http://smtom.lecture.ub.ac.id/
Password:

LECTURE 2: Ecophysiology and Science

Don't wait somebody else to tell you what to do

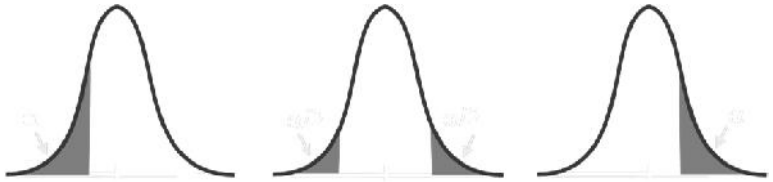
To know what something good to do may need understanding of the system well enough

Illustrative Example: "Body Weight"

- **The problem:**
  - In the 1970s, 20–29 year old men in the U.S. had a mean (**μ**) body weight of 170 pounds (>77.1 kg).
  - Standard deviation (σ) was 40 pounds.
  - It is then tested whether mean body weight in the population now differs.
- **Hypothesis**
  - **Null:** $H_{0:}$ μ = 170 ("**no difference**")
  - **Alternative:** $H_{a:}$ μ > 170 (**one-sided test**) or $H_{a:}$ μ ≠ 170 (**two-sided test**)

What des this mean to you

- There is enough evidence to conclude
- There is not enough evidence to support



Nonstatistical Hypothesis Testing…

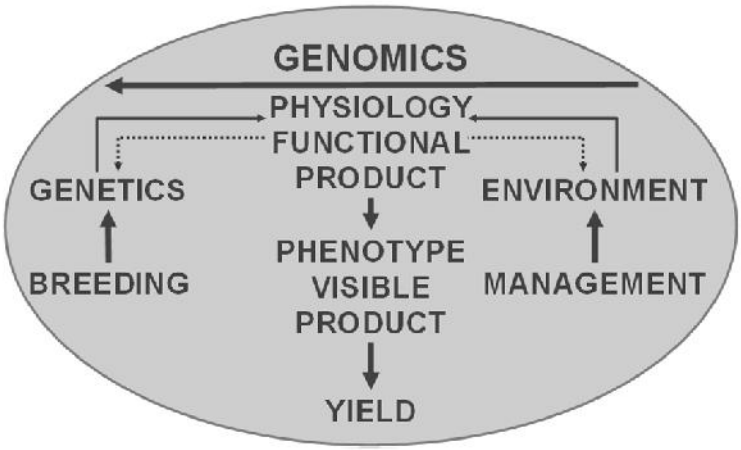
- An example of hypothesis testing without the statistics is a criminal trial
- In a trial, a jury must decide between two hypotheses.
  - H_0 (the null hypothesis): The defendant is innocent
  - H_1 (the alternative hypothesis or research hypothesis): The defendant is guilty
- The jury
  - does not know which hypothesis is true, and
  - must make a decision on the basis of evidence presented.

11.4

1. INTRODUCTION

1. Whatever you do to improve plant growth and development in order to increase the productivity of crops, it is achieved through the improvement of physiological processes.
2. The application of nitrogen fertilizer is to improve the physiological processes such as
   - photosynthesis through an increase in chlorophyll and photosynthetic enzymes especially Rubisco.
3. Breeding or genetic engineering is also addressed to improve physiological processes.
4. The development of C4 rice receiving considerable attention in research in last 2-3 decades is also addressed to improve physiological processes.

5. Plant growth and development and yield are the products of integrated physiological processes such as photosynthesis, respiration, and plant biomass synthesis.
6. The physiological processes are controlled by genes, and can be improved by genetic manipulation (breeding & genetic engineering).
7. The physiological processes are influenced by environmental factors, and can be improved by environmental management.
8. Physiological processes may also affect genetic control and environmental influence



Ecophysiology is the study of environmental influence on physiological processes or plant functions.
Physiological Ecology is the study of physiological processes in response to environmental factors

