ISA 444: Business Forecasting

01 - Course Overview, Introductions and an Overview of Forecasting

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Fall 2020

Outline

Learning Objectives for Today's Class

Main Learning Outcomes

- **Describe course objectives & structure.**
- **Describe what do we mean by forecasting and explain the PIVASE framework.**
- **Explain the differences between cross sectional, time series, and panel datasets.**
- **Identify and describe the basic components of a time series including trends, seasonal components, and cycles.**

Outline

Different Types/Components of Analytics

The analytics journey

- **Pre-analytics/Data Management:** where one attempts to extract the needed data for analysis.
- **Descriptive analytics:** where one attempts to understand the data through visualizations and descriptive statistics.
- **Predictive analytics:** statistical and machine learning models are used.
- **Prescriptive analytics:** mathematical models are used to make recommendations for business actions.

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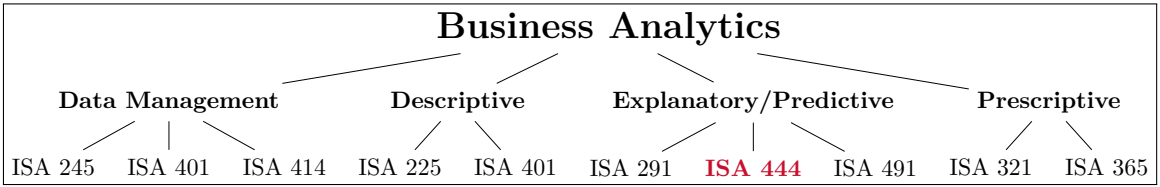
- Predictive analytics: statistical and machine learning models are used.
- **Prescriptive analytics: mathematical models are used to make recommendations for business actions.**

Miami's Business Analytics Curriculum: A Perspective



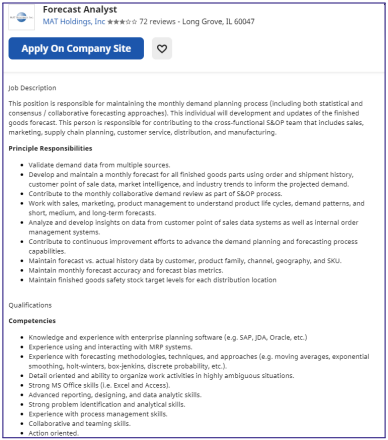
My take on the courses within the business analytics major/minor at Miami University.

Course Objectives

By the end of this course, you should be able to:

- **Explain the purpose of forecasting in a business setting.**
- **Use the basic tools of forecasting including plots, summary measures, transformations, measures of forecast accuracy, and prediction intervals.**
- **Forecast a nonseasonal time series using simple exponential smoothing.**
- **Forecast a nonseasonal time series using linear exponential smoothing.**
- **Use decomposition methods and Holt-Winters smoothing methods to forecast a seasonal time series.**
- **Use ARIMA models to forecast a time series.**
- **Use simple and multiple linear regression models to forecast a time series.**

Why should you care? - An Exploration of the Job Market [1]



Forecast Analyst
MAT Holdings, Inc ★★★☆☆ 72 reviews - Long Grove, IL 60047

Apply On Company Site

Job Description

This position is responsible for maintaining the monthly demand planning process (including both statistical and consensus / collaborative forecasting approaches). This individual will development and updates of the finished goods forecast. This person is responsible for contributing to the cross-functional S&OP team that includes sales, marketing, supply chain planning, customer service, distribution, and manufacturing.

Principle Responsibilities

- Validate demand data from multiple sources.
- Develop and maintain a monthly forecast for all finished goods parts using order and shipment history, customer point of sale data, market intelligence, and industry trends to inform the projected demand.
- Contribute to the monthly collaborative demand review as part of S&OP process.
- Work with sales, marketing, product management to understand product life cycles, demand patterns, and short, medium, and long-term forecasts.
- Analyze and develop insights on data from customer point of sales data systems as well as internal order management systems.
- Contribute to continuous improvement efforts to advance the demand planning and forecasting process capabilities.
- Maintain forecast vs. actual history data by customer, product family, channel, geography, and SKU.
- Maintain monthly forecast accuracy and forecast bias metrics.
- Maintain finished goods safety stock target levels for each distribution location

