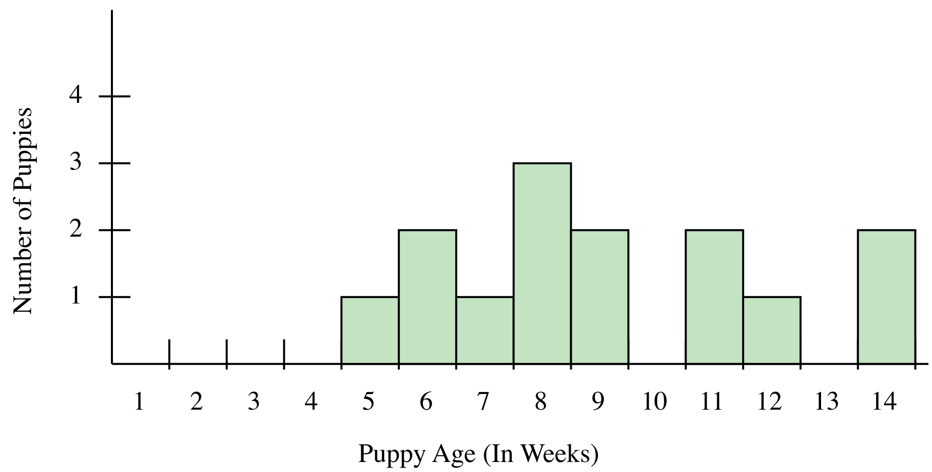
Remember, you may be called upon to present any one of these problems to the class, so you need to bring your complete assignment, where you have shown your work and explained your reasoning. Presentations do not receive full credit for a correct final answer without explanation or derivation.

1) **Discrete Probabilities**
For the distribution of puppy ages from our in-class activity (reproduced below):

(a) Compute $\langle j^2 \rangle$ and $\langle j \rangle^2$.

(b) Determine Δj for each j and use Equation 1.11 in Griffiths to compute the standard deviation.

(c) Use your results in (a) and (b) to check Equation 1.12.



We'll use Equation 1.12 *a lot; this problem helps us understand its constituent parts using discrete numbers. Feel free to use a spreadsheet as long as you can identify the equations used and show one example calculation per column.*

2) **Probabilities** (*two students will present this, one for each part*)
For the two probability distributions below, do the following: i) determine A, ii) determine the average $\langle x \rangle$, iii) determine the variance σ_x^2, and iv) sketch $\rho(x)$.

(a)
$$\rho(x) = \begin{cases} A, & \text{if } a \leq x \leq b \\ 0, & \text{else} \end{cases}$$

(b)
$$\rho(x) = Ae^{\left(\frac{-x^2}{2a^2}\right)} \qquad -\infty < \infty$$

(You'll need to look up some *definite integrals* in an integral table for this one, or perhaps in the back cover of your textbook. If an integrand is odd about the center of the limits of integration, do you even have to do the integral?)

These are the fundamental tasks we'll be doing throughout the course, for all kinds of probability distributions. The second distribution is a Gaussian function; we will use those integrals that you had to look up quite frequently so keep them handy.

3) Functions of Theta

The needle on a broken car speedometer is free to swing, and bounces perfectly off the pins at either end, so that if you give it a flick it is equally likely to come to rest at any angle between 0 and π.

(a) What is the probability density, $\rho(\theta)$? *Hint*: $\rho(\theta)d\theta$ is the probability that the needle will come to rest between θ and $(\theta + d\theta)$. Graph $\rho(\theta)$ as a function of θ, from $-\pi/2$ to $3\pi/2$. (Of course, *part* of this interval is excluded, so $\rho(\theta)$ is zero there.) Make sure the total probability is 1.

(b) Compute $\langle\theta\rangle$, $\langle\theta^2\rangle$, and σ, for this distribution.

(c) Compute $\langle\sin(\theta)\rangle$, $\langle\cos(\theta)\rangle$, and $\langle\cos^2(\theta)\rangle$.

Here we are practicing much of the same tasks as the previous problem, so don't get thrown off by this being a function of θ *instead of* x*. All the same equations* 1.16 *to* 1.19 *apply. The difference is that now you must define* $\rho(\theta)$ *instead of it being given to you. We'll also get practice taking integrals of trigonometric functions.*