Capgemini

IWSM MENSURA

HAARLEM 7-9 OCTOBER 2019

Demand Forecasting & Capacity Planning Using TimeSeries Data

Niteen Kumar
Capgemini

At Capgemini we see things differently

We believe that technology is **made by people, for people**

People are at the **center** of everything we do

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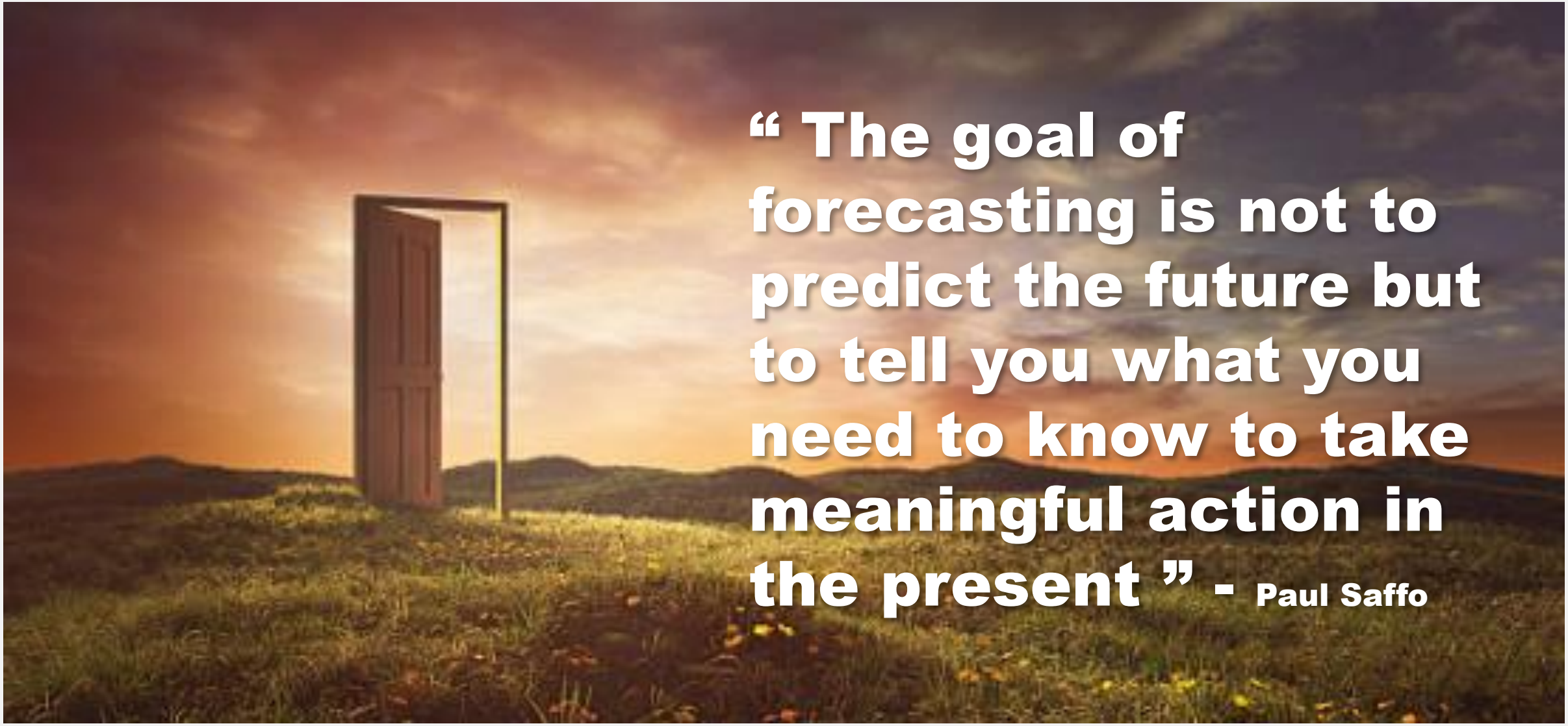

“ The goal of forecasting is not to predict the future but to tell you what you need to know to take meaningful action in the present ” - Paul Saffo

WHAT IS TIME SERIES?

