STEM innovators

Real world statistics

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Educator notes

Learning objectives

- Explaining the role of large data sets in making decisions about health care
- Analysing data in smoking and lung cancer mortality
- Projecting a career path for a medical statistician

Time needed: 60 minutes

Curriculum links

- Science
  - Working scientifically
  - Analysis and evaluation
- Maths
  - Statistics

Resources required

- Real world statistics presentation slides
- Extracting information from data student sheet
- Careers in statistics student sheet

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Slide 1
Introduction

- Tell students they will be discussing the role of statisticians in society, how data tells a story and the career trajectory of a statistician

Slide 2
What do statisticians do?

Starter activity
What is a statistician?

5 mins

- Ask students to discuss the two questions on the slide in pairs
- Tell them to note down their agreed responses, which will be reviewed at the end of the module

Slide 3
Smokey timelines

Activity 1
Extracting information from data

25 mins

- In this activity, students will engage with a complex graph showing smoking and lung cancer rates for males and females separately, over time, with two y-axes
- Hand out **Real world statistics student sheet** and ask students in pairs or small groups to have a look at the graph in detail
- Explain to students that the aim of their exercise is to discuss the questions they can answer with the information they have in the graph – there are some key words on the student sheet to help them
- The questions are as follows:
  1. How is the incidence of lung cancer over time related to the changes in smoking prevalence?
  2. How likely is it that a male smoker will get lung cancer?
  3. Does smoking cause lung cancer?
  4. Which year shows the largest percentage of female smokers in the adult population?
  5. Why has the number of people smoking continued to decline since 1980?
  6. What happens to the difference between male and female prevalence of smoking in the period 1948 to 2016?
- Remind students that the aim is **not** to answer the six questions provided, but to agree which questions can, and which cannot, be answered from the data provided
- Explain that this encourages deep understanding of what the graph shows, the limitations of the data and the difference between 'the data' and 'explanations of the data'

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Slide 3

Smokey timelines Continued…

- Once students have had a few minutes to discuss, ask them to feedback their thoughts to the class – providing a reason why they think the question can or cannot be answered by the graph

Slide 4

Extracting information from data: answers

- Once you have had feedback from the class, move forward to **Slide 4** and discuss why the graph can and cannot answer the following questions:
  1. This can be answered by the graph – but the relationship is positive for men (when smoking goes down, lung cancer goes down) and negative for women (when smoking goes down, lung cancer goes up)
  2. The right-hand axis shows the incidence of lung cancer in the population, not just smokers. So, it is not possible to answer this question from the data
  3. The data for smoking and lung cancer does not prove that lung cancer is or is not caused by smoking – it simply shows a correlation. Correlated data (data showing similar trends) does not prove causation e.g. wearing gloves and injuries due to slipping on ice are correlated, but gloves do not cause people to slip on ice
  4. It is possible to see there was the highest number of female smokers in 1966
  5. This question goes beyond the data. Scientists and other experts may have ideas about what might be causing smoking rates to decline, but additional information would be needed to explain this trend. It is not possible to answer this question with the data available
  6. The graph can answer this question. It shows more equal numbers of males and females smoking over time, as female smoking increases and male smoking decreases
- Explain to students that the type of information you get plays a big role in the questions you can answer

Slide 5-6

Extracting information from data: answers 2

- Move on to **Slide 5** and ask students to consider the questions which can't be answered by the data shown in the graph alone (Questions 2, 3 and 5). What additional information would be needed to answer these questions?
- Responses can be recorded on the board or on paper by students
- When you have finished discussing, move on to **Slide 6** and discuss how their responses correspond to the explanations:
  2. More data is needed on the incidence of lung cancer in male smokers, not just men with lung cancer
  3. More data is needed on the incidence of lung

Slide 5-6

Extracting information from data: answers 2 Continued…

cancer in male and female smokers and how the number of cigarettes smoked per day affects incidence of lung cancer

5. More information on changes over this period which could affect how much people smoke is needed. For example, the rise in cost of cigarettes compared with rise in average income; health education promotions on television and in schools; the publication of studies linking smoking and cancer; etc.

Slide 7

Which skills do statisticians need?

Activity 2

Careers in statistics

25 mins

- Show students the list of skills on **Slide 7**
- Divide the class into different groups (or use the same groups from the previous exercise)
- Tell the groups to discuss which of these skills are the most important for a statistician and to rank the top three skills needed
- Take feedback from the groups. Ask for justification for each chosen skill. Can students suggest any additional skills that might be useful?
- The top three skills might include any of:
  - Managing people
  - Critical thinking
  - Problem solving
  - Communication (speaking, presenting and writing)
  - Mathematical skills
  - Attention to detail
  - Teamwork
  - Computer skills
- When you have received feedback, explain that most of these skills are useful for a statistician to have
- Use the following explanation to summarise their roles:
  - Statisticians design and manage experiments and surveys. They organise collections of data then process and analyse that data. They look for patterns to help make decisions and answer questions. They then advise on findings and recommend strategies or solutions
  - Statisticians often work in teams and across different disciplines, so interpersonal and communication skills are important. They also need to communicate the findings to colleagues and clients
- If students have access to the web, tell them to use the suggested weblinks to research the career profile of a medical/clinical statistician to help with the next activity (you can also print these pages):
  - https://www.abpi.org.uk/medicine-discovery/academic-collaboration-education-skills/careers-in-the-pharmaceutical-industry/case-studies/statistician/
  - https://ckclinical.co.uk/clinical-sector/biometrics/an-interview-with-a-biostatistician/

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Slide 7

Which skills do statisticians need? Continued…

- https://www.statslife.org.uk/careers/profiles/1140-jennifer-rogers-medical-statistician
- https://targetjobs.co.uk/careers-advice/job-descriptions/279107-statistician-job-description
- https://www.prospects.ac.uk/case-studies/biostatistician-emma

- Ask students to produce a CV for a clinical statistician applying for jobs. They can use the template provided on the student sheet
- If resources or time do not allow, you can suggest students make a flowchart to show how to become a statistician, using the subheaders in the **Real world statistics student sheet**
- Explain that they should refer to the skills they identified as being useful for statisticians earlier
- Ask students to present their completed CVs to the class and explain what about this individual (on the CV) makes them the best applicant

Slide 8

Reflection

- Return to the questions from the starter activity and ask students to look at their earlier responses and add notes to reflect their new learning
- Encourage them to think about the role of a statistician in relation to their own career path – many of the relevant skills and personality traits are useful across many careers

Extension/homework

- Ask students to the use the quiz on the GSK Apprentice page to explore their own career preferences and potential career paths relating to the pharma industry through the GSK website: https://www.gsk.com/en-gb/careers/apprentices-students-and-graduates/
- Encourage students to share their result in the next lesson – were they surprised, interested, happy?