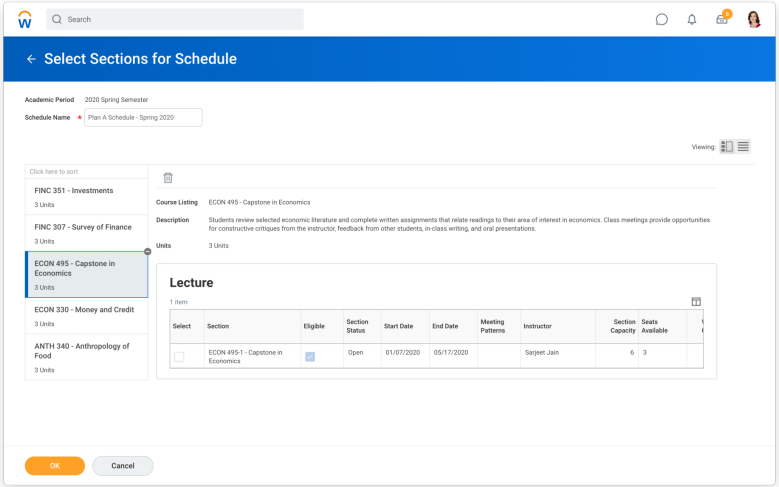
02 - Experiemental Design

HCI/PSYCH 522
Iowa State University

January 20, 2022

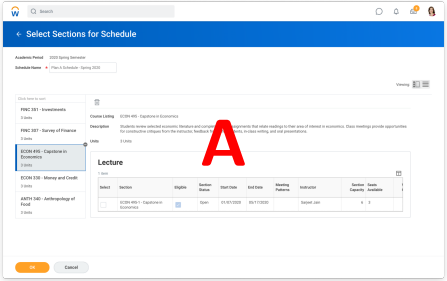
Workday Course Registration Case Study

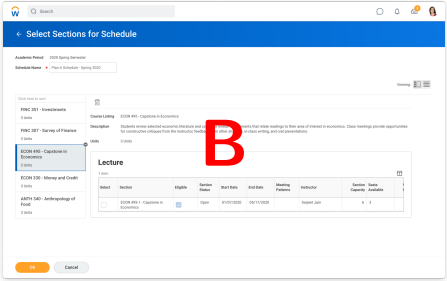


Hypothesis

Scientific question: Does the type of registration system (A vs B) affect mean registration time?

Null hypothesis: No
Alternative hypothesis: Yes





Recruitment

Randomization

```
registration <- data.frame(subjectID = 1:30,
                           system = sample(rep(c("A","B"), times = 15)))
registration
```

```
##    subjectID system
## 1          1      B
## 2          2      A
## 3          3      A
## 4          4      A
## 5          5      A
## 6          6      A
## 7          7      A
## 8          8      B
## 9          9      A
```

Balanced experiment

```
table(registration$system)

##
##  A  B
## 15 15
```

Data Collection

Exploratory statistics

```
summary(registration)
```

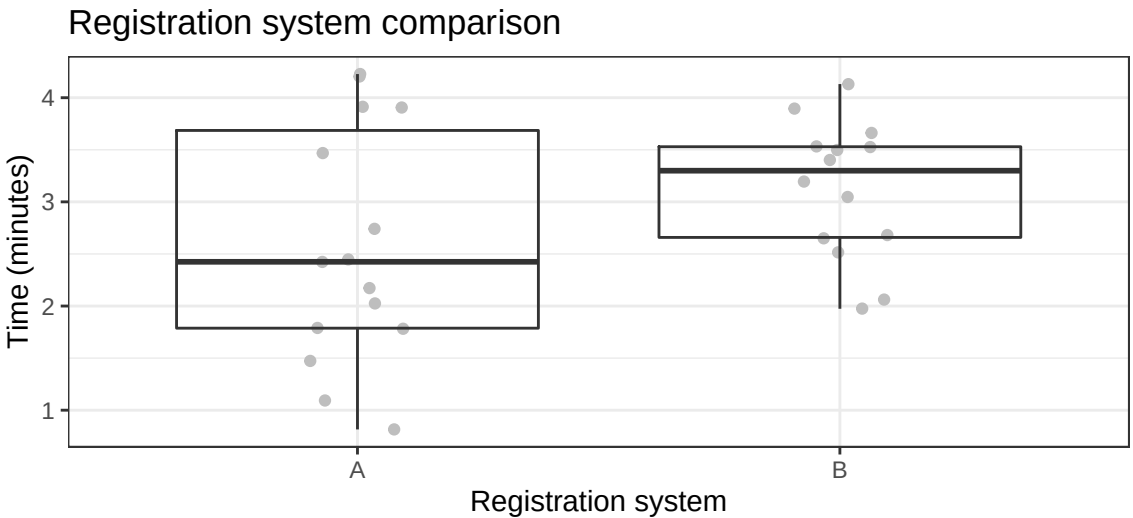
```
##    subjectID        system              time
##  Min.   : 1.00   Length:30          Min.   :0.8155
##  1st Qu.: 8.25   Class :character   1st Qu.:2.0621
##  Median :15.50   Mode  :character   Median :2.7388
##  Mean   :15.50                      Mean   :2.8362
##  3rd Qu.:22.75                      3rd Qu.:3.5307
##  Max.   :30.00                      Max.   :4.2267
##                                     NA's   :1
```

