Data Preparation

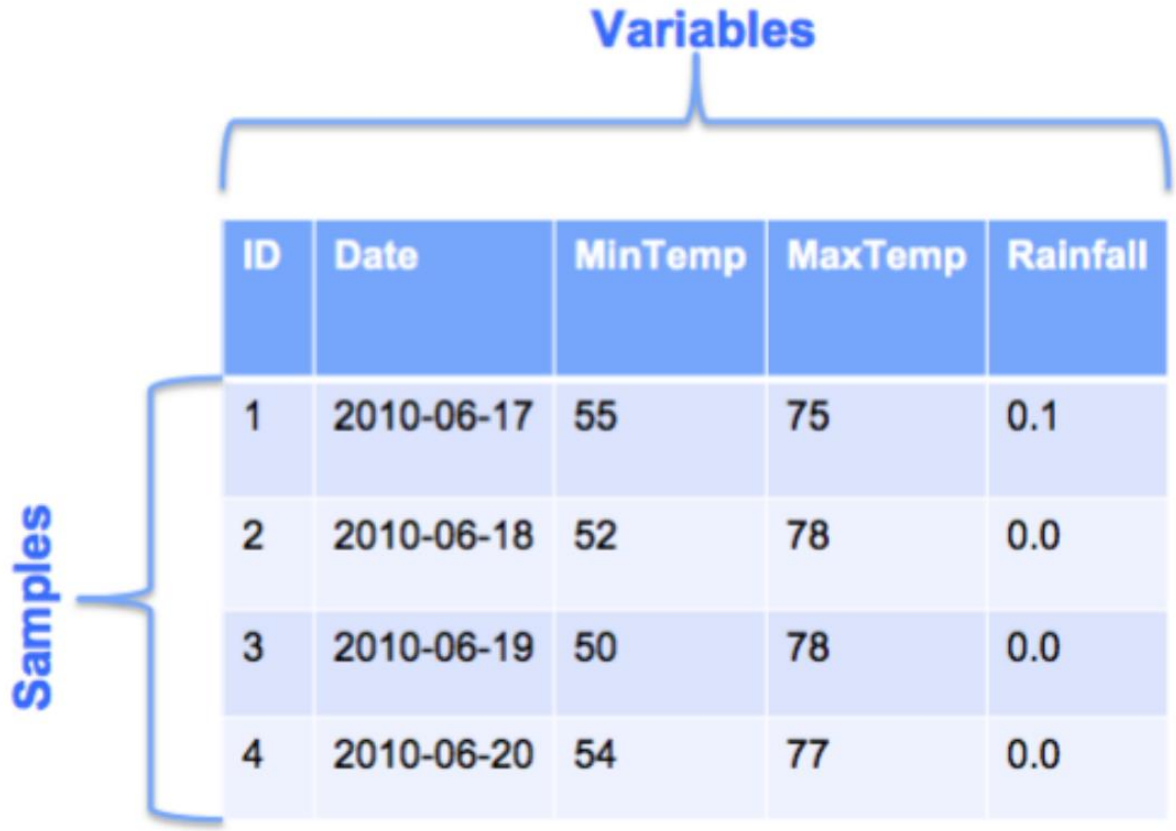
Get to Know about data

How would it be arranged for analytics?

What is the data format?

Data table

- Same terminology
  - **Sample**
    - Row
    - Instance
    - Record
    - Observation
    - Example
  - **Variables**
    - Features
    - Attribute
    - Field
    - Column
    - Dimension



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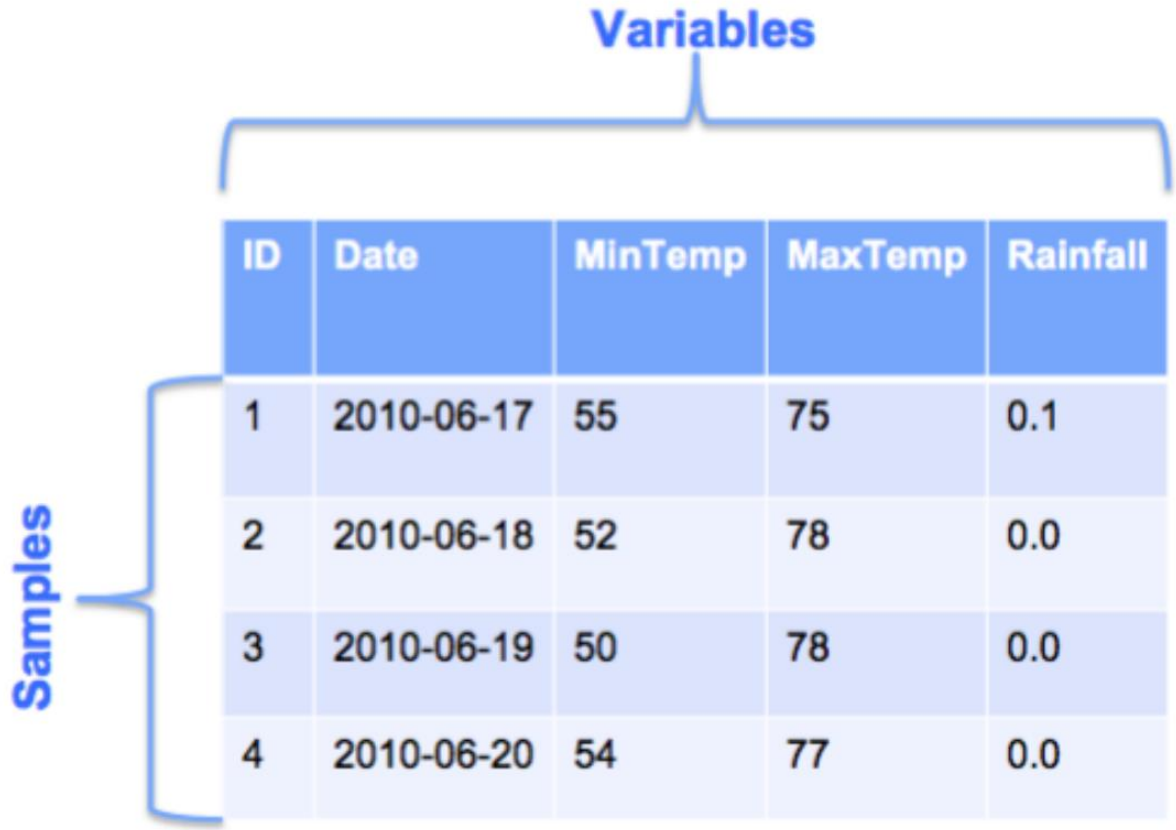
Variable types

- **DATE**
- **String**
- **Categorical data**
  - Color
  - Gender
  - Product Category
- **Number**
  - Temperature
  - Rainfall
  - Height
  - Age



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Get to Know about data

Will data be in perfect form?

