



DS363: Design and Learning with Data

Module 02

Data Thinking

Lecture 2

Wan Fang

Southern University of Science and Technology

Agenda

- Data, Narrative, Visualization
 - The 3-minute Story
 - The Big Idea
 - Examples & Exercises

- Four Types of Data Analytics
 - **Descriptive**, which answers the question, “*What happened?*”
 - **Diagnostic**, which answers the question, “*Why did this happen?*”
 - **Predictive**, which answers the question, “*What might happen in the future?*”
 - **Prescriptive**, which answers the question, “*What should we do next?*”



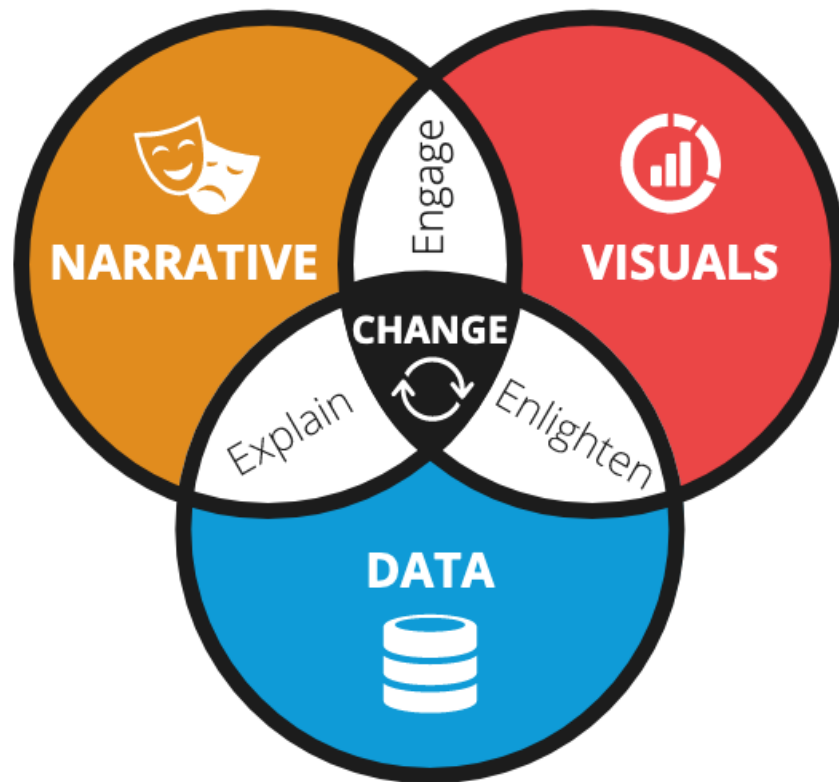
Data, Narrative, Visualization

Wan Fang

Southern University of Science and Technology

[Adapted from Storytelling with Data by Cole Nussbaumer Knaflic]

Data Stories that Drive Changes



Data stories are proven to be more memorable, persuasive, and engaging than statistics alone.

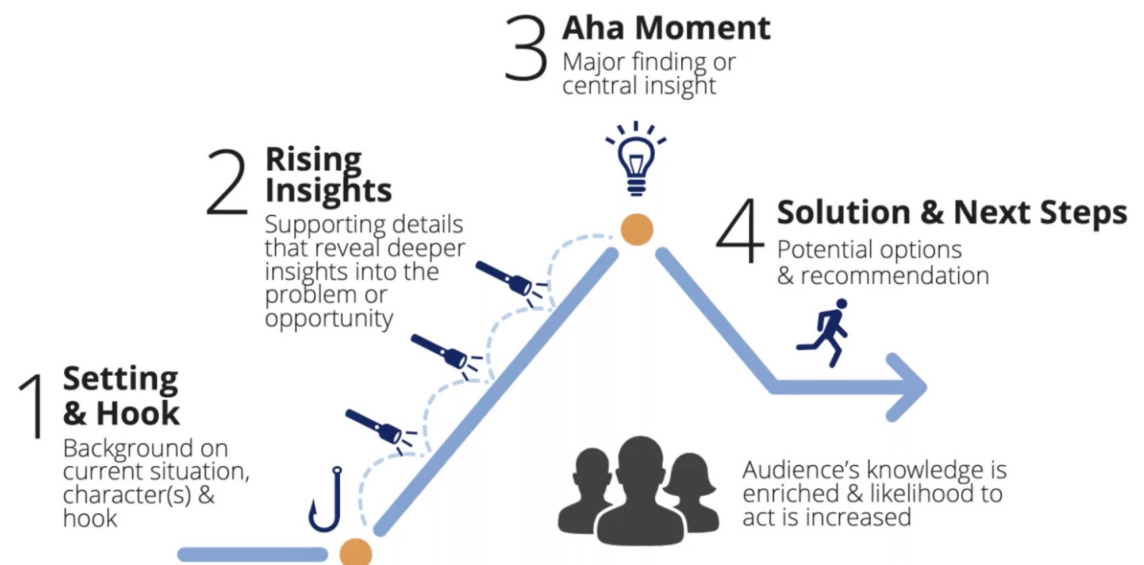
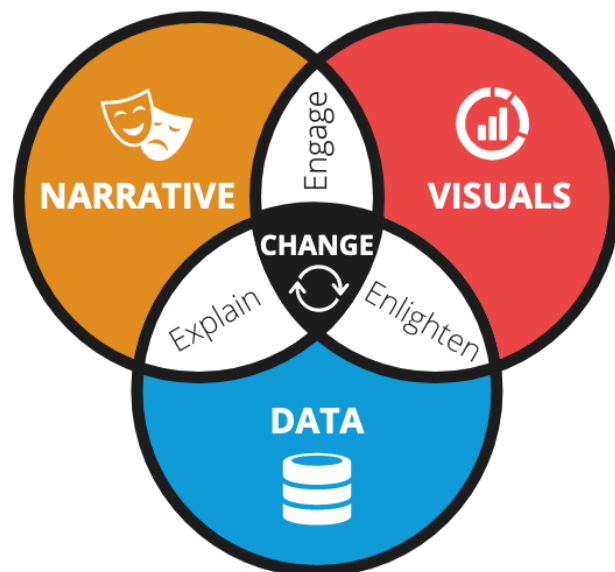
- But how do we tell data stories?

“Storytelling is the most powerful way to put ideas into the world today.”

Today’s corporate world is rife with poorly designed slides cluttered with inappropriate charts, and data storytelling is the key to converting data to insights that drive actions and value.

Narrative Structure

- **Most stories follow a common arc ...**
 - A protagonist who faces a complication goes on a journey of resolving a difficulty before returning to their normal lives.
 - Aristotle's Tragedy Structure, Campbell's Hero's Journey, and Freytag's Pyramid are variations of these common patterns in stories.
- **Data stories stand to benefit from the age-old narrative structure.**
 - A data story begins by setting the scene of the current situation, proceeds by providing insights that lead up to the central insight, and ends with relevant recommendations.



