ERROR MANAGEMENT THEORY
Predicts Human Judgments and Decisions

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Abstract

Error management theory predicts Human Judgments & Decisions and often views cognitive biases as adaptations of the human mind to deal with problems that were faced by human ancestors. Human development has involved trial and error, made mistakes and then tried to improve. Type I error is essentially the rejection of the true null hypothesis. It is not possible to completely eliminate the probability of a type I error in hypothesis testing. Type II error is a situation where in a hypothesis test fails to reject the null hypothesis that is false. Type III error is correctly rejecting the null hypothesis for the wrong reason and Type IV error is gives incorrect interpretation of a correctly rejected Null hypothesis. Modern human behavior can be understood using the above discussed errors. Error is an important part of the process, whereas mistakes or errors made in childhood are viewed as part of growing up and learning, in a business context errors are often seen as something to be feared, a shameful sign of incompetence, something entirely negative.

Key words: Error, Hypothesis, Human Judgment.

Introduction

In today's fast changing business world innovation is a key to success; but the process of innovating new business models and processes is one inextricably linked to making errors. In fact, several academic studies have shown that companies can learn more of business value from negative outcomes than positive ones. Human development has involved trial and error, made mistakes and then tried to improve. In business the trials that lead to successful innovation, new processes and better performance necessarily entail errors on the way. Type I error is essentially the rejection of the true null hypothesis. It is not possible to completely eliminate the probability of a type I error in hypothesis testing. Type II error is a situation where in a hypothesis test fails to reject the null hypothesis that is false. Type III error is correctly rejecting the null hypothesis for the wrong reason and Type IV error is gives incorrect interpretation of a correctly rejected Null hypothesis. Error management theory predicts that biases will evolve in human judgments and decisions whenever the following criteria are met: (a) the decision had recurrent impacts on fitness (reproductive success), (b) the decision is based on uncertain information, and (c) the costs of false-positive and false-negative errors associated with that decision were recurrently asymmetrical over evolutionary time.

Objectives

- To encourage trainees to make errors and encourage them in reflection.
- To understand the causes of errors.
- To identify suitable strategies.
- To avoid making errors in future.

Error management theory- the concept

Management theory explains how evolutionary forces may have influenced human decision-making. Error management theory often views cognitive biases as adaptations of the human mind to deal with problems that were faced by human ancestors. The human mind, for instance, prefers to commit a type 1 positive error over a type 2 false negative error. This is because false positive errors would have been more costly to the survival chances of our ancestors living in the ancient age than false negative errors. The theory was proposed by

American psychologists David Buss and Martie Haseltion and has been used to explain modern human behavior.

All human development has involved trial and error, made mistakes and then tried to improve. In business the trials that lead to successful innovation, new processes and better performance necessarily entail errors on the way. Error is an important part of the process. Whereas mistakes or errors made in childhood are viewed as part of growing up and learning, in a business context errors are often seen as something to be feared, a shameful sign of incompetence, something entirely negative.

In some companies fear of the negative aspect of error becomes a phobia, causing an exclusive focus on error prevention policies. According to Frese rather than focus solely on eradicating errors, organizations should: "Embed within their culture ways to reduce the negative consequences of errors and enhance the positive - a process we call error management."

Error types

Type I error shows false positives, Type II, error and false negative. Behavioral science has become good at identifying factors related to Type I and II errors. Type III error correctly rejects the null hypothesis, and Type IV error correctly rejects the incorrect interpretation of the null hypothesis. Type III and IV errors will help behavioral science create as stronger theory-method-statistics connection. Statistical Decision-Making Considerations in addition to rejecting and retaining the Null Hypothesis.

Predicting false positives and false negative Biases

Error management theory proposes that the same principle of design applies to the evolution of judgment mechanisms in the human mind. Ancestrally, in many areas of social judgment, the costs of false positive and false negative errors differed. When the costs of false negatives are greater, error management theory predicts a bias toward false positives (as in the smoke alarm example); when the costs of false positives are greater, error management theory predicts a bias toward false negatives.

	Truth about the population	
Decision based on sample	**H_0 is true**	**H_0 is false**
Fail to reject H_0	Correct Decision (probability = 1 - α)	**Type II Error** - fail to reject H_0 when it is false (probability = β)
Reject H_0	**Type I Error** - rejecting H_0 when it is true (probability = α)	Correct Decision (probability = 1 - β)

Decision based on sample	**H_0 is true**	
	Type III Error(γ)	**Type IV error**
Reject H_0	• Correctly reject the null hypothesis. • Solving the wrong problems. • The right answer but for the wrong question	• Incorrect interpretation of a correctly rejected Null hypothesis.

ERROR LEVELS	**EXPLINATION**
Type I	A Type I error occurs when there really is no difference (association, correlation.) overall, but random sampling caused your data to show a statistically significant

	difference (association, correlation...). So your conclusion that the two groups are really different (associated, correlated) is an error.
Type II	A Type II error occurs when there really is a difference (association, correlation) overall, but random sampling caused your data to not show a statistically significant difference. So your conclusion that the two groups are not really different is an error
Type III & Type 0 Error	The term Type III error has two different meanings. One definition (attributed to Howard Raiffa) is that a Type III error occurs when you get the right answer to the wrong question. This is sometimes called a Type 0 error
Type IV	Actually, a specific type of Type III error. When you correctly reject the null hypothesis, but make a mistake interpreting the results, you have committed a Type IV error

Type I Error (False Positive Error)

A type I error occurs when the null hypothesis is true, but is rejected. Let me say this again, a type I error occurs when the null hypothesis is actually **true**, but was rejected as **false** by the testing.

