

Odds, Probabilities, Odds Ratios

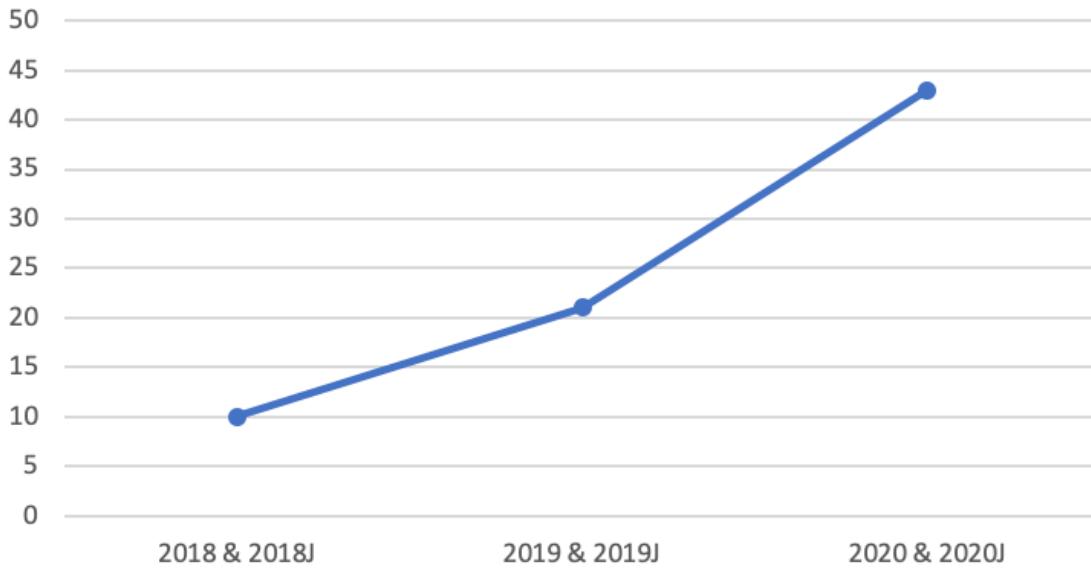
SDS 291 – Multiple Regression

April 1, 2020

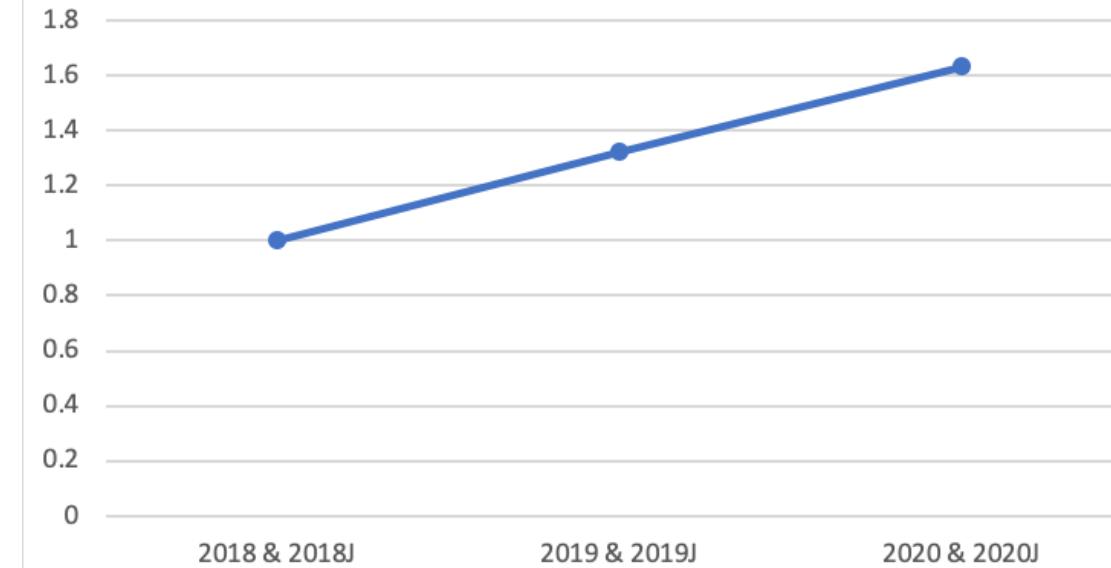
Recapping Transformations

Growth in SDS Majors

SDS Graduating Majors (N)



