Topic 4 Sampling Distributions

Tutorial agenda:

1. go through key concepts
2. tutorial questions
3. Q&A

Key concept
T7 L4

Sampling Distribution Properties

Mean of sample means

$$\mu_{\bar{X}} = \mu$$

s.d. of sample means = standard error of the mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

- $\sigma > \sigma_{\bar{X}}$
- As $n \uparrow$, $\sigma_{\bar{X}} \downarrow$

Sampling from Normal Populations

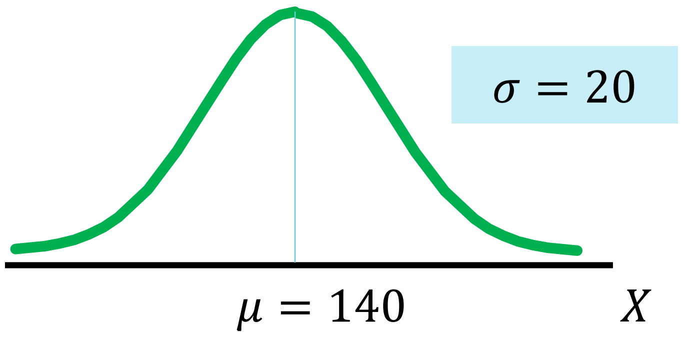
From a normally distributed population $X \sim N(\mu, \sigma^2)$

the sample means also follow normal distribution $\bar{X} \sim N(\mu_{\bar{X}}, (\sigma_{\bar{X}})^2)$

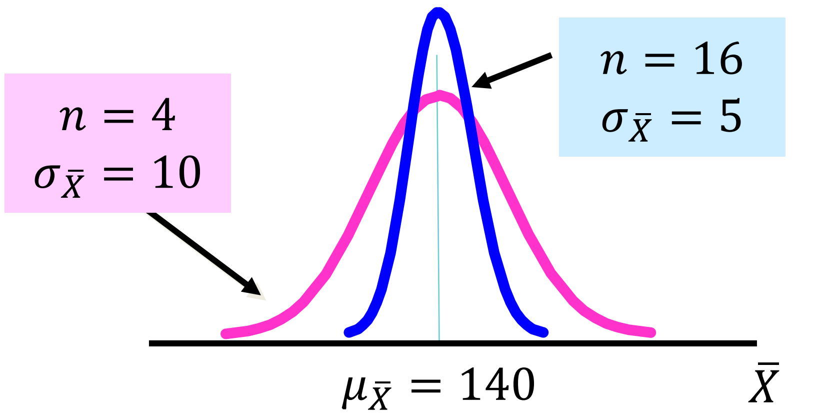
$\mu_{\bar{X}} = \mu$ and $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$

