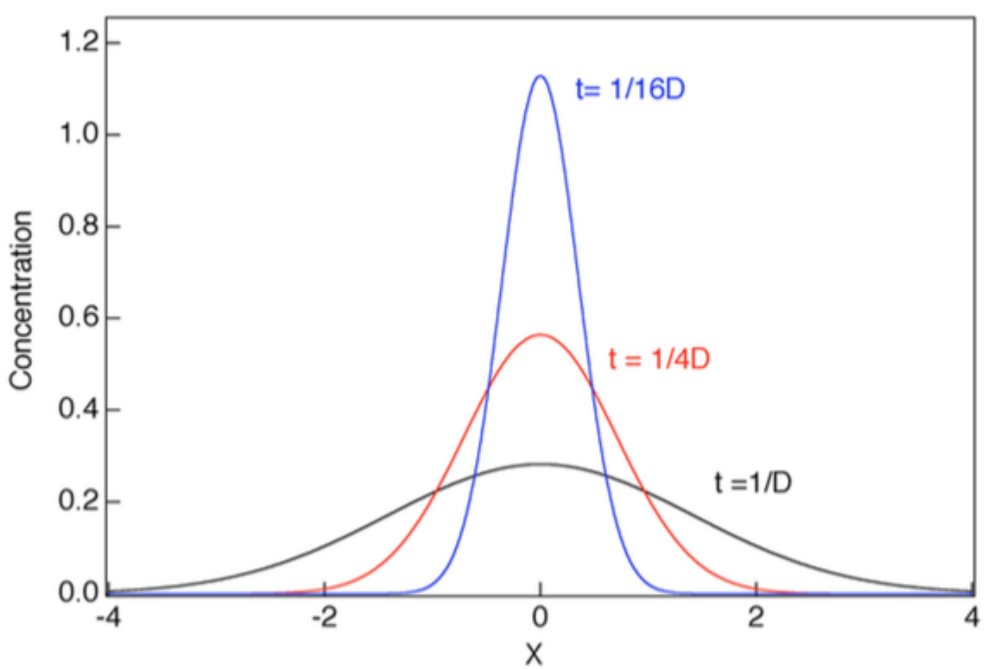
Gaussian Distributions in Analytical Chemistry

$$y(x) = y_0 exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$$



Chem M3LC
Rob Corn

I. Standard Deviations and Error Analysis

$$y(x) = \frac{1}{\sigma\sqrt{2\pi}} exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$$

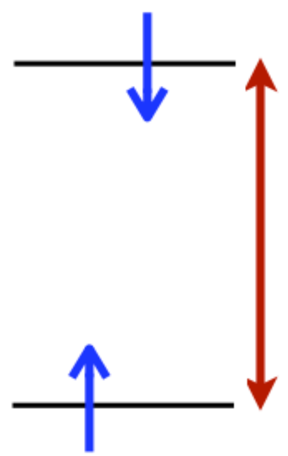
$$\mu \approx \bar{x}$$

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{N-1}}$$

$$\sigma \approx s$$

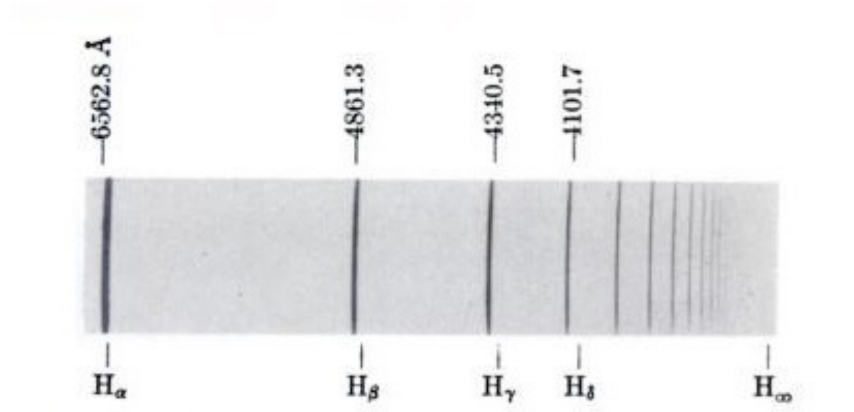
s is the standard deviation of N data points.

