## Chapter 5: Basics of statistical analysis.

Full answers to study questions

1. Friendship example:

	Boys		Girls		Significance	Is the analysis significant? What is the chance of a Type I Error?	Which group has significantly more friends?	Comment on the variability in the dataset.
Lab	Mean	SD	Mean	SD	p			
1	7.8	1.3	9.2	2.6	.049	Yes: 4.9%	Girls	More for girls
2	6.1	1.6	6.5	1.2	.500	No: 50%	Neither	Similar
3	6.8	3.5	5.2	2.9	.051	No: 5.1%	Neither	Slightly larger for boys
4	8.3	2.3	10.6	1.9	.005	Yes: 0.5%	Girls	More for boys

2. Generalised Anxiety Disorder example:

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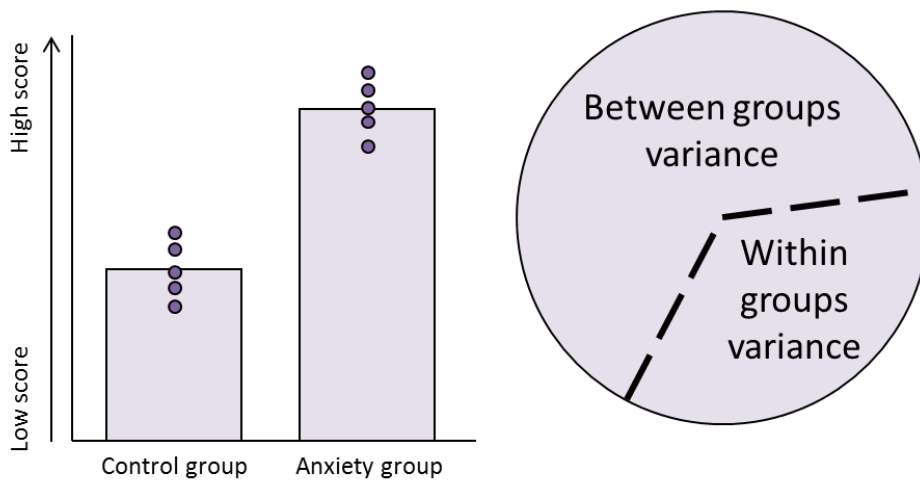
2.1. Mean would be higher for the clinical group, giving a large amount of between group variability. There is likely to be variability within conditions, but this would be smaller than the variability between the conditions.

2.2. There probably would be a significant difference, so the between groups variance slice is likely to take up much of the cake with a far smaller slice of within groups variance (similar to the Lab One cake example in the chapter).

3. Extraversion example:

3.1. Area under the normal distribution curve: The mean is 48, and that is represented by the thick black line that goes through the centre of the distribution. You needed to mark the area between 32 and 45, so 45 is just slightly less than 48 and the line just to the left of the mean. The line to the far left represents the 32 line, and therefore you are looking for the area between the two purple lines.
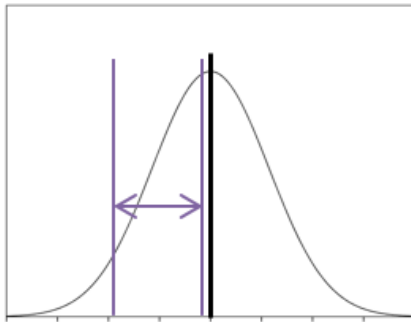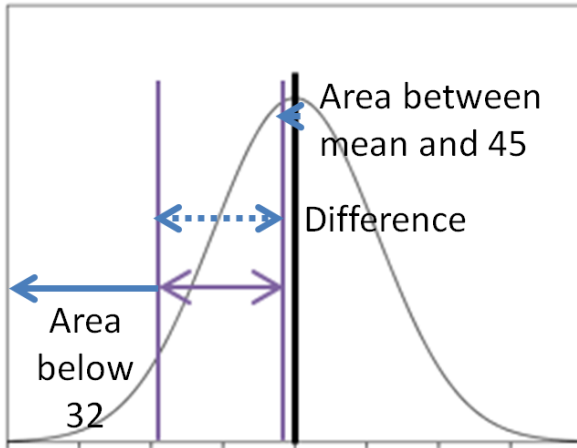