2. ECOPHYSIOLOGY SCIENCE

1. Science

- Plant Ecophysiology is an experimental science that seeks to describe the physiological mechanisms that underlie ecological observations (Lambers *et al*., 1998)
- Science is a way of thinking and a method of investigation to understand natural phenomena including plant growth and yield
  - The word science comes from the latin word *scientia* which means "*to know*"
  - The scientific process is dynamic (always changing) and creative

SCIENCE

2. The Scientific Process

- The scientific process, in general, involves
  - Observation*. Making careful observations to recognize and state a problem*
  - Asumption*. Developing an educated guess as to the nature of that problem*
  - Hypothesis*. Based on the educated guess make some predictions that can be tested*
  - Experiment*. Perform experiments to test the predictions*

3. Theory

- If the predictions are true and consistent results can be demonstrated, a new theory may emerge
- The experiment may still have value if the results show that the predictions are not true or accurate.

4. Hypothesis

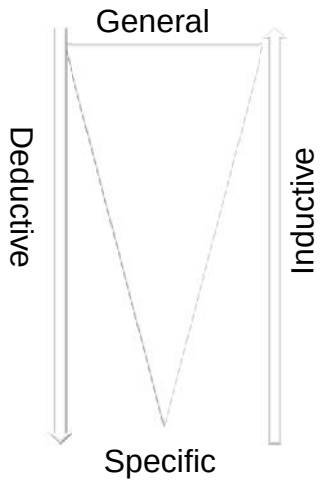
1. A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.
2. A tentative statement that proposes a possible explanation to some phenomenon or event.
3. Something taken to be true for the purpose of argument or investigation.
4. A useful hypothesis is a **testable** statement which may include a prediction.

- Is the following statement a hypothesis?
  - Terdapat intraksi antara genotipe dengan lingkungan
- First, it is grammatically wrong
  - Intraksi tedapat antara genotipe dengan lingkungan
  - An interaction was found between soybean genotypes and environments
- It is more like a conclusion as interaction is not easy to test for it is difficult to find a control or comparison.
  - The new soybean genotypes were influenced by environments
- The above statement can be tested, is not a good hypothesis

3. HYPOTHESIS FORMULATION

- The formulation of hypothesis (*tentative statement*) involves two methods of reasoning or logic
  - DEDUCTIVE
  - INDUCTIVE
- This is the logic used by scientists to draw conclusions from a set of facts
- Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a *top-down approach*.

- Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories that is called sometimes a *bottom up approach*
- Hypothesis = hypo + thesis, thesis is a statement that is put forward as a premise to be tested or accepted



The Process of Deductive reasoning

- It might be begun with thinking up a theory about our topic of interest that is then narrowed down into more specific hypotheses to test.
- It may be narrowed down even further when observations are collected to address the hypotheses. This ultimately leads to the position making easier to test the hypotheses with specific data - a confirmation (or not) of our original theories. Thus the process is:
  - Theory
  - Hypothesis
  - Observation
  - Confirmation

The Process of Inductive Reasoning

- It is begun with specific observations and measures, and detection of patterns or regularities which then lead to the formulation of some tentative hypotheses to explore, and finally to end up developing some general conclusions or theories.
- Thus the process is from:
  - Observation
  - Pattern
  - Tentative Hypothesis
  - Theory

Examples

Adham & Rizik

***Adham* .** I've noticed previously that every time I kick a ball up, it comes back down, so I guess this next time when I kick it up, it will come back down, too.

Rizik. That's Newton's Law. Everything that goes up must come down. And so, if you kick the ball up, it must come down

Adham is using *inductive reasoning*, arguing from observation, while

Rizik is using *deductive reasoning*, arguing from the law of gravity

Example of Deductive

1. All men are mortal (given)
2. Socrates was a man (given)
3. Socrates was mortal (conclusion)

- In deductive, you're just drawing conclusions from known facts.
- If the given facts are true, then there's no way that your conclusion is wrong
- You don't really get any "new" knowledge from deductive reasoning; you just reorganize old knowledge

Example of Inductive

1. Socrates was Greek (given)
2. Most Greeks ate fish (given)
3. Socrates probably ate fish (conclusion)

- Inductive reasoning draws conclusions that are most likely not wrong.
- However, your conclusion is not necessarily right - maybe Socrates was allergic to fish.
- Inductive reasoning give new knowledge, with the trade-off that your conclusion may be faulty.

