

Assignment Project Exam Help

Lecture 1 : GGR376

Spatial Data Science II

<https://powcoder.com>

Dr. Adams

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Office Hours: By Appointment

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GGR376: Spatial Data Science II

Lectures:

1:10pm to 3:00pm (Wednesday)

Labs/Tutorials:

- PRA0101, 9:10am to 11:00am (Thursday)
- PRA0102, 11:10am to 1:00pm (Thursday)
- PRA0103, 3:10am to 5:00pm (Thursday)

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This course builds on spatial data analysis and quantitative methods introduced in GGR276, and aims to provide a broad study of advanced statistical methods and their use in a spatial context in physical, social, and environmental sciences. The course covers theories, methods, and applications geared towards helping students develop an understanding of the important theoretical concepts in spatial data analysis, and gain practical experience in application of spatial statistics to a variety of physical, social and environmental problems using advanced statistical software. [24L, 12P]

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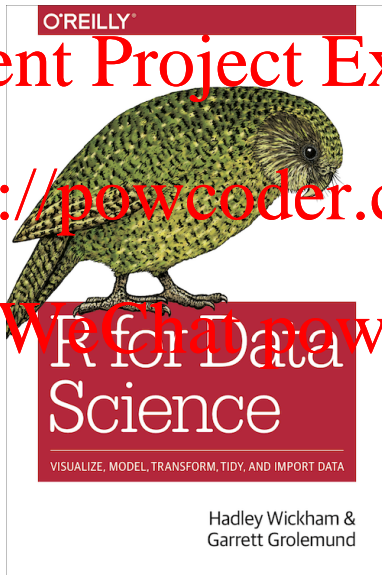
Course Text

This course uses readings that are highlighted in the course outline.

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What is statistics?

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The practice or science of collecting and analyzing numerical data in large quantities, especially for the purpose of inferring proportions in a whole from those in a representative sample.

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What is my goal in this course?

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I want you to be able to use data to answer questions
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- ▶ Further develop your ability to write R code

```
a <- 42  
A <- a * 2 # R is case sensitive  
print(a)
```

```
## [1] 42
```

```
print(A)
```

```
## [1] 84
```

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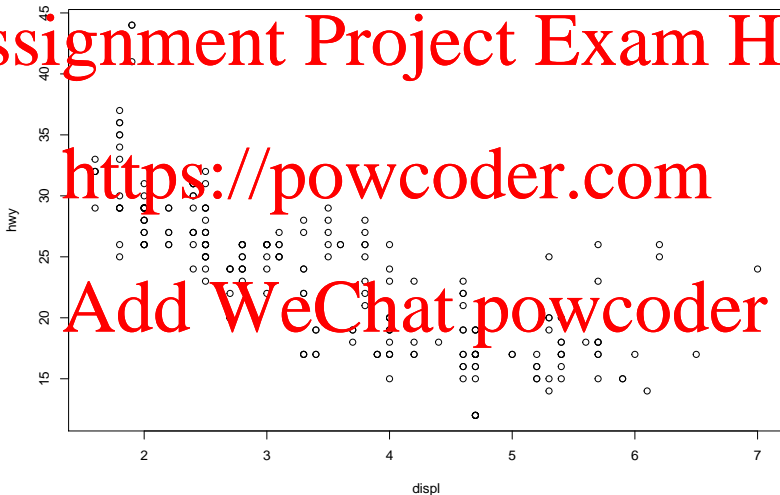
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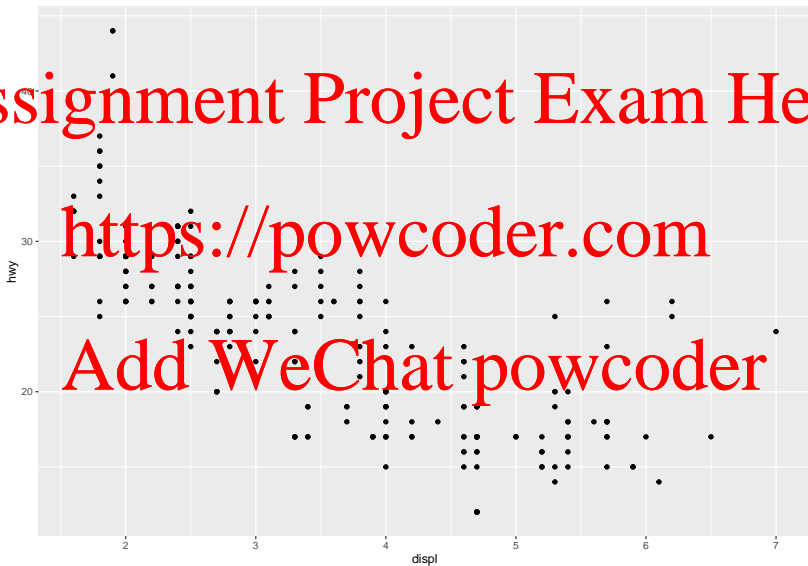
- ▶ Develop an understanding of data visualization using the grammar of graphics.
- ▶ Apply the grammar of graphics using ggplot2 in R (Wickham 2016)
- ▶ DEMO: Plot EPA fuel efficiency data on the next slide
 - ▶ hwy = highway miles per gallon
 - ▶ displ = engine displacement (litres)
 - ▶ Total volume of all the cylinders in an engine

