The Basics

What really makes a chart effective are font, color and design and the depth of critical analysis displayed. In other words, do you have information worth making a chart for and have you portrayed it accurately? Remember that a single wrong data point can discredit the rest of the information and make the entire chart worthless.

In this chapter I provide practical guidelines and templates for fonts and the choice of colors — bright or muted. I answer questions like: Do two numbers constitute a chart? What is good data?

These basics provide the backbone and foundation for executing intelligent and persuasive charts.

Data Integrity

Tell the whole truth

Predicting the future?
Charting estimates with a definitive range or plotting projections far into the future gives a faulty impression of precision. Both practices use a precise tool to define arbitrary numbers.

estimate

projections
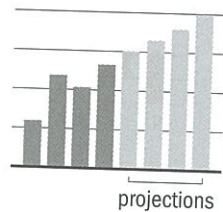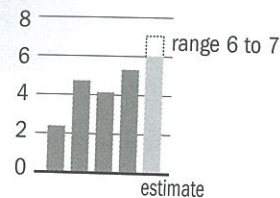
Do sweat the small stuff
Data is only as good as its source. Getting data from reputable and impartial sources is critical. For example, market share data should be benchmarked against a third party to avoid bias and add credibility.

Always assess data with a critical eye. If there is something wrong with one number, it is important to get to the bottom of it. One wrong data point can destroy the credibility of the whole chart.
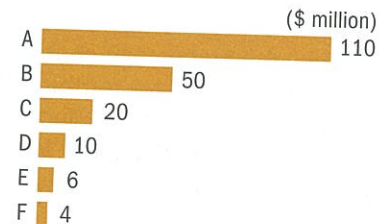
*Bad data + Good visualization = Bad chart*

One size doesn't fit all
Every set of data requires individual analysis and interpretation. There are many ways to present and visualize the same set of data. The choice ultimately depends on the intended message.

Example
A bar chart shows the revenue of all the companies in a particular market.

A pie chart, on the other hand, shows company A has 55% of the total market.

Total market: $200 million
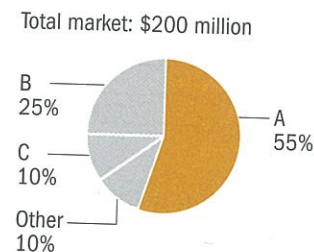
Put numbers in context
Build credibility by presenting facts fairly. An initiative to hire 200 people can be 1% of the workforce in one company or 10% in another company.

Showing a percentage without a base number is also meaningless. A 10% increase from what number to what number?

Example
Market share for product x

The only conclusion we can draw from the two pie charts is that A and B both have a 60% market share. However, not knowing the size of each market makes it impossible to judge which has more sales.

Leave rounding to the end
Don't round off your numbers until the last step in the presentation process. Rounding the figures up and down during the analysis stage can lead to final results that are far from the truth and subsequent erroneous interpretations.

Example	Data	After rounding
	12.4	12
	16.5	17
Percent change	+33.1%	+41.7%

Example	Data	After rounding
Company A	$2.9 billion	$3 billion
Company B	3.1	3
Company C	4.2	4

The comparison between company A and B is lost. Besides, $0.2 billion or $200 million is a lot of money.

Beware of showing a big percentage change based on small numbers. It is generally unfair to compare the percentage change in revenue of a big company to that of a small company. Even if a small company increases its revenue threefold, it may still be a small sliver in the total market.

## Data Richness

The more, the merrier?

Rich data means quality data — accurate data from reputable sources plus effective filtering of the data for the audience. In presentation, sometimes less is more.

Exercise judgment, edit

In the research stage, a bigger data set allows more in-depth analysis. In the edit phase, it is important to assess whether all your extra information buries the main point of the story or enhances the story and makes it more convincing.

Example
Without the benefit of editing and filtering, the bar charts show extensive detail of the revenues of all the companies in the market. However, the highlight of the story — the growth in market share of company B — is buried in the details.

Last year
($ million)
A	32
B	20
C	18
D	12
E	10
F	8

This year
($ million)
A	32
B	30
C	15
D	10
E	8
F	5
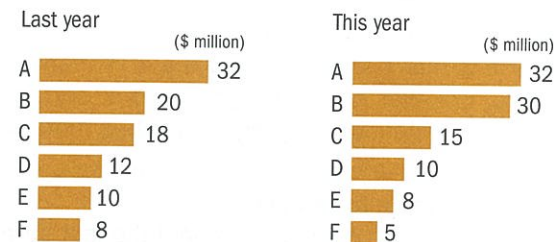
After analyzing the data, the pie charts show company B has a stronger market presence. Even though some details are lost in combining the smaller companies, the readers benefit from the editor's effort in highlighting the underlying data.

Last year ($ million)
B $20   A $32
C $18
Other $30

This year ($ million)
B $30   A $32
C $15
Other $23
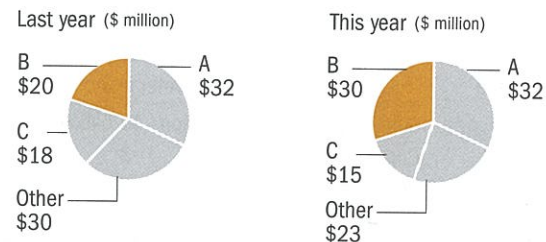
Tell the whole story with an excerpt
It is acceptable to extract a few numbers out of a series if these data points tell a story without misleading the reader to make wrong assumptions of the past and future.

Example
It is not deceiving to extract the recent performance data since sales have been basically rising at a steady rate. However, it is more advantageous to show all eight quarters to accentuate the point that performance has been consistently strong.

q1 q2 q3 q4 q1 q2 q3 q4
2008   2009

q2 q3 q4
2009
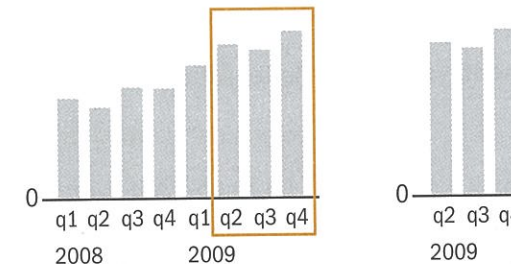
However, it would be misleading to extract the last three quarters in the chart below. In this case, excluding the previous quarters hides the bad performance data. The reader would draw a different conclusion if all the facts were shown.

