Science mission accomplished

Now comes the paperwork

- So far
  - You found your question
  - Designed and did your experiment
  - Analyzed your data

- Rest of the course – about getting your stuff out there

Comments Stats

- I looked up two questions that came up

  - F-Statistic – Null hypothesis includes the intercept

  - Adjusted R^2 – not recommended to use this for model selection, more a relict of old times

- One main problem I saw: lots of problems with **numeric that were recorded categorical!**

Comments Stats II

- If you have a **fixed hypothesis**, analysis is a lot easier, should be one line

  - lm / glm (y ~ f(predictors))

- Plus, if you know this already, you can **create some data** and try out whether you can expect to get significance (power analysis)

- I hope you have realized by now why it makes sense to **play through the whole analysis before** you take your data ;)

Scientific Writing

Why care abo

SIR ISAAC NEWTON.
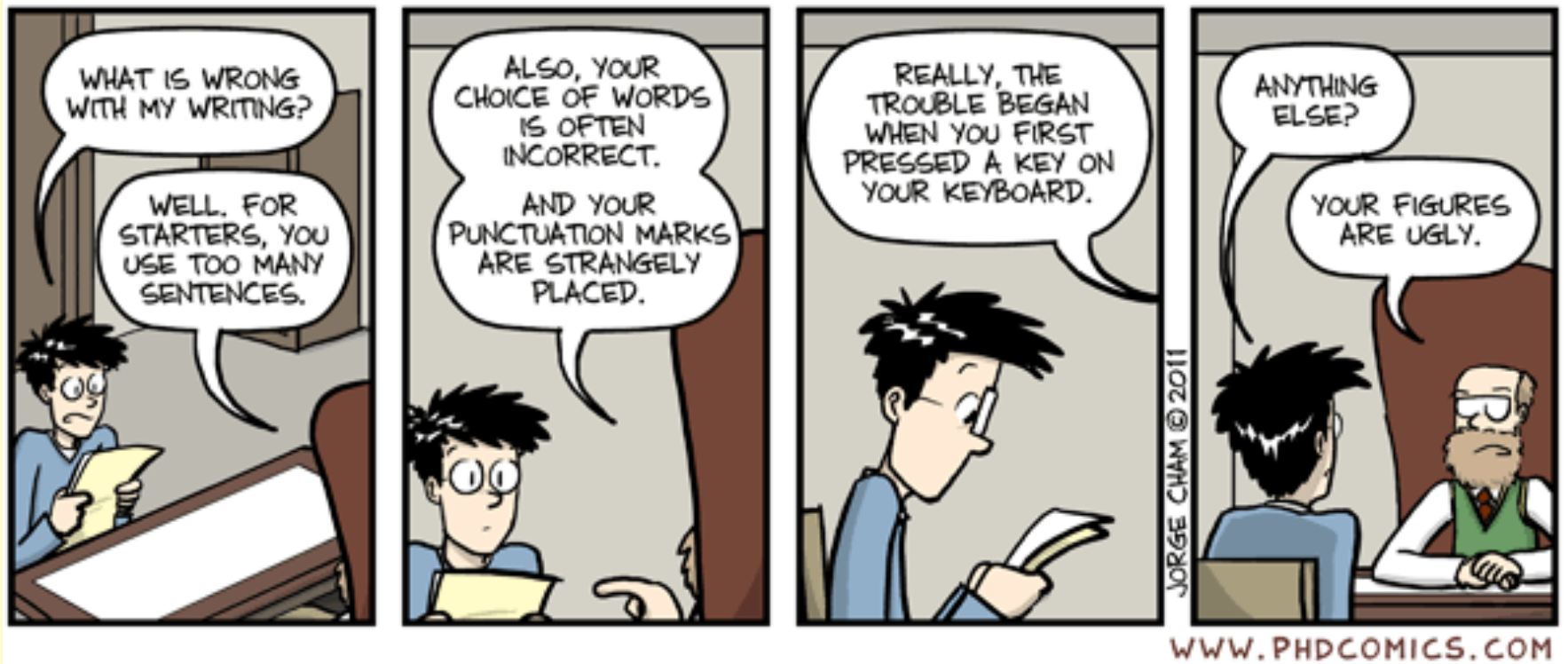
- **Main reason**: the scientific me steps, depends on communica

- Secondary purposes: attributi

  – In parts, the grading of your mas researchers and professors dep communicate their cause in writi

