Testing mass distribution of binaries from magnitude difference of visual binary stars.

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Masses of stars m_1 and m_2 are drawn independently from IMF f(m) – ***Random Pairing (RP)***

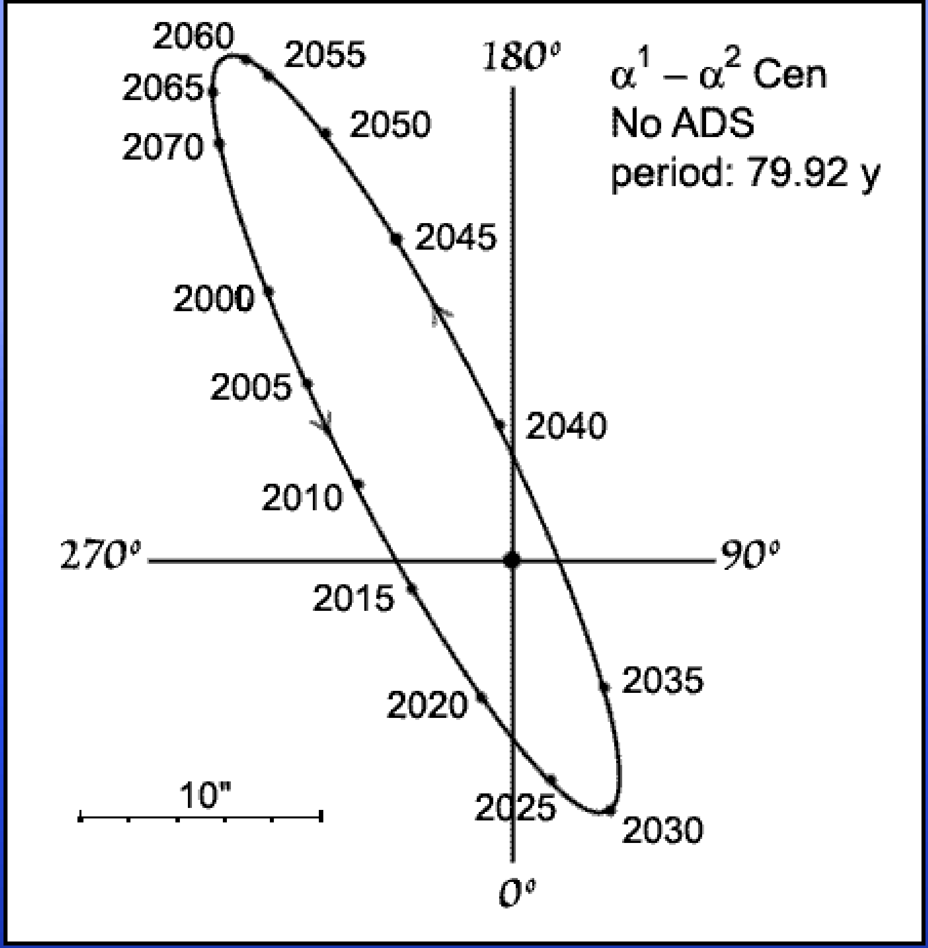
The **mass ratio distribution f(q)** describes the distribution over $q=m_2/m_1$

The primary mass m_1 is inferred from f(m), while f(q) is used to determine a companion mass m_2 – ***Primary-Constrained Pairing*** **(PCP)**

Total mass of binary system $m_1 + m_2$ is drawn from f(m), mass ratio is determined with f(q) – **Split-Core Pairing (SCP)**

See M. B. N. Kouwenhoven, et al. A&A 493, 979–1016 (2009)

Pairing function	Primary mass	Secondary mass	Total mass
	M_1	M_2	M_1+M_2
RP	f(m)	f(m)	
PCP	f(m)	f(q)	
SCP	f(q)		f(m)

