Point Estimates

Single value estimate (guess) of pop parameter based on data

Parameters: any numerical description of pop
- Pop mean
- Pop variance

Pop = all skittles, param = % green skittles

Pop = all neurons in V1, param = % affected by auditory stimuli

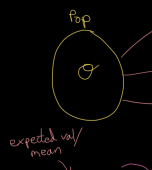
Pop = all dogs in USA, param = average ear length } θ

indicates estimate } $\hat{\theta}$ = average ear length in sample of 3 dogs

Leo photo } could lead to too high estimate (Need sample size to be big enough)

$\hat{\theta} = 0.25$ (av ear length in sample)

We want good estimators (that give good estimates)
- → How do we define goodness?
- → How do we figure out estimators?

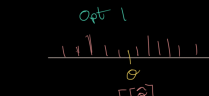


expected val/ mean

$E[\hat{\theta}] = \theta$

Bias of an estimator: $E[\hat{\theta}] - \theta$

If 0 → Unbiased estimator



Variance of estimator: $E[(\hat{\theta} - E(\hat{\theta}))^2]$

Low variance High variance

Mean squared error (MSE): $E[(\hat{\theta} - \theta)^2]$

↓ Rearrange

$MSE = Var(\hat{\theta}) + Bias(\hat{\theta})^2$

Based on both bias & variance

Consistency:

$\hat{\theta}$ is consistent estimator if:

↑ sample size = $\hat{\theta}$ converges to θ

Unbiased but not consistent example:

$X_1, X_2, \ldots, X_n$ $\quad \hat{\mu} = X_1$

$E[X_i] = \mu$

Does not converge to μ w/ more data

$\hat{\mu} = \frac{\sum X_i}{N}$ pop mean = mean of sample ~~mean~~

Is $\hat{\mu}$ unbiased? $E[\hat{\mu}] = \mu$

$$E[\hat{\mu}] = E\left[\frac{\sum X_i}{N}\right] = \frac{1}{N}\sum \underbrace{E[X_i]}_{\mu} = \frac{1}{N}\sum \mu = \frac{N\mu}{N} = \mu$$

Yes

pop variance = variance of sample

$\hat{\sigma}^2 = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \bar{Y})^2$ Biased

$\hat{\sigma}^2 = \frac{1}{n-1}\sum_{i=1}^{n}(Y_i - \bar{Y})^2$ Unbiased