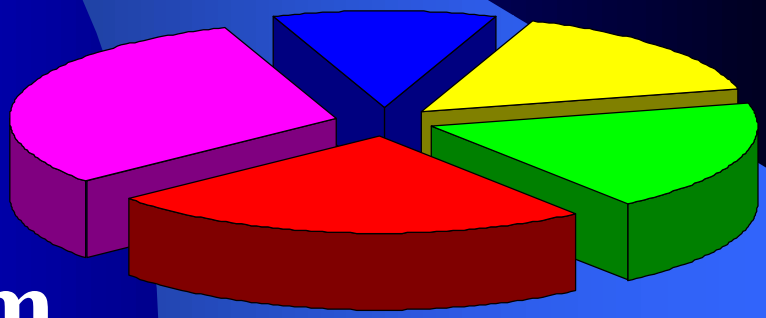
HP World Conference

Graphical Information Systems

Presented By John Lehner, CEO
Kathryn G. Lehner, CFO
PowerGraphs.com



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Graphical Information Systems

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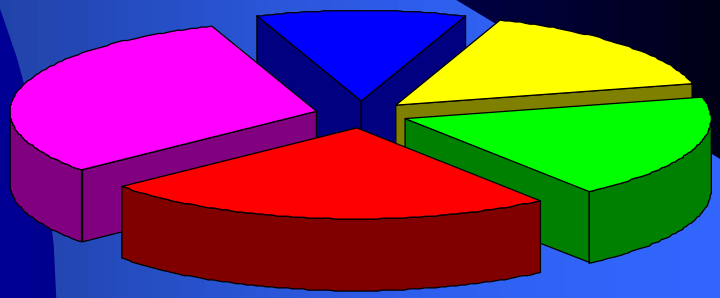

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Graphical Information Systems

Inter-Relationships among events is the most critical aspect of many managerial decisions

managerial analysis.

Information Overload

Demands

Graphical Representation

of these

inter-relationships

managerial analysis.

Graphical Representation

increases

Managerial Productivity

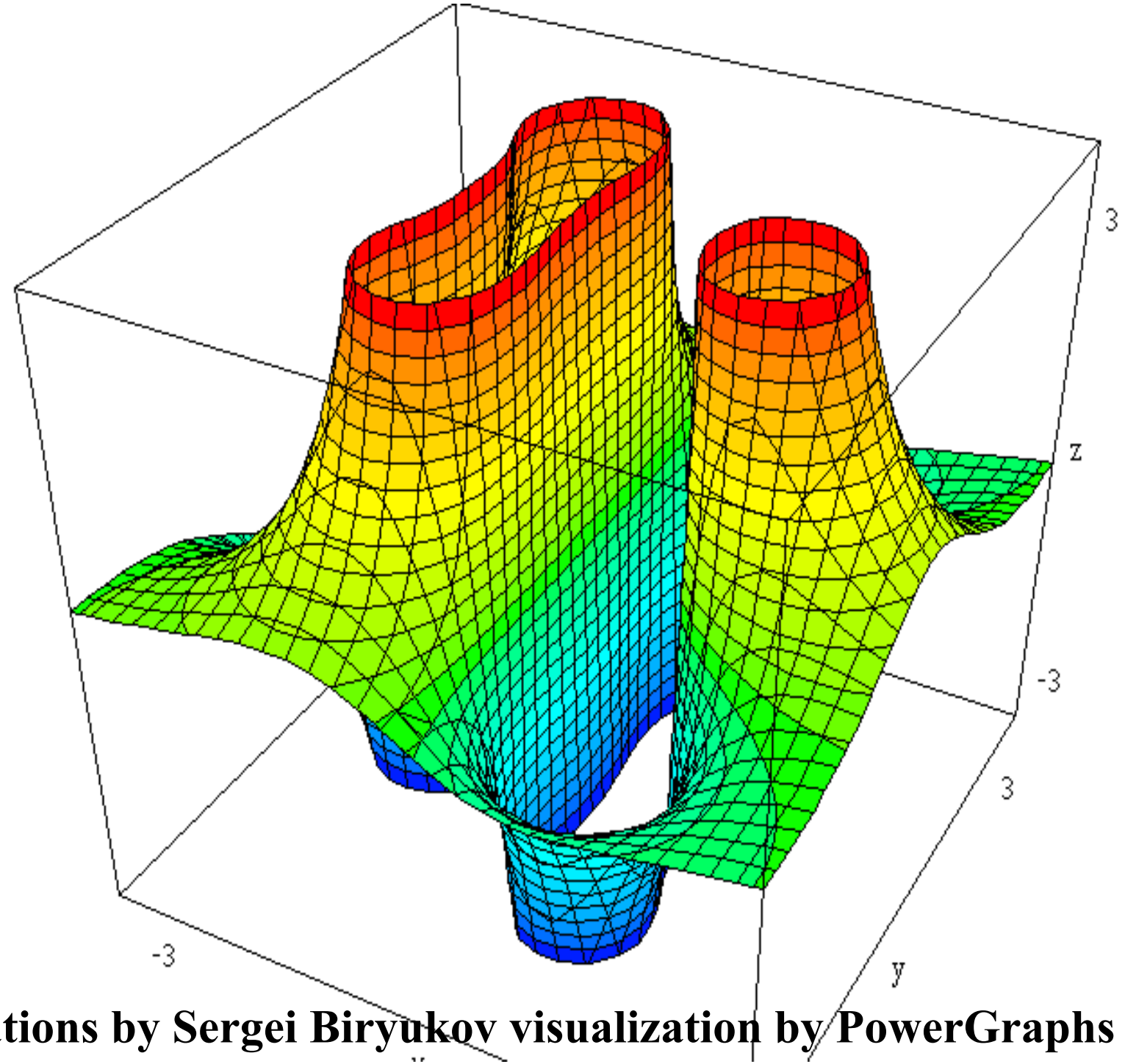
&

Intuition& self confidence

by having

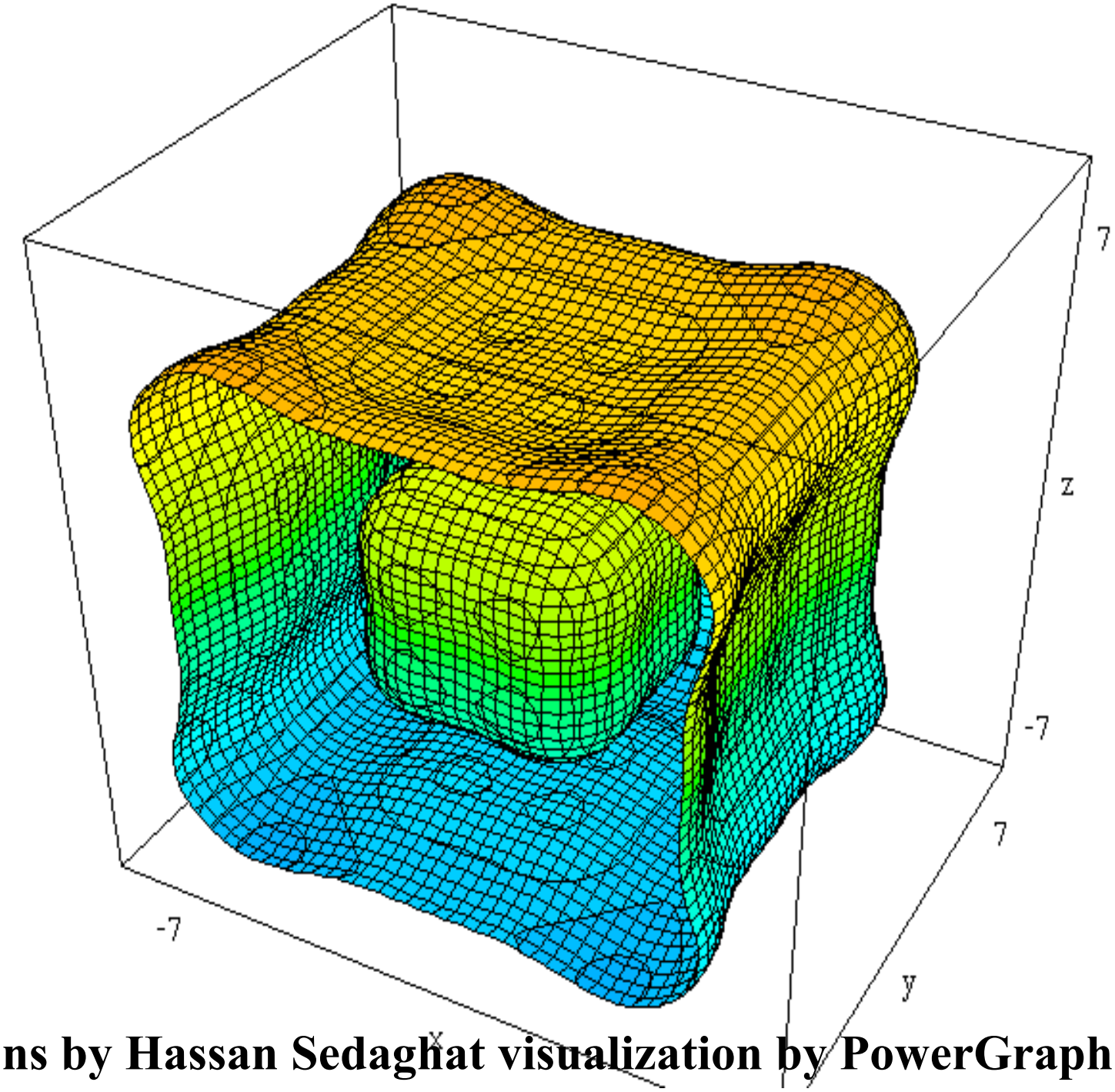
quantitative support

Is Your Data Fluid?



Equations by Sergei Biryukov visualization by PowerGraphs

Easy to Interpret?



Equations by Hassan Sedaghat visualization by PowerGraphs

managerial analysis.

visual comprehension
of
data & events

produces a better &
quicker comprehension

of the reality
of events and their
projections

graphical analysis…

visual comprehension
of
data & events

for the value of
statistical measures

strengthens intuition &
thereby
produces
better decisions

managerial analysis.

visualize
inter-actions &
produce better decisions

DO NOT CONCENTRATE ON THE FORMULAS

develop a managerial
feel (intuition)

will learn.....

1. managerial intuition

- developed for the statistical measures

- visualize with graphs of data & events

will learn.....

2. managerial intuition

why the standard deviation is important & what it looks like graphically

will learn.....

3. managerial intuition

working knowledge of regression analysis useful for projections

Successful Management

Requires Managing
Huge Amounts of
Information

And that requires a new
IT InfraStructure:

Successful Management

Requires a new IT InfraStructure:

an E-InfoStructure with Graphical Information

an E-InfoStructure with Graphical Information

brings in external information which moves in tandem with your data

an E-InfoStructure
with Graphical Information

external information
develops a
reference point
for your responsibilities

as they move in tandem
within the
larger economy

external information
produces relativity

for your department
or firm with
the larger
economy this

increases productivity
thru better decisions

an E-InfoStructure
with Graphical Information

external information
increases

managerial
effectiveness, &
efficiencies,

&

external information
provides
national & foreign
economic/financial
indicators
which serve as a
basis for comprehension
& relativity of
your responsibilities

external information
in graphical form

produce & support
managerial intuition

decisions are quicker
being better informed
produces
self

external

national & foreign

economic/financial

are available

on the web

for your analysis &

application

national economic indicators

Foreign Trade: census.gov/foreign-trade/www/press.html#current

Natl Assn Purchasing Mgrs: napm.org/

Consumer Price Index:
stats.bls.gov/news.release/cpi.toc.htm

GDP: bea.doc.gov/bea/newsrel/gdp101p.htm

Producer Price Index:
stats.bls.gov/news.release/ppi.toc.htm

Employment Cost Index:
stats.bls.gov/news.release/eci.toc.htm

Import/Export Prices:
stats.bls.gov/news.release/ximpim.toc.htm

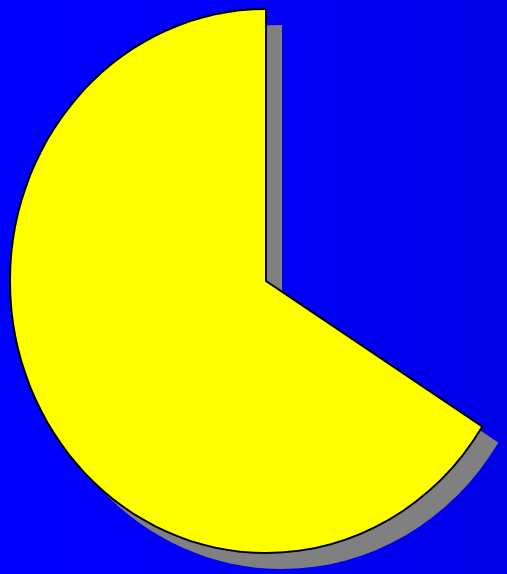
Federal Budget:
stats.bls.gov/news.release/cpi.toc.htm

Graphical Information Systems

Managerial Decisions & Projections

Using Graphed Data Sets

Decisions & Perceptions

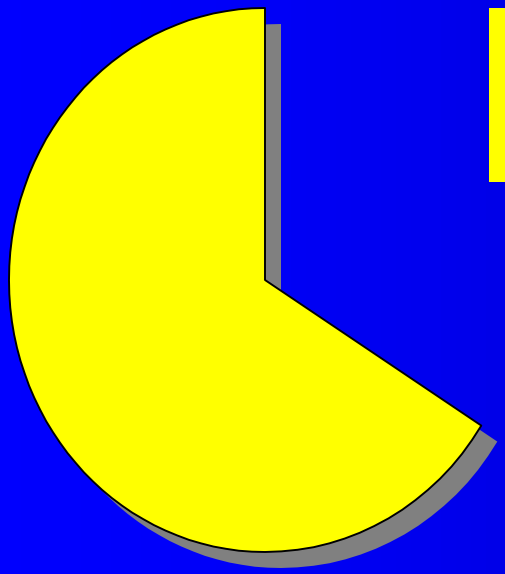


If I see farther than others its by stepping on their glasses

"The Missing Piece"

Decisions & Perceptions

- "The Missing Piece"
- e- Infostructure



Graphical Information

which Supports

Managerial

Decisions & Intuition

Topics

- Graphical Information
- Statistical Relationships
- **Managerial Intuition**

How ?

- Stats
- Graphs
- Managerial Decisions & Confidence

Perceived thru Graphs

Between Data Sets

The Law of……

Equal Ignorance

Stat VS. Math

Any Decision
Described With a
Math Formula

is programmable &
does not
require a
Human Decision

STAT vs. MATH

Decisions Not Described With a Math Formula

Requires a Human Decision

stat was created to deal with these more difficult problems

STAT vs. MATH

stats useful for decision making

graphical visualization:

- **standard deviation**
- **2 or more sets of data**
- **correlation**
- **projections**

Standard Deviation

1. indicates spread within the data

2. how diverse or spread out is the data?

3. this is a range or dispersion

data not spread out is more reliable and useful for decision making and projections

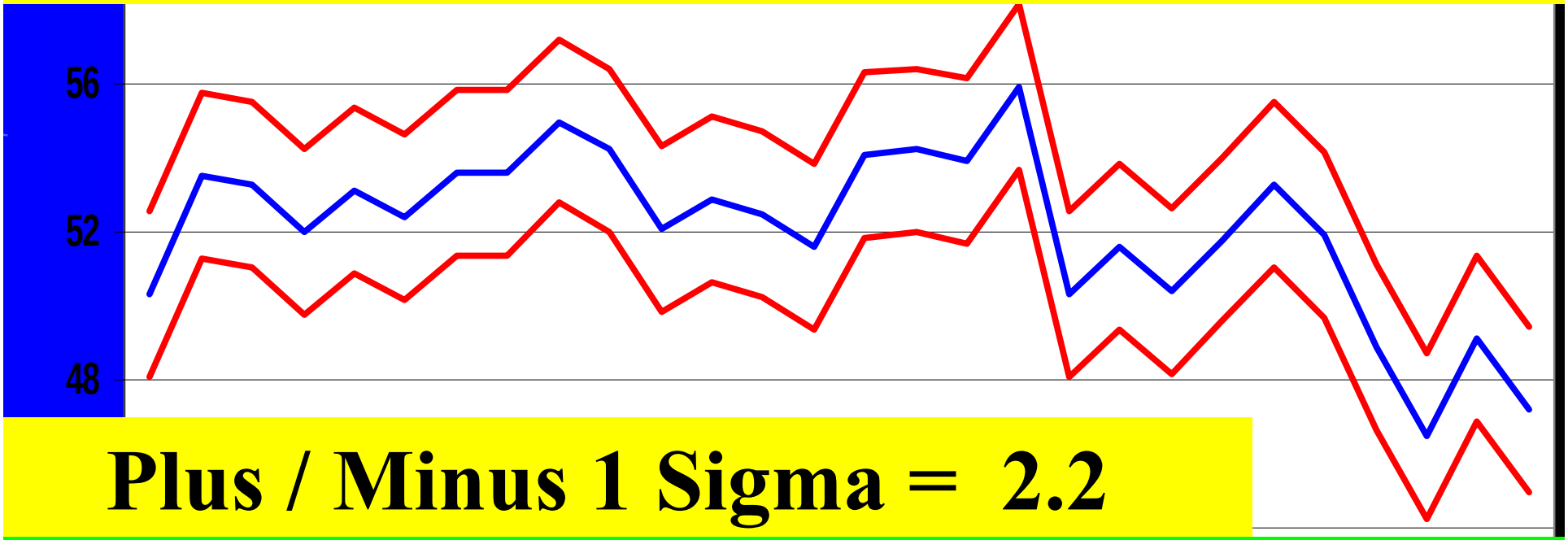
Standard Deviation

std deviation also called sigma

std deviation usually
presented as plus and minus
which is the distance away
(in both a plus and minus direction)
± from the data

