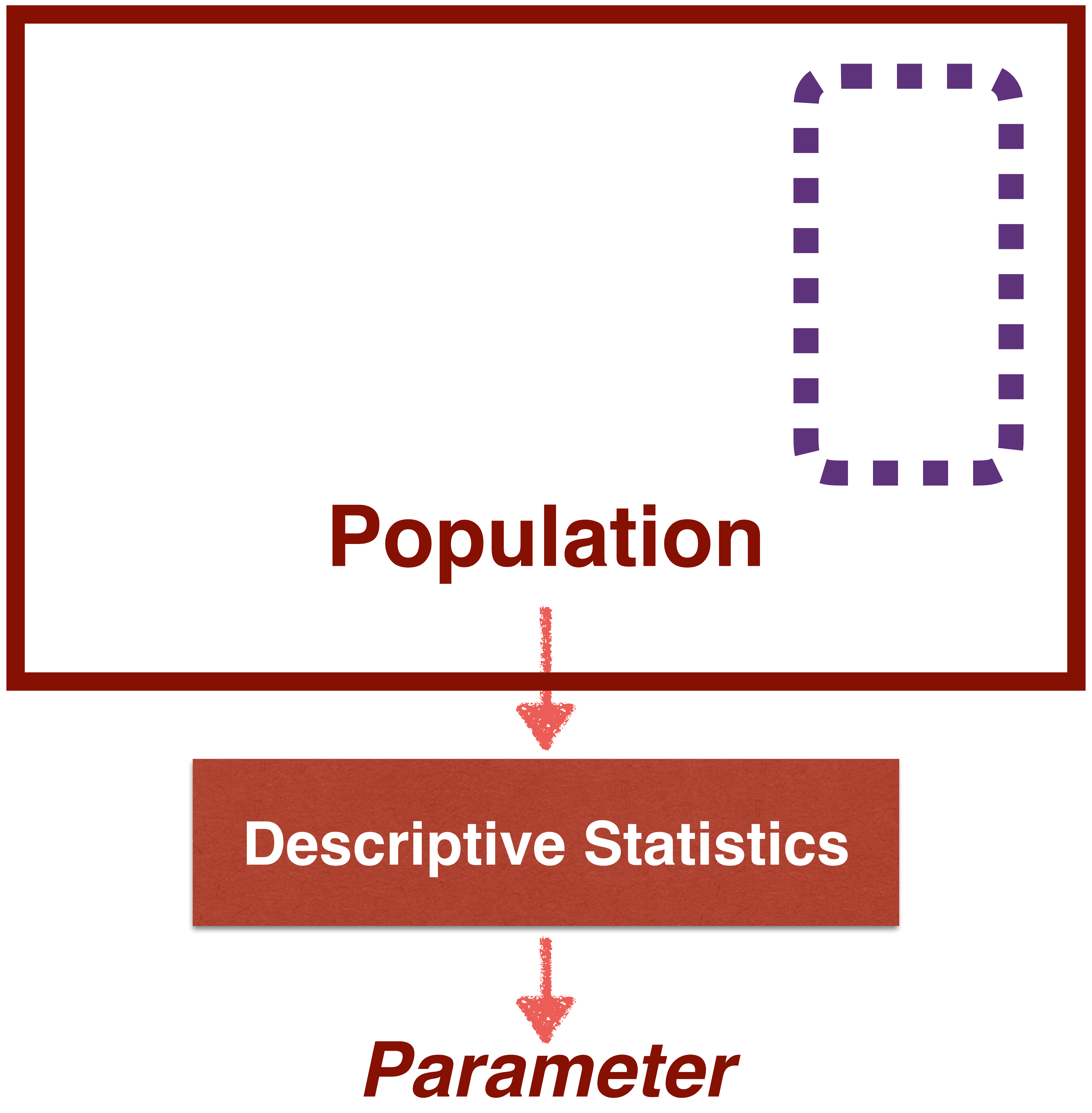
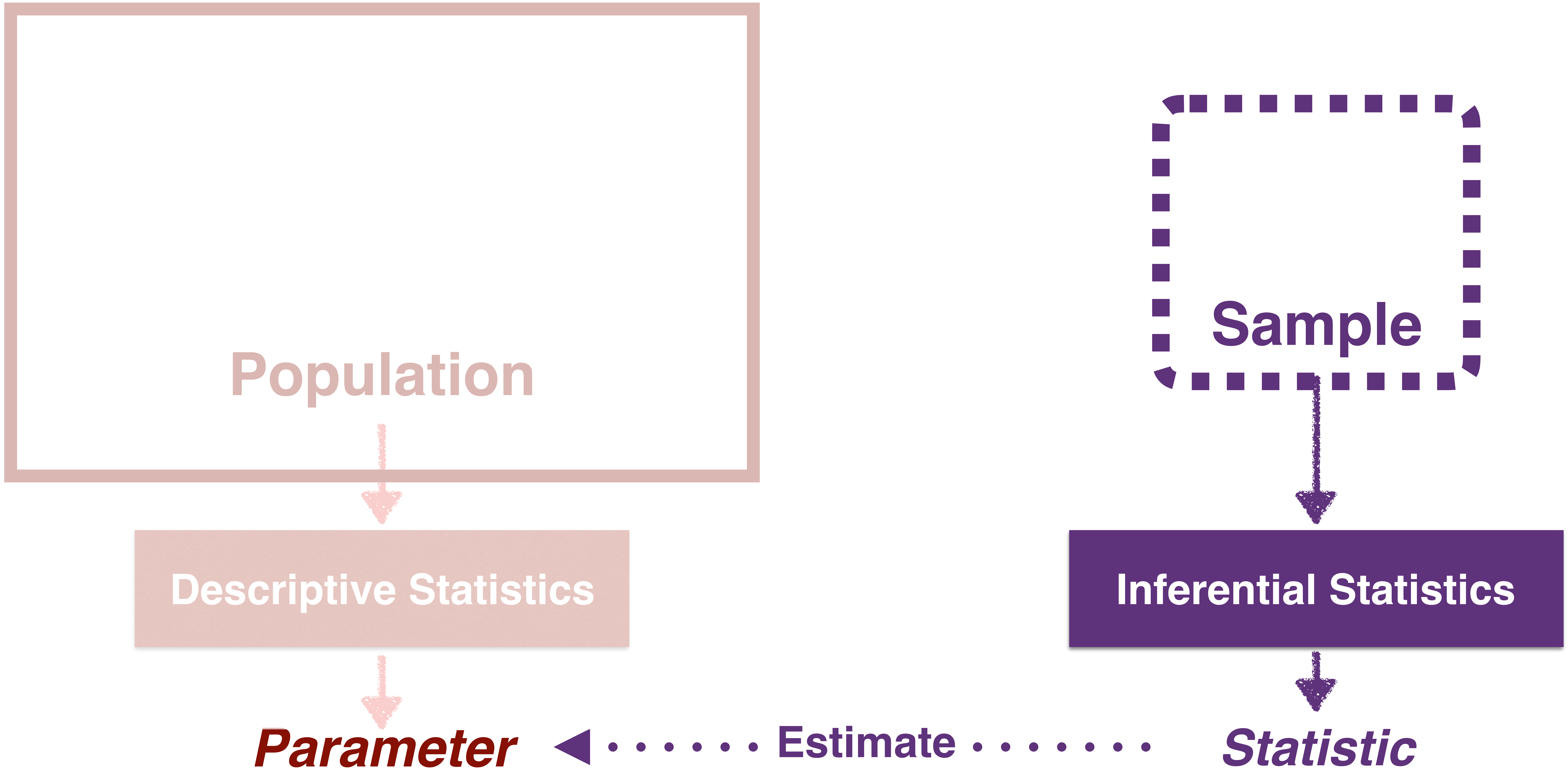
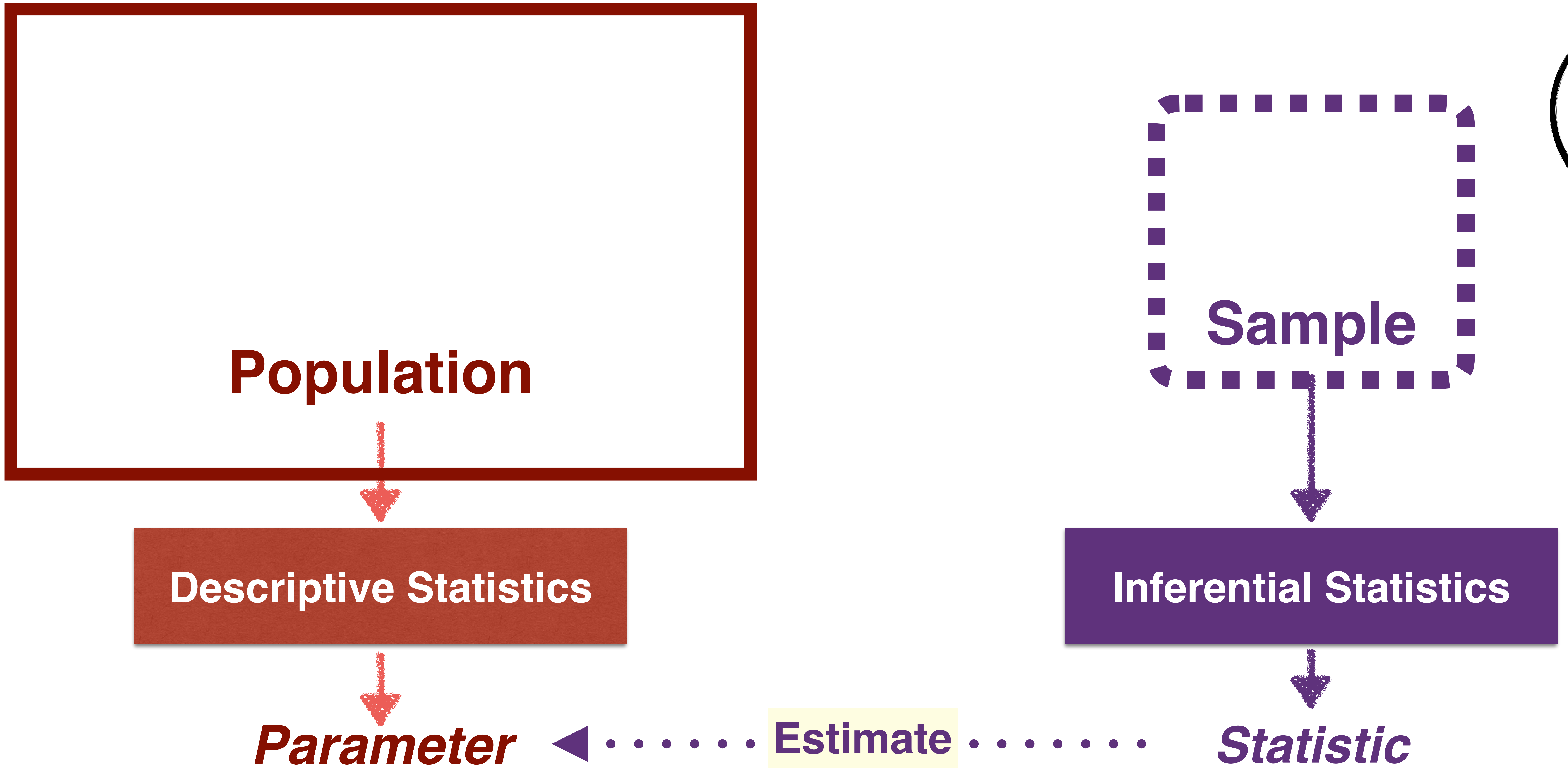
Sampling and Estimation

