

## Solutions to Exercises 3

These solutions contain screen shots of a data analysis undertaken in Minitab. Also note how the data have been entered into the Minitab worksheet.

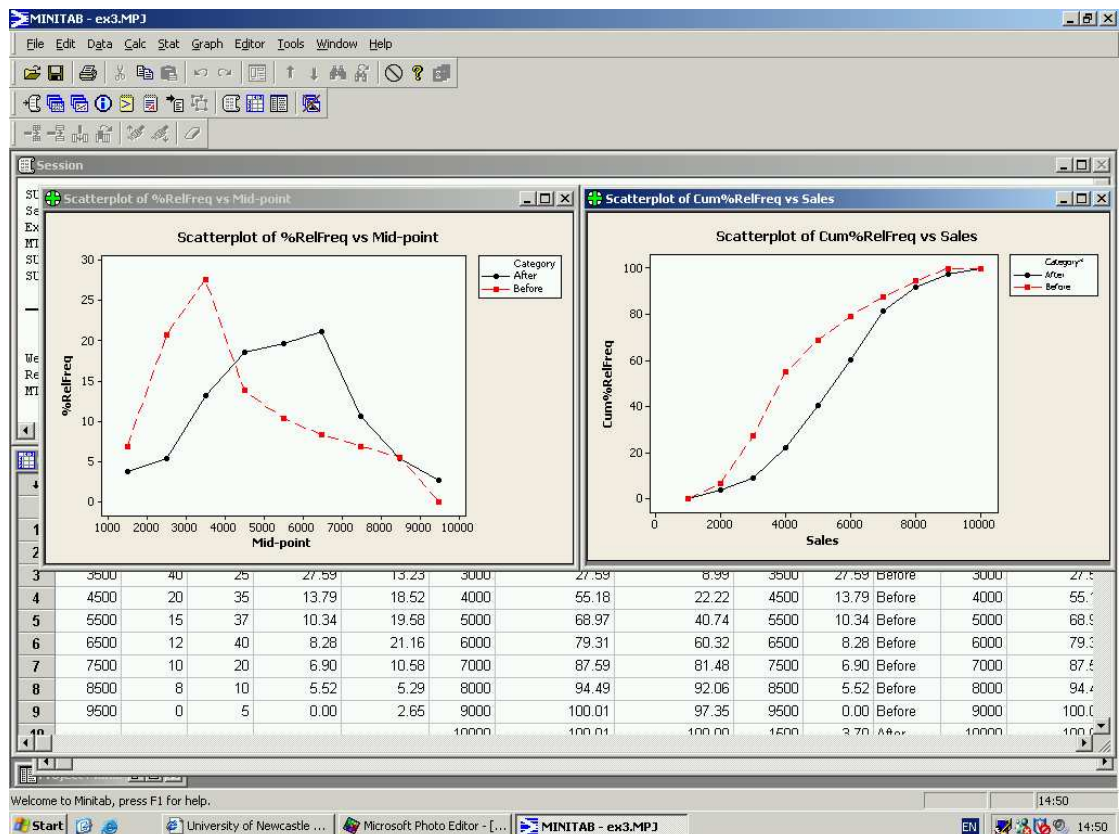
1. (a) Percentage relative frequency:

Daily Sales	Before	After	Sales Mid-point	% Rel. Freq.	
				Before	After
$1000 \leq \text{sales} < 2000$	10	7	1500	6.90	3.70
$2000 \leq \text{sales} < 3000$	30	10	2500	20.69	5.29
$3000 \leq \text{sales} < 4000$	40	25	3500	27.59	13.23
$4000 \leq \text{sales} < 5000$	20	35	4500	13.79	18.52
$5000 \leq \text{sales} < 6000$	15	37	5500	10.34	19.58
$6000 \leq \text{sales} < 7000$	12	40	6500	8.28	21.16
$7000 \leq \text{sales} < 8000$	10	20	7500	6.90	10.58
$8000 \leq \text{sales} < 9000$	8	10	8500	5.52	5.29
$9000 \leq \text{sales} < 10000$	0	5	9500	0.00	2.65
<b>Totals</b>	145	189		100.00	100.00

- (b) Percentage cumulative relative frequency:

Daily Sales	Before	After	Sales Upper-point	% Cumulative Rel. Freq.	
				Before	After
			1000	0.00	0.00
$1000 \leq \text{sales} < 2000$	10	7	2000	6.90	3.70
$2000 \leq \text{sales} < 3000$	30	10	3000	27.59	8.99
$3000 \leq \text{sales} < 4000$	40	25	4000	55.18	22.22
$4000 \leq \text{sales} < 5000$	20	35	5000	68.97	40.74
$5000 \leq \text{sales} < 6000$	15	37	6000	79.31	60.32
$6000 \leq \text{sales} < 7000$	12	40	7000	87.59	81.48
$7000 \leq \text{sales} < 8000$	10	20	8000	94.49	92.06
$8000 \leq \text{sales} < 9000$	8	10	9000	100.01	97.35
$9000 \leq \text{sales} < 10000$	0	5	10000	100.01	100.00

- (c) The plot of the polygons is in the left-hand plot in the graphic below. It shows a clear increase in sales due to the advertising campaign.
- (d) The plot of the ogives is in the right-hand plot in the following graphic.



- (e) The ogives show that the level of sales reached on 25% of days is around 3000ish before the campaign and just over 4000 after the campaign – this can be seen by looking at what sales volume correspond to a cumulative relative frequency of 25%. Can we get more accurate figures? Yes, we can use some mathematics to get a more accurate answer.

### Before the campaign

Suppose we want to know the figure corresponding to sales achieved 25% of the time. Let's call this  $s$ . Then the frequency table in (b) tells us that  $s$  must be between 2000 and 3000. Now

$$25 = 6.9 + 87.48\% \times (27.59 - 6.9),$$

that is, 25 is 87.48% of the way between 6.9 and 27.59 and therefore the value we need for  $s$  will be 87.48% of the way between 2000 and 3000, that is

$$s = 2000 + 87.48\% \times (3000 - 2000) = 2874.8.$$

So sales of around 2875 items will be made on 25% of days.

Note that the figure 87.48% was calculated using

$$\frac{25 - 6.9}{27.59 - 6.9} = 87.48\%.$$

Now let's look at how many sales are made on at least 50% of days. The percentage we need to calculate is

