

# ANALYTICAL & CRITICAL THINKING INVIEW OF STATISTICS: DAY 2

UGANDA BUREAU OF STATISTICS (UBoS)



**UBoS**



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# Presentation Outline



## DAY 1: Monday, September 3, 2018

- ☐ Facts on SESRIC (video show)
- ☐ Expected Training Outputs
- ☐ Overview/Definitions of Analytical and Critical Thinking
- ☐ Understanding Analytical and Critical Thinking
- ☐ Group Discussions and/or Presentations on:
  - Analytical and Critical Thinking Skills: Similarities and Differences
- ☐ Importance and Benefits of Analytical and Critical Thinking
- ☐ Group Discussions / Q&A



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## Presentation Outline cont..



### DAY 2: Tuesday September 4, 2018

- ☐ Review of DAY 1 (key points)
- ☐ What are good Analytical/Critical like?
- ☐ Group Discussions and/or presentations on:
  - Challenges and Opportunities for the Critical Analysis in the Assessment / National Statistics System (NSS)
- ☐ Practical Application of Analytical and Critical Thinking Skills in Statistical Production
- ☐ Group Discussions on:
  - The way Forward/Recommendations for Analytical and Critical Thinking for the Development of Statistics

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# Facts on SESRIC (Video Show)



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## Expected Training Outputs (Objectives)



- ❑ Staff/Participants equipped with Analytical and Critical Thinking Skills
- ❑ Staff are in position to identify some of the Analytical and Critical Skills that they possess
- ❑ Practical Application of Analytical and Critical Thinking Skills in Statistical Production



# What are good Analytical/ Critical Thinkers like ?



Ref: [www.insightassessment.com](http://www.insightassessment.com)

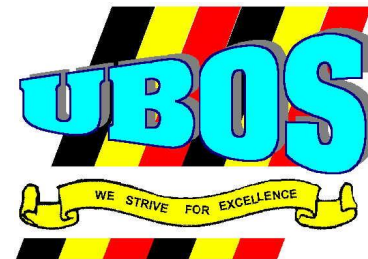
# What are good Analytical/ Critical Thinkers like ?

## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition:

“The scales measure the application of reasoning skills for the purpose of forming a reflective judgment about what to believe or what to do in a given context or problematic situation”.

- **Analysis:** Analytical skills are used to identify assumptions, reasons, themes, and the evidence used in making arguments or offering explanations

# What are good Analytical/ Critical Thinkers like ?



## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont...

- **Interpretation:** Interpretation is the process of discovering, determining, or assigning meaning. Interpretation skills can be applied to anything, e.g. written messages, charts, diagrams, maps, graphs, memes, and verbal and non-verbal exchanges.



# What are good Analytical/ Critical Thinkers like ?

## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont..

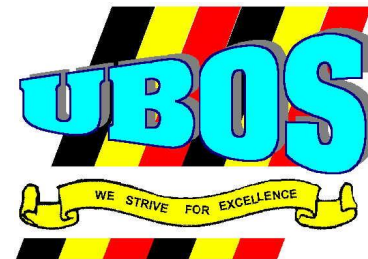
- **Inference:** Inference skills enable us to draw conclusions from reasons, evidence, observations, experiences, or our values and beliefs.
- **Evaluation:** Evaluative reasoning skills enable us to assess the credibility of sources of information and the claims they make.

# What are good Analytical/ Critical Thinkers like ?

## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont..

- **Explanation:** Explanation is the process of justifying what we have decided to do or what we have decided to believe. People with strong explanation skills provide the evidence, methods, and considerations they actually relied on when making their judgment.

# What are good Analytical/ Critical Thinkers like ?



## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont..

- **Deduction:** Deductive reasoning is rigorously logical and clear cut. Deductive skills are used whenever we determine the precise logical consequences of a given set of rules, conditions, beliefs, values, policies, principles, procedures, or terminology.

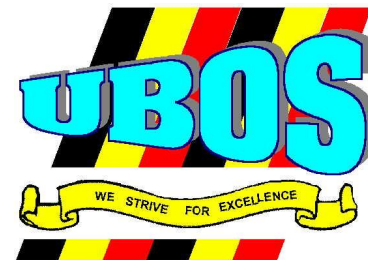
# What are good Analytical/ Critical Thinkers like ?

## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont..

