



conrad

School of Entrepreneurship and Business

Agenda

01
Recap

02
Comparing
Two
Populations



Important Terms

■ Parameter:

A number that describes a population characteristic.

Average gross income of all Canadian residents in 2019



■ Statistic:

A number that describes a sample characteristic.

2019 gross income of residents from a sample of two provinces.



Measurement and Scaling

- **Measurement**

Standardized process of assigning numbers or other symbols to certain characteristics of objects of interests according to pre-specified rules

- **Characteristics for Standardization**

- One-to-one correspondence between the symbol and the characteristic in the object that is being measured
- Rules for assignment should be invariant over time* and the objects being measured

The taste of Honey Munch Cereal is



Statement

Academic detailing is a useful form of education that aligns providers' prescribing behavior with evidence-based practice.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|-------------------|----------|---------|-------|----------------|
| 1 | 2 | 3 | 4 | 5 |

Example: Divide 100 points among the following characteristic of a delivery service according to how important each characteristic is to you when selecting a delivery company

Accurate Invoicing _____

Delivery as Promised _____

Lower Price _____

Hypothesis Testing

- The general goal of a hypothesis test is to rule out chance (sampling error) as a plausible explanation for the results from a research study.
- Is also called *significance testing*
- Tests a claim about a parameter using evidence (data in a sample)
- Let's consider a one-sample z test (test used to test means when population variance is known)

Key Terms

- A. Null and alternative hypotheses
- B. Test statistic
- C. P-value and interpretation

Null and Alternative Hypotheses

- Convert the research question to null and alternative hypotheses
- The **null hypothesis (H_0)** is a claim of “no difference in the population”
- The **alternative hypothesis (H_a)** claims “ H_0 is false”
- Collect data and seek evidence against H_0 as a way of bolstering H_a (deduction)

Interpretation

- P -value answer the question: What is the probability of the observed test statistic ... **when H_0 is true?**
- Thus, smaller and smaller P -values provide stronger and stronger evidence against H_0
- Small P -value \Rightarrow strong evidence

Conventions*

$P > 0.10 \Rightarrow$ non-significant evidence against H_0

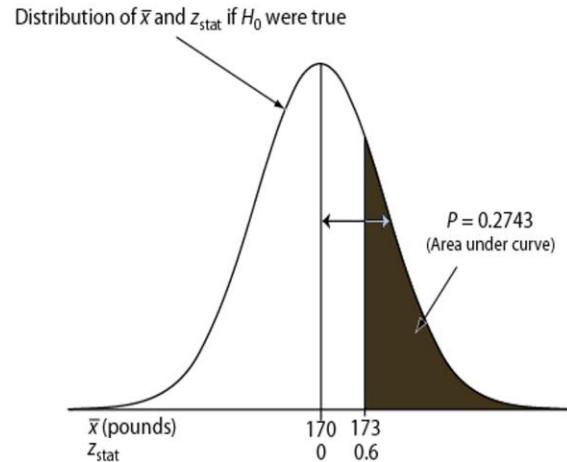
$0.05 < P \leq 0.10 \Rightarrow$ marginally significant evidence

$0.01 < P \leq 0.05 \Rightarrow$ significant evidence against H_0

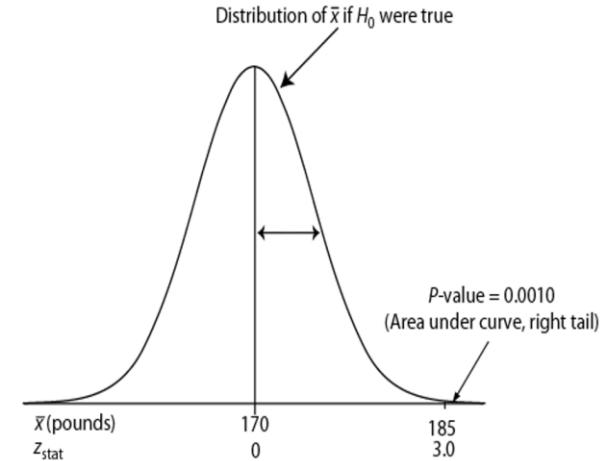
$P \leq 0.01 \Rightarrow$ highly significant evidence against H_0

Another look at P vs CI's

One-sided P -value for z_{stat} of 0.6



One-sided P -value for z_{stat} of 3.0



$$\begin{aligned} n &= 64 \\ \sigma &= 40 \\ Z &= 2 \end{aligned}$$

$$95\% \text{ CI} = 163 - 183$$

\in

170

\notin

$$95\% \text{ CI} = 175 - 195$$



DATA ANALYSIS

Organizing your data in a sheet

Stacked data:

Multiple cases (rows) for each subject

| Subject | Take-outs per month | Quantity |
|---------|---------------------|----------|
| 1 | Before COVID | 3 |
| 1 | During COVID | 2 |
| 1 | After COVID | 5 |
| 2 | Before COVID | 3 |
| 2 | During COVID | 8 |
| 2 | After COVID | 4 |
| 3 | Before COVID | 3 |
| 3 | During COVID | 7 |
| 3 | After COVID | 1 |

Unstacked data:

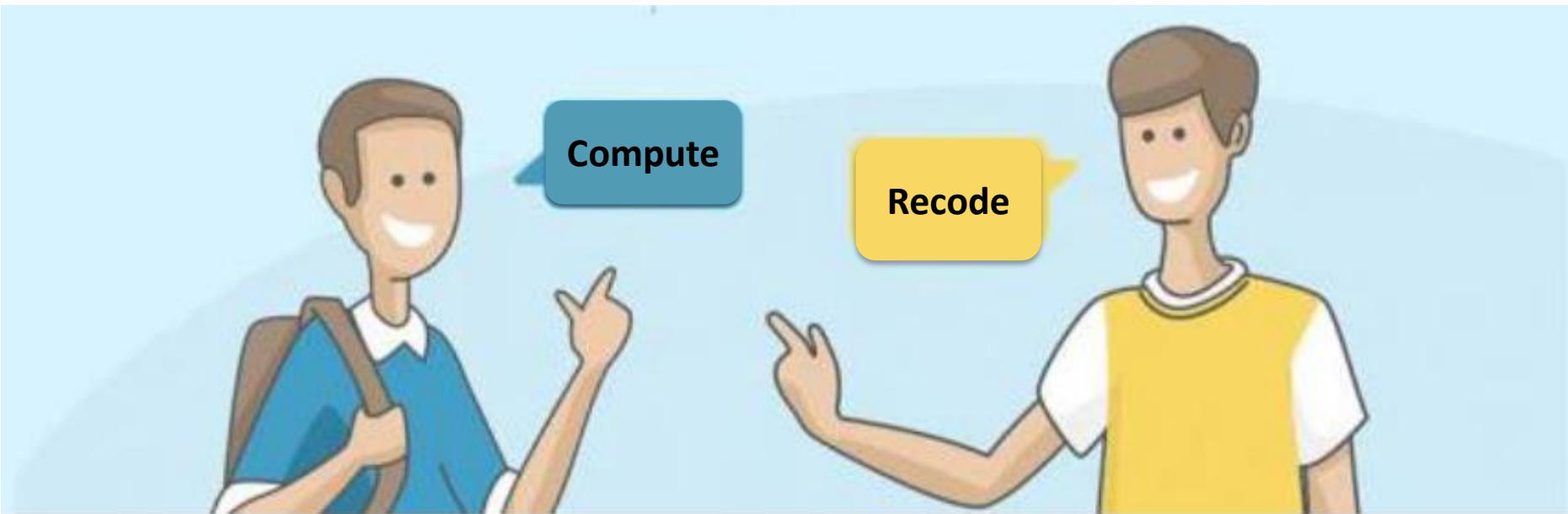
Only one case (row) per subject



| Subject | Before COVID | During COVID | After COVID |
|---------|--------------|--------------|-------------|
| 1 | 3 | 2 | 5 |
| 2 | 3 | 8 | 4 |
| 3 | 3 | 7 | 1 |



