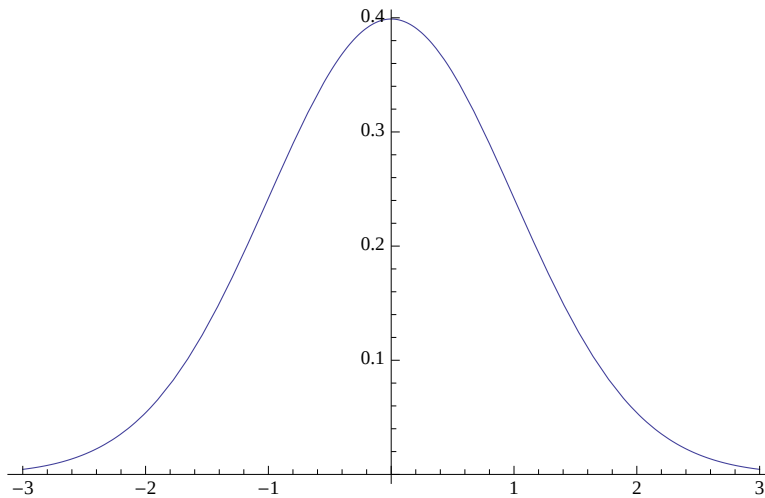


■ sample statistics for samples from a normal distribution

```
Print["A parent population"]  
Plot[PDF[NormalDistribution[0, 1], x], {x, -3, 3}]
```

A parent population

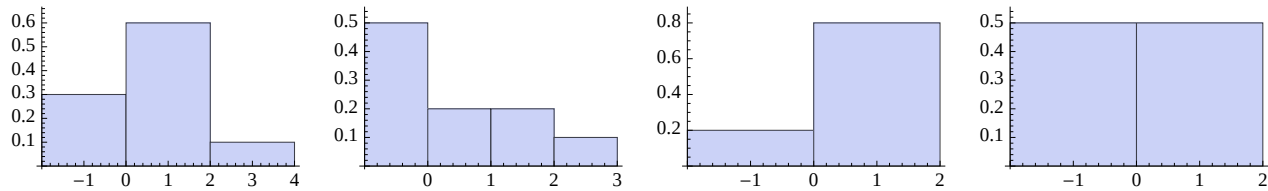


■ detail

```
Clear[nSize, i, numSets, SampleMeans, SampleStDevs, SampleMaxs, plts]  
nSize = 10;  
numSets = 4;  
SampleMeans = {};  
SampleStDevs = {};  
SampleMaxs = {};  
For[i = 1, i ≤ numSets, i++,  
  SampleSets[i] = RandomReal[NormalDistribution[0, 1], nSize];  
  plts[i] = Histogram[SampleSets[i], Automatic, "Probability"];  
  AppendTo[SampleMeans, Mean[SampleSets[i]]];  
  AppendTo[SampleStDevs, StandardDeviation[SampleSets[i]]];  
  AppendTo[SampleMaxs, Max[SampleSets[i]]]  
]  
Print["A sample should resemble its parent population."]  
Print["Samples vary, especially for a small sample size!"]  
Print[GraphicsArray[ Table[plts[i], {i, 1, numSets}] ] ]  
Print["Each sample has some summary  
  statistics. We collect a single statistic from all samples. "]  
Print["collection of xbar: ", SampleMeans]  
Print["collection of s: ", SampleStDevs]  
Print["collection of max: ", SampleMaxs]
```

A sample should resemble its parent population.

Samples vary, especially for a small sample size!



Each sample has some summary statistics.

We collect a single statistic from all samples.

collection of xbar: {0.715912, 0.39148, 0.414032, 0.156688}

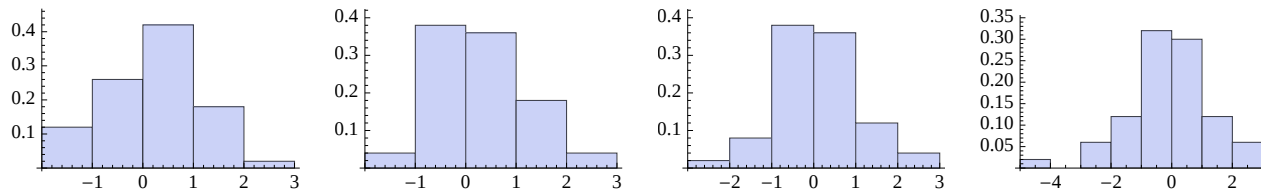
collection of s: {1.32771, 0.895873, 0.948078, 0.962673}

collection of max: {2.86439, 2.00623, 1.68047, 1.41217}

```
Clear[nSize, i, numSets, SampleMeans, SampleStDevs, SampleMaxs, plts]
nSize = 50;
numSets = 4;
SampleMeans = {};
SampleStDevs = {};
SampleMaxs = {};
For[i = 1, i ≤ numSets, i++,
  SampleSets[i] = RandomReal[NormalDistribution[0, 1], nSize];
  plts[i] = Histogram[SampleSets[i], Automatic, "Probability"];
  AppendTo[SampleMeans, Mean[SampleSets[i]]];
  AppendTo[SampleStDevs, StandardDeviation[SampleSets[i]]];
  AppendTo[SampleMaxs, Max[SampleSets[i]]];
]
Print["A sample should resemble its parent population."]
Print["Samples vary, even for a moderate sample size"]
Print[GraphicsArray[ Table[plts[i], {i, 1, numSets}] ] ]
Print["Each sample has some summary
  statistics. We collect a single statistic from all samples. "]
Print["collection of xbar: ", SampleMeans]
Print["collection of s: ", SampleStDevs]
Print["collection of max: ", SampleMaxs]
```

A sample should resemble its parent population.

Samples vary, even for a moderate sample size



Each sample has some summary statistics.

We collect a single statistic from all samples.

collection of xbar: {0.172797, 0.284518, 0.106196, -0.0935475}

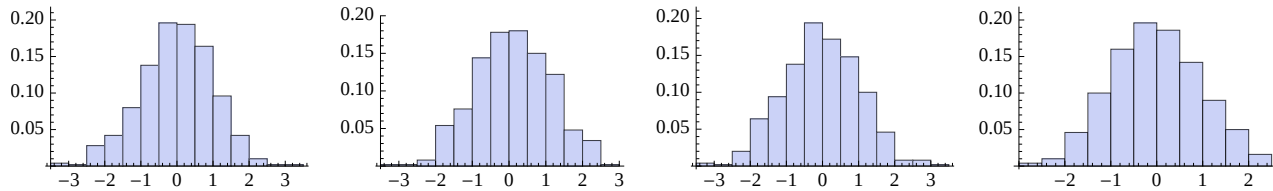
collection of s: {0.951445, 0.905154, 0.963243, 1.26533}

collection of max: {2.08352, 2.59664, 2.11494, 2.87431}

```
Clear[nSize, i, numSets, SampleMeans, SampleStDevs, SampleMaxs, plts]
nSize = 500;
numSets = 4;
SampleMeans = {};
SampleStDevs = {};
SampleMaxs = {};
For[i = 1, i ≤ numSets, i++,
  SampleSets[i] = RandomReal[NormalDistribution[0, 1], nSize];
  plts[i] = Histogram[SampleSets[i], Automatic, "Probability"];
  AppendTo[SampleMeans, Mean[SampleSets[i]]];
  AppendTo[SampleStDevs, StandardDeviation[SampleSets[i]]];
  AppendTo[SampleMaxs, Max[SampleSets[i]]];
]
Print["A sample should resemble its parent population."]
Print["Samples vary, even for a large sample size!"]
Print[GraphicsArray[ Table[plts[i], {i, 1, numSets}] ] ]
Print["Each sample has some summary
      statistics. We collect a single statistic from all samples. "]
Print["collection of xbar: ", SampleMeans]
Print["collection of s: ", SampleStDevs]
Print["collection of max: ", SampleMaxs]
```

A sample should resemble its parent population.

