

1. With  $A \in R^{n.. \times a}$  and  $B \in R^{n.. \times b}$  defined in L24, show that

$$\mathcal{R}(1_{n..}, A - 1_{n..}1_a^+, B - 1_{n..}1_b^+) \subset \mathcal{R}(1_{n..}1_{n..}^+, AA^+ - 1_{n..}1_{n..}^+, BB^+ - 1_{n..}1_{n..}^+).$$

$$\begin{aligned} (1_{n..}, A - 1_{n..}1_a^+, B - 1_{n..}1_b^+) &= (1_{n..}, A, B) \begin{pmatrix} 1 & -1_a^+ & -1_b^+ \\ 0 & I_a & 0 \\ 0 & 0 & I_b \end{pmatrix} \\ &= (1_{n..}1_{n..}^+, AA^+ - 11^+, BB^+ - 11^+) \begin{pmatrix} 1_{n..} & A & B \\ 0 & A & 0 \\ 0 & 0 & B \end{pmatrix} \begin{pmatrix} 1 & -1_a^+ & -1_b^+ \\ 0 & I_a & 0 \\ 0 & 0 & I_b \end{pmatrix} \\ &= (1_{n..}1_{n..}^+, AA^+ - 11^+, BB^+ - 11^+) \begin{pmatrix} 1_{n..} & A - 1_{n..}1_a^+ & B - 1_{n..}1_b^+ \\ 0 & A & 0 \\ 0 & 0 & B \end{pmatrix} \end{aligned}$$

$$\text{So } \mathcal{R}(1_{n..}, A - 1_{n..}1_a^+, B - 1_{n..}1_b^+) \subset \mathcal{R}(1_{n..}1_{n..}^+, AA^+ - 1_{n..}1_{n..}^+, BB^+ - 1_{n..}1_{n..}^+).$$

2. data file 873.txt contains numeric variable y and character variable A and B.

- (1) Find SSA=SSM by running

```
data a;
  infile "D:\873.txt";
  input y A $ B $ @@;
proc anova;
  class A;
  model y=A;
run;
```

$$\text{SSA} = \text{SSM} = 295.2111.$$

- (2) Find SSB=SSM by running

```
proc anova;
  class B;
  model y=B;
run;
```

$$\text{SSB} = \text{SSM} = 7.7333.$$

(3) Find SSM by running

```
proc anova;  
  class A B;  
  model y=A B A*B;  
run;
```

**SSM = 388.2667.**

(4) Is SSA in (1) equals SSA in (3)? Is SSB in (2) equals SSB in (3)? Is SSM-SSA-SSB equals SSAB in (3)? This is how proc anova calculates SSA, SSB and SSAB. Did SAS log gives a warning?

**Yes, SSA in (1) is SSA in (3). Yes SSB in (2) is SSB in (3)  
Yes SSM-SSA-SSB is SSAB in (3). Yes SAS log did give warning.**