10-Proyecto-Hipertension-Mexico

July 13, 2024

1 Hipertensión México

```
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

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(4363, 36)
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	FOLIO_I	sexo	edad	concentracion_hemoglobina	temperatura_ambiente	\
0	2022_01001004	2	41	14.2	22	
1	2022_01001009	2	65	14.1	9	
2	2022_01001012	2	68	14.2	22	
3	2022_01001013	1	35	15.7	11	
4	2022_01001015	2	65	12.7	7	

	valor_acido_urico	valor_albumina	valor_colesterol_hdl	\
0	4.8	4.0	34	
1	4.4	3.8	73	
2	4.8	4.0	34	
3	6.5	4.1	49	
4	4.2	4.2	41	

	valor_colesterol_ldl	valor_colesterol_total	valor_creatina	\
0	86.0	139	0.58	
1	130.0	252	0.62	
2	86.0	139	0.58	
3	107.0	203	0.91	
4	76.0	145	0.71	

	resultado_glucosa	valor_insulina	valor_trigliceridos	\
0	92.0	4.0	123	
1	111.0	9.4	131	
2	92.0	4.0	123	
3	106.0	7.4	297	
4	109.0	16.9	136	

	resultado_glucosa_promedio	valor_hemoglobina_glucosilada	valor_ferritina	\
0	103	5.2	2.7	
1	131	6.2	2.7	

```
2                       103                           5.2              2.7
3                       105                           5.3              2.7
4                       154                           7.0              2.7

   valor_folato  valor_homocisteina  valor_proteinac_reactiva  \
0          23.4                 4.9                      0.02
1          23.4                 4.9                      0.02
2          23.4                 4.9                      0.02
3          23.4                 4.9                      0.02
4          23.4                 4.9                      0.02

   valor_transferrina  valor_vitamina_bdoce  valor_vitamina_d   peso  \
0                 1.1                 167.0              20.8  74.55
1                 1.1                 167.0              20.8   2.00
2                 1.1                 167.0              20.8   2.00
3                 1.1                 167.0              20.8  81.50
4                 1.1                 167.0              20.8   2.00

   estatura  medida_cintura  segundamedicion_peso  segundamedicion_estatura  \
0     147.3             0.0                 64.70                     154.0
1     151.0             0.0                 96.75                     152.2
2     151.0             0.0                 68.70                     144.8
3     173.4            98.5                 64.70                     154.0
4     151.0             0.0                 97.15                     161.3

   distancia_rodilla_talon  circunferencia_de_la_pantorrilla  \
0                     48.5                              33.5
1                     44.5                              41.1
2                     42.3                              37.8
3                     48.5                              33.5
4                     49.6                              42.0

   segundamedicion_cintura  tension_arterial  sueno_horas  masa_corporal  \
0                      0.0               107            4      32.889389
1                    113.7               104            2       1.000000
2                    103.7               105            1       1.000000
3                      0.0               117            5      26.265339
4                    118.9               123            2       1.000000

   actividad_total  riesgo_hipertension
0              120                    1
1              240                    0
2              480                    0
3              275                    1
4              255                    0
```

riesgo_hipertension	proportion
1	0.645427
0	0.354573

1.1 Preprocesamiento

1.2 Train, Test & Validation

1.3 Procesamiento

	sexo	edad	concentracion_hemoglobina	temperatura_ambiente	\
count	1745.00	1745.00	1745.00	1745.00	
mean	1.60	47.58	14.23	21.42	
std	0.49	14.30	1.17	3.01	
min	1.00	4.00	5.50	2.00	
25%	1.00	37.00	14.20	22.00	
50%	2.00	49.00	14.20	22.00	
75%	2.00	58.00	14.20	22.00	
max	2.00	93.00	19.90	35.00	

	valor_acido_urico	valor_albumina	valor_colesterol_hdl	\
count	1745.00	1745.00	1745.00	
mean	4.80	3.88	36.32	
std	0.81	0.44	9.71	
min	0.20	1.00	13.00	
25%	4.80	4.00	34.00	
50%	4.80	4.00	34.00	
75%	4.80	4.00	34.00	
max	11.00	5.30	279.00	

	valor_colesterol_ldl	valor_colesterol_total	valor_creatina	…	\
count	1745.00	1745.00	1745.00	…	
mean	87.68	143.78	0.62	…	
std	16.93	25.28	0.22	…	
min	11.10	41.00	0.28	…	
25%	86.00	139.00	0.58	…	
50%	86.00	139.00	0.58	…	
75%	86.00	139.00	0.58	…	
max	200.00	292.00	8.27	…	

	medida_cintura	segundamedicion_peso	segundamedicion_estatura	\
count	1745.00	1745.00	1745.00	
mean	67.39	65.67	153.79	
std	46.60	7.56	8.49	
min	0.00	2.00	0.00	
25%	0.00	64.70	154.00	
50%	89.40	64.70	154.00	

```
75%           101.10                64.70                    154.00
max           152.10               126.40                    182.60

       distancia_rodilla_talon  circunferencia_de_la_pantorrilla  \
count                  1745.00                           1745.00
mean                     48.48                             34.04
std                       3.57                              4.29
min                       0.00                              0.00
25%                      48.50                             33.50
50%                      48.50                             33.50
75%                      48.50                             33.50
max                      97.30                            102.30

       segundamedicion_cintura  tension_arterial  sueno_horas  masa_corporal  \
count                  1745.00           1745.00      1745.00        1745.00
mean                     19.87            123.97         3.29          22.39
std                      40.34             22.85         3.45          12.40
min                       0.00              0.00         1.00           1.00
25%                       0.00            111.00         2.00          19.55
50%                       0.00            122.00         3.00          26.05
75%                       0.00            136.00         4.00          30.36
max                     165.00            200.00        99.00          60.51

       actividad_total
count          1745.00
mean            485.30
std             753.21
min              10.00
25%             240.00
50%             380.00
75%             580.00
max           17820.00

[8 rows x 34 columns]

Feature: sexo

     Absolute frequency Relative frequency Accumulated frequency Accumulated %
sexo
2                 1,051             60.23%                 1,051         60.23%
1                   694             39.77%                 1,745        100.00%
```

1.3.1 Detección y remoción de variables poco pobladas

para valores con cantidad de valores nulos $> 65\%$

