Probability, Prediction, and a "30% Change of Rain"

"The probabilistic analysis of random behavior lies at the very heart of how we understand physical phenomena, from everything from quantum mechanics to the weather.[1]"

Introduction

As a subset of statistics, probability is listed in the textbooks right after the chapters on organizing data and learning about averages and variations. Then probability – using a number between 0 and 1 to indicate the likelihood of an event – progresses into "binomial probability distribution," "normal distribution," hypothesis testing," and "regression and correlation."
We are not going to do all that in this paper but I will say in my next life time a minor in statistics with emphasis on probability will go a long way.

Here are the rules to use probability in a statement:
a. The closer to 1 the probability assignment is, the more likely the event is to occur.
b. This probability is frequency divided by sample size or $p = \frac{f}{n}$

Example for the simple math:

If we shoot 50 rounds (sample size) and hit the target 25 times (frequency) then 25/50 = ½, or .5, or 50%. The probability of hitting the target is one-half, or another way of saying it is, one out of two bullets will hit the target (on average).

Task of paper

Given the examples of playing horse or "Bar Dice," using a set (event) of 60 for dice, a straight in poker, this paper will then explore the issue of how they determine what it means with "There is a 30% chance of rain."

Textbook quotes:

"Probability is the study of events whose outcomes are random." Flipping a fair coin a million times, we know, will be about 50% because the coin is either heads or tails, but we don't know each time we flip it what the outcome will be.
"The distinction between our ignorance about the outcome of a particular trial and our knowing the aggregate behavior of many trials is the peculiar domain of randomness and probability" (p. 2).

"Probability has application in many areas."

"Probability is a fascinating study that has many real-world applications."

You'll like this famous quote from Einstein: *"God does not play dice with the universe"* (p. 3).

[1] Michael Starbird. (200). *What are the chances? Probability made clear*. Chantilly, VA: The Teaching Company.

"Ace up - Six towards you!" (a test question)

Playing "Horse[2]"

Kunsan (by the sea), circa 1968, Officers Club Bar, 166th TAC Fighter Squadron, F-100 fighter pilots: Jamie, José, Ron, & me.
The picture is to show the Dice cup, five dice (one is a die), and some ammo for my target shooting example to show the size comparison (.45 ACP and 7,62x51 - German).

Cannot tell you how much fun we had (aces wild) double shake of the Dice cup, "BAM!" on the table, count, recount, BAM! Again, drinks, and more Horse!

Of course, this is to get into what random numbers or dice add up to and how often one can expect to see, better: what one of us would "expect" or "predict" (or know) what the probability is for, say, all aces? I have no idea what the probability[3] is, but will tell you five aces will cost you a round – right then.

Let me roll some dice for you. This is fun, educational, and on our way to the 30% chance of rain today…

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[2] The game is called "Bar Dice." See the rules at: http://www.barnonedrinks.com/games/b/bar-dice-342.html

[3] Had to work for this math, but for five of a kind: "The answer is $5*(1/6)^5$ =5/3750 = 1/750 =~ 0.001333."

What are the chances?

"Outcomes of individual random events are unknown, but the aggregate behavior of random events is predictable" (p. 5). [A good stats teacher will repeat this nine times an hour in class.]

First, we covered the example of flipping a fair coin knowing the average will end up being near 50% but not each flip – we could get, for example, 10 heads (or tails) in a row.

Second, let's look at dice. This is the best example of how to describe random phenomena. Again, a die has six sides. When you roll a die you will end up with one of six numbers or 1 through 6. The example in my text book shows Dr. Starbird doing an experiment with an urn holding 60 dice. So, he shakes it up and rolls the dice. He knows when the sorting and counting is done he should have approximately as many 1s as 2s as 3s as 4s as 5s as 6s. There should be about 10 each but we should not really expect exactly 10. There should be some variety but an even distribution – that is just the way probability works.

For my experiment for this paper I rolled the dice from my cup with five die 12 times (60) or 12 "sets."

1	2	3	4	5	6	(sides of each die)
9	18	6	10	11	6	First roll of 60 Lots of 2s and short on 6s. All the numbers showed up and we didn't all 4s!
5	10	12	12	10	11	Second roll of 60 – I just had to play here, 60 is not enough for anyone…
8	9	10	14	9	10	Third roll of 60 – every number shows up, and we have has variety.
12	8	6	11	11	11	Fourth roll of 60 – they all have to add up to 60 – we expect near a 10.
						What do you think the columns should add up to?
35	**45**	**34**	**47**	**41**	**38**	How close are they? Maybe the same percentage as the single sets?

I certainly do not have an answer for why they are so far apart but, again, this is probability. The professor had 15 3s and 6 4s so his was not that much different than mine. Perhaps, the number of shakes, how hard the cup is slammed down, or just dirty dice?

Let me know what you come up with when you test your dice or die!

