Simulación y Optimización

Optimización Introducción Parte III

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Mapa curricular de la materia

Simulación

Optimización

Mapa curricular de la materia

Simulación

Optimización

Mapa curricular de Optimización

- Definiciones
- Modelo de optimización
- Programación no lineal
- Programación lineal
- Análisis de sensibilidad

Mapa curricular de Optimización

- Definiciones
- Modelo de optimización
- **Programación no lineal**
- Programación lineal
- Análisis de sensibilidad

Mapa curricular de programación no lineal

1. Operación con ciclos
2. Criterio técnico
3. Función objetivo
4. Restricciones
5. Parámetros
6. Variables de decisión
7. Regresión
8. Resolución con LINGO y Excel

Extracción por solvente

Extracción por solvente

Un equipo de extracción con solvente opera con ciclos iguales. La preparación del equipo para cada ciclo demora *tp* = 0.25 h. La cantidad *m* (kg) de producto extraído en un tiempo *t* (h) está dada por la siguiente correlación:

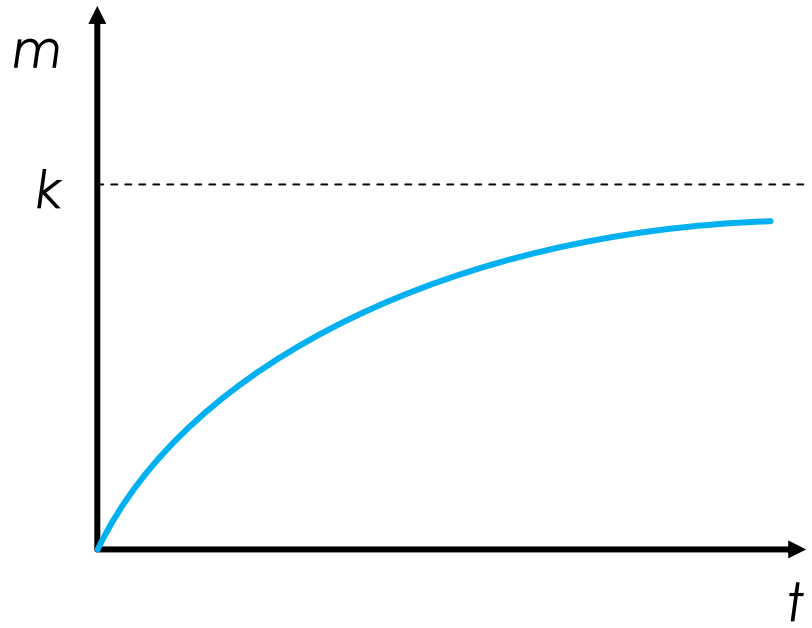
$$m = k\left(1 - e^{-t/\tau}\right)$$

donde *k* = 15 kg y τ = 10 h.

Se debe extraer *mo* = 150 kg en el menor tiempo *to* posible.

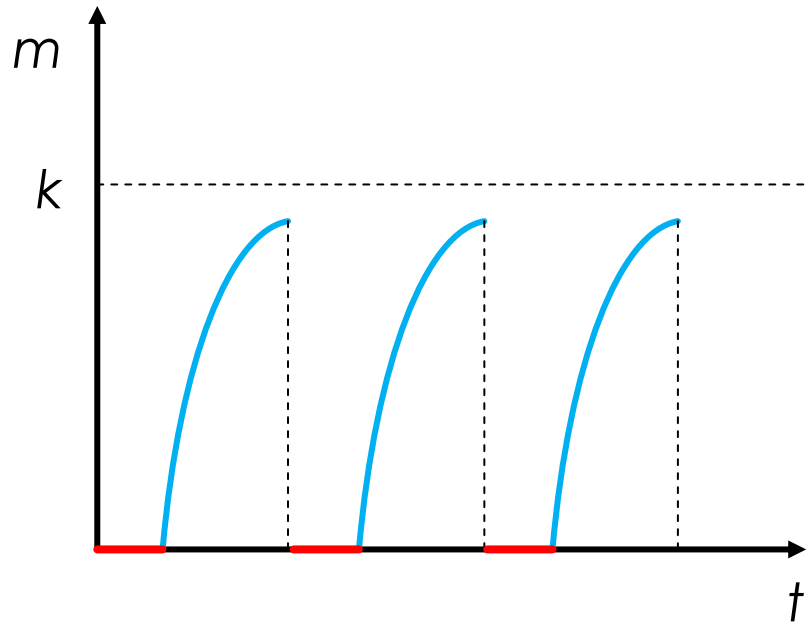
Problema

- En ciclo: $m = k\left(1 - e^{-t/\tau}\right)$.
- Un $n = 1$ ciclo no es suficiente porque $mo > k$.

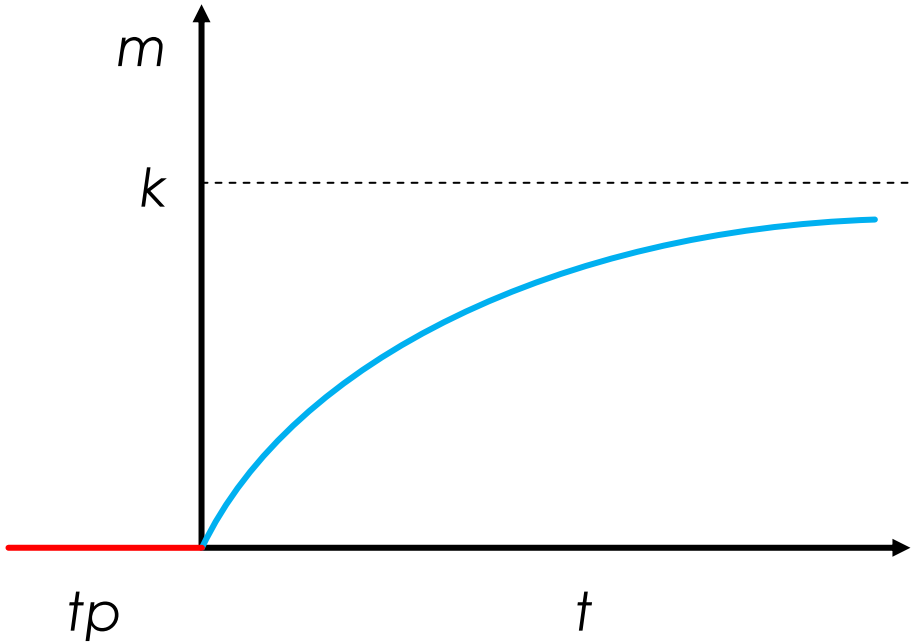


Valores extremos

- Operación con *n* ciclos.
- Un valor alto de *n* implica sumar *n* tiempos muertos.
- Debe haber un valor óptimo de *n* intermedio.

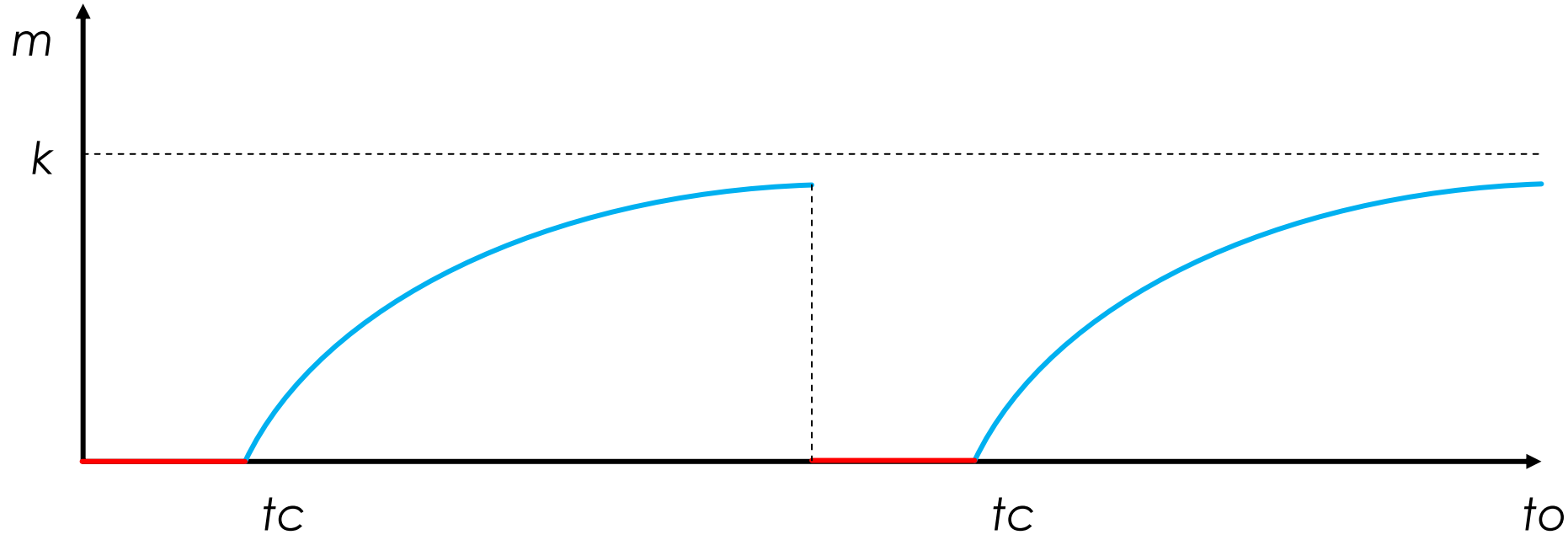


Tiempo de un ciclo



- Tiempo de ciclo (h): $tc = tp + t$.
- Extracción por ciclo (kg): $m = k\left(1 - e^{-t/\tau}\right)$.

Varios ciclos



- Tiempo de operación (h): $to = n\,tc$.
- Extracción total (kg): $mo = n\,m$.

Elementos del modelo

- Criterio: Técnico
- Función objetivo:
  - Tiempo de operación (h): to.
- Restricciones:
  - Tiempo de ciclo (h): $tc = tp + t$.
  - Tiempo de operación (h): $to = n\ tc$.
  - Extracción total (kg): $mo = n\ m$.
  - Extracción de ciclo (kg): $m = k\left(1 - e^{-t/\tau}\right)$.

Elementos del modelo

Parámetros

- tp = 0.25 h/ciclo
- k = 15 kg/ciclo
- τ = 10 h/ciclo
- mo = 150 kg

Variables de decisión

- to: Tiempo total de operación (h).
- tc: Duración del ciclo (h/ciclo).
- t: Duración de la extracción en un ciclo (h/ciclo).
- n: Cantidad de ciclos (ciclo).
- m: Masa extraída en un ciclo (kg/ciclo).

Modelo estándar

$$\underset{to,tc,t,n,m}{\text{Min}} \; to$$

s. a:

$$tc = tp + t$$

$$to = n\,tc$$

$$mo = n\,m$$

$$m = k\left(1 - e^{-t/\tau}\right)$$

$$to \geq 0, tc \geq 0, t \geq 0$$

$$n \in \mathbb{N}, m \geq 0$$

- tp = 0.25 h/ciclo
- k = 15 kg/ciclo
- τ = 10 h/ciclo
- mo = 150 kg

$GL = 5 - 4 = 1 > 0$

Extracción por solvente.lg4

Modelo en LINGO

- No es necesario despejar variables.
- No es necesario ordenar las restricciones.

Lingo Model - Extracción por solvente

```
! Extracción por solvente;
Data:
  k = 15;     ! kg/ciclo;
  tau = 10;   ! h/ciclo;
  tp = 0.25; ! h/ciclo;
  mo = 150;   ! kg;
EndData

[FO]   Min = to;

[Rtc] tc = tp+t;
[Rto] to = n*tc;
[RMo] mo = n*m;
[RM]   m = k*(1-@exp(-t/tau));
[Rn]   @gin(n);
```

Resultados en LINGO

Variable	Value	Reduced Cost
K	15.00000	0.000000
TAU	10.00000	0.000000
TP	0.2500000	0.000000
MO	150.0000	0.000000
TO	124.0585	0.000000
TC	2.385741	0.000000
T	2.135741	0.000000
N	52.00000	0.4788611E-02
M	2.884615	0.000000

Row	Slack or Surplus	Dual Price
FO	124.0585	-1.000000
RTC	0.000000	-52.00000
RTO	0.000000	-1.000000
RMO	0.000000	0.8253968
RM	-0.4748330E-07	42.92063

Análisis de la solución

- Valor óptimo *tc* = 2.385741 h = 2 h 23 min 8.67 s
- No es práctico.
- Valor práctico *tc* = 2.25 h = 2 h 15 min.
- ¿Cuál sería el nuevo procedimiento de operación?

Modificación del modelo

- $GL = 5 - 4 = 1 > 0$
- Al fijar tc, $GL = 4 - 4 = 0$.
- Alternativas:
  - Relajar $mo = n\,m$.
  - Relajar $n \in \mathbb{N}$.

$$\underset{to,tc,t,n,m}{\text{Min}} \; to$$

s. a:

$$tc = tp + t$$

$$to = n\,tc$$

$$mo = n\,m$$

$$m = k\left(1 - e^{-t/\tau}\right)$$

$$to \geq 0, tc \geq 0, t \geq 0$$

$$n \in \mathbb{N}, m \geq 0$$

Alternativa 1

Solución original

- *tc* = 2 h 23 min 8.67 s
- $mo = n\,m$
- *to* = 124 h 3 min 30.6 s
- *n* = 52 ciclos
- *n m* = *mo* = 150 kg

Solución alternativa 1

- *tc* = 2 h 15 min
- $mo \leq n\,m$
- *to* = 126 h
- *n* = 56 ciclos
- *n m* = 152.266184 kg > *mo* = 150 kg

Alternativa 2

Solución original

- *tc* = 2 h 23 min 8.67 s
- $mo = n\,m$
- *to* = 124 h 3 min 30.6 s
- *n* = 52 ciclos
- *n m* = *mo* = 150 kg

Solución alternativa 2

- *tc* = 2 h 15 min
- $n \geq 0$
- *to* = 124 h 7 min 29.28 s
- *n* = 55.16656 ciclos
- *n m* = *mo* = 150 kg
- El último ciclo debe tener una duración menor que *tc*.