Is there any missing or errorless data?

What's wrong?

ID	Date	MinTemp	MaxTemp	Rainfall
1	2010-06-17	56	24	0.1
2	2016-06-18	52	26	3,678.9
3	2010-06-19	50	26	0.0
4	2010-06-20	54	25	0.0

ID	Date	MinTemp	MaxTemp	Rainfall
1	2010-06-17	56	75	--
2	2016-06-18	52	78	--
3	2010-06-19	--	78	0.1
4	2010-06-20	54	77	--

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What's wrong?

- **Incomplete Data**
  - **Missing Data**
  - **Duplicate Data**
  - **Different measure**
  - **Different scaling**
  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Address
Angela	430 Park Drive
Sidney	7800 West View Street
Sid	7800 West View Street
Ratan	12443 Mountain Avenue
Kiril	45 East 5th St
Kiril	1220 Mill Avenue
Zhou	4345 Apple Lane

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What's wrong?

- **Incomplete Data**
  - **Missing Data**
  - **Duplicate Data**
  - **Different measure**
  - **Different scaling**
  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Zip Code
Angela	346412
Sidney	92618
Ratan	8033A
Kiril	11012
Zhou	59285

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Data Cleaning

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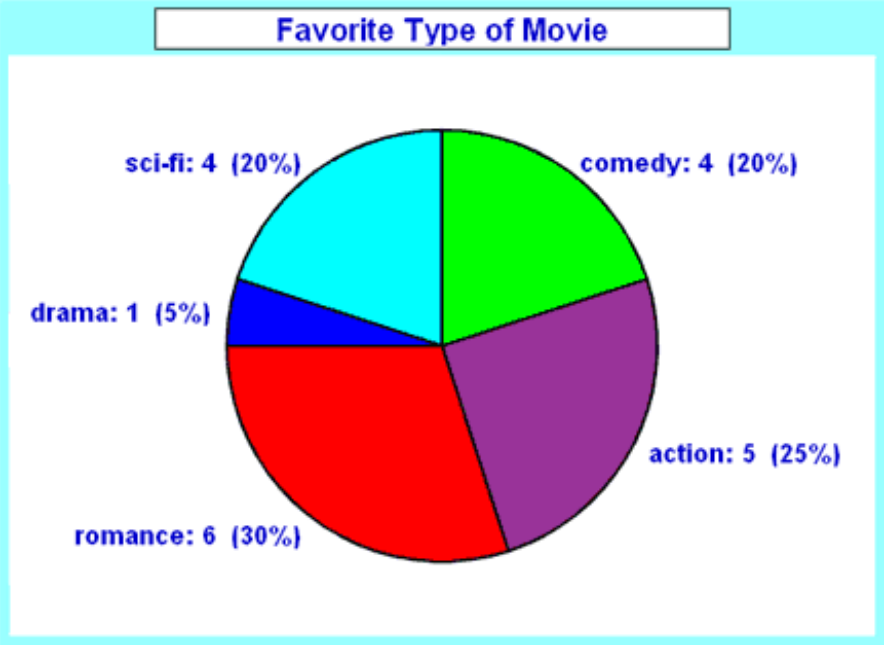
Data visualization

How would we visualize the data?

Is the data perfect or noisy?

Visualize data

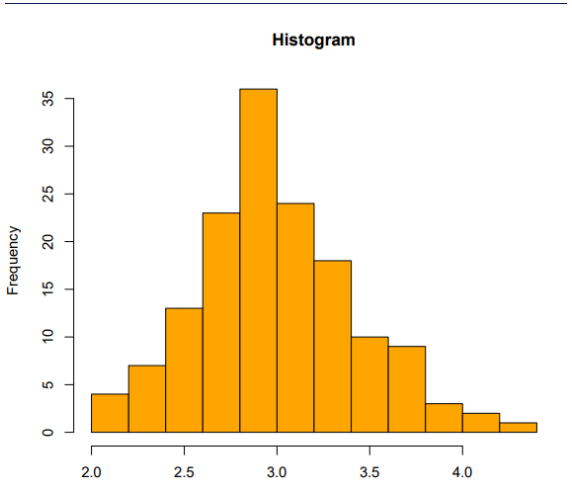
- **Pie Plot**
  - represent the percentage share of different categories
    - implicit and assumed that the category is exhaustive

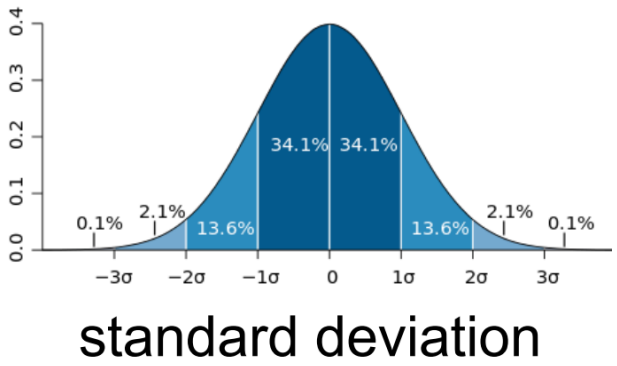


- **Bar Plot**
  - category vs the count or percentage of each category
    - Show top category

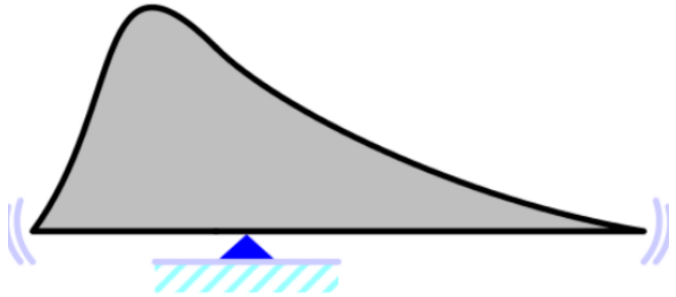
Visualize data

- **Statistical View**
  - Histogram
    - Distribution of Data
    - Probability
    - Statistical values
      - Mean
      - Standard deviation

