Regresiones lineales

El propósito de este script es determinar si un modelo lineal es adecuado para construir una función analítica entre el salario y las medidas del esfuerzo. Esto dependerá de la significancia estadística de las variables, así como el número que haya de estas en cada modelo.

In [1]:
```
from sklearn.preprocessing import StandardScaler
import statsmodels.api as sm
import pandas as pd
import numpy as np
import math
import os
import warnings
print('Modulos importados')
```

```
Modulos importados
```

In [2]:
```
# Configuraciones
warnings.filterwarnings('ignore')
# Reduzcamos el número de línea a leer
pd.options.display.max_rows = 5
```

In [3]:
```
# Años de análisis
period = 11
csv = '.csv'
# Directorios
pitcher_path = '../../Data/New_Data/Free_Agent/Pitchers/complete_free_agents_pitchers_'
hitter_path = '../../Data/New_Data/Free_Agent/Hitters/complete_free_agents_hitters_'
# Originales:
df_pitcher = [None]*period
df_hitter = [None]*period
```

In [4]:
```
# Función para normalizar datos
def normalizar(df):
    df_normalizado = df.copy()
    for etiqueta in df.columns:
        maximo = df[etiqueta].max()
        minimo = df[etiqueta].min()
        df_normalizado[etiqueta] = (df[etiqueta] - minimo) / (maximo - minimo)

    return df_normalizado
```

In [5]:
```
for i in range(0,period):
    df_pitcher[i] = pd.read_csv(pitcher_path + str(2011 + i) + csv)
    df_hitter[i] = pd.read_csv(hitter_path + str(2011 + i) + csv)
```

Veamos el tipo de datos contenidos en las bases de datos

In [6]:
```
df_pitcher[2].head()
```

Out[6]:

	Jugador	Valor_contrato	Valor_promedio_contrato	Posicion	Juegos	Juegos_iniciados	Inning_pitched	Bateos	Carreras	Carreras_gan
0	Zack Greinke	147000000	24500000	SP	29	28	177.7	152	54	
1	J.P. Howell	2850000	2850000	RP	67	0	62.0	42	14	
2	Brian Wilson	1000000	1000000	RP	18	0	13.7	8	1	
3	Peter Moylan	0	0	RP	14	0	15.3	23	11	
4	Anibal Sanchez	80000000	16000000	RP	29	29	182.0	156	56	

5 rows × 22 columns

In [7]:
```
df_hitter[8].head()
```

Out[7]:

	Jugador	Valor_contrato	Valor_promedio_contrato	Posicion	Juegos	Porcetnaje_juegos	At-bats	Bateos	Home-runs	RBI	Porcentaje_bateo
0	Bryce Harper	330000000	25384615	RF	157	0.969	573	149	35	114	0.260
1	Andrew McCutchen	50000000	16666667	RF	59	0.364	219	56	10	29	0.256
2	Blake Parker	0	0	RP	60	0.370	1	0	0	0	0.000
3	Manny Machado	300000000	30000000	3B	156	0.963	587	150	32	85	0.256
4	Garrett Richards	15500000	7750000	SP	3	0.019	2	0	0	0	0.000

Debido a la enorme diferencias en la magnitud entre el promedio de victorias y los sueldos, se tendrá que estadandarizar los sueldos.
A pesar de que intuitivamente no tenemos que usar la columna del valor de contrato, también estandarizémosla.

In [9]:

```
# Originales:
df_pitcher_copy = [None]*period
df_hitter_copy = [None]*period
```

In [12]:
```
for i in range(1,period):
    df_pitcher_copy[i] = df_pitcher[i].copy()
    df_hitter_copy[i] = df_hitter[i].copy()

    maximo_p_1 = df_pitcher_copy[i]['Sueldo'].max()
    minimo_p_1 = df_pitcher_copy[i]['Sueldo'].min()

    maximo_h_1 = df_hitter_copy[i]['Sueldo'].max()
    minimo_h_1 = df_hitter_copy[i]['Sueldo'].min()

    df_pitcher_copy[i]['Sueldo_estandarizado'] = (df_pitcher_copy[i]['Sueldo'] - minimo_p_1)/(maximo_p_1 - m
    df_hitter_copy[i]['Sueldo_estandarizado'] = (df_hitter_copy[i]['Sueldo'] - minimo_h_1)/(maximo_h_1 - mir

    maximo_p_2 = df_pitcher_copy[i]['Valor_contrato'].max()
    minimo_p_2 = df_pitcher_copy[i]['Valor_contrato'].min()

    maximo_h_2 = df_hitter_copy[i]['Valor_contrato'].max()
    minimo_h_2 = df_hitter_copy[i]['Valor_contrato'].min()

    df_pitcher_copy[i]['Valor_contrato_estandarizado'] = (df_pitcher_copy[i]['Valor_contrato'] - minimo_p_2)
    df_hitter_copy[i]['Valor_contrato_estandarizado'] = (df_hitter_copy[i]['Valor_contrato'] - minimo_h_2)/(
```

In [13]:
```
df_hitter_copy[3].head()
```

Out[13]:

	Jugador	Valor_contrato	Valor_promedio_contrato	Posicion	Juegos	Porcetnaje_juegos	At-bats	Bateos	Home-runs	RBI	Porcentaje_bateo
0	Robinson Cano	240000000	24000000	2B	157	0.969	595	187	14	82	0.314
1	Kendrys Morales	7540983	7540983	DH	98	0.605	367	80	8	42	0.218
2	Chris Young	7250000	7250000	RF	111	0.685	325	72	11	38	0.222
3	Chris Young	7250000	7250000	RP	30	0.185	1	0	0	0	0.000
4	Corey Hart	6000000	6000000	RF	68	0.420	232	47	6	21	0.203

Ahora, tanto la variable dependiente como independiente están en el intervalo $[0,1]$

In [14]:
```
df_pitcher_copy[2].head()
```

Out[14]:

	Jugador	Valor_contrato	Valor_promedio_contrato	Posicion	Juegos	Juegos_iniciados	Inning_pitched	Bateos	Carreras	Carreras_gan
0	Zack Greinke	147000000	24500000	SP	29	28	177.7	152	54	
1	J.P. Howell	2850000	2850000	RP	67	0	62.0	42	14	
2	Brian Wilson	1000000	1000000	RP	18	0	13.7	8	1	
3	Peter Moylan	0	0	RP	14	0	15.3	23	11	
4	Anibal Sanchez	80000000	16000000	RP	29	29	182.0	156	56	

5 rows × 24 columns

I. Victorias en función del salario

$$ \delta_{t} = a + b\omega_{t} + e_{t} $$
donde δ_{t} son las victorias por temporada. Se aplicará el modelo tanto para agentes libres que sean *hitters* o *pitchers*. Para cada año de análisis, consideraremos el promedio de victorias como medida del esfuerzo y el total del salario, para después hacer con el valor del contrato.

Creemos una lista para guardar los modelos y proceder a obtenerlos

In [15]:
```
# Modelos
hitter_model_I_a = [None]*period
pitcher_model_I_a = [None]*period
```

In [16]:
```
for i in range(1,period):
    # Hitters:
    y_hitter = df_hitter_copy[i]['Promedio_victorias'].tolist()
    x_hitter = df_hitter_copy[i]['Sueldo_estandarizado'].tolist()

    x_hitter = sm.add_constant(x_hitter)

    hitter_model_I_a[i] = sm.OLS(y_hitter, x_hitter).fit()

    # Pitchers:
    y_pitcher = df_pitcher_copy[i]['Promedio_victorias'].tolist()
    x_pitcher = df_pitcher_copy[i]['Sueldo_estandarizado'].tolist()

    x_pitcher = sm.add_constant(x_pitcher)

    pitcher_model_I_a[i] = sm.OLS(y_pitcher, x_pitcher).fit()
```