- **Deductive Arguments** are ***arguments that claim to provide complete support for the conclusion***
  - For example, arguments whose claim is that if the premises are true, the conclusion ***must*** be true
  - Equivalently, we can say that deductive arguments are those whose claim is that it impossible to have true premises and false conclusion at the same time
- **Inductive Arguments** are arguments that claim to provide *some, but not complete, support* for the conclusion
  - An important consequence of this definition is that with inductive arguments, no matter how strong they are, it is always ***possible*** for the conclusion to be false even though the premises are true.

- What do you think
  - If it is the first hypothesis, then you proceed to change the dry cells with new ones, but do not change the bulb.
  - If it doesn't light, then test the second hypothesis by changing the bulb but using the same dry cells.)
- A hypothesis may be stated in a more general ways such as:

  If the oxygen content is exhausted, the insects will die.

  Stated to include all cases, we say:

  All insects or all animals will die in the absence of oxygen.

Many Examples

- **Deductive Arguments**
  - All dogs are mammals,.all mammals have kidneys, therefore all dogs have kidneys.
  - Since all squares are rectangles, and all rectangles have four sides,, all squares have four sides.
  - All chemists are smart, since chemists are scientists and all scientists are smart. (Note: Although the conclusion is probably false, the flaw in the argument is that one of the premises is presumably false; it remains true that ***if*** the premises are true, the conclusion must also be true.)

Deductive & Inductive Examples

- Inductive Arguments
  - All swans we have seen have been white; therefore all swans are white.
  - All swans we have seen have been white; therefore the next swan we see will be white.
  - All known planets travel about the sun in ellipitical orbits; therefore all planets travel about the sun in ellipitical orbits.
  - Exploration of the surface of Mars has produced some surprising facts. Therefore exploration of the surface of Jupiter will produce some surprising facts.
  - Since Chris is a good athlete, Chris's sister must be a good athlete also.

Deductive & Inductive Examples

9. **Syllogism**
   - One of the most common and useful forms of deductive reasoning is the **syllogism**
   - The syllogism is a specific form of argument that has three easy steps.
     - Every X has the characteristic Y
     - This thing is X
     - Therefore, this thing has the characteristic Y

10. Analysis of Arguments
    - Rizik's argument is clearly from the general (the law of gravity) to the specific (this kick)
    - Adham's argument may be less obviously from the specific (each individual instance in which he has observed balls being kicked up and coming back down) to the general (the prediction that a similar event will result in a similar outcome in the future) because he has stated it in terms only of the *next* similar event--the next time he kicks the ball

II. Trial

1. Case A
   - If a child puts his or her hand into a bag of candy and withdraws three pieces, all of which are red,
   - he or she may conclude that all the candy is red
   - **Inductive**

TRIAL

2. Case B
   - Jimmy Hendrix, Martha Washington, Rosalind Franklin, and
   - John Wayne are all dead,
   - therefore, all men are mortal (**Inductive**)
3. Case C
   - All cars have tires,
   - therefore your car has tires (**Deductive**)
4. Case D
   - All men are mortal
   - Ms. Wilcox is a woman
   - Therefore, Ms. Wilcox is immortal (ha, ha) (**Deductive**)

TRIAL

5. Case E
   - A person drives down a particular road at rush hour several times and finds the traffic terrible each time. Therefore, this is a good road to avoid at rush hour (**Inductive**)
6. Case F
   - Dobermans are dogs. Max is a Doberman. Max is a dog (**Deductive**)
7. Case G
   - Well, I've observed many patients receive that drug combination, and I've never seen any problems with it. Therefore, this is not a clinically important drug interaction (**Inductive**)