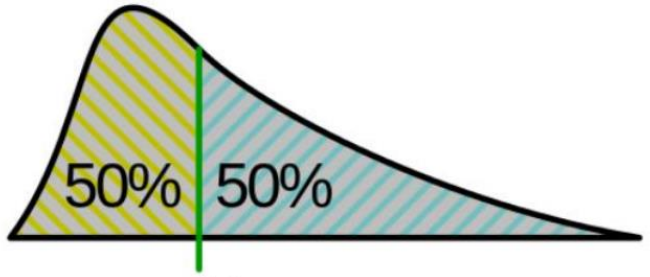




standard deviation



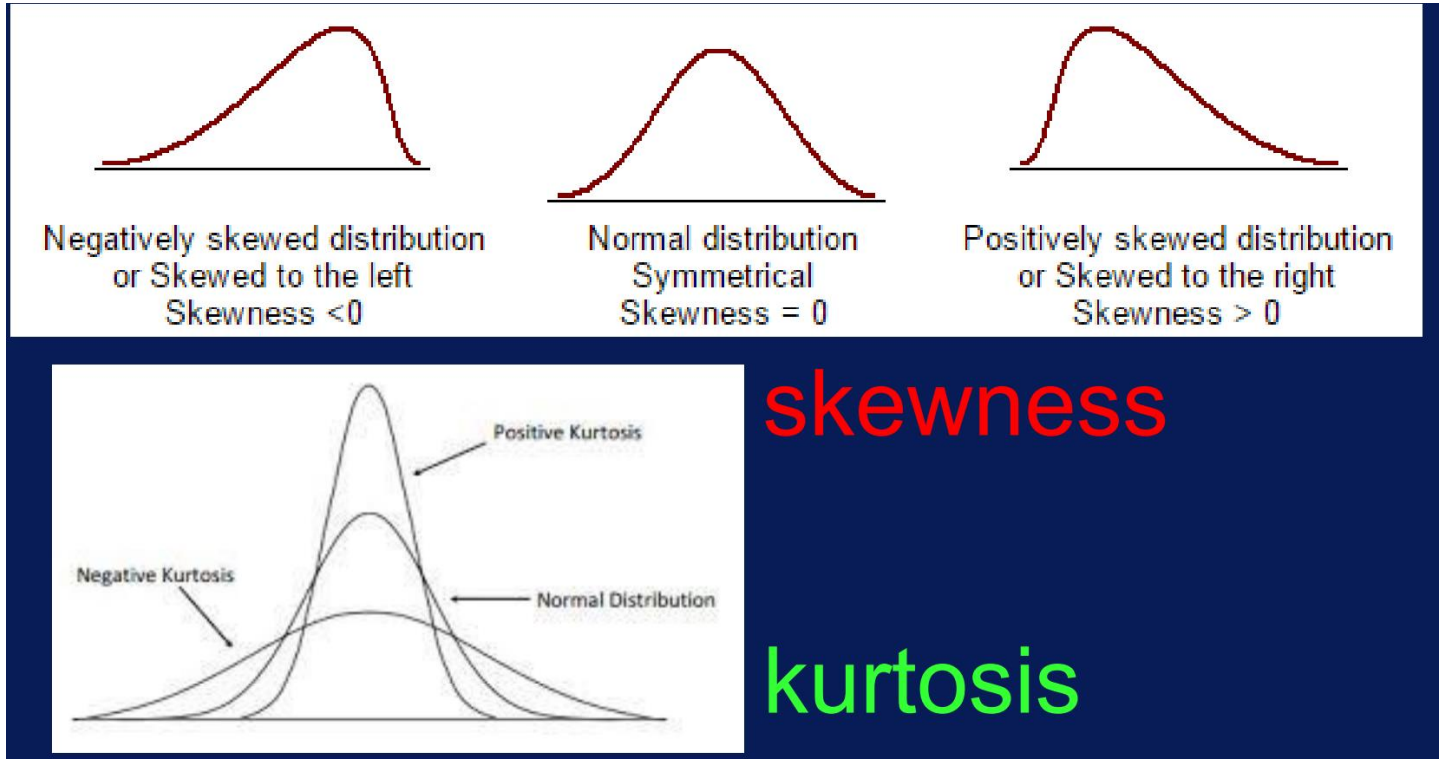
mean



median

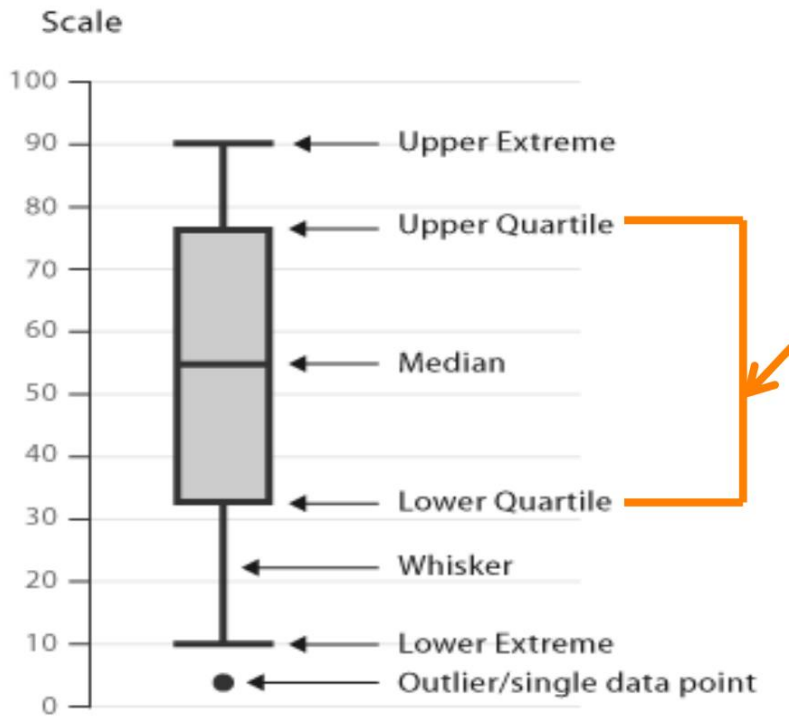
Visualize data

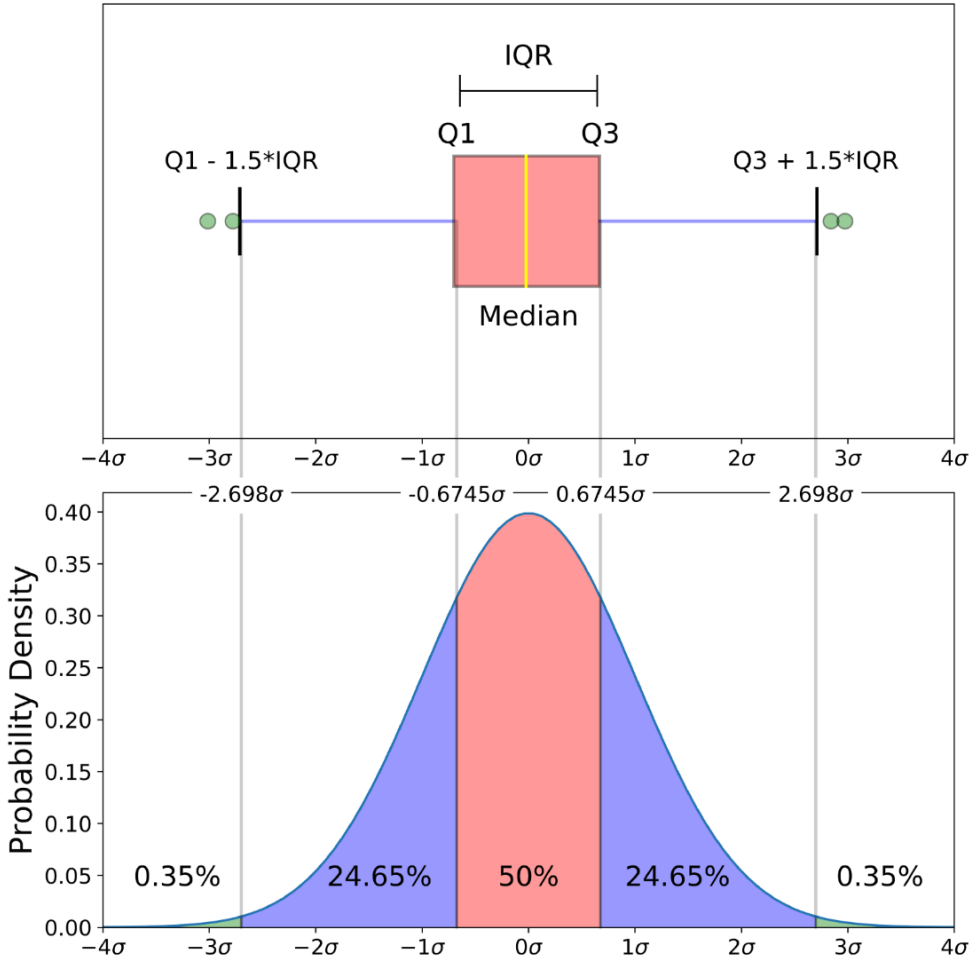
- **Statistical View**
  - **Histogram**
    - Distribution of Data
    - Probability
    - Statistical values
      - Skewness
      - kurtosis



