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EXAMINATION FOR BA BSc ETC 1999


STATISTICS

Visualising Information

(Time allowed: THREE hours)

Attempt all SIX questions. All questions are worth equal marks.

1. Perceptual scientists have discovered a number of "laws" which describe how human beings process graphical information.

  (a) State Stevens' law and explain its consequences for statistical graphics.
      [Fully explain any notation you might use.]

  (b) Give three examples of graphs which Stevens' law says are not good graphs.

  (c) Explain Weber's law.

  (d) Steven's law says that our perception of the relative size of values encoded by areas and volumes is conservative when compared to our perception of the same values encoded by lengths. Use Weber's law to give a reason why the use of length to encode values is preferable to the use of area or volume.

2. Different kinds of graphical display can reveal different features of data sets. Some plots display very specific aspects of a data set and some provide a more general view.

  (a) What information does a boxplot give about a set of values?

  (b) Are boxplots good plots? Use what you know about perception to justify your answers.

  (c) Sometimes a single plot is produced containing boxplots for several samples plotted against a common scale. Such a plot is sometimes used to investigate whether there is a dependence of the spread of the samples on their location. Name a weakness in this kind of display and suggest a better plot.

  (d) Describe how to produce a plot which is specifically designed to reveal lack of symmetry in the distribution of a sample.

  (e) A number of general purpose plots can also reveal lack of symmetry. Describe three such plots.

3. Histograms and density plots both provide a way of looking at the distribution of a set of values.

    (a) What kind of features can be identified in histograms and density plots.

    (b) Density plots can usually be considered preferable to histograms. Explain why this is.

    (c) Indicate under what circumstances a histogram might be a preferable way of presenting information about a sample.

    (d) What elements of perceptual theory indicate that density plots and histograms should be good at showing what they show?

4. This question deals with aspects of colour vision and the use of colour in graphs.

    (a) Write a short description how the human visual system handles the perception of colour.

    (b) Describe how colour can be used to enhance graphs. Cover both the benefits and the pitfalls of using colour in graphs.

5. Humans have a wonderful ability to see and interpret structure in three dimensional space.

    (a) Write a short essay of about one page which indicates how we are able to perceive three dimensional structure so well. How can our three dimensional abilities be used when we look at two dimensional graphs?