Samples vary, even for a large sample size!



Each sample has some summary statistics.

We collect a single statistic from all samples.

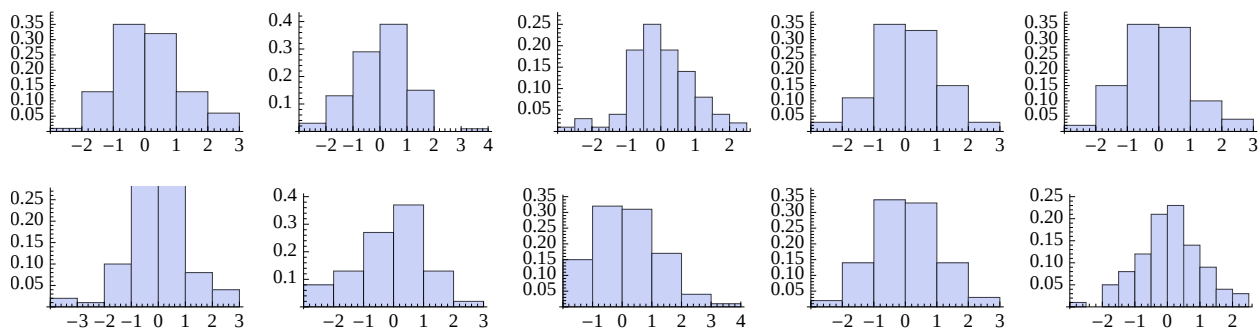
collection of xbar: {-0.000992995, 0.108071, -0.0346502, -0.0136192}

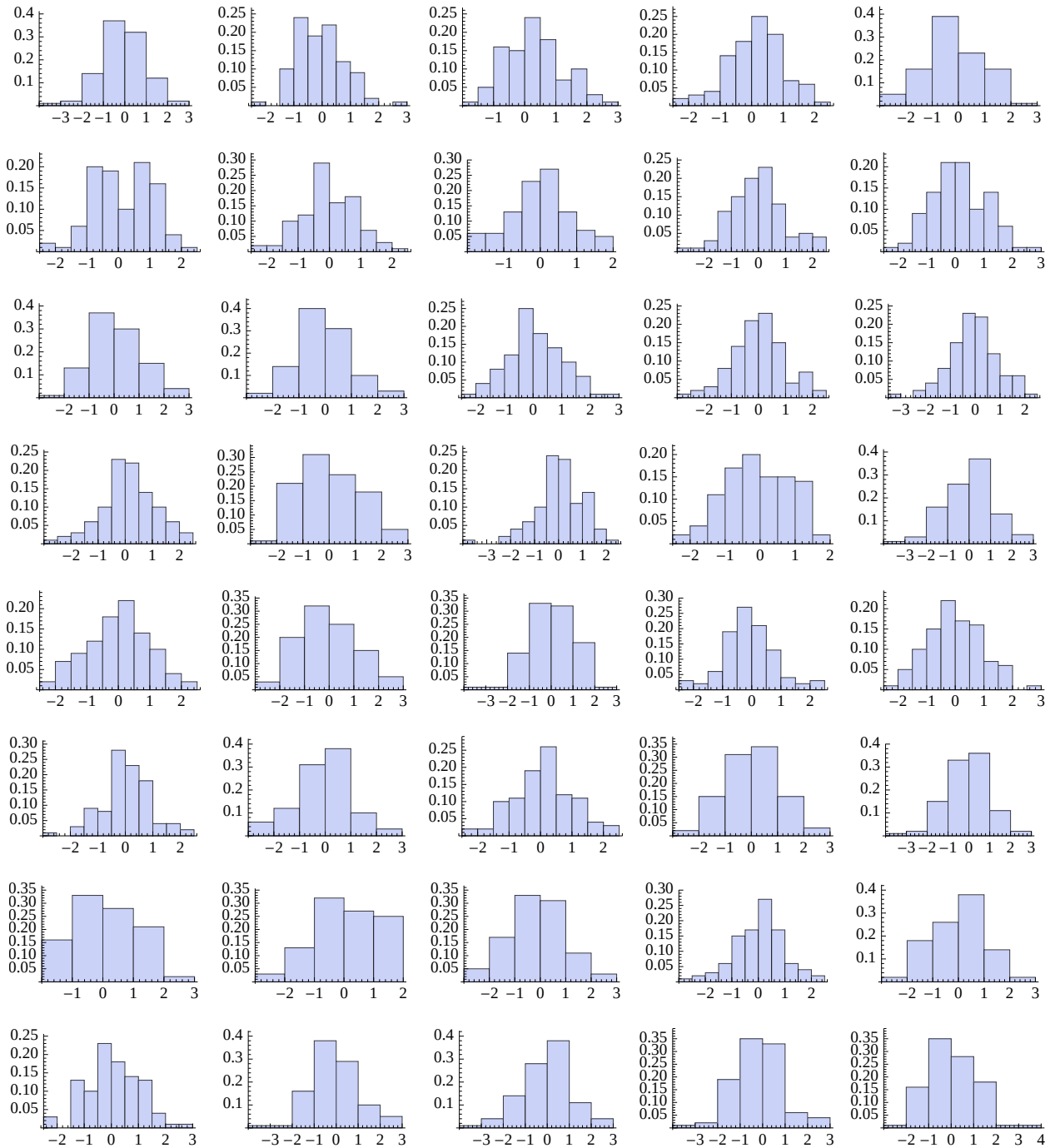
collection of s: {1.00817, 1.02182, 1.0342, 0.959555}

collection of max: {3.45132, 2.67471, 3.24315, 2.49224}

■ COLLECT SAMPLES STATISTICS FROM MULTIPLE RANDOM SAMPLES OF THE SAME SIZE

```
Clear[nSize, i, j, k, numSamplesPerRow, numRows,
      numSamples, SampleMeans, SampleStDevs, SampleMaxs, plts]
nSize = 100;
numSamplesPerRow = 5;
numRows = 10;
SampleMeans = {};
SampleStDevs = {};
SampleMaxs = {};
For[j = 1, j ≤ numRows, j++,
  For[i = 1, i ≤ numSamplesPerRow, i++,
    SampleSets[j, i] = RandomReal[NormalDistribution[0, 1], nSize];
    plts[j, i] = Histogram[SampleSets[j, i], Automatic, "Probability"];
    AppendTo[SampleMeans, Mean[SampleSets[j, i]]];
    AppendTo[SampleStDevs, StandardDeviation[SampleSets[j, i]]];
    AppendTo[SampleMaxs, Max[SampleSets[j, i]]];
  ]
  Print[GraphicsArray[ Table[plts[j, k], {k, 1, numSetsPerRow}] ] ]
]
numSamples = numSamplesPerRow * numRows;
Print["There are ", numSamples, " samples of size ", nSize]
```





