Overview of Survey Research

BUS 230: Business Research and Communication
Goals of this chapter:

- Learn potential and sources for biases in survey research.
- Learn about types of measurements that can be obtained with survey research.

Learning objectives:

- LO2: Recognize and use the appropriate techniques to collect or use survey data to address a research problem.
- LO2.C: Identify sources of respondent and administrative error and develop the ability to construct and administer a survey instrument that minimizes these errors.
Goals of this chapter:
- Learn potential and sources for biases in survey research.
- Learn about types of measurements that can be obtained with survey research.

Learning objectives:
- LO2: Recognize and use the appropriate techniques to collect or use survey data to address a research problem.
- LO2.C: Identify sources of respondent and administrative error and develop the ability to construct and administer a survey instrument that minimizes these errors.
**Simple random sample**: when all members of the population have an equal probability of being selected for the sample.

- Selection of one observation is independent of another being selected (no point-of-contact, cluster sampling, etc).
- This *does not* mean taking a representative sample - though you should still expect your example to be representative of the population.
- Most important: selection is independent from the outcome/dependent variable.
Random Sampling

**Simple random sample:** when all members of the population have an equal probability of being selected for the sample.

- Selection of one observation is independent of another being selected (no point-of-contact, cluster sampling, etc).
- This *does not* mean taking a representative sample - though you should still expect your example to be representative of the population.
- Most important: selection is independent from the outcome/dependent variable.
Random Sampling

**Simple random sample:** when all members of the population have an equal probability of being selected for the sample.

- Selection of one observation is independent of another being selected (no point-of-contact, cluster sampling, etc).
- This *does not* mean taking a representative sample - though you should still expect your example to be representative of the population.
- Most important: selection is independent from the outcome/dependent variable.
Simple random sample: when all members of the population have an equal probability of being selected for the sample.

- Selection of one observation is independent of another being selected (no point-of-contact, cluster sampling, etc).
- This *does not* mean taking a representative sample - though you should still expect your example to be representative of the population.
- Most important: selection is independent from the outcome/dependent variable.
- **Unbiased estimator**: when a sample estimate (statistic) of a population parameter on average returns the true population parameter.

- **Bias**: when a sample estimate on average returns a value different than the population parameter.

- **Random sampling error**: statistical fluctuations determined by chance due to random sampling.
  
  - Unbiased error.
  
  - Easy to estimate the size of the sampling error (you used this estimate for H-tests, confidence intervals).
**Unbiased estimator**: when a sample estimate (statistic) of a population parameter on average returns the true population parameter.

**Bias**: when a sample estimate on average returns a value different than the population parameter.

**Random sampling error**: statistical fluctuations determined by chance due to random sampling.

- Unbiased error.
- Easy to estimate the size of the sampling error (you used this estimate for H-tests, confidence intervals).
Unbiased versus Biased Estimators

- **Unbiased estimator**: when a sample estimate (statistic) of a population parameter on average returns the true population parameter.
- **Bias**: when a sample estimate on average returns a value different than the population parameter.
- **Random sampling error**: statistical fluctuations determined by chance due to random sampling.
  - Unbiased error.
  - Easy to estimate the size of the sampling error (you used this estimate for H-tests, confidence intervals).
Unbiased versus Biased Estimators

- **Unbiased estimator:** when a sample estimate (statistic) of a population parameter on average returns the true population parameter.

- **Bias:** when a sample estimate on average returns a value different than the population parameter.

- **Random sampling error:** statistical fluctuations determined by chance due to random sampling.
  - Unbiased error.
    - Easy to estimate the size of the sampling error (you used this estimate for H-tests, confidence intervals).
Unbiased versus Biased Estimators

- **Unbiased estimator**: when a sample estimate (statistic) of a population parameter on average returns the true population parameter.

- **Bias**: when a sample estimate on average returns a value different than the population parameter.

- **Random sampling error**: statistical fluctuations determined by chance due to random sampling.
  - Unbiased error.
  - Easy to estimate the size of the sampling error (you used this estimate for H-tests, confidence intervals).
**Systematic error**: some imperfect aspect of your research design causes additional error.

- It is typically impossible to measure systematic error.
- Systematic error causes **sample bias**, the persistent tendency of the results to be biased due to a problem in the sampling procedure.
Systematic error: some imperfect aspect of your research design causes additional error.

It is typically impossible to measure systematic error.

