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Making Sense of Data: Understanding the principles of statistical analysis

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EAPC vzw

Galilee
HOLY METROPOLIS OF
MESOGAIA AND LAVREOTIKI

Universidad de Navarra

Transilvania
University
of Brasov
FACULTY OF MEDICINE

HOSPICE CASA SPERANȚEI
MAKING EVERY MOMENT COUNT

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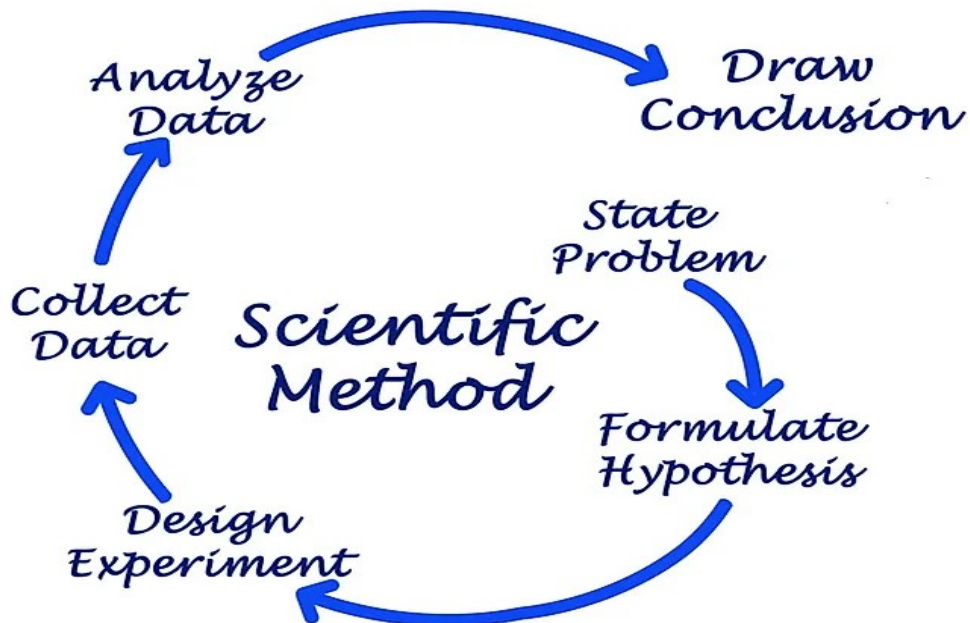attitude · communication · competence

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Aims

- Identify the principles and practices of quantitative data analysis

Objectives

- Understand the core principles within the descriptive presentation of research data

- Recognise common statistical tests used in quantitative research

- Identify common errors in the reporting of statistical findings

Scientific Method cycle: State Problem → Formulate Hypothesis → Design Experiment → Collect Data → Analyze Data → Draw Conclusion
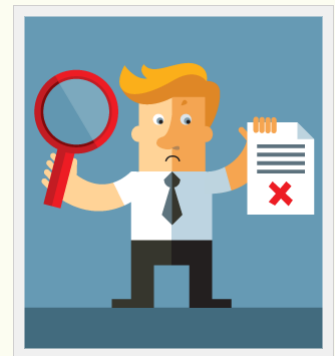
Data Analysis

Considerations;

- Research question / Operational definitions / Data collection instruments / quality of the original data
- Applying statistical techniques
  - Descriptive, Inferential
- Interpreting the information
- Explaining limitations

Data

- Primary data:
  - Novel data collected from research
- Secondary data:
  - From existing research

Nominal

- Eye colour / Gender / Handedness / Place of residence
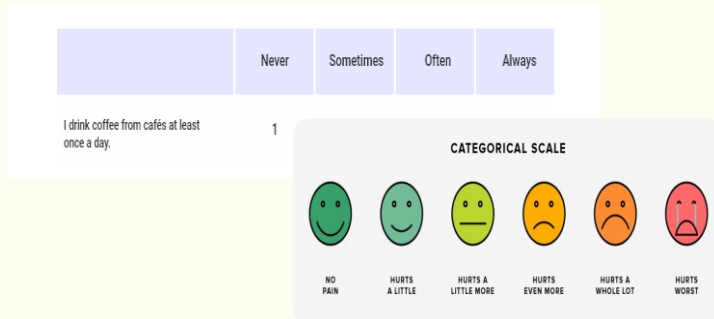

What is your Gender?	Where do you live?
• Male	1. Town/City Centre
• Female	2. Suburbs
• Other	3. Country
• ?	

