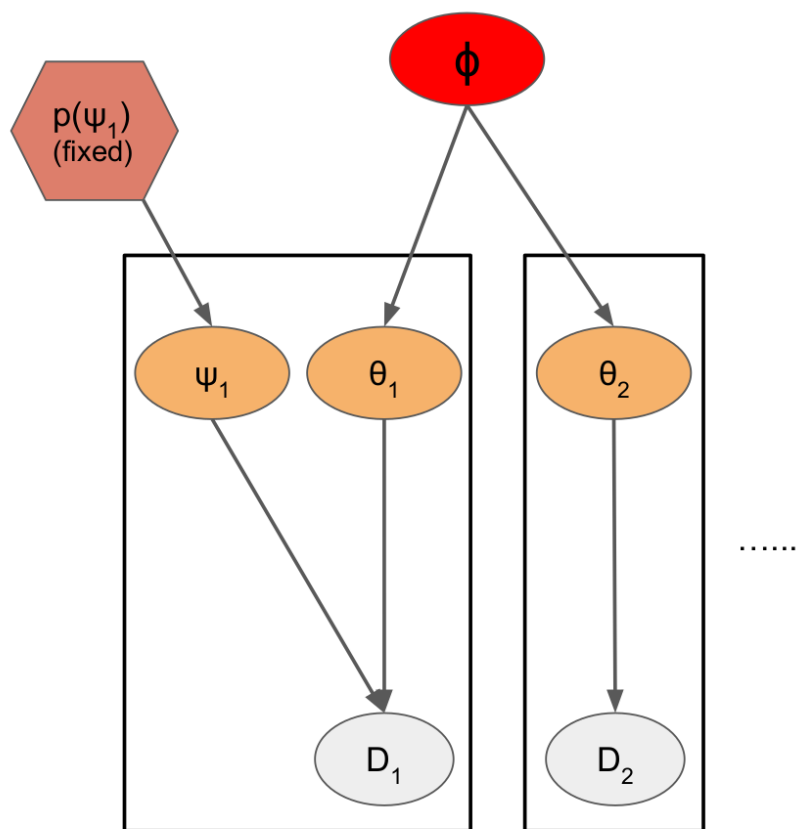


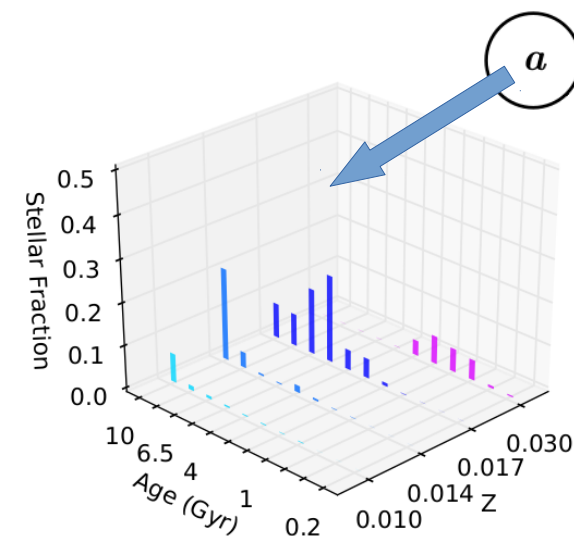
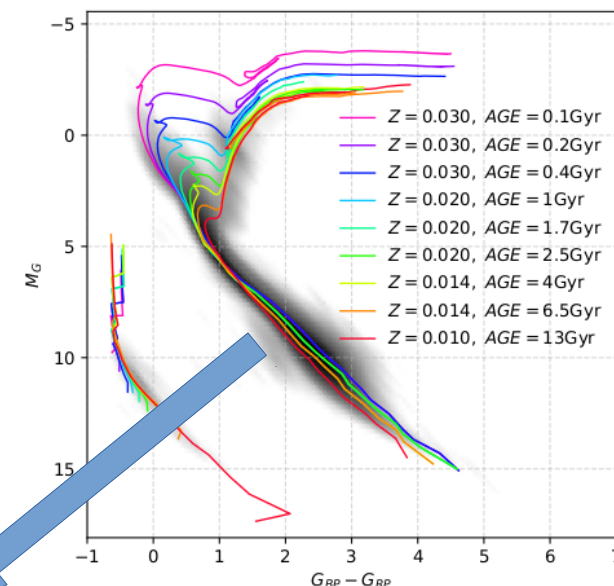
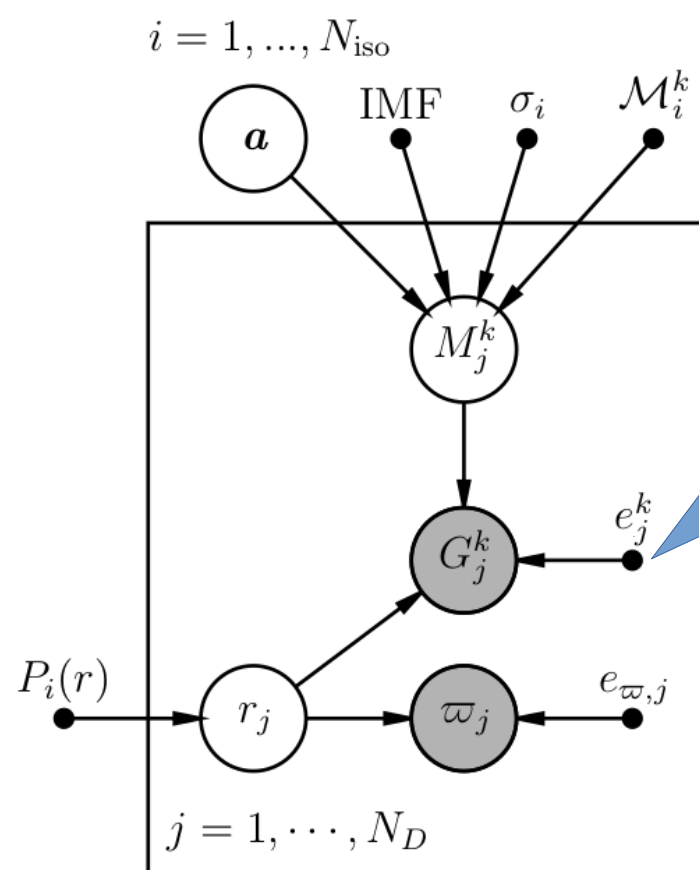
DEMO DAWGI BHM

Age-metallicity inference of a simple stellar population.

