Graphical skills activity sheet

Line graphs

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Line graphs

Line graphs are an important form of data presentation as they allow you to view multiple pieces of information. They reveal trends and changes over time.

A line graph is only appropriate for continuous data, which is data that can take any particular value, such as the number of extreme heat days in a year (when temperature exceeds 40.6°C).

Instructions

This skills-based activity is based on the 2019 article Projections of Human Exposure to Dangerous Heat in African Cities Under Multiple Socioeconomic and Climate Scenarios by Rohat et al. and the IPCC report Impacts, Adaptation and Vulnerability.

The article estimates the future level of extreme heat for the 10 most exposed African cities in the twenty-first century. The unit of measurement is billion person-days per year i.e., the sum of the annual number of days a person will suffer extreme heat in these urban areas.

City	Billion person-days per year				Population
	Historical	2030s	2060s	2090s	
Bamako	141.07	652.21	1369.45	1936.75	2817000
Cairo	419.56	1425.74	2910.53	3777.41	10025657
Cape Town	0.09	0.80	2.39	3.40	4710000
Harare	0.08	0.71	2.53	5.41	2123132
Kano	248.98	1484.36	3674.96	5849.81	4219000
Khartoum	368.39	1517.69	2780.37	3542.77	639598
Kigali	0.00	0.07	0.97	4.88	1132686
Kinshasa	33.79	401.60	1120.69	1764.03	17071000
Niamey	104.47	560.86	1873.22	3790.87	1026848
Yaoundé	7.03	66.55	138.23	180.86	2765600

Table 1 data for RCP 4.5 with 1.8°C warming and medium effort to curb emissions

Questions from the PowerPoint

1. Study the data.
2. Map the 10 cities shown.
3. Produce a simple line graph showing the change in exposure to extreme heat in African cities.

   Follow the steps on the next page to create a line graph for the data on extreme heat exposure.

a. To create a line graph, open an excel spreadsheet and copy in the data from above. Highlight columns A to E rows 3 to 12 (i.e., from Bamako down to 180.86 for Yaoundé).

b. Select the Insert tab, Line graph, and click Line with markers.

c. You now need to change the axis. Select the Chart design tab and click **Select data**. In the pop-up window (now on your screen) click the Select Row/Column button. This will place Time on the *x* axis and Billion person-days per year on the *y* axis.

d. Add the title "Extreme Heat Exposure for 10 African Cities".

e. Left click the graph and click the + button to add Axis Titles. On the *x* axis add the title: Time, and on the *y* axis add the title: Billion person-days per year.

4. Describe your graph. Are all of the cities affected in the same way? Which cities have the most and least risk?

5. What do you think happens to the reliability of these forecasts as time progresses?

6. Figure 1 shows the population projection for these 10 African cities. Using this figure, and your line graph from Q3, analyse the projected environmental and demographic changes in Africa. [6]

