Pre: Estadística descriptiva que nos faltó.

- Varianza poblacional estimada
- Desviación estándar poblacional estimada
- Error estándar real
- Error estándar estimado

Varianza poblacional

$$\sigma_x^2 \ (\text{varianza real}) = \frac{\sum (X - \bar{X})^2}{N}$$

Varianza poblacional

$$\sigma_x^2 \ (\text{varianza real}) = \frac{\sum (X - \bar{X})^2}{N}$$

$$s_x^2 \ (\text{varianza estimada}) = \frac{\sum (X - \bar{X})^2}{N - 1}$$

Desviación estándar poblacional

$$\sigma_x \text{ (desviación real)} = \sqrt{\frac{\sum(X - \bar{X})^2}{N}}$$

Desviación estándar poblacional

$$\sigma_x \text{ (desviación real)} = \sqrt{\frac{\sum(X - \bar{X})^2}{N}}$$

$$s_x \text{ (desviación estimada)} = \sqrt{\frac{\sum(X - \bar{X})^2}{N - 1}}$$

Error estándar de la media

$$\sigma_{\bar{x}} \ \text{(error estándar)} = \frac{\sigma_X}{\sqrt{N}}$$

Error estándar de la media

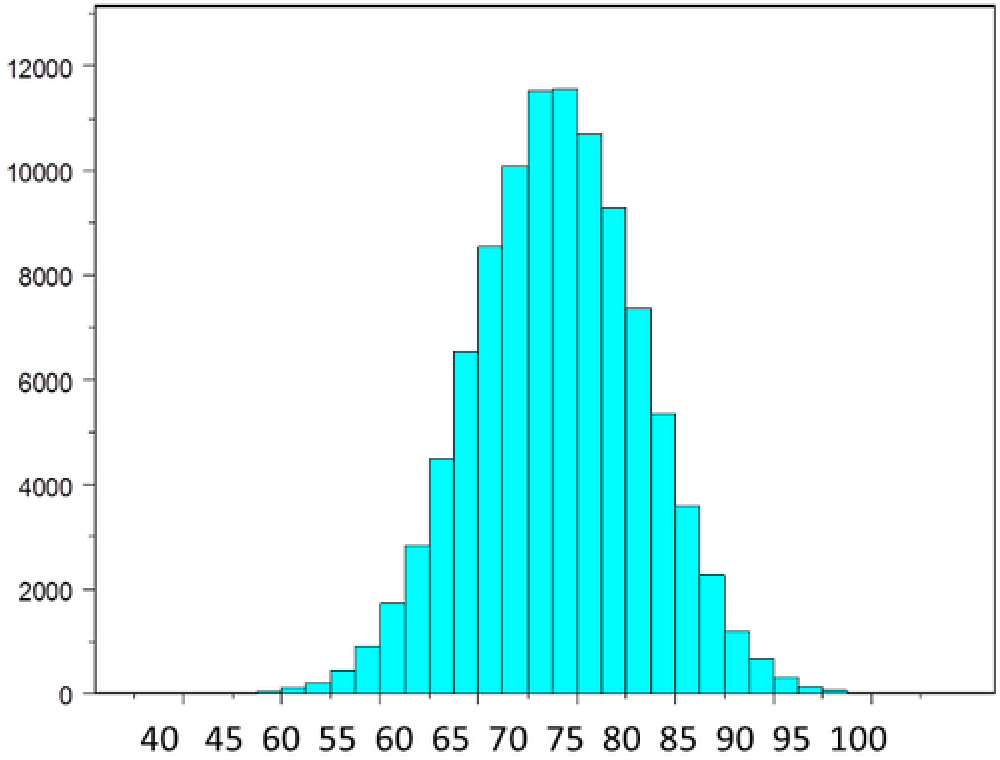
$$\sigma_{\bar{x}} \text{ (error estándar)} = \frac{\sigma_X}{\sqrt{N}}$$

$$s_{\bar{x}} \text{ (error estimado)} = \frac{s_X}{\sqrt{N}} = \sqrt{\frac{s_X^2}{N}}$$

Estadística inferencial

Estadística inferencial

- Generalización
- Pruebas de hipótesis
- Base en Teorema Central del Límite


12000
10000
8000
6000
4000
2000
0
40 45 60 55 60 65 70 75 80 85 90 95 100

- Estadística paramétrica

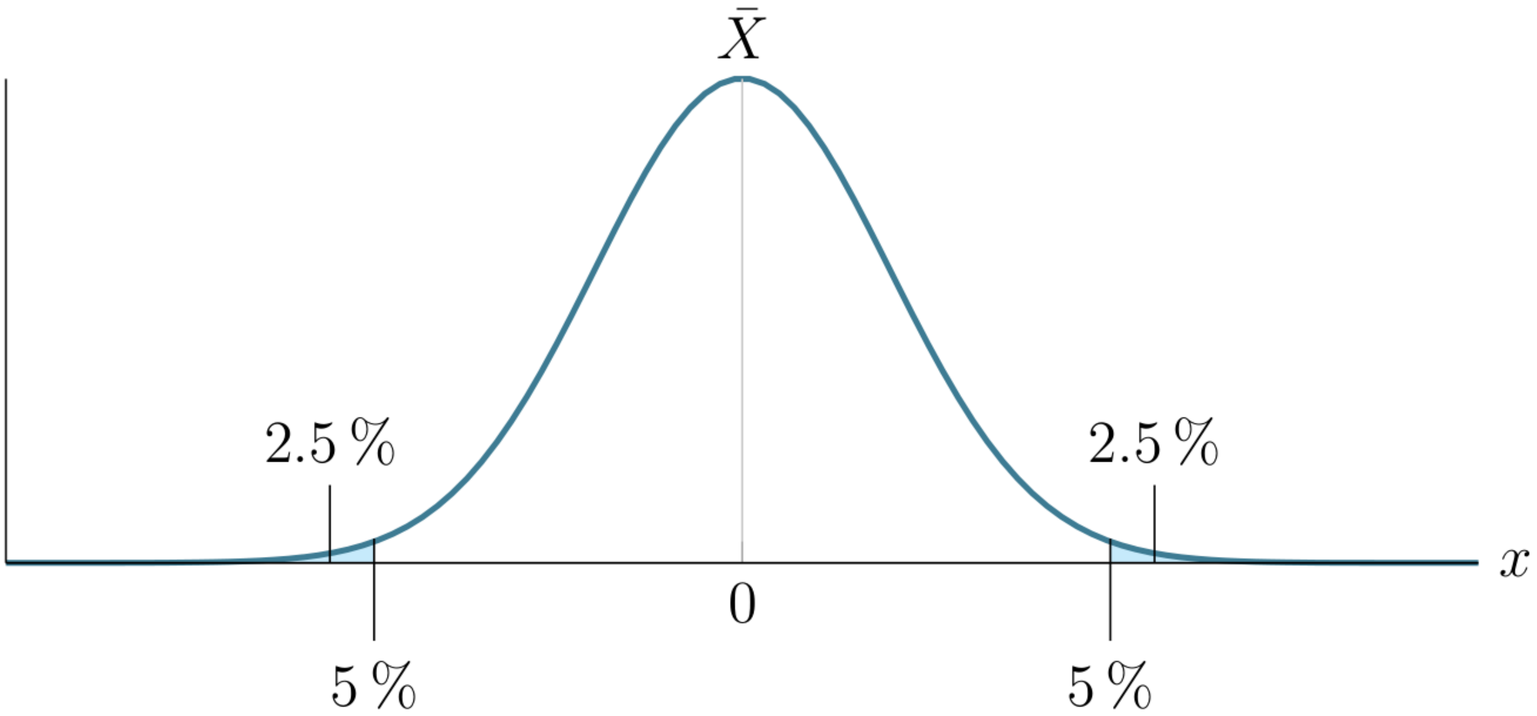
- Estadística paramétrica
  - Variable dependiente con distribución normal
  - Nivel intervalar o de razón

- Estadística paramétrica
  - Variable dependiente con distribución normal
  - Nivel intervalar o de razón
- Estadística no paramétrica

- Estadística paramétrica
  - Variable dependiente con distribución normal
  - Nivel intervalar o de razón
- Estadística no paramétrica
  - No

Pruebas de hipótesis

1) Establecer hipótesis experimental
2) Diseñar experimento para probarla
3) Traducir a hipótesis estadísticas
4) Hacer análisis inferencial

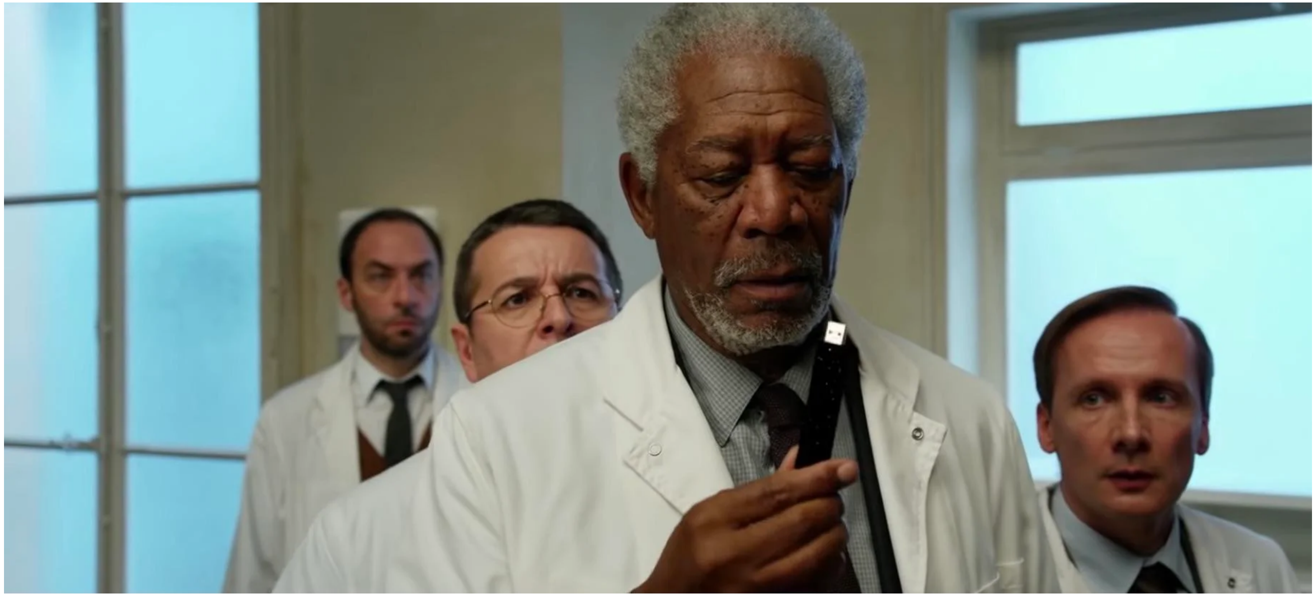

$\bar{X}$
2.5 %
2.5 %
x
0
5 %
5 %

Prueba

- Comparación con la población de origen
- Requisitos
  - Distribución aproximadamente normal
  - Selección al azar
  - Parámetros conocidos
    - Media
    - Desviación

Ejemplo

Ejemplo



Ejemplo

$$\mu = 100$$

$$\sigma_X = 15$$

Ejemplo

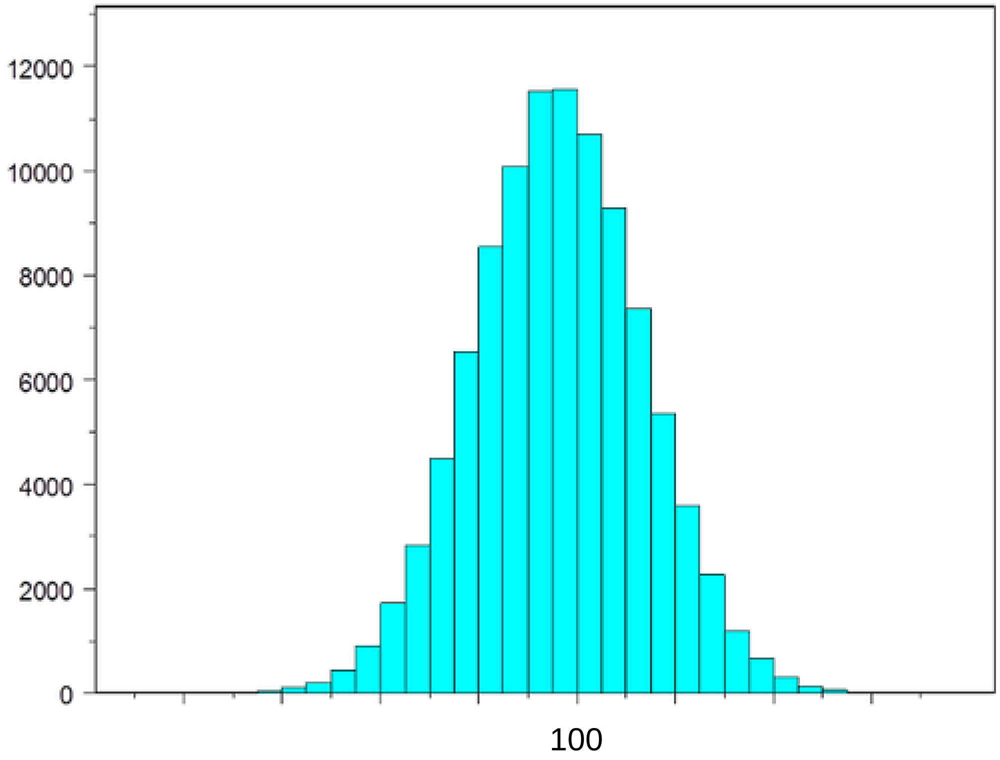
$$\mu = 100$$

$$\sigma_X = 15$$

$$\bar{X} = 105$$

$$N = 36$$

Ejemplo



Ejemplo

$$H_0 : \mu = 100$$

$$H_a : \mu \neq 100$$

Ejemplo

$$H_0 : \mu = 100$$

$$H_a : \mu \neq 100$$

Agotan todas las posibilidades

Recordando el puntaje

$$z = \frac{X - \bar{X}}{S_X}$$

Diferencia con respecto a la media sobre desviación estándar

Ejemplo

- Elegir un nivel de Alpha (probabilidad de error tipo I)
- Complementario a nivel Beta

