All the Stuff You Need To Know

Dr. Chelsea Parlett-Pelleriti

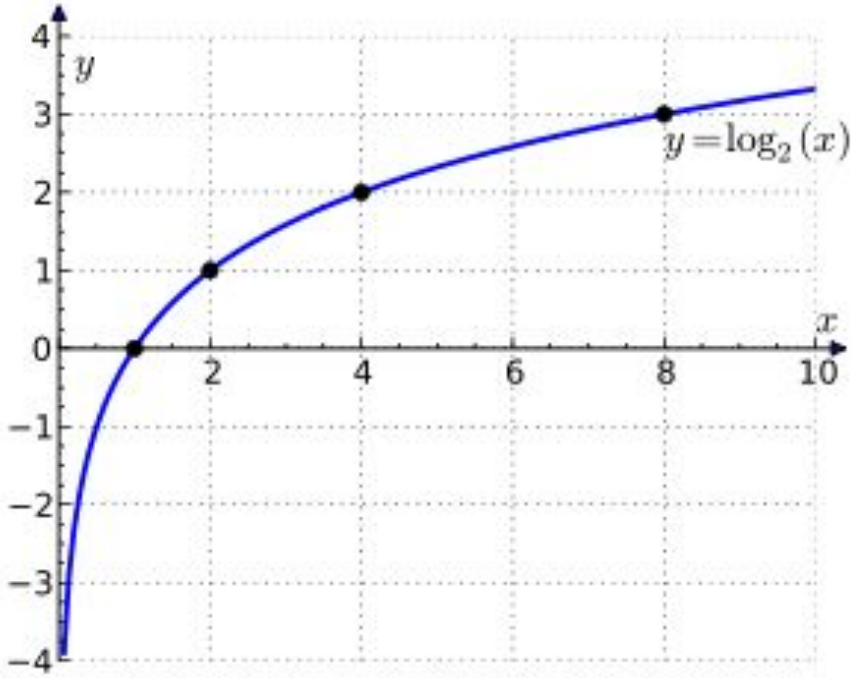

Welcome!
Everything is fine.

Mean, Median, Mode

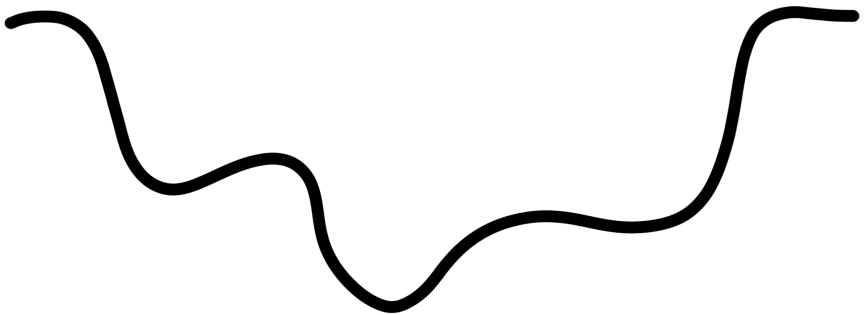
Standard Deviation, Standard Error

Logarithms

Log rules:

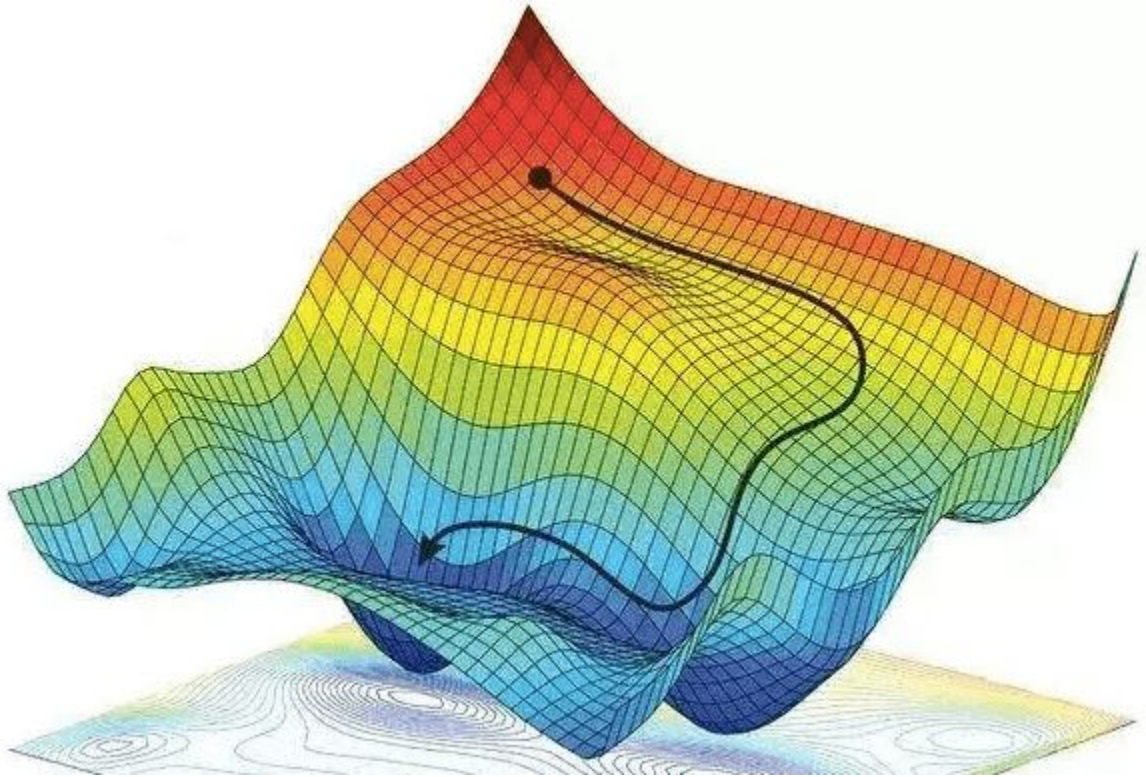


Derivatives

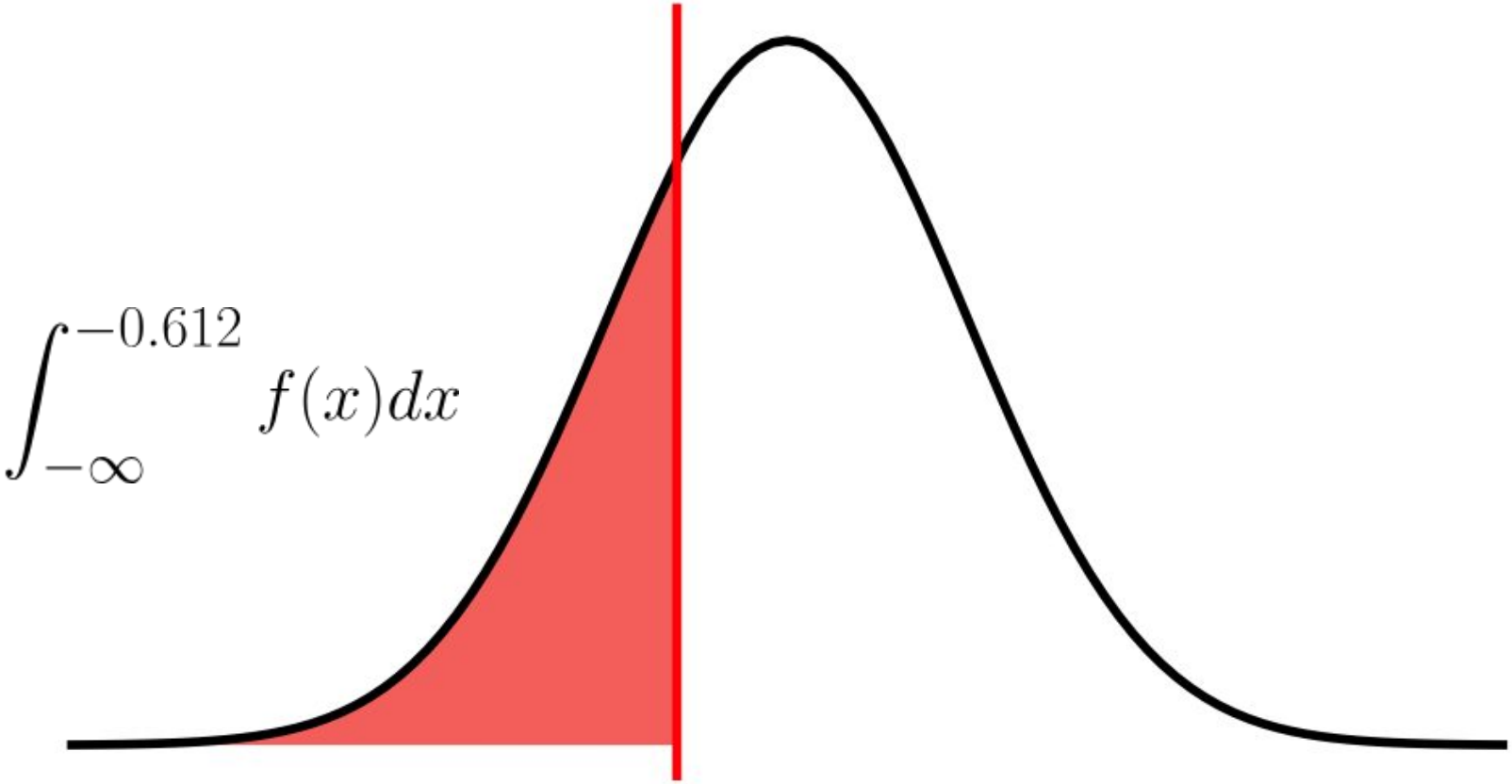


Second Derivatives

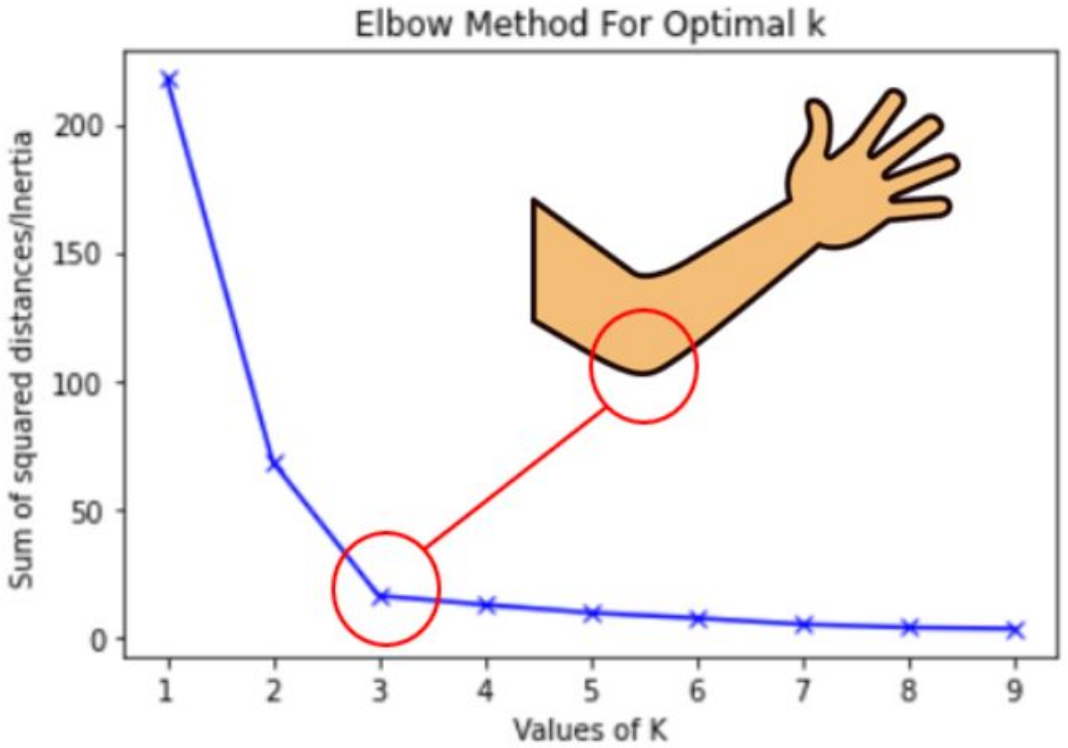
Partial Derivative



Integrals



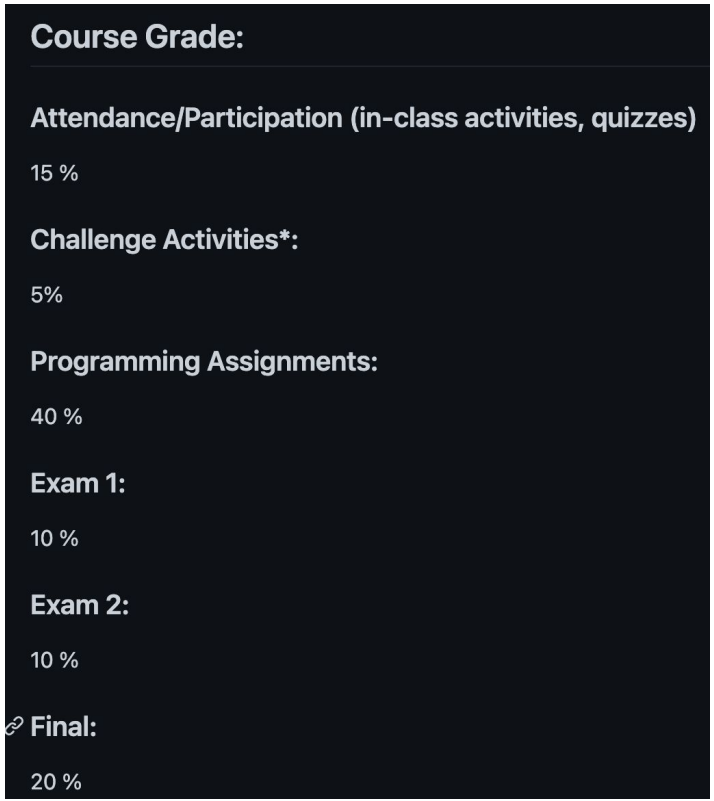
Elbow Method



Line plot between K and inertia

Linear Combinations

Example:



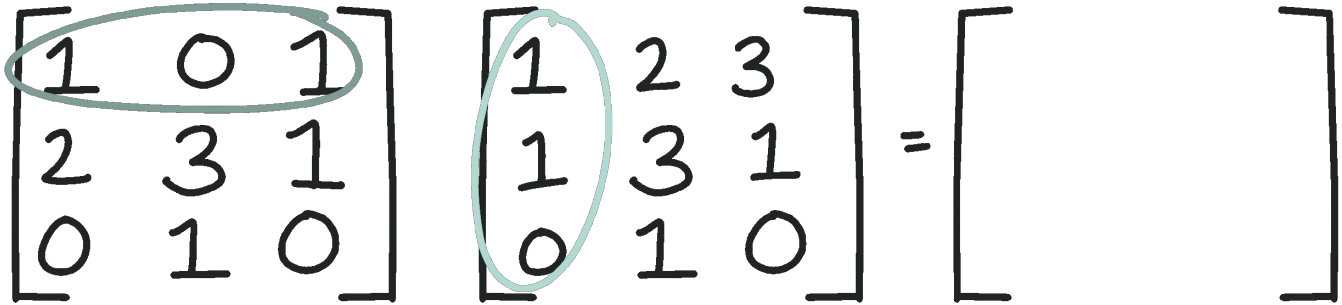
Linear Combinations

Generally:

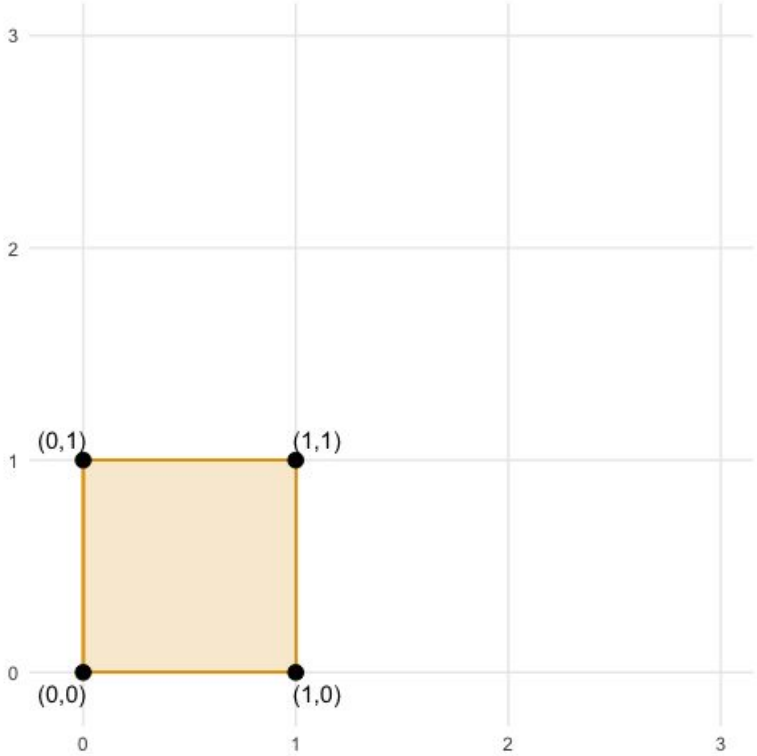
$$\sum_{i=0}^{n} w_i * x_i$$

Matrices and Vectors

- Data as a Matrix/Vector (it’s just an excel spreadsheet)
- Matrix Algebra

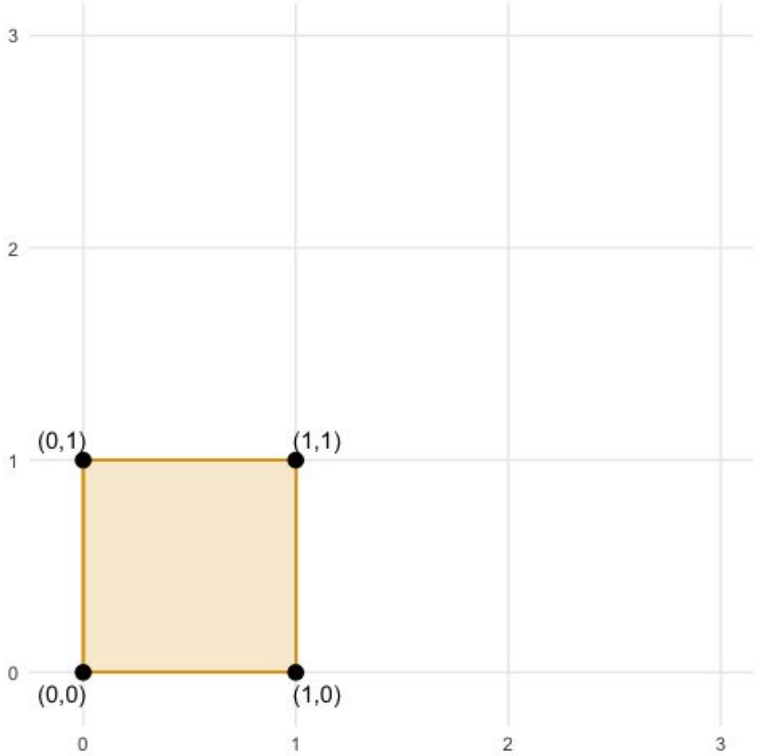


Eigendecomposition



Eigendecomposition

$$\begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$$



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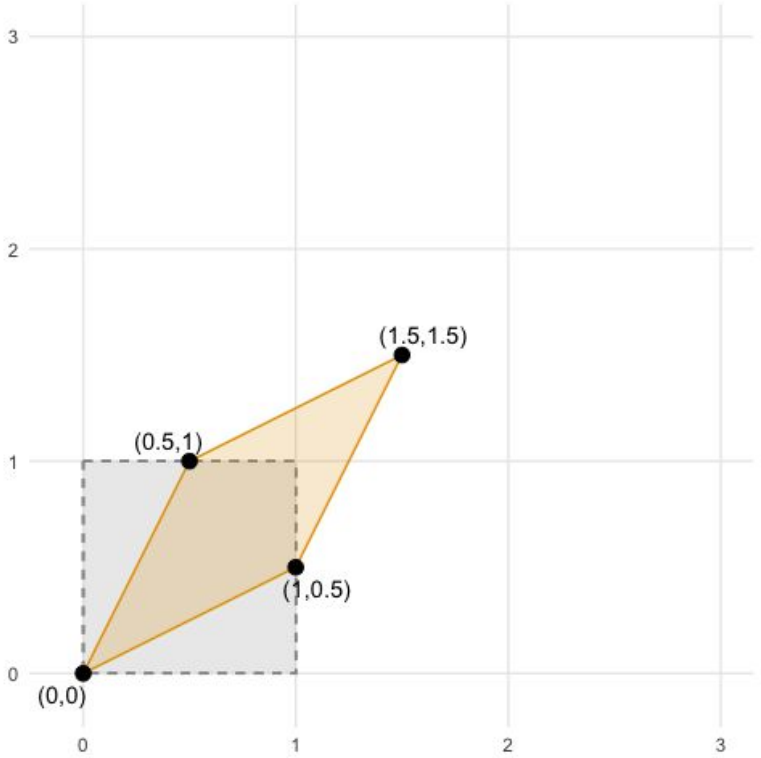

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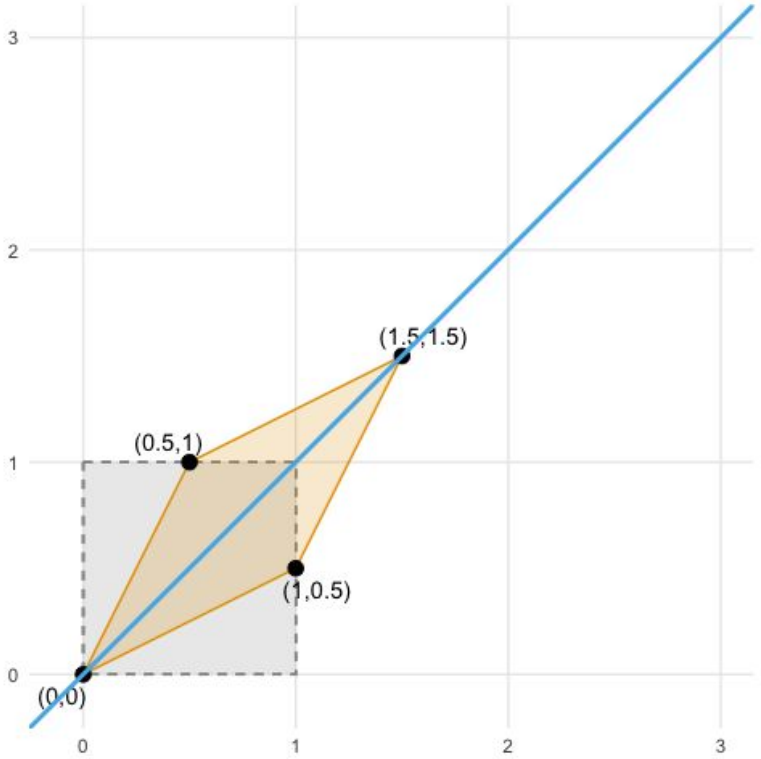

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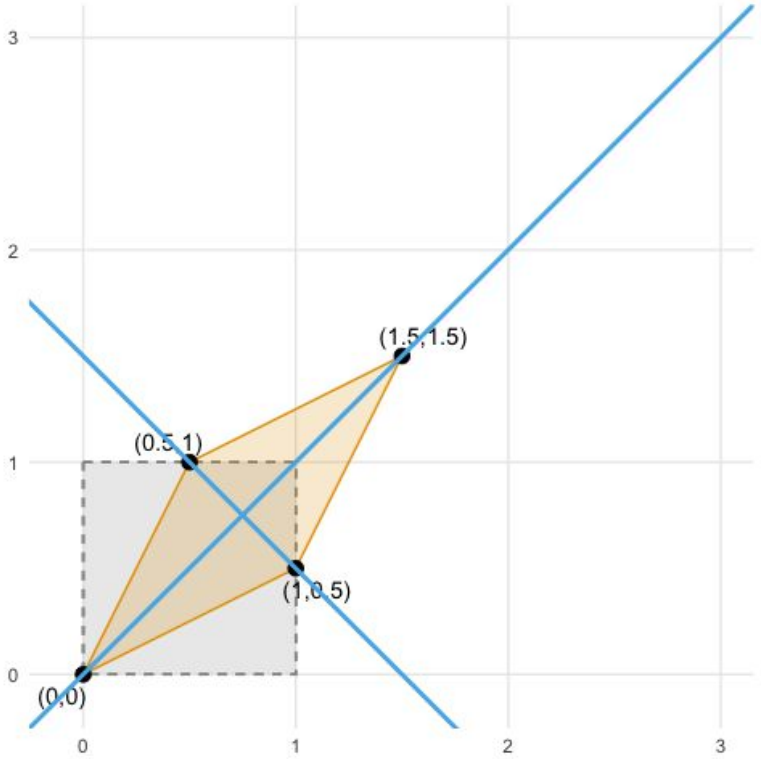


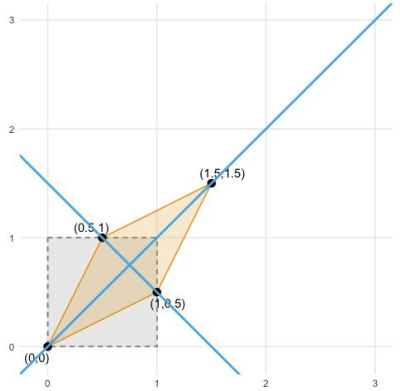
Eigendecomposition

1. What are the directions of stretch and squish?

2. How much do we stretch and squish?

Eigendecomposition

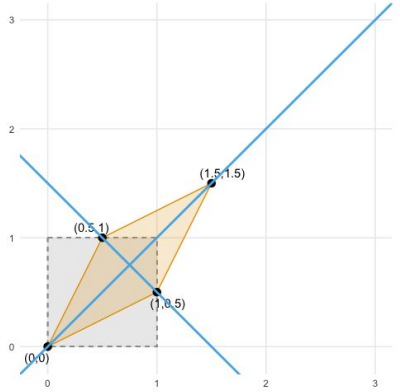
$$\begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix} \quad Ax = \lambda x$$



$$|A - \lambda I| = 0$$

Eigendecomposition

$$\begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix} Ax = \lambda x$$



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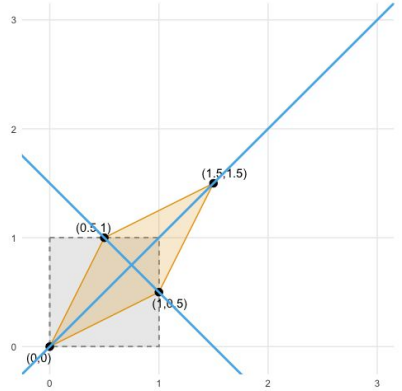
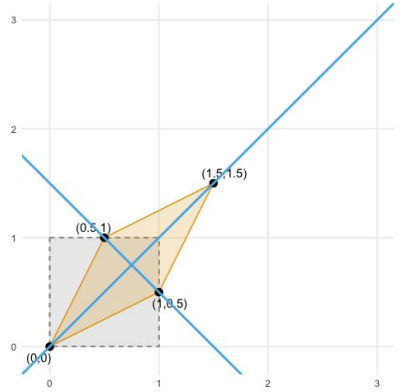


