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Statistical Report Revised and updated version

AMDG article 1

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Contents

0 Conjuration

The purpose of a statistical report is to describe statistical considerations and analyses as precisely as possible. The report is intended to be a support for the client in the writing of scientific papers, as well as a documentation for the author (and other statisticians) of the entire statistical analysis.

It is not the intention that the client understand all the technical details of the report, but it is important that the client sees to it that the author's description of the problems is correct, and that the proposed solutions address the research questions adequately.

1 Background

A number of 940 individuals from Nuuk and Sisimiut in Greenland are participating in this study. A subset of 929 of these have information on sex, age and place of residence, while another subset of 697 individuals (686 of these are overlapping with the first subset) have had a photo taken of both the left and right eye. The statistical analysis is comprised by three sub-analyses:

1. Do the participants represent Greenland? Statistically, we are modelling the association between three levels of participation and the variables *age*, *sex* and *residence* (Nuuk or Sisimiut) for individuals. This is a sort of non-responder analysis.

2. Is the diagnosis of an individual influenced by age, sex, and place of resident? Statistically, we are modelling the association between diagnosis and the variables *age*, *sex* and *residence*.

3. Is the diagnosis of the eye influenced by the image quality of the eye photo? Statistically, we are modelling the association of a diagnosis of *HD* or *ARM* in an eye and the variable *image quality* on two levels, adjusting for the variables *age*, *sex* and *place of residence* of the individual.

2 Data

The Access table *Artikel 1* is exported as a tab delimited text file [1] and then imported to SAS as *Artikel1.sas7bdat*. The first two parts of the analysis are based on this table containing information on 929 individuals from Nuuk and Sisimiut. The third part of the analysis is based on the Access table *Inuit Final Data* which has been exported as a tab delimited text file and then imported to SAS as *Inuitfinaldata.sas7bdat*. The table contains information on 1,394 photographs of the eye of 697 individuals. The 686 of these individuals are contained in *Artikel1.sas7bdat* as well.

For the supplementary analyses in Rthese SAS-files were converted to Rformat.

[1] A decimal is replaced by a period and the Danish *ø* is replaced by *oe*.

3 Statistical models

The level of individual participation as well as the classes of individual diagnoses may be ranked. Hence, we will use a proportional odds model for part one and two of the analysis. In the third part of the statistical analysis, we are dividing classes of eye diagnoses into two groups and may consequently use the logistic regression model. The statistical models used in the analyses are described in the following sections.

3.1 Logistic regression model

For a response, u, with two possible levels 0 and 1, one may describe the probability of level 1 by a logistic regression model:

$$\text{logit}\left(p\right) = \ln\left(\frac{p}{1-p}\right) = \ln\left(\text{odds}\left(u=1\right)\right) = \alpha + X\beta,\ X : \text{explanatory variables}$$

Using the binomial distribution with $p = pr\left(u=1\right)$:

$$y \in B\left(n,p\right),\ y : \text{no. individuals with } u = 1$$

3.2 Proportional odds model

For a response, u, with k possible levels, we assume the levels $1, 2, ..., k$ to be ordered[2]. Let p_j denote the probability of $u = j$ and let y_j be the number of occurrences of $u = j$ out of n possible $\left(\sum_{j=1}^{k} y_j = n\right)$. The outcome $\{y_1, y_2, ...y_k\}$ may then be modelled by a multinomial distribution:

$$\text{mult}_k\left(n,\mathbf{p}\right) = pr\left(y_1, y_2, ...y_k\right) = \frac{n!}{y_1!y_2!...y_k!} p_1^{y_1} p_2^{y_2} ... p_k^{y_k} \quad (1)$$

If we wish to relate the probability of $u = j$ to a set of explanatory variables, we use the cumulative logit as link function:

$$\text{logit}\left(g_j\right) = \ln\left(\frac{g_j}{1-g_j}\right) = \alpha_j + X\beta,\ j = 1, 2, ..., k-1 \quad (2)$$

where $g_j = pr\left(u \leq j\right) = \sum_{l \leq i} p_l$ and X is the set of explanatory variables.

Let x_p denote the value of an explanatory variable p with corresponding parameter β_p. If variable p is continuos then $\exp\left(\beta_p\right)$ expresses the change in the odds $pr\left(u \leq j\right)/pr\left(u > j\right)$ of a unit increase in the value of variable p for all cutpoints $j = 1, 2, ..., k-1$. By definition $g_k = pr\left(z \leq k\right) = 1$. As an example, let the response u denote the severity of a condition which is increasing in j. Then for $\beta_p > 0$, a unit increase in x_p increases the probability of lower ratings of severity as opposed to higher ratings of severity at all cutpoints. If variable p is categorical including levels v and w, then $\exp\left(\beta_{p,v} - \beta_{p,w}\right)$ expresses the change in the odds $pr\left(u \leq j\right)/pr\left(u > j\right)$ for an individual on level v as opposed to an individual

[2]Meaning either: $1 \prec 2 \prec ... \prec k$ or $1 \succ 2 \succ ... \succ k$.

on level w with others being equal. If we again assume the response u to denote the severity of a condition increasing in j, then for $\beta_{p,v} - \beta_{p,w} > 0$, the individual on level v will, compared to the individual on level w, have an increased probability of lower ratings of severity as opposed to higher ratings of severity at all cutpoints j.

The model defined by (1) and (2) is called a proportional odds model because it assumes constant effects of each explanatory variable over the cutpoints j.

4 Estimation

The models are estimated using the Genmod procedure in SAS and the statistical package R.

5 Results

The results of the three sub-analyses are described in detail in the following sections.

5.1 Individual participation

The levels of participation may be ranked as:

$$\text{Not participating} \prec \text{Partially participating} \prec \text{Fully participating}$$

with *Fully participating* as the highest level of participation and *Not participating* as the lowest.

We fitted a model with interction between sex, place of residence and age (as a linear term), i.e. allowing for separate dependence of participation rates on age between sexes and locations. The estimated effects for the four sex×place of residence groups are shown in figure 1.

It turns out that there is no interaction between the factors, nor is there any effect of age on the participation rate, so a completely adequate description of data is that given in table 5.1.

In general, individuals from Nuuk have on average lower odds for a high participation level compared to individuals from Sisimiut (OR = 0.73. Women have higher odds for participation than men (OR = 1.52), i.e. are more likely to participate in the study. The effect of sex on the participation rate is the same in both Nuuk and Sisimiut. The empirical percentages and numbers are given in more detail in table 2.

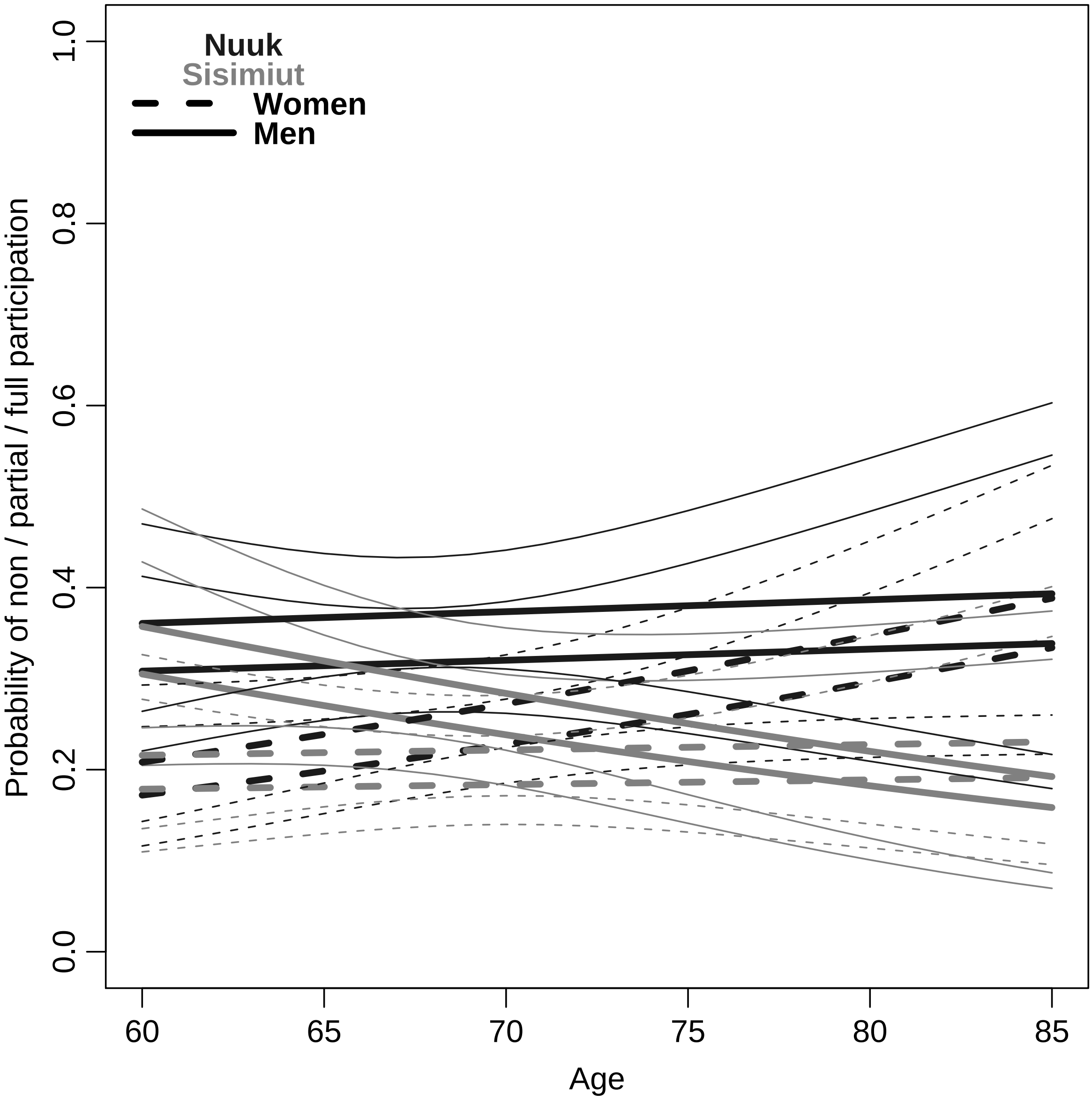

Figure 1: *Estimated probabilities of non-participation by sex, residence and age. The lower lines represent the probability of non-participation, the upper lines the combined probabilities of none and partial participation. Thus the distance above the upper lines are the probabilities of full participation. The thin lines represent 95% confidnece intervalks. Statistically the dependence on age is not significant.*

Table 1: *Estimates of probabilities (in %) and odds-ratios of higher level of participation from the individual participation analysis. The lower half of the table is just the complementary probabilities of the upper half.*

Participation Category	Residence	Sex	Participation % Estimate	95% c.i.	Empirical
None	Nuuk	Men	31.4	26.6–36.8	31.9
		Women	23.1	19.2–27.5	23.3
	Sisimiut	Men	25.1	20.4–30.6	24.4
		Women	18.0	14.3–22.4	17.7
None+Partial	Nuuk	Men	36.7	31.5–42.3	37.0
		Women	27.5	23.2–32.3	27.0
	Sisimiut	Men	29.8	24.6–35.6	29.4
		Women	21.7	17.5–26.6	22.3
Full+Partial	Nuuk	Men	68.6	73.4–63.2	68.1
		Women	76.9	80.8–72.5	76.7
	Sisimiut	Men	74.9	79.6–69.4	75.6
		Women	82.0	85.7–77.6	82.3
Full	Nuuk	Men	63.3	68.5–57.7	63.0
		Women	72.5	76.8–67.7	73.0
	Sisimiut	Men	70.2	75.4–64.4	70.6
		Women	78.3	82.5–73.4	77.7

	OR	95% c.i.	p
Female vs. male	1.52	1.15–2.03	0.003
Resident of Nuuk vs. Sisimiut	0.73	0.54–0.98	0.035

Table 2: *Participation rates and numbers by sex and location*

	Nuuk			Sisimiut			Both		
	Men	Women	All	Men	Women	All	Men	Women	All
(%)									
None	23.3	31.9	27.2	17.7	24.4	20.8	20.9	28.7	24.4
Partial	3.7	5.0	4.3	4.7	5.0	4.8	4.1	5.0	4.5
Full	73.0	63.0	68.5	77.7	70.6	74.4	75.0	66.3	71.0
Sum	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N)									
None	69	76	145	38	44	82	107	120	227
Partial	11	12	23	10	9	19	21	21	42
Full	216	150	366	167	127	294	383	277	660
Sum	296	238	534	215	180	395	511	418	929

5.2 Individual diagnoses

The diagnoses *CNV* and *GA* are known as wet and dry *AMD* and are ranked equally in severity. Similarly, Normal and HD are considered of equal severity and are also combined[3]. Consequently, diagnosis at the person-level has the following ranking of possible diagnoses of individuals:

$$Normal/HD \prec ARM \prec AMD$$

with *AMD* as the highest level of severity and *Normal/HD* as the lowest.

