

# GammaLib - Bug #2266

## Verify computation of WSTAT in GCTAOnOffObservation::likelihood\_wstat

10/28/2017 10:52 AM - Knödlseeder Jürgen

<b>Status:</b>	Closed	<b>Start date:</b>	10/28/2017
<b>Priority:</b>	Normal	<b>Due date:</b>	
<b>Assigned To:</b>	Knödlseeder Jürgen	<b>% Done:</b>	100%
<b>Category:</b>		<b>Estimated time:</b>	0.00 hour
<b>Target version:</b>	1.5.0		

### Description

The pull distribution obtained with the WSTAT statistic seems to be too broad, the fit results appear however relatively unbiased (see #2263).

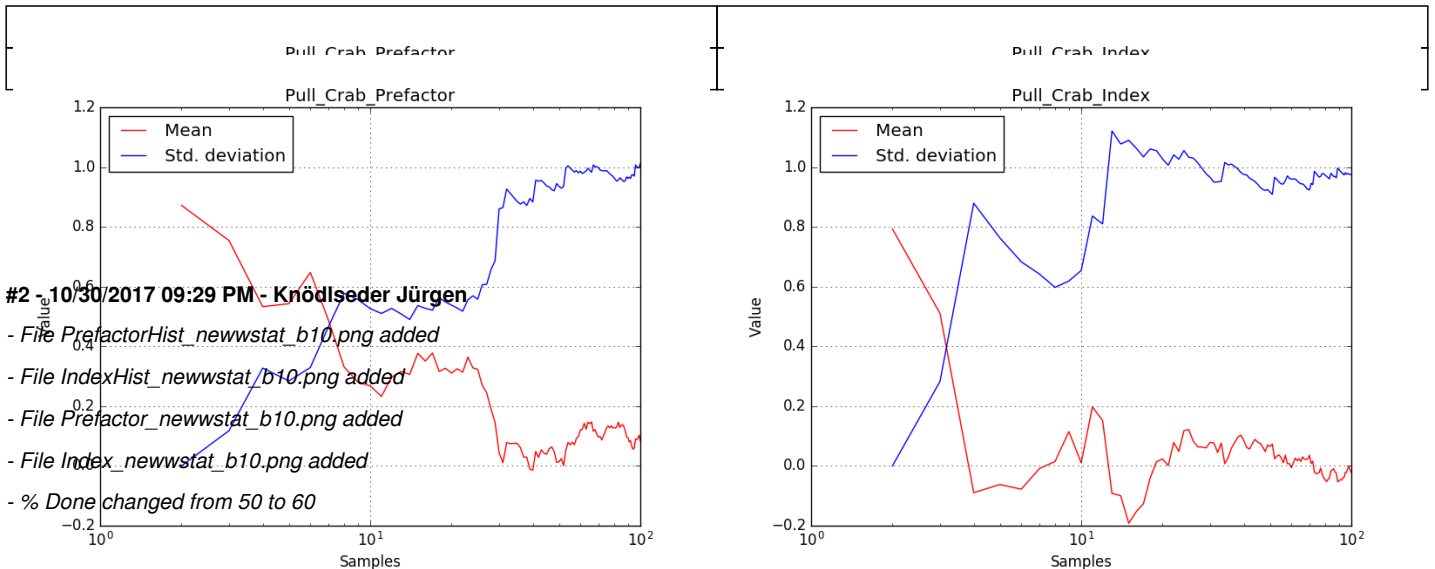
The formulae for the WSTAT should be verified to correct this issue (is there for example somewhere a factor of 2 in the log-likelihood that could lead to too large errors?)

