presence of these restrictions, higher (lower) optimal weights would have been assigned.

To illustrate this, let's go back to the course evaluations of Professor C and more in particular, the optimal percentage contributions of the statement 'This lecturer has good contacts with the students' in the key dimension 'Individual Lecturer Characteristics'. In the evaluation of the courses 'Banks & Stocks B' (66607) and 'Corporate Finance' (8911) DEA attached the maximum allowed importance to this statement (i.e., 30%). Straightforwardly, if the restriction pertaining to this statement would have been less stringent (i.e., upper bound of 40% instead of 30%) DEA would have weighted this statement more heavily in the SET scores for these two courses. As a result, for these two courses, the contact of the teacher with the students appears to be a relative strength. An opposite reasoning applies in the evaluations

of the courses ‘Corporate Finance’ (1421), ‘Banks & Stocks A’ (8636), ‘ Banks & Stocks B’ (9029), and ‘ Banks & Stocks B’ (9157) where the statement is granted the minimum allowed importance of 5%. In case of more flexibility, the optimal impact of this statement in the SET scores would have been lower. By consequence, these downwardly binding restrictions are perceived as 'revealed evidence' of a relative weakness in the performance of Professor C when lecturing these respective courses. In the evaluation of the course ‘Banks & Stocks A’ (8522), the contact with the students is neither seen to be a relative strength nor a relative weakness as the weight restriction is not binding. In sum, binding weight restrictions enable a quick and largely objective identification of relative strengths and weaknesses in an evaluated teacher performance. In Table 3b, superscripts ‘W’ and ‘S’ are used to indicate respectively relative strengths and weaknesses. Clearly, this feature of DEA is interesting in the definition of key messages in an individual feed-back report.

Up to now, teacher performance has only been analyzed at the level of the individual course. While providing detailed and useful insights, ideally, individual course evaluations should be summarized into key messages for the teacher. Essentially, this boils down to solving the following question: when can a questionnaire item, indicated as relative strength (weakness) in one or more course evaluations, be considered as an overall relative strength (weakness) in the evaluated teacher’s performance. In cases where the weight restrictions pertaining to a particular statement is upwardly (downwardly) binding in all evaluated courses, the answer is straightforward. For Professor C, for instance, binding restrictions on the statements ‘The lectures takes into account my knowledge and skills’ (weakness), ‘The lectures encourage reflecting and actively digesting the course material’ (weakness), ‘The pace of the lecture’ (strength), and ‘The lecturer treats each student with respect’ (strength) clearly indicate general features in teacher C’s performance. A largely similar reasoning applies to the

statements where restrictions are binding in the evaluation of all but one course performance (e.g. ‘In this part of the schooling I have learned a lot’, ‘The employed lecture material is conveniently arranged and understandable’, and ‘In general, I have a good impression of these lectures’). Conversely, the interpretation is less apparent when the findings from the individual courses are mixed. Perfect illustrations are the statements ‘The lectures are well-structured’, and ‘The lecturer has good contacts with the students’ with respectively 5 and 4 indications of relative weaknesses and 2 indications of relative strengths. In the absence of any standard rules, subjectivity from part of the evaluator is unavoidable. The idea, however, should be that a statement can only be considered as an overall relative strength (weakness) for a teacher when it is indicated as such in the majority (e.g., $2/3$) of the evaluations of his or her courses. In the evaluation of Professor C, for example, a required amount of 5 indications seems reasonable. Note that this is only a proposal. Some evaluators may be more (less) stringent when it comes to acknowledging relative strengths and weaknesses in the summary of the teacher’s performance evaluation, thereby setting higher (lower) limits. Nevertheless, limit values should not contradict intuition. When, for instance, in the evaluation of seven courses, a statement is indicated only once as weakness and six times as a mediocre relative performance (e.g., the item ‘During the lectures didactical equipment is functionally used’ for professor C), it seems hard to justify that this statement is an overall weakness. Based on the limit value of ‘5’, respectively six and five statements were established as overall weakness and strength in Professor C’s teaching performance.