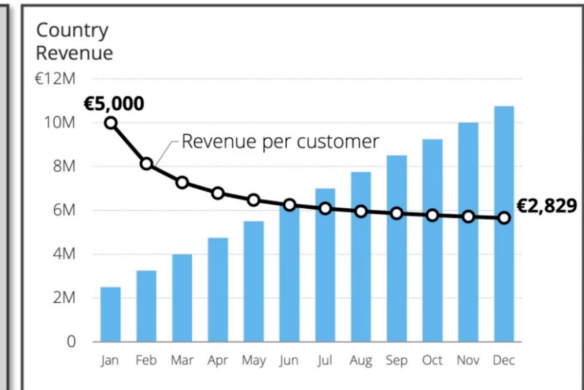
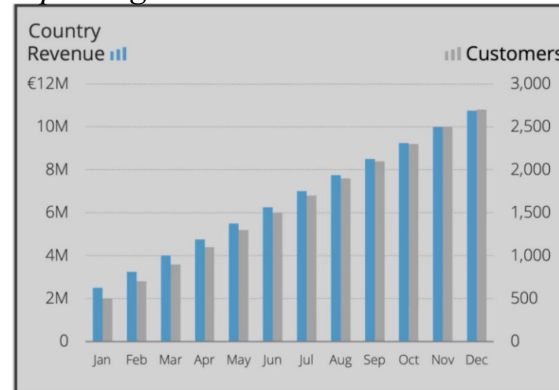
Data

- Analysts facing a deluge of data may be tempted to squeeze all the available data into one chart.
 - Those who do so risk muddling their data stories with noise and confusing their audience.

Identify Right Data for Your Data Story

Explicitly demonstrating that the revenue per customer is falling is a better choice than plotting the total revenue and customer.

Calculated metrics may be more insightful than total values.

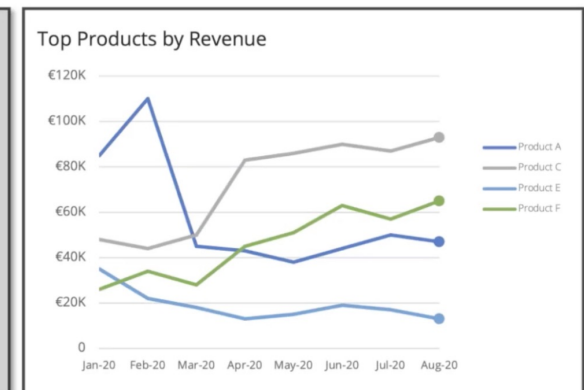
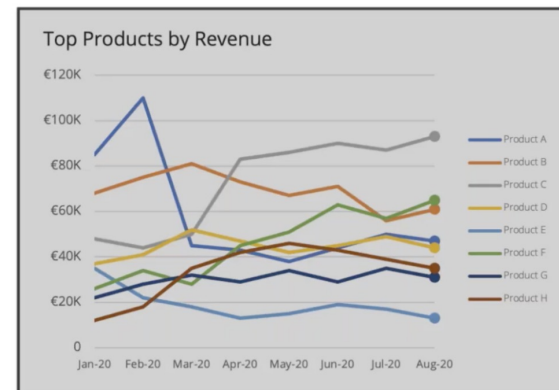


- That is why selecting the right data in a data story is crucial.
 - Data storytellers should remove or aggregate secondary data points, as the examples below demonstrate.

Remove Surplus Data that Isn't Needed

Often, less is more when it comes to showing multiple charts in one graph.

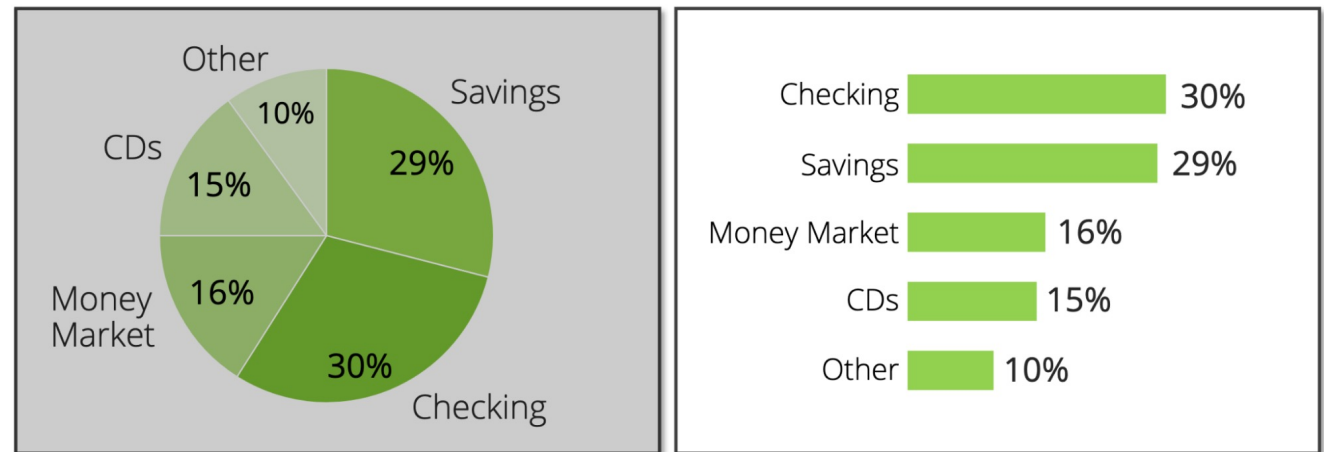
Ask yourself **what is essential** to making your point. Remove what's unnecessary.



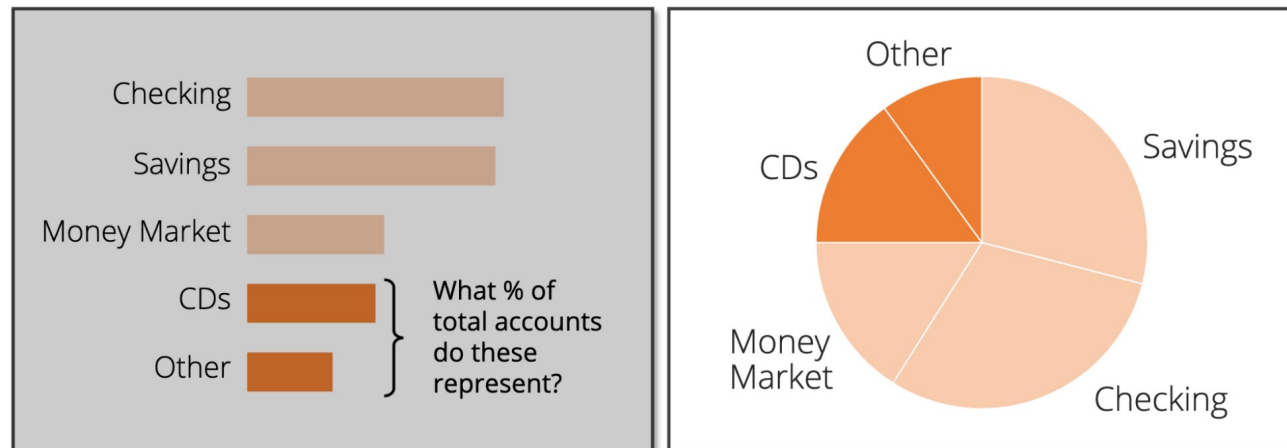
Visuals

1. Choose the appropriate visualization

- Visualizations differ in effectiveness based on the context of the data story.
- The key is to select the best chart based on the message.