There are 50 samples of size 100

```

Print["Collect the sample means from
      these samples; show a histogram of sample means."]
Print["The histogram shows ", numSamples, " sample means."]
Print["These are from a new population of
      all possible sample means for samples of size ", nSize]
Print[SampleMeans]
Histogram[SampleMeans, Automatic, "Probability"]

Print["Collect the sample standard deviations from these
      samples; show a histogram of sample standard deviations."]
Print["The histogram shows ", numSamples, " sample standard deviations."]
Print["These are from a new population of all possible
      sample standard deviations for samples of size ", nSize]
Print[SampleStDevs]
Histogram[SampleStDevs, Automatic, "Probability"]

Print[
  "Collect the sample maxs from these samples; show a histogram of sample maxs."]
Print["The histogram shows ", numSamples, " sample maxs."]
Print["These are from a new population
      of all possible sample maxs for samples of size ", nSize]
Print[SampleMaxs]
Histogram[SampleMaxs, Automatic, "Probability"]

```

Collect the sample means from these samples; show a histogram of sample means.

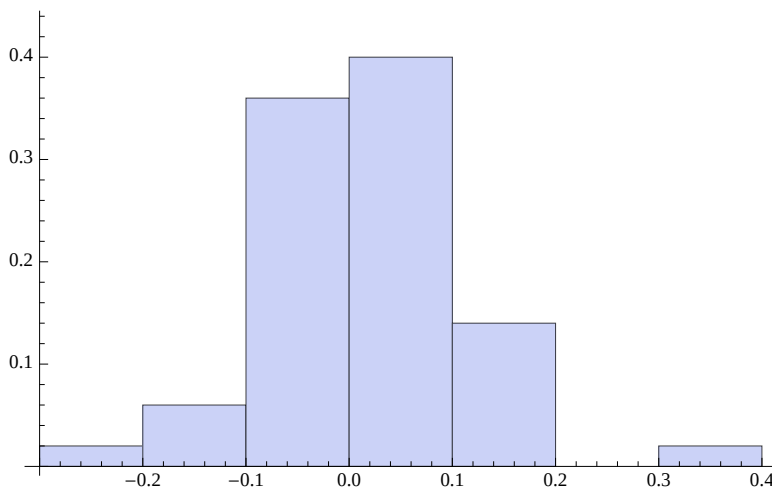
The histogram shows 50 sample means.

These are from a new population of all possible sample means for samples of size 100

```

{0.0659442, 0.0353722, 0.0214125, 0.0112779, 0.0024348, 0.0129827, -0.083635, 0.129061,
0.0302688, 0.0587686, -0.0855644, -0.0402346, 0.309727, 0.131015, -0.201562,
0.146361, -0.0186051, -0.010994, -0.0194121, 0.13242, 0.0887434, -0.136876,
0.110255, 0.00214352, -0.0727518, 0.136115, 0.0511166, 0.037263, -0.0793707,
-0.0218053, -0.00712934, -0.0480826, 0.0460438, -0.0926869, -0.0280855, 0.0492758,
-0.0213601, 0.0862636, 0.0298238, -0.028485, 0.128406, 0.0577545, -0.175471,
0.0344331, -0.0166359, 0.0872449, -0.0747816, -0.0102756, -0.196076, 0.0204643}

```

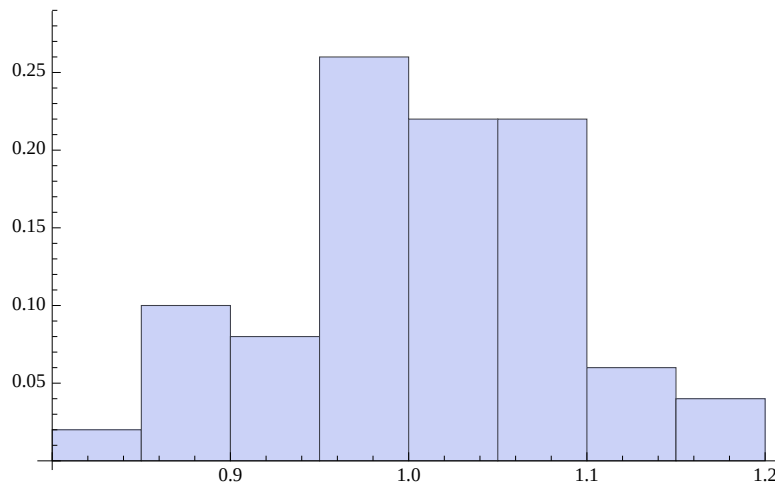


Collect the sample standard deviations from these samples; show a histogram of sample standard deviations.

The histogram shows 50 sample standard deviations.

These are from a new population of all possible sample standard deviations for samples of size 100

```
{1.11633, 1.03076, 0.928942, 1.02869, 1.09762, 1.04055, 1.15566, 1.08952, 1.02228,
0.972791, 1.04697, 0.845876, 0.938423, 0.894863, 1.07247, 0.944705, 0.881427,
0.875702, 0.984672, 0.980264, 1.04356, 1.00841, 0.92069, 0.965525, 0.966762,
0.989458, 1.15319, 0.988886, 0.950694, 1.14439, 0.975201, 1.08291, 1.00453,
0.883291, 0.957388, 0.854067, 1.07096, 0.982267, 1.00935, 1.05907, 1.04995,
1.05978, 1.10811, 0.957589, 1.05005, 0.963653, 1.09155, 1.09011, 1.01504, 1.05543}
```

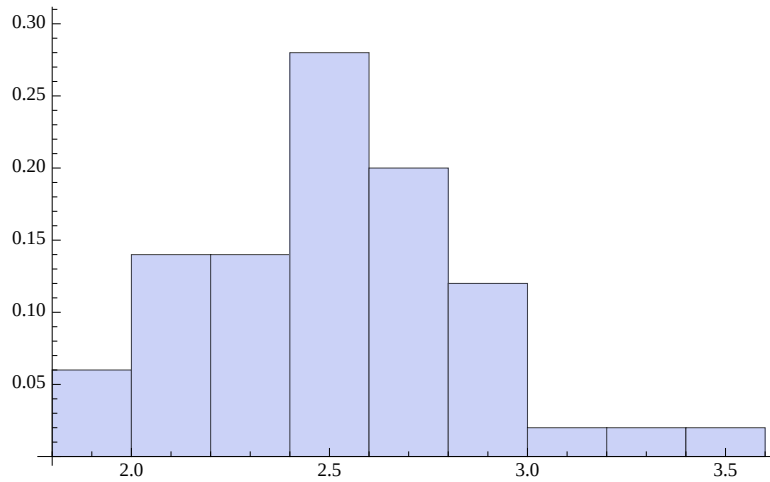


Collect the sample maxs from these samples; show a histogram of sample maxs.

