Lecture 9: Monte Carlo estimates of various statistics

Professor Ilias Bilionis

Estimating predictive quantiles

What are the predictive quantiles?

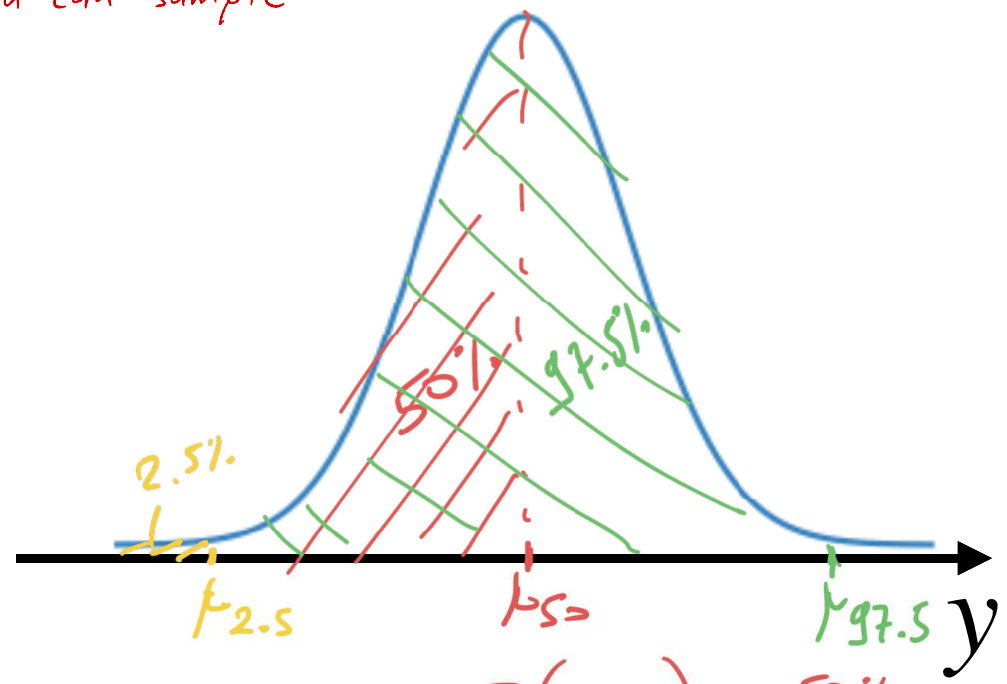
- Take a random variable $X \sim p(x)$ and some function $g(x)$.

- Let $Y = g(X)$ and $F(y)$ be the CDF of Y.

- The q-predictive quantile of Y is the value μ_q such that:

$$p(Y \leq \mu_q) = \frac{q}{100}$$

$$F(\mu_q) = \frac{q}{100}$$



$F(\mu_{50}) = 50\%$

median

$F(\mu_{97.5}) = 97.5\%$

Estimating the predictive quantiles

- We need to find:

$$F(\mu_q) = \frac{q}{100}$$

- We can turn this into a root finding problem:

$$F(\mu_q) - \frac{q}{100} = 0$$

- However, $F(y)$ is known and we will use an estimate.

Estimating the predictive quantiles

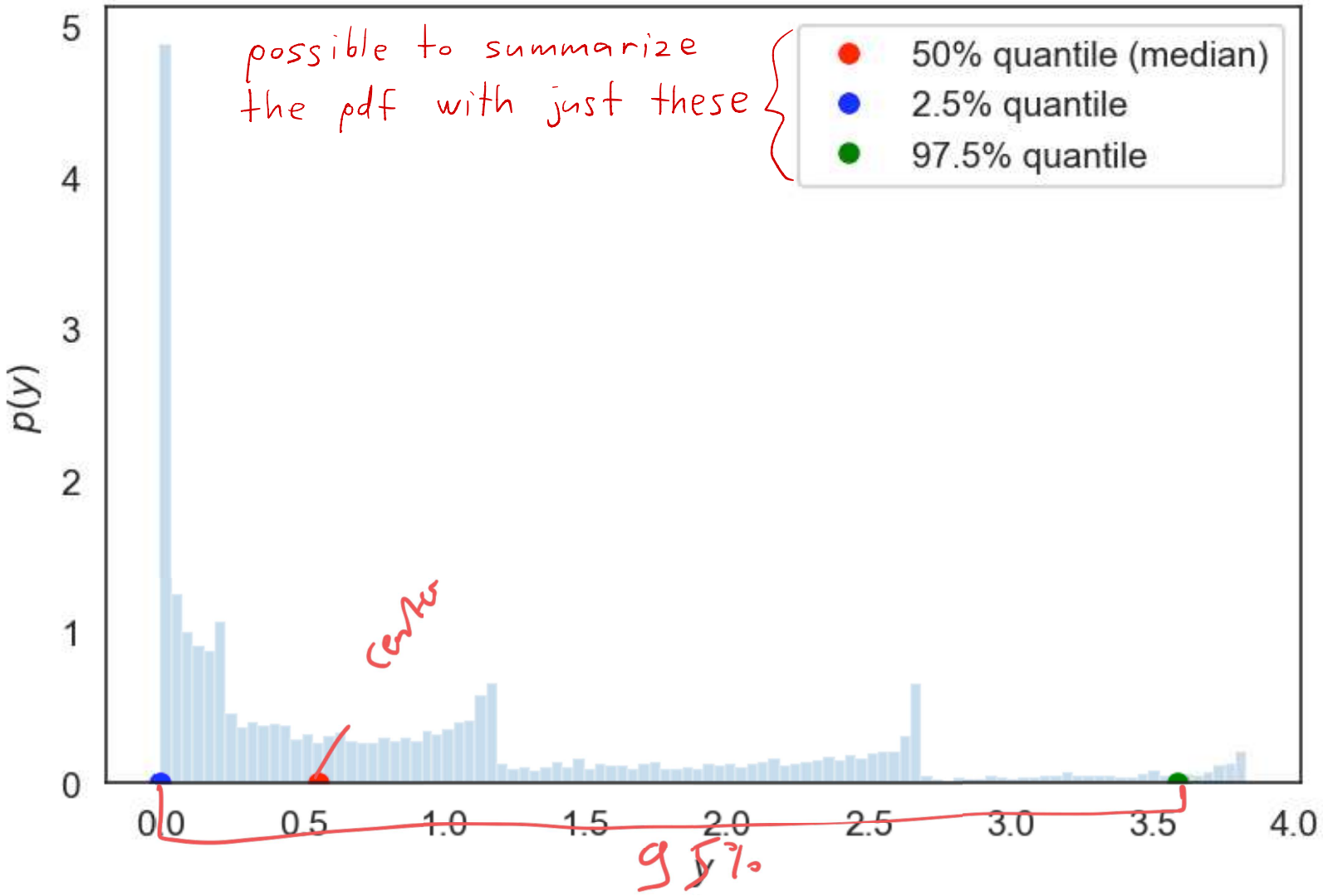
- Take $X_1, X_2, \ldots$ independent identical copies of X.
- Find the sampling estimate of the CDF of $Y = g(X)$, say $\bar{F}_N(y)$.
- Numerically solve the root finding problem:

$$\bar{F}_N(\mu_q) - \frac{q}{100} = 0$$

solve for μ_q

- Obtain estimate of the quantile $\bar{\mu}_{q,N}$.

Example: 1D - Predictive Quantiles



PREDICTI
SCIENCE LABORATORY

Example: 1D Box Plots