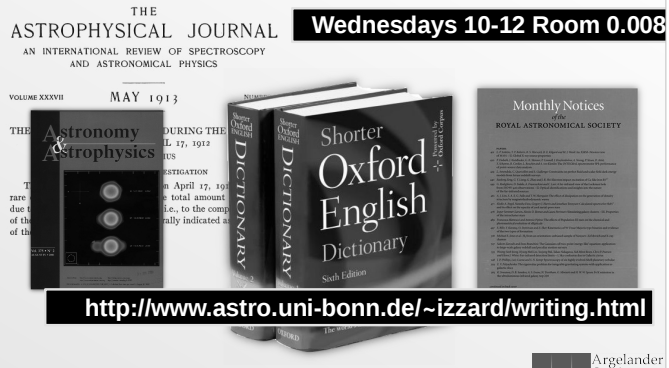
Scientific Writing 6951



Wednesdays 10-12 Room 0.008

http://www.astro.uni-bonn.de/~izzard/writing.html

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Previously on *Scientific Writing*

- We discussed the different sections in a "traditional" paper:
  Intro : Method : Results : Discussion : Conc.
- **Paragraphs**: units of information
- **Sentences**: units of communication
- Logical progression and
  *the **flow** of ideas*

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Exercise

- Multiple choice:
  - **Part 2**
- Write flowing sentences
  - **Improve me!**

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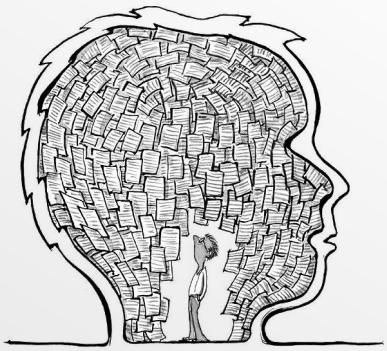

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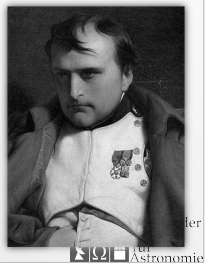
This week: figures, tables, equations

- ***Why why why?***
  "A picture tells a thousand words"
  Chinese proverb or tram advert?
  or "**Un bon croquis vaut mieux qu'un long discours**"
- Non-linear reading:
  often we look ***only* at pictures!**
- Talks and posters are (should be)
  75% + pictures!



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Why use graphics?

- Show **lots of data quickly** and together
- Compare data (e.g. to data, models)
- More "physical" than words
- **~ Language independent**
- Lots of tips in *"Eloquent Science"* and the second *A&A* book on *"Scientific Writing for Young Astronomers"*

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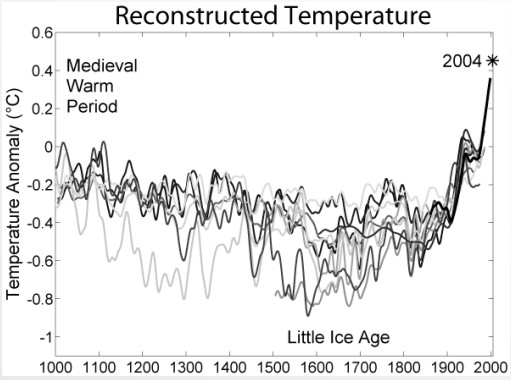
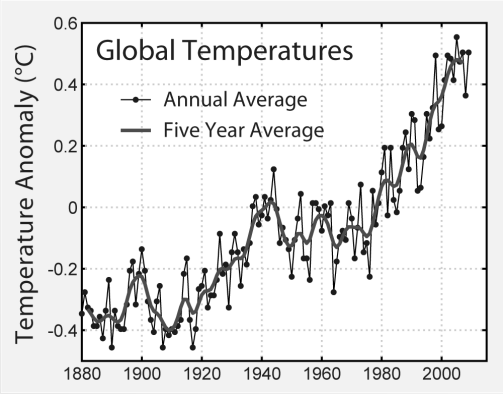
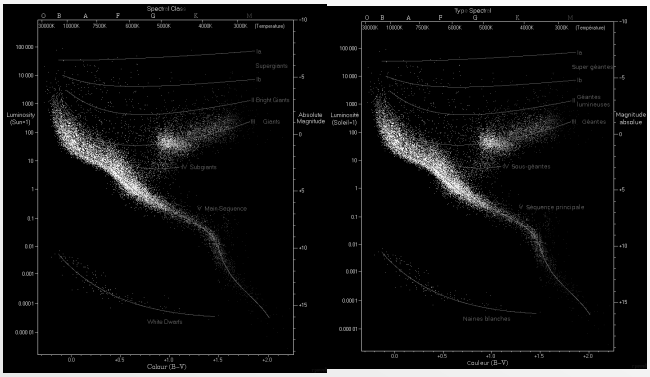
Lots of data