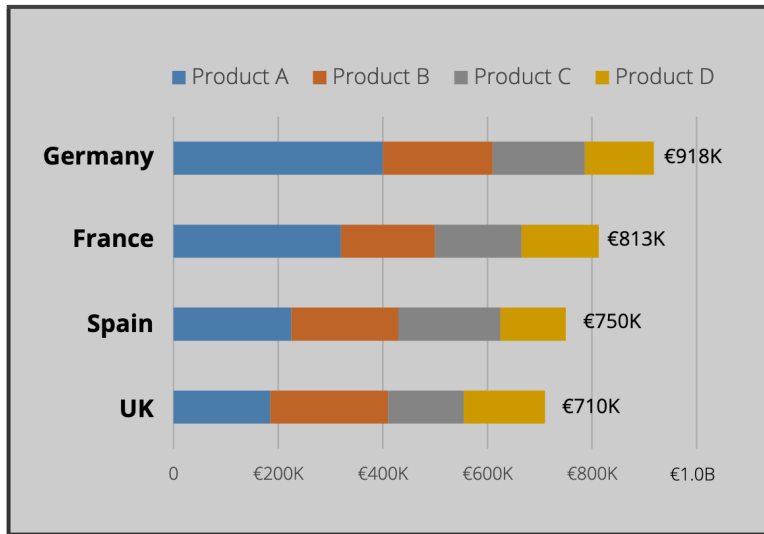
Bar charts are superior to pie charts in communicating differences in proportions



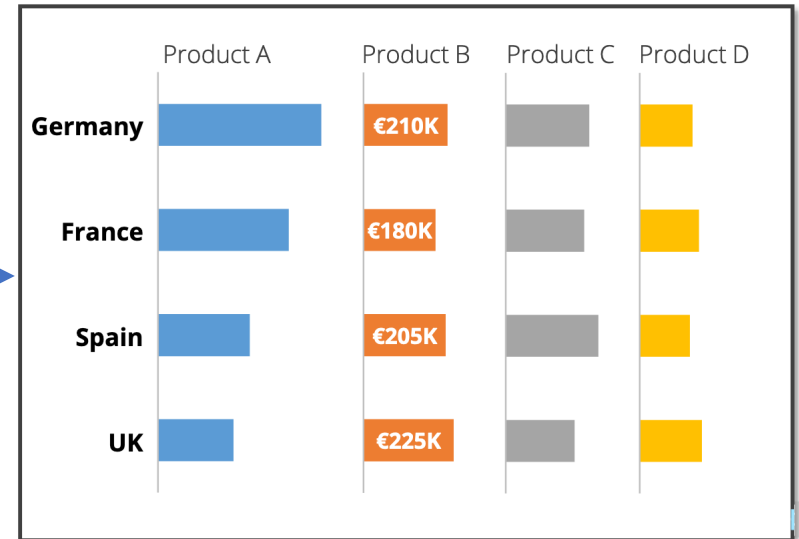
Pie charts are a better choice when illustrating the sum of proportions across categories

Visuals

2. Calibrate the visuals to the message



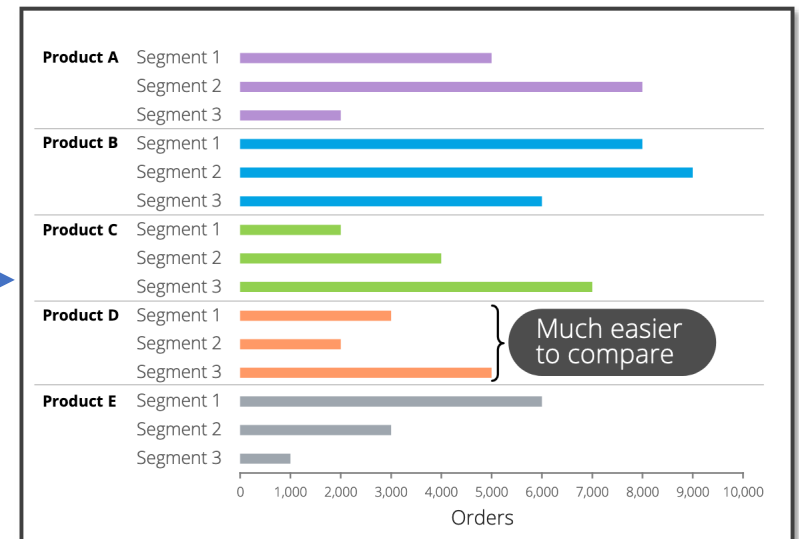
A comparison of the total revenue from each country



A comparison of the revenue of individual products across countries, especially for product B



