%DatingGame --a game between choosy females and three types of males.

%Females invest time attempting to discriminate between male types 1 & 2,

%then mate or not based on this "dating" process. This version finds the

%frequency-dependent solutions and plots the results across a range of the

%magnitude of a particular parameter. It also finds ESS outcomes across the

%parameter range with the coercer (male type 3) included on equal terms

%with the other two types. In this version type 3 may or may not invest

%time pairing like the other two types do. \*Note\*: types 2 & 3 must differ

%in more than just coercion per se for results to be obtained. We include

%partial access (cuckoldry) to partners of types 1 and 2 by type 3 and

%partners of type 1 by 2.

r1 = 1.0; %1.0; repro payoff for mating of female & type 1 male, fitness

r2 = 0.6; %0.6; repro payoff for mating of female & type 2 male, fitness

R32 = 0.8; %0.8; r3/r2, to account for any repro've cost of coercion

r3 = R32\*r2; %R32\*r2; repro payoff for type 3 male, fitness

tf = 12; %12; time female invests in a reproductive event, time

t1 = 12; %12; time type 1 male invests in a reproductive event, time

t2 = 1; %1; time type 2 male is in a reproductive event, time

t3 = 0; %0; time type 3 male is in a reproductive event, time

tn = 1; %1; time female is not in estrus per cycle, time

b1 = 0.5; %0.5; male 1 prob of break-up after a reproductive event

b2 = 1; %1; male 2 prob of break-up after a reproductive event

del = 3; %3; exponential discrimination parameter, 1/time

half = 3; %3; sigmoid discrimination time at half maximal, time

mult = 1.5; %1.5; sigmoid discrimination exponent multiplier, 1/time

sigp = 1; %1; primary sex ratio: # males / # females at fertilization

lamf = 1; %1; expected reproductive lifetime of male type 1, time

lam1 = 1; %1; expected reproductive lifetime of male type 2, time

lam2 = 1; %1; expected reproductive lifetime of females, time

lam3 = 1; %1; expected reproductive lifetime of male type 3, time

gam1 = 1; %1; chance a reproductive liaison yields offspring, type 1

gam2 = 0.4; %0.4; chance a reproductive liaison yields offspring, type 2

gam3 = 0.1; %0.1; chance a forced mating yields offspring, type 3

Dfn = 0; %0; discrimination function: 0 = hyperbolic, 1 = sigmoid

c1 = 1; %1; 1=choose male type 1; 0=avoid type 1

c2 = 0; %0; 1=choose male type 2; 0=avoid type 2

c0 = 1; %1; 1=take unidentified males; 0=avoid unidentified males

om = 0; %0; exponent of c0=(1-d)^om

k12 = 0; %0; frac of type 1 offspring fathered by 2 per unit freq

k13 = 0; %0; frac of type 1 offspring fathered by 3 per unit freq

k23 = 0; %0; frac of type 2 offspring fathered by 3 per unit freq

%Variables and code for production runs

res = 500; %Sets resolution of the graphs

xx = 1:res+1;%Vector of run numbers

xmax = 1.0; %Largest magnitude of the parameter of interest %\*\*\*modify\*\*\*

xmin = 0.0; %Smallest magnitude of the parameter of interest %\*\*\*modify\*\*\*

xdef = 0.6; %Default value of the parameter being varied %\*\*\*modify\*\*\*

xinc = (xmax - xmin)/res; %Increment size for each calculation

x = (xx - 1) \* xinc + xmin; %x-vector for graphing

f1 = zeros(1,res+1); %Fraction of males in population that are type 1

f2 = zeros(1,res+1); %Fraction of males in population that are type 2

f3 = zeros(1,res+1); %Fraction of males in population that are type 3