TIME ORDER

SEASIONALITY

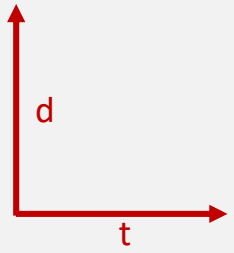
RANDOMNESS

TREND

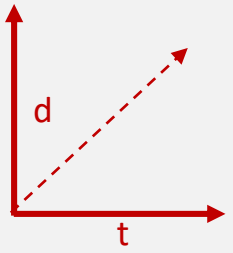
CYCLICAL

COMPONENT OF TIME SEREIS

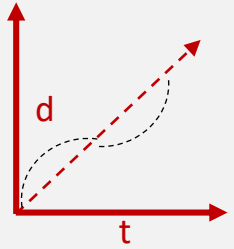
WEEK	DATA	TYPE	TECHNIQUE
W1	30	L	SIMPLE AVERAGE MOVING AVERAGE EXPONENTIAL SMOOTHING
W2	32	L	
W3	31	L	
W4	30	L	



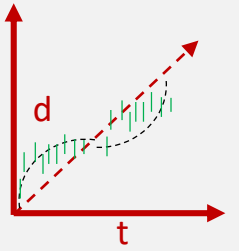
WEEK	DATA	TYPE	TECHNIQUE
W1	30	L+T	LINEAR REGRESSION HOLT'S METHOD
W2	34	L+T	
W3	36	L+T	
W4	39	L+T	



WEEK	DATA	TYPE	TECHNIQUE
W1	30	L+T+S	BASIC MODEL WINTERS MODEL
W2	34	L+T+S	
W3	38	L+T+S	
W4	32	L+T+S	
W1	32	L+T+S	
W2	37	L+T+S	
W3	40	L+T+S	
W4	35....+N	L+T+S	



WEEK	DATA	TYPE	TECHNIQUE
W1	30	L+T+S+C	SINUSOIDAL MODEL
W2	34	L+T+S+C	
W3	38	L+T+S+C	
W4	32	L+T+S+C	
W1	32	L+T+S+C	
W2	37	L+T+S+C	
W3	40	L+T+S+C	
W4	35...+N	L+T+S+C	



CAN YOU FORECAST?

Primary Factor (PF):	60%
Damping Factor (DF):	40%

Primary Factor:	0,20
Secondary Factor:	0,03

WEEK	DATA
W1	33
W2	34
W3	35
W4	37
W5	38
W6	34
W7	39
W8	**44**

WEEK	DATA
W1	33
W2	30
W3	33
W4	23
W5	30
W6	53
W7	47
W8	**36**

WEEK	DATA	FACTOR
W1	33	
W2	30	
W3	33	10%
W4	23	15%
W5	30	20%
W6	53	25%
W7	47	30%
W8	**40**	

WEEK	DATA	PREDICTION
W1	33	-
W2	30	33
W3	33	31
W4	23	32
W5	30	27
W6	53	29
W7	47	43
W8	**46**	

WEEK	DATA	PREDICTION
W1	33	26,5
W2	30	30,3
W3	33	34,1
W4	23	34,7
W5	30	36,5
W6	53	43,1
W7	47	47,2
W8	**47,2**	

CAN YOU FORECAST?

Primary Factor (PF):	60%
Damping Factor (DF):	40%

Primary Factor:	0,20
Secondary Factor:	0,03

WEEK	DATA
W1	33
W2	34
W3	35
W4	37
W5	38
W6	34
W7	39
W8	**44**
+39+(39-34)	

WEEK	DATA
W1	33
W2	30
W3	33
W4	23
W5	30
W6	53
W7	47
W8	**36**
Simple Average	
AVERAGE(W1:W7)	

WEEK	DATA	FACTOR
W1	33	
W2	30	
W3	33	10%
W4	23	15%
W5	30	20%
W6	53	25%
W7	47	30%
W8	**40**	
Weighted Moving Average		
SUM(D*F) FOR ALL WEEKS		

WEEK	DATA	PREDICTION
W1	33	-
W2	30	33
W3	33	31
W4	23	32
W5	30	27
W6	53	29
W7	47	43
W8	**46**	
Single Exp Smoothing		
=PF*W7D+DF*W7PREDICTION		

WEEK	DATA	PREDICTION
W1	33	26,5
W2	30	30,3
W3	33	34,1
W4	23	34,7
W5	30	36,5
W6	53	43,1
W7	47	47,2
W8	**47,2**	
Double Exp Smoothing		