Observemos los resúmenes de las regresiones

Hitters

In [17]:
```
for i in range(1,period):
    print(hitter_model_I_a[i].summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.021
Method:                 Least Squares   F-statistic:                  0.001698
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.967
Time:                        09:46:46   Log-Likelihood:                 65.615
No. Observations:                  49   AIC:                            -127.2
Df Residuals:                      47   BIC:                            -123.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5191      0.013     41.275      0.000       0.494       0.544
x1            -0.0019      0.047     -0.041      0.967      -0.096       0.092
==============================================================================
```

```
Omnibus:                        4.196   Durbin-Watson:                   1.365
Prob(Omnibus):                  0.123   Jarque-Bera (JB):                3.963
Skew:                          -0.641   Prob(JB):                        0.138
Kurtosis:                       2.457   Cond. No.                         5.25
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.040
Model:                            OLS   Adj. R-squared:                  0.028
Method:                 Least Squares   F-statistic:                     3.199
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0777
Time:                        09:46:46   Log-Likelihood:                 98.048
No. Observations:                  78   AIC:                            -192.1
Df Residuals:                      76   BIC:                            -187.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4972      0.011     46.251      0.000       0.476       0.519
x1             0.0576      0.032      1.789      0.078      -0.007       0.122
==============================================================================
Omnibus:                        9.063   Durbin-Watson:                   0.624
Prob(Omnibus):                  0.011   Jarque-Bera (JB):                5.432
Skew:                          -0.475   Prob(JB):                       0.0661
Kurtosis:                       2.123   Cond. No.                         4.30
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.011
Method:                 Least Squares   F-statistic:                   0.04023
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.841
Time:                        09:46:46   Log-Likelihood:                 134.37
No. Observations:                  92   AIC:                            -264.7
Df Residuals:                      90   BIC:                            -259.7
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
```

```
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5042      0.008     62.062      0.000       0.488       0.520
x1            -0.0053      0.026     -0.201      0.841      -0.058       0.047
==============================================================================
Omnibus:                       11.983   Durbin-Watson:                   0.727
Prob(Omnibus):                  0.002   Jarque-Bera (JB):                3.771
Skew:                          -0.026   Prob(JB):                        0.152
Kurtosis:                       2.010   Cond. No.                         4.66
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.001
Model:                            OLS   Adj. R-squared:                 -0.012
Method:                 Least Squares   F-statistic:                   0.09970
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.753
Time:                        09:46:46   Log-Likelihood:                101.08
No. Observations:                  79   AIC:                            -198.2
Df Residuals:                      77   BIC:                            -193.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5159      0.010     51.559      0.000       0.496       0.536
x1             0.0092      0.029      0.316      0.753      -0.049       0.067
==============================================================================
Omnibus:                       13.836   Durbin-Watson:                   0.688
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                4.995
Skew:                          -0.325   Prob(JB):                       0.0823
Kurtosis:                       1.954   Cond. No.                         4.00
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.063
Model:                            OLS   Adj. R-squared:                  0.054
Method:                 Least Squares   F-statistic:                     7.132
Date:                Wed, 29 Jun 2022   Prob (F-statistic):            0.00877
Time:                        09:46:46   Log-Likelihood:                 157.21
```

```
No. Observations:                 108   AIC:                            -310.4
Df Residuals:                     106   BIC:                            -305.1
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5080      0.007     73.304      0.000       0.494       0.522
x1             0.0792      0.030      2.671      0.009       0.020       0.138
==============================================================================
Omnibus:                        0.752   Durbin-Watson:                   0.673
Prob(Omnibus):                  0.687   Jarque-Bera (JB):                0.849
Skew:                          -0.185   Prob(JB):                        0.654
Kurtosis:                       2.772   Cond. No.                         5.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.013
Model:                            OLS   Adj. R-squared:                 -0.003
Method:                 Least Squares   F-statistic:                    0.8014
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.374
Time:                        09:46:46   Log-Likelihood:                 82.715
No. Observations:                  64   AIC:                            -161.4
Df Residuals:                      62   BIC:                            -157.1
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5060      0.013     39.648      0.000       0.481       0.532
x1             0.0346      0.039      0.895      0.374      -0.043       0.112
==============================================================================
Omnibus:                        8.269   Durbin-Watson:                   0.556
Prob(Omnibus):                  0.016   Jarque-Bera (JB):                4.219
Skew:                           0.410   Prob(JB):                        0.121
Kurtosis:                       2.046   Cond. No.                         4.88
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
```

```
Dep. Variable:                      y   R-squared:                       0.002
Model:                            OLS   Adj. R-squared:                 -0.016
Method:                 Least Squares   F-statistic:                    0.1261
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.724
Time:                        09:46:46   Log-Likelihood:                 64.263
No. Observations:                  58   AIC:                            -124.5
Df Residuals:                      56   BIC:                            -120.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5284      0.015     35.781      0.000       0.499       0.558
x1            -0.0174      0.049     -0.355      0.724      -0.115       0.081
==============================================================================
Omnibus:                        7.720   Durbin-Watson:                   0.882
Prob(Omnibus):                  0.021   Jarque-Bera (JB):                6.879
Skew:                          -0.754   Prob(JB):                       0.0321
Kurtosis:                       3.756   Cond. No.                         4.80
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.026
Model:                            OLS   Adj. R-squared:                  0.010
Method:                 Least Squares   F-statistic:                     1.657
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.203
Time:                        09:46:46   Log-Likelihood:                 74.775
No. Observations:                  65   AIC:                            -145.5
Df Residuals:                      63   BIC:                            -141.2
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5329      0.014     38.382      0.000       0.505       0.561
x1             0.0509      0.040      1.287      0.203      -0.028       0.130
==============================================================================
Omnibus:                        7.580   Durbin-Watson:                   0.852
Prob(Omnibus):                  0.023   Jarque-Bera (JB):                6.898
Skew:                          -0.758   Prob(JB):                       0.0318
Kurtosis:                       3.499   Cond. No.                         4.38
==============================================================================
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.076
Model:                            OLS   Adj. R-squared:                  0.056
Method:                 Least Squares   F-statistic:                     3.767
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0584
Time:                        09:46:46   Log-Likelihood:                 56.818
No. Observations:                  48   AIC:                            -109.6
Df Residuals:                      46   BIC:                            -105.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4797      0.015     31.572      0.000       0.449       0.510
x1             0.0844      0.043      1.941      0.058      -0.003       0.172
==============================================================================
Omnibus:                        5.392   Durbin-Watson:                   1.209
Prob(Omnibus):                  0.067   Jarque-Bera (JB):                4.553
Skew:                           0.744   Prob(JB):                        0.103
Kurtosis:                       3.251   Cond. No.                         4.23
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.058
Model:                            OLS   Adj. R-squared:                  0.046
Method:                 Least Squares   F-statistic:                     4.531
Date:                Wed, 29 Jun 2022   Prob (F-statistic):            0.0367
Time:                        09:46:46   Log-Likelihood:                 92.286
No. Observations:                  75   AIC:                            -180.6
Df Residuals:                      73   BIC:                            -175.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5193      0.011     46.328      0.000       0.497       0.542
x1             0.0914      0.043      2.129      0.037       0.006       0.177
==============================================================================
```

```
Omnibus:                        0.369   Durbin-Watson:                   0.742
Prob(Omnibus):                  0.832   Jarque-Bera (JB):                0.535
Skew:                           0.029   Prob(JB):                        0.765
Kurtosis:                       2.590   Cond. No.                         5.36
==============================================================================

Notes:
```

Los resultados muestran que, en general, hay poca significancia estadística para explicar las victorias con el salario de los agentes libres. Así mismo, tampoco tiene poder predictivo puesto que la R^2 es baja. Faltará corroborar esto con validación cruzada, sin embargo, el hecho de la baja significancia estadística no cambiará.

Pitchers

In [44]:

```
for i in range(1,period):
    print(pitcher_model_I_a[i].summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.007
Model:                            OLS   Adj. R-squared:                 -0.051
Method:                 Least Squares   F-statistic:                    0.1269
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.726
Time:                        01:05:24   Log-Likelihood:                 25.191
No. Observations:                  19   AIC:                            -46.38
Df Residuals:                      17   BIC:                            -44.49
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5194      0.027     19.110      0.000       0.462       0.577
x1             0.0168      0.047      0.356      0.726      -0.083       0.116
==============================================================================
Omnibus:                        2.770   Durbin-Watson:                   1.289
Prob(Omnibus):                  0.250   Jarque-Bera (JB):                1.560
Skew:                          -0.422   Prob(JB):                        0.459
Kurtosis:                       1.879   Cond. No.                         3.77
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
```

```
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.020
Method:                 Least Squares   F-statistic:                  0.003177
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.955
Time:                        01:05:24   Log-Likelihood:                 63.550
No. Observations:                  51   AIC:                            -123.1
Df Residuals:                      49   BIC:                            -119.2
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4999      0.014     35.082      0.000       0.471       0.529
x1             0.0027      0.047      0.056      0.955      -0.093       0.098
==============================================================================
Omnibus:                        3.936   Durbin-Watson:                   0.591
Prob(Omnibus):                  0.140   Jarque-Bera (JB):                3.242
Skew:                          -0.506   Prob(JB):                        0.198
Kurtosis:                       2.291   Cond. No.                         5.00
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.011
Model:                            OLS   Adj. R-squared:                 -0.004
Method:                 Least Squares   F-statistic:                    0.7258
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.397
Time:                        01:05:24   Log-Likelihood:                 95.650
No. Observations:                  68   AIC:                            -187.3
Df Residuals:                      66   BIC:                            -182.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4842      0.011     45.026      0.000       0.463       0.506
x1             0.0246      0.029      0.852      0.397      -0.033       0.082
==============================================================================
Omnibus:                       12.905   Durbin-Watson:                   1.153
Prob(Omnibus):                  0.002   Jarque-Bera (JB):                3.681
Skew:                           0.141   Prob(JB):                        0.159
Kurtosis:                       1.896   Cond. No.                         4.28
```

```
================================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
================================================================================
Dep. Variable:                      y   R-squared:                       0.047
Model:                            OLS   Adj. R-squared:                  0.034
Method:                 Least Squares   F-statistic:                     3.483
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0662
Time:                        01:05:24   Log-Likelihood:                 93.291
No. Observations:                  72   AIC:                            -182.6
Df Residuals:                      70   BIC:                            -178.0
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4992      0.011     47.178      0.000       0.478       0.520
x1             0.0696      0.037      1.866      0.066      -0.005       0.144
==============================================================================
Omnibus:                        9.701   Durbin-Watson:                   0.759
Prob(Omnibus):                  0.008   Jarque-Bera (JB):                3.587
Skew:                          -0.217   Prob(JB):                        0.166
Kurtosis:                       1.996   Cond. No.                         4.88
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
================================================================================
Dep. Variable:                      y   R-squared:                       0.043
Model:                            OLS   Adj. R-squared:                  0.030
Method:                 Least Squares   F-statistic:                     3.259
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0751
Time:                        01:05:24   Log-Likelihood:                 105.71
No. Observations:                  75   AIC:                            -207.4
Df Residuals:                      73   BIC:                            -202.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4987      0.009     53.934      0.000       0.480       0.517
x1             0.0690      0.038      1.805      0.075      -0.007       0.145
```

```
==============================================================================
Omnibus:                        3.307   Durbin-Watson:                   0.716
Prob(Omnibus):                  0.191   Jarque-Bera (JB):                1.891
Skew:                          -0.101   Prob(JB):                        0.388
Kurtosis:                       2.249   Cond. No.                         5.67
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.033
Model:                            OLS   Adj. R-squared:                  0.008
Method:                 Least Squares   F-statistic:                     1.326
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.257
Time:                        01:05:24   Log-Likelihood:                 54.701
No. Observations:                  41   AIC:                            -105.4
Df Residuals:                      39   BIC:                            -102.0
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4896      0.018     27.252      0.000       0.453       0.526
x1             0.0515      0.045      1.152      0.257      -0.039       0.142
==============================================================================
Omnibus:                        2.601   Durbin-Watson:                   1.550
Prob(Omnibus):                  0.272   Jarque-Bera (JB):                1.575
Skew:                           0.207   Prob(JB):                        0.455
Kurtosis:                       2.134   Cond. No.                         4.89
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.019
Method:                 Least Squares   F-statistic:                  0.006386
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.937
Time:                        01:05:24   Log-Likelihood:                 59.417
No. Observations:                  55   AIC:                            -114.8
Df Residuals:                      53   BIC:                            -110.8
Df Model:                           1
Covariance Type:            nonrobust
```

```
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5220      0.016     31.912      0.000       0.489       0.555
x1            -0.0049      0.061     -0.080      0.937      -0.127       0.117
==============================================================================
Omnibus:                        8.398   Durbin-Watson:                   0.763
Prob(Omnibus):                  0.015   Jarque-Bera (JB):                8.164
Skew:                          -0.936   Prob(JB):                       0.0169
Kurtosis:                       3.245   Cond. No.                         5.60
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.031
Model:                            OLS   Adj. R-squared:                  0.010
Method:                 Least Squares   F-statistic:                     1.472
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.231
Time:                        01:05:24   Log-Likelihood:                52.140
No. Observations:                  48   AIC:                            -100.3
Df Residuals:                      46   BIC:                            -96.54
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5162      0.019     27.557      0.000       0.478       0.554
x1             0.0625      0.051      1.213      0.231      -0.041       0.166
==============================================================================
Omnibus:                        8.856   Durbin-Watson:                   1.203
Prob(Omnibus):                  0.012   Jarque-Bera (JB):                7.994
Skew:                          -0.896   Prob(JB):                       0.0184
Kurtosis:                       3.886   Cond. No.                         4.63
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.001
Model:                            OLS   Adj. R-squared:                 -0.017
Method:                 Least Squares   F-statistic:                   0.03318
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.856
```

```
Time:                        01:05:24   Log-Likelihood:                 57.720
No. Observations:                  58   AIC:                            -111.4
Df Residuals:                      56   BIC:                            -107.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5035      0.016     32.091      0.000       0.472       0.535
x1             0.0105      0.058      0.182      0.856      -0.105       0.126
==============================================================================
Omnibus:                        4.976   Durbin-Watson:                   0.668
Prob(Omnibus):                  0.083   Jarque-Bera (JB):                4.923
Skew:                           0.698   Prob(JB):                       0.0853
Kurtosis:                       2.703   Cond. No.                         4.97
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.082
Model:                            OLS   Adj. R-squared:                  0.067
Method:                 Least Squares   F-statistic:                     5.549
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0217
Time:                        01:05:24   Log-Likelihood:                 74.453
No. Observations:                  64   AIC:                            -144.9
Df Residuals:                      62   BIC:                            -140.6
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5115      0.013     38.064      0.000       0.485       0.538
x1             0.1463      0.062      2.356      0.022       0.022       0.270
==============================================================================
Omnibus:                        1.407   Durbin-Watson:                   0.718
Prob(Omnibus):                  0.495   Jarque-Bera (JB):                1.123
Skew:                          -0.324   Prob(JB):                        0.570
Kurtosis:                       2.975   Cond. No.                         6.62
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Observamos los mismos problemas.

De esto, podemos concluir que este modelo no es el más adecuado, por lo que ahora se intentará con el resto de medidas de esfuerzo respectivamente para *hitters* y *pitchers*.

Contrato

Análogamente, veamoslo para el valor del contrato del agente libre:

In [18]:
```
# Modelos
hitter_model_I_b = [None]*period
pitcher_model_I_b = [None]*period
```

In [72]:
```
for i in range(1,period):
    # Hitters:
    y_hitter = df_hitter_copy[i]['Promedio_victorias'].tolist()
    x_hitter = df_hitter_copy[i]['Valor_contrato_estandarizado'].tolist()

