Dispersion measures for grouped univariate data

BEA140 Quantitative Methods - Module 2

UNIVERSITY *of* TASMANIA

Dispersion

In these slides we will look at a number of dispersion measures for grouped univariate data.

Recall that in statistics **dispersion measures** attempt to give us an idea of how *stretched* or *squeezed* a data set is.

Dispersion - Variance (Computation)

We can calculate the **variance** of grouped data as follows:

$$\sigma^2 = \frac{\Sigma f_i X_i^2 - \frac{(\Sigma f_i X_i)^2}{N}}{N} \qquad \text{(population)}$$

$$s^2 = \frac{\Sigma f_i X_i^2 - \frac{(\Sigma f_i X_i)^2}{n}}{n-1} \qquad \text{(sample)}$$

Note: When calculating variance (or standard deviation - see the next slide), it is more efficient and less error prone to use a table.

Dispersion - Variance Example

Going back to the grouped travel time data introduced in the slides on 'central tendency measures for grouped univariate data':

time	frequency (f_i)	class mark (X_i)	$f_i X_i$	X_i^2	$f_i X_i^2$
$0 \leq x_i < 10$	1	4.5	4.5	20.25	20.25
$10 \leq x_i < 20$	2	14.5	29	210.25	420.5
$20 \leq x_i < 30$	3	24.5	73.5	600.25	1800.75
$30 \leq x_i < 40$	1	34.5	34.5	1190.25	1190.25
$40 \leq x_i < 50$	2	44.5	89	1980.25	3960.5
			$\Sigma f_i X_i = 230.5$		$\Sigma f_i X_i^2 = 7392.25$

$$s^2 = \frac{\Sigma f_i X_i^2 - \frac{(\Sigma f_i X_i)^2}{n}}{n-1} = \frac{7392.25 - \frac{230.5^2}{9}}{8} = 186.11 \text{ (to 2 dp).}$$

Dispersion - Standard Deviation

(population) $\sigma = \sqrt{\sigma^2}$ (sample) $s = \sqrt{s^2}$

Sanity Check: A "*rule of thumb*" is that the range is usually somewhere between 3 and 8 times the standard deviation.

I.e. for a population we usually have:

$$3\sigma \leq \text{range} \leq 8\sigma.$$

Dispersion - Standard Deviation Example

For our grouped travel time data, we obtained the variance $s^2 = 186.11$ (to 2 dp).

Hence the standard deviation is $s = \sqrt{186.11} = 13.64$ (to 2 dp).

Sanity Check: the range is $\frac{49}{13.64} \approx 3.59$ times the standard deviation, which is inside the 3-8 band for our sanity check.

. . . that's it for now, thanks for watching!

Don't forget that you can ask questions via:

(i) face-to-face lectures;

(ii) workshops or tutorials;

(iii) consultation hours; or

(iv) email.