AI1110
Assignment 6

Pranav B
AI21BTECH11023

26 May 2022

Outline

Papoulis Chapter 4 problem 4.34

We place at random n particles in $m > n$ boxes. Find the probability p that the particles will be found in n preselected boxes (one in each box). Consider the following cases:
(a) M-B (Maxwell-Boltzmann)-the particles are distinct; all alternatives are possible.
(b) B-E (Bose-Einstein)-the particles cannot be distinguished; all alternatives are possible.
(c) F-D (Fermi-Dirac)-the particles cannot be distinguished; at most one particle is allowed in a box.

Solution

a) *because* all particles are distinct each particle can be put into any of the m boxes.
therefore total number of ways $=m^n$
Now the number of ways in which the balls can be present in the preselected boxes is $= n!$
thereforep $= \frac{n!}{m^n}$

b)Given all particles are identical. Assume k_i number of balls to be present in the ith box.

$$\sum_{i=1}^{m} k_i = n \tag{1}$$

Number of possible solutions for this is = ${}^{m+n-1}C_{m-1}$
The number of favourable outcomes is =1

$$\therefore p = \frac{1}{{}^{m+n-1}C_{m-1}} \tag{2}$$

$$\implies p = \frac{n!(m-1)!}{(m+n-1)!} \tag{3}$$

c)Since the particles are not distinguishable, Total ways equals the number of ways of selecting n out of m $= {}^{m}C_{n}$
and favourable outcomes=1

$$p = \frac{1}{{}^{m}C_{n}} \tag{4}$$

$$\implies p = \frac{n!(m-n)!}{m!} \tag{5}$$