We found no interaction between age and the other variables. A test for absence of all interactions between age, sex and place of residence gave $\chi^2(4) = 3.51, \mathrm{p} = 0.476$. Neither did we find any effect of sex, $\chi^2(1) = 0.021, \mathrm{p} = 0.884$. This leaves us with a description af the diagnosis severity only depending on age and place of residence. The estimates from this final model is given in figure 5.2, and the corresponding estimates in table 3.

Table 3: *Estimates of parameters from the individual diagnosis analysis.*

	OR	95% c.i.	p
Age per year	1.09	1.07–1.12	0.000
Resident of Nuuk vs. Sisimiut	0.41	0.30–0.55	0.000

The odds-ratio (OR) in table 3 states the relative odds for receiving a more severe diagnosis as opposed to the probability of receiving a less severe diagnosis. Individuals from Nuuk do on average have lower odds for a more severe diagnosis compared to individuals from Sisimiut (OR = 0.41). This means that the ratio of the number of persons with a diagnosis of (at least) a given severity, to those with less is 41% in Nuuk of what the same ratio is in Sisimiut. Or put differently, this ratio is 2.5 times larger in Sisimiut than in Nuuk.

Also, the analysis showed increasing odds of a severe diagnosis by increasing age. This is also clear from figure 5.2.

[3] According to Nis Andersen.

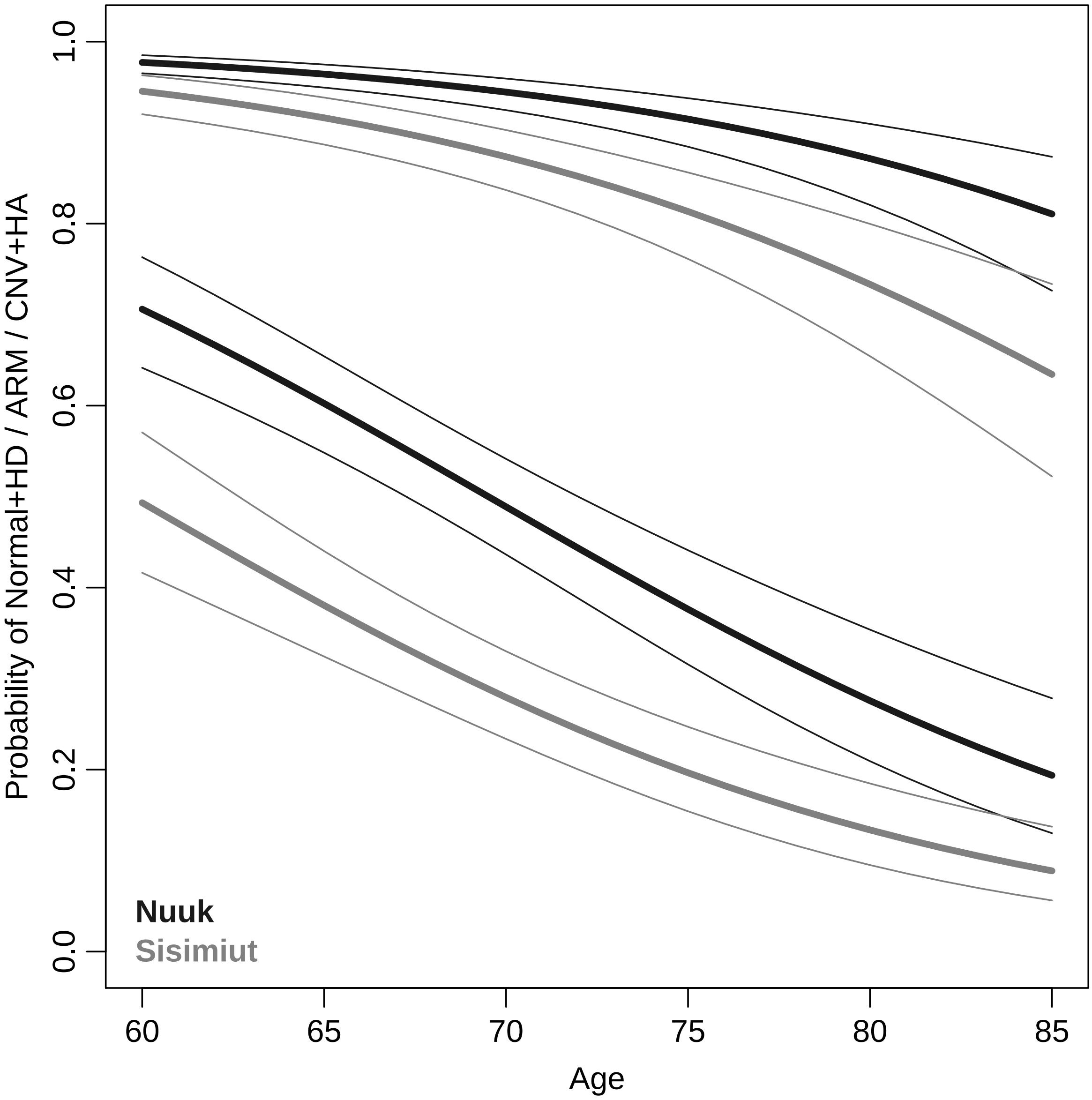

Figure 2: *Estimated probabilities of diagnosis residence and age. The lower lines represent the probability of Normal+HD, the upper lines the combined probabilities of Normal+HD and ARM. Thus the distance above the upper lines are the probabilities of full AMD. The thin lines represent 95% confidence intervals.*

5.3 Image quality

We have 9 different levels of image quality of eye photos. In this analysis they are divided into two groups:

Gradable photo quality 1-4 and 6

Ungradable photo quality 5 and 7-9

Because the diagnosis groups *HD* and *ARM* are hard to grade for poor quality fundus photos, the hyphotesis is that we for *HD* and *ARM* have an over-representation of good quality images compared to other groups of diagnosis.

Each individual has had both the left and the right eye photographed. It is important to take into consideration the correlation between the diagnosis of the left and right eye of the same individual[4]. The estimates of the statistical analysis with a diagnose of *HD* or *ARM* as endpoint are listed in table 5.3. A diagnosis of the eye of *HD* or *ARM* is defined as a diagnosis of *HD* or *ARM* and not *AMD* or *Normal*.

Table 4: *Estimates of parameters from the image quality analysis*

	Estimate	Std. Error	p	OR
Ungradable vs. gradable photo quality	−5.920	0.670	< 0.0001	0.00
Adjusting for				
Age per year	−0.155	0.019	< 0.0001	0.86
Female vs. male	0.225	0.257	0.380	1.25
Resident of Nuuk vs. Sisimiut	0.044	0.252	0.862	1.04
Left vs. right eye	0.200	0.153	0.191	1.22

The estimates and standard error are on the log-scale. The *OR* in table 5.3 states the odds for the eye diagnosis of either *HD* or *ARM*. An ungradable photo quality highly reduces the probability of an eye diagnosis of either *HD* or *ARM*. Adjustment for age, sex, residence and whether the photo was taken of the left or right eye does not change this result.

Tabular analysis

The effects of image quality on the two diagnostic variables HD and ARM are further elucidated in table 5. Clearly, the ungradable photos (categories 5,7,9) are overrepresented among eyes with diagnosis 0 of both HD and ARM.

From the graphical counterpart of table 5 seen in figure 3, it is even more apparent that the simultaneous occurreence of HD=0 and ARM=0 are closely associated with poor image quality.

Further subdivisions by the other variables does not reveal any further differences in image quality.

[4]The correlation between the left and right eye of the same individual is taken into consideration using the repeated option in the Genmod procedure.

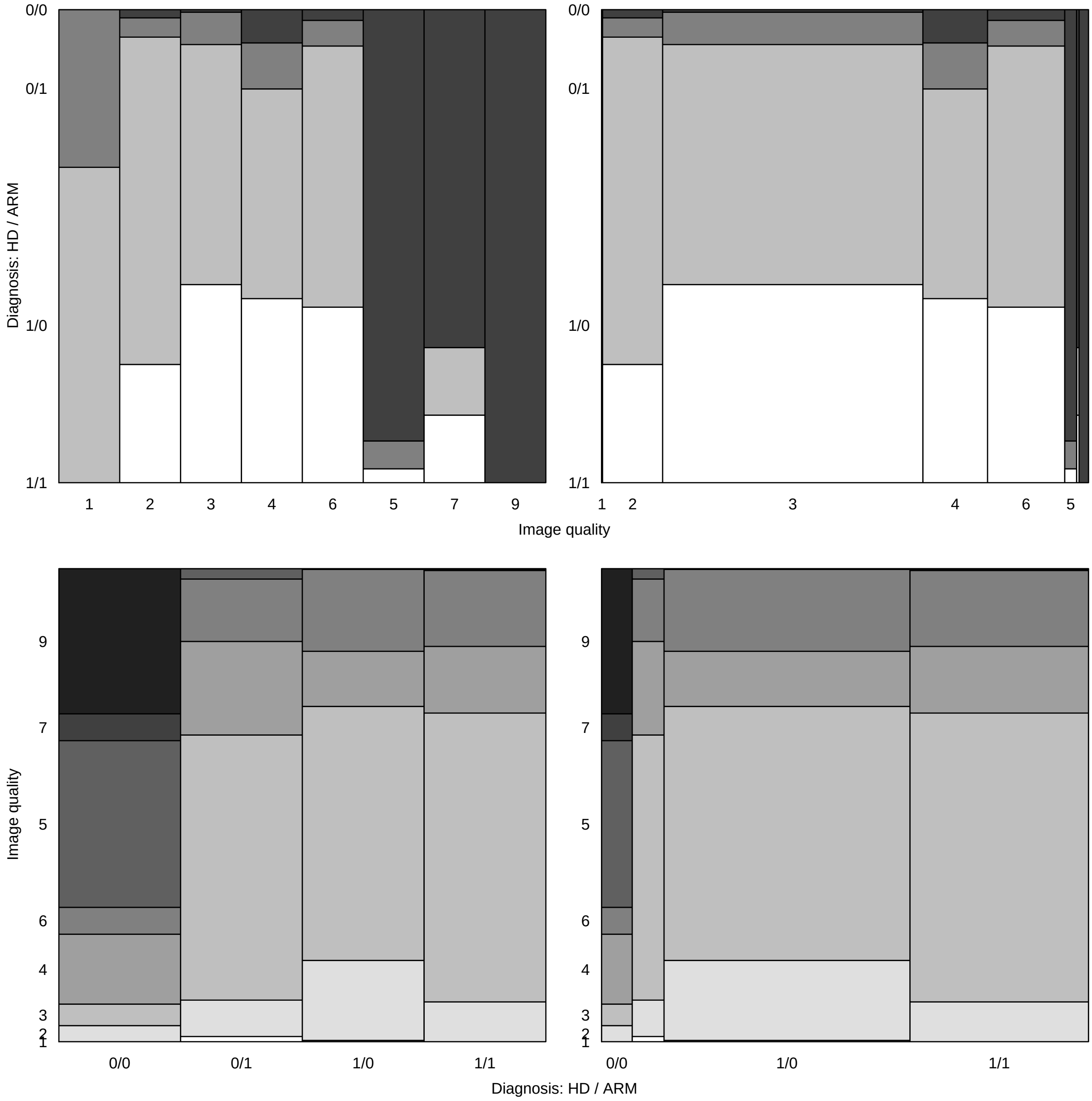

Figure 3: *Diagnoses as a function image quality (top panel) and vice versa. The left panels are with equal width of the columns, the rightmost with a width proportional to the number in each.*

Table 5: *Cross classification of eye-diagnoses versus photograpic quality. Note that categories 5 and 6 of the image quality variable are interchanged.*

Diagnosis			Fundus image quality								
HD	ARM		1	2	3	4	6	5	7	9	Total
		No.									
0	0		0	3	4	13	5	31	5	27	88
	1		1	7	51	18	12	2	0	0	91
1	0		2	119	378	82	122	0	1	0	704
	1		0	43	312	72	82	1	1	0	511
Total			3	172	745	185	221	34	7	27	1394
		%									
0	0		0.0	3.4	4.5	14.8	5.7	35.2	5.7	30.7	100.0
	1		1.1	7.7	56.0	19.8	13.2	2.2	0.0	0.0	100.0
1	0		0.3	16.9	53.7	11.6	17.3	0.0	0.1	0.0	100.0
	1		0.0	8.4	61.1	14.1	16.0	0.2	0.2	0.0	100.0
Total			0.2	12.3	53.4	13.3	15.9	2.4	0.5	1.9	100.0

6 Statistical results in short

The three groups of participation in the study (*Not participating*, *Partially participating* and *Fully participating*) differ significantly only with respect to sex and place of residence: Women and inhabitants of Sisimiut are more likely to participate.

