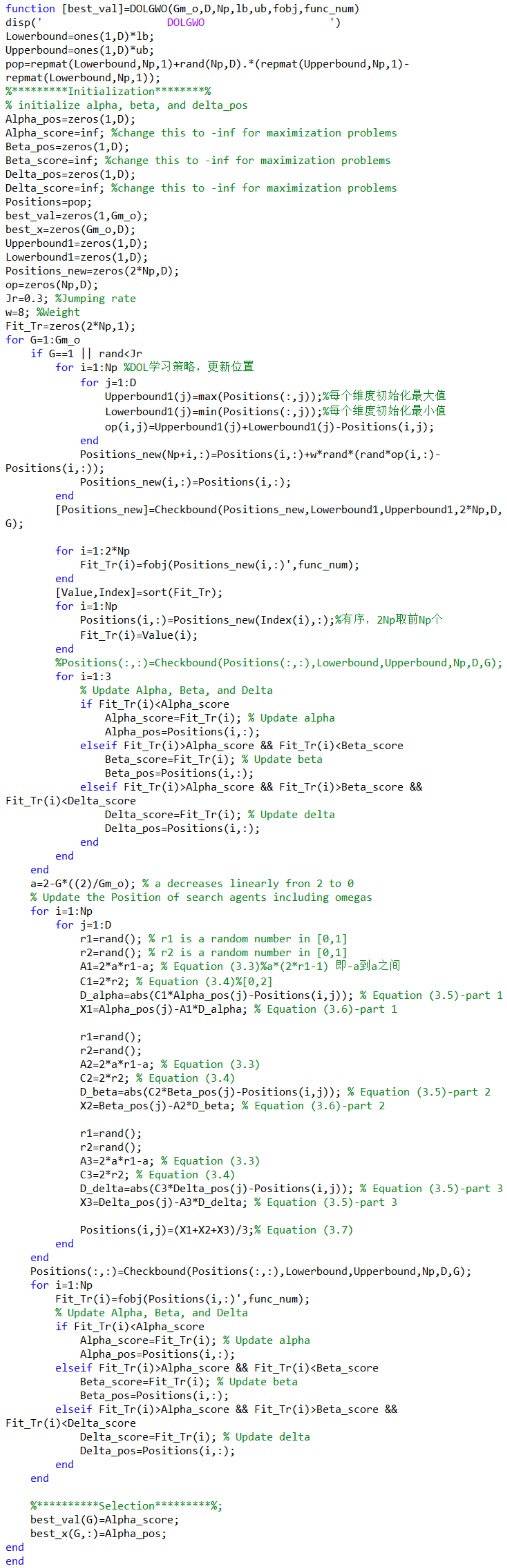
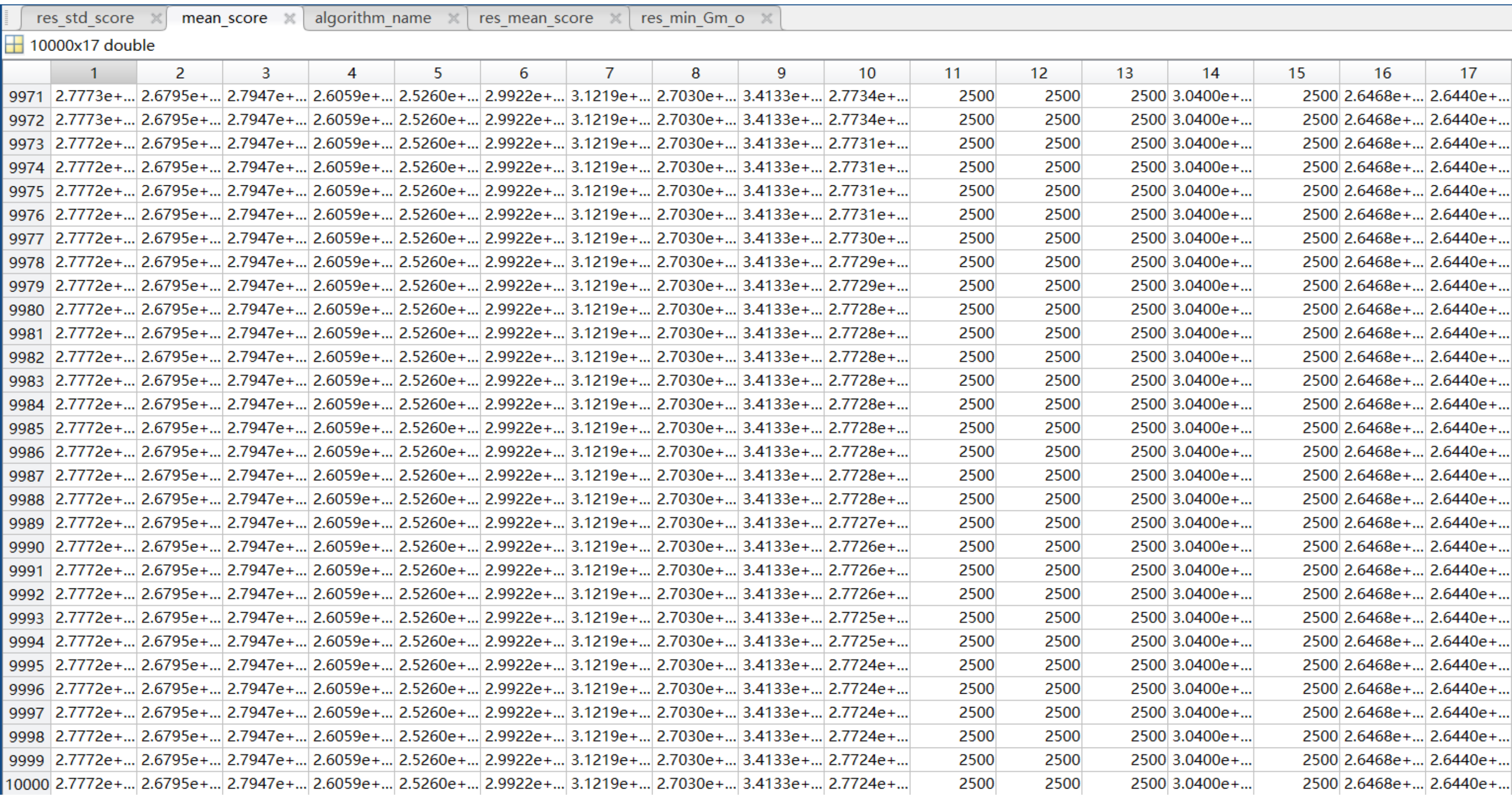


```
function [best_val]=DOLGWO(Gm_o,D,Np,lb,ub,fobj,func_num)
disp('                    DOLGWO                    ')
Lowerbound=ones(1,D)*lb;
Upperbound=ones(1,D)*ub;
pop=repmat(Lowerbound,Np,1)+rand(Np,D).*(repmat(Upperbound,Np,1)-
repmat(Lowerbound,Np,1));
%*********Initialization********%
% initialize alpha, beta, and delta_pos
Alpha_pos=zeros(1,D);
Alpha_score=inf; %change this to -inf for maximization problems
Beta_pos=zeros(1,D);
Beta_score=inf; %change this to -inf for maximization problems
Delta_pos=zeros(1,D);
Delta_score=inf; %change this to -inf for maximization problems
Positions=pop;
best_val=zeros(1,Gm_o);
best_x=zeros(Gm_o,D);
Upperbound1=zeros(1,D);
Lowerbound1=zeros(1,D);
Positions_new=zeros(2*Np,D);
op=zeros(Np,D);
Jr=0.3; %Jumping rate
w=8; %Weight
Fit_Tr=zeros(2*Np,1);
for G=1:Gm_o
    if G==1 || rand<Jr
        for i=1:Np %DOL学习策略，更新位置
            for j=1:D
                Upperbound1(j)=max(Positions(:,j));%每个维度初始化最大值
                Lowerbound1(j)=min(Positions(:,j));%每个维度初始化最小值
                op(i,j)=Upperbound1(j)+Lowerbound1(j)-Positions(i,j);
            end
            Positions_new(Np+i,:)=Positions(i,:)+w*rand*(rand*op(i,:)-
Positions(i,:));
            Positions_new(i,:)=Positions(i,:);
        end
        [Positions_new]=Checkbound(Positions_new,Lowerbound1,Upperbound1,2*Np,D,
G);

        for i=1:2*Np
            Fit_Tr(i)=fobj(Positions_new(i,:)',func_num);
        end
        [Value,Index]=sort(Fit_Tr);
        for i=1:Np
            Positions(i,:)=Positions_new(Index(i),:);%有序，2Np取前Np个
            Fit_Tr(i)=Value(i);
        end
        %Positions(:,:)=Checkbound(Positions(:,:),Lowerbound,Upperbound,Np,D,G);
        for i=1:3
            % Update Alpha, Beta, and Delta
            if Fit_Tr(i)<Alpha_score
                Alpha_score=Fit_Tr(i); % Update alpha
                Alpha_pos=Positions(i,:);
            elseif Fit_Tr(i)>Alpha_score && Fit_Tr(i)<Beta_score
                Beta_score=Fit_Tr(i); % Update beta
                Beta_pos=Positions(i,:);
            elseif Fit_Tr(i)>Alpha_score && Fit_Tr(i)>Beta_score &&
Fit_Tr(i)<Delta_score
                Delta_score=Fit_Tr(i); % Update delta
                Delta_pos=Positions(i,:);
            end
        end
    end