II. Absorption Spectroscopy

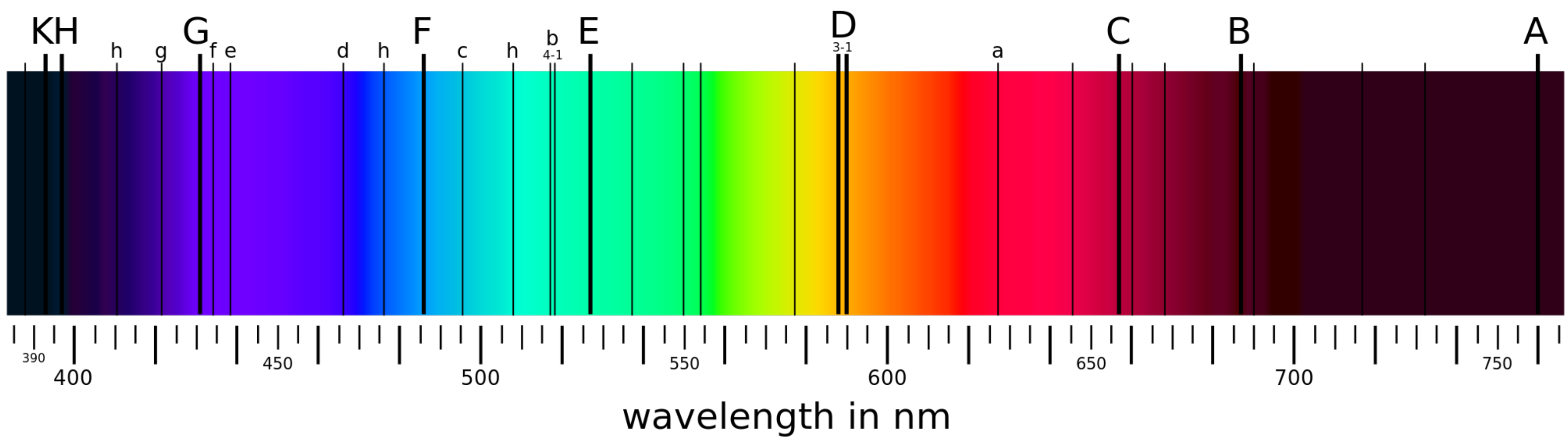


$$\Delta E = h\nu$$

$$M + h\nu \rightarrow M^*$$

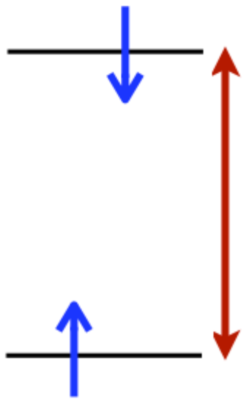


Atomic Hydrogen



Fraunhofer lines from sunlight

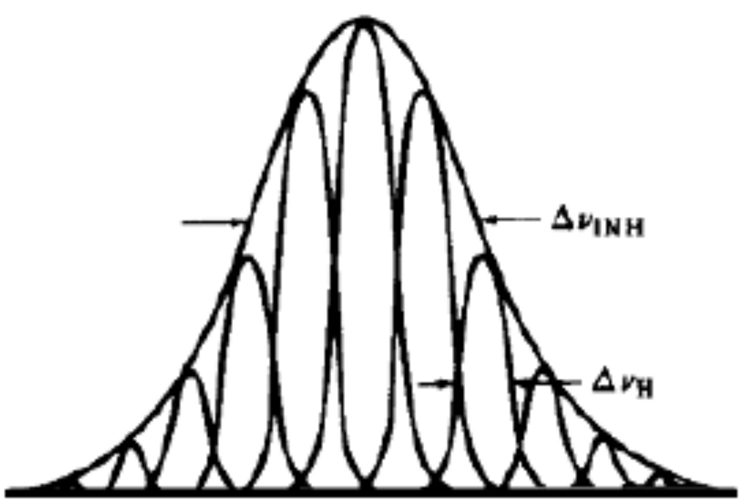
II. Absorption Spectroscopy in Liquids



$\Delta E = h\nu$

$M + h\nu \rightarrow M^*$

Different microenvironments yield different energy levels.