- Writing helps you thinking

  – Start writing early in your thesis structure your thoughts and question your logic
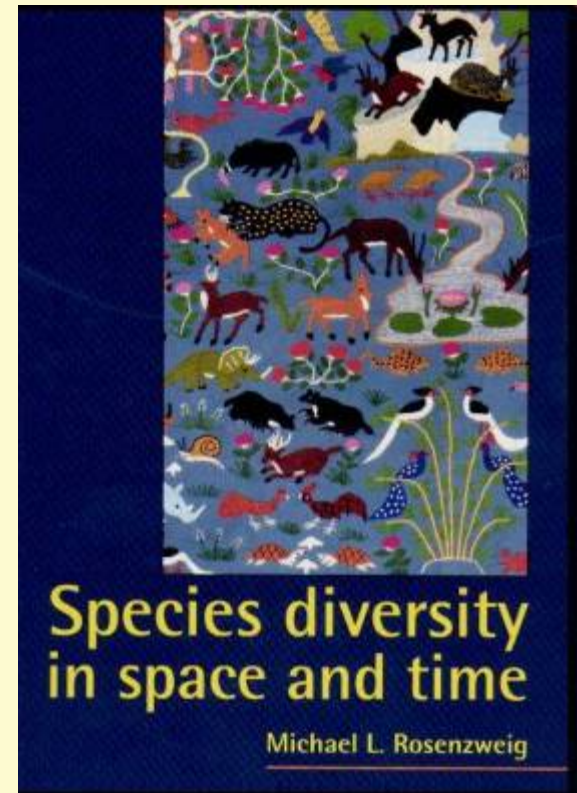
If I have seen further it is by standing on ye sholders of Giants

Am I a good writer?

- I saw some good writing already

- But if you think you're a perfect writer, it is probably because you have not yet discovered your "writing problems"

Species diversity in space and time

Michael L. Rosenzweig

Like most scientists, I write with difficulty or even pain. Audubon apparently was like the rest of us. He wrote the following gem to fellow ornithologist, J. Bachman, in 1834 (quoted by Alice Ford, 1957, *The Bird Biographies of John James Audubon*, Macmillan, NY, pp. vii, viii):

> God...save you the trouble of ever publishing books on
> natural science... I would rather go without a
> shirt...through the whole of the Florida swamps in
> mosquito time than labor as I have...with the pen.

Today, however, we know that writing, at least science writing, is partly a skill. And skills can be improved. The pain can be reduced.

If you have read anything I wrote more than a few years ago, you will notice a marked change in my style. My writing talent still lies at the abysmal end of the scale, but I did deliberately change my style. It may startle you. It may even repel you. It will sound – if I have learned my lessons – offhand, conversational, light and unstudied. You may marvel at my gall in simply dictating a first draft and than abandoning it to the printer.

The paragraphs are shorter. The sentences are shorter.

And the sentences sometimes start with 'but'. Paragraphs, too.

You will rarely find the passive voice. Short, common, even coarse Germanic verbs abound at the expense of more delicate, refined Romance verbs.

Except for the verb 'to be'. My masters have taught me to hate that verb and to view it as an enemy of comprehension.

Though you may disapprove, you will understand what I write with less trouble than before. This book presents enough difficulties. I did not want to make it even harder to understand by using standard, 19th century, scientific, Prusso-Victorian prose. You would not have been amused.

Writing and logic are „eternal" human qualities

The **liberal arts** ([Latin](): *artes liberales*) are those subjects or skills that in [classical antiquity]() were considered essential for a free person ([Latin](): *liberal*, "worthy of a free person")[1] to know in order to take an active part in civic life, something that (for [Ancient Greece]()) included participating in public debate, defending oneself in court, serving on juries, and most importantly, military service. [Grammar](), [rhetoric](), and [logic]() were the core liberal arts, while [arithmetic](), [geometry](), the theory of [music](), and [astronomy]() also played a (somewhat lesser) part in education.[2]

Read this!!!

SCIENCE

Sounder Thinking Through Clearer Writing

A graduate course on scientific writing can, if appropriately designed, strengthen scientific thinking.

F. Peter Woodford

writing goes up. I feel strongly enough about it to teach a course on the Principles of Scientific Writing for graduate students, in the hope that when they come to contribute to the literature they will do a better job than we, the scientists of today, seem to have done.

Sometimes a skeptic will ask me, "Do you really think it's so important to improve scientific writing? We know it's usually a bit on the pompous side, but once you get used to the conventions you can zip through it pretty easily and get to the author's meaning." Personally, I *don't* find it so easy to zip through the pretentious constructions, and I think that one all too frequently arrives at a meaning that was not intended. But more telling than either of these reasons for concern is

Can teach some "laws" about writing, but the most important thing is that you start reflecting about the way you write

A process that has a lot to do with experience

Today: structure

Lecture next week: style!

