

# Business Data Analysis

MGM509

## Lecture 7

Visualization for Evaluating and  
Communicating Performance

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## What we will cover

1. Why and when to use data visualization
2. Types of charts and when to use them
3. Principles of good design and communication
4. Tools and platforms for visualization

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# Introduction



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# Why Visualize Data?



Makes complex data easier to understand



Helps identify patterns, trends, and outliers



Enhances decision-making



Communicate clearly



Support analytical reasoning



Inspire action and insight

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## The Power of Visual Communication



Visuals are processed 60,000x faster than text by the human brain, enabling quicker understanding.



Well-designed charts help people grasp patterns and relationships without needing to interpret raw numbers.



Visuals enhance storytelling by linking data to decisions, making information more persuasive and memorable.



In presentations, data visuals increase engagement and reduce cognitive load for audiences.

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## When to Use Visualization vs. Tables?



Use Tables when the audience needs exact numerical values, comparisons between specific points, or reference-style reporting.



Use Charts when the goal is to highlight trends, relationships, or outliers in data; ideal for presenting insights visually.



Combine Both in dashboards or reports where summaries (charts) are paired with detail (tables) for deeper analysis.



Consider your audience: executives may prefer charts for quick insights, while analysts may prefer tables for detailed examination.

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# Types of Data Visualizations



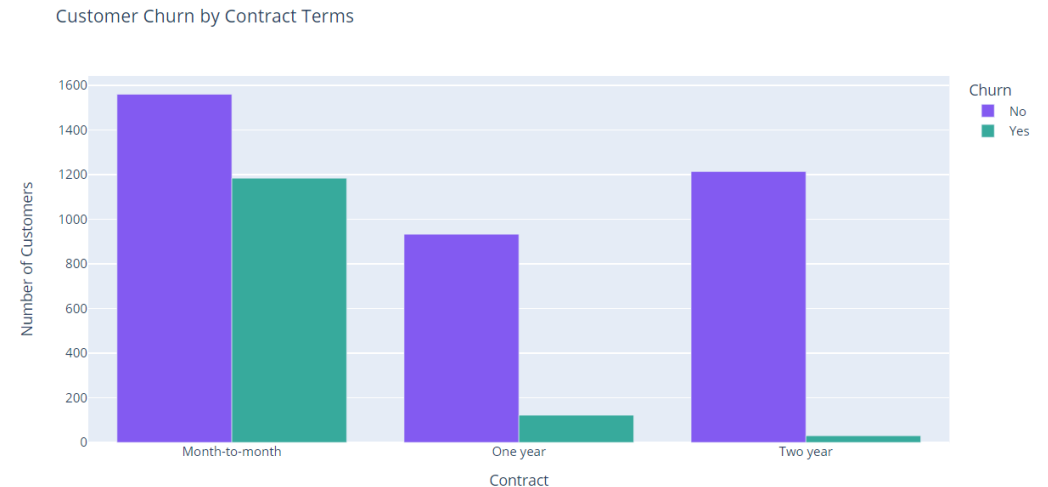
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## Bar Chart – Comparing Categories

- Best for categorical comparisons
- Horizontal layout for long labels
- Avoid overloading with too many bars

**Ex. Use Case:** Compare churn rate by contract type

**Insight:** Identify which contract type (Month-to-Month, One-Year, Two-Year) has the highest churn rate.



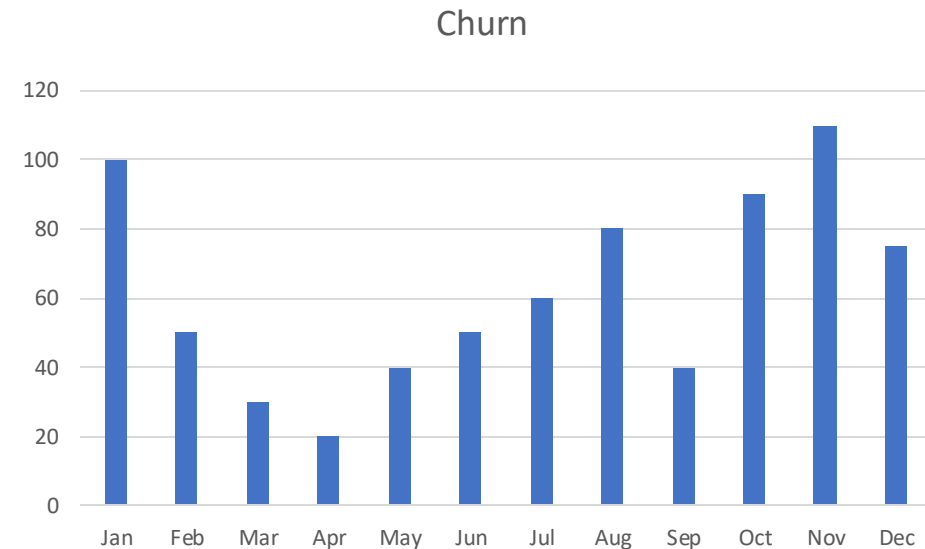
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## Column Chart – Comparing Over Time

