Normal Distribution

Presentation By
Dr Chitra Pandya
Under Guidance of
Dr Utkarsh Shah

- https://www.youtube.com/watch?v=4HpvBZnHOVI
- What was that???
- Would this shape be formed if I changed the pattern of the pegs?

Lecture Format

- Brief over view of Mean, Standard Deviation
- Distribution of Data
- Normal Distribution: Characteristics
- Normal Probabilities
- Standard Normal Distribution
- Central Limit Theorem

Mean

- Weight (in kg) of 9 children

3
5
5
7
7
7
9
9
11

Mean = Sum of weight of all 66 children/ Total number of Children

=63/9

=7

Mean Deviation and Standard Deviation

- Mean Deviation = Average of deviations form arithmetic mean = 16/9 = 1.7
- Standard Deviation = 2.5

Root

Mean

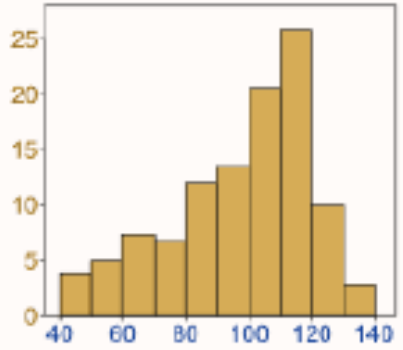
Square

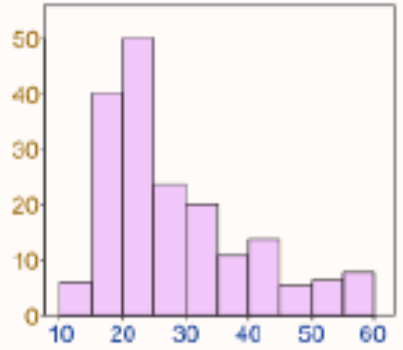
Deviation

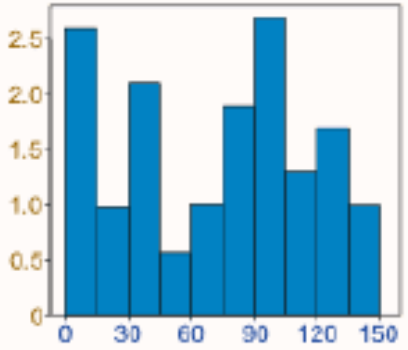
	Weight(x)	Mean(u)	Deviation= x-u	Deviation Square
	3	7	-4	16
	5	7	-2	4
	5	7	-2	4
	7	7	0	0
	7	7	0	0
	7	7	0	0
	9	7	2	4
	9	7	2	4
	11	7	4	16
Total	63		0(16)	48

