6.2 **Transforming and Combining Random Variables**

**Linear Transformations**

In Chapter 2, we studied the effects of linear transformations on the shape, center, and spread of a distribution of data. Recall:

Adding (or subtracting) a constant, a, to each observation:

Adds a to measures of center and location (mean, median, quartiles, percentiles).

Does not change the shape or measures of spread (range, *IQR*, standard deviation).

Multiplying (or dividing) each observation by a constant, b:

Multiplies (divides) measures of center and location (mean, median, quartiles, percentiles) by b.

Multiplies (divides) measures of spread (range, *IQR*, standard deviation) by |b|.

Does not change the shape of the distribution

Example:

Pete’s Jeep Tours offers a popular half-day trip in a tourist area. There must be at least 2 passengers for the trip to run, and the vehicle will hold up to 6 passengers. Define *X* as the number of passengers on a randomly selected day

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Passengers *xi*** | 2 | 3 | 4 | 5 | 6 |
| **Probability *pi*** | 0.15 | 0.25 | 0.35 | 0.20 | 0.05 |

Find the mean and standard deviation for the number of passengers.

Pete charges $150 per passenger. The random variable *C* describes the amount Pete collects on a randomly selected day.

Find the mean and standard deviation for the daily collections

It costs Pete $100 per trip to buy permits, gas, and a ferry pass. The random variable *V* describes the profit Pete makes on a randomly selected day.

Find the mean and standard deviation for the daily net profit

Example 2:

A car dealership tracks home many cars are sold in the first hour of the day. The probability distribution is :

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cars Sold** | 0 | 1 | 2 | 3 |
| **Probability** | 0.15 | 0.25 | 0.35 | 0.20 |

1. Find the mean and standard deviation for the number of cars sold
2. The sales manager gets a $500 bonus for every car sold. Find the mean and standard deviation for the bonus received
3. To encourage customers to come in early, the sales manager spends $75 of his own money for coffee and pastries. This $75 is deducted from his bonus for his net earnings. Find the mean and standard deviation for his net earnings

**In General**

If *Y* = *a* + *bX* is a linear transformation of the random variable *X*, then

* The probability distribution of *Y* has the same shape as the probability distribution of *X*.
*  = *a* *+ b*.
* = |*b*| (since *b* could be a negative number).

Example: Baby and the Bathwater

One brand of bathtub comes with a dial to set water temperature. With the dial set at “Babysafe”, the temperature X in Celcius is N(34, 2).

1. Define Y as the temperature in Fahrenheit. Given the conversion formula is F = 1.8C + 32, find the mean and standard deviation of Y.
2. Pediatricians say that bathwater for babies should be between 900F and 1000F. Find the probability that on a random selected day that the water temperature is between these two temperatures.