Physics 336
HW4

1. Define the following terms:

(a) mean

(b) median

(c) mode

(d) Compare the above terms for the case of

(i) a Gaussian Distribution

(ii) a Poisson Distribution

(iii) a binomial distribution with equal probabilities

(iv) a binomial distribution with unequal probabilities

2. Plot together (over a reasonable range) a Poisson distribution and a Gaussian distribution (with the same $\sigma$) for each of the following cases:

(a) $\mu = 1.0$

(b) $\mu = 2.5$

(c) $\mu = 5.0$

(d) $\mu = 10.$

(e) $\mu = 100$

(f) When is a Gaussian distribution a good approximation of a Poisson distribution?

3. Briefly describe the conditions when the following probability distributions are expected to apply:

(a) binomial

(b) Poisson

(c) Gaussian

4. Suppose a variable $x$ is confined to the domain $0 < x < 6$. This variable has the probability distrtibution given by

$$P(x) = \frac{1}{1 + (x-2)^2}$$

(a) Determine the mean, median and mode of this distribution.

(b) Calculate the probability that $1 < x < 2$.

(c) What fraction of the time will $x$ be within $1\sigma$ of the mean? within $2\sigma$?

5. Suppose 6 fair coins are tossed repeatedly.

(a) What fraction of the tosses are expected to result in 3 heads?

(b) Define success as tossing 2 or 3 or 4 heads. What fraction of the tosses are expected to result in success?

(c) What fraction of tosses are expected to result in at least 5 coins showing the same?

6. 5 unfair coins (each with $P_h = 0.65$) are tossed. How many heads are expected? What is the uncertainty?

7. A baseball player hit 52 home runs last year in 695 plate appearances. Use a Poisson distribution to describe this player's performance.

(a) What is the probability that this player hit 3 or more home runs in one game? Assume that, in a game, the player makes 5 plate appearances.

(b) What is the probability that the player did not hit a home run in 10 consecutive games?

(c) Evaluate the statement: If this player has not hit a home run in 10 consecutive games, then a home run is overdue and more likely to happen soon because of the law of averages.

8. A radiation counting experiment records, during successive 10-second intervals, the following numbers of counts:

$N =$ 0, 2, 1, 1, 1, 0, 1, 1, 1, 0, 0, 5, 2, 2, 3, 0, 1, 0, 1, 3, 2, 1, 1, 0, 0, 0, 1, 4, 0, 2

Does this data fit a Poisson distribution?