USING SAS INTERACTIVELY TO EXAMINE AND DIAGNOSE PSYCHIATRIC PATIENTS

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This paper describes a SAS Program which interviews a psychiatric patient and, based on the responses, makes one or more psychiatric diagnoses. The SAS Program runs interactively, and uses PUT and INPUT statements to communicate with the patient. A series of macros performs the diagnoses after the data are collected.

Background

The use of the computer in performing psychiatric, as well as other medical diagnosis, has been of considerable interest. Rogers et al. (1979) give an up-to-date review of the relevant literature on computer-assisted medical (including psychiatric) diagnosis. There are several advantages in using computers to perform diagnosis, some of which were noted in Rogers et al. (1979), including objectivity, perfect reliability (in that given identical data the computer will always make the same diagnosis), the ability to access and virtually instantly use a data base far larger than could any clinician, the use of the program by less trained personnel for screening purposes, the ability to store large quantities of data without distortion over time, and the ability to perform complex logical/mathematical operations instantly, etc.

These computer programs are generally divided into three types: (a) those using Bayes' theorem to obtain conditional probabilities of a syndrome based upon a constellation of symptoms (scale scores), (b) those using linear discriminant analysis to classify patients based upon discriminant functions developed from data from previous patients, and (c) those which use boolean (binary logical) finite algebraic logic to branch down a decision tree until reaching a node (including the null node). In psychiatry, probably the two most interesting systems are CATIE, and DIAGNO, both mentioned in Spitzer et al. (1974). Both programs use input data from instruments describing mental state (i.e., psychiatric scales), and use a boolean decision theoretic approach to arrive at a diagnosis. None of the psychiatric diagnostic programs interact directly with a patient, but instead require a clinician to mediate and perform rating and assessment.

Dove et al. (1977) examined the use of computers to take medical histories directly from patients, although the computers do not make diagnoses, but rather print out a summary for the physician. Patients experienced little problem with the system. The physicians involved found the process useful in indicating problems which needed further exploration, and the patients involved developed positive attitudes towards the process. In fact, there is some evidence that for information with high emotional (alcohol-related) content, patients will disclose such information to a computer 30% more often than to another person (Anonymous, 1979).

The DIS

The test used in the development of the system is a state-of-the-art psychiatric instrument, the DIS, developed by Robins and her co-workers at Washington University, St. Louis. One of the advantages of the DIS is that it was developed using the nosologic system from the American Psychiatric Association's Diagnostic and Statistical Manual (DSM-III) and thus was designed to produce a DSM-III diagnosis.

The process of making DSM-III diagnoses involves using responses to one or more tests, and a set of rules, to arrive at one of the psychiatric diagnoses in the DSM-III. The computer does this using macros written by the developers at the DIS.

The SAS Program

The SAS Program, called SASDIS, is too long to list here. In fact, it is basically the longest DATA step either of us have ever seen, and takes about 60 pages to list. Figure 1 contains a small portion of the program. The program operates under TSO, and a CLIST which allocates files IN and OUT to the terminal is necessary. Figure 2 contains this CLIST.

Figures 1 and 2 here

Once IN and OUT are allocated, SAS interacts with the patient, asking him or her about 250 questions. Actually, the number of questions asked is many more than 250, because (a) many of the questions have multiple sub-questions, and (b) usually, a YES answer to a question elicits a series of questions probing the circumstances leading to the YES response. Figure 3 contains a flowchart of the probe subroutine. The SAS statements necessary to implement this routine cover about 3 pages.

Input is done using four "subroutines", accessed via a LINK-RETURN setup. The subroutines are CHRANS, NUMANS, YESNO, PROBE. Actually, all the subroutines ultimately call CHRANS, so that subroutine contains the only INPUT statement in the program.

Figure 3 here

CHRANS

This subroutine inputs a character string and places the response in the variable CRESP. It is invoked as follows: LINK CHRANS; then the variable at issue may be set equal to CRESP.

NUMANS

NUMANS inputs a string and checks that
it contains the character representation of a number, and if it does, sets a variable called NRESP equal to that number. If not, it informs the patient that only numeric responses are acceptable and inputs another response. This avoids the problem of SAS getting upset when the user types an illegal response. An example of the invoking sequence is:

\begin{verbatim}
PUT 'HOW MANY TIMES HAVE YOU HAD THIS PROBLEM?'
LINK NUMANS;
DISX ; NRESP;
\end{verbatim}

YESNO

The YESNO routine inputs a character response, but the only ones it allows are 'YES' or 'NO'. It links to CHRANS to obtain a string, checks it to make sure it is 'YES' or 'NO' and if so, returns. If not, it informs the patient that only 'YES' or 'NO' are legal, and tries again. It is invoked as follows:

\begin{verbatim}
PUT 'HAVE YOU EVER BEEN MARRIED?';
LINK YESNO;
MARRIED = CRESP;
\end{verbatim}

Two variables are set: CRESP and NRESP. CRESP will contain a 'YES' or 'NO'. The numeric variable, NRESP, is set to 1 if the answer is a 'NO', and a 5 if the answer is a 'YES'. Many of the questions require YES or NO responses, but use the numeric value.