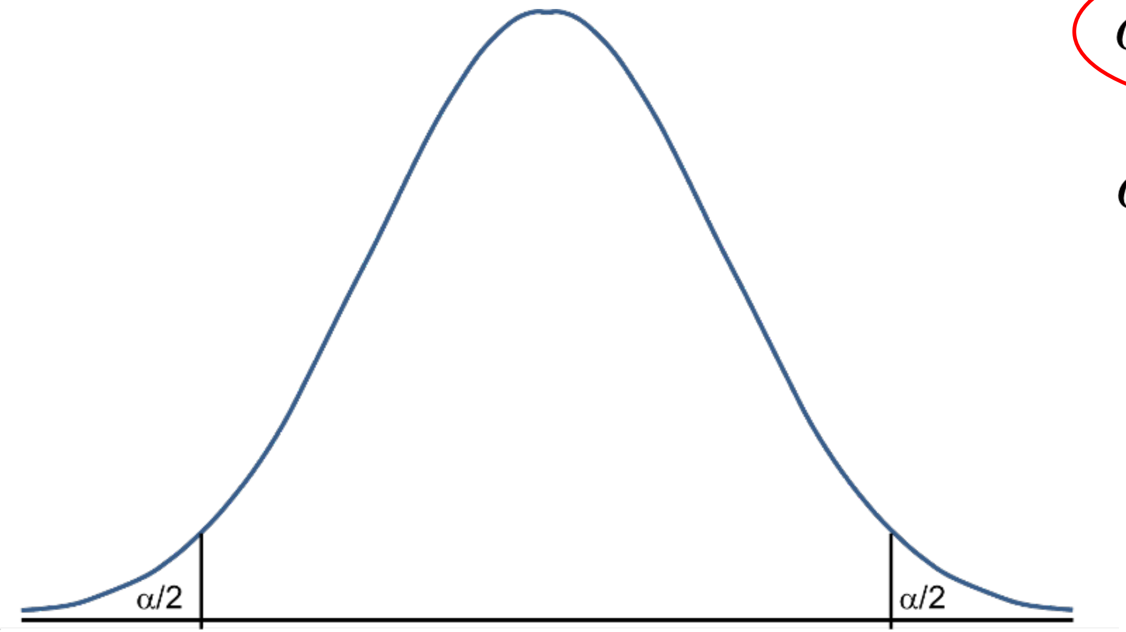
$$\alpha = .05$$

$$\alpha = .01$$

¿Por qué no usar un alpha más estricto?

	Existe Efecto	No Existe Efecto
Decimos que sí existe efecto	Correcto	Falso positivo Error tipo I Error α
Decimos que no existe efecto	Falso negativo Error tipo II Error β	Correcto

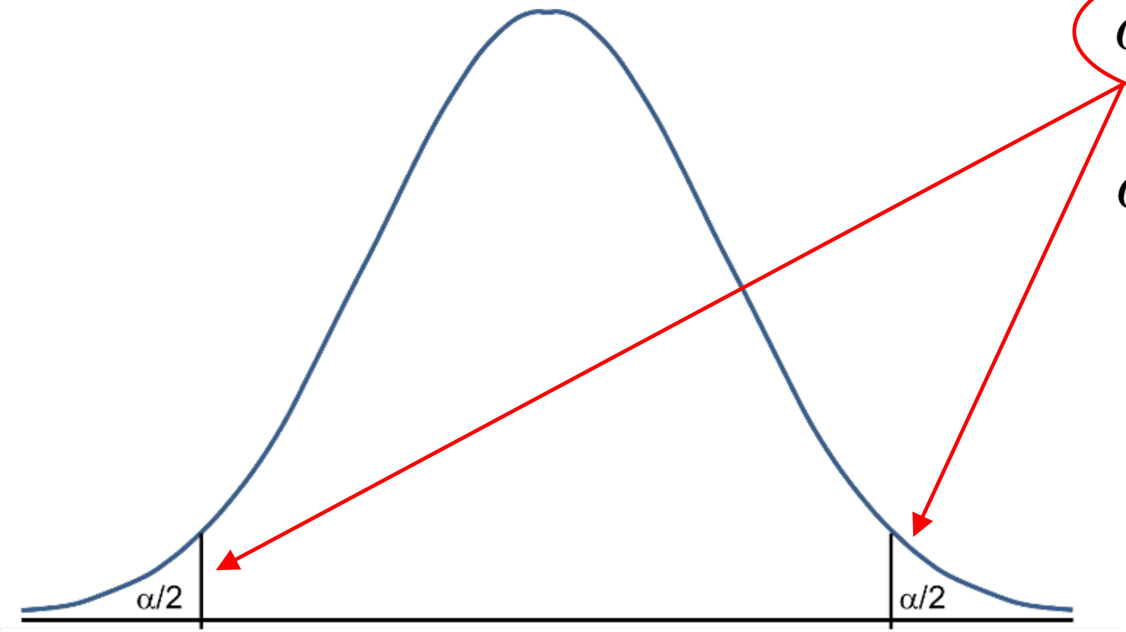
Ejemplo



$$\alpha = .05$$

$$\alpha = .01$$

Ejemplo



$\alpha = .05$

$\alpha = .01$

Ejemplo

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952

$$\alpha = .05$$

Ejemplo

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
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2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952

$$\alpha = .05$$

$$\frac{\alpha}{2} = .025$$

Ejemplo

$$\mu = 100$$

$$\sigma_X = 15$$

$$\bar{X} = 105$$

$$N = 36$$

Resta convertir el valor de la media en puntaje Z

Ejemplo

$$z = \frac{X - \bar{X}}{S_X}$$

Para dato único

$$z_{obt} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

Para media muestral

Ejemplo

$$z = \frac{X - \bar{X}}{S_X}$$

Para dato único

$$z_{obt} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

Para media muestral

$$\sigma_{\bar{X}} = \frac{\sigma_X}{\sqrt{N}}$$

Ejemplo

$\mu = 100$ $\bar{X} = 105$

$\sigma_X = 15$ $N = 36$

$$\sigma_{\bar{X}} = \frac{\sigma_X}{\sqrt{N}} = \frac{15}{\sqrt{36}} = \frac{15}{6} = 2.5$$

Ejemplo

$\mu = 100$ $\bar{X} = 105$

$\sigma_X = 15$ $N = 36$

$\sigma_{\bar{X}} = 2.5$

$$z_{obt} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}} = \frac{105 - 100}{2.5} = \frac{+5}{2.5} = +2.00$$

Ejemplo

$\mu = 100$ $\bar{X} = 105$

$\sigma_X = 15$ $N = 36$

$\sigma_{\bar{X}} = 2.5$ $z_{obt} = +2.00$

$z_{crit} = \pm 1.96$

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
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2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952

$\frac{\alpha}{2} = .025$

Ejemplo

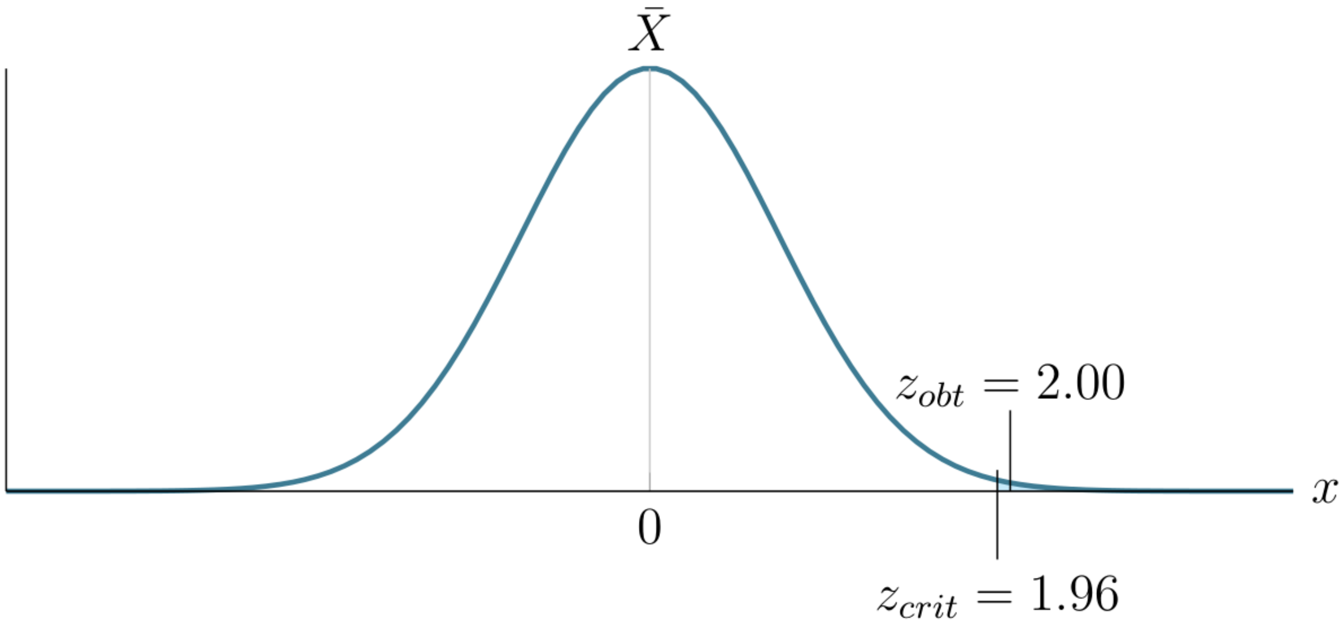
$$z_{obt} = +2.00$$

$$z_{crit} = \pm 1.96$$

$$H_0 : \mu = 100$$

$$H_a : \mu \neq 100$$

Ejemplo

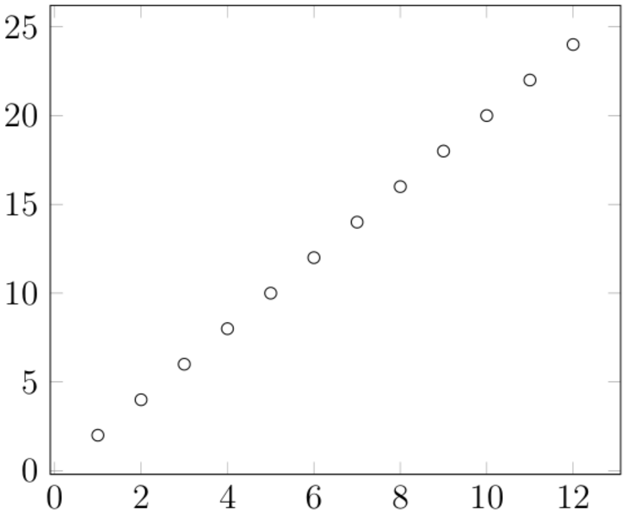


Correlación

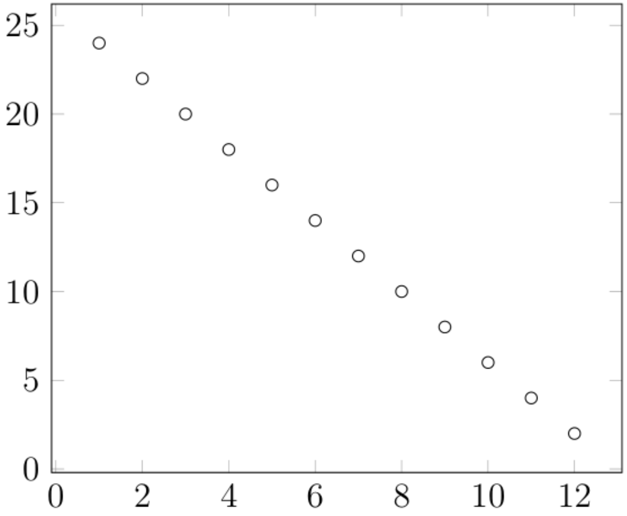
- Cambio ordenado
- Datos completos, no MTC
- Resumen relaciones
- Direcciones
  - +, -, :(
  - Fuerza

