S.4 MatLAB Scripts, Data, & Frequency Histograms Showing Results from the Monte Carlo Analyses

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- **SNAKE RIVER STEELHEAD UNIMPOUNDED scaled by time (per day)**
- **#8 SNAKE RIVER STEELHEAD UNIMPOUNDED comparison with FRASER STEELHEAD scaled by time (per day)**
- **COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by time (per day) 2002**
- **COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by time (per day) 2003**
- **#9 COLUMBIA-SNAKE ENTIRE STEELHEAD comparison with FRASER STEELHEAD scaled by time (per day)**
Chinook Results

% This script will test the hypothesis that the estimated survivals for
% Fraser River and Columbia-Snake River are equal
% We will use the randraw.m script ('EFFICIENT RANDOM VARIATES
% GENERATOR')
% from a binomial distribution)
% For the Fraser River Chinook - there are 6 survival estimates
% available
% For the Columbia River Chinook - there are 8 PIT tag survival
% estimates
% available for the Upper Columbia River, and 1 acoustic tag survival
% estimate for the Lower Columbia River (below Bonneville Dam)
% We assume a binomial distribution for the survival estimates,
% defined as B(S,N*), where S is the estimated survival proportion,
% and N* is the number of fish released (decreased from N to give the
% variance on the survival estimate reported)

% MATLAB Version 7.4.0.287 (R2007a)

FRASER RIVER CHINOOK

clear all
% survival estimates calculated using the CJS method using Program MARK
FR_Ch_surv = [.30154, .16864, .23039, .02041, .32154, .31480]; % Mike's data
FR_Ch_SE = [.20611, .11710, .05447, .03567, .20673, .06658];
% N_star is a calculated number of fish released that results in the
% variance
% (standard error) calculated by the CJS method
FR_Ch_N_star = round((FR_Ch_surv.*(1-FR_Ch_surv))./FR_Ch_SE.^2);
V_FR_Ch = zeros(1,10000);
y_FR_Ch = zeros(10000,6);
for kk=1:10000
    for ii=1:length(FR_Ch_surv)
        % for each individual group (ii), generate a random survival
        % estimate
        y_FR_Ch(kk,ii) = randraw('binom', [FR_Ch_N_star(ii),
            FR_Ch_surv(ii)], 1)/FR_Ch_N_star(ii);
    end
    % for a set (kk) of six random generated survival estimates,
    % calculate
    % the average across the six stocks

\[ V_{\text{FR Ch}}(kk) = \text{mean}(y_{\text{FR Ch}}(kk,:)) \]

end

end

\text{hist}(V_{\text{FR Ch}}, 20); h = \text{findobj(gca,'Type','patch')} ; \text{set}(h,'FaceColor',[.8 .8 .8]);
\text{title}('\textbf{Fraser River Chinook}','\text{fontsize}',9);
\text{disp('The mean value for FRASER RIVER CHINOOK survival estimates is ')} ; \text{disp(mean(V_{\text{FR Ch}}))}

S = \text{sort}(V_{\text{FR Ch}});
\text{disp('Lower 95\% CI is ')} ; \text{disp}(S(250))
\text{disp('Upper 95\% CI is ')} ; \text{disp}(S(9750))

\text{axis([0 1 0 1.05*max(hist(V_{\text{FR Ch}}, 20))])};

The mean value for FRASER RIVER CHINOOK survival estimates is 0.2263

Lower 95\% CI is 0.1260

Upper 95\% CI is 0.3388
SNAKE RIVER CHINOOK IMPOUNDED

% PIT tags survival estimates (NOAA)
CR_Ch_Upper_surv = [.524, .452, .266, .551, .528, .353, .530, .612];
% standard errors for the PIT tags survival estimates (NOAA)
CR_Upper_SE = [.043, .087, .015, .057, .023, .045, .063, .016];
% N_star is calculated to reflect the reported standard errors (NOAA)
CR_Ch_Upper_N_star = round((CR_Ch_Upper_surv.*(1-
CR_Ch_Upper_surv))./CR_Upper_SE.^2);
V_CR_Ch_Upper = zeros(1,10000);
y_CR_Ch_Upper = zeros(10000,8);
for kk=1:10000
    for ii=1:length(CR_Ch_Upper_surv)
        y_CR_Ch_Upper(kk,ii) = randraw('binom',
        [CR_Ch_Upper_N_star(ii), CR_Ch_Upper_surv(ii)],
        1)/CR_Ch_Upper_N_star(ii);
        V_CR_Ch_Upper(kk)=mean(y_CR_Ch_Upper(kk,:));
    end
end
hist(V_CR_Ch_Upper,20);h =
findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('fSnake River Chinook Impounded','fontsize',9);
disp('The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival
estimates is ');disp(mean(V_CR_Ch_Upper))
S=sort(V_CR_Ch_Upper);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Upper,20))]);
The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival estimates is
0.4770

Lower 95% CI is
0.4431

Upper 95% CI is
0.5107
#1SNAKE RIVER CHINOOK IMPOUNDED comparison
with FRASER RIVER CHINOOK

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_1 = V_CR_Ch_Upper-V_FR_Ch;
hist(V_diff_1,50);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\bfDifferences between Snake R Chinook Impounded and
FR','fontsize',9);
S=sort(V_diff_1);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_1,50))]);
Lower 95% CI is 0.1350
Upper 95% CI is 0.3551
%C. Schreck's 2004 acoustic tags estimated survival
CR_Ch_Lower_surv = [.636];
%number of fish released (C. Schreck)
CR_Ch_Lower_N = [763];
V_CR_Ch_Lower = zeros(1,10000);
y_CR_Ch_Lower = zeros(10000,1);
for kk=1:10000
    for ii=1:length(CR_Ch_Lower_surv)
        y_CR_Ch_Lower(kk,ii) = randraw('binom', [CR_Ch_Lower_N(ii),
CR_Ch_Lower_surv(ii)], 1)/CR_Ch_Lower_N(ii);
        V_CR_Ch_Lower(kk)=mean(y_CR_Ch_Lower(kk,:));
    end
end
hist(V_CR_Ch_Lower,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('fSnake River Chinook Unimpounded','fontsize',9);
disp('The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates is ');
disp(mean(V_CR_Ch_Lower))
S=sort(V_CR_Ch_Lower);
disp('Lower 95% CI is ');disp(S(250))
disp('Lower 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Lower,20))]);
The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates is
    0.6362
Lower 95% CI is
    0.6016
Lower 95% CI is
    0.6697
#2 SNAKE RIVER CHINOOK UNIMPOUNDED comparison with FRASER RIVER CHINOOK