Systematic error causes sample bias, the persistent tendency of the results to be biased due to a problem in the sampling procedure.
- **Systematic error**: some imperfect aspect of your research design causes additional error.

- It is typically impossible to measure systematic error.

- Systematic error causes **sample bias**, the persistent tendency of the results to be biased due to a problem in the sampling procedure.
Nonresponse error: systematic error that occurs when individuals surveyed choose not to participate in the research, and the choice to not participate may be related to the outcome variable.

Self-selection bias: bias that results from nonresponse error.

Examples:
- Viterbo awareness survey: individuals less knowledgeable and/or less interested in Viterbo University were less likely to respond to the survey.
- Customer satisfaction survey: individuals who are satisfied, but by no means excited, about product or service are less likely to respond to a customer satisfaction survey.
Nonresponse Error

- **Nonresponse error**: systematic error that occurs when individuals surveyed choose not to participate in the research, and the choice to not participate may be related to the outcome variable.

- **Self-selection bias**: bias that results from nonresponse error.

  - Examples:
    - Viterbo awareness survey: individuals less knowledgeable and/or less interested in Viterbo University were less likely to respond to the survey.
    - Customer satisfaction survey: individuals who are satisfied, but by no means excited, about product or service are less likely to respond to a customer satisfaction survey.
Nonresponse Error

- **Nonresponse error**: systematic error that occurs when individuals surveyed choose not to participate in the research, *and the choice to not participate may be related to the outcome variable*.

- **Self-selection bias**: bias that results from nonresponse error.

- **Examples**:
  - Viterbo awareness survey: individuals less knowledgeable and/or less interested in Viterbo University were less likely to respond to the survey.
  - Customer satisfaction survey: individuals who are satisfied, but by no means excited, about product or service are less likely to respond to a customer satisfaction survey.
Nonresponse Error

- **Nonresponse error**: systematic error that occurs when individuals surveyed choose not to participate in the research, and the choice to not participate may be related to the outcome variable.

- **Self-selection bias**: bias that results from nonresponse error.

Examples:

- Viterbo awareness survey: individuals less knowledgeable and/or less interested in Viterbo University were less likely to respond to the survey.

- Customer satisfaction survey: individuals who are satisfied, but by no means excited, about product or service are less likely to respond to a customer satisfaction survey.
Nonresponse Error

- **Nonresponse error**: systematic error that occurs when individuals surveyed choose not to participate in the research, and the choice to not participate may be related to the outcome variable.

- **Self-selection bias**: bias that results from nonresponse error.

Examples:
- Viterbo awareness survey: individuals less knowledgeable and/or less interested in Viterbo University were less likely to respond to the survey.
- Customer satisfaction survey: individuals who are satisfied, but by no means excited, about product or service are less likely to respond to a customer satisfaction survey.
Response Bias

- **Response bias**: a bias that exists when respondents either consciously or unconsciously give answers to questions that misrepresent the truth.

- **Appear intelligent**: respondents deliberately falsify the answer to hide the fact they don’t know or didn’t keep track of this information.
  - Respondents might guess what answer is expected from them, give answers that would please the interviewer or researcher.
  - Example: Price paid for grocery items, respondents might guess instead of honestly answering they don’t remember.

- **Average person effect**: respondents try to appear average, often happens with questions related to income or spending.
Response Bias

- **Response bias**: a bias that exists when respondents either consciously or unconsciously give answers to questions that misrepresent the truth.

- Appear intelligent: respondents deliberately falsify the answer to hide the fact they don’t know or didn’t keep track of this information.
  - Respondents might guess what answer is expected from them, give answers that would please the interviewer or researcher.
  - Example: Price paid for grocery items, respondents might guess instead of honestly answering they don’t remember.

- Average person effect: respondents try to appear average, often happens with questions related to income or spending.
• **Response bias**: a bias that exists when respondents either consciously or unconsciously give answers to questions that misrepresent the truth.
• Appear intelligent: respondents deliberately falsify the answer to hide the fact they don’t know or didn’t keep track of this information.
  • Respondents might guess what answer is expected from them, give answers that would please the interviewer or researcher.
  • Example: Price paid for grocery items, respondents might guess instead of honestly answering they don’t remember.
• Average person effect: respondents try to appear average, often happens with questions related to income or spending.
Response bias: a bias that exists when respondents either consciously or unconsciously give answers to questions that misrepresent the truth.

