Applied Epidemiology I: Summary Statistics and Graphs

Enoch Yi-Tung Chen

Department of Medical Epidemiology and Biostatistics, Karolinska Insitutet

November 26, 2020

Acknowledgements

This course material is based on my learning from Anastasia Lam's teachings in last year's Applied Epidemiology I lab sessions, and readings from *Epidemiology* by Gordis [1], *A First Course in Probability and Statistics* by Goldsman and Goldsman [2], *Principles of Biostatistics* by Pagano and Gauvreau [3], and *Biostatistics I* by Gabriel and Frumento [4]. I especially want to thank Marlene Stratmann for reviewing the slides and Prof. Paul Dickman for providing me with suggestions to improving the teaching.

Outline

1. Summary statistics
   - Bad example
   - Measures of Central Tendency: mean, median, mode
   - Measures of Dispersion: range, IQR, variance, standard deviation
2. Graphs
   - Bad examples
   - Learning from errors
   - Histogram
   - Bar chart
   - Scatter plot
   - Box plot
   - Line graph
   - Stratification
   - Putting graphs together
   - Export
   - Study map
3. References

Summary statistics: Bad example

What is the problem here?

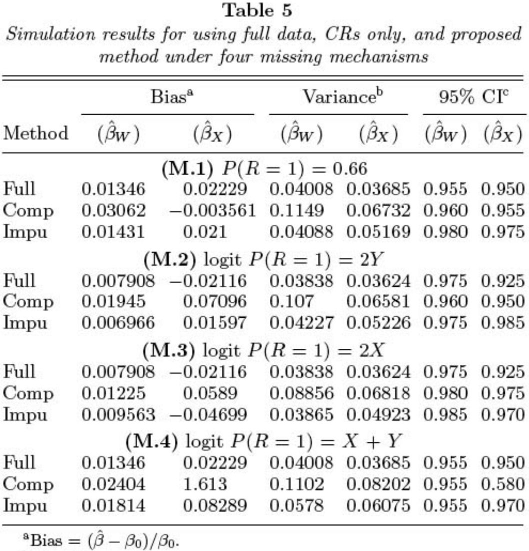


Table 5

Simulation results for using full data, CRs only, and proposed method under four missing mechanisms

	Bias[a]		Variance[b]		95% CI[c]	
Method	$(\hat{\beta}_W)$	$(\hat{\beta}_X)$	$(\hat{\beta}_W)$	$(\hat{\beta}_X)$	$(\hat{\beta}_W)$	$(\hat{\beta}_X)$
(M.1) $P(R = 1) = 0.66$						
Full	0.01346	0.02229	0.04008	0.03685	0.955	0.950
Comp	0.03062	−0.003561	0.1149	0.06732	0.960	0.955
Impu	0.01431	0.021	0.04088	0.05169	0.980	0.975
(M.2) logit $P(R = 1) = 2Y$						
Full	0.007908	−0.02116	0.03838	0.03624	0.975	0.925
Comp	0.01945	0.07096	0.107	0.06581	0.960	0.950
Impu	0.006966	0.01597	0.04227	0.05226	0.975	0.985
(M.3) logit $P(R = 1) = 2X$						
Full	0.007908	−0.02116	0.03838	0.03624	0.975	0.925
Comp	0.01225	0.0589	0.08856	0.06818	0.980	0.975
Impu	0.009563	−0.04699	0.03865	0.04923	0.985	0.970
(M.4) logit $P(R = 1) = X + Y$						
Full	0.01346	0.02229	0.04008	0.03685	0.955	0.950
Comp	0.02404	1.613	0.1102	0.08202	0.955	0.580
Impu	0.01814	0.08289	0.0578	0.06075	0.955	0.970

[a] Bias = $(\hat{\beta} - \beta_0)/\beta_0$.