The three groups of individual diagnosis (*Normal/HD*, *ARM* and *AMD*) differ significantly w.r.t. age and place of residence: diagnoses are more severe in Sisimiut, and severity increase by age.

The group of eyes with a diagnosis of *ARM* or *HD* in either eye differ significantly from other groups of diagnosis regarding the quality of the photo. Adjustment for age, sex and place of residence does not change this result. Specifically, a poor image quality is predictive of a 0-diagnosis both for HD and for ARM.

7 Programs

7.1 1_data.sas

This SAS-program reads the original data and converts them into SAS format.

```
                                                   "Program: 1_data.sas"                    21:49 Saturday, January 3,

NOTE: Copyright (c) 1999-2001 by SAS Institute Inc., Cary, NC, USA.
NOTE: SAS (r) Proprietary Software Release 8.2 (TS2M0)
      Licensed to NOVO NORDISK IT A/S, Site 0090670005.
NOTE: This session is executing on the WIN_PRO  platform.



NOTE: SAS initialization used:
      real time           12.61 seconds
      cpu time            0.91 seconds


NOTE: AUTOEXEC processing beginning; file is c:\stat\bxc.sas\autoexec.sas.

---------------------------------------------------------------
N:\Bendix\Steno\NisA\sas\1_data.sas
---------------------------------------------------------------
NOTE: Libref HER was successfully assigned as follows:
      Engine:        V8
      Physical Name: N:\Bendix\Steno\NisA\sas
NOTE: Libref DATA was successfully assigned as follows:
      Engine:        V8
      Physical Name: N:\Bendix\Steno\NisA\data
NOTE: Libref DAT6 was successfully assigned as follows:
      Engine:        V6
      Physical Name: N:\Bendix\Steno\NisA\data
NOTE: Directory for library DEMO contains files of mixed engine types.
NOTE: Libref DEMO was successfully assigned as follows:
      Engine:        V8
      Physical Name: n:\bendix\demodb\data
NOTE: Library MAPS does not exist.
NOTE: Libref TPL was successfully assigned as follows:
      Engine:        V6
      Physical Name: c:\stat\bxc.sas\sasuser

NOTE: AUTOEXEC processing completed.

           *-------------------;
           * SAS data sæt ;
           *-------------------;

           libname Nis v8 '..\Data' ;
NOTE: Libname NIS refers to the same physical library as DATA.
NOTE: Libref NIS was successfully assigned as follows:
      Engine:        V8
      Physical Name: N:\Bendix\Steno\NisA\data

           * Import of text files;
           proc import out=nis.artikel1
            datafile="p:\DtVs\Nis\Data\artikel1.txt"
            dbms=tab replace;
            getnames=yes;
            datarow=2;
           run;

            /**********************************************************************
            *   PRODUCT:   SAS
            *   VERSION:   8.2
            *   CREATOR:   External File Interface
            *   DATE:      03JAN04
            *   DESC:      Generated SAS Datastep Code
            *   TEMPLATE SOURCE:  (None Specified.)
            ***********************************************************************/
               data NIS.ARTIKEL1                                 ;
              %let _EFIERR_ = 0; /* set the ERROR detection macro variable */
               infile 'p:\DtVs\Nis\Data\artikel1.txt' delimiter='09'x MISSOVER DSD lrecl=32767 firstobs=2 ;
                  informat lbnr $6. ;
                  informat bygd $3. ;
                  informat US_cli_spg_fot $5. ;
                  informat Alder best32. ;
                  informat Agegroup $7. ;
                  informat INCL best32. ;
                  informat AMD_class $8. ;
                  informat R_eye $6. ;
                  informat L_eye $6. ;
```

```
34                informat AMD_fotograding $6. ;
35                informat BIRTH $20. ;
36                informat sexe $3. ;
37                informat USdato $19. ;
38                informat foto best32. ;
39                informat FRAFLYTTET $1. ;
40                informat DOED $1. ;
41                informat iris_dxt $3. ;
42                informat ancest $6. ;
43                format lbnr $6. ;
44                format bygd $3. ;
45                format US_cli_spg_fot $5. ;
46                format Alder best12. ;
47                format Agegroup $7. ;
48                format INCL best12. ;
49                format AMD_class $8. ;
50                format R_eye $6. ;
51                format L_eye $6. ;
52                format AMD_fotograding $6. ;
53                format BIRTH $20. ;
54                format sexe $3. ;
55                format USdato $19. ;
56                format foto best12. ;
57                format FRAFLYTTET $1. ;
58                format DOED $1. ;
59                format iris_dxt $3. ;
60                format ancest $6. ;
61             input
62                         lbnr $
63                         bygd $
64                         US_cli_spg_fot $
65                         Alder
66                         Agegroup $
67                         INCL
68                         AMD_class $
69                         R_eye $
70                         L_eye $
71                         AMD_fotograding $
72                         BIRTH $
73                         sexe $
74                         USdato $
75                         foto
76                         FRAFLYTTET $
77                         DOED $
78                         iris_dxt $
79                         ancest $
80             ;
81             if _ERROR_ then call symput('_EFIERR_',1);  /* set ERROR detection macro variable */
82             run;

NOTE: Numeric values have been converted to character values at the places given by: (Line):(Column).
      81:44
NOTE: The infile 'p:\DtVs\Nis\Data\artikel1.txt' is:
      File Name=p:\DtVs\Nis\Data\artikel1.txt,
      RECFM=V,LRECL=32767

NOTE: 929 records were read from the infile 'p:\DtVs\Nis\Data\artikel1.txt'.
      The minimum record length was 70.
      The maximum record length was 134.
NOTE: The data set NIS.ARTIKEL1 has 929 observations and 18 variables.
NOTE: DATA statement used:
      real time           1.19 seconds
      cpu time            0.09 seconds

929 rows created in NIS.ARTIKEL1 from p:\DtVs\Nis\Data\artikel1.txt.

NOTE: NIS.ARTIKEL1 was successfully created.
NOTE: PROCEDURE IMPORT used:
      real time           12.61 seconds
      cpu time            0.37 seconds


83         proc contents data=nis.artikel1;
84         run;

NOTE: PROCEDURE CONTENTS used:
      real time           1.51 seconds
      cpu time            0.06 seconds

NOTE: The PROCEDURE CONTENTS printed page 1.

85
86         proc import out=nis.InuitFinalData
87          datafile="p:\DtVs\Nis\Data\InuitFinalData.txt"
88          dbms=tab replace;
```

```
89          getnames=yes;
90          datarow=2;
91         run;

92          /**********************************************************************
93          *   PRODUCT:   SAS
94          *   VERSION:   8.2
95          *   CREATOR:   External File Interface
96          *   DATE:      03JAN04
97          *   DESC:      Generated SAS Datastep Code
98          *   TEMPLATE SOURCE:  (None Specified.)
99          ***********************************************************************/
100            data NIS.INUITFINALDATA                          ;
101           %let _EFIERR_ = 0; /* set the ERROR detection macro variable */
102            infile 'p:\DtVs\Nis\Data\InuitFinalData.txt' delimiter='09'x MISSOVER DSD lrecl=32767 firstobs=2 ;
103               informat patient_ID $6. ;
104               informat Image_Quality best32. ;
105               informat eye $7. ;
106               informat ID best32. ;
107               informat CNV best32. ;
108               informat GA best32. ;
109               informat ARM best32. ;
110               informat HD best32. ;
111               informat CNV_GA_ARM_HD $6. ;
112               format patient_ID $6. ;
113               format Image_Quality best12. ;
114               format eye $7. ;
115               format ID best12. ;
116               format CNV best12. ;
117               format GA best12. ;
118               format ARM best12. ;
119               format HD best12. ;
120               format CNV_GA_ARM_HD $6. ;
121            input
122                         patient_ID $
123                         Image_Quality
124                         eye $
125                         ID
126                         CNV
127                         GA
128                         ARM
129                         HD
130                         CNV_GA_ARM_HD $
131            ;
132            if _ERROR_ then call symput('_EFIERR_',1);  /* set ERROR detection macro variable */
133            run;

NOTE: Numeric values have been converted to character values at the places given by: (Line):(Column).
      132:44
NOTE: The infile 'p:\DtVs\Nis\Data\InuitFinalData.txt' is:
      File Name=p:\DtVs\Nis\Data\InuitFinalData.txt,
      RECFM=V,LRECL=32767

NOTE: 1394 records were read from the infile 'p:\DtVs\Nis\Data\InuitFinalData.txt'.
      The minimum record length was 32.
      The maximum record length was 36.
NOTE: The data set NIS.INUITFINALDATA has 1394 observations and 9 variables.
NOTE: DATA statement used:
      real time           0.97 seconds
      cpu time            0.12 seconds

1394 rows created in NIS.INUITFINALDATA from p:\DtVs\Nis\Data\InuitFinalData.txt.

NOTE: NIS.INUITFINALDATA was successfully created.
NOTE: PROCEDURE IMPORT used:
      real time           2.47 seconds
      cpu time            0.16 seconds

134        proc contents data=nis.InuitFinalData;
135        run;

NOTE: PROCEDURE CONTENTS used:
      real time           0.16 seconds
      cpu time            0.01 seconds

NOTE: The PROCEDURE CONTENTS printed page 2.

136
137        *check af  AMD_fotograding: ABCD=CNV|GA|ARM|HD og AMD_class:CNV>GA>ARM>HD (iflg. Nis er CNV og GA sideordnet)
137      ! ;
138        data test;
139         set nis.artikel1;
140         test_AMD_fotograding=compress(max(substr(L_eye,1,1),
141                                           substr(R_eye,1,1))||
142                                       max(substr(L_eye,2,1),
```

```
143                                                 substr(R_eye,2,1))||
144                                             max(substr(L_eye,3,1),
145                                                 substr(R_eye,3,1))||
146                                             max(substr(L_eye,4,1),
147                                                 substr(R_eye,4,1)));
148          if test_AMD_fotograding le .z then test_AMD_fotograding="0000";
149          keep AMD_fotograding test_AMD_fotograding AMD_class;
150         run;

NOTE: Character values have been converted to numeric values at the places given by: (Line):(Column).
      140:36   141:43   142:43   143:43   144:43   145:43   146:43   147:43   148:5
NOTE: Numeric values have been converted to character values at the places given by: (Line):(Column).
      140:32   142:39   144:39   146:39
NOTE: Invalid numeric data, test_AMD_fotograding='....' , at line 148 column 5.
lbnr=1189 bygd=N US_cli_spg_fot=000 Alder=93.35 Agegroup=80- INCL=2 AMD_class=  R_eye=  L_eye=  AMD_fotograding=0000
BIRTH=21-2-1907 00:00:00 sexe=K USdato=  foto=. FRAFLYTTET=  DOED=1 iris_dxt=0 ancest=  test_AMD_fotograding=0000
_ERROR_=1 _N_=687
NOTE: Invalid numeric data, test_AMD_fotograding='....' , at line 148 column 5.
lbnr=1234 bygd=N US_cli_spg_fot=000 Alder=92.95 Agegroup=80- INCL=1 AMD_class=  R_eye=  L_eye=  AMD_fotograding=0000
BIRTH=18-7-1907 00:00:00 sexe=K USdato=  foto=. FRAFLYTTET=  DOED=  iris_dxt=0 ancest=  test_AMD_fotograding=0000
_ERROR_=1 _N_=688
NOTE: Invalid numeric data, test_AMD_fotograding='....' , at line 148 column 5.
..............
ERROR: Limit set by ERRORS= option reached.  Further errors of this type will not be printed.
lbnr=1076 bygd=N US_cli_spg_fot=000 Alder=78.09 Agegroup=75-79 INCL=1 AMD_class=  R_eye=  L_eye=  AMD_fotograding=0000
BIRTH=27-5-1922 00:00:00 sexe=M USdato=  foto=. FRAFLYTTET=  DOED=  iris_dxt=0 ancest=  test_AMD_fotograding=0000
_ERROR_=1 _N_=706
NOTE: Missing values were generated as a result of performing an operation on missing values.
      Each place is given by: (Number of times) at (Line):(Column).
      243 at 140:32   243 at 142:39   243 at 144:39   243 at 146:39
NOTE: There were 929 observations read from the data set NIS.ARTIKEL1.
NOTE: The data set WORK.TEST has 929 observations and 3 variables.
NOTE: DATA statement used:
      real time           0.67 seconds
      cpu time            0.07 seconds

151
152         proc freq data=test;
153          table AMD_fotograding*test_AMD_fotograding/ nopercent nocol norow;
154          table AMD_class*AMD_fotograding/ nopercent nocol norow;
155         run;

NOTE: There were 929 observations read from the data set WORK.TEST.
NOTE: The PROCEDURE FREQ printed pages 3-4.
NOTE: PROCEDURE FREQ used:
      real time           0.10 seconds
      cpu time            0.02 seconds

156
157
158         *---------------;
159         * Formater ;
160         *---------------;
161         proc format library = work;
162
162       !  value deltag
163          1 = 'ikke deltagelse'
164          2 = 'delvis deltagelse'
165          3 = 'fuld deltagelse';
NOTE: Format DELTAG has been output.
166
166       !  value diagnose
167          0 = 'Normal'
168          1 = 'HD'
169          2 = 'ARM'
170          3 = 'AMD';
NOTE: Format DIAGNOSE has been output.
171         run ;

NOTE: PROCEDURE FORMAT used:
      real time           0.56 seconds
      cpu time            0.01 seconds


ERROR: Errors printed on page 4.

NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA 27513-2414
NOTE: The SAS System used:
      real time           38.02 seconds
      cpu time            2.65 seconds

The SAS System                                                                       21:49 Saturday, January 3, 2004   1

The CONTENTS Procedure
```

```
Data Set Name: NIS.ARTIKEL1                          Observations:         929
Member Type:   DATA                                  Variables:            18
Engine:        V8                                    Indexes:              0
Created:       21:50 Saturday, January 3, 2004       Observation Length:   128
Last Modified: 21:50 Saturday, January 3, 2004       Deleted Observations: 0
Protection:                                          Compressed:           NO
Data Set Type:                                       Sorted:               NO
Label:


           -----Engine/Host Dependent Information-----

Data Set Page Size:         12288
Number of Data Set Pages:   11
First Data Page:            1
Max Obs per Page:           95
Obs in First Data Page:     73
Number of Data Set Repairs: 0
File Name:                  N:\Bendix\Steno\NisA\data\artikel1.sd7
Release Created:            8.0202M0
Host Created:               WIN_PRO


       -----Alphabetic List of Variables and Attributes-----

 #    Variable          Type    Len    Pos    Format     Informat
-----------------------------------------------------------------
 7    AMD_class         Char      8     45    $8.        $8.
10    AMD_fotograding   Char      6     65    $6.        $6.
 5    Agegroup          Char      7     38    $7.        $7.
 4    Alder             Num       8      0    BEST12.    BEST32.
11    BIRTH             Char     20     71    $20.       $20.
16    DOED              Char      1    114    $1.        $1.
15    FRAFLYTTET        Char      1    113    $1.        $1.
 6    INCL              Num       8      8    BEST12.    BEST32.
 9    L_eye             Char      6     59    $6.        $6.
 8    R_eye             Char      6     53    $6.        $6.
 3    US_cli_spg_fot    Char      5     33    $5.        $5.
13    USdato            Char     19     94    $19.       $19.
18    ancest            Char      6    118    $6.        $6.
 2    bygd              Char      3     30    $3.        $3.
14    foto              Num       8     16    BEST12.    BEST32.
17    iris_dxt          Char      3    115    $3.        $3.
 1    lbnr              Char      6     24    $6.        $6.
12    sexe              Char      3     91    $3.        $3.

The SAS System                                                              21:49 Saturday, January 3, 2004   2

The CONTENTS Procedure

Data Set Name: NIS.INUITFINALDATA                    Observations:         1394
Member Type:   DATA                                  Variables:            9
Engine:        V8                                    Indexes:              0
Created:       21:50 Saturday, January 3, 2004       Observation Length:   72
Last Modified: 21:50 Saturday, January 3, 2004       Deleted Observations: 0
Protection:                                          Compressed:           NO
Data Set Type:                                       Sorted:               NO
Label:


              -----Engine/Host Dependent Information-----

Data Set Page Size:         8192
Number of Data Set Pages:   13
First Data Page:            1
Max Obs per Page:           113
Obs in First Data Page:     86
Number of Data Set Repairs: 0
File Name:                  N:\Bendix\Steno\NisA\data\inuitfinaldata.sd7
Release Created:            8.0202M0
Host Created:               WIN_PRO


     -----Alphabetic List of Variables and Attributes-----

#    Variable         Type    Len    Pos    Format     Informat
---------------------------------------------------------------
7    ARM              Num       8     32    BEST12.    BEST32.
5    CNV              Num       8     16    BEST12.    BEST32.
9    CNV_GA_ARM_HD    Char      6     61    $6.        $6.
6    GA               Num       8     24    BEST12.    BEST32.
8    HD               Num       8     40    BEST12.    BEST32.
4    ID               Num       8      8    BEST12.    BEST32.
2    Image_Quality    Num       8      0    BEST12.    BEST32.
3    eye              Char      7     54    $7.        $7.
```

```
1    patient_ID       Char      6     48    $6.        $6.
```

