Phys 114 **Week 4: Amy's reading advice** **2021**

My observations about reading this week:

1. Unless you have had a good **course in probability theory, G&T Ch. 3.1-3.7** is the best reference this week, as opposed to B&B Ch. 3

B&B Ch. 3 will give you very concise reminders of
- discrete and continuous probability distributions
- independent random variables
- means and variances
- Gaussian distributions, Bernoulli trials and the binomial distribution
- The definition of a 1-dimensional random walk
- It has some stuff which is relevant, but may seem slightly beside the main point, like Ch. 3.3, 3.5 on linear transformations. But an example this week is the average magnetization $M = \mu(n - (N-n))$ vs. the average magnetic moment, μn, of a 2-state spin system.

2. The **B&B mathematical Appendices** C.1, 2, 3 are really useful for our work in stat mech. G&T has some similar information, but people using the online version of the text don't have the appendices (do they?).

3. Lagrange multipliers are pretty well described in G&T 3.11.1. B&B Appendix C.13 talks about only one multiplier, while G&T gives the general case. The example with a die with 6 sides, where you know $\Sigma_j P_j = 1$ and $\Sigma_j j P_j$ = known value is a good one, on which we have a homework problem. Two constraints means two Lagrange multipliers: λ_1 and λ_2 (or alternatively, labelled as α and β.)

4. Things G&T does well that B&B does less well, or skips
- Probability is based on information
- Discussion of information and uncertainty, leading to a definition of the "uncertainty function" S. This is discussed both for one experiment, and two experiments done simultaneously. (So it is completely like the entropy of two systems, A and B, side-by-side.)
- A discussion of the **law of large numbers** and **central limit theorem**
- Description of the **ensemble concept**: We can imagine an experiment done under identical conditions M times; or equivalently, M identical systems (the ensemble) on which an experiment is done once
- Ch. 3.41's Example 3.11 seems really useful ... it talks about a die with 3 sides and is a leadup to the Lagrange multipliers example (a die with 6 sides) done in section 3.11.1.
- Ch. 4.1 is a great discussion of **doing stat mech** in a logical way: Specify the macrostate and microstates that can contribute to it. Then choose an ensemble. Then calculate stuff.
- The paradigm of a **random walk** is treated thoroughly.

5.Oops ... G&T seem to tell us on p. 172 that their spins have value $\pm$ 1/2, and then on p. 173 treat them as if they have value $\pm$ 1. Don't let this throw you off. If spins had values $\pm \frac{k}{2}$ say, it would be the case that

$$S_1 = \frac{k}{2} \cdot \frac{1}{5} = \frac{k}{10}$$

at the top of p. 174. Just a linear transformation of the random variable, dude!