Correlación

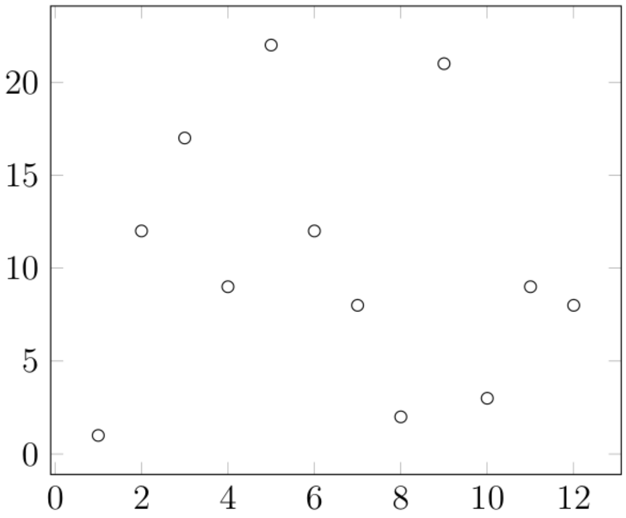
+1



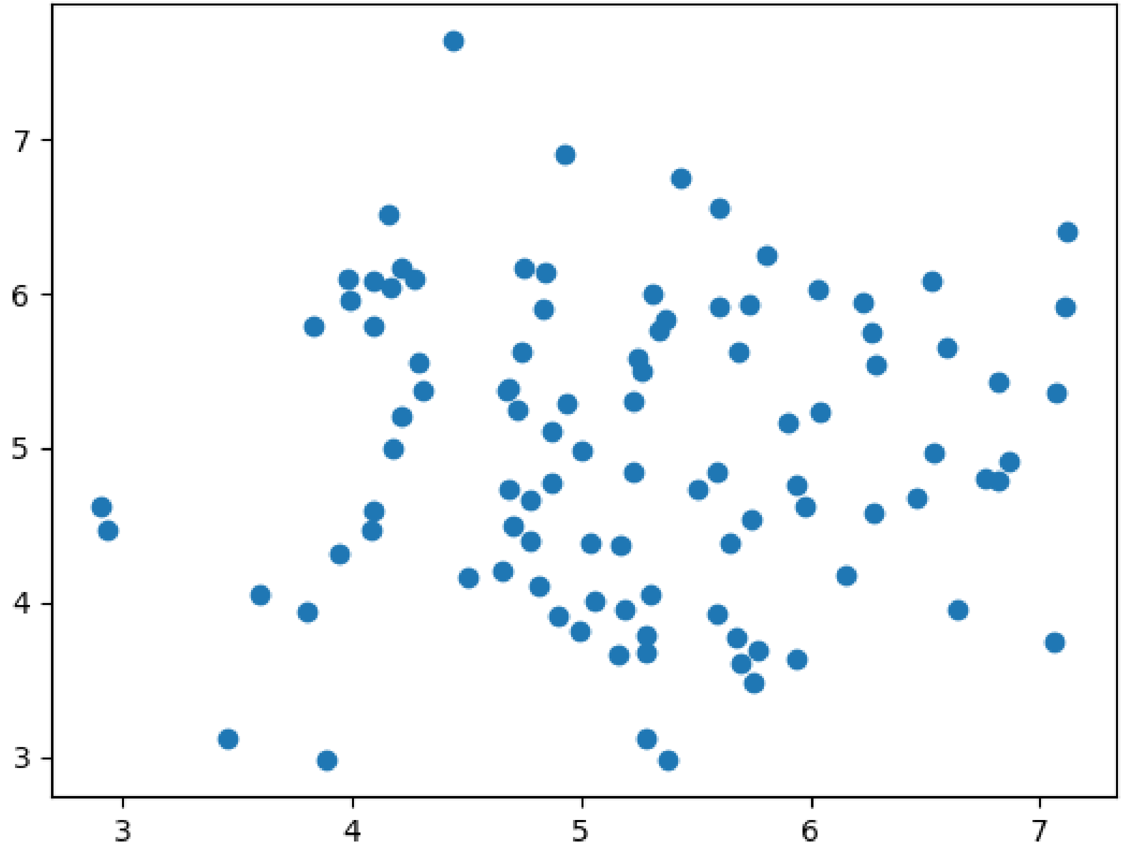
-1



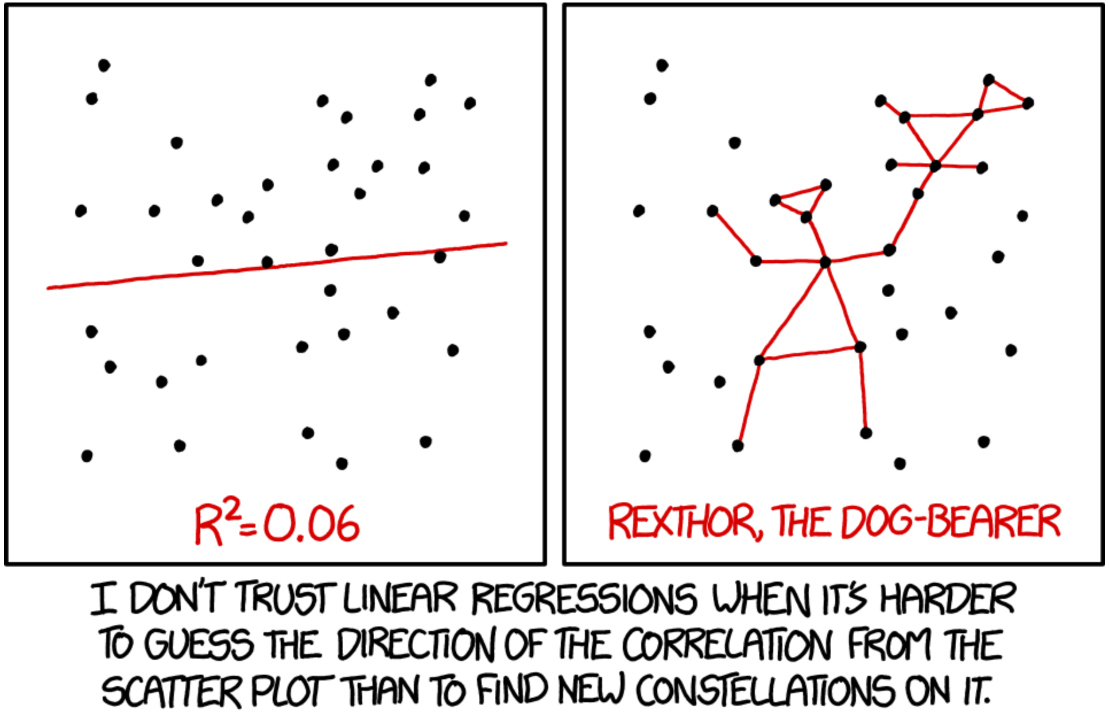
0



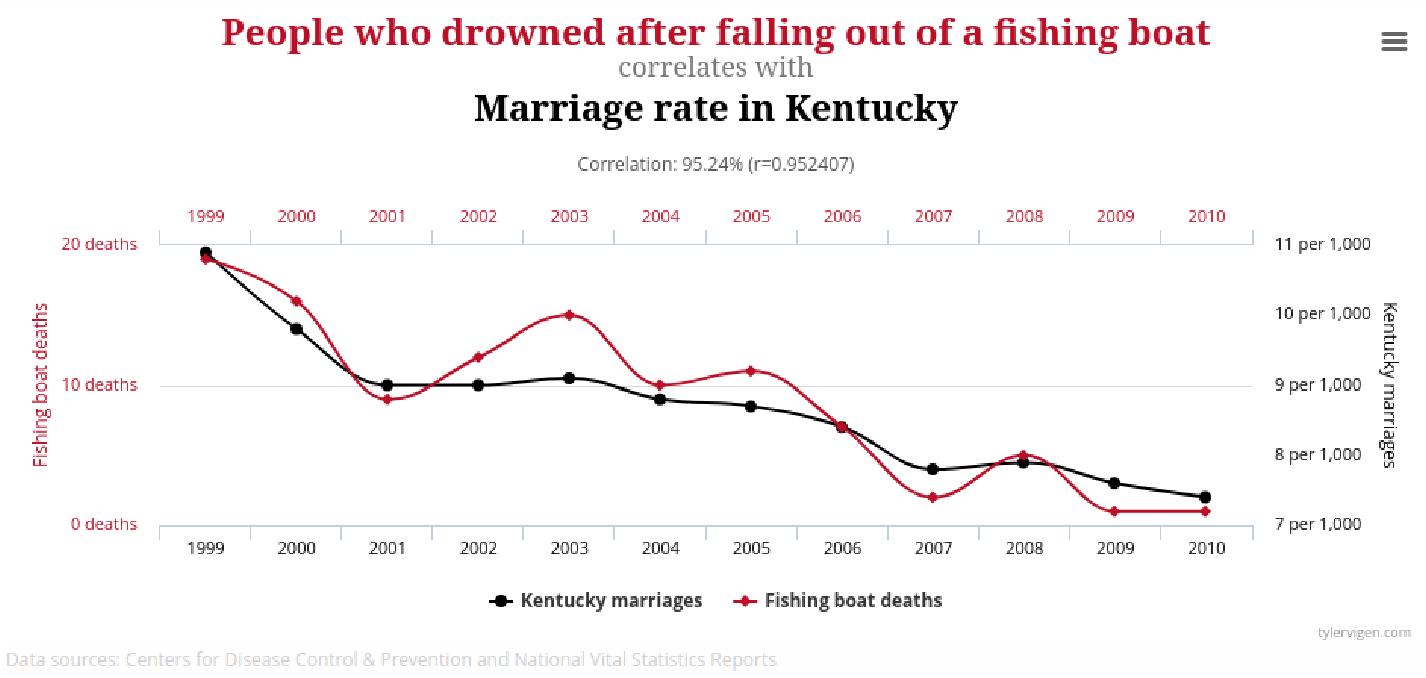
Correlación



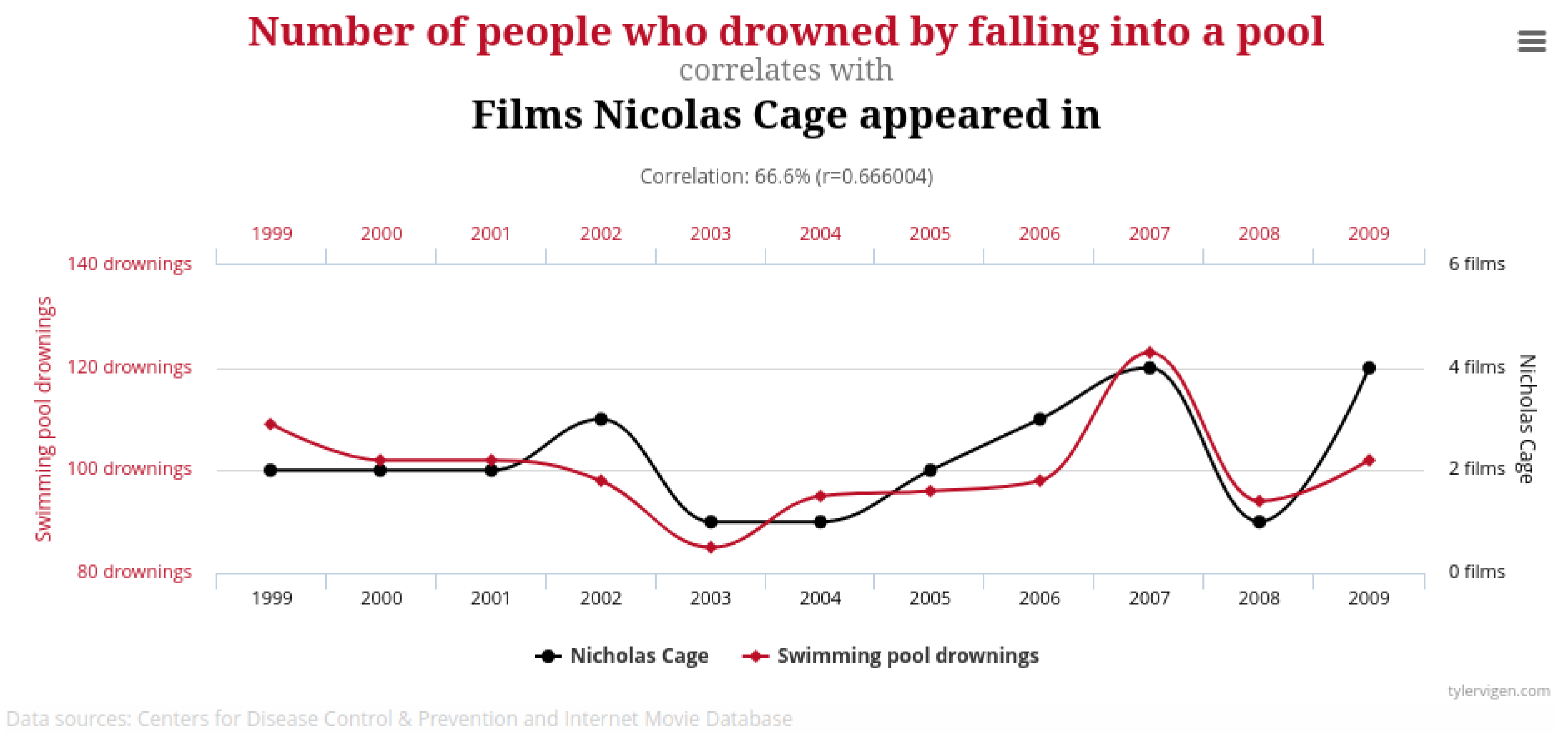
Correlación



Correlaciones espurias



Correlaciones espurias



Correlación

- Coeficiente de correlación producto-momento de Pearson
  - Consistencia de pares