    x_hitter = sm.add_constant(x_hitter)

    hitter_model_I_b[i] = sm.OLS(y_hitter, x_hitter).fit()

    # Pitchers:
    y_pitcher = df_pitcher_copy[i]['Promedio_victorias'].tolist()
    x_pitcher = df_pitcher_copy[i]['Valor_contrato_estandarizado'].tolist()

    x_pitcher = sm.add_constant(x_pitcher)

    pitcher_model_I_b[i] = sm.OLS(y_pitcher, x_pitcher).fit()
```

Pitchers

In [73]:
```
for i in range(1,period):
    print(pitcher_model_I_b[i].summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.068
```

```
Model:                            OLS   Adj. R-squared:                  0.013
Method:                 Least Squares   F-statistic:                     1.235
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.282
Time:                        11:39:21   Log-Likelihood:                 25.786
No. Observations:                  19   AIC:                            -47.57
Df Residuals:                      17   BIC:                            -45.68
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5390      0.018     29.302      0.000       0.500       0.578
x1            -0.0598      0.054     -1.111      0.282      -0.173       0.054
==============================================================================
Omnibus:                        2.153   Durbin-Watson:                   1.363
Prob(Omnibus):                  0.341   Jarque-Bera (JB):                1.583
Skew:                          -0.528   Prob(JB):                        0.453
Kurtosis:                       2.059   Cond. No.                         3.71
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.014
Model:                            OLS   Adj. R-squared:                 -0.006
Method:                 Least Squares   F-statistic:                    0.6884
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.411
Time:                        11:39:21   Log-Likelihood:                 63.904
No. Observations:                  51   AIC:                            -123.8
Df Residuals:                      49   BIC:                            -119.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4964      0.011     44.882      0.000       0.474       0.519
x1             0.0508      0.061      0.830      0.411      -0.072       0.174
==============================================================================
Omnibus:                        3.690   Durbin-Watson:                   0.634
Prob(Omnibus):                  0.158   Jarque-Bera (JB):                2.989
Skew:                          -0.473   Prob(JB):                        0.224
Kurtosis:                       2.285   Cond. No.                         6.25
==============================================================================
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.002
Model:                            OLS   Adj. R-squared:                 -0.013
Method:                 Least Squares   F-statistic:                    0.1443
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.705
Time:                        11:39:21   Log-Likelihood:                 95.352
No. Observations:                  68   AIC:                            -186.7
Df Residuals:                      66   BIC:                            -182.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4886      0.009     51.639      0.000       0.470       0.508
x1             0.0129      0.034      0.380      0.705      -0.055       0.080
==============================================================================
Omnibus:                       14.508   Durbin-Watson:                   1.114
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                3.811
Skew:                           0.120   Prob(JB):                        0.149
Kurtosis:                       1.865   Cond. No.                         4.77
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.014
Model:                            OLS   Adj. R-squared:                 -0.001
Method:                 Least Squares   F-statistic:                    0.9609
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.330
Time:                        11:39:21   Log-Likelihood:                 92.033
No. Observations:                  72   AIC:                            -180.1
Df Residuals:                      70   BIC:                            -175.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5091      0.009     58.468      0.000       0.492       0.526
x1             0.0513      0.052      0.980      0.330      -0.053       0.156
==============================================================================
Omnibus:                       11.225   Durbin-Watson:                   0.718
```

```
Prob(Omnibus):                  0.004   Jarque-Bera (JB):                3.997
Skew:                          -0.255   Prob(JB):                        0.136
Kurtosis:                       1.964   Cond. No.                         6.53
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.009
Model:                            OLS   Adj. R-squared:                 -0.004
Method:                 Least Squares   F-statistic:                    0.6815
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.412
Time:                        11:39:21   Log-Likelihood:                104.42
No. Observations:                  75   AIC:                            -204.8
Df Residuals:                      73   BIC:                            -200.2
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5069      0.008     64.677      0.000       0.491       0.523
x1             0.0309      0.037      0.826      0.412      -0.044       0.105
==============================================================================
Omnibus:                        7.956   Durbin-Watson:                   0.587
Prob(Omnibus):                  0.019   Jarque-Bera (JB):                2.955
Skew:                          -0.089   Prob(JB):                        0.228
Kurtosis:                       2.044   Cond. No.                         5.36
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.063
Model:                            OLS   Adj. R-squared:                  0.039
Method:                 Least Squares   F-statistic:                    2.626
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.113
Time:                        11:39:21   Log-Likelihood:                55.351
No. Observations:                  41   AIC:                            -106.7
Df Residuals:                      39   BIC:                            -103.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
```

```
------------------------------------------------------------------------------
const          0.4959      0.012     41.219      0.000       0.472       0.520
x1             0.0696      0.043      1.621      0.113      -0.017       0.156
==============================================================================
Omnibus:                        0.989   Durbin-Watson:                   1.632
Prob(Omnibus):                  0.610   Jarque-Bera (JB):                0.873
Skew:                           0.090   Prob(JB):                        0.646
Kurtosis:                       2.308   Cond. No.                         4.38
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.001
Model:                            OLS   Adj. R-squared:                 -0.018
Method:                 Least Squares   F-statistic:                   0.02789
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.868
Time:                        11:39:21   Log-Likelihood:                 59.428
No. Observations:                  55   AIC:                            -114.9
Df Residuals:                      53   BIC:                            -110.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5223      0.013     38.708      0.000       0.495       0.549
x1            -0.0113      0.067     -0.167      0.868      -0.147       0.124
==============================================================================
Omnibus:                        8.274   Durbin-Watson:                   0.760
Prob(Omnibus):                  0.016   Jarque-Bera (JB):                8.061
Skew:                          -0.932   Prob(JB):                       0.0178
Kurtosis:                       3.216   Cond. No.                         6.06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.026
Model:                            OLS   Adj. R-squared:                  0.005
Method:                 Least Squares   F-statistic:                     1.220
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.275
Time:                        11:39:21   Log-Likelihood:                 52.013
No. Observations:                  48   AIC:                            -100.0
```

```
Df Residuals:                       46   BIC:                            -96.28
Df Model:                            1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5248      0.014     36.331      0.000       0.496       0.554
x1             0.0812      0.073      1.105      0.275      -0.067       0.229
==============================================================================
Omnibus:                        7.907   Durbin-Watson:                   1.248
Prob(Omnibus):                  0.019   Jarque-Bera (JB):                6.908
Skew:                          -0.854   Prob(JB):                       0.0316
Kurtosis:                       3.733   Cond. No.                         6.16
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.018
Method:                 Least Squares   F-statistic:                 0.0005237
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.982
Time:                        11:39:21   Log-Likelihood:                 57.704
No. Observations:                  58   AIC:                            -111.4
Df Residuals:                      56   BIC:                            -107.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5054      0.013     38.995      0.000       0.479       0.531
x1            -0.0016      0.071     -0.023      0.982      -0.143       0.140
==============================================================================
Omnibus:                        4.905   Durbin-Watson:                   0.668
Prob(Omnibus):                  0.086   Jarque-Bera (JB):                4.859
Skew:                           0.689   Prob(JB):                       0.0881
Kurtosis:                       2.668   Cond. No.                         5.95
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.071
```

