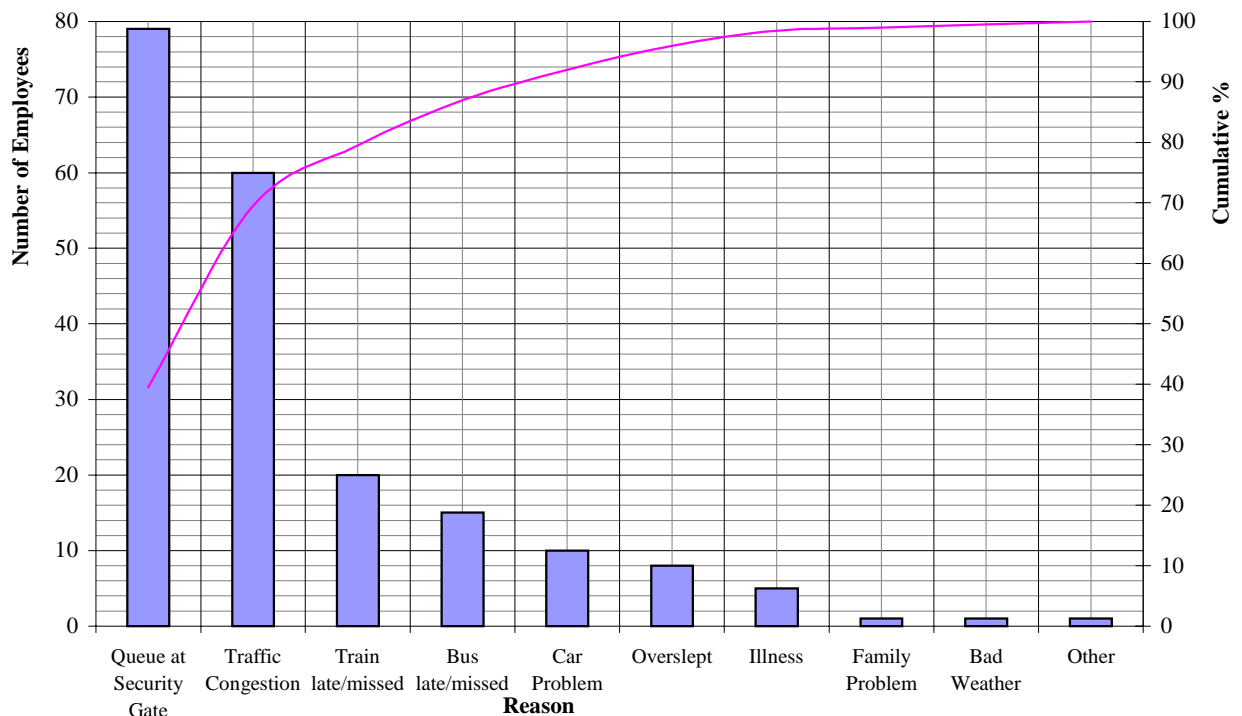# Pareto Charts

Data Sheet

Vilfredo Pareto (1848 - 1923) was an Italian economist who studied the distribution of wealth. He found that usually a small proportion of the people (about 20%) control the majority (about 80%) of a society's wealth. This 'Pareto Principle' has also been found to apply in other situations, particularly quality management. When studying things like delays in schedules, customer complaints, employee absenteeism and accidents, Dr Joseph Juran discovered that a small number of causes is generally responsible for a large percentage of the effect.

A Pareto chart is a bar chart in which the categories are arranged in order of their frequencies from the most frequent to the least frequent. This allows you to see clearly what the most important factors are in a given situation. The Pareto chart can also include a cumulative % graph. For each category this shows the total percentage contribution of that category and all preceding categories.

For example, in a survey to find the main causes of lateness in a factory's work force a random sample of 200 employees who were late for work were asked the reason why. The Pareto chart below shows the results.

**Reasons for Lateness given by Factory Workers**

The most important factors are shown by the bars at the left hand side of the chart.
This is also where the cumulative % graph is steepest.

A Pareto chart helps to identify the most important causes of a problem. Targeting these main causes is likely to give the most cost-effective improvement scheme.

In this example, the main cause of lateness was the delay caused by the security gate. On realising this, the manager introduced a new procedure at the gate to speed things up. Another random sample of 200 employees who were late for work was taken after the change in procedure. The second Pareto chart shows these results.