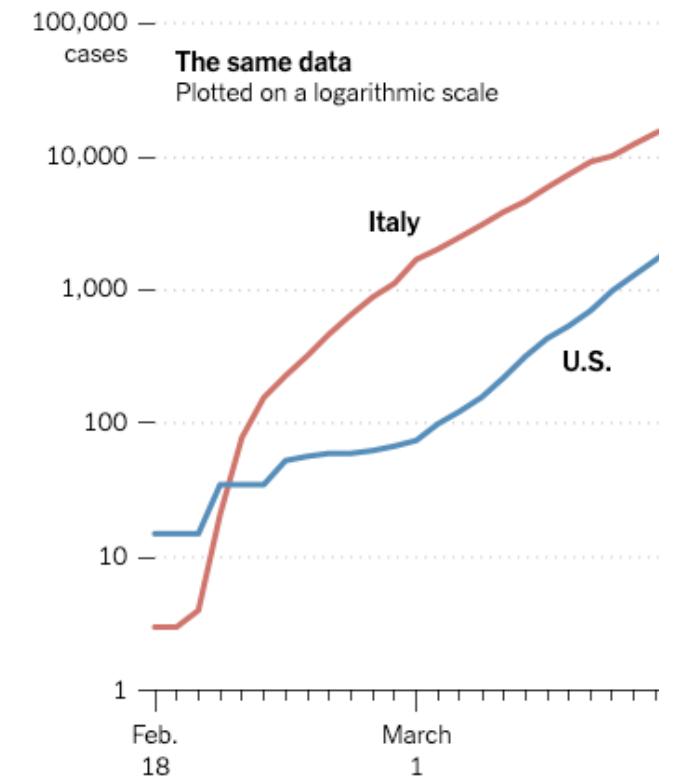
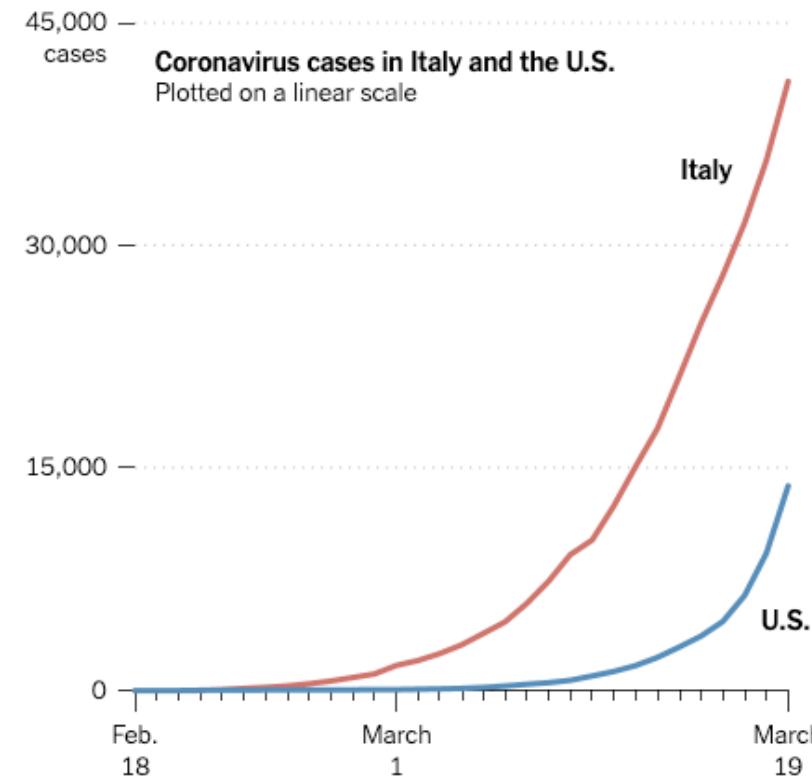
SDS Graduating Majors (Log N)



