Class 1: Introduction to Business Forecasting

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Who am I?

- Krzysztof Zaremba
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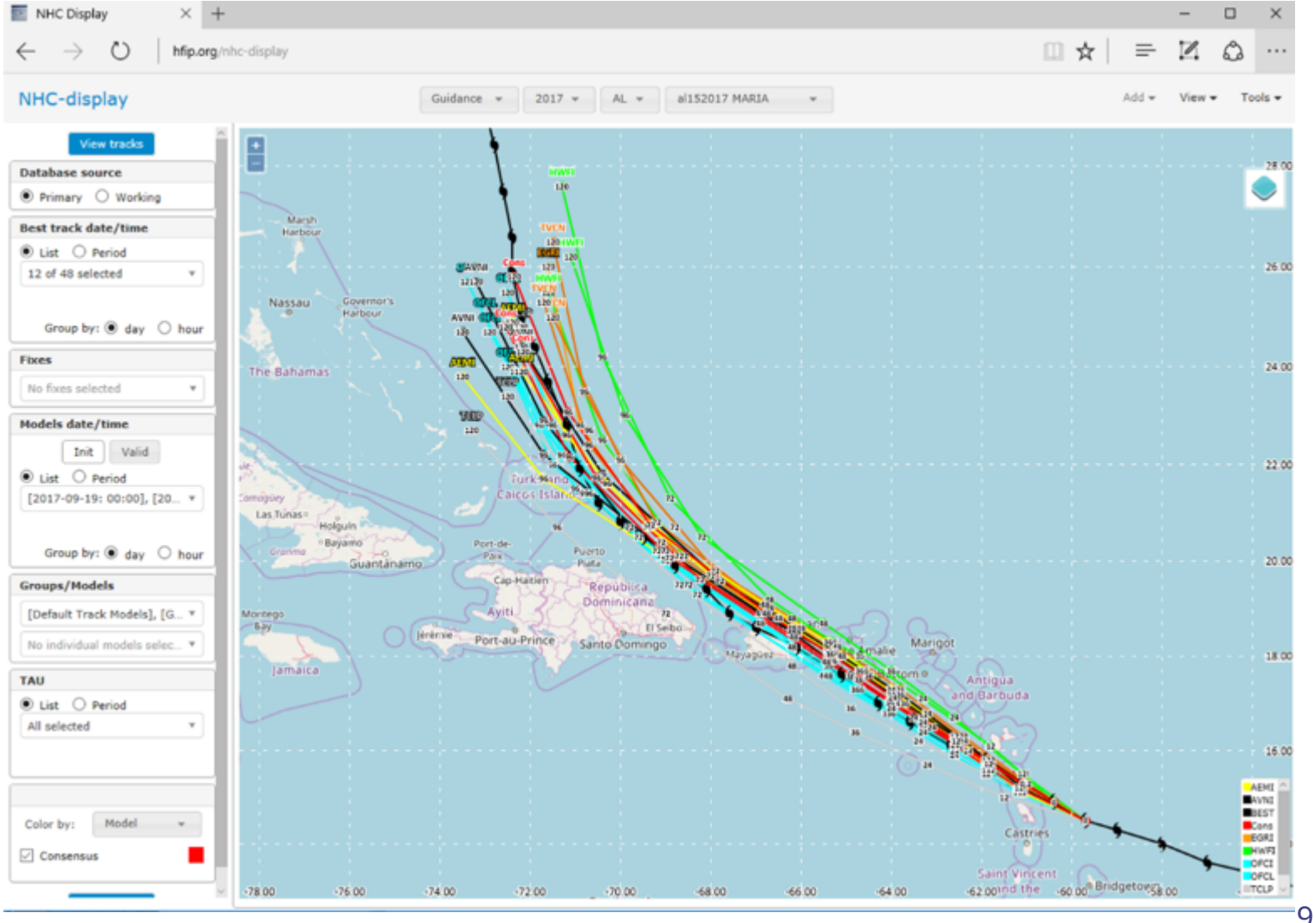
  - **Office hours:** Calendly, virtual, Tuesday 2-3pm or by appointment

Who are you?

