



TapRoot®
ROOT CAUSE ANALYSIS

2021 Global TapRoot® Summit

Trending Techniques for Incident Data

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Trending Poll: Your Favorite Graph

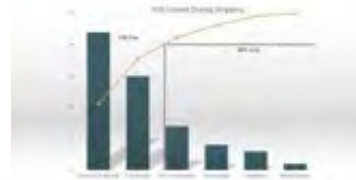
☐ Bar Chart



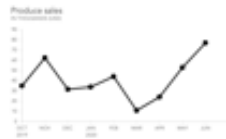
☐ Pie Chart



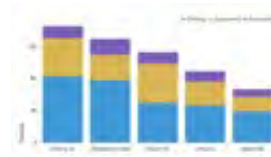
☐ Pareto Chart



☐ Line Graph

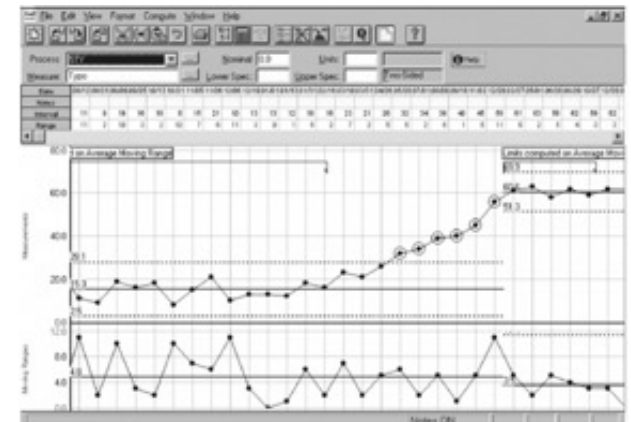


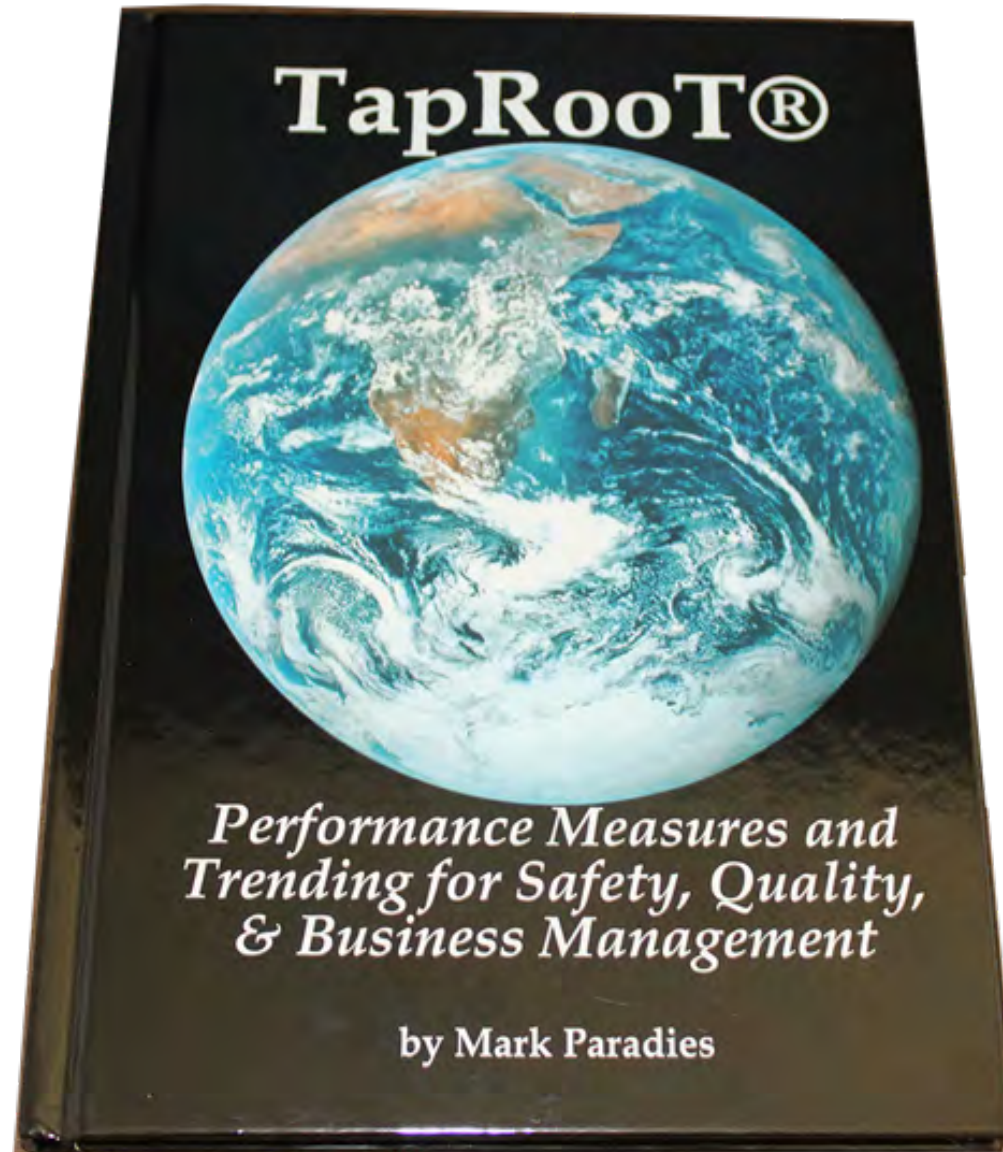
☐ Stacked Bar Chart



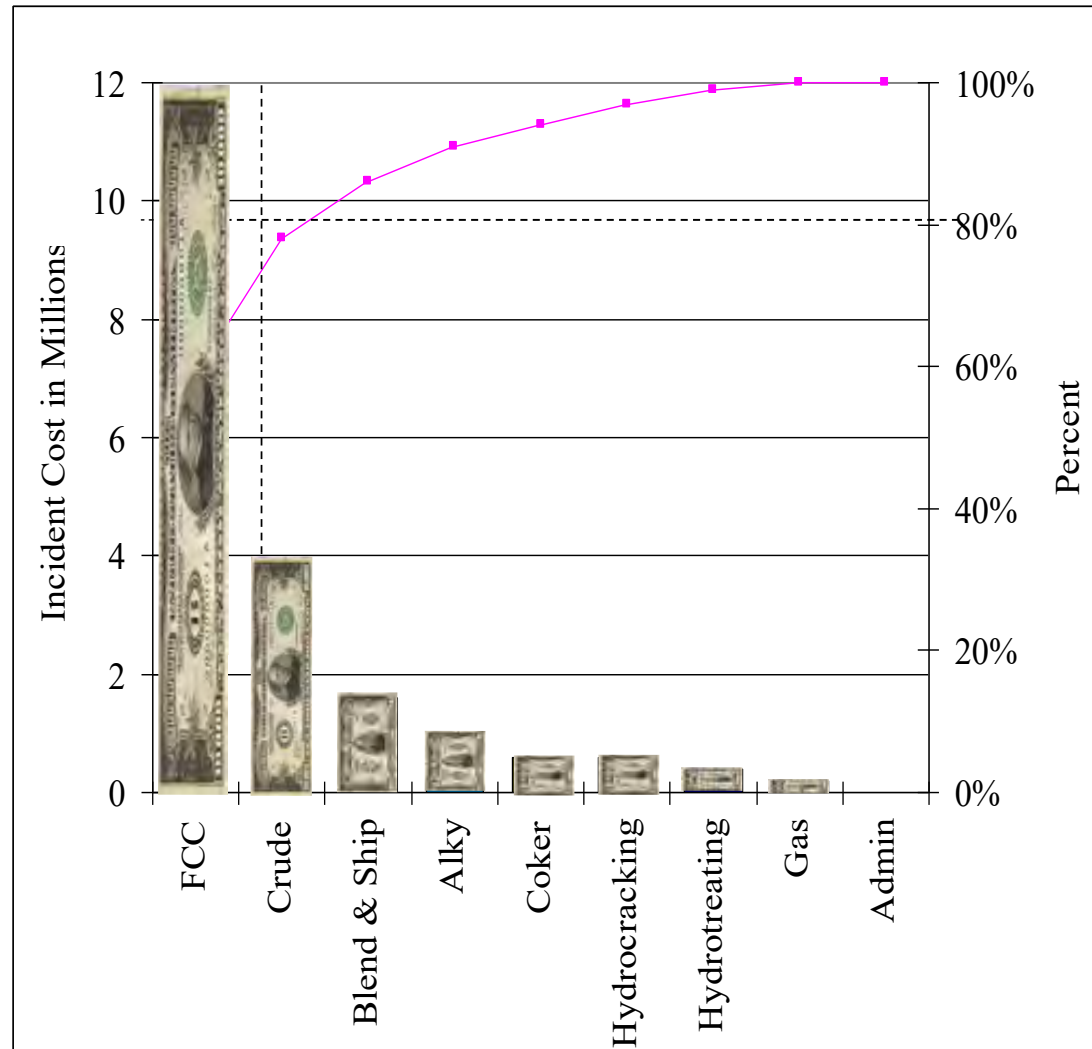
☐ Process Behavior Chart

☐ Other

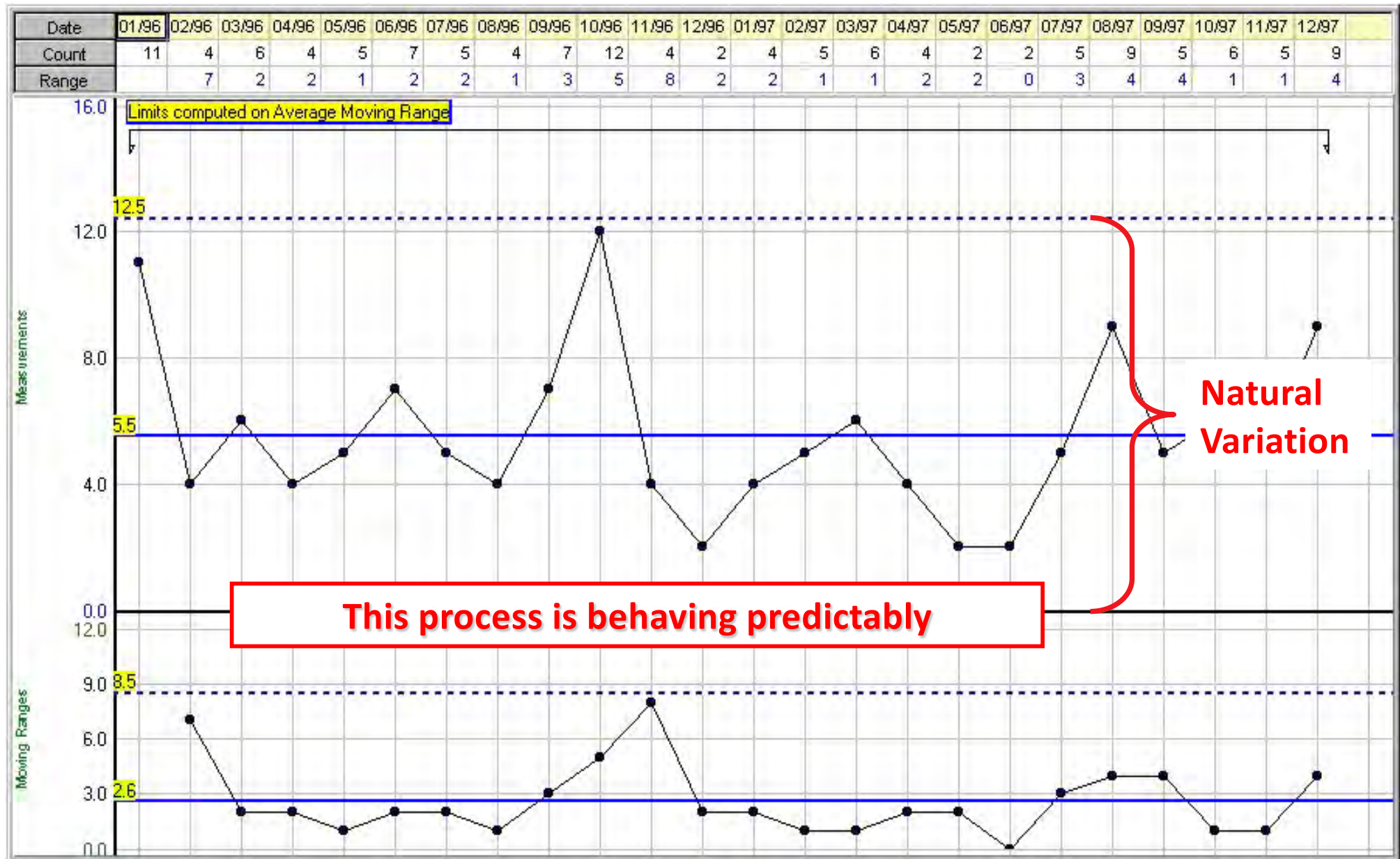




Pareto Chart



Process Behavior Chart



Pareto Chart Example

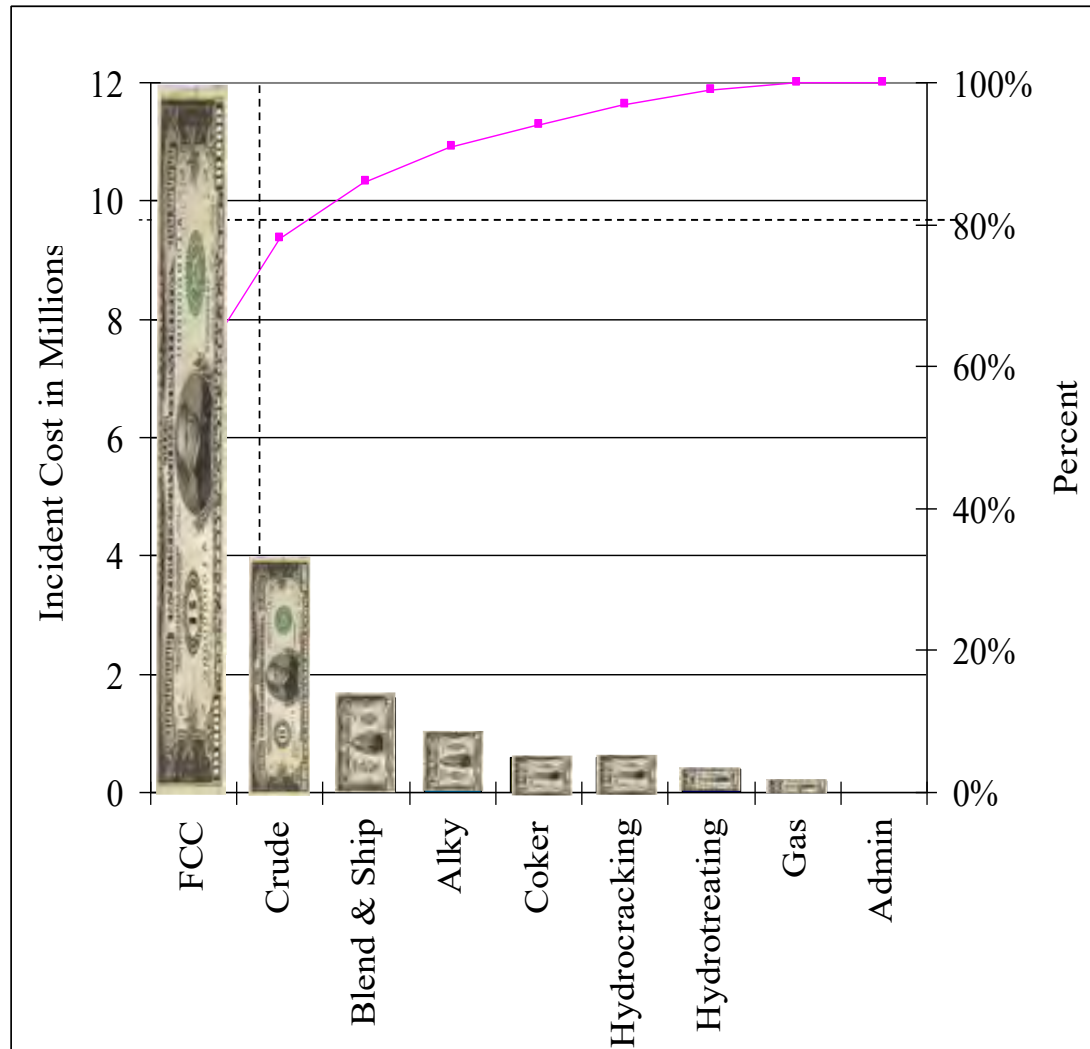
What is the
period of time?

80/20?

