Grade Curve Analysis in R

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Abstract

This vignette is intended to instruct users on how to set up and manipulate routines to curve (scale) a set of grades from an exam in a large class. The curves can be generated automatically, based on statistical distribution, or interactively by graphical inspection of a plot of the grade distribution.

1 Grade Curve

Given a (possibly) large set of grades from an exam, or a course, we need to determine where letter-grade cut-offs should be set for numerical scores. This package provides help on how to scale the scores and, finally, assign letter-grades associated with each numerical test score.

The programs in ProfessR provide a quick interactive procedure for quickly assigning the scaled letter-grades. As an example, make an artificial set of gaussian distributed grades,

```
> g = rnorm(n = 200, m = 82, sd = 10)
> g[g > 100] = 100
> g[g < 1] = 1
```

For now we want to establish divisions for the grades, temporarily, and later we will show how one can extract the divisions interactively. Using the boxplot function we calculate the quartiles and use these for now,

```
> B = boxplot(g, plot = FALSE)
> divs = c(min(g), B$stats[1:4] + diff(B$stats)/2, max(g))
```

The divisions divide the scores into groups that are assigned grades. The use of the boxplot function often provides good guides for dividing a large set of real test grades. The main code in ProfessR now can plot the grades and

```
> library(ProfessR)
> get(getOption("device"))(width = 12, height = 7)
> D1 = do.grades(g, divs = divs, tit = "GEOL 105 Exam 1")
```

```
Grade divisions:
53.90071
63.94162
77.82548
84.66772
93.83351
100
Letter Grade Distribution:
1 A+ 14
2 A 2
3 A- 7
4 B+ 10
5 B 16
6 B- 33
7 C+ 14
8 C 14
9 C- 17
10 D+ 31
11 D 28
12 D- 7
13 E 7
Numeric Grade Distribution:
1 100 14
2 96 2
3 92 7
4 88 10
5 84 16
6 80 33
7 76 14
8 72 14
9 68 17
10 64 31
11 60 28
12 56 7
13 52 0
[1] "Mean Score= 73.6540440853986"
```

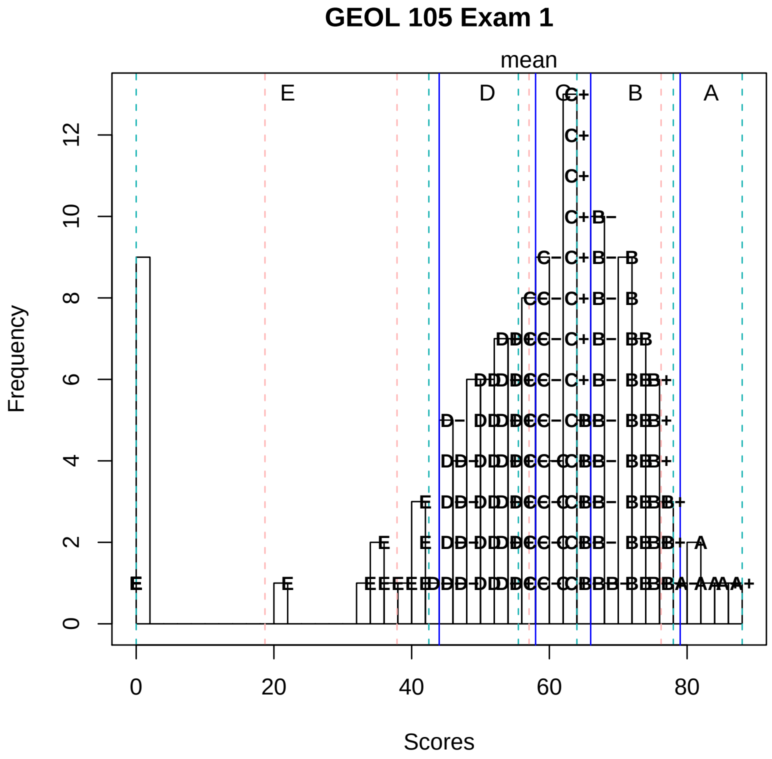
display a histogram of the grades with divisions illustrated (vertical dashed lines) and grade cut-offs marked. In addition other statistics are shown, including the mean, and standard deviations from the mean.

Normally the automatic method does not work to complete satisfaction, so the program can be run interactively by removing the divs argument. The user must then select the cut-offs graphically by clicking 4 times on the plot to set the desired distribution of grades. This allows an instructor to shift the cut-off points slightly depending on the slight variations that often occur on real test scores. For example if there is a small peak in near the boundary between A and B, the instructor may wish to give a slight boost to those students by bumping them up to an A- grade if they autoatically would fall into the B+ category.

The out put of the do.grades routine includes all the original grades, the scaled values and the letters associated with those scores. The letters are assigned by the divisions and linearly interpolated between division marks to get plus and minus categories (A-, B+, etc...) . The scaled scores are stored for later use, say for averaging hourly exams and the scaled final exam. (Since the hourly exams and the final exams are scaled individually, the final course grade , which is a weighted average of these test scores would not necessarily be scaled).

Once the divisions are set, a final presentation plot can be generated by using the divisions extracted from the user input via the locator() function. For this vignette, however, we replace the user's input with the generated divisions determined above, although in a real situation this would not be used. In this example we load a set of real data recorded on the second exam from a geology test at the University of North Carolina,

```
> data(E2grades)
> g = E2grades
> B = boxplot(g[g > 1], plot = FALSE)
> divs = c(min(g), B$stats[1:4] + diff(B$stats)/2, max(g))
> G1 = do.grades(g, divs = divs, tit = "GEOL 105 Exam 1")
> J = jist(G1$hist, G1$grades, G1$lett)
```



showing all the letters grades plotted on the histogram. Students can see their grade and are often satisfied that they understand the idea of scaling.