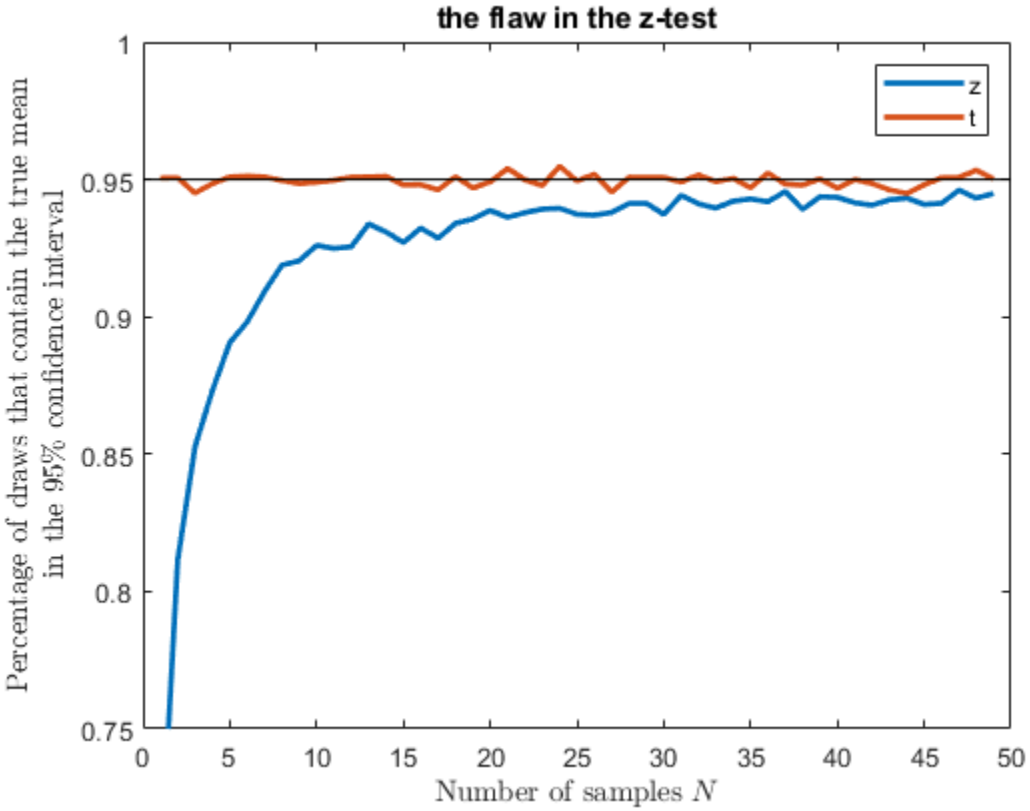
```
% assume population distribution is standard normal.
% repeatedly draw samples (a 1000 times) of size N = 2:50

clear; close all;

REP = 10000; % number of repititions

figure;

% z-confidence interval
count = zeros(1, 50);
for N = 2:50
    z = norminv(0.975);
    for r = 1:REP
        sample = randn(N, 1);
        mu = mean(sample); % sample mean
        sig = std(sample); % estimate standard deviation
        sem = sig/sqrt(N);
        % the two limits of the 95% confidence interval ([0.025
 0.975])
        conf_start = mu - z*sem;
        conf_end = mu + z*sem;
        if conf_start < 0 && conf_end > 0
            count(N) = count(N) + 1;
        end
    end
    count(N) = count(N)/REP;
end

plot(count(2:end), 'LineWidth', 2); hold on;

% t-confidence interval
count = zeros(1, 50);
for N = 2:50
    t = tinv(0.975, N-1); % t-score accounts for degrees of freedom
    for r = 1:REP
        sample = randn(N, 1);
        mu = mean(sample); % sample mean
        sig = std(sample); % estimate standard deviation
        sem = sig/sqrt(N);
        % the two limits of the 95% confidence interval ([0.025
 0.975])
        conf_start = mu - t*sem;
        conf_end = mu + t*sem;
        if conf_start < 0 && conf_end > 0
            count(N) = count(N) + 1;
        end
    end
    count(N) = count(N)/REP;
end

plot(count(2:end), 'LineWidth', 2); hold on;
```

```
legend('z', 't')
x=get(gca,'xlim');
line(x, [0.95 0.95], 'Color', 'black', 'LineWidth',
 0.05, 'HandleVisibility', 'off'); hold on;
ylim([0.75 1]);
xlabel('Number of samples $N$', 'Interpreter', 'latex')
ylabel({'Percentage of draws that contain the true mean','in the 95\%
 confidence interval'}, 'Interpreter', 'latex')
title('the flaw in the z-test')
```



Published with MATLAB® R2018a