

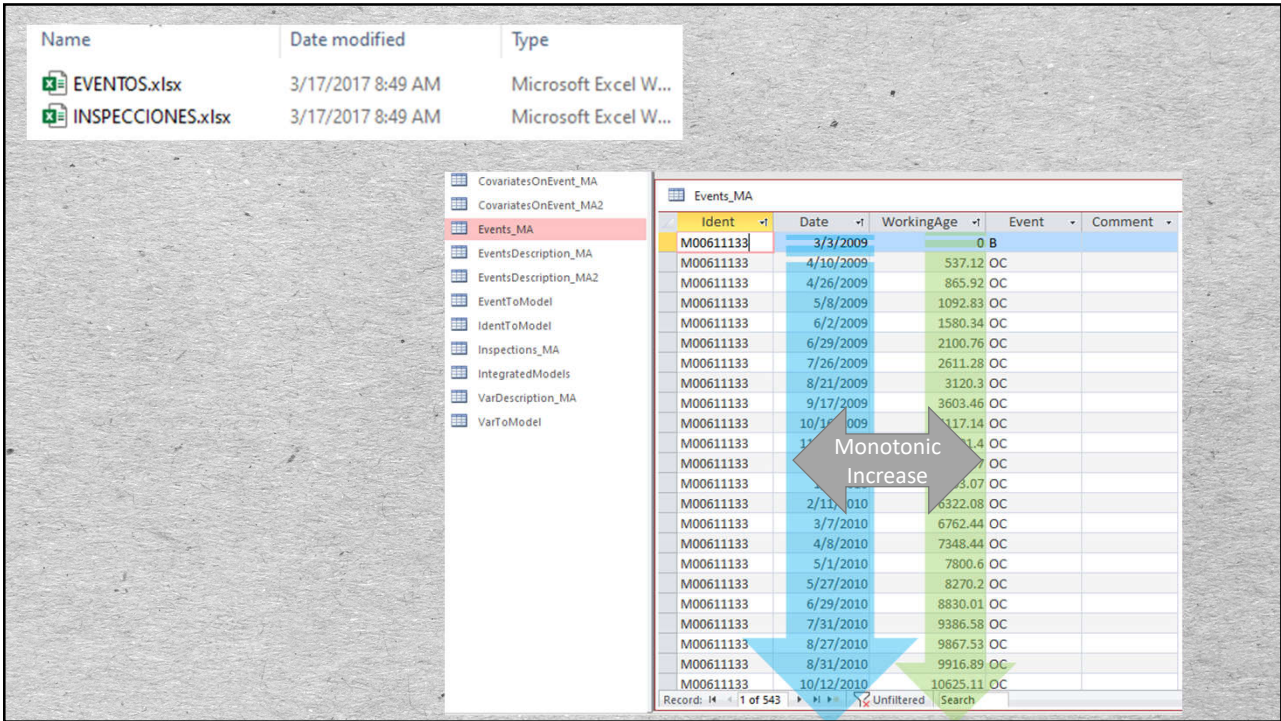
04.3F Marginal Analysis

In the real world most equipment and systems are **complex**.

Definitions:

- Simple item:** Affected by a single or (dominant) failure mode.
- Complex item:** Subject to > 1 failure mode.
- Marginal Analysis:** Reliability analysis of multiple failure modes within the complex item assuming that :
- The failures of each failure mode are independent of one another. For example, the failure of one component (failure mode) does not contribute to the failure probability of another failure mode does not
 - A **“Living RCM”** process is the only way to ensure good data for Marginal Analysis

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Name	Date modified	Type
EVENTOS.xlsx	3/17/2017 8:49 AM	Microsoft Excel W...
INSPECCIONES.xlsx	3/17/2017 8:49 AM	Microsoft Excel W...

