Misc. Variance

Sample (Biased) : $s_n^2 = \frac{\sum_i (x_i - \overline{x})^2}{n}$

Variance : $\sigma^2 = s_n^2 + (\overline{x} - \mu)^2$

Sample (Unbiased) [not σ_S] : $\sigma_S^2 = \frac{\sum_i (x_i - \overline{x})^2}{n-1} \Rightarrow \underline{E(\sigma_S^2) = \sigma^2}$

Chain Rule : $\sigma_z^2 = \sum_i \left(\frac{\partial z}{\partial \overline{x}_i} \right)^2 \sigma_i^2$

Variance By Correlation

Correlated Sum : $\sigma_{A+B}^2 = \sigma_A^2 + \sigma_B^2 + 2(\overline{x}_{AB} - \overline{x}_A \, \overline{x}_B)$

Uncorrelated Sum : $\sigma^2 = \sum_i \sigma_i^2$

[Correlated] Multiple : $\sigma_{nA}^2 = n^2 \sigma_A^2$

Weighted Averages:

Variance : $\sigma_W^2 = \frac{1}{\sum_i \left(1/\sigma_i^2\right)}$

Average : $X_W = \frac{\sum_i x_i \left(1/\sigma_i^2\right)}{\sum_i \left(1/\sigma_i^2\right)} = \frac{\sum_i x_i \left(1/\sigma_i^2\right)}{\sigma_W^2}$

X% Uncertainty: $X = \frac{\sigma}{\bar{\mu}}$

Poisson Distribution

$$\boxed{P(n) = \left(\frac{\lambda^n}{n!} \right) e^{-\lambda}}$$

- $\lambda = \mu_n = \sigma_n^2 =$ average counts-per-time rate
- $\sigma_{n=N} \approx \sqrt{N}$ for large $n = N > 20$

Exponential Distribution

$$\boxed{P(t) = \lambda e^{-\lambda t}}$$

- $\mu_t = 1/\lambda =$ average waiting time for next count in Poisson Dist. λ
- $\sigma_t = 1/\lambda^2$