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% Example 4.7 %

% Copulas in Portfolio Loss Computation %

% 5 Sectors - Low Correlation %

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% 1. Load Data

ptforig=dataset('XLSFile','Chap4copula5.xlsx');

ptf=ptforig(:,{'SECTOR','ID','EXPOSURE','PD','LGD'});

% 2. Parameter set-up

randn('state', 1234567);

ncustomer=size(ptf,1);

nsim=10000;

nsec=5;

corr=0.1;

corrmat2=NaN(nsec,nsec);

for i=1:nsec

for j=1:nsec

if i==j

corrmat2(i,j)=1;

else

corrmat2(i,j)=corr;

end

end

end

% 3. Copula random simulation

rndcopula2 = copularnd('Gaussian',corrmat2, nsim)';

% 4. Database enrichement with copula simulations

ss=[1 2 3 4 5]';

rndnew2 = dataset({ss, 'SECTOR'},...

{rndcopula2(:,:),'NameRnd'});

joindb = join(ptf,rndnew2);

ptfcopula2 = double(joindb);

% 5. Default simulation and portfolio evaluation

simdefault2 = NaN(ncustomer,nsim);

for i=1:ncustomer

for j=1:nsim

verif= ptfcopula2(i,4)- ptfcopula2(i,5+j);

if(verif>=0)

simdefault2(i,j)= (1-ptfcopula2(i,5))\*ptfcopula2(i,3); % 1-LGD

else

simdefault2(i,j)= 1\*ptfcopula2(i,3);

end

end

end

ptfvalue2 =sum(simdefault2);

% 6. Loss computation

loss2=sum(ptfcopula2(:,3)) - ptfvalue2;

q999copula2=quantile(loss2,0.999);

UL999copula2= q999copula2 - mean(loss2);

% 1.8279e+06

UL999copula2/sum(ptfcopula2(:,3))

% 0.1828

sortloss2=sort(loss2);

ES999loss2=mean(sortloss2(1,0.999\*nsim:end));

ULEL2=ES999loss2-mean(loss2);

aa2=[q999copula2; ES999loss2; UL999copula2;ULEL2];

% 7. Check bias

EL=sum(ptfcopula2(:,3).\*ptfcopula2(:,4).\*ptfcopula2(:,5));

verificaloss=(mean(loss2)-EL)/EL;

% 1.6303e+05

% 0.0899

% Graph

figure; spessore=15; hold('on');

hist(loss2, 80); set(gca,'XLim',[100000 2000000]);

title('Low correlation 5 sectors','Fontsize',spessore);

xlabel('Loss','Fontsize',spessore), ylabel('Frequency','Fontsize',spessore);

FontSizeAxes=spessore;

set(gca,'FontSize',FontSizeAxes);

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]);

set(gcf, 'PaperOrientation', 'landscape');

%%

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Example 4.7 %

% Copulas in Portfolio Loss Computation %

% 5 Sectors - High Correlation %

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% 1. Load Data

ptforig=dataset('XLSFile','Chap4copula5.xlsx');

ptf=ptforig(:,{'SECTOR','ID','EXPOSURE','PD','LGD'});

% 2. Parameter set-up

randn('state', 1234567);

ncustomer=size(ptf,1);

nsim=10000;

nsec=5;

corr=0.5;

corrmat2=NaN(nsec,nsec);

for i=1:nsec

for j=1:nsec

if i==j

corrmat2(i,j)=1;

else

corrmat2(i,j)=corr;

end

end

end

% 3. Copula random simulation

rndcopula2 = copularnd('Gaussian',corrmat2, nsim)';

% 4. Database enrichement with copula simulations

ss=[1 2 3 4 5]';

rndnew2 = dataset({ss, 'SECTOR'},...

{rndcopula2(:,:),'NameRnd'});

joindb = join(ptf,rndnew2);

ptfcopula2 = double(joindb);

% 5. Default simulation and portfolio evaluation

simdefault2 = NaN(ncustomer,nsim);

for i=1:ncustomer

for j=1:nsim

verif= ptfcopula2(i,4)- ptfcopula2(i,5+j);

if(verif>=0)

simdefault2(i,j)= (1-ptfcopula2(i,5))\*ptfcopula2(i,3); % 1-LGD

else

simdefault2(i,j)= 1\*ptfcopula2(i,3);

end

end

end

ptfvalue2 =sum(simdefault2);

% 6. Loss computation

loss2=sum(ptfcopula2(:,3)) - ptfvalue2;

q999copula2=quantile(loss2,0.999);

UL999copula2= q999copula2 - mean(loss2);

% 1.8279e+06

UL999copula2/sum(ptfcopula2(:,3));

% 0.1828

sortloss2=sort(loss2);

ES999loss2=mean(sortloss2(1,0.999\*nsim:end));

ULEL2=ES999loss2-mean(loss2);

aa2=[q999copula2; ES999loss2; UL999copula2; ULEL2]

% 7. Check bias

EL=sum(ptfcopula2(:,3).\*ptfcopula2(:,4).\*ptfcopula2(:,5));

verificaloss=(mean(loss2)-EL)/EL;

% 1.6303e+05

% 0.0899

figure; spessore=15; hold('on');

hist(loss2, 80); set(gca,'XLim',[100000 2000000]);

title('High correlation 5 sectors','Fontsize',spessore);

xlabel('Loss','Fontsize',spessore), ylabel('Frequency','Fontsize',spessore);

FontSizeAxes=spessore;

set(gca,'FontSize',FontSizeAxes);

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]); %left bottom width heigh

set(gcf, 'PaperOrientation', 'landscape');

%%

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Figure all 3 alternatives %

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

figure; spessore=15; hold('on');

% 1.

subplot(1,3,1);

hist(lossgran, 80); set(gca,'XLim',[100000 2000000]);

title('Low correlation 20 sectors','Fontsize',spessore);

xlabel('Loss','Fontsize',spessore), ylabel('Frequency','Fontsize',spessore);

FontSizeAxes=spessore;

set(gca,'FontSize',FontSizeAxes);

% 2.

subplot(1,3,2); hist(loss1, 80); set(gca,'XLim',[100000 2000000]);

title('Low correlation 5 sectors','Fontsize',spessore);

xlabel('Loss','Fontsize',spessore);

FontSizeAxes=spessore;

set(gca,'FontSize',FontSizeAxes);

% 3.

subplot(1,3,3); hist(loss2, 80); set(gca,'XLim',[100000 2000000]);

title('High correlation 5 sectors','Fontsize',spessore);

xlabel('Loss','Fontsize',spessore);

FontSizeAxes=spessore;

set(gca,'FontSize',FontSizeAxes);

set(gcf, 'PaperPositionMode', 'manual');

set(gcf, 'PaperUnits', 'centimeters');

set(gcf, 'PaperPosition', [0.5 0.5 28 20]); %left bottom width heigh

set(gcf, 'PaperOrientation', 'landscape');