C3

Laboratorio 1

Universidad de Buenos Aires –
Exactas
departamento de física

Septiembre 2021

REPASO

*** Mediciones y sus incertezas** $(x´ \pm \Delta x)$ cm

*** Influencia del observador**

- **a) Uso de programa para análisis de imagen y medición de longitudes características de discos de $Ni_{80}Fe_{20}$**
- **b) N mediciones de la longitud de un objeto particular**

REPASO

Ej. Medida de una longitud $x´$:

$(x´ \pm \Delta x)$ cm => $x´ \in (x´ - \Delta x, x´ + \Delta x)$

x' (cm)	Δx (cm)	E_r	$E_r\%$
2,5	0,1	0,04	4
8,3	0,1	0,012	1,2
15,0	0,1	0,0067	0,67

* **Errores sistemáticos** (corrimiento de cero, calibración)
* **Errores causales** (observador, instrumentos,...)

Como definir un rango de incerteza para cada medición directa?

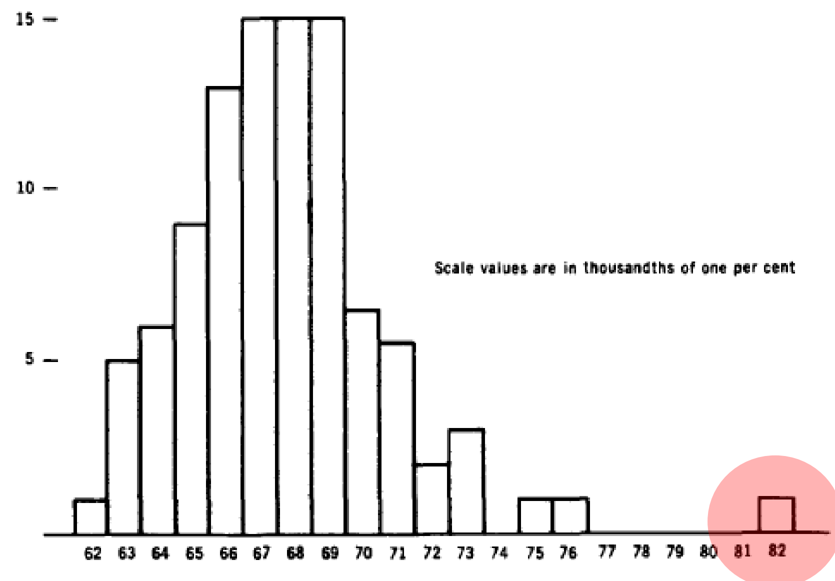
* Resolución del instrumento de medición
* Muestreo estadístico

Errores casuales => Estadística. N mediciones

Espesor de una hoja de papel, N= 95

thickness in mm.			
.0757	.0762	.0769	.0746
.0808	.0793	.0781	.0821
.0811	.0772	.0770	.0756
.0655	.0683	.0714	.0746
.0741	.0710	.0748	.0711
.0756	.0772	.0776	.0759
.0775	.0785	.0760	.0761
.0747	.0765	.0735	.0776
.0719	.0762	.0802	.0713
.0734	.0833	.0833	.0783
.0755	.0740	.0714	.0743
.0788	.0817	.0794	.0766
.0731	.0716	.0726	.0714
.0833	.0794	.0783	.0788
.0767	.0775	.0765	.0793
.0787	.0798	.0864	.0817
.0784	.0799	.0789	.0802
.0784	.0820	.0796	.0818
.0830	.0796	.0778	.0767
.0741	.0680	.0733	.0723
.0759	.0766	.0772	.0466**
.0810	.0812	.0789	.0776
.0777	.0759	.0795	.0790
.0784	.0786	.0797	.0859

