Research Methodology

Asst. Prof. Dr. Wannaporn Siripala

Students who want to do thesis or dissertation want to know how to write research methodology and want to know how to prepare themselves for write chapter 3 research methodology.

ISIC model create from the three 21st Century Skills categories

Learning skills (the four C's) teach students about the mental processes required to adapt and improve upon a modern work environment.

- **Critical thinking**: Finding solutions to problems
- **Creativity**: Thinking outside the box
- **Collaboration**: Working with others
- **Communication**: Talking to others

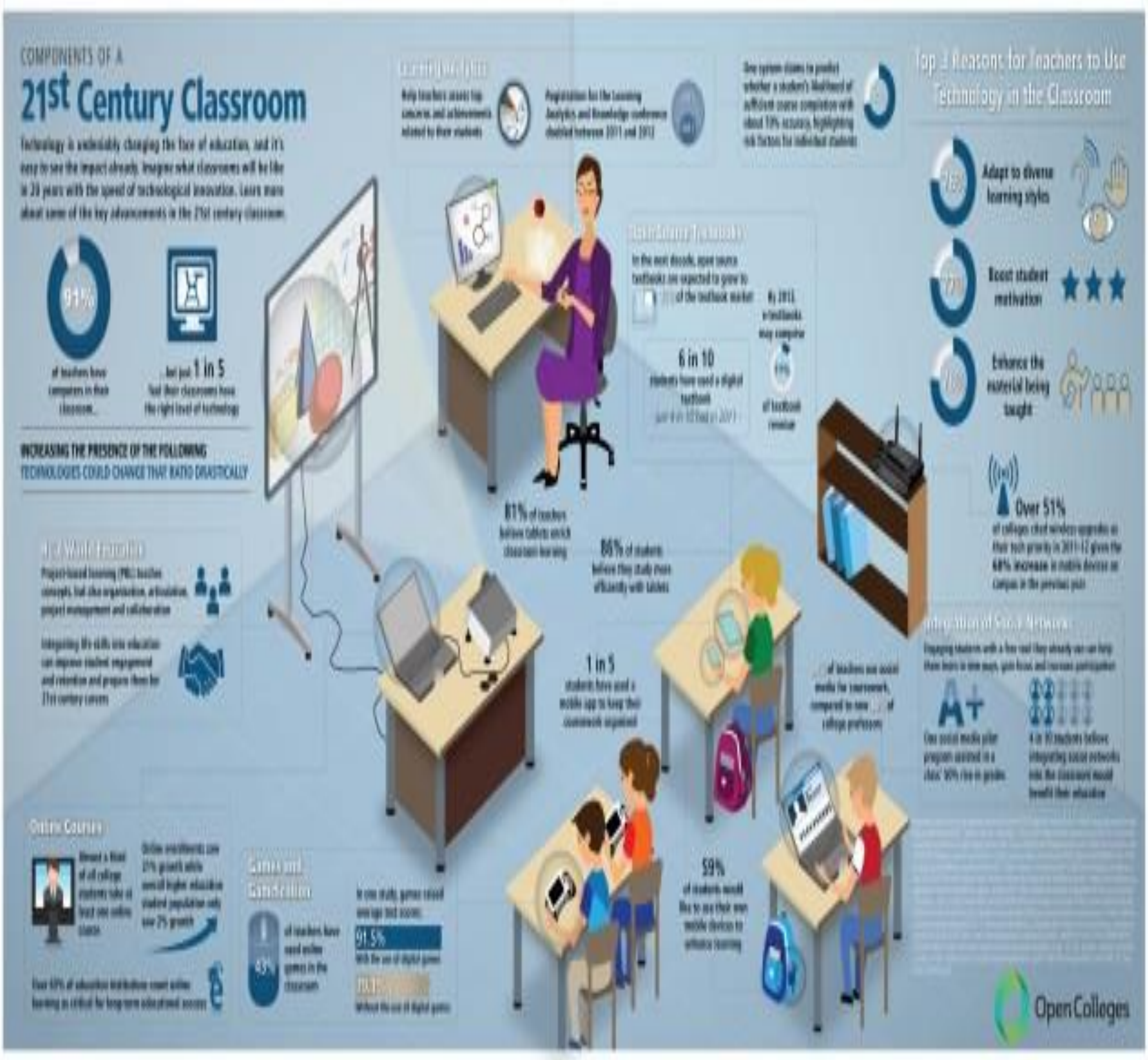
Literacy skills (IMT) focuses on how students can discern facts, publishing outlets, and the technology behind them. There's a strong focus on determining trustworthy sources and factual information to separate it from the misinformation that floods the Internet.

- **Information literacy**: Understanding facts, figures, statistics, and data
- **Media literacy**: Understanding the methods and outlets in which information is published
- **Technology literacy**: Understanding the machines that make the Information Age possible

Life skills (FLIPS) take a look at intangible elements of a student's everyday life. These intangibles focus on both personal and professional qualities. Altogether, these categories cover all twelve 21st Century skills that contribute to a student's future career.

- **Flexibility**: Deviating from plans as needed
- **Leadership**: Motivating a team to accomplish a goal
- **Initiative**: Starting projects, strategies, and plans on one's own
- **Productivity**: Maintaining efficiency in an age of distractions
- **Social skills**: Meeting and networking with others for mutual benefit

Figure 1 Components of a 21st Century Classroom



Source https://www.edtechdigest.com/2012/08/18/trends-infographic-components-of-a-21st-century-classroom/

Component of A 21st Century Classroom

Technology in undeniability changing the face of education, and it's easy to see the impact already. Imagine what classrooms will be like in 20 years with the speed of technology innovation. Learn more about some of the key advancements in the 21st century classroom.

Learning Analytics

Help teachers assess top concerns and achievements related to their students.

Top 3 reasons for teachers to use technology in the classroom

76% Adapt to diverse learning styles

77% Boost student motivation

76% Enhance the material being taught

ISIC Model

Table 1 Relate from Teaching and learning in the 21st century, Component of a 21st century classroom and Instructor in the 21st to ISIC model

Teaching and learning in the 21st century	Component of a 21st century classroom	Instructor in the 21st	ISIC model
Information media and technology skills - Information literacy		Content, Knowledge Co-learner / co-investigate	Investigate information and knowledge
	Learning analysis		Smart in analysis
Learning and Innovation skills - Creativity & innovation			Improve and creation
Learning and Innovation skills - Communication & collaboration			Complete and presented

Step for study or write research methodology, we can use the ISIC model to support writing chapter 3 research methodology as follow.

ISIC model

- **I** - Investigate information and knowledge
- **S** - Smart in analysis
- **I** - Improve and creation
- **C** - Complete and presented

1. Investigate information and knowledge

1.1 Study about structure ISIC from chapter 3 research methodology.

Each research study will have a different Chapter 3 format. Here, the format will reflect the population, sample, research instrument, quality of the research instrument, and data analysis without specifying the formula used in the research.

Structure ISIC Form Chapter 3

3.1 Research Design

3.2 Samples and Sample size

3.2.1 Population

3.2.2 Samples

3.2.3 Sampling Methods

3.3 Data Collection

3.4 Research Instrument

3.5 Content Validity and Reliability

3.6 Data Analysis

3.6.1 Descriptive Statistics

3.6.2 Inferential Statistics

1.2 Study correlation between chapter 1 introduction and chapter 3 research methodology

Table 2 Correlation between chapter 1 introduction and chapter 3 research methodology

Chapter 1 Introduction	Chapter 3 Research Methodology
1.3 Research Hypothesis	3.6 Data Analysis 3.6.2 Inferential Statistics
1.4 Research Objective	3.6 Data Analysis 3.6.1 Descriptive Statistics 3.6.2 Inferential Statistics
1.5 Scope of the Research Study	3.2 Sample and Sample Size 3.2.1 Population 3.2.2 Sample

1.3 Study about research design.

Students will write only one method for research design (qualitative research, quantitative research and mixed method). In item research design, students don't write meaning of research design.

When you want to write research design. You will know about qualitative, quantitative and mixed method or mixed model.

Qualitative Research is research that researchers must investigate to study and observe and groups of people who want to study every aspect in detail in an **in-depth manner**. Use participatory observation methods and informal interviews are the main data collection, data analysis uses logical analysis, not intended to be collected numbers for analysis.

Qualitative research process

1. Determine the research topic
2. Prepare for data collection
3. Collect qualitative data
4. Record qualitative data
5. Analyze qualitative data
6. Summarize results and write a report.

Quantitative Research is research that aims to find Quantitative facts and conclusions Emphasis is placed on using numerical data as confirmatory evidence. The accuracy of the findings and conclusions uses objective tools. Collect information such as Questionnaires, tests, observations, interviews, experiments, etc.

Quantitative research process

1. Choose a research topic.
2. Define sub-issues
3. Make a hypothesis
4. Research design
5. Gather information
6. Analyze data and interpret meanings.
7. Present a report on research results.

Mixed Method or Mixed Model

Mixed methods research or mixed model combines elements of quantitative research and qualitative research in order to answer your research question. Mixed methods can help you gain a more complete picture than a standalone quantitative or qualitative study, as it integrates benefits of both methods.

Mixed methods research is often used in the behavioral, health, and social sciences, especially in multidisciplinary settings and complex situational or societal research.

It's easy if you consider research design from research instruction.

Example

Table 3 Show correlated with instrument and research method

Instrument	Research Method
Questionnaire	Quantitative method
Test	Quantitative method
Interview	Qualitative method
Observation	Qualitative method
Questionnaire + Interview	Mixed method
Test + Questionnaire	Quantitative method
Test + Interview	Mixed method
Interview + Observation	Qualitative method

So, you will write research design only one method that you want to use.

1.5 Study about Sample and Sample size

Population is the term typically used to refer to the number of people in a single area. Governments conduct a census to quantify the size of a resident population within a given jurisdiction. The term is also applied to non-human animals, microorganisms, and plants, and has specific uses within such fields as ecology and genetics.

In education and society, when you say about population, you will think about university, college, school, class, administrator, teacher and students. But another, you can think about people, managers, administration etc.

Sample refers to a smaller, manageable version of a larger group. It is a subset containing the characteristics of a larger population. Samples are used in statistical testing when population sizes are too large for the test to include all possible members or observations.

