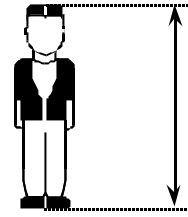


Stature



Data Sheet

It is generally known that the ‘average’ man is taller than the ‘average’ woman and that stature also varies from one nationality to another. Manufacturers need to take into account such differences when they design products.

The table below gives the heights of a representative sample of men and women from each of eight countries.

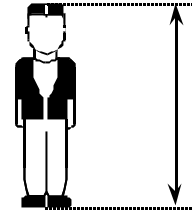
Stature (mm)	UK		China		Japan		Netherlands		USA		France		Germany		Italy	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
under 1360	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1360 -	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1380 -	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	1
1400 -	0	1	0	6	0	2	0	0	0	1	0	1	0	1	0	1
1420 -	0	2	0	14	0	7	0	1	0	2	0	2	0	2	0	2
1440 -	0	3	0	26	0	17	0	1	0	5	0	5	0	4	0	5
1460 -	0	10	0	47	0	36	0	2	0	9	0	12	0	10	0	12
1480 -	0	15	1	78	1	65	0	7	0	18	1	22	0	17	1	21
1500 -	0	34	2	99	1	100	0	12	0	28	1	39	0	31	1	36
1520 -	0	42	4	127	3	135	0	22	1	44	2	63	1	48	0	60
1540 -	0	69	10	134	9	153	0	35	1	63	6	88	3	70	10	80
1560 -	4	91	20	139	18	152	0	61	3	82	10	113	5	92	11	98
1580 -	3	108	35	115	34	128	1	80	8	99	20	129	10	111	19	120
1600 -	20	124	55	87	58	93	0	102	11	110	32	131	21	120	30	124
1620 -	24	118	80	58	86	58	10	119	20	113	51	118	34	120	45	119
1640 -	37	115	104	35	113	31	8	115	34	107	74	101	54	109	62	102
1660 -	54	90	126	22	130	14	19	121	62	90	91	73	77	90	79	83
1680 -	90	70	124	5	133	5	34	93	56	87	110	48	99	68	94	57
1700 -	84	48	122	0	138	2	52	88	88	56	110	28	116	46	105	37
1720 -	110	29	105	4	104	1	75	58	102	39	119	15	123	29	107	21
1740 -	116	16	78	1	73	0	96	38	112	17	100	5	119	17	103	8
1760 -	100	9	60	0	48	0	114	19	111	15	89	5	105	8	92	9
1780 -	98	3	36	0	27	0	122	15	103	7	68	0	84	4	76	3
1800 -	83	2	20	0	14	0	119	7	88	4	48	2	61	2	58	1
1820 -	65	1	10	0	6	0	106	2	70	2	31	0	40	1	42	0
1840 -	43	0	5	0	2	0	80	1	51	1	18	0	24	0	28	0
1860 -	32	0	2	0	2	0	69	1	34	0	10	0	13	0	17	0
1880 -	18	0	1	0	0	0	42	0	21	0	5	0	6	0	10	0
1900 -	10	0	0	0	0	0	26	0	12	0	2	0	3	0	5	0
1920 -	5	0	0	0	0	0	14	0	6	0	1	0	1	0	3	0
1940 -	2	0	0	0	0	0	7	0	4	0	1	0	1	0	1	0
1960 -	2	0	0	0	0	0	3	0	1	0	0	0	0	0	1	0
1980 -	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
2000 or over	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

N.B 1360 – means from 1360 up to, but not including 1380.



Stature

Worksheet



Use the data for

- 1 a Using the same scales on each:
 - i draw a histogram to show the distribution of heights in the sample of men;
 - ii draw a histogram to show the distribution of heights for the women.
 b Compare and contrast the two histograms and explain what they tell you about the height distribution of men and women in the country.

- 2 a Calculate the mean and standard deviation of the heights of:
 - i the men;
 - ii the women.
 b Explain what your answers to part a tell you about the height of men and women in the country.

- 3 a Use the table on the Data Sheet or your histogram of the male sample to estimate the number of men in the sample whose heights lie within:
 - i one standard deviation of the mean;
 - ii two standard deviations of the mean;
 - iii three standard deviations of the mean.
 b Repeat part a for the sample of women.
 c Comment on your answers to parts a and b.

- 4 Designers often design products to cater for sizes between the 5th percentile of the female distribution and the 95th percentile of the male distribution.
Use the table on the Data Sheet or your histograms to estimate:
 - a the 5th percentile in the sample of women's heights;
 - b the 95th percentile in the sample of men's heights.

