Google Summer of Code 2022 Report

Project: Bayesian Excess Variance (Bexvar) in Stingray

The aim of the proposed project was to implement the Bayesian excess variance (Bexvar) method in Stingray (A Python library for the analysis of astronomical time series).

The Stingray project is a sub-organization of OpenAstronomy, which is a collaboration between open-source astronomy and astrophysics projects to share resources, ideas, and to improve code.

Proposed Deliverables:

Deliverable	**Status**
Implementation of the Bexvar method into Stingray infrastructure	Achieved
Inclusion of tests to ensure code's performance and stability	Achieved
Complete documentation and tutorials for the method	Achieved

Project Summary:

The Bexvar method have been implemented along with tests and documentation into the Stingray repository.

The bexvar() method implemented in bexvar module facilitates users to obtain posterior distributions on the Bayesian excess variance, given a light curve data as input parameters. It is developed on the bases of the work by Buchner et al. (2021). The modularized structure and support for default values of optional input parameters such as `frac_exp`, `bg_counts` and `bg_ratio` makes the method generalized and easy to use on any light curve data.

The method has been tested with multiple functional and unit tests to ensure its reliability. A detailed documentation along with tutorials have been created.

In addition to the proposed deliverables, an effort to include bexvar() method as a method to Stingray's Lightcurve class is in progress. This work would also include preliminary addition of new optional parameters (`frac_exp`, `bg_counts` and `bg_ratio`) into Stingray's Lightcurve class. This will enable users to use facilities provided by the Lightcurve class on data containing these attributes.

Repositories:

https://github.com/StingraySoftware/stingray

https://github.com/StingraySoftware/notebooks

Pull Requests:

Pull Request	Status	Description
Bayesian Excess Variance (Bexvar) in Stingray – GsoC'22 project	Merged	The core of the project, includes implementation of bexvar() method, along with documentation and tests
Add find_bexvar() method in Lightcurve class and its relevant tests – GsoC'22	Approved	Contains work done to add bexvar() method in Stingray's Lightcurve class and addition of three new optional parameters in Lightcurve class
Bexvar tutorial notebook	In Review	A jupyter notebook showcasing the usage of bexvar method with examples, it also includes a section summarizing theoretical explanation of bexvar .

Beyond GSoC:

At the time of this writing, support for new parameters added in Lightcurve class is being worked upon.

While the bexvar method is successfully implemented in Stingray, the logical next steps would be to work on improvement of its speed and investigate on possible vectorization of some of the internal functions.

Acknowledgement:

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Blogs:

List of blogs created during the scope of these project.

- GSoC @ Stingray blog #0
- GSoC @ Stingray: Beginning of the journey. blog #1
- GSoC @ Stingray: Diving into coding period. blog #2
- GSoC @ Stingray: Testing Testing Testing … #blog 3

Profiles:

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