### History

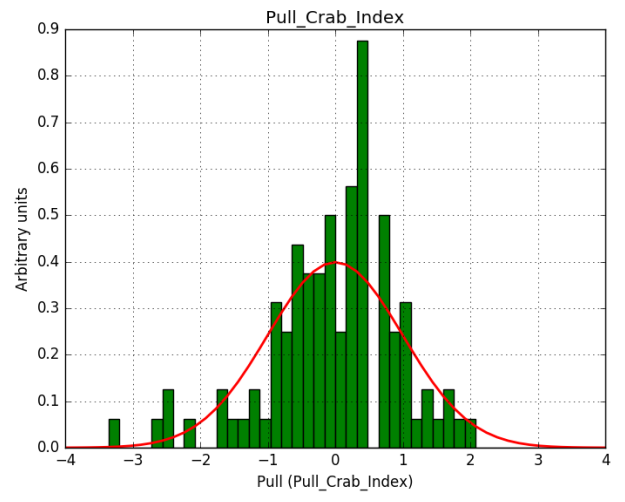
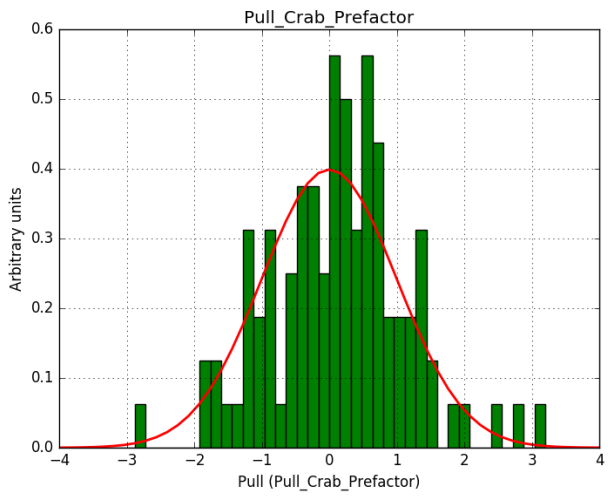
#### #1 - 10/28/2017 06:07 PM - Knödlseeder Jürgen

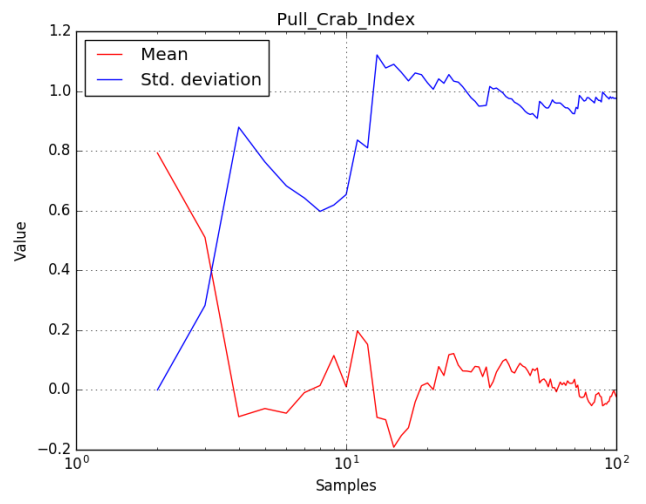
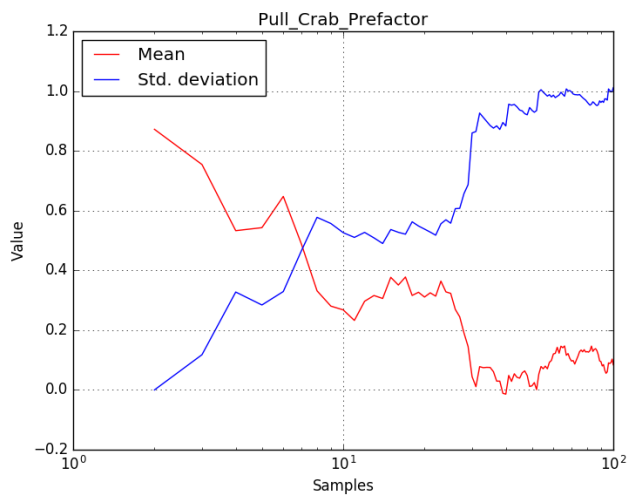
- File PrefactorHist\_newwstat\_b05.png added
- File Index\_newwstat\_b05.png added
- File IndexHist\_newwstat\_b05.png added
- File Prefactor\_newwstat\_b05.png added
- Status changed from New to In Progress
- Assigned To set to Knödlseeder Jürgen
- % Done changed from 0 to 50

The formulae for the derivative in the general case were not correct. After correcting the formula things seems to be okay. Here an example for 5 energy bins between 100 GeV and 100 TeV.



Here the same for 10 bins. Also looks okay.

