BIOL 300 Assignment 10, Spring 2012

Chapter 14

15. **(a)** Increase bias (subjects having different ethnic backgrounds might be assigned to different treatments, introducing a confounding variable). No likely effect on sampling error.
(b) Reduce sampling error. No effect on bias.
(c) No direct effect on either bias or sampling error (but will affect decisions about sample size that will in turn affect sampling error).
(d) Reduce sampling error (blocking). No effect on bias.
(e) Increase bias (sample not a random sample). No clear effect on sampling error.
(f) Increase bias (if effect is compared to a general population rather than a proper control group). No likely effect on sampling error.
(g) Decrease sampling error. No effect on bias.
(h) Increase bias (expectations might affect response to treatment). No effect on sampling error.

Chapter 15

15. **(a)** A large sample size makes ANOVA more robust to departures from the assumption of normality. In addition, a large sample size increases the power of the test.
(b) A balanced design makes ANOVA more robust to departures from the assumption of equal variances. In addition, a balanced design increases the power of the test compared with an unbalanced design having the same total sample size.

17. **(a)**

Group i	Group j	$\overline{Y}_i - \overline{Y}_j$	SE	q	$q_{0.05,k,N-k}$	Conclusion
6	1	23.26	7.13	3.26	2.47	Reject H_0
6	3	12.60	7.45	1.69	2.47	Do not reject H_0
3	1	10.67	7.13	1.50	2.47	Do not reject H_0

(b) These are unplanned comparisons – we are searching for differences between groups rather than testing a specific difference between two groups identified as crucial prior to seeing the data.
(c) This would result in a probability of making at least one Type 1 error greater than $\alpha = 0.05$ during the course of testing all pairs of means.
(d) 0.05.

18. **(a)** $SE_{\bar{Y}}$ is a measure of the precision of the estimate of the mean: it is the standard deviation of the sampling distribution of the mean.
(b) H_0: Mouse strains in the population do not differ in the mean number of minutes spent in the open.
H_A: Mouse strains in the population differ in the mean number of minutes spent in the open.

Source of variation	Sum of squares	*df*	Mean squares	*F*-ratio	*P*
Groups (Strain)	5.4087	3	1.8029	14.66	0.00001
Error	2.9515	24	0.1230		
Total	8.3602	27			

The critical value $F_{0.05(1),3,24} = 3.01$. Since $F > 3.01$, $P < 0.05$, reject H_0. Conclude that mouse strains in the population vary in the mean number of minutes spent in the open.
(c) Random-effects ANOVA: the four inbred strains were picked at random from a population of strains.
(d) Variance among groups: $s_A^2 = 0.240$.
Variance within groups, $MS_{error} = 0.120$.
(e) Repeatability = 0.66.
(f) The fraction of total variance that is among groups.

21. **(a)**

Source of variation	Sum of squares	*df*	Mean squares	*F*-ratio	*P*
Groups (specimens)	0.015788	24	0.000658	3.96	0.0005
Error	0.004150	25	0.000166		
Total	0.019938	49			

Statistical Table D shows that the critical value $F_{0.05(1),24,25}$ is between 1.94 and 2.03 (actual value is 1.96). Since the observed *F*-ratio is greater, $P < 0.05$.
(b) The mean squares for error are the estimate for the variance within groups for head width: 0.00017.
(c) $s^2_A = (0.000658 - 0.000166)/ 2 = 0.000246$.
(d) The repeatability is 0.000246 / (0.000246 + 0.000166) or 0.597.
(e) This is slightly less than the repeatability of the femur measurement, indicating that head size has a higher proportion of its total variation attributable to measurement error.