- Use for time-series data
- Maintain equal intervals
- Show trends at a glance

**Ex. Use Case:** Monthly churn count  
across different billing months

**Insight:** Detect seasonal or monthly  
spikes in churn activity.



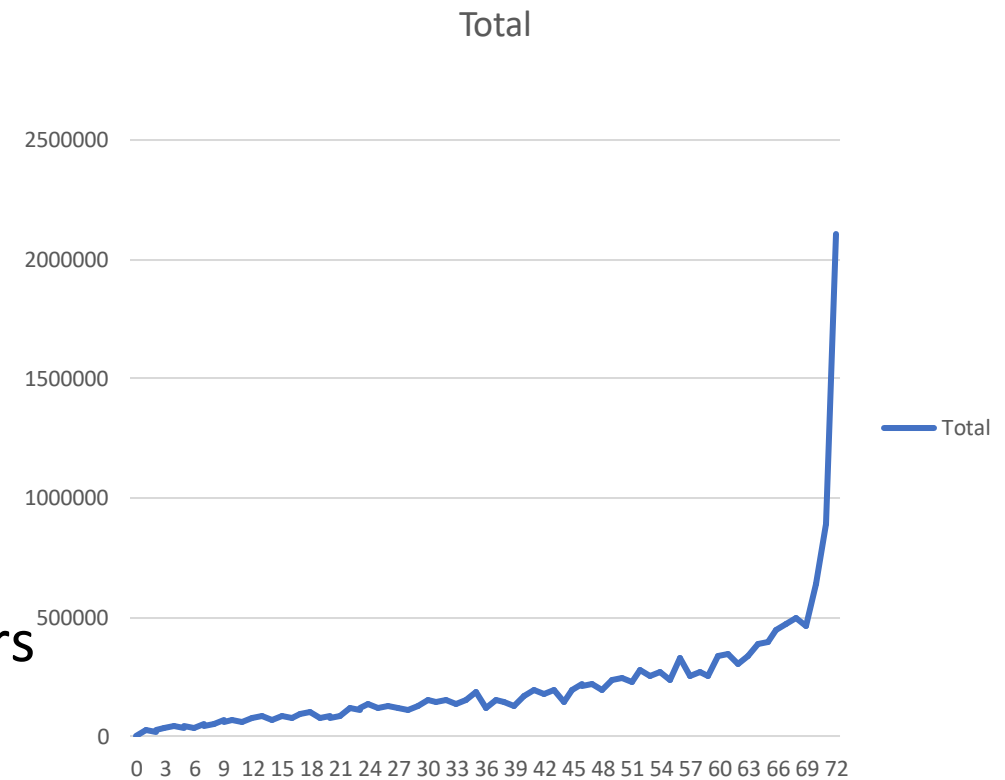
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## Line Chart – Showing Trends

- Best for continuous data
- Multiple lines for comparison
- Smooth vs. stepped lines

**Ex. Use Case:** Track total revenue generated over customer tenure

**Insight:** Understand how long-term customers contribute to revenue growth.



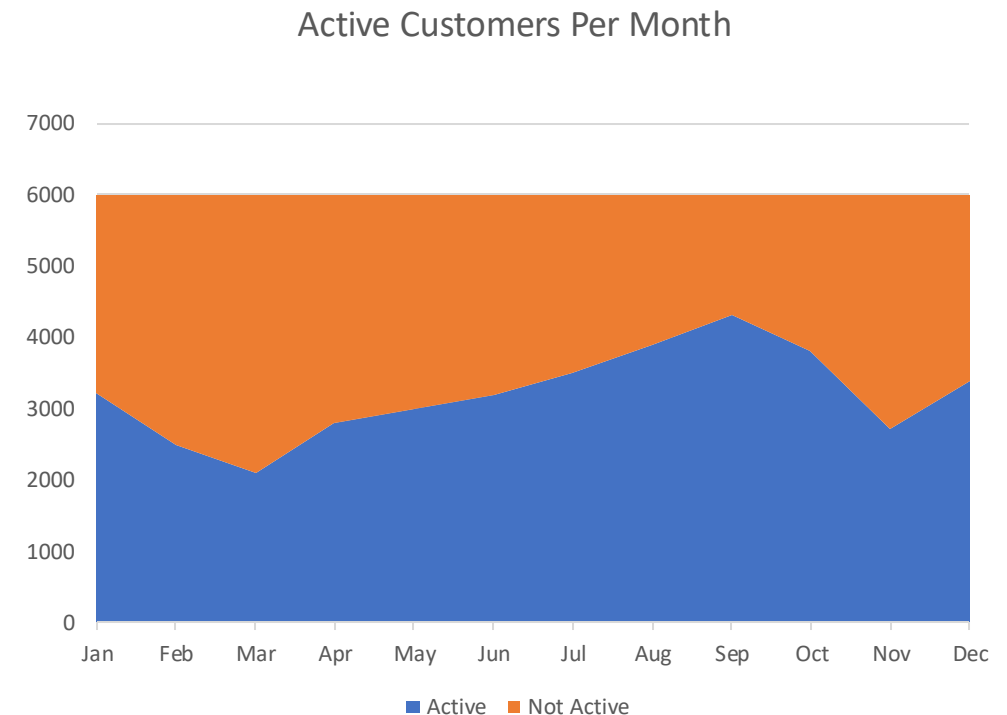
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## Area Chart – Cumulative Trends

- Good for part-to-whole over time
- Use sparingly to avoid overlap
- Stacked area for comparisons

**Ex. Use Case:** Visualize total number of active customers over time

**Insight:** Detect drops in customer base over months.



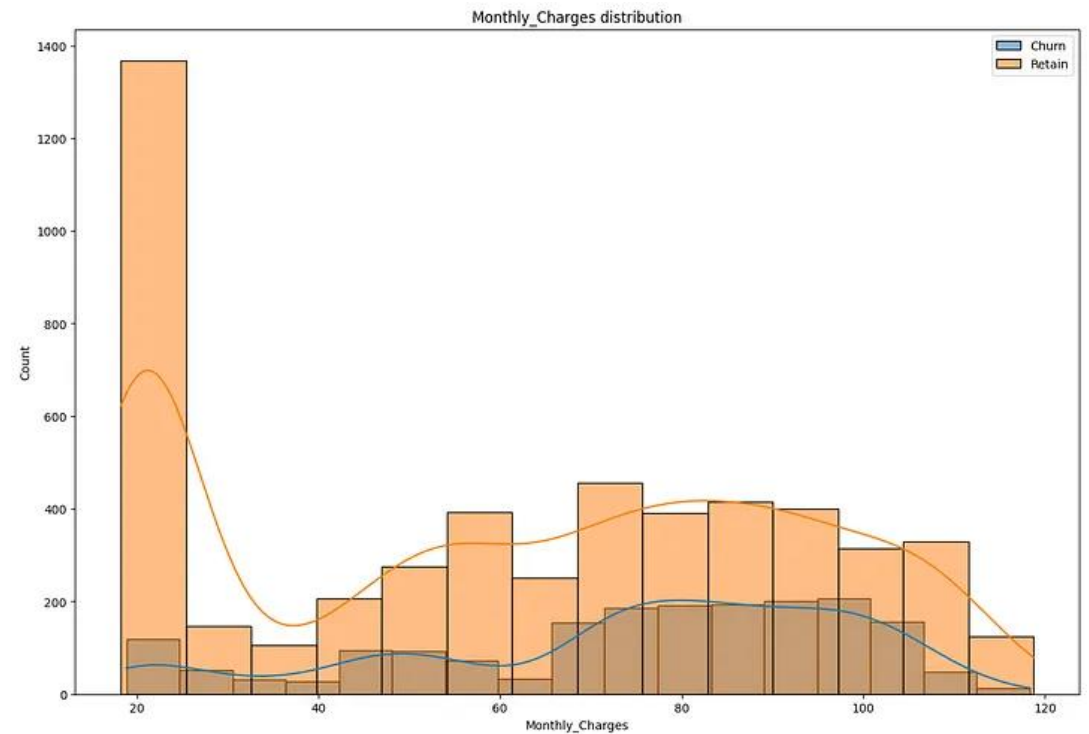
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## Histogram – Frequency Distribution

