

## ASTRONOMY 300B: Homework Number 2

Prof. J. Bechtold

Due: Wednesday, January 28, 2009, in class

### 1. The binomial distribution. (30 pts)

Perform the following experiment: Get 10 pennies, and put them in a box. Shake the box, and record how many heads there are – this is one “game”. Repeat 15 times.

- Plot a histogram of the number of games in which N heads were recorded, versus N (for N=0 to 10), (1) for the first 5 games, (2) for 10 games, and (3) for all 15 games. Use sm, excel or some other computer program to make your plots.
- Give the expression for the binomial distribution functions describing these histograms, and plot them on the same graphs as your data.

### 2. Mean and variance of the binomial distribution. (20pts)

Recall the binomial distribution,

$$P(k,n,p) = \binom{n}{k} p^k (1-p)^{n-k}$$

where k=number of successes in n tries where the probability of success in each try is p.

- (a) Show that the mean  $\mu = np$ .

Hint: Make the following substitutions:  $y=k-1$  and  $m=n-1$ . Then use the fact that by definition, probabilities are normalized to unit sum.

- (b) Show that the variance  $\sigma^2 = n p (1-p)$

Hint: use a similar trick to the one in part (a).