

ST512- Osborne
Lab 14 - Split-plot designs

1. Consider problem Rao 16.8 (from HW5). The data can be read in using ‘icedcream.sas’.
 - (a) Read the problem carefully, reread it if necessary.
 - (b) Draw a picture with 12 boxes to represent the 12 coolers in the experiment.
 - (c) Split these boxes for coolers into “subplots” or spaces for half-gallon ice cream cartons.
 - (d) Note that in the language of split-plots, we can match up the following two lists as an exercise:
 - i. storage time
 - ii. coolers
 - iii. brand
 - iv. cartons
 - (e) Plot the avg. flavor ratings (y) against time, using different symbols for brand.

```
proc gplot;  
  plot avgrate*time=brand;  
run;
```
 - (f) To fit a completely randomized split-plot design, consider

```
proc mixed method=type3;  
  class time brand cooler;  
  model avgrate=time|brand/ddfm=satterth;  
  random cooler(brand);  
run;
```
 - (g) Observe which denominator MS terms were used in the F ratios:
 - i. For time effect, $F = MS[Time]/MS[E]$ on 2, 18 df
 - ii. For time \times brand interaction, $F = MS[Time \times brand]/MS[E]$ on 4, 18 df
 - iii. For brand effect, $F = MS[brand]/MS[cooler(brand)]$ on 2, 9 df
 - iv. For nested random cooler effect, $F = MS[cooler(brand)]/MS[E]$ on 9, 18 df
 - (h) Find the estimated varcomps in the output $\hat{\sigma}_s^2 = 15$ and $\hat{\sigma}^2 = 25$.
 - (i) To visualize the nested cooler effect, you could plot against time again with a separate symbol for cooler:

```
proc sort; by brand;run;  
proc gplot;  
  by brand;  
  plot avgrate*time=cooler;  
run;
```
 - (j) Carry out multiple comparisons among the time means using a Bonferroni adjustment for $k = 3$ contrasts:

```
lsmeans time/adj=bon;
```
 - (k) After which storage time would you most like to taste this iced cream?