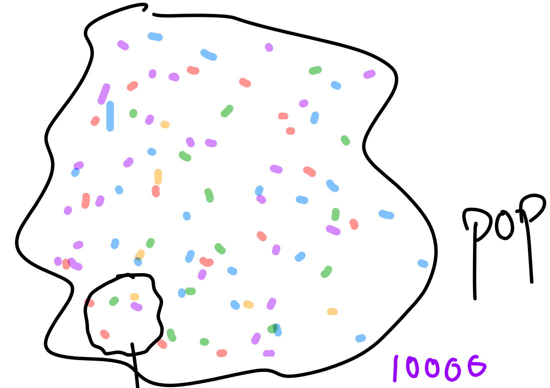
CENTRAL LIMIT THEOREM

1. CLT → Central limit Theorem
2. Confidence Interval.

Central Limit Theorem

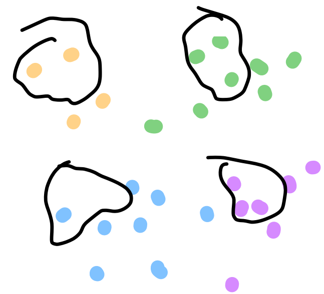
* Sampling Techniques

1. Random sampling
2. Systematic sampling
3. Cluster Sampling → Stratified Sampling



Sample

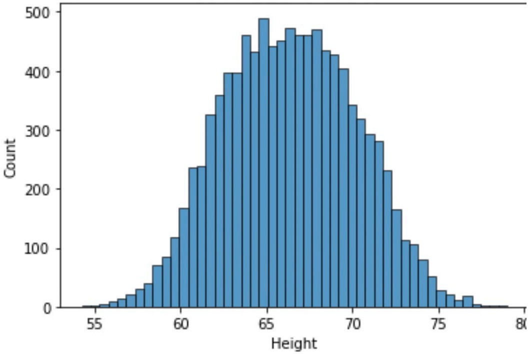
Inference about pop from the samples.

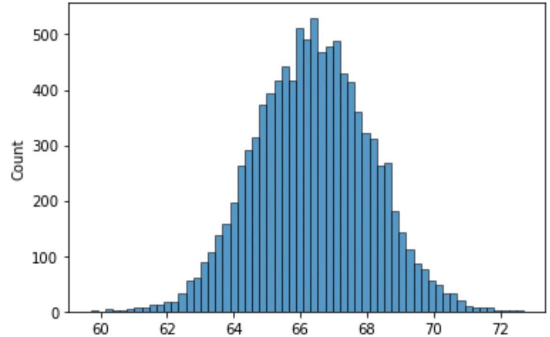


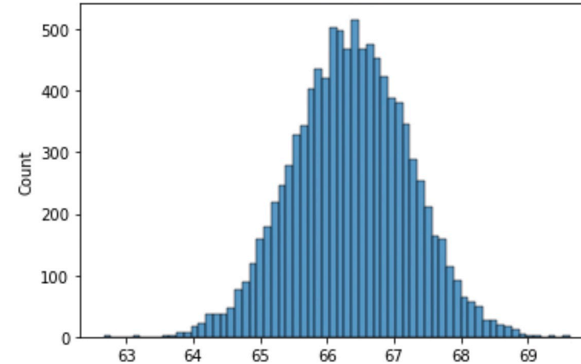
200 people

100 shares

1 2 3 4 5 . . . 200







Original

$\mu = 66.3675$

$\sigma_p = 3.8475$

Sample size = 5

$\mu = 66.375$

$\sigma_5 = 1.729$

Sample size = 20

$\mu = 66.36$

$\sigma_{20} = 0.8650$

$X \rightarrow$ Random Variable $\rightarrow \bar{X}$

Central Limit Theorem

If "n" denotes the sample size

& σ denotes the population std

$\left\{ \begin{array}{l} n=5 \\ n=10 \\ n=25 \\ \vdots \end{array} \right\}$

the Std of the sampling distⁿ of means

distⁿ of sample mean

$$\boxed{\delta = \left(\frac{\sigma}{\sqrt{n}} \right)}$$

AKA "Standard Error"

