02 - Scientific Process

HCI/PSYCH 522 Iowa State University

January 20, 2022

Workday Course Registration Case Study

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Hypothesis

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

Null hypothesis: No Alternative hypothesis: Yes

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Recruitment

Recruitment



Randomization

```
registration <- data.frame(subjectID = 1:30,</pre>
```

```
system = sample(rep(c("A", "B"), times = 15)))
```

registration

##	subjectID	system
## 1	1	В
## 2	2	A
## 3	3	А
## 4	4	А
## 5	5	А
## 6	6	А
## 7	7	А
## 8	8	В
## 9	9	А

Balanced experiment

table(registration\$system)

A B ## 15 15

Data Collection



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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><</pre>
## 1 A 15 2.57 1.13
## 2 B 14 3.13 0.661
```

Visualization

Registration system comparison



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
                10 Median
                              30
                                         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
```

```
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```

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.

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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

Sample

Data vs Information

DIFFERENCE BETWEEN DATA AND INFORMATION



DATA

Data is raw, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized.



INFORMATION

When data is processed, organized, structured or presented in a given context so as to make it useful, it is called information.



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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
 - maximum count does not exist
 - maximum count exists
 - Continuous

Data Types

Data Types Graphic



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Statistical Methods for Continuous Dependent Variables



Scientific Process

