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**Dangers of Percent
and How to Avoid Them**



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Six Uses of Percent

Use:

- Percent of whole
- Compare two percents
- Percent gained
- Successive profits and losses over time
- Quality or accuracy
- Changes in quality over time

Danger:

- Fractions clearer
- Often misleads
- Often errors
- Not symmetrical
- Only 1/3 the info
- Hides smaller

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Notes and ideas:

Percent of Whole

- DANGER: Hides your valuable information.
- Reduced fraction is clearer:
 - 1 out of 7 is clearer than 14%
 - 1 out of 16 is clearer than 6%
- Unreduced fractions (counts) tell the size:
 - 2 out of 5 = 40% is less credible than
 - 23 out of 57 = 40%
- 40% tells little. 2 out of 5 tells more.
 - 23 out of 57 tells even more.
 - 23 sales and 34 barren phone calls per day tells it all. That's what should be charted!

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Notes and ideas:

Compare Two Percents

- DANGER: comparing percents from two groups requires equal sized groups.

For example:

83% of divorced men remarry.

75% of divorced women remarry.

- 200 men $.83 = 166$
400 wom $.75 = 300$ x 1.3 more women.

100 men $.83 = 83$
100 wom $.75 = 75$ x 1.1 more men.

500 men $.83 = 415$
500 wom $.75 = 375$ x 1.1 more men.

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Notes and ideas:

Percent Gained

- DANGER: Even experts make large calculation errors.
- "... JAMS grew by more than 2,300 percent from 1987 to 1993. In 1987, JAMS handled fewer than 1,200 cases; in 1993, it averaged 1,200 cases a month."
Richard Reuben, *California Lawyer*,
February 1994, p.55.
- Write the factor gained _____.
Write the percent gained _____.

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Notes and ideas:

Successive Profits and Losses Over Time

- DANGER: Most people think percent is symmetrical. WRONG! It isn't!
- With a 10% gain followed by a 10% loss you are 1% below where you started.
- Trick: Always use 100 as your start in trying to understand this:
 $100 + 10\% = 100 + 10 = 110$. Then,
 $110 - 10\% = 110 - 11 = 99$! 1% below!

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Notes and ideas:

Quality or Accuracy

- **DANGER:** Only 1/3 the original counts info.
- **Ignores number** of events based on:
33% from 1 sale and 2 barren calls
is not as convincing as
33% from 104 sales & 212 barren calls.
- **Ignores time** in which events occurred.
- **Hides** small changes in the smaller which
is buried in the total.
- 774 won and 223 lost in 32 seasons tells it
all. Coach Dean Smith, North Carolina.

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Notes and ideas:

Changes in Quality Over time

- DANGER: Acceleration of smaller part is hidden by control of larger part.
- Sample cases:

% safe acts	Safe & unsafe acts
% sold	Sales & barren calls
% of market sold	U.S. & foreign sales

