

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?

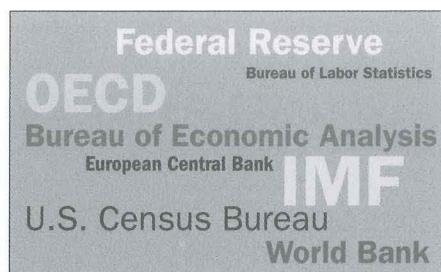
These basics provide the backbone and foundation for executing intelligent and persuasive charts.

How to create effective charts

The best charting practice is to systematically follow four essential steps — research, edit, plot and review.

1

Research



2

Edit

Absolute values		Percentage change	
A	B	A	B
10	100	+100%	+10%
20	110	+200%	+20%
30	120		

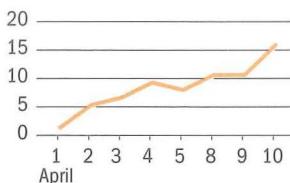
- Research from up-to-the-minute authoritative sources.
- Use an independent source for disputable data that is open to interpretation, such as market share, to avoid bias and conflict of interest.
- Obtain permission to use the data, if required.

- Identify your key message.
- Choose the best data series to illustrate your point, e.g. market share vs. total revenue.
- Filter and simplify the data to deliver the essence of the data to your intended audience.
- Make numerical adjustments to the raw data to enhance your point, e.g. absolute values vs. percentage change.

Plot

Headline of the chart

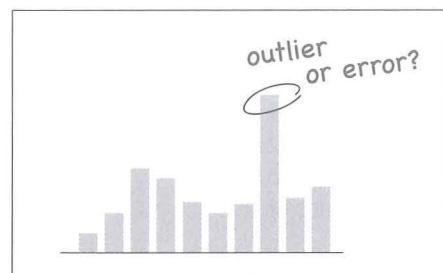
Brief description of the chart



- Choose the right chart type to present the data, e.g. a line to show trend or a bar to show discrete quantities.
- Choose the appropriate chart settings, e.g. scale, y-axis increments and baseline.
- Label the chart, e.g. title, description, legends and source line.
- Use color and typography to accentuate the key message.

Review

outlier
or error?



- Check the plotted data against your sources.
- Use judgment to evaluate whether your chart makes sense.
- Try to look at the chart from the reader's perspective.
- Verify your data with additional sources and consult with experts in the field for questionable content and outliers.
- Refer to this book to check best charting practices.

Too often, this step is skipped for the sake of expedience. However, taking the time to go over every step of your work can make the difference between a professional and an amateur attempt. Unlike a misspelled word in a story, one wrong number discredits the whole chart.

Tangible evidence

When calculating the figures and plotting the graphs, use decimal places for accuracy. However, in labeling your chart, round off the numbers to the significant digit (or digits) for easy comparison. For example, labeling 12.345 may be more precise than 12.3, but it distracts from the visual impact of the chart.

Words vs. Charts

Charting is a powerful tool that puts a series of numbers in close proximity to each other. The numbers in a chart convey information to the reader both visually and narratively. The same set of numbers looks more concrete and precise when charted than when presented in a story or a caption.

Test

Numbers in a story:

Company A earns \$100 million and outperforms company B which earns \$75 million.

Numbers plotted:

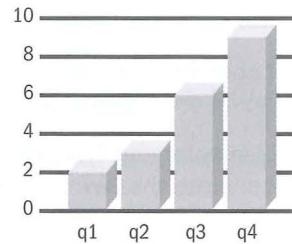
Earnings in millions
A \$100
B \$75

The chart shown above on the right allows you to make a judgment at a glance. It is more memorable than a string of numbers held together by words.

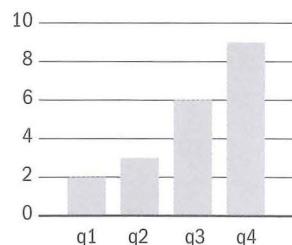
Let the data speak for itself

The best chart should be free of any distraction and allow the reader to compare or contrast the data and draw a conclusion.

A chart with obtrusions such as heavy gridlines and 3-D rendering obscures the data and diverts the reader's attention from the content.



In contrast, a clean and crisp chart allows the reader to focus on the data, which is the message of the story.



Create the right comparison

Same numbers, different stories

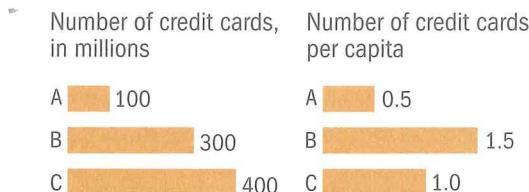
Filter and edit the data to keep it consistent and relevant to your message. Embellishments are not a substitute for organizing and presenting the data in the right way.

Example

Credit card issued by bank X in each country

Country	Number of credit cards	Population	Number of credit cards per capita
A	100 million	200 million	0.5
B	300	200	1.5
C	400	400	1.0

Presenting the number of credit cards on an aggregate basis and on a per capita basis will tell two different stories and convey different impressions with the same data.



