

# Histogram Bin Error

N – number of events

$P_i$  – probability in  $i^{\text{th}}$  bin  $P_i = \int_{x_i}^{x_{i+1}} f(x)dx$

$n_i$  – number of events in  $i^{\text{th}}$  bin

**N Known (M.C., Dice throws,...)**

**Binomial**

$$\mu_{n_i} = NP_i = n_i$$

$$\sigma_{n_i} = \sqrt{NP_i(1 - P_i)}$$

**N Unknown (Everything else,...)**

**Binomial**

$$\mu_{n_i} = NP_i = n_i$$

$$\sigma_{n_i} = \sqrt{NP_i(1 - P_i)}$$

**Poissonian (counting experiment)**

$$\mu'_N = N \quad \text{so} \quad \mu'_{n_i} = P_i N$$

$$\sigma'_N = \sqrt{N} \quad \sigma'_{n_i} = P_i \sqrt{N}$$

**Combining Binomial and Poissonian**

$$\sigma_{n_i \text{Total}}^2 = \sigma_{n_i}^2 + \sigma'_{n_i}{}^2 = NP_i(1 - P_i) + NP_i^2 = NP_i = n_i$$

**A counting experiment in a single bin !**