A comparison across products for each segment

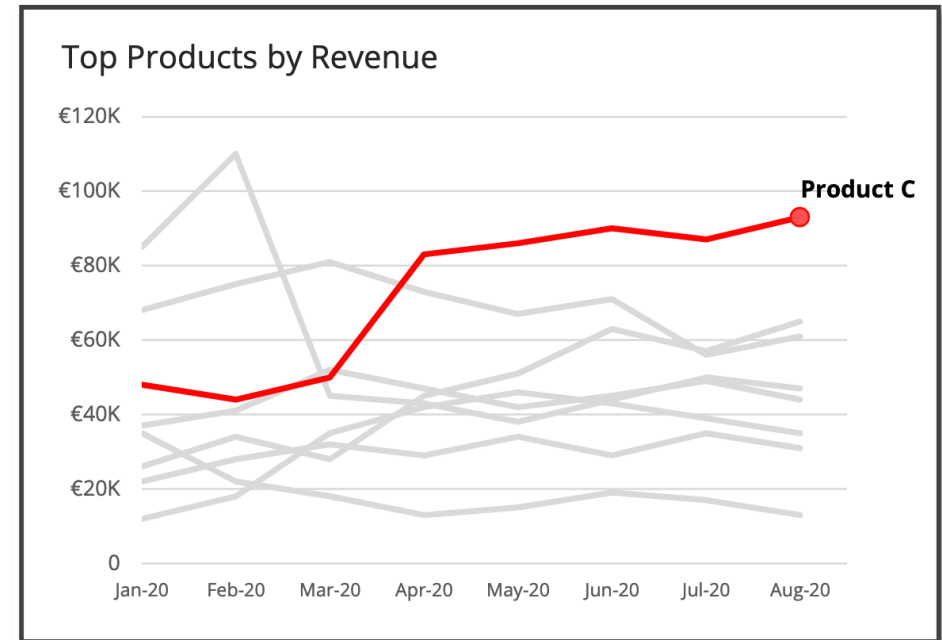


A comparison across segments for each product

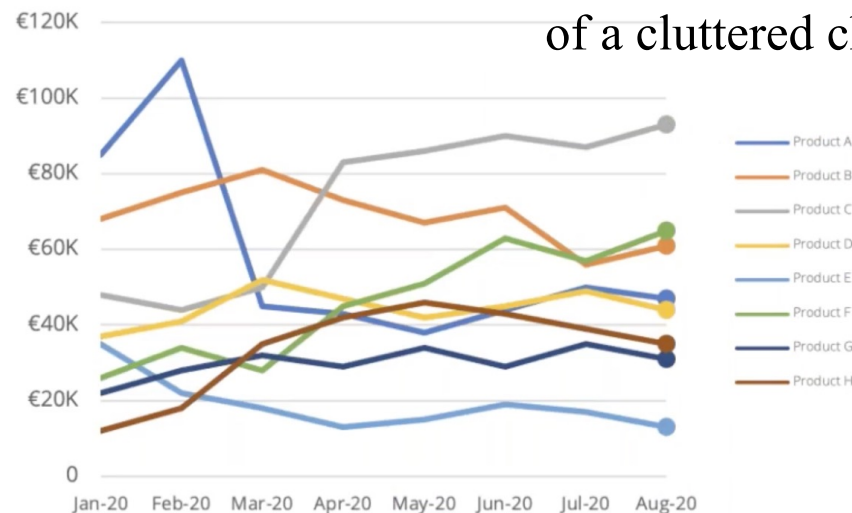
Visuals

3. Focusing the attention of the audience

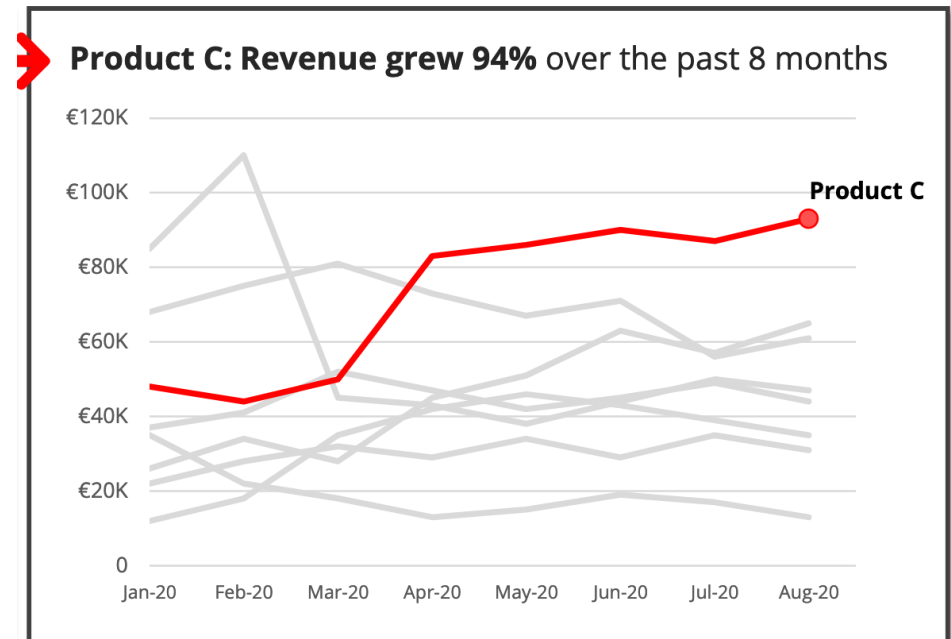
- The audience pays attention to what stands out in a chart. Highlighting the key points distills the signal from the noise, allowing the audience to garner insights from charts quickly.



Top Products by Revenue



A common example of a cluttered chart



The 3-minute story & Big Idea

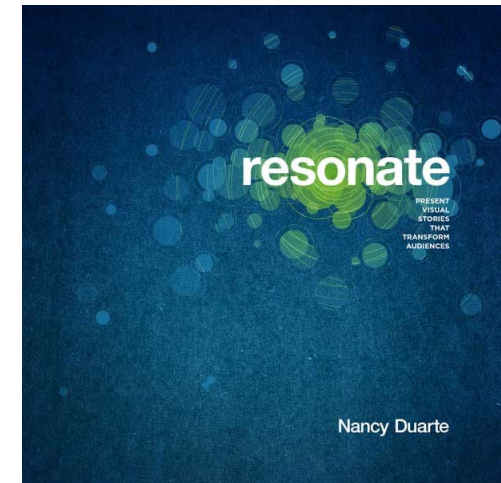
- The idea behind each of these concepts is that you are able to boil the “*so-what*” down to a paragraph and, ultimately, to a single, concise statement.
 - You must really know your stuff—*know what the most important pieces are* as well as *what isn't essential* in the most stripped-down version.
- While it sounds easy, being concise is often more challenging than being verbose.
 - Mathematician and philosopher Blaise Pascal recognized this in his native French, with a statement that translates roughly to “*I would have written a shorter letter, but I did not have the time*” (a sentiment often attributed to Mark Twain).

3-minute story

- The 3-minute story is exactly that:
 - *if you had only three minutes to tell your audience what they need to know, what would you say?*
- A great way to ensure you are clear on and can articulate the story you want to tell.
 - Being able to do this removes you from dependence on your slides or visuals for a presentation.
 - This is useful in the situation where your boss asks you what you're working on or if you find yourself in an elevator with one of your stakeholders and want to give her the quick rundown.
 - Or if your half-hour on the agenda gets shortened to ten minutes, or to five.
- If you know exactly what it is you want to communicate, you can make it fit the time slot you're given, even if it isn't the one for which you are prepared.

Big Idea

- The Big Idea boils *the so-what* down even further: to a single sentence.
 - This is a concept that Nancy Duarte discusses in her book, *Resonate* (2010).
- The Big Idea has three components:
 1. It must articulate your unique point of view;
 2. It must convey what's at stake; and
 3. It must be a complete sentence.
- Let's consider an illustrative 3-minute story and Big Idea,
 - Leveraging the summer learning program on science example that was introduced previously.



Let's consider a specific example

- **Imagine you are a fourth-grade science teacher.**
- You just wrapped up an experimental pilot summer learning program on science that was aimed at giving kids exposure to the unpopular subject.
- You surveyed the children at the onset and end of the program to understand whether and how perceptions toward science changed.
- You believe the data shows a great success story.
- You would like to continue to offer the summer learning program on science going forward.

Please identify the *Who, What, and How*

- *who we have identified as our audience,*
- *what we need them to know and do, and*
- *the data that will help us make our case*

Identify the *Who*, *What*, and *How*

- **Who:** The budget committee that can approve funding for continuation of the summer learning program.
- **What:** The summer learning program on science was a success; please approve budget of \$X to continue.
- **How:** Illustrate success with data collected through the survey conducted before and after the pilot program.

The *Who*, *What*, and *How* identified

- *who we have identified as our audience,*
- *what we need them to know and do, and*
- *the data that will help us make our case*

3-minute story: TLDR

- A group of us in the science department were brainstorming about how to resolve an ongoing issue we have with incoming fourth-graders. It seems that when kids get to their first science class, they come in with this attitude that it's going to be difficult and they aren't going to like it. It takes a good amount of time at the beginning of the school year to get beyond that. So we thought, what if we try to give kids exposure to science sooner? Can we influence their perception? We piloted a learning program doing just that. We invited elementary school students large group of second- and third-graders. Our goal was exposure to science in hopes of forming positive perceptions were successful, we surveyed the students before and after the program. We found that, going into the program, the biggest segment of students, 40%, felt just "OK" about science, whereas after the program, most of these shifted into positive perceptions, with nearly 70% of total students expressing some level of interest toward science. We feel that this demonstrates the success of the program and that we should not only continue to offer it, but also to expand our reach with it going forward.



TL;DR or TLDR stands for "Too Long; Didn't Read."

3-minute story: An Example

A group of us in the science department were brainstorming about how to resolve an ongoing issue we have with incoming fourth-graders.

General Background

It seems that when kids get to their first science class, they come in with this attitude that it's going to be difficult and they aren't going to like it.

Specific Elaboration

It takes a good amount of time at the beginning of the school year to get beyond that.

Setup the Conflict

So we thought, what if we try to give kids exposure to science sooner? Can we influence their perception?

Raise the Question

We piloted a learning program last summer aimed at doing just that.