Reasons for Lateness given by Factory Workers
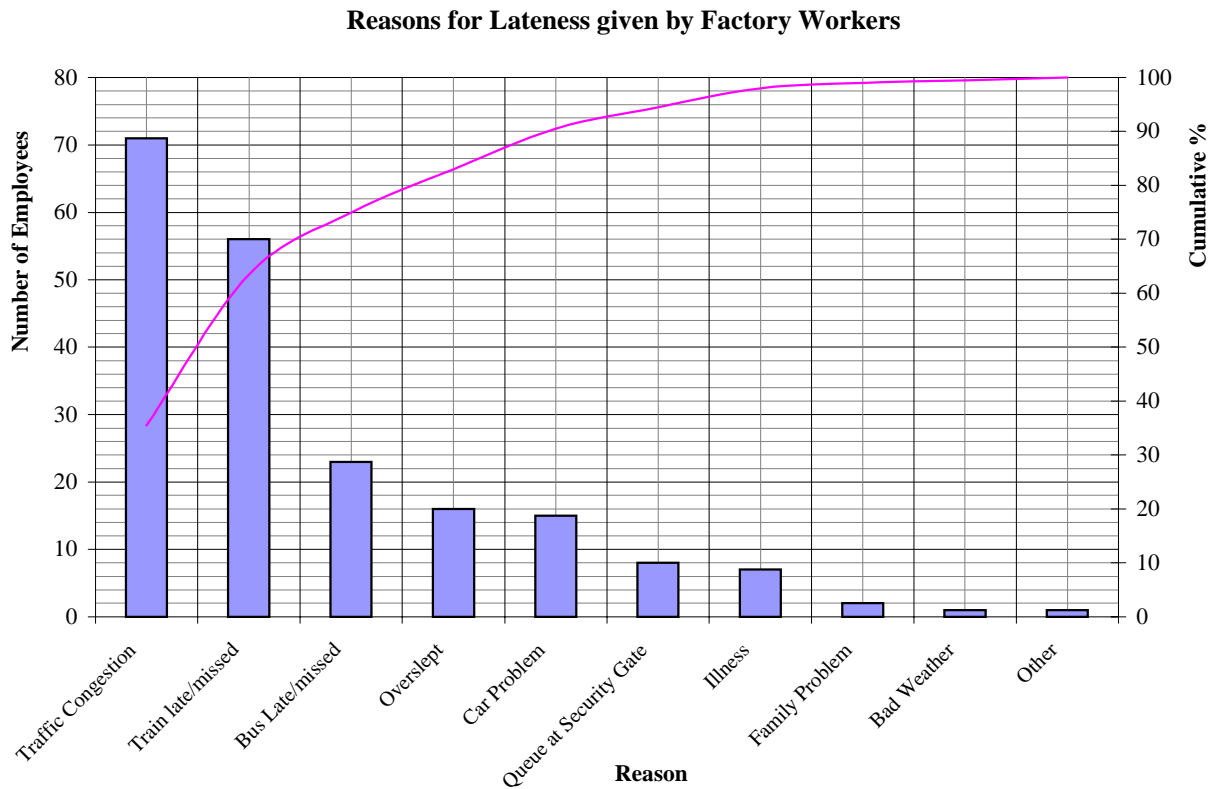
This chart shows that delays at the security gate are now much less of a problem.

This example illustrates how Pareto charts are useful in revealing the most important causes of a problem. Allocating time, human, and financial resources to solving the main causes is likely to achieve the best results.

Of course it might be found that the main cause of the problem is beyond control. Even in such cases a Pareto chart would be useful in identifying less significant causes that could be addressed.
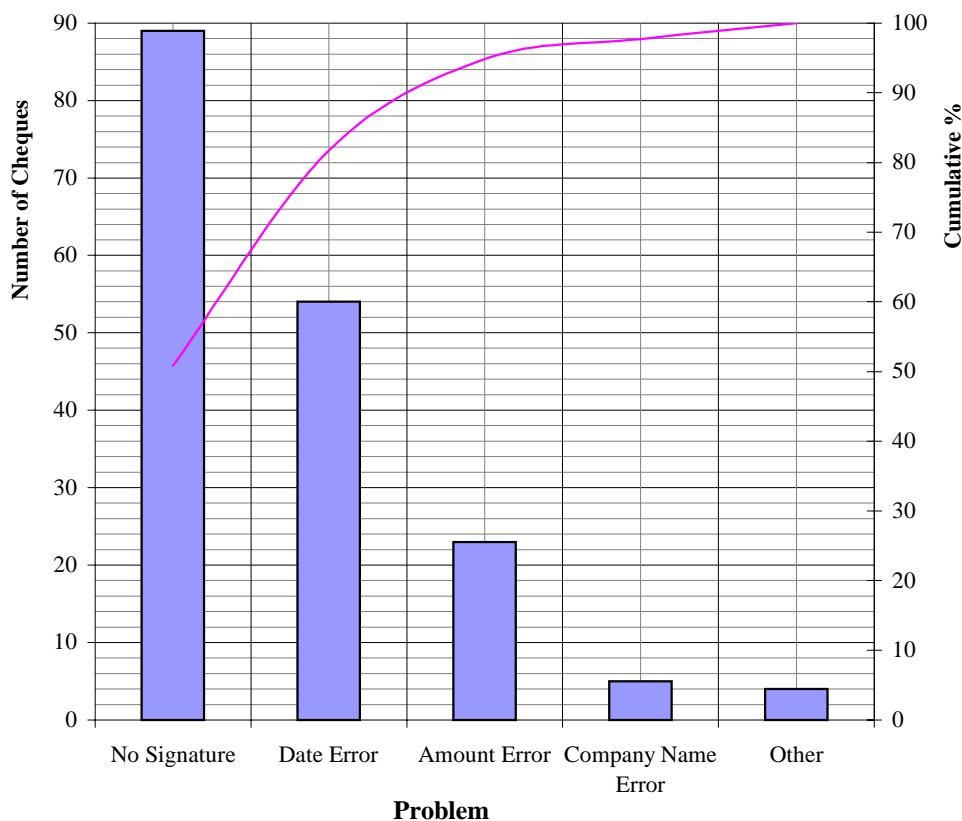
Pareto Charts