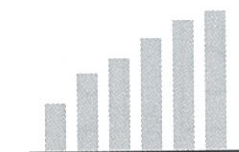q1 q2 q3 q4 q1 q2 q3 q4
2008   2009

q2 q3 q4
2009
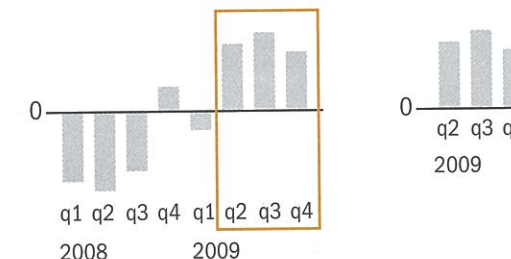
Data quantity does not equal data richness. Plotting a lot of data points is not necessarily better. A series of data points is meaningful and significant if it indicates a change from the baseline pattern.

Inconclusive
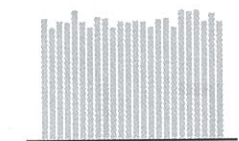
An upward trend

Legibility

With thousands of typefaces available today, in different styles and weights — serif, sanserif, italic, all caps, light, medium, bold and black — choosing type can be a daunting task. In the end, though, type in charts is meant to describe the information and not to adorn. And it is with that perspective that typography should be chosen purely on the merit of legibility.

Terminology

**Serif** type has a stroke added to the beginning or end of the main strokes of the letter.

Sanserif type means "letter without serifs."

Type size is the height of the type, which originated from the height of the metal block on which the letter was cast. In digital type, the type size is the height of the assumed equivalent of the block, and not the dimension of the letter itself.
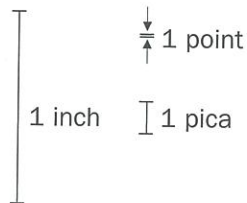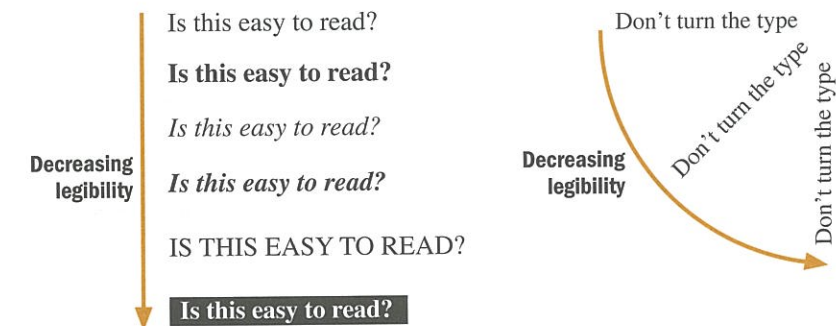
A point is the unit of measure for type size. Twelve points make a pica. A pica is close to one-sixth of an inch.
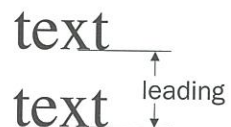
Leading *(pronounced led-ing)* is the vertical distance from the baseline of one line to the baseline of the next.

Basic rules of type legibility in charts

- In general, the leading should be about two points larger than the type size for comfortable reading, for example, 10-point type with 12-point leading.
- Don't set type too small or too condensed (condensed).
- Whether it is serif or sanserif, keep the type style simple. Use **bold** or *italic* only to emphasize a point. Don't use ***bold and italic*** at the same time.
- Don't use ALL CAPS. It is hard to read. Just like handwriting, we use upper- and lowercase letters.
- Avoid knocking white type out of black or color.
- Avoid hyphenation.
- Don't use highly stylized fonts (*stylized*).
- Don't set type at an angle.
- Don't track the type (t h i s   i s   t r a c k i n g).

Is this easy to read?

Is this easy to read?

Is this easy to read?

Is this easy to read?

IS THIS EASY TO READ?

Is this easy to read?

Decreasing legibility

Don't turn the type

Decreasing legibility

Simple test for legibility Reduce the chart on a copy machine to a reasonably small size. When typography is done right, the type will still be legible.

Typography in charts

In charts, typography should not be center stage. The data is the focus. Type in charts is there to describe the chart clearly and not to evoke an emotion, as in a fashion magazine or political poster. Poor typography draws undue attention away from the underlying data, which carries the main message. The impulse to use type styles to spice up the chart should be avoided at all costs. Typography done right helps present the information in the most efficient and direct way.

DON'T Don't permit typography to oppress the underlying data.

DO Keep the typography simple. The headline can be either bold or a couple of sizes larger.

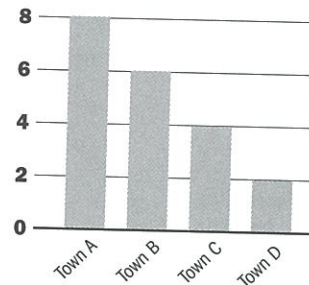Don't use all caps or knock white type out of black.

Don't use bold italic.

Don't use bold for the numbers on the scale.

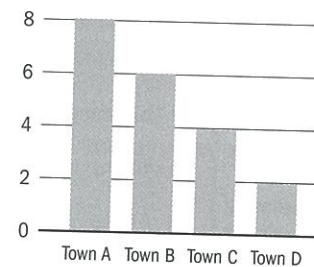Don't set type at an angle.

HEADLINE OF THE CHART

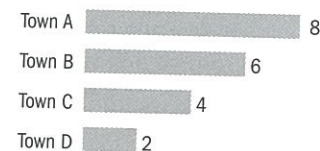*A brief description that outlines what the data shows*

Headline of the chart

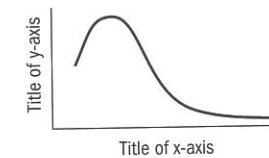A brief description that outlines what the data shows

Alternatively, chart the data as horizontal bars to accommodate long names.

DON'T Don't use highly stylized fonts or turn the type sideways to save space.
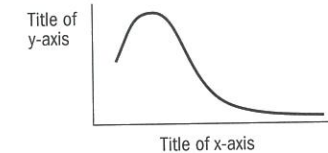
𝕳eadline of the chart
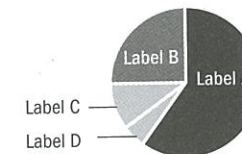
A brief description that outlines what the data shows

DO Serif and sanserif fonts can complement each other and add variety, and are still highly legible.
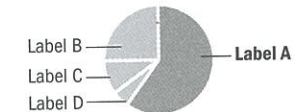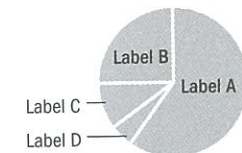
Headline of the chart

A brief description that outlines what the data shows

DON'T Don't knock white type out of black or color. Legibility is compromised.

DO Use bold to increase legibility on a shaded background or to emphasize a segment.

