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Data Analytics

Practice Question on Null Hypothesis

<u>Read the paragraph and answer the questions given below</u>

A superintendent in a medium size school has a problem. The mathematical scores on nationally standardized achievement tests such as the SAT and ACT of the students attending her school are lower than the national average. The school board members, who don't care whether the football or basketball teams win or not, is greatly concerned about this deficiency. The superintendent fears that if it is not corrected, she will lose her job before long.

As the superintendent was sitting in her office wondering what to do, a salesperson approached with a briefcase and a sales pitch. The salesperson had heard about the problem of the mathematics scores and was prepared to offer the superintendent a "deal she couldn't refuse." The deal was teaching machines to teach mathematics, guaranteed to increase the mathematics scores of the students. In addition, the machines never take breaks or demand a pay increase.

The superintendent agreed that the machines might work, but was concerned about the cost. The salesperson finally wrote some figures. Since there were about 1000 students in the school and one machine was needed for every ten students, the school would need about one hundred machines. At a cost of $10,000 per machine, the total cost to the school would be about $1,000,000. As the superintendent picked herself up off the floor, she said she would consider the offer, but didn't think the school board would go for such a big expenditure without prior evidence that the machines actually worked. Besides, how did she know that the company that manufactures the machines might not go bankrupt in the next year, meaning the school would be stuck with a million dollars worth of useless electronic junk.

The salesperson was prepared, because an offer to lease ten machines for testing purposes to the school for one year at a cost of $500 each was made. At the end of a year the superintendent would make a decision about the effectiveness of the machines. If they worked, she would pitch them to the

school board; if not, then she would return the machines with no further obligation.

An experimental design was agreed upon. One hundred students would be randomly selected from the student population and taught using the machines for one year. At the end of the year, the mean mathematics scores of those students would be compared to the mean scores of the students who did not use the machine. If the means were different enough, the machines would be purchased.

Questions:
1. What is the null hypothesis?
Answer:
The null hypothesis here would the affect of teaching machines not working and the machine not having any effect on the student's math score.

2. What is the alternative hypothesis?
    Answer:
    The alternative hypothesis would be the teaching machines working and the teaching machines having an effect on the students' math score.

3. What are the two possible realities (states of the world) regarding the machines' effectiveness?
    Answer:
    The 2 possibilities are simply the teaching machines either working to affect the scores or not machines not working to affect the scores.

4. The study obtained different math improvement scores for the two groups. What are the two relevant reasons for why this difference is there?
    Answer:
    The two relevant reasons are random varitation in the selections of students for the study and the other is different scores caused by the affect of teaching machines used for the students in the study.

5. If we decide to use the machines but they don't really work, is this a good decision? What name do we give decision in terms of the hypothesis testing table?
    Answer:
    No, theoretically considering that the teaching machines work but practically they don't, it's an example of Type 1 error.

6. If we decide not to use the machines but they really do work, is this a good decision? What name do we give to this decision in terms of the hypothesis testing table?
    Answer:
    No, theoretically considering that the teaching machines don't work but practically they do, it's an example of Type 2 error.

7. What two choices can we make about the null hypothesis? What determines which of these two choices we make?
Answer:
The choices would be rejecting Null Hypothesis or failing to reject null hypothesis. The decision is not affect of the machines but instead it's is based on the statistics that we get perform and p and alpha values which are set.

8. If the reality is the machines don't work, and we repeated this experiment 100 times, about what percentage of the time would we decide to use the machines anyway?
Answer:
5%. This question assumes that in reality the machines don't work. Our decision about the machines isn't based on this reality. It is based on the p-value we get with our statistic and if it is less than alpha (.05), then we reject H_o and decide that the machines do work.