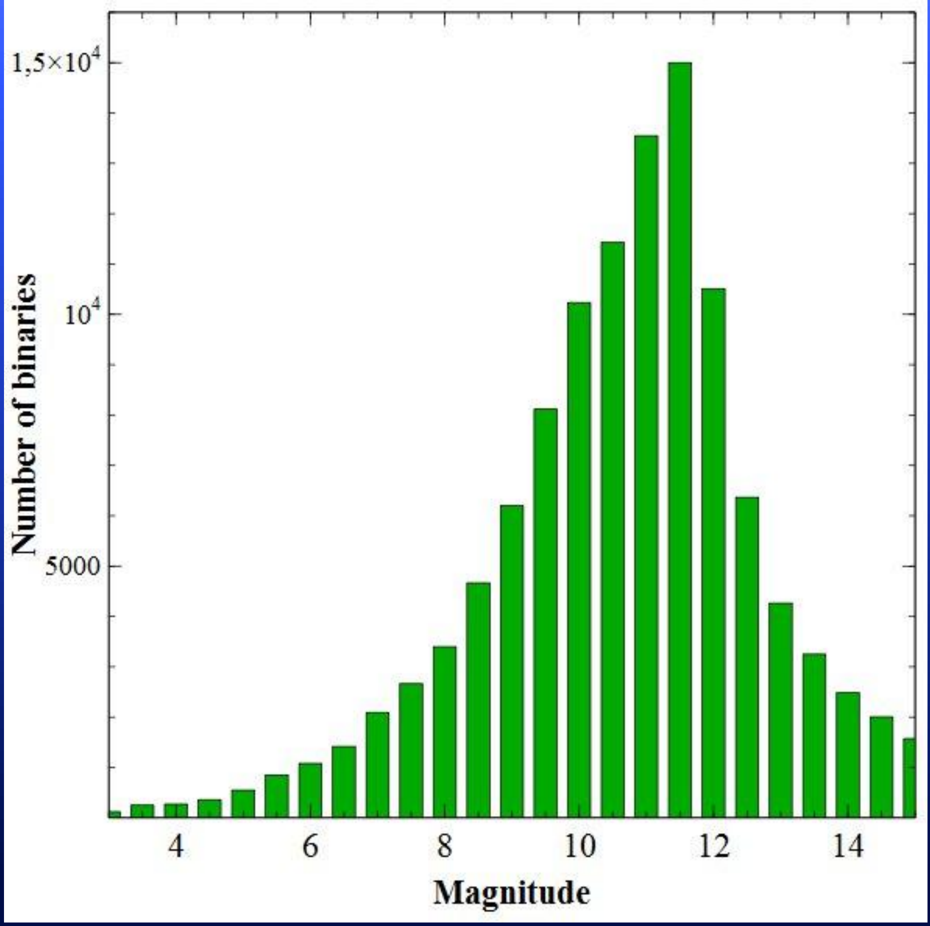


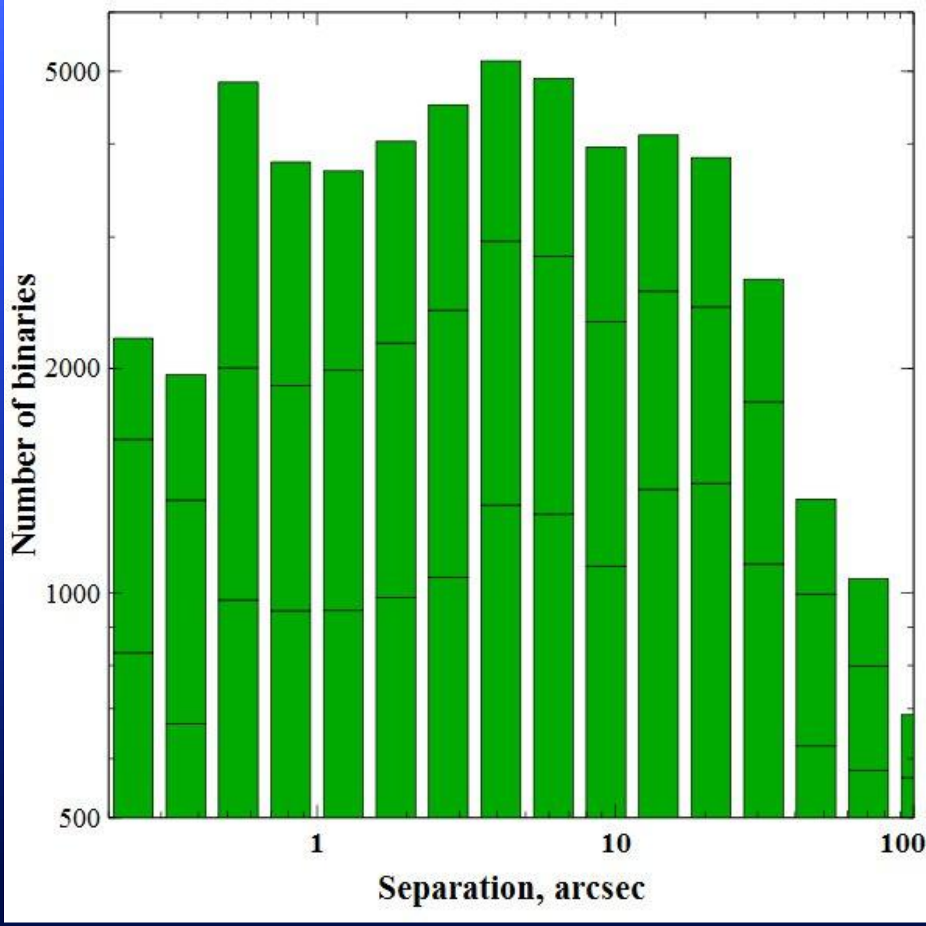
Components of **visual binaries** are observed as distinct sources of light. The total number of entries in *catalogues* is around 120,000.

