Lecture 1: Mathmatical Foundations

Averages $N=6$

$y = 1, 2, 3, 3, 4, 4$

- $\bar{y} = \frac{1+2+3+3+4+4}{6} = 2.83$
- $\bar{y} = \frac{1}{6}\cdot 1 + \frac{1}{6}\cdot 2 + \frac{2}{6}\cdot 3 + \frac{2}{6}\cdot 4$

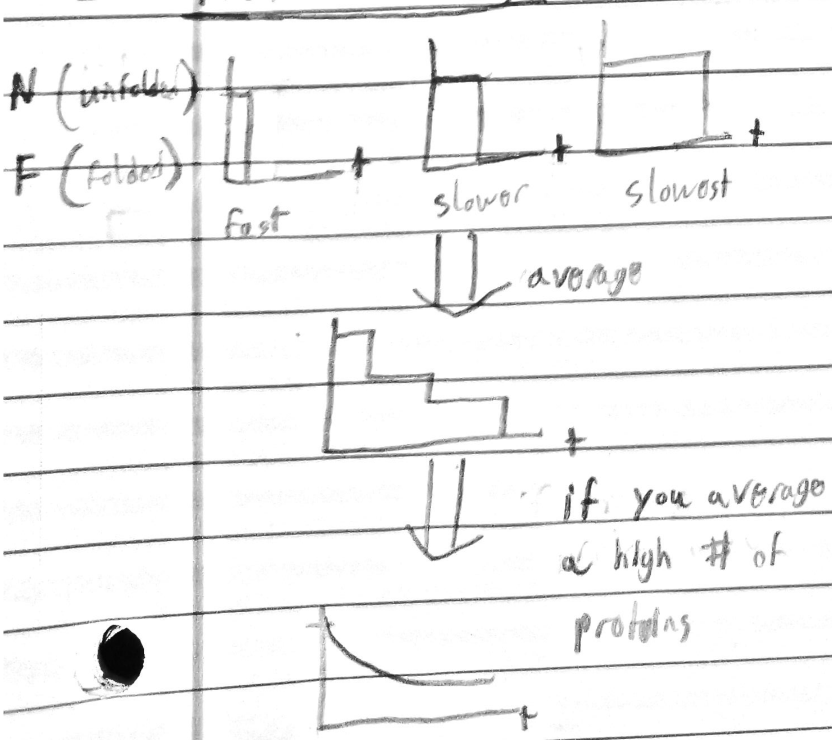
probability

- $\bar{y} = \sum_{i=1}^{6} y_i p_i , \quad \sum p_i = 1$
- $y_i \to y(x)$ [from discrete values to continous function]

$\bar{y} = \int y(x)\, p(x)\, dx$

Infinite summations are somewhat "equivalent" to integrals: Riemann sums.

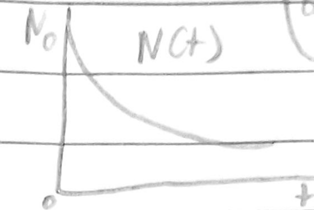
Ex. Protein Folding N to F



Ex. Derivative models

$\frac{\Delta N}{\Delta t} \approx \frac{\delta N}{\delta t}$ (δ instead of d since N can depend on more than just t.)

$N_0 \gg 1$ (N_0 is initial # of unfolded proteins.)



($N(t)$ is # of unfolded proteins at a given time)

Rate of protein folding proportional to # of unfolded proteins (N).

$$\frac{dN}{dt} = -kN$$

$$\int_{N_0}^{N(t)} \frac{d\tilde{N}}{\tilde{N}} = \int_0^t -k\, d\tilde{t}$$

($\tilde{N}$ is a dummy variable to distinguish from bounds or constants.)

$$\ln \tilde{N} \Big|_{N_0}^{N(t)} = -k\tilde{t} \Big|_0^t$$

$$\ln N(t) - \ln N_0 = -kt$$

$$\ln \frac{N(t)}{N_0} = -kt$$

$$\frac{N(t)}{N_0} = e^{-kt} \to \boxed{N(t) = N_0 e^{-kt}}$$

$2A \to A_2$

$$\frac{d[A_2]}{dt} = k[A]^2$$

$A + B \to AB$

$$\frac{d[AB]}{dt} = k[A][B]$$