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AP STATISTICS – MS. KLIMCZUK

Testing Hypotheses about Proportions

Ingots are huge pieces of metal, often weighing more than 20,000 pounds, made in a giant mold. The metal, used for making parts for cars and planes, must be cast in one large piece. If it cracks while being made, the crack can ruin the part. Airplane manufacturers insist that metal for their planes be defect-free, so the ingots must be made over if any cracking is detected, a process costing thousands of dollars. Metal manufacturers would like to avoid all cracking if possible. But the casting process is complicated and not everything is completely under control.



In one plant that specializes in very large (over 30,000 lb) ingots designed for the airplane industry, about 20% of the ingots have had some kind of crack. Hoping to reduce cracking, the plant engineers and chemists recently tried out some changes in the casting process. Since then, 400 ingots have been cast and only 17% of them have cracked. Should management declare victory? Has the cracking rate really decreased, or was 17% just due to luck?

Here, we have a random sample. We have 400 ingots cast with the new methods. Each random sample that we gather will have somewhat different proportions of cracked ingots. Is the 17% that we observe merely a result of sampling variability, or is this lower cracking rate strong enough evidence to assure management that the true cracking rate is really below 20%?

We want to know if the changes made by the engineers have lowered the cracking rate from 20%. Humans are natural skeptics, so to test whether the changes have worked, we will assume that they didn’t.

***What would be the null hypothesis here? Why?***

***What would be the alternative hypothesis here? Why?***

What would persuade you to believe the cracking rate actually went down? How much smaller must the cracking rate be before we *are* convinced that it has changed? This is the crucial question in a hypotheses test. Thinking about standard deviations will help you answer this question.

***Can we use a normal model here? Check all of your conditions.***

***Let’s start by finding the standard deviation of the sample cracking rate.***

Use the formula $SD\left(\hat{p}\right)=\sqrt{\frac{p\_{0}q\_{0}}{n}}$. We use $p\_{0}$ and $q\_{0}$ to remind us that the parameter comes from the null hypotheses.

***Now, draw the normal model that fits this scenario.***

***What is the probability of observing a cracking rate of 17% or less?***

Now management must decide whether this would provide strong evidence to reject the null hypothesis and conclude that the true cracking has decreased.

***What do you think? Do you think this provides enough evidence? Why or why not?***