Parameter vs. Statistic

How much sleep did AP Statistics students get last night?

- **Parameter →** number that describes **population,** usually unknown, usually given.
  - Symbols = mostly **Greek** letters
    - μ = mean, σ = standard deviation, p = proportion
  - *Example: Average hours all AP Statistics students slept last night.*

- **Statistic →** number computed from **sample**. Observed, known. Used to estimate parameter.
  - Symbols = mostly **English** letters
    - $\bar{x}$ *(x-bar)* = mean, s = standard deviation, $\hat{p}$ *(p-hat)* = proportion
  - *Example: Average hours my sampled students slept last night.*

	Mean	Standard deviation	Proportion	Size
Statistics (sample)	$\bar{x}$	s	$\hat{p}$	n
Parameter (population)	μ	σ	p	N

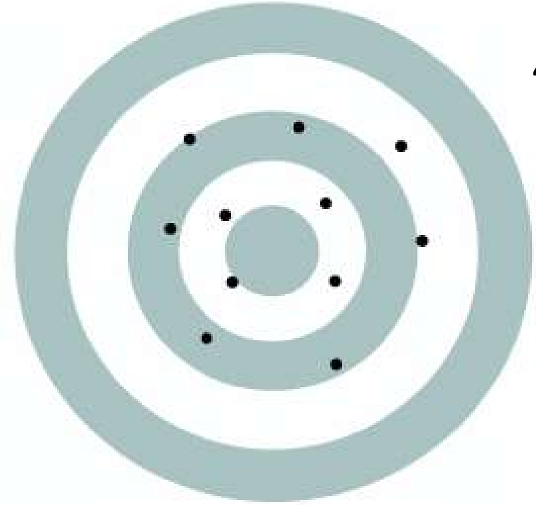
Bias (mean) vs. Variability (s.d.)

- **Bias** → Difference between **center** of sampling distribution and "true center" of parameter
  - *Example: Mean height of class,* $\bar{x}$*=64.85 inches, and true mean* μ *of heights of everyone.*

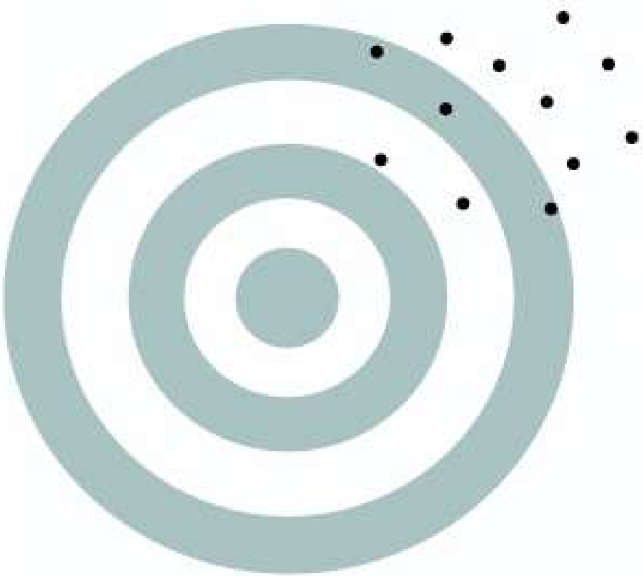
- **Variability** → **Spread** of sampling distribution
  - Larger distribution → smaller spreads.
    - Levels out when population (N) is 10+ times larger than sample (n)
  - *Example: Standard deviation of your heights,* s*=4.853, vs. true standard deviation* σ *of heights of everyone.*

