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Profiling logical but can be misused

By JASON BROWN
Sat, Nov 20 - 4:54 AM

Bombs hidden in toner cartridges, people with masks or explosive underwear making their way onto international flights — it's a scary time to travel. (I wonder if a new question at the security gates will be: "Did you put on your face this morning?")

We need efficient security, and there is a growing inclination to use profiling. But will this make us safer?

The mental jump from particular examples to a general principle is called induction, and it is as natural to us humans as breathing and eating. On the coin of logic, it's the flip side of deduction, which moves from general rules to particular instances. Cavemen would observe bears attacking humans and would infer that all bears are dangerous, and such inductions were critical to our survival. We always look for patterns.

But the problem lies not so much with induction per se, but with how we frequently use it inappropriately. Often when we generalize, we ignore counter-examples that go against the grain. And we commonly base our stereotypes on a small sample of examples, when statistics tell us that we can't conclude much of anything when the sample size is small.

But the problem is often more insidious than this. It's a commonly made probability error.

Suppose we've noticed that of the last 40 terrorists caught, 36 were from Group A. (This group might be based on gender, race, point of origin or other criteria.) And suppose there are 10,000,000 people in Group A, with an estimated 1,000 terrorists among them. Should we be suspicious of all people from Group A? Many people would be.

But what's confusing is this: The probability, given that a person is a terrorist, that he or she is from Group A is very high — 36 of 40, or 90 per cent — but irrelevant to safety. On the other hand, the probability, given that a person is from Group A, that he or she is a terrorist is very low — 1,000 of 10,000,000, or 0.01 per cent.

It is the latter that we need to focus on, but we often confuse the two.

And if you find conditional probabilities hard, you're not alone. During the O.J. Simpson murder trial in 1995, his legal team said that only a small proportion of women who have been abused are killed by their partners. The probability that an abused woman would subsequently be murdered by her mate is small, and completely irrelevant to the trial because we know Nicole Simpson was killed.

The vital probability is, given that an abused woman was murdered, what is the probability that her spouse committed the crime? In fact, it is quite high.

Whether the confusion was intentional or not, the error might have had a strong impact on the jurors.

Having said all this, profiling is still difficult for most of us to avoid. Security is more complicated than simply profiling. It isn't feasible or practical to search every person or parcel that comes into Canada, and it is here that mathematics comes to the fore.

Air security and customs agencies take into account several criteria for incoming goods and people (point of origin, physical appearance, nervousness and so on) and input their

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findings into algorithms based on data mining (the searching of historical data for patterns) that produce a risk score. People or packages with a high score are then subject to further investigation.

While there is always room for improvement, let's hope mathematics will stand on guard for thee.

•This November column is dedicated to all those Canadians who have secured our country and those who still do. Thank you!

Jason I. Brown is a mathematics professor at Dalhousie University in Halifax. His research that used mathematics to uncover how the Beatles played the opening chord of A Hard Day's Night has garnered worldwide attention. He is also the author of the book Our Days Are Numbered: How Mathematics Orders Our Lives.

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