Regresión

Línea de tendencia

T (K)	σ_{Ge} (10^{-4} S/cm)
400	0.05
500	0.10
600	0.20
700	0.40
800	1.00
900	2.00
1000	4.00

Conductividad Ge - Regresión.xlsx

Regresión lineal

- *n*: Cantidad de puntos (x_i, y_i) a ajustar.
- $y = ax + b$
- *a* y *b*: parámetros a ajustar.

$$\underset{a,b}{\text{Min}} \sum_{i=1}^{n} \left(y_i - (a\, x_i + b) \right)^2$$

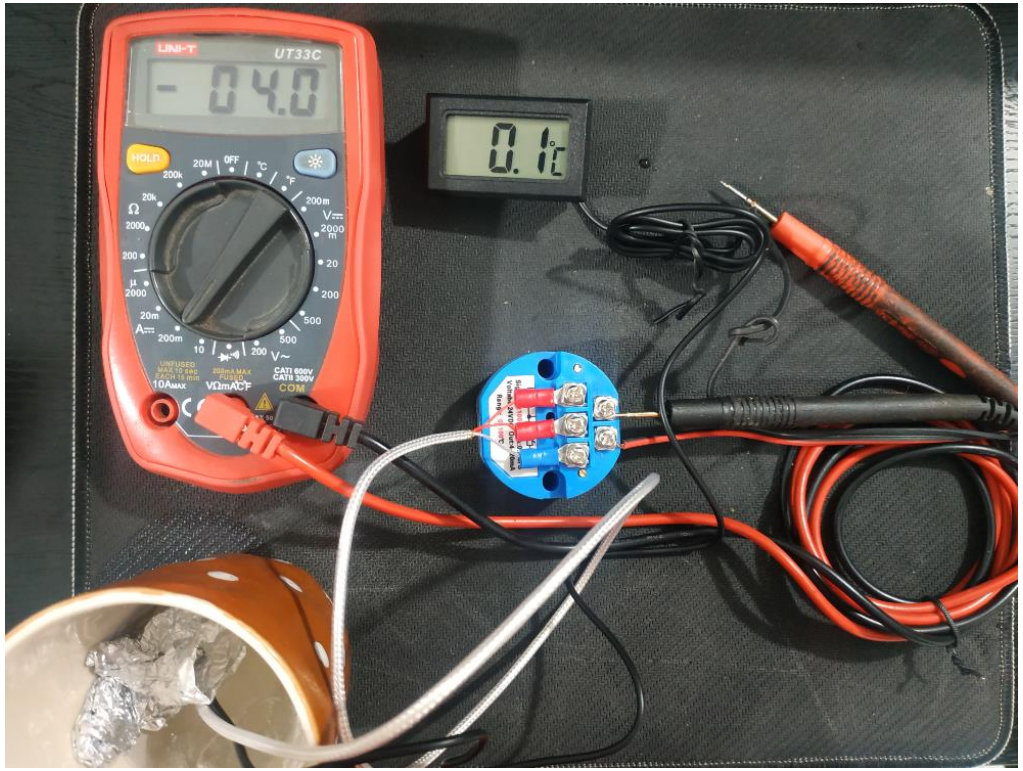
Regresión.xlsx

Regresión lineal

- $Y = \beta_0 + \beta_1 X$
- $S(\beta_0, \beta_1) = \sum_{i=1}^{n} \left(y_i - (\beta_0 + \beta_1 x_i)\right)^2$
- $\frac{\partial S}{\partial \beta_0} = 0, \frac{\partial S}{\partial \beta_1} = 0$
- $\hat{\beta}_1 = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{\sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2}$
- $\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$
- En Excel: ESTIMACION.LINEAL(Y,x)

Calibración de un transmisor para una Pt100

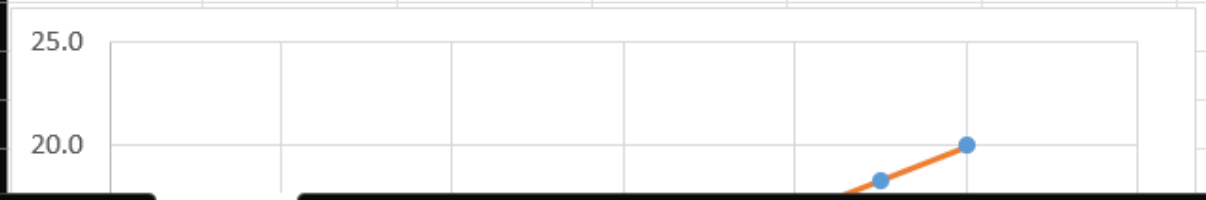
T (°C)	I (mA)
0.4	4.0
10	5.3
20	7.0
30	8.5
40	10.4
50	12.0
60	13.3
70	15.1
80	16.6
90	18.3
100	20.0



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	T (°C)	I (mA)	I(T)	Error^2		a	b						
2	0.4	4.0	4	1.78E-02		1.61E-01	3.8019787						
3	10	5.3	5	1.28E-02									
4	20	7.0	7	5.90E-04									
5	30	8.5	9	1.83E-02									
6	40	10.4	10	2.35E-02									
7	50	12.0	12	2.02E-02									
8	60	13.3	13	2.85E-02									
9	70	15.1	15	3.96E-04									
10	80	16.6	17	8.33E-03									
11	90	18.3	18	5.84E-06									
12	100	20.0	20	7.47E-03									
13			Suma =	1.38E-01									
14													

Con la función de Excel.

$$\min_{a,b} \sum_{i=1}^{n} \left(y_i - (a\,x_i + b) \right)^2$$



Lineal sol | Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

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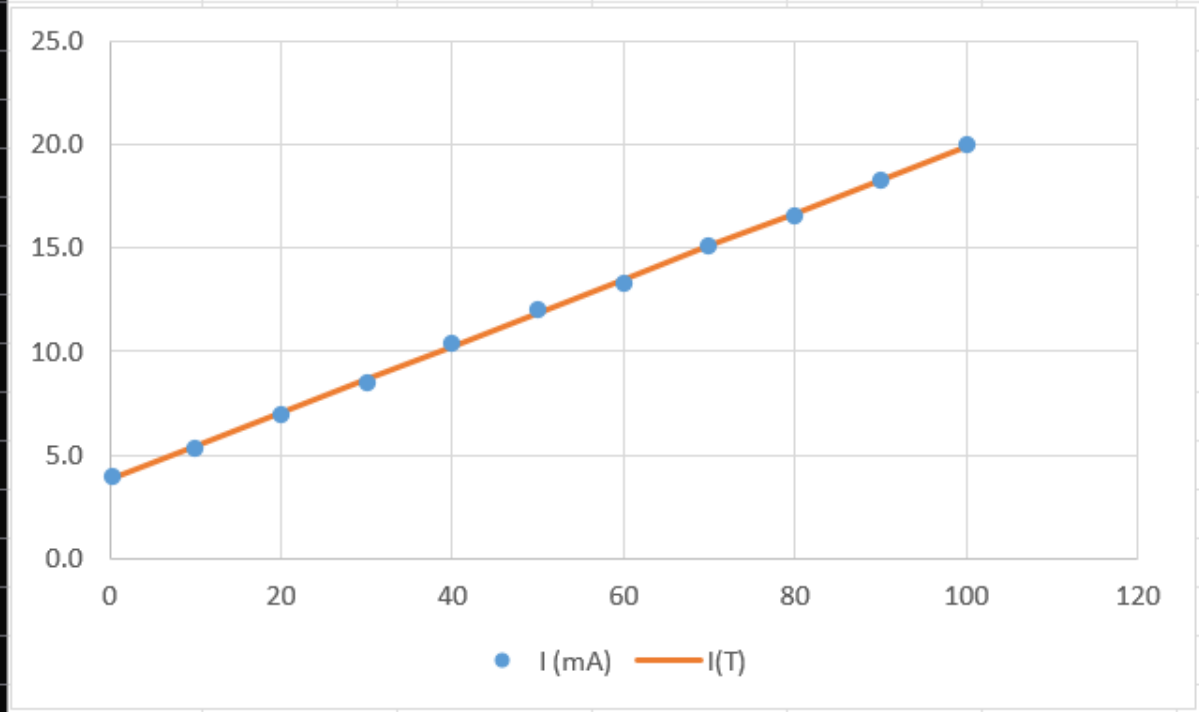
Predeterminado | Normal | Ver salt. Pág. | Diseño de página | Vistas personalizadas | Vista de hoja | Vistas de libro | Cambiar entre modos de | Modo oscuro | Mostrar | Zoom | 100% | Ampliar selección | Zoom | Nueva ventana | Organizar todo | Inmovilizar | Cambiar ventanas | Ventana | Macros | Macros

F3

	A	B	C	D	E	F	G	H	I	J	K	L	M
13			**Suma =**	1.38E-01									
14													



Lineal sol | Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

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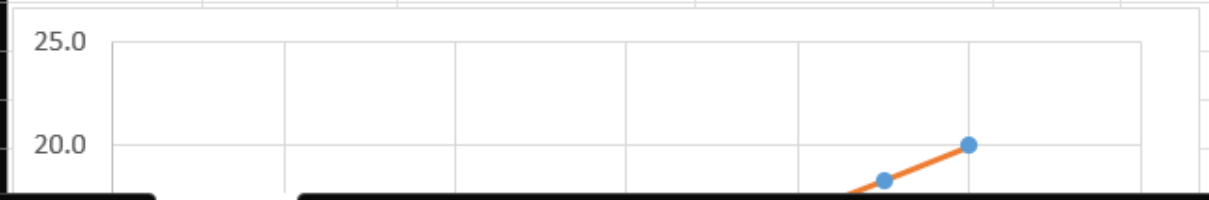
Pegar | Portapapeles | Calibri | 11 | Fuente | Alineación | Científica | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Ordenar y filtrar | Buscar y seleccionar | Edición | Complementos

DISTR.T.2C

= ESTIMACION.LINEAL(B2:B12,A2:A12)

	A	B	C	D	E	F	G	H
1	T (°C)	I (mA)	I(T)	Error^2		a	b	
2	0.4	4	=F$2*A2+G$2	=(B2-C2)^2		B12,A2:A12)		
3	10	5.3	=F$2*A3+G$2	=(B3-C3)^2				
4	20	7	=F$2*A4+G$2	=(B4-C4)^2				
5	30	8.5	=F$2*A5+G$2	=(B5-C5)^2				
6	40	10.4	=F$2*A6+G$2	=(B6-C6)^2				
7	50	12	=F$2*A7+G$2	=(B7-C7)^2				
8	60	13.3	=F$2*A8+G$2	=(B8-C8)^2				
9	70	15.1	=F$2*A9+G$2	=(B9-C9)^2				
10	80	16.6	=F$2*A10+G$2	=(B10-C10)^2				
11	90	18.3	=F$2*A11+G$2	=(B11-C11)^2				
12	100	20	=F$2*A12+G$2	=(B12-C12)^2				
13			**Suma =**	=SUMA(D2:D12)				
14								

$$\min_{a,b} \sum_{i=1}^{n} \left(y_i - (a\,x_i + b) \right)^2$$



Lineal sol | Lineal | No lineal | No lineal 2

Modificar | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión... • Guardado | Buscar

Archivo | Inicio | Insertar | Disposición de página | Fórmulas | Datos | Revisar | Vista | Automatizar | Programador | Ayuda | Comentarios | Compartir

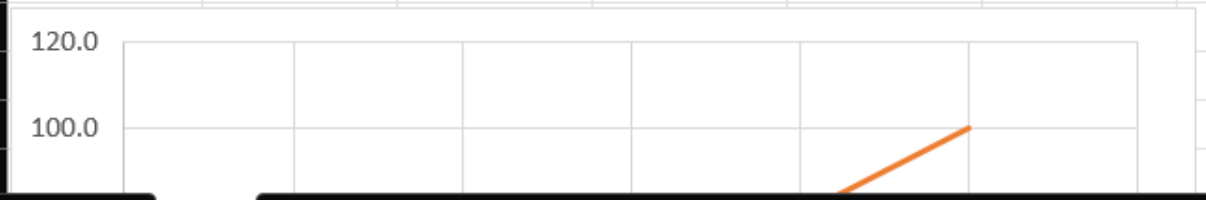
Pegar | Portapapeles | Calibri | 11 | Fuente | Alineación | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Edición | Complementos | Analizar datos | Copilot

F4

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	T (°C)	I (mA)	I(T)	Error^2									
2	0.4	4.0	0	1.30E+01	**a =**	1.00E+00							
3	10	5.3	10	2.21E+01	**b =**	0.00E+00							
4	20	7.0	20	1.69E+02									
5	30	8.5	30	4.62E+02									
6	40	10.4	40	8.76E+02									
7	50	12.0	50	1.44E+03									
8	60	13.3	60	2.18E+03									
9	70	15.1	70	3.01E+03									
10	80	16.6	80	4.02E+03									
11	90	18.3	90	5.14E+03									
12	100	20.0	100	6.40E+03									
13			**Suma =**	2.37E+04									
14													
15													
16													
17													
18													

$$\min_{a,b} \sum_{i=1}^{n} \left(y_i - (a x_i + b) \right)^2$$

Con Solver.



Lineal | No lineal | No lineal 2 | +

Listo | Accesibilidad: es necesario investigar | 130%

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Pegar | Portapapeles | Fuente | Alineación | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Edición | Complementos | Analizar datos | Copilot

Objeto 1 | =INCRUSTAR("Equation.DSMT4","")

	A	B	C	D	E	F	G	H	I	J	K	L	M
13			**Suma =**	2.37E+04									
14													
15													
16													
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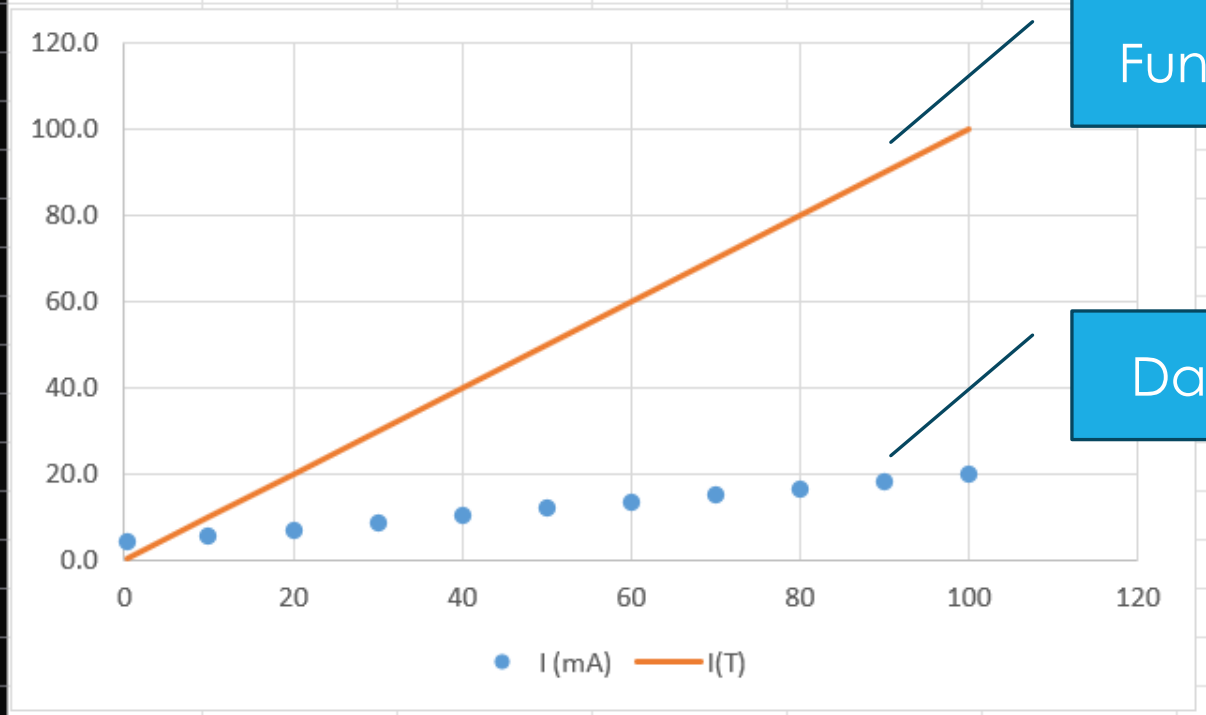
30													



Función: líneas

Datos: puntos

- Facilita la inicialización de los parámetros.
- Permite identificar óptimos locales.