PROBE

As mentioned earlier, PROBE is the most complex routine in the entire SAS program, and covers about 3 pages. Figure 4 contains a typical probing sequence, in response to a YES to a question regarding belly pain. How probe behaves depends upon which answers are legal. The PROBE routine checks a variable called TYPE, which is a character string of length 5, each character of which can be zero or 1. Probe questions have from one to five permissible responses (the numbers 1 to 5). A 1 means no, a 5 means yes, and 2, 3, or 4 mean sort of yes, but... or "yes and...". For some questions, only a 1 or a 5 are legal alternatives, in which case PROBE behaves like YESNO. In this case, TYPE would be set to '10001'. For questions in which 1, 2, and 5 are the only legal alternatives (for example), TYPE would be set to '11001' and PROBE would behave accordingly.

EXAMPLE

When a patient who is reasonably non-psychotic enters, either for research or clinical purposes, the receptionist explains that we would like him or her to interact with a computer. We explain that it is very much like an interview or conversation except that it will involve a computer, and that the responses available to the patient will usually be 'YES', 'NO', or a number. The patient is shown the terminal, shown where the keys are, instructed to type a "return" after each response, and if he or she has no questions, started. Figure 4 contains the beginning interactions with the machine (the patient's responses are in small letters).

\begin{verbatim}
Figure 4 here
\end{verbatim}

When the patient is finished, SAS uses the resulting SAS dataset as input to a series of macros, obtained from Washington University in St. Louis, to produce a diagnostic profile of the patient. These are also placed in a SAS dataset, and may be used later, along with the responses of other subjects.

SIGNIFICANCE

There are four significant results resulting from this project. First, such a system enables a psychiatrist or psychologist to operate more efficiently, and at less cost per patient, by using comparatively inexpensive computer time as a substitute for comparatively expensive psychiatrist time. It will, of course, not be possible to replace a psychiatrist or psychologist with a computer, but it may be possible to replace some of her time with a computer's time.

Second, there are patients who feel uncomfortable in confiding their problems to another person, be she psychiatrist, psychologist, or nurse. Such a system, enables such a person to avoid interacting with another person.

Third, such a system may be useful in large scale psychiatric screening projects, as there are many jobs in which stable individuals are desired.

Fourth, such a system is useful in psychiatric research, in which patients who meet certain inclusion/exclusion criteria, including a diagnosis, are qualified as subjects.

References:


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LENGTH CRESH $ 15 TYPE $ 5;
FILE OUT;
PUT 'DIAGNOSTIC INTERVIEW SCHEDULE';
PUT 'DEVELOPED BY ROBINS ET AL (1980)';
PUT 'INTERACTIVE COMPUTER PROGRAM DEVELOPED BY';
PUT 'ROBERT M. HAMER AND R.K. ELSWICK (1981)';
PUT 'THE DIAGNOSTIC INTERVIEW SCHEDULE (DIS) IS A PSYCHIATRIC';
PUT 'INTERVIEW, DESIGNED TO ASSESS PATIENTS OR SUBJECTS,';
PUT 'DURING THE COURSE OF THE INTERVIEW, THIS COMPUTER WILL';
PUT 'ASK YOU QUESTIONS BY DISPLAYING THEM ON THIS SCREEN, IN';
PUT 'THE SAME MANNER AS THESE LINES ARE DISPLAYED,';
PUT 'YOU WILL BE ASKED TO RESPOND BY TYPING IN AN';
PUT 'ANSWER (USUALLY "YES" OR "NO", BUT SOMETIMES A NUMBER),';
PUT 'AFTER YOU HAVE TYPED IN YOUR RESPONSE, PRESS THE';
PUT 'THE "RETURN" KEY. (THE RECEPTIONIST SHOULD HAVE ALREADY';
PUT 'GIVEN YOU INSTRUCTIONS AND SHOWN YOU HOW TO PRESS';
PUT 'THE KEY). IF HE OR SHE HAS NOT, PLEASE CALL HIM';
PUT 'OR HER AND HAVE THAT DONE,';
ST: PUT 'ARE YOU READY TO START (TYPE "YES" OR "NO" AND';
PUT 'PRESS THE "RETURN" KEY.');
LINK YESNO;
IF CRESH='NO' THEN DO;
PUT 'CALL THE RECEPTIONIST';
GOTO ST; END;

