CHAPTER 4

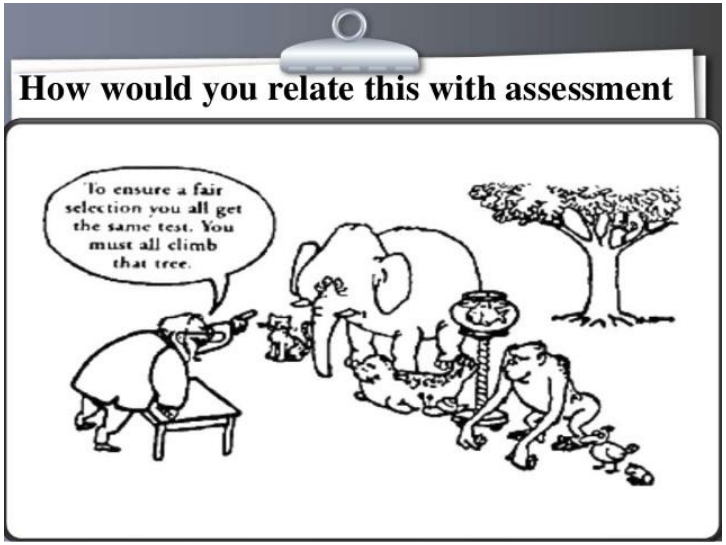
FUNDAMENTAL RESEARCH ISSUES

LEARNING OBJECTIVES

- ✓ Define variables and describe the operational definitions of variables
- ✓ Describe the different relationships between variables:
  - ✓ Positive
  - ✓ Negative
  - ✓ Curvilinear
  - ✓ No relationship
- ✓ Compare and contrast non-experimental and experimental research methods
- ✓ Distinguish between an independent variable and a dependent variable
  - Discuss the limitations of laboratory experiments and the advantage of using multiple methods of research
  - Distinguish between construct validity, internal validity, and external validity

VALIDITY

- **Validity** is the extent to which a concept, conclusion, or measurement is well-founded and corresponds accurately to the real world.
- It encompasses the entire experimental concept and establishes whether the results obtained meet all of the requirements of the scientific research method.
- There are three key types of validity:
  - Construct validity
  - Internal validity
  - External validity



VALIDITY

- **Construct validity** *concerns whether one's methods of studying variables are accurate.*
  - That is, "the degree to which a **test** measures what it claims, or purports, to be measuring."
  - You might think of construct validity as a "labeling" issue.
    - When you implement a program that you call a "Head Start" program, is your label an accurate one?
    - When you measure what you term "self esteem" is that what you were really measuring?
  - **Operational Definitions**: Construct validity is achieved by clearly defining the constructs being measured.
    - *It helps researchers communicate their ideas with others!*

VALIDITY

- **Internal validity** refers to the accuracy of conclusions about *cause and effect*.
- Thus, internal validity is only relevant in studies that try to establish a *causal relationship*.
- It's not relevant in most observational or descriptive studies, for instance.
- For studies that assess the effects of social programs or interventions, internal validity is perhaps the primary consideration.
  - You would like to be able to conclude that your program or treatment made a difference -- it improved test scores or reduced symptomology.
- The key question in internal validity is whether observed changes can be attributed to your program or intervention (i.e., the cause) and **not** to other possible causes (sometimes described as "alternative explanations" for the outcome).

VALIDITY

- **External validity** *concerns whether one can generalize the findings of a study to other settings.*
  - *External Validity* involves generalizing from your study context to other people, places or times (can it be repeated across people, places and times),
  - *Construct Validity* involves generalizing from your measures to the *concept* of your measures *(Is it measuring the concepts that you say you're measuring:* operationalization*)*.

VARIABLES

- Any event, situation, behavior, or individual characteristics that varies
- They're the things encountered in our lives even though not used formally
- The elements we observe, compare, and measure in a research study
  - It is a common word used among researchers to describe the fundamental elements being observed and analyzed in a research study.
  - You won't be able to do very much in research unless you know how to talk about *variables*.
    - A *variable* is any entity that can take on different values.
  - When constructing your hypotheses and analyzing data, it is important to understand how many and what types of variables you're interested in studying, as well as their relationships to other variables.

