Data Science in Aerospace

Descriptive Statistics

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1 Test Flight Performance

The following values represent the fuel consumption (in liters per hour) of 7 different aircraft during a test flight:

$$166,\ 158,\ 202,\ 166,\ 150,\ 86,\ 135.$$

$$86,\ 135,\ 150,\ 158,\ 166,\ 166,\ 202.$$

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \approx 151.9 \text{ l/h}$$

$$\text{mode} = 166 \text{ l/h}$$

$$\text{median} = 158 \text{ l/h}$$

$$\text{range} = 116 \text{ l/h}$$

$$\text{Mean Deviation} = \frac{1}{n}\sum_{i=1}^{n} |x_i - \overline{x}| \approx 24.2 \text{ l/h}$$

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2 \approx 1262.8 \text{ (l/h)}^2$$

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2} \approx 35.5 \text{ l/h}$$

$$\text{CV} = \frac{S}{\overline{x}} \approx 0.23$$

$$\frac{3(\overline{x} - \text{median})}{S} \approx -0.52$$

- Sketch the corresponding dot plot. Calculate and interpret the following parameters: mean, mode, median, range, mean absolute deviation, variance, standard deviation, and coefficient of variation.

2 Fuel Consumption Analysis

The table below presents the fuel consumption values (in liters) for 66 flights conducted by an airline:

649	719	1863	129	3498	1295
2125	6849	938	97	219	4169
465	319	1045	2385	890	1197
444	1388	812	6468	2468	997
367	1493	775	6725	450	3495
749	569	2295	7495	2445	6791
890	3955	1269	3377	4356	3679
1197	525	985	650	2997	357
1630	1339	1194	4996	2576	1190
1185	997	746	1243	2150	168
4987	1383	1956	277	782	1520

- Represent and interpret the information contained in this data appropriately.

3 Altimeter Calibration

An experiment was conducted with an aircraft's altimeter to evaluate its accuracy in measuring altitude changes during flight maneuvers. For this purpose, the altitude deviations (in feet) were recorded at 10 different points, as shown below:

10.6	10.7	10.1	10.9	10.8
10.2	11.0	10.3	10.5	10.9

- Present three measures of central tendency and three measures of dispersion for the observed data, interpret them, and suggest which is the most appropriate within each group of measures.

4 Fuel Capacity Analysis

Consider a sample of 100 airplanes of a particular model, where the manufacturer specifies a fuel capacity of 450 gallons. The observed fuel capacities are grouped into 9 classes, as shown in the table below:

Fuel Capacity (gallons)	Frequency
$420 - 424$	2
$425 - 429$	5
$430 - 434$	6
$435 - 439$	14
$440 - 444$	18
$445 - 449$	27
$450 - 454$	19
$455 - 459$	8
$460 - 464$	1

- Calculate sample measures of location, dispersion, and skewness, and interpret the results.

Fuel Capacity	Freq. (F_i)	Relative Freq.	Cumulative Freq.
$420 - 424$	2	0.02	0.02
$425 - 429$	5	0.05	0.07
$430 - 434$	6	0.06	0.13
$435 - 439$	14	0.14	0.27
$440 - 444$	18	0.18	0.45
$445 - 449$	27	0.27	0.72
$450 - 454$	19	0.19	0.91
$455 - 459$	8	0.08	0.99
$460 - 464$	1	0.01	1.00

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} F_i x_i \approx 444.2 \text{ gallons}$$

$$\text{modal class} = 445 - 449 \text{ gallons}$$

$$\text{median class} = 445 - 449 \text{ gallons}$$

$$\text{median} = L + \frac{0.5 - f_a^-}{f_a - f_a^-}\Delta = 445 + \frac{0.50 - 0.45}{0.72 - 0.45} \times 5 \approx 445.9 \text{ gallons}$$

$$\text{range} = 464 - 420 = 44 \text{ gallons}$$

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n} F_i(x_i - \overline{x})^2 \approx 81.2 \text{ gallons}^2$$

$$S \approx 9.01 \text{ gallons}$$

$$\frac{3(\overline{x} - \text{median})}{S} \approx -0.57$$