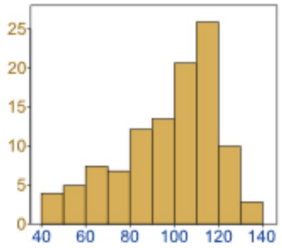
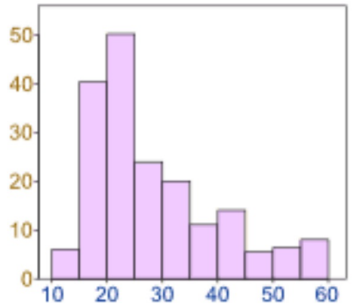
Section 12-7: Normal Distributions

Data can be "distributed" (spread out) in different ways.

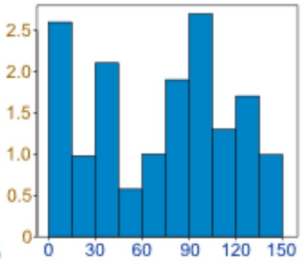
it can be bunched up more to the right...



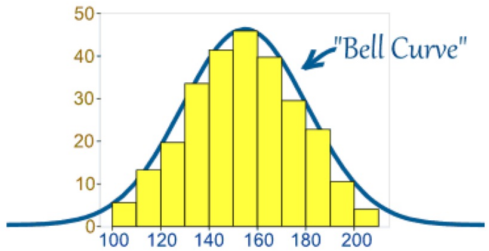
...or more to the left.



Or it can be all jumbled up



But there are many cases where the data tends to be around a central value with no bias left or right.



A Normal Distribution

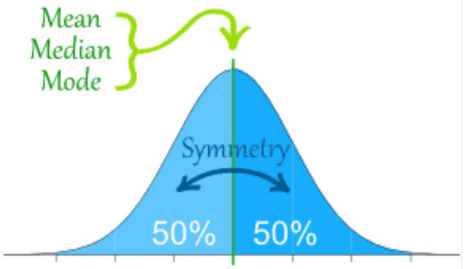
If you collect enough data, many things closely follow a Normal Distribution:

- heights of people
- size of things produced by machines
- errors in measurements
- blood pressure
- marks on a test

We say the data is "normally distributed".

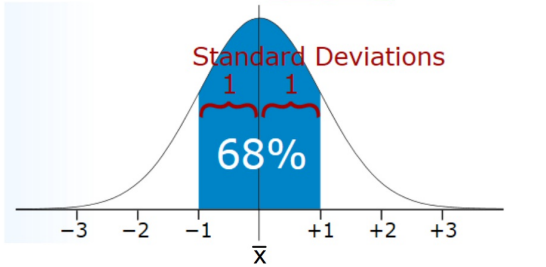
The Normal Distribution has:

- mean = median = mode
- symmetry about the center
- 50% of values less than the mean and 50% greater than the mean

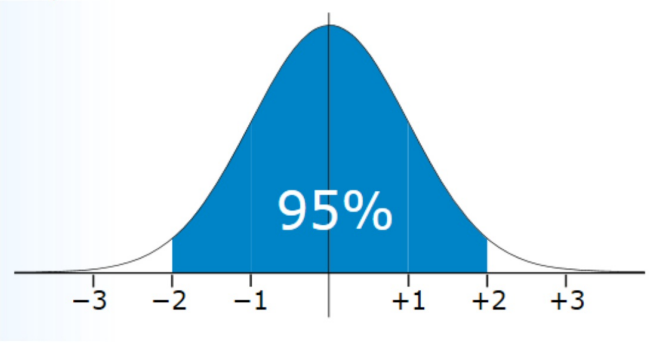


The 68-95-100 Rule
For Normal Distributions

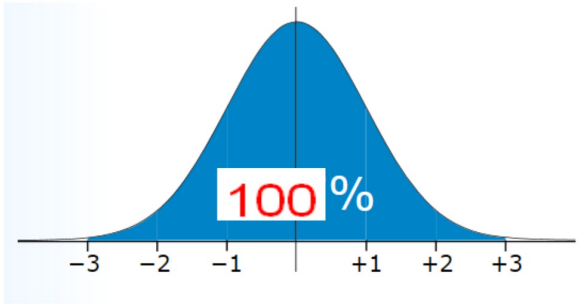
Approximately 68% of the observations fall within 1 standard deviation of the mean



Approximately 95% of the observations fall within 2 standard deviations of the mean



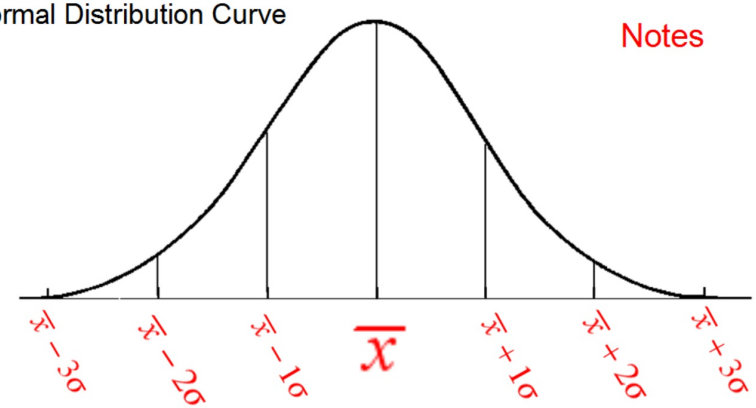
Approximately 100 % of the observations fall within 3 standard deviations of the mean