MEASURING FORECAST ACCURACY

Primary Factor:	0,20
Secondary Factor:	0,03

WEEK	DATA	PREDICTION	ERROR	MAD	MSD	MAPE
W1	33					
W2	30	26,5	3,54	3,54	12,50	0,12
W3	33	30,3	2,69	2,69	7,22	0,08
W4	23	34,1	-11,07	-11,07	122,61	0,48
W5	30	34,7	- 4,75	- 4,75	22,55	0,16
W6	53	36,5	16,45	16,45	270,71	0,31
W7	47	43,1	3,92	3,92	15,38	0,08
W8	**47,2**			**7,07**	**75,16**	**0,21**
Double Exp Smoothing						

BASIC STEPS IN FORECASTING

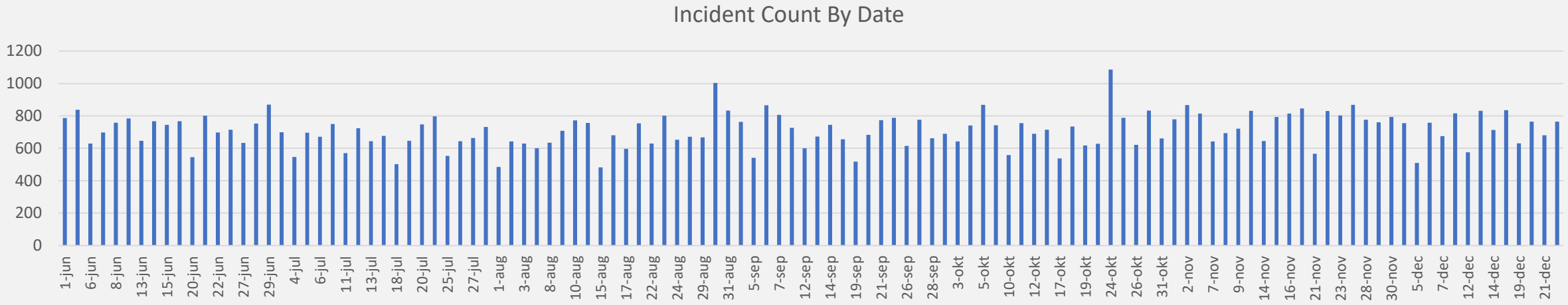
- Problem definition
- Gathering Data
- Exploratory Analysis
- Choosing & Fitting Model
- Evaluating Forecast Model

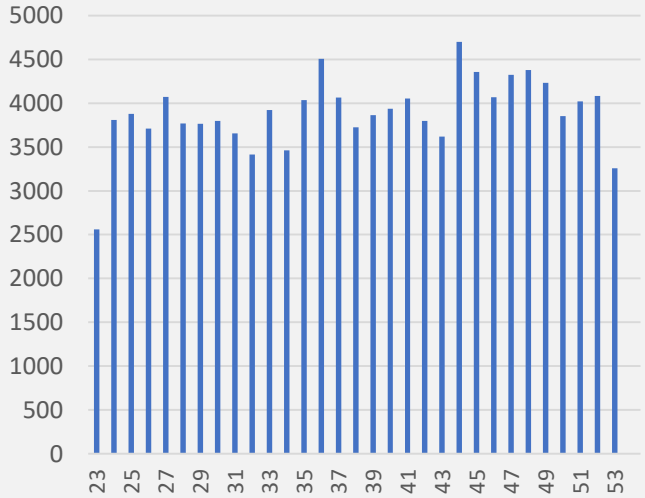
PROBELM DEFINITION

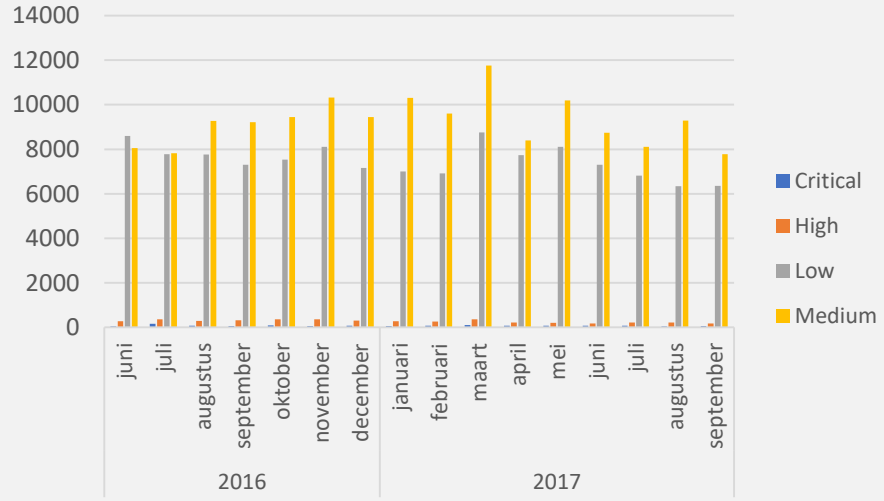
Forecasting monthly service demand and required capacity to service those demand with higher accuracy

