NAME_____

From the 2018 programme

- Hypotheses
- Variables
- Experimental and control groups
- Placebos
- Longitudinal vs. Case-studies
- Quantitative and qualitative data
- Data representation.
  - Interpreting and drawing results tables and graphs
  - Know how to find mean, median, range, probability
- Have an understanding of correlation coefficients in scatter plots
- Analysing and identify trends, patterns and relationships
- Commenting on experiment validity and reliability and outline ways to improve
- Influence of errors, nature of the procedure, sample size etc.
- Select, synthesise and use evidence to make and justify conclusions
- Experimental bias
- Purpose of blind studies and clinical studies
- Ethical considerations

Science Inquiry

- *identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes*
- *design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics*
- *conduct investigations, including the collection of data related to homeostasis and the use of models of disease transmission, safely, competently and methodically for the collection of valid and reliable data*
- *represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions*
- *interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; and use reasoning to construct scientific arguments*
- *select, use and/or construct appropriate representations, including diagrams, models and flow charts, to communicate conceptual understanding, solve problems and make predictions.*
- *communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports*

PERIOD	CONTENT	ACTIVITIES & EQUIPMENT
1	BASE-LINE ASSESSMENT - **plan** an experiment (prior knowledge) 1. Teacher poses to class – "How does body posture affect blood pressure?" Teacher leads student thought process around conducting this experiment. [If there is not enough electronic sphygmomanometers to go around then, • use manual sphygmomanometers and stethoscopes or, • students could study (teachers choice) "Caffeine increases heart rate immediately upon drinking/red food colouring increases heart rate immediately upon drinking…"] 2. By then end of the lesson, there should be a class agreed method (which could be written up later)…replicates are the different groups (validity), randomly select subjects, etc. etc.	e-Sphygmos. Stethoscopes
2	Students conduct the experiment – should be in quick time…20 minute write-up to save time/exam conditions…quick review/feedback	e-Sphygmos. Stethoscopes timers
3	Various worksheets – hypotheses, ***percentage increase/decrease***, 'placebo' methodology rather than just a placebo pill and why it is done, randomly selecting subjects, blind/double blind, ethics listed from text (again).	"The Placebo Effect" - Dateline (SBS)
4	Discrete and Continuous data, Discrete (bar graph/histogram) and Continuous data (line graph/scattergram), Quantitative (line graph/scattergram) and Qualitative data (bar graph/histogram), correlation index (0-1) visualizing graphically	Various graphs supplied. Using Excel to plot graphs (scatter plot cf line graph
5	ASSESSMENT – **plan** an experiment taking into consideration 1. Title, Aim, Independent variable, Dependent variable, Hypothesis, Materials, Methods, Results Table ('skeleton') [If you continue on to conduct the experiment, then include in the report actual results in the table, conclusions, references and acknowledgements.] 2. No bias; a. random selection of subjects b. blind experiment c. double blind 3. Reliability planned for; a. averages b. replicates c. repeated procedures 4. Validity planned for; Everything above plus - i. controlled variables OR before/after results ii. control groups with placebo (procedures or pill) iii. discrete/continuous data 5. What results would support your hypothesis and what results would refute your hypothesis? (always 2 here!) ***UWA/Curtin University/RPH*** A. "A diet of lean red meat reduces blood cholesterol." B. "A diet including lupin enriched bread decreases blood cholesterol." C. "A diet including regular cups of tea decreases blood cholesterol."	

INVESTIGATING SCIENTIFICALLY FOR HUMAN BIOLOGY STUDENTS

SECTION 1 – A bit of background.

Q 1. What are the synonyms for Investigating Scientifically?

Q2. How long has Investigating Scientifically, (in whatever inquisitive form), been used by the human species?

SECTION 2 – Plan an experiment…how much can you remember?

Q1. Without any help from your teacher OR from the internet/electronically, design an experiment to test the following theory;

"Human blood pressure decreases by half between standing and lying prone on the ground."

SECTION 3 – HYPOTHESIS (This is one of the things in Human Biology (Science) that causes the most consternation…BUT it doesn't have to be!)

What is a hypothesis?

Q1. (a) Write down your own definition of what a hypothesis is? (b) How many of you have it is an educated guess?

HYPOTHESES are short testable statements. If they are testable, then they must have the 2 variables in them to test.

The following table has some more common problems that occur. Each one listed has;

1. the part that is incorrect underlined and boldface
2. an explanation as to why it is incorrect and then
3. how it should have been written.