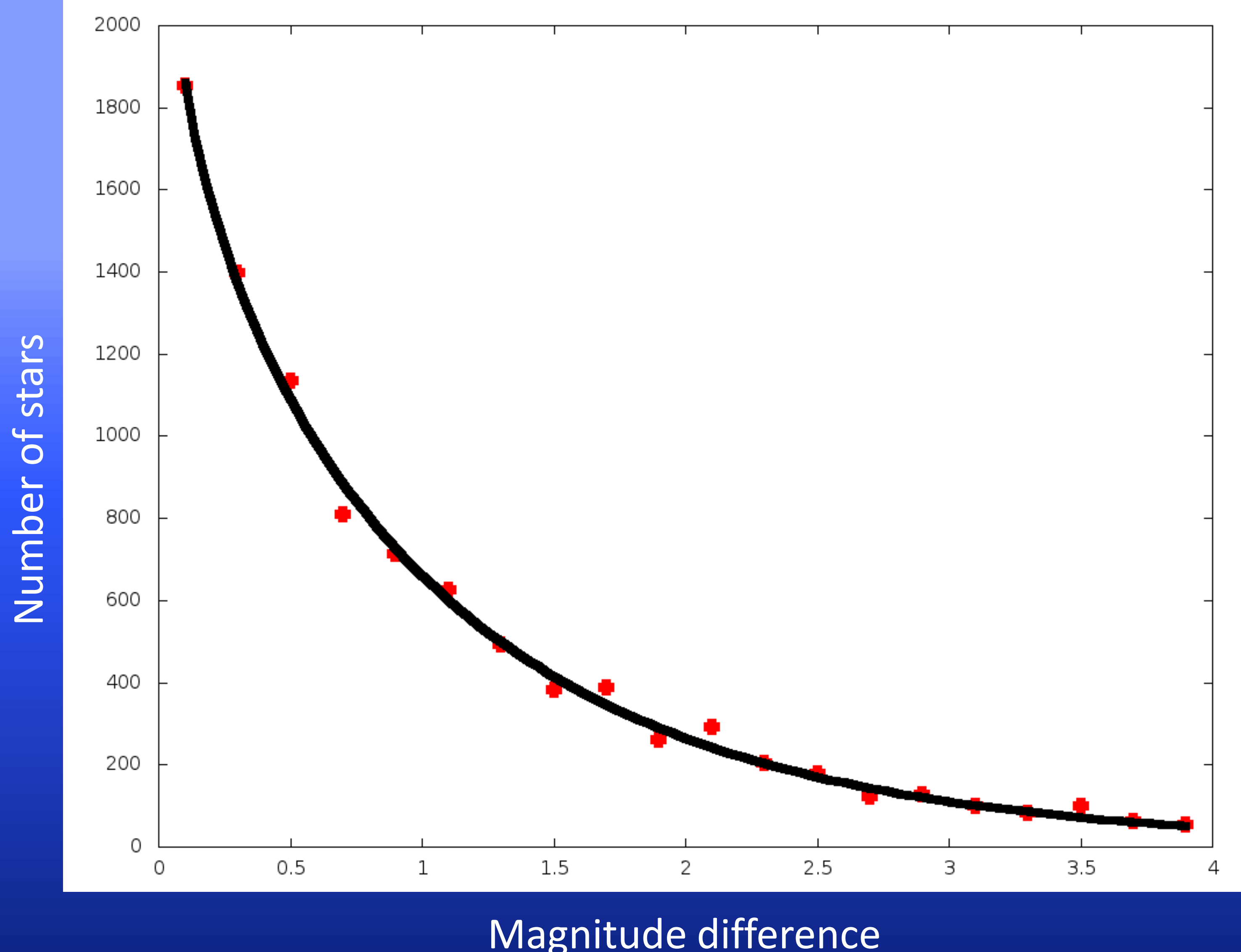
Catalog of Components of Double & Multiple stars (CCDM),
The Washington Visual Double Star Catalog (WDS),
Tycho Double Star Catalogue (TDSC)

