

NAG Library Function Document

nag_make_indices (m01zac)

1 Purpose

nag_make_indices (m01zac) inverts a permutation, and hence converts a rank vector to an index vector, or vice versa.

2 Specification

```
#include <nag.h>
#include <nagm01.h>
void nag_make_indices (size_t ranks[], size_t n, NagError *fail)
```

3 Description

There are two common ways of describing a permutation using an Integer vector **ranks**. The first uses ranks: **ranks**[*i*] holds the index value to which the (*i* + 1)th data element should be moved in order to sort the data; in other words its rank in the sorted order. The second uses indices: **ranks**[*i*] holds the current index value of the data element which would occur in (*i* + 1)th position in sorted order. For example, given the values

3.5 5.9 2.9 0.5

to be sorted in ascending order, the ranks would be

2 3 1 0

and the indices would be

3 2 0 1.

The m01d- functions generate ranks, and the m01e- functions require indices to be supplied to specify the re-ordering. However if it is desired simply to refer to the data in sorted order without actually re-ordering them, indices are more convenient than ranks (see Section 10). nag_make_indices (m01zac) can be used to convert ranks to indices, or indices to ranks, as the two permutations are inverses of one another.

4 References

None.

5 Arguments

- 1: **ranks**[**n**] – size_t *Input/Output*
On entry: **ranks** must contain a permutation of the Integers 0 to **n** – 1.
On exit: **ranks** contains the inverse permutation.
- 2: **n** – size_t *Input*
On entry: the length of the array **ranks**.
Constraint: $0 \leq \mathbf{n} \leq \text{MAX_LENGTH}$, where MAX_LENGTH is an implementation-dependent value for the maximum size of an array.

- 3: **fail** – NagError * *Input/Output*
 The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

6 Error Indicators and Warnings

NE_BAD_RANK

Invalid **ranks** vector.
 Elements of **ranks** contain a value outside the range 0 to $n - 1$ or contain a repeated value. **ranks** does not contain a permutation of the Integers 0 to $n - 1$; on exit these elements are usually corrupted.

NE_INT_ARG_GT

On entry, $n = \langle value \rangle$.
 Constraint: $n \leq \langle value \rangle$, an implementation-dependent size that is printed in the error message.

NE_INT_ARG_LT

On entry, $n = \langle value \rangle$.
 Constraint: $n \geq 0$.

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_make_indices (m01zac) is not threaded in any implementation.

9 Further Comments

None.

10 Example

The example program reads a matrix of real numbers and prints its rows with the elements of the 1st column in ascending order as ranked by nag_rank_sort (m01dsc). The program first calls nag_rank_sort (m01dsc) to rank the rows, and then calls nag_make_indices (m01zac) to convert the rank vector to an index vector, which is used to refer to the rows in sorted order.

10.1 Program Text

```
/* nag_make_indices (m01zac) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#include <nag.h>
#include <stdio.h>
#include <nag_stdlib.h>
#include <nag_stddef.h>
#include <nagm01.h>

#ifdef __cplusplus
extern "C"
```

```

{
#endif
    static Integer NAG_CALL compare(const Nag_Pointer a, const Nag_Pointer b);
#ifdef __cplusplus
}
#endif

#define VEC(I, J) vec[(I) *tdvec + J]
int main(void)
{
    Integer exit_status = 0, tdvec;
    NagError fail;
    double *vec = 0;
    size_t i, j, m, n, *rank = 0;

    INIT_FAIL(fail);

    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[\n]");
#else
    scanf("%*[\n]");
#endif
    printf("nag_make_indices (m01zac) Example Program Results\n");
#ifdef _WIN32
    scanf_s("%" NAG_UFMT "%" NAG_UFMT "", &m, &n);
#else
    scanf("%" NAG_UFMT "%" NAG_UFMT "", &m, &n);
#endif
    if (m >= 1 && n >= 1) {
        if (!(vec = NAG_ALLOC(m * n, double)) || !(rank = NAG_ALLOC(m, size_t))) {
            printf("Allocation failure\n");
            exit_status = -1;
            goto END;
        }
        tdvec = n;
    }
    else {
        printf("Invalid m or n.\n");
        exit_status = 1;
        return exit_status;
    }
    for (i = 0; i < m; ++i)
        for (j = 0; j < n; ++j)
#ifdef _WIN32
            scanf_s("%lf", &VEC(i, j));
#else
            scanf("%lf", &VEC(i, j));
#endif
    /* nag_rank_sort (mOldsc).
     * Rank sort of set of values of arbitrary data type
     */
    nag_rank_sort((Pointer) vec, m, (ptrdiff_t) (n * sizeof(double)), compare,
                  Nag_Ascending, rank, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_rank_sort (mOldsc).\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    /* nag_make_indices (m01zac).
     * Inverts a permutation converting a rank vector to an
     * index vector or vice versa
     */
    nag_make_indices(rank, m, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_make_indices (m01zac).\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    printf("Matrix with rows sorted according to column 1\n");
    for (i = 0; i < m; ++i) {

```

```

    for (j = 0; j < n; ++j)
        printf(" %7.1f ", VEC(rank[i], j));
    printf("\n");
}
END:
    NAG_FREE(vec);
    NAG_FREE(rank);
    return exit_status;
}

static Integer NAG_CALL compare(const Nag_Pointer a, const Nag_Pointer b)
{
    double x = *((const double *) a);
    double y = *((const double *) b);
    return (x < y ? -1 : (x == y ? 0 : 1));
}

```

10.2 Program Data

```

nag_make_indices (m01zac) Example Program Data
12 3
6.0 5.0 4.0
5.0 2.0 1.0
2.0 4.0 9.0
4.0 9.0 6.0
4.0 9.0 5.0
4.0 1.0 2.0
3.0 4.0 1.0
2.0 4.0 6.0
1.0 6.0 4.0
9.0 3.0 2.0
6.0 2.0 5.0
4.0 9.0 6.0

```

10.3 Program Results

```

nag_make_indices (m01zac) Example Program Results
Matrix with rows sorted according to column 1
    1.0      6.0      4.0
    2.0      4.0      9.0
    2.0      4.0      6.0
    3.0      4.0      1.0
    4.0      9.0      6.0
    4.0      9.0      5.0
    4.0      1.0      2.0
    4.0      9.0      6.0
    5.0      2.0      1.0
    6.0      5.0      4.0
    6.0      2.0      5.0
    9.0      3.0      2.0

```
