PH689-01 – Fall 2006
Statistical methods for physics and astrophysics
SOLUTIONS to Assignment #1

1. Consider 3 baseball players:

Player A was at bat 200 times, hitting .310;

player B was at bat 250 times, hitting .290;

player C was at bat 300 times, hitting .265.

Find:

(a) The probability that when either player A, B or C were at bat, the ball was hit safely;

P(hit/A)=0.31; P(hit/B)=0.29; P(hit/C)=0.265;

P(A at bat)≡P(A)=200/750=0.267;

P(B)=250/750=0.333;

P(C)=300/750=0.400;

Use theorem of total probability:

P(hit)=Σ_i P(hit/i)P(i) = 0.31*0.267+0.29*0.333+0.400*0.265=0.285;

(b) The probability that, given that a hit was recorded, it came from player A, B or C.

Use Bayes' theorem:

P(A/hit)=$\frac{P(hit/A)\cdot p(A)}{P(hit)}$=0.290;

P(B/hit)=0.339;

P(C/hit)=0.372.

2. Sketch a proof of the following basic properties of probability, based on Kolmogoroff's axioms:

(a) P($\emptyset$)=0;

Use the result from part (b) with A=S:

P($\emptyset$)=1-P(S)=1-1=0.

(b) P($\overline{A}$)=1-P(A)

Since $S = A \cup \overline{A}$, and A and $\overline{A}$ are mututally exclusive:

P(S)=P(A)+P($\overline{A}$)=1 $\Rightarrow$P($\overline{A}$)=1-P(A).

(c) P(A $\cup$ B) = P(A) + P(B) - P(A $\cap$ B)

It is sufficient to use a 'graphical' method to realize that the set A $\cap$ B needs to have its probability subtracted, in order to avoid double-counting of probabilities.

3. Find a suitable random experiment and two events A and B that are

(a) independent;

Experiment is: toss of 2 coins.

A={coin 1 shows Heads, coin 2 shows either}, P(A)=1/2;

B={coin 1 shows either, coin 2 shows Tails}, P(B)=1/2;

A$\cap$B={coin 1 shows H and coin 2 shows T}, P(A$\cap$B)=1/4.

Since P(A)$\cdot$P(B)=P(A$\cap$B), the two events are independent.

(b) not independent.

Experiment is: toss of 1 coin.

A={coin shows Heads}, P(A)=1/2

B={coin shows Tails}, P(B)=1/2.

A$\cap$B={coin shows H and T}, P(A$\cap$B)=0;