Hans Julius Skaug
Norwegian Computing Center
P.O.Box 114 Blindern
N-0314 Oslo
NORWAY

H_IJ

A set of computer routines
for
test of serial independence

written by

Hans Julius Skaug
email: skaug@nr.no

October 1994

1 Introduction

HIJ is a collection of ANSI C-rutines for evaluation of the test statistics $\hat{H}^{(q)}$, $\hat{I}^{(q)}$ and $\hat{J}^{(q)}$ introduced in Skaug and Tjøstheim [1] for test of serial independence in the time series $X_1, \ldots, X_n$. Routines for calculating permutation p-values for the tests are also provided. For questions about the definition of $\hat{H}^{(q)}$, $\hat{I}^{(q)}$ and $\hat{J}^{(q)}$, and about the properties of the tests the paper Skaug and Tjøstheim [1], which follows this delivery, should be consulted.

The interface to the routines are through the three functions `hij()`, `cumulative()` and `hij_perm()`. In this reference manual quantities in typewriter typeface, for instance `hij()`, denote objects in the computer program. File names are written in italic, for instance *hij.c*.

2 Contents of delivery

The delivery contains the following files:

manual.ps	This document in Postscript format.
hij.c	C-source file which contains the test routines.
hij.h	Header file which contains definitions and declarations for *hij.c*.
example.c	An example of how to use the routines in *hij.c*
result	The output produced by *example.c*.
paper.ps	Postscript file which contains the paper Skaug and Tjøstheim [1].

3 Routines

3.1 Calculation of $\hat{H}_m$, $\hat{I}_m$ and $\hat{J}_m$

NAME

`hij`: calculates $\hat{H}_m$, $\hat{I}_m$ and $\hat{J}_m$.

SYNOPSIS

```
void hij( double X[], int n, double h, double H[], double I[], double J[],
          int q, double tmp[], double a, double b)
```

DESCRIPTION

Calculates $\hat{H}_m$, $\hat{I}_m$ and $\hat{J}_m$ from observations $X_1, \ldots, X_n$. See the file *example.c* for an example of how to use hij()

PARAMETERS

`X`	The vector which contains the observation $X_1, \ldots, X_n$.
`n`	Number of observations. Must be less or equal to the dimension of `X`.
`h`	The bandwidth parameter h_n. See Skaug and Tjøstheim [1, p. 8] for choise of h_n.
`H,I,J`	Vectors for the returned values of the test statistics. For instance `H[m]` containes the values of $\hat{H}_m$, $m = 1, \ldots, q-1$. By convension `H[0]`$=$ `I[0]`$=$`J[0]`$=0$.
`q`	The dimension of `H`, `I` and `J`.
`tmp`	Vector of the same dimension as `X`. Used by the routine as working space.
`a,b`	The constants in the support of the weight function (see Skaug and Tjøstheim [1, p. 8].

3.2 Calculation of $\hat{H}^{(q)}$, $\hat{I}^{(q)}$ and $\hat{J}^{(q)}$

NAME

`cumulative`: calculates $\hat{H}_m$, $\hat{I}_m$ and $\hat{J}_m$.

SYNOPSIS

```
void cumulative(double T[], int q)
```

DESCRIPTION

Calculates the cumulativ test statistics $\hat{H}^{(q)}$, $\hat{I}^{(q)}$ and $\hat{J}^{(q)}$ from $\hat{H}_m$, $\hat{I}_m$ and $\hat{J}_m$. See the file *example.c* for an example of how to use cumulative()

3.3 Permutation tests

NAME

`hij_perm`: calculates permutation p-values for the test statistics.

SYNOPSIS

```
void hij_perm( double X[], int n, double h, double *P_H, double *P_I,
               double *P_J, int q, double tmp[], double a, double b)
```

DESCRIPTION

Calculates the conditional p-values for the tests based on $\hat{H}^{(q)}$, $\hat{I}^{(q)}$ and $\hat{J}^{(q)}$

See Skaug and Tjøstheim [1, Section. 3.2] for definition of the p-values.

PARAMETERS

`X`	The vector which contains the observation $X_1, \ldots, X_n$.
`n`	Number of observations. Must be less or equal to the dimension of `X`.
`h`	The bandwidth parameter h_n. See Skaug and Tjøstheim [1, p.] for choise of h_n.
`H_P,I_P,J_P`	Pointers to the returned p-values.
`q`	The lag at which the test statistics are calculated.
`tmp`	Vector of the same dimension as `X`. Used by the routine as working space.
`a,b`	The constants in the support of the weight function (see Skaug and Tjøstheim [1, p. 8]).

BUGS

The routine uses the standard C library function `rand()`.

If possible some other random number generator should be used instead.

References

[1] H. J. Skaug and D. Tjøstheim. Testing for serial independence using measures of distance between densities. Under revision for Econometrica, 1994.