**Combining Random Variables (6.2b)**

At times it is useful to combine random variables. Let’s say a company is making guitars and sets aside all of the guitars at its factory that have defects. Defects show up as either dents or scratches. The following two tables show the probability distributions for numbers of dents or number of scratches:

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of dents, X** | 1 | 2 | 3 |
| **P(X)** | .5 | .3 | .2 |

|  |  |  |
| --- | --- | --- |
| **Number of scratches, Y** | 1 | 2 |
| **P(Y)** | .7 | .3 |

1. Find the mean, variance, and standard deviation of X. Do the same for Y.

The company is interested in the probability distribution of these variables combined (total defects).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Total Defects,**  **X + Y** | | Number of dents, X | | |
| 1 | 2 | 3 |
| Number of Scratches, Y | 1 | 2 |  |  |
| 2 |  |  |  |

1. Complete the table for the total number of defects to find all possible combinations of defects.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Total Defects,**  **X + Y** |  |  |  |  |
| **P(X + Y)** |  |  |  |  |

1. Make a table showing the probability distribution of (X + Y).
2. Use the table from #3 to find the mean, variance, and standard deviation of (X + Y).
3. Which of the following statements are true? Circle the statement if it is true.



Sometimes it is useful to subtract random variables from each other. Let’s say a company is making cupcakes and knows the total amount of sugar in an entire cupcake as well as the sugar in just the frosting on top. The following two tables show the probability distributions for total sugar (in grams) and sugar from the frosting only:

|  |  |  |
| --- | --- | --- |
| **Sugar From Frosting, Y** | 10 | 11 |
| **P(Y)** | .4 | .6 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Sugar, X** | 50 | 51 | 52 |
| **P(X)** | .2 | .7 | .1 |

1. Find the mean, variance, and standard deviation of X. Do the same for Y.

The company is interested in the probability distribution of sugar in just the cupcake mix, before frosting is added. (Sugar in Mix = Total Sugar – Sugar From Frosting)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sugar in the Mix, X – Y** | | Total Sugar, X | | |
| 50 | 51 | 52 |
| Sugar from Frosting, Y | 10 | 40 |  |  |
| 11 |  |  |  |

1. Complete the table below to find all possible values of Sugar in Mix.
2. Complete the table showing the probability distribution for (X – Y).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **X – Y** |  |  |  |  |
| **P(X – Y)** |  |  |  |  |

1. Find the mean, variance, and standard deviation of (X **–** Y).
2. Write an equation that shows how the means of these variables are related (similar to #5).
3. Write an equation that shows how the variances of these variables are related (similar to #5).