

270.307 Combining Measurements with Models Mid-Term Test, Fall 2005

Name:

Answer FOUR of these questions and attach this question sheet to the top of your answers. The expected number of marks is shown after each question.

- (a) State the steps in applying the Maximum Likelihood Principle (MLP) (10 marks)
 - (b) Explain why the MLP is useful by referring to a specific example in which it is applied (explain the argument but a detailed proof is not needed) (10 marks)
- (a) Define, mathematically, the probability density function (pdf) for a random variable that is uniformly distributed between 1 and 2. (7 marks)
 - (b) Draw a diagram of the pdf and calculate the mean and the variance of the random variable. (7 marks)
 - (c) Calculate the probability a random number with this distribution lies between 1.75 and 2.5 (6 marks)
- (a) Explain, using labelled diagrams, the Ptolemaic model of the universe. (8 marks)
 - (b) Describe the part that Copernicus played in over-throwing the Ptolemaic model by explaining the model he proposed and discussing its pros and cons. (8 marks)
 - (c) Referring to your answers to (a) and (b) explain the meaning of: “measurement” and “model.” (4 marks)
4. Explain the steps in interpolation using sine and cosine functions with known frequencies. Identify the data, model, and parameters in the problem using an example of your choice. (20 marks)
5. Examine the 4 diagrams overleaf. In each one, observations (+) are plotted against time from a hypothetical experiment. In each case, predictions of a model are shown at the observation times (o). The solid line is the model prediction plotted continuously against time.

In each case, you are told that the observational error is believed to be a random number with a Gaussian pdf of mean 0 and variance 1. Make inferences about the consistency of the model and the data in each case explaining your answers. (20 marks)