Initiate the solution

We invited elementary school students and ended up with a large group of second- and third-graders.

What we did

Our goal was to give them earlier exposure to science in hopes of forming positive perception.

Why we did it

To test whether we were successful, we surveyed the students before and after the program.

How we did it

We found that, going into the program, the biggest segment of students, **40%**, felt just "OK" about science, whereas after the program, most of these shifted into positive perceptions, with nearly **70%** of total students expressing some level of interest toward science.

We found that ...

We feel that this demonstrates the success of the program and that we should not only continue to offer it, but also to expand our reach with it going forward.

What we want ...

Big Idea

- The pilot summer learning program was successful at improving students' perceptions of science and, because of this success, we recommend continuing to offer it going forward; **please approve our budget for this program.**



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Four Types of Data Analytics

Wan Fang

Southern University of Science and Technology

[Adapted from Harvard Business School Online by Catherine Cote]

Data Analytics To Improve Decision-making

- Data is a powerful tool that's available to organizations at a staggering scale.
 - When harnessed correctly, it has the potential to drive decision-making, impact strategy formulation, and improve organizational performance.



Four Types of Analytics

- **Analytics** is used to extract meaningful insights from data that can drive decision-making and strategy formulation.
 - There are **four types of analytics** you can leverage depending on the data you have and the type of knowledge you'd like to gain.

Descriptive analytics

- looks at data to examine, understand, and describe something that's already happened.

Diagnostic analytics

- goes deeper than descriptive analytics by seeking to understand the "why" behind what happened.

Predictive analytics

- relies on historical data, past trends, and assumptions to answer questions about what will happen in the future.

Prescriptive analytics

- identifies specific actions an individual or organization should take to reach future targets or goals.

Descriptive Analytics

- **The simplest type of analytics and the foundation the other types are built on.**
 - It allows you to pull trends from raw data and succinctly describe what happened or is currently happening.
 - If you're new to the field of data analytics, descriptive analytics is an accessible and rewarding place to start.
- **Descriptive analytics answers the question, “*What happened?*”**
 - For example, imagine you're analyzing your company's data and find there's a seasonal surge in sales for one of your products: a video game console.
 - Here, descriptive analytics can tell you, “This video game console experiences an increase in sales in October, November, and early December each year.”
- **Data visualization is a natural fit for communicating descriptive analysis**
 - because charts, graphs, and maps can show trends in data—as well as dips and spikes—in a clear, easily understandable way.

Descriptive Analytics: Examples

Traffic and Engagement Reports

- One example of descriptive analytics is reporting. If your organization tracks engagement in the form of social media analytics or web traffic, you're already using descriptive analytics.
 - These reports are created by taking raw data—generated when users interact with your website, advertisements, or social media content—and using it to compare current metrics to historical metrics and visualize trends.



- The three other analytics types can then be used to determine why traffic from each source increased or decreased over time, if trends are predicted to continue, and what your team's best course of action is moving forward.

Descriptive Analytics: Examples

Demand Trends

- Descriptive analytics can also be used to identify trends in customer preference and behavior and make assumptions about the demand for specific products or services.

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教育

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2020年

Diagnostic Analytics

- The process of using data to determine the causes of trends and correlations between variables.
 - It can be viewed as a logical next step after using descriptive analytics to identify trends.
 - Diagnostic analysis can be done manually, using an algorithm, or with statistical software (such as Microsoft Excel).
- Several concepts in diagnostic analytics:
 - hypothesis testing
 - difference between correlation and causation
 - diagnostic regression analysis

Diagnostic Analytics

Hypothesis Testing

- The statistical process of proving or disproving an assumption.
 - Having a hypothesis to test can guide and focus your diagnostic analysis.
 - The hypothesis directs your analysis and serves as a reminder of what you're aiming to prove or disprove.
- Hypotheses can be future-oriented, but these aid predictive or prescriptive analytics.
 - *“If we change our company’s logo, more people in North America will buy our product.”*
- When conducting diagnostic analytics, hypotheses are historically-oriented.
 - *“I predict this month’s decline in sales was caused by our product’s recent price increase.”*

Diagnostic Analytics

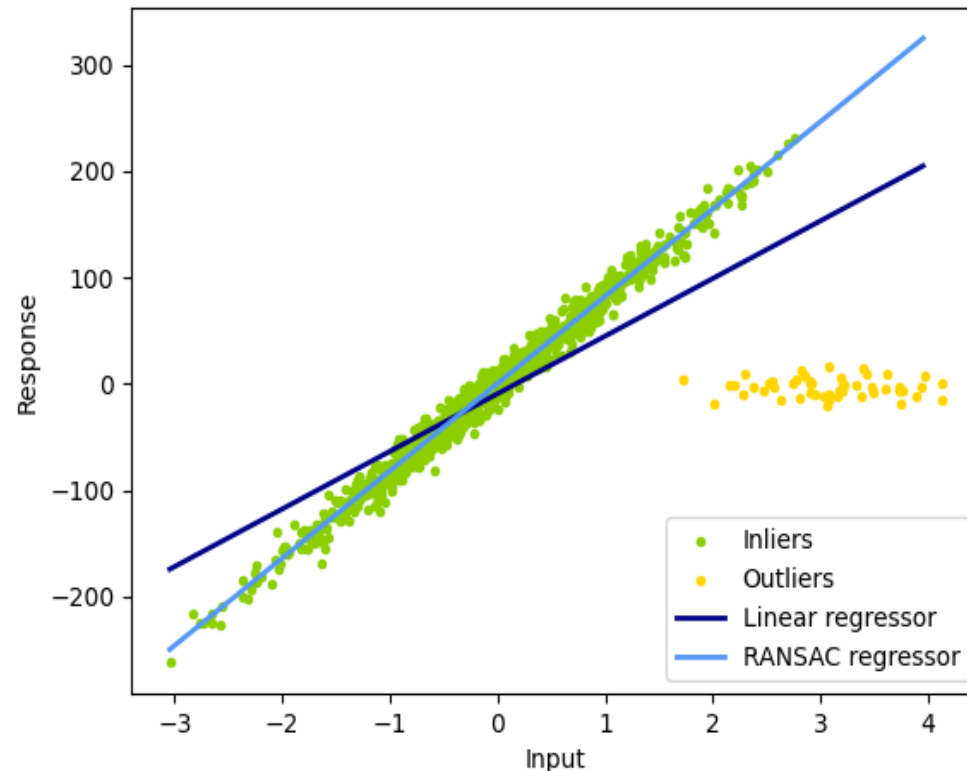
Correlation vs. Causation

- When exploring relationships between variables, it's important to be aware of the distinction between correlation and causation.
 - If two or more variables are correlated, their directional movements are related.
- The key in diagnostic analytics is remembering that
 - *just because two variables are correlated, it doesn't necessarily mean one caused the other to occur.*
- If your organization is able to dedicate resources to running controlled experiments, you may be able to determine causation between variables.
 - While determining causation is ideal, correlation can still offer the insight needed to make sense of your data and use it to make impactful decisions.

Diagnostic Analytics

Diagnostic Regression Analysis

- Regression analysis can be used to determine the relationship between two or more variables.

