Galaxy Stellar Mass Function

Weigel + 2016

* $\boxed{\text{The } 1/V_{max} \text{ Technique}}$ (Schmidt 1968)

weight each object by the maximum volume it could be detected in.

To estimate the number density Φ we bin in stellar mass :

$$\boxed{\Phi_j \, d\log M = \sum_{i}^{N_{bin}} \frac{w_{spec,i}}{V_{max,i}}}$$

$w_{spec,i}$ = spectroscopic completeness.

$$\boxed{V_{max,i} = \frac{4\pi}{3} \frac{\Omega^s}{\Omega^{sky}} \cdot \left(d_c(z_{max,i})^3 - d_c(z_{min,i})^3 \right)}$$

(Hogg 1999).

$\Omega^{sky} = 41\,253 \deg^2 \equiv$ surface area of entire sky

$\Omega^s \equiv$ survey area covered by our sample

$d_c(z) \equiv$ comoving distance at redshift z.

- $z_{min,i} \equiv$ lower redshift limit of sample.
- $z_{max,i} = \min\left(z^s_{max}, z^{mass}_{max,i} \right)$,

$z^s_{max} \equiv$ maximum z of sample.

$z^{mass}_{max,i} \equiv$ maximum z for object i (Pozzeti method).

Sherman + 2019.

first → bin in redshift.

second → bin in mass.

If $z_{max} < z^s_{min}$:

$$V_{max} = \min\left(V_{max}(0, z_{max}), V_{max}(z^s_{min}, z^s_{max}) \right)$$

⊛ Error calculation

For each mass bin j:

$$W_{eff,j} = \frac{\sum_i^{N_{bin}} \frac{w^2_{spec,i}}{V^2_{max,i}}}{\sum_i^{N_{bin}} \frac{w_{spec,i}}{V_{max,i}}} \quad , \quad N_{eff,j} = \frac{\sum_i \frac{w_{spec,i}}{V_{max,i}}}{W_{eff,j}} = \frac{\left(\sum \frac{w_{spec,i}}{V_{max,i}}\right)^2}{\sum \frac{w^2_{spec,i}}{V^2_{max,i}}}$$

For large N_j $\sigma_{\phi,up}$ and $\sigma_{\phi,low}$ approach the limit:

$$W_{eff} \times \sqrt{N_{eff}} = \boxed{\sqrt{\sum_i^{N_{bin}} \frac{w^2_{spec}}{V^2_{max,i}}}}$$

Sherman + 2019 → poisson errors.