Sampling and Central Limit Theorem

1. Sampling
2. Central Limit Theorem


Population
Descriptive Statistics
Parameter


Population
Sample
Descriptive Statistics
Inferential Statistics
Parameter
Estimate
Statistic


Population
Descriptive Statistics
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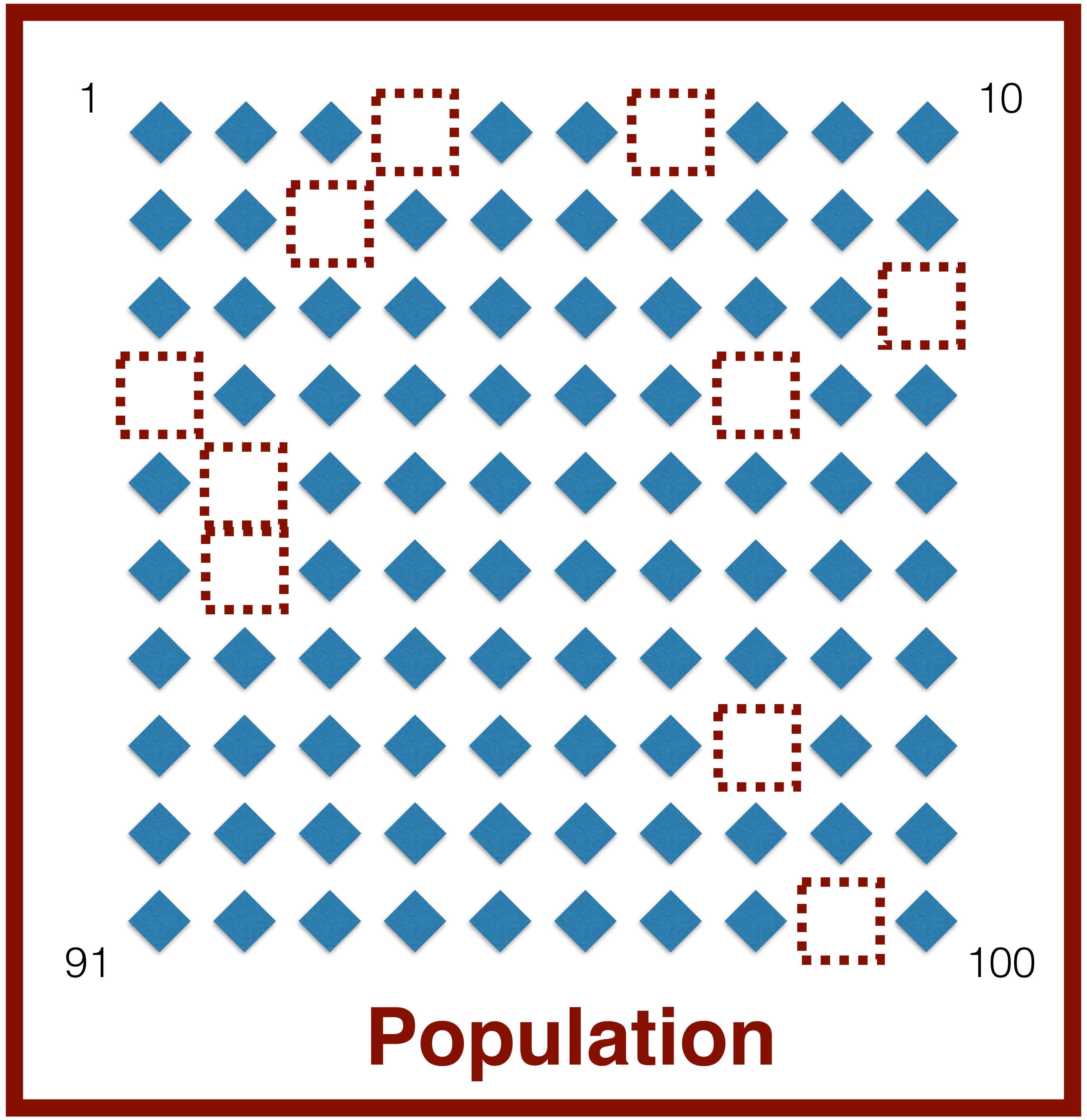
What's the best way to do sampling?