Summary statistics:
Measures of Central Tendency: mean, median, mode

- Mean: the sum of the values of a variable and dividing by number of the observations

Summary statistics: Measures of Central Tendency: mean, median, mode

- Mean: the sum of the values of a variable and dividing by number of the observations
- Median: the middle (the 50th centile) observation

Summary statistics:
Measures of Central Tendency: mean, median, mode

- Mean: the sum of the values of a variable and dividing by number of the observations
- Median: the middle (the 50th centile) observation
- Mode: the value that occurs most frequently

Summary statistics:
Measures of Central Tendency: mean, median, mode

- Mean: the sum of the values of a variable and dividing by number of the observations
- Median: the middle (the 50th centile) observation
- Mode: the value that occurs most frequently

```
. tabstat age // will only give you mean

    variable |      mean
-------------+----------
         age |  56.41176
------------------------

. tabstat age, s(count mean median) // s stands for statistics
    variable |         N      mean       p50
-------------+------------------------------
         age |        34  56.41176        56
--------------------------------------------
```

Summary statistics: Measures of Dispersion: range, IQR, variance, standard deviation

- Range: the difference between the maximum and the minimum

Summary statistics: Measures of Dispersion: range, IQR, variance, standard deviation

- Range: the difference between the maximum and the minimum
- Interquartile range: the absolute difference between the 25th percentile of the observations and the 75th.

Summary statistics: Measures of Dispersion: range, IQR, variance, standard deviation

- Range: the difference between the maximum and the minimum
- Interquartile range: the absolute difference between the 25th percentile of the observations and the 75th.
- Variance, standard deviation (sd): a measure of spread of the data

Summary statistics: Measures of Dispersion: range, IQR, variance, standard deviation

- Range: the difference between the maximum and the minimum
- Interquartile range: the absolute difference between the 25th percentile of the observations and the 75th.
- Variance, standard deviation (sd): a measure of spread of the data

$$s^2 = \widehat{Var}(x) = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

```
. tabstat age, s(count range min max iqr var sd)

    variable |         N     range       min       max
-------------+----------------------------------------
         age |        34        20        47        67
------------------------------------------------------

    variable |       iqr  variance        sd
-------------+------------------------------
         age |        10  36.12834  6.010686
--------------------------------------------
```

Graphs: Bad examples

Graphs can say more than texts! But it depends.....

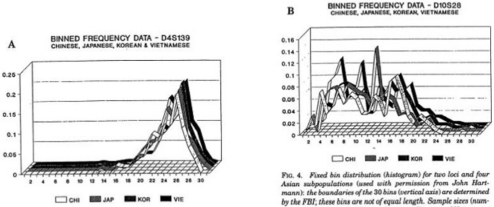
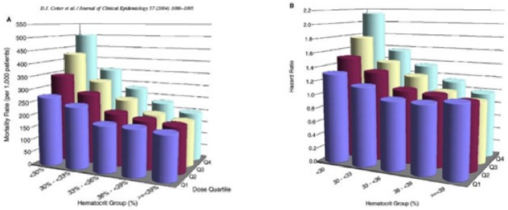


Fig. 4. *Fixed bin distribution (histogram) for two loci and four Asian subpopulations (used with permission from John Hartmann): the boundaries of the 30 bins (vertical axis) are determined by the FBI; these bins are not of equal length. Sample sizes (numbers of individuals) for Chinese, Japanese, Korean and Vietnamese are* 103, 125, 93 *and* 215 *for* D4S139 *and* 120, 137, 100 *and* 193 *for* D10S28. *The horizontal axis is the bin number; bins are not of equal length.*

Graphs: Bad examples

Too fancy?



D.J. Cotter et al. / Journal of Clinical Epidemiology 57 (2004) 1086–1095

Graphs: Bad examples

Insufficient info?