f12 = zeros(1,res+1); %Unstable male 1-2 combination

f13 = zeros(1,res+1); %Unstable male 1-3 combination

f23 = zeros(1,res+1); %Unstable male 2-3 combination

f123 = zeros(1,res+1); %Unstable male 1-2-3 combination

M1 = zeros(1,res+1); %Fraction of all mated males that are type 1

M2 = zeros(1,res+1); %Fraction of all mated males that are type 2

M3 = zeros(1,res+1); %Fraction of all mated males that are type 3

d = zeros(1,res+1); %Fraction of dates for which types are discerned

Ff = zeros(1,res+1); %Fitness of females

F1 = zeros(1,res+1); %Fitness of type 1 males

F2 = zeros(1,res+1); %Fitness of type 2 males

F3 = zeros(1,res+1); %Fitness of type 3 males

p1 = zeros(1,res+1); %Frequency of type 1 males in the dating pool

p2 = zeros(1,res+1); %Frequency of type 2 males in the dating pool

p3 = zeros(1,res+1); %Frequency of type 3 males in the dating pool

tau = zeros(1,res+1); %Time a male spends in the dating pool

td = zeros(1,res+1); %Time spent attempting to recognize a male's type

%xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

ESSold = [4]; %Set ESSold to a unique value

for i = 1:res+1 %for loop for storing data

FLAG = 1; %Signals absence of one-type or two-type ESS

FLAG123 = 0; %Signals no unstable mix of all 3 types

r2 = x(i); %\*\*\*\*\*\*parameter being varied on x axis\*\*\*\*\*\*\*\*\*\*\*

r3 = R32\*r2;

%r3 = x(i);

T1 = gam1\*t1 + (gam1\*tf + tn)\*(1 - b1)/b1; %Time male 1 out of pool

T2 = gam2\*t2 + (gam2\*tf + tn)\*(1 - b2)/b2; %Time male 2 out of pool

T3 = gam3\*t3; %Time male 3 out of pool

the1 = (gam1\*tf + tn)/b1; %Time until fem visits pool after type 1 mate

the2 = (gam2\*tf + tn)/b2; %Time until fem visits pool after type 2 mate

the3 = gam3\*(tf + tn); %Time until fem visits pool after type 3 mate

tau1 = sigp\*(lam1/lamf)\*the1 - T1; %Wait time for pure male 1

if tau1 < 0

tau1 = 0;

end

tau2 = sigp\*(lam2/lamf)\*the2 - T2; %Wait time for pure male 2

if tau2 < 0

tau2 = 0;

end

tau3 = sigp\*(lam3/lamf)\*the3 - T3; %Wait time for pure male 3

if tau3 < 0

tau3 = 0;

end

%Wait times for mixes of male types:

tau12 = (T1\*gam2\*lam2\*r2/b2 - T2\*gam1\*lam1\*r1\*(1-k12)/b1)/...

(gam1\*lam1\*r1\*(1-k12)/b1 - gam2\*lam2\*r2/b2);

tau13 = (T1\*gam3\*lam3\*r3 - T3\*gam1\*lam2\*r1\*(1-k13)/b1)/...

(gam1\*lam1\*r1\*(1-k13)/b1 - lam3\*gam3\*r3);

tau23 = (T2\*gam3\*lam3\*r3 - T3\*gam2\*lam3\*r2\*(1-k23)/b2)/...

(gam2\*lam2\*r2\*(1-k23)/b2 - lam3\*gam3\*r3);

F11 = lam1\*(gam1\*r1/b1)/(tau1 + T1); %Fxy=fit of type x in pure type y

F12 = lam1\*(1-k12)\*(gam1\*r1/b1)/(tau2 + T1);

F13 = lam1\*(1-k13)\*(gam1\*r1/b1)/(tau3 + T1);

F21 = lam2\*(gam2\*r2/b2)/(tau1 + T2) + k12\*F11;

F22 = lam2\*(gam2\*r2/b2)/(tau2 + T2);

F23 = lam2\*(1-k23)\*(gam2\*r2/b2)/(tau3 + T2);

F31 = lam3\*(gam3\*r3)/(tau1 + T3) + k13\*F11;

F32 = lam3\*(gam3\*r3)/(tau2 + T3) + k23\*F22;

F33 = lam3\*(gam3\*r3)/(tau3 + T3);

F112y = lam1\*(gam1\*r1/b1)/(tau12 + T1); %Fxyz=fit: type x in y-z mix

F113y = lam1\*(gam1\*r1/b1)/(tau13 + T1);

F123y = lam1\*(gam1\*r1/b1)/(tau23 + T1);

F212y = lam2\*(gam2\*r2/b2)/(tau12 + T2);

F213y = lam2\*(gam2\*r2/b2)/(tau13 + T2);

F223y = lam2\*(gam2\*r2/b2)/(tau23 + T2);

F312y = lam3\*(gam3\*r3)/(tau12 + T3);

F313y = lam3\*(gam3\*r3)/(tau13 + T3);

F323y = lam3\*(gam3\*r3)/(tau23 + T3);

ESS = []; %Start with no ESS

f1(i) = 0; f2(i) = 0; f3(i) = 0;