$$\begin{bmatrix} 1-\lambda & 0.5 \\ 0.5 & 1-\lambda \end{bmatrix}$$

$$(1-\lambda)(1-\lambda) - (0.5)(0.5)$$

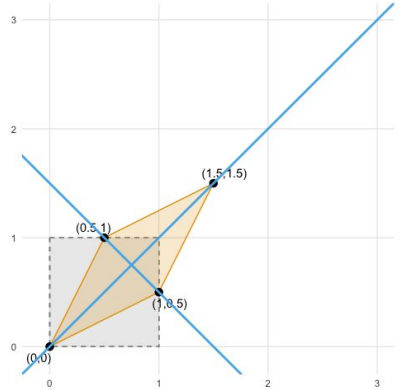
$$|A - \lambda I| = 0$$

$$\begin{bmatrix} 1-\lambda & 0.5 \\ 0.5 & 1-\lambda \end{bmatrix}$$



$$(1-\lambda)(1-\lambda) - (0.5)(0.5)$$

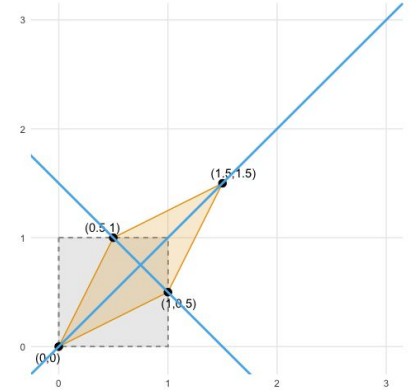
$$\lambda^2 - 2\lambda + 0.75$$



$$(\lambda - 1.5)(\lambda - 0.5)$$

$$\lambda = 1.5, 0.5$$

$$\lambda^2 - 2\lambda + 0.75$$



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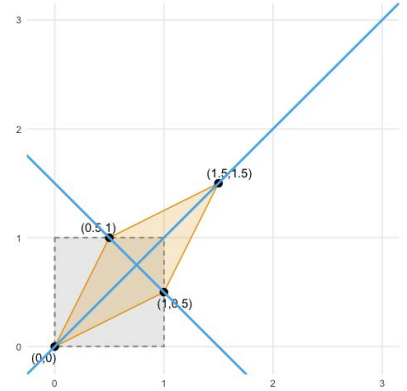

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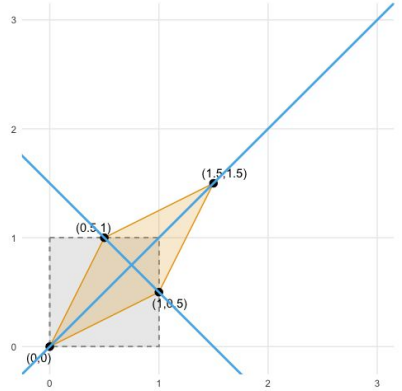


$$\begin{bmatrix} 0.707 \\ 0.707 \end{bmatrix} \quad \begin{bmatrix} -0.707 \\ 0.707 \end{bmatrix}$$

$$\lambda = 1.5, 0.5$$

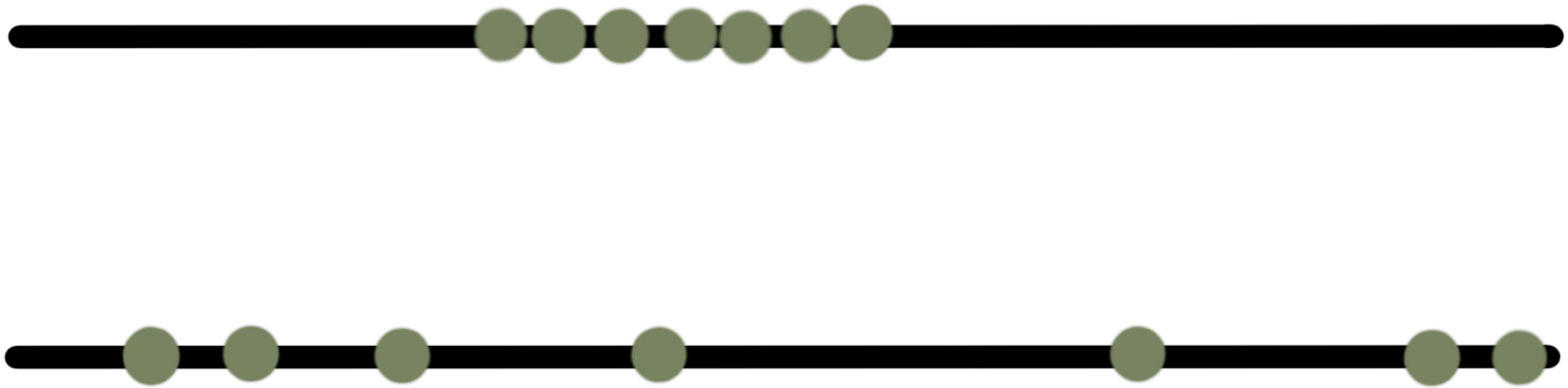
$$\begin{bmatrix} 1-\lambda & 0.5 \\ 0.5 & 1-\lambda \end{bmatrix}$$

$$\begin{bmatrix} 0.707 \\ 0.707 \end{bmatrix} \begin{bmatrix} -0.707 \\ 0.707 \end{bmatrix}$$

