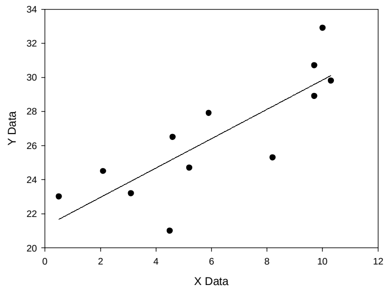
(Answers calculated by RNC — *caveat emptor*.) In some of these examples I'll quote exact p values, rather than just saying '$p < 0.05$'. Don't worry about this — since you're operating from tables and I'm doing some of these questions on a computer to save time, I can quote exact p values when you can't. If I say '$p = .03$', your tables would show that $p < .05$, but not that $p < .01$. If I say '$p = .125$', your tables would show that the answer is not significant at $p = .01$ (i.e. $p > .01$)… and so on.

Q1 *visual decay*



sample covariance = 9.789
$s_X = 3.373$
$s_Y = 3.558$

$r = .816$, $p = .001$ two-tailed, $n = 12$
regression $Y = 21.24 + 0.86\,X$

Full working for Q1:

Call blink rate X and decay time Y. Plot your scatterplot as above. There's no obvious non-linear relationship, so doing a linear correlation makes sense. Data points, written as $\{x,y\}$ pairs, are {2.1, 24.5}, {10.3, 29.8}, {5.9, 27.9}, {10, 32.9}, {0.5, 23}, {4.5, 21}, {3.1, 23.2}, {8.2, 25.3}, {5.2, 24.7}, {9.7, 30.7}, {4.6, 26.5}, {9.7, 28.9}. **You should be able to enter these into your calculator and get *r* directly.** If you were to do it by hand, you'd calculate these:

$$\sum xy = (2.1\times 24.5) + (10.3\times 29.8) + \ldots + (9.7\times 28.9) = 2065.84$$
$$\sum x = 2.1 + 10.3 + \ldots + 9.7 = 73.8$$
$$\sum x^2 = 2.1^2 + 10.3^2 + \ldots + 9.7^2 = 579.04$$
$$\sum y = 24.5 + 29.8 + \ldots + 28.9 = 318.4$$
$$\sum y^2 = 24.5^2 + 29.8^2 + \ldots + 28.9^2 = 8587.48$$
$$n = 12$$

OK… now for the sample covariance and sample standard deviations. Using the formula sheet:

$$\text{cov}_{XY} = \frac{\sum (x-\bar{x})(y-\bar{y})}{n-1} = \frac{\sum xy - \frac{\sum x \sum y}{n}}{n-1} = \frac{2065.84 - \frac{73.8\times 318.4}{12}}{11} = 9.789$$

$$s_X = \sqrt{s_X^2} = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}} = \sqrt{\frac{579.04 - \frac{(73.8)^2}{12}}{11}} = \sqrt{11.379} = 3.373$$

$$s_Y = \sqrt{s_Y^2} = \sqrt{\frac{\sum (y-\bar{y})^2}{n-1}} = \sqrt{\frac{\sum y^2 - \frac{(\sum y)^2}{n}}{n-1}} = \sqrt{\frac{8587.48 - \frac{(318.4)^2}{12}}{11}} = \sqrt{12.661} = 3.558$$

Now we can calculate r (and r^2):

$$r_{XY} = \frac{\text{cov}_{XY}}{s_X s_Y} = \frac{9.789}{3.373\times 3.558} = 0.816$$
$$r^2 = 0.666$$

… and a t statistic:

$$t_{n-2} = t_{10} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0.816\sqrt{10}}{\sqrt{1-0.816^2}} = 4.464$$

With 10 *df*, $t = 4.464$ is significant at the $\alpha = 0.01$ two-tailed level (i.e. $p < .01$ two-tailed). (A computer would tell you that $p = .001$.) Next, to calculate the **regression** of Y on X (predicting Y from X), we aim to calculate the equation

$$\hat{Y} = bX + a$$

Your calculator should be able to give you *a* and *b* directly (and you've already entered the data to calculate r, so you should be able to retrieve a and b very quickly). But if you had to calculate them by hand, you'd do it like this… First, we need the means of x and y:

$$\bar{x} = \frac{\sum x}{n} = \frac{2.1 + 10.3 + \ldots + 9.7}{12} = 6.15$$

$$\bar{y} = \frac{\sum y}{n} = \frac{29.8 + 27.9 + \ldots + 28.9}{12} = 26.533$$

Now we have all the information to calculate a and b:

$$b = \frac{\text{cov}_{XY}}{s_X^2} = r\frac{s_Y}{s_X} = 0.816 \times \frac{3.558}{3.373} = 0.86$$

$$a = \bar{y} - b\bar{x} = 26.533 - 0.86 \times 6.15 = 21.24$$

So our regression equation, which you can add to your scatterplot, is

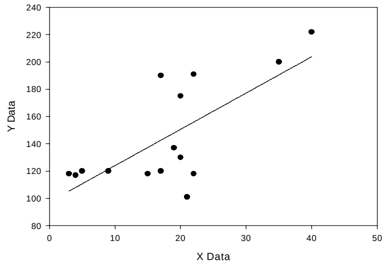
$$Y = a + bX = 21.24 + 0.86X$$

You can plot it by taking two or more x values that are reasonably far apart and calculating predicted values of Y, giving you $\{x, \hat{y}\}$ pairs. You should also find that the line passes through $\{0, a\}$, and $\{\bar{x}, \bar{y}\}$, i.e. through {0, 21.24} and {6.15, 26.533}.

(This calculation — not hard, but time-consuming — should emphasize the importance of having a calculator that does the hard work for you in the exam!)

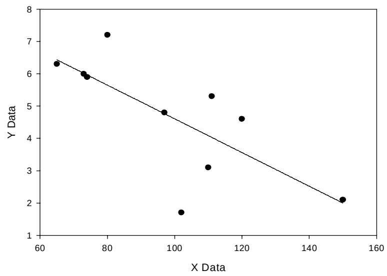
Q2 *Necker*

$r = .711$, $p = .003$ two-tailed, $n = 15$
regression Y = 97.431 + 2.66 X



Q3 *frog RGC*

$r = –.738$, $p = .015$ two-tailed, $n = 10$
regression Y = 9.825 – 0.0522 X

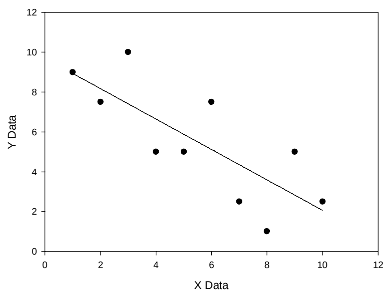


Q4 *Vatican / ice cream*

Correlate location rank with price rank (calling the result Spearman's correlation coefficient r_s):

Location rank: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Price rank: 9, 7.5, 10, 5, 5, 7.5, 2.5, 1, 5, 2.5

This gives you $r_s = –.778$. Since $n = 10$, $p = .008$ two-tailed (as calculated by the program SPSS). However, different calculation techniques will give slightly different answers for p; for $r_s = –.778$ and $n = 10$ your tables will show you that $.01 < p < .02$, two-tailed.



Q5 *impulsivity, CSF 5HIAA*

$r = –.054$, $p = .883$ two-tailed, $n = 10$
(regression Y = 30.57 – .0155 X — you'll often see published figures in which 'non-significant' regression lines are plotted, mainly so you can see the line is flat and useless as a predictor.)