Your two best friends in SPSS



CONTEXT

Brand Tracking Questionnaire WAVE 3 - V7

1 Brand X Customer Strategy Quant Survey Instrument – Survey #1

QUESTIONNAIRE

Project #:

Wave (if a tracker): 1

SURVEY NAME: Brand X Brand Tracker

SURVEY LENGTH (MINS): XX

SAMPLE SOURCE/COUNTRY/DETAILS:

| COUNTRY | LANGUAGE(S) | SOURCE(S) |
|---------|-------------|-----------|
| US | English | XX |
| China | XX | XX |

VERSION/DATE/ COLOR OF AMENDS:

| REQUIREMENTS | QUESTION NUMBERS/ NOTE |
|-------------------------------|------------------------|
| OPEN-ENDS (CHA) | |
| OTHER SPECIFY | |
| Personal Identifiable Info | NO |
| FLASH DETECTION | N/A |
| NON-STANDARD FLASH | N/A |
| ADVANCED IMAGE/VIDEO SECURITY | ONLY DEFAULT SECURITY |
| CONJOINT | N/A |
| ALGORITHM | N/A |
| MAX DIFF | N/A |
| OTHER COMPLEX SET UP | N/A |
| DATA FILE | EXCEL, SPSS, ASCII |

No set quotas for Age – but check that Age is falling representative to census.

No set quotas for Shoppers or Non Shoppers – let fall naturally

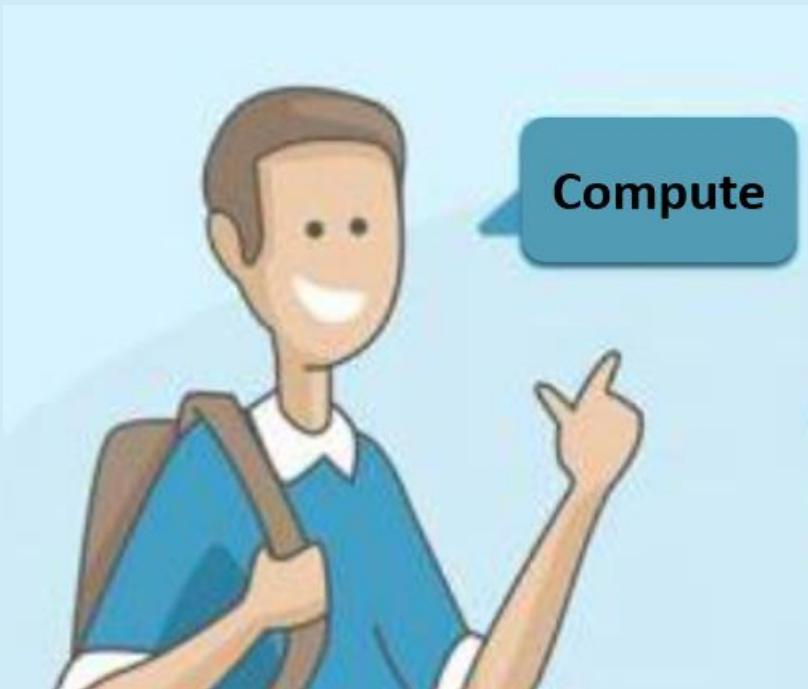


357614 SPSS

| Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Scale | Measure | Role |
|-------------------|---------|-------|----------|--------------------------------------|-------------------|---------|---------|---------|---------|---------|------|
| 1 respid | Numeric | 8 | 0 | respid | None | None | 8 | Right | Scale | Input | |
| 2 status | String | 8 | 0 | status | None | None | 20 | Left | Nominal | Input | |
| 3 interview_start | Date | 10 | 0 | interview_start | None | None | 8 | Right | Nominal | Input | |
| 4 interview_end | Date | 10 | 0 | interview_end | None | None | 8 | Right | Nominal | Input | |
| 5 htotallinem... | Numeric | 17 | 2 | Survey duration ... | None | None | 8 | Right | Scale | Input | |
| 6 userid | String | 1 | 0 | userid | None | None | 50 | Left | Nominal | Input | |
| 7 subsid | String | 18 | 0 | SubsID | None | None | 50 | Left | Nominal | Input | |
| 8 s1 | Numeric | 1 | 0 | Are you... | {1, Male}... | None | 8 | Right | Nominal | Input | |
| 9 os2 | String | 5 | 0 | Please enter yo... | None | None | 5 | Left | Nominal | Input | |
| 10 dregion | Numeric | 1 | 0 | dRegion | {1, NORTHE... | None | 8 | Right | Nominal | Input | |
| 11 dregion1 | Numeric | 1 | 0 | dRegion1 | {1, Northeast...} | None | 8 | Right | Nominal | Input | |
| 12 s3 | Numeric | 2 | 0 | Please enter yo... | None | None | 8 | Right | Scale | Input | |
| 13 hage | Numeric | 2 | 0 | PLEASE CODE... | {1, 1-17}... | None | 8 | Right | Nominal | Input | |
| 14 s4_1 | Numeric | 1 | 0 | No, not of Hispan... | None | None | 8 | Right | Nominal | Input | |
| 15 s4_2 | Numeric | 1 | 0 | Yes, Mexican, M... | None | None | 8 | Right | Nominal | Input | |
| 16 s4_3 | Numeric | 1 | 0 | Yes, Puerto Ric... | None | None | 8 | Right | Nominal | Input | |
| 17 s4_4 | Numeric | 1 | 0 | Yes, Cuban (Ar... | None | None | 8 | Right | Nominal | Input | |
| 18 s4_5 | Numeric | 1 | 0 | Yes, Central / S... | None | None | 8 | Right | Nominal | Input | |
| 19 s4_6 | Numeric | 1 | 0 | Yes, other Hispan... | None | None | 8 | Right | Nominal | Input | |
| 20 s5_1 | Numeric | 1 | 0 | White / Caucasi... | None | None | 8 | Right | Nominal | Input | |
| 21 s5_2 | Numeric | 1 | 0 | Black / African A... | None | None | 8 | Right | Nominal | Input | |
| 22 s5_3 | Numeric | 1 | 0 | Asian or Pacific ... | None | None | 8 | Right | Nominal | Input | |
| 23 s5_4 | Numeric | 1 | 0 | Alaskan Native / ... | None | None | 8 | Right | Nominal | Input | |
| 24 s5_5 | Numeric | 1 | 0 | Other (Specify) ... | None | None | 8 | Right | Nominal | Input | |
| 25 s5_5_other | String | 22 | 0 | Other (Specify) ... | None | None | 50 | Left | Nominal | Input | |
| 26 s7 | Numeric | 1 | 0 | Which of the foll...{1, Single (n... | None | 8 | Right | Nominal | Input | | |

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode ON



SPSS®**amazon**

Brand Personality

Q10 Now we'd like you to think again about these stores as if they were people. Below is a list of different words and phrases that might be used to describe different people. Please check the box under the store if you think that a particular word describes the store. (Please check all that apply for each brand)

PROGRAMMER: RANDOMIZE LIST. ACCEPT MULTIPLE ANSWERS PER BRAND.

