Data Analysis Problems - III

1. What is the optimum aperture to use for photometry of radially symmetric Gaussian, exponential and Moffat profile images ?

   Parameterise each distribution using the FWHM as the "scale" size and consider the case of constant Gaussian background noise (ie. faint images where sky noise dominates).

   How good is the optiumum aperture relative to the MVB obtainable, for example, from idealised profile fitting (ie. assume the image sampling is sufficiently good that you can use integrals to estimate the MVB).

2. The following are Milky Way satellite galaxies:
   Carina – 87 kpc; Draco – 76 kpc; Fornax – 131 kpc; Leo I – 251 kpc; Leo II – 230 kpc; LMC – 49 kpc; Sculptor – 78 kpc; Sextans – 90 kpc; SMC – 58 kpc; Ursa Minor – 69 kpc.
   Using the distances given and the statement that searches for Galactic satellites are complete in the range 30–300kpc, what is the best fit radially-symmetric power law distribution for these satellites ?

   What happens to this result if we add in the other two satellites,
   Sgr – 24 kpc and Phoenix – 390 kpc and assume search completeness in the range 20–450 kpc ?

3. The apparent I-band magnitude (extinction-corrected) of the Tip of the Red Giant Branch (TRGB) is a commonly used distance estimator for nearby galaxies out to $\sim$10Mpc. [The absolute I-band magnitude of the

TRGB is very close to -4.0 over a wide range of metallicities]. For the sparsely populated RGB of faint dwarf galaxies what bias is introduced in the distance estimate if only a small sample of RGB stars is available (eg. 10,20,50,100, 1000). Assume an RGB luminosity function that rises linearly to fainter magnitudes from the theoretical tip and that the top 2.5 magnitudes of the RGB are equivalently visible in the data.