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Careers in Data Science (You Know, Statistics)

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May 24, 2016

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http://heather.cs.ucdavis.edu/MenloAtherton.pdf

Confusing Terms

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• We live in the Age of Buzzwords.

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Confusing Terms



- We live in the Age of Buzzwords.
- Trust me:

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Confusing Terms



- We live in the Age of Buzzwords.
- Trust me: Data Science = Statistics.

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- But isn't Data Science = Computer Science + Statistics?

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- I'm a computer scientist and a statistician and I say No.

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Confusing Terms



- We live in the Age of Buzzwords.
- Trust me: Data Science = Statistics.
- But isn't Data Science = Computer Science + Statistics?
- I'm a computer scientist and a statistician and I say No.
- Statisticians have always had to be highly skilled with computers.

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More Confusing Terms

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• Big Data:

• Yes, have many huge data sets these days.

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- Yes, have many huge data sets these days.
- Yes, typically requires parallel computation (one of my areas).

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- Yes, have many huge data sets these days.
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- But still, not really a new paradigm.

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 - Fancy new term for use of data for prediction.

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• Methods either invented by statisticians (e.g. Random Forests) or statistically motivated.

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How to Become a GOOD Data Scientist

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How to Become a GOOD Data Scientist

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• I'll get to examples of Data Science shortly.

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How to Become a GOOD Data Scientist

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• I'll get to examples of Data Science shortly. But first, what does one need to do Data Science well?

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How to Become a GOOD Data Scientist

- I'll get to examples of Data Science shortly. But first, what does one need to do Data Science well?
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What Really Counts

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What Really Counts

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• FAR more important than Stat vs. CS: **Depth of insight**, not rote memorization.

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- In statistics, in computing sample variance, we divide by n-1, not n:

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \overline{X})^2$$

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Why not divide by *n*? **IS THERE A GOOD REASON FOR THIS**?
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Why not divide by *n*? **IS THERE A GOOD REASON FOR THIS**?

• Can you recognize Simpson's Paradox when you see it?

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One More Slide on Prep for DS Career

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One More Slide on Prep for DS Career

• GENERAL knowledge, awareness and insight are key!

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• Do you know terms like *ameliorate*, *morbidity* and *elasticity of demand*?

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- Do you know terms like *ameliorate*, *morbidity* and *elasticity of demand*?
- How about FDA, HOV and CPI?

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One More Slide on Prep for DS Career

- GENERAL knowledge, awareness and insight are key!
- Do you know terms like *ameliorate*, *morbidity* and *elasticity of demand*?
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- Can't be a good data miner without *understanding the data*!

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One More Slide on Prep for DS Career

- GENERAL knowledge, awareness and insight are key!
- Do you know terms like *ameliorate*, *morbidity* and *elasticity of demand*?
- How about FDA, HOV and CPI?
- Can't be a good data miner without *understanding the data*! Ptolemy's epicycles fiasco.

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All Right, Then, What Do DS People Do?

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All Right, Then, What Do DS People Do?

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• Example: Software running in a satellite notices a bright light in a forest.

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All Right, Then, What Do DS People Do?

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• Example: Software running in a satellite notices a bright light in a forest. Is it a fire? Maybe just a reflection?

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• Example: Software running in a satellite notices a bright light in a forest. Is it a fire? Maybe just a reflection? How can previous data be used here?

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All Right, Then, What Do DS People Do?

- Example: Software running in a satellite notices a bright light in a forest. Is it a fire? Maybe just a reflection? How can previous data be used here?
- Example: You, humans, can spot the speaker:



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- Example: Software running in a satellite notices a bright light in a forest. Is it a fire? Maybe just a reflection? How can previous data be used here?
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But can software spot me?

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But can software spot me?

Detailed Example

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Careers in
Data Science
(You Know,
Statistics)

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Goals:

Detailed Example

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Careers in Data Science (You Know, Statistics)	Detailed Example
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Menlo- Atherton High School	Goals:
	 Show you something different from AP Stat.

Detailed Example

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Goals:

- Show you something different from AP Stat.
- Show that serious math is involved (calculus, matrix theory).

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Detailed Example

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Atherton Hig School Goals:

- Show you something different from AP Stat.
- Show that serious math is involved (calculus, matrix theory).
- This will get a little technical; don't feel that you need to follow 100%.

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Detailed Example

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Atherton Hig School Goals:

- Show you something different from AP Stat.
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- This will get a little technical; don't feel that you need to follow 100%.
- The Question: Will Mary like the movie Captain America?

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Will Mary Like the Movie Captain America?

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Will Mary Like the Movie Captain America?

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• Mary hasn't seen the movie.

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Will Mary Like the Movie Captain America?

- Mary hasn't seen the movie.
- But we have Mary's ratings on some other movies, and we have ratings of *Captain America* by some other people.

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Will Mary Like the Movie Captain America?

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 How do we use this data to guess Mary's rating of this movie?

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Neighborhood-Based Approach

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Neighborhood-Based Approach

• Find people ("neighbors") in our dataset whose movie tastes are similar to Mary's.

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• Find people ("neighbors") in our dataset whose movie tastes are similar to Mary's.

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• Of those, focus on the ones that have seen *Captain America*.

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Neighborhood-Based Approach

- Find people ("neighbors") in our dataset whose movie tastes are similar to Mary's.
- Of those, focus on the ones that have seen *Captain America*.
- Guess Mary's rating of the movie to be the mean of the ratings in that group.

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A More Nuanced Model

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A More Nuanced Model

• Y_{ij} is user i's rating of movie j.

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A More Nuanced Model

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- Y_{ij} is user i's rating of movie j.
- We want to predict Y_{Mary,Cpt.Am.}.

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A More Nuanced Model

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- Y_{ij} is user i's rating of movie j.
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- Latent Factor Model:

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- Y_{ij} is user i's rating of movie j.
- We want to predict Y_{Mary,Cpt.Am}.
- Latent Factor Model:

$$Y_{ij} = \mu + \alpha_i + \beta_j + \epsilon_{ij}$$

where

• $\mu = \text{mean ratings over all users and all movies.}$

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- α_i = tendency for user i to give higher/lower ratings than the typical user

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- β_j = tendency for movie j to be rated higher/lower than the typical movie

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- β_j = tendency for movie j to be rated higher/lower than the typical movie
- $\epsilon_{ij} = \text{sum of all unknown effects, e.g. user i's mood when viewing movie j}$
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Where Does the Data Come in?

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• But HOW will we get those estimates?

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One Common Method

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Details not shown. :-)

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Careers in Data Science (You Know, Statistics)

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Menlo-Atherton High School • Beware of the buzzwords like *data science*. Modern methodology is not really new.

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