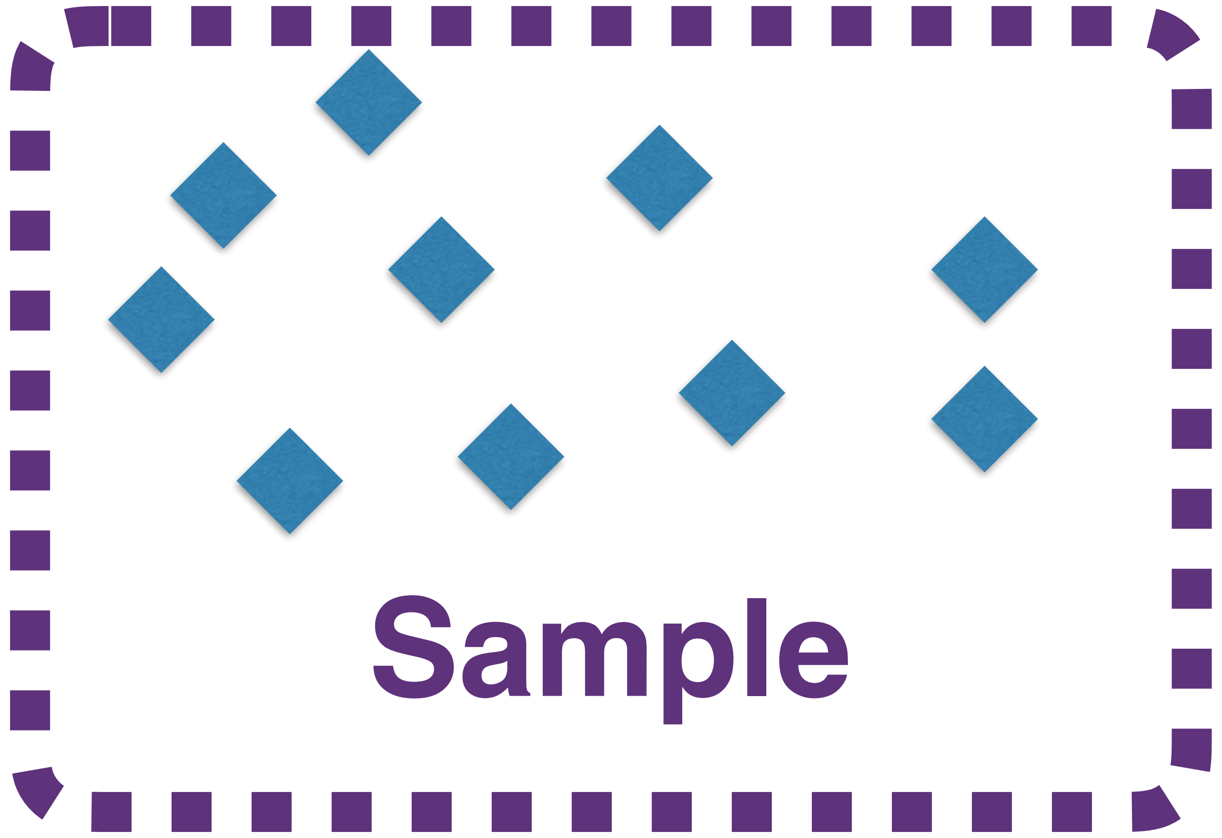
Simple Random Sampling

Every element has equal probability to be selected



Random Number Generator

38	4	52	13	99
42	30	31	78	7



Simple Random Sampling

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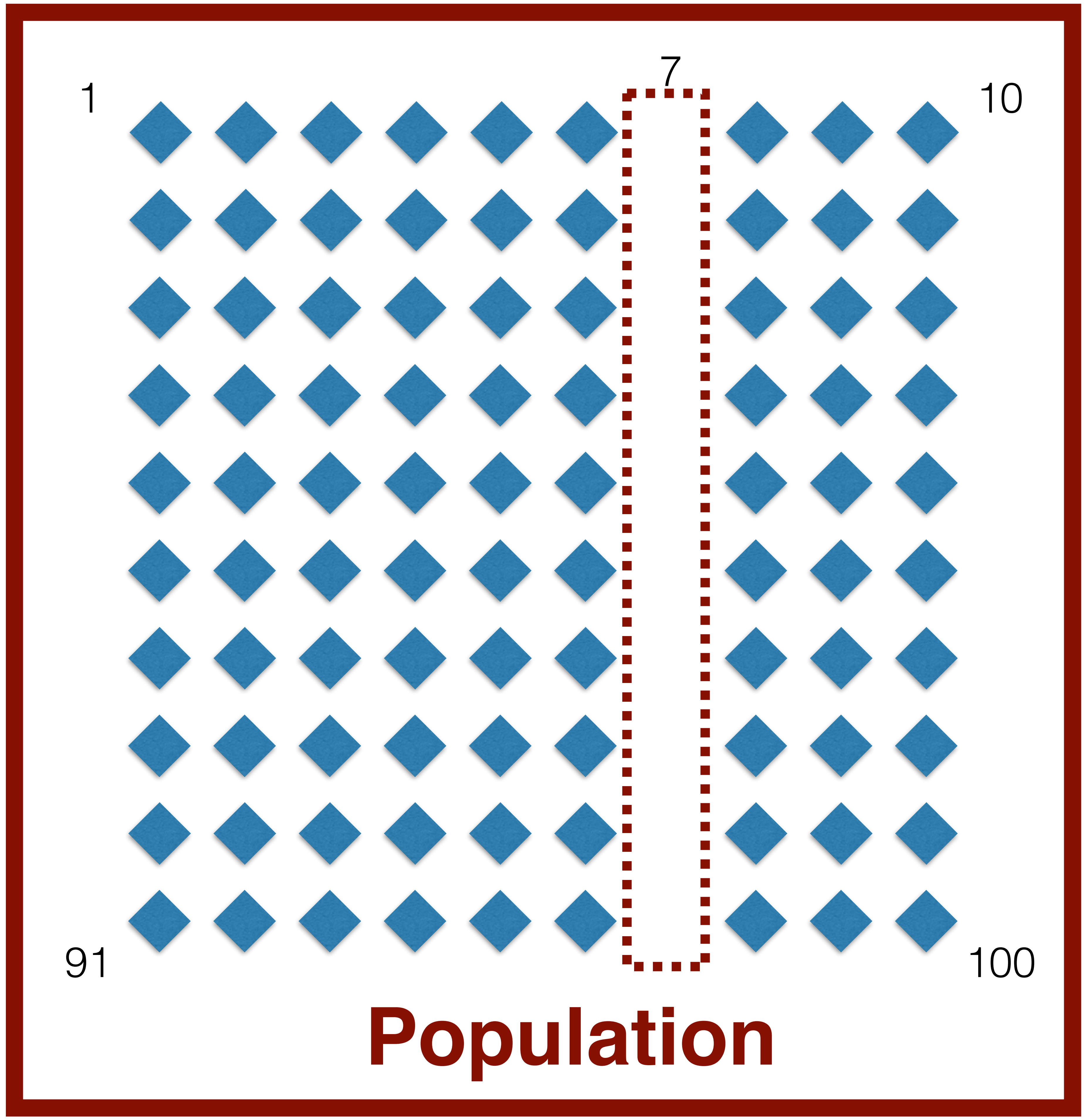
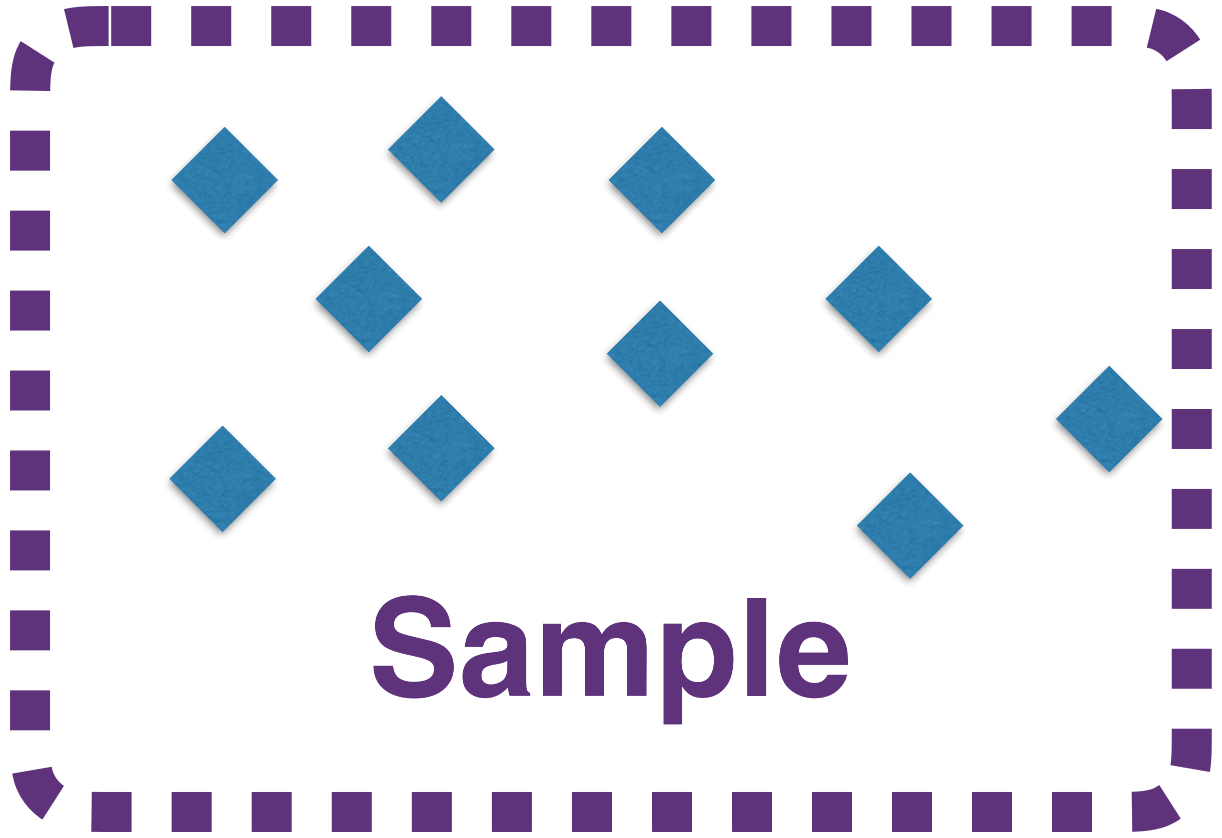


