Module 8 Practice problem and Homework answers

Practice problem, page 1

Is the research hypothesis one-tailed or two-tailed?

Answer: two tailed

In the set up for the problem, we said that the independent variable would influence the dependent variable, but we did not specific how (i.e. that enjoyment would increase as expenditures increase or that enjoyment would decrease as expenditures increase). When we leave open the possibility for either a direct or an indirect relationship, as we have done there, the hypothesis is classified as a two-tailed hypothesis.

page 3

What is the mean of the Xs?

Answer: 5.5

$$\bar{x} = \frac{\sum x}{N} = \frac{109.9}{20} = 5.5$$

What is the mean of the Ys?

Answer: 5.7

$$\bar{x} = \frac{\sum x}{N} = \frac{113}{20} = 5.7$$

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What is the value of the sum of the product of the mean deviations of X and Y?

Answer: 24.3

To find this answer, first find the mean deviation for each x and for each y (reminder, mean deviation = $x - \bar{x}$ or $y - \bar{y}$), then multiply the values of these deviations for each pair of values together, and then add those values. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 7th column, which is the product of the values in the 5th and 6th columns.

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What is the sum of the squared mean deviations of X?

Answer: 48.1

To find this answer, square the mean deviation of X. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 8th column, which is square of the value in the 5th column.

Practice problem page 6, continued

What is the sum of the squared mean deviations of Y?

Answer: 162.6

To find this answer, square the mean deviation of Y. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 9th column, which is square of the value in the 6th column.

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What number goes on the top of the fraction in the correlation formula?

Answer: 24.3

The top of the fraction in the r formula looks like a mess, but it's asking you for a value that you calculated in the calculation table – the value at the bottom of the 7th column that was the result of the multiplication of the mean deviations of X and the mean deviations of Y.

What is the value of r?

Answer: 0.27

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} = \frac{24.2}{\sqrt{48.5*162.8}} = \frac{24.2}{\sqrt{7895.8}} = \frac{24.2}{88.9} = 0.27$$

The positive result of the correlation calculation indicates that enjoyment _____ as expenses increase.

Answer: increases

A positive r value indicates that the two variables are directly related, which means that as one goes up, the other does too, or, as one goes down, so does the other.

The relationship between expenses and enjoyment is _____.

Answer: weak

A perfect correlation is indicated by a correlation value of -1 or +1. A strong correlation comes close to 1 or +1, but doesn't quite get there, while a weak correlation is close to 0.

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What is the value of N in this problem?

Answer: 20

Note: sometimes people add the number of X values to the number of Y values to determine the value of N when they work correlation (and regression) problems. The thing to remember is that each X,Y pair represents one person or case.

Practice Problem page 8, continued

What is the degrees of freedom value for this problem?

Answer: 18

d*f = N- 2 = 20 – 2 = 18*

What is the calculated t value for this problem?

Answer: 1.51

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} = \frac{0.27\sqrt{20-2}}{\sqrt{1-(.27^2)}} = \frac{.27\sqrt{18}}{\sqrt{1-.073}} = \frac{.27*4.2}{\sqrt{.93}} = \frac{1.1}{.96} = 1.15$$

What is the critical t value for this problem?

Answer: 2.101

At 18 degrees of freedom for a two-tailed test, the t table gives us a critical value of 2.101.

Is the relationship significant?

Answer: no

Because the critical value (2.101) is greater than the calculated value (1.15), we have to reject the null and conclude that the relationship between expenditures and enjoyment is not significant.

Homework
page 1

Is the research hypothesis one-tailed or two-tailed?

Answer: one-tailed

We're testing the hypothesis that playing non-educational video games are detrimental to children's ability to concentrate on an academic task. Because we're predicting a direction (detrimental) rather than being open to both directions (either detrimental or helpful), this is a one-tailed hypothesis.

What is the mean for playing time?

Answer: 3.7

$$\bar{x} = \frac{\sum x}{N} = \frac{59}{16} = 3.7$$

Homework page 1, continued

What is the mean for reading time?

Answer: 18.8

$$\bar{x} = \frac{\sum x}{N} = \frac{301}{16} = 18.8$$

What is the value of the sum of the product of the mean deviations of X and Y?