Country C has the largest total market. This chart reflects the overall credit card market.

Country B has the highest issuance per capita. This chart demonstrates the success of the marketing effort in country B despite its smaller population.

If the raw data is insufficient to tell the story, do not add decorative elements. Instead, research additional sources and adjust data to stay on point.

Frame the reference

It's all relative

Imagine your wealthy uncle gave you \$10,000. You would be happy. If you found out he had given your brother \$20,000, would you still feel \$10,000 richer? or \$10,000 poorer?

\$10,000 richer?



\$10,000 poorer?



The frame of the information dictates how readers interpret the data. People need a reference point.

When you supply the reference point, you control the message.

Readers frame the information based on what they expect to see. Even with a random number, they will create a reference point and assign meaning to it.

Quiz

Stock A is \$100 a share. A. high

The share price is... B. low

C. not sure

It is impossible to assess whether \$100 is a fair price without any context. If we knew, for example, the 52-week high and low of stock A, we could answer this question.

Creating reference with charts

A single number by itself may not mean much.

Plotting a series of numbers together can create an impact.

Example

A statement with a single number has no implication.

Stock B is at \$5 a share.

However, by plotting prices of stock B over time, the chart clearly shows that at \$5, the stock has lost half its value.



Send the right signal

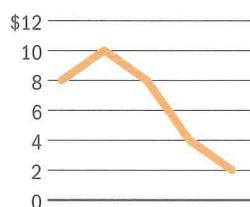
One set of numbers can be charted in many ways. **People feel the pain of a \$1,000 loss more than the joy of a \$1,000 gain.** Use the right context to communicate the message you intend.

Example

Performance of stock A

Share price	Percent change from first data point
\$ 8	0 %
10	+25
8	0
4	-50
2	-75

Plotting the actual share prices:



Plotting the percentage change in prices will bring the line into negative territory. This accentuates the drop in share prices. Just by setting the baseline, the chart visually implies the performance is unacceptable.

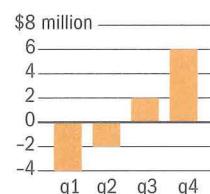


Both charts give a fair picture. Clearly, the choices you make in charting create the framework that sends a specific message to the readers.

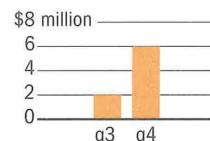
The message of the chart should be consistent with ALL the facts and evidence available. For instance, when plotting profit and loss, a chart that omits previous quarters with poor performance would misrepresent the facts.

Example

Full disclosure



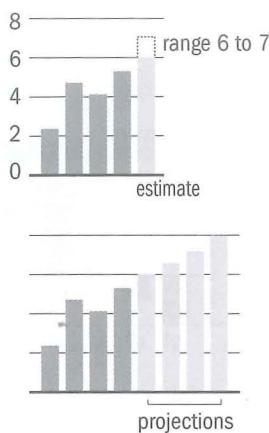
Half truth



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.



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.

$$\text{Bad data} + \text{Good visualization} = \text{Bad chart}$$

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.

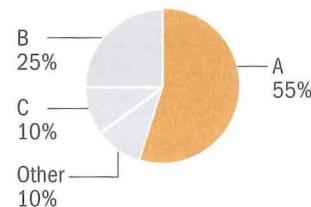
Example

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

	(\$ million)
A	110
B	50
C	20
D	10
E	6
F	4

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.

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.

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.

The more, the merrier?

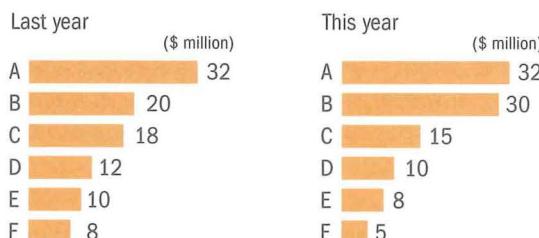
Rich data means quality data — accurate data from reputable sources plus effective filtering of the data for the audience. In presentation, sometimes less is more.

Exercise judgment, edit

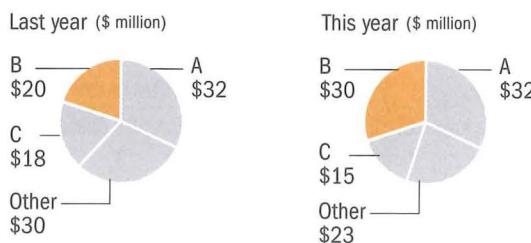
In the research stage, a bigger data set allows more in-depth analysis. In the edit phase, it is important to assess whether all your extra information buries the main point of the story or enhances the story and makes it more convincing.

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.



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.