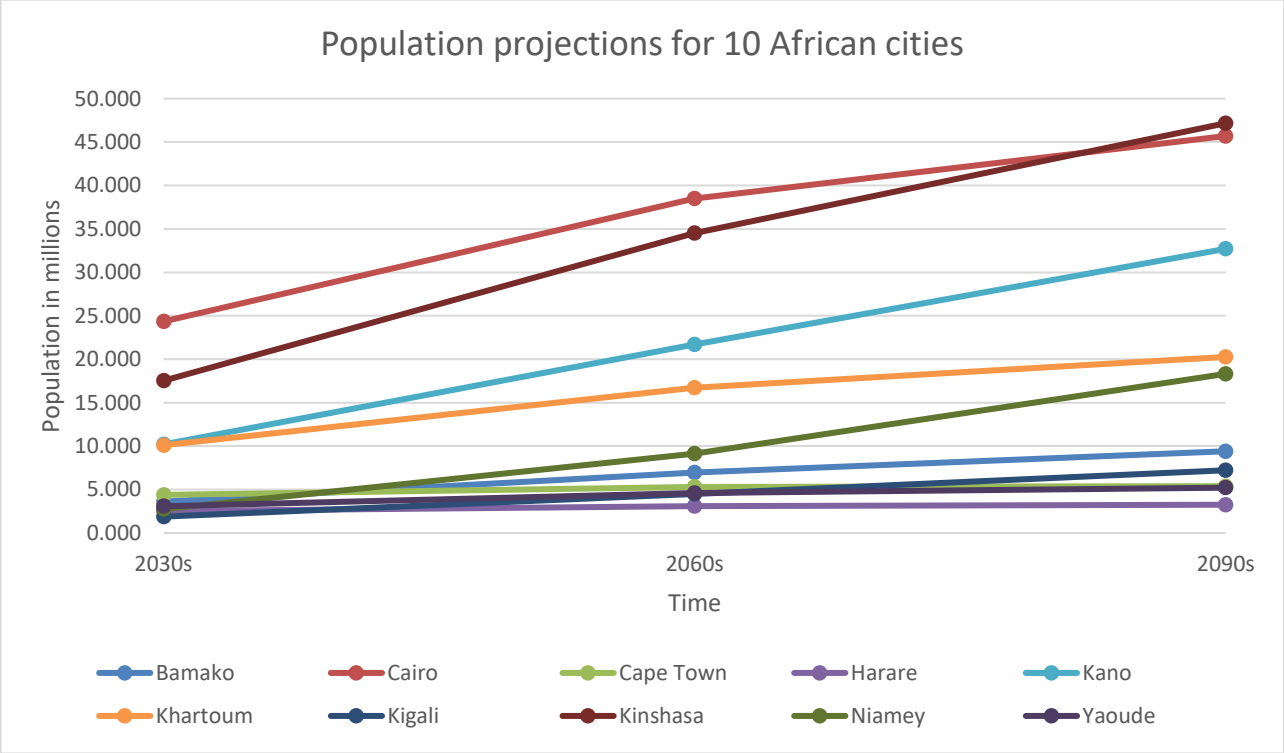

Figure 1

Answers

2. The 10 cities are mapped out in this Mapcustomizer.

3. The data is graphed on the next page.

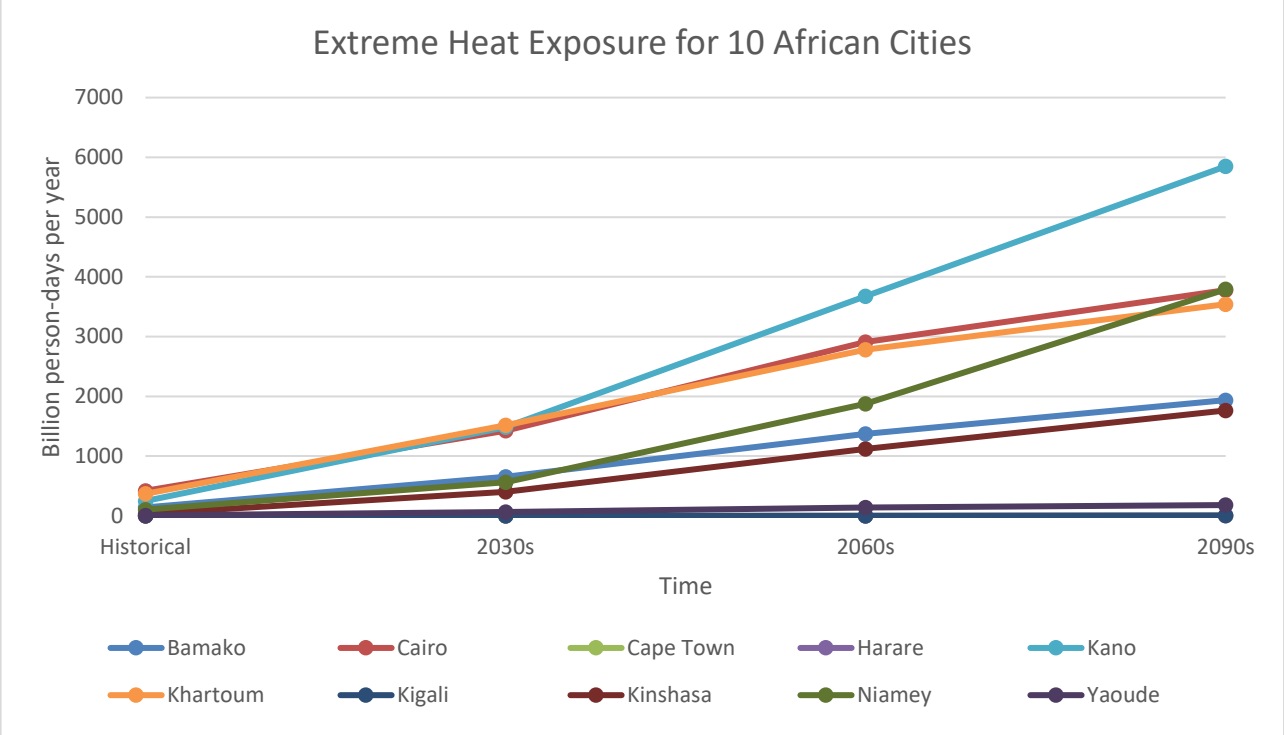

Figure 2

4. Khartoum in Sudan will suffer the most extreme heat days by 2030. Thereafter, from the 2030s to the 2090s, the graph shows that Yaoudé and Kigali will see a limited increased in billion person-days per year of extreme heat (whilst still being in the top 10 *most* exposed cities in Africa). There is a marked increase for the other eight cities, with a sharp rise for Niamey between the 2060s and 2090s. By 2040 Kano (the second most populous city in Nigeria) is the outlier with an extreme high number of billion person-days per year. This number continues to rise throughout the twenty-first century. The forecast is this city will suffer 5849.81 billion person-days per year by 2090.

5. Reliability diminishes over time as unforeseen events may occur in the future. These might be negative as, for example, climate change could worsen with the RCP 8.5 scenario, or it might improve with the advent of newly invented technology, or behavioural change.

6. This question requires analysis of environmental and demographic changes over time. A level 2 answer (4–6 marks) can only be achieved with clear analysis of the quantitative evidence provided in both line graphs, which makes appropriate use of data in support. Clear connections between different aspects of the data and evidence must be identified.

   Level 1 answers (1–3 marks) will demonstrate basic analysis of the quantitative evidence provided, making limited use of the data and evidence in support.

   The question requires analysis of the data shown in the graphs. Level 2 answers must make explicit reference to changes over time and make specific reference to the data to support points made.