Sample size is the number of completed responses your survey receives. It's called a sample because it only represents part of the group of people (or target population) whose opinions or behavior you care about. For example, one way of sampling is to use a "random sample," where respondents are chosen entirely by chance from the population at large. With this definition in mind, let's dive into the following topics:

Wondering how to calculate sample size? If you'd like to do the calculation by hand, use the following formula:

Formula 1 How to Calculate Sample Size

$$\textbf{Sample Size} = \frac{\text{(Z-score)^2 x StdDev x (1-StdDev)}}{\text{(confidence interval)^2}}$$

or

$$sample\ size = \frac{(Z - score)^2 \times StdDev \times (1 - StdDev)}{(confidence\ interval)^2}$$

1. Determine the population size (if known).
2. Determine the confidence interval.
3. Determine the confidence level.
4. Determine the standard deviation (a standard deviation of 0.5 is a safe choice where the figure is unknown)
5. Convert the confidence level into a Z-Score.

Formula 2 How to Calculate Sample Size

$$sample\ size = \frac{Z^2_{1-\frac{\alpha}{2}}\, p(1-p)}{d^2}$$

$Z_{1-\frac{\alpha}{2}}$ is standard normal variate (at 5% type 1 error (p < 0.05) it is 1.96 and at 1% type 1 error (p < 0.01) it is 2.58). As in majority of studies p value are considered significant below 0.05 hence 1.96 is used in formula

p = Expect proportion in population based on previous studies or pilot studies

d = Absolute error or precision – Has to be decided by researcher

Example, let us assume that a researcher wants to estimate proportion of patients having hypertension in paediatric age group in a city. According to previously published studies actual number of hypertensives may not be more than 15%. The researcher wants to calculate this sample size with the precision / absolute error of 5% and at type 1 error of 5%. So, if we use the above formula.

Actual number of hypertensives may not be more than 15% = p = 0.15

Precision / absolute error of 5% = d = 0.05

Type 1 error of 5% = $Z^2_{1-\frac{\alpha}{2}}$ = $(1.96)^2$

$$sample\ size = \frac{1.96^2 \times 0.15(1-0.15)}{0.05^2} = 196$$

So for this cross sectional study researcher has to take at least 196 subjects. If the researcher wants to increase the error (decrease the precision) then denominator will increase and hence sample size will decrease.

Formula 3 How to Calculate Sample Size

For quantitative variable

Suppose the same researcher is interested in knowing average systolic blood pressure of children of the same city then below mentioned formula should be used as blood pressure is a quantitative variable.

$$sample\ size = \frac{Z^2_{1-\frac{\alpha}{2}} SD^2}{d^2}$$

$Z_{1-\frac{\alpha}{2}}$ is standard normal variate as mentioned in previous section.

SD = Standard deviation of variable. Value of standard deviation can be taken from previously done study or through pilot study.

d = Absolute error or precision as mentioned in previous section

Formula 4 How to Calculate Sample Size

Internet, you can find some web site to help you

Figure 2 Show website calculate your sample size

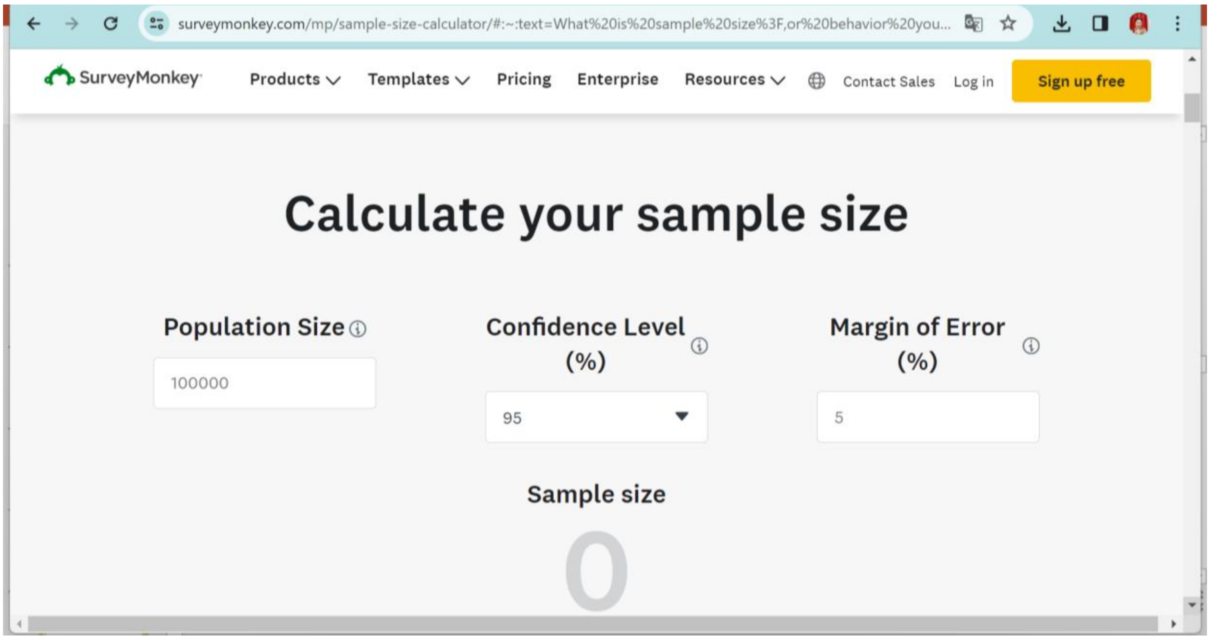


Figure 3 Show website calculate your sample size

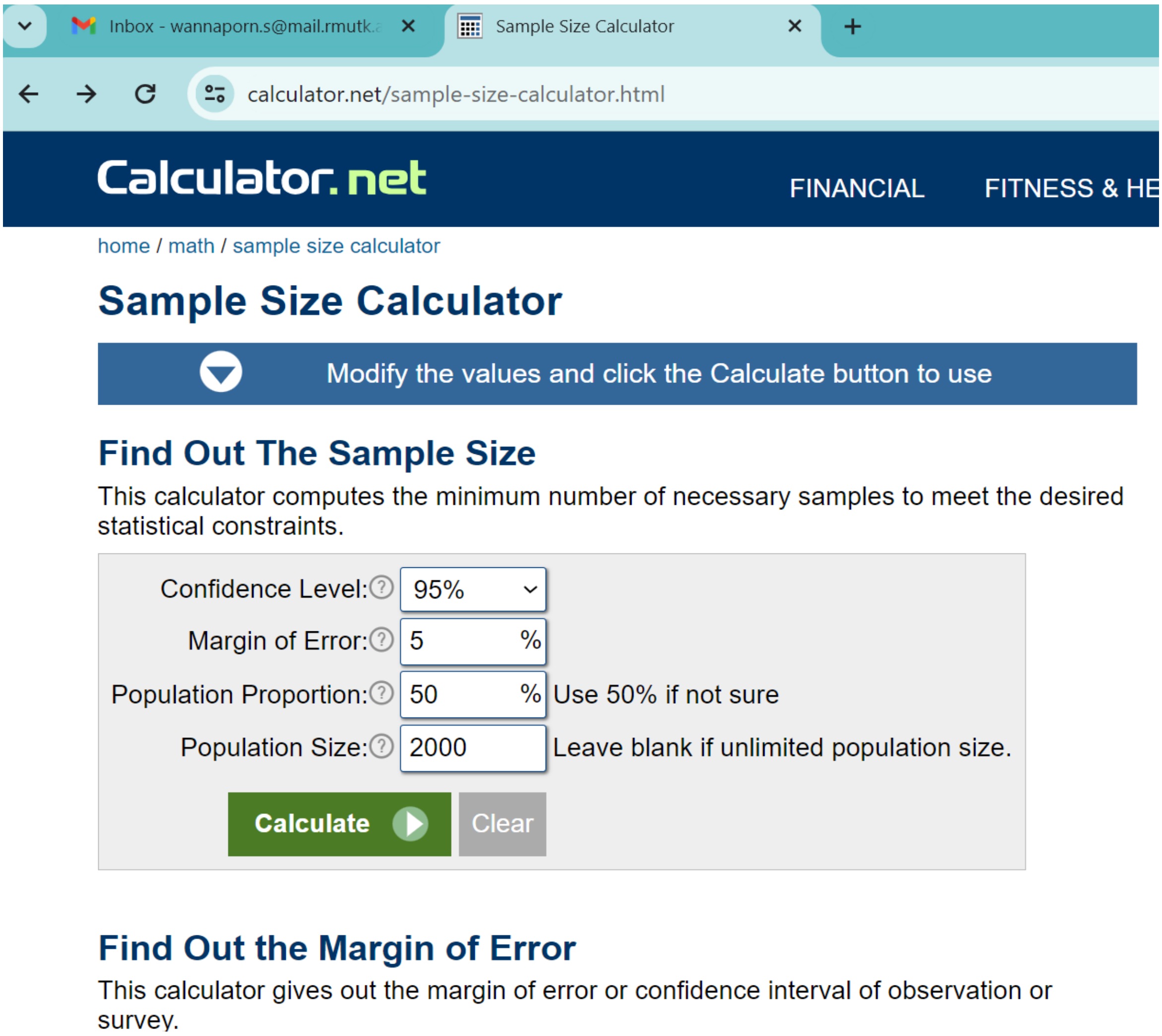
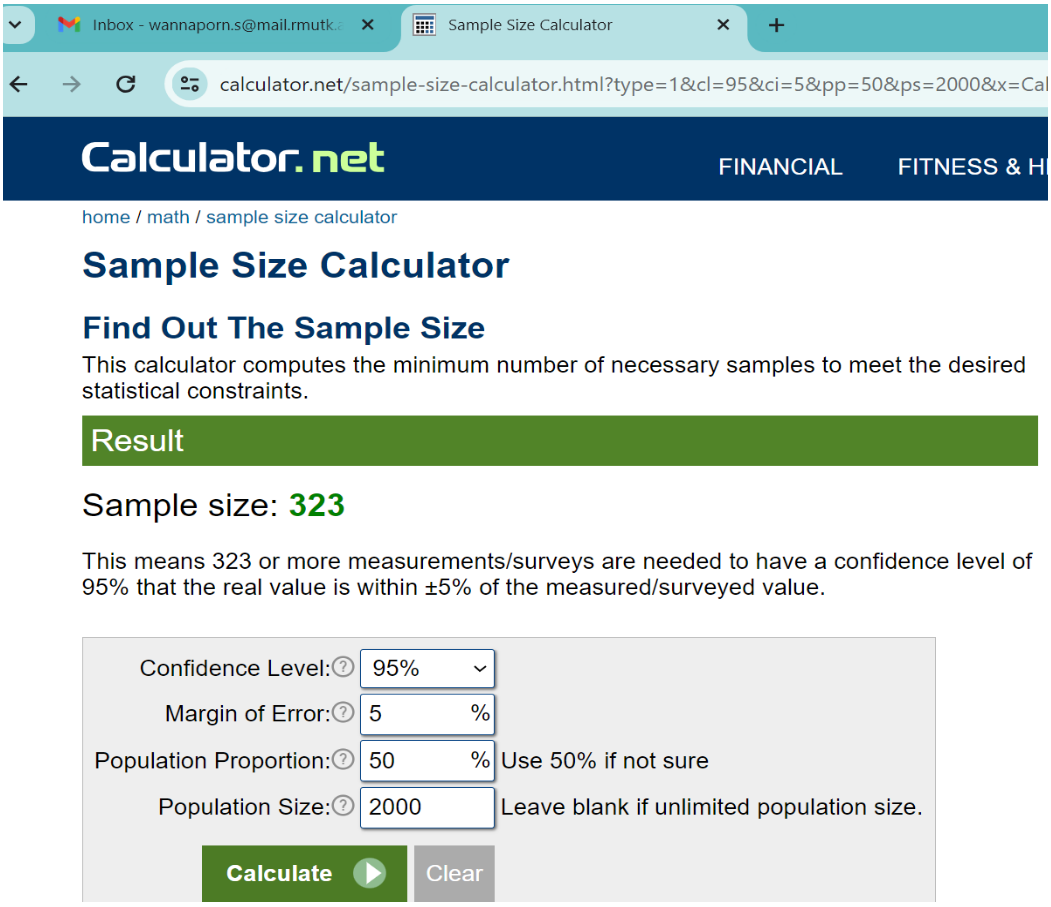


