

15.301/310, Managerial Psychology
Prof. Dan Ariely
Recitation 6: Descriptive Statistics

What wrong with giving survey in class?

-select by people who come to class.

Is something wrong with that?

-more people come to exam

some people come earlier, some people come later, maybe we want to think about that when giving the survey

Today we talk about a most exciting topic - Measurement

In general, we think there are 4 types of scales: nominal, ordinal, interval, and ratio.

And those have diff properties and diff ways to think about them

nominal scale

just a label, doesn't tell us bigger or smaller, no order, can't infer any relationship

such as gender – no order

or bus number – some people take bus 1, some bus 15. we know anything about bus 1?

No, just labels

can think of others?

-student ID#

Assume random

-U/G

No, because we know one is more than the other. Grad degree, means also got u degree, it is more. Doesn't mean learned more, but more yrs of school

How about days of the week – nominal?

No, we know about relationship. Tues comes 2 days after Sunday

What else?

-ethnicity

-what city you are from

Is this actually nominal?

This is a very good point though

You can think about things as being nominal, and we can think of them as having some relationship.

Think about cities – we know east or west coast. From LA, SF, we know something about the cities, so is a relationship

-any nominal label – alphabetical

That's right. Big issue is what is nominal Depends on our goal

Ex. Say I think women nicer than men, I could say gender is not a nominal scale if we think about niceness

All about the question – what is the thing you want to use it for?

Bus numbers

Could be Cambridge has some system for bus #s

Buildings at MIT – nominal?

Look random, but some logic somewhere. At least some of the numbers

For those things, it would be not nominal

Nominal – no particular use

Think about it – put on x axis, switch around and it would not make any difference.

Switch in any way want – no difference

Ordinal Scale

Is continuity in number, but only continuity in the #

In fact, ordinal, interval, and ratio scales all have continuity in the data, but depend on different description of this data

Ordinal – knowing one, know is bigger than something else

Know house #17 is further away than #15, but don't know by how much. Don't know how big distance

Interval scale – intervals the same between

Ratio Scale – intervals between same plus there is a meaningful zero.

Why we care about meaningful zero?

-neutral pt

Ok, but why do we care about it?

Multiply things and is meaningful

Think about deg F, think about today, 50 degrees. And then – oh, today is 100. is it twice as hot as yesterday? No. 0 not a meaningful 0

What if heart rate 40, exercise, goes up to 80. would we say heart rate has doubled?

Absolutely. 0 is meaningful pt, so can double numbers, divide them, keep their meaning.

Ratio scale Allows to measure in percentages

What are some ratio scales?

-population

Meaningful zero and 75 people is 5 more than 70, etc (interval)

-Kelvin temp scale

-price

0, know what is. If \$1, half as much as \$2

-typing

WPM

Time spend in morning getting ready

Number pencils in your hair

Lets talk about interval scale

Graduation scale but without a meaningful zero.

Mostly physical measurements

Distance, time, weight

-voltage. Comparing, not consistent zero

I lack knowledge in that domain. Likely

Am I hot or not is a great website

2 undergrads Started program, sitting in coffee shop watching people walking by. Made a program that is like people walking by. See pictures of people, rate them

I have my picture posted on that site

I don't look very often.

First looked, very disappointed, then rating went up

We have lots of data from them

Anybody seen the adds in SF?

The two founders, naked with the laptops in front of their... where their underwear would be and it shows their real rating. Not real attractive

Was slight deviation

Interval scale or ordinal scale? We know 5 is more than 4. but do we know if 7 from 6 is same as 4 from 3? Diff in 2 scales is if intervals are of equal size on scale

Clearly not ratio scale

The reason this is so important is in a lot of these scales we do research – how happy are you feeling, how attractive do you find this person, how likely are you to buy this thing?

-ordinal equal size, interval... or other way around?

Ordinal means one is more than the other, but we don't know the size of the differences

Interval also gets bigger, but the amount of the step is always the same.