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_2 = V_CR_Ch_Lower-V_FR_Ch;
hist(V_diff_2,50);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('bfDifferences between Snake R Chinook Unimpounded and FR','fontsize',9);
S=sort(V_diff_2);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_2,50))])
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_2,50))])
Lower 95% CI is
  0.2957
Upper 95% CI is
  0.5155

Differences between Snake R Chinook Unimpounded and FR
COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2006

% for this part we have to consider 1) the Kintama results for 2006, and 2) the synthetic result for 2004 that was obtained by multiplying the PIT tag results (above Bonneville) with the acoustic results (below Bonneville)

CR_Ch_Entire_surv = [.27523]; % Kintama 2006 results
CR_Ch_Entire_SE = [.06878];

CR_Ch_Entire_N_star = round((CR_Ch_Entire_surv.*(1-CR_Ch_Entire_surv))./CR_Ch_Entire_SE.^2);

V_CR_Ch_Entire_2006 = zeros(1,10000);
y_CR_Ch_Entire_2006 = zeros(10000,1);

for kk=1:10000
    for ii=1:length(CR_Ch_Entire_surv)
        y_CR_Ch_Entire_2006(kk,ii) = randraw('binom', [CR_Ch_Entire_N_star(ii), CR_Ch_Entire_surv(ii)], 1)/CR_Ch_Entire_N_star(ii);
        V_CR_Ch_Entire_2006(kk)=mean(y_CR_Ch_Entire_2006(kk,:));
    end
end

hist(V_CR_Ch_Entire_2006,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor', [.8 .8 .8]);
title('fEntire Columbia-Snake River Chinook - 2006 results', 'fontsize', 9);
disp('The mean value for COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2006 survival estimates is ');
disp(mean(V_CR_Ch_Entire_2006))
S=sort(V_CR_Ch_Entire_2006);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_2006,20))])

The mean value for COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2006 survival estimates is

0.2748

Lower 95% CI is
0.1429

Upper 95% CI is
0.4048
COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2004

%the 2004 synthetic results
V_CR_Ch_Entire_2004=y_CR_Ch_Lower.*y_CR_Ch_Upper(:,6);
hist(V_CR_Ch_Entire_2004,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Entire Columbia-Snake River Chinook - 2004 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2004 survival estimates is ');disp(mean(V_CR_Ch_Entire_2004))
S=sort(V_CR_Ch_Entire_2004);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_2004,20))]);
The mean value for COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK 2004 survival estimates is
0.2242

Lower 95% CI is
0.1682

Upper 95% CI is
0.2818
COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK (2006 and 2004 combined)

V.CR.Ch.Entire=zeros(1,10000);
for kk=1:10000

V.CR.Ch.Entire(kk)=mean([V.CR.Ch.Entire_2006(kk),V.CR.Ch.Entire_2004(kk)]);
end
The mean value for COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK survival estimates is 0.2495. Lower 95% CI is 0.1796 and Upper 95% CI is 0.3241.
#3COLUMBIA-SNAKE RIVER-ENTIRE CHINOOK
comparison with FRASER RIVER CHINOOK

differences between pairs (CR avg. surv - FR avg. surv)
V_diff_3 = V_CR_Ch_Entire-V_FR_Ch;
hist(V_diff_3,50); h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('fDifferences between Entire Columbia-Snake R and FR 
','fontsize',9);
S=sort(V_diff_3);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_3,50)))];end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_3,50))]);end
Lower 95% CI is
-0.1079

Upper 95% CI is
0.1486
FRASER RIVER CHINOOK scaled by distance (per 100 km)

FR_Ch_dist = [330.8, 330.8, 395.22, 367.93, 330.6, 355.02]; % Kintama results
V_FR_Ch_dist = zeros(1,10000);
y_FR_Ch_dist = zeros(10000,6);
for kk=1:10000
    for ii=1:length(FR_Ch_surv)
        ...
    end
end
\[ y_{\text{FR Ch dist}}(kk,ii) = (y_{\text{FR Ch}}(kk,ii))^{(100/\text{FR Ch dist}(ii))}; \]

\[ V_{\text{FR Ch dist}}(kk) = \text{mean}(y_{\text{FR Ch dist}}(kk,:)); \]

end
end
hist(V_{\text{FR Ch dist}},20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('\textbf{Fraser River Chinook scaled by distance (per 100 km)}','fontsize',9);
disp('The mean value for FRASER RIVER CHINOOK survival estimates scaled by distance (per 100 km) is '); disp(mean(V_{\text{FR Ch dist}}))
S=sort(V_{\text{FR Ch dist}});
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([0 1 0 1.05*max(hist(V_{\text{FR Ch dist}},20))]);
The mean value for FRASER RIVER CHINOOK survival estimates scaled by distance (per 100 km) is
0.5447

Lower 95% CI is
0.3457

Upper 95% CI is
0.6882
SNAKE RIVER CHINOOK IMPOUNDED scaled by distance (per 100 km)

```matlab
CR_Ch_Upper_dist = [506]; % PIT results
V_CR_Ch_Upper_dist = zeros(1,10000);
y_CR_Ch_Upper_dist = zeros(10000,8);
for kk=1:10000
    for ii=1:length(CR_Ch_Upper_surv)
        y_CR_Ch_Upper_dist(kk,ii) = (y_CR_Ch_Upper(kk,ii))^(100/CR_Ch_Upper_dist);
        V_CR_Ch_Upper_dist(kk)=mean(y_CR_Ch_Upper_dist(kk,:));
    end
end
hist(V_CR_Ch_Upper_dist,20); h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Snake River Chinook Impounded scaled by distance (per 100 km)','fontsize',9);
disp('The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival estimates scaled by distance (per 100 km) is ');
disp(mean(V_CR_Ch_Upper_dist))
S=sort(V_CR_Ch_Upper_dist);
disp('Lower 95% CI is ');
disp(S(250))
disp('Upper 95% CI is ');
disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Upper_dist,20))]);
The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival estimates scaled by distance (per 100 km) is
0.8590

Lower 95% CI is
0.8458

Upper 95% CI is
0.8710
```
# SNAKE RIVER CHINOOK IMPOUNDED comparison with FRASER CHINOOK scaled by distance