We conclude this section by mentioning that all the aforementioned results are readily summarized into a feedback report. An illustration for Professor C can be found in Appendix 3. The report consists of three parts. The upper part presents the SET scores of all of Professor C’s evaluated courses as well as some administrative information (see, Table 2). The middle

part of the report visualizes the percentage contributions of the key dimensions. The bottom part of the sheet further lists the most profound relative strengths and weaknesses in Professor C's teaching performance. Both the middle and the lower part are mainly retrieved from Table 3b. The feedback report could be further complemented with written comments from individual student questionnaires about particular strengths and weaknesses. Note that such a format could be easily mailed to the teachers together with additional information on the exact purposes of the evaluation system, a brief description of the used methodology, an invitation for feedback sessions, and/or a summary of the faculty results.

Faculty results

So far, only individual course and teacher results have been discussed. Nevertheless, it is also of interest to provide an overall impression of what qualities and shortcomings are frequently observed among faculty staff. While the literature (e.g. Hativa, 1995) points to several benefits of such a university-wide picture (e.g. feedback to the faculty board, etc.), perhaps, the most important of all is that such an overview might enable teachers to put their results into a wider perspective. Or, to put it in the words of an evaluated teacher: "I think the evaluation process will be more constructive to my reflection if there was some way in which the generally observed findings could be fed back to me. This would enable me to compare my own results with my colleagues' achievements, thereby indicating which areas particularly deserve instant action." This statement seems to confirm the point made by Peel (2005) when he claims that the role of 'the other' in stimulating opportunities for reflection is pivotal. Indeed, an overall faculty report might make the teachers more 'self' aware of their evaluation results. Consequently, it may encourage reflection on teaching and foster debate about and dissemination of best practice teaching behaviour. Also in this respect, DEA sits quite comfortably. In fact, faculty results can be quite easily derived from the percentage

contributions as in Table 3b. One only needs to calculate the percentages of individual courses in which a statement was evaluated as respectively a relative strength and a relative weakness (cf. Table 4).

[Table 4 About Here]

In table 4, questionnaire items and key dimensions are considered as a general characteristic of faculty staff when they are indicated as relative strength or weakness in more than 60% of the evaluated courses. While being subjective, this cut-off value seems intuitively reasonable. In the case of HUB, this means that teachers are generally performing well when it comes to organizing their lectures, teaching at an appropriate pace, speaking sufficiently load an clear during the lectures, and treating each student with respect. Areas where further improvement is possible include: taking into account the knowledge and skills of students when organizing lectures, making lecture material more conveniently arranged and understandable, encouraging reflection and an active digestion of course material, organizing the lectures so that they are better structured, and explaining the course material in a better way.

Conclusion

The current paper contributes to the literature in that it clearly deviates from the current methodology to process questionnaire data in student evaluations of teacher performance (SETs). In contrast to the traditional arithmetic average SET scores, the idea was to use a specially tailored version of the Data Envelopment Analysis methodology (DEA) to construct SET scores and to translate the results into useful insights and messages for faculty self-improvement. Compared to the common practice, DEA has several advantages. First, questionnaire items are no longer relegated to the status of being of equal importance. Instead DEA accounts for different values and interpretations that teachers attach to ‘good teaching’.

Second, each evaluated teacher performance (i.e., for lecturing a particular course) is put into a relative perspective to be optimally evaluated. As a result, teachers who receive low SET scores for lecturing certain courses can no longer blame their poor evaluation on unfair weights. Third, DEA is a nonparametric technique which implies that only limited assumptions are required on how the different teaching aspects interrelate. Fourth, DEA is flexible to incorporate stakeholder opinion (e.g. teachers, students, practitioners, pedagogical experts, etc.) in the construction of the SET scores. Clearly, this involvement is beneficial for the credibility and acceptance of the evaluation results. Finally, DEA provides a summarizing picture of the teacher's overall performance together with additional information on the teacher's most important relative strengths and weaknesses. Based on these advantages, it seems fair to say that DEA is well-suited to handle teacher evaluation exercises.