OPERATIONAL DEFINITIONS OF VARIABLES

- Consider the claim that "90% of the mind's power is unused."
  - The Nobel Prize winning neurophysiology Sir John Eccles apparently repeated that idea at a lecture at the University of Colorado.
  - The claim may go all the way back to Freud's statement that 90% of the mind is "under the surface" like an iceberg!
- To adopt a scientific attitude toward this claim, think about how you would test it. First you would have to define the terms.
  - What is "the mind's power"?
  - How do you measure it?
  - How do you take a percentage of it?
- In all likelihood the claim that "90% of mind power is unused" has *never been tested*.
- When people say "90% of the brain's power is unused" it may be a nice way of saying, "Most people only use a small percentage of their brains."

OPERATIONAL DEFINITIONS OF VARIABLES

- ✓ Are a set of procedures used to measure and manipulate variables
- ✓ This allows variables to be studied empirically
- ✓ *It helps communicate ideas to others*
- **Construct validity** refers to the adequacy of the operational definition of variables:
  - Does the operational definition of a variable actually reflect the true **theoretical** meaning of the variable?

"Our goal is to establish language that is gender-neutral, ethnic-neutral and age-neutral, while celebrating our spirit of diversity."

RELATIONSHIPS BETWEEN VARIABLES

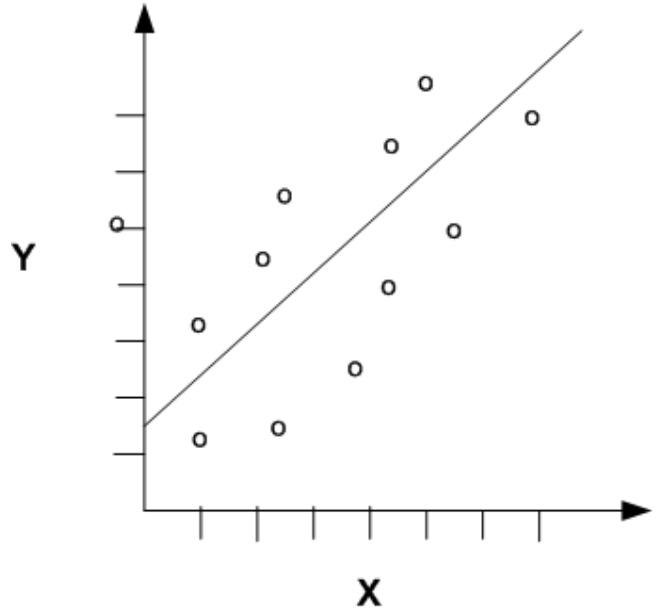
- A Linear relationship is a statistical term used to describe the relationship between two variables.
- They can be expressed in a graphical format where the independent variable and dependent variables are connected by a straight line

$$y = mx + b$$

(Graphically, $y = mx + b$ plots in the x-y plane as a line with slope "m" and y-intercept "b".)