Worksheet

1   Use the first Pareto chart to answer the following questions:
    a   How many of the latecomers said delays at the security gate caused their lateness?
    b   What percentage of latecomers blamed the security gate?
    c   What percentage of latecomers blamed traffic congestion?
    d   How many of the main causes does it take to account for 80% of the problems?

2   Repeat question 1 using the second Pareto Chart.

3   The accounts department of a company records problems with cheques received from customers over a six month period. The results are shown in the Pareto chart below.

**Problems with cheques received in 6 month period**

    a   Find the total number of problem cheques received during this period.
    b   Estimate the percentage of these that were due to:
       i   a missing signature   ii   an error in the date
       iii   an error in the amount   iv   an error in the company name.
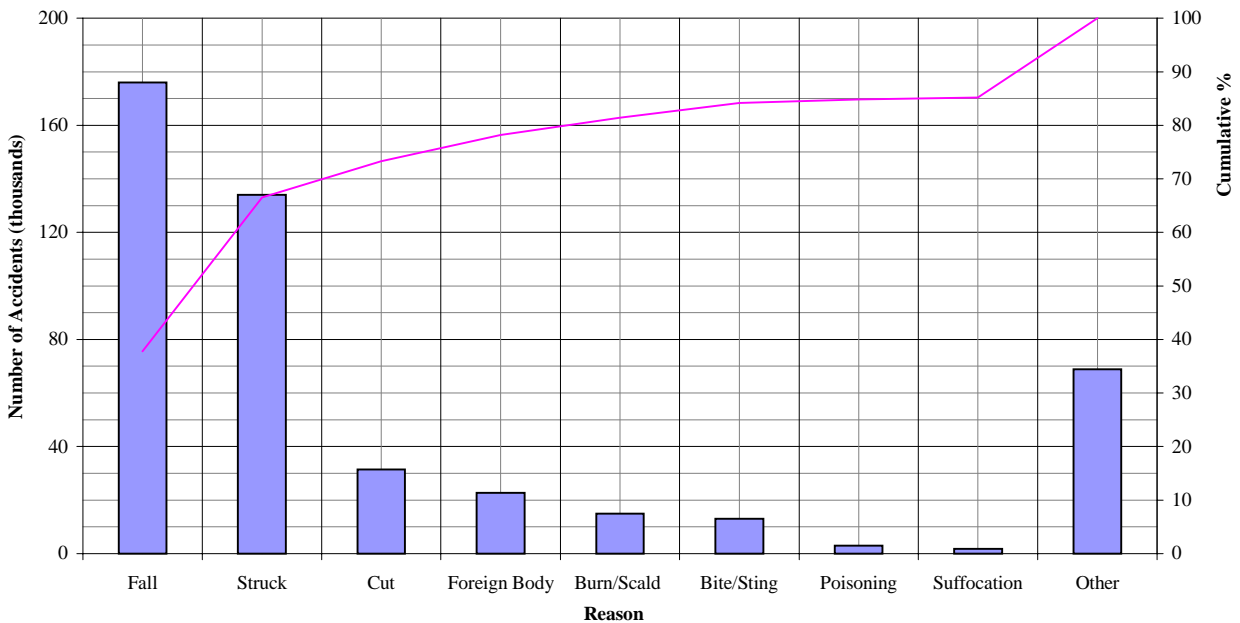
4   The Pareto charts below show the causes of injuries for which children needed hospital treatment in 1999. The first chart includes those children aged 0 to 4 years and the second those aged 5 to 14 years.