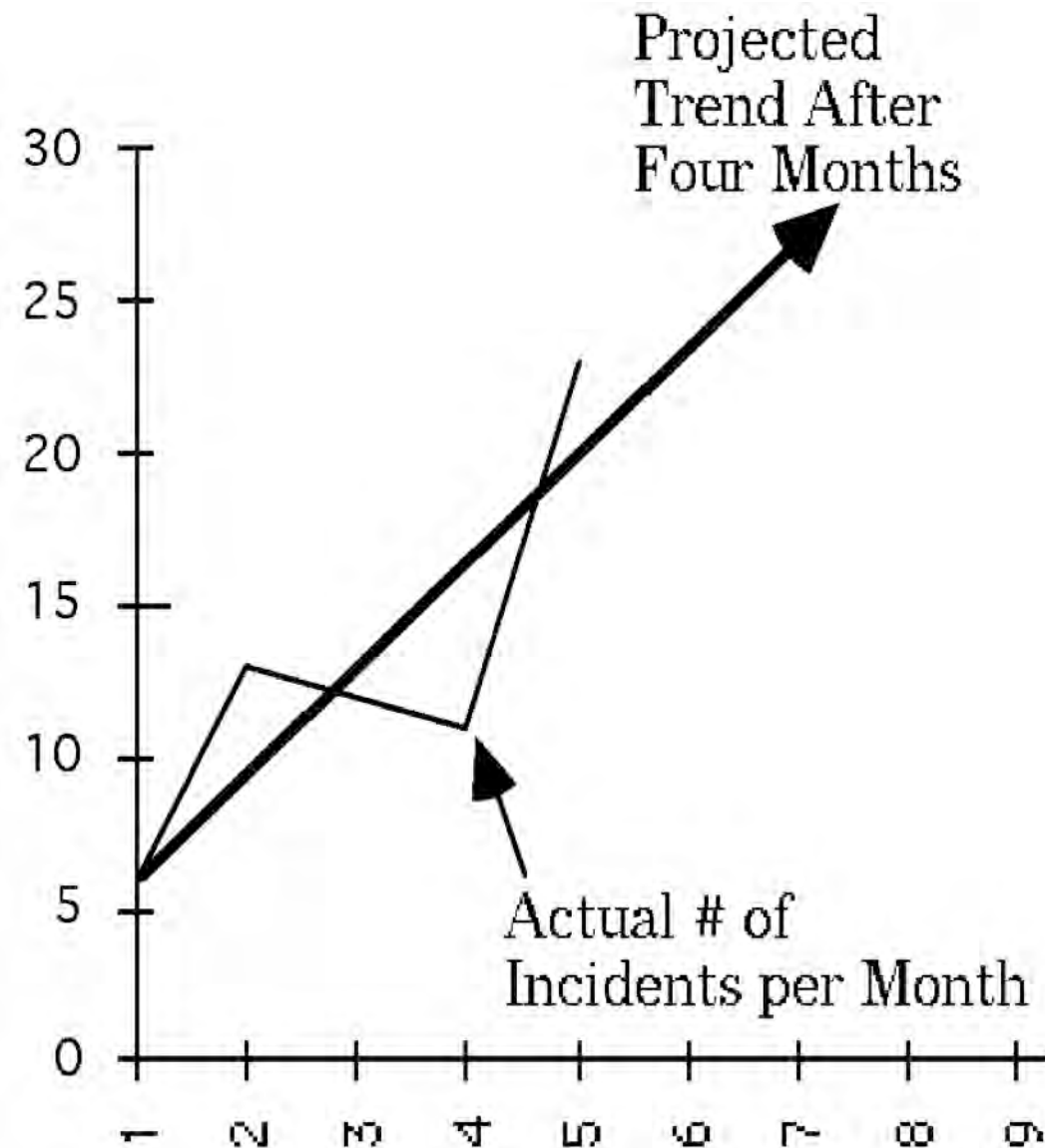
Counts or
dollars?

Does it change
over time?