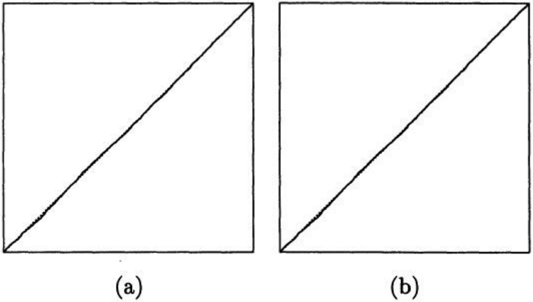
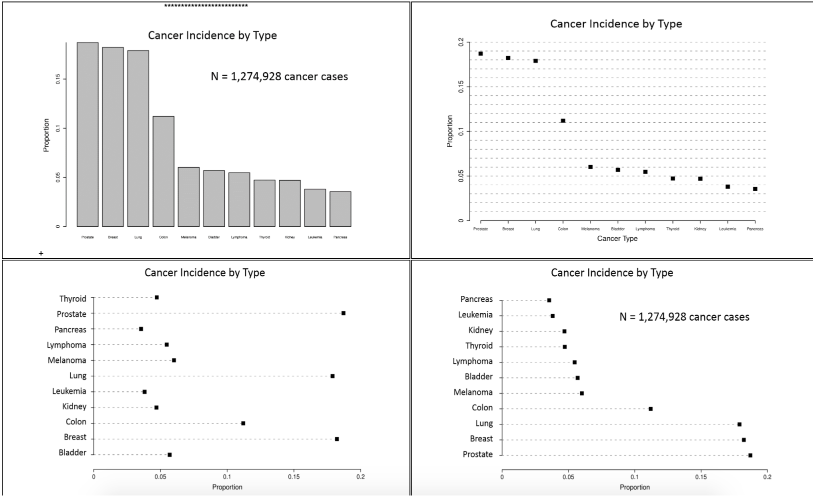


Figure 1. SRQ Plots of T_i/T_n (Vertical Axes) Against i/n (Horizontal Axes) for the Gibbs Sampler (a) and an Alternating Gibbs/Independence Sampler (b) for the Pump Failure Data Based on Runs of Length 5,000. Lines through the origin with unit slope are shown dashed; axis ranges are from 0 to 1 for all axes.

Graphs: Bad examples

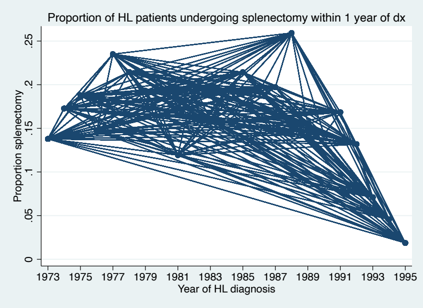
Sometimes there is no right nor wrong, it just depends on your interest.



Graphs: Learning from errors

Which part went wrong here?
Hint: something was missed in the code.

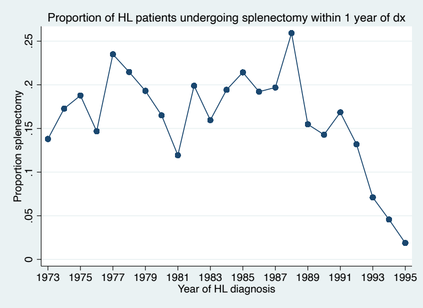
```
twoway connected prop diagyear, ///
subtitle("Proportion of HL patients") ///
ytitle(Proportion splenectomy) ///
xlabel(1973(2)1995)
```



Graphs: Learning from errors

It makes such a big difference if you missed sort!

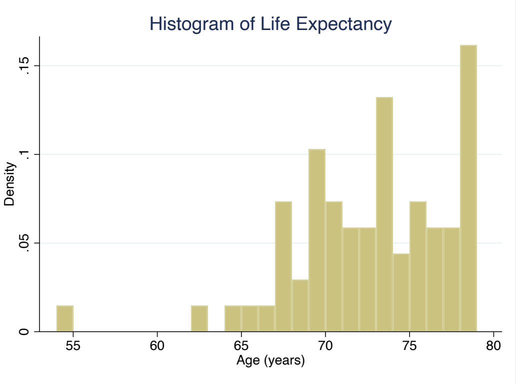
```
twoway connected prop diagyear, ///
subtitle("Proportion of HL patients") ///
ytitle(Proportion splenectomy) ///
xlabel(1973(2)1995) ///
sort
```



Graphs: Histogram

Histogram depicts the distribution of data, where x-axis is usually a continuous variable.

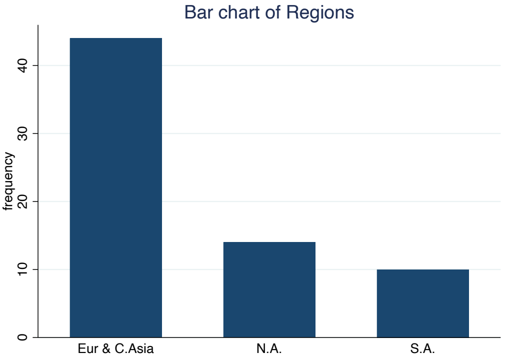
```
hist lexp, title("Histogram of Life Expectancy") ///
           xtitle(Age (years)) width(1) /// By each age
           graphregion(color(white)) //
```



Graphs: Bar chart

Bar chart shows the distribution of discrete (categorical) data.