CovariatesOnEvent_MA
CovariatesOnEvent_MA2
Events_MA
EventsDescription_MA
EventsDescription_MA2
EventToModel
IdentToModel
Inspections_MA
IntegratedModels
VarDescription_MA
VarToModel

Ident	Date	WorkingAge	Event	Comment
M00611133	3/3/2009	0	B	
M00611133	4/10/2009	537.12	OC	
M00611133	4/26/2009	865.92	OC	
M00611133	5/8/2009	1092.83	OC	
M00611133	6/2/2009	1580.34	OC	
M00611133	6/29/2009	2100.76	OC	
M00611133	7/26/2009	2611.28	OC	
M00611133	8/21/2009	3120.3	OC	
M00611133	9/17/2009	3603.46	OC	
M00611133	10/16/2009	4117.14	OC	
M00611133	11/12/2009	4601.4	OC	
M00611133	12/11/2009	5164.47	OC	
M00611133	1/8/2010	5663.07	OC	
M00611133	2/11/2010	6322.08	OC	
M00611133	3/7/2010	6762.44	OC	
M00611133	4/8/2010	7348.44	OC	
M00611133	5/1/2010	7800.6	OC	
M00611133	5/27/2010	8270.2	OC	
M00611133	6/29/2010	8830.01	OC	
M00611133	7/31/2010	9386.58	OC	
M00611133	8/27/2010	9867.53	OC	
M00611133	8/31/2010	9916.89	OC	
M00611133	10/12/2010	10625.11	OC	

Life beginning
All failure modes

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Name	Date modified	Type
EVENTOS.xlsx	3/17/2017 8:49 AM	Microsoft Excel W...
INSPECCIONES.xlsx	3/17/2017 8:49 AM	Microsoft Excel W...

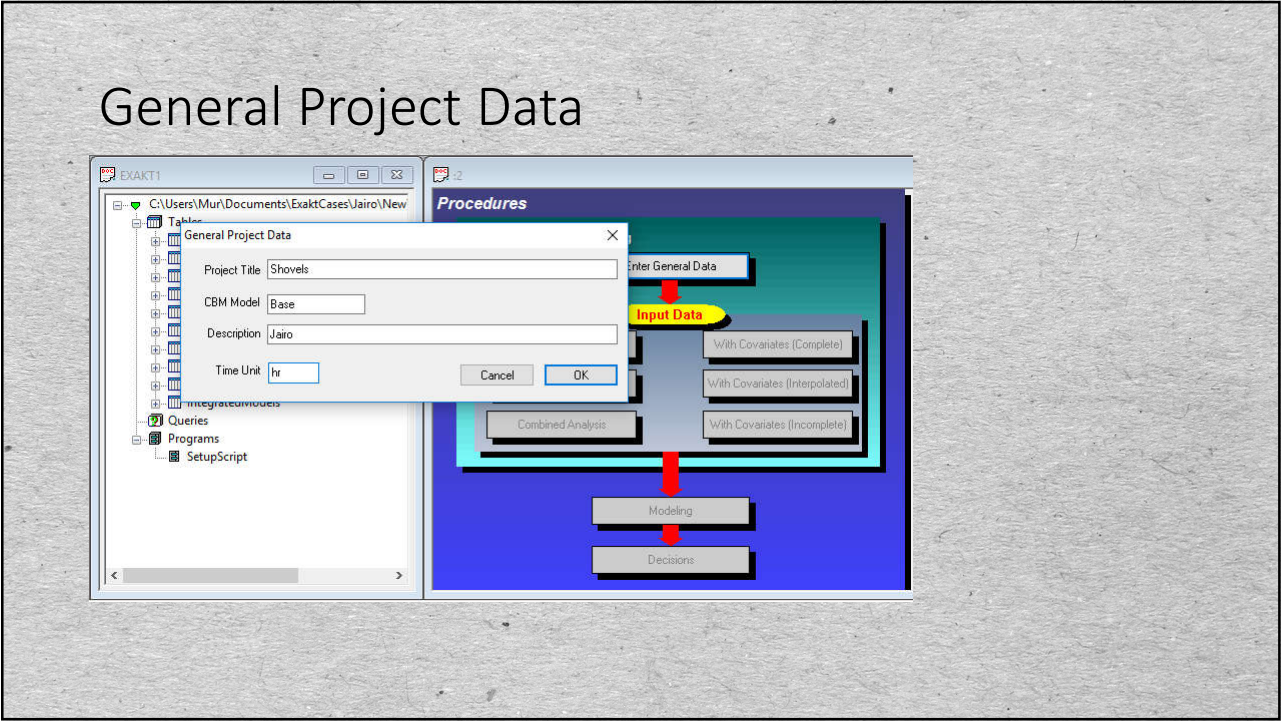
CovariatesOnEvent_MA
CovariatesOnEvent_MA2
Events_MA
EventsDescription_MA
EventsDescription_MA2
EventToModel
IdentToModel
Inspections_MA
IntegratedModels
VarDescription_MA
VarToModel

