BB 101 Tutorial – 5

Assignment question.
This tutorial contains two assignments. Assignment 5 (2 marks) and assignment 6 (2 marks). Please write the answer on an A4 sheet and submit it at the beginning of the tutorial class. Ensure your Roll number and name are on the A4 sheet. You have to prepare the answer before coming to the class.

In the lecture we saw that ideas from basic statistics is necessary for understanding biological data. We will consider a few examples

1. Analysing the data of cancer patients, one of the doctors — Dr. Alfred Knudson — did a seminal study named *"Mutation and cancer: Statistical study of Retinoblastoma"* (cancer in eyes). Cancer is a result of genetic mutations. If a person has certain inherited mutations, there is a high chance that the person will get cancer. Imagine such patients (with inherited mutations) visiting a doctor.

   (a) Consider a tissue and assume that tumour growth happens at different random locations in the tissue. What is the probability ($P(r, m)$) that you will find such a patient with exactly r tumours if the average number of tumours is m? (1 Mark)

   (b) What is the probability that the you will find a patient with at least 1 tumour if the average number of tumour is m? (1 Mark)

   (c) Plot $P(r, m)$ versus r for m=3. (1 Mark)

   (d) If the probability that the you will find a patient with at least 1 tumour = 95%, what is the average number of tumours (approximate it to the nearest integer)? (1 Mark)

   (Dr. Knudson anlysed his data this way)

   First two questions are Assignment 5 and the last two questions are Assignment 6.

   (Please turn over to see tutorial questions)

Tutorial question:

1. We learned that molecular motors kinesin and dynein can generate force and drag cargo inside our cells. Scientists have purified single kinesin and dynein motor molecules in laboratory and have examined the speed with which they will move when a force f is applied against their movement (like a cargo). It turns out that these two motors show interestingly different force-velocity relations. Dynein velocity is highly sensitive when the applied force varies in the small force range, and insensitive when the force is varied in the large force range. That is, the velocity change is larger when the force is changed by a single unit at low forces. At large forces, the velocity change is smaller when force is changed by a single unit. For kinesin, this is opposite. That is, at small applied forces, the kinesin velocity is less sensitive to force change. At large applied force, the kinesin velocity highly sensitive to force change. Make an approximate sketch of velocity as a function of force both for kinesin and dynein (both should be plotted in the same graph making it easy to compare). Scale the X-axis with the maximum force generated by the respective motor; scale the Y-axis with the maximum velocity at zero force for the respective motor.