Exercise 1

Statista Motor Company produces two models, the Regressa and the Devion. The factory produces a total of 320 vehicles per day. Of that 320, 105 are Regressa models and 215 are Devion models. Each vehicle is thoroughly inspected throughout the process of production. The average number of vehicles with no more than five defects and more than five defects can be seen in the table.

Statista Motors	No More Than 5 Defects	More Than 5 Defects	Total
Regressa	82	23	105
Devion	190	25	215
Total	272	48	320

Find the probability that a randomly selected vehicle after final inspection will have more than 5 defects given it is a Regressa model.

Contingency Table

We will use this contingency table to calculate a **conditional probability**.

Statista Motors	No More Than 5 Defects	More Than 5 Defects	Total
Regressa	82	23	105
Devion	190	25	215
Total	272	48	320

Reminder: The conditional probability P(B|A) is defined as the probability that event B will occur after event A already occurred. The vertical line can also be interpreted as "given". In other words this would be the probability that event B would occur given A has already occurred.

Find Probability

Find the probability that a randomly selected vehicle after final inspection will have more than 5 defects **given** it is a Regressa model.

$$\mathbf{P(More\ than\ 5\ defects\ |\ Regressa)}$$

The formula tells us that we should divide the probability that the selected vehicle is a Regressa and has more than 5 defects by the probability that it is a Regressa.

$$\mathbf{\frac{P(Regressa\ and\ More\ than\ 5\ defects)}{P(Regressa)}}$$

Find Probability

Statista Motors	No More Than 5 Defects	More Than 5 Defects	Total
Regressa	82	23	105
Devion	190	25	215
Total	272	48	320

$$\text{P(Regressa and more than 5 defects)} = \frac{23}{320}$$

$$\text{P(Regressa)} = 105/320$$

$$\frac{P(Regressa\ and\ more\ than\ 5\ defects)}{P(Regressa)} = \frac{\frac{23}{320}}{\frac{105}{320}} = \frac{\mathbf{23}}{\mathbf{105}}$$

Probability from the Table

This probability can also be derived straight from the table.

Statista Motors	No More Than 5 Defects	More Than 5 Defects	Total
Regressa	82	23	105
Devion	190	25	215
Total	272	48	320

This conditional probability notation says that we should find the probability that the vehicle would have more than 5 defects given it is a Regressa model. This tells that we should be selecting only the vehicles that appear in the Regressa row in the table. There are a total of 105 vehicles in this category. Twenty-three of that 105 have more than 5 defects. This is consistent with the results obtained using the formula.

Exercise 2

Statista Motors builds 2 models of cars, the Regressa and the Devion. Seventy percent of the company’s customers purchase the Regressa and thirty percent purchase the Devion. In an effort to increase revenue, the company has recently changed the floor mat policy so that floor mats are no longer standard equipment. Since the policy change the company has found that twenty percent of those who purchase a Regressa also order floor mats. They have also found that sixty percent of those who purchase the Devion also order floor mats. The marketing manager would like to determine the probability that a randomly selected customer will purchase a Devion with floor mats.

Exercise 2

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The marketing manager would like to determine the probability that a randomly selected customer will purchase a Devion with floor mats.

Exercise 2

According to the given information the probability that a randomly selected customer would purchase floor mats given a Regressa model was chosen is equal to 0.2.

P(Floor Mats l Regressa) = 0.2

The probability that floor mats would be purchased given a Devion model is chosen is equal to 0.6.

P(Floor Mats l Devion) = 0.6

From this we can see that whether or not a customer purchases floor mats is dependent on which model is chosen.

Assign Symbols

In order to simplify the probability notation we can assign symbols to the events.

R - Represent the event that a randomly selected customer purchases a Regressa

F - Represent the event that floor mats are purchased

NF - Represent the event no floor mats were purchased

Find Probability

We were asked to find the probability that a randomly selected customer will purchase a Devion with floor mats. We will express that in probability notation as the probability that events D and F will both occur.

P(D and F)

According to the formula this will be calculated as the probability that event D will occur times the probability that event F will occur given D has already occurred.

$$\mathrm{P(D\ and\ F)} = \mathrm{P(D)} \cdot \mathrm{P(F|D)} = 0.3 \cdot 0.6 = 0.18$$

Exercise 3

Fifty-eight percent of American children (ages 3 to 5) are read to every day by someone at home. Suppose 5 children are randomly selected.

What is the probability that at least 1 is read to every day by someone at home?

Exercise 3 (cont.)

Fifty-eight percent of American children (ages 3 to 5) are read to every day by someone at home. Suppose 5 children are randomly selected.

What is the probability that at least 1 is read to every day by someone at home?

The phrase at least 1 means 1 or 2 or 3 or 4 or 5 are read to every day.

The only alternative to this outcome would be that none are read to every day.

Exercise 3 (cont.)

The probability that none are read to every day is the complement to the probability that at least 1 is read to every day.

We can find the probability that at least 1 is read to every day using the formula for the compliment.

$$P(at\ least\ 1\ read\ to\ every\ day) = 1 - P(none\ are\ read\ to\ every\ day)$$

$$P(none\ are\ read\ to\ every\ day) = P(all\ 5\ are\ not\ read\ to\ every\ day)$$

Exercise 3 (cont.)

We are told that 58% are read to every day. This means that 42% of American children ages 3 to 5 are not read to every day by someone at home.

$$P(read\ to\ every\ day) = 0.58$$

$$P(not\ read\ to\ every\ day) = 1 - 0.58 = 0.42$$

Exercise 3

Since these 5 subjects are chosen randomly from the population it is not unreasonable to assume that the selections represent independent events. We can use the multiplication rule for independent events to find the probability that none are read to every day by multiplying 0.42 by itself 5 times.

$$P(none\ are\ read\ to\ every\ day) = 0.42 \cdot 0.42 \cdot 0.42 \cdot 0.42 \cdot 0.42$$

This would most commonly be expressed in its exponent form as 0.42 raised to the 5th power.

$$P(none\ are\ read\ to\ every\ day) = 0.42^5 = 0.013$$

$$P(at\ least\ 1\ read\ to\ every\ day) = 1 - 0.013 = 0.987$$