The SAS System 21:49 Saturday, January 3, 2004 3

The FREQ Procedure

Table of AMD_fotograding by test_AMD_fotograding

AMD_fotograding test_AMD_fotograding

Frequency	0000	0001	0010	0011	0101	0111	Total
0000	252	0	0	0	0	0	252
0001	0	286	0	0	0	0	286
0010	0	0	18	0	0	0	18
0011	0	0	0	312	0	0	312
0101	0	0	0	0	1	0	1
0111	0	0	0	0	0	14	14
1000	0	0	0	0	0	0	1
1001	0	0	0	0	0	0	3
1010	0	0	0	0	0	0	4
1011	0	0	0	0	0	0	17
1110	0	0	0	0	0	0	4
1111	0	0	0	0	0	0	17
Total	252	286	18	312	1	14	929

(Continued)
Table of AMD_fotograding by test_AMD_fotograding

AMD_fotograding test_AMD_fotograding

Frequency	1000	1001	1010	1011	1110	1111	Total
0000	0	0	0	0	0	0	252
0001	0	0	0	0	0	0	286
0010	0	0	0	0	0	0	18
0011	0	0	0	0	0	0	312
0101	0	0	0	0	0	0	1
0111	0	0	0	0	0	0	14
1000	1	0	0	0	0	0	1
1001	0	3	0	0	0	0	3
1010	0	0	4	0	0	0	4
1011	0	0	0	17	0	0	17
1110	0	0	0	0	4	0	4
1111	0	0	0	0	0	17	17
Total	1	3	4	17	4	17	929

Table of AMD_class by AMD_fotograding

AMD_class AMD_fotograding

Frequency	0000	0001	0010	0011	0101	0111	Total
ARM	0	0	18	312	0	0	330
CNV	0	0	0	0	0	0	46
GA	0	0	0	0	1	14	15

```
HD        |       0 |     286 |       0 |       0 |       0 |       0 |     286
--------- -------- -------- -------- -------- -------- --------
Normal    |       9 |       0 |       0 |       0 |       0 |       0 |       9
--------- -------- -------- -------- -------- -------- --------
Total             9      286       18      312        1       14      686

The FREQ Procedure

Table of AMD_class by AMD_fotograding

AMD_class     AMD_fotograding

Frequency|1000    |1001    |1010    |1011    |1110    |1111    |  Total
--------- -------- -------- -------- -------- -------- --------
ARM       |       0 |       0 |       0 |       0 |       0 |       0 |     330
--------- -------- -------- -------- -------- -------- --------
CNV       |       1 |       3 |       4 |      17 |       4 |      17 |      46
--------- -------- -------- -------- -------- -------- --------
GA        |       0 |       0 |       0 |       0 |       0 |       0 |      15
--------- -------- -------- -------- -------- -------- --------
HD        |       0 |       0 |       0 |       0 |       0 |       0 |     286
--------- -------- -------- -------- -------- -------- --------
Normal    |       0 |       0 |       0 |       0 |       0 |       0 |       9
--------- -------- -------- -------- -------- -------- --------
Total             1        3        4       17        4       17      686

Frequency Missing = 243
```

7.2 init.r

This program reads the two SAS datasets and stores them in R-format for convenience

```
 R 1.8.1
 --------------------------------------------
 Program:  init.R
  Folder:  N:\Bendix\Steno\NisA\R
 Started:  fredag 09. januar 2004, 12:58:24
 --------------------------------------------
> # Read the SAS datasets created by Dorte's program
> #
> art1 <- read.sas( "artikel1", "..\\data" )
> save( art1, file="../data/art1.Rdata" )
> summary( art1 )
      lbnr      bygd     us.cli.s      alder         agegroup       incl          amd.clas       r.eye
 1001   :  1   N:534   000:227   Min.   :60.42   60-64:303   Min.   :1.000         :243   0001   :355
 1002   :  1   S:395   010:  6   1st Qu.:63.91   65-69:286   1st Qu.:1.000   ARM   :330          :243
 1003   :  1           100:  7   Median :67.34   70-74:190   Median :1.000   CNV   : 46   0011   :205
 1004   :  1           101: 26   Mean   :68.82   75-79: 89   Mean   :1.041   GA    : 15   0000   : 46
 1005   :  1           110:  3   3rd Qu.:72.28   80-  : 61   3rd Qu.:1.000   HD    :286   0010   : 32
 1006   :  1           111:660   Max.   :93.35               Max.   :3.000   Normal:  9   0111   : 11
 (Other):923                                                                              (Other): 37
     l.eye       amd.foto                  birth        sexe                   usdato          foto
 0001   :330   0011   :312   22-5-1938 00:00:00:  3   K:511                        :227   Min.   :  1.000
 0011   :244   0001   :286   4-2-1933 00:00:00 :  3   M:418   14-6-2000 00:00:00: 14   1st Qu.:  2.000
        :243   0000   :252   7-1-1934 00:00:00 :  3           11-5-2000 00:00:00: 12   Median :  2.000
 0000   : 36   0010   : 18   7-3-1935 00:00:00 :  3           15-5-2000 00:00:00: 12   Mean   :  1.961
 0010   : 34   1011   : 17   1-1-1923 00:00:00 :  2           22-5-2000 00:00:00: 12   3rd Qu.:  2.000
 0111   : 16   1111   : 17   1-1-1932 00:00:00 :  2           29-5-2000 00:00:00: 12   Max.   :  2.000
 (Other): 26   (Other): 27   (Other)           :913           (Other)           :640   NA's   :243.000
 fraflytt      doed      iris.dxt     ancest
  :917           :895   0:233    1111   :442
 1:  5    2      : 13   1: 29           :316
 2:  2    1      :  7   2: 24    1113   : 21
 4:  2    7      :  3   3: 25    11     : 17
 6:  2    8      :  3   9:618    3333   : 13
 8:  1    3      :  2            1112   : 11
         (Other):  6             (Other):109
>
> eyes <- read.sas( "inuitfinaldata", "..\\data" )
> save( eyes, file="../data/eyes.Rdata" )
> summary( eyes )
    patient.       image.qu        eye            id              cnv                ga
 1001   :   2   Min.   :1.000   Left :697   Min.   :   1.0   Min.   :0.00000   Min.   :0.00000
 1004   :   2   1st Qu.:3.000   Right:697   1st Qu.: 349.3   1st Qu.:0.00000   1st Qu.:0.00000
 1005   :   2   Median :3.000               Median : 697.5   Median :0.00000   Median :0.00000
 1007   :   2   Mean   :3.666               Mean   : 697.5   Mean   :0.04089   Mean   :0.04161
 1008   :   2   3rd Qu.:4.000               3rd Qu.:1045.8   3rd Qu.:0.00000   3rd Qu.:0.00000
 1009   :   2   Max.   :9.000               Max.   :1394.0   Max.   :1.00000   Max.   :1.00000
 (Other):1382
      arm              hd            cnv.ga.a
```

```
 Min.   :0.0000   Min.   :0.0000   0001   :696
 1st Qu.:0.0000   1st Qu.:1.0000   0011   :460
 Median :0.0000   Median :1.0000   0000   : 82
 Mean   :0.4319   Mean   :0.8716   0010   : 66
 3rd Qu.:1.0000   3rd Qu.:1.0000   0111   : 27
 Max.   :1.0000   Max.   :1.0000   1010   : 13
                                   (Other): 50
>
 --------------------------------------------
 Program: init.R
  Folder: N:\Bendix\Steno\NisA\R
   Ended: fredag 09. januar 2004, 12:59:05
 Elapsed: 00:00:41
 --------------------------------------------
```

.

