

ODEQ

<p>ODSOL: OD1: choosebox</p> <p>ODL2: choosebox</p>	<p>OD 1. ORDER</p> <p>autonomous: $\{ 'd1Y(X) \}$ separable: $\{ 'd1Y(X) = \}$ linear: $\{ 'd1Y(X) = f(X) \}$ Bernoulli: $\{ 'd1Y(X) = \}$ homogeneous: $\{ 'd1Y(X) = \}$ spec. Riccati: $\{ 'd1Y(X) = \}$ gen. Riccati: $\{ 'd1Y(X) = f(aX+b)Y(X) \}$</p> <p>CANCEL OK</p>	<p>OD LINEAR 2. ORDER</p> <p>$'d1d1Y(X) + aY(X) = 0'$: $'d1d1Y(X) + aY(X) + bX = \}$ $'d1d1Y(X) - aX^nY(X) = \}$ 2. ord. linear: $\{ 'd1d1Y(X) = \}$ Euler: $\{ 'X^2d1d1Y(X) = \}$ Bessel: $\{ 'X^2d1d1Y(X) = \}$ Modified Bessel: $\{ 'X^2d1d1Y(X) = \}$ Legendre: $\{ '(1-X^2)d1d1Y(X) = \}$</p> <p>CANCEL OK</p>
<p>ODSOL: ODN2: choosebox</p> <p>ODH: choosebox</p>	<p>OD NONLINEAR 2. ORDER</p> <p>autonomous: $\{ 'd1d1Y(X) \}$ Ender-Fowler: $\{ 'd1d1Y(X) = \}$ Ernakou: $\{ 'd1d1Y(X) + \}$ homogeneous: $\{ 'd1d1Y(X) = \}$ gen. homogeneous: $\{ 'd1d1Y(X) = \}$ Lienard: $\{ 'd1d1Y(X) + \}$ $'d1d1Y(X) - d1Y(X) = f(Y(X))'$ $'d1d1Y(X) = f(Y(X))d1Y(X)'$</p> <p>CANCEL OK</p>	<p>OD HIGHER ORDER</p> <p>$'d1d1d1d1Y(X) + aY(X) = 0'$: $'d1d1d1d1Y(X) + aY(X) = 0'$ $'d1d1d1Y(X) = f(Y(X))'$ $'d1d1d1d1Y(X) = f(Y(X))'$ $'Y(X)d1d1d1Y(X) = f(Y(X))'$</p> <p>CANCEL OK</p>
<p>ODSOL: ODS: OD systems</p> <p>some systems</p>	<p>OD SYSTEMS</p> <p>1. ORD. LIN. HOM. SYS: 1. ORD. LIN. INHOM. SYS: 2. ORD. LIN. HOM. SYS: 2. ORD. LIN. INHOM. SYS:</p> <p>CANCEL OK</p>	<p>$\{ d1X(t) = aX(t) + bY(t) \}$ $\{ d1Y(t) = cX(t) + dY(t) \}$ $\{ d1X(t) = aX(t) + bY(t) + e1 \}$ $\{ d1Y(t) = cX(t) + dY(t) + e2 \}$ $\{ d1d1X(t) = aX(t) + bY(t) \}$ $\{ d1d1Y(t) = cX(t) + dY(t) \}$ $\{ d1d1X(t) = aX(t) + bY(t) + e1 \}$ $\{ d1d1Y(t) = cX(t) + dY(t) + e2 \}$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>
<p>ODSOL: OD1: homogenous OD</p> <p>solution for $f(U)=U^2$ gives solution for $Y(X)$</p>	<p>homogeneous: $\{ d1Y(X) = f\left(\frac{Y(X)}{X}\right) \}$ subst: $\{ U(X) = \frac{Y(X)}{X} \}$ $Xd1U(X) = f(U(X)) - U(X)$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>	<p>$\ln\left(\frac{U(X)-1}{U(X)}\right) = \ln(X) + cC0$ $d1Y(X) = \left(\frac{Y(X)}{X}\right)^2$ $Y(X) = -\frac{1}{e^{\ln(X)+cC0}-1}$ 0=0</p> <p>Help Y+DE Subst Solus Desol DTAG</p>