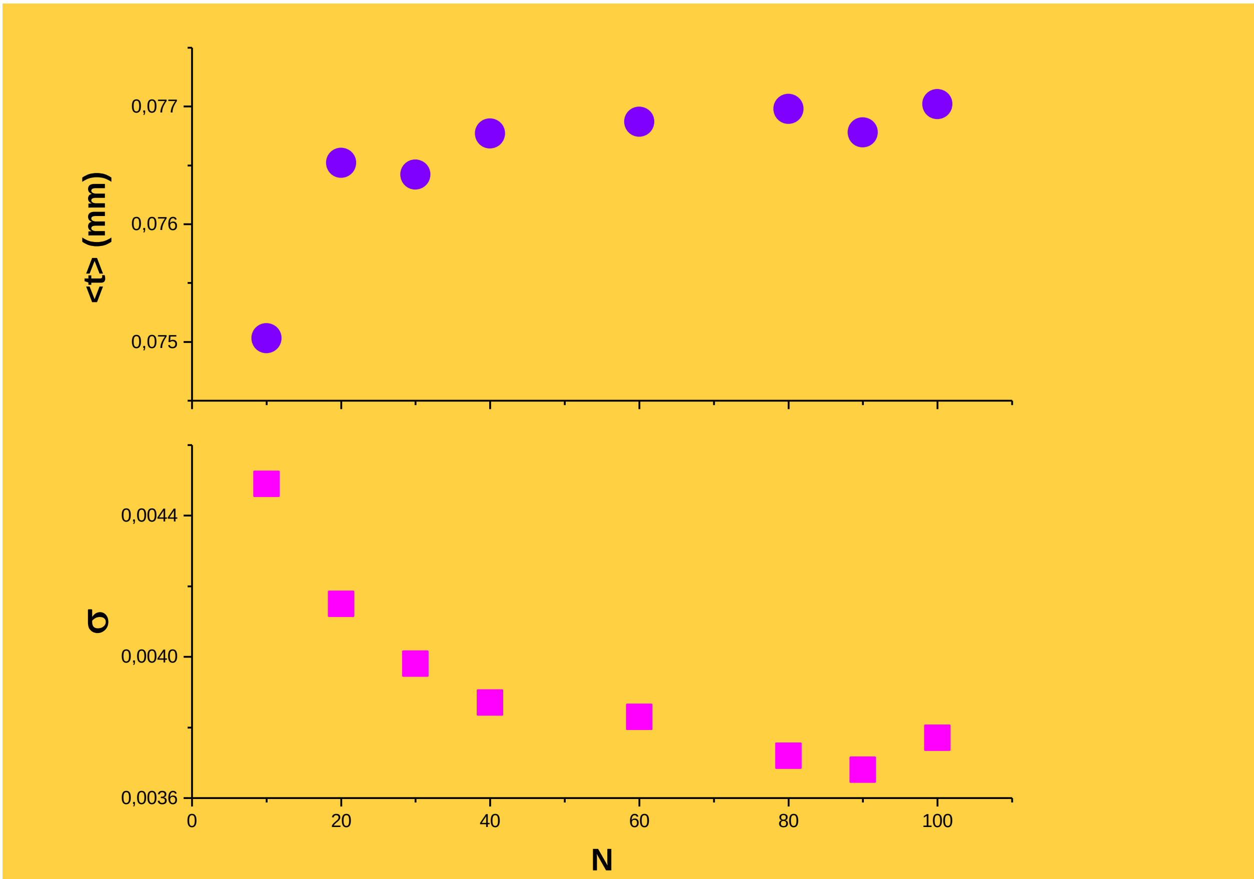
Contenido de magnesio en caños N=100

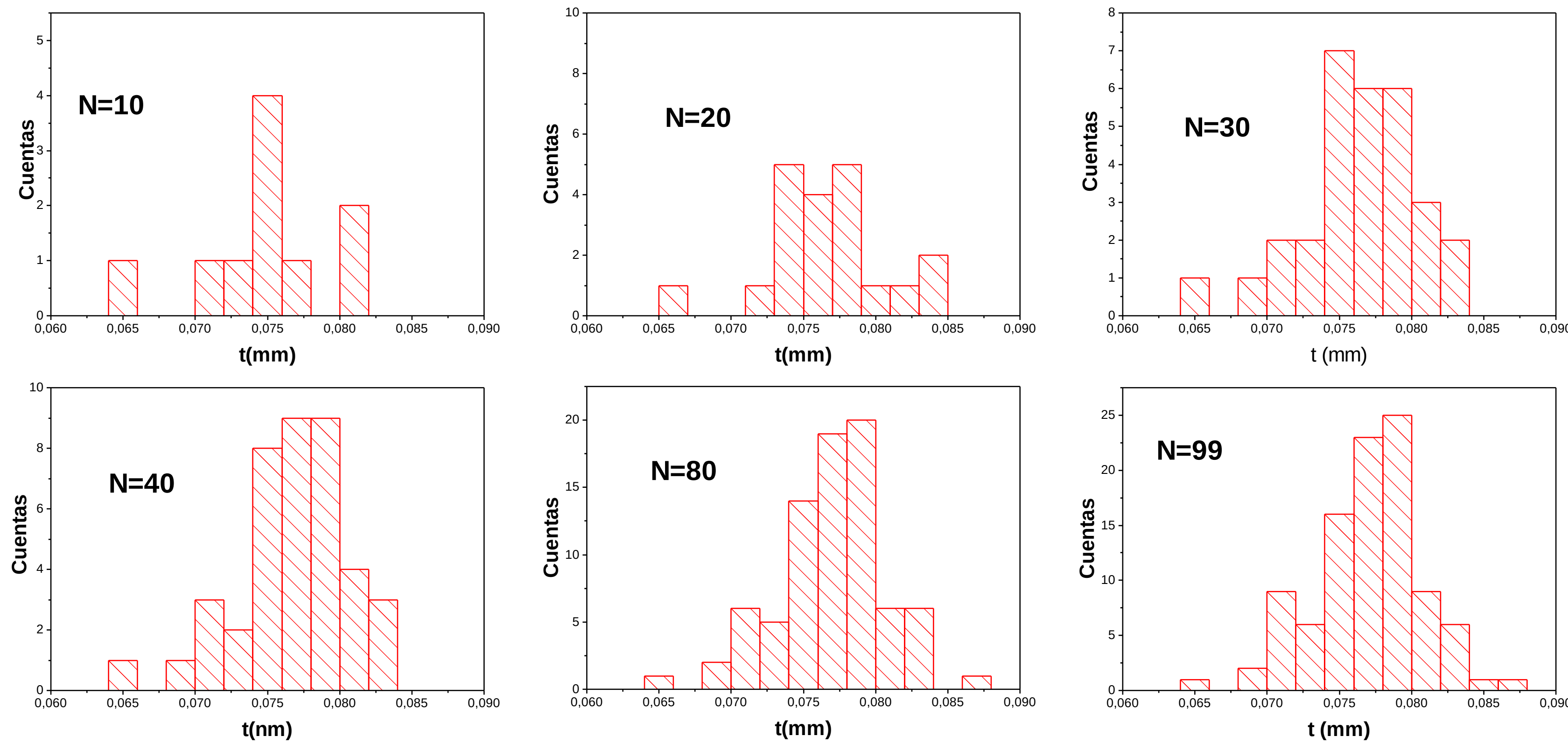


Experimentation and measurement. W.J. Youden, NIST Special publication 672- 1997

Análisis de la pagina anterior “Medida del espesor de una pagina de papel”

Cálculo de valores medios y desviación standard “por columna”

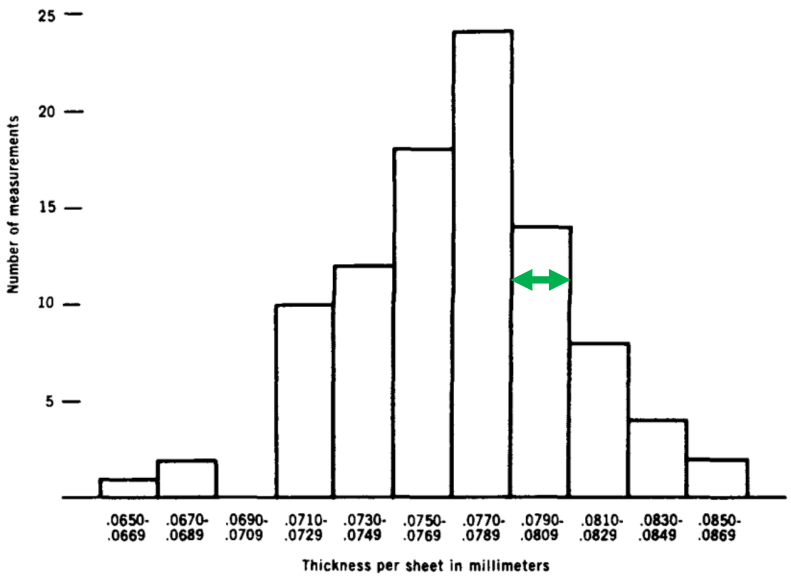




N=10
N=20
N=30
N=40
N=80
N=99
Cuentas
t(mm)
t (mm)
t(nm)
0,060
0,065
0,070
0,075
0,080
0,085
0,090