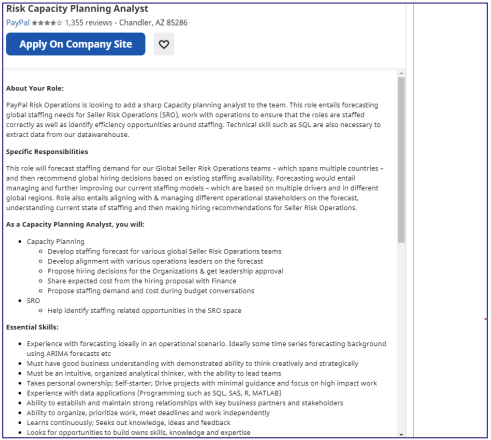
Qualifications

Competencies

- Knowledge and experience with enterprise planning software (e.g. SAP, JDA, Oracle, etc.)
- Experience using and interacting with MRP systems.
- Experience with forecasting methodologies, techniques, and approaches (e.g. moving averages, exponential smoothing, holt-winters, box-jenkins, discrete probability, etc.).
- Detail oriented and ability to organize work activities in highly ambiguous situations.
- Strong MS Office skills (i.e. Excel and Access).
- Advanced reporting, designing, and data analytic skills.
- Strong problem identification and analytical skills.
- Experience with process management skills.
- Collaborative and teaming skills.
- Action oriented.

Required qualifications for a *forecast analyst* position. Click on the image to open the ad.

Why should you care? - An Exploration of the Job Market [2]



Risk Capacity Planning Analyst

PayPal ★★★★☆ 1,355 reviews · Chandler, AZ 85286

Apply On Company Site

About Your Role:

PayPal Risk Operations is looking to add a sharp Capacity planning analyst to the team. This role entails forecasting global staffing needs for Seller Risk Operations (SRO), work with operations to ensure that the roles are staffed correctly as well as identify efficiency opportunities around staffing. Technical skill such as SQL are also necessary to extract data from our datawarehouse.

Specific Responsibilities

This role will forecast staffing demand for our Global Seller Risk Operations teams – which spans multiple countries – and then recommend global hiring decisions based on existing staffing availability. Forecasting would entail managing and further improving our current staffing models – which are based on multiple drivers and in different global regions. Role also entails aligning with & managing different operational stakeholders on the forecast, understanding current state of staffing and then making hiring recommendations for Seller Risk Operations.

As a Capacity Planning Analyst, you will:

- Capacity Planning
  - Develop staffing forecast for various global Seller Risk Operations teams
  - Develop alignment with various operations leaders on the forecast
  - Propose hiring decisions for the Organizations & get leadership approval
  - Share expected cost from the hiring proposal with Finance
  - Propose staffing demand and cost during budget conversations
- SRO
  - Help Identify staffing related opportunities in the SRO space

Essential Skills:

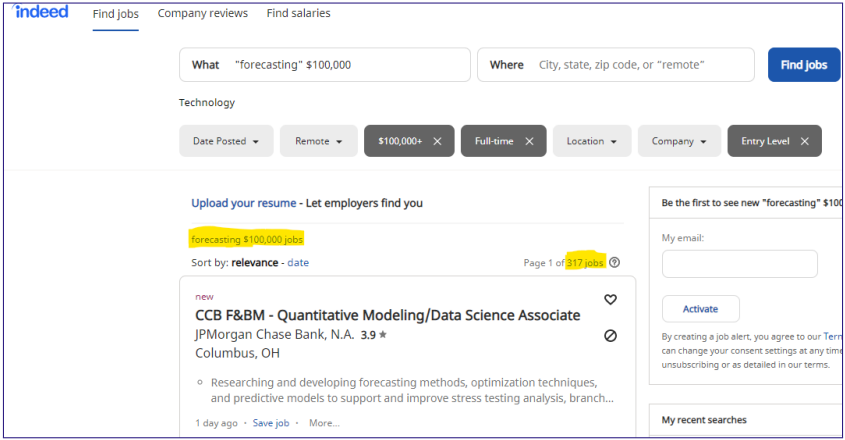
- Experience with forecasting Ideally in an operational scenario. Ideally some time series forecasting background using ARIMA forecasts etc
- Must have good business understanding with demonstrated ability to think creatively and strategically
- Must be an intuitive, organized analytical thinker, with the ability to lead teams
- Takes personal ownership; Self-starter; Drive projects with minimal guidance and focus on high impact work
- Experience with data applications (Programming such as SQL, SAS, R, MATLAB)
- Ability to establish and maintain strong relationships with key business partners and stakeholders
- Ability to organize, prioritize work, meet deadlines and work independently
- Learns continuously; Seeks out knowledge, Ideas and feedback
- Looks for opportunities to build owns skills, knowledge and expertise

Required qualifications for a *Risk Capacity Planning Analyst* at Paypal. Click on the image to open the ad.

