Practical 3.2

Exercise P1: Measures of association

1. Open your textbook on p.149 at the **Stereo** file.
2. On the computer, open the **Stereo** file on ClickUP in the ***Data files for Practicals*** folder
3. Construct a scatter diagram for the **Stereo** data by using Excel 2010. See Practical 2 2017 Exercise P4. Follow the detailed Excel instructions on p.80. Compare your answer with *Figure 3.15* on p.149.

> **Note:** The scatter diagram shows a positive relationship, where higher sales (y) are associated with a larger number of commercials (x).

4. a) Calculate the sample covariance and sample correlation coefficient using a **spread sheet** in Excel 2010. (See spread sheets below 4b)
   - Type the word Total in cell A12 and Average in cell A13.
   - Calculate the total for the number of *Commercials* (x) in cell B12, by using the AutoSum button Σ.
   - Calculate the average number of *Commercials* (x), by entering the formula in cell B13: =AVERAGE(B2:B11) .
   - Calculate the total *Sales Volume* (y) in cell C12 and the average *Sales Volume* (y) in cell C13.
   - Complete the headings as in *Table P1.1* below. $(x-\bar{x})$ can be written as (x-xbar) in Excel 2010.
   - To calculate $(x-\bar{x})$, enter the following formula in cell D2: =(B2-B13) . The reason for the $ signs in front of the column and row reference is to instruct Excel to use the specified cell B13, and not to change the cell reference once you copy the formula to other cells.
   - Copy this formula to D3:D11, by dragging the formula to these cells.
   - Calculate the total for column D in cell D12.
   - To calculate $(x-\bar{x})^2$, enter the following formula in cell E2: =(B2-B13)^2 .
   - Copy this formula to E3:E11, by dragging the formula to these cells.
   - Calculate the total for column E in cell E12.
   - To calculate $(y-\bar{y})$, enter the following formula in cell F2: =(C2-C13) .
   - Copy this formula to F3:F11, by dragging the formula to these cells.
   - Calculate the total for column F in cell F12.
   - To calculate $(y-\bar{y})^2$, enter the following formula in cell G2: =(C2-C13)^2 .
   - Copy this formula to G3:G11, by dragging the formula to these cells.
   - Calculate the total for column G in cell G12.
   - To calculate $(x-\bar{x})\,(y-\bar{y})$, enter the following formula in cell H2: =(D2*F2).
   - Copy this formula to H3:H11, by dragging the formula to these cells.

- Calculate the total for column H in cell H12.

> Note: $\sum(x-\bar{x})(y-\bar{y})$ can also be calculated by entering the following formula in cell H12: =SUMPRODUCT(D2:D11,F2:F11) .

- Calculate the sample covariance by entering the formula in cell B16: =H12/9 .
- Calculate the sample standard deviation of (x) by entering the formula in cell B17: =SQRT(E12/9) .
- Calculate the sample standard deviation of (y) by entering the formula in cell B18: =SQRT(G12/9) .
- Calculate the sample correlation coefficient of (x) and (y) by entering the formula in cell B19: =B16/(B17*B18) .

4. b) Calculate the sample covariance and sample correlation coefficient using the Excel 2010 functions **COVARIANCE.S and CORREL**. (See spread sheets below).

- Enter the following formula in cell B22: =COVARIANCE.S(B2:B11,C2:C11).
- Enter the following formula in cell B23: = CORREL(B2:B11,C2:C11) .
- Compare the results obtained with Figure *p.1.1* and Figure *p.1.2* below.

	A	B	C	D	E	F	G	H
1	**Week**	**Commercials (x)**	**Sales (y)**	**x-xbar**	**(x-xbar)^2**	**y-ybar**	**(y-ybar)^2**	**(x-xbar)(y-ybar)**
2	1	2	50	-1	1	-1	1	1
3	2	5	57	2	4	6	36	12
4	3	1	41	-2	4	-10	100	20
5	4	3	54	0	0	3	9	0
6	5	4	54	1	1	3	9	3
7	6	1	38	-2	4	-13	169	26
8	7	5	63	2	4	12	144	24
9	8	3	48	0	0	-3	9	0
10	9	4	59	1	1	8	64	8
11	10	2	46	-1	1	-5	25	5
12	**Total**	30	510	0	20	0	566	99
13	**Average**	3	51					
14								
15								
16	**Covariance (x,y)**	11						
17	**(x)**	1.490711985						
18	**(y)**	7.930251502						
19	**Correlation (x,y)**	0.930490581						
20								
21								
22	**Covariance (x,y)**	11						
23	**Correlation (x,y)**	0.930490581						
24								

Figure *p.1.1*

	A	B	C	D	E	F	G	H
1	**Week**	**Commercials (x)**	**Sales (y)**	**x-xbar**	**(x-xbar)^2**	**y-ybar**	**(y-ybar)^2**	**(x-xbar)(y-ybar)**
2	1	2	50	=B2-B13	=(B2-B13)^2	=C2-C13	=(C2-C13)^2	=D2*F2
3	2	5	57	=B3-B13	=(B3-B13)^2	=C3-C13	=(C3-C13)^2	=D3*F3
4	3	1	41	=B4-B13	=(B4-B13)^2	=C4-C13	=(C4-C13)^2	=D4*F4
5	4	3	54	=B5-B13	=(B5-B13)^2	=C5-C13	=(C5-C13)^2	=D5*F5
6	5	4	54	=B6-B13	=(B6-B13)^2	=C6-C13	=(C6-C13)^2	=D6*F6
7	6	1	38	=B7-B13	=(B7-B13)^2	=C7-C13	=(C7-C13)^2	=D7*F7
8	7	5	63	=B8-B13	=(B8-B13)^2	=C8-C13	=(C8-C13)^2	=D8*F8
9	8	3	48	=B9-B13	=(B9-B13)^2	=C9-C13	=(C9-C13)^2	=D9*F9
10	9	4	59	=B10-B13	=(B10-B13)^2	=C10-C13	=(C10-C13)^2	=D10*F10
11	10	2	46	=B11-B13	=(B11-B13)^2	=C11-C13	=(C11-C13)^2	=D11*F11
12	**Total**	=SUM(B2:B11)	=SUM(C2:C11)	=SUM(D2:D11)	=SUM(E2:E11)	=SUM(F2:F11)	=SUM(G2:G11)	=SUM(H2:H11)
13	**Average**	=AVERAGE(B2:B11)	=AVERAGE(C2:C11)					
14								
15								
16	**Cov (x,y)**	=H12/9						
17	**(x)**	=SQRT(E12/9)						
18	**(y)**	=SQRT(G12/9)						
19	**Cor (x,y)**	=B16/(B17*B18)						
20								
21								
22	**Cov(x,y)**	=COVARIANCE.S(B2:B11,C2:C11)						
23	**Cor(x,y)**	=CORREL(B2:B11,C2:C11)						
24								

Figure *p.1.2*