Compare data vs data/models



Language independent



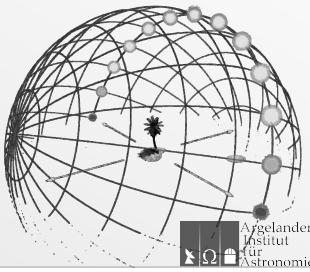
http://upload.wikimedia.org/wikipedia/commons/6/6b/HRDiagram.png
http://upload.wikimedia.org/wikipedia/commons/7/75/HRDiagram-Fr.png

Making figures

- Seems easy ("just put it in Excel")
- ***May take a day to get an image right***

Five key points (see *"Eloquent Science"* p108)

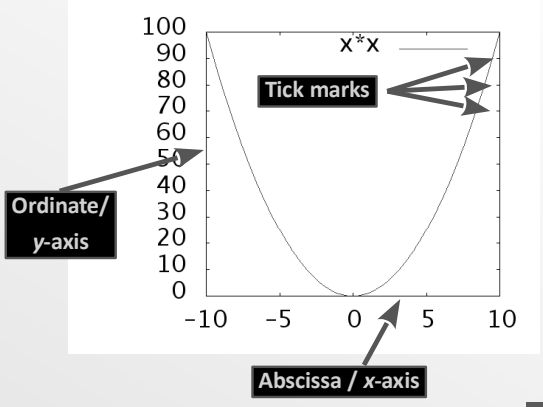
1. **Design**
2. **Size**
3. **Aesthetics**
4. **Consistency**
5. **Annotation**



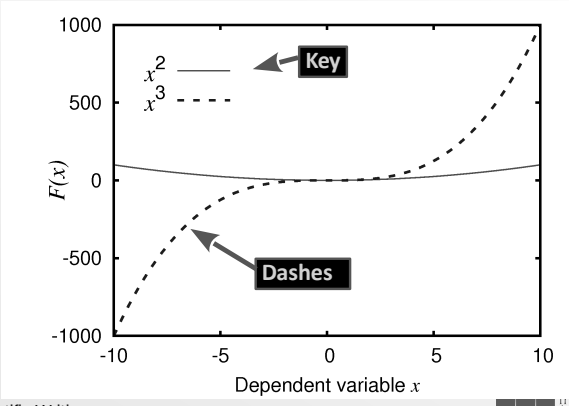
Design

- Many Types of graph:
- **Scatter, Line, Surface, Pie, Bar**
- Choose which you use **carefully**!
- Keep it **simple**, not confusing
- Make the **DATA** stand out, not the borders/axes/grid/labels etc.

