

mjj fit

Running fit using HHbbgg framework

- Make WS: `python makeWorkspaceHHbbgg.py -d
jsons/VHbb_20190402_full_alessandro_backup_check.json -n 4 --nbins 15 -s
jsons/VHbb_20190402_settings_alessandro_backup_check.json -m 0 -o workspace_name.root`

- Plot Dataset: `python plotDatasets.py -i workspace_name.root -n 4 -s
jsons/VHbb_20190402_settings_alessandro_backup_check.json -o VHbb_test`

- In order to get functional form from workspace produced by `mkaeWorkspaceHHbbgg` test:
`/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/checkingFit_WS.C`

- Output DC (from HHbbgg framework):
`/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit`

- Output WS (from HHbbgg framework):
`/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit`

Output workspaces [100, 135] fit

-->
`/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/output_9May_WS_and_DC`

Low Vpt

Cat 1) 0.0.35 > 0 > 0

Cat 2) 0.35-0.75 > 0.15 > 0.016

Cat 3) 0.75-0.90 > 0.6 > 0.14

Cat 4) 0.90-1.00 > 1.90 > 1.50

High Vpt

Cat 1) 0.0.30 > 0 > 0

Cat 2) 0.30-0.65 > 0.10

Cat 3) 0.65-0.85 > 0.80

Cat 4) 0.85-1.00 > 3.90

Bias studies

1)
`/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit`

2)
<https://github.com/cms-analysis/HiggsAnalysis-CombinedLimit/wiki/nonstandard#roomultipdf-conventional-bias-stud>

3) Tutorial datacards: <http://twiki.ihep.ac.cn/twiki/view/CMS/CombineTutorial#The%20datacards>

4) Code for accessing workspaces and creating other fitting form:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

==

How to run the bias studies in Combine

1) combine output_DC_forBiasStudy/Mjj_201900402_lowVpt_backup_today_DCnew.txt -M GenerateOnly --setParameters pdf_index=0 -t 100 --expectSignal 1 --saveToys -m 125 --freezeParameters pdf_index -S 0

2) combine output_DC_forBiasStudy/Mjj_201900402_lowVpt_backup_today_DCnew.txt -M FitDiagnostics --setParameters pdf_index=0 --toysFile higgsCombineTest.GenerateOnly.mH125.123456.root -t 100 --rMin -10 --rMax 10 --freezeParameters pdf_index

1) creates toys with a given functional form used for the fit (defined by the pdf_index variable) and for mu=1 (expectSignal=1)

2) runs the fit on the same toys but using other functional forms that will need to be checked (pdf_index=1,2,3,4,) and check bias

For highVpt workspaces, we need to add an additional command to help the fit convergence (most of the parameters are at boundary):

```
combine output_DC_forBiasStudy/biasStudy_highVpt_update16May.txt -M FitDiagnostics --setParameters cate3=1 --toysFile higgsCombineTest.GenerateOnly.mH125.123456.root -t 500 --rMin=-10 --rMax=10 --freezeParameters cate3 --cminDefaultMinimizerStrategy 0
```

How to check bias

```
root -l fitDiagnostics.root
```

```
tree_fit_sb->Draw("(r-1)/rErr>>h(20,-4,4)")
```

```
h->Fit("gaus")
```

Where to find datacards to be used for bias study

* low Vpt:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

* high Vpt:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

* The workspaces the datacards above refer to are here:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

* The code that creates the roomultipdf object dumped in the workspace and in the datacard for the bias study is here:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
```

* The code that makes the final bias plot is here:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimit

* REMINDER: pdf_index=0: Cheb, pdf_index=1: Bern, pdf_index=2: Exp, pdf_index=3:PowerLaw

* category0: cate0=0: nominal Cheb, cate0=1: alt Bern, cate0=2: alt exp; cate0=3: alt power law;

* category1: cate1=0: nominal Cheb, cate1=1: alt Bern, cate1=2: alt exp; cate1=3: alt power law;

* category2: cate2=0: nominal Cheb, cate2=1: alt Bern, cate2=2: alt exp; cate2=3: alt power law;

* category3: cate3=0: nominal Cheb, cate3=1: alt Bern, cate3=2: alt exp; cate3=3: alt power law;

Code that runs fit to data

Backup in mail to [alessandro.calandri@cernNOSPAMPLEASE.ch](mailto:alessandro.calandri@cern.ch) - May 7 (16h45)

Code here: /t3home/acalandr/VHbb/data_driven/makeWorkspaceHHbbgg.py

Additional implementation that runs more fits for bias study

Backup in mail to [alessandro.calandri@cernNOSPAMPLEASE.ch](mailto:alessandro.calandri@cern.ch) - May 8 (18h13)

Optimization F-test nominal fit Cheb

Using F-test

1) low V_{pt} - cat0: cheb2 ---> cheb1 used (after optimisation on bias study)

- cat1: cheb2

- cat2: cheb3

- cat3: cheb 3

1) high V_{pt} - cat0: cheb1

- cat1: cheb2

- cat2: cheb2

- cat3: cheb 2

Optimization F-test alternative fit Bern polynomial

1) low V_{pt} - cat0: bern2. --> bern1 used (after optimisation on bias study)

- cat1: bern2

- cat2: bern3

Where to find datacards to be used for bias study

- cat3: bern 3

1) high Vpt

- cat0: bern1

- cat1: bern2

- cat2: bern2

- cat3: bern 2

Optimization alternative fit expo for bias study

#low Vpt

