My Stat Report

www.agilequalitysupport.com

ADVANCED

DATA ANALYSIS

Company Name ACME S.r.l.

Document ID: AQS_STAT_ADV_ 000_ITA_022022

Brief data description: Data analysis to determine the installation of solar panels

Document approval

The signatures below certify that the data and statistical analysis have been analyzed and verified by competent personnel in statistical analysis and according to the internal procedures of Agile Quality Support S. r. l.

	Name/ Signature/Date	Role
Prepared by	Campanile Antonella 07.02.2022 11:16:57 GMT+00:00	Quality Consultant
Approved by	Di Palo Saul 08.02.2022 09:12:35 GMT+00:00	CEO

Document versions

This section records the versions of the document and any updates

Revision	Update	Source	Month/Year
022022	First version	Order number XX	02/2022

1 Contents

1 Advanced Data Analysis 2
1.1 Description of the problem 2
1.2 Data 2
1.3 What are the factors that influence the response in a significant way? 2
1.4 Determining the best settings 2
1.5 2D and 3D graphs of the statistical model 3
1.6 Definitions 5
1.7 Data Used 5
1.8 Output of the statistical programme in support of the conclusions set out 5

1 Advanced Data Analysis

1.1 Description of the problem

Technicians measure heat flux and insolation as part of a solar thermal energy test. An energy engineer wants to determine how to predict and maximize total heat flux and insolation using other variables: the location of the east, south, and north focal points, and the time of day.

1.2 Data

Data	Description	Variable Type
Heat Flow	Total heat flux in kilowatts	Response
Insolation	Insolation in watts/m^2	Response
Est	The position of the focal point from the east, in inches	Predictor
Sud	The position of the focal point from the south, in inches	Predictor
Nord	The position of the focal point from the north, in inches	Predictor
Time of day	Time at which data is collected	Predictor

The data sheet is available in the "Data Used" section.

1.3 What are the factors that influence the response in a significant way?

- Insolation is significantly influenced by: Exposure to North and East
- Heat Flow is significantly influenced by: Exposure to north and time of day

The model has been validated and is considered acceptable

1.4 Determining the best settings

The optimal settings have been chosen in order to Maximize heat flow and Maximize insolation and are as follows:

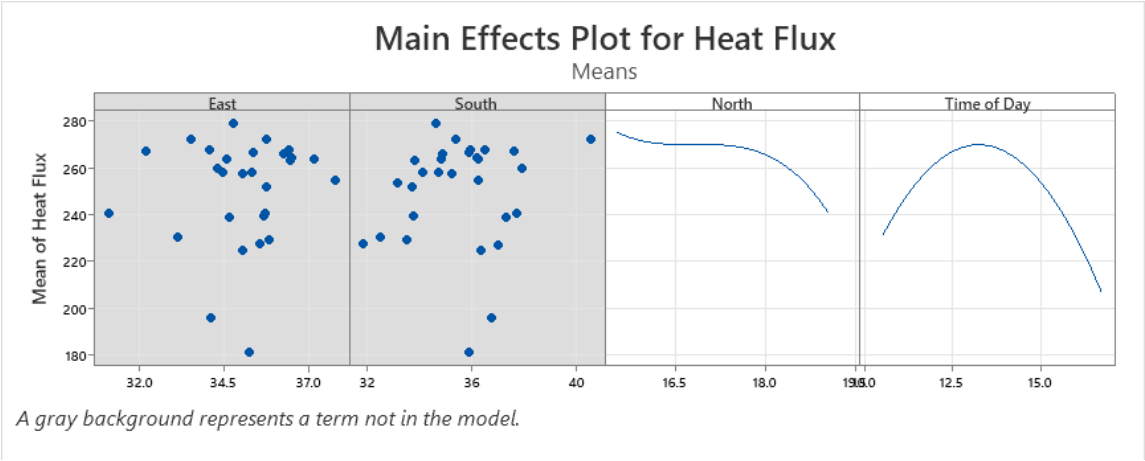
East: 31.08 inches

North: 15.54 inches

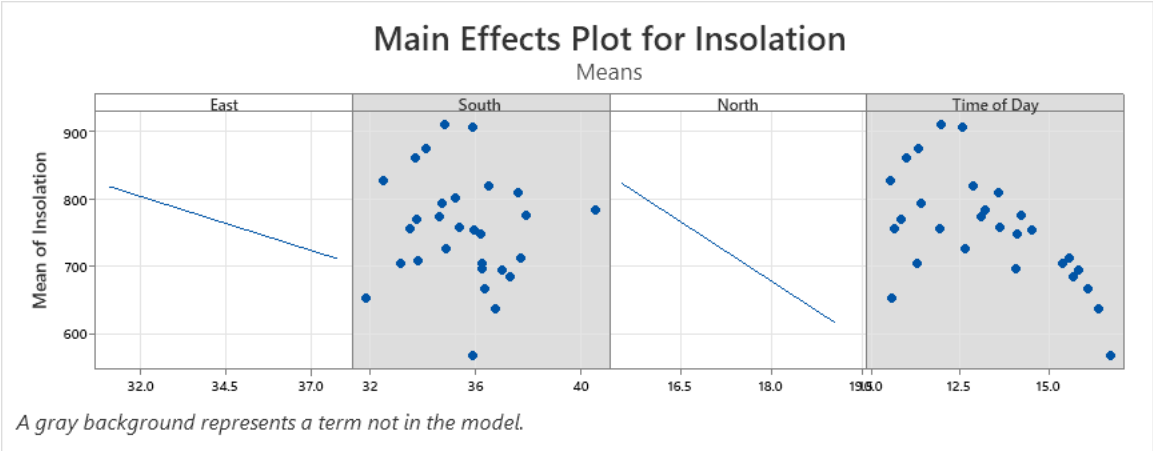
Time: 13.20 (corresponds to about 13:15)

An insolation of 886,388 watts/m^2 and a flow of 274,927 kilowatts are assumed.

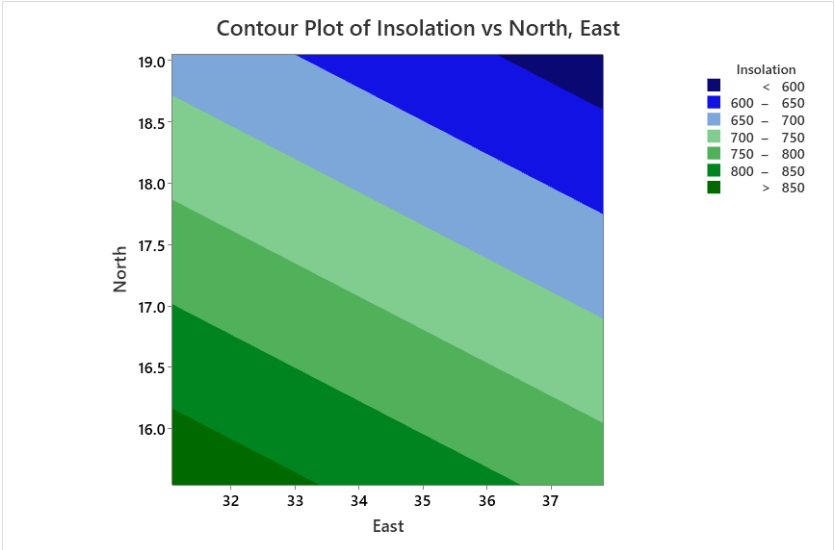
1.5 2D and 3D graphs of the statistical model

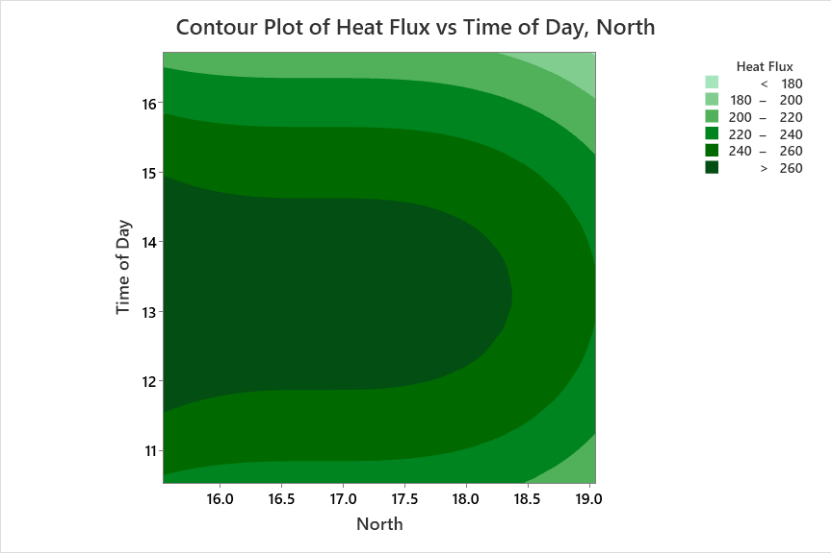


A gray background represents a term not in the model.

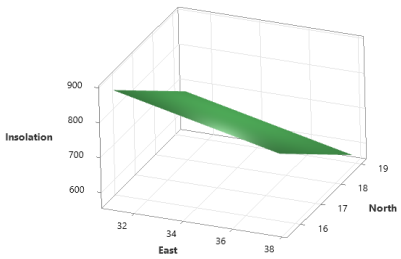


A gray background represents a term not in the model.

