GRADING & NORMALIZATION PROCEDURE

To determine the final numerical grades in EE 140, the Z-transform and normalization procedure will be used extensively. Use of the Z-transform for grade computation helps to reduce variations in grading, average, and standard deviation for different TA's and different lab sections. Since 30% of your final grade is based upon your lab grade and performance, such a normalization procedure is important to maintain maximum fairness.

The Z-transformation normalizes all raw grades so that the final grades result in a distribution that has an **average of 0** and a **standard deviation of 1**. To determine the Z-grades of a series of raw grades G_i, the following formula is used:

$$Z(G_i) = \frac{G_i - G_{avg}}{\sigma_G} \tag{1}$$

where G_{avg} is the average of all grades, and σ_G is the standard deviation of all grades.

Based on the above equation, the Z-transform of each portion of the course is first determined. Then a weighted sum of these Z-transforms is calculated to obtain a raw final grade. The Z-transform of this final raw grade is then used to calculate the final normalized numerical grade for each individual. The formulas used in this course to calculate numbers for the non-lab categories on my grade sheet are:

$$Z(HW) = \frac{Avg.HW - Avg.HW_{avg}}{\sigma_{Avg.HW}} \tag{2}$$

$$Z(M) = \frac{M - M_{avg}}{\sigma_M} \tag{3}$$

$$Z(Final) = \frac{Final - Final_{avg}}{\sigma_{Final}}, \tag{4}$$

where the averages and standard deviations above are determined using data from the whole class.

The lab grades are determined through a more complex procedure, which may be enumerated as follows:

(1) Calculate the Z-grades for each TA. The equation for this is as follows:

$$Z(Lab.Each.TA) = \frac{200}{1500} \times \frac{L1 - L1_{avg}}{\sigma_{L1}} + \frac{300}{1500} \times \frac{L2 - L2_{avg}}{\sigma_{L2}} + \frac{900}{1500} \times \frac{L3 - L3_{avg}}{\sigma_{L3}} + \frac{100}{1500} \times \frac{L4 - L4_{avg}}{\sigma_{L4}}, \tag{5}$$

where X_{avg} is the average of parameter X for a given TA, and σ_X is the standard deviation of X for that TA.

(2) Calculate the overall Z-grades based on the overall average of the class:

$$Z(Lab) = \frac{Z(Lab.Each.TA) - Z(Lab.Each.TA)_{avg}}{\sigma_{Z(Lab.Each.TA)}}, \tag{6}$$

where the average and standard deviation are now determined using data from the whole class.

The total weighted grade is calculated from

$$Overall = 0.15 \times Z(HW) + 0.25 \times Z(M) + 0.30 \times Z(Final) + 0.30 \times Z(Lab) \quad , \quad (7)$$

where $Z(Lab)=Z(All)$ from Eq. (6). The final normalized grade is calculated from:

$$Z(Overall) = \frac{Overall - Overall_{avg}}{\sigma_{Overall}} \quad (8)$$

Note that to evaluate one's standing in the class with respect to all others, one should look at the calculated Z grades, not the raw grades received. Also, note that the Z-transform is really just spreading the distribution out to make it easier to see where each student stands. In the past, this technique has been found to the most fair for everyone involved. Using this grading procedure, we can hopefully ensure a uniform grade assignment.

If you have any questions, please come and see me in my office.