Exploratory statistics

```
registration %>%
  group_by(system) %>%
  summarize(n = sum(!is.na(time)),
            mean = mean(time, na.rm = TRUE),
            sd = sd(time, na.rm = TRUE))
```

```
## # A tibble: 2 x 4
##   system     n  mean    sd
##   <chr>  <int> <dbl> <dbl>
## 1 A         15  2.57 1.13
## 2 B         14  3.13 0.661
```

Visualization



Two-sample t-test

```
t.test(time ~ system, data = registration)

##
##  Welch Two Sample t-test
##
## data:  time by system
## t = -1.6405, df = 22.796, p-value = 0.1146
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.2695283  0.1468389
## sample estimates:
## mean in group A mean in group B
##        2.565219        3.126563
```

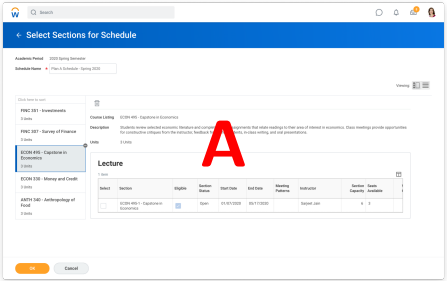
Regression

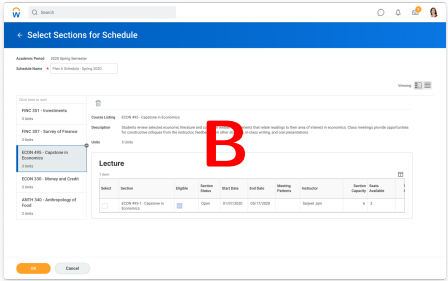
```
summary(lm(time ~ system, data = registration))

##
## Call:
## lm(formula = time ~ system, data = registration)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.74973 -0.60921 -0.07862  0.53688  1.66149
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.5652     0.2420  10.602    4e-11 ***
## systemB       0.5613     0.3482   1.612    0.119
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9371 on 27 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:  0.08778,Adjusted R-squared:  0.054
```

Conclusion and Decision

Conclusion: Since p-value > 0.05, there is insufficient evidence to indicate any difference in mean registration time between the two systems.

Decision: The decision of which system to use may depend on many factors including cost.





What was done well in this study?

What was done poorly in this study?

What else could have been done?