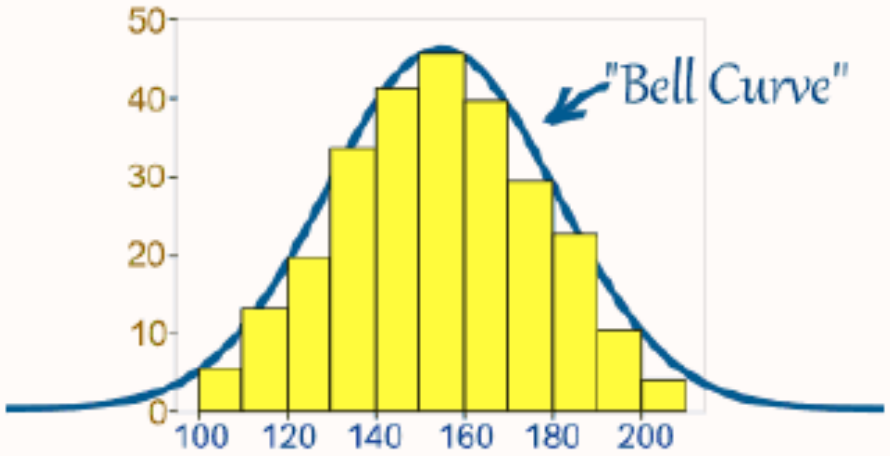
Data Distribution

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



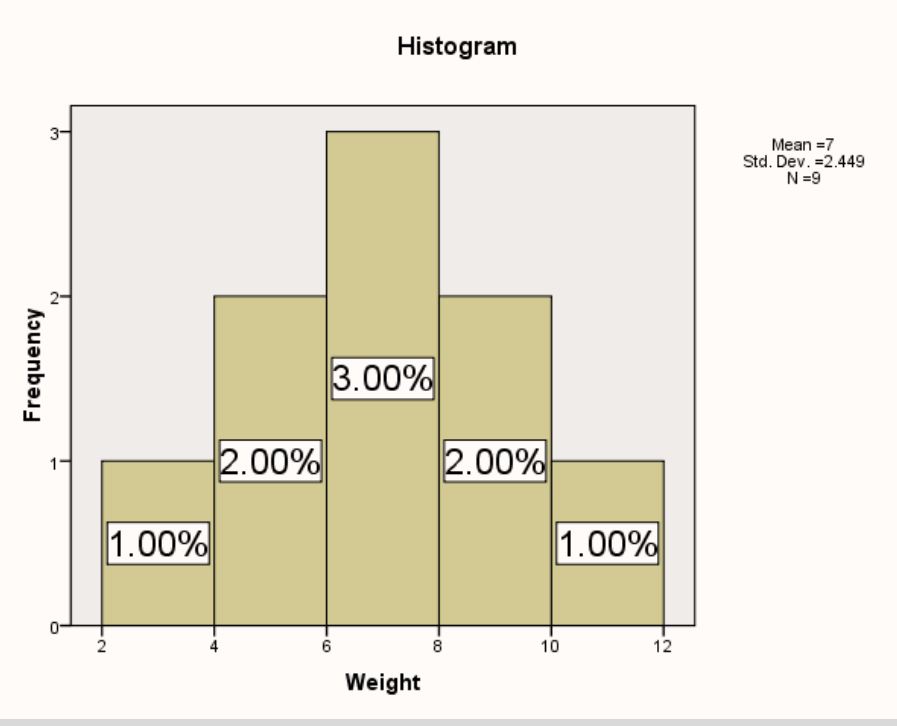


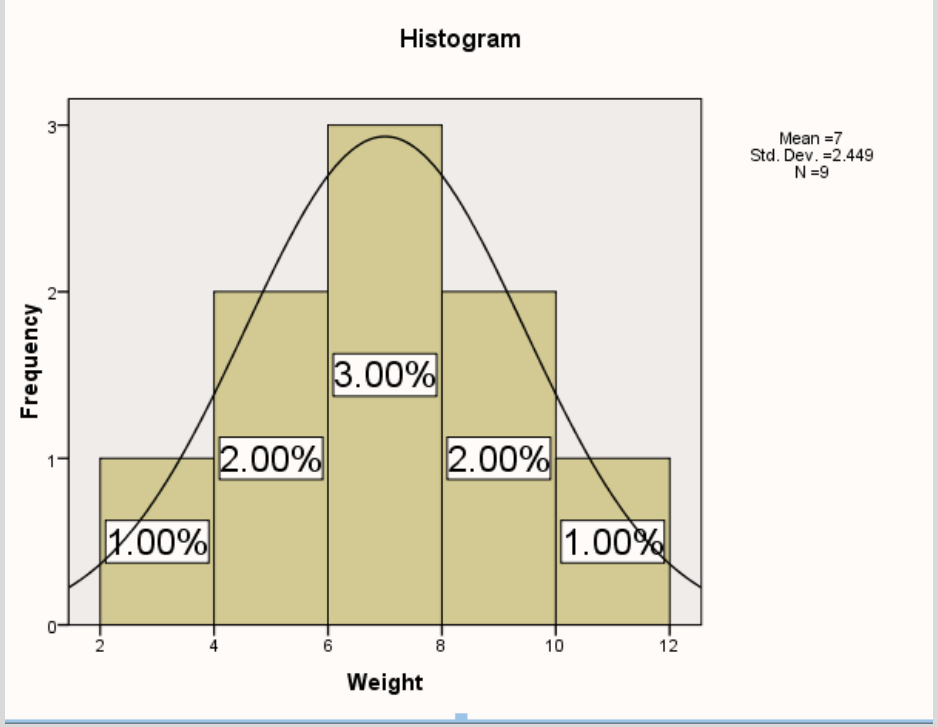




Normal Distribution/ Gaussian Distribution

- Nothing “Normal” about it!!
- One of the most important distributions is the Normal Distribution
- When a set of continuous data forms a bell shaped curve when plotted in a histogram

