# **Teacher Notes for Prescription Drugs in the ER**

## **Motivation and Essential Understandings**

Emergency Rooms or Departments (ERs or EDs) play a critical role in the healthcare delivery system in the United States. They are essential pillars of the system to handle cases of trauma, urgent health problems and also the “first resort” for those without any health insurance and hence act as a safety net. In the context of the recent opioid epidemic, EDs have drawn attention of practitioners and scholars of whether they contribute to this crisis by prescription of analgesic drugs.

* What are the drivers of opioid prescriptions in an ED setting?

## **Context and Dataset**

Students will interpret trends for opioid prescriptions in the ED using data from the **National Hospital Ambulatory Medical Care Survey** (NHAMCS) published by the National Center for Health Statistics.

This lesson was a summative exercise for a Statistics for Nurses course. Students work with small datasets in Excel to demonstrate basic statistical numeracy. Students incorporate these methods and concepts in their final projects as an assessment to demonstrate skills.

## **Learning Objectives**

Students will be able to:

## Describe methods of exploratory data analysis used in research

## Create tests of hypotheses

## Evaluate relationships between different factors (features)

## Recognize the predictive value of data analysis through visualizations

## **Data Science Concepts and Skills**

1. Summary statistics
2. Exploratory data analysis; Static and interactive data visualization
3. Data wrangling; data dictionary
4. Logistic regression; decision trees

## **Students**

This lesson is for late undergraduate students. Students should be familiar with statistical concepts, basic data visualizations, and have worked in Excel. Though visualizations are produced using Python, students will not need to perform hands-on exercises in Python or R.

## **Time to Teach this Lesson**

This lesson can be taught in 2 sessions along with a worksheet and data visualizations.

**First Week**: 1-hour prep, 2-hour class session; independent work with Excel

**Second Week**: 2-hour class session + review and directions for incorporating work into final projects

## **Lesson Materials**

You will find all the lesson materials in the GenAI GitHub repository. The Jupyter notebook is not necessary to teach this lesson but is available to those who wish to teach more hands-on Data Science.

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| **Materials** | **File** | **Description** |
| Lecture 1 | Instructor proprietary | PPT Lecture on Inferential Statistics & hypotheses formulation |
| Lecture 2 | Instructor proprietary | PPT Lecture on Multivariate Statistics |
| Worksheet | Worksheet\_excel\_Prescription\_Drugs\_in\_ER\_2020.docx | Lesson worksheet for descriptive Statistics |
| Visualizations | Visualizations\_Prescription\_Drugs\_in\_ER\_2020.pptx | PPT Slides of Visualizations |
| Dataset | UMA\_Clean\_2\_xlsx | Cleaned NHAMCS dataset |
| Data dictionary | NHAMCS\_Data\_Dictionary.pdf | Pdf of data dictionary explaining the column headings (data fields) in the datasets |
| Jupyter notebook |  | Python scripts for visualizations and predictive model in an annotated Jupyter notebook |
| Jupyter notebook pdf |  | Pdf version of annotated Jupyter notebook |
| Template | Lesson\_Template\_Prescription\_Drugs\_in\_ER\_2020.docx | Lesson planner with links to resources |

## **Teaching Strategies**

* Review Statistics concepts of correlation
* Pose **challenge questions** for engagement and allow students to interpret visualizations and hypothesize. Students may have difficulty limiting inferences to within the scope of the dataset, so discuss over-hypothesizing beyond the data.

## **Lesson Narrative**

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| **Module 0: Pre-lesson** |

Ask students to read articles on ED operations and studies on opioid prescriptions. (1) How was pain measured? (2) How else would you measure it? (2) What other data could have been collected or seems missing? (3) How would you summarize the analyses used?

Review lessons on Inferential Statistics, hypothesis testing, and Multivariate Statistics.

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| **Module 1: Datasets and Exploratory Data Analysis** |

**Introduce the NHAMCS dataset**

Since 2018, the National Hospital Ambulatory Medical Care Survey (NHAMCS) began focusing on just the ambulatory visits made to emergency departments. Review aspects of the dataset: size, scope, purpose (ambulatory, not hospital admittance).The dataset in this lesson has been cleaned (fewer features) for easier manipulations and visualizations.

Focus on data fields: Pain Scale, Age-group, Ethnicity, Payer, Gender, Number of chronic conditions.

Use worksheet to step through exercises in descriptive statistics.

Based on the data fields and the descriptive statistics, can you suggest other Nursing research questions than those below?

* H1: Prescription patterns vary by level of pain. Higher the pain, higher likelihood of being prescribed an opioid
* H2: Prescription patterns vary by gender
* H3: Prescription patterns vary by type of payer. Private pay patients are more likely to receive medications than publicly-funded patients.

**Explore features and correlations of Interest**

Introduce the data dictionary to explain the data: definitions of data elements, their meanings, and allowable values.

Present correlation matrix. What features (columns) are correlated?

* Histograms (3) – race; pain; age … opioid as dependent variable
* Histograms with fitted line

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| **Module 2: Explain Predictive Modeling** |

Present two models for prediction.

* **Decision tree** to profile patient: multiple splits on AGE: PAIN SCALE; RACE; Total Chronic Conditions; immediacy; Opioids prescribed - data splits via gini index (v. information gain)
* **Logistic regression** as a binary model – Opioid (yes/no) as function of Pain Scale

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| **ASSIGNMENT:** Ask students to review their worksheets, hypothesis and the data visualizations from the models. Provide the students guidance on how to incorporate these findings into their final project. |

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| **Module 3: Close Out** |

Post-assessment questions.

* What are some of the limitations of using this dataset?
* If you had an opportunity to include data on more variables in this survey, what would those be? Explain your choices of variables.
* Are there any state-level policies that dictate how prescriptions can be made in the ED?
* If we had information on the state that the visit took place in, how would that information be useful?
* Dosage limits - Personal ids – how many times the same person visits & is given an opioid?
* Policy question: State restrictions on prescriptions of opioid drug monitoring program (PDMP)