SPLIT INTO 3-4 QUESTIONS TO REDUCE SCROLLING, RANDOMIZE DESCRIPTORS

| | {1} Brand X | JC {2} Penney | {11} Kohl's | Nordstro {3} m | {23} Amazon | {15} TJ Maxx |
|---------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Fashionable | <input type="checkbox"/> |
| Innovative | <input type="checkbox"/> |
| Frustrating | <input type="checkbox"/> |
| Bland | <input type="checkbox"/> |
| Friendly | <input type="checkbox"/> |
| Old Fashioned | <input type="checkbox"/> |
| Welcoming | <input type="checkbox"/> |
| Fun | <input type="checkbox"/> |
| Magical | <input type="checkbox"/> |
| Generous | <input type="checkbox"/> |
| Entertaining | <input type="checkbox"/> |
| Trustworthy | <input type="checkbox"/> |
| Traditional | <input type="checkbox"/> |
| Inspiring | <input type="checkbox"/> |
| Surprising | <input type="checkbox"/> |
| Helpful | <input type="checkbox"/> |

**Fashion
Forward**

357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

| | Name | Type | Width | Decimals | Label | Values | Missing |
|-----|-----------|---------|-------|----------|---|--------|---------|
| 307 | q10_13_3 | Numeric | 1 | 0 | Traditional (Now we'd like you to think again...) | None | None |
| 308 | q10_14_3 | Numeric | 1 | 0 | Inspiring (Now we'd like you to think again a...) | None | None |
| 309 | q10_15_3 | Numeric | 1 | 0 | again ... | None | None |
| 310 | q10_16_3 | Numeric | 1 | 0 | in ab... | None | None |
| 311 | q10_17_3 | Numeric | 1 | 0 | agai... | None | None |
| 312 | q10_99_3 | Numeric | 1 | 0 | ink ag... | None | None |
| 313 | q10_1_23 | Numeric | 1 | 0 | k agai... | None | None |
| 314 | q10_2_23 | Numeric | 1 | 0 | again ... | None | None |
| 315 | q10_3_23 | Numeric | 1 | 0 | again... | None | None |
| 316 | q10_4_23 | Numeric | 1 | 0 | n abo... | None | None |
| 317 | q10_5_23 | Numeric | 1 | 0 | ain a... | None | None |
| 318 | q10_6_23 | Numeric | 1 | 0 | ink a... | None | None |
| 319 | q10_7_23 | Numeric | 1 | 0 | agai... | None | None |
| 320 | q10_8_23 | Numeric | 1 | 0 | about ... | None | None |
| 321 | q10_9_23 | Numeric | 1 | 0 | ain ab... | None | None |
| 322 | q10_10_23 | Numeric | 1 | 0 | again ... | None | None |
| 323 | q10_11_23 | Numeric | 1 | 0 | k agai... | None | None |
| 324 | q10_12_23 | Numeric | 1 | 0 | k agai... | None | None |
| 325 | q10_13_23 | Numeric | 1 | 0 | Traditional (Now we'd like you to think again...) | None | None |
| 326 | q10_14_23 | Numeric | 1 | 0 | Inspiring (Now we'd like you to think again a...) | None | None |
| 327 | q10_15_23 | Numeric | 1 | 0 | Surprising (Now we'd like you to think again ...) | None | None |

Compute Variable

Target Variable: FashionForwardAmazon

Numeric Expression: 1

Type & Label...

Function group:

- All
- Arithmetic
- CDF & Noncentral CDF
- Conversion
- Current Date/Time
- Date Arithmetic
- Date Creation

Functions and Special Variables:

If... (optional case selection condition)

Buttons: OK, Paste, Reset, Cancel, Help

Data View **Variable View**

IBM SPSS Statistics Processor is ready

Unicode:ON

10:13 AM 9/24/2020

357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

| | Name | Type | Width | Decimals | Label | Values | Missing |
|-----|-----------|---------|-------|----------|---|--------|---------|
| 307 | q10_13_3 | Numeric | 1 | 0 | Traditional (Now we'd like you to think again...) | None | None |
| 308 | q10_14_3 | Numeric | 1 | 0 | Gain a... | None | None |
| 309 | q10_15_3 | Numeric | 1 | 0 | Again ... | None | None |
| 310 | q10_16_3 | Numeric | 1 | 0 | ain ab... | None | None |
| 311 | q10_17_3 | Numeric | 1 | 0 | agai... | None | None |
| 312 | q10_99_3 | Numeric | 1 | 0 | ink ag... | None | None |
| 313 | q10_1_23 | Numeric | 1 | 0 | k agai... | None | None |
| 314 | q10_2_23 | Numeric | 1 | 0 | again ... | None | None |
| 315 | q10_3_23 | Numeric | 1 | 0 | again... | None | None |
| 316 | q10_4_23 | Numeric | 1 | 0 | n abo... | None | None |
| 317 | q10_5_23 | Numeric | 1 | 0 | ain a... | None | None |
| 318 | q10_6_23 | Numeric | 1 | 0 | think a... | None | None |
| 319 | q10_7_23 | Numeric | 1 | 0 | agai... | None | None |
| 320 | q10_8_23 | Numeric | 1 | 0 | about ... | None | None |
| 321 | q10_9_23 | Numeric | 1 | 0 | ain ab... | None | None |
| 322 | q10_10_23 | Numeric | 1 | 0 | again ... | None | None |
| 323 | q10_11_23 | Numeric | 1 | 0 | k agai... | None | None |
| 324 | q10_12_23 | Numeric | 1 | 0 | agai... | None | None |
| 325 | q10_13_23 | Numeric | 1 | 0 | again... | None | None |
| 326 | q10_14_23 | Numeric | 1 | 0 | Inspiring (Now we'd like you to think again a...) | None | None |
| 327 | q10_15_23 | Numeric | 1 | 0 | Surprising (Now we'd like you to think again ...) | None | None |

Compute Variable: If Cases

Include all cases
 Include if case satisfies condition:
`q10_1_23 = 1 & q10_2_23 = 1 & q10_14_23 = 1`

Function group:
 All
 Arithmetic
 CDF & Noncentral CDF
 Conversion
 Current Date/Time
 Date Arithmetic
 Date Creation
 Date Extraction
 Inverse DF
 ...

Functions and Special Variables:

Continue Cancel Help

Data View

Variable View

IBM SPSS Statistics Processor is ready

Unicode:ON

10:15 AM
9/24/2020

Fashionable (Now we'd like you to think again about these stores as if they were people. Below is a list of different words and phrases that might be used to describe different people. Please check the box under the store if you think that a particular word

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|-----------|---------|---------------|--------------------|
| Valid | 0 | 1250 | 28.9 | 77.7 |
| | 1 | 358 | 8.3 | 22.3 |
| | Total | 1608 | 37.1 | 100.0 |
| Missing | System | 2723 | 62.9 | |
| Total | | 4331 | 100.0 | |

Innovative (Now we'd like you to think again about these stores as if they were people. Below is a list of different words and phrases that might be used to describe different people. Please check the box under the store if you think that a particular word

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|-----------|---------|---------------|--------------------|
| Valid | 0 | 386 | 8.9 | 24.0 |
| | 1 | 1222 | 28.2 | 76.0 |
| | Total | 1608 | 37.1 | 100.0 |
| Missing | System | 2723 | 62.9 | |
| Total | | 4331 | 100.0 | |

Inspiring (Now we'd like you to think again about these stores as if they were people. Below is a list of different words and phrases that might be used to describe different people. Please check the box under the store if you think that a particular word

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|-----------|---------|---------------|--------------------|
| Valid | 0 | 1266 | 29.2 | 78.7 |
| | 1 | 342 | 7.9 | 21.3 |
| | Total | 1608 | 37.1 | 100.0 |
| Missing | System | 2723 | 62.9 | |
| Total | | 4331 | 100.0 | |



FashionForwardAmazon

| | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|-----------|---------|---------------|--------------------|
| Valid | 1.00 | 133 | 3.1 | 100.0 |
| Missing | System | 4198 | 96.9 | |
| Total | | 4331 | 100.0 | |



Likelihood Recommend

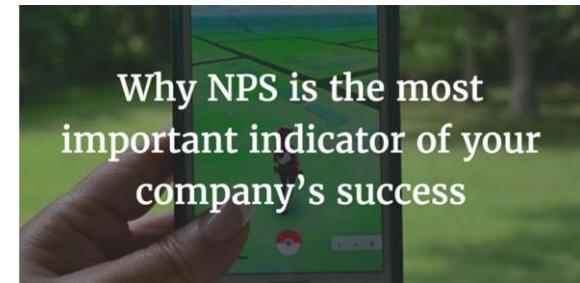
Q13 How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend.

PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND. SHOW EACH RETAILER ON SEPARATE SCREENS.

| | Brand X | JC Penney | Kohl's | Nordstrom | Amazon | TJ Maxx |
|---|---------|-----------|--------|-----------|--------|---------|
| 0 | ○ | ○ | ○ | ○ | ○ | ○ |
| 1 | ○ | ○ | ○ | ○ | ○ | ○ |
| 2 | ○ | ○ | ○ | ○ | ○ | ○ |
| 3 | ○ | ○ | ○ | ○ | ○ | ○ |
| 4 | ○ | ○ | ○ | ○ | ○ | ○ |
| 5 | ○ | ○ | ○ | ○ | ○ | ○ |
| 6 | ○ | ○ | ○ | ○ | ○ | ○ |
| 7 | ○ | ○ | ○ | ○ | ○ | ○ |



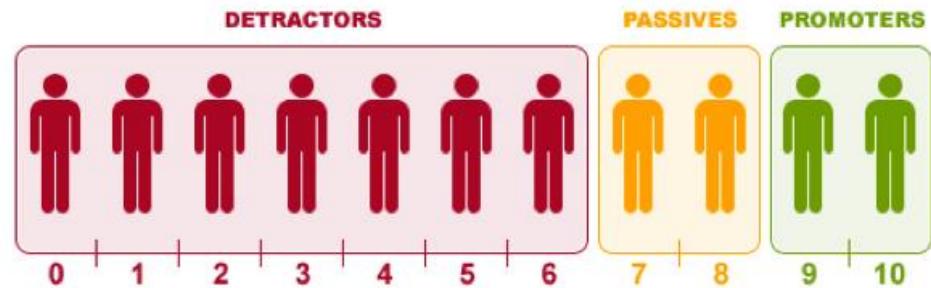
7 benefits of NPS: why use it over other customer satisfaction tools?



Ten Reasons Why Your Business Should Be Tracking the Net Promoter ScoreSM

CLOUDCHERRY | JANUARY 13, 2016

Net Promoter Score® (NPS®) and why you should be using it!



$$\text{Net Promoter Score} = \% \text{ Promoters} - \% \text{ Detractors}$$

*357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

| | Name | Type | Width | Decimals | Label | Values | Missing |
|-----|-----------|---------|-------|----------|---|----------------------|------------------------|
| 696 | q12x1 | Numeric | 1 | 0 | Brand X | {1, Within th... | None |
| 697 | q12x2 | Numeric | 1 | 0 | JC Penney | {1, Within th... | None |
| 698 | q12x11 | Numeric | 1 | 0 | Kohl's | {1, Within th... | None |
| 699 | q12x3 | Numeric | 1 | 0 | Nordstrom | {1, Within th... | None |
| 700 | q12x23 | Numeric | 1 | 0 | Amazon | {1, Within th... | None |
| 701 | q12x15 | Numeric | | | | {1, Within th... | None |
| 702 | q13_1_1 | Numeric | | | | mmend th... | {0, Not at all... None |
| 703 | q13_1_2 | Numeric | | | | mmend th... | {0, Not at all... None |
| 704 | q13_1_11 | Numeric | | | | mmend th... | {0, Not at all... None |
| 705 | q13_1_3 | Numeric | | | | mmend th... | {0, Not at all... None |
| 706 | q13_1_23 | Numeric | | | | mmend th... | {0, Not at all... None |
| 707 | q13_1_15 | Numeric | | | | mmend th... | {0, Not at all... None |
| 708 | q19a_24 | Numeric | | | | ou with the... | {1, Never he... None |
| 709 | q19anew_1 | Numeric | | | | h the follo... | {1, Never he... None |
| 710 | q19anew_2 | Numeric | | | | u with the ... | {1, Never he... None |
| 711 | q19anew_3 | Numeric | 1 | 0 | Lancome (How familiar are you with the follo... | {1, Never he... None | |
| 712 | q19anew_4 | Numeric | 1 | 0 | Kiehls (How familiar are you with the followi... | {1, Never he... None | |
| 713 | q19anew_5 | Numeric | 1 | 0 | Clarisonic (How familiar are you with the foll... | {1, Never he... None | |
| 714 | q19anew_6 | Numeric | 1 | 0 | Chanel (How familiar are you with the followi... | {1, Never he... None | |
| 715 | q19anew_7 | Numeric | 1 | 0 | Clarins (How familiar are you with the followi... | {1, Never he... None | |
| 716 | q19anew_8 | Numeric | 1 | 0 | Shiseido (How familiar are you with the follo... | {1, Never he... None | |

Recode into Different Variables

Numeric Variable > Output Variable: q13_1_23 >> NPSAmazon

Output Variable
Name: NPSAmazon
Label:

Old and New Values...

If... (optional case selection condition)

OK Paste Reset Cancel Help

Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

Type here to search

10:32 AM 9/24/2020

*357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

| | Name | Type | Width | Decimals | Label | Values | Missing |
|-----|-----------|---------|-------|----------|--|-------------------|---------|
| 696 | q12x1 | Numeric | 1 | 0 | Brand X | {1, Within th... | None |
| 697 | q12x2 | Numeric | 1 | 0 | JC Penney | {1, Within th... | None |
| 698 | q12x11 | Numeric | 1 | 0 | Kohl's | {1, Within th... | None |
| 699 | q12x3 | Numeric | 1 | 0 | Nordstrom | {1, Within th... | None |
| 700 | q12x23 | Numeric | | | | {1, Within th... | None |
| 701 | q12x15 | Numeric | | | | {1, Within th... | None |
| 702 | q13_1_1 | Numeric | | | | {1, Not at all... | None |
| 703 | q13_1_2 | Numeric | | | | {1, Not at all... | None |
| 704 | q13_1_11 | Numeric | | | | {1, Not at all... | None |
| 705 | q13_1_3 | Numeric | | | | {1, Not at all... | None |
| 706 | q13_1_23 | Numeric | | | | {1, Not at all... | None |
| 707 | q13_1_15 | Numeric | | | | {1, Not at all... | None |
| 708 | q19a_24 | Numeric | | | | {1, Never he... | None |
| 709 | q19anew_1 | Numeric | | | | {1, Never he... | None |
| 710 | q19anew_2 | Numeric | | | | {1, Never he... | None |
| 711 | q19anew_3 | Numeric | | | | {1, Never he... | None |
| 712 | q19anew_4 | Numeric | 1 | 0 | Kiehls (How familiar are you with the followi... | {1, Never he... | None |
| 713 | q19anew_5 | Numeric | 1 | 0 | Clarisonic (How familiar are you with the foll... | {1, Never he... | None |
| 714 | q19anew_6 | Numeric | 1 | 0 | Chanel (How familiar are you with the followi... | {1, Never he... | None |
| 715 | q19anew_7 | Numeric | 1 | 0 | Clarins (How familiar are you with the followi... | {1, Never he... | None |
| 716 | q19anew_8 | Numeric | 1 | 0 | Shiseido (How familiar are you with the followi... | {1, Never he... | None |

Recode into Different Variables: Old and New Values

Old Value
 Value:
 System-missing
 System- or user-missing
 Range:
 through

 Range, LOWEST through value:

 Range, value through HIGHEST:

 All other values

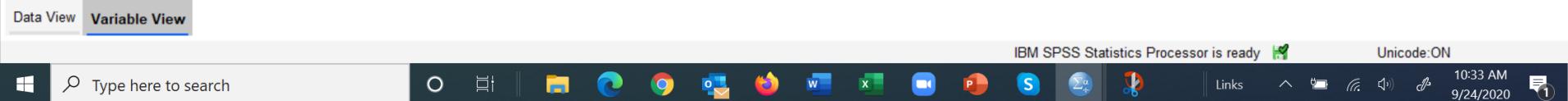
New Value
 Value:
 System-missing
 Copy old value(s)