```
No hay variables con valores nulos > 65%
```

1.3.2 Detección y remoción de variables unitarias

cuando el 90% de la información se agrupe dentro de una sola variable

`No hay variables unitarias`

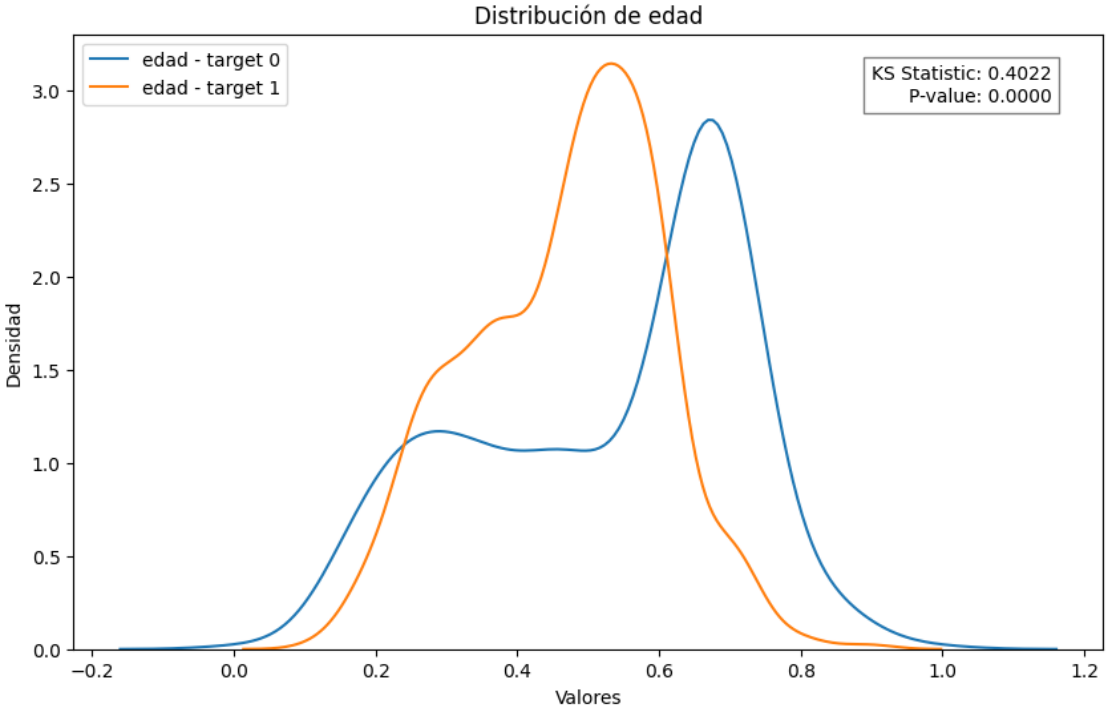
1.3.3 Transformación de los datos

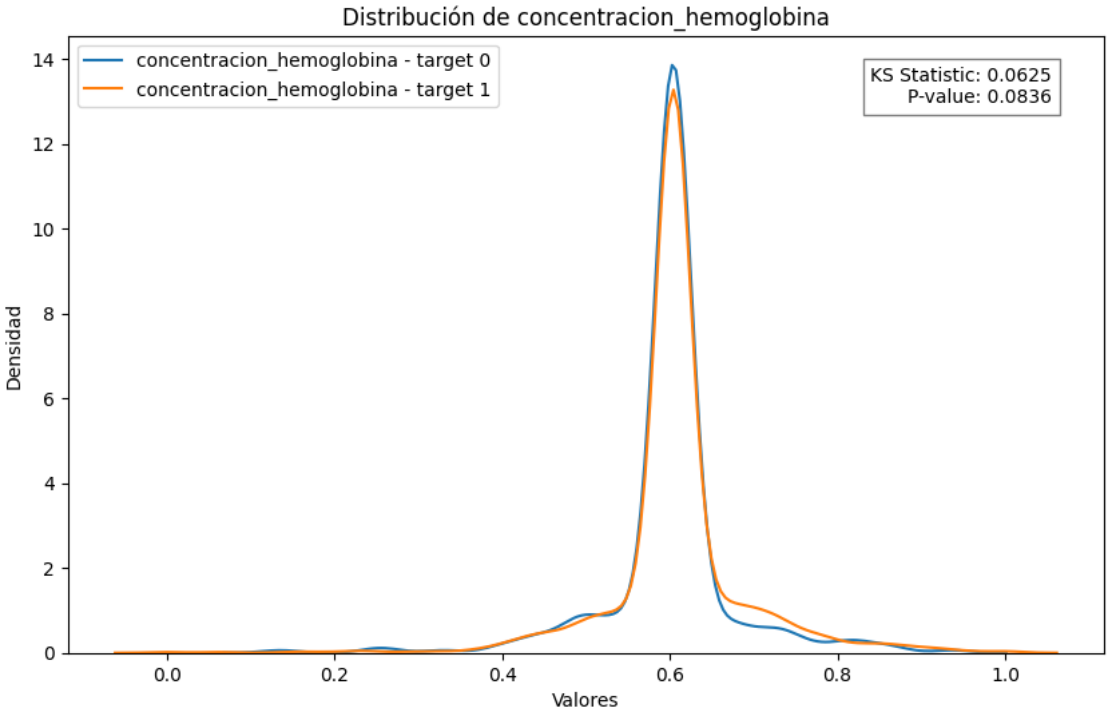
Detección y tratamiento de valores ausentes y escalamiento 1. Númericas: - MixMaxScaler - SimpleImputer(strategy="median") 2. Categoricas: - SimpleImputer(strategy="most_frequent") - OneHotEncoder(drop="first", handle_unknown="ignore")

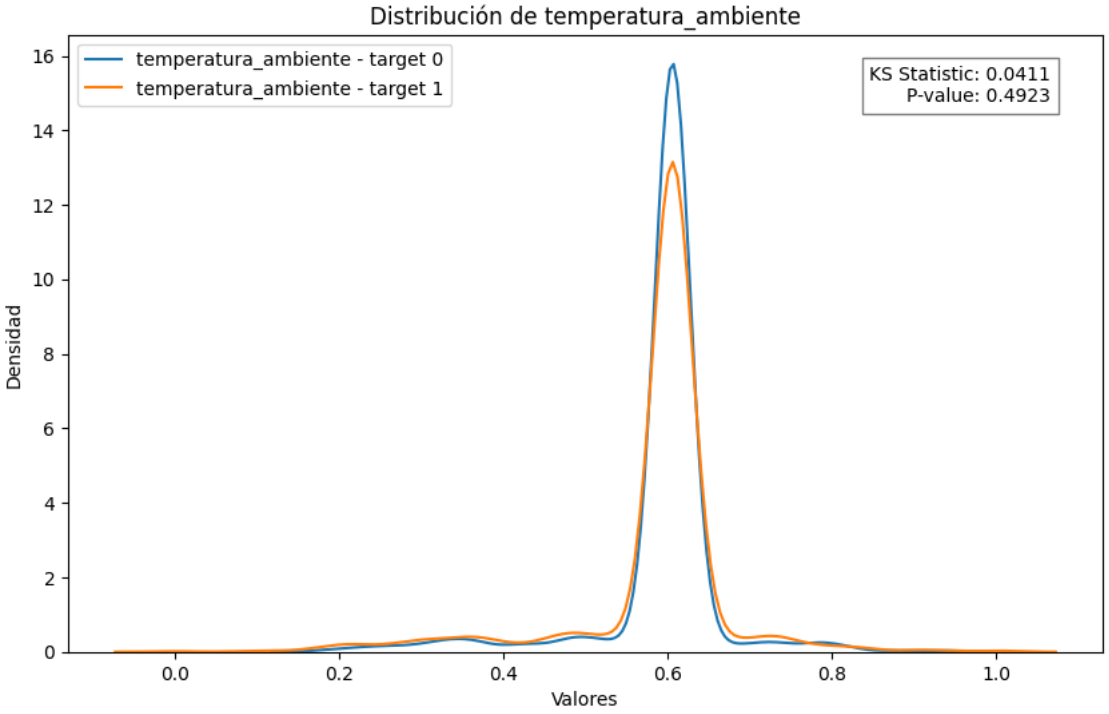
1.4 Análisis

1.4.1 Distribuciones de las características

por categoría




Distribución de concentracion_hemoglobina
concentracion_hemoglobina - target 0
concentracion_hemoglobina - target 1
KS Statistic: 0.0625
P-value: 0.0836
Densidad
Valores
0
2
4
6
8
10
12
14
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de temperatura_ambiente
temperatura_ambiente - target 0
temperatura_ambiente - target 1
KS Statistic: 0.0411
P-value: 0.4923
Densidad
Valores
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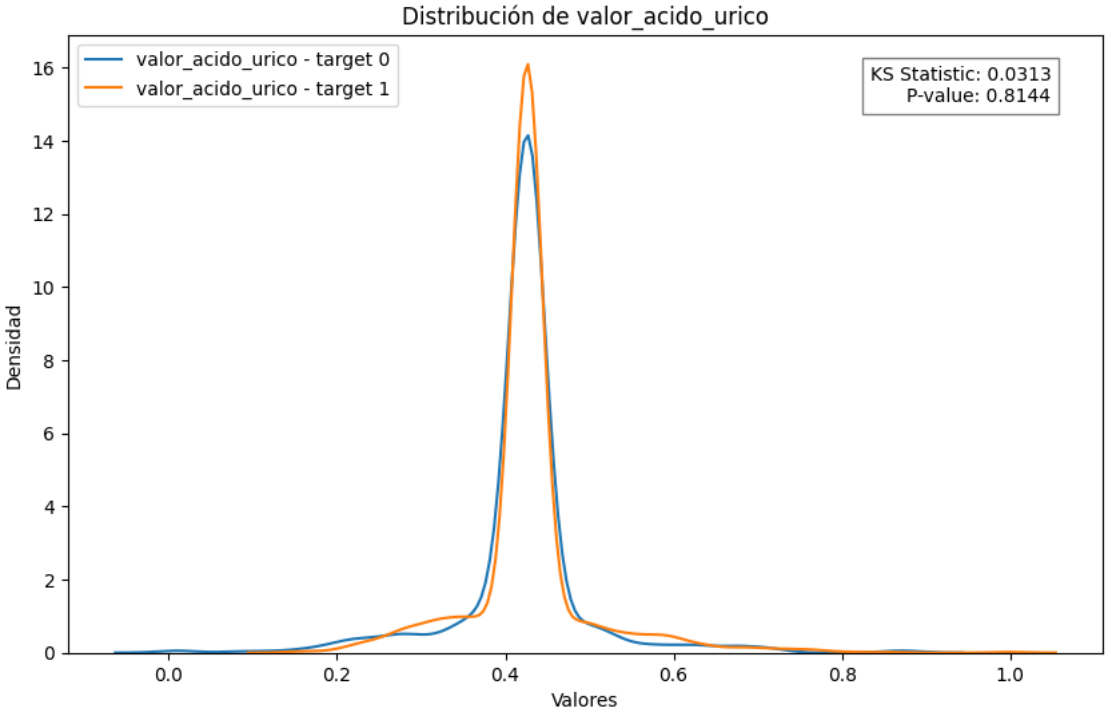
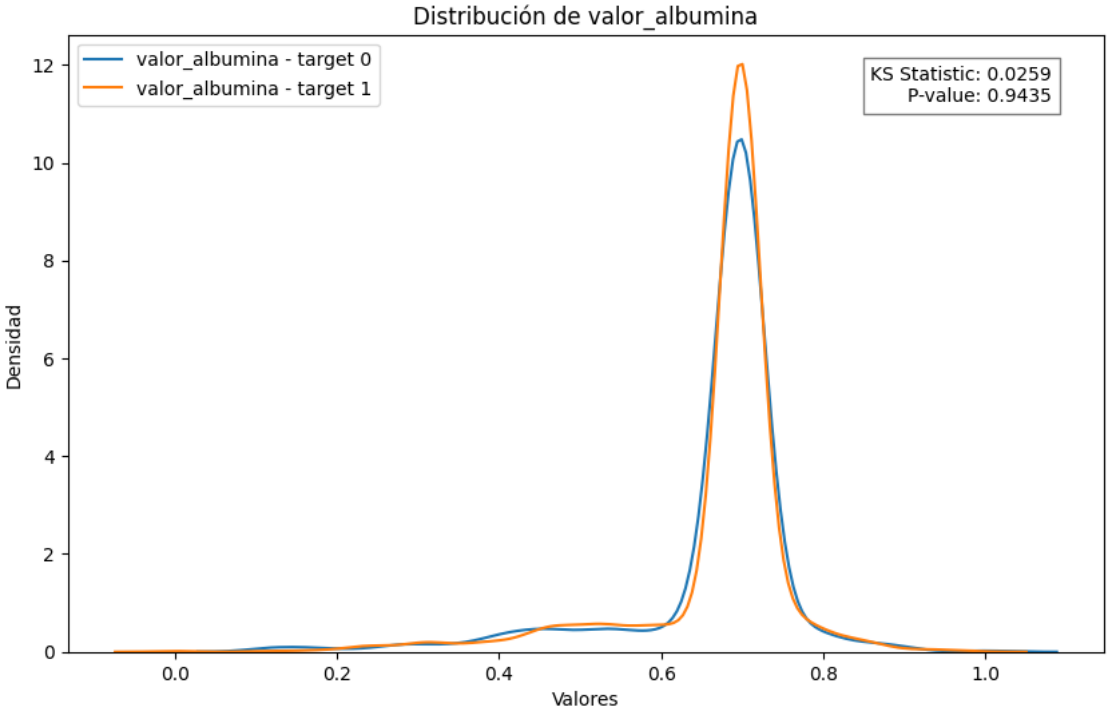
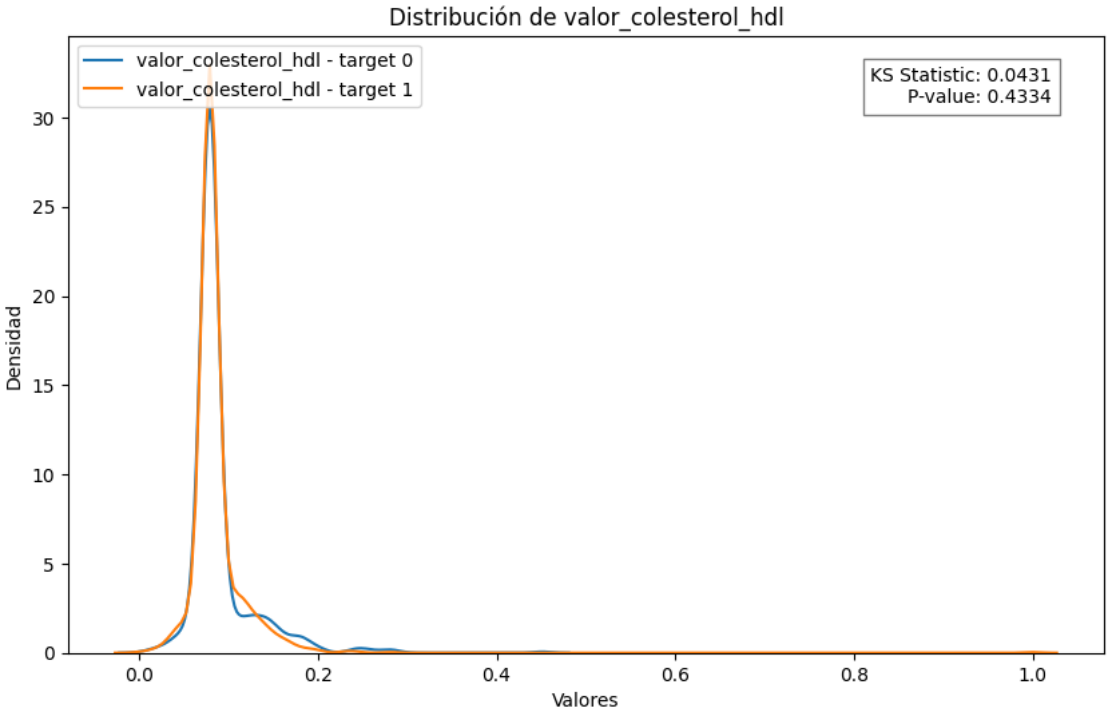
2
4
6
8
10
12
14
16
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_acido_urico
valor_acido_urico - target 0
valor_acido_urico - target 1
KS Statistic: 0.0313
P-value: 0.8144
Densidad
Valores
0
2
4
6
8
10
12
14
16
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_albumina
valor_albumina - target 0
valor_albumina - target 1
KS Statistic: 0.0259
P-value: 0.9435
Densidad
Valores
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_colesterol_hdl
valor_colesterol_hdl - target 0
valor_colesterol_hdl - target 1
KS Statistic: 0.0431
P-value: 0.4334