- Shows how data is distributed
- Useful for identifying skewness, modality
- Set appropriate bin widths

**Ex. Use Case:** Show distribution of MonthlyCharges

**Insight:** Understand common pricing bands among customers.



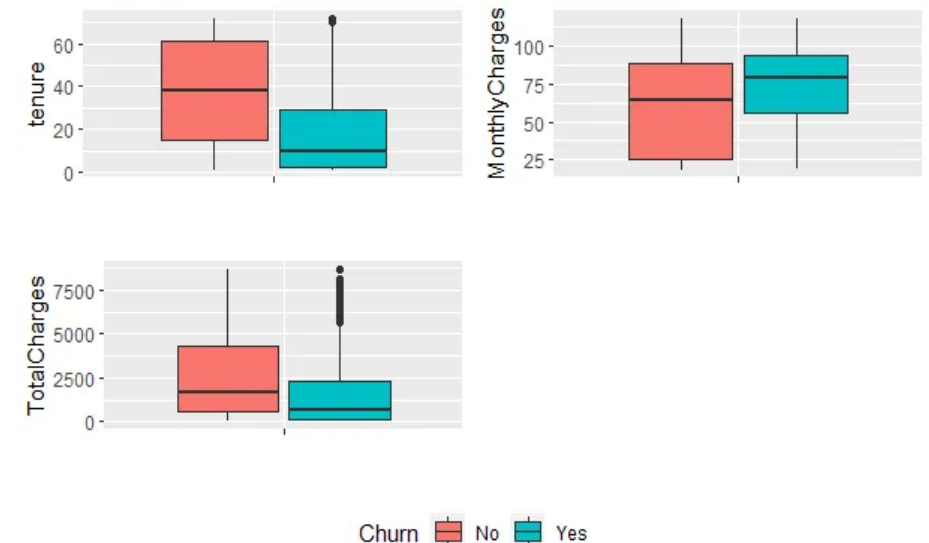
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## Boxplot – Distribution Summary

- Shows median, quartiles, outliers
- Great for comparing multiple groups
- Compact and information-dense

**Ex. Use Case:** Compare MonthlyCharges  
by churn status

**Insight:** See if customers who churn  
tend to pay more.



Churn Percentage in numeric variables

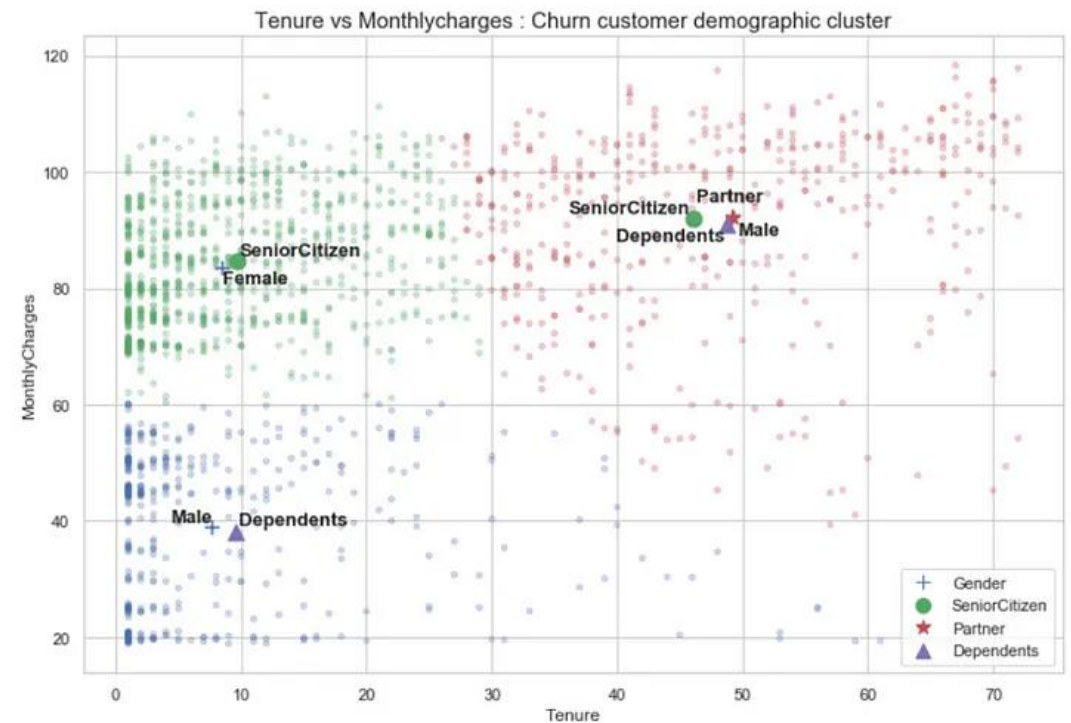
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## Dot Plot – Detailed Comparisons

- Shows exact values clearly
- Minimalist alternative to bar charts
- Effective for small datasets