HYPOTHESIS	PROBLEM IN THIS HYPOTHESIS	WHY IT IS INCORRECT	HOW SHOULD IT READ
Human blood pressure decreases by half between standing and lying prone on the ground because the heart doesn't have to work as hard.	Human blood pressure decreases by half between standing and lying prone on the ground **because the heart doesn't have to work as hard.**	The hypothesis is a testable statement. We do not try and explain a hypothesis. We test it to see if there is a link between the two variables – the Independent and Dependent Variables. Explanations are done in the latter stages of the experimental report	If a person changes their position from standing to lying prone on the ground, then their blood pressure will drop by 50% OR Blood pressure decreases by 50% between standing and sitting positions
Blood pressure, which is measured using a sphygmomanometer, decreases by half between standing and lying prone on the ground	Blood pressure, **which is measured using a sphygmomanometer**, decreases by half between standing and lying prone on the ground	No need for equipment. This/these can be put into the materials section of the report.	If a person changes their position from standing to lying prone on the ground, then their blood pressure will drop by 50% OR Blood pressure decreases by 50% between standing and sitting positions
Blood pressure is an important measure of a human's fitness. In this experiment, we will be testing a 50% reduction in blood pressure between standing and lying prone on the ground.	[A]**Blood pressure is an important measure of a human's fitness**. [B]**In this experiment**, [C]**we** [D]**will be testing a comment** that there will be a 50% reduction in blood pressure between standing and lying prone on the ground.	A – no need to explain why the whole experiment is done…other parts/the whole experiment will explain this to the readers. B – you have just collected data, and written a report…and the readers know it's a report…stop writing too much – the report is just a bare minimum of the relevant information. C – No "I, WE, MY, US, OUR, ACCURATE, PROVE" in a report. (NB. ACCURATE/ACCURACY is what you physically do in an experiment; it is not what you write about!) Rarely in Investigating is anything proved! (Laws might be considered 'proved' but for safety, don't even do this!) HOWEVER, you can use disprove in the report though! "The hypothesis is DISPROVED" Why is there this discrepancy?) D – we do not test "comments", we test the hypotheses in experiments…Oh and by the way, teachers are allowed to use "I, WE, MY, US, OUR, ACCURATE, PROVE" whenever we like…"Don't do as I do, do as I say!"	If a person changes their position from standing to lying prone on the ground, then their blood pressure will drop by 50% OR Blood pressure decreases by 50% between standing and sitting positions

Remember, there are really only two types of people who will ever read your report;

1. The colleagues checking your report for English expression, experimental design - checking for the lack of bias, suitable validity and reliability, before you publish the findings...(so that you don't get egg on your face if there are any errors) and,
2. The scientists in the field in which your report lies (it will give them some background information and may even give them some ideas on understanding or improving their own experiment/s...or even take them in new and exciting ways!) Keep the hypothesis simple (the two variable linked by increase/decrease) for these people to understand!

EXPERIMENTAL VARIABLES AND HYPOTHESIS WORKSHEET

For each of the following brief explanations of experiments, list the Independent Variable, the Dependent Variable, 4 Controlled Variables, and write a Hypothesis.

EXPERIMENT	VARIABLE/S		
	INDEPENDENT	DEPENDENT	CONTROLLED (4)
1. A student used ground calcium carbonate ($CaCO_3$). He then brushed the teeth on one side of the face, top and bottom. On the other half he used normal tooth paste to see the effectiveness of $CaCO_3$ in cleaning teeth.			
HYPOTHESIS:			
2. A student grew tomato plants in pots that contained a mix of sand and; Zoo Poo, Super Pooper, Faecal Dynamics, no fertilizer. She did this to find out how good Super Pooper was compared to the other Decomposed faecal materials.			
HYPOTHESIS:			
3. In a study in alleviating stress without the use of medicinal drugs, 50 people were given soft stress balls to squeeze when they were stressed. The other 50 subjects were given hard stress balls.			
HYPOTHESIS:			
4. A scientist measured the blood pressure (BP) of a large group of people before she started the experiment. She then asked one smaller group of people (taken from the larger group) to drink a placebo beverage that contained NO caffeine. The rest of the large group were asked to drink coffee. She then measured the BP at regular intervals for the next 8 hours.			
HYPOTHESIS:			

EXPERIMENTAL VARIABLES AND HYPOTHESIS WORKSHEET 1

Directions: Take the following inferences and turn them into formal hypotheses.

Formal Hypothesis Format:

A short sentence, Independent Variable increases/decreases Dependant variable.
OR
If responding variable is related to manipulated variable, **then** prediction.

