Spotlight Session: Normal of Not?   **School Affiliation:**

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Abstract: After studying the empirical rule and normal calculations, students often mistakenly apply these procedures to nonnormal distributions. To highlight this fallacy, I created an activity in which a college professor grades on the "normal curve." Students quickly realize the dangers of assuming normality while increasing their understanding of normal procedures.

Author Notes: The normal distribution activity is located below. Specific notes and comments follow at the end of the document.

NORMAL DISTRIBUTIONS: GRADING ON THE BELL-CURVE

Professor Blue at the University of Central Boondockia has never taken a formal statistics course; however, he has heard about the bell-shaped curve and has some knowledge of the empirical rule for normal distributions. Professor Blue teaches an Honors Sociology class in which he grades on the bell-curve. He assigns grades to his students' tests by assuming a normal distribution and utilizing the empirical rule. Professor Blue reasons that if IQ and SAT scores follow a normal distribution, then his students' scores must do so also. Therefore upon scoring his Sociology tests, he determines the mean and standard deviation for his class. He then uses the empirical rule to assign letter grades so that 68% score "C," 95% score "B - D," and 99.7% score an "A –F."

The following test grades occur on his mid-term exam.

78	85	93	62	82	76	74	73	91	66
89	88	86	94	65	90	84	92	94	92
82	85	80	77	52	84	78	83		

You are working as Professor Blue's graduate assistant and he has asked that you use the empirical rule to determine which of these grades he should assign as "A," "B," "C," "D," and "F." To get started, enter the test scores into your calculator and complete the following. *(Round all answers to the nearest tenth.)*

Mean Score:_____   Median:_____   Standard
Deviation:_____

Use the above data to complete the following table and sketch.

Sketch and label a normal curve of this distribution.

Distance from the Mean	Test Score
-3 sd	
-2 sd	
-1 sd	
Mean	
1 sd	
2 sd	
3 sd	

Using the guidelines given by Professor Blue and your data from the previous table, determine the test grades that will qualify for each letter category. Organize your answers in Table 2. Then referring back to the original test scores, compute the number of students to earn each letter grade on this particular test and enter that data into Table 3.

TABLE 2   **TABLE 3**

Letter Grade Assigned	Test Score Interval
A	
B	
C	
D	
F	

Letter Grade Assigned	Number of Students Receiving this Grade
A	
B	
C	
D	
F	

As a student of statistics, you have some concerns about Professor Blue's use of the normal distribution in this context. Prepare a report, (or letter,) to Professor Blue explaining your concerns. You need to include any evidence that supports why his practice may not be statistically sound. Use your knowledge gained throughout this chapter to prepare your argument. Include at least one sketch of the data with your discussion.

You will need to submit a copy of these completed pages with your written report/letter. Reports should be typed. There is no minimum or maximum assigned length; however, your arguments need to be backed up by both logic and statistics. Appropriate grammar is required.

Author Notes:
The worksheet pages may be completed during class or assigned as homework. I usually assign this as an out-of-class project and allow two weeks for the entire project to be completed. I also allow students to work with a partner on this project as discussing their work with a fellow student often leads to both a

greater understanding and a better final product. I like to give each student his/her own set of data. I achieve this by changing one or more of the numbers above. This leads to differing graphs and conclusions and enhances our follow-up discussions in class.

For the final report, it is essential that students graph the original data. I require at least one sketch, but I always encourage my students to use a number of different graphing tools to examine the data. Frequent graphical displays that my students like to use are NPP plots, modified boxplots, histograms, and stemplots. This particular set of data shows an outlier if students perform a modified boxplot in their TI-83 – some years I include the outlier and other years I change that data value. The NPP Plot for this data is also interesting for students to examine.

Aside from graphing the data to check for normality, I want my students to question the appropriateness of applying the empirical rule in this situation. Even if we don't include the outlier in the data and are willing to consider the data as approximately normal, what are the consequences to the students in the class? Students will quickly pick up on the "unfairness" aspect in this scenario, but again I want them to utilize statistics to convince me that it is unfair. Comparing percentile scores of a "B" test grade to a "D" grade is an excellent, and easy, way for students to strongly argue against this method of grading.

Even if you use this activity outside of class, spend a few days discussing the results and teaching your students how to use their knowledge of statistics to write appropriate arguments.