The histogram shows 50 sample maxs.

These are from a new population of all possible sample maxs for samples of size 100

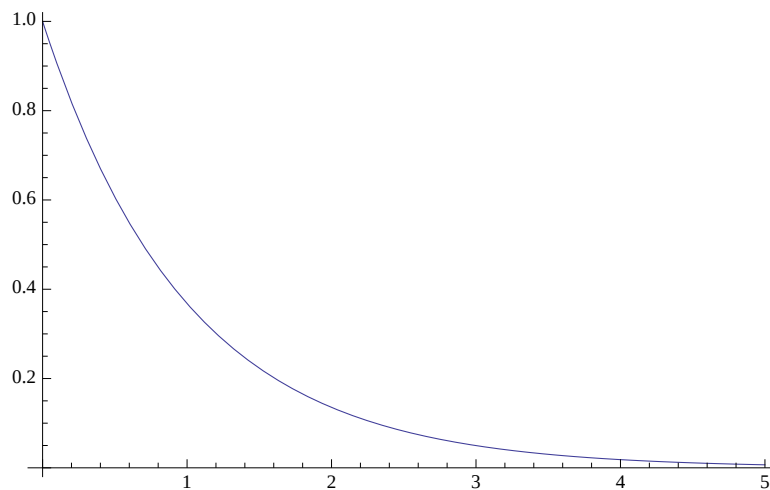
```
{2.75271, 3.05442, 2.40562, 2.86251, 2.76798, 2.85925, 2.63314, 3.20367,
2.96381, 2.46888, 2.34146, 2.64175, 2.97316, 2.07709, 2.07631, 2.22354,
2.35896, 1.99857, 2.35991, 2.52696, 2.50863, 2.74065, 2.60497, 2.29126,
2.49053, 2.45131, 2.52437, 2.1773, 1.83188, 2.61939, 2.16478, 2.09276, 2.31666,
2.35688, 2.79604, 2.18183, 2.55031, 2.41048, 2.93106, 2.44491, 2.51818,
1.97702, 2.77986, 2.1932, 2.80881, 2.54699, 2.76823, 2.52848, 2.54337, 3.45491}
```



■ sample statistics for samples from an exponential distribution

```
Print["A parent population"]  
Plot[PDF[ExponentialDistribution[1], x], {x, 0, 5}]
```