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Ordinal

- Grades / Satisfaction

	Never	Sometimes	Often	Always
I drink coffee from cafés at least once a day.	1			

CATEGORICAL SCALE

NO PAIN | HURTS A LITTLE | HURTS A LITTLE MORE | HURTS EVEN MORE | HURTS A WHOLE LOT | HURTS WORST

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Interval

- Time / Temperature / Income

10 — WORST POSSIBLE PAIN
9
8
7
6
5 — MODERATE PAIN
4
3
2
1
0 — NO PAIN
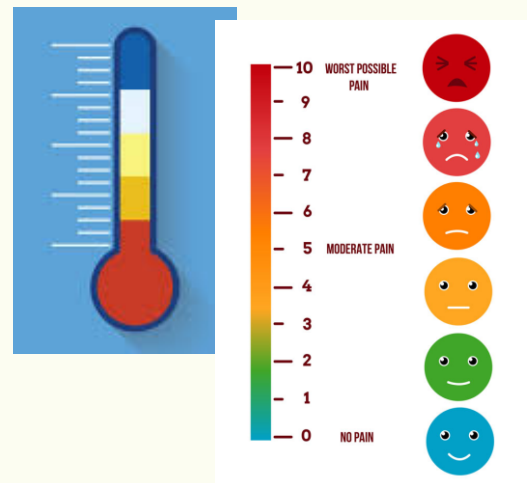
Ratio

- Blood Pressure / Height / Weight
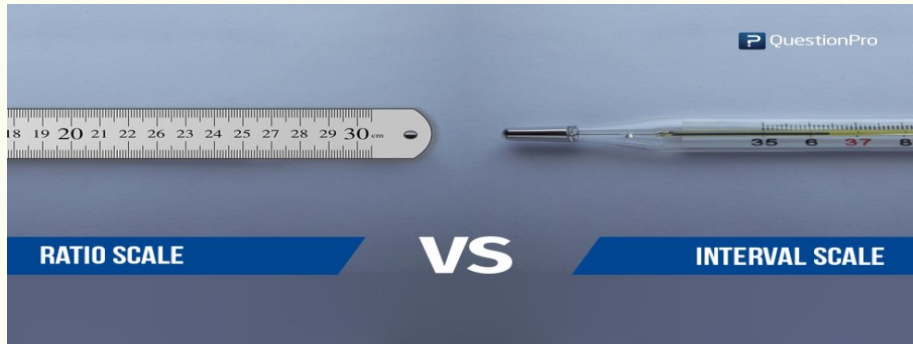
Levels of Data

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Descriptive

- Ways to summarise the data

Inferential

- Allows us to infer something about the sample
  - test hypotheses
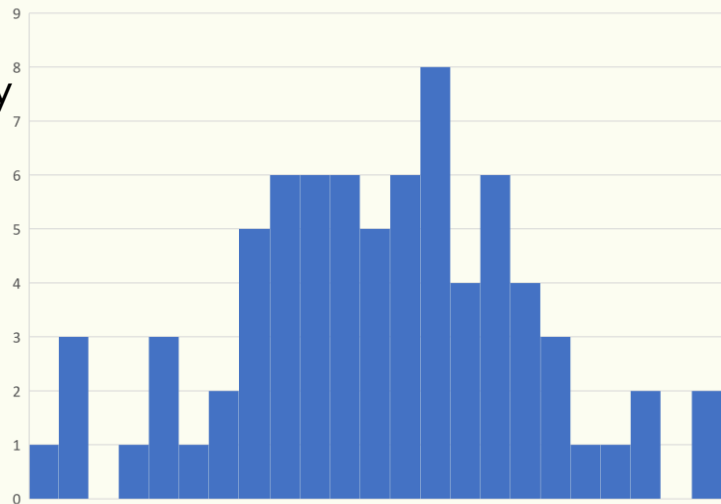 - examine relationships
  - make predictions