Densidad
Valores
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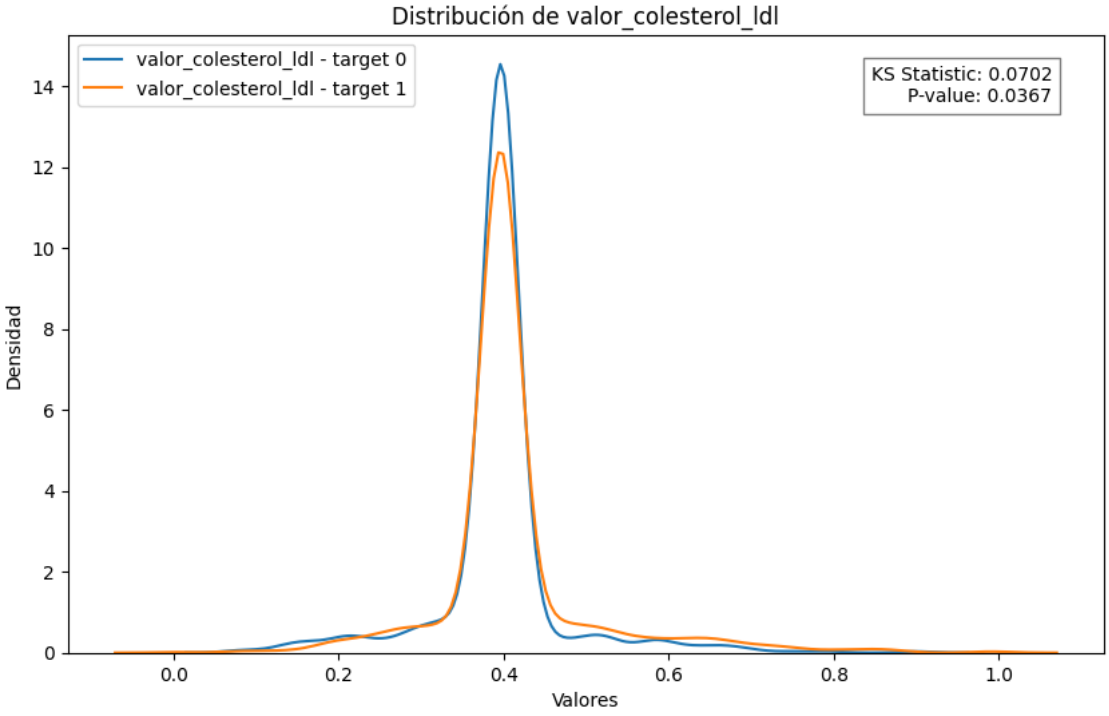
5
10
15
20
25
30
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_colesterol_ldl
valor_colesterol_ldl - target 0
valor_colesterol_ldl - target 1
KS Statistic: 0.0702
P-value: 0.0367
Densidad
Valores
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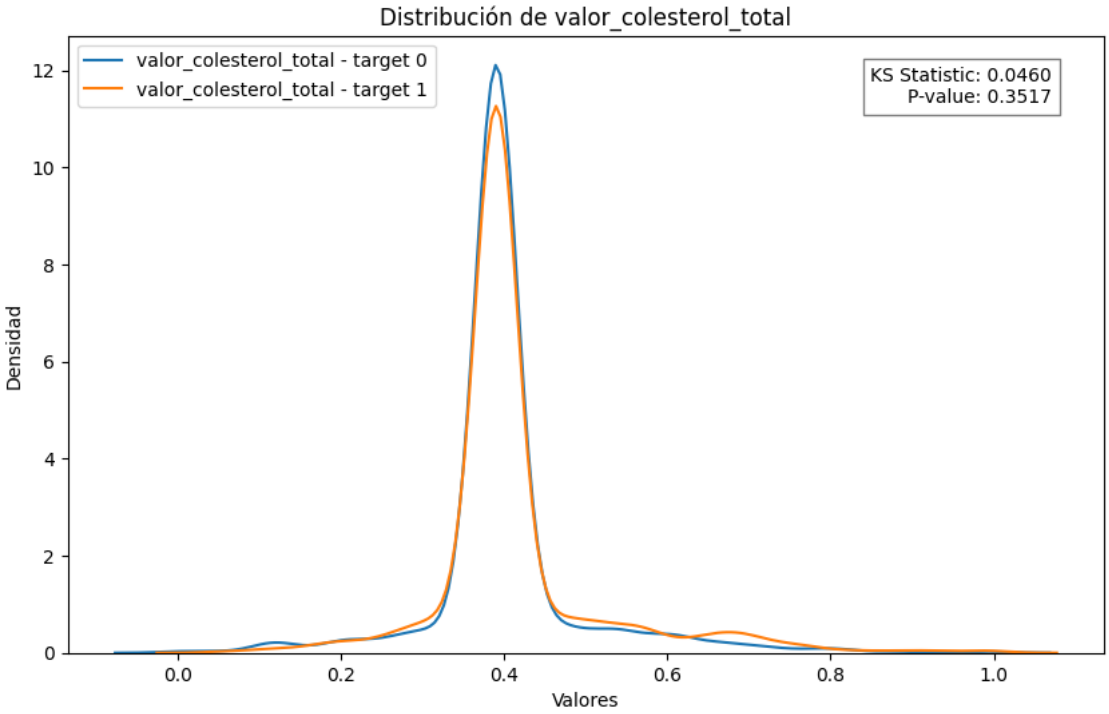
2
4
6
8
10
12
14
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_colesterol_total
valor_colesterol_total - target 0
valor_colesterol_total - target 1
KS Statistic: 0.0460
P-value: 0.3517
Densidad
Valores
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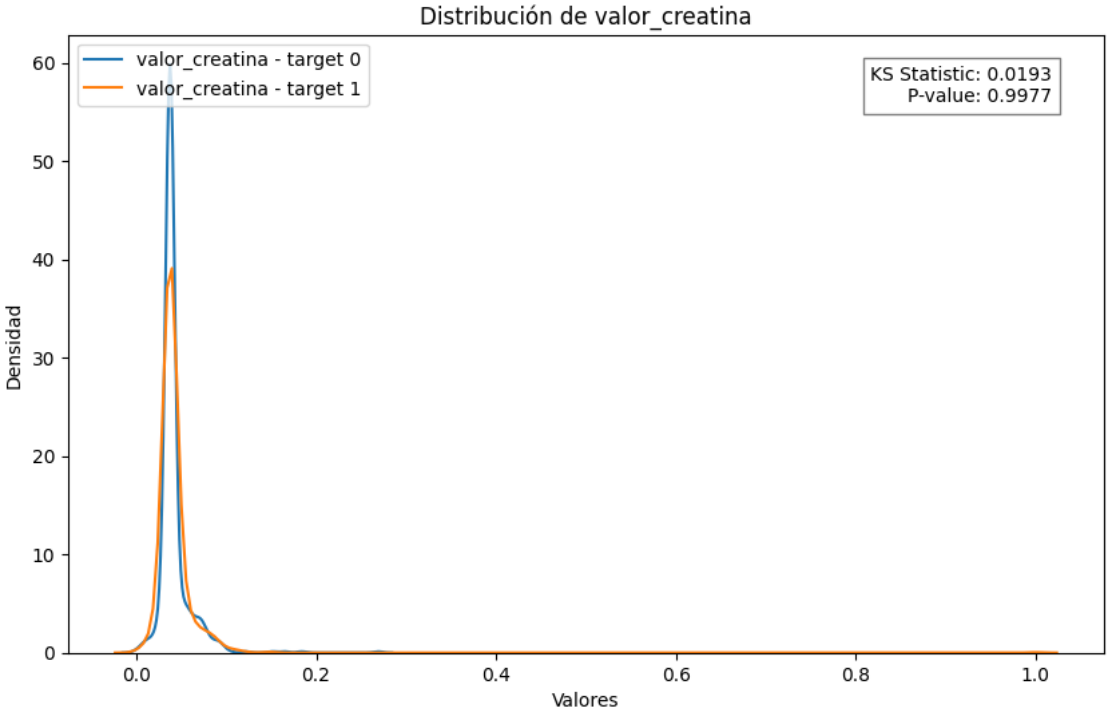
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de valor_creatina
valor_creatina - target 0
valor_creatina - target 1
KS Statistic: 0.0193
P-value: 0.9977
Densidad
Valores
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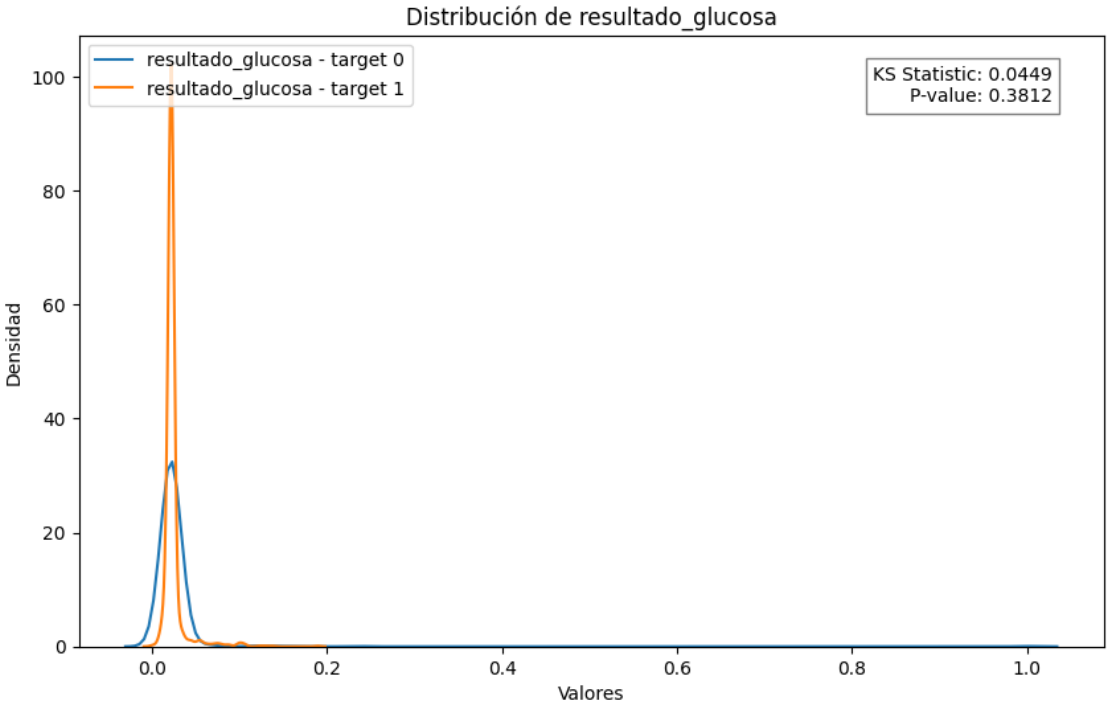
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de resultado_glucosa
resultado_glucosa - target 0
resultado_glucosa - target 1
KS Statistic: 0.0449
P-value: 0.3812
Densidad
Valores
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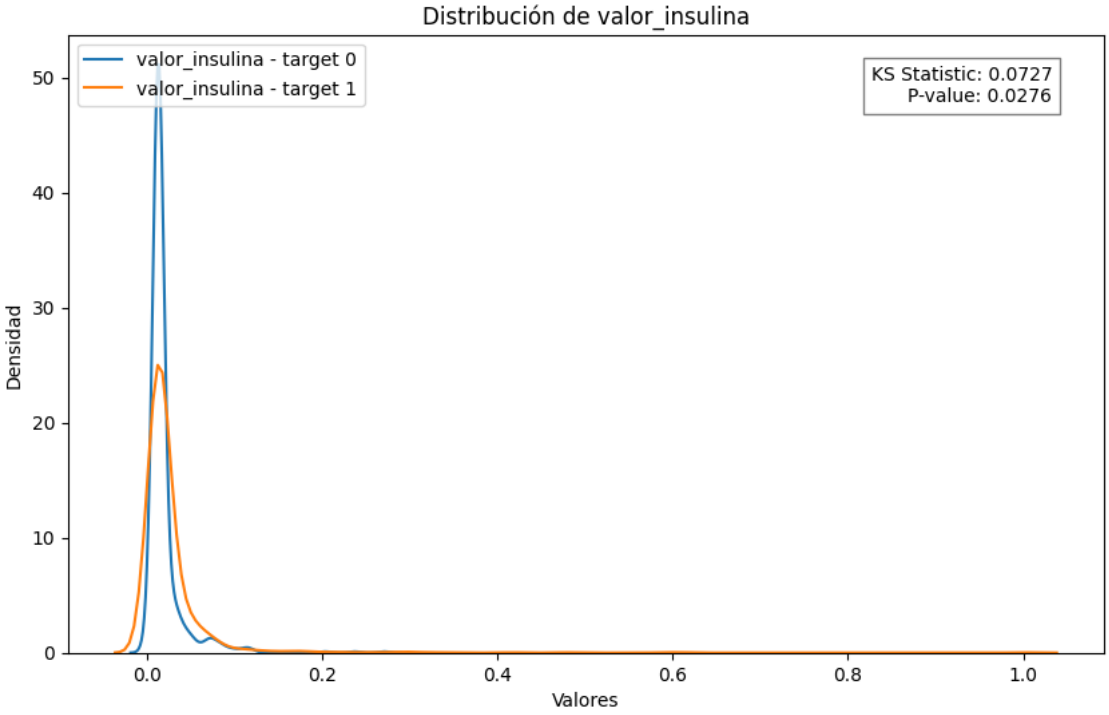
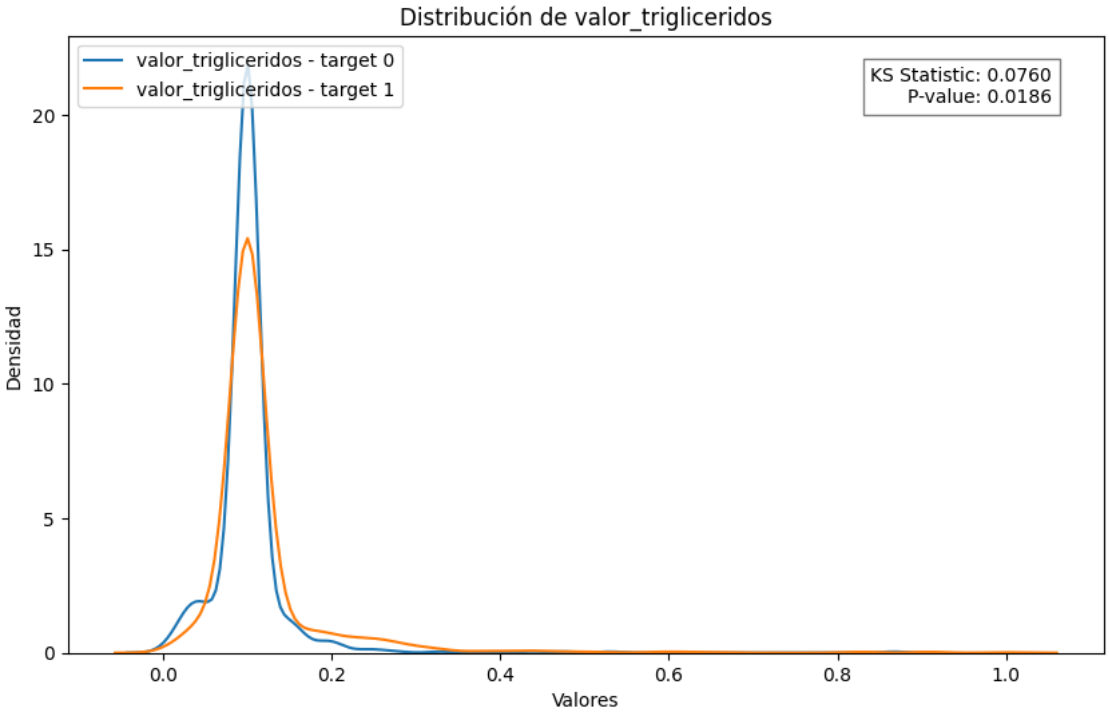
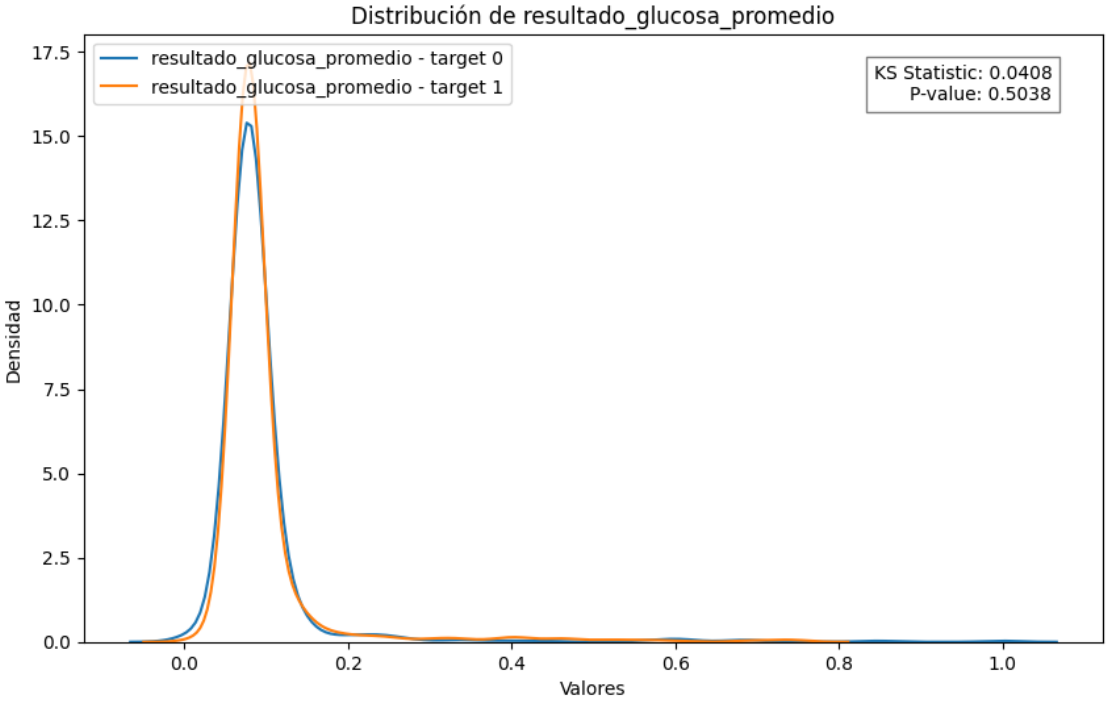
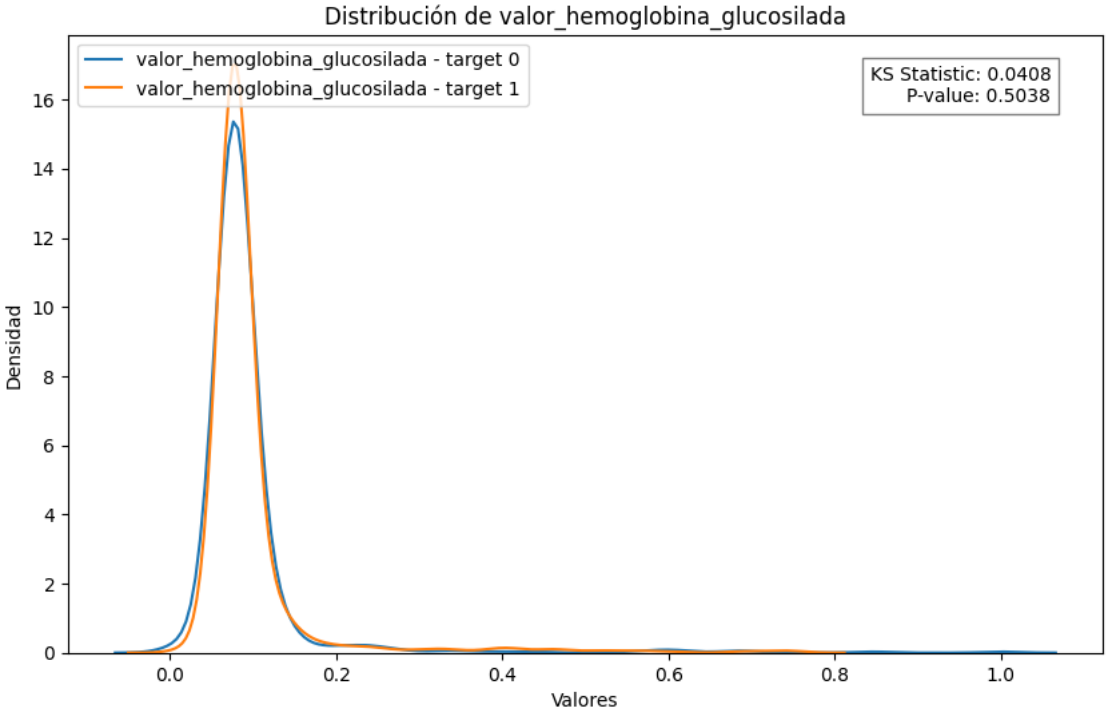
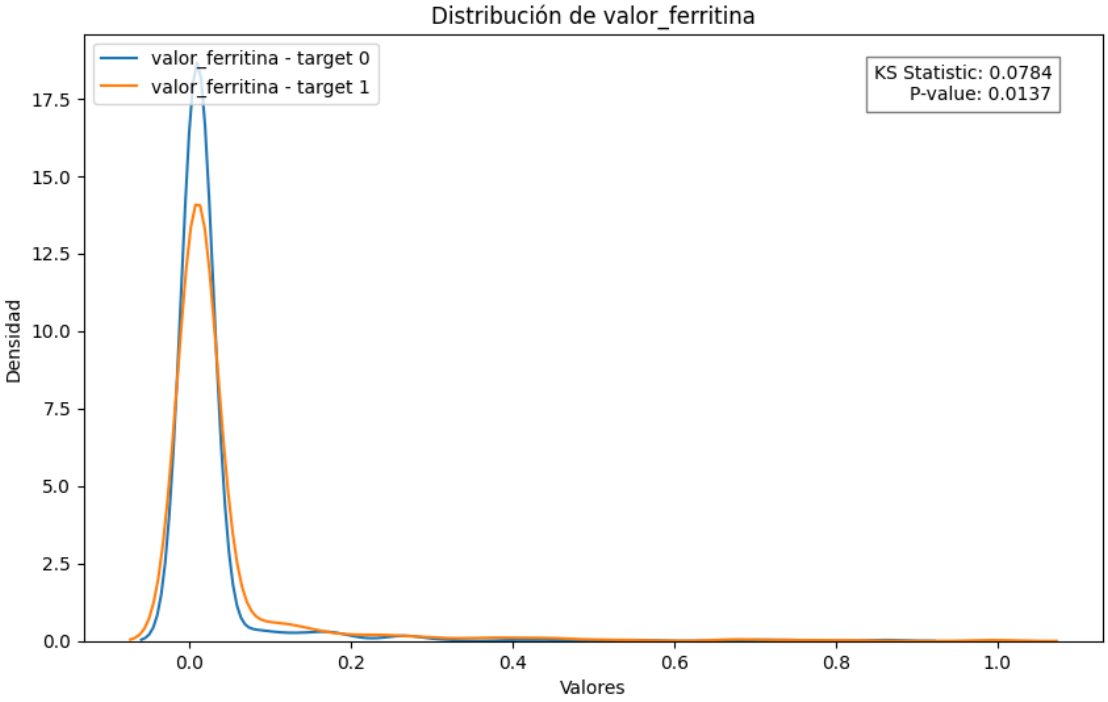
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0

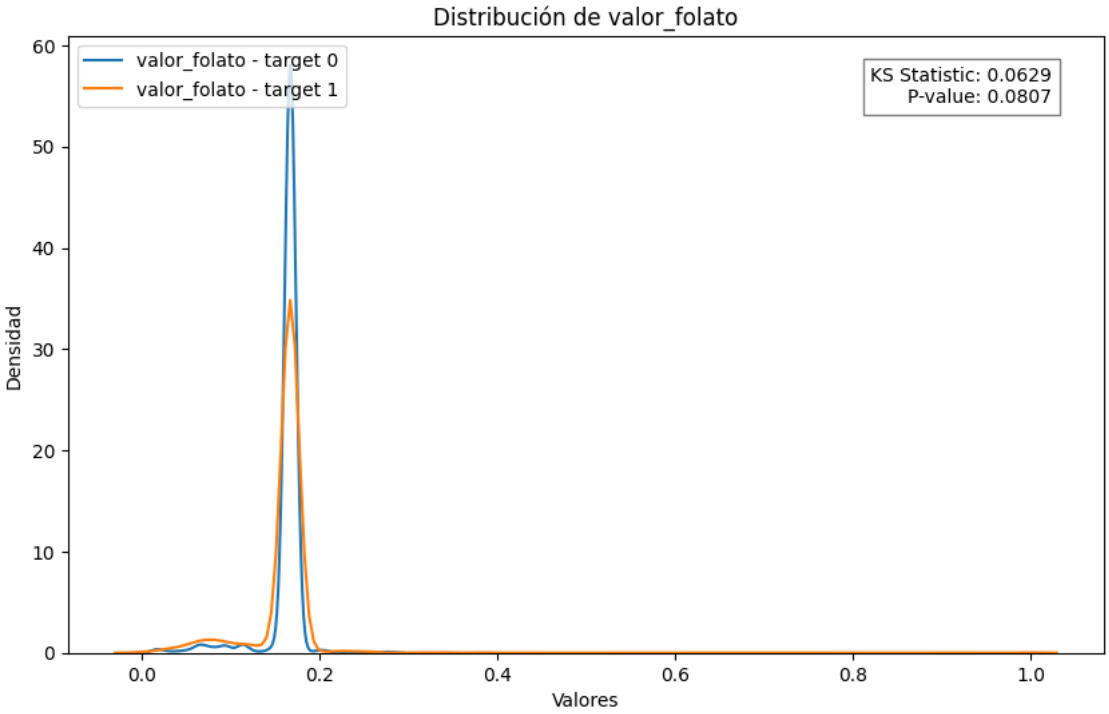

Distribución de valor_insulina
valor_insulina - target 0
valor_insulina - target 1
KS Statistic: 0.0727
P-value: 0.0276
Densidad
Valores
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0

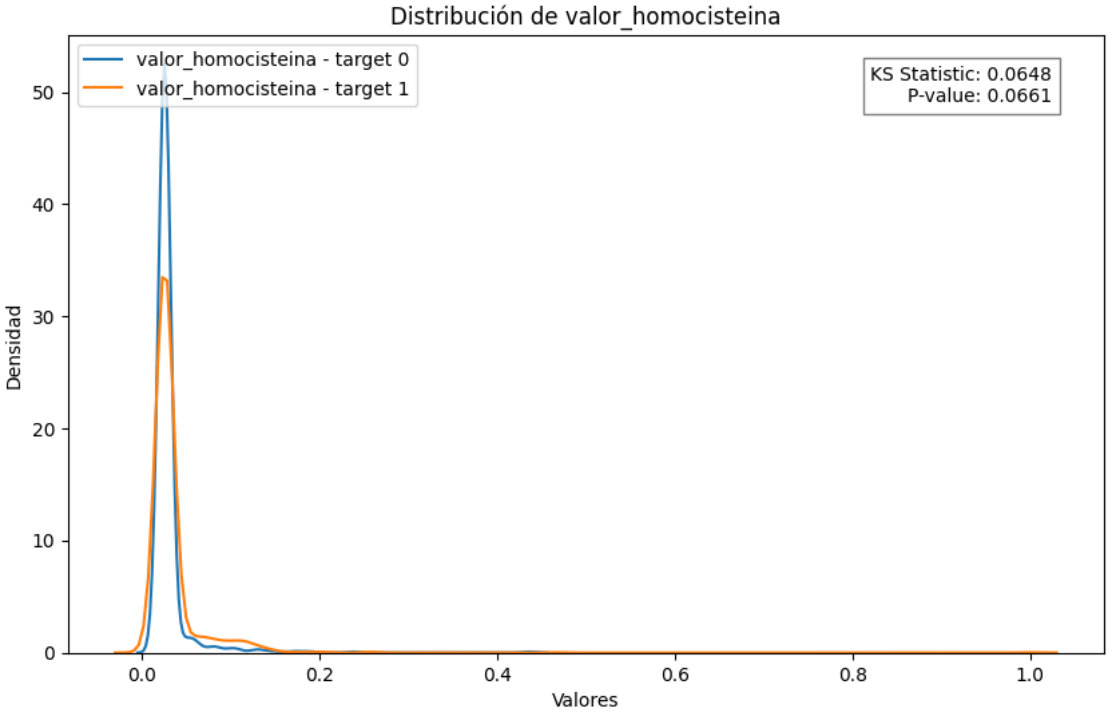

Distribución de valor_triglicéridos
