

Evaluating Risk: Are bacon sandwiches bad for you?



Note: to avoid confusion when talking about percentage increase and decrease, it is good practice to focus on percentage points, eg. an increase from 10 percentage points to 12 is unambiguous. The danger of ambiguous phrasing is always a risk when talking in percentages!

What does a 20% risk on top of a 5% risk really mean?

1. 5
2. 3
3. 7
4. $\frac{5}{100} = \frac{1}{20}$; $\frac{3}{60} = \frac{1}{20}$; $\frac{7}{140} = \frac{1}{20}$; $\frac{1}{20}$
5. 20
6. 2
7. 5
8. $\frac{20}{100} = \frac{1}{5}$; $\frac{2}{10} = \frac{1}{5}$; $\frac{5}{25} = \frac{1}{5}$; $\frac{1}{5}$
9. 20% of 5 = 1, total cases = 5 + 1 = 6
 20% of 3 = $\frac{3}{5} = 0.6$, total cases = 3 + 0.6 = 3.6, so (3 or) 4
 20% of 7 = $\frac{7}{5} = 1.4$, total cases = 7 + 1.4 = 8.4, so 8 (or) 9
 20% of 5% = $\frac{20}{100} \times \frac{5}{100} = \frac{1}{100} = 0.01 = 1\%$
 (or start by observing that the additional number of cases is 1%)

It's a risky business ...

Disease	The basic (absolute) risk	The extra (relative) risk	Total no. of sufferers	
Stripy Foot	8% of 100 = 8	50% of 8 = 4	12	8% increased by 50% = 12%
Knobbly Knee	60% of 100 = 60	5% of 60 = 3	63	60% increased by 5% = 63%
Bent Elbow	24% of 100 = 24	75% of 24 = 18	42	24% increased by 75% = 42%
Humpy Shoulder	15% of 100 = 15	80% of 15 = 12	27	15% increased by 80% = 27%
Creased Neck	3% of 100 = 3	100% of 3 = 3	6	3% increased by 100% = 6, equivalent to doubling
Can't Get Out of Bed	27% of 100 = 27	200% of 27 = 54	81	27% increased by 200% = 81, equivalent to tripling
Can't Get A Life	44% of 100 = 44	125% of 44 = 55	99	44% increased by 125% = 99%

Note: students should be helped to realise that whether a relative increased risk is significant or not depends on how big the initial risk is - an increase of 5% in 60% is an extra 3%, the same as a 100% increase in 3%.

Evaluating Risk: Answers to worksheets

<http://motivate.maths.org/content/MathsHealth/Risk/>

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Statins: How useful are they?

Expected number of cases without statins	Expected number of cases with statins
10% of 25 = 2.5 so 2 or 3 cases	Reduce to 8% 8% of 25 = 2 so 0 or 1 case
10% of 40 = 4 so 4 cases	Reduce to 8% 8% of 40 = 3.2 so roughly 3 cases
10% of 120 = 12 so 12 cases	Reduce to 8% 8% of 120 = 9.6 so 9 or 10 cases
10% of 45 = 4.5 so 4 or 5 cases	Reduce to 8% 8% of 45 = 3.6 so 3 or 4 cases

Questions:

10%; 8%; 2%; $\frac{2}{8} = 25\%$

100 people taking statins prevents 2 heart attacks or strokes, so 50 people taking statins prevents 1 heart attack or stroke

Options:

- 10 out of 100 people will experience a heart attack or stroke in 10 years if they **do not** take statins.
- 92 out of 100 people will avoid a heart attack or stroke in 10 years if they **do** take statins.
- Your chance of **experiencing** a heart attack or stroke in 10 years if you don't take statins is 90%.
- In order to save one person from experiencing a heart attack or stroke in 10 years, we would need to treat **50** people with statins.
- Statins reduce your chance of avoiding a heart attack or stroke in 10 years **by** 2%.
- If 100 people do not take statins, on average **10** of them will have a heart attack or stroke in a 10-year period.
- If 500 people do take statins, on average **40** of them will have a heart attack or stroke in a 10-year period.
- With statins, 20% **fewer** possible outcomes for you will include experiencing a heart attack or stroke in 10 years.

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The Journey to School

10. Bar graph
11. 12
12. 4
6. Even for 12 year-olds, the risk of an accident is less than 0.1% or less than 1 child in 1000 at each year of age, and the figures are for all accidents, which includes minor ones - so the risk is pretty small.
7. 12, the difference is 93 (365 compared to 272).
8. 14, the difference is 3 (214 compared to 211).
9. 16 (101 compared to 95).
12. Pie chart
13. Bus/tram
14. Walking
15. No indication of total number of children using each mode of transport so no sense of what proportion of children using a given mode are at risk. In fact, a lot more children walk than cycle and walking is quite a bit safer than cycling.

The Risk Game

$$\text{Relative increase} = \frac{\% \text{ difference}}{\text{absolute risk}}$$

Smoking: 1 in 7 is approx 14%, actual increase is 13% from 1% to 14%, so relative increase is $13/1 = 1300\%$

Petrol: Actual decrease in volume bought is about 5 litres, relative decrease is $5/13 \approx 38\%$

VAT: Actual increase is 2.5%, relative increase is $2.5/17.5 \approx 14\%$

A level Further Maths: Actual increase is 6239, relative increase is $6239/5443 \approx 115\%$

Rain in Manchester: Actual increase is 1.5mm, relative increase is $1.5/4.5 \approx 33\%$

True or False

- The risk to girls of being the victim of a crime is less than 20% of the risk to boys. FALSE (actually about 28%)
- Knife crime rates have fallen by almost 20% since 2006. TRUE (they have fallen by about 18% since 2006)
- The risk of being burgled is more than 7% on average. FALSE (about 3% on average)
- You are 50% less likely to be very worried about crime if you read a tabloid newspaper than if you read a broadsheet. FALSE (about twice as likely)

Note: The purpose of this worksheet is to help students to realise that perceived risk of crime may well be quite different from actual risk. It is also worth making the point, however, that the figures given are national statistics for the UK, and cannot be applied directly to other countries or to smaller regions of the UK.

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