

# Formulas

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## Statistics 2 PSBE2-07

### Exercises

#### Fisher Z Transformation

1. A regression model  $Y_j = \beta_0 + \beta_1 X_j + \varepsilon_j$  has  $n = 11$  observations. The sample correlation between  $X$  and  $Y$  is 0.60. We test the null hypothesis  $H_0 : \rho = 0$  (the true correlation between the  $X$  and  $Y$  variables is zero).
  - (a) What is the  $t$ -value to test the null hypothesis?
  - (b) What is the  $p$ -value to test the null hypothesis? Summarise your results of the test.
  - (c) What can you say about the results of the test with respect to the sample correlation coefficient?
2. A linear regression with 11 data points has an estimated  $\beta_1$  of 4.5 and a sample correlation between the  $X$  and  $Y$  values of 0.60.
  - (a) What is the  $t$ -value to test the null hypothesis that the correlation  $\rho$  is zero? Summarise your results of the test.
  - (b) What is the  $t$ -value to test the null hypothesis that  $\beta_1$  is zero? Summarise your results of the test.
  - (c) What is the standard error of the estimate of  $\beta_1$ ? What does this tell you about the reliability of the  $t$ -test you performed, and how might you improve the test?
  - (d) How are these two tests similar/different?
3.  $X$  and  $Y$  are a bivariate normal distribution from which a sample of 40 observations is taken. The sample correlation between  $X$  and  $Y$  is 0.833. We test the null hypothesis  $H_0 : \rho = 0.750$ . The alternative hypothesis is  $H_a : \rho_0 > 0.750$ .
  - (a) What is the Fisher transform  $r_z$  of the random variable  $r$  of the correlation  $r$  between  $X$  and  $Y$ ?
  - (b) What is the Fisher transform of the observed correlation?
  - (c) What is the distribution of  $r_z$ ?
  - (d) What is the Fisher transform of the correlation  $\rho_0$  assumed in the null hypothesis?
  - (e) What is the  $z$ -value to test this null hypothesis?
  - (f) What is the  $p$ -value for this test of the null hypothesis?
  - (g) What is the 95% confidence interval for the true value of the Fisher transform of the correlation?
  - (h) What is the 95% confidence interval for the true value of the correlation?
  - (i) Summarise your results of the previous parts.

4. Using the data set Album Sales (JASP>data library>regression>album sales), we have the following outputs:

Table 1: Descriptive Statistics

	sales	adverts
Valid	200	200
Missing	0	0
Mean	193.200	614.412
Std. Deviation	80.699	485.655
Minimum	10.000	9.104
Maximum	360.000	2271.860

Table 2: Model Summary

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	RMSE
1	0.578	0.335		65.991

Table 3: Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
1	(Intercept)	134.140	7.537			< .001
	adverts	0.096	0.010			< .001

- Fill in the missing values (highlighted lilac). Explain the steps you take to calculate the appropriate values.
- Perform a hypothesis test for correlation (there are two ways of doing this). State the null and alternative hypotheses, compute your statistic and summarise your findings.
- Compute the confidence interval for the correlation. Explain all intermediary steps.