

ANALYSIS AND PRESENTATION OF STUDENT EVALUATIONS OF FACULTY DATA USING SAS

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Eastern Kentucky University has recently endorsed Student Evaluations of Faculty (SEF) as a concept. However, as with any agreement in principle, the mechanics of actually implementing such a plan creates many problems. Two of the concerns expressed by the faculty in discussing the principle of SEF were the method of analyzing the results and the use of the results. The faculty was in almost total agreement that the evaluations would be worthwhile if they provided feedback to the instructor and were not used in promotion decisions. Therefore, having the evaluation results for each faculty member compared only to his own efforts was a desirable quality of the analysis process.

Some faculty members were concerned about the wording of the questions that were used in collecting the information from the students. Still others were concerned with the method of presenting the analysis to the faculty because, in many cases, a faculty member may not be quantitatively oriented or he may have a prejudice regarding computer-processed results. This last concern was expressed by many faculty members and centered around the idea of not wanting to wade through stacks of computer printout while trying to interpolate numerical descriptions of human traits. However, the concept of reducing the results to only a few numbers was rejected on the ground that this could easily lead to a comparative analysis among faculty members by the administration.

Another condition which impacted with the problem of implementing SEF data using a computerized system was the affinity the academic community has for committees. Early in the process of defining the systems and methods of SEF implementation, faculty committees were appointed to address segments of the problem. This led to the need to locate some form of semi-prepackaged computer program which could be tailored to the implementation situation with a minimum of effort on the part of the committee members.

Many of the drawbacks of implementing SEF were diminished using SAS. Therefore, it may be worthwhile to present the methodology of SEF using SAS to others facing similar situations and to describe the methodology as an example of the flexibility of SAS.

As related in the foregoing, the process of setting up the SEF system, several committees were appointed to address individual segments of the entire project. One committee concerned itself with the wording of the questions to be asked of the students. Another committee was appointed to address the scheduling problems of administering the test. A separate committee was assigned the task of converting the test results into a data set ready for analysis, while a fourth committee was established to develop some form of a data analysis procedure that could easily be adjusted to individual departmental

needs within the University. The analytical procedure developed within the constraints given to the data analysis committee constitutes the theme of this paper.

The data set committee developed a procedure by which faculty members would receive a deck of punched computer cards with the responses of each student to the SEF questions. These cards also contained coding to identify the instructor. The punching of the cards was automated with the aid of a standardized test form and a photomechanical reader. This reduced the manual labor and shortened the time between administration of the questionnaires and the availability of the resultant data deck.

The task of data analysis committee was the development of a procedure which would allow individual faculty members to analyze their results with a minimum of effort and still maintain control over their data set. The key concept in the entire procedure was that each faculty member would have access only to his SEF results. By not recording the data in any form other than on the response sheets (by the students) and the punched cards (by machine), wide acceptance of this plan was gained from the faculty, since both of these recorded data sets were in the hands of the faculty.

The data cards distributed to each individual faculty member produced a SAS data set with the instructor's name and 18 question response variables. The values of the response variables ranged from 0 to 4 and corresponded to the individual questions asked of the students on the questionnaire. The number of observations in the data set was equal to the number of students answering the questions. Each of the response variables were arranged such that a low value corresponded to a low evaluation of that particular trait while a high value corresponded to a favorable response. The only cards needed with the data deck consisted of the JCL cards and a minimum number of SAS data set cards to identify the variables for the purpose of establishing an initial data set. The rest of the data management was accomplished using SAS statements and procedure cards.

In the analysis of the results under the constraints of the situations, two goals were paramount:

1. The results should be readily interpretable by individuals who were not quantitatively oriented.
2. The results should be meaningful only by the data collected from the students of each individual instructor.

In order to accomplish the first goal, the use of pictorial descriptive statistics was selected as the best form of conveying analytical

information to individuals not accustomed to interpreting numerical output. The second goal precluded the use of relative standings among faculty members. However, relativity within the data set of an individual faculty member was acceptable. Therefore, the use of comparisons of response deviations was pursued in order to identify strong and weak traits of the instructor. The underlying philosophy was that the faculty member should be presented with information concerning their strong and weak traits (relative only to themselves), since they are in a position to capitalize on the strong traits and improve their weaker traits without worrying about job security or response manipulation. This type of analysis would also guarantee that each faculty member would receive some strong and some not so strong trait results, thereby providing even the best instructor some areas of improvement.

By subtracting a grand mean from each mean response deviation, a vector of relative traits was computed which was printed in chart form using the "PROC CHART" procedure. The composite formula used to produce this vector was:

$$D_{.j} = \left[\frac{1}{n} \sum_{i=1}^n (x_{ij} - \bar{x}_{i.}) \right]$$

$$- \left[\frac{1}{kn} \sum_{j=1}^k \sum_{i=1}^n (x_{ij} - \bar{x}_{i.}) \right] \text{ for } j=1 \text{ to } k$$

where: x = student response to question
 i = index of students (i = 1 to n)
 j = index of questions (j = 1 to k)
 k = # of questions
 n = # of students