COVID-19

Bending the Curve

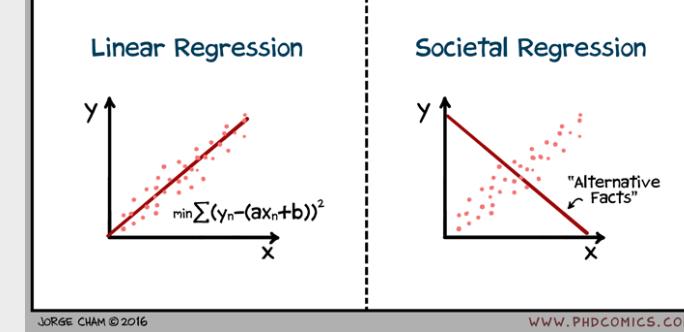
Logarithmic scales can emphasize the rate of change in a way that linear scales do not. Italy seems to be slowing the coronavirus infection. The number of cases in the United States continues to double every few days.



By The New York Times | Data from Worldometer

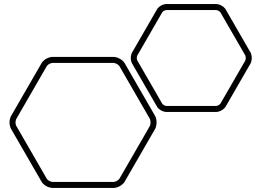
Transformations Linearize Patterns

It's easier to interpret linear relationships



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Odds, Probabilities, and Odds Ratios



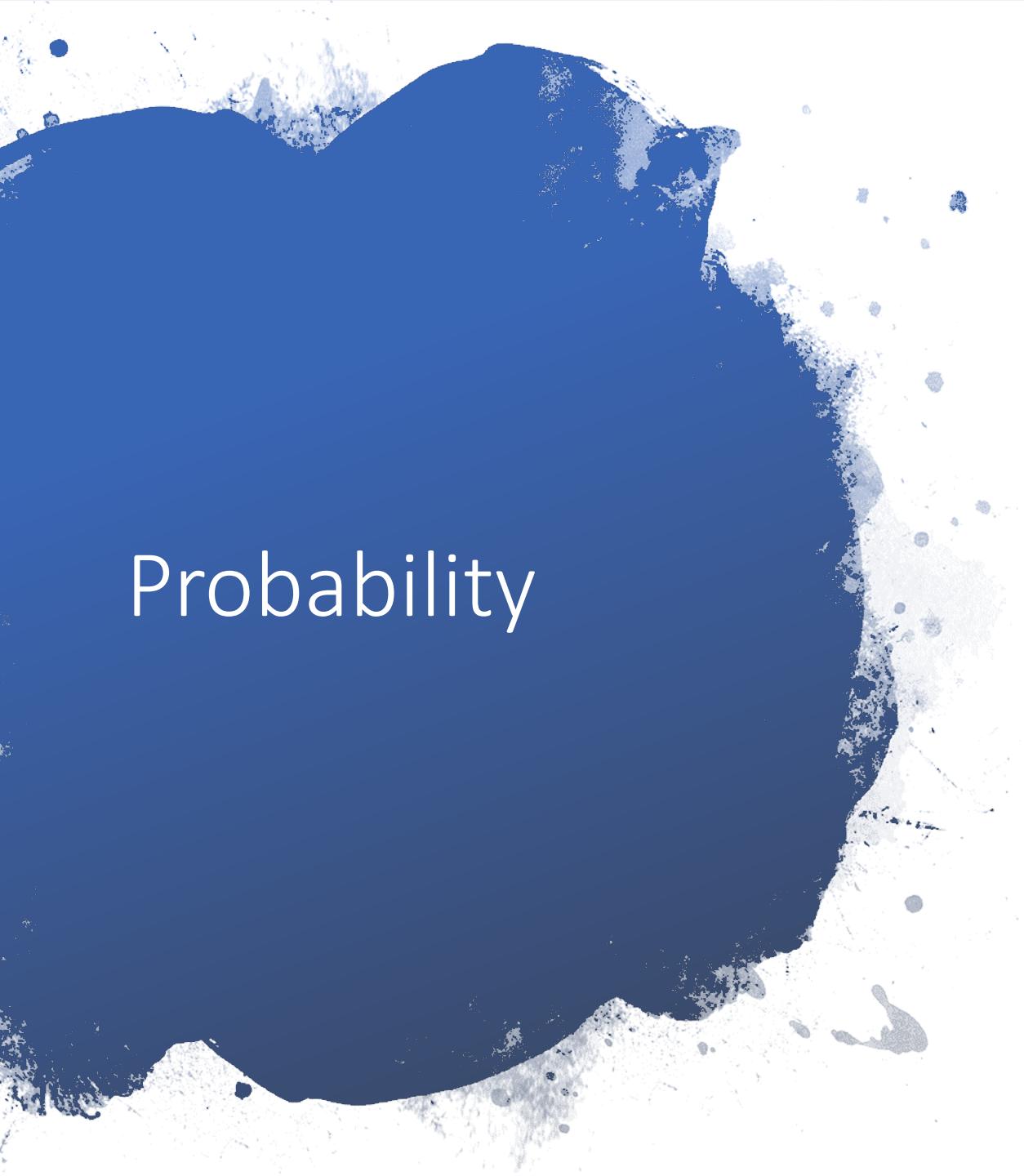
What are Odds and Probabilities?