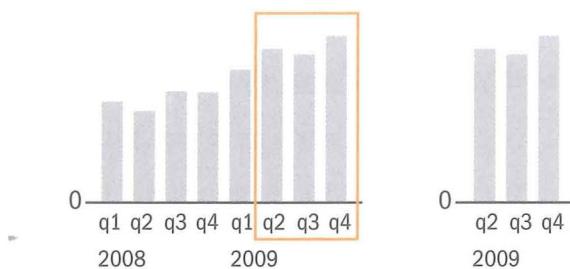


Tell the whole story with an excerpt

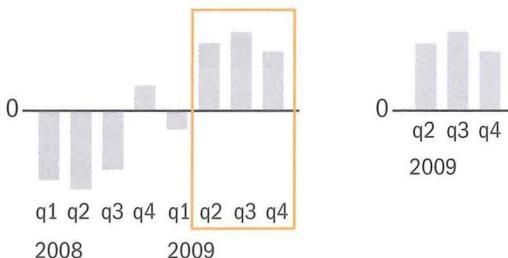
It is acceptable to extract a few numbers out of a series if these data points tell a story without misleading the reader to make wrong assumptions of the past and future.

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.



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.



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



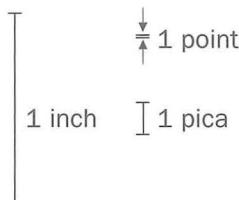
Serif type has a stroke added to the beginning or end of the main strokes of the letter.



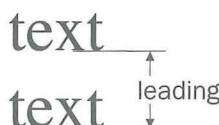
Sanserif type means “letter without serifs.”



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.



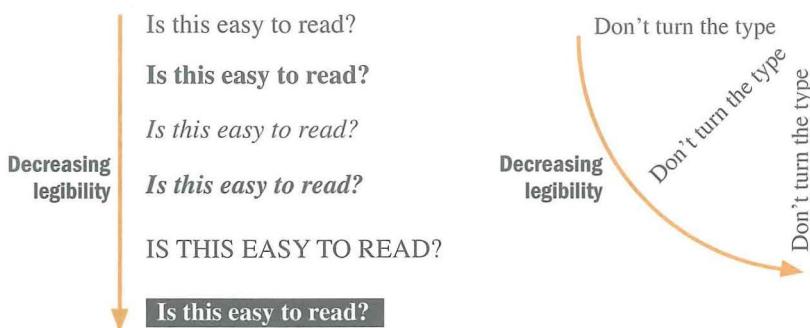
A point is the unit of measure for type size. Twelve points make a pica. A pica is close to one-sixth of an inch.



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 (*this is tracking*).



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.



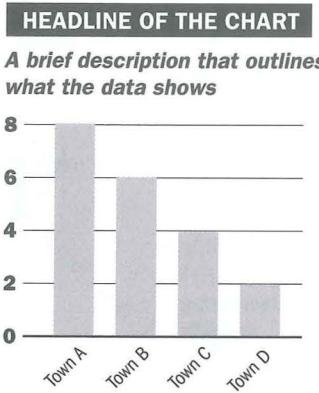
Don't permit typography to oppress the underlying data.

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.

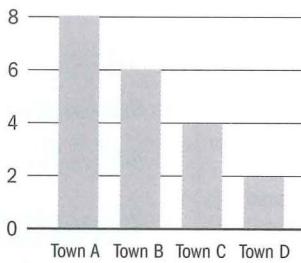
Don't set type at an → angle.



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

Headline of the chart

A brief description that outlines what the data shows



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

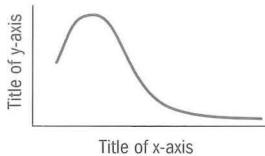
Town A	8
Town B	6
Town C	4
Town D	2



Don't use highly stylized fonts or turn the type sideways to save space.

Headline of the chart

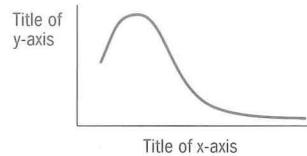
A brief description that outlines what the data shows



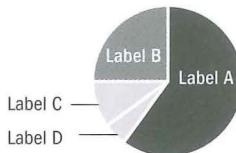
Serif and sanserif fonts can complement each other and add variety, and are still highly legible.

Headline of the chart

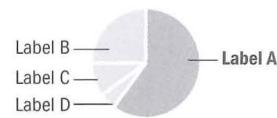
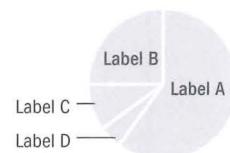
A brief description that outlines what the data shows