1. Chocolate may cause pimples.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

2. Memory recall may be affected by the amount of salt in the foods consumed.
Independent variable: _____ Dependent variable: _____
Formal hypothesis:
_____
_____

3. Sleep times may be affected by the amount of blue light exposure.
Manipulated variable: _____ Dependent variable: _____
Formal hypothesis:
_____
_____

4. Varying the temperature of the incubator has some affect on the growth rates of bacteria.
Independent variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

5. People have reported that they get headaches after consuming Monosodium glutamate (MSG).
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

6. Temperature may decrease hair growth rates.
Independent variable: _____ Dependent variable: _____
Formal hypothesis:
_____
_____

EXPERIMENTAL VARIABLES AND HYPOTHESIS WORKSHEET 2

Directions: Take the following inferences and turn them into formal hypotheses.

Formal Hypothesis Format:

A short sentence, increase/decrease Independent Variable → increases/decreases Dependant variable.
OR
If responding variable is related to manipulated variable, **then** prediction.

1. Chillies may reduce cancer
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

2. Changing light intensity levels may affect sleep patterns.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

3. Tomato plant growth may be affected by carbon dioxide levels.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

4. Skin surface bacterial growth may be affected by the type of wash taken each day.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

5. Xylene (previously in permanent marker pens) may cause cancer.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

6. Deodorant may cause vasoconstriction of skin arterioles.
Manipulated variable: _____ Responding variable: _____
Formal hypothesis:
_____
_____

INVESTIGATING SCIENTIFICALLY

PRACTICE IN IDENTIFYING VARIABLES AND WRITING HYPOTHESES - WORKSHEET 4

Fill in the following table. NAME _____

COMMENT	INDEPENDENT VARIABLE	DEPENDENT VARIABLE	HYPOTHESIS	CONTROLLED VARIABLES (4)	RESULTS SUPPORTING/REFUTING HYPOTHESIS
"Sloths have much less thyroxin in their blood compared to a similar sized mammal. That's why they move so slowly!" (Maybe this should be done with the other species of sloth - the student!")	Amount of thyroxin in blood	Movement rate	As the amount of thyroxin in the blood of a mammal decreases, the slower its rate of movement	Same mammal sizes Same activity rates Same health M=F Nos.	Sloths have the lowest thyroxin levels and are also the slowest movers of all the mammals tested
"Higher temperatures will produce more skin cell molting in humans than lower temperatures."					
"Your skin looks flushed (slightly red) when consuming Caffeine as it affects vasodilation."					
"The new cleaning liquid, "Kapow" is better than the older liquid, Kaboom."					
"Tomato plants grow better if a banana peel is placed below their roots."					
"Red fruit lowers blood cholesterol compared to other colours of fruit."					
"The crispiness of food affects how nice the food is perceived."					
"White bread decays faster than brown bread."					

PERCENTAGE INCREASE OR DECREASE

SECTION 4 – SOME SIMPLE MATHS REQUIRED FOR INVESTIGATING SCIENTIFICALLY

i. **MODE** – in a series of numbers, it is the number that occurs the **most**. What is the mode for each of the following series of numbers?
   a. 18, 20, 37,18,37,20, 20, 18,37, 20
   b. 2.7, 3.4, 1.8, 2.7, 1.8, 2.9, 3.8

ii. **MEDIAN** – in a series of numbers, it is the middle number WHEN ALL OF THE NUMBERS ARE IN ORDER! What is the median for the following?
   a. 18, 20, 37,18,37,20, 20, 18,37, 20
   b. 2.7, 3.4, 1.8, 2.7, 1.8, 2.9, 3.8
   c. 2.7, 3.4, 1.8, 2.7, 1.8, 2.9

iii. **MEAN** – the calculated value provided by dividing the sum of all numbers by the tally of the numbers involved

$$\text{MEAN} = \frac{\Sigma \text{ all numbers}}{\text{Tally of numbers added up for the above}}$$

Calculate the mean for each of the following sets of numbers.
   a. 18, 20, 37,18,37,20, 20, 18,37, 20
   b. 2.7, 3.4, 1.8, 2.7, 1.8, 2.9, 3.8

iv. **PERCENTAGE INCREASE OR DECREASE** – **as a percentage** of the old number, is the new number higher or lower than the old number

$$\frac{\text{New Value} - \text{Old Value}}{|\text{Old Value}|} \times 100\%$$

1. If the answer is positive (new value is higher than the old value) then it is a percentage increase.
2. If the answer is negative (new value is lower than the old value) then it is a percentage decrease.
3. For number 2, if a negative answer results. The negative sign indicates that it is a percentage decrease.

The above formula can be written in a number of different ways...

$$Percent\ Change = \frac{Change}{Original} \times 100$$

$$Percent\ change = \frac{later - earlier}{earlier} \cdot 100\%$$

Example:
The Happy-Go-Lucky Beach was 163 feet long from parking lot to high tide. After last year's hurricane came ashore, the beach only measured 154 feet long. What is the precent change of this beach after the hurricane?
First ask yourself if this is this an increase or decrease? The original was greater than the new distance so it is a decrease. This will be reflected in a negative answer!

