

★ minitab may help w/ Mw from now on ☺

sum of normal
dist. variables =
normal dist.

$$\sigma_T = \sqrt{\sigma_{x_1}^2 + \sigma_{x_2}^2 + \sigma_{x_3}^2}$$



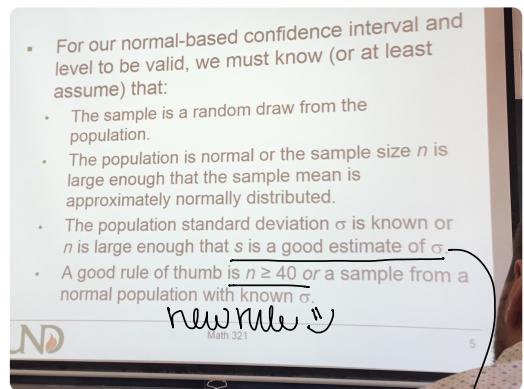
Hypothesis Testing

One-Sample Z-Test

One-Sample Z-Tests (8.1-8.2)

- Example: (Milk data) Suppose our bottle-filling machine is supposed to dispense 2.04 L of milk. Recall, a sample of size 50 gave $\bar{X} = 2.0727$, $s = 0.0711$. Does the machine need to be recalibrated?

extra makes up for any lack just in case



pop.
SD

may be too much
pop mean > 2.04?
recalibrate or just normal sampling var?

- * assume machine works properly
 → null hyp - nothing is off ←
 → alt. hyp - $\mu \neq 2.04$, negation of null

$$z = \frac{\bar{X} - \mu_0}{s/\sqrt{n}} \quad z \text{ STAT EQUATION}$$

$$z = ??? \quad \dots$$

$$H_0 : \mu = 2.04$$

$$H_a : \mu \neq 2.04$$

$$\text{Sample : } 2.0727 \quad (\bar{x})$$

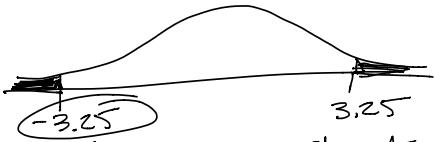
$$s = 0.0711$$

$$n = 50$$

$$\frac{2.0727 - 2.04}{0.071/\sqrt{50}} = \boxed{3.25}$$

if H_0 true, $\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$ + $z \sim N(0, 1)$
Cut off point?

$$P(|z| \geq 3.25)$$



look up chart
 $\Phi(-3.25) = 0.0006$
 total = 0.0012

$\therefore H_0$ is correct + sample was terrible

or

H_0 is wrong ($\mu \neq 2.04$)

Since P is so small, \therefore machine needs recalibration

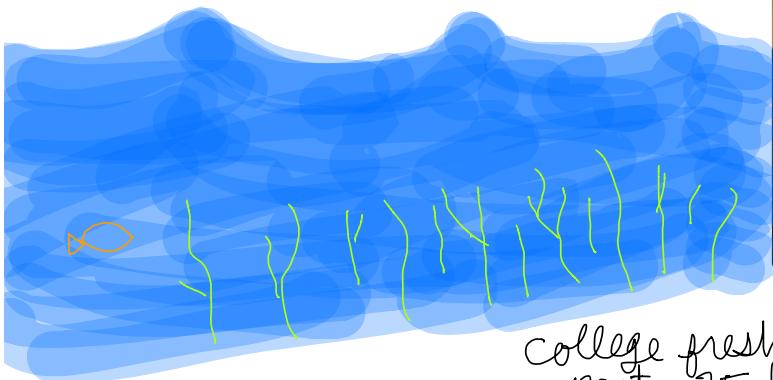
Strong evidence machine is not working properly + ↗

Study distributions (normal vs. binomial)

evidence in support of...

- We should decide if we care about a one-sided or two-sided alternative, **ideally before we see the data.**
- Two-sided: $H_0: \mu = \mu_0$ vs. $H_a: \mu \neq \mu_0$
- One-sided: $H_0: \mu = \mu_0$ vs. $H_a: \mu > \mu_0$
or: $H_0: \mu = \mu_0$ vs. $H_a: \mu < \mu_0$
- With a one-sided alternative, the implied alternative is actually $\mu \leq \mu_0$ or $\mu \geq \mu_0$, but it is convenient to state only the equality.





$$H_0: \mu = 7.5$$

$$H_a: \mu < 7.5$$

college freshman
party 7.5 hours
weekly
(nat'l average)

- All hypothesis tests follow this general pattern:
 - We observe some difference in a sample and wish to decide if it reflects a true difference in the population.
 - Identify the null and alternative hypotheses.
 - Compute a test statistic which has a known distribution when the null hypothesis is true.
 - Find a P -value: the probability of a statistic as or more unusual than the one we observed, when the null hypothesis is true.

one sided or
2 sided?

Before data
gathered

evidence in support of...

- We should decide if we care about a one-sided or two-sided alternative, **ideally before we collect data**.
 - Two-sided: $H_0: \mu = \mu_0$ vs. $H_a: \mu \neq \mu_0$
 - One-sided: $H_0: \mu = \mu_0$ vs. $H_a: \mu > \mu_0$
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