Nevertheless, in its basic (even restricted) version, DEA still suffers from some limitations that could be addressed in future work: the sensitivity of the evaluation results (i.e., SET scores) towards potential outliers, extreme values, and data irregularities and the inability to account for the influence of background variables. The sensitivity of conventional DEA to outlying observations or data irregularities results from the basic feature to include all n observations in the comparison sample in the performance evaluations. As a result, atypical observations could heavily disturb all evaluation results (as they typically perform as benchmarks). Further, original DEA does not account for the influence of background variables. Essentially, this implies assuming that the environment has no influence on the attainable performance. Particularly in the context of evaluating teacher performances such an assumption seems hardly tenable and very much open to criticism. First of all, there are the numerous findings in the academic literature which suggest that one or more background conditions (e.g., class size, teacher gender, teacher experience, course grades, timing of the

course) may have a significant influence on SET scores (Abrami *et al.*, 1980; Cashin, 1995; Centra, 2003; d'Appollonia *et al.*, 1997; Eiszler, 2002; Feldman, 1997; Griffin, 2001, 2004; Langbein, 1994, 2008; Lin, 2009; Marsh, 1987, 2007; Marsh *et al.*, 1997, 2000; Nasser *et al.* 2006; Ting, 2000; etc.). Second, there is the practical experience from teachers themselves which indicates that some teaching environments are more constructive to high-quality teaching (and, hence, high SET scores) while other environments make such a level of teaching less evident. Consequently, if not accounting for the influence of background variables, one risks obtaining evaluations results which can be seriously biased and misleading. Recently, Cazals et al. (2002), Daraio and Simar (2005, 2007a, 2007b), and De Witte and Kortelainen (2008) developed some extentions in the basic DEA framework to make the results to data irregularities and atypical observations, to account for the operating environment, and to explore which of the environmental variables have a significant impact on the DEA-scores. Implementing these developments in the above presented approach clearly are interesting avenues for future research that may benefit the reliability and validity of DEA to evaluate teacher performance.

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Appendix 1

The first dimension *'Learning & Value'* is measured by respectively (i) The lecturer justifies this part of the schooling in function of our formation, (ii) In this part of the schooling I have learned a lot, and (iii) In general, I have a good impression of these lectures. The second dimension, *'Examinations & Assignments'*, comprises only one question: (iv) The requirements and agreements concerning the exam evaluation are clear. The third dimension evaluates the *'Lecture organization'* and consists of six questions: (v) The lecture takes into account my knowledge and skills, (vi) The employed lecture material (syllabus, hand book, electronic documentation) is conveniently arranged and understandable, (vii) During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…), (viii) The lectures encourage reflecting and actively digesting the course material, (ix) The lectures are well-structured, (x) The pace of the lecture is good. The fourth and last teaching dimension measures '*Individual Lecturer Characteristics*' in relation to the teaching performance by using six question, respectively (xi) The lecturer reacts to questions, suggestions, and critical remarks in a serene and constructive manner, (xii) The lecturer has good contacts with the students, (xiii) During the lectures one speaks sufficiently load and clear, (xiv) The lecturer treats each student with respects, (xv) The lecturer gives useful examples, applications or exercises, and (xvi) The lecturer explains the course material in a good way.