Note: your articles for this class MUST follow the structure discussed here

Some more comments at the end

Publication types

- Article
  - **Research article**
  - Review
  - Essays / Opinion
- Correspondence
  - Letter to the editor, technical comment
- News / book reviews
- Press releases / newspaper articles / blogs
- Grant applications
- Reviewer comments

Important points

Respect conventions!

in particular about the structure

Make a selection!

Writing a good paper is not about telling everything you know or have done about a topic – it's about telling a story and selecting the relevant details!

Repetition

Tell them what you gonna tell them, then tell them, and then tell them what you told them!

Before we start – rule 1 and 2 of communication

- Who is my audience?
  - A journal in the field of your study, so a journal that is read by people who are interested in your specific research field

- **Exercise:** What do I want to say?
  - This is your job – what is the main message that you want to tell people with your paper?
  - After you finished, tell your key message to your neighbor

Let's go!

Keep your story in mind

The structure of a research paper

- Title
- Abstract
  - Keywords

- Introduction
- Methods
- Results
- Conclusion

- (References, Appendices)

- A paper is about telling a story
- You tell this story 3 ¾ times
  - Title
  - Abstract
  - Introduction 1/4
  - Conclusions ½
  - Whole paper

The hourglass structure

- General

- Specific

- General

- In
  - Abstract
  - Main paper

Introduction

Methods

Results

Conclusions
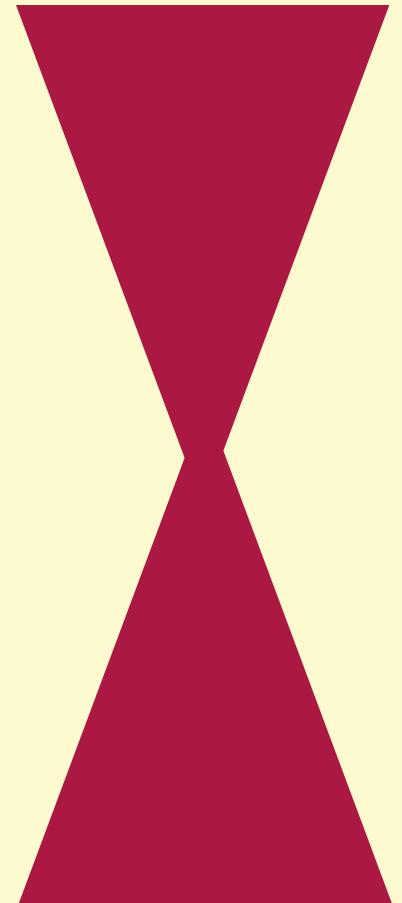
The title

- First time you tell your story
  - Should reflect your main message

- 97% of all your readers read only your title – you want to make sure that those are interested in your research keep on reading and remember it
  - Signal the topic (species, approach, question)
  - Make it specific and informative (hint what you found out)
    - Testing the effect of light on growth in a temperate forest
    - Light acts positive on growth in a temperate forest
    - Light acts positive on growth in a southern German mixed coniferous forest

Title styles
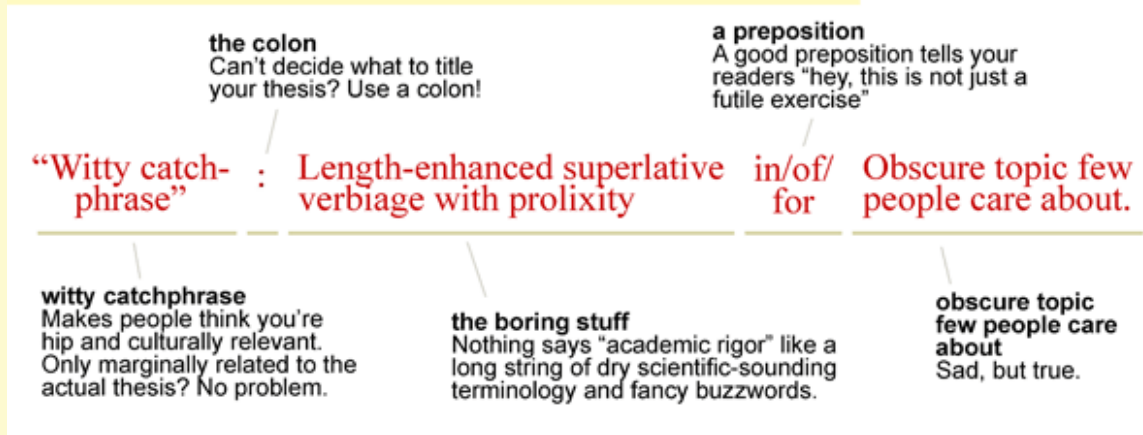
- Dry and exact? Funny? Provocative?
- Some correlative results
  - Title contains "?" → more downloads, less citations. Increase of ? in titles by 50-200% in the last 40 yrs
  - Length → inconclusive
  - Disciplinary abbreviations UP, country names DOWN
  - Funny, punctuation → negative ☹