Lineal | No lineal | No lineal 2 | +

Listo | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión.xlsx | Buscar

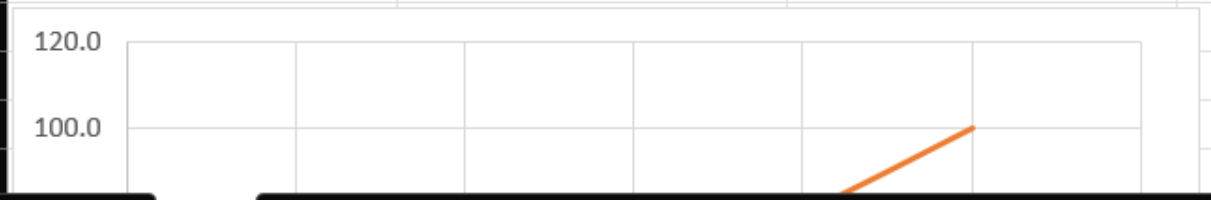
Archivo | Inicio | Insertar | Disposición de página | Fórmulas | Datos | Revisar | Vista | Automatizar | Programador | Ayuda | Comentarios | Compartir

Pegar | Portapapeles | Calibri | 11 | Fuente | Alineación | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Edición | Complementos | Analizar datos | Copilot

C2 | =F$2*A2+F$3

	A	B	C	D	E	F	G
1	T (°C)	I (mA)	I(T)	Error^2			
2	0.4	4	=F$2*A2+F$3	=(B2-C2)^2	a =	1	
3	10	5.3	=F$2*A3+F$3	=(B3-C3)^2	b =	0	
4	20	7	=F$2*A4+F$3	=(B4-C4)^2			
5	30	8.5	=F$2*A5+F$3	=(B5-C5)^2			
6	40	10.4	=F$2*A6+F$3	=(B6-C6)^2			
7	50	12	=F$2*A7+F$3	=(B7-C7)^2			
8	60	13.3	=F$2*A8+F$3	=(B8-C8)^2			
9	70	15.1	=F$2*A9+F$3	=(B9-C9)^2			
10	80	16.6	=F$2*A10+F$3	=(B10-C10)^2			
11	90	18.3	=F$2*A11+F$3	=(B11-C11)^2			
12	100	20	=F$2*A12+F$3	=(B12-C12)^2			
13			**Suma =**	=SUMA(D2:D12)			
14							

$$\min_{a,b} \sum_{i=1}^{n} \left(y_i - (a\,x_i + b)\right)^2$$



Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

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Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Orde

D13

	A	B	C	D	E	F
1	T (°C)	I (mA)	I(T)	Error^2		
2	0.4	4.0	0	1.30E+01	a =	1.00E+00
3	10	5.3	10	2.21E+01	b =	0.00E+00
4	20	7.0	20	1.69E+02		
5	30	8.5	30	4.62E+02		
6	40	10.4	40	8.76E+02		
7	50	12.0	50	1.44E+03		
8	60	13.3	60	2.18E+03		
9	70	15.1	70	3.01E+03		
10	80	16.6	80	4.02E+03		
11	90	18.3	90	5.14E+03		
12	100	20.0	100	6.40E+03		
13			Suma =	2.37E+04		
14						
15						
16						
17						
18						

$$\min_{a,b} \sum_{i=1}^{n} (y_i -$$

120.0
100.0

Lineal | No lineal | No lineal 2 | +

Señalar | Accesibilidad: es necesario investigar

Parámetros de Solver

Establecer objetivo: $D$13

Para: ○ Máx ◉ Mín ○ Valor de: 0

Cambiando las celdas de variables:
$F$2:$F$3

Sujeto a las restricciones:

Agregar | Cambiar | Eliminar | Restablecer todo | Cargar/Guardar

☐ Convertir variables sin restricciones en no negativas

Método de resolución: GRG Nonlinear | Opciones

Método de resolución

Seleccione el motor GRG Nonlinear para problemas de Solver no lineales suavizados. Seleccione el motor LP Simplex para problemas de Solver lineales, y seleccione el motor Evolutionary para problemas de Solver no suavizados.

Ayuda | Resolver | Cerrar

Autoguardado | Regresión.xlsx | Buscar

Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Ordenar y filtrar | Herramientas de datos | Previsión | Análisis

	A	B	C	D	E	F
1	T (°C)	I (mA)	I(T)	Error^2		
2	0.4	4.0	4	1.78E-02	a =	1.61E-01
3	10	5.3	5	1.28E-02	b =	3.80E+00
4	20	7.0	7	5.90E-04		
5	30	8.5	9	1.83E-02		
6	40	10.4	10	2.35E-02		
7	50	12.0	12	2.02E-02		
8	60	13.3	13	2.85E-02		
9	70	15.1	15	3.96E-04		
10	80	16.6	17	8.33E-03		
11	90	18.3	18	5.84E-06		
12	100	20.0	20	7.47E-03		
13			Suma =	1.38E-01		

$$\underset{a,b}{\text{Min}} \sum_{i=1}^{n} (y_i -$$

Resultados de Solver

Solver encontró una solución. Se cumplen todas las restricciones y condiciones óptimas.

Informes: Responder, Sensibilidad, Límites

(•) Conservar solución de Solver

( ) Restaurar valores originales

[ ] Volver al cuadro de diálogo de parámetros de Solver

[ ] Informes de esquema

Aceptar | Cancelar | Guardar escenario...

Solver encontró una solución. Se cumplen todas las restricciones y condiciones óptimas.

Al usar el motor GRG, Solver ha encontrado al menos una solución óptima local. Al usar Simplex LP, significa que Solver ha encontrado una solución óptima global.

25.0

20.0

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión.xlsx | Buscar

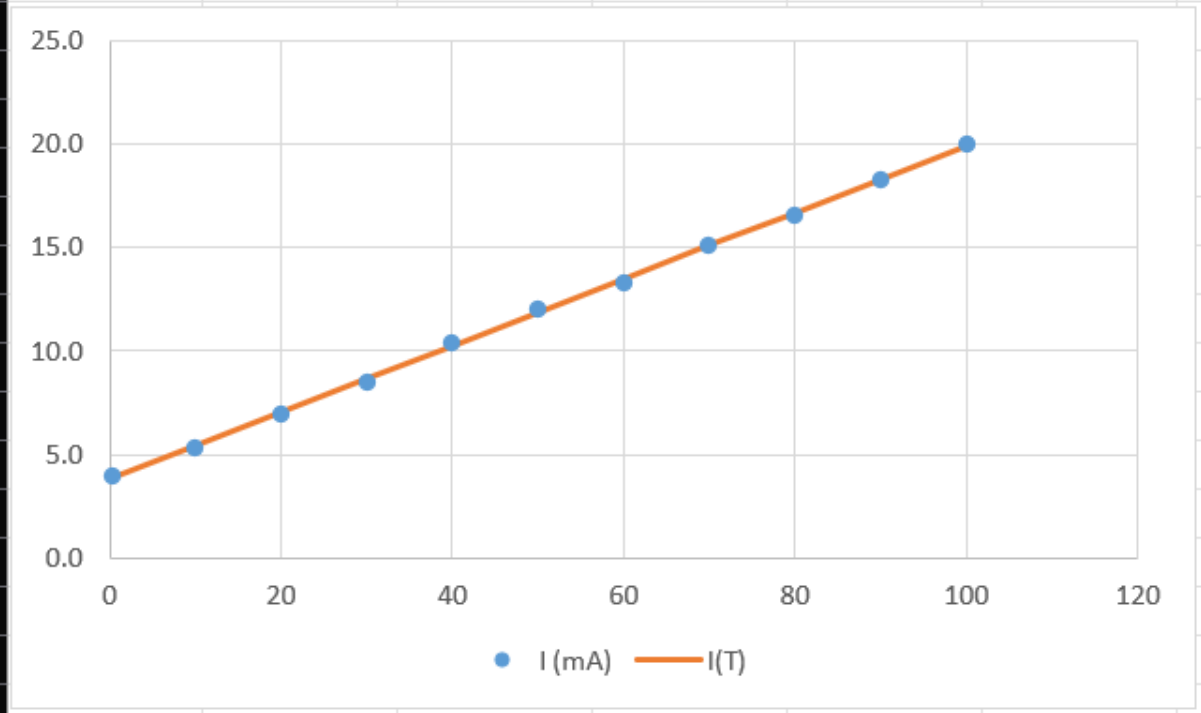
Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Ordenar y filtrar | Herramientas de datos | Previsión | Análisis

F4

	A	B	C	D	E	F	G	H	I	J	K	L	M
13			**Suma =**	1.38E-01									
14													



Lineal | No lineal | No lineal 2 | +

Listo | Accesibilidad: es necesario investigar | 130%

Regresión no lineal

- Correlación de Vogel para ajustar la viscosidad del agua de mar.
- $\mu = e^{\frac{a}{T+b}+c}$
- *a*, *b* y *c*: Parámetros a ajustar.

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(\mu_i - e^{\frac{a}{T_i+b}+c} \right)^2$$

T (C°)	μ (cP)
10	1.30
20	1.00
30	0.80
40	0.65
50	0.54
60	0.46
70	0.40
80	0.35
90	0.31

Regresión.xlsx

Autoguardado | Regresión.xlsx | Buscar

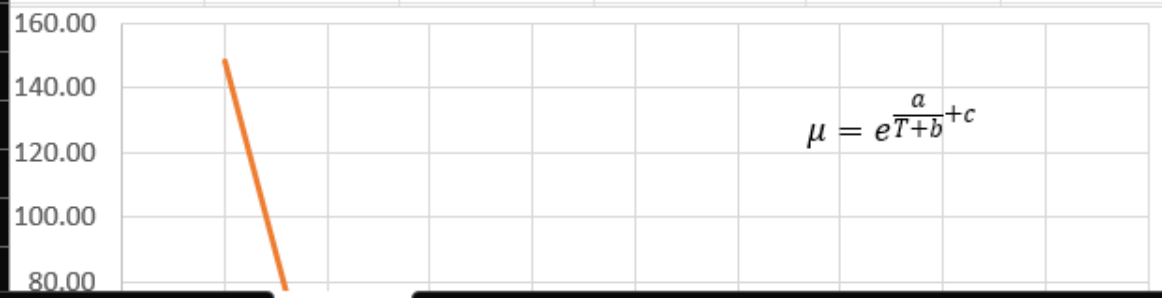
Archivo | Inicio | Insertar | Disposición de página | Fórmulas | Datos | Revisar | Vista | Automatizar | Programador | Ayuda | Comentarios | Compartir

Pegar | Portapapeles | Calibri | 11 | Fuente | Alineación | General | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Edición | Complementos | Analizar datos | Copilot

F5

	A	B	C	D	E	F	G	H	I	J	K	L
1	**T (C°)**	**μ (cP)**	**μ(T)**	**Error²**								
2	10	1.30	148.41	2.16E+04	**a =**	1.00E+02						
3	20	1.00	28.03	7.31E+02	**b =**	1.00E+01						
4	30	0.80	12.18	1.30E+02	**c =**	0.00E+00						
5	40	0.65	7.39	4.54E+01								
6	50	0.54	5.29	2.26E+01								
7	60	0.46	4.17	1.38E+01								
8	70	0.40	3.49	9.55E+00								
9	80	0.35	3.04	7.22E+00								
10	90	0.31	2.72	5.80E+00								
11			**Suma =**	2.26E+04								
12												

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - e^{\frac{a}{T_i+b}+c} \right)^2$$