Appendix 1: questionnaire outline: 4 key dimensions with 16 questionnaire items

	Key dimensions & Questionnaire items	Average	Stdev
	Learning & Value		
-	The lecturer justifies this part of the schooling in function of our formation.	3.866	0.548
-	In this part of the schooling I have learned a lot.	3.734	0.601
-	In general, I have a good impression of these lectures.	3.642	0.572
	Examinations & Assignments		
-	The requirements and agreements concerning the exam evaluation are clear.	3.622	0.694
	Lecture Organization		
-	The lectures takes into account my knowledge and skills.	3.688	0.590
-	The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	3.957	0.521
-	During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	3.835	0.686
-	The lectures encourage reflecting and actively digesting the course material.	3.567	0.624
-	The lectures are well-structured.	3.623	0.637
-	The pace of the lecture.	4.038	0.646
	Individual Lecturer Characteristics		
-	The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	3.749	0.658
-	The lecturer has good contacts with the students.	4.138	0.437
-	During the lectures one speaks sufficiently load and clear.	3.212	0.323
-	The lecturer treats each student with respect.	3.875	0.590
-	The lecturer gives useful examples, applications or exercises.	3.796	0.653
-	The lecturer explains the course material in a good way.	3.638	0.641

Appendix 2: Absolute contributions of the teaching dimensions and questionnaire items for Professor C

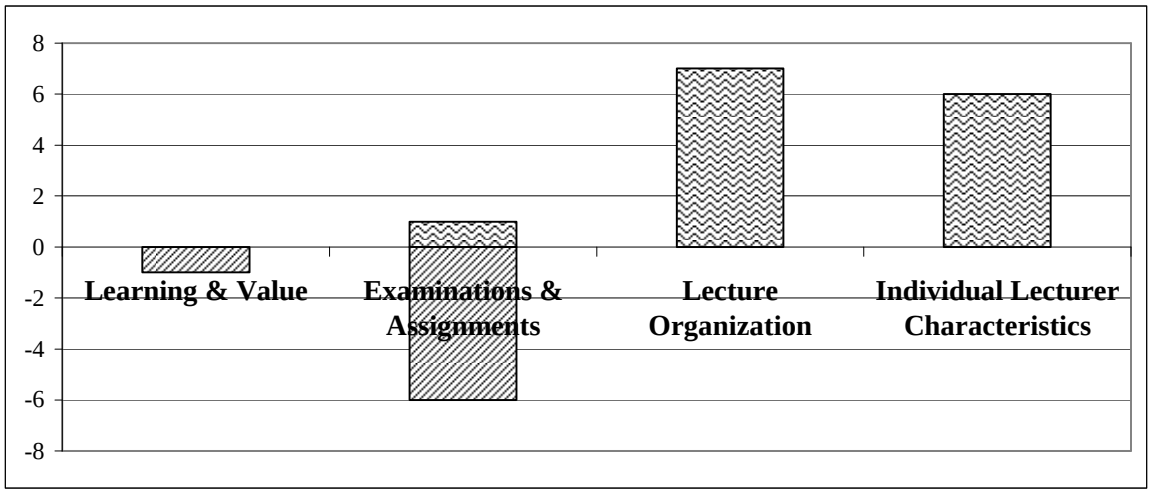
Key dimensions & Questionnaire items	Banks & Stock B (66607)	Corporate Finance (1421)	Banks & Stocks A (8522)	Banks & Stocks A (8636)	Corporate Finance (8911)	Banks & Stock B (9029)	Banks & Stock B (9157)
	(83.31%)	**(94.31%)**	**(85.09%)**	**(89.77%)**	**(91.79%)**	**(77.16%)**	**(76.61%)**
Learning & Value	**0.0000**	**0.0000**	**0.0231**	**0.0070**	**0.0000**	**0.0000**	**0.0037**
- The lecturer justifies this part of the schooling in function of our formation.	0.0000	0.0000	0.0231	0.0070	0.0000	0.0000	0.0037
- In this part of the schooling I have learned a lot.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- In general, I have a good impression of these lectures.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Examinations & Assignments	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
- The requirements and agreements concerning the exam evaluation are clear.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lecture Organization	**0.0964**	**0.5124**	**0.1288**	**0.1554**	**0.1108**	**0.5361**	**0.1732**
- The lectures takes into account my knowledge and skills.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	0.0000	0.0245	0.0385	0.0432	0.0308	0.1930	0.0708
- The lectures encourage reflecting and actively digesting the course material.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- The lectures are well-structured.	0.0056	0.3370	0.0000	0.0000	0.0000	0.1998	0.0000
- The pace of the lecture.	0.0908	0.1509	0.0903	0.1122	0.0800	0.1433	0.1024
Individual Lecturer Characteristics	**0.7365**	**0.4306**	**0.699**	**0.7353**	**0.807**	**0.2354**	**0.5891**
- The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	0.1572	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- The lecturer has good contacts with the students.	0.0000	0.0000	0.0000	0.0000	0.1189	0.0000	0.0000
- During the lectures one speaks sufficiently load and clear.	0.0263	0.4306	0.0809	0.0584	0.0000	0.0000	0.0109
- The lecturer treats each student with respect.	0.5530	0.0000	0.6181	0.6769	0.6881	0.2354	0.5782
- The lecturer gives useful examples, applications or exercises.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
- The lecturer explains the course material in a good way.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix 3: Individual feedback report