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Basic Scatter Plot



Better Scatter Plot (ggplot2)



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Plot 1, Basic Scatter Plot

```
plot(x = mpg$displ, y = mpg$hwy, ylab = "hwy",  
      xlab = "displ")
```

Plot 2, Better Scatter Plot

```
library(ggplot2)
```

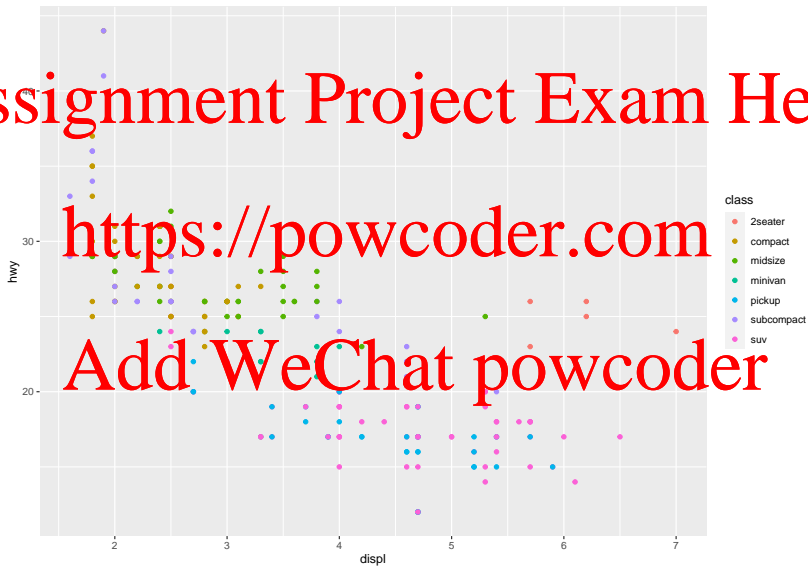
```
ggplot(data = mpg) +
```

```
  geom_point(mapping = aes(x = displ, y = hwy))
```

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Modify the Aesthetics: Include car class information



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- ▶ Learn how to select an appropriate statistical approach
- ▶ Understand the challenges that occur when modelling data
- ▶ Explore cognitive bias and how it may affect your analysis (Haselton, Nettle, and Andrews 2015)

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```
## [1] "Fit a linear model"
```

