Principles of field plot experiments

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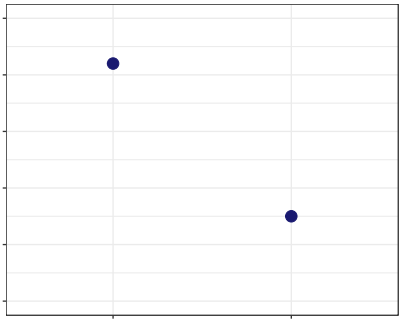
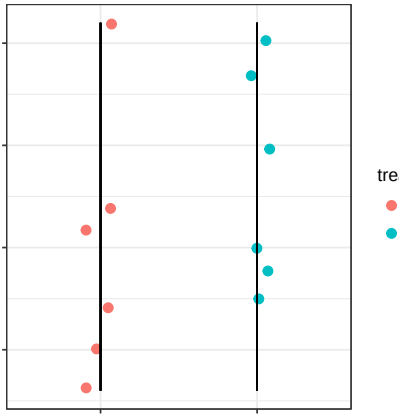
To call the statistician after the experiment may be no more than asking him to perform a postmortem examination ...

... he may be able to say what the experiment died of.

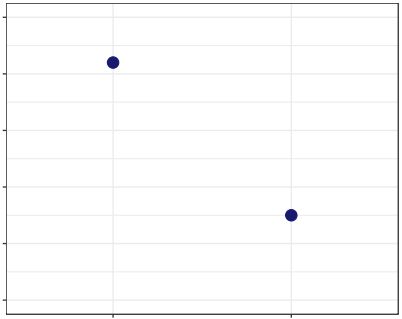
– R.A. Fisher, 1938

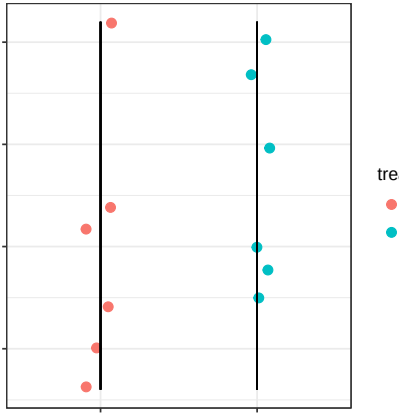
- A new drug has been tested for its efficacy for control of high blood pressure.





- A new drug has been tested for its efficacy for control of high blood pressure.
- As a doctor, do you prescribe your patient the drug ?





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- Within this degree of attainable control, replication effectively reduces the random variation or noise in the comparisons examined in the analysis, and provides an opportunity to estimate the typical size of this random component in individual measurements.

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  - variation in repeated measurements taken over a time interval reflects the variation in the single subject's response to the drug over time.

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  - Augment the trial

Blocking

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  - Control and adjust for some of the variation in experimental units, hence increase the precision by grouping together a set of experimental units that are more or less homogeneous.
  - Increase convenience, to allow different sizes of experimental units, link an insurance policy against disturbances that may or may not arise during the course of an experiment.

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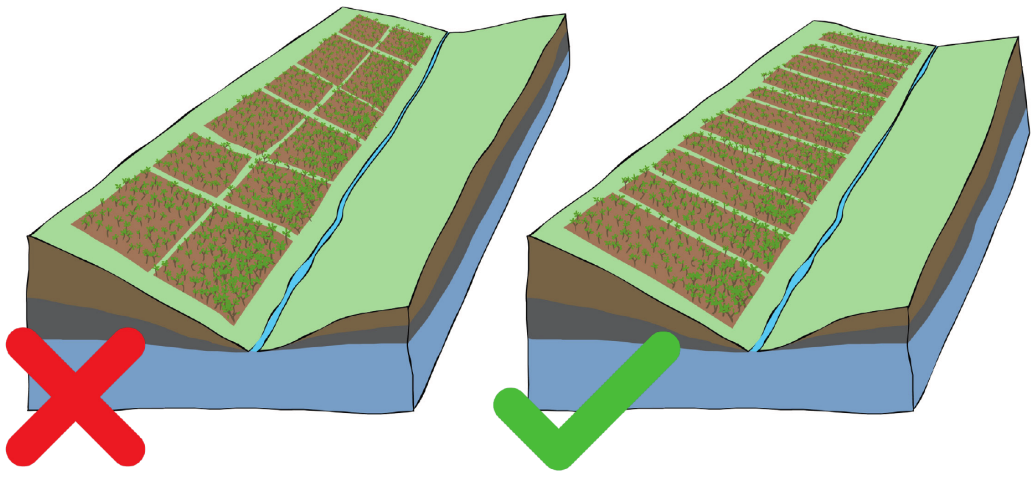
Addressing heterogeneity through blocking



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  - a horticulturist may assign his or her favorite variety of experimental crop to the parts of the field that look the most fertile,
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- The preferred variety or drug may then appear to give better results no matter how good or bad it actually is.