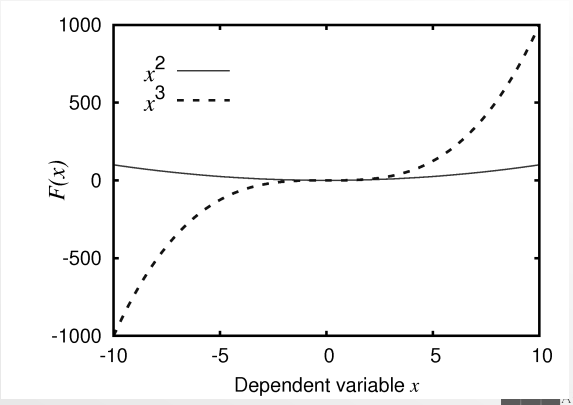
Line graphs



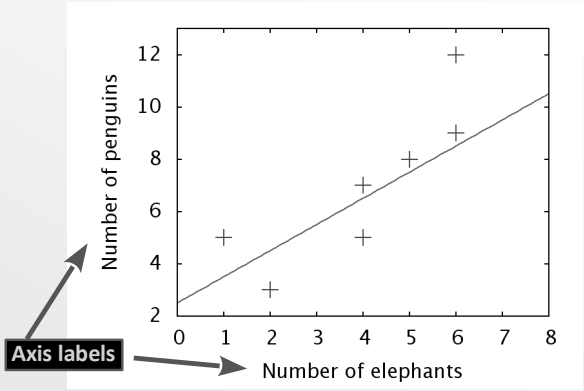
Line graphs



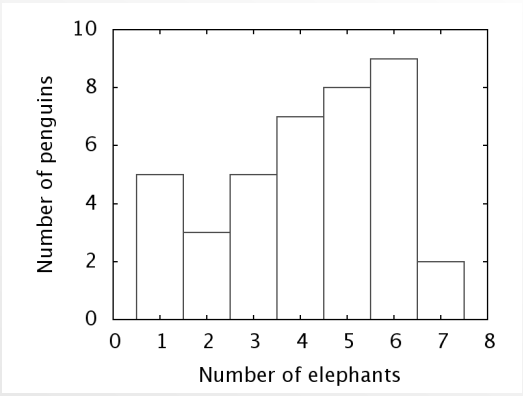
Line graphs



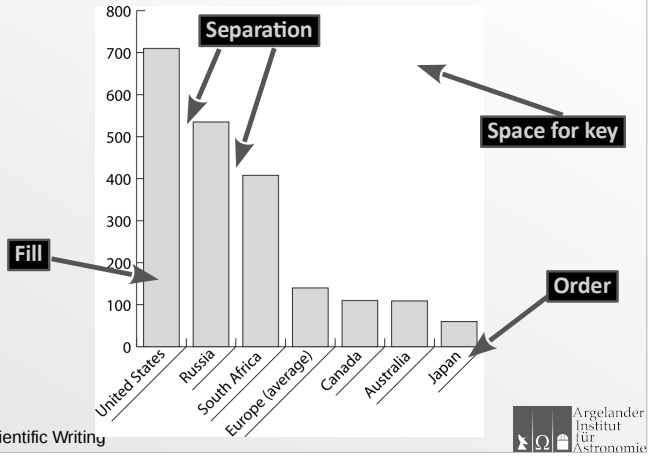
Scatter plot



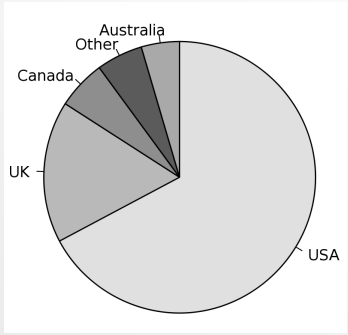
Bar charts



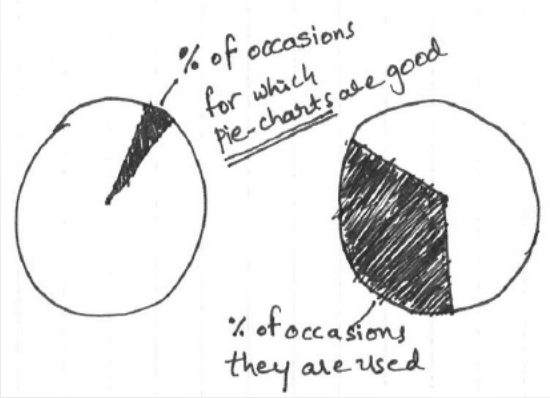
Bar charts



Pie charts



Pie charts



Captions

- Explain your figure in a caption
- Not too short, not too long
- A&A *hates* long captions! So...
- Put the information *in the figure:*

  Do not make reading the caption necessary!
- **NOT**: "This plot shows the velocity of *x*."

  instead "The velocity of *x*."

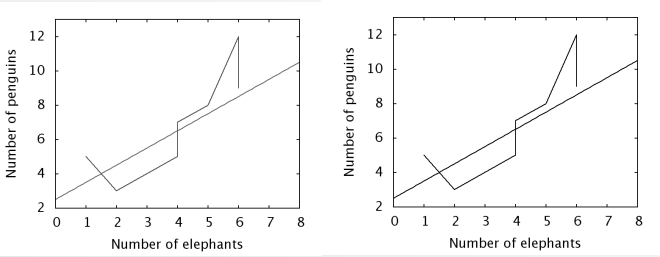
  TALK ABOUT THE (ABSTRACT) DATA

  (not the plot itself which is just a load of dots and lines!)