```
## lm(formula = hwy ~ displ, data = mpg)
```

```
## [1] "Here are the coefficients"
```

```
##           Estimate Std. Error      Pr(>|t|)
```

```
## (Intercept) 35.697651  0.7203676 2.123519e-125
```

```
## displ      -8.530589  0.1945137 1.038974e-46
```

```
## [1] "Explanatory ability"
```

```
## [1] 0.5850056
```

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ASSESSMENT STRUCTURE AND DATES		
Item	Weight	Due Date (5:00 pm)
Tutorial 1	5%	Jan 20
Tutorial 2	5%	Jan 27
Tutorial 3	5%	Feb 03
Tutorial 4	5%	Feb 07
Tutorial 5	5%	Mar 09
Assignment 1	15%	Feb 24
Assignment 2	15%	Mar 23
Assignment 3	5%	Apr 06
Pop Quiz	10%	In-Class

*Late penalties occur if an assignment is not submitted by the due date and time, which is determined by Quercus. Please ensure enough time to upload files.

Figure 2: How are you graded?

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Review Outline <https://powcoder.com>

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This course uses free and open-source software (FOSS)

▶ R
▶ RStudio <https://powcoder.com>

R: A statistical programming language

RStudio: A development environment for R

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Installing R

Go to <https://cran.r-project.org/>

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Download and install

The Comprehensive R Archive Network

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Source Code for Contributors

Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- The latest release (2017-11-30, Kite-Eating Tree) [R-3.4.3.tar.gz](#), read [what's new](#) in the latest version.
- Sources of [R alpha and beta releases](#) (daily snapshots, created only in time periods before a planned release).
- Daily snapshots of current patched and development versions are [available here](#). Please read about [new features and bug fixes](#) before filing corresponding feature requests or bug reports.
- Source code of older versions of R is [available here](#).
- Contributed extension packages

Questions About R

- If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

Figure 3: CRAN Download Page

Installing RStudio

After downloading R, go to

<https://www.rstudio.com/products/rstudio/download/#download>

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RStudio requires 3GB of RAM. If you don't already have it, download it here.

Installers for Supported Platforms

Installers	Size	Date	MD5
RStudio 1.1.383 - Windows Vista/7/8/10	85.8 MB	2017-10-09	450755b853dcdbaa60be641552ef3c0f
RStudio 1.1.383 - Mac OS X 10.6+ (64-bit)	74.5 MB	2017-10-09	ec121f9abc0b817ddcca85d71a5988e3
RStudio 1.1.383 - Ubuntu 12.04-15.10/Debian 8 (32-bit)	89.2 MB	2017-10-09	9588bce746f2a5e8da299c4a8b35d4fa
RStudio 1.1.383 - Ubuntu 12.04-15.10/Debian 8 (64-bit)	91.4 MB	2017-10-09	3eede731b7706a7e5bbf090f4991358f
RStudio 1.1.383 - Ubuntu 12.04-15.10/Debian 8 (64-bit)	66.4 MB	2017-10-09	6ccc0c127730c44ee5c5c91fc2ec28
RStudio 1.1.383 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	88.1 MB	2017-10-09	36b4d00c6ec5c6a39194287b468ceb44
RStudio 1.1.383 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	90.6 MB	2017-10-09	ae400e2504ec9c5862343c24fe3cd61d

Zip/Tarballs

Zip/tar archive	Size	Date	MD5
RStudio 1.1.383 - Windows Vista/7/8/10	22.9 MB	2017-10-09	7b779ac0cbe9fcd1eef7af133010be
RStudio 1.1.383 - Ubuntu 12.04-15.10/Debian 8 (32-bit)	9.9 MB	2017-10-09	b277c6422a51293370c0ab300f6cdc8
RStudio 1.1.383 - Ubuntu 12.04-15.10/Debian 8 (64-bit)	98.3 MB	2017-10-09	370f6b565b8371f0adff943cef56ba44