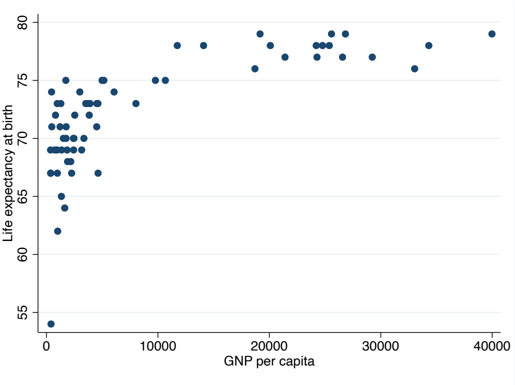
```
graph bar (count), over(region) ///
                   title("Bar chart of Regions") ///
                   graphregion(color(white)) //
```



Graphs: Scatter plot

Scatter plot demonstrates the relationship between two continuous variables.

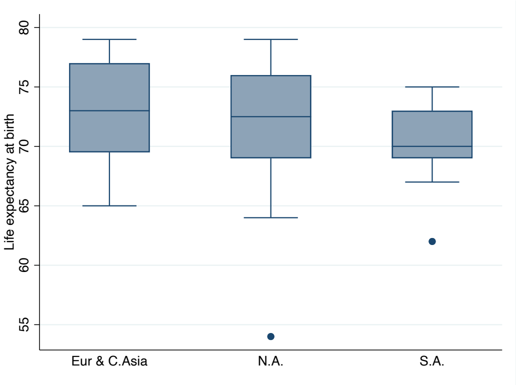
```
twoway scatter lexp gnppc, graphregion(color(white))
```



Graphs: Box plot

Box plot summarises the distribution of the data, with the 25th, 50th, and 75th percentile and 1.5 IQR.

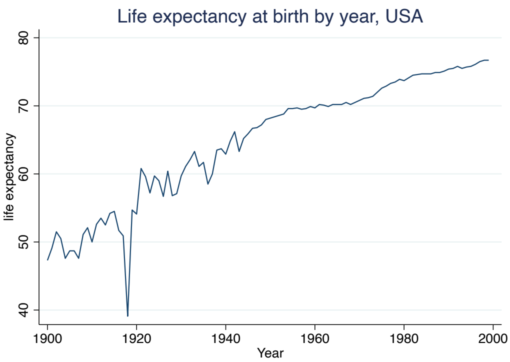
```
graph box lexp, over (region) ///
                graphregion(color(white))
```



Graphs: Line graph

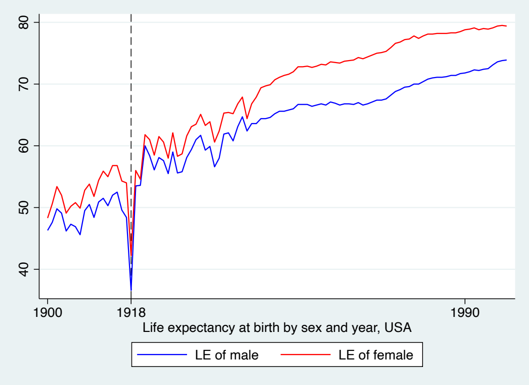
Line graph functions similarly as scatter plots, with time as x-axis usually.

```
sysuse uslifeexp, clear
twoway line le year, title("Life expectancy at birth by year, USA")
       graphregion(color(white)) }
```



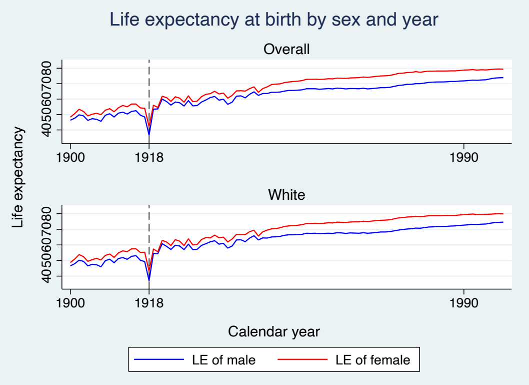
Graphs: Stratification

Data is already in separate columns. Or using `by()`.
Hint: `by()` is often used in individual-level data.



