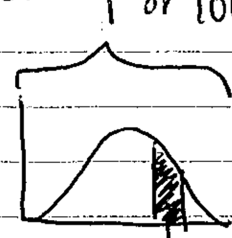
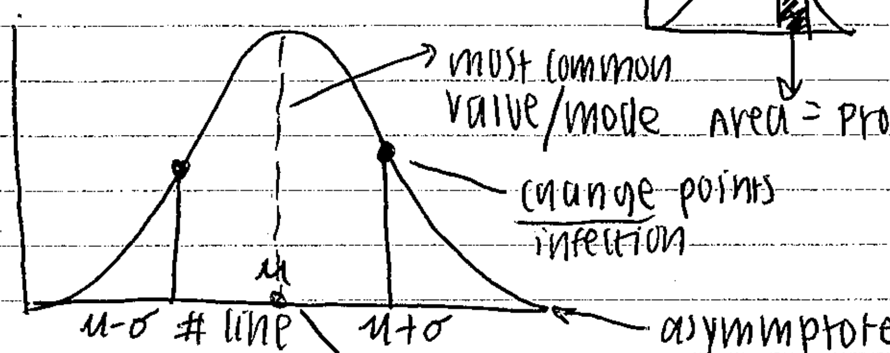
CONTINUOUS VARIABLES AND CURVES 1/12/24

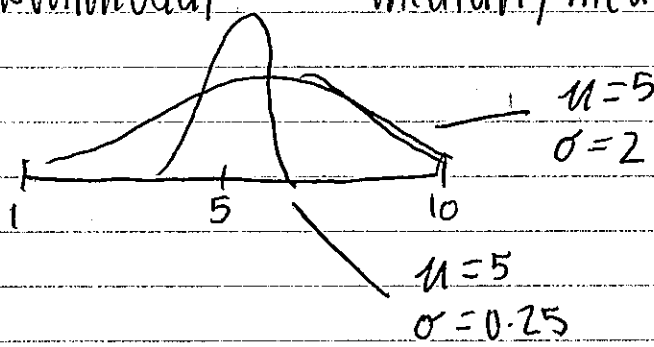


Area = Probability = Percent

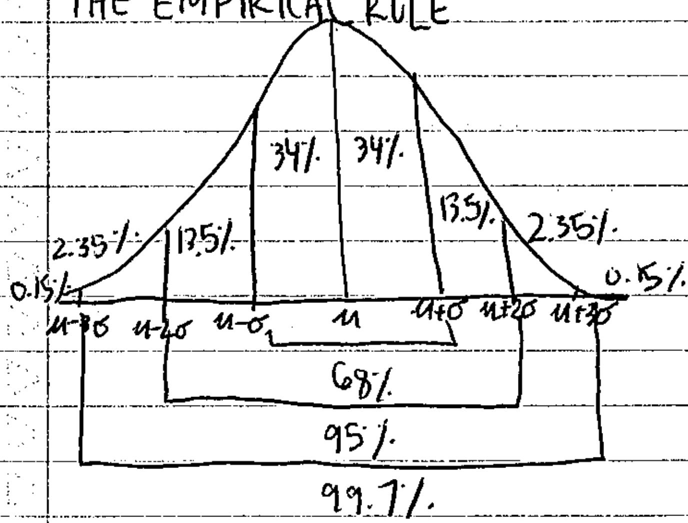
continuous curves
- density curves, bell curves



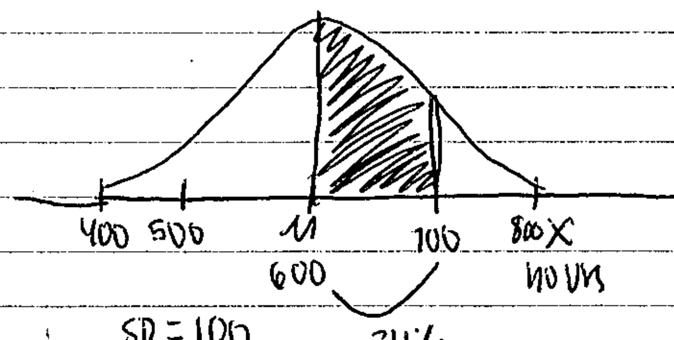
*unimodal



THE EMPIRICAL RULE



SUNSHINE RADIO EXAMPLE:



SD = 100

mean = 600

$P(600 < x < 700) = 0.34$

∃x a 34% chance that SR lasts 600-700 hours

< and ≤ makes NO DIFFERENCE

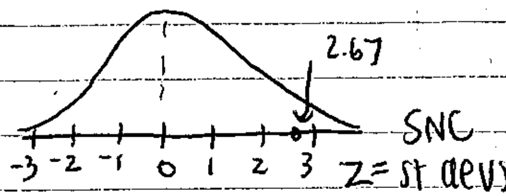
Z SCORES AND Z CURVES 1/17/24

BIO

$\mu = 70$ $\quad Z = \frac{X-\mu}{\sigma}$

$X = 74$

$\sigma = 1.5$ $\quad Z_{bio} = \frac{74-70}{1.5} = 2.67$

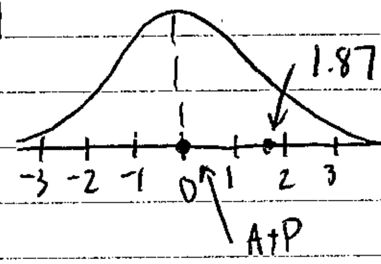


HIST.

$\mu = 86$ $\quad Z_{hist} = \frac{91-86}{2.67} = 1.87$

$X = 91$

$\sigma = 2.67$

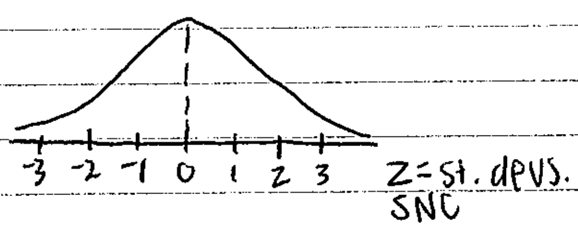


ANAT + PHIS

EX: ~~PIZZA PROBLEM~~ #9: FIRST AID COURSE

Robert: 1.10 Juan: 1.70 Susan: -2.00

Joel: 0.00 Jan: -0.80 Linda: 1.60



a: above mean ~ Robert, Juan, Linda

b. on the mean ~ Joel

d. $\mu = 150$ $\sigma = 20$

$Z = \frac{X-\mu}{\sigma}$

Robert:

$1.1 = \frac{X-150}{20}$

$22 = X - 150$

$\boxed{172 = X}$

Susan:

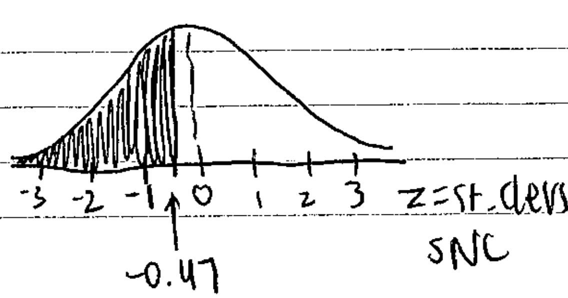
$-2 = \frac{X-150}{20}$

$-40 = X - 150$

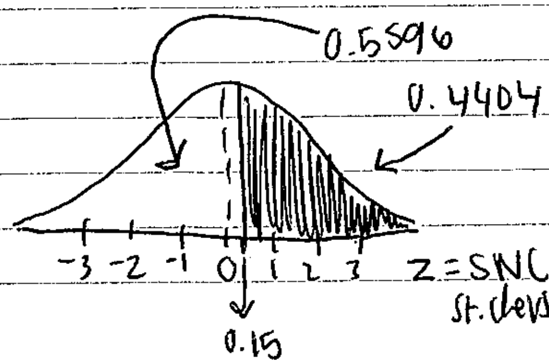
$\boxed{X = 110}$

HW

16. 0.3192



20.

