Chapter 1

Preparation

1. Before reading Chapter 1, consider the following questions:
   - Where in a scientific paper are the research questions presented?
   - Where is the motivation discussed?
   - How do the authors convince you that their methods are appropriate?
2. Read the following abstract from Halpern et al. (2008).

A GLOBAL MAP OF HUMAN IMPACT ON MARINE ECOSYSTEMS

The management and conservation of the world's oceans require synthesis of spatial data on the distribution and intensity of human activities and the overlap of their impacts on marine ecosystems. We developed an ecosystem-specific, multiscale spatial model to synthesize 17 global data sets of anthropogenic drivers of ecological change for 20 marine ecosystems. Our analysis indicates that no area is unaffected by human influence and that a large fraction (41%) is strongly affected by multiple drivers. However, large areas of relatively little human impact remain, particularly near the poles. The analytical process and resulting maps provide flexible tools for regional and global efforts to allocate conservation resources; to implement ecosystem-based management; and to inform marine spatial planning, education, and basic research.

In point form, use words or phrases from the abstract to describe the following:

1. The motivation for the study:
   -

2. The research objective:
    -
3. The approach or methods employed:
    -
    -
    -
4. The key results of the study:
    -
    -
    -
5. The impacts or implications of the study:
    -
    -
    -

Chapter 2

Preparation

1. Before reading Chapter 2, consider the following questions:
   - What role do figures play in communicating science?
   - Are graph styles chosen arbitrarily?
   - What is a box plot?
   - When communicating science, is including a good graph enough?
2. Imagine that you have found a new planet and you are able to measure the temperature of the planet at various locations on the surface of the planet: 10 in the northern half of the planet and 10 in the southern half of the planet. The northern data and the southern data show opposite patterns. You have now been asked to characterize the temperature of the planet over one year.

   Using your imaginary data,[1] sketch a graph that captures how you think you would best present the temperature data for this new planet.

[1] You can choose whatever temperatures and patterns you want for your new planet.

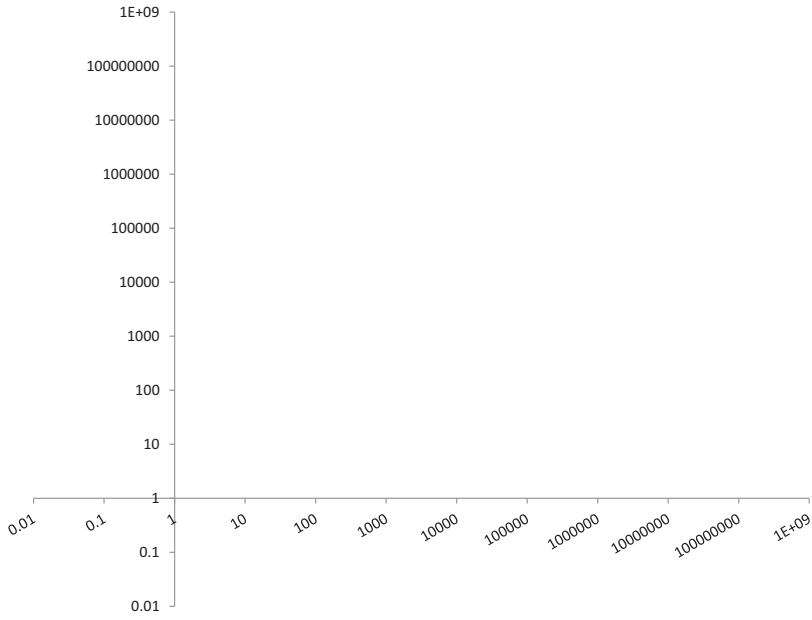
Chapter 3

Preparation

1. Before reading Chapter 3, consider the following questions:
   - What natural cycles commonly influence environmental data?
   - Why do environmental scientists focus on patterns in time and space?
   - What is the difference between a process and an event?
2. Fill in the following spreadsheet with an appropriate timescale (seconds, minutes, days, years, decades, centuries, millennia … billions of years) and spatial scale (micrometres, metres, kilometres, 100s kilometres, 1000s kilometres …) for each word or phrase on the list. You do not have to be exact but try to capture the scales within an order of magnitude.