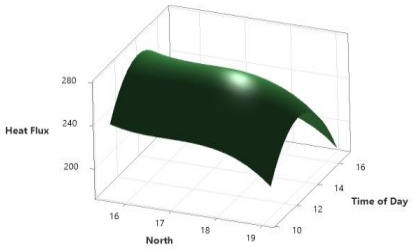




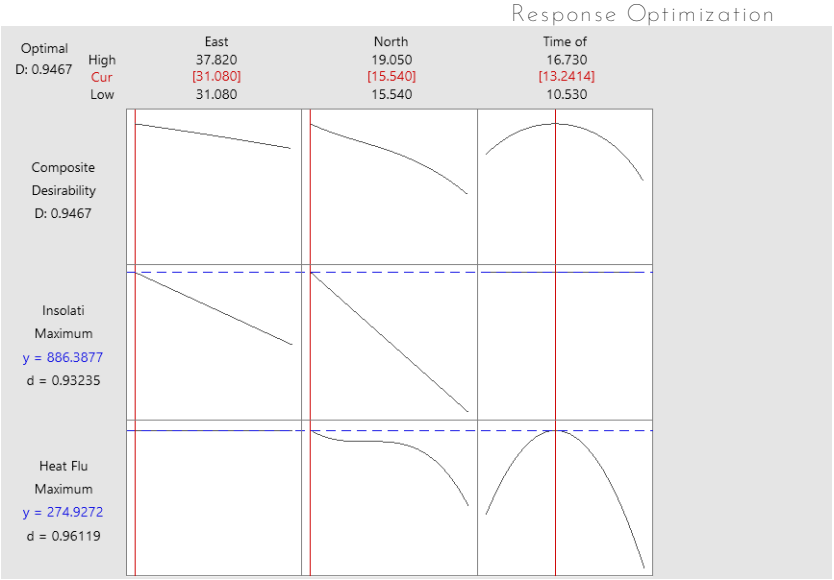
Surface Plot of Insolation vs North, East



Surface Plot of Heat Flux vs Time of Day, North



Response Optimization



1.6 Definitions

Term	Definition
Response	Variable of interest in an experiment, measured and observed. The answer is also called a dependent variable
Predictors	Variables in an experiment that affect the response. These variables can be set and measured. Predictors are also called independent variables

1.7 Data Used

Heat flow	Insolation	East	South	North	Schedule
271.8	783.35	33.53	40.55	16.66	13.2
264	748.45	36.5	36.19	16.46	14.11
238.8	684.45	34.66	37.31	17.66	15.68
230.7	827.8	33.13	32.52	17.5	10.53
251.6	860.45	35.75	33.71	16.4	11
257.9	875.15	34.46	34.14	16.28	11.31
263.9	909.45	34.6	34.85	16.06	11.96
266.5	905.55	35.38	35.89	15.93	12.58
229.1	756	35.85	33.53	16.6	10.66
239.3	769.35	35.68	33.79	16.41	10.85
258	793.5	35.35	34.72	16.17	11.41
257.6	801.65	35.04	35.22	15.92	11.91
267.3	819.65	34.07	36.5	16.04	12.85
267	808.55	32.2	37.6	16.19	13.58
259.6	774.95	34.32	37.89	16.62	14.21
240.4	711.85	31.08	37.71	17.37	15.56
227.2	694.85	35.73	37	18.12	15.83
196	638.1	34.11	36.76	18.53	16.41
278.7	774.55	34.79	34.62	15.54	13.1
272.3	757.9	35.77	35.4	15.7	13.63
267.4	753.35	36.44	35.96	16.45	14.51
254.5	704.7	37.82	36.26	17.62	15.38
224.7	666.8	35.07	36.34	18.12	16.1
181.5	568.55	35.26	35.9	19.05	16.73
227.5	653.1	35.56	31.84	16.51	10.58
253.6	704.05	35.73	33.16	16.02	11.28
263	709.6	36.46	33.83	15.89	11.91
265.8	726.9	36.26	34.89	15.83	12.65
263.8	697.15	37.2	36.27	16.71	14.06

1.8 Output of the statistical programme in support of the conclusions set out

THERMALENERGYTEST. MTW

Regression Analysis: Heat Flux versus East, South, North, Time of Day

Stepwise Selection of Terms

α to enter = 0.15, α to remove = 0.15

Regression Equation

Heat Flux = 11752 - 2212 North + 136.8 Time of Day + 131.6 North*North - 5.162 Time of Day*Time of Day - 2.61 North*North*North

