% PUB\_STRAT\_CLEAN solves the simultaneous differential equations model of Higginson & Munafo.

% This code carries out the sensitivity analysis of the appendix.

% The remaining code is available at: https://zenodo.org/record/155251#.V-jQSDKZMi4

% numeric parameters

V\_expWeighting=0.09; % funding bias to sig exploratory

V\_maxSample=2000; % maximum sample size

V\_effectRealExp=0.2; % probability exploratory has real effect

V\_effectSizeExp=0.21; % effect size of exploratory

V\_effectSizeCon=0.21; % effect size of confirmatory

V\_falsepos=0.05; % alpha

V\_stdev=1; % standard deviation

V\_setupcost=20; % baseline cost of each experiment

V\_minsamp=3; % minimum community acknowledged sample size

V\_sampsizeCon=100; % size of confirmatory test

V\_propAcceptCon=0.5; % proportion of confirmatory accepted

V\_dimintot=0.9; % rate of diminshing value of publications

V\_maxratio=10; % maximum power allowed

%[~,~,panlabels]=subplotarrange(6);

% create symbolic things

syms sampsizeExp propExp expWeighting maxSample effectRealExp maxratio

syms effectSizeExp effectSizeCon falsepos stdev setupcost minsamp sampsizeCon propAcceptCon dimintot

%%%%%%%% MODEL %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% approximation for power

mstar=(-(pi()\*stdev^2./(2\*sampsizeExp)).\*log(4\*falsepos.\*(1-falsepos)));

brac=(2./(pi()\*(stdev^2./sampsizeExp))).\*(sqrt(mstar)-effectSizeExp).^2;

signm=((mstar-effectSizeExp^2))./(sqrt((mstar-effectSizeExp^2).^2)+10^-12);

powerExp=0.5-0.5.\*signm.\*sqrt(1-exp(-1\*brac));

% approximation for power

mstar=(-(pi()\*stdev^2./(2\*sampsizeCon)).\*log(4\*falsepos.\*(1-falsepos)));

brac=(2./(pi()\*(stdev^2./sampsizeCon))).\*(sqrt(mstar)-effectSizeCon).^2;

signm=((mstar-effectSizeCon^2))./(sqrt((mstar-effectSizeCon^2).^2)+10^-12);

powerCon=0.5-0.5.\*signm.\*sqrt(1-exp(-1\*brac));

% acceptability by journal

accprob=1-minsamp./sampsizeExp;

% all exploratory non-sig are file drawered

nExp=propExp.\*(maxSample./(setupcost+2\*sampsizeExp)).\*accprob.\*(powerExp.\*effectRealExp+falsepos.\*(1-effectRealExp));

% number of exploratory wrong

nWrongExp=propExp.\*(maxSample./(setupcost+2\*sampsizeExp)).\*accprob.\*falsepos.\*(1-effectRealExp);

% publication in exploratory and confirmatory

% proportion of confirmatory are published if not significant

% all published if significant

pWrongExp=(nWrongExp+10.^-6)/(nExp+10.^-6);

nCon=(1-propExp)\*maxSample./(setupcost+2\*sampsizeCon)\*...

 ((powerCon.\*(1-pWrongExp)+falsepos.\*pWrongExp)... % significant: TP & FP

 +propAcceptCon\*((1-powerCon).\*(1-pWrongExp)+(1-falsepos).\*pWrongExp)); % non-sig: FN & TN

 % total false negatives

nFalseNeg=(1-propExp).\*(maxSample./(setupcost+2\*sampsizeCon)).\*((1-powerCon).\*(nWrongExp/nExp))...

 +propExp.\*(maxSample./(setupcost+2\*sampsizeExp)).\*((1-powerExp).\*effectRealExp);

propFalseNeg=nFalseNeg./((1-propExp).\*(maxSample./(setupcost+2\*sampsizeCon))+propExp.\*(maxSample./(setupcost+2\*sampsizeExp)));

% wrong published: false positive and false negative

nWrong=(1-propExp).\*(maxSample./(setupcost+2\*sampsizeCon)).\*propAcceptCon\*(falsepos.\*(1-(nWrongExp/nExp))+(1-powerCon).\*(nWrongExp/nExp))...

+propExp.\*(maxSample./(setupcost+2\*sampsizeExp)).\*accprob.\*falsepos.\*(1-effectRealExp);

propWrong=nWrong./(nCon+nExp);

% fitness is sum of two things - weighted impact factor and number with diminishing returns

fitness=(expWeighting.\*nExp)+(1-exp(-dimintot\*(nExp+nCon.\*(1./(1+exp((nCon/(nExp+10^-6)-maxratio)))))));%

% SENSIVITY ANALYSIS

if dosens==1

 nvarvals=51;

 dmnvals=[0.55 0.55 0.9 0.9]%0.5:0.05:0.8%

 eWvals=[ 0.055 0.09 0.055 0.09]%0.05:0.005:0.08%;

 FitSci=nan(5,6,nvarvals,length(dmnvals));

 optsval4D=nan(5,6,nvarvals,length(dmnvals));

 optpval4D=nan(5,6,nvarvals,length(dmnvals));

 optnCon4D=nan(5,6,nvarvals,length(dmnvals));

 optnExp4D=nan(5,6,nvarvals,length(dmnvals));

 optwrong4D=nan(5,6,nvarvals,length(dmnvals));

