

Name: _____

Homework 4 – Ast 399 – Spring 2003
Due Mon April 14, 2003

1. You are given a spreadsheet with some data on standard stars and the Eclipsing system RCMa. Your main task for this homework is to reduce the data. This spread sheet will be emailed to all of you as an attachment. The easiest way to do the homework will be to put the formulas in the spread sheet, however, you can do this by hand if you wish. To that end, you can access the following programs from tinsley:
 - avg – calculates the mean $\pm \sigma$ for a list of numbers
 - avge – calculates the weighted mean $\pm \sigma$ for a list of numbers and their values σ
 - (a) Compute the UT midtime of each observation (set of 10 measurements) and fill in the appropriate box on the spreadsheet as fractional hours.
 - (b) For each observation (*e.g.* set of 10), compute the local sidereal time, Hour angle and Airmass of the observation. If you are using excel, the trig functions assume that you are using radians, not degrees for the calculation. There are $\pi/180$ radians per degree. This conversion factor is in cell U1 of the spreadsheet.
 - (c) Compute the mean and standard deviation for each set of 10 observations for the object+sky and the sky values and enter into the appropriate columns on the spread sheet.
 - (d) Compute the sky-subtracted average object counts, and the standard deviation (being careful to propagate the errors as discussed in class).
 - (e) Convert this to an instrumental magnitude $\pm \sigma$, again propagating the errors. The term “instrumental magnitude” assumes that the zero point = 0, or $\text{mag} = -2.5 \log(\text{counts}/\text{sec})$. Enter this into the correct places on the spread sheet. Leave the other fields blank – we will discuss this in class.
2. Two stars have apparent V-band magnitudes of $V=7\text{mag}$ and $V=5\text{mag}$, respectively.
 - (a) What is the ratio of their observed fluxes?
 - (b) If one wanted to obtain photometry of each star, at the same signal-to-noise ratio, how much longer would one have to integrate (expose) the CCD?
3. You are observing a faint star and would like 1% accuracy in your photometric measurement (*e.g.* a signal-to-noise ratio of 100:1). After 5 minutes of integration time with a CCD on a 2.5-meter diameter telescope, you have a signal-to-noise ratio of 10:1 (10% accuracy).
 - (a) What is the total integration time required to achieve the desired signal-to-noise ratio of 100:1? Do you think it is worth striving for this accuracy of measurement?
 - (b) If you could increase the quantum efficiency of your detector by a factor of 10, what would be the total integration time required to achieve the desired signal-to-noise ratio of 100:1? Do you think it would now be worth striving for this accuracy of measurement?