$$r = \frac{\sum(z_X z_Y)}{N}$$

Correlación

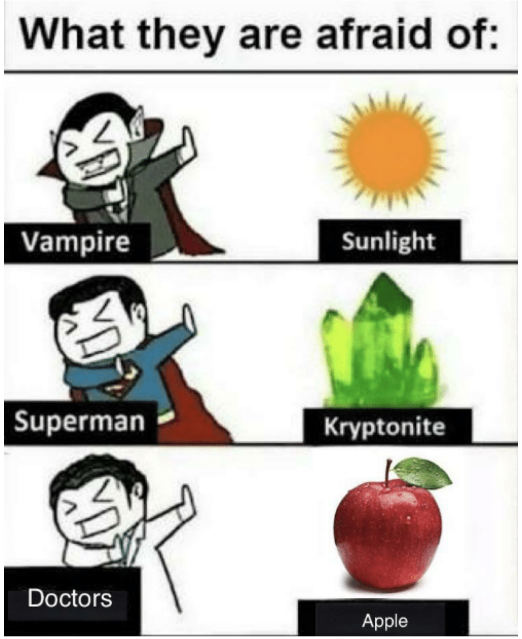
- Coeficiente de correlación producto-momento de Pearson
  - Consistencia de pares

$$r = \frac{\sum(z_X z_Y)}{N}$$

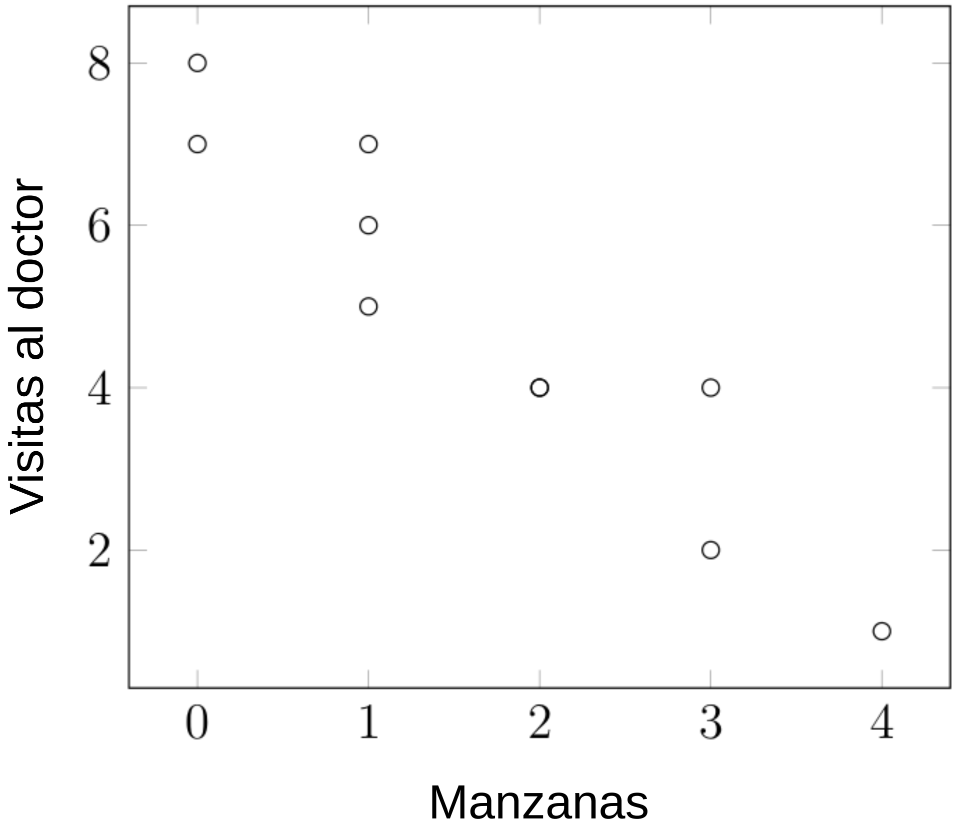
$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

Ejemplo

Ejemplo


What they are afraid of:
Vampire
Sunlight
Superman
Kryptonite
Doctors
Apple

Ejemplo



Ejemplo

$$N = 10$$

Participante	Manzanas	Visitas al doc
1	0	8
2	0	7
3	1	7
4	1	6
5	1	5
6	2	4
7	2	4
8	3	4
9	3	2
10	4	0

Ejemplo

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

Ejemplo

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

$$r = \frac{10(52) - (17)(47)}{\sqrt{[10(45) - 289][10(275) - 2209]}}$$

Ejemplo

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

$$r = \frac{10(52) - (17)(47)}{\sqrt{[10(45) - 289][10(275) - 2209]}}$$

$$r = \frac{520 - 799}{\sqrt{[161][541]}}$$

Ejemplo

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

$$r = \frac{10(52) - (17)(47)}{\sqrt{[10(45) - 289][10(275) - 2209]}}$$

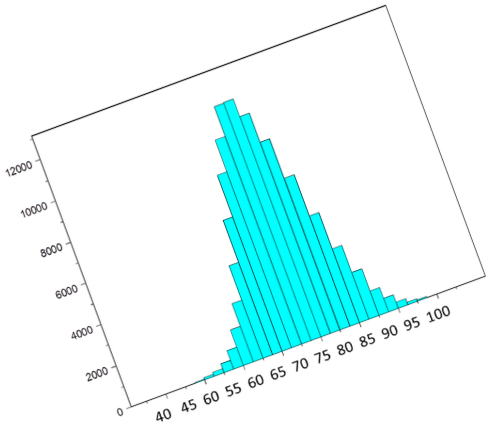
$$r = \frac{520 - 799}{\sqrt{[161][541]}}$$

$$r = \frac{-279}{295.129}$$

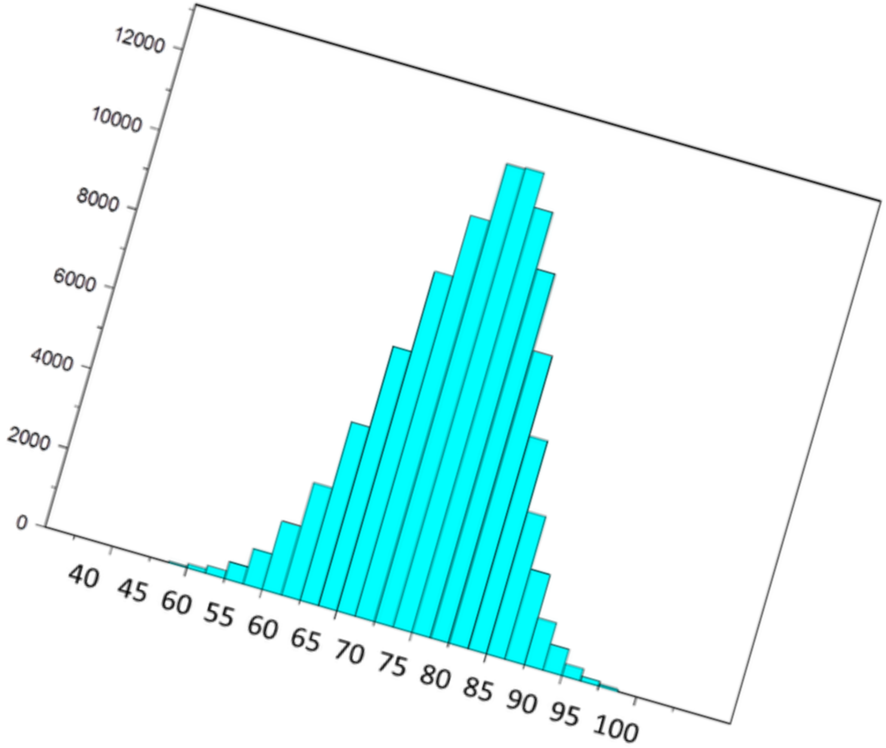
$$r = -.95$$

Ejemplo

Ejemplo


12000
10000
8000
6000
4000
2000
0
40 45 60 55 60 65 70 75 80 85 90 95 100

Ejemplo



12000
10000
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65
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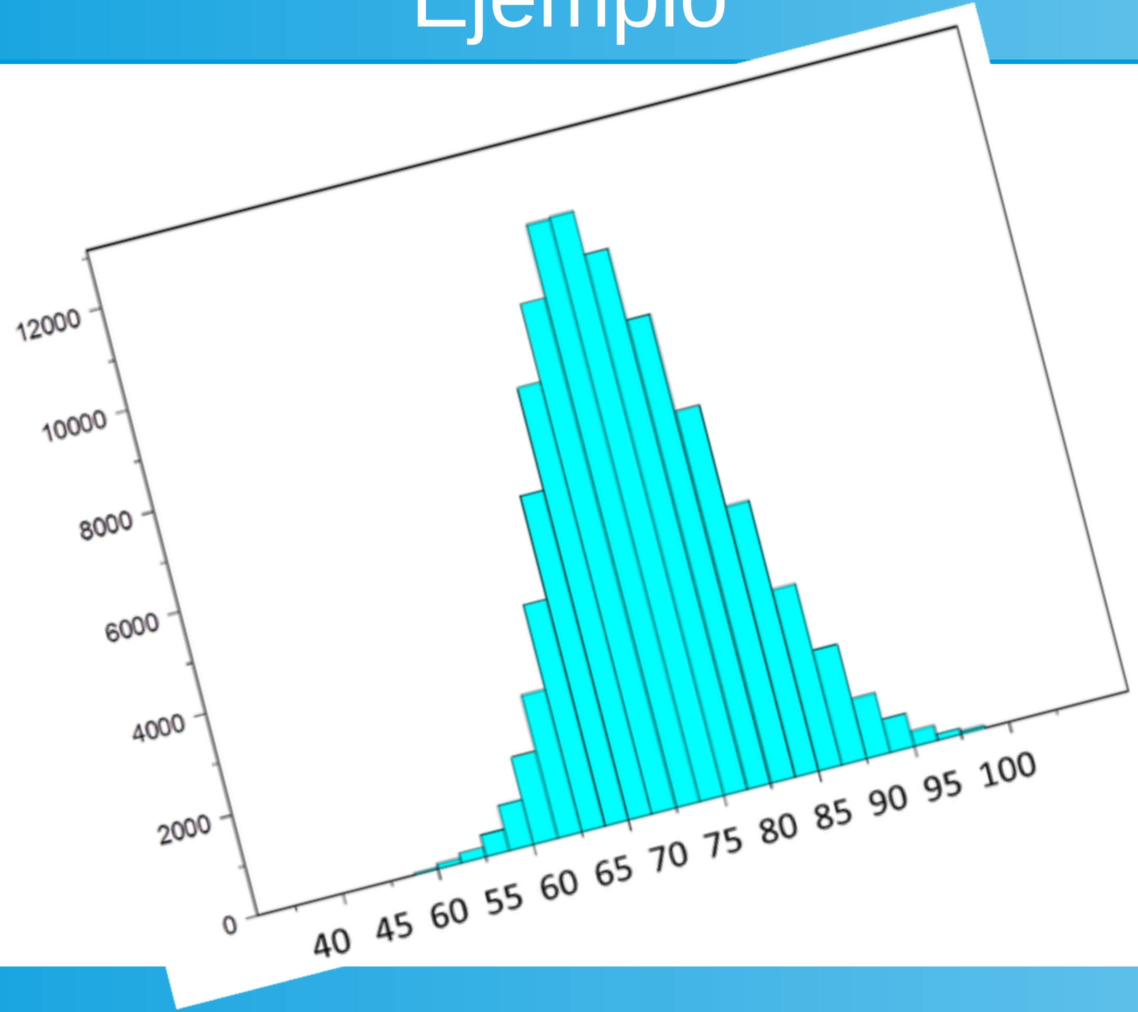
90
95
100

Ejemplo



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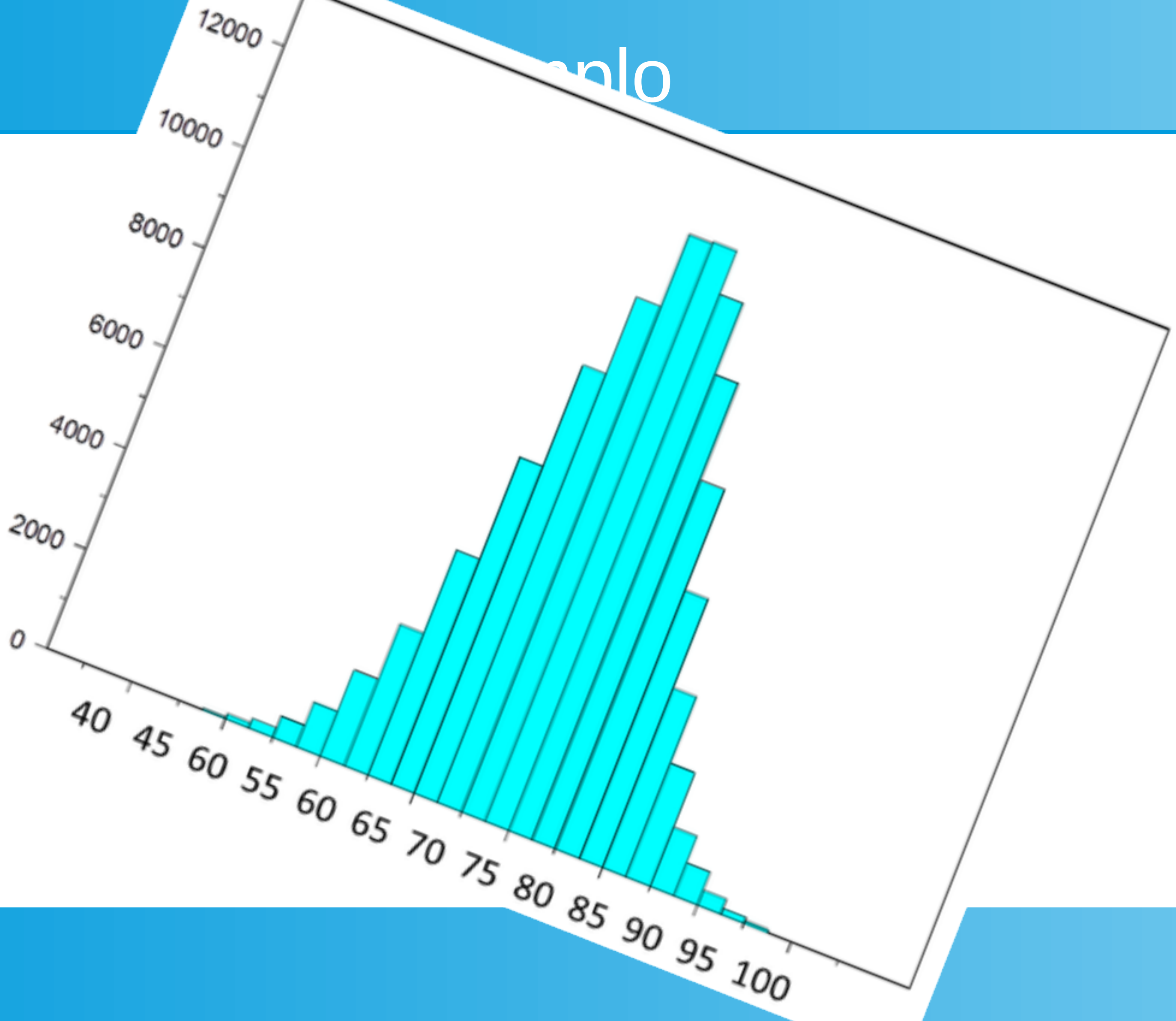
40 45 60 55 60 65 70 75 80 85 90 95 100