$\boxed{n > 30}$

$$\bar{X} = \frac{(X_1 + X_2 + X_3 + X_4 + X_5 \dots X_n)}{n}$$

$\bar{X}$ is a RV

denote my sample means also RV

$\bar{X}$ follow Gaussian Distribution

Normal $D b^n$

with

- Mean/Expected value $E[\bar{X}] = \mu$
- (Std dev^n of $\bar{X} = \frac{\sigma}{\sqrt{n}}$)

$\bar{X} \sim N\left(\mu, \sigma/\sqrt{n}\right)$

* If our original pop^n is normally distributed.

n doesn't matter

$n = 1 \quad \bar{X} \sim N$

$n = 2 \quad \bar{X} \sim N$

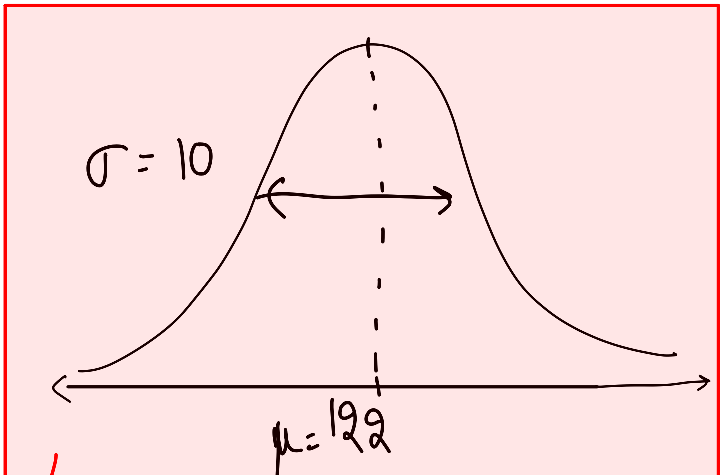
$n = 30 \quad \bar{X} \sim N$

* If our Original is not normally distributed or unknown

$n > 30 \qquad \bar{X} \sim N$

Systolic blood pressure of a group of people is known to have an average of 122 mmHg and a standard deviation of 10 mmHg

Calculate the probability that the average blood pressure of 16 people will be greater than 125 mmHg.



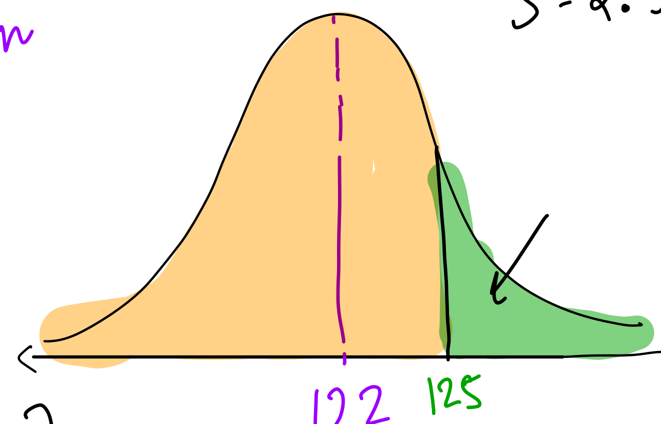
Pop^n

$n = 16$

$\bar{X} \sim N\left(\mu, \frac{\sigma}{\sqrt{n}}\right) \Rightarrow \bar{X} \sim N\left(122, \frac{10}{\sqrt{16}}\right)$

Sample mean

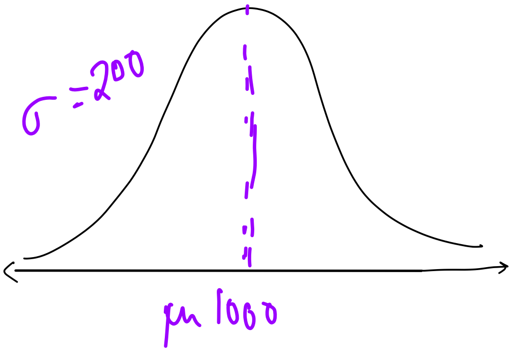
$S = 2.5$



$$Z = \frac{125 - 122}{2.5} = 1.2$$

$$P[\bar{X} > 125] = 0.115$$

Weekly toothpaste sales have a mean 1000 and std dev 200. What is the probability that the average weekly sales next month is more than 1110?