Old --> New:
 0 thru 6 --> 1
 7 thru 8 --> 2
 9 thru 10 --> 3

Add Change Remove

Output variables are strings Width: 8
 Convert numeric strings to numbers ('5'->5)

Continue Cancel Help



Frequency Table

Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. Amazon)

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|----------------------------------|-----------|---------|---------------|--------------------|
| Valid | Not at all likely to recommend 0 | 5 | .1 | .3 | .3 |
| | 1 | 4 | .1 | .2 | .6 |
| | 2 | 6 | .1 | .4 | .9 |
| | 3 | 3 | .1 | .2 | 1.1 |
| | 4 | 9 | .2 | .6 | 1.7 |
| | 5 | 53 | 1.2 | 3.3 | 5.0 |
| | 6 | 62 | 1.4 | 3.9 | 8.8 |
| | 7 | 146 | 3.4 | 9.1 | 17.9 |
| | 8 | 264 | 6.1 | 16.4 | 34.3 |
| | 9 | 312 | 7.2 | 19.4 | 53.7 |
| | Will definitely recommend 10 | 744 | 17.2 | 46.3 | 100.0 |
| | Total | 1608 | 37.1 | 100.0 | |
| Missing | System | 2723 | 62.9 | | |
| | Total | 4331 | 100.0 | | |



NPS Amazon

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|------------|-----------|---------|---------------|--------------------|
| Valid | Detractors | 142 | 3.3 | 8.8 | 8.8 |
| | Passives | 410 | 9.5 | 25.5 | 34.3 |
| | Promoters | 1056 | 24.4 | 65.7 | 100.0 |
| | Total | 1608 | 37.1 | 100.0 | |
| Missing | System | 2723 | 62.9 | | |
| | Total | 4331 | 100.0 | | |

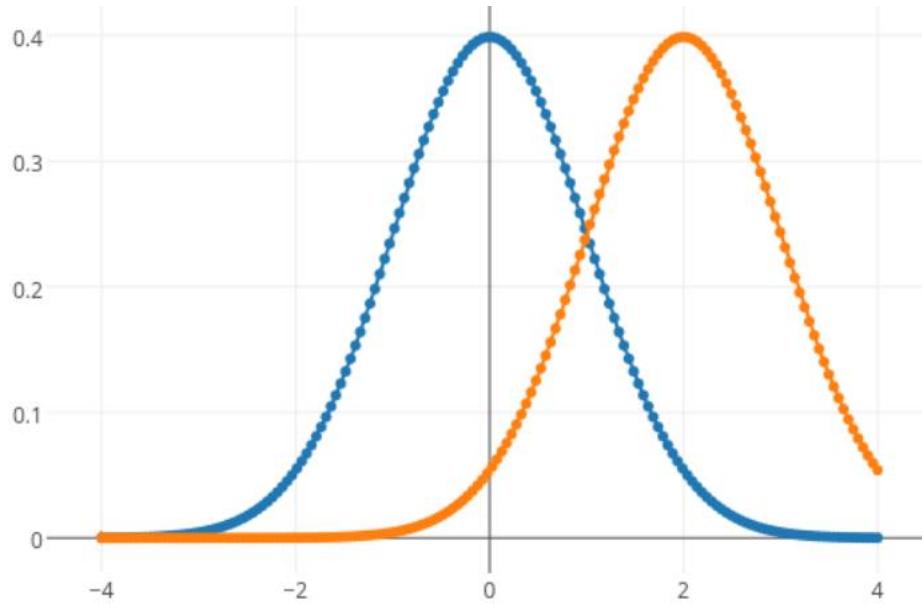
What is Amazon's NPS ?

NPS Amazon = 65.7 – 8.8 = 56.9

Comparing Two Populations



Comparing Means of Two Populations



**Inferences About the Difference Between
Two Population Means: σ_1 and σ_2 Known**

**Inferences About the Difference Between
Two Population Means: σ_1 and σ_2
Unknown**

Estimating the Difference Between Two Population Means

Let μ_1 equal the mean of population 1 and μ_2 equal the mean of population 2.

The difference between the two-population means is

$$\mu_1 - \mu_2.$$

To estimate $\mu_1 - \mu_2$, we will select a simple random sample of size n_1 from population 1 and a simple random sample of size n_2 from population 2.

Let \bar{x}_1 equal the mean of sample 1 and \bar{x}_2 equal the mean of sample 2.

The point estimator of the difference between the means of the populations 1 and 2 is $\bar{x}_1 - \bar{x}_2$

Sampling Distribution of $\bar{x}_1 - \bar{x}_2$

Expected Value

$$E(\bar{x}_1 - \bar{x}_2) = \mu_1 - \mu_2$$

Standard Error

$$\sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

where: σ_1 = standard deviation of population 1

σ_2 = standard deviation of population 2

n_1 = sample size from population 1

n_2 = sample size from population 2

Interval Estimation of $\mu_1 - \mu_2$: σ_1 and σ_2 Known

Interval Estimate

$$\bar{x}_1 - \bar{x}_2 \pm z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

where:

$1 - \alpha$ is the confidence coefficient

So, if we need a 95% CI, then $\alpha = 0.05$

And for 99% CI, $\alpha = 0.01$

Hypothesis Tests About $\mu_1 - \mu_2$: σ_1 and σ_2 Known

Hypotheses

$$H_0: \mu_1 - \mu_2 \geq D_0$$

$$H_a: \mu_1 - \mu_2 < D_0$$

Left-tailed

$$H_0: \mu_1 - \mu_2 \leq D_0$$

$$H_a: \mu_1 - \mu_2 > D_0$$

Right-tailed

$$H_0: \mu_1 - \mu_2 = D_0$$

$$H_a: \mu_1 - \mu_2 \neq D_0$$

Two-tailed

Test Statistic

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Example



Titleist is a manufacturer of golf equipment and has developed a new golf ball that has been designed to provide "extra distance."

In a test of driving distance using a mechanical driving device, a sample of Titliest balls was compared with a sample of golf balls made by Callaway, a competitor. The sample statistics below

| | Sample #1 <u>Titleist</u> | Sample #2 <u>Callaway</u> |
|-------------|------------------------------|------------------------------|
| Sample Size | 120 balls | 80 balls |
| Sample Mean | 275 yards | 258 yards |

Based on data from previous driving distance tests, the two population standard deviations are known with $\sigma_1 = 15$ yards and $\sigma_2 = 20$ yards.

Hypothesis Tests About $\mu_1 - \mu_2$: σ_1 and σ_2 Known

■ p -Value Approach

Develop the hypotheses.

$$H_0: \mu_1 - \mu_2 \leq 0$$
$$H_a: \mu_1 - \mu_2 > 0$$

Right-tailed test

where:

μ_1 = mean distance for the population
of Titleist golf balls

μ_2 = mean distance for the population
of Callaway golf balls



Compute the value of the test statistic.

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$z = \frac{(235 - 218) - 0}{\sqrt{\frac{(15)^2}{120} + \frac{(20)^2}{80}}} = \frac{17}{2.62} = 6.49$$



Hypothesis Tests About $\mu_1 - \mu_2$: σ_1 and σ_2 Known

p -Value Approach

Compute the *p*-value.

Social Science Statistics

For $z = 6.49$, the *p* -value < .0001.

Determine whether to reject H_0 .

Conventions*

$P > 0.10 \Rightarrow$ non-significant evidence against H_0

$0.05 < P \leq 0.10 \Rightarrow$ marginally significant evidence

$0.01 < P \leq 0.05 \Rightarrow$ significant evidence against H_0

$P \leq 0.01 \Rightarrow$ highly significant evidence against H_0

Because p -value $\leq .01$, we reject H_0 .