```
Model:                            OLS   Adj. R-squared:                  0.056
Method:                 Least Squares   F-statistic:                     4.768
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0328
Time:                        11:39:21   Log-Likelihood:                 74.081
No. Observations:                  64   AIC:                            -144.2
Df Residuals:                      62   BIC:                            -139.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5221      0.011     47.451      0.000       0.500       0.544
x1             0.1461      0.067      2.183      0.033       0.012       0.280
==============================================================================
Omnibus:                        2.590   Durbin-Watson:                   0.730
Prob(Omnibus):                  0.274   Jarque-Bera (JB):                2.023
Skew:                          -0.431   Prob(JB):                        0.364
Kurtosis:                       3.126   Cond. No.                         6.97
==============================================================================

Notes:
```

Hitters

In [74]:

```
for i in range(1,period):
    print(hitter_model_I_b[i].summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.001
Model:                            OLS   Adj. R-squared:                 -0.020
Method:                 Least Squares   F-statistic:                   0.05244
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.820
Time:                        11:39:40   Log-Likelihood:                 65.642
No. Observations:                  49   AIC:                            -127.3
Df Residuals:                      47   BIC:                            -123.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5197      0.010     51.845      0.000       0.499       0.540
x1            -0.0107      0.047     -0.229      0.820      -0.105       0.084
==============================================================================
```

```
Omnibus:                        4.290   Durbin-Watson:                   1.360
Prob(Omnibus):                  0.117   Jarque-Bera (JB):                4.051
Skew:                          -0.649   Prob(JB):                        0.132
Kurtosis:                       2.452   Cond. No.                         5.11
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.011
Model:                            OLS   Adj. R-squared:                 -0.002
Method:                 Least Squares   F-statistic:                    0.8739
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.353
Time:                        11:39:40   Log-Likelihood:                 96.885
No. Observations:                  78   AIC:                            -189.8
Df Residuals:                      76   BIC:                            -185.1
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5063      0.009     55.807      0.000       0.488       0.524
x1             0.0440      0.047      0.935      0.353      -0.050       0.138
==============================================================================
Omnibus:                        7.944   Durbin-Watson:                   0.563
Prob(Omnibus):                  0.019   Jarque-Bera (JB):                5.427
Skew:                          -0.502   Prob(JB):                       0.0663
Kurtosis:                       2.187   Cond. No.                         5.93
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.002
Model:                            OLS   Adj. R-squared:                 -0.009
Method:                 Least Squares   F-statistic:                    0.1657
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.685
Time:                        11:39:40   Log-Likelihood:                 134.43
No. Observations:                  92   AIC:                            -264.9
Df Residuals:                      90   BIC:                            -259.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
```

```
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5042      0.007     77.206      0.000       0.491       0.517
x1            -0.0171      0.042     -0.407      0.685      -0.100       0.066
==============================================================================
Omnibus:                       12.546   Durbin-Watson:                   0.727
Prob(Omnibus):                  0.002   Jarque-Bera (JB):                3.855
Skew:                          -0.029   Prob(JB):                        0.145
Kurtosis:                       1.999   Cond. No.                         7.12
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.001
Model:                            OLS   Adj. R-squared:                 -0.012
Method:                 Least Squares   F-statistic:                   0.06194
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.804
Time:                        11:39:41   Log-Likelihood:                101.07
No. Observations:                  79   AIC:                            -198.1
Df Residuals:                      77   BIC:                            -193.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5170      0.009     60.637      0.000       0.500       0.534
x1             0.0116      0.047      0.249      0.804      -0.082       0.105
==============================================================================
Omnibus:                       13.716   Durbin-Watson:                   0.685
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                5.031
Skew:                          -0.332   Prob(JB):                       0.0808
Kurtosis:                       1.958   Cond. No.                         6.14
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.025
Model:                            OLS   Adj. R-squared:                  0.016
Method:                 Least Squares   F-statistic:                     2.766
Date:                Wed, 29 Jun 2022   Prob (F-statistic):             0.0992
Time:                        11:39:41   Log-Likelihood:                 155.09
```

```
No. Observations:                 108   AIC:                            -306.2
Df Residuals:                     106   BIC:                            -300.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5149      0.006     83.023      0.000       0.503       0.527
x1             0.0472      0.028      1.663      0.099      -0.009       0.103
==============================================================================
Omnibus:                        1.555   Durbin-Watson:                   0.538
Prob(Omnibus):                  0.460   Jarque-Bera (JB):                1.395
Skew:                          -0.140   Prob(JB):                        0.498
Kurtosis:                       2.518   Cond. No.                         5.12
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.025
Model:                            OLS   Adj. R-squared:                  0.010
Method:                 Least Squares   F-statistic:                     1.604
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.210
Time:                        11:39:41   Log-Likelihood:                 83.121
No. Observations:                  64   AIC:                            -162.2
Df Residuals:                      62   BIC:                            -157.9
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5072      0.010     49.615      0.000       0.487       0.528
x1             0.0521      0.041      1.267      0.210      -0.030       0.134
==============================================================================
Omnibus:                        7.056   Durbin-Watson:                   0.587
Prob(Omnibus):                  0.029   Jarque-Bera (JB):                3.691
Skew:                           0.366   Prob(JB):                        0.158
Kurtosis:                       2.079   Cond. No.                         5.01
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
```

```
Dep. Variable:                      y   R-squared:                       0.004
Model:                            OLS   Adj. R-squared:                 -0.014
Method:                 Least Squares   F-statistic:                    0.2323
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.632
Time:                        11:39:41   Log-Likelihood:                 64.318
No. Observations:                  58   AIC:                            -124.6
Df Residuals:                      56   BIC:                            -120.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5279      0.012     42.438      0.000       0.503       0.553
x1            -0.0239      0.050     -0.482      0.632      -0.123       0.075
==============================================================================
Omnibus:                        7.645   Durbin-Watson:                   0.875
Prob(Omnibus):                  0.022   Jarque-Bera (JB):                6.799
Skew:                          -0.741   Prob(JB):                       0.0334
Kurtosis:                       3.785   Cond. No.                         4.73
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.014
Model:                            OLS   Adj. R-squared:                 -0.002
Method:                 Least Squares   F-statistic:                    0.8675
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.355
Time:                        11:39:41   Log-Likelihood:                 74.376
No. Observations:                  65   AIC:                            -144.8
Df Residuals:                      63   BIC:                            -140.4
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5494      0.010     52.464      0.000       0.528       0.570
x1            -0.0530      0.057     -0.931      0.355      -0.167       0.061
==============================================================================
Omnibus:                        8.837   Durbin-Watson:                   0.793
Prob(Omnibus):                  0.012   Jarque-Bera (JB):                8.289
Skew:                          -0.805   Prob(JB):                       0.0159
Kurtosis:                       3.685   Cond. No.                         5.90
==============================================================================
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.142
Model:                            OLS   Adj. R-squared:                  0.124
Method:                 Least Squares   F-statistic:                     7.623
Date:                Wed, 29 Jun 2022   Prob (F-statistic):            0.00825
Time:                        11:39:41   Log-Likelihood:                 58.610
No. Observations:                  48   AIC:                            -113.2
Df Residuals:                      46   BIC:                            -109.5
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.4816      0.012     38.534      0.000       0.456       0.507
x1             0.1316      0.048      2.761      0.008       0.036       0.227
==============================================================================
Omnibus:                        4.874   Durbin-Watson:                   1.302
Prob(Omnibus):                  0.087   Jarque-Bera (JB):                3.954
Skew:                           0.591   Prob(JB):                        0.138
Kurtosis:                       2.239   Cond. No.                         4.62
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
                            OLS Regression Results
==============================================================================
Dep. Variable:                      y   R-squared:                       0.024
Model:                            OLS   Adj. R-squared:                  0.011
Method:                 Least Squares   F-statistic:                     1.823
Date:                Wed, 29 Jun 2022   Prob (F-statistic):              0.181
Time:                        11:39:41   Log-Likelihood:                 90.953
No. Observations:                  75   AIC:                            -177.9
Df Residuals:                      73   BIC:                            -173.3
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.5291      0.010     55.108      0.000       0.510       0.548
x1             0.0642      0.048      1.350      0.181      -0.031       0.159
==============================================================================
```

```
Omnibus:                        0.855   Durbin-Watson:                   0.700
Prob(Omnibus):                  0.652   Jarque-Bera (JB):                0.901
Skew:                          -0.121   Prob(JB):                        0.637
Kurtosis:                       2.521   Cond. No.                         5.70
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

A diferencia del salario, el valor del contrato tiende a tener un mayor grado de significancia estadística que en el caso del salario, aunque no el suficiente a lo largo de todos los años como para que se considere un modelo adecuado.