Ejemplos

Figure 2. Histogram for 95 measurements of paper thickness



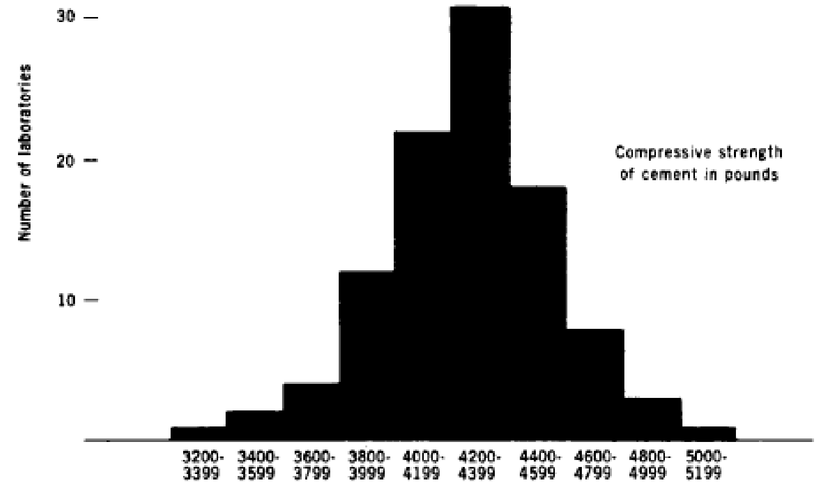
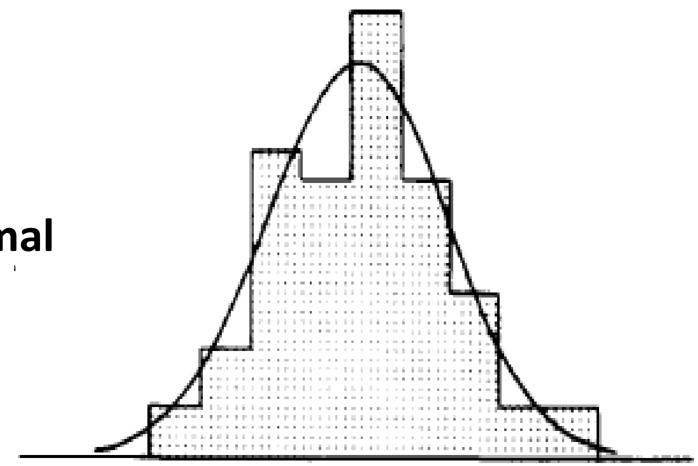
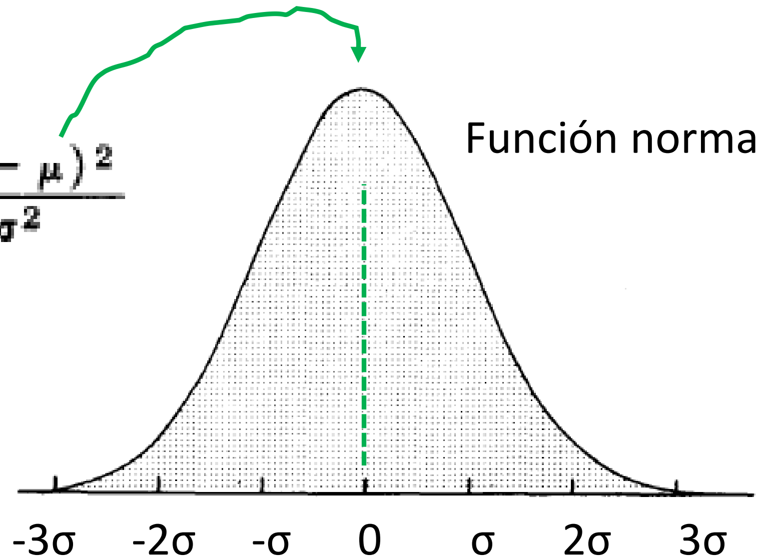


Figure 6. Histogram for cement tests reported by 102 laboratories.

Se describe con una función *Gaussiana* o normal



$$y = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



* Distribución simétrica
* Limites $x \to +\infty$, $x \to -\infty$

Parámetros: μ y σ

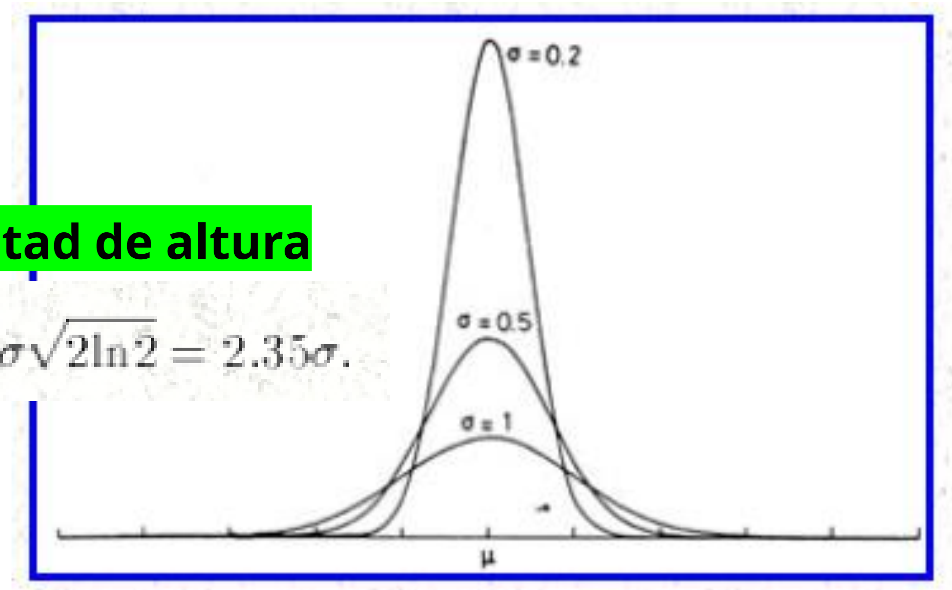
Habiamos definido:

$$\langle x \rangle = \sum_{i=0}^{N} x_i \,/\, N$$

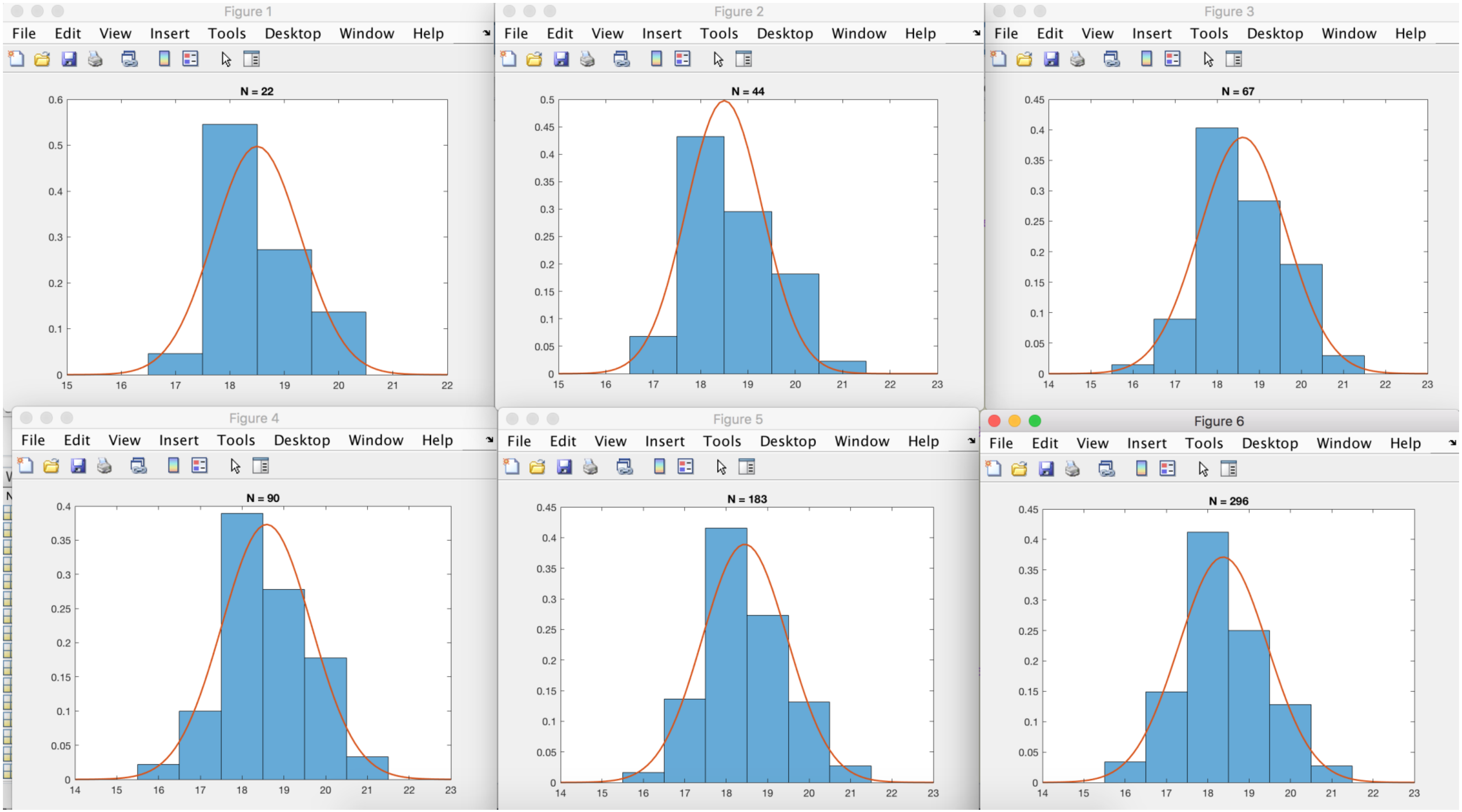
$$\sigma = \sqrt{\left(\frac{1}{N-1}\sum_{i=0}^{N}(x_i - \langle x \rangle)^2\right)}$$