7.3 part-reg.r

This program analyses the data for participation, fits a sequence of models documenting the conclusion that participation rates only depend on place of residence and sex. Also produces plots and tables.

```
 R 1.8.1
 --------------------------------------------
 Program:  part-reg.R
  Folder:  N:\Bendix\Steno\NisA\R
 Started:  fredag 09. januar 2004, 14:17:32
 --------------------------------------------
> # Read the data
> #
> load( file="../data/art1.Rdata" )
> attach( art1 )
>
> # Define the participation variable
> #
> delt <- factor( 2 - ( us.cli.s == "000" ) + ( us.cli.s == "111" ),
+                 labels=c("Ikke","Delvis","Helt") )
> table( us.cli.s, delt )
        delt
us.cli.s Ikke Delvis Helt
     000 227    0      0
     010   0    6      0
     100   0    7      0
     101   0   26      0
     110   0    3      0
     111   0    0    660
>
> # Empirical participation percentages
> #
> ftable( round(
+ sweep( table( cut( alder, breaks=seq(60,90,5), right=F ), delt, bygd, sexe ), c(1,3,4),
+        table( cut( alder, breaks=seq(60,90,5), right=F ), bygd, sexe ), "/" ) * 100,
+            1 ), row.vars=c(1) )
        delt  Ikke                    Delvis                   Helt
        bygd     N           S           N           S           N           S
        sexe     K     M     K     M     K     M     K     M     K     M     K     M

[60,65)       14.9  35.6  28.1  36.9   1.1   2.3   4.7   0.0  83.9  62.1  67.2  63.1
[65,70)       26.1  30.0  14.3  19.6   2.2   6.2   1.6   5.9  71.7  63.7  84.1  74.5
[70,75)       29.5  25.6   2.1  20.5   3.3   7.0   2.1   5.1  67.2  67.4  95.7  74.4
[75,80)       26.7  31.6  28.0   6.7  20.0  10.5   4.0  13.3  53.3  57.9  68.0  80.0
[80,85)       14.3  57.1  18.2  16.7   0.0   0.0  18.2   0.0  85.7  42.9  63.6  83.3
[85,90)       20.0   0.0  20.0   0.0   0.0   0.0  40.0   0.0  80.0 100.0  40.0 100.0
>
> library( MASS )
> # Reproduction of old model from first report
> #
> summary( org <- polr( delt ~ I(alder<75) + I(sexe=="K") + I(bygd=="N"), Hess=T ) )
Call:
polr(formula = delt ~ I(alder < 75) + I(sexe == "K") + I(bygd ==
    "N"), Hess = T)

Coefficients:
                        Value Std. Error   t value
I(alder < 75)TRUE   0.3132694  0.1869322  1.675845
I(sexe == "K")TRUE  0.4479546  0.1455131  3.078448
I(bygd == "N")TRUE -0.3179524  0.1481039 -2.146819
```

```
Intercepts:
            Value   Std. Error t value
Ikke|Delvis -0.8257  0.2087    -3.9570
Delvis|Helt -0.5906  0.2076    -2.8453

Residual Deviance: 1335.380
AIC: 1345.380
> exp( ci.lin( org )[,c(1,5,6)] )
                    Estimate      2.5%     97.5%
I(alder < 75)TRUE  1.3678900 0.9482748 1.9731864
I(sexe == "K")TRUE 1.5651077 1.1767473 2.0816382
I(bygd == "N")TRUE 0.7276375 0.5443131 0.9727054
Ikke|Delvis        0.4379211 0.2909199 0.6592017
Delvis|Helt        0.5540064 0.3688407 0.8321292
>
> # Main effects model with linear effect of age
> #
> mmod <- polr( delt ~ I(sexe=="K") + I(bygd=="N") + I(alder-70), Hess=T )
> summary( mmod )
Call:
polr(formula = delt ~ I(sexe == "K") + I(bygd == "N") + I(alder -
    70), Hess = T)

Coefficients:
                          Value Std. Error    t value
I(sexe == "K")TRUE  0.435455588 0.14544877  2.9938760
I(bygd == "N")TRUE -0.315980294 0.14803928 -2.1344355
I(alder - 70)      -0.007738656 0.01120504 -0.6906408

Intercepts:
            Value   Std. Error t value
Ikke|Delvis -1.0805  0.1384    -7.8088
Delvis|Helt -0.8459  0.1363    -6.2080

Residual Deviance: 1337.651
AIC: 1347.651
> exp( ci.lin( mmod )[,c(1,5,6)] )
                    Estimate      2.5%     97.5%
I(sexe == "K")TRUE 1.5456671 1.1622773 2.0555222
I(bygd == "N")TRUE 0.7290738 0.5454566 0.9745021
I(alder - 70)      0.9922912 0.9707366 1.0143244
Ikke|Delvis        0.3394220 0.2587961 0.4451661
Delvis|Helt        0.4291847 0.3285972 0.5605632
>
> # Interaction model
> #
> imod <- polr( delt ~ I(sexe=="K") * I(bygd=="N") * I(alder-70), Hess=T )
> summary( imod )
Call:
polr(formula = delt ~ I(sexe == "K") * I(bygd == "N") * I(alder -
    70), Hess = T)

Coefficients:
                                                         Value Std. Error    t value
I(sexe == "K")TRUE                                 0.330014875 0.23489785  1.4049293
I(bygd == "N")TRUE                                -0.409133693 0.22119205 -1.8496763
I(alder - 70)                                      0.033881925 0.02631017  1.2877880
I(sexe == "K")TRUE:I(bygd == "N")TRUE              0.135982793 0.30441062  0.4467084
I(sexe == "K")TRUE:I(alder - 70)                  -0.037288783 0.03600702 -1.0355977
I(bygd == "N")TRUE:I(alder - 70)                  -0.039431165 0.03566655 -1.1055502
I(sexe == "K")TRUE:I(bygd == "N")TRUE:I(alder - 70)  0.007591293 0.04710873  0.1611441

Intercepts:
            Value   Std. Error t value
Ikke|Delvis -1.1620  0.1712    -6.7880
Delvis|Helt -0.9261  0.1693    -5.4695

Residual Deviance: 1332.653
AIC: 1350.653
>
> # Test of interactions
> #
> mmod$deviance - imod$deviance
[1] 4.997662
> 1 - pchisq( mmod$deviance - imod$deviance, mmod$df - imod$df )
[1] 0.2875375
>
> # Useful sequences for plotting predictions
> #
> one <- rep( 1, 26 )
> acn <- seq( 60, 85, 1 ) - 70
> bcl <- gray( c(1,5)/10 )
>
> # Plot of the probabilities of non / patial / full response in the
```

```
> # model with age-interaction.
> #
> plt( "part-prob" )
> par( mar=c(3,3,1,1), mgp=c(3,1,0)/1.6 )
> c.K.N <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(1,1,0,1,0,0,0,-1,0), "*" ) +
+                         outer( acn, -c(0,0,1,0,1,1,1,-0,0), "*" ) )[,-(2:4)] )
> c.K.S <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(1,0,0,0,0,0,0,-1,0), "*" ) +
+                         outer( acn, -c(0,0,1,0,1,0,0,-0,0), "*" ) )[,-(2:4)] )
> c.M.N <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(0,1,0,0,0,0,0,-1,0), "*" ) +
+                         outer( acn, -c(0,0,1,0,0,1,0,-0,0), "*" ) )[,-(2:4)] )
> c.M.S <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(0,0,0,0,0,0,0,-1,0), "*" ) +
+                         outer( acn, -c(0,0,1,0,0,0,0,-0,0), "*" ) )[,-(2:4)] )
> matplot( acn + 70, cbind( c.K.N, c.K.S, c.M.N, c.M.S ),
+          xlab="Age", ylim=c(0,1),
+          ylab="Probability of non / partial / full participation",
+          type="l", lty=repp( 2:1, 6 ), lwd=rep(c(4,1,1),4),
+          col=repp( c(bcl,bcl), 3 ) )
> c.K.N <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(1,1,0,1,0,0,0,0,-1), "*" ) +
+                         outer( acn, -c(0,0,1,0,1,1,1,0,-0), "*" ) )[,-(2:4)] )
> c.K.S <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(1,0,0,0,0,0,0,0,-1), "*" ) +
+                         outer( acn, -c(0,0,1,0,1,0,0,0,-0), "*" ) )[,-(2:4)] )
> c.M.N <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(0,1,0,0,0,0,0,0,-1), "*" ) +
+                         outer( acn, -c(0,0,1,0,0,1,0,0,-0), "*" ) )[,-(2:4)] )
> c.M.S <- tigol( ci.lin( imod,
+                 ctr.mat=outer( one, -c(0,0,0,0,0,0,0,0,-1), "*" ) +
+                         outer( acn, -c(0,0,1,0,0,0,0,0,-0), "*" ) )[,-(2:4)] )
> matlines( acn + 70, cbind( c.K.N, c.K.S, c.M.N, c.M.S ),
+           type="l", lty=repp( 2:1, 6 ), lwd=rep(c(4,1,1),4),
+           col=repp( c(bcl,bcl), 3 ) )
> lines( cnr( c( 0.03, 0.13), 1-c(0.10,0.10) ), lwd=4, lty=2 )
> lines( cnr( c( 0.03, 0.13), 1-c(0.13,0.13) ), lwd=4, lty=1 )
> text( cnr( 0.15, 1-0.10 ), "Women", adj=c(0,0.5), font=2 )
> text( cnr( 0.15, 1-0.13 ), "Men", adj=c(0,0.5), font=2 )
> text( cnr( 0.14, 1-0.04 ), "Nuuk", col=bcl[1], adj=c(0.5,0.5), font=2 )
> text( cnr( 0.14, 1-0.07 ), "Sisimiut", col=bcl[2], adj=c(0.5,0.5), font=2 )
>
> # Main effects model without linear effect of age
> #
> fmod <- polr( delt ~ I(sexe=="K") + I(bygd=="N"), Hess=T )
> summary( fmod )
Call:
polr(formula = delt ~ I(sexe == "K") + I(bygd == "N"), Hess = T)

Coefficients:
                        Value Std. Error   t value
I(sexe == "K")TRUE  0.4246723  0.1445190  2.938523
I(bygd == "N")TRUE -0.3112606  0.1478217 -2.105649

Intercepts:
            Value   Std. Error t value
Ikke|Delvis -1.0908  0.1376    -7.9249
Delvis|Helt -0.8563  0.1355    -6.3190

Residual Deviance: 1338.125
AIC: 1346.125
>
> # Test of interactions
> #
> fmod$deviance - imod$deviance
[1] 5.471552
> 1 - pchisq( fmod$deviance - imod$deviance, fmod$df - imod$df )
[1] 0.3610754
>
> # Work out estimated odds-ratios of participation
> #
> exp( ci.lin( fmod, subset=1:2 )[,-(2:4)] )
                    Estimate      2.5%     97.5%
I(sexe == "K")TRUE 1.5290893 1.1519087 2.0297738
I(bygd == "N")TRUE 0.7325229 0.5482709 0.9786948
>
> # Work out estimated probabilities
> #
> cmat <- rbind( c(-0,-1,1,0),
+               c(-1,-1,1,0),
+               c(-0,-0,1,0),
+               c(-1,-0,1,0),
+               c(-0,-1,0,1),
+               c(-1,-1,0,1),
```

```
+                c(-0,-0,0,1),
+                c(-1,-0,0,1) )
> rownames( cmat ) <- paste( rep( c( "Men", "Women" ), 4 ),
+                           repp( rep( c( "Nuuk", "Sisimiut" ), 2 ), 2 ),
+                           repp( c("None", "None+Partial"), 4 ), sep=", " )
> colnames( cmat ) <- rownames( ci.lin( fmod ) )
> cmat
                              I(sexe == "K")TRUE I(bygd == "N")TRUE Ikke|Delvis Delvis|Helt
Men, Nuuk, None                                0                 -1           1           0
Women, Nuuk, None                             -1                 -1           1           0
Men, Sisimiut, None                            0                  0           1           0
Women, Sisimiut, None                         -1                  0           1           0
Men, Nuuk, None+Partial                        0                 -1           0           1
Women, Nuuk, None+Partial                     -1                 -1           0           1
Men, Sisimiut, None+Partial                    0                  0           0           1
Women, Sisimiut, None+Partial                 -1                  0           0           1
> ssh <- tigol( ci.lin( fmod, ctr.mat=cmat )[,c(1,5,6)] )
> ssh
                               Estimate      2.5%     97.5%
Men, Nuuk, None               0.3144215 0.2656455 0.3676695
Women, Nuuk, None             0.2307288 0.1917657 0.2749156
Men, Sisimiut, None           0.2514697 0.2041493 0.3055475
Women, Sisimiut, None         0.1801308 0.1432183 0.2240690
Men, Nuuk, None+Partial       0.3670239 0.3145745 0.4228236
Women, Nuuk, None+Partial     0.2749446 0.2317013 0.3228671
Men, Sisimiut, None+Partial   0.2981200 0.2456678 0.3564788
Women, Sisimiut, None+Partial 0.2173905 0.1752849 0.2663439
> dnam <- list( Sex=c( "Men", "Women" ),
+               Residence=c( "Nuuk", "Sisimiut" ),
+               Category=c("None", "None+Partial"),
+               colnames( ssh ) )
> est <- array( ssh, dim=sapply( dnam, length ), dimnames=dnam )
> ftable( round( 100 * est, 1 ), row.vars=3:1 )
                              Estimate 2.5% 97.5%
Category     Residence Sex
None         Nuuk      Men        31.4 26.6  36.8
                       Women      23.1 19.2  27.5
             Sisimiut  Men        25.1 20.4  30.6
                       Women      18.0 14.3  22.4
None+Partial Nuuk      Men        36.7 31.5  42.3
                       Women      27.5 23.2  32.3
             Sisimiut  Men        29.8 24.6  35.6
                       Women      21.7 17.5  26.6
>
> # Work out empirical probabilities of participation
> #
> ftable( margins( emp <- table( sexe, bygd, delt ) ) )
         delt Ikke Delvis Helt Sum
sexe bygd
K    N          69     11  216 296
     S          38     10  167 215
     Sum       107     21  383 511
M    N          76     12  150 238
     S          44      9  127 180
     Sum       120     21  277 418
Sum  N         145     23  366 534
     S          82     19  294 395
     Sum       227     42  660 929
> ftable( round( emp <- 100 * sweep( emp, 1:2, apply( emp, 1:2, sum ), "/" ), 1 ) )
         delt Ikke Delvis Helt
sexe bygd
K    N        23.3    3.7 73.0
     S        17.7    4.7 77.7
M    N        31.9    5.0 63.0
     S        24.4    5.0 70.6
>
> dnam <- list( Sex=c( "Men", "Women" ),
+               Residence=c( "Nuuk", "Sisimiut" ),
+               Category=c("None", "None+Partial"),
+               c(colnames( ssh ), "Empirical") )
> xssh <- array( NA, dim=sapply( dnam, length ), dimnames=dnam )
> xssh[,,,1:3] <- est * 100
> xssh[1:2,1:2,1,4] <- emp[2:1,1:2,1]
> xssh[1:2,1:2,2,4] <- emp[2:1,1:2,1] + emp[2:1,1:2,2]
> round( ftable( xssh, row.vars=3:1 ), 1 )
                              Estimate 2.5% 97.5% Empirical
Category     Residence Sex
None         Nuuk      Men        31.4 26.6  36.8      31.9
                       Women      23.1 19.2  27.5      23.3
             Sisimiut  Men        25.1 20.4  30.6      24.4
                       Women      18.0 14.3  22.4      17.7
None+Partial Nuuk      Men        36.7 31.5  42.3      37.0
                       Women      27.5 23.2  32.3      27.0
             Sisimiut  Men        29.8 24.6  35.6      29.4
                       Women      21.7 17.5  26.6      22.3
```

```
>
 ---------------------------------------------
 Program: part-reg.R
  Folder: N:\Bendix\Steno\NisA\R
   Ended: fredag 09. januar 2004, 14:17:38
 Elapsed: 00:00:06
 ---------------------------------------------
```