Graphs: Putting graphs together

`grc1leg2` plays the role in plotting graphs together.
Hint: `grc1leg2` is not a default Stata command. See `help grc1leg2` to install it.

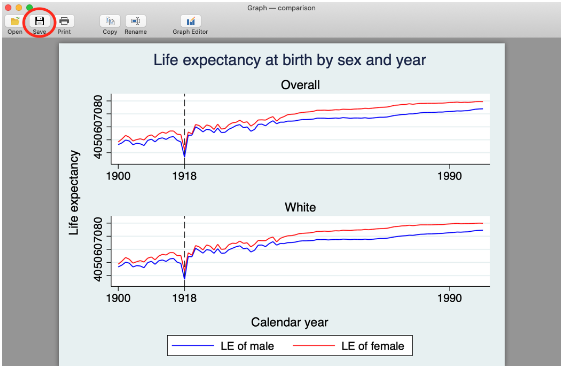


Graphs: Export

- A standard way:

```
graph export "location" /// assign the location
, as(pdf) name("")
```

- An intuitive way:



Graphs: Study map

Check the webpage: `https://extremepresentation.com/tools/`

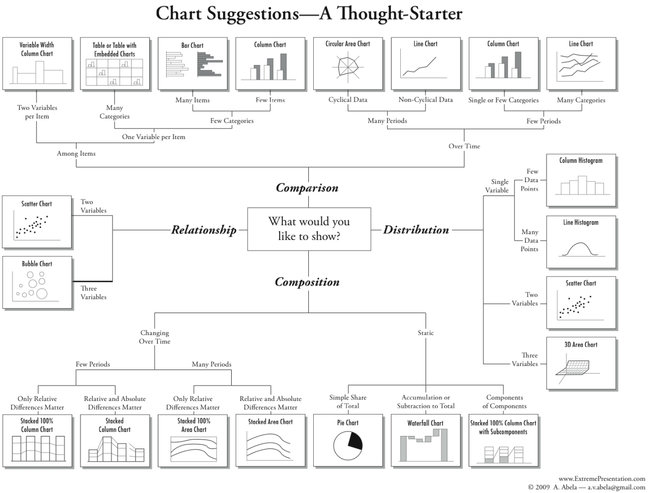


Chart Suggestions—A Thought-Starter

Variable Width Column Chart
Table or Table with Embedded Charts
Bar Chart
Column Chart
Circular Area Chart
Line Chart
Column Chart
Line Chart

Two Variables per Item
Many Categories
Many Items
Few Items
Cyclical Data
Non-Cyclical Data
Single or Few Categories
Many Categories
Few Categories
Many Periods
Few Periods
One Variable per Item
Over Time
Among Items

Comparison

Scatter Chart
Two Variables
Bubble Chart
Three Variables
Relationship

What would you like to show?

Distribution
Single Variable
Few Data Points
Column Histogram
Many Data Points
Line Histogram
Two Variables
Scatter Chart
Three Variables
3D Area Chart

Composition
Changing Over Time
Static
Few Periods
Many Periods
Only Relative Differences Matter
Relative and Absolute Differences Matter
Only Relative Differences Matter
Relative and Absolute Differences Matter
Simple Share of Total
Accumulation or Subtraction to Total
Components of Components
Stacked 100% Column Chart
Stacked Column Chart
Stacked 100% Area Chart
Stacked Area Chart
Pie Chart
Waterfall Chart
Stacked 100% Column Chart with Subcomponents

www.ExtremePresentation.com
© 2009 A. Abela — a.v.abela@gmail.com

References

1. Gordis L. *Epidemiology*. Philadelphia, PA: Elsevier/Saunders, 2014. ISBN 9781455737338.
2. David Goldsman PG. *A First Course in Probability and Statistics*. Georgia Institute of Technology, 2020.
3. Marcello Pagano KG. *Principles of Biostatistics*. Cengage Learning, Inc, 2000. ISBN 0534229026.
4. Erin Gabriel PF. Epidemiology PhD program, Karolinska Institutet, 2020.