Ancho a mitad de altura

$$\mathrm{FWHM} = 2\sigma\sqrt{2\ln 2} = 2.35\sigma.$$



Cuidado "con tirar una Gaussiana" !!

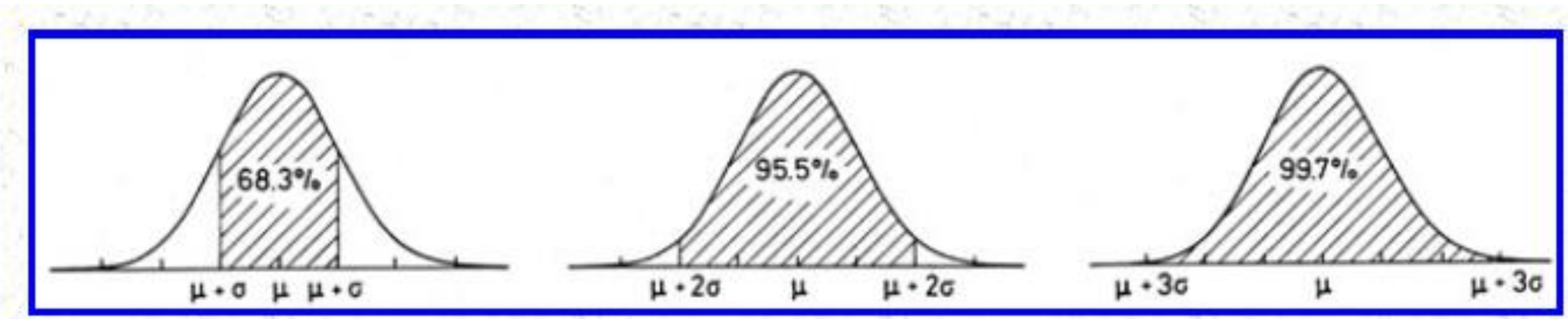


Como calculo el numero de cuentas en el intervalo (μ-σ, μ+σ)?

Si grafico N(x)/N como función de x, entonces, puedo describir a la función distribución de las cuentas como:

$$y = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$P(x_1 \leq x \leq x_2) = \int_{x1}^{x2} P(x)\, dx; \qquad \int P(x)\, dx = 1$$



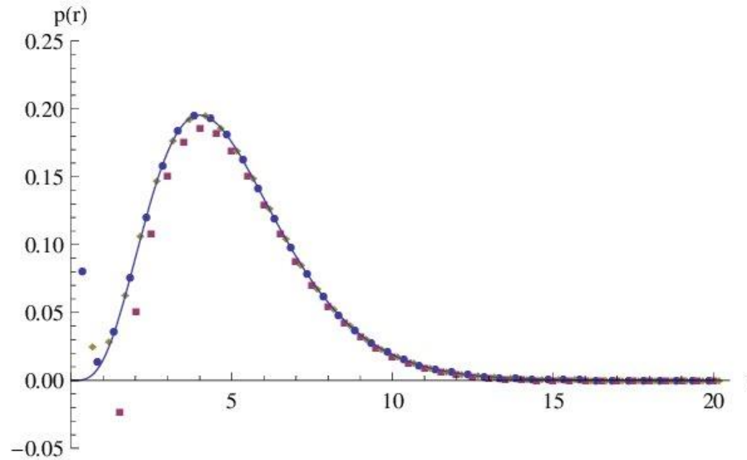
Porcentajes calculados a partir de la integral de la curva

$N_{cuentas}$ (μ-σ, μ+σ)/N_{total} * 100

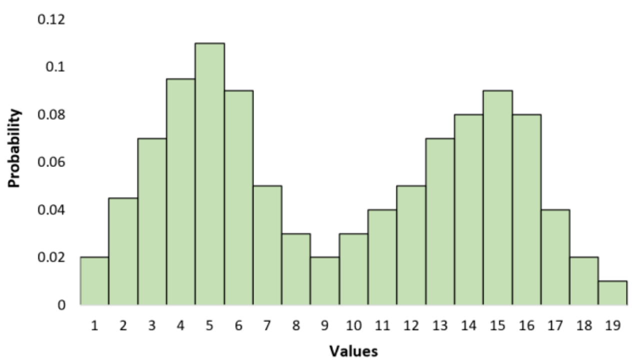
Otras distribuciones

Poisson

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

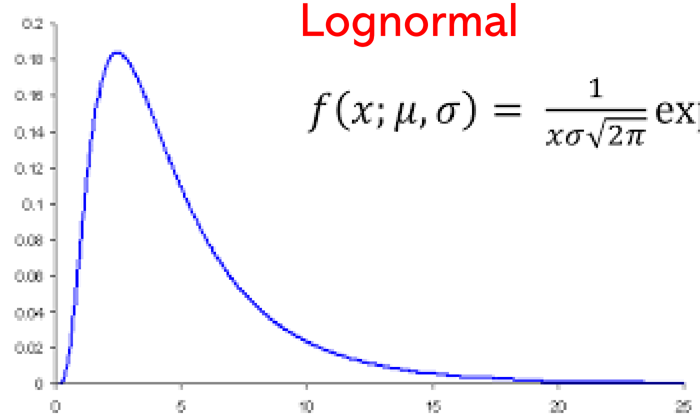


Bimodal



Lognormal

$$f(x;\mu,\sigma) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left(-\frac{(\ln x - \mu)^2}{2\sigma^2}\right)$$