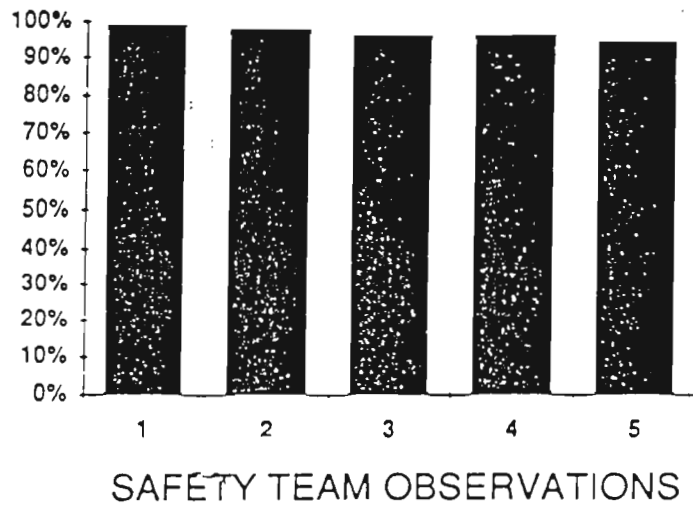
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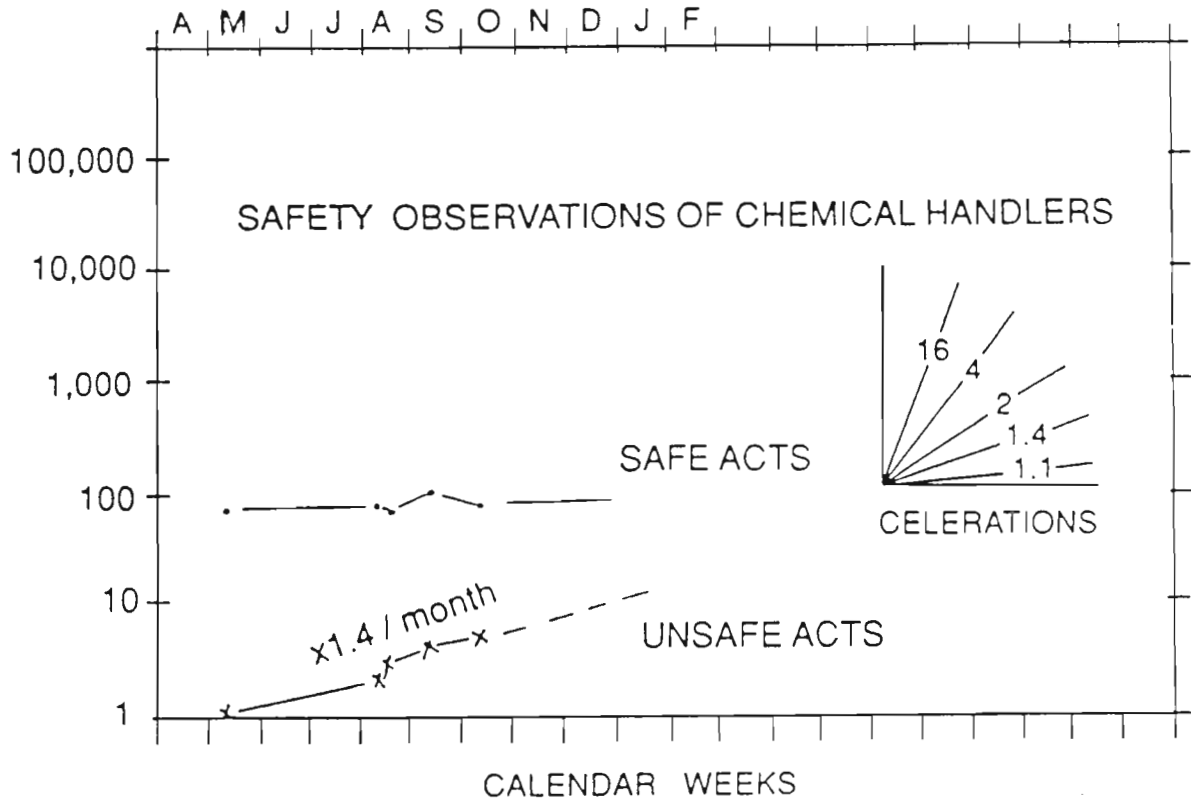
Notes and ideas:

Chemical Handlers Safety Acts Observed Percent Safe vs Safe and Unsafe

PERCENT SAFE ACTS OBSERVED



CALENDAR MONTHS



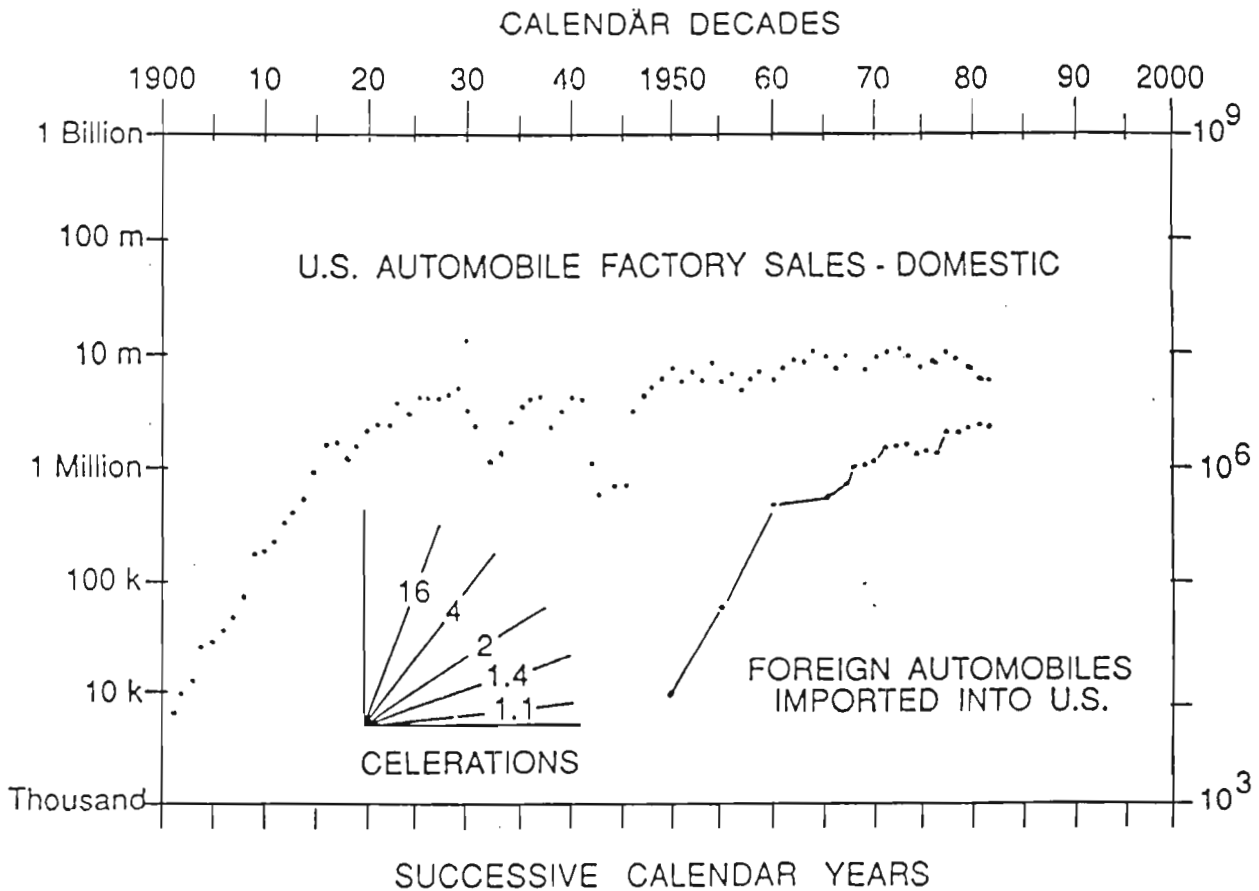
Notes and ideas:

DANGERS of PERCENT-8A

U.S. Sales vs Foreign Automobile Sales Percent of Market vs U.S. Sales and Foreign Sales

U.S. PERCENT OF MARKET

YEAR	RATIO	TOTAL	% MARKET
1950	80-1	81	99 %
1960	6-1	7	86 %
1970	4-1	5	80 %
1980	2.5-1	3.5	71 %
1982	2-1	3	67 %



Notes and ideas:

How Many Points on a Percent scale?

- 100? WRONG!
There are only 100 points when there are 99 things in the sample.
- There is one more point on the scale than there are things counted.
2 things: 0=0%, 1=50%, 2=100%: 3 pts.
5 things: 0%,20%,40%,60%,80%,100%
- Over 100 things gives decimal percents.
199 things = 200 points with .5 percents.

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Notes and ideas:

Why Percent is So Confusing

- Percent tries to do multiplication and division by adding and subtracting.
x1.20 is expressed as + 20%
x3.40 is expressed as + 240% (- 1.0)
but
÷ 1.20 is not - 20%, it is -17%
÷ 3.40 is not - 240%, it is -71%
- Trick: always start at 100 to convert multiples (x or ÷) to percents (%).
 $100 \div 1.20 = 83$; $100 - 83 = -17\%$
You try $100 \div 5.0 = \underline{\quad}$; $100 - \underline{\quad} = \underline{\quad} \%$

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Notes and ideas:

Greatest Danger: Percent Ignores Time

- "You can take time out of behavior, but you can't take behavior out of time."
Eric Haughton, Toronto, Ont., 1974.
- Both count and time (frequency) must be tracked to shorten cycle time and to build fluid, automatic company performance.
- Percent gives up both count and time in its attempt to record proportion.
- Percent is less sensitive to company changes than frequency (count per time).

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Notes and ideas:

What to do if your Boss requires Percent

- Make both a percent chart and a frequency chart.
- Make your departmental decisions from your frequency chart.
- Show your boss both charts.
- The superior sensitivity of the frequency charts to change usually prevails.
- If not, present only the percent chart, and use your frequency chart in secret.

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Notes and ideas:

How to Avoid Dangers of Percent



- DON'T USE IT!
- Chart original two counts that disappeared into calculation of percent. They had to exist. Often original counts are left at the work station. Use a proportional chart.
- When you see percents in reports, convert and chart their original frequencies before deciding. Often, you find errors. Always, you see more than the author did.

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Notes and ideas:

How to See Frequencies on Proportional Charts

- A frequency is a dot on proportional charts.
- The following practice sheet has 100 standard change charts. Up the left of each are 7 dots. Each is x10 above the lower. Going up they are 1, 10, 100, 1000, 10,000, 100,000 and 1,000,000 per day.
- To read these graphics, point to and say the frequency of the dot inside each mini-chart on the next practice sheet. Your coach will pace you. Fluency is 60 per min.

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Notes and ideas:

Name _____ Date _____

Point Say the frequency of each dot on the SCC: (one per minute, ten per minute).

Ref.Freqs. x10
Num Ord, Page 1
Pics = 7

	1 per min	10 per min	100 per min	1000 pr min	1 per day	10 per day	100 per day			
										(10)
										(20)
										(30)
										(40)
										(50)
										(60)
										(70)
										(80)
										(90)
										(100)

DANGERS of PERCENT-14A

How to See Proportions Between Original Counts

- Chart both counts on proportional paper!
- Proportion is the vertical chart distance between the wanted count ("•" a dot) and the unwanted count ("x" an x).
- To practice this concept, point and say how far the "•" is above the "x" on the following practice sheet.
"times one" (x1), "times 10" (x10)
When "•" is below the "x," say
"divide ten" ($\div 10$), "divide 100" ($\div 100$).

