



Is your Height Normal?

The *CensusAtSchool* 2000/01 questionnaire captured the following data for the heights of 7068 pupils from year 3 to year 11 with:

- sample Mean = 152.4 cm
- sample standard deviation = 15.43 cm

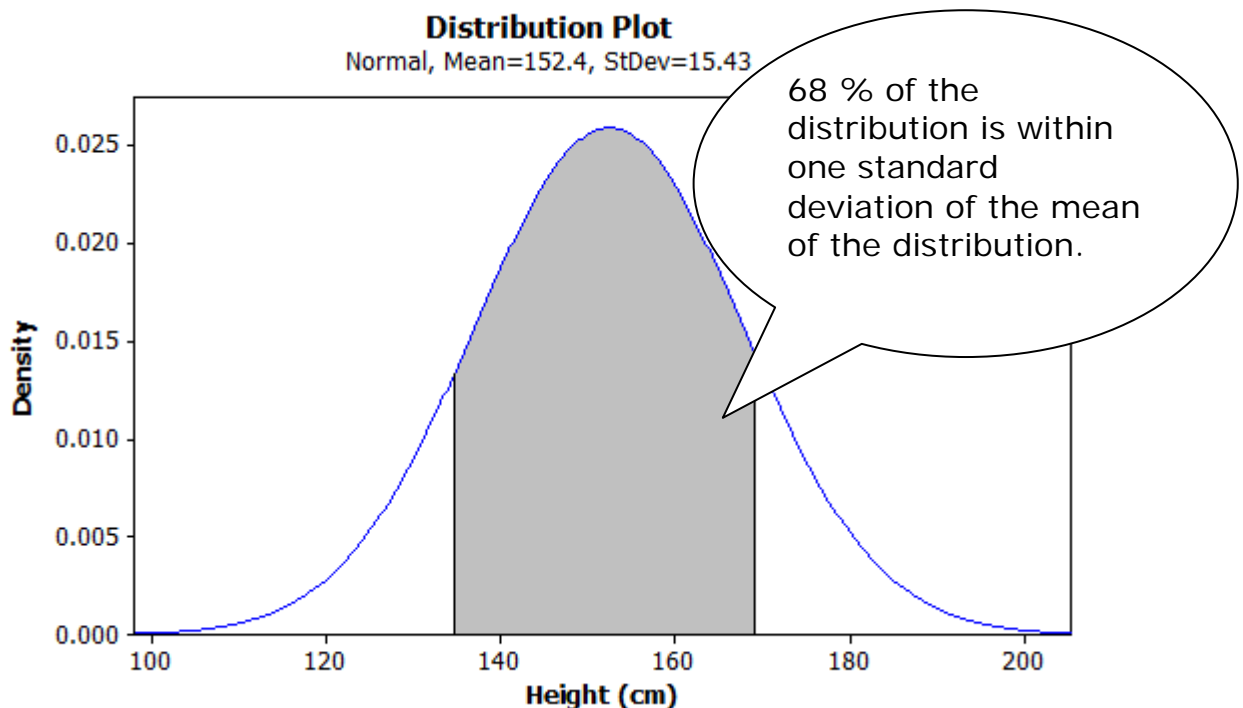
Height less than (cm)	Total number of pupils
106.11	8
121.54	119
136.97	1233
152.40	3441
167.83	5854
183.26	6959
198.69	7067

Table 1 Height of children *CensusAtSchool* 2000/01

TASK A

Check the proportions of this data against the standard Normal distribution of of which:

- 68% of the distribution is within one standard deviation of the mean;
- 95% of the distribution is within two standard deviations of the mean;
- 99.7 % of the distribution is within three standard deviations of the mean.





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TASK B

Using the data in table 1 as a model for the whole population and assuming a Normal Distribution, if a teacher takes a party of school children from years 3 to 11 to Alton Towers the number of children who may not ride the scary rides can be worked out.