Selection biases

1. Faint stars
2. Close binaries certainly miss components with large Δmag
3. Wide binaries are contaminated by optical pairs
4. Multiple systems







We restrict our sample to a certain range of observed parameters:

1. Magnitude of **both** components should be brighter than 11m
2. Only pairs with angular separation $1.5 < \rho < 15$ arcsec are considered

9246 binaries are present in the final sample

Comprehensive analytic formulae for stellar evolution as a function of mass and metallicity

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ABSTRACT
We present analytic formulae that approximate the evolution of stars for a wide range of mass M and metallicity Z. Stellar luminosity, radius and core mass are given as a function of age, M and Z, for all phases from the zero-age main sequence up to, and including, the remnant stages. For the most part we find continuous formulae accurate to within 5 per cent of detailed models. These formulae are useful for purposes such as population synthesis that require very rapid but accurate evaluation of stellar properties, and in particular for use in combination with N-body codes. We describe a mass-loss prescription that can be used with these formulae, and investigate the resulting stellar remnant distribution.

Visual binaries are wide non-interacting systems, therefore we may use reliable single star interpolation formulas estimating stellar luminosity as a function of stellar mass and age.
We carry out series of Monte Carlo simulations in order to build population synthesis model and select the appropriate f(q) and f(m) distributions.

Likely, different physical processes are responsible for the formation scenarios of wide and close binaries: Early core fragmentation and Disk fragmentation.
Unfortunately, present theoretical models fail to predict exact primordial distribution either for each of them separately or for the whole population of binaries.