valor_triglicéridos - target 0
valor_triglicéridos - target 1
KS Statistic: 0.0760
P-value: 0.0186
Densidad
Valores
0
5
10
15
20
0.0
0.2
0.4
0.6
0.8
1.0

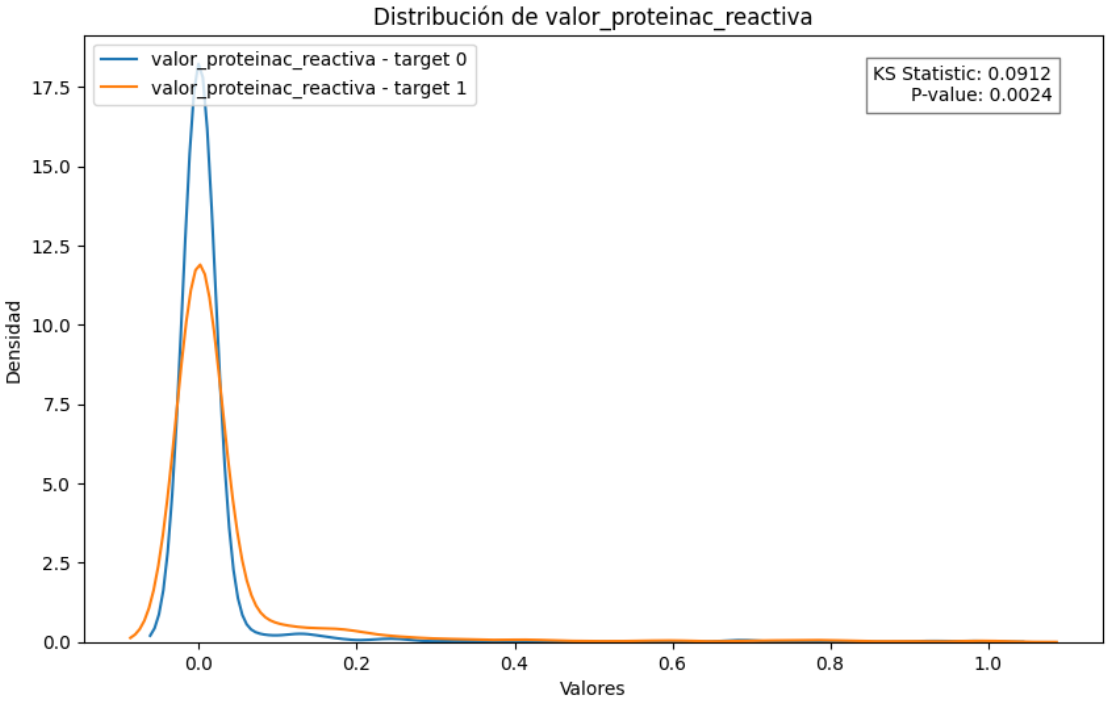

Distribución de resultado_glucosa_promedio
resultado_glucosa_promedio - target 0
resultado_glucosa_promedio - target 1
KS Statistic: 0.0408
P-value: 0.5038
Densidad
Valores
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0.0
0.2
0.4
0.6
0.8
1.0

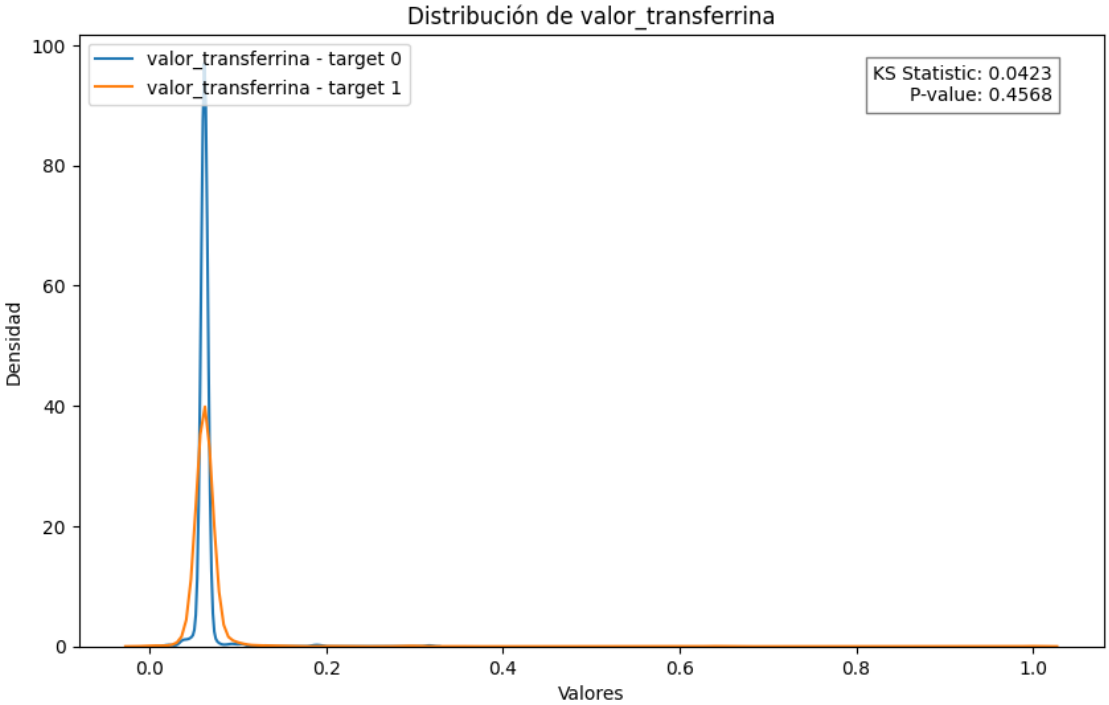

Distribución de valor_hemoglobina_glucosilada
valor_hemoglobina_glucosilada - target 0
valor_hemoglobina_glucosilada - target 1
KS Statistic: 0.0408
P-value: 0.5038
Densidad
Valores
0
2
4
6
8
10
12
14
16
0.0
0.2
0.4
0.6
0.8
1.0

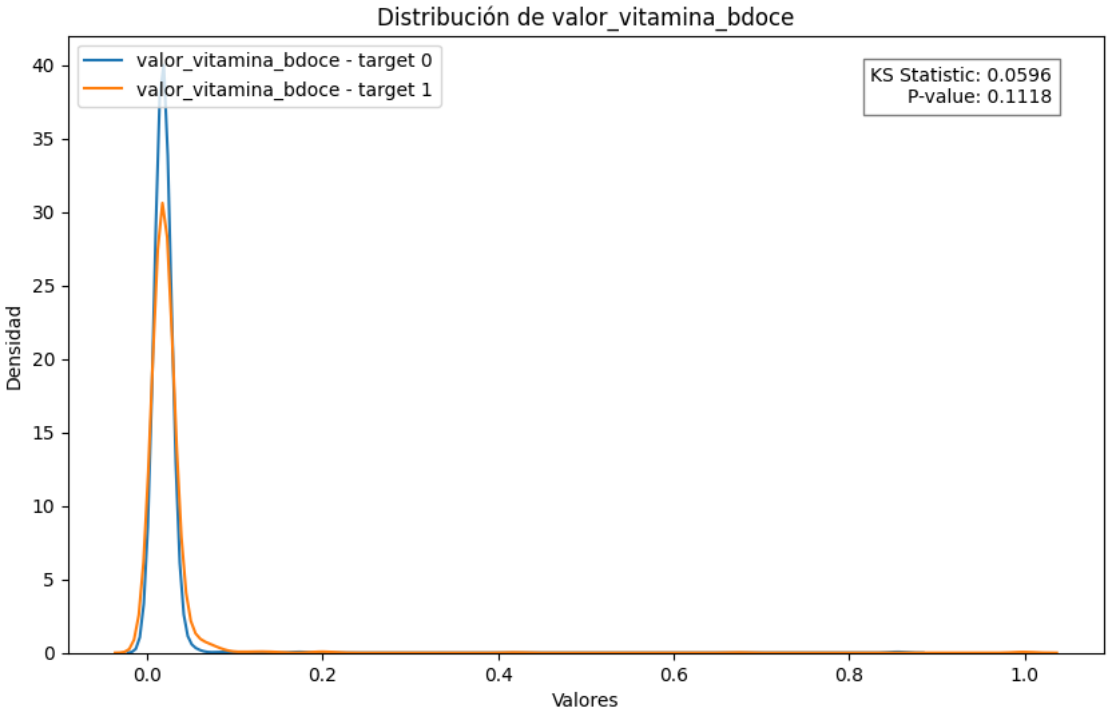

Distribución de valor_ferritina
valor_ferritina - target 0
valor_ferritina - target 1
KS Statistic: 0.0784
P-value: 0.0137
Densidad
Valores
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0.0
0.2
0.4
0.6
0.8
1.0

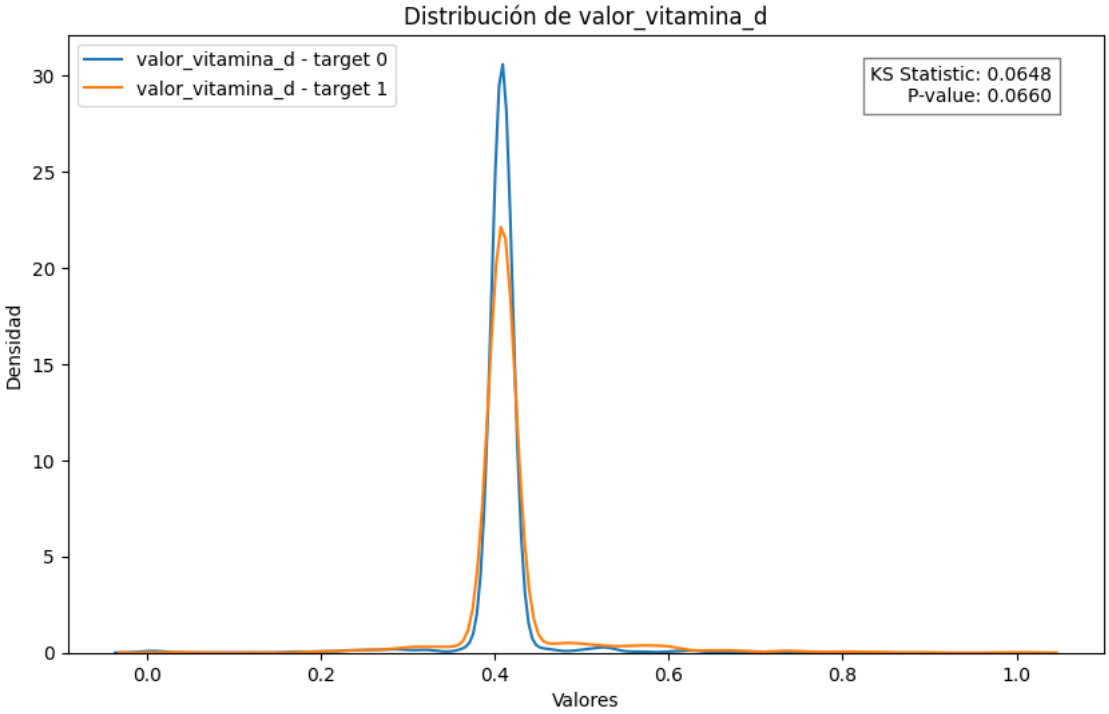

Distribución de valor_folato
valor_folato - target 0
valor_folato - target 1
KS Statistic: 0.0629
P-value: 0.0807
Densidad
Valores
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0

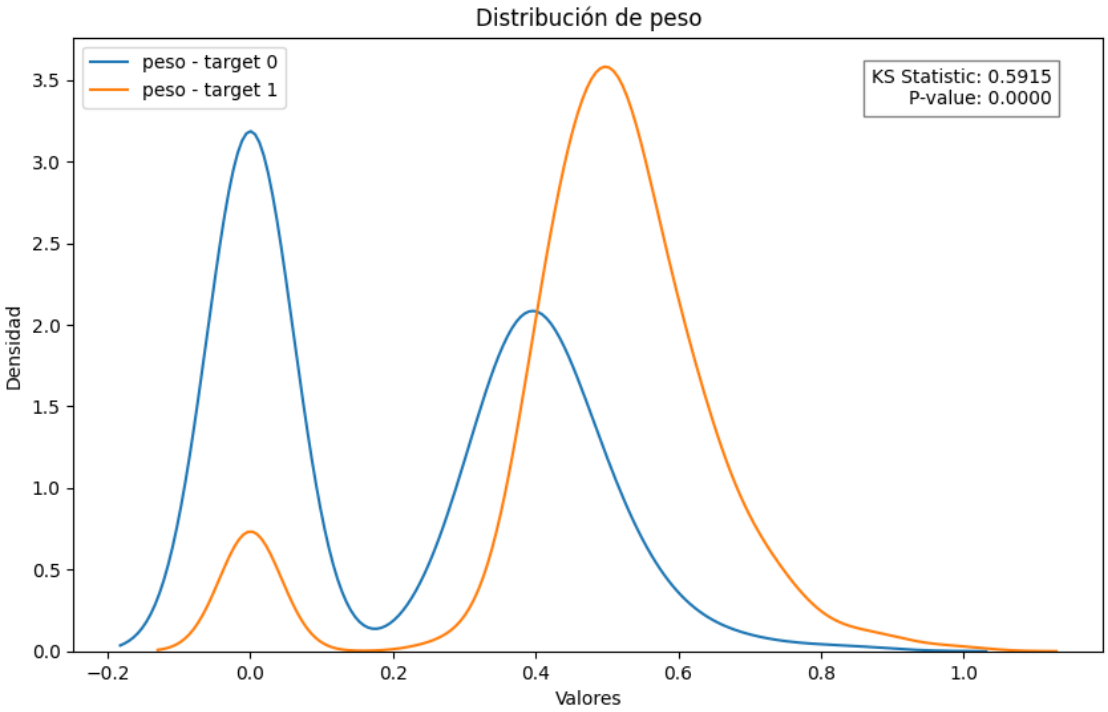

Distribución de valor_homocisteina
valor_homocisteina - target 0
valor_homocisteina - target 1
KS Statistic: 0.0648
P-value: 0.0661
Densidad
Valores
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0

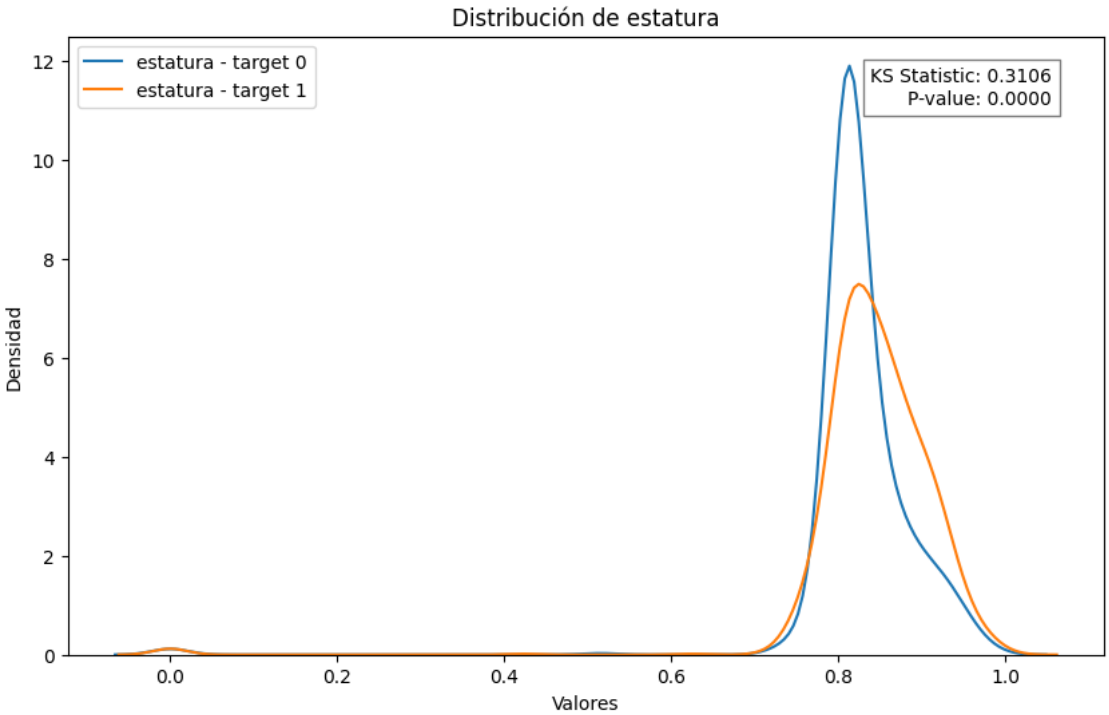

Distribución de valor_proteinac_reactiva
valor_proteinac_reactiva - target 0
valor_proteinac_reactiva - target 1
KS Statistic: 0.0912
P-value: 0.0024
Densidad
Valores
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0.0
0.2
0.4
0.6
0.8
1.0

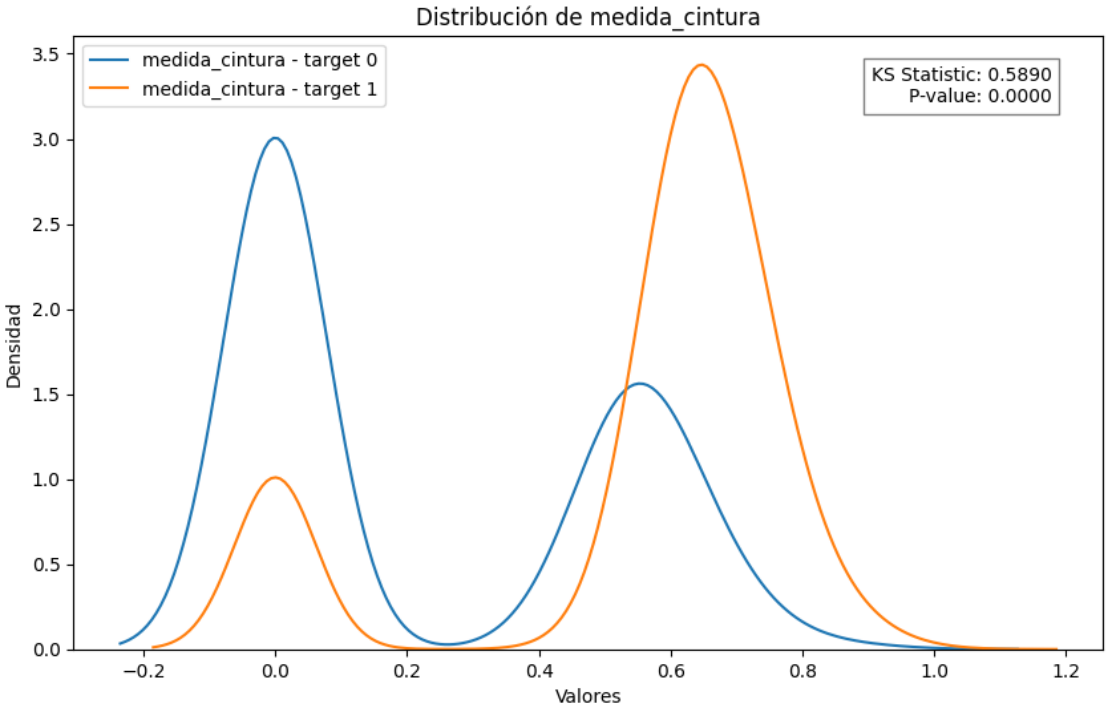