10% of the population

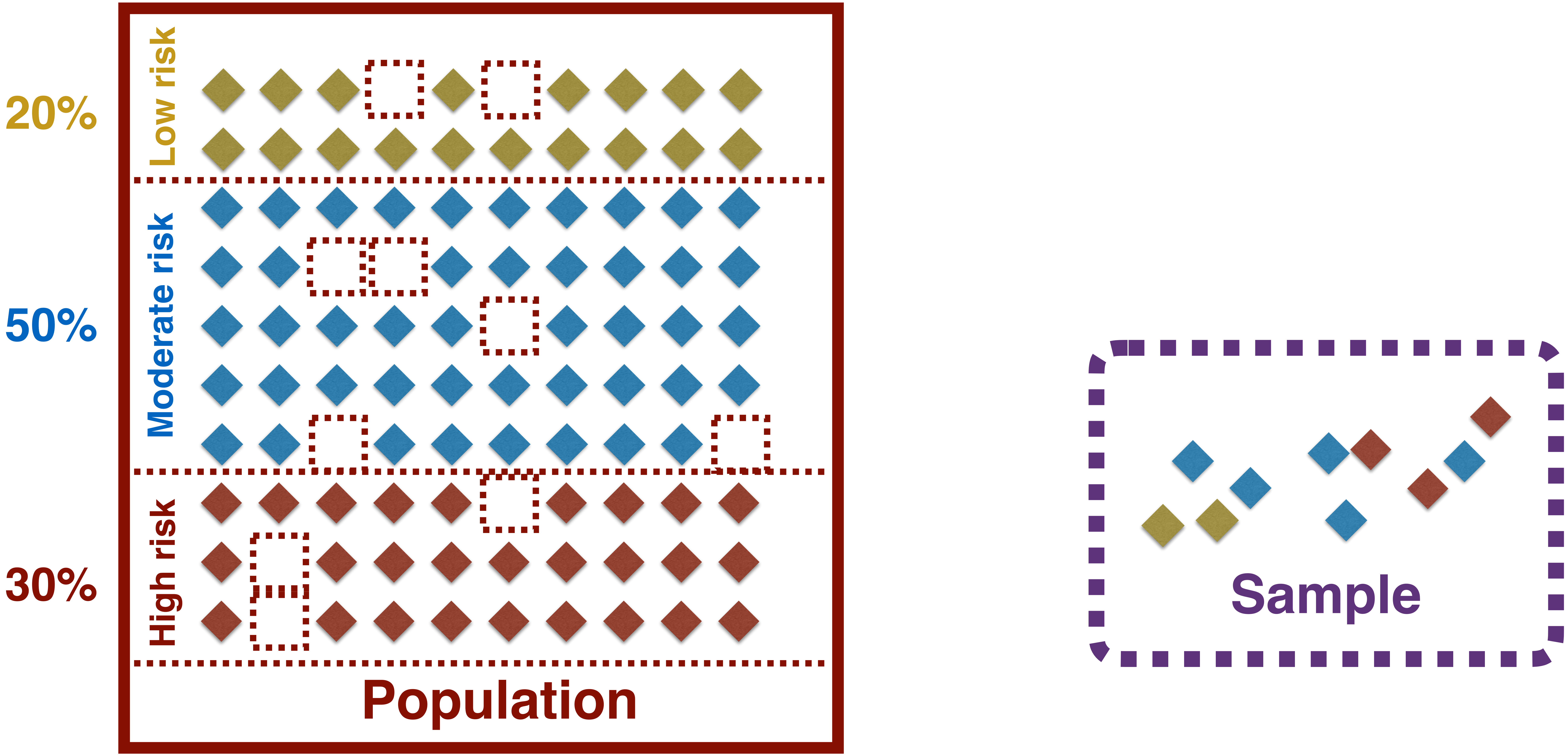
Select accounts with last digit

Systematic Sampling



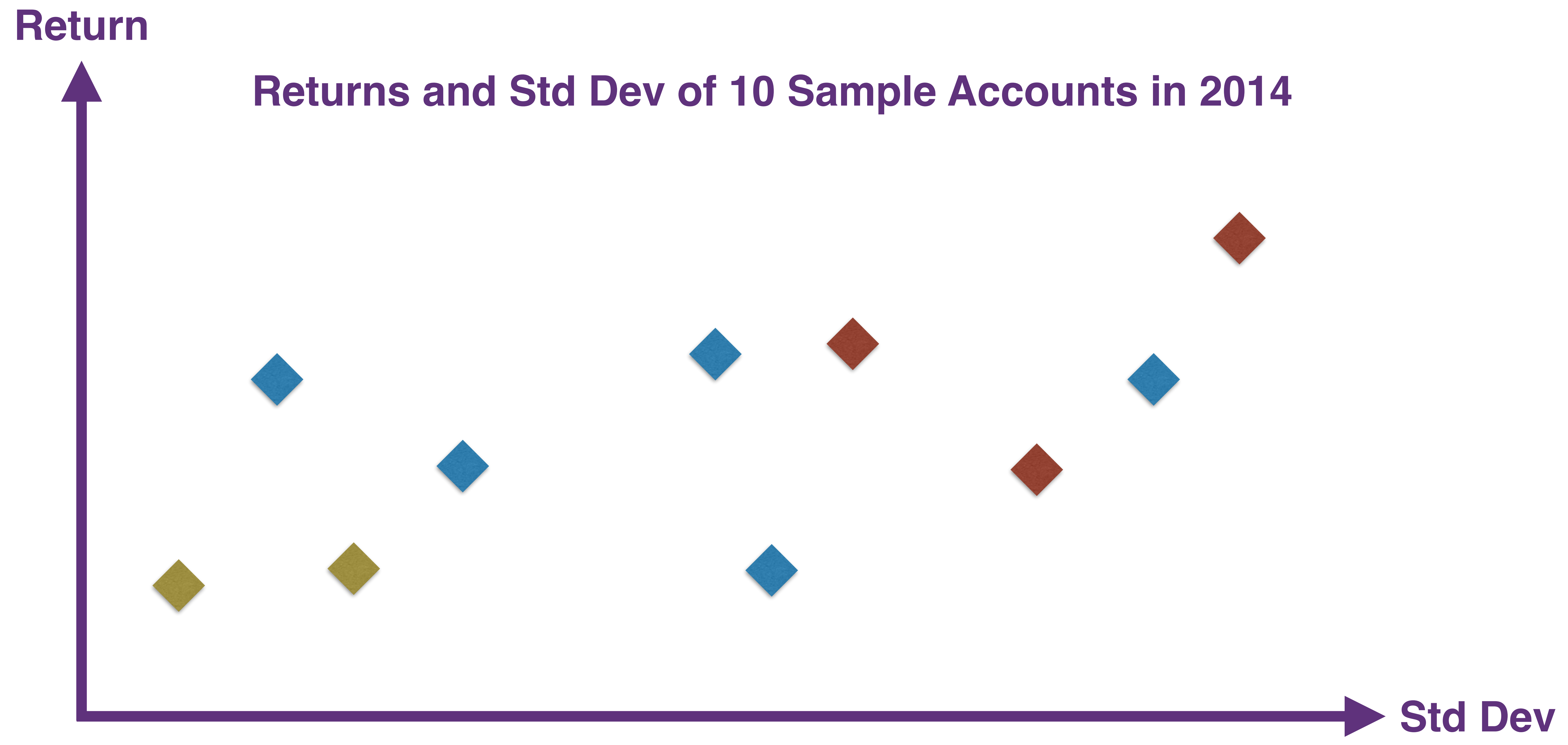
Stratified Random Sampling

Random selection from subgroups



Cross-Sectional Data