Descriptive Statistics

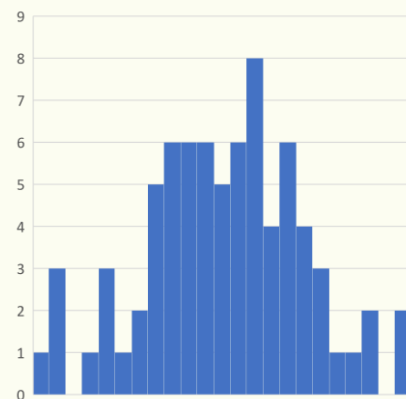Measures of Frequency
-Range
-%

Descriptive Statistics

Central Tendency
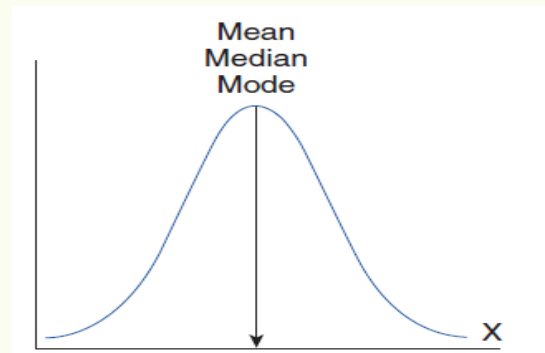-mid-point (median)
-most common value (mode)
-average (mean)

Descriptive Statistics

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Central Tendency
-mid-point (median)
-most common value (mode)
-average (mean)

Distribution
-Parametric

Descriptive Statistics

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- 25 Patients
- Pain Scores

	Pain
1	4.00
2	5.00
3	6.00
4	3.00
5	4.00
6	6.00
7	7.00
8	1.00
9	5.00
10	8.00
11	6.00
12	4.00
13	6.00
14	5.00
15	3.00
16	6.00
17	8.00
18	5.00
19	6.00
20	9.00
21	3.00
22	7.00
23	5.00
24	7.00
25	4.00

Mean – 5.32
Mode – 6
Median – 5
SD – 1.84
CI – (4.5, 6.0)

Ward 8Y

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Descriptive Statistics

Central Tendency
-mid-point (median)
-most common value (mode)
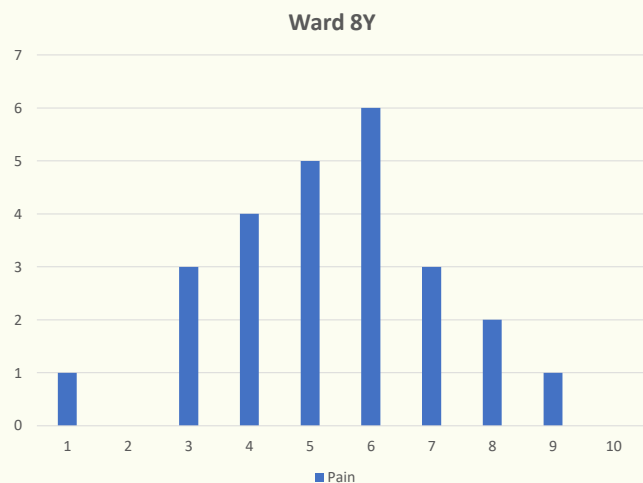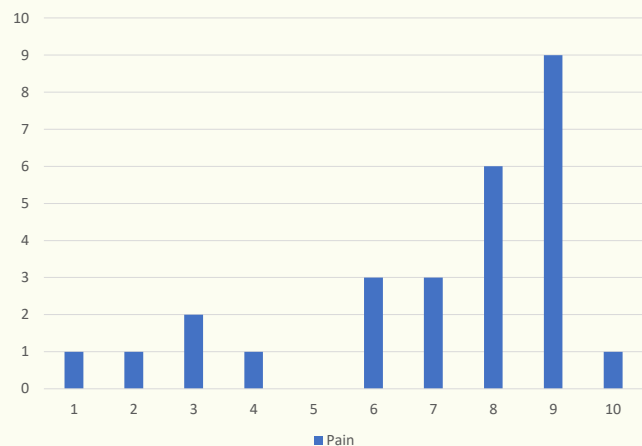-average (mean)
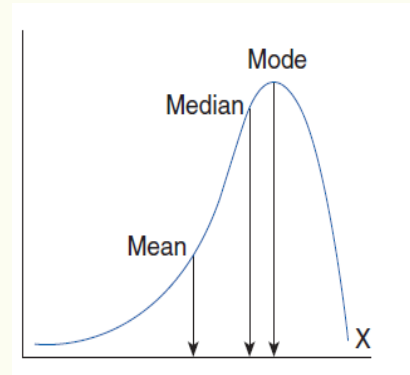
Distribution
-Non-Parametric