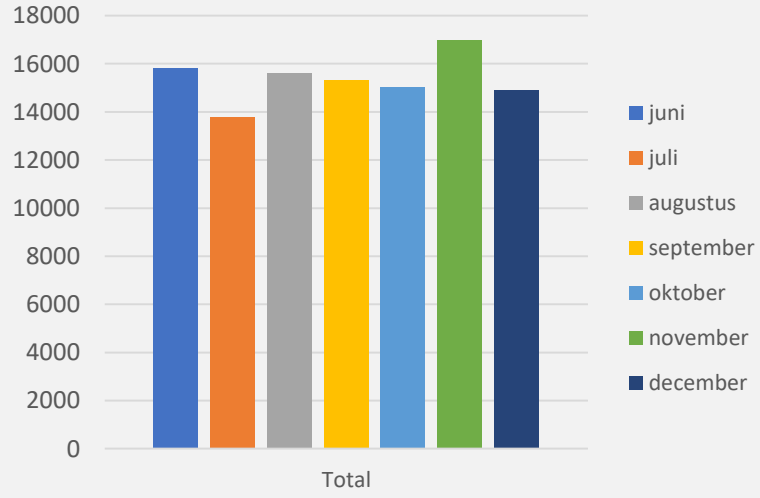
YEAR	MONTH	QUARTER (X)	Q-INCIDENTS ACTUALS	REQUIRED FTE
2017	1	1	300	
2017	2			
2017	3			
2017	4	2	540	
2017	5			
2017	6			
2017	7	3	885	
2017	8			
2017	9			
2017	10	4	580	
2017	11			
2017	12			
2018	1	5	??	??
2018	2			
2018	3			
			DEMAND FORECAST	**CAPACITY FORECAST**