Figure 4 Show example website calculater.net for sample size



When you put population size, website will show sample size

Sometimes you can use table for determining sample size for a finite population

The size of the population and the amount of error the researcher is willing to tolerate is what determines the size of the sample. The table that follows was developed for situations where the researcher wants to come within 5 percentage points (with 95 percent certainty) of what the results would have been if the entire population had been surveyed. A more flexible approach is to use a sample size calculator that allows you to enter your preferences

Table 4 Table for Determining the Needed Size of a Randomly Chosen Sample from a Given Finite Population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30,* 607-610.

Example

Population is 400 students from Krejcie & Morgan table sample is 196 students

Sampling Method

Sampling is a method that allows researchers to infer information about a population based on results from a subset of the population, without having to investigate every individual. Reducing the number of individuals in a study reduces the cost and workload, and may make it easier to obtain high quality information, but this has to be balanced against having a large enough sample size with enough power to detect a true association.

Sampling Methods has two types

- Probability Sampling Methods
- Non-Probability Sampling Methods

Probability Sampling Methods

1. Simple random sampling

2. Systematic sampling

3. Stratified sampling

4. Clustered sampling

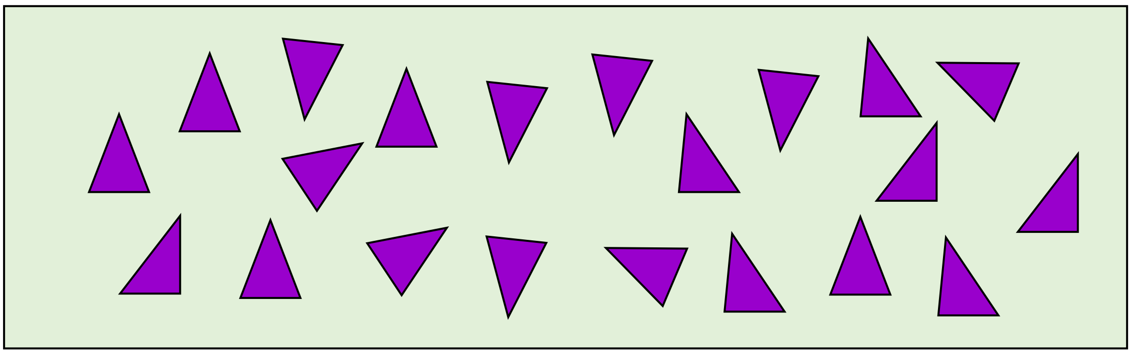
5. Multi - stage sampling

In this paper show only sampling method that help students to use in research (simple random sampling, Systematic sampling, Stratified sampling and Clustered sampling). But for easy to research, you may be use stratified sampling and cluster sampling.

Simple random sampling

As with all probability sampling methods, simple random sampling allows the sampling error to be calculated and reduces selection bias. A specific advantage is that it is the most straight forward method of probability sampling. **A disadvantage of simple random sampling** is that you may not select enough individuals with your characteristic of interest, especially if that characteristic is uncommon. It may also be difficult to define a complete sampling frame and inconvenient to contact them, especially if different forms of contact are required (email, phone, post) and your sample units are scattered over a wide geographical area.

Figure 5 show simple random sampling



Systematic sampling

Individuals are selected at regular intervals from the sampling frame. The intervals are chosen to ensure an adequate sample size. If you need a sample size *n* from a population of size *x*, you should select every $\left(\frac{x}{n}\right)^{th}$ individual for the sample. For example, if you wanted a sample size of 100 from a population of 1000, select every $\left(\frac{1000}{100}\right)$= 10^{th} member of the sampling frame.

Systematic sampling is often **more convenient than simple random sampling**, and it is easy to administer. However, it may also lead to bias, for example if there are underlying patterns in the order of the individuals in the sampling frame, such that the sampling technique coincides with the periodicity of the underlying pattern. As a hypothetical example, if a group of students were being sampled to gain their opinions on college facilities, but the Student Record Department's central list of all students was arranged such that the sex of students alternated between male and female, choosing an even interval (e.g. every 20^{th} student) would result in a sample of all males or all females. Whilst in this example the bias is obvious and should be easily corrected, this may not always be the case.

In this method, the population is first divided into subgroups (or strata) who all share a similar characteristic. It is used when we might reasonably expect the measurement of interest to vary between the different subgroups, and we want to ensure representation from all the subgroups. For example, in a study of stroke outcomes, we may stratify the population by sex, to ensure equal representation of men and women. The study sample is then obtained by taking equal sample sizes from each stratum. In stratified sampling, it may also be appropriate to choose non-equal sample sizes from each stratum.

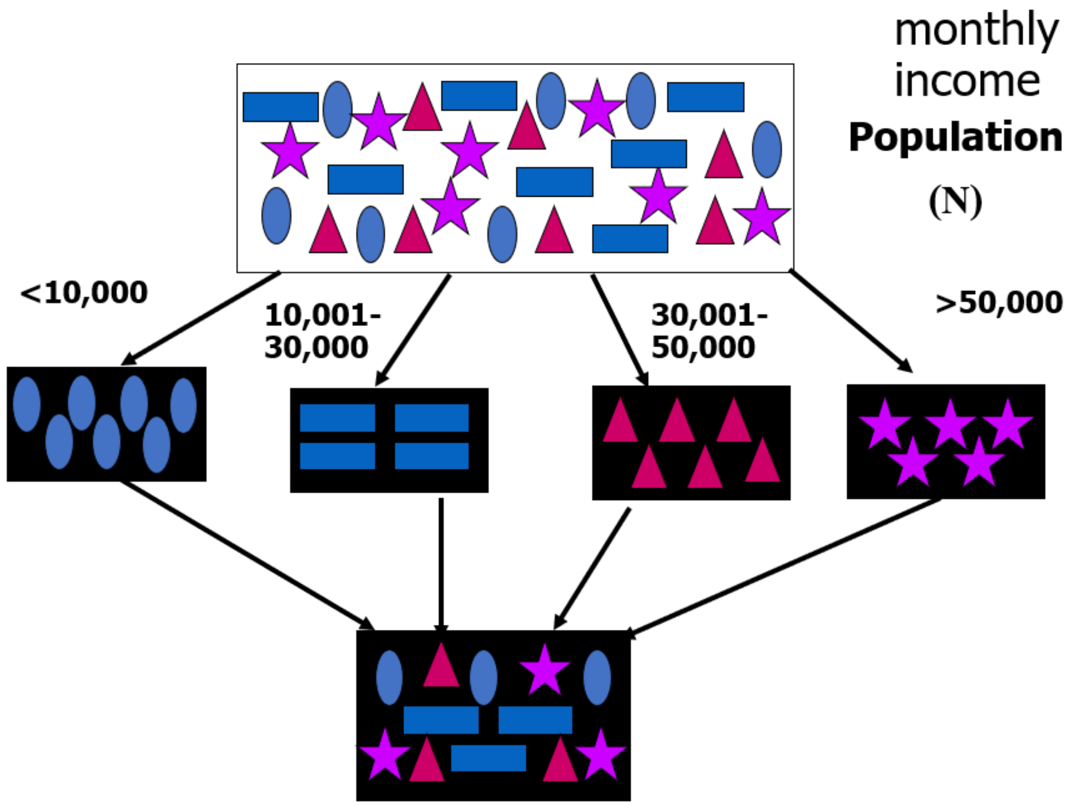
For example, in a study of the health outcomes of nursing staff in a county, if there are three hospitals each with different numbers of nursing staff (hospital A has 500 nurses, hospital B has 1000 and hospital C has 2000), then it would be appropriate to choose the sample numbers from each hospital *proportionally* (e.g. 10 from hospital A, 20 from hospital B and 40 from hospital C). This ensures a more realistic and accurate estimation of the health outcomes of nurses across the county, whereas simple random sampling would over-represent nurses from hospitals A and B. The fact that the sample was stratified should be taken into account at the analysis stage.

Stratified sampling

Classify a sample of a population according to certain characteristics. The samples within the same class are the most similar and the sample units between the classes differed the most

After dividing the population into layers, the next layer is random sampling by a simple random sampling method to obtain the full sample size according to the proportion of the population in each layer. (Proportionate Stratified Random Sampling)

Figure 6 show stratified sampling



When you use stratified sampling, you will compute by proportion or use EXCEL.

Figure 7 show computing stratified sampling by EXCEL

Example

1	Population			Stratified	
2	Age	18-25 years old	58	36	← $\frac{(58\times145)}{233}$
3		26-30 years old	52	32	
4		31-35 years old	55	34	
5		36-40 years old	27	17	← $\frac{(27\times145)}{233}$
6		age 41 and older	41	26	
7		Total	233	145	

Clustered sampling

In a clustered sample, subgroups of the population are used as the sampling unit, rather than individuals. The population is divided into subgroups, known as clusters, which are randomly selected to be included in the study. Clusters are usually already defined, for example individual GP practices or towns could be identified as clusters. In single-stage cluster sampling, all members of the chosen clusters are then included in the study. In two-stage cluster sampling, a selection of individuals from each cluster is then randomly selected for inclusion. Clustering should be taken into account in the analysis. The General Household survey, which is undertaken annually in England, is a good example of a (one-stage) cluster sample. All members of the selected households (clusters) are included in the survey.

