

Appendix

Probability: The Study of Randomness with Excel, JMP, Minitab, SPSS, CrunchIt!, R, and TI-83/-84 Calculators

Randomness

Random phenomena are the basis of probability studies. What will be the result of the next flip of a coin? What will be the sex of the next baby born today at your local hospital? The result of a toss of two dice? Most of these technologies can generate random numbers to help in the simulations of this section.



1. Click **Data** → **Data Analysis** → **Random Number Generation**.
2. Enter the number of variables (columns) you wish to generate and the number of rows.
3. Select the type of distribution from the drop-down box.
4. Enter the parameters of the distribution.
5. Enter an output range (the default is a new worksheet).

Examples:

If you want to simulate repeated tosses of a fair coin, use Bernoulli with $p = 0.5$.

If you want to simulate tossing a die, enter the values 1 through 6 in one column and the probabilities ($=1/6$) in an adjacent column. Select “Discrete” and specify that range as the “Value and Probability Input Range.” To simulate tossing two dice, generate two columns and then add the results into a third.



1. Right-click on the header of an empty column in a new worksheet (otherwise, you may not get as many random numbers as you wish).
2. At the bottom of the dialog box, next to “Initialize Data,” use the drop-down to change the type to **Random**.
3. In the dialog box, select the type of random numbers you want. For integers between a and b, select “Random Integer” and enter a and b. For numbers between 0 and 1, select “Random Uniform.” For simple 0 or 1 data (as in flipping a coin), select either “Random Integer” or “Random Indicator.”

To simulate tossing two dice, generate two columns of Random Integer data between 1 and 6, then right-click in a new column and select “Formula.” Enter a formula by clicking the variables just created. The command would look like

Column1+Column2



1. Click **Calc** → **Random Data**.
2. Select the type. Minitab can generate random integers as well as data from many types of distributions.
3. Enter the number of rows to generate and the columns (as Cxx-Cyy) and the parameters of the distribution.
4. Click **OK**.

For example, to simulate flips of a fair coin, you can use “Integer,” with 0 as the minimum and 1 as the maximum.

To simulate throwing a die, use “Integer” with 1 as the minimum and 6 as the maximum. For two dice, generate two single dice columns and add them together using **Calc** → **Calculator**. Specify a new column for the result and enter the formula (as in C1+C2).



1. Page down and enter some value in the first column of an empty worksheet to correspond with the number of random numbers you wish to generate. You may have to enter interim values to be able to go down as far as you want.
2. Click **Transform** → **Compute Variable**.
3. Enter a destination column name.
4. In the “Function Group” box, select **Random Numbers**.
5. Select the type of numbers (or distribution) you want from the list. A “help” screen will appear in the lower center of the dialog box to inform you of the parameters. Double-click on the type to transfer the shell to the formula box.
6. Enter the parameters as specified by the help.

For example, to simulate flips of a fair coin, you can use RV.Bernoulli, with 0.5 as the probability.

To simulate throwing a die, use RV.Uniform with 1 as the minimum and 6 as the maximum. Truncate that result to integer using **Transform** → **Compute Variable** with Trunc from the “Arithmetic” function group. For two dice, generate two single dice columns and add them together using **Transform** → **Compute Variable**. Specify a new column for the result and enter the formula (as in V1+V2).

CRUNCH IT!

1. Click **Insert** → **Random Numbers**.
2. Select the type you want.
3. Enter the parameters and the number of samples (rows).
4. Click **Calculate**.

To simulate flipping a fair coin, use Binomial with $n = 1$ and $p = 0.5$.

There is no ability to simulate events like throwing dice.



TI-83/-84

TI calculators can simulate random integers (equally likely) or observations from Normal and Binomial distributions. For random integers,

1. Press **[MATH]** **[>]** **[>]** **[>]** (to PRB) and select 5:randInt(.
2. Specify the parameters: min,man,n. Close the parentheses.
3. Press **[STO]** **[2nd]** **[1]** to store the results in L1.

To simulate 100 flips of a fair coin, the command would look like

```
randInt(0,1,100)→L1.
```

To simulate throwing a pair of dice, generate two lists using 1 as the minimum and 6 as the maximum (say, into L1 and L2); place the cursor in the list header for L3 in the statistics editor and enter the formula $\boxed{2\text{nd}}\boxed{1}\boxed{+}\boxed{2\text{nd}}\boxed{2}$.



R has many ways to generate random numbers; for equally likely integers, the easiest is to use a command like

```
> x <- sample(min:max,n,replace=TRUE)
```

100 tosses of a die would look like

```
> x <-sample(1:6,100,replace=TRUE)
```

To toss two dice, generate two sets and add the results as

```
> sum<-x+y
```