Extension

- 5 a Assume that the distribution of the height of men in the country is normal with the mean and standard deviation that you found in question 2.
For each height group that had a non-zero frequency in the original sample of men:
 - i find the expected frequency in a random sample of 1000;
 - ii compare your answer to the frequency in the original sample.
 b Repeat part a for the sample of women.



Teacher Notes

Unit Advanced Level, Using and applying statistics

Notes

This activity is mainly intended as a starter for work on the normal distribution, but the extension also gives an opportunity for using the data after students have learnt how to use a standard normal table to fit a normal distribution.

Before students start the activity it is suggested that you discuss with them the meaning of a 'representative sample' and how such a sample might be obtained.

It is intended that students share the work, each investigating the data for just one of the countries. To be able to complete the activity students must be able to:

- draw and interpret histograms;
- calculate and interpret the mean and standard deviation of a sample;
- use linear interpolation in a grouped frequency table or a histogram to estimate the number of items within a range of values;
- find percentiles from a grouped frequency table or histogram;

Students can do the work by hand or use the accompanying Excel spreadsheet.

After students have each completed the activity for one country, it is suggested that you pool the results for the group. The answers to questions 1 and 2 should enable you to discuss the way stature varies from one country to another, as well as between genders, and how this will affect manufacturers who design goods for export.

The answers to question 3 lead to the usual results for a normal distribution that:

- roughly two-thirds of a normal distribution lies within one standard deviation of the mean;
- roughly 95% of a normal distribution lies within two standard deviations of the mean;
- nearly all of a normal distribution lies within three standard deviations of the mean.

Some answers are given on the following page. Note that in this case the data was simulated using the means and standard deviations given in the Department of Trade and Industry's publication 'ADULTDATA'. This and two similar publications, 'CHILDATA' and 'OLDER ADULTDATA' can be obtained from www.dti.gov.uk/publications (the Department of Trade and Industry's website). Use Browse and the alphabetical index to locate the publication you would like to order - at the time of writing these were available free of charge.

The data provided on the Data Sheet were contrived to give similar results to those expected from a normal distribution. It is important that students realise that in practice samples from a normal distribution can vary much more than they do in this case, especially when samples are small. A computer simulation package that gives more realistic simulations was devised by Neville Hunt and Sidney Tyrrell at Coventry University and James Nicholson and Gerry Mulhern at Queens University Belfast in a Nuffield-funded project. This package 'DISCUSS Sampling and Estimation' can be found on www.mis.coventry.ac.uk/~nhunt/sample. Students could use the 'Why sample?', 'Variation' and 'Distributions' sections of this package as follow-up activities to give them a better understanding of just how much samples from a Normal distribution can vary.



Answers

- 1 a The histograms should give the usual shape for a normal distribution, being reasonably symmetrical with a peak at the centre.
- b The shape of the histogram for the women is similar in shape to that for the men, but with a lower central value. This suggests that the ‘average’ woman is smaller than the ‘average’ man. In most cases the histogram for men is ‘wider’ than that for women suggesting that the heights of women is less variable than the heights of the men.

2

The table gives the mean and sample standard deviation for each dataset.

Country	Gender	Mean (mm)	Standard Deviation (mm)
UK	Men	1754	70.0
	Women	1620	64.9
China	Men	1691	62.1
	Women	1554	57.4
Japan	Men	1686	57.6
	Women	1558	51.2
Netherlands	Men	1795	65.4
	Women	1650	65.5
USA	Men	1760	71.2
	Women	1626	69.9
France	Men	1718	68.3
	Women	1604	60.6
Germany	Men	1733	64.6
	Women	1619	65.4
Italy	Men	1728	74.0
	Women	1610	64.2

- 3 In each case the number of men/women should be close to those expected from a normal distribution:
- approximately 680 within one standard deviation of the mean;
 - approximately 950 within two standard deviations of the mean;
 - approximately 997 within three standard deviations of the mean.

4

The table gives the 5th percentile in the sample of women’s heights and the 95th percentile in the sample of men’s heights for each country.

Country	5th percentile (women)	95th percentile (men)
UK	1511 mm	1872 mm
China	1460 mm	1793 mm
Japan	1473 mm	1781 mm
Netherlands	1543 mm	1902 mm
USA	1510 mm	1877 mm
France	1504 mm	1832 mm
Germany	1510 mm	1839 mm
Italy	1504 mm	1851 mm

- 5 The expected frequencies should be close, but not identical to the frequencies given on the Data Sheets.