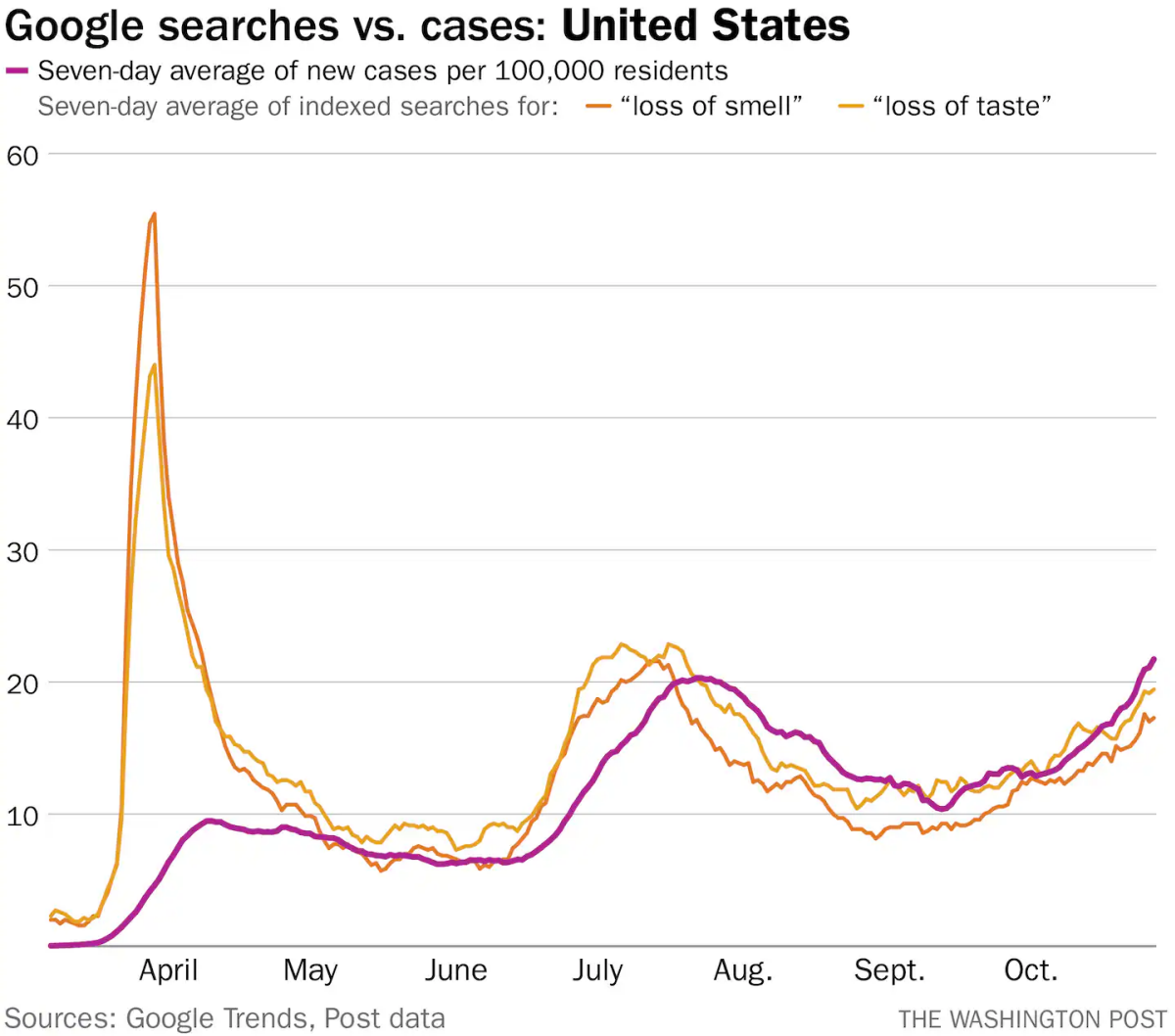
What Is This Class About?

