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Excel™-Based Graphical Tools for Comparing Grades Across Multiple Lab or Tutorial Sections

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Extended Abstract

Instructors often face the challenge of maintaining grading consistency in large classes with multiple teaching assistants (TAs) and lab and/or tutorial sections. Students quite reasonably expect that assignments are graded to similar standards no matter what section they find themselves in; teaching assistants sometimes feel uncertain about whether their grading matches their colleagues' and wonder how much variation is reasonable; and, critically, instructors of large classes can sometimes lack a good way of surveying the class as a whole, and may instead find themselves making judgements based on incomplete data in response to student concerns.

We have developed a simple Excel™-based tool, provided in the **Appendices** to help instructors more easily achieve this at-a-glance summary of grades across many lab/tutorial sections of a class. Importantly, these tools attempt to take into account one source of variation that is likely to contribute to differences between sections: the academic ability of students enrolled in these sections. Our aim in developing this tool was to allow instructors to simply paste in columns of grades, which the spreadsheet would use to automatically generate some simple graphs summarizing each section's data. Instructors can then make quick visual comparisons across the class to get a sense of the consistency and variability in the grades being awarded across the various sections of the class.

This tool can be used to quickly create boxplots showing the distribution of grades in each section. One set of boxplots illustrates variation between sections in students' performance on a universal assessment separate from lab or tutorial work (e.g., a midterm test covering lecture content). The second set compares the lab or tutorial grades (averaged across a number of assignments) across the several sections. It is not reasonable to expect identical plots, but one might reasonably expect the interquartile ranges (IQRs, the portion of the data covered by the "box" in the boxplot) of lab/tutorial grades to overlap across sections. If outlying IQRs with little overlap are detected in a particular section, a glance at the midterm boxplots would indicate if the unusual lab/tutorial grades make sense. This tool also allows instructors to quickly generate a scatterplot in which midterm test grade appears on one axis and average lab/tutorial grade appears on the other axis. In this case, each student is represented by one point on the scatterplot, and the lab/tutorial section in which the student is enrolled is indicated by the type of marker used for the point (a legend is automatically generated for quick reference). When examining a plot like this, an instructor will likely observe some relationship between students' midterm test and lab/tutorial grade; however, if many students in a particular lab/tutorial section are falling above or below the "pack" on the scatterplot then this might be worth a closer look.

The **Appendix** also contains a text and a video guide to modifying these tools to include additional or larger sections. Instructors who wish to see the spreadsheet tools in action are encouraged to watch this video and to contact the authors with any questions.

Since this tool illustrates trends, it may not highlight issues immediately, and it is certainly not intended to replace proper TA training. However, it may add to TA training by promoting the importance of grading consistency between TAs. Sample graphs may be used to open discussions about a typical distribution of grades; how this distribution may vary between sections; and how unlikely it is that any single TA would find their lab/tutorials populated with all high- or low-achieving students. This could then lead to discussions on the importance of grading accurately and responsibly, and the importance of being able to distinguish high-quality work from low-quality

work, thus setting the groundwork for application of the grading rubric. Mid-course, the Excel™ tool could be applied to the grading data to date; allowing TAs to assess how they are grading in comparison to their peers; and whether student ability is a factor in the distribution of grades within their sections. This provides another opportunity for TAs to reflect on their grading practices, and for the instructor to identify TAs who may benefit from further guidance. This process may be repeated at the end of the term in order to provide TAs with further feedback. In addition to enhancing TA training, this data could help instructors become more aware of how students and TAs are experiencing course assignments and marking guides, highlighting possible issues with the training, guidance, and support that instructors are providing.