Colours

Colours help but **beware**:

your graphics should also look good in **black/white/greyscale**



Colours

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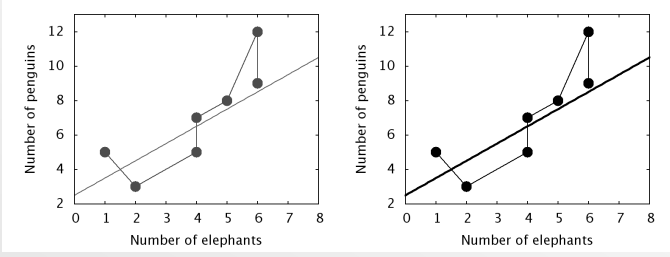
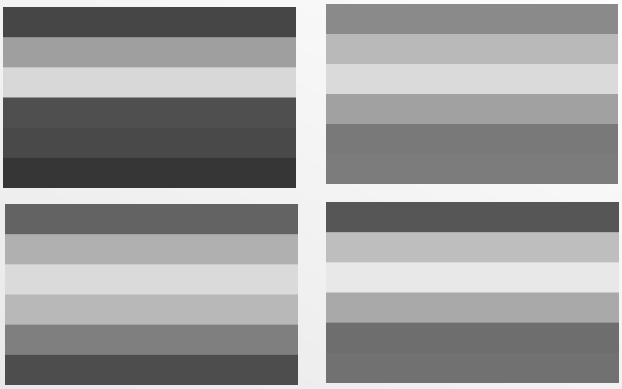
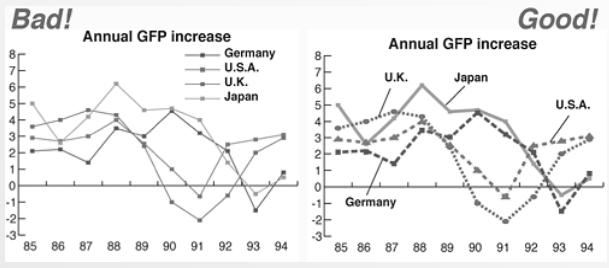


Colours



http://jfly.iam.u-tokyo.ac.jp/color/#assign

"Redundant Coding"



Do and do not

- Axis labels : **always always always!**
  - Graph title? If necessary.
- Font: Sans serif, size size size

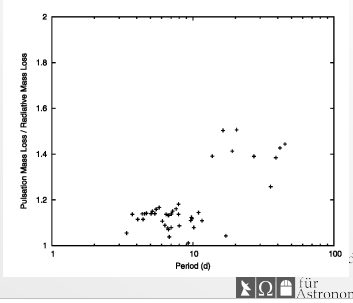
Not comic sans!

- Line width : **beware rescaling!**
- Colours: aim for **contrast**
- ***The data*** should stand out
- Error bars! Data without errors is *useless*
- Be ***consistent*** throughout the paper!

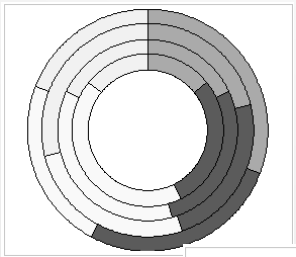
The quick brown fox jumps over the lazy dog...
The quick brown fox jumps over the laz
The quick brown fox jumps over
The quick brown fox jumps
The quick brown fox jum
Shoot me in the head

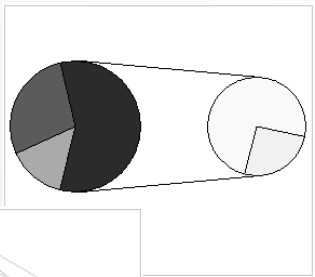
Size of the plot

- Single or two-column?
- Do not crowd the plot!
- Panels: label (a), (b) etc. ***inside*** the plot
- Use **all the space**!

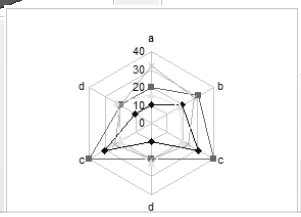


Bad examples

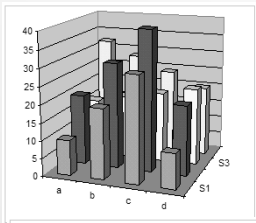


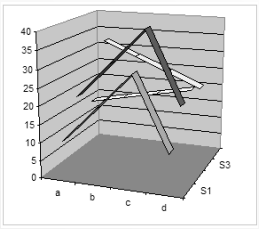


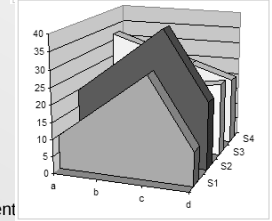
I hate Excel



Bad examples





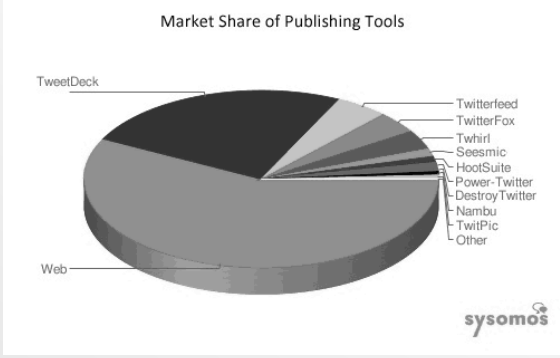


I *really* hate Excel

Bad examples

Which **orange** dot is larger?

