- How are RVs distributed

$= P(X = x \; ; \; \_\_\_\_)$ but this is a problem for continuous RVs.

- Q: What is the $P(H = 5.67296823429695\ldots)$

5.665 5.67 5.674

$H \in \mathbb{R}$

  - Does this question even make sense?
  - Where are we going to use it?
  - Probability is, for all practical purposes 0 $(1/\infty)$

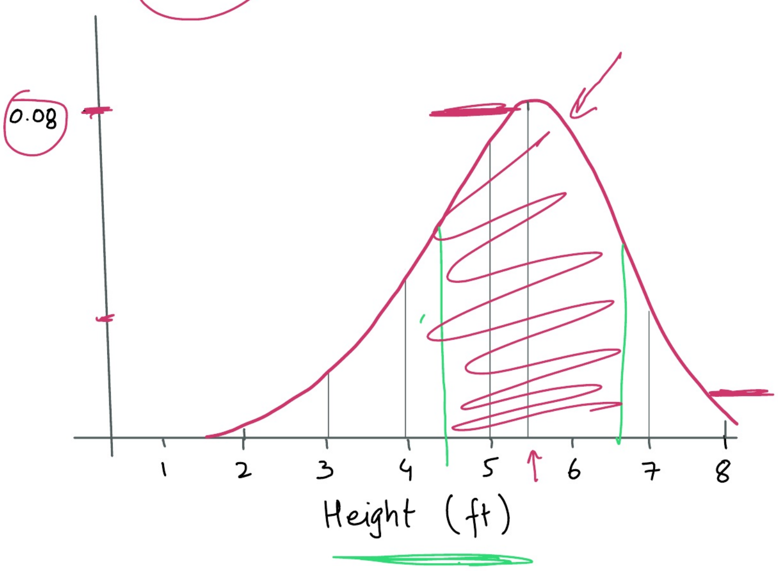
- We want to do analysis, so we are more interested in height being in a specific range.

- We'll use a trick:

Y label here?

Likelihood

Units?



$\int_a^q 5x + 19$

Likelihood denotes the chances that we will get the value of the RV in the "vacinity"

It's a function, which when integrated will give us the probability

- The larger the likelihood, the larger the probability
- The " " range, " " " "

Likelihood $= f(X)$ X is the RV.

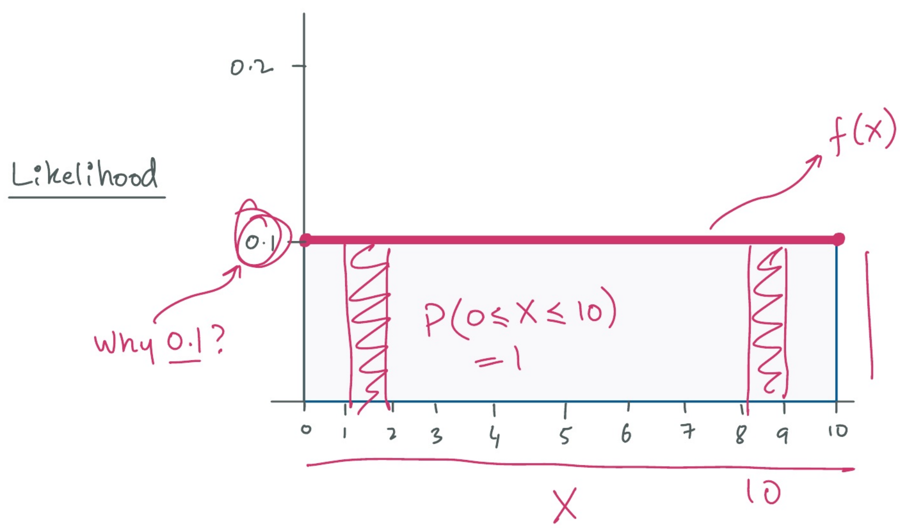
$$P(a \le X \le b) = \int_a^b f(x)\, dx$$

if $a = b$, $P(X) = 0$

if $a = -\infty$, $b = +\infty$ $P(x) = 1$

denotes the universe for $\mathbb{R}$

- Creating $f(X)$ is difficult (somewhat)
- Let's make an easy one first



"Uniform distribution"

$$f(X; v) = v$$

$\to 0.1$

- All numbers are equally likely
- More accurately, if you divide the domain of the RV in equal parts, all parts are equally likely.