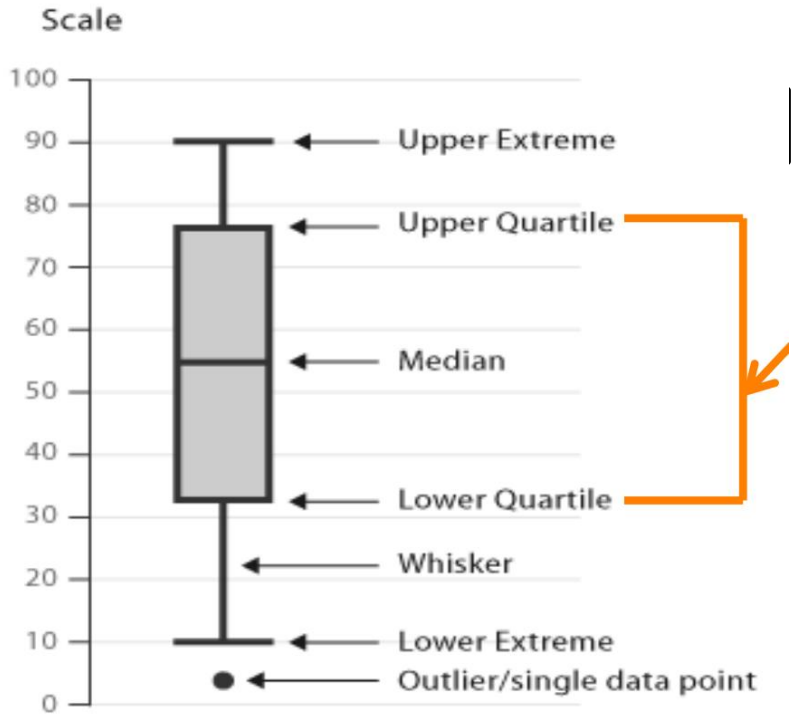
Visualize data

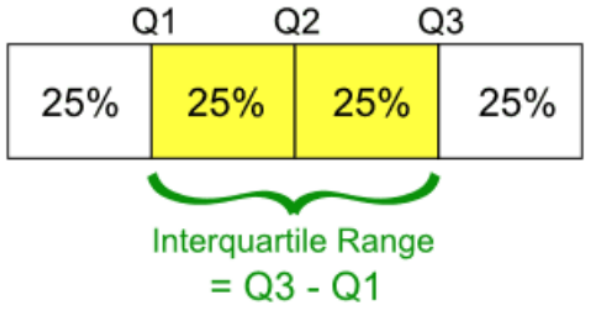
- **Box Plot**
  - Distribution of data



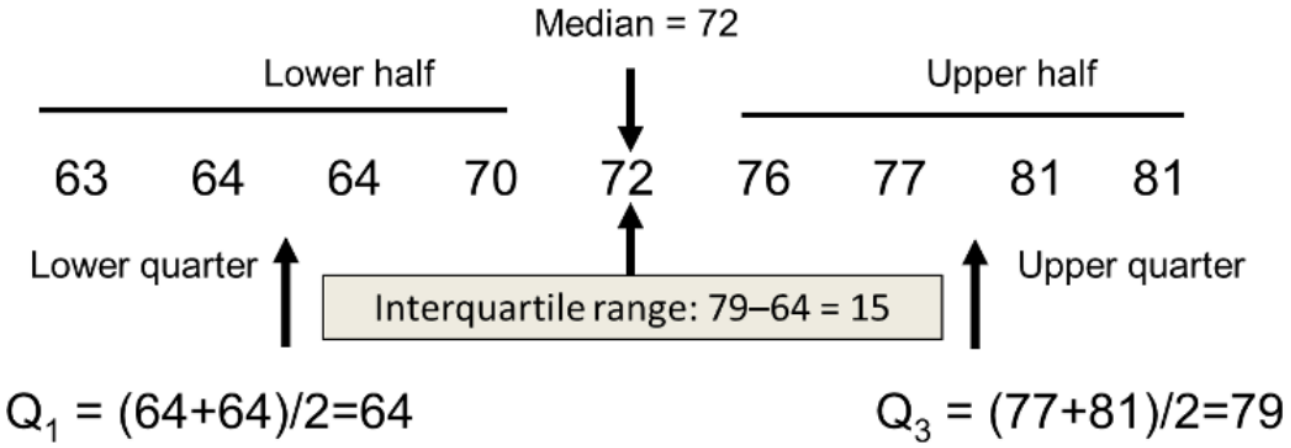


alize data



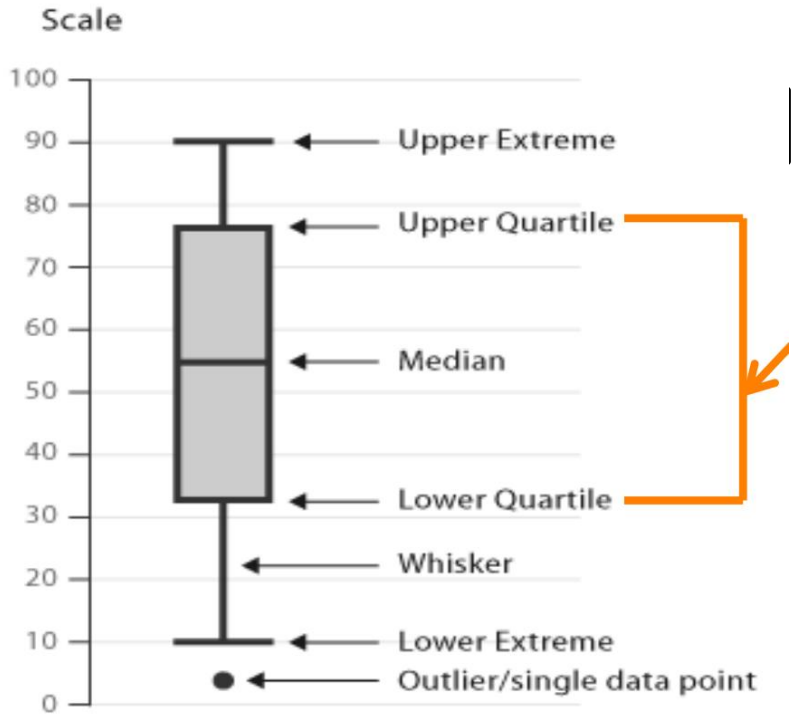