  - http://undergraduatesciencelibrarian.org/2011/12/20/will-this-post-be-cited-more-often-non-content-factors-that-influence-citation-rates/
  - http://theoreticalecology.wordpress.com/2012/04/17/do-catchy-titles-attract-more-citations/

Exercise

- Think about titles for your paper

- Choose the three best and write them down

- Keep in mind: your title is the first time you are telling your story

Example from the group

- Are men more generous than women?

- Investigating the influence of gender on generosity?

- Different demographics and charity

2nd time you tell your story: the abstract

- Abstract is a "mini paper"

  - **Set the scene**
    - **Tropical forests** are some of the most species-rich ecosystems of the world.
  - **Raise the problem**
    - The reason for this, **however,** is still widely debated. Hypotheses range from processes related to productivity over environmental stability to the historical changes in geography.
  - **Introduce your approach**.
    - **Here,** we tried to contrast these different hypotheses by using data from … together with .. (fancy new method)
  - **State your results**
    - **We find** that hypothesis X seems to be significantly better supported by our data than all alternatives we test. Specifically …
  - **Give your conclusions and discuss the wider significance**
    - **In conclusion**, our study supports the hypothesis that species diversity in the tropics is mainly drive by higher productivity. These results challenge some long-held ideas about geographical stability being the main reason for global diversity patterns. They also have important practical applications for mitigation of climate change, as …
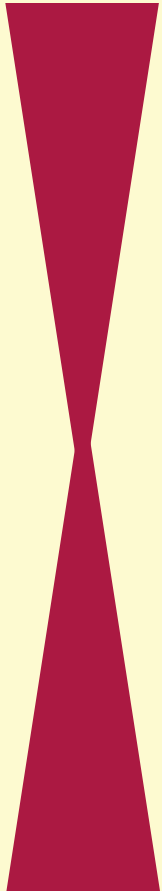
Connecting dynamic vegetation models to data – an inverse perspective

Florian Hartig[1]*, James Dyke[2], Thomas Hickler[3], Steven I. Higgins[4], Robert B. O'Hara[3], Simon Scheiter[3] and Andreas Huth[1]

[1]UFZ – Helmholtz Centre for Environmental Research, 04318 Leipzig, Germany, [2]Institute for Complex Systems Simulation, University of Southampton, Southampton SO171 BJ, UK, [3]Biodiversity and Climate Research Centre (LOEWE BiK-F), 60325 Frankfurt am Main, Germany, [4]Institut für Physische Geographie, Goethe Universität Frankfurt am Main, 60438 Frankfurt am Main, Germany

ABSTRACT

Dynamic vegetation models provide process-based explanations of the dynamics and the distribution of plant ecosystems. They offer significant advantages over static, correlative modelling approaches, particularly for ecosystems that are outside their equilibrium due to global change or climate change. A persistent problem, however, is their parameterization. Parameters and processes of dynamic vegetation models (DVMs) are traditionally determined independently of the model, while model outputs are compared to empirical data for validation and informal model comparison only. But field data for such independent estimates of parameters and processes are often difficult to obtain, and the desire to include better descriptions of processes such as biotic interactions, dispersal, phenotypic plasticity and evolution in future vegetation models aggravates limitations related to the current parameterization paradigm. In this paper, we discuss the use of Bayesian methods to bridge this gap. We explain how Bayesian methods allow direct estimates of parameters and processes, encoded in prior distributions, to be combined with inverse estimates, encoded in likelihood functions. The combination of direct and inverse estimation of parameters and processes allows a much wider range of vegetation data to be used simultaneously, including vegetation inventories, species traits, species distributions, remote sensing, eddy flux measurements and palaeorecords. The possible reduction of uncertainty regarding structure, parameters and predictions of DVMs may not only foster scientific progress, but will also increase the relevance of these models for policy advice.