<p>ODSOL: ODL2: OD with solutions</p> <p>Euler equation</p>	<p>$d1d1Y(X) + aY(X) = 0$ $a < 0: (Y(X) = C1 \cdot \sinh(X\sqrt{-a}) + C2 \cdot \cosh(X\sqrt{-a}))$ $a = 0: (Y(X) = C1 + C2 \cdot X)$ $a > 0: (Y(X) = C1 \cdot \sin(X\sqrt{a}) + C2 \cdot \cos(X\sqrt{a}))$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>	<p>$X^2d1d1Y(X) + aXd1Y(X) + bY(X) = 0$ $'(1-a)^2 - 4 \cdot b > 0': Y(X) = \ln\left(\frac{1-a}{2}\right) \cdot C$ $'(1-a)^2 - 4 \cdot b = 0': Y(X) = \ln\left(\frac{1-a}{2}\right) \cdot C$ $'(1-a)^2 - 4 \cdot b < 0': Y(X) = \ln\left(\frac{1-a}{2}\right) \cdot C$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>
<p>ODSOL: ODN2: nonlinear OD with solutions</p> <p>ODN2: solution for $f(Y)=1/Y$</p>	<p>autonomous: $\{ d1d1Y(X) = f(Y(X)) \}$ $\left(\frac{1}{Y(X)} \right)$ RISCH $\left(C1 + 2 \cdot \text{RISCH}(f(Y), Y) \right) \cdot Y$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>	<p>$d1d1Y(X) + f(X) \cdot Y(X) = a \cdot Y(X)^{(-2)}$ sol.: $\{ C1 \cdot Y(X)^2 = M(X)^2 \} \cdot a + (C2 + C1 \cdot X)$ $M(X) = \text{sol. of } (d1d1M(X) + f(X) \cdot M(X) = 0)$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>
<p>ODSOL: ODN2: nonlinear OD</p> <p>solution for $f(Y)=Y$</p>	<p>$d1d1Y(X) = f(Y(X)) \cdot d1Y(X)$ RISCH $\left(\frac{1}{\text{RISCH}(f(Y), Y) + C1} \right) \cdot Y = C2 \cdot X$</p> <p>Help Y+DE Subst Solus Desol DTAG</p>	<p>$d1d1Y(X) = Y(X) \cdot d1Y(X)$ $2 \cdot \tan\left(\frac{(C2+X) \cdot C1}{\sqrt{2} \cdot C1}\right) \cdot C1$ $Y(X) = \frac{1}{\sqrt{2} \cdot C1}$ 0=0</p> <p>Help Y+DE Subst Solus Desol DTAG</p>
<p>ODSOL: ODH: higher order OD</p> <p>ODH: 3. order nonlinear OD</p>	<p>$d1d1d1d1Y(X) + aY(X) = 0$ $a = 0: (Y(X) = C1 + C2 \cdot X + C3 \cdot X^2)$ $a \neq 0: Y(X) = C1 \cdot e^{-\frac{1}{3} \cdot X} + C2 \cdot e^{\frac{1}{2} \cdot X} + C3 \cdot e^{\frac{1}{3} \cdot X}$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>	<p>$d1d1d1d1Y(X) = f(Y(X))$ subst: $\{ M(Y) = d1Y(X)^2 \}$ $d1d1M(Y) = 2 \cdot f(Y) \cdot M(Y)$</p> <p>OD1 ODL2 ODN2 ODH ODS Help</p>

ODSOL: Help	<p>4ESOL SOLUTIONS OF OD = ORDINARY DIFFERENTIAL EQNS FROM CHOOSEBOX</p> <p>OD1 - + OD 1. ORDER ODL2 - + OD LINEAR 2. ORDER ODN2 - + OD NONLIN. 2. ORDER ODH - + OD HIGHER ORDER ODS - + OD SYSTEMS ODlist.. LIST WITH EXAMPLES PUT OD STACK, DECOMPOSE WITH EVAL EDIT AND +LIST AGAIN</p> <p>+SKIP SKIP+ +DEL DEL+ DEL L INS</p>	<p>Y+DE OD 'Y(X)=...' + '0=0' SOLUTION IN OD Subst OD 'Y=...' 'Z'=...' + DE' SUBSTITUTE IN DE OR TERM CALLS d+der</p> <p>Solve 'A=B' 'Y,Y(X)' + SOLUTION SOLVE EQ (NONRIGOROUS) +Funct OD + 'Y(X)'... 3 LIST OF FUNCTIONS FOR Subst,Solve</p> <p>Desolve OD 'Y(X)' + OD SOLUTION dEval dIF(2),3RF(X) + derF EVAL DERIVATIVES OF</p> <p>+SKIP SKIP+ +DEL DEL+ DEL L INS</p>