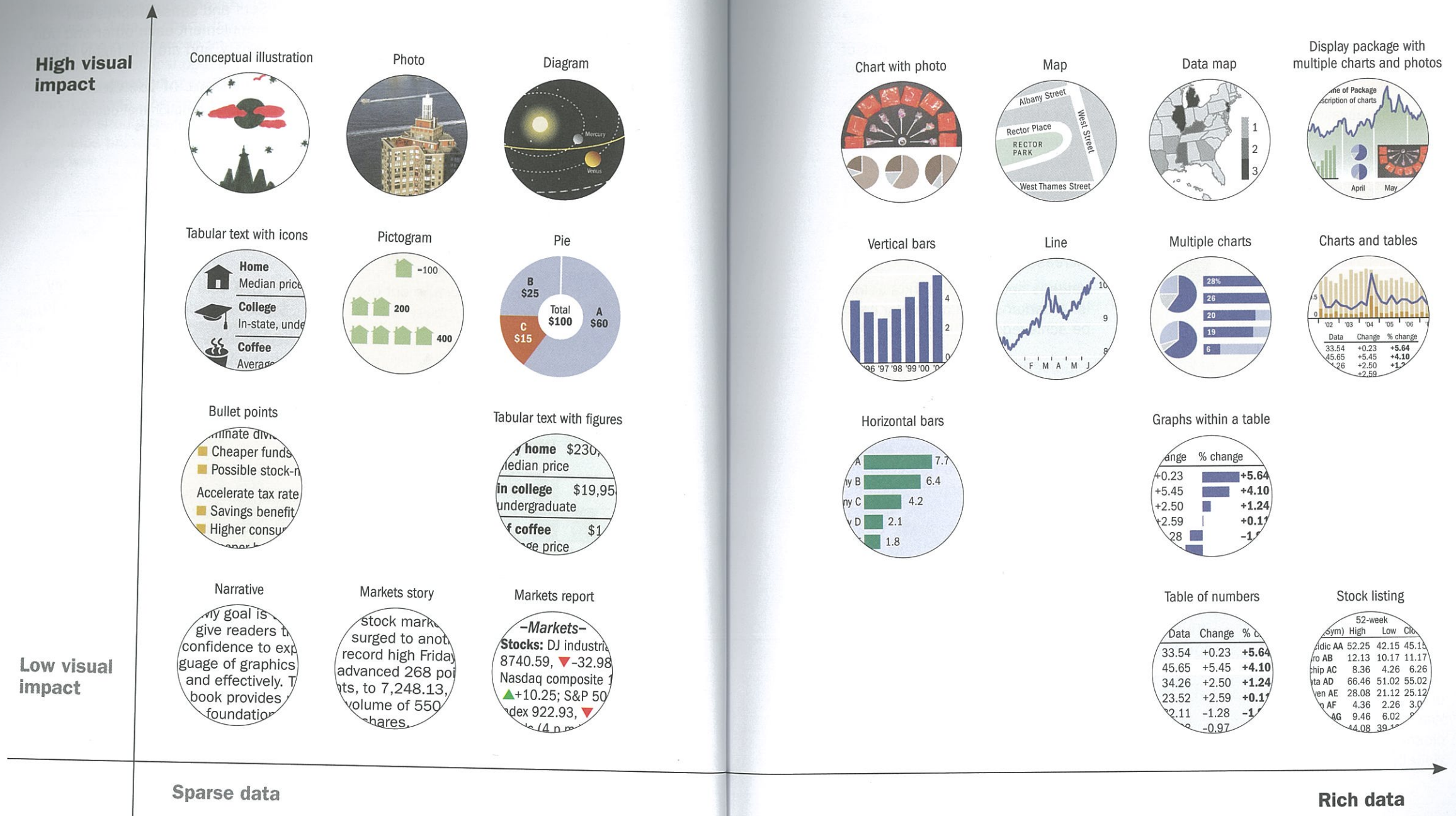**DON'T** Don't set a huge amount of text in bold. Emphasizing everything means nothing gets emphasized.

Name	Data	Data	Data
Company A	0.0	0.0	0.0
Company B	0.0	0.0	0.0
Company C	0.0	0.0	0.0
Company D	0.0	0.0	0.0

DO Use bold type to emphasize the focal point of the message. Be judicious.

Name	Data	Data	Data
Company A	0.0	0.0	**0.0**
Company B	0.0	0.0	**0.0**
Company C	0.0	0.0	**0.0**
Company D	0.0	0.0	**0.0**

Rich data, high visual impact

High visual impact

Conceptual illustration

Photo

Diagram

Chart with photo

Map
Albany Street
Rector Place
RECTOR PARK
West Street
West Thames Street

Data map
1
2
3

Display package with multiple charts and photos
me of Package
scription of charts
April   May

Tabular text with icons
Home
Median price
College
In-state, unde
Coffee
Average

Pictogram
=100
200
400

Pie
B $25
Total $100
C $15
A $60

Vertical bars
4
2
0
'96 '97 '98 '99 '00 '0

Line
10
9
8
F M A M J

Multiple charts
28%
26
20
19
6

Charts and tables
5
0
'02 '03 '04 '05 '06
Data   Change   % change
33.54   +0.23   +5.64
45.65   +5.45   +4.10
.26   +2.50   +1.2
        +2.59

Bullet points
inate divi
Cheaper funds
Possible stock-r
Accelerate tax rate
Savings benefit
Higher consu

Tabular text with figures
y home $230
edian price
in college $19,95
undergraduate
f coffee $1
e price

Horizontal bars
A   7.7
y B   6.4
ny C   4.2
y D   2.1
1.8

Graphs within a table
ange   % change
+0.23   +5.64
+5.45   +4.10
+2.50   +1.24
+2.59   +0.1
28   -1

Narrative
my goal is
give readers t
confidence to exp
guage of graphics
and effectively. T
book provides
foundation

Markets story
stock mark
surged to anot
record high Friday
advanced 268 poi
ts, to 7,248.13,
olume of 550
hares.

Markets report
–Markets–
Stocks: DJ industri
8740.59, ▼-32.98
Nasdaq composite
▲+10.25; S&P 50
dex 922.93, ▼
s (4 p

Table of numbers
Data   Change   % c
33.54   +0.23   +5.64
45.65   +5.45   +4.10
34.26   +2.50   +1.24
23.52   +2.59   +0.1
2.11   -1.28   -1
        -0.97

Stock listing
52-week
sym) High   Low   Clo
dic AA 52.25 42.15 45.1
ro AB   12.13 10.17 11.17
hip AC   8.36   4.26   6.26
ta AD   66.46 51.02 55.02
en AE   28.08 21.12 25.12
n AF   4.36   2.26   3.0
AG   9.46   6.02
        44.08 39

Low visual impact

Sparse data

Rich data

Color

Basics

Decreasing saturation

Different hue

Darker value

Describing colors

There are three main attributes of a color: hue, saturation and value.