Plus / Minus 1 Std Deviation or Sigma

Std Deviation = Red Lines

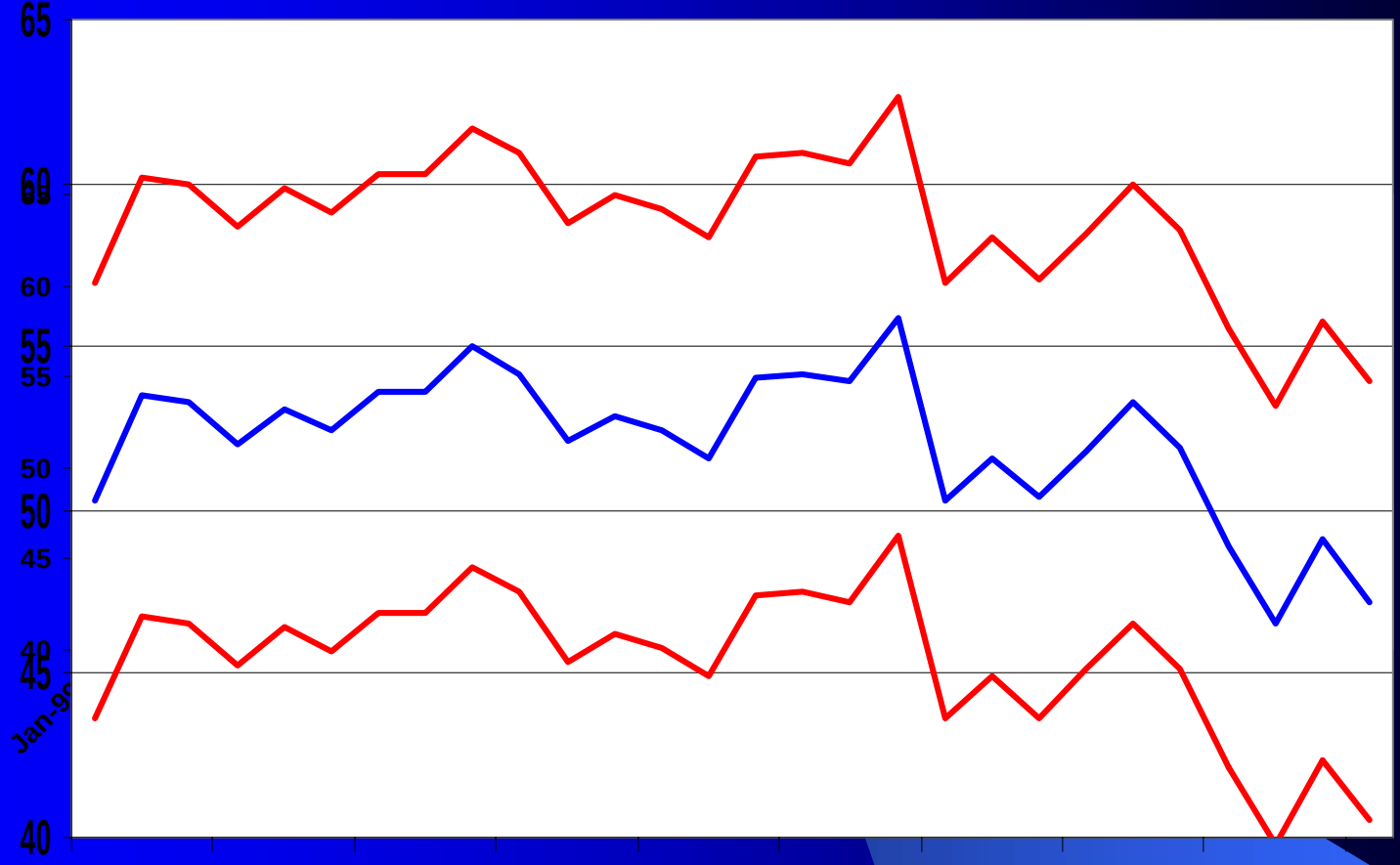


Plus / Minus 1 Sigma = 2.2

Graphic Visualization provides more meaning than the figure of 2.2 (your data is the blue line)

Stats Information.....

Std Deviation = Red Lines



Plus / Minus 3 Sigma = 6.6

Stats Information….

Standard Deviations

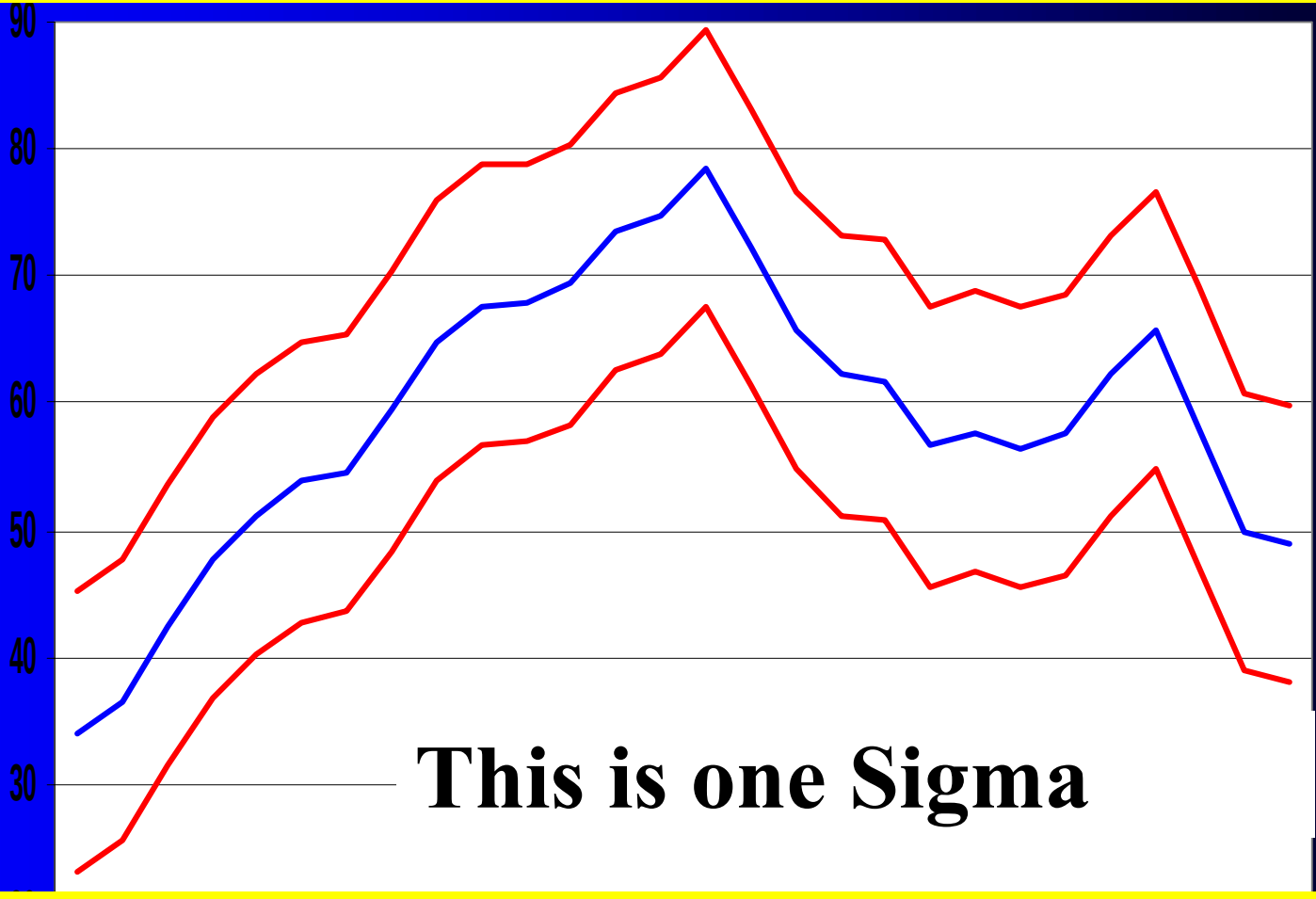
Plus / Minus 3 Sigma = 6 Sigma

….. the standard tool in mfg.

generally 6 sigma is to much variation for Managerial Decision Making

Stats Information.....

Std Deviation = Red Lines



Plus / Minus 1 Sigma = 11

Plus / Minus 3 Sigma = 33/side

STAT vs. MATH

stats useful for decision making

graphical visualization:

- **3 sets of data**
- **correlation**
- **projections (regression)**

Practical Stats

statistics was created to deal with daily problems which can not be explained or defined with a math formula

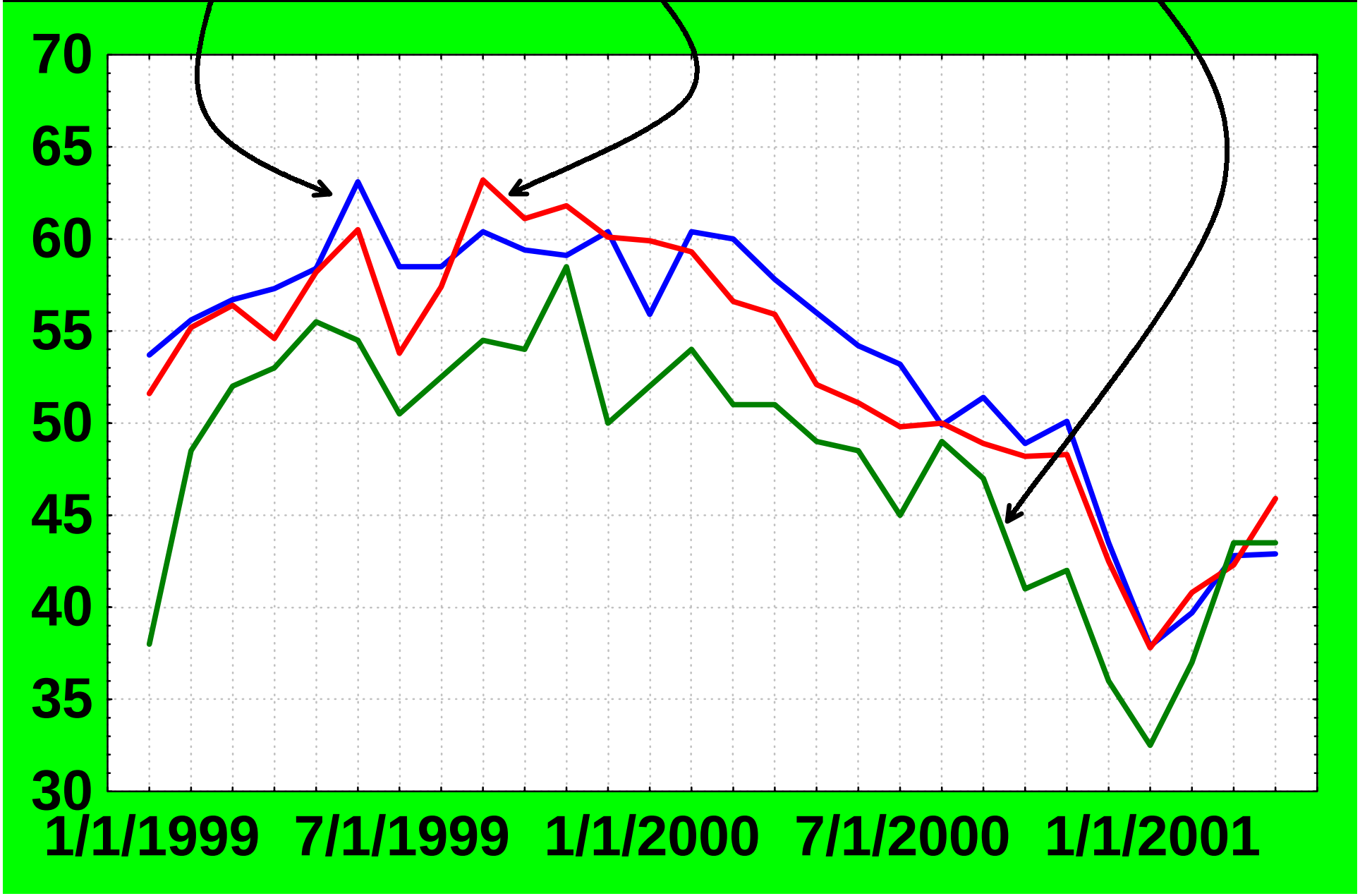
stats involve a lot of ranges & estimates & %'s

Practical Stats:No Formulas

the objective is make
stats managerially useful
by developing &
strengthening your intuition

stats involve a lot of estimates &
is useful for decision making &
supporting intuition

Production, New Order, Back Log



HIGH CORRELATIONS

	PROD	NEWO	BACK
PROD	1.00		
NEWO	0.96	1.00	
BACK	0.92	0.93	1.00

CORRELATIONS

- Data Sets that move together Up or Down
- Example:

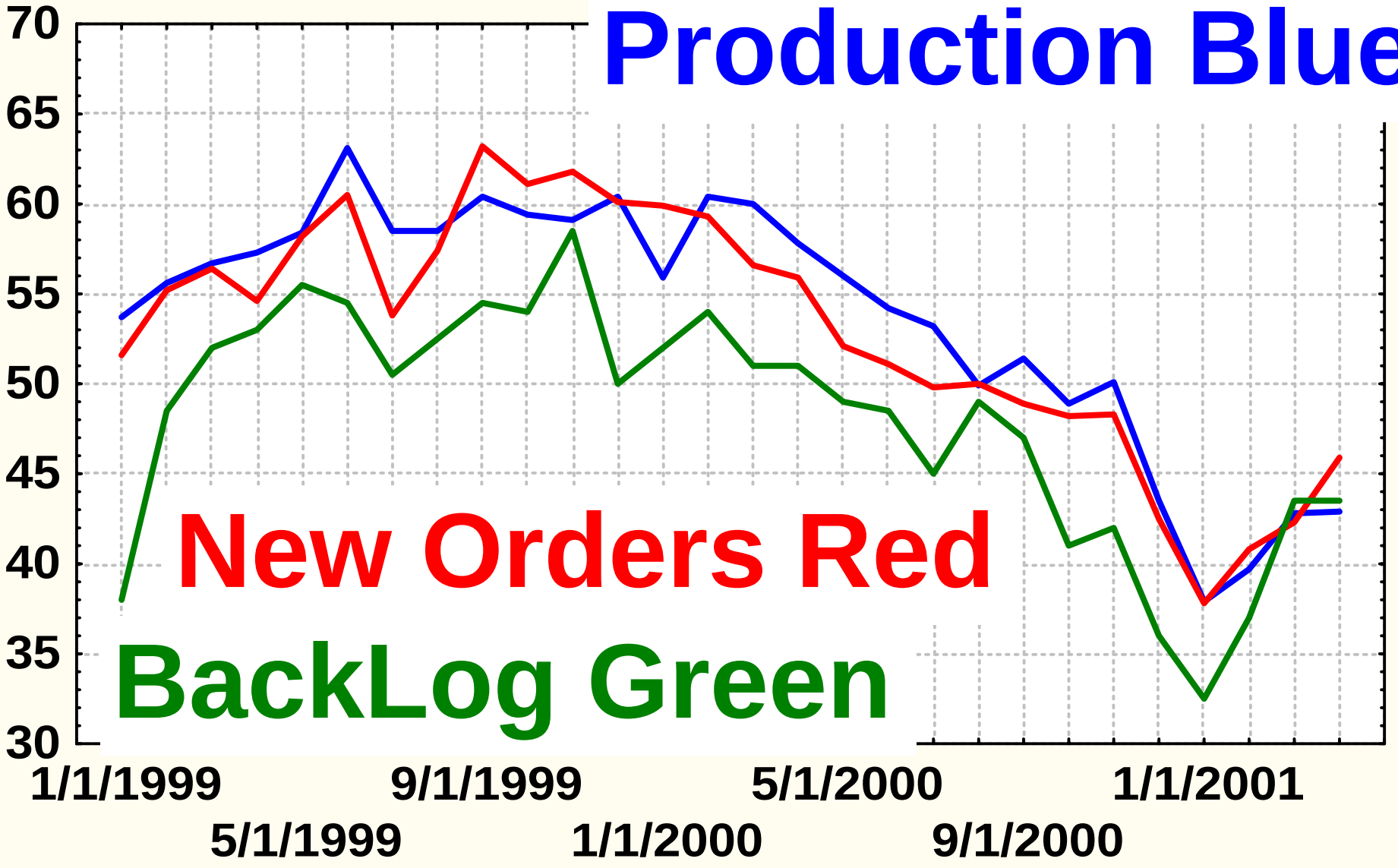
As one data set increases another can increase or decrease in tandem this is a co-movement

CORRELATIONS

moving in tandem
does not imply
cause & effect

correlation simply means
the data moves at the same time
cause & effect
is the result of research

HIGHLY CORRELATED DATA



CORRELATIONS

	PRODN	NEWORD	BKLOG
PRODN	1.00		
NEWORD	.96	1.00	
BKLOG	.92	.94	1.00

Projection / Prediction

the PRODUCTION BLUE line

is your data……..

the other data;

BACKLOG & NEWORDER

is EXTERNAL DATA

(from the web) & is

useful for decision making

Projection / Prediction

Given the High Correlations

Either

BACKLOG or NEWORDER

is a good Predictor of

your PRODUCTION BLUE

line using a

regression projection

The Regression Formula

Simple Regression Formula

$$Y = a + bx$$

Multiple Regression Formula

$$Y = a + b_1x_1 + b_2x_2$$

Projection / Prediction

projection of your Production data using the external data as a driver (which is the X variable) in Regression Analysis

- **The predicted value of your data is the Y**
- **Simple Regression = one X predictor**
- **Multiple Regression = two X predictor**