Then ratio has all properties of previous 2 plus a meaningful zero

Thing about scales is we can use them statistically.

Can you take an average of a nominal scale?

Anyone say no?

Anyone say yes?

Looks odd to take average of nominal scale.

If I code every female in this class as 1 and every male as 0 and take the average, what would I get?

Proportional number of people in the class

Usually people say nominal scale can't take average of

Which is often true

Bus 1, bus 15, can't say something about bus 8, meaningless

Apt numbs, harder to imagine, but some cases might make sense

All depends on what scale you have and what you need to know

Year when something founded – what scale?

-interval

Why not ratio?

0 defined by part religion. If think of nothing existing before, but existing after, but otherwise not meaningful 0

Altitude. What is alt?

-ratio

yeah

Population?

-ratio

Sad point about these scales

And the reason I emphasize them so much – is that in most cases when you ask for peoples opinions on these scales, we behave as if ratio scale. Double, say people at MIT twice as happy as people at Harvard. Nevertheless, these scales not always ratio scales. Every time we double, the assumption is ratio, but is not always ratio. Many cases, behave as if ratio scale, wishing have interval scale, but in most cases we only have ordinal scale. 1-10 scales, hard to assume each step is same size. Means all we have is ordinal. The happy thing is we have stats. More people we get, even though only have ordinal scale, treat as ratio scale, a lot of stats are indifferent to this assumption. Good to try to think about making ratio or interval scale, but even if we don't, we have some help

What scales do we have? (slide)

Most cases, only have ordinal scales

Luckily statistics – go into next time

Not good to do better to think about scales, but some help out there

Sometimes ask very small resolution. On scale 1-1000, how do you feel today?
Usually crazy. Many cases, people can't distinguish that level of happiness

Know scales, now move to descriptive stats

Basic pt w/ stats is the following – very hard to see all kinds of numbers

Lots of them out there

So let's say PD (red sox pitcher, Pedro Martinez)

People batting against him get .209

Why say? Why not give all the numbers?

How many people, thousands?

Lots of zeros, some 1s

Very hard to figure out this data, right?

But by 1 number, can get info from these numbers

Now, is this 1 number hiding some information?

Are there missing things from this number?

-yeah

Like what?

-standard deviation

Can calculate that, you remember? What is standard deviation? You know what? I think that is a good thing, you will have all kinds of ?'s on the exam based on this

What is probability that Red Sox will win series?

-1

Outside of wishful thinking, how calculate the probability? See how useful this class is?

You learned something, and now you can use it.

-15/16

How calculated?

-assume $\frac{1}{2}$ chance of winning each game

4 in a row, multiply

Happen unless cardinals win all 4 games.

$.5 * .5 * .5 * .5$

Cardinals chances. 1 minus that for Red Sox.

Statistics – represent something, but also hides a lot of information

Example – Pedro Martinez

Get better over time?

Get worse?

Bad some days? random?

We have a lot of responsibility as the reporters to report what is relevant

Wrong to report one aspect

Hiding info by doing things like describing stats with 1 number.
Can compare better to other people, useful, but
Careful not to hide important aspects

Describing a state (slide)

Started – some royalty interested in gambling
Wanted someone to teach them how to

Ex slide

How much you like 15.301?

If take average, hides some data

Compare classes – how many people attend 15.301 vs course 1 class?

Not real data, by the way

Average is the one you are most familiar with.

Give example for averages used in daily life

-average time get to class

-hours of sleep

GPA

-number of emails you send

We do all these things with averages, or mean. I want to present 2 others, the mode and the median.

Mode - most popular occurrence in the data

Think about ages

Could be average age here is 23. but could be most people 18 and some people are 80

Average very diff picture than mode.

Why want to know mode?

-focus on as part of group

Where does most of the data fall? This can be very important

Sometimes multiple modes – some 18, some 80, none in the middle

Bimodal dist

Median numb exactly halfway between lowest, highest number.

