GRADING & NORMALIZATION PROCEDURE

To determine the grade and relative standing for each individual in EE C247B / ME C218, Z-transform normalization procedures will be used extensively. In particular, via Z-transform, all raw grades will first be normalized so that their overall distribution has an **average of 0** and a **standard deviation of 1**. This procedure greatly facilitates determination of one's relative standing in the class and simplifies the assignment of grades, since after normalization, grades can be assigned according to how far above or below **0** each final Z-score ends up.

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 Z-values for the various categories on my grade sheet are:

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

$$Z(M1) = \frac{M1 - M1_{avg}}{\sigma_{M1}} \tag{3}$$

$$Z(Proj) = \frac{Proj - Proj_{avg}}{\sigma_{Proj}} \tag{4}$$

$$Z(Final) = \frac{Final - Final_{avg}}{\sigma_{Final}} \tag{5}$$

where the averages and standard deviations above are determined using data from the whole class. The total weighted grade is calculated as follows:

$$Overall = 0.20 \times Z(HW) + 0.20 \times Z(M1) + 0.25 \times Z(Proj) + 0.35 \times Z(Final) \tag{6}$$

The final normalized grade is determined using:

$$Z(Overall) = \frac{Overall - Overall_{avg}}{\sigma_{Overall}} \tag{7}$$

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 individual stands. In the past, this technique has been found to be 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.