Forecasting involves making predictions about future events based on historical data and relevant information

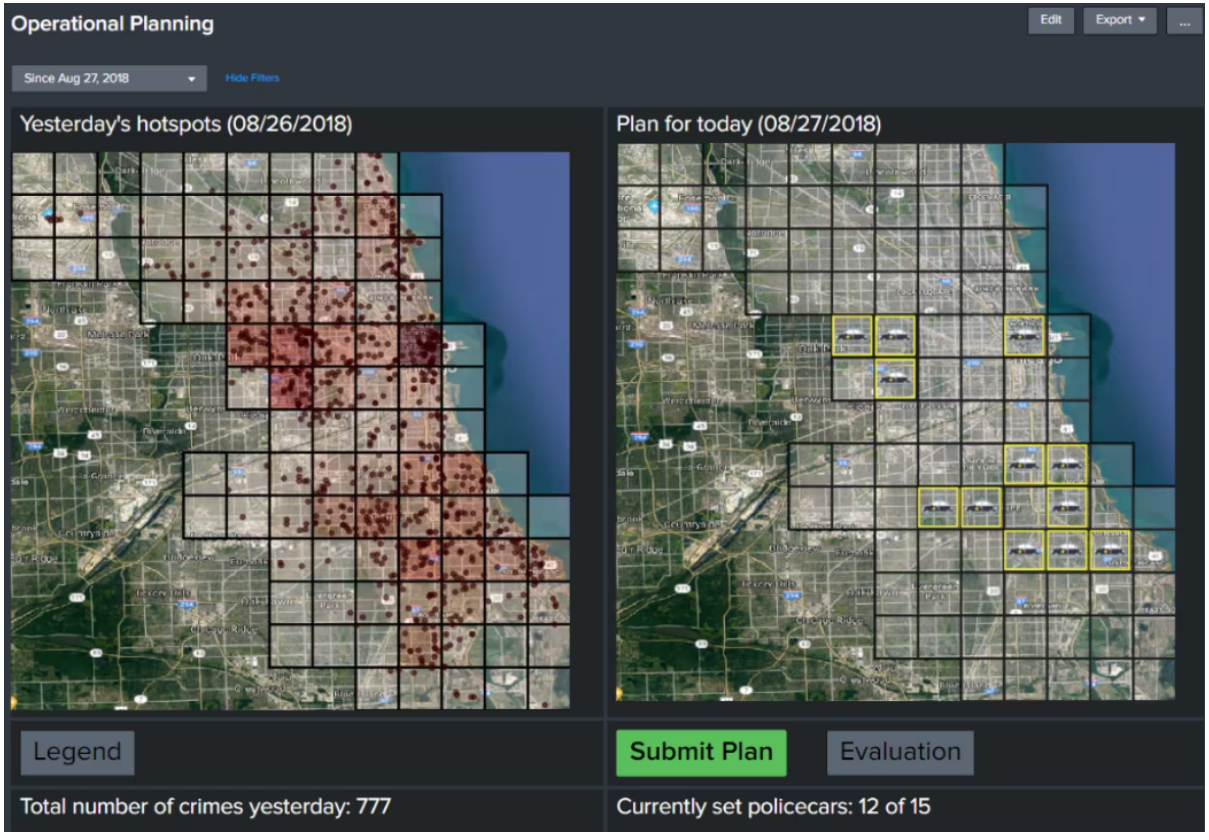
1. **Weather Forecasting**
   - Predicting hurricanes → timely reactions and preparations.



1. **Epidemic Forecasting**
    - Predicting disease outbreaks → effective public health responses.



1. **Criminal Activity Forecasting**
   - Identifying crime hot-spots → increase the number of patrols.
   - Identifying individuals at risk of committing crimes → sending warning letters.