Distribución de valor_transferrina
valor_transferrina - target 0
valor_transferrina - target 1
KS Statistic: 0.0423
P-value: 0.4568
Densidad
Valores
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0

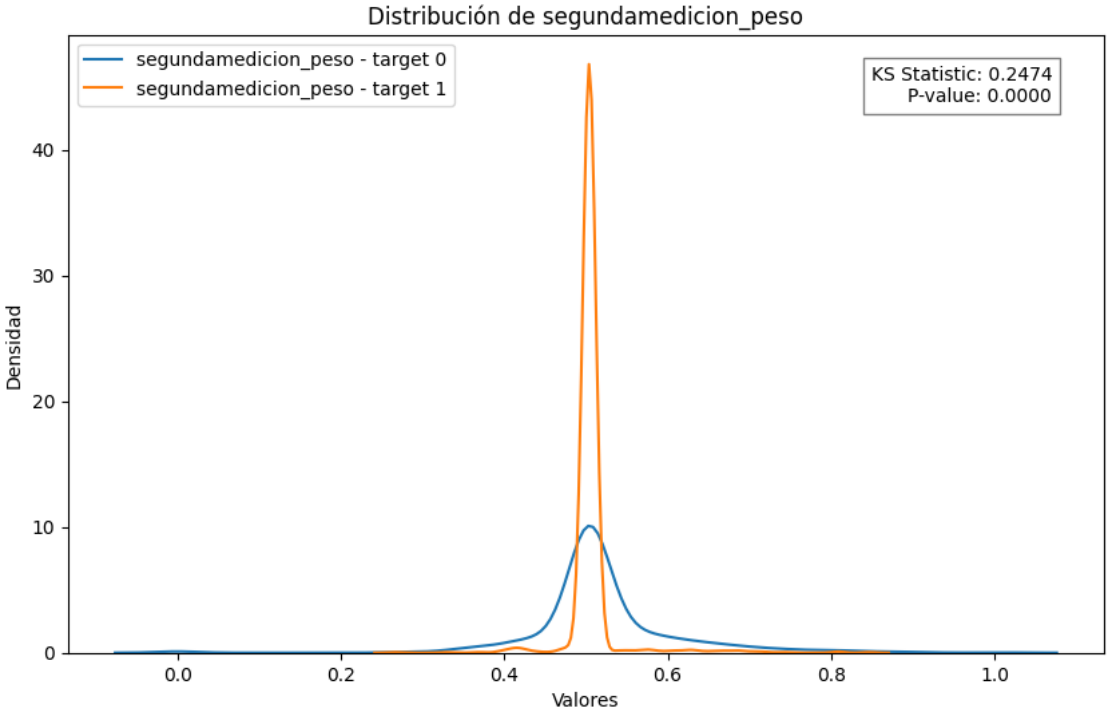

Distribución de valor_vitamina_bdoce
valor_vitamina_bdoce - target 0
valor_vitamina_bdoce - target 1
KS Statistic: 0.0596
P-value: 0.1118
Densidad
Valores
0
5
10
15
20
25
30
35
40
0.0
0.2
0.4
0.6
0.8
1.0

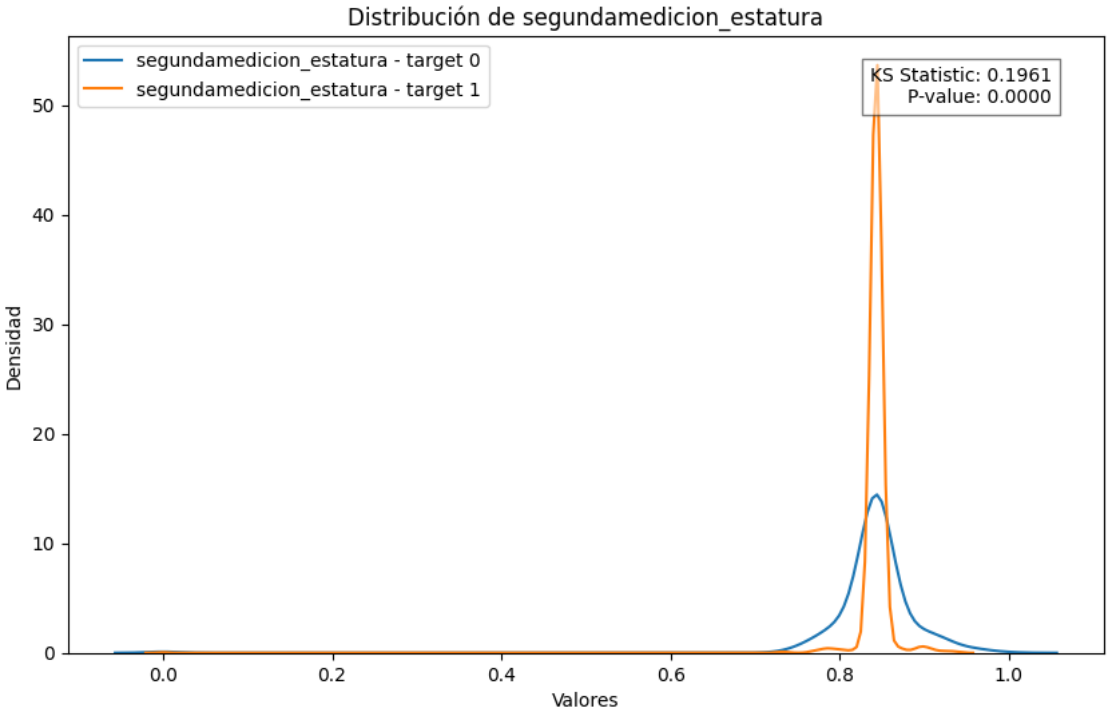

Distribución de valor_vitamina_d
valor_vitamina_d - target 0
valor_vitamina_d - target 1
KS Statistic: 0.0648
P-value: 0.0660
Densidad
Valores
0
5
10
15
20
25
30
0.0
0.2
0.4
0.6
0.8
1.0

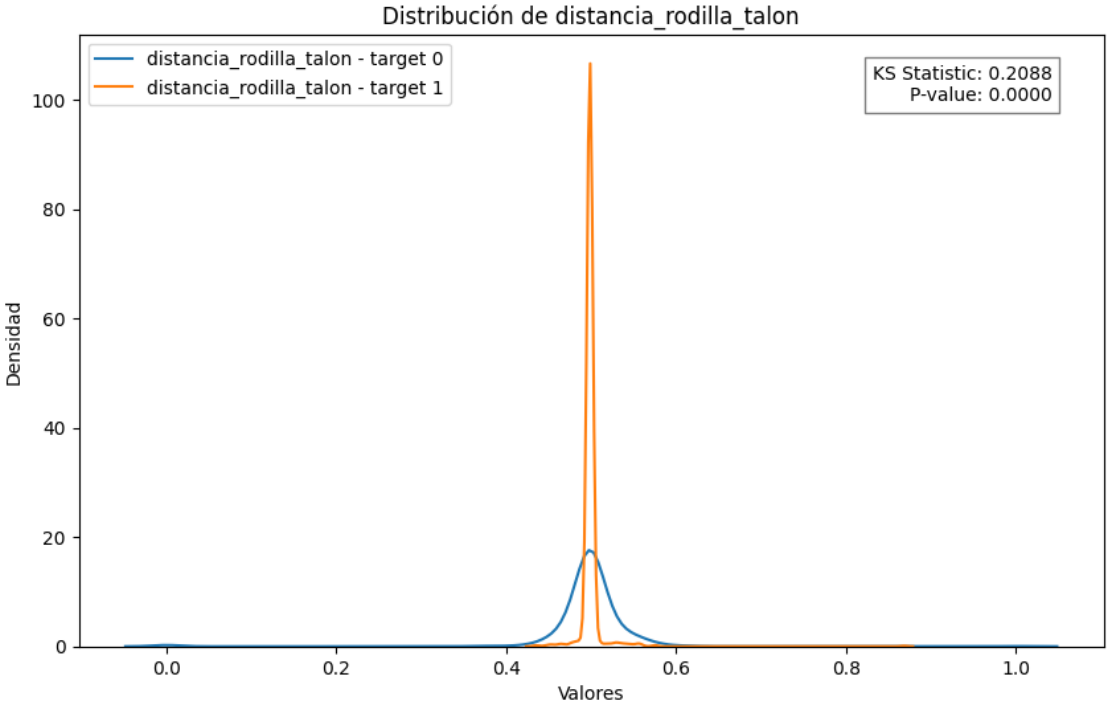

Distribución de peso
peso - target 0
peso - target 1
KS Statistic: 0.5915
P-value: 0.0000
Densidad
Valores
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
−0.2
0.0
0.2
0.4
0.6
0.8
1.0

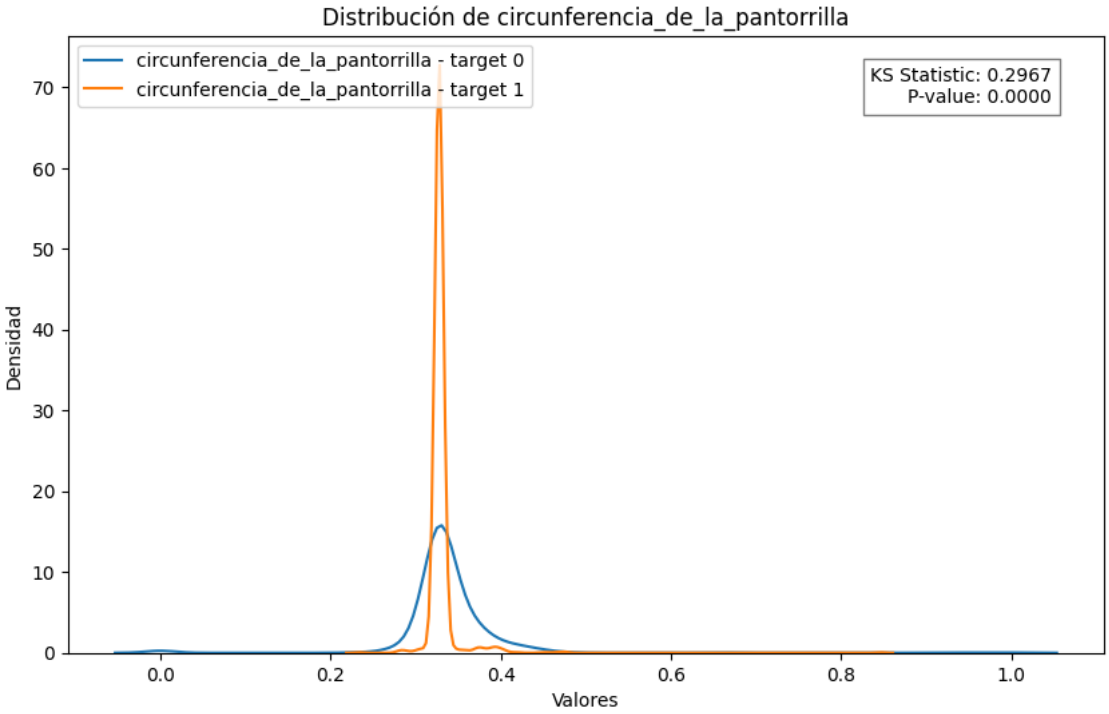

Distribución de estatura
estatura - target 0
estatura - target 1
KS Statistic: 0.3106
P-value: 0.0000
Densidad
Valores
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0

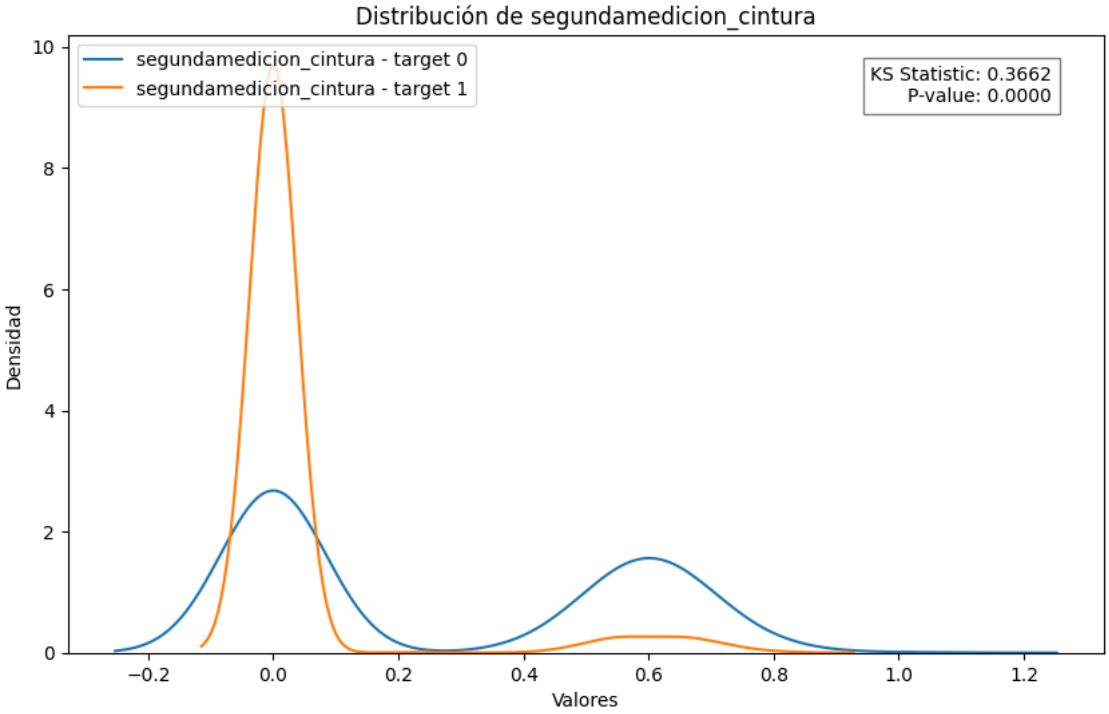

Distribución de medida_cintura
medida_cintura - target 0
medida_cintura - target 1
KS Statistic: 0.5890
P-value: 0.0000
Densidad
Valores

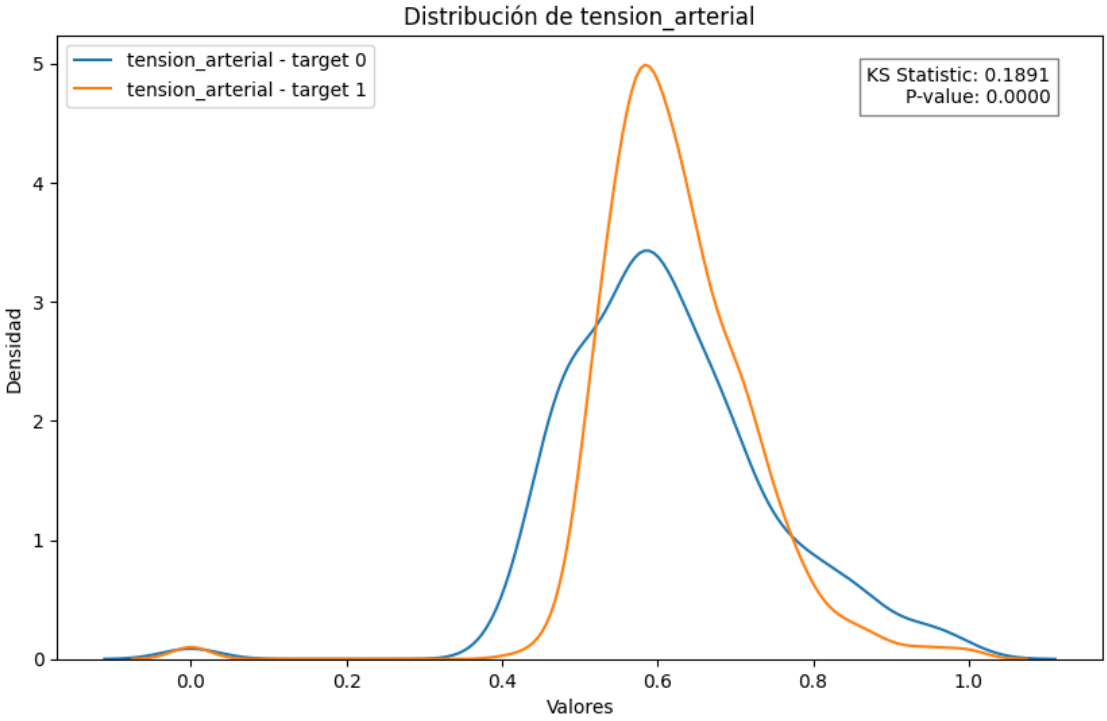

Distribución de segundamedicion_peso
segundamedicion_peso - target 0
segundamedicion_peso - target 1
KS Statistic: 0.2474
P-value: 0.0000
Densidad
Valores

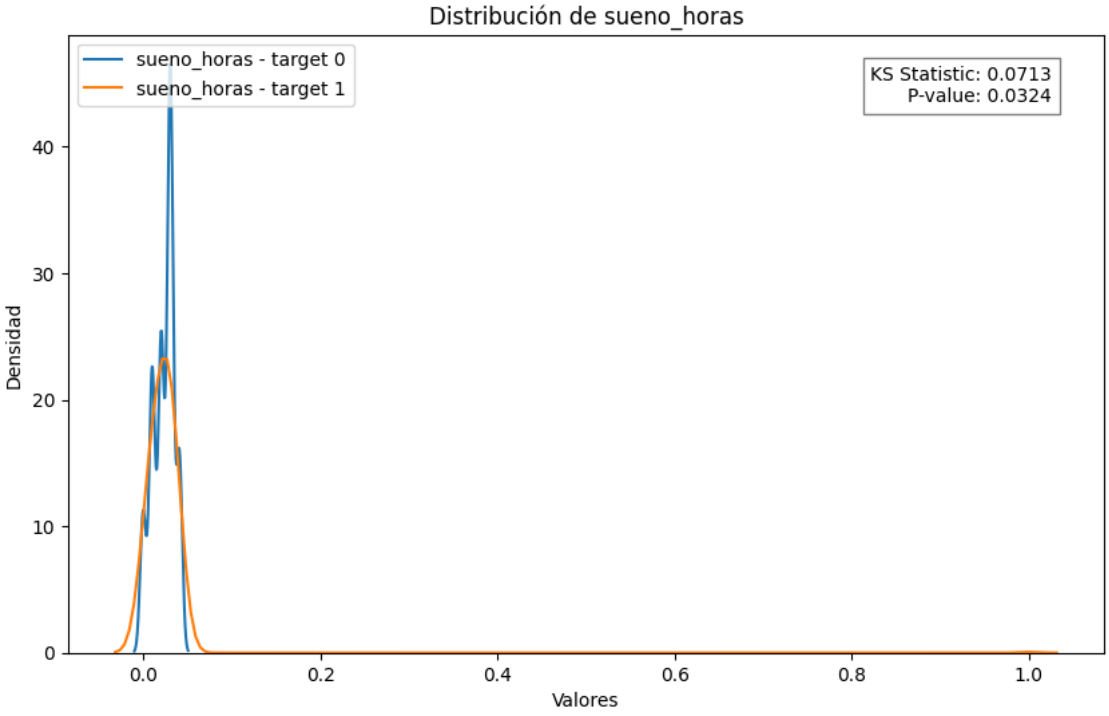

Distribución de segundamedicion_estatura
segundamedicion_estatura - target 0
segundamedicion_estatura - target 1
KS Statistic: 0.1961
P-value: 0.0000
Densidad
Valores
0
10
20
30
40
50
0.0
0.2
0.4
0.6
0.8
1.0

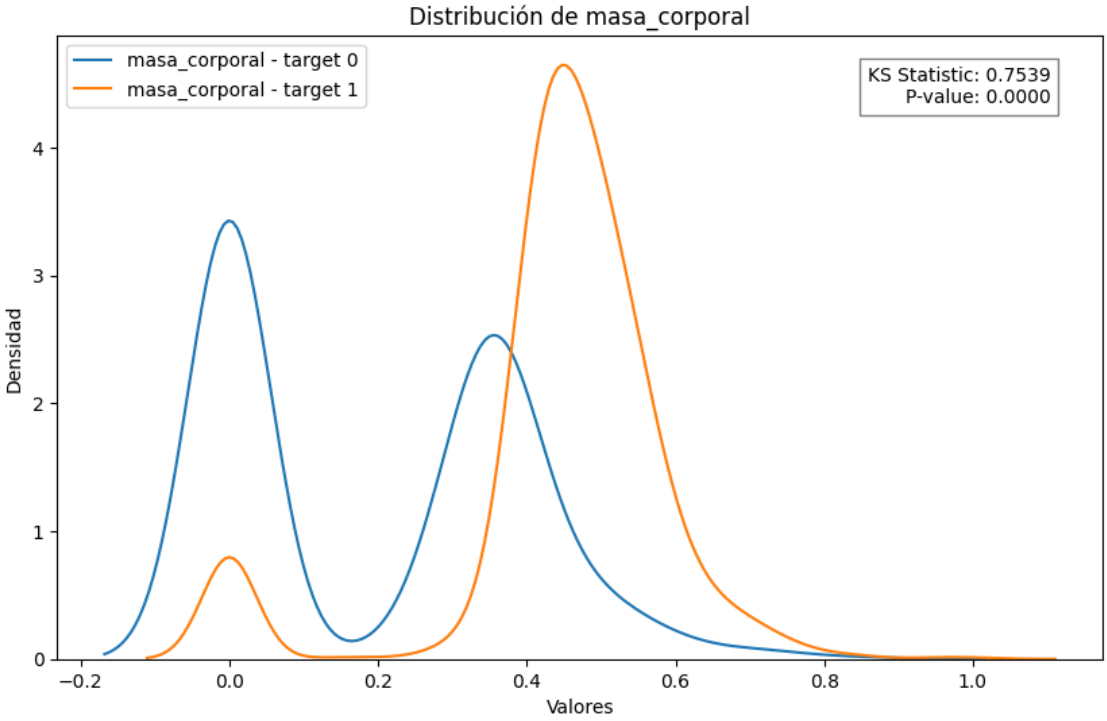