$$\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$$

Population Distribution

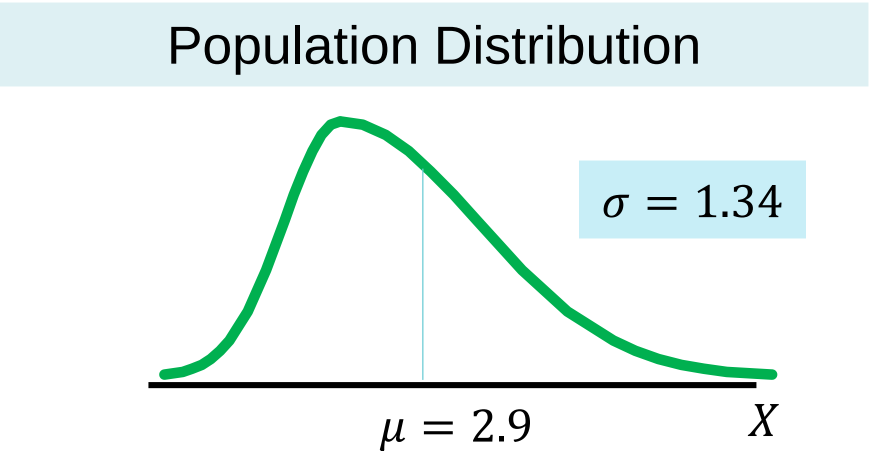


Sample Mean Distributions



Sampling from Non-Normal Populations

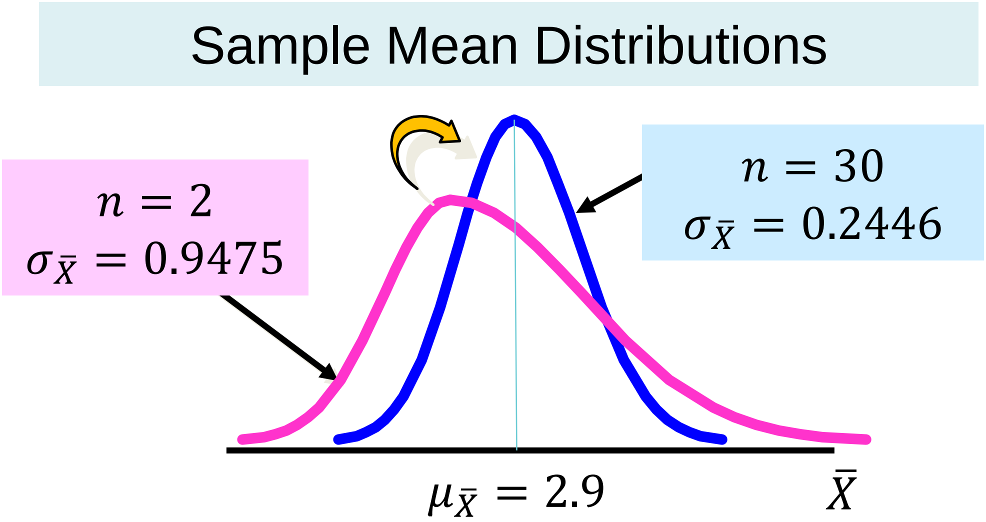
From a not normally distributed population,
still $\mu_{\bar{X}} = \mu$ and $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$,
the distribution of $\bar{X}$ will vary from sample sizes



Central Limit Theorem

$n \geq 30$

As sample size gets large enough, sample mean distribution becomes NORMAL regardless of population distribution



Summary of Sampling Distribution

Distribution	$n < 30$	$n \geq 30$
Normal	$\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$	$\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$
Non-normal	Since the population is non-Normal, and the sample size is small, we are unable to tell the distribution of sample mean, and the corresponding probability	The population distribution is non-normal, but the sample size is large (n≥30). We can conclude that $\bar{X} \sim N(140, (\frac{20}{\sqrt{30}})^2)$ according to the Central Limit Theorem. $\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$

$X \sim N(\mu, \sigma^2) \rightarrow \bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right) \rightarrow Z \sim N(0, 1^2) \rightarrow$ Probability

Step 1: always change to ≤ first

Step 2: use formula to standardize

$$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

Step 3: calculate Z

Step 4: find probability in Z table

Calculator

- Casio fx-50F
- Casio fx-82ES plus

(Your best friend: google
& maybe me???)

Date Set:

163.6 156.2 166.3 179.3 157.8 165.4 159.5 161.7 160.4

1. Change to "Lin" mode

   MODE MODE 5 1

2. Clear previous data

   SHIFT CLR 1 EXE

3. Input data

163.6	M+	156.2	M+	166.3	M+	179.3	M+
157.8	M+	165.4	M+	159.5	M+	161.7	M+
160.4	M+						

4. Calculate descriptive statistics

Mean:	SHIFT	2 1 1	EXE	= 163.3555556
Population standard deviation:	SHIFT	2 1 2	EXE	= 6.459637417
Sample standard deviation:	SHIFT	2 1 3	EXE	= 6.851480132
No. of Data Input:	SHIFT	1 3	EXE	= 9