\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

\* Analysis of Random Effects ;

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

An experiment was conducted to compare four different fermentation processes: F1, F2, F3, and F4. An organic raw material is common to each process and can be made in batches that are adequate for four runs. This raw material exhibits substantial variation batch-to-batch. A block design was used with the following results (the response in a measure of fermentation efficiency and in measured in percent):

**Data** Ferment;

input Batch Process $ Response @@;

title1 'Mason, Gunst, & Hess: Exercise 10.17';

Datalines;

1 F1 84 2 F1 79 3 F1 76 4 F1 82 5 F1 74

1 F2 83 2 F2 72 3 F2 82 4 F2 97 5 F2 76

1 F3 92 2 F3 87 3 F3 82 4 F3 84 5 F3 75

1 F4 89 2 F4 74 3 F4 80 4 F4 79 5 F4 83

;

run;

**Proc** **Print** data=Ferment;

**run**;

ods rtf;

**Proc** **GLM** data=Ferment;

\* Illustrate that GLM Standard Errors are Incorrect;

class batch process;

model response = batch process;

random batch / test;

lsmeans process / stderr pdiff;

**run**;

**Proc** **Mixed** data=Ferment CL Covtest;

\* Mixed has Correct Standard Errors;

class batch process;

model response = process;

random batch ;

lsmeans process / adjust=tukey pdiff;

**run**;

ods rtf close;