7.4 diag-reg.r

This program analyses the data on diagnosis severity, fits a sequence of models documenting the conclusion that participation rates only depend on place of residence and age. Also produces plots and tables.

```
 R 1.8.1
 ---------------------------------------------
 Program:  diag-reg.R
  Folder:  N:\Bendix\Steno\NisA\R
 Started:  fredag 09. januar 2004, 15:37:45
 ---------------------------------------------
> # Read the data
> #
> load( file="../data/art1.Rdata" )
> attach( art1 )
>
> # Get a useful function
> #
> source( "c:/stat/r/bxc/library/epi/r/x.relevel.R" )
> relevel
function (f, lv, first = F)
{
    relev <- function(x, ref, ...) {
        lev <- levels(x)
        if (is.character(ref))
            ref <- match(ref, lev)
        if (is.na(ref))
            stop("if a single value, lv must be an existing level")
        nlev <- length(lev)
        if (ref < 1 || ref > nlev)
            stop(paste("lv=", ref, " must be in 1:", nlev, sep = ""))
        factor(x, levels = lev[c(ref, seq(along = lev)[-ref])])
    }
    if (!is.list(lv) && length(lv) == 1)
        fnew <- relev(f, lv)
    if (!is.list(lv) && length(lv) > 1)
        lv <- list(lv)
    if (is.list(lv)) {
        fnew <- f
        newnames <- levels(f)
        uninames <- character(length(lv))
        for (s in 1:length(lv)) {
            uninames[s] <- newnames[lv[[s]]] <- rep(if (is.null(names(lv)))
                paste(levels(f)[lv[[s]]], collapse = "+")
            else names(lv)[s], length(lv[[s]]))
        }
        levels(fnew) <- newnames
        if (!is.null(first)) {
            if (!first)
                fnew <- factor(fnew, c(levels(f)[-unlist(lv)],
                  uninames))
            if (first)
                fnew <- factor(fnew, c(uninames, levels(f)[-unlist(lv)]))
        }
    }
    factor(fnew)
}
>
> # Define the diagnostic classes
> #
> table( amd.clas, relevel( amd.clas, list( 5:6, 2, 3:4 ) ) )

amd.clas     HD+Normal ARM CNV+GA
         243   0         0   0
  ARM      0   0       330   0
  CNV      0   0         0  46
  GA       0   0         0  15
  HD       0 286         0   0
  Normal   0   9         0   0
Warning messages:
```

```
1: number of items to replace is not a multiple of replacement length
2: number of items to replace is not a multiple of replacement length
> diag <- relevel( amd.clas, list( 5:6, 2, 3:4 ) )
Warning messages:
1: number of items to replace is not a multiple of replacement length
2: number of items to replace is not a multiple of replacement length
> diag[diag==""] <- NA
> table( diag )
diag
          HD+Normal        ARM    CNV+GA
        0       295        330        61
> table( factor( diag ) )

HD+Normal        ARM    CNV+GA
      295        330        61
> diag <- factor( diag )
>
> # Empirical diagnosis percentages
> #
> ftable( round(
+ sweep( table( cut( alder, breaks=seq(60,90,5), right=F ), diag, bygd, sexe ), c(1,3,4),
+         table( cut( alder, breaks=seq(60,90,5), right=F ), bygd, sexe ), "/" ) * 100,
+             1 ), row.vars=c(1) )
        diag HD+Normal                    ARM                     CNV+GA
        bygd         N           S           N           S           N           S
        sexe         K     M     K     M     K     M     K     M     K     M     K     M

[60,65)           50.6  42.5  25.0  24.6  27.6  19.5  43.8  36.9   6.9   1.1   0.0   1.5
[65,70)           43.5  41.2  23.8  23.5  29.3  25.0  57.1  49.0   0.0   2.5   4.8   5.9
[70,75)           29.5  39.5  31.9  15.4  32.8  30.2  59.6  43.6   8.2   4.7   4.3  15.4
[75,80)           20.0  26.3   8.0  20.0  30.0  26.3  56.0  40.0  23.3  10.5   8.0  20.0
[80,85)           35.7  14.3   9.1   0.0  35.7  28.6  45.5  50.0  14.3   0.0  18.2  33.3
[85,90)           30.0   0.0   0.0   0.0  20.0   0.0   0.0   0.0  30.0 100.0  60.0 100.0
>
> ftable( margins( table( diag, bygd, sexe ) ) )
               sexe   K   M Sum
diag      bygd
HD+Normal N         116  93 209
          S          49  37  86
          Sum       165 130 295
ARM       N          87  57 144
          S         111  75 186
          Sum       198 132 330
CNV+GA    N          23   9  32
          S          12  17  29
          Sum        35  26  61
Sum       N         226 159 385
          S         172 129 301
          Sum       398 288 686
>
> ftable( round(
+ sweep( margins( table( diag, bygd, sexe ), mar=1:3), 2:3,
+        margins( apply( table( diag, bygd, sexe ), 2:3, sum ) ), "/" ) * 100,
+            1 ), row.vars=c(1) )
          bygd     N                 S                 Sum
          sexe     K     M   Sum     K     M   Sum     K     M   Sum
diag
HD+Normal       51.3  58.5  54.3  28.5  28.7  28.6  41.5  45.1  43.0
ARM             38.5  35.8  37.4  64.5  58.1  61.8  49.7  45.8  48.1
CNV+GA          10.2   5.7   8.3   7.0  13.2   9.6   8.8   9.0   8.9
Sum            100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0
>
> library( MASS )
>
> # Main effects model with linear effect of age
> #
> mmod <- polr( diag ~ I(sexe=="K") + I(bygd=="N") + I(alder-70), Hess=T )
> summary( mmod )
Call:
polr(formula = diag ~ I(sexe == "K") + I(bygd == "N") + I(alder -
    70), Hess = T)

Coefficients:
                         Value Std. Error    t value
I(sexe == "K")TRUE  0.02251673 0.15446082  0.1457763
I(bygd == "N")TRUE -0.90294627 0.15471978 -5.8360107
I(alder - 70)       0.09193248 0.01302225  7.0596467

Intercepts:
              Value   Std. Error t value
HD+Normal|ARM -0.9346  0.1524    -6.1349
ARM|CNV+GA     1.9452  0.1765    11.0208

Residual Deviance: 1186.989
AIC: 1196.989
```

```
> exp( ci.lin( mmod )[,c(1,5,6)] )
                   Estimate      2.5%     97.5%
I(sexe == "K")TRUE 1.0227721 0.7556168 1.3843828
I(bygd == "N")TRUE 0.4053736 0.2993351 0.5489757
I(alder - 70)      1.0962908 1.0686641 1.1246317
HD+Normal|ARM      0.3927249 0.2913451 0.5293821
ARM|CNV+GA         6.9953645 4.9495740 9.8867346
> exp( -ci.lin( mmod )[1:3,c(1,6,5)] )
                   Estimate     97.5%      2.5%
I(sexe == "K")TRUE 0.9777349 0.7223436 1.3234222
I(bygd == "N")TRUE 2.4668604 1.8215742 3.3407370
I(alder - 70)      0.9121667 0.8891800 0.9357477
>
> # Interaction model
> #
> imod <- polr( diag ~ I(sexe=="K") * I(bygd=="N") * I(alder-70), Hess=T )
> summary( imod )
Call:
polr(formula = diag ~ I(sexe == "K") * I(bygd == "N") * I(alder -
    70), Hess = T)

Coefficients:
                                                          Value Std. Error     t value
I(sexe == "K")TRUE                                 -0.264945967 0.23056932 -1.14909464
I(bygd == "N")TRUE                                 -1.173897713 0.25193491 -4.65952772
I(alder - 70)                                       0.111182302 0.02876534  3.86514799
I(sexe == "K")TRUE:I(bygd == "N")TRUE               0.463850604 0.32016006  1.44880846
I(sexe == "K")TRUE:I(alder - 70)                   -0.030698093 0.03735528 -0.82178717
I(bygd == "N")TRUE:I(alder - 70)                   -0.003180827 0.04158575 -0.07648837
I(sexe == "K")TRUE:I(bygd == "N")TRUE:I(alder - 70)  0.004439898 0.05247537  0.08460917

Intercepts:
              Value   Std. Error t value
HD+Normal|ARM -1.1115  0.1863    -5.9654
ARM|CNV+GA     1.7785  0.2005     8.8724

Residual Deviance: 1183.480
AIC: 1201.480
>
> # Test of interactions
> #
> mmod$deviance - imod$deviance
[1] 3.509278
> 1 - pchisq( mmod$deviance - imod$deviance, mmod$df - imod$df )
[1] 0.476469
>
> # Final effects model with linear effect of age
> #
> fmod <- polr( diag ~ I(bygd=="N") + I(alder-70), Hess=T )
> summary( fmod )
Call:
polr(formula = diag ~ I(bygd == "N") + I(alder - 70), Hess = T)

Coefficients:
                         Value Std. Error   t value
I(bygd == "N")TRUE -0.90294273 0.15471798 -5.836055
I(alder - 70)       0.09209042 0.01297581  7.097085

Intercepts:
              Value   Std. Error t value
HD+Normal|ARM -0.9479  0.1223    -7.7521
ARM|CNV+GA     1.9321  0.1515    12.7535

Residual Deviance: 1187.010
AIC: 1195.010
> exp( ci.lin( fmod )[,c(1,5,6)] )
                   Estimate      2.5%     97.5%
I(bygd == "N")TRUE 0.4053750 0.2993373 0.5489757
I(alder - 70)      1.0964640 1.0689302 1.1247070
HD+Normal|ARM      0.3875376 0.3049491 0.4924932
ARM|CNV+GA         6.9039585 5.1303233 9.2907679
> exp( -ci.lin( fmod )[1:2,c(1,6,5)] )
                   Estimate     97.5%      2.5%
I(bygd == "N")TRUE 2.4668517 1.8215742 3.3407135
I(alder - 70)      0.9120227 0.8891205 0.9355148
>
> # Useful sequences and colors for plotting predictions
> #
> one <- rep( 1, 26 )
> acn <- seq( 60, 85, 1 ) - 70
> bcl <- gray( c(1,5)/10 )
>
> # Plot of the probabilities of Normal+HD / HD response from interaction model
> #
> plt( "diag-prob-i" )
```

```
> par( mar=c(3,3,1,1), mgp=c(3,1,0)/1.6 )
> c.M.S <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(0,0,0,0,0,0,0,-1,0), "*" ) +
+                        outer( acn, -c(0,0,1,0,0,0,0,-0,0), "*" ) )[,-(2:4)] )
> c.M.N <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(0,1,0,0,0,0,0,-1,0), "*" ) +
+                        outer( acn, -c(0,0,1,0,0,1,0,-0,0), "*" ) )[,-(2:4)] )
> c.K.N <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(1,1,0,1,0,0,0,-1,0), "*" ) +
+                        outer( acn, -c(0,0,1,0,1,1,1,-0,0), "*" ) )[,-(2:4)] )
> c.K.S <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(1,0,0,0,0,0,0,-1,0), "*" ) +
+                        outer( acn, -c(0,0,1,0,1,0,0,-0,0), "*" ) )[,-(2:4)] )
> matplot( acn + 70, cbind( c.K.N, c.K.S, c.M.S, c.M.N ),
+          ylab="Probability of Normal+HD / ARM / CNV+HA", ylim=c(0,1),
+          xlab="Age", type="l",
+          lty=c(2,0,0,2,0,0,1,0,0,1,0,0,), # lty=repp(2:1,6),
+          lwd=rep(c(4,1,1),4), col=repp( c(bcl,bcl), 3 ) )
> c.M.S <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(0,0,0,0,0,0,0,0,-1), "*" ) +
+                        outer( acn, -c(0,0,1,0,0,0,0,0,-0), "*" ) )[,-(2:4)] )
> c.M.N <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(0,1,0,0,0,0,0,0,-1), "*" ) +
+                        outer( acn, -c(0,0,1,0,0,1,0,0,-0), "*" ) )[,-(2:4)] )
> c.K.N <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(1,1,0,1,0,0,0,0,-1), "*" ) +
+                        outer( acn, -c(0,0,1,0,1,1,1,0,-0), "*" ) )[,-(2:4)] )
> c.K.S <- tigol( ci.lin( imod,
+                ctr.mat=outer( one, -c(1,0,0,0,0,0,0,0,-1), "*" ) +
+                        outer( acn, -c(0,0,1,0,1,0,0,0,-0), "*" ) )[,-(2:4)] )
> matlines( acn + 70, cbind( c.K.N, c.K.S, c.M.S, c.M.N ),
+           lty=c(2,0,0,2,0,0,1,0,0,1,0,0,), #repp(2:1,6),
+           lwd=rep(c(4,1,1),4), col=repp( c(bcl,bcl), 3 ) )
> lines( cnr( c(0.03,0.13), c(0.10,0.10) ), lwd=4, lty=2 )
> lines( cnr( c(0.03,0.13), c(0.13,0.13) ), lwd=4, lty=1 )
> text( cnr(0.15,0.10), "Women", adj=c(0,0.5), font=2 )
> text( cnr(0.15,0.13), "Men", adj=c(0,0.5), font=2 )
> text( cnr( 0.14, 0.04 ), "Nuuk", col=bcl[1], adj=c(0.5,0.5), font=2 )
> text( cnr( 0.14, 0.07 ), "Sisimiut", col=bcl[2], adj=c(0.5,0.5), font=2 )
>
> # Plot of the probabilities of Normal+HD / HD response from final model
> #
> plt( "diag-prob-f" )
> par( mar=c(3,3,1,1), mgp=c(3,1,0)/1.6 )
> c.N <- tigol( ci.lin( fmod,
+              ctr.mat=outer( one, -c(1,0,0,-1), "*" ) +
+                      outer( acn, -c(0,1,0,-0), "*" ) )[,-(2:4)] )
> c.S <- tigol( ci.lin( fmod,
+              ctr.mat=outer( one, -c(0,0,0,-1), "*" ) +
+                      outer( acn, -c(0,1,0,-0), "*" ) )[,-(2:4)] )
> matplot( acn + 70, cbind( c.N, c.S ),
+          xlab="Age", ylim=c(0,1),
+          ylab="Probability of Normal+HD / ARM / CNV+HA",
+          type="l", lty=1, lwd=rep(c(4,1,1),4),
+          col=repp( bcl, 3 ) )
> c.N <- tigol( ci.lin( fmod,
+              ctr.mat=outer( one, -c(1,0,-1,0), "*" ) +
+                      outer( acn, -c(0,1,-0,0), "*" ) )[,-(2:4)] )
> c.S <- tigol( ci.lin( fmod,
+              ctr.mat=outer( one, -c(0,0,-1,0), "*" ) +
+                      outer( acn, -c(0,1,-0,0), "*" ) )[,-(2:4)] )
> matlines( acn + 70, cbind( c.N, c.S ), lwd=rep(c(4,1,1),4),
+           col=repp( bcl, 3 ), lty=1 )
> text( cnr( 0.03, 0.09 ), "Nuuk", col=bcl[1], adj=c(0,1), font=2 )
> text( cnr( 0.03, 0.05 ), "Sisimiut", col=bcl[2], adj=c(0,1), font=2 )
>
> exp( ci.lin( fmod )[,-(2:4)] )
                   Estimate      2.5%     97.5%
I(bygd == "N")TRUE 0.4053750 0.2993373 0.5489757
I(alder - 70)      1.0964640 1.0689302 1.1247070
HD+Normal|ARM      0.3875376 0.3049491 0.4924932
ARM|CNV+GA         6.9039585 5.1303233 9.2907679
>
>
>
>
>
 --------------------------------------------
 Program: diag-reg.R
  Folder: N:\Bendix\Steno\NisA\R
   Ended: fredag 09. januar 2004, 15:40:37
 Elapsed: 00:02:52
 --------------------------------------------
```