RStudio 1.1.383 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	88.8 MB	2017-10-09	4e81a3242bc3e672061c74e388ec902b
RStudio 1.1.383 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	91.4 MB	2017-10-09	alce682f868fd7cfc7b4a6011d17e43d

Source Code

A tarball containing source code for RStudio v1.1.383 can be downloaded from [here](#)

Figure 4: RStudio Download Page

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- ▶ A set of cheatsheets (reference guides) are available on the RStudio website.
- ▶ Bring the Base R cheat sheet to each class.

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R Cheatsheets Link:

<https://www.rstudio.com/resources/cheatsheets/>

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- ▶ Only use your University of Toronto e-mail address (i.e. @mail.utoronto.ca)
- ▶ Include the course code (GGR376) in the subject line
- ▶ Include your full name and student number in the body of the e-mail.

<https://powcoder.com>

Please read the course handouts and check the course website site before e-mailing a question, to make sure that it has not already been answered.

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- ▶ If your question is answered in a document, you will receive an email starting: "Review Course Documents"

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- ▶ All requests for extensions are handled by the Department of Geography.
<https://powcoder.com>
 - ▶ Details are on course outline.
- ▶ **Neither I nor a TA can grant you an extension.**

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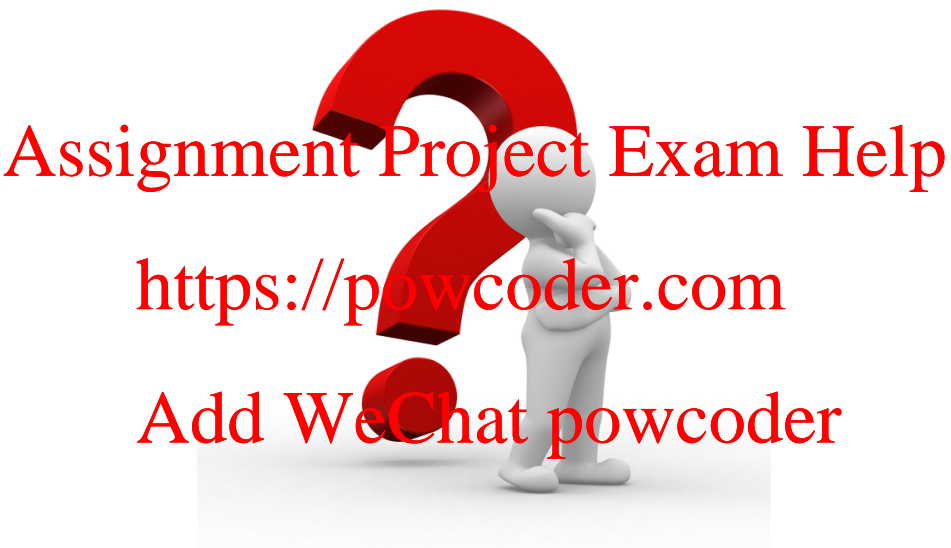


Figure 5: Questions before moving on?

Pre-test (15 minutes)

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At the end of the Pre-test, please pass all your papers to the front.

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Think you're good at guessing stats? Guess again. Whether we consider ourselves math people or not, our ability to understand and work with numbers is terribly limited, says data visualization expert Alan Smith.

<https://www.youtube.com/watch?v=ogeGJS0GEF4>

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Review (Mostly)

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Statistics encompasses the following with data.

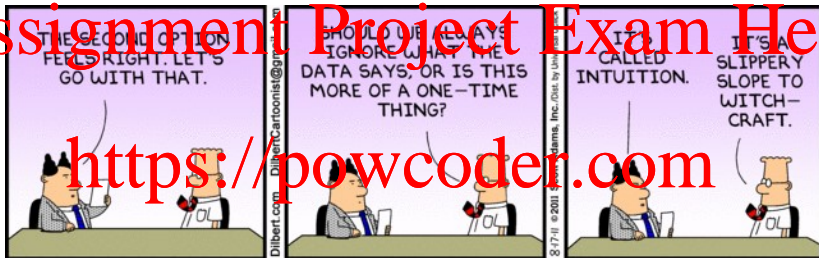
- ▶ collection
 - ▶ data acquisition
 - ▶ data munging (cleaning)
- ▶ analysis
- ▶ interpretation
- ▶ presentation
- ▶ organization

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Figure 6: Gut Feelings

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Population, the totality of the set of interest

- ▶ People in a country

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Sample, a subgroup of the population.

- ▶ The respondents to a survey.

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Population and Sample II

Let's visualize what the difference.

The Population



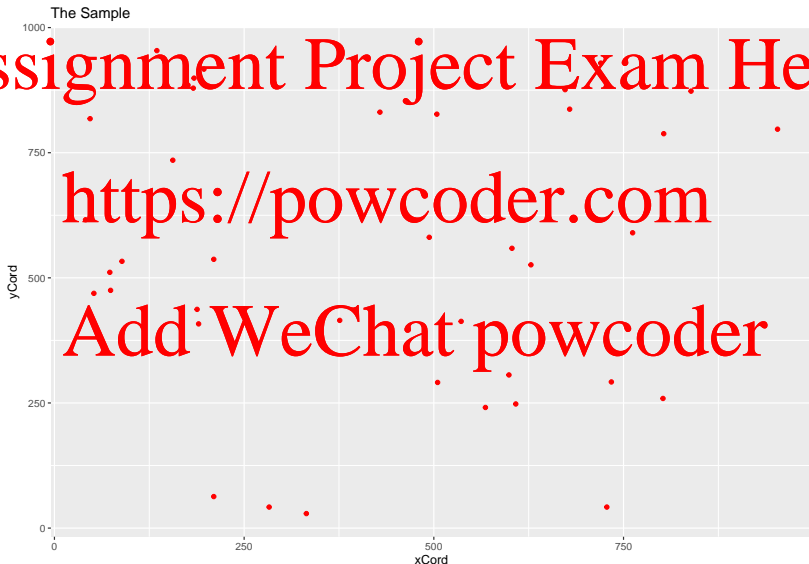
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Population

Here is a sample.



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1. View summary statistics
2. Basic plots
3. Define my question
4. Conduct an appropriate analysis

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What may we be interested in knowing?

Basic summary statistics?

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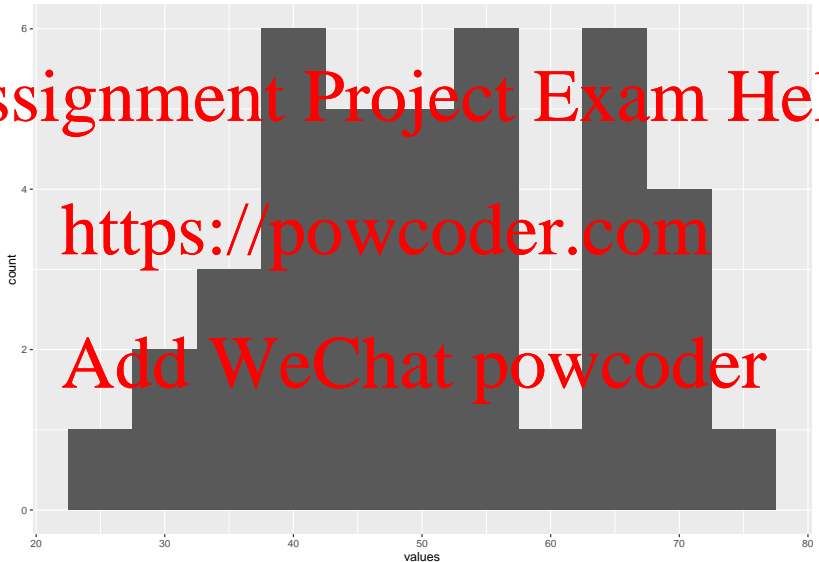
```
summary(sampleA)[,c(1:3)]
```