 % loop over the fitness functions

 for fitfuncnum=1:5

 % loop over the fitness parameters

 for fitpars=1:length(dmnvals)

 V\_expWeighting=eWvals(fitpars);

 V\_dimintot=dmnvals(fitpars);

 % loop over the variable of interest

 for varn=1:6

 % check the values of the others

 V\_minsamp=3;

 V\_falsepos=0.05; % alpha

 V\_setupcost=20; % baseline cost of each experiment

 V\_effectRealExp=0.2; % probability exploratory has real effect

 V\_effectSizeExp=0.21; % effect size of exploratory

 V\_effectSizeCon=0.21; % effect size of confirmatory

 V\_stdev=1; % standard deviation

 V\_propAcceptCon=0.5; % for one of the analyses

 % loop over the values

 for x1=1:nvarvals

 switch varn

 case 1

 V\_setupcost=100\*(x1)/(nvarvals);

 case 2

 V\_effectRealExp=0.2\*2\*(x1)/(nvarvals);

 case 3

 V\_effectSizeExp=0.21\*3\*(x1)/(nvarvals);

 case 4

 V\_effectSizeCon=0.21\*3\*(x1)/(nvarvals);

 case 5

 V\_stdev=2\*(x1)/(nvarvals);

 case 6

 V\_propAcceptCon=(x1-1)/(nvarvals-1);

 end

 paramnames={expWeighting dimintot setupcost effectRealExp effectSizeExp effectSizeCon minsamp falsepos maxSample stdev propAcceptCon sampsizeCon maxratio };

 paramvals={V\_expWeighting V\_dimintot V\_setupcost V\_effectRealExp V\_effectSizeExp V\_effectSizeCon V\_minsamp V\_falsepos V\_maxSample V\_stdev V\_propAcceptCon V\_sampsizeCon V\_maxratio };

 % simplify things

 optwrong=subs(propWrong,paramnames,paramvals);

 optnCon=subs(nCon,paramnames,paramvals);

 optnExp=subs(nExp,paramnames,paramvals);

 V\_fitness=subs(fitness,paramnames,paramvals);

 % get the optimal strategy

 [optx,opty]=findmaxsym(V\_fitness,propExp,sampsizeExp,0,[0 1],[1 V\_maxSample/20],[1 1]);

 optx=optx(~isnan(optx));

 opty=opty(~isnan(opty));

 optpval4D(fitfuncnum,varn,x1,fitpars)=optx(numel(optx));

 optsval4D(fitfuncnum,varn,x1,fitpars)=opty(numel(opty));

 % fill in the other stuff

 optwrong4D(fitfuncnum,varn,x1,fitpars)=double(subs(optwrong,{propExp,sampsizeExp},{optpval4D(fitfuncnum,varn,x1,fitpars),optsval4D(fitfuncnum,varn,x1,fitpars)}));

 optnCon4D(fitfuncnum,varn,x1,fitpars)=double(subs(optnCon,{propExp,sampsizeExp},{optpval4D(fitfuncnum,varn,x1,fitpars),optsval4D(fitfuncnum,varn,x1,fitpars)}));

 optnExp4D(fitfuncnum,varn,x1,fitpars)=double(subs(optnExp,{propExp,sampsizeExp},{optpval4D(fitfuncnum,varn,x1,fitpars),optsval4D(fitfuncnum,varn,x1,fitpars)}));

 switch fitfuncnum

 case 1

 FitSci(fitfuncnum,varn,x1,fitpars)=(optnCon4D(fitfuncnum,varn,x1,fitpars).\*optnExp4D(fitfuncnum,varn,x1,fitpars)).\*(1-optwrong4D(fitfuncnum,varn,x1,fitpars))/2;

 case 2

 FitSci(fitfuncnum,varn,x1,fitpars)=(optnCon4D(fitfuncnum,varn,x1,fitpars).\*optnExp4D(fitfuncnum,varn,x1,fitpars));

 case 3

 FitSci(fitfuncnum,varn,x1,fitpars)=(optnExp4D(fitfuncnum,varn,x1,fitpars)+optnCon4D(fitfuncnum,varn,x1,fitpars).\*optnExp4D(fitfuncnum,varn,x1,fitpars)/3).\*(1-optwrong4D(fitfuncnum,varn,x1,fitpars));

 case 4

 FitSci(fitfuncnum,varn,x1,fitpars)=(optnCon4D(fitfuncnum,varn,x1,fitpars)+optnCon4D(fitfuncnum,varn,x1,fitpars).\*optnExp4D(fitfuncnum,varn,x1,fitpars)/3).\*(1-optwrong4D(fitfuncnum,varn,x1,fitpars));

 case 5

 FitSci(fitfuncnum,varn,x1,fitpars)=((optnCon4D(fitfuncnum,varn,x1,fitpars)+optnExp4D(fitfuncnum,varn,x1,fitpars))/2+(optnCon4D(fitfuncnum,varn,x1,fitpars).\*optnExp4D(fitfuncnum,varn,x1,fitpars))/3).\*(1-optwrong4D(fitfuncnum,varn,x1,fitpars));

 end

 end

 end

 end

 end

end