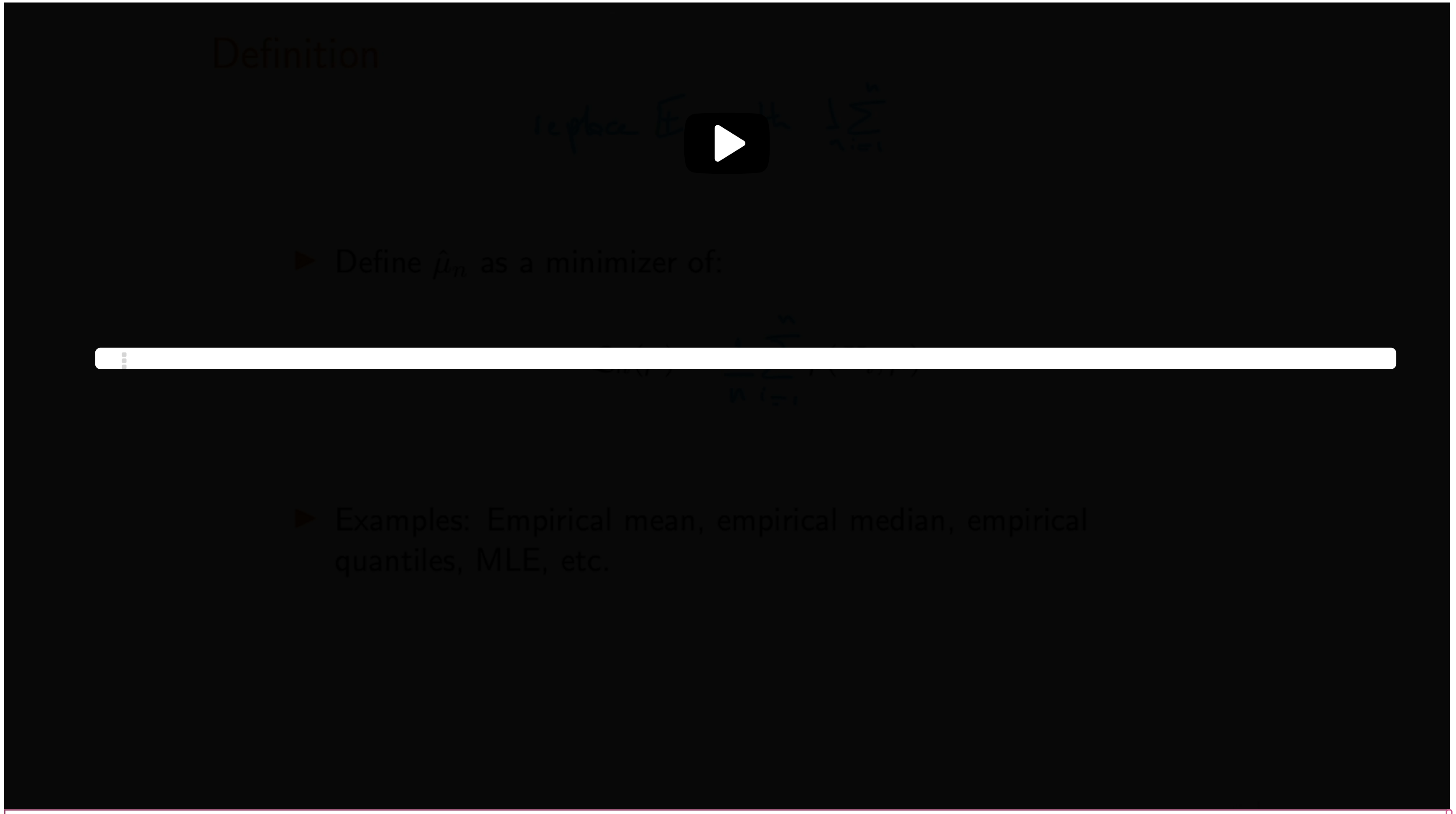
3. Recall the Ideas for M-estimation

Recall: Ideas for M-estimation



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Concept check: Defining M-estimators

1/1 point (graded)

Suppose we have access to a distribution $\mathbf{P}$ which has an unknown parameter μ^* that we would like to estimate from samples $X_1, \ldots, X_n \stackrel{iid}{\sim} \mathbf{P}$. Suppose we have a **loss function** $\rho(x, \mu)$ with the property that

$$\mu^* = \text{argmin}_{\mu \in \mathbb{R}} \mathbb{E}_{X \sim \mathbf{P}} \left[\rho(X, \mu)\right].$$

What commonly used statistical trick is used to define an M-estimator? (Refer to the slides.)

- ○ Using the KL divergence instead of TV distance.
- ○ The method of moments.
- ● Replacing expectations with averages.

✔

Solution:

The correct response is "Replacing expectations with averages." Indeed, we have that the equation

$$\mu^* = \text{argmin}_{\mu \in \mathbb{R}} \mathbb{E}_{X \sim \mathbf{P}} \left[\rho(X, \mu)\right]$$

becomes

$$\widehat{\mu} = \text{argmin}_{\mu \in \mathbb{R}} \frac{1}{n} \sum_{i=1}^{n} \left[\rho(X_i, \mu)\right]$$

upon replacing the expectation by an average over the sample. Here, $\widehat{\mu}$ is precisely the M-estimator associated with $\rho(x, \mu)$.

The response "Using the KL divergence instead of TV distance." is incorrect. Rather, the KL divergence was used specifically in the context of maximum likelihood estimation. It does not play a role in the context of M-estimation.

The response "The method of moments." is also incorrect. The method of moments is a tool for parameter estimation which is distinct from M-estimation. The method of moments is not what is used to define an M-estimator.

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Answers are displayed within the problem

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