7.5 photo.r

Supplements the statistical analyses of the image quality with tabulations of the outcomes.

```
 R 1.8.1
 --------------------------------------------
 Program:  photo.R
  Folder:  N:\Bendix\Steno\NisA\R
 Started:  søndag 11. januar 2004, 13:24:16
 --------------------------------------------
> # Useful function for making percentages
> #
> source( "xpc.R" )
>
> pctab <-
+ function( tab, mar )
+ {
+ # What are the diemsions complementary to the one
+ # to be summed over
+ #
+ cpm <- ( 1:length( dim( tab ) ) )[-mar]
+
+ # Then sweep out the sum
+ #
+ sweep( margins( tab, mar ), cpm, apply( tab, cpm, sum ), "/" ) * 100
+ }
>
> load( file="../data/art1.Rdata" )
> source( "c:/stat/r/bxc/library/epi/r/x.relevel.R" )
> relevel
function (f, lv, first = F)
{
    relev <- function(x, ref, ...) {
        lev <- levels(x)
        if (is.character(ref))
            ref <- match(ref, lev)
        if (is.na(ref))
            stop("if a single value, lv must be an existing level")
        nlev <- length(lev)
        if (ref < 1 || ref > nlev)
            stop(paste("lv=", ref, " must be in 1:", nlev, sep = ""))
        factor(x, levels = lev[c(ref, seq(along = lev)[-ref])])
    }
    if (!is.list(lv) && length(lv) == 1)
        fnew <- relev(f, lv)
    if (!is.list(lv) && length(lv) > 1)
        lv <- list(lv)
    if (is.list(lv)) {
        fnew <- f
        newnames <- levels(f)
        uninames <- character(length(lv))
        for (s in 1:length(lv)) {
            uninames[s] <- newnames[lv[[s]]] <- rep(if (is.null(names(lv)))
                paste(levels(f)[lv[[s]]], collapse = "+")
            else names(lv)[s], length(lv[[s]]))
        }
        levels(fnew) <- newnames
        if (!is.null(first)) {
            if (!first)
                fnew <- factor(fnew, c(levels(f)[-unlist(lv)],
                  uninames))
            if (first)
                fnew <- factor(fnew, c(uninames, levels(f)[-unlist(lv)]))
        }
    }
    factor(fnew)
}
>
> # Define the diagnostic classes
> #
> diag <- relevel( art1$amd.clas, list( 5:6, 2, 3:4 ) )
Warning messages:
1: number of items to replace is not a multiple of replacement length
2: number of items to replace is not a multiple of replacement length
> table( art1$amd.clas, diag )
        diag
             HD+Normal ARM CNV+GA
         243   0         0   0
  ARM      0   0       330   0
  CNV      0   0         0  46
  GA       0   0         0  15
  HD       0 286         0   0
  Normal   0   9         0   0
> diag[diag==""] <- NA
```

```
> art1$diag <- factor( diag )
> table( art1$diag )

HD+Normal       ARM    CNV+GA
      295       330        61
>
> load( file="../data/eyes.Rdata" )
> names( eyes )[1] <- "lbnr"
> sam <- merge( art1[,c("lbnr","diag","agegroup","bygd","sexe")], eyes, all.y=T )
> dim( art1 )
[1] 929  19
> dim( eyes )
[1] 1394    9
> dim( sam )
[1] 1394   13
> summary( sam )
      lbnr             diag        agegroup     bygd       sexe        image.qu        eye
 1001   :   2   HD+Normal:590   60-64:428   N   :770   K   :796   Min.   :1.000   Left :697
 1004   :   2   ARM      :660   65-69:432   S   :602   M   :576   1st Qu.:3.000   Right:697
 1005   :   2   CNV+GA   :122   70-74:298   NA's: 22   NA's: 22   Median :3.000
 1007   :   2   NA's     : 22   75-79:128                          Mean   :3.666
 1008   :   2                   80-  : 86                          3rd Qu.:4.000
 1009   :   2                   NA's : 22                          Max.   :9.000
 (Other):1382
       id               cnv                ga                arm               hd             cnv.ga.a
 Min.   :   1.0   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000   0001   :696
 1st Qu.: 349.3   1st Qu.:0.00000   1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:1.0000   0011   :460
 Median : 697.5   Median :0.00000   Median :0.00000   Median :0.0000   Median :1.0000   0000   : 82
 Mean   : 697.5   Mean   :0.04089   Mean   :0.04161   Mean   :0.4319   Mean   :0.8716   0010   : 66
 3rd Qu.:1045.8   3rd Qu.:0.00000   3rd Qu.:0.00000   3rd Qu.:1.0000   3rd Qu.:1.0000   0111   : 27
 Max.   :1394.0   Max.   :1.00000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000   1010   : 13
                                                                                        (Other): 50
> attach( sam )
>
> image.qu <- relevel( factor( image.qu ), list(1,2,3,4,6,5,7,8) )
>
> ftable( margins( ttmp <- table( hd, arm, image.qu ), 3 ), row.vars=1:2 )
       image.qu   1   2   3   4   6   5   7   9 Sum
hd arm
0  0              0   3   4  13   5  31   5  27  88
   1              1   7  51  18  12   2   0   0  91
1  0              2 119 378  82 122   0   1   0 704
   1              0  43 312  72  82   1   1   0 511
> round( ftable( xpc( ttmp, 3 ), row.vars=1:2 ), 1 )
       image.qu (%)     1     2     3     4     6     5     7     9   All     N
hd arm
0  0                  0.0   3.4   4.5  14.8   5.7  35.2   5.7  30.7 100.0  88.0
   1                  1.1   7.7  56.0  19.8  13.2   2.2   0.0   0.0 100.0  91.0
1  0                  0.3  16.9  53.7  11.6  17.3   0.0   0.1   0.0 100.0 704.0
   1                  0.0   8.4  61.1  14.1  16.0   0.2   0.2   0.0 100.0 511.0
>
> ftable( margins( ttmp <- table( eye, hd, arm, image.qu ), 4 ), row.vars=1:3 )
             image.qu   1   2   3   4   6   5   7   9 Sum
eye   hd arm
Left  0  0              0   2   2   5   2  11   4  13  39
         1              0   3  25   6  10   1   0   0  45
      1  0              1  49 188  42  59   0   0   0 339
         1              0  22 164  47  40   1   0   0 274
Right 0  0              0   1   2   8   3  20   1  14  49
         1              1   4  26  12   2   1   0   0  46
      1  0              1  70 190  40  63   0   1   0 365
         1              0  21 148  25  42   0   1   0 237
> round( ftable( xpc( ttmp, 4 ), row.vars=1:3 ), 1 )
             image.qu (%)     1     2     3     4     6     5     7     9   All     N
eye   hd arm
Left  0  0                  0.0   5.1   5.1  12.8   5.1  28.2  10.3  33.3 100.0  39.0
         1                  0.0   6.7  55.6  13.3  22.2   2.2   0.0   0.0 100.0  45.0
      1  0                  0.3  14.5  55.5  12.4  17.4   0.0   0.0   0.0 100.0 339.0
         1                  0.0   8.0  59.9  17.2  14.6   0.4   0.0   0.0 100.0 274.0
Right 0  0                  0.0   2.0   4.1  16.3   6.1  40.8   2.0  28.6 100.0  49.0
         1                  2.2   8.7  56.5  26.1   4.3   2.2   0.0   0.0 100.0  46.0
      1  0                  0.3  19.2  52.1  11.0  17.3   0.0   0.3   0.0 100.0 365.0
         1                  0.0   8.9  62.4  10.5  17.7   0.0   0.4   0.0 100.0 237.0
>
> ftable( margins( ttmp <- table( bygd, hd, arm, image.qu ), 4 ), row.vars=1:3 )
            image.qu   1   2   3   4   6   5   7   9 Sum
bygd hd arm
N    0  0              0   0   1   9   5  14   3  18  50
        1              0   2  18   4   5   1   0   0  30
     1  0              0  75 235  58  97   0   1   0 466
        1              0  21 123  34  46   0   0   0 224
S    0  0              0   3   3   4   0  17   2   9  38
        1              1   5  33  14   7   1   0   0  61
     1  0              2  42 134  24  25   0   0   0 227
        1              0  20 180  38  36   1   1   0 276
```

```
> round( ftable( xpc( ttmp, 4 ), row.vars=1:3 ), 1 )
            image.qu (%)     1     2     3     4     6     5     7     9   All     N
bygd hd arm
N    0  0                  0.0   0.0   2.0  18.0  10.0  28.0   6.0  36.0 100.0  50.0
        1                  0.0   6.7  60.0  13.3  16.7   3.3   0.0   0.0 100.0  30.0
     1  0                  0.0  16.1  50.4  12.4  20.8   0.0   0.2   0.0 100.0 466.0
        1                  0.0   9.4  54.9  15.2  20.5   0.0   0.0   0.0 100.0 224.0
S    0  0                  0.0   7.9   7.9  10.5   0.0  44.7   5.3  23.7 100.0  38.0
        1                  1.6   8.2  54.1  23.0  11.5   1.6   0.0   0.0 100.0  61.0
     1  0                  0.9  18.5  59.0  10.6  11.0   0.0   0.0   0.0 100.0 227.0
        1                  0.0   7.2  65.2  13.8  13.0   0.4   0.4   0.0 100.0 276.0
>
> ftable( margins( ttmp <- table( sexe, hd, arm, image.qu ), 4 ), row.vars=1:3 )
            image.qu   1   2   3   4   6   5   7   9 Sum
sexe hd arm
K    0  0              0   2   2   5   5  21   2  18  55
        1              0   5  30  15   8   1   0   0  59
     1  0              2  57 209  47  70   0   0   0 385
        1              0  26 176  49  44   1   1   0 297
M    0  0              0   1   2   8   0  10   3   9  33
        1              1   2  21   3   4   1   0   0  32
     1  0              0  60 160  35  52   0   1   0 308