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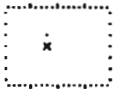
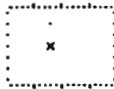
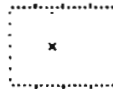





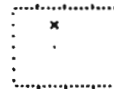
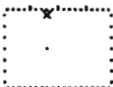
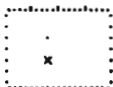
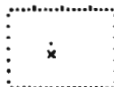
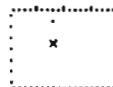
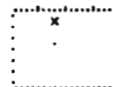
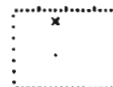
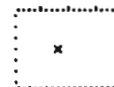
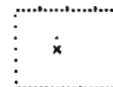


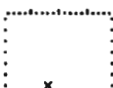

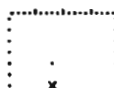
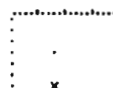
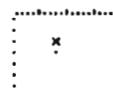
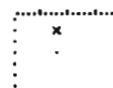
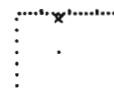
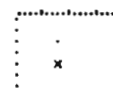
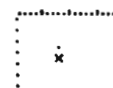
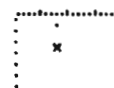
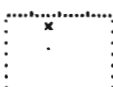
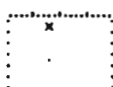
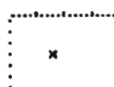
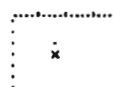
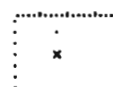
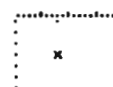
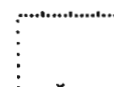
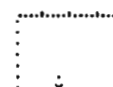
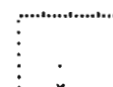
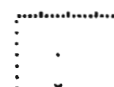
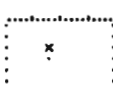
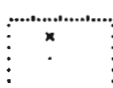
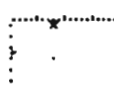
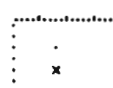
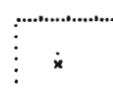
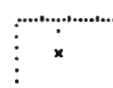
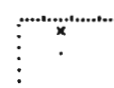
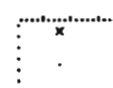
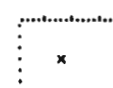

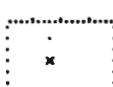
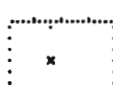
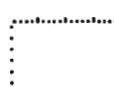
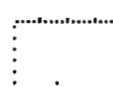
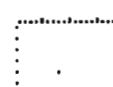
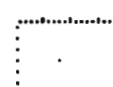
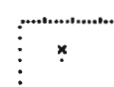
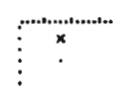
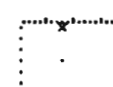
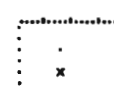
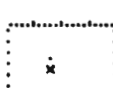
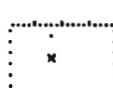
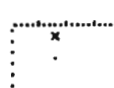
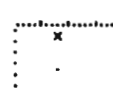
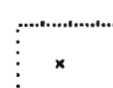
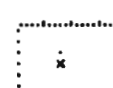
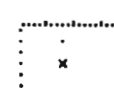
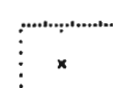
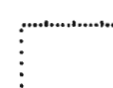
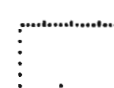
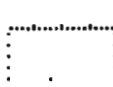
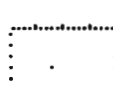
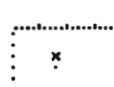
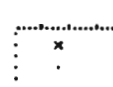
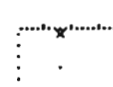
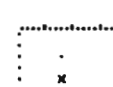
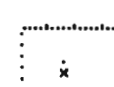
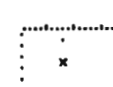
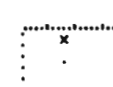
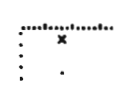
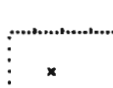
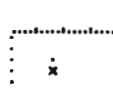
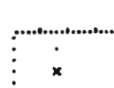
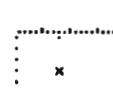
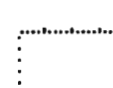
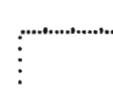
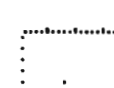
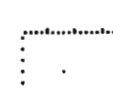
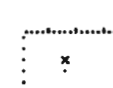
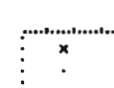
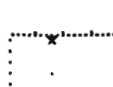
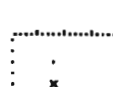
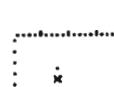
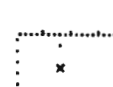
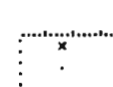
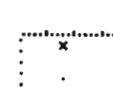
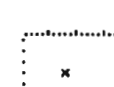
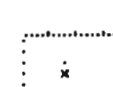
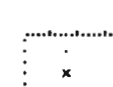
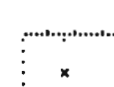
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Notes and ideas:

Name _____ Date _____

Point say accuracy proportion for each pair (times one, times ten)

Ref. Accy. Props-x10
Num Ord, Page 1
Pics = 16

 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 /10	 /100	(10)
 /1000	 x100	 x10	 x100	 /100	 /1000	 x100	 x1000	 x10	 x1	(20)
 x1000	 x100	 x10	 x1	 x10	 x100	 x1000	 x1	 x10	 x100	(30)
 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	(40)
 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	 x100	(50)
 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	(60)
 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	(70)
 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	 x100	(80)
 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	(90)
 x1	 x10	 x100	 x1000	 x1	 x10	 x100	 x1000	 x1	 x10	(100)

DANGERS OF PERCENT-15A

How to See Change in Proportion Over Time

- Change in proportion is the chart area enclosed by two lines of interest.
- When area widens proportion increases.
- When area narrows proportion decreases
- To practice this concept, point and say "increase," "maintain," or "decrease" for the change in proportion in each of the following performance pictures™. Your coach will pace you.

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Notes and ideas:

Name _____ Date _____

Point Say how proportion changes across time: (increasing, inc)

Perf.Pics.Prop
 Num Ord, Page 1
 Pics = 14

DANGERS of PERCENT-16A

										(10)
										(20)
										(30)
										(40)
										(50)
										(60)
										(70)
										(80)
										(90)
										(100)

How to Name Performance Pictures™

- Performance pictures™ have been named by workers.
- Names permit describing the different patterns of wanted and unwanted performance change in conversation.
- On the next practice sheet point to the picture and say its name. Your coach will pace you.

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




























































































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Notes and ideas:

Name _____ Date _____

Point Say Performance Picture™ name: (cross over, jaws, climb)

Perf. Pics. Name
Num Ord, Page 1
Pics = 14

										(10)
										(20)
										(30)
										(40)
										(50)
										(60)
										(70)
										(80)
										(90)
										(100)

DANGERS of PERCENT-17A

How to Name Slopes on Standard Proportion Charts

- Slopes (celerations) are named by how much the frequency multiplies each period.
- The reference celerations are:
 - x1 ("times one"), a horizontal line.
 - x1.1 ("Times one point one"), line goes up times 10 distance all way across chart.
 - x1.4 ("times one point four"), line goes half way up all way across chart.
 - x2 ("times two"), from corner to corner.
 - x4 line goes all way up, half way across.
 - x16 line all way up, one quarter across.

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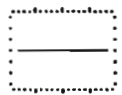
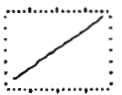
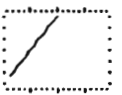
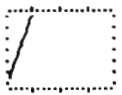
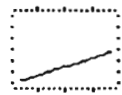

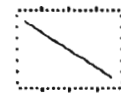
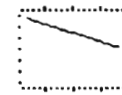
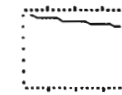

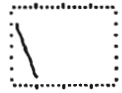
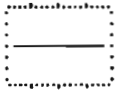
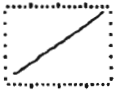

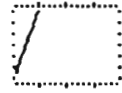
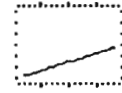
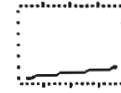
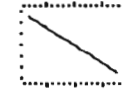
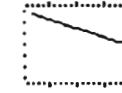

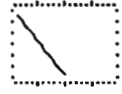

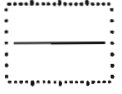
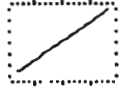
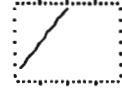

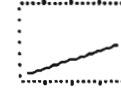
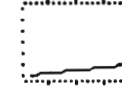
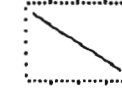
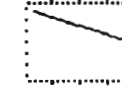

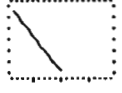
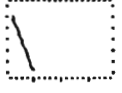
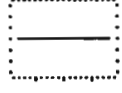
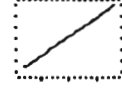
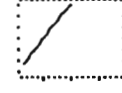
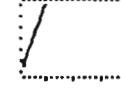
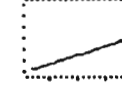
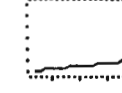
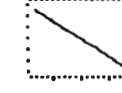
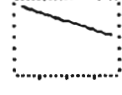

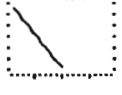
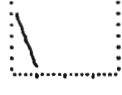
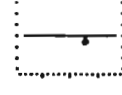
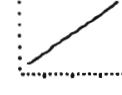
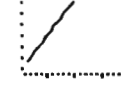
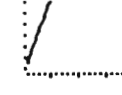
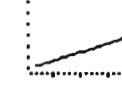

