

# Lecture 4: Continuous Random Variables

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## Expectation and variance of a continuous random variable

# Expectation of a continuous random variable

- The expectation of a continuous random variable is:

$$\mathbb{E}[X] = \int x p(x) dx$$

where the integral is over all the possible values.

- Its properties are the same as the expectation of a discrete random variable.

$$\mathbb{E}[X + c] = \mathbb{E}[X] + c; \quad \mathbb{E}[\lambda X] = \lambda \mathbb{E}[X]$$

# Expectation of a function of a continuous random variable

- The expectation of a function of the random variable is:

$$\mathbb{E}[f(X)] = \int f(x) p(x) dx$$

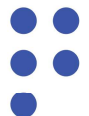
# Variance of a continuous random variable

- The variance of a continuous random variable is:

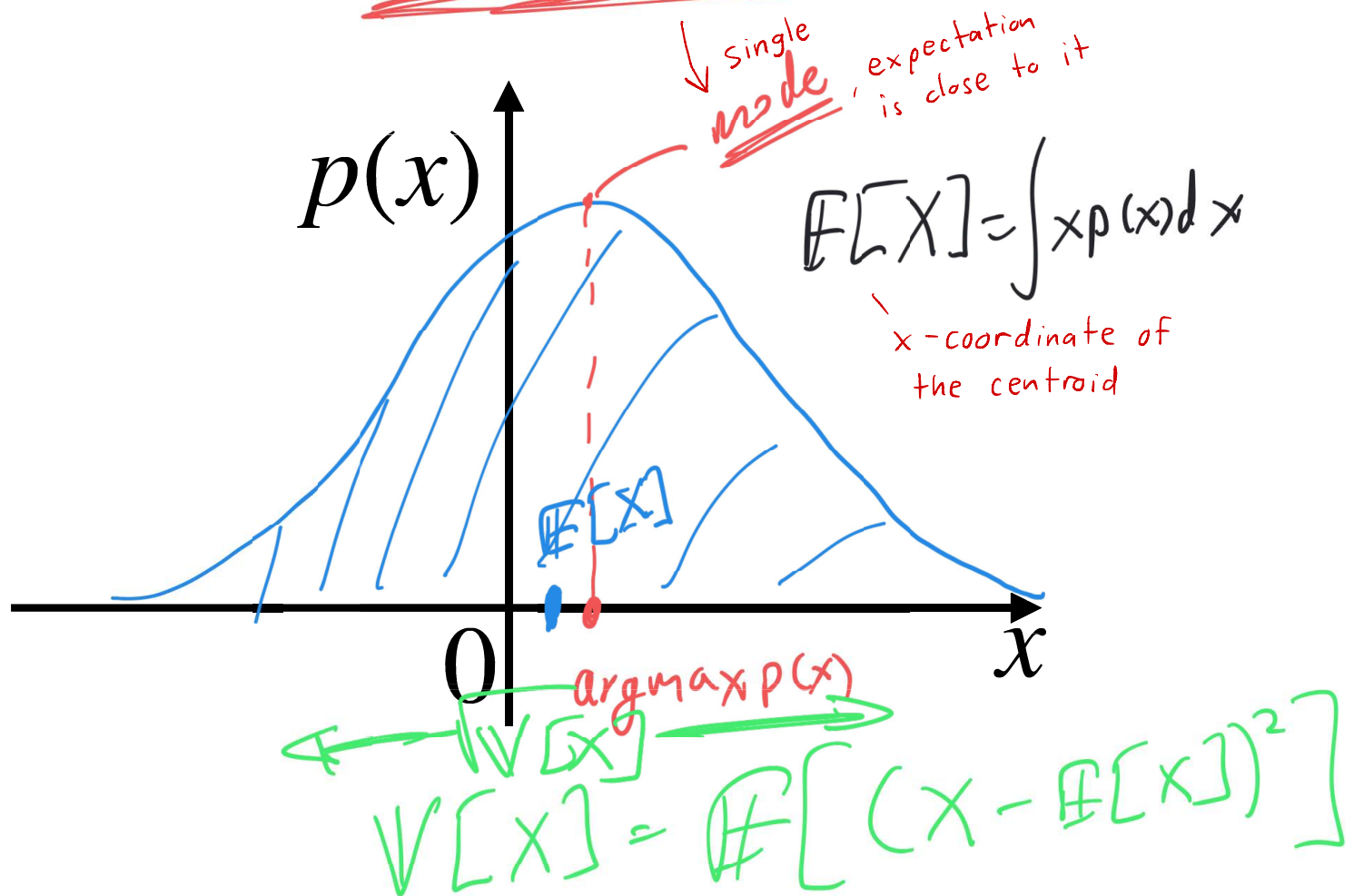
$$\mathbb{V}[X] = \mathbb{E} \left[ (X - \mathbb{E}[X])^2 \right].$$

- Its properties are the same as the variance of a discrete random variable.

$$\begin{aligned} \mathbb{V}[X + c] &= \mathbb{V}[X] ; & \mathbb{V}[\lambda X] &= \lambda^2 \mathbb{V}[X] \\ \mathbb{V}[X] &= \mathbb{E}[X^2] - (\mathbb{E}[X])^2 \end{aligned}$$



# Interpretation of expectation and variance for a good random variable



# Careful with how you interpret expectation and variance for a bad random variable