**Hue** is how we normally describe color such as red, green and blue.

Saturation is the intensity of the color. A color with higher saturation is more intense in the same hue. For instance, a red becomes a more intense red (less pinkish) as the saturation increases.

Value is how light or dark a color is. A darker shade of a color can be achieved by adding black ink.

Warm and cool colors

Warm colors are those in the red area of the color spectrum such as red, orange, yellow and brown. Cool colors are the blue side of the spectrum and include blue, green and neutral gray.

Warm colors appear larger than cool colors so red can visually overpower blue even if used in equal amounts. Warm colors appear closer while cool colors visually recede.

Warm colors

Cool colors

Color wheel
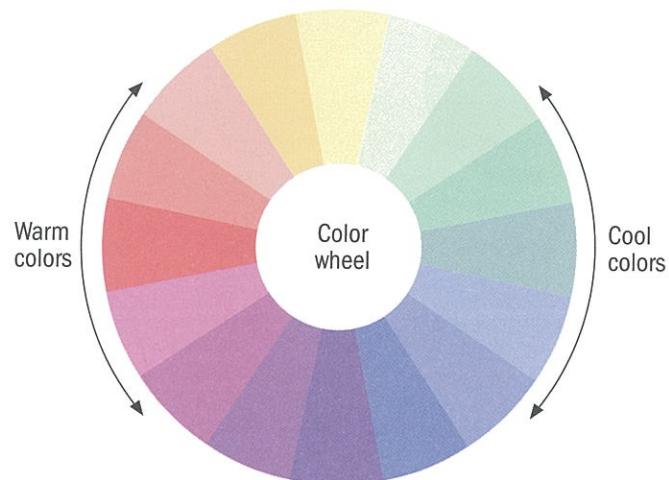
Specifying colors

Colors can be specified in different ways, depending on the application.

CMYK

Cyan, magenta, yellow, black are the four inks used by printers to produce full-color printing. In theory, overprinting cyan, magenta and yellow produces black, but in reality, the combination is a muddy brown. Black is used as the fourth printing ink to get a crisp solid black. Colors are specified as percentages of these inks.

Example
CMYK (100, 30, 0, 0) will print a color with 100% cyan, 30% magenta, 0% yellow and 0% black.

Cyan

Magenta   Yellow
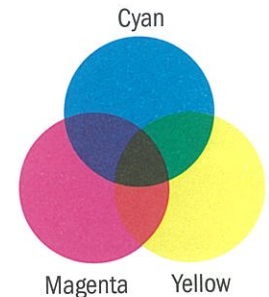
RGB

Red, green and blue light sources are combined to display colors on television and computer monitors. When all three lights illuminate simultaneously, white light is produced. When working with images for the screen, colors are assigned by the amount of red, green and blue. The range of each color component runs from 0 to the highest value 255.

Example
Red   RGB (255, 0, 0)

Red

Green   Blue
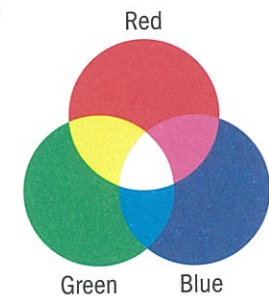
Hex value/hex triplet

A six-digit hexadecimal number or triplet is used to define colors in web design. Colors can be specified in the format of #RRGGBB, where RR, GG, and BB are the hexadecimal values for the red, green and blue values of the color. The range of each color component is from #00 to the highest value #FF.

Example
Red   RGB (255,0,0)   #FF0000
Green   RGB (0,255,0)   #00FF00
Blue   RGB (0,0,255)   #0000FF

Color palettes

A color palette for charts should include the basic colors and three to five shades of each hue. This gives you the option of using fewer colors within a chart to avoid distraction. Once you choose a palette, stay with it for the entire presentation so all the visuals look coordinated.

Bright color palette

Muted color palette

Color in charts

Admit colors into charts gracefully, as you would receive in-laws into your home. Don't apply all the colors in your palette at the same time. Using too many colors in a single chart is confusing and garish. Instead, choose harmonious combinations, such as different shades of the same color or colors on the same side of the color wheel. Limit the scope — even if color is available, it is okay not to use it at all.

Don't choose your colors arbitrarily. Choose them strategically to compare and contrast your data effectively. Every time you change a color, it signifies a change in information or an added layer of data. Ultimately, the information you present should determine every color you choose for your charts.

DON'T Don't use multiple colors to represent the same kind of data.

DO Use the same color to represent the same variable so the readers can focus on comparing the data.
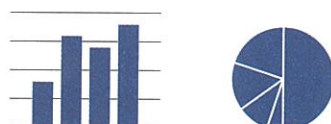
A darker shade or a different color can be used to highlight the focal point.

DON'T Don't use different colors or colors on the opposite side of the color wheel in a multiple-bar chart. The color contrast distracts the reader from the data.
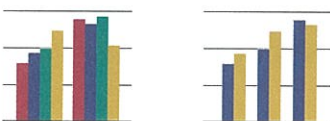
DO Use graduating shades of one color or colors on the same side of the color wheel to keep a multiple-bar chart clean and crisp. The readers can then focus on the underlying data.
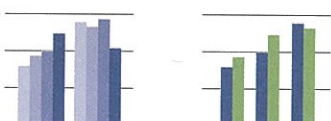
DON'T Don't set the scale with alternating light and dark colors in the middle of the scale. The eyes can't draw meaningful comparison jumping between light and dark shades.

DO The color scale should graduate from lightest to darkest or vice versa, regardless of the color. A simple test is to convert the color scale to black and white and check for smooth progression from light to dark.

-3 -2 -1 0 1 2 3 4

-3 -2 -1 0 1 2 3 4

Test: Convert the color scale to gray scale to test for the gradation.