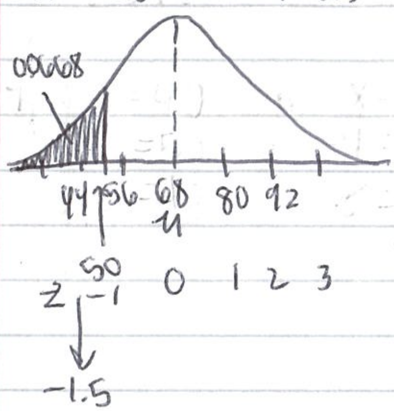


REVIEW:

Pacific Yellowfin Tuna

$\mu = 68 \quad \sigma = 12 \text{ lbs}$

$$z = \frac{x-\mu}{\sigma}$$

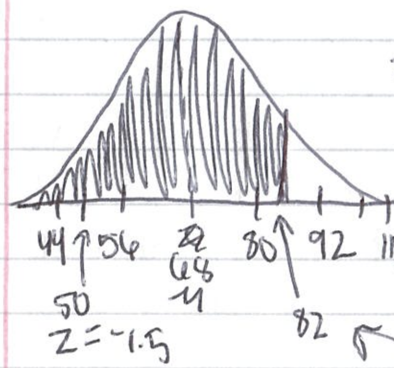


$P(x < 50) = 0.0668 \quad = \frac{50-68}{12} = -1.5$

∃x a 6.68% chance that a PYT caught is less than 50 lbs

$x = \text{lbs}$

$z = \text{st. devs}$



$z = 1.167$

$$\frac{82-68}{12} = 1.167$$

$P(50 < x < 82) = 0.8122$

0.0668 0.8790

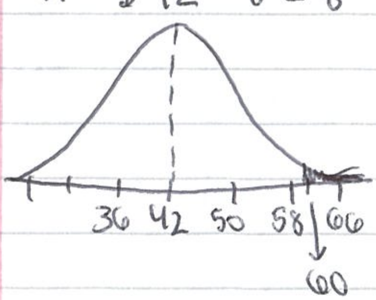
0.8790 − 0.0668

∃x a 81.22% that a PYT caught is b/w 50 and 82 lbs

CALC WAY:
2nd → vars
2: normalcdf(

Flight for Life

$\mu = 42 \quad \sigma = 8$ longer than 60



$P(x > 60) = 0.0122$

∃x a 01.22% chance that a flight for life helicopter with take more than 60 min to respond

x = min

COLLEGE BOARD VIDEO NOTES 1/20/2024

4.2 ESTIMATING PROBABILITES USING SIMULATION

Law of Large Numbers - simulated probabilities seem to get closer to the true probability as the # of trials increases
↳ variability from true probability also decreases

CONDUCTING A SIMULATION
Random # generator
- describe how the digits imitate the trial
- ~~recor~~ determine what is recorded from each trial
- perform many trials
- calculate relative frequency of successful trials

⟶ Example: sharpshooter
#1-82 = made OR #01-82 = made
#83-100 = missed OR #83-99,00 = missed

4.9 COMBINING RANDOM VARIABLES

~~PROBABILITY DISTRIBUTION~~ mm didn't take away ne thing

4.9 pt 2. mm doesn't make sense

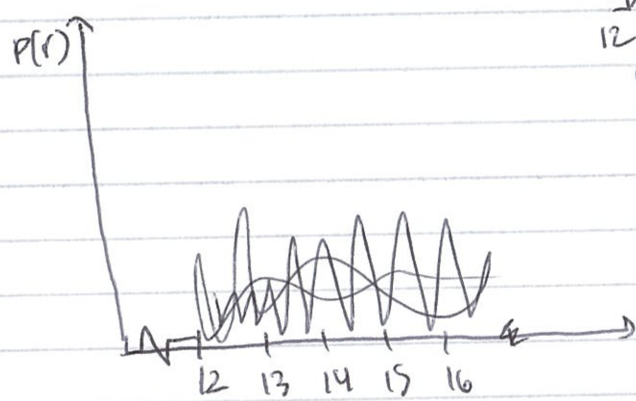
Binomial:

- n = trials $\qquad \mu = np$
- S/F $\qquad \sigma = \sqrt{npq}$
- independent
- probability is given $p=$ $q=$
- $\frac{r \text{ successes}}{n \text{ trials}}$

#9 drug dealers

$P(X \geq 12) = 0.028 + 0.009 + 0.002 = 0.039$

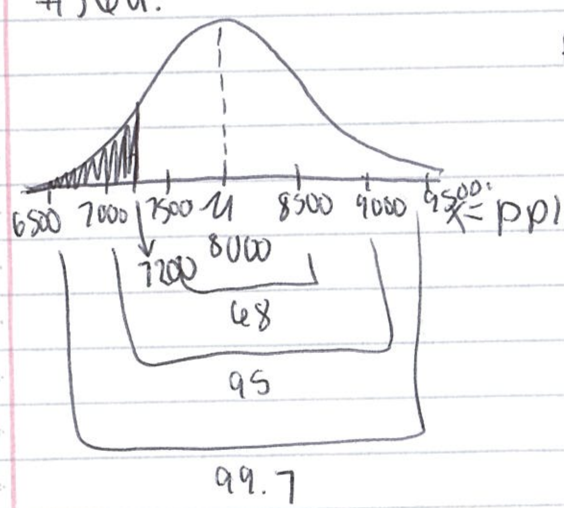
∃x a 3.9% chance that 12/16 or mo...



binomcdf

$\left.\begin{array}{l} \text{trials: } 16 \\ p = 0.5 \\ x = 11 \end{array}\right\}$ 1− = ☺

#36a.



$P(X < 7200) = 0.0548$

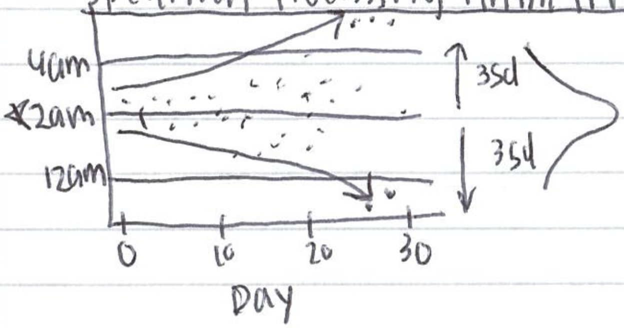
normalcdf

∃x a 5.48%...

Against All Odds Notes 1/25

- W. Edward Deming ~ statistical ~~product~~ ~~proces~~ process control SPC
  - "Japanese Miracle"
- process ~ chain of steps that turns inputs into outputs
- control charts used to monitor control
- ~~variation~~ common cause variation ~ normal human errors
- special cause variation ~ sudden and unexpected

Specimen Processing Finish Time - Month 1



- more inconsistent
- less reliable

- points out of the barriers is out of control

Decision Rules
1. one point out of control
2. 2 of 3 points b/w 2 and 3sd's on the same side of mean
3. 4 of 5 points on same side of mean
4. 8 in a row on the same side of mean
   ↳ book says 9

- random variable x in statistical control

PROCEDURE:
1. find μ and σ of x distribution
2. create graph vertical axis = x horizontal = time
3. control limits $\mu \pm 2\sigma$ and $\mu \pm 3\sigma$
4. Plot

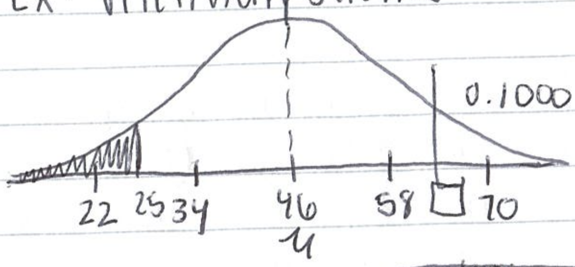
Warning signals:
1. Beyond 3σ
2. 9 consecutive all below / above center μ
3. at least 2 of 3 consecutive points beyond 2σ

7.3 NORMAL? 1/25/2024

EX: Veterinary Science $\mu = 46$ beats/min 95% data 22–70

$\sigma = 12$

$70 - 22 = \frac{48}{4}$



b. $P(X < 25) = \boxed{0.0\cancel{397}\ 399}$ (400) normcdf(1, 25, 46, 12)