	Timescale	Spatial Scale
Cell division		
Plate tectonics		
Population growth		
An earthquake		
Evolution		
Ocean circulation		
Weather		
Migration (pick an animal)		
Glaciations		
Soil development		

3. On the graph below, plot your timescales (*x*-axis) and spatial scales (*y*-axis) from the spreadsheet in Question 2. Label each point with the processes in Column A.


1E+09
100000000
10000000
1000000
100000
10000
1000
100
10
1
0.1
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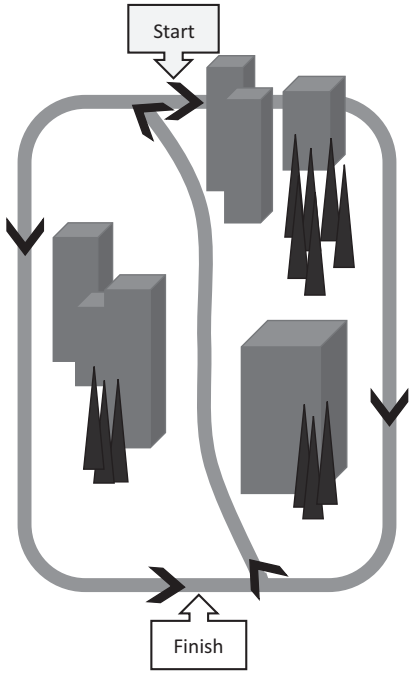
0.01
0.1
1
10
100
1000
10000
100000
1000000
10000000
100000000
1E+09

Chapter 4

Preparation

1. Before reading Chapter 4, consider the following questions:
   - How do we know if a storm is coming, or an earthquake?
   - How are violations of environmental regulations detected?
   - Where does the data come from for environmental indices?
   - How do you decide where and how often to collect monitoring data?
2. You have been asked to document a local race. The proposed track is below. Where would you position yourself to document the race? Why? What would you see from that position? What information about the race could you collect from your vantage point?



Chapter 5

Preparation

1. Before reading Chapter 5, consider the following questions:
   - What comes first, the question or the research?
   - How do I write a good research question?
   - Where do I start?
2. Given your understanding of how science actually happens, draw a flow chart that represents a generalized but realistic scientific process:

Chapter 6

Preparation

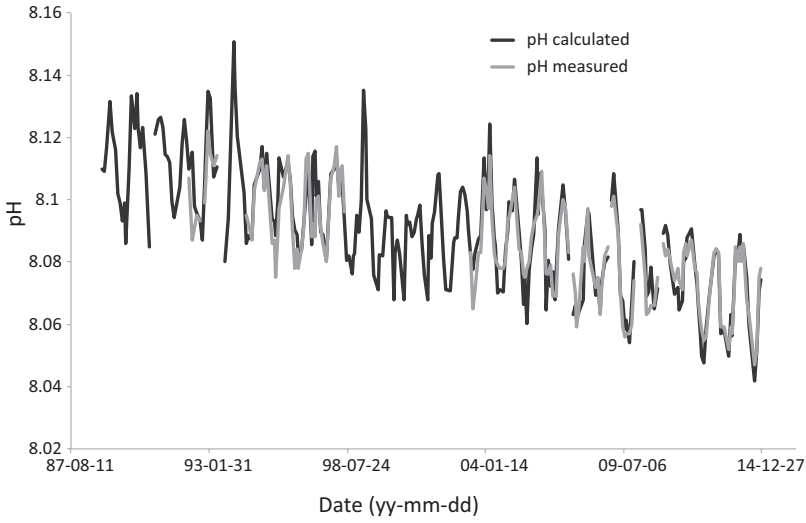
1. Before reading Chapter 6, consider the following questions:
   - What data could help answer your question?
   - Where can you find published data?
   - How do you know what to plot?
2. Consider the following question: How has the 2010 implementation of protected areas influenced the deforestation rates in tropical regions of Asia, Africa, and South America?[1]
   a. What data do you think you would need to answer this question?
   b. Imagining the data that you would collect, sketch a plot (or series of plots) that you think would be a reasonable way to present the data that you identified in question (a) above.