   - Figure 1 reveals population change across all 10 African cities. Demographically all these urban centres are projected to grow.
   - By 2090, the smallest population growth is in Harare with an increase of only 732,000 people. This will make managing extreme heat more feasible.

- Figure 1 shows the largest population change over the whole period is in Kinshasa with an increase of 29,634 people. This increase in population coincides with a period of time when increased extreme heat is forecast for the city. Figure 2 shows extreme heat exposure is expected to rise from 33.79 billion person-days per year to 1764.03 by 2090 for Kinshasa.
- The majority of Egypt's landscape is desert with high temperatures and low rainfall. If analysed per capita, the city of Cairo is the most vulnerable to future demographic and environmental problems. By 2090, the city will have 45 million people (the second highest population projection for the continent) and it is in the top 3 most exposed cities to extreme heat.
- Figure 2 shows Kano with continuous, positive population change which, coupled with the highest level of extreme heat exposure, will endanger the city's 32 million residents by the end of the century.
- The extreme heat expected in Kano (Nigeria), Kano (Niger), and Khartoum (Sudan) can be explained by their location in the Sahel. This region suffers from droughts, which are becoming more intense. Often followed by heavy rainfall and flooding. Sahelians are trapped in a viscous cycle of over-grazing, natural disasters, and climate change. This is expected to lead to future conflict and rural-urban migration.
- Yaoudé in Cameroon shows little increase in billion person-days per year of extreme heat. This may be because it is an equatorial country with high annual precipitation.

AO3 = 6