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



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



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



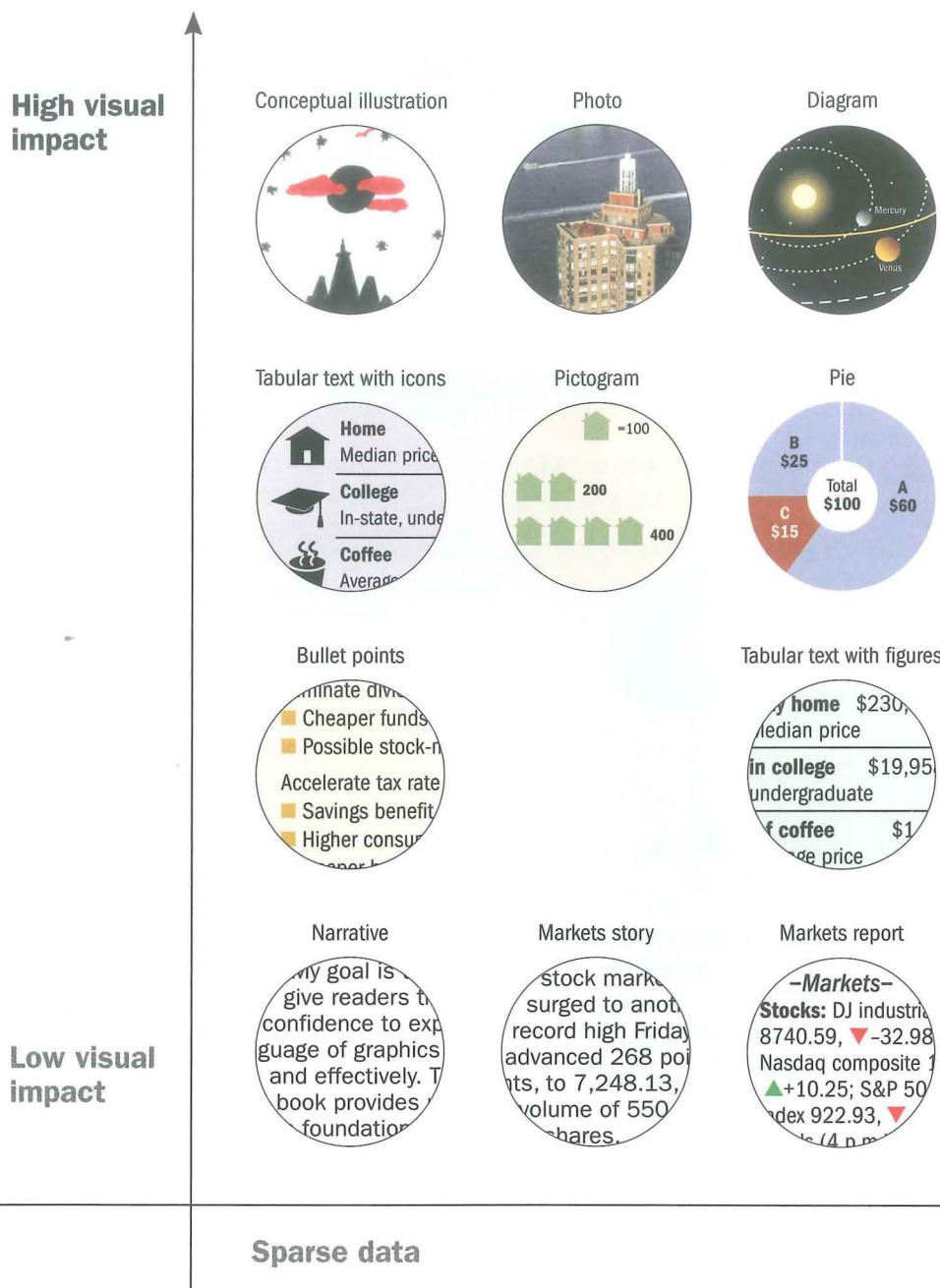
Use bold type to emphasize the focal point of the message. Be judicious.

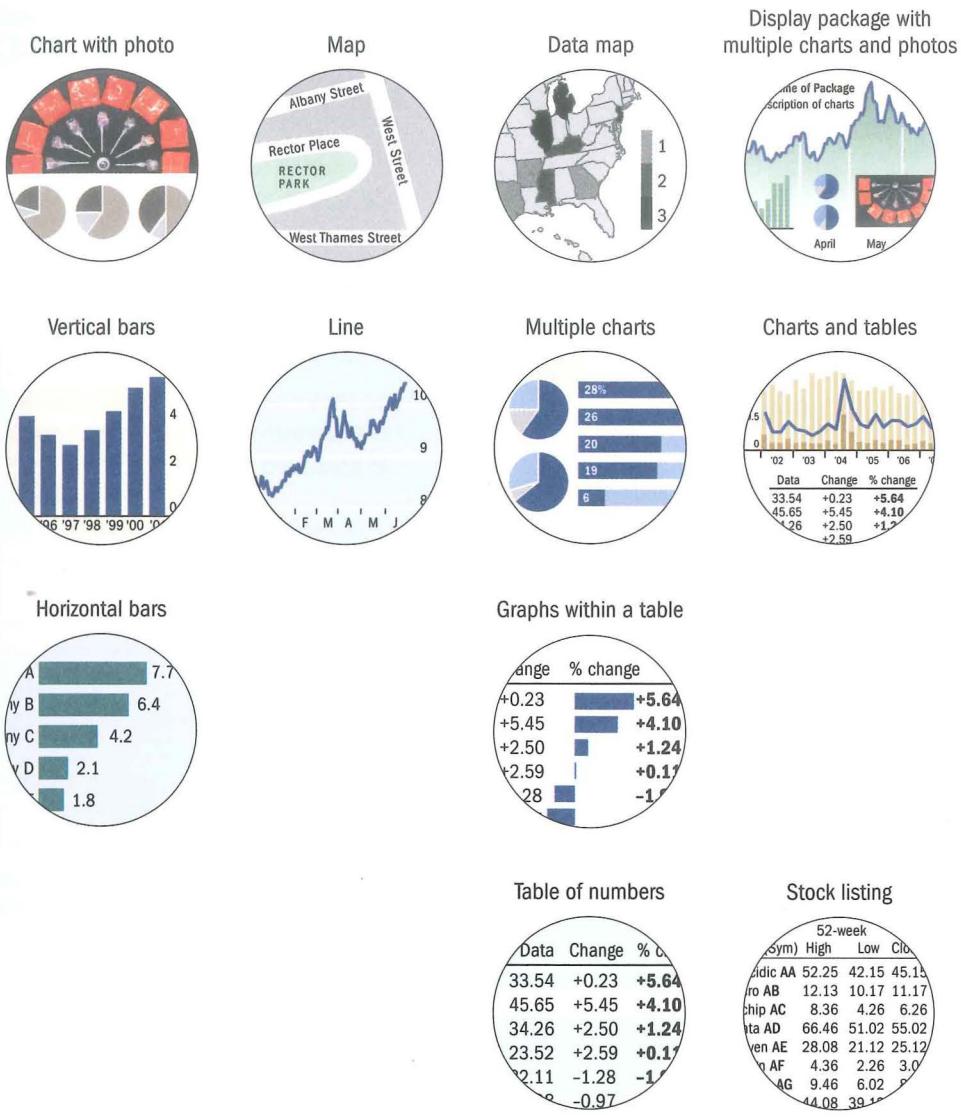
Name	Data	Data	Data
Company A	0.0	0.0	0.0
Company B	0.0	0.0	0.0
Company C	0.0	0.0	0.0
Company D	0.0	0.0	0.0