What Is This Class About?

Forecasting in Business

- Improve decision making
- With increasing availability of data, firms rely on almost scientific methods to make decisions

Applications

1. **Pricing**: Optimize pricing (Example: Health Insurance, Uber)
2. **Employee Churn**: Identify factors predicting employees leaving the company and implement measures to retain valuable talent (Example: EC)
3. **Anticipating Demand**: Adjust inventory management to minimize waste and meet customer needs effectively (Example: Meal Kits)
4. **Strategic Investment Decisions**: Forecast market trends to predict suitability for investments (Example: Electric Cars)

Your turn

- Get in pairs
- Consider your past employment or your future employment
- Think about how forecasting could solve some problems in the context of industry you are considering
- (5 min)

What will you learn?

1. Getting Business Information from the Data
    - Analyze data, evidence, and arguments to make reasoned judgments
2. Problem Solving and Forecasting
    - Formulate, evaluate, and implement statistical models for business forecasting.
    - Interpret the results and validate assumptions
    - Key technical skill very valuable on the job market!
3. Decision Making and Communication
    - Choose optimal options to achieve objectives.
    - Communicate findings, conclusions, and recommendations effectively to business professionals

Organization

- **Schedule**:
  - Group Section 001
    - Tuesday 08:00 -10:00 hrs. Room: RH 104
    - Thursday 08:00 -09:30 hrs. Room: RH 104
  - Group Section 002
    - Tuesday 10:00 -12:00 hrs. Room: PF 105
    - Thursday 10:00 -11:30 hrs. Room:PF 105

- **Textbooks**
  - See canvas course materials and syllabus

Grading

- 20% 2x Midterms
- 30% Final Exam
- 15% Quizzes (with 1 week notice, in-class)
- 15% Final Project (In groups of 3)
- 0% Homeworks

Pre-requisites

- Mathematics III or Linear Algebra I
- Statistics II or Statistical Inference

Language

- Class is in English
- But your English is not evaluated
- I will understand your English
- Great occasion to learn vocabulary useful for interviews