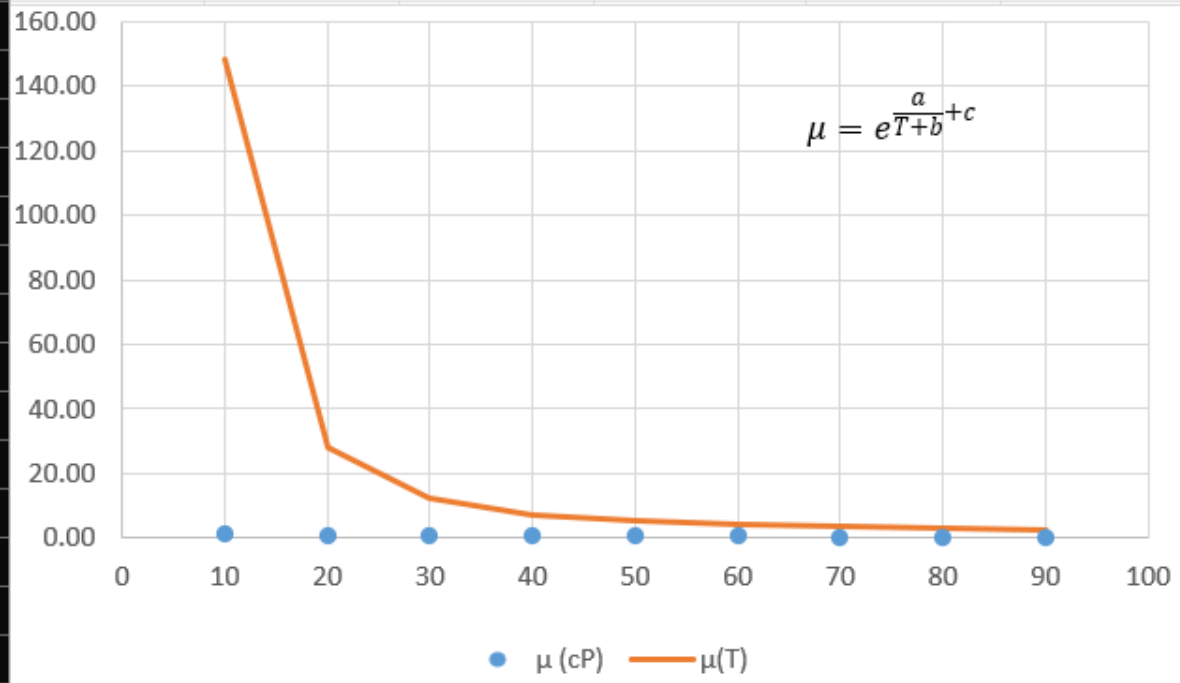


$$\mu = e^{\frac{a}{T+b}+c}$$

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

	A	B	C	D
10	90	0.31	2.72	5.80E+00
11			**Suma =**	2.26E+04



Autoguardado | Regresión.xlsx | Buscar

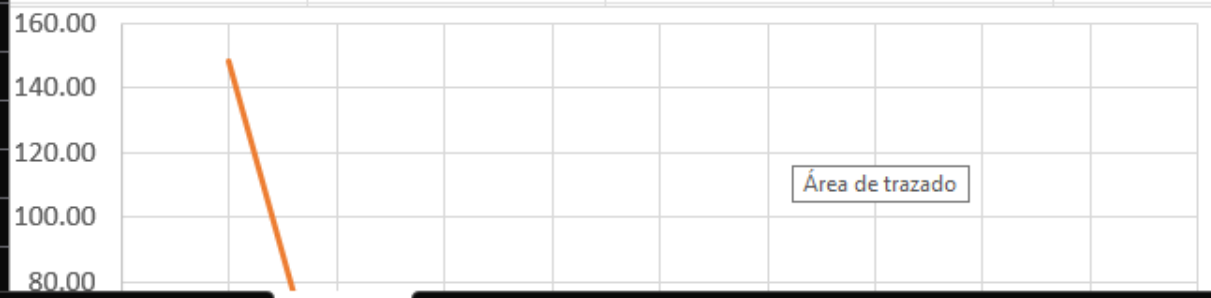
Archivo | Inicio | Insertar | Disposición de página | Fórmulas | Datos | Revisar | Vista | Automatizar | Programador | Ayuda | Comentarios | Compartir

Pegar | Portapapeles | Calibri | 11 | Fuente | Alineación | Número | Formato condicional | Dar formato como tabla | Estilos de celda | Estilos | Insertar | Eliminar | Formato | Celdas | Edición | Complementos | Analizar datos | Copilot

C2 | =EXP(F$2/(A2+F$3)+F$4)

	A	B	C	D	E	F	G
1	T (C°)	μ (cP)	μ(T)	Error^2			
2	10	1.3	=EXP(F$2/(A2+F$3)+F$4)	=(B2-C2)^2	a =	100	
3	20	1	=EXP(F$2/(A3+F$3)+F$4)	=(B3-C3)^2	b =	10	
4	30	0.8	=EXP(F$2/(A4+F$3)+F$4)	=(B4-C4)^2	c =	0	
5	40	0.65	=EXP(F$2/(A5+F$3)+F$4)	=(B5-C5)^2			
6	50	0.54	=EXP(F$2/(A6+F$3)+F$4)	=(B6-C6)^2			
7	60	0.46	=EXP(F$2/(A7+F$3)+F$4)	=(B7-C7)^2			
8	70	0.4	=EXP(F$2/(A8+F$3)+F$4)	=(B8-C8)^2			
9	80	0.35	=EXP(F$2/(A9+F$3)+F$4)	=(B9-C9)^2			
10	90	0.31	=EXP(F$2/(A10+F$3)+F$4)	=(B10-C10)^2			
11			Suma =	=SUMA(D2:D10)			
12							

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - e^{\frac{a}{T_i+b}+c} \right)^2$$



$$\mu = e^{\frac{a}{T+b}+c}$$

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión.xlsx | Buscar

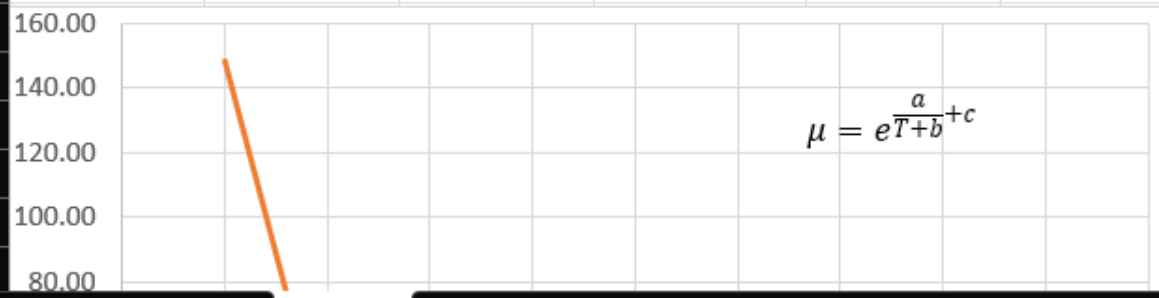
Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Orde

	A	B	C	D	E	F
1	T (C°)	μ (cP)	μ(T)	Error^2		
2	10	1.30	148.41	2.16E+04	a =	1.00E+02
3	20	1.00	28.03	7.31E+02	b =	1.00E+01
4	30	0.80	12.18	1.30E+02	c =	0.00E+00
5	40	0.65	7.39	4.54E+01		
6	50	0.54	5.29	2.26E+01		
7	60	0.46	4.17	1.38E+01		
8	70	0.40	3.49	9.55E+00		
9	80	0.35	3.04	7.22E+00		
10	90	0.31	2.72	5.80E+00		
11			Suma =	2.26E+04		
12						

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - e^{\frac{a}{T_i+} \right.$$



$$\mu = e^{\frac{a}{T+b}+c}$$

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar

Parámetros de Solver

Establecer objetivo: $D$11

Para: Máx | Mín | Valor de: 0

Cambiando las celdas de variables:

$F$2:$F$4

Sujeto a las restricciones:

Agregar | Cambiar | Eliminar | Restablecer todo | Cargar/Guardar

Convertir variables sin restricciones en no negativas

Método de resolución: GRG Nonlinear | Opciones

Método de resolución

Seleccione el motor GRG Nonlinear para problemas de Solver no lineales suavizados. Seleccione el motor LP Simplex para problemas de Solver lineales, y seleccione el motor Evolutionary para problemas de Solver no suavizados.

Ayuda | Resolver | Cerrar

Autoguardado | Regresión.xlsx | Buscar

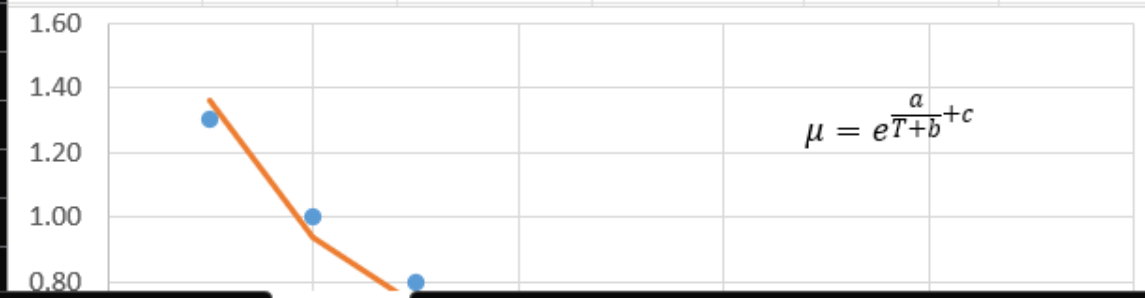
Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Obtener y transformar datos | Consultas &conexiones | Cotizaciones | Monedas | Tipos de datos | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Ordenar y filtrar | Texto en columnas | Herramientas de datos | Análisis de hipótesis | Previsión | Esquema | Solver | Análisis

I3

	A	B	C	D	E	F
1	**T (C°)**	**μ (cP)**	**μ(T)**	**Error²**		
2	10	1.30	1.36	3.77E-03	**a =**	8.21E+01
3	20	1.00	0.94	4.11E-03	**b =**	3.21E+01
4	30	0.80	0.73	5.49E-03	**c =**	-1.64E+00
5	40	0.65	0.60	2.10E-03		
6	50	0.54	0.53	1.98E-04		
7	60	0.46	0.47	1.39E-04		
8	70	0.40	0.43	1.04E-03		
9	80	0.35	0.40	2.74E-03		
10	90	0.31	0.38	4.75E-03		
11			**Suma =**	2.43E-02		
12						

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - \right.$$



$$\mu = e^{\frac{a}{T+b}+c}$$

Resultados de Solver

Solver encontró una solución. Se cumplen todas las restricciones y condiciones óptimas.

Informes
Responder
Sensibilidad
Límites

(•) Conservar solución de Solver
( ) Restaurar valores originales

☐ Volver al cuadro de diálogo de parámetros de Solver
☐ Informes de esquema

Aceptar | Cancelar | Guardar escenario...

Solver encontró una solución. Se cumplen todas las restricciones y condiciones óptimas.

Al usar el motor GRG, Solver ha encontrado al menos una solución óptima local. Al usar Simplex LP, significa que Solver ha encontrado una solución óptima global.

Lineal | No lineal | No lineal 2 | +

Listo | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión.xlsx | Buscar

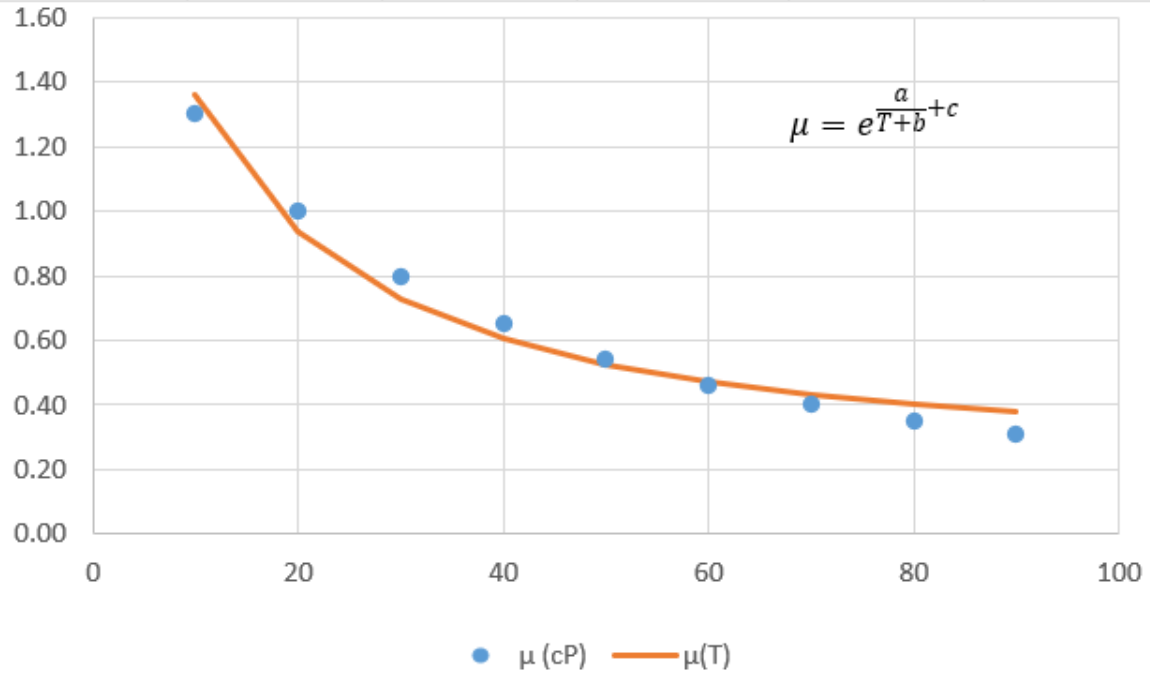
Archivo Inicio Insertar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Ordenar y filtrar | Herramientas de datos | Previsión | Análisis

I3

	A	B	C	D
10	90	0.31	0.38	4.75E-03
11			**Suma =**	2.43E-02



No es un buen ajuste.
Hay que ejecutar
nuevamente *Solver*.

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

Autoguardado | Regresión... • Última modificación: Hace 7 h | Buscar

Archivo Inicio Insertar Dibujar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

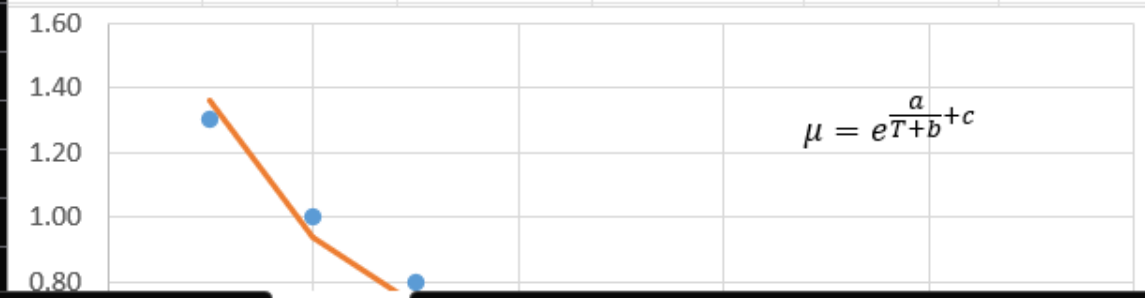
Obtener y transformar datos | Consultas &conexiones | Tipos de datos

D11

	A	B	C	D	E	F
1	T (C°)	μ (cP)	μ(T)	Error^2		
2	10	1.30	1.36	3.77E-03		
3	20	1.00	0.94	4.11E-03		
4	30	0.80	0.73	5.49E-03		
5	40	0.65	0.60	2.10E-03		
6	50	0.54	0.53	1.98E-04		
7	60	0.46	0.47	1.39E-04		
8	70	0.40	0.43	1.04E-03		
9	80	0.35	0.40	2.74E-03		
10	90	0.31	0.38	4.75E-03		
11			Suma =	2.43E-02		
12						

a =	8.21E+01
b =	3.21E+01
c =	-1.64E+00

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - \right.$$



$$\mu = e^{\frac{a}{T+b}+c}$$

Lineal | No lineal | No lineal 2

Señalar | Accesibilidad: es necesario investigar

Parámetros de Solver

Establecer objetivo: $D$11

Para: Máx | Mín | Valor de: 0

Cambiando las celdas de variables:

$F$2:$F$4

Sujeto a las restricciones:

Agregar | Cambiar | Eliminar | Restablecer todo | Cargar/Guardar

Convertir variables sin restricciones en no negativas

Método de resolución: GRG Nonlinear | Opciones

Método de resolución

Seleccione el motor GRG Nonlinear para problemas de Solver no lineales suavizados. Seleccione el motor LP Simplex para problemas de Solver lineales, y seleccione el motor Evolutionary para problemas de Solver no suavizados.