II. Salario en función de las medidas de esfuerzo

$$ \omega_{t} = a + b\delta_{t} + e_{t} $$

donde δ_{t} es un vector que contiene todas las estadísticas deportivas. Se aplicará el modelo tanto para agentes libres que sean *hitters* o *pitchers*. Lo que se hará es regresar sobre todas las medidas del esfuerzo con el objetivo de determinar cuáles variables son significativas para el modelo y cuáles no

In [51]:
```
df_hitter_copy[1].columns
```

Out[51]:
```
Index(['Jugador', 'Valor_contrato', 'Valor_promedio_contrato', 'Posicion',
       'Juegos', 'Porcetnaje_juegos', 'At-bats', 'Bateos', 'Home-runs', 'RBI',
       'Porcentaje_bateo', 'OPS', 'Equipo', 'Sueldo', 'Victorias',
       'Juegos totales', 'Promedio_victorias', 'Sueldo_estandarizado',
       'Valor_contrato_estandarizado'],
      dtype='object')
```

In [50]:
```
df_pitcher_copy[1].columns
```

Out[50]:
```
Index(['Jugador', 'Valor_contrato', 'Valor_promedio_contrato', 'Posicion',
       'Juegos', 'Juegos_iniciados', 'Inning_pitched', 'Bateos', 'Carreras',
       'Carreras_ganadas', 'Walks', 'Strike-outs', 'Wins', 'Losses', 'Saves',
       'WHIP', 'ERA', 'Equipo', 'Sueldo', 'Victorias', 'Juegos totales',
       'Promedio_victorias', 'Sueldo_estandarizado',
       'Valor_contrato_estandarizado'],
      dtype='object')
```

In [69]:
```
for i in range(1,period):
    # Hitters:
    scaler_h = StandardScaler()
    x_hitter = df_hitter_copy[i].iloc[:, [4,5,6,7,8,9,10,11,14,15,16]]
    scaler_h.fit(x_hitter)
    scaler_h.transform(x_hitter)
    y_hitter = df_hitter_copy[i]['Sueldo_estandarizado']

    x_hitter = sm.add_constant(x_hitter)

    hitter_model_II_a[i] = sm.OLS(y_hitter, x_hitter).fit()

    # Pitchers:
    scaler_p = StandardScaler()
    x_pitcher = df_pitcher_copy[i].iloc[:, [4,5,6,7,8,9,10,11,12,13,14,15,16,19,20,21]]
    scaler_p.fit(x_pitcher)
    scaler_p.transform(x_pitcher)
    y_pitcher = df_pitcher_copy[i]['Sueldo_estandarizado']

    x_pitcher = sm.add_constant(x_pitcher)

    pitcher_model_II_a[i] = sm.OLS(y_pitcher, x_pitcher).fit()
```

In [68]:
```
# Modelos
hitter_model_II_a = [None]*period
pitcher_model_II_a = [None]*period
```

Lo siguiente es un código sin normalizar:

for i in range(1,period):

```
    # Hitters:
    x_hitter = df_hitter_copy[i][['Juegos', 'Porcetnaje_juegos', 'At-bats', 'Bateos', 'Home-
    runs', 'RBI',
                                  'Porcentaje_bateo', 'OPS', 'Victorias', 'Juegos totales',
                                  'Promedio_victorias']]
    #x_hitter = normalizar(x_hitter)
    y_hitter = df_hitter_copy[i]['Sueldo_estandarizado']
```

```
x_hitter = sm.add_constant(x_hitter)

hitter_model_II_a[i] = sm.OLS(y_hitter, x_hitter).fit()

# Pitchers:
x_pitcher = df_pitcher_copy[i][['Juegos', 'Juegos_iniciados', 'Inning_pitched', 'Bateos',
'Carreras',
                               'Carreras_ganadas', 'Walks', 'Strike-outs', 'Wins',
'Losses', 'Saves',
                               'WHIP', 'ERA','Victorias', 'Juegos totales',
'Promedio_victorias']]
#x_pitcher = normalizar(x_pitcher)
y_pitcher = df_pitcher_copy[i]['Sueldo_estandarizado']

x_pitcher = sm.add_constant(x_pitcher)

pitcher_model_II_a[i] = sm.OLS(y_pitcher, x_pitcher).fit()
```

Hitters

In [70]:

```
for i in range(1,period):
    print(hitter_model_II_a[i].summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.322
Model:                              OLS   Adj. R-squared:                  0.166
Method:                   Least Squares   F-statistic:                     2.060
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):             0.0580
Time:                          11:03:20   Log-Likelihood:                 19.582
No. Observations:                    49   AIC:                            -19.16
Df Residuals:                        39   BIC:                           -0.2454
Df Model:                             9
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Juegos                -0.0009      0.002     -0.551      0.585      -0.004       0.002
Porcetnaje_juegos     -0.1882      0.369     -0.510      0.613      -0.935       0.559
At-bats               -0.0004      0.001     -0.372      0.712      -0.002       0.002
Bateos                 0.0033      0.003      1.051      0.300      -0.003       0.010
Home-runs             -0.0059      0.014     -0.436      0.665      -0.033       0.022
```

```
RBI                   0.0053      0.006      0.945      0.351      -0.006       0.017
Porcentaje_bateo      -1.0350      1.215     -0.852      0.399      -3.492       1.422
OPS                   0.0799      0.399      0.200      0.842      -0.728       0.887
Victorias             0.0009      0.003      0.328      0.744      -0.005       0.007
Juegos totales        0.0012      0.002      0.712      0.480      -0.002       0.005
Promedio_victorias  5.63e-06   1.71e-05      0.328      0.744    -2.9e-05    4.03e-05
==============================================================================
Omnibus:                       12.135   Durbin-Watson:                   1.497
Prob(Omnibus):                  0.002   Jarque-Bera (JB):               12.489
Skew:                           1.035   Prob(JB):                      0.00194
Kurtosis:                       4.354   Cond. No.                     2.73e+18
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 1.12e-30. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.219
Model:                              OLS   Adj. R-squared:                  0.116
Method:                   Least Squares   F-statistic:                     2.121
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):             0.0393
Time:                          11:03:20   Log-Likelihood:                 8.6717
No. Observations:                    78   AIC:                             2.657
Df Residuals:                        68   BIC:                             26.22
Df Model:                             9
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Juegos                -0.1980      0.152     -1.299      0.198      -0.502       0.106
Porcetnaje_juegos     31.4561     24.717      1.273      0.207     -17.867      80.779
At-bats                0.0012      0.001      1.035      0.305      -0.001       0.004
Bateos                -0.0013      0.004     -0.357      0.722      -0.009       0.006
Home-runs             -0.0041      0.012     -0.332      0.741      -0.029       0.021
RBI                    0.0055      0.005      1.128      0.263      -0.004       0.015
Porcentaje_bateo       0.7859      0.819      0.960      0.340      -0.848       2.419
OPS                   -0.5325      0.371     -1.437      0.155      -1.272       0.207
Victorias              0.0047      0.003      1.795      0.077      -0.001       0.010
Juegos totales        -0.0002      0.001     -0.171      0.865      -0.003       0.002
Promedio_victorias  2.922e-05   1.63e-05      1.795      0.077   -3.27e-06    6.17e-05
==============================================================================
Omnibus:                       18.966   Durbin-Watson:                   1.598
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               26.022
```

```
Skew:                          1.047   Prob(JB):                     2.24e-06
Kurtosis:                      4.904   Cond. No.                     4.47e+18
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 4.47e-31. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.317
Model:                              OLS   Adj. R-squared:                  0.223
Method:                   Least Squares   F-statistic:                     3.375
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):           0.000725
Time:                          11:03:20   Log-Likelihood:                 24.428
No. Observations:                    92   AIC:                            -24.86
Df Residuals:                        80   BIC:                             5.406
Df Model:                            11
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                  3.7646     71.345      0.053      0.958    -138.217     145.746
Juegos                -0.1141      0.464     -0.246      0.806      -1.037       0.809
Porcetnaje_juegos     17.9890     75.130      0.239      0.811    -131.524     167.502
At-bats                0.0019      0.001      2.404      0.019       0.000       0.003
Bateos                -0.0012      0.003     -0.373      0.710      -0.007       0.005
Home-runs              0.0152      0.008      1.840      0.069      -0.001       0.032
RBI                   -0.0030      0.005     -0.612      0.542      -0.013       0.007
Porcentaje_bateo       1.2974      1.230      1.055      0.295      -1.150       3.744
OPS                   -0.9638      0.508     -1.898      0.061      -1.974       0.047
Victorias             -0.0664      0.852     -0.078      0.938      -1.762       1.629
Juegos totales        -0.0211      0.441     -0.048      0.962      -0.899       0.857
Promedio_victorias    10.6975    137.658      0.078      0.938    -263.250     284.645
==============================================================================
Omnibus:                       11.545   Durbin-Watson:                   1.677
Prob(Omnibus):                  0.003   Jarque-Bera (JB):               11.874
Skew:                           0.822   Prob(JB):                      0.00264
Kurtosis:                       3.626   Cond. No.                     2.55e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.55e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.538
Model:                              OLS   Adj. R-squared:                  0.462
Method:                   Least Squares   F-statistic:                     7.079
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):           8.21e-08
Time:                          11:03:20   Log-Likelihood:                 23.974
No. Observations:                    79   AIC:                            -23.95
Df Residuals:                        67   BIC:                             4.485
Df Model:                            11
Covariance Type:              nonrobust
==========================================================================================
                             coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------
const                    10.8603     77.810      0.140      0.889    -144.449     166.169
Juegos                   -0.5847      0.512     -1.143      0.257      -1.606       0.436
Porcetnaje_juegos        93.6330     82.858      1.130      0.262     -71.751     259.017
At-bats                   0.0041      0.001      4.194      0.000       0.002       0.006
Bateos                   -0.0042      0.003     -1.201      0.234      -0.011       0.003
Home-runs                 0.0177      0.008      2.309      0.024       0.002       0.033
RBI                      -0.0073      0.004     -1.714      0.091      -0.016       0.001
Porcentaje_bateo          1.6021      0.795      2.014      0.048       0.014       3.190
OPS                      -1.0557      0.334     -3.160      0.002      -1.722      -0.389
Victorias                 0.4126      0.945      0.436      0.664      -1.474       2.299
Juegos totales           -0.0660      0.484     -0.136      0.892      -1.032       0.900
Promedio_victorias      -66.0053    152.040     -0.434      0.666    -369.479     237.469
==============================================================================
Omnibus:                       10.366   Durbin-Watson:                   1.755
Prob(Omnibus):                  0.006   Jarque-Bera (JB):               10.715
Skew:                           0.730   Prob(JB):                      0.00471
Kurtosis:                       4.059   Cond. No.                     2.53e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.53e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.201
Model:                              OLS   Adj. R-squared:                  0.109
Method:                   Least Squares   F-statistic:                     2.190
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):             0.0210
Time:                          11:03:20   Log-Likelihood:                 41.155
No. Observations:                   108   AIC:                            -58.31
```

```
Df Residuals:                        96   BIC:                            -26.12
Df Model:                            11
Covariance Type:              nonrobust
================================================================================
                          coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const                -50.2689     53.647     -0.937      0.351    -156.758      56.220
Juegos                -0.0181      0.104     -0.174      0.862      -0.225       0.189
Porcetnaje_juegos      2.7132     16.885      0.161      0.873     -30.803      36.229
At-bats                0.0011      0.001      1.643      0.104      -0.000       0.002
Bateos                -0.0028      0.003     -1.041      0.301      -0.008       0.003
Home-runs              0.0109      0.007      1.557      0.123      -0.003       0.025
RBI                   -0.0017      0.004     -0.427      0.670      -0.010       0.006
Porcentaje_bateo       1.3441      0.593      2.267      0.026       0.167       2.521
OPS                   -0.5356      0.211     -2.543      0.013      -0.954      -0.117
Victorias             -0.6318      0.631     -1.002      0.319      -1.884       0.620
Juegos totales         0.3115      0.334      0.933      0.353      -0.351       0.974
Promedio_victorias   102.2839    101.311      1.010      0.315     -98.817     303.385
==============================================================================
Omnibus:                       74.925   Durbin-Watson:                   1.622
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              454.553
Skew:                           2.299   Prob(JB):                     1.97e-99
Kurtosis:                      11.937   Cond. No.                     2.04e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.04e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.363
Model:                              OLS   Adj. R-squared:                  0.243
Method:                   Least Squares   F-statistic:                     3.017
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):            0.00434
Time:                          11:03:20   Log-Likelihood:                 21.082
No. Observations:                    64   AIC:                            -20.16
Df Residuals:                        53   BIC:                             3.583
Df Model:                            10
Covariance Type:              nonrobust
================================================================================
                          coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const                 22.5230     14.809      1.521      0.134      -7.180      52.226
Juegos                 0.8581      0.585      1.468      0.148      -0.315       2.031
```