GATHERING DATA

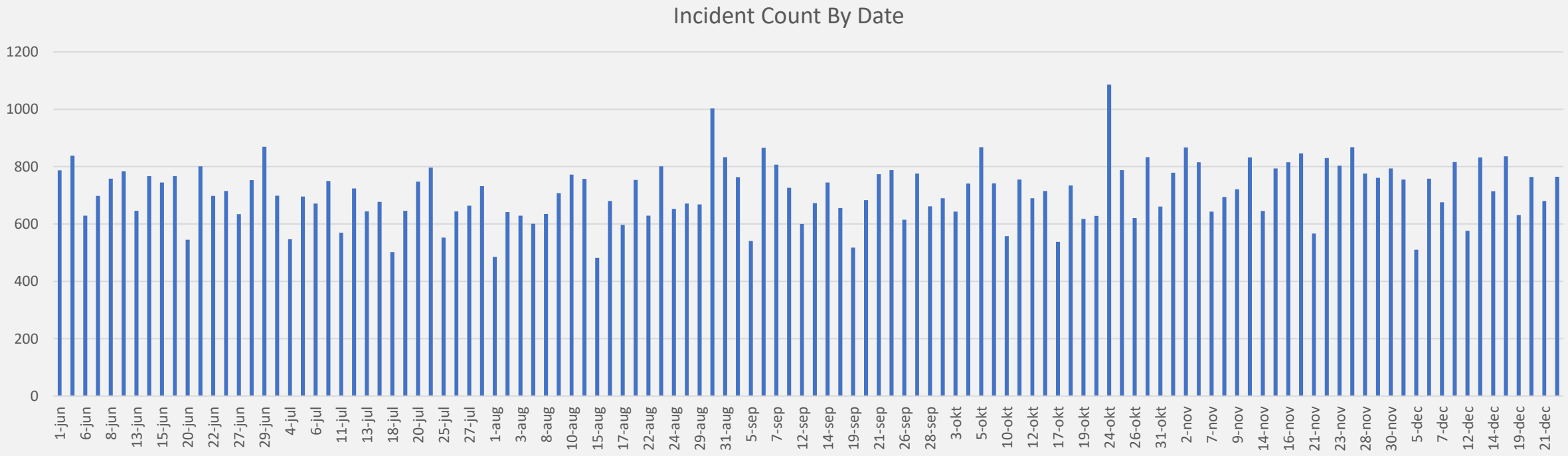








EXPLORATORY ANALYSIS



REAL TIME DATA IS NOT SO CLEAR AND VISUAL INSPECTION IS NOT SO HELPFUL

CHOOSING A FITTING MODEL

YEAR	MONTH	QUARTER (X)	Q-ACTUALS INCIDENTS
2017	1	1	300
2017	2		
2017	3		
2017	4	2	540
2017	5		
2017	6		
2017	7	3	885
2017	8		
2017	9		
2017	10	4	580
2017	11		
2017	12		
2018	1	5	416
2018	2		
2018	3		
2018	4	6	760
2018	5		
2018	6		
2018	7	7	1191
2018	8		
2018	9		
2018	10	8	760
2018	11		
2018	12		

CHOOSING A FITTING MODEL

YEAR	MONTH	QUARTER (X)	Q-INCIDENTS ACTUALS
2017	1	1	300
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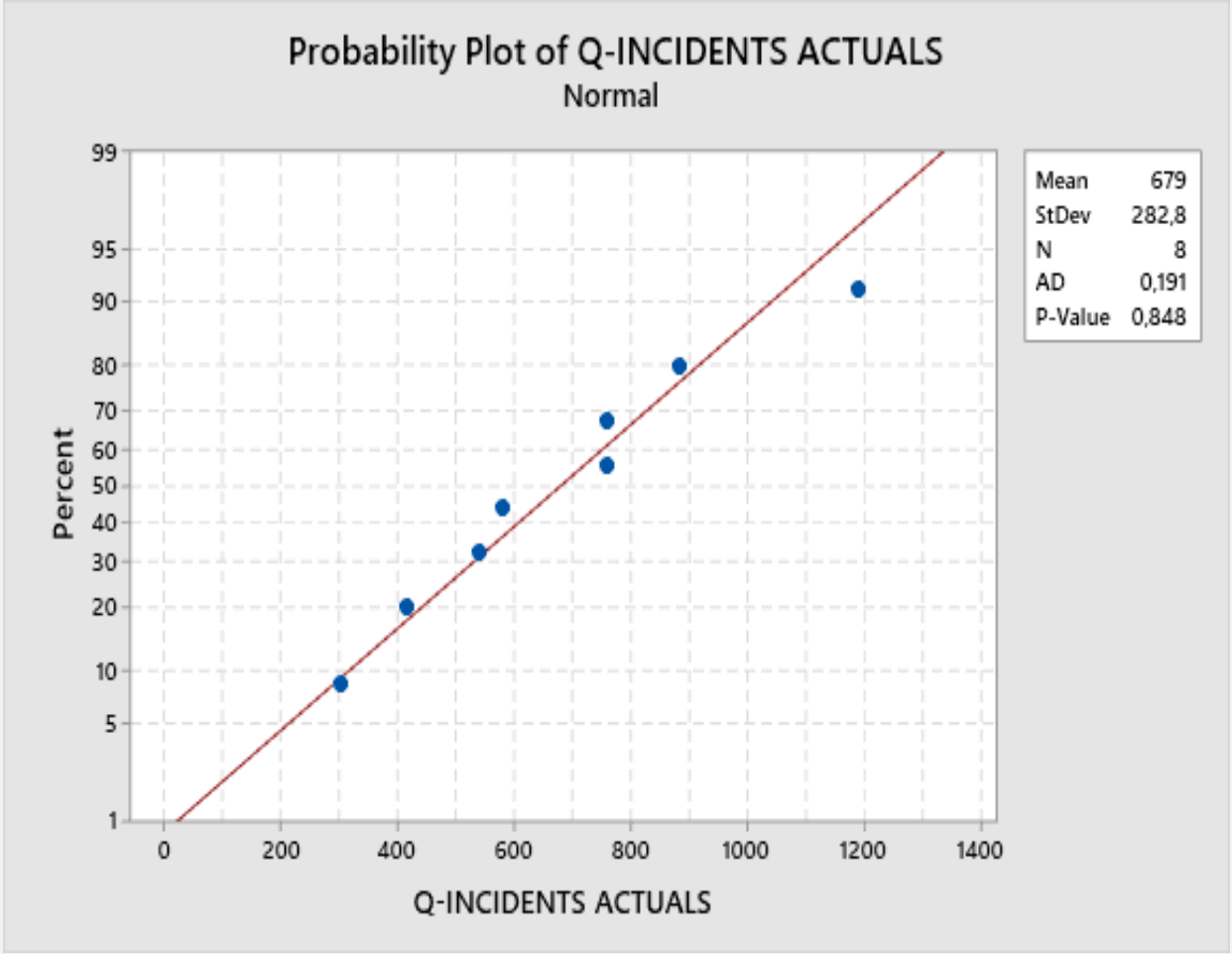
2018	12		