**Ex. Use Case:** Visualize average tenure by customer type (gender, senior citizen, etc.)

**Insight:** Spot subtle differences not visible in bar charts.



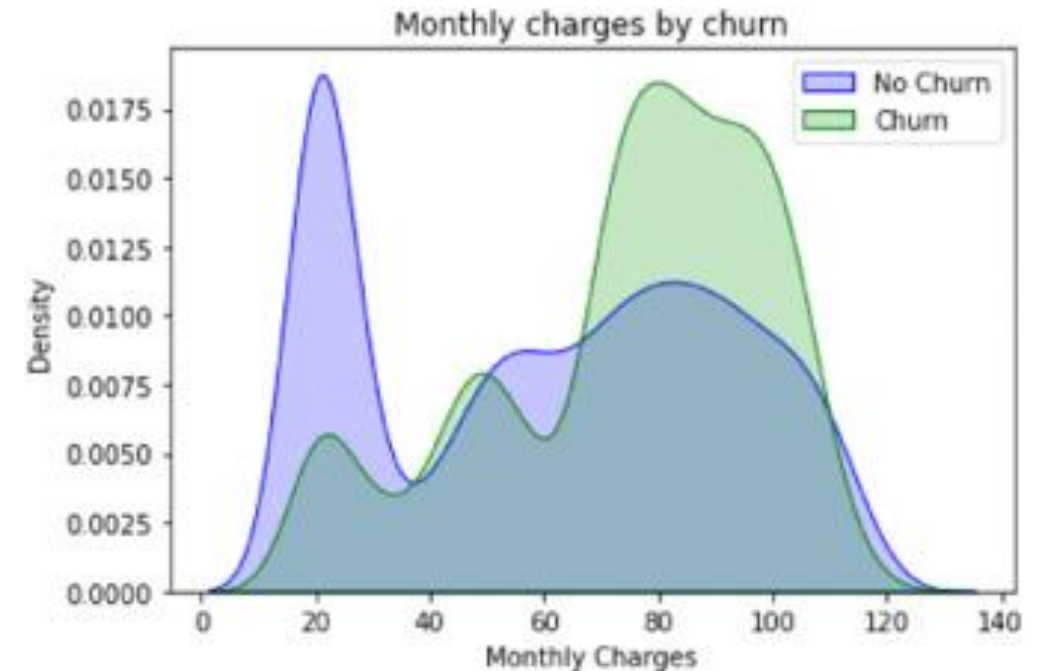
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## Density Plot – Smooth Distribution Shape

- Smoothed alternative to histogram
- Highlights distribution patterns
- Use kernel functions

Ex. Use Case: Compare density of monthly charges between churned and retained customers

**Insight:** Identify whether certain monthly charges correlate with churn.



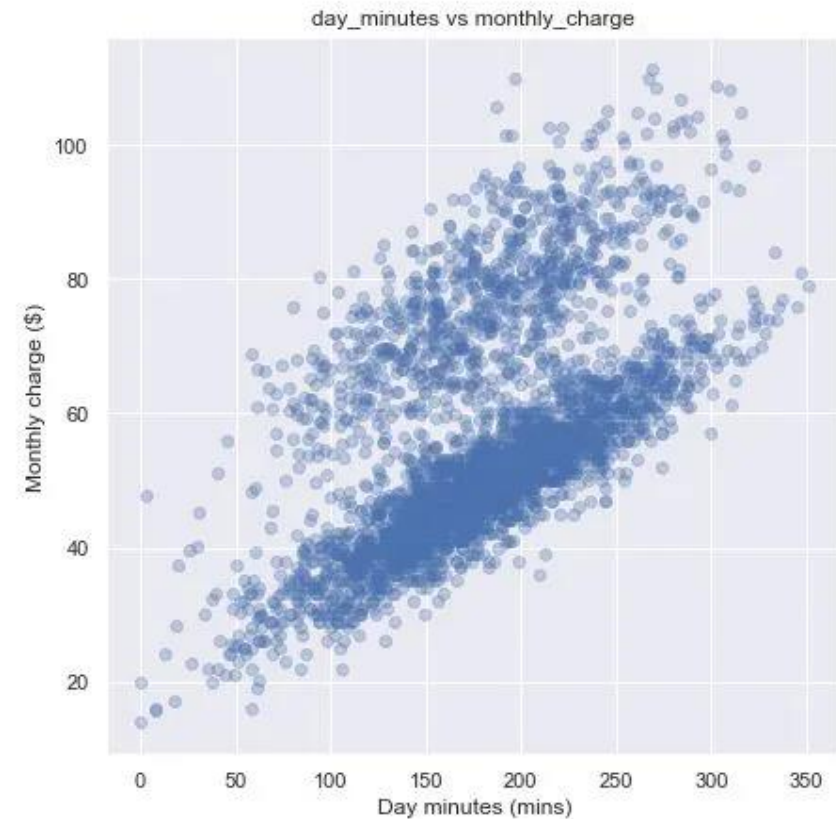
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## Scatter Plot – Correlation &amp; Clusters

- Shows relationships between variables
- Highlights outliers and trends
- Can include trendlines

**Ex. Use Case:** Plot daily minutes vs.  
MonthlyCharges

**Insight:** Identify relationships visually.



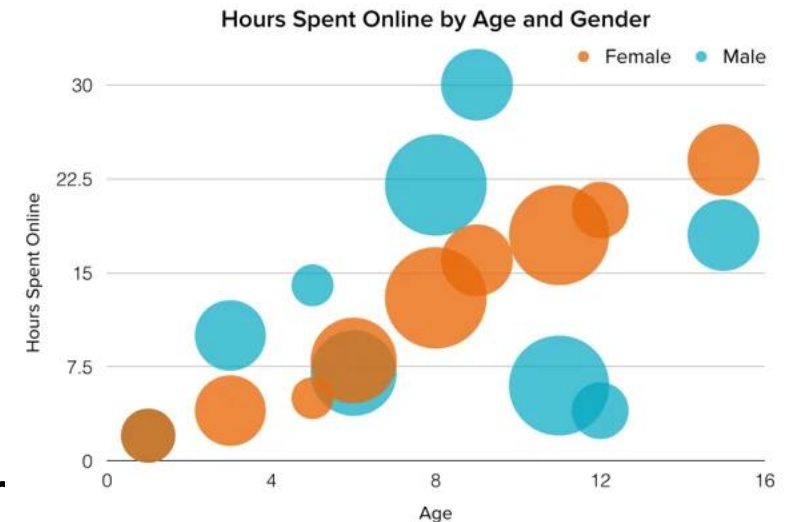
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## Bubble Chart – Adding a Third Variable