Software - R

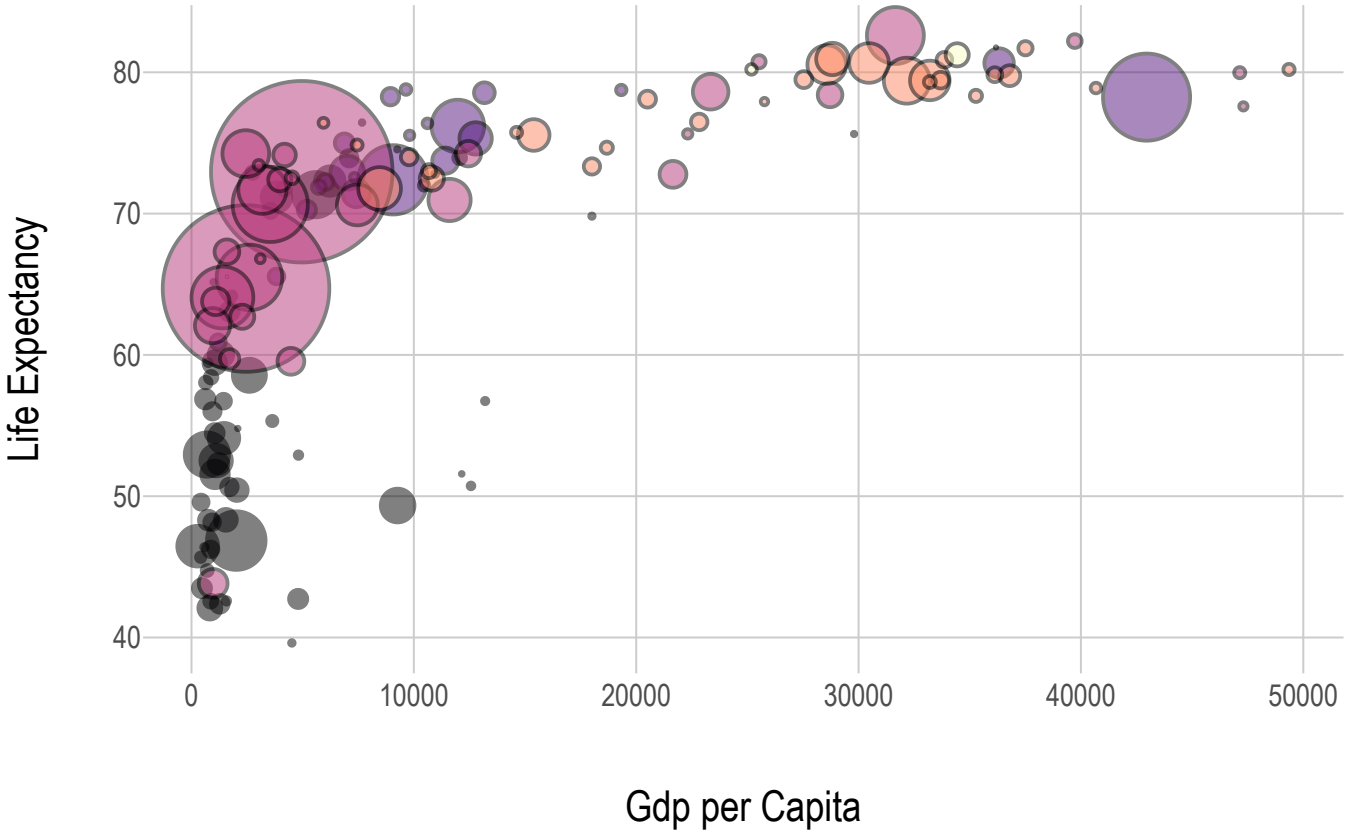
Performing actual forecasts with data

- Widely Used: R is a popular language for data analysis and statistical computing
- Open-Source: R is free!
- Community Support: You can easily find plenty of tutorials and help
- Data Visualization: Amazing vizualizations and ways to communicate your findings