```
if cat==0: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.006,-0.1,0.) #AC slope for cat0 low Vpt
```

```
if cat==1: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.008,-0.1,0.) #AC slope for cat1 low Vpt
```

```
if cat==2: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.006,-0.1,0.) #AC slope for cat2 low Vpt
```

```
if cat==3: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.008,-0.1,0.) #AC slope for cat3 low Vpt
```

#high Vpt

```
if cat==0: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.004,-0.1,0.) #AC slope for cat0 high Vpt
```

```
if cat==1: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.006,-0.1,0.) #AC slope for cat1 high Vpt
```

```
if cat==2: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.002,-0.1,0.) #AC slope for cat2 high Vpt
```

```
if cat==3: norm=ROOT.RooRealVar("exp_slope_%scat%d" % (label,cat),"exp_slope_%scat%d" %
(label,cat),-0.004,-0.1,0.) #AC slope for cat3 high Vpt
```

---++ Optimization alternative fit power-law for bias study

```
norm=ROOT.RooRealVar("pow_%scat%d" % (label,cat),"pow_%scat%d" % (label,cat),-100.,100.) #AC:
linear term RooGenericPdf
```

#lowVpt

```
if cat==0: norm.setVal(-1);
```

```
if cat==1: norm.setVal(-1);
```

```
if cat==2: norm.setVal(-1);
```

Optimization F-test alternative fit Bern polynomial

```
if cat==3: norm.setVal(-1)
```

```
#high Vpt
```

```
if cat==0: norm.setVal(-1);
```

```
if cat==1: norm.setVal(-1);
```

```
if cat==2: norm.setVal(-1);
```

```
if cat==3: norm.setVal(-1)
```

Running fit using HHbbgg framework

> Combining cheb (nom), i.e. cate0=0 vs bern (alt), i.e. cate0=1

```
combine
```

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits/GenerateOnly -M GenerateOnly --setParameters cate0=0 -t 100 --expectSignal 1 --saveToys -m 125 --freezeParameters cate0 -S 0
```

```
combine output_DC_forBiasStudy/Mjj_201900402_lowVpt_backup_today_DCnew_new.txt -M FitDiagnostics --setParameters cate0=1 --toysFile higgsCombineTest.GenerateOnly.mH125.123456.root -t 100 --rMin -10 --rMax 10 --freezeParameters cate0
```

```
==
```

Output Datacards for bias study:

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits/Datacard/
```

```
/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits/Datacard/
```

```
===
```

How to check bias:

cate0=0 -> nominal Cheb category 0, cate0=1 -> alternative Bern category 0, cate0=2 -> alternative exp category 0, cate0=3 -> alternative powe law category 0

cate1=0 -> nominal Cheb category 1, cate1=1 -> alternative Bern category 1, cate1=2 -> alternative exp category 1, cate1=3 -> alternative powe law category 1

cate2=0 -> nominal Cheb category 2, cate2=1 -> alternative Bern category 2, cate2=2 -> alternative exp category 2, cate2=3 -> alternative powe law category 2

cate3=0 -> nominal Cheb category 3, cate3=1 -> alternative Bern category 3, cate2=2 -> alternative exp category 3, cate2=3 -> alternative powe law category 3

Calculating significance

```
combine -M Significance output_9May_WS_and_DC/nom_cheb_lowVpt_v2.txt -t -1 --expectSignal=1
```

Where to find data cards for final significance estimation:

- low Vpt:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits

- high VPt:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/output_DC_highVpt_update16M

- combine datacard:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits

Datacards with background normalization

- Discussion on rate parameters:

https://indico.cern.ch/event/577649/contributions/2339440/attachments/1380196/2097805/beyond_simple_datacards.p

- low Vpt:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits

- low Vpt (Correlated rate parameters):

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/biasStudies/CMSSW_8_1_0/src/HiggsAnalysis/CombinedLimits

- high Vpt:

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/output_DC_highVpt_update16M

- high Vpt (correlated rate parameters):

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/output_DC_highVpt_update16M

NEW OPTIMIZATION OF DNN BOUNDARIES TO IMPROVE SIGNIFICANCE WITH DATA YIELD FREE FLOATING

/t3home/acalandr/VHbb/data_driven/DD_fit_HHbbgg/HHbbgg_ETH/Limits/macros/newCategorization_DNNcuts

- low Vpt:

- config0: old DNN categorization

- config1: [0,0.25,0.5,0.75,1]

-

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-- AlessandroCalandri - 2018-10-11

This topic: Sandbox > CheckLFuncertaintyonVHbb

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