Variance and Covariance

$$\frac{\Sigma(x_i - \mu)^2}{N}$$

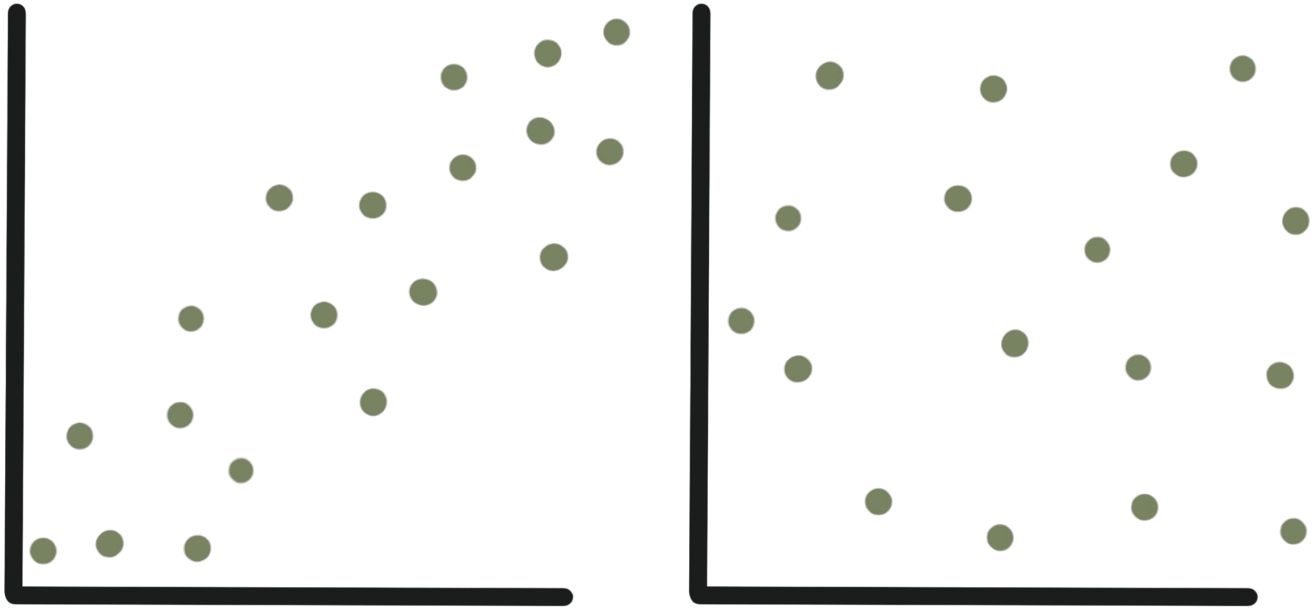
Which has higher variance?



Variance and Covariance

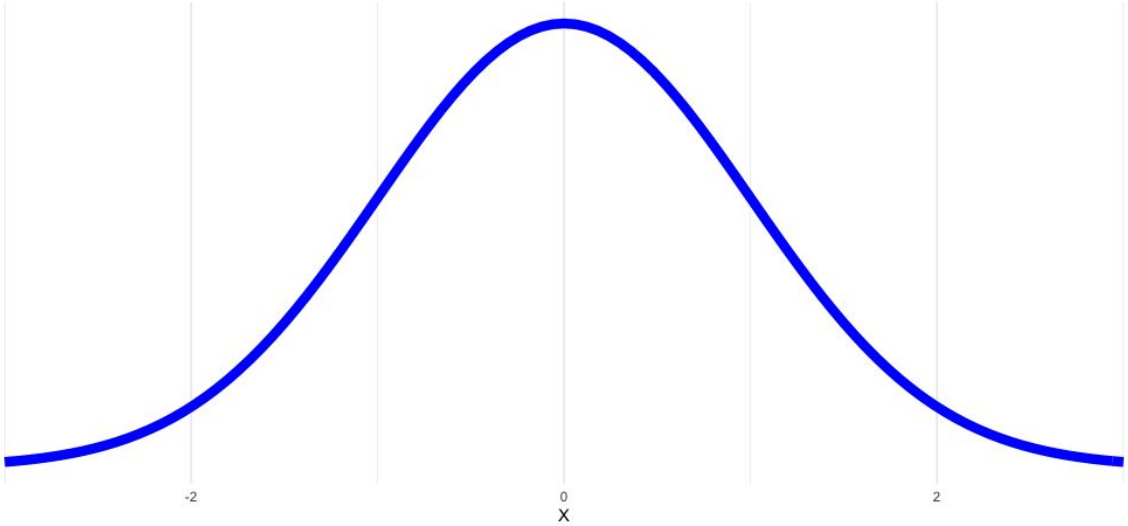
$$\frac{\Sigma(x_i - \mu_x)(y_i - \mu_y)}{N}$$

Which has higher covariance?



Normal Distribution

- Symmetric, Unimodal
- “Bell Curve”
- 68-95-99.7 rule
- CLT



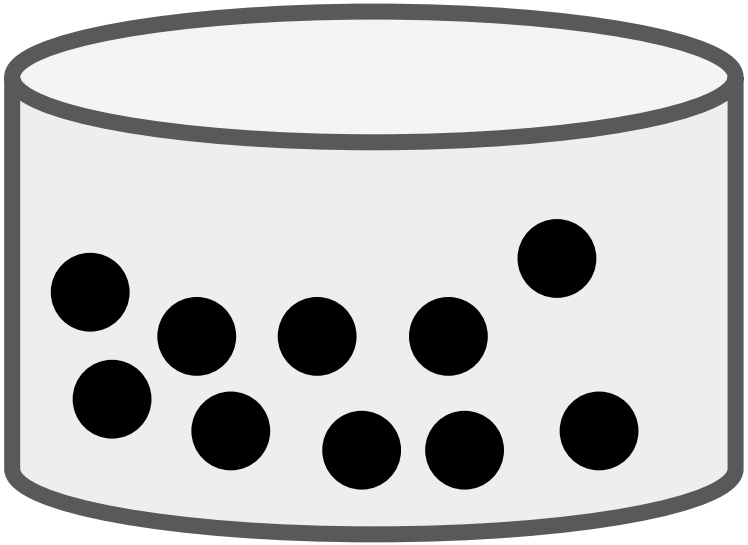
Data Types

- Continuous
- Categorical
  - Nominal
    - Dummy
  - Ordinal
  - Interval
- Boolean
- Text