Ayuda | Resolver | Cerrar

Autoguardado | Regresión... • Última modificación: Hace 7 h | Buscar

Archivo Inicio Insertar Dibujar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

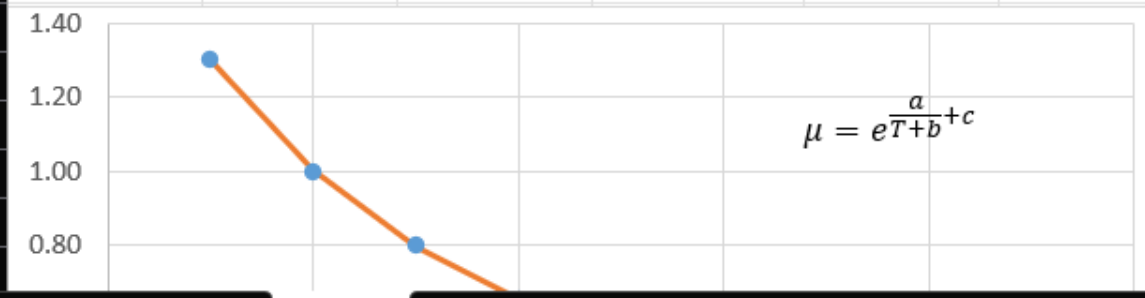
Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Ordenar y filtrar | Herramientas de datos | Previsión | Análisis

I3

	A	B	C	D	E	F
1	**T (C°)**	**μ (cP)**	**μ(T)**	**Error²**		
2	10	1.30	1.30	5.16E-15	**a =**	5.78E+02
3	20	1.00	1.00	1.98E-06	**b =**	1.34E+02
4	30	0.80	0.80	1.32E-05	**c =**	-3.75E+00
5	40	0.65	0.65	4.65E-08		
6	50	0.54	0.54	7.45E-06		
7	60	0.46	0.46	2.36E-06		
8	70	0.40	0.40	1.49E-06		
9	80	0.35	0.35	4.96E-07		
10	90	0.31	0.31	1.62E-07		
11			**Suma =**	2.72E-05		
12						

$$\underset{a,b,c}{\text{Min}} \sum_{i=1}^{n} \left(y_i - \right.$$



$$\mu = e^{\frac{a}{T+b}+c}$$

Resultados de Solver

Solver ha convergido a la solución actual. Se cumplen todas las restricciones.

Informes: Responder, Sensibilidad, Límites

(•) Conservar solución de Solver
( ) Restaurar valores originales

[ ] Volver al cuadro de diálogo de parámetros de Solver
[ ] Informes de esquema

Aceptar | Cancelar | Guardar escenario...

Solver ha convergido a la solución actual. Se cumplen todas las restricciones.

Solver realizó 5 iteraciones para las que el objetivo no se movió de manera significativa. Intente usar un valor de convergencia más pequeño u otro punto de inicio.

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | Abriendo: Regresión.xlsx | 130%

Autoguardado | Regresión.xlsx | Buscar

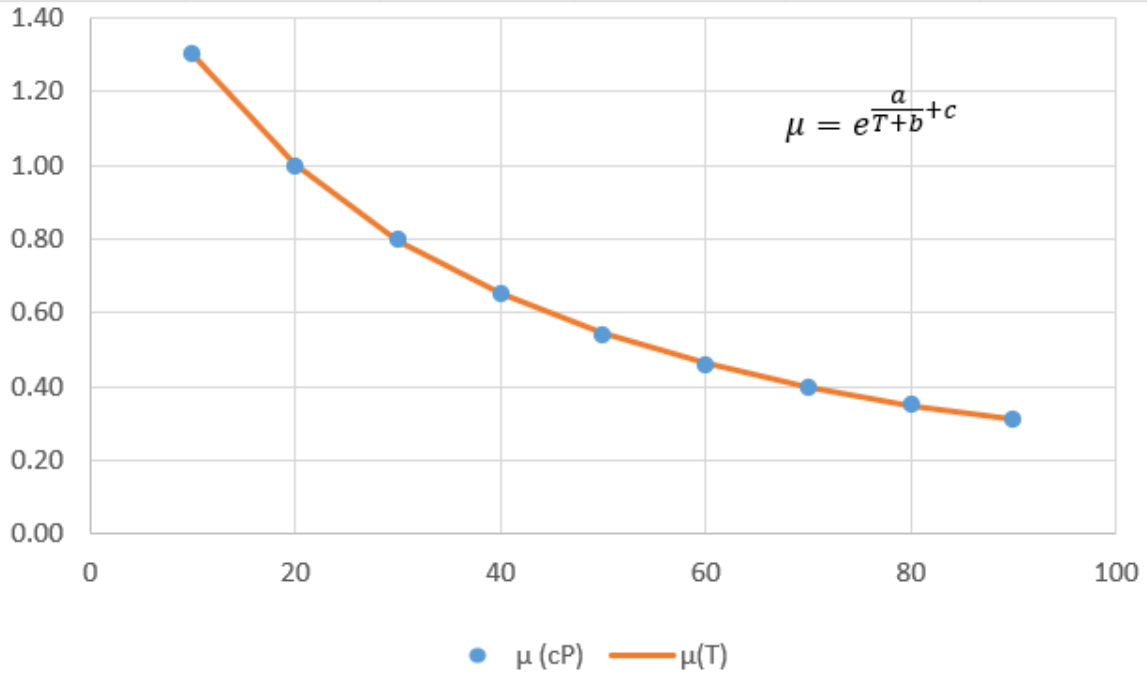
Archivo Inicio Insertar Dibujar Disposición de página Fórmulas Datos Revisar Vista Automatizar Programador Ayuda | Comentarios | Compartir

Obtener datos | Actualizar todo | Consultas y conexiones | Propiedades | Vínculos de libro | Cotizaciones | Monedas | Ordenar | Filtro | Borrar | Volver a aplicar | Avanzadas | Texto en columnas | Análisis de hipótesis | Previsión | Esquema | Solver

Obtener y transformar datos | Consultas &conexiones | Tipos de datos | Ordenar y filtrar | Herramientas de datos | Previsión | Análisis

H3

	A	B	C	D
10	90	0.31	0.31	1.62E-07
11			**Suma =**	2.72E-05

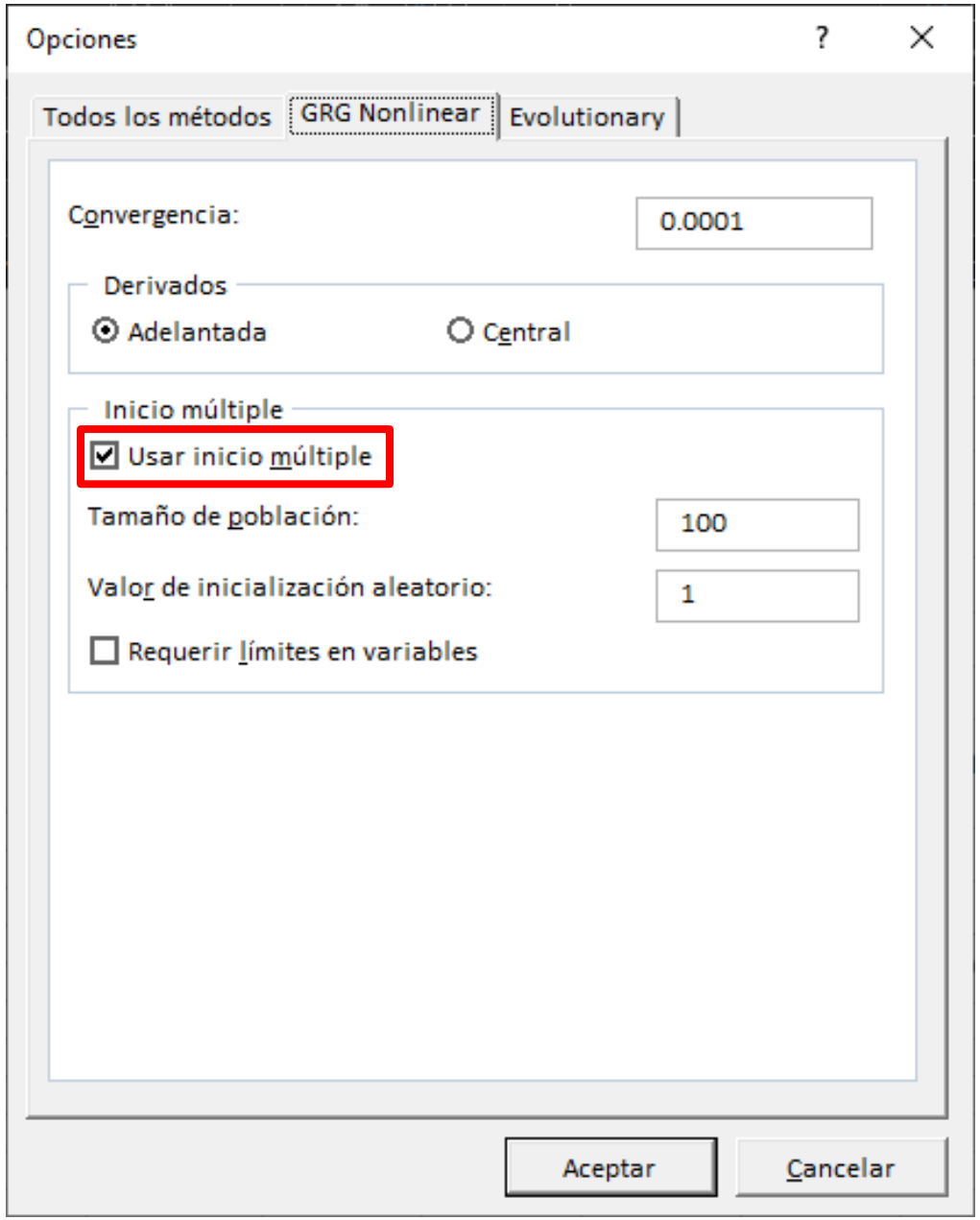


Es un buen ajuste.
Tiene el mínimo valor de la suma de los errores al cuadrado.

Lineal | No lineal | No lineal 2

Listo | Accesibilidad: es necesario investigar | 130%

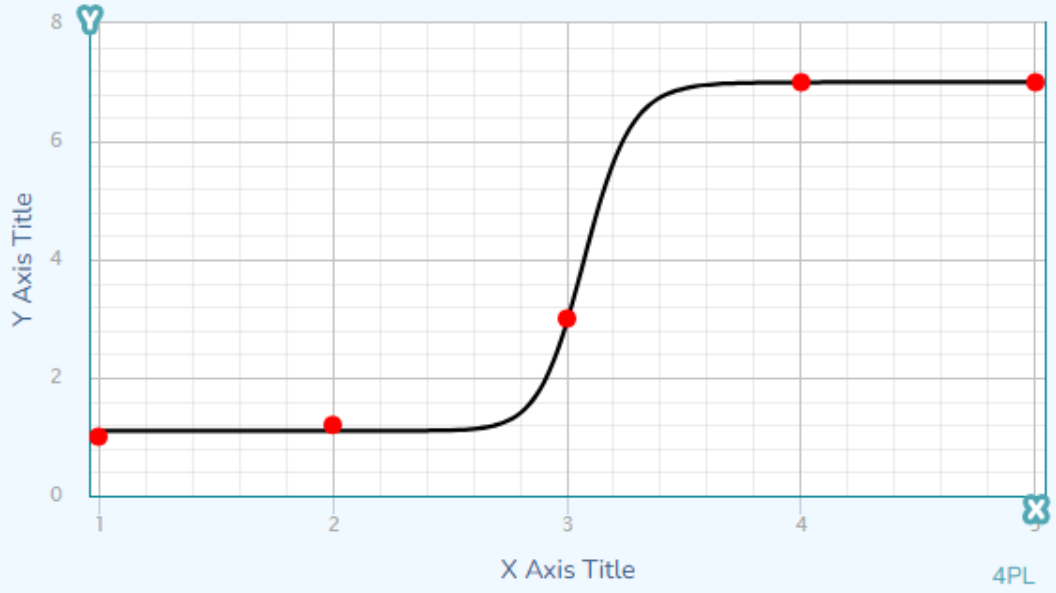
Inicio múltiple en *Solver*



MyCurveFit [BETA]