Why should you care? - An Exploration of the Job Market [3]

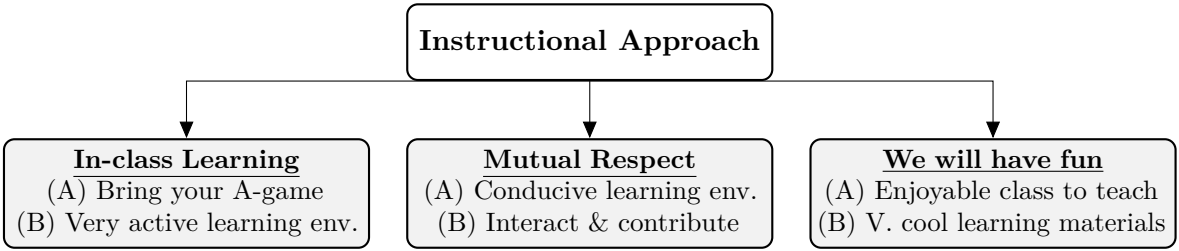
Required qualifications for a *Lead Business Intelligence Analyst* at Spectrum Health. Click on the image to open the ad.

Why should you care? - An Exploration of the Job Market [4]



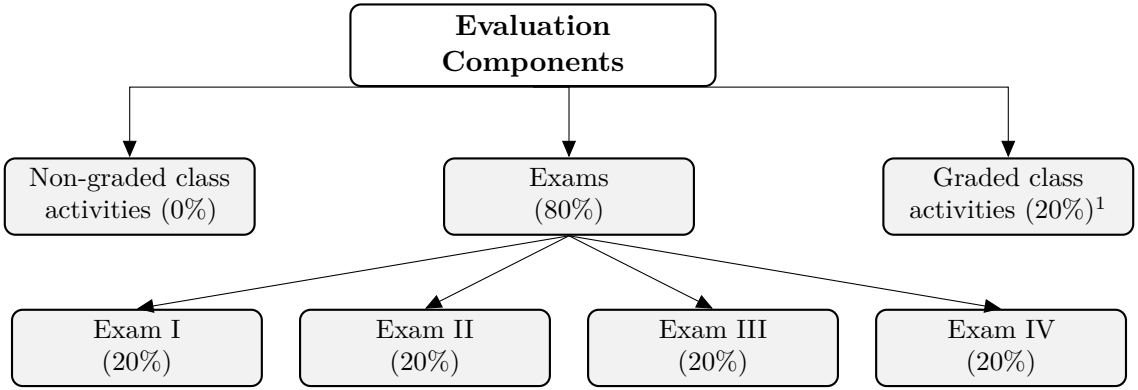
Number of full-time, entry-level, $100,000+ jobs on *Indeed.com*, with the term "forecasting" as of August 14, 2020. Click on the image to update the search.

Instructional Approach



An overview of the instructional approach for ISA 444.

How will I Evaluate your Learning?



An overview of the evaluation components for ISA 444.

[1]Note that I drop the lowest three graded class assignments/activities. We should have 20+ of these graded assignments/activities during the semester.

About Me - My Route to Miami University

Academic Experience

- **Application of Data-Driven Decisions (D^3) in 3 Continents.**
- **Interests: Health-care, logistics, occupational safety & portfolios.**
- **Partnered with: Aflac, Fatigue Science, JB Hunt, Maven Machines & Tennibot**

Journey with Data-Driven Decision (D^3) Making.

Your Academic Background Motivation for Taking this Class

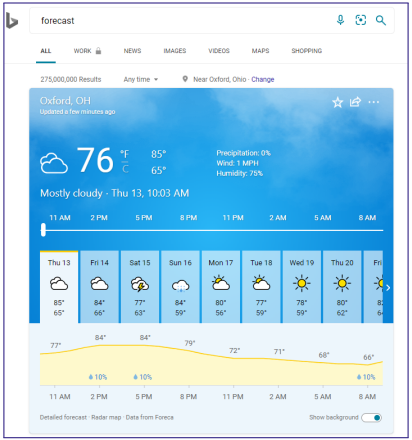
In-Class Poll:

Please use your phone, computer, or tablet and:

- **Go to https://www.menti.com/.**
- **Insert the code shown on my screen.**
- **Answer the two questions.**

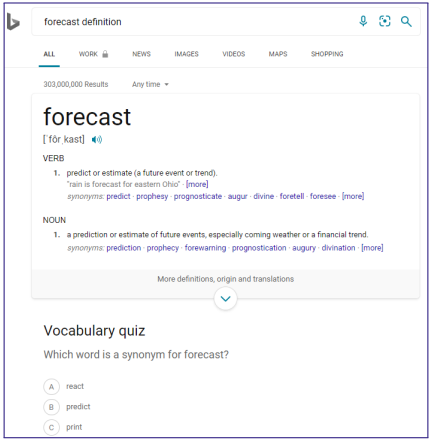
Outline

When I Searched for Forecast on the Web



People tend to link forecasting to the "weather" (at least that is what search engines think).

Definition – from Bing



The definition of the term "forecast" as obtained from Bing/Merriam-Webster.