$$\frac{50 - 27.59}{55.18 - 27.59} = 81.23\%.$$

Therefore, the sales figure we need is

$$s = 3000 + 81.23\% \times (4000 - 3000) = 3812.3.$$

Similarly, for 75% of days, the calculations are

$$\frac{75 - 68.97}{87.59 - 69.97} = 34.22\%$$

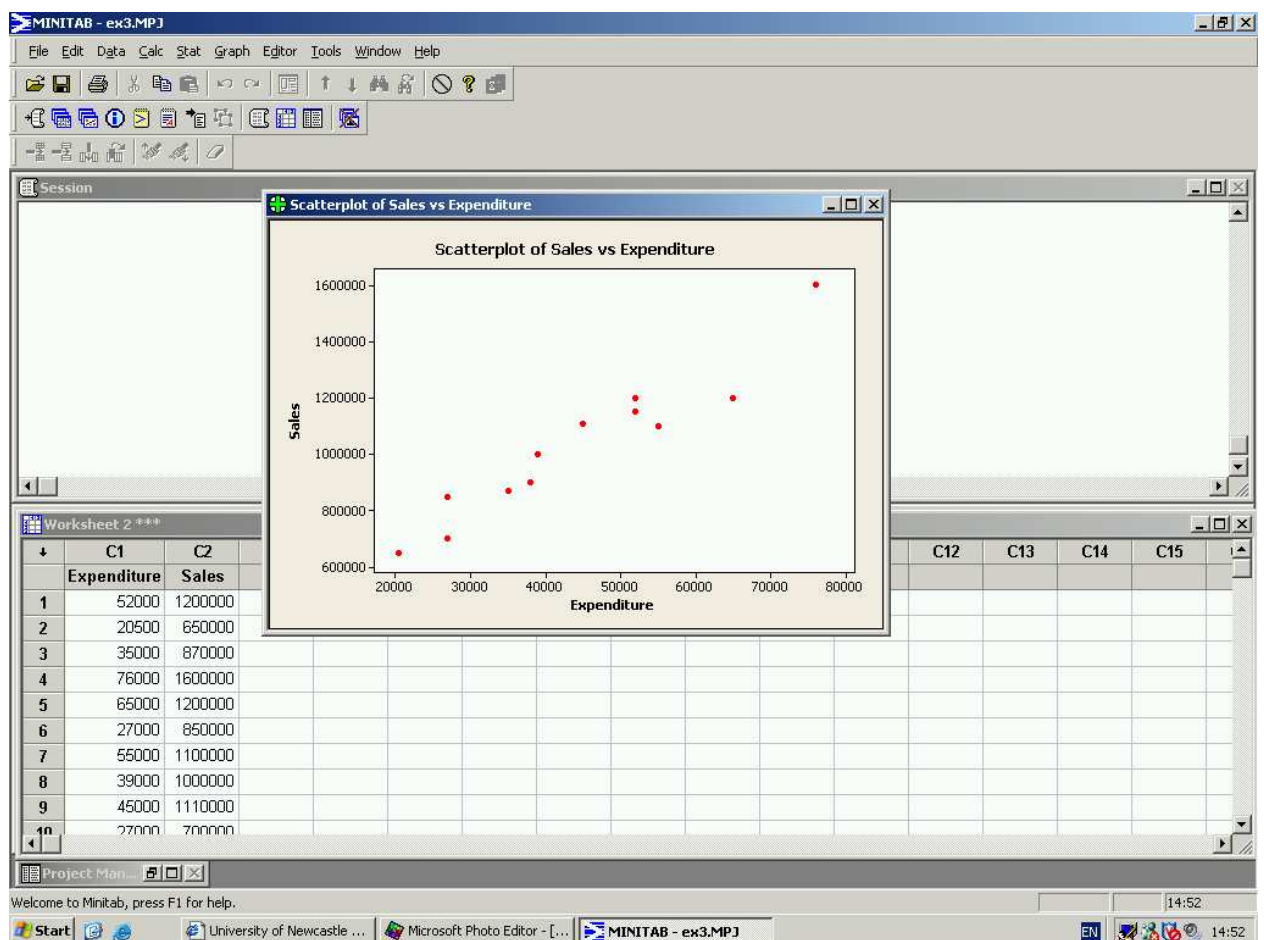
and so

$$s = 5000 + 34.22\% \times (6000 - 5000) = 5342.2.$$

We can calculate the sales figures for after the campaign in a similar way, giving the following summary results:

Percentage	Before	After
25%	2874.8	4150.1
50%	3812.3	5472.9
75%	5342.2	6693.8

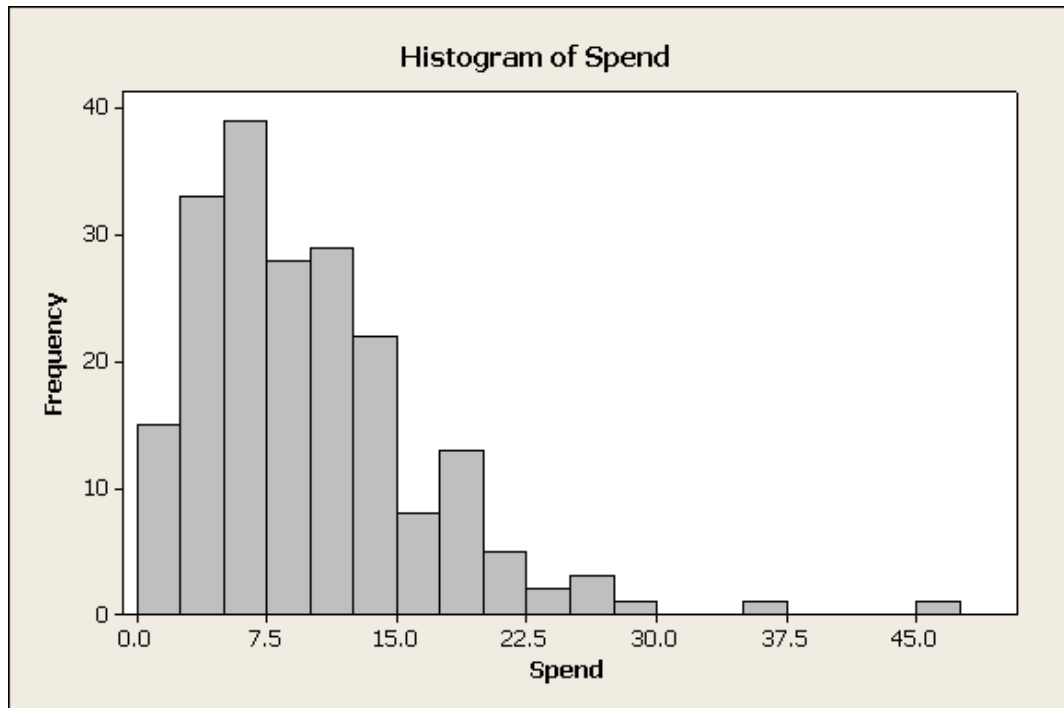
- The graph below is a scatterplot of the data. It clearly shows the increased benefit in sales as advertising expenditure is increased.