V_diff_4 = V_CR_Ch_Upper_dist-V_FR_Ch_dist;
hist(V_diff_4,50);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Differences between SNAKE R CHINOOK IMPOUNDED and FR scaled by distance (per 100 km)', 'fontsize', 9);
S=sort(V_diff_4);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_4,50))])end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_4,50))])end
Lower 95% CI is 0.1703
Upper 95% CI is 0.5115

SNAKE RIVER CHINOOK UNIMPOUNDED scaled by distance (per 100 km)
CR_Ch_Lower_dist = [212]; % C. Schreck's results
V_CR_Ch_Lower_dist = zeros(1,10000);
y_CR_Ch_Lower_dist = zeros(10000,1);
for kk=1:10000
    for ii=1:length(CR_Ch_Lower_surv)
        y_CR_Ch_Lower_dist(kk,ii) = (y_CR_Ch_Lower(kk,ii))^(100/CR_Ch_Lower_dist);
        V_CR_Ch_Lower_dist(kk)=mean(y_CR_Ch_Lower_dist(kk,:));
    end
end
hist(V_CR_Ch_Lower_dist,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('fSnake River Chinook Unimpounded scaled by distance (per 100 km)', 'fontsize', 9);
disp('The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates scaled by distance (per 100 km) is ');
disp(mean(V_CR_Ch_Lower_dist))
S=sort(V_CR_Ch_Lower_dist);
disp('Lower 95% CI is ');
disp(S(250))
disp('Upper 95% CI is ');
disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Lower_dist,20))]);
The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates scaled by distance (per 100 km) is 0.8078

Lower 95% CI is
0.7868

Upper 95% CI is
0.8277
#5SNAKE RIVER CHINOOK UNIMPOUNDED comparison with FRASER CHINOOK scaled by distance

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_5 = V_CR_Ch_Lower_dist-V_FR_Ch_dist;
hist(V_diff_5,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor', [.8 .8 .8]);
title('fDifferences between Snake R Chinook Unimpounded and FR scaled by distance (per 100 km)', 'fontsize', 9);
S = sort(V_diff_5);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
Lo_V_diff_5 = S(250); Hi_V_diff_5 = S(9750);
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_5,50))]); end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_5,50))]); end
Lower 95% CI is
Upper 95% CI is 0.4601
COLUMBIA-SNAKE ENTIRE CHINOOK scaled by distance (per 100 km) 2006

CR_Ch_Entire_dist = [910];%Kintama results
V_CR_Ch_Entire_dist_2006 = zeros(1,10000);
y_CR_Ch_Entire_dist = zeros(10000,1);
for kk=1:10000
    for ii=1:length(CR_Ch_Entire_surv)
        y_CR_Ch_Entire_dist(kk,ii) = (y_CR_Ch_Entire_2006(kk,ii))^((100/CRCr_Ch_Entire_dist));
        V_CR_Ch_Entire_dist_2006(kk)=mean(y_CR_Ch_Entire_dist(kk,:));
    end
end
hist(V_CR_Ch_Entire_dist_2006,20);h = findobj(gca,'Type','patch');set(h,'FaceColor', [.8 .8 .8]);
title('fEntire Columbia-Snake R Chinook scaled by distance (per 100
km) - 2006 results','fontsize',9);
disp('The mean value for COLUMBIA- SNAKE ENTIRE CHINOOK survival
estimates scaled by distance (per 100 km) 2006 is
');disp(mean(V_CR_Ch_Entire_dist_2006))
S=sort(V_CR_Ch_Entire_dist_2006);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_dist_2006,20))]);
The mean value for COLUMBIA- SNAKE ENTIRE CHINOOK survival estimates
scaled by distance (per 100 km) 2006 is
0.8649

Lower 95% CI is
0.8075

Upper 95% CI is
0.9054
COLUMBIA-SNAKE ENTIRE CHINOOK scaled by distance (per 100 km) 2004

%the 2004 synthetic results
V_CR_Ch_Entire_dist_2004=(y_CR_Ch_Lower.*y_CR_Ch_Upper(:,6)).^(100/(506 +212));
hist(V_CR_Ch_Entire_dist_2004,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Entire Columbia-Snake River Chinook scaled by distance (per 100 km) - 2004 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by distance (per 100 km) 2004 is ');
disp(mean(V_CR_Ch_Entire_dist_2004))
S=sort(V_CR_Ch_Entire_dist_2004);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_dist_2004,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by distance (per 100 km) 2004 is 0.8111

Lower 95% CI is 0.7801

Upper 95% CI is 0.8383

COLUMBIA-SNAKE ENTIRE CHINOOK scaled by distance (per 100 km) (2006 and 2004)
V_CR_Ch_Entire_dist = zeros(1,10000);
for kk=1:10000
V_CR_Ch_Entire_dist(kk)=mean([V_CR_Ch_Entire_dist_2006(kk),V_CR_Ch_Entire_dist_2004(kk)]);
end
hist(V_CR_Ch_Entire_dist,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('fEntire Columbia-Snake River Chinook scaled by distance (per 100 km)','','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by distance (per 100 km) is ');disp(mean(V_CR_Ch_Entire_dist))
S=sort(V_CR_Ch_Entire_dist);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_dist,20))])
The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by distance (per 100 km) is
0.8380

Lower 95% CI is
0.8073

Upper 95% CI is
0.8639

Entire Columbia-Snake River Chinook scaled by distance (per 100 km)
#6 COLUMBIA-SNAKE ENTIRE CHINOOK comparison with FRASER CHINOOK scaled by distance (per 100 km)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_6 = V_CR_Ch_Entire_dist_2006-V_FR_Ch_dist;
hist(V_diff_6,50);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('bfDifferences between Entire Columbia-Snake R and FR scaled by distance (per 100 km)'','fontsize',9);
S=sort(V_diff_6);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_6,50))]);end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_6,50))]);end
Lower 95% CI is
 0.1670

Upper 95% CI is
 0.5179
FRASER RIVER CHINOOK scaled by time (per day)