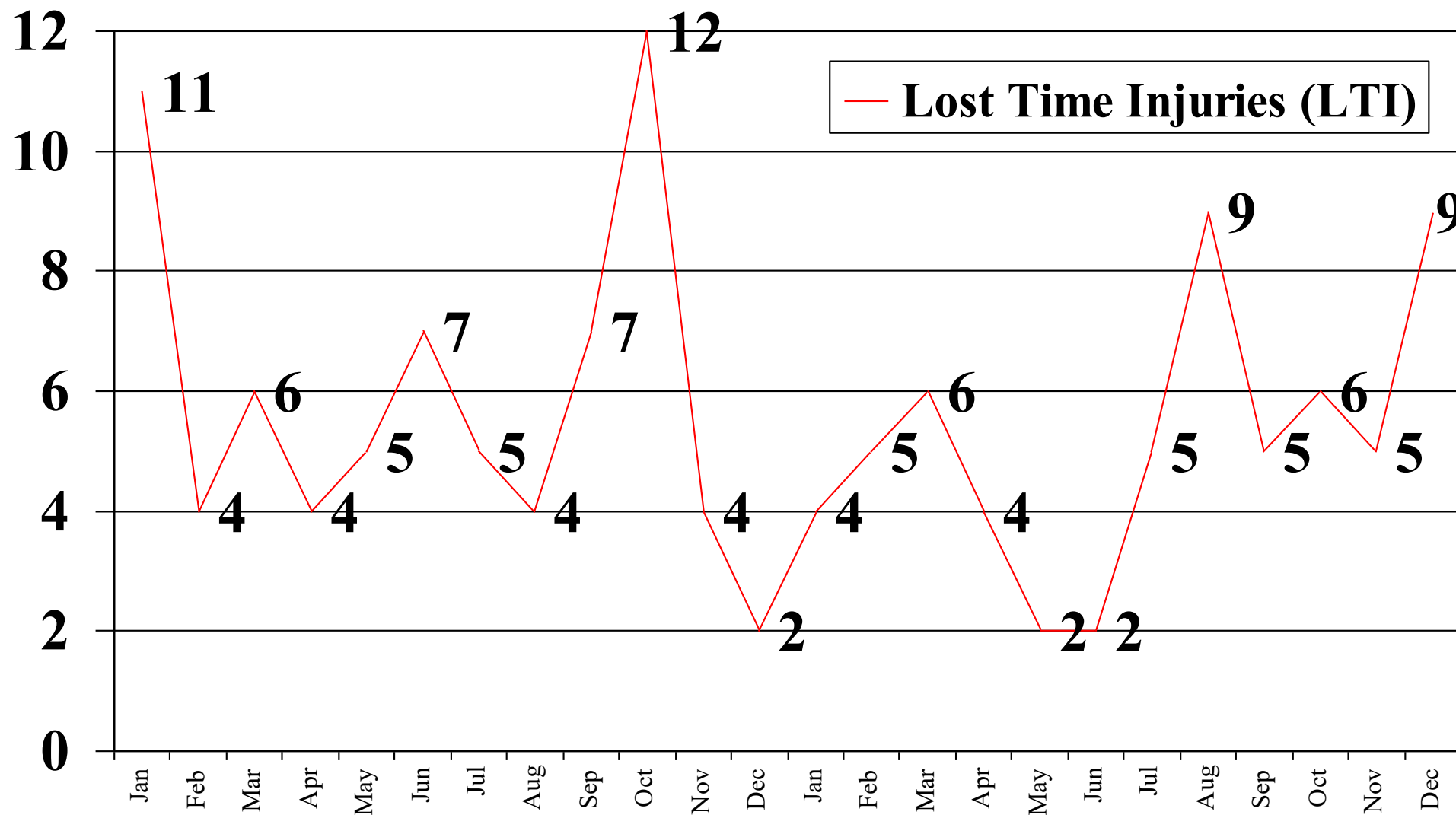
Pareto Chart



Before Process Behavior Charts

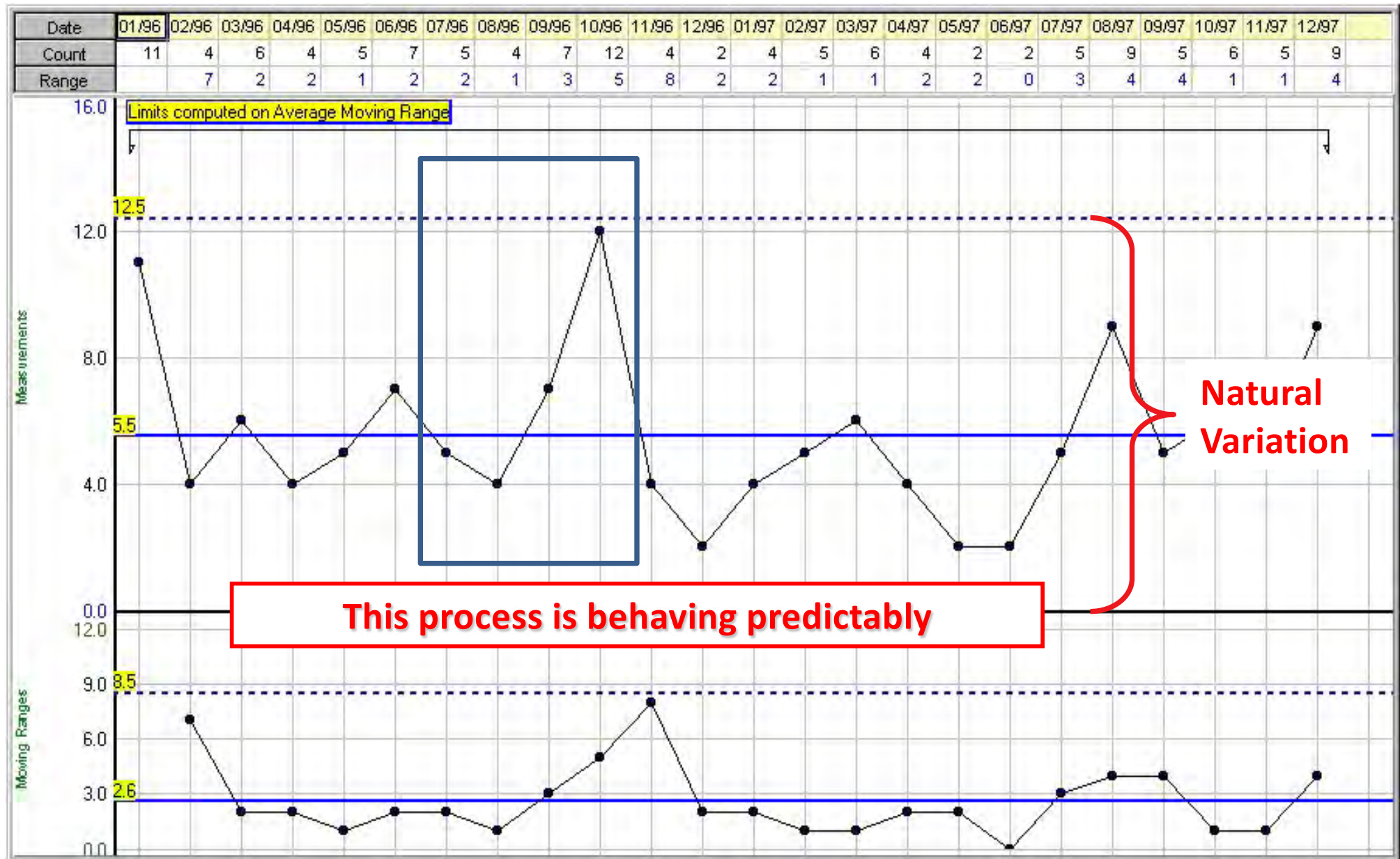


LTI: What Months Are Abnormal?



Find out by drawing a Process Behavior Chart...

Process Behavior Chart Example



Basis for Trending Over Time

The mathematical basis for trending was developed by Dr. Walter A. Shewhart at Bell Labs & published in the 1931 book:

Economic Control of Quality of Manufactured Product

- Controlled processes are variable but predictable within a range.
- It's counterproductive to try to control variation within the range of random (or routine) variation in a controlled process.



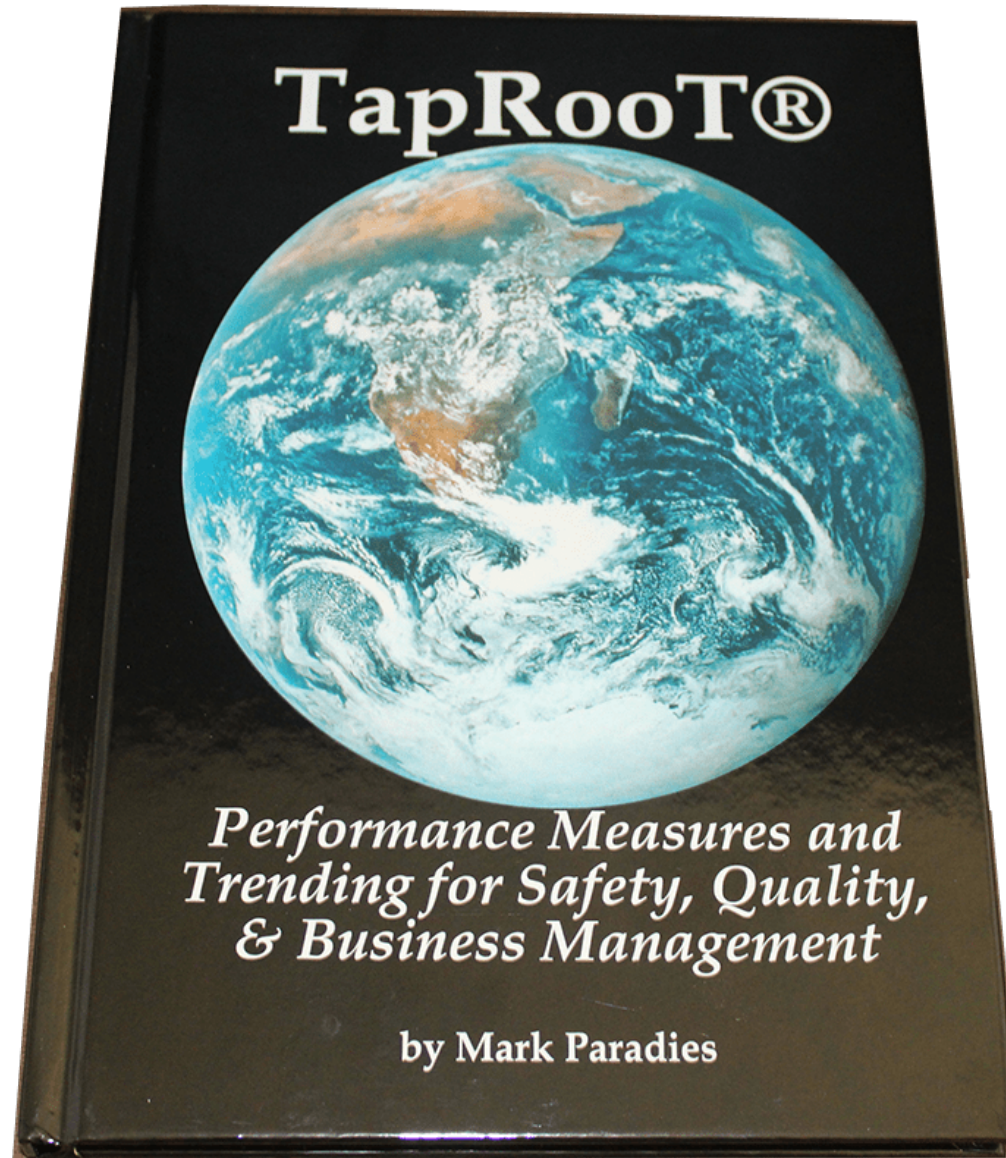
Process Behavior Chart of Choice: XmR

Simple math needed to draw XmR Charts:

- Count or measure X
- Calculate the "Moving Range" (mR):
use subtraction $mR = |X_1 - X_2|$
- Using at least 5 points, calculate the limits for X and mR.
 - Calculate the average \bar{X} (X) = add X's & divide by # of X's
 - Calculate the average \bar{mR} (mR) = add R's & divide by # of R's
 - Calculate the upper limit for X = $\bar{X} + (2.66 \cdot \bar{mR})$
 - Calculate the lower limit for X = $\bar{X} - (2.66 \cdot \bar{mR})$
 - Calculate the upper limit for mR = $3.268 \cdot \bar{mR}$

