A supervision guide for student projects at AAU

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Contents

Chapter 1

Supervision guide

This is a simple GitBook to assist students to write projects in partial fulfilment of the requirements of a degree in economics at Aalborg University.

It is a collection of project based tools. The idea is that students should be able to browse the table of contents, and see if there is something that they need on the page. There is too much content for a complete read-through, so I would recommend *picking and choosing* based on your needs.

The content is updated periodically, and can *NOT* be referred to as an official source. **All regulations and study program guides take precedence over any content on this site.**

The content is also personalised to the extent that I provide some information about when I will personally be unavailable. Apart from that, it is my hope that at least some of the content will be useful to students of all level.

1.1 Other pages that might be of interest

1.1.1 My research page

Rob's recent research page - anyone that is looking for code to process an SFC model for a report, or just wants to get some ideas about how different data can be visualised can browse the site and borrow and steal whatever is useful.

If you do use some of the code, and you're in academia, it would be pretty cool to get a reference (we are measured according to the relevance of our research) and every little bit helps.

The best option for me would be if you refer to my PhD:

> Smith, R.A.B. (2020). Essays on macroeconomic interactions of sectoral balance sheets. Aalborg Universitetsforlag. Aalborg Univer-

sitet. Det Samfundsvidenskabelige Fakultet. Ph.D.-Serien

OR, you can get the bibtex reference here

1.2 License

Chapter 2

Introduction to supervision

This is an introduction text that explains that I will be your supervisor for your project and outlines some guidelines for our collaboration.

2.1 The introductory letter - Meeting procedure and formalities

Supervision letter: This is a copy of the introductory mail that you received, modified slightly for variation in group sizes (and trimming some of the niceties).

To get started, let's get a few things done.

2.1.1 To do list

Step 1: Please make an MS Teams Team and invite me to it (as an owner). Step 2: Make a plan for the first meeting. (See the info below) Step 3: Figure out how you are going to work together (you cannot just divide up the project into small parts and each do a different part) - we'll discuss this in the first meeting.

In the first meeting I will be the moderator (i.e. like a meeting-coordinator) - I will keep track of the time, make sure we talk about everything on the list, and try to let everyone have a chance to speak.

We need to discuss how you as a group are going to approach writing a project together. It is both an exciting and challenging process, part of the challenge is to get several individuals in the same room (teams for now I presume) where all group members can be heard, and can contribute to the development of the project.

To help with that, we are going to need to have some formalities in our meetings (otherwise I will just end up speaking far too much), and we won't achieve what

needs to be done in the discussions.

2.1.2 Roles and responsibilities in the meetings

Formalities: for every meeting you need to as a group select the following 3 people: (These need to be different for every meeting, but one person can take on multiple roles in smaller groups.)

1. The person responsible for sending the agenda (talking points) before the meeting. (At least 1 day before the meeting.)
2. The note-taker for that meeting (Will be responsible for sending a summary of the meeting to everyone after the meeting).
3. The moderator for that meeting (will be responsible for keeping the meeting running on time and according to the agenda).

Just as a suggestion: I will include a rather formal meeting agenda in the team files section that you can use to save some time setting up a meeting agenda each time. Just change the headings that you want to and then update the table of contents (right-click on it and click on "update field").

2.1.3 Rules for the meetings (short and sweet)

1. Everyone is treated with respect.
2. When one person is talking, all other people must listen. Not just keep quiet, but actually listen to the suggestions / comments.

I will share a supervision guide with you all once you have made the team, then we will use MS Teams to set up our meetings. I'll show you how to do this - I will also make an agenda for the first meeting, and ask everyone to send me points they would like raised.

Please make the MS Team, discuss among you who will do what role in the first meeting, and we can cover the rest once we meet.

Important notice: The time have available for supervision are spread evenly through the semester, it is entirely your responsibility as a group to arrange to use the time allocated through the semester.

Best regards, Robert Smith

2.2 How many meetings?

1. **Introductory meeting:** We will go through literature search and a few useful tools for writing in a collaborative project. (I will try to do a digital/video guide so that you can watch / view / pause rewind the info as much as you please.)

Here I will also try to get to understand where you are as a group in terms of 5 main areas:

a. Your subject specific knowledge (this till be in terms of the specific topic that you have chosen to work on).

b. Your experience and knowledge of group project work.

c. Your skills in project and process management for getting the job done.

d. Your technical academic skills – Theory of science, methodology, methods and theory.

e. Your project writing skills – The practical writing tools, reference mangers, programming skills, collaboration tools etc.

2. **Meeting 2:** You need to have worked on and bring a complete problem statement (see the guide and tips below), we will discuss it in the first meeting.

3. **Meeting 3:** The literature review, and expected method should be done, and any data or materials you plan to use should be collected. We will go through your planned method and argumentation in the meeting.

4. **Meeting 4:** The analysis should be complete, and you should have some working points for your discussion / conclusions. We will go through your arguments verbally, and I will probe any major gaps I see in your thinking.

2.3 Language

As you can see from this text, my first language is English. So anyone that wants to work on their English writing, or just get more exposure to economics in English it might be a good opportunity for you – If you want to work outside of the country or in most multinationals here in DK it is typically a requirement (Danmarks Nationalbank included). You will not be assessed on your grammar, but you will need to make sense and write in a professional manner.

If you would prefer to work in Danish, you are of course welcome to.

To get the most out of the supervision I recommend that in addition to the introductory meeting, 3 group meetings should be sufficient.

Chapter 3

Guidelines for supervision

1. Any team member can communicate with me via Teams on behalf of your group. I expect that all communication has been discussed an agreed upon.
2. Just as you can expect me to read and provide comments on the days of meetings, I expect you to respect the deadlines you choose.
    a. If you want something read before the meeting, it must be sent to me **at least 2 working days before the meeting**, **I.e. Midnight Thursday for a Monday meeting**. (Max 10 pages per meeting)
3. I will read and comment generally on the work but **will not make decisions for you**. Your ability to choose and apply the correct methods is part of what you will be assessed on.
4. Each meeting is planned for one hour.
5. **For every meeting you should bring with:**
    a. Your problem statement (as it evolves with your work).
    b. A list of literature that you have covered up to that point (only the literature you have already read).
    c. Any additional formalities (this will depend on how big your group is).
6. The date by which you will be ready for the next meeting.

3.1 Examinations

You can write and be examined in Danish or English. If you choose Danish, it might be the case that one of our Danish speaking staff will join in the

examination, 1x external examiner + me + possibly 1x Danish AAU examiner. This will depend on departmental resources, but you will not be disadvantaged in any way because of any limitations that I might have with the Danish language.

3.2 Leave periods (absenteeism)

I will be away from Aalborg for the following periods:

1. From 03/11/2021 to 07/11/2021 (week 44).

3.3 Teaching and time pressures

Weeks 47 and 48 I will have a large number of lectures to teach, and will not be able to provide any feedback during those weeks.

3.4 Rough guide to project structures

This is a **very rough** guide to writing a project. It is intended to give you a very basic idea of what to include in a good project.

In terms of pages, each group will know how many people they have, the official **maximum number of pages** (by character count, 2400 key-strokes including spaces) are:

1 Person: 15 pages

2 People: 25 pages

3 People: 30 pages

4 People: 40 pages

Check the official guidelines here

Filling the pages is not the goal, and you will not be given a higher grade for filling all of your allocated pages with pointless text. You will also not be penalised if you can get your message across clearly in fewer pages. Keep in mind, that the average journal article is roughly 15 – 25 double spaced pages (around 8000 words).

You only need to address **one** problem, and to do it as well as possible.

The written project is intended **to communicate** that you have done your homework on your subject. This means that as a student **you should be able to demonstrate that you**:

1. Can identify an economic problem (or gap in the literature) that you think needs to be addressed (and why?!).

2. Can find, read and understand literature about the problem, and how others have dealt with it (reading and organising literature).
3. Can find the relevant information or data that you need to assess the problem, and that you know what to do with it when you do find it (number 2 helps with this) (data and methods).
4. Can present your findings in a well written document, where you give credit to all the authors that helped you to understand the problem (references).
5. If you make a statement, you either need to back it up with your own evidence, or someone else's.

Compressing all of that into 8000 words is much more challenging than filling 40 pages with unnecessary text and graphics. It also requires much more cooperation on and discussion of what needs to go into those pages to make them as effective as possible.

A good group member is one that can read a piece of writing critically and give constructive feedback – to do this effectively is necessary for all group members to be clear about the "red thread" in the project (the "why").

I would personally prefer that you write about 15 pages of really good work than 40 pages of low-quality work.

3.5 For a journal article size paper these are some rough guidelines:

The share of pages between the sections depends on how much space you *need*. I say *need*, because people reading your work want to get the clearest message, in as few words as possible. A (very) rough guide as to how many (academic) references each section could have is included in red text.

1. Abstract (+-150 words)
2. Introduction (0.75 – 1.25 pages) (Motivation, justification, explanation of why? (4 – 5 references))
3. Literature / theory (1.5 – 3 pages, depending on how theoretical your paper is) (Demonstrate reading (6 – 12 references))
4. Method (0.75 – 3 pages, depending on how complex the explanation needs to be) (Justify choice, explain details (4 – 5 references))
5. Results (1 – 3 pages) (Presentation of results (2 – 5 references))
6. Discussion (2 – 5 pages) (Interpretations, comparisons, perspectives (4 – 5 references))
7. Conclusion (1 page) (Link discussion to introduction (No new references))

(The max pages in this example is 16.5 pages – it is just an example, and the split between the sections will change depending on the type of research.)

(Min references in this example is 20, but this is on the high side. You won't have time to read as much as that. 8 – 15 references in total should be enough if you find some really good ones.)

Keep it simple! That is the best advice I ever got. . . and the hardest to follow, because you really need to be sure of what you're talking about to write clearly and simply.

Chapter 4

Time planning and limitations

Be aware of the time you have left to do the research. Data / information collection and organisation takes time, and you need to get started on it early if you want to be able to say anything useful by the time you finish writing your project up. If you are efficient in how you work this guide might help:

A brief guide:

1. Problem identification and reading: 1 week
2. Write literature review: 1 week
3. Write first draft of introduction: 2 days
4. Data collection: 1 week
5. Write method and methodology section: 3 days
6. Data cleaning and analysis: 2 weeks
7. Write results: 1 week
8. Write conclusion: 2 days
9. Re-write introduction: 2 days
10. Check document for references and errors: 1 day

Total: 8 weeks. From mid-March this would get you to mid-May, or from mid-September it would take you to mid-November.