nplo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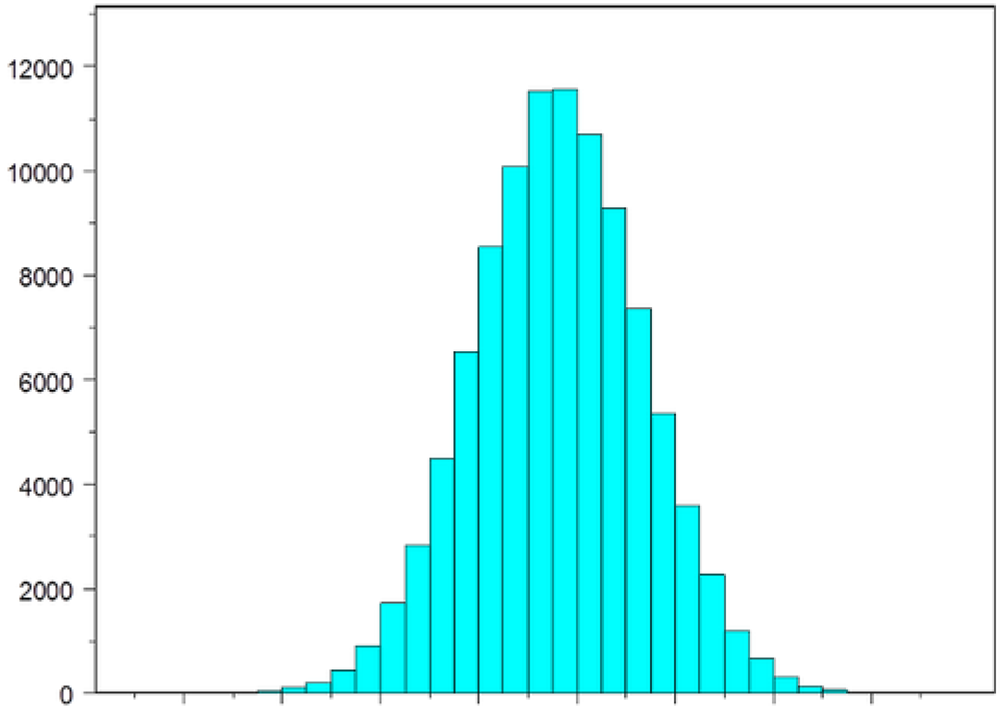
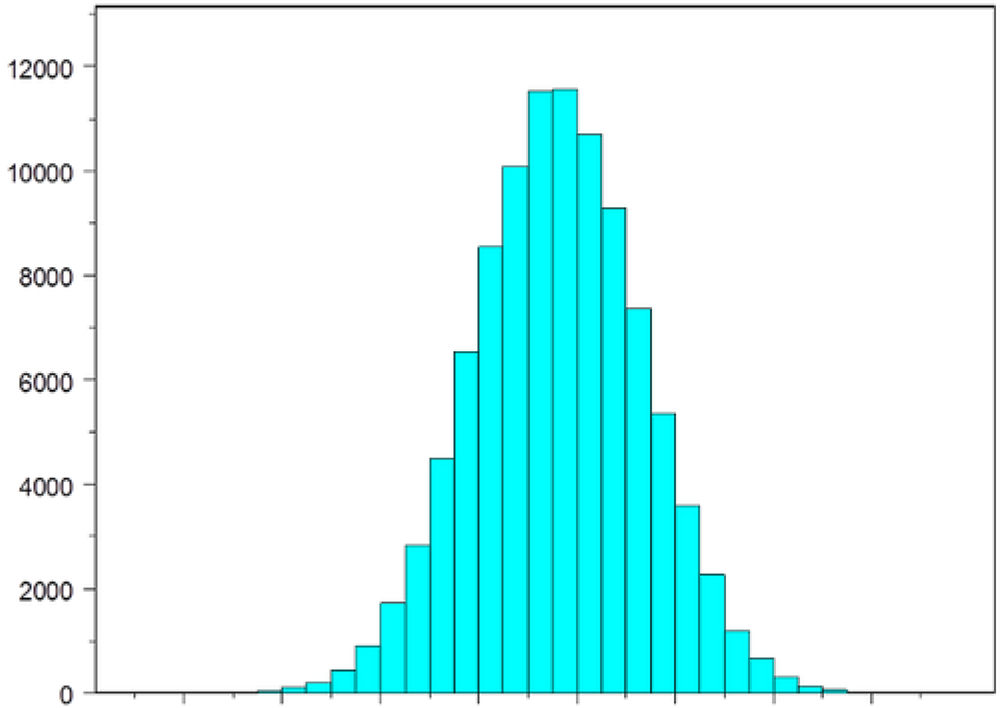
4000
2000
0
40 45 60 55 60 65 70 75 80 85 90 95 100