$$y(x) = y_0 exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$$

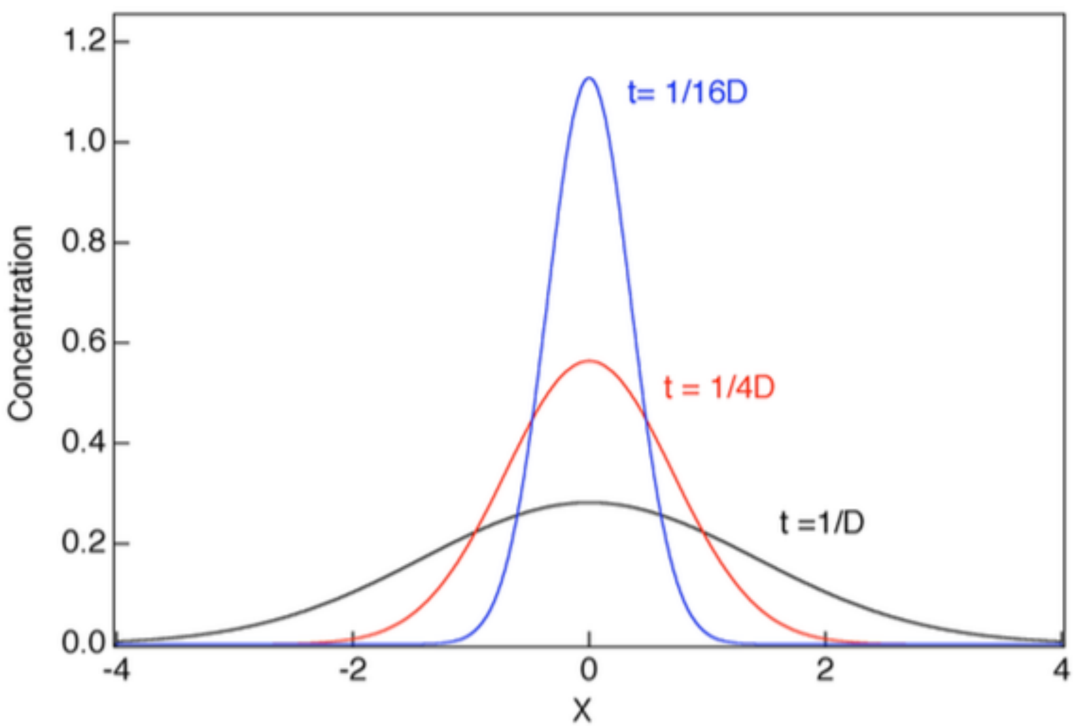
Inhomogeneous Broadening: Gaussian Lineshapes

III. Chromatography

Gaussian Molecular Diffusion in One Dimension (x)

$$C(x,t) = \frac{N}{2(\pi D t)^{1/2}} exp\left(\frac{-x^2}{2\sigma^2}\right)$$

C = Concentration; N = total # of molecules



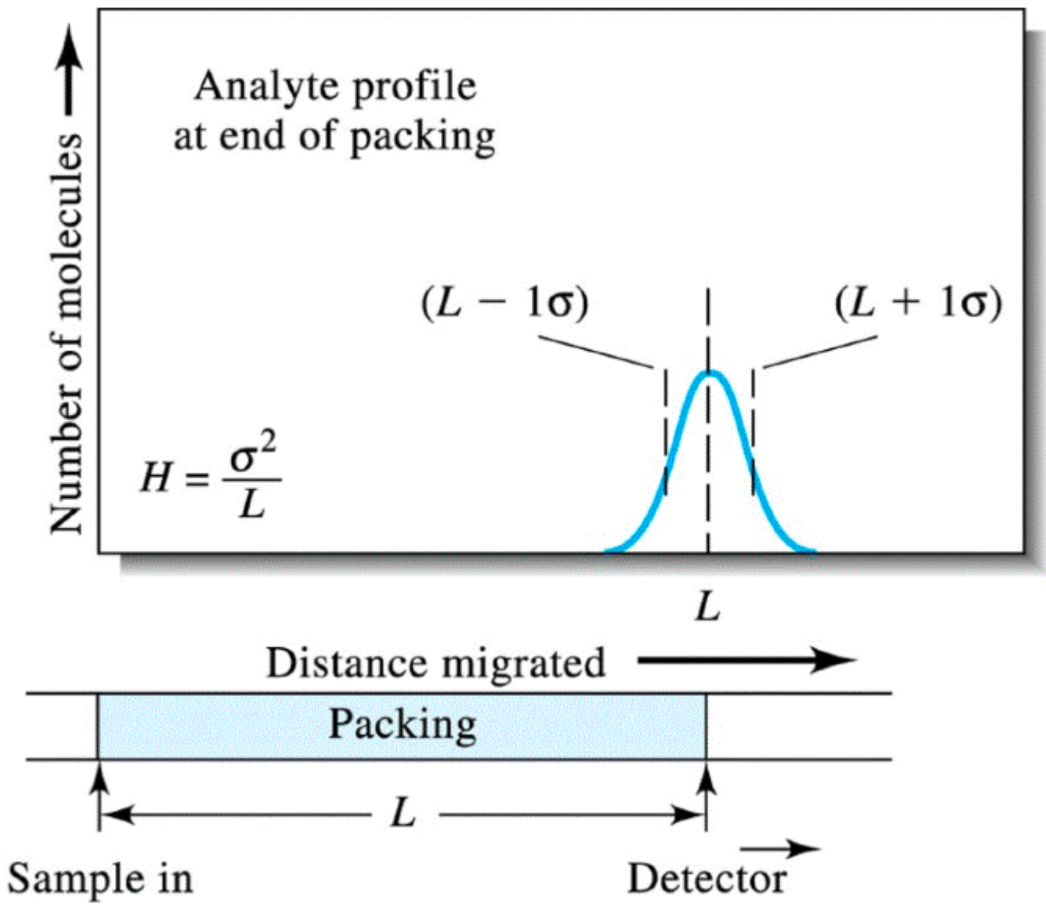
D = Diffusion Constant

$$\sigma = \sqrt{2Dt}$$

Distribution width increases with the square root of time.