Porcetnaje_juegos	-139.3765	94.662	-1.472	0.147	-329.244	50.491
At-bats	-0.0002	0.001	-0.194	0.847	-0.002	0.002
Bateos	0.0047	0.003	1.407	0.165	-0.002	0.011
Home-runs	0.0189	0.011	1.732	0.089	-0.003	0.041
RBI	-0.0034	0.005	-0.697	0.489	-0.013	0.006
Porcentaje_bateo	2.6994	1.345	2.007	0.050	0.002	5.397
OPS	-1.1852	0.510	-2.326	0.024	-2.207	-0.163
Victorias	-0.0794	0.054	-1.476	0.146	-0.187	0.029
Juegos totales	-0.1389	0.092	-1.515	0.136	-0.323	0.045
Promedio_victorias	13.4033	8.813	1.521	0.134	-4.273	31.079

Omnibus:	19.694	Durbin-Watson:	1.474
Prob(Omnibus):	0.000	Jarque-Bera (JB):	27.293
Skew:	1.202	Prob(JB):	1.18e-06
Kurtosis:	5.110	Cond. No.	2.66e+18

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 1.03e-30. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

OLS Regression Results

Dep. Variable:	Sueldo_estandarizado	R-squared:	0.299
Model:	OLS	Adj. R-squared:	0.132
Method:	Least Squares	F-statistic:	1.786
Date:	Wed, 29 Jun 2022	Prob (F-statistic):	0.0844
Time:	11:03:20	Log-Likelihood:	16.357
No. Observations:	58	AIC:	-8.713
Df Residuals:	46	BIC:	16.01
Df Model:	11		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	205.6594	504.594	0.408	0.685	-810.036	1221.355
Juegos	-0.1977	0.239	-0.826	0.413	-0.679	0.284
Porcetnaje_juegos	31.5120	38.806	0.812	0.421	-46.600	109.624
At-bats	-0.0005	0.001	-0.577	0.567	-0.002	0.001
Bateos	0.0048	0.003	1.462	0.151	-0.002	0.012
Home-runs	0.0079	0.015	0.533	0.596	-0.022	0.038
RBI	0.0012	0.006	0.201	0.842	-0.011	0.014
Porcentaje_bateo	0.5193	0.907	0.572	0.570	-1.307	2.345
OPS	-0.2708	0.350	-0.774	0.443	-0.975	0.433
Victorias	2.4694	5.321	0.464	0.645	-8.241	13.180

```
Juegos totales        -1.2659      3.115     -0.406      0.686      -7.535       5.003
Promedio_victorias  -400.6241    862.021     -0.465      0.644   -2135.782    1334.533
==============================================================================
Omnibus:                       38.934   Durbin-Watson:                   1.516
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              124.196
Skew:                           1.906   Prob(JB):                     1.07e-27
Kurtosis:                       9.071   Cond. No.                     1.23e+07
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.23e+07. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.405
Model:                              OLS   Adj. R-squared:                  0.281
Method:                   Least Squares   F-statistic:                     3.273
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):            0.00179
Time:                          11:03:20   Log-Likelihood:                 16.356
No. Observations:                    65   AIC:                            -8.713
Df Residuals:                        53   BIC:                             17.38
Df Model:                            11
Covariance Type:             nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                102.9063     69.455      1.482      0.144     -36.402     242.215
Juegos                 0.5705      0.280      2.041      0.046       0.010       1.131
Porcetnaje_juegos    -92.9827     45.339     -2.051      0.045    -183.921      -2.045
At-bats               -0.0005      0.001     -0.431      0.669      -0.003       0.002
Bateos                 0.0066      0.004      1.690      0.097      -0.001       0.014
Home-runs              0.0266      0.007      3.560      0.001       0.012       0.042
RBI                   -0.0059      0.004     -1.559      0.125      -0.013       0.002
Porcentaje_bateo       1.3297      1.081      1.230      0.224      -0.839       3.499
OPS                   -0.9315      0.492     -1.894      0.064      -1.918       0.055
Victorias              1.0383      0.772      1.345      0.185      -0.511       2.587
Juegos totales        -0.6342      0.430     -1.475      0.146      -1.497       0.228
Promedio_victorias  -167.6584    124.735     -1.344      0.185    -417.845      82.528
==============================================================================
Omnibus:                        5.786   Durbin-Watson:                   1.778
Prob(Omnibus):                  0.055   Jarque-Bera (JB):                5.027
Skew:                           0.659   Prob(JB):                       0.0810
Kurtosis:                       3.343   Cond. No.                     2.11e+06
==============================================================================
```

```
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.11e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.405
Model:                              OLS   Adj. R-squared:                  0.223
Method:                   Least Squares   F-statistic:                     2.229
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):             0.0347
Time:                          11:03:20   Log-Likelihood:                 10.667
No. Observations:                    48   AIC:                             2.665
Df Residuals:                        36   BIC:                             25.12
Df Model:                            11
Covariance Type:              nonrobust
==========================================================================================
                             coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------
const                     2.2861     13.614      0.168      0.868     -25.324      29.896
Juegos                   -0.0487      0.170     -0.286      0.776      -0.394       0.296
Porcetnaje_juegos         2.2530     10.265      0.219      0.828     -18.564      23.070
At-bats                   0.0052      0.004      1.172      0.249      -0.004       0.014
Bateos                   -0.0036      0.014     -0.262      0.795      -0.032       0.024
Home-runs                 0.0010      0.025      0.039      0.969      -0.051       0.053
RBI                       0.0021      0.010      0.220      0.827      -0.017       0.022
Porcentaje_bateo         -1.6954      2.272     -0.746      0.460      -6.302       2.912
OPS                       0.6447      0.652      0.989      0.329      -0.677       1.966
Victorias                 0.1033      0.480      0.215      0.831      -0.869       1.076
Juegos totales           -0.0449      0.227     -0.198      0.845      -0.506       0.416
Promedio_victorias       -5.3127     28.757     -0.185      0.854     -63.635      53.010
==============================================================================
Omnibus:                        6.538   Durbin-Watson:                   1.450
Prob(Omnibus):                  0.038   Jarque-Bera (JB):                6.260
Skew:                           0.533   Prob(JB):                       0.0437
Kurtosis:                       4.411   Cond. No.                     1.56e+05
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.56e+05. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.313
```

```
Model:                            OLS   Adj. R-squared:                  0.193
Method:                 Least Squares   F-statistic:                     2.609
Date:                Wed, 29 Jun 2022   Prob (F-statistic):            0.00837
Time:                        11:03:20   Log-Likelihood:                 31.151
No. Observations:                  75   AIC:                            -38.30
Df Residuals:                      63   BIC:                            -10.49
Df Model:                          11
Covariance Type:            nonrobust
================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const            -66.2732     40.882     -1.621      0.110    -147.970      15.424
Juegos             0.0330      0.151      0.219      0.828      -0.269       0.335
Porcetnaje_juegos -6.1553     24.490     -0.251      0.802     -55.095      42.785
At-bats            0.0009      0.001      1.004      0.319      -0.001       0.003
Bateos             0.0020      0.003      0.695      0.490      -0.004       0.008
Home-runs      -5.796e-05      0.007     -0.009      0.993      -0.013       0.013
RBI             7.221e-05      0.004      0.019      0.985      -0.007       0.008
Porcentaje_bateo  -0.2200      0.942     -0.234      0.816      -2.102       1.662
OPS               -0.0740      0.361     -0.205      0.838      -0.795       0.647
Victorias         -0.7591      0.461     -1.648      0.104      -1.680       0.162
Juegos totales     0.4091      0.252      1.622      0.110      -0.095       0.913
Promedio_victorias 123.6057    74.674      1.655      0.103     -25.619     272.830
==============================================================================
Omnibus:                       27.830   Durbin-Watson:                   1.437
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               51.852
Skew:                           1.350   Prob(JB):                     5.50e-12
Kurtosis:                       6.051   Cond. No.                     1.54e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.54e+06. This might indicate that there are
strong multicollinearity or other numerical problems
```

Se aprecia que la valriable que tiende a ser estadísticamente significativa a lo largo de los años es *at-bats* y en menos ocasiones, secundándole, es *home-runs* y *victorias*.

