Week 2: Data Wrangling

Video 2.1: Pre-processing Data in Python

Data pre-processing

- the process of converting or mapping data from initial "raw" form into another format, in order to prepare the data for further analysis
- Often known as data cleaning, data wrangling

Learning Objectives:

- Identify and handle missing values
- Data formatting: pandas
- Data normalization (centering/scaling)
- Data Binning
- Turning Categorical values to numernic variables

Simple Dataframe Operations

```
import pandas as pd

# access column
df["column-name"]

# assign to variable
column1 = df["column-name"]

# manipulate values of whole column (ex: +1 all values)
df["column-name"] = df["column-name"]+1
```

Video 2.2: Dealing with Missing Values in Python

Missing Values

- What is a missing value?
- Missing values occue when no data value is stored for a variable (feature) in an observation
- Could be represented as:
    - "?"
    - "N/A"
    - 0
    - a blank cell
    - NaN

How to deal with missing data?

- Check with the data collection source
- check if you can retrieve the missing values
- maybe just remove the data where the missing value is found
    - drop the variable entirely
    - drop the individual entry
- replace the missing values
    - replace it with an average (of similar datapoints)
    - replace it by frequency
    - replace it based on other funtions (if the data scientist knows something additional about the missing data)
- Leave it as missing data

Dealing with missing categorical data

- Replace with mode (the value that appears most often in column)

How to drop missing values in Python (pandas)

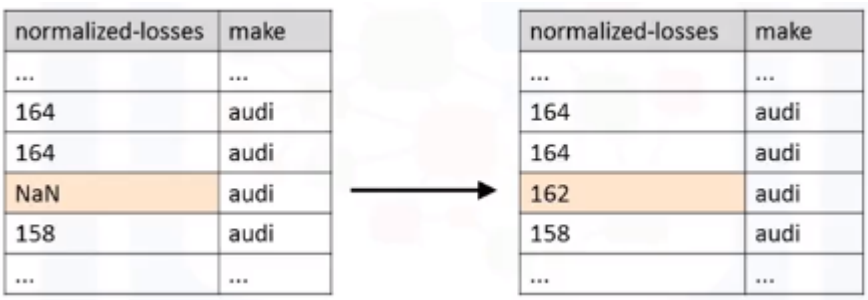
- Use df.dropna()

highway-mpg	price
...	...
20	23875
22	NaN
29	16430
...	...

```
# drop the entire row
df.dropna(axis=0)

# drop the entire column
df.dropna(axis=1)

# drop the NaN in price
df.dropna(subset=["price"], axis=0, inplace=True)

#or

df = df.dropna(subset=["price"], axis=0)
```

How to replace missing values in Python

- use df.replace(missing_value, new_value)

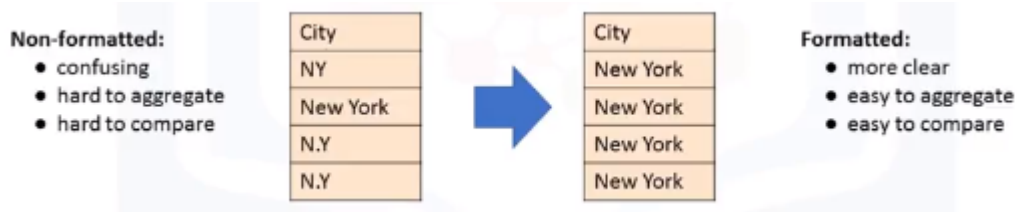



```
#set a mean
mean = df["normalized-losses"].mean()

#replace
df["normalized-losses"].replace(np.nan, mean)
```

Video 2.3: Data Formatting in Python

Data Formatting

- Data are usually collected from different places and sorted in different formats
- Bringing data into a common standard of expression allows users to make meaningful comparison



Applying calculations to an entire column

- Convert "mpg" to "L/100km" in Car dataset

```
# convert entire column (ex: mpg to L/100km)
df["city-mpg"]= 235/df["city-mpg"]

#rename
df.rename(columns=("city-mpg", "city-L/100km"), inplace=True)
```

Incorrect Data Types

- Sometimes the wrong data type is assigned to a feature

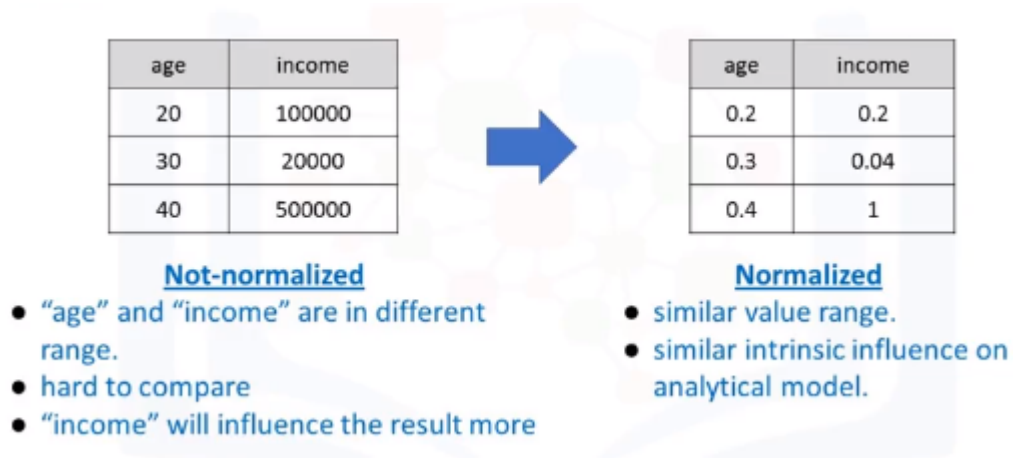
```
# To identify data types
df.dtypes()
```

```
# to convert data types
df.astype()

df["price"] = df["price"].astype("int")
```