What are they?

Where have you seen them? Give 1-2 examples.

Probabilities: π = Proportion of "Successes"

$$\bar{y} = \frac{\sum y_i}{n} = \frac{\text{\# of 1's}}{\text{\# of trials}} = \text{Proportion of "successes"}$$



Probability

- π = Proportion of “Successes”

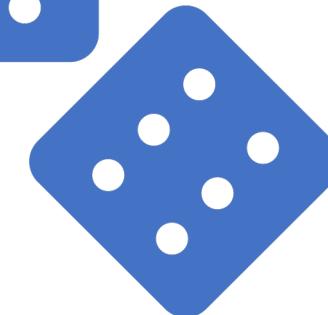
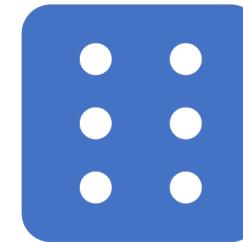
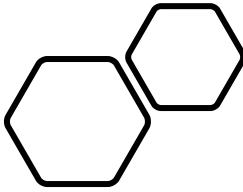
$$\frac{\text{Successes}}{\text{Total}}$$

Odds

“Successful” Events :
“Unsuccessful”
Events

“Successes”

“Failures”



If π = proportion of “yes” (success, 1, ...)

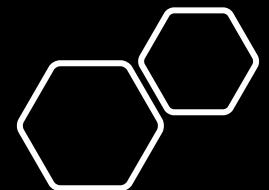
the odds of yes are (is)

$$\frac{P(yes)}{P(no)} = \frac{\pi}{1 - \pi}$$

$$odds = \frac{\pi}{1 - \pi} \Leftrightarrow \pi = \frac{odds}{1 + odds}$$

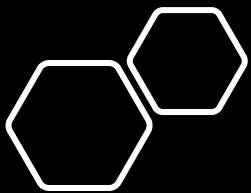
Odds \longleftrightarrow Probability

A little bit of algebra shows



Let's imagine you're mini-golfing

Ft. away	3	4	5	6	7
Made	84	88	61	61	44
Missed	17	31	47	64	90
Total	101	119	108	125	134
Prob.	$84/101 = 0.832$	$88/119 = 0.739$	$61/108 = 0.565$	$61/125 = 0.488$	$44/134 = 0.328$
Odds	$84/17 = 4.94$	$88/31 = 2.84$	$61/47 = 1.30$	$61/64 = 0.95$	$44/90 = 0.49$



Odds Ratios

- What are the odds you'll make a putt from 7 feet away compared to 6 feet?

Ft. away	6	7
Made	61	44
Missed	64	90
Total	125	134
Prob.	.488	.328
Odds	0.95	0.49
	0.49 / 0.95	
		=
Odds Ratio		0.512

95% CI for an Odds Ratio

$$\ln(OR) \pm Z^* \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}}$$

$$-0.66 \pm (1.96 * 0.256) = -1.17, -0.16$$
$$\exp(-1.17, -0.16)$$

95% CI for OR: 0.31, 0.85

	Made	Missed
Farther (7ft)	(a) 44	(b) 90
Closer (6 ft)	(c) 61	(d) 64
Odds	7ft : 44/90	6ft: 61/64
Odds Ratio	7ft / 6ft = 0.512	
ln(OR)	-0.667	
SE_ln(OR)	0.25	