Answer: -114.94

To find this answer, first find the mean deviation for each x and for each y (reminder, mean deviation = x – $\bar{x}$ or y – $\bar{y}$), then multiply the values of these deviations for each pair of values together, and then add those values. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 7th column, which is the product of the values in the 5th and 6th columns.

What is the sum of the squared mean deviations of X?

Answer: 79.44

To find this answer, square the mean deviation of X. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 8th column, which is square of the value in the 5th column.

What is the sum of the squared mean deviations of Y?

Answer: 382.44

To find this answer, square the mean deviation of Y. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 9th column, which is square of the value in the 6th column.

Homework page 1, continued

x (playing)	y (reading)	$\bar{x}_1$	$\bar{y}_1$	X_1-$\bar{x}_1$	y_1-$\bar{y}_1$	$(x_1 - \bar{x}_1)(y_1 - \bar{y}_1)$	$(X_1$-$\bar{x}_1)^2$	$(y_1$-$\bar{y}_1)^2$
5	25	3.7	18.8	1.3	6.2	8.06	1.69	38.44
7	12	3.7	18.8	3.3	-6.8	-22.44	10.89	46.24
7	14	3.7	18.8	3.3	-4.8	-15.84	10.89	23.04
3	17	3.7	18.8	-0.7	-1.8	1.26	0.49	3.24
7	16	3.7	18.8	3.3	-2.8	-9.24	10.89	7.84
2	23	3.7	18.8	-1.7	4.2	-7.14	2.89	17.64
6	17	3.7	18.8	2.3	-1.8	-4.14	5.29	3.24
2	21	3.7	18.8	-1.7	2.2	-3.74	2.89	4.84
3	17	3.7	18.8	-0.7	-1.8	1.26	0.49	3.24
2	24	3.7	18.8	-1.7	5.2	-8.84	2.89	27.04
1	23	3.7	18.8	-2.7	4.2	-11.34	7.29	17.64
5	18	3.7	18.8	1.3	-0.8	-1.04	1.69	0.64
0	29	3.7	18.8	-3.7	10.2	-37.74	13.69	104.04
5	11	3.7	18.8	1.3	-7.8	-10.14	1.69	60.84
2	14	3.7	18.8	-1.7	-4.8	8.16	2.89	23.04
2	20	3.7	18.8	-1.7	1.2	-2.04	2.89	1.44
						Σ=-114.94	Σ=79.44	Σ=382.44

What is the value of r?

Answer: -0.66

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}} = \frac{-114.94}{\sqrt{79.44 * 382.44}} = \frac{-114.94}{\sqrt{30381.03}} = \frac{-114.94}{174.30} = -0.66$$

The result of the correlation calculation indicates that as time spent playing video games increases, time spent on an academic task _____.

Answer: decreases

Because the correlation value is negative, the relationship between the independent variable and dependent variable is indirect. This means that as the values of one variable increase, the values on the other variable decrease.

Homework page 1, continued
What is the calculated t value?

Answer: -3.29

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} = \frac{-0.66\sqrt{16-2}}{\sqrt{1-(-.66^2)}} = \frac{-.66\sqrt{14}}{\sqrt{1-.44}} = \frac{-.66*3.74}{\sqrt{.56}} = \frac{-2.47}{.75} = -3.29$$

What is the critical t value?

Answer: 1.761

At df=14 for a one-tailed research hypothesis, the t table gives us a critical value of 1.761.

Note: remember that critical values are given in absolute value. When comparing a negative calculated t value to a critical t value, make the critical t value negative for comparison purposes. Said another way, take the absolute value of the calculated t value in order to compare it to the critical value.

Is the relationship between time spent playing video games and attention span significant?

Answer: yes

Because the magnitude of the calculated t value (3.29) is greater than the critical value, we can conclude that the relationship between our independent and dependent variable is significant.

page 2
Is the research hypothesis one-tailed or two-tailed?

Answer: one-tailed

We're testing the hypothesis that the more time a person spends laughing, the less stress s/he will feel.* Because we're predicting a direction (laughter helps with stress) rather than being open to both directions, this is a one-tailed hypothesis.

*Note that the causal order of the relationship could go the other way – the less stress a person feels, the more s/he will laugh. Because of the way that correlation is set up, it doesn't really matter which variable in the analysis is the independent variable and which is the dependent variable, so we don't need to worry about the ambiguity of the causal order too much in this problem.

