In[56]:=
```
Manipulate[i = 0; populationSize; sampleSize; nIter;
 Dynamic[If[i < nIter, (
    If[i == 0, {populationSizeEstimate = Table[0, {j, nIter}];
      CurrentPopulationSizeEstimate = Table[0, {j, nIter}];
      population = Range[1, populationSize];}]; i++;
    (* RandomChoice[] does sampling WITH replacement *)
    populationSizeEstimate[[i]] = 2 * Mean[ RandomChoice[population, sampleSize]] - 1;
    CurrentPopulationSizeEstimate[[i]] = N[Mean [populationSizeEstimate[[1 ;; i]]]];
    p1 = ListPlot[CurrentPopulationSizeEstimate[[1 ;; i]],
      PlotLabel → Text["Convergence of population size estimator (2 X̄n-1)
           as funciton of number of samples and sample size\n" <>
         "\tnumber of samples taken =  " <> ToString[i] <>
         "\t      Current estimator value = " <> ToString[
          CurrentPopulationSizeEstimate[[i]] <>
         "\n\tCurrent estimator mean   =  " <> ToString[
          Mean[CurrentPopulationSizeEstimate[[1 ;; i]]] <>
         "\tCurrent estimator Variance = " <> ToString[
          Variance[CurrentPopulationSizeEstimate[[1 ;; i]]]],
      PlotRange → {{0, nIter}, {populationSize - 0.05 populationSize,
         populationSize + 0.05 populationSize}}, ImageSize → 500, AxesLabel →
       {"number of samples", "Estimator value of population size"}, Joined → True];
    p2 = Line[{{1, populationSize}, {nIter, populationSize}}];
    p3 = Show[p1, Graphics[{Red, p2}]]
   ), p3]],
 {{populationSize, 10 000, "Population Size?:"}, 20,
  1 000 000, 10, Appearance → "Labeled", ContinuousAction -> False},
 {{sampleSize, 30, "sample Size?:"}, 10, 100, 1,
  Appearance → "Labeled", ContinuousAction -> False},
 {{nIter, 500, "number of samples to take?:"}, 100, 100 000, 10,
  Appearance → "Labeled", ContinuousAction -> False},
 AutorunSequencing → {{2, 120}}
]
```

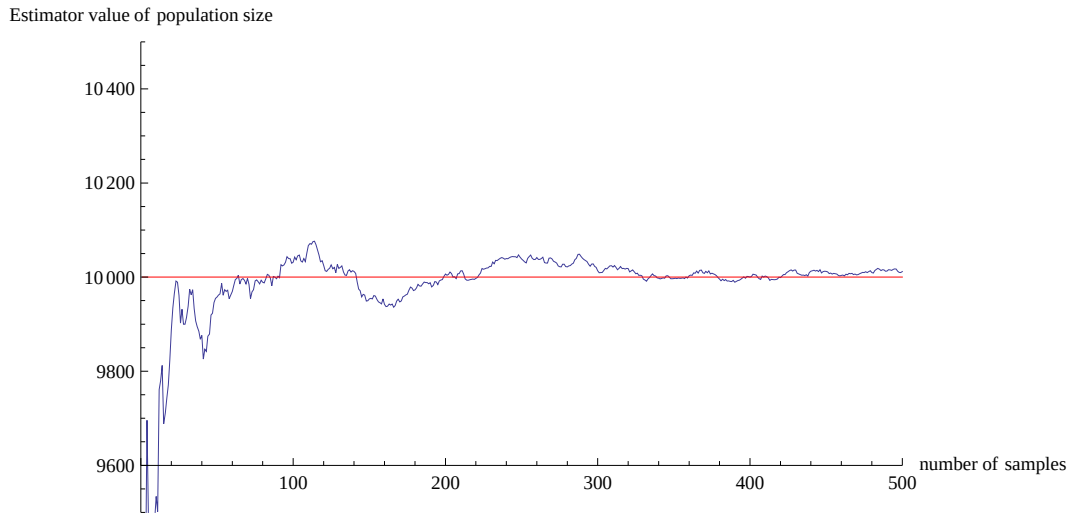
Population Size?: 10 000

sample Size?: 30

number of samples to take?: 500

Convergence of population size estimator $(2\,\bar{X}_n - 1)$ as funciton of number of samples and sample size

number of samples taken = 500 Current estimator value = 10011.9

Current estimator mean = 9980.76 Current estimator Variance = 17777.2

Out[56]=