- Size indicates magnitude of third dimension
- Can become cluttered

**Ex. Use Case:** Hours spent vs. Age with bubble size representing Gender

**Insight:** Explore multi-variable patterns in church drivers.



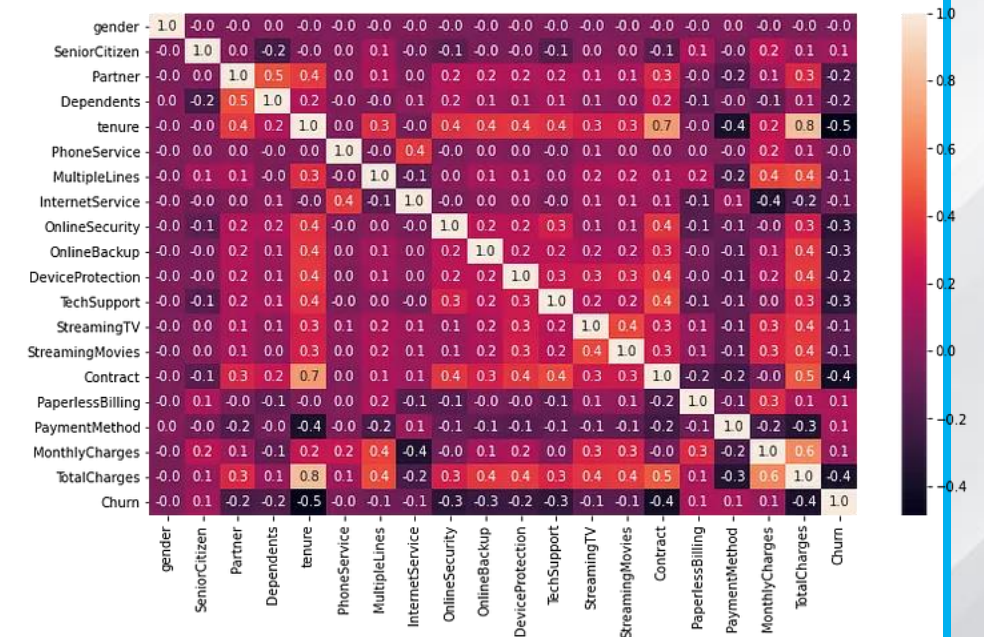
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## Heatmap – Visualizing Matrix-Style Data

- Good for comparing categories vs. categories
- Use color gradients
- Normalize data for readability

**Ex. Use Case:** Churn rate by Contract Type and Internet Service

**Insight:** Discover combinations that lead to high churn.



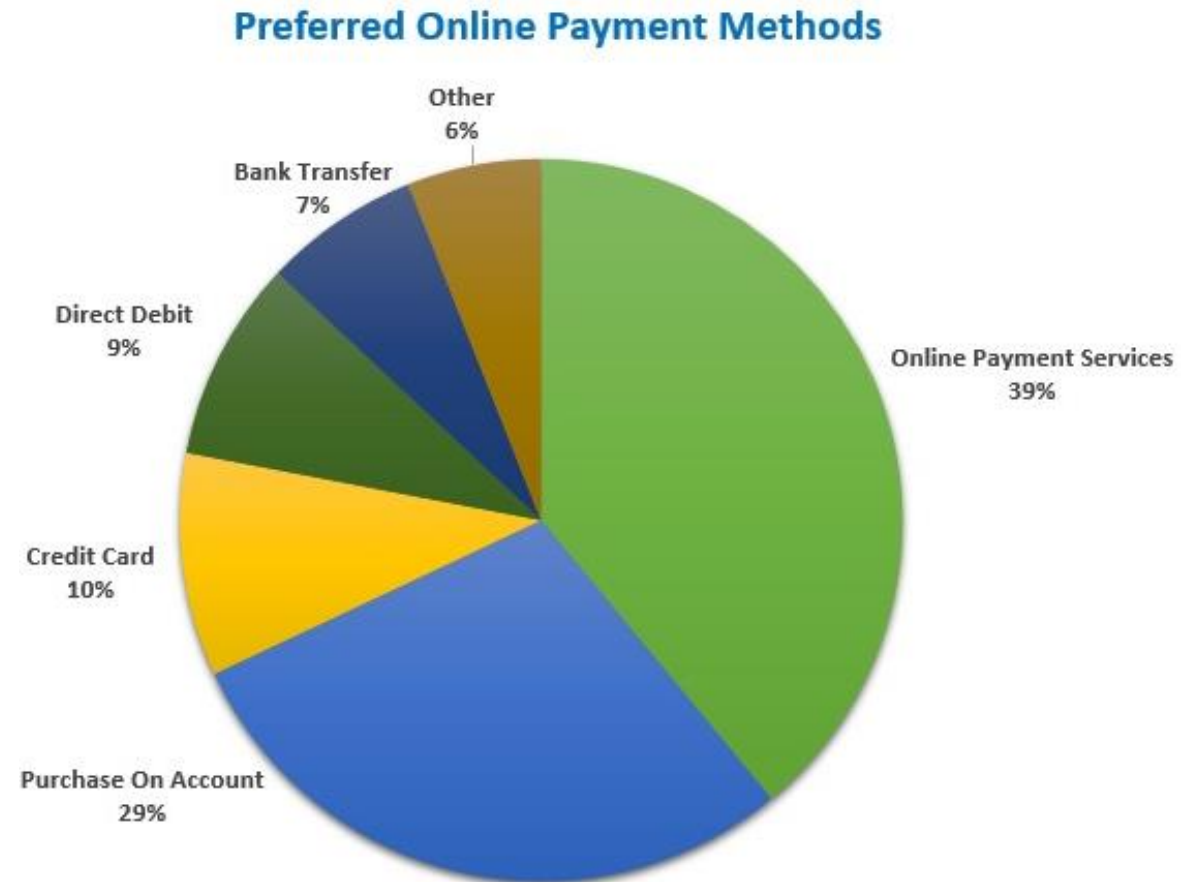
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## Pie Chart (Use with Caution)

- Effective only with few categories
- Difficult to compare angles
- Consider alternatives (bar, donut)