Entropy

$$H(p) = -\sum_{i}^{N} p(x_i) * log(p(x_i))$$

Measure of surprise



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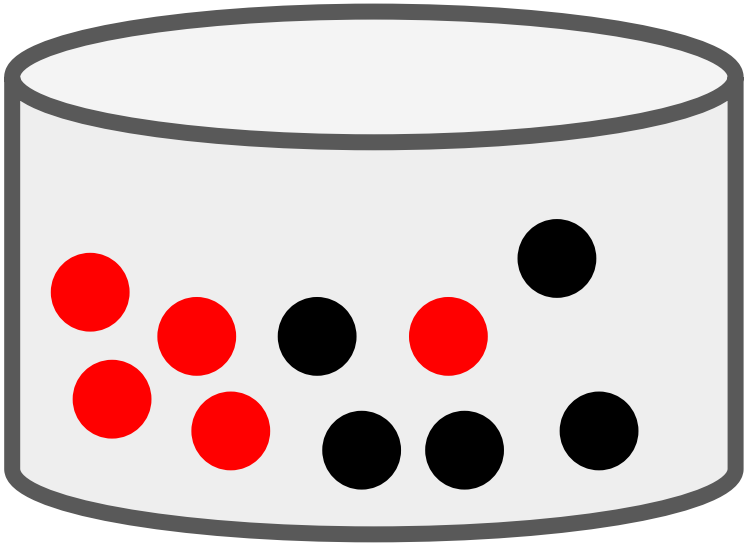
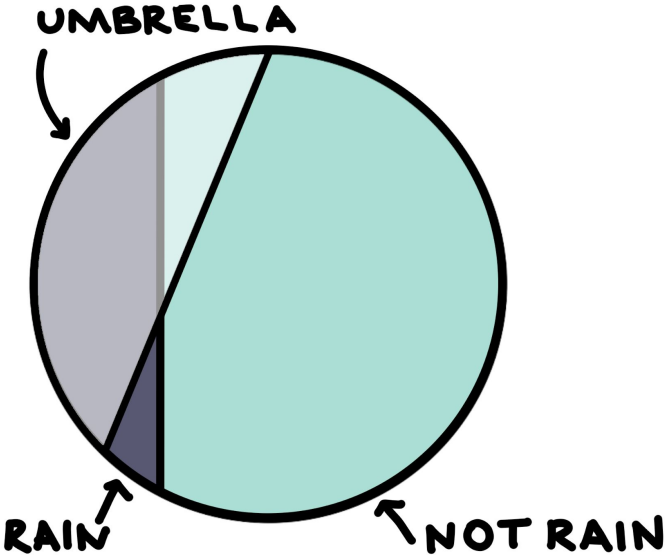
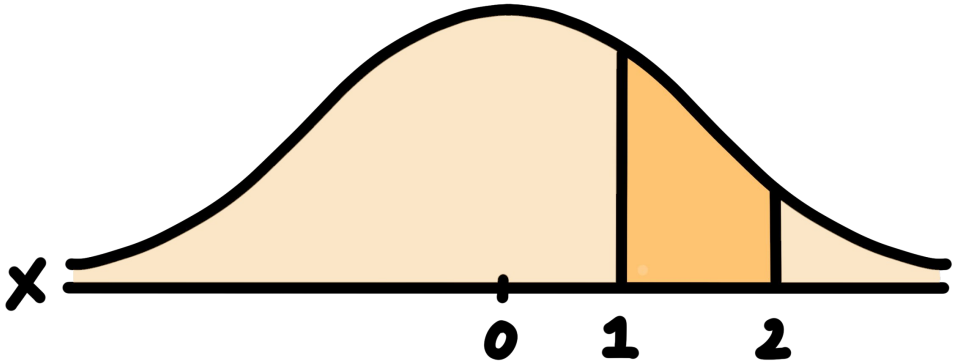


