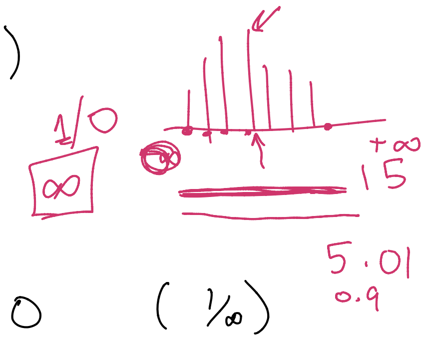
- How are RVs distributed

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

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



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

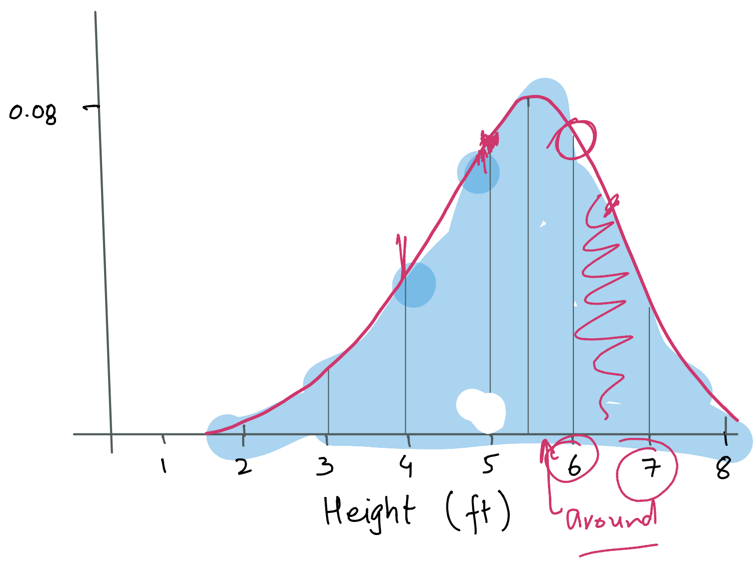
- We want to do analysis, so we are more interested in height being in a specific range.

- We'll use a trick:

Y label here?

Likelihood

Units?



$\int_{-\infty}^{+\infty} - \, dx$

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

RV

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

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

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

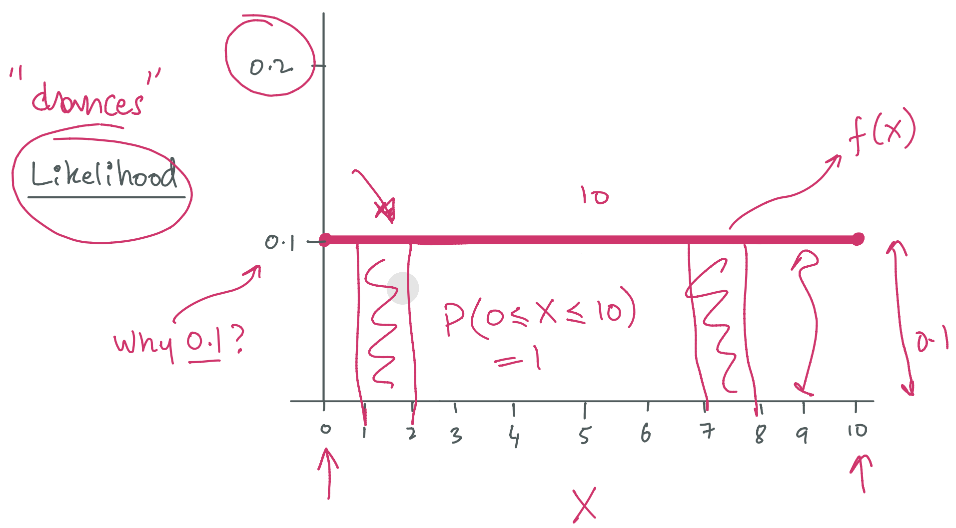
$$P(a \le X \le b) = \int_a^b f(x)\,dx$$