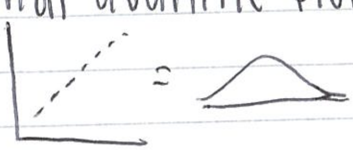
e. upper 10% invNorm(0.1, 46, 12) = $\boxed{61.38 \text{ bpm}}$

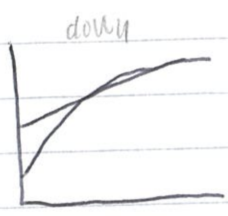
CHECKS FOR NORMALCY:

1. Histogram ~ roughly bell shaped
2. Outliers
   - no more than 1
   - box-and-whisker to check
   - $\frac{\text{above}}{\text{below}}$ $Q_{3/1}$ by an amt greater than 1.5 × IQR
3. Skewness ~ normal are symmetric

   Pearson's index $= \frac{3(\bar{x} - \text{median})}{sd}$ $-1 \leq PI \leq 1$ = normal

4. Normal quantile plot (Nprobability P)

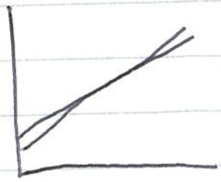




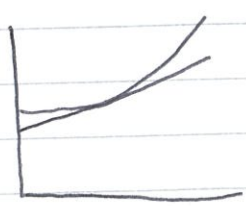
not normal
skewed left

CALC:

2nd y= stat plot



normal



not normal
skewed right

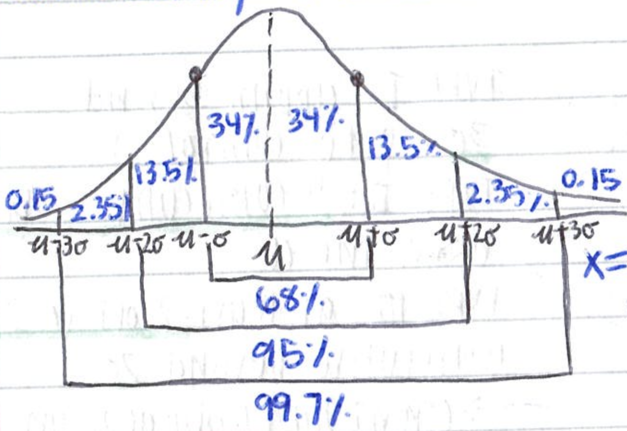
thick tails

UNIT 7:

(CHAPTER 6):

NORMAL CURVE: Empirical Rule, Z scores, area = prob

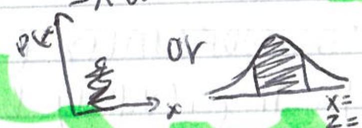
CONTINUOUS / NORMAL CURVE:



- bell-shaped, unimodal
- symmetric over μ (mean, med., mode)
- never touches line ~ asymptote
- inflection points

X = ☆ need!

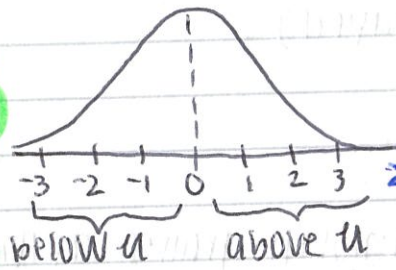
4 THINGS:
- notation
- answer
- ∃x a....



< and ≤ same

Z-SCORES:

$$Z = \frac{x-\mu}{\sigma}$$



SNC

z = st. devs. ☆

→ ZE TABLE (table 5)

area left = −

area right = +

→ CALC WAY

2nd → vars

2: normalcdf

↑ cumulative

lower/ ~~high~~ upper = $4\sigma \pm \mu$

INVERSE NORMAL:

% is given

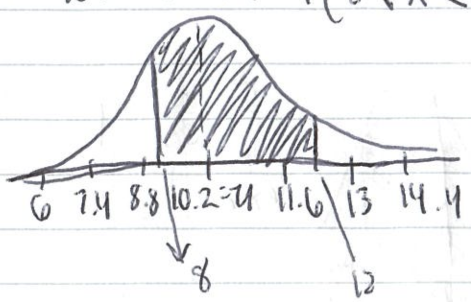
2nd → vars

3: invNorm(% as decimal, $\mu=0$, $\sigma=1$, tail: CENTER)

REVIEW

CHILDREN'S FISHING POND SNC

$\mu = 10.2''$ $\sigma = 1.4''$ $P(8 < x < 12) = 0.8426$



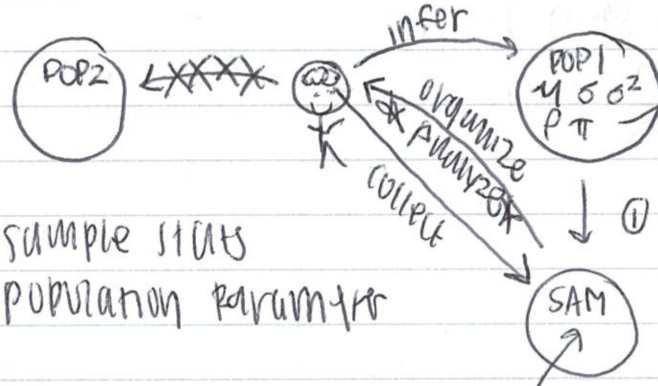
∃x an 84.27% chance that $\boxed{\text{a random fish}}$ caught at children's fishing pond is between 8" and 12"

x = ~~[illegible]~~ inches

6.4

population = all measurements of interest

sample = a subset of the measurements from the pop



$y = \alpha + \beta x$

⓪ List

Estimation

confidence intervals

① simple random sample

→ simple random

→ ~~experiment~~

→ systematic

→ cluster

→ stratified

Decision

hypothesis testing

sample stats

population parameter

$\bar{x}, s, s^2, r^2,$

$y = a + bx,$

$\hat{p} = \frac{r}{n}$

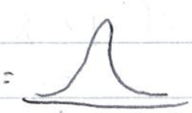
~~[illegible]~~ ORIG x DISTR

Theorem 6.1

$\frac{\sigma}{\sqrt{n}}$ = standard error

Theorem 6.2

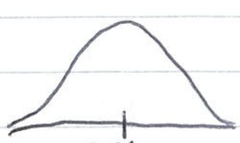
$\bar{x} =$



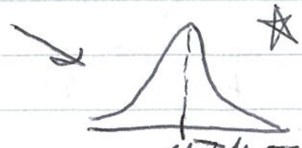
narrower σ shrinks when avg sinks

$\sigma_{\bar{x}} = \frac{1.4}{\sqrt{5}} = 0.6261$

NORMAL



NOT NORMAL



★ n = BIG ≥ 30

same $<$ μ, $\mu_{\bar{x}}$

diff $<$ σ, $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

$\bar{x}$ = avg of 5 ∝

$\mu_{\bar{x}} \approx \mu$ $\sigma_{\bar{x}}$

$\bar{x}$ = avg

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

★ n $<$ lil, big

★ has to start out normal

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

50 PENNIES AGES 1/31/24

P #	BYr	Age
1	2014	~~9~~10
2	2023	~~0~~1
3	2021	~~2~~3
4	2010	1~~3~~4
5	2003	2~~0~~1
6	1968	5~~8~~6
7	1999	2~~4~~5
8	1998	2~~8~~6
9	1984	40
10	2022	2
11	2019	5
12	2003	21
13	1981	43
14	1964	60
15	2005	19
16	1998	26
17	1981	43
18	1998	26
19	1981	43
20	1983	41
21	1996	28
22	2001	23
23	2014	10
24	2019	5
25	2001	24