A parent population

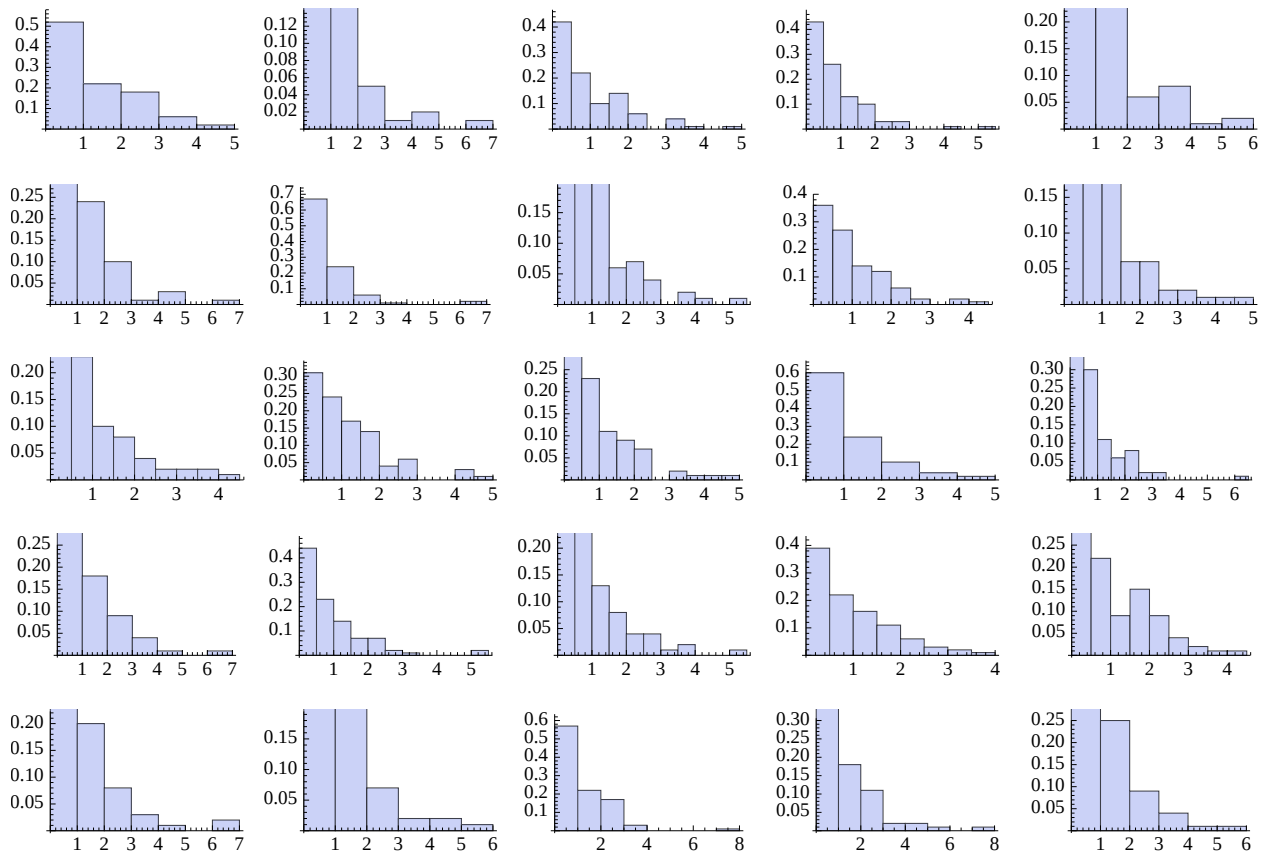


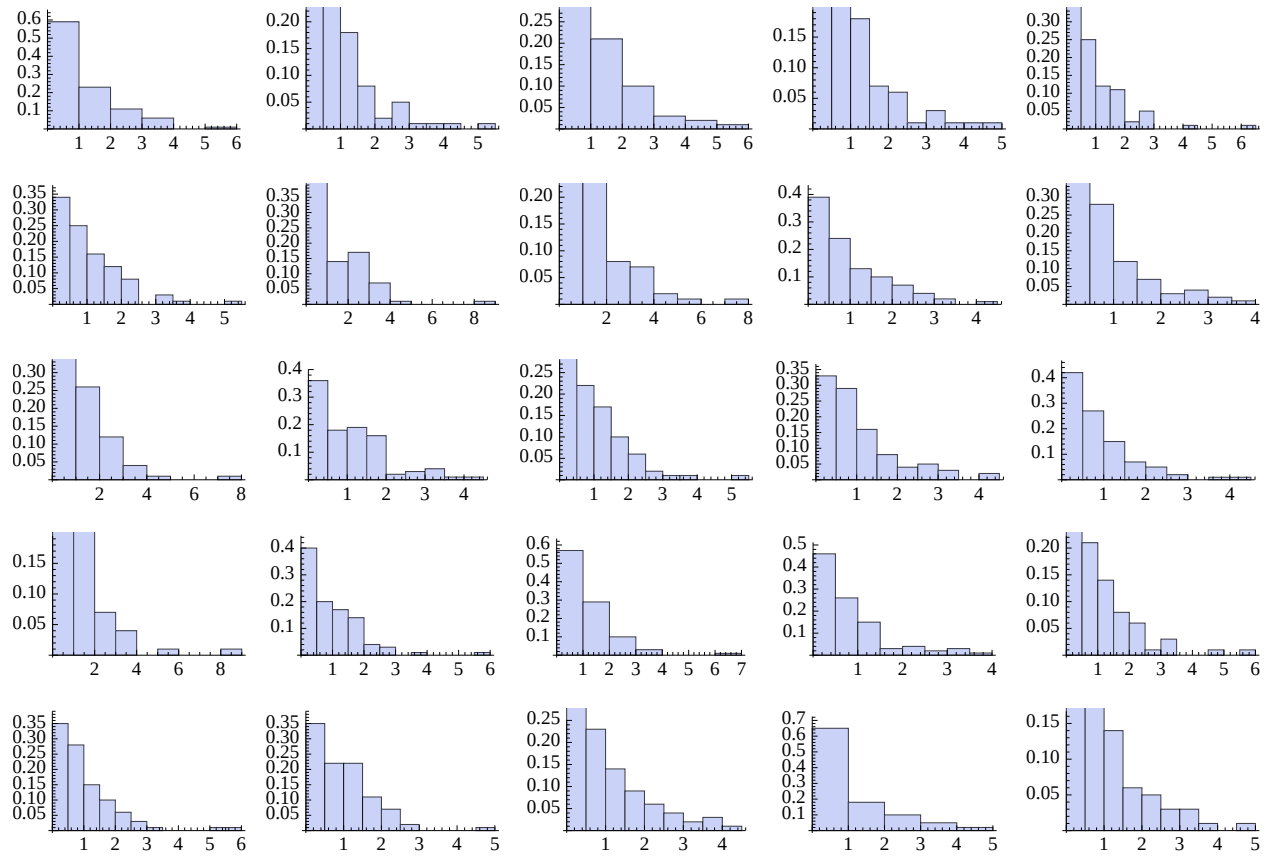
■ COLLECT SAMPLES STATISTICS FROM MULTIPLE RANDOM SAMPLES OF THE SAME SIZE

```

Clear[nSize, i, j, k, numSamplesPerRow, numRows,
      numSamples, SampleMeans, SampleStDevs, SampleMaxs, plts]
nSize = 100;
numSamplesPerRow = 5;
numRows = 10;
SampleMeans = {};
SampleStDevs = {};
SampleMaxs = {};
For[j = 1, j ≤ numRows, j++,
  For[i = 1, i ≤ numSamplesPerRow, i++,
    SampleSets[j, i] = RandomReal[ExponentialDistribution[1], nSize];
    plts[j, i] = Histogram[SampleSets[j, i], Automatic, "Probability"];
    AppendTo[SampleMeans, Mean[SampleSets[j, i]]];
    AppendTo[SampleStDevs, StandardDeviation[SampleSets[j, i]]];
    AppendTo[SampleMaxs, Max[SampleSets[j, i]]];
  ]
  Print[GraphicsArray[ Table[plts[j, k], {k, 1, numSetsPerRow}] ] ]
]
numSamples = numSamplesPerRow * numRows;
Print["There are ", numSamples, " samples of size ", nSize]

```





There are 50 samples of size 100

```

Print["Collect the sample means from
      these samples; show a histogram of sample means."]
Print["The histogram shows ", numSamples, " sample means."]
Print["These are from a new population of
      all possible sample means for samples of size ", nSize]
Print[SampleMeans]
Histogram[SampleMeans, Automatic, "Probability"]

Print["Collect the sample standard deviations from these
      samples; show a histogram of sample standard deviations."]
Print["The histogram shows ", numSamples, " sample standard deviations."]
Print["These are from a new population of all possible
      sample standard deviations for samples of size ", nSize]
Print[SampleStDevs]
Histogram[SampleStDevs, Automatic, "Probability"]

Print[
  "Collect the sample maxs from these samples; show a histogram of sample maxs."]
Print["The histogram shows ", numSamples, " sample maxs."]
Print["These are from a new population
      of all possible sample maxs for samples of size ", nSize]
Print[SampleMaxs]
Histogram[SampleMaxs, Automatic, "Probability"]

```

Collect the sample means from these samples; show a histogram of sample means.

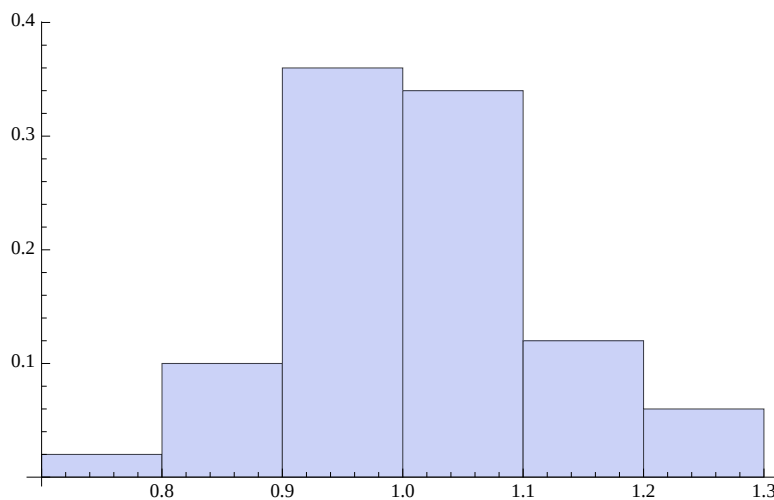
The histogram shows 50 sample means.