CHOOSING A FITTING MODEL

YEAR	MONTH	QUARTER (X)	Q-ACTUALS INCIDENTS
2017	1	1	300
2017	2		
2017	3		
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2018	2		
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2018	4	6	760
2018	5		
2018	6		
2018	7	7	1191
2018	8		
2018	9		
2018	10	8	760
2018	11		
2018	12		

CHOOSING A FITTING MODEL

QUARTER (X)	Q-ACTUALS INCIDENTS	PERIOD AVERAGE	SEASONAL FACTOR
1	300	358	0,53
2	540	650	0,96
3	885	1038	1,53
4	580	670	0,99
5	416		0,53
6	760		0,96
7	1191		1,53
8	760		0,99

CHOOSING A FITTING MODEL

QUARTER (X)	Q-ACTUALS INCIDENTS	PERIOD AVERAGE	SEASONAL FACTOR	DESESAONLIZED INCIDENTS (Y)
1	300	358	0,53	569
2	540	650	0,96	564
3	885	1038	1,53	579
4	580	670	0,99	588
5	416		0,53	789
6	760		0,96	794
7	1191		1,53	779
8	760		0,99	770

DATA UNDER ANALYSIS

QUARTER (X)	Q-ACTUALS INCIDENTS	PERIOD AVERAGE	SEASONAL FACTOR	DESESAONLIZED INCIDENTS (Y)
1	300	358	0,53	569
2	540	650	0,96	564
3	885	1038	1,53	579
4	580	670	0,99	588
5	416		0,53	789
6	760		0,96	794
7	1191		1,53	779
8	760		0,99	770

Regression Equation

DE-SEASONLAIZED INCIDENTS COUNT = 500,7 + 39,62 QUARTER (X)

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
59,5622	75,59%	71,53%	60,93%

CHOOSING A FITTING MODEL

Regression Equation

DE-SEASONLAIZED INCIDENTS COUNT = 500,7 + 39,62 QUARTER (X)

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
59,5622	75,59%	71,53%	60,93%

QUARTER (X)	TREND FORECAST 500,7 + 39,62 QUARTER (X)
9	857
10	897
11	937
12	976

CHOOSING A FITTING MODEL

Regression Equation

DE-SEASONLAIZED INCIDENTS COUNT = 500,7 + 39,62 QUARTER (X)

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
59,5622	75,59%	71,53%	60,93%

QUARTER (X)	TREND FORECAST 500,7 + 39,62 QUARTER (X)	FINAL FORECAST (TREND + SEASON)
9	857	452
10	897	859
11	937	1432
12	976	963

EVALUATING THE FORECASTING MODEL

QUARTER (X)	Q-ACTUALS INCIDENTS	TREND FORECAST	FINAL FORECAST	FORECASTING ERROR
9	514	857	452	12%
10	907	897	859	5%
11	1376	937	1432	-4%
12		976	963	

CAPACITY PLANNING

QUARTER (X)	Q-ACTUALS INCIDENTS	TREND FORECAST	FINAL FORECAST	FORECASTING ERROR	PRODUCTIVITY	PLANNED FTE	ACTUAL REQUIRED FTE
9	514	857	452	12%	6	5	6
10	907	897	859	5%	6	10	11
11	1376	937	1432	-4%	6	17	16

CAPACITY UTILIZATION IS BETTER W.R.T TO PLAN AVAILABITY


Will they have questions at the end?