```
PRINT=DESIGN(SOLUTION)/
```

For example, in a 2 × 3 (factors A, B) design with one empty cell. The solution matrix P of this design would be

$$P = \begin{pmatrix} p_{11} & p_{21} & p_{31} & p_{41} & p_{51} & 0 \\ p_{12} & p_{22} & p_{32} & p_{42} & p_{52} & 0 \\ p_{13} & p_{23} & p_{33} & p_{43} & p_{53} & 0 \\ p_{14} & p_{24} & p_{34} & p_{44} & p_{54} & 0 \\ p_{15} & p_{25} & p_{35} & p_{45} & p_{55} & 0 \\ p_{16} & p_{26} & p_{36} & p_{46} & p_{56} & 0 \end{pmatrix}$$

The first column of P indicates that the hypothesis corresponding to the sum of squares of CONSTANT is

$$p_{11}\mu_{11}+p_{12}\mu_{12}+p_{13}\mu_{13}+p_{14}\mu_{21}+p_{15}\mu_{22}+p_{16}\mu_{23} = 0$$

where $\mu_{ij}$ is the population mean of cell (i,j).

Similarly, column 2 of P represents the coefficients of the linear combinations of cell means being tested for the sum of squares of A, columns 3 and 4 are for the sum of squares of B, and the last two columns are for the sum of squares of AB.

**An Example.** The following example is taken from Bancroft (1968, p. 20). Quantitative chemical experiments were run to determine the reacting weights of silver (SILVER) and iodine (IODINE) in silver iodine. Five different batches of silver and two different batches of iodine were used in the experiment. These were treated, and then a determination of the reacting weights was made. The coded data are given in Table 1.15. Note that there are two empty cells in the experiment.

**Table 1.15**

| | | Silver | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Iodine | 1 | 22<br>25 | 41<br>41 | 29<br>20<br>37 | 49<br>50 | 55 |
| | 2 | -1<br>40<br>18 | 23<br>13 | – | 61 | – |

The MANOVA commands illustrated in Figure 1.15a produce the analysis shown in Figures 1.15b-1.15d.

**Figure 1.15a**

```
RUN NAME        A 5*2 DESIGN WITH EMPTY CELLS.
COMMENT         DATA ARE TAKEN FROM BANCROFT(1968) PAGE 20.
VARIABLE LIST   SILVER IODINE RESP
INPUT FORMAT    FREEFIELD
INPUT MEDIUM    CARD
MANOVA          RESP BY SILVER(1,5) IODINE(1,2)/
                PRINT=DESIGN(DECOMP,BIAS)/
                DESIGN=SILVER,IODINE,SILVER BY IODINE/
                DESIGN=IODINE,SILVER,SILVER BY IODINE/
READ INPUT DATA
1 1 22
1 1 25
1 2 -1
1 2 40
1 2 18
2 1 41
2 1 41
2 2 23
2 2 13
3 1 29
3 1 20
3 1 37
4 1 49
4 1 50
4 2 61
5 1 55
END INPUT DATA
FINISH
```