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

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

denotes the universe for $\mathbb{R}$

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



"Uniform distribution"

$$f(x\,;\,v) = v$$

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

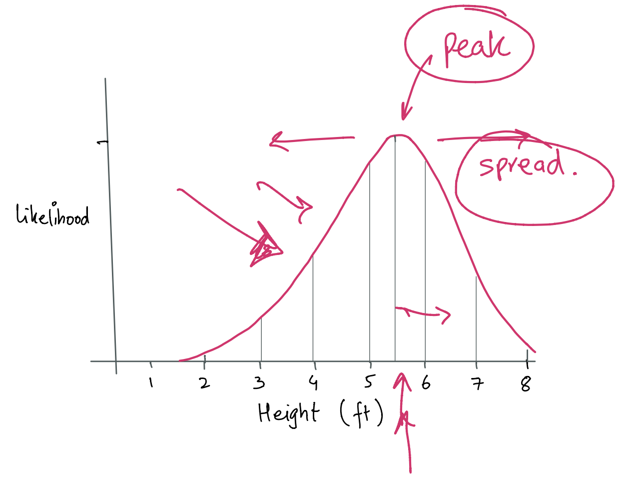
$$P(8 \le X \le 9) = \int_8^9 v\,dx$$

$$= 0.1$$

For our weight RV, we need more parameters!

peak = μ

spread = σ

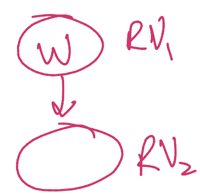


$$f(\underline{x};\ \overset{5.5}{\mu},\overset{1.5}{\sigma}) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma}}$$

— 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

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

— Normally distributed but not standard

We create another RV

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

$(5-5)/2 = 0$

$7-5/2 = 01$

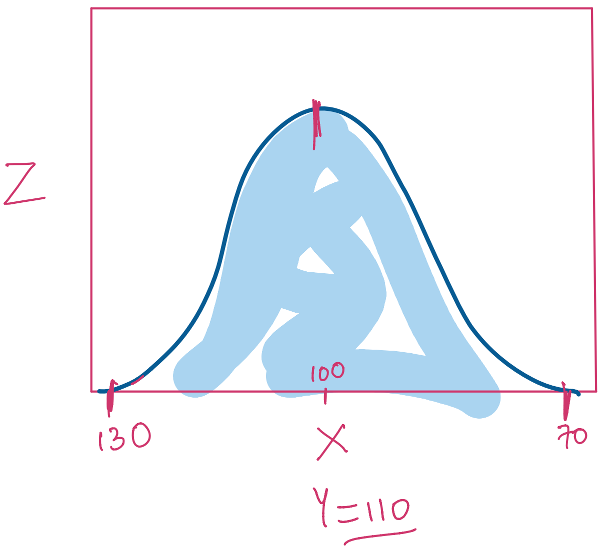
Now, $S \sim N(0, 1)$

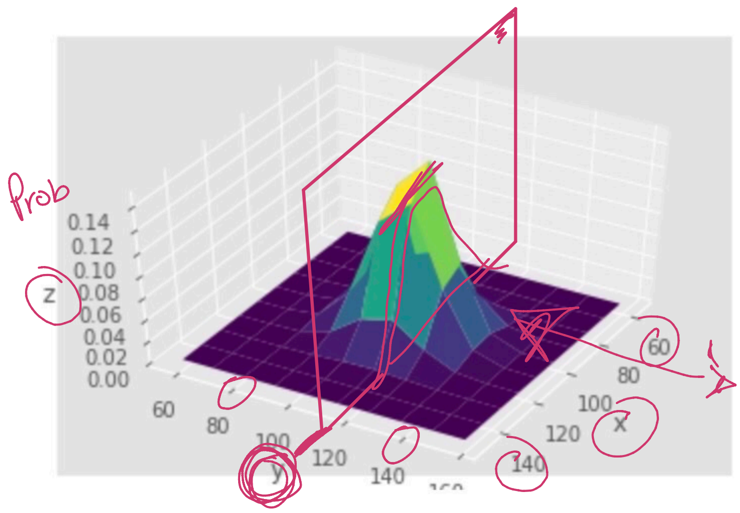
S is "standard normal distributed".

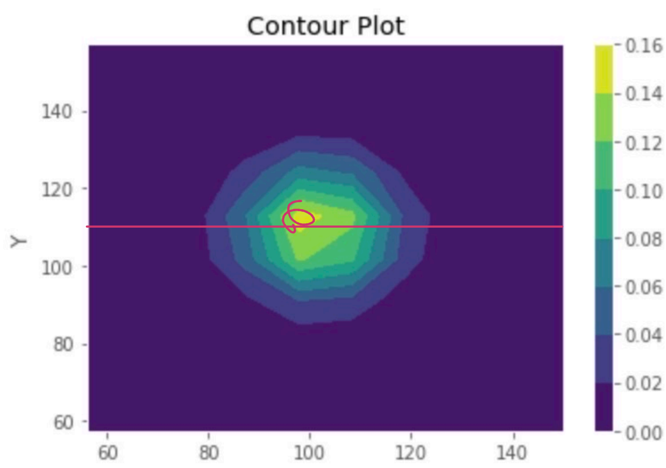
- Practical view of normal distribution
- Student T - distribution
- Beta distribution
- Exponential distribution