3. To make a histogram by hand, we can start with a frequency table or a stem and leaf plot. Here is a frequency table with class boundaries in steps of £2.50.

Class	Frequency	Class	Frequency
$0.0 < x \leq 2.5$	15	$25.0 < x \leq 27.5$	3
$2.5 < x \leq 5.0$	33	$27.5 < x \leq 30.0$	1
$5.0 < x \leq 7.5$	39	$30.0 < x \leq 32.5$	0
$7.5 < x \leq 10.0$	29	$32.5 < x \leq 35.0$	0
$10.0 < x \leq 12.5$	28	$35.0 < x \leq 37.5$	1
$12.5 < x \leq 15.0$	22	$37.5 < x \leq 40.0$	0
$15.0 < x \leq 17.5$	8	$40.0 < x \leq 42.5$	0
$17.5 < x \leq 20.0$	13	$42.5 < x \leq 45.0$	0
$20.0 < x \leq 22.5$	5	$45.0 < x \leq 47.5$	1
$22.5 < x \leq 25.0$	2	$47.5 < x \leq 50.0$	0

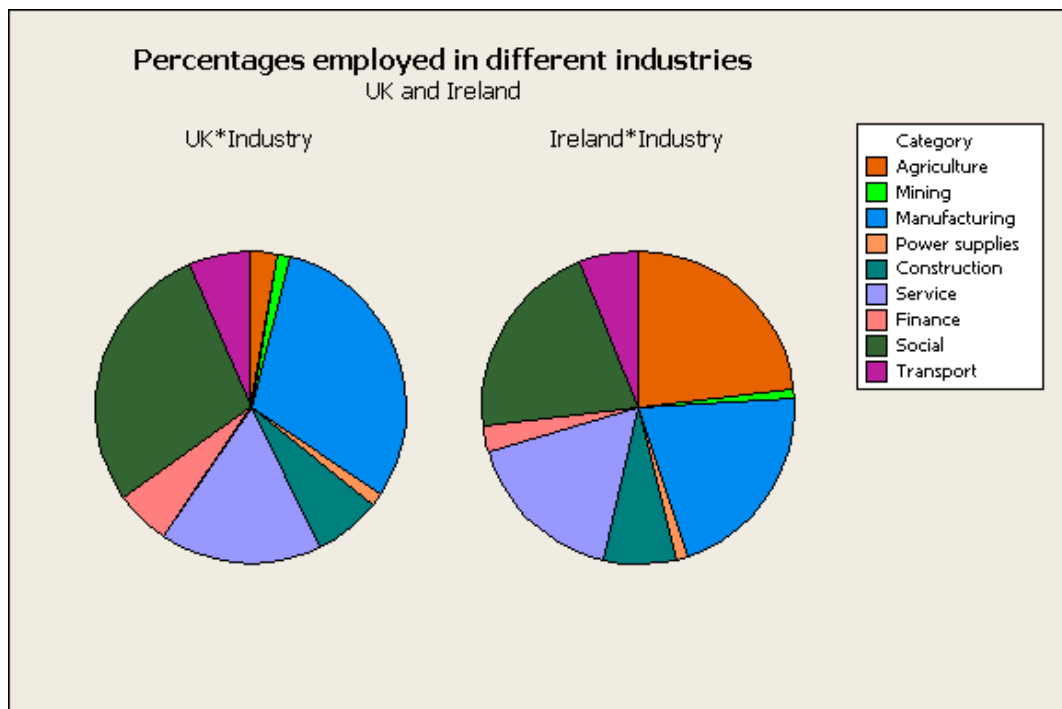
A suitable histogram is shown below.



4. To draw a pie chart by hand we need to calculate the angles. In this data set the figures given are percentages so we know that the total is 100. For example, for Agriculture in Ireland, the required angle, in degrees, is

$$\frac{23.2}{100} \times 360 = 82.8.$$

Pie charts are shown below. The proportion working in agriculture is much greater in Ireland. The proportions working in manufacturing and in social and personal services are somewhat smaller in Ireland.



5. A time series plot is shown below.

