

Results_step_counting_algorithms

March 25, 2026

1 Algunos resultados iniciales sobre la cuenta de pasos en dataset WPM

En este cuaderno vamos a hacer una primera exploración de los resultados con los algoritmos de cuenta de pasos aplicados al dataset WPM.

Actualmente, tenemos implementados los siguientes algoritmos (8):

- MODEL_COG_WALKING_EVENTS.
- MODEL_THIGH_WALKING_EVENTS.
- MODEL_STEP_COUNT_WRIST.
- MODEL_STEP_COUNT_THIGH.
- MODEL_STEP_COUNT_HIP.
- MODEL_STEP_DETECTION_THRESHOLD_THIGH.
- MODEL_STEP_DETECTION_THRESHOLD_HIP.
- MODEL_VERISENSE_THIGH (*debo mejorar la algoritmia, los resultados distan del ground-truth*).

Un primer análisis lo podemos realizar mediante varios **scatterplots** comparativos de los valores ground-truth y predichos de los pasos. La ubicación de los datos nos permitirá intuir si el respectivo modelo sobreestima (valores situados por encima de la recta $y = x$) o subestima (datos por debajo de $y = x$) los pasos dados por todos los participantes.

```
[37]: import pandas as pd

# Mostrar todas las columnas
pd.set_option('display.max_columns', None)

# Mostrar todas las filas
pd.set_option('display.max_rows', None)

df_ground_truth_steps_all_participants = pd.read_csv('./
↳Ground_truth_steps_all_participants.csv', sep=";")
print(df_ground_truth_steps_all_participants.head())
```

	PARTICIPANTE	DE PIE DOBLANDO TOALLAS	DE PIE MOVIENDO LIBROS \
0	1002	36.0	18.0
1	1003	20.0	NaN
2	1006	27.0	38.0
3	1011	19.0	16.0

4	1013	53.0	58.0
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	DE PIE BARRIENDO	CAMINAR USUAL SPEED	CAMINAR CON MÓVIL O LIBRO \
0	80.0	216.0	208.0
1	55.0	220.0	220.0
2	83.0	234.0	209.0
3	91.0	180.0	190.0
4	95.0	250.0	247.0

	CAMINAR CON LA COMPRA	CAMINAR ZIGZAG	TROTAR	SUBIR Y BAJAR ESCALERAS \
0	220.0	220.0	310.0	245.0
1	227.0	217.0	290.0	206.0
2	224.0	220.0	336.0	280.0
3	188.0	200.0	254.0	180.0
4	255.0	250.0	300.0	323.0

	CINTA E1	CINTA E2	CINTA E3	CINTA E4	CINTA E5	CINTA E6	CINTA E7 \
0	316.0	358.0	412.0	452.0	493.0	507.0	655.0
1	309.0	376.0	430.0	474.0	510.0	616.0	632.0
2	338.0	407.0	446.0	485.0	610.0	648.0	200.0
3	306.0	344.0	403.0	447.0	488.0	530.0	613.0
4	352.0	390.0	433.0	472.0	513.0	580.0	614.0

	VUELTA A LA CALMA	TAPIZ RODANTE
0	37.0	3193
1	38.0	3347
2	NaN	3134
3	90.0	3131
4	60.0	3354

1.0.1 Algoritmo 1: MODEL_COG_WALKING_EVENTS

```
[38]: df_model_cog_walking_events = pd.read_csv('./
↳steps_all_participants_MODEL_COG_WALKING_EVENTS.csv')
print(df_model_cog_walking_events.head())
```

	participant_id	activity	steps
0	PMP1003	DE PIE DOBLANDO TOALLAS	212
1	PMP1006	DE PIE DOBLANDO TOALLAS	194
2	PMP1006	DE PIE MOVIENDO LIBROS	197
3	PMP1006	DE PIE BARRIENDO	175
4	PMP1006	CAMINAR USUAL SPEED	227

```
[39]: print(df_ground_truth_steps_all_participants.columns)
print(df_model_cog_walking_events.columns)
```

```
Index(['PARTICIPANTE', 'DE PIE DOBLANDO TOALLAS', 'DE PIE MOVIENDO LIBROS',
      'DE PIE BARRIENDO', 'CAMINAR USUAL SPEED', 'CAMINAR CON MÓVIL O LIBRO',
```

```

        'CAMINAR CON LA COMPRA', 'CAMINAR ZIGZAG', 'TROTAR',
        'SUBIR Y BAJAR ESCALERAS', 'CINTA E1', 'CINTA E2', 'CINTA E3',
        'CINTA E4', 'CINTA E5', 'CINTA E6', 'CINTA E7', 'VUELTA A LA CALMA',
        'TAPIZ RODANTE'],
        dtype='object')
Index(['participant_id', 'activity', 'steps'], dtype='object')