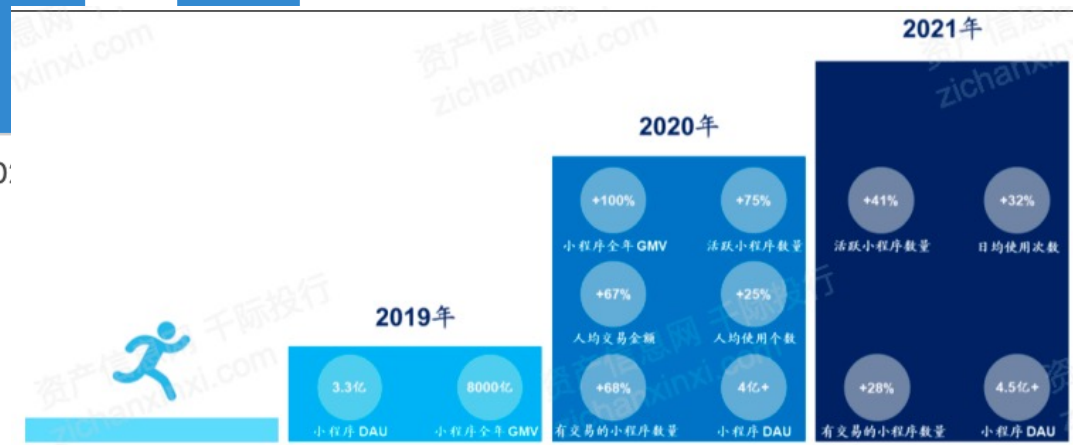
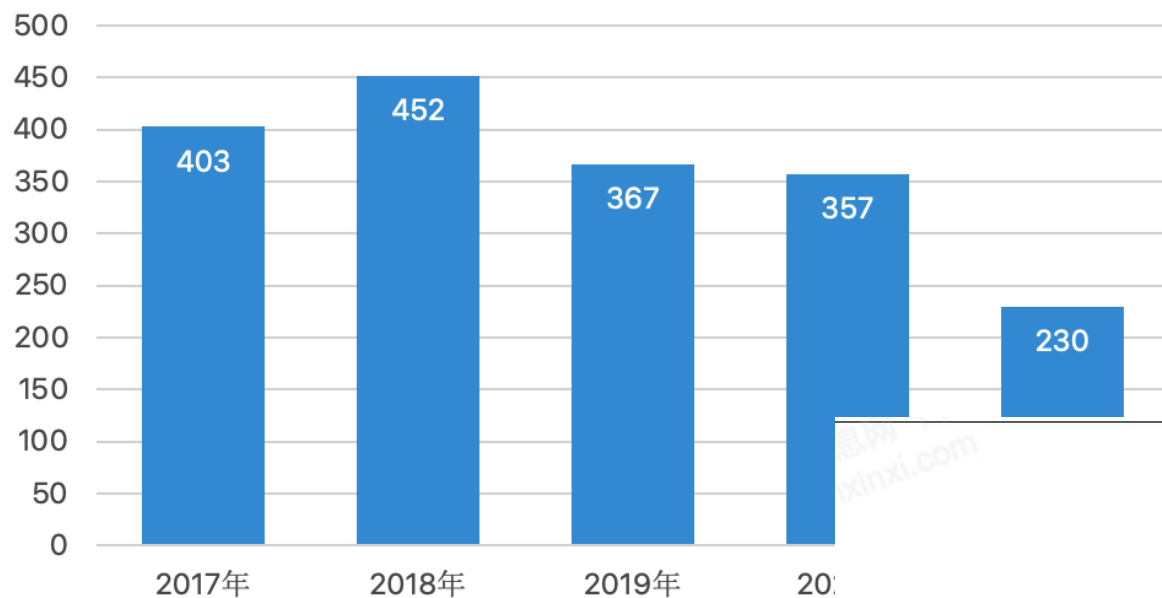


- Diagnostic analytics: when regression analysis is used to explain the relationships between variables in a historical context.
- Predictive analytics: the regression can then be used to develop forecasts for the future.

Diagnostic Analytics: Examples

Examining Market Demand

2017-2022年中国移动应用在架数量（万款）



Report

Predictive Analytics

- **The use of data to predict future trends and events.**
 - It uses historical data to forecast potential scenarios that can help drive strategic decisions.
- The predictions could be for the **near future** or the **more distant future**, such as predicting your company's cash flows for the upcoming year.
 - For instance, predicting the malfunction of a piece of machinery later that day
- Predictive analysis can be conducted **manually** or **using machine-learning algorithms**.
 - Either way, historical data is used to make assumptions about the future.

Predictive Analytics: Examples

Manufacturing: Preventing Malfunction

不同类型的维护

- 响应式维护 —— 出问题了再进行维护
 - 例子： 替换汽车蓄电池
 - 问题： 非预期的失效可能导致高昂的代价， 潜在危险
- 定期维护 —— 按照固定的时间间隔定定期维护
 - 例子： 5000 英里汽车更换机油
 - 问题： 不必要的维护导致浪费； 不能消除所有的失效问题
- 预测式维护 —— 预测问题出现的的时机
 - 例子： 预测某种 G M 汽车模型的潜在问题， 通过检测电池， 油泵， 电机等信息
 - 问题： 提高复杂设备的预测精度非常困难

