

Baseline correction of amplitude or power

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% Averaging before or after baseline correction (the praxis)
X = [1 2 3 4; 4 5 6 7] % two trials with 4 time samples (tsampl)
B = mean(X(:,[1 2]),2) % the mean of the first 2 tsampl = baseline
Xm = mean(X,1) % mean across trials
Bm = mean(B,1) % mean across trials
B = repmat(B,1,size(X,2)) % to have B for all tsampl

% 'absolute' baseline
mean(X - B) == Xm-Bm % same

% 'relative' baseline
mean(X ./ B) ~= Xm./Bm % different

% 'relchange' baseline
mean((X-B) ./ B) ~= (Xm-Bm)./Bm % different

% 'decibel' baseline (this baseline is defined only for power)
mean(10*log10(X ./ B)) ~= 10*log10(Xm./Bm) % different

% Amplitude vs. Power (proof of principle)
X = 2;
B = 4;

% 'absolute' baseline
(X - B)^2 ~= X^2 - B^2 % different

% 'relative' baseline
(X/B)^2 == X^2 / B^2 % same

% 'relchange' baseline
((X-B)/B)^2 ~= ((X^2-B^2)/B^2) % different

% 'decibel' baseline (this baseline is defined only for power)
(10*log10(X/B))^2 ~= 10*log10(X^2/B^2) % different

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% Scaling of the baseline corrections

% 'absolute' baseline
% when X == B → X-B == 0; minmax = [-inf inf]

% 'relative' baseline
% when X == B → X/B == 1; minmax = [0 inf]
% linear scaling in plots might not be appropriate
B = 0:0.1:10; X = ones([1 length(B)]);
figure, plot(B,X./B), xlabel('Baseline values'),
ylabel('Amplitude/Power')

```

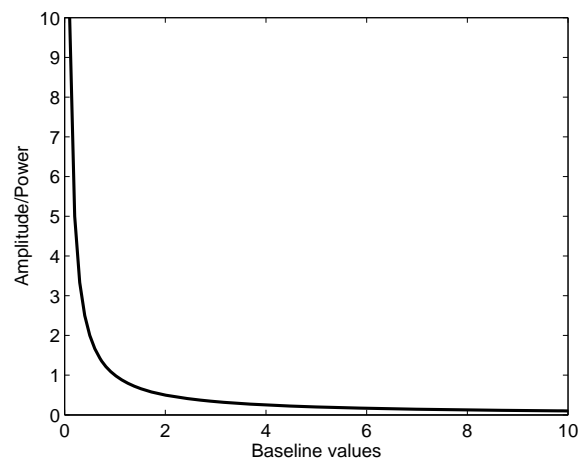


Figure 1: Linear scaled plot for 'relative' baseline. The effect of different baseline values for a signal level of 1.

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% 'relchange' baseline
% when X == B → (X-B)/B == 0; minmax = [-1 inf]
% linear scaling in plots might not be appropriate

% 'decibel' baseline, a and b must be positive
% when X == B → 10*log10(X/B) == 0; minmax = [-inf inf];

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% Baseline correction simulations
% Determine distributions for data from baseline correction

Xm = 10; % mean of a dist.
Bm = 5; % mean of b dist. - baseline
SDx = 0.05; % std as percent of mean
SDb = 0.05;
it = 100000; % number of iterations
```

Distributions of baseline corrected amplitude values:

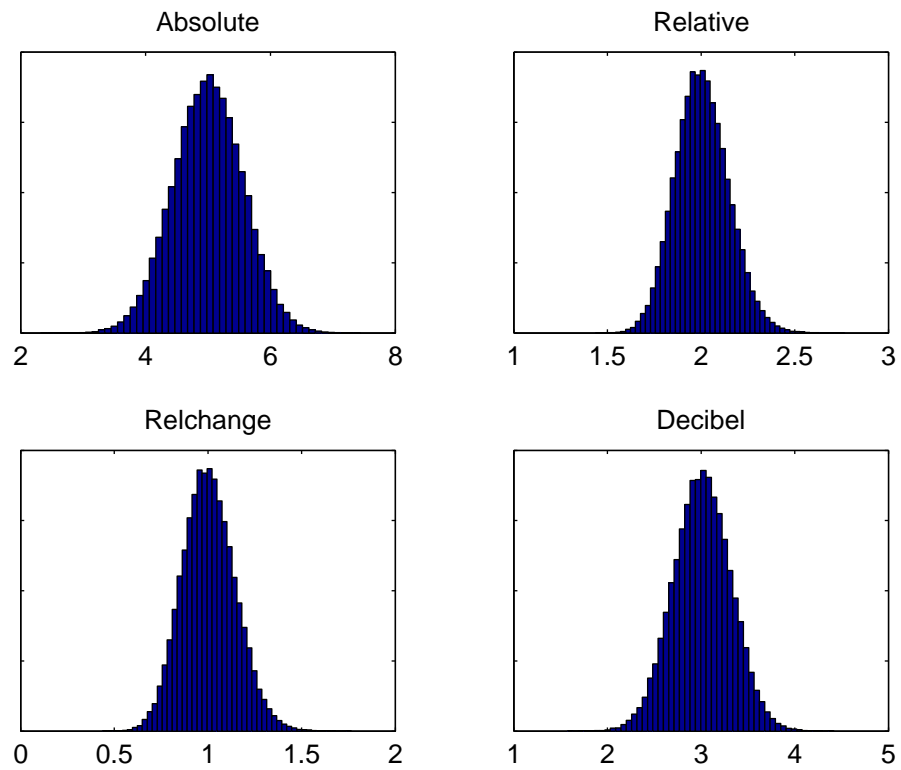


Figure 2: $SDx = 0.05$; $SDb = 0.05$

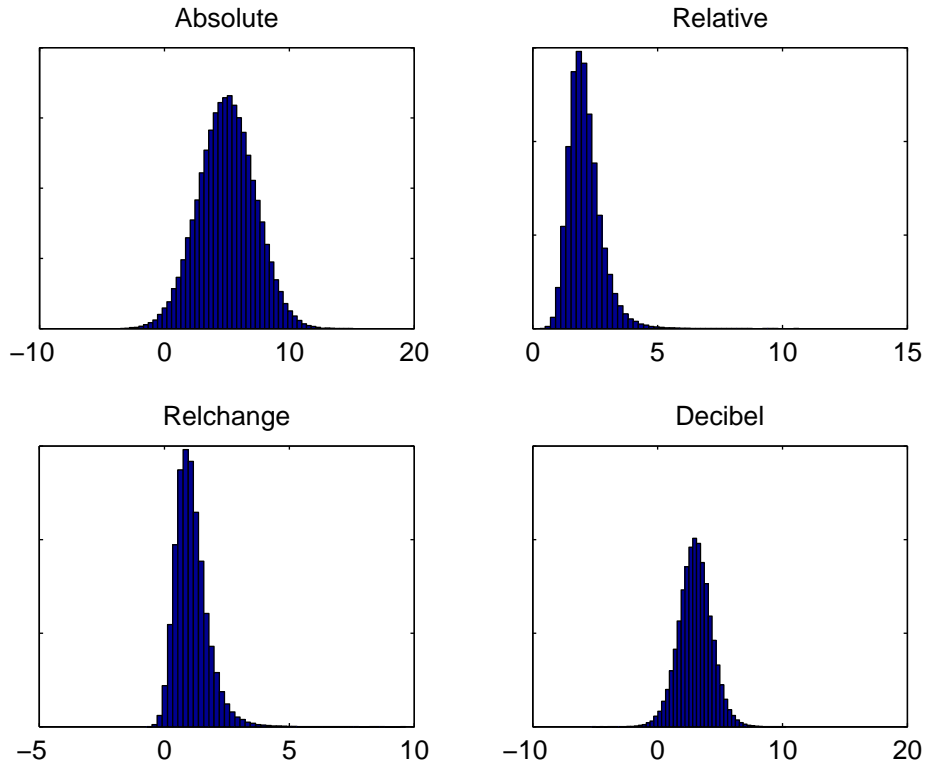


Figure 3: $SD_x = 0.2$; $SD_b = 0.2$

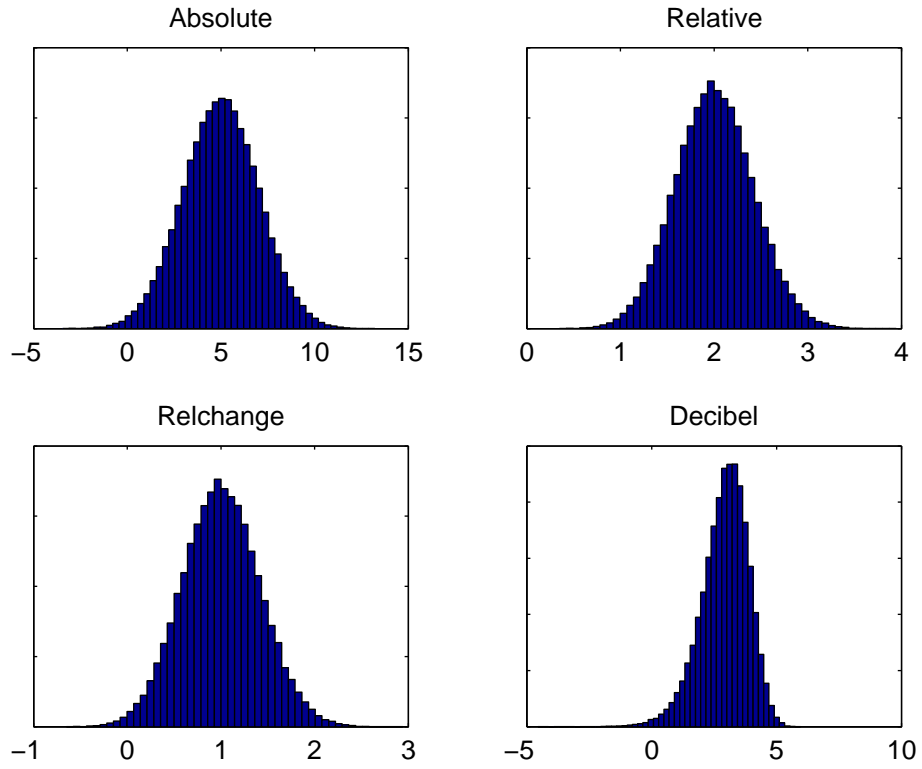


Figure 4: $SD_x = 0.2$; $SD_b = 0.05$

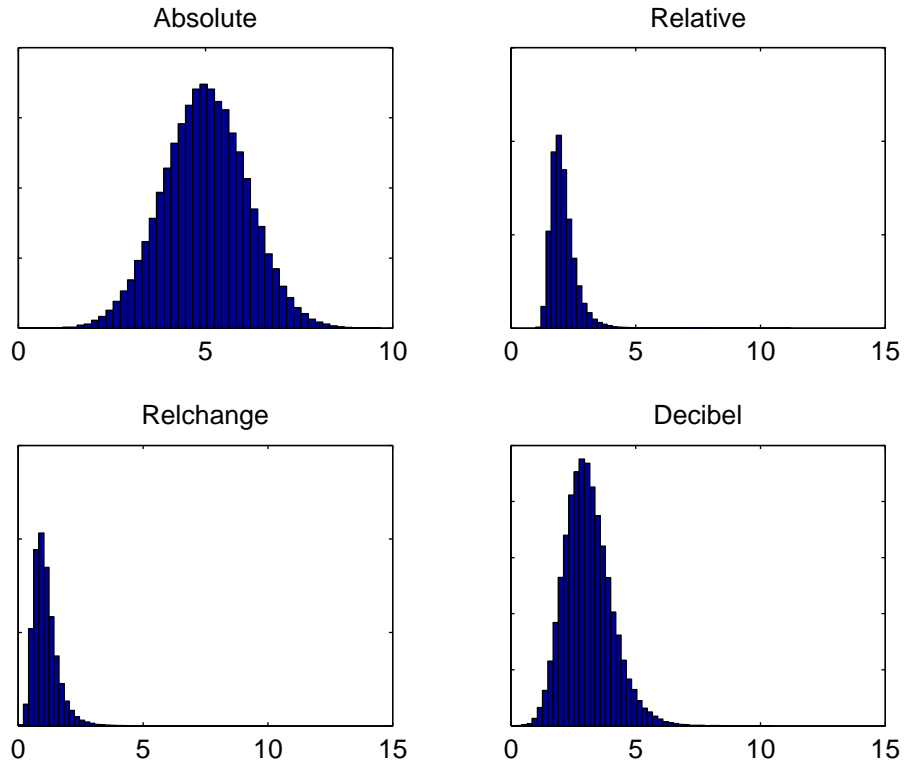


Figure 5: $SD_x = 0.05$; $SD_b = 0.2$

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% Baseline correction simulations (the script)
% Determine distributions for data from baseline correction %
% M.J. Henry & B. Herrmann, updated: 2016-03-25
% ----- %

% Scaling of the baseline corrections
% 'absolute' baseline
% with a == b -> a-b = 0; minmax = [-inf inf]

% 'relative' baseline
% with a == b -> a/b = 1; minmax = [0 inf]

% 'relchange' baseline
% with a == b -> (a-b)/b = 0; minmax = [-1 inf]

% 'decibel' baseline
% with a == b -> 10*log10(a/b) = 0; minmax = [-inf inf];
% a and b must be positive
% ----- %
clear all

% User defined %
Xm = 10; % mean of a dist.
Bm = 5; % mean of b dist. - baseline
SDx = .05; % std as percent of mean
SDb = .2;
it = 100000; % number of iterations
% ----- %

x = randn(1,it).*(Xm*SDx) + Xm; % assuming constant shift in amplitude dist
with stimulation
b = randn(1,it).*(Bm*SDb) + Bm; % assuming normal distribution of baseline
amplitudes

% 'absolute' baseline
A = x - b;

% 'relative' baseline
R = x ./ b;

% 'relchange' baseline
C = (x - b) ./ b;

% 'decibel' baseline
D = 10 * log10(x ./ b);

h = figure;
Ah = hist(A); Rh = hist(R); Ch = hist(C); Dh = hist(D);
subplot(2,2,1),hist(A,50),title('Absolute'),set(gca,'YTickLabel',{''});
subplot(2,2,2),hist(R,50),title('Relative'),set(gca,'YTickLabel',{''});
subplot(2,2,3),hist(C,50),title('Relchange'),set(gca,'YTickLabel',{''});
subplot(2,2,4),hist(D,50),title('Decibel'),set(gca,'YTickLabel',{''});

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