Bad examples



So it's mostly on the web then...

Tables

- Shows **precise** information in a list
- More **concise** than textual explanation
- **Emphasise** points from the text
- Is a table ***really*** necessary?
- Order rows/columns
- Consistent (parallel) headings
- Many small tables better than one large
- Beware too many horizontal/vertical lines
- **Appendix ?**

Equations

- Equations are ***part of the flow of text*** !
- Short equations in the text itself
- Use text to **describe** what the eq. is for
- What do the **symbols mean**?
- **Scalars**: Italic $c_s \quad v \quad K \quad \xi$
- **Operators**: Roman $\log(x) \quad \exp(y) \quad \sin(z)$
- **Units**: sometimes Roman $M_\odot$ vs $\mathrm{M}_\odot$ $\mathrm{km\,s^{-1}}$

Equations

The speed of sound c_s is calculated from,

$$c_s^2 = \frac{\partial p}{\partial \rho}, \quad (1)$$

where ρ is the density and p is the pressure.

NOT: where ρ = density and p= pressure.

References:

- The speed of sound is a function of pressure and density (Eq. 1).

NOT:

- Equation (1) gives the sound speed.

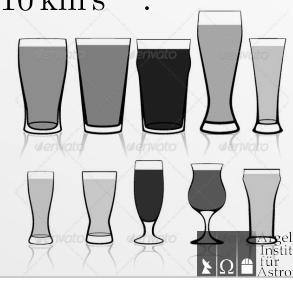
Numbers

- Small numbers should be written in full

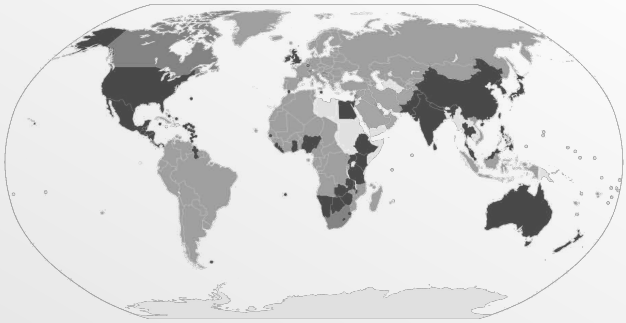
  I found **ten** pints of beer in the fridge.

- Exact ***results*** should be in numbers, with **units**!

We find that $c_s = 10\,\mathrm{km\,s^{-1}}$.



- Beware , (comma) and . (decimal point)
  - In **English**, **10.123** is a bit more than **ten**
  - And **10,123** is ten **thousand**, one hundred and twenty three!



Source: wikipedia

Referencing Fig./Tab./Eq.

- If using **LaTeX** : use **\label** and **\ref**

Do not ever manually number figures / tables / equations!

- Fig. (1) Eq. (2) Table 4

  Brackets () or not? **See your journal's style guide.**

- **All** figs/table/eqs should have numbers!

  (otherwise, why are they there?)

- **Sequential**! i.e. in the **order in which they appear**
- **Appendix** e.g.: See equation (A.2), table (B.3)

Improve me

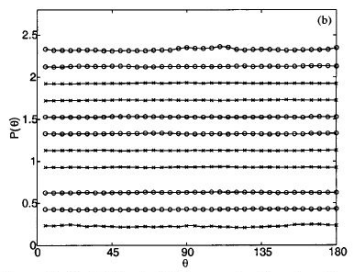


Figure 8. Probability distribution as a function of position in the film for angle made by the largest ellipsoidal axis of the chain with (a) the x-axis (ϕ) and (b) the y-axis (θ). The successive probability distributions are vertically offset by 0.1 for clarity.

