STACUP-2023

Hands-On
Session-3

Python Based Statistics and its Application in Astrophysics & Cosmology

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Project Allotment

Project-1.

Constraint Cosmological Parameters of Flat-LCDM Model using Hubble Parameter Measurements.

$$H\,(z; H_0, \Omega_{m0}) = H_0\sqrt{\Omega_{m0}(1+z)^3 + 1 - \Omega_{m0}}$$

$$\text{Parameters:}\ \ \mathbb{P} = \{H_0, \Omega_{m0}\}$$

Project-2.

Constraint Cosmological Parameters of Non-Flat-ΛCDM Model using Hubble Parameter Measurements.

$$H\left(z; H_0, \Omega_{m0}, \Omega_{\Lambda 0}\right) = H_0\sqrt{\Omega_{m0}(1+z)^3 + \left(1 - \Omega_{m0} - \Omega_{\Lambda 0}\right)(1+z)^2 + \Omega_{\Lambda 0}}$$

$$\text{Parameters: } \mathbb{P} = \{H_0, \Omega_{m0}, \Omega_{\Lambda 0}\}$$

Project-3.

Constraint Cosmological Parameters of Flat-ωCDM Model using Hubble Parameter Measurements.

$$H\left(z; H_0, \Omega_{m0}, \omega\right) = H_0\sqrt{\Omega_{m0}(1+z)^3 + (1-\Omega_{m0})^{3(1+\omega)}}$$

$$\text{Parameters:}\ \ \mathbb{P} = \{H_0, \Omega_{m0}, \omega\}$$

Project-4.

Constraint Cosmological Parameters of Flat-ztCDM Model using Hubble Parameter Measurements.

$$H\left(z; H_0, z_t\right) = H_0 \sqrt{\frac{(1+z)^3}{\frac{1}{2}(1+z_t)^3+1} + \frac{(1+z_t)^3}{(1+z_t)^3+2}}$$

$$\text{Parameters: } \mathbb{P} = \{H_0, z_t\}$$

Project-5.

Constraint Cosmological Parameters of Flat-qCDM Model using Hubble Parameter Measurements.

$$H(z; H_0, q) = H_0 (1+z)^{1+q}$$

Parameters: $\mathbb{P} = \{H_0, q\}$

Project-6.

Constraint Cosmological Parameters of Flat-LCDM Model using Type Ia Supernovae Observations.

Luminosity distance: $d_L = c(1+z)\int_0^z \frac{dx}{H(x)}$

$$H\left(z; H_0, \Omega_{m0}\right) = H_0\sqrt{\Omega_{m0}(1+z)^3 + 1 - \Omega_{m0}}$$

Parameters: $\mathbb{P} = \{H_0, \Omega_{m0}\}$

Project-7.

Constraint Cosmological Parameters of Flat-ωCDM Model using Type Ia Supernovae Observations

$$\text{Luminosity distance:} d_L = c(1+z)\int_0^z \frac{dx}{H(x)}$$

$$H\left(z; H_0, \Omega_{m0}, \omega\right) = H_0\sqrt{\Omega_{m0}(1+z)^3 + (1-\Omega_{m0})^{3(1+\omega)}}$$

$$\text{Parameters: } \mathbb{P} = \{H_0, \Omega_{m0}, \omega\}$$

Project-8.

Constraint Cosmological Parameters of Flat-ztCDM Model using Type Ia Supernovae Observations

$$\text{Luminosity distance:} d_L = c(1+z)\int_0^z \frac{dx}{H(x)}$$

$$H(z; H_0, z_t) = H_0\sqrt{\frac{(1+z)^3}{\frac{1}{2}(1+z_t)^3+1} + \frac{(1+z_t)^3}{(1+z_t)^3+2}}$$

$$\text{Parameters: } \mathbb{P} = \{H_0, z_t\}$$

Project-9.

Constraint Cosmological Parameters of Flat-qCDM Model using Type Ia Supernovae Observations

$$\text{Luminosity distance:} d_L = c(1+z)\int_0^z \frac{dx}{H(x)}$$

$$H(z; H_0, q) = H_0 (1+z)^{1+q}$$

$$\text{Parameters: } \mathbb{P} = \{H_0, \mathrm{q}\}$$

Project-10.

Determine Mars Orbit using Kepler's Triangulation Technique

The position of object moving under the influence of a gravitational force:

$$r(\theta; \alpha, \epsilon, \omega) = \frac{\alpha}{1 + \epsilon \cos \theta - \omega}$$

Parameters: $\mathbb{P} = \{\alpha, \epsilon, \omega\}$