$\frac{154 - 163}{163} \times 100 =$ | $\frac{(154 - 163)}{163} \times 100 =$ | $\frac{-9}{163} \times 100 = -5.52\%$

The number of beach goers last summer averaged 255 people a day. This summer, the average number of beach goers is 288 per day. What is the percent of change?

$\frac{288 - 255}{255} \times 100 =$

$\frac{33}{255} \times 100 = 12.94\%$
Being positive means an increase – but you knew this anyway!

QUESTIONS

1. A patient goes to the orthodontist because his teeth are 7 millimeters off the center line to the left. After 4 months of treatment, his teeth have moved 3 millimeters to the right. What is the percent of change that has occurred in the 4 months?

2. The recommended time to take a math test is 23 minutes. You complete it in 18 minutes. What is the percentage decrease in time between your time and the recommended time?

3. In order for maximum growth of orange trees in a grove, the farmer must plant the trees exactly 2m apart to ensure the best sun exposure as well as equitable nutrient absorption. During a storm that left 6 inches of rain in 8 hours, the soil shifted and caused a tree to move within 1.7m of another tree. What is the percentage change of the trees location to the other?

4. Bella's lap time for the 100 meter dash was 13.87 seconds on her first trial. Her second trial time was 14.15 seconds. What was the change of percent between her first trial and her second trial?

5. The following results are from a test to see what difference there is in the blood of 3 people. Answer the questions that refer to this table.

	blood sugar levels (mg/dL)		
time hours	normal physiological responses	pre-diabetic	diabetic
0	86.5	93	175
0.5	87.5	125	250
1	105	175	362
2	98	150	350
3	87.5	79	325
3.5	87.5	71	328
4	87.5	67	292
4.5	87.5	62.5	275
5	87.5	65	262
5.5	87	75	240
6	87	88	220
6.5	86.5	89	200
7	86.5	93	175

1. Write a suitable title for the table. (1 MARK)
2. Plot the following data on a graph. (8)
3. Describe the difference/s between the other 2 plots when compared to the person with normal physiological responses. (4)
4. At the end of your 3 plots, sketch 3 lines showing what is most likely to happen to the blood glucose levels for the next 4 hours without the subjects having any further food. (3)
5. What is the percentage change from 1.5 to 2.5 hours for all three plots? [Show all working.] (6)

6.

a. One of the data points seems to be an 'anomaly'/error/outlier. On which of the graphs does it appear and what is the 'data set' for this error? (2)
b. Suggest a logical reason why this error may have occurred? (1)
c. How could any errors in future experiments be reduced? (1)
d. Why should all possible outliers/errors be included when calculating averages? (1)
e. Besides your answer to Q6.b., suggest 3 ways how could this experiment be improved. (3)

What Is the Placebo Effect?

A placebo is anything that seems to be a "real" medical treatment -- but isn't. It could be a pill, a shot, or some other type of "fake" treatment. What all placebos have in common is that they do not contain an active substance meant to affect health.

How Are Placebos Used?

Researchers use placebos during studies to help them understand what effect a new drug or some other treatment might have on a particular condition.

For instance, some people in a study might be given a new drug to lower cholesterol. Others would get a placebo. None of the people in the study will know if they got the real treatment or the placebo.

Researchers then compare the effects of the drug and the placebo on the people in the study. That way, they can determine the effectiveness of the new drug and check for side effects.

What Is the Placebo Effect?

Sometimes a person can have a response to a placebo. The response can be positive or negative. For instance, the person's symptoms may improve. Or the person may have what appears to be side effects from the treatment. These responses are known as the "placebo effect."

There are some conditions in which a placebo can produce results even when people know they are taking a placebo. Studies show that placebos can have an effect on conditions such as: Depression, Pain, Sleep disorders, Irritable bowel syndrome, Menopause

In one study involving asthma, people using a placebo inhaler did no better on breathing tests than sitting and doing nothing. But when researchers asked for people's perception of how they felt, the placebo inhaler was reported as being as effective as medicine in providing relief.

How Does the Placebo Effect Work?

Research on the placebo effect has focused on the relationship of mind and body. One of the most common theories is that the placebo effect is due to a person's expectations. If a person expects a pill to do something, then it's possible that the body's own chemistry can cause effects similar to what a medication might have caused.

For instance, in one study, people were given a placebo and told it was a stimulant. After taking the pill, their pulse rate sped up, their blood pressure increased, and their reaction speeds improved. When people were given the same pill and told it was to help them get to sleep, they experienced the opposite effects.