Can confuse w/ average, mean, but is not the mean.

Sort by order and find central person

Why is not the mean?

What is the mode in this first example. We say, there are 7 numbers... we go 1, 2, 3, and the next is the one in the middle

What is difference – this approach and approach to find average?

Talking about central person.

What is the median here? (slide)

-27

if no middle person, take mid 2, halfway in between

Some other tricks. For example, what if we have

123 85 24 24 24 20 18 15 2 1

How calc median under those conditions?

Between 24, 20, but are three 24s, one 20

Could slide in relative proportion, divide space not evenly

The Mean

The average, most used stat

Very compact, basis of every stat we will go over later

Problems with this

Outliers – vastly skew dist of ages if a couple far from average

But has nice properties for computation

In papers, will plot some things

Plots I (slide)

People solved q1, q2 correct in imaginary test

What see in data?

Any pattern?

How do you interpret?

Over time, people improve in q1, q 2 not much improvement

Emphasize diff things w/ type of graph – line graph, bar graph, etc

Accepted standard:

w/ nominal scales, not use line graphs

it would be arbitrary

doesn't mean ordinal, interval scales have to be line graphs, but very unconventional to use line graphs for nominal data.

Plots II

Pie charts, first impression probability of different segments

Stack bars - Joint effect of 2 years gives effect of both years together

Went over mean, median, mode, now look at

How these things change depending on what the distribution is like.

In this distribution, where is mean, mode, median?

All Exactly in middle

This bimodal distribution? Where will the mean be?

Mean in middle

2 modes

Median in center

Try to describe data, take complex patterns and summarize for people

We are telling a story, look, we have all this data and we're just going to summarize it for you in some meaningful way

It is your job to understand what the full story is and therefore you want to look at it in a variety of different ways and only then figure out what the most important aspect and summarize those

Surprisingly subjective endeavor

Why does baseball use mean? Should't you want to care what is the likelihood of strikeouts that PD will have in the next game? Would be mode, not mean.

Very different stories from the data

When have data, recommend you plot it. Then figure most important aspects, summarize those

One more example, shifted to right. Lots have B, few people have A

What would be mean, mode, median?

What easiest?

-mode

Mean, median shifted to the right.

Shifted to infinity, mean would go to infinity

More extreme, mean more to the right

Distribution Descriptors (slide)

Other useful statistics

Range –the mean to the max

Another mean to max idea called the interquarter range

Instead of calculating 1 median, calculate 3 medians

Take median, then on each side of the median take another median

So you end up with 4 portions, divided out by the 3 medians

Drop top and bottom quarter, just deal with the 2 in between

Focus on middle quarters

Lets say math exam

Some great at math, some just write 0 and go away, not try

Use this to find range of people who took it seriously, and find the mean of those exams

Variance, already talked about

How mean, median, mode relate to scales we talked about?
Which can use for each scale?

Nominal scale

-Mode

Use mode, doesn't make sense to use anything else

What about ordinal scale?

-Mode, median

Mode used for every one

Interval scale?

Use all

Ratio scale – all

Correlation – the relationship between 2 variables

(Slide)

Hour in morning vs performance in 15.301

See people wake up early don't do as well

Have all these data points. How can we describe with line?

Find line that minimizes distances to it

Kind of like an average, but an average line

Will Show 6 correlations

0 completely unrelated

1 match exactly

Want you to guess the correlation

(slides)

Write correlations

How close were you in guessing?

Most people completely miss the first few, think really not much correlation there

Most people find correlation of .3 hard to grasp

Biased against order. Don't think there's as much order in the data as there really is

-doesn't correlation calculation depend on equation for line?