The later you start, the later you finish, or… if you have a deadline… the more you have to sacrifice in terms of quality.

Remember to add time for:

- Reading and feedback

4.1 Reverse time-planning

A very powerful way to plan your project is to take the delivery date and work backwards.

Pick your delivery date, and then work out how much time you need for each of the jobs you need to do – but starting from the last job first.

I will also share a project planner with you all when we have shared supervision space established.

Chapter 5

Guide for report writing

Author: *Verena Stingl*

5.1 Structuring your report

While there are many ways to structure your report, there is typically an underlying logic related to how you "tell a compelling story" in any of these reports. The typical story flow is the following:

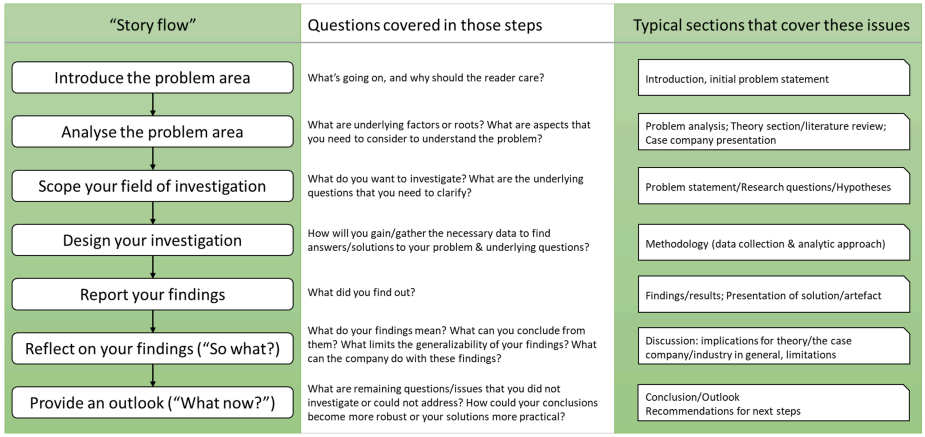


Figure 5.1: Story flow

5.2 General recommendations

- *A report is not a mystery novel.* Never leave the reader wondering why they are reading about some topic or why they should care. That means:
- Start your report on point with introducing the specific problem area, and what makes that area problematic. E.g. *"Day-to-day delivery operations operate under high fluctuations in demand. This variability creates challenges for both efficient stock keeping and staff planning, when actual needs are known less than 24h before they should be met."*
- Give an outlook how you will help understand and overcome the challenge, i.e. what the reader can expect to get out of this report.
- When you introduce a new section or theme, tell the reader why this is important - especially in the "literature" or "theory" section. E.g. *"Day-to-day delivery operations can cope with demand fluctuation through three approaches: improving forecasts, working with buffers, or increasing flexibility in their processes. In the following we are introducing these three approaches and under which condition they are sensible strategies, and thereafter will discuss them in the context of our case company."*

5.3 Define your golden thread (rød tråd)

This should ideally be done before starting detail writing and make sure that it does not make twists and loops. A report should have a clear argumentative structure, that means:

- If a section does not help the reader to understand better what the problem is, what you did to tackle it, or what your problem solution really is, it probably has no place in the report.
- If a section requires knowledge from later in the report to be understandable, it is probably badly placed
- If you cannot formulate a conclusion regarding the current section that will build a bridge to what you will tell in the next section(s), it is probably not necessary to have that section.
- If a section repeats what has been written earlier in the report, you should probably cut down on the redundancies

5.4 Create signposts

It is massively helpful for the flow of the text to start a section with a purpose statement, and conclude it with some sort of summary. However, there are good and bad ways to do it.

Good ways to start provide the reader with a frame in which they can "mentally" place the details provided later in the section. Bad ways just state the obvious and take up space. For example:

- BAD way to start a section: *"The purpose of this section is to introduce the methodology and give an overview of the collected data."* does not tell you anything that a section header could have implied; does not connect to what has been written before.

- GOOD way to start a section: *"To investigate this problem further, we relied on a combination of qualitative and quantitative data collection methods that provided insights on the current warehousing practices. Specifically we…"* → links to the previous section (i.e. the problem introduced before), gives an outlook on what will be covered ("qualitative and quantitative data collection methods") and why this is relevant (to understand more about the current warehousing practices).

Good ways to end provide the reader with a reminder of the most important points of the section, and how it relates both to the general theme and to what will come after. Bad ways, again, just state the obvious and take up space. For example:

- BAD way to end a section: *"In this section we have presented the theory on forecasting, buffering, and flexible process design."* → tells nothing more than a section heading would have told you. Does not build a bridge to the next section.

- GOOD way to end a section: *"Each of the discussed approaches for dealing with demand fluctuation comes with specific advantages and disadvantages that are dependent on the context of the organization. In the following section we will discuss how these approaches could be relevant for the case of [case company]."* → Highlights what the important points of the theory section were (applicability of the different approaches is dependent on context) and links to whats coming next (using the newly build understanding of which approach can succeed where to analyse the options of the case company)

5.5 Use precise and professional language

Colloquialisms can take attention away from otherwise thorough work and can make the report appear unprofessional. A great resource for finding the right words is the "Academic Phrasebank" by Manchester University: https://www.phrasebank.manchester.ac.uk/

5.6 Make convincing claims

Especially in the introduction, you have to make claims about the case company or the industry that they are working in, for example regarding trends, or specific challenges or problems. In this section you want to persuade the reader that they should care, so make sure that your claims are convincing and specific (e.g. by using numbers or quotes instead of mere descriptions and by referencing to trustworthy sources). For example:

- Unconvincing claim: "*Demand in construction material has skyrocketed*" What does "skyrocket" mean? Where and when has demand increased? What's covered by construction material?
- Convincing claim: "*Due to increased home renovations during the Corona pandemic, the demand for construction material in Denmark has increased by X% (of sales volume in DKK) in Q1 2021 compared to Q1 2020 (REFERENCE TO SOURCE). While all types of construction material have seen a rise in demand, the groups [material 1], [material 2] and [material 3] have had the highest increase by X%, Y%, and Z%."*
- Unconvincing claim: *"The most important aspect to manage when introducing green policies are social issues"* What is meant by "social issues" and "green policies"? Who does the managing? Why exactly is it important (and more so than other aspects)?
- Convincing claim: *"To reduce overall green-house gas emissions within a society, policies need to address technological, economic, and social issues (REFERENCE TO RELIABLE SOURCE). Social issues here refer to the potential (negative) consequences of these policies for some groups within society, or all people in society. Fears of such negative consequences could trigger substantial civil opposition to these policies, even as technological solutions become increasingly available. Acknowledging this risk, EU commission's vice-president Frans Timmermans recently stated in an interview with the Guardian* '[We] should make the social issue the pivotal issue in all of this. [..] This could become the biggest stumbling block' *(REFERENCE TO INTERVIEW)."*

5.7 Filling the pages is not the goal

You will not be given a higher grade for filling all of your allocated pages with pointless text. You will also not be penalised if you can get your message across clearly in fewer pages.

5.8 Don't try to save the world

You only need to address one well-scoped problem, and address it in a manner that is reasonable in relation to your time and skill. Thus, you will have to

make decisions on what aspects of the problem area you focus on, and which areas you will not tackle in your project.

Similar you will make decisions regarding which solution paths to follow and which to abandon. Clearly articulate your decisions, mention briefly those aspects/solutions that you are aware of but have decided not to investigate (either in the problem definition and/or in the discussion). Don't write long theoretical sections on issues/approaches that were out of scope for you! For example:

- In the problem statement: *"There are a number of known barriers to the adoption of digital technologies in manufacturing, typically grouped as technical, structural, and cultural barriers [REFERENCE]. For this project, we focus only on technical barriers in our solution development. However, we will consider potential implications of structural and cultural barriers in the discussion of this report."*
- Concluding the theory section: *"Advanced forecasting techniques can be a promising approach to manage demand fluctuation in context where [CONTEXTS WHERE IT WORKS]. However, as we have described in the company background, [case company]'s demand is driven by [DIFFERENT FACTORS]. Thus, we will focus instead on approaches related to increasing the process flexibility as an alternative approach to handle their daily demand fluctuations."*
- In the discussion: *"Our project has helped to identify the main technological barriers for the adoption of [technology X] in [case company]. We have made several propositions how to overcome these technological barriers in moving forward in their digitalization, such as [EXAMPLES]. However, our propositions have not yet considered structural and cultural barriers, such as the fit of the technology with current processes and business models, or potential fear of changes related to the digitalization. Thus, in developing implementation plans for these propositions, we advise [case company] to investigate into potential barriers related to their organizational structure and culture. Specifically, throughout our project, we have noted [… your thoughts on these other barriers]"*

5.9 Reading & revising is just as important as writing

I will of course read and comment on your report, but I will never go to the detail level that you can provide to each other (and I will not re-read sections on which I have commented earlier in the project). So set time aside to read the sections of your colleagues (or assign one or two of the group members the role of reviewer). Read critically against questions such as:

- Is the golden thread (rød tråd) clear?

- Does the argument have a logical structure?
- Are the claims convincing?
- Is the language appropriate?
- Is there text that serves no purpose?

Then give constructive feedback – be specific and give examples (and be nice). For example:

- *"In the second paragraph you introduce [Theme X] but it is a bit unclear how this connects to the paragraph before. Maybe you could add…"*
- *"I remember we had a quote from the production manager, we could use it to strengthen the argument you make here.."*

Chapter 6

Data sources for project inspiration

6.1 Economic time-series databases

1. The Bank for International Settlements
   - https://www.bis.org/statistics/index.htm
2. OECD - stat-bank
   - https://stats.oecd.org
3. AMECO - Annual macroeconomic of the European Commission's Directorate General for Economic and Financial Affairs
   - https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/macro-economic-database-ameco_en
4. The World Bank open data source
   - https://data.worldbank.org
   - Sub-components for microdata, DataBank and a data catalogue
5. Eurostat Database
   - https://ec.europa.eu/eurostat/data/database
6. Danish Data - Kim Abildgren's historical database
   - https://sites.google.com/view/kim-abildgren/historical-statistics
7. Jorda-Schularick-Taylor Macrohistory Database
   - http://www.macrohistory.net/data/

6.2 Income and income inequality databases

1. World Inequality Database
   - https://wid.world/
2. United Nations University WIID – World Income Inequality Database

   - https://www.wider.unu.edu/data?fbclid=IwAR0X8Sj1rcjM5ovy2triA5Y0wo3iApFzV7CEas_ktj139oofcQHjI_ts9F4
3. Luxumborg income database
   - https://www.lisdatacenter.org/our-data/

6.3 Datasets available via CALDISS

It is certainly a good idea to visit the CALDISS website or speak with a representative, as they offer some great introductory courses and access to some great data.