Ident	Date	WorkingAge	Event	Comment
M00611133	8/31/2010	9916.89	OC	
M00611133	10/12/2010	10625.11	OC	
M00611133	11/6/2010	11052.08	OC	
M00611133	12/16/2010	11539.99	OC	
M00611133	1/15/2011	12008.54	OC	
M00611133	2/12/2011	12519.85	OC	
M00611133	3/17/2011	13068.9	OC	
M00611133	4/22/2011	13663.93	EF1	
M00611133	4/22/2011	13663.93	OC	
M00611133	4/27/2012	13663.93	B	
M00611133	5/29/2012	14240.53	OC	
M00611133	6/4/2012	14336.71	OC	
M00611133	7/1/2012	14817.6	OC	
M00611133	7/29/2012	15262.73	OC	
M00611133	9/2/2012	15800.44	OC	
M00611133	10/14/2012	16432.26	OC	
M00611133	11/4/2012	16764.22	OC	
M00611133	12/5/2012	17200.64	OC	
M00611133	1/12/2013	17837.7	OC	
M00611133	4/13/2013	18951.55	OC	
M00611133	4/24/2013	19091.93	OC	
M00611133	5/21/2013	19544.31	OC	
M00611133	5/30/2013	19708.28	EF2	

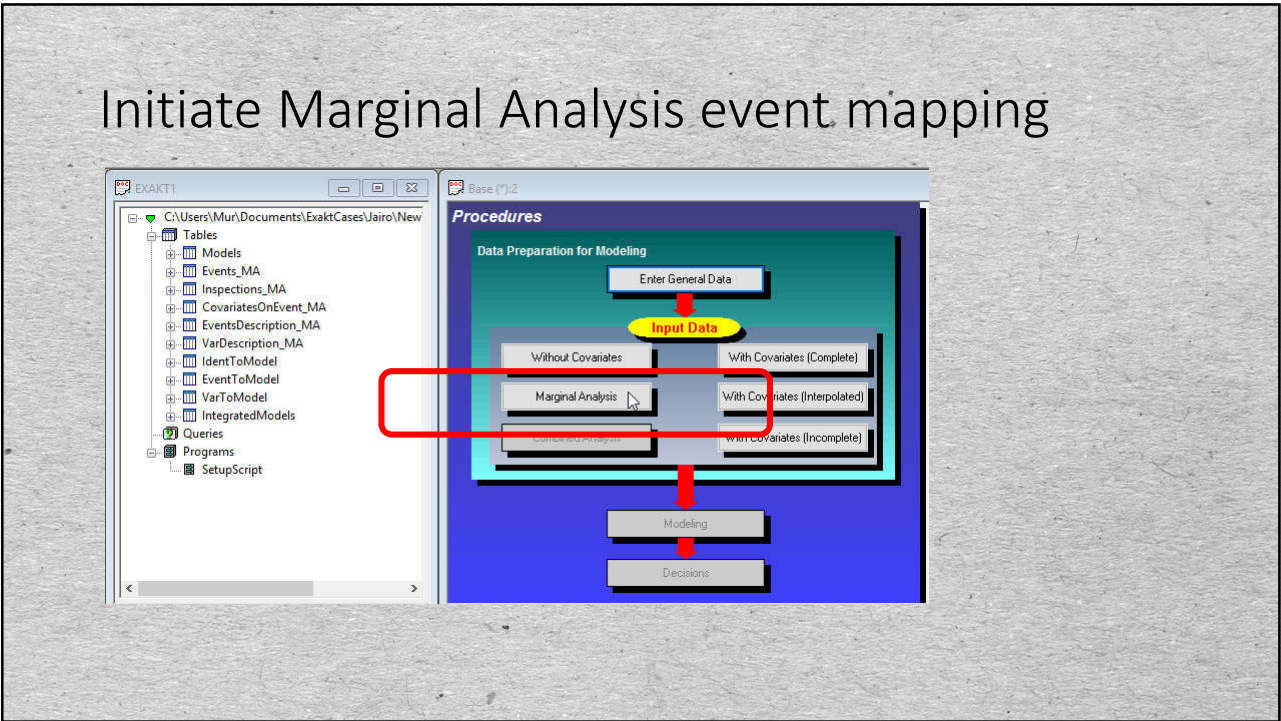
Two possible repair policies upon failure of one failure mode:
1. "All failure modes renewed".
2. "Only the failed failure mode(s) renewed".