Ejemplo

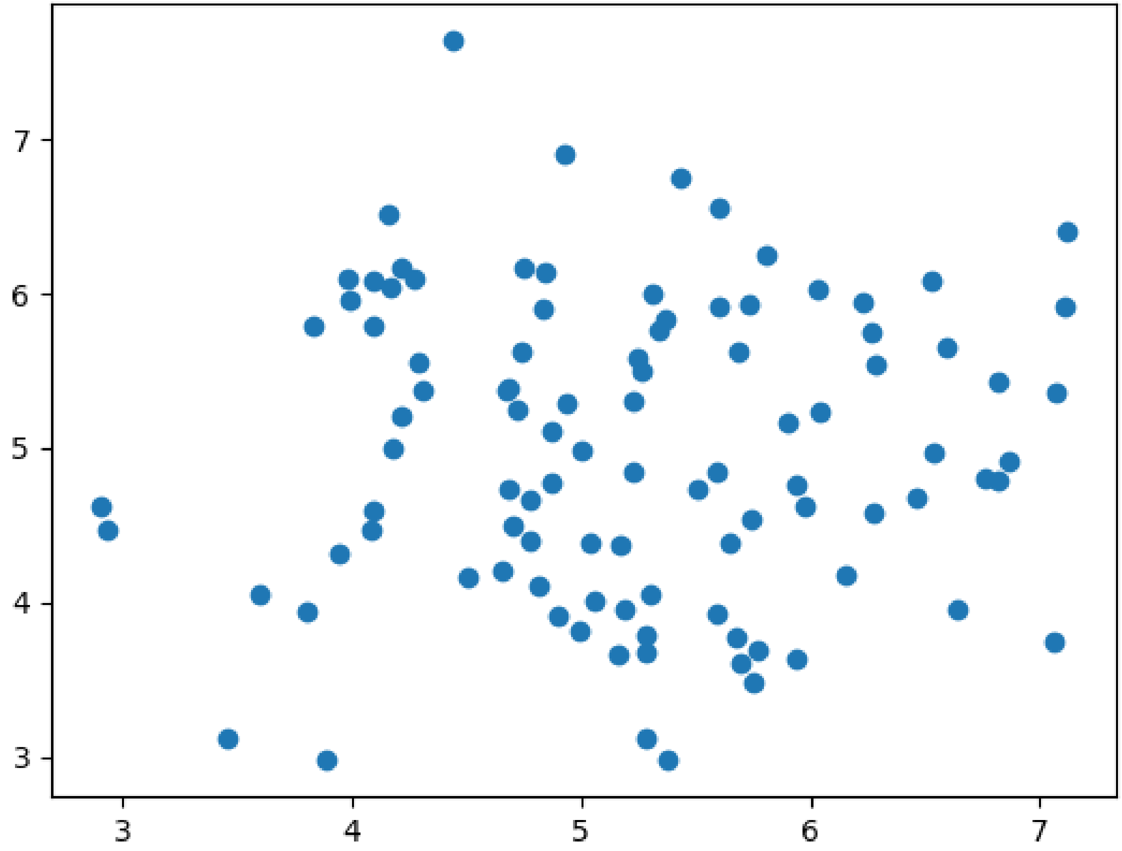


Ejemplo

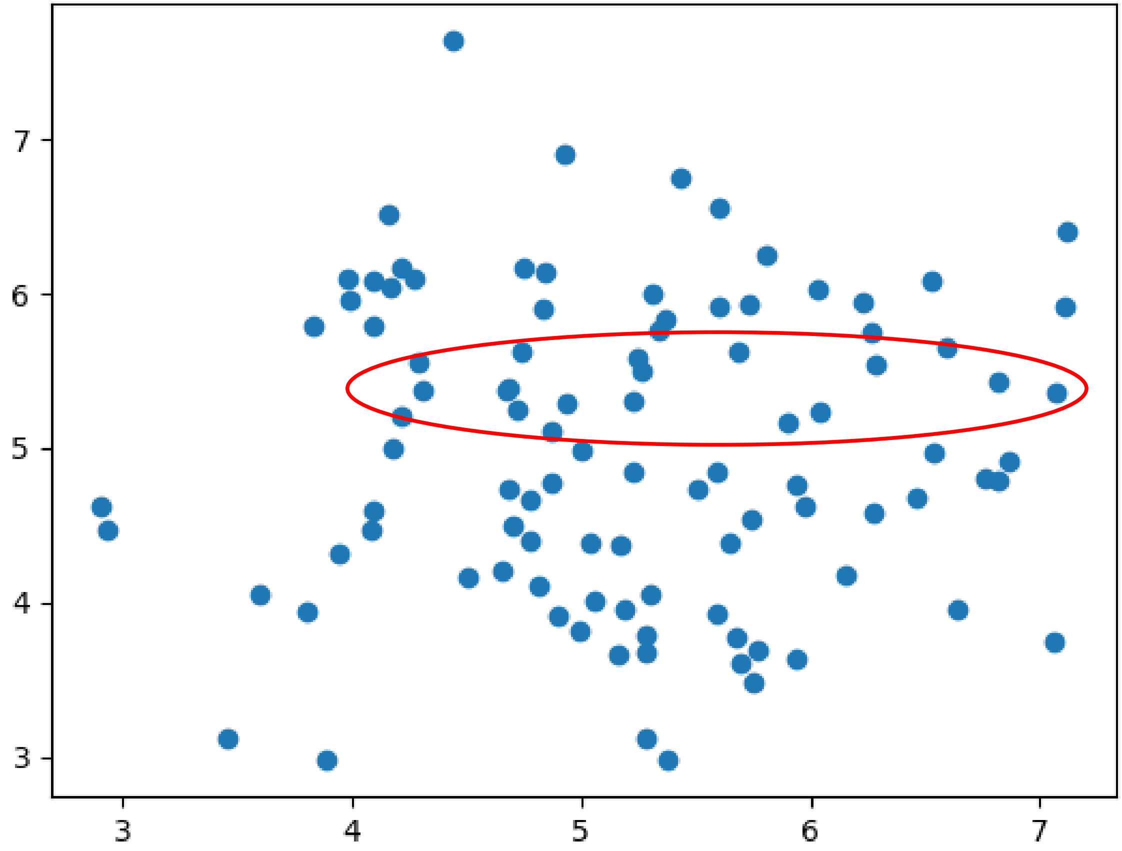


$$\rho = 0$$

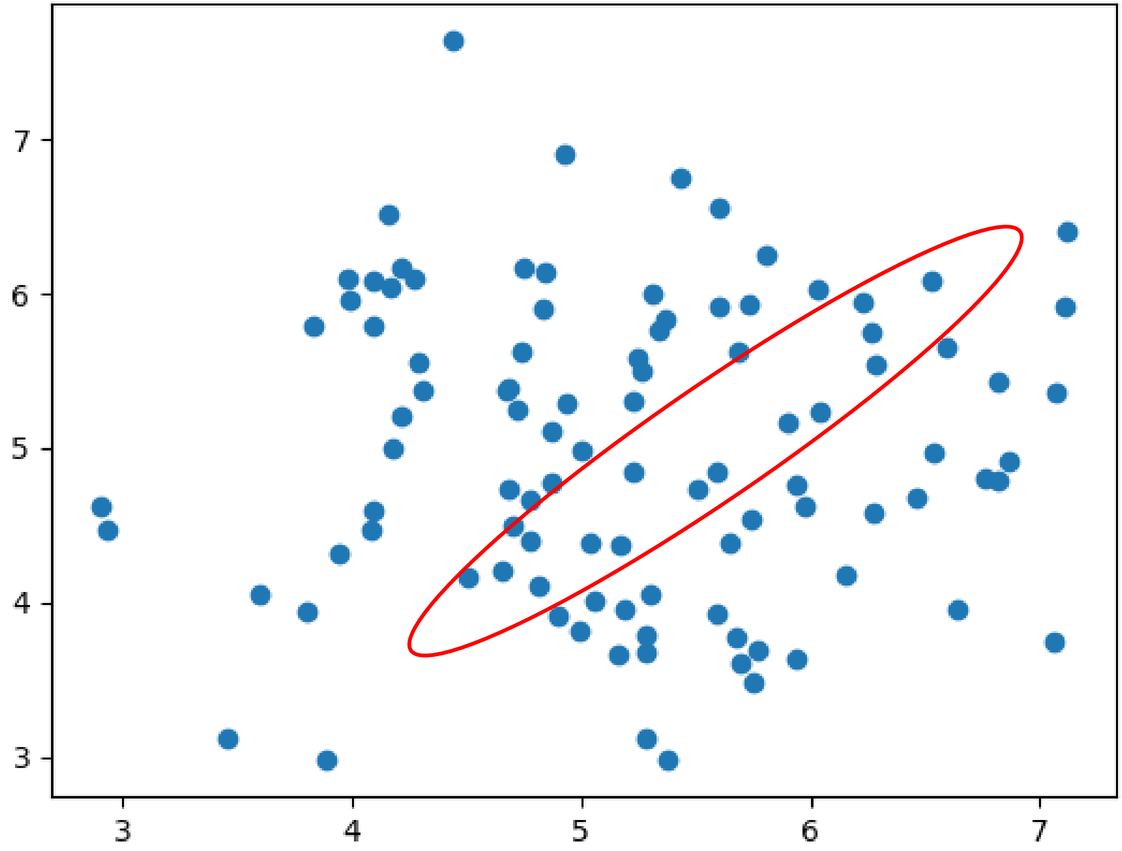
Ejemplo



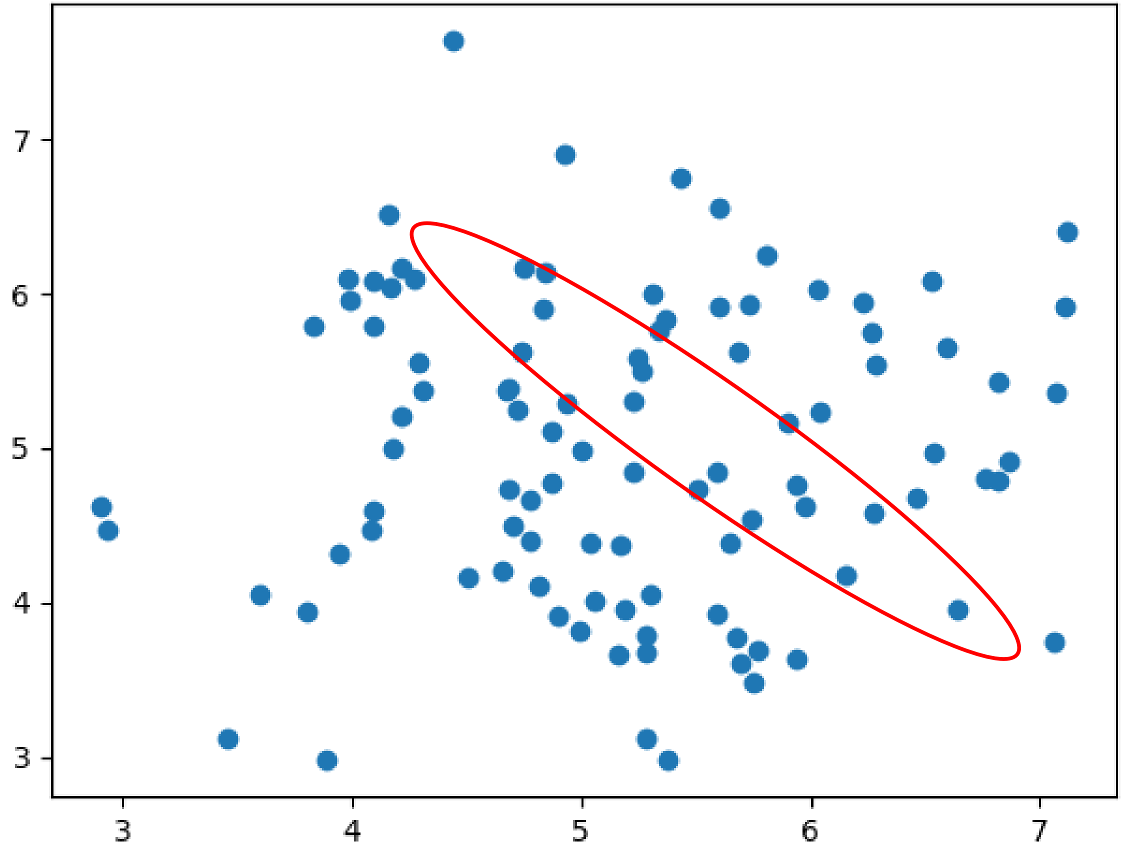
Ejemplo



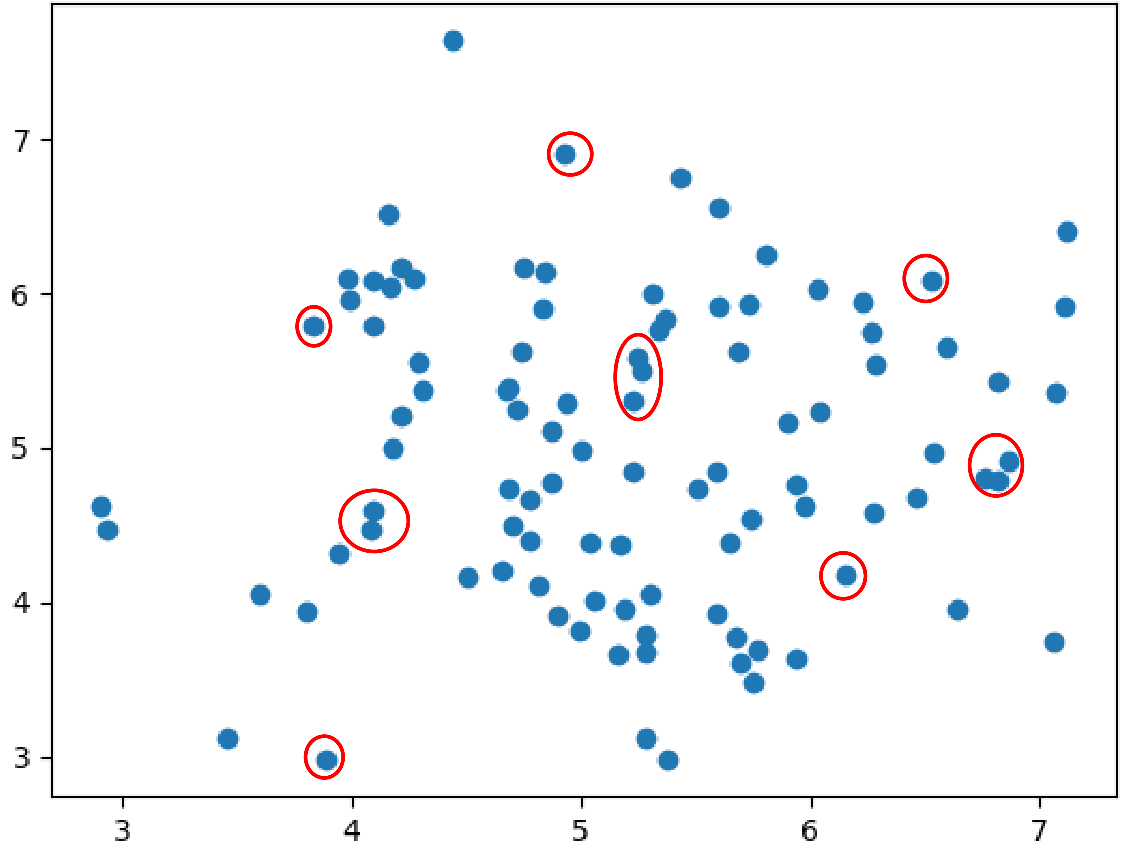
Ejemplo



Ejemplo



Ejemplo

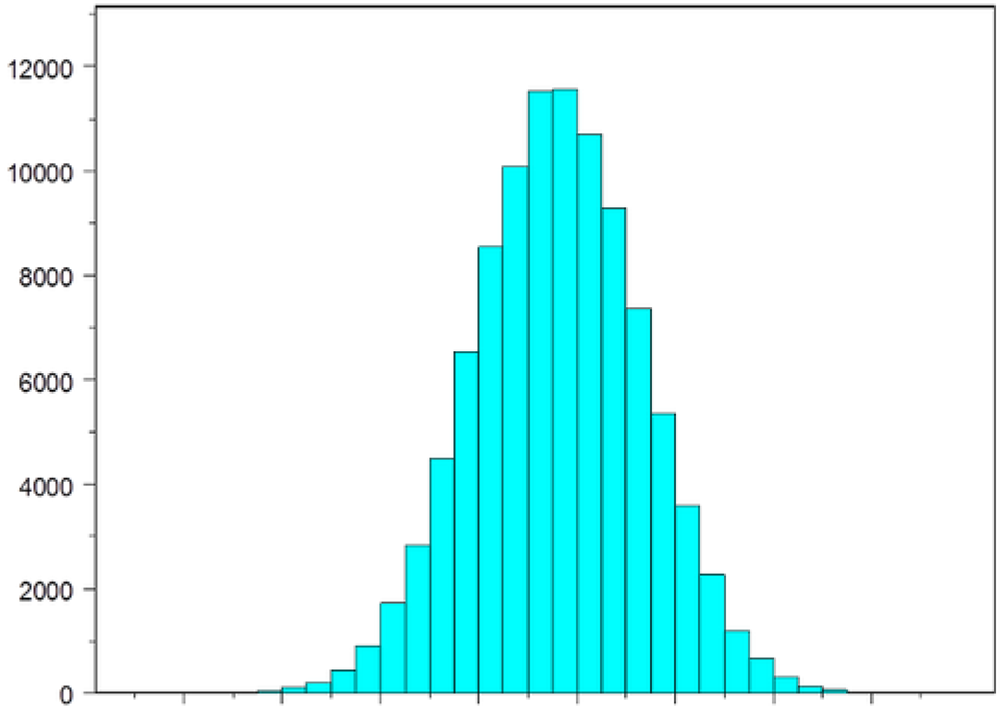


Ejemplo

$$H_0 : \rho = 0$$

$$H_a : \rho \neq 0$$

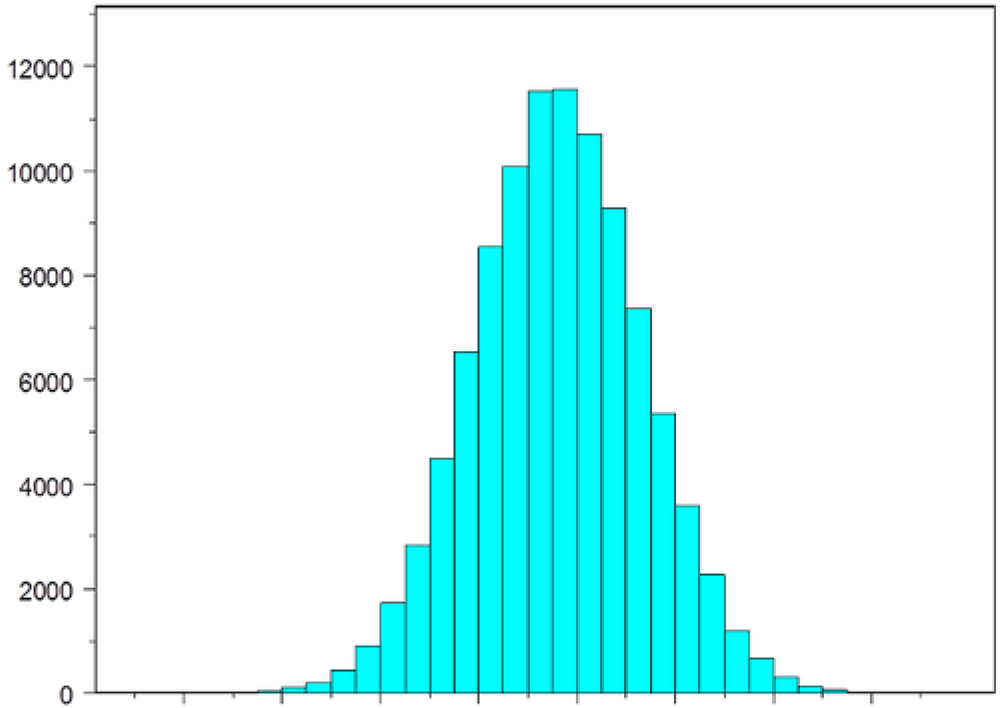
Ejemplo



$$r = -.95$$

$$\rho = 0$$

Ejemplo

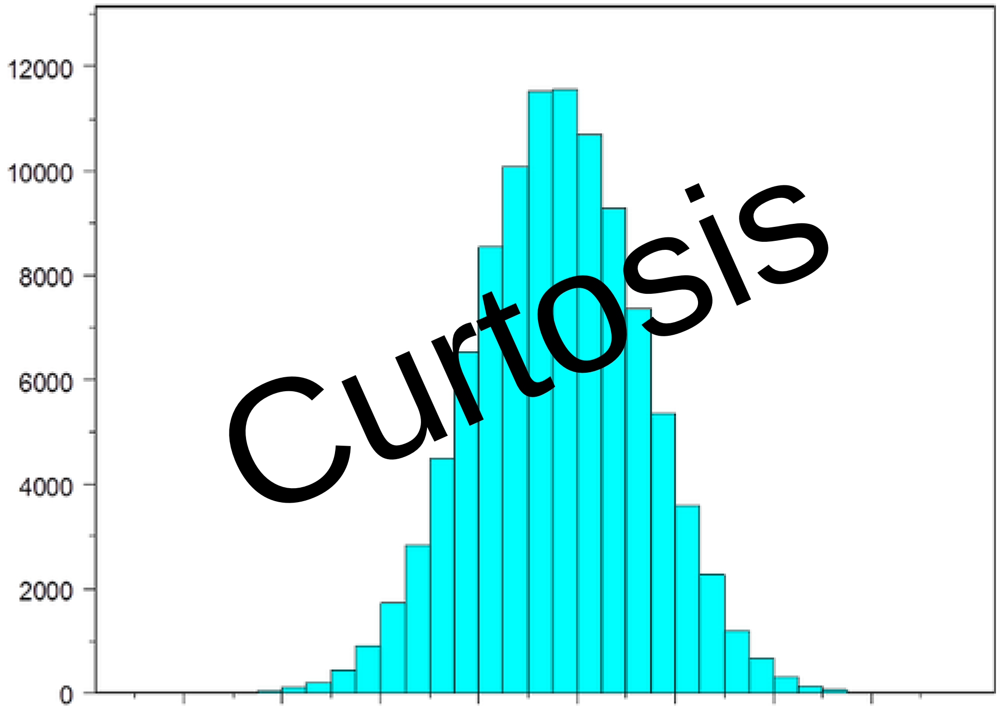


$\rho = 0$

$r = -.95$

Miente

Ejemplo



$$r = -.95$$

$$\rho = 0$$

Ejemplo

df =N-2	Level of significance for a one-tailed test			
	.05	.025	.01	.005
	Level of significance for a two-tailed test			
	.10	.05	.02	.01
1	.988	.997	.9995	.9999
2	.900	.950	.980	.990
3	.805	.878	.934	.959