Ben's talk



Example: Alzate et al. (2021)



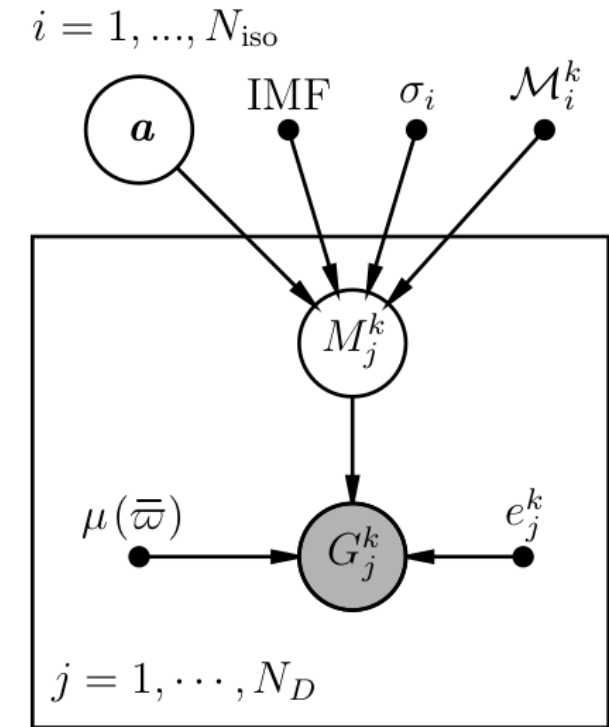
$$p(D_i | \theta_i) = \int d\psi_i p(D_i | \theta_i, \psi_i) p(\psi_i)$$

Simple stellar population model (DEMO)