- **Induction:** Inductive reasoning relies on estimating likely outcomes. Decision making in contexts of uncertainty relies on inductive reasoning. Inductive decisions can be based on analogies, case studies, prior experience, statistical analyses, simulations, hypotheticals, trusted testimony, and the patterns we may recognize in a set of events, experiences, symptoms or behaviors.

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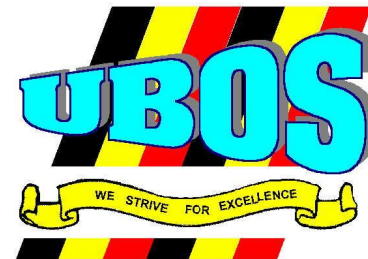
# What are good Analytical/ Critical Thinkers like ?



## Measuring Critical Thinking Skills based Delphi Expert Consensus' Definition: cont..

- **Numeracy:** Numeracy refers to the ability to make judgments based on quantitative information in a variety of contexts. People with strong numeracy can describe how quantitative information is gathered, manipulated, and represented textually, verbally, and visually in graphs, charts, tables and diagrams. Numeracy requires all the core critical thinking skills.

# What are good Analytical/ Critical Thinkers like ?

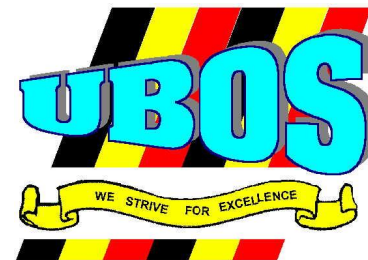


## “Cultivating A Positive Critical Thinking Mindset”

- **Truth-seeking** – Ask courageous and probing questions. Think deeply about the reasons and evidence for and against a given decision you must make.
- **Open-mindedness** – Listen patiently to someone who is offering opinions with which you do not agree. As you listen, show respect and tolerance toward the person offering the ideas.



# What are good Analytical/ Critical Thinkers like ?



## “Cultivating A Positive Critical Thinking Mindset”

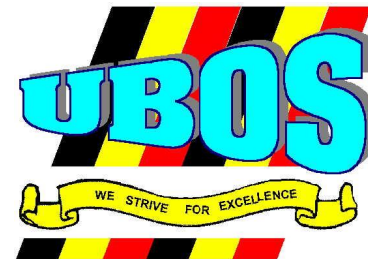
- **Analyticity** – Identify an opportunity to consciously pause to ask yourself about all the foreseeable and likely consequences of a decision you are making. Ask yourself what that choice, whether it is large or small, will mean for your future life and behavior.
- **Systematicity** – Focus on getting more organized. Make lists of your most urgent work...Make lists of the most important priorities and obligations as well.



*Peter A Facione and Gittens 2016*

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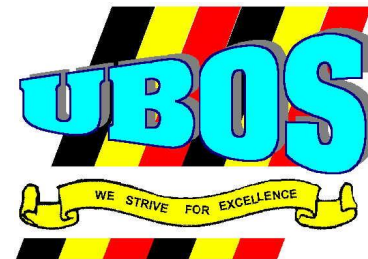
# What are good Analytical/ Critical Thinkers like ?



## “Cultivating A Positive Critical Thinking Mindset”

- **Critical Thinking Confidence** – Commit to resolve a challenging problem by reasoning it through. Embrace a question, problem, or issue that calls for a reasoned decision, and begin working on it yourself or in collaboration with others.
- **Inquisitiveness** – Learn something new. Go out and seek information about any topic of interest, but not one that you must learn about for work, and let the world surprise you with its variety and complexity.

# What are good Analytical/ Critical Thinkers like ?



## “Cultivating A Positive Critical Thinking Mindset”

- **Judiciousness** – Revisit a decision you made recently and consider whether it is still the right decision. See if any relevant new information has come to light. Ask if the results that had been anticipated are being realized. If warranted, revise the decision to better suit your new understanding of the state of affairs.

*Peter A Facione and Gittens 2016*

# Challenges and Opportunities for Critical Analysis in Assessment

## What is a **Good Problem Solving Assessment?**

Good problem solving skills or the ability to identify solutions to problems in a systematic manner is an ability which acts to empower individuals in both their professional or working, as well as in their personal lives. Many organizations are therefore increasingly recognizing that knowledge and skills in problem-solving and decision-making is not only valuable but may well be a key differentiating factor in an increasingly high tech, ever-changing and fast-moving global economy”.

# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

Recent research has identified the following ten aspects of problem solving as crucial to success in organizations of all sizes and types. This is the ability to:

- test assumptions by taking data and circumstances into account;
- apply a range of different possible strategies to problem solving;
- utilize a range of tools appropriately to help solve problem;

# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

Recent research has identified the following ten aspects of problem solving as crucial to success in organizations of all sizes and types. This is the ability to:

- use mathematical and risk calculations, including cost management to solve problems;
- show independence and initiative in identifying problems and solving them;
- develop creative, innovative solutions;



# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

Recent research has identified the following ten aspects of problem solving as crucial to success in organizations of all sizes and types. This is the ability to:

- develop practical implementable solutions;
- solve problems collaboratively or in teams;
- apply or extrapolate problem solving strategies from one area to another; and
- wisely resolve client or customer concerns in relation to problems experienced.

# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

So how can we assess whether leaders of teams or even individuals on teams have at least some of the above skills sets, or the aptitude to develop these skills? Well, most of the above are not so much about style but are about competency and can therefore be described in specific competencies. These competencies are as follows:

- **CRITICAL THINKING:** looks at an individual's capacity to think rigorously and broadly about issues, challenges or problems and to optimize his or her route to finding potential solutions that work. This competency category asks the question *"With how much confidence do you believe in your own open-mindedness and ability to solve problems of many types through the successful application of your personal thinking and judgment?"*

# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

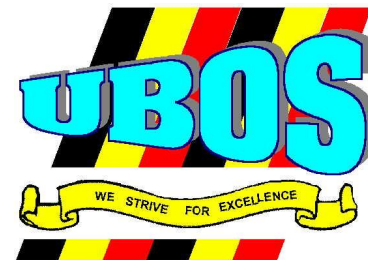
- **DATA GATHERING AND PROCESSING:** looks at the extent to which an individual systematically and comprehensively gathers the information that he or she needs to solve problems efficiently and effectively. This competency category asks the question *“How well do you assemble all the relevant data and organize and categorize it for further analysis?”*
- **LATERAL CONCEPTUALIZATION:** looks at the extent to which an individual looks to bring in ideas, hypotheses or even potential solutions that are not the most ‘immediate or most obvious’ to others. This competency category asks the question *“To what extent do you actively move outside the realm of ‘conventional’ thinking and ideas to create new insights or opportunities?”*

# Challenges and Opportunities for Critical Analysis in Assessment

What is a Good Problem Solving Assessment? Cont..

- **RISK ASSESSMENT:** looks at the extent to which an individual systematically calculates implications of potential courses of action or decisions. This competency category asks the question *“How effectively do you engage in the formal assessment of the consequences of suggested solutions to problems?”*
- **TOOL SELECTION SKILLS:** looks at how effectively an individual determines how the ‘process’ of solving a problem, or making a decision, should ‘unfold’ or be designed. This competency category asks the question *“How well do you understand a range of problem solving tools or techniques and use the right one in the right circumstances?”*

# Challenges and Opportunities for Critical Analysis in Assessment



What is a Good Problem Solving Assessment? Cont..

- **ALTERNATIVE WEIGHING ABILITY:** looks at the extent to which an individual fairly assesses data, ideas, options and possibilities to ensure the best decisions are likely to be made, drawing on his or her own experience and those of others, where necessary. This competency category asks the question *“How effectively do you evaluate competing alternatives on a reasonable comparative basis?”*
- **PERCEPTION AND JUDGMENT:** looks at the extent to which an individual effectively synthesizes what he or she sees, hears or senses in order to form a clear view of what may be viable and practical as a cause of executable action. This competency category asks the question *“How well do you assimilate information and interpret what you experience to make good sense of it to make a decision?”*



OCTOBER 30, 2013 by [DR. JON WARNER](#) in [PROBLEM SOLVING AND DECISION-MAKING SKILLS](#)

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# Challenges and Opportunities for Critical Analysis in Assessment

