AGAINST ALL ODDS
EPISODE 13 – "TWO-WAY TABLES"
TRANSCRIPT

FUNDER CREDITS

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INTRO

Pardis Sabeti
Hi, I'm Pardis Sabeti and this is *Against All Odds*, where we make statistics count.

'Til now we've been talking about quantitative variables – cold hard numbers. But statistics can also help us analyze relationships between categorical variables. Things like gender, race, occupation… or as we'll see, happiness.

Somerville, Massachusetts is a densely populated city just outside Boston. Its diverse residents range from those who've lived here their whole lives, to students temporarily passing through, to new immigrants just getting started in America.

In 2011, Somerville decided to add some unconventional questions to its annual census...

> **Joe Curtatone**
> "How happy do you feel right now? How satisfied are you with your life in general? Taking everything into account, how satisfied are you with Somerville as a place to live?"

Pardis Sabeti
Mayor Joe Curtatone is a devotee of data – and his team of statisticians collects info on far more than just the usual municipal business of potholes or police pay.

> **Joe Curtatone**
> There's no data set that's not important and you cannot be too redundant in the types of data set. Hence we collect happiness survey! We'll collect any form of data that is available, we'll mine anything that is out there to confirm our approach, our findings, our policies, and we'll ask probative questions of what we're finding.

Pardis Sabeti
Sent to every household, it asked residents how happy they were and how they rated their city and neighborhood on a scale from one to ten. So what does this have to do with deciding how to run a city government?

> **Joe Curtatone**
> Well I don't know of anyone who's going to move to Somerville because we have a higher bond rating or a balanced budget. I mean, can I live here? Is it a great place to raise my family? / Am I happy to be here? When I come home despite all that's going on in the world today / do I say, man it's really good to be in Somerville. Absolutely that has to be part of our thinking if you really want to lead a city.

Daniel Hadley
And what we found was that people were pretty happy, pretty darn happy. So the average happiness score was a 7.5, the average life satisfaction was a 7.7, and that's true in most surveys, people are a little more optimistic about their life than about their momentary happiness.

Pardis Sabeti
The idea is to find out what things correlated most closely with happiness – and think about what Somerville could do that would raise satisfaction with the city and hopefully in turn raise happiness levels.

Joseph Curtatone
Are you really happier because you're next to a transit node? Are you happier because you live closer to a park? Is your neighborhood significantly, statistically happier because you got zero-sort recycling before everyone else? Those are the type of things we want to ask ourselves to help guide our decision-making as we move forward.

Pardis Sabeti
One way to analyze all the data that rolls into the Somerstat office is by creating a two-way table**.** We can look at two categorical variables and see how they relate. Let's choose residents' happiness and how they rated the beauty of the city's physical setting. We can boil down the residents' numerical ratings into three categories, allowing us to create a 3x3 table.

They could be Unhappy, So-so, or Happy. And they could think that Somerville's physical setting was Bad, OK, or Good. Happiness is our row variable and Physical Beauty is our column variable.

The next step in figuring out what the two-way table can tell us about our data is to look at the distribution of each variable separately. The Total column on the right gives the total count for each of the rows, that is, how many people are in each category of happiness. The Total row along the bottom lists how many people rated Somerville's physical setting in each category. So for instance the total amount of residents who rated the city's beauty OK was 2,521, and the total amount of residents who were Happy was 3,373. These totals are often called marginal distributions, because they're out on the margins of the two-way table.

Percentages are a great way to glean more info from a two-way table. You just have to keep straight which number is the numerator and which is the denominator in the fraction that leads to your percent. The total of the group you're interested in is always on the bottom of your fraction. So here's the distribution of our row variable, happiness. The total number of residents surveyed is 5,785 so that's the denominator. Of course the percents sum to 100%. At 58.31%, the majority of respondents rated themselves as Happy. We

can add the percentages for the column variable, physical beauty, as well. Again, the denominator is 5785 since the total group we're interested in is all the respondents. Now we can see the percentages who rated the city's physical setting as each category. At 43.58%, the largest group said Somerville was doing just OK in the looks department.

We can dig even deeper into the two-way table's data by computing what statisticians call conditional distributions. Let's investigate how just the Unhappy people rated Somerville's beauty. It's a conditional distribution because we're looking at the distribution of one variable restricted to a single outcome of the other variable. In this case we're looking at the distribution of beauty ratings just within the Unhappy group. So for the moment, we are only interested in the first row, the Unhappy respondents. Our denominator is 275, since that's the total number of residents who said they were unhappy. Once you do the math, you can see that 32.73% of the Unhappy respondents said Somerville looks Bad, 44.73% said it looks OK, and just 22.55% said Somerville's physical beauty was Good. Now things can get interesting because we can compare that percentage breakdown against the conditional distribution of those who reported that they are Happy. Only 16.04% of the Happy residents said Somerville looks Bad, which is half the proportion of Unhappy people who did.

Here's another case where a graphic display can help us discern what the data are saying. A bar graph visually displays the fact that a higher percentage of unhappy people gave the city's physical setting bad ratings, as you can see from the red bars. As happiness goes up, the percentage of Bad responses for beauty goes down. And as you can see from the heights of the green bars, happier people were more likely to give Somerville's beauty a rave review.

> **Daniel Hadley**
> Does that mean that people who are happier just have a rosier perspective? They're more optimistic and they see beauty where sad people don't? Or is it that having a nice neighborhood, you know, being in a city that is really beautiful does impact your happiness? And I think, you know, if I had to say, I would say, I would imagine that it's a little bit of both.

Pardis Sabeti
As we know, correlation isn't necessarily causation. But now that Somerville has identified a link between residents' happiness levels and their thoughts on the city's physical beauty, officials want to dig deeper in the next survey to find out which attributes are related to higher grades for aesthetics.

> **Daniel Hadley**
> So we could even ask questions like-- Do you like having trees in your front yard? How would you rate the park space near your house? How

would you rate the beauty of your street? And then when you throw it on a map, you could start to tell the differences. Oh well people in this neighborhood on this street rated the beauty physical setting high and this street not so much. Well what's the differences? Is it street trees, is it having a narrow sidewalk? It's these kinds of questions that matter for urban design and when we're planning new neighborhoods could really help inform what we're thinking as far as the urban design and feel of the city.

Pardis Sabeti
That's the kind of data that can inform the city's decisions on where to devote resources. Then when future happiness surveys are shipped out, city leaders can again dip into the data to see whether their efforts have paid off.

For *Against All Odds*, I'm Pardis Sabeti. See you next time!

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