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

The Visual–Data Continuum

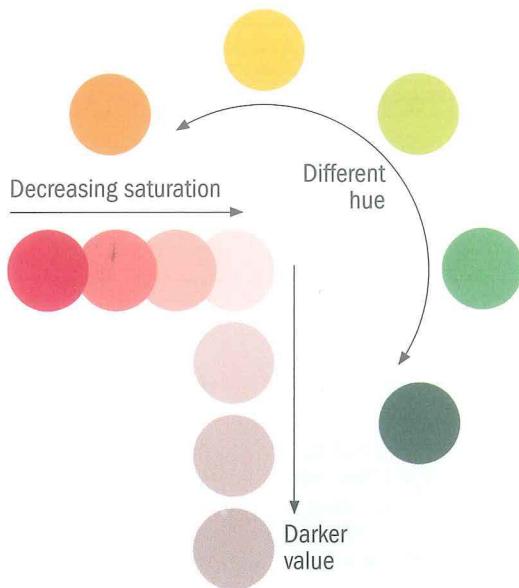
Rich data, high visual impact





Rich data

Basics



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.

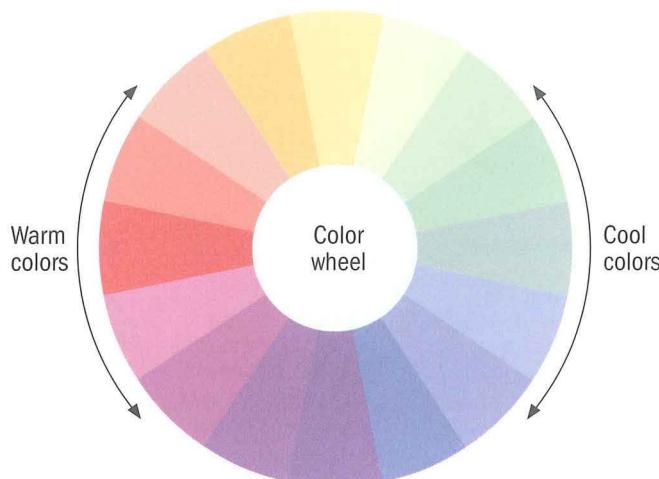
Saturation is the intensity of the color. A color with higher saturation is more intense in the same hue. For instance, a red becomes a more intense red (less pinkish) as the saturation increases.

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.



Specifying colors

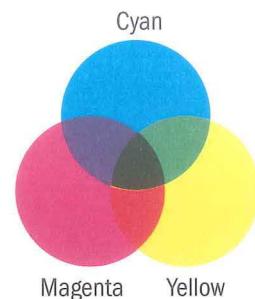
Colors can be specified in different ways, depending on the application.

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.