Experts also say that there is a relationship between how strongly a person expects to have results and whether or not results occur. The stronger the feeling, the more likely it is that a person will experience positive effects. There may be a profound effect due to the interaction between a patient and health care provider.

The same appears to be true for negative effects. If people expect to have side effects such as headaches, nausea, or drowsiness, there is a greater chance of those reactions happening.

The fact that the placebo effect is tied to expectations doesn't make it imaginary or fake. Some studies show that there are actual physical changes that occur with the placebo effect. For instance, some studies have documented an increase in the body's production of endorphins, one of the body's natural pain relievers.

One problem with the placebo effect is that it can be difficult to distinguish from the actual effects of a real drug during a study. Finding ways to distinguish between the placebo effect and the effect of treatment may help improve the treatment and lower the cost of drug testing. And more study may also lead to ways to use the power of the placebo effect in treating disease.

WebMD Medical Reference Reviewed by Melinda Ratini, DO, MS on February 23, 2016

https://www.webmd.com/pain-management/what-is-the-placebo-effect#1

https://www.vox.com/science-and-health/2017/6/1/15711814/open-label-placebo-kaptchuk

Blind experiment

From Wikipedia, the free encyclopedia

A **blind** or **blinded experiment** is a scientific experiment where some of the people involved are prevented from knowing certain information that might lead to conscious or subconscious bias on their part, thus invalidating the results.

For example, when asking consumers to compare the tastes of different brands of a product, the identities of the product should be concealed - otherwise consumers will generally tend to prefer the brand they are familiar with. Similarly, when evaluating the effectiveness of a medical drug, both the patients and the doctors who administer the drug may be kept in the dark about the dosage being applied in each case - to forestall any chance of a placebo effect, observer bias, or conscious deception.

Single-blind describes experiments where information that could introduce bias or otherwise skew the result is withheld from the participants, but the experimenter will be in full possession of the facts.

Double-blind describes an especially stringent way of conducting an experiment—usually, on human test subjects—which attempts to eliminate subjective, unrecognized biases carried by an experiment's subjects *and* conductors. In most cases, double-blind experiments are held to achieve a higher standard of scientific rigor than blind or non-blind experiments.

http://en.wikipedia.org/wiki/Blind_experiment

REDUCING BIAS - THE RANDOM SELECTION OF SUBJECTS

SIMPLY

1. Number all subjects (making sure of gender equity in any group).
2. Make a decision at the outset of the experiment - when the first number is chosen, which oif the groups is it going itnto? (eg. first one pulled out is going into the control group)
3. As each of the random numbers are generated (see below), alternate their placement into each of the 2 groups (or more groups) until all subjects have been assigned a group.

- RANDOM NUMBER GENERATION -
  - Numbers 1 - X on uniform sheets of paper and placed into a hat/opaque paper bag/container...randomly shake the contents/numbers...close your eyes and chose a number out of the hat!
  - Random number generator on computer or your calculators!
  - Close your eyes and place you pen randomly on a telephone book (what's that!) or set of numbers written on a sheet of paper!

Discrete OR *Continuous*

Discrete: refers to the ability to count the number of objects you are graphing. When you need to show the quantity of the items you are investigating you use a discrete graph. Such graphs are **column** graph, **bar** graph, and **pie** graph. (e.g. how many pens does each student have; what is the height of each student; what is the temperature of different solutions, etc ...). A pie graph is used to show proportions of discrete data (e.g. what is the proportion of kids who weigh above 60kg compare to the proportion of those weighing less than 60kg).

Continuous: refers to the continuous recording of data. (e.g. when you're measuring the temperature of water every three minutes as it cools down continuously). The **line** graph is used in such a situation.

On this worksheet identify which of the following sets of data show discrete data (**D**) or continuous data (**C**). Draw an appropriate graph for each set of data.

1

Preferred sport	Number of players
tennis	15
scuba diving	20
golf	12
sky diving	4
archery	20
soccer	25

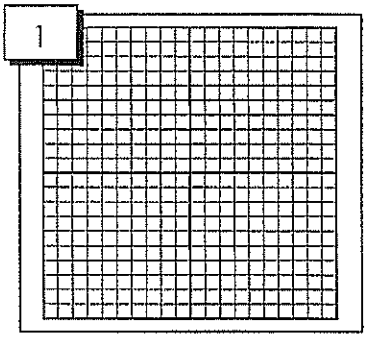
2

Age (years)	Height of a person(cm)
12	150
14	160
15	165
16	170
17	175
20	180
25	180
30	180
35	180
45	180
55	178
60	175
70	170