E.g. To ride on the Thi3teen you have to be over 120 cm.

$$Z = \frac{x - \text{mean}}{\text{Standard deviation}}$$

$$Z = \frac{120 - 152.4}{15.43} = -2.1$$

z	0.00	0.01	0.02	0.03
-3.4	0.0003	0.0003	0.0003	0.0003
-3.3	0.0005	0.0005	0.0005	0.0004
-3.2	0.0007	0.0007	0.0006	0.0006
-3.1	0.0010	0.0009	0.0009	0.0009
-3.0	0.0013	0.0013	0.0013	0.0012
-2.9	0.0019	0.0018	0.0018	0.0017
-2.8	0.0026	0.0025	0.0024	0.0023
-2.7	0.0035	0.0034	0.0033	0.0032
-2.6	0.0047	0.0045	0.0044	0.0043
-2.5	0.0062	0.0060	0.0059	0.0057
-2.4	0.0082	0.0080	0.0078	0.0075
-2.3	0.0107	0.0104	0.0102	0.0099
-2.2	0.0139	0.0136	0.0132	0.0129
-2.1	0.0179	0.0174	0.0170	0.0166
-2.0	0.0228	0.0222	0.0217	0.0212

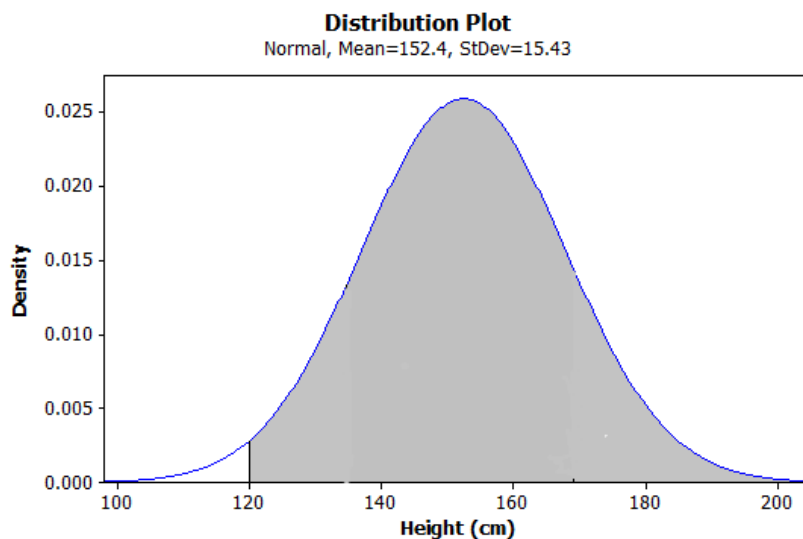
$$P(z \leq -2.1) = 0.0179$$

Table 2 Extract from Standard Normal Cumulative Probability Table

From the table of Standard Normal probabilities

$$P(z \leq -2.1) = 0.0179 \text{ or } 1.79\%$$

Therefore 1.79% of the party will be unable to ride on the Thi3teen, which is only about 1 pupil per full coach (standard coach capacity up to 53/57 seats).

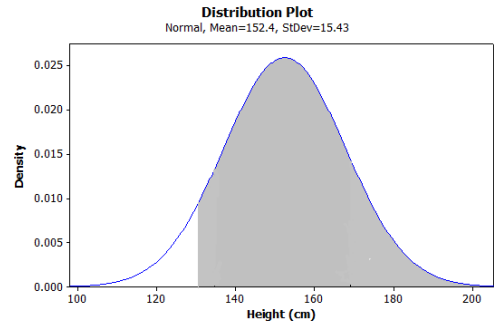




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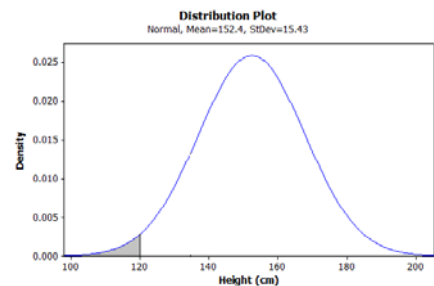
Work out how many pupils will **not** be able to ride on :-

1. Gallopers Carousel (Height must be over 130 cm)



2. Oblivion (Height must be over 140cm)

3. Big Wobble World (Height must be between 0.9m - 1.2m)



TASK C

Given that in a large group of children there are 103 children (1.46 %) with a height of 120 cm or under. Compare this to our result in Task B.

Recalculate the number of children who may not ride the Thi3teen if only years 7 to 11 are allowed to go on the trip to Alton Towers.

Sample statistics for years 7 to 11 are:

- sample mean= 162.2 cm
- sample standard deviation = 10.73 cm
- sample size = 4019 and assume the data are Normally Distributed