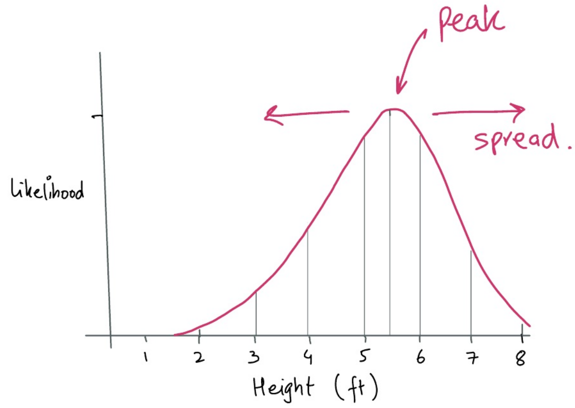
$$P(8 \le X \le 9) = \int_8^9 v\, dx$$

$$= 0.1$$

For our weight RV, we need more parameters!

peak $= \mu$

spread $= \sigma$



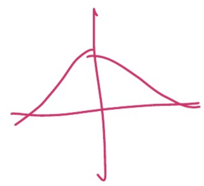
$H \sim N(5.5, 1)$

$$f(x;\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma}}$$

— Highest value when $x = \mu$

"Normal distribution" or "Gaussian distribution".

if we set $\mu = 0$, $\sigma = 1$, we get the standard normal distribution.



But how?

W : Our RV for weight

$$W \sim N(\mu_s, \sigma_s)$$

$y = 5x$

— Normally distributed but <u>not</u> standard

We create another RV

$$S = (W - \mu_s)/\sigma_s$$

$5 - 5.5)/1$

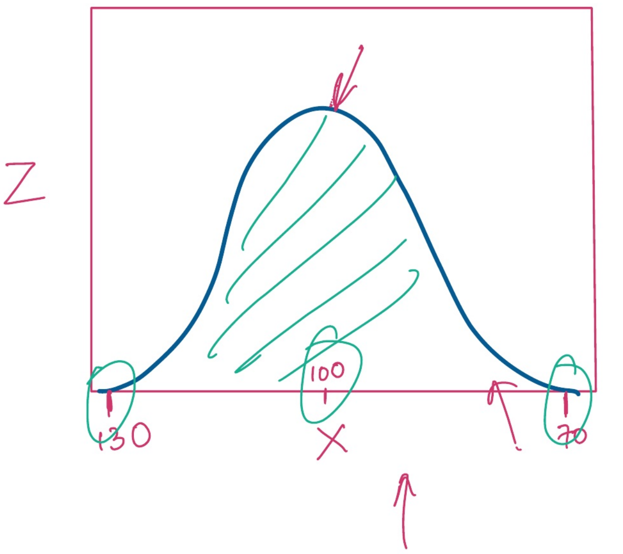
Now, $S \sim N(0, 1)$

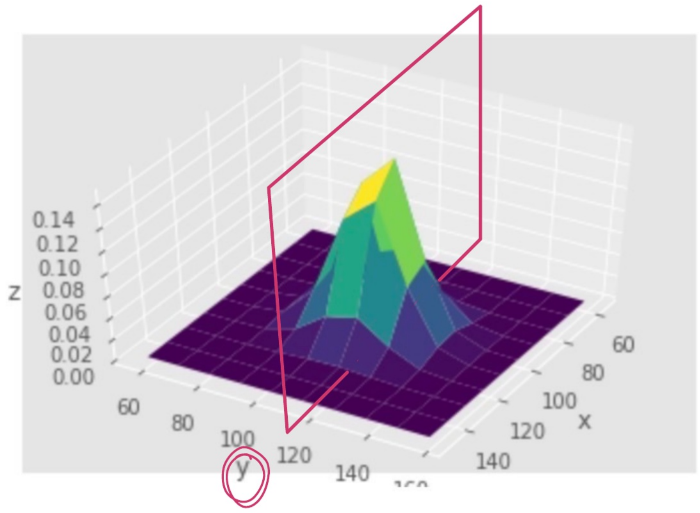
S is "standard normal distributed".

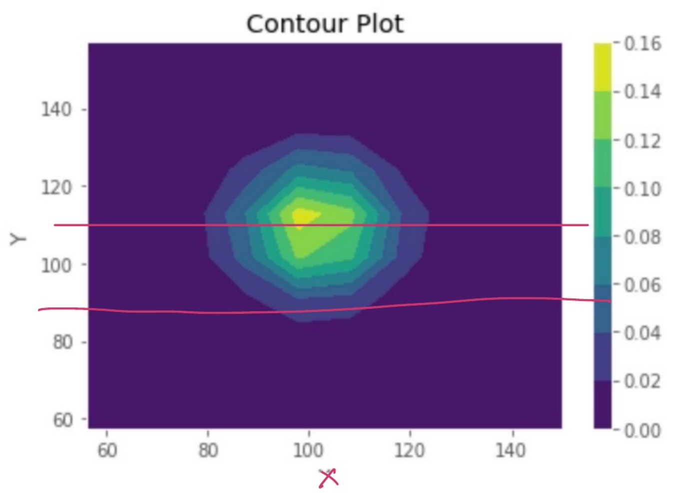
- Practical view of normal distribution
- Student T - distribution
- Beta distribution
- Exponential distribution

- Joint Probabilities of Continuous RVs

Often we are interested in the "shape" and relative likelihood.

