1. **Problem:**
   A continuous random variable X was measured 21 times. The sorted measurements are shown below.

21.24	23.74	23.78	23.98	24.51	25.85	25.93
26.66	27.13	27.17	27.29	27.93	28.67	29.31
29.65	33.64	34.37	40.17	44.43	46.83	47.16

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 21. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 21 \rceil$	6	25.85
Q2	$\lceil 0.5 \times 21 \rceil$	11	27.29
Q3	$\lceil 0.75 \times 21 \rceil$	16	33.64

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 33.64 - 25.85 \\ &= 7.79 \end{aligned}$$

We determine the outlier boundaries.

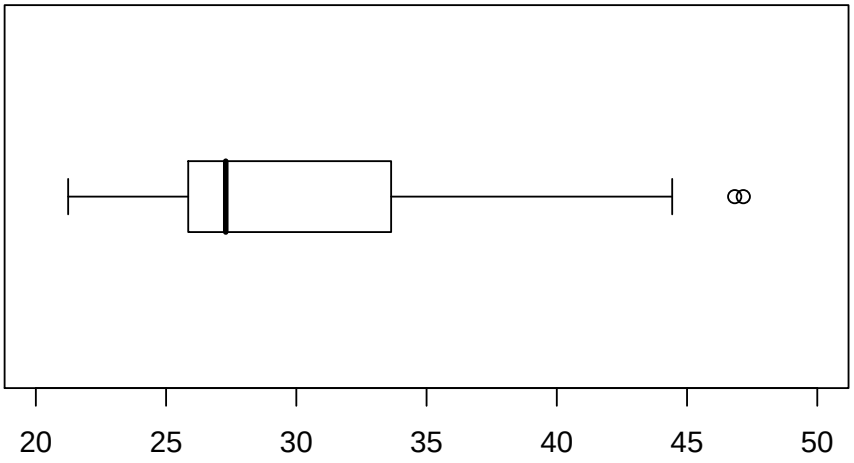
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 25.85 - 1.5 \times 7.79 \\ &= 14.165 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 33.64 + 1.5 \times 7.79 \\ &= 45.325 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{46.83, 47.16\}$$

We identify the ends of the whiskers: 21.24 and 44.43. We plot the boxplot.



2. **Problem:**
   A continuous random variable X was measured 45 times. The sorted measurements are shown below.

74.75	78.43	90.82	90.88	90.97	104.42	105.48	109.42	110.64
111.09	112.41	121.07	122.36	123.39	124.00	125.65	125.68	125.89
127.96	128.25	129.25	129.80	131.73	132.27	134.16	135.09	135.59
136.81	138.99	139.51	139.72	142.02	142.52	143.80	144.10	144.18
145.84	146.11	147.44	147.46	147.71	147.81	148.26	148.28	149.52

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 45. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 45 \rceil$	12	121.07
Q2	$\lceil 0.5 \times 45 \rceil$	23	131.73
Q3	$\lceil 0.75 \times 45 \rceil$	34	143.8

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 143.8 - 121.07 \\ &= 22.73 \end{aligned}$$

We determine the outlier boundaries.

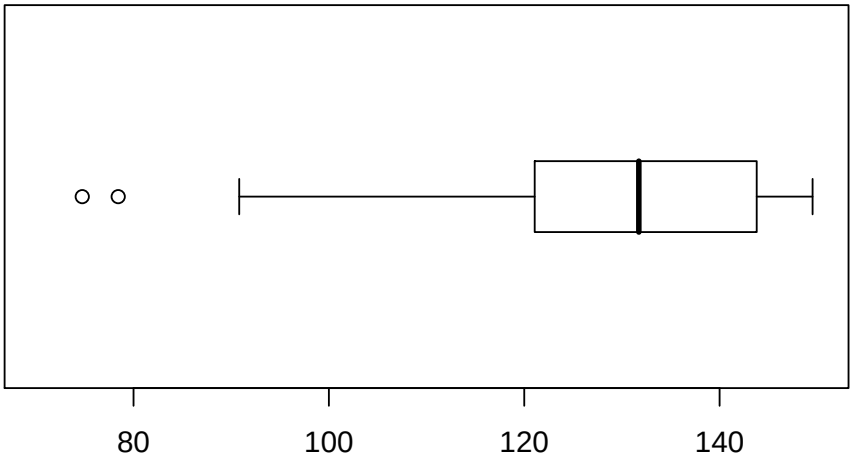
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 121.07 - 1.5 \times 22.73 \\ &= 86.975 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 143.8 + 1.5 \times 22.73 \\ &= 177.895 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{74.75, 78.43\}$$

We identify the ends of the whiskers: 90.82 and 149.52. We plot the boxplot.