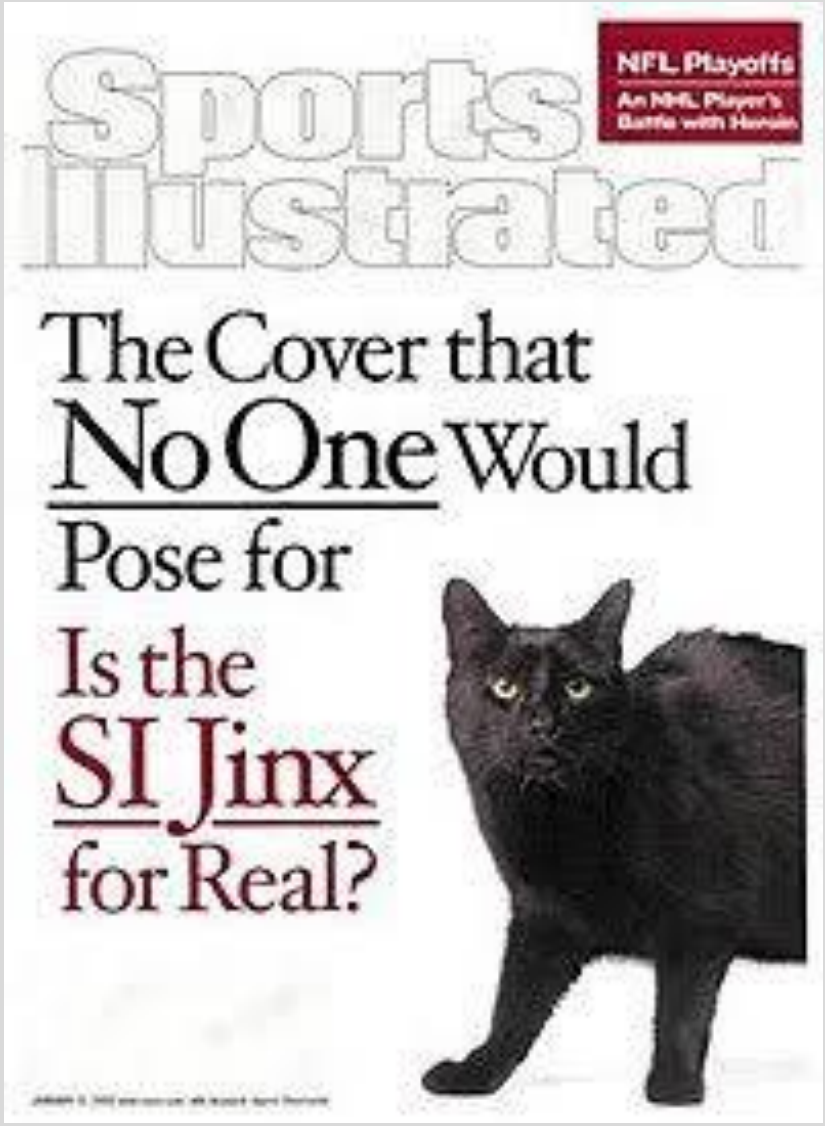




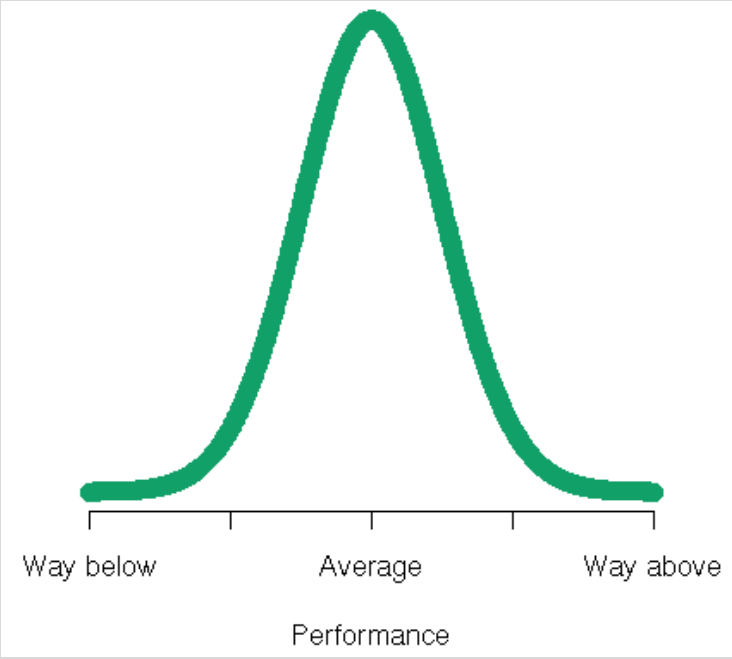
- Many Biometric measures follow ND for large sample sizes

  Eg. Adult Height, Hemoglobin, Weight, Systolic Blood

- But why?????