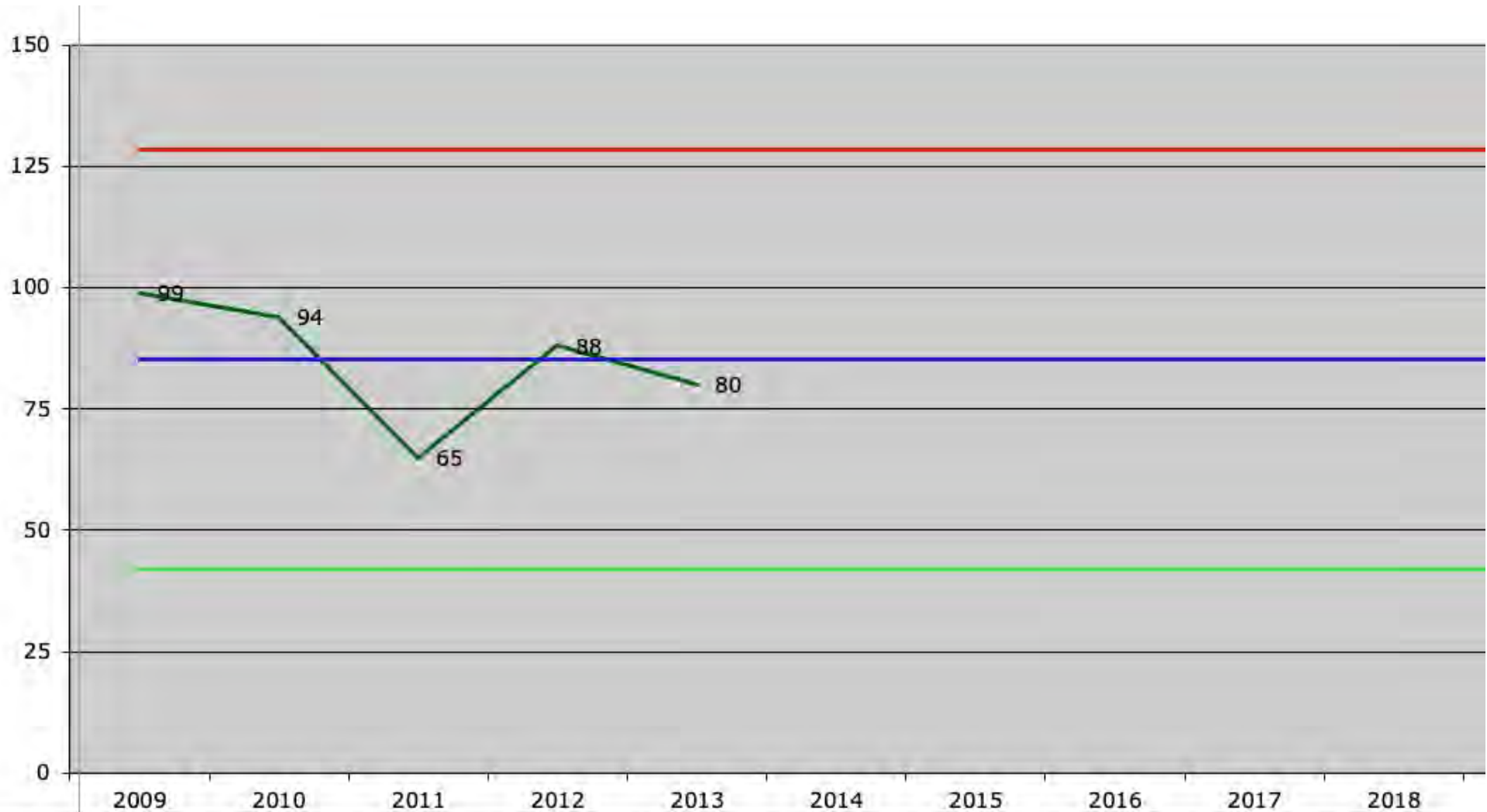
TapRoot[®] Performance Measures and Trending for Safety, Quality, and Business Management

Trending Book (Book 8)



Example based on real data ... Fatality Rate

International Oil & Gas Producers 2018 Report on Safety ... Statistics 2009 - 2013



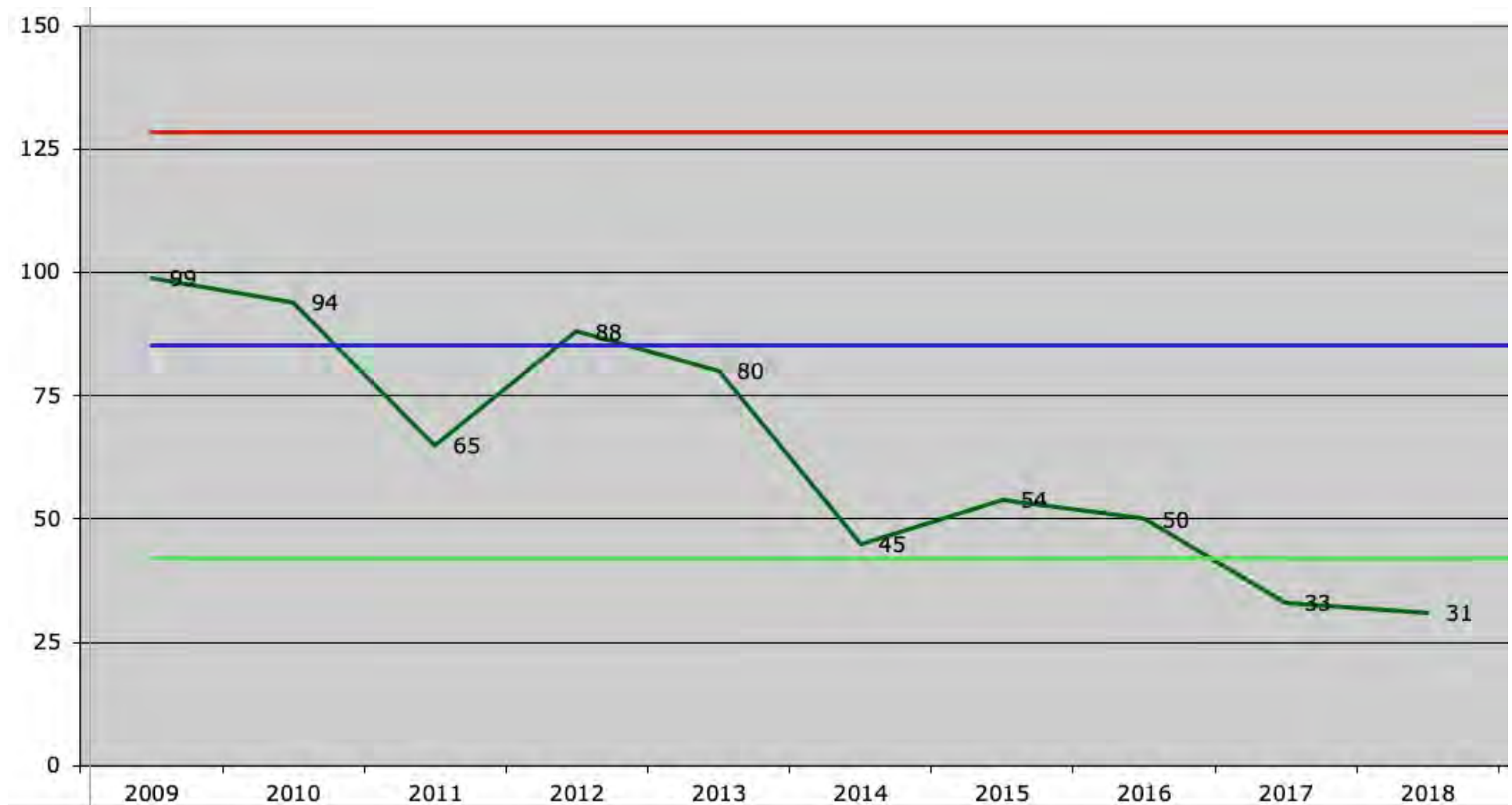
Example based on real data ... Fatality Rate

International Oil & Gas Producers 2018 Report on Safety ... Statistics 2009 - 2014