Zero timed

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Cleaning the data (chronology sequences)
assisted by the software.

M00611383	03/10/2017	21447.74	IN	Check whether this history is temporary suspended or "EF/ES" is missing.
M00611133	17/02/2016	28312	IN	This record has larger WAge than the next record. Id=M00611133, Date=02/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	25/03/2016	28683	IN	This record has larger WAge than the next record. Id=M00611133, Date=03/26/2016, WAge=27163, Event=OC in Events table.
M00611133	04/12/2013	19007	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	19/04/2016	28933	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	22/04/2013	19137	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	18/05/2014	21111	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	25/05/2016	29299	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	25/06/2015	25942	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	24/06/2014	21518	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	07/03/2016	29683	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.
M00611133	07/06/2015	26052	IN	This record has larger WAge than the next record. Id=M00611133, Date=04/21/2016, WAge=26561.2, Event=OC in Events table.

Working age of the Oil Analysis Inspection record is larger than the WorkingAge of the Oil Change OC subsequent record even though they would have occurred at the same time. Difference 1750.81. hrs

CMI_Inspections

M00611133

Ident	Date	WorkingAge	HN	Precedence	Event	AL	BO	C	CAL	CR	CU	DI	FE	H2	MG	MD	NA	NIT	OD
M00611133	31/01/2016	28142	4	0	*	1.3	3.3	0	1379	0.7	2.1	0	4	0	1215	45.1	5.5	6	12
M00611133	17/02/2016	28312	4	0	*	2	4.1	2	1524	1.4	3.1	0	8	0	1369	64.1	6.5	7	13
M00611133	21/02/2016	26561.19	4	1	OC	0	0	0	1500	0	0	0	0	0	1200	0	0	0	0
M00611133	21/02/2016	28353	4	0	*	2.2	3.5	3	1414	1.3	3.3	0	8	0	1274	0	0	0	0
M00611133	07/03/2016	28603	4	0	*	1	0.4	0	1206	0.6	1	0	3	0	1076	0	0	0	0

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Model Variables

Submodel Name

Comment

Fix shape parameter = 1

Current Submodel Name

ie

Covariates

Unselected

Selected

DI

H2

MG

MD

NA

NIT

OD

PD

FE

Cancel

OK

Procedures

Data Preparation

Working Data

Select Covariates

Add Derived Covariates

Parameters

Scale = 22704.2

Shape = 2.26301 (S)

Gamma

FE = 0.0289068 (NS)