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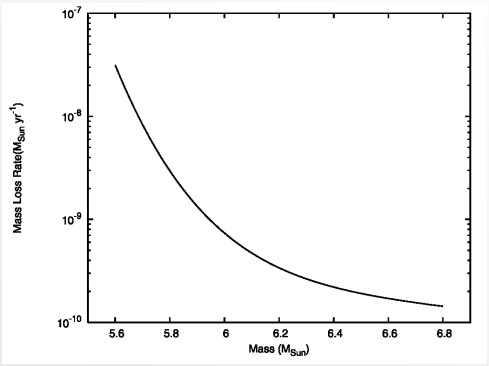
Improve me



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Improve me

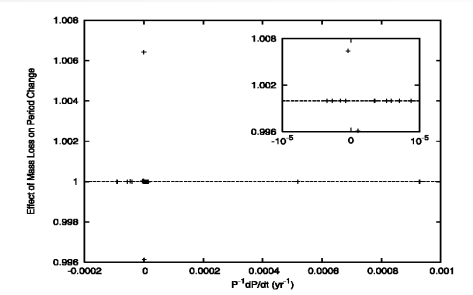

FIG. 11.—Fractional contribution of mass loss toward the period change for Cepheids as a function of period change. Cepheids with a period change not affected by the mass-loss rate would fall on the dashed line. Deviations from the dashed line measure how much mass loss plays a role.

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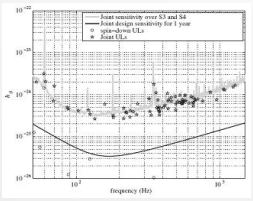

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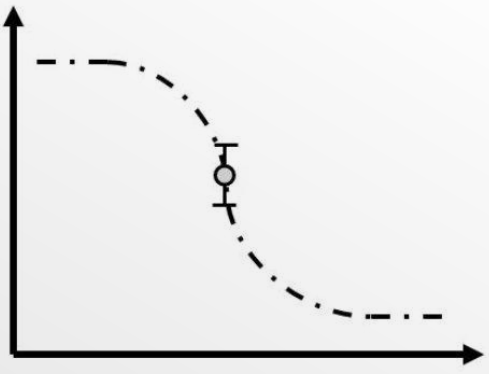

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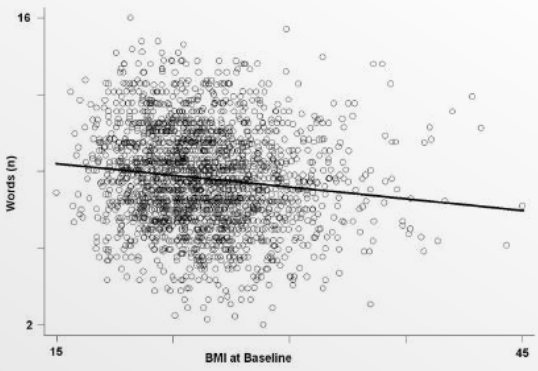

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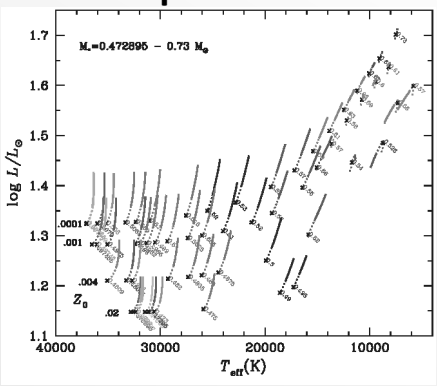

Michaud et al 2011

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Urgh

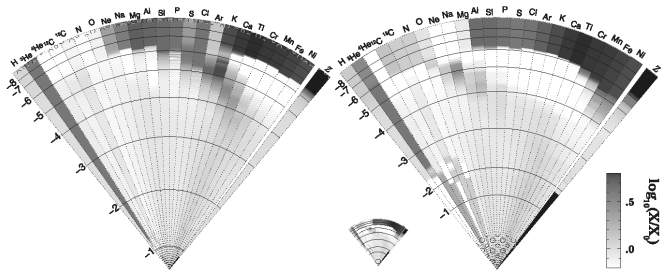

Fig. 4. Color-intensity coded concentrations in two HB stars of the same metallicity after 25 Myr on the HB. *Left panel* with a $T_{\rm eff}$ of 14 000 K (0.59 $M_\odot$) and *right panel* of 30 100 K (0.51 $M_\odot$). The radial coordinate is the radius and its scale is linear, but the logarithmic value of the mass coordinate above a number of points, $\log \Delta M/M_*$, is shown on the left of the horizontal black line. The concentration scale is given in the right insert. Small circles near the top of the left panel mark the extent of the surface convection zone, while similar circles near the center of both models mark the central convection zone. The small inset in between the two panels shows the high $T_{\rm eff}$ star, that is the right panel, on the radius scale of the low $T_{\rm eff}$ star, that is the left panel. For $-7 < \log \Delta M/M_* < -4$ the concentration is quite different for many species. It is surprisingly so for C and O for $\log \Delta M/M_* > -2$. See the text. A black-and-white version of this figure may be found in Fig. A.1.