[1] Question inspired by: Blankespoor, B., Dasgupta, S. and Wheeler, D. (2017). Protected areas and deforestation: new results from high-resolution panel data. *Nat. Resour. Forum*, 41: 55–68. DOI: 10.1111/1477-8947.12118.

Chapter 7

Preparation

1. Before reading Chapter 7, consider the following questions:
   - Where do I find a description of the published data I found?
   - When I plot the data, it doesn't look right. Why?
   - There are gaps in the data. Do I have to do anything about them?
2. Consider the following graph:



PREP FIGURE 7.1 Ocean pH data from station ALOHA in the subtropical North Pacific Ocean.

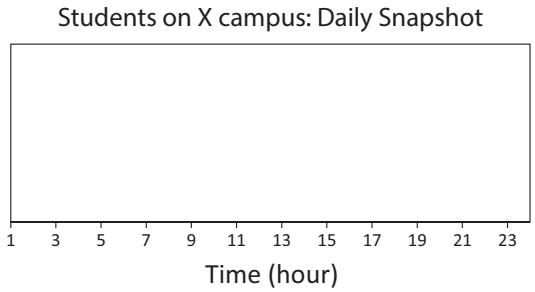
Data from the European Environmental Agency, adapted from Dore, J. E., R. Lukas, D. W. Sadler, M. J. Church, and D. M. Karl (2009). Physical and biogeochemical modulation of ocean acidification in the central North Pacific. *PNAS*, 106: 12235–12240.

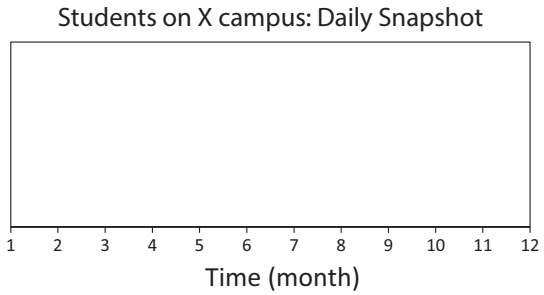
a. Other than the data, try to list at least 10 of the aspects of the graph that could be changed in some way:
   1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.
   9.
   10.

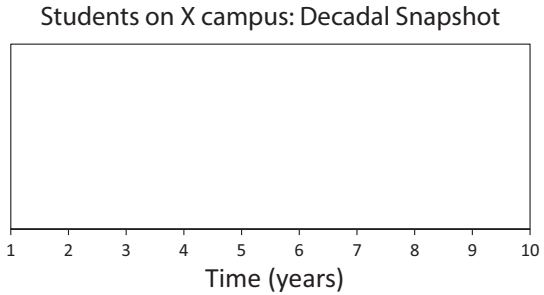
Chapter 8

Preparation

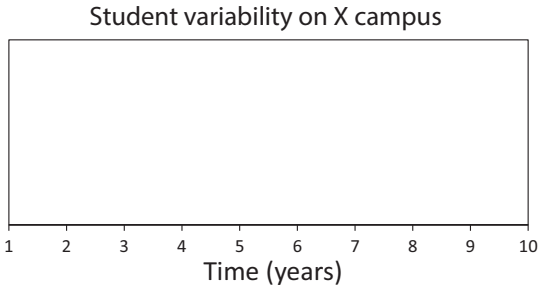
1. Before reading Chapter 8, consider the following questions:
   - How can one signal in a data set be isolated?
   - What is the difference between an average and a running average?
   - What is an anomaly data set?
2. Imagine how the number of students on your campus changes over a day, a year, and a decade. Draw a graph for each timescale.







3. Draw a new graph, using only one line, that captures (combines) the three different timescales of change that you have sketched out in question 2.



Chapter 9

Preparation

1. Before reading Chapter 9, consider the following questions:
   - When looking at environmental data, how can you tell what is a signal and what is noise?
   - When more than one pattern of variability is present in the data set, how can you decide which one is dominant?
   - If there are multiple signals of variability present in the data, can we always isolate them?
2. You have been asked to isolate the annual pattern of air pollution in a particular location from a record of ozone concentrations that has an hourly resolution collected over 20 years.
   a. Do you think you could do it?
   b. How would you try to go about doing it?
   c. What might complicate your ability to isolate the annual variability in the record?

