IMGD 2905

Fundamentals of Statistics

Chapter 1

Even You Can Learn Statistics and Analytics
An Easy to Understand Guide to Statistics and Analytics

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Why Do We Need Statistics?

Game
445 446 397 226
388 3445 188 1002
47762 432 54 12
98 345 2245 8839
77492 472 565 999
1 34 882 545 4022
827 572 597 364

Aggregate data into meaningful information.

Ok, but what are statistics?

→ First, some key words

\[ \bar{x} = \ldots \]
Key Words

- **Population** – all members of group pertaining to a study

**Q:** examples?
Key Words

- **Population** – all members of group pertaining to a study
  - e.g., every person in IMGD 2905 in D-term
  - e.g., every *League of Legends* player in North America

- In many cases, **impossible** to survey a population!
  - Typical for game analytics → want to understand/improve game for all

**Q:** So ... what to do?
Key Words

- **Sample** – part of population selected for analysis
  - e.g., all *League of Legends* players at WPI
  - e.g., students at one table in IMGD 2905

Q: Is sample same as population? Is it *representative*?

- Often want *sample* to be representative of *population*. ...
  - (e.g., poll: “did you finish chart for Project 2, Part 1?”)
- But Is it? → method to obtain sample is important! (We won’t talk much about this right now, however.)
More Key Words

- **Variable** – characteristic of individuals in population analyzing
  - e.g., time spent in competitive mode in *Starcraft 2*
  - e.g., vehicle choice in *Grand Theft Auto* (GTA)

- **Independent variable** is inherent in population, versus **dependent variable** that want to assess
More Key Words

• **Observation** – all variable values for sample
  – e.g., *PUBG* hours/week and Best Rank (that week).
    Two observations could be:
    “Player A: Rank #2, 2 hours”
    “Player B: Rank #30, 7.5 hours”
  – Can be continuous (time) or discrete (rank)

• Often, data in grid
  – **Observation** in rows
  – **Variables** in columns
  – Format works well for spreadsheet
  – Consider our project 1 ➔ *PUBG* data!

<table>
<thead>
<tr>
<th>Player</th>
<th>Hours</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>#2</td>
</tr>
<tr>
<td>B</td>
<td>7.5</td>
<td>#30</td>
</tr>
</tbody>
</table>
Putting It Together

• Designing *Super Mario World* levels

• What are some dependent variables?

• What are some independent variables?

• Other variables of interest?

• What are some observations?

[https://tinyurl.com/trb4h7v](https://tinyurl.com/trb4h7v)

[https://tinyurl.com/s8tcprt](https://tinyurl.com/s8tcprt)
Putting It Together

- Designing *Super Mario World* levels
- What are some **dependent variables**?
- What are some **independent variables**?
- Other **variables** of interest?
- What are some **observations**?

- **Time, Deaths/fails, Fun** ...
- **Koopas, power ups, gap lengths** ...
- **Time spent getting coins, Number of jumps** ...

A, 10s, 12 jumps

https://tinyurl.com/trb4h7v

https://tinyurl.com/s8tcprt

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Even More Key Words

- **Parameter** – measure of dependent variable for population
  - e.g., average crashes in *Mario Cart* level for every player
  - Usually what we want to know, but can’t get easily
- **Statistic** – measure of dependent variable in sample
  - e.g., average crashes in Mario Cart level for IMGD 2905 class
- **Statistics** – set of numerical methods for getting information about population based on data from sample, usually to get information about population parameters

“Statistics - a branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data.”
-Merriam-Webster dictionary
Sources of Data

• **Published** – generally made available from those that collected it
  – e.g., *PUBG* Developer API data
  – e.g., Metacritic’s reviews and ratings
  – e.g., HOTS Logs dataset on *Heroes of the Storm*

• **Experiments** – multiple trials to collect data from sample
  – Can be in laboratory or “real world” setting
  – e.g., play shooter, add lag and play again

• **Survey** – ask people to answer questions
  – e.g., self-rating as gamer, difficulty with level, ...
  – Ethical issues with stress and use of data
  → **Institute Review Board (IRB)** for approval with human subjects
Sampling Concepts

• **Sampling** – process by which members of population selected for sample
  – e.g., choose ½ class based on seat, or choose ½ class based on alphabet
• **Probability sampling** – sampling considering likelihood of selection
  – e.g., survey for intended Champ, ask ½ class, but when tournament starts, result different. Why? → sample didn’t consider League players! (e.g., often similar analogy for voter polls)
  – e.g., voluntary polls/surveys
  – Use probability sampling whenever possible, but sometimes it is not (cost) or not known
• **Sampling with replacement** – once sample, put back in pool
  – e.g., die roll to see which attack boss makes
• **Sampling without replacement** – once sample, won’t sample again
  – e.g., user survey – don’t allow to submit twice
  – e.g., deck of 52 cards for blackjack
Using Sample Data

• Word “sample” comes from same root word as “example”
  – Similarly, one sample does not prove a theory, but rather is an example

• Basically, in general, definite statement cannot be made about characteristics of all systems

• Instead, make probabilistic statement about range of most systems

→ That’s where statistics come in!

Statistics – set of numerical methods for getting information about population based on data from sample, usually to get information about population parameters