Online Curve Fitting

@MyCurveFit | Join | Log in



R^2:0.9994, aR^2:0.9972, P:0.03549, SE:0.1414, SSE:0.02, F:446.2, AIC:−5.418, BIC:−6.98, DoF:1

a = 1.099995, b = 31.0305, c = 3.072862, d = 7.000825

$y = 7.000825 + (1.099995 - 7.000825)/(1 + (x/3.072862)^{31.0305})$

Fit Method ▼

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- Use your fit for predictions

contact@mycurvefit.com

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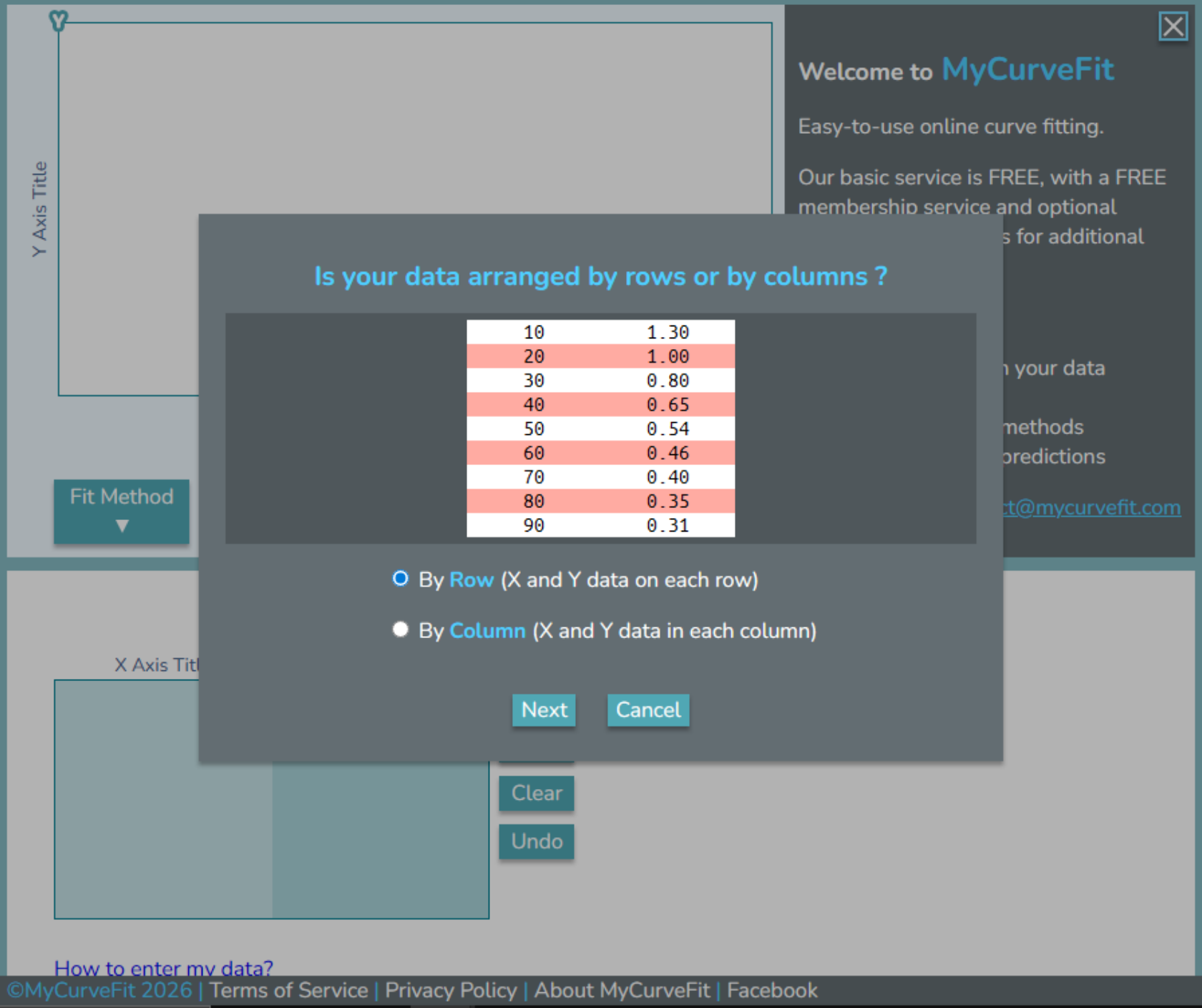
X Axis Title	Y Axis Title
1	1
2	1.2
3	3
4	7
5	7

Swap | Paste | Clear

MyCurveFit


Y Axis Title
Welcome to MyCurveFit
Easy-to-use online curve fitting.
Our basic service is FREE, with a FREE membership service and optional
s for additional
Is your data arranged by rows or by columns ?
10 1.30
20 1.00
30 0.80
40 0.65
50 0.54
60 0.46
70 0.40
80 0.35
90 0.31
By Row (X and Y data on each row)
By Column (X and Y data in each column)
Next
Cancel
Fit Method
your data
methods
predictions
t@mycurvefit.com
X Axis Titl
Clear
Undo
How to enter my data?
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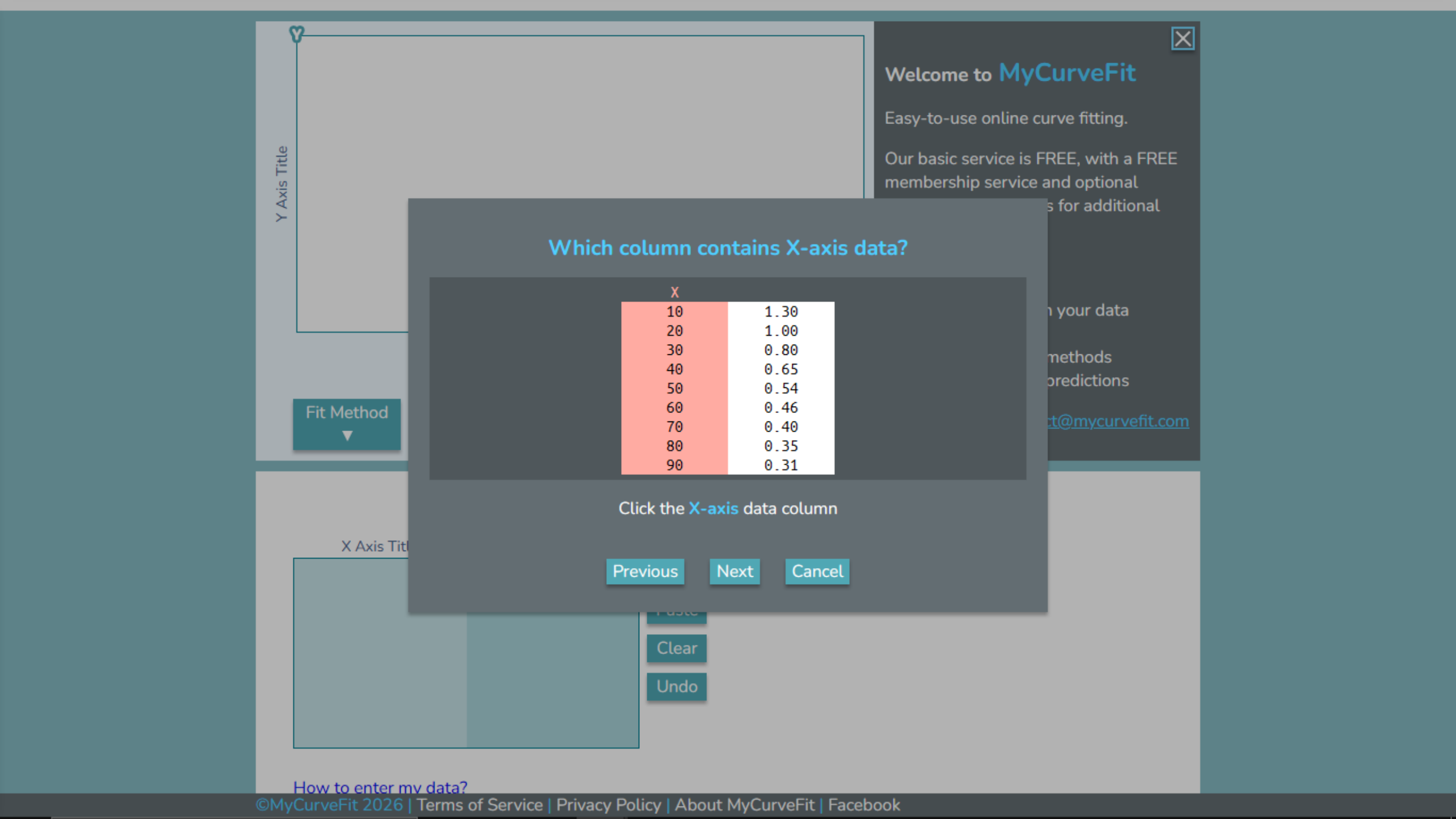
Y Axis Title
Welcome to MyCurveFit
Easy-to-use online curve fitting.
Our basic service is FREE, with a FREE membership service and optional
s for additional
Which column contains X-axis data?
X
10 1.30
20 1.00
30 0.80
40 0.65
50 0.54
60 0.46
70 0.40
80 0.35
90 0.31
Click the X-axis data column
Previous
Next
Cancel
Fit Method
your data
methods
predictions
@mycurvefit.com
X Axis Tit
Clear
Undo
How to enter my data?
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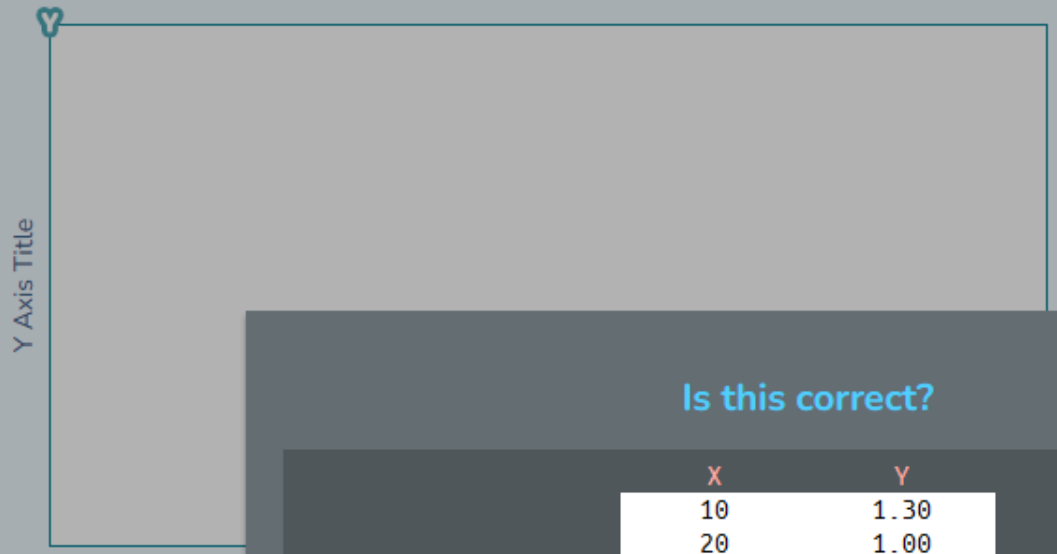

Fit Method ▼

Is this correct?

X	Y
10	1.30
20	1.00
30	0.80
40	0.65
50	0.54
60	0.46
70	0.40
80	0.35
90	0.31

Click Apply to accept.

Previous | Apply | Cancel

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s for additional

n your data

methods
predictions

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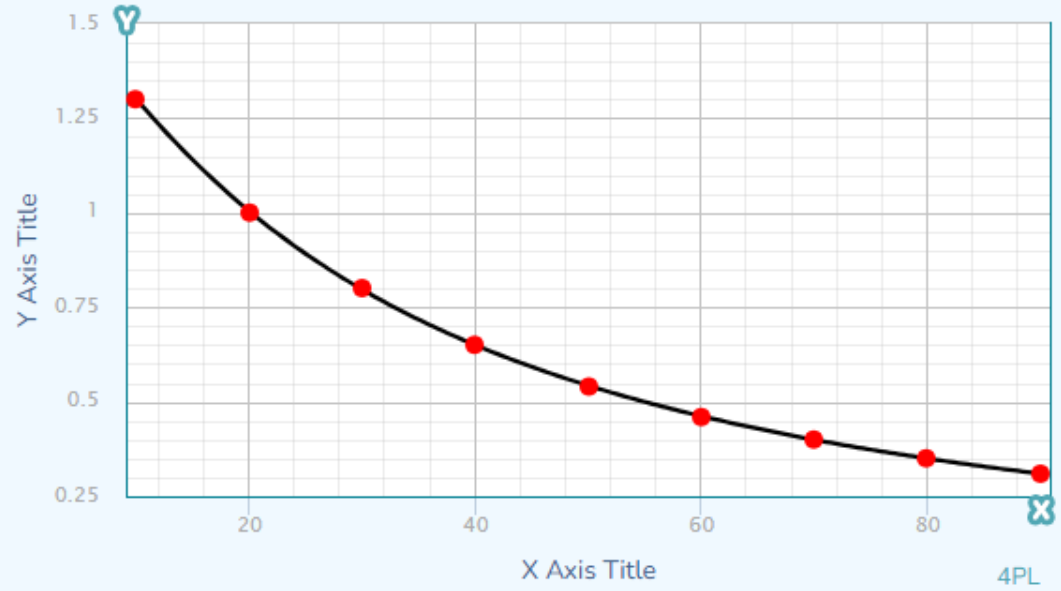
X Axis Titl

Clear

Undo

How to enter my data?



4PL

R^2:1, aR^2:0.9999, P:3.458*10^{-11}, SE:0.002646, SSE:0.00003501, F:31550, AIC:−78.57, BIC:−77.78, DoF:5, AICc: −68.57

a = 1.659682, b = 1.234282, c = 28.6026, d = −0.01846477

$y = -0.01846477 + (1.659682 - -0.01846477)/(1 + (x/28.6026)^{1.234282})$

Fit Method ▼

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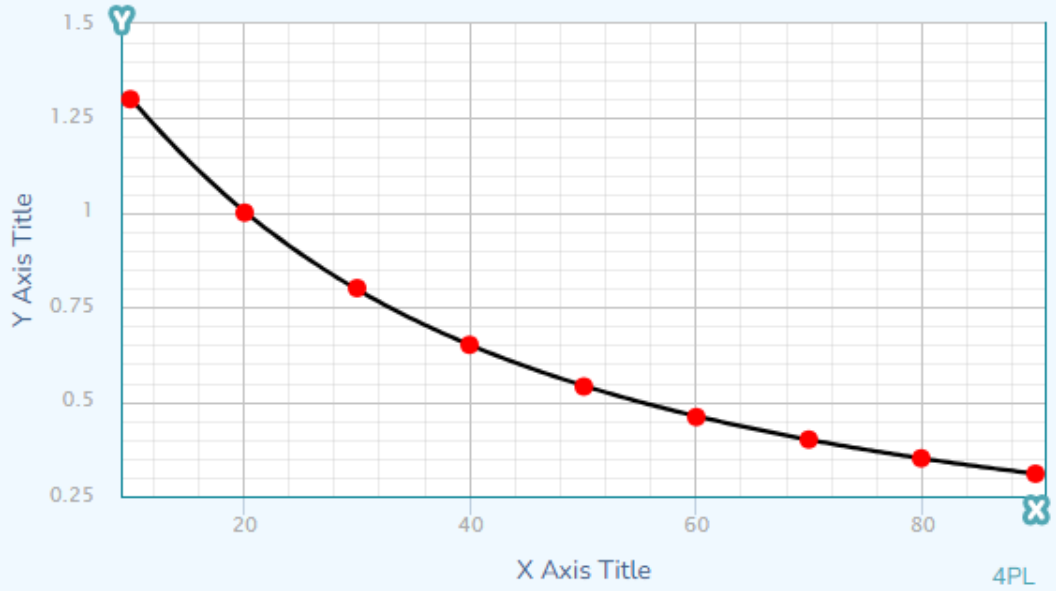
- Set axes titles
- Try different fit methods
- Use your fit for predictions

contact@mycurvefit.com

Export XLSX ▼ | Share | Predict ▼

X Axis Title	Y Axis Title
10	1.3
20	1
30	0.8
40	0.65
50	0.54
60	0.46
70	0.4
80	0.35
90	0.31

