

# Hypothesis Testing: Part I

## 1. Preliminaries

### *Definition of Terms*

- **Hypothesis:** a statement about a population parameter. The goal of a hypothesis test is to decide, based on a sample from the population, which of two complementary hypotheses is true.
- **Null hypothesis and alternative hypothesis:** the two complementary hypotheses in a hypothesis testing problem.

If  $\theta$  denotes a population parameter, the general format of the null and alternative hypotheses is  $H_0 : \theta \in \Theta_0$  and  $H_1 : \theta \in \Theta_0^c$  where  $\Theta_0$  is some subset of the parameter space and  $\Theta_0^c \equiv \Theta_1$  is its complement. Furthermore,  $\Theta_0$  is called the *null parameter space* while  $\Theta_1$  is called the *alternative parameter space*.

- **Hypothesis testing procedure or hypothesis test:** a rule that specifies (i) for which sample values the decision is made to accept  $H_0$  as true and (ii) for which sample values  $H_0$  is rejected and  $H_1$  is accepted as true.

Note: "Accepting" a hypothesis simply means that we do not have enough evidence to conclude otherwise and thus, we cannot reject it. Hence, it may be more appropriate to say that we "do not reject" a hypothesis.

- **Critical/rejection region:** the subset of the sample space for which  $H_0$  will be rejected
- **Acceptance region:** the complement of the critical region
- **Test statistic:** a statistic whose observed value determines whether to reject or not reject  $H_0$ . This is due to the fact that the critical region and the acceptance region are formed by dividing the sampling distribution of the test statistic into two complementary portions.

In the next section, *likelihood ratio tests* are discussed as one method of finding/constructing hypothesis tests. We focus on this first and as we go into the methods of evaluating tests, we discover another method of constructing a hypothesis test by using a particular lemma.

## 2. Constructing Tests: (focus on Likelihood Ratio Tests)

Recall: Given a random sample from a parent distribution  $f(x|\theta)$  (where  $\theta$  can be a vector), the likelihood function is defined by

$$L(\theta|\underline{x}) = f(\underline{x}|\theta) = \prod_{i=1}^n f(x_i|\theta)$$

Let  $\Theta$  denote the parameter space.

**Def.** The *likelihood ratio test statistic* for testing  $H_0 : \theta \in \Theta_0$  versus  $H_1 : \theta \in \Theta_0^c$  is

$$\lambda(\underline{x}) = \frac{\sup_{\theta \in \Theta_0} L(\theta|\underline{x})}{\sup_{\theta \in \Theta} L(\theta|\underline{x})}$$

# Hypothesis Testing Practical Memorandum

## Phototropism

**Victor M. Corman**



## **Hypothesis Testing Practical Memorandum Phototropism:**

*Asking Questions in Biology* Christopher J. Barnard, 2009      *Asking Questions in Biology* Peter McGregor, Chris Barnard, Francis Gilbert, 2016-11-17 Asking and answering questions is the cornerstone of science yet formal training in understanding this key process is often overlooked Asking Questions in Biology unpacks this crucial process of enquiry from a biological perspective at its various stages The full text downloaded to your computer With eBooks you can search for key concepts words and phrases make highlights and notes as you study share your notes with friends eBooks are downloaded to your computer and accessible either offline through the Bookshelf available as a free download available online and also via the iPad and Android apps Upon purchase you ll gain instant access to this eBook Time limit The eBooks products do not have an expiry date You will continue to access your digital ebook products whilst you have your Bookshelf installed

*Asking Questions in Biology* Christopher J. Barnard, Francis Sylvest Gilbert, Dr Peter McGregor, 2015      *Asking Questions in Biology* Christopher J. Barnard, Francis Gilbert, Francis Sylvest Gilbert, Peter K. McGregor, 2011 Asking the right questions in the right way is a fundamental skill in scientific enquiry This text introduces students of the biological sciences to the skills of observation and enquiry      **A Collection of Procedures for Non-standard Hypothesis Testing Problems in Order Restricted Spaces** Mark C. Baker, 2015 In many practical situations the most appropriate alternative in hypothesis testing is order restricted and is therefore in the investigators best interest to use testing procedures developed for the specific alternatives at hand Some of the most commonly seen applications of order restricted inference can be found in biology A collection of tests for inference regarding equality of  $k$  correlation coefficients against ordered alternatives will be presented Also inference under order restrictions for  $k$  means from a lognormal distribution will be discussed We will also be investigating inference on lognormal populations in the presence of inflated zeros for ordered alternatives The focus will be on the most common type of order restriction seen in practice which is the simple order however tree order and umbrella order will also be examined briefly      *Hypothesis Testing in Excel - The Excel Statistical Master* Mark Harmon, 2011-04-09

Complete step by step instructions showing how to perform every type of hypothesis test and how to do each in Excel This manual will make you an expert on knowing exactly how and when to use all types of hypothesis tests hypothesis tests of mean vs proportion one tailed vs two tailed tests one sample vs two sample tests and unpaired data vs paired data tests and how to set them all up in Excel This manual is loaded with completed problems and screenshots in Excel of all major variations of hypothesis tests All hypothesis tests regardless of type can be solved in four steps This manual walks you through that four step process during each of the many solved problems The instructions are clear and easy to follow but at the graduate level Nothing but simple explanations all taught in small bite size lessons The emphasis is on problem solving not on useless complicated hard to apply theory that fills many statistics course If you are currently taking a difficult graduate level statistics course that covers hypothesis tests you will find this manual to be an outstanding course supplement

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