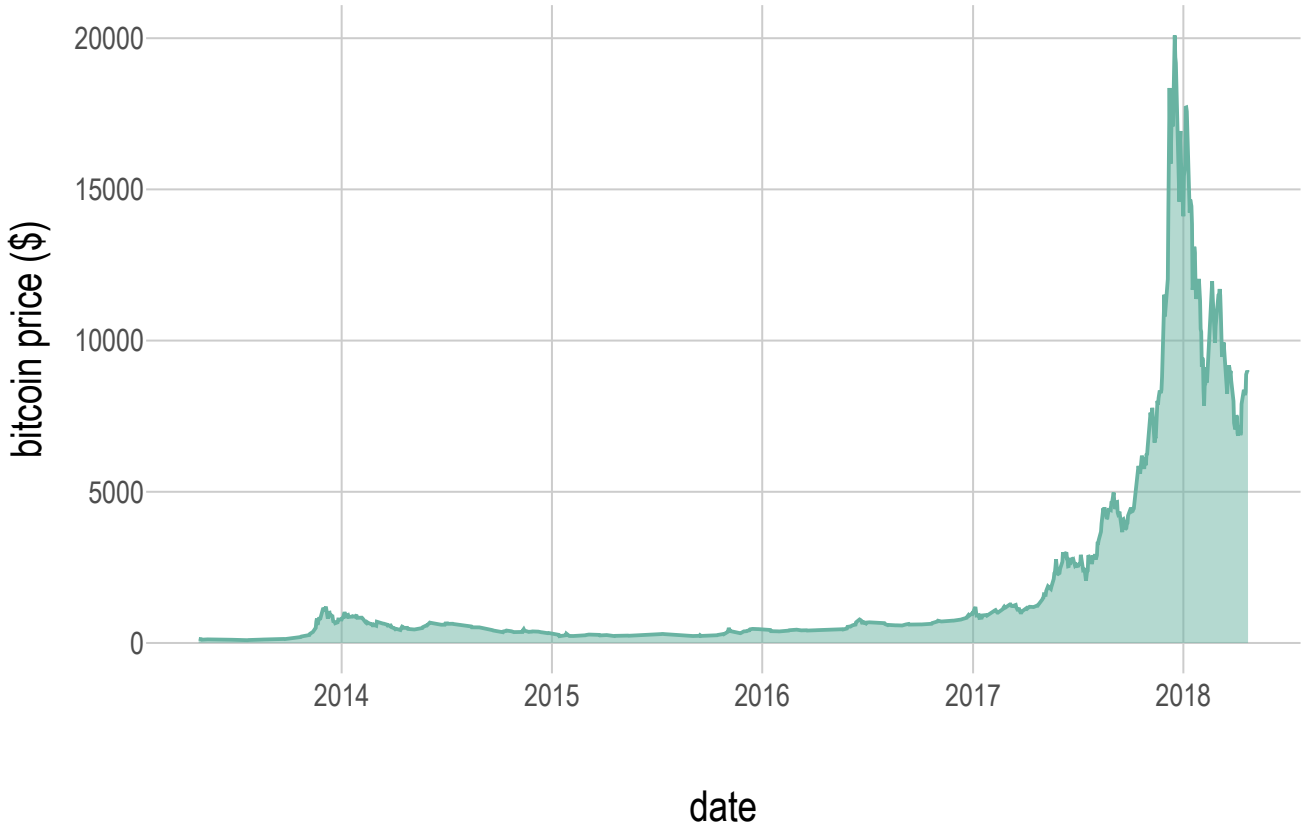
Public Wifi Antennas in Mexico City

In html slides

Life expectation vs GDP per Capita



Bitcoin price in time



Remarks

- We will use it for practical exercises with data
- You will use it for the final project
- We will learn some of it together in class
- Chatgpt is your friend
- You might be evaluated on reading the output of R code

Introduction to Forecasting

Tools will often depend on the horizon and data availability

Forecasting Horizons

- Very Short Horizon:
  - High-Frequency Trading:
    - Real-time price predictions for financial trading
  - Traffic Flow Management:
    - Optimizing traffic signals based on real-time data
- Short Horizon:
  - Retail Store:
  - Forecasting cashier scheduling based on historical foot traffic and transaction data
  - Public bikes:
  - Predict the availability of bikes at bike station and adjust the number
- Long Horizon:
  - New obesity drug:

Overview of Forecasting Techniques

1. Qualitative Forecasting
    - Based on subjective judgment and expert opinions
    - Suitable for unique situations or new markets
    - Examples: Predicting economic impacts of oil price changes or political stability in a region
2. Quantitative Forecasting
    - Uses historical data and numerical techniques
    - Suitable when data is available and continuity assumptions hold true
        - *Continuity assumption*: past trends and relationships continue in the future
        - When it holds?
            - Interest rates and investments
        - When it does not hold?
            - Covid Cases & Deaths and Vaccines

Methods of Quantitative Forecasting

Time Series Forecasting

- Time series data: collection of data points for a single unit (one firm, one person, one country, one) ordered chronologically.
- Time series forecasting: identifying patterns and trends in historical data to predict future values