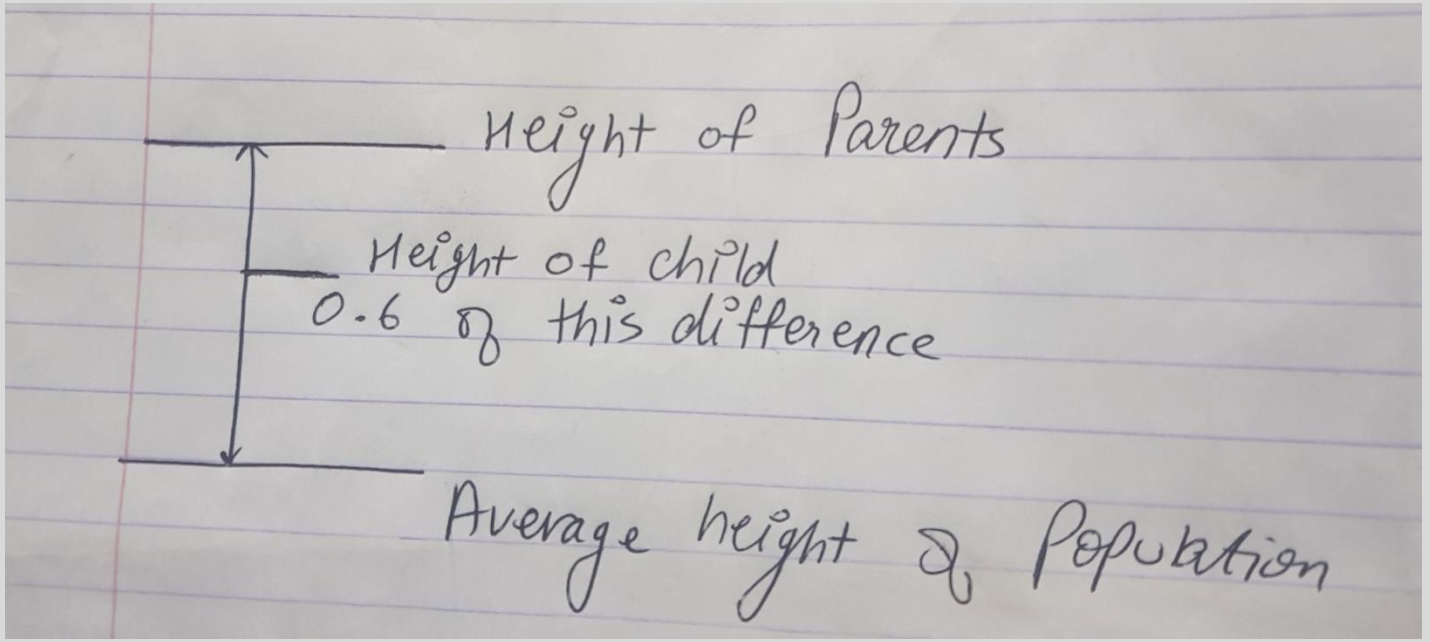

Sports Illustrated
NFL Playoffs
An NHL Player's Battle with Heroin
The Cover that No One Would Pose for
Is the SI Jinx for Real?

- Reason for Normal Distribution in Nature →Biological parameters regress towards the mean
- **The *Sports Illustrated* curse and regression to the mean :** Showing of an athlete on the front cover of that magazine applies a sort of black magic to that athlete's capabilities, and that he will soon perform badly, or not up to expectations.



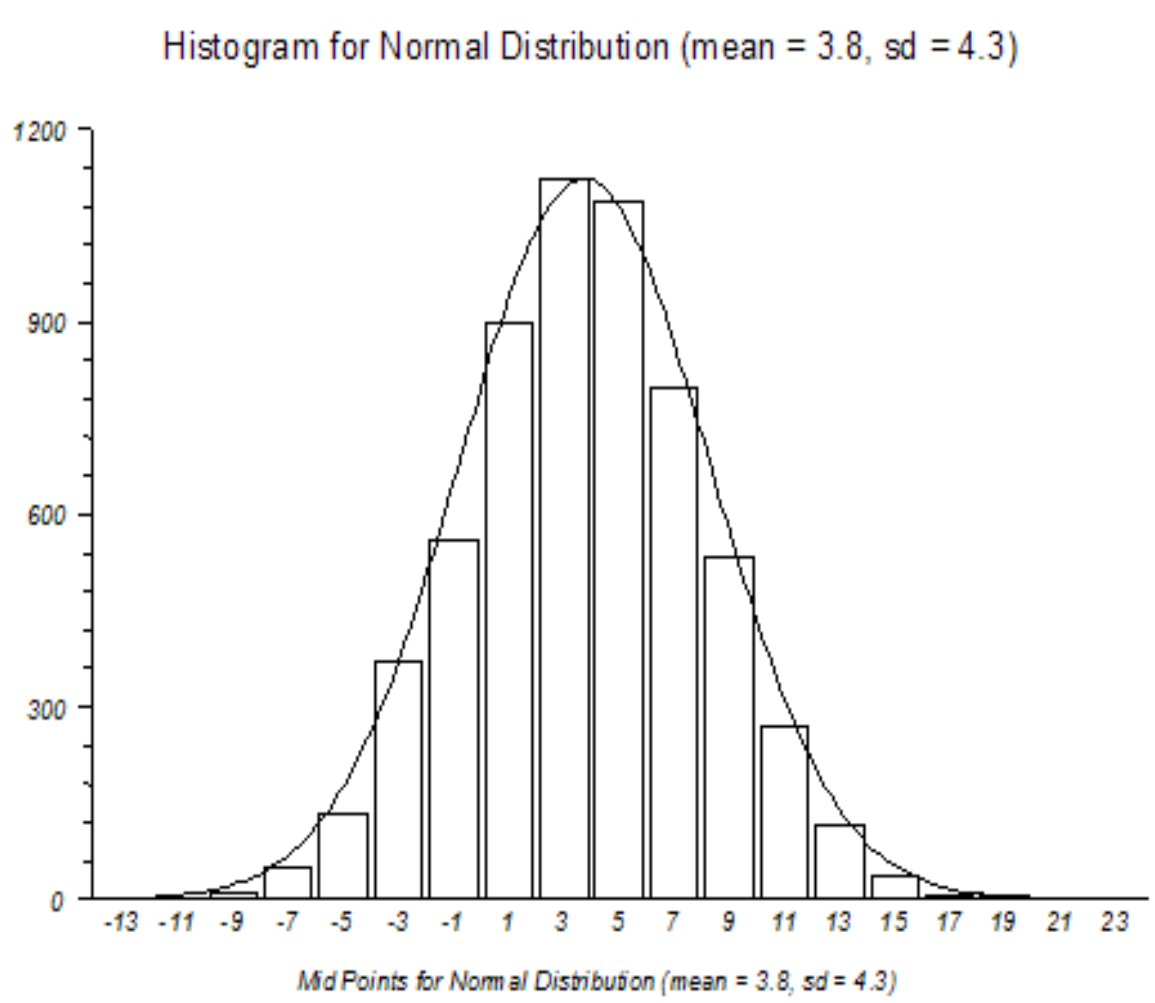
Just for Fun! You can check for yourself if its true!!!!!!

