RooFit & RooStats

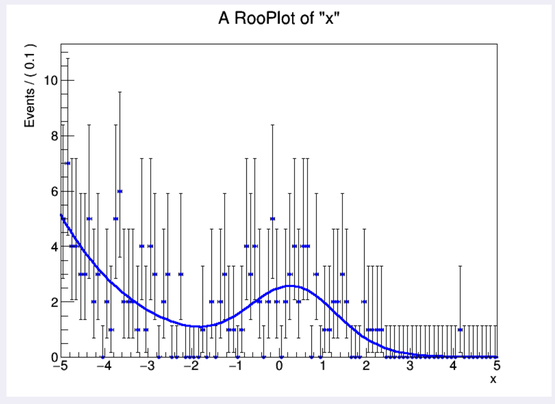
a python data science *Cheat Sheet*

What is RooFit?

The Toolkit for Data Modeling with ROOT (**RooFit**) is a package that allows for modeling probability distributions in a compact and abstract way. **RooStats** is a project to create statistical tools built on top of **RooFit** and distributed in ROOT. It is a joint project between the LHC experiments and the ROOT team.

A Simple Example

```
import ROOT
w = ROOT.RooWorkspace()
w.factory('Gaussian::g(x[-5,5],mu[-3,3],sigma[1])')
w.factory('Exponential::e(x,tau[-.5,-3,0])')
w.factory('SUM::model(s[50,0,100]*g,b[100,0,1000]*e)')
x = w.var('x')
pdf = w.pdf('model')
frame = x.frame()
data = pdf.generate(ROOT.RooArgSet(x))
data.plotOn(frame)
fitResult = pdf.fitTo(data,ROOT.RooFit.Save())
pdf.plotOn(frame)
frame.Draw()
```



Parameter Estimation and Fitting

The following materials were required to complete the research:

- Curabitur pellentesque dignissim
- Eu facilisis est tempus quis
- Duis porta consequat lorem
- Eu facilisis est tempus quis

The following equations were used for statistical analysis:

Working with workspaces

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Statistical Tests with RooStats

RooVariables, RooPdfs, Data and Composite Models

RooFit classes have a 1:1 correspondences to mathematical objects. e.g. variable → RooRealVar, function → RooAbsReal, probability density function → RooAbsPdf.

Variables and P.D.Fs

```
observable = ROOT.RooRealVar(‘‘x’’,’’x’’,-10,10)
mean = ROOT.RooRealVar(‘‘mean’’,’’Mean’’,-10,10)
sigma = ROOT.RooRealVar(‘‘sigma’’,’’Width’’,3,-10,10)
gauss = ROOT.RooGaussian(‘‘gauss’’,’’pdf title’’,x,mean,sigma)
```

Importing Data from Histograms

```
hh = ROOT.TH1F(‘‘hh’’,’’some histogram’’,21,-10,10)
x = ROOT.RooRealVar(‘‘x’’,’’x’’,-10,10)
data = ROOT.RooDataHist(‘‘data’’,’’dataset with x’’,x,hh)
```

Common P.D.Fs

```
ROOT.RooBifurGauss(‘‘name’’, ‘‘title’’, x, μ, σ_L, σ_R)
ROOT.RooExponential(‘‘name’’, ‘‘title’’, x, c)
ROOT.RooPolynomial(‘‘name’’, ‘‘title’’, x, RooArgList(c_1,c_2)
ROOT.RooPoisson(‘‘name’’, ‘‘title’’, x, η)
```

Bifurcated Gaussian	$f(x;\mu,\sigma) = \frac{1}{N} \cdot \exp(-(x-\mu)^2/(2\sigma(x-\mu)^2)$
Exponential	$f(x;c) = \frac{1}{N} \exp(cx)$
Polynomial	$f(x;c_0,...,c_n) = \frac{1}{N} \cdot \left(1 + \sum_{k=1}^{n} c_k x^k\right)$
Poisson	$f(x;\eta) = \frac{1}{x!} \cdot \eta^x \exp(-\eta)$

Composite Models from P.D.Fs

For a set of PDFs e.g. `signalpdf` and `backgroundpdf` and a fractional normalization `fsig`:

```
fsig = ROOT.RooRealVar(‘‘fsig’’,’’signal fraction’’,0.5,0.,1.)
model = ROOT.RooAddPdf(‘‘model’’,’’model’’,
          RooArgList(signalpdf,backgroundpdf),RooArgList(fsig))
```

Some text here. Explaining caveats or links to more PDFs etc.

Possible location for ROOT, RooFit, DIANA-hep and NIKHEF logos.