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Descriptive Statistics

• 25 Patients
• Pain Scores

	Pain
1	10.00
2	9.00
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10	6.00
11	2.00
12	9.00
13	3.00
14	8.00
15	8.00
16	5.00
17	9.00
18	5.00
19	9.00
20	5.00
21	8.00
22	5.00
23	8.00
24	8.00
25	9.00

Mean – 6.8
Mode – 9
Median – 8
SD – 2.61
CI – (5.7 – 7.9)

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Slide 1

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Data Distribution

- Standard Deviation
  - Spread
- Standard Error
- Confidence Intervals
  - Accuracy
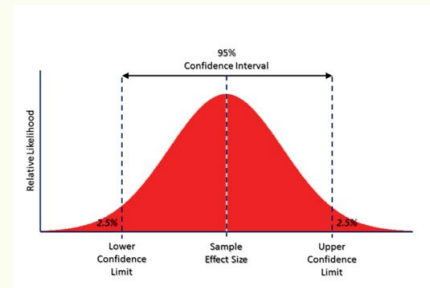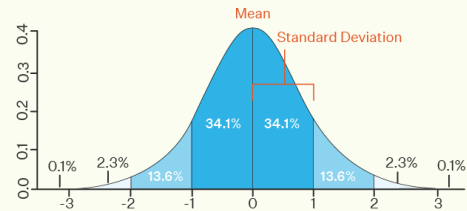
Slide 2

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Descriptive Statistics

- 25 Patients
- Pain Scores

	Pain
1	4.00
2	5.00
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14	5.00
15	3.00
16	6.00
17	8.00
18	5.00
19	6.00
20	9.00
21	3.00
22	7.00
23	5.00
24	7.00
25	4.00

Mean – 5.32
Mode – 6
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Ward 8Y
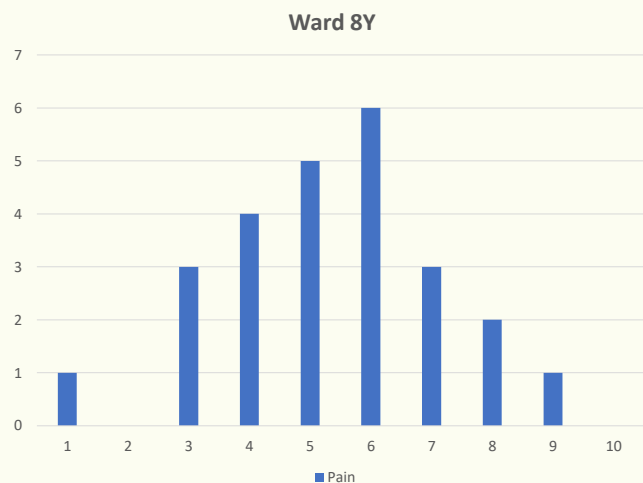
Descriptive Statistics

- 25 Patients
- Pain Scores

Mean – 6.8
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	Pain
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7	6.00
8	9.00
9	1.00
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11	2.00
12	9.00
13	3.00
14	8.00
15	8.00
16	5.00
17	9.00
18	5.00
19	9.00
20	5.00
21	8.00
22	5.00
23	8.00
24	8.00
25	9.00

Ward 8Y
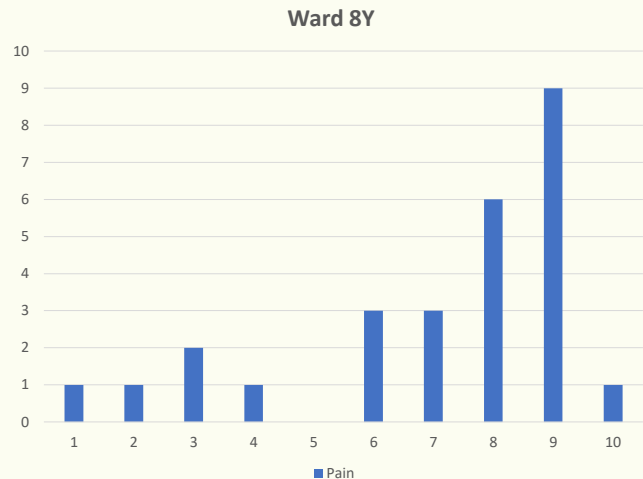
Summary

- Types of data
  - N – O – I - R
- Mean, Mode, Median
  - Summarise data
- Data distribution important
  - Parametric / Non-parametric Analysis