- Joint Probabilities of Continuous RVs

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

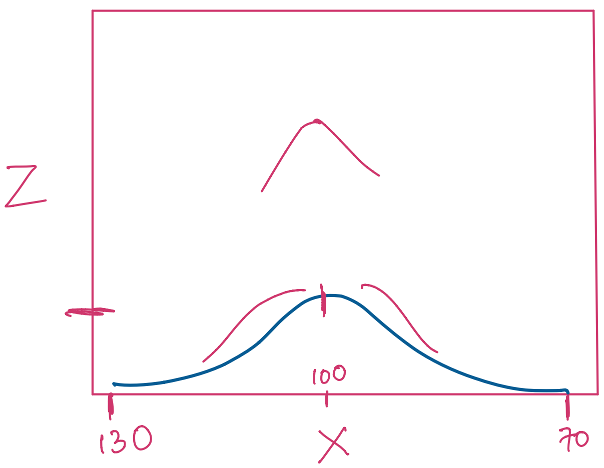


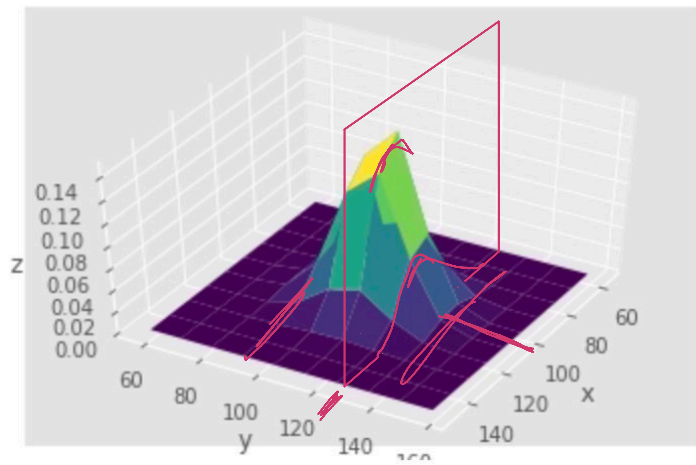


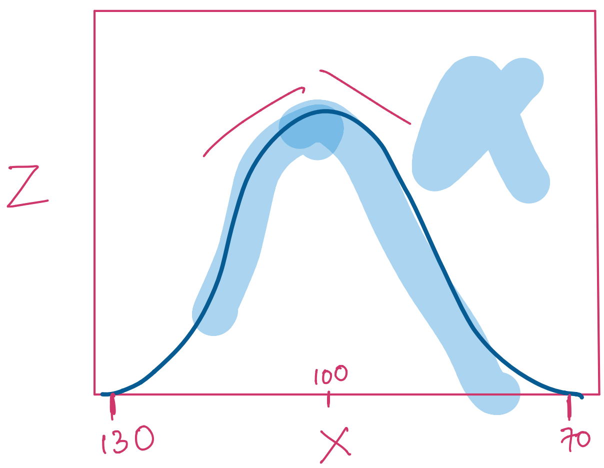


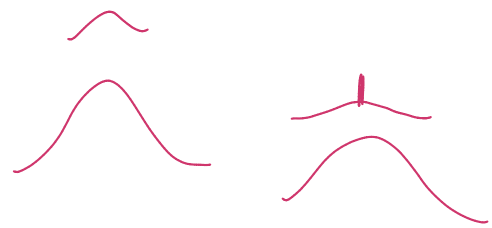
* This cut is <u>not</u> the marginal!

Let's move the cut!