Thinking Required

International Oil & Gas Producers 2018 Report on Safety Statistics 2009 - 2018

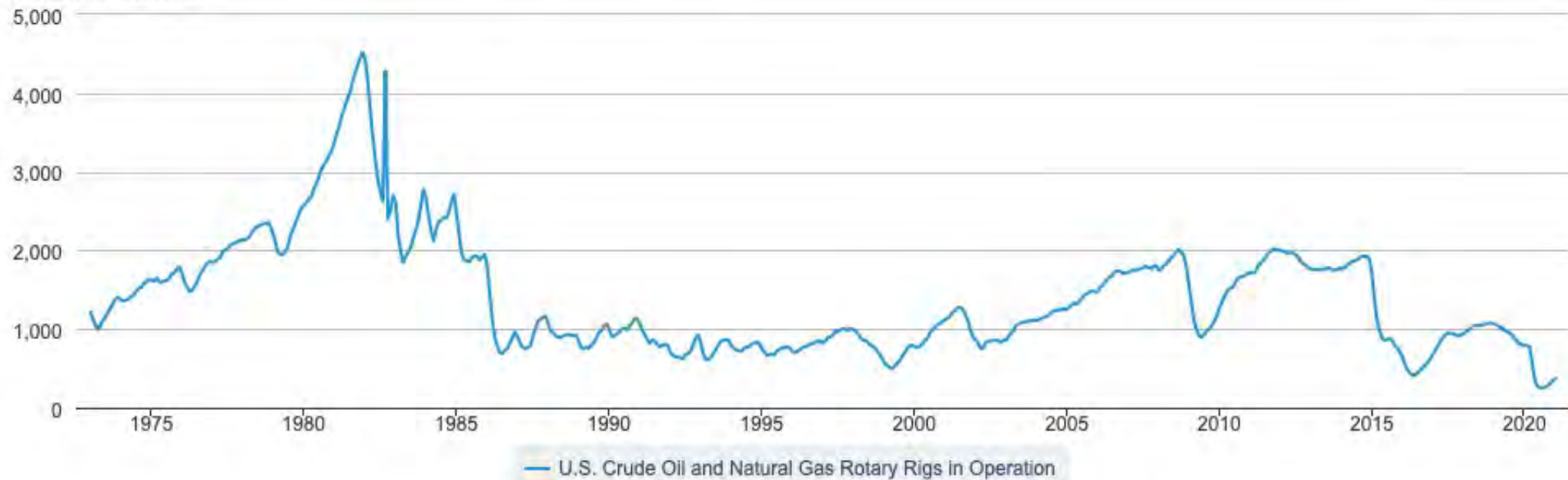


Rig Count in USA

U.S. Crude Oil and Natural Gas Rotary Rigs in Operation

 [DOWNLOAD](#)

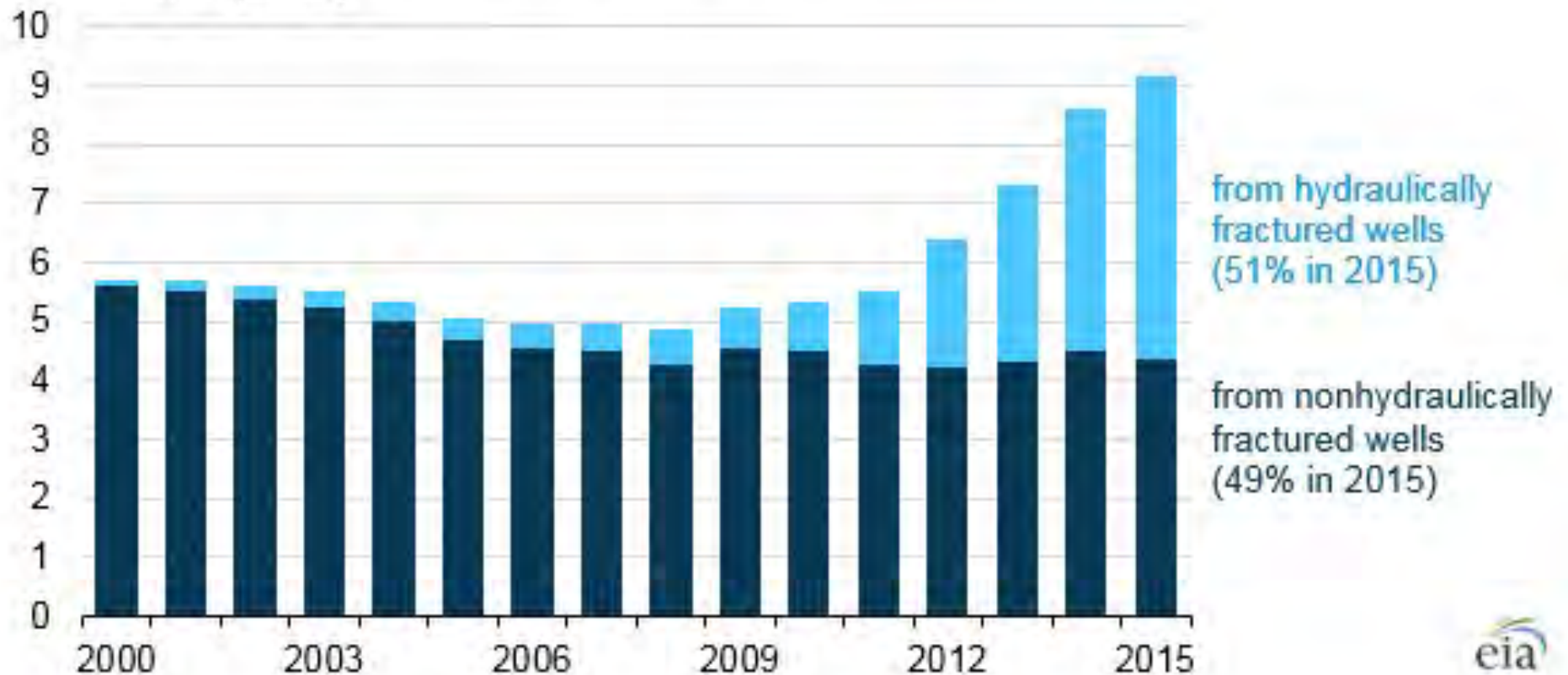
Number of Elements



Horizontal Drilling and Fracking

Oil production in the United States (2000-2015)

million barrels per day



Oil & Gas Production

Change in oil and gas production since 2010



PRODUCT **Lost Time Injuries 1996-1997**

MEASUREMENT

CHART
NO.

PART
NO.

UNIT OF
MEASURE

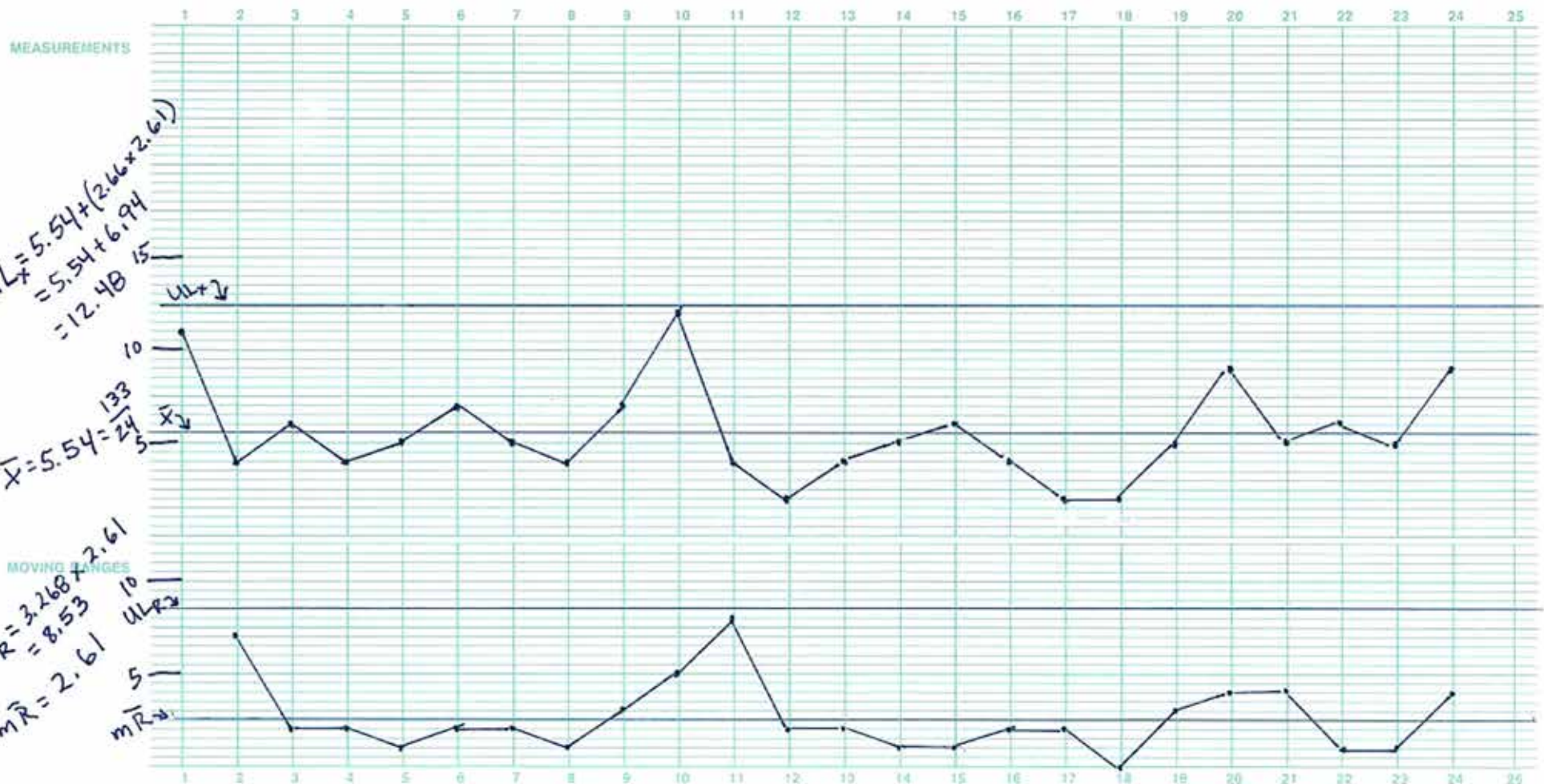
ZERO
EQUALS

DATE **96**

TIME **Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 97 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec**