Hyper-parameter	\mathbf{a}		Stellar fraction vector
Parameters	M_j^k	mag	Absolute magnitude
	$\varpi_{\text{true},j}$	mas	True parallax
	$G_{\text{true},j}^k$	mag	True apparent magnitude
Data	G_j^k	mag	Observed apparent magnitude
	e_j^k	mag	Apparent magnitude error
Fixed quantities	μ	mas	Distance modulus
	\mathcal{M}_i^k	mag	Absolute magnitude isochrone
	σ_i^k	mag	Observed apparent magnitude
	$\phi(m)$		Initial mass function

K=1,2,3 > white, blue, red phot. bands

$$G_{\text{true},j}^k = M_j^k + \mu$$



$$M_j^k \sim \mathcal{N}(\mathcal{M}_i^k(m), \sigma_i^k(m))$$

$$G_j^k \sim \mathcal{N}(G_{\text{true},j}^k, e_j^k)$$

Simple stellar population model (DEMO)

$$P(\mathbf{a}|G_j^k) = P(\mathbf{a}) \prod_{j=1}^{N_D} \int \frac{S(G_j^k) P(G_j^k | G_{\text{true}}^k) P(M_j^k | \mathbf{a})}{\ell(\mathbf{a}, S)} dM_j^k$$

Hyper-prior:

$$P(\mathbf{a}) = \frac{\Gamma(\xi N_{iso})}{\Gamma(\xi)^{N_{iso}}} \prod_{i=1}^{N_{iso}} a_i^{\xi-1}$$

Likelihood:

$$P(G_j^k | G_{\text{true},j}^k) = \prod_{k=1}^3 \mathcal{N}(G_j^k | G_{\text{true},j}^k, e_j^k).$$

Prior:

$$P(M_j^k | \mathbf{a}) \propto \sum_{i=1}^{N_{iso}} a_i \int_{m_{l,i}}^{m_{u,i}} \phi(m) \prod_{k=1}^3 \mathcal{N}(M_j^k | \mathcal{M}_i^k, \sigma_i^k) dm.$$

Implementation:

$$P(\mathbf{a}|G_j^k) \propto P(\mathbf{a}) \prod_{j=1}^{N_D} \sum_{i=1}^{N_{iso}} a_i P_{ij}$$

- 1) P_{ij}
- 2) Sampling the posterior
- 3) Estimate AMD and credible intervals using percentiles.