1. Refinitiv Eikon (Financial Time Series Data - Much like the Thomson Reuters Datastream)
   - https://www.caldiss.aau.dk/faciliteter/data/eikon/
   - Home page for additional information
     - https://eikon.thomsonreuters.com/index.html

6.4 AAU based databases

1. Surveybanken
   - https://www.surveybanken.aau.dk

6.5 Diverse datasets

1. The Harvard Dataverse
   - https://dataverse.harvard.edu/dataverse/harvard
2. Kaggle - datasets used for machine learning and AI applications
   - https://www.kaggle.com/datasets
3. The New York Times Github repository
   - https://github.com/nytimes
4. FiveThirtyWight Github page
   - https://github.com/fivethirtyeight
5. The MIT Observatory of Economic Complexity - Economic trade data
   - https://oec.world
6. The Google public data explorer (run in Chrome)
   - https://www.google.com/publicdata/directory
7. European Union Open Data portal
   - https://data.europa.eu/euodp/en/data/
8. GESIS data, including
   - Eurobarometer data
     - https://www.gesis.org/en/eurobarometer-data-service/search-data-access/data-access
   - International Social Survey Programme (ISSP)
     - https://www.gesis.org/en/issp/home

9. European Social Survey data
    - https://www.europeansocialsurvey.org/

6.6 Danish data

1. Danmarks Statistik
    -
2. Danish Data Archive - The Danish Data Archive is a national service for social-, history- and health sciences.
    - http://dda.dk/simple-search
3. Rigsarkivets surveydata
    - https://www.sa.dk/da/forskning-rigsarkivet/benyt-surveydata/
4. Geographic shape files
    - SDFE: https://sdfe.dk/hent-data
    - Geodatastyrelsen: https://gst.dk
    - DAGI: https://sdfe.dk/hent-data/danmarks-administrative-geografiske-inddeling

Chapter 7

Rough guide to writing a problem statement

Coming up with a good question does not mean coming up with a question that will change the world. It means coming up with a question that you can answer **in the time you are allowed**, and **with the tools you have (or have time to learn)**.

A note on how to get started with your problem selection – try to be curious. It is going to take some active effort.

Most of you have identified an area of interest, rather than any specific question. These are just a few pointers to help you to identify a good problem.

- If you want to read a pretty good "how-to" guide, try this one: https://www.wikihow.com/Write-a-Problem-Statement

You need to actively apply yourselves to *finding* a question:

7.1 Step 1: Brainstorm / ideation

- Find a meeting room and mind-map an area of economics that you are interested in.
- A very high-level overview of the courses (like the table of contents in your textbooks) you have done so far should help you to understand the tools that you have, which you can use to answer whatever question you end up asking.
  - Some of these tools will be theories, models, data types and sources. The learning outcomes of your courses are also a good guide (check Moodle).

- If you really want to be active in your search for problems, and deal with real life issues – pick up a phone and make some calls to people in the area or industry you want to look at. These kinds of discussion can be really motivating and insightful.
- As a group you can really benefit by getting ideas and input from each other. This does not need to take a long time but does require effort.
- Don't get caught up by not deciding what to do – get into a room, set a time frame and get finished with the choice early.

Some interesting possible approaches can be seen here – many of these are related to innovation to products, but the general ideas can be used to create research ideas too:

- "The 7 All-time Greatest Ideation Techniques"
  - https://innovationmanagement.se/2013/05/30/the-7-all-time-greatest-ideation-techniques/
- "The master ideation toolbox - 10 tools to unleash creativity from anyone."
  - https://uxdesign.cc/the-master-online-ideation-toolbox-part-1-2-47401c3ad861
- "Our favorite ideation tools"
  - https://www.boardofinnovation.com/staff_picks/our-favorite-ideation-tools/
- "Ideation in Design Thinking: Tools and Methods" - 05/02/2017 - by Rafiq Elmansy
  - https://www.designorate.com/ideation-design-thinking-tools/

7.1.1 Digital tools for getting your project started

There are a heap of tools available:

7.1.1.1 Tools that can help with brainstorming and project management

1. Trello
2. Padlet
3. Notion
4. Prezi
5. Wonder
6. Mural

7.1.1.2 Tools that can help with content creation for questionnaires / interactive quizzes

1. Mentimeter
2. Peergrade
3. MS Forms (Integration of Forms with Teams and OneDrive)
4. Fyrebox
5. Coogle
6. Kahoot

7.1.1.3 Communication tools for collaboration

1. OSX apple screen sharing (with control option)
2. OSX Facetime
3. Slack
4. MS Teams
5. Facebook messenger (A Facebook company)
6. Disqord
7. Skype / Skype for business
8. WhatsApp (A Facebook company)

7.1.1.4 Additional learning tools for self-learning or training

1. DataCamp
2. Khan Academy
3. Udemy
4. Coursera
5. Edx
6. Google Analytics Academy
7. Microsoft Learn - For Power BI

7.1.2 Courses in Econometrics at AAU

The following main methods are covered in each of the semesters, and economic analyses should be conducted that reflect a knowledge up to at least the level of technical analysis of each semester.

7.1.2.1 Methods notes - Econometrics 4. semester

1. OLS - simple linear regression
2. OLS - multiple linear regression
3. Linear regressions in matrices
4. Inference and hypothesis testing
5. And 6. OLS - Assymptotics, functional form and prediction
    1. Goodness of fit
6. Multiple regression analysis with qualitative data
    1. Using dummy variables

7. Heteroskedasticity.
8. Normal distribution model specification.
    1. Proxy variables measure error.
9. Non-nested models, missing data, outliers, least absolute deviations, estimations and multicollinearity.
10. Instrumental variables - 2 stage least squares.
11. Instrumental variables continued - 2 stage least squares with heteroskedasticity.
12. PROBIT and LOGIT

7.1.2.2 Methods notes - Econometrics 5. semester

1. Time series and seasonality trends
2. Cyclical correlation in univariate time-series
3. AR and MA processes
    1. ACF and PACF
4. Stationarity
5. ARIMA - Autoregressive Integrated Moving Average Model
6. Mandatory exercise in forecasting
    1. Properties and evaluation
7. Multivariate time series analysis
    1. Engel-Granger
    2. ARDL - Auto-regressive distributed lag models
8. Dynamic models with non stationary variables
    1. Cointegration and error correction models
    2. Spurious regression
9. Further extension
    1. Cointegration and bounce test
10. VAR
    1. Vector

7.2 Step 2: Getting that problem statement clear

Where to start?

Read. This starts with a good literature search.

Some reflective questions that I recommend you consider before the meeting:

1. **What are you investigating (you have a problem statement for this already - but it still lacks some clarity)?**
   i.e. What do you mean by: "årsagen"? What do you mean by: "handel med omverden"? How do you define globalisation? When you say "påvirke", what do you mean?

Is it all people in the USA? All industries? Aggregate economic measures?
When you talk about effects, it usually implies that there is some kind of causal relationship… When looking at national economic aggregates - there are many possible "causes" for changes. Political, social, economic, technological, etc.

2. **Why is it important to investigate this?**
    1. Who would care about this result? i.e. why are you doing this research? what is the motivation behind finding an answer to this question?
    2. What is the problem that you are actually trying to throw some light on?
3. **How have others explored this?**
    1. What did they find?
    2. What are some of the conclusions that have been drawn?
    3. Are there some concerns/issues with how other people have investigated it?
4. **How could you possibly explore this question?**
    1. Are there some alternative explanations that have not been considered?
    2. Are there some other perspectives that have been ignored? For example… if the USA is able to strengthen it's trade position, what are the consequences for smaller countries that compete in the same markets?
    3. Is there some new data available that illuminates a new part of the problem?
    4. Are there better measures available for inequality / trade performance / competitiveness / etc. ?
5. **How are you going to make the choice about what road to take?**
    1. If you had all the money and time in the world, how would you investigate this problem?
    2. What are the first steps / minimum requirements needed to be able to answer the question?
    3. What options are real possibilities in the time that is left?
    4. Who is going to do what?

7.3 Using the introduction as the route to the problem statement

A good introduction leads to a good problem statement, but this is only possible if you have some good material to work with.

7.3.1 Example flow of a good introduction

1. You could list some shocking figures or numbers that highlight that there is some area / issue that we should be concerned about. It could also be some clear contradiction or controversy in the literature that needs clarification - but this requires some careful reading. (This defines the problem area that you want to address - normally these are the effects of some other problem that can be identified.)

2. You could then explain that some people see (explain) these facts/figures from the perspective of A / B / C . . . and conclude that X / Y / Z. Another group of researchers suggest that there may be another way to interpret these figures.. they say. . . etc. (This highlights existing theories in the literature - these could be conflicting explanations for the effects that are observed by different researchers. Always remember that research can have a particular agenda, i.e. to promote efficiency of markets, or to critique main-stream literature - so be a little critical when reading. Every researcher is trying to sell their ideas.)

3. Next, you could explain that 'these' different approaches suggest that this problem could be investigated by doing E/F/G. (Identification of possible ways of addressing the issue - There are a variety of quantitative and qualitative methods, and some people rely more on some than on others. This section should still be able to refer to how other people have addressed the issue. Here is where you narrow down what might be a good way to look at the problem.)

4. More specifically, therefore, we want to investigate how / if / what the effects of / etc. (By this stage you should be able to be specific about the exact part of the problem that you are interested in addressing, and all of the arguments for why it is interesting should already have been made.)

7.4 Some general notes about writing a problem statement

The general structure of questions in most economic analyses is: What is, has been, or will be the impact of **A** on **B**?

7.4.1 Where do you find a problem in macroeconomics?

Many economic queries attempt to measure social consequences, and most often try to assign a financial value to those consequences. Sometimes this is phrased as a "comparative outcome" or "alternative scenario". Normally this means that one option is *better* than another. This is not surprising, since pretty much all macroeconomic variables are aggregated financial values or derivatives thereof.

Other ways to frame a question could be:

1. Why is one option better than the other? How can you tell?
2. How does a change in X affect income for the economy / households / teachers?
3. How many people are employed?
4. Labour productivity?
5. How is the standard of living affected?

