

STAT2011 Statistical Models

Semester 1, 2012

Week 3 Computer Exercise

This week we simulate drawing chips from an urn, both with and without replacement, using the `sample()` function. Before you commence, finish off any work from earlier weeks if necessary.

1. Create a vector `urn1=rep(c("white","black"),c(100,100))` representing an urn with 100 white and 100 black chips.
2. Create a 100-by-100 matrix of zeroes called `with1`:

```
with1 <- matrix(0,100,100)
```

3. Execute the following `for` loop, which draws 100 samples of size 100 *with replacement*, storing each in a column of `with1`:

```
for (i in 1:100){  
  with1[,i] <- sample(x=urn1,size=100,replace=TRUE)  
}
```

4. Obtain a vector `Xwith1` consisting of the numbers of "white" in each column. There are various ways to do this. For instance,

```
sum(with1[,1]=="white")
```

gives the number of "white" in column 1 of `with1`. A very quick (but tricky) method uses `apply(...)` (hint: `(with1=="white")` is a matrix!), a slower (but easier) method uses a `for` loop.

5. Repeat questions 2 to 4, but this time sample *without replacement*. Use object names `without1` and `Xwithout1`.
6. Repeat questions 1 to 5, but this time use an urn with 20 white and 180 black chips; use object names `urn2`, `with2`, `without2`, etc.

7. Prepare the graph window for a 2-by-2 array using `par(mfrow=c(2,2))` (`mfrow` stands for “**m**ultiple **f**igures, filling along **r**ows”). In your text file you’ll need to use this inside a `\graph... \end` block:

```
\graph
par(mfrow=c(2,2))
...                <--- your commands from Q8 below go here
\end
```

8. Create 4 histograms all on the same scale using e.g.

```
hist(Xwith1,breaks=0:100,ylim=c(0,0.25),prob=TRUE)
```

Arrange them so that `Xwith1` is above `Xwithout1` and beside `Xwith2` (you need to put all 4 commands in the one `\graph` block).

9. Compute the means and standard deviations of the four `Xwith*` vectors.
10. Comment on similarities, differences and any other interesting features of these vectors; in particular consider the questions below.
- What do you expect the means to be roughly equal to in each case?
 - Do you expect some standard deviations to be bigger or smaller than others? Explain clearly.