%median travel time
FR_Ch_time = [4.13, 3.4, 13.31, 12.23, 5.04, 19.2]; %Kintama results
V_FR_Ch_time = zeros(1,10000);
y_FR_Ch_time = zeros(10000,6);
for kk=1:10000

for ii=1:length(FR_Ch_surv)
    y_FR_Ch_time(kk,ii) = (y_FR_Ch(kk,ii))^(1/FR_Ch_time(ii));
    V_FR_Ch_time(kk)=mean(y_FR_Ch_time(kk,:));
end

hist(V_FR_Ch_time,20); h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Fraser River Chinook scaled by time (per day)','fontsize',9);
disp('The mean value for FRASER RIVER CHINOOK survival estimates scaled by time (per day) is ');
disp(mean(V_FR_Ch_time))
S=sort(V_FR_Ch_time);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_FR_Ch_time,20))]);

The mean value for FRASER RIVER CHINOOK survival estimates scaled by time (per day) is
0.6504

Lower 95% CI is
0.4279

Upper 95% CI is
0.8296

Fraser River Chinook scaled by time (per day)
SNAKE RIVER CHINOOK IMPOUNDED scaled by time (per day)

%median travel time
CR_Ch_Upper_time = [21.71, 22.88, 40.01, 31.19, 18.24, 21.36, 22.43, 20.31]; % PIT results
V_CR_Ch_Upper_time = zeros(1,10000);
y_CR_Ch_Upper_time = zeros(10000,8);
for kk=1:10000
    for ii=1:length(CR_Ch_Upper_surv)
        y_CR_Ch_Upper_time(kk,ii) = (y_CR_Ch_Upper(kk,ii))^(1/CR_Ch_Upper_time(ii));
        V_CR_Ch_Upper_time(kk)=mean(y_CR_Ch_Upper_time(kk,:));
    end
end
hist(V_CR_Ch_Upper_time,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('Snake River Chinook Impounded scaled by time (per day)','fontsize',9);
disp('The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival estimates scaled by time (per day) is '); disp(mean(V_CR_Ch_Upper_time))
S=sort(V_CR_Ch_Upper_time);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Upper_time,20))]);
The mean value for SNAKE RIVER CHINOOK IMPOUNDED survival estimates scaled by time (per day) is
0.9687

Lower 95% CI is
0.9654

Upper 95% CI is
0.9716
#7SNAKE RIVER CHINOOK IMPOUNDED comparison with FRASER CHINOOK scaled by time (per day)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_7 = V_CR_Ch_Upper_time-V_FR_Ch_time;
hist(V_diff_7,50);h = findobj(gca,'Type','patch');set(h,'FaceColor', [.8 .8 .8]);
title('bfDifferences between Snake R Chinook Impounded and FR scaled by time (per day)', 'fontsize', 9);
S = sort(V_diff_7);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_7,50))]); end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_7,50))]); end
Lower 95% CI is
0.1393
Upper 95% CI is 0.5411

Differences between Snake R Chinook Impounded and FR scaled by time (per day)

SNAKE RIVER CHINOOK UNIMPOUNDED scaled by time (per day)
%median travel time
CR_Ch_Lower_time = [3.42];%Schreck's results
V_CR_Ch_Lower_time = zeros(1,10000);
y_CR_Ch_Lower_time = zeros(10000,1);
for kk=1:10000
    for ii=1:length(CR_Ch_Lower_surv)
        y_CR_Ch_Lower_time(kk,ii) = (y_CR_Ch_Lower(kk,ii))^(1/CR_Ch_Lower_time(ii));
        V_CR_Ch_Lower_time(kk)=mean(y_CR_Ch_Lower_time(kk,:));
    end
end
hist(V_CR_Ch_Lower_time,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\textbf{Snake River Chinook Unimpounded scaled by time (per day)}','fontsize',9);
disp('The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates scaled by time (per day) is ');disp(mean(V_CR_Ch_Lower_time))
S=sort(V_CR_Ch_Lower_time);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Lower_time,20))]);
The mean value for SNAKE RIVER CHINOOK UNIMPOUNDED survival estimates scaled by time (per day) is
    0.8761

Lower 95% CI is
    0.8619

Upper 95% CI is
    0.8894
#8SNAKE RIVER CHINOOK UNIMPOUNDED comparison with FRASER CHINOOK scaled by time (per day)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_8 = V_CR_Ch_Lower_time-V_FR_Ch_time;
hist(V_diff_8,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('bfDifferences between Snake R Chinook Unimpounded and FR scaled by time (per day)','fontsize',9);
S=sort(V_diff_8);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_8,50))])
Lower 95% CI is
0.0447

Upper 95% CI is
0.4471
COLUMBIA-SNAKE ENTIRE CHINOOK scaled by time (per day) 2006

%median travel time
CR_Ch_Entire_time = [23.24];%Kintama results
V_CR_Ch_Entire_time_2006 = zeros(1,10000);
y_CR_Ch_Entire_time = zeros(10000,1);
for kk=1:10000
    for ii=1:length(CR_Ch_Entire_surv)
        y_CR_Ch_Entire_time(kk,ii) = (y_CR_Ch_Entire_2006(kk,ii))^(1/CR_Ch_Entire_time);
        V_CR_Ch_Entire_time_2006(kk)=mean(y_CR_Ch_Entire_time(kk,:));
    end
end
hist(V_CR_Ch_Entire_time_2006,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Entire Columbia-Snake River Chinook scaled by time (per day) - 2006 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) 2006 is ')
disp(mean(V_CR_Ch_Entire_time_2006))
S=sort(V_CR_Ch_Entire_time_2006);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_time_2006,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) 2006 is
    0.9446

Lower 95% CI is
    0.9197

Upper 95% CI is
    0.9618
COLUMBIA-SNAKE ENTIRE CHINOOK scaled by time (per day) 2004

%the 2004 synthetic results
V_CR_Ch_Entire_time_2004=(y_CR_Ch_Lower.*y_CR_Ch_Upper(:,6)).^(1/(21.36 +3.42));
hist(V_CR_Ch_Entire_time_2004,20);h = 
findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\bfEntire Columbia-Snake River Chinook scaled by time (per day) - 2004 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) 2004 is ')
disp(mean(V_CR_Ch_Entire_time_2004))
S=sort(V_CR_Ch_Entire_time_2004);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_Ch_Entire_time_2004,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) 2004 is
0.9411
Lower 95% CI is 0.9306

Upper 95% CI is 0.9502

COLUMBIA-SNAKE ENTIRE CHINOOK scaled by time (per day) (2006 and 2004 combined)