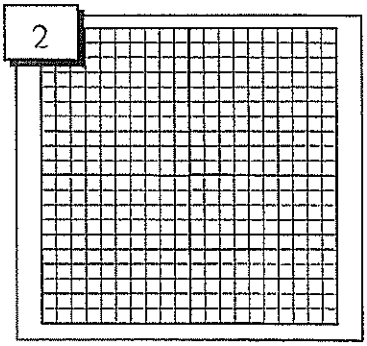
3

Speed (ms^{-1})	Distance covered (m) in 2 seconds
30	60
60	120
90	180
120	240
150	300

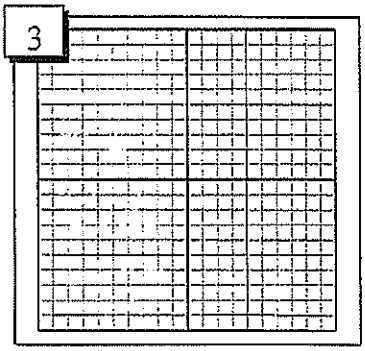
1



2



3



Discrete and Continuous Data

The numerical data that we will use in this course falls into 1 of 2 categories : **discrete** and **continuous**.

A type of data is **discrete** if there are only a finite number of values possible or if there is a space on the number line between each 2 possible values.

Ex. A 5 question quiz is given in a Math class. The number of correct answers on a student's quiz is an example of discrete data. The number of correct answers would have to be one of the following : 0, 1, 2, 3, 4, or 5. There are not an infinite number of values, therefore this data is discrete. Also, if we were to draw a number line and place each possible value on it, we would see a space between each pair of values.

Ex. In order to obtain a taxi license in Las Vegas, a person must pass a written exam regarding different locations in the city. How many times it would take a person to pass this test is also an example of discrete data. A person could take it once, or twice, or 3 times, or 4 times, or… . So, the possible values are 1, 2, 3, … . There are infinitely many possible values, but if we were to put them on a number line, we would see a space between each pair of values.

Discrete data usually occurs in a case where there are only a certain number of values, or when we are counting something (using whole numbers).

Continuous data makes up the rest of numerical data. This is a type of data that is usually associated with some sort of physical measurement.

Ex. The height of trees at a nursery is an example of continuous data. Is it possible for a tree to be 76.2" tall? Sure. How about 76.29"? Yes. How about 76.2914563782"? You betcha! The possibilities depends upon the accuracy of our measuring device.

One general way to tell if data is continuous is to ask yourself if it is possible for the data to take on values that are fractions or decimals. If your answer is yes, this is usually continuous data.

Ex. The length of time it takes for a light bulb to burn out is an example of continuous data. Could it take 800 hours? How about 800.7? 800.7354? The answer to all 3 is yes.

QUESTIONS

Classify each set of data as discrete or continuous.

1) The number of suitcases lost by an airline.

2) The height of corn plants.

3) The number of ears of corn produced.

4) The number of green M&M's in a bag.

5) The time it takes for a car battery to die.

6) The production of tomatoes by weight.

