PHYS 391 - Day 5

- Consistency of Values
- t-distribution
- Error function

Question for the Day

- In the 2012 ATLAS Higgs discovery paper, two values were measured from different final states

$$m_{\gamma\gamma} = 126.6 \pm 1.2 \text{ GeV}$$

$$m_{4l} = 123.5 \pm 0.9 \text{ GeV}$$

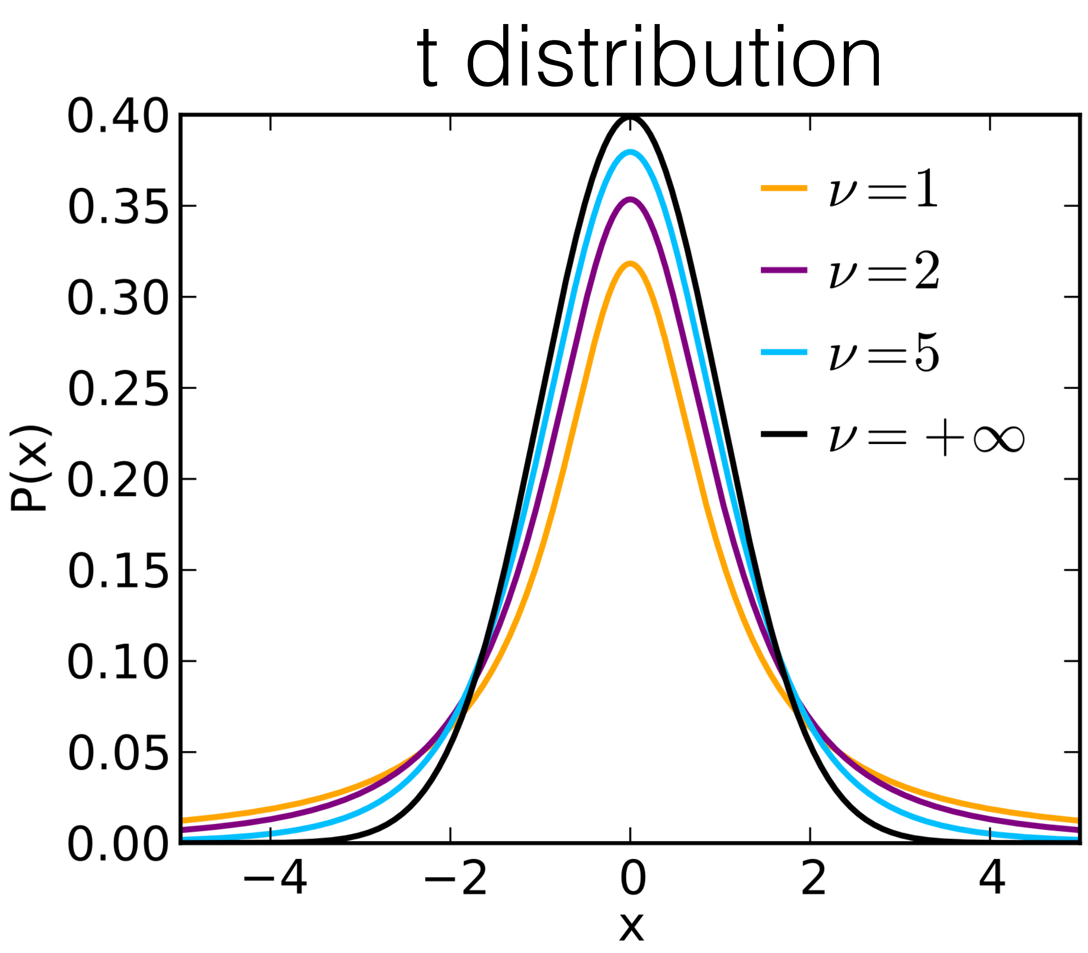
- Assuming these are independent measurements of the same thing, find the probability of a difference this large (or larger) based on the quoted uncertainties

t-distribution

- Sample standard deviation s_x uncertainty:

$$\delta\overline{x} = \frac{s_x}{\sqrt{N}} \qquad \frac{\delta s_x}{s_x} = \frac{1}{\sqrt{2(N-1)}}$$

- Can accommodate this properly with the t-distribution



t value to give P(z<t) = 95%

N-1	t value
∞	1.96
60	2.00
20	2.09
10	2.23
2	4.30

Error Function

- Taylor defines the error function as the integral of a Gaussian distribution within t:

$$\mathrm{erf}(t) = \frac{1}{\sqrt{2\pi}} \int_{-t}^{t} e^{-z^2/2} dz$$

- Python uses a more usual math definition

$$\mathrm{erf}(t) = \frac{2}{\sqrt{\pi}} \int_{0}^{t} e^{-z^2} dz$$

- Difference is factor of $\sqrt{2}$ in t

Error Function in Python

```
[1]: import math
     print(math.erf(1))
```

```
0.8427007929497148
```

```
[2]: print(math.erf(1/math.sqrt(2)))
```

```
0.6826894921370859
```

Check with a few values, also if using online error function calculators