V_CR_Ch_Entire_time = zeros(1,10000);
for kk=1:10000
V_CR_ChEntire_time(kk)=mean([V_CR_ChEntire_time_2006(kk),V_CR_ChEntire_time_2004(kk)]);
end
hist(V_CR_ChEntire_time,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\bfEntire Columbia-Snake River Chinook scaled by time (per day)','fontsize',9);
disp('The median value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) is ');
disp(median(V_CR_ChEntire_time));
S=sort(V_CR_ChEntire_time);
disp('Lower 95% CI is ');
disp(S(250));
disp('Upper 95% CI is ');
disp(S(9750));
axis([0 1 0 1.05*max(hist(V_CR_ChEntire_time,20))]);

The median value for COLUMBIA-SNAKE ENTIRE CHINOOK survival estimates scaled by time (per day) is 
0.9433
Lower 95% CI is 
0.9300
Upper 95% CI is 
0.9532
#9 COLUMBIA-SNAKE ENTIRE CHINOOK comparison with FRASER CHINOOK scaled by time (per day)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_9 = V_CR_Ch_Entire_time-V_FR_Ch_time;
hist(V_diff_9,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
t = title('f Differences between Entire Columbia-Snake R and FR scaled by time (per day)', 'fontsize', 9);
S = sort(V_diff_9);
disp('Lower 95% CI is'); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_9,50))]);
Lower 95% CI is  
0.1124

Upper 95% CI is 
0.5145
Steelhead

This script will test the hypothesis that the estimated survivals for Fraser River and Columbia-Snake River are equal. We will use the randraw.m script ('EFFICIENT RANDOM VARIATES GENERATOR') from a binomial distribution. For the Fraser River Steelhead - there are 7 survival estimates available. For the Columbia River Steelhead - there are 8 PIT tag survival estimates available for the Upper Columbia River, and 2 acoustic tag survival estimates for the Lower Columbia River (below Bonneville Dam). We assume a binomial distribution for the survival estimates, defined as B(S,N*), where S is the estimated survival proportion, and N* is the number of fish released (decreased from N to give the variance on the survival estimate reported).

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FRASER RIVER STEELHEAD

clear all
% survival estimates calculated using th CJS method using Program MARK
FR_St_surv = [.419, .251, .699, .223, .201, .115]; % Table 1
FR_St_SE = [.157, .105, .169, .115, .082, .108, .078]; % Table 1
% N star is a calculated number of fish released that results in the variance
% calculated by the CJS method
FR_St_N_star = round((FR_St_surv.*(1-FR_St_surv))./FR_St_SE.^2);
V_FR_St = zeros(1,10000);
y_FR_St = zeros(10000,7);
for kk=1:10000
    for ii=1:length(FR_St_surv)
        % for each individual group (ii), generate a random survival estimate
        % from a binomial distribution B(FR_St_surv(ii),FR_St_star(ii))
        y_FR_St(kk,ii) = randraw('binom', [FR_St_N_star(ii), FR_St_surv(ii)], 1)/FR_St_N_star(ii);
    % for a set (kk) of seven random generated survival estimates, calculate
    % the average across the seven stocks
    V_FR_St(kk)=mean(y_FR_St(kk,:));

The mean value for FRASER RIVER STEELHEAD survival estimates is 0.3000
Lower 95% CI is 0.2118
Upper 95% CI is 0.3904

SNAKE RIVER STEELHEAD IMPOUNDED

%PIT tags survival estimates (NOAA)
CR_St_Upper_surv = [.457, .462, .4, .379, .038, .234, .288, .418];
%standard errors for the PIT tags survival estimates (NOAA)
CR_Upper_SE = [.067, .050, .016, .032, .003, .045, .011, .052];
% N_star is calculated to reflect the reported standard errors
CR_St_Upper_N_star = round(((CR_St_Upper_surv.*(1-
CR_St_Upper_surv)))./CR_Upper_SE.^2);
V_CR_St_Upper = zeros(1,10000);
y_CR_St_Upper = zeros(10000,8);
for kk=1:10000
    for ii=1:length(CR_St_Upper_surv)
        y_CR_St_Upper(kk,ii) = randraw('binom',
        [CR_St_Upper_N_star(ii), CR_St_Upper_surv(ii)],
        1)/CR_St_Upper_N_star(ii);
        V_CR_St_Upper(kk)=mean(y_CR_St_Upper(kk,:));
    end
end
hist(V_CR_St_Upper,20);h =
findobj(gca,'Type','patch');set(h,'FaceColor', [.8 .8 .8]);
title('Upper Columbia River Steelhead','fontsize',9);
disp('The mean value for SNAKE RIVER STEELHEAD IMPOUNDED survival
estimates is ');disp(mean(V_CR_St_Upper))
S=sort(V_CR_St_Upper);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Upper,20))]);
The mean value for SNAKE RIVER STEELHEAD IMPOUNDED survival estimates is
0.3345
Lower 95% CI is
0.3067
Upper 95% CI is
0.3630
#1SNAKE RIVER STEELHEAD IMPOUNDED comparison with FRASER RIVER STEELHEAD

differences between pairs (CR avg. surv - FR avg. surv)
V_diff_1 = V_CR_St_Upper-V_FR_St;
hist(V_diff_1,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('Differences between Upper CR and FR','fontsize',9);
S=sort(V_diff_1);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([min(S)-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_1,50))])
Lower 95% CI is -0.0593
Upper 95% CI is 0.1284
SNAKE RIVER STEELHEAD UNIMPOUNDED

CR_St_Lower_surv = [.76, .63];
CR_Lower_SE = [.047, .019];  
%N_star is calculated to reflect the reported standard errors  
CR_St_Lower_N_star = round((CR_St_Lower_surv.*(1-  
CR_St_Lower_surv))./CR_Lower_SE.^2);  
V_CR_St_Lower = zeros(1,10000);  
y_CR_St_Lower = zeros(10000,2);  
for kk=1:10000  
    for ii=1:length(CR_St_Lower_surv)  
        y_CR_St_Lower(kk,ii) = randraw('binom',  
        [CR_St_Lower_N_star(ii), CR_St_Lower_surv(ii)],  
        1)/CR_St_Lower_N_star(ii);  
        V_CR_St_Lower(kk)=mean(y_CR_St_Lower(kk,:));  
    end  
end  
hist(V_CR_St_Lower,20);h =  
findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);  
title('fLower Columbia River Steelhead','fontsize',9);  
disp('The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival  
estimates is ');disp(mean(V_CR_St_Lower))  
S=sort(V_CR_St_Lower);  
disp('Lower 95% CI is ');disp(S(250))  
disp('Lower 95% CI is ');disp(S(9750))  
axis([0 1 0 1.05*max(hist(V_CR_St_Lower,20))]);  
The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival estimates is  
0.6948  
Lower 95% CI is  
0.6450  
Lower 95% CI is  
0.7437
#2 SNAKE RIVER STEELHEAD UNIMPOUNDED comparison with FRASER RIVER STEELHEAD

