Lies, Damned Lies, and Statistics

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Objectives

• Provide a brief overview of the descriptive statistics used to summarize large amounts of data

• Describe the components of the Virginia EMS Patient Care Information System:
  • Virginia Pre Hospital Information Bridge (VPHIB)
  • Virginia Statewide Trauma Registry (VSTR)

• Review Virginia EMS data trends for 2007 through 2013
Lies and Statistics

• “There are three kinds of lies: lies, damned lies, and statistics.”
  • Attributed to Benjamin Disraeli
  • Now believed to have been coined by Mark Twain

• Phrase is sometimes used
  • To describe the use of statistics to bolster weak arguments
  • By those distrustful of the presenter’s and/or analyst’s motives
What is (are) Statistics?

- Statistics *IS* a discipline
  - Study of the collection, organization, analysis, interpretation, and presentation of data
- Statistics *ARE* numbers calculated from a set of data
  - Mean (average), standard deviation
  - Minimum, median, maximum
  - Many others . . .
- To prevent statistics from becoming lies, one must:
  - Use proper descriptions of the data being studied
  - Avoid bias when using samples of the whole
Numbers are Numbers - NOT!

• Groups of numbers (distributions or probability distributions) don’t always look the same

• “Bell shaped curve” or Normal distribution
  • Very common
  • Not the only way numbers like to congregate!

• MANY other distributions exist, but you don’t need to know about them BUT . . .
  • You should be aware of two other common distributions, left skewed and right skewed
Normal Distribution

- Life would be easy (but boring) if all numbers grouped themselves in the familiar “bell shaped curve”
  - Characterized by symmetry
  - Measure of central tendency (middle) = mean (μ)
  - Measure of spread (variability) = standard deviation (SD, Std Dev, or σ)
    - SD is ~ average distance of observed values from the mean
    - Large standard deviations
      - Often occur with small groups of numbers
      - Can indicate data that do not follow the normal distribution!
Skewed Distributions

- **Skewness** is a measure of asymmetry
  - Named for the location of the *tail* of the distribution
- Right skewed data are very common in health care
  - Characterized by *asymmetry*
  - Measure of *central tendency* (middle) = *median*
  - Measure of *spread* (variability) = *inter-quartile range (IQR)* represents middle 50% of the data
    - 75th percentile value - 25th percentile value

- Let’s apply our new found knowledge to some actual Virginia EMS data . . .
Example: Distribution of VPHIB Data*

* Includes all reported calls, regardless of call type or destination

\[
\text{Response Time} = \text{UnitArrivedSceneDate} - \text{UnitEnRouteDate}
\]
## Example: Statistics for VPHIB Data*

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Calls</td>
<td>860,368</td>
<td>885,636</td>
<td>842,018</td>
<td>910,883</td>
<td>1,054,323</td>
</tr>
<tr>
<td>N Missing Values</td>
<td>63,197</td>
<td>71,742</td>
<td>79,339</td>
<td>60,132</td>
<td>76,995</td>
</tr>
<tr>
<td>Minimum</td>
<td>-1,439.0</td>
<td>-1,439.0</td>
<td>-525,585.0</td>
<td>-4,733,277.1</td>
<td>-527,032.0</td>
</tr>
<tr>
<td>01st Percentile</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>05th Percentile</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>10th Percentile</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>25th Percentile</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Median</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>75th Percentile</td>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
<td>8.7</td>
<td>9.0</td>
</tr>
<tr>
<td>90th Percentile</td>
<td>13.0</td>
<td>13.0</td>
<td>13.0</td>
<td>15.0</td>
<td>16.0</td>
</tr>
<tr>
<td>95th Percentile</td>
<td>18.0</td>
<td>18.0</td>
<td>17.0</td>
<td>21.0</td>
<td>24.0</td>
</tr>
<tr>
<td>99th Percentile</td>
<td>34.0</td>
<td>33.0</td>
<td>31.0</td>
<td>46.3</td>
<td>55.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>1,439.0</td>
<td>1,439.0</td>
<td>1,471.0</td>
<td>3,682,086.2</td>
<td>4,207,687.5</td>
</tr>
<tr>
<td>Average</td>
<td>7.5</td>
<td>5.8</td>
<td>4.9</td>
<td>16.3</td>
<td>18.8</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>63.7</td>
<td>77.5</td>
<td>577.3</td>
<td>6,696.8</td>
<td>5,327.8</td>
</tr>
</tbody>
</table>