These are from a new population of all possible sample means for samples of size 100

```

{1.20303, 0.973722, 0.966136, 0.8753, 1.13775, 1.02959, 0.937565, 1.09657, 0.941017,
 0.940225, 0.844335, 1.13482, 0.906224, 1.03077, 0.898174, 0.983541, 0.914469,
 0.986415, 0.930306, 1.06206, 1.06006, 1.04192, 1.1533, 1.10777, 1.07254,
 1.08033, 1.01, 1.02923, 1.04046, 0.921314, 1.05966, 1.21405, 1.24822, 0.98496,
 0.843949, 1.1194, 1.04873, 0.944806, 1.03207, 0.844274, 1.16351, 0.953832,
 1.06204, 0.799658, 0.92676, 1.01686, 0.950256, 1.06768, 0.995702, 0.968526}

```

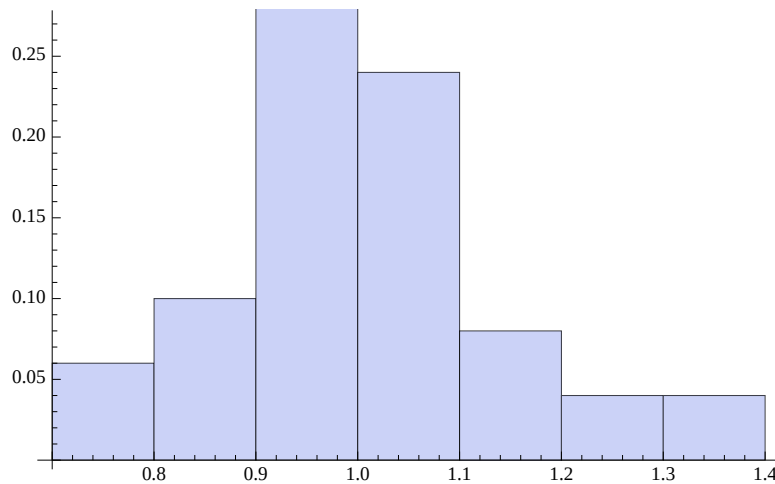


Collect the sample standard deviations from these samples; show a histogram of sample standard deviations.

The histogram shows 50 sample standard deviations.

These are from a new population of all possible sample standard deviations for samples of size 100

```
{1.1219, 1.00961, 0.937075, 0.871703, 1.17029, 1.08805, 1.03022, 0.949746, 0.861326,
0.950951, 0.925532, 0.983147, 0.936212, 1.0305, 0.93174, 1.07974, 0.934294,
0.946661, 0.832141, 0.905869, 1.18539, 1.04202, 1.09176, 1.2478, 1.03454, 1.0573,
0.947055, 1.06966, 0.947127, 0.938702, 0.909671, 1.31097, 1.33867, 0.865006,
0.793083, 1.13319, 0.907198, 0.913502, 0.905198, 0.774572, 1.25166, 0.901076,
1.06274, 0.780736, 0.995648, 0.963936, 0.828135, 0.985575, 1.04093, 0.907858}
```

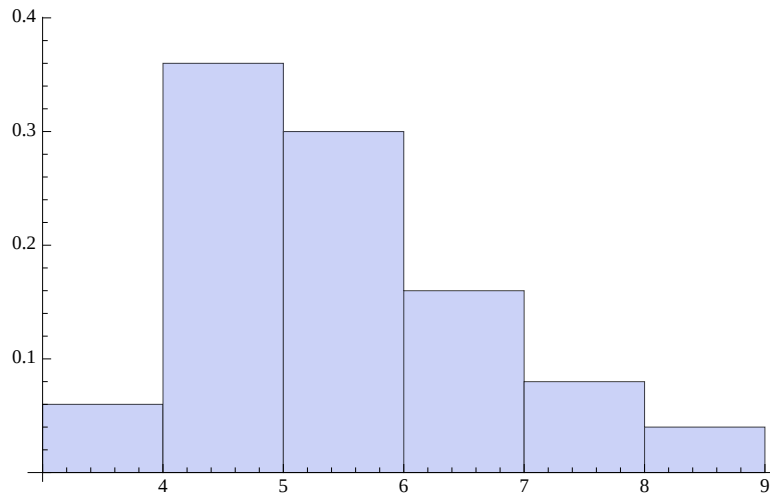


Collect the sample maxs from these samples; show a histogram of sample maxs.

The histogram shows 50 sample maxs.

These are from a new population of all possible sample maxs for samples of size 100

```
{4.98668, 6.27459, 4.57435, 5.40055, 5.46172, 6.11864, 6.38927, 5.1317,
4.46484, 4.89201, 4.22363, 4.9291, 4.78144, 4.44571, 6.06493, 6.50016, 5.10138,
5.30587, 3.66434, 4.22652, 6.68785, 5.11295, 7.08741, 7.90394, 5.24127,
5.37979, 5.01847, 5.51588, 4.86038, 6.03271, 5.28161, 8.20873, 7.27989,
4.13349, 3.58146, 7.43214, 4.24973, 5.19826, 4.10596, 4.25912, 8.94419,
5.53224, 6.65066, 3.63074, 5.89204, 5.88808, 4.73732, 4.4498, 4.93853, 4.55569}
```

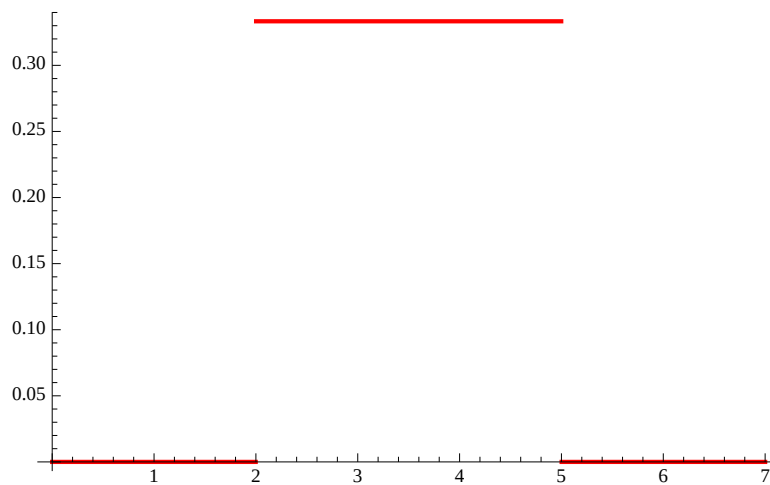


■ sample statistics for samples from a uniform distribution

```
Print["A parent population"]
```

```
Plot[PDF[UniformDistribution[{2, 5}], x], {x, 0, 7}, PlotStyle -> {Red, Thick}]
```