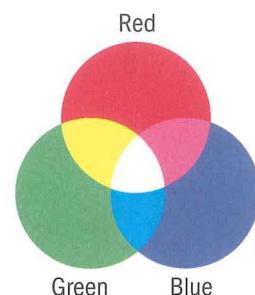


RGB

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)



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

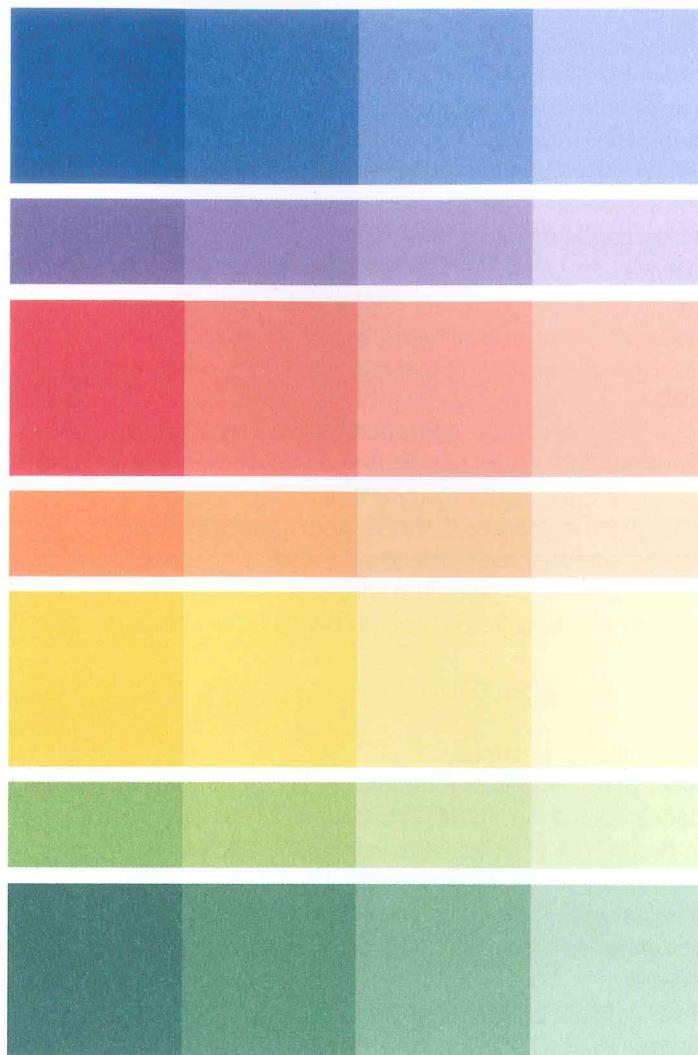
Green RGB (0,255,0) #00FF00

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



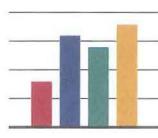
Color in charts

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 use multiple colors to represent the same kind of data.



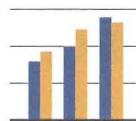
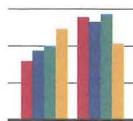
Use the same color to represent the same variable so the readers can focus on comparing the data.



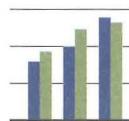
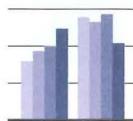
A darker shade or a different color can be used to highlight the focal point.



Don't 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.

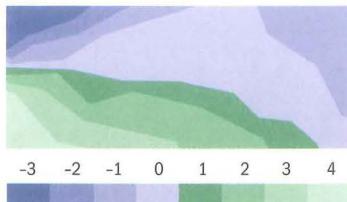


Use graduating shades of one color or colors on the same side of the color wheel to keep a multiple-bar chart clean and crisp. The readers can then focus on the underlying data.

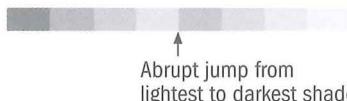




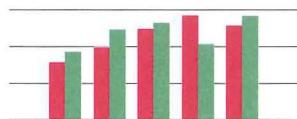
DON'T
Don't set the scale with alternating light and dark colors in the middle of the scale. The eyes can't draw meaningful comparison jumping between light and dark shades.



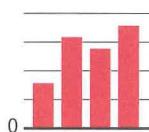
Test: Convert the color scale to gray scale to test for the gradation.



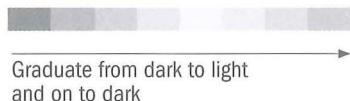
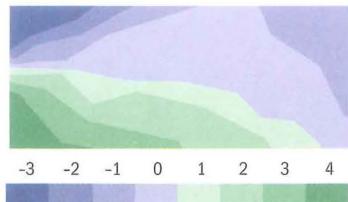
DON'T
In general, avoid thematic representation of colors, such as red and green to show Christmas sales.



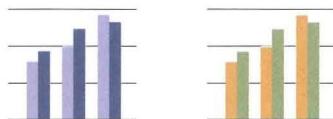
DON'T
Don't use red for positive numbers in a bar chart. Red is strongly associated with losses in business.



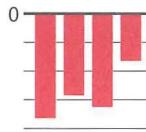
DO
The color scale should graduate from lightest to darkest or vice versa, regardless of the color. A simple test is to convert the color scale to black and white and check for smooth progression from light to dark.



DO
Colors can reflect the tone, for instance, deep blue for conservative and bright colors for something cheerful.



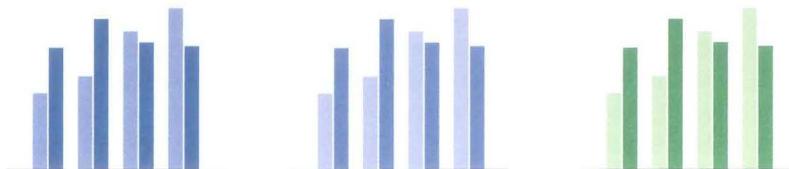
DO
Depicting negative earnings in red bars can be highly effective.