Definition and Purpose

Forecast *is a prediction or estimate of an actual outcome expected in a future time period or for another situation.*[2]

- *The purpose of forecasting is to inform the process of planning.*
- *The purpose of planning is to develop a course of action so that things don't "just continue" based on a no-change forecast.*

[2]The definition and purpose provided in this slide are from: Ord, K., Fildes, R., & Kourentzes, N. (2017). Principles of Business Forecasting (2nd ed., p. 3). Wessex Press Inc.

Working Definitions – From Prof. Jones-Farmer

Forecasting

The process of predicting a future event. The objective of most time series analyses is to provide forecasts of future values of the time series.

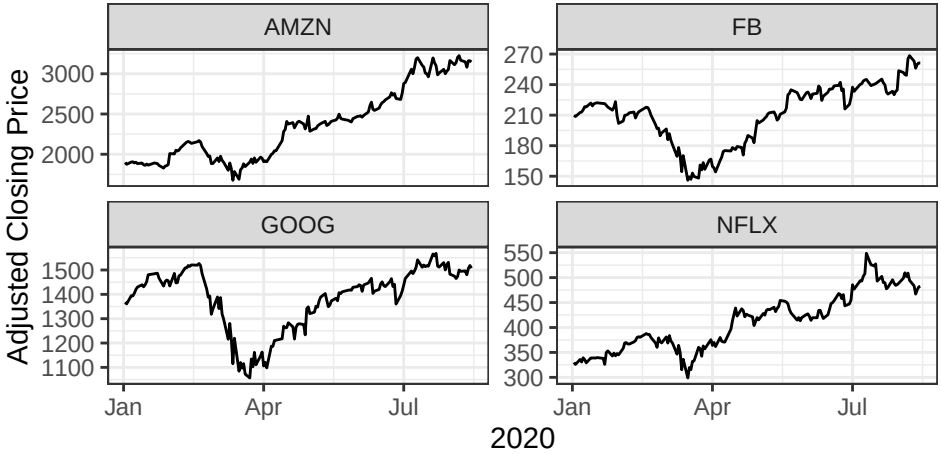
Time Series

A time series is a sequence of observations on a variable measured at successive points in time or over successive periods of time. In the simplest cases, observations are evenly spaced at regular intervals such as hourly, daily, weekly, monthly, or yearly, or at any other regular interval.[3]

[3] Both definitions are based on Dr. Allison Jones-Farmer's lecture notes, Miami University, Spring 2020.

The FAANG (- AAPL) Time Series Data - an R Exercise [1]

Let us get and generate the time series below. **I promised this class will be fun!!!**



COVID-19 did not have any long-lasting effects on Tech stocks.

The FAANG (- AAPL) Time Series Data - an R Exercise [2]

We can actually quantify my statement in green from the previous slide by computing the percent change in each of the four stock prices when compared to January 2, 2020. This can be done as follows: (see live coding session in class).[4]

```
## The percent changes (from January 2, 2020) in the AMZN, FB, GOOG and NFLX
##  stocks are: 66.6%, 23.9%, 10.2%, and 44.2%, respectively.
```

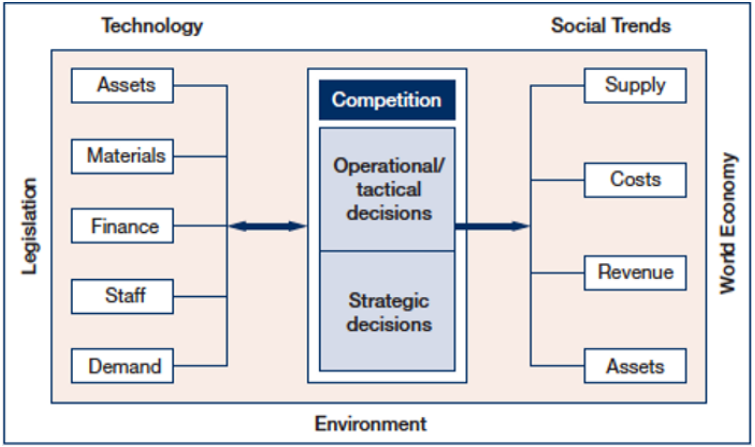
[4] The printed numbers from my computations had a current date of August 14, 2020. Thus, the numbers will change (slightly) unless we use the same ending date for our calculations.

Why do we Forecast? – A Conceptual Framework (PIVASE)[5]

- **Purpose:** What do we hope to achieve by generating the forecast? That is, what plans are dependent upon the results of the forecasting exercise? How far ahead do we wish to forecast? We refer to this period as the forecasting horizon.
- **Information:** What do we know that may help us in forecasting. And when will we know it? Detailed data is only useful if it is available in timely fashion.
- **Value:** How valuable is the forecast? What would you pay for perfect knowledge?
- **Analysis:** From analyzing the data can we develop a model that captures its characteristics? And how does it perform on new (hold-out sample) data?
- **System:** What models and software are needed to meet the needs of the organization?
- **Evaluation:** How do we know whether a particular forecasting exercise was effective and what the potential is for improvement?