- **Relationship of box plot vs distribution of data**

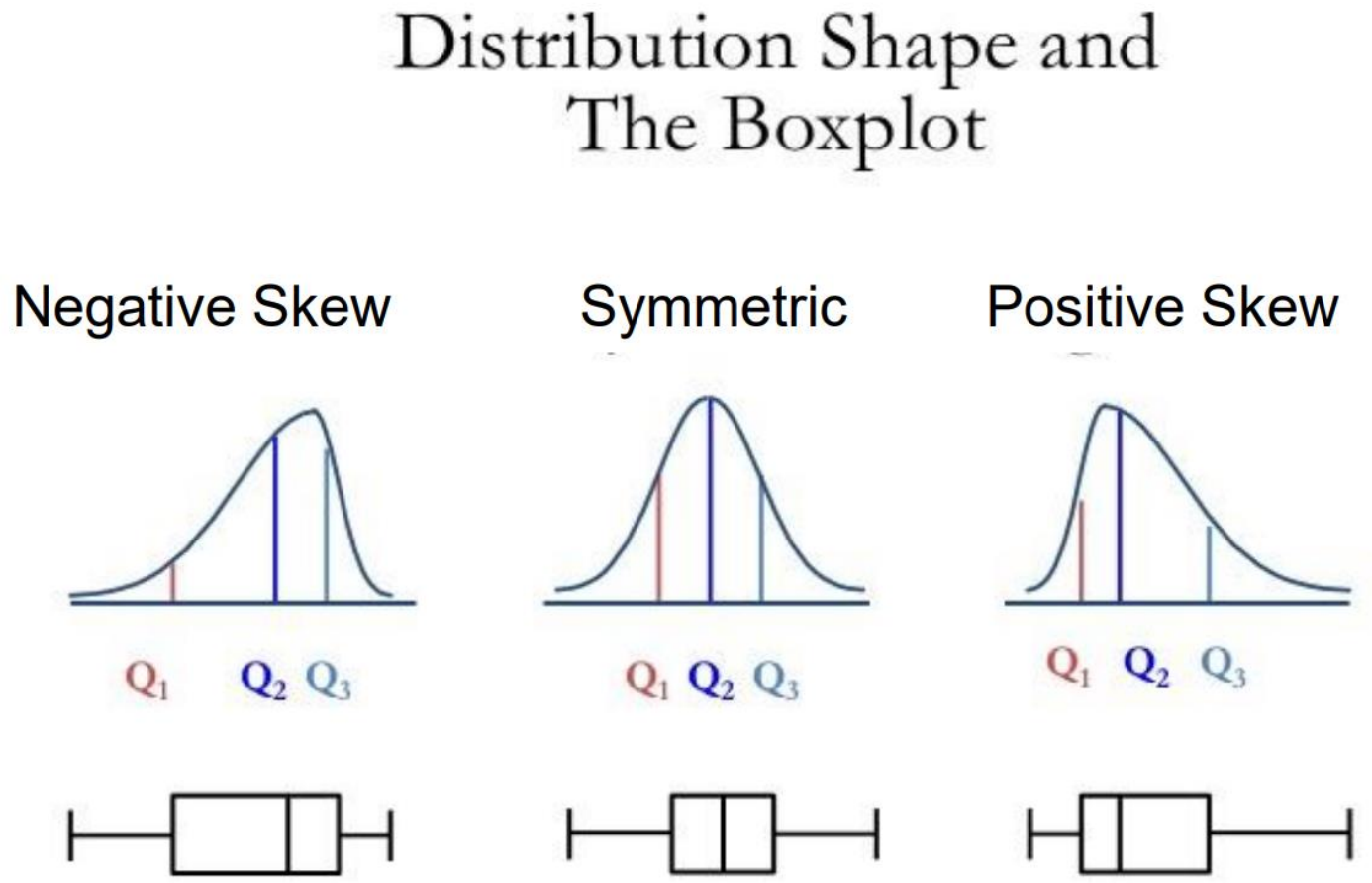


https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf

alize data



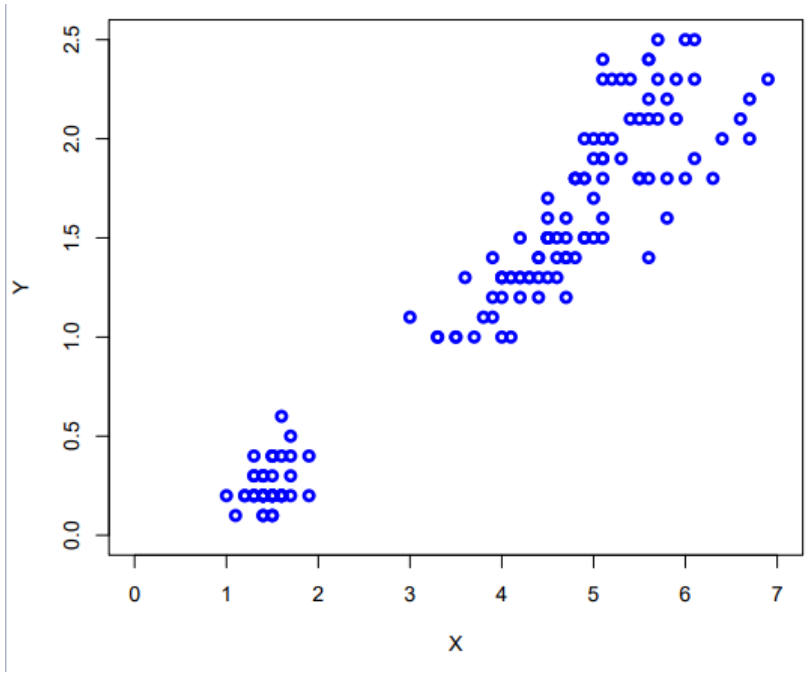
- **Relationship of box plot vs distribution of data**