*Includes all reported calls, regardless of call type or destination.*
Find $x$:

It’s right here!
Virginia Pre Hospital Information Bridge

- EMS data submission is mandated by the Code of Virginia § 32.1-116.1 and EMS regulations
- Current minimum dataset (VPHIB) was officially adopted on February 6, 2010 by the State Board of Health
- All EMS responses are required to be submitted to OEMS WITHIN 30 DAYS in the format prescribed by OEMS
- Agencies may submit above and beyond this minimum dataset if desired to collect further information on an agency, locality, or regional level
Virginia Statewide Trauma Registry

• Virginia Statewide Trauma Registry (VSTR) was mandated by the state legislature in Virginia as of July 1, 1987

• The Code of Virginia statute §32.1-116.1 outlines the reporting procedure for the Trauma Registry through establishment of the Emergency Medical Services Patient Care Information System (EMS PCIS)

• ALL licensed hospitals which render emergency medical services shall participate in the Trauma Registry

• OEMS determines the format for reporting data which must be submitted WITHIN 60 DAYS FROM THE END OF THE QUARTER
Relationship between VPHIB and VSTR

Trauma patients brought to a Virginia hospital by a Virginia EMS agency
Behind the Scenes Comparison

VSTR

VPHIB
## Definitions for Call Type

<table>
<thead>
<tr>
<th>Type of Service Requested</th>
<th>Call Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>911 Response (Scene) (Default)</td>
<td><em>Emergency</em></td>
</tr>
<tr>
<td>Flagdown/Walk-in Emergent</td>
<td></td>
</tr>
<tr>
<td>Interfacility Transfer (unscheduled)</td>
<td></td>
</tr>
<tr>
<td>Mutual Aid</td>
<td></td>
</tr>
<tr>
<td>Rendezvous/Intercept</td>
<td></td>
</tr>
<tr>
<td>Flagdown/Walk-in Non-emergent</td>
<td><em>Non-Emergency</em></td>
</tr>
<tr>
<td>Interfacility Transfer (scheduled)</td>
<td></td>
</tr>
<tr>
<td>Medical Transport</td>
<td></td>
</tr>
<tr>
<td>Standby</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Incidents by Call Type

[Bar chart showing incidents by call type from 2007 to 2013. The chart indicates a trend where the number of incidents increases over the years, with a significant rise in 2013. The categories are Blank/Unknown, Non-Emergency, and Emergency.]
# Definitions for Disposition

<table>
<thead>
<tr>
<th>Incident/Patient Disposition</th>
<th>Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated and Released</td>
<td>Treated</td>
</tr>
<tr>
<td>Treated, Referred to Law Enforcement</td>
<td>Treated</td>
</tr>
<tr>
<td>Treated, Transferred Care</td>
<td></td>
</tr>
<tr>
<td>Treated, Transferred by EMS</td>
<td></td>
</tr>
<tr>
<td>Treated, Transported by Private Vehicle</td>
<td></td>
</tr>
<tr>
<td>Dead at Scene</td>
<td></td>
</tr>
<tr>
<td>No Treatment Required</td>
<td>Not_Treated</td>
</tr>
<tr>
<td>Patient Refused Care</td>
<td></td>
</tr>
<tr>
<td>No Patient Found</td>
<td>No_Patient</td>
</tr>
<tr>
<td>Standby Only - No Patient Contacts</td>
<td>Cancelled</td>
</tr>
<tr>
<td>Cancelled</td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Assessed} = \text{Treated} + \text{Not\_Treated}
\]
Figure 2. Incidents by Disposition

The chart illustrates the number of incidents by disposition from 2007 to 2013. The data is categorized into five types of dispositions:

- Blank/Unknown
- Cancelled
- No_Patient
- Not_Treated
- Treated

Each bar for a given year is segmented by these dispositions, with the total number of incidents increasing from 2007 to 2013.
Figure 3. Emergency Calls Where The Patient Was Assessed

Number of Incidents

Calendar Year

2007 2008 2009 2010 2011 2012 2013

Not_Treated Treated
Please Note:

All Figures from this point forward include incidents that were emergency dispatches in which the patient received treatment.

\[ \pi, \text{ the ratio of the diameter to the circumference of a circle, is an irrational number} \]

\[ i, \text{ the square root of } (-1), \text{ is an imaginary number, not a real number} \]
Figure 4a. Incidents per Day by Month
Figure 4b. Incidents per Day by Month
Figure 5. Average Incidents per Day of the Week

Number of Incidents per Day

Day of the Week

Sunday Monday Tuesday Wednesday Thursday Friday Saturday

2007 2008 2009 2010 2011 2012 2013
Figure 6. Incidents per Hour
Figure 7. Incident Location Type

The bar chart shows the number of incidents by location type and calendar year from 2007 to 2013. The categories include:

- Unspecified/Missing
- Street or Highway
- Specified Other Loc.
- Residential Inst.
- Public Building
- Home/Residence
- Health Care Facility

The chart indicates a general increase in incidents over the years, with the majority occurring in Home/Residence locations. The specific number of incidents for each year and category is represented by the length of the bars. The tallest bars correspond to Home/Residence incidents in 2010 and 2013.
Figure 8. Patient Gender by Incident

Percentage of Patients

Calendar Year

2007 2008 2009 2010 2011 2012 2013

Unknown Male Female
Figure 9. Patient Race by Incident
Figure 10. Patient Ethnicity by Incident

Percentage of Patients

Calendar Year

2007 2008 2009 2010 2011 2012 2013

Hispanic Unknown Non Hispanic
Figure 12a. Primary Symptoms - Trend

- Number of Incidents
- Calendar Year
- Other
- Null
- Missing
- Pain
- Pulmonary
- AMS/CNS
- General Symptoms
- Cardiovascular
- Abdominal Pain
- GI Other
- Headache
- Bleeding
- Miscellaneous Other
Figure 12b. Primary Symptoms - 2013

- Pain
- AMS/CNS
- Pulmonary
- General Symptoms
- Cardiovascular
- Other
- Abdominal Pain
- GI Other
- Bleeding
- None
- Headache
- Missing
- Null
- Transport Only
- Miscellaneous Other
- Wounds & Related
- CardioRespiratory Arrest
- Allergic Reaction
- GI Bleeding
- Obstetrics - Contractions
- Death

Number of Incidents

0 40,000 80,000 120,000 160,000 200,000
Figure 13a. Procedures Performed - Trend

- Number of Incidents
- Calendar Year

- Other
- Null
- Missing
- Venous Access
- Cardiac
- Immobilization
- Assessment
- Airway
- BLS
- Wound Care
Figure 13b. Procedures Performed - 2013

- Venous Access
- Missing
- Cardiac
- Assessment
- Null
- Immobilization
- Airway
- Other
- BLS
- Unknown
- Wound Care
- Behavioral Intervention
- Rescue
- Inactive Code
- Medication...
- Oxygen Administration

Number of Incidents

0 50,000 100,000 150,000 200,000 250,000 300,000 350,000
Figure 14a. Medications Given - Trend

- Missing
- Null
- Oxygen
- IV Solutions +/- Electrolytes
- Bronchodilators & Related
- Cardiovascular Agents
- CNS Non Opioids
- CNS Opioids
- Antiemetics
- Autonomic Agents
- CNS Agents, Other
- Diagnostic Agents

Number of Incidents

Calendar Year

2007 2008 2009 2010 2011 2012 2013
Figure 14b. Medications Given - 2013

- Oxygen
- Bronchodilators & Related
- CNS Non Opioids
- Missing
- Autonomic Agents
- Diagnostic Agents
- Antihistamines
- Antihypoglycemics
- Pituitary
- Blood Modifiers
- Insulin
- Nasal and Throat Agents, Topical
- Anesthetics, Topical Ophthalmic

Number of Incidents

0 50,000 100,000 150,000 200,000 250,000
Translate the following expression:

\[
\sqrt{-1} \quad 2^3 \quad \sum \quad \pi \\
\text{i} \quad 8 \quad \text{Sum} \quad \text{pi}
\]

\[\pi \approx 3.14\]
Questions?

Virginia

Office of Emergency Medical Services

Virginia Department of Health

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