Practica I

Objetivos: Determinar el **intervalo de incerteza** en una medición. Análisis de la **distribución** de N valores de la medición de una magnitud - estadística

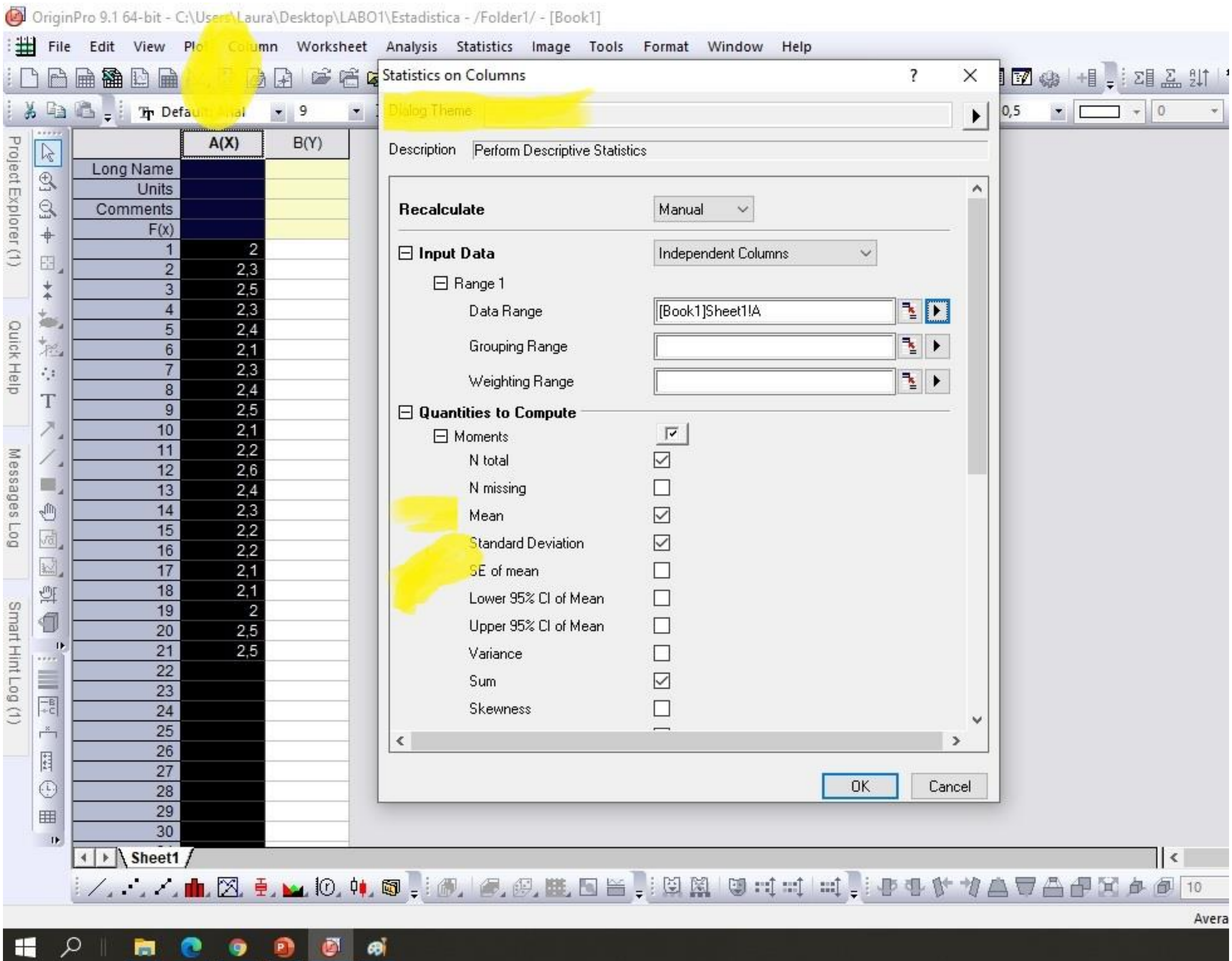
A: Medida de N discos "idénticos"

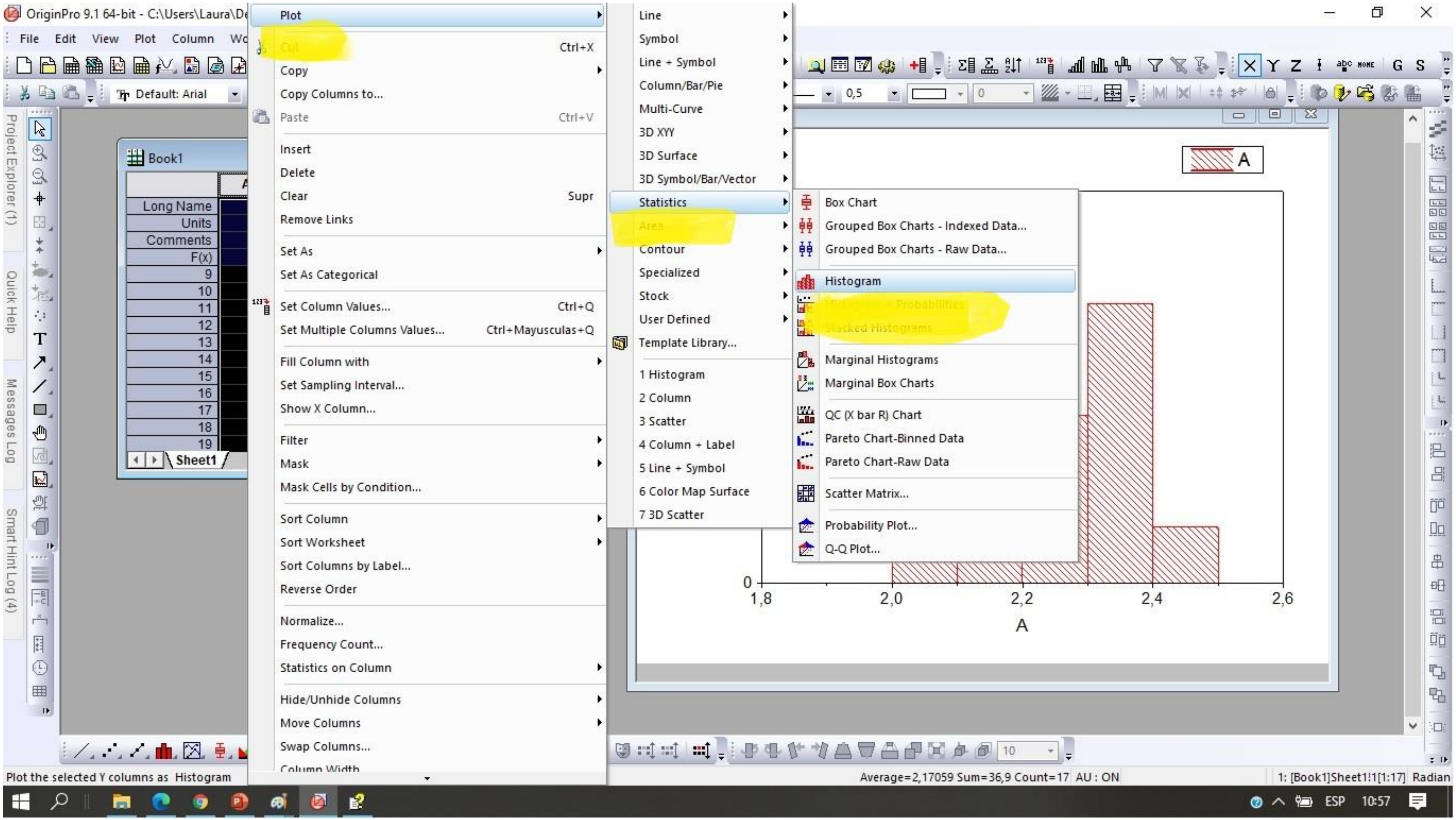
- Información sobre la imagen: tomada por un microscopio de fuerza atómica. Resolución lateral: algunos nm (dependiendo microscopio)