        1              0  15 127  23  38   0   0   0 203
> round( ftable( xpc( ttmp, 4 ), row.vars=1:3 ), 1 )
            image.qu (%)     1     2     3     4     6     5     7     9   All     N
sexe hd arm
K    0  0                  0.0   3.6   3.6   9.1   9.1  38.2   3.6  32.7 100.0  55.0
        1                  0.0   8.5  50.8  25.4  13.6   1.7   0.0   0.0 100.0  59.0
     1  0                  0.5  14.8  54.3  12.2  18.2   0.0   0.0   0.0 100.0 385.0
        1                  0.0   8.8  59.3  16.5  14.8   0.3   0.3   0.0 100.0 297.0
M    0  0                  0.0   3.0   6.1  24.2   0.0  30.3   9.1  27.3 100.0  33.0
        1                  3.1   6.2  65.6   9.4  12.5   3.1   0.0   0.0 100.0  32.0
     1  0                  0.0  19.5  51.9  11.4  16.9   0.0   0.3   0.0 100.0 308.0
        1                  0.0   7.4  62.6  11.3  18.7   0.0   0.0   0.0 100.0 203.0
>
> ftable( margins( ttmp <- table( agegroup, hd, arm, image.qu ), 4 ), row.vars=1:3 )
                image.qu   1   2   3   4   6   5   7   9 Sum
agegroup hd arm
60-64    0  0              0   0   2   0   1   4   2   6  15
            1              1   1  10   0   0   0   0   0  12
         1  0              2  53 145  29  38   0   0   0 267
            1              0  15  98  11  10   0   0   0 134
65-69    0  0              0   2   0   5   0  11   1   7  26
            1              0   2  15   4   2   0   0   0  23
         1  0              0  45 125  23  38   0   1   0 232
            1              0  13  87  25  26   0   0   0 151
70-74    0  0              0   1   2   4   0   7   1   7  22
            1              0   2  11   4   5   1   0   0  23
         1  0              0  14  67  18  38   0   0   0 137
            1              0   8  71  13  24   0   0   0 116
75-79    0  0              0   0   0   3   3   8   0   2  16
            1              0   0  11   6   2   1   0   0  20
         1  0              0   4  19   7   4   0   0   0  34
            1              0   4  28  14  11   1   0   0  58
80-      0  0              0   0   0   1   1   1   1   5   9
            1              0   2   4   4   3   0   0   0  13
         1  0              0   1  13   5   4   0   0   0  23
            1              0   1  19   9  11   0   1   0  41
> round( ftable( xpc( ttmp, 4 ), row.vars=1:3 ), 1 )
                image.qu (%)     1     2     3     4     6     5     7     9   All     N
agegroup hd arm
60-64    0  0                  0.0   0.0  13.3   0.0   6.7  26.7  13.3  40.0 100.0  15.0
            1                  8.3   8.3  83.3   0.0   0.0   0.0   0.0   0.0 100.0  12.0
         1  0                  0.7  19.9  54.3  10.9  14.2   0.0   0.0   0.0 100.0 267.0
            1                  0.0  11.2  73.1   8.2   7.5   0.0   0.0   0.0 100.0 134.0
65-69    0  0                  0.0   7.7   0.0  19.2   0.0  42.3   3.8  26.9 100.0  26.0
            1                  0.0   8.7  65.2  17.4   8.7   0.0   0.0   0.0 100.0  23.0
         1  0                  0.0  19.4  53.9   9.9  16.4   0.0   0.4   0.0 100.0 232.0
            1                  0.0   8.6  57.6  16.6  17.2   0.0   0.0   0.0 100.0 151.0
70-74    0  0                  0.0   4.5   9.1  18.2   0.0  31.8   4.5  31.8 100.0  22.0
            1                  0.0   8.7  47.8  17.4  21.7   4.3   0.0   0.0 100.0  23.0
         1  0                  0.0  10.2  48.9  13.1  27.7   0.0   0.0   0.0 100.0 137.0
            1                  0.0   6.9  61.2  11.2  20.7   0.0   0.0   0.0 100.0 116.0
75-79    0  0                  0.0   0.0   0.0  18.8  18.8  50.0   0.0  12.5 100.0  16.0
            1                  0.0   0.0  55.0  30.0  10.0   5.0   0.0   0.0 100.0  20.0
         1  0                  0.0  11.8  55.9  20.6  11.8   0.0   0.0   0.0 100.0  34.0
            1                  0.0   6.9  48.3  24.1  19.0   1.7   0.0   0.0 100.0  58.0
80-      0  0                  0.0   0.0   0.0  11.1  11.1  11.1  11.1  55.6 100.0   9.0
            1                  0.0  15.4  30.8  30.8  23.1   0.0   0.0   0.0 100.0  13.0
         1  0                  0.0   4.3  56.5  21.7  17.4   0.0   0.0   0.0 100.0  23.0
            1                  0.0   2.4  46.3  22.0  26.8   0.0   2.4   0.0 100.0  41.0
> round( ftable( xpc( ttmp, 4 ), row.vars=c(2:3,1) ), 1 )
                image.qu (%)     1     2     3     4     6     5     7     9   All     N
hd arm agegroup
0  0   60-64                   0.0   0.0  13.3   0.0   6.7  26.7  13.3  40.0 100.0  15.0
```

```
       65-69                   0.0  7.7  0.0 19.2  0.0 42.3  3.8 26.9 100.0  26.0
       70-74                   0.0  4.5  9.1 18.2  0.0 31.8  4.5 31.8 100.0  22.0
       75-79                   0.0  0.0  0.0 18.8 18.8 50.0  0.0 12.5 100.0  16.0
       80-                     0.0  0.0  0.0 11.1 11.1 11.1 11.1 55.6 100.0   9.0
   1   60-64                   8.3  8.3 83.3  0.0  0.0  0.0  0.0  0.0 100.0  12.0
       65-69                   0.0  8.7 65.2 17.4  8.7  0.0  0.0  0.0 100.0  23.0
       70-74                   0.0  8.7 47.8 17.4 21.7  4.3  0.0  0.0 100.0  23.0
       75-79                   0.0  0.0 55.0 30.0 10.0  5.0  0.0  0.0 100.0  20.0
       80-                     0.0 15.4 30.8 30.8 23.1  0.0  0.0  0.0 100.0  13.0
1  0   60-64                   0.7 19.9 54.3 10.9 14.2  0.0  0.0  0.0 100.0 267.0
       65-69                   0.0 19.4 53.9  9.9 16.4  0.0  0.4  0.0 100.0 232.0
       70-74                   0.0 10.2 48.9 13.1 27.7  0.0  0.0  0.0 100.0 137.0
       75-79                   0.0 11.8 55.9 20.6 11.8  0.0  0.0  0.0 100.0  34.0
       80-                     0.0  4.3 56.5 21.7 17.4  0.0  0.0  0.0 100.0  23.0
   1   60-64                   0.0 11.2 73.1  8.2  7.5  0.0  0.0  0.0 100.0 134.0
       65-69                   0.0  8.6 57.6 16.6 17.2  0.0  0.0  0.0 100.0 151.0
       70-74                   0.0  6.9 61.2 11.2 20.7  0.0  0.0  0.0 100.0 116.0
       75-79                   0.0  6.9 48.3 24.1 19.0  1.7  0.0  0.0 100.0  58.0
       80-                     0.0  2.4 46.3 22.0 26.8  0.0  2.4  0.0 100.0  41.0
>
> ftable( margins( ttmp <- table( agegroup, image.qu ), 2 ), row.vars=1 )
         image.qu   1   2   3   4   6   5   7   9 Sum
agegroup
60-64               3  69 255  40  49   4   2   6 428
65-69               0  62 227  57  66  11   2   7 432
70-74               0  25 151  39  67   8   1   7 298
75-79               0   8  58  30  20  10   0   2 128
80-                 0   4  36  19  19   1   2   5  86
> round( ftable( xpc( ttmp, 2 ), row.vars=1 ), 1 )
         image.qu (%)     1     2     3     4     6     5     7     9   All     N
agegroup
60-64                   0.7  16.1  59.6   9.3  11.4   0.9   0.5   1.4 100.0 428.0
65-69                   0.0  14.4  52.5  13.2  15.3   2.5   0.5   1.6 100.0 432.0
70-74                   0.0   8.4  50.7  13.1  22.5   2.7   0.3   2.3 100.0 298.0
75-79                   0.0   6.2  45.3  23.4  15.6   7.8   0.0   1.6 100.0 128.0
80-                     0.0   4.7  41.9  22.1  22.1   1.2   2.3   5.8 100.0  86.0
>
> # Plot of the marginal connection between hd / arm and image quality
> #
> plt( "hd-phot" )
> par( mar=c(3,3,1,1), mgp=c(3,1,0)/1.6 )
> tabplot( table( image.qu, hd ), rowlabs="left" )
> mtext( side=1, "HD", line=2 )
> mtext( side=2, "Image quality", line=2 )
>
> plt( "arm-phot" )
> par( mar=c(3,3,1,1), mgp=c(3,1,0)/1.6 )
> tabplot( table( image.qu, arm ), rowlabs="left" )
> mtext( side=1, "ARM", line=2 )
> mtext( side=2, "Image quality", line=2 )
>
> plt( "hd-arm-phot", height=10, width=20, pointsize=20 )
> par( mfrow=c(1,2), mar=c(2,2,1,1), oma=c(1.5,1.5,0,0), mgp=c(3,1,0)/1.6 )
> tabplot( table( image.qu, paste( hd, arm, sep="/" ) ), rowlabs="left",
+         equal=T )
> tabplot( table( image.qu, paste( hd, arm, sep="/" ) ), rowlabs="left",
+         equal=F )
> mtext( side=1, line=0, outer=T, "Diagnosis: HD / ARM" )
> mtext( side=2, line=0, outer=T, "Image quality" )
>
> plt( "phot-hd-arm", height=10, width=20, pointsize=20 )
> par( mfrow=c(1,2), mar=c(2,2,1,1), oma=c(1.5,1.5,0,0), mgp=c(3,1,0)/1.6 )
> tabplot( table( relevel( factor( paste( hd, arm, sep="/" ) ), list(4,3,2,1) ),
+                 image.qu ), rowlabs="left", equal=T )
> tabplot( table( relevel( factor( paste( hd, arm, sep="/" ) ), list(4,3,2,1) ),
+                 image.qu ), rowlabs="left", equal=F )
> mtext( side=1, line=0, outer=T, "Image quality" )
> mtext( side=2, line=0, outer=T, "Diagnosis: HD / ARM" )
>
>
>
>
>
 ---------------------------------------------
 Program: photo.R
  Folder: N:\Bendix\Steno\NisA\R
   Ended: søndag 11. januar 2004, 13:24:19
 Elapsed: 00:00:03
 ---------------------------------------------
```