Michaud et al 2011

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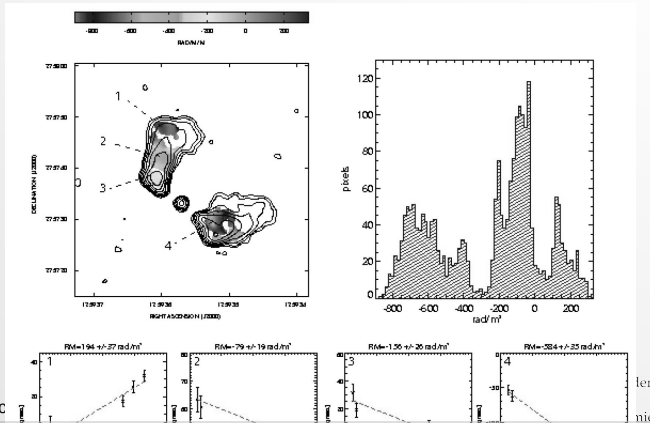
Improve me



ler

nie

What's missing?

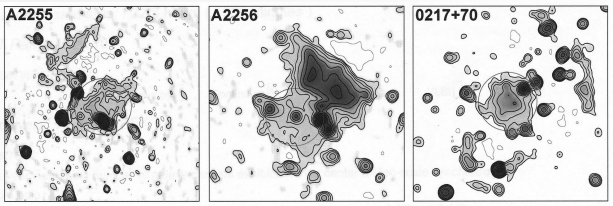


Figure 2 Total intensity VLA images at 1400 MHz of the radio halos sample proposed for Effelsberg 100-m observations: A399 (Murgia et al. 2010), A520 (Govoni et al. 2001), A523 (Giovannini et al. 2011), A665 (Vacca et al. 2010), A1914 (Bacchi et al. 2003), A2219 (Bacchi et al. 2003), A2255 (Govoni et al. 2005), A2256 (Clarke & Ensslin 2006), 0217+70 (Brown et al. 2011). Red circles indicate the Effelsberg beam at 1400 MHz (9.35′). Green lines indicate negative contours.

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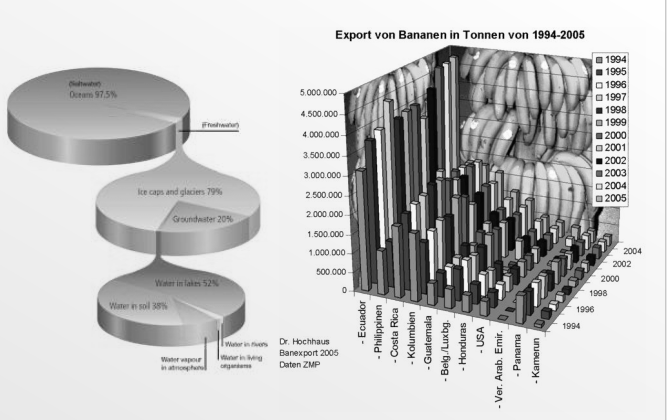

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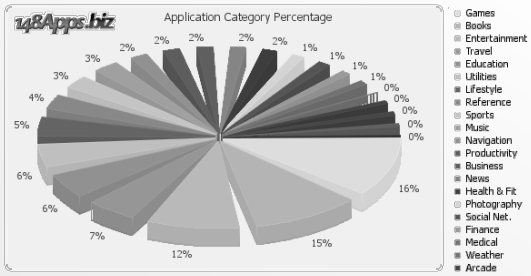

http://peltiertech.com/extra-distortion-in-a-pie-chart/

This clearly illustrates the distortion of the fancy wedge-gapped 3D pie chart. The amount of these pies that are **made up of nothing** is **31%**, leaving **only 69%** for **displaying data**. The largest wedge, which comprises 17% of the data, fills only 11% of the circle.

We humans are bad enough at judging areas and angles, so when the angles are distorted in this way, **we're hopeless.**