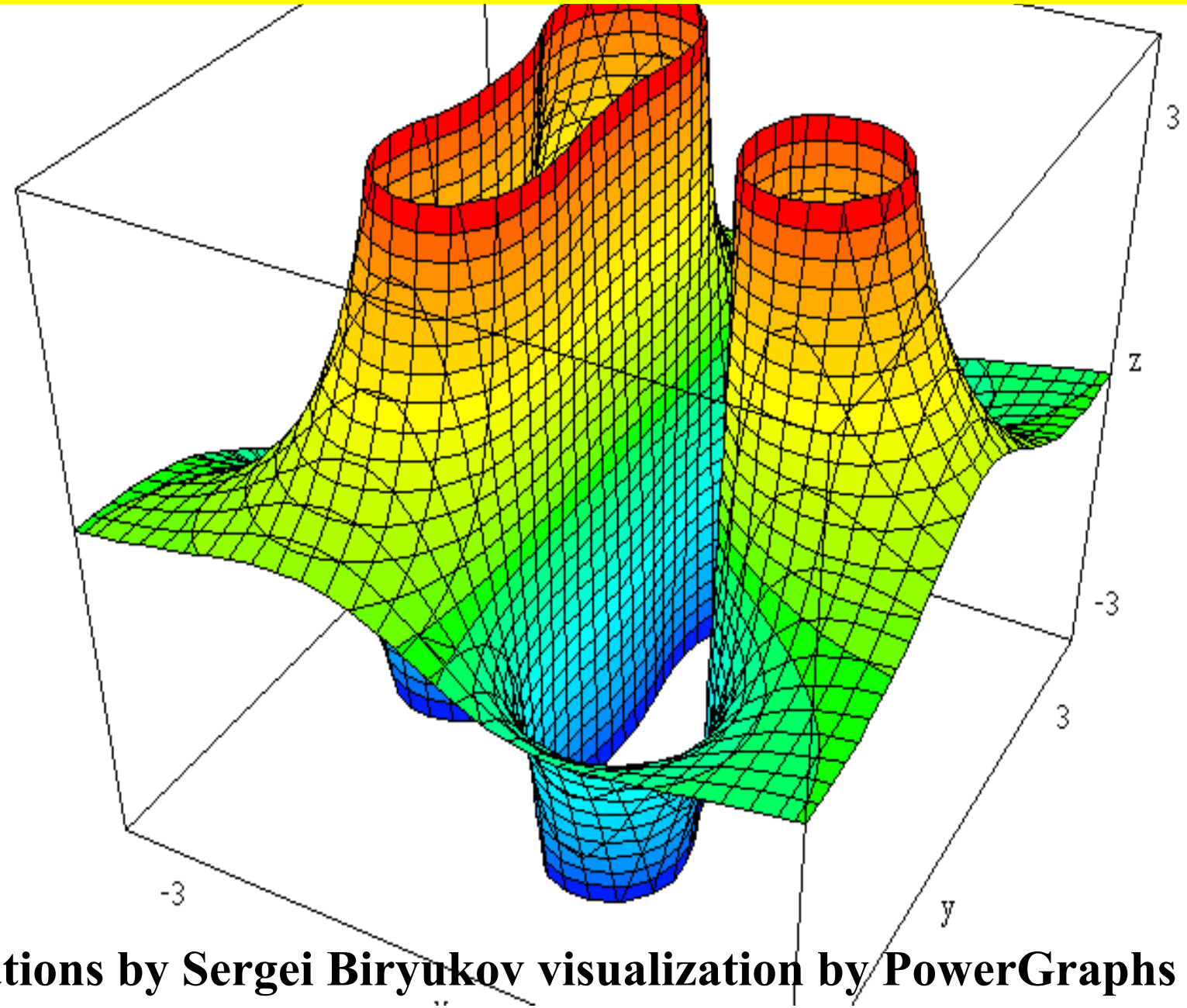
Projection / Prediction

using the external data as a driver (which is the X variable) for the predicted Y variable in Regression Analysis

involves selecting an X:
first, managerial experience & intuition

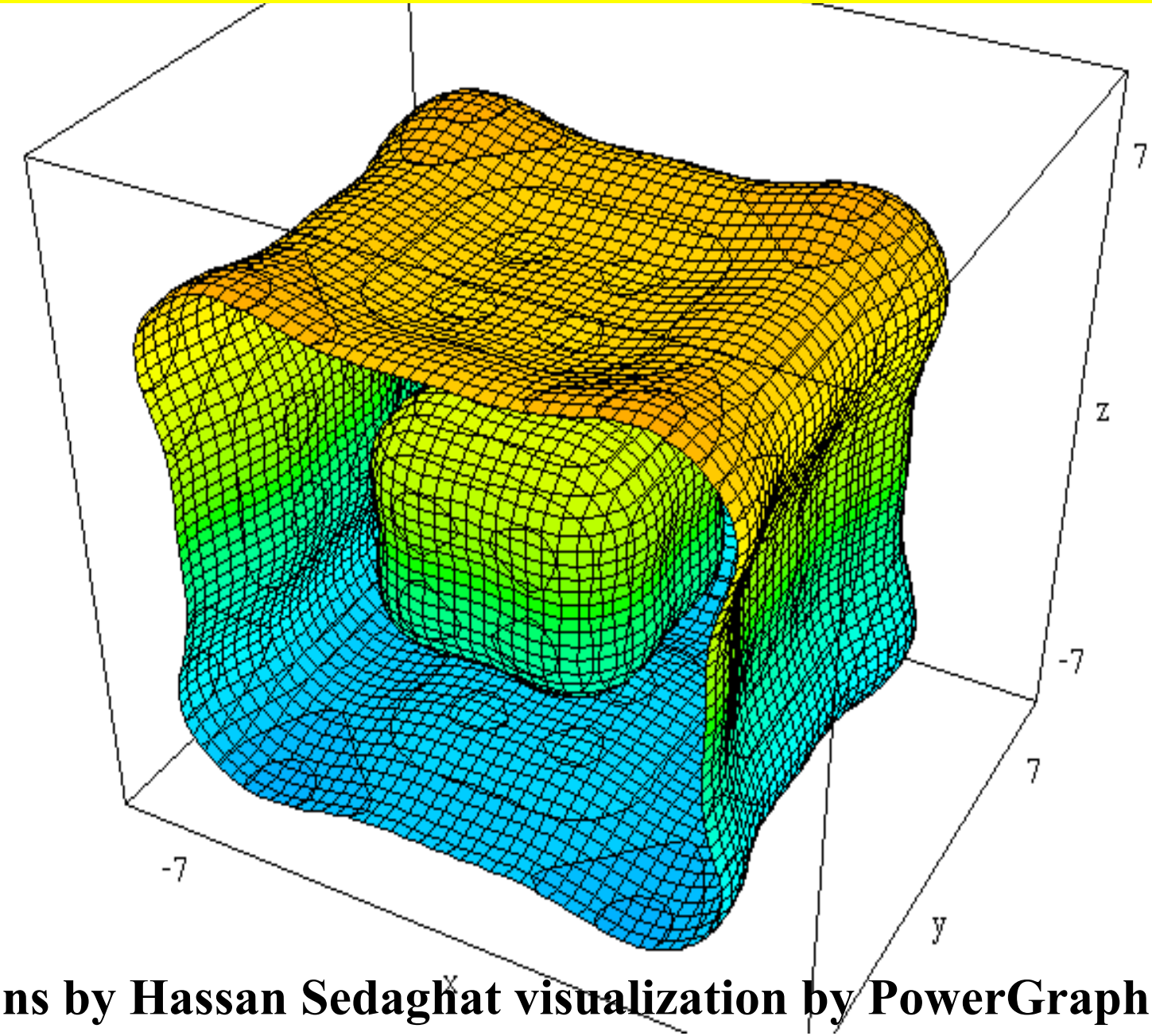
second, the X's & Y's should be correlated (related quantatively)

this data is very unstable but correlated



Equations by Sergei Biryukov visualization by PowerGraphs

is this data highly correlated?



Equations by Hassan Sedaghat visualization by PowerGraphs

Decision Rule: Correlation

- Decision Cut Off Point

No Predictor Variable (X)

Should Be Included In The Regression Formula

Which Has A Higher Correlation With Another X Variable

Than With Dependent Y Variable

Decision Rule: Correlation

- Decision Cut Off Point

No Predictor Variable (X)

Should Be Included In The

Regression Formula

The Best

Which Has A Higher Correlation

With Another X Variable

XXX

Than With Dependent Y Variable

Decision Rule: Correlation

- Restated: - Decision Cut Off Point
  Include Only ‘ X ’ Variables In
  A Projection Formula

- Which Have A Higher Correlation
  With The Y Variable
  Than With Another X Variable

Decision Rule: High Correlation

- If 2 ‘ X ’ Variables Are Very Highly Correlated

Include Only One in the Regression Formula

- **Not Both (when highly correlated)** as No Additional Information is Added…… Only Duplicated

The Law of……

Equal Ignorance

Regression Formulas

Simple Regression:

$Y = a + bx$, or

$Y = \alpha + \beta x$,

α = alpha, β = beta

Multiple Regression:

$Y = a + b_1x_1 + b_2x_2$, or

$Y = \alpha + \beta_1x_1 + \beta_2x_2$

Regression Formula: where

Y = your predicted / projected production value

a or α = the point where x hits the y axis, or the fixed point, or the fixed value in a cost formula

useful for projecting costs

Regression Cost Formula

a cost formula (better for budgeting)
is a simple regression, with one X
variable (the predictor of Y)

$$Y = a + bx$$

where, a = the fixed portion, &
x = the variable portion, &
Y = projected cost

Regression Projection Formula

$$Y = a + bx$$

$$Y = a + b_1x_1 + b_2x_2,$$

- **Y = your predicted PRODUCTION BLUE line**
- **a or α = the point where x hits the y axis, or the fixed value in a cost formula**

Regression Formula: where

$$Y = a + bx$$

$$Y = a + b_1x_1 + b_2x_2,$$

---

b, or b_1 or b_2 =

the coefficient or weight

x or x_1 or x_2 =

the predictor x value

for your Production Y value

Cost Formula

a cost formula
is a simple regression formula
to identify the fixed & variable
parts of a cost:

where:

a or α = fixed portion of a cost, &
x = the predictor (driver) variable
& b = the variable portion

Regression Cost Formula

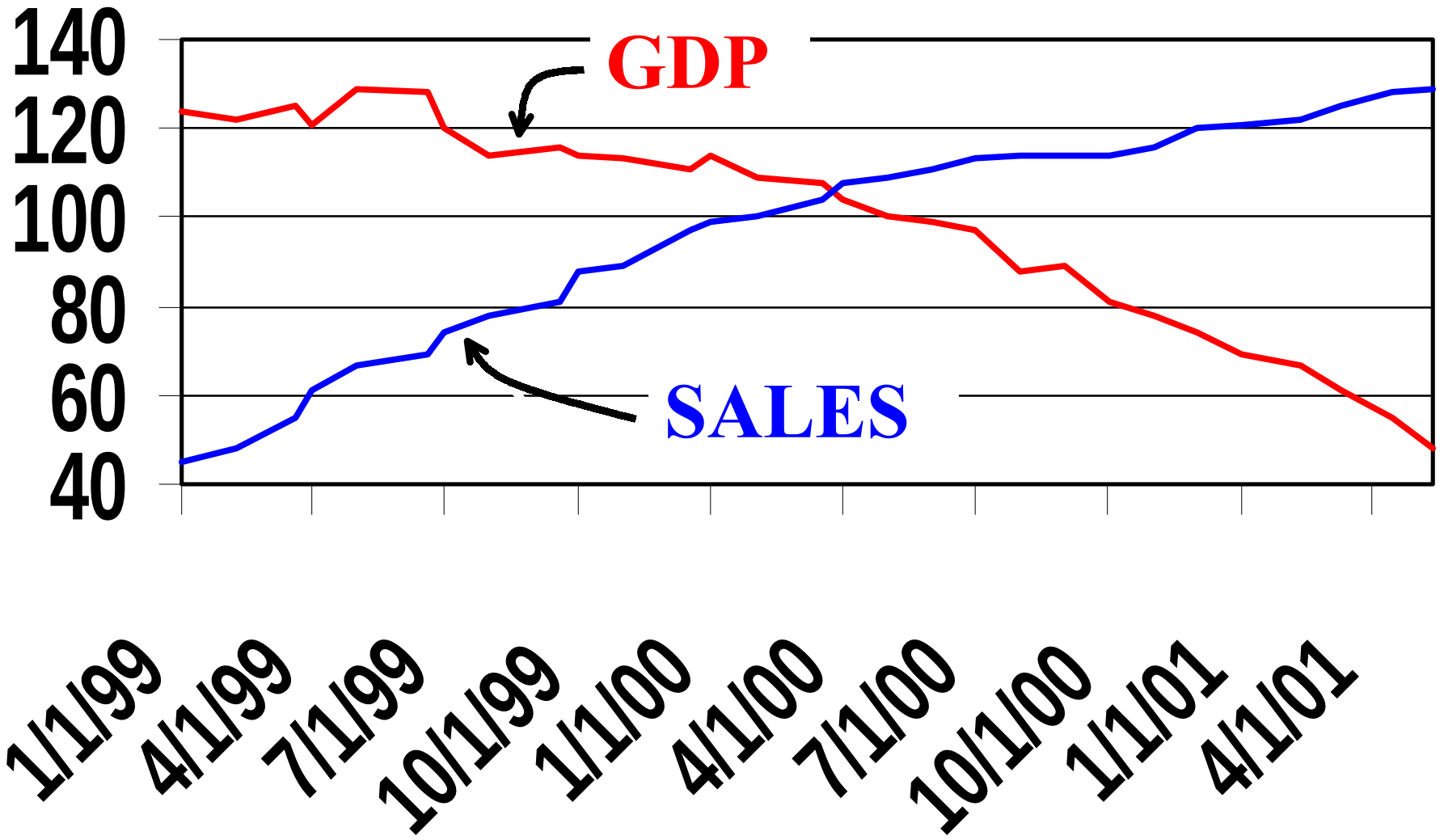
- a cost formula (better for budgeting) is a simple regression, with one X variable (the predictor of Y)

a cost formula identifies the fixed & variable parts of a cost

restated: it defines cost behavior & is useful also for revenues

$$Y = a + bx$$

Negative High Correlation



Highly Correlated Data

	GDP	SALES
GDP	1.00	
SALES	-.87	1.00

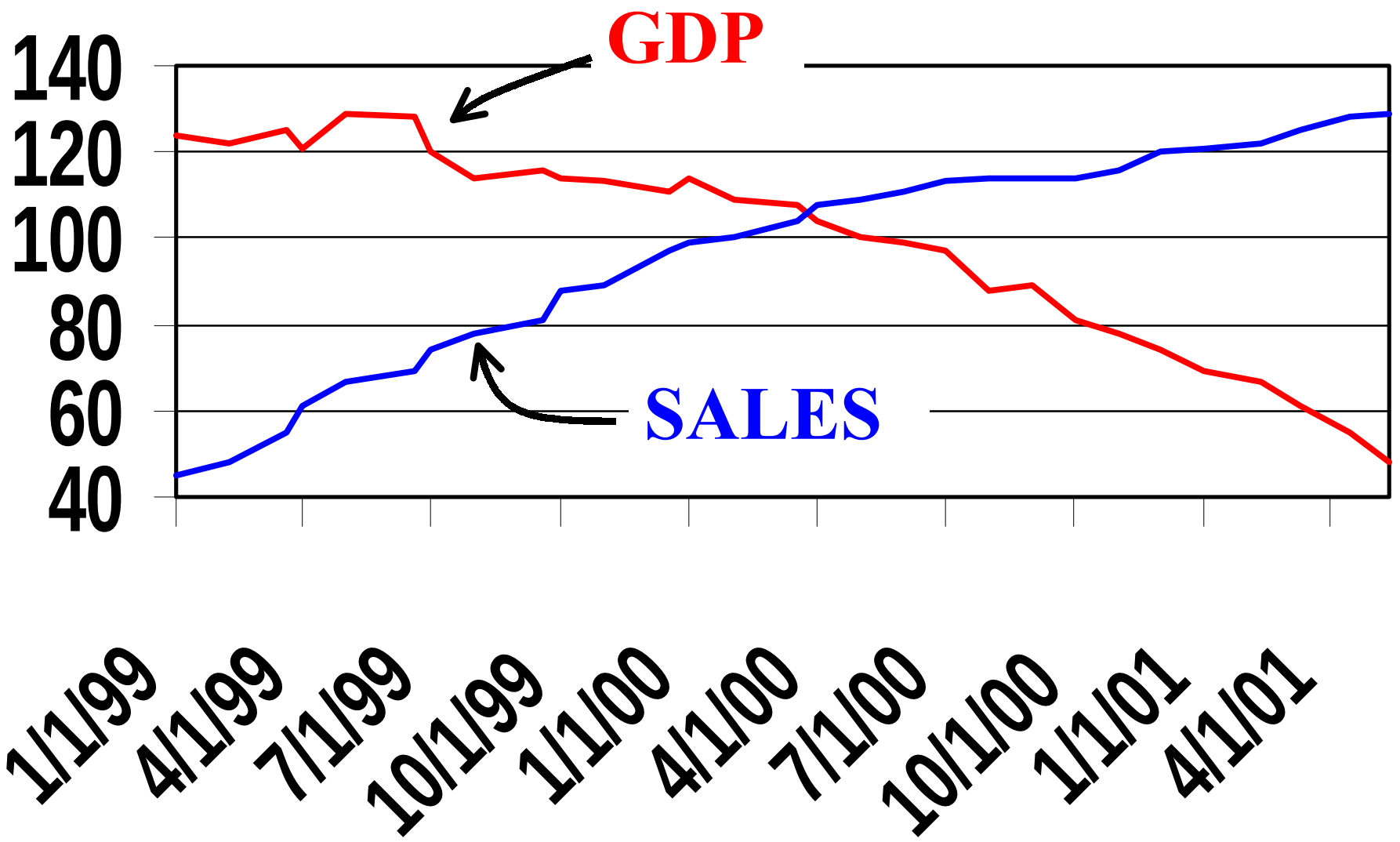
Negative Correlation

Correlation is the key
for choosing the X variables
as predictors of Y

Correlation can be either
Positive or Negative

Select any high correlation.