Visualize data

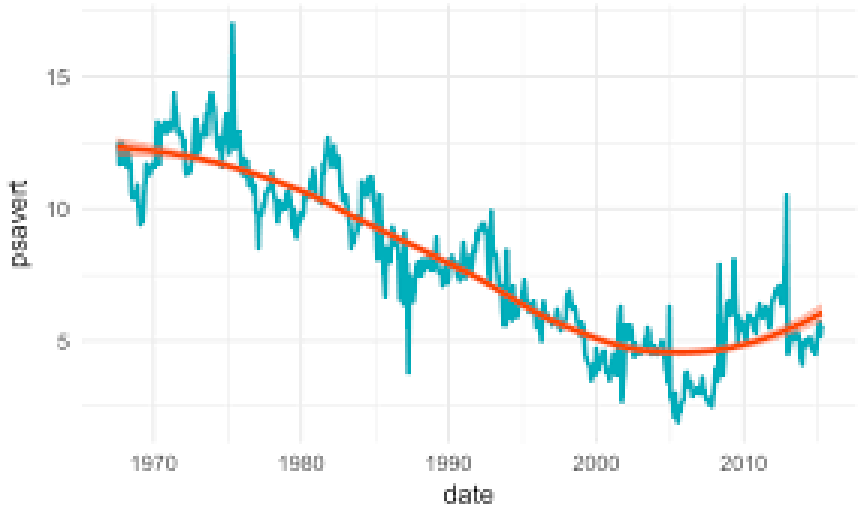
- **Line Plot**
  - Sequential data (Time series data)
    - Trends Prediction

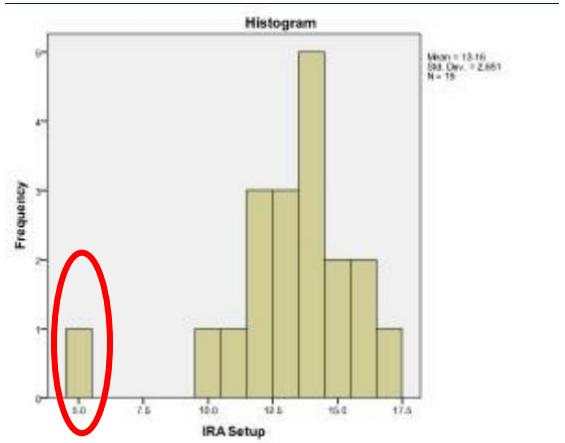
- **Scatter Plot**
  - Relationship between 2 variables
    - Correlation