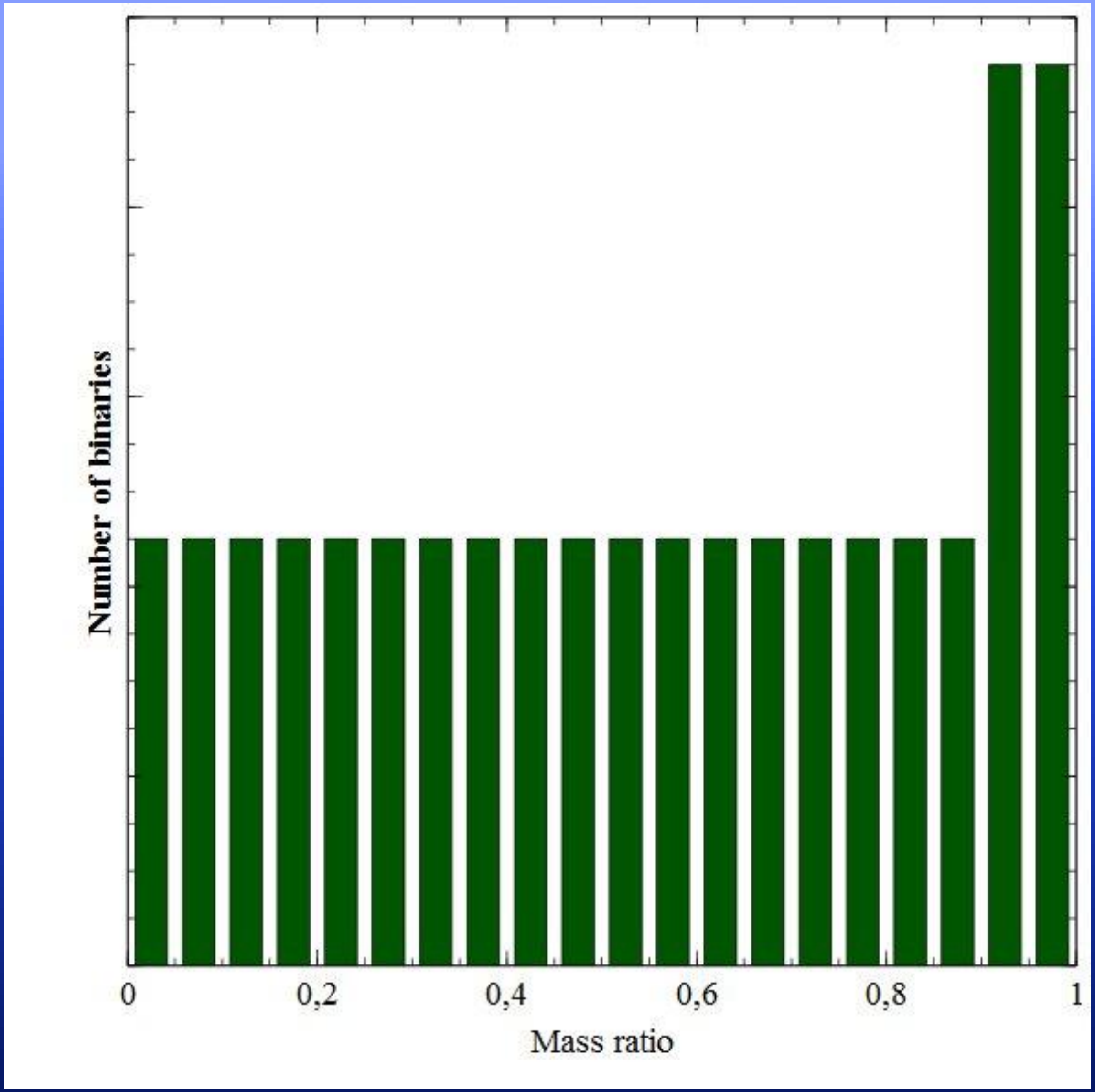
See K. Kratter, The Formation of Binaries, in proceedings for the ESO Workshop 'Evolution of Compact Binaries' (2011)

f(m) $\propto m^{\alpha}$, $m < 0.5M_{Sun}$
f(m) $\propto m^{\beta}$, $M_{Sun} < m < 0.5M_{Sun}$
f(m) $\propto m^{\gamma}$, $m > M_{Sun}$

f(q) – flat, linear slope, twin peak?

The same filters for magnitude and separation of binaries are applied for real catalogue data and population synthesis model.