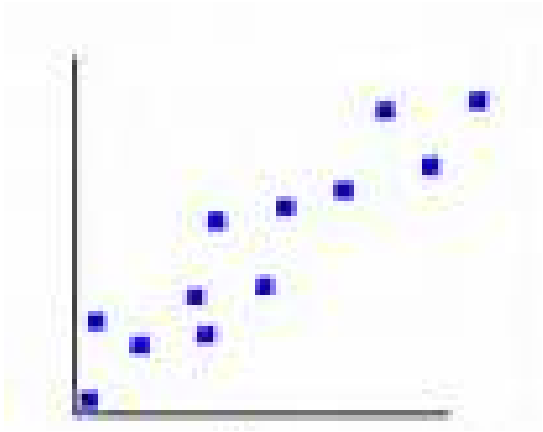
RELATIONSHIPS BETWEEN VARIABLES

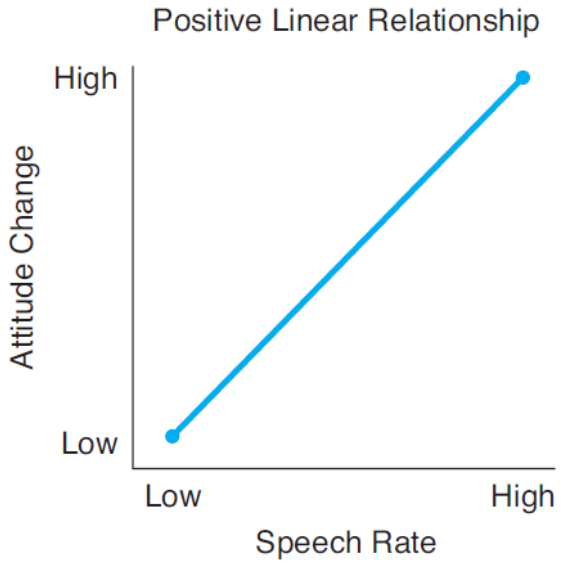
- A linear equation is where two variables describe a relationship in which the value of one of the variables depends on the value of the other variable.
- In a linear equation, *x* is the independent variable and *y* depends on it (the dependent variable).
- In statistics, this is regression.



RELATIONSHIPS BETWEEN VARIABLES

- **Positive linear relationship**
  - *Increase in one variable results in increase in another*

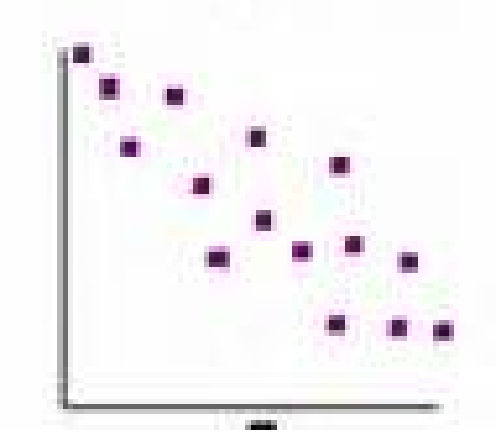


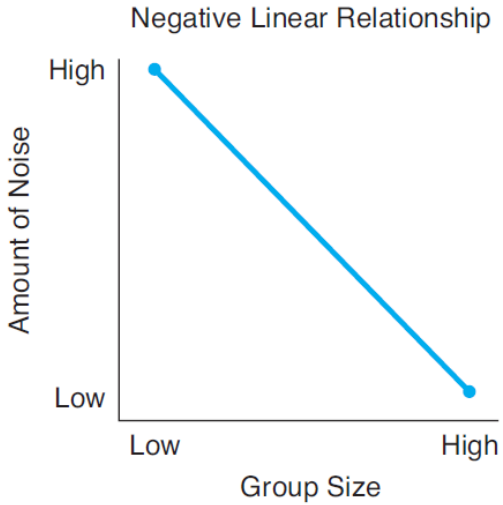


  - **Positive Graph**: As Attitude Change increases, Speech Rate increases.

RELATIONSHIPS BETWEEN VARIABLES

- **Negative linear relationship**
  - *Increase in one variable results in decrease in another*





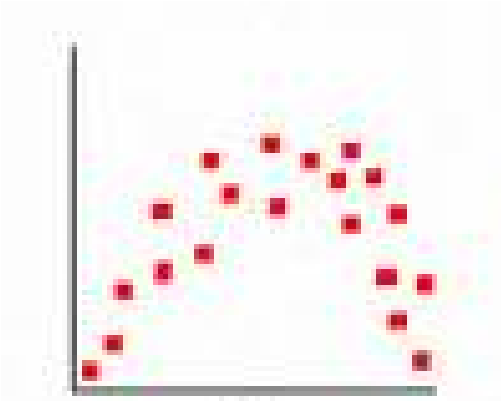
  - **Negative Graph**: As Amount of Noise Increases, Group Size decreases.

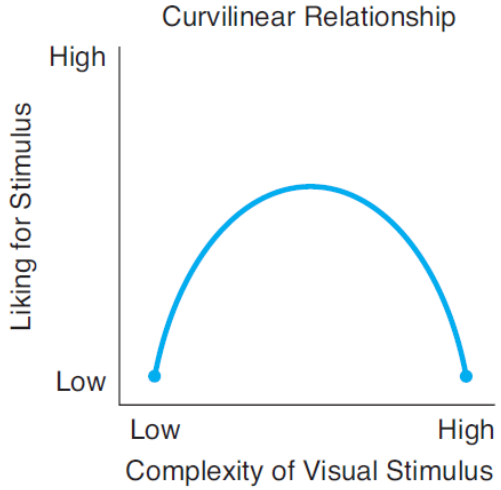
RELATIONSHIPS BETWEEN VARIABLES

- **Curvilinear relationship**
  - *A Curvilinear Relationship is a type of relationship between two variables where as one variable increases, so does the other variable, but only up to a certain point, after which, as one variable continues to increase, the other decreases.*
  - For example: A curvilinear relationship would be staff cheerfulness and customer satisfaction. The more cheerful a service staff is, the higher the customer satisfaction, but only up to a certain point.
    - When a service staff is too cheerful, it might be perceived by customers as fake or annoying, bringing down their satisfaction level.