A parent population

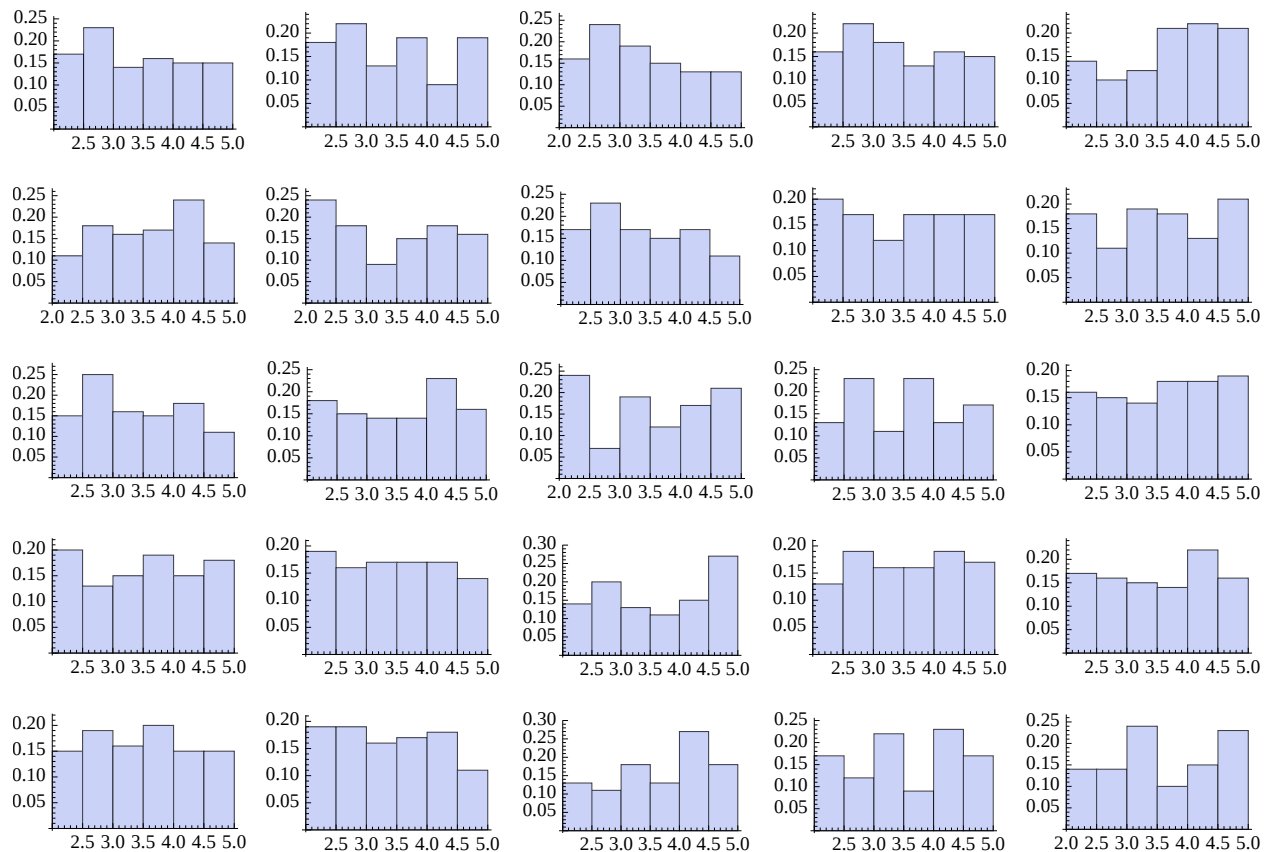


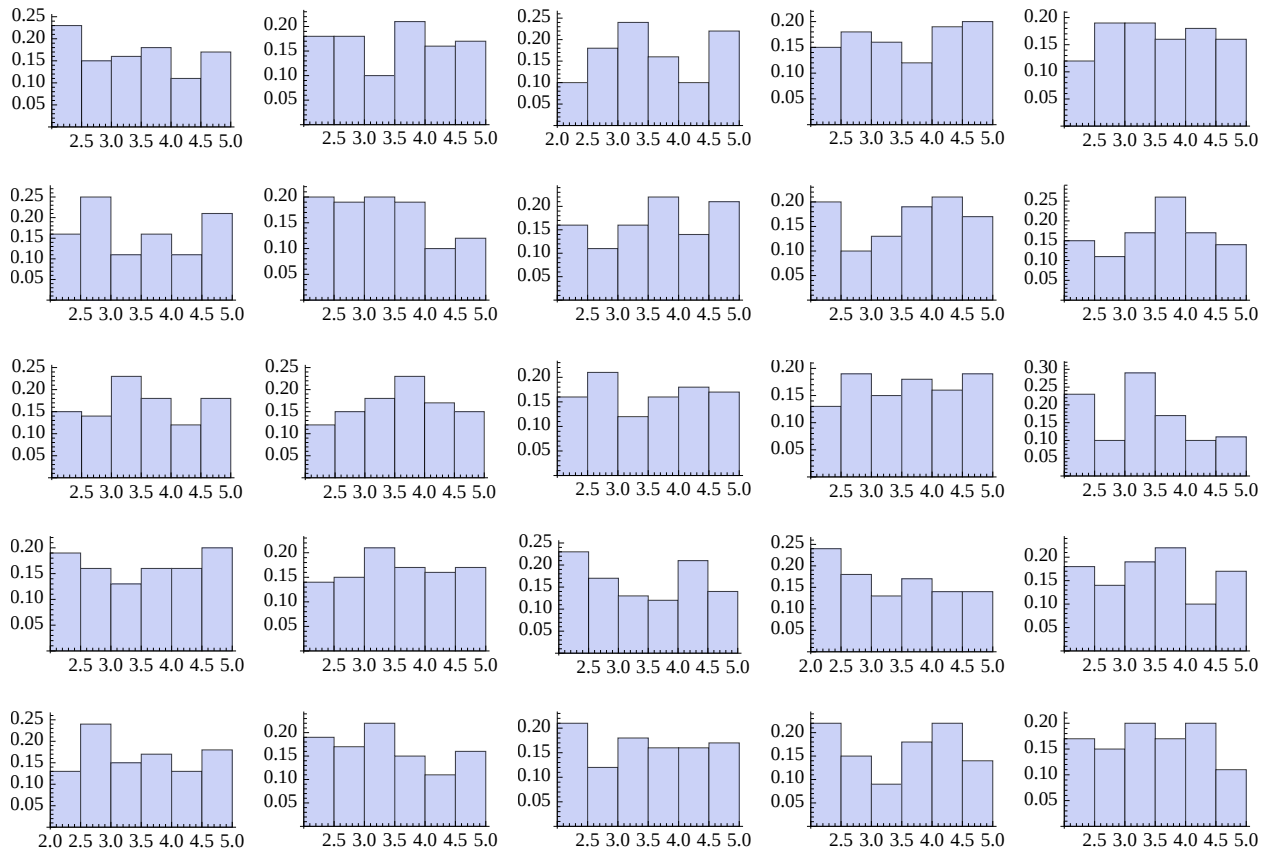
■ COLLECT SAMPLES STATISTICS FROM MULTIPLE RANDOM SAMPLES OF THE SAME SIZE

```

Clear[nSize, i, j, k, numSamplesPerRow, numRows,
      numSamples, SampleMeans, SampleStDevs, SampleMaxs, plts]
nSize = 100;
numSamplesPerRow = 5;
numRows = 10;
SampleMeans = {};
SampleStDevs = {};
SampleMaxs = {};
For[j = 1, j ≤ numRows, j++,
  For[i = 1, i ≤ numSamplesPerRow, i++,
    SampleSets[j, i] = RandomReal[UniformDistribution[{2, 5}], nSize];
    plts[j, i] = Histogram[SampleSets[j, i], Automatic, "Probability"];
    AppendTo[SampleMeans, Mean[SampleSets[j, i]]];
    AppendTo[SampleStDevs, StandardDeviation[SampleSets[j, i]]];
    AppendTo[SampleMaxs, Max[SampleSets[j, i]]];
  ]
  Print[GraphicsArray[ Table[plts[j, k], {k, 1, numSetsPerRow}] ] ]
]
numSamples = numSamplesPerRow * numRows;
Print["There are ", numSamples, " samples of size ", nSize]