Cluster sampling can be more efficient that simple random sampling, especially where a study takes place over a wide geographical region. For instance, it is easier to contact lots of individuals in a few GP practices than a few individuals in many different GP practices. Disadvantages include an increased risk of bias, if the chosen clusters are not representative of the population, resulting in an increased sampling error.

Sometimes we can say "Cluster sampling is a probability sampling technique where researchers divide the population into multiple groups (clusters) for research. So, researchers then select random groups with a simple random or systematic random sampling technique for data collection and unit of analysis".

Example: A researcher wants to conduct a study to judge the performance of sophomores in business education across the U.S. It is impossible to conduct a research study that involves a student in every university. Instead, cluster sampling allows the researcher to club the universities from each city into one cluster. These clusters then define the sophomore student population in the U.S. Next, either using simple random sampling or systematic random sampling and randomly picking clusters for the research study. Subsequently, by using simple or systematic sampling, the sophomore's from each of these selected clusters can be chosen on whom to conduct the research study.

In this sampling technique, researchers analyze a sample that consists of multiple sample parameters such as demographics, habits, background – or any other population attribute, which may be the focus of conducted research. This method is usually conducted when groups that are similar yet internally diverse form a statistical population. Instead of selecting the entire population, cluster sampling allows the researchers to collect data by bifurcating the data into small, more productive groups.

Applications of Cluster Sampling

This sampling technique is used in an area or geographical cluster sampling for market research. A broad geographic location can be expensive to survey compared to surveys sent to clusters divided based on region. The sample numbers must be increased to achieve accurate results, but the cost savings make this process of rising clusters attainable.

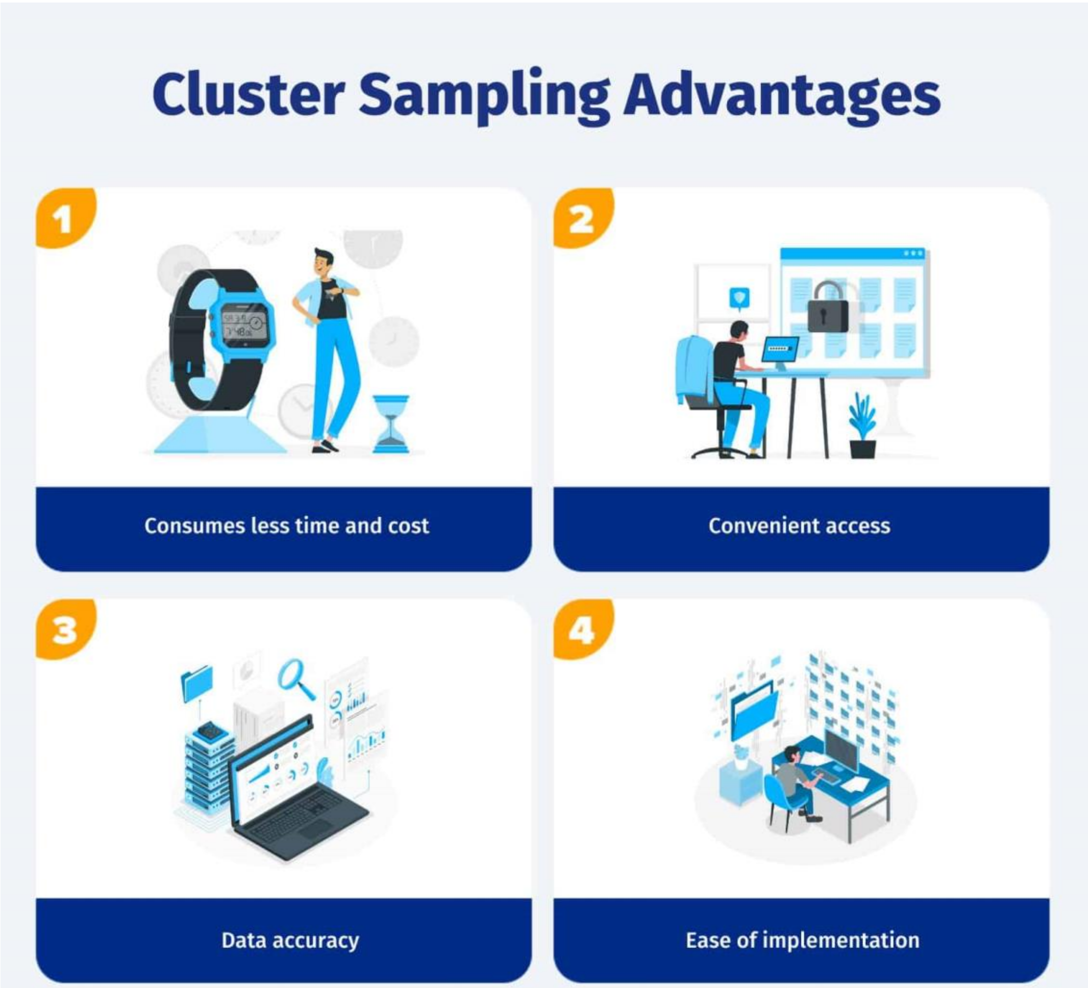
Cluster Sampling in Statistics

The technique is widely used in statistics where the researcher can't collect data from the entire population. So, it is the most economical and practical solution for research statisticians. Take the example of a researcher looking to understand smartphone usage in Germany. In this case, the cities of Germany will form clusters. This sampling method is also used in wars and natural calamities to draw inferences about a population, where collecting data from every individual residing is impossible.

Cluster Sampling Advantages

There are multiple advantages to using cluster sampling. Here they are:

Figure 8 Steps of cluster sampling advantages



Source: https://www.questionpro.com/blog/cluster-sampling/

Consumes less time and cost: Sampling of geographic segmentation divided groups requires less work, time, and cost. It’s a highly economical method to observe clusters instead of randomly doing them throughout a particular region by allocating a limited number of resources to those selected clusters.

Convenient access: Researchers can choose large samples with this convenience sampling technique, and that will increase accessibility to various clusters.

Data accuracy: Since there can be large samples in each cluster, loss of data accuracy in information per individual can be compensated.

Ease of implementation: Cluster sampling facilitates information from various areas and groups. Researchers can quickly implement it in practical situations compared to other probability sampling methods.

In comparison to simple random sampling, this technique can be useful in deciding the characteristics of a group, such as population, and researchers can implement it without having a sampling frame for all the elements of the entire population.

Cluster Sampling vs Stratified Sampling

Since cluster sampling and stratified random sampling are pretty similar, there could be issues with understanding their finer nuances. So, let’s talk about the significant differences between cluster sampling and stratified sampling:

Table 5 Show related between cluster sampling and stratified sampling

Cluster Sampling	Stratified Sampling
Elements of a population are randomly selected to be a part of groups (clusters).	The researcher divides the entire population into even segments (strata).
Members from randomly selected clusters are a part of this sample.	Researchers consider individual components of the strata randomly to be a part of sampling units.
Researchers maintain homogeneity between clusters.	Researchers maintain homogeneity within the strata.
Researchers divide the clusters naturally.	The researchers or statisticians primarily decide the strata division.
The key objective is to minimize the cost involved and enhance competence.	The key objective is to conduct accurate sampling, along with a properly represented population.

Non-Probability Sampling Methods

1. Convenience sampling

2. Quota sampling

3. Judgement (or Purposive) Sampling

4. Snowball sampling

Convenience sampling is perhaps the **easiest** method of sampling, because participants are selected based on availability and willingness to take part. Useful results can be obtained, but the results are prone to significant bias, because those who volunteer to take part may be different from those who choose not to (volunteer bias), and the sample may not be representative of other characteristics, such as age or sex. Note: volunteer bias is a risk of all non-probability sampling methods.

Quota sampling This method of sampling is often used by market researchers. Interviewers are given a quota of subjects of a specified type to attempt to recruit.

For example, an interviewer might be told to go out and select 20 adult men, 20 adult women, 10 teenage girls and 10 teenage boys so that they could interview them about their television viewing. Ideally the quotas chosen would proportionally represent the characteristics of the underlying population.

Whilst this has the advantage of being relatively straight forward and potentially representative, the chosen sample may not be representative of other characteristics that weren't considered (a consequence of the **non-random** nature of sampling).

Judgement (or Purposive) sampling Also known as selective, or subjective, sampling, this technique relies on the judgement of the researcher when choosing who to ask to participate. Researchers may implicitly thus choose a "representative" sample to suit their needs, or specifically approach individuals with certain characteristics. This approach is often used by the media when canvassing the public for opinions and in qualitative research.

Judgement sampling has the advantage of being time-and cost-effective to perform whilst resulting in a range of responses (particularly useful in qualitative research). However, in addition to volunteer bias, it is also prone to errors of judgement by the researcher and the findings, whilst being potentially broad, will not necessarily be representative.

Example

In one primary school (Grade 1-6) each Grade has 4 classes. Teacher A teaches grade 6 and wants to compare old technique teaching and flipped classroom. So, teacher A select 2 classes from 4 classes. (Class P has average high scores, Class Q has average low scores, Class R has average low scores, Class S has average high scores) So, teacher A select Class Q and Class R because two classes have average low scores. Teacher A use purposive sampling to select class. Characteristic of class has average low scores. (When you want to study new technique to teach student, you will select class has low scores or low achievement, you don't select class has high scores or low achievement, students who have high scores or high achievement can learn by every technique but some techniques can develop students who have low scores to high scores.)

Snowball sampling This method is commonly used in social sciences when investigating hard-to-reach groups. Existing subjects are asked to nominate further subjects known to them, so the sample increases in size like a rolling snowball. For example, when carrying out a survey of risk behaviors amongst intravenous drug users, participants may be asked to nominate other users to be interviewed.

Snowball sampling can be effective when a sampling frame is difficult to identify. However, by selecting friends and acquaintances of subjects already investigated, there is a significant risk of selection bias (choosing a large number of people with similar characteristics or views to the initial individual identified).

Target Group

When the researcher is interested in only one group of people who have unique characteristics. The number of people may be more or less depending on the case. There is no definite determination. But what's important is that the researcher must clearly specify the characteristics of the sample unit of interest.

For example, if the research was to identify approximately how many parents read a particular article in their child's school newsletter, the target population would be all parents of children at that school. The target units would then be the individual parents, and the school could provide a list of parent contact details which would serve as a sampling frame.

Example of a target group is a company's customer base, the population of particular country, the students at a particular university or tenants of a housing association.