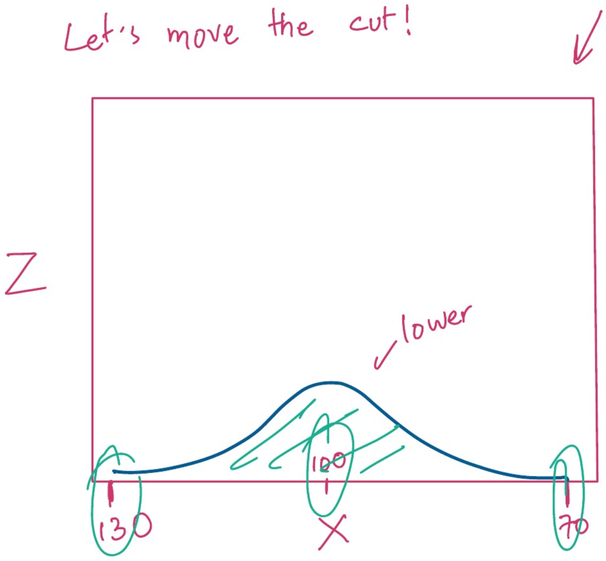


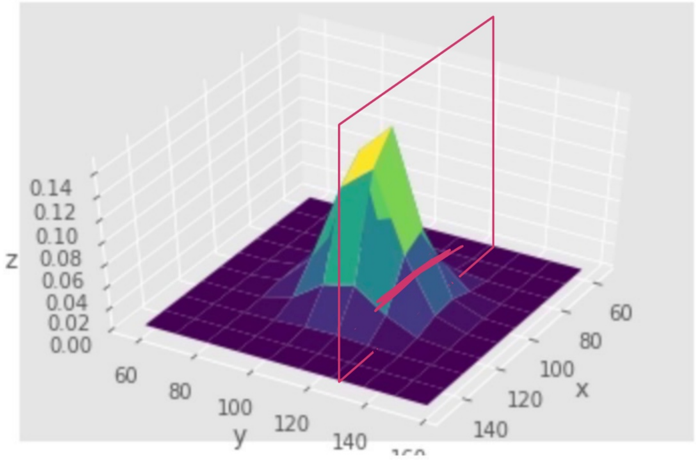


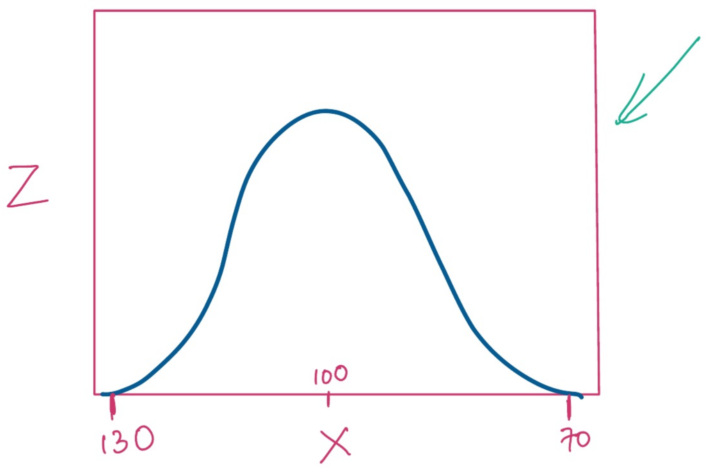


* This cut is not the marginal!

Let's move the cut!







So,

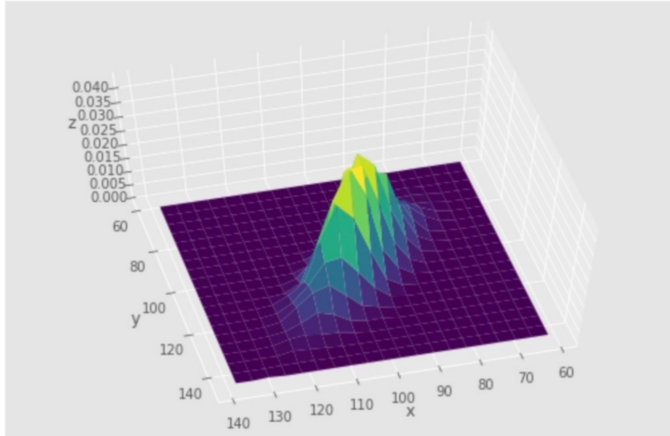
$$f(X \mid Y = 100) = f(X \mid Y = 130)$$