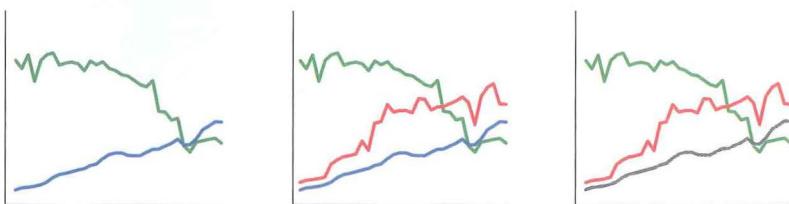
Color chart templates

With the bright color palette

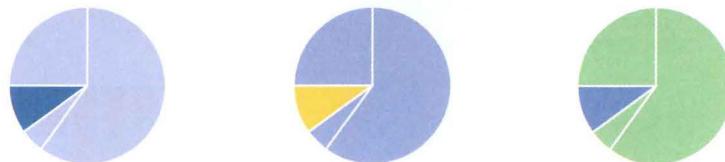
Use different shades of the same color or colors on the same side of the color wheel.



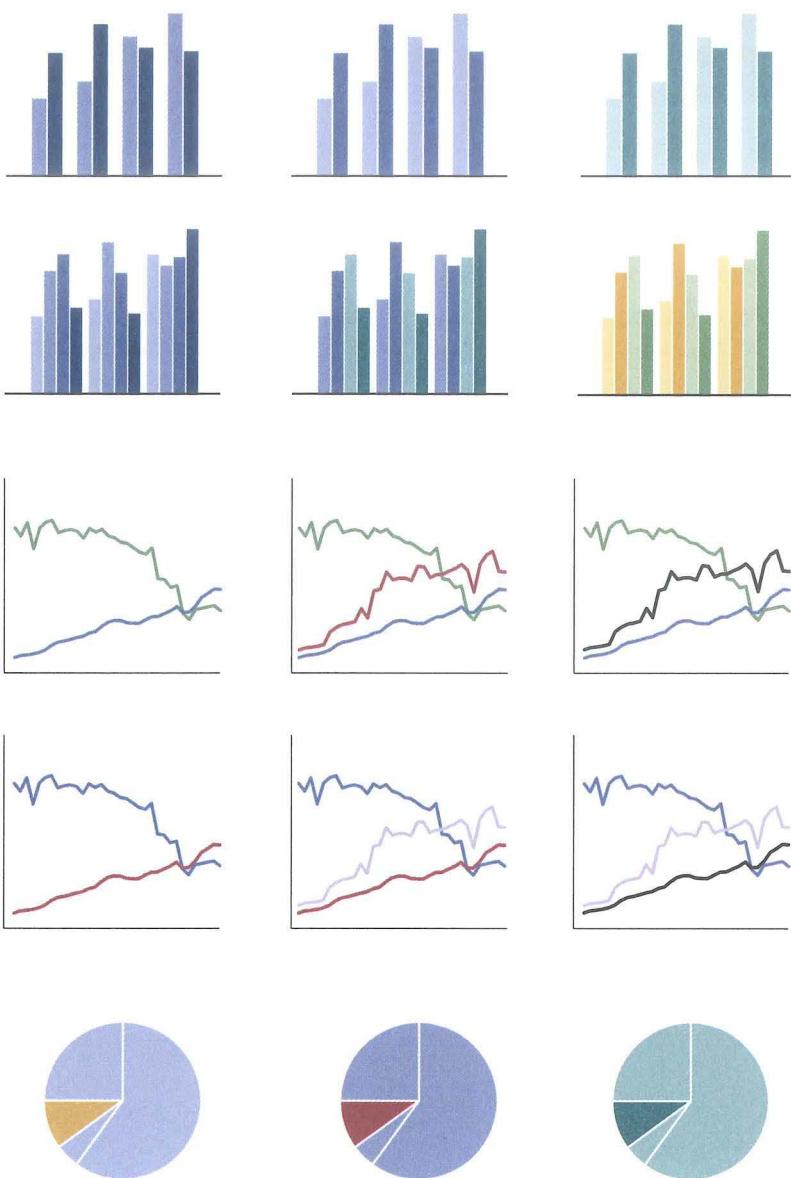
Use bright or dark colors such as red and black to emphasize the important line.



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



With the muted color palette



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

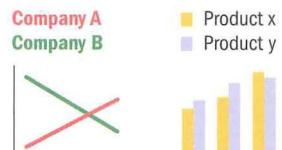
Color combinations such as red/green or blue/yellow are on opposite sides of the color wheel. The color hues are very different but they can be similar in value or lightness. The color intensity overpowers the underlying data. The colors even vibrate when used in large quantities. These color combinations 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.