Titleist®
#1 ball in golf.®



Test Statistic When Population Standard Deviations are not Known

Interval Estimation of $\mu_1 - \mu_2$: σ_1 and σ_2 Unknown

When σ_1 and σ_2 are unknown, we will:

- use the sample standard deviations s_1 and s_2 as estimates of σ_1 and σ_2 and replace $z_{\alpha/2}$ with $t_{\alpha/2}$.

Interval Estimate

$$\bar{x}_1 - \bar{x}_2 \pm t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Where the degrees of freedom for $t_{\alpha/2}$ are:

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right)^2}{\frac{1}{n_1 - 1} \left(\frac{s_1^2}{n_1} \right)^2 + \frac{1}{n_2 - 1} \left(\frac{s_2^2}{n_2} \right)^2}$$

Difference Between Two Population Means: σ_1 and σ_2 Unknown



Example: Amazon

Are female customers more likely to recommend Amazon to their friends and family than male customers?

| | |
|---------------|---------|
| S1 Are you... | GO TO |
| | Male S2 |
| | Female |

| Likelihood Recommend | | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Q13 How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. | | | | | | |
| PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND. SHOW EACH RETAILER ON SEPARATE SCREENS. | | | | | | |
| | Brand X | JC Penney | Kohl's | Nordstrom | Amazon | TJ Maxx |
| 0 | <input type="radio"/> |
| 1 | <input type="radio"/> |
| 2 | <input type="radio"/> |
| 3 | <input type="radio"/> |
| 4 | <input type="radio"/> |
| 5 | <input type="radio"/> |
| 6 | <input type="radio"/> |
| 7 | <input type="radio"/> |

Hypothesis Tests About $\mu_{\text{Females (1)}} - \mu_{\text{Males (2)}}$ $\sigma_{\text{Females (1)}} \text{ and } \sigma_{\text{Males (2)}}$ Unknown

Hypotheses

$$H_0: \mu_1 - \mu_2 \geq D_0$$

$$H_a: \mu_1 - \mu_2 < D_0$$

Left-tailed

$$H_0: \mu_1 - \mu_2 \leq D_0$$

$$H_a: \mu_1 - \mu_2 > D_0$$

Right-tailed

$$H_0: \mu_1 - \mu_2 = D_0$$

$$H_a: \mu_1 - \mu_2 \neq D_0$$

Two-tailed

Test Statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$



Which of the above are
we using?



357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

| | Name | Type | Decimals | Label | Values | Missing | Columns | Align |
|----|-----------------|---------|---------------------------|----------------------------------|--------------------|---------------------|---------|-------|
| 1 | respid | N | 0 | respid | None | None | 8 | Right |
| 2 | status | S | 0 | Means... | None | None | 20 | Left |
| 3 | interview_start | D | General Linear Model | None | None | 8 | Right | |
| 4 | interview_end | D | Generalized Linear Models | None | None | 8 | Right | |
| 5 | htotaltimein... | N | Mixed Models | None | None | 8 | Right | |
| 6 | userid | S | Correlate | None | None | 8 | Right | |
| 7 | subsid | S | Regression | None | None | 50 | Left | |
| 8 | s1 | N | Loglinear | None | None | 50 | Left | |
| 9 | os2 | S | Neural Networks | 0 | SubsID | None | 50 | Left |
| 10 | dregion | N | Classify | 0 | Are you... | {1, Male}... | 8 | Right |
| 11 | dregion1 | N | Dimension Reduction | 0 | Please enter yo... | None | 5 | Left |
| 12 | s3 | N | Scale | 0 | dRegion | {1, NORTH...} | 8 | Right |
| 13 | hage | N | Nonparametric Tests | 0 | dRegion1 | {1, Northeas...} | 8 | Right |
| 14 | s4_1 | N | Forecasting | 0 | Please enter yo... | None | 8 | Right |
| 15 | s4_2 | N | Survival | 0 | PLEASE CODE... | {1, 1-17}... | 8 | Right |
| 16 | s4_3 | N | Multiple Response | 0 | No, not of Hisp... | None | 8 | Right |
| 17 | s4_4 | N | Missing Value Analysis... | 0 | Yes, Mexican, ... | None | 8 | Right |
| 18 | s4_5 | Numeric | 1 | Complex Samples | 0 | Yes, Puerto Ric... | None | Right |
| 19 | s4_6 | Numeric | 1 | Spatial and Temporal Modeling... | 0 | Yes, Cuban (Ar... | None | Right |
| 20 | s5_1 | Numeric | 1 | Direct Marketing | 0 | Yes, Central / S... | None | Right |
| 21 | s5_2 | Numeric | 1 | | 0 | Yes, other Hisp... | None | Right |
| | | | | | 0 | White / Caucasi... | None | Right |
| | | | | | 0 | Black / African ... | None | Right |

Data View Variable View

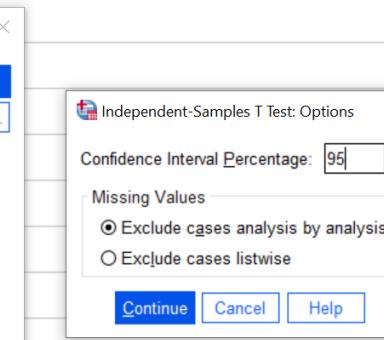
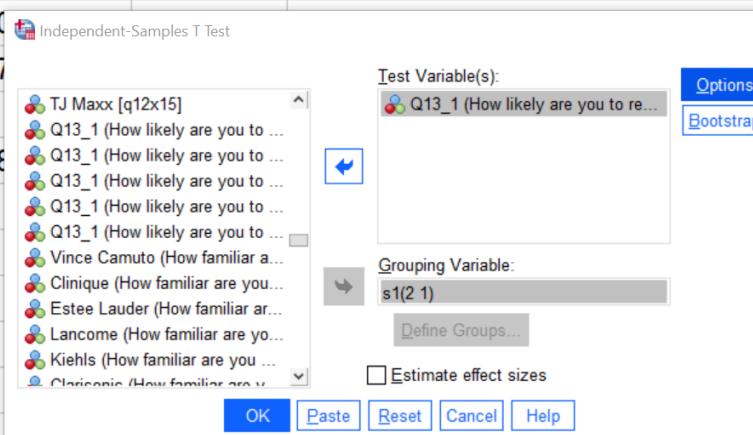
Independent-Samples T Test...

IBM SPSS Statistics Processor is ready Unicode:ON

Type here to search

O D F G C M W X S P L 4:27 PM 9/22/2020

| | Type | Width | Decimals | Label | Values |
|----|------------|---------|-----------------------------------|--|--------------|
| 1 | Numeric | 8 | 0 | respid | None |
| 2 | String | 8 | 0 | status | None |
| 3 | start Date | 10 | 0 | interview_start | None |
| 4 | end Date | 10 | 0 | Independent-Samples T Test | None |
| 5 | in... | Numeric | 17 | TJ Maxx [q12x15] | None |
| 6 | String | 1 | Q13_1 (How likely are you to ... | None | |
| 7 | String | 18 | Q13_1 (How likely are you to ... | None | |
| 8 | Numeric | 1 | Q13_1 (How likely are you to ... | None | |
| 9 | String | 5 | Q13_1 (How likely are you to ... | None | |
| 10 | Numeric | 1 | Vince Camuto (How familiar a... | None | |
| 11 | Numeric | 1 | Clinique (How familiar are y... | None | |
| 12 | Numeric | 2 | Estee Lauder (How familiar ar... | None | |
| 13 | Numeric | 2 | Lancome (How familiar are yo... | None | |
| 14 | Numeric | 1 | Kiehls (How familiar are you ... | None | |
| 15 | Numeric | 1 | Clarisonic (How familiar are y... | None | |
| 16 | Numeric | 1 | - | NG AGE BREAKS: | {1, 1-17}... |
| 17 | Numeric | 1 | 0 | No, not of Hispanic, Latino or Spanish origin (Are you of Hispanic, Latin... | None |
| 18 | Numeric | 1 | 0 | Yes, Mexican, Mexican American or Chicano (Are you of Hispanic, Latin... | None |
| 19 | Numeric | 1 | 0 | Yes, Puerto Rican (Are you of Hispanic, Latino or Spanish origin?) | None |
| 20 | Numeric | 1 | 0 | Yes, Cuban (Are you of Hispanic, Latino or Spanish origin?) | None |
| 21 | Numeric | 1 | 0 | Yes, Central / South American (Are you of Hispanic, Latino or Spanish ... | None |
| 22 | Numeric | 1 | 0 | Yes, other Hispanic, Latino or Spanish origin (Are you of Hispanic, Lat... | None |
| 23 | Numeric | 1 | 0 | White / Caucasian (Which of the following describes your racial or eth... | None |
| 24 | Numeric | 1 | 0 | Black / African American (Which of the following describes your racial o... | None |