    (b) The following two graphs show two different ways of drawing the same surface. (The surface represents ozone concentrations in the north-east United States.)
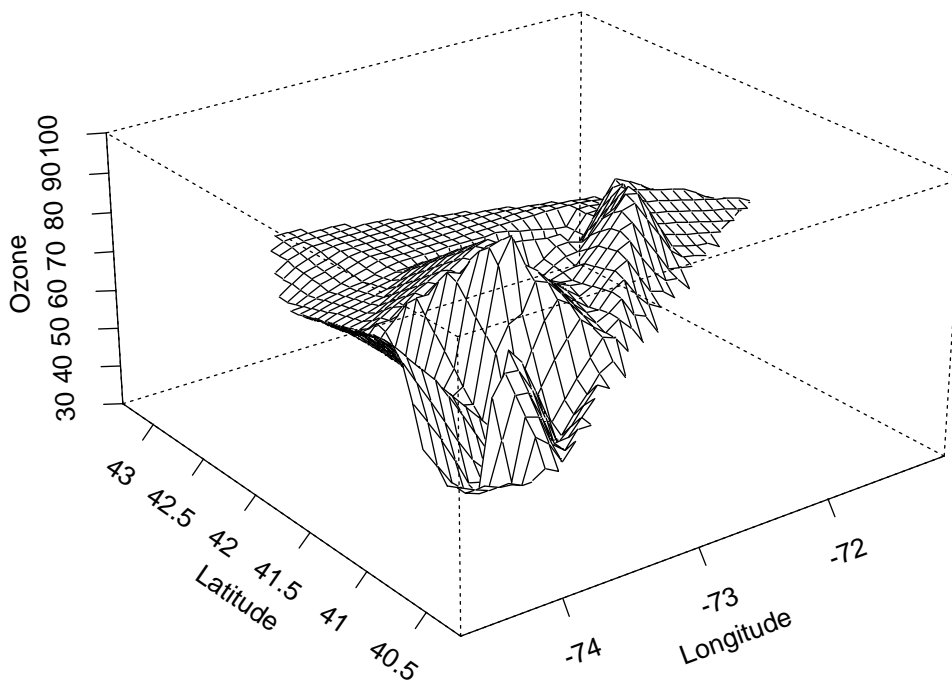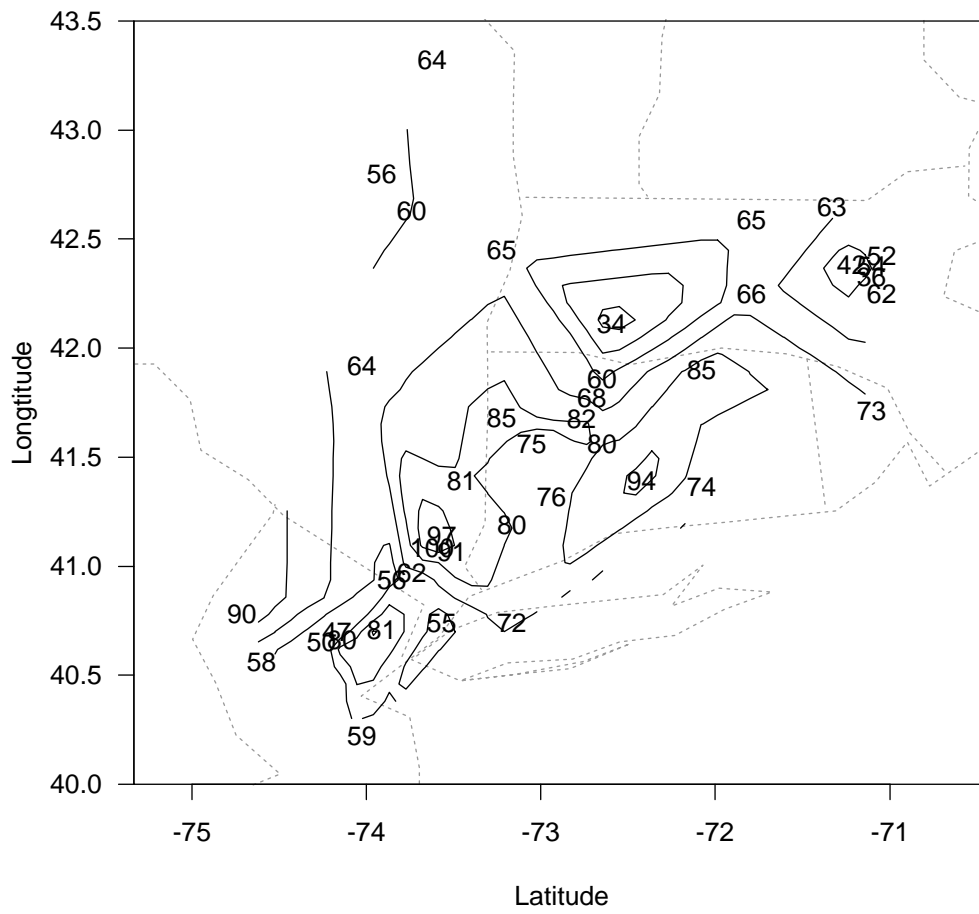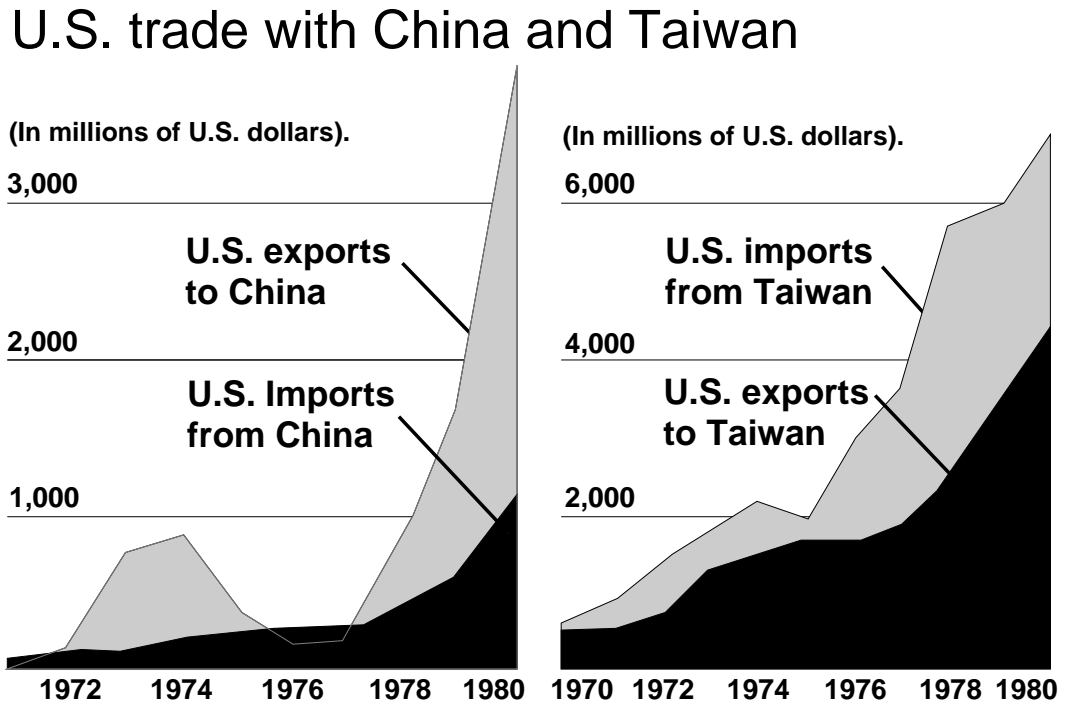
What are the advantages and disadvantages of plotting the surface in each of these two ways?