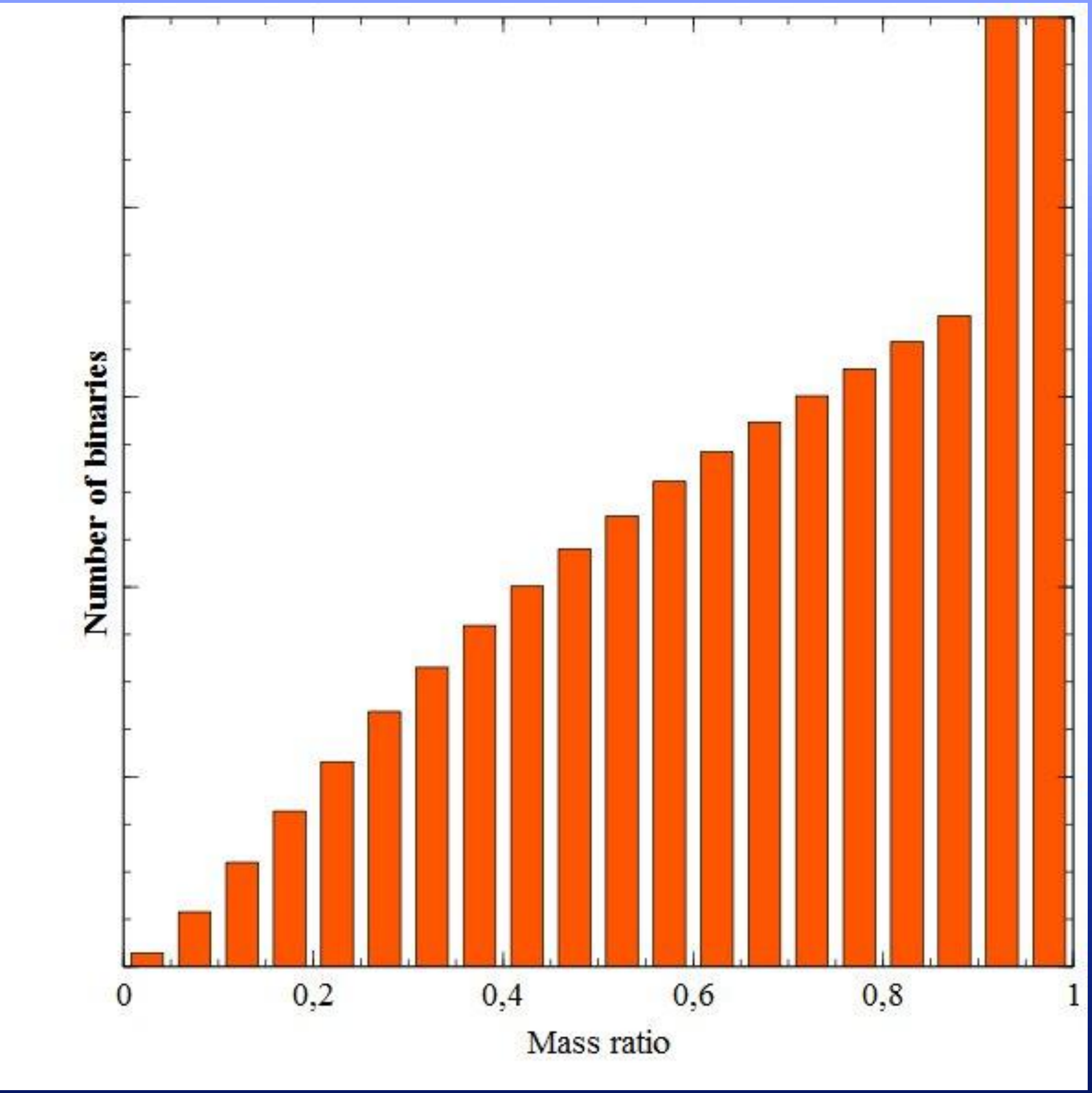
f(q) distribution