1.6 Study about research instrument and determining the quality of research instrument.

A Research Instrument is a tool used to collect, measure, and analyze data related to your research interests. These tools are most commonly used in health sciences, social sciences, and education to assess patients, clients, students, teachers, staff, etc. A research instrument can include interviews, tests, surveys, or checklists. The Research Instrument is usually determined by researcher and is tied to the study methodology. This document offers some examples of research instruments and study methods.

Types of Research Instruments: Interviews

Interviews or the interaction where verbal questions are posed by an interviewer to elicit verbal responses from an interviewee.

Structured Interview: A formal set of questions posed to each interviewee and recorded using a standardized procedure.

Unstructured Interview: A less formal set of questions; the interviewer modifies the sequence and wording of questions.

Non-Directive Interview: An unguided interview, including open-ended questions and use of spontaneous engagement.

Focus Interview: An emphasis on the interviewees subjective and personal responses where the interviewer engages to elicit more information.

Focus Group Interview: A group of selected participants are asked about their opinion or perceptions concerning a particular topic.

Types of Research Instruments: Observations

Observation (watching what people do) is a type of correlational (non-experimental) method where researchers observe ongoing behavior.

Structured Observations: Research conducted at a specific place, time, where participants are observed in a standardized procedure. Rather than writing a detailed description of all behaviors observed, researchers code observed behaviors according to a previously agreed upon scale. Naturalistic

Naturalistic Observation: The study the spontaneous behavior of participants in natural surroundings. The researcher simply records what they see in whatever way they see it.

Participant Observation: A variation on natural observations where the researcher joins in and becomes part of the group they are studying to get a deeper insight into their lives.

Types of Research Instruments: Surveys

Survey research encompasses any measurement procedures that involve asking questions of respondents. The types of surveys can vary on the span of time used to conduct the study. They can be comprised of cross-sectional surveys and/or longitudinal surveys. Types of questions asked in surveys include:

Free-Answer: Also referred to as open-ended questions, these include unrestricted, essay, or unguided questions.

Guided Response Type: Recall-type questions asking the participant to recall a set of categories. Multiple-choice or multiple response questions.

Types of Research Instruments: Test

Test is type of Measurement tools, and they are used by researchers and practitioners to aid in the assessment or evaluation of research participants, clients, or patients. The tools are used to measure or collect data on a variety of variables, depending on the research questions.

A **test** or **quiz** is used to examine someone's knowledge of something to determine what he or she knows or has learned. Testing measures the level of skill or knowledge that has been reached.

Types of academic achievement tests can be divided into 2 types: standardized test and tests created by teachers themselves. The test will ask what the learner has learned from their studies. Teaching which can be grouped into 6 types of behavior: knowledge, memory, understanding, application, analysis, Synthesize and evaluate. The test can be divided into both multiple choice and subjective forms that are both open-ended test and closed-ended test. It is up to the teacher to apply it according to the content and level students appropriately.

When researcher want to test students, it's easy to use multiple choice. Number of questions base on student ages and contents. But number of questions must more than number of questions that researcher want to use. Because, when determining the quality of the test, the number of questions may be reduced.

Types of Research Instruments: Questionnaire

A questionnaire is a research tool that contains a list of questions requiring responses from a predefined group of people. It is used to collect relevant information that can help you arrive at definite results during research.

Questionnaires are used to collect both qualitative and quantitative data from respondents. It combines different question types like close-ended and open-ended questions that allow you to extract large volumes of data from respondents, even when the researcher isn't available to coordinate data collection firsthand.

The purpose of a questionnaire is to build up your research dataset by asking standardized questions to help you get the right answers. While questionnaires are closely related to surveys, they do not mean the same thing.

Types of Questions for Any Questionnaire

Close Ended Questions

A close-ended question is one that limits possible responses to options like Yes/No, True/False, and the likes. It comes with pre-selected answer options and requires the respondent to choose one of the options that closely resonates with her thoughts, opinion, or knowledge. Close-ended questions are best used in quantitative research because they allow you to collect statistical information from respondents. If you want to gather a large amount of data that can be analyzed quickly, then asking close-ended questions is your best bet.

Close-ended Question Samples

1. How do you start your day?
   - With coffee
   - With exercises
   - With meditation

2. What is your favorite genre of music?
- Reggae
- Blues
- Afropop
- Rap

Dichotomous Questions

A dichotomous question is a type of close-ended question that has only 2 opposite answer-options. It requires the research participants to choose one of the 2 available options as a response to the question. The most common type of dichotomous question is the yes/no question.

A dichotomous question allows respondents to provide short, concise, and direct answers in the research questionnaire. Dichotomous questions are used to collect quantitative information from respondents, and to also eliminate unnecessary complexities in data collection. Other common formats of dichotomous questions are true/false questions and agree/disagree questions.

Dichotomous Question Samples

1. Would you like to have something to drink?
- Sure
- Not at all

2. Did you enjoy this training?
- Yes
- No

Likert Scale Question

This is a type of psychometric question that measures the respondent's perception or opinion on a topic or subject matter. It uses points to rank different opinions, thoughts, and experiences in line with the topic at hand and the overall research context. **A Likert scale question is popular as a 4-point scale, 5-point scale, or 7-point scale.** Likert scale questions are important for research because they can be used to measure someone's attitude and determine the extent to which they agree or disagree with a particular question or statement.

How would you rate the impact that technology companies have on society?

1	2	3	4	5	6	7
very negative	negative	slightly negative	Neutral	Slightly positive	Positive	Very positive

Technology companies have a positive impact on my personal life?

Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
………………	………….	…………….	…………….	…………….

When I have a problem, I greatly value the advice of my roommate?

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neutral
- ○ Somewhat disagree
- ○ Strongly disagree

Multi-Choice Questions

As the name suggests, a multi-choice question is one that gives respondents more than 2 answer-options to choose from. It is sometimes referred to as an objective response question and it requires the respondent to choose the most relevant option from the available choices. Typically, a multi-choice question has 3 parts—the stem, the answer, and the distractors. The stem is the actual question being asked; the answer is the right response to the question and the distractors are the other available choice options.

Multi-choice Question Examples

1. What is your favorite drink?
   - Tea
   - Coffee
   - Wine
   - Juice
2. What is your favorite smartphone brand?
   - iPhone
   - Samsung
   - Tecno
   - Gionee

Content Validity and Reliability

Research validity is categorized into four main types, which involve:

1. Construct validity
2. Content validity

3. Face validity
4. Criterion validity

Construct Validity is a great way of ensuring that the measurement method aligns well with the construct that you aim to measure. Suppose you plan to build a questionnaire for the diagnosis of depression, it's essential for you to know: is your questionnaire really able to measure the construct for depression? Or does it measure the respondent's behavior, level of happiness, or some different construct?

For attaining construct validity, it's imperative to make sure that the indicators you use are cautiously developed on the relevant existing knowledge. So, the questionnaire should include only the relevant questions that can effectively gauge the popular indicators of depression.

Content validity is used for evaluating if a test can represent the different aspects of a specific construct. In order to generate valid results, it's essential that the content of the survey, test or any measurement method you use must cover the relevant & necessary areas of the subject it intends to measure.

For example, imagine that I designed a test that evaluates how well students understand statistics at a level appropriate for an introductory college course. Content validity assesses my test to see if it covers suitable material for that subject area at that level of expertise. In other words, does my test cover all pertinent facets of the content area? Is it missing concepts?

Face validity is used for considering how appropriate the content of a particular test looks on the surface. It seems quite similar to the content validity, but it is considered to be a more subjective and informal type of assessment.

Factor Analysis Advanced content validity assessments use multivariate factor analysis to find the number of underlying dimensions that the test items cover. In this context, analysts can use factor analysis to determine whether the items collectively measure a sufficient number and type of fundamental factors. If the measurement instrument does not sufficiently cover the dimensions, the researchers should improve it.

Quality of research instrument means content validity, reliability. Determining the quality of each type of research tool is different. Each type of research instrument is specified to collect data according to the needs of the research objective or research hypotheses.

Content validity is the degree to which a test or assessment instrument evaluates all aspects of the topic, construct, or behavior that it is designed to measure. Do the items fully cover the subject? High content validity indicates that the test fully covers the topic for the target audience. Lower results suggest that the test does not contain relevant facets of the subject matter.

How to Measure Content Validity

Measuring content validity involves assessing individual questions on a test and asking experts whether each one targets characteristics that the instrument is designed to cover. This process compares the test against its goals and the theoretical properties of the construct. Researchers systematically determine whether each item contributes, and that no aspect is overlooked.

Table 6 Show related between instrument and content validity

Instrument	Content validity
Questionnaire Test Interview Observation	} IOC CVR CVI

IOC (Index of Item-Objective Congruence) Rovinelli & Hambleton's Index of Item-Objective Congruence (1977)

$$IOC = \frac{\sum R}{N}$$

IOC = Index of Item Objective Congruence

R = Expert Opinion Scores

(+1 make sure that questions are correspond with the objectives

0 not sure if the questions correspond to the objectives

-1 make sure that questions are not correspond with the objectives)

$\sum R$ = Sum of Expert Opinion Scores

N = Number of Expert

Criteria IOC > 0.5

Reliability

Cronbach's alpha is a way of assessing reliability by comparing the amount of shared variance, or covariance, among the items making up an instrument to the amount of overall variance. The idea is that if the instrument is reliable, there should be a great deal of covariance among the items relative to the variance.

Cronbach's alpha is equivalent to taking the average of all possible split-half reliabilities. Most computer packages for statistics in wide use today can compute

Cronbach's alpha. Often it is helpful to examine what the Cronbach's alpha becomes after a particular item is deleted. If Cronbach's alpha goes up considerably upon deletion of an item, the item may not belong in the measure.

Kuder Richardson

Kuder-Richardson Formula 20, or KR-20, is **a measure reliability for a test with binary variables** (i.e. answers that are right or wrong). Reliability refers to how consistent the results from the test are, or how well the test is actually measuring what you want it to measure.

The KR20 is used for items that have varying difficulty. For example, some items might be very easy, others more challenging. **It should only be used if there is a correct answer for each question** — it shouldn't be used for questions with partial credit is possible or for scales like the Likert Scale

- If all questions in your binary test are equally challenging, use the **KR-21** (see below).
- If you have a test with more than two answer possibilities (or opportunities for partial credit), use Cronbach's Alpha instead.

KR-20 Scores

The scores for KR-20 range from 0 to 1, where 0 is no reliability and 1 is perfect reliability. The closer the score is to 1, the more reliable the test. Just what constitutes an "acceptable" KR-20 score depends on the type of test. In general, a score of above .5 is usually considered reasonable.