Details

Comparative Report

Weibull PHM

Residual Analysis

In Order of Appearance

Residuals Against Exp

Transformed Residuals

Variance Stabilized

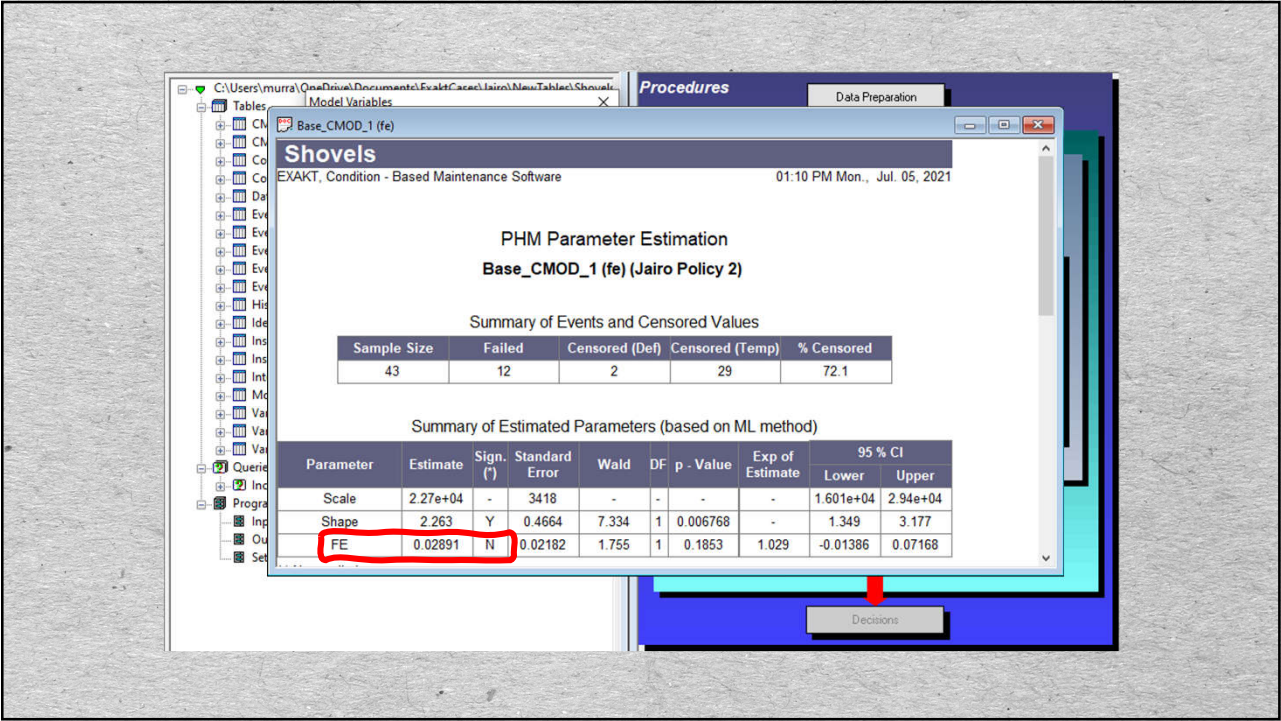
Summary Report

Transition Probability Model

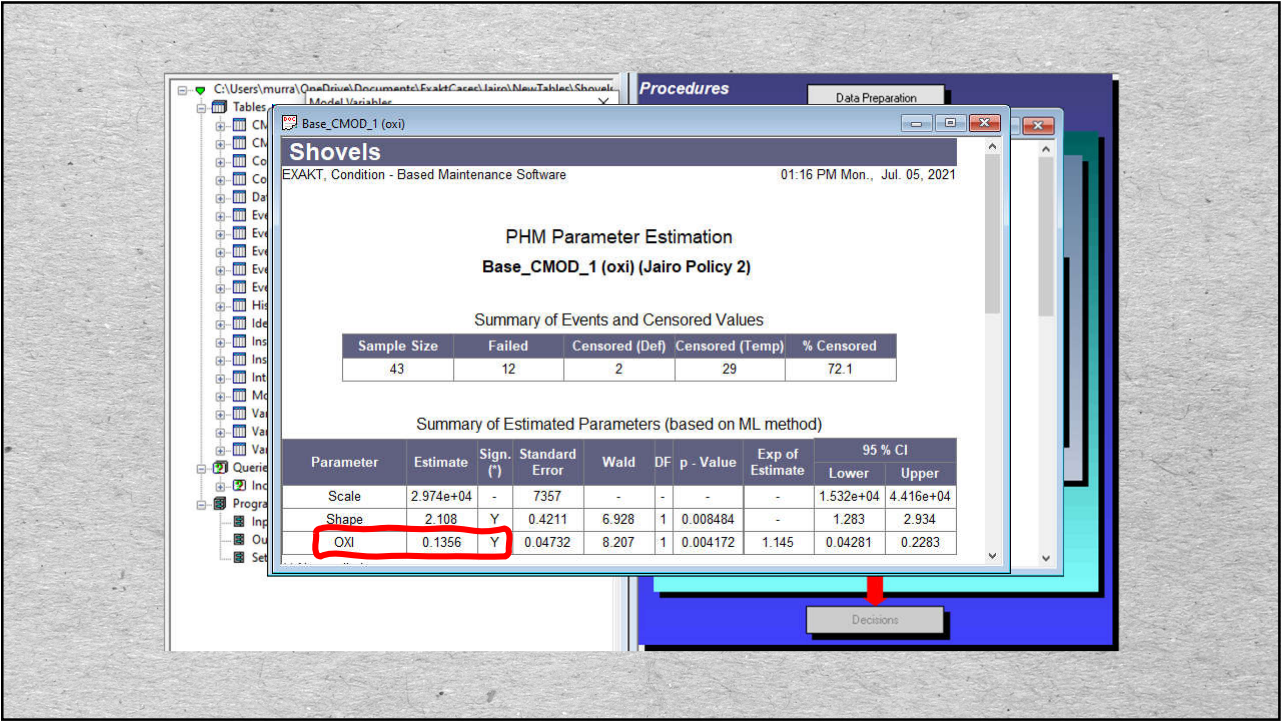
Decision Model

Decisions

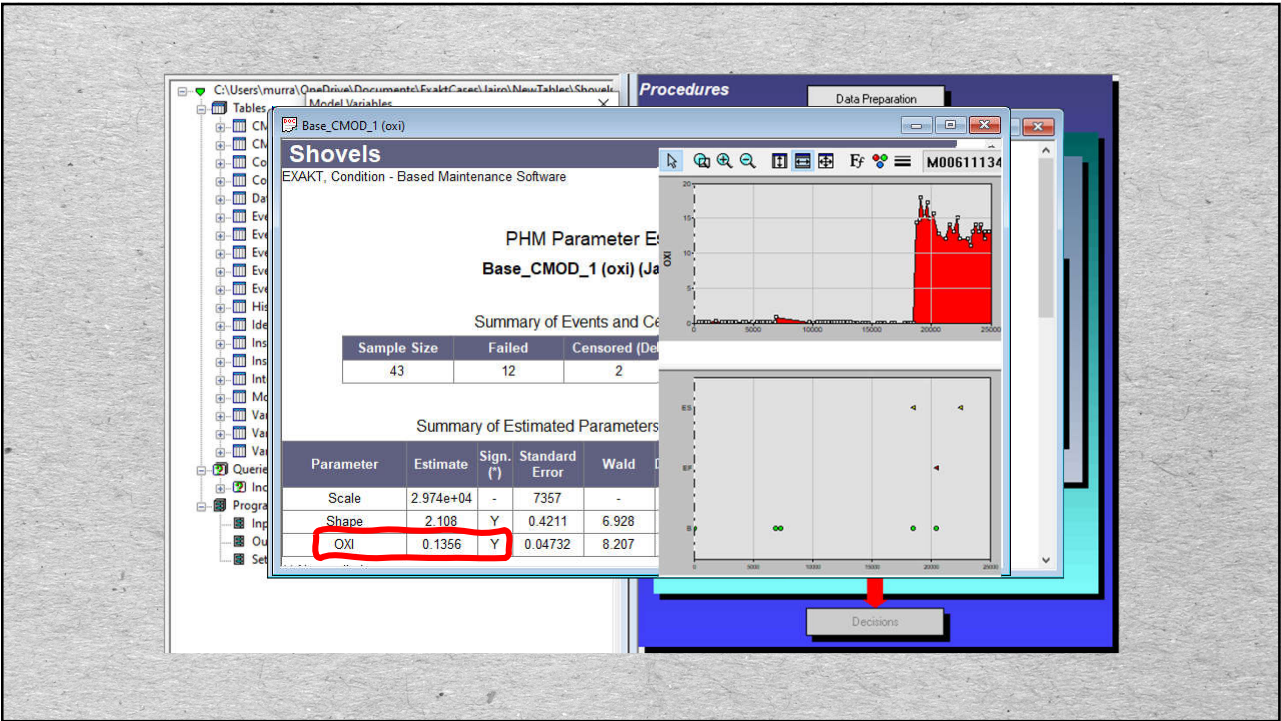
