

# Getting Started

## Introductory problem—coin tossing

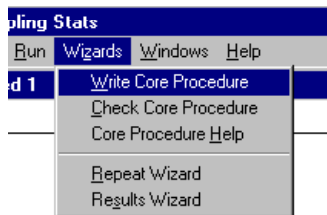
### METHOD 1 — USING RESAMPLING STATS' WIZARDS

What are the chances that you will get 14 or more heads in 20 tosses of a fair coin? There are 3 basic steps to a simulation to solve this problem:

- 1 Write a “core procedure” (in this case, flipping a coin 20 times and counting heads)
- 2 Repeat it lots of times and record the outcomes (the number of heads each time)
- 3 Analyze the results to see how often you get 14 or more heads

Using the RESAMPLING STATS “Wizards” menu:

1. From the “Wizards” menu, select “Write Core Procedure.” A blank window (called a “program window” or “edit window”) will open up.



2. Click on this blank program window (called “Core Procedure”) to make it active, then type the following:

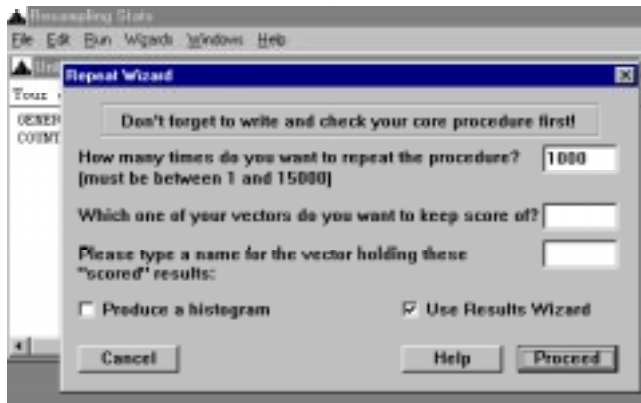
**GENERATE 20 1,2 flips**

**COUNT flips =1 heads**

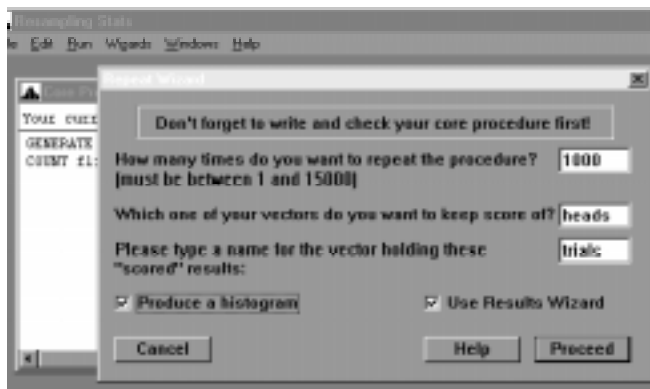


This will generate, at random and with equal probability, twenty "1's" or "2's" and put them in a vector called "flips." (A vector is just a list of numbers.) We'll let "1" = "heads." Then it will count how many "1's" there are in "flips," and put the result of that count into "heads."

3. From the "Wizards" menu, select "Check Core Procedure" to make sure your commands are typed correctly.
4. From the "Wizards" menu, select "Repeat Wizard," and answer the questions.

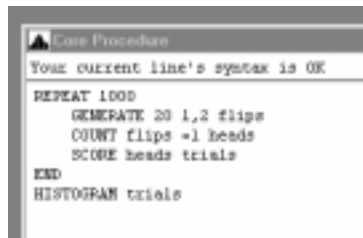


You can leave the "number of repeats" at 1000. The vector you want to keep score of is, of course, "heads." You can name the scorekeeping vector anything with 8 characters or less; we'll use here "trials." To obtain a histogram of simulation results, select "Produce a histogram." Here's how the dialog box should look now:



Then click “proceed” — RESAMPLING STATS will then repeat your commands 1000 times and record the results of each trial in the vector “scrboard.” “Scrboard” now contains 1000 numbers, each number representing the number of heads in a particular set of 20 tosses.