Instructor		Pers.Nr.	M/F	Age	PhD	< 2 years	Reseach%
Professor C		3453	F	39	Yes	No	50%

Enq.Nr.	Course	Dir.	Group	Master	Class size	contact	**Score**
66607	Banks & Stock B	Comm.Ir.	2JU [1]	X	57	16	**73.58%**
1421	Corporate finance	Comm.Sc.	1EW [2]	0	21	30	**83.05%**
8522	Banks & Stock A	Comm.Sc.	1BE [1]	0	64	30	**75.72%**
8636	Banks & Stock A	Comm.Sc.	1BW [1]	0	156	30	**78.02%**
8911	Corporate finance	Comm.Sc.	1EW [1]	0	27	30	**78.84%**
9029	Banks & Stock B	Comm.Sc.	1LC [1]	0	100	16	**65.99%**
9157	Banks & Stock B	Comm.Sc.	1SB [1]	0	121	16	**64.14%**
					Overall SCORE:		**75.76%**

[1]: academic year 2005/2006, [2]: academic year 2006/2007



STRENGTHS

+ The pace of the lectures is good **(7/7)**
+ Students indicate that you treat them with a lot of respect **(7/7)**
+ In general, students have a good impression of your lectures **(5/7)**
+ Students appreciate that the lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner **(5/7)**

WEAKNESSES

- Lectures should more encourage reflecting and actively digesting the course material **(7/7)**
- The knowledge and skills of the students should be more considered **(7/7)**
- For some lectures, students indicate that what they have learned was only moderate. **(6/7)**
- Students indicate that the lecture material (syllabus, hand book, texts, electronic documentation) for some courses could be more conveniently arranged and understandable. **(6/7)**
- Some lectures could be better structured **(5/7)**
- The course material can sometimes be better explained **(5/7)**

Table 1: Student and teacher opinion on the importance of key dimensions and questionnaire items