67
65
61
63.5
67
67
61
62
75
66
72
63
62
56
70
58
67

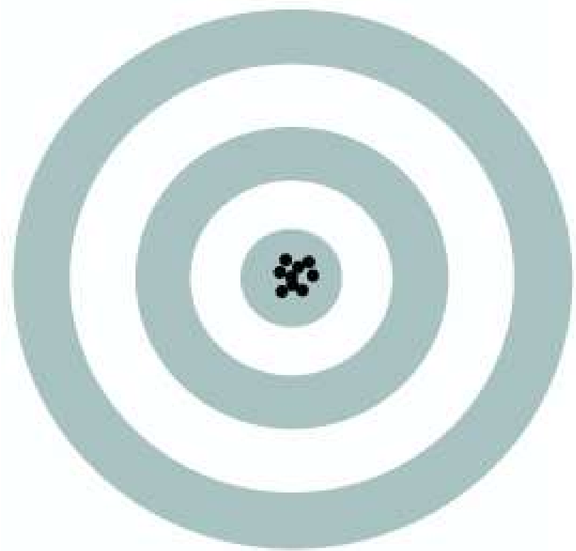
High bias
Low variability



Low bias
High variability

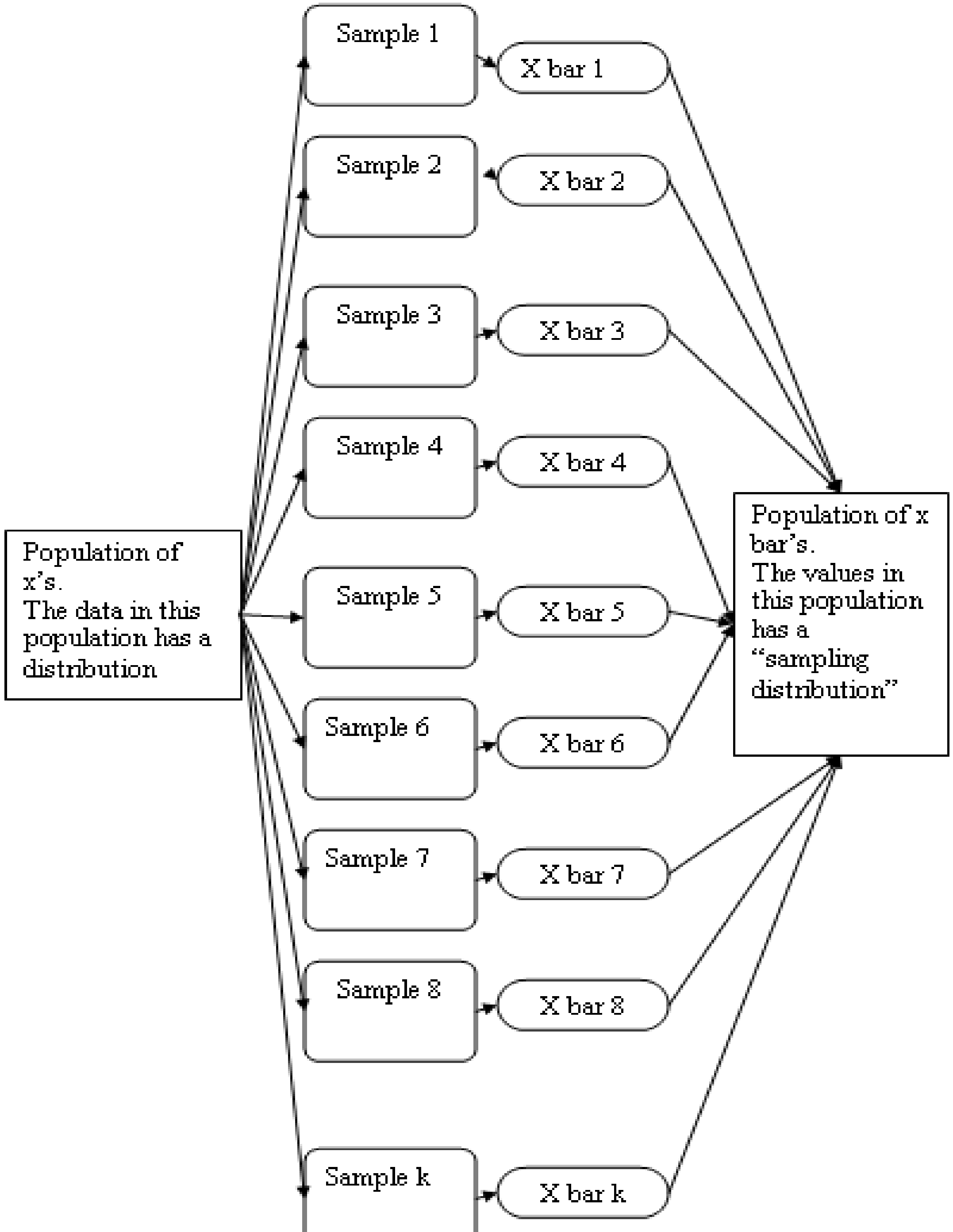


High bias
High variability



Low bias
Low variability

- http://onlinestatbook.com/stat_sim/sampling_dist/index.html


Population of x's.
The data in this population has a distribution
Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6
Sample 7
Sample 8
Sample k
X bar 1
X bar 2
X bar 3
X bar 4
X bar 5
X bar 6
X bar 7
X bar 8
X bar k
Population of x bar's.
The values in this population has a "sampling distribution"

The Central Limit Theorem

- Foundation of inferential statistics (rest of course)
- Sampling distribution:
  - "The distribution of values of the statistic in all possible samples of size *n* from the population."

"For any population, when n is large enough, the sampling distribution is approximately normal."

Conditions (prop.)

Independent

Math:	$N \geq 10n$
Words:	Population *(N)* is 10+ times bigger than sample *(n)*.
Summary:	"Sample is just a small slice."

Normal

Math:	$np \geq 10$ and $n(1-p) \geq 10$
Words:	Expected mean of success and failure must be 10+.
Summary:	"Sample is big enough."

Random

What it sounds like. Usually stated.

Conditions (mean)

Independent

Math:	$N \geq 10n$
Words:	Population *(N)* is 10+ times bigger than sample *(n)*.
Summary:	"Sample is just a small slice."

Normal

Math:	$n \geq 30$
Words:	For ***most*** populations, sample size (n) of 30+ gets Normality.
Summary:	"Sample is big enough."

Random

What it sounds like. Usually stated.

Example, proportion

