ResearchUpdate3-1-16

Graham Roberts

April 2016

1 Introduction

A fair amount has happened since the last update. I am now homing in on membership probabilities I believe. I began by plotting the density of stars as a function of of radial distance from the median in both proper motion and spacial space, but those, didn't quite turn into anything useful. Normalizing the bins that were expanding by a power of radius wasn't terribly challenging, but also wasn't quite meaningful. I haven't completely abandoned that path, but I've been pursuing slightly different means to an end.

2 continuous functions

I created a couple continuous bell curves that model the distributions of stars of my known members as a function of radial distance. This was merely a measure of frequency. not density, so I did not normalize the bin sizes, which would ultimately have proven unneccesary. These curves could be used to calulate the probability that a star would have a given radial distance, assuming it was member of the cluster $P(R|M)$., I then calculated an approximate uniform distribution of stars. Using this I was able o calculate the probability of a stars having a radius $P(R)$. next I mixed my knowns back into the catalog, and found the excess in stars above my approximated uniform distribution of field stars. This excess, I defined as the increased stellar density as the result of the presence of the Alpha Persei cluster. I approximated this to be the number of stars in the cluster. bBy that count we expected to have 697, out of 97000 stars as members of the cluster, which is not a number I intend to use as a hard limit, but it served nicely as the probability of being a member merely by being in the catalog, $P(M) = \frac{697}{97819}$. This set us up to actually calculate the probability of being a member assuming a given radial distance.

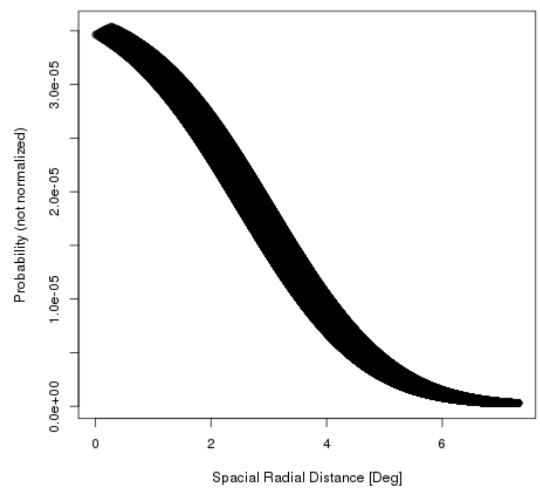
Using the Identities for conditional probabilities.

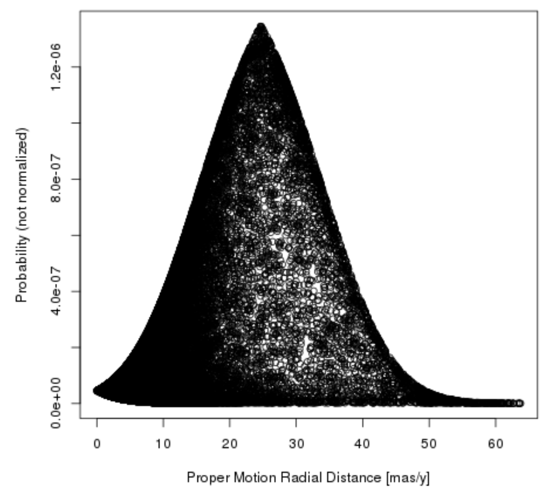
$$P(R|M) = \frac{P(R \cap M)}{P(M)}$$
$$P(M|R) = \frac{P(R \cap M)}{P(R)}$$
$$P(R \cap M) = P(R|M)P(M)$$
$$P(M|R) = \frac{P(R|M)P(M)}{P(R)}$$

This is a derivation of Bayes' theorem, of Bayesian Statistics fame, although this one identity does not take my work outside the realm of frequentist statistics. The only remaining problem was that my probability density functions, were just that, density functions. It was meaningless to calculate the probabilities that a stars would have radial distance less than or equal to the measured radial distance. As stars began to have greater radial distances, these values would increase, despite the fact that logically speaking these objects, are less likely to be in the cluster. As radial distance increased to infinity it would be trivial to note that a member of the cluster would indeed fall somewhere in all of space. Instead I measured the probability that a star would have a greater or equal radial distance assuming membership, and the probabilities that a star would have a greater or equal radial distance, simply by being a star. It is worth noting that the spatial area bins of the different samples changed at the exact same rate as a function of radial distance. This dynamic bin size against which I was measuring made normalizing against the different areas as radius increased unnecessary. These are both plots of the same y values, those being the products of probabilities gained from each distribution.

3 plots

Below I include just a couple plots, these are the distributions of membership probabilities over radial distances. They are not quite properly normalized, but if we de ide to pursue this direction I can nornmalize them better.





Having seen both of them I have also included a 3D plot of the multi[lied distributions, although axis labels are still broken on my 3D graph