- Consider an experiment to compare the effects on blood pressure of three exercise programs, where each program is observed four times, giving a total of 12 observations. Now, given 12 subjects, imagine making a list of all possible assignments of the 12 subjects to the three exercise programs so that 4 subjects are assigned to each program. (There are $\frac{12!}{(4!4!4!)}$, or 34,650 ways to do this.) If the assignment of subjects to programs is done in such a way that every possible assignment has the same chance of occurring, then the assignment is said to be a completely random assignment.

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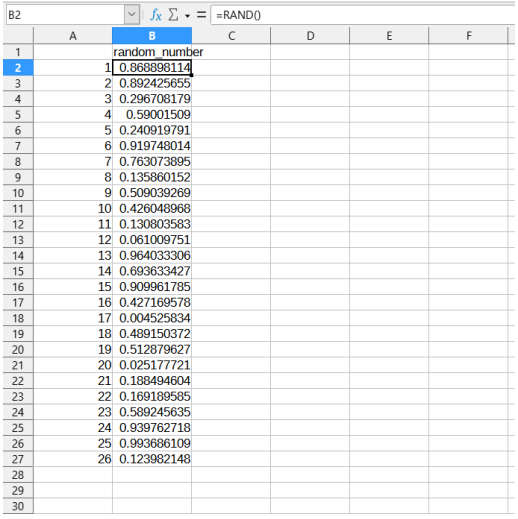
- The most common random number generators on computers or calculators generate n-digit real numbers between zero and one. Single digit random numbers can be obtained from an n-digit real number by reading the first digit after the decimal point. Pairs of digits can be obtained by reading the first two digits after the decimal point, and so on.

Randomization: An Exercise in Spreadsheet



	A	B	C	D	E	F
1		random_number				
2	1	0.868898114				
3	2	0.892425655				
4	3	0.296708179				
5	4	0.59001509				
6	5	0.240919791				
7	6	0.919748014				
8	7	0.763073895				
9	8	0.135860152				
10	9	0.509039269				
11	10	0.426048968				
12	11	0.130803583				
13	12	0.061009751				
14	13	0.964033306				
15	14	0.693633427				
16	15	0.909961785				
17	16	0.427169578				
18	17	0.004525834				
19	18	0.489150372				
20	19	0.512879627				
21	20	0.025177721				
22	21	0.188494604				
23	22	0.169189585				
24	23	0.589245635				
25	24	0.939762718				
26	25	0.993686109				
27	26	0.123982148				
28						
29						
30						

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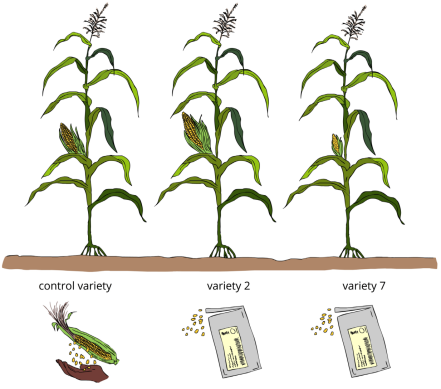
- In many instances, this high degree of control means that the data collected are actually representative of only a very special situation, reflecting the particular laboratory procedures, batch of experimental material, et cetera, used in the performance of the experiment. As a result, meaningful inferences usually need to be based on comparisons within an experiment, with the idea that anything unusual, but common, to all trials in the experiment will "cancel out" in the analysis.

- "Comparison" often leads to the inclusion of one or more experimental controls.
  - For example, in addition to the four carefully defined "experimental treatments", while evaluating pipeline varieties, one or two "locally adapted" cultivars are included so as to provide a comparison to what might have happened in a "normal" scenario or how would the "local check" perform in controlled experimental conditions.
- A large difference between responses form these treatment and "checks" could indicate unanticipated influences of the experimental procedure *per se*; a small or negligible difference might be viewed as support for the investigators' intent that "checks" are a reasonable representation for genotypes suited to the target environment.



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- This uniformity is both an advantage and a weakness of a controlled experiment.
- Clearly the result of an experiment is, applicable only to conditions that are the same as, or similar to, that under which the experiment was conducted.

A glass could be:

- Half full (optimist)
- Half empty (pessimist)
- Twice as big as it needs to be (project manager)
- Half the required amount of liquid for it to overflow (realist)

Idiosyncrasies:

- How it can be half full or half empty ? FULL is FULL and EMPTY is EMPTY.
- If completely full, half with air and half with water.
- Only optimistic can see half empty, how can they be a pessimist ?
- Half full could be the answer, if you think you have enough there.
- Half empty could be the answer, if what you have is not sufficient.

References