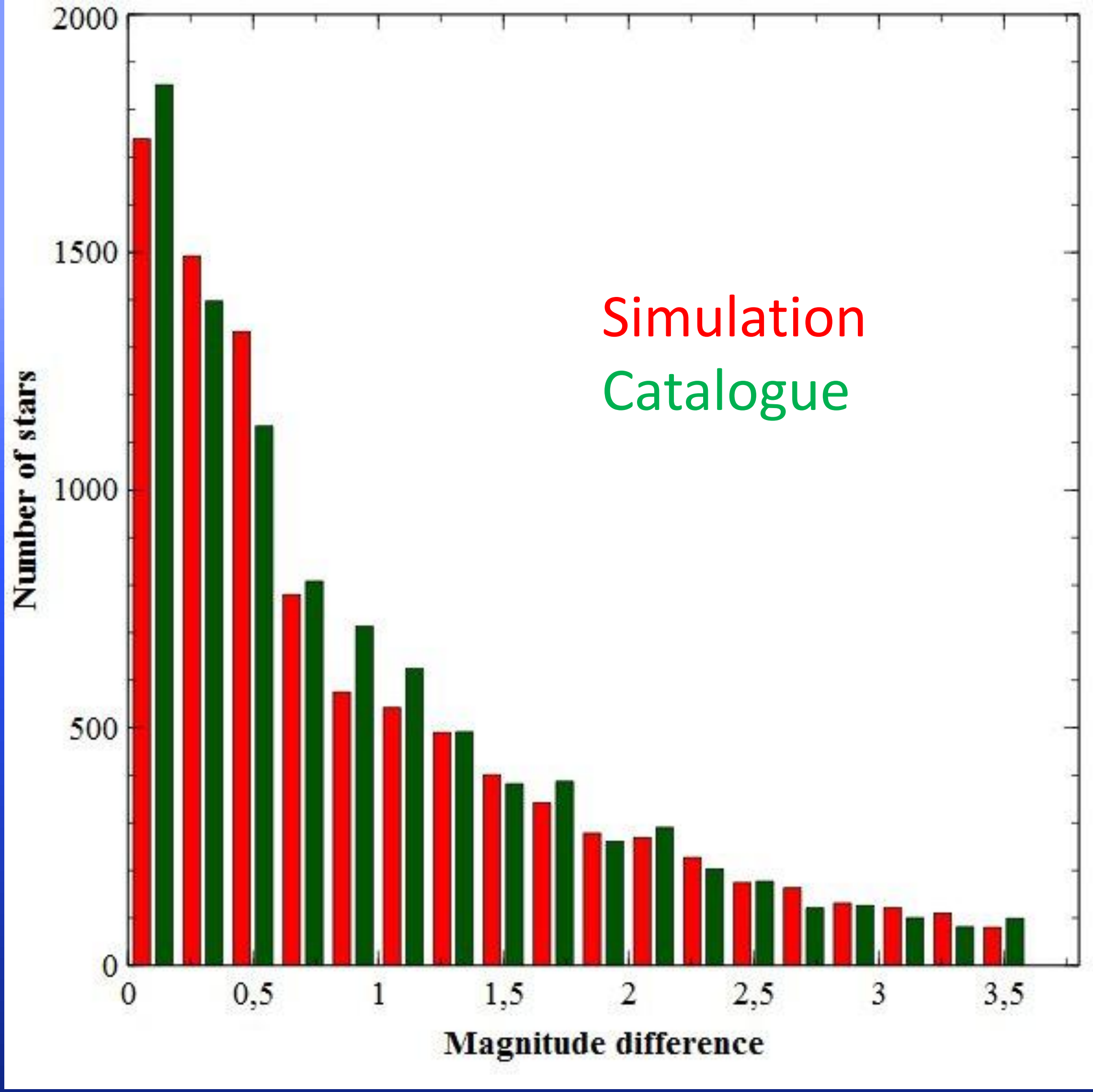
Flat distribution?