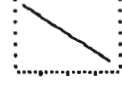


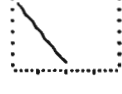
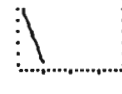
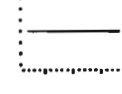
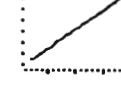
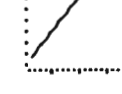
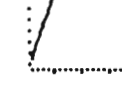
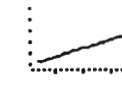
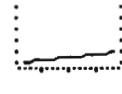
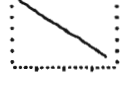

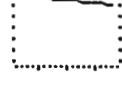
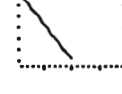
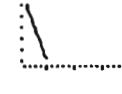
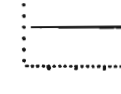
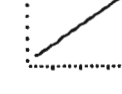
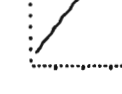
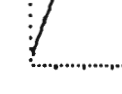
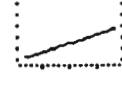
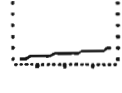
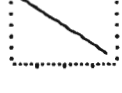
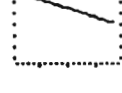
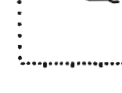
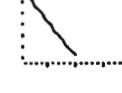
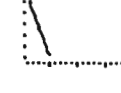
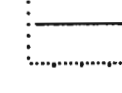
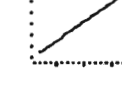
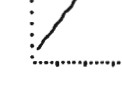
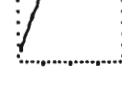
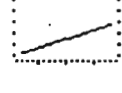
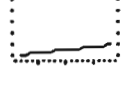
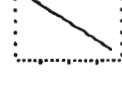
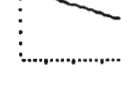
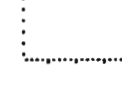
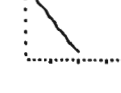

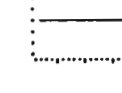
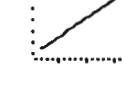


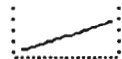



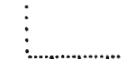
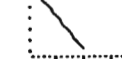

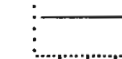
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Notes and ideas:

Name _____ Date _____

Point Say the celeration of each line (times two, times four).

Ref.Cels-Corners
Num Ord, Page 1
Pics = 11

 x1	 x2	 x4	 x16	 x1.4	 x1.1	 /2	 /1.4	 /1.1	 /4	(10)
 /16										(20)
 /16										(30)
 /16										(40)
 /16										(50)
 /16										(60)
 /16										(70)
 /16										(80)
 /16										(90)
 /16										(100)

DANGERS of PERCENT-18A

How to Name Program Effects

- Program changes always produce **two independent** effects on performance:
 - A jump up or down the chart, and
 - A turn up or down in the slope.
- These two effects are called:
"jump-up", "no-jump", or "jump-down".
"turn-up", "no-turn", or, "turn-down".
Combinations are: "no-jump:turn-up",
or "jump-up:turn-down"
- Point to and name the program effects on the next practice sheet.

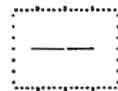
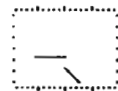
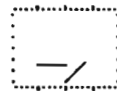
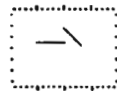
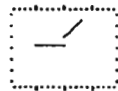
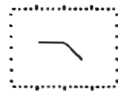
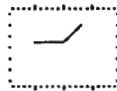
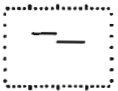
Behavior Research Company

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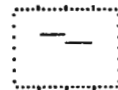
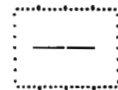
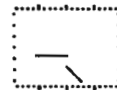
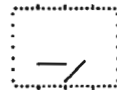
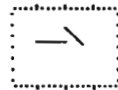
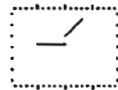
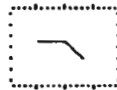
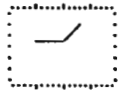
Notes and ideas:

Name _____ Date _____

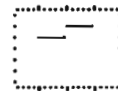
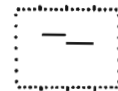
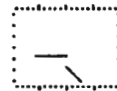
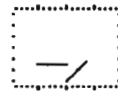
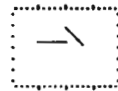
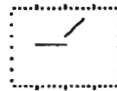
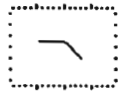
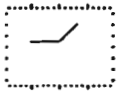
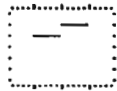
Point Say the Jump-Turn combinations (No Jump No Turn, Jump Down No Turn)