Distribución de distancia_rodilla_talon
distancia_rodilla_talon - target 0
distancia_rodilla_talon - target 1
KS Statistic: 0.2088
P-value: 0.0000
Densidad
Valores
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0

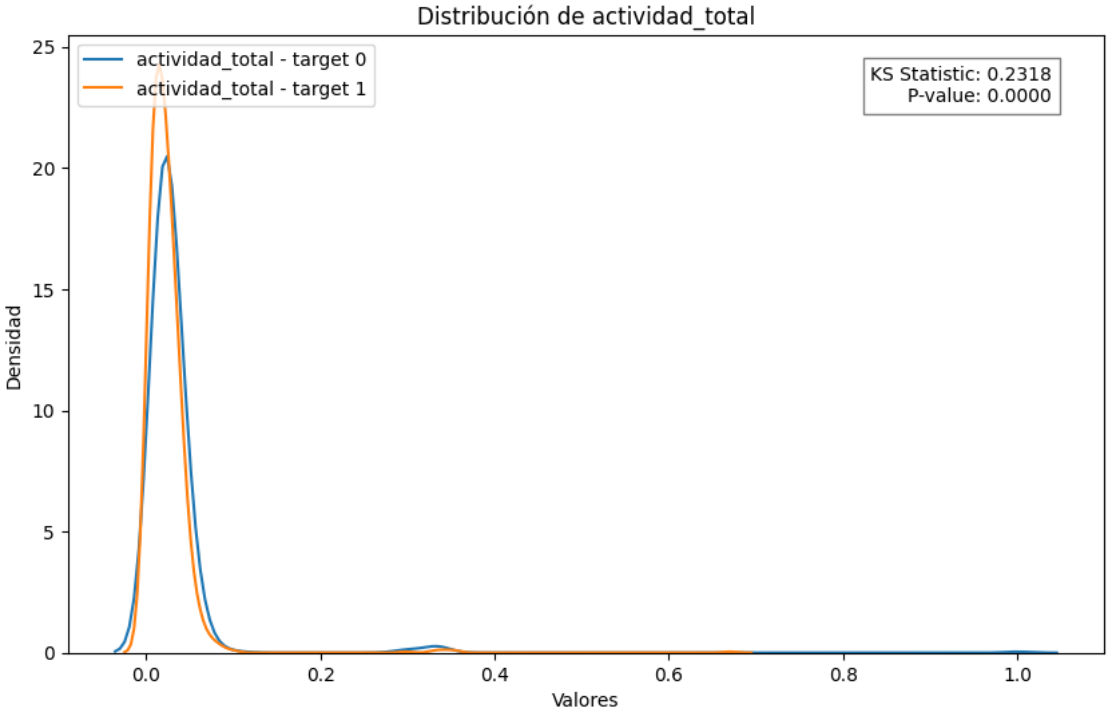

Distribución de circunferencia_de_la_pantorrilla
circunferencia_de_la_pantorrilla - target 0
circunferencia_de_la_pantorrilla - target 1
KS Statistic: 0.2967
P-value: 0.0000
Densidad
Valores
0
10
20
30
40
50
60
70
0.0
0.2
0.4
0.6
0.8
1.0

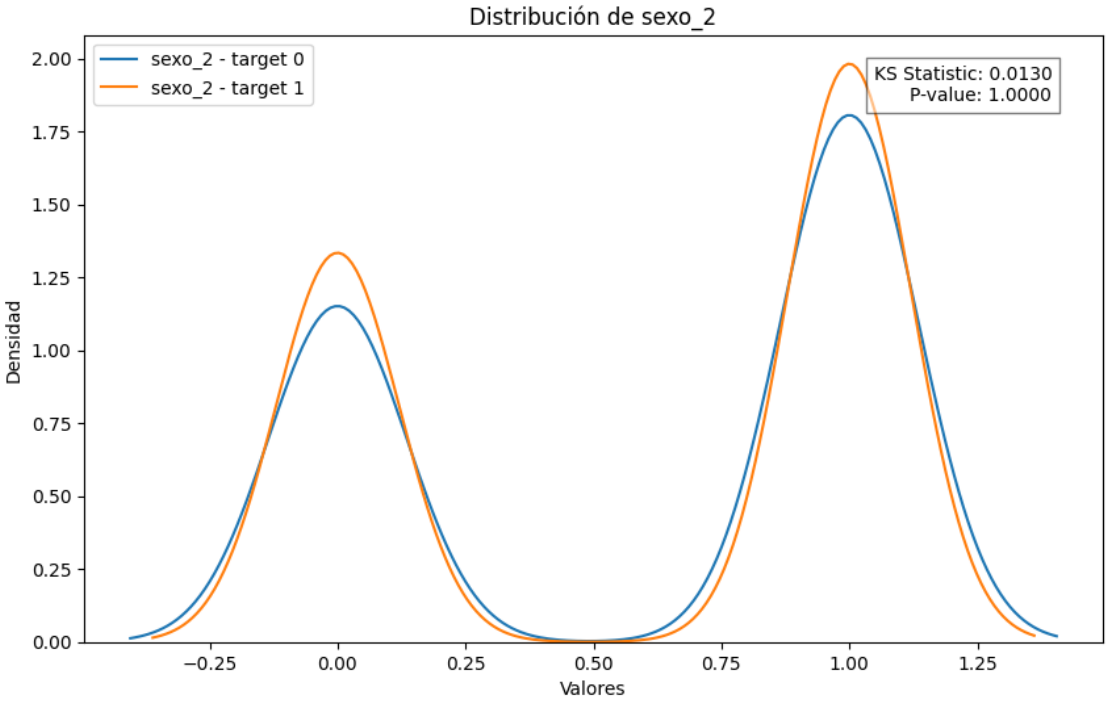

Distribución de segundamedicion_cintura
segundamedicion_cintura - target 0
segundamedicion_cintura - target 1
KS Statistic: 0.3662
P-value: 0.0000
Densidad
Valores
0
2
4
6
8
10
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2


Distribución de tension_arterial
tension_arterial - target 0
tension_arterial - target 1
KS Statistic: 0.1891
P-value: 0.0000
Densidad
Valores
0
1
2
3
4
5
0.0
0.2
0.4
0.6
0.8
1.0

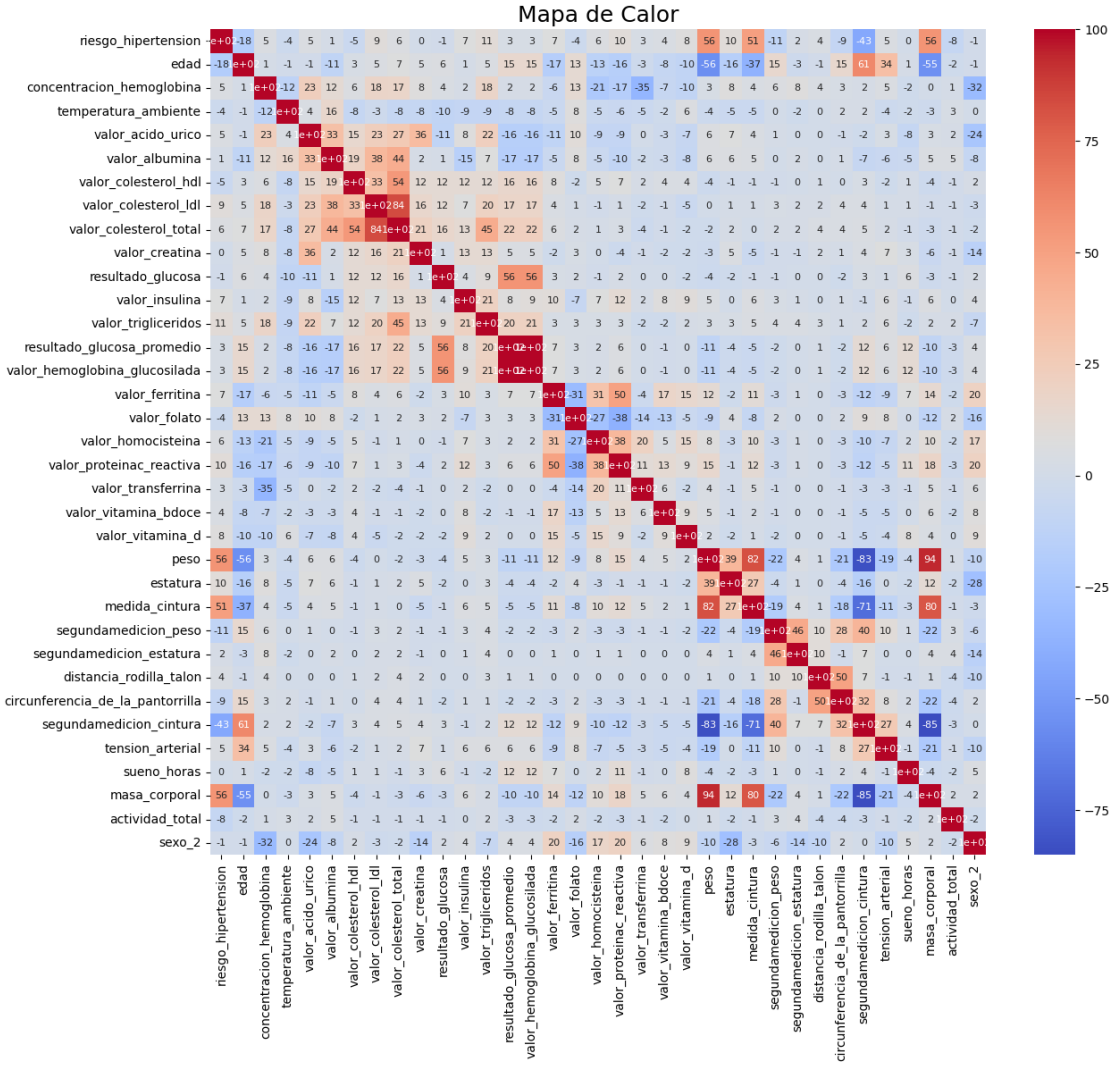

Distribución de sueno_horas
sueno_horas - target 0
sueno_horas - target 1
KS Statistic: 0.0713
P-value: 0.0324
Densidad
Valores
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de masa_corporal
masa_corporal - target 0
masa_corporal - target 1
KS Statistic: 0.7539
P-value: 0.0000
Densidad
Valores
0
1
2
3
4
−0.2
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de actividad_total
actividad_total - target 0
actividad_total - target 1
KS Statistic: 0.2318
P-value: 0.0000
Densidad
Valores
0
5
10
15
20
25
0.0
0.2
0.4
0.6
0.8
1.0


Distribución de sexo_2
sexo_2 - target 0
sexo_2 - target 1
KS Statistic: 0.0130
P-value: 1.0000
Densidad
Valores
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
−0.25
0.00
0.25
0.50
0.75
1.00
1.25

1.4.2 Correlación de las características



1.5 Modelo base