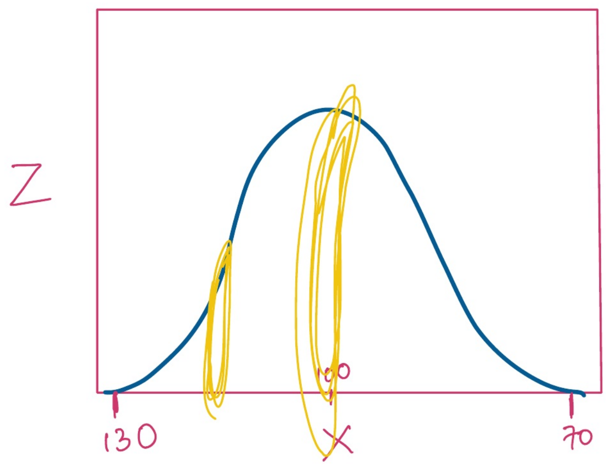
... Changing 'Y' has no effect on probability of X!

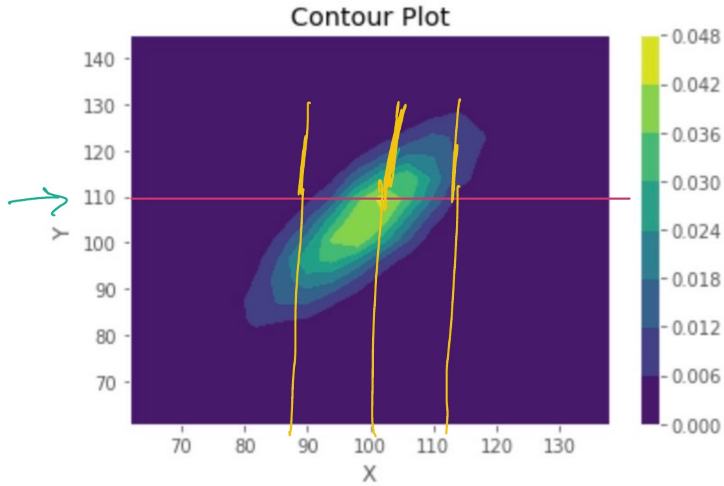
X is independant of Y!

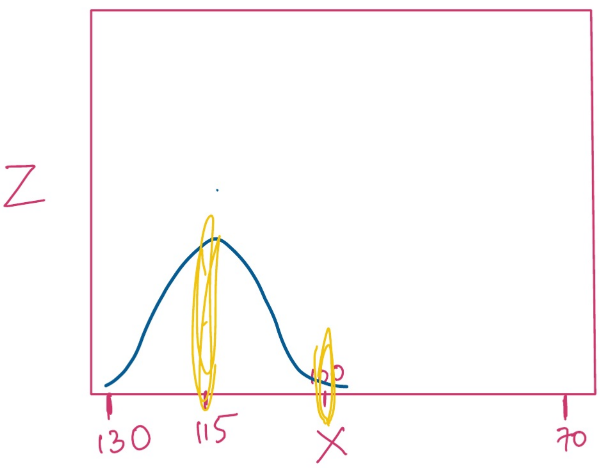
How about the second one ?

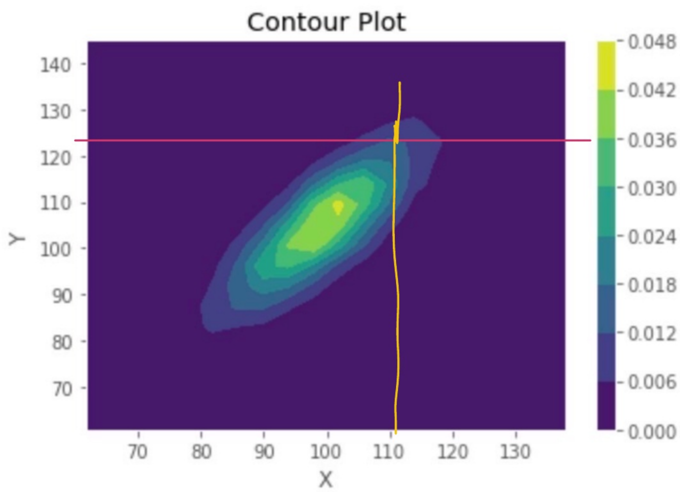
Now this is example of two variable is dependent.











There is no way to rescale this to make the two distributions the same!

$f(X \mid Y = 110) \;!=\; f(X \mid Y = 125)$

Both are diffeirent its mean that both are dependent to each other.

Changing Y has an effect on X!

This elongation is measured through co-variance.

Co-variance is difference between the value from independent to become independent.

key point to keep in mind.

1 . you can draw 2D plot
2. you can draw from 2D to 3D plot
3 . Contoure Graph
3 . Understand the hand Gesture