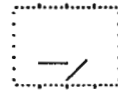
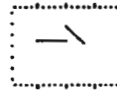
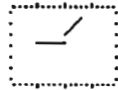
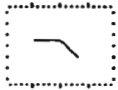
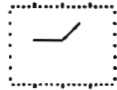
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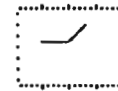
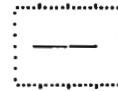
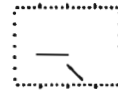
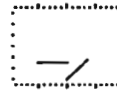
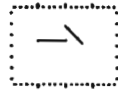
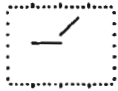
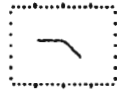
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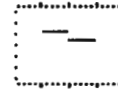
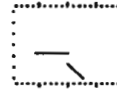
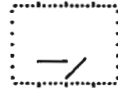
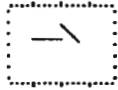
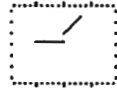
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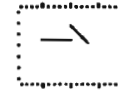
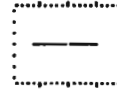
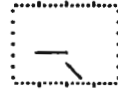
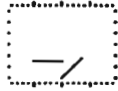
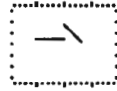
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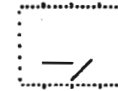
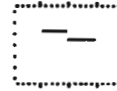
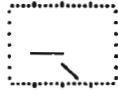
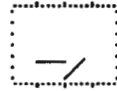
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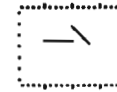
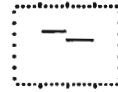
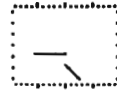
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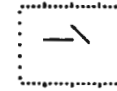
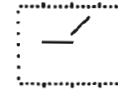
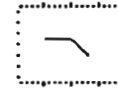
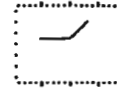
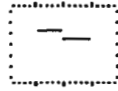
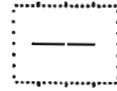
(70)



(80)



(90)



(100)

DANGERS of PERCENT-19A



How to See Outlier Probabilities



- On a standard proportion chart you can easily see how far an outlier is above or below the course of other frequencies.
- This distance can be described by the number of course widths it is away.
- This number of course widths translates directly into the statistical probability that the outlier would occur by chance.
- The next slide lists these probabilities.

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Notes and ideas:



Probability of Outliers: Peaches or Lemons



Bounces away from course edge:	Probability is one out of a:	St. Dev. from mean:
Half	Thousand	4
One	Million	6
One and a half	Billion	8
Two	Trillion	10

Mnemonic: "Half a bounce is half a ton"

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Notes and ideas:



How to Learn from Peaches and Lemons



- Gilbert pointed out in 1978 how much we can learn from exemplary performers.
- We have extended this concept to learning what not to do from lemony performers, and also from peachy and lemony days in one worker's chart.
- A peach is a significantly good and a lemon is a significantly bad performance.
- On the next practice sheet point to and say the probability and type fruit in each chart.

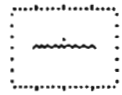
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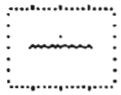
Notes and ideas:

Name _____ Date _____

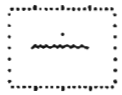
Point Say the probability of the outlier: 1 out of a (thousand, million).



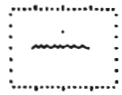
thousand



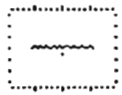
million



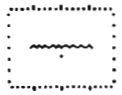
billion



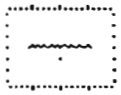
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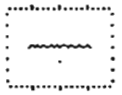
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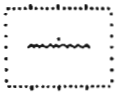
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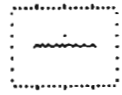
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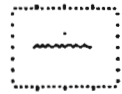
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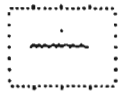
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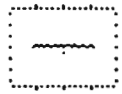
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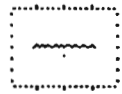
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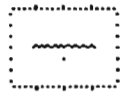
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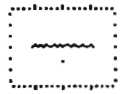
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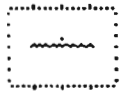
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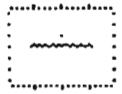
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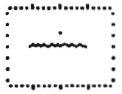
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(90)



(100)



DANGERS of PERCENT-22A

Standard Change Chart Set Covers All Company Levels

Type chart:

- Daily
- Weekly
- Monthly
- Yearly

Used to monitor:

- Performer
- Process
- Organization
- Nation or World

Performance Navigation™ system uses this chart set to monitor and improve company production and quality.