Twin peak for binaries with q≈1?

f(q) distribution

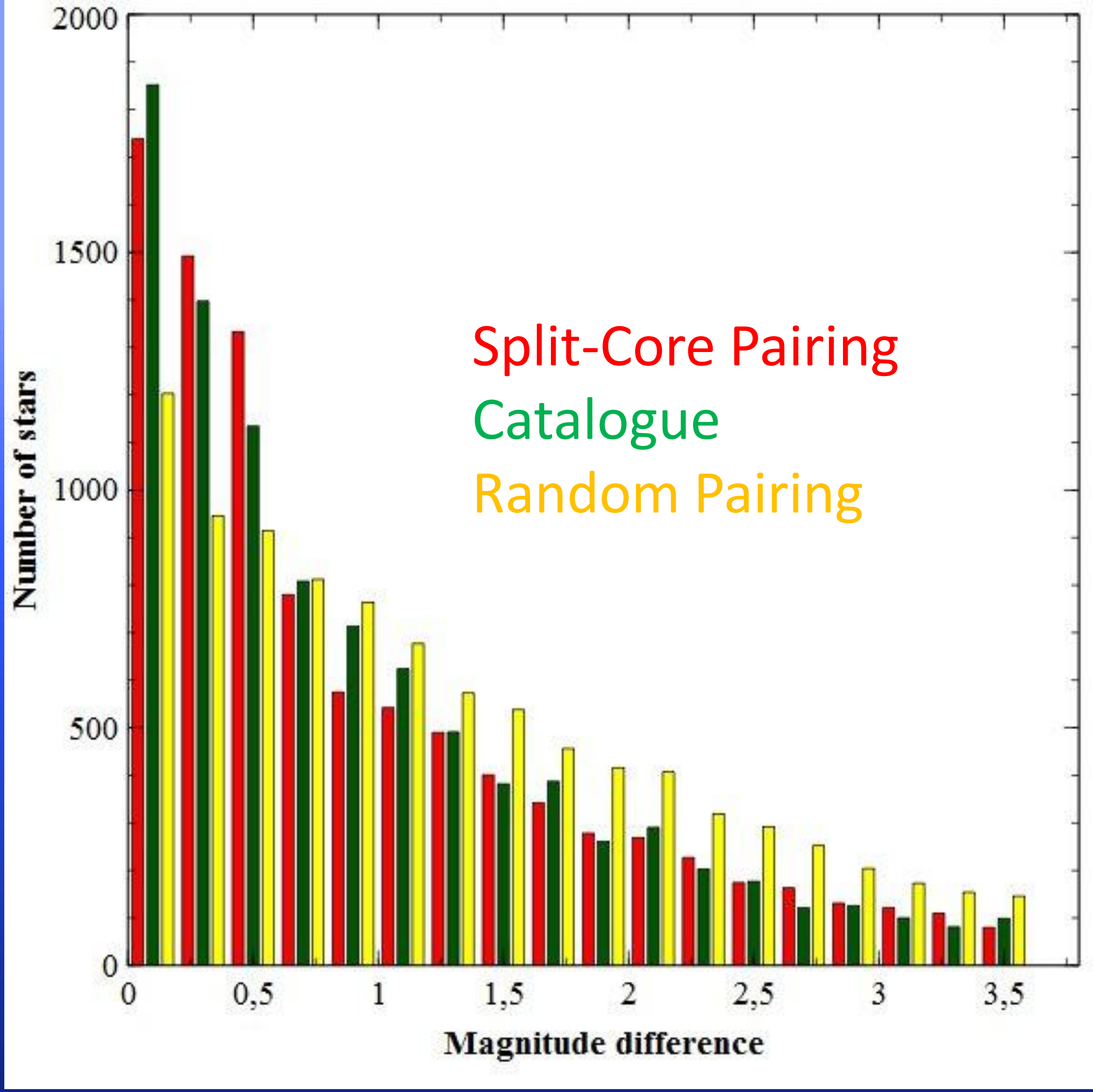


Systems with low generated q are more likely to be excluded due to selection bias. Generating and final f(q) distributions are different!



The best fitting is obtained with Split-Core Pairing (SCP) which involves flat generating f(q) distribution with a twin peak.

f(m) $\propto m^{-2.1}$, $m < 0.5M_{Sun}$ **f(m)** $\propto m^{-2.4}$, $m > 0.5M_{Sun}$



Random Pairing certainly contradict observational data.
Models with twin peak give a better fitting.
The choice between PCP and SCP is less evident.