That's right. When we say correlation, assume linear

Life much more complex than linear relation between 2 lines, then have to look at different equation

Fit different function

Very good point

Talked about the 4 scales
Talked about distribution
Range
variance

Final thing bring to your attention, objective vs subjective measurements

Presidential Election – truly meaningless statistics
Do we need to see another survey that tells us the range is within the margin of error?

2 types of measurement

subjective, objective

subjective measures: things that there is no external way to know whether they are true or not

How happy does color red make you?

No objective way for me to know how happy the color red makes you

Subj. measurement. You are the ultimate judge, no other way to go about it

Intuitions,

Baseball game – will they win tonight? You might be right or wrong, but

If give me best guess, I can't tell if is your best guess or not. Only w/in your mind are these numbers created, no way for me to evaluate objectively

Opinion, all of these are the same

Objective, look at behavior, I can see your behavior. And sometimes people do other than what they say they do
Many cases, this is better

If I ask how much you enjoy this class, 5 pt scale, is it objective or subjective?

Subjective, it's got all kinds of problems.

Measure who showed up to class

Objective but not necessarily correlated

Maybe it's not the people who like it, but people who hate it so much, they want to fuel their hatred by anecdotes. Or if someone has a good friend who is coming to class.

Doesn't have to be correlated, but it is an objective measure.

So which is better? Subjective? Objective?

-objective, don't care what people think, want to predict what do

These things are very different, right?

If you ask people if it is important to save the dolphins, they say yes

But if you walk into a supermarket, how many people buy dolphin safe tuna? They are not going to pay another dollar, in order to save the dolphins

Sometimes you will care about one, and sometimes about the other.

Oh, btw, you remember that last time we did a bet, for 50/100 dollars? I just want you to realize that this is all for real. You take bets in this class, you have to pay, and if you make money, you also get money, right?

(asks for the \$50 from last class, student gives it to professor)

Look, I have to keep the reputation. This is all for real.

So sometimes big difference between subjective and objective.

What else are reasons one might be better than the other?

The main point is that objective in many cases is better, but there are some things we have no objective way to measure.

Sometimes w/ objective scale, can measure what you did, but not why you did it

Think about measuring come to class

Can measure who comes to class, I can't figure out why you came. Can be all kinds of reasons, but w/o asking you, I will never know.

Objective is better, easier measure, but can't measure everything

Paper on parking cars

Another – if stand next to man when urinate, take longer or shorter to finish?

2 theories – faster because don't want competition, get out of there. Or longer, stress makes harder for them to start. And in fact, that seems to be the result.

Exp – had someone stand next to or not, and measured how long it took them these are objective measures.

We can look at Choices, payment, options, bid, where they go – all objective measures

Statistically expensive. Look at the case of choice.

Objective measures

Slide

Limited things we can observe

Imagine have some scale, people dist on scale

1 case, half yes, half no

2nd, one says no, not capture how vary

Capture data across scale. If asking about 1 number, may get something wrong

An example:

Try to sell MIT rings, figure out price to sell at

Say cost \$300

Try one price out. Say I'm a market research company, trying to make a price

Survey, would pay 100? Everyone says yes

So I know I can charge more than that, but I don't know how much more. I'm not asking at the right price.

Ask around 300, much more information, people discriminate

When ask about choice, less info than ratings

Subjective measures intention – what would you do, what would other people do?

Often better to ask what others would do. Why?

Many cases only way to know what others would do is to infer from your own behavior.

Might be easier to admit others would do it

If I say, would you cheat in the next problem set? Unlikely to get a yes response.

When ask, How many others likely to cheat in next problem set? Get a different answer

Another way

People try to think aloud. Not very popular these days, but it's interesting. Train to do something and tell what think as they do it. Surfing the web, what are you thinking as you surf the web? Verbalize it. Oh, this looks like an interesting little gadget, and oh, this is a different link...

Ton of data, hard to interpret. But sometimes interesting

I want to make sure you understand, and I think you do, that quantitative does not mean objective. When we have these scales 1-10, it doesn't mean they are objective scales.