```
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
```

```
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-
packages/sklearn/neighbors/_classification.py:238: DataConversionWarning: A
column-vector y was passed when a 1d array was expected. Please change the shape
of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
```

```
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
```

```
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

```
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

	model	f1-score-train	std-dev	f1-score-test	roc-auc-test
0	knn	0.838397	0.0169	0.887227	0.91
1	svc	0.809724	0.0281	0.877858	0.92
2	logistic_regression	0.814890	0.0277	0.882751	0.91
3	xgb	0.989688	0.0088	0.992285	1.00

	model	f1-score-train	std-dev	f1-score-test	roc-auc-test
0	knn	0.856660	0.0197	0.887509	0.91
1	svc	0.834657	0.0251	0.883152	0.91
2	logistic_regression	0.832215	0.0253	0.879567	0.90
3	xgb	0.993279	0.0053	0.997865	1.00

1.6 Selección de características

Selección por correlación

	riesgo_hipertension
count	35.000000
mean	13.600000
std	21.469815
min	0.000000
25%	3.500000
50%	6.000000
75%	10.000000
max	100.000000

Seleccionando las características más correlacionadas con la variable objetivo

```
25
```

Eliminando características altamente correlacionadas entre sí

```
21
1. tension_arterial
2. valor_acido_urico
3. valor_vitamina_d
4. valor_insulina
5. estatura
6. distancia_rodilla_talon
```

```
7. edad
8. circunferencia_de_la_pantorrilla
9. actividad_total
10. valor_colesterol_hdl
11. valor_trigliceridos
12. valor_colesterol_ldl
13. valor_vitamina_bdoce
14. segundamedicion_peso
15. temperatura_ambiente
16. valor_ferritina
17. valor_folato
18. valor_homocisteina
19. concentracion_hemoglobina
20. valor_proteinac_reactiva
21. masa_corporal
```

1.6.1 Selección por RFE

```
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

```
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
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```

```
Total de features 15
1. edad
2. concentracion_hemoglobina
3. valor_colesterol_hdl
4. valor_colesterol_ldl
5. valor_trigliceridos
6. resultado_glucosa_promedio
7. valor_hemoglobina_glucosilada
8. valor_vitamina_d
9. peso
10. estatura
11. medida_cintura
12. segundamedicion_cintura
13. tension_arterial
14. masa_corporal
15. actividad_total
```

1.6.2 Selección por XGBoost

```
                Models         Id  No_features  ROC  ROC_AUC    F1  Recall  \
0  logistic regression    model_1           28  0.8     0.91  88.0    92.0
1  logistic regression   model_29           28  0.8     0.91  88.0    92.0
2  logistic regression   model_57           28  0.8     0.91  88.0    92.0
3  logistic regression   model_85           28  0.8     0.91  88.0    92.0
4  logistic regression  model_113           28  0.8     0.91  88.0    92.0

   Accuracy  Brier Importance_type  \
0      83.0   17.0      total_gain
1      83.0   17.0     total_cover
2      83.0   17.0          weight
3      83.0   17.0            gain
4      83.0   17.0           cover

                                    Best_features
```

```
0  temperatura_ambiente,sexo_2,valor_folato,valor…
1  segundamedicion_estatura,sexo_2,valor_vitamina…
2  temperatura_ambiente,valor_folato,valor_transf…
3  temperatura_ambiente,sexo_2,edad,valor_creatin…
4  sexo_2,segundamedicion_estatura,estatura,circu…
```

```
28
1. temperatura_ambiente
2. sexo_2
3. valor_folato
4. valor_transferrina
5. valor_vitamina_bdoce
6. valor_vitamina_d
7. segundamedicion_estatura
8. valor_homocisteina
9. circunferencia_de_la_pantorrilla
10. valor_creatina
11. sueno_horas
12. valor_acido_urico
13. edad
14. valor_albumina
15. valor_insulina
16. estatura
17. resultado_glucosa_promedio
18. medida_cintura
19. peso
20. valor_trigliceridos
21. valor_colesterol_ldl
22. resultado_glucosa
23. concentracion_hemoglobina
24. valor_colesterol_hdl
25. valor_colesterol_total
26. tension_arterial
27. actividad_total
28. masa_corporal
```

1.7 Modelado con las mejores características

1.7.1 Logistic Regression

GridSearch

```
Fitting 3 folds for each of 720 candidates, totalling 2160 fits
```

```
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/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_sag.py:349:
ConvergenceWarning: The max_iter was reached which means the coef_ did not
converge
  warnings.warn(
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
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DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
```

```
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py:540: FitFailedWarning:
1440 fits failed out of a total of 2160.
The score on these train-test partitions for these parameters will be set to -1.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got l1
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
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    return fit_method(estimator, *args, **kwargs)
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    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got l1
```

```
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver sag supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
```

```
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got
elasticnet penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got
elasticnet penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
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    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
```

```
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 75, in _check_solver
    raise ValueError(
ValueError: Only 'saga' solver supports elasticnet penalty, got
solver=liblinear.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver sag supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
```

```
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1204, in fit
    raise ValueError("l1_ratio must be specified when penalty is elasticnet.")
ValueError: l1_ratio must be specified when penalty is elasticnet.

