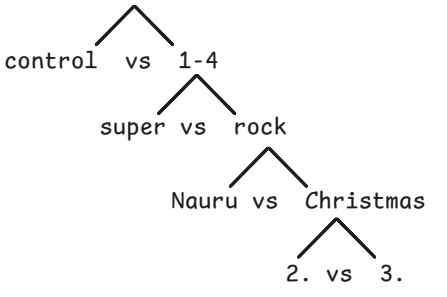
Class contrasts

Ex 1. Write a full set of orthogonal contrast for the following treatments.

1. Rock phosphate from Nauru Island
2. Rock phosphate from Christmas Island (Quarry #1)
3. Rock phosphate from Christmas Island (Quarry #2)
4. Superphosphate
5. Control (no phosphate)



$$\mu_5 = \frac{\mu_1+\mu_2+\mu_3+\mu_4}{4} \Rightarrow \mu_1+\mu_2+\mu_3+\mu_4-4\mu_5=0$$

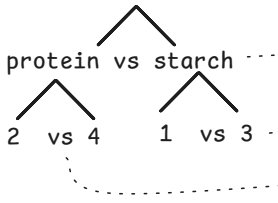
$$\mu_4 = \frac{\mu_1+\mu_2+\mu_3}{3} \Rightarrow \mu_1+\mu_2+\mu_3-3\mu_4=0$$

$$\mu_1 = \frac{\mu_2+\mu_3}{3} \Rightarrow 2\mu_1-\mu_2-\mu_3=0$$

$$\mu_2=\mu_3 \Rightarrow \mu_2-\mu_3=0$$

Ex 2. Write a full set of orthogonal contrast for the following treatments.

1. Protein diet
2. Starch diet
3. Protein diet
4. Starch diet



$$\frac{\mu_1+\mu_3}{2}=\frac{\mu_2+\mu_4}{2} \Rightarrow \mu_1-\mu_2+\mu_3-\mu_4=0$$

$$\mu_1=\mu_3 \Rightarrow \mu_1-\mu_3=0$$

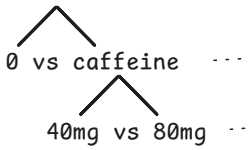
$$\mu_2=\mu_4 \Rightarrow \mu_2-\mu_4=0$$

Factorial contrasts

Ex 3. How does caffeine and writing-medium affect time-to-solve a problem in seconds? Write a full set of orthogonal contrast for the following treatments. Use a 2x3 factorial design.

- No coffee; paper
- No coffee; chalk
- 40mg caffeine; paper
- 40mg caffeine; chalk
- 80mg caffeine; paper
- 80mg caffeine; chalk

Factor A: 0 vs. 40 vs. 80mg caffeine



$$\mu_0=\frac{\mu_{40}+\mu_{80}}{2} \Rightarrow 2\mu_0-\mu_{40}-\mu_{80}=0 \Rightarrow a_1=(2,-1,-1)$$

$$\mu_{40}=\mu_{80} \Rightarrow \mu_{40}-\mu_{80}=0 \Rightarrow a_2=(0,1,-1)$$

Factor B: paper vs. chalk

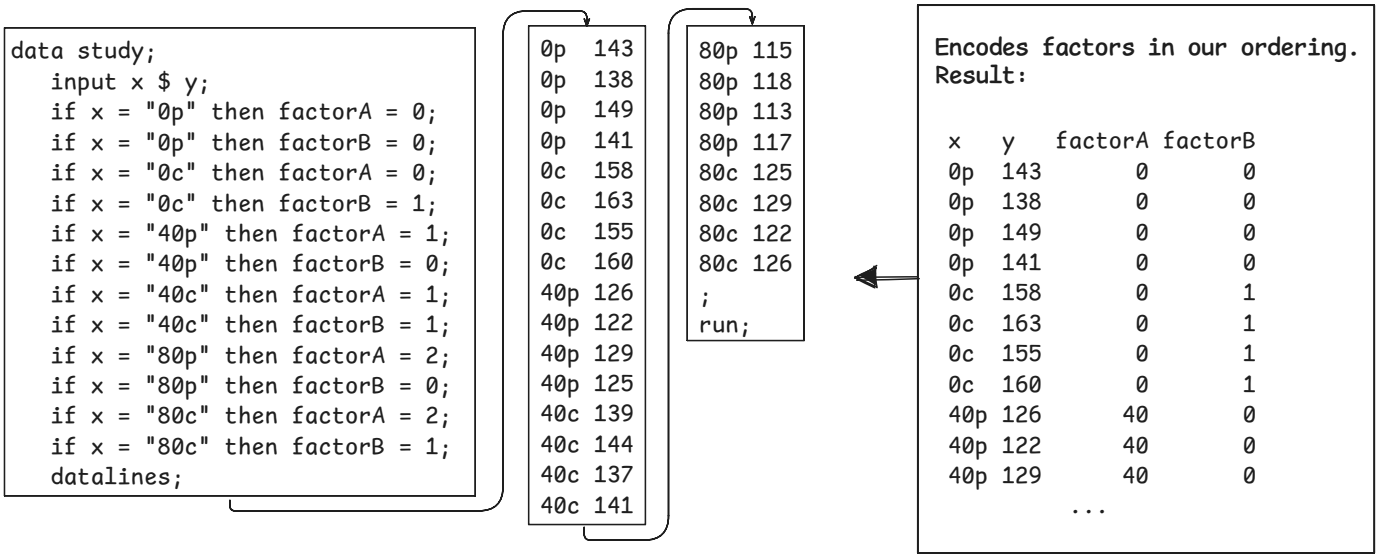


$$\mu_p=\mu_c \Rightarrow \mu_p-\mu_c=0 \Rightarrow b=(1,-1)$$

Interactions:

$$a_1 \otimes b = (2,-2,-1,1,-1,1)$$

$$a_2 \otimes b = (0,0,1,-1,-1,1)$$



RUN:

```
proc glm data=study;
   class factorA factorB;
   model y = factorA factorB factorA*factorB;

   contrast 'A1' factorA  2 -1 -1;
   contrast 'A2' factorA  0  1 -1;
   contrast 'B'  factorB  1 -1;
   contrast 'A1 x B' factorA*factorB  2 -2  -1  1  -1  1;
   contrast 'A2 x B' factorA*factorB  0  0   1 -1  -1  1;
run;
```

OR:

```
proc glm data=study;
   class factorA factorB;
   model y = factorA*factorB;

   contrast 'A1' factorA*factorB  2 2 -1 -1 -1 -1;
   contrast 'A2' factorA*factorB  0 0  1  1 -1 -1;
   contrast 'B'  factorA*factorB  1 -1 1 -1  1 -1;
   contrast 'A1 x B' factorA*factorB  2 -2  -1  1  -1  1;
   contrast 'A2 x B' factorA*factorB  0  0   1 -1  -1  1;
run;
```

GET:

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
A1	1	3104.083333	3104.083333	293.68	<.0001
A2	1	600.250000	600.250000	56.79	<.0001
B	1	1107.041667	1107.041667	104.74	<.0001
A1 x B	1	21.333333	21.333333	2.02	0.1725
A2 x B	1	25.000000	25.000000	2.37	0.1415