My advice: copy the template when you start writing!

Until you are sure you know better ☺

Indicator words help!

Exercise: write the abstract of your paper

Side remark: some journals have different abstract styles and structure

- Structured abstract (numbered)

- Nature, Science, PNAS → methods in small print in the end

Other parts of the "abstract/title" section

Role of Brazilian Amazon protected areas in climate change mitigation

Britaldo Soares-Filho[a,1], Paulo Moutinho[b,c], Daniel Nepstad[b,c], Anthony Anderson[d], Hermann Rodrigues[a], Ricardo Garcia[a], Laura Dietzsch[b], Frank Merry[e], Maria Bowman[c], Letícia Hissa[a], Rafaella Silvestrini[a], and Cláudio Maretti[d]

[a]Centro de Sensoriamento Remoto, Universidade Federal de Minas Gerais, Belo Horizonte, 31270-901, Minas Gerais, Brazil; [b]Instituto de Pesquisa Ambiental da Amazônia, Belém, 66035-170, Pará, Brazil; [c]The Woods Hole Research Center, Falmouth, MA 02540; [d]World Wildlife Fund–Brasil, Brasília, 71620-430, DF, Brazil; and [e]The Gordon and Betty Moore Foundation, Palo Alto, CA 94304

Protected areas (PAs) now shelter 54% of the remaining forests of the Brazilian Amazon and contain 56% of its forest carbon. However, the role of these PAs in reducing carbon fluxes to the atmosphere from deforestation and their associated costs are still uncertain. To fill this gap, we analyzed the effect of each of 595 Brazilian Amazon PAs on deforestation using a metric that accounts for differences in probability of deforestation in areas of pairwise comparison. We found that the three major categories of PA (indigenous land, strictly protected, and sustainable use) showed an inhibitory effect, on average, between 1997 and 2008. Of 206 PAs created after the year 1999, 115 showed increased effectiveness after their designation as protected. The recent expansion of PAs in the Brazilian Amazon was responsible for 37% of the region's total reduction in deforestation between 2004 and 2006 without provoking leakage. All PAs, if fully implemented, have the potential to avoid 8.0 ± 2.8 Pg of carbon emissions by 2050. Effectively implementing PAs in zones under high current or future anthropogenic threat offers high payoffs for reducing carbon emissions, and as a result should receive special attention in planning investments for regional conservation. Nevertheless, this strategy demands prompt and predictable resource streams. The Amazon PA network represents a cost of US$147 $\pm$ 53 billion (net present value) for Brazil in terms of forgone profits and investments needed for their consolidation. These costs could be partially compensated by an international climate accord that includes economic incentives for tropical countries that reduce their carbon emissions from deforestation and forest degradation.

Amazon Region Protected Areas | effectiveness | reducing emissions from deforestation and forest degradation | simulation model | opportunity cost

if they were created for purposes other than environmental conservation (6). Under this definition, PAs in the Brazilian Amazon include strictly protected and sustainable-use conservation reserves (categories I–VI) (7) as well as indigenous lands, with their social and cultural priorities, and military areas (Table S1). These PAs cover a total area of 1.9 million km², encompassing 45.6% of the Amazon biome in Brazil or 54% of its remaining forest ($\approx$ 3.4 million km²), and this figure keeps increasing. Between 2002 and 2009, 709 thousand km² were designated as new PAs (Fig. 1 and Fig. S1C). Many of these new PAs receive financing from the Amazon Protected Areas Program (ARPA), a program launched by the Brazilian government in 2002 that aims to support a total of 600,000 km² of new and existing PAs, making it the most ambitious PA program in the world. This recent PA expansion partially contributed to a 75% decrease in deforestation in the Brazilian Amazon from 2004–2009, representing a 64% reduction below the 10-year average (5, 8). Thus, as political momentum builds to compensate nations that lower their carbon emissions from tropical deforestation (4), there is a timely need to measure the contribution of the Amazon PAs to Brazil's effort to mitigate climate change.

Previous studies have quantified the effectiveness of these PAs in reducing deforestation (9–11), but the methods adopted to measure PA performance are somewhat controversial (12). We reviewed nine studies (9–17) of PA effects on tropical deforestation, summarizing their methods, assumptions, and main conclusions (Table S2). The methods of these studies vary from simple comparisons of deforestation rates in zones inside and outside groups of PAs [all PAs of a region or groups of PAs, wall-to-wall data, high or low spatial resolution, time-period or annual

Author list

THE AUTHOR LIST: GIVING CREDIT WHERE CREDIT IS DUE

The first author
Senior grad student on the project. Made the figures.