RELATIONSHIPS BETWEEN VARIABLES

- **Curvilinear relationship**
  - Includes U-shaped and inverted U-shaped curves
  - This type of relationship is sometimes referred to as a *non-monotonic function*.

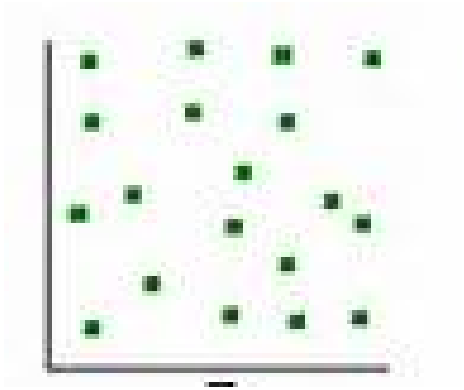


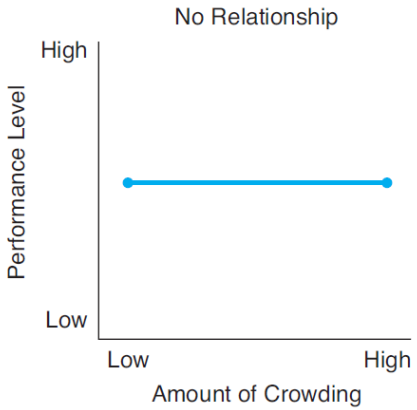


  - **Curvilinear Graph**: As Liking for Stimulus continues to increase, Complexity of Visual Stimulus will increase but then at a certain threshold, it will begin to decrease.

RELATIONSHIPS BETWEEN VARIABLES

- **No relationship**
  - When there is no relationship between the two variables, the graph is simply a flat line.





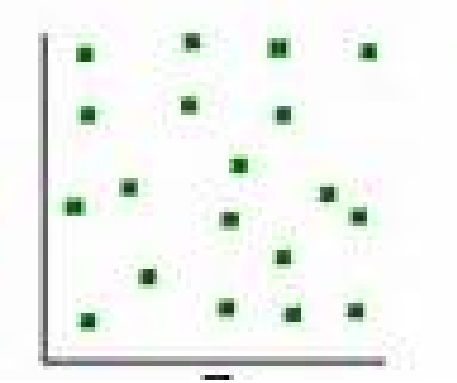
  - **Flat-line graph**: There is no relationship between Performance Level and Amount of Crowding

RELATIONSHIPS BETWEEN VARIABLES

- Correlation coefficients explain how strongly variables are related to one another.
- **Correlation coefficient**: is the numerical index of the strength of relationship between variables
- The correlation coefficient is statistically denoted by *r*, and it tells us how closely data in a scatterplot fall along a straight line.
- The closer that the absolute value of *r* is to one, the closer that the data are correlated.
- If $r = 1$ or $r = -1$ then the data set is perfectly aligned.
- Data sets with values of *r* close to zero show little to no straight-line relationship.

RELATIONSHIPS BETWEEN VARIABLES

- When one detects a relationship between variables, one reduces uncertainty by increasing one's understanding of the variables that one is examining.
- The term *uncertainty* implies that there is randomness in events
  - Scientists refer to this as *random variability* in events that occur.
  - Research can reduce random variability by identifying systematic relationships between variables.
  - The more random variability there is between variables, the more the scatter plots looks like:



NONEXPERIMENTAL VERSUS EXPERIMENTAL METHODS

- **Nonexperimental method**
  - With the **nonexperimental method**, relationships are studied by making observations or measures of the variables of interest.
  - This may be done by asking people to describe their behavior, directly observing behavior, recording physiological responses, or even examining various public records such as census data.
    - In all these cases, variables are observed as they occur naturally.
  - It is impossible to determine which variable causes the other.