ODSOL: Help	<p>dEval dIF(2),3RF(X) + derF EVAL DERIVATIVES OF SPECIAL FUNCTIONS dIACOT(2) + -1/(1+2^2) n + 3(.,3R(Y(X))) n.TH DERIVATIVE d+der 'dIV(X)' + '3R(Y(X))' Works For d1..d9</p> <p>HINT: RISCH(F(X),X)=/F(X) dX =INDEFINITE INTEGRAL</p> <p>4</p> <p>+SKIP SKIP+ +DEL DEL+ DEL L INS</p>	<p>RAD SHOW</p> <p>Example diffEq</p> <p>DISOLVE: '3R(Y(X))=X' LIN: '3R(Y(X))=X*Y(X) SEP: '3R(Y(X))=X/Y(X) BERN: '3R(Y(X))=Y(X)+ HOMO: '3R(Y(X))=Y(X)/ EXACT: '3R(Y(X))=Y(X) FYDY: 'X=Y(X)*3R(Y(X) FXDY: 'Y(X)=EXP(3R(Y(X))</p> <p>CANCEL OK</p>
OD1:Examples		
OD1: Dlsolve: solve 1. order DEQ (4s) Y→DE: insert solution (2.3s)	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = X \cdot Y(X) + 1 - X^2$ $Y(X) = \left[\left(X e^{-\frac{X^2}{2}} + c C0 \right) e^{\frac{X^2}{2}} \right]_{0=0}$ <p>Examp DEQ Disol Linde Sepde Bernd</p>	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = k \cdot Y(X) + X$ $Y(X) = \frac{k^2 \cdot C e^{k \cdot X} - (k \cdot X + 1)}{k^2}$ <p>Examp DEQ Disol Linde Sepde Bernd</p>
Linde: separable DEQ (1s)		
OD1: Sepde: separable DEQ (1s)	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = \frac{X}{Y(X)}$ $\frac{Y(X)^2}{2} = \frac{X^2}{2} + C$ <p>Examp DEQ Disol Linde Sepde Bernd</p>	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = Y(X) + Y(X)^2$ $\left[(-1 \cdot e^X + C) \cdot \frac{1}{e^X} \right]^{(-1)}_{0=0}$ <p>Examp DEQ Disol Linde Sepde Bernd</p>
Bernde: Bernoulli diff.eq. Y→DE: insert solution (2s)		
OD1: Homode: homogenous DEQ (3s)	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = \frac{Y(X)}{Y(X) + 1}$ $\frac{1}{Y(X)} \cdot X - \ln\left(\left \frac{Y(X)}{X}\right \right) = \ln(X)$ <p>Examp DEQ Disol Linde Sepde Bernd</p>	<p>5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = \frac{Y(X) - X}{Y(X)^{(-2)} - X}$ $-\left[Y(X) \cdot X - \frac{1}{2} \cdot X^2 \right] - \frac{1}{Y(X)} = C$ <p>Homod Exact Fxdy Fxdy Diser LDEQ</p>
Exactde: exact DEQ (2s)		
OD1: Fydy: DEQ of form X=F(Y,Y') (2s)	<p>5: 4: 3: 2: 1:</p> $X = Y(X) \cdot \frac{\partial}{\partial X}(Y(X)) + \frac{\partial}{\partial X}(Y(X))^2$ $X(P) = Y(P) \cdot P + P^2$ $\frac{\partial}{\partial P}(Y(P)) = -\frac{2P^2 + Y(P) \cdot P}{P^2 - 1}$ <p>Homod Exact Fxdy Fxdy Diser LDEQ</p>	<p>5: 4: 3: 2: 1:</p> $Y(X) = e^{\frac{\partial}{\partial X}(Y(X))} + 2 \cdot X \cdot \frac{\partial}{\partial X}(Y(X))$ $Y(X) = e^{F(X)} + 2 \cdot X \cdot F(X)$ $\frac{\partial}{\partial X}(F(X)) = -\frac{F(X)}{e^{F(X)} + 2 \cdot X}$ <p>Homod Exact Fxdy Fxdy Diser LDEQ</p>
Fxdy: DEQ of form Y=G(X,Y') (2s)		