## What is a Good Problem Solving Assessment? Cont..

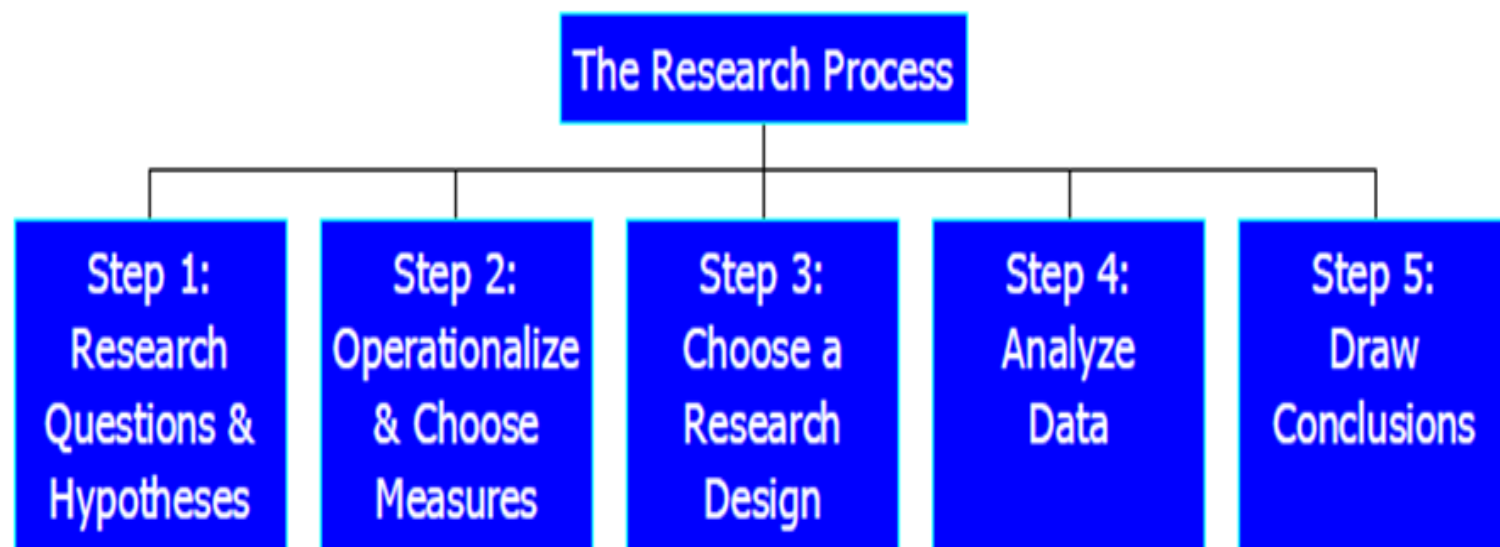
“Once we have a set of competencies such as the above, we can readily ask questions relating to each of these which assess an individual’s current knowledge or skills and better appreciate where gaps occur which we can then address specifically in the future with training or coaching. And rather than having to do this work from scratch, the problem solving effectiveness profile from RTM has already fully developed this assessment”...



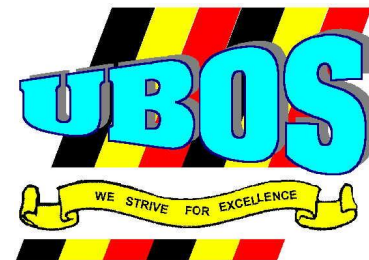
# Challenges and Opportunities for Critical Analysis in Assessment



# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



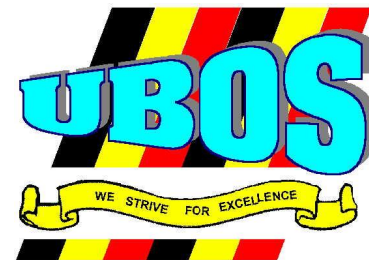
## ➤ Step 1: Research Questions

- Research questions reflect the problem that the researcher wants to investigate.
- Research questions can be formulated based on theories, past research, previous experience, or the practical need to make data-driven decisions in a work environment.
- Research questions are **vital** important because they, in large part, dictate what type of statistical analysis is needed as well as what type of research design may be employed.

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# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## ➤ **Step 1: Research Questions. Cont...**

- **Examples of Research Questions**
- Can changes in diet and upbringing compensate for genetic abnormalities?
- When do children become aware that other people have thought processes of their own, and what makes this awareness possible?

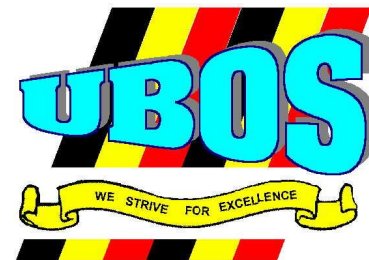


## Step I: Research Questions. Cont...

### ➤ Hypotheses:

- While research questions are fairly general, hypotheses are specific predictions about the results, made **prior** to data collection.
- **Examples:** A researcher thinks that if expectant mothers use vitamin pills, the birth weight of the babies will increase. The average birth weight of the population is 8.6 pounds.
- An engineer hypothesizes that the mean number of defects can be decreased in a manufacturing process of compact disks by using robots instead of humans for certain tasks. The mean number of defective disks per 1000 is 18.

# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## Step 2: Operationalize & Choose Measures

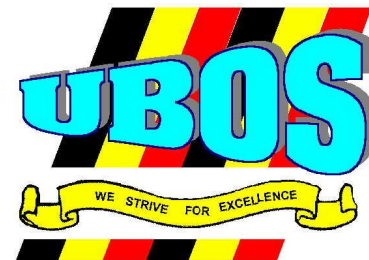
- Many variables of interest in education and psychology are abstract concepts that cannot be directly measured.
- This doesn't preclude us from studying these things, but requires that we clearly define the specific behaviors that are related to the concept of interest.

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# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## Step 2: Operationalize & Choose Measures. Cont...

### ➤ Measuring Abstract Concepts

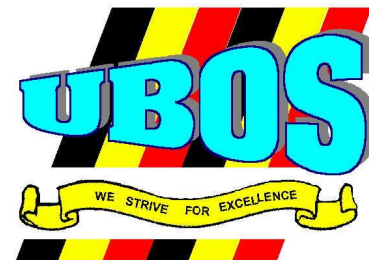
- The process of defining variables and choosing a reliable and accurate measurement tool is called operationalizing your variables.
- Good measurement is **vital** to the trustworthiness of your results!



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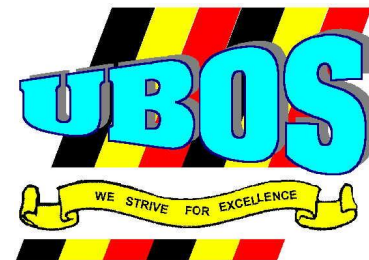
## ➤ Step 3: Choose a Research Design

- In Step 3, we develop a plan for collecting the data we need (i.e., a “blueprint” for the study)
- This is called **research design**, and includes things such as:
  - Who will participate in the study?
  - Who will receive the intervention?
  - Will there be a “control group”?
  - Will data be collected longitudinally?
  - What instrument will be used to collect data?
  - What type of data will be collected?

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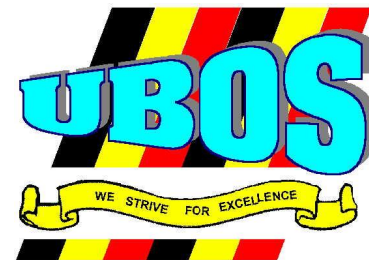


- **Step 3: Choose a Research Design. Cont...**
- **Need to develop concept note/survey protocol**
  - Survey Objectives
  - Survey Organisation
  - Survey Methodology
    - Sampling Procedure
    - Household Listing and final Respondents Selection
  - Questionnaire design
  - Interviewing Technique
  - Tabulation Plan
  - Data Management
  - Implementation Schedule



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## ➤ **Step 4: Analyze the Data**

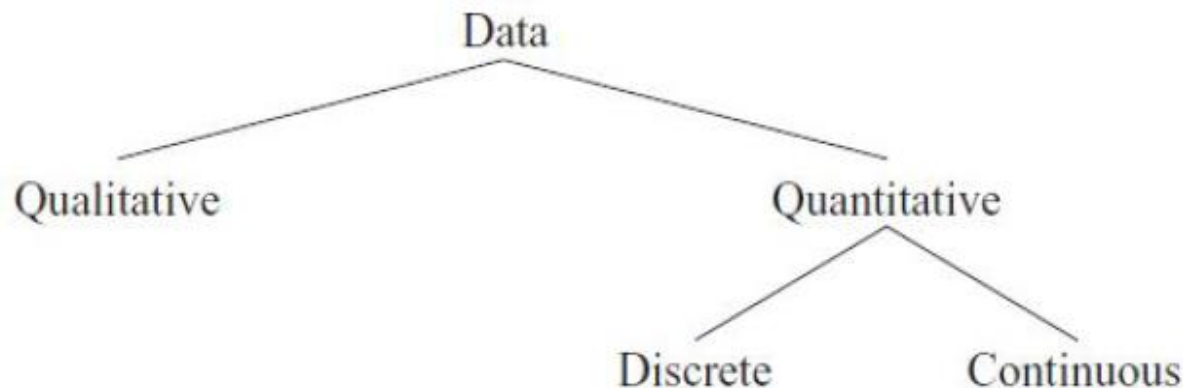
- Once the data have been **collected**, the results must be **organized** and **summarized** so that we can answer the research questions.
- This is the purpose of statistics
- The choice of analysis at this stage depends **entirely** on two prior steps:
  - - **The research questions**
  - - **How the variable is measured**