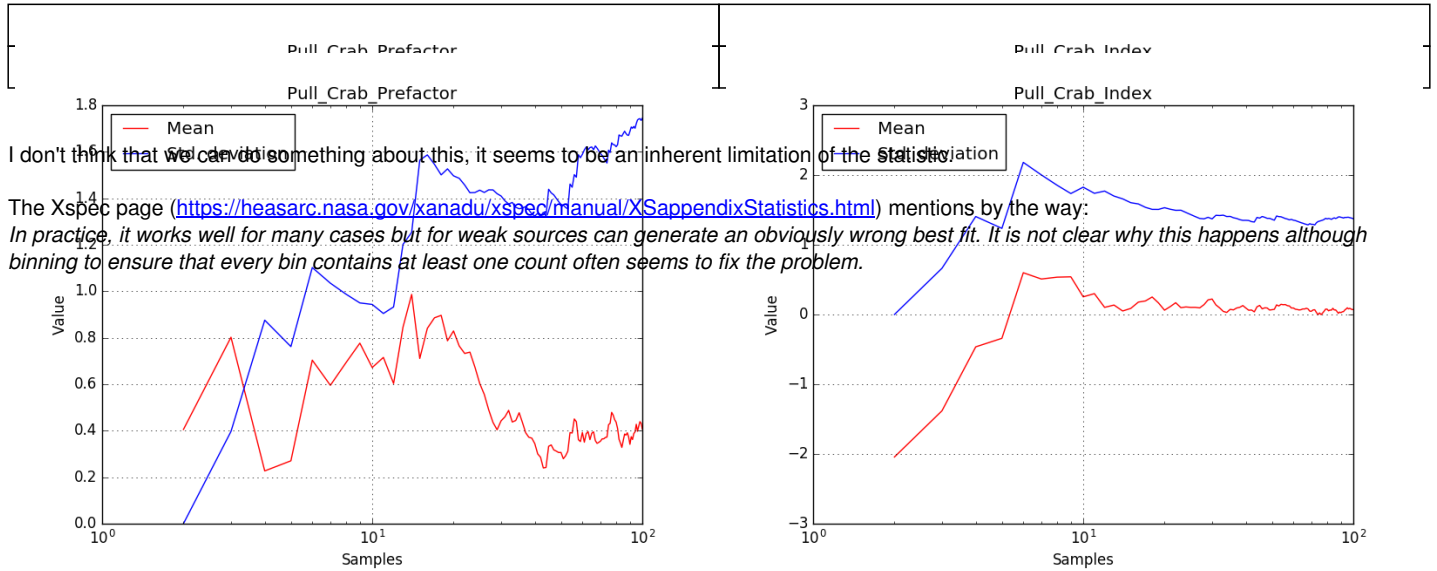




#3 - 10/30/2017 09:42 PM - Knödseder Jürgen

- File PrefactorHist\_newwstat\_0.05-100\_b40.png added
- File Prefactor\_newwstat\_0.05-100\_b40.png added
- File Index\_newwstat\_0.05-100\_b40.png added
- File IndexHist\_newwstat\_0.05-100\_b40.png added
- Status changed from In Progress to Closed
- % Done changed from 60 to 100

I also checked the pull distributions for 40 bins and an energy range from 50 GeV to 100 TeV. Now the Prefactor seems to be slightly biased and too broad. I double checked all formulae and did not find any error. I guess this behaviour comes from the fact that in many cases the number of On or Off events per bin is zero and the special cases where the background estimate is set to zero is encountered.



I don't think that we can do something about this, it seems to be an inherent limitation of the Statistics. The Xspec page (<https://heasarc.nasa.gov/xanadu/xspec/manual/XSappendixStatistics.html>) mentions by the way: In practice, it works well for many cases but for weak sources can generate an obviously wrong best fit. It is not clear why this happens although binning to ensure that every bin contains at least one count often seems to fix the problem.

Files

PrefactorHist_newwstat_b05.png	40.7 KB	10/28/2017	Knödseder Jürgen
Index_newwstat_b05.png	44.4 KB	10/28/2017	Knödseder Jürgen
IndexHist_newwstat_b05.png	38.8 KB	10/28/2017	Knödseder Jürgen
Prefactor_newwstat_b05.png	42.5 KB	10/28/2017	Knödseder Jürgen
PrefactorHist_newwstat_b10.png	40.3 KB	10/30/2017	Knödseder Jürgen
IndexHist_newwstat_b10.png	39.3 KB	10/30/2017	Knödseder Jürgen
Prefactor_newwstat_b10.png	42.5 KB	10/30/2017	Knödseder Jürgen
Index_newwstat_b10.png	44.4 KB	10/30/2017	Knödseder Jürgen
PrefactorHist_newwstat_0.05-100_b40.png	40.9 KB	10/30/2017	Knödseder Jürgen
Prefactor_newwstat_0.05-100_b40.png	48.3 KB	10/30/2017	Knödseder Jürgen
Index_newwstat_0.05-100_b40.png	33.3 KB	10/30/2017	Knödseder Jürgen
IndexHist_newwstat_0.05-100_b40.png	46.5 KB	10/30/2017	Knödseder Jürgen