01 Measures of Frequency
02 Central Tendency
03 Measure of Dispersion
04 Variability

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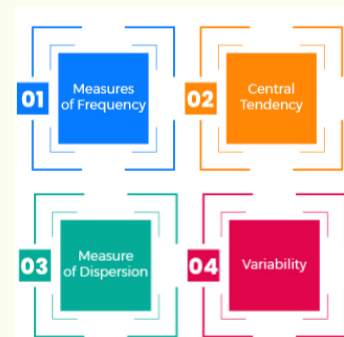
Common Statistical Tests

1. What type, and how many variables do I have
   - Univariate / Bivariate / Multivariate
2. What kind of data do the variables have
   - N O I R
3. What is the data distribution
   - Parametric – Non-Parametric
4. Do I have a single group (within) or paired groups (between)
5. Looking for a relationship, or differences between my variables

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Hypothesis Testing and p-values

- Based on comparisons
  - within group variances
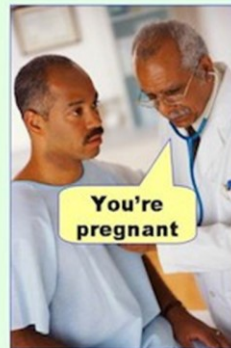 - between group variances

- $p \leq 0.05$

- Clinical Significance
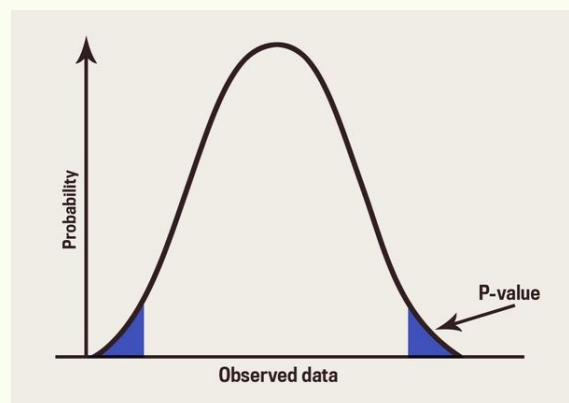
Hypothesis testing – Errors

- In rejecting the Ho we are making an error
  - Type I error is a false positive

- In accepting the Ho we are making an error
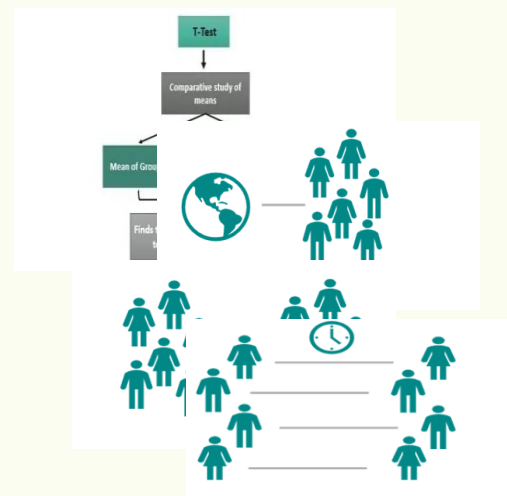 - Type II error is a false negative

Power – normally > 80%

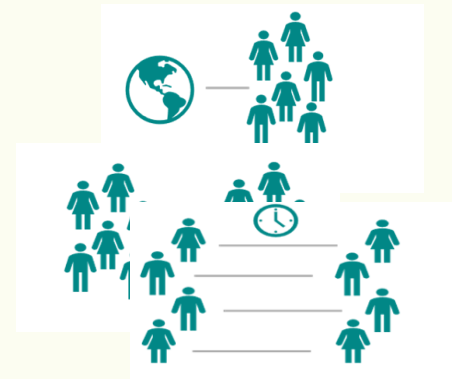# Comparing Means

Parametric Data - t-tests
-One sample t-test
-Independent/Two sample t-test
-Paired Samples t-test

Comparing Means

Non-parametric Data - t-tests

- One sample Wilcoxon signed ranks test
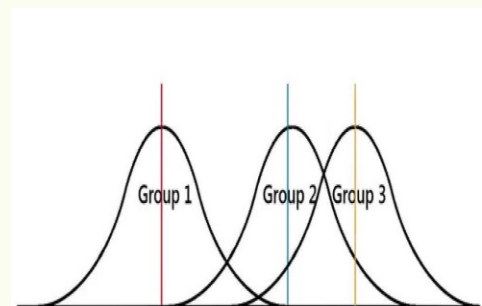- Mann Whitney U test
- Wilcoxon signed ranks test.