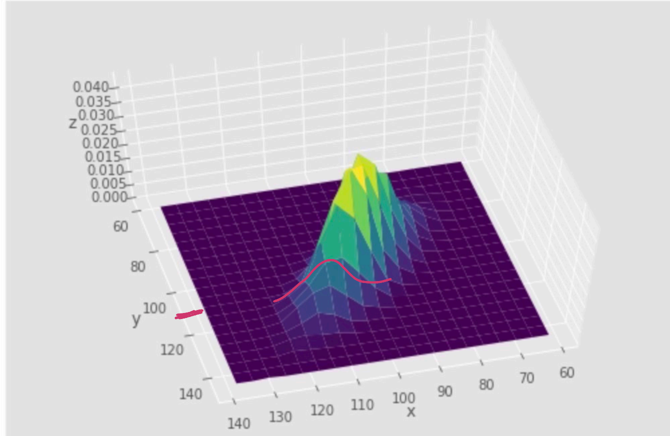
So,

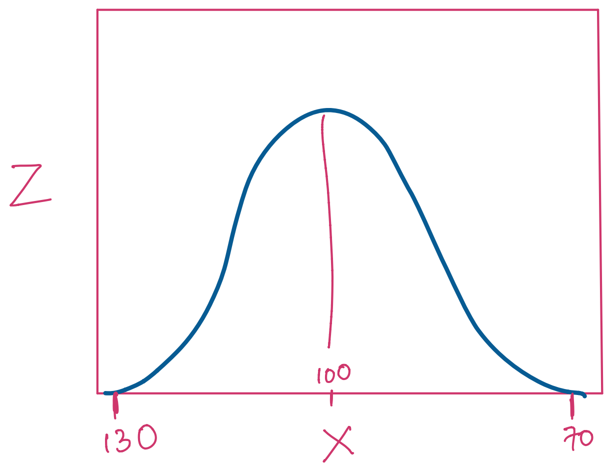
$$f(X \mid Y = 100) = f(X \mid Y = 130)$$

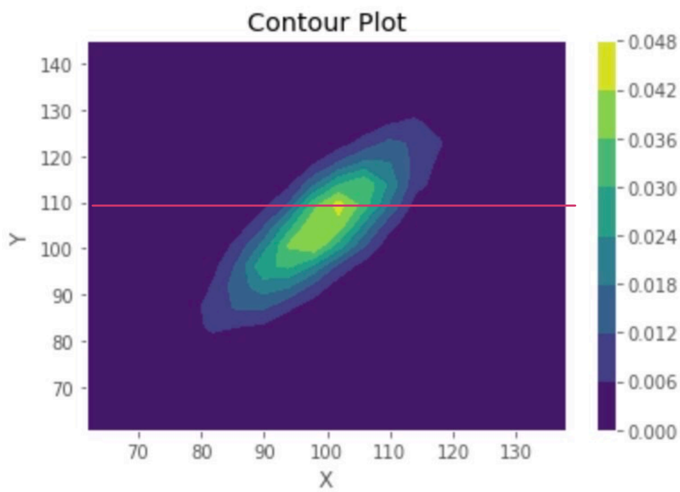
... Changing 'Y' has no effect on probability of X!

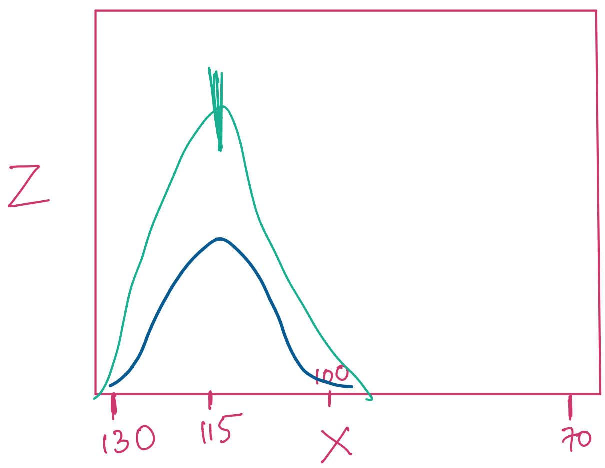
X is independant of Y!

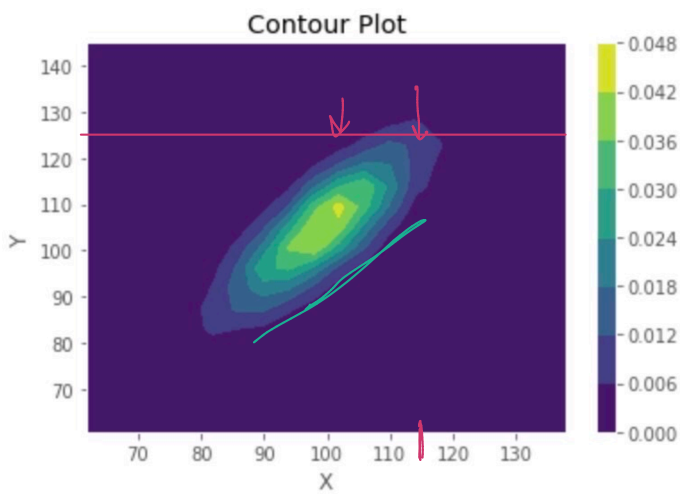
How about the second one ?











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

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

Changing Y has an effect on X!

This elongation is measured through co-variance.