	Key dimensions & Questionnaire items	Exp1	Exp2	Exp3	Exp4	…	Exp29	Exp30	Exp31	Exp32	Average	Min	Max
	Learning & Value	**29**	**7**	**28**	**50**	…	**56**	**29**	**33**	**11**	**31.87%**	**7.00%**	**56.00%**
-	The lecturer justifies this part of the schooling in function of our formation.	30	5	30	30	…	10	10	20	30	21.97%	5.00%	50.00%
-	In this part of the schooling I have learned a lot.	50	90	40	65	…	60	70	40	20	48.28%	20.00%	90.00%
-	In general, I have a good impression of these lectures.	20	5	30	5	…	30	20	40	50	29.75%	5.00%	50.00%
	Examinations & Assignments	**35**	**27**	**11**	**25**	…	**22**	**29**	**11**	**22**	**23.69%**	**5.00%**	**57.00%**
-	The requirements and agreements concerning the exam evaluation are clear.	100	100	100	100	…	100	100	100	100	100.00%	100.00%	100.00%
	Lecture Organization	**24**	**33**	**39**	**19**	…	**11**	**29**	**28**	**33**	**22.07%**	**6.00%**	**39.00%**
-	The lectures takes into account my knowledge and skills.	8	10	15	10	…	20	7	10	5	14.06%	5.00%	30.00%
-	The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	20	30	25	20	…	20	23	10	20	21.72%	10.00%	30.00%
-	During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	7	15	15	10	…	10	16	10	10	12.13%	5.00%	50.00%
-	The lectures encourage reflecting and actively digesting the course material.	35	15	10	10	…	25	14	20	25	16.50%	9.00%	35.00%
-	The lectures are well-structured.	15	10	20	25	…	15	25	30	25	19.84%	5.00%	30.00%
-	The pace of the lecture.	15	20	15	25	…	10	15	20	15	15.75%	10.00%	30.00%
	Individual Lecturer Characteristics	**12**	**33**	**22**	**6**	…	**11**	**14**	**28**	**33**	**22.37%**	**5.00%**	**42.00%**
-	The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	15	15	10	10	…	15	9	20	5	13.44%	5.00%	23.00%
-	The lecturer has good contacts with the students.	10	5	15	10	…	10	11	10	5	13.22%	5.00%	30.00%
-	During the lectures one speaks sufficiently load and clear.	20	10	15	10	…	10	15	20	5	14.84%	5.00%	30.00%
-	The lecturer treats each student with respect.	10	10	15	20	…	10	14	10	5	14.03%	5.00%	25.00%
-	The lecturer gives useful examples, applications or exercises.	20	30	20	20	…	15	25	20	20	18.00%	5.00%	35.00%
-	The lecturer explains the course material in a good way.	25	30	25	30	…	40	26	20	60	26.47%	10.00%	60.00%

Table 2: Course evaluations using equal weighting, average budget allocation weights, DEA weights and restricted DEA weights

Nr.	Teacher	Course	Class	Contact	EW	BA FW	DEA	DEA_R
…	…	…	…	…	…	…	…	…
8673	Professor B	Micro Economics A	1BW [1]	45	3.650	3.729	85.50%	79.25%
8674	Professor B	Micro Economics B	1BW [2]	30	3.697	3.805	86.19%	80.10%
9487	Professor B	Micro Economics B	1DW [2]	30	4.101	4.191	94.81%	88.14%
66607	**Professor C**	**Banks & Stock B**	**2JU [1]**	**16**	**3.582**	**3.469**	**83.31%**	**73.58%**
1421	**Professor C**	**Corporate finance**	**1EW [2]**	**30**	**3.981**	**3.922**	**94.31%**	**83.05%**
8522	**Professor C**	**Banks & Stock A**	**1BE [1]**	**30**	**3.677**	**3.578**	**85.09%**	**75.72%**
8636	**Professor C**	**Banks & Stock A**	**1BW [1]**	**30**	**3.750**	**3.652**	**89.77%**	**78.02%**
8911	**Professor C**	**Corporate finance**	**1EW [1]**	**30**	**3.801**	**3.707**	**91.79%**	**78.84%**
9029	**Professor C**	**Banks & Stock B**	**1LC [1]**	**16**	**3.250**	**3.108**	**77.16%**	**65.99%**
9157	**Professor C**	**Banks & Stock B**	**1SB [1]**	**16**	**2.944**	**2.935**	**76.61%**	**64.14%**
8927	Professor D	Quantitative Methods	1EW [1]	30	3.508	3.530	87.60%	75.22%
9583	Professor D	Quantitative Methods	2LB [2]	30	3.400	3.326	83.60%	71.28%
…	…	…	…	…	…	…	…	…

[1]: academic year 2005/2006; [2]: academic year 2006/2007; EW = Equal Weighting; BA FW = Fixed BA weights; DEA = Full flexibility DEA-weighting; DEA_R = Restricted DEA-weighting with proportional virtual weight restrictions as in (6) and (7).