Height of Child = More than average height of population by 0.6 times the difference between the average height of parents and the average height of the population!!!!

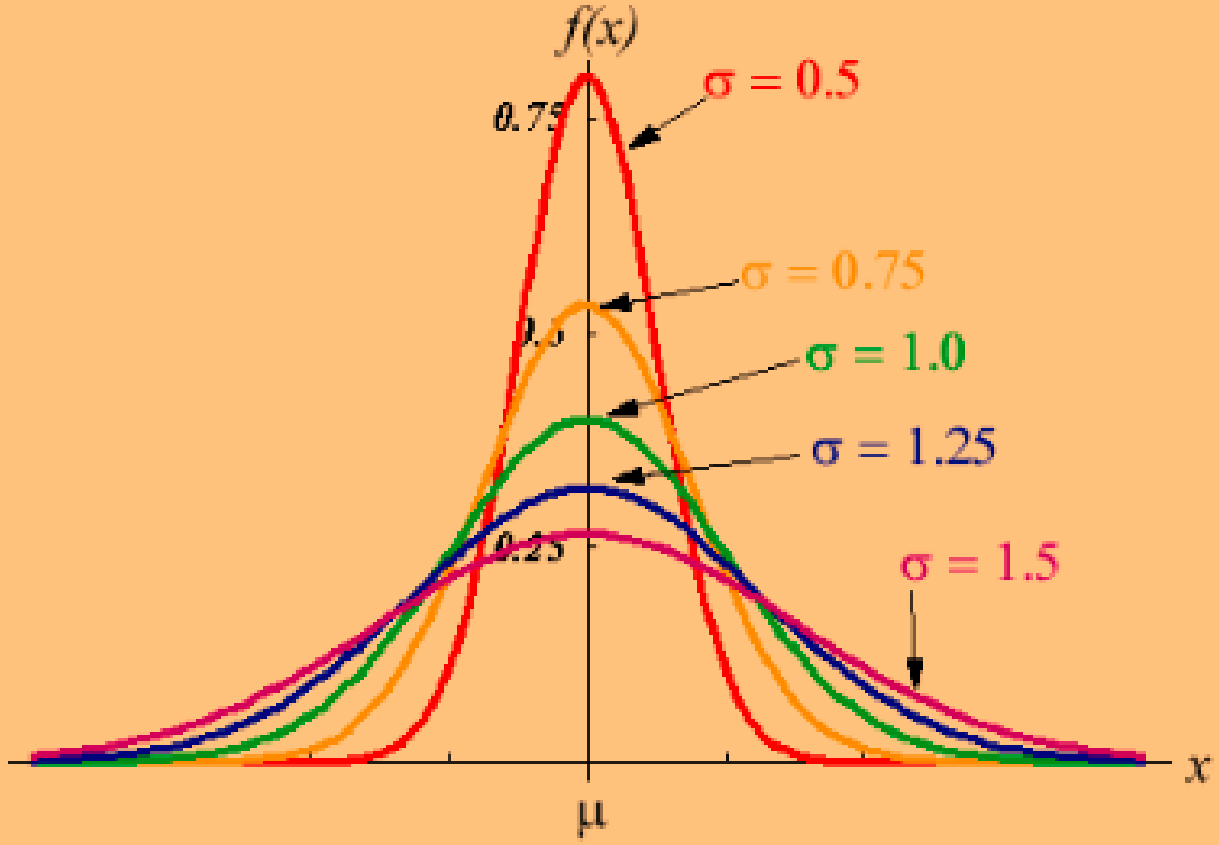


Characteristics of a Normal Curve

- Bell Shaped Symmetric Curve
- Mean=Median=Mode



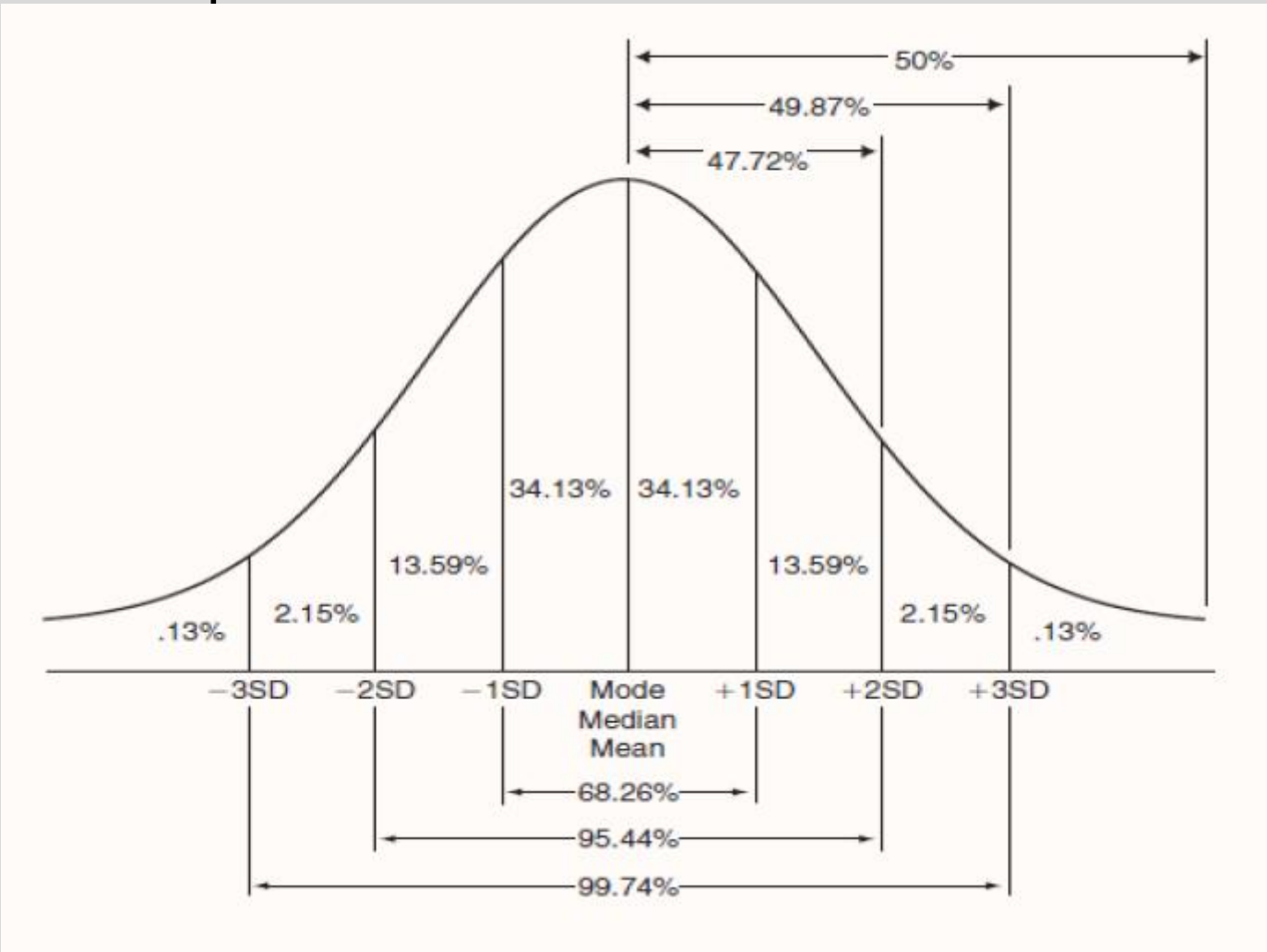
- Unimodal (One mode, One peak)
- Completely defined by 2 statistics: Mean and Standard Distribution
  - Curve on one side is mirror image of the other side
  - Highest frequency is in middle around the mean; Smoothly decreases on either sides; Lowest frequency at the extremes
  - Total area under ND curve = 1 or 100%