- **Model Hipotesis**

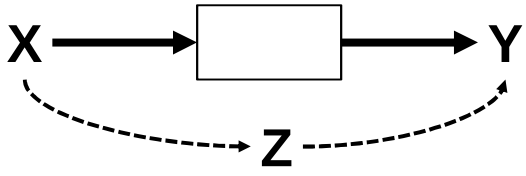
  "If— [I do this] –, then – [this] — will happen because — [this] — "

  "Jika – [X dilakukan] –, maka peristiwa [Y] – akan terjadi karena – [Z]— "

  atau

  "Peristiwa [Y] akan terjadi, jika – [X dilakukan] karena – [Z]— "

- Analisis dengan cermat
  - jika sesuatu tindakan/masukan [**X**] dilakukan,
  - apa yang akan terjadi [**Y**],
  - berdasarkan pertimbangan (fakta) ilmiah [**Z**] yang mengarahkan cara pengujian.



Sebagai contoh:

- "*If I put a plant in red light instead of normal sunlight* [**X**]*, then the plant will not grow as fast* [**Y**]."
- "Jika tanaman ditempatkan dibawah cahaya merah [**X**] dari pada dibawah sinar matahari normal, tanaman tidak akan tumbuh begitu cepat [**Y**] "
- *"Tomato plants exhibit higher rate of growth* (**Y**) *when planted in compost rather in soil* (**X**)"
- Tanaman tomat menunjukkan laju pertumbuhan yang lebih tinggi (**Y**) apabila ditanaman pada kompost dari pada tanah (**X**)

- Pernyataan diatas belum lengkap karena pertimbangan/alasan (*reasoning*) ilmiah [Z] tidak disertakan, sehingga perlu perbaikan seperti berikut.

  "Pertumbuhan suatu tanaman akan terhambat (**Y**) jika tanaman tersebut ditempatkan dibawah cahaya merah (**X**) dari dibawah cahaya normal, karena kekurangan energi cahaya dari spektrum lain (**Z**) "

- Hipotesis sering dicirikan oleh penggunaan kata "**dapat**" dalam pernyataan.

- Kata "**dapat**" memberikan peluang untuk hipotesis ditolak dan untuk mengingatkan kita akan aspek yang luput dari perhatian (tidak ada yang sempurna).
- Kalimat berikut menggunakan kata "**dapat**" tetapi tidak dalam bentuk pernyataan hipotesis yang mengisyaratkan cara pengujian.
  1. Coklat dapat mengakibatkan jerawat
  2. Garam dalam tanah dapat mempengaruhi pertumbuhan tanaman
  3. Pertumbuhan tanaman dapat dipengaruhi temperatur

4. Sinar ultraviolet dapat mengakibatkan kangker kulit
5. Temperatur dapat mengakibatkan daun berubah warna

- Pernyataan lain yang bersifat prediksi dan kesimpulan dan bukan hipotesis adalah sebagai berikut.
  - “Pohon akan berubah warna pada suhu rendah” – adalah pernyataan prediksi.
  - “Sinar ultraviolet mengakibatkan kanker kulit” – dapat merupakan kesimpulan.

- This kind of reasoning can be modeled as follows
  1. If ...
  2. Then...
  3. But...
  4. Therefore...
- For example,

  we might hypothesize that "The color of a mineral is determined by its crystal structure."
- And so we could test this hypothesis using deductive reasoning

1. If
   the color of a mineral is determined by its crystal structure;
2. then
   all purple minerals should have the same crystal structure.
3. But
   purple amethyst has a hexagonal structure and purple fluorite has an isometric structure (determined by observations).
4. Therefore
   the hypothesis is not supported

2. Hypothesis Formulation Steps

1. What is the research topic that you are interested in?
   - Why are you interested in the topic?
   - What is the problem (is there any problem, is that important?)?
   - Can you formulate a topic to be a problem statement?
2. Why does the problem take place (occur), what are the possible causes, and formulate your hypothesis

3. What is the problem. Mario switched on a flashlight, but failed to light. This posed a problem
4. Why (Observation & Literature Study). Mario examined closely the parts.
   - He brought out the three dry cells to find out if they were properly connected, and found out they were.
   - Then he examined the switch and looked closely at the bulb.
5. Formulate a tentative hypothesis. After a preliminary collection of data, Mario formulated a tentative answer. His possible answer may either be
   - "*Maybe the dry cells are already consumed*" or
   - "*The bulb is not working anymore*".