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_2 = V_CR_St_Lower-V_FR_St;
hist(V_diff_2,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('bfDifferences between Lower CR and FR','fontsize',9);
S=sort(V_diff_2);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_2,50))]) end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_diff_2,50))]) end
Lower 95% CI is
  0.2920
Upper 95% CI is
  0.4945
% the 2002 synthetic results
V_CR_St_Entire_2002 = y_CR_St_Lower(:,1).*y_CR_St_Upper(:,6);
hist(V_CR_St_Entire_2002,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
The mean value for COLUMBIA-SNAKE RIVER ENTIRE STEELHEAD 2002 survival estimates is 0.1780

Lower 95% CI is 0.1118

Upper 95% CI is 0.2502
COLUMBIA-SNAKE RIVER-ENTIRE STEELHEAD 2003

%the 2003 synthetic results
V_CR_St_Entire_2003=y_CR_St_Lower(:,2).*y_CR_St_Upper(:,7);
hist(V_CR_St_Entire_2003,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]); title('Entire Columbia-Snake River Steelhead - 2003 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE RIVER ENTIRE STEELHEAD 2003 survival estimates is ');
disp(mean(V_CR_St_Entire_2003));
S=sort(V_CR_St_Entire_2003);
disp('Lower 95% CI is ');
disp(S(250));
disp('Upper 95% CI is ');
disp(S(9750));
axis([0 1 0 1.05*max(hist(V_CR_St_Entire_2003,20))]);
The mean value for COLUMBIA-SNAKE RIVER ENTIRE STEELHEAD 2003 survival estimates is
0.1815

Lower 95% CI is
0.1646

Upper 95% CI is
0.1990
#3COLUMBIA-SNAKE RIVER ENTIRE STEELHEAD
comparison with FRASER RIVER STEELHEAD

V_CR_St_Entire=zeros(1,10000);  
for kk=1:10000  
  V_CR_St_Entire(kk)=mean([V_CR_St_Entire_2002(kk),V_CR_St_Entire_2003(kk)]);  
end
V_dist_3 = V_CR_St_Entire-V_FR_St; %between Entire CR Ch and FR Steelhead
hist(V_dist_3,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('fDifferences between Entire Columbia-Snake R and FR (2006 only)' , 'fontsize', 9);
S=sort(V_dist_3);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_dist_3,50))]); end
if max(S)<0; axis([min(S)-0.1 0.1 0 1.05*max(hist(V_dist_3,50))]); end
Lower 95% CI is
-0.2174

Upper 95% CI is
-0.0224

Differences between Entire Columbia-Snake R and FR (2006 only)
**FRASER RIVER STEELHEAD scaled by distance (per 100 km)**

\[
\text{FR}_\text{St}_\text{dist} = [324.25, 330.8, 351.53, 351.53, 342.05, 362.78, 362.78];
\]

\[
\text{V}_{\text{FR}_\text{St}_\text{dist}} = \text{zeros}(1,10000);
\]

\[
\text{y}_{\text{FR}_\text{St}_\text{dist}} = \text{zeros}(10000,7);
\]

for \( kk=1:10000 \)

\[
\text{for ii}=1:\text{length}(\text{FR}_\text{St}_\text{surv})
\]

\[
\text{y}_{\text{FR}_\text{St}_\text{dist}}(kk,ii) = (\text{y}_{\text{FR}_\text{St}}(kk,ii))^{(100/\text{FR}_\text{St}_\text{dist}(ii))};
\]

\[
\text{V}_{\text{FR}_\text{St}_\text{dist}}(kk) = \text{mean} (\text{y}_{\text{FR}_\text{St}_\text{dist}}(kk,:));
\]

end

end

\[
\text{hist}(\text{V}_{\text{FR}_\text{St}_\text{dist}},20); \text{h} = \text{findobj(gcxa,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);}
\]

\[
\text{title('Fraser River Steelhead scaled by distance (per 100 km'),'fontsize',9);}
\]

\[
\text{disp('The mean value for FRASER RIVER STEELHEAD survival estimates scaled by distance (per 100 km) is ')};\text{disp(mean(\text{V}_{\text{FR}_\text{St}_\text{dist}}))}
\]

\[
\text{S=sort(\text{V}_{\text{FR}_\text{St}_\text{dist}})};
\]

\[
\text{disp('Lower 95% CI is ')};\text{disp(S(250))}
\]

\[
\text{disp('Upper 95% CI is ')};\text{disp(S(9750))}
\]

\[
\text{axis([0 1 0 1.05*max(hist(\text{V}_{\text{FR}_\text{St}_\text{dist}},20))])};
\]

The mean value for FRASER RIVER STEELHEAD survival estimates scaled by distance (per 100 km) is 0.6573

Lower 95% CI is 0.5424

Upper 95% CI is 0.7351
SNAKE RIVER STEELHEAD IMPOUNDED scaled by distance (per 100 km)

CR_St_Upper_dist = [506]; % PIT results
V_CR_St_Upper_dist = zeros(1,10000);
y_CR_St_Upper_dist = zeros(10000,8);
for kk=1:10000
    for ii=1:length(CR_St_Upper_surv)
        y_CR_St_Upper_dist(kk,ii) = (y_CR_St_Upper(kk,ii))^((100/CR_St_Upper_dist);
        V_CR_St_Upper_dist(kk)=mean(y_CR_St_Upper_dist(kk,:));
    end
end
hist(V_CR_St_Upper_dist,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
The mean value for SNAKE RIVER STEELHEAD IMPOUNDED survival estimates scaled by distance (per 100 km) is

0.7833

Lower 95% CI is

0.7705

Upper 95% CI is

0.7954
#4 SNAKE RIVER STEELHEAD IMPOUNDED comparison with FRASER STEELHEAD scaled by distance (per 100 km)

V \_diff\_4 = V\_CR\_St\_Upper\_dist - V\_FR\_St\_dist;
hist(V\_diff\_4,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('Differences between Snake R Steelhead Impounded and FR scaled by distance (per 100 km)');
S = sort(V\_diff\_4);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V\_diff\_4,50))])
Lower 95% CI is
0.0474