Math → prob randInt mean: 24.1 ≈ 24

lower: 1

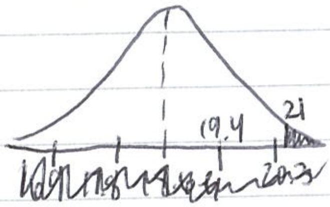
upper: 25

n: 10

6.5 Central Limit Theorem

ACT PROBLEM $\mu = 18.6$ $\sigma = 5.9$

$P(X \geq 21) = 0.3405$

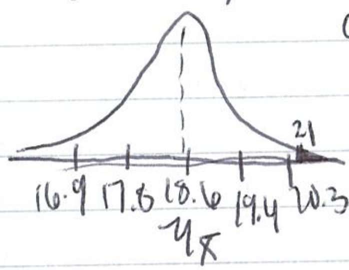


Micek did it

X = ACT score

$P(\bar{X} \geq 21) = 0.0020$ $n = 50 > 30$ $\therefore$ CLT invoked

$\sigma_{\bar{x}} = 5.9/\sqrt{50} = 0.8344$ → avg score on ACT

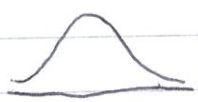


∃x a 0.2% chance that a random group of 50 students is more than 21 ~~[illegible]~~

$\bar{X}$ = avg ACT score for 50 students

1,000 bets $\mu = -0.0530$

$\sigma = 0.998$



100,000 bets $\mu = -0.0530$

$\sigma = 0.03$

CENTRAL LIMIT THEOREM

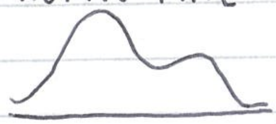
ORIGINAL x DISTRIBUTION

NORMAL

*has to start normal; can work with big/small n's

NOT NORMAL

doesn't matter



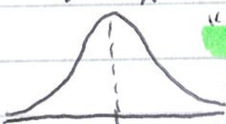
$\mu = \mu_{\bar{x}}$

$\sigma \neq \sigma_{\bar{x}}$

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

"standard error"

* n = BIG ≥ 30
∴ CLT is invoked



← $\bar{x}$ is narrower/tighter

→ CALC WAY ~ 2nd → vars

normalcdf(_ , _ , $\sigma/\sqrt{n}$)

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

6.6 Normal Appx to Binomial 2/6/24 (snart+svbash)

vaccine ~ binomial $p = 0.85$ 300 ppl proportion/percents

Normal approximation

n = trials → higher n = closer to normal distribution

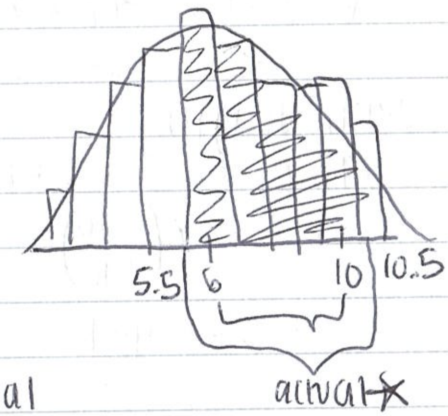
r = successes $np > 5$ } 10 for AP exam

p = success $nq > 5$

$q = 1 - p$ failure

continuity correction — turning r into x

- left point $x = r - 0.5$
- right point $x = r + 0.5$



EXAMPLE: $n = 40$ trial $p = 0.50$ ∴ a normal approximation is justified

$np = (40)(0.5) = 20 > 5$ ✓

$nq = (40)(0.5) = 20 > 5$

ANAIJ

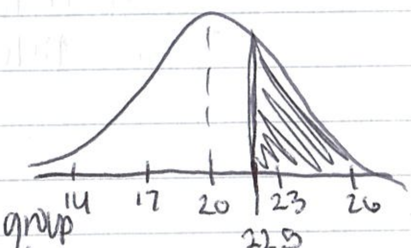
still have to check

$\mu = np \rightarrow \boxed{20}$

$\sigma = \sqrt{npq} \rightarrow \boxed{3.16}$

CALC:
2: normalcdf

$r \geq 23 = x > 22.5$ $P(x > 22.5) = 0.2146$



$\hat{p}$ = group of %s

EXAMPLE: $n = 25$ 5 years 10 years 0.25

$P(x \geq 7.5) = 0.2819$

$\hat{p} = r/n$ $\mu_{\hat{p}} = p$ and $\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}}$