Abrupt jump from lightest to darkest shade

Graduate from dark to light and on to dark
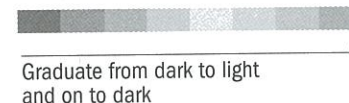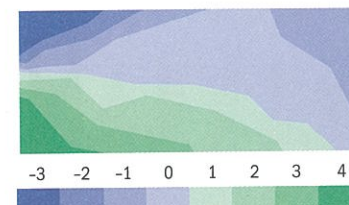
DON'T In general, avoid thematic representation of colors, such as red and green to show Christmas sales.
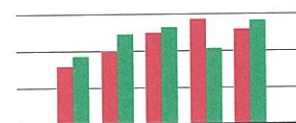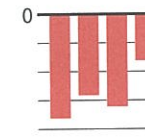
DO Colors can reflect the tone, for instance, deep blue for conservative and bright colors for something cheerful.
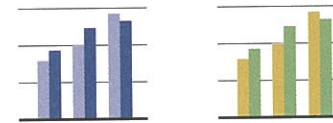
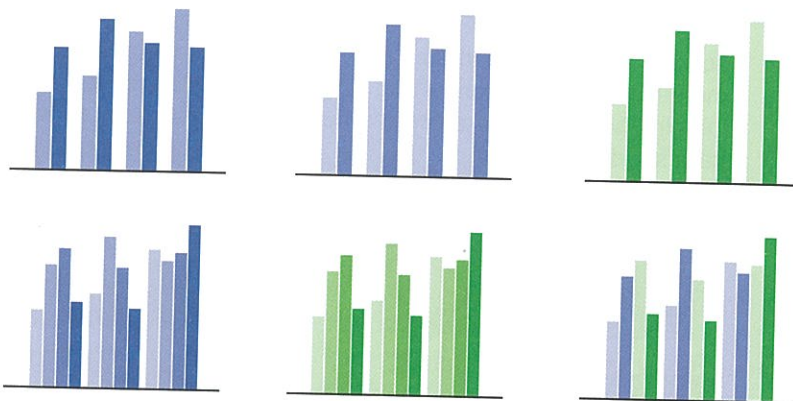**DON'T** Don't use red for positive numbers in a bar chart. Red is strongly associated with losses in business.
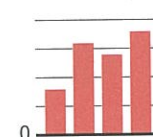
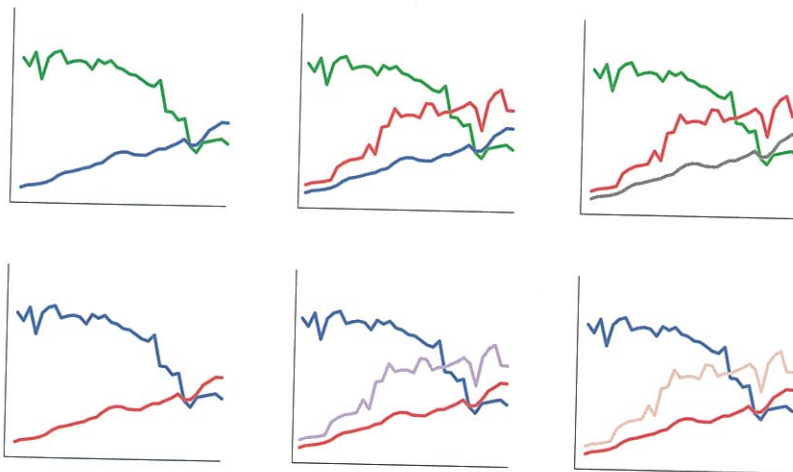**DO** Depicting negative earnings in red bars can be highly effective.

Color

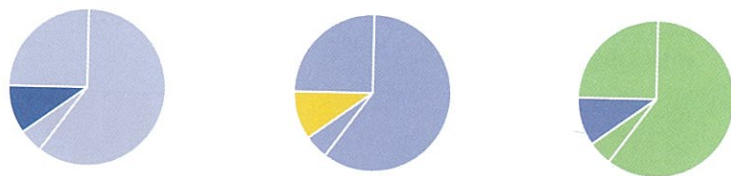## Color chart templates

With the bright color palette

Use different shades of the same color or colors on the same side of the color wheel.
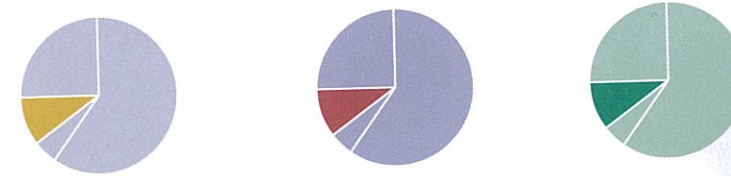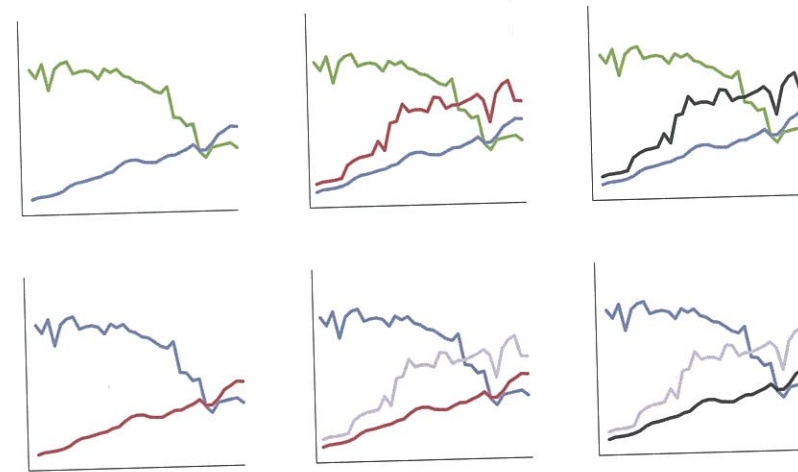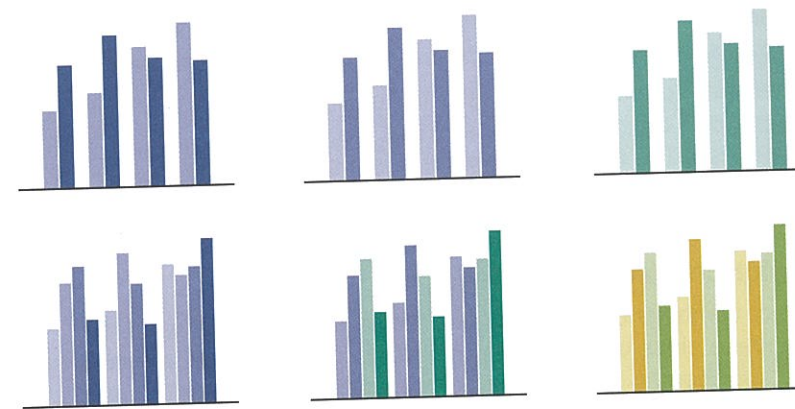
Use bright or dark colors such as red and black to emphasize the important line.

Use a darker shade or a different color to highlight a segment.

With the muted color palette

Color

Coloring for the color blind

A color change in any chart element signifies a change in information or an added layer of data. If color is a carrier of information and is not seen, the translation of information is severely impeded. A chart is only successful if a reader can access, read and understand the content.

According to the National Institutes of Health, about 1 in 10 men have some form of color blindness. There are two major types of color blindness. The most common form is distinguishing between red and green and the other type is distinguishing between blue and yellow.

Color combination pitfalls

Color combinations such as red/green or blue/yellow are on opposite sides of the color wheel. The color hues are very different but they can be similar in value or lightness. The color intensity overpowers the underlying data. The colors even vibrate when used in large quantities. These color combinations are distracting for readers with normal color vision. The lack of contrast in lightness makes it virtually unreadable for color-blind users.