**Ex. Use Case:** Distribution of customer payment methods

**Insight:** Understand payment preferences (credit card, bank transfer, etc.).



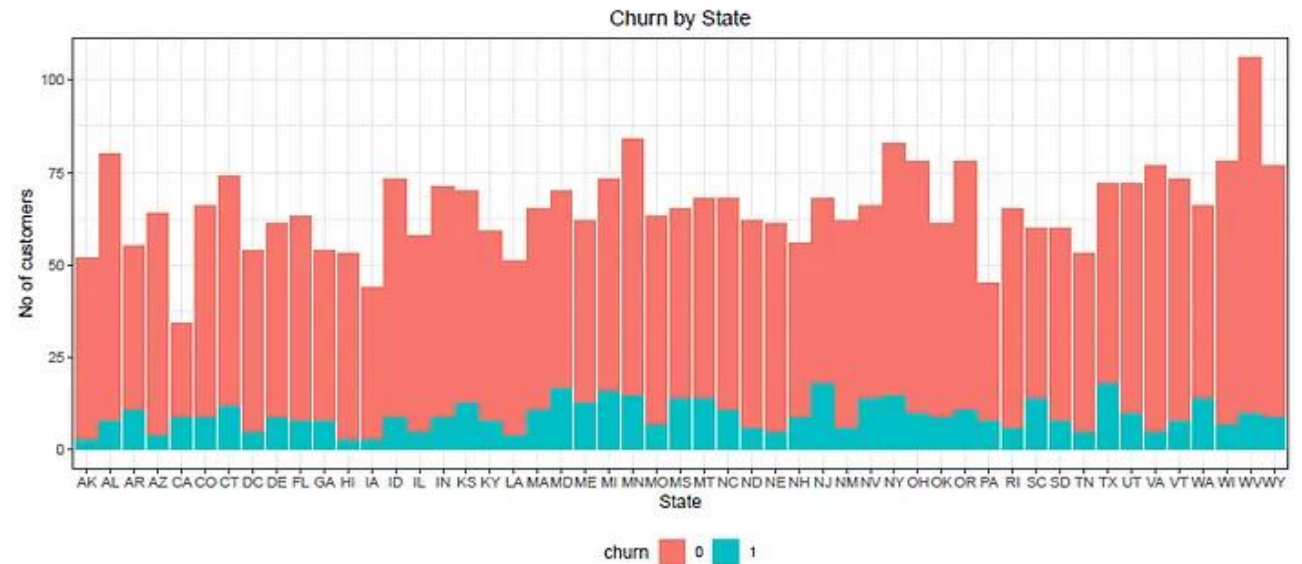
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## Stacked Bar/Area – Part-to-Whole Over Time

- Tracks multiple categories
- Watch for visual overload
- Use contrasting colors

**Ex. Use Case:** Breakdown of churn  
vs. no churn by state

**Insight:** See churn proportion  
across states



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# Word Clouds – Exploratory Text Visualization

- Frequency = font size
- Useful for qualitative insights
- Avoid over-interpretation

**Ex. Use Case:** Customer feedback or reasons for churn (if available as text)

**Insight:** Highlight most mentioned churn drivers.



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## Sankey Diagrams – Flow Relationships

- Show process flows or transitions
- Width of paths = quantity
- Interactive versions add value

**Ex. Use Case:** Flow from contract type

→ internet service → churn status

**Insight:** Visualize customer journey and where churn occurs.



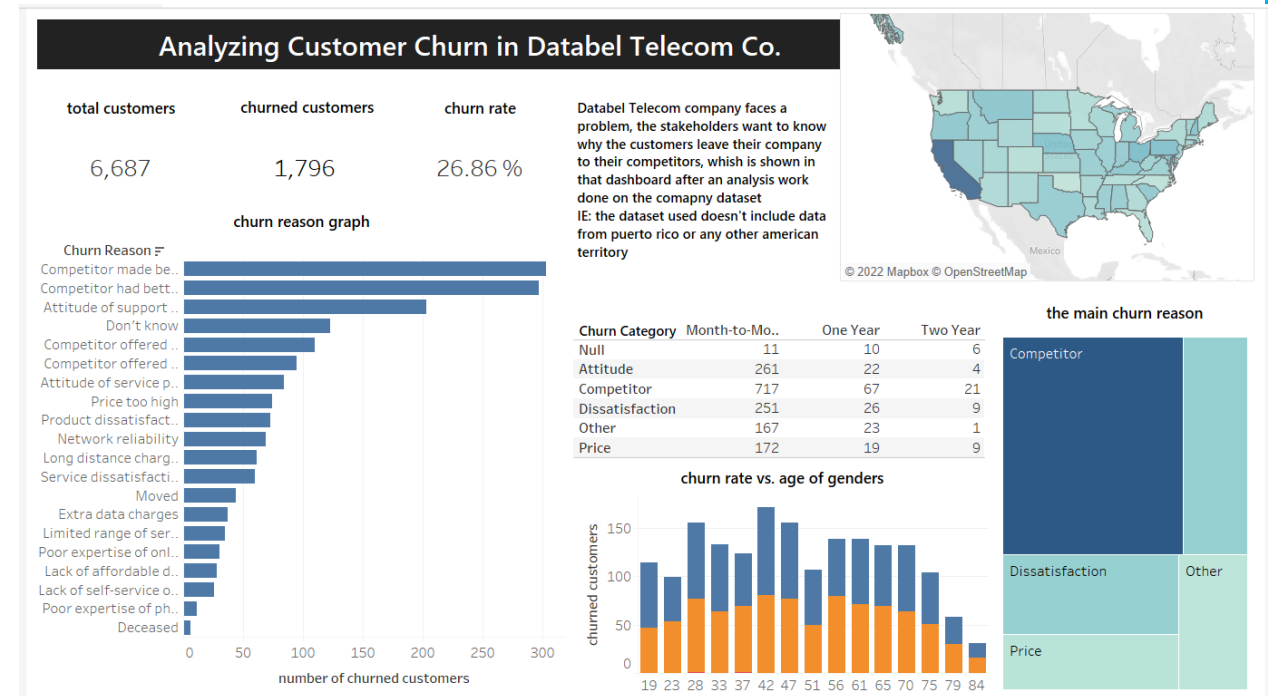
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## Treemaps – Nested Categories

- Area represents proportion
- Good for hierarchical data
- Use color to group subcategories

**Ex. Use Case:** Customer distribution by demographics and churn status

**Insight:** Show segment sizes in a compact format.



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## Chart Selection Matrix

- Start with your question: What are you trying to communicate? Trends, comparisons, proportions, or relationships?
- Use this decision flow:

|                     |              |                   |              |
|---------------------|--------------|-------------------|--------------|
| <b>Comparison</b>   | Bar chart    | Column chart      | Line chart   |
| <b>Distribution</b> | Histogram    | Boxplot           | Density plot |
| <b>Relationship</b> | Scatter plot | Bubble chart      | Heatmap      |
| <b>Composition</b>  | Pie chart    | Stacked Bar chart | Treemap      |

- Consider data type: Are you showing categorical, continuous, or time-series data?
- Audience matters: Executives prefer simple visuals with clear takeaways, analysts want details.