```
##      xCoord      yCoord      values  
##  Min.      : 41.0      Min.      : 29.0      Min.      :26.00  
##  1st Qu.:181.2      1st Qu.:382.5      1st Qu.:41.00  
##  Median :403.5      Median :548.0      Median :51.00  
##  Mean    :413.4      Mean    :566.1      Mean    :51.20  
##  3rd Qu.:639.2      3rd Qu.:832.5      3rd Qu.:63.25  
##  Max.      :953.0      Max.      :954.0      Max.      :74.00
```

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Basic Plots: Histogram



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- ▶ Identify a statistical model capable of testing our hypothesis or modelling our interest.
- ▶ For example
 - ▶ T-Test
 - ▶ ANOVA
 - ▶ Kruskal-Wallis Test
 - ▶ Linear Regression Model

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We can separate our statistical techniques into two themes:

1. Descriptive Statistics
▶ Methods of how we organize and summarize the data.

2. Inferential Statistics
▶ Methods of analysis based on probability theory.

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An important step in your analysis because it provides a chance to learn about the data.

- ▶ Graphs
- ▶ Charts
- ▶ Tables

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Inference a conclusion based on evidence and reasoning.

- ▶ <https://powcoder.com>
Make conclusions about a population from a sample of observations
 - ▶ *Hypothesis testing*

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Cognitive Bias 1:

During WWII the Center for Naval Analyses collected data on where gunshots were present on returning planes.

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Take a few minutes and write down how you would use this information to reinforce planes.

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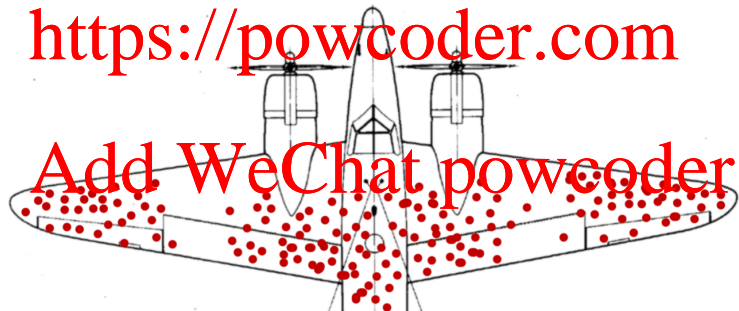


Figure 7: Example of bullet holes

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<https://powcoder.com>

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Reading 1:

<https://powcoder.com>
Sundali, D., & Croson, R. (2005). Biases in casino betting: The hot hand and the gambler's fallacy. Judgment and Decision Making, 1(1), 1.

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Haselton, Martie G., Daniel Nettle, and Paul W. Andrews. 2015.
"The Evolution of Cognitive Bias."

doi:10.1002/9780470939376.ch25.

<https://powcoder.com>

Wickham, Hadley. 2010. "A Layered grammar of graphics." *Journal of Computational and Graphical Statistics* 19 (1): 3–28.

doi:10.1198/jcgs.2009.07098.

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