



Chapter 11 / Capítulo 11

Evidence-based biomedicine: methodology for research, standardization, and scientific procedural aspects (English Edition)

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Inference / Inferencia

Statistical inference focuses on methods for drawing conclusions or generalizations about a population from a sample. In this way, it makes estimates about what might occur in the population from which the sample was drawn. The two main approaches to statistical inference are estimation and hypothesis testing. Within estimation, there are two approaches:

Point estimation: This approach provides a single value that approximates the parameter of interest in the population. However, a point estimate alone does not tell us how accurate this approximation is.

Interval estimation: In this case, we are given a range, or interval, of possible values, and the actual value of the parameter is expected to fall within it. This approach gives us a measure of the uncertainty associated with our estimate, since we are not limited to a single value.

In summary, statistical inference is about inferring a population from a sample, and to do so, we can use estimation methods that provide a point estimate or an interval of possible values.

11.1. Confidence intervals

A confidence interval represents a range of values within which we are confident that the population parameter we are trying to estimate lies. The width of this confidence interval depends on two main factors:

- 1) **Sample size:** The larger the sample size we use in our estimate, the narrower the confidence interval will be. A larger sample size provides a more accurate estimate.
- 2) **Confidence level:** The confidence level is the probability with which we expect the true value of the parameter to lie within the interval. The most commonly used confidence level is 95 %, which means that we are confident that in approximately 95 out of 100 repetitions of the estimation process, the true value of the parameter will be contained within the interval.

The fundamental idea behind a 95 % confidence interval is that if we repeated the estimation process numerous times (say, 100 times), we would expect the true value of our estimate to fall within at least 95 of those intervals.

It is important to note that confidence intervals can be calculated to estimate any population parameter, whether it be the mean, median, proportion, or others. To perform this calculation, you need the standard error, which measures the variability of the estimator.

The standard error depends on the population parameter we are trying to estimate and the underlying probability distribution.

11.2. Hypothesis testing

A statistical hypothesis is an assumption about one or more populations, and it may be true or false. These statistical hypotheses are tested using information collected from samples, and regardless of whether they are confirmed or refuted, there is a possibility of error in the process. The hypothesis formulated with the intention of being rejected is called the null

hypothesis and is symbolized as H_0 . The action of rejecting H_0 implies the acceptance of an alternative hypothesis, represented as H_1 .

11.3. Statistical significance

To determine whether we should reject the null hypothesis (H_0) or not, it is essential to evaluate the probability (p) that our data is consistent with the premise of H_0 . If the probability is extremely low, it could indicate that it would be very unlikely to obtain similar data if H_0 were true. On the other hand, if the value of this probability is considerably high, we would not have sufficient reason to contradict H_0 and, therefore, we would not reject it. The question then is to determine which probability values are considered high or low. Generally, a threshold of 0,05 is used as the cutoff, meaning that if $p < 0.05$, we reject H_0 and conclude that the result is statistically significant, favoring the alternative hypothesis (H_1).

Statistical significance refers to the probability of obtaining a sample that shows a discrepancy even greater than the one under H_0 . In other words, statistical significance quantifies the difference between a null hypothesis and the sample data. The closer the value of p is to zero, the more evidence we have against the null hypothesis.

Now, we find no significant differences ($p > 0,05$) when comparing two treatments. We can conclude that both treatments are equal. The way to express this result would be to indicate that "There is insufficient evidence to reject H_0 ." This implies that a non-significant result never proves that the null hypothesis is true. When we obtain a p -value that is not significant, we must consider the sample size, since a small sample size decreases the test's ability to detect significant differences