...NG AGE BREAKS

SPSS Output

T-Test

| Group Statistics | | | | | |
|---|------------|------|------|----------------|-----------------|
| | Are you... | N | Mean | Std. Deviation | Std. Error Mean |
| Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. Amazon) | Female | 1140 | 8.76 | 1.676 | .050 |
| | Male | 468 | 8.74 | 1.457 | .067 |



Independent Samples Test

| Q13_1 (How likely are you to recommend the following retailer to friends and family members, on a scale from 0-10, where 0=Not at all likely to recommend, and 10= Will definitely recommend. Amazon) | Levene's Test for Equality of Variances | | | | t-test for Equality of Means | | | | 95% Confidence Interval of the Difference | | |
|---|---|------|------|---------|------------------------------|-------------|-----------------|-----------------------|---|-------|--|
| | F | Sig. | t | df | Significance | | Mean Difference | Std. Error Difference | Lower | Upper | |
| | | | | | One-Sided p | Two-Sided p | | | | | |
| Equal variances assumed | 3.991 | .046 | .337 | 1606 | .368 | .736 | .030 | .089 | -.144 | .204 | |
| Equal variances not assumed | | | .357 | 992.175 | .361 | .721 | .030 | .084 | -.134 | .194 | |

Comparing Proportions of Two Populations

Estimating the Difference Between Two Population Proportions

Let p_1 equal the proportion in population 1 and p_2 equal the proportion in population 2.

The difference between the two-population proportions is $p_1 - p_2$.

To estimate $p_1 - p_2$, we will select a simple random sample of size n_1 from population 1 and a simple random sample of size n_2 from population 2.

The point estimator of the difference between the proportions of the populations 1 and 2 is $\bar{p}_1 - \bar{p}_2$

Sampling Distribution of $\bar{p}_1 - \bar{p}_2$

Expected Value

$$E(\bar{p}_1 - \bar{p}_2) = p_1 - p_2$$

Standard Error

$$\sigma_{\bar{p}_1 - \bar{p}_2} = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

where: n_1 = size of sample taken from population 1

n_2 = size of sample taken from population 2

Sampling Distribution of $\bar{p}_1 - \bar{p}_2$

If the sample sizes are large, the sampling distribution of $\bar{p}_1 - \bar{p}_2$ can be approximated by a normal probability distribution.

The sample sizes are sufficiently large if all of these conditions are met:

$$n_1 p_1 \geq 5$$

$$n_1(1 - p_1) \geq 5$$

$$n_2 p_2 \geq 5$$

$$n_2(1 - p_2) \geq 5$$

Interval Estimation of $p_1 - p_2$

Interval Estimate

$$\bar{p}_1 - \bar{p}_2 \pm z_{\alpha/2} \sqrt{\frac{\bar{p}_1(1-\bar{p}_1)}{n_1} + \frac{\bar{p}_2(1-\bar{p}_2)}{n_2}}$$

where:

$1 - \alpha$ is the confidence coefficient

So, if we need a 95% CI, then $\alpha = 0.05$

And for 99% CI, $\alpha = 0.01$

Hypothesis Tests about $p_1 - p_2$

Hypotheses

Let's stick with the Two-tailed test (i.e. $p_1 = p_2$)

$$H_0: p_1 - p_2 \geq 0$$

$$H_a: p_1 - p_2 < 0$$

Left-tailed

$$H_0: p_1 - p_2 \leq 0$$

$$H_a: p_1 - p_2 > 0$$

Right-tailed

$$H_0: p_1 - p_2 = 0$$

$$H_a: p_1 - p_2 \neq 0$$

Two-tailed

Hypothesis Tests about $p_1 - p_2$

Pooled Estimate of Standard Error of $\bar{p}_1 - \bar{p}_2$

$$\sigma_{\bar{p}_1 - \bar{p}_2} = \sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

where:

$$\bar{p} = \frac{n_1 \bar{p}_1 + n_2 \bar{p}_2}{n_1 + n_2}$$

Hypothesis Tests about $p_1 - p_2$

Test Statistic

$$z = \frac{(\bar{p}_1 - \bar{p}_2)}{\sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where:

$$\bar{p} = \frac{n_1 \bar{p}_1 + n_2 \bar{p}_2}{n_1 + n_2}$$

Difference Between Two Population Proportions:

Example: Amazon vs. Nordstrom

There is no difference between the proportion of Amazon customers who are likely to purchase within the next month as compared to the proportion of Nordstrom customers?

NORDSTROM

Likelihood to Purchase

Q12 For the following retailers, when do you anticipate your next purchase at that store might be?

PROGRAMMER: ALLOW ONLY ONE ANSWER PER BRAND.

amazon

| | Brand X | JC Penney | Kohl's | Nordstrom | Amazon | TJ Maxx |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Within the next month | <input type="radio"/> |
| Within next 1-3 months | <input type="radio"/> |
| With next 3-6 months | | | | | | |
| Within next 6-9 months | <input type="radio"/> |
| Within 9 months – 1 year | <input type="radio"/> |
| Longer than 1 year | <input type="radio"/> |
| I'm not sure when I will shop there again | | | | | | |

Hypothesis Tests about $p_{Amazon} - p_{Nordstrom}$

Hypothesis

$$H_0: p_1 - p_2 = 0$$

$$H_a: p_1 - p_2 \neq 0$$



NORDSTROM

Test Statistic

$$z = \frac{(\bar{p}_1 - \bar{p}_2)}{\sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where:

$$\bar{p} = \frac{n_1 \bar{p}_1 + n_2 \bar{p}_2}{n_1 + n_2}$$



SPSS doesn't directly do this test, so we seek help elsewhere 😊

Social Science Statistics

357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

Name

| 689 | d3d_7 | N | target (Do you own a credit or charge card from any of these department ... | No | |
|-----|------------|---------|--|--|-----|
| 690 | d3d_8 | N | CPenney (Do you own a credit or charge card from any of these depart... | No | |
| 691 | d3d_9 | N | ohl's (Do you own a credit or charge card from any of these department ... | No | |
| 692 | d3d_10 | N | one of these (Do you own a credit or charge card from any of these dep... | No | |
| 693 | d4 | N | Which of the following statements best describes your current employme... | {1} | |
| 694 | d4a | N | Which of the following statements best describes you? | {1} | |
| 695 | responseid | N | responseid | No | |
| 696 | q12x1 | N | Brand X | {1} | |
| 697 | q12x2 | N | JC Penney | {1} | |
| 698 | q12x11 | N | Kohl's | {1} | |
| 699 | q12x3 | N | Nordstrom | {1} | |
| 700 | q12x23 | N | Amazon | {1} | |
| 701 | q12x15 | N | TJ Maxx | {1} | |
| 702 | q13_1_1 | N | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} | |
| 703 | q13_1_2 | N | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} | |
| 704 | q13_1_11 | N | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} | |
| 705 | q13_1_3 | N | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} | |
| 706 | q13_1_23 | Numeric | 2 | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} |
| 707 | q13_1_15 | Numeric | 2 | Q13_1 (How likely are you to recommend the following retailer to friends ... | {0} |
| 708 | q19a_24 | Numeric | 1 | Vince Camuto (How familiar are you with the following brands, for women'... | {1} |
| 709 | q19anew_1 | Numeric | 1 | Clinique (How familiar are you with the following brands, for skincare and ... | {1} |

