PSYC122: Week 11-15 – Statistical formulae

Week 11

The **variance** (for a sample) is the sum of the squared deviations of the scores from the mean, divided by the number of scores:

$$\frac{\Sigma(X - \bar{X})^2}{N}$$

The **standard deviation** (for a sample) is the square root of the variance:

$$\sqrt{\frac{\Sigma(X - \bar{X})^2}{N - 1}}$$

The **covariance** is the sum of deviations of the scores from the mean for one variable (X), multiplied by the deviations of the scores from the mean of the second variable (Y); divided by the number of pairs of scores (N) minus 1:

$$\frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{N - 1}$$

Pearson's correlation coefficient (*r*) is the covariance divided by the standard deviation for X, multiplied by the standard deviation for Y:

$$r = \frac{\dfrac{\Sigma(X - \bar{X})(Y - \bar{Y})}{N - 1}}{\sqrt{\dfrac{\Sigma(X - \bar{X})^2}{N - 1}} * \sqrt{\dfrac{\Sigma(Y - \bar{Y})^2}{N - 1}}}$$

The **coefficient of determination (*R²*)** is the correlation coefficient squared:

$$R^2 = r^2 = r * r$$

Week 12

Spearman's rho (*r_s*) is the non-parametric equivalent of Pearson's r, based on ranking scores, to be used when data are not normally distributed. As you won't have to calculate Spearman's rho by hand, I have not listed the equation here.

The **Bonferroni adjustment** refers to the calculation of a new significance level in the context of multiple tests, by dividing the normal significance level (usually 0.05) by the number of tests performed.

Week 13

In the formula for a **regression line** the dependent (or outcome) variable (*y*) equals the intercept (*b₀*) plus the slope (*b₁*) multiplied by the predictor (*x*) plus the error (*e*):

$$y = b_0 + b_1 * x + e$$

Week 14

The **expected frequencies (*E*)** are calculated by multiplying the two relevant marginal totals (the row total and the column total) for a cell and dividing by the total number of participants N:

$$E = \frac{r * c}{N}$$

Chi-square is the sum of the squared differences between the observed and the expected frequencies, divided by the expected frequencies:

$$X^2 = \Sigma \frac{(O - E)^2}{E}$$

The **degrees of freedom** for chi-square are calculated by multiplying the number of columns (*c*) minus 1 with the number of rows (*r*) minus 1:

$$df = (c - 1)(r - 1)$$

Step-by-step instructions for calculating chi-square:

1. Note the **observed frequencies** in each cell.
2. Calculate the **expected frequency** for each cell by multiplying the two relevant marginal totals (the row total and the column total) for that cell and divide by the total number of participants in the sample.
3. Calculate **chi-square** (see formula above) by:
   a. Calculating the difference between the observed and the expected frequency for each cell and squaring that number;
   b. Dividing the result by the expected frequency for that cell.
4. Add up the results for all cells to acquire chi-square.
5. Determine the **degrees of freedom** by multiplying the number of columns minus 1 by the number of rows minus 1 (see formula above).
6. Look up the significance of chi-square in the table below.

Table E   Critical values of χ^2 at various levels of probability (chi-square)

For any particular *df* the observed value of χ^2 is significant at a given level of significance if it is *equal to* or *larger than* the critical values shown in the table.

df	0.10	0.05	0.02	0.01	0.001
1	2.71	3.84	5.41	6.64	10.83
2	4.60	5.99	7.82	9.21	13.82
3	6.25	7.82	9.84	11.34	16.27
4	7.78	9.49	11.67	13.28	18.46
5	9.24	11.07	13.39	15.09	20.52
6	10.64	12.59	15.03	16.81	22.46
7	12.02	14.07	16.62	18.48	24.32
8	13.36	15.51	18.17	20.09	26.12
9	14.68	16.92	19.68	21.67	27.88
10	15.99	18.31	21.16	23.21	29.59
11	17.28	19.68	22.62	24.72	31.26
12	18.55	21.03	24.05	26.22	32.91
13	19.81	22.36	25.47	27.69	34.53
14	21.06	23.68	26.87	29.14	36.12
15	22.31	25.00	28.26	30.58	37.70
16	23.54	26.30	29.63	32.00	39.29
17	24.77	27.59	31.00	33.41	40.75
18	25.99	28.87	32.35	34.80	42.31
19	27.20	30.14	33.69	36.19	43.82
20	28.41	31.41	35.02	37.57	45.32
21	29.62	32.67	36.34	38.93	46.80
22	30.81	33.92	37.66	40.29	48.27
23	32.01	35.17	38.97	41.64	49.73
24	33.20	36.42	40.27	42.98	51.18
25	34.38	37.65	41.57	44.31	52.62
26	35.56	38.88	42.86	45.64	54.05
27	36.74	40.11	44.14	46.97	55.48
28	37.92	41.34	45.42	48.28	56.89
29	39.09	42.56	46.69	49.59	58.30
30	40.26	43.77	47.96	50.89	59.70