Predictive Analytics: Examples

Manufacturing: Preventing Malfunction

涡轮发动机的预测式维护

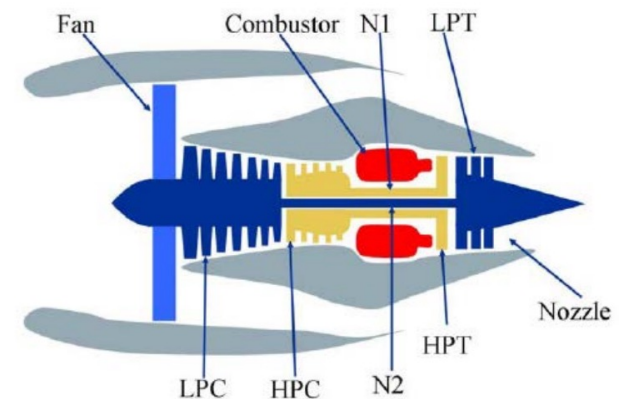
从 100 台相同型号发动机上采集的传感器数据

在问题出现之前，预测和修正潜在问题

- 引入和分析历史传感数据
- 训练模型预测失效的时机
- 部署模型到实时传感数据之中
- 实时预测失效事件

Data provided by NASA PCoE

<http://ti.arc.nasa.gov/tech/dash/pcoe/prognostic-data-repository/>



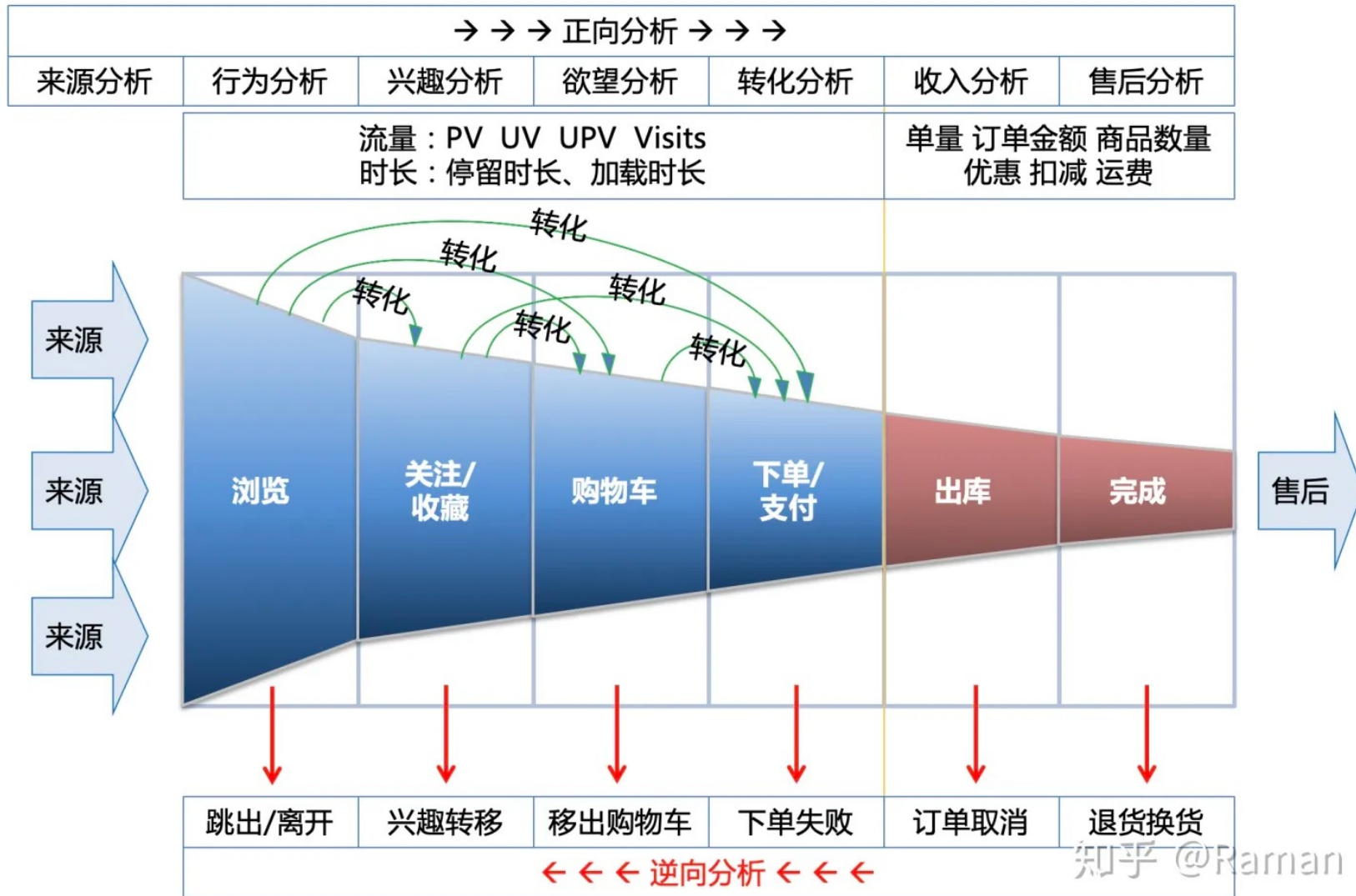
Predictive Analytics: Examples

Marketing: Behavioral Targeting

- In marketing, consumer data is abundant and leveraged to create content, advertisements, and strategies to better reach potential customers where they are.
 - By examining historical behavioral data and using it to predict what will happen in the future, you engage in predictive analytics.
- Predictive analytics can be applied in marketing to **forecast sales trends** at various times of the year and plan campaigns accordingly.
- Additionally, historical behavioral data can help you predict a lead's likelihood of moving down the funnel **from awareness to purchase**.

