Using Machine Learning to Increase Significance (σ) of our measurement of WWγ

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How we're getting "signals":

DETECT

The detector records data from results of multiple collisions

SORT

The events are sorted via certain parameters as either likely a signal or discarded

usually sorted using a "rough chop" method initially, which is faster but excludes some would-be signals

ex: discarding all events without a transverse momentum of at least 20 GeV

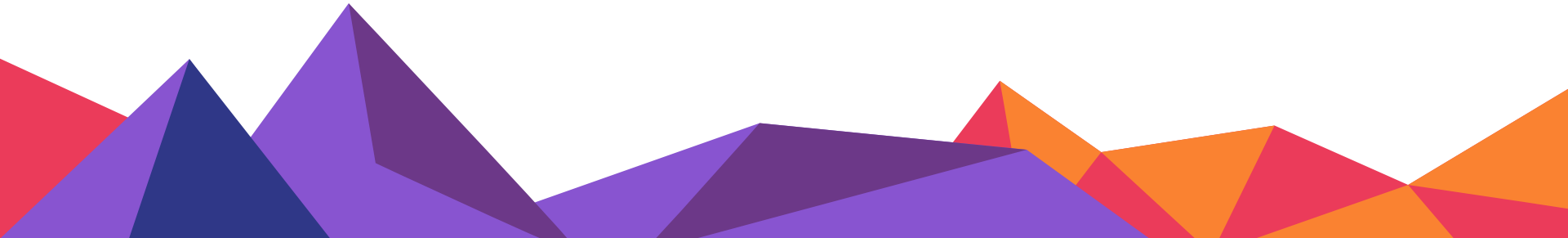
ANALYSE

We can look at characteristics of the "signal" data and analyse trends

Let’s talk about Significance (σ):

def: Describes how much variability there is in a given set of data around a mean or average.

In our case: whether an event is statistically significant enough to be considered separate from the “background”, i. e. all the other possible combinations that are not the one combination we’re interested in (WW***γ***).



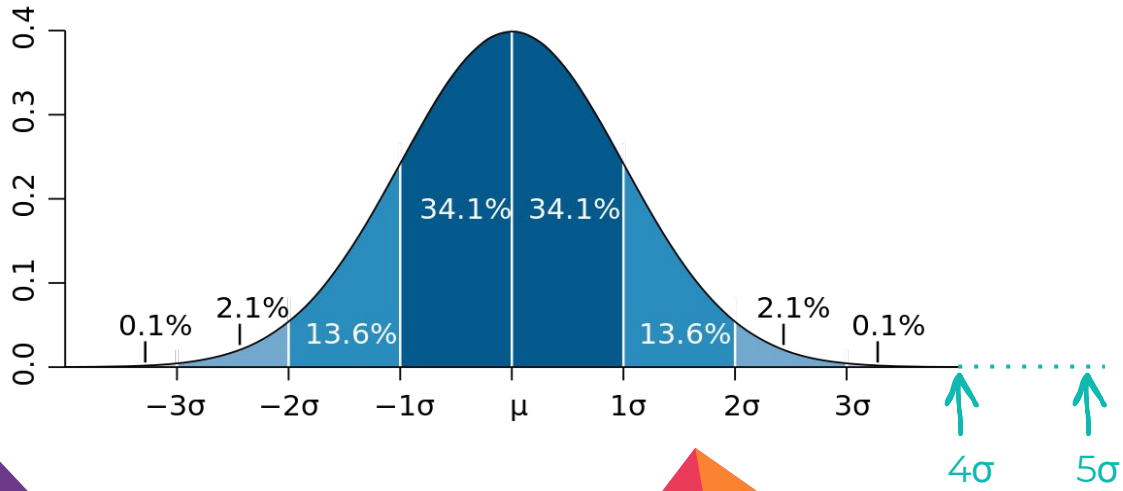
Let's talk about Significance (σ):

$$\sigma = \frac{s}{\sqrt{b}}$$

s = signal
b = background

What is sigma though?

- 3 σ for evidence = 1 in 770 chance
- 5 σ for discovery = 1 in 3.5 million chance



Why go higher than 5σ?

- lower error
- reaffirm or deviate from Standard Model?
  → how so? new physics?
- what trends does it show?
  → do these trends follow the same pattern as other combinations produced by pp* collisions?

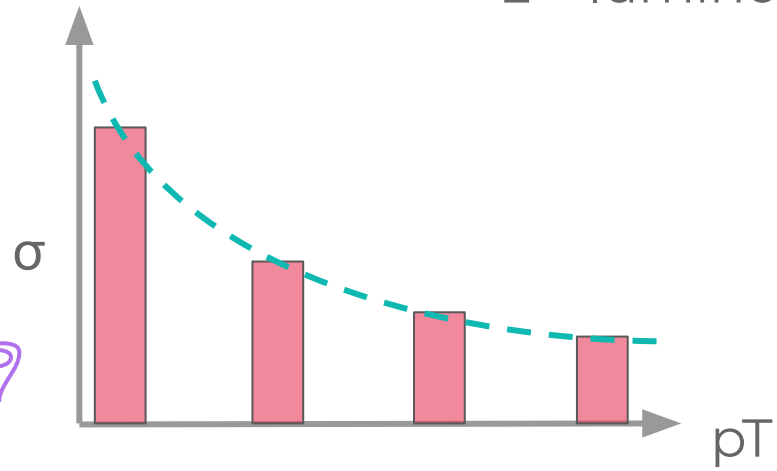
* “pp collisions” is short for proton-proton collisions, which is the type of collision being studied at CERN

A Different σ : Cross-Section

$$N = \sigma L \rightarrow \sigma = \frac{N}{L}$$

N = # of events
σ = cross-section
L = luminosity

Example:
100 signals total
- 60 with pT between 20-30
- 20 with pT between 30-40
- 10 with pT between 40-50
- 10 with pT > 50



My Project:

I'll be **using Machine Learning** to better sort detections so as to **raise the significance** of our measurement of WW***γ*** thereby **lowering the error** of the measurement and **allowing us to look at trends** shown by this specific combination.

I'll most likely **use the TMVA package** as it is already a part of ROOT but will branch out if need be.

Credits

- Presentation template by Slidesgo

Questions?