- Información sobre los discos: los discos están compuestos de una aleación de $Ni_{80}Fe_{20}$ y micro-fabricados a partir de una película delgada de este material (espesor: 20nm)

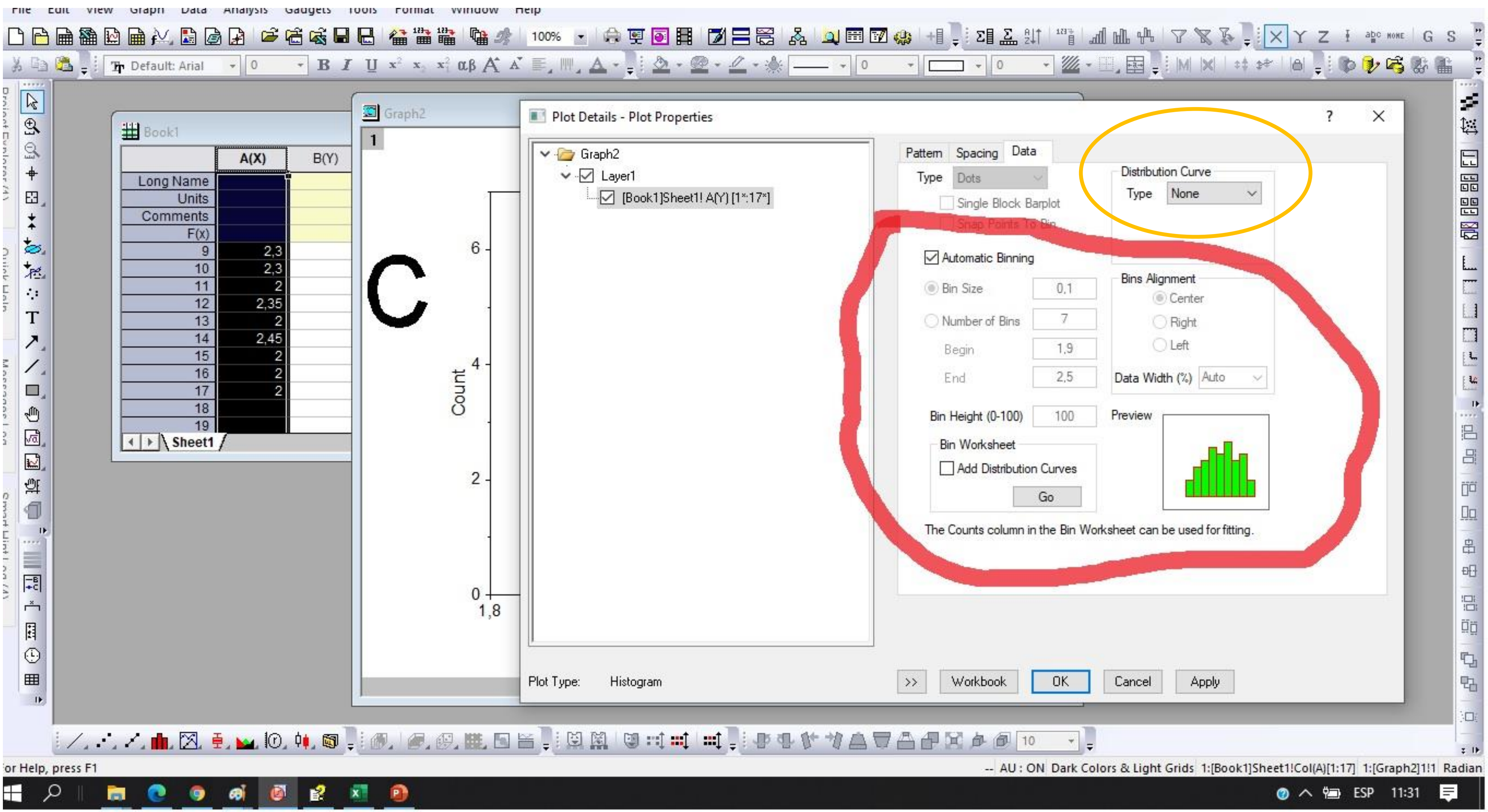
B: Medida de la longitud característica de un cuerpo N veces

Análisis de datos: sobre uso del origin





OriginPro 9.1 64-bit - C:\Users\Laura\De
File Edit View Plot Column Wo
Plot
Cut Ctrl+X
Copy
Copy Columns to...
Paste Ctrl+V
Insert
Delete
Clear Supr
Remove Links
Set As
Set As Categorical
Set Column Values... Ctrl+Q
Set Multiple Columns Values... Ctrl+Mayusculas+Q
Fill Column with
Set Sampling Interval...
Show X Column...
Filter
Mask
Mask Cells by Condition...
Sort Column
Sort Worksheet
Sort Columns by Label...
Reverse Order
Normalize...
Frequency Count...
Statistics on Column
Hide/Unhide Columns
Move Columns
Swap Columns...
Line
Symbol
Line + Symbol
Column/Bar/Pie
Multi-Curve
3D XYY
3D Surface
3D Symbol/Bar/Vector
Statistics
Area
Contour
Specialized
Stock
User Defined
Template Library...
1 Histogram
2 Column
3 Scatter
4 Column + Label
5 Line + Symbol
6 Color Map Surface
7 3D Scatter
Box Chart
Grouped Box Charts - Indexed Data...
Grouped Box Charts - Raw Data...
Histogram
Histogram + Probabilities
Stacked Histograms
Marginal Histograms
Marginal Box Charts
QC (X bar R) Chart
Pareto Chart-Binned Data
Pareto Chart-Raw Data
Scatter Matrix...
Probability Plot...
Q-Q Plot...
Book1
Long Name
Units
Comments
F(x)
Sheet1
Default: Arial
A
1,8 2,0 2,2 2,4 2,6
Plot the selected Y columns as Histogram
Average=2,17059 Sum=36,9 Count=17 AU : ON
1: [Book1]Sheet1!1[1:17] Radian
ESP 10:57