Negative High Correlation



Projection / Prediction

Sales Blue line is your data…

the other data……. GDP

is EXTERNAL DATA from the web

Given the High Correlation

-.87 GDP

is a good Predictor of

your Sales Blue line

Projection / Prediction

Given the High Correlation

-.87 GDP

is a good Predictor of your Sales Blue line

the negative simply indicates these 2 data sets move in opposite directions

Projection / Prediction

Projection of your data
use the external data GDP as a driver

this is the X variable in
Regression Analysis to predict Sales

the predicted value of your
sales data is the Y values

Simple Regression =
has one X predictor

Predict Sales Using GDP

Simple Regression

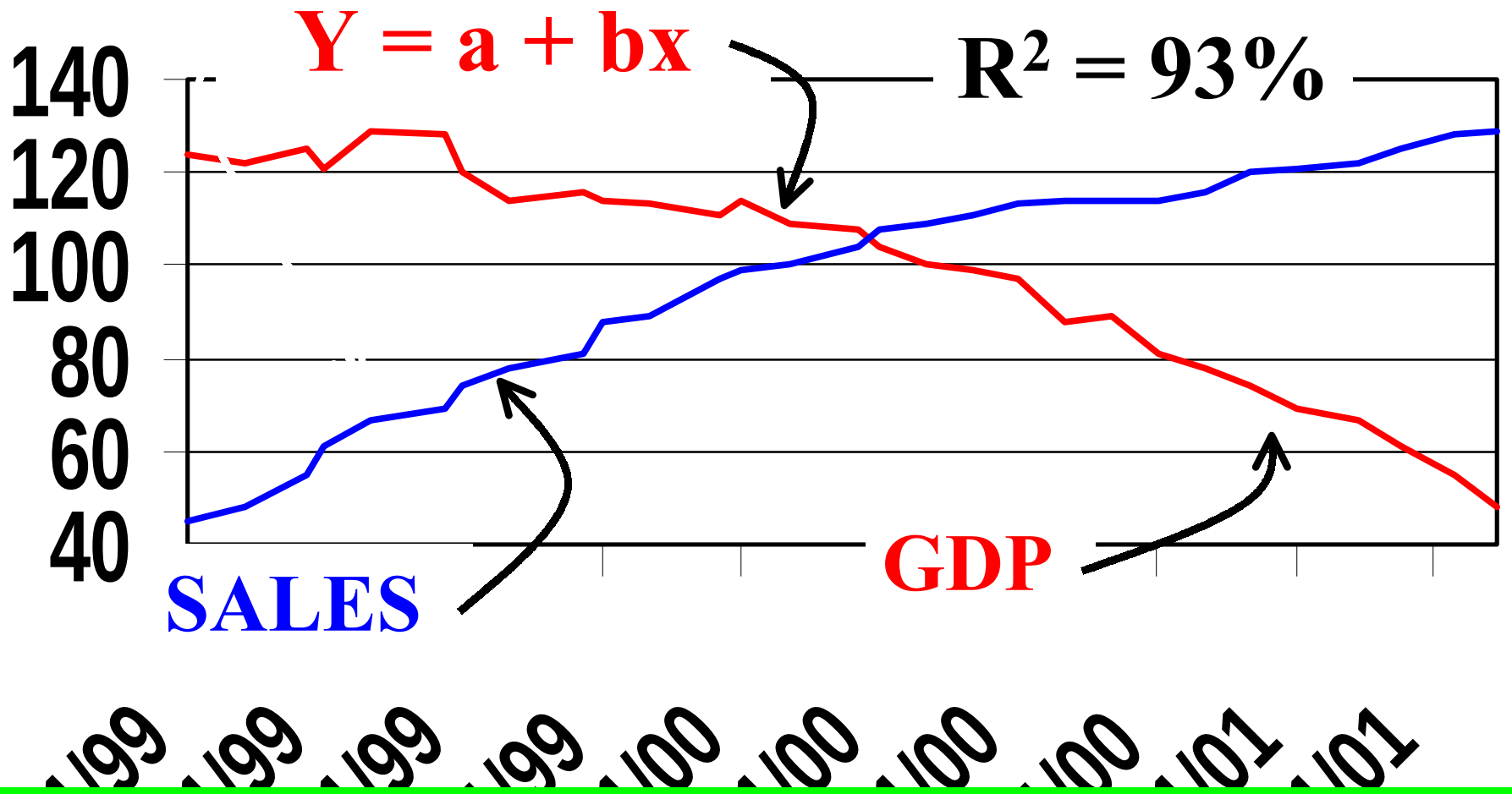
$$Y = a + bx$$

Sales — **GDP (external data)**

The more simple the equation the better for Decision Making

generally, do not use more than 3 X's

Negative High Correlation



Predict Sales Using GDP

High Correlation

One additional Decision Rule:

Use only X variables that are
Managerial Intuitive

If 2 X variables
are highly correlated but
are not Managerial Intuitive as
to their inter-relationship do not
use them

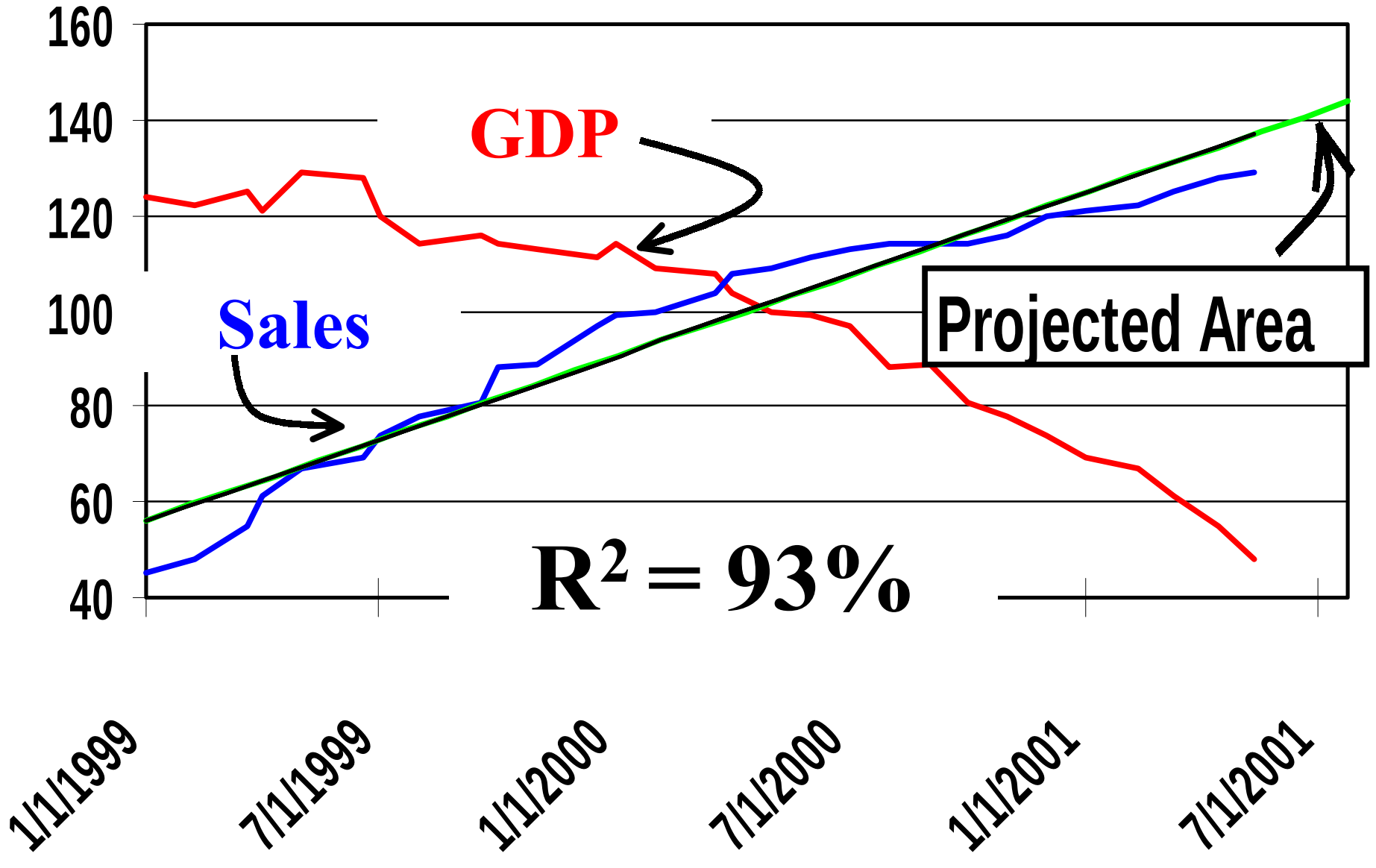
High Correlation

Over time as the " environment "

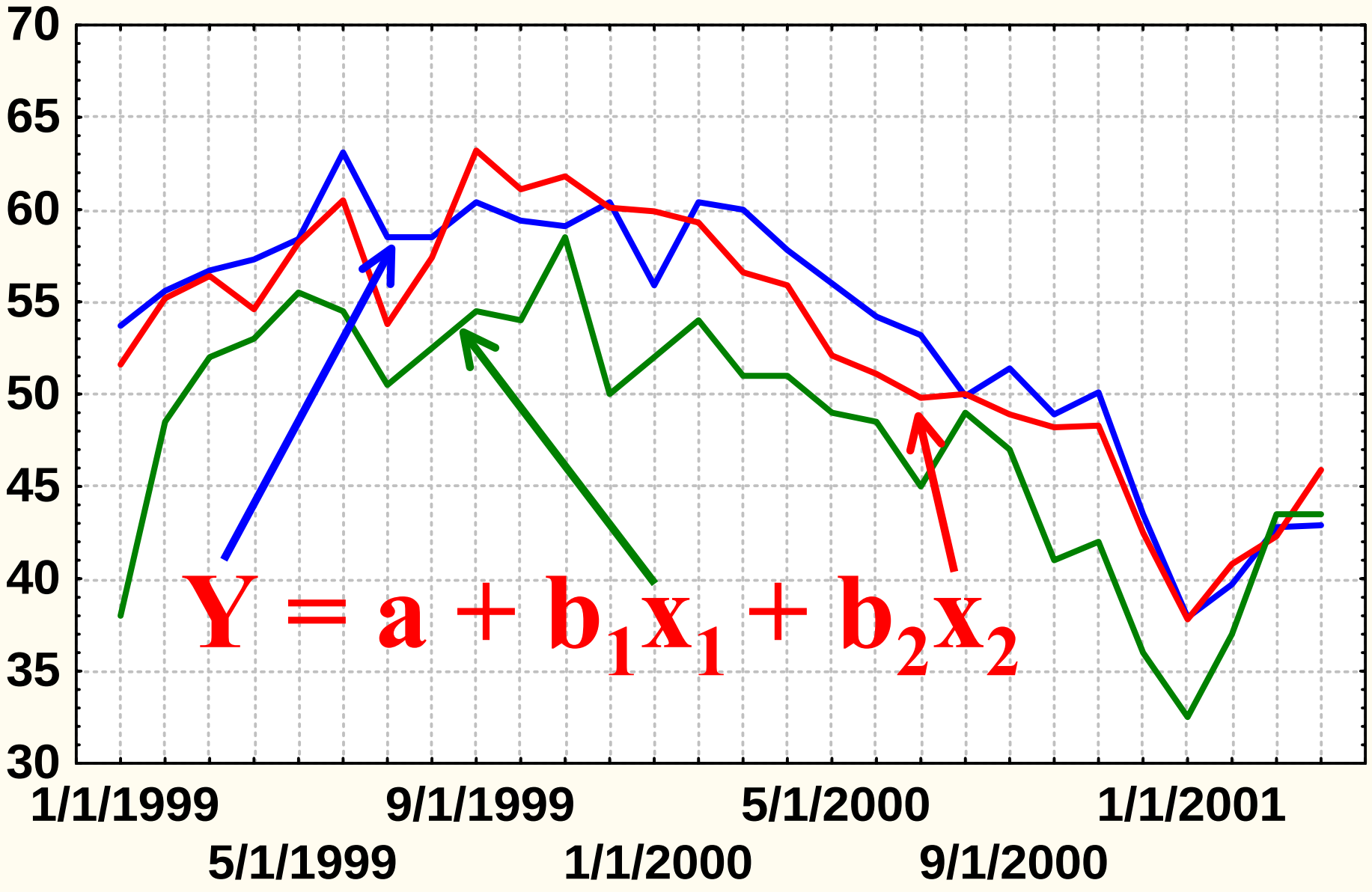
in which these highly correlated
X and Y variables changes,
the correlations
will change
and thereby become
unrelated and unreliable

they must be Managerially Intuitive

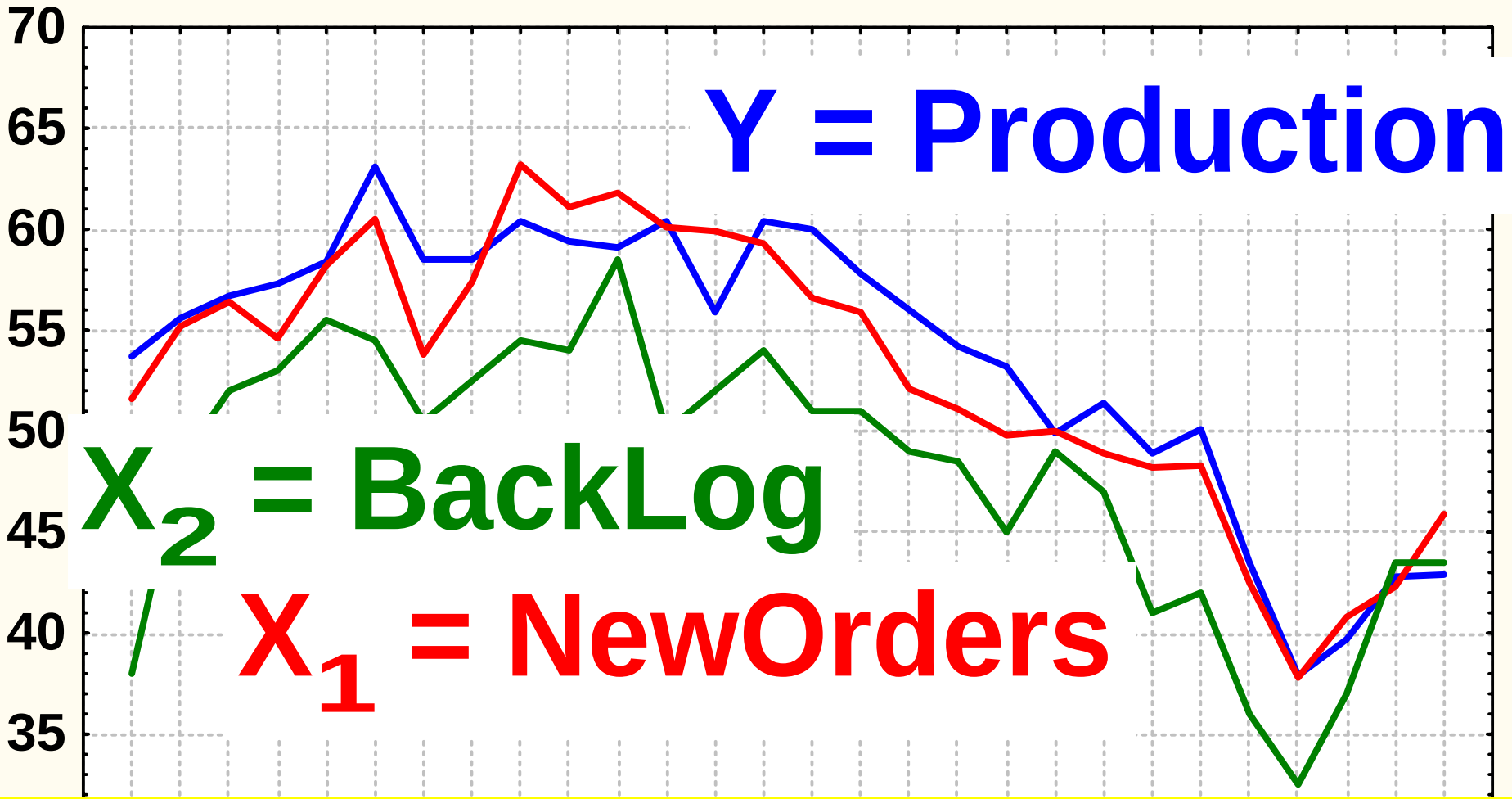
simple regression projection



Multiple Regression

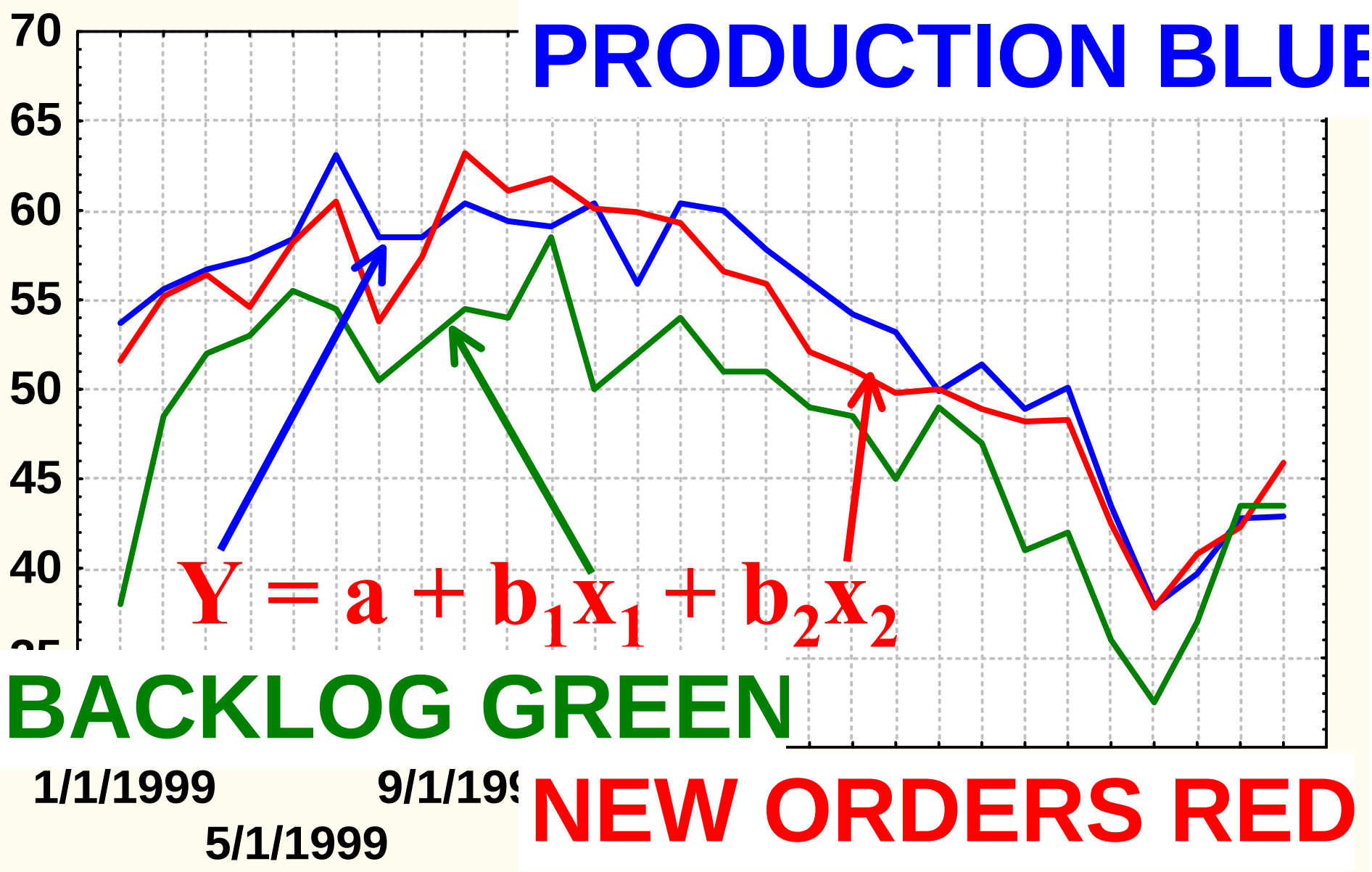


Multiple Regression



$$Y = a + b_1 x_1 + b_2 x_2$$

Regression Projection Graph



HIGHLY CORRELATED DATA

using the highly correlated data in this example the projection of the future production involved this equation:

$$Y = a + b_1x_1 + b_2x_2$$

the method involved the following:

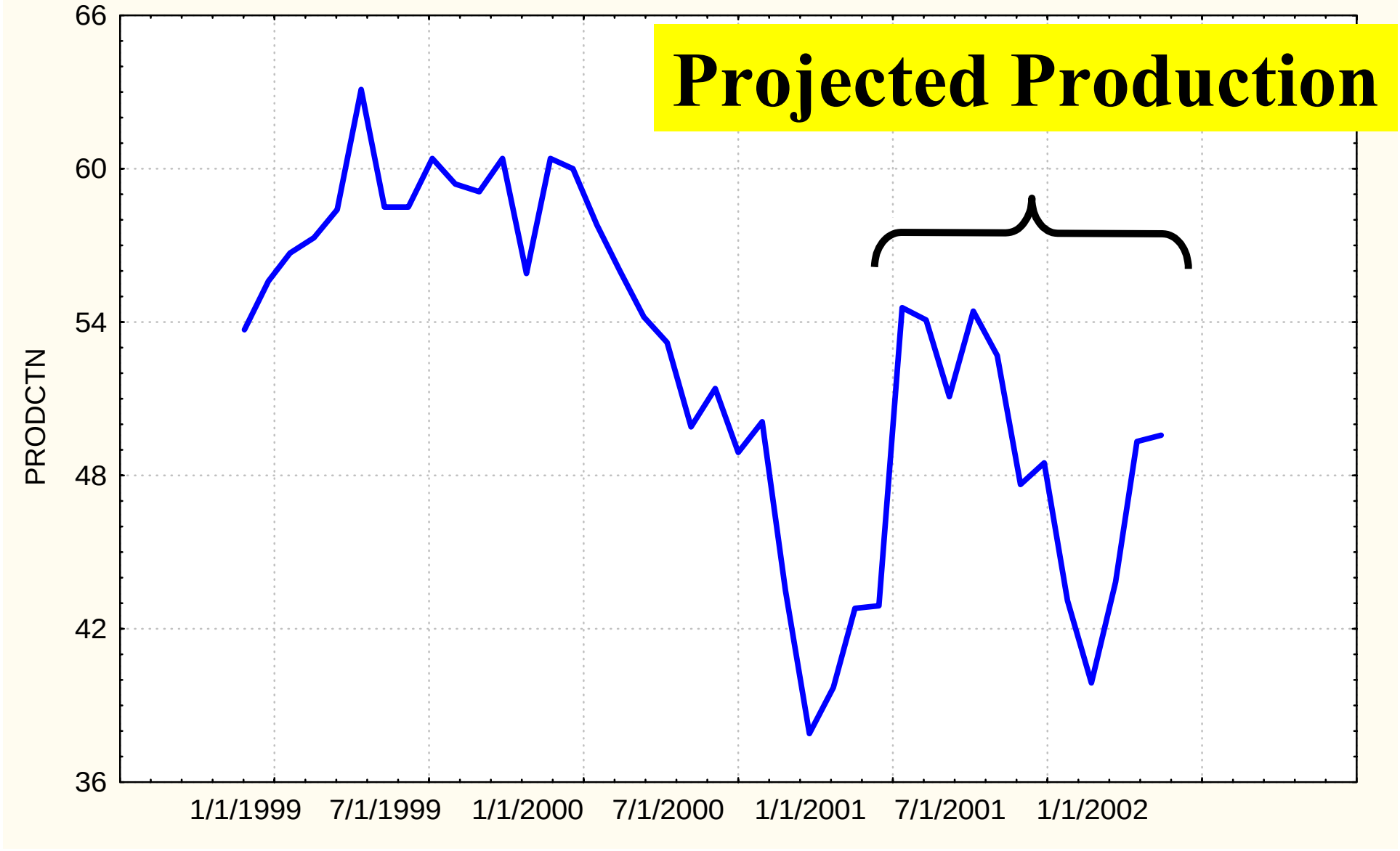
Projected Production – (assumptions)

Production is a function of regressing each independent variable on the other as they had high correlations

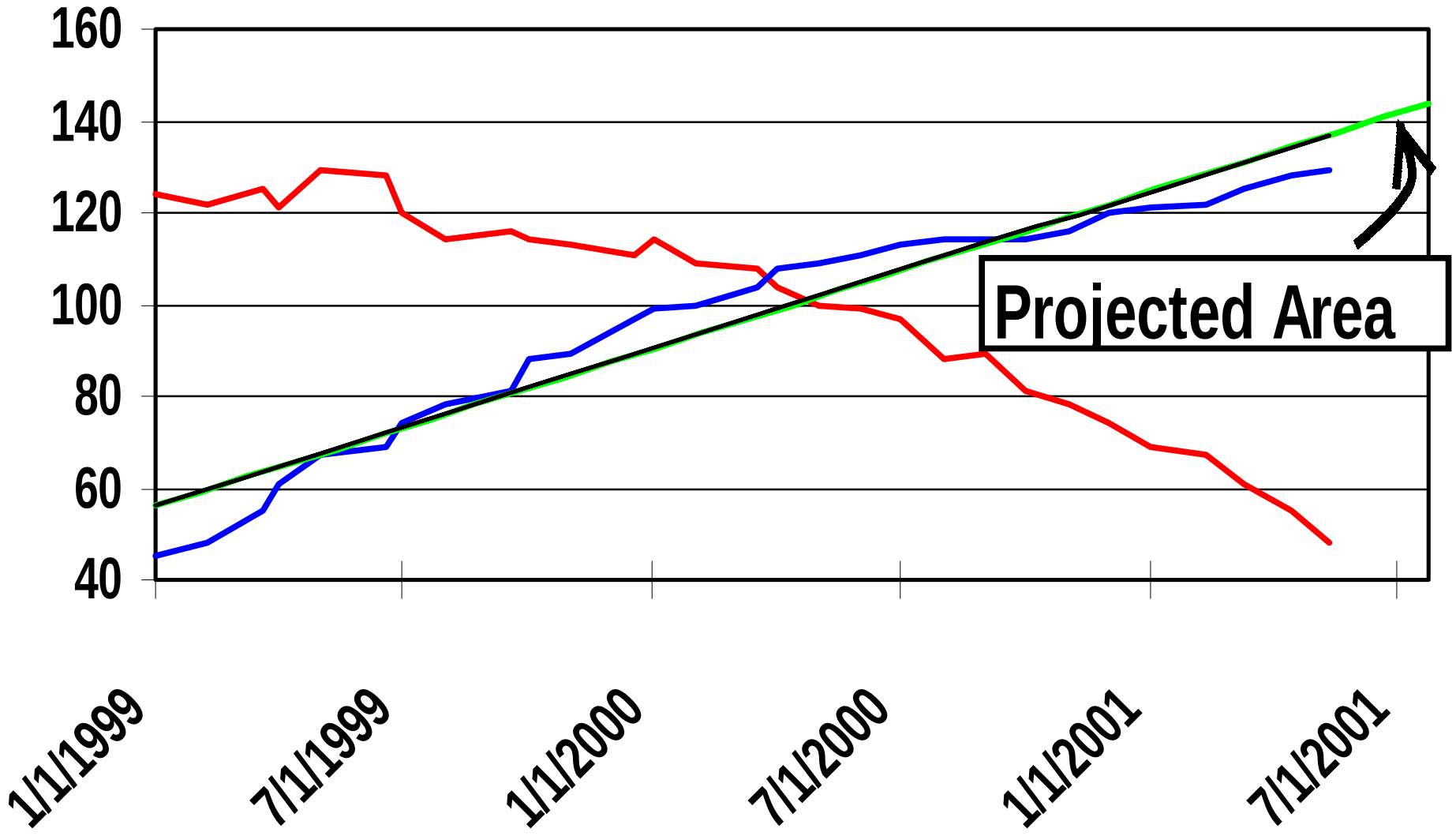
Secondly, the projected X values were shifted forward 12 months

… the dependent Y (production) was then projected in the graph

Production Projection Graph



simple regression projection



measures of the quality of the regression formula

sometimes referred to as the

‘ goodness of fit ’

1. the R^2 : measures how well the X predicts the Y
2. the standard error of the estimate
3. the standard error
4. residuals

standard error of the estimate Y

standard error of the estimate of Y (the predicted value)

the difference between the actual Y values and the predicted Y values on the regression line

this difference is sometimes called the ‘ prediction error ’

standard error of the estimate

measures the quality of the regression equation in predicting Y

this measure is also called the ‘ standard deviation of Y ’

when the standard error of Y is large (relative to the regressed Y) the X is of little value in predicting Y

standard error (deviation) of the estimate of Y

a large std error of the estimate indicates the values are not stable nor consistent therefore any projections made using this X to predict this Y are not useful

how is a ‘ small ’ standard error of the estimate determined:

1. **the size of the standard error as a percent of the mean of the actual Y values**

$$\frac{\text{std error}}{\text{mean of Y}} = \%$$

how is a ‘ small ’ standard error of the estimate determined:

Note: if this % is to high to be managerially useful (based on your intuition) then the std error of the estimate is considered to large

$$\frac{\text{std error}}{\text{mean of Y}} = \%$$

how is a ‘ small ’ standard error of the estimate determined:

- **calculate the range of the Y or the range of a projection of Y using the standard error of the estimate (ie. its ± value)**

range ＝ mean of Y ± std error

standard error of the estimate

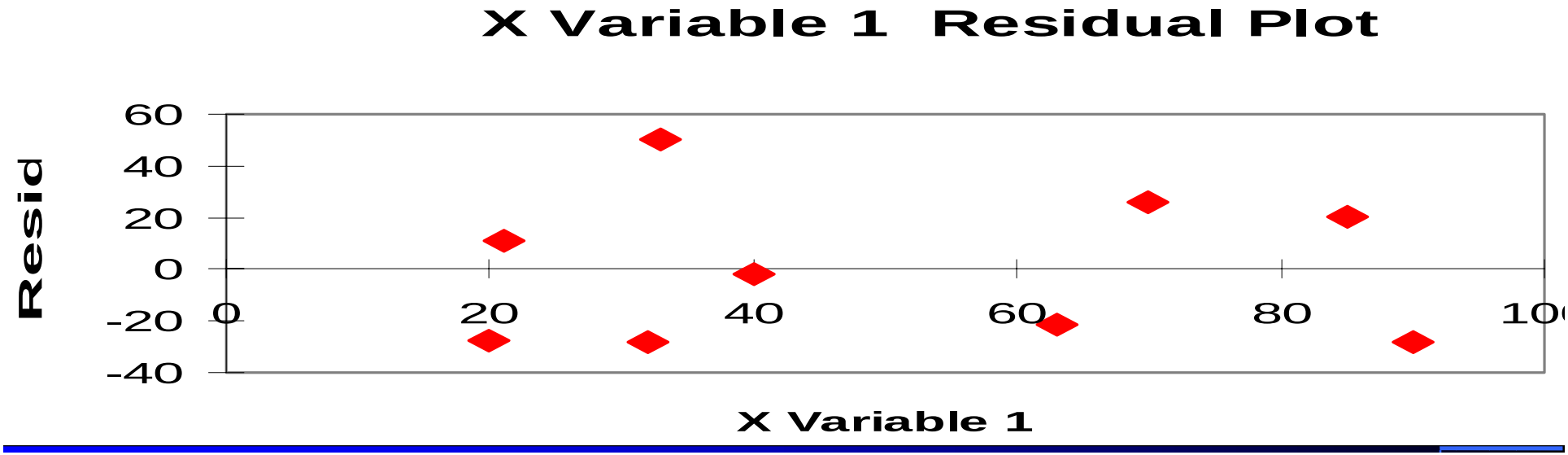
Note: if this range of Y is to wide to be managerially useful (based on your intuition) then the std error of the estimate is considered to large

range =

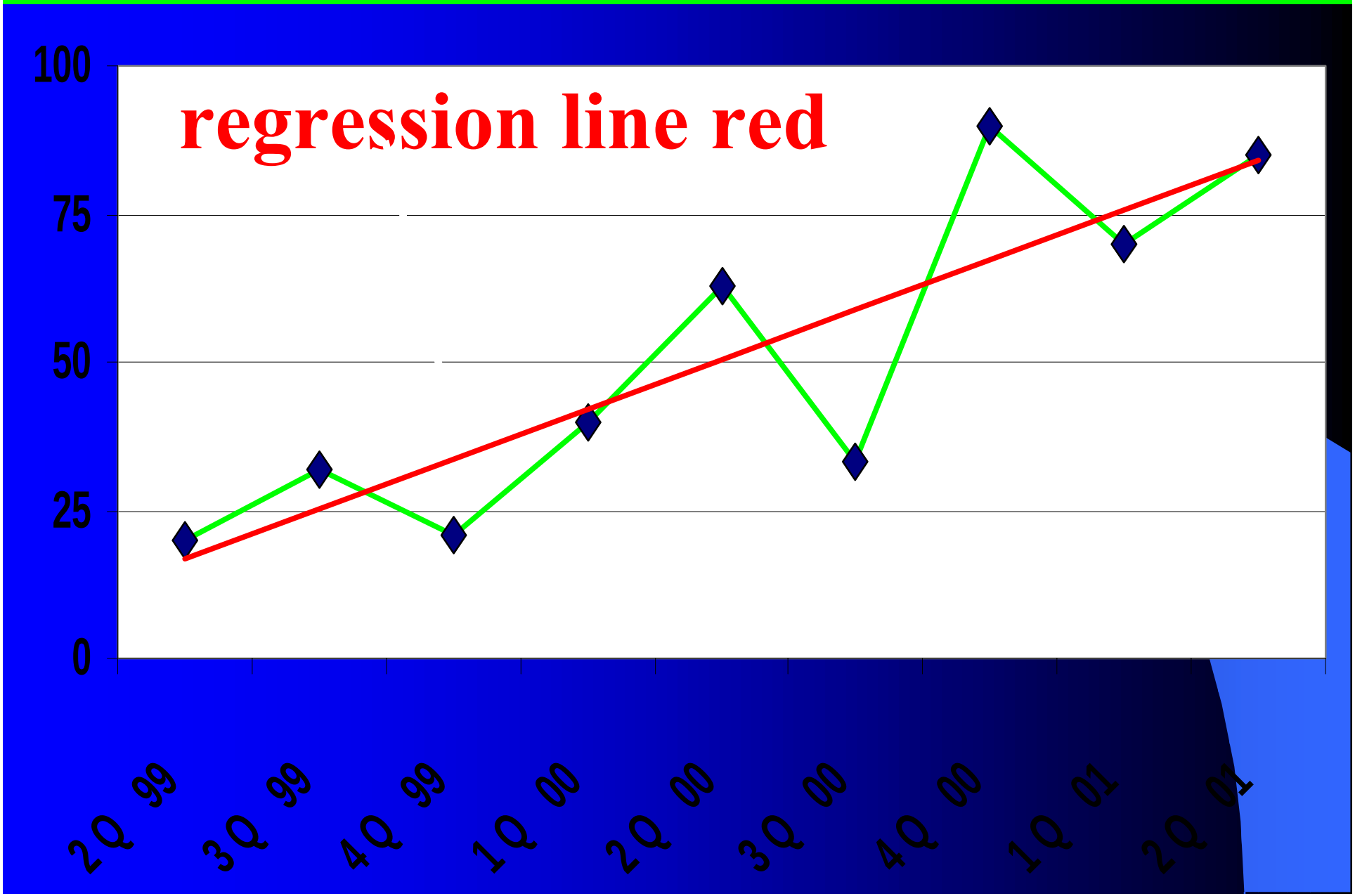
mean of Y ± std error

analysis of residuals

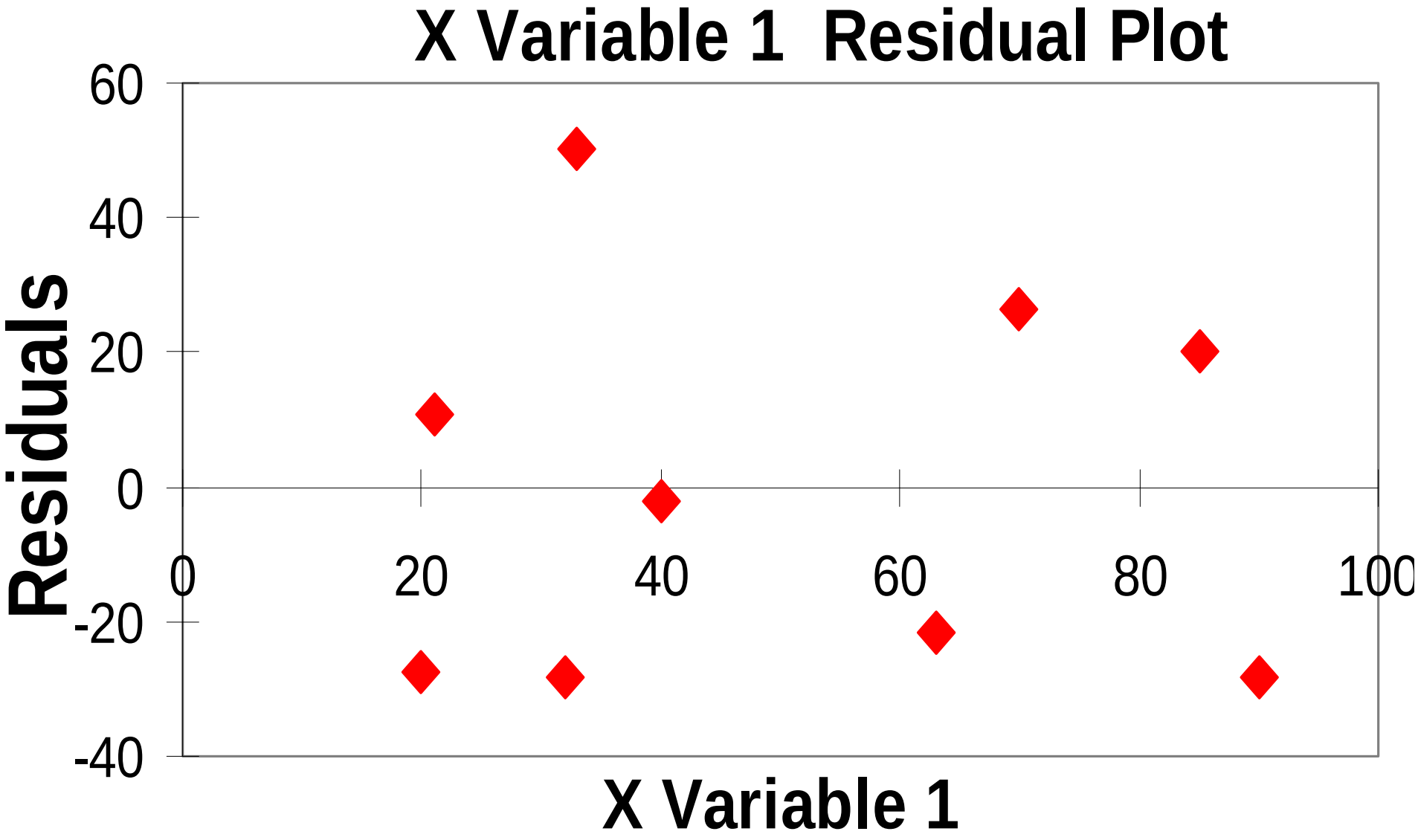
residuals should NOT have a determinable or observable pattern when graphed



