

NAG Library Function Document

nag_rank_sort (m01dsc)

1 Purpose

nag_rank_sort (m01dsc) ranks a vector of arbitrary data type objects in ascending or descending order.

2 Specification

```
#include <nag.h>
#include <nagm01.h>

void nag_rank_sort (const Pointer vec, size_t n, ptrdiff_t stride,
                    Integer (*compare)(const Nag_Pointer a, const Nag_Pointer b),
                    Nag_SortOrder order, size_t ranks[], NagError *fail)
```

3 Description

nag_rank_sort (m01dsc) ranks a set of n data objects of arbitrary type, which are stored in the elements of an array at intervals of length **stride**. The ranks are in the range 0 to $n - 1$.

Either ascending or descending ranking order may be specified.

nag_rank_sort (m01dsc) uses a variant of list merging as described by Knuth (1973).

4 References

Knuth D E (1973) *The Art of Computer Programming (Volume 3)* (2nd Edition) Addison–Wesley

5 Arguments

- 1: **vec[n]** – const Pointer *Input*
On entry: the array of objects to be ranked.
- 2: **n** – size_t *Input*
On entry: the number n of objects.
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: **stride** – ptrdiff_t *Input*
On entry: the increment between data items in **vec** to be ranked.
Note: if **stride** is positive, **vec** should point at the first data object; otherwise **vec** should point at the last data object.
Constraint: $0 < |\mathbf{stride}| \leq p$, where p is an implementation-dependent value for the maximum size_t size on the system, divided by **n** if **n** is positive.
- 4: **compare** – function, supplied by the user *External Function*
nag_rank_sort (m01dsc) compares two data objects. If its arguments are pointers to a structure, this function must allow for the offset of the data field in the structure (if it is not the first).

The function must return:

- 1 if the first data field is less than the second,
- 0 if the first data field is equal to the second,
- 1 if the first data field is greater than the second.

The specification of **compare** is:

Integer compare (const Nag_Pointer a, const Nag_Pointer b)

1: **a** – const Nag_Pointer *Input*
 On entry: the first data field.

2: **b** – const Nag_Pointer *Input*
 On entry: the second data field.

5: **order** – Nag_SortOrder *Input*

On entry: specifies whether the array is to be ranked into ascending or descending order.

Constraint: **order** = Nag_Ascending or Nag_Descending.

6: **ranks[n]** – size_t *Output*

On exit: the ranks of the corresponding data elements in **vec**.

7: **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_PARAM

On entry, argument **order** had an illegal value.

NE_INT_ARG_EQ

On entry, **stride** = $\langle value \rangle$.

Constraint: **stride** $\neq 0$.

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.

On entry, **stride** = $\langle value \rangle$.

Constraint: $|\mathbf{stride}| \leq \langle value \rangle$, an implementation-dependent size that is printed in the error message.

NE_INT_ARG_LT

On entry, **n** = $\langle value \rangle$.

Constraint: **n** ≥ 0 .

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_rank_sort (m01dsc) is not threaded in any implementation.

9 Further Comments

The time taken by nag_rank_sort (m01dsc) is approximately proportional to $n \log(n)$.

10 Example

The example program reads a list of real numbers and ranks them into ascending order.

10.1 Program Text

```
/* nag_rank_sort (m01dsc) 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

int main(void)
{
    Integer exit_status = 0;
    NagError fail;
    double *vec = 0;
    ptrdiff_t step;
    size_t i, n, *rank = 0, step_u;

    INIT_FAIL(fail);

    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[\n]");
#else
    scanf("%*[\n]");
#endif
    printf("nag_rank_sort (m01dsc) Example Program Results\n\n");
#ifdef _WIN32
    scanf_s("%" NAG_UFMT "%" NAG_UFMT "", &n, &step_u);
#else
    scanf("%" NAG_UFMT "%" NAG_UFMT "", &n, &step_u);
#endif
    step = (ptrdiff_t) step_u;
    if (n >= 1) {
        if (!(vec = NAG_ALLOC(n, double)) || !(rank = NAG_ALLOC(n, size_t))) {
            printf("Allocation failure\n");
            exit_status = -1;
            goto END;
        }
    }
}
```

```

    }
}
else {
    printf("Invalid n or step.\n");
    exit_status = 1;
    return exit_status;
}
for (i = 0; i < n; ++i)
#ifdef _WIN32
    scanf_s("%lf", &vec[i]);
#else
    scanf("%lf", &vec[i]);
#endif
/* nag_rank_sort (m01dsc).
 * Rank sort of set of values of arbitrary data type
 */
nag_rank_sort((Pointer) vec, n, step * (ptrdiff_t) (sizeof(double)),
               compare, Nag_Ascending, rank, &fail);
if (fail.code != NE_NOERROR) {
    printf("Error from nag_rank_sort (m01dsc).\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}
printf("    Data        Rank\n");
for (i = 0; i < n; ++i)
    printf("    %7.4f    %4" NAG_UFMT "\n", vec[i], rank[i]);
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_rank_sort (m01dsc) Example Program Data
12
1
5.3 4.6 7.8 1.7 5.3 9.9 3.2 4.3 7.8 4.5 1.2 7.6

10.3 Program Results

nag_rank_sort (m01dsc) Example Program Results

Data	Rank
5.3000	6
4.6000	5
7.8000	9
1.7000	1
5.3000	7
9.9000	11
3.2000	2
4.3000	3
7.8000	10
4.5000	4
1.2000	0
7.6000	8