NONEXPERIMENTAL VERSUS EXPERIMENTAL METHODS

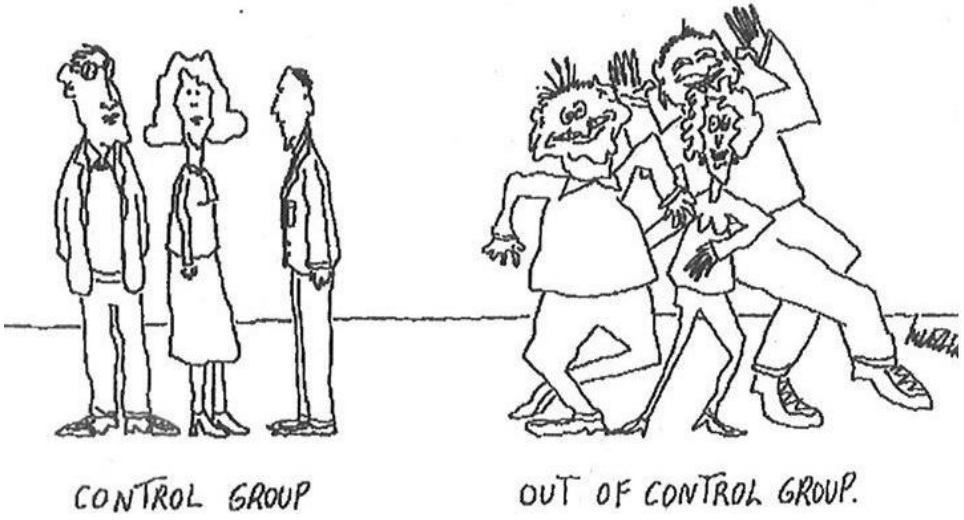
- **Nonexperimental method**
  - *A **third variable** is any variable that is **extraneous** to the two variables being studied.*
    - Any number of other third variables may be responsible for an observed relationship between two variables.
  - *When one actually knows that an uncontrolled third variable is operating, one can call the third variable a **confounding variable**.*
  - *If two variables are confounded, they are intertwined so one cannot determine which of the variables is operating in a given situation.*
    - *Structural Equation Modeling (SEM)*
  - *In a nonexperimental study, it is difficult to tell if a confounding variable is responsible for an outcome.*
  - Because the nonexperimental method allows one to observe covariation between variables, another term that is frequently used to describe this procedure is the *correlational method*.
  - Weakness of the nonexperimental method come from:
    - No manipulation of the independent variable
    - Extraneous variables are not kept constant
    - No random selection of sample

NONEXPERIMENTAL VERSUS EXPERIMENTAL METHODS

- **Experimental method**
  - The experimental method reduces ambiguity in the interpretation of results.
  - With the experiment method, one variable is manipulated and the other is measured.
  - *The manipulated variable is called the **independent variable** and the variable that is measured is termed the **dependent variable**.*
  - In an experiment, all extraneous variables are kept constant. This is called **experimental control**.
    - If a variable is held constant, it cannot be responsible for the results of the experiment.
    - In other words, any variable that is held constant cannot be a confounding variable.

NONEXPERIMENTAL VERSUS EXPERIMENTAL METHODS

- **Experimental method**
  - The experimental method eliminates the influence of such variables by **randomization**.
  - Randomization ensures that an extraneous variable is just as likely to affect one experimental group as it is to affect the other group.
  - To eliminate the influence of individual characteristics, the researcher assigns participants to the two groups in a random fashion.



INTERNAL VALIDITY AND CAUSALITY

- **Internal validity** *is the ability to draw conclusions about causal relationships from the results of a study.*
  - A study has high internal validity when strong inferences can be made that one variable caused changes in the other variable.
  - Strong causal inferences can be made more easily when the experimental method is used.

INTERNAL VALIDITY AND CAUSALITY

- **Strong internal validity requires 3 elements:**
  - *Temporal precedence:*
  - *Covariation between the two variables*
  - *Elimination of plausible alternative explanations*

INTERNAL VALIDITY AND CAUSALITY

- **Temporal precedence:**
  - The process of establishing that the cause did indeed happen before the effect.
  - If a researcher (based on the data) cannot specify which variable is the cause and which is the effect, than he or she is unable to establish temporal precedence.
  - If one cannot meet this necessary condition but the variables are statistically related then one can only say that the two variables are related (i.e., you cannot say that they are causally related).