Observations at a single point in time



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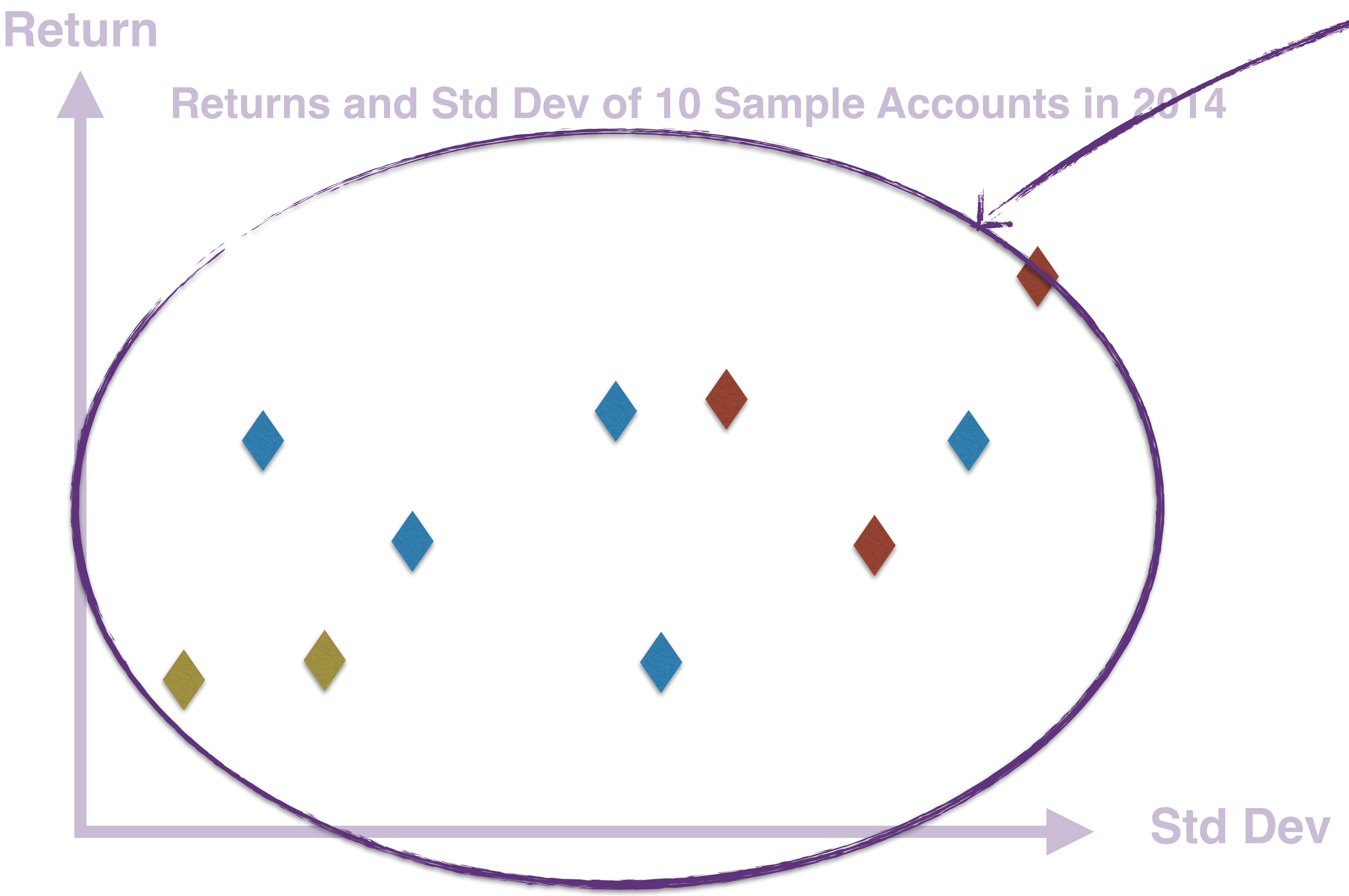
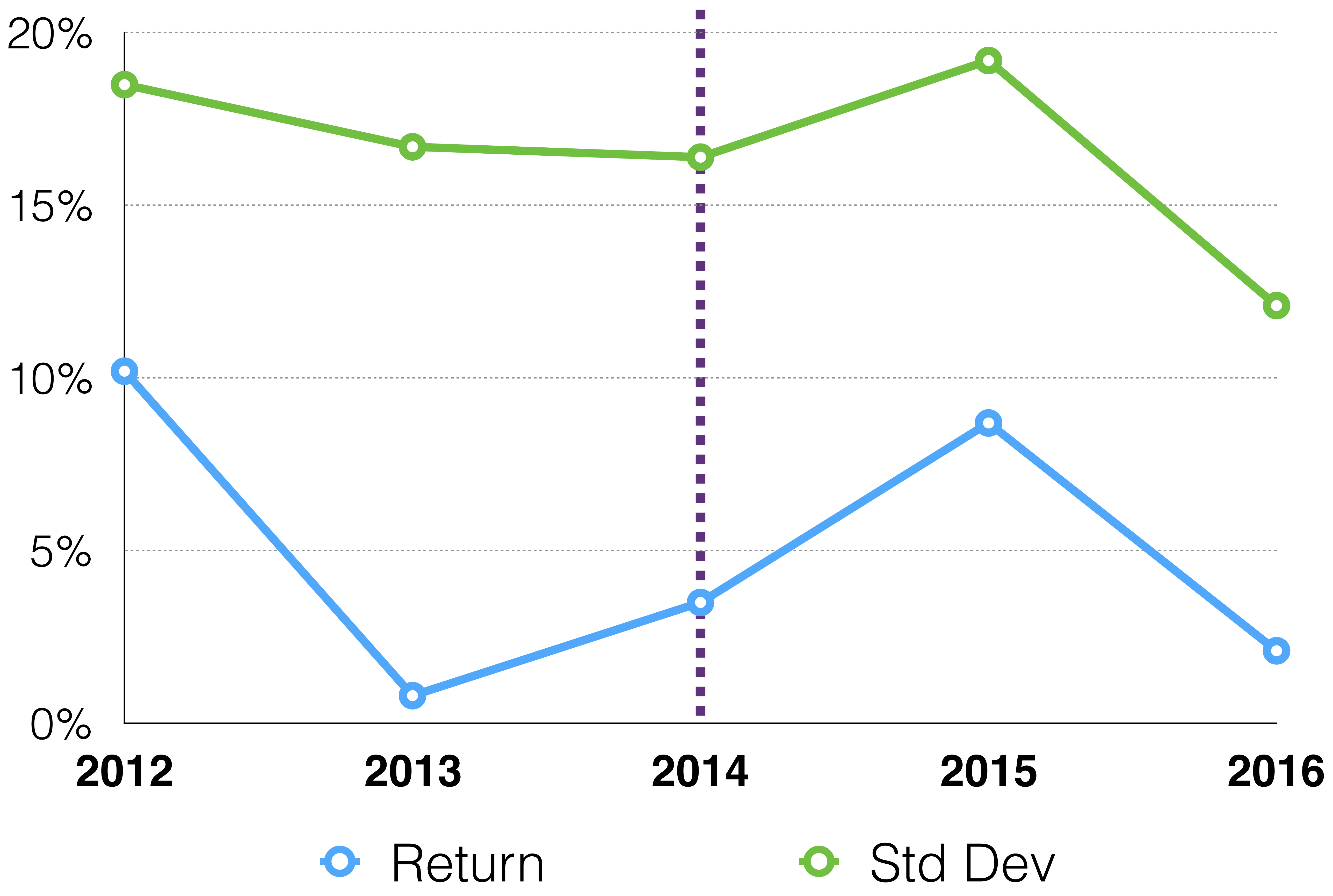
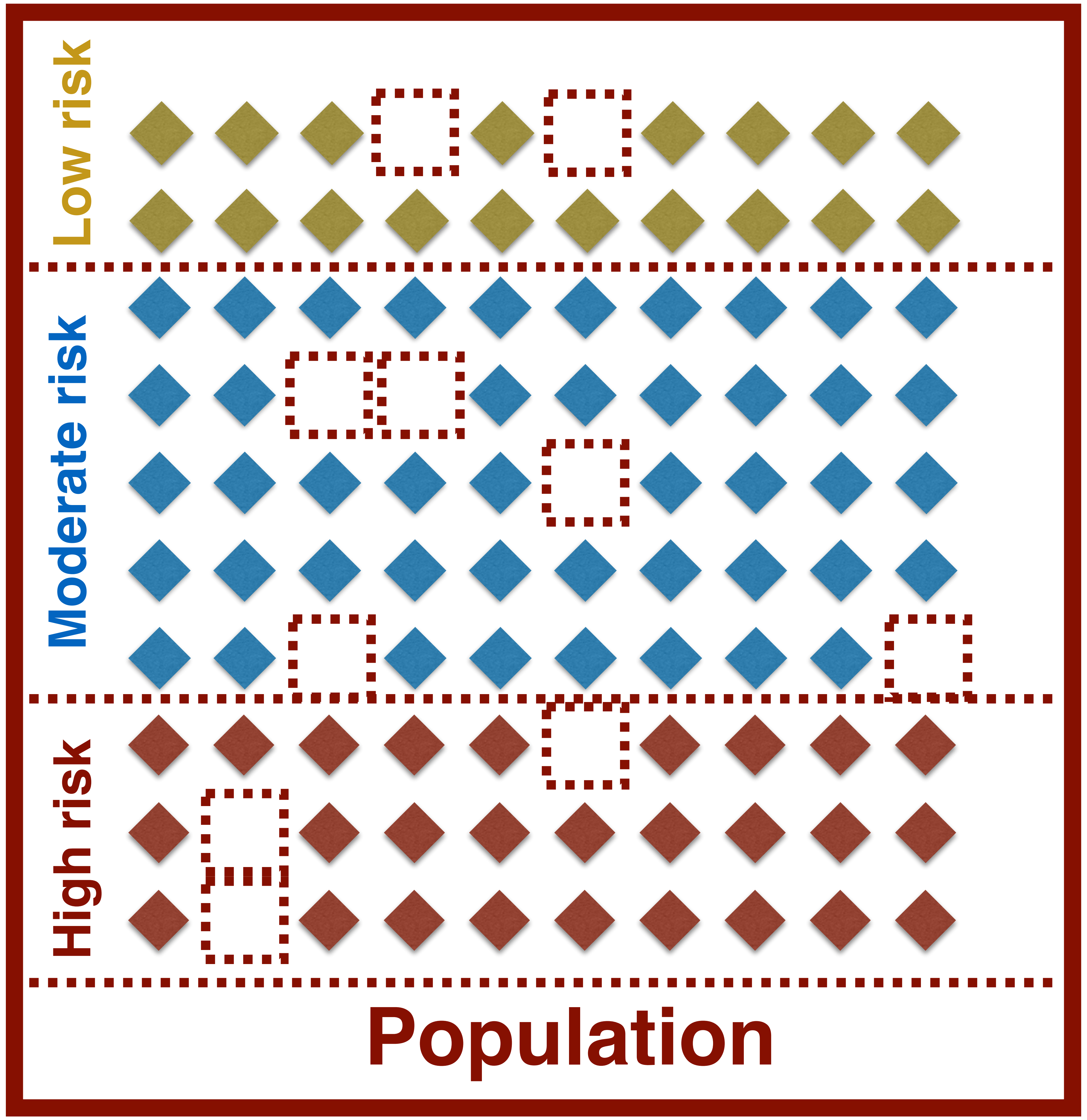
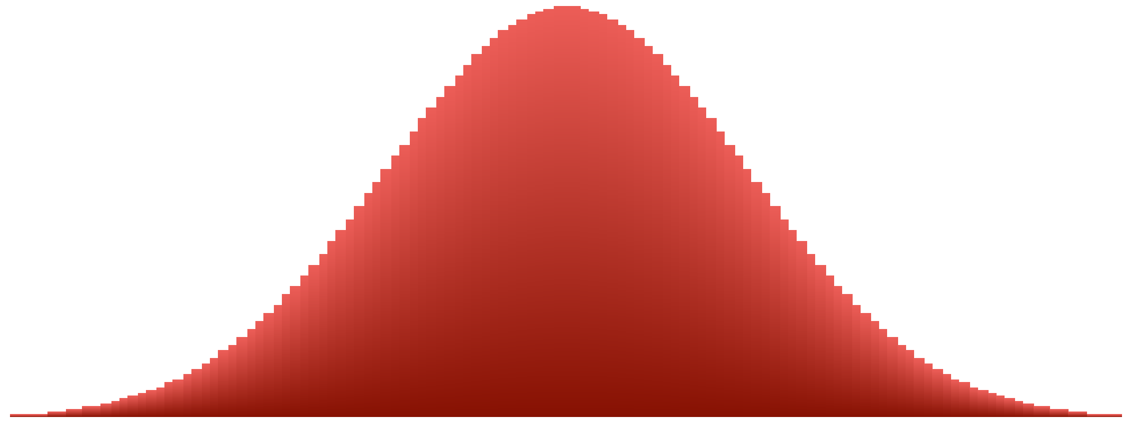