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# Enhancing Visuals with Design Elements



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## Core Principles of Visualization

## Clarity and Simplicity:

- Avoid clutter and chart junk
- Use intuitive layouts and labels
- Prioritize important data

## Accuracy and Integrity:

- Represent data truthfully
- Avoid exaggerating or misrepresenting scales
- Use proper baselines and proportions

Highlighting Key  
Patterns and Trends:

- Use color and size to emphasize
- Provide context (e.g., benchmarks or averages)
- Show movement or change over time

Avoiding Misleading  
Visuals:

- Watch for distorted axes or pie slices
- Beware of cherry-picking data ranges
- Clearly label all data and sources

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# Gestalt Principles for Better Visual Grouping



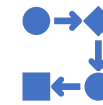
## Proximity

Objects placed close together are perceived as a group. Use spacing to define logical sections of a dashboard or cluster related data points.



## Similarity

Elements that look similar (same shape, color, size) are seen as related. Apply consistent styles to categorize or link related metrics.



## Continuity

The eye follows smooth, continuous lines and paths. Arrange data along logical flows (e.g., line charts, directional arrows) to guide the viewer's attention naturally.

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## Common Misuses and Mistakes

3D effects, excessive colors



Poor axis scaling



Using wrong chart type for goal



Emphasize simplicity and message clarity



Ask: "What do I want the viewer to understand?"

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7Key Design Principles for Great  
Data Visualization (1)**Clarity**

Keep it simple and remove clutter — every element should serve a purpose.

**Accuracy**

Ensure scales, proportions, and representations are truthful and not misleading.

**Consistency**

Use consistent colors, fonts, and styles to create a cohesive look.

**Focus**

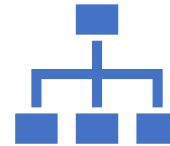
Highlight the most important information using contrast, size, or color.

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7Key Design Principles for Great  
Data Visualization (2)**Accessibility**

Use colorblind-friendly palettes and ensure readability for all users.

**Labeling**

Always include clear titles, axis labels, legends, and source annotations.

**Visual Hierarchy**

Organize elements so that the viewer sees the most important information first.

**Context**

Provide enough context (e.g., units, benchmarks) so data makes sense.

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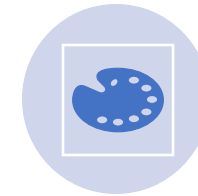
# Color Theory in Data Visualization



Use color for meaning, not decoration



Avoid red-green combinations



Use palettes (ColorBrewer, Adobe)



Fonts, colors, icons, gridlines



Avoid mixed chart styles in same dashboard



Establish branding for regular reporting

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## Using Shape and Size Effectively

**Size Communicates Magnitude:** Larger elements naturally draw attention and can represent higher values.

**Shape Suggests Meaning:** Unique shapes can distinguish categories (e.g., circles vs. squares in scatter plots).

**Consistency Matters:** Ensure shape and size usage is consistent across visuals—conflicting meanings confuse viewers.

**Avoid Deception:** Don't distort size proportionally (e.g., area or volume) unless mathematically justified. Misleading size exaggerates or hides key insights.

**Highlighting Patterns:** Use shapes and size variations to highlight outliers, clusters, or trends.

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# Annotations and Storytelling