The symmetric, unimodal form of a normal distribution makes both the mode and median equal to the mean. As you see in the diagram, the smaller the value of σ, the more the data cluster about the mean, so the narrower the bell shape. Larger values of σ correspond to more dispersion and a wider bell shape.

Normal Probabilities

- https://www.youtube.com/watch?v=6YDHBFVIvIs
- So how can we know the probabilities?



Confidence Limits

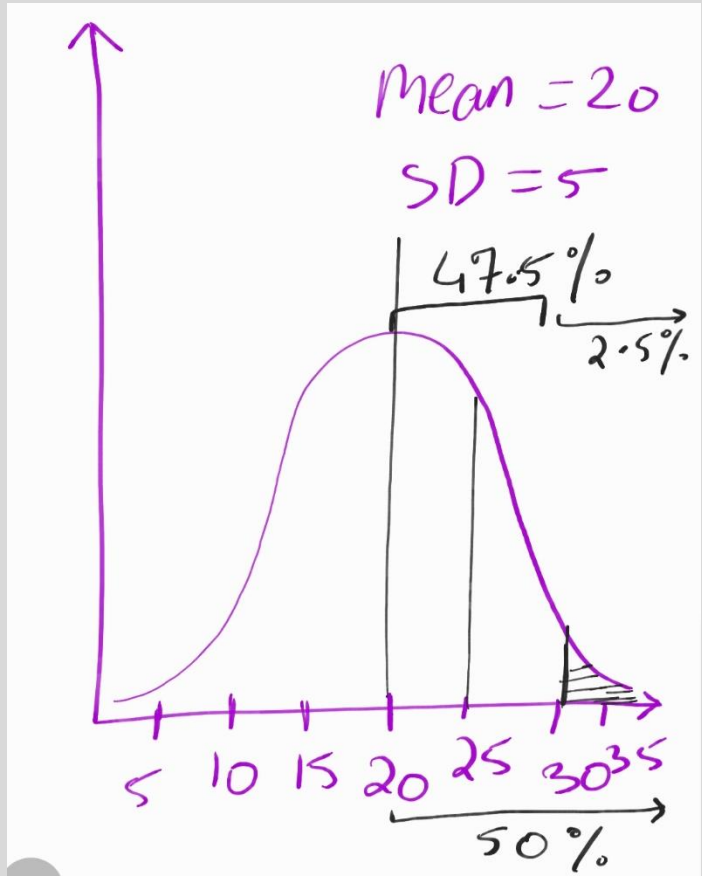
- Mean ± 1SD → 68% of the values in the distribution (34% on one side)
- Mean + 2SD → 95% of the values in the distribution (47.5% on one side)
- Mean + 3SD → 99.7% of the values in the distribution (49.85% on one side)