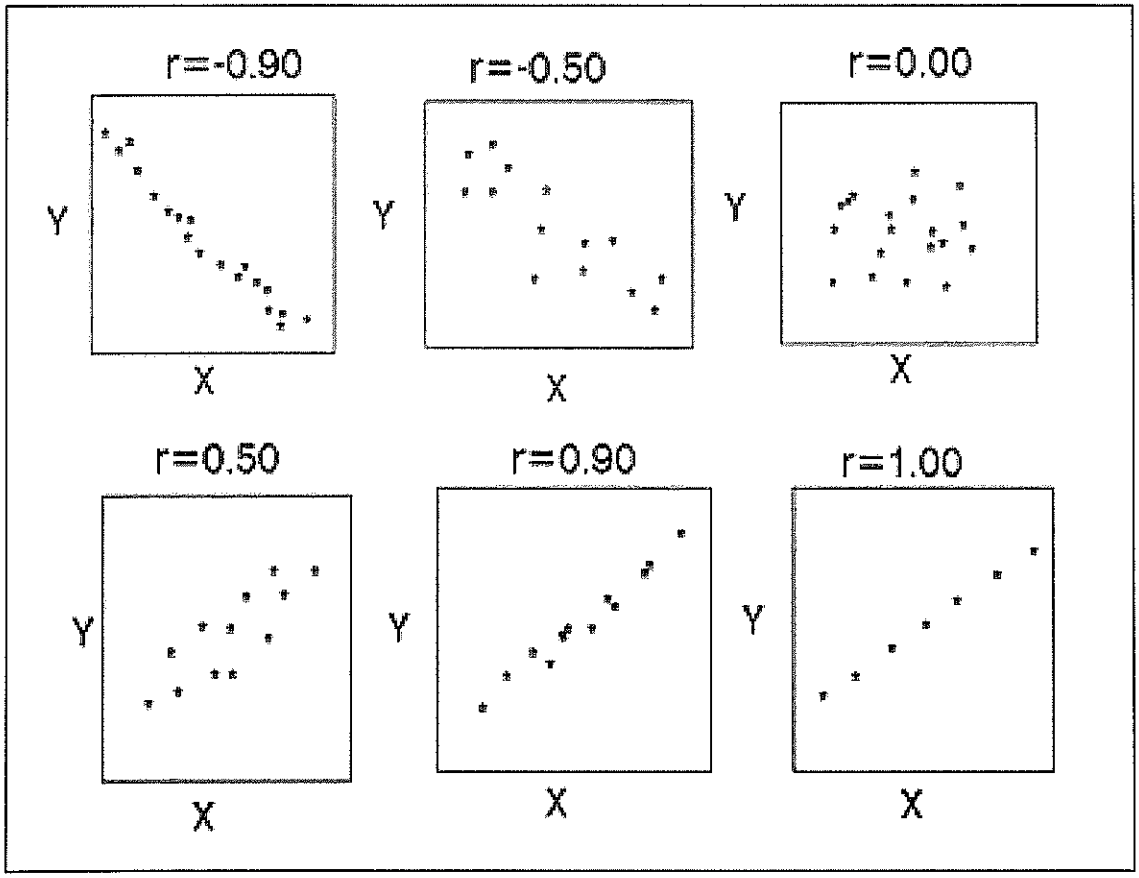
CORRELATION COEFFICIENT

The relationship between two variables.

Correlation Properties (NOTE: the symbol for correlation is r)

1. Correlation is unit free. eg. If we changed the final exam scores from percentage to decimals the correlation would remain the same.
2. Correlation, r, is limited to $-1 \leq r \leq 1$.
3. For a positive association, $r > 0$; for a negative association $r < 0$.
4. Correlation, r, measures the linear association between two **quantitative variables**.
5. Correlation measures the strength of a linear relationship only. (See the following scatterplots for a visual representation of the values of r.)
6. The closer r is to 0 the weaker the relationship; the closer to 1 or – 1 the stronger the relationship. **The sign of the correlation provides slope direction only.**
7. Correlation can be affected by outliers

http://sites.stat.psu.edu/~ajw13/stat200_upd/02_quantrel/02_quantrel_print.html



SECTION 5- PLANNING

To conduct an experiment, a scientist first 'scribbles down' some ideas all the time thinking about the things needed to have VALIDITY and RELIABILITY in the design. The scribble might even be a labelled diagram.

Q1. Write down the meaning of VALIDITY and RELIABILITY in your own words.
Q2. Plan for the following by drawing a quick sketch of the likely experimental set-up.

THE SCIENTIFIC METHOD - PLANNING FOR AN EXPERIEMNT

TITLE: "An Investigation Into ...", "An Experiment To Determine...", "A Report Into The Effectiveness..."

AIM: What you intend to find out. Your interest/the methods will give you some idea about what to write here.

INDEPENDENT VARIABLE: The variable that is purposefully changed

DEPENDENT VARIABLE: The variable that you get from changing the IV

HYPOTHESIS: ↑ IV →↓DV, OR ↑↑, OR ↓↓
Yes, it is an educated guess! But what is an 'EDUCATED GUESS'? Once you are studying in your area of interest/expertise, and you have some detailed knowledge from other experiments (your own and others), then you have a pretty good idea as to what the results will be anyway...you just need some data to back up what you are saying!

CONTROL GROUP:
IV NOT CHANGED

CONTROLLED VARIABLES:
GENERAL STUFF -

- #MALE ≡ #FEMALE
- AVERAGE AGE
  (What does this imply?)
- HEALTH
- ENVIRONMENTAL CONDITIONS
  - TEMPERATURE
  - HUMIDITY
  - LIGHT
  - SOUND/AMBIANCE
  - WIND