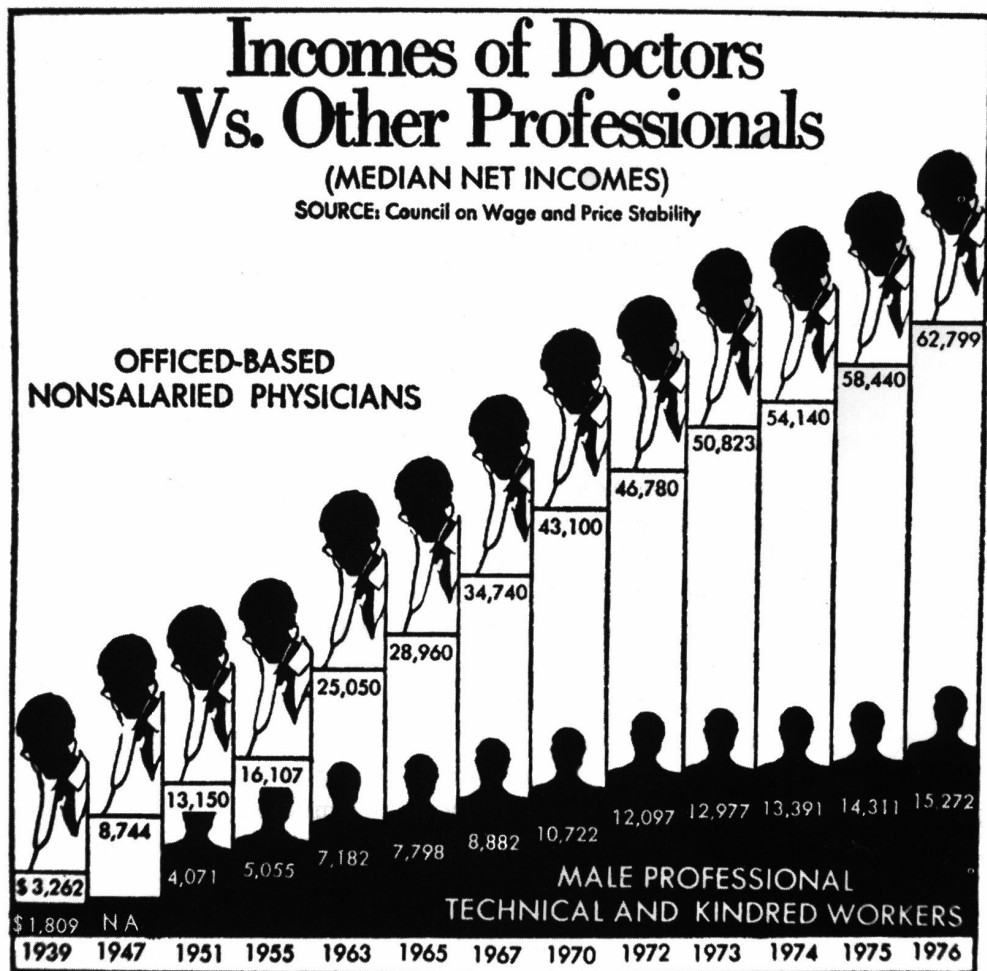**6.** In this question you will be asked to examine **two** graphs and to describe the problems you see in them.

(a) The following graph appeared in the *New York Times*, June 14, 1981.

U.S. trade with China and Taiwan

There are a number of things which makes this graph hard to interpret. List what you see as the problems in this display and recommend changes which could improve it.

(b) The following graph appeared in the *Washington Post*, Jan. 11, 1979.

Incomes of Doctors Vs. Other Professionals
(MEDIAN NET INCOMES)
SOURCE: Council on Wage and Price Stability

OFFICED-BASED NONSALARIED PHYSICIANS

MALE PROFESSIONAL TECHNICAL AND KINDRED WORKERS

1939	1947	1951	1955	1963	1965	1967	1970	1972	1973	1974	1975	1976
$3,262	8,744	13,150	16,107	25,050	28,960	34,740	43,100	46,780	50,823	54,140	58,440	62,799
$1,809	N A	4,071	5,055	7,182	7,798	8,882	10,722	12,097	12,977	13,391	14,311	15,272

The accompanying article makes the point that the increases in doctor's salaries are quite reasonable. The graph has been constructed in a way which reinforces what is said in the article, but it presents a very misleading picture. Explain how the graph is misleading and explain what changes need to be made in order to present a more unbiased picture.

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