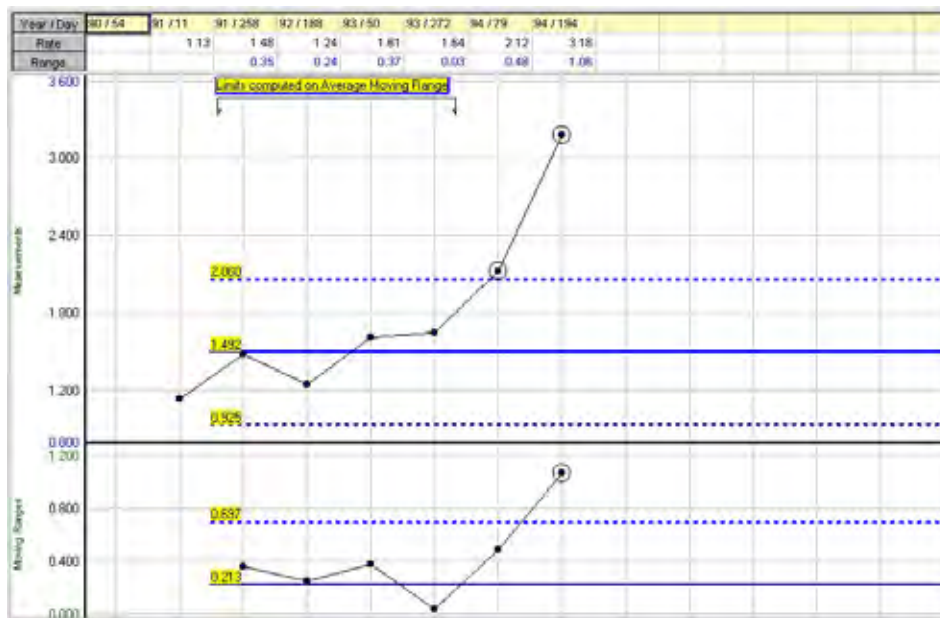
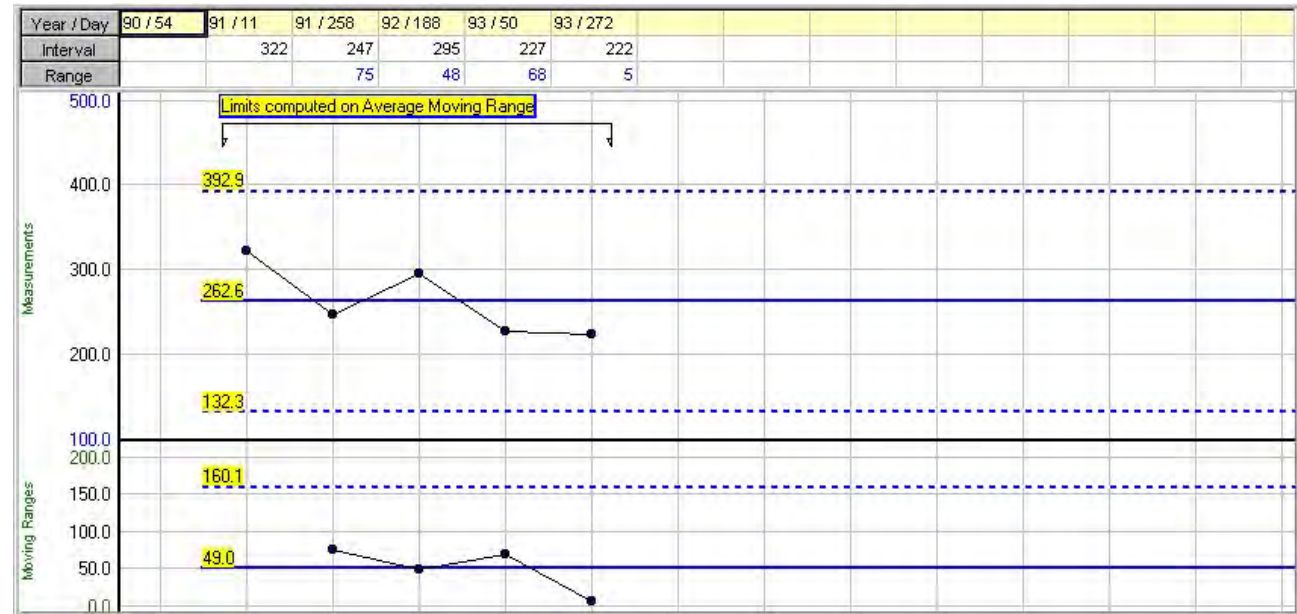
NOTES

MEASUREMENTS	11	4	6	4	5	7	5	4	7	12	4	2	4	5	6	4	2	2	5	9	5	6	5	9
MOVING RANGES	X	7	2	2	1	2	2	1	3	5	8	2	2	1	1	2	2	0	3	4	4	1	1	4