Chapter 10

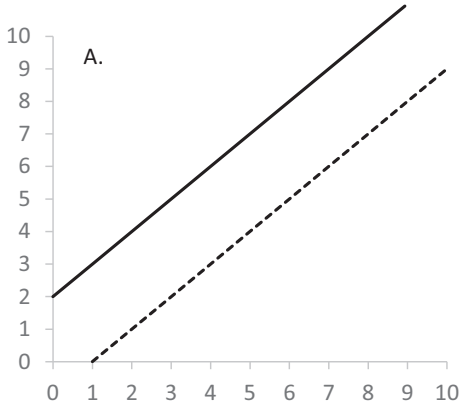
Preparation

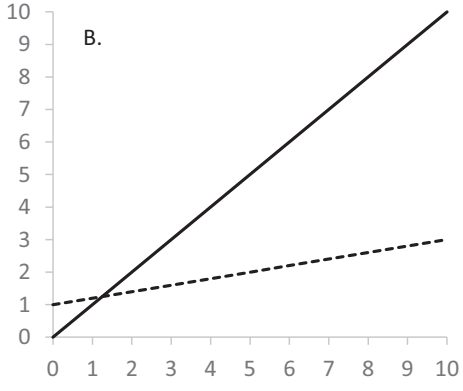
1. Before reading Chapter 10, consider the following questions:
   - How does the mean value of your data set relate to the distribution of your data?
   - What is a standard deviation? Why is it useful?
2. How does the lifespan of an individual organism relate to the average lifespan of a group of this same type of organism?
3. Draw a schematic diagram or graph that reflects the answer that you gave in question (2) above.

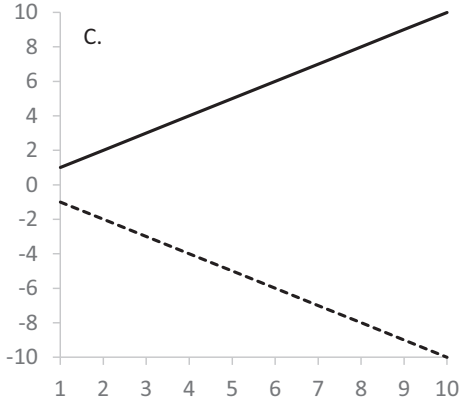
Chapter 11

Preparation

1. Before reading Chapter 11, consider the following questions:
   - Can one data set, from one location, really represent a global phenomenon?
   - Do other sites show the same signal?
   - How can I compare data collected from two (or more) different locations?
2. Consider the following graphs. Identify which one(s) show a strong common variability between the two data sets and which one(s) show weak common variability between the two data sets?