Table 3a: Absolute contributions of the teaching dimensions and questionnaire items for Professor C

Key dimensions & Questionnaire items	Banks & Stock B (66607)	Corporate Finance (1421)	Banks & Stocks A (8522)	Banks & Stocks A (8636)	Corporate Finance (8911)	Banks & Stock B (9029)	Banks & Stock B (9157)
	(73.58%)	**(83.05%)**	**(75.72%)**	**(78.02%)**	**(78.84%)**	**(65.99%)**	**(64.14%)**
Learning & Value	**0.1964**	**0.2216**	**0.2020**	**0.2082**	**0.2104**	**0.1760**	**0.1533**
- The lecturer justifies this part of the schooling in function of our formation.	0.0589	0.0665	0.0606	0.0625	0.0105	0.0880	0.0766
- In this part of the schooling I have learned a lot.	0.0393	0.0443	0.0404	0.0416	0.0947	0.0352	0.0307
- In general, I have a good impression of these lectures.	0.0982	0.1108	0.1010	0.1041	0.1052	0.0528	0.0460
Examinations & Assignments	**0.1307**	**0.1475**	**0.1345**	**0.1386**	**0.1401**	**0.1172**	**0.1899**
- The requirements and agreements concerning the exam evaluation are clear.	0.1307	0.1475	0.1345	0.1386	0.1401	0.1172	0.1899
Lecture Organization	**0.2030**	**0.2291**	**0.2088**	**0.2154**	**0.2177**	**0.1820**	**0.1768**
- The lectures takes into account my knowledge and skills.	0.0101	0.0115	0.0104	0.0108	0.0109	0.0091	0.0088
- The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	0.0203	0.0481	0.0209	0.0215	0.0218	0.0182	0.0177
- During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	0.0325	0.0115	0.0856	0.0883	0.0892	0.0746	0.0725
- The lectures encourage reflecting and actively digesting the course material.	0.0183	0.0206	0.0188	0.0194	0.0196	0.0164	0.0159
- The lectures are well-structured.	0.0609	0.0687	0.0104	0.0108	0.0109	0.0091	0.0088
- The pace of the lecture.	0.0609	0.0687	0.0627	0.0646	0.0653	0.0546	0.0531
Individual Lecturer Characteristics	**0.2057**	**0.2321**	**0.2117**	**0.2182**	**0.2203**	**0.1844**	**0.1213**
- The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	0.0473	0.0116	0.0487	0.0502	0.0507	0.0092	0.0279
- The lecturer has good contacts with the students.	0.0617	0.0116	0.0148	0.0109	0.0661	0.0092	0.0061
- During the lectures one speaks sufficiently load and clear.	0.0144	0.0697	0.0635	0.0655	0.0110	0.0092	0.0364
- The lecturer treats each student with respect.	0.0514	0.0580	0.0529	0.0545	0.0551	0.0461	0.0303
- The lecturer gives useful examples, applications or exercises.	0.0103	0.0580	0.0106	0.0109	0.0154	0.0092	0.0085
- The lecturer explains the course material in a good way.	0.0206	0.0232	0.0212	0.0262	0.0220	0.1015	0.0121

Table 3b: Percentage contributions of the teaching dimensions and questionnaire items for Professor C