```





There are 50 samples of size 100

```

Print["Collect the sample means from
      these samples; show a histogram of sample means."]
Print["The histogram shows ", numSamples, " sample means."]
Print["These are from a new population of
      all possible sample means for samples of size ", nSize]
Print[SampleMeans]
Histogram[SampleMeans, Automatic, "Probability"]

Print["Collect the sample standard deviations from these
      samples; show a histogram of sample standard deviations."]
Print["The histogram shows ", numSamples, " sample standard deviations."]
Print["These are from a new population of all possible
      sample standard deviations for samples of size ", nSize]
Print[SampleStDevs]
Histogram[SampleStDevs, Automatic, "Probability"]

Print[
  "Collect the sample maxs from these samples; show a histogram of sample maxs."]
Print["The histogram shows ", numSamples, " sample maxs."]
Print["These are from a new population
      of all possible sample maxs for samples of size ", nSize]
Print[SampleMaxs]
Histogram[SampleMaxs, Automatic, "Probability"]

```

Collect the sample means from these samples; show a histogram of sample means.

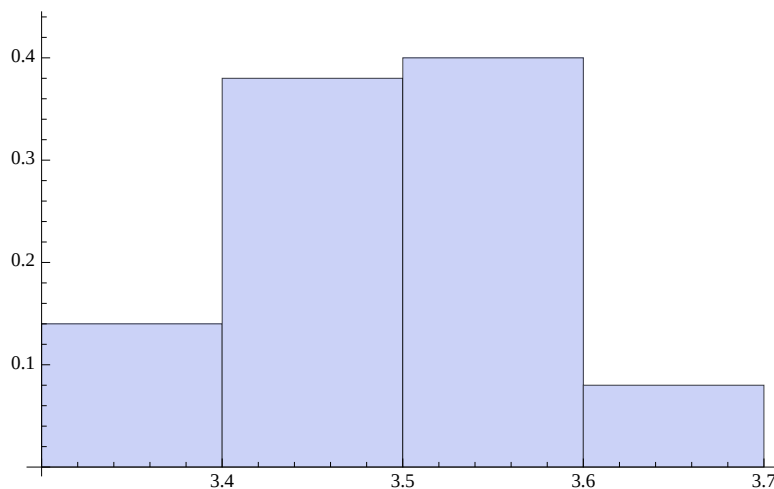
The histogram shows 50 sample means.

These are from a new population of all possible sample means for samples of size 100

```

{3.43796, 3.4229, 3.36761, 3.41968, 3.67217, 3.5657, 3.4363, 3.3873, 3.48767,
 3.54969, 3.4213, 3.53056, 3.5041, 3.52597, 3.59409, 3.49176, 3.42673, 3.62824,
 3.5261, 3.54696, 3.48452, 3.40797, 3.66604, 3.56922, 3.59507, 3.38953,
 3.48952, 3.58352, 3.57699, 3.54937, 3.47229, 3.31352, 3.60247, 3.57067,
 3.55126, 3.50686, 3.56666, 3.49778, 3.53325, 3.34675, 3.51159, 3.53286,
 3.41101, 3.35883, 3.46704, 3.46817, 3.37479, 3.46652, 3.45815, 3.45453}

```

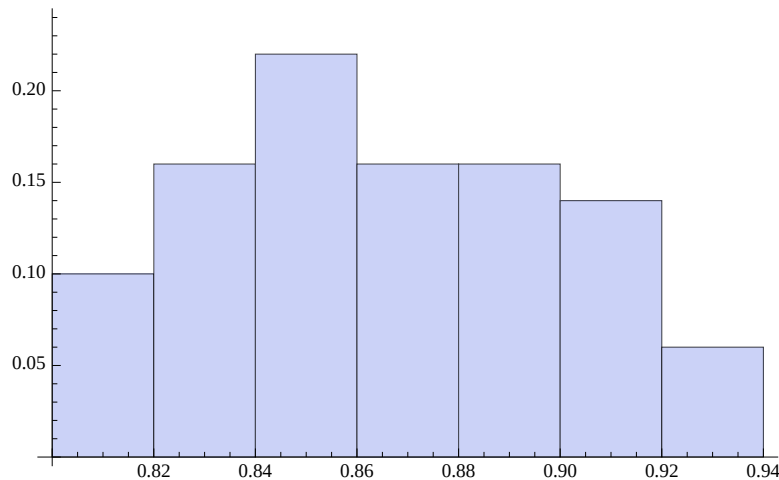


Collect the sample standard deviations from these samples; show a histogram of sample standard deviations.

The histogram shows 50 sample standard deviations.

These are from a new population of all possible sample standard deviations for samples of size 100

```
{0.890064, 0.882715, 0.829746, 0.834822, 0.873709, 0.811248, 0.917309, 0.808017,
0.908275, 0.869148, 0.820423, 0.859021, 0.932063, 0.854591, 0.90038, 0.903865, 0.862986,
0.898922, 0.859054, 0.855179, 0.843438, 0.863415, 0.848497, 0.866883, 0.899106,
0.878604, 0.883686, 0.84343, 0.886849, 0.828397, 0.901467, 0.818353, 0.850937,
0.886555, 0.82222, 0.834526, 0.804707, 0.856458, 0.862292, 0.825673, 0.923683,
0.85871, 0.938222, 0.902299, 0.85367, 0.83941, 0.883143, 0.904603, 0.87661, 0.815341}
```



Collect the sample maxs from these samples; show a histogram of sample maxs.

The histogram shows 50 sample maxs.

These are from a new population of all possible sample maxs for samples of size 100

```
{4.99323, 4.98864, 4.99831, 4.86398, 4.99264, 4.98355, 4.98616, 4.99429,
4.94081, 4.97243, 4.99165, 4.98587, 4.96795, 4.99429, 4.97913, 4.96955,
4.94804, 4.98874, 4.99754, 4.99711, 4.97991, 4.98235, 4.96579, 4.99564,
4.98807, 4.99275, 4.99555, 4.96534, 4.97502, 4.90359, 4.97989, 4.9823, 4.94759,
4.93067, 4.98239, 4.99361, 4.99174, 4.98537, 4.97004, 4.9479, 4.98972, 4.9755,
4.98051, 4.95699, 4.93459, 4.97057, 4.97595, 4.96496, 4.88924, 4.99277}
```