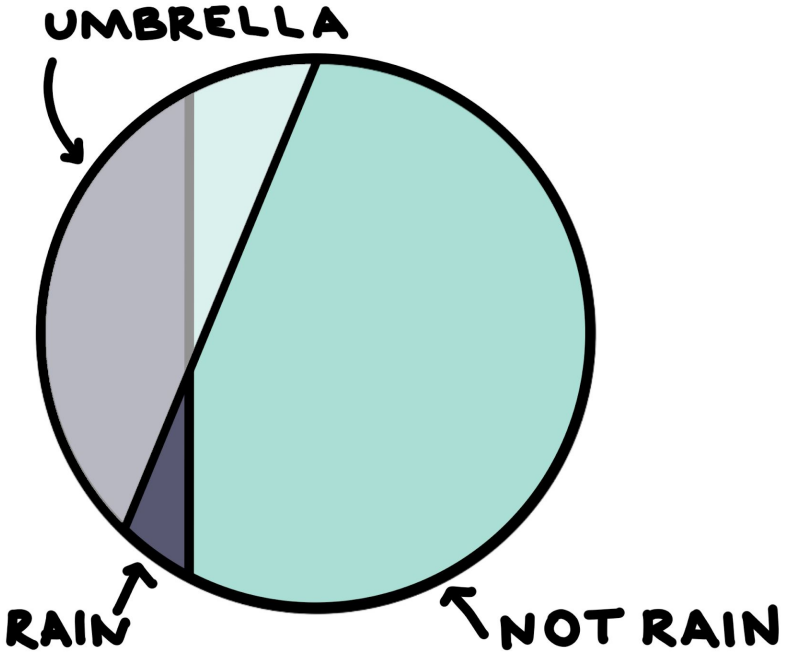
Probability



$$P(1 > x > 2 \mid u = 0, sd = 1)$$



Conditional Probability

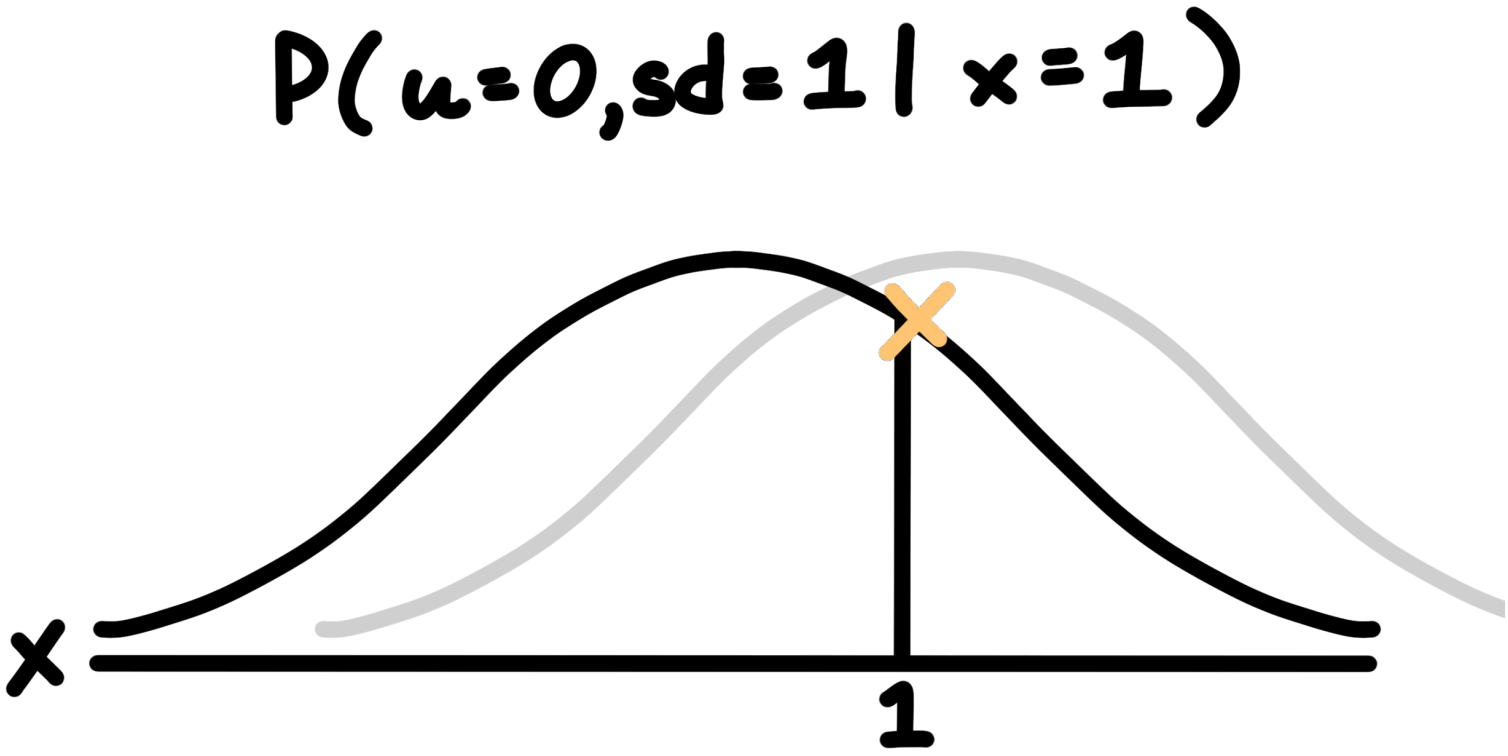


Bayes Rule

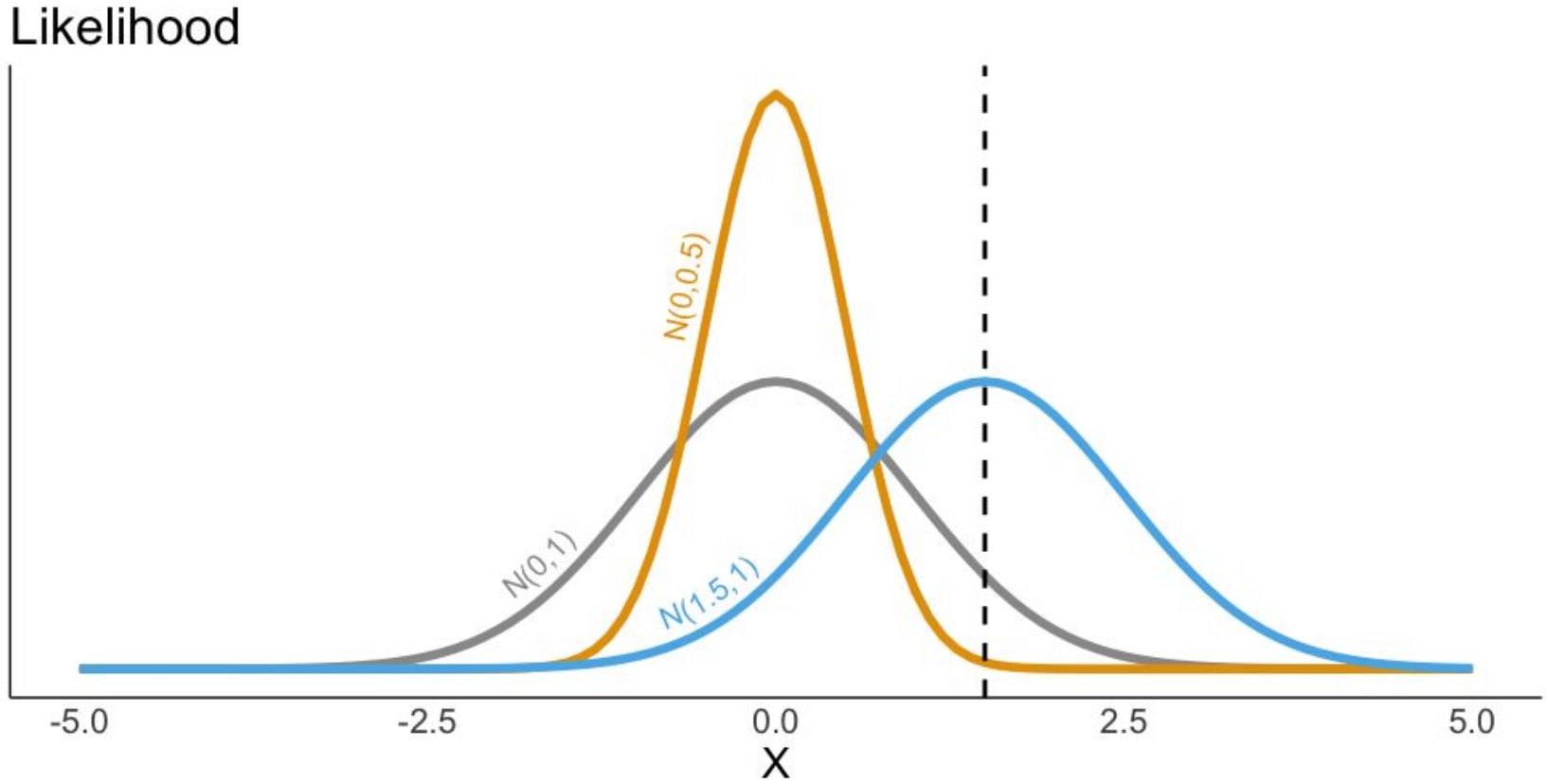
$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)}$$

Covid	+ Test	Count
Yes	*Yes*	40
Yes	*No*	10
No	*Yes*	5
No	*No*	145

Likelihood



Maximum Likelihood Estimation

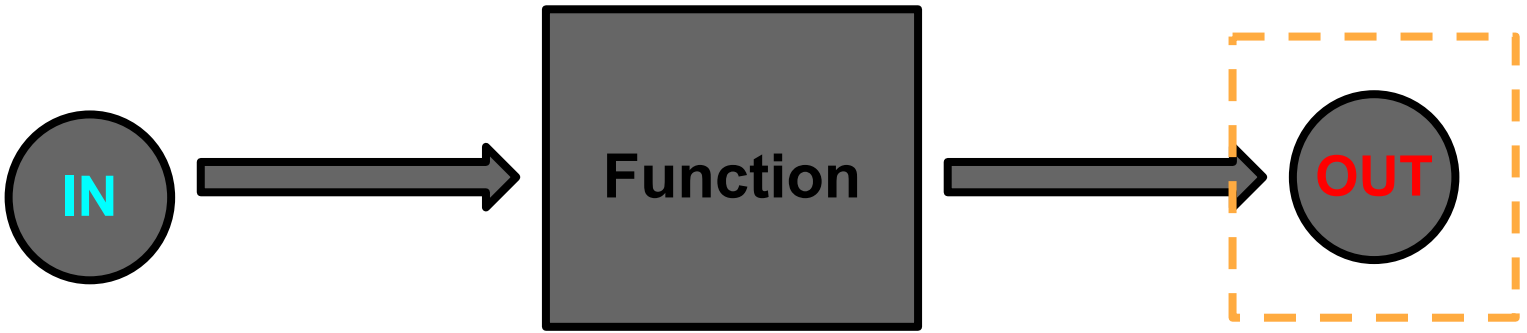


Odds

$$\frac{p}{1-p}$$

Prediction vs. Inference

Prediction



Prediction vs. Inference

Inference