3. **Problem:**
   A continuous random variable X was measured 18 times. The sorted measurements are shown below.

30.18	30.53	30.56	30.95	31.21	31.28
31.48	32.07	32.22	32.33	32.49	32.72
33.33	33.72	35.60	36.14	37.41	38.56

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 18. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 18 \rceil$	5	31.21
Q2	$\lceil 0.5 \times 18 \rceil$	9	32.22
Q3	$\lceil 0.75 \times 18 \rceil$	14	33.72

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 33.72 - 31.21 \\ &= 2.51 \end{aligned}$$

We determine the outlier boundaries.

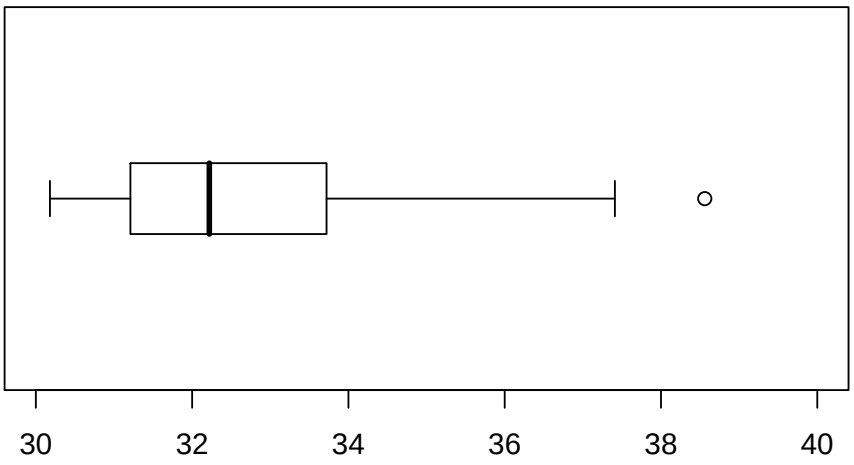
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 31.21 - 1.5 \times 2.51 \\ &= 27.445 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 33.72 + 1.5 \times 2.51 \\ &= 37.485 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{38.56\}$$

We identify the ends of the whiskers: 30.18 and 37.41. We plot the boxplot.



4. **Problem:**
   A continuous random variable X was measured 63 times. The sorted measurements are shown below.

30.25	31.09	31.09	31.12	31.30	31.36	31.38	31.45	31.53
31.54	31.54	31.58	31.64	31.70	31.76	31.78	31.88	31.93
31.98	32.04	32.15	32.16	32.21	32.25	32.26	32.29	32.30
32.32	32.33	32.33	32.38	32.39	32.39	32.52	32.54	32.54
32.55	32.55	32.57	32.58	32.60	32.60	32.64	32.65	32.66
32.71	32.73	32.73	32.73	32.74	32.75	32.77	32.77	32.79
32.85	32.85	32.85	32.91	32.93	32.94	32.94	32.96	32.99

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 63. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 63 \rceil$	16	31.78
Q2	$\lceil 0.5 \times 63 \rceil$	32	32.39
Q3	$\lceil 0.75 \times 63 \rceil$	48	32.73

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 32.73 - 31.78 \\ &= 0.95 \end{aligned}$$

We determine the outlier boundaries.

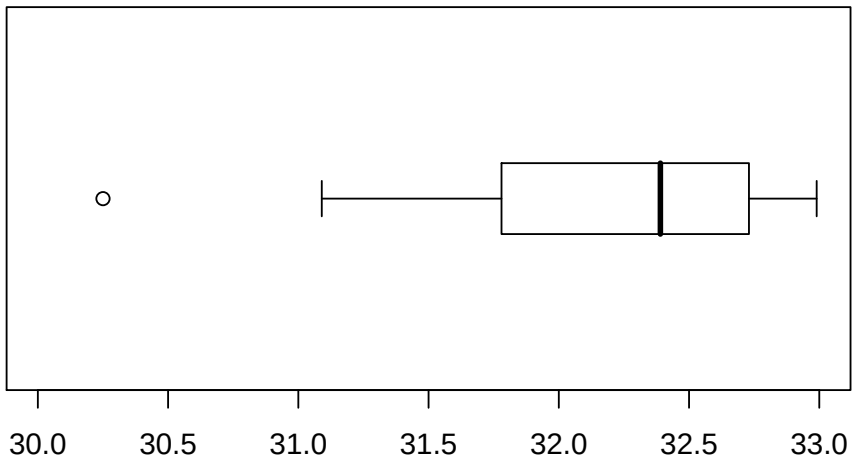
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 31.78 - 1.5 \times 0.95 \\ &= 30.355 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 32.73 + 1.5 \times 0.95 \\ &= 34.155 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{30.25\}$$

We identify the ends of the whiskers: 31.09 and 32.99. We plot the boxplot.