3.2. I worked out 3 ways, but there could be more. Some are a bit convoluted!
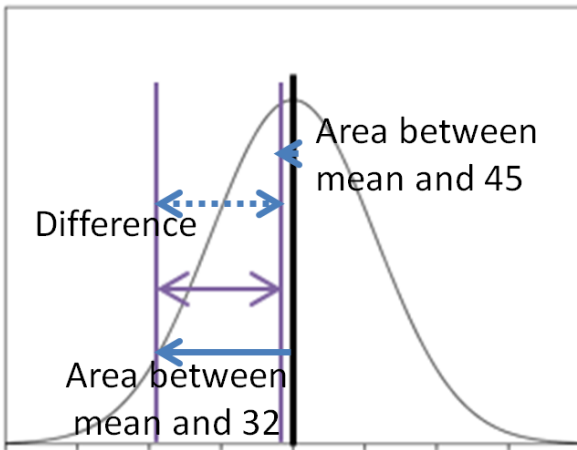
3.2.1. Area beyond (below) 45 minus the area beyond (below) 32.
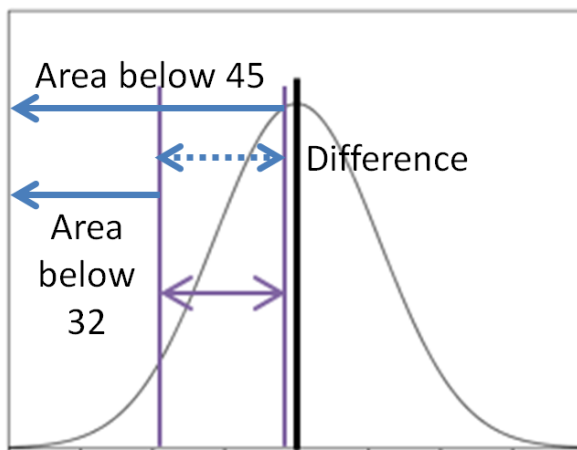
3.2.2. Total area beyond (below) the mean is 50%. Calculate the area between the mean and 45 and the area beyond (below) 32. Add these two together and subtract them from 0.50.

3.2.3. Calculate the area between the mean and 32, then subtract from this the area between the mean and 45.

Full answers for additional dataset

	All participants	Males	Females
Mode	10	10	12 and 14
Median	10	9	12
Mean	10.5	8.7	12.3
Range	16	13	12
Variance	16.58	14.68	13.12

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| Standard deviation | 4.07 | 3.83 | 3.62 |

All participants, mode:

10 (occurs four times)

All participants, median:

Ordered from smallest to largest: 3 4 6 7 8 8 8 10 10 <u>10 10</u> 11 12 12 12 14 14 16 16 19

10 and 10 are the middle numbers (underlined above), as there are two middle numbers, the mean needs to be calculated.

$$Median = \frac{10 + 10}{2}$$

$$Median = \frac{20}{2}$$

$$Median = 10$$

All participants, mean:

$$Mean = \frac{3 + 4 + 6 + 7 + 8 + 8 + 8 + 10 + 10 + 10 + 10 + 11 + 12 + 12 + 12 + 14 + 14 + 16 + 16 + 19}{20}$$

$$Mean = \frac{210}{20}$$

$$Mean = 10.5$$

All participants, range:

Ordered from smallest to largest: 3 4 6 7 8 8 8 10 10 10 10 11 12 12 12 14 14 16 16 19

$$Range = 19 - 3$$

$$Range = 16$$

All participants, variance:

Remember that you need to use the mean ($\bar{x}$) to calculate the variance. We already calculated this, so $\bar{x}$ = 10.5.

Male participants				Female participants			
Particip. number	Social anxiety score (x)	$x - \bar{x}$	$x - \bar{x}^2$	Particip. number	Social anxiety score (x)	$x - \bar{x}$	$x - \bar{x}^2$
1	16	5.5	30.25	11	12	1.5	2.25
2	12	1.5	2.25	12	14	3.5	12.25

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3	10	-0.5	0.25	13	19	8.5	72.25
4	4	-6.5	42.25	14	16	5.5	30.25
5	6	-4.5	20.25	15	8	-2.5	6.25
6	8	-2.5	6.25	16	10	-0.5	0.25
7	10	-0.5	0.25	17	11	0.5	0.25
8	3	-7.5	56.25	18	14	3.5	12.25
9	10	-0.5	0.25	19	12	1.5	2.25
10	8	-2.5	6.25	20	7	-3.5	12.25

$$Variance = \frac{\sum(x - \bar{x})^2}{N - 1}$$

$$Variance = \frac{\begin{array}{c}30.25 + 2.25 + 0.25 + 42.25 + 20.25 + 6.25 + 0.25 + 56.25 + 0.25 + 6.25 + \\ 2.25 + 12.25 + 72.25 + 30.25 + 6.25 + 0.25 + 0.25 + 12.25 + 2.25 + 12.25\end{array}}{20 - 1}$$

$$Variance = \frac{315}{19}$$

$$Variance = 16.58$$

All participants, standard deviation:

$$Standard\ deviation = \sqrt{Variance}$$

$$Standard\ deviation = \sqrt{16.58}$$

$$Standard\ deviation = 4.07$$

Male participants, mode:

10 (occurs three times)

Male participants, median:

Ordered from smallest to largest: 3 4 6 8 8 10 10 10 12 16

8 and 10 are the middle numbers (underlined above), as there are two middle numbers, the mean needs to be calculated.

$$Median = \frac{8 + 10}{2}$$

$$Median = \frac{18}{2}$$

$$Median = 9$$

Male participants, mean:

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$$Mean = \frac{3 + 4 + 6 + 8 + 8 + 10 + 10 + 10 + 12 + 16}{10}$$

$$Mean = \frac{87}{10}$$

$$Mean = 8.7$$

<u>Male participants, range:</u>

Ordered from smallest to largest: 3 4 6 8 8 10 10 10 12 16

$$Range = 16 - 3$$

$$Range = 13$$

<u>Male participants, variance:</u>

Remember that you need to use the mean ($\bar{x}$) to calculate the variance. We already calculated this, so $\bar{x}$ = 8.7.