Show 5 entries

Year	GDP
2010	9400
2011	10342
2012	10376
2013	10866
2014	11076

Showing 1 to 5 of 18 entries

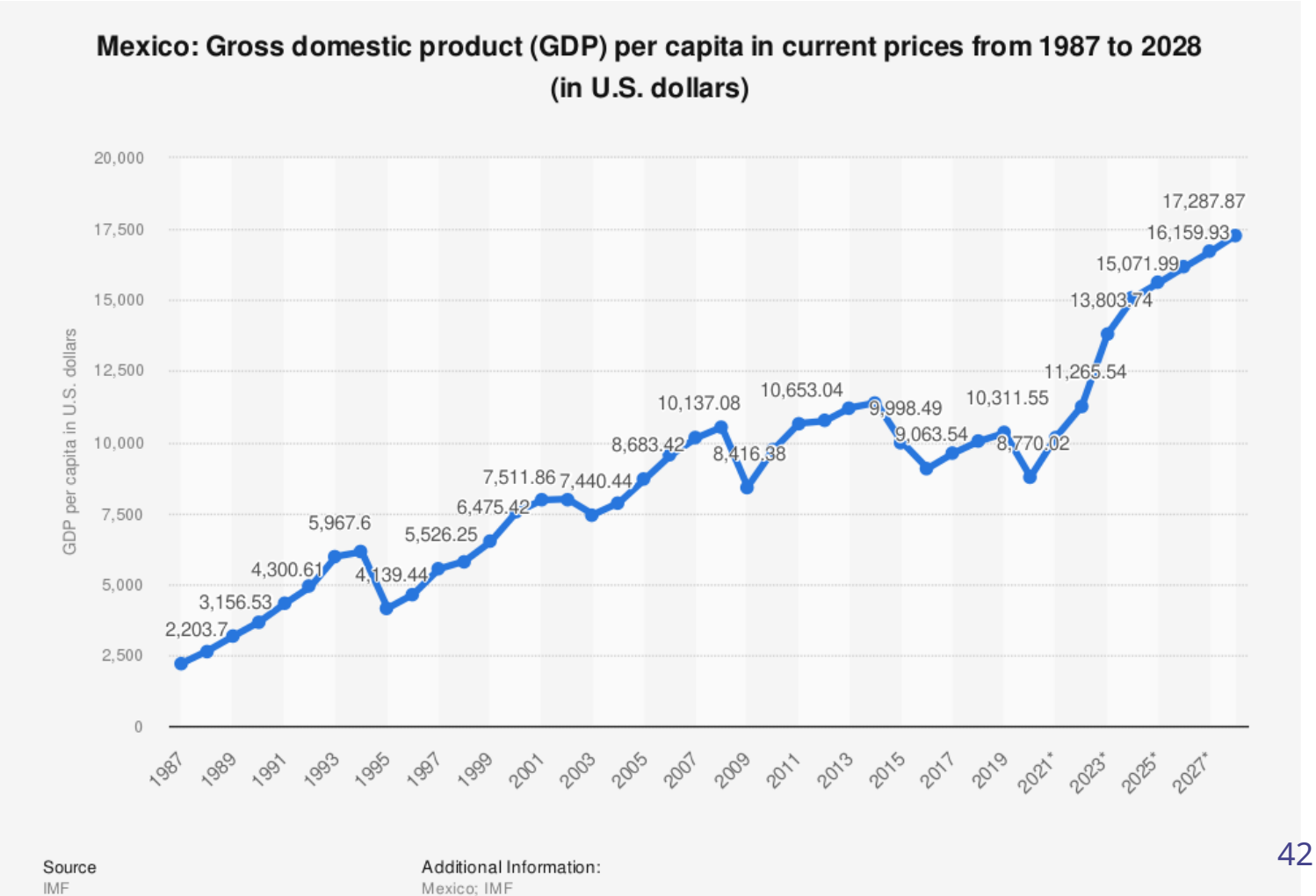
Previous 1 2 3 4 Next

In simple terms:

- We don't care about what causes what
- We just hope that past values of the variable and its historical behavior can predict its future values

Example: Forecasting of GDP

- Time series forecasting can help predict a country's Gross Domestic Product.



Explanatory Models

- We have data on both the variable of interest and other variables related to it
- We consider how other variables impact the outcome of interest
- We use these relationships to make forecasts

Example: Sales at a new location

- Should we open a new Starbucks at ITAM?
- Using existing locations, analyze impact of:
  - Foot traffic
  - Neighborhood income
  - Competitors' stores
- Given these relationships, what would be sales at ITAM?