The third author
First year student who actually did the experiments, performed the analysis and wrote the whole paper. Thinks being third author is "fair".

The second-to-last author
Ambitious assistant professor or post-doc who instigated the paper.

Michaels, C., Lee, E. F., Sap, P. S., Nichols, S. T., Oliveira, L., Smith, B. S.

The second author
Grad student in the lab that has nothing to do with this project, but was included because he/she hung around the group meetings (usually for the food).

The middle authors
Author names nobody really reads. Reserved for undergrads and technical staff.

The last author
The head honcho. Hasn't even read the paper but, hey, he got the funding, and his famous name will get the paper accepted.

JORGE CHAM © 2005

www.phdcomics.com

- IRONY DISCLAIMER!!! → if you are not sure how the list should really be ordered, see lecture on good scientific practice

Keywords

- An article or thesis usually also has some keywords.

- Allow people to find your paper if they search for this words
  - ISI: Title, abstract, keywords
  - Google scans whole documents - probably not as important as it used to be

- Good strategy: chose keywords complementary to title and abstract, e.g. for important technical terms that you didn't want to include in the abstract

Introduction

- 4 Parts
  - The broad topic (1-2 paragraphs)
    - Topic, what has been done before
  - Introduce the problem (1-2 paragraphs)
    - What is the gap in knowledge
  - Your approach (1 paragraph)
    - What method / data did you use
  - Your specific questions
    - Could also be together with the approach
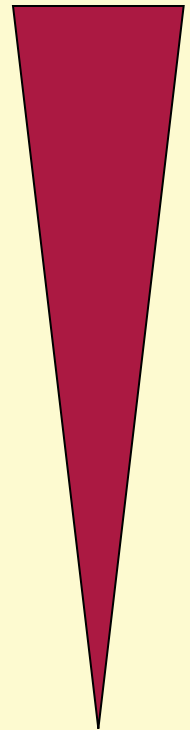
Some tips (not rules)

- Start with 1 paragraph each

- In ecology there is a certain expectation that you show that you know the literature by citing a large amount of papers in the first and second section - if done well (mini-review) that's helpful, sometimes, however, it seems also distracting to me

- Use of indicator words to make the role of a paragraph more clear
  - However, problem/ challenge; here, we used, we applied; we asked, we tested

- Try: each sentence in the abstract corresponds to one paragraph
  - Can't always be done, but makes a good connection between introduction and abstract
- Similarly, question (last) section should be picked up the results

Exercise: go back to the introduction you wrote

1) Sketch how you would restructure

2) Write your last paragraph: what are the specific questions you answer here?

The methods

- Purpose:
  - Describe exactly what you have done ($\rightarrow$ lecture on Reproducibility)

- So basically, there's not a lot of big strategy about it – describe what you have done

- Tricky thing: do this in a way that people understand it
  - Also, you don't have too much space – an average journal article is about 7000 words or shorter.

Structure of the methods

- Usually subsections such as
  - Study region
  - Data
  - Statistical analysis / Model
  - (Analysis)

- Some people recommend to state the purpose of your methodology in the beginning, others don't like that because it was there right before in the intro … depends on your expectation about the readers

Content of the methods

- Figures in the methods are nice ($\rightarrow$ see lecture about graphics)
    - Map of the study region / plot design
    - Diagram

- Again, you will have to do a selection.
    - Method section is about the things a reader needs to understand the study
    - Technical information that is necessary to replicate it exactly (Software version, etc.) can be moved to an (online) appendix if this makes the methods better readable

Think about the questions in the experimental design lecture

- Explain how you adressed
  - Construct validity
  - Statistical and internal validity, in particular confounding factors etc.

- If there were problems with those things, do not discuss them yet. This is what we do in the discussion.

Keep in mind you story

Results

- Contain your results

- What you show is necessarily a selection:
  - What is most relevant to your story
  - Results should reflect the questions in abstract and at the end of the introduction (**normally one subsection in the results per question!**)

- No big creativity in the content, but a lot of creativity in the presentation (in particular figures, but also what you highlight)

Results must be neutral!

- **Establish what can clearly be seen**
  - E.g. correlation between A and B
- But **leave interpretation for the conclusions**
  - B causes A

- **Results are neutral and factual, no speculation**
  - But doesn't mean you have to reduce your text to simply describing what we see in the figures
    - Anyways, describe the results and not the figures – not: Fig.1 shows, but better: we find that A~B (Fig.1)
  - Can give interpretation or crosslinks when they are obvious
    - E.g. We also found a positive correlation between X and A. However, note that this is known to be an artifact of the method / approach as we discussed in the methods"

Exercise: sketch and structure your main results

Think about your questions

What are your answers to these questions after the study?

