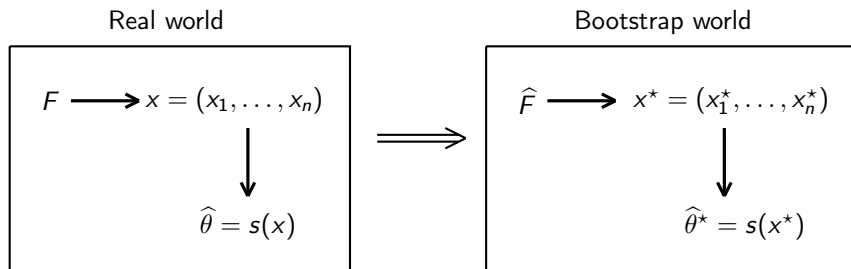


Plug-in principle and bootstrapping

- ★ Assume: Have observed x_1, \dots, x_n iid from F
- ★ Empirical distribution \hat{F} puts probability $\frac{1}{n}$ on each x_1, \dots, x_n
- ★ Parameter of interest: $\theta = t(F)$
- ★ Plug-in principle: $\hat{\theta} = t(\hat{F})$
- ★ Bootstrapping: Schematic view



Bootstrapping of standard error

- ★ Have $F \rightarrow x = (x_1, \dots, x_n)$
- ★ Empirical distribution \hat{F}
- ★ Parameter of interest: $\theta = t(F)$
- ★ Estimator: $\hat{\theta} = s(x)$
- ★ Want to estimate $SD_F [\hat{\theta}]$
- ★ Ideal bootstrap estimator: $SD_{\hat{F}} [\hat{\theta}^*]$
- ★ Pseudo code for bootstrap estimator \widehat{SE}_B
 - for** $b = 1, 2, \dots, B$ **do**
 - Generate $x^{*b} = (x_1^{*b}, \dots, x_n^{*b})$
 - Evaluate $\hat{\theta}^*(b) = s(x^{*b})$
 - end for**
 - Estimate $SD_{\hat{F}} [\hat{\theta}^*]$ by

$$\widehat{SE}_B = \sqrt{\frac{1}{B-1} \sum_{b=1}^B \left(\hat{\theta}^*(b) - \hat{\theta}^*(\cdot) \right)^2}$$