A legend that relies on color alone to convey information can be extra work for general users and possibly indecipherable for color-blind readers. Legends are often difficult for most readers since our eyes cannot draw immediate distinction between small color swatches, especially when there is not enough contrast in color and value.
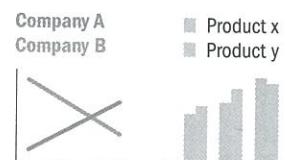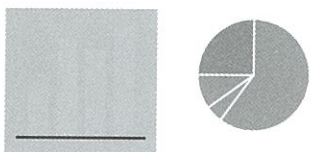
Different hues, same value

Color text and legends

Company A
Company B

Product x
Product y
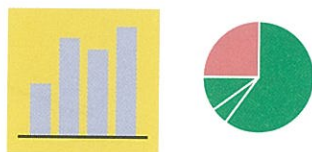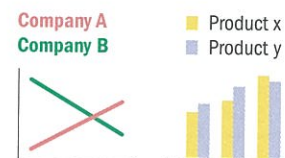
Lack of contrast when converted to black and white:

Company A
Company B

Product x
Product y

Strategies for selecting effective colors

1 Set type in black

Black provides the highest contrast. It is most effective to use black type on a light background. Color type is hard to read even for readers with normal color vision. If you need a dark background for design reasons, use white type and not color type.

Use black text   White text
Use black text   White text

2 Label directly on chart elements

Direct labeling is helpful for all readers. If you must use a legend, be sure the colors have high contrast in values.

In addition to using darker shades to highlight a bar or a line, you can set the label in bold typeface. See segment B in the pie chart on the right. This redundant means of presenting information will guarantee all information conveyed with color is also clear without color.

A
B
A
B
C
D
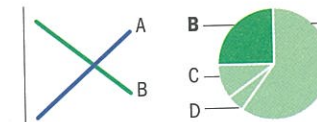
3 Ensure high contrast in values

If a different color is used to distinguish different chart elements or signify a change in data, use a lighter or darker shade of that second color. It is easier for the eyes to differentiate lightness or darkness. Sufficient contrast in values makes the chart more accessible to all readers.

4 Final test: Convert to gray scale

Print the chart in black and white or make a copy in gray scale to test whether the contrast in values, not colors, is sufficient. The colors work if the chart holds up in black and white.

Color scale application

The **heat map** is one of the tools that investors use to identify new opportunities in changing markets so that they can then take advantage of them. Juxtaposing a series of heat maps can help reveal how prices of different securities move together.

Example
Change in volatility in a stock index option over the course of a trading day.

Strike price

Contract maturity

Strike price
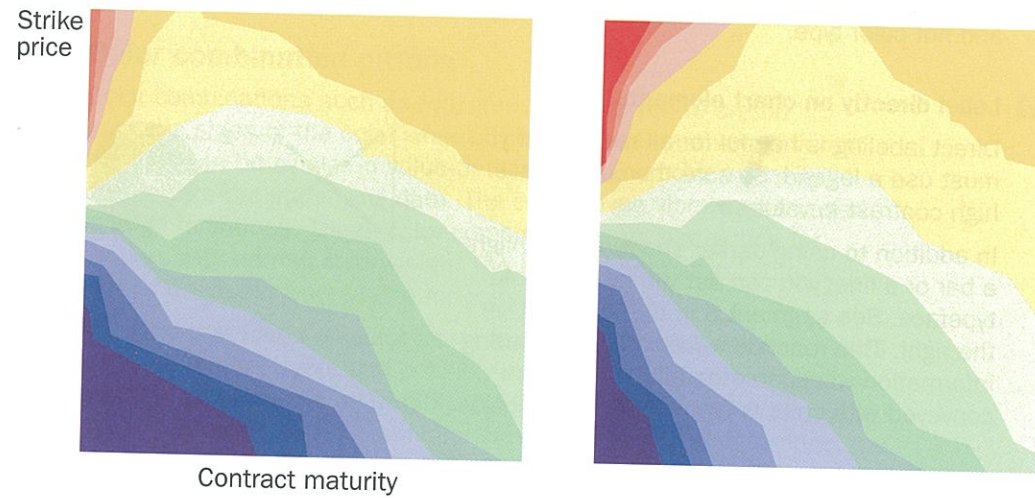
Contract maturity

Color is the third dimension that is used to show the relationship among three variables in a flat display. These heat maps show how the change in options volatility depends on both contract maturity and strike price over time.

Any measure that shows a continuous range of values can be mapped with a color gradient.

Change in volatility


(−)　　　　　　　　　　0　　　　　　　　　　+
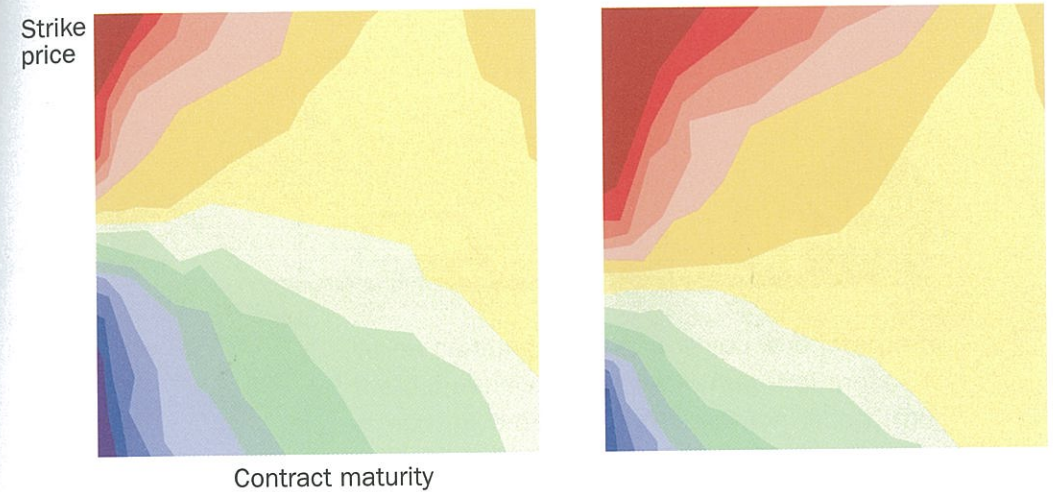
Overall, the color scale should graduate smoothly from lightest to darkest or vice versa, regardless of the color. There should not be alternating dark and light strips in the middle of the spectrum.

Pies

Slicing and dicing

Pie charts should not be used to illustrate complicated relationships among many segments. It is easier to compare two vertical bars than two slices in a pie.

