RLSQPM	CERN Program Library	E201

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Least Squares Polynomial Fit

Subroutine subprograms RLSQPM and DLSQPM fit a polynomial

$$p_m(x) \;=\; \sum_{j=0}^{m} a_j x^j$$

of degree m to n equally-weighted data points (x_i, y_i). The calculated coefficients a_j are such that

$$S_m^2 \;=\; \sum_{i=1}^{n} \bigl(y_i - p_m(x_i)\bigr)^2 \;=\; \min .$$

Subroutine subprograms RLSQP1 and DLSQP1 fit a straight line $p_1(x) \;=\; a_0 + a_1 x$ to n such points.
Subroutine subprograms RLSQP2 and DLSQP2 fit a parabola $p_2(x) \;=\; a_0 + a_1 x + a_2 x^2$ to n such points.
An estimate $s \;=\; \sqrt{S_m^2/(n-m-1)}$ of the standard deviation σ is calculated.
On CDC and Cray computers, the double-precision versions DLSQPM, DLSQP1 and DLSQP2 are not available.

Structure:

SUBROUTINE subprograms
User Entry Names: RLSQPM, RLSQP1, RLSQP2, DLSQPM, DLSQP1, DLSQP2
External References: RVSET (F002), DVSET (F002), DVSUM (F002), DVMPY (F002), DSEQN (F012)

Usage:

For t = R (type REAL), t = D (type DOUBLE PRECISION),

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CALL tLSQPM(N,X,Y,M,A,SD,IFAIL)
CALL tLSQP1(N,X,Y,A0,A1,SD,IFAIL)
CALL tLSQP2(N,X,Y,A0,A1,A2,SD,IFAIL)
```

N (INTEGER) Number n of data points.

X (type according to t) One-dimensional array of length $\geq$ N. On entry, X(i) contains the abscissas x_i, $(i = 1, 2, \ldots, n)$.

Y (type according to t) One-dimensional array of length $\geq$ N. On entry, Y(i) contains the ordinates y_i, $(i = 1, 2, \ldots, n)$.

M (INTEGER) Degree m of the polynomial to be fitted.

A (type according to t) One-dimensional array of dimension (0:d), where d $\geq$ M. Contains, on exit, in A(j) the coefficients a_j, $(j = 0, 1, \ldots, m)$.

A0,A1,A2 (type according to t) Contain, on exit, the coefficients a_0, a_1 for $p_1(x) = a_0 + a_1 x$ or a_0, a_1, a_2 for $p_2(x) = a_0 + a_1 x + a_2 x^2$, respectively.

SD (type according to t) Contains, on exit, the estimate s.

IFAIL (INTEGER) Error flag.
= 0 : Normal case,
= 1 : N $\leq$ 1 or M $<$ 0 or M $\geq$ N or M $>$ 20,
= −1 : The matrix of normal equations is numerically singular.

In the case IFAIL $\neq$ 0: M = 0, A(j) = 0 and A0 = A1 = A2 = 0 on exit.

Method:

The normal equations are solved. On computers other than CDC or Cray, double-precision mode arithmetic is used internally for `RLSQPM`, `RLSQP1` and `RLSQP2`.

Notes:

Meaningful results can usually be obtained only for small values of m (typically < 10).

References:

1. D.H. Menzel, Fundamental formulas of physics, v. 1, (Dover, New York 1960) 116–122.

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