INTERNAL VALIDITY AND CAUSALITY

- **Covariation between the two variables**
  - Covariation of the cause and effect is the process of establishing that the experiment or program had some measurable effect.
  - For example, in the study of Greek learning, the results showed that the group with the computer package performed better than those without.
  - This can be summed up as: If you use the program, there is an outcome. Without the program, there is no outcome.
  - More of the program equals more of the outcome. Less of the program equals less of the outcome.
  - Covariation of the cause and effect cannot explain what causes the effect, or establish whether it is due to the expected manipulated variable or to a confounding variable.

INTERNAL VALIDITY AND CAUSALITY

- **Elimination of plausible alternative explanations**
  - Is achieved through strong experimental design, eliminating confounding variables, and ensuring that they cannot have any influence.
  - Randomization, control groups, and repeat experiments are the best ways to eliminate these variables and maintain high validity.
    - For example, if we study the effects of activity level on weight gain, it would certainly be important to control for some possible confounding variables:
      - age, illnesses that may cause weight gain, family obesity history, etc.

DEPENDENT AND INDEPENDENT VARIABLES

- Researchers use the terms **independent variable** and **dependent variable** when referring to the variables being studied.
  - **Independent variables**
    - Considered to be the cause
    - Usually manipulated by the researcher
  - **Dependent variables**
    - Considered to be the effect
    - Usually measured by the researcher
- After manipulating the independent variable, the researchers measure the dependent variable. The basic idea is that the researchers make changes in the independent variable and then see if the dependent variable changes in response.

ISSUES WHEN CHOOSING A METHOD

- The **external validity** of a study is the extent to which the results can be generalized to other populations and settings.
- Another alternative is to try to conduct an experiment in a field setting.
  - In a **field experiment**, the independent variable is manipulated in a natural setting.
- Artificiality of experiments occurs in more controlled environments (e.g., laboratories)

ISSUES WHEN CHOOSING A METHOD

- There are ethical and practical considerations:
  - Sometimes the experimental method is not a feasible alternative because experimentation would be either unethical or impractical.
    - For example, child-rearing practices would be impractical to manipulate with the experimental method.
- **Participant variables** (also called *subject variables* and *personal attributes*) are characteristics of individuals, such as age, gender, ethnic group, nationality, birth order, personality, or marital status.
  - These variables are by definition nonexperimental and so must be measured.
  - They are often referred to as demographic data on questionnaires

ISSUES WHEN CHOOSING A METHOD

- **Description of behavior**
  - A major goal of science is to provide an accurate description of events.
  - Thus, the goal of much research is to describe behavior; in those cases, causal inferences are not relevant to the primary goals of the research.
  - A classic example of descriptive research in psychology comes from the work of Jean Piaget, who carefully observed the behaviour of his own children as they matured.
    - Through observation and description, Piaget constructed his developmental theory which involved 4 stages of development :
      - Sensorimotor
      - Preoperational
      - Concrete Operational
      - Formal Operational

ISSUES WHEN CHOOSING A METHOD

- **Successful predictions of future behavior**
  - In many real-life situations, a major concern is to make a successful prediction about a person's future behavior
    - For example, success in school, ability to learn a new job, or probable interest in various major fields in college.
    - In such circumstances, there may be no need to be concerned about issues of cause and effect.
    - It is possible to design measures that increase the accuracy of predicting future behavior.

ISSUES WHEN CHOOSING A METHOD

- **Advantages of multiple methods**
  - Perhaps most important, complete understanding of any phenomenon requires study using multiple methods, both experimental and nonexperimental.
  - No method is perfect, and no single study is definitive.
  - The more ways a phenomenon is studied the more confident we can be in understanding it.

EVALUATING RESEARCH: Summary of the Three VALIDITIES

- *Validity* refers to "truth" and the accurate representation of information.
- Research can be described and evaluated in terms of three types of validity:
- **Construct validity**
  - refers to the adequacy of the operational definitions of variables
- **Internal validity**
  - refers to one's ability to accurately draw conclusions about causal relationships
- **External validity**
  - is the extent to which results of a study can be generalized to other populations and settings

- "Hypothesis and Operational Definition Exercise"
  - Due before class Next Tuesday