These are justification options (evidence) to motivate *why* an investigation is a good idea. Just remember that you need to be able to find the evidence to back up your arguments. As noted in the example of an introduction flow above, your selection of a method should be the logical conclusion of your reading.

7.4.2 Answering the Why?

Why is it that investigating this problem will be beneficial? To answer the question generally requires awareness of:

1. What?
2. When?
3. Where?
4. Who?
5. In what way?
6. How?

These things are the specifics of the problem statement, but they will not provide you with the answer to why it is important.

The best place to find an answer to *why?* is to read some of the most recent work on the topic you have found. Anything that has been published has been read and edited by at least 5 people by the time it goes to a journal. The arguments in those articles should therefore be pretty reasonable.

Once you understand your *why?* you can start with the specifics

7.4.3 What?

For example: If you chose to research currency markets, some of the sub-categories could be (What?):

- Trading platforms
- Exchange rate policies
- Regulations
- Common currency areas
- Clearing and settlement systems
- Speculation
- Risk-mitigation / hedging

This delimitation is often determined by the problem area that you identify. Normally illustrated by something interesting or concerning, which leads you to think that investigating the area might be interesting.

You can go the other way around, and check what has been written about recently or is currently being funded at the EU or national levels. Read some of the latest literature relating to it and then identify if there is a similar problem in an area that has not yet been investigated.

A third possibility is to open up some of the really amazing data repositories of major institutions and see if some of those can inspire you.

7.4.4 When?

You need to be carefully aware of what time period you choose to investigate, as it has direct consequences for the types of conclusions you can make from your analysis. If you look at 1950 -1970 consumption data, you can't really say anything intelligent about the use of disposable income in 2020.

Historical analysis is crucial in economics, but you should always be aware of how the structure of the economies of the world have shifted over time.

Education rates, the type of institutions that exist, levels of unemployment, the size of government, etc.

A trendy catch phrase for this kind of context is PESTLE, an anagram for how the context of countries change:

1. Political
2. Economic
3. Social
4. Technological

5. Legal
6. Environmental

Please **don't write this list out and do a PESTLE analysis** in your projects, it is just to tell you that there are many changes that take place over time. And that you need to think specifically about time in your problem statement.

7.4.5 Where?

This is quite obvious but is not only related to geographical borders. For example, a study could be:

- National
- Municipal
- Regional
- Global
- Local (or micro)

7.4.6 Who?

Which groups are involved in your project, and who is it that will be interested in reading the results of your research? Who will the research / problem investigation be useful or interesting for.

- Demographic specific (Ex., students, low-income families, employees at public institutions)
- Institution specific (Ex. Banks, the national bank, the stock exchange, or one specific institution)
- Industry specific (Ex. Mining, agriculture, home owners associations, mortgage institutes, or alternatively at a "sector" level, such as households, firms, government etc.)
- Country specific
- Etc.

7.4.7 In what way?

You also need to know what kind of impact or relationship you are looking for. Is it,

- *How much of the behaviour of A can be explained by B*?
- Is it a *theoretical or empirical issue* or are you interested in?

- Or *how much influence will A have on B? Or vice versa, or both*?
- Is it causal? Are you arguing that one thing is *causing* another thing? – you have to be quite careful trying to do these ones.

7.4.8 How?

Finally, you need to be able to explain how you are going to investigate the problem. You should consider your tools and your course on methodology (and philosophy of science) to be able to figure out how will you answer the question.

You can boggle your brain a bit with the wiki-page on philosophy of science here:

https://en.wikipedia.org/wiki/Philosophy_of_science

Recall that methodology is layered, a very simplistic way to think about it is as a hierarchy:

> Philosophy of science

-> Methodology

--> Theory

----> Methods

You can watch a few videos about what this is:

1. This one is pretty good, but a little dry: https://youtu.be/IvwkMxgahA4
2. Daniel Hausman - This one has some interesting perspectives (but is much better in 2x speed): https://youtu.be/EfF6WD8s_ps (but he doesn't really list any specific philosophies)
3. Paul Hoyningen-Huene at Leibniz Universität Hannover has a whole course on it if you get really caught up in it - https://www.youtube.com/watch?v=tP8teUgZcBY&list=PLGV2ddg-PFGvWKDeTyrUji7TXY8y1SHjl (He is pretty entertaining and you could learn a lot in his course – and have a few laughs at dad jokes – in 22 lectures)
4. Marc Lavoie – This might help if you are interested in locating the theory you are using in either heterodox or orthodox categories of economic methodology. Disclaimer: I do not believe this is a constructive way to categorise methodology, but it is a common way. https://youtu.be/DEROFQIao4o

The philosophy of science defines what kind of results will be considered valid. For example, is it valid to make a conclusion about the future based on the past (i.e. to use data to make predictions)?

Some examples of this are:

- Cartesian / Euclidian philosophies of science

- The Babylonian mode of thinking
- Critical realism
- Scepticism
- Logical positivism

This colour coded conceptual map of philosophy might put some of the terms you come across into perspective (with some spin on "education"):

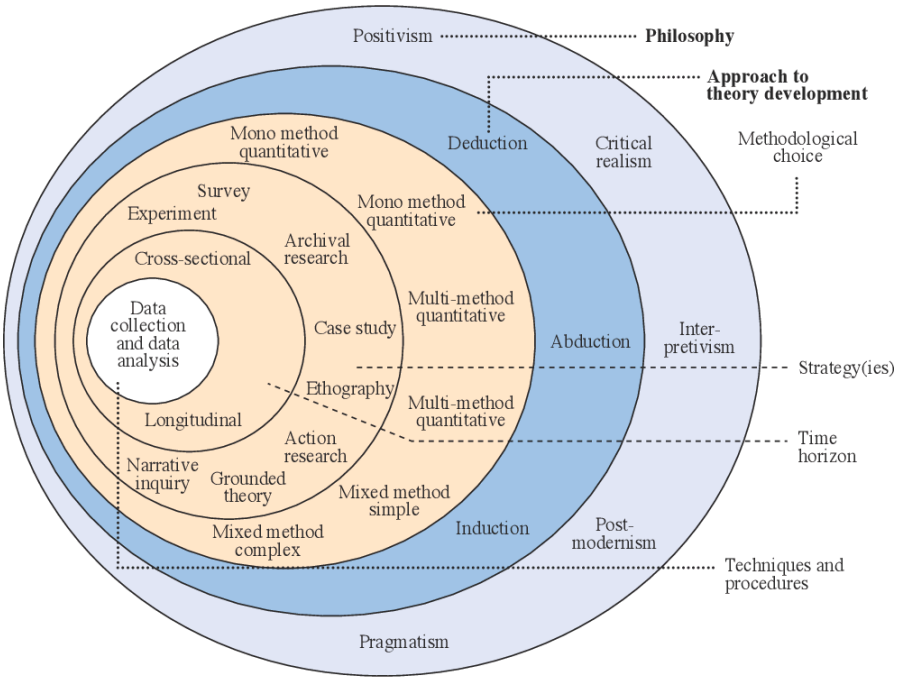
https://cmapspublic3.ihmc.us/rid%3D1196256709922_36526043_8120/1196256715039I908793757I8261Iimage

Theories use methods, and methods are part of a particular methodology, and the methodology is made valid by the theory of science inside which it fits.

Methods are at the bottom of the pyramid, and can be quantitative or qualitative, or a combination of both. It is important to be aware of what you are doing and using. They are normally used to motivate one or another theory.

This stuff can be extremely dry and boring, or it can also be super interesting (if you are into it). It is how we know, that we know, that what we know, is really something factual – or what a fact is in the first place. It is closely related to metaphysics, epistemology and ontology. None of which will help you cook an egg in the morning, but you might find the study as fascinating as I do (even if I will never suck up the energy to finish reading Immanuel Kant's *Critique of Pure Reason*).

This Saunders et al. research onion is a pretty useful way to think about each of the decisions we make when constructing out research. Starting from the outside moving inwards:



e 1. Research onion[1]

Source: Saunders, Lewis and Thornhill (2019), Research methods for business students

Chapter 8

Alternative platforms for writing projects

This is a brief list of options when writing a project. Some options are best suited to complex data work, such as Rmarkdown, whereas others are better suited to collaborative writing, such as Overleaf, MS Word via MS Teams.

Each of these platforms are presented in short videos below. There are some clear advantages to using some rather than others. For each you will need to have some knowledge about how the program works in order to use it, and this might require a time investment.

My preference is to recommend open-source options that allow for efficient collaboration and / or reproducible research.

Free / open source options

1. Overleaf / LaTeX
2. RMarkdown
3. Google Docs (but you pay in terms of data security)

Paid / Subscription options

1. MS Word

8.1 Overleaf (LaTeX)

Overleaf offers a number of excellent guides for getting started, but for those that would like an explanation from me of some of the basics, please feel free to watch the following videos.

One of the most powerful features of Overleaf is the ability to who any change is attributed to, and to roll back changes incrementally. This is possible due to the built in version control features that the platform offers.

1. Video: How open an account in Overleaf
2. GitHub: Template documents and resources
3. Video: Integration of Mendely with Overleaf
4. Integration of Git with Overleaf (Quite a heavy Spanish accent, but a good guide)

8.2 RMarkdown

RMarkdown is a derivative of Markdown syntax, and is a very simple way to write. The video guide below covers a lot of ground, and uses the GitHub template that follows as an example.

1. Video: Getting started with Rmarkdown
2. GitHub: Project template for single or multi-file projects

8.3 MS Word via MS Teams

MS Word files can be dropped into the "General" chat area of any Team created using the MS Teams app. These files can then be edited simultaneously by all team members.

Chapter 9

Reference and bibliography management

With the aid of technology, it is not possible to very easily and efficiently manage and utilise the literature sources that you need when writing an academic project.

The first step is finding the appropriate literature, which is explained in more detail in the chapter below. This section is included in advance as it is useful to select the bibliography management software in advance of completing a literature search.

Each of the more popular reference management software tools have a variety of advantages and disadvantages, depending on what program you choose to work in.

My own preferences are shaped by my experience with each program - and a desire to make sure that the content I create will be accessible to me always, regardless of whether I am at the university or not. If better options exist I would be most interested in hearing about them.

The first two software options enable in-text referencing and automatic generation of reference lists in MS word. The last option, of manually collecting your reference data, is the most inefficient, but has some benefits. The videos below will link to the Loom hosting service, and provide a guide to Mendely. Refworks can do pretty much everything that Mendeley can, but it is expensive to use once you leave the university.

Order of preference

1. Mendeley
2. Refworks

3. Manual storage

9.1 Videos of reference software

1. Video: Mendeley in 5 minutes: Part 1 Video: Mendeley in 5 minutes: Part 2 Video: Mendeley in 5 minutes: Part 3
2. Use of in-text referencing in Ms Word
3. In-text referencing, and creating a reference list in Ms Word
4. Integration of Mendely and Overleaf
5. GitHub Example: Citation options and text edit options in Overleaf
6. Video: Reference lists in RMarkdown
7. Video: Citation options in RMarkdown (Same video as in 6. above)

Chapter 10

Literature searching

Literature searches can be completed in a number of ways. There are several very useful free literature search options, as well as more expensive options that you will have access to as a university student.

10.1 Free search options

1. Google Scholar
2. Semantic Scholar

10.2 Paid search options

These options are very effectively combined and the University library website. Where the *Primo* service can be used to search a wide variety of databases for a specific search string (or phrase).

1. Aalborg University Universitetsbiblioteket

The university site also allows students to access each of the available underlying databases individually and use the special search features that are available for each. Several of these databases allow for bulk exportation of bibliographic information, and can be easily synchronised with referencing software described in the section above.

2. Databases and suppliers

A short video introdution to literature search is included as a video reference below. This link will take you to a video recorded and stored on the **Loom** hosting platform.

10.3 Literature search videos

1. How to conduct an efficient literature search
2. How to construct the key search criteria for your literature search
3. How to save and export search results

Chapter 11

Appendix: Literature search construction

11.1 Project title

Stock-flow consistent models – property and mortgage

11.2 Description of subject

Stock flow consistent model to cover mortgage debt of the household sector

11.3 Problem statement for project

Debt to disposable income levels in several Danish sectors have risen to the highest ever recorded levels, while the Danish central bank (Danmarks nationalbank), the IMF and Finanstilsynet all report that there are no serious threats to financial stability. Financial deregulation, relaxation of borrowing criteria and product innovation have been cited as the leading causes of this trend. This thesis aims to explore credit creation and macro-financial risks related to the expansion of household debt in Denmark by examining institutional sector and individual household balance sheets.

11.4 Search criteria development – summary

1. Step 01: List all concepts
2. Step 02: Group words into "Blocks" of concepts
3. Step 03: Check for any synonyms
4. Step 04: Add Boolean operators

5. Step 05: Prioritise blocks according to subject
6. Step 06: Selection of appropriate databases
7. Step 07: Perform search block by block
8. Step 08: Combine search blocks
9. Step 09: Refine search parameters based on results
10. Step 10: Document search results and search limiters
11. Step 11: Compare results and refine search parameters
12. Step 12: Export final list of documents
13. Step 13: Repeat steps 07 to 12 for each database
14. Step 14: Remove duplicates identified from different databases
15. Step 15: Remove non-relevant documents based on title and abstract
16. Step 16: Read core literature
17. Step 17: From core reading, find and read any key literature identified by other authors.

11.5 Search criteria development

11.5.1 Step 01: List all concepts

1. Stock Flow Consistent Models
2. Structural Econometric Models
3. Mortgage debt
4. Housing market
5. Macroeconomic models
6. Post Keynesian theory
7. Denmark
8. Households
9. Sector balance analysis
10. Household debt

11.5.2 Step 02: Group words into "Blocks" of concepts

1. "Stock Flow Consistent Models" OR "Structural Econometric Models" OR "Sector balance analysis"
2. "Macroeconomic"
3. "Mortgage debt" OR "Housing market"
4. "Post Keynesian theory"
5. "Denmark"
6. "Households"
7. "debt" OR Credit"

11.5.3 Step 03: Check for any synonyms (and use MS Word to check for spelling errors)

1. "Stock Flow Consistent Models" OR "stock flow consistent" OR "Stock-flow consistent" OR "SFC models" OR "SFC" OR "Structural Economet-

ric Models" OR "Structural econometric" OR "SEM models" OR "Sector balance analysis" OR "SBA" OR "Sector financial balances"
2. "Macroeconomic model" OR "National model" OR "aggregate model"
3. "Mortgage debt" OR "mortgage bonds" OR "Mortgage credit" OR "mortgage borrowing" OR "Housing market"
4. "Post Keynesian" OR "Post-keynesian"
5. "Denmark" OR "Danish" OR "Nordic" OR "Scandinavian"
6. "Households"
7. "debt" OR Credit"

11.5.4 Step 04: Add Boolean operators

1. "Stock Flow Consistent Model*" OR "stock flow consistent" OR "Stock-flow consistent" OR "SFC model*" OR "SFC" OR "Structural Econometric Model*" OR "Structural econometric" OR "SEM model*" OR "Sector* balance analysis" OR "SBA" OR "Sector* financial balance*"
2. "Macroeconomic model*" OR "National model*" OR "aggregate model*"
3. "Mortgage debt" OR "mortgage bonds" OR "Mortgage credit" OR "mortgage borrowing" OR "Housing debt"
4. "Post Keynesian" OR "Post-Keynesian"
5. "Denmark" OR "Danish" OR "Nordic" OR "Scandinavian"
6. "Household*"
7. "debt" OR Credit"

11.5.5 Step 05: Prioritise blocks according to subject

Starting with the most relevant first

("Stock Flow Consistent" OR "Stock-flow consistent" OR "SFC model*")

OR

("Structural Econometric" OR "SEM model*")

AND

("Macroeconomic model*" OR "National model*" OR "aggregate model*" OR "sector* model")

AND

("Mortgage debt" OR "mortgage bonds" OR "Mortgage credit" OR "mortgage borrowing" OR "Housing debt" OR "Housing market" OR "Property market" OR "Property Prices")

AND

("Post Keynesian" OR "Post-Keynesian")

AND

("Denmark*" OR "Danish" OR "Nordic" OR "Scandinavia*")

AND

("Household*" OR "private sector")

AND

("debt" OR "Credit")

Optional alternative to add to SFC ("Sector* balance analys*" OR "Sector* financial balance*")

11.5.6 Step 06: Perform search block by block

11.5.7 Step 07: Combine search blocks

11.5.8 Step 08: Document search results and limitations

11.5.9 Step 09: Compare results and refine search parameters

11.5.9.1 1. Scopus

Scopus (371 results)

Search string:

ALL(("Stock Flow Consistent" OR "Stock-Flow Consistent") AND (macroeconomic* model*)) AND DOCTYPE(ar OR re OR bk OR ch OR cp OR sh) AND (LIMIT-TO(LANGUAGE, "English"))

Scopus (138 results)

Search string:

TITLE ("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND ALL ("propert*" OR "hous*" OR "mortgage") AND DOCTYPE (ar OR re OR bk OR ch OR cp OR sh) AND (LIMIT-TO (LANGUAGE , "English"))

Scopus (6 results) + housing

Search string:

TITLE ("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND ALL ("housing") AND DOCTYPE (ar OR re OR bk OR ch OR cp OR sh) AND (LIMIT-TO (LANGUAGE , "English"))

Scopus (3 results) + mortgage

Search string:

TITLE ("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND ALL ("mortgage") AND DOCTYPE (ar OR re OR bk OR ch OR cp OR sh) AND (LIMIT-TO (LANGUAGE , "English"))

Scopus (26 results) + property housing mortgage

Search string:

TITLE (“Stock Flow Consistent” OR “Stock-Flow Consistent” OR “SFC”) AND ALL (“propert*” OR “hous*” OR “mortgage”) AND DOCTYPE (ar OR re OR bk OR ch OR cp OR sh) AND NOT (“Chromatography” OR “lipid solid fat” OR “solid fat content” OR “silico-ferrite off calcium” OR molecular* OR “service function chaining” OR “service-function chaining” OR “chemistry” OR “space-filling curve” OR “Sequential Function Chart*” OR “SFC binder”) AND (LIMIT-TO (LANGUAGE , “English”))

Scopus (23 results) + property housing mortgage

Search string:

TITLE (“Stock Flow Consistent” OR “Stock-Flow Consistent” OR “SFC”) AND ALL (“property market” OR “housing market” OR “mortgage debt”) AND ALL (“economics”) AND DOCTYPE (ar OR re OR bk OR ch OR cp OR sh) AND (LIMIT-TO (LANGUAGE , “English”))

11.5.9.2 2. EBSCOhost (Business Source Premier, Academic Source Premier) (119 results)

(Search options: Also search in full text of the articles)

(Limits: Academic search premier Language: English Publication Type: All Document Type: Article, book chapter, proceeding, report)

(Limits: Business search premier Language: English Publication Type: Academic journal, Book Document Type: Article, book entry, proceeding, report, working paper)

EBSCOhost (119 results)

Search string:

(“Stock Flow Consistent” OR “Stock-Flow Consistent”) AND (macroeconomic* model*)

EBSCOhost (25 results) (included)

Search string:

(“Stock Flow Consistent” OR “Stock-Flow Consistent” OR “SFC”) (Limit: TITLE) AND (macroeconomic* model*)

EBSCOhost (9 results)

Search string:

(“Stock Flow Consistent” OR “Stock-Flow Consistent”) AND (macroeconomic* model*) AND (“Denmark*” OR “Danish” OR “Nordic” OR “Scandinavia*”)

11.5.9.3 3. ProQuest

ProQuest (529 results)

Search string:

("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND (macroeconomic* AND model*) AND (LA(English))

ProQuest (43 results)

Search string:

TI("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND ALL (macroeconomic* AND model*) AND (LA(English))

Source type

Conference Papers & Proceedings, Dissertations & Theses, Scholarly Journals, Working Papers

Document type

Article, Book, Book Chapter, Conference Paper, Country Report, Literature Review, Report, Technical Report, Working Paper/Pre-Print

Language

English

11.5.9.4 4. JSTOR

JSTOR (96 results) (selection included – JSTOR requires click to export)

Search string:

(("Stock Flow Consistent" OR "Stock-Flow Consistent") AND (macroeconomic* model*)) AND la:(eng OR en)

JSTOR (19 results)

Search string:

(ti:("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") la:(eng OR en)

JSTOR (13 results)

Search string:

(ti:("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") AND (macroeconomic* model*)) AND la:(eng OR en)

11.5.9.5 5. Web of Science

Web of Science (67 results)

Search string:

("Stock Flow Consistent" OR "Stock-Flow Consistent") AND (macroeconomic* model*)

Web of Science (24 results)

Search string:

("Stock Flow Consistent" OR "Stock-Flow Consistent" OR "SFC") (Limit: TITLE) AND (macroeconomic* model*)

Web of Science (1 results)

Search string:

("Stock Flow Consistent" OR "Stock-Flow Consistent") AND (macroeconomic* model*) AND ("Denmark*" OR "Danish" OR "Nordic" OR "Scandinavia*")

11.6 Summary

Total of 146 documents found

Chapter 12

Presentations

Each semester students approach me asking what "I would prefer they present?". This really is not a question of preference, but there seems to be enough inconsistency in expectations to make it worth while asking the supervisor what to do.

Some supervisors must have an expectation that something new is presented - or this would not arise as a question.

12.1 First and foremost: Check the learning and knowledge objectives for the project!

The only thing you can be graded against are the formal descriptions in the study or project description. These are often quite broad, but these are the grounds that need to be covered **at a minimum** for the project to pass.

These objectives can be met by either the written or the oral contibutions of the student. So if you have failed to complete part of the objectives in the written part - you might consider covering the ground in the presentation. Although this might not be the most effective strategy, since there is a good chance you will be asked questions that reflect those objectives in the question and answer part of your defence.

12.2 So what is the purpose of the presentation?

The presentation is an opportunity to communicate the contribution that you have made. It is also an opportunity to set the stage for the defence that follows.

Ideally you want to make an interesting and compelling presentation. Interesting in the sense that the content should be interesting to listen to, and compelling

in the sense that you need to convince the people listening that you know what you are talking about.

That may seem like subjective and useless information - but first impressions matter, and a strong presentation that is well delivered creates a firm foundation for a good strong defence.

12.3 Something old or something new?

You each have 8-10 minutes to convince the examiner that you have done something interesting and or useful.

This could be presenting the work you have already submitted in written form - bearing in mind that the examiners will have read the project. This can be beneficial if the written project does not capture the full extent of the work and findings of the research. Although, you should also be able to explain why it was never included in the written part in the first place.

An example of this could be a complex economic model, with perhaps 50 or 100 equations - where a full explanation of all intricacies would result in a very (impractically) long document that failed to capture the main point of your research.

12.4 It's about communicating value

As mentioned above, it can help to think about the idea that you have 15 minutes to convince the examiners of the value of the work you have done.

The remainder of the exam will be sufficient time to ask a good mixture of questions on the project, during which you will get a chance to "defend" the work that you submitted in written form.

It's not a sales pitch, but you do need to "sell your work" in some sense of the expression - sometimes the best way to do so is focussing on the work that you have already done, and sometimes that is to present something additional to the work done - but as I personally do not have a preference, and will not penalise anyone for doing one or the other.

12.5 What not to do

Do not show up un-prepared - plan what you want to say, figure out how you are going to say it, and practice the presentation a couple of times before the defence.

The corollary of the point above is the only thing that I do not recommend, which is to spend all of your presentation time highlighting all of the flaws in

your work - it is good to have perspective on the work, but if the perspective is all negative it can create a highly critical atmosphere.

I.e. if you spend all of your presentation time making your work sound poor, it can keep the focus there for the remainder of the defence. If, on the other hand, the shortcomings are, for example, "challenges to be overcome in future projects" and oversimplifications in your model are "areas that you want to develop the model further", then you are able to direct the focus towards progress and achievement, rather than inadequacies in your work.

12.6 What is of value in academia?

This is a rather dangerous question to try to answer in a little blurb on the internet, but I will hazard a short suggestion. The only reason I am mentioning anything like this here is that after submitting your written assignment, you might realise that some part of the assignment was lacking in quality.

There are a few things that good quality academic work often demonstrates, some of which can be highlighted indirectly in a presentation of your project:

1. A careful consideration of the area of research and in doing so found a particular issue you would like to investigate or address.
    - **Example:** "We approached the _____ area of economics since we were interested to find out _____"
2. Consultation of academic literature on both the area in question and the specific problem.
    - **Example:** "One of the first authors to investigate the issue, *'Name'*, raised _____ concerns, which still apply to research in the area today"
3. Consultation of literature on previous attempts to investigate the problem and the methods that previous researchers have used.
    - **Example:** "Several approaches have been taken to investigate the topic, *'name'* first used _____, and *'name'* was able to mitigate some of the problems faced by…. in …"
4. A clear understanding of the choice of method, the method itself and the limitations thereof.
5. A careful and appropriate application of a method to the problem, taking care not to over-reach in the interpretation of results.
6. A clear line of reasoning from start to finish.

Chapter 13

Data retrieval and plotting

The examples used in this section (excluding the plotly interactive plots at the bottom) can all be found in a complete RMarkdown file called "SingleDocument.Rmd" in one of my other GitHub repositories, here.

13.1 Example data sourcing and manipulation

One of the benefits of online database API access is that you can readily source up to date data directly from web locations without having to save files locally in advance.

Most of the major data providers have easy to handle R packages for directly importing data while building your document. The following code chunk requires several packages to be installed:

13.1.1 Loading the required packages

The first `sapply` function is just a nice abbreviation that can be used to run the `require`command for all of the packages listed in the preceding vector. It can of course be modified to run any function.

The second part is particularly useful when writing PDF documents, as you can set the standard chunk options up front in your document and adjust all image settings at once if you choose to change your document setup.

These packages are mostly used in setting up additional plot options for ggplot 2 for aesthetic purposes, like controlling the colour palette, the location and size of the legend etc. All of that plotting code is included just before the plots below.

13.1.2 Collecting the data from the Danmarks Statistik API

```
##############################################################################
# Danmarks statistik example
##############################################################################

# This uses a package called statsDK, which needs to be built from Mikkel Krogsholm's
#
#    install.packages("devtools")
#    library(devtools)
#    devtools::install_github("mikkelkrogsholm/statsDK")

# Fetching interest rate data, and filter for mortgage products
##############################################################################
dk_mortgage_interest_raw_data <- data.table(sdk_retrieve_data(table_id = "DNRNURI",
                                                              DATA = paste0(c("AL51EFFI
                                                              INDSEK = paste0(c("1400"
                                                              VALUTA = "z01",
                                                              LØBETID1 = "ALLE",
                                                              RENTFIX = paste0(c("1A",
                                                              LAANSTR = "ALLE",
                                                              Tid = "*")) %>%
    select(-c(VALUTA, LØBETID1, LAANSTR, INDSEK)) %>%
    #mutate(Value = str_replace_all(INDHOLD, pattern = "..", "")) %>%
    mutate(Value = as.double(INDHOLD, na.rm = TRUE)/100,
           RENTFIX = str_replace_all(RENTFIX, pattern = " - - ", "")) %>%
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = " - ", "")) %>%
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "- ", "")) %>%
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "Over 6 months and up to and in
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "Over 1 year and up to and incl
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "Over 2 years and up to and inc
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "Over 3 years and up to and inc
    mutate(RENTFIX = str_replace_all(RENTFIX, pattern = "Over 5 years and up to and inc
    mutate(Interest_Fixation = str_replace_all(RENTFIX, pattern = "Over 10 years", "Fi
    mutate(Date = str_replace_all(TID, pattern = "M", "")) %>%
    mutate(Date = paste0(Date, "01")) %>%
    mutate(Date = as.Date(Date,format='%Y%m%d'))  %>%
    mutate(Interest_Fixation = factor(Interest_Fixation, order = TRUE,
                                      levels = c("01 year",
                                                 "02 year",
                                                 "03 year",
                                                 "05 year",
                                                 "10 year",
                                                 "Fixed"))) %>%
```

```
    select(-INDHOLD, -RENTFIX, -TID) %>%
    filter(!is.na(Value))


DK_yield_curves_rates <- dk_mortgage_interest_raw_data %>%
    filter(DATA != "Administration rate (per cent) (not indexed)",
           !is.na(Value)) %>%
    select(-DATA)
```

13.1.3 Adding some extra plotting options

This section includes some additional code that makes writing a document a little more user friendly.

The first part includes some directory specifications, based on the location that the user saves this file.

The second part includes a number of ggplot2 theme and colour palette modifications that can be modified for personal preference.

- The line-width for all line plots in the document.
- Palettes with shades of red, black, blue for 4 5 and 6 variables.
- A mixed colour palette of 10 colours for categorical variables.
- Alternative legend placements inside the plotting area. (This saves a lot of space in the final document).
- Percentage formats that work with latex and ggplot2.
- Simplified command to introduce dashed lines for 5 and 6 variables.
- A theme adjustment to reduce font size in all plots.

```
##############################################################################
# Set up some extra features for plots that will be used later

plot_line_width = 0.85

##############################################################################
# Set colour palettes
##############################################################################

blackpalette <- c("0, 0, 0",
                  "125, 125, 125",
                  "75, 75, 75",
                  "225, 30, 0")
bluepalette <- c("0, 50, 130",
                 "0, 170, 255",
                 "0, 200, 255",
                 "0, 55, 255")
redpalette <- c("255, 45, 0",
```

```
                "255, 200, 0",
                "255, 155, 0",
                "255, 100, 0")

blackpalette_five <- c("0, 0, 0",
                       "185, 190, 200",
                       "115, 115, 115",
                       "75, 75, 75",
                       "225, 30, 0")
bluepalette_five <- c("0, 50, 130",
                      "0, 150, 255",
                      "0, 175, 255",
                      "0, 200, 255",
                      "0, 55, 255")
redpalette_five <- c("255, 45, 0",
                     "255, 200, 0",
                     "255, 175, 0",
                     "255, 145, 0",
                     "255, 100, 0")

blackpalette_six <- c("0, 50, 130",
                      "0, 0, 0",
                      "185, 190, 200",
                      "115, 115, 115",
                      "75, 75, 75",
                      "225, 30, 0")
bluepalette_six <- c("0, 50, 130",
                     "0, 100, 255",
                     "0, 130, 255",
                     "0, 165, 255",
                     "0, 200, 255",
                     "0, 55, 255")
redpalette_six <- c("255, 45, 0",
                    "255, 240, 0",
                    "255, 210, 0",
                    "255, 180, 0",
                    "255, 155, 0",
                    "255, 100, 0")

randompalette <- c("91, 163, 111",
                   "84, 135, 158",
                   "76, 99, 143",
                   "204, 157, 2",
                   "156, 0, 0",
                   "110, 99, 194",
```

```
                    "11, 132, 176",
                    "237, 133, 28",
                    "23, 87, 11",
                    "49, 163, 79")

blackpalette <- sapply(strsplit(blackpalette, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
bluepalette <- sapply(strsplit(bluepalette, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
redpalette <- sapply(strsplit(redpalette, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))

blackpalette_five <- sapply(strsplit(blackpalette_five, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
bluepalette_five <- sapply(strsplit(bluepalette_five, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
redpalette_five <- sapply(strsplit(redpalette_five, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))

blackpalette_six <- sapply(strsplit(blackpalette_six, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
bluepalette_six <- sapply(strsplit(bluepalette_six, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))
redpalette_six <- sapply(strsplit(redpalette_six, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))

randompalette <- sapply(strsplit(randompalette, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue=255))


##############################################################################
# Define random colours for plots and theme settings
##############################################################################

random_srv_palette <- c("91, 163, 111",
                        "84, 135, 158",
                        "156, 0, 0",
                        "204, 157, 2",
                        "110, 99, 194",
                        "11, 132, 176",
                        "76, 99, 143",
                        "237, 133, 28",
                        "23, 87, 11",
                        "11, 132, 176",
                        "49, 163, 79")
```

```
random_srv_palette <- sapply(strsplit(random_srv_palette, ", "), function(x)
    rgb(x[1], x[2], x[3], maxColorValue = 255))

##############################################################################
# Set plot options
##############################################################################
# Create alternative legend placements inside the plots

legend_bottom_right_inside <- theme(legend.spacing = unit(0.02, "cm"),
                                    legend.background = element_rect(colour = "white",
                                    legend.key.size = unit(0.5, 'lines'),
                                    legend.justification=c(1,0),
                                    legend.position=c(1,0))

legend_top_right_inside <- theme(legend.spacing = unit(0.02, "cm"),
                                 legend.background = element_rect(colour = "white", siz
                                 legend.key.size = unit(0.5, 'lines'),
                                 legend.justification=c(1,1),
                                 legend.position=c(1,1))

legend_top_left_inside <- theme(legend.spacing = unit(0.02, "cm"),
                                legend.background = element_rect(colour = "white", size
                                legend.key.size = unit(0.5, 'lines'),
                                legend.justification=c(0,1),
                                legend.position=c(0,1))

legend_bottom_left_inside <- theme(legend.spacing = unit(0.02, "cm"),
                                   legend.background = element_rect(colour = "white", s
                                   legend.key.size = unit(0.5, 'lines'),
                                   legend.justification=c(0,0),
                                   legend.position=c(0,0))

##############################################################################
# Create percentage number format settings object for plots
##############################################################################

# This setting is specifically important for LaTeX generated PDF documents, as the esc

pct_scale_settings <- scales::percent_format(accuracy = NULL,
                                             scale = 100,
                                             prefix = "",
                                             suffix = "\\%",
                                             big.mark = " ",
                                             decimal.mark = ".",
                                             trim = TRUE)
```

```
##############################################################################
# Define dash types for plots
##############################################################################
#  0 = blank, 1 = solid, 2 = dashed, 3 = dotted, 4 = dotdash, 5 = longdash, 6 = twodash

plt_line_types_5 <- c("solid", "dashed", "dashed", "2222", "2222")
plt_line_types_6 <- c("solid", "dotdash", "dashed", "dashed", "2222", "2222")

##############################################################################
# Define additional plotting theme settings for server data
##############################################################################

theme_extra <- theme_minimal() +
    theme(text = element_text(size=8))+
    theme(axis.text.x = element_text(angle=90, vjust=0.5))+
    theme(plot.title = element_text(hjust = 0.5))
```

13.1.4 Plotting the data

Creating a plot for the data depends quite critically on the structure of the data that you provide to the function. ggplot2 is most effective when you keep your data in "long-format", which basically means that all descriptive and categorising variables have their own columns and the "values" that each observation take are located in a single long column. This is structure is terrible for human comprehension but much easier to process programatically.

The plot that follows is a line plot of Danish interest rates. Note the places where you need to record the "fig.caption" and "caption" labels. `fig.cap = "Danish interest rates"` is included in the code chunk, whereas, `caption = "Source: Statistics Denmark (Danmarks Statistik), own calculations"` is included in the `labs`options for the plot.

```
# Plot the data with GGPlot
##############################################################################
DK_rate_curves <- ggplot() +
    geom_line(data = DK_yield_curves_rates,
              mapping = aes(x = Date,
                            y = Value,
                            group = Interest_Fixation,
                            colour = Interest_Fixation),
              lwd = 0.5) +
    labs(x = "Interest fixation term", y = "Rate of interest",
         caption = "Source: Statistics Denmark (Danmarks Statistik), own calculations") +
    scale_colour_manual(values = randompalette) +
```

```
    #scale_colour_gradient(low = "#ffffff", high = "#050f80") +
    #facet_wrap(~Growth) +
    scale_y_continuous(labels = pct_scale_settings) +
    theme_extra +
    theme(legend.direction = "vertical",
          legend.box = "horizontal") +
    legend_top_right_inside +
    guides(col = guide_legend(nrow = 3,
                              byrow = FALSE,
                              title = "Interest fixation"))
DK_rate_curves
```

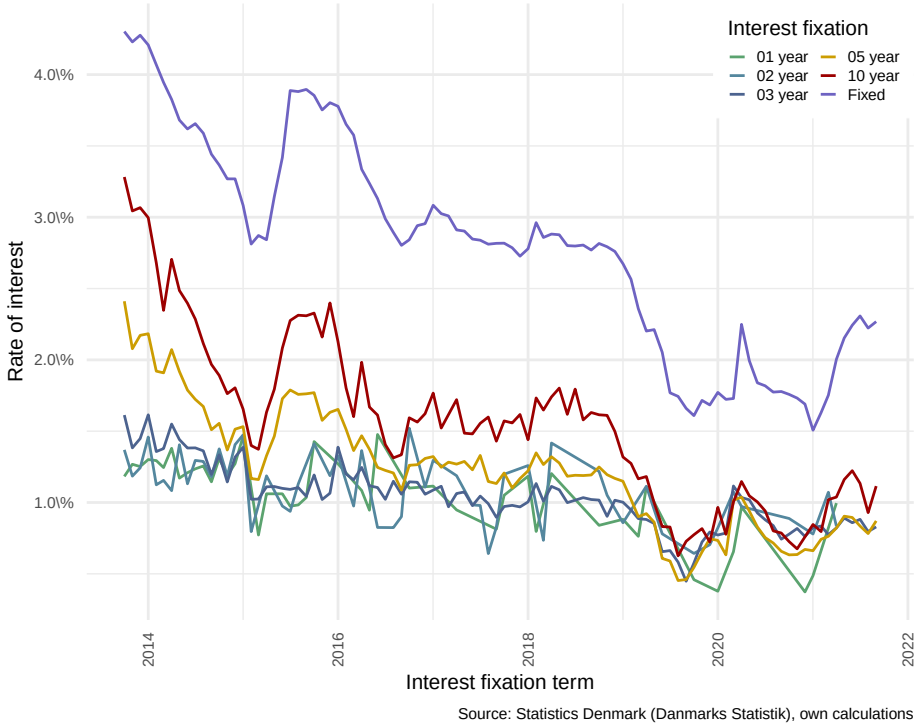
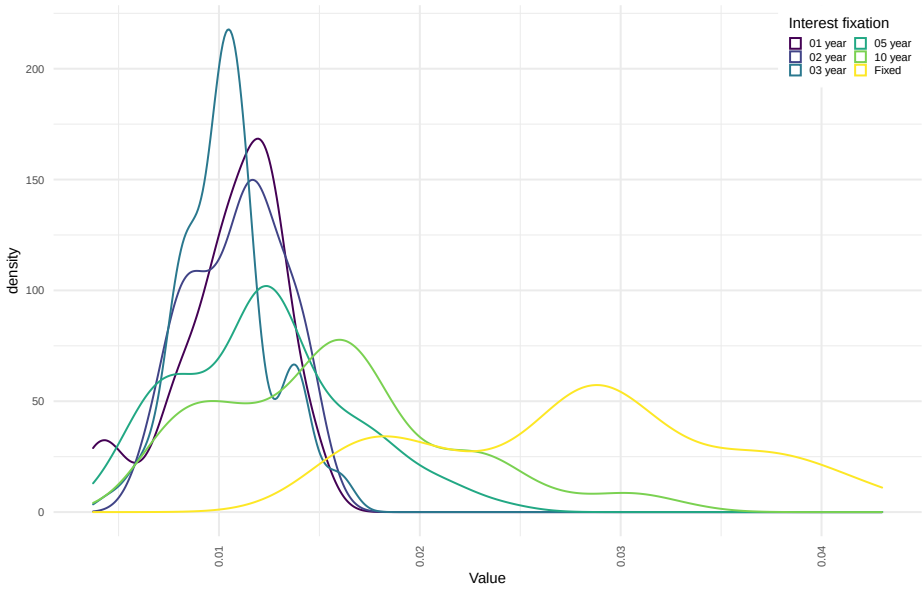


Figure 13.1: Danish interest rates

13.1.5 Density plots using ggplot2

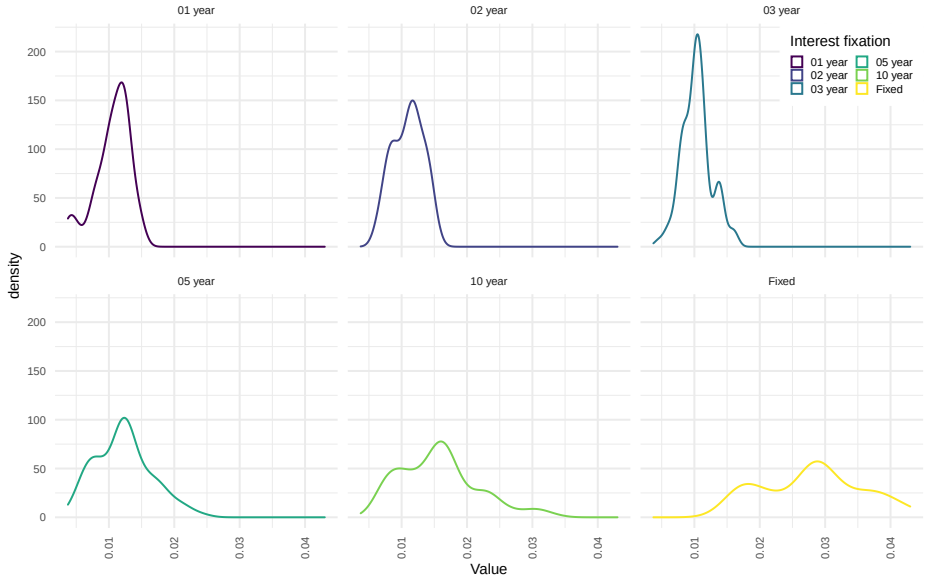
ggplot2 offers a wide range of automatic image processing options. Including density plots.

```
density_plot_interest_rates <- ggplot() +
        geom_density(data = DK_yield_curves_rates,
                     mapping = aes(x = Value,
                                   group = Interest_Fixation,
                                   colour = Interest_Fixation)) +
    theme_extra +
    legend_top_right_inside +
    guides(col = guide_legend(nrow = 3,
                              byrow = FALSE,
                              title = "Interest fixation"))
density_plot_interest_rates
```



And the ability to automatically create a tiled "faceted" plot of underlying groupings.

```
density_plot_interest_rates <- ggplot() +
        geom_density(data = DK_yield_curves_rates,
                     mapping = aes(x = Value,
                                   group = Interest_Fixation,
                                   colour = Interest_Fixation)) +
    facet_wrap(~Interest_Fixation) +
    theme_extra +
    legend_top_right_inside +
    guides(col = guide_legend(nrow = 3,
                              byrow = FALSE,
                              title = "Interest fixation"))
density_plot_interest_rates
```



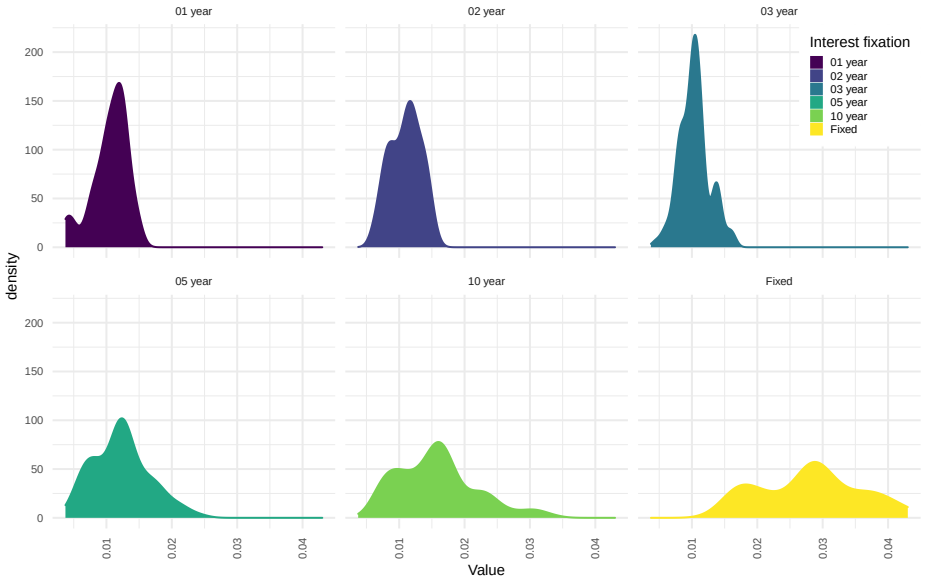
With minor modifications to the `aes` (aesthetics) properties, you can automatically change all plots to be filled in for these density plots. The Fill aesthetic is not available for all `geom`'s, so you will need to investigate the options for the ones that you are interested in.

You can see that I have also modified the number of rows in the legend to 6, to keep the legend narrower - since it overlaps the data in the top right corner. Additional legend options can be seen here. The identical legend settings and titles for `col` and `fill` prevent duplicate legends from being created. you can test this out by modifying one of the title texts.

The two options `theme_extra`, and `legend_top_right_inside`, are created above in the additional charting options section, and illustrate one way to keep your plotting code a little cleaner.

```
density_plot_interest_rates <- ggplot() +
        geom_density(data = DK_yield_curves_rates,
                     mapping = aes(x = Value,
                                   group = Interest_Fixation,
                                   colour = Interest_Fixation,
                                   fill = Interest_Fixation)) +
    facet_wrap(~Interest_Fixation) +
    theme_extra +
    legend_top_right_inside +
    guides(col = guide_legend(nrow = 6,
                              byrow = FALSE,
                              title = "Interest fixation"),
           fill = guide_legend(nrow = 6,
```

```
                                byrow = FALSE,
                                title = "Interest fixation"))
density_plot_interest_rates
```



13.2 Example table

The `kableExtra` package provides some exceptionally simple quickformatting options for both html and PDF table generation. (Link to explainer page here)

The above sourced interest rate data can be quickly laid out in a table as follows:

```
pre_created_table <- DK_yield_curves_rates %>%
          arrange(Interest_Fixation) %>%
          spread(key = Interest_Fixation, value = Value)

pre_created_table %>%
  kbl(caption = "Table of interest rates over time") %>%
  kable_styling(bootstrap_options = c("striped", "hover"))
```

13.3 Interactive html plots with Plotly

A scatter plot with labels on all points can be easily created (some axis limits for the data were necessary below). I also wanted uniform dot sizes and so simply used `Value / Value` which returns `1` for all dot sizes.

```
library(plotly)

a <- as.numeric(min(DK_yield_curves_rates$Date)) * 24 * 60 * 60 * 1000
b <- as.numeric(max(DK_yield_curves_rates$Date)) * 24 * 60 * 60 * 1000

fig <- plot_ly(DK_yield_curves_rates %>%
    filter, x = ~Date, y = ~Value,
  # Hover text:
  text = ~paste("Interest rate: ", Value, '%<br>Fixation:', Interest_Fixation),
  mode = "markers",
  color = ~Value, size = ~Value/Value
) %>%
  layout(xaxis = list(range = c(a, b)))

fig
```

Modifying this plot to return lines, we just need to arrange the data in the correct order to ensure that the lines traced follow the correct pattern.

```
library(plotly)

a <- as.numeric(min(DK_yield_curves_rates$Date)) * 24 * 60 * 60 * 1000
b <- as.numeric(max(DK_yield_curves_rates$Date)) * 24 * 60 * 60 * 1000

fig <- plot_ly(DK_yield_curves_rates %>%
    arrange(Date),
```

Table 13.1: Table of interest rates over time

Date	01 year	02 year	03 year	05 year	10 year	Fixed
2013-10-01	0.01183	0.01369	0.01613	0.02411	0.03282	0.04302
2013-11-01	0.01268	0.01185	0.01383	0.02078	0.03044	0.04229
2013-12-01	0.01252	0.01243	0.01448	0.02172	0.03067	0.04276
2014-01-01	0.01301	0.01459	0.01615	0.02183	0.02997	0.04208
2014-02-01	0.01294	0.01124	0.01357	0.01921	0.02680	0.04069
2014-03-01	0.01245	0.01155	0.01378	0.01909	0.02347	0.03945
2014-04-01	0.01380	0.01083	0.01550	0.02072	0.02705	0.03826
2014-05-01	0.01171	0.01405	0.01441	0.01918	0.02486	0.03681
2014-06-01	0.01209	0.01131	0.01382	0.01788	0.02397	0.03619
2014-07-01	0.01236	0.01295	0.01383	0.01723	0.02286	0.03656
2014-08-01	0.01256	0.01288	0.01362	0.01673	0.02114	0.03589
2014-09-01	0.01145	0.01181	0.01197	0.01510	0.01968	0.03442
2014-10-01	0.01309	0.01376	0.01334	0.01555	0.01891	0.03366
2014-11-01	0.01189	0.01186	0.01144	0.01368	0.01763	0.03269
2014-12-01	0.01272	0.01406	0.01318	0.01514	0.01804	0.03269
2015-01-01	0.01465	0.01474	0.01387	0.01532	0.01654	0.03083
2015-02-01		0.00796	0.01023	0.01168	0.01399	0.02812
2015-03-01	0.00772		0.01024	0.01161	0.01373	0.02872
2015-04-01	0.01061	0.01187	0.01110	0.01328	0.01633	0.02842
2015-05-01			0.01112	0.01465	0.01794	0.03145
2015-06-01	0.01061	0.00975	0.01099	0.01728	0.02083	0.03419
2015-07-01	0.00974	0.00938	0.01092	0.01789	0.02276	0.03888
2015-08-01	0.00983	0.01130	0.01105	0.01758	0.02313	0.03881
2015-09-01	0.01035		0.01043	0.01762	0.02309	0.03896
2015-10-01	0.01427	0.01412	0.01193	0.01770	0.02328	0.03854
2015-11-01			0.01021	0.01576	0.02160	0.03752
2015-12-01		0.01188	0.01065	0.01632	0.02399	0.03803
2016-01-01	0.01271	0.01328	0.01388	0.01653	0.02127	0.03778
2016-02-01			0.01200	0.01513	0.01803	0.03652
2016-03-01		0.00975	0.01159	0.01364	0.01602	0.03576
2016-04-01	0.01084	0.01364	0.01246	0.01468	0.01983	0.03336
2016-05-01	0.00946		0.01117	0.01373	0.01669	0.03237
2016-06-01	0.01477	0.00825	0.01105	0.01246	0.01613	0.03131
2016-07-01			0.01022	0.01225	0.01406	0.02989
2016-08-01		0.00824	0.01149	0.01207	0.01313	0.02893
2016-09-01		0.00901	0.01058	0.01087	0.01335	0.02803
2016-10-01	0.01101	0.01521	0.01145	0.01261	0.01594	0.02842
2016-11-01			0.01142	0.01265	0.01564	0.02941
2016-12-01		0.01108	0.01058	0.01309	0.01623	0.02955
2017-01-01	0.01115	0.01296	0.01087	0.01322	0.01767	0.03084
2017-02-01			0.01114	0.01247	0.01522	0.03025
2017-03-01			0.00970	0.01283		0.03009
2017-04-01	0.00948	0.01188	0.01063	0.01269	0.01721	0.02911
2017-05-01			0.01074	0.01288	0.01486	0.02903
2017-06-01		0.00983	0.00978	0.01229	0.01481	0.02847
2017-07-01		0.00979	0.01045	0.01330	0.01555	0.02839
2017-08-01		0.00642	0.00992	0.01147	0.01599	0.02811
2017-09-01	0.00813	0.00827	0.00896	0.01133	0.01430	0.02817
2017-10-01	0.01051	0.01198	0.00972	0.01207	0.01572	0.02818
2017-11-01			0.00980	0.01102	0.01558	0.02786
2017-12-01			0.00969	0.01168	0.01617	0.02727

```
    x = ~Date,
    y = ~Value,
    color = ~Interest_Fixation,
  # Hover text:
  text = ~paste("Interest rate: ", Value, '%<br>Fixation:', Interest_Fixation),
  mode = 'lines'
) %>%
  layout(xaxis = list(range = c(a, b)))

fig
```