TAMS38
Computer exercises 5

Preparation: *Read about* 2^k*- and* 2^{k-p}*-designs.*

Bring collection of formulas and tables, and calculators to the computer exercise class.

1 – Analysis according to 2^5-design.

In exercise 6-25 in "Design and Analysis of Experiments" – Montgomery, the 2^5*-factorial design is described in connection with the production of semiconductors. One has studied the influence of five factors on production. Results*

(1)	7	d	8	e	8	de	6
a	9	ad	10	ae	12	ade	10
b	34	bd	32	be	35	bde	30
ab	55	abd	50	abe	52	abde	53
c	16	cd	18	ce	15	cde	15
ac	20	acd	21	ace	22	acde	20
bc	40	bcd	44	bce	45	bcde	41
abc	60	abcd	61	abce	65	abcde	63

You must first download the design matrix. Download file `uppg5-1.MPJ` *from the course webpage. Go to* **File/Other Files/Import Special Text...** *in* **Store Data in columns** *write c1-c32. Choose file* `uppg5-1.MPJ`. *Now, we have design matrix* **F** *in c1-c32.*

Put the y-values in C33 in correct order (think which order is the proper one). Name A-, B-, C-, D-, E- and Y proper columns, i.e., columns c2, c3, c5, c9, c17, c33.

You should do an analysis under a complete five factor model :

```
SET C34
1:32
END
```

give you the numeration of rows in c34 allowing you to identify the different parameter estimates eventually. With the help of matrix calculus, you can estimate the parameters.

```
COPY C1-C32 M1
COPY C33 M2
TRANS M1 M3
MULT M3 M2 M4
COPY M4 C35
LET C36=C35/32
```

Go to **Data/Sort...**. *In Sort columns write c36 c34, in by column write c36 and in Store sorted data in: choose columns in current worksheet and write c37 c38. Now you have parameter estimates sorted in order of the C37 and their No. in the parameter vector in C38.*

a) Identify the various parameters associated with the effects.

Write in the session window

```
LET C39=32*C37*C37
PRINT C37-C39
```

b) How one can estimate the parameter for the variance?

Now column C39 includes sums of squares in the usual form consisting of SS_A, SS_B, SS_{AB} etc. Now you should calculate the sum of the 31 first elements of c39. Take first

```
SUM C39
```

and then

```
LET K1 = värdet på summan - 29829.0
```

(Minitab can not do everything at once.) We remove the last element in the C39 since it is not included in the traditional division of SS_{TOT}. Calculate also

```
STDEV C33
```

and then

```
LET K2= 31*(värdet på STDEV)**2
PRINT K1 K2
```

Compare values of K1 and K2. Think about that K1=K2=SS_{TOT}.

Using a normal probability plot you will find the most interesting effects, but first remove

μ-estimate which has number 32 among the sorted parameter estimates of C37.

```
COPY C37 C40;
OMIT  32.
NSCORES C40 C41
PLOT C41*C40
```

c) Here you'll find the four effects that seem significant. Which? What factors seem to be of no importance?

Instead of working yourself with matrices one may a ready command

```
FFACTORIAL Y=A|B|C|D|E;
GPARETO;
GEFFECTS.
```

d) Analyze now the data according to an appropriate model with k factors where $k < 5$. Go to **Stat/ANOVA/Balanced ANOVA...**, *fill the response variable and model, request all the residual plots in Graphs, all the means that corresponds to model.*

e) Do you see something interesting in the plots?

f) Choose levels for factors by constructing suitable confidence interval with simultaneous confidence about 0.95 for all intervals together.

g) Do the reliability of the conclusions is reduced in the projected 2^3 -factorial design?

2 – Analysis of the reduced 2^6-factorial design

One wants to study the effect of six pesticides each of which can be used at low or high level. So we have six factors

Factor	*Low level*	*High level*
A: BMC	*0%*	*5%*
B: Malathion	*3%*	*6%*
C: Tedion	*1%*	*2%*
D: Chlordane	*2%*	*5%*
E: Lindane	*1%*	*4%*
F: Pyrethrum	*2%*	*4%*

In each experiment, we feed 10 insects with a particular mixture of pesticides and the average life span (in seconds) after treatment is determined. Results ae given in the random *order in which the tests were carried out:*

ce	*181*	*acdf*	*162*	*bd*	*135*	*abdf*	*131*
ae	*172*	*(1)*	*182*	*df*	*171*	*ab*	*136*
abef	*140*	*bf*	*171*	*acef*	*159*	*bcde*	*105*
bcdf	*165*	*cf*	*176*	*bc*	*179*	*abcdef*	*109*
acde	*139*	*be*	*187*	*ac*	*165*	*af*	*176*
ef	*186*	*abce*	*131*	*bcef*	*181*	*ad*	*150*
de	*164*	*abcf*	*125*	*cdef*	*163*	*abde*	*115*
abcd	*112*	*adef*	*158*	*bdef*	*128*	*cd*	*166*

a) F was applied according to the rule F=ABCDE. Sort the observations in the right order with respect to the level combinations A, B, C, D and E, i.e., (1), a, b, ab, osv. Consider what effects are aliases by using generator for the study plan.

Open a new project and upload the design matrix to do 2^5*-factorial design. Sorted observations are given in the data file* `uppg5-2.MPJ`*. Put in the observations in column c33.*

Do an analysis. If you use `FFACTORIAL` *you should give name F for column C32 and then use the model Y=A|B|C|D|E|F.*

b) What factors seem to have influence?

c) Use ANOVA to do appropriate analysis where you only consider some part of the factors. Study residual plots.

d) Is there any combination of the pesticides that you recommend?