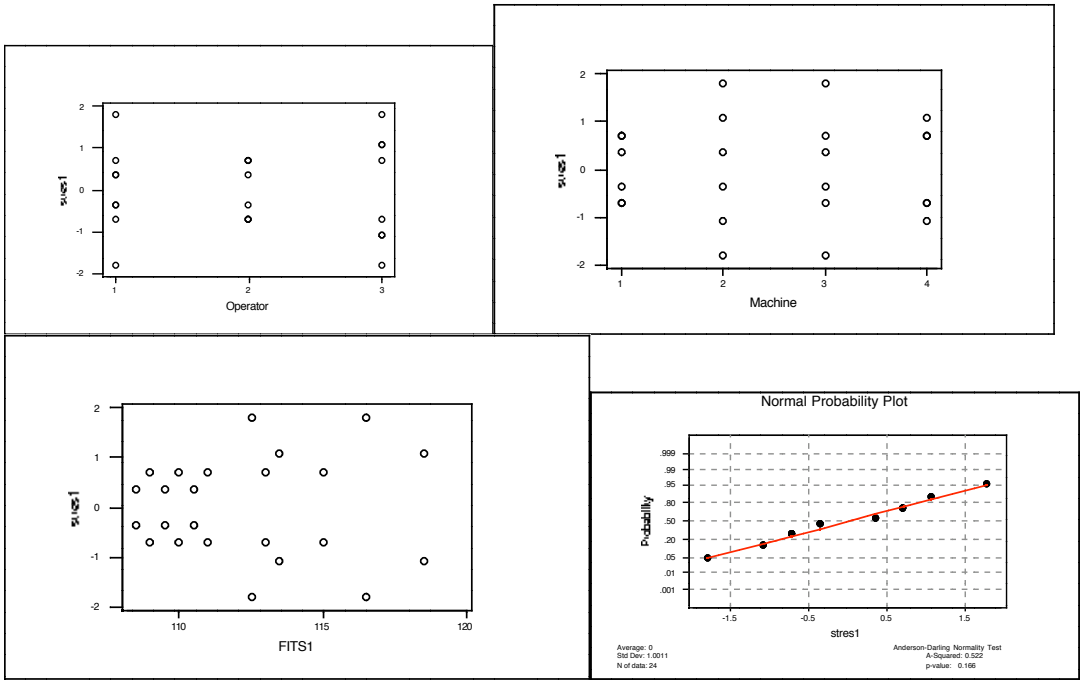
BREAKING STRENGTH EXAMPLE (TWO-WAY RANDOM EFFECTS)

The factors that influence the breaking strength of a synthetic fiber are being studied. Four production machines and three operators are randomly selected. A two-way factorial experiment is run, with two observations per treatment combination, using raw material from the same production batch, with breaking strength as response.

Residual plots:



Max/min standard deviations

By operator 1.55, 2.70 (size 8)

By machine 2.32, 4.46 (size 6)

Running on Minitab

1. As fixed effect:

Analysis of Variance (Balanced Designs)

Factor	Type	Levels	Values
Operator	fixed	3	1 2 3
Machine	fixed	4	1 2 3 4

Analysis of Variance for Strength

Source	DF	SS	MS	F	P
Operator	2	160.333	80.167	21.14	0.000
Machine	3	12.458	4.153	1.10	0.389
Operator*Machine	6	44.667	7.444	1.96	0.151

Error	12	45.500	3.792
Total	23	262.958	

II. Designating factors as “random”

Analysis of Variance (Balanced Designs)

Factor	Type	Levels	Values
Operator	random	3	1 2 3
Machine	random	4	1 2 3 4

Analysis of Variance for Strength

Source	DF	SS	MS	F	P
Operator	2	160.333	80.167	10.77	0.010
Machine	3	12.458	4.153	0.56	0.662
Operator*Machine	6	44.667	7.444	1.96	0.151
Error	12	45.500	3.792		
Total	23	262.958			