# SOME EXAMPLES

# ER Example

- Florida:  26.6% overall

| Obese | | | | |
|---|---|---|---|---|
| obese | Frequency | Percent | 95% Confidence Limits for Percent | |
| No | 269 | 61.5561 | 56.9772 | 66.1350 |
| Yes | 168 | 38.4439 | 33.8650 | 43.0228 |
| Total | 437 | 100.000 | | |

# ER Example

- Florida:  26.6% overall
- Ho: p = 0.266
- Ha: p > 0.266
- p = proportion of all ER patients who are obese
- Test Statistic: $$z = \frac{0.384 - 0.266}{\sqrt{\frac{(0.266)(1-0.266)}{437}}} = 5.58$$
- P-value = P(Z > 5.58) ≈ 0
- The obesity rate in ER is statistically significantly higher than the overall rate in Florida

# EXAMPLE 2

# Example 2

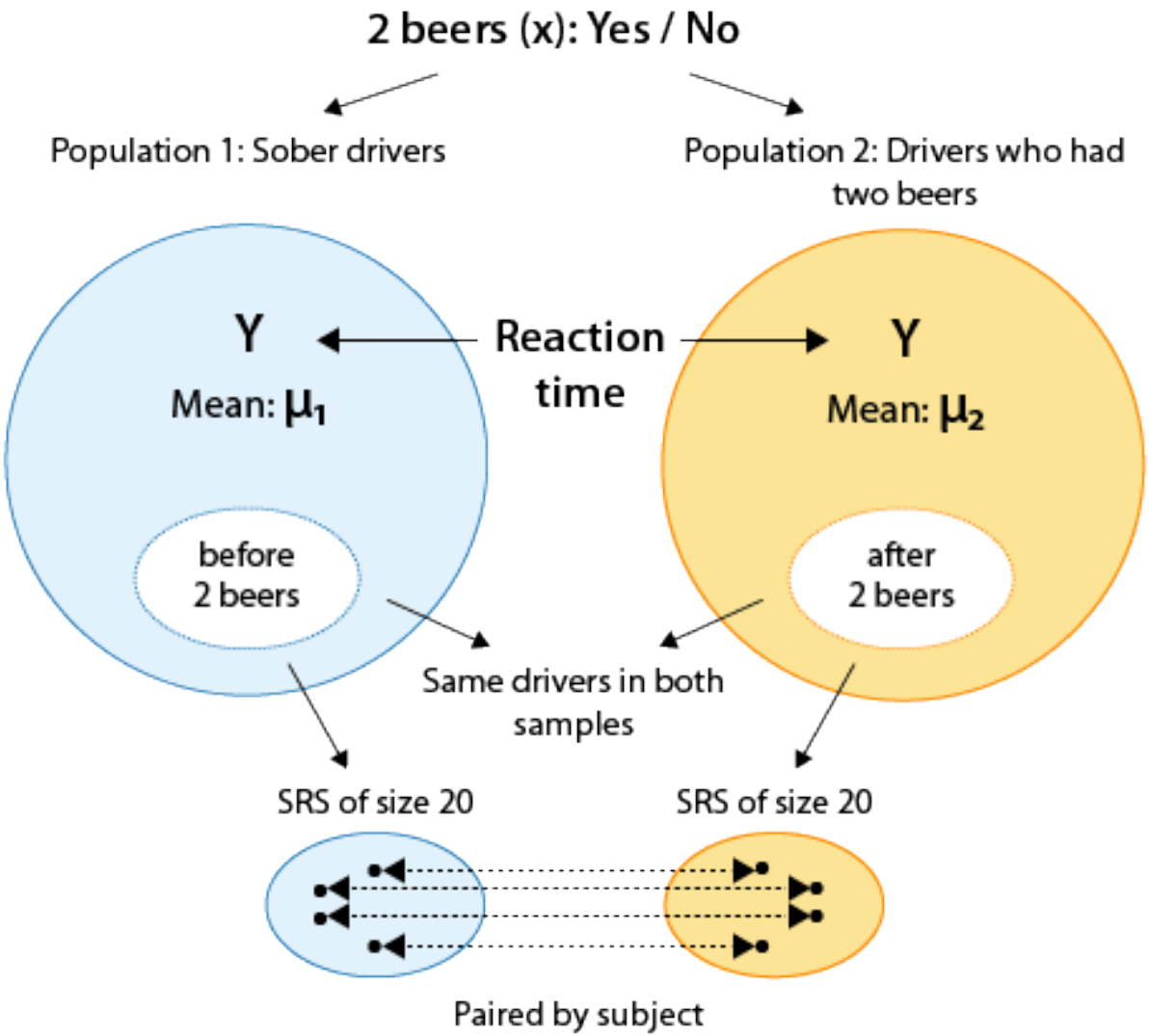
- An agricultural company interested in reducing the time needed to harvest its crops hired a mechanical engineer to design a mechanical harvester for bell peppers
- To heighten the precision of his machine, the engineer measured and recorded the angle at which peppers hang on the plant
- Perform a one-sample t-test to determine whether the data gives good evidence that peppers hang on plants at an angle (different from zero)
- Excel Dataset, CSV Dataset (See Materials for Links)

