

$x \sim$ uniformly distributed in $[-1, 1]$

$$f(x) = \sin(\pi x) + \cos(2\pi x) \approx \sum_{i=0}^N a_i \cdot \psi_i(x).$$

where:

Not an exponentiation. (just notation).

$$a_i := \frac{\langle f, \psi_i \rangle}{\langle \psi_i, \psi_i \rangle} \quad ; \quad i = 0, 1, 2, \dots, N.$$

$$\langle f, g \rangle := \int_{-1}^1 f(x) \cdot g(x) \cdot \underbrace{\frac{1}{2}}_{\text{pdf of } x} dx$$

$\{\psi_i\}_{i=0}^N$ are the first N Legendre polynomials.