residuals graphed from this data



analysis of residuals



R^2 = Coefficient of Determination

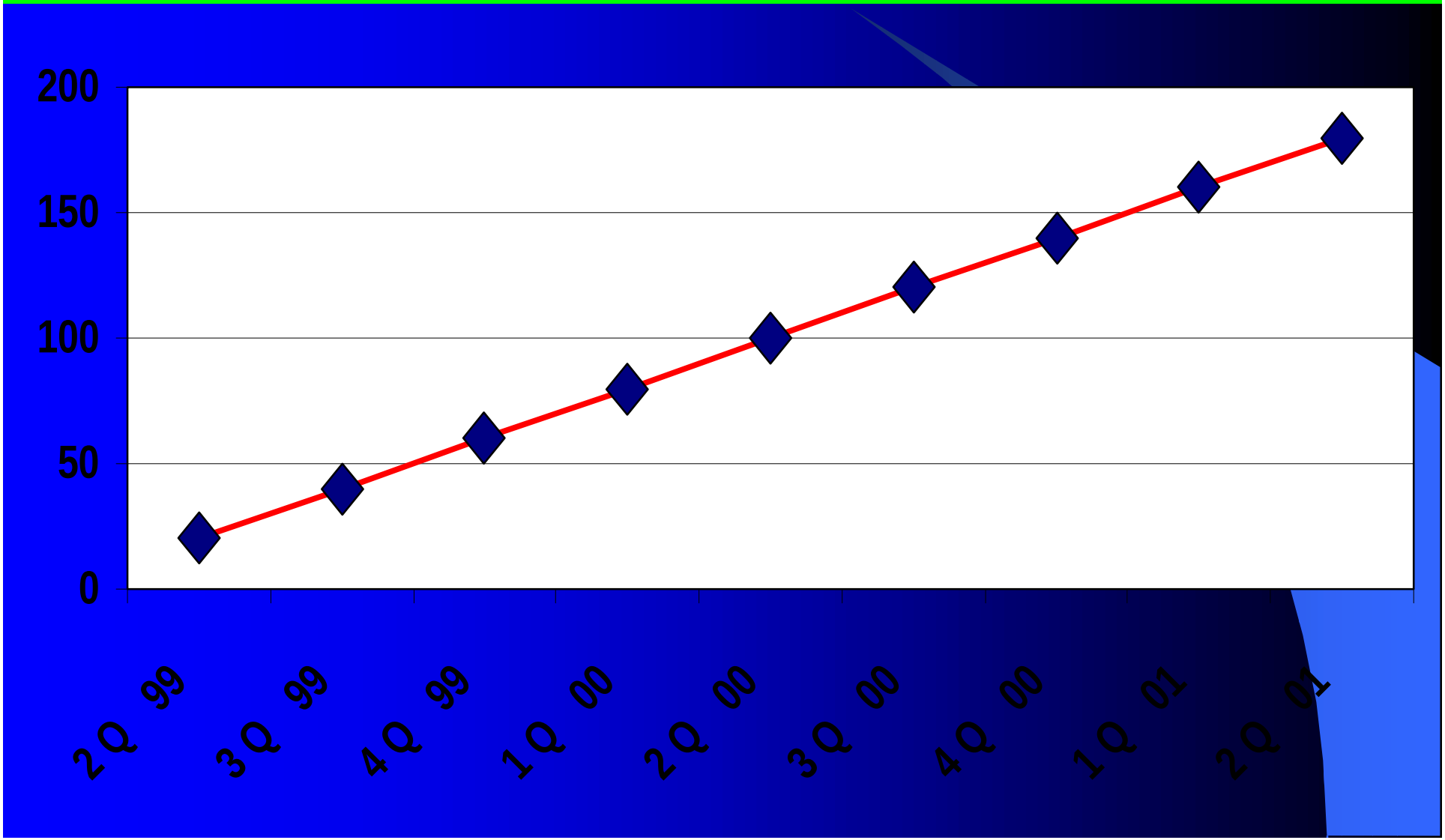
this is another measure of the
‘ goodness of fit ’
(an evaluation)
of the regression equation and its predictions

R^2 = Coefficient of Determination

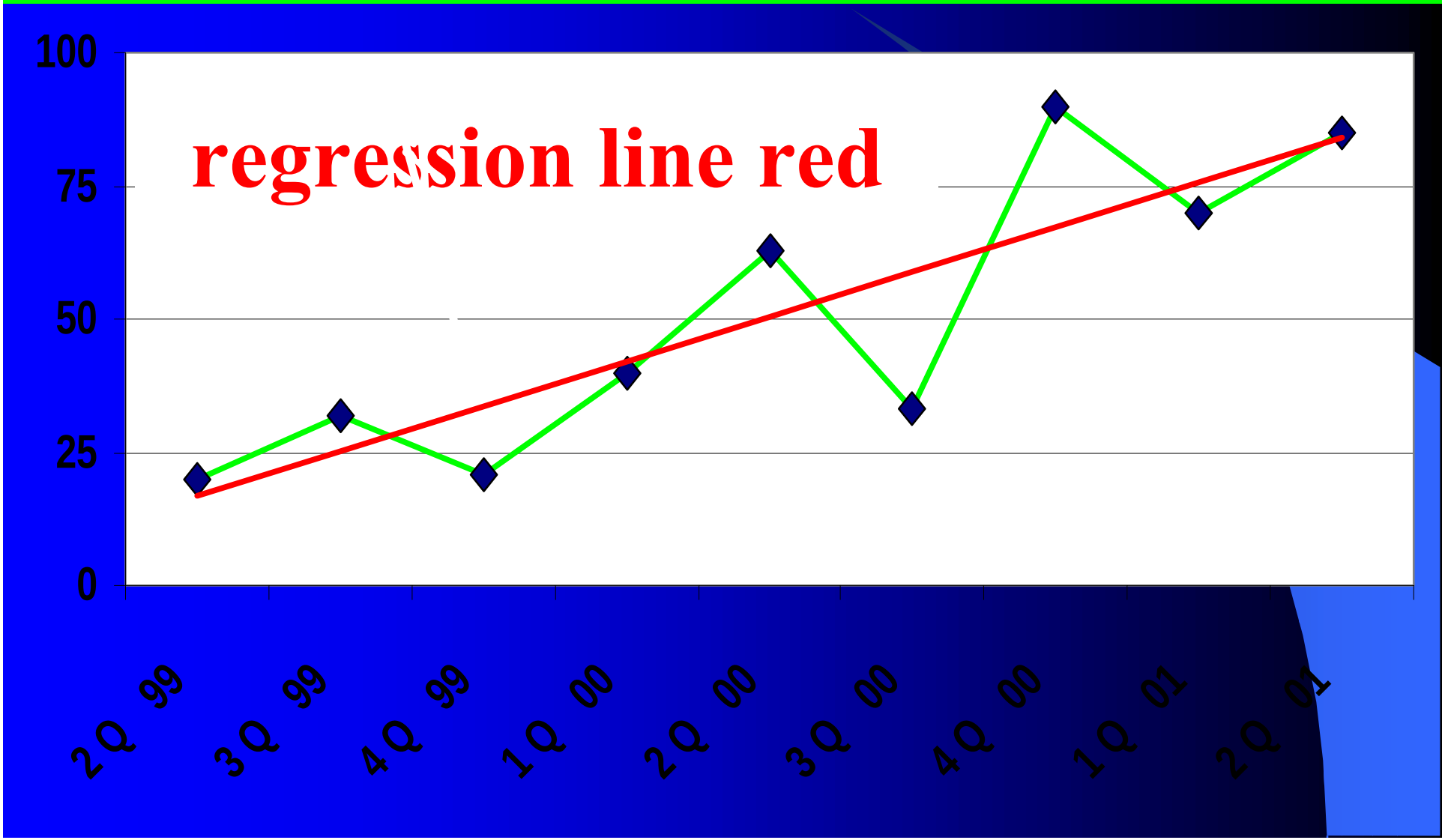
represents the proportion of the predicted Y that is determined by X

& therefore determined by the regression formula or the regression line

when all points are on the regression line the $R^2 = 1$



when all points are NOT on the regression line the $R^2 \neq 1$

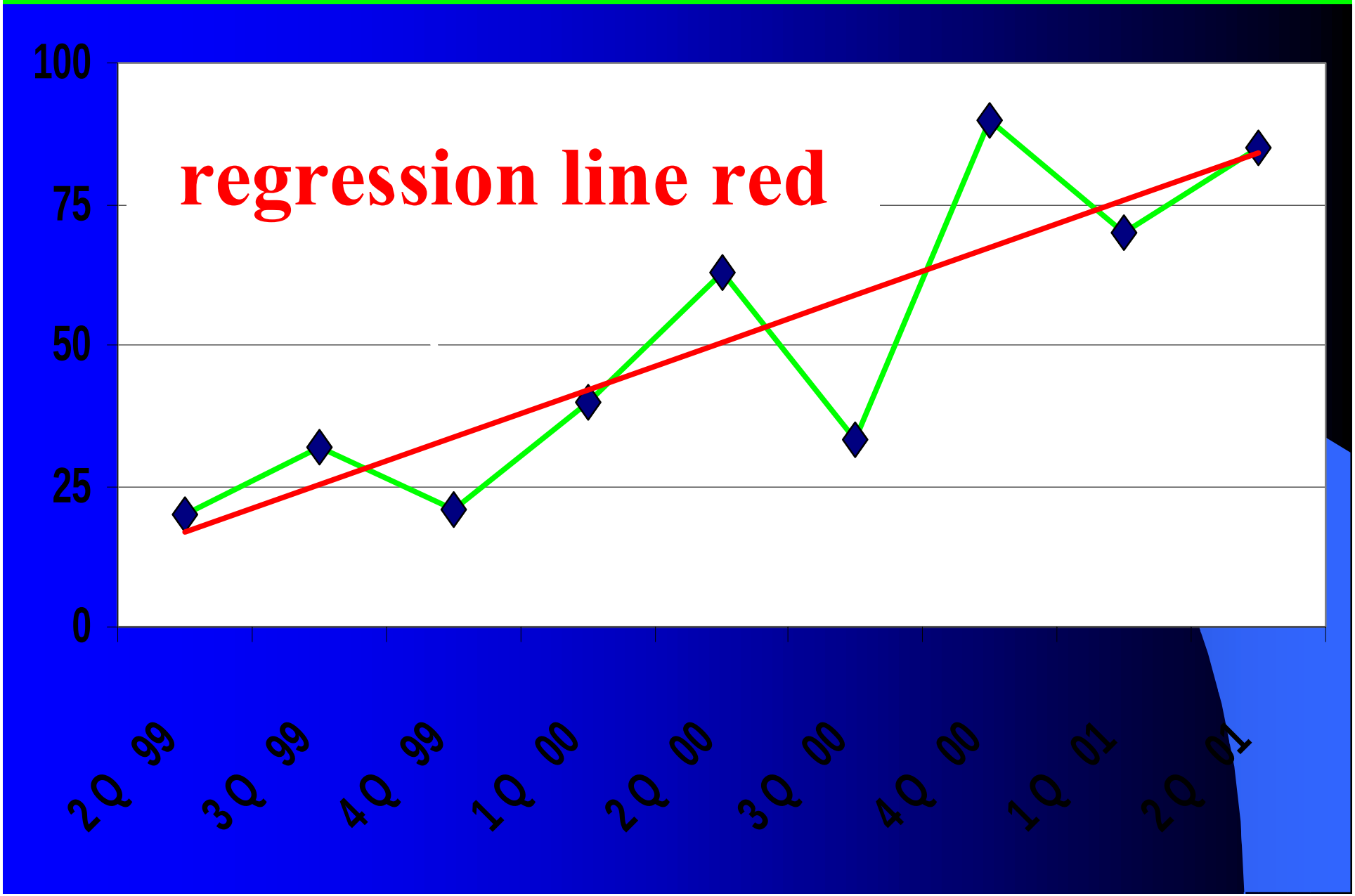


R^2 = Coefficient of Determination

= almost always less than 1
but greater than zero
= never greater than than 1
but never less than zero

should be greater than 70%
for the regression equation
to be managerially useful

this $R^2 = 73\%$


regression line red
100
75
50
25
0
2Q 99
3Q 99
4Q 99
1Q 00
2Q 00
3Q 00
4Q 00
1Q 01
2Q 01

Managerial Intuition

be comfortable with

1. correlation
2. Standard deviation
3. Regression projections
4. Std error of estimate
5. R^2
6. residual graphs

be comfortable with

1. correlation s/b over 70%
the co-movement of 2 data sets
which move in tandem
this is not a cause & effect 2.
standard deviation should
be small relative to mean
or to a specific value
& calculate the ± range

managerial intuition

3. regression projections
a simple the equation is better
limit the X's to a max of 3
don't over analyze

4. Std error of estimate
s/b small relative to mean of Y or
to a specific value & calculate
the ± range which s/b narrow

be comfortable

5. R^2 = Coefficient of Determination

the proportion of the predicted Y that is determined or explained by X in the regression formula

generally s/b over 70%

managerial intuition

6. residuals

the error term or the unexplained % after the R^2

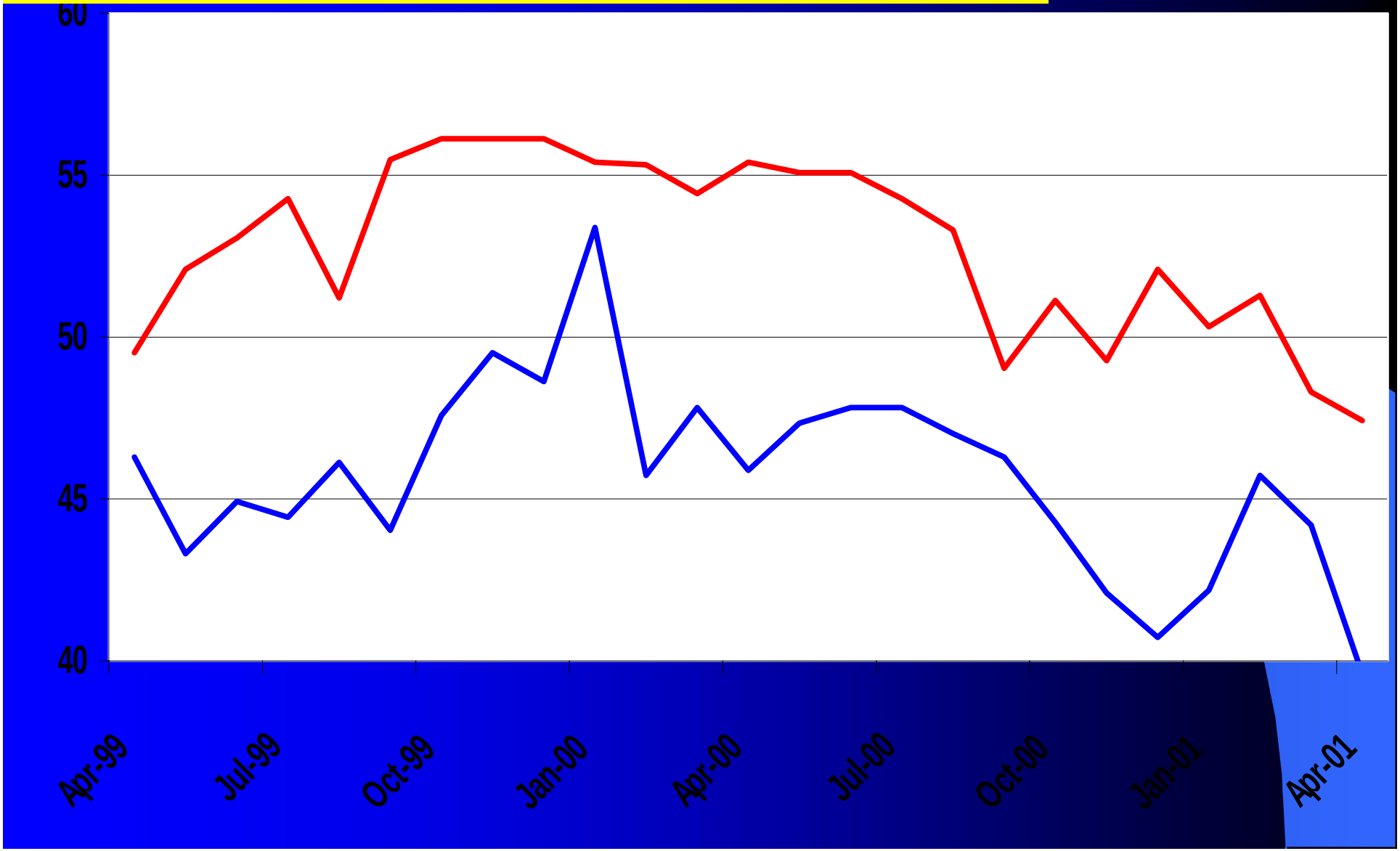
graph the residuals against the X variable