# Analysis

- Step 1: Ho: $\mu = 0$ vs. Ha: $\mu \neq 0$
  - $\mu$ = true mean angle at which peppers hang on the plant
- Steps 2 and 3 in software (p-value = 0.0037)
  - See Materials for Links to
    - SPSS Output (SPSS Dataset)
    - SAS Output (SAS Code, SAS Dataset)
- The mean angle at which peppers hang on the plant is significantly different from zero. (assumptions reasonable)
- Confidence Interval: (1.1239 5.2333)

# Paired t-test (Case CQ)

- Drinking and Driving Example (This is in Module 13)
- A sample of 20 drivers was chosen, and their reaction times in an obstacle course were measured before and after drinking two beers
- The purpose of this study was to check whether drivers are impaired after drinking two beers
- The measurements are PAIRED, the two variables (before and after) are DEPENDENT!!
- Solution – reduce to one sample by taking differences for each pair and conduct test on only the differences


2 beers (x): Yes / No
Population 1: Sober drivers
Population 2: Drivers who had two beers
Y
Mean: $\mu_1$
Reaction time
Y
Mean: $\mu_2$
before 2 beers
after 2 beers
Same drivers in both samples
SRS of size 20
SRS of size 20
Paired by subject

# Drinking and Driving Example

| Driver | 1 | 2 | 3 | 4 | . . . | 20 |
|---|---|---|---|---|---|---|
| Sample 1 (Before) | 6.25 | 2.96 | 4.95 | 3.94 | . . . | 4.69 |
| Sample 2 (After) | 6.85 | 4.78 | 5.57 | 4.01 | . . . | 3.72 |
| **Differences** (Before - After) | -0.60 | -1.82 | -0.62 | -0.07 | | 0.97 |

# Paired t-test

- The null hypothesis is always:
  - Ho: $\mu_d = 0$ (can use values other than zero in some cases)
- The alternative hypothesis is one of:
  - Ha: $\mu_d < 0$ **(one-sided)**
  - Ha: $\mu_d > 0$ **(one-sided)**
  - Ha: $\mu_d \neq 0$ **(two-sided)**
- Other than slight change in notation, same as one-sample t-test

$$t = \frac{\bar{y}_d - 0}{s_d/\sqrt{n}}$$

# Drinking and Driving Example

- See Materials for Links to
  - Data: Beers (SPSS format, SAS format, Excel format)
  - SPSS Output
  - SAS Output, SAS Code
- Test statistic is t = -2.58
- p-value is 0.009
- The data provide enough evidence to reject Ho and conclude that drinking two beers does slow the reaction times of drivers

# Caution

- In the output, we are generally provided the two-sided p-value
- We must be very careful when converting this to a one-sided p-value (if this is not provided by the software)
- IF the data are in the direction of our alternative hypothesis then we can simply take half of the two-side p-value
- IF, however, the data are NOT in the direction of the alternative, the correct p-value is VERY LARGE and is the complement of half the two-sided p-value

# Drinking and Driving Example

- Quantify the effect that two beers have on the driver
- 95% confidence interval for $\mu_d$, the mean of the differences (before - after), is roughly (-0.9, -0.1)
- We can therefore say with 95% confidence that drinking two beers increases the total reaction time of the driver by between 0.1 and 0.9 of a second