Swap | Paste | Clear | Undo



4PL

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Fit Method ▲

- Linear ▶
- Polynomial ▶
- Nonlinear ▶
- Cubic Spline ▶
- User Defined

Weighting ▼

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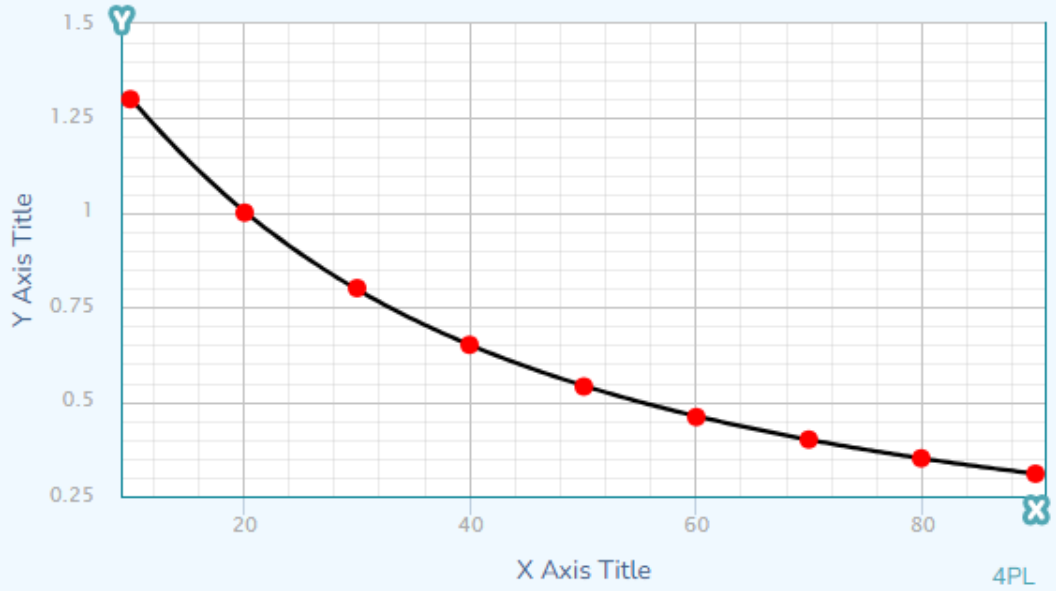

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Fit Method ▲

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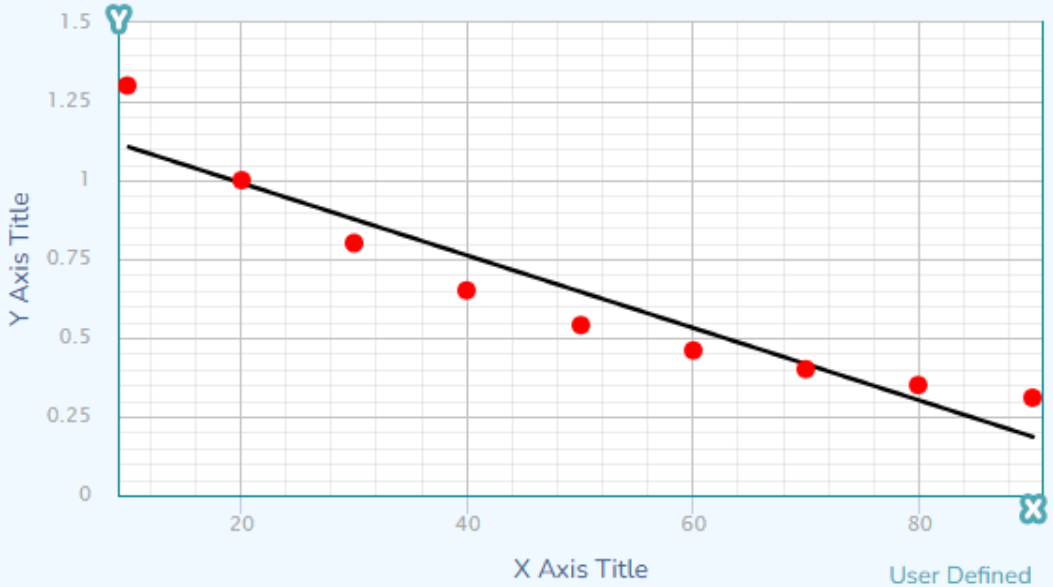

User Defined

R^2:0.898, aR^2:0.8689, P:0.0003388, SE:0.1135, SSE:0.09012, F:30.82, AIC:−11.89, BIC:−11.5, DoF:7, AICc:−9.893

c = 1.220556, m = −0.0115

y = −0.0115x + 1.220556

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To get started:

- Enter or paste in your data
- Set axes titles
- Try different fit methods
- Use your fit for predictions

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Fit Method ▲

- Linear ▶
- Polynomial ▶
- Nonlinear ▶
- Cubic Spline ▶
- User Defined

How to define my fit?

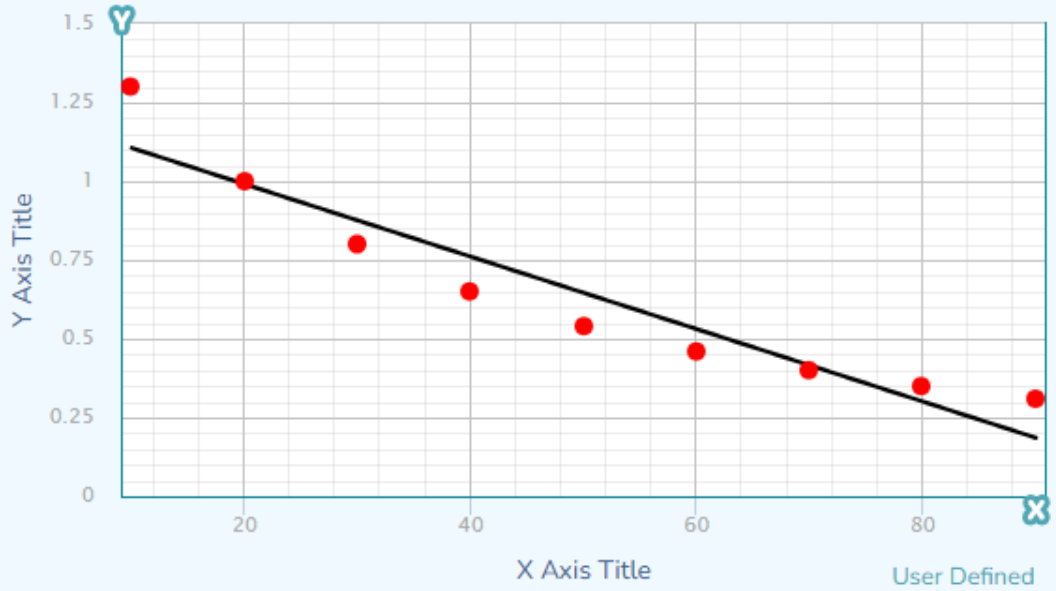
Weighting ▼

y= m*x+c

Initial Estimates: What's this? **Constraints:** What's this?

		Min:	Max:	
c=	1			1.220556
m=	1			-0.0115

Plot estimate



User Defined

R^2:0.898, aR^2:0.8689, P:0.0003388, SE:0.1135, SSE:0.09012, F:30.82, AIC:−11.89, BIC:−11.5, DoF:7, AICc:−9.893

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- Use your fit for predictions

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Fit Method ▲

Linear ▶

Polynomial ▶

Nonlinear ▶

Cubic Spline ▶

User Defined

How to define my fit?

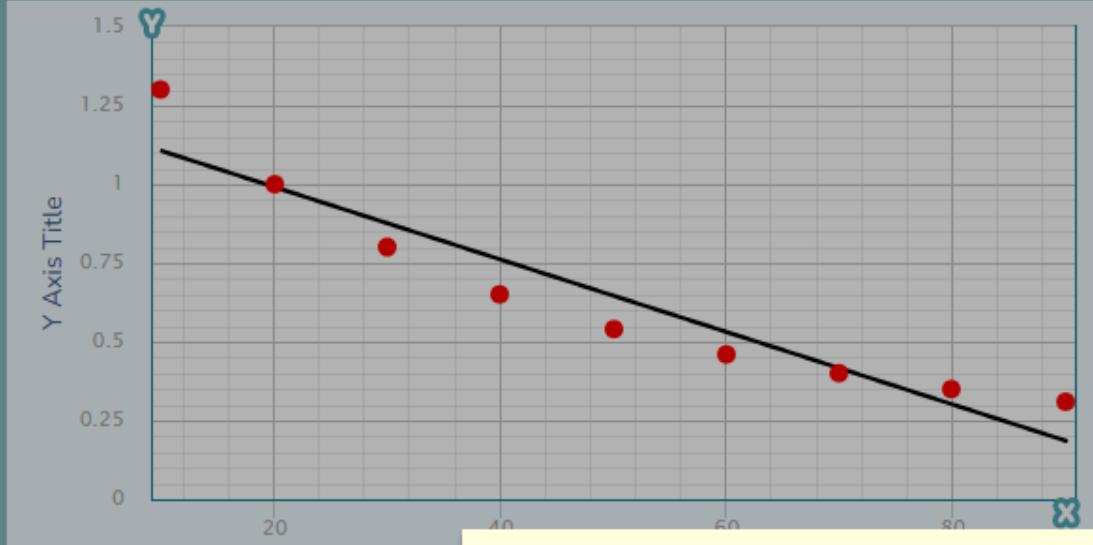
y= exp(a/(x+b)+c)

Weighting ▼

Apply

Initial Estimates: What's this? **Constraints:** What's this?

c=	1	Min:		Max:	1.220556
m=	1	Min:		Max:	-0.0115



R²:0.898, aR²:0.8689, P:0.0003388, SE:0.1135,

To use more coefficients, please login or join. It is free to create an account and access more functionality.

Log in | Join | Cancel

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To get started:

- Enter or paste in your data
- et axes titles
- y different fit methods
- se your fit for predictions

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Fit Method ▲

- Linear ▶
- Polynomial ▶
- Nonlinear ▶
- Cubic Spline ▶
- User Defined

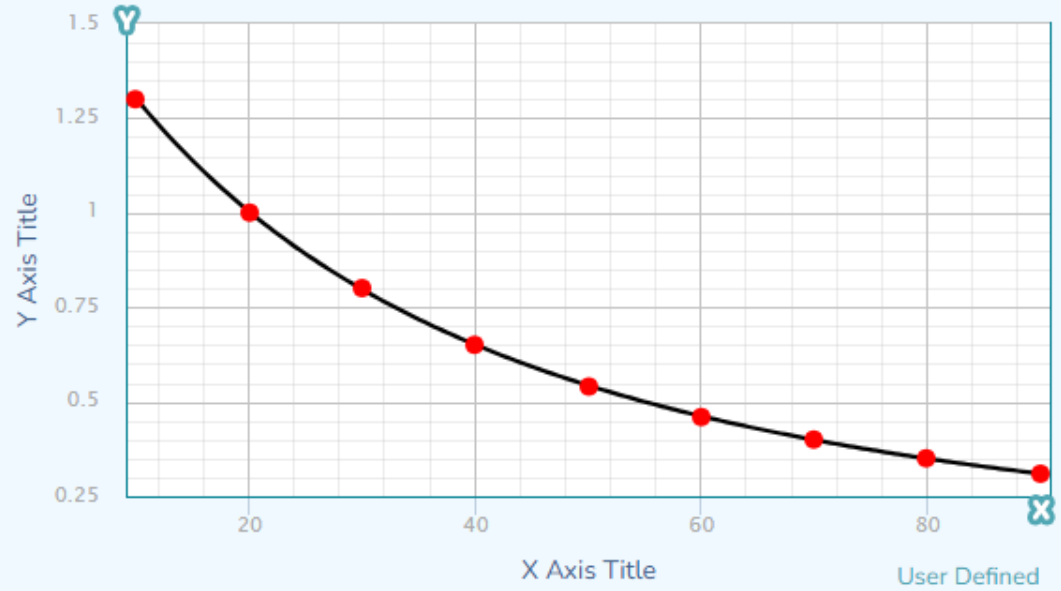
Weighting ▼

y= exp(a/(x+b)+c)

Initial Estimates: What's this? **Constraints:** What's this?

		Min:	Max:	
c=	1			1.220556
m=	1			-0.0115

Plot estimate



R²:1, aR²:1, P:6.384*10⁻¹⁴, SE:0.00213, SSE:0.00002721, F:64940, AIC:−82.84, BIC:−82.25, DoF:6, AICc:−78.04

a = 577.5535, b = 133.8519, c = −3.752549

y = exp(577.5535/(x + 133.8519)−3.752549)

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- Set axes titles
- Try different fit methods
- Use your fit for predictions

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Fit Method ▲

- Linear ▶
- Polynomial ▶
- Nonlinear ▶
- Cubic Spline ▶
- User Defined

How to define my fit?

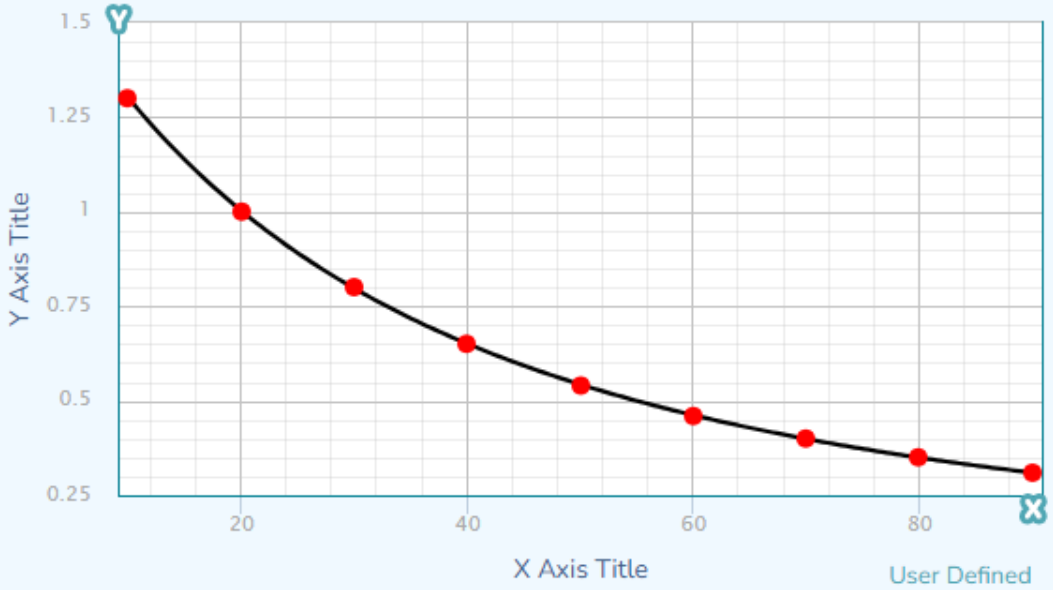
Weighting ▼

y= exp(a/(x+b)+c)

Initial Estimates: What's this? **Constraints:** What's this?

a=	1	Min:		Max:	577.5535
b=	1	Min:		Max:	133.8519
c=	1	Min:		Max:	-3.752549

https://mycurvefit.com/#initial-estimates-help



User Defined

Goodness Measures What's this?		
R^2		1
aR^2		1
P		$6.384*10^{-14}$
SE		0.00213
SSE		0.00002721
F		64940
AIC		−82.84
BIC		−82.25
DoF		6
AICc		−78.04
Coefficients		
a	577.5535	± 23.74
b	133.8519	± 3.439
c	−3.752549	± 0.07005
Equation		
y = exp(577.5535/(x + 133.8519)−3.752549)		

Copy Fit Details | Export Equation

Fit Method ▲

Linear ▶

How to define my fit?