****THINGS SPECIFIC TO YOUR EXPERIMENT****

TEST GROUP:
IV CHANGED

SKETCH THE EXPERIMENTAL SET-UP

RSHS GLOSSARY

Analyse	To think about or examine something carefully whilst looking for patterns or relationships.
Assumption	Variables that may have an effect on the results but these effects are so small that these variables can be assumed to have little effect on the overall results of the experiment. The data is still valid and reliable.
Average	The value calculated by adding up all the scores and then dividing by the number of scores. Reduces error values/outliers in data sets.
Collaborate	Work with others to perform a specific task.
Conclusion	Determination of whether the hypothesis should be accepted or rejected. by looking at your investigation's results .
Continuous data	Quantitative data with a potentially infinite number of possible values along a continuum (see discrete data).
Control group	Test subjects randomly assigned to not receive the experimental treatment.
Controlled variables	Variables that can affect the results of an experiment and therefore they are kept the same between all groups/individuals involved in a test.
Data	Information/numbers that has been collected in doing an experiment.
Data Logger	An electronic device that records information (e.g. sound, light, temperature) over a period of time
Dependent variable	The data recorded from a change in the 'subject' being investigated. Also known as the responding variable.
Discrete data	Quantitative data consisting of a number of separate values where intermediate values are not permissible (see continuous data).
double blind	Neither the researcher nor the subjects know whether they are receiving the treatment or a placebo. "Blinding" helps reduce biased results.
Equipment	The physical tools that you need for your investigation
Evaluate	Think about what was good or bad about something/the effectiveness of the processes in the experiment.
Evidence	What data supports the conclusions/statements presented
Experimental group	Test subjects randomly assigned to receive the experimental treatment. (ie they experience the independent variable)
Extraneous variable	Extra variables (not the independent, dependent, or control variable) that may influence an experiment, but are not accounted for or measured or are beyond control. Examples may include factors you consider unimportant at the time of an experiment, such as the manufacturer of the glassware in a reaction or the colour of paper used to make a paper airplane.
Fair Test	A type of investigation where you change one thing and keep everything else the same
Graph	A visual representation of the relationship between the independent variable and the dependent variable
Hypothesis	Testable statement containing both independent and dependent variables. Can be written as an "If...then..." statement
Identify	Recognise something as being of a particular type (e.g. identifying an insect as being of a particular species)
Independent Variable	The variable that is manipulated or changed by the researcher.
Investigation	A scientific process of answering a question, exploring an idea or solving a problem that requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities.
Law	A generalized statement set after a number of different observations. It has no explanations or exceptions when it is framed. (Framed – organised and succinctly stated.)
Limitation	A problem or error in an investigation that might affect the results

Materials	A list of tools (hardware) and substances (consumables) used for specific purposes in an experiment.
Mean	The average calculated by adding up all the scores and then dividing by the number of scores.
Method	Ordered and numbered procedures used to carry out an experiment.
Model	A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea
Observe	To watch changes in an object using senses
Placebo (placebo treatment)	A fake treatment that should have no effect, outside of the power of suggestion. Example: In drug trials, test patients may be given a pill containing the drug or a placebo, which resembles the drug (pill, injection, liquid) but doesn't containing the active ingredient.
random or randomness	Selected or performed without following any pattern or method. To avoid unintentional bias, researchers often use random number generators or flip coins to make selections.
Prediction	A guess about what will happen, based on what you already know
Qualitative data	Information that is not numerical in nature - sensory information (sight, touch, smell, hearing, taste) that is used to draw conclusions.
Quantitative data	Numerical (number) information that is used to draw conclusions.
Raw data	The initial quantitative information that a scientist gets while conducting an experiment. All raw data is written in a data table in the scientist's log book.
Relationship	The connection or association between ideas or between components of systems and structures
Reliability	The extent to which repeated observations and/or measurements taken under identical circumstances will yield similar results
Reliable data	Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results for the same population
Repeat trials	Tests within an experimental investigation that that are carried out more than once under the same set of conditions.
Replicates	Independent experiments that use the same method in order to validate findings.
Research	To locate, gather, record and analyse information in order to develop an understanding
Results	The outcome of your investigation bsed on a series of repeatable observations or data
Second-hand data	Data recorded by other scientist/s. The person receiving the data is asked to collate it, and write a report on it for presentation to other scientists.
Scientific literacy	The ability to use scientific knowledge, understanding, and inquiry skills to identify questions, acquire new knowledge, explain science phenomena, solve problems and draw evidence-based conclusions in making sense of the world, and to recognise how understandings of the nature, development, use and influence of science help us make responsible decisions and shape our interpretations of information
Simulation	A representation of a process, event or system which imitates the real situation.
Single blind	When either the experimenter or subject is unaware whether the subject is getting the treatment or a placebo. Blinding the researcher helps prevent bias when the results are analysed. Blinding the subject prevents the participant from having a biased reaction.
Statistical significance	Observation based on application of a statistical test, that a relationship probably is not due to pure chance.
Survey	A collection of facts, figures or people's opinions about something by asking a series of questions
Table	An arrangement of data or ideas in rows and columns.
Theory	An explanation of a set of observations that is based on one or more proven hypotheses which has been accepted through consensus by a group of scientists.
Validity	The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.
Variable	A factor that can be changed, kept the same or measured in an investigation e.g. time, distance, blood pressure, light, body temperature, temperature, arterial diameter.