Apply the following formula *once for each item*:

$$KR-20=\left(\frac{n}{n-1}\right)\left(\frac{1-\sum pq}{S^2}\right)$$

where:

- n = sample size for the test,
- Var = variance for the test,
- p = proportion of people passing the item,
- q = proportion of people failing the item.
- Σ = sum up (add up). In other words, multiple Each question's p by q, and then add them all up. If you have 10 items, you'll multiply p*q ten times, then you'll add those ten items up to get a total.

As this can quickly get tedious for tests with a large amount of items, it's usually calculated with some type of software like Excel. Dr. Katrina Korb put together a great PowerPoint showing the steps in Excel for calculating the Kuder-Richardson 20. You can download it RS 12 Calculating Reliability of a Measure.

KR-21

The KR-21 is similar, except it's used for a test where the items are all about the same difficulty.

The formula is $$KR-21=\left(\frac{n}{n-1}\right)\left(1-\frac{\bar{X}\left(n-\bar{X}\right)}{nS^2}\right)$$

where:

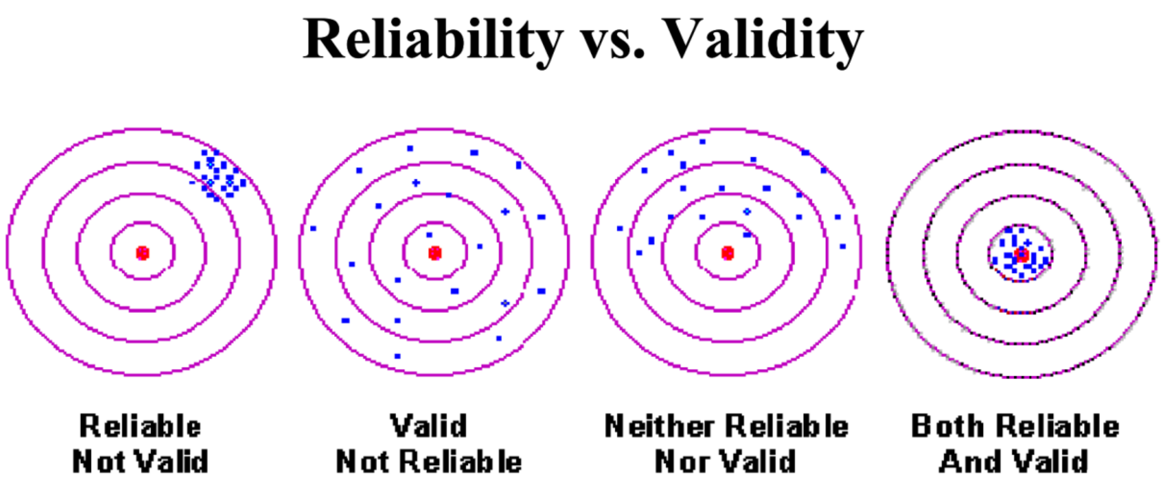
- n= sample size,
- Var= variance for the test,
- M = mean score for the test.

Table 7 Show related between instrument and reliability

Instrument	reliability
Test	Kuder Richardson KR-20, KR-21
Questionnaire	Cronbach's alpha

Test use only Kuder Richardson because test have answer 0, 1 (true has 1 score, false has 0 score)

Figure 7 Reliability vs. Validity



Source:
https://kb.hsri.or.th/dspace/bitstream/handle/11228/3942/DataSource_Jiruth.pdf?sequence=2&isAllowed=y

Education, we have measure for quality. It means difficulty (p) and discrimination (r) of test

$$p = \frac{R_H + R_L}{N_H + N_L}$$

R_H number of people who answered correctly in the high group

R_L number of people who answered correctly in the low group

N_H The total number of people in the high group

N_L The total number of people in the low group

	Difficult value	Meaning
p	0.81 – 1.00	Very easy
	0.20 – 0.80	Moderate difficulty
	0.00 – 0.19	Very difficult

$$r = \frac{R_H - R_L}{N_H \, or N_L}$$

R_H number of people who answered correctly in the high group

R_L number of people who answered correctly in the low group

N_H The total number of people in the high group

N_L The total number of people in the low group

Discriminant power	Meaning
r < 0.20	Low power of discrimination
r ≥ 0.20	Good power of discrimination

1.7 Study about data collection

When researchers write data collection, they will write step by step of research and describe about step for show method to do.

Example

Study theory or journal for design model

Survey by questionnaire

Deep interview

Analyze and confirm model

1.8 Study about data analysis

This item has two parts. One is descriptive statistics and another is inferential statistics (for test hypotheses). When you write this item, you will write base on descriptive statistics and inferential statistics. How to select descriptive statistics and inferential statistics. You will think about related between research objective or research hypotheses with statistics.

Descriptive Statistics

- Frequency
- Percent
- Mean or Average
- Standard deviation

Table 8 Correlation between instrument and descriptive statistics

Instrument	Descriptive Statistics
interview	Frequency
Observe	Frequency
Questionnaire	Frequency Percentage (number more than 100 researcher can compute to percentage)
Questionnaire (rating scale, Likert scale)	Frequency Percentage (number more than 100 researcher can compute to percentage) Mean or Average Standard deviation
Test	Frequency Development (Post test – Pre test)

Inferential Statistics

- t-test dependent sample
- t-test independent sample
- ANOVA
- Chi – square

- Factor Analysis
- Multiple r regression

Table 9 Correlation between instrument and inferential statistics

Instrument	Inferential Statistics
Test (pre-test, post-test)	t-test dependent variables t-test independent variables
Questionnaire	ANOVA Chi – square (χ^2) Multiple r regression

Table 10 Overview of Inferential Statistical Tests

Statistical Test	Type of measure	Overview
t-test	Comparison	Used to compare the results of two groups (statistical significance of differences in groups' means)
Analysis of variance (ANOVA)	Comparison	Used to compare the results of more than two groups (statistical significance of differences in groups' means)
Analysis of covariance (ANCOVA)	Comparison	Used to compare the results of more than two groups controlling for covariates
Chi- square (χ^2)	Association	A test of significance based on the null hypothesis, used to test the association between two categorical variables.
Cramer's V	Association	Used to test the strength of the relationship between two variables
		Results in a score between 0 and 1 (0 indicates no relationship whatsoever and 1 indicates a perfect relationship)

Statistical Test	Type of measure	Overview
Pearson product moment correlation	Correlation	Used to determine the strength and direction of relationship between two variables
Multiple r regression	Correlation	Used to relate three or more continuous variables

S - Smart in analysis

Analysis how to compute content validity and reliability, how to select statistics for compute data.

Content Validity Ratio

For this overview, let's look at a more intuitive approach.

Most assessment processes in this realm obtain input from subject matter experts. Lawshe* proposed a standard method for measuring content validity in psychology that incorporates expert ratings. This approach involves asking experts to determine whether the knowledge or skill that each item on the test assesses is "essential," "useful, but not necessary," or "not necessary."

His method is essentially a form of inter-rater reliability about the importance of each item. You want all or most experts to agree that each item is "essential."

Lawshe then proposes that you calculate the content validity ratio (CVR) for each question:

$$CVR = \frac{N_e - (\frac{N}{2})}{N/2}$$

Where:

- N_e = Number of "essentials" for an item.
- N = Number of experts.

Using this formula, you'll obtain values ranging from -1 (perfect disagreement) to +1 (perfect agreement) for each question. Values above 0 indicate that more than half the experts agree.

However, it's essential to consider whether the agreement might be due to chance. Don't worry! Critical values for the ratio can help you make that determination. These critical values depend on the number of experts. You can find them here: Critical Values for Lawshe's CVR.

The content validity index (CVI) is the mean CVR for all items and it provides an overall assessment of the measurement instrument. Values closer to 1 are better.

Finally, CVR distinguishes between necessary and unnecessary questions, but it does not identify missing facets.

Lawshe then proposes that you calculate the content validity ratio (CVR) for each question:

Where: N_e = Number of "essentials" for an item.

N = Number of experts.

Using this formula, you'll obtain values ranging from -1 (perfect disagreement) to +1 (perfect agreement) for each question. Values above 0 indicate that more than half the experts agree.

- The content validity index (CVI) is the mean CVR for all items and it provides an overall assessment of the measurement instrument. Values closer to 1 are better.
- Finally, CVR distinguishes between necessary and unnecessary questions, but it does not identify missing facets.

$$IOC = \frac{\sum R}{N}$$

IOC (The Index of Item-Objective Congruence)

Example How to use IOC

	ITEM	EXPERT			Σ	IOC	INTERPRET
		1	2	3			
1		-1	0	0	-1	-0.3	CAN'T USE
2		1	1	1	3	1.0	USE
3		1	0	1	2	0.7	USE
4		1	-1	0	0	0.0	CAN'T USE
5		0	-1	-1	-2	-0.7	CAN'T USE
	remark	IOC ≥ 0.5					
		IOC < 0.5					

Mean or Average

You can compute mean or average by software etc. EXCEL or SPSS or another software. You will present by table.

Before you present by table, you will consider about how to interpret.

Example

1 Means strongly disagree
2 Means disagree
3 Means undecided
4 Means agree
5 Means strongly agree

Interpret

Average	Interpret
1.00 – 1.50	Strongly disagree
1.51 - 2.50	Disagree
2.51 – 3.50	Undecided
3.51 – 4.50	Agree
4.51 – 5.00	Strongly agree

Example

Items	$\bar{X}$	**S**	**Interpret**
1. ……………………...	3.57	0.18	Agree
2. ……………………...	2.69	0.36	Undecided
3. ……………………..	4.58	0.20	Strongly agree
4. ……………………..	1.70	0.13	Disagree

t-test

You will use t-test, when your instrument is test, test for research, you will use multiple-choice test. It's easy when you use multiple-choice test. True has 1 score and false has 0 score. Sometimes, you want to use essay test. You can compute hypotheses by t-test. But essay test, it's hard to check the exam. Because you will set clear examination methods.

Example

Question1 full score 10 scores. Answer and scoring.

- Answer content A 3 scores
- Answer content B 5 scores
- Answer content C 7 scores
- Answer content D 10 scores

You use t-test dependent variables, when you use only one class and you test two times (Pre-test and Post-test).

You use t-test independent variables, when you use two classes and you test two times (Pre-test and Post-test). Two classes which was chosen, it is necessary to select classes with a similar number of students.

t – test for dependent sample

$$t = \frac{\sum d}{\sqrt{\frac{n\left(\sum d^2\right)-\left(\sum d\right)^2}{n-1}}}, df = n-1$$

d: difference per paired value
(The difference for each pair of scores)
n: number of samples

t – test for independent sample

Case 1 t – test equal variance

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{S_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \qquad df = n_1 + n_2 - 2$$

$$S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}$$

Case 2 t – test unequal variance

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}}} \qquad df = \nu$$

$$\nu = \frac{\left(\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1-1}+\frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2-1}}$$

$\bar{X}_1$: Mean value of the first group

$\bar{X}_2$: Mean value of the second group

n_1 : Size of the first group
n_2 : Size of the second group
S_1 : Standard deviation of the first group
S_2 : Standard deviation of the second group

Multiple Regression

Multiple regression is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. The objective of multiple regression analysis is to use the independent variables whose values are shown to predict the value of the single dependent value.