Before we come to the conclusions – some repetitions about validity

Validity

- Validity = how certain can I be in my conclusions given my data / experiment / observational approach

- *Construct validity*
  - Do I measure the things that I want to measure?
- *Statistical validity*
  - Stats correct?
- *Internal validity*
  - Correlation != causality
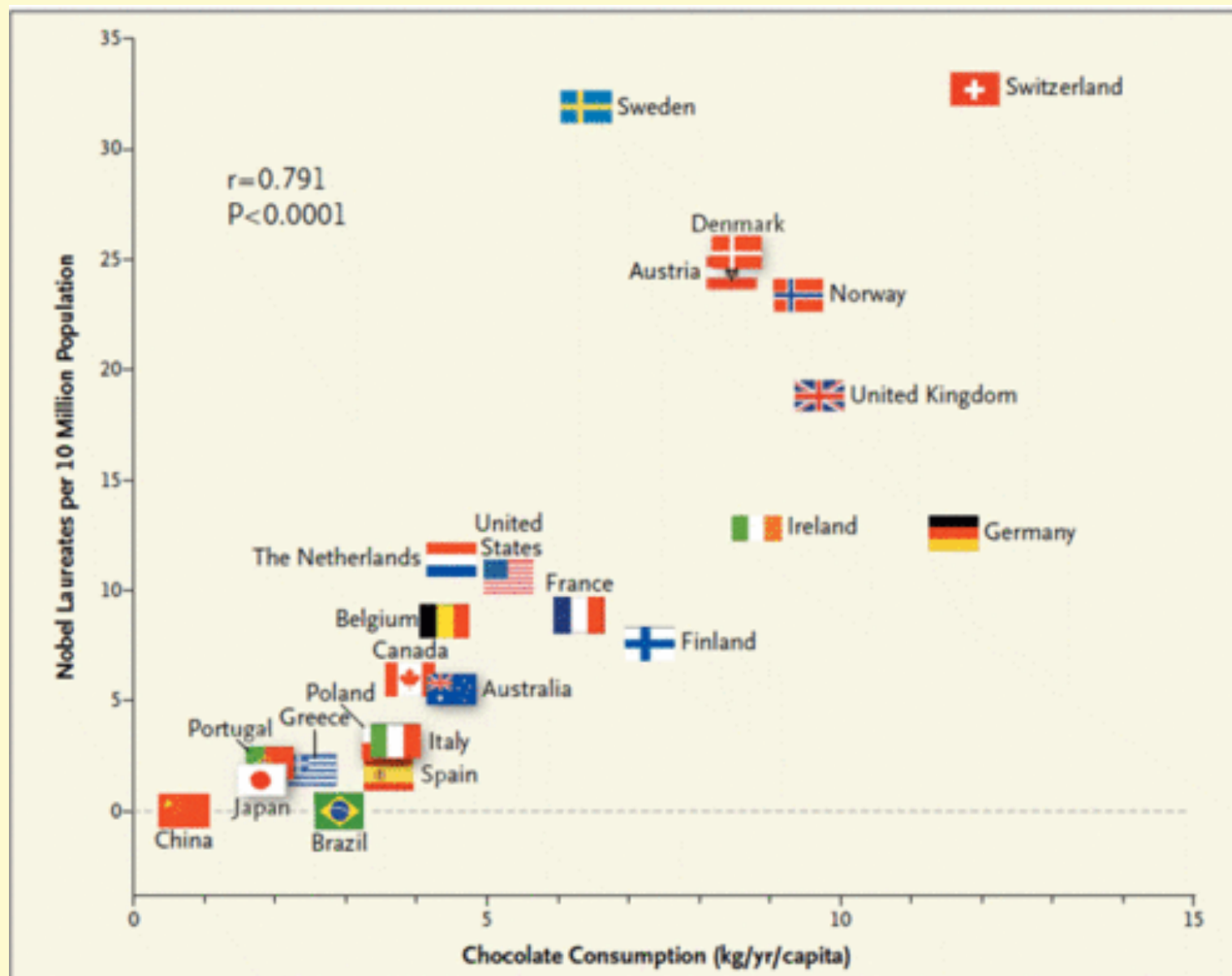- External validity
  - Extrapolations can be wrong

Figure 1. Correlation between Countries' Annual Per Capita Chocolate Consumption and the Number of Nobel Laureates per 10 Million Population.

