A Small Example of Randomization Test

In this made-up example, we'll consider a two-sided p-value for the randomization test. In addition (unlike the hog example), the treatment groups will be small in size; this makes it possible to consider and write out all splits of the observations in the randomization test into two groups.
(In the hog example, we didn't write out all possible splits of 100 hogs into two groups of 50; instead, we made 10,000 random splits and used those to get a p-value. It would have been too difficult to write out all possible random splits in the hog example.)

Example:
Suppose we do an experiment with 4 subjects. Two subjects are randomly assigned to treatment A; the other 2 receive treatment B. The response variable is number right on a 10 point quiz.
The subjects that received treatment A had scores of 7 and 5 on the quiz.
The subjects that received treatment B had scores of 3 and 1 on the quiz.

Compute a 2-sided p-value for testing for a difference between treatments A & B.

Solution:

Original Data are:

A	B	Difference in Means
7 5	3 1	6 - 2 = 4

All possible assignments of the observed values 7,5,3,1 into two groups "A" & "B":

A	B	Difference in Means	Absolute Difference (for 2-sided p-value)
7 5	3 1	4	4
7 3	5 1	2	2
7 1	5 3	0	0
3 1	7 5	-4	4
5 1	7 3	-2	2
5 3	7 1	0	0

2-sided p-value is 2/6 or about 0.333 because 2 of the 6 possible assignments of subjects to treatment groups have an absolute difference as far from 0 as the absolute difference observed in the original data |4|=4.

There is no convincing evidence that one treatment is better than the other because it would not be too unusual (2 out of 6 chance) to see results as extreme as those we obtained even if the treatment has no effect on the quiz scores.