Less effective order

It's intuitive to read top to bottom and clockwise. **Never chart segments clockwise from smallest to largest.** By ordering the slices from smallest to largest in clockwise direction or vice versa, the least important segment has the most prominent position.
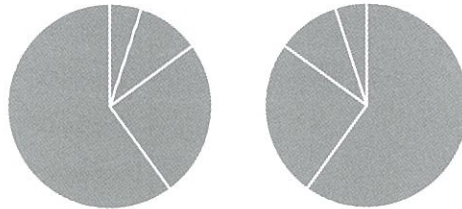
Too many slices

It's difficult to compare and contrast many segments. **A pie chart shouldn't have more than five slices.**

If there are more than five, combine the smaller and less significant segments to create the fifth slice and label it "Other." If all segments have to be represented separately, use a stacked or segmented bar chart instead. See page 79.

Larger segments on top

start here

2nd largest

largest segment

3rd

4th
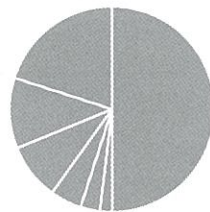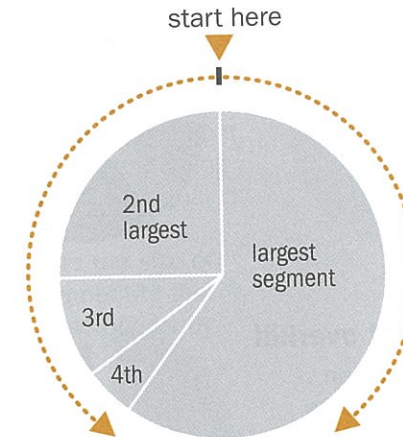
Reading a pie chart is like reading a clock. It's intuitive to start at 12 o'clock and go clockwise.

Therefore, it is most effective to **place the largest segment at 12 o'clock on the right to emphasize its importance.**

The best way to order the rest of the segments is to place the second biggest slice at 12 o'clock on the left; the rest would follow counterclockwise. The smallest slice will fall near the bottom of the chart, in the least significant position.

The only exception to the ordering is when all the slices are close in value. In this case, start at 12 o'clock on the right and go clockwise from largest to smallest.

15%

35%

20%

30%
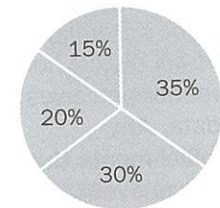
Just like in bar and line charts, direct labeling helps the reader to quickly identify individual segments and focus on the comparison between them.

Pies

Dressing up the slices

Pie charts are not as effective in presenting complex data as line or bar charts, but they are good visual tools for showing portions of a whole. Avoid the temptation to dress up a pie by using different colors or 3-D effects, which will distort how the reader perceives the data. **Any embellishments that are not relevant to the data have no place in a chart.**
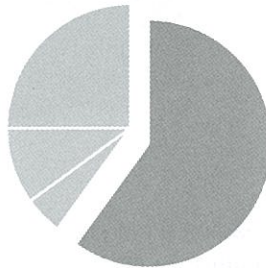
Distracting shades and colors

A pie with multiple shades or colors distracts the reader from immediate comparison of the segments.
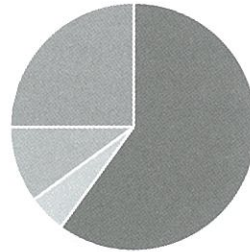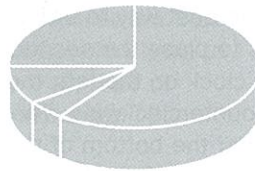
Special effect overkill

Don't use more than one trick to highlight a segment, for instance, don't both shade and pull out the slice you want to emphasize.

Incorrect data representation

Since the area is used to represent each segment's relative value, a pie with three-dimensional rendering misrepresents each segment's proportion to the whole.
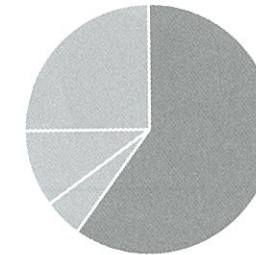
Keep the shading simple

It is generally easier to compare different lengths than different sizes of segments of a pie. Therefore, keep it simple when shading the slices. The goal is for the reader to compare the size of any segment to the whole pie efficiently.
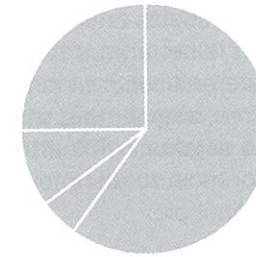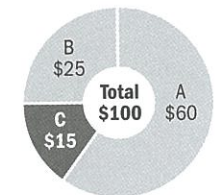
Highlight the important slice

Use different shading to highlight one or two important segments.

The highlighted segment doesn't have to be the largest slice. However, do not reorder the segments.

A donut pie chart can be used to display the total value inside the pie.

Slicing a slice

The function of charts is to give an immediate impression of a visual message. Asking readers to do the math in their heads totally defeats the purpose of charting. Always do the work for your readers.

Stop slicing already!

While pie charts are commonly used in the business world, it is not always the ideal format in which to compare and contrast different segments visually. Therefore, **segmenting within a slice makes the second segment difficult to grasp.** It's too much work for most readers to compare the final slice to the original pie.

30% 40% 15% 10% 5%

25% 60% 10% 5%

= 10% x 15%
= **1.5% of the original pie**
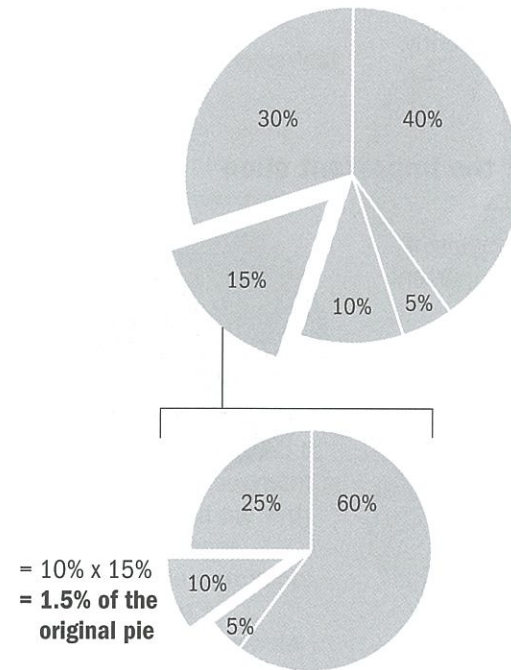
Go for a bar, instead of another pie
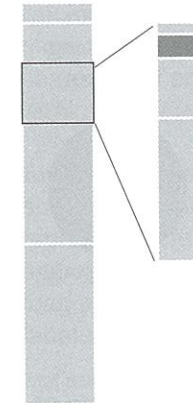
A segmented bar chart in general is more efficient than a pie chart at showing portions of a whole. It also allows for more segments than a pie without looking confusing. Be sure to label both the percentages and the actual values. It helps to put the segments in real terms.

