Statistics for Business

Testing about the population mean (μ)

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Testing population means

HELLO! In the previous task, we have learned how to test a population (real or theoretical) proportion through a sample proportion (the sample proportion is the estimator for the population proportion). For that, we used the sampling distribution of the sample proportion.

Now, we are going to learn how to test a population mean (μ) through its natural estimator, the arithmetic mean (from now on, AM) ($\overline{x} = \frac{\sum_i x_i}{n}$). For that, just like for proportions, we must take the sampling distributions of the means. The thing is that we have different sampling distributions for the AM, depending on the situation we are. More concretely, these situations are about:

(a) if population is normal distributed (or at least if we can assume that they are normal distributed, looking at the histogram for example, but that assumption should be validated at the end of the inference process by the goodness fo fit test - e.g., chi-square -);

(b) if σ population standard deviation (or its squared value, the variance) is known;

(c) and finally if the sample size is big enough (for us big enough will be a $n = 30$ sample size).

Depending on those circumstances, the sampling distribution of AM is different as you can see on slides 6-12 about parametric tests; more clearly and briefly on slide 12. This slide is very important and you should always keep it on mind (well, the exam is online, so keep it on your desk).

The sampling distributions on that slide are very different. In this lesson, we will deal with situations when σ is known. In those cases, the sampling distribution of AM is normal, if population is normal and if population is not normal, in addition, the sample size must be big enough.

Now an example about testing. We think that mean daily sales (population mean, μ) have decreased from its 25 normal value. Daily sales are NON NORMAL with $\sigma = 7$. We took a sample of 49 days resulting a 22 AM. Can we really say that sales have decreased? $\alpha = 0.01$

$H_0 : \mu \geq 25$ (the opposite of the our suspicions)

We reject the null hypothesis (big real mean) when AM is small. Hence, test is one-sided on the lower side.

The sampling distribution of AM is (as sample size is big enough despite the population is not normal): $\overline{x} \sim N(25, \frac{7}{\sqrt{49}} = 1)$ (see slide no. 12)

To get the the p-value, we calculate this probability using the previous sampling distribution: $P[\overline{x} < 22]$.

We can also calculate the critical value for AM: $P[\overline{x} < \overline{x}_0] = 0.01 \rightarrow \frac{\overline{x}_0 - 25}{1} = -2.32$ and get $\overline{x}_0$. If 22 is smaller than the critical value we reject; otherwise, we accept.

Instead of taking AM as reference, we can also take the z score: $z = \frac{22 - 25}{1} = -3$. As -3 is smaller than -2.32, we reject. Taking z score as reference is a good thing to understand the next lesson. Remember this please.

Now solve problems no. 151, 153 and 156 from the workbook. Remember to state correctly the null hypothesis. Draw a plot, like in solution of problem no 159 (given apart in the blog) explaining the decision. And take not decision, not just accept or reject, but stating waht are you accepting or rejecting.

Ok? Thank you.