[4]From: Ord, K., Fildes, R., & Kourentzes, N. (2017). Principles of Business Forecasting (2nd ed., p. 3-6).

Why do Businesses Forecast?



Some of the typical forecasting needs of many organizations.[6]

[6] From: Ord, K., Fildes, R., & Kourentzes, N. (2017). Principles of Business Forecasting (2nd ed., p. 7).

Outline

Cross Sectional Data [1]

Cross Sectional Data: Measurements on multiple units, recorded in a single time period.

Example 1: H1B 2020 Data for Senior Data Scientists at Netflix[7]

EMPLOYER	JOB TITLE	BASE SALARY	LOCATION
NETFLIX INC	SENIOR DATA SCIENTIST	375,000	LOS GATOS, CALIFORNIA
NETFLIX INC	SENIOR DATA SCIENTIST	400,000	LOS GATOS, CALIFORNIA
NETFLIX INC	SENIOR DATA SCIENTIST	420,000	LOS GATOS, CALIFORNIA
NETFLIX INC	SENIOR DATA SCIENTIST	420,000	LOS GATOS, CALIFORNIA
NETFLIX INC	SENIOR DATA SCIENTIST	450,000	LOS GATOS, CALIFORNIA
NETFLIX INC	SENIOR DATA SCIENTIST	600,000	LOS GATOS, CALIFORNIA

[7] Data scraped from https://h1bdata.info/index.php?em=NETFLIX+INC&job=SENIOR+DATA+SCIENTIST&city=LOS+GATOS&year=2020 on August 14, 2020 using the rvest package in R. The printing was limited to those individuals who started on/after January 01, 2020, with the filters specified in the URL.

Cross Sectional Data [2]

Cross Sectional Data: Measurements on multiple units, recorded in a single time period.

Example 2: Heart Disease Dataset[8]

age	sex	restingBP	maxHR	label
60.00	1.00	130.00	132.00	2
63.00	0.00	108.00	169.00	2
59.00	1.00	178.00	145.00	1
57.00	1.00	152.00	88.00	2
60.00	0.00	158.00	161.00	2
52.00	1.00	125.00	168.00	2
45.00	1.00	128.00	170.00	1
51.00	1.00	140.00	122.00	2
58.00	1.00	140.00	165.00	1
51.00	1.00	100.00	143.00	1
65.00	0.00	160.00	151.00	1
57.00	0.00	120.00	163.00	1
66.00	0.00	178.00	165.00	2

[8] Data sampled from this UCI Machine Learning Repository.

Cross Sectional Data [3]

Cross Sectional Data: Measurements on multiple units, recorded in a single time period.

Example 3: NBA 2019-2020 Leaders - Top 12 in PTS/Game[9]

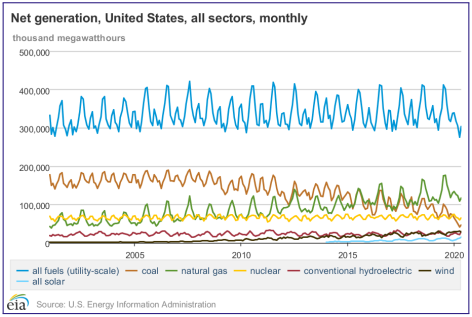
Player	Pos	Age	Tm	G	FG	FG%	eFG%	PTS
James Harden	SG	30	HOU	68	9.9	.444	.543	34.30
Bradley Beal	SG	26	WAS	57	10.4	.455	.520	30.50
Damian Lillard	PG	29	POR	66	9.5	.463	.563	30.00
Trae Young	PG	21	ATL	60	9.1	.437	.519	29.60
Giannis Antetokounmpo	PF	25	MIL	63	10.9	.553	.589	29.50
Luka Doncic	PG	20	DAL	61	9.5	.463	.531	28.80
Kyrie Irving	PG	27	BRK	20	10.0	.478	.546	27.40
Russell Westbrook	PG	31	HOU	57	10.6	.472	.493	27.20
Kawhi Leonard	SF	28	LAC	57	9.3	.470	.524	27.10
Devin Booker	SG	23	PHO	70	9.0	.489	.544	26.60
Karl-Anthony Towns	C	24	MIN	35	9.0	.508	.600	26.50
Anthony Davis	PF	26	LAL	62	8.9	.503	.536	26.10

[9]Data scraped from Basketball-Reference on August 14, 2020 using the rvest package in R. The printing with limited to the top 12 players and the selected variables.

Time Series Data [1]

Time Series Data: Comparable measurements recorded on a single (or a few) variables over time (usually a long period of time).

