ME 7960, Homework
Name:

1.(Due Feb 3) We will show later in class that the probability density distribution for eddy sizes l in a homogeneous turbulent flow can be derived to be

$$p(l) = \frac{5}{3} \frac{1}{L\left[(L/\eta)^{5/3} - 1\right]} \left(\frac{l}{L}\right)^{-8/3}$$

This is true for $\eta \leq l \leq L$ and is zero elsewhere. η is the Kolmogorov scale and L is the integral length scale.

a. Compute the cfd for the eddy size distribution.

b. Plot $p(l)$ vs. l and interpret

c. For a Reynolds number of 1000 and an integral length scale, $L = 1$, what is the Kolmogorov scale?

d. For the same conditions described in c, what is the probability that an eddy in this flow has a length scale less than 1/2 L?

2. Define a 2-D domain where $0 \leq x \leq 1$ and $0 \leq y \leq 1$. Within this domain, define 100 uniformly distributed points. Assign a value of 0 to half the points (in $0 \leq x \leq 1$ and $0 \leq y \leq 0.5$) and a value of 1 to the other points.

Given the above, write a program that will

a) Define a length scale of a random length between $0.2 \leq l \leq 0.5$ b) Select two points at random in the domain c) Check to see if the distance between these points is less than l d) If so, change the value assigned to these points to the average of the two points. e) Repeat this process 5000 times.

Plot the rms value of the points every 100 iterations. Note the mean value will remain 0.5, but the rms value should decrease with time. Keep repeating iterations until the rms has decreased to at least 1 percent of its original value. Plot in linear-linear, log-log, and semi-log coordinates. What can you say about the rate of decay of the rms?

This will be a preview to some work we will do later when talking about stochastic models for turbulent mixing. Since we won't have class next week the above two exercises should give you some things to think about and keep you busy.