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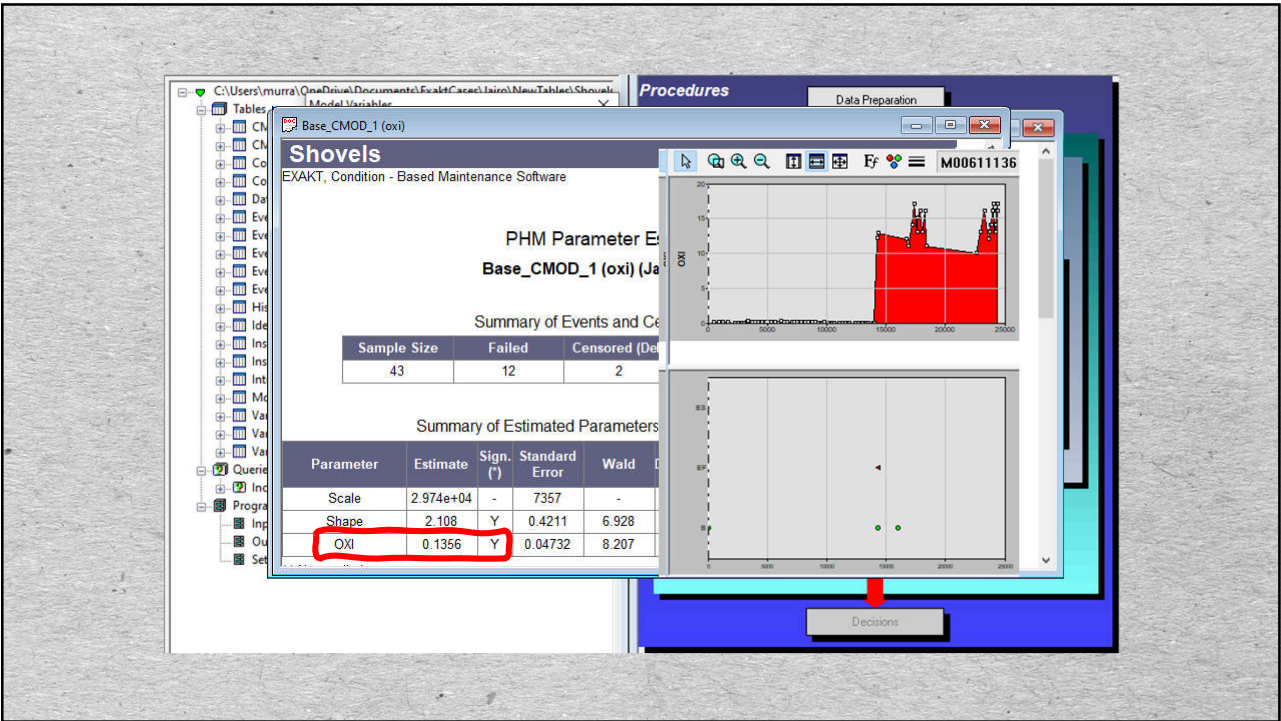
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