



# Implementation of basics of statistics in the world of coffee machines for best in-cup quality and 0 defect objective

Coffee machines manufacturing has been growing significantly in past years at Nespresso reaching important volumes To support Nestlé ambition of 0 defect on coffee machines and in cup quality consistency, use of statistics has become a must.

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## AEROCCINO 4 BURNT MILK

**Background**  
First production of new milk frother Aeroccino 4 to support support worldwide market launch.



**Issue**  
12% Milk burnt issue escalated by Nespresso markets and observed during routine life cycle tests just before launch

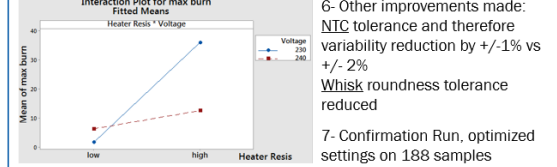
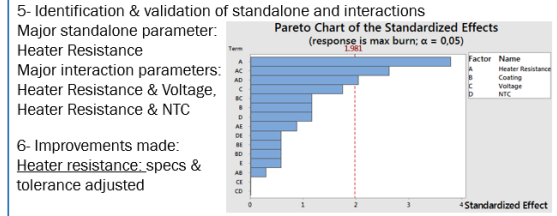
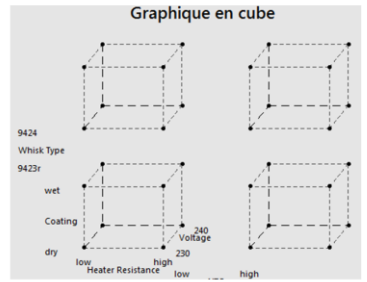


**Statistical Method : DOE**  
1- Choice of fixed milk 2% fat and temperature 6 deg +/-2

2- Determination of potential process influencers through brainstorm: Heater resistance, Coating, Voltage, Sensor (NTC), Whisk type

3- DOE preparation: parameters, extreme values, sample selection

4- Trials



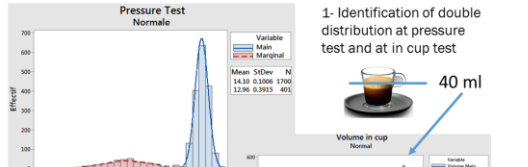
**Results**  
• Reduction of burnt milk issue by 100 times to 0.12%  
• Reduction with reconstituted milk (Hong Kong) from 32% to 1.2%  
• User manual updated for milk and cleaning  
• Laboratory test standards updated with milk burning tests

## U IN CUP VOLUME

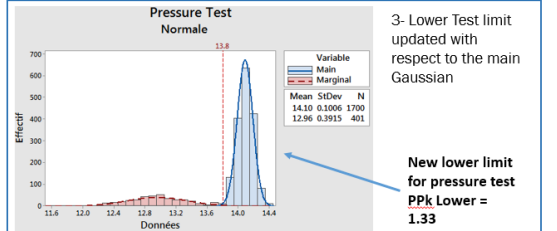
**Background**  
U machine launched worldwide end 2012.



**Issue**  
Volume in cup (25ml for ristretto, 40 ml for espresso, 110ml for lungo) out of spec at final test at machine manufacturer



2- Confirmation of the root cause by extracting coffee from machines in marginal distribution. Pressure highly correlated with coffee volume



4- Verification of each statistical distribution for each characteristic coming from routine production test. This is now performed on pilot run before official production start.

5- Manufacturer working to understand root cause of leakages, implement corrective actions and improve the Manufacturing Line First Time Right

**Results**  
1- Coffee quantity in cup back within specifications for U machine  
2- Production release standard updated for any new machine developed to make sure this case never happens again for any variable characteristic

## NOISY INISSIA

**Background**  
Inissia B2C machines is Nespresso best seller. Worldwide Worldwide Launch performed end 2013.



**Issue**  
Noisy machines after 50-100 coffee preparation. Root cause: Delamination of check valve (bi material component)



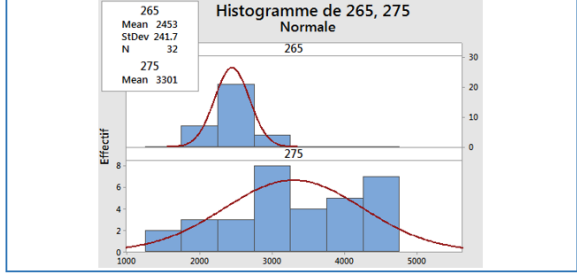
**Statistical Method : DOE**  
1- Identification of critical parameters. Temperature & mould cavities (16)  
2- DOE preparation with 1 parameter. Cavities used to manage temperature

Inissia	Temp	Temp	Cavity	Nb cycles before small increase of noise
Mach 1	X	1	1	2500
Mach 2	X	2	2	2900
Mach 3	X	3	3	2300
Mach 4	X	4	4	4200
Mach 5	X	5	5	4300
Mach 6	X	6	6	1900
Mach 7	X	7	7	4000
Mach 8	X	8	8	4200

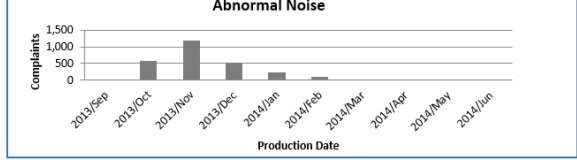
3- Pre DOE with 8 machines.  
Two-sample T for Nb Cycles  
Temp: 265 (Mean: 2500, StDev: 283, SE Mean: 141) vs 275 (Mean: 3575, StDev: 1121, SE Mean: 560)  
Difference = mu (265) - mu (275)  
Estimate for difference: -1075  
95% CI for difference: (-2914; 764)  
T-Test of difference = 0 (vs !=): T-Value = -1,86  
F-Value = 0,160, DF = 3

4- Average different between the 2 temperatures but difference not significative. Indicative result as sample size and test power are low

5 - Confirmation run on 32 machines at 265 degrees and 275 degrees



**Results**  
Noise issue drastically reduced on Inissia machines produced from March 2014



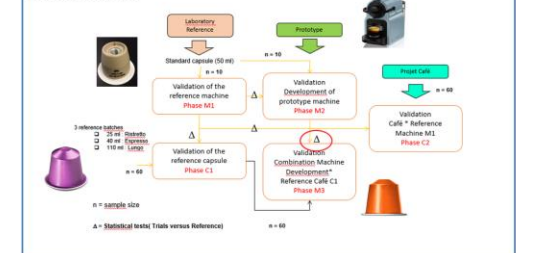
## SYSTEM (MACHINE/CAPSULE) INTERACTION

**Background**  
No specific process to do the validation for machine/coffee machine/coffee interaction

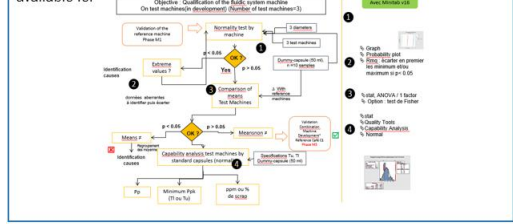


**Issue**  
During validation of machines and coffee, very complicated to differentiate impactors of deviations

**Statistical Method :**  
1- Create a complete statistical validation plan to understand machine and coffee interaction



2- Deploy specific process using statistical data analysis on machine/coffee parameters under development with a dedicated Minitab user guide available for



**Results:**  
Process Capability Ppk of Flow time parameter under control

