Statistics A Level – Preparatory Work 2022

Statistics is about the analysis of data. The skills required lie not only in mathematics, but in all walks of life: English, Psychology, Biology, Media, Politics etc.

It will be beneficial to try these questions in advance of the start of your course.

<u>Designing Investigations</u>

1. You are working for a pet store (selling pet supplies, treatment, accessories, etc.) and are asked by the manager to create an entrance display poster to entice customers into the store.
    What data might you want to collect to make this display effective?

2. A swimming coach learns about a new breathing technique that may help swimmers complete the 50 m free-style in a faster time.
    How could you test if this breathing technique is effective?

3. A company delivers stock to warehouses around the country from a central depot. The longer the lorries are on the road, the more expensive it is to transport goods. There are **five** viable options for a trade route from Watford (where the depot is) to Hereford (where the warehouse is).
    How could you determine which route might be the best?

4. This year there has been contradictory views over whether facemasks are effective in preventing the **transmission** of coronavirus.
    What data might you collect to help influence your view?

<u>Probability</u>

1. Ali asked 200 students which sport they like best. They could choose swimming or tennis or athletics. The two-way table shows some information about their answers.

	Swimming	Tennis	Athletics	Total
Female			19	
Male	36	42		
Total	79		54	200

      a. Complete the two-way table.
One of the students is chosen at random.
Find the probability that:
      b. the student likes tennis
      c. the student is male and likes athletics

2. In a packet of cornflower seeds, 80% are a blue-flowering variety and 20% are white flowering. 90% of the blue-flowering variety germinates and 70% of the white-flowering variety germinates.
          a. Show this on a probability tree.
          b. What proportion of the seeds overall germinate?

3. A student is chosen at random from a class of 8 girls and 11 boys.
    Two of the girls and 4 of the boys cycle to college.
    Let G: chosen student is a girl
    Let C: chosen student cycles to college.

    Draw this information on a Venn diagram.

Data Handling

1. This frequency table shows data concerning some horses in paddocks. Answer the questions below in the spaces provided, using the spare column in the table to make clear your method of calculating the mean.

No. of horses in paddocks	No. of paddocks with this number of horses	
0	2	
1	4	
2	9	
3	7	
4	6	
5	1	
6	1	

    a. How many empty paddocks were there?
    b. How many paddocks were there altogether?
    c. How many horses were there altogether?
    d. What was the mean number of horses per paddock?
    e. What was the modal number of horses per paddock?

2. Elen and Jordanna are conducting an experiment on parasitic bacteria. This frequency table shows the number of bacteria in a petri dish at the end of the experiment:

| Number of bacteria (hundreds)	Midpoint	No. of petri dishes with this number of bacteria	
1 – 5		0	
6 – 10		1	
11 – 15		2	
16 – 20		8	
21 – 25		10	
26 – 30		12	
31 – 35		4	
36 - 40		3	

    a. Calculate an estimate of the mean number of bacteria, using the spare columns in the table to make the method clear.
    b. Why is this only an estimate of the mean number of bacteria in a petri dish?

Data Representation

1.

Young people are drinking less

British 16 to 24-year-olds who drank alcohol in the last week (%)
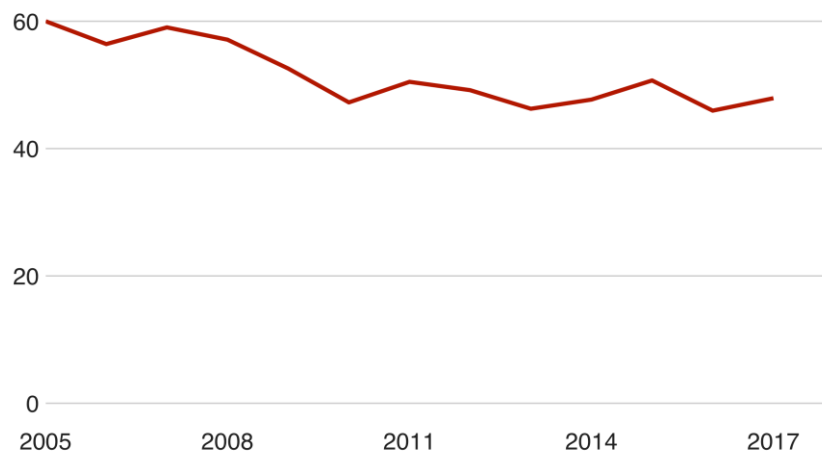
Source: Office for National Statistics   BBC