--------------------------------------------------------------------------------
192 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l1', 'elasticnet', 'l2'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
148 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
```

```
of LogisticRegression must be a str among {'l2', 'elasticnet', 'l1'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
63 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l2', 'l1', 'elasticnet'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
36 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l2', 'l1'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
101 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
```

```
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l1', 'l2'} or None.
Got 'none' instead.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
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DataConversionWarning: A column-vector y was passed when a 1d array was
```

```
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)

Mejores hiperparámetros encontrados GridSearchCV:
{'C': 10, 'max_iter': 100, 'penalty': 'l2', 'solver': 'newton-cholesky'}

/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
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Fitting 3 folds for each of 720 candidates, totalling 2160 fits

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/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_logistic.py:1271:
UserWarning: 'n_jobs' > 1 does not have any effect when 'solver' is set to
'liblinear'. Got 'n_jobs' = 8.
  warnings.warn(
/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_logistic.py:1271:
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```

```
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UserWarning: 'n_jobs' > 1 does not have any effect when 'solver' is set to
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/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
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/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py:540: FitFailedWarning:
1440 fits failed out of a total of 2160.
The score on these train-test partitions for these parameters will be set to -1.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got l1
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ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got l1
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
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  File "/usr/local/lib/python3.12/site-
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    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
```

```
ValueError: Solver sag supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
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    return fit_method(estimator, *args, **kwargs)
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  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got
elasticnet penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got
elasticnet penalty.

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90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
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    estimator.fit(X_train, y_train, **fit_params)
```

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  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
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packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
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  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 75, in _check_solver
    raise ValueError(
ValueError: Only 'saga' solver supports elasticnet penalty, got
solver=liblinear.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
```

```
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver sag supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1204, in fit
    raise ValueError("l1_ratio must be specified when penalty is elasticnet.")
ValueError: l1_ratio must be specified when penalty is elasticnet.

--------------------------------------------------------------------------------
262 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l2', 'elasticnet', 'l1'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
86 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
```

```
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l2', 'l1'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
68 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
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_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l1', 'elasticnet', 'l2'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
64 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
```

```
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l1', 'l2'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
60 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
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validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l2', 'l1', 'elasticnet'} or None.
Got 'none' instead.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_logistic.py:1271:
UserWarning: 'n_jobs' > 1 does not have any effect when 'solver' is set to
'liblinear'. Got 'n_jobs' = 8.
  warnings.warn(

Mejores hiperparámetros encontrados GridSearchCV:
{'C': 100, 'max_iter': 100, 'penalty': 'l1', 'solver': 'liblinear'}

/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
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Fitting 3 folds for each of 720 candidates, totalling 2160 fits

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DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

```
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_sag.py:349:
ConvergenceWarning: The max_iter was reached which means the coef_ did not
converge
  warnings.warn(
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/linear_model/_sag.py:349:
ConvergenceWarning: The max_iter was reached which means the coef_ did not
converge
  warnings.warn(
/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py:540: FitFailedWarning:
1440 fits failed out of a total of 2160.
The score on these train-test partitions for these parameters will be set to -1.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got l1
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
```

```
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got l1
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
```

```
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver sag supports only 'l2' or None penalties, got l1 penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cg supports only 'l2' or None penalties, got
elasticnet penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver newton-cholesky supports only 'l2' or None penalties, got
elasticnet penalty.
```

```
--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver lbfgs supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 75, in _check_solver
    raise ValueError(
ValueError: Only 'saga' solver supports elasticnet penalty, got
solver=liblinear.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
```

```
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1194, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
             ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 67, in _check_solver
    raise ValueError(
ValueError: Solver sag supports only 'l2' or None penalties, got elasticnet
penalty.

--------------------------------------------------------------------------------
90 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1473, in
wrapper
    return fit_method(estimator, *args, **kwargs)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/local/lib/python3.12/site-
packages/sklearn/linear_model/_logistic.py", line 1204, in fit
    raise ValueError("l1_ratio must be specified when penalty is elasticnet.")
ValueError: l1_ratio must be specified when penalty is elasticnet.

--------------------------------------------------------------------------------
114 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l1', 'elasticnet', 'l2'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
```

```
22 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l1', 'l2'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
98 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l2', 'l1', 'elasticnet'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
224 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
```

```
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'l2', 'elasticnet', 'l1'} or None.
Got 'none' instead.

--------------------------------------------------------------------------------
82 fits failed with the following error:
Traceback (most recent call last):
  File "/usr/local/lib/python3.12/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 1466, in
wrapper
    estimator._validate_params()
  File "/usr/local/lib/python3.12/site-packages/sklearn/base.py", line 666, in
_validate_params
    validate_parameter_constraints(
  File "/usr/local/lib/python3.12/site-
packages/sklearn/utils/_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'penalty' parameter
of LogisticRegression must be a str among {'elasticnet', 'l2', 'l1'} or None.
Got 'none' instead.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
```

```
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)

Mejores hiperparámetros encontrados GridSearchCV:
{'C': 100, 'max_iter': 100, 'penalty': 'l2', 'solver': 'lbfgs'}

/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
/usr/local/lib/python3.12/site-packages/sklearn/utils/validation.py:1310:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

	score_type	model
0	corr	LogisticRegression(C=10, n_jobs=-1, solver='ne…
1	rfc	LogisticRegression(C=100, n_jobs=-1, penalty='…
2	xgb	LogisticRegression(C=100, n_jobs=-1)

```
                                          best_params  f1-score-train  std-dev  \
0  {'C': 10, 'max_iter': 100, 'penalty': 'l2', 's…        0.824621   0.0246
1  {'C': 100, 'max_iter': 100, 'penalty': 'l1', '…        0.830923   0.0191
2  {'C': 100, 'max_iter': 100, 'penalty': 'l2', '…        0.824062   0.0209

   f1-score-test  roc-auc
0       0.879320     0.91
1       0.886207     0.91
2       0.881952     0.91
```

1.7.2 XGB

GridSearch

```
Fitting 3 folds for each of 972 candidates, totalling 2916 fits

Mejores hiperparámetros encontrados GridSearchCV:
{'colsample_bytree': 0.8, 'gamma': 0.4, 'learning_rate': 0.2, 'max_depth': 4,
'min_child_weight': 1, 'n_estimators': 200, 'subsample': 0.8}
Fitting 3 folds for each of 972 candidates, totalling 2916 fits
Mejores hiperparámetros encontrados GridSearchCV:
{'colsample_bytree': 0.8, 'gamma': 0.4, 'learning_rate': 0.1, 'max_depth': 4,
'min_child_weight': 1, 'n_estimators': 100, 'subsample': 1.0}
Fitting 3 folds for each of 972 candidates, totalling 2916 fits
Mejores hiperparámetros encontrados GridSearchCV:
{'colsample_bytree': 1.0, 'gamma': 0, 'learning_rate': 0.01, 'max_depth': 5,
'min_child_weight': 1, 'n_estimators': 100, 'subsample': 1.0}
```

```
  score_type                                              model  \
0       corr  XGBClassifier(base_score=None, booster=None, c…
1        rfe  XGBClassifier(base_score=None, booster=None, c…
2        xgb  XGBClassifier(base_score=None, booster=None, c…

                                          best_params  f1-score-train  std-dev  \
0  {'colsample_bytree': 0.8, 'gamma': 0.4, 'learn…        0.987392   0.0067
1  {'colsample_bytree': 0.8, 'gamma': 0.4, 'learn…        0.989698   0.0088
2  {'colsample_bytree': 1.0, 'gamma': 0, 'learnin…        0.991977   0.0082

   f1-score-test  roc-auc
0       0.987493      1.0
1       0.992276      1.0
2       0.994083      1.0
```

```
learning_rate :  0.1
n_estimators :  100
max_depth :  4
min_child_weight :  1
gamma :  0.4
```

```
subsample :  1.0
colsample_bytree :  0.8
```

1.8 Evaluación del modelo

1.8.1 Predicción sobre datos de validación

```
       edad  concentracion_hemoglobina  temperatura_ambiente  \
0  0.674157                   0.604167              0.606061
1  0.134831                   0.604167              0.606061
2  0.651685                   0.604167              0.606061
3  0.752809                   0.402778              0.636364
4  0.550562                   0.604167              0.606061

   valor_acido_urico  valor_albumina  valor_colesterol_hdl  \
0           0.425926        0.697674              0.078947
1           0.425926        0.697674              0.078947
2           0.425926        0.697674              0.078947
3           0.351852        0.744186              0.116541
4           0.425926        0.697674              0.078947

   valor_colesterol_ldl  valor_colesterol_total  valor_creatina  \
0              0.396506                0.390438        0.037547
1              0.396506                0.390438        0.037547
2              0.396506                0.390438        0.037547
3              0.576496                0.581673        0.040050
4              0.396506                0.390438        0.037547

   resultado_glucosa  valor_insulina  valor_trigliceridos  \
0           0.021879        0.012903             0.100114
1           0.021879        0.012903             0.100114
2           0.021879        0.012903             0.100114
3           0.059631        0.028083             0.175199
4           0.021879        0.012903             0.100114

   resultado_glucosa_promedio  valor_hemoglobina_glucosilada  valor_ferritina  \
0                    0.077748                       0.076923         0.009677
1                    0.077748                       0.076923         0.009677
2                    0.077748                       0.076923         0.009677
3                    0.284182                       0.284615         0.009677
4                    0.077748                       0.076923         0.009677

   valor_folato  valor_homocisteina  valor_proteinac_reactiva  \
0      0.167429            0.025707                       0.0
1      0.167429            0.025707                       0.0
2      0.167429            0.025707                       0.0
3      0.167429            0.025707                       0.0
4      0.167429            0.025707                       0.0
```

```
   valor_transferrina  valor_vitamina_bdoce  valor_vitamina_d      peso  \
0            0.062112              0.017832          0.408528  0.000000
1            0.062112              0.017832          0.408528  0.276426
2            0.062112              0.017832          0.408528  0.000000
3            0.062112              0.017832          0.408528  0.000000
4            0.062112              0.017832          0.408528  0.402643

   estatura  medida_cintura  segundamedicion_peso  segundamedicion_estatura  \
0  0.810956        0.000000              0.451768                  0.803395
1  0.823308        0.000000              0.504019                  0.843373
2  0.810956        0.000000              0.500804                  0.789157
3  0.810956        0.000000              0.497588                  0.857612
4  0.838883        0.521368              0.504019                  0.843373

   distancia_rodilla_talon  circunferencia_de_la_pantorrilla  \
0                 0.461459                          0.404692
1                 0.498458                          0.327468
2                 0.479959                          0.315738
3                 0.503597                          0.365591
4                 0.498458                          0.327468

   segundamedicion_cintura  tension_arterial  sueno_horas  masa_corporal  \
0                 0.509091             0.715     0.020408       0.000000
1                 0.000000             0.575     0.000000       0.270208
2                 0.598788             0.780     0.010204       0.000000
3                 0.572121             0.600     0.030612       0.000000
4                 0.000000             0.625     0.000000       0.380141

   actividad_total  sexo_2
0         0.028636     1.0
1         0.031443     1.0
2         0.023021     1.0
3         0.003650     1.0
4         0.024705     1.0

(1309, 3)
```

1.8.2 Métricas de evaluación

```
F1 Score: 0.9952
ROC AUC: 0.9987
Confusion Matrix:
[[463   1]
 [  7 838]]


Classification Report:
```

	precision	recall	f1-score	support
0	0.99	1.00	0.99	464
1	1.00	0.99	1.00	845
accuracy			0.99	1309
macro avg	0.99	0.99	0.99	1309
weighted avg	0.99	0.99	0.99	1309

1.9 Estabilidad del modelo

Population Stability Index (PSI)

```
/tmp/ipykernel_66336/2007159006.py:52: DeprecationWarning: Calling
np.sum(generator) is deprecated, and in the future will give a different result.
Use np.sum(np.fromiter(generator)) or the python sum builtin instead.
  psi_value = np.sum(sub_psi(expected_percents[i], actual_percents[i]) for i in
range(len(expected_percents)))
```

	Característica	Valor PSI	Interpretación
0	edad	0.0033	No hay cambios significativos
1	concentracion_hemoglobina	0.0074	No hay cambios significativos
2	valor_colesterol_hdl	0.3399	Grandes cambios
3	valor_colesterol_ldl	3.9001	Grandes cambios
4	valor_trigliceridos	0.0010	No hay cambios significativos
5	resultado_glucosa_promedio	0.1191	Pequeños cambios
6	valor_hemoglobina_glucosilada	0.0083	No hay cambios significativos
7	valor_vitamina_d	0.0053	No hay cambios significativos
8	peso	0.1023	Pequeños cambios
9	estatura	0.0024	No hay cambios significativos
10	medida_cintura	0.1997	Pequeños cambios
11	segundamedicion_cintura	0.1996	Pequeños cambios
12	tension_arterial	0.0015	No hay cambios significativos
13	masa_corporal	0.0852	No hay cambios significativos
14	actividad_total	0.0360	No hay cambios significativos

	riesgo_hipertension
1978	100.00001
1413	100.00001
2044	0.00000
703	100.00001
3563	100.00001
…	…
4084	100.00001
3762	100.00001
399	0.00000
499	0.00000

```
519             100.00001

[1309 rows x 1 columns]

/tmp/ipykernel_66336/2007159006.py:52: DeprecationWarning: Calling
np.sum(generator) is deprecated, and in the future will give a different result.
Use np.sum(np.fromiter(generator)) or the python sum builtin instead.
  psi_value = np.sum(sub_psi(expected_percents[i], actual_percents[i]) for i in
range(len(expected_percents)))

0.0
```

1.9.1 Desempeño del poder predictivo

	Característica	Poder predictivo train	Poder predictivo val	Tasa_Crecimiento
0	edad	60.28	87.89	45.80
1	concentracion_hemoglobina	3.64	4.66	28.02
2	valor_colesterol_hdl	3.93	0.52	-86.77
3	valor_colesterol_ldl	12.82	9.03	-29.56
4	valor_trigliceridos	20.74	17.92	-13.60
5	resultado_glucosa_promedio	1.20	1.33	10.83
6	valor_hemoglobina_glucosilada	1.23	0.83	-32.52
7	valor_vitamina_d	12.68	5.10	-59.78
8	peso	789.55	750.39	-4.96
9	estatura	16.84	43.24	156.77
10	medida_cintura	614.45	583.63	-5.02
11	segundamedicion_cintura	401.78	382.39	-4.83
12	tension_arterial	4.26	2.73	-35.92
13	masa_corporal	851.09	767.95	-9.77
14	actividad_total	12.59	2.99	-76.25

CSI

```
edad
concentracion_hemoglobina
valor_colesterol_hdl
valor_colesterol_ldl
valor_trigliceridos
resultado_glucosa_promedio
valor_hemoglobina_glucosilada
valor_vitamina_d
peso
estatura
medida_cintura
segundamedicion_cintura
tension_arterial
masa_corporal
actividad_total
```

```
---------------------------------------------------------------------------
IndexError                                Traceback (most recent call last)
Cell In[82], line 3
      1 csi_results = []
      2 for feat in best_features:
----> 3     csi_value = calculate_csi(X_train_transformed[feat], X_val_transformed[feat], buckets=3)
      4     csi_interpretation = interpret_psi(csi_value)
      5     csi_results.append({"Característica": feat, "Valor PSI": csi_value, "Interpretación": csi_interpretation})

Cell In[74], line 27, in calculate_csi(expected, actual, buckets)
     25 if expected_percent[i] == 0:
     26     expected_percent[i] = 0.0001
---> 27 if actual_percent[i] == 0:
     28     actual_percent[i] = 0.0001
     30 csi_value += (actual_percent[i] - expected_percent[i]) * np.log(actual_percent[i] / expected_percent[i])

IndexError: index 90 is out of bounds for axis 0 with size 90
```

1.10 Estabilidad KS