- APPEAR INTELLIGENT: respondents deliberately falsify the answer to hide the fact they don’t know or didn’t keep track of this information.
  - Respondents might guess what answer is expected from them, give answers that would please the interviewer or researcher.
  - Example: Price paid for grocery items, respondents might guess instead of honestly answering they don’t remember.

- AVERAGE PERSON EFFECT: respondents try to appear average, often happens with questions related to income or spending.
Response Bias

- **Response bias**: a bias that exists when respondents either consciously or unconsciously give answers to questions that misrepresent the truth.

- **Appear intelligent**: respondents deliberately falsify the answer to hide the fact they don’t know or didn’t keep track of this information.
  - Respondents might guess what answer is expected from them, give answers that would please the interviewer or researcher.
  - Example: Price paid for grocery items, respondents might guess instead of honestly answering they don’t remember.

- **Average person effect**: respondents try to appear average, often happens with questions related to income or spending.
Unconscious response bias: well meaning respondents unconsciously give answers that misrepresent the truth.

- Situation might dictate response. Example: preference for aircraft given on the plane.
- Unexpected question: respondents have thought little about the question, give best initial answer they can.
- Example: intentions of buying a product, consumers may not accurately predict their own future buying behavior.
- Time lapse: respondents may under-report activities that occurred long ago which are difficult to remember in detail.
Unconscious response bias: well meaning respondents unconsciously give answers that misrepresent the truth.

Situation might dictate response. Example: preference for aircraft given on the plane.

Unexpected question: respondents have thought little about the question, give best initial answer they can.

Example: intentions of buying a product, consumers may not accurately predict their own future buying behavior.

Time lapse: respondents may under-report activities that occurred long ago which are difficult to remember in detail.
Unconscious response bias: well meaning respondents unconsciously give answers that misrepresent the truth.

Situation might dictate response. Example: preference for aircraft given on the plane.

Unexpected question: respondents have thought little about the question, give best initial answer they can.

Example: intentions of buying a product, consumers may not accurately predict their own future buying behavior.

Time lapse: respondents may under-report activities that occurred long ago which are difficult to remember in detail.
Unconscious response bias: well meaning respondents unconsciously give answers that misrepresent the truth.

Situation might dictate response. Example: preference for aircraft given on the plane.

Unexpected question: respondents have thought little about the question, give best initial answer they can.

Example: intentions of buying a product, consumers may not accurately predict their own future buying behavior.

Time lapse: respondents may under-report activities that occurred long ago which are difficult to remember in detail.
Unconscious response bias: well meaning respondents unconsciously give answers that misrepresent the truth.

Situation might dictate response. Example: preference for aircraft given on the plane.

Unexpected question: respondents have thought little about the question, give best initial answer they can.

Example: intentions of buying a product, consumers may not accurately predict their own future buying behavior.

Time lapse: respondents may under-report activities that occurred long ago which are difficult to remember in detail.
Types of Response Bias

- **Acquiescence bias:** when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias:** when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias:** either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
**Types of Response Bias**

- **Acquiescence bias:** when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias:** when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias:** either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Types of Response Bias

- **Acquiescence bias**: when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias**: when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias**: either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Types of Response Bias

- **Acquiescence bias:** when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias:** when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias:** either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Types of Response Bias

- **Acquiescence bias**: when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias**: when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias**: either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Types of Response Bias

- **Acquiescence bias**: when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias**: when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias**: either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Types of Response Bias

- **Acquiescence bias**: when respondents tend to agree or disagree with every statement.
  - Can happen with surveys concerning new products.

- **Extremity bias**: when respondents choose to use extreme responses on a scale; some respondents have the opposite problem and almost always refuse to pick extreme responses.

- **Social desirability bias**: either consciously or unconsciously, respondents give answers to appear prestigious, socially conscious or avoid appearing socially unattractive.
  - Did you vote in the last election?
  - Do you have termites in your home?
  - Questions regarding sensitive issues, such as sexual activity.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.
- Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.
- Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

- Avoid questions concerning subconscious behavior.
Structured questions: give respondents a limited categories to choose answer from.

- Might not be necessary for age, unless you feel respondents are sensitive about this.
- Might help with details that are difficult to remember, such as number of hours spent studying, price paid for a product.
- Allow a “I don’t remember” or similar response.

Disguised questions: questions do not reveal purpose of the research project, which might cause extremity bias, acquiescence bias, or nonresponse bias.

