

Part 7.2: Probability it is Less Than or Up To

The next part is very similar, but this time instead of working out the probability it is exactly, we want to work out the probability it is less than or up to a particular number. Let's look at an example:

Example

I was at an outlet store and there was a watch sale on, the only catch was there was a 40% chance that the watch didn't work. I decided that I would buy 5 watches and then sell on whichever ones did work that I didn't need. What is the probability that less than 3 watches work?

Answer

The first thing I always do is draw a number line and highlight the numbers I want, this helps avoid making silly mistakes... remember the number line starts at zero.

0 1 2 3 4 5

This is super important... do it every time! Otherwise you will make mistakes.

(Graphics Calculator)

Again we go into STATS (2) → DIST (F5) and this time we go into BINM (F5) and when we are working out the probability it is up to we use Bcd (Binomial Cumulative Distribution). In this case $x = 2$ (the number we want up to), Numtrial = 5 and $p = 0.6$. This would look like this:

```
Binomial C.D
Data : Variable
x : 2
Numtrial : 5
p : 0.6
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Which gives us an answer of 0.31744.

(Formula)

We can see that $x = 0, 1$ or 2 , $n = 5$ and $\pi = 0.6$. This means we need to substitute into the formula 3 times, once for each value of x ... we get

$$P(X = 2) = \binom{5}{2} 0.6^2 (1 - 0.6)^{5-2} = 0.2304$$

$$P(X = 1) = \binom{5}{1} 0.6^1 (1 - 0.6)^{5-1} = 0.0768$$

$$P(X = 0) = \binom{5}{0} 0.6^0 (1 - 0.6)^{5-0} = 0.01024$$

We then add these up giving 0.31744.

As you can see these two answers match up.

Exercise 7.2

- The probability of having to stop at a traffic light is 0.4. If I drive through 5 sets of traffic lights on the way to work what is the probability:
 - I don't have to stop
 - I have to stop at 3 or less traffic lights?
 - I have to stop at less than 3 traffic lights?
- In a multi-choice test there are 5 possible answers to each question. What is the probability if you are guessing for all 10 questions that you get:
 - None right?
 - Less than 3 questions correct?
 - 8 or less questions correct?
- I have a box of 6 calculators. The probability of the calculator working is 0.9. What is the probability that:
 - Less than 2 work?
 - Up to 5 work?
 - None work?
- Each morning I make myself lunch. 60% of the time I make myself cheese sandwiches, the rest of the time I make something else. What is the probability in one week (5 days) I have:
 - Less than 3 cheese sandwiches?
 - Up to 2 days where I have something else for lunch?
 - 1 or less days where I have cheese sandwiches?