    a=2-G*((2)/Gm_o); % a decreases linearly fron 2 to 0
    % Update the Position of search agents including omegas
    for i=1:Np
        for j=1:D
            r1=rand(); % r1 is a random number in [0,1]
            r2=rand(); % r2 is a random number in [0,1]
            A1=2*a*r1-a; % Equation (3.3)%a*(2*r1-1) 即-a到a之间
            C1=2*r2; % Equation (3.4)%[0,2]
            D_alpha=abs(C1*Alpha_pos(j)-Positions(i,j)); % Equation (3.5)-part 1
            X1=Alpha_pos(j)-A1*D_alpha; % Equation (3.6)-part 1

            r1=rand();
            r2=rand();
            A2=2*a*r1-a; % Equation (3.3)
            C2=2*r2; % Equation (3.4)
            D_beta=abs(C2*Beta_pos(j)-Positions(i,j)); % Equation (3.5)-part 2
            X2=Beta_pos(j)-A2*D_beta; % Equation (3.6)-part 2

            r1=rand();
            r2=rand();
            A3=2*a*r1-a; % Equation (3.3)
            C3=2*r2; % Equation (3.4)
            D_delta=abs(C3*Delta_pos(j)-Positions(i,j)); % Equation (3.5)-part 3
            X3=Delta_pos(j)-A3*D_delta; % Equation (3.5)-part 3

            Positions(i,j)=(X1+X2+X3)/3;% Equation (3.7)
        end
    end
    Positions(:,:)=Checkbound(Positions(:,:),Lowerbound,Upperbound,Np,D,G);
    for i=1:Np
        Fit_Tr(i)=fobj(Positions(i,:)',func_num);
        % Update Alpha, Beta, and Delta
        if Fit_Tr(i)<Alpha_score
            Alpha_score=Fit_Tr(i); % Update alpha
            Alpha_pos=Positions(i,:);
        elseif Fit_Tr(i)>Alpha_score && Fit_Tr(i)<Beta_score
            Beta_score=Fit_Tr(i); % Update beta
            Beta_pos=Positions(i,:);
        elseif Fit_Tr(i)>Alpha_score && Fit_Tr(i)>Beta_score &&
Fit_Tr(i)<Delta_score
            Delta_score=Fit_Tr(i); % Update delta
            Delta_pos=Positions(i,:);
        end
    end

    %**********Selection*********%;
    best_val(G)=Alpha_score;
    best_x(G,:)=Alpha_pos;
end
end
```



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
9971	2.7773e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7734e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9972	2.7773e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7734e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9973	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7731e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9974	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7731e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9975	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7731e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9976	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7731e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9977	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7730e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9978	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7729e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9979	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7729e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9980	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9981	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9982	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9983	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9984	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9985	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9986	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9987	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9988	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7728e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9989	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7727e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9990	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7726e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9991	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7726e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9992	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7726e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9993	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7725e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9994	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7725e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9995	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9996	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9997	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9998	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
9999	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...
10000	2.7772e+...	2.6795e+...	2.7947e+...	2.6059e+...	2.5260e+...	2.9922e+...	3.1219e+...	2.7030e+...	3.4133e+...	2.7724e+...	2500	2500	2500	3.0400e+...	2500	2.6468e+...	2.6440e+...