Label

Data View Variable View

Frequencies... IBM SPSS Statistics Processor is ready Unicode:ON

Type here to search

12:45 PM 9/23/2020

357614 SPSS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

Name Type Width Decimals Label

| | | | | | |
|-----|------------|---------|---|---|--|
| 689 | d3d_7 | Numeric | 1 | 0 | Target (Do you own a credit or charge card from any of these department ... No) |
| 690 | d3d_8 | Numeric | 1 | 0 | JCPenney (Do you own a credit or charge card from any of these depart... No) |
| 691 | d3d_9 | Numeric | 1 | 0 | Kohl's (Do you own a credit or charge card from any of these department ... No) |
| 692 | d3d_10 | Numeric | 1 | 0 | None of these (Do you own a credit or charge card from any of these dep... No) |
| 693 | d4 | Numeric | 1 | 0 | Which of the following statements best describes your current employme... {1} |
| 694 | d4a | Numeric | 1 | 0 | Which of the following statements best describes you? {1} |
| 695 | responseid | Numeric | | | |
| 696 | q12x1 | Numeric | | | |
| 697 | q12x2 | Numeric | | | |
| 698 | q12x11 | Numeric | | | |
| 699 | q12x3 | Numeric | | | |
| 700 | q12x23 | Numeric | | | |
| 701 | q12x15 | Numeric | | | |
| 702 | q13_1_1 | Numeric | | | owing retailer to friends ... {0} |
| 703 | q13_1_2 | Numeric | 2 | 0 | Q13_1 (How likely are you to recommend the following retailer to friends ... {0} |
| 704 | q13_1_11 | Numeric | 2 | 0 | Q13_1 (How likely are you to recommend the following retailer to friends ... {0} |
| 705 | q13_1_3 | Numeric | 2 | 0 | Q13_1 (How likely are you to recommend the following retailer to friends ... {0} |
| 706 | q13_1_23 | Numeric | 2 | 0 | Q13_1 (How likely are you to recommend the following retailer to friends ... {0} |
| 707 | q13_1_15 | Numeric | 2 | 0 | Q13_1 (How likely are you to recommend the following retailer to friends ... {0} |
| 708 | q19a_24 | Numeric | 1 | 0 | Vince Camuto (How familiar are you with the following brands, for women'... {1} |
| 709 | q19anew_1 | Numeric | 1 | 0 | Clinique (How familiar are you with the following brands, for skincare and ... {1} |

Frequencies

Variable(s):

- Nordstrom [q12x3]
- Amazon [q12x23]

Statistics...

Charts...

Format...

Style...

Bootstrap...

Display frequency tables Create APA style tables

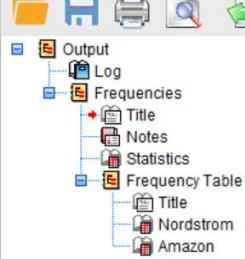
OK **Paste** **Reset** **Cancel** **Help**

Data View **Variable View**

IBM SPSS Statistics Processor is ready

Unicode:ON

Links 12:46 PM 9/23/2020



| | Nordstrom | Amazon |
|---------|-----------|--------|
| N | 1590 | 1608 |
| Missing | 2741 | 2723 |

Frequency Table

Nordstrom

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|---|-----------|---------|---------------|--------------------|
| Valid | Within the next month | 262 | 6.0 | 16.5 | 16.5 |
| | Within next 1-3 months | 350 | 8.1 | 22.0 | 38.5 |
| | With next 3-6 months | 300 | 6.9 | 18.9 | 57.4 |
| | Within next 6-9 months | 147 | 3.4 | 9.2 | 66.6 |
| | Within 9 months – 1 year | 135 | 3.1 | 8.5 | 75.1 |
| | Longer than 1 year | 105 | 2.4 | 6.6 | 81.7 |
| | I'm not sure when I will shop there again | 291 | 6.7 | 18.3 | 100.0 |
| | Total | 1590 | 36.7 | 100.0 | |
| Missing | System | 2741 | 63.3 | | |
| | Total | 4331 | 100.0 | | |

Amazon

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|---|-----------|---------|---------------|--------------------|
| Valid | Within the next month | 1068 | 24.7 | 66.4 | 66.4 |
| | Within next 1-3 months | 336 | 7.8 | 20.9 | 87.3 |
| | With next 3-6 months | 108 | 2.5 | 6.7 | 94.0 |
| | Within next 6-9 months | 26 | .6 | 1.6 | 95.6 |
| | Within 9 months – 1 year | 17 | .4 | 1.1 | 96.7 |
| | Longer than 1 year | 6 | .1 | .4 | 97.1 |
| | I'm not sure when I will shop there again | 47 | 1.1 | 2.9 | 100.0 |
| | Total | 1608 | 37.1 | 100.0 | |
| Missing | System | 2723 | 62.9 | | |
| | Total | 4331 | 100.0 | | |

NORDSTROM

amazon

Type here to search

IBM SPSS Statistics Processor is ready

Unicode:ON

12:47 PM
9/23/2020

Z Score Calculator for 2 Population Proportions

The z-score test for two population proportions is used when you want to know whether two populations or groups (e.g., liberals and conservatives) differ significantly on some single (categorical) characteristic - for example, whether they watch *South Park*.

To use the calculator, just input the proportions (or absolute numbers) for your two samples in the textboxes below, together with the size of each sample. Then press the "Calculate Z" button.

Sample 1 Proportion (or total number)

0.664

Sample 1 Size (N_1)

1608

Sample 2 Proportion (or total number)

0.165

Sample 2 Size (N_2)

1590

Significance Level:

- 0.01
- 0.05
- 0.10

One-tailed or two-tailed hypothesis?:

- One-tailed
- Two-tailed

No calculation performed yet.

[Calculate Z](#)

[Reset](#)

Social Science Statistics

Z Score Calculator for 2 Population Proportions

Success!

You'll find the values for z and p below. Blue means your result is significant, red means it's not.

Sample 1 Proportion (or total number)

.664

Sample 1 Size (N_1)

1608

Sample 2 Proportion (or total number)

.165

Sample 2 Size (N_2)

1590

Significance Level:

- 0.01
- 0.05
- 0.10

One-tailed or two-tailed hypothesis?:

- One-tailed
- Two-tailed

The value of z is 28.6262. The value of p is < .00001. The result is significant at $p < .05$.

[Calculate Z](#)

[Reset](#)



Group Work

- Since we have 79 registered students, 20 groups will be created with students being randomly assigned
- Please submit your work no later than 10:00pm EST. There is no drop box, work needs to be submitted via email to harvir.bansal@uwaterloo.ca
- Please ensure that you clearly outline the steps taken in your analysis as well as the results.
- As I have said multiple times, data analysis is not a spectator sport so PLAY and have fun

Hands-on Data Analysis

- All questions below refer to the brand tracking questionnaire and data made available for this class on LEARN
 1. Are there any stores where males and females different in their commitment to the brand? Explain via analysis
 2. Are Kohl's customers equally likely to purchase a product within the next 9 months as compared to TJ Maxx's customers?
 3. As compared to Amazon's NPS score which retailer must work hardest to compete?

TILL
NEXT
TIME