Weighting ▼

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contact@mycurvefit.com

ZunZunSite3 Online Curve Fitting and Surface Fitting Web Site

2D Functions	3D Functions	Characterizers	Site Related
Introduction	Introduction	Introduction	Introduction

Welcome to ZunZunSite3

This is a mirror of ZunZun.com, which is currently offline under mysterious circumstances. Few modifications have been made, including contact information of the original author.

Here you can curve fit and surface fit your 2D and 3D data online with a rich set of error histograms, error plots, curve plots, surface plots, contour plots, auto-generated source code, and PDF file output.

If you're looking for high quality curve fitting and surface fitting, this is the site for you! Source code is available at the Bitbucket Code Repository.

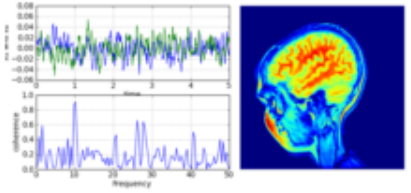
To begin, select an equation family from the drop-down menus above or try the "Function Finders" to help determine the best curve fit for your data.

FindCurves

Powered by Debian Linux

Written in Python

Using the Django Web Framework



ZunZunSite3 Online Curve Fitting and Surface Fitting Web Site

2D Functions | **3D Functions** | **Characterizers** | **Site Related**

Introduction | Introduction | Introduction | Introduction

- Introduction
- Spline Interpolation
- User Defined Function
- Function Finder
- Astrophysics
- BioScience
- BurkardtCollectionBased
- Engineering
- Exponential
- FourierSeries
- LegendrePolynomial
- Logarithmic
- Miscellaneous
- NIST
- Optical
- Peak
- Polyfunctional
- Polynomial
- Power

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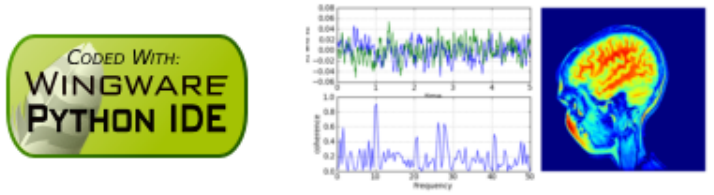

ZunZunSite3 Online Curve Fitting and Surface Fitting Web Site

2D Functions	3D Functions	Characterizers	Site Related
User Defined Function			

2D User Defined Function

User Defined Function 2D y = user defined function

Curve fitting and surface fitting web application source code
Django (this site) Django (Python 2) Flask CherryPy Bottle

Curve fitting and surface fitting GUI application source code
tkinter pyQt5 pyGtk wxPython

Miscellaneous application source code
Animated Confidence Intervals
Initial Fitting Parameters
Multiple Statistical Distributions Fitter

Core fitting library source code
pyeq2 (Python 2) pyeq3

Link to additional information and history

Fitting Interface For User Defined Function 2D
y = User Defined Function

Pulldown Menu

Introduction | Submit (may take several minutes) | Home

Introduction

Please select an option from the pull-down menu above.

Curve fitting and surface fitting web application source code
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Introduction | Submit (may take several minutes) | Home

- Introduction
- Text Data Editor
- User Defined Function Editor
- Fitting Target
- Data Labels For Graphs
- Graph Scaling And Lin/Log Control
- Graph Size
- Scientific Notation For Graphs

troduction

from the pull-down menu above.

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Fitting Interface For User Defined Function 2D
y = User Defined Function

Pulldown Menu

Text Data Editor | Submit (may take several minutes) | Home

Text data editor

Cut-and-paste text or edit data here

- (•) Convert commas to spaces (1,2,0,3 yields 1 2 0 3)
- ( ) Use comma as decimal separator (1,203 = 1.203)
- ( ) Remove commas from text (1,2,0,3 yields 1203)

- (•) Standard Unweighted Fitting: no weights required
- ( ) Weighted Fitting: each data point requires a weight

```
This data is provided as an example, cut and paste
as needed to model your data. All lines of text
that do not begin with a number are ignored.

Weighted fitting requires an additional number to
be used as a weight when fitting. The site does
not calculate any weights, which are used as:
   error = weight * (predicted - actual)
You must provide any weights you wish to use.

    X         Y
  5.357     0.376
  5.457     0.489
  5.797     0.874
```

Clear All Text

Fitting Interface For User Defined Function 2D
y = User Defined Function

Pulldown Menu

Text Data Editor | Submit (may take several minutes) | Home

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```
X       Y
10      1.30
20      1.00
30      0.80
40      0.65
50      0.54
60      0.46
70      0.40
80      0.35
90      0.31
```

Clear All Text

Fitting Interface For User Defined Function 2D
y = User Defined Function

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```
X       Y
10      1.30
20      1.00
30      0.80
40      0.65
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60      0.46
70      0.40
80      0.35
90      0.31
```

Clear All Text

Fitting Interface For User Defined Function 2D
y = User Defined Function

Pulldown Menu

User Defined Function Editor | Submit (may take several minutes) | Home

Text Function Editor

Cut-and-paste text or edit your function here

```
# Enter the text of your function here. Comments begin
# with a "#". Lines with no text are ignored.
# Use an upper case "X" to represent your data.
# Note that most spreadsheets use log base 10 for
# a LOG() function, here log() is the natural log.
# The site uses power() or **, not the caret '^'.
# The site uses fabs() not abs() for absolute value.
# The web site will automatically decode the
# parameter names (coefficient names) that you use.
# See the examples below for ideas on function entry.
```

Example User Defined Functions

```
C * exp(2.2/X) + 51.0 + pi ** e - sinc(1.1) / [B + A]  # coefficients are A, B and C
```

```
Scale * exp(X) + offset  # Scale and offset are coefficents in this example
```

```
# the following three examples are equivalent
power(X+shift, C0)  # shift and C0 are coefficients in this example
[X+shift] ** C0     # shift and C0 are coefficients in this example
(X+shift) ** C0     # shift and C0 are coefficients in this example
```

```
MX + B  # This fails, it should be written as M*X + B
```

Links To Help For Pre-Defined Internal Functions

Exponents And Logarithms:	exp log log10 log2

Fitting Interface For User Defined Function 2D
y = User Defined Function

Pulldown Menu

User Defined Function Editor | Submit (may take several minutes) | Home

Text Function Editor

Cut-and-paste text or edit your function here

```
exp(a/(X+b)+c)
```

Example User Defined Functions

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C * exp(2.2/X) + 51.0 + pi ** e - sinc(1.1) / [B + A]  # coefficients are A, B and C
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power(X+shift, C0)  # shift and C0 are coefficients in this example
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(X+shift) ** C0     # shift and C0 are coefficients in this example
```

```
MX + B  # This fails, it should be written as M*X + B
```

Links To Help For Pre-Defined Internal Functions

Exponents And Logarithms:	exp log log10 log2

Fitting Data

```
Elapsed time: 00:00:00 (hh:mm:ss)

Current time on server: Fri Jun 12 17:55:23
Time of last update   : Fri Jun 12 17:55:23

Server load average for the past 1 minute:   0.06
Server load average for the past 5 minutes:  0.12
Server load average for the past 15 minutes: 0.16
```

Load < 2 means the server cores are running with a light load.
Load = 2 means the server cores each average 100% CPU with a single user.
Load > 2 means the server cores each average 100% CPU with multiple users.

ZunZunSite3
User Defined Function 2D
y = User Defined Function

Coefficients And Text Reports	Histograms	Statistical Scatterplots	Data Graphs
Introduction and PDF Link	Introduction and PDF Link	Introduction and PDF Link	Introduction and PDF Link

Introduction and PDF Link

Please select an item from the pull-down menu above.

You can download almost all of these reports as a single PDF file.
Hint: if the graphs are too small, you can go back and increase the graph size.

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ZunZunSite3
User Defined Function 2D
y = User Defined Function

Coefficients And Text Reports | Histograms | Statistical Scatterplots | Data Graphs

Introduction and PDF Link | Introduction and PDF Link | Introduction and PDF Link | Introduction and PDF Link

- Introduction and PDF Link
- Evaluate This Equation At A Point
- User Defined Function Text
- Coefficients
- Coefficient and Fit Statistics
- Error Listing
- Error Statistics
- Data Statistics

Introduction and PDF Link

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ZunZunSite3
User Defined Function 2D
y = User Defined Function

Coefficients And Text Reports | Histograms | Statistical Scatterplots | Data Graphs

Coefficients

Coefficients

```
y = User Defined Function

Fitting target of lowest sum of squared absolute error = 2.7210617700971931E-05

a =  5.7755349118308777E+02
b =  1.3385187426769699E+02
c = -3.7525493273039130E+00
```

Curve fitting and surface fitting web application source code
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tkinter pyQt5 pyGtk wxPython

Miscellaneous application source code
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Core fitting library source code
pyeq2 (Python 2) pyeq3

Prompt para regresión

Con los datos de la tabla que te envío, de viscosidad \mu en función de la temperatura T, ajusta por regresión los coeficientes de la siguiente función: \mu(T) = exp(a/(T+b)+c).

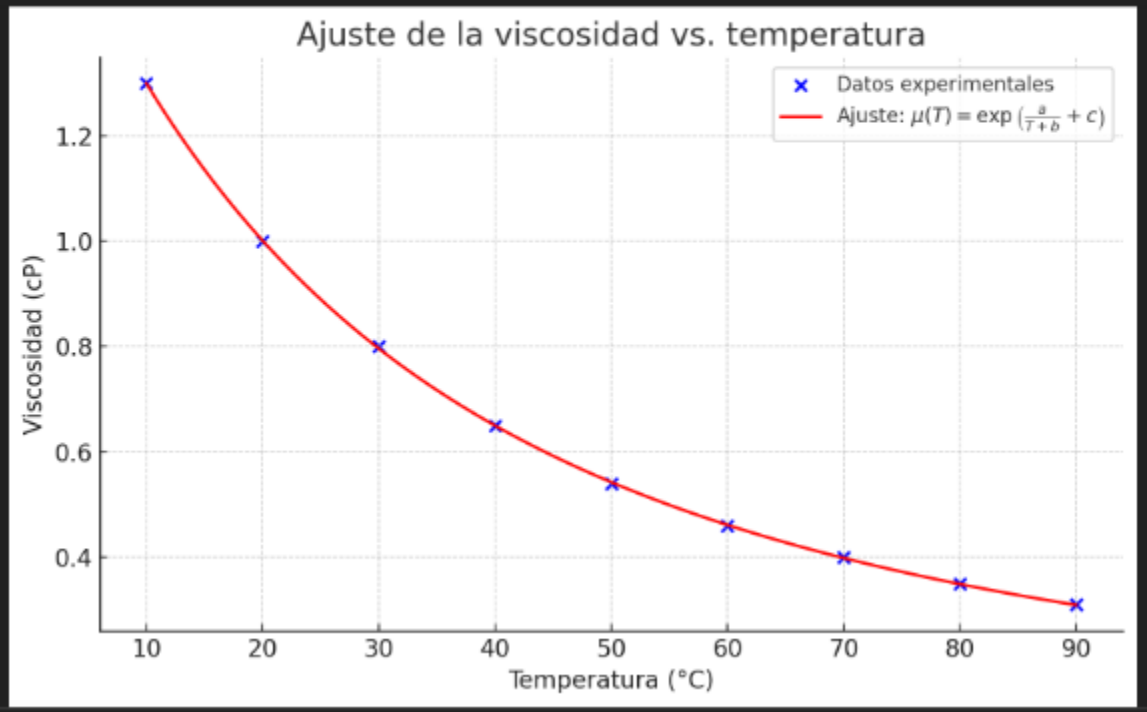
ChatGPT 4o

10	1.30
20	1.00
30	0.80
40	0.65
50	0.54
60	0.46
70	0.40
80	0.35

ura T

Con los datos de la tabla que te envío, de viscosidad \mu en función de la temperatura T, ajusta por regresión los coeficientes de la siguiente función: \mu(T) = exp(a/(T+b)+c).

Ajuste De La Viscosidad Vs. Temperatura



Claro, expresando los coeficientes ajustados con **cuatro cifras significativas**, tenemos:

$$\mu(T) = \exp\left(\frac{a}{T+b} + c\right)$$

Con:

- $a = 577.6$
- $b = 133.9$
- $c = -3.753$

Entonces, la ecuación ajustada queda:

$$\mu(T) = \exp\left(\frac{577.6}{T+133.9} - 3.753\right)$$

📌 *Importante:* esta fórmula está en función de la **temperatura T en grados Celsius** y da la viscosidad μ en **centipoise (cP)**.

Temperaturas de la correlación

En °C

- a = 577.6
- b = 133.9
- c = -3.753

En K

- a = 577.6
- b = 133.9 - 273.15 = -139.25
- c = -3.753

- En correlaciones y expresiones donde la temperatura figura sola, se suele trabajar con temperaturas absolutas.
- En correlaciones y expresiones donde la presión figura sola, se suele trabajar con presión absoluta.

Mapa curricular de programación no lineal

1. Operación con ciclos
2. Criterio técnico
3. Función objetivo
4. Restricciones
5. Parámetros
6. Variables de decisión
7. Regresión
8. Resolución con LINGO y Excel