look for a fixed pattern

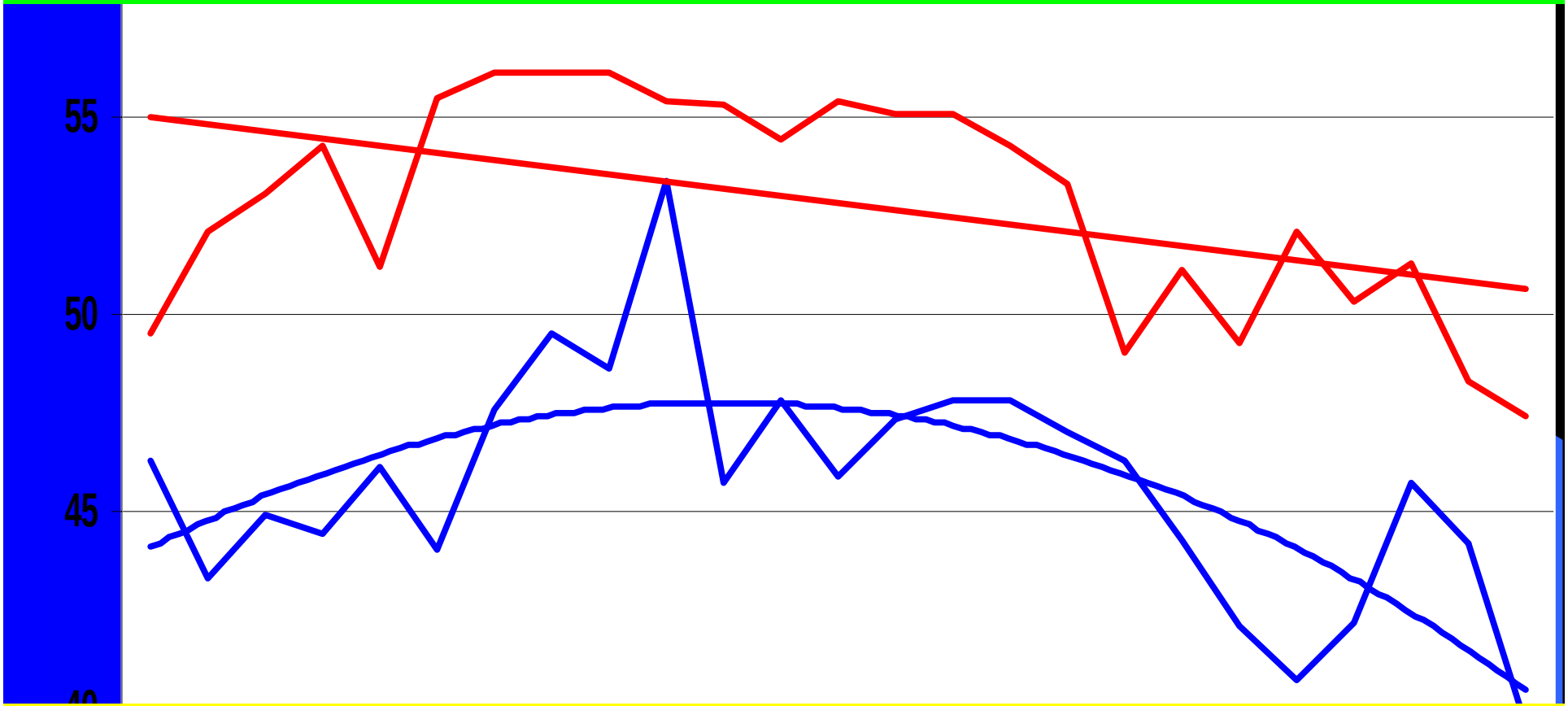
a random pattern or

no pattern is best

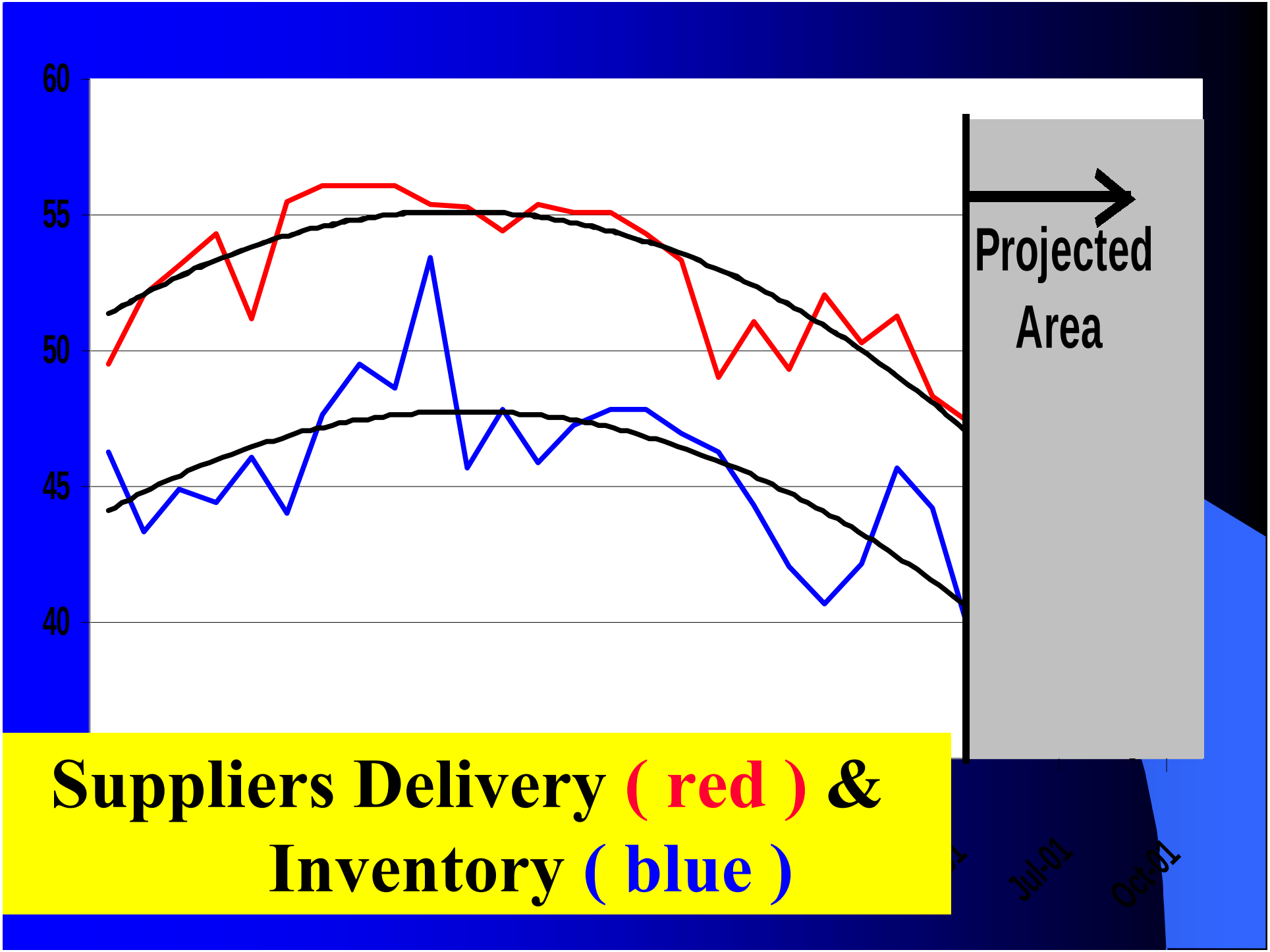
Suppliers Delivery (red) & Inventory (blue)



straight line (red) is
linear regression line

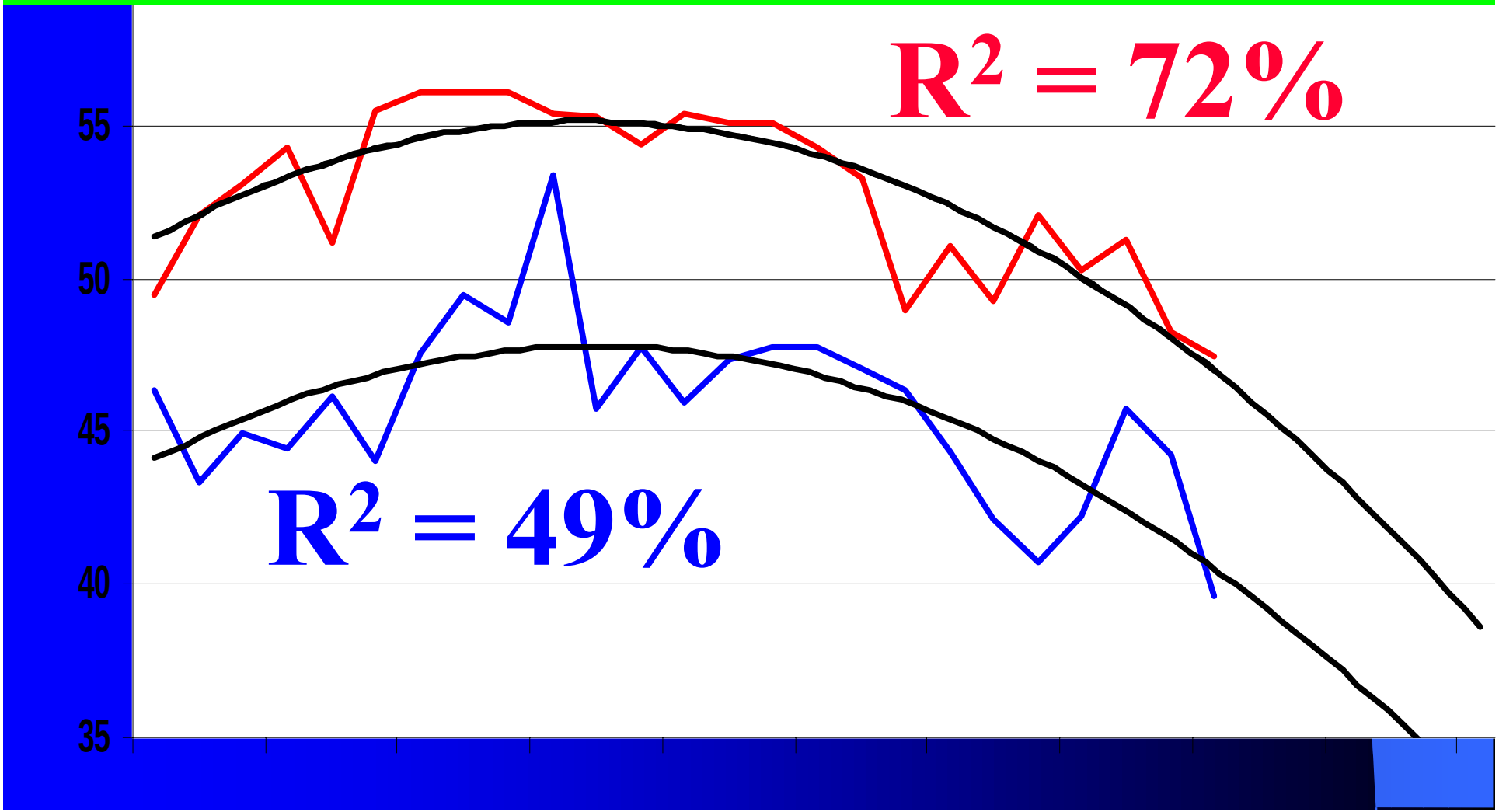


curved line (blue) is
non-linear regression line

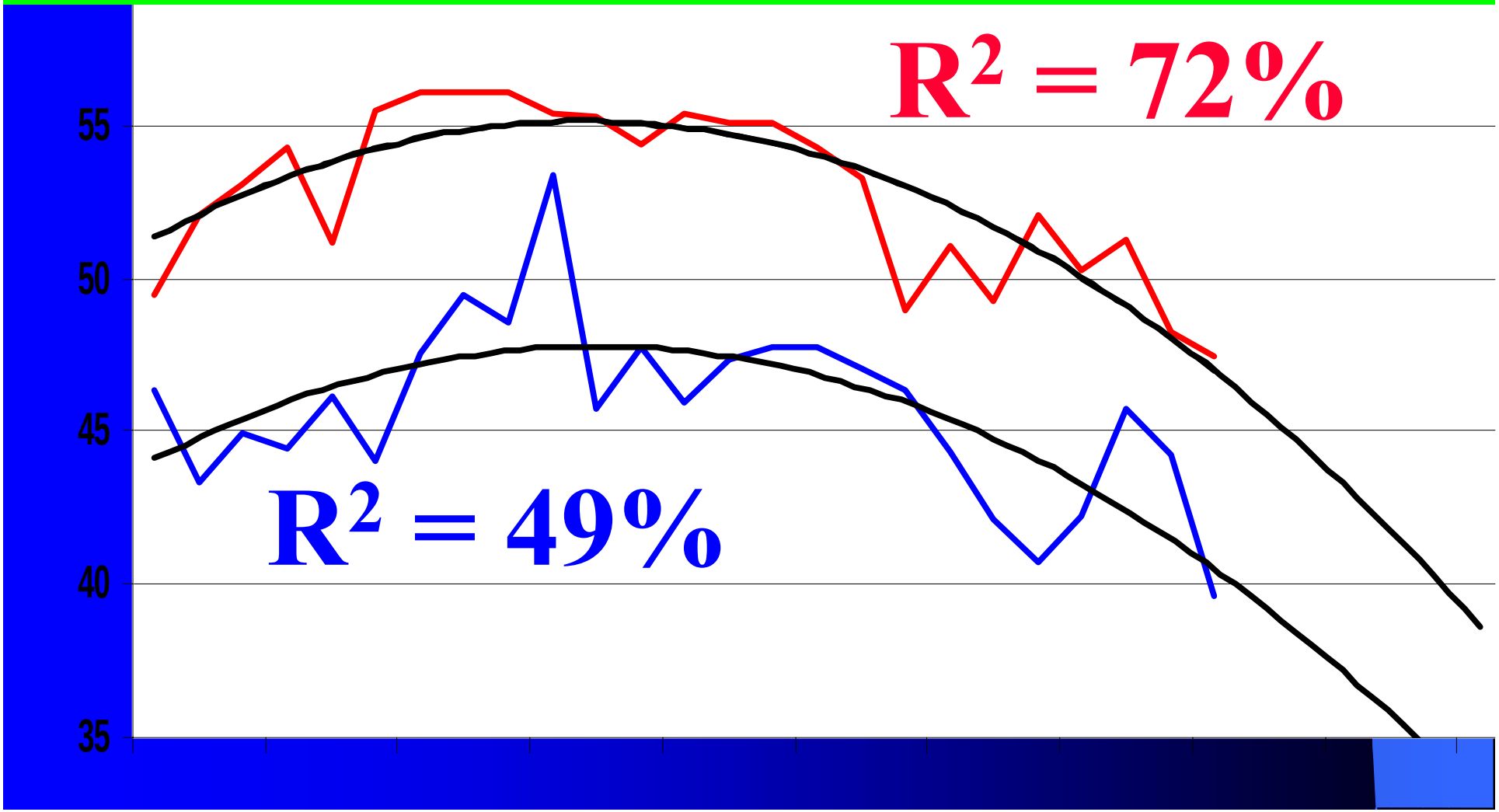


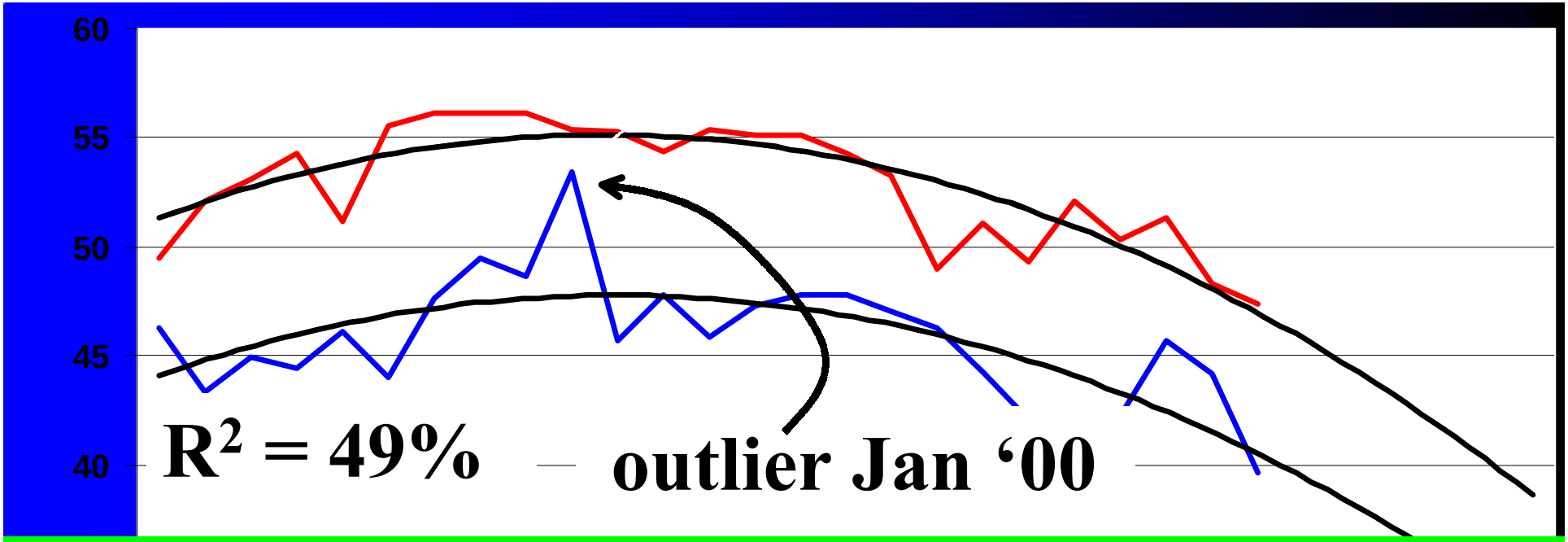
Suppliers Delivery (red) & Inventory (blue)

the R^2 value indicates how well the X variable explains the changes in the Y variable