OD1: Dlseries: power series of solution up to order 4 (9s)	<p>6: 5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X}(Y(X)) = e^X - Y(X)^2$ $X + \frac{1}{2} \cdot X^2 + \frac{-1}{6} \cdot X^3 + \frac{-5}{24} \cdot X^4$ <p>Homod Exact Fxdy Fxdy Diser LDEQ</p>	<p>6: 5: 4: 3: 2: 1:</p> $Y(X) = \frac{\partial}{\partial X}(Y(X))$ $\frac{\partial}{\partial X} \left(\frac{\partial}{\partial X}(Y(X)) \right)$ <p>Help DNY d+der Y+DE DTAG EXFAN</p>
DNY: n. derivative of Y(X)		
ODH: Ynfx: solve Y(n)(X)=f(X) (9.5s)	<p>8: 7: 6: 5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X} \left(\frac{\partial}{\partial X}(Y(X)) \right) = \frac{1}{X}$ $C1 - C2 \cdot X0 - X0 - C3 \cdot \ln(X00) - C4 \cdot \ln(X01)$ <p>Examp DEQ Ynfx Fxyk Fygn Fhon</p>	<p>8: 7: 6: 5: 4: 3: 2: 1:</p> $\frac{\partial}{\partial X} \left(\frac{\partial}{\partial X} \left(\frac{\partial}{\partial X}(Y(X)) \right) \right)^2 + \frac{\partial}{\partial X} \left(\frac{\partial}{\partial X}(Y(X)) \right)^2$ $F(X) = \frac{\partial}{\partial X} \left(\frac{\partial}{\partial X}(Y(X)) \right)^2$ $\frac{\partial}{\partial X}(F(X)) + F(X)^2 - 4 = 0$ <p>Examp DEQ Ynfx Fxyk Fygn Fhon</p>
Fxyk: DEQ f(X,Y ^(k) ..Y ⁽ⁿ⁾)=0 (1s)		

<p>ODH: Fyyn: DEQ f(Y..Y⁽ⁿ⁾) (9.5s)</p> <p>Phom: homogeneous DEQ (7s)</p>	<pre> 7: 6: 5: 4: 3: d/dX (d/dX (d/dX (Y(X)))) - Y(X) - d/dX (d/dX (Y(X))) 2: F(Y) = - d/dX (Y(X)) 1: Y(P(Y)^2, d1d1P(Y) + Y(P(Y)) - d1P(Y)^2 - 1 Examp DEQ Ynfx Fxyk Fyyn Phom </pre>	<pre> 6: 5: 4: 3: Y(X) - d/dX (d/dX (Y(X))) - d/dX (Y(X))^2 = 0 2: Y(X) = e^(-X) * integral from 0 to X of 2(X) dX 1: d12(X) = 0 Examp DEQ Ynfx Fxyk Fyyn Phom </pre>
<p>ODH: Powser: power series coefficients up to order 4, X0=0 (40s)</p> <p>d→der: d1Y(X) to ∂X(Y(X))</p>	<pre> 8: 7: 6: 5: 4: d/dX (d/dX (Y(X))) + X*Y(X) = 0 3: 2: 1: C2*a2=0 a0+6*a3=0 2*a1+24*a4=0 Power LDEQ Help </pre>	<pre> 6: 5: 4: 3: d1d1Y(X) + X*Y(X) = 0 2: d/dX (d/dX (Y(X))) + X*Y(X) = 0 1: Help DNY d-der Y-DE DTAG BHPAN </pre>
<p>ODLIN: Examples ODLIN</p> <p>L→DE: list to DEQ (1.4s)</p> <p>Ldsolve: linear DEQ (3s)</p>	<pre> RAD XYZ DEC R= 'X' \OME Examples ODLIN 7: L-DE: { 1 4 4 'X^2*EXP' 6: LDESOLVE: '3X(3X(Y(X)) 5: LHSOLVE: { 1 1 -2 1 3 4: WRONSMT: { 'COS(X)' X 3: REDU: { '3X(3X(Y(X)) + 2: INHO: { { 'X^2' 'X-1 1: EULER: { ' (X+1)^3*3X(X) Help LDEQ Help </pre>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ ODLIN> USR 5: 4: 3: L-DE: { 1 4 4 X^2.e^(-2*X) 2: d/dX (d/dX (Y(X))) + 4*d/dX (Y(X)) + 4*Y(X) = 1: Y(X) = X^4 + 12*X*cC1 + (12+24*X)*cC0 ExodL L-DE Ldsol Lhsol Wrns Redu </pre>
<p>ODLIN: Lhsolve: solve homogenous DEQ from list of roots with multiplicity (2s)</p> <p>Example with complex roots (3s)</p>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ ODLIN> USR 6: 5: 4: LHSOLVE: { 1 1 -2 1 3 13 3: d1d1d1Y(X) - 2*d1d1Y(X) - 5*d1Y(X) 2: Y(X) = c11.e^X + c21.*1/e^2X + c31.e^2X 1: 0=0 Help Y-DE Subst Solus +Fund Desol </pre>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ ODLIN> USR 6: 5: 4: LHSOLVE: { 1 -i 1 2 23 3: d1d1d1d1Y(X) - 5*d1d1d1Y(X) + 14*d 2: Y(X) = b11.e^X*cos(X) + c11.e^X*SIN(X) 1: 0=0 Help Y-DE Subst Solus +Fund Desol </pre>
<p>ODLIN: Redu: reduced DEQ from special solution (2s)</p> <p>Inho: special solution from fundamental system (13s)</p>	<pre> 6: 5: 4: 3: d/dX (d/dX (Y(X))) + 4-2X/dX (Y(X)) + 2X/dX (Y(X)) 2: (X-1)*d1d1Y(X) - 2*d1Y(X) = 0 1: Wrns Redu Inho Euler LDEQ Help </pre>	<pre> 6: 5: 4: { X^(-2) (X-1)^3 3: 3*X^2 2: 1 1: c1*X^(-2) + c2*(X-1)^3 (6*X^3 - 12*X^2 + 3*X Wrns Redu Inho Euler LDEQ Help </pre>
<p>ODLIN: Euler: Euler DEQ to linear DEQ (13s)</p> <p>Example: examples</p>	<pre> RAD XYZ DEC R= 'X' \OME Examples ODLIN 7: L-DE: { 1 4 4 'X^2*EXP' 6: LDESOLVE: '3X(3X(Y(X)) 5: LHSOLVE: { 1 1 -2 1 3 4: WRONSMT: { 'COS(X)' X 3: REDU: { '3X(3X(Y(X)) + 2: INHO: { { 'X^2' 'X-1 1: EULER: { ' (X+1)^3*3X(X) Help LDEQ Help </pre>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ ODLIN> USR 5: 4: 3: { d/dX (Y1(X)) = Y1(X) - Y2(X) + 1 d/dX (Y2) 2: (12*cV1 + 6*cV2 + 12)*e^2X - (6*cV1 + 6 1: c0=0 0=0 Examp DEQ Ynfx Fxyk Fyyn Phom </pre>
<p>ODSYS: →Sdeq: list to system (1s)</p> <p>Sdsolve: Solve linear system of 1. order (8s)</p> <p>YK→SD: insert solution (12s)</p>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ DESYS> USR 6: 5: 4: 3: { c1 -1 13 { 2 4 e^X 2: { d/dX (Y1(X)) = Y1(X) + 1*Y2(X) + 1 d/dX (Y2) 1: { d1d1d1Y(2) - (3*d1d1Y(2) - d1Y(2)) - Wrns Sdsol SDEQ Sdsol YK-SD Ysol </pre>	<pre> RAD XYZ DEC R= 'X' \OME ODEQ DESYS> USR 5: 4: 3: { d/dX (Y1(X)) = Y1(X) - Y2(X) + 1 d/dX (Y2) 2: (12*cV1 + 6*cV2 + 12)*e^2X - (6*cV1 + 6 1: c0=0 0=0 Examp DEQ Ynfx Fxyk Fyyn Phom </pre>
<p>ODSYS: Shored: reduction of homogeneous system with known solution (0.5s)</p> <p>Sinho: special solution of inhomogeneous system (6.4s)</p>	<pre> 6: 5: 4: 3: { { -1 1 } { -X^2 2*X^2+1 } 2: { { 1 13 } { 2 4 } 1: { { 2X } { 1 } Shore Sinho LDEQ Help </pre>	<pre> 6: 5: 4: 3: { { e^X (1/2*X + 1/4) 1/2*e^X } { X*e^X e^X 2: { 1 13 } { 2 4 } 1: { 3X-7 4X-103 Shore Sinho LDEQ Help </pre>