Participant number	Social anxiety score (x)	$x - \bar{x}$	$x - \bar{x}^2$
1	3	-5.7	32.49
2	4	-4.7	22.09
3	6	-2.7	7.29
4	8	-0.7	0.49
5	8	-0.7	0.49
6	10	1.3	1.69
7	10	1.3	1.69
8	10	1.3	1.69
9	12	3.3	10.89
10	16	7.3	53.29

$$Variance = \frac{\sum(x - \bar{x})^2}{N - 1}$$

$$Variance = \frac{32.49 + 22.09 + 7.29 + 0.49 + 0.49 + 1.69 + 1.69 + 1.69 + 10.89 + 53.29}{10 - 1}$$

$$Variance = \frac{132.1}{9}$$

$$Variance = 14.68$$

<u>Male participants, standard deviation:</u>

$$Standard\ deviation = \sqrt{Variance}$$

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$$Standard\ deviation = \sqrt{14.68}$$

$$Standard\ deviation = 3.83$$

Female participants, mode:

12 and 14 (both scores occur twice)

Female participants, median:

Ordered from smallest to largest: 7 8 10 11 <u>12 12</u> 14 14 16 19

12 and 12 are the middle numbers (underlined above), as there are two middle numbers, the mean needs to be calculated.

$$Median = \frac{12 + 12}{2}$$

$$Median = \frac{24}{2}$$

$$Median = 12$$

Female participants, mean:

$$Mean = \frac{7 + 8 + 10 + 11 + 12 + 12 + 14 + 14 + 16 + 19}{10}$$

$$Mean = \frac{123}{10}$$

$$Mean = 12.3$$

Female participants, range:

Ordered from smallest to largest: 7 8 10 11 12 12 14 14 16 19

$$Range = 19 - 7$$

$$Range = 12$$

Female participants, variance:

Remember that you need to use the mean ($\bar{x}$) to calculate the variance. We already calculated this, so $\bar{x}$ = 12.3.

Participant number	Social anxiety score (x)	$x - \bar{x}$	$x - \bar{x}^2$
11	12	-0.3	0.09
12	14	1.7	2.89
13	19	6.7	44.89
14	16	3.7	13.69

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15	8	-4.3	18.49
16	10	-2.3	5.29
17	11	-1.3	1.69
18	14	1.7	2.89
19	12	-0.3	0.09
20	7	-5.3	28.09

$$Variance = \frac{\sum(x - \bar{x})^2}{N - 1}$$

$$Variance = \frac{0.09 + 2.89 + 44.89 + 13.69 + 18.49 + 5.29 + 1.69 + 2.89 + 0.09 + 28.09}{10 - 1}$$

$$Variance = \frac{118.1}{9}$$

$$Variance = 13.12$$

Female participants, standard deviation:

$$Standard\ deviation = \sqrt{Variance}$$

$$Standard\ deviation = \sqrt{13.12}$$

$$Standard\ deviation = 3.62$$

1. Females are more socially anxious, as can be seen by all three measures of central tendency.

2. Scores are dispersed more widely for males, as can be seen in all three measures of dispersion.

3. Females have bimodal social anxiety scores with both 12 and 14 occurring twice.

4. Z score answers:

   4.1. 0.61 SD *below* the mean

   - $(8-10.5)/4.07 = -0.61$

   4.2. 0.6179 would be expected to score above 9.3

   - The z score for 9.3 is $(9.3-10.5)/4.07) = -0.295$. The distance between this z score and the mean is 0.1179 (rounding the z score to 0.30). The distance beyond the mean (a z score of 0) is 0.50. Add these two together to give a proportion of $0.50 + 0.1179 = 0.6179$. There are other ways of calculating this. As long as you got to the right answer, that is fine.

   4.3. 18.26% would be expected to score between 10.9 and 12.9.

   - The z score for 10.9 is $(10.9-10.5)/4.07 = 0.098$ and the z score for 12.9 is $(12.9-10.5)/4.07 = 0.5897$. The area beyond 0.10 (rounding up) is 0.4602 and the area beyond 0.59 (again,

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rounding up) is 0.2776. To calculate the distance between these, 0.4602-0.2776 = 0.1826. Then multiple this by 100 to get the answer of 18.26% would be expected to score between 10.9 and 12.9. Again, this could have been calculated in various ways, as long as you got to the right final answer!

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