The visual approach of overseeing lab/tutorial grades by section and TA has some disadvantages. Any data summary method is only as good as the data set that underlies it: the size of the groups, number of lab/tutorial sections, and type of assignments may all affect the final product. In addition, this method is likely to work best at revealing issues as the term goes on, rather than early on. There is no substitute for thorough TA training and an approach that aims to prevent problems before they arise. However, this graphical method provides a systematic approach to monitoring grades when closer oversight is not possible, and it gives a complete picture of the class grades as a whole, which can otherwise be elusive in very large classes. It is less intrusive for TAs than the review and re-grade by instructors of selected graded assignments, and attempts to take into account the fact that grading will always vary to some extent between groups. We consider this resource to be another tool for the course coordinating and TA training toolkits—a tool that may be used to examine class grades for consistency between sections, and which may also be used to open further dialogue about grading practices and instructor support of TAs.

Keywords: grading, TAs

Link to Supplemental Materials: http://www.ableweb.org/volumes/vol-34/gass/supplement.htm

Appendix

How to Use the Tell-Tale Graphs Template

(An instructional video showing this process is also available at:**http://www.ableweb.org/volumes/vol-34/gass/supplement.htm)**

1. You will need two Excel files open: the template file, and a file containing your class data, sorted by lab section. The **first tab** (tabs are found at the lower left side of the screen) of the template file contains some basic instructions.
2. **Boxplots**: In the **second tab**, you can make side-by-side boxplots of the lab/tutorial grade distributions for each lab section. Simply highlight your lab grade data, copy it (*Ctrl-C*), and paste it (*Ctrl-V*) into the blue columns of the template. Each lab section should occupy a single column. As you paste in the data, the formulas in the yellow area will compute their values automatically and you will see the boxplots appear on the graph. The **third tab** of the template file allows you to generate the same graph using exam grades. Again, just copy your data (exam grades, this time) from your source file and paste it into the blue columns, with one column for each lab section. The boxplots will appear as you enter the data. These boxplots are set up to show the interquartile range (IQR; the range of data falling between the 25th and 75th percentiles) as the boxed area, and vertical bars extending to the maximum and minimum values in each data set. (Another common type of boxplot, where the vertical bars add 1.5*IQR to each end of the box and outliers are marked with asterisks, is best done using dedicated statistical software.) When all of the data has been imported, you might wish to adjust the axes so that your data takes up most of the available space. To do this, just right-click on an axis and choose *Format Axis* from the menu that appears. Then set the maximum and minimum values to Fixed rather than Auto, and specify the values at which the axis should begin and end.
3. **Scatterplot**: The **fourth tab** of the template file allows you to construct a scatterplot, using each student's exam grade and lab/tutorial grade as x,y coordinates. Each lab section is designated as a separate series, so the type of marker tells you which lab section the data point is associated with (listed in the legend to the right of the plot). In this case, you will need to copy two columns of data (lab/tutorial grade and exam grade) for each lab/tutorial section into blue area of the template. As you copy and paste the data you will see the points appear on the graph. The graph is set to show linear trendlines for each series of data. If you wish to see the data without the trendlines, in the Layout tab at the top of your screen (under Chart Tools), click *Trendlines* and choose *None*. If you wish to see all of the points in a particular data series, just click on any one point and they will all be highlighted.

4. **Exporting the graphs**: The simplest way to export an Excel chart is to click on the chart area (not on any particular data point, axis, label, or error bar), then copy (*Ctrl-C*). Choose the application to paste it into, and then Paste (*Ctrl-P*). If you paste into Word or Powerpoint, you retain the ability to edit things like axis and chart titles, which can be very handy.

What if you have more than 25 lab sections, or more than 75 students per group?