Book1
A(X)
B(Y)
Long Name
Units
Comments
F(x)
Sheet1
Graph2
C
Count
1,8
Plot Details - Plot Properties
Graph2
Layer1
[Book1]Sheet1! A(Y) [1*:17*]
Pattern
Spacing
Data
Type
Dots
Single Block Barplot
Snap Points To Bin
Distribution Curve
Type
None
Automatic Binning
Bin Size
0,1
Number of Bins
7
Begin
1,9
End
2,5
Bins Alignment
Center
Right
Left
Data Width (%)
Auto
Bin Height (0-100)
100
Bin Worksheet
Add Distribution Curves
Go
Preview
The Counts column in the Bin Worksheet can be used for fitting.
Plot Type:
Histogram
Workbook
OK
Cancel
Apply
For Help, press F1
AU : ON Dark Colors & Light Grids 1:[Book1]Sheet1!Col(A)[1:17] 1:[Graph2]1!1 Radian

Pagina “bins” pares x, y

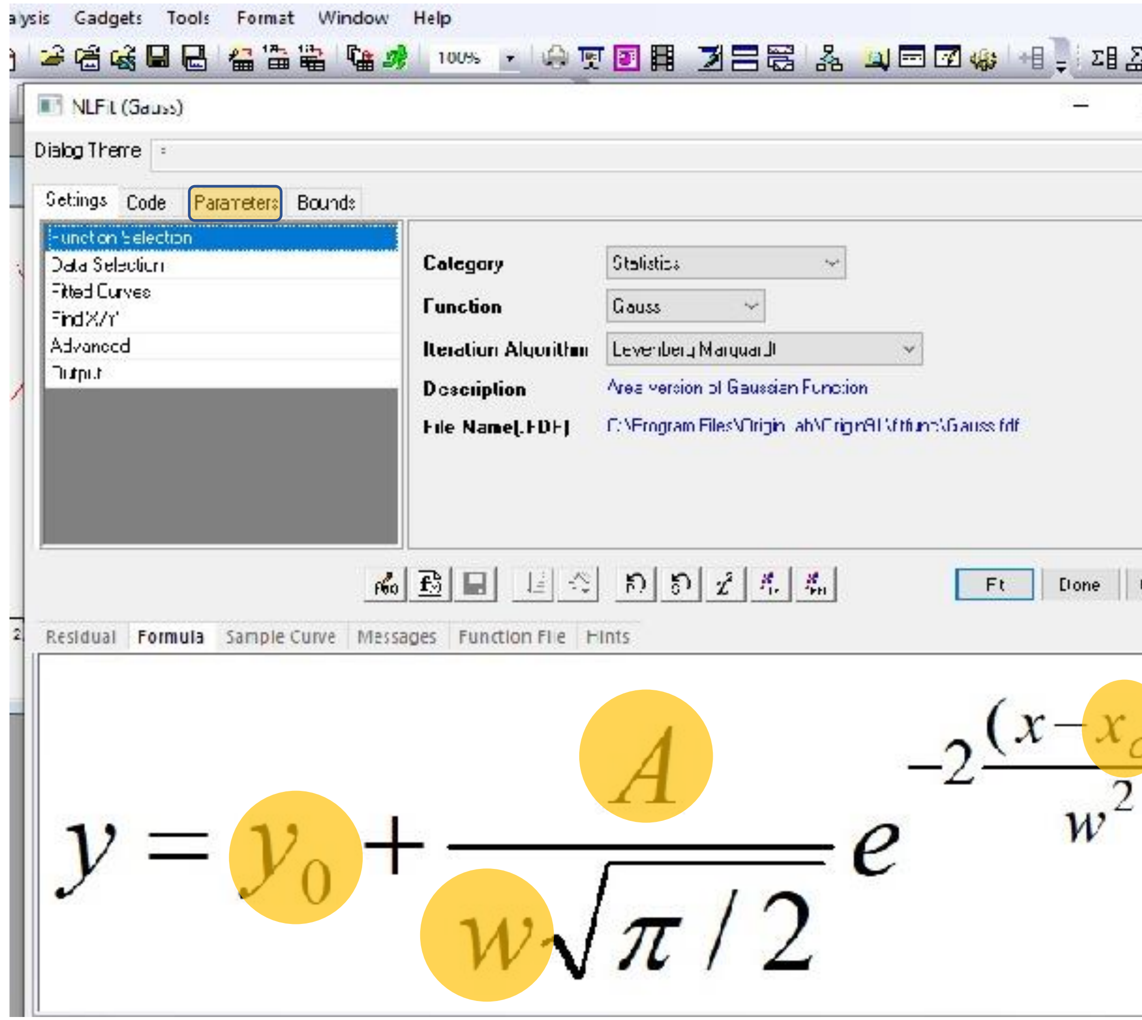
X: longitud
Y: cuentas

Para buscar la mejor curva

Analysis => Fitting

=> Nonlinear curve fit

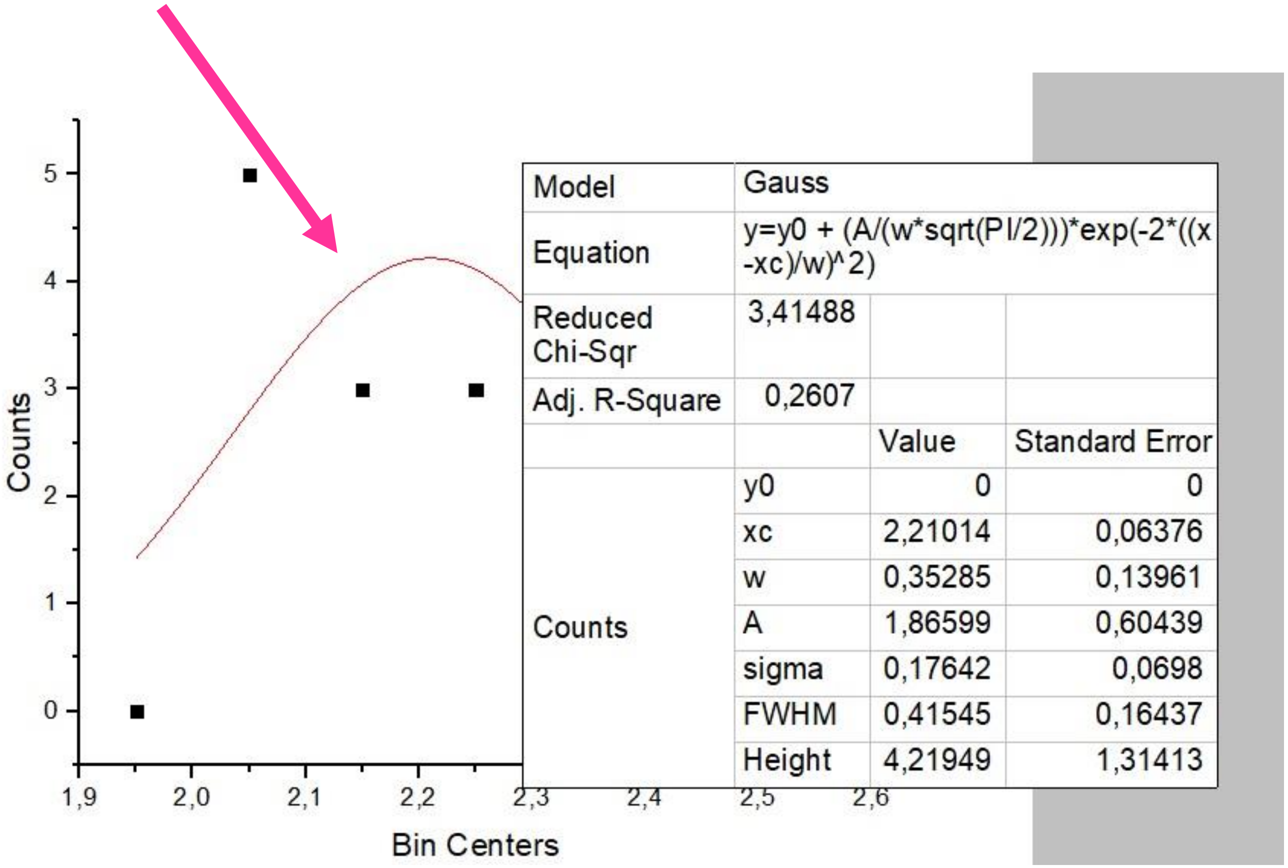
=> Open dialog



En la ventana elegir:

Category: Statistics
Function: Gauss

AJUSTE



Model	Gauss		
Equation	y=y0 + (A/(w*sqrt(PI/2)))*exp(-2*((x-xc)/w)^2)		
Reduced Chi-Sqr	3,41488		
Adj. R-Square	0,2607		
		Value	Standard Error
Counts	y0	0	0
	xc	2,21014	0,06376
	w	0,35285	0,13961
	A	1,86599	0,60439
	sigma	0,17642	0,0698
	FWHM	0,41545	0,16437
	Height	4,21949	1,31413

Chi-Sqr

R-square

Standard error

INFORME

Informe

- Titulo
- Lista de autores
- Resumen
- Introducción teórica/ antecedentes problema
- Detalles Experimentales
- Resultados y discusión

  Gráficos

  Tablas
- Conclusiones
- Bibliografía/ Referencias

Stripe_domains_reorientation_ × RotatableBarturenM-EPJB86-4- × about_experiment.pdf × about_experiment.pdf

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Rotatable anisotropy of epitaxial $Fe_{1-x}Ga_x$ thin films*

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Abstract. We show by a combined magnetic force microscopy and synchrotron radiation spectroscopy study that stripe-like patterned magnetic domains are present in $Fe_{1-x}Ga_x$ thin films. These stripes, whose origin is attributed to an out-of-plane magnetic component, can be rotated by an external magnetic field.

1 Introduction

Coupling magnetization of nanostructures to external non-magnetic fields is a challenge of today's research on nanomagnetism. For instance, electric fields were ado[pted] to control local magnetization in multiferroic materials [1], spin polarized currents to generate RF coherent emission in nanopillars [2], self-organized templates to switch magnetization [3]. These and many others experiments promise new means to control local magnetic properties in spintronics devices avoiding cumbersome inductive means.