Time-Series Data

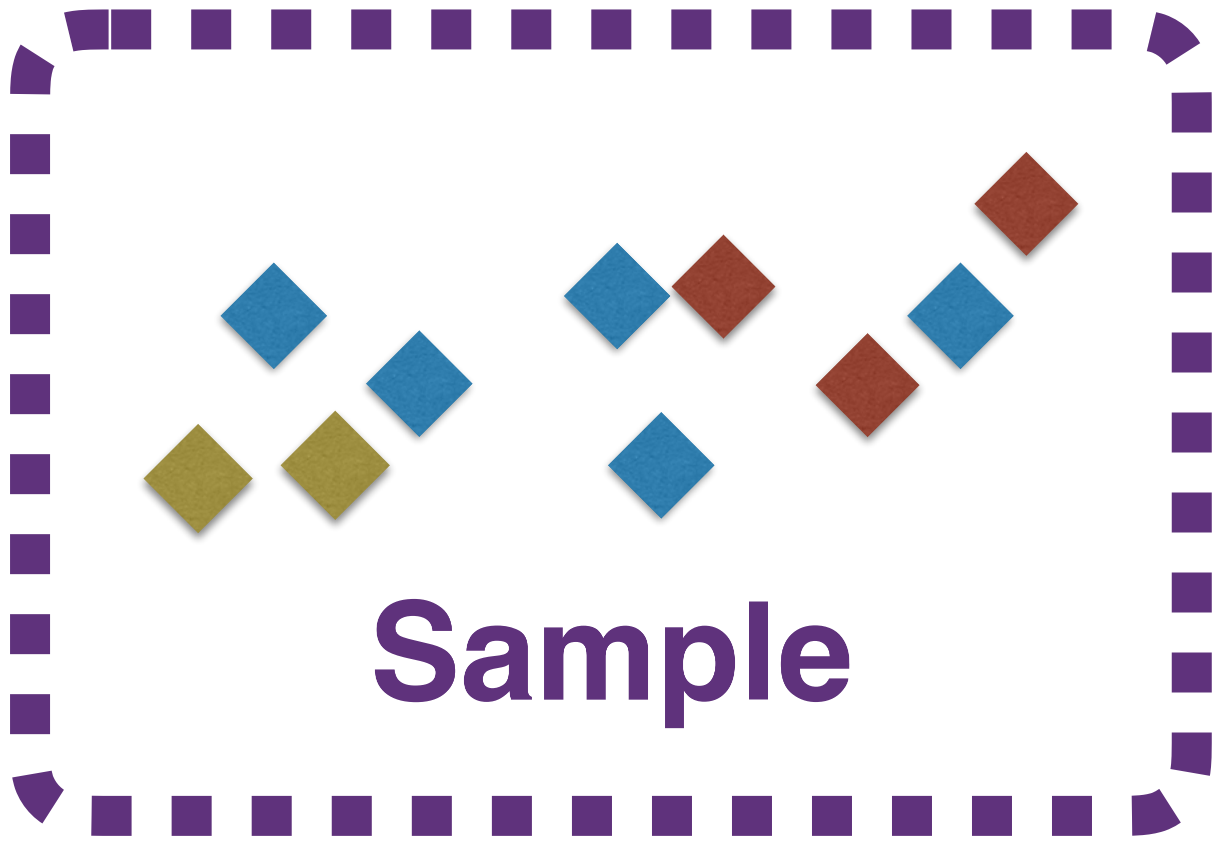
Observations over a period of time





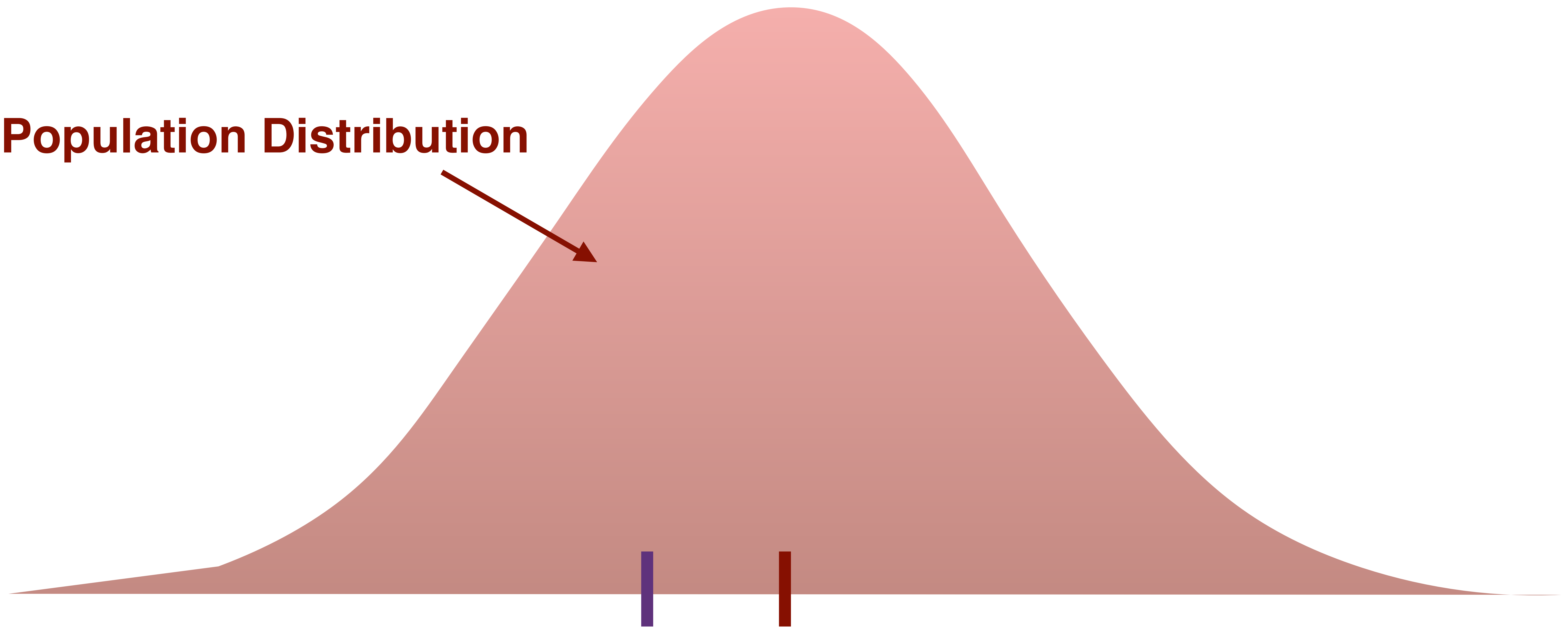


Population mean: μ
Population std dev: σ



Sample mean: $\bar{x}$
Sample std dev: s

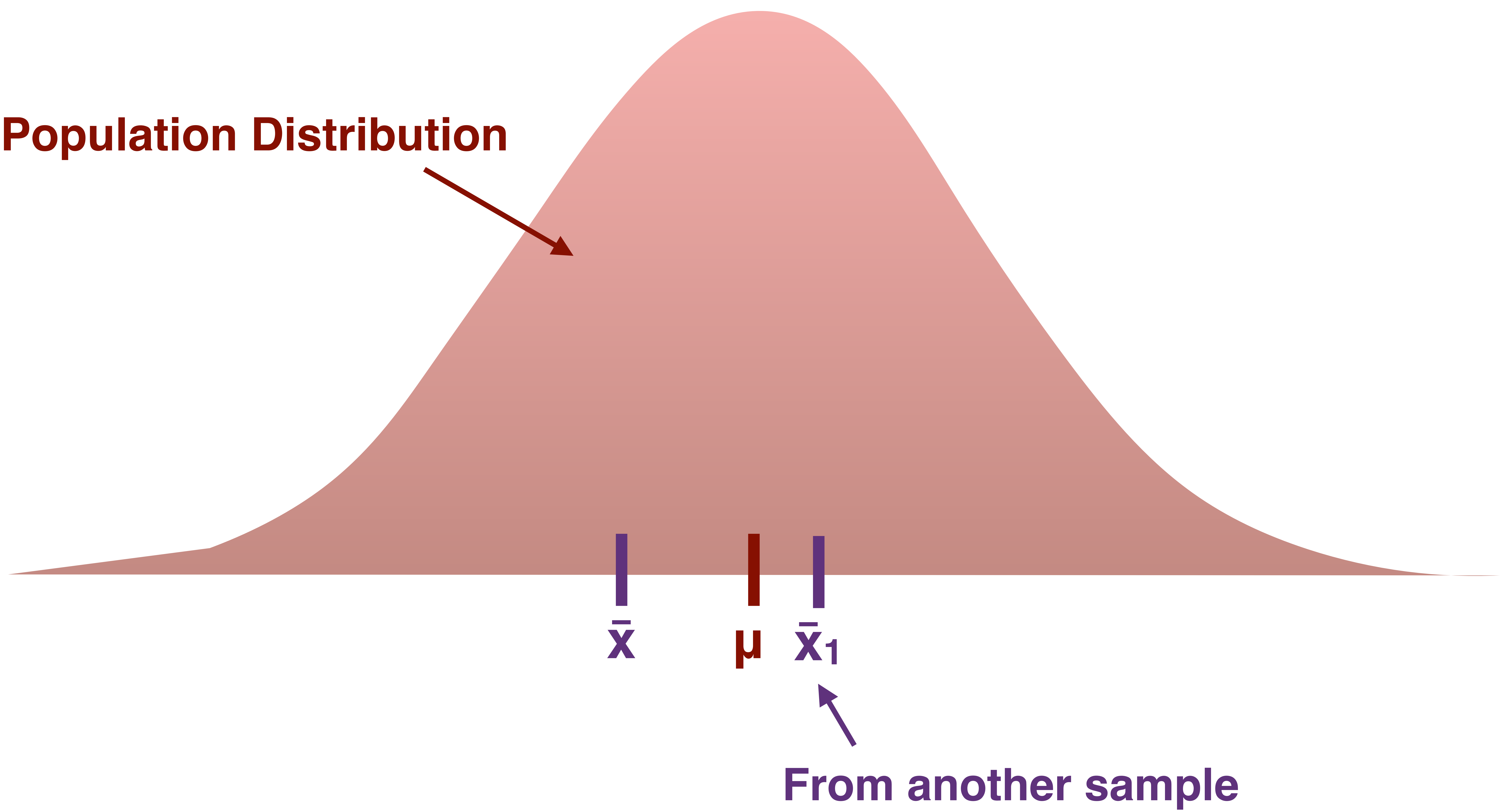
Sampling Error



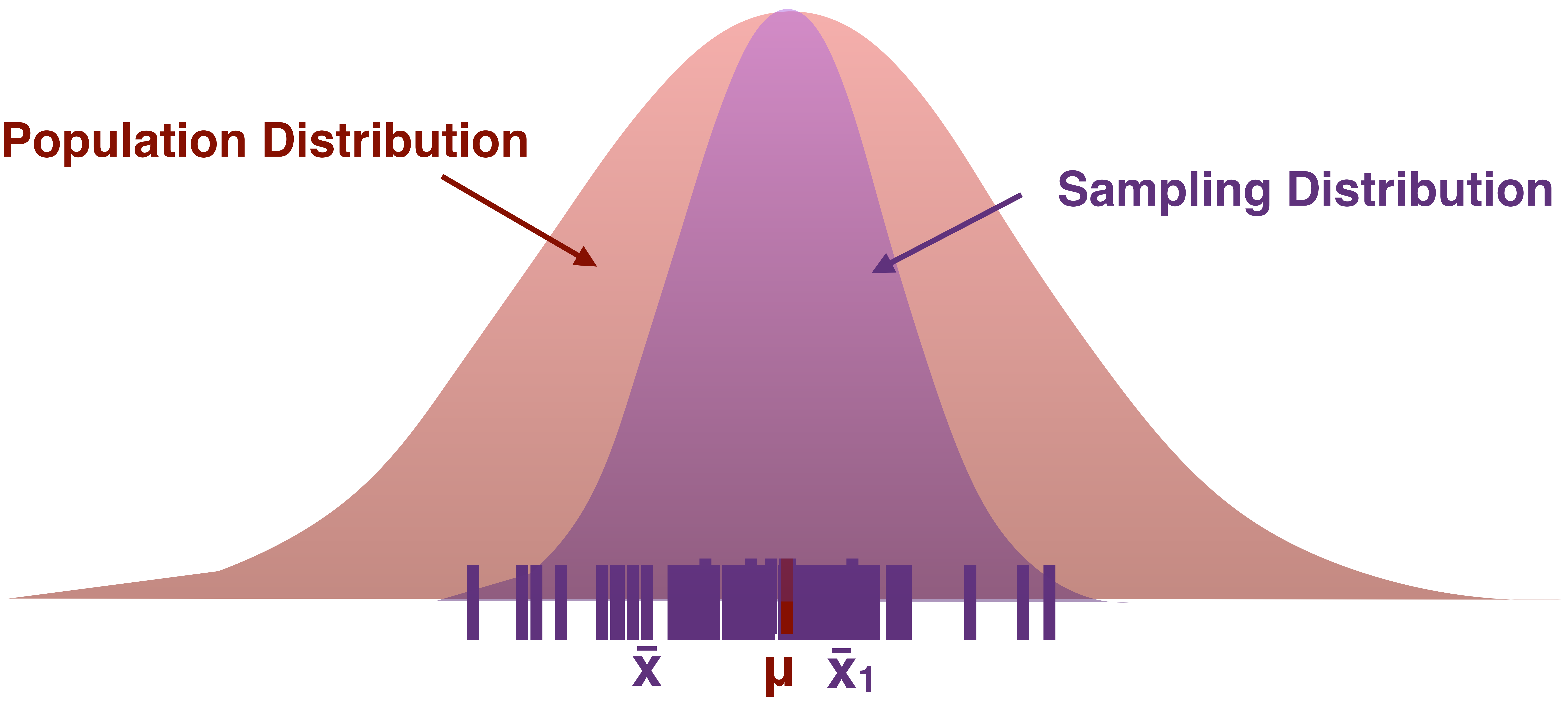
Sampling error of the mean = $\bar{x}$ - μ

Sampling error of the std dev = s - σ

Sampling Error



Sampling Error