ANOVA (Analysis of Variance)

Is there a statistical difference between the methods of two or more independent groups

Example:

- Two-way ANOVA
- Factorial ANOVA
- Welch's F-test ANOVA
- Ranked ANOVA
- Games-Howell Pairwise Test

Usage ANOVA. When the null hypotheses states that the means of the various groups are the same. If there is a statistically significant result, it means that the two populations are not equal or different.

Sample questions

Does age, gender, or income affect how much customers spend in your store on an ongoing basis?

Does marital status (single, married, disvorced, widowed) affect your mood?

ANCOVA (Analysis of covariance)

It is a comparative study of means by controlling the variables that influence the dependent variable. If not controlled, the results of the study may not be clear. The dependent variable is different between groups of independent variables. (such as gender, age, or treatment used in the experiment). Is it the result of the treatment only or is there another complication that there are other variables that make the difference?

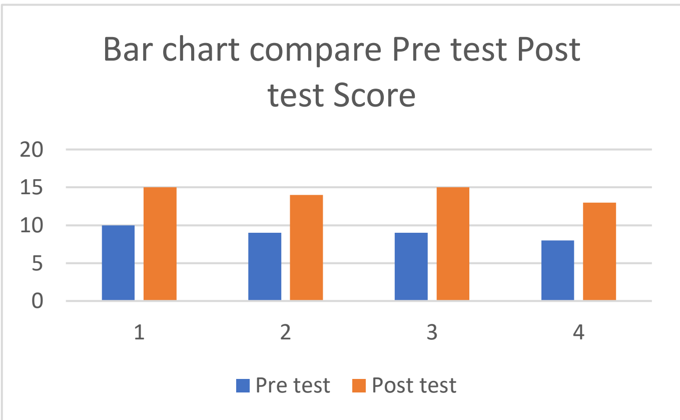
1. If we want to compare training results, will using different training methods have different effects on learning? A covariate may be the level of prior knowledge on the training topic.
2. If you want to compare loyalty to the organization between employees with different levels of education. A covariate might be organizational justice. Organizational support or executive leadership recognition.

I - Improve and creation

When you write chapter 3 research methodology complete. You will read and recheck. Sometimes you must compare between chapter 1 and chapter 3 (from table 1). It helps you to design chapter 4 and chapter 5.

From chapter 3 – Research instrument and data analysis. It helps you to write chapter 4

Table 11 Show related between chapter 3 Research Methodology and chapter 4 Analysis Result

<table>
<tr><th colspan="2">Chapter 3 Research Methodology</th><th>Chapter 4 Analysis Result</th></tr>
<tr><th>Research Instrument</th><th>Data Analysis</th><th>Results</th></tr>
<tr><td>Interview</td><td>frequency</td><td>content</td></tr>
<tr><td>Observe</td><td>frequency</td><td>content</td></tr>
<tr><td>Questionnaire</td><td>- Frequency
- Percentage</td><td>Present items, frequency and percentage by table or pie chart or bar chart
Table
<table>
<tr><th>No.</th><th>Pre-test (20)</th><th>Post-test (20)</th></tr>
<tr><td>1</td><td>10</td><td>15</td></tr>
<tr><td>2</td><td>9</td><td>14</td></tr>
<tr><td>3</td><td>9</td><td>15</td></tr>
<tr><td>4</td><td>8</td><td>13</td></tr>
</table>
Bar chart


</td></tr>
</table>

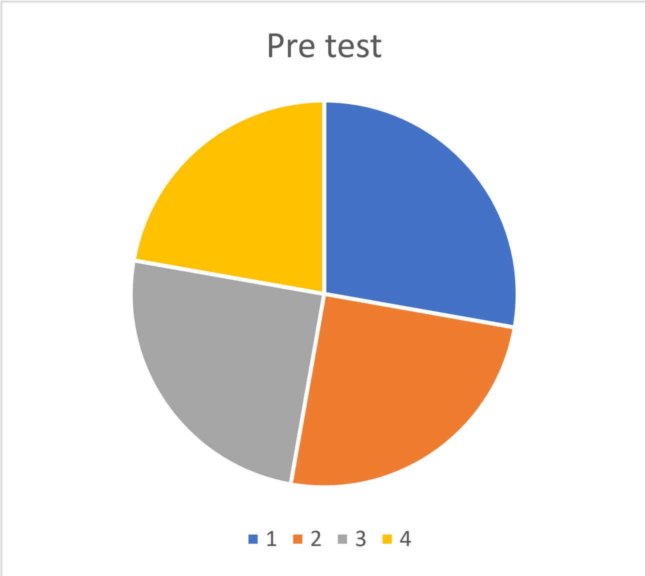
<table>
<tr><th colspan="2">Chapter 3 Research Methodology</th><th>Chapter 4 Analysis Result</th></tr>
<tr><th>Research Instrument</th><th>Data Analysis</th><th>Results</th></tr>
<tr><td></td><td></td><td>Pie chart

</td></tr>
<tr><td>Questionnaire</td><td>- Frequency
- Percentage
- Mean or average
- Standard deviation</td><td>Present items, frequency or percentage, mean or average, standard deviation and interpret by table

Table
<table><tr><th>items</th><th>frequency</th><th>$\bar{X}$</th><th>S</th><th>interpret</th></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Test (pre-test, post-test)</td><td>- Frequency
- Development</td><td><table><tr><th>No.</th><th>Pre-test</th><th>Post-test</th><th>Development (Post test – Pre test)</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table></td></tr>
</table>

<table>
<tr><th colspan="2">Chapter 3 Research Methodology</th><th>Chapter 4 Analysis Result</th></tr>
<tr><th>Research Instrument</th><th>Data Analysis</th><th>Results</th></tr>
<tr><td>Test (pre-test, post-test)</td><td>t-test dependent variables</td><td>
<table>
<tr><th>items</th><th>df</th><th>$\bar{X}$</th><th>S</th><th>t</th><th>p</th></tr>
<tr><td>Pre test</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Post test</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
$t_{\alpha,df} =$
</td></tr>
<tr><td>Test (pre-test, post-test) for two class</td><td>t-test independent variables</td><td>
<table>
<tr><th>Class</th><th>df</th><th>$\bar{X}_{pre}$</th><th>S_{pre}</th><th>$\bar{X}_{post}$</th><th>S_{post}</th><th>t</th><th>p</th></tr>
<tr><td>Class A</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Class B</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
$t_{\alpha,df} =$
</td></tr>
<tr><td>Questionnaire</td><td>ANOVA</td><td>
<table>
<tr><th>SOV
(Source of Variation)</th><th>df.</th><th>SS
(Sum of Square)</th><th>MS
(Mean of Square)</th><th>F</th></tr>
<tr><td>Between group</td><td>k-1</td><td>SS_B</td><td>$MSB = \frac{SSB}{k-1}$</td><td>$F = \frac{MSB}{MSE}$</td></tr>
<tr><td>Within group</td><td>n-k</td><td>SS_W</td><td>$MSE = \frac{SSE}{n-k}$</td><td></td></tr>
<tr><td>total</td><td>n-1</td><td>SS_T</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Questionnaire</td><td>ANCOVA</td><td>
<table>
<tr><th>Effect</th><th>SS</th><th>df.</th><th>MS</th><th>F</th><th>p</th></tr>
<tr><td>Covariate</td><td>SS_C</td><td>p</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td>SS_A</td><td>k-1</td><td>MS_A</td><td>F_A</td><td>p_A</td></tr>
<tr><td>Error</td><td>SS_{ERROR}</td><td>n-p-k</td><td>MS_{ERROR}</td><td></td><td></td></tr>
<tr><td>total</td><td>SS_{TOTAL}</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Chapter 5 Conclusion

Conclusion, you can write by summary from table and content. Sometimes you can copy from summary interpretation of results from the table.

C - Complete and presented

When you finish chapter 1-3 and you want to present chapter 1-3 with a PowerPoint.

Step 1 you will show all items chapter 3

Step 2 you will check key words for present. It's complete or not.

Step 3 you will answer the questions.

1. Is research design true or false?
2. Does your research want population, samples?
3. Are sampling methods true or false?
4. Is data collection complete or not?
5. Is research instrument related with research objective?
6. Is research instrument related with research hypotheses?
7. Is content validity and reliability complete or not?
8. Is data analysis related with research objective?
9. Is data analysis related with research hypotheses?
10. Are your PowerPoints presentation to interesting?

The questions make you can check your' s paper complete or not. You have the opportunity to review the completeness of the work before presentation day.

When you are done analyzing the quality of the research instrument. You will complete Chapter 3 with your results, and you will include the instrument quality determination table in the appendix.

Example

During present proposal defend (Chapter 1-3)

Chapter 3 Research Methodology

- Content Validity and Reliability

Chapter 3 show only method to complete content validity and reliability of research instruments

Questionnaire analysis content validity by IOC (The Index of Item-Objective Congruence) and analysis reliability by Cronbach alpha

During present final defend (Chapter 1-5, MA.) or progress (Chapter 1-4 or Chapter 1-5, Ph.D.)