5. **Problem:**
   A continuous random variable X was measured 9 times. The sorted measurements are shown below.

70.11	71.99	72.06
72.33	72.59	72.82
73.21	73.52	74.31

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 9. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 9 \rceil$	3	72.06
Q2	$\lceil 0.5 \times 9 \rceil$	5	72.59
Q3	$\lceil 0.75 \times 9 \rceil$	7	73.21

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 73.21 - 72.06 \\ &= 1.15 \end{aligned}$$

We determine the outlier boundaries.

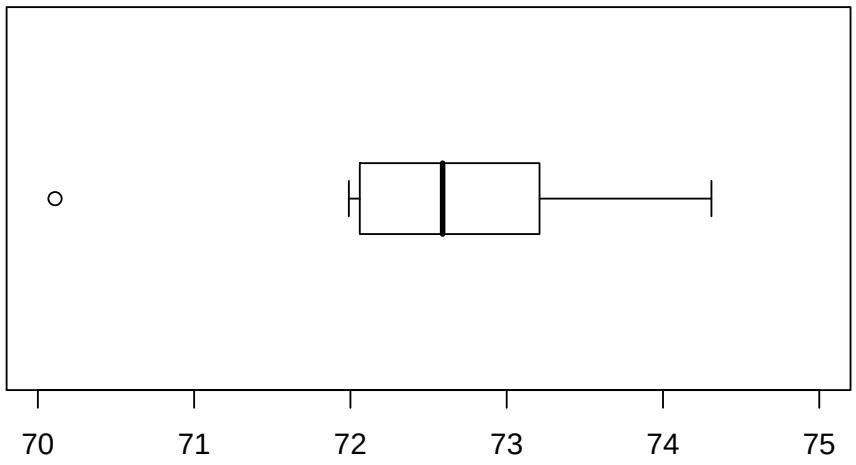
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 72.06 - 1.5 \times 1.15 \\ &= 70.335 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 73.21 + 1.5 \times 1.15 \\ &= 74.935 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{70.11\}$$

We identify the ends of the whiskers: 71.99 and 74.31. We plot the boxplot.



6. **Problem:**
A continuous random variable X was measured 56 times. The sorted measurements are shown below.

60.05	60.06	60.07	60.08	60.09	60.11	60.16	60.16
60.17	60.20	60.22	60.23	60.29	60.32	60.32	60.35
60.36	60.38	60.41	60.42	60.44	60.46	60.47	60.48
60.51	60.52	60.55	60.56	60.57	60.58	60.58	60.60
60.62	60.65	60.68	60.68	60.71	60.80	60.85	60.88
60.88	60.92	60.92	61.11	61.18	61.27	61.36	61.40
61.42	61.47	61.55	61.59	61.62	61.74	61.79	62.12

Create a boxplot representing these measurements.

Solution: The sample size, n, is 56. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 56 \rceil$	14	60.32
Q2	$\lceil 0.5 \times 56 \rceil$	28	60.56
Q3	$\lceil 0.75 \times 56 \rceil$	42	60.92

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 60.92 - 60.32 \\ &= 0.6 \end{aligned}$$

We determine the outlier boundaries.

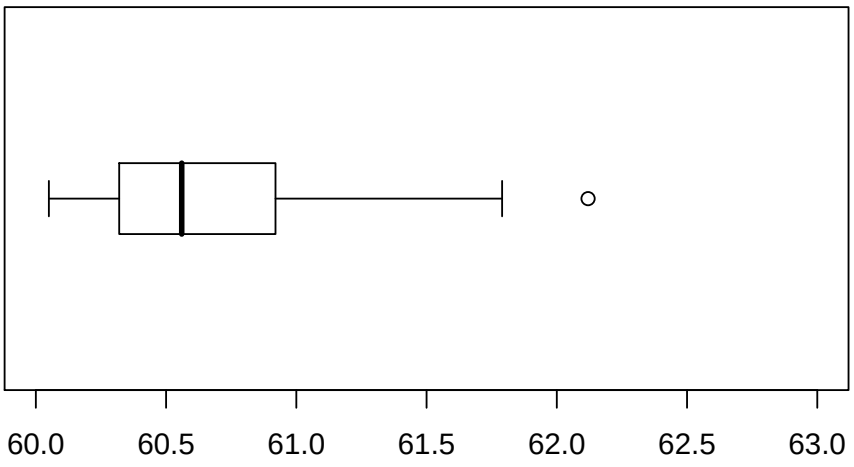
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 60.32 - 1.5 \times 0.6 \\ &= 59.42 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 60.92 + 1.5 \times 0.6 \\ &= 61.82 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{62.12\}$$

We identify the ends of the whiskers: 60.05 and 61.79. We plot the boxplot.