1. To add additional lab sections to the boxplots:
    a. First, hover your cursor over the top of column Z, then right-click and choose Insert. You will see a new column appear. If you need to add additional columns of data, just hit Ctrl-Y as many times as necessary to repeat the Insert procedure.
    b. You will need to extend the formulas in the yellow area so that they will work on your new columns. To do this, first hover your cursor over the lower right corner of cell Y4; you will see the cursor turn into a plus sign. Click and drag sideways to highlight the adjacent cells in your new columns, then release. Repeat this process by extending the formulas from cells Y5 through Y10.
    c. Before you import your data, it's a good idea to label your new columns with the numbers of your additional lab sections in row 14. Then, paste in your data as described in Step 2 above.
    d. You won't see the boxplots corresponding to the new data until you make a few adjustments to the graph. Click on the chart area, then from the Chart Tools area at the top of your screen, choose *Design*. Click the *Select Data* button, and the Select Data Source window will appear. Click in the Chart Data Range field, and replace the "Y" with the letter corresponding to your rightmost column of data. (For example, if you had added one more lab section, you'd replace "Y" with "Z".)
    e. You might not see lines extending to maximum and minimum values on your newly-added boxplots. The best method seems to be first to delete the existing error bars: from Chart Design, click Layout, then Error Bars, and choose *None* from the list. Then click somewhere empty on the chart, then click Error Bars again, and choose *More error bars options…* You'll be prompted for the series; for the upward bars, it will be called "upper quartile" or "Series 1". Then select "Plus", and from Error Amount choose Custom and click *Specify Value*. Delete any contents of the Positive Error Value field, and then highlight the formula-containing cells in Row 4. Click OK and Close and the upward bars should appear. Then click somewhere blank on the chart area and then click Error Bars one more time. For the downward bars, the series will be called "lower quartile" or "Series 3". Then select "Minus", and from Error Amount choose Custom and click *Specify Value*. Delete any contents of the Negative Error Value field, and then highlight the formula-containing cells in Row 10. Click OK and Close and the downward bars should appear.
    f. Now that you've taken the trouble to make these modifications, feel free to save yourself a copy of your customized template so you only have to go through this once!

2. **To include more than 75 marks in a section in the boxplots:**
    a. First, paste in your data. If you have more than 75 students in a section, you'll see the data extend out below the blue area on the template.
    b. The formulas in rows 5 through 9 are set up to work with data in rows 15 through 89. To extend them to cover more rows, just click on a formula and change the 89 to the row number of your last data point, and hit *Enter*. So, if you had a column of data extending to row 95, then just change the 89 to 95 in the each formula. If you have a bunch of sections with more than 75 students, the quickest solution is to change the first set of formulas (the ones in column A), then click the lower right corner of each changed cell and drag sideways to include all of the formula cells in that row. As you make these changes, you should see the data get incorporated into your boxplots.

3. **To add additional lab sections to the scatterplot:**
    a. Create new lab section number headers for your new columns, remembering that you will be pasting in two columns of data for each additional lab section.
    b. Paste in the data.

c. From Chart Tools, click *Design* and then choose *Select Data*. In the scatterplot, each lab section is listed as a separate series so that it will be indicated with a distinct marker in the plot. In the Legend Entries (Series) area on the right of the window, choose *Add* to specify a new series. For Series Name, enter the lab section number. Then click in the Series x-values field, and highlight your lab/tutorial assignment data for that lab section. Then click in the Series y-values field, and highlight your exam grade data for that lab section.

d. Repeat this process for each new lab section. You will see the new points appear on the plot. You might need to expand the legend area a bit to see all of the new legend entries.

e. If you want trendlines, and you don't see one for the new series, click on any point in the series and then from Chart Tools choose Layout and then Trendlines. Choose Linear and you should see it displayed.

4. To include more than 75 marks in a section in the scatterplot:

a. First, paste in your data. If you have more than 75 students in a section, you'll see the data extend out below the blue area on the template.

b. From Chart Tools, choose *Design*, then click *Select Data*. Recall that each lab section is a separate series in the scatterplot. For any section with more than 75 students, you'll need to edit the series to include these additional data. To edit a series, click on the series number in the Select Data Source window, then click *Edit*. For both the x-values and y-values fields, change the "78" to the number of your final row of data.

c. You should see the additional data points appear on the graph. Once again, this might be a good time to save your custom template so that you don't have to do this ever again!

Mission, Review Process & Disclaimer

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