F1(i) = 0; F2(i) = 0; F3(i) = 0; Ff(i) = 0;

p1(i) = 0; p2(i) = 0; p3(i) = 0;

M1(i) = 0; M2(i) = 0; M3(i) = 0;

d(i) = 0; td(i) = 0; tau(i) = 0;

if (F11 > F21)&&(F11 > F31) %Condition for pure type 1 ESS

ESS = [ESS 1]; %Concatenate ESS id#

FLAG = 0; %No unstable 3-type mix is possible

f1(i) = 1; f2(i) = 0; f3(i) = 0; %Frequencies of male types

tau(i) = tau1; %Set waiting time

F1(i) = F11; F2(i) = F21; F3(i) = F31; %Male fitnesses

p1(i) = 1; p2(i) = 0; p3(i) = 0; %Fractions of male types in pool

M1(i) = 1; M2(i) = 0; M3(i) = 0; %Fractions of male types mated

d(i) = 0; td(i) = 0; %No discrimination

end

if (F22 > F12)&&(F22 > F32) %Condition for pure type 2 ESS

ESS = [ESS 2]; %Above comments apply

FLAG = 0;

f1(i) = 0; f2(i) = 1; f3(i) = 0;

tau(i) = tau2;

F1(i) = F12; F2(i) = F22; F3(i) = F32;

p1(i) = 0; p2(i) = 1; p3(i) = 0;

M1(i) = 0; M2(i) = 1; M3(i) = 0;

d(i) = 0; td(i) = 0;

end

if (F33 > F13)&&(F33 > F23) %Condition for pure type 3 ESS

ESS = [ESS 3]; %Above comment apply

FLAG = 0;

f1(i) = 0; f2(i) = 0; f3(i) = 1;

tau(i) = tau3;

F1(i) = F13; F2(i) = F23; F3(i) = F33;

p1(i) = 0; p2(i) = 0; p3(i) = 1;

M1(i) = 0; M2(i) = 0; M3(i) = 1;

d(i) = 0; td(i) = 0;

end

if (F12 > F22)&&(F21 > F11) %Possible 1-2 mix ESS

ff1 = 0.5; ff1st = 0.051; %Freq of type 1 males & step size for f1

FF1 = 1.0; FF2 = 0.5; %Starting fitnesses of types 1+2

flag = 1; %0 ends the loop when f1=0 or 1 & F1<>F2

while (abs(FF1 - FF2) > 1e-5)&&flag %Keep adjusting toward FF1=FF2

ff1 = ff1 + ff1st; %Take a step with f1(i)

if ff1 < 0 %Restrict f1(i) between 0 and 1

ff1 = 0;

elseif ff1 > 1

ff1 = 1;

end

ff2 = 1-ff1; %Find f2(i) from f1(i)

if (abs(ff1st) < 1e-5)&&((ff1 <= 0)||(ff1 >= 1))

flag = 0; %Stop the loop with f1 = 0 or 1 & fitnesses ~=

end %Now do a hill climb based on td to maximize Ff

td(i) = 0; tdst = 0.11/del; Ffold = 0; %Initialize

while (abs(tdst) > 1e-5/del) %While step size is large enough

td(i) = td(i) + tdst; %Take a step with td(i)

if td(i) < 0 %Restrict td(i) to non-zero values

td(i) = 0;

end

dd = 1 - exp(-del\*td(i)); %Discrimination fraction

c0 = (1 - dd)^om; %c0 can depend on d(i)

m1 = dd\*c1 + (1 - dd)\*c0; %Mate prob for encountered 1

m2 = dd\*c2 + (1 - dd)\*c0; %Mate prob for encountered 2

%Time spent with a female

T1 = td(i) + m1\*gam1\*t1 + m1\*(gam1\*tf + tn)\*(1-b1)/b1;

T2 = td(i) + m2\*gam2\*t2 + m2\*(gam2\*tf + tn)\*(1-b2)/b2;

the1 = (gam1\*tf + tn)/b1; %Time female spends with mate 1

the2 = (gam2\*tf + tn)/b2; %Time female spends wiht mate 2

sig = sigp\*(ff1\*lam1 + ff2\*lam2)/lamf; %Sex ratio

%bb and cc are terms in the quadratic equation for tau12

bb = T1+T2-sig\*(ff1\*m1\*the1 + ff2\*m2\*the2 + td(i));

cc = T1\*T2 - sig\*(ff1\*T2\*(m1\*the1 + td(i)) ...