Say want to measure how much you like another class

Can give you a subjective measure of how much you like it on a 10 pt scale.

How can we do objective measure? Give me some examples.

-how many problem sets turned in

Use grade as approximation. What else?

How can you measure objective liking?

-ask if would recommend class

Say coming up with a new product, new satellite dish
Can ask how likely to buy it, how get objective measure?
Want to predict if they will buy.

-compare it to something
Buy this vs this. What else?
-how much talk about
-website, how many keep coming back to check?

Can also ask people about data
This costs \$8, would you buy it?
If you had to travel 2 hours to get this, would you do it?
This is kind of a hybrid, right?
Giving us in perspective if they do something, but what they give us is an objective scale.

-another interesting scale is the
Guttman scale
Hasn't been used very much, but it's very nice.
Imagine I want to do a Guttman scale for how studious you are.
I try to create a set of questions where each subsequent one assumes you have done the
previous one

Say we had 3 behaviors
Come to classes
Submit all problem sets
Study for the test.

Ordered

There are people who come to class
People who submit problem sets also come to class
Most serious people do all 3

Subjective measurement (slide)

Subjective measurement very popular
Cheap
Lots of data w/ few questions
Tell us things we cannot observe

Also limitations
Problems w/ interpreting questions

If I ask you at the beginning of the semester about your tendency to study well, you will give me a very different answer than if I ask you in the middle of the semester. At the beginning of semester, you have an inability to figure out how busy you will be.

Also have Social desirability and demand, which are objective measures though
If I asked how many of you cheated on the exam, you might keep that info to yourself.
But if I ask you about cheating, it is a very different story.

Would you like to watch The Piano or Rambo? A lot of people would say yes, I want to watch The Piano, but when the day comes Rambo gets rented more frequently.

I can frame a question to make you think I want you to answer in some way that you would.

I would say, "don't you agree that apple is a great computer?"

Each has advantages

Beware subjective measures to predict behavior

Fresh Samantha Paradox

4 juices

Asked rank worst to best

Market share

Most highly ranked juice not purchased

Lowest bought just as much as 2nd highest

How could this be?

-What kind of info was taster given when making the choice? People actually tasted it?

-ranking skewed statistics

Suggestion correct

3 segments people

Each ranked diff juice 1st and all ranked orange-carrot 2nd

The second best problem

Rankings not always translate to behavior

Nobody ever buys 2nd best

How solve this problem?

Predict market share – only ask ranking for best, not whole range?

Do we never want to know ranking?

Ranking not give much info for predicting market share, but sometimes want to know what is 2nd best and in particular, how far it is from 1st best

Ratings more imp than ranking

Ratings we actually know the difference, how much of a difference.

Imagine you were ambassador for product B

Prod A1, B1 (slide)

Would you want to know if you are below the arrow or above the arrow? Close or far?

B2, A2, may drop B2 all together if so far behind

But B1, may be so close, want to try to compete for market share

Ranking not give these things. Rating might be better

Objective measures easier to make inferences from in terms of interpreting behavior

All kinds of things we can do that are totally objective measures. Instead of asking if you like this class, can ask how many friends did you tell that you like this class.

Hw many minutes a day spend studying? All kinds of questions like that

To determine if subjective or objective measures would be better, understand exactly what measuring

ask ? how much prepare for case x could be other variables

statistics is an art

depends on data and measurements you've done.

Your responsibility as a researcher, business person, someone who writes report is not just to present 3 bar graphs, table. Have to truly look at the distribution, data, try to figure out the important aspects of this data.

McKinsey have templates for reporting data. Assumes all will be the same. But it is absolutely not true

important to look at real data, figure out what to tell based on this data

really your responsibility to do it well.

no hard rules

that's it for today, please fill out the evaluation forms

my old advisor used to say that these evaluation forms are taken with the seriousness they deserve. We do care about this, we want feedback.