After the responses are read in (program lines 21, 22), the next step is to calculate a vector of respondent's means for the response variables (program line 23) such that each row's mean is calculated according to:

$$\bar{x}_{i.} = \frac{\sum_{j=1}^k x_{ij}}{k} \text{ for } i = 1 \text{ to } n$$

This vector of values measures the mean rating assigned by each individual student with respect to this particular class and instructor. By first calculating the response means vector one can adjust for the difference in student's rating scales. The formula employed for the creation of the response deviations is presented below and is easily accomplished by the array facility of SAS79 (program lines 24-27):

$$d_{ij} = x_{ij} - \bar{x}_{i.} \text{ for } j = 1 \text{ to } k \text{ and } i = 1 \text{ to } n$$

The response deviations measure the weighting each student attributes to the individual questions relative to the student's grading base (which may vary between students) as the standard to each student's response to each question. The

idea behind this structure is that it is valuable to know that the student did consider that the particular trait being measured is different from (either above or below) the average of all traits (as the student perceives average). The student's perception of trait variability was judged to be more meaningful than trying to measure the differences among traits on an absolute scale; or stated differently, relative measurements may yield more useful information than an untested absolute measurement.

Now it becomes useful to find the mean of each of the response deviations for each instructor. In order to calculate the mean response deviation for each of the questions asked for all of the students that responded, the PROC MEANS procedure is used with an output statement (program lines 31, 32). This produces a horizontal vector of mean response deviations calculated with the following formula:

$$\bar{d}_{.j} = \frac{\sum_{i=1}^n d_{ij}}{n} \text{ for } j = 1 \text{ to } k$$

The values in this vector represent the mean deviation for all students relative to their individual grading systems for all questions asked. Note that there is no assurance that the mean of this vector will be zero since the deviations summed are deviations across a different axis. After outputting the mean response deviations, a grand mean can be determined for the data set which will provide an overall base of comparison for the individual instructor (program line 35). The grand mean is subtracted from the individual mean response deviations (program lines 36-41), producing a vector of balanced average relative values, called grand deviations. This vector of grand deviations will measure relative strong and weak traits of the instructor as viewed by his students. To accomplish this, the following two formulas are used:

$$\text{GRAND MEAN } G = \frac{\sum_{j=1}^k \bar{d}_{.j}}{k}$$

$$\text{GRAND DEVIATIONS } D_{.j} = \bar{d}_{.j} - G \text{ for } j = 1 \text{ to } k$$

The SAS data set now contains observations which are the grand deviations as presented in the initial formula of this paper, and indexing variables. The PROC CHART procedure in SAS is admirably suited to create a vivid pictorial representation of the grand deviations. These values will be printed out in pictorial form such that a mean line will represent the grand mean with vertical bars above and below the line. The length of these bars above and below the grand mean line indicate the relatively weak and strong traits of the instructor, as judged by his students. The labelling capabilities of SAS give great flexibility in annotating these charts (program lines 1-20 and 46-51). Multiple charts can be produced for different instructors using

the BY statement (program lines 30, 31, 43). Since the student responses for each individual instructor are used in the calculation of this bar graph, and the entire data set has been averaged several different times, comparison between instructors will yield little information to an administrator attempting to compare instructor efficiency. However, this bar chart does provide the instructor an easily interpretable printout of his performance as seen by his students. This allows him to take whatever measures he deems desirable to improve the weaker traits without fear for his job security and preempts the need to try to manipulate student responses in future evaluations.

SAS Program

```

1  PROC FORMAT;
2  VALUE QSTN_F
3      1=QSTN1 LABEL
4      2=QSTN2 LABEL
5      3=QSTN3 LABEL
6      .
7      .
8      .
9      .
10     .
11     .
12     .
13     .
14     .
15     .
16     .
17     .
18     .
19     .
20     18=QSTN18 LABEL;
21  DATA RAWDATA;
22  INPUT NAME $10. @11 (Q1-Q18) (1.);
23  STUDMEAN=MEAN(OF Q1-Q18);
24  ARRAY Q Q1-Q18;
25  DO OVER Q;
26  Q=Q-STUDMEAN;

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27  END;
28  DROP STUDMEAN;
29  CARDS;
30  PROC SORT; BY NAME;
31  PROC MEANS NOPRINT MEAN; BY NAME;
32  OUTPUT OUT=QMEANS MEAN=QMEAN1-QMEAN18;
33  DATA WORKSET1;
34  SET QMEANS;
35  GM=MEAN(OF QMEAN1-QMEAN18);
36  ARRAY QARRAY QMEAN1-QMEAN18;
37  DO OVER QARRAY;
38  QUESTION= I ;
39  DEVIATION=QARRAY-GM;
40  OUTPUT;
41  END;
42  DROP GM QMEAN1-QMEAN18;
43  PROC CHART; BY NAME;
44  VBAR QUESTION /SUMVAR=DEVIATION
45  ASCENDING DISCRETE;
46  FORMAT QUESTION QSTN_F;
47  LABEL QUESTION
48  =ITEMS ON EVALUATION INSTRUMENT
49  DEVIATION
50  =DEVIATION FROM GRAND MEAN;
51  TITLE STUDENT EVALUATION REPORT;

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SAS Output for SEF Data

STUDENT EVALUATION REPORT
NAME=INSTRUCTOR
BAR CHART OF DEVIATION