In this context, magnetoelastic coupling in magnetostrictive nanomagnets has potential for controlling magnetic properties by mechanical deformation. For instance, some of us reported recently high-frequency (around 200 MHz) magnetocaloric effect triggering in MnAs thin films epitaxied on GaAs(001) substrates [4].

These considerations motivate the magnetic properties study reported in this article. We focus on strong magnetoelastic $Fe_{1-x}Ga_x$ thin films prepared by Molecular Beam Epitaxy on GaAs(001). It is well known [that] $Fe_{1-x}Ga_x$ magnetoelastic coupling is tuned by the Ga content, displaying a high λ_{100} coefficient (400×10^{-6} for $x = 20\%$) and a strong dependence of the magnetostrictive coefficient on the Ga concentration [5,6].

Here, we report on the rotatable anisotropy of

OP magnetic anisotropy due to $Fe_{1-x}Ga_x$ magnetostriction, probably enhanced by epitaxial constraints [7,8].

2 Sample growth

OJO

$Fe_{1-x}Ga_x$ thin films with $x = 15\%$ were deposited by MBE on C(2×2)-Zn terminated ZnSe epilayer, a prototype of low reactive iron/semiconductor interfa[ce] [9]. Details of the MBE-growth of a pseudomorphic [..]-nm thick ZnSe epilayer have been reported previously [7]. Such epilayer constitutes an efficient chemical barri[er] t[o] separate $Fe_{1-x}Ga_x$ from the substrate. We kept constant the growth temperature at 180 °C. At the end of the Fe-Ga growth, the samples were transferred from the MBE chamber to UHV-interconnected multi-chambers, where films compositions were firstly analyzed by X-ray photoemission spectroscopy (XPS). At the end, the films were protected by a 3 nm thick gold capping layer.

El informe va a una columna y espacio y medio de espaciado entre líneas.

3 Experimental

As observed in reference [7] $Fe_{1-x}Ga_x$ thin films are under a compressive strain. It was found that the in-plane lattice parameter of bulk iron is preserved leading to a marked tetragonal distortion. This tetragonal distortion is meta-

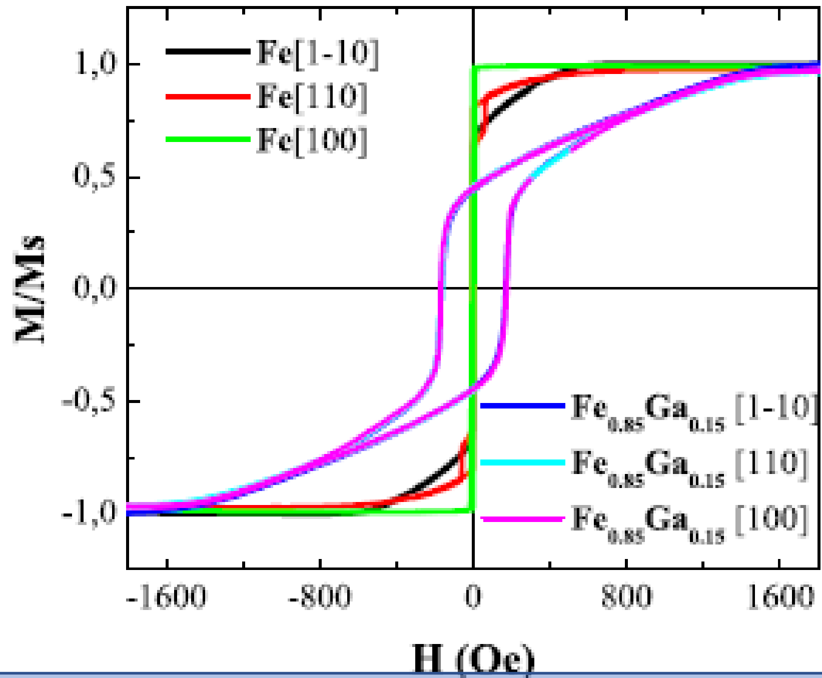

Fig. 2. VSM measurements of pure iron and FeGa thin films epitaxied on ZnSe/GaAs(001) substrates.