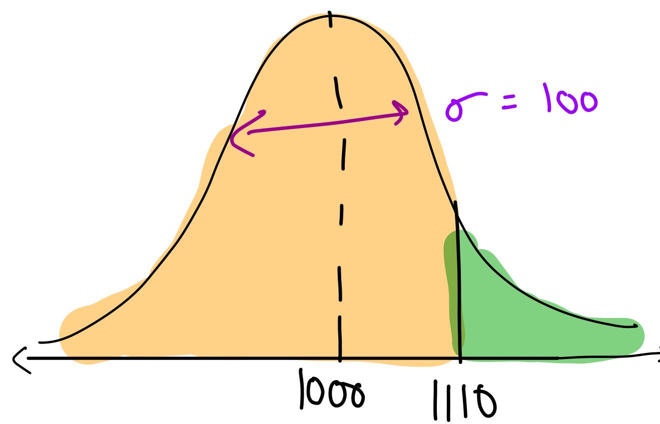
$$\bar{X} = \frac{X_1 + X_2 + X_3 + X_4}{4}$$

$n = 4$

$$\bar{X} \sim N\left(1000, \frac{200}{\sqrt{4}}\right)$$

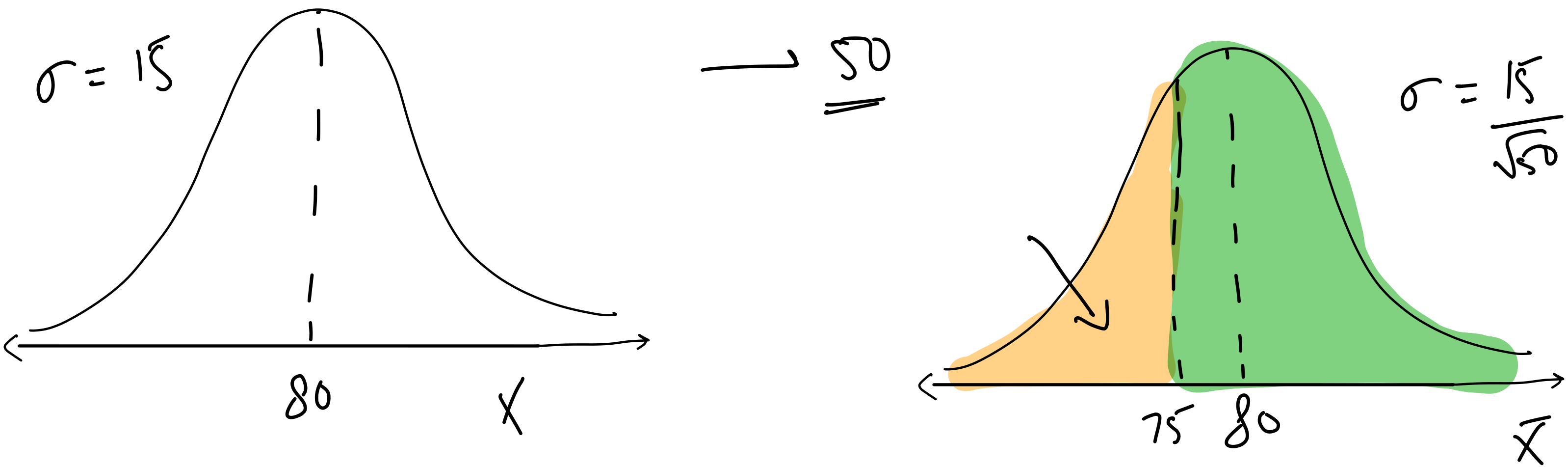
38 users have participated

A	0.29	29%
B	0.13	55%
C	0.11	16%
D	0.08	0%



$$\boxed{0.1366}$$

In an e-commerce website, the average purchase amount per customer is \$80 with a standard deviation of \$15. If we randomly select a sample of 50 customers, what is the probability that the average purchase amount in the sample will be less than \$75?