Q. Given Mean weight= 20kg, SD= 5kg

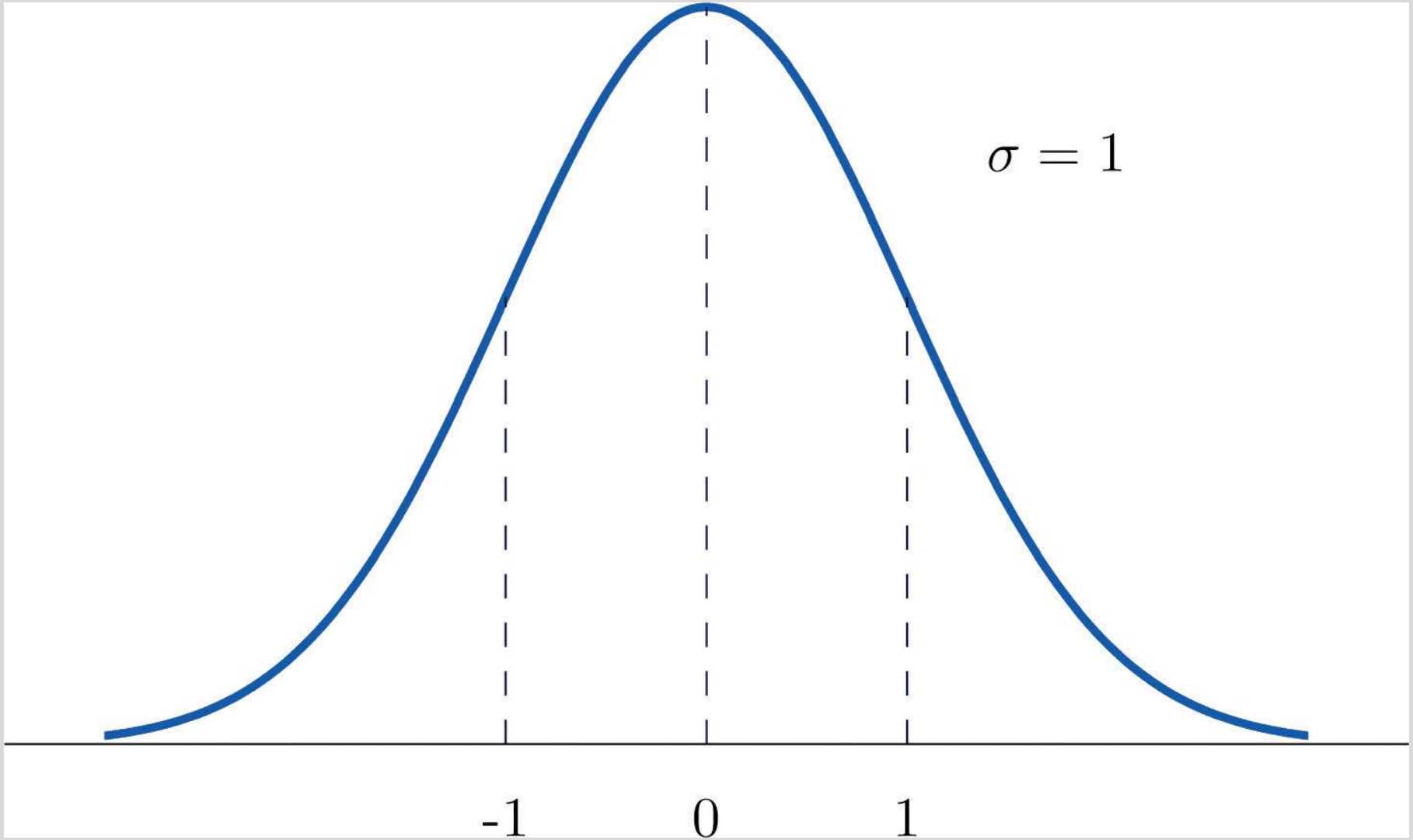
What are the chances that the weight of 1 child will be:

-more than 30kg?

-more than 27.5 kg?