III. Chromatography

Chromatographic Peaks are Gaussian in shape.
Resolution measure by H ("plate height").

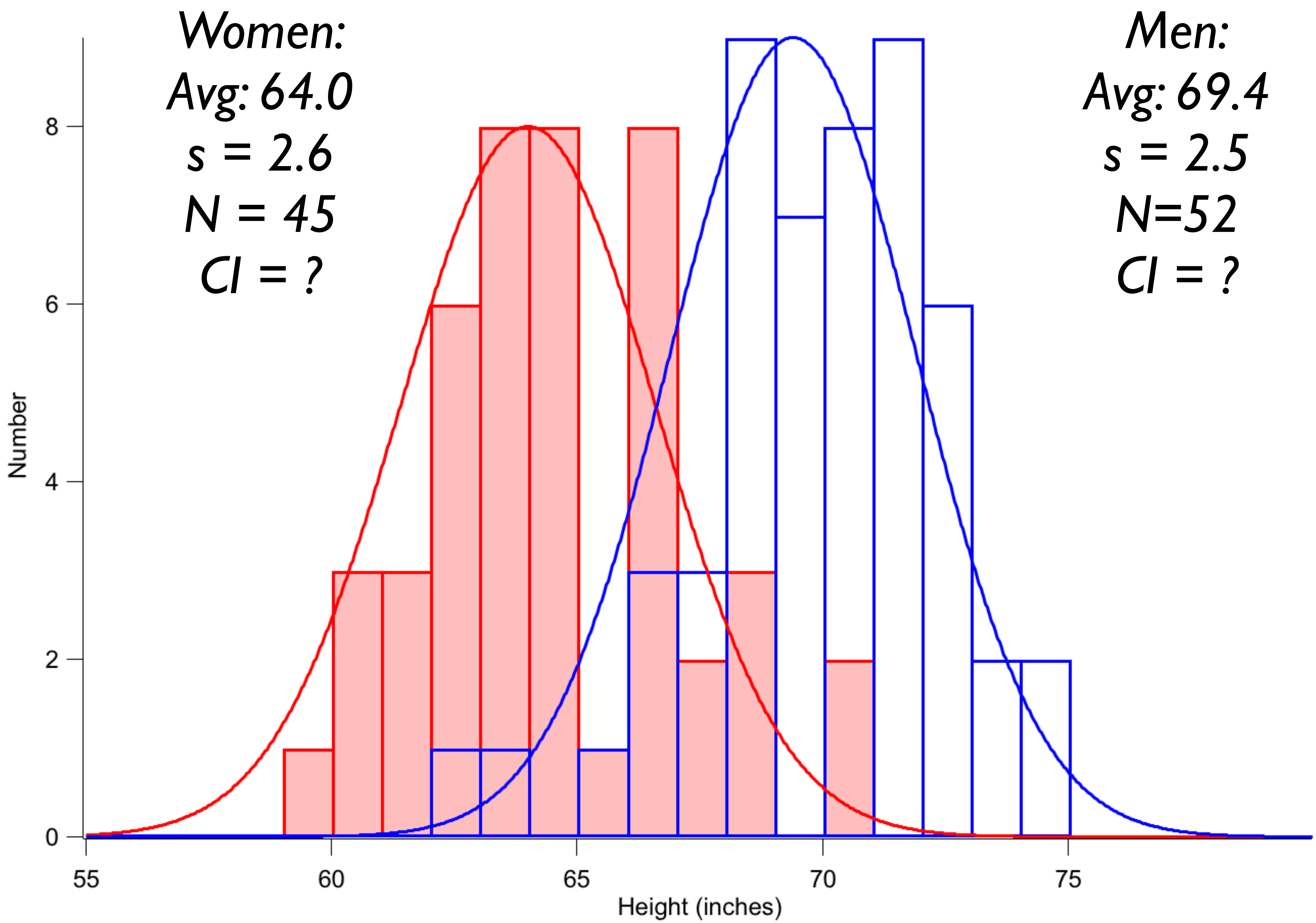


$$y(x) = y_0 exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$$

$$H = \frac{\sigma^2}{L}$$

Smaller H, better resolution.

Gaussian Distributions in Height



Gaussian Distributions in Height