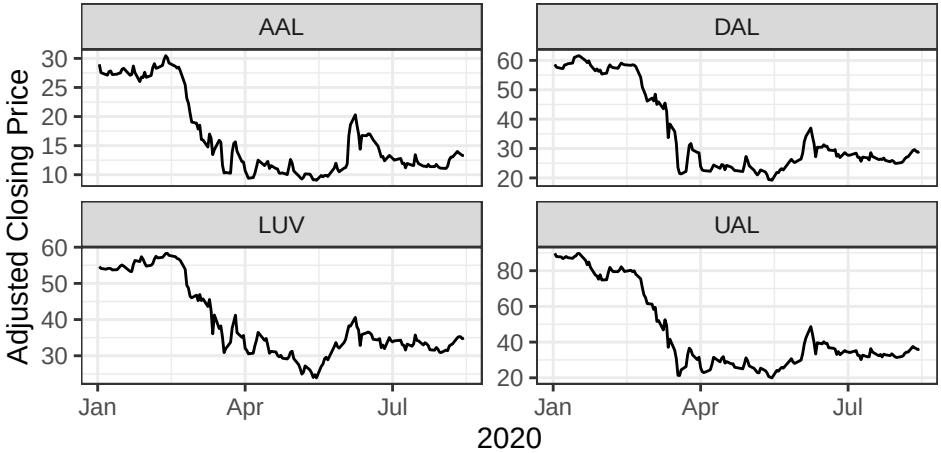
Example 1: Net Power Generation in the U.S.



Net monthly electricity generation in the U.S. from the U.S. Energy Information Adminstration.

Time Series Data [2]

Example 2: Stock prices of U.S. Airlines



As of August 14, 2020: COVID-19 had a substantial impact on these airline stocks.

Panel Data

Panel Data: Cross sectional measurements (usually many variable) repeated over time (usually over a few time periods).

Example: World Bank's Data[10]

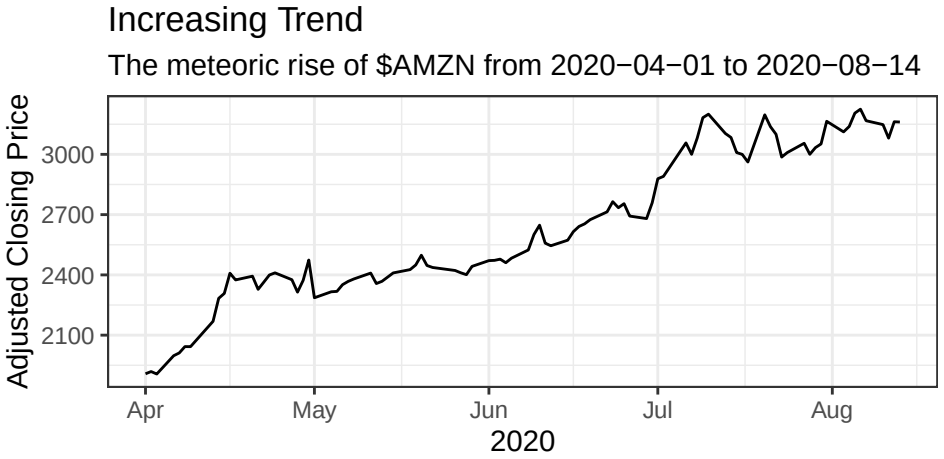
iso3c	date	NY.GDP.MKTP.KD.ZG	SH.DYN.NMRT	SH.HIV.INCD.ZS	SH.MED.BEDS.ZS	SH.MED.PHYS.ZS	SH
CHN	2017.00	6.95	4.60			1.98	
CHN	2018.00	6.75	4.30			1.98	
CHN	2019.00	6.11	4.30			1.98	
EGY	2017.00	4.18	11.60	0.06	1.60	0.80	
EGY	2018.00	5.31	11.20	0.06		0.45	
EGY	2019.00	5.56	11.20	0.06		0.45	
USA	2017.00	2.22	3.60			2.61	
USA	2018.00	3.18	3.50			2.61	
USA	2019.00	2.33	3.50			2.61	

[10] Data queried from the World Bank Data Catalog using the wbstats package in R. The printed results show a snapshot of 7 variables (out of a much larger panel dataset). You can think of panel data as a cross-sectional dataset with a longitudinal/time component.