Key dimensions & Questionnaire items	Banks & Stock B (66607)	Corporate Finance (1421)	Banks & Stocks A (8522)	Banks & Stocks A (8636)	Corporate Finance (8911)	Banks & Stock B (9029)	Banks & Stock B (9157)
	(73.58%)	**(83.05%)**	**(75.72%)**	**(78.02%)**	**(78.84%)**	**(65.99%)**	**(64.14%)**
Learning & Value	**26.69%**	**26.69%**	**26.68%**	**26.68%**	**26.68%**	**26.67%**	**23.90% W**
- The lecturer justifies this part of the schooling in function of our formation.	30.0%	30.0%	30.0%	30.0%	5.0% W	50.0% S	50.0% S
- In this part of the schooling I have learned a lot.	20.0% W	20.0% W	20.0% W	20.0% W	45.0%	20.0% W	20.0% W
- In general, I have a good impression of these lectures.	50.0% S	50.0% S	50.0% S	50.0% S	50.0% S	30.0%	30.0%
Examinations & Assignments	**17.77% W**	**17.77% W**	**17.77% W**	**17.77% W**	**17.77% W**	**17.77% W**	**29.61% S**
- The requirements and agreements concerning the exam evaluation are clear.	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Lecture Organization	**27.59% S**	**27.59% S**	**27.59% S**	**27.59% S**	**27.59% S**	**27.59% S**	**27.59% S**
- The lectures takes into account my knowledge and skills.	5.0% W	5.0% W	5.0% W	5.0% W	5.0% W	5.0% W	5.0% W
- The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	10.0% W	21.0%	10.0% W	10.0% W	10.0% W	10.0% W	10.0% W
- During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	16.0%	5.0% W	41.0%	41.0%	41.0%	41.0%	41.0%
- The lectures encourage reflecting and actively digesting the course material.	9.0% W	9.0% W	9.0% W	9.0% W	9.0% W	9.0% W	9.0% W
- The lectures are well-structured.	30.0% S	30.0% S	5.0% W	5.0% W	5.0% W	5.0% W	5.0% W
- The pace of the lecture.	30.0% S	30.0% S	30.0% S	30.0% S	30.0% S	30.0% S	30.0% S
Individual Lecturer Characteristics	**27.96% S**	**27.96% S**	**27.96% S**	**27.96% S**	**27.96% S**	**27.96% S**	**18.91%**
- The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	23.0% S	5.0% W	23.0% S	23.0% S	23.0% S	5.0% W	23.0% S
- The lecturer has good contacts with the students.	30.0% S	5.0% W	7.0%	5.0% W	30.0% S	5.0% W	5.0% W
- During the lectures one speaks sufficiently load and clear.	7.0%	30.0% S	30.0% S	30.0% S	5.0% W	5.0% W	30.0% S
- The lecturer treats each student with respect.	25.0% S	25.0% S	25.0% S	25.0% S	25.0% S	25.0% S	25.0% S
- The lecturer gives useful examples, applications or exercises.	5.0% W	25.0%	5.0% W	5.0% W	7.0%	5.0% W	7.0%
- The lecturer explains the course material in a good way.	10.0% W	10.0% w	10.0% W	12.0%	10.0% W	55.0%	10.0% W

Table 4: faculty strengths and weaknesses

	Key dimensions & Questionnaire items	STRENGTH	WEAKNESS
	Learning & Value	**2.83%**	**45.47%**
-	The lecturer justifies this part of the schooling in function of our formation.	59.62%	18.68%
-	In this part of the schooling I have learned a lot.	10.00%	56.98%
-	In general, I have a good impression of these lectures.	30.38%	34.34%
	Examinations & Assignments	**20.75%**	**51.70%**
-	The requirements and agreements concerning the exam evaluation are clear.	-	-
	Lecture Organization	**89.62%** *	**4.15%**
-	The lectures takes into account my knowledge and skills.	15.47%	72.45% *
-	The employed lecture material (syllabus, hand book, texts, electronic documentation) is conveniently arranged and understandable.	14.34%	74.15% *
-	During the lectures didactical equipment is functionally used (black board, transparents, video, computer, language practicum, laboratory,…).	0.75%	44.91%
-	The lectures encourage reflecting and actively digesting the course material.	10.38%	81.7% *
-	The lectures are well-structured.	19.43%	66.79% *
-	The pace of the lecture.	99.25% ****	0.38%
	Individual Lecturer Characteristics	**75.66% ***	**9.81%**
-	The lecturer reacts to questions, suggestions and critical remarks in a serene and constructive manner.	40.38%	54.34%
-	The lecturer has good contacts with the students.	29.81%	50.57%
-	During the lectures one speaks sufficiently load and clear.	64.15% ****	23.21%
-	The lecturer treats each student with respect.	67.36% ****	23.77%
-	The lecturer gives useful examples, applications or exercises.	17.36%	58.30%
-	The lecturer explains the course material in a good way.	2.26%	68.49% *