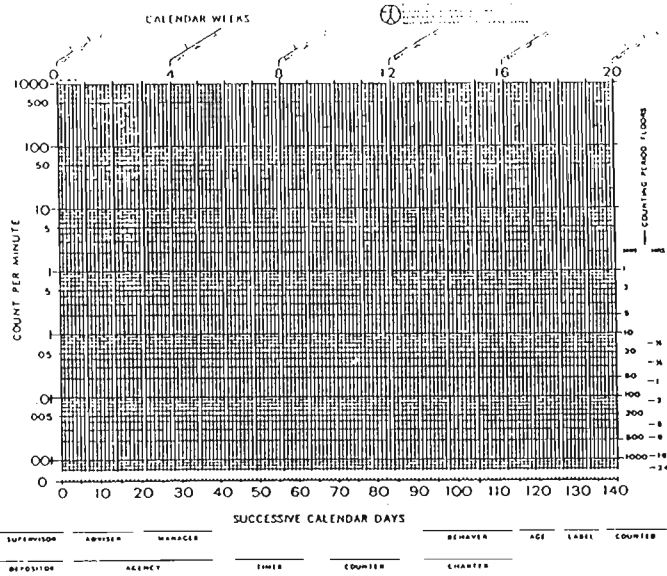
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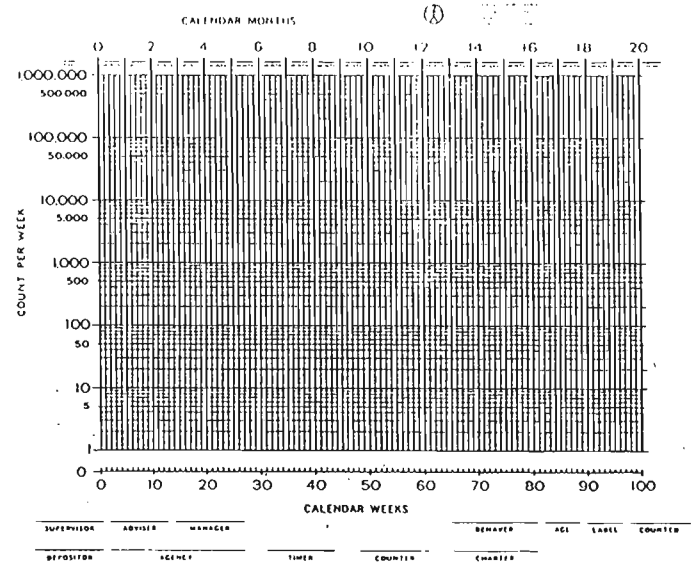
Notes and ideas:

Standard Change Chart Set Covers all Company Levels

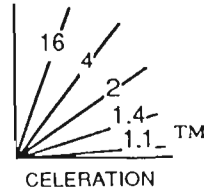
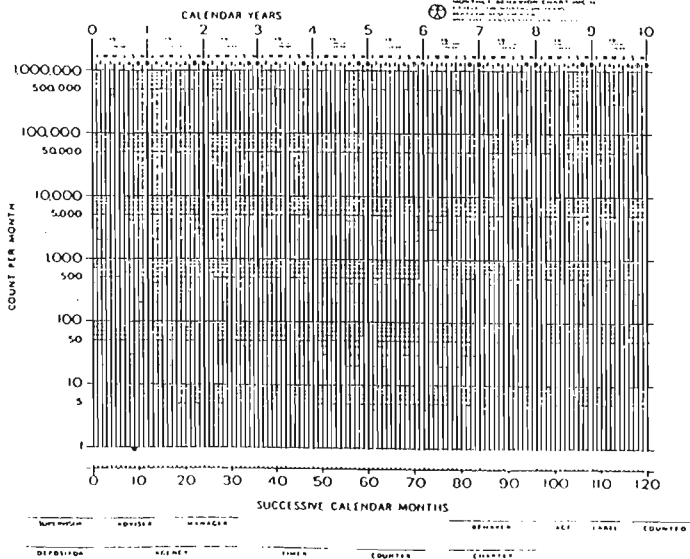
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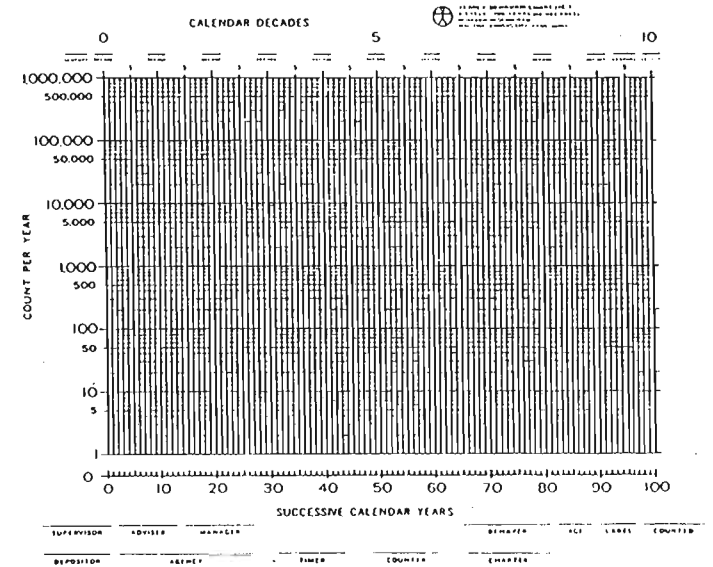
WEEKLY



MONTHLY



YEARLY



DANGERS of PERCENT-23A

Closing Quotes

- Frequency is universal Skinner 1950
- Self charting Skinner 1938
- Ignore percent Skinner 1969
- Use multiply scale Meadows 1972
- Use standard multiply scale Lindsley 1965
- Learn from exemplary performers Gilbert 1978

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Notes and ideas:

