DATA VISUALIZATION AND STORY TELLING
**Table of Contents**

About the course .................................................................................................................. 2

Overview of Data Visualization .......................................................................................... 3

The advantages and benefits of good data visualization .................................................. 3

Why data visualization is important for any career ......................................................... 3

Data Preparation in Microsoft Excel .................................................................................. 5

Design Principles of Visualization .................................................................................... 6

Choosing the Right Tool and Right Graph ....................................................................... 8

What are Data Visualization Techniques? ......................................................................... 9

Good Chart Checklist ......................................................................................................... 9

Selecting the right chart type ............................................................................................ 10

Line Charts .......................................................................................................................... 10

Pie Charts ............................................................................................................................ 12

Bar Charts and Column Charts ......................................................................................... 14

Treemap ................................................................................................................................ 16

Dual Axis Chart .................................................................................................................. 18

Area Chart ........................................................................................................................... 19

Pyramid Chart ..................................................................................................................... 21

Word Cloud .......................................................................................................................... 23

Tables .................................................................................................................................... 24

Developing an Interactive Dashboard ............................................................................... 25

Activity .................................................................................................................................. 25

Structuring the Narrative .................................................................................................... 26

What is Narrative Structure? .............................................................................................. 26

Types of Narrative Structure ............................................................................................. 26

Author Driven and Reader Driven Stories ........................................................................ 27

Persuasion and Power of Stories ....................................................................................... 28

Lessons in Storytelling ......................................................................................................... 29

Activity .................................................................................................................................. 29

Principles of Effective Storytelling .................................................................................... 30

Importance of Storytelling from the Stakeholder’s Point of View ................................... 31
About the course

Overview
In this two-day course we amalgamate the art of storytelling and science of data visualization together to understand finer nuances of storytelling. It will cover a wide range of topics from visualization technology, design elements, structuring a narrative. It not only provides well researched knowledge and best practices but also let participants apply these principles in practice.

Objective
On completion of this course, participants will be able to:

- Understand technology eco system for data visualization.
- Use design principles for effective data visualization.
- Choose right framework for right context and for right audience.
- Determine appropriate visualization for drawing attention to core idea.
- Create compelling narratives for the audience.
Overview of Data Visualization

Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyze massive amounts of information and make data-driven decisions.

The advantages and benefits of good data visualization

Our eyes are drawn to colors and patterns. We can quickly identify red from blue, square from circle.

Our culture is visual, including everything from art and advertisements to TV and movies. Data visualization is another form of visual art that grabs our interest and keeps our eyes on the message.

When we see a chart, we quickly see trends and outliers. If we can see something, we internalize it quickly. It’s storytelling with a purpose. If you’ve ever stared at a massive spreadsheet of data and couldn’t see a trend, you know how much more effective a visualization can be.

Why data visualization is important for any career

Data visualization is important for almost every career. It can be used by teachers to display student test results, by computer scientists exploring advancements in artificial intelligence (AI) or by executives looking to share information with stakeholders.

It also plays an important role in big data projects. As businesses accumulated massive collections of data during the early years of the big data trend, they needed a way to get an overview of their data quickly and easily.

Visualization tools were a natural fit.

The better you can convey your points visually, whether in a dashboard or a slide deck, the better you can leverage that information.
Other benefits of data visualization include the following:

- The ability to absorb information quickly, improve insights and make faster decisions.
- An increased understanding of the next steps that must be taken to improve the organization.
- An improved ability to maintain the audience’s interest with information they can understand.
- An easy distribution of information that increases the opportunity to share insights with everyone involved.
- Eliminate the need for data scientists since data is more accessible and understandable; and
- An increased ability to act on findings quickly and, therefore, achieve success with greater speed and less mistakes.
## Data Preparation in Microsoft Excel

<table>
<thead>
<tr>
<th>Import data</th>
<th>Adjust formats</th>
<th>Correct inconsistencies</th>
<th>Remove duplicates</th>
<th>Combine data</th>
</tr>
</thead>
</table>

### Data preparation process

1. **Import data**
   - Split data along delimiters (e.g. comma or semicolon)
   - Extract parts from data entries
   - Remove leading and trailing spaces

2. **Format adjustments**
   - Standardize formats (e.g. dates, currencies, units)
   - Store data in the correct format (e.g. value, text, date)
   - Replace unrecognized or corrupted characters (e.g. ÁÝ)
   - Check for truncated entries (i.e. entries that have been cut off)

3. **Correct inconsistencies**
   - Check for inconsistent entries using custom rules (e.g. age > 0)
   - Numerical data: Check for outliers
   - Survey data: Recognize suspicious response patterns
   - Categorical data: Check for wrong categories (e.g. “no” vs. “0”)
   - Missing values: Add data or remove rows

4. **Remove duplicates**
   - Deduplicate your data considering fuzzy duplicates

5. **Combine data sets**
   - Lookup values from other tables
Design Principles of Visualization

1. **Balance the Design**

A design is balanced when the key visual elements (color, shape, texture, and negative space) are equally distributed across the frame (or in our case, the dashboard). This doesn’t mean each side of the design is an exact replica of the other, necessarily; you can achieve asymmetrical balance by offsetting larger charts and graphs with small elements.

There are three different types of balances in design:

- **Symmetrical** - Each side of the visual is the same as the other
- **Asymmetrical** - Both sides are different but still have a similar visual weight
- **Radial** - Elements are placed around a central object which acts as an anchor

2. **Emphasize the Key Areas**

The user’s attention should be drawn to the right data points by carefully choosing the size, colors, contrast, and negative space. The goal of the data visualization is to make sure that the important data doesn’t go unnoticed and emphasizing it helps. Since the attention of a user first falls in the top-left corner of a plot, you should place the important data points there.

3. **Illustrating Movement**

Movement directs the user’s attention in a certain direction, just like emphasis. Your visual elements should mimic movement in an “F” pattern, which is how people read. Starting from top left to right, and gradually down the page.

You could also illustrate movement across the page by using complementary colors that can catch the viewer’s gaze and take it across the page. This principle is more applicable to static visualizations. If your data visualization tool is capable of animation and interactive designs, the movement aspect should already be covered.
4. **Smart Use of Patterns**

Repeated design elements form a pattern. When it comes to visualizing your data, patterns make for a great way to display similar types of information spread across the page as one. If the data on the page is too much for emphasizing, establishing a pattern by using similar colors, chart types and elements are the way to go.

Patterns also make it easier to communicate an anomaly, since any disruption in the pattern will naturally draw the viewer’s attention and curiosity. Using patterns is one of the simplest and most effective design principles when it comes to data visualization.

5. **Proportion**

If you are going to draw a picture of a bird on a tree, the tree will be significantly bigger compared to the bird. In data visualization, the proportion is made up of the size of each element on the page. Proportions in data visualization can indicate the weight of different data sets and the relationship between their values.

If you need to emphasize the importance of a certain data point, all you must do is to make it bigger than the rest. In addition to this, you should ensure that the chart reflects the interrelationship of various numbers as accurately as possible. For example, if a slice in a pie chart is marked 36%, it should use 36% of the area inside the chart.

6. **Proper Rhythm**

Rhythm is a rather vague design principle that is closely associated with movement. A design is said to have a balanced rhythm when the design elements together create a pleasing movement to the eye. If the design elements like shapes, colors, or proportions together create a “choppiness”, you might want to rearrange them to facilitate smooth eye movement across the data.

7. **Variety**

Variety is an important factor that keeps viewers engaged and interested in your data. It's all about finding ways to visualize your data using different and interesting design elements to avoid repetition. The result will be a data visualization which is not only eye-catching but also helps the viewer retain the information presented for longer.

8. **Theme**

A unified theme ensures every part of your design is consistent and follows a standard. This should happen naturally if you have taken care of the design principles. You can incorporate a theme for your company or based on the niche of the visualization. This helps connect with the user on a deeper level and augments the visual design.
If you have data you want to visualize, make sure you use the right charts. While your data might work with multiple chart types, it’s up to you to select the one that ensures your message is clear and accurate. Remember, data is only valuable if you know how to visualize it and give context.

**CHART SUGGESTIONS - A THOUGHT-STARTER**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>Comparison charts are used to compare one or more datasets. They can compare items or show differences over time.</td>
</tr>
<tr>
<td>Relationship</td>
<td>Relationship charts are used to show a connection or correlation between two or more variables.</td>
</tr>
<tr>
<td>Composition</td>
<td>Composition charts are used to display parts of a whole and change over time.</td>
</tr>
<tr>
<td>Distribution</td>
<td>Distribution charts are used to show how variables are distributed over time, helping identify outliers and trends.</td>
</tr>
</tbody>
</table>
What are Data Visualization Techniques?

Here are a few data visualizations that you must know:

- **Know the target audience** – this shouldn’t come as a surprise. Designing a chart of a graph should always be done based on the audience that will view it.
- **Create a goal** – or more like a logical narrative. Ensure to set clear goals that must be conveyed through the infographic. Also, the relevant content type is a must.
- **Choose the chart type** – A pie chart does not complement every information visually. Similarly, a bar graph does not show every statistic clearly. Choose the chart part accurately to put forth the information.
- **Context** – Use of colors is encouraged depending upon the context. A decrease in the profit growth could be marked red, whereas green could show the increasing parameter.
- **Use tools** – Yes, one of the easiest ways to create data visuals is using tools. Use them as they make the charts intuitive as well as easy to read.

**Good Chart Checklist**

- ✔ Type of chart compatible with the narrative (message).
- ✔ No color overload (3 colors max).
- ✔ One chart, one message.
- ✔ Metaphors aligned with the narrative.
- ✔ I don’t need to read the caption to understand the chart.
- ✔ The caption is used as a synthesis opportunity.
- ✔ The caption does not explain the chart again.
- ✔ Bias checked by a third party.
Selecting the right chart type

Line Charts

A line chart reveals trends or change over time. Line charts can be used to show relationships within a continuous data set and can be applied to a wide variety of categories, including daily number of visitors to a site or variations in stock prices.
Best practices for creating line charts:

- Clearly label your axes - Make sure the viewer knows what they are evaluating.
- Remove distracting chart elements - Grids, varying colors, and bulky legends can distract the viewer from quickly seeing the overall trend.
- Zoom in on the y-axis if your data set starts above zero - In certain cases, changing the scale of the y axis makes it easier for.
- Avoid comparing more than 5-7 lines - You don’t want your chart to become cluttered or hard to read. Visualize the data you need to tell your story, nothing more.
The pie chart is one of the most used and hated chart types of all time. Pie charts are used to show parts of a whole. A pie chart represents numbers in percentages, and the total sum of all the divided segments equals 100 percent.
Best practices for creating pie charts:

- Make sure your segments add up to 100 - Sounds obvious, but this is a common mistake.
- Keep it clean and consistent. Compare just a few categories to get your point across. If the pie slices have roughly the same size, consider using a bar or column chart instead.
- Avoid using 3-D imagery or tilt your pie chart - This often makes your data impossible to read, because your viewer is trying to quickly compare angles.
Bar Charts and Column Charts

Bar and column charts are used to compare different items. Bars on a column chart are vertical while bars on a bar chart are horizontal. Bar charts are generally used to help avoid clutter when one data label is long or if you have more than 10 items to compare. They are easy to understand and to create.

Best practices for creating bar and column charts:

- Start the y-axis at zero - Our eyes are sensitive to the area of bars on a chart. If those bars are truncated, the viewer might draw the wrong conclusions.
- Label the axes - Labelling the axes gives your viewer context.
- Put value labels on bars - This helps to preserve the clean lines of the bar lengths.
- Avoid using too many colors "rainbow effect". Using a single color, or varying shades of the same color, is a much better practice. You can highlight one bar if that is the message you want to get across.
Treemaps show parts of a whole. They display hierarchical information as a cluster of rectangles varying in size and color, depending on their data value. The size of each rectangle represents a quantity, while the color can represent a number value or a category.

Treemaps allow you to view trends and make comparisons quickly – especially if one color is particularly prominent. While spreadsheets can show multiple rows of data, treemaps can
accommodate hundreds of thousands of items in one organized display, making it easy to spot patterns in seconds. Plus, if made correctly, they make very efficient use of space.

Best practices for creating a Treemap

- Start with clean data and a clear message - Treemaps can often involve a lot of data, so it’s important to know exactly what you want to highlight.
- Use bright, contrasting colors so each region is easily defined - But, remember to avoid the ‘rainbow effect.’ Choose your colors wisely.
- Label each region appropriately with text or numbers - It makes it easier for the viewer to evaluate your treemap quickly, without error.
- Avoid clutter your treemap with too many boxes - Treemaps can contain any number of boxes, but space is limited! You don’t want your treemap to be hard to read.
With a dual axis chart, you are essentially combining multiple charts and adding a second y-axis for comparison. Some members of the data visualization community are skeptical about the use of dual axis charts because they can often be confusing, poorly designed, and misleading to the viewer.

Let’s go over the different types of dual axis charts and the best ways to use them:

- **Column and Line Chart** – This dual axis chart combines a column chart with a line chart.
- **Dual Line Chart** – This dual axis chart compares two line charts. There can be more than two lines if need be.
- **Dual Column Chart** – This dual axis column chart shows two sets of data displayed side by side.
- **Multiple Axes Chart** – This displays the most complex version of the dual axis chart. Here you see three sets of data – with three y-axes.
Area charts are a lot like line charts, with a few subtle differences. They can both show change over time, overall trends, and continuity across a dataset. But, while area charts may function the same way as line charts, the space between the line and axis is filled in, indicating volume.
Best practices for creating Area charts

- Make it easy to read - Avoid occlusion. This happens when one or more layers covers important information on the chart.
- Use a stacked area chart - If you have multiple data sets and want to emphasize part-to-whole relationships.
- Use area charts to look at the bigger picture - Take population for example: Line charts are good for showing net change in population over time, while area charts are good for showing the total population over time.
- Avoid comparing too many datasets. Use instead a line chart, its cleaner.
- Give the proper context with appropriate labels and legends.
Pyramid charts (triangle chart or triangle diagram) are a fun way to visualize foundation-based relationships. They appear in the form of a triangle that has been divided into horizontal sections with categories labeled according to their hierarchy. They can be oriented up or down depending on the relationships they represent. The stacked layers can also show the order of steps in a particular process.

Leading Management Mistakes

- Going into business for the wrong reasons
- Advice from family and friends
- Being in the wrong place at the wrong time
- Entrepreneur gets worn-out and/or underestimated the time
- Family pressure on time and money commitments
- Pride
- Lack of market awareness
- The entrepreneur falls in love with the product/business
- Lack of financial responsibility and awareness
- Lack of a clear focus
- Too much money
- Optimistic/Realistic/Pessimistic
Best practices for creating Pyramid Charts

- Pick a topic and clearly label your subcategories - Decide what information you want to convey with your pyramid and clearly label your layers.
- Organize your subcategories - Decide the order and value of each section on your pyramid.
- Organize the subcategories based on their hierarchy.
- Be consistent - Keep the spacing of your sections even and pick a pleasing color palette.
- Keep subcategories to a minimum. Adding many layers and colors can make your pyramid hard to read.
Word clouds (also known as tag clouds) are a type of weighted list. Word clouds display text in varying font sizes, weight, or colors to show frequencies or categories. They can be arranged alphabetically or at random. They help people identify trends and patterns that might have been difficult to see otherwise.

Best practices for creating a Word Cloud

- Provide context - Word clouds are visually eye-catching and provide information about frequency, but they often don’t give the viewer any context.
- Use word clouds to show frequency - Avoid using them to display complex topics like the budget or healthcare crisis.
- Watch your word length - longer words take up more space and can be misleading.
- Word clouds are great for filtering and analyzing data.
- Avoid making your words too similar in size or color.
Tables display data in rows and columns. Tables make it easy to compare pairs of related values or to display qualitative information (e.g., quarterly sales over several years).

There are multiple reasons you might select a table over a graph, as the right way to visualize your data.

**Best practices for creating reporting tables**

- Ask yourself how your table will be used and define your audience.
- Consider removing grid lines to increase readability.
- Always include the source(s) of your data.
- Numbers should be aligned to the right because it makes easier to compare. Text can be aligned left, but you might prefer to center it for readability.
- Use color or formatting to draw the viewer to specific values (cells) in your table.
Developing an Interactive Dashboard

An interactive dashboard is a data management tool that harnesses the power of Excel data analysis tools such as Pivot Tables and Pivot Charts to track, analyze, monitor, and display key business metrics. In a dashboard, data becomes visual, and with tools such as slicers, users can interact with the data enabling them to make data-driven well-informed business decisions.

Dashboards can be simple or complex, and there is no right or wrong way to design a dashboard. Get creative and tell the story of your data!

Activity

Create a simple interactive dashboard in Excel.

Steps

1. Start with clean dataset.
2. Format as table.
3. Create the first pivot table and pivot chart.
4. Create multiple pivot tables and pivot charts.
5. Assembling the dashboard.
6. Adding slicers and timelines.
7. Connecting slicers.
8. Updating the dashboard.
Structuring the Narrative

A good book has a beginning, middle, and end - but a good storyteller knows it’s not always that simple. Getting from beginning to end requires you to follow a certain structure to create an engaging and exciting experience for the reader.

What is Narrative Structure?

Narrative structure, also referred to as a storyline or plotline, describes the framework of how one tells a story. It’s how a book is organized and how the plot is unveiled to the reader.

Most stories revolve around a single question that represent the core of the story. Will Harry potter defeat Voldemort? Will Romeo and Juliet end up together? Will Frodo destroy the Ring?

The series of events that follow to answer this defining question is what creates your narrative structure.

Various components work together to build a narrative structure, but it’s mostly centered around the development of your plot and your main character(s).

Types of Narrative Structure

- **Linear/Chronological**: When the author tells a story in chronological order. This structure can include flashbacks, but most of the narrative is told in the order that it occurs. Most books tend to fall under this narrative structure.

- **Nonlinear/Fractured**: A nonlinear structure tells the story out of chronological order, jumping disjointedly through the timeline. David Mitchell’s Cloud Atlas is an example of this narrative structure, as it switches between multiple characters at different points in time.

- **Circular**: In a circular narrative, the story ends where it began. Although the starting and ending points are the same, the character(s) undergo a transformation, affected by the story’s events. S.E. Hinton’s The Outsiders is an example of circular narrative structure.

- **Parallel**: In parallel structure, the story follows multiple storylines, which are tied together through an event, character, or theme. F. Scott Fitzgerald’s The Great Gatsby or the movie Finding Nemo are both examples of this structure.

- **Interactive**: The reader makes choices throughout the interactive narrative, leading to new options and alternate endings. These stories are most prominent as “choose your own adventure” books.
Author Driven and Reader Driven Stories

Rudyard Kipling once wrote, “If history were taught in the form of stories, it would never be forgotten.” The same applies to data. Companies must understand that data will be remembered only if presented in the right way. And often a slide, spreadsheet or graph is not the right way; a story is.

An author-driven narrative doesn’t allow the reader to interact with the charts.

The data and visualizations are chosen by the author and presented to the reader as a finished product, like a printed magazine article.

Conversely, the reader-driven narrative provides ways for the reader to play with data.

Most captivating storytellers grasp the importance of understanding the audience. They might tell the same story to a child and adult, but the intonation and delivery will be different. In the same way, a data-based story should be adjusted based on the listener. For example, when speaking to an executive, statistics are likely key to the conversation, but a business intelligence manager would likely find methods and techniques just as important to the story.
If you need to make an argument about an issue about which you feel very strongly, don’t use rhetoric. Tell a story instead.

