(1) An urn contains 6 white marbles and 4 black marbles. If two marbles are randomly selected from the urn without replacement. Let x be the random variable representing the number of white marbles selected.

(a) What are the possible values of x?

$x = 0$, $x = 1$, $x = 2$

(b) Is x a continuous or discrete random variable?

Because the values of x are the result of a count and are whole number values, x is a discrete random variable.

(c) Create a probability distribution table for x. (Do your probabilities add up to 1?)

x	0	1	2
$P(x)$	$\frac{2}{15}$	$\frac{8}{15}$	$\frac{1}{3}$

(d) Determine the mean (or expected value) of x.

$\mu = \sum xP(x) = 0 \cdot \frac{2}{15} + 1 \cdot \frac{8}{15} + 2 \cdot \frac{1}{3} = 1.2$

(e) Determine the standard deviation of x.

$\sigma = \sqrt{\sum (x-\mu)^2 P(x)}$. With L_1 as x and L_2 as $P(x)$, 1-Var Stats L_1, L_2 yields 0.6531972647.

(2) A local grocery store has determined that (to the nearest minute) 15% of the customers take 1 minute to check out, 20% take 2 minutes to check out, 30% take 3 minutes to check out, 25% take 4 minutes to check out, and the rest take 5 minutes to check out.

(a) What is the average number of minutes it takes for one of the customers of this store to check out?

With L_1 as time (that is, $x = 1$, $x = 2$, $x = 3$, $x = 4$, and $x = 5$) and L_2 as probability (that is $P(1) = 0.15$, $P(2) = 0.20$, $P(3) = 0.30$, $P(4) = 0.25$, and $P(5) = 0.10$), 1-Var Stats L_1, L_2 yields $\bar{x} = 2.95$. So, on average it takes a customer 2.95 minutes to check out.

(b) If in a typical hour the store has 85 customers, how many check-out clerks would the store need to meet the demand?

If there are 85 customers, each taking 2.95 minutes to check out, then this requires $85 \cdot 2.95 = 250.75$ worker-minutes per hour. Since the greatest number of worker-minutes a single person can provide in one hour is 60, there would need to be a total of $\frac{250.75}{60} = 4.17916667$ workers per hour. Since we cannot have a fraction of a person, we will need 5 total checkout clerk bodies per hour, although not all 5 will have to be working for the entire time.

(3) *USA Today* reported that approximately 25% of all state prison inmates released on parole become repeat offenders while on parole. Suppose the parole board is examining five prisoners up for parole. Let x be the number of prisoners out of five on parole who become repeat offenders.

(a) The probability distribution for x is shown here.

x	0	1	2	3	4	5
$P(x)$	0.237	0.395	0.264	0.088	0.015	0.001

(i) What is the probability that one or more of the five parolees will be repeat offenders?

(That is, what is $P(x \geq 1)$?)

$P(x \geq 1) = 0.395 + 0.264 + 0.088 + 0.015 + 0.001 = 0.763$. So, there is a probability of 76.3% that one or more of the five parolees will be a repeat offender.

(ii) What is the probability that fewer than 3 will be repeat offenders?

(That is, what is $P(x < 3)$?)

$P(x < 3) = 0.237 + 0.395 + 0.264 = 0.896$. So, there is a probability of 89.6% that fewer than 3 will be repeat offenders.

(iii) What is the expected number of repeat offenders out of five?

$\mu = \sum xP(x)$. With L_1 as x and L_2 as $P(x)$, 1-Var Stats yields $\bar{x} = 1.252$.

(4) Sara is a 60-year-old Anglo female in reasonably good health. She wants to take out a $50,000 term (that is, straight death benefit) life insurance policy until she is 65. The policy will expire on her 65th birthday. (So, if she dies before her 65th birthday, the policy will pay out $50,000. Otherwise, it expires and pays out nothing.)

The probability of death in a give year is provide by the Vital Statistics Section of the *Statistical Abstract of the United States*.

$x =$ age	60	61	62	63	64
Probability of death	0.00756	0.00825	0.00896	0.00965	0.01035

(a) Sara is applying to Big Rock Insurance Company for her term insurance policy. What is the total expected cost to Big Rock Insurance over the years 60 through 64? (Again, in the case that Sara does not die, the cost to the insurance company is $0.)

To compute the expected cost (value) we can use $\mu = \sum xP(x)$ where x is either $50000 or $0. Since multiplying by 0 yields 0, we really only need consider the cases when $x = 50000$.

So, the expected cost is $50000 * 0.00756 + 50000 * 0.00825 + 50000 * 0.00965 + 50000 * 0.01035 = 2238.50$. That is, the expected cost to the insurance company is $2238.50.

(b) If Big Rock Insurance Company charges $5000 for the policy, then what is the expected profit for this policy?

Because the expected cost is $2238.50 and the known revenue is $5000, the expected profit is $5000 - 2238.50 = 2761.50$ dollars.