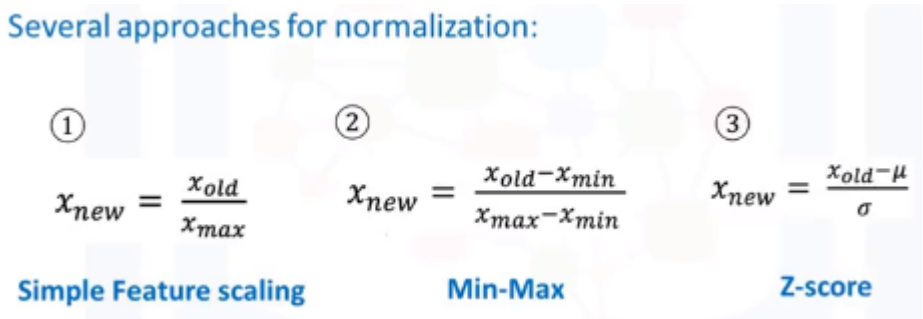
Video 2.4: Data Normalization in Python

Data Normaliztion

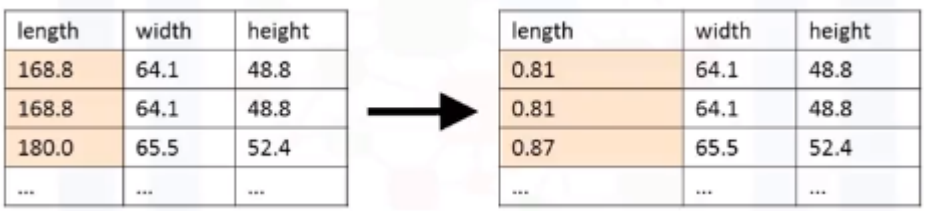
- Uniform the features value with different range
- normalization makes the range of the values consistens, which may make statistical analyses easier down the road



Methods of normalizing data



Simple feature scaling in Python



length	width	height
168.8	64.1	48.8
168.8	64.1	48.8
180.0	65.5	52.4
...	...	...

length	width	height
0.81	64.1	48.8
0.81	64.1	48.8
0.87	65.5	52.4
...	...	...

```
# divide max value
df["length"] = df["length"]/df["length"].max()
```

Min-max in Python

length	width	height
168.8	64.1	48.8
168.8	64.1	48.8
180.0	65.5	52.4
...	...	...

→

length	width	height
0.41	64.1	48.8
0.41	64.1	48.8
0.58	65.5	52.4
...	...	...

```
df["length"] = (df["length"]-df["length"].min())/(df["length"].max()-
df["length"].min())
```

Z-score

length	width	height
168.8	64.1	48.8
168.8	64.1	48.8
180.0	65.5	52.4
...	...	...

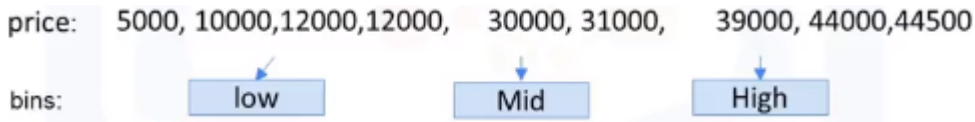
→

length	width	height
-0.034	64.1	48.8
-0.034	64.1	48.8
0.039	65.5	52.4
...	...	...

```
df["length"] = (df["length"]-df["length"].mean())/df["length"].std()
```

Video 2.5: Binning in Python

- Binning: grouping of values into "bins"
- Converts numeric into categorical variables
- Group a set of numerical values into a set of "bins"
- ex: "price" is in a feature range from 5000 ti 45500, he wants to have a better representation of price



Binning in Python

price
13495
16500
18920
41315
5151
6295
...

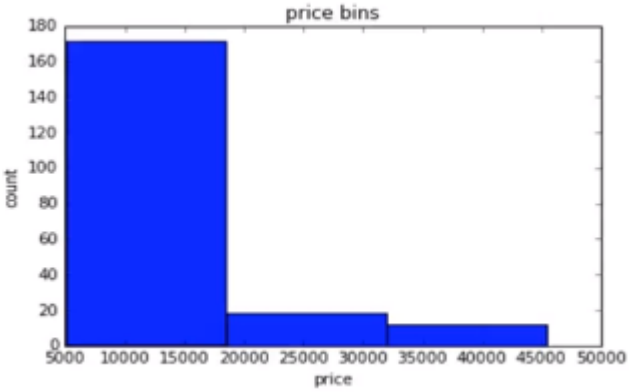
→

price	price-binned
13495	Low
16500	Low
18920	Medium
41315	High
5151	Low
6295	Low
...	...

```
binwidth = int((max(df["price"])-min(df["price"]))/4)

bins = range(min(df["price"]), max(df["price"]), binwidth)

group_names = ['Low','Med','High']
```

```
df['price']= pd.cut(df['price'], bins, labels=group_names)
```

Visualizing binned data



Video 2.6: Turning Categorical Variables into quantitative variables in Python

Categorical Variables

- Problem:
- Most Statistical models cannot take in the objects/strings as input
- "One-hot encoding"

Car	Fuel	...	gas	diesel
A	gas	...	1	0
B	diesel	...	0	1
C	gas	...	1	0
D	gas	...	1	0

Dummy variables in Python pandas

- Use pandas.get_dummies() method
- Convert categorical variables to dummy variables (0 or 1)

```
pd.get_dummies(df['fuel'])
```