+ ff2\*T1\*(m2\*the2 + td(i)));

ttau = (-bb + sqrt(bb\*bb - 4\*cc))/2; %tau12 quadratic

pp1 = ff1\*(ttau+T2)/(ff1\*(ttau+T2) + ...

ff2\*(ttau+T1)); %Type 1 male freq in mate pool

pp2 = 1 - pp1; %Type 2 male freq in mate pool

pp3 = 0; %Type 3 male freq in mate pool

Ff(i) = lamf\*(pp1\*m1\*gam1\*r1/b1+pp2\*m2\*gam2...%Female fit

\*r2/b2)/(pp1\*m1\*the1 + pp2\*m2\*the2 + td(i));

F1y = lam1\*(m1\*gam1\*r1/b1)/(ttau + T1); %Baseline F1

F2y = lam2\*(m2\*gam2\*r2/b2)/(ttau + T2); %Baseline F2

FF1 = (1-k12\*ff2)\*F1y; %Type 1 male fitness

FF2 = ff1\*k12\*F1y + F2y; %Type 2 male fitness

if (Ff(i) < Ffold)||((td(i) <= 0)&&(tdst < 0))

tdst = -tdst/2.1; %Reverse direction and shrink step

end

Ffold = Ff(i); %Store Ff as Ffold for next loop comparison

end

if FF1 > FF2 %Reverse direction and shrink step size?

if ((ff1st < 0)&&(ff1 < 1))||((ff1st > 0)&&(ff1 >= 1))

ff1st = - ff1st/2.1;

end

elseif FF2 > FF1 %Reverse direction and shrink step size?

if ((ff1st > 0)&&(ff1 > 0))||((ff1st < 0)&&(ff1 <= 0))

ff1st = -ff1st/2.1;

end

end

end

ttd = td(i); td(i) = 0; %Prevents td(i) carry-over to other cases

FF3 = lam3\*gam3\*r3/(ttau+T3)+k13\*ff1\*F1y+k23\*ff2\*F2y; %Coercer fit

if (FF1 > FF3) %Coercer cannot invade

if flag %Signals 0<f1<1

ESS = [ESS 12]; %Stores ESS result

FLAG = 0; %No unstable 3-type mix is possible

d(i) = dd; td(i) = ttd; tau(i) = ttau; %Set d, td, tau

p1(i) = pp1; p2(i) = pp2; p3(i) = pp3; %fractions in pool

M1(i) = p1(i)\*m1/(p1(i)\*m1 + p2(i)\*m2); %type 1 mate frac

M2(i) = 1 - M1(i); %type 2 mate frac

M3(i) = 0; %type 3 mate frac

f3(i) = 0; %No type 3 males in this case

f1(i) = ff1; f2(i) = ff2; %Set fractions of types 1 & 2

F1(i) = FF1; F2(i) = FF2; F3(i) = FF3; %Set fitnesses

else %f1(i)>1 or f1(i)<0

if ff1 >= 1 %Type 1 tends to frequency 1

ESS = [ESS 1201]; %Unstable 1-2 mix dominated by type 1

f12(i) = 0.9; %Store graph indicator of 1201

else %f(i) <= 0, Type 2 -> frequency 1

ESS = [ESS 1202]; %Unstable 1-2 mix dominated by type 2

f12(i) = 0.1; %Store graph indicator of 1202

end

d(i) = 0; td(i) = 0; tau(i) = 0; %Set all values to zero

f1(i) = 0; f2(i) = 0; f3(i) = 0;

F1(i) = 0; F2(i) = 0; F3(i) = 0;

p1(i) = 0; p2(i) = 0; p3(i) = 0;

M1(i) = 0; M2(i) = 0; M3(i) = 0;

end

elseif FLAG %Restore the null results and T1 and T2 + non-discr 1-2

FLAG = 0; FLAG123 = 1; %123 is a potential outcome

end

end %ends the if for the 12 mixture case

T1 = gam1\*t1 + (gam1\*tf + tn)\*(1 - b1)/b1; %Set T1 & T2 to no-discrim

T2 = gam2\*t2 + (gam2\*tf + tn)\*(1 - b2)/b2;

if (F13 > F33)&&(F31 > F11) %Condition for 1-3 mix ESS

aa = (sigp/lamf)\*(lam1-lam3)\*(tau13\*(the1-the3)+T3\*the1-T1\*the3);

bb = (sigp/lamf)\*lam3\*(tau13\*(the1-the3)+the1\*T3-the3\*T1);

cc = lam3\*the3\*(sigp/lamf)\*(tau13+T1)-tau13^2-(T1+T3)\*tau13-T1\*T3;

if abs(aa) < 1e-6 %aa, bb, & cc are quadratic terms

f1y = -cc/bb; %Solves the linear equation

else

f1y = (-bb + sqrt(bb^2 - 4\*aa\*cc))/(2\*aa); %Solve the quadratic

end

if f1y >= 1 %Type 1 only, correct fits for extra-pair

F113 = F113y;