7. **Problem:**
   A continuous random variable X was measured 72 times. The sorted measurements are shown below.

70.55	72.53	73.18	74.03	74.62	76.55	76.75	78.42	78.69
79.97	83.18	83.40	84.49	84.71	85.08	85.70	85.85	86.15
86.27	87.83	87.86	88.31	88.57	88.89	89.11	89.28	89.81
90.19	90.41	90.57	90.71	91.13	91.70	91.88	92.57	92.94
92.94	93.04	93.54	93.88	94.03	94.20	94.29	94.53	94.62
95.11	95.37	95.47	95.50	95.63	95.86	96.12	96.20	96.40
96.53	96.98	97.01	97.18	97.44	97.65	97.86	97.99	98.06
98.14	98.47	98.85	98.85	99.03	99.12	99.29	99.49	99.93

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 72. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 72 \rceil$	18	86.15
Q2	$\lceil 0.5 \times 72 \rceil$	36	92.94
Q3	$\lceil 0.75 \times 72 \rceil$	54	96.4

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 96.4 - 86.15 \\ &= 10.25 \end{aligned}$$

We determine the outlier boundaries.

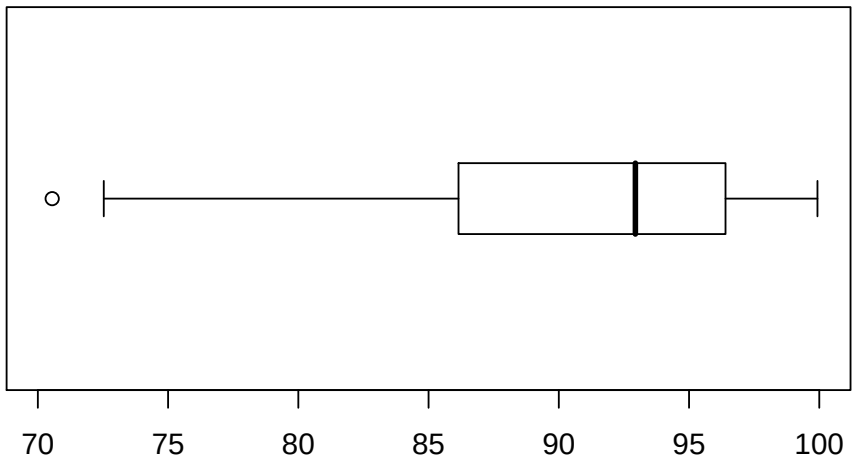
$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 86.15 - 1.5 \times 10.25 \\ &= 70.775 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 96.4 + 1.5 \times 10.25 \\ &= 111.775 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{70.55\}$$

We identify the ends of the whiskers: 72.53 and 99.93. We plot the boxplot.



8. **Problem:**
   A continuous random variable X was measured 25 times. The sorted measurements are shown below.

73.00	76.82	81.49	83.06	83.18
83.67	83.86	84.23	85.38	85.45
85.89	85.95	86.04	86.05	86.81
88.00	88.10	89.22	89.24	89.52
89.53	89.59	89.67	89.68	89.82

   Create a boxplot representing these measurements.

Solution: The sample size, n, is 25. We determine the indeces and values of Q1, Q2, and Q3.

Quartile	Formula for i	i	x
Q1	$\lceil 0.25 \times 25 \rceil$	7	83.86
Q2	$\lceil 0.5 \times 25 \rceil$	13	86.04
Q3	$\lceil 0.75 \times 25 \rceil$	19	89.24

We determine the IQR.

$$\begin{aligned} \text{IQR} &= \text{Q3} - \text{Q1} \\ &= 89.24 - 83.86 \\ &= 5.38 \end{aligned}$$

We determine the outlier boundaries.

$$\begin{aligned} \text{lower boundary} &= \text{Q1} - 1.5 \times \text{IQR} \\ &= 83.86 - 1.5 \times 5.38 \\ &= 75.79 \end{aligned}$$

$$\begin{aligned} \text{upper boundary} &= \text{Q3} + 1.5 \times \text{IQR} \\ &= 89.24 + 1.5 \times 5.38 \\ &= 97.31 \end{aligned}$$

We determine the outliers.

$$\text{outliers} = \{73\}$$

We identify the ends of the whiskers: 76.82 and 89.82. We plot the boxplot.