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	11752	5789	2.03	0.054	
North	-2212	1012	-2.19	0.039	950525.12
Time of Day	136.8	21.3	6.44	0.000	1926.18
North*North	131.6	58.7	2.24	0.035	3766941.81
Time of Day*Time of Day	-5.162	0.838	-6.16	0.000	2180.39
North*North*North	-2.61	1.13	-2.31	0.030	933629.70

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.98829	96.10%	95.25%	89.59%

Analysis of Variance

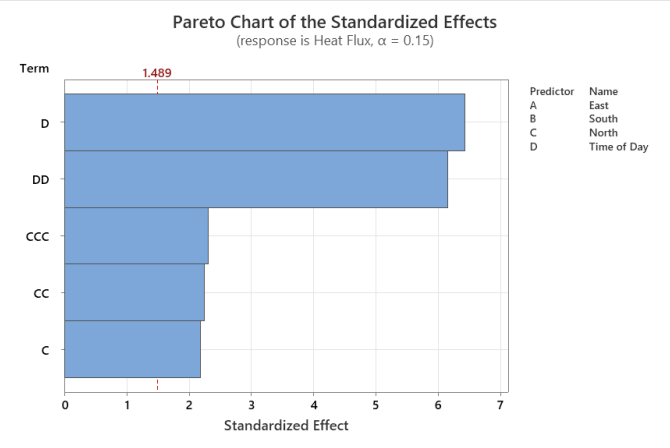
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	5	14109.6	2821.92	113.41	0.000
North	1	118.9	118.87	4.78	0.039
Time of Day	1	1030.5	1030.45	41.41	0.000
North*North	1	125.2	125.23	5.03	0.035
Time of Day*Time of Day	1	944.8	944.82	37.97	0.000

North*North*North	1	132.6	132.57	5.33	0.030
Error	23	572.3	24.88		
Total	28	14681.9			

Fits and Diagnostics for Unusual Observations

Obs	Heat Flux	Fit	Resid	Std Resid	
18	196.00	204.93	-8.93	-2.05	R
22	254.50	244.99	9.51	2.08	R
24	181.50	177.86	3.64	1.97	X

R Large residualX Unusual X



THERMALENERGYTEST. MTW

Regression Analysis: Insolation versus East, South, North, Time of Day

Stepwise Selection of Terms

α to enter = 0.15, α to remove = 0.15

Regression Equation

Insolation = 2291 - 15.88 East - 58.6 North

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2291	370	6.20	0.000	
East	-15.88	8.01	-1.98	0.058	1.01
North	-58.6	12.5	-4.69	0.000	1.01

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
59.6763	48.07%	44.07%	35.77%

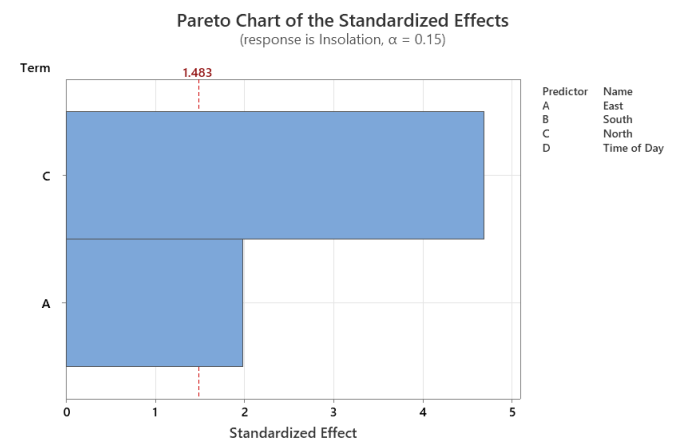
Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	85698	42849	12.03	0.000
East	1	13980	13980	3.93	0.058
North	1	78300	78300	21.99	0.000
Error	26	92593	3561		
Total	28	178291			

Fits and Diagnostics for Unusual Observations

Obs	Insolation	Fit	Resid	Std Resid	
16	711.9	779.1	-67.2	-1.37	X

X Unusual X



THERMALENERGYTEST.MTW

Response Optimization: Insolation, Heat Flux

Parameters

Response	Goal	Lower	Target	Upper	Weight	Importance
Insolation	Maximum	568.55	909.45		1	1
Heat Flux	Maximum	181.50	278.70		1	1

Solution

Solution	East	North	Time of Day	Insolation Fit	Heat Flux Fit	Composite Desirability
				Property		Property
1	31.08	15.54	13.2414	886.388	274.927	0.946657

Multiple Response Prediction

Variable	Setting
East	31.08
North	15.54
Time of Day	13.2414

Response	Fit	SE Fit	95% CI	95% PI
Insolation	886.4	38.5	(807.3, 965.5)	(740.4, 1032.3)
Heat Flux	274.93	3.21	(268.28, 281.58)	(262.65, 287.20)