

Boğaziçi University
Department of Physics

Phys 497

Spring 2008

Problem Set #4
Due on Tuesday, 20 May 2008

Principle of Maximum Entropy (75 pts)

Consider a publisher selling the lecture notes for 1st and 2nd year students. Their price list is as follows:

Lecture Note	$g(A_i)$ – Price (YTL)	Probability
Phys 101	10	$P(A_1)$
Phys 102	12	$P(A_2)$
Phys 201	20	$P(A_3)$
Phys 202	15	$P(A_4)$
Phys 221	30	$P(A_5)$

At the end of the day, the publisher states that their average price for all these notes is $G = 16$ YTL. You will find the probability distribution of the lecture notes using the principle of maximum entropy.

- a) Write down the Lagrangian function L for this problem (5 pts)
- b) Write down the Lagrange multiplier α in terms of β (5 pts)
- c) Write down $f(b)$ and make a plot of it using Matlab for $b = [0, 0.5]$ (20 pts)
- d) Find the zero-crossing point by zooming in several times around the region of interest. This is your β . Submitting the plot is optional. (Hint: Turn on grids using `grid` command.) (15 pts)
- e) Use β found in previous part, to find α stated in part (b) (5 pts)
- f) Find the probabilities for each lecture notes, $P(A_i)$, and confirm that: (5 pts)

$$\sum_i P(A_i) = 1$$

$$\sum_i P(A_i)g(A_i) = 16 \text{ YTL}$$

- g) Find entropy for the above probability distribution, and call it S_{\max} (5 pts)
- h) Now we will perform a simple test. Assume that, in fact, Phys 202 notes were out, so $P(A_4) = 0$. Repeat parts (e,f,g) and show numerically that the entropy you find is less than S_{\max} : $S(\beta') < S(\beta)$. (15 pts)

Note: Do not derive the equations. Use the equations given in class or in the lecture notes.