Outline

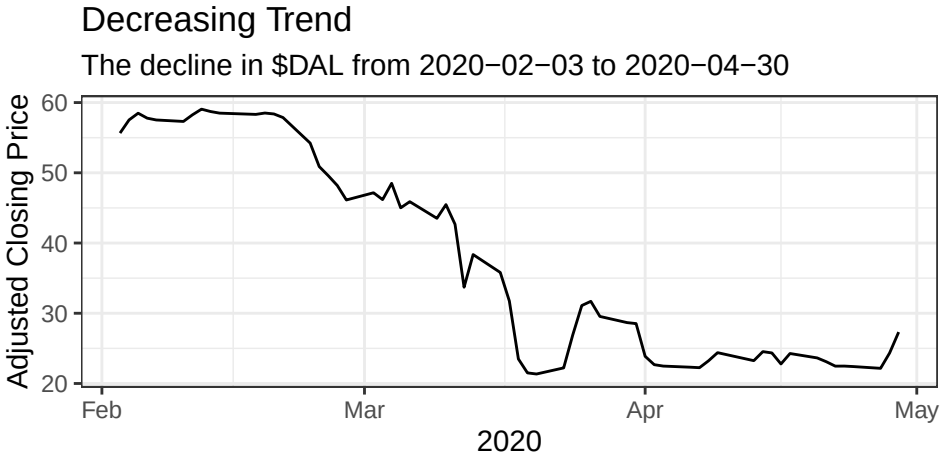
Trend [1]

A **trend** is an increasing or decreasing pattern over time.



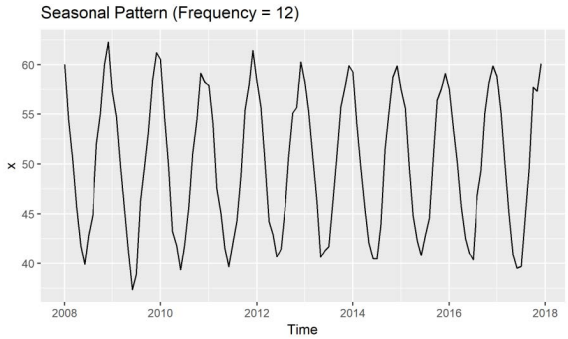
Trend [2]

A **trend** is an increasing or decreasing pattern over time.



Seasonality [1]

Seasonality refers to the property of a time series that displays REGULAR patterns that repeat at a constant frequency (m).

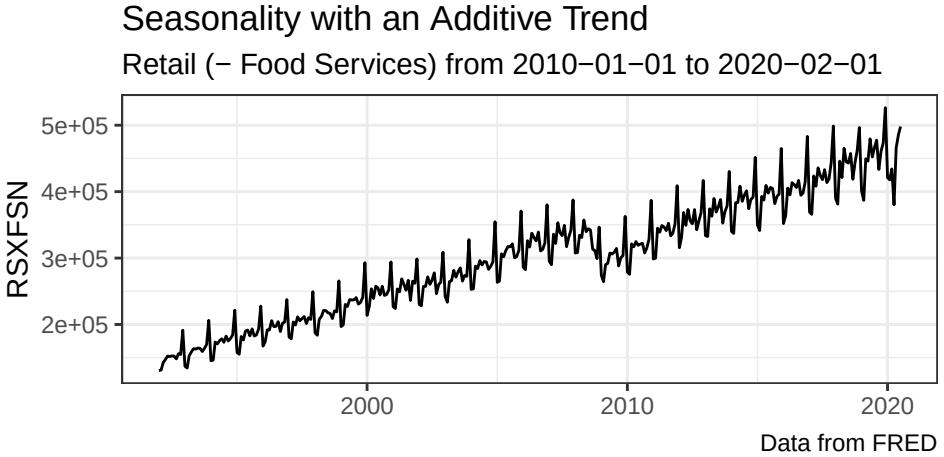


A time series with a monthly seasonal pattern.[11]

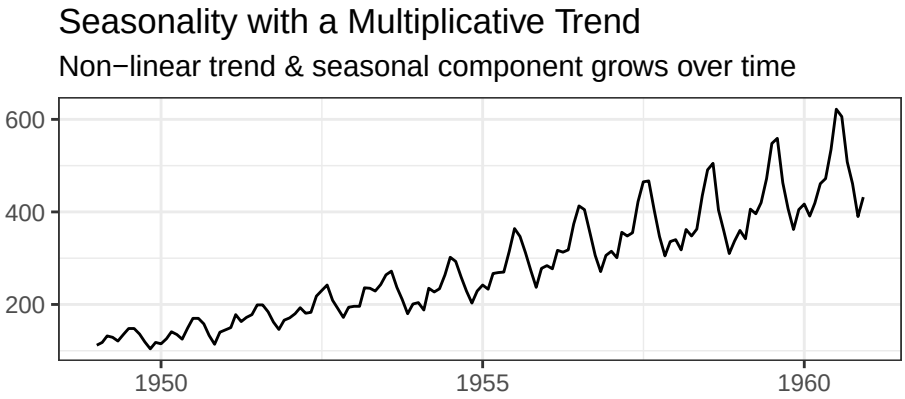
[11] Figure is from Dr. Allison Jones-Farmer's lecture notes, Miami University, Spring 2020.