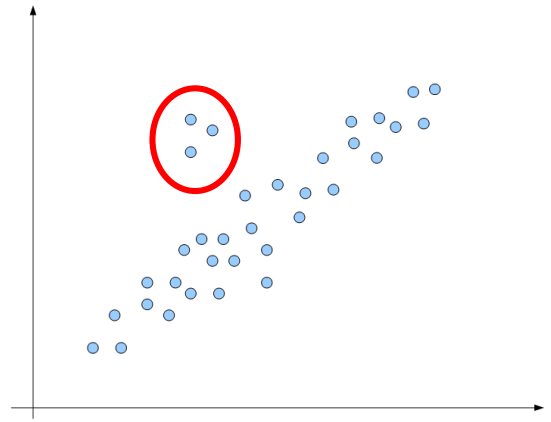


Visualize data

- **Trend**
- **Outlier**

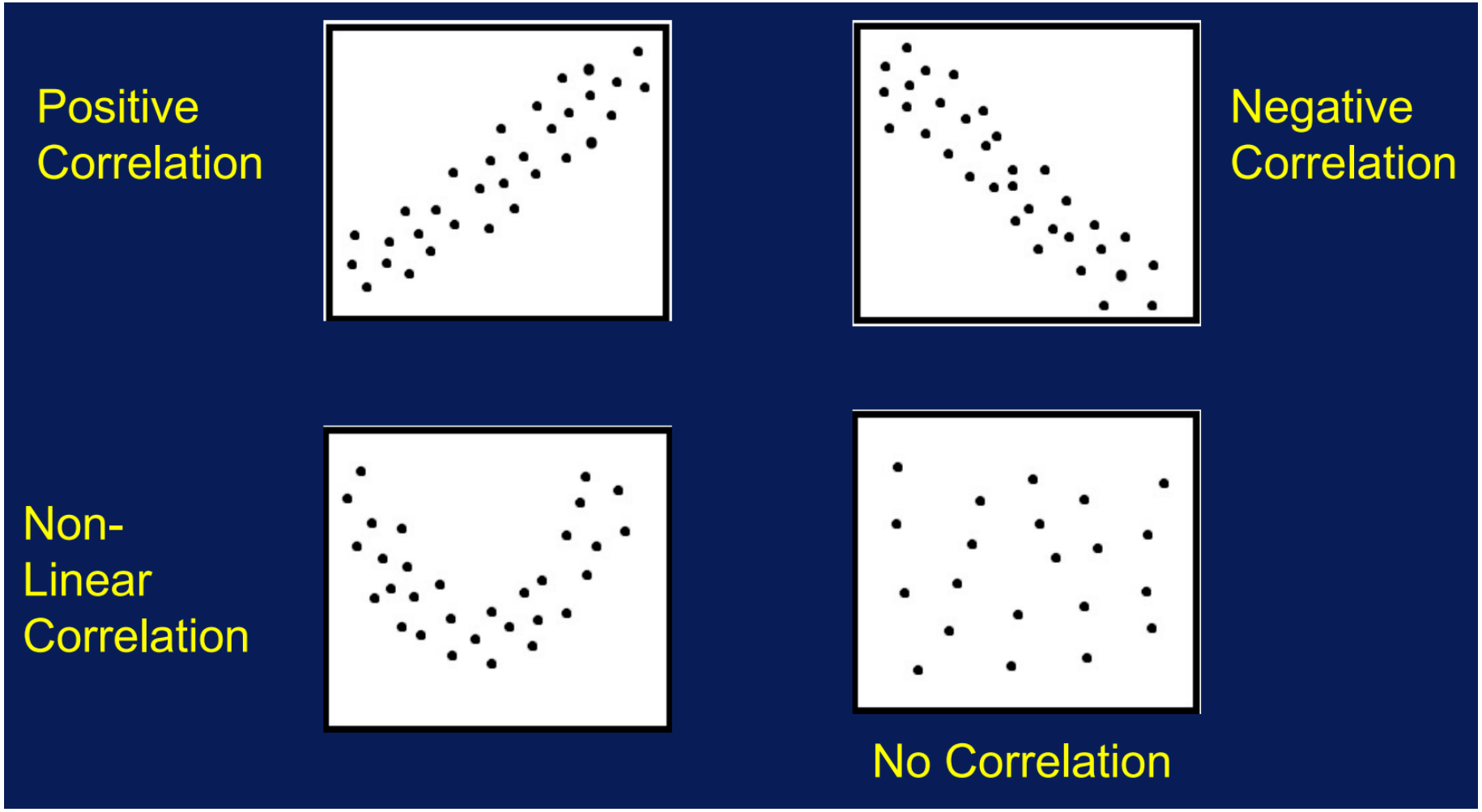






Visualize data

- **Scatter plots of two variables (features)**
  - **Show Correlation between them**



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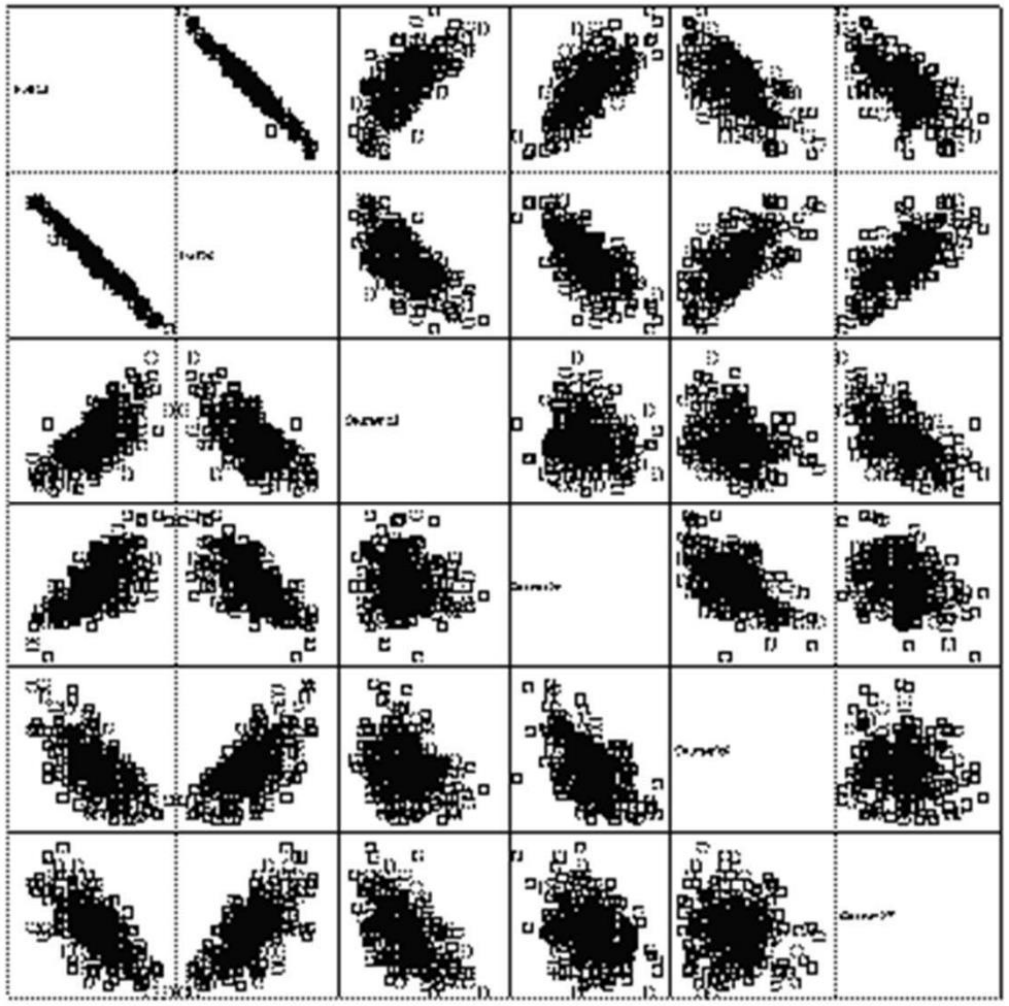
Visualize data

- **Scatter plots of multi-variables (features)**
  - **Show Correlation between a pair of them**



https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf

How to make data valid

Should data be changed or transformed?

How to correct any missing or errorless data?

Data Cleaning

- **Incomplete Data**
  - **Missing Data**
  - **Duplicate Data**
  - **Different measure**
  - **Different scaling**
  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Age	Income
Angela	34	80
~~*Sidney*~~	~~*--*~~	~~*56*~~
~~*Ratan*~~	~~*10*~~	~~*--*~~
~~*Kiril*~~	~~*68*~~	~~*--*~~
Zhou	45	120

Problem Solving: Remove all records containing missing data
Good point: **Simple**
Critical point: **may not have enough data**

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Data Cleaning

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  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Age	Income
Angela	34	80
Sidney	0	*56*
Ratan	*10*	0
Kiril	*68*	0
Zhou	45	120

Problem Solving: Replace missing data with 0
Good point: **Simple**
Critical point: **Lead to mislead and become outlier**
May not be allowed especially for regression application

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Data Cleaning

- **Incomplete Data**
  - **Missing Data**
  - **Duplicate Data**
  - **Different measure**
  - **Different scaling**
  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Age	Income
Angela	34	80
Sidney	39	*56*
Ratan	*10*	80
Kiril	*68*	80
Zhou	45	120

Problem Solving: Replace missing data with some values
Ex. Mean / Median / Most occurrence / History value / Regression prediction / center of the cluster

Good point: **Better representation**

Critical point: **Need Historical Data and Higher Computation**

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Data Cleaning

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  - **Missing Data**
  - **Duplicate Data**
  - **Different measure**
  - **Different scaling**
  - **Invalid**
  - **Noisy**
  - **Outliers**

Name	Address
Sidney	7800 West View Street
~~*Sid*~~	~~*7800 West View Street*~~
~~*Kiril*~~	~~*45 East 5th St*~~
Kiril	1220 Mill Avenue