Third, let's look at one die. Of course, it has the same six sides. If we roll the die we can say the probability of any one of the six numbers is equally likely to show up. The professor says this best: "we give a number to this equality by saying there is a 1 out of 6 chance, for example, a 5 will arise if I roll the die" (p. 15). So he goes on to say just count how many outcomes there are and then the chance is 1 over that number. The probability of the example 5 coming up is 1 out of 6. This is $p = \frac{1}{6}$

The probability of a 5 <u>not</u> coming up is – that is, everything else – is going to be $(1 - \frac{1}{6})$ or $\frac{5}{6}$

Fourth, let's ask what's the probability of rolling a die and getting an odd number? (The collection of outcomes is called an event.) Then, as there are three odd numbers, 1, 3, and 5, the probability is just 3 out of six. Therefore, $p = \frac{3}{6}$

Fifth, to finish up this section I want to cover one example with playing cards and show one more event to highlight our topic of probability.

*[**Thank you!** for reading this far as the lesson in probability will make the rain a bit easier to understand.]*

Let's play poker a second. We are looking at a straight. This is a long quote but really interesting and the only way I can explain the numbers. Our teacher says "So to get the actual number of hands possible in poker it's 2,598, 960, because we take the 311,875,299 of hands that count the order in which we get them and divide by the fact that each hand has been counted 120 different times" (p. 20).

There are 10,200 poker hands that are straight (in order – like 3, 4, 5, 6, 7 – but in any suit). The probability of getting a straight is 10,200 divided by 2,598,960 which is the probability of .004. This is 4 out of a thousand.

These numbers again show how to compute the probability of some event – such as the number of straights – and this is done by counting the outcomes and dividing by the total number of outcomes that there are. This fraction is the probability of that event.

Like straights: 10,200/2,598,960 (hands over total) = .004, or 4 out of a thousand or 4/1000.

A 30% chance of rain

The weather man says "There is a 30% chance of rain in your region tomorrow."
What exactly does this mean?

First of all, how much rain is rain? The book says 0.01 of an inch (1/100th of an inch).

Second, this means 30% of the region will get 0.01 inches of rain. (This assumes a homogeneous region.)

Third, "*Technically, the probability of precipitation (PoP) is defined as the likelihood of occurrence (expressed as a percent) of a measurable amount (.01 inch or more) of liquid precipitation (or the water equivalent of frozen precipitation) during a specified period of time at a random point in the forecast area*" (p. 70). This is the author's definition improved from the underline above which is changed from "at any given point" which of course is a probability issue.

This 'given point' or 'at one specific spot' means for a 30% chance of rain "that if the weather circumstances are like they are today, then in 30 out of 100 subsequent days, if you're predicting the next day's weather, in 30 out of 100 of those subsequent days, you would expect to find at least 100th of an inch of rain landing on that spot" (pp. 74-75).

"It does not mean that it's expected to rain for 30% of the time. That's not true."

There is a challenge when the land is not homogeneous as in part hills or mountainous areas then the probability will change. But, we are talking about the term 'on average' the rain will be 30% and this would be on homogeneous terrain.

Ok, let's look at one of his multiple choice questions to determine how well people understand the phrase "The chance of rain is 30%":

(a) Rain will occur 30% of the day.

(b) At a specific point in the forecast area, for example, our house, there is a 30% chance of rain occurring.

(c) There is a 30% chance that rain will occur somewhere in the forecast area during the day.

(d) Thirty percent of the forecast area will receive rain, and 70% will not.

Which one did you pick?

At first I was raising an eyebrow over his answer, but the more I think about it, his method may have the hook in it to make the correct answer stay with the students. Let's see what you think about his remembering method. I will add he borrowed the question from some 'modern paper' so he is also proving something (reckon it is about probability?).

He said none of them are correct. This is his hook. Now look at how he handles the answer so we can remember.

(a) No. This was easy.
(b) He said the modern paper picked this one as the answer but he covered this (hope I did too) saying "no" to a specific point. It is just not true.
(c) This question would be ok if all the land was the same. He makes a big argument in his lecture hour about the variability of the land and the rain fall being different. He says some places always get the rain due to the terrain. Don't know how true that it is but that is what he says.
(d) This would be correct if it said 'on average' will receive, rather than 'will' receive.

"Because the prediction of rain is an inherently probabilistic matter" one cannot say 'will' receive rain.

Well, I hope the 'enlightenment' on *"the probabilistic analysis of random behavior"* and how it correlates to a clearer look at what "30% chance of rain"[4] means. My answer to folks who bring this 30% chance up will be "This means a 70% chance of not getting any rain."

Along with enjoying the statistics and using my Dice cup again – I do miss my fighter pilot buddies I flew with in Korea and especially the F-100 - but being a Monk isn't too bad.

Thanks again for reading this.

G♥

[4] Just to let you know if the folks doing all the *Global Climate Engineering* keep blasting the atmosphere with HAARP experiments, microwaving, and destroying the ozone to let the UV rays 'dice' through us, then all bets are off on any 30% rain issues as they will be able to 'predict' the weather - because they <u>own</u> it.