Age-metallicity distribution (AMD): Pleiades

Ben's talk

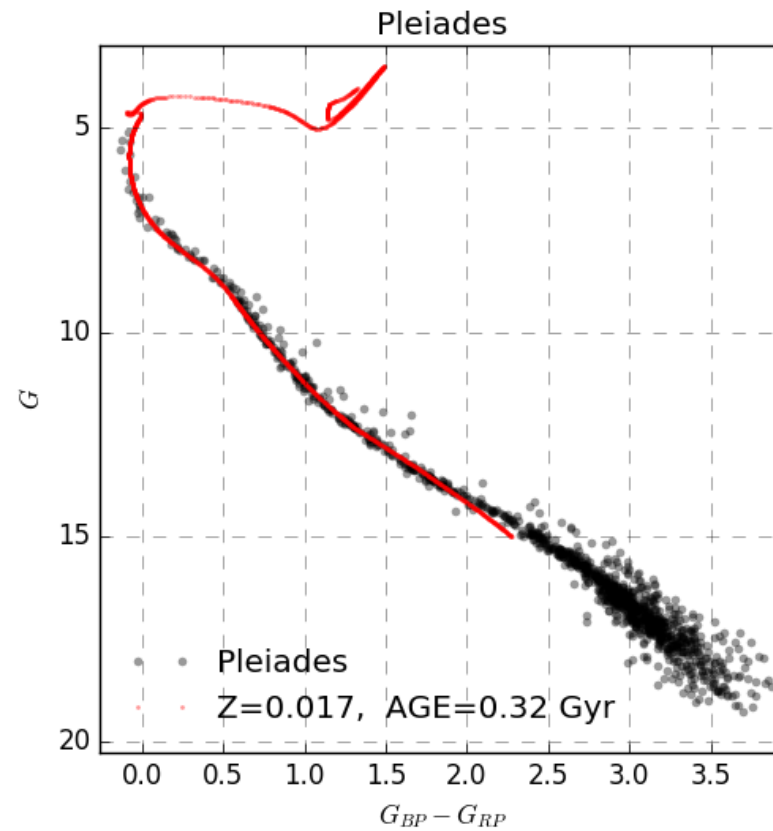
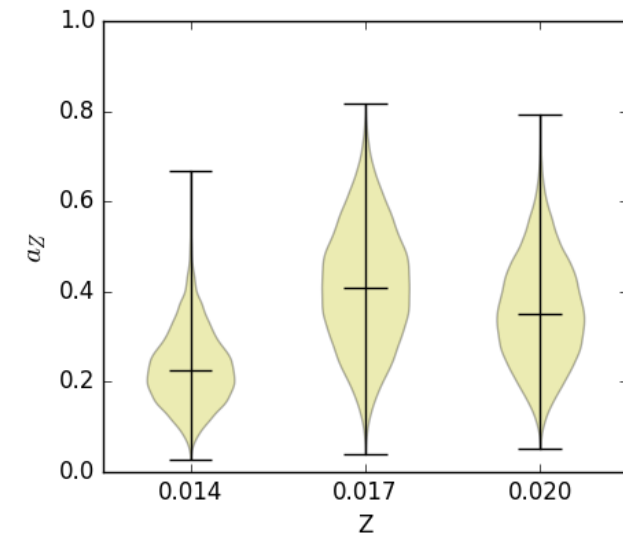
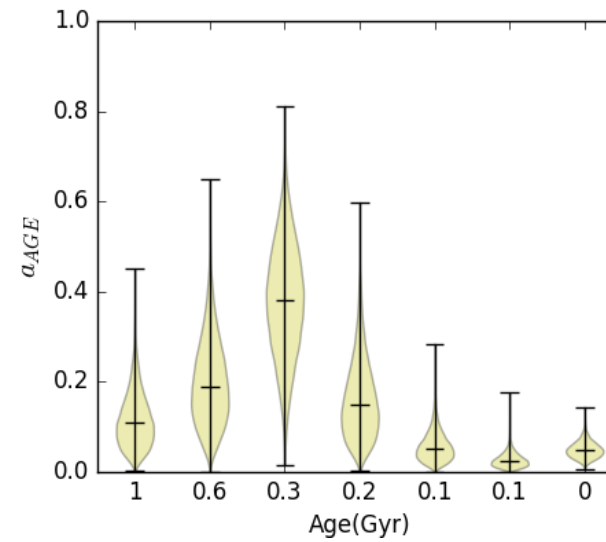
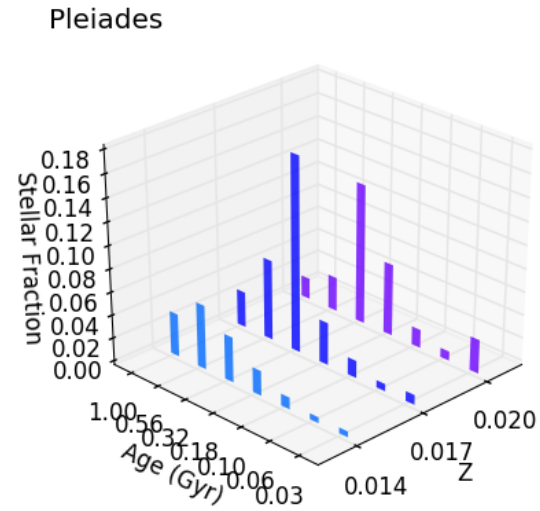
HBM: Practical advice

- Carefully consider dependencies in your model.
- Beware selection effects; these can be included in the model but may be complex.
- Usually good to try on a mock population first!

Activities:

- Infer the of the population for stars brighter than: $G=20$ mag and $G=15$ mag.
- Infer AMD for $G=20$ mag for Salpeter and Kroupa IMF.

Results: $G < 15$ mag



Results: $G < 20$ mag