F213 = F213y + k12\*F113y;

elseif f1y <= 0 %Type 3 only, correct fits for extra-pair

F113 = F113y\*(1-k13);

F213 = F213y\*(1-k23);

else %Types 1 & 3 both present -> corrections

F113 = F113y\*(1-k13\*(1-f1y));

F213 = F213y\*(1-k23\*(1-f1y)) + f1y\*k12\*F113y;

end

if F113 > F213 %Type 2 cannot invade

if (f1y >= 1)||(f1y <= 0) %Outcome unstable

if f1y >= 1

ESS = [ESS 1301]; %Unstable 1-3 mix dominated by type 1

f13(i) = 0.9; %Store graph indicator of 1301

else %f1(i) <= 0

ESS = [ESS 1303]; %Unstable 1-3 mix dominated by type 3

f13(i) = 0.1; %Store graph indicator of 1303

end

tau(i) = 0; %Set variables to zero

f1(i) = 0; f2(i) = 0; f3(i) = 0;

p1(i) = 0; p2(i) = 0; p3(i) = 0;

M1(i) = 0; M2(i) = 0; M3(i) = 0;

F1(i) = 0; F2(i) = 0; F3(i) = 0;

d(i) = 0; td(i) = 0;

else %Outcome stable

ESS = [ESS 13]; %Stable 1-3 mix

FLAG = 0; %No unstable 3-type mix is possible

f1(i) = f1y; %Variables determined as above

f3(i) = 1 - f1(i);

f2(i) = 0;

tau(i) = tau13;

F1(i) = F113; F2(i) = F213; F3(i) = F113;

p1(i) = f1(i)\*(tau(i)+T3)/(f1(i)\*(tau(i)+T3) + f3(i) ...

\*(tau(i)+T1));

p3(i) = 1 - p1(i);

p2(i) = 0;

M1(i) = p1(i); M2(i) = p2(i); M3(i) = p3(i);

d(i) = 0; td(i) = 0;

f123(i) = 0; %Removing the 12300 signal if present

end

elseif FLAG %F113 < F213 and type 2 can invade

FLAG = 0; FLAG123 = 1; %123 is a potential outcome

end

end

if (F23 > F33)&&(F32 > F22) %Condition for 2-3 mix ESS

aa = (sigp/lamf)\*(lam2-lam3)\*(tau23\*(the2-the3)+T3\*the2-T2\*the3);

bb = (sigp/lamf)\*lam3\*(tau23\*(the2-the3)+the2\*T3-the3\*T2);

cc = lam3\*the3\*(sigp/lamf)\*(tau23+T2)-tau23^2-(T2+T3)\*tau23-T2\*T3;

f2y = (-bb + sqrt(bb^2 - 4\*aa\*cc))/(2\*aa); %Quadratic for f2

if abs(aa) < 1e-6

f2y = -cc/bb;

else

f2y = (-bb + sqrt(bb^2 - 4\*aa\*cc))/(2\*aa); %Solve the quadr

end

if f2y >= 1

F323 = F323y + k23\*F223y;

F123 = F123y\*(1-k12);

elseif f2y <= 0

F323 = F323y;

F123 = F123y\*(1-k13);

else

F323 = F323y + k23\*f2y\*F223y;

F123 = F123y\*(1-k12\*f2y-k13\*(1-f2y));

end

if F323 > F123 %Type 1 cannot invade

if (f2y >= 1)||(f2y <= 0) %If f2 is out of range (unstable mix)

if f2y >= 1

ESS = [ESS 2302]; %Unstable 2-3 mix dominated by 2

f23(i) = 0.9; %Store graph indicator of 2302

else %f2(i) <= 0

ESS = [ESS 2303]; %Unstable 2-3 mix dominated by 3

f23(i) = 0.1; %Store graph indicator of 2303

end

tau(i) = 0;

f1(i) = 0; f2(i) = 0; f3(i) = 0;

p1(i) = 0; p2(i) = 0; p3(i) = 0;