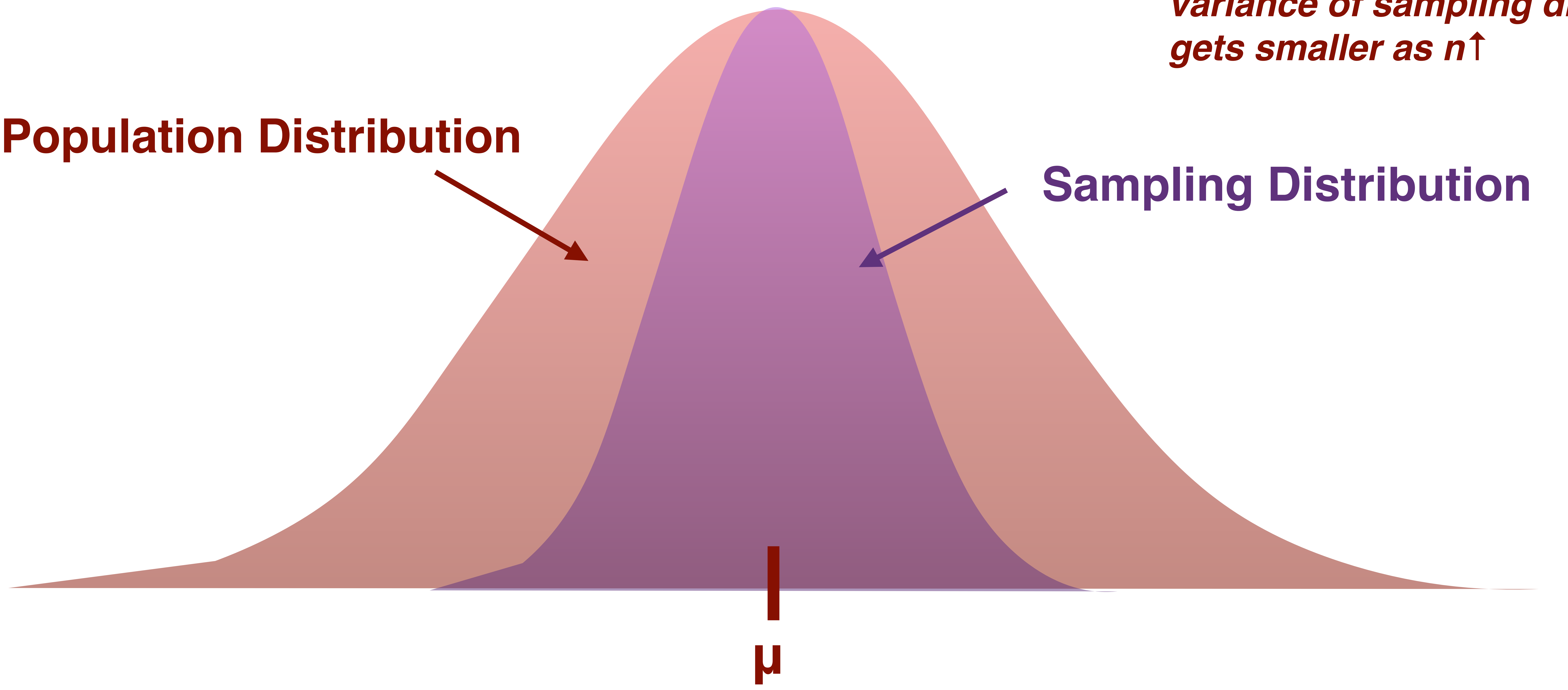


Central Limit Theorem

"For simple random samples of size n from a population with mean μ and variance σ^2, the sampling distribution of the sample mean approaches a normal distribution with mean μ and variance σ^2/n."

variance of sampling distribution gets smaller as n↑

As Sample size n ⬆



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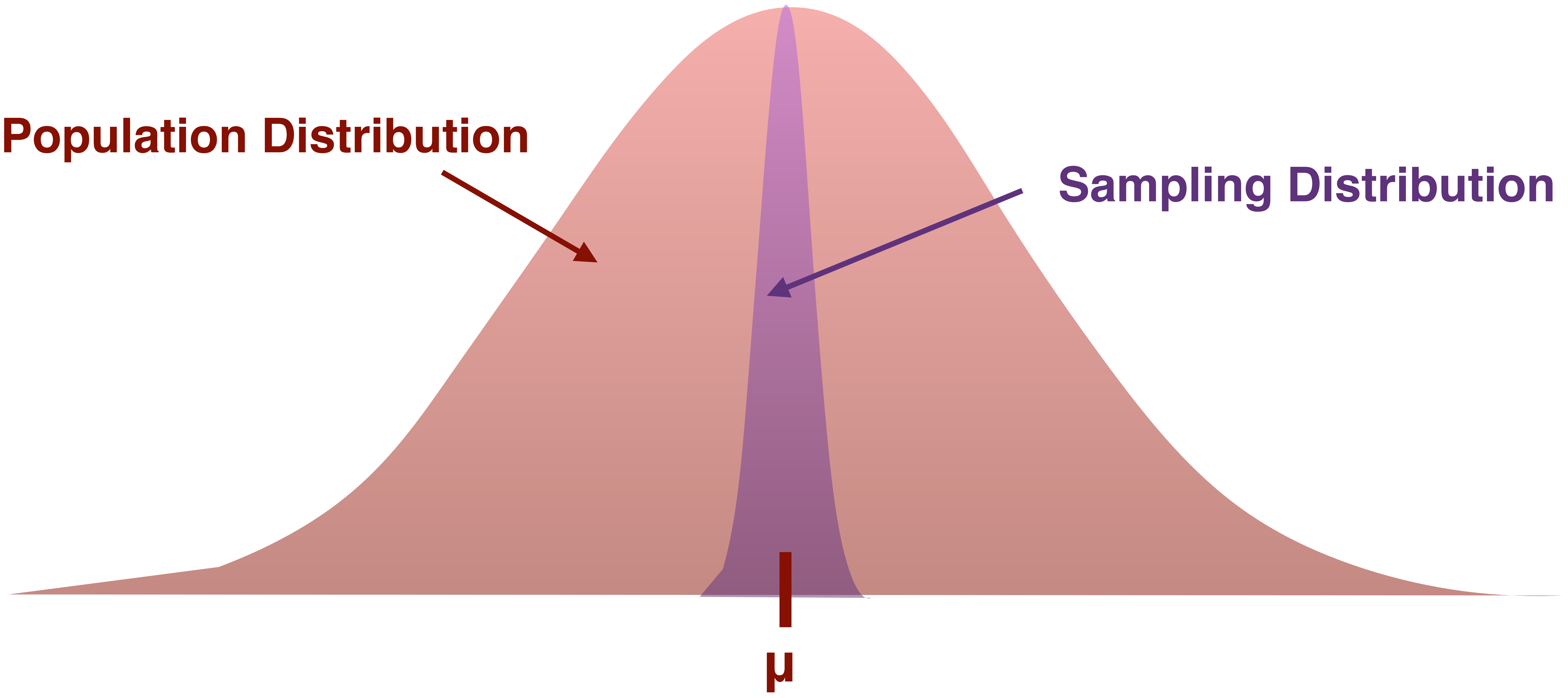

