

Fundamentals of Statistical Modeling (VT21)

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Lab 1

{{1}}

Exercise 0 (local macros)

In this course, we'll make extensive use of Stata's `local macros`. If they're new to you, get familiar with the help of the code below. Copy and paste it in a new do-file and run it one chunk at a time.

The Stata command `display` (abbreviated with `di`) prints strings in the Results window and can also be used as a hand calculator (`help display`).

```
* Chunk 1
local a = "Fundamentals of statistical modeling."
di "`a'"
```

```
* Chunk 2
local a = "statistical modeling"
di "Fundamentals of `a'."
```

```
* Chunk 3
local a = "Fundamentals of"
local b = "statistical"
local c = "modeling."
di "`a' `b' `c'"
```

```
* Chunk 4
local a = "Fundamentals"
local b = "`a' of"
local c = "`b' statistical"
local d = "`c' modeling."
di "`d'"
```

```
* Chunk 5
di exp(2) * exp(-2)
```

```
* Chunk 6
local a = "exp(2)"
local b = "exp(-2)"
di `a' * `b'
```

```
* Chunk 7
local a = "2"
local b = "exp(`a')"
local c = "exp(-`a)'"
```

```

di `b' * `c'

* Chunk 8
sysuse auto, clear
describe

local yvar = "weight"
local xvars = "length mpg"
local xvars2 = "price"
regress `yvar' `xvars' `xvars2'

```

Exercise 1

Some of the distributions we'll be working with in this course are:

- Normal: https://en.wikipedia.org/wiki/Normal_distribution
- Skew-normal: https://en.wikipedia.org/wiki/Skew_normal_distribution
- Gamma: https://en.wikipedia.org/wiki/Gamma_distribution
- Beta: https://en.wikipedia.org/wiki/Beta_distribution
- Exponential: https://en.wikipedia.org/wiki/Exponential_distribution
- Chi-squared: https://en.wikipedia.org/wiki/Chi-squared_distribution
- Weibull: https://en.wikipedia.org/wiki/Weibull_distribution
- Bernoulli: https://en.wikipedia.org/wiki/Bernoulli_distribution
- Negative binomial: https://en.wikipedia.org/wiki/Negative_binomial_distribution

Get familiar with the distributions above.

- Are they useful to model continuous or discrete variables?
- What's their support?
- By how many parameters are they parametrized?
- What does their shape look like?
- Which Stata functions implement their probability mass / probability density functions? And their cumulative distribution functions? You can find the entire list of Stata's statistical functions here: `help density_functions`.

Exercise 2

Load the data

```
{{2}}
```

We assume that $f(y_n)$ is normal. Estimate the parameters μ and σ . Use the `normalden()` function.

```
{{3}}
```

Estimate again the parameters μ and σ , but this time constrain the parameter σ to be positive by replacing $\sigma = \exp(\theta)$ (cf. slide 34). You'll get now an estimate of θ . Recover the MLE of σ . (Note that the MLE $\hat{\sigma}$ is the same but this "trick" improves computational stability).

```
{{4}}
```

Plot the estimated density $\hat{f}(y_n)$ over the sample histogram.

```
{{5}}
```

Plot the model-based estimated CDF $\hat{F}(y_n)$ (cf. slide 38) over the empirical CDF (cf. slide 19). The function `normal()` returns the CDF of a standard normal distribution.

```
{{6}}
```

Exercise 3

Assume that $f(y_g)$ is (2-parameter) gamma. Estimate the parameters α and β using the `gammaden()` function. Fix the location parameter g (the third argument of the `gammaden()` function), equal to 0.

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Plot the estimated density $\hat{f}(y_g)$ over the sample histogram.

{{8}}

Exercise 4

We assume that $f(y_b)$ is beta. Estimate the parameters α and β using the `betaden()` function.

{{9}}

Plot the estimated density $\hat{f}(y_b)$ over the sample histogram. (OBS: We need to be careful when plotting the estimated density function close to the boundaries of the distribution's support).

{{10}}

Exercise 5

We assume that $f(y_e)$ is exponential. Estimate the parameter λ . You'll need to code the density of an exponential distribution yourself: $f(y; \lambda) = \lambda \exp(-\lambda y)$

{{11}}

Plot the estimated density $\hat{f}(y_e)$ over the sample histogram.

{{12}}

Exercise 6

We assume that $f(y_c)$ is chi-squared. Estimate the parameter k using the `chi2den()` function.

{{13}}

Plot the estimated density $\hat{f}(y_c)$ over the sample histogram.

{{14}}