Upper 95% CI is
0.2418
SNAKE RIVER STEELHEAD UNIMPOUNDED scaled by distance (per 100 km)

\[
\text{CR\_St\_Lower\_dist} = [212];
\]
\[
\text{V\_CR\_St\_Lower\_dist} = \text{zeros}(1,10000);
\]
\[
\text{y\_CR\_St\_Lower\_dist} = \text{zeros}(10000,2);
\]
\[
\text{for } kk=1:10000
\]
\[
\quad \text{for } ii=1:\text{length(CR\_St\_Lower\_surv)}
\]
\[
\quad \quad \text{y\_CR\_St\_Lower\_dist}(kk,ii) = (y\_CR\_St\_Lower(kk,ii))^{100/\text{CR\_St\_Lower\_dist}};
\]
\[
\quad \text{V\_CR\_St\_Lower\_dist}(kk) = \text{mean}(y\_CR\_St\_Lower\_dist(kk,:));
\]
\[
\text{end}
\]
\[
\text{end}
\]
\[
\text{hist(V\_CR\_St\_Lower\_dist,20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);}
\]
\[
\text{title('The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival estimates scaled by distance (per 100 km) is ')};
\]
\[
\text{disp(mean(V\_CR\_St\_Lower\_dist))}
\]
\[
\text{S=sort(V\_CR\_St\_Lower\_dist)};
\]
\[
\text{disp('Lower 95% CI is ')};
\]
\[
\text{disp(S(250))}
\]
\[
\text{disp('Upper 95% CI is ')};
\]
\[
\text{disp(S(9750))}
\]
\[
\text{axis([0 1 0 1.05*max(hist(V\_CR\_St\_Lower\_dist,20))])};
\]

The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival estimates scaled by distance (per 100 km) is 0.8410

Lower 95% CI is 0.8127

Upper 95% CI is 0.8678
#5 SNAKE RIVER STEELHEAD UNIMPOUNDED comparison with FRASER STEELHEAD scaled by distance (per 100 km)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_5 = V_CR_St_Lower_dist - V_FR_St_dist;
hist(V_diff_5, 50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('bfDifferences between Snake R Steelhead Unimpounded and FR scaled by distance (per 100 km)');
S = sort(V_diff_5);
disp('Lower 95% CI is '); disp(S(250));
disp('Upper 95% CI is '); disp(S(9750));
Lo_V_diff_5 = S(250); Hi_V_diff_5 = S(9750);
if min(S)>0; axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_5,50))]); end
if max(S)<0; axis([min(S)-0.1  0.1  0 1.05*max(hist(V_diff_5,50))]);end
Lower 95% CI is
  0.1010
Upper 95% CI is
  0.3007
COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by distance (per 100 km) 2002

%the 2002 synthetic results
V_CR_St_Entire_dist_2002=(y_CR_St_Lower(:,1).*y_CR_St_Upper(:,6)).^(100/(506+212));
hist(V_CR_St_Entire_dist_2002,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Entire Columbia-Snake River Steelhead scaled by distance (per 100 km) - 2002 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by distance (per 100 km) 2002 is ');
disp(mean(V_CR_St_Entire_dist_2002));
S=sort(V_CR_St_Entire_dist_2002);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Entire_dist_2002,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by distance (per 100 km) 2002 is
0.7844

Lower 95% CI is 
0.7370

Upper 95% CI is 
0.8245
COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by distance (per 100 km) 2003

%the 2003 synthetic results
V_CR_St Entire dist 2003=(y_CR_St_Lower(:,2).*y_CR_St_Upper(:,7)).^(100/(506+212));
hist(V_CR_StEntire dist 2003,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('fEntire Columbia-Snake River Steelhead scaled by distance (per 100 km) - 2003 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by distance (per 100 km) 2003 is ');
disp(mean(V_CR_St_Entire_dist_2003));
S=sort(V_CR_St_Entire_dist_2003);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Entire_dist_2003,20))]);

The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by distance (per 100 km) 2003 is
0.7884

Lower 95% CI is
0.7778

Upper 95% CI is
0.7986
#6COLUMBIA-SNAKE ENTIRE STEELHEAD comparison with FRASER STEELHEAD scaled by distance (per 100 km)

% differences between pairs (CR avg. surv - FR avg. surv)
V_CR_St_Entire_dist=zeros(1,10000);
for kk=1:10000

V_CR_St_Entire_dist(kk)=mean([V_CR_St_Entire_dist_2002(kk),V_CR_St_Enti re_dist_2003(kk)]);

end
V_diff_6 = V_CR_St_Entire_dist-V_FR_St_dist;
hist(V_diff_6,50);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\bfDifferences between Entire COlumbia-Snake R and FR scaled by distance (per 100 km)\n','fontsize',9);
S=sort(V_diff_6);
disp('Lower 95\% CI is ');disp(S(250))
disp('Upper 95\% CI is ');disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_6,50))]);
Lower 95\% CI is
0.0482

Upper 95\% CI is
0.2455

Differences between Entire COlumbia-Snake R and FR scaled by distance (per 100 km)
FRASER RIVER STEELHEAD scaled by time (per day)

FR_St_time = [5.71, 6.17, 8.5, 10.52, 3.89, 2.9, 10.39]; % Kintama results
V_FR_St_time = zeros(1, 10000);
y_FR_St_time = zeros(10000, 7);
for kk = 1:10000
    for ii = 1:length(FR_St_surv)
        y_FR_St_time(kk, ii) = (y_FR_St(kk, ii))^(1/FR_St_time(ii));
        V_FR_St_time(kk) = mean(y_FR_St_time(kk, :));
    end
end
hist(V_FR_St_time, 20); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('Fraser River Steelhead scaled by time (per day)');
disp('The mean value for FRASER RIVER STEELHEAD survival estimates scaled by time (per day) is
S = sort(V_FR_St_time);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([0 1 0 1.05*max(hist(V_FR_St_time, 20))]);
The mean value for FRASER RIVER STEELHEAD survival estimates scaled by time (per day) is
0.7575