# Practical Application of Analytical and Critical Thinking Skills in Statistical Production

## ➤ **Step 4: Analyze the Data. Cont...**

- **Variables and Types of Data**

The classification of variables can be summarized as follows:



# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## ➤ Step 4: Analyze the Data. Cont...

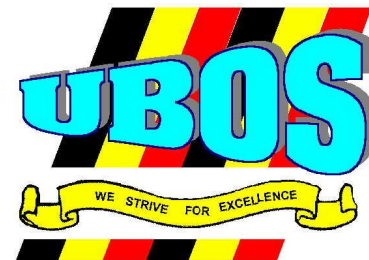
### • Variables and Types of Data

- Variables can be classified as **qualitative** or **quantitative**.
- **Qualitative variables** are variables that can be placed into **distinct categories**, according to some characteristic or attribute. For example, if subjects are classified according to gender (male or female), then the variable gender is qualitative. Other examples of qualitative variables are religious preference and geographic locations.
- **Quantitative variables** are **numerical** and can be ordered or ranked.
- For example, the variable age is numerical, and people can be ranked in order according to the value of their ages. Other examples of quantitative variables are heights, weights, and body temperatures.



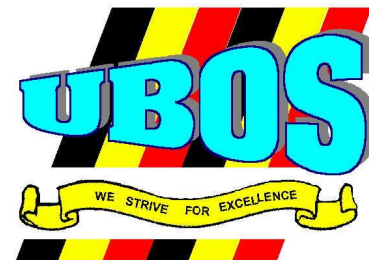


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- **Step 4: Analyze the Data. Cont...**
- **Variables and Types of Data. Cont...**
- **Quantitative variables** can be further classified into two groups:
- **discrete and continuous.**
- **Definitions**
- **Discrete variables** assume values that can be counted. E.g. Number of students in a class.
- **Continuous variables** can assume an infinite number of values between any two specific values. They are obtained by measuring.

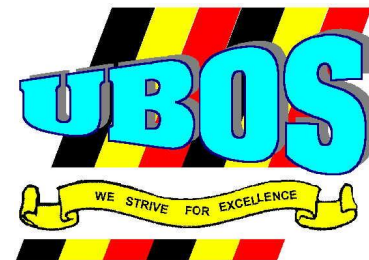
# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## ➤ **Step 5: Draw Conclusions**

- After analyzing the data, we can make judgments about our initial research questions and hypotheses.
- Are these results consistent with previous studies?
- The conclusions drawn from a study may provide a starting point for new research.

# Practical Application of Analytical and Critical Thinking Skills in Statistical Production

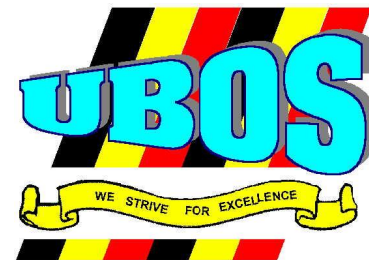


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# Practical Application of Analytical and Critical Thinking Skills in Statistical Production



## ➤ Step 5: Draw Conclusions. Cont...

- Despite the anxiety usually associated with statistics, data analysis is a relatively small piece of the larger research process.
- There is a misconception that the **trustworthiness** of statistics is **independent** of the **research process** itself.
- This is **absolutely** incorrect!
- A statistical analysis can in **no way** compensate for a poorly designed study!!!!

# References



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- **Peter A Facione, © 2016 Measured Reasons LLC, and based in part on material from chapter 2 of Think Critically, Facione and Gittens, 2016, Pearson Education.**
- <http://www.measuredreasons.com> and [pfacione@measuredreasons.com](mailto:pfacione@measuredreasons.com)
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- **Lecture notes..Basic Statistics Training Dec. 2016:Yusupha Dibba(UTG)**



## Thank you for your attention!

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