

STAT1010: EXERCISE SHEET 5

1. Continuation of exercises 3 and 4 from exercise sheet 4. Find 95% confidence intervals for the mean differences in efficiency for all pairs of production methods using Tukey's honestly significant differences. Do this exercise both by hand and in excel.

Hint: Because the sample sizes are not equal, Tukey's HSD is given by

$$HSD = q_{\alpha}(k, DFW) \cdot \sqrt{\frac{MSW}{2} \left(\frac{1}{n_i} + \frac{1}{n_j} \right)}.$$

2. The attached excel file contains salaries in thousands of dollars per year for executives in three job types and three locations.
 - a) Conduct a 2-way ANOVA and create an interaction plot in excel.
 - b) Use contrasts in order to investigate whether type I and type II jobs pay the same salary and whether the average of the two is the same as the salary for a type III job. Do this exercise both in excel and by hand using the output from a).
 - c) Are the contrasts in b) orthogonal?
3. An experiment was designed to study the performance of 4 different detergents for cleaning fuel injectors. The following cleanliness readings were obtained for 12 tanks of gas distributed over 3 different engines:

	Detergent A	Detergent B	Detergent C	Detergent D
Engine 1	45	47	48	42
Engine 2	43	46	50	37
Engine 3	51	52	55	49

- a) Looking at the detergents as treatments and the engines as blocks, obtain the appropriate ANOVA table from excel and test whether there are differences in the detergents or engines. Cross-check the entries of that table (except for the sum of squares) by pen and paper calculations.
 - b) Determine Tukey's honestly significant difference between detergents by pen and paper calculations ($\alpha = 5\%$). Find the exact p -values for the significantly different detergent pairs from excel.
4. Replicate the matrix calculations on pages 170/171 in excel and confirm the result using both excel's own regression tool and the regression tool from the Real Statistics toolbox. *Hint: The excel commands for the transpose and the inverse of a matrix and for the multiplication of two matrices are TRANSPOSE, MINVERSE and MMULT. All of these are array formulas, which means that they must be entered in a somewhat unfamiliar way: First mark an area exactly of the expected size of the output matrix. Next enter the formula in the field directly above the spreadsheet beside f_x . Finish the command by pressing Control+Shift+Enter simultaneously.*