Lower 95% CI is
0.6294

Upper 95% CI is
0.8251
SNAKE RIVER STEELHEAD IMPOUNDED scaled by time (per day)

\[
\text{CR\_St\_Upper\_time} = [14.38, 18.63, 15.63, 17.05, 32.19, 20.37, 19.91, 12.78];
\%
\text{PIT results}
\]
\[
\text{V\_CR\_St\_Upper\_time} = \text{zeros}(1,10000);
\text{y\_CR\_St\_Upper\_time} = \text{zeros}(10000,8);
\text{for kk=1:10000}
\text{for ii=1:length(CR\_St\_Upper\_surv)}
\text{y\_CR\_St\_Upper\_time(kk,ii) = (y\_CR\_St\_Upper(kk,ii))^{(1/CR\_St\_Upper\_time(ii))};}
\text{V\_CR\_St\_Upper\_time(kk)=mean(y\_CR\_St\_Upper\_time(kk,:));}
\text{end}
\text{end}
\]
hist(V_CR_St_Upper_time,20); h =
findobj(gca,'Type','patch'); set(h,'FaceColor',.8 .8 .8);
title('\bfSnake River Steelhead Impounded scaled by time (per
day)'),'fontsize',9);
disp('The mean value for SNAKE RIVER STEELHEAD IMPOUNDED survival
estimates scaled by time (per day) is '); disp(mean(V_CR_St_Upper_time))
S=sort(V_CR_St_Upper_time);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Upper_time,20))]);
The mean value for SNAKE RIVER STEELHEAD IMPOUNDED survival estimates
scaled by time (per day) is
0.9374

Lower 95% CI is 0.9328

Upper 95% CI is 0.9417
#7 SNAKE RIVER STEELHEAD IMPOUNDED comparison with FRASER STEELHEAD scaled by time (per day)

% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_7 = V_CR_St_Upper_time-V_FR_St_time;
hist(V_diff_7,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('bf Differences between Snake R Steelhead Impounded and FR scaled by time (per day)','fontsize',9);
S=sort(V_diff_7);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_7,50))]);

Lower 95% CI is 
0.1121

Upper 95% CI is 
0.3089

Differences between Snake R Steelhead Impounded and FR scaled by time (per day)
SNAKE RIVER STEELHEAD UNIMPOUNDED scaled by time (per day)

```matlab
CR_St_Lower_time = [2.77, 2.66];
V_CR_St_Lower_time = zeros(1,10000);
y_CR_St_Lower_time = zeros(10000,2);
for kk=1:10000
    for ii=1:length(CR_St_Lower_surv)
        y_CR_St_Lower_time(kk,ii) = (y_CR_St_Lower(kk,ii))^(1/CR_St_Lower_time(ii));
        V_CR_St_Lower_time(kk)=mean(y_CR_St_Lower_time(kk,:));
    end
end
hist(V_CR_St_Lower_time,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('\bfSnake River Steelhead Unimpounded scaled by time (per day)','fontsize',9);
disp('The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival estimates scaled by time (per day) is ');disp(mean(V_CR_St_Lower_time))
S=sort(V_CR_St_Lower_time);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Lower_time,20))]);
The mean value for SNAKE RIVER STEELHEAD UNIMPOUNDED survival estimates scaled by time (per day) is
    0.8728

Lower 95% CI is
    0.8501

Upper 95% CI is
    0.8940
```
#Snake River Steelhead Unimpounded comparison with Fraser Steelhead scaled by time (per day)

```matlab
% differences between pairs (CR avg. surv - FR avg. surv)
V_diff_8 = V_CR_St_Lower_time-V_FR_St_time;
hist(V_diff_8,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor',[.8 .8 .8]);
title('fDifferences between Columbia-Snake R Unimpounded and FR scaled by time (per day)', 'fontsize', 9);
S=sort(V_diff_8);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_8,50))]);
```
Lower 95% CI is 0.0429

Upper 95% CI is 0.2485
COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by time (per day) 2002

%the 2002 synthetic results
V_CR_St_Entire_time_2002=(y_CR_St_Lower(:,1).*y_CR_St_Upper(:,6)).^(1/(20.37+2.77));
hist(V_CR_St_Entire_time_2002,20);h=findobj(gca,'Type','patch');set(h,'FaceColor', [.8 .8 .8]);
title('\bfEntire Columbia-Snake River Steelhead scaled by time (per day) - 2002 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by time (per day) 2002 is ')
disp(mean(V_CR_St_Entire_time_2002))
S=sort(V_CR_St_Entire_time_2002);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Entire_time_2002,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by time (per day) 2002 is
0.9273

Lower 95% CI is
0.9097

Upper 95% CI is
0.9419
COLUMBIA-SNAKE ENTIRE STEELHEAD scaled by time (per day) 2003

%the 2003 synthetic results
V_CR_St_Entire_time_2003=(y_CR_St_Lower(:,2).*y_CR_St_Upper(:,7)).^(1/(19.91+2.66));
hist(V_CR_St_Entire_time_2003,20);h = findobj(gca,'Type','patch');set(h,'FaceColor',[.8 .8 .8]);
title('Entire Columbia-Snake River Steelhead scaled by time (per day) - 2003 results','fontsize',9);
disp('The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by time (per day) 2003 is ')
disp(mean(V_CR_St_Entire_time_2003))
S=sort(V_CR_St_Entire_time_2003);
disp('Lower 95% CI is ');disp(S(250))
disp('Upper 95% CI is ');disp(S(9750))
axis([0 1 0 1.05*max(hist(V_CR_St_Entire_time_2003,20))]);
The mean value for COLUMBIA-SNAKE ENTIRE STEELHEAD survival estimates scaled by time (per day) 2003 is

0.9271

Lower 95% CI is

0.9232

Upper 95% CI is

0.9310
#9COLUMBIA-SNAKE ENTIRE STEELHEAD comparison with FRASER STEELHEAD scaled by time (per day)

% differences between pairs (CR avg. surv - FR avg. surv)
V_CR_St_Entire_time=zeros(1,10000);
for kk=1:10000
    V_CR_St_Entire_time(kk)=mean([V_CR_St_Entire_time_2002(kk),V_CR_St_Entire_time_2003(kk)]);
end
V_diff_9 = V_CR_St_Entire_time-V_FR_St_time;
hist(V_diff_9,50); h = findobj(gca,'Type','patch'); set(h,'FaceColor', [.8 .8 .8]);
t=title('Differences between Entire Columbia-Snake R and FR scaled by time (per day)');
S=sort(V_diff_9);
disp('Lower 95% CI is '); disp(S(250))
disp('Upper 95% CI is '); disp(S(9750))
axis([-0.1 max(S)+0.1 0 1.05*max(hist(V_diff_9,50))])

Lower 95% CI is
0.1015

Upper 95% CI is
0.2993

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