Upper and Lower Bounds
Examples i) If Length $=4 \mathrm{~m}$ to nearest metre
then $\quad 3.5 \leq L<4.5$
2) 1 t Length $=4 \mathrm{~m}$ to nearest 10 cm

$$
3.95 \mathrm{~m} \leq L<4.05 \mathrm{~m}
$$

3) Tine $=26 \mathrm{~s}$ to nearest second

$$
25.5 \leq T<26.5
$$

Calculations

1) A carpet is $4 m \times 3 \mathrm{~m}$ each measurement to the nearest metre Find the nominal area and upper and lower bounds for the area.

Nominal Area $=4 \times 3=12 \mathrm{~m}^{2}$

$$
\begin{aligned}
& 3.5 \mathrm{~m} \leq \text { Length }<4.5 \mathrm{~m} \\
& 2.5 \mathrm{~m} \leq \text { Width }<3.5 \mathrm{~m} \\
& \text { Area }=\text { Length } \times \text { Width }
\end{aligned}
$$

Upper Bound $=4.5 \times 3.5=15.75 \mathrm{~m}^{2}$
Lower Bound $=3.5 \times 2.5=8.75 \mathrm{~m}^{2}$

$$
8.75 \mathrm{~m}^{2} \leq \text { Area }<15.75 \mathrm{~m}^{2}
$$

Find bounds for Perimeter

$$
\begin{aligned}
p & =2 L+2 W \\
\text { upper Bound } & =2 \times 4.5+2 \times 3.5=16 \mathrm{~m} \\
\text { Lower Bound } & =2 \times 3.5+2 \times 2.5=12 \mathrm{~m} \\
12 \mathrm{~m} & \leq \text { Perimeter }<16 \mathrm{~m}
\end{aligned}
$$

Speed, Time, Distance
John runs the 100 m (measured to nearest $m$ )
John takes 12 s (measured to nearest second)
Find Lower and Upper Bounds for John's speed

$$
\begin{aligned}
99.5 \mathrm{~m} & \leq \text { Distance }<100.5 \mathrm{~m} \\
11.5 \mathrm{~s} & \leq \text { Time }<12.5 \mathrm{~s} \\
\text { Speed } & =\frac{\text { Distance }}{\text { Time }} \\
\text { Upper Bound } & =\frac{100.5}{11.5}=8.74 \mathrm{~ms}^{-1} \mathrm{~m} / \mathrm{s}
\end{aligned}
$$

$$
\begin{gathered}
\text { Lower Bound }=\frac{99.5}{12.5}=7.96 \mathrm{~ms}^{-1} \\
7.96 \mathrm{~m} / \mathrm{s} \leq \text { Speed }<8.74 \mathrm{~m} / \mathrm{s}
\end{gathered}
$$

A piece of string is 20 m to nearest 10 cm A piece is cut off measuring 4 m to nearest 10 cm Find bounds for the piece that is left.

$$
\begin{gathered}
\text { Piece Left }=\text { Original }- \text { Cut Oft } \\
19.95 \leq \text { Original }<20.05 \\
3.95 \leq \text { Cut -oft }<4.05
\end{gathered}
$$

Upper Bound for Piece Left $=20.05-3.95$

$$
\begin{aligned}
& =16.1 \mathrm{~m} \\
& =19.95-4.05 \\
& =15.9 \mathrm{~m}
\end{aligned}
$$

Lower Bound

$$
15.9 \mathrm{~m} \leq \text { Piece Lett }<16.1 \mathrm{~m}
$$

Exercise

1) Jack runs for 45 seconds (to nearest second) at a speed of $6.4 \mathrm{~m} / \mathrm{s}$ (to neurat 0.1 of a second) Find upper and lower bounds for the distance he rus

$$
\begin{aligned}
& 44.5 \mathrm{~s} \leq \text { Time }<45.5 \mathrm{~s} \\
& 6.35 \mathrm{~m} / \mathrm{s} \leq \text { Speed }<6.45 \mathrm{~m} / \mathrm{s} \\
& \text { Distance }=\text { Speed } \times \text { Time } \\
& \text { Upper Bound }=45.5 \times 6.45=293.5 \mathrm{~m} \\
& \text { Lower Bound }=44.5 \times 6.35=282.6 \mathrm{~m}
\end{aligned}
$$

Homework Revision Topics
Rules of Indices
Rearrange Formula
Factorise Quadratic Expressions
Expand Brackets
Complete the Square
Distance Time Graph
Plotting Graphs Using Tables of Values
Density
Bounds