the 72% is OK for projections
the 49% is too low
to be of value in regression

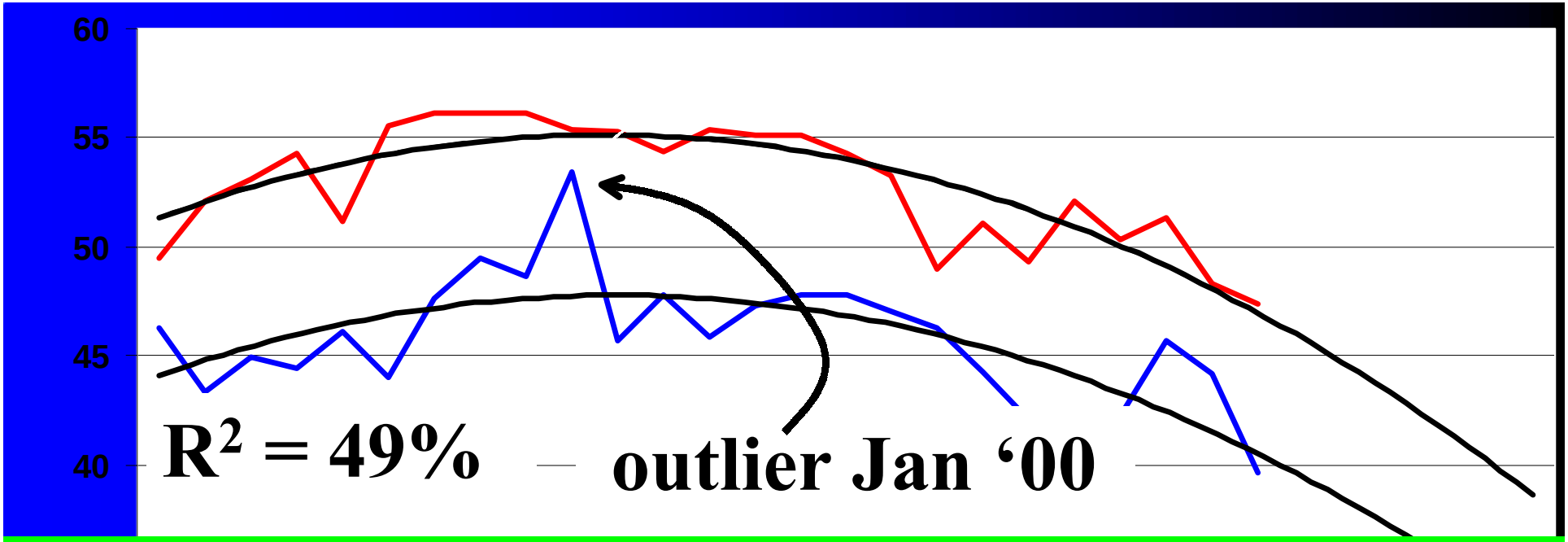




the 49% is too low to be of value

however, if the outlier (unusual) value (the high point) at about January '00 is removed from the analysis

the R^2 value will increase



if the outlier value is removed from the analysis the manager must be comfortable in deciding

that this point value is truly unusual and could be removed

the graph will not go down perpetually

at some point it will change direction

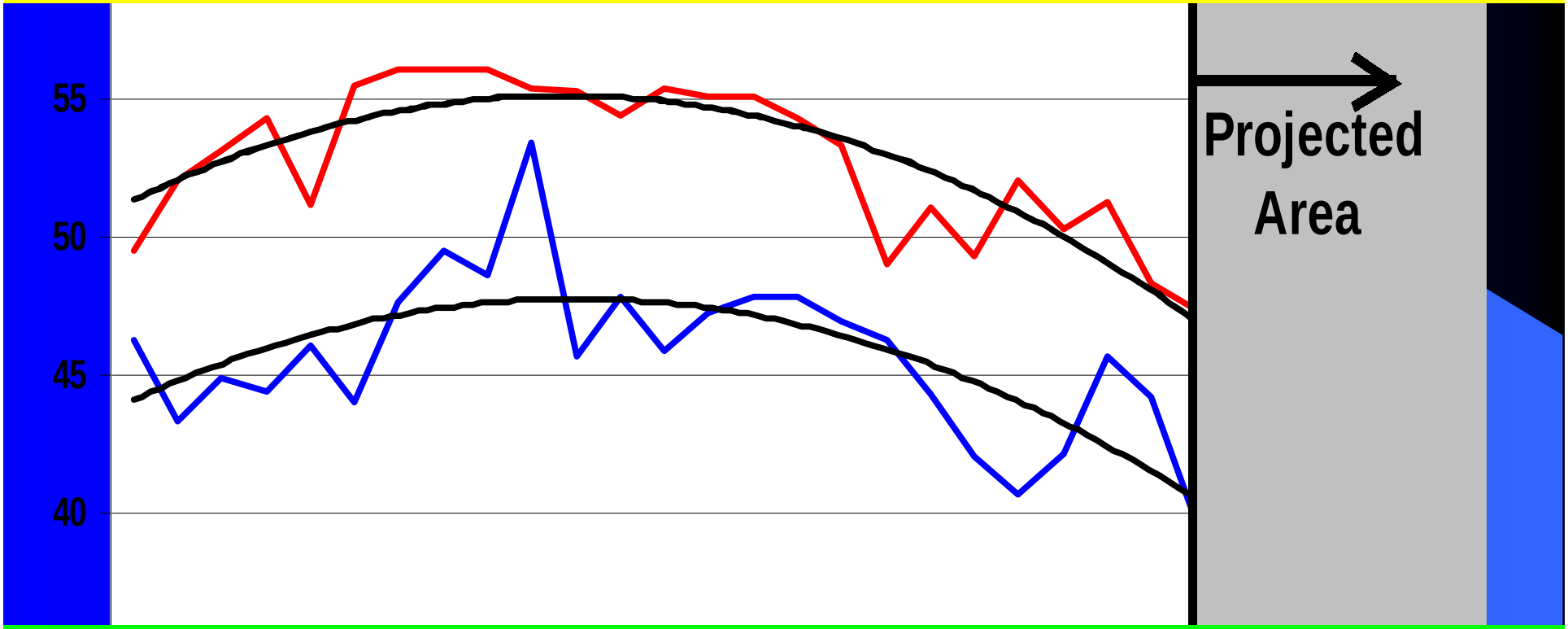
we just don't know when

inflection point = when the graph changes direction

what is needed is to inject

an inflection point at a point in time

into the future



this will change the direction

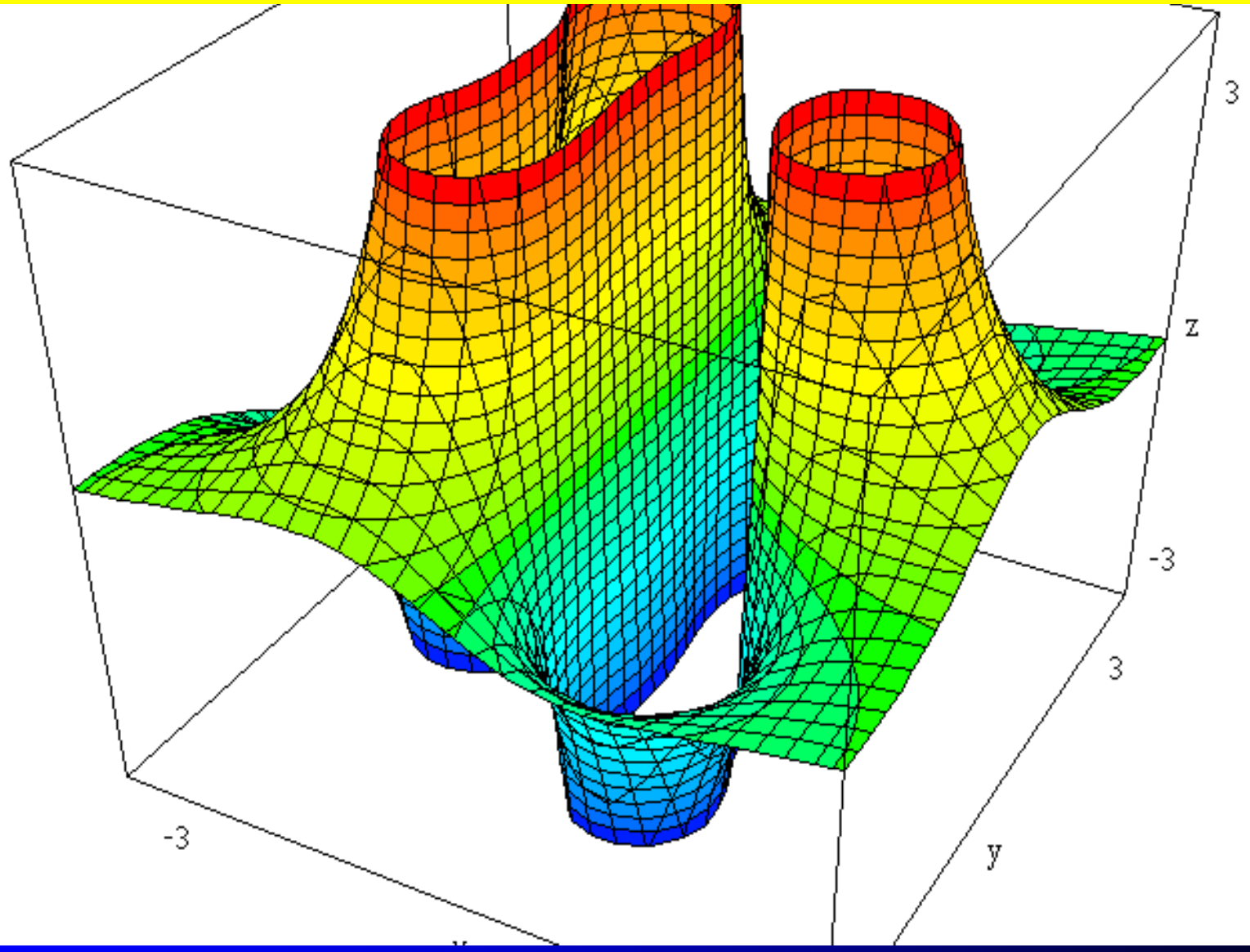
of the graph

inflection point =
when the graph changes direction

the formulas are of limited value
and must be changed
when the graph changes

one suggestion is to
use the same formula that
drove the graph the last time
it went up

is this multiple regression?



Equations by Sergei Biryukov visualization by PowerGraphs

Topics

- Graphical Information
- Statistical Relationships
- **Managerial Intuition**

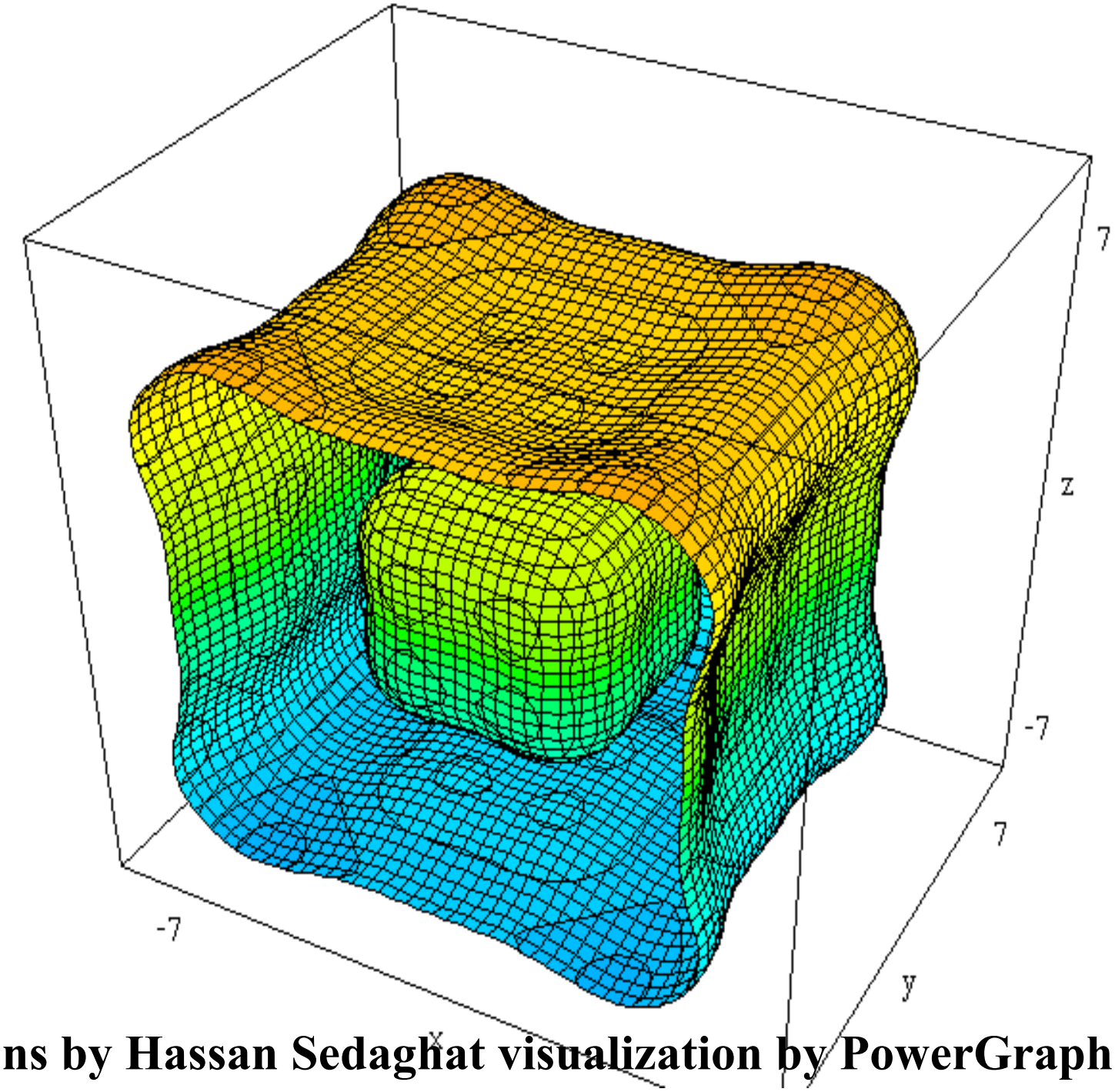
How ?

- Stats
- Graphs
- Managerial Decisions & Confidence

Perceived thru Graphs

Between Data Sets

Easy to Interpret?



Equations by Hassan Sedaghat visualization by PowerGraphs

managerial analysis.

visualize
inter-actions &
produce better decisions

DO NOT CONCENTRATE ON THE FORMULAS

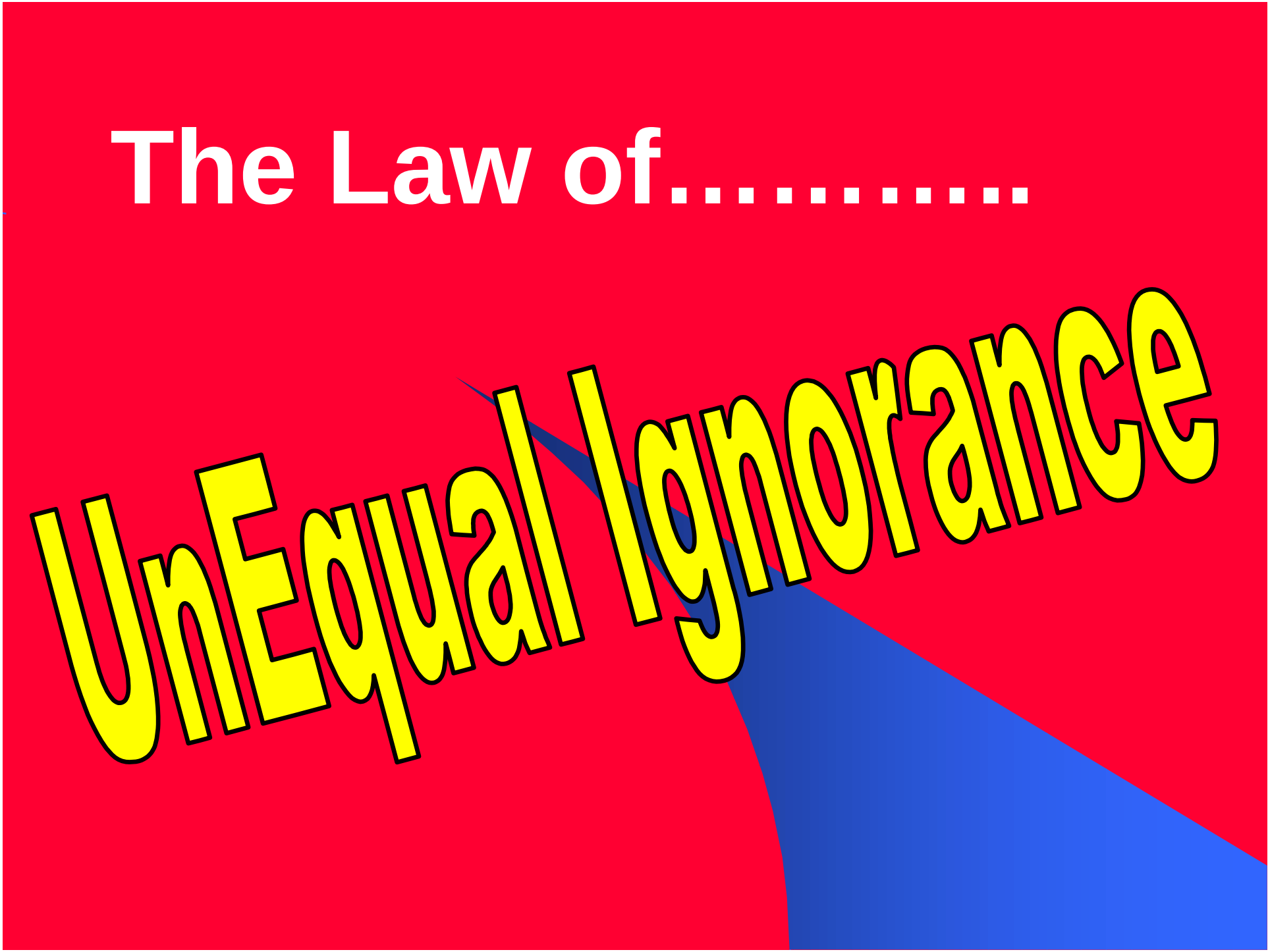
develop a managerial
feel (intuition)

The Law of……

Equal Ignorance

changes to…

The Law of……



an E-InfoStructure
with Graphical Information

external information
increases

managerial
effectiveness, &
efficiencies,

&