Homework page 2, continued

Calculate the mean of laughing time.

Answer: 59.2

$$\bar{x} = \frac{\sum x}{N} = \frac{1183}{20} = 59.2$$

Calculate the mean of stress level.

Answer: 15.8

$$\bar{x} = \frac{\sum x}{N} = \frac{317}{20} = 15.8$$

What is the value of the sum of the product of the mean deviations of X and Y?

Answer: -2328.6

To find this answer, first find the mean deviation for each x and for each y (reminder, mean deviation = x – $\bar{x}$ or y – $\bar{y}$), then multiply the values of these deviations for each pair of values together, and then add those values. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 7th column, which is the product of the values in the 5th and 6th columns.

What is the sum of the product of the squared mean deviations of X?

Answer: 16626.6

To find this answer, square the mean deviation of X. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 8th column, which is square of the value in the 5th column.

What is the sum of the product of the squared mean deviations of Y?

Answer: 896.6

To find this answer, square the mean deviation of Y. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 9th column, which is square of the value in the 6th column.

Homework page 2, continued

x (laughing)	y (stress)	$\bar{x}_1$	$\bar{y}_1$	X_1-$\bar{x}_1$	y_1-$\bar{y}_1$	$(x_1 - \bar{x}_1)$ $(y_1 - \bar{y}_1)$	$(X_1$-$\bar{x}_1)^2$	$(y_1$-$\bar{y}_1)^2$
29	19	59.2	15.8	-30.2	3.2	-96.64	912.04	10.24
54	30	59.2	15.8	-5.2	14.2	-73.84	27.04	201.64
15	27	59.2	15.8	-44.2	11.2	-495.04	1953.64	125.44
18	15	59.2	15.8	-41.2	-0.8	32.96	1697.44	0.64
80	5	59.2	15.8	20.8	-10.8	-224.64	432.64	116.64
71	19	59.2	15.8	11.8	3.2	37.76	139.24	10.24
87	15	59.2	15.8	27.8	-0.8	-22.24	772.84	0.64
65	6	59.2	15.8	5.8	-9.8	-56.84	33.64	96.04
37	19	59.2	15.8	-22.2	3.2	-71.04	492.84	10.24
41	22	59.2	15.8	-18.2	6.2	-112.84	331.24	38.44
76	11	59.2	15.8	16.8	-4.8	-80.64	282.24	23.04
60	9	59.2	15.8	0.8	-6.8	-5.44	0.64	46.24
27	19	59.2	15.8	-32.2	3.2	-103.04	1036.84	10.24
97	12	59.2	15.8	37.8	-3.8	-143.64	1428.84	14.44
82	11	59.2	15.8	22.8	-4.8	-109.44	519.84	23.04
63	12	59.2	15.8	3.8	-3.8	-14.44	14.44	14.44
4	26	59.2	15.8	-55.2	10.2	-563.04	3047.04	104.04
81	11	59.2	15.8	21.8	-4.8	-104.64	475.24	23.04
95	18	59.2	15.8	35.8	2.2	78.76	1281.64	4.84
101	11	59.2	15.8	41.8	-4.8	-200.64	1747.24	23.04
						Σ=-2328.6	Σ=16626.6	Σ=896.6

What is the value of r?

Answer: -0.60

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} = \frac{-2328.6}{\sqrt{16626.6 * 896.6}} = \frac{-2328.6}{\sqrt{14907409.6}} = \frac{-2328.6}{3861} = -0.60$$

The result of the correlation calculation indicates that stress level _____ as time spent laughing increases.

Answer: decreases

Because the correlation value is negative, the relationship between the independent variable and dependent variable is indirect. This means that as the values of one variable increase, the values on the other variable decrease.

Homework page 2, continued
What is the calculated t value?

Answer: -3.18

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} = \frac{-0.6\sqrt{20-2}}{\sqrt{1-(-.6^2)}} = \frac{-.6\sqrt{18}}{\sqrt{1-.36}} = \frac{-.6*4.24}{\sqrt{.64}} = \frac{-2.54}{.80} = -3.18$$

What is the critical t value?

Answer: 1.734

At df=18 for a one-tailed research hypothesis, the t table gives us a critical value of 1.734.