Comparing More than two means

One way Analysis of Variance (ANOVA)

- Assumptions
  - Independent Data
  - Normal distribution
  - Homogeneity of variance

Ho – no difference in the means of the all groups

- Does not tell us which groups are different (Tukey test)

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Comparing More than two means

Two way ANOVA

Generates three Ho

- Ho1 - no difference in means of the exercise groups
- Ho2 – no difference in means of gender groups
- Ho – no interaction effect between gender and exercise groups

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Relationships

Scale Data - Correlations
- Parametric Distribution
  - Pearsons Correlation
- Non-Parametric
  - Spearmans Rho

- Ho – No correlation between variables

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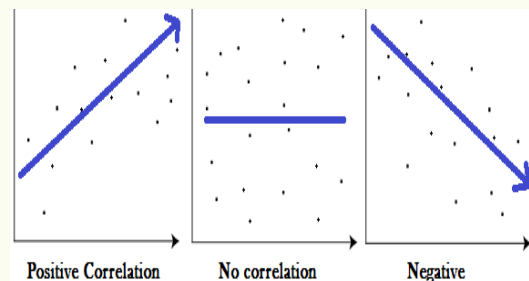
Relationships

Categorical Data – Chi Square

- Goodness of Fit
  - Ho – the gender split will be even
- Test of Independence
 - Ho – Gender is not dependent on the type of exercise

| Gender	Frequency
Male	35
Female	15
Total	50

Gender	Yoga	Weights	Total
Male	11	24	35
Female	10	5	15
Total	21	29	50

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Regression

Models a predictive relationship between IV and DV

- Simple Linear Regression
  - Variance / Parametric Data /Linear
  - Ho – Pain has no statistically significant effect on Pain
- Multiple Regression
- Logistic Regression
  - DV is binary
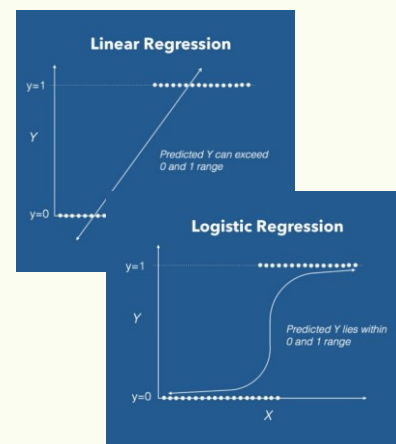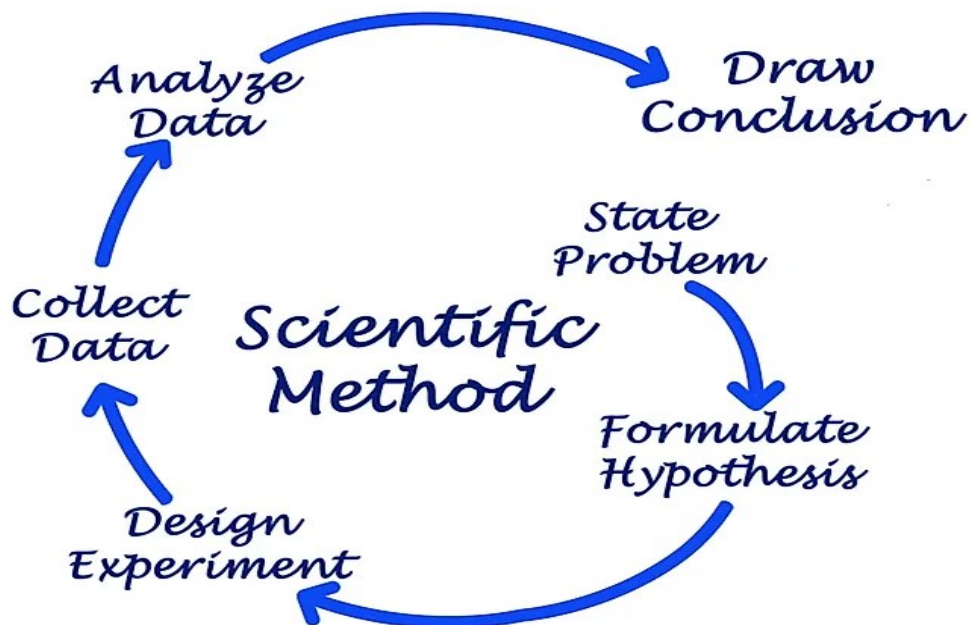
THANK YOU

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