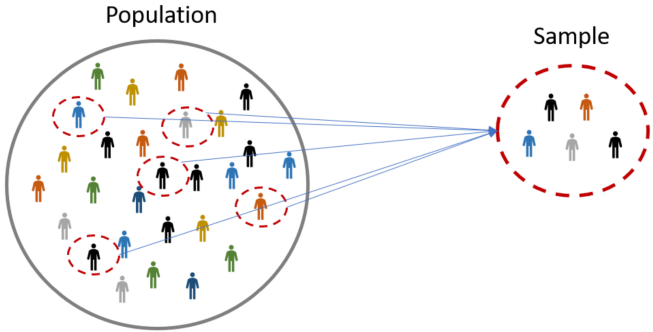
Data Collection Methods

Population vs Sample

from https://www.scribbr.com/methodology/population-vs-sample/

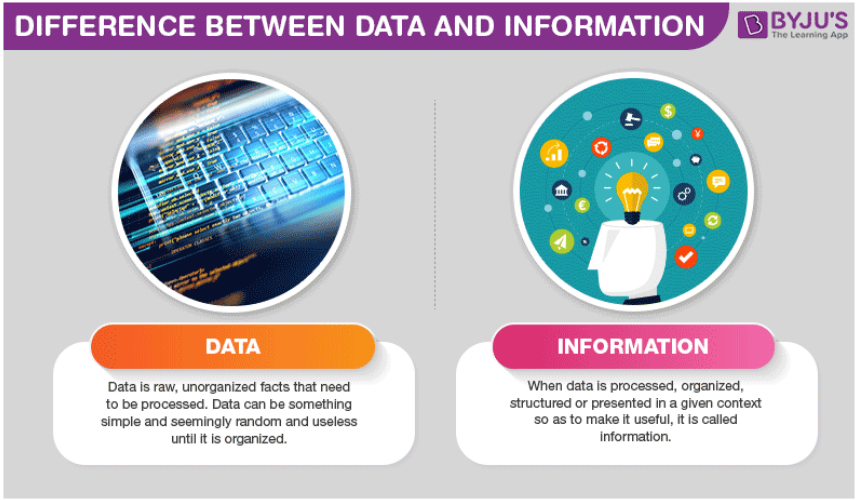
A population is the entire group that you want to draw conclusions about.

A sample is the specific group that you will collect data from.



Sample

Data vs Information



Information spectrum

Data quality (least informative to most informative)

- Survey
- Observational study
- Randomized experiment
  - paired/blocked

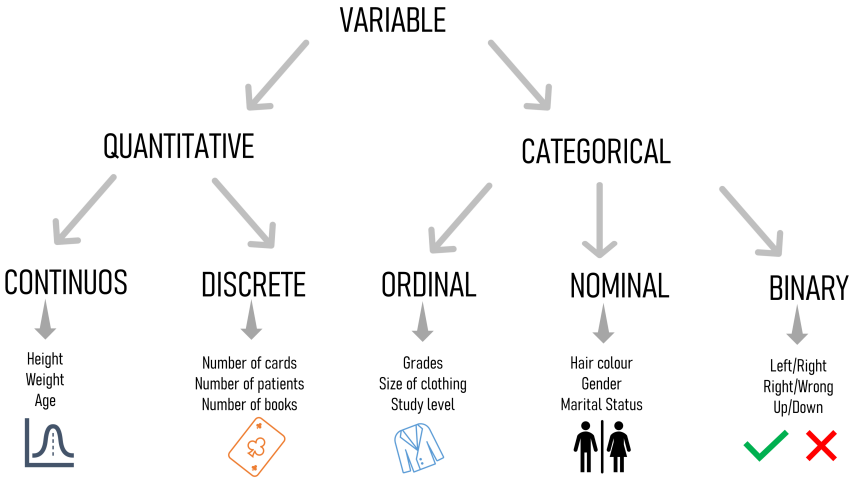
Sample (least informative to most informative)

- You
- Select students
- Randomly selected students
- All students

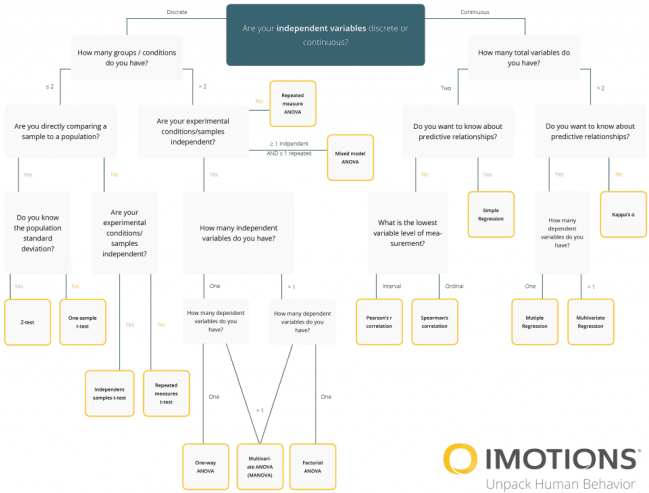
Data Types

- Qualitative: categorical or non-numeric
  - Binary: only two options
  - Nominal: order doesn't matter
  - Ordinal: order matters
- Quantitative: numerical
  - Discrete: count
    - upper maximum does not exist
    - upper maximum exists
  - Continuous

Data Types Graphic



Statistical Methods for Continuous Dependent Variables



IMOTIONS
Unpack Human Behavior