ST: PUT 'WHAT IS YOUR SEX? (ANSWER M FOR MALE OR F FOR FEMALE)';
LINK CHNANS;
DIS001=CRESH;
IF DIS001 NE 'M' & DIS001 NE 'F' THEN GO TO Q001;
PUT 'HOW OLD WERE YOU ON YOUR LAST BIRTHDAY?';
LINK NUMANS;
DIS002=NRESP;
PUT 'WHAT YEAR WERE YOU BORN?';
LINK NUMANS;
YEARBORN=NRESP;
Y=YEARBORN-1800;
IF Y>0 THEN YEARBORN=Y;
PUT 'WHAT MONTH WERE YOU BORN? (ANSWER WITH A NUMBER.)';
PUT 'JANUARY=1';
PUT 'FEBRUARY=2';
PUT 'MARCH=3';
PUT 'APRIL=4';
LINK NUMANS;
MONTHBORN=NRESP;
PUT 'WHAT DAY OF THE MONTH?';
LINK NUMANS;
DAYBORN=NRESP;
DIS003=(MONTHBORN+1)*4+(DAYBORN-2)+YEARBORN;
PUT 'ARE YOU PRESENTLY MARRIED OR ARE YOU MOWED, SEPARATED,';
PUT 'DIVORCED, OR HAVE YOU NEVER BEEN MARRIED?';
PUT 'MARRIED? (YES OR NO)';
LINK YESNO;
IF NRESP='5' THEN GO TO Q005;
Did you tell a doctor about (Sx)?

- NO → CODE 5
- YES → CODE 3

 Did you tell any other professional about (Sx)?

- NO → GO TO B
- YES → CODE 2

 Did (Sx) ever the result of physical illness or injury?

- NO → CODE 5
- YES → GO TO BOX C

 Did (Sx) always the result of using medication, drugs or alcohol?

- NO → CODE 5
- YES → CODE 3

 When you told the doctor, what was his diagnosis?" "(What did he say was causing (Sx)?)

- NO → CODE 5
- YES → RECORD ALC/MED AND CODE 4

 When (Sx) was not due to medication, drugs, or alcohol, was it always the result of a physical illness or injury?

- NO → CODE 5
- YES → RECORD ALC/MED & ILL AND CODE 4

Other professionals include social workers, nurses, clergy, psychologists, dentists, chiropractors, and pediatricians.
(YES OR NO)
no

NOW I AM GOING TO ASK YOU ABOUT HEALTH PROBLEMS THAT MIGHT HAVE OCCURRED AT ANY TIME IN YOUR LIFE.

HAVE YOU HAD A LOT OF TROUBLE WITH ABDOMINAL OR BELLY PAIN? (YES OR NO)
yes

DID YOU TELL A DOCTOR ABOUT IT?
yes

WHEN YOU TOLD THE DOCTOR, WHAT WAS HIS DIAGNOSIS? (WHAT DID HE OR SHE SAY WAS CAUSING IT?)

I WILL PRESENT A LIST OF POSSIBLE DIAGNOSES FROM WHICH YOU WILL HAVE TO CHOOSE

PLEASE CHOOSE THE ONE THAT BEST DESCRIBES THE DIAGNOSIS

THE LIST INCLUDES ...  

NERVES  DRUGS  PHYSICAL  NO DEFINITE
STRESS  ALCOHOL  ILLNESS/INJURY  DIAGNOSIS
ANXIETY  MEDICATION
DEPRESSION
MENTAL ILLNESS

WAS IT ...  

NERVES?  no
STRESS?  no
ANXIETY?  no
DEPRESSION?  no
MENTAL ILLNESS?  no
MEDICATION?  no
DRUGS?  no
ALCOHOL?  no
PHYSICAL ILLNESS OR INJURY?
yes

WAS IT ALWAYS THE RESULT OF A PHYSICAL ILLNESS OR INJURY?
yes

HAVE YOU EVER HAD A LOT OF TROUBLE WITH BACK PAIN? (YES OR NO)
no

HAVE YOU EVER HAD PAIN IN THE JOINTS? (YES OR NO)
no

HAVE YOU EVER HAD PAINS IN YOUR ARMS OR LEGS OTHER THAN IN THE JOINTS? (YES OR NO)
no

DID YOU TELL A DOCTOR ABOUT IT?
no

DID YOU TELL ANY OTHER PROFESSIONAL ABOUT IT?
no

DID YOU TAKE MEDICATION FOR IT MORE THAN ONCE?
yes

WAS IT EVER THE RESULT OF A PHYSICAL ILLNESS OR INJURY?
no

WAS IT EVER THE RESULT OF USING MEDICATION, DRUGS, OR ALCOHOL?
yes

WAS IT ALWAYS THE RESULT OF USING MEDICATION, DRUGS, OR ALCOHOL?