A type I error, or false positive, is asserting something as true when it is actually false. This false positive error is basically a "false alarm" – a result that indicates a given condition has been fulfilled when it actually has not been fulfilled (i.e., erroneously a positive result has been assumed).

Let's use a shepherd and wolf example. Let's say that our null hypothesis is that there is "no wolf present." A type I error (or false positive) would be "crying wolf" when there is no wolf present. That is, the **actual condition** was that there was no wolf present; however, the shepherd wrongly indicated there was a wolf present by calling "Wolf! Wolf!" This is a type I error or false positive error.

Type II Error (False Negative)

A type II error occurs when the null hypothesis is false, but erroneously fails to be rejected. Let me say this again, a type II error occurs when the null hypothesis is actually **false**, but was accepted as **true** by the testing. A type II error, or false negative, is where a test result indicates that a condition failed, while it actually was successful. A Type II error is committed when we fail to believe a true condition. A tabular relationship between truthfulness/falseness of the null hypothesis and outcomes of the test can be seen in the table below:

Type III Error (correctly reject the null hypothesis)

The Well-known type I and type II errors in statically hypothesis testing has been the subject of much research and justifiably engages the attention of prating managers. All too often, however our concern with accepting or rejecting a hypothesis on false grounds blinds us to the possibility that we are testing the wrong hypothesis. Kimball (1957) defined "error of the third kind in statistical consulting" as the error of giving the right answer to the wrong problem. Kimball attributed this type of error to poor communication between the consultant and the client. Raiffa (1968) described a type III error as correctly solving the wrong problem.

The first and foremost question to be asked in any problem-solving context is whether we are solving the right problem. This is where type III error enters the picture (Type III error is solving the wrong problems). The probability of correctly rejecting the null hypothesis for the wrong reason (i.e., the risk that both the (rejected) null and (accepted) alternative hypotheses are false [Mosteller, 1948, p. 63]).The term originally defined by Mitroff and Feathering ham (1974). Seems to be a misnomer considering its preeminence over type I and Type II errors. Type III error is not a construct that can be treated using elegant statically techniques. It is an error that cannot be quantified because it emanates from the perceptions of people.

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Type III errors- a two-tailed test instead of a one-tailed test
Type III errors can generally be avoided by running a two-tailed test **.** A one-tailed test has a higher power if your hypothesized direction is correct. However, if your direction is wrong, the one-tailed test will return the probability of a Type III error (only you won't realize this!). For example, let's say you hypothesize that there is a difference between the means of two samples, and that the mean difference is lower. You test this theory by running a left-tailed test. The test returns a small p-value and you (correctly) reject the null hypothesis that the means are the same. However, unknown to you, the means *are* different: it's just that one set is *higher* (i.e. you should have run a right-tailed test), not lower. Type III errors aren't limited to differences between means. They can happen in every type of statistical test (e.g., correlations, proportions, variances etc.).

Type IV error (Incorrect interpretation of a correctly rejected Null hypothesis.)

A **Type IV error** is when you correctly reject the null hypothesis but make a mistake interpreting the results. Some common reasons that Type IV errors happen include aggregation bias (the wrong assumption that "what is true for the group is true for the individual"); running the wrong test for your data and collinearity among predictors.

The interpretation of the significant interaction was examined to determine whether it qualified as a type IV error. A type IV error was defined as the incorrect interpretation of a correctly rejected null hypothesis .

A type IV error was defined as the incorrect interpretation of a correctly rejected null hypothesis. Statistically significant interactions were classified in one of the following categories: (1) correct interpretation, (2) cell mean interpretation, (3) main effect interpretation, or (4) no interpretation. Interpretations classified as cell means or main effects were considered type IV errors.

General types of errors
Three general types of errors occur in lab measurements: random error, systematic error, and gross errors.
Random errors(or indeterminate) errors are caused by uncontrollable fluctuations in variables that affect experimental results as students open and close A sufficient number of measurements result in evenly distributed data scattered around an average value or mean. This positive and negative scattering of data is characteristic of random errors. The estimated standard deviation (the error range fora data set) is often reported with measurements because random errors are difficult to eliminate. Also, a "best-fit line" is drawn through graphed data in order to "smooth out" random error.
Systematic error (or determinate) errors are instrumental, methodological, or personal mistakes causing "lopsided" data, which is consistently deviated in one direction from the true value.
Gross errors are caused by experimenter carelessness or equipment failure. These "outliers" are so far above or below the true value that they are usually discarded when assessing data. The "Q-Test" (discussed later) is a systematic way to determine if a data point should be discarded.
Trial and error
Trial and error are a problem-solving method in which multiple attempts are made to reach a solution. It is a basic method of learning that essentially all organisms use to learn new behaviors. Trial and error is trying a method, observing if it works, and if it doesn't trying a new method. This process is repeated until success or a solution is reached.
For example imagine moving a large object such as a couch into your house. You first try to move it in through the front door and it gets stuck. You then try it through the back door and it doesn't fit. You then move it through the double patio doors and it fits! You just used trial and error to solve a problem. Edward Thorndike, a researcher who studied learning theory by using cats and a specially made 'puzzle box.' He studied how cats learned to escape from the box and concluded it was through trial and error. This was a shift from the theory of insight learning which proposes that problem solving happens in a sudden flash of understanding rather than through trial and error.

Conclusion

Type I and type II errors are highly depending upon the language or positioning of the null hypothesis. Changing the positioning of the null hypothesis can cause type I and type II errors to switch roles. Type III error and type IV error are opposite to the type I error and type II error. Errors made in childhood are viewed as part of growing up and learning, Error management theory often views cognitive biases as adaptations of the human mind to deal with problems that were faced by human ancestors. Error Management Theory, types 1, 2, 3 and 4 error theories are used for predicts Human Judgments & Decisions and explains modern human behavior.

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