In July 2018, the BBC ran an article about the improving health of the younger generation. The above is a time series showing the percentage of students who drank alcohol in the last week.

    a.   Estimate the percentage of British 16-24 year olds who drank alcohol in the last week in 2011.

    b.   What extra information may be useful to help understand this diagram better?

    c.   Suggest a reason why the graph may not support the headline.

2.

Majority of academics are white

Percentage of Russell Group academic staff in each ethnicity, excluding those who refuse to say or do not identify

White, 86%
Indian and South Asian, 6%
Chinese and East Asian, 6%
Mixed, 1%
Black, 1%
Arab, 0.4%
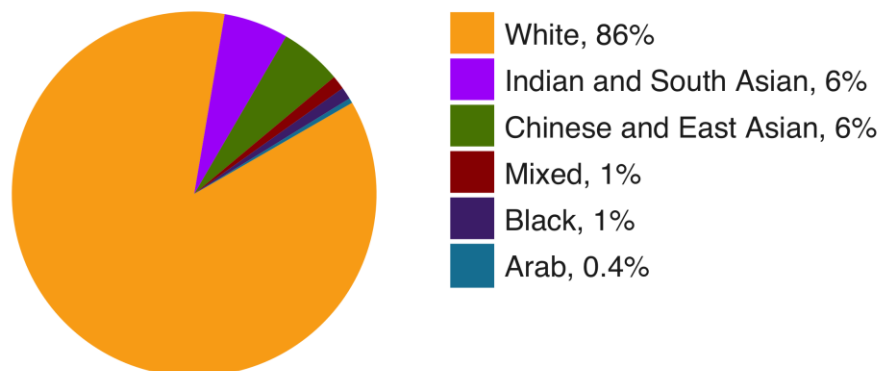
Source: BBC Freedom of Information requests of 22 Russell Group universities   BBC

In December 2018, the BBC ran an article about the racial pay-gap between university researchers. The diagram above was created to illustrate the racial profile of academics.

    a.   Name this statistical diagram.

    b.   Calculate, to the nearest degree, the angle made by the orange slice.

    c.   What extra information would be useful to know in order to understand this diagram better?

   d.   Suggest a possible reason why the diagram would not support the headline.

