Stat 311: HW 1, Solutions

Fritz Scholz

1. Give the results when executing the following commands in an R session.

```
> z.q <- qnorm(.05)
> z.q
[1] -1.644854
> ?qnorm
The Normal Distribution

Description:

    Density, distribution function, quantile function and random
    generation for the normal distribution with mean equal to mean
    and standard deviation equal to sd.

Usage:

    dnorm(x, mean = 0, sd = 1, log = FALSE)
    pnorm(q, mean = 0, sd = 1, lower.tail = TRUE, log.p = FALSE)
    qnorm(p, mean = 0, sd = 1, lower.tail = TRUE, log.p = FALSE)
    rnorm(n, mean = 0, sd = 1)
> pnorm(z.q)
[1] 0.05
This appears to reproduce what went into qnorm.
> runif(5)
[1] 0.9107611 0.4162975 0.6798494 0.6997313 0.8762448
This seems to produce 5 random numbers from a uniform distribution
over the interval (0,1).
> ?runif
The Uniform Distribution

Description:

    These functions provide information about the uniform distribution
    on the interval from min to max.  dunif gives the density,
    punif gives the distribution function qunif gives the quantile
    function and runif generates random deviates.

Usage:

    dunif(x, min=0, max=1, log = FALSE)
    punif(q, min=0, max=1, lower.tail = TRUE, log.p = FALSE)
    qunif(p, min=0, max=1, lower.tail = TRUE, log.p = FALSE)
    runif(n, min=0, max=1)
```

```
> factorial(5)
120
 factorial(x) (x! for non-negative integer x) is
   defined to be gamma(x+1)
> factorial(9)/(factorial(4)*factorial(5))
[1] 126
> choose(9,4)
[1] 126
```
The last two commands produce the same result since they are
the same quantity, one computed explicitly through factorials,
the other through the function choose.
```
 choose(n,k) is defined for all
     real numbers n and integer k.  For k >= 1 as n(n-1)...(n-k+1) /
     k!, as 1 for k = 0 and as 0 for negative k.  Non-integer values of
     k are rounded to an integer, with a warning.
```

Explain the resulting output in each case as well as you can. Make use of the help facility in R, either by starting the interface opened up by `help.start()` (searching via `Search Engine & Keywords`) or by using `?command`, for example: `?qnorm` or `?choose`, on the R command line.

2. Problem 3 of the text (p. 20), with the introductory paragraph modified (clarified) as follows: Statisticians say that a procedure is biased when it tends to either underestimate or overestimate the quantity that is to be measured.

   (a) Suppose the table is 120" long, then a true ruler would fit onto it, end to end, very close to 10 times. However, with the ruler being .1 inch short, there will be about a $10 \times 0.1 = 1$ inch gap by the time I have measured out 10 end to end rulers, thinking that I have measured 120" by that time. Measuring that final gap I would report a length of about 121", i.e., we would overestimate the table length.

   (b) Shedding heavier clothes will reduce the measured weight in June more than shedding light clothes would do. Thus children with heavier clothes in the winter will appear to have gained less weight than children who shed lighter clothes, all other things being equal. Say we have two children with clothes weighing 15 pounds and 10 pounds respectively in winter, but both will wear same weight clothes (7 pounds) in summer. Assume that both children have a true (naked) weight gain of 5 pounds, then the two respective weight gains with clothes on will be: $X + 7 + 5 - (X + 15) = -3$ and $Y + 7 + 5 - (Y + 10) = 2$. The true weight gain for heavier dressed children will tend to be underestimated.

3. Take a penny and spin it 100 times on a smooth surface (either a smooth flat floor or table top). Make sure you get a good spin each time, discard the missed tries. See the link after this HW 1 assignment for an illustration of a good spin. If the spin gets disturbed or the penny falls off the table redo your spin. In 50 of these spins, have the Penny's head facing you as you flick it (this is shown in the illustration) and in the other 50 spins have the head facing away from you. For each type of spin record the number of heads facing up that result. Report the results by replacing the ? in the table below by your observed counts.

   My results are shown in the table below. Quite a surprise!

when you spin the head is facing	number of heads facing up in 50 tries
you	2
away	6

   Please tape the penny you used to your assignment. Do this task conscientiously. We all will benefit from these 180×100 spins. It may take you about 40-45 minutes.