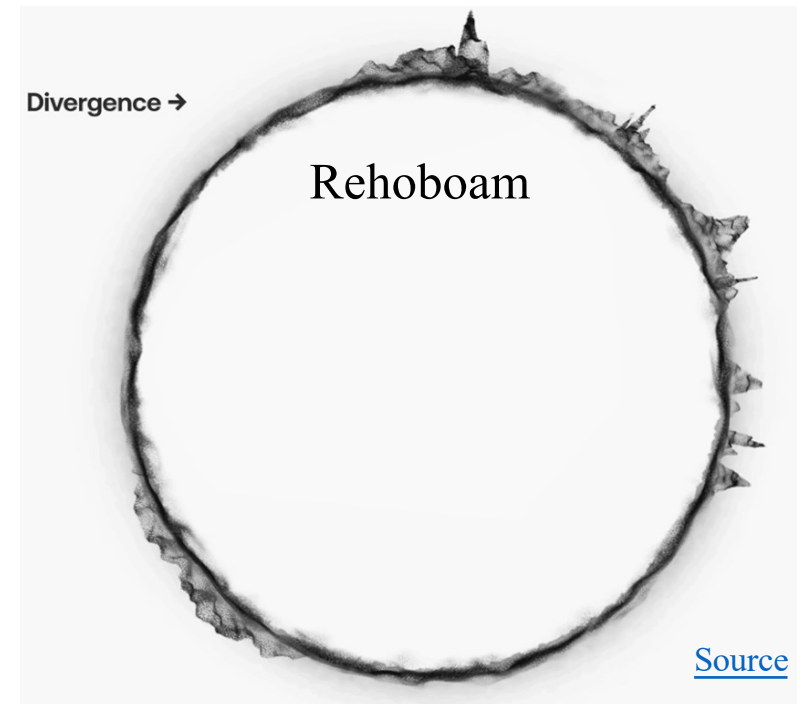
Predictive Analytics: Examples

Marketing: Behavioral Targeting



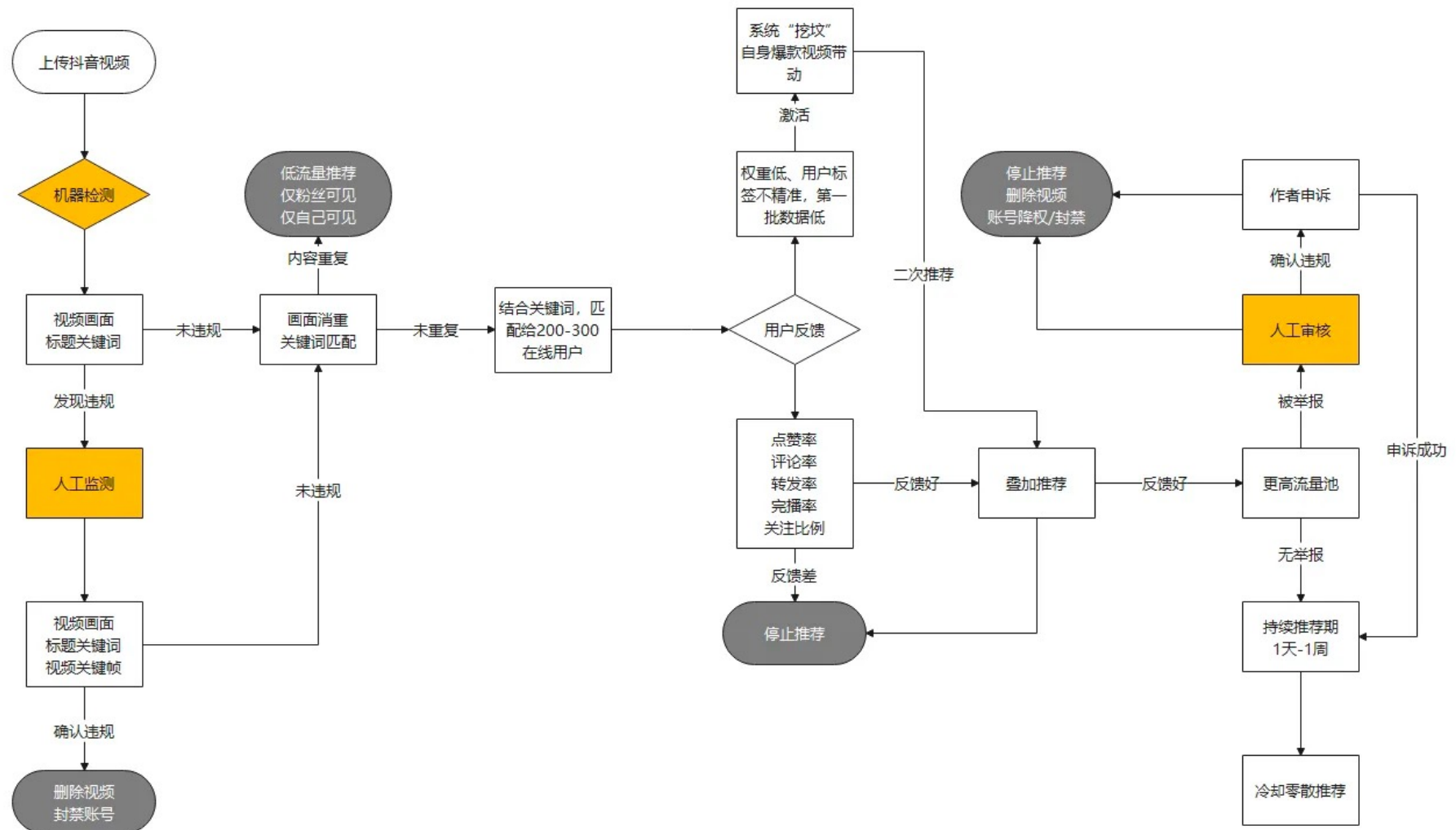
Prescriptive Analytics

- The process of using data to determine an optimal course of action.
 - By considering all relevant factors, this type of analysis yields recommendations for next steps.
 - Prescriptive analytics is a valuable tool for data-driven decision-making.



- It's important to note:
 - While algorithms can provide data-informed recommendations, they can't replace human discernment.
 - Your judgment is valuable and necessary to provide context and guard rails to algorithmic outputs.

Prescriptive Analytics: Examples



Prescriptive Analytics: Examples

视频信息:

aweme_id: 视频ID
desc: 视频描述
create_time: 创建时间
height: 视频高度
width: 视频宽度
dynamic_cover: 动态封面
ratio: 清晰度
has_watermark: 是否有水印
bit_rate_gear_name: 码率清晰度 (视频清晰度可能影响视频评分?)
quality_type: 质量类型
bit_rate: 视频比率
is_h265: 是否为H265视频
duration: 时长
user_digged: 作者自己点赞
allow_share: 是否允许分享
allow_comment: 是否允许评论
with_goods: 包含商品
is_top: 是否置顶
is_vr: 是否VR视频
is_ads: 是否广告视频
risk_infos: 风险信息
position: 位置

is_pgshow: 是否PGC内容
interaction_stickers: 互动贴纸

音乐信息:

id: 音乐id
title: 音乐标题
author: 音乐作者
album: 音乐专辑
cover: 音乐封面
duration: 音乐时长
has_edited: 音乐是否被编辑过
user_count: 使用人数
collect_stat: 收藏人数
owner_id: 作者id
owner_nickname: 作者昵称
is_original: 是否原创
binded_challenge_id: 绑定挑战赛
strong_beat: 节拍数据 (可绘制波形图)
is_commerce_music: 是否商业音乐
is_original_sound: 是否原声
shoot_duration: 视频使用时长

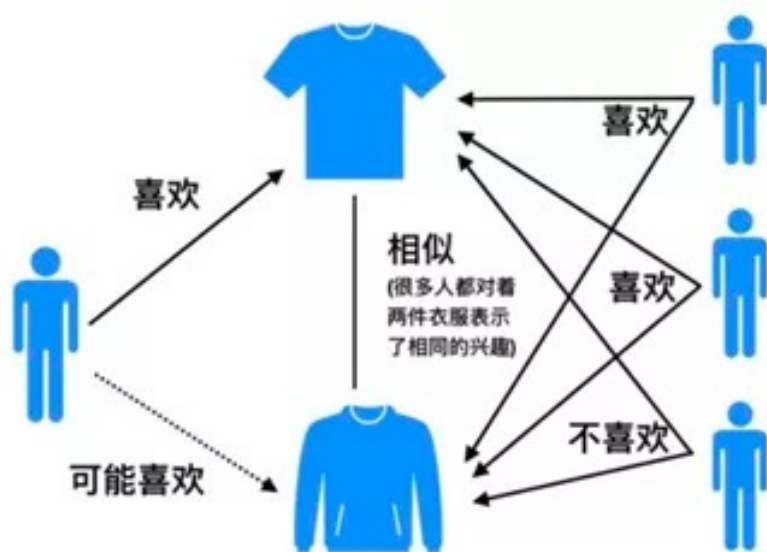
用户信息:

nickname: 创作者昵称
avatar: 头像
signature: 签名
total_favorited: 总获赞
fans_count: 粉丝数
following_count: 关注数
dongtai_count: 动态数

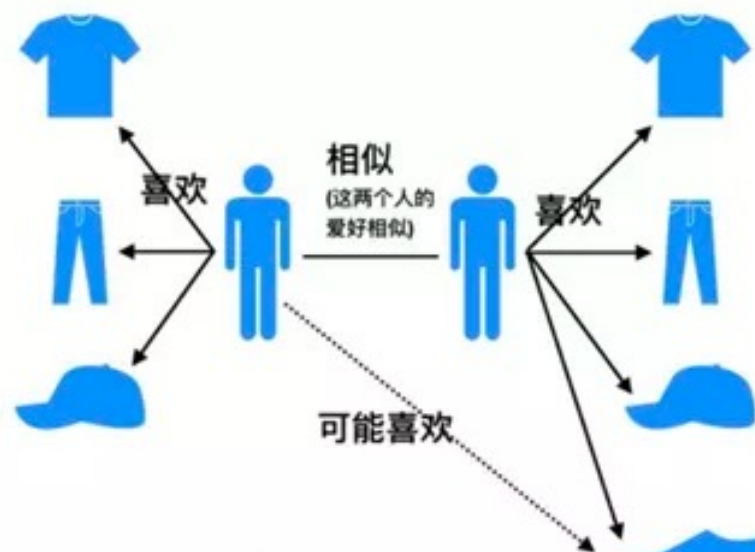
用户的行为数据:

who, 唯一的用户标识
when, 具体时间
where, 地理位置
what, 交互的内容 (包括上面的使用、音乐和创作人)
which, 用户的行为 (上滑、下滑、左滑、右滑、点赞, 关注, 点评
environment, 网络环境、运营商画像、设备品牌型号...

Prescriptive Analytics: Examples



基于物品的协同过滤



基于用户的协同过滤

Resource of Data

- Industry report: 艾瑞网, 德勤
- Academic research: 知网
- Public data: [国家数据](#)
- Internet Data: 八爪鱼



DS363: Design and Learning with Data

<https://ds363.ancorasir.com/>

Thank you~

Wan Fang
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