3.
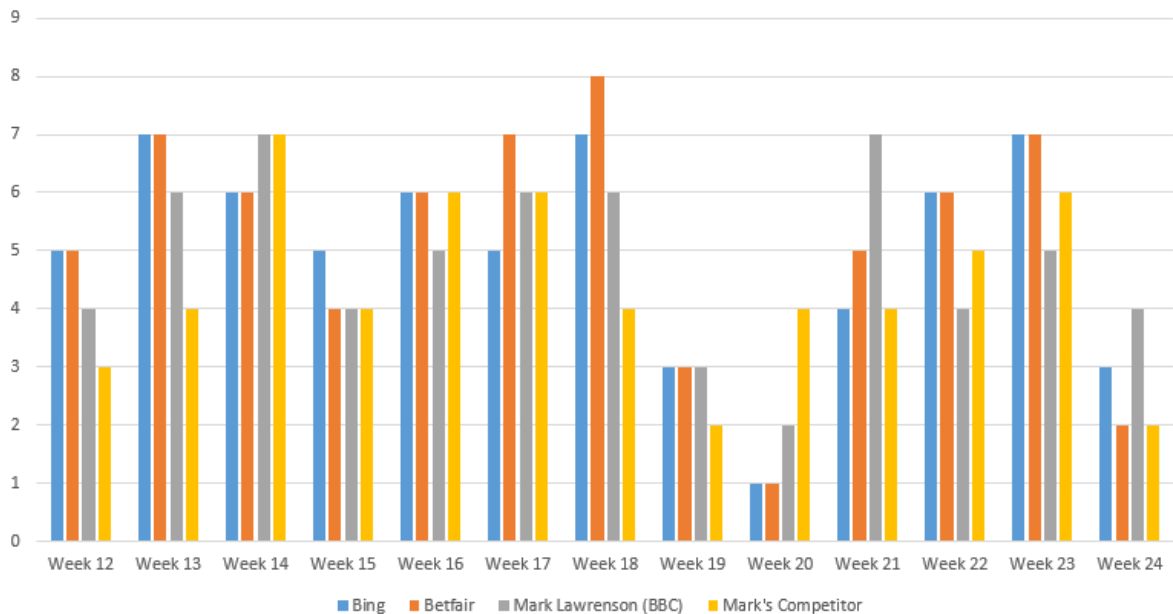
This multi-bar chart shows the number of correct predictions during each week of the Premier League (starting at week 12) for Bing, Betfair.com, Mark Lawrenson and his competitor set through BBC Sport

    a. How many correct predictions has Mark Lawrenson made throughout these 12 weeks?

    b. How many more correct predictions has Mark Lawrenson made over his competitor in these 12 weeks?

    c. Which predictor made the most correct predictions in a week, and which week was this?

    d. Which week did people generally do the worst for correct predictions?

    e. Which predictor was generally the best?

    f. What does this graph tell you about predicting the results of Premier League games?

4.
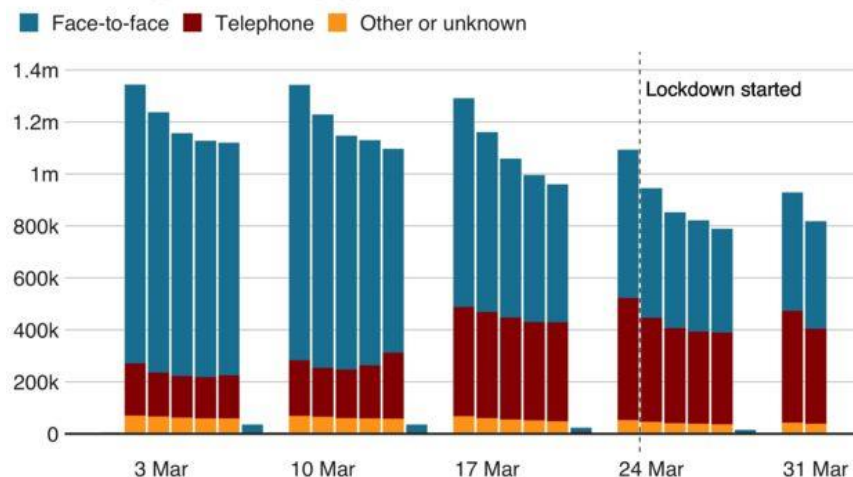
During the Covid-19 outbreak, the BBC reported that the proportion of GP telephone appointments had increased throughout March 2020. The stacked bar chart time series was displayed.

    a. Estimate the percentage of telephone appointments on 3 March 2020

    b. Suggest a possible reason for the small and non-existent bars in the graph above.

    c. Suggest a possible reason for the repeating trend shown in the graphs above.

    d. Does the graph support the headline? Explain your answer.

5.