Pitcher

In [71]:

```
for i in range(1,period):
    print(pitcher_model_II_a[i].summary())
```

```
                            OLS Regression Results
```

```
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.930
Model:                              OLS   Adj. R-squared:                  0.685
Method:                   Least Squares   F-statistic:                     3.797
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):              0.103
Time:                          11:30:45   Log-Likelihood:                 18.467
No. Observations:                    19   AIC:                            -6.934
Df Residuals:                         4   BIC:                             7.233
Df Model:                            14
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Juegos                -0.0430      0.019     -2.290      0.084      -0.095       0.009
Juegos_iniciados      -0.2394      0.106     -2.257      0.087      -0.534       0.055
Inning_pitched        -0.0083      0.033     -0.253      0.813      -0.100       0.083
Bateos                 0.0040      0.027      0.148      0.890      -0.071       0.079
Carreras              -0.0359      0.038     -0.948      0.397      -0.141       0.069
Carreras_ganadas       0.0342      0.033      1.027      0.363      -0.058       0.127
Walks                  0.0569      0.022      2.597      0.060      -0.004       0.118
Strike-outs            0.0022      0.007      0.299      0.780      -0.018       0.023
Wins                   0.2009      0.091      2.209      0.092      -0.052       0.454
Losses                 0.3156      0.123      2.567      0.062      -0.026       0.657
Saves                 -0.0156      0.013     -1.177      0.304      -0.053       0.021
WHIP                  -5.9510      2.602     -2.287      0.084     -13.174       1.272
ERA                    0.9809      0.389      2.521      0.065      -0.099       2.061
Victorias              0.0236      0.010      2.393      0.075      -0.004       0.051
Juegos totales         0.0183      0.011      1.625      0.180      -0.013       0.050
Promedio_victorias     0.0001   6.09e-05      2.393      0.075   -2.34e-05       0.000
==============================================================================
Omnibus:                        5.571   Durbin-Watson:                   1.917
Prob(Omnibus):                  0.062   Jarque-Bera (JB):                3.114
Skew:                           0.736   Prob(JB):                        0.211
Kurtosis:                       4.329   Cond. No.                     5.88e+18
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 4.15e-32. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.535
Model:                              OLS   Adj. R-squared:                  0.355
Method:                   Least Squares   F-statistic:                     2.964
```

Date:	Wed, 29 Jun 2022	Prob (F-statistic):	0.00432
Time:	11:30:45	Log-Likelihood:	25.572
No. Observations:	51	AIC:	-21.14
Df Residuals:	36	BIC:	7.834
Df Model:	14		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Juegos	-0.0014	0.004	-0.343	0.733	-0.009	0.007
Juegos_iniciados	0.0082	0.022	0.370	0.713	-0.037	0.053
Inning_pitched	-0.0013	0.005	-0.251	0.803	-0.011	0.009
Bateos	-0.0035	0.004	-0.838	0.408	-0.012	0.005
Carreras	-0.0067	0.015	-0.442	0.661	-0.037	0.024
Carreras_ganadas	0.0064	0.018	0.350	0.728	-0.031	0.043
Walks	-0.0035	0.004	-0.888	0.381	-0.012	0.005
Strike-outs	0.0018	0.002	0.999	0.324	-0.002	0.005
Wins	0.0390	0.020	1.989	0.054	-0.001	0.079
Losses	0.0442	0.019	2.282	0.028	0.005	0.084
Saves	0.0082	0.004	2.263	0.030	0.001	0.015
WHIP	0.0785	0.264	0.298	0.768	-0.456	0.613
ERA	-0.0133	0.040	-0.332	0.742	-0.095	0.068
Victorias	-0.0010	0.003	-0.368	0.715	-0.007	0.005
Juegos totales	0.0009	0.002	0.435	0.667	-0.003	0.005
Promedio_victorias	-6.29e-06	1.71e-05	-0.368	0.715	-4.1e-05	2.84e-05

Omnibus:	28.084	Durbin-Watson:	1.600
Prob(Omnibus):	0.000	Jarque-Bera (JB):	64.811
Skew:	1.545	Prob(JB):	8.44e-15
Kurtosis:	7.577	Cond. No.	4.61e+18

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 1.63e-31. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

OLS Regression Results

Dep. Variable:	Sueldo_estandarizado	R-squared:	0.510
Model:	OLS	Adj. R-squared:	0.357
Method:	Least Squares	F-statistic:	3.322
Date:	Wed, 29 Jun 2022	Prob (F-statistic):	0.000558
Time:	11:30:45	Log-Likelihood:	19.277
No. Observations:	68	AIC:	-4.554
Df Residuals:	51	BIC:	33.18

```
Df Model:                           16
Covariance Type:             nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         43.6971     78.345      0.558      0.579    -113.587     200.981
Juegos        -0.0004      0.002     -0.245      0.807      -0.004       0.003
Juegos_iniciados  0.0028      0.002      1.268      0.211      -0.002       0.007
Inning_pitched  0.0033      0.005      0.701      0.487      -0.006       0.013
Bateos        -0.0011      0.005     -0.236      0.814      -0.010       0.008
Carreras       0.0107      0.011      1.010      0.317      -0.011       0.032
Carreras_ganadas -0.0084      0.012     -0.697      0.489      -0.033       0.016
Walks         -0.0046      0.004     -1.206      0.233      -0.012       0.003
Strike-outs    0.0013      0.002      0.588      0.559      -0.003       0.006
Wins          -0.0162      0.018     -0.888      0.379      -0.053       0.020
Losses        -0.0036      0.022     -0.165      0.869      -0.047       0.040
Saves          0.0048      0.003      1.487      0.143      -0.002       0.011
WHIP           0.1205      0.132      0.913      0.366      -0.145       0.385
ERA           -0.0026      0.020     -0.131      0.897      -0.042       0.037
Victorias      0.4070      0.963      0.423      0.674      -1.526       2.340
Juegos totales -0.2717      0.485     -0.560      0.578      -1.246       0.702
Promedio_victorias -65.5662    155.411     -0.422      0.675    -377.567     246.435
==============================================================================
Omnibus:                        7.190   Durbin-Watson:                   2.092
Prob(Omnibus):                  0.027   Jarque-Bera (JB):                6.562
Skew:                           0.734   Prob(JB):                       0.0376
Kurtosis:                       3.400   Cond. No.                     1.68e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.68e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.707
Model:                             OLS   Adj. R-squared:                  0.621
Method:                  Least Squares   F-statistic:                     8.276
Date:                 Wed, 29 Jun 2022   Prob (F-statistic):           1.34e-09
Time:                         11:30:45   Log-Likelihood:                 52.821
No. Observations:                   72   AIC:                            -71.64
Df Residuals:                       55   BIC:                            -32.94
Df Model:                           16
Covariance Type:             nonrobust
==============================================================================
```

	coef	std err	t	P>|t|	[0.025	0.975]
const	-16.2781	49.290	-0.330	0.742	-115.058	82.502
Juegos	-0.0009	0.001	-1.026	0.309	-0.003	0.001
Juegos_iniciados	0.0028	0.001	2.522	0.015	0.001	0.005
Inning_pitched	-0.0055	0.003	-1.639	0.107	-0.012	0.001
Bateos	0.0061	0.003	1.998	0.051	-1.78e-05	0.012
Carreras	-0.0094	0.011	-0.830	0.410	-0.032	0.013
Carreras_ganadas	0.0031	0.011	0.279	0.781	-0.019	0.026
Walks	-0.0016	0.002	-0.673	0.503	-0.006	0.003
Strike-outs	0.0047	0.001	3.828	0.000	0.002	0.007
Wins	0.0076	0.011	0.675	0.503	-0.015	0.030
Losses	0.0112	0.011	1.006	0.319	-0.011	0.033
Saves	0.0035	0.002	1.484	0.144	-0.001	0.008
WHIP	-0.1753	0.088	-1.983	0.052	-0.352	0.002
ERA	0.0235	0.015	1.594	0.117	-0.006	0.053
Victorias	-0.2304	0.624	-0.369	0.713	-1.480	1.020
Juegos totales	0.1017	0.307	0.332	0.741	-0.513	0.716
Promedio_victorias	37.2402	100.281	0.371	0.712	-163.728	238.208

Omnibus:	16.849	Durbin-Watson:	1.748
Prob(Omnibus):	0.000	Jarque-Bera (JB):	25.200
Skew:	0.908	Prob(JB):	3.37e-06
Kurtosis:	5.259	Cond. No.	1.64e+06

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.64e+06. This might indicate that there are
strong multicollinearity or other numerical problems.

OLS Regression Results

Dep. Variable:	Sueldo_estandarizado	R-squared:	0.649
Model:	OLS	Adj. R-squared:	0.552
Method:	Least Squares	F-statistic:	6.692
Date:	Wed, 29 Jun 2022	Prob (F-statistic):	3.09e-08
Time:	11:30:45	Log-Likelihood:	59.864
No. Observations:	75	AIC:	-85.73
Df Residuals:	58	BIC:	-46.33
Df Model:	16		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-64.7772	50.905	-1.273	0.208	-166.675	37.121

```
Juegos                0.0012      0.002      0.618      0.539      -0.003       0.005
Juegos_iniciados      0.0050      0.009      0.571      0.570      -0.012       0.022
Inning_pitched       -0.0014      0.004     -0.395      0.695      -0.009       0.006
Bateos               -0.0021      0.003     -0.629      0.532      -0.009       0.005
Carreras             -0.0073      0.009     -0.825      0.413      -0.025       0.010
Carreras_ganadas      0.0165      0.010      1.684      0.097      -0.003       0.036
Walks                -0.0088      0.003     -2.914      0.005      -0.015      -0.003
Strike-outs           0.0023      0.001      1.801      0.077      -0.000       0.005
Wins                  0.0212      0.008      2.592      0.012       0.005       0.038
Losses               -0.0016      0.009     -0.182      0.856      -0.019       0.016
Saves                 0.0031      0.003      1.007      0.318      -0.003       0.009
WHIP                  0.1735      0.195      0.892      0.376      -0.216       0.563
ERA                  -0.0279      0.026     -1.069      0.290      -0.080       0.024
Victorias            -0.9399      0.622     -1.510      0.136      -2.186       0.306
Juegos totales        0.4014      0.317      1.266      0.211      -0.233       1.036
Promedio_victorias  151.3231    100.029      1.513      0.136     -48.907     351.553
==============================================================================
Omnibus:                       46.886   Durbin-Watson:                   1.850
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              258.611
Skew:                           1.703   Prob(JB):                     6.97e-57
Kurtosis:                      11.435   Cond. No.                     2.00e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large,  2e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.561
Model:                              OLS   Adj. R-squared:                  0.297
Method:                   Least Squares   F-statistic:                     2.126
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):             0.0462
Time:                          11:30:45   Log-Likelihood:                 17.973
No. Observations:                    41   AIC:                            -3.946
Df Residuals:                        25   BIC:                             23.47
Df Model:                            15
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                16.9374     22.369      0.757      0.456     -29.131      63.006
Juegos               -0.0042      0.002     -1.745      0.093      -0.009       0.001
Juegos_iniciados      0.0024      0.002      1.239      0.227      -0.002       0.006
Inning_pitched        0.0031      0.007      0.457      0.652      -0.011       0.017
```

