preliminary version::
Preliminary problems for the course Fluid Dynamics II (turbulence) SS 2016

to be done until ?.
this is a preliminary version to show which topics are relevant -

Given are two data sets, analyze the both sets and compare the results. One set is from homogeneous isotropic turbulence the other are measured wind data. Always give a short explanation what you did and what the results shows.

the commeon notation is $u = u' + < u >$

1.) basic chracateristica:
determine for the given data set:

- mean value
- magnitude of fluctuations $< u'^2 >:= \sigma_u^2$
- degree of turbulence $< u'^2 > / < u >^2$
- statistics $p(u)$; $p(u')$ and $p(u'/\sigma_u)$

++ Problem - show how these quantities change with different sizes of averaging intervals. Discuss the results- Discuss the statistics

2.) two-point quantities:
determine for the given data set:

- power spectrum $E(f)$ or $E(k)$
  - Problems - show the $k^{-5/3}$ scaling of the power spectrum,
    pay attention to smoothing of power spectra, to the inertia range, using u or u'
- autocorrelation
  - ++ show numerically that the power spectrum is the Fourier transform of the autocorrelation
- integral length
- ++ Komogorov length (necessary to estimate from data also the dissipated energy)
- determine the velocity increments u_r for $r = 2^m, m = 0, 1, 2, ...$
- determine the structure function $< u_r^2 >= \sigma_r^2$
- determine the structure function $< u_r^n >$
  be careful with the sign

- estimate the scaling exponents $< u_r^n > \propto r^{\xi_n}$
  - compare with K62 scaling,
  - ++ compare with other proposed scaling (She-Levesque ... see publications)
- estimate the scaling exponents $< u_r^n > \propto < u_r^3 >^{\xi'_n}$
  - compare with K62 scaling,
  - ++ explain the ESS (Benzi publication)
  - ++ with other proposed scaling (She-Levesque ... see publications)
- determine the probabilities $p(u_r)$, $p(u_r/\sigma_r)$
- discuss intermittency effects on different quantities

3.) n-point quantities:
determine for the given data set:

- conditioned probabilities $p(u_r|u_{r'})$
- ++ $p(u_r|u_{r'}, u_{r''})$, use for $u_{r'}, u_{r''}$ sufficient large bins ($a < u_{r'} < b$) so that probabilities can be obtained

Problem - ++ Can evidence for the Markow properties $p(u_r|u_{r'}) = p(u_r|u_{r'}, u_{r''})$ be given?