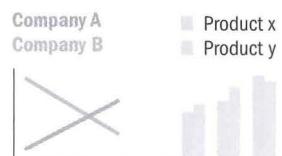
Different hues, same value



Color text and legends



Lack of contrast when converted to black and white:



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.

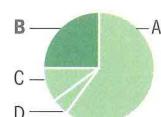
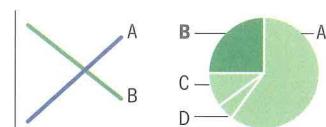
Use black text	White text
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Use black text	White text
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2 Label directly on chart elements

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

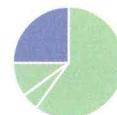
In addition to using darker shades to highlight a bar or a line, you can set the label in bold typeface. See segment B in the pie chart on the right. This redundant means of presenting information will guarantee all information conveyed with color is also clear without color.



3 Ensure high contrast in values

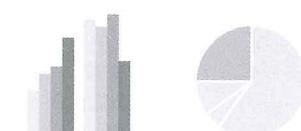
If a different color is used to distinguish different chart elements or signify a change in data, use a lighter or darker shade of that second color. It is easier for the eyes to differentiate lightness or darkness.

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.

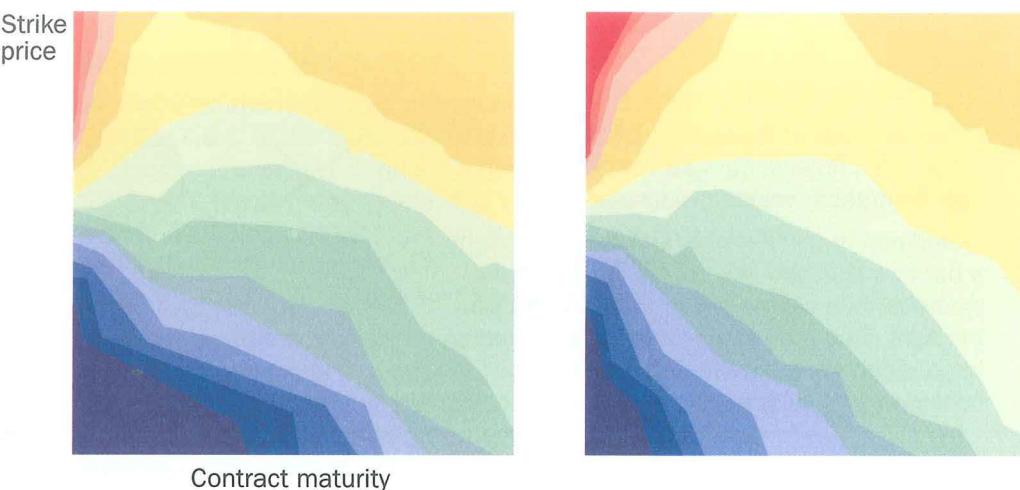


Color scale application

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.

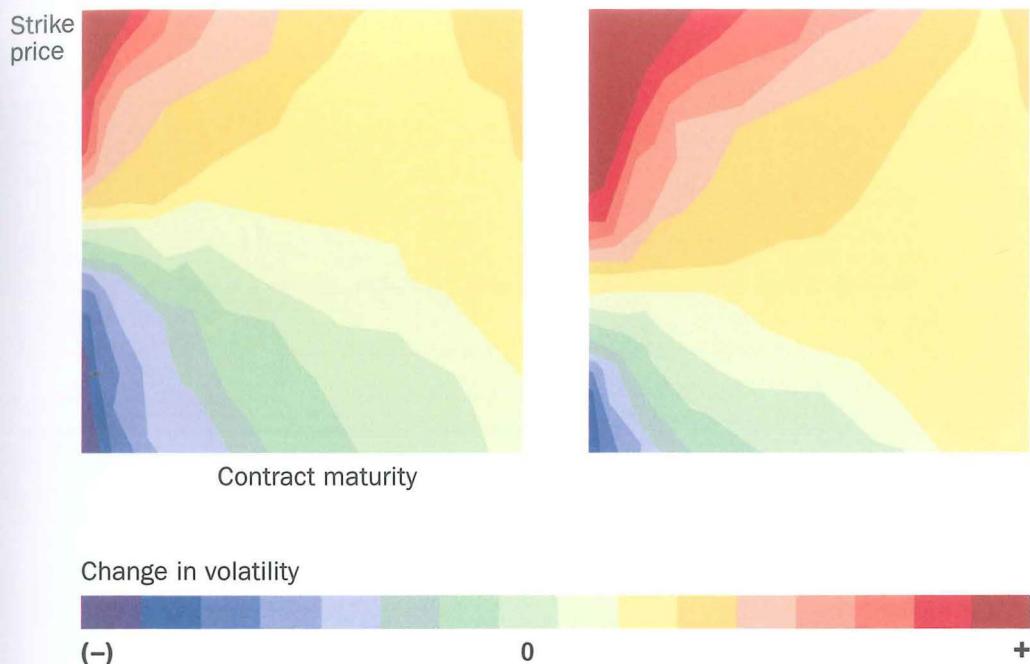
Example

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



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.



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.