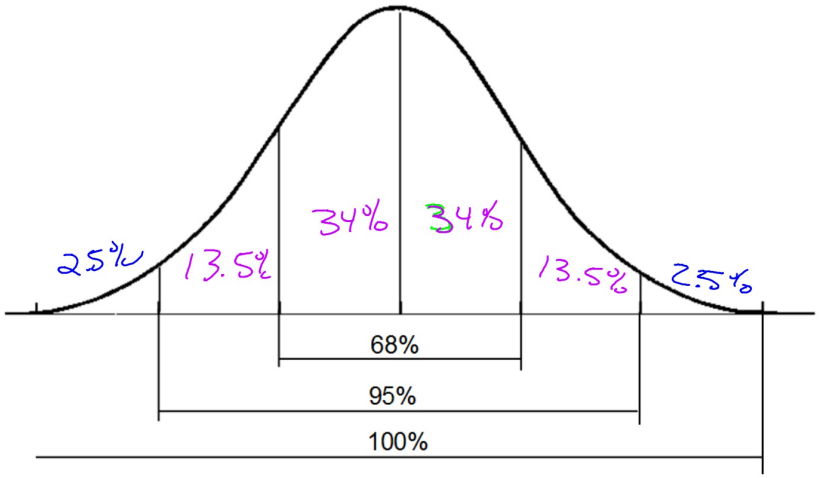


http://www.mathsisfun.com/data/standard-normal-distribution-table.html

Normal Distribution Curve

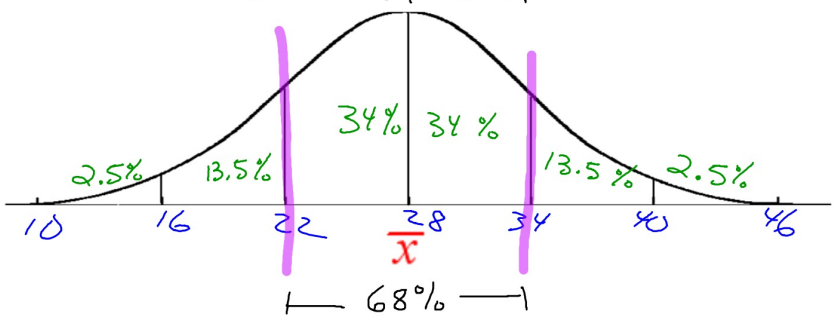
Notes





An employer surveyed its employees about commuting time to work. The mean commuting time was 28 minutes with a standard deviation of 6 minutes.

1. Within what range of times do 68% of the workers spend time commuting? 22 to 34 min



2. Within what range of times do 95% of the workers spend time commuting? 16 to 40 min

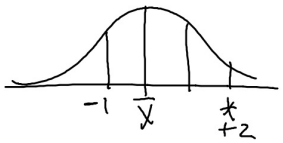
3. What % of workers spend between 10 and 22 minutes commuting? 16%

4. What % of workers spend between 28 and 40 minutes commuting? 47.5%

5. What % of workers spend between 22 and 46 minutes commuting? 84%

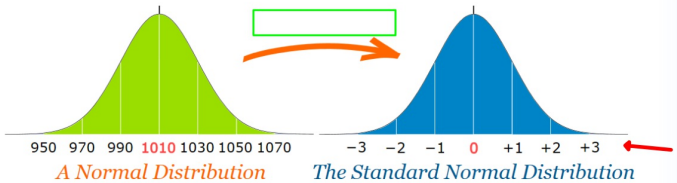
6. What % of workers spend less than 40 minutes commuting? 97.5%

A standardized test had the following statistics:
Mean = 83 Std Dev = 3



1. Your score was 89.
   a. Find your z-score. $\frac{89-83}{3} = 2$
   b. What % of the scores were less than yours? 97.5%

2. Your score was 80.
   a. Find your z-score. $\frac{80-83}{3} = -1$
   b. What % of the scores were better than yours? 84%



We can take any Normal Distribution and convert it to The Standard Normal Distribution.

So to convert a value to a Standard Score ("z-score"):

- first subtract the mean,
- then divide by the Standard Deviation

And doing that is called "Standardizing":

these #'s represent the number of standard deviations above and below the mean… z-score

A cereal manufacturer samples some boxes of cereal which are supposed to weight 16 ounces.
The mean weight of the boxes sampled was 15 with a standard deviation of 1

1. What % of the boxes weighed less than 17 ounces? 97.5%
2. What interval contained 95% of the boxes? 13 to 17
   withing 2 standard devations
3. What % of the boxes contained from 13 to 15 ounces? 47.5%
4. A box is rejected if it is more than 2 ounces from the advertised weight. What % of the boxes were rejected.

A box won't be rejected if it is anywhere from 14 to 18 ounces (16±2). This means anything less than 14 ounces will be rejected which is 16% of all the boxes.