Übungsaufgaben Tukey-Test und Kontraste

1.) A one-way ANOVA is carried out using the performance scores from **four** different treatment groups of 9 cases each. A significant F is obtained. For this analysis, $SS_w = 656$, and the treatment group means are as follows:

$\bar{x}_1 = 20.3$, $\bar{x}_2 = 19.1$, $\bar{x}_3 = 15.3$, $\bar{x}_4 = 12.2$

a) How many possible pairs of means can be compared (= number of simple contrasts)?

b) Compute MS_w. Apply the Tukey test ($\alpha = 0.05$) to the pairwise comparisons between means and find what pairs of means are significant.

2.) An ANOVA for a balanced design (n = 21) gave the following result:

Group I	*Group II*	*Group III*
$\bar{x}_1 = 7.1$	$\bar{x}_2 = 5.40$	$\bar{x}_3 = 3.50$

Source	ν	MS	F-statistic
Between	2	68.1	6.81
Within	60	10.0	

a) Formulate a contrast ψ to state the following hypothesis:

"the population means decrease linearly from group I over group II to group III "

b) Compute $\hat{\psi}$. Compute the standard error $s_{\hat{\psi}}$ for the contrast.

c) Test the contrast with $\alpha = 0.05$.

3.) A one-way ANOVA is carried out using the performance scores of **four** different treatment groups of 15 cases each. A significant F is obtained. For this analysis, $SS_w = 336$, and the treatment group means are as follows:

$\bar{x}_1 = 20.0$, $\bar{x}_2 = 19.0$, $\bar{x}_3 = 17.5$, $\bar{x}_4 = 16.0$

Compute MS_w. Apply the Tukey test ($\alpha = 0.05$) to the pairwise comparisons between means and find what pairs of means are significant.

4.) An ANOVA for a balanced design (n = 11) gave the following result:

Group I (control)	*Group II*	*Group III*
$\bar{x}_1 = 8.50$	$\bar{x}_2 = 6.00$	$\bar{x}_3 = 5.00$

Source	ν	MS	F-statistic
Between	2	100.75	4.03
Within	30	25	

a) Formulate two *planned* contrasts ψ_1, ψ_2 to state the following null hypotheses with appropriate coefficients:
$\psi_1 = 0$: "the mean of the control group (I) equals the mean of the treated subjects (II and III combined)".
$\psi_2 = 0$: "the means of the two treatment groups are equal".

b) Are the two contrasts orthogonal? Explain briefly. Compute the t-statistics for the two contrasts ψ_1 and ψ_2.

c) Test the two contrasts contrast at $\alpha = 0.05$ each (contrast-based α).

5.) An ANOVA for a balanced design (n = 21) gave the following result:

Group I	*Group II*	*Group III*
$\bar{x}_1 = 6.60$	$\bar{x}_2 = 5.80$	$\bar{x}_3 = 4.40$

Source	ν	MS	F-statistic
Between	??	26.04	??
Within	??	6.0	

d) Compute the following 2 contrasts:
$\hat{\psi}_1$ = "test group I against the mean of the groups II and III"
$\hat{\psi}_2$ = "test group II against group III (simple contrast)"

e) Compute the standard error $s_{\hat{\psi}_1}$ for the first contrast. The standard error for the second contrast is $s_{\hat{\psi}_2} = 0.76$.