University of Waterloo   STAT 332 – R.J. MacKay

Tutorial 5
A Statistical Emergency

T5 – 1. It's 11:35 am and I'm desperately preparing for a 12:30 class. The 'phone rings – as usual, I cannot resist.

"John here from Westcast. I've got an urgent sampling problem."

[*You should know that Westcast is a foundry that produces automobile parts in very large numbers. They make castings by pouring molten iron into molds and letting if cool and solidify.*]

"What's the problem?" I ask, continuing to write my lecture notes.

"Well, you know how we pour iron from a big ladle into molds – about 16 molds can be poured from each ladle of iron."

"Yes," I interrupt. "There are two castings for each mold, aren't there? So that would be 32 castings from each ladle?"

"You've got it," said John. "Well, we had a problem this morning. You remember how we innoculate each ladle with Remag to ensure we get the correct nodularity?"

['*Innoculation' means that a special chemical is added to each ladle of molten iron; this chemical creates the required crystalline structure of the iron when it solidifies – the nodularity.*]

"Well, there were two ladles that we're not sure got innoculated. The castings from those ladles are mixed up with those from four other ladles. There's about 190 castings in all. We can't ship them until we're sure that the nodularity is OK in all of them."

"Can't you tell which castings came from which ladle?" I asked.

"No way," said John. "Worse than that, we have to cut up the castings to check their nodularity."

"If there was no innoculant added, will every casting from that ladle be bad?" I wondered aloud.

"Yes," said John. "All 32 from that ladle would show a nodularity problem."

"So what's the question?" I asked, thinking I'd have to skip lunch.

"We're going to take a sample of castings from the 192 and check their nodularity. How many do we have to cut up?"

"Well, what are the consequences of shipping bad castings," I asked.

"Pretty severe," John replied. "Our customer is going to be upset. He's already mad because of the delay this screw-up is causing."

"How confident do you need to be?" I asked.

"We'd like to be certain but we don't want to sacrifice too many castings. I'm thinking of 99%," John answered.

"OK," I said. "I'll call you back at 2:30 after my class."

"I need the answer within 10 minutes," John said. "If you can't do it by then, we'll just go ahead with some sort of scheme. Call me back."

I put down the 'phone, wishing I'd prepared my lecture last night instead of going to a slide show on New Zealand.

THE QUESTION: Determine the required sample size and a sampling protocol with an explanation that John can understand over the 'phone; be sure to state clearly the assumptions you make. You have 10 minutes.

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