In the article "Evaluation of Low-Temperature Properties of HMA Mixtures" (P. Sebaaly, A. Lake, and J. Epps, *Journal of Transportation Engineering*, 2002: 578–583), the following values of fracture stress (in megapascals) were measured for a sample of 24 mixtures of hot-mixed asphalt (HMA).

30	75	79	80	80	105	126	138	149	179	179	191
223	232	232	236	240	242	245	247	254	274	384	470

- Find the modes and the range for the sample

Three mode $\Rightarrow$ 80, 179, 232

Range = 470 − 30 = 440

Quartiles

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- Find the first and third quartiles of the asphalt data

$n \Rightarrow (n+1)$

1st Quartile $\Rightarrow 0.25\,(n+1)$

Integer → location

fraction → 0.25

$\frac{x_6 + x_7}{2}$

Sample size = 24

$0.25(24+1) = 6.25$

x_6 ← $\frac{105+126}{2}$ = 115.5

x_7

2nd Quartile → $0.5\,(n+1)$

$0.75(24+1) = 18.75$

x_{18}

$x_{19} \Rightarrow \frac{242+245}{2} \Rightarrow 243.5$

3rd Quartile → $0.75\,(n+1)$

Percentiles

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30	75	79	80	80	105	126	138	149	179	179	191
223	232	232	236	240	242	245	247	254	274	384	470

Quantile

- Find the 65th percentile of the asphalt data

$0.65(24+1) = 16.25$ ← x_{16}, x_{17} ⊕ ⇒ /2

65th percentile $= \frac{236+240}{2} = 238$

Summary Statistics for Categorical Data

- A process manufactures crankshaft journal bearings for an internal combustion engine. Bearings whose thicknesses are between 1.486 and 1.490 mm are classified as conforming, which means that they meet the specification. Bearings thicker than this are reground, and bearings thinner than this are scrapped. In a sample of **1000 bearings**, **910 were conforming**, **53 were reground**, and **37 were scrapped**. Find the frequencies and sample proportions.

frequency 910, 53, 37

proportion $\frac{910}{1000}$, $\frac{53}{1000}$, $\frac{37}{1000}$