1. One of California's largest prisons is the Men's Colony outside San Luis Obispo. Two years ago, 26% of the approximately 6000 inmates at the Men's Colony were white. Suppose that this proportion has not changed. If a random sample of 80 inmates is taken, what is the probability that in the sample, more than 37% will be white?

Independence met, N≥800. Normality met, np>10, n(1-p)>10. Randomness stated.

$$\frac{0.37-0.26}{\sqrt{\frac{(0.26)(0.74)}{80}}}=2.24$$

$$1-0.9875=0.0125$$

~1.25% chance that this sample would have more than 37% whites.

Example, mean

Studies suggest that a new nitrogen/oxygen blend allows divers to dive with a mean dive time of 58.81 minutes, and a standard deviation of 5.2 minutes.

1. If a random sample of 25 divers is taken, what is the probability that the average time they stay underwater is more than an hour?
2. If a random sample of 100 divers is taken, what is the probability that the average time they stay underwater is more than an hour?

Example *ANSWER*

Studies suggest a new nitrogen/oxygen blend allows divers to dive with a mean dive time of 58.81 minutes, and standard deviation 5.2 min.

1. If a random sample of 25 divers is taken, what is the probability that the average time they stay underwater is more than an hour?

Independence met, N≥250. Normality not met, n<30. Randomness stated.

$$\frac{60-58.81}{\frac{5.2}{\sqrt{25}}}=1.08$$

$$1-0.8599=0.1401$$

If we assume Normality, then there is ~14.01% chance that a random sample of 25 divers would have a mean dive time more than one hour.

2. If a random sample of 100 divers is taken, what is the probability that the average time they stay underwater is more than an hour?

Independence met, N≥1000. Normality met, n>30. Randomness stated.

$$\frac{60-58.81}{\frac{5.2}{\sqrt{100}}}=2.29$$

$$1-0.9890=0.011$$

~1.1% chance that a random sample of 100 divers would have a mean dive time more than one hour.