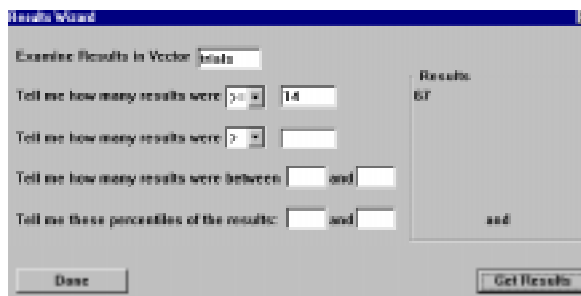
Note how RESAMPLING STATS adds the **REPEAT**, **SCORE**, **END** and **HISTOGRAM** commands to your core procedure to accomplish this:



```

Core Procedure
Your current line's syntax is OK
REPEAT 1000
  GENERATE 20 1,2 flips
  COUNT flips =1 heads
  SCORE heads trials
END
HISTOGRAM trials
  
```

5. Now it's time to analyze the results. If it is not already open, select “Results Wizard,” from the “Wizards” menu and answer the questions. We are interested in analyzing the results in “trials,” so leave that as is in the first line. Our original question was about the probability of getting 14 or more heads, so, in the second line select  $\geq$  (“greater than or equal”), type in **14**, and select “get results.” The answer – 67 — appears in the panel on the right.



Results Wizard

Example Results in Vector: trials

Tell me how many results were  $\geq$  14

Tell me how many results were  $>$  [ ]

Tell me how many results were between [ ] and [ ]

Tell me these percentiles of the results: [ ] and [ ]

Results: 67

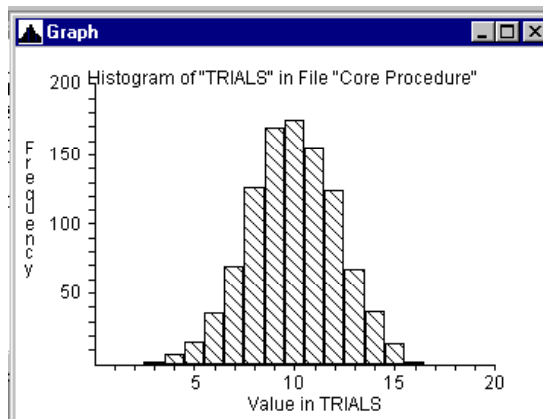
Done Get Results

Conclusion – 14 or more heads out of 20 flips occurred 67 out of 1000 times, for an estimated probability of .067.

## METHOD 2 - WRITING A FULL PROGRAM YOURSELF

You can also solve this program by entering all the commands yourself – here's the program, with an explanation of what each command does:

<b>REPEAT 1000</b>	Repeat the following steps 1000 times
<b>GENERATE 20 1,2 flips</b>	Randomly generate twenty "1's" and "2's"
<b>COUNT flips =1 heads</b>	How many "1's" (heads)?
<b>SCORE heads trials</b>	Keep score of this result
<b>END</b>	End the repeat loop and go back to the beginning
<b>HISTOGRAM trials</b>	Produce a histogram of all the trial results
<b>COUNT trials &gt;= 14 result</b>	Find out how many times you got >= 14 "1's"
<b>PRINT result</b>	Print the result to the screen (not to the printer – for that select "file/Print")



Here is the frequency table RESAMPLING STATS produces along with the histogram. "Bin center" refers to the x-axis value ("number of heads"). When there are many possible x-axis values (not the case here), the data will be grouped into "bins" centered around equally-spaced points along the x-axis.

**VECTOR NO. 1: TRIALS**

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Bin Center	Freq	Cum Pct	Pct
3	3	0.3	0.3
4	5	0.5	0.8
5	14	1.4	2.2
6	42	4.2	6.4
7	70	7.0	13.4
8	100	10.0	23.4
9	157	15.7	39.1
10	198	19.8	58.9
11	143	14.3	73.2
12	121	12.1	85.3
13	82	8.2	93.5
14	40	4.0	97.5
15	17	1.7	99.2
16	7	0.7	99.9
17	1	0.1	100.0

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Note: Each bin covers all values within 0.5 of its center.

Result = 67

Interpretation: 67 times out of 1000, the simulation produced 14 or more “1’s” (heads). This can be seen in the area of the histogram above and to the right of the value 14. Our estimate of the probability of obtaining 14 or more heads is .067.

**NOTE**

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You can use either method— Wizards or entering commands — to construct your program. Most of the illustrations in this guide present the latter approach.

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