Bateos	0.0006	0.007	0.085	0.933	-0.013	0.014
Carreras	-0.0151	0.022	-0.677	0.505	-0.061	0.031
Carreras_ganadas	-0.0020	0.019	-0.102	0.920	-0.042	0.038
Walks	-0.0051	0.006	-0.891	0.382	-0.017	0.007
Strike-outs	0.0017	0.003	0.539	0.595	-0.005	0.008
Wins	0.0046	0.024	0.190	0.851	-0.045	0.054
Losses	0.0600	0.022	2.735	0.011	0.015	0.105
Saves	0.0056	0.004	1.528	0.139	-0.002	0.013
WHIP	0.1223	0.145	0.846	0.405	-0.175	0.420
ERA	-0.0165	0.014	-1.162	0.256	-0.046	0.013
Victorias	-0.0637	0.080	-0.800	0.431	-0.228	0.100
Juegos totales	-0.1007	0.139	-0.724	0.476	-0.387	0.186
Promedio_victorias	10.0793	13.311	0.757	0.456	-17.336	37.495

Omnibus:	4.743	Durbin-Watson:	1.556
Prob(Omnibus):	0.093	Jarque-Bera (JB):	3.443
Skew:	0.565	Prob(JB):	0.179
Kurtosis:	3.860	Cond. No.	1.75e+18

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 8.21e-31. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

OLS Regression Results

Dep. Variable:	Sueldo_estandarizado	R-squared:	0.300
Model:	OLS	Adj. R-squared:	0.006
Method:	Least Squares	F-statistic:	1.019
Date:	Wed, 29 Jun 2022	Prob (F-statistic):	0.459
Time:	11:30:45	Log-Likelihood:	23.375
No. Observations:	55	AIC:	-12.75
Df Residuals:	38	BIC:	21.37
Df Model:	16		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-276.1550	438.327	-0.630	0.532	-1163.502	611.192
Juegos	-0.0017	0.002	-1.074	0.289	-0.005	0.001
Juegos_iniciados	0.0024	0.003	0.905	0.371	-0.003	0.008
Inning_pitched	-0.0024	0.005	-0.443	0.660	-0.013	0.008
Bateos	0.0014	0.005	0.266	0.791	-0.009	0.012
Carreras	0.0137	0.011	1.285	0.207	-0.008	0.035
Carreras_ganadas	-0.0147	0.011	-1.323	0.194	-0.037	0.008

```
Walks                -0.0001      0.004     -0.038      0.970      -0.008       0.008
Strike-outs           0.0008      0.003      0.261      0.796      -0.005       0.007
Wins                  0.0069      0.022      0.315      0.755      -0.038       0.052
Losses                0.0148      0.023      0.630      0.533      -0.033       0.062
Saves                 0.0043      0.004      1.154      0.256      -0.003       0.012
WHIP                 -0.0525      0.166     -0.316      0.754      -0.389       0.284
ERA                   0.0067      0.023      0.294      0.770      -0.040       0.053
Victorias            -2.7945      4.683     -0.597      0.554     -12.275       6.686
Juegos totales        1.7052      2.706      0.630      0.532      -3.772       7.182
Promedio_victorias  452.8614    758.754      0.597      0.554   -1083.156    1988.879
==============================================================================
Omnibus:                       25.666   Durbin-Watson:                   1.545
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               51.791
Skew:                           1.415   Prob(JB):                     5.67e-12
Kurtosis:                       6.820   Cond. No.                     8.09e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 8.09e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.286
Model:                              OLS   Adj. R-squared:                 -0.082
Method:                   Least Squares   F-statistic:                    0.7768
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):              0.698
Time:                          11:30:45   Log-Likelihood:                 8.4654
No. Observations:                    48   AIC:                             17.07
Df Residuals:                        31   BIC:                             48.88
Df Model:                            16
Covariance Type:             nonrobust
==============================================================================
                          coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                36.7573     96.420      0.381      0.706    -159.892     233.407
Juegos               -0.0034      0.002     -1.535      0.135      -0.008       0.001
Juegos_iniciados      0.0041      0.003      1.404      0.170      -0.002       0.010
Inning_pitched       -0.0007      0.008     -0.091      0.928      -0.016       0.015
Bateos               -0.0053      0.008     -0.656      0.517      -0.022       0.011
Carreras             -0.0354      0.021     -1.662      0.107      -0.079       0.008
Carreras_ganadas      0.0392      0.022      1.814      0.079      -0.005       0.083
Walks                 0.0077      0.008      0.981      0.334      -0.008       0.024
Strike-outs           0.0018      0.003      0.691      0.495      -0.003       0.007
Wins                  0.0150      0.025      0.604      0.550      -0.036       0.066
```

```
Losses                0.0149      0.024      0.619      0.541      -0.034       0.064
Saves                 0.0068      0.012      0.583      0.564      -0.017       0.030
WHIP                  0.0199      0.097      0.205      0.839      -0.178       0.218
ERA                  -0.0021      0.015     -0.142      0.888      -0.033       0.028
Victorias             0.4332      1.122      0.386      0.702      -1.855       2.722
Juegos totales       -0.2277      0.598     -0.381      0.706      -1.447       0.992
Promedio_victorias  -69.5376    180.959     -0.384      0.703    -438.607     299.532
==============================================================================
Omnibus:                        7.602   Durbin-Watson:                   1.693
Prob(Omnibus):                  0.022   Jarque-Bera (JB):                6.710
Skew:                           0.733   Prob(JB):                       0.0349
Kurtosis:                       4.099   Cond. No.                     1.37e+06
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.37e+06. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.534
Model:                              OLS   Adj. R-squared:                  0.353
Method:                   Least Squares   F-statistic:                     2.940
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):            0.00273
Time:                          11:30:45   Log-Likelihood:                 30.124
No. Observations:                    58   AIC:                            -26.25
Df Residuals:                        41   BIC:                             8.781
Df Model:                            16
Covariance Type:              nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                -5.7843      9.224     -0.627      0.534     -24.412      12.844
Juegos               -0.0072      0.004     -1.958      0.057      -0.015       0.000
Juegos_iniciados      0.0066      0.004      1.764      0.085      -0.001       0.014
Inning_pitched        0.0024      0.009      0.270      0.789      -0.015       0.020
Bateos                0.0063      0.008      0.767      0.448      -0.010       0.023
Carreras              0.0104      0.022      0.473      0.638      -0.034       0.055
Carreras_ganadas     -0.0270      0.022     -1.227      0.227      -0.071       0.017
Walks                 0.0023      0.008      0.275      0.785      -0.015       0.019
Strike-outs           0.0023      0.003      0.709      0.482      -0.004       0.009
Wins                  0.0024      0.029      0.084      0.934      -0.056       0.061
Losses               -0.0197      0.028     -0.696      0.490      -0.077       0.038
Saves                 0.0033      0.012      0.272      0.787      -0.021       0.028
WHIP                 -0.2415      0.094     -2.580      0.014      -0.431      -0.052
```

```
ERA                   0.0656      0.022      3.032      0.004       0.022       0.109
Victorias            -0.1139      0.316     -0.361      0.720      -0.751       0.524
Juegos totales        0.0990      0.155      0.640      0.526      -0.213       0.411
Promedio_victorias    6.9038     18.820      0.367      0.716     -31.103      44.911
==============================================================================
Omnibus:                       14.765   Durbin-Watson:                   1.532
Prob(Omnibus):                  0.001   Jarque-Bera (JB):               21.786
Skew:                           0.877   Prob(JB):                     1.86e-05
Kurtosis:                       5.437   Cond. No.                     8.35e+04
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 8.35e+04. This might indicate that there are
strong multicollinearity or other numerical problems.
                            OLS Regression Results
==============================================================================
Dep. Variable:     Sueldo_estandarizado   R-squared:                       0.498
Model:                              OLS   Adj. R-squared:                  0.327
Method:                   Least Squares   F-statistic:                     2.911
Date:                  Wed, 29 Jun 2022   Prob (F-statistic):            0.00225
Time:                          11:30:45   Log-Likelihood:                 49.512
No. Observations:                    64   AIC:                            -65.02
Df Residuals:                        47   BIC:                            -28.32
Df Model:                            16
Covariance Type:               nonrobust
==============================================================================
                         coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const                -52.2350     29.254     -1.786      0.081    -111.087       6.617
Juegos                -0.0021      0.001     -2.495      0.016      -0.004      -0.000
Juegos_iniciados       0.0025      0.001      2.723      0.009       0.001       0.004
Inning_pitched        -0.0009      0.003     -0.296      0.768      -0.007       0.005
Bateos                -0.0054      0.003     -1.803      0.078      -0.011       0.001
Carreras               0.0061      0.009      0.682      0.499      -0.012       0.024
Carreras_ganadas      -0.0004      0.008     -0.050      0.960      -0.017       0.017
Walks                  0.0038      0.003      1.166      0.250      -0.003       0.010
Strike-outs            0.0009      0.001      0.763      0.449      -0.002       0.003
Wins                   0.0208      0.009      2.208      0.032       0.002       0.040
Losses                 0.0081      0.011      0.753      0.455      -0.013       0.030
Saves                  0.0040      0.003      1.556      0.126      -0.001       0.009
WHIP                   0.0373      0.067      0.559      0.579      -0.097       0.171
ERA                   -0.0092      0.008     -1.092      0.280      -0.026       0.008
Victorias             -0.6734      0.342     -1.970      0.055      -1.361       0.014
Juegos totales         0.3209      0.180      1.781      0.081      -0.042       0.683
```

```
Promedio_victorias   109.7434     55.525      1.976      0.054      -1.959     221.446
==============================================================================
Omnibus:                       45.549   Durbin-Watson:                   1.436
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              318.257
Skew:                           1.719   Prob(JB):                     7.79e-70
Kurtosis:                      13.370   Cond. No.                     9.18e+05
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 9.18e+05. This might indicate that there are
strong multicollinearity or other numerical problems.
```

Notamos que no hay alguna variable que persista más de tres años siendo estadísticamente significativa. EL comportamiento tiende a ser aleatorio.