- Normal Curve with Mean=0, SD=1

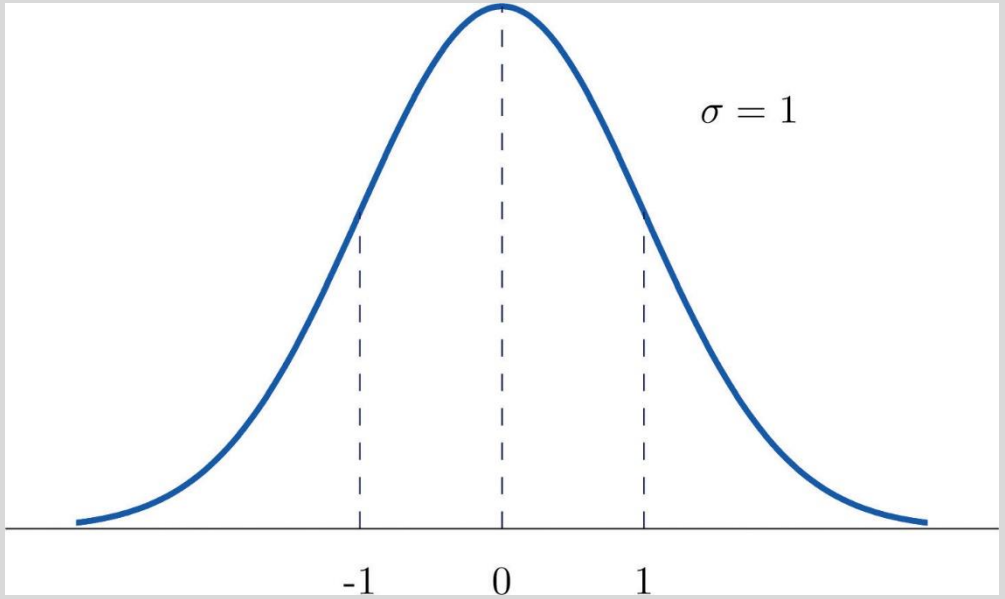


Standard Normal Distribution

- There is only one standardized normal curve
- Based on infinitely large number of observations
- Standard normal variate/Normalized variable (Z) = (x-u)/S.D.
- Z values also follow ND with mean=0, SD=1

Areas of the standard normal curve with mean 0 and standard deviation 1

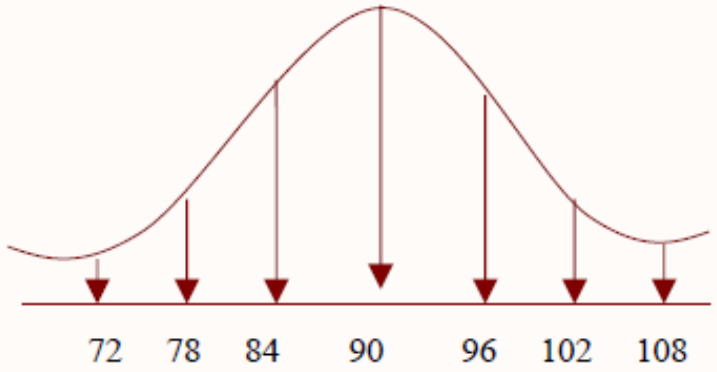
Relative deviate (z) $\frac{(x-\bar{x})}{\sigma}$	Proportion of area from middle of the curve of designated deviation
0.00	.0000
0.50	.1915
1.00	.3413
1.50	.4332
2.00	.4772
3.00	.4987
4.00	.49997
5.00	.4999998



All of the Infinite Normal Curves can be converted to a Standard Normal Curve

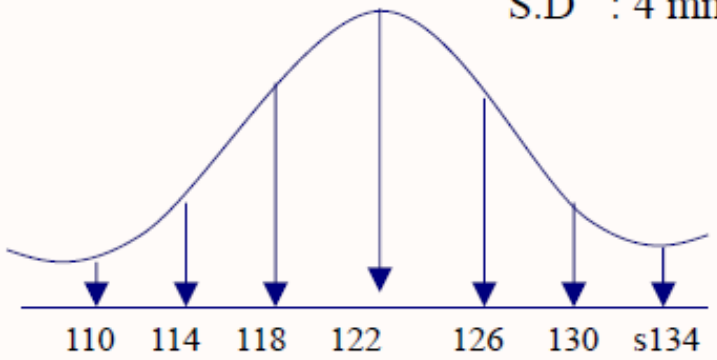
Transforming a Normal Variate to a Standard Normal Variate

Blood Glucose
Mean: 90 mg/dL
S.D : 6 mg/dL



Blood glucose (mg/dL)

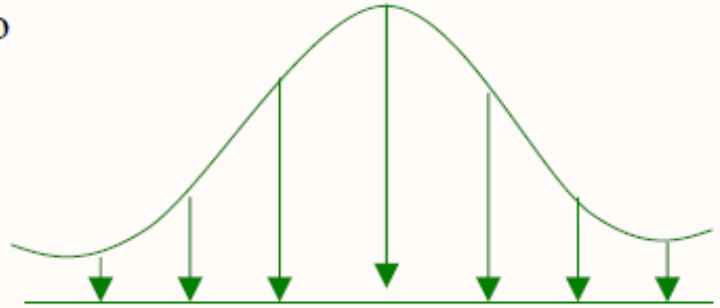
Systolic BP
Mean: 122 mmHg
S.D : 4 mmHg



Systolic BP (mmHg)

$$Z = \frac{(x_i - mean)}{S.D}$$

But they can be reduced to Std. Normal distn.



Standard Normal distribution

Mean= 0 S.D = 1

Practice

Central Limit Theorem

- https://www.youtube.com/watch?v=jvoxEYmQHNM
- The distribution of averages approaches Normal distribution
- Even when distribution from which the average was computed is not normal
- Its mean will approach the mean of the parent distribution
- As the sample size increases

Keep Calm
and be
Normally Distributed!