Average daily nitrogen dioxide (NO2) readings

Figures from monitoring stations in the UK
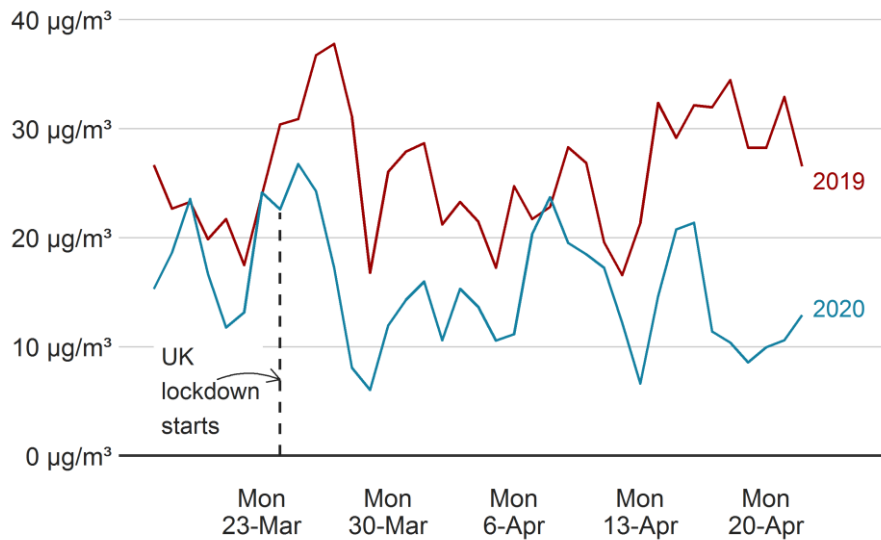
μg/m³ = micrograms per cubic metre
2019 data plotted against equivalent day of the week in 2020

Source: Defra   BBC

During the Covid-19 outbreak of 2020, the BBC reported that air quality had improved as a result of lockdown.

a. When lockdown started, estimate the difference in average daily NO2 readings between 2019 and 2020.
b. Do you agree with the headline? Explain your answer.

Technology

Data is almost never analysed without the aid of a computer. To help you in the course, you should definitely make yourself familiar with a spreadsheet program (e.g. Microsoft Excel or Google Sheets).

1. In the first column of the spreadsheet, enter any numbers you like for the first 10 rows.
2. Find the spreadsheet command that will calculate the following:
   a. The total of all 10 numbers
   b. The average of all 10 numbers
   c. How many numbers you have entered

   Use the internet to find out if you are not sure.

Mathematical Skills (use a calculator!!)

1. A formula is given by:

    $$V = s - \frac{m^2}{n}$$

    Find the value of V if $s = 44$, $m = 12$ and $n = 23$.

2. A formula is given by:

    $$a + bc = d$$

    Find the value of d if $a = 45$, $b = 1.64$ and $d = 15$.

3. A formula is given by:

    $$\sqrt{np(1 - p)} = s$$

    Find the value of s if $n = 40$ and $p = 0.23$.

4. A formula is given by:

    $$t = \frac{(a - b) - c}{\sqrt{\dfrac{x^2}{m} + \dfrac{y^2}{n}}}$$

    Find the value of t when $a = 14$, $b = 7$, $c = 5$, $x = 1.1$, $y = 1.7$, $m = 34$ and $n = 27$.

5. A formula is given by:

    $$t = \frac{(a - b) - c}{\sqrt{s\left(\dfrac{1}{n} + \dfrac{1}{m}\right)}}, \qquad \text{where} \quad s = \frac{(n - 1)x^2 + (m - 1)y^2}{n + m - 2}$$

    Find the value of t when $a = 23$, $b = 4$, $c = 7$, $x = 3.5$, $y = 3.7$, $m = 12$ and $n = 15$.

Statistics in the Media (use the internet!!)

The following are claims that have been reported in the media recently: each one is **not completely true**. Research online to find out **why**.

1. A vaccine for coronavirus was made in 2001.
    (Source: Facebook posts)

2. Scotland has the highest taxes anywhere in Europe.
    (Source: UK Prime Minister, 4 September 2019)

3. Millions of women have been plunged into poverty because of changes to the pension age made in 2011.
    (Source: Shadow Secretary of State for Education, 24 November 2019)

4. 15,000 passengers are arriving into the UK daily at the moment.
    (Source: Health Secretary, 16 April 2020)