4	.729	.811	.882	.917
5	.669	.754	.833	.874
6	.622	.707	.789	.834
7	.582	.666	.750	.798
8	.549	.632	.716	.765
9	.521	.602	.685	.735
10	.497	.576	.658	.708
20	.360	.423	.492	.537
30	.296	.349	.409	.449
40	.257	.304	.358	.393
50	.231	.273	.322	.354

Ejemplo

$$N = 10$$

df =N-2	Level of significance for a one-tailed test			
	.05	.025	.01	.005
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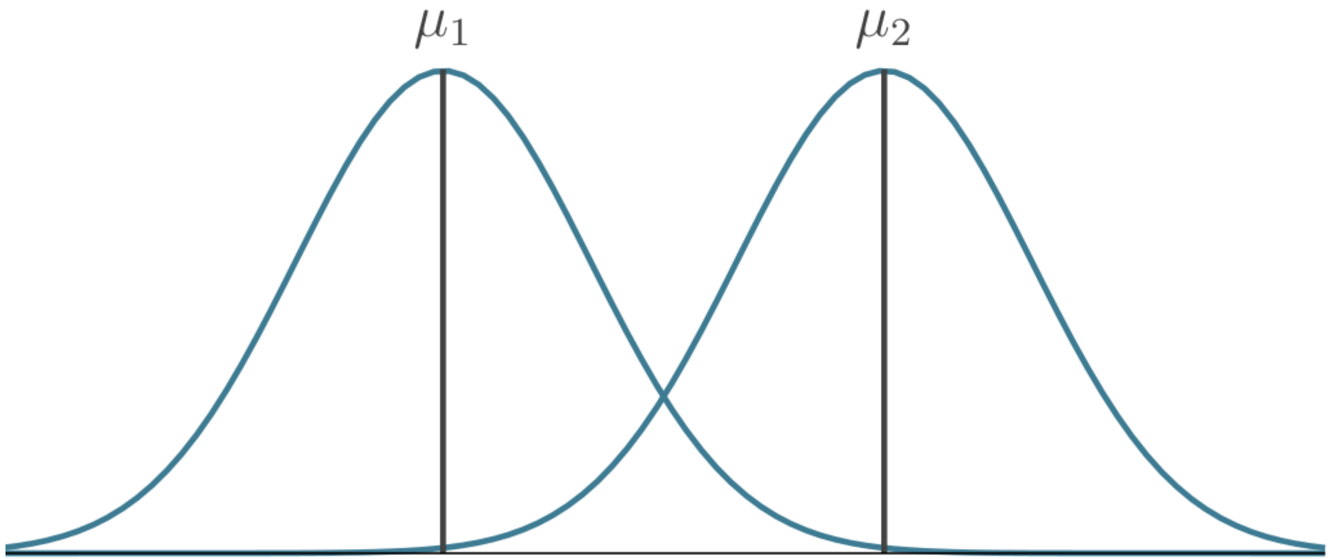
Ejemplo

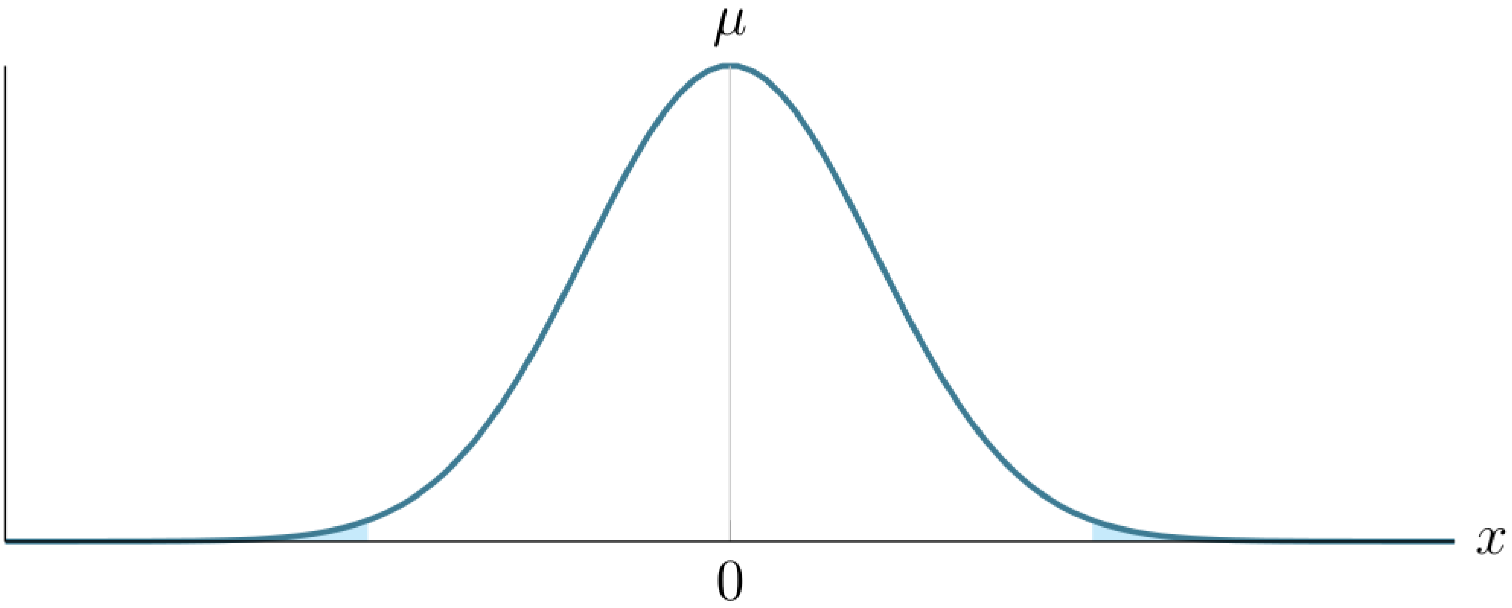
Comparación de grupos

- Dos muestras de una población
- Desconocemos los parámetros poblacionales
- Determinar efecto de manipulaciones

Comparación de grupos



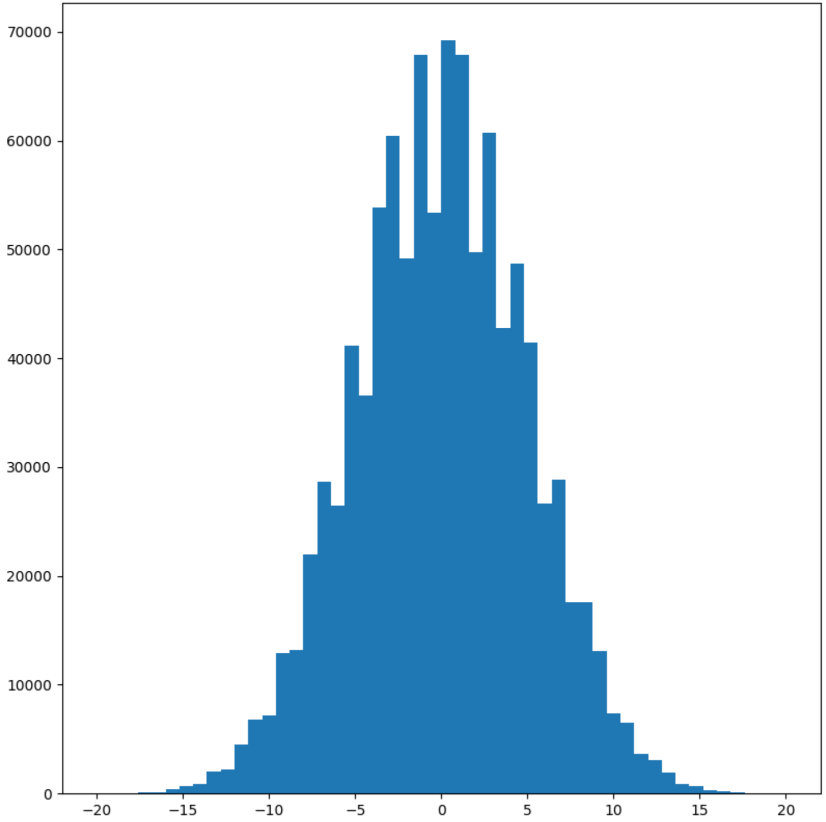
Comparación de grupos



Comparación de grupos

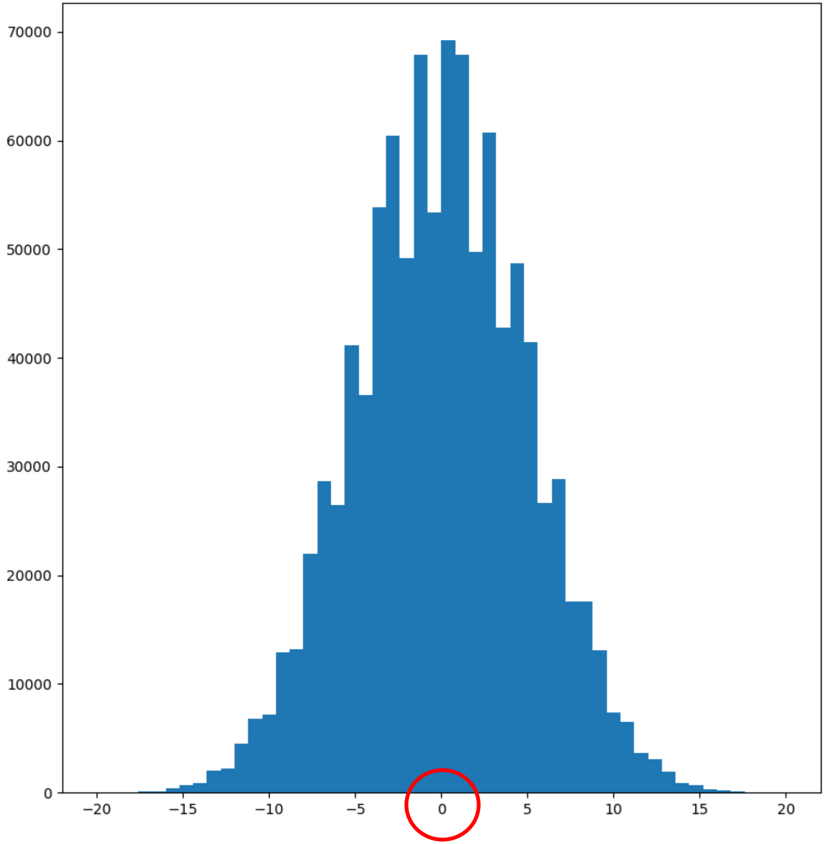
$$\bar{X}_1 - \bar{X}_2 = \mathrm{Dif}_X$$