Note: remember that critical values are given in absolute value. When comparing a negative calculated t value to a critical t value, make the critical t value negative for comparison purposes. Said another way, take the absolute value of the calculated t value in order to compare it to the critical value.

Is the relationship between time spent laughing and stress level significant?

Answer: yes

Because the magnitude of the calculated t value (3.18) is greater than the critical value, we can conclude that the relationship between our independent and dependent variable is significant.

page 3
Is the research hypothesis one-tailed or two-tailed?

Answer: two-tailed

We're testing the hypothesis that commute time and productive morning time are significantly related. There are two competing ideas about how they're related, since you think that the longer the commute, the greater the morning productive time, while your co-worker expects to find the opposite. Since there are two possibilities for how these variables could be related, we are testing a two-tailed hypothesis.

Calculate the mean for commute time.

Answer: 51.1

$$\bar{x} = \frac{\sum x}{N} = \frac{715}{14} = 51.1$$

Homework page 3, continued

Calculate the mean for productive time.

Answer: 51.1

$$\bar{x} = \frac{\sum x}{N} = \frac{205}{14} = 14.6$$

What is the sum of the product of the squared mean deviations of X?

Answer: 9606.94

To find this answer, square the mean deviation of X. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 8th column, which is square of the value in the 5th column.

What is the sum of the product of the squared mean deviations of Y?

Answer: 1001.24

To find this answer, square the mean deviation of Y. If you are using a calculation table like the one used in this course, this will be the sum at the bottom of the 9th column, which is square of the value in the 6th column.

Homework page 3, continued

x (commute)	y (productive)	$\bar{x}_1$	$\bar{y}_1$	X_1-$\bar{x}_1$	y_1-$\bar{y}_1$	$(x_1 - \bar{x}_1)(y_1 - \bar{y}_1)$	$(X_1$-$\bar{x}_1)^2$	$(y_1$-$\bar{y}_1)^2$
16	0	51.1	14.6	-35.1	-14.6	512.46	1232.01	213.16
77	15	51.1	14.6	25.9	0.4	10.36	670.81	0.16
9	15	51.1	14.6	-42.1	0.4	-16.84	1772.41	0.16
16	3	51.1	14.6	-35.1	-11.6	407.16	1232.01	134.56
80	2	51.1	14.6	28.9	-12.6	-364.14	835.21	158.76
69	22	51.1	14.6	17.9	7.4	132.46	320.41	54.76
50	28	51.1	14.6	-1.1	13.4	-14.74	1.21	179.56
78	20	51.1	14.6	26.9	5.4	145.26	723.61	29.16
52	17	51.1	14.6	0.9	2.4	2.16	0.81	5.76
47	10	51.1	14.6	-4.1	-4.6	18.86	16.81	21.16
79	12	51.1	14.6	27.9	-2.6	-72.54	778.41	6.76
66	27	51.1	14.6	14.9	12.4	184.76	222.01	153.76
11	21	51.1	14.6	-40.1	6.4	-256.64	1608.01	40.96
65	13	51.1	14.6	13.9	-1.6	-22.24	193.21	2.56
						Σ=666.34	Σ=9606.94	Σ=1001.24

What is the value of r?

Answer: 0.21

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} = \frac{666.34}{\sqrt{9606.94 * 1001.24}} = \frac{666.34}{\sqrt{9618852.61}} = \frac{666.34}{3101.43} = 0.21$$

The result of the correlation calculation indicates that early morning productivity time _____ with morning commute time.

Answer: increases

Because the correlation value is positive, the relationship between the independent variable and dependent variable is direct. This means that as the values of one variable increase, the values on the other variable also increase.

What is the calculated t value?

Answer: 0.75

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} = \frac{0.21\sqrt{14-2}}{\sqrt{1-(.21^2)}} = \frac{.21\sqrt{12}}{\sqrt{1-.044}} = \frac{.21*3.46}{\sqrt{.96}} = \frac{.73}{.98} = 0.75$$

Homework page 3, continued

What is the critical t value?

Answer: 2.179

At df=12 for a two-tailed research hypothesis, the t table gives us a critical value of 2.179.

Is the relationship between time spent laughing and stress level significant?

Answer: no

Because the calculated t value (0.75) is not greater than the critical value, we must conclude that the relationship between our independent and dependent variable is not significant.