Problem Solving: Delete Old record -> Replace with New one
or by defined rules

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Data Cleaning

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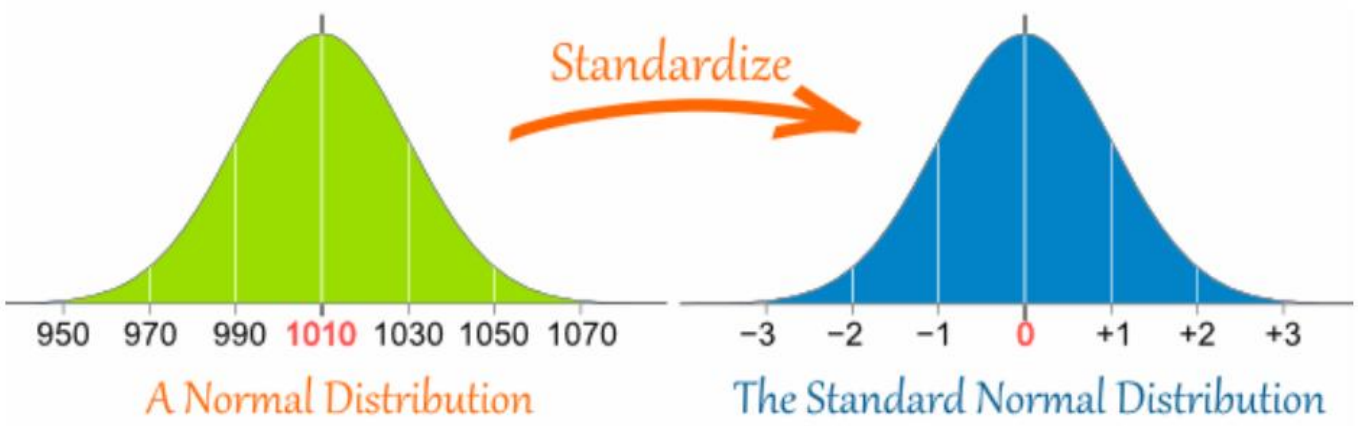

Problem Solving:

Ex: Distribution Shifting and Scaling

Normalization / Log transform

Note: **scaling method selection depends on the domain problem.**

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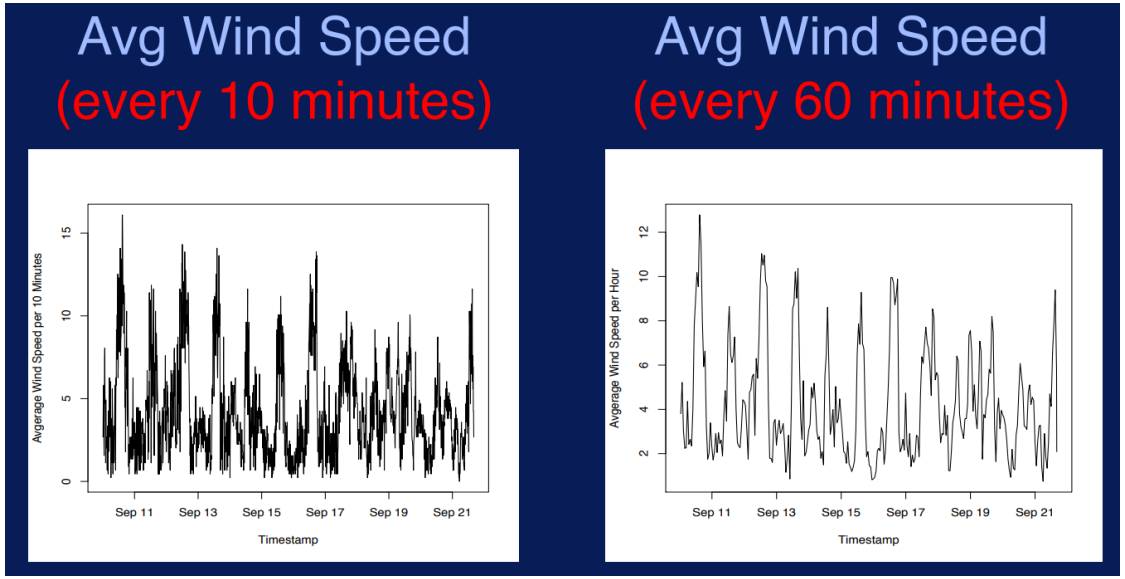
Problem Solving:

Ex: Removing / Filtering

Note: **Removing carefully.**



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Data Cleaning

- **Incomplete Data**
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  - **Different measure**
  - **Different scaling**
  - **Invalid**
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  - **Outliers**

Problem Solving:

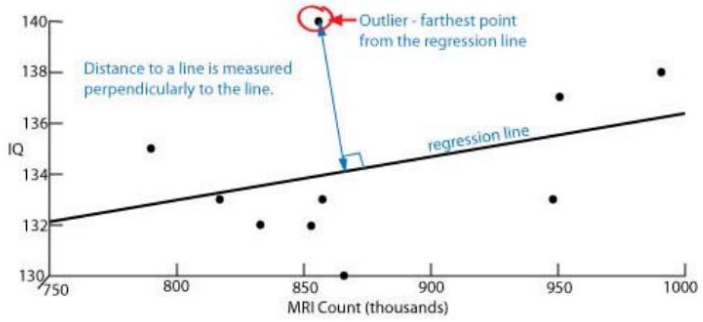
Ex: Removing

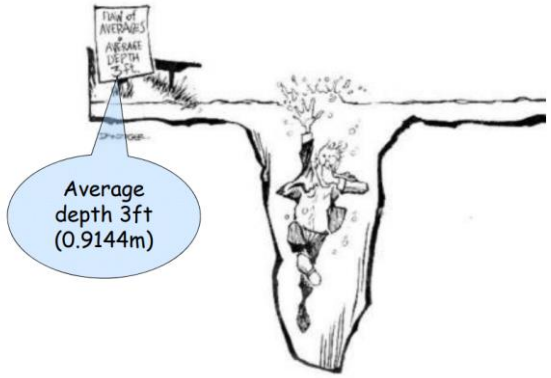
Replacing with specify value

such as most frequent value or

trend of its group

Note: **Removing carefully.**





https://paginas.fe.up.pt/~ec/files_1112/week_02_descriptive_statistics.pdf

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Exercise

[13, -, 15, 16, 16, -, 19, 20, 21, 0, 22, 25, 0, 33, 1000, 35, 36, 40, -, 45]

Perform Data Cleaning

Calculate

- **sorting from min to max**
- **mean / median / min / max**
- **normalized value in rage of 0 to 1 ([0,1])**
- **z-normalized value**

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998