Comparación de grupos



$$\bar{X}_1 - \bar{X}_2 = \mathrm{Dif}_X$$

Comparación de grupos



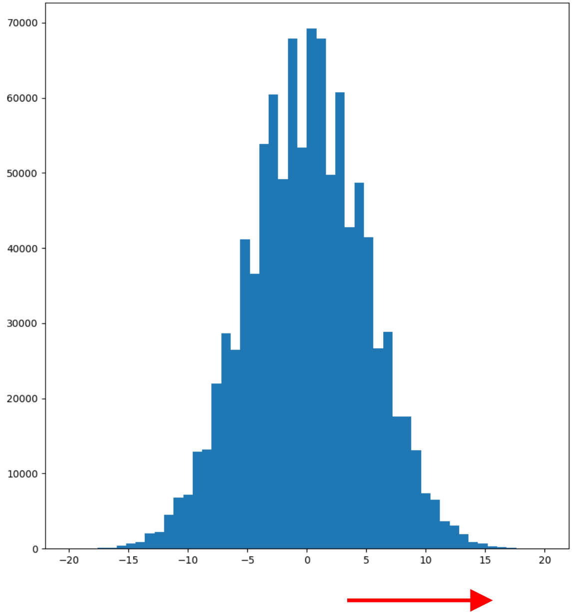
$$\bar{X}_1 - \bar{X}_2 = \mathrm{Dif}_X$$

Prueba t

- Determina la posición de la distribución de la diferencia encontrada

Prueba t

- Determina la posición de la distribución de la diferencia encontrada



Prueba t

- Determina la posición de la distribución de la diferencia encontrada
- Requisitos
  - Intervalar o razón
  - Distribuciones de puntajes normales
  - Varianzas homogéneas
  - n similar

Prueba t

- Variantes
  - Muestras independientes
    - Dos muestras al azar, sin que para una importe la otra
  - Muestras relacionadas
    - Pareadas o un mismo grupo

Prueba t

$$H_0 : \mu_1 - \mu_2 = 0$$

$$H_a : \mu_1 - \mu_2 \neq 0$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

$$z = \frac{X - \bar{X}}{S_X}$$

$$z_{obt} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

Como z, indica la posición en la distribución normal

$$z = \frac{X - \bar{X}}{S_X}$$

$$z_{obt} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

Prueba t

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Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

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Prueba t

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$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$s^2_{pool} = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}$$

Prueba t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

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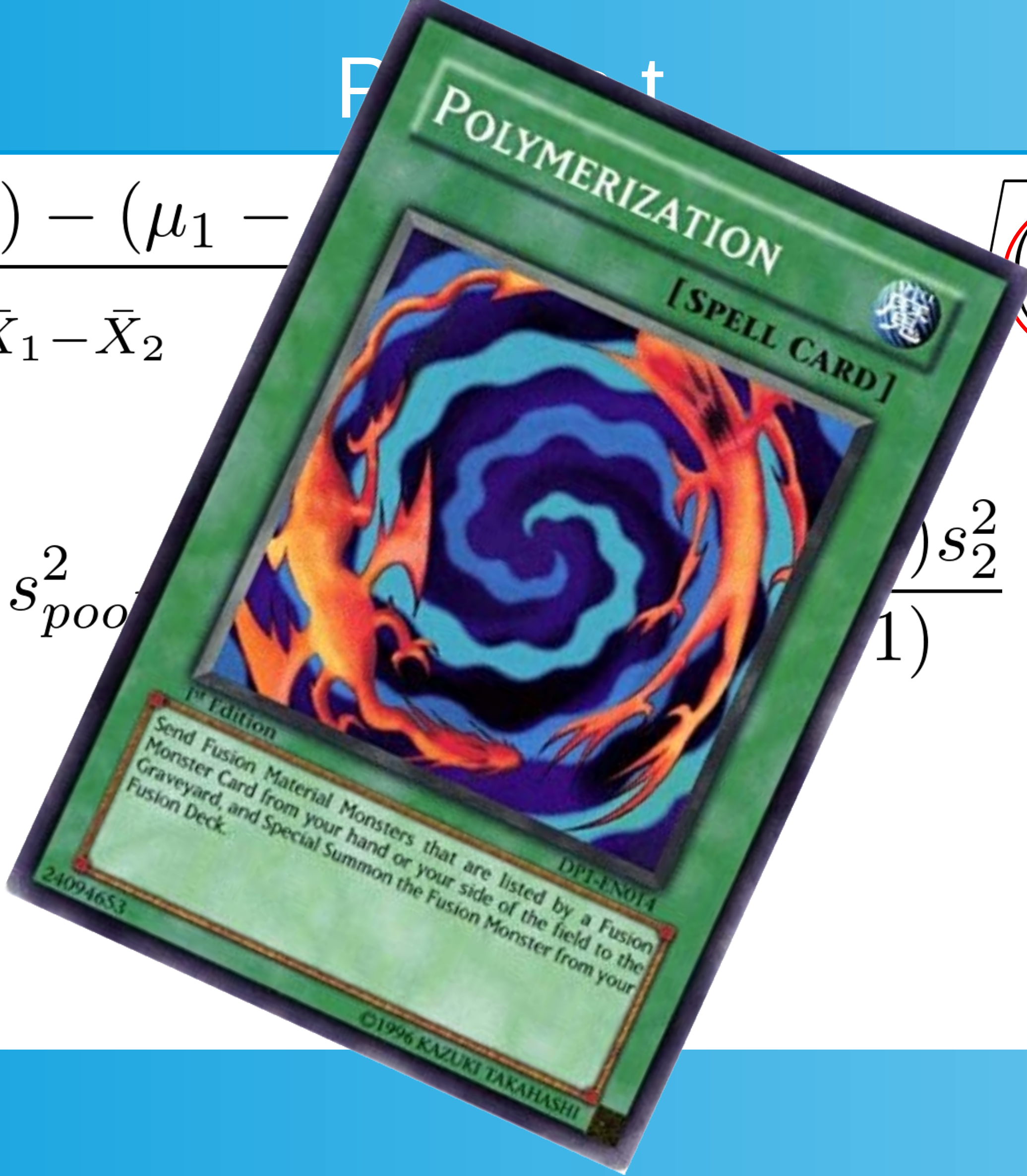
P t

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \ldots}{s_{\bar{X}_1 - \bar{X}_2}} \ldots \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$s^2_{poo\ldots} \ldots \frac{\ldots)s_2^2}{\ldots 1)}$$



Prueba t

$$s^2_{pool} = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}$$

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$t_{obt} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}}$$

Ejemplo

Ejemplo

$$n_1 = 17$$

$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

Ejemplo

$$n_1 = 17 \qquad n_2 = 15$$

$$\bar{X}_1 = 23 \qquad \bar{X}_2 = 20$$

$$s_1^2 = 9.0 \qquad s_2^2 = 7.5$$

Ejemplo

$$s^2_{pool}$$

$$n_1 = 17 \qquad\qquad n_2 = 15$$

$$s_{\bar{X}_1 - \bar{X}_2}$$

$$\bar{X}_1 = 23 \qquad\qquad \bar{X}_2 = 20$$

$$t_{obt}$$

$$s^2_1 = 9.0 \qquad\qquad s^2_2 = 7.5$$

Ejemplo

$$s^2_{pool} = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{(n_1-1)+(n_2-1)}$$

$$= \frac{(17-1)9+(15-1)7.5}{(17-1)+(15-1)}$$

$n_1 = 17$

$\bar{X}_1 = 23$

$s_1^2 = 9.0$

$n_2 = 15$

$\bar{X}_2 = 20$

$s_2^2 = 7.5$

Ejemplo

$$n_1 = 17 \qquad \bar{X}_1 = 23 \qquad s_1^2 = 9.0$$

$$\begin{aligned} s_{pool}^2 &= \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{(n_1-1)+(n_2-1)} \\ &= \frac{(17-1)9 + (15-1)7.5}{(17-1)+(15-1)} \\ &= \frac{144+105}{30} \end{aligned}$$

$$n_2 = 15 \qquad \bar{X}_2 = 20 \qquad s_2^2 = 7.5$$

Ejemplo

$$n_1 = 17$$

$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$\begin{aligned}
s_{pool}^2 &= \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{(n_1-1)+(n_2-1)} \\
&= \frac{(17-1)9 + (15-1)7.5}{(17-1)+(15-1)} \\
&= \frac{144+105}{30} \\
&= \frac{249}{30} \\
&= 8.3
\end{aligned}$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

Ejemplo

$$\mathrm{s}_{pool}^2 = 8.3$$

$$n_1 = 17 \qquad n_2 = 15$$

$$\bar{X}_1 = 23 \qquad \bar{X}_2 = 20$$

$$s_1^2 = 9.0 \qquad s_2^2 = 7.5$$

Ejemplo

$$\mathrm{s}^2_{pool} = 8.3$$

$$n_1 = 17$$

$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$\begin{aligned} s_{\bar{X}_1 - \bar{X}_2} &= \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \\ &= \sqrt{8.3\left(\frac{1}{17} + \frac{1}{15}\right)} \end{aligned}$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

Ejemplo

$$\mathrm{s}^2_{pool} = 8.3$$

$$n_1 = 17$$

$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$\begin{aligned} s_{\bar{X}_1 - \bar{X}_2} &= \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \\ &= \sqrt{8.3\left(\frac{1}{17} + \frac{1}{15}\right)} \\ &= \sqrt{8.3(0.126)} \end{aligned}$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

Ejemplo

$$s^2_{pool} = 8.3$$

$$n_1 = 17$$

$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

$$\begin{aligned} s_{\bar{X}_1 - \bar{X}_2} &= \sqrt{\left(s^2_{pool}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \\ &= \sqrt{8.3\left(\frac{1}{17} + \frac{1}{15}\right)} \\ &= \sqrt{8.3(0.126)} \\ &= \sqrt{1.046} \\ &= 1.023 \end{aligned}$$

Ejemplo

$$s^2_{pool} = 8.3$$

$$s_{\bar{X}_1-\bar{X}_2} = 1.023$$

$$n_1 = 17$$

$$n_2 = 15$$

$$\bar{X}_1 = 23$$

$$\bar{X}_2 = 20$$

$$s_1^2 = 9.0$$

$$s_2^2 = 7.5$$

Ejemplo

$$\mathrm{s}^2_{pool} = 8.3 \qquad \mathrm{s}_{\bar{X}_1 - \bar{X}_2} = 1.023$$

$$n_1 = 17 \qquad n_2 = 15$$

$$\bar{X}_1 = 23 \qquad \bar{X}_2 = 20$$

$$s_1^2 = 9.0 \qquad s_2^2 = 7.5$$

$$\begin{aligned} t_{\text{obtenida}} &= \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}} \\ &= \frac{(23 - 20) - 0}{1.023} \end{aligned}$$

Ejemplo

$$\mathrm{s}^2_{pool} = 8.3 \qquad \mathrm{s}_{\bar{X}_1 - \bar{X}_2} = 1.023$$

$$n_1 = 17 \qquad n_2 = 15$$

$$\bar{X}_1 = 23 \qquad \bar{X}_2 = 20$$

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Ejemplo

$$s^2_{pool} = 8.3 \qquad s_{\bar{X}_1 - \bar{X}_2} = 1.023$$

$$n_1 = 17 \qquad n_2 = 15$$

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$$\begin{aligned} t_{\text{obtenida}} &= \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}} \\ &= \frac{(23 - 20) - 0}{1.023} \\ &= \frac{(+3.0) - 0}{1.023} \\ &= +2.93 \end{aligned}$$

Ejemplo

$$s^2_{pool} = 8.3 \qquad s_{\bar{X}_1 - \bar{X}_2} = 1.023$$

$$n_1 = 17 \qquad n_2 = 15$$

$$\bar{X}_1 = 23 \qquad \bar{X}_2 = 20$$

$$s^2_1 = 9.0 \qquad s^2_2 = 7.5$$

$$\begin{aligned} t_{\text{obtenida}} &= \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}} \\ &= \frac{(23 - 20) - 0}{1.023} \\ &= \frac{(+3.0) - 0}{1.023} \\ &= +2.93 \end{aligned}$$

Ejemplo

$$\mathrm{t}_{\mathrm{obtenida}} = +2.93$$

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$\bar{X}_1 = 23$

$s_1^2 = 9.0$

$n_2 = 15$

$\bar{X}_2 = 20$

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Ejemplo

$$t_{\text{obtenida}} = +2.93$$

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$$\bar{X}_1 = 23$$

$$s_1^2 = 9.0$$

$$n_2 = 15$$

$$\bar{X}_2 = 20$$

$$s_2^2 = 7.5$$

Critical values of *t* for two-tailed tests

Significance level (α)

Degrees of freedom *(df)*	.2	.15	.1	.05	.025	.01	.005	.001
21	1.323	1.494	1.721	2.080	2.414	2.831	3.135	3.819
22	1.321	1.492	1.717	2.074	2.405	2.819	3.119	3.792
23	1.319	1.489	1.714	2.069	2.398	2.807	3.104	3.768
24	1.318	1.487	1.711	2.064	2.391	2.797	3.091	3.745
25	1.316	1.485	1.708	2.060	2.385	2.787	3.078	3.725
26	1.315	1.483	1.706	2.056	2.379	2.779	3.067	3.707
27	1.314	1.482	1.703	2.052	2.373	2.771	3.057	3.690
28	1.313	1.480	1.701	2.048	2.368	2.763	3.047	3.674
29	1.311	1.479	1.699	2.045	2.364	2.756	3.038	3.659
30	1.310	1.477	1.697	2.042	2.360	2.750	3.030	3.646
40	1.303	1.468	1.684	2.021	2.329	2.704	2.971	3.551