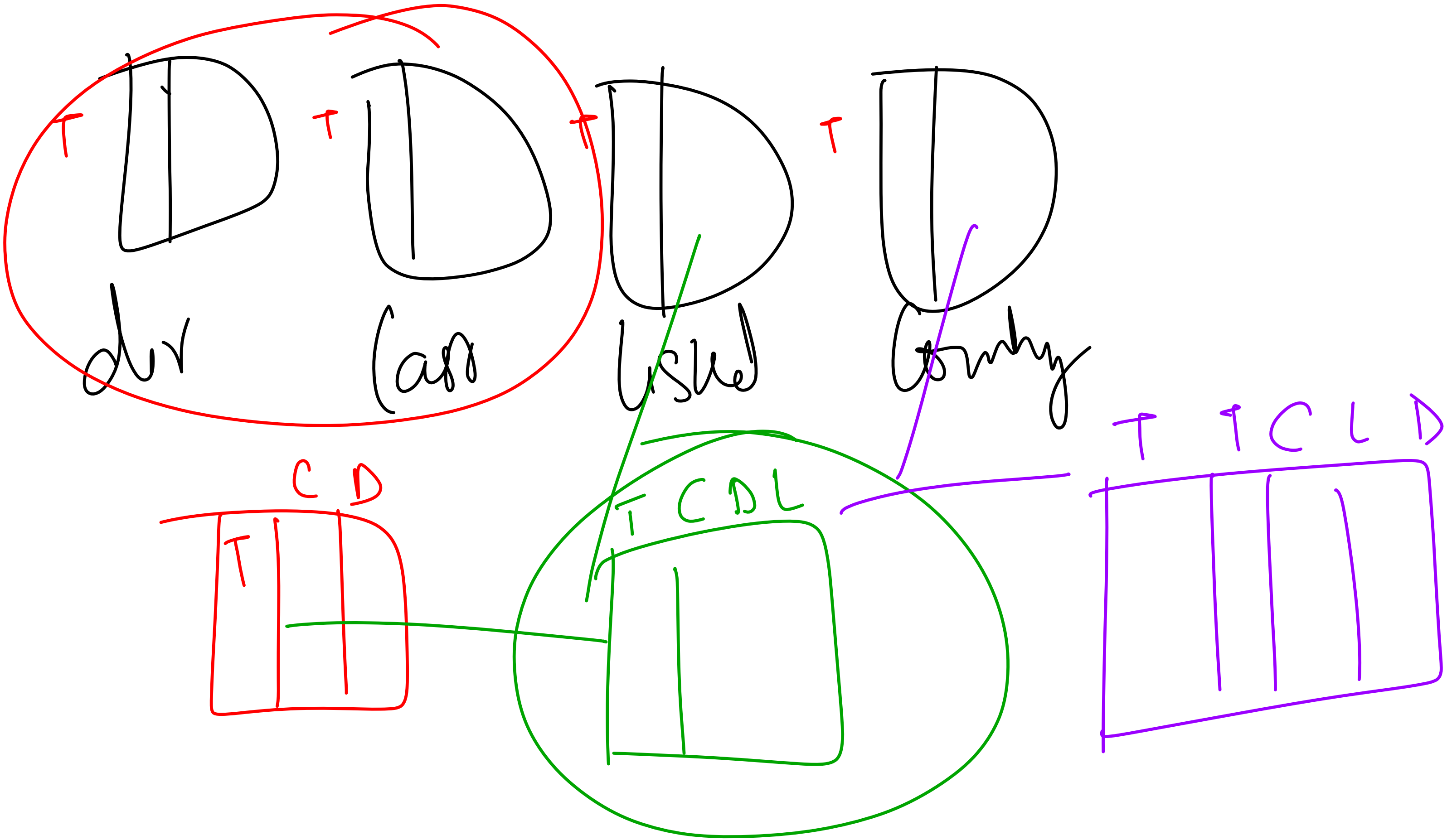
$$\text{norm.cdf}\left(\left(75-80\right)/\left(15/\sqrt{50}\right)\right)$$

$$\begin{array}{llll} & \nearrow & T & 2/3 \\ A & & & \\ & \searrow & F & 1/3 \end{array}$$

$$\begin{array}{llll} & \nearrow & T & 4/5 \\ B & & & \\ & \searrow & F & 1/5 \end{array}$$

1. $\underset{T}{\frac{2}{3}} \times \underset{T}{\frac{4}{5}} + \underset{F}{\frac{1}{3}} \times \underset{F}{\frac{1}{5}}$

2. $\frac{2}{3} \times \frac{1}{5} + \frac{1}{3} \times \frac{4}{5}$



T
C D
T C D L
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