Seasonality [2]

Seasonality refers to the property of a time series that displays REGULAR patterns that repeat at a constant frequency (m).



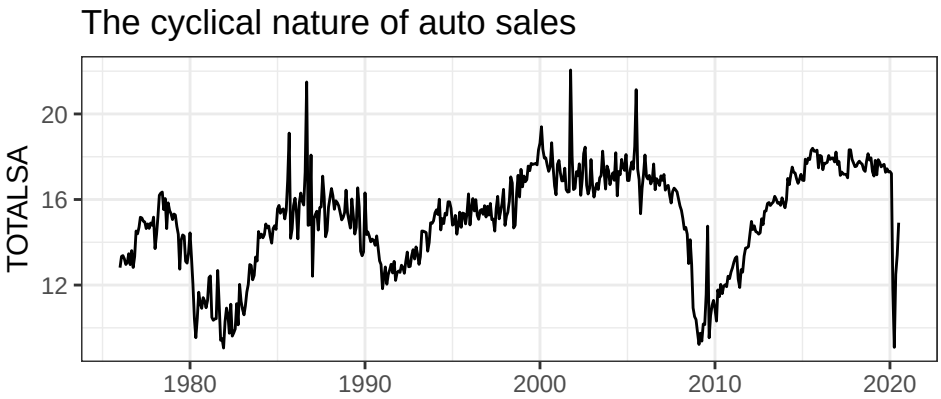
Seasonality [3]



AirPassengers R Dataset −− Source: Box, G. E. P., Jenkins, G. M. and Reinsel, G. C. (1976) Time Series Analysis, Forecasting and Control.

Cycle [1]

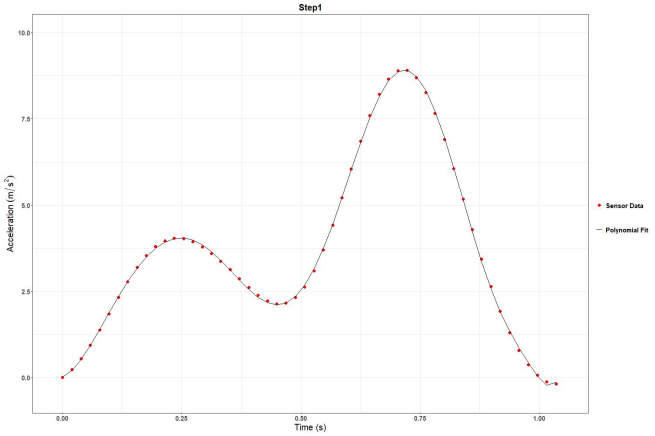
Cyclical fluctuations are somewhat irregular (unknown duration).



Total Vehicle Sales [TOTALSA], retrieved from FRED, Federal Reserve Bank of St. Louis https://fred.stlouisfed.org/series/TOTALSA, August 14, 2020.

Cycle [2]

Cyclical fluctuations are somewhat irregular (unknown duration).



A gait "cycle" from an IMU attached to the ankle. Joint work with the University at Buffalo.

Outline

Summary of Main Points

Main Learning Outcomes

- **Describe course objectives & structure.**
- **Describe what do we mean by forecasting and explain the PIVASE framework.**
- **Explain the differences between cross sectional, time series, and panel datasets.**
- **Identify and describe the basic components of a time series including trends, seasonal components, and cycles.**

Things to Do

- Thoroughly read Chapter 1 of our book, which can be downloaded from the Publisher (if you have not gotten your book yet).
- Go through the slides, examples and make sure you have a good understanding of what we have covered.
- Complete the graded assignment (refer to our next slide or Canvas) for more details.

Graded Assignment: Evaluating your Retention/Focus

Please go to Canvas (click here) and answer the four questions. **Due August 21, 2020 [11:59 PM, Ohio local time].**

What/Why/Prep? The purpose of this assignment is to evaluate your understanding and retention of the material covered in Class 01. In order to prepare for this, you should have either actively attended class and/or watched the recording from WebEx.

General Guidelines:

- Individual assignment.
- This is a timed assignment (i.e. once you start the assignment you will have 25 minutes to complete 4 questions). The purpose of the time limit is to help you evaluate how much you have retained/understood from class. If the concepts we covered today are well-understood, this should take 10-15 minutes.
- Proctorio is NOT required for this assignment.
- You will need to have R installed (or accessible through the Remote Desktop)

ISA 444: Business Forecasting

01 - Course Overview, Introductions and an Overview of Forecasting

Fadel M. Megahed

Associate Professor
Department of Information Systems and Analytics
Farmer School of Business
Miami University
Email: fmegahed@miamioh.edu
Office Hours: Click here to schedule an appointment

Fall 2020