The Boris Johnson Brexit bus lie that the NHS would get an extra £350m a week was one of the most contentious issues of the 2016 EU referendum campaign. Along with “Turkey is joining the EU”, the claim that the UK sends £350m a week to the EU, and that money could instead be spent on the NHS created much debate during and after the referendum result.

Effective storytelling can serve anyone in leadership who seeks to persuade others to his or her point of view. Opinion-based rhetoric is often more polarizing than persuasive, while statistics are often gone in one ear and out the other. But a careful blending of rhetoric and facts, woven into the right story, can change minds.
Lessons in Storytelling

Activity

Write a story to describe the dashboard you have created earlier.
Principles of Effective Storytelling

Shaping an effective story with a point of view is a learned skill. Here are some suggestions.

- **Know your message.** When it comes to persuasion, we resist being told what to think but we are open to why we must think it. Savvy preachers use this technique on Sundays. Good stories have more than a point of view; they have a message. As such they are tools of persuasion. You consider what you want others to do and why you want them to do it. That is your message.

- **Find the right example.** Look for what people around you are doing that relates to your point of view. If you want to persuade people to adopt safety standards, tell the story of what happened when someone did not follow protocol. If you want to demonstrate the benefits of a new process, use a story to explain how an individual would benefit.

- **Weave your narrative.** It is best to use real-life examples, as Ellison did. Therefore, talk about what an employee did to ensure safety or how a team adopted a new process and achieved improved results. Tie to a narrative by following strong story structure. Describe the situation. Talk about what happened. Close with the benefits pitch.

- **Convey passion.** You don’t need to go overboard, but you do need to demonstrate your conviction. Do this through your choice of words — ones that draw pictures. And do it through your delivery — raising your voice on a key point, pausing for emphasis, and following through with well-paced flow.

- **Support with facts.** Using a narrative approach doesn’t mean you can’t use facts. Weave them into your narrative or begin or end your story with them. For example, one in four children is falling behind in math by the third grade. So, if you’re trying to convince people this is a problem worth addressing, you might say, “Let me tell you the story of Daniel, a fourth grader at Summit Elementary...” Then you sketch the story. And perhaps after telling Daniel’s story, you close with a few more facts about the need for remedial math schooling.
Importance of Storytelling from the Stakeholder’s Point of View

The foundation of any great story is knowing your audience. Understanding what’s important to your audience will help them become invested in your story. What separates good storytellers from great storytellers is the ability to shift from knowing your audience to learning from them. Understanding what’s working or not working on the fly can strengthen your rapport with your audience to help you best tailor your story.

Similarly, stakeholders have their own motivations, sets of priorities, and challenges. Each of them has a seat at the table for a key purpose. Learning from them ensures what’s created caters to each of their needs.

Remove Your Ego

As designers, it’s easy to get caught up in wanting complete ownership that a design solution is yours. Each team member and stakeholder have an opinion about the experience, and that’s okay. They are all providing feedback from their own perspective. Once you’re able to remove your intrinsic motivation in any design project, you can better leverage everyone else’s expertise. By empowering each stakeholder and learning from them, you can approach solving a problem from every possible angle. As a result, the design solution that is created will reflect everyone’s expertise and shift from being yours to ours.

Ask Questions

While designers are often given the opportunity to bridge communication across an organization, it doesn’t mean you’re expected to be an expert in each role. To feel confident, you’re making the correct design decisions, you need to continuously ask questions. These questions can range from feedback about design challenges to understanding the data model to why certain items are prioritized and more. Often, these questions will lead to deeper insights about the true problem you and your team is trying to solve. Work with your teammates and stakeholders to understand the reasoning behind why each decision is made. Having a holistic understanding of each person’s mindset will help guide you toward better design choices.
Reference

2. https://searchbusinessanalytics.techtarget.com/definition/data-visualization
10. https://medium.com/salesforce-ux/storytelling-for-stakeholders-5c1c4231cfa