Add callouts to key insights



Use titles to communicate the main point



Guide viewer through narrative



Group related visuals



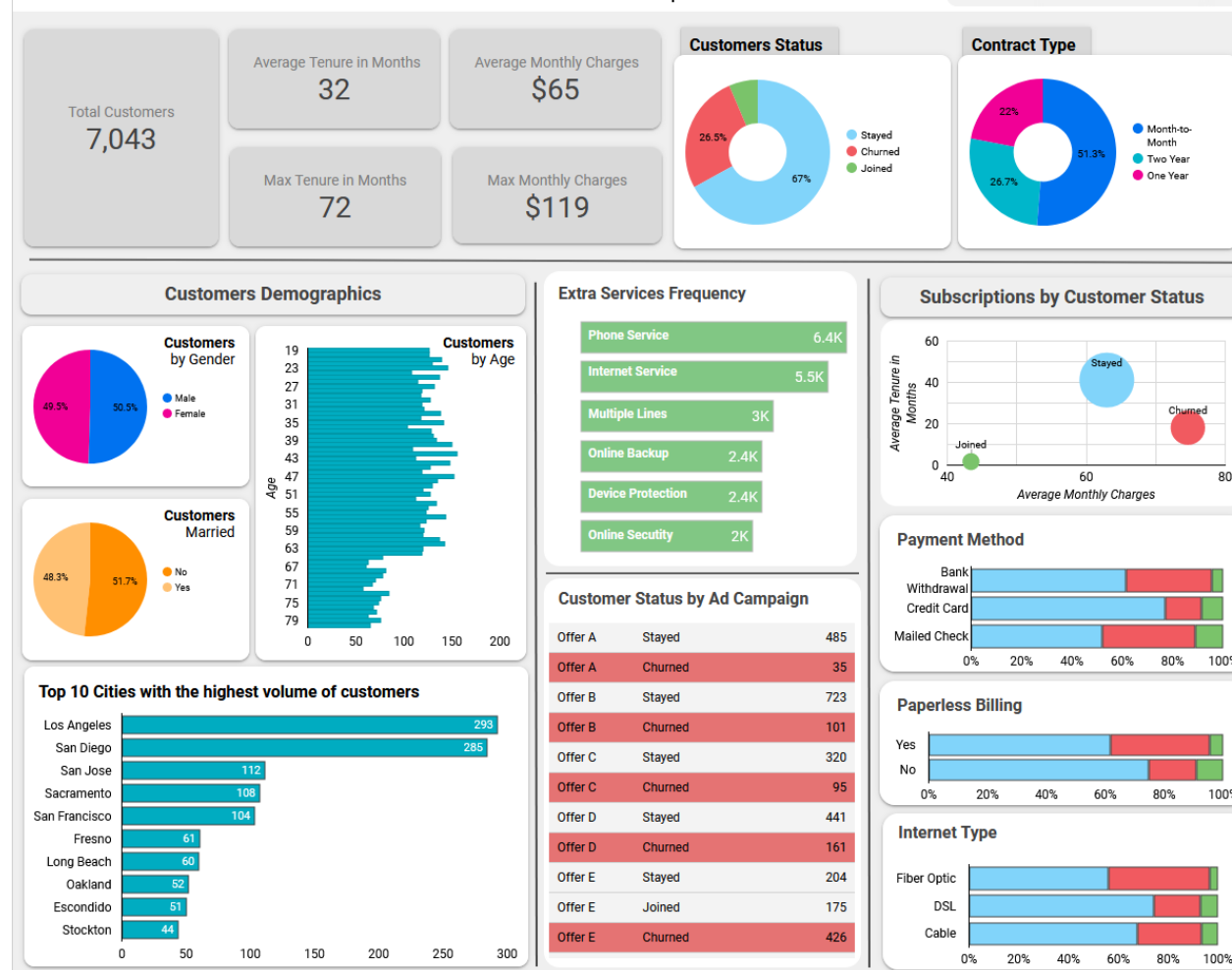
Keep high-value insights at top/left



Align and space consistently

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## Dashboards for Telco Customer Churn Analysis



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# Tools and Platforms for Data Visualization



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# Excel – Basics and Quick Wins

## Capabilities

- Data Cleaning: Easily filter, transform, and validate data using formulas and built-in tools.
- Visualization: Offers bar, line, scatter, pie charts, and PivotCharts.
- Statistical Analysis: Supports descriptive statistics, correlation, and regression (via Analysis ToolPak).
- Forecasting: Built-in tools like Trendlines and Forecast.
- Automation: Macros, VBA, and Python (in Excel 365) allow for advanced customization.
- Integration: Connect to databases, use Power Query/Power Pivot, or export to Power BI.

## Limitations

- Limited to ~1M rows; not suited for big data.
- Easy to introduce human error or overwrite formulas.
- Lacks built-in support for advanced ML or AI.
- Difficult to audit, reproduce, or collaborate on complex workflows.
- Visualization and interactivity are limited without external tools.

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# Tableau / Power BI

### Capabilities

- Interactive Dashboards: Enable real-time filtering, drill-downs, and slicers for dynamic analysis.
- Advanced Visuals: Custom visualizations, heatmaps, treemaps, bullet graphs, and more.
- Data Connectivity: Connect to a wide range of data sources—databases, cloud, APIs, spreadsheets.
- Data Modeling: Power BI uses DAX; Tableau has calculated fields for custom logic.
- Storytelling: Combine multiple charts into storyboards to present insights clearly.
- Collaboration: Easy publishing and sharing of dashboards via Tableau Server/Online or Power BI Service.

### Limitations

- Steep learning curve for DAX (Power BI) and calculated fields (Tableau).
- Performance issues when handling extremely large or complex data models.
- Licensing costs can be high for enterprise users.
- Limited data cleaning—complex transformations may still need Power Query, SQL, or Python.
- Over-design risk—users may emphasize aesthetics over insight if not guided by best practices.

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# Python (Matplotlib, Seaborn, Plotly)

### Capabilities

- Customization: Full control over every visual element; tailor charts to exact specifications.
- Advanced Chart Types: Create violin plots, pair plots, heatmaps, animations, and 3D visuals.
- Integration: Combine with pandas, NumPy, scikit-learn, and other libraries in seamless workflows.
- Automation & Reproducibility: Code-based charts are easy to update, reproduce, and share via scripts.
- Interactivity: Plotly and Dash support web-based interactive dashboards.

### Limitations

- Requires coding: Not as accessible to non-programmers or business users.
- Steep learning curve for mastering aesthetics and syntax (especially in Matplotlib).
- Setup/configuration time: Setting up environments and dependencies can be time-consuming.
- Slower dashboard delivery: Building dashboards from scratch can take longer than drag-and-drop tools.
- Limited default styling: Compared to Tableau/Power BI, visuals may require more effort to polish.

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# R (ggplot2, Shiny), D3.js, Flourish

### Capabilities

- R (ggplot2, Shiny): Excellent for statistical data visualization with high-quality static plots and interactive web apps.
- D3.js: A JavaScript library for creating complex, interactive, and animated SVG-based web visualizations.
- Flourish: No-code tool to create professional-looking visual stories and embeddable graphics.
- Customization & Reproducibility: Especially strong with R and D3.js for tailored, transparent code-driven visuals.
- Storytelling and Publishing: Flourish and Shiny allow sharing on the web with user-friendly interfaces.

### Limitations

- Steep learning curve for D3.js (requires solid JavaScript and web dev skills).
- R can be complex for those unfamiliar with its syntax or statistical conventions.
- Limited drag-and-drop functionality compared to tools like Power BI or Tableau.
- Flourish free tier is limited, and advanced visuals may require a paid license.
- Deployment overhead: Hosting Shiny apps or D3-based sites may require additional setup.

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7****Key Points****Visuals Accelerate Understanding**

Data visualizations help translate complex information into accessible insights, enabling faster and more informed decisions.

**Choose the Right Chart for the Right Task**

The effectiveness of a visualization depends on aligning the chart type with the analytical goal—comparison, distribution, relationship, or composition.

**Design Principles Matter**

Clarity, accuracy, and consistency are critical in building trustworthy and engaging visuals. Gestalt principles and proper use of shape, size, and color enhance comprehension.

**Dashboards Should Tell a Story**

Effective dashboards prioritize layout, focus, and user needs—positioning key KPIs prominently and organizing content logically.

**Tool Choice Impacts Capabilities**

Whether using Excel, Tableau, Python, or R, each platform has strengths and limitations. Select tools based on data size, technical expertise, and visualization goals.

## For Discussion Panel and Next Lecture:

- Chapter 8 “Visualizing Model Performance”
- Activity:
  - Using Telco Customer Datasets in Excel
  - Create charts to visualize:
    - Churn by State
    - Churn by gender and monthly charge
    - Charge vs minutes used
    - Tenure vs. dependents
    - Monthly charge vs internet service

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## For Discussion Panel and Next Lecture



Thank You