- Example: Satisfaction with Economics Ph.D. program.
- Ask several different types of questions.

Avoid questions concerning subconscious behavior.
Explore four different types of data:
- Nominal Data
- Ordinal Data
- Interval Data
- Ratio Data

Introduce the types of statistical methods appropriate for each.
Explore four different types of data:

- Nominal Data
- Ordinal Data
- Interval Data
- Ratio Data

Introduce the types of statistical methods appropriate for each.
Nominal Data: qualitative data that consists of categories that cannot be ordered in a meaningful way.

Example: Store Location
- Inside mall.
- Outdoor shopping complex.
- Stand-alone store.

Statistical methods:
- T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
- Test for a difference in sales volume between store locations.
- Chi-squared test of independence: tests for a relationship between two categorical variables.
- Test to see if store location and customer satisfaction are related.
- Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

Nominal Data: qualitative data that consists of categories that cannot be ordered in a meaningful way.

Example: Store Location

- Inside mall.
- Outdoor shopping complex.
- Stand-alone store.

Statistical methods:

- T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
- Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
- Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.
- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.
- **Statistical methods:**
  - T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
  - Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
  - Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.
- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.
- **Statistical methods**:
  - T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
  - Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
  - Z-tests for proportions: What proportion of all stores are inside malls?
**Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.

**Example: Store Location**
- Inside mall.
- Outdoor shopping complex.
- Stand-alone store.

**Statistical methods:**
- T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
- Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
- Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.
- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.
- **Statistical methods**:
  - T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
    - Test for a difference in sales volume between store locations.
  - Chi-squared test of independence: tests for a relationship between two categorical variables.
    - Test to see if store location and customer satisfaction are related.
  - Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data: qualitative data that consists of categories that cannot be ordered in a meaningful way.

Example: Store Location
- Inside mall.
- Outdoor shopping complex.
- Stand-alone store.

Statistical methods:
- T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
- Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
- Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.
- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.
- **Statistical methods**:
  - **T-tests for difference in means tests**: used for quantitative data, but the nominal data can define groups to compare.
    - Test for a difference in sales volume between store locations.
  - **Chi-squared test of independence**: tests for a relationship between two categorical variables.
    - Test to see if store location and customer satisfaction are related.
  - **Z-tests for proportions**: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.
- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.
- **Statistical methods**:
  - T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
    - Test for a difference in sales volume between store locations.
  - Chi-squared test of independence: tests for a relationship between two categorical variables.
    - Test to see if store location and customer satisfaction are related.
  - Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data: qualitative data that consists of categories that cannot be ordered in a meaningful way.

Example: Store Location
- Inside mall.
- Outdoor shopping complex.
- Stand-alone store.

Statistical methods:
- T-tests for difference in means tests: used for quantitative data, but the nominal data can define groups to compare.
  - Test for a difference in sales volume between store locations.
- Chi-squared test of independence: tests for a relationship between two categorical variables.
  - Test to see if store location and customer satisfaction are related.
- Z-tests for proportions: What proportion of all stores are inside malls?
Nominal Data

- **Nominal Data**: qualitative data that consists of categories that cannot be ordered in a meaningful way.

- **Example: Store Location**
  - Inside mall.
  - Outdoor shopping complex.
  - Stand-alone store.

- **Statistical methods:**
  - **T-tests for difference in means tests**: used for quantitative data, but the nominal data can define groups to compare.
    - Test for a difference in sales volume between store locations.
  - **Chi-squared test of independence**: tests for a relationship between two categorical variables.
    - Test to see if store location and customer satisfaction are related.
  - **Z-tests for proportions**: What proportion of all stores are inside malls?
**Ordinal data**: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.

- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is *not appropriate* to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

**Statistical methods:**
- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
- Example: Mann-Whitney U-Test tests whether the median of two samples are different.
- Z-tests for Proportions: What proportion of the population rates ‘Good’ or better?
Ordinal data: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.

- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is not appropriate to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

Statistical methods:

- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
- Example: Mann-Whitney U-Test tests whether the median of two samples are different.
- Z-tests for Proportions: What proportion of the population rates 'Good' or better?
Ordinal data: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.

- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is not appropriate to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

Statistical methods:

- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
- Example: Mann-Whitney U-Test tests whether the median of two samples are different.
- Z-tests for Proportions: What proportion of the population rates 'Good' or better?
Ordinal data: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.

- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is *not appropriate* to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

Statistical methods:

- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
- Example: Mann-Whitney U-Test tests whether the median of two samples are different.
- Z-tests for Proportions: What proportion of the population rates 'Good' or better?
Ordinal data: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.
- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is *not appropriate* to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

Statistical methods:
- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
  - Example: Mann-Whitney U-Test tests whether the median of two samples are different.
  - Z-tests for Proportions: What proportion of the population rates 'Good' or better?
**Ordinal data**: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.

- Excellent.
- Very good.
- Good.
- Poor.
- Very poor.

It is *not appropriate* to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).

**Statistical methods:**

- Compute medians.
- Nonparametric methods: statistical methods that involve replacing data with ranks.
- Example: Mann-Whitney U-Test tests whether the median of two samples are different.

**Z-tests for Proportions**: What proportion of the population rates 'Good' or better?
**Ordinal Data**

- **Ordinal data**: qualitative data, but order is meaningful, but quantitative values assigned to categories are meaningless.
  - Excellent.
  - Very good.
  - Good.
  - Poor.
  - Very poor.
- It is *not appropriate* to add, subtract, multiply and divide ordinal data (and therefore cannot take averages).
- **Statistical methods**:
  - Compute medians.
  - Nonparametric methods: statistical methods that involve replacing data with ranks.
  - Example: Mann-Whitney U-Test tests whether the median of two samples are different.
  - Z-tests for Proportions: What proportion of the population rates 'Good' or better?
Interval data: order is meaningful, and distances are meaningful. However, there is no natural zero.

- Examples: temperature, time.

Ratio data: order, differences, and zero are all meaningful.

- Examples: weight, prices, speed.

Statistical methods:

- Too many to mention.
- You can compute means, compare means between groups.
- You can compute correlation between two variables that are interval or ratio.
Interval data: order is meaningful, and distances are meaningful. However, there is no natural zero.

- Examples: temperature, time.

Ratio data: order, differences, and zero are all meaningful.

- Examples: weight, prices, speed.

Statistical methods:

- Too many to mention.
- You can compute means, compare means between groups.
- You can compute correlation between two variables that are interval or ratio.
Interval and Ratio Data

- Interval data: order is meaningful, and distances are meaningful. However, there is no natural zero.
  - Examples: temperature, time.
- Ratio data: order, differences, and zero are all meaningful.
  - Examples: weight, prices, speed.
- Statistical methods:
  - Too many to mention.
  - You can compute means, compare means between groups.
  - You can compute correlation between two variables that are interval or ratio.
Interval data: order is meaningful, *and* distances are meaningful. However, there is *no natural zero*.

- Examples: temperature, time.

Ratio data: order, differences, and zero are all meaningful.

- Examples: weight, prices, speed.

Statistical methods:
- Too many to mention.
- You can compute means, compare means between groups.
- You can compute correlation between two variables that are interval or ratio.
Interval and Ratio Data

- **Interval data**: order is meaningful, \textit{and} distances are meaningful. However, there is \textit{no natural zero}.
  - Examples: temperature, time.
- **Ratio data**: order, differences, and zero are all meaningful.
  - Examples: weight, prices, speed.
- **Statistical methods**:
  - Too many to mention.
  - You can compute means, compare means between groups.
  - You can compute correlation between two variables that are interval or ratio.
Interval and Ratio Data

- Interval data: order is meaningful, and distances are meaningful. However, there is no natural zero.
  - Examples: temperature, time.
- Ratio data: order, differences, and zero are all meaningful.
  - Examples: weight, prices, speed.
- Statistical methods:
  - Too many to mention.
    - You can compute means, compare means between groups.
    - You can compute correlation between two variables that are interval or ratio.
Interval and Ratio Data

- **Interval data**: order is meaningful, and distances are meaningful. However, there is no natural zero.
  - Examples: temperature, time.
- **Ratio data**: order, differences, and zero are all meaningful.
  - Examples: weight, prices, speed.
- **Statistical methods**:
  - Too many to mention.
  - You can compute means, compare means between groups.
  - You can compute correlation between two variables that are interval or ratio.
Interval and Ratio Data

- Interval data: order is meaningful, and distances are meaningful. However, there is no natural zero.
  - Examples: temperature, time.
- Ratio data: order, differences, and zero are all meaningful.
  - Examples: weight, prices, speed.
- Statistical methods:
  - Too many to mention.
  - You can compute means, compare means between groups.
  - You can compute correlation between two variables that are interval or ratio.