30% 40% 15% 10% 5%

60% 25% 10% 5%

$120 $50 $20 $10
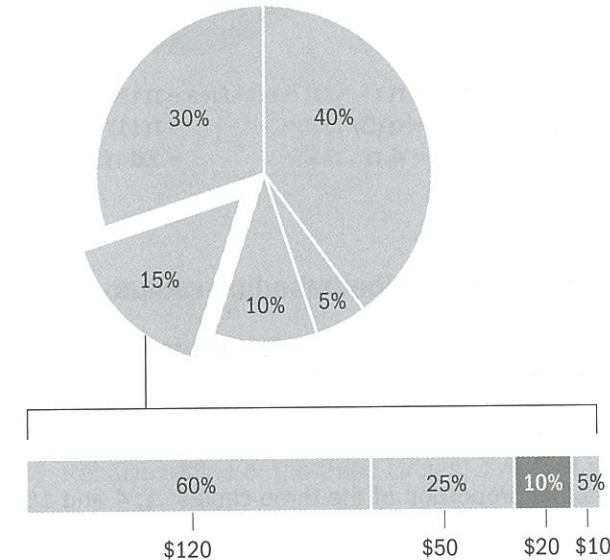
One segmented bar within another is also a fine choice.

Pictograms

Choice of icons

Avoid using partial icons in a pictogram. The purpose of a pictogram is to create a snapshot of the data. Partial icons add confusion.

The only exception is when using a square as an icon. A square works even if a small sliver of the unit is used.

■▮ 115

A truncated person or airplane is not only illegible but also disturbing.

👤▌ 150

✈✈ 150

Bad icons

Even though a pictogram is more visually engaging than a bar chart, it is less effective for comparing a large amount of data. A pictogram should be used only when comparing a few simple data series.

Icons in pictograms are not meant to be works of art. Icons that are visually interesting do not necessarily make good symbols for pictograms. A symbol with **too many details** hinders the readers from comparing the underlying data. When these symbols are used in multiples, they create a cluttered and busy picture.

Distracting variations

Don't use different versions of a symbol to represent the variables. The combinations can be very distracting and it is hard for the readers to compare the underlying data. The focus should be the information and not the drawing.

Existing home sales	New home sales	Homes foreclosed
🏠🏠🏠🏠🏠 🏠🏠🏠🏠🏠 🏠🏠 **12**	🏠🏠🏠🏠🏠 🏠🏠🏠🏠🏠 🏠 **11**	🏠🏠🏠 **3**

Good icons

Icons or symbols are used to depict quantitative information in pictorial graphs. Pictograms can give a quick snapshot of quantity and volume, but are not suited to chart massive amounts of data. A bar chart is far more effective than a pictogram when comparing discrete quantities of several complex data series.

Icons used in pictograms should be simple. When these symbols are used in multiples, they still maintain a clear picture and present the data in an attractive and efficient way.
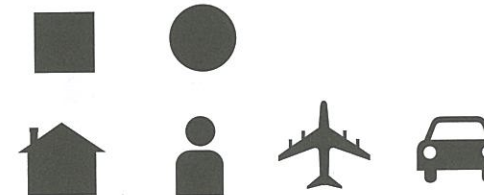
One symbol, various shades

Use one symbol with different shades to represent the variables. The readers can focus on comparing and contrasting the data and not on the different styles of the icon.

| Existing home sales	New home sales	Homes foreclosed
🏠🏠🏠🏠🏠 🏠🏠🏠🏠🏠 🏠🏠 **12**	🏠🏠🏠🏠🏠 🏠🏠🏠🏠🏠 🏠 **11**	🏠🏠🏠 **3**

A test for determining a good icon:

☑ Simple.

☑ Symmetrical.

☑ Clear and crisp even when reduced to a small size.

☑ Roughly fits in a square.

Pictograms

Comparing quantities

If the data points are close together, do not use a pictogram. It is difficult to contrast and discern subtle differences in a busy picture.

■ =1

Cars **10**

Boats **9**

Planes **8**
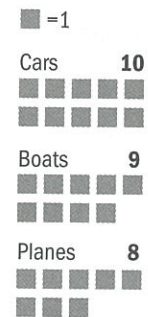
No shrinking houses or people

Don't chart quantitative information based on the area or height of an icon. Human eyes can't draw meaningful comparisons from irregular shapes. Stretching an icon in any dimension to represent the value only makes a chart look amateurish.

House vs. McMansion?

100   200   100   200

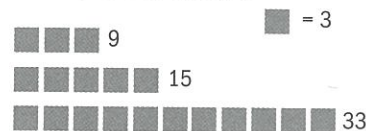Dwarf vs. giant?

100   200   100   200

Avoid partial icons and awkward units

Avoid using partial icons. If most of the data points have to be represented by partial icons, a bar chart is more effective.
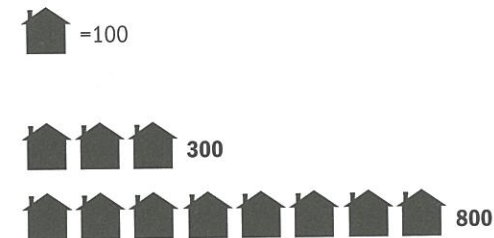
Confusing partial icons

■ 9   ■ = 10

■■ 15

■■■■ 33

Awkward increments

■■■ 9   ■ = 3

■■■■■ 15

■■■■■■■■■■■ 33

Comparing with multiple units

A pictogram takes the form of a bar chart and uses icons or symbols to visualize the data. Multiple units of a symbol are used to represent the discrete quantities.

An effective pictogram is visually engaging and gives a quick comparison of the variables.

=100

300

800

Natural units

In an effective pictogram, most data points should be multiples of a complete icon. Each icon should represent a natural counting increment, such as 1, 2, 5, 10, 50 and 100.

■■■ 30   ■ = 10

■■■■■ 50

■■■■■■■■■■■ 110

■■■ 6   ■ = 2

■■■■■ 10

■■■■■■■■■■■ 22
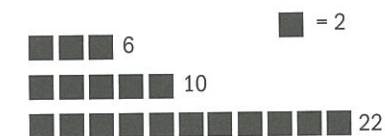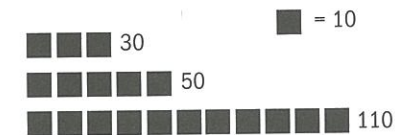
Always label the data values of a pictogram. Don't make the readers count.

Icons should be organized in groups of 5 or 10 to facilitate easy visual counting.

Unnatural grouping

12

Effective grouping

12