M1(i) = 0; M2(i) = 0; M3(i) = 0;

F1(i) = 0; F2(i) = 0; F3(i) = 0;

d(i) = 0; td(i) = 0;

else

ESS = [ESS 23]; %Stable 2-3 mix

FLAG = 0; %No unstable 3-type mix is possible

f2(i) = f2y;

f3(i) = 1 - f2(i);

f1(i) = 0;

tau(i) = tau23;

F1(i) = F123; F2(i) = F223; F3(i) = F323;

p2(i) = f2(i)\*(tau(i)+T3)/(f2(i)\*(tau(i)+T3) + f3(i) ...

\*(tau(i)+T2));

p3(i) = 1 - p2(i);

p1(i) = 0;

M1(i) = p1(i); M2(i) = p2(i); M3(i) = p3(i);

d(i) = 0; td(i) = 0;

end

elseif FLAG %F323 < F123 and type 1 can invade

FLAG = 0; FLAG123 = 1; %123 is a potential outcome

end

end

if FLAG123&&(numel(ESS) == 0) %123 outcome applies if no ESS's

ESS = [123];

f123(i) = 0.3333; tau(i) = 0; %Set variables to zero

f1(i) = 0; f2(i) = 0; f3(i) = 0;

F1(i) = 0; F2(i) = 0; F3(i) = 0;

p1(i) = 0; p2(i) = 0; p3(i) = 0;

M1(i) = 0; M2(i) = 0; M3(i) = 0;

d(i) = 0; td(i) = 0;

end

if (ESS ~= ESSold) %Send each new ESS to screen with boundary x value

disp(x(i))

disp(ESS)

elseif (numel(ESS) ~= numel(ESSold)) %Check for double ESS

disp(x(i))

disp(ESS)

end

ESSold = ESS; %Update ESSold so new ESS's can be recognized

end

disp(1)

%Four output figures

figure %Figure 1 Frequencies of Male Types

hold on

plot([xdef xdef],[0 1],'k--')

plot(x,f1,'b')

plot(x,f2,'r')

plot(x,f3,'g')

plot(x,f12,'Color',[1,0.5,1]) %Unstable 1-2 mix is purple

plot(x,f13,'Color',[1,0.5,0]) %Unstable 1-3 mix is orange

plot(x,f23,'c') %Unstable 2-3 mix is cyan

plot(x,f123,'k') %Unstable 1-2-3 mix is black

xlabel('Reproductive success of type 2 males, r2')

%xlabel('Reproductive success of type 3 males, r3')

ylabel('Frequencies: f1=blue, f2=red, f3=green')

axis([0 xmax 0 1])

hold off

figure %Figure 2 Tau and td

hold on

AX=plotyy(x,tau,x,td,'plot');

plot([xdef xdef],[0 8],'k--')

axis([0 xmax 0 8])

set(get(AX(1),'Ylabel'),'String','Time in male pool (tau, blue)')

set(get(AX(2),'Ylabel'),'String','Discrimination time (td, carmine)')

set(AX(1),'Ylim',[0 8])

set(AX(2),'Ylim',[0 0.2])

set(AX(1),'YTick',[0:1:8])

set(AX(2),'YTick',[0:0.02:0.2])

xlabel('Reproductive success of type 2 males, r2')

%xlabel('Reproductive success of type 3 males, r3')

hold off

figure %Figure 3 Fitnesses

hold on

%plot(x,Ff,'k')

plot(x,F1,'b')

plot(x,F2,'r')

plot(x,F3,'g')

plot([xdef xdef],[0 0.2],'k--')

axis([0 xmax 0 0.2])

xlabel('Reproductive success of type 2 males, r2')

%xlabel('Reproductive success of type 3 males, r3')

ylabel('Fitnesses: males 1=blue 2=red 3=green; females=top male')

hold off

figure %Figure 4 Pool proportions and d

hold on

plot(x,p1,'c')

plot(x,p2,'Color',[1,0.5,0])

plot(x,M1,'b')

plot(x,M2,'r')

plot(x,M3,'g')

plot(x,d,'k')

plot([xdef xdef],[0 1],'k--')

axis([0 xmax 0 1])

xlabel('Reproductive success of type 2 males, r2')

%xlabel('Reproductive success of type 3 males, r3')

ylabel('M1=blue, p1=cyan; M2=red, p2=orange; M3=green; d=black')

hold off