A.
10
9
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6 7 8 9 10

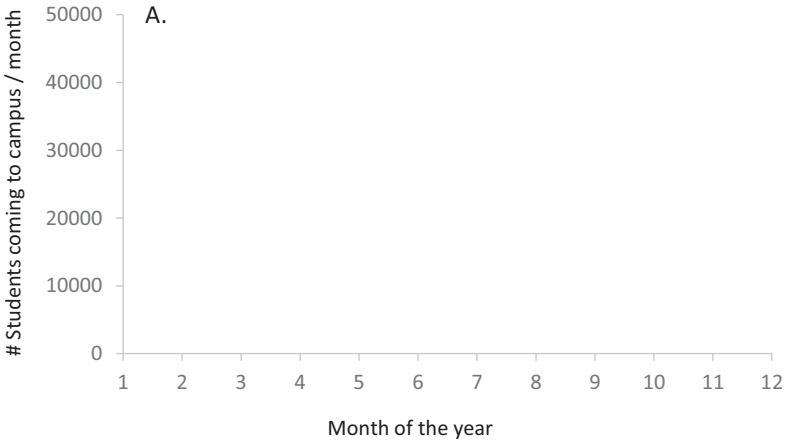

B.
10
9
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6 7 8 9 10

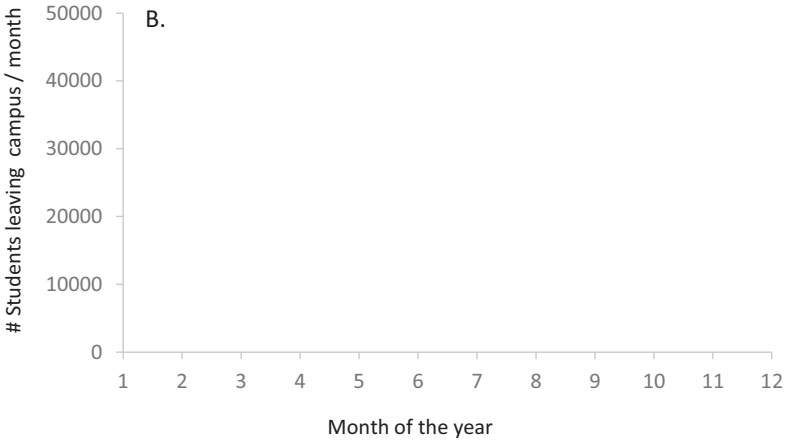

C.
10
8
6
4
2
0
-2
-4
-6
-8
-10
1 2 3 4 5 6 7 8 9 10

Chapter 12

Preparation

1. Before reading Chapter 12, consider the following questions
   - How does a system change over time?
   - Can we predict future behaviour based on past data?
   - What is the difference between correlation and regression analysis?
   - How do you start to build a model?
2. Revisit the graphs you drew in Chapter 8. On the graph you drew reflecting the number of students on campus over a year, label:
   a. the periods in time when the number of people coming to campus exceeds the number of people leaving the campus;
   b. the periods in time when the number of people leaving campus exceeds the number of people coming to the campus; and
   c. the periods of time when the number of people coming to campus and the number of people leaving campus are equal.
3. On panel (a), draw a graph that represents the inflow of student over the year. On panel (b), draw a graph that represents the outflow of students over the year.


A.
Students coming to campus / month
50000
40000
30000
20000
10000
0
1
2
3
4
5
6
7
8
9
10
11
12
Month of the year


B.
Students leaving campus / month
50000
40000
30000
20000
10000
0
1
2
3
4
5
6
7
8
9
10
11
12
Month of the year

Chapter 13

Preparation

1. Before reading Chapter 13, consider the following questions:
   - What should be in a research proposal?
   - How can I find good references?
   - How much detail do I need to include in the methods section?
   - How can I avoid plagiarism?
2. Below is a list of things that have to happen in order to make a pizza. Number the steps in the order that they should happen. Draw a flow chart that depicts the sequence of events. If two things can happen at the same time, consider splitting your flow chart into two streams to show more than one activity occurring at the same time.
   - Preheat the oven to a high temperature.
   - Buy flour, yeast, tomato sauce, cheese, and whatever else is needed to make a good pizza.
   - Grate the cheese.
   - Roll the dough into a flat circle.
   - Mix warm water and yeast; let sit for 15 minutes.
   - Cook the pizza for about 15 minutes.
   - Add the flour to the yeast mixture, knead for 5 minutes.
   - Let the dough sit until doubled in size, about 1.5 hours.
   - Invite friends over.
   - Spread the tomato sauce, cheese, and other ingredients on the dough.
   - Then let the pizza cool a few minutes before cutting it into slices.
   - Enjoy eating the pizza with your friends.
   - Prepare the table / find plates and napkins.

Chapter 14

Preparation

1. Before reading Chapter 14, consider the following questions:
   - What is the purpose of an abstract?
   - What is the difference between an abstract and an introduction?
   - Who reads the abstract of a paper and who reads the introduction?
2. A typical science paper is organized into sections: Introduction, Methods, Results, Discussion, Conclusions. Draw a diagram that relates the content in the abstract to the **content** in these typical sections. This doesn't mean place the abstract in order (the abstract comes first). It means connect the information that is presented in these typical sections to the information that is presented in the abstract.
3. Consider your research proposal or a topic that you find interesting. Jot down the information that you would include in the abstract and the information that you would include in the introduction.