What can you say for sure from your results?

In the conclusion, make sure you separate facts from conjecture / speculation

Discussion and conclusions

Several functions

1. Summarize your main findings (remember, some people only read the conclusions)
2. Discuss your findings, connect to other findings, speculate about reasons
3. Discuss limitations (could also be switched with previous)
4. Final conclusions, applications and further research

→ Conclusions are quite complex to write, a lot of different topics
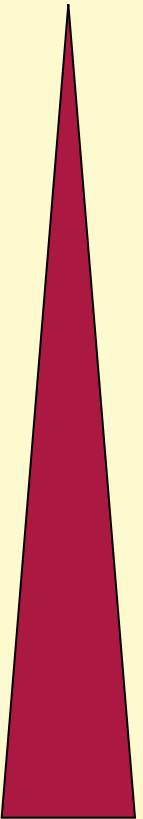
Discussion and conclusions

Several functions

1. Summarize your main findings (remember, some people only read the conclusions)
2. Discuss your findings, about reasons
3. Discuss limitations (cou
4. Final conclusions, appl

→ Conclusions are quite c

Alternative:

Do 1-3 several times for each question, divided by subsections, and then the conclusion section or subsection

I don't like this. One paper, one main question,

1) Summarize findings

- Common to restate the problem, significance and the methods in the beginning

- I personally don't like restating the general problem – even if you're jumping to the conclusions directly, you probably have just read the abstract

- However, a sentence about the approach is OK
  - In this study, we used method X to test whether prevalence of A is associated to factor B. Our main result is that there is a significant correlation of B with A. This correlation, however, was only found when factor C was also present.

2) Discuss, connect and speculate about mechanisms

- Our findings support earlier findings of (X, 2005) and (Y, 2002) who also found a positive correlation between A and B. The fact that this correlation was only present in samples under conditions C may also explain previous opposite results such as (ZZ, 2006,2008), as neither of these previous studies controlled for C. The reason for this positive association and the fact that it is affected by C is still unknown. We speculate that mechanism R could be a reason for this. This idea is given further support by the observation that the correlation between A and B is affected by C. Such an effect would be expected if R is really the cause of this Correlation, as R is dependent on C (XAY, 1968).

3) Discuss limitations

- Most important: some people understand that as having to discuss everything they didn't control / measure / model → WRONG!
  - Discuss only the limitations that credibly question/limit your result
  - Hopefully, you can also find good arguments as to why we can still believe in your main findings

- **Sense of this section is to establish the domain under which your results are valid, not to question your approach in general**
  - **External validity**

- A good opportunity to discuss criticism of reviewers and readers that is to be expected
  - Design, small sample size, …

Final conclusions, applications and further research

- I like starting this paragraph with: in conclusion, our study shows (what you think is the main message)

- Importance and practical application
    - Important for our understanding of …
    - Sheds new light on the discussion about the introduction of …
    - Based on our findings, we recommend …
    - Further research is necessary to finally establish …

- OK, don't overdo it for our projects ;)
- Many journals do the conclusions as an extra section

Exercise – sketch your discussion and conclusion section

If you want, discuss with your group, e.g. about the main limitations

Some general comments

Attitude

- Main aim is clarity – think about your question and what you want to say, not that you need to fill a page

- Some people say it helps them for writing if they explain another person what the study is about and what you found
  - But maybe it helps to keep in mind a person that you are speaking to

- KISS

Writing strategies / writer's block

- I don't think "how write a PhD thesis in 5 days" work – good writing costs time!

- There are as many different strategies as there are books, and it depends a lot on the personality
  - People who write fast and revise a lot
  - People who write slow

- Writer's block – get some sleep, think about what you want to say … if you don't know what you want to say, it's not writer's block, you just don't know what to say → find out and don't make speed writing exercises

Some things that (seem) to work

- Avoid distraction and (potentially) internet (I get most writing done on the train)

- If you don't seem productive, force yourself to go on for a while – many people need at least an hour to get into the flow

- However, if you're tired, uninspired or otherwise incapacitated, leave the text alone for the moment – it doesn't help to waste time then

- Maybe try to create some motivation / pressure for you? → depends on your personality
  - You are lucky, don't have to do it yourself in this course!

Homework

- Start writing your paper.

- Upload your draft as far as you are on Ilias until Sunday (optional). It doesn't need to be finished. I will try to comment on as many papers as possible on Monday!