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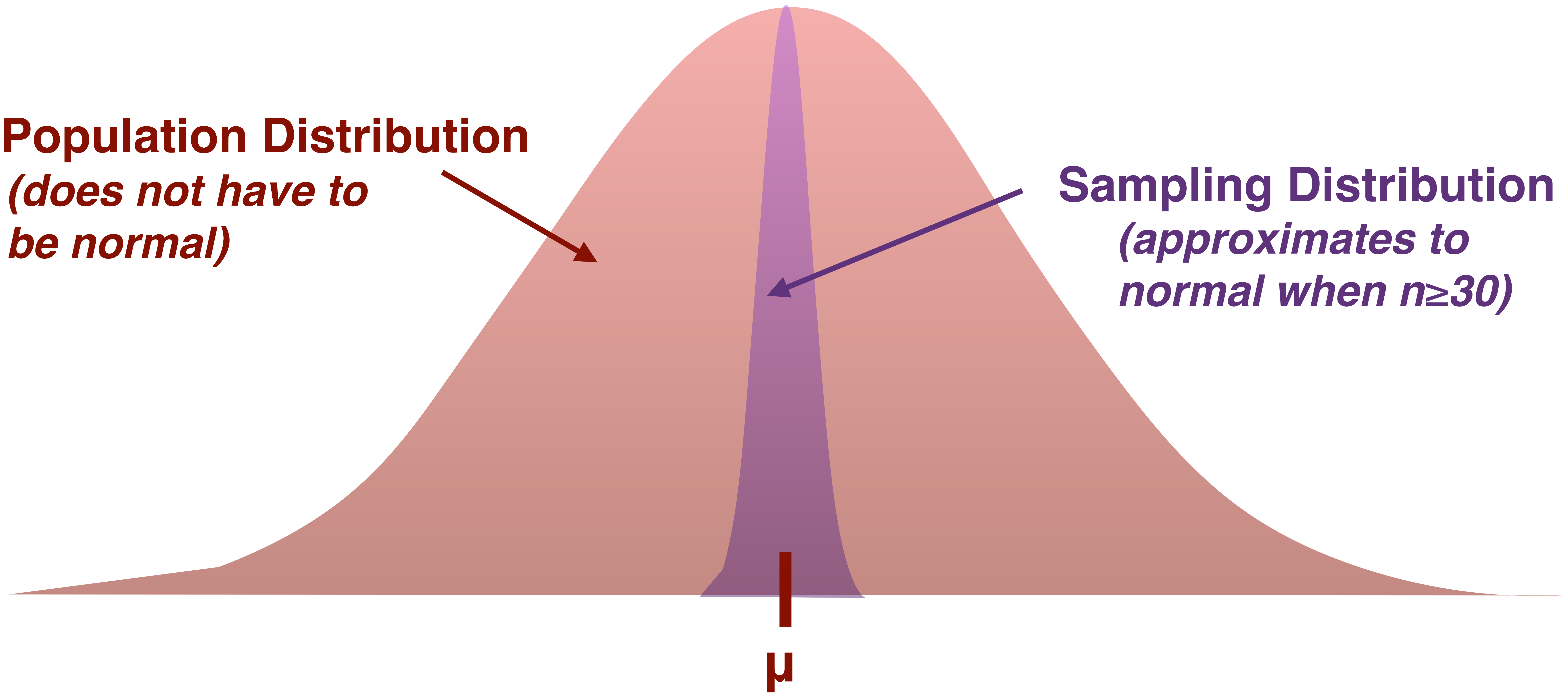


The average daily return of a stock is 0.18% and the standard deviation of returns is 0.95%. An analyst, who does not know these parameters, picked a sample of 30 random observations to analyse. What is the mean and standard deviation of the sample distribution?

According to Central Limit Theorem,

$$\text{mean of } \bar{X} = \mu_x$$

$$= 0.18\%$$

$$\sigma_{\bar{X}} = \sigma_x/\sqrt{n}$$

$$= 0.95/\sqrt{30}$$

$$= 0.17\%$$

The analyst picked another stock and collated 100 random samples of its daily returns. He found that the sample mean is 0.23% and the sample standard deviation is 1.19%. Calculate and interpret the mean and standard deviation of the sample distribution.

When population parameters are unknown, we may use the sample statistics to estimate it.

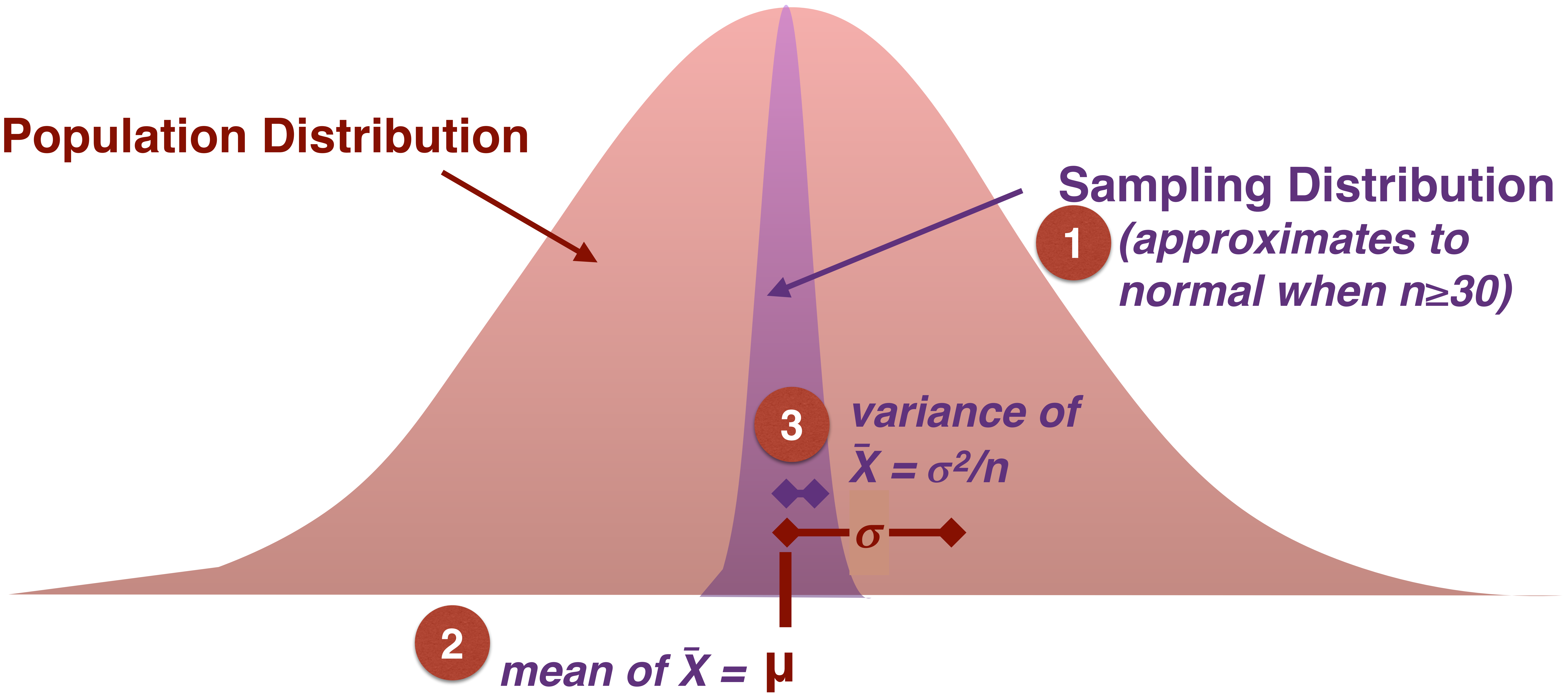
$$\text{mean of } \bar{X} = \bar{X}$$
$$= 0.23\%$$

$$s_{\bar{X}} = s/\sqrt{n}$$
$$= 1.19/\sqrt{100}$$
$$= 0.12\%$$

This implies that if we took all possible combinations of samples of size 100 from the population, the mean of the sample returns would be 0.23% and the standard deviation of the sample returns will be 0.12%.

Central Limit Theorem

"For simple random samples of size n from a population with mean μ and variance σ^2, the sampling distribution of the sample mean approaches a normal distribution with mean μ and variance σ^2/n."



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