Chapter 3 Research Methodology

- Content Validity and Reliability

Chapter 3 show method to complete content validity and reliability and result content validity and reliability of research instruments

Questionnaire analysis content validity by IOC (The Index of Item-Objective Congruence). Questionnaire has IOC = 0.7and reliability has Cronbach alpha = 0.8

References

มนตรี พิริยะกุล. Analysis of Covariance (ANCOVA). *วารสารรามคำแหง.* ปีที่ 29 ฉบับที่ 1 มกราคม - มิถุนายน 2555.

https://courses.lumenlearning.com/suny-hccc-research-methods/chapter/chapter-8-sampling/

https://kb.hsri.or.th/dspace/bitstream/handle/11228/3942/DataSource_Jiruth.pdf?sequence=2&isAllowed=y

https://libguides.sjf.edu/tests#:~:text=Test%20and%20Instruments%20are%20types,depending%20on%20the%20research%20questions.

https://statisticsbyjim.com/basics/content-validity/

https://www.calculator.net/sample-size-calculator.html?type=1&cl=95&ci=5&pp=50&ps=2000&x=Calculate

https://www.djsresearch.co.uk/glossary/item/Target-Population

https://www.edtechdigest.com/2012/08/18/trends-infographic-components-of-a-21st-century-classroom/

https://www.formpl.us/blog/questionnaire-types

https://www.geopoll.com/blog/sample-size-research/#How_to_Calculate_Sample_Size

https://www.icevonline.com/blog/what-are-21st-century-skills

https://www.panoramaed.com/blog/comprehensive-guide-21st-century-skills

https://www.questionpro.com/blog/cluster-sampling/

https://www.statisticshowto.com/kuder-richardson/

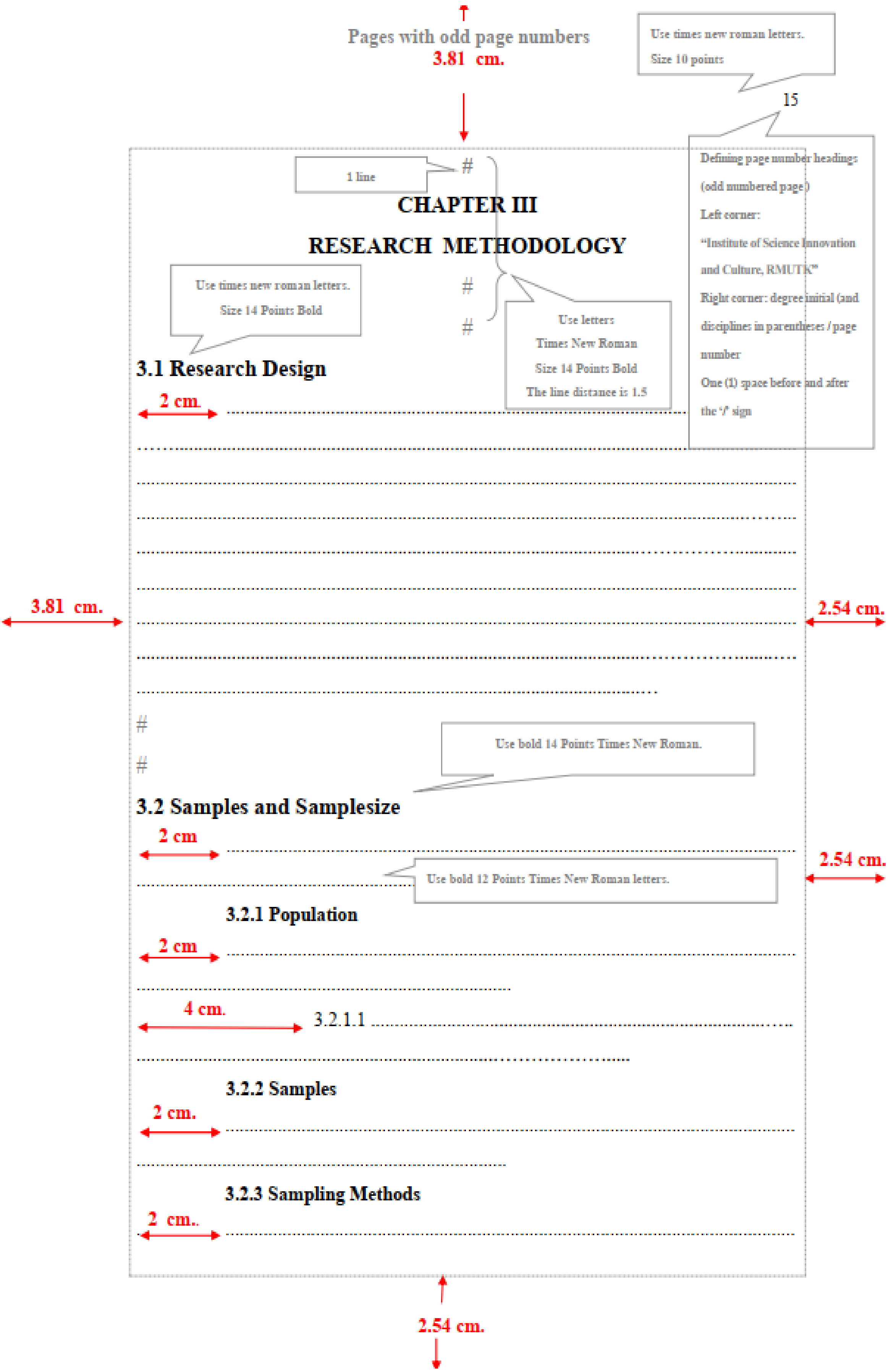
https://sunthud.com/media/Teaching/IntroStat/Spring16/Ch9_ANCOVA.pdf

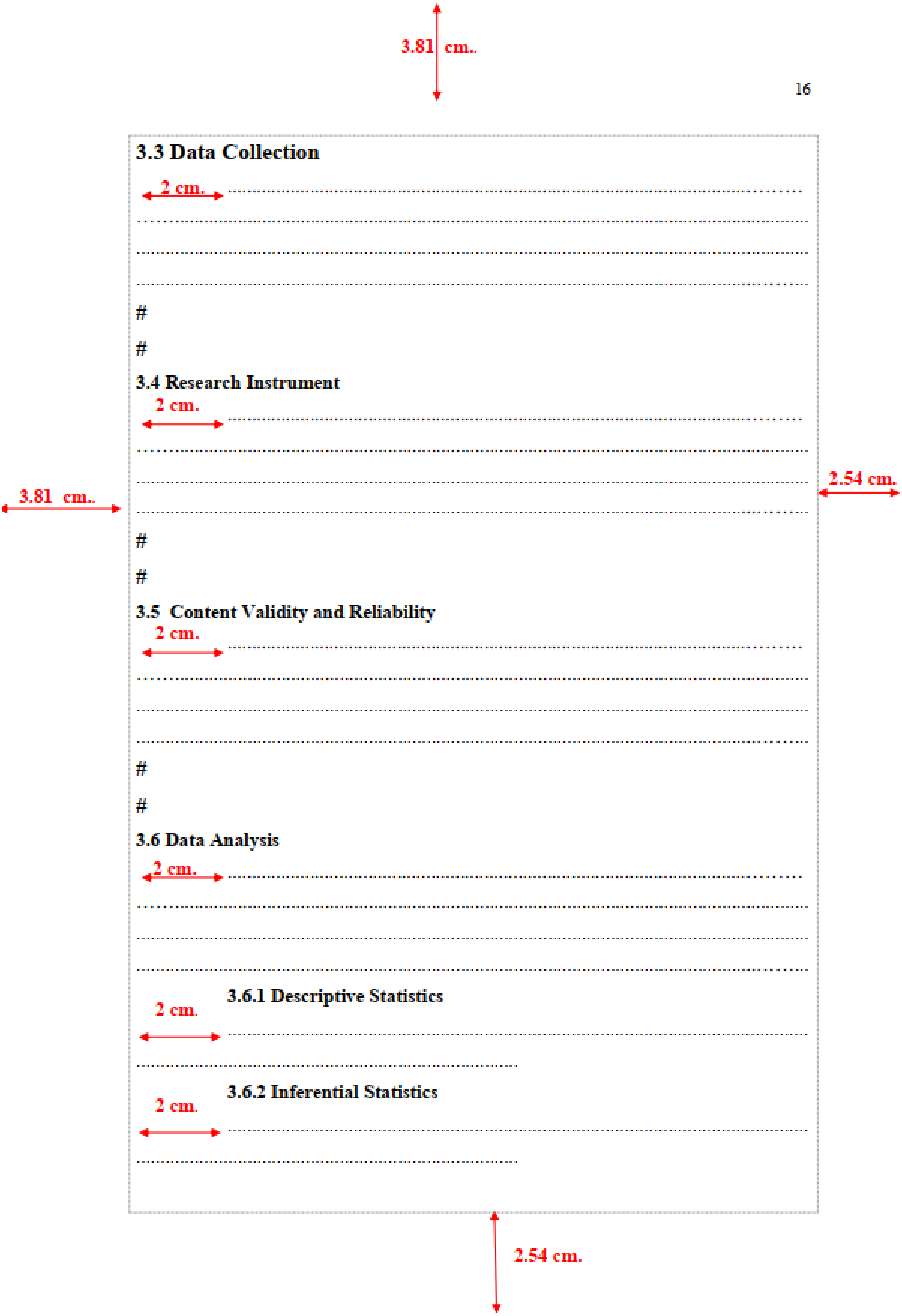
https://www.surveymonkey.com/mp/sample-size-calculator/

https://www.tc.columbia.edu/media/administration/institutional-review-board-/guide-amp-resources---documents/Published_Study-Material-Examples.pdf

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30,* 607-610.

APPENDIX


Pages with odd page numbers
3.81 cm.
Use times new roman letters.
Size 10 points
15
Defining page number headings
(odd numbered page)
Left corner:
"Institute of Science Innovation and Culture, RMUTK"
Right corner: degree initial (and disciplines in parentheses / page number
One (1) space before and after the '/' sign
1 line
#
CHAPTER III
RESEARCH METHODOLOGY
Use times new roman letters.
Size 14 Points Bold
#
#
Use letters
Times New Roman
Size 14 Points Bold
The line distance is 1.5
3.1 Research Design
2 cm.
3.81 cm.
2.54 cm.
#
#
Use bold 14 Points Times New Roman.
3.2 Samples and Samplesize
2 cm
2.54 cm.
Use bold 12 Points Times New Roman letters.
3.2.1 Population
2 cm
4 cm.
3.2.1.1
3.2.2 Samples
2 cm.
3.2.3 Sampling Methods
2 cm..
2.54 cm.


3.81 cm..
16
3.3 Data Collection
2 cm.
#
#
3.4 Research Instrument
2 cm.
3.81 cm..
2.54 cm.
#
#
3.5 Content Validity and Reliability
2 cm.
#
#
3.6 Data Analysis
2 cm.
3.6.1 Descriptive Statistics
2 cm.
3.6.2 Inferential Statistics
2 cm.
2.54 cm.

Form IOC for questionnaire

Items	Exp1	Exp2	Exp3	IOC	Remark
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

+1 make sure that questions are correspond with the objectives

0 not sure if the questions correspond to the objectives

-1 make sure that questions are not correspond with the objectives

Form IOC for questionnaire

Items	Exp1	Exp2	Exp3	IOC	Remark
1. ……………… a. b. c. d.					
2. ……………… a. b. c. d.					
3. ……………… a. b. c. d.					
4. ……………… a. b. c. d.					

+1 make sure that questions are correspond with the objectives

0 not sure if the questions correspond to the objectives

-1 make sure that questions are not correspond with the objectives

Remark

Each exam question must be marked correct answer by ✓ or × or circle the options (O)