EXAMPLE: 5 STEPS TO FORMULATE A HYPOTHESIS

1. **What is the problem**

   A worker on a fish-farm notices that his trout seem to have more fish lice in the summer, when the water levels are low

2. **Why** (Observations & Literature study), **What is the possible cause**

   Why it happens, the worker wants to find out why

   His observations lead him to believe that the amount of oxygen is the reason – fish that are oxygen stressed tend to be more susceptible to disease and parasites.

3. **Formulate a tentative Hypothesis**

   He proposes a general hypothesis.

   "Water levels affect the amount of lice suffered by rainbow trout."

   This is a good general hypothesis, but it gives no guide to how to design the research or experiment

4. **Refine the Hypothesis**.. The hypothesis must be refined to give a little direction.

   "Rainbow trout suffer more lice when water levels are low"

   Now there is some directionality, but the hypothesis is not really testable,

5. **Formulate a testable Hypothesis**

   so the final stage is to design an experiment around which research can be designed, a testable hypothesis.

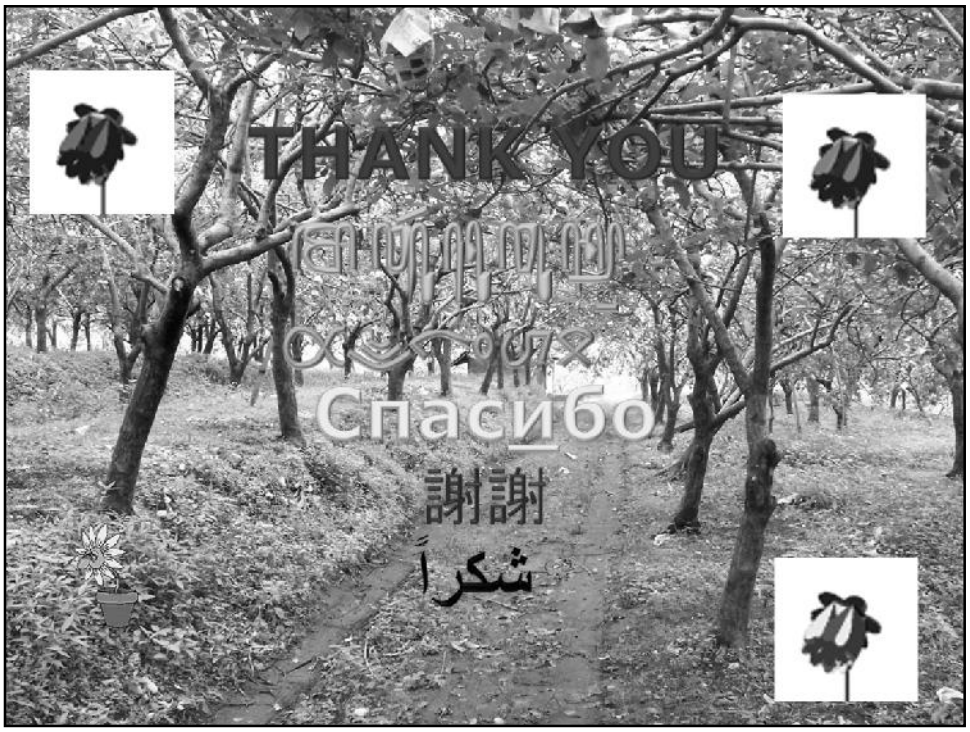
   "*Rainbow trout suffer more lice in low water conditions because there is less oxygen in the water*"

   [**Y**]: Rainbow trout suffer more lice

   [X]: Low water conditions

   [Z]: Less oxygen in the water

   This is a testable hypothesis – he has established variables, and by measuring the amount of oxygen in the water, eliminating other controlled variables, such as temperature, he can see if there is a correlation against the number of lice on the fish.


THANK YOU
Спасибо
謝謝
شكراً