Non-fatal injuries to children aged 0 - 4 years
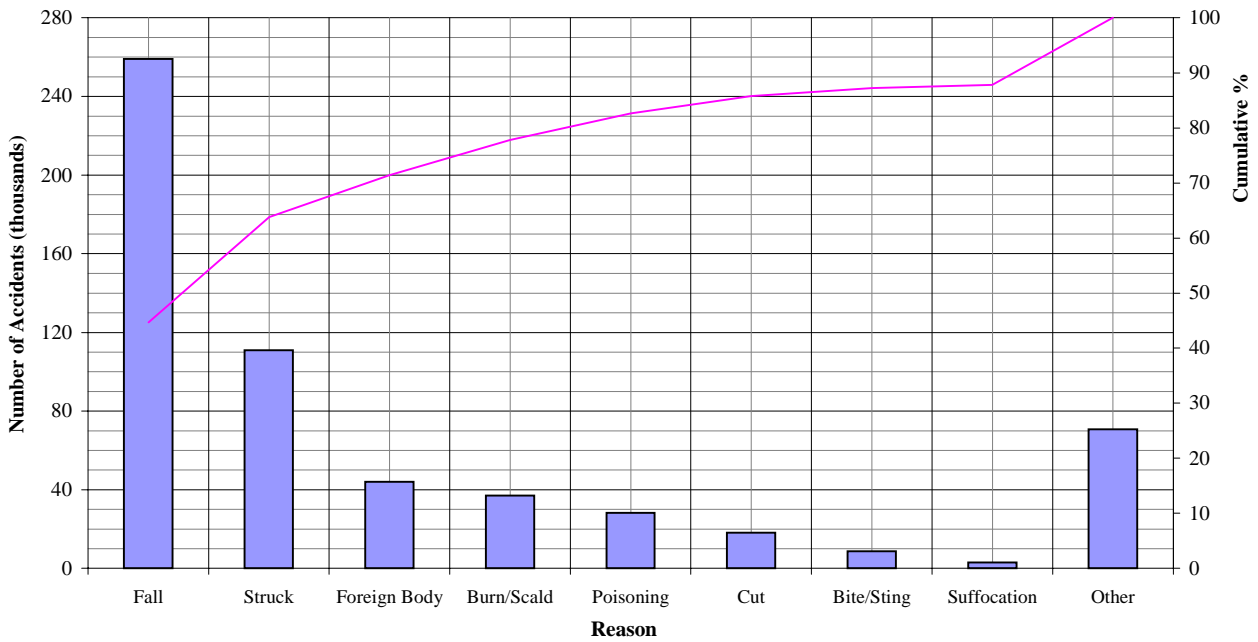
Non-fatal injuries to children aged 5 - 14 years

Source: The Home Accident Surveillance System (HASS) data 1999

Compare:
a   the average number of casualties (of any type) per year of age in each age group.
b   the data on each type of accident suffered by children in the two age-groups.

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Teacher Notes

Unit   Advanced Level, Using and applying statistics

Notes on the Activity
Students need to be familiar with bar charts and cumulative percentage graphs. In the *Using and applying statistics* examination students are often asked to interpret an unfamiliar type of chart. This activity is intended to prepare students for this by using a type of combination chart that they are not likely to have met before. As in the examination the Data Sheet can be given to students in advance so that they can study the information given on it before attempting the worksheet.

Answers   Values are given to nearest %. Allow some leeway especially in question 4 - students will only be able to give approximate answers from the charts.

1   a   79   b   40%   c   30%   d   3

2   a   8   b   4%   c   36%   d   4

3   a   175
    b   i   51%   ii   31%   iii   13%   iv   3%

4   a   A total of 580 000 children aged 0 to 4 year old is equivalent to approximately 116 000 per year.
        A total of 466 000 children aged 5 to 14 year old is equivalent to approximately 46 600 per year

    b   The most common type of accident in both age groups are falls. These account for about 45% of accidents suffered by 0 to 4 year olds and 38% of accidents suffered by 5 to 14 year olds.

        The second most common type of accident is also the same in both age groups - being struck by something. This accounts for about 19% of accidents suffered by 0 to 4 year olds and 29% of accidents suffered by 5 to 14 year olds.

        Together these two categories of accident account for well over 60% of accidents in both age groups.

        A foreign body is a more common type of accident in children aged 0 to 4 years, accounting for about 8%. A foreign body causes only about 5% of accidents in children aged 5 to 14 years.

        Burns and scalds are also more common in the younger age group, accounting for approximately 6% of accidents in the 0 to 4 age group, but only about 3% of accidents in the 5 to 14 age group.

        Poisoning is much more common in the 0 to 4 age group than the 5 to 14 age group, the percentages being 5% and 1% of accidents respectively.

        Cuts requiring hospital treatment are more common in children aged 5 to 14 years, accounting for about 7%, whereas in children aged 0 to 4 years, cuts account for only about 3% of accidents.

        Bites and stings are relatively uncommon in both age groups accounting in each case for about 3% of the accidents.

        Suffocation is also relatively rare accounting for less than 1% of accidents in both age groups.

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