Show 10 entries

S_ID	Address	F_Traffic	N_Income	C_Stores	Sales
1	123 Main St	100	60000	2	5000
2	456 Oak Ave	150	75000	1	6000
3	789 Elm Rd	80	55000	3	4500
4	321 Maple Ln	120	80000	2	7000
5	543 Birch St	200	70000	1	8000
6	876 Pine Ave	90	60000	3	5500
7	987 Cedar Rd	180	90000	2	9000
8	654 Walnut Ln	110	85000	1	7500
9	234 Spruce St	140	75000	2	6500
10	**ITAM**	**170**	**65000**	**1**	

Showing 1 to 10 of 10 entries Previous 1 Next

Steps of Forecasting

1. **Problem Definition**
   - Clearly define the forecasting objective.
   - Example: Forecasting ride demand during holidays for Uber.
2. **Gather Data**
   - Identify and collect relevant data.
   - Example: Historical ride data and local event information.
3. **Preliminary Explanatory Analysis**
   - Understand data characteristics and relationships.
   - Example: Analyzing trends and patterns in ride demand during holidays.
4. **Choosing and Fitting the Model**
   - Select and fit the appropriate forecasting model.
   - Example: Estimate multiple linear regression or time series forecasting.
5. **Evaluating the Model**
   - Assess the model's performance using historical data.
   - Example: Comparing model predictions with actual ride demand during past holidays.

Methods of Qualitative Forecasting

Delphi Method

- A structured communication process to reach a consensus for complex, uncertain and long terms forecasting tasks
  1. Select a group of experts
  2. Invite them to the study. They are anonymous and don't talk to each other!
  3. Ask them to answer a questionnaire
  4. Get initial responses
  5. Compile them into summary
  6. Send them summary and get their feedback with refined answers
  7. Reiterate until consensus is reached or no further improvement

Example: Determining Technological Trends

- What are the risks of AI developments?
- Panel of experts from academia and industry
  - Computer scientists, engineers, CEOs of AI companies, ethic experts
- Send them questionnaires asking about potential threats
- Compile responses into summary and send them back
- Get more rounds of responses until consensus
- Identify the most probable risks

Brainstorming

- Creative technique for generating ideas.
- Encourages free thinking and building on suggestions.
- Appropriate for exploring possibilities.
  - Form a group (no need for experts)
  - State the problem
  - Encourage ideas, no matter how crazy
  - Build and combine each others' ideas
  - Document the ideas and synthesize them

Example: Enhancing Employee Engagement

- Tech company's HR department.
- Representatives from HR, IT, and different departments.
- Generate ideas for a mobile app to enhance employee engagement.
- Write them down and implement the relevant ones

Panel of Experts

- Assemble knowledgeable individuals
  - At the same time and spot
- They meet, offer insights and expertise, and discuss
- Aid in well-informed decisions.
- Sometimes ends up with a report with conculsions

Example: Environmental Policy Formulation

- Government agency want to find identify and address most pressing environmental issues
- Environmental scientists, economists, conservationists, and policymakers.
- Discuss policy options.
- Create comprehensive environmental policies.

Focus Groups

- Gather diverse participant - experts
- Share perceptions, attitudes, and opinions.
- Provide qualitative data and consumer insights.

Example: Market Research for a New Beverage

- Proposing a new TV Show and trying to see how well it will do
- Participants from various demographics.
- Understand consumers' preferences and perceptions about the TV show
- Fine-tune the product and marketing strategy.

Remainder of the course

Quantatitve Forecasting

1. Ungraded quiz on Thursday
2. Review of Statistics *(Midterm 1: 21st February)*
3. Simple linear regression *(Midterm 2: 3rd April)*
4. Multiple linear regression
5. Time Series *(Final: May)*

Fundamental tools to:

- Make predictions,
- Quantify uncertainty,
- Intepret it and communicate it

Questions?