Two More Types of Process Behavior Charts

Interval Chart

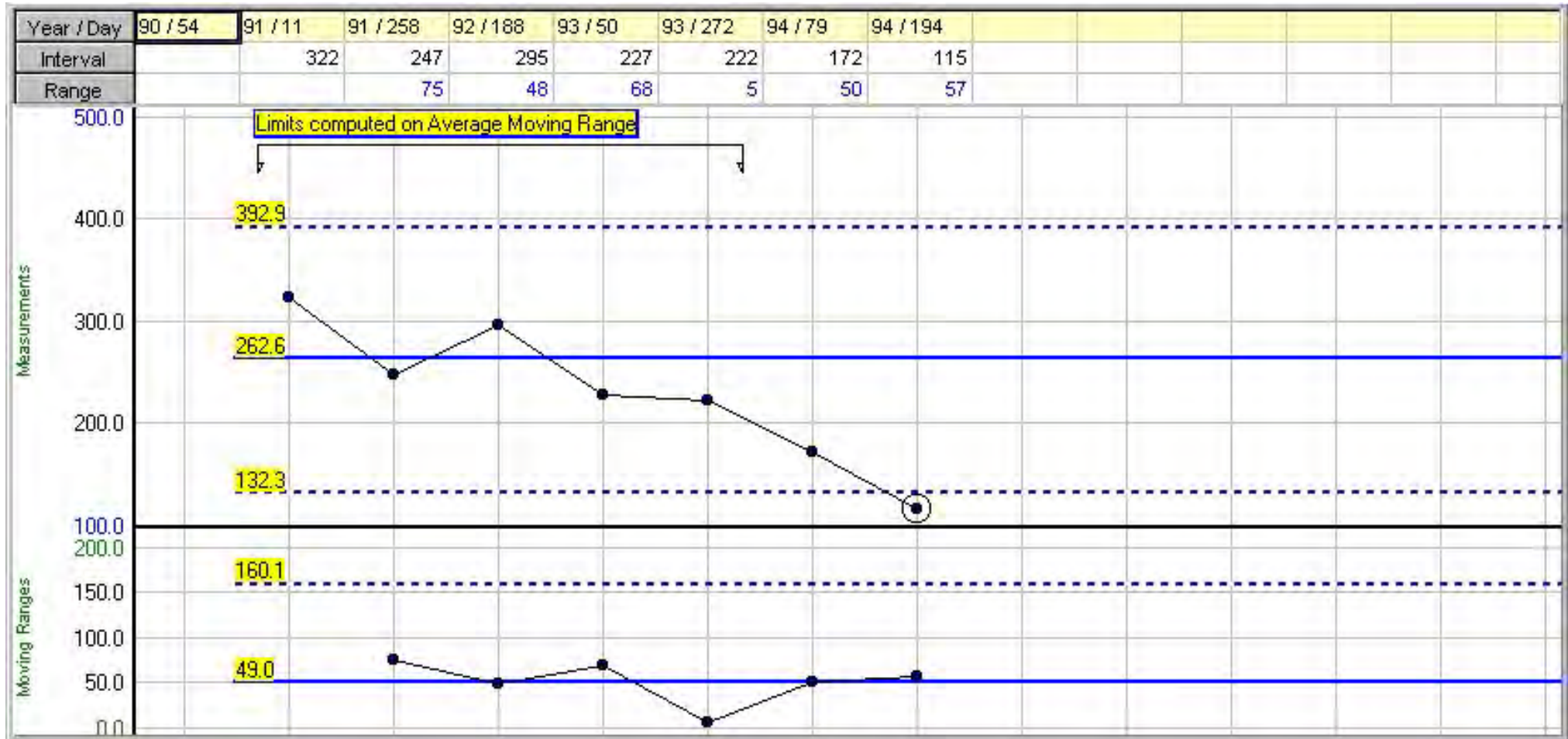


Rate Chart

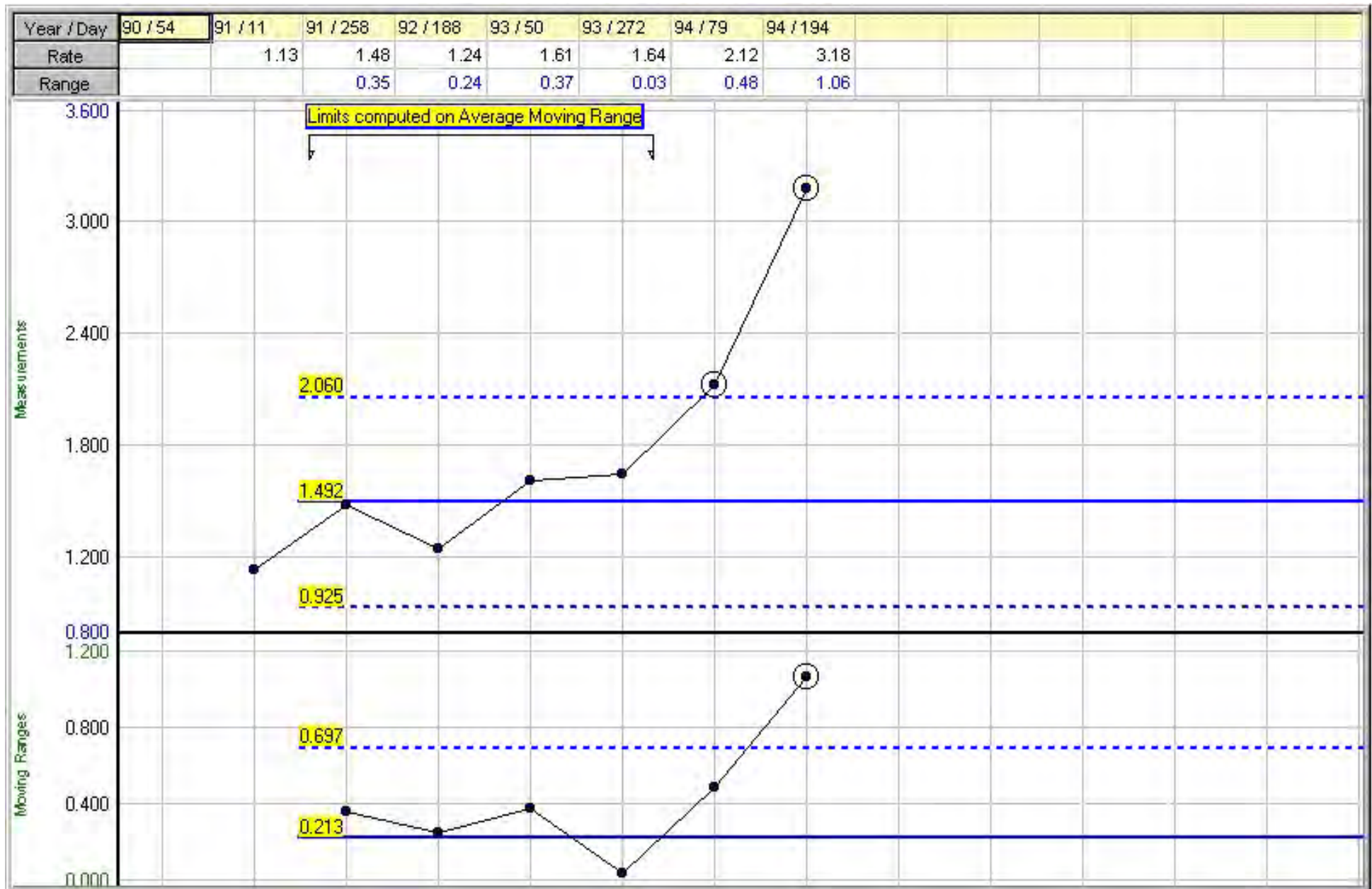
Interval Chart (days between incidents)



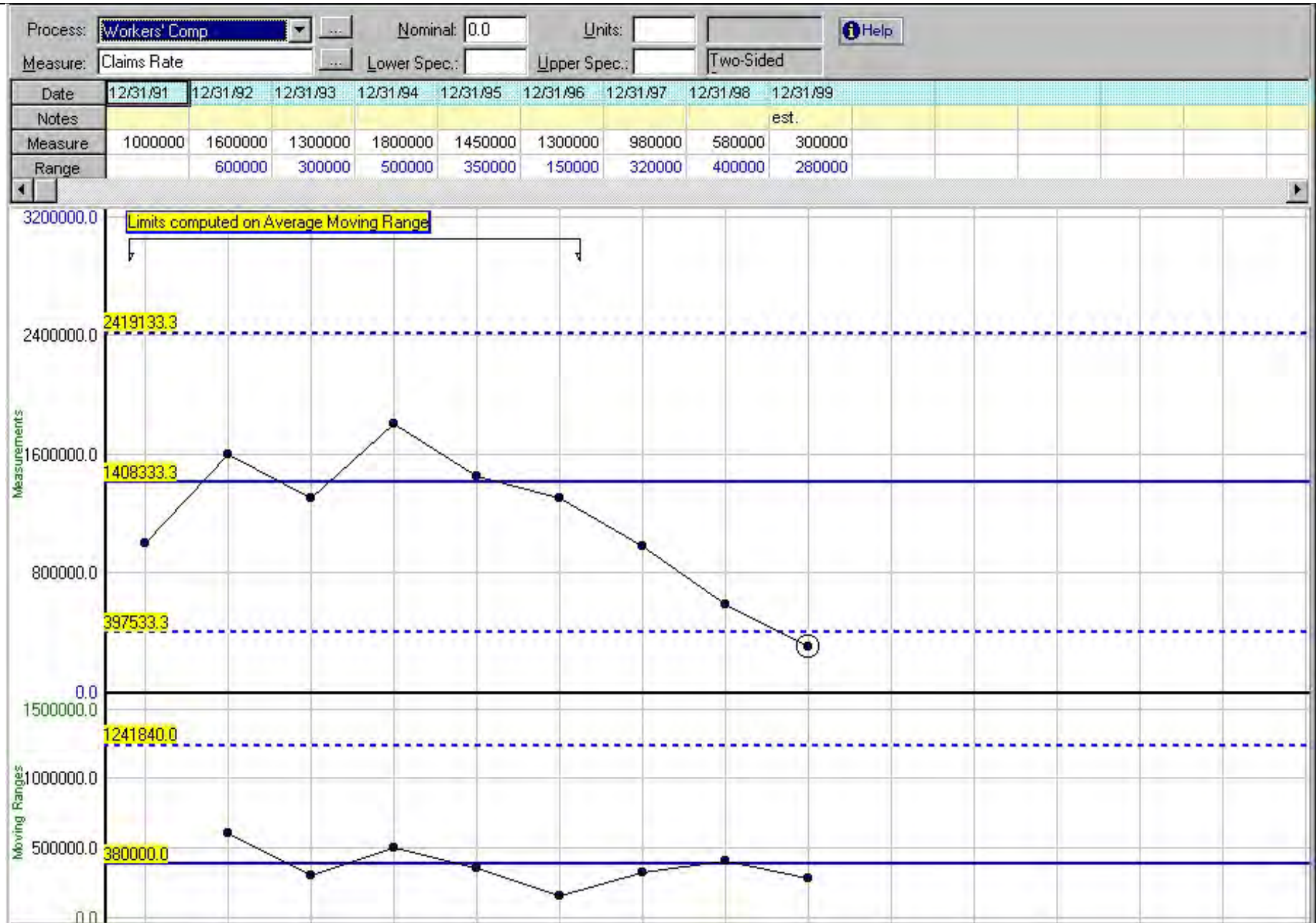
Interval Chart (days between incidents)



Rate Chart (365 X 1/days between incidents)



Workers' Comp Claims Rate (\$ / year)



Workers' Comp Claims Interval (years / \$MM)