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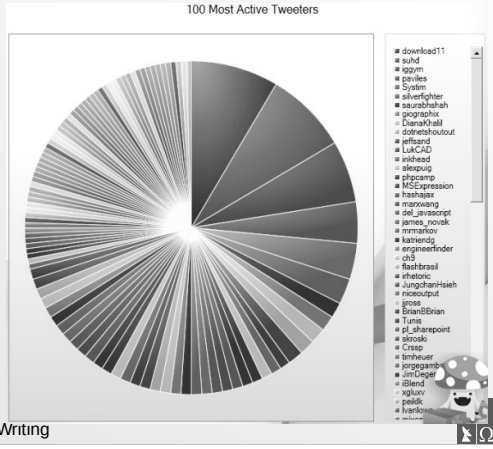
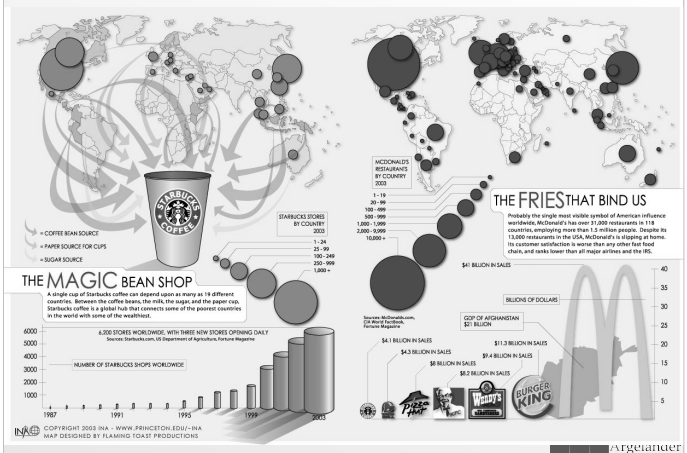
Make it stop!



This gauge shows one number. Gauges make very inefficient use of space but are often used on dashboards where space is at a premium.

http://www.statsblogs.com/2012/05/30/winner-of-the-bad-graph-contest-announced/



OMG!

- The Hurley "**52 bug**" (Hurley et al 2002 MNRAS)

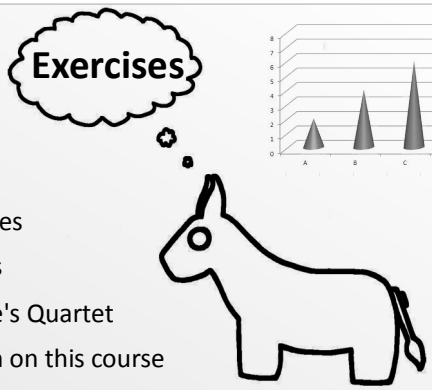
$$\frac{1}{\tau_{\rm sync}} = 52^{5/3}\sqrt{\frac{GM}{R^3}}\frac{MR^2}{I}\,q^2\,(1+q)^{5/6}\,E_2\,(\frac{R}{a})^{17/2}$$

- The original formula from Zahn (1977, A&A)

$$\frac{1}{\tau_{\rm sync}} = 5\,2^{5/3}\sqrt{\frac{GM}{R^3}}\frac{MR^2}{I}\,q^2\,(1+q)^{5/6}\,E_2\,(\frac{R}{a})^{17/2}$$

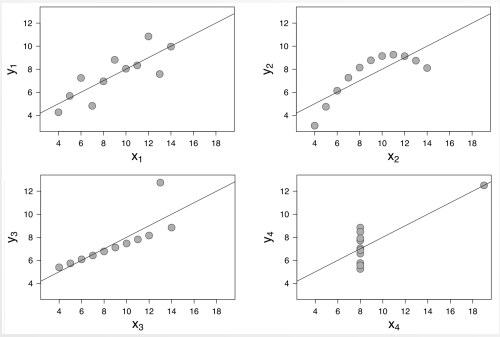
Only a factor of *45* different . . .

Better!



- Ithaca times
- US politics
- Anscombe's Quartet
- Discussion on this course
- http://www.informationisbeautiful.net/visualizations/

Anscombe's Quartet



$$\bar{x} = 9$$
$$\sigma_x = 11$$
$$\bar{y} = 7.5$$
$$\sigma_y \simeq 4.12$$
$$R = 0.816$$
$$y = 3.00 + 0.50x$$

http://en.wikipedia.org/wiki/Anscombe%27s_quartet

Anscombe (1973) *The American Statistician vol 27, pp 17*

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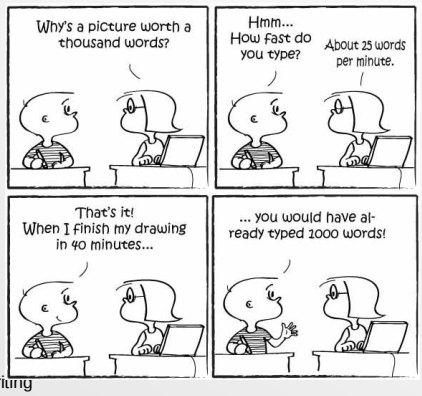
John McCarthy (famous computer scientist):

"As the Chinese say, 1001 words is worth more than a picture."



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