```

```

[40]: # Ajustamos formato del dataframe predicho para que sea comparable con el de
      ↪ground truth:
df_model_cog_walking_events_wide = df_model_cog_walking_events.pivot_table(
    index='participant_id',
    columns='activity',
    values='steps'
).reset_index()

df_model_cog_walking_events_wide.rename(columns={'participant_id':
      ↪'PARTICIPANTE'}, inplace=True)
df_model_cog_walking_events_wide

```

```

[40]: activity PARTICIPANTE CAMINAR CON LA COMPRA CAMINAR CON MÓVIL O LIBRO \
0          PMP1003          NaN          NaN
1          PMP1006          224.0          211.0
2          PMP1011          207.0          201.0
3          PMP1019          228.0          226.0
4          PMP1020          223.0          211.0
5          PMP1022          206.0          196.0
6          PMP1025          213.0          207.0
7          PMP1026          NaN          NaN
8          PMP1027          204.0          197.0
9          PMP1032          230.0          227.0
10         PMP1036          225.0          211.0
11         PMP1038          211.0          206.0
12         PMP1039          249.0          240.0
13         PMP1042          234.0          227.0
14         PMP1043          220.0          214.0
15         PMP1045          205.0          198.0
16         PMP1047          244.0          238.0
17         PMP1048          208.0          203.0
18         PMP1049          237.0          235.0
19         PMP1050          249.0          252.0
20         PMP1051          210.0          200.0
21         PMP1052          194.0          182.0
22         PMP1053          217.0          209.0
23         PMP1055          219.0          209.0
24         PMP1057          180.0          176.0
25         PMP1058          225.0          222.0
26         PMP1060          241.0          237.0

```

27	PMP1061	233.0	230.0
28	PMP1063	234.0	223.0
29	PMP1064	236.0	218.0
30	PMP1066	240.0	244.0
31	PMP1067	232.0	230.0
32	PMP1068	203.0	202.0
33	PMP1069	207.0	211.0
34	PMP1070	211.0	209.0
35	PMP1072	243.0	232.0
36	PMP1073	247.0	248.0
37	PMP1074	NaN	NaN
38	PMP1076	201.0	197.0
39	PMP1081	239.0	226.0
40	PMP1085	218.0	213.0
41	PMP1086	212.0	207.0
42	PMP1088	213.0	211.0
43	PMP1090	237.0	239.0
44	PMP1091	220.0	214.0
45	PMP1093	207.0	202.0
46	PMP1095	206.0	203.0

activity	CAMINAR USUAL	SPEED	CAMINAR ZIGZAG	DE PIE BARRIENDO \
0		NaN	NaN	NaN
1		227.0	216.0	175.0
2		204.0	208.0	201.0
3		229.0	236.0	196.0
4		230.0	230.0	210.0
5		206.0	201.0	225.0
6		207.0	205.0	212.0
7		NaN	NaN	NaN
8		205.0	192.0	199.0
9		245.0	244.0	204.0
10		216.0	223.0	196.0
11		209.0	217.0	193.0
12		246.0	240.0	209.0
13		228.0	230.0	171.0
14		217.0	215.0	215.0
15		201.0	195.0	204.0
16		253.0	252.0	208.0
17		202.0	211.0	208.0
18		227.0	231.0	217.0
19		251.0	244.0	203.0
20		200.0	214.0	211.0
21		199.0	193.0	189.0
22		220.0	217.0	209.0
23		210.0	216.0	217.0
24		183.0	193.0	188.0

25	224.0	240.0	184.0
26	239.0	243.0	178.0
27	241.0	212.0	199.0
28	227.0	228.0	202.0
29	228.0	238.0	215.0
30	243.0	247.0	209.0
31	236.0	229.0	228.0
32	216.0	206.0	197.0
33	217.0	221.0	209.0
34	212.0	208.0	212.0
35	238.0	247.0	200.0
36	251.0	249.0	202.0
37	NaN	NaN	NaN
38	204.0	198.0	195.0
39	233.0	233.0	211.0
40	216.0	214.0	197.0
41	200.0	205.0	217.0
42	218.0	217.0	215.0
43	246.0	240.0	207.0
44	220.0	210.0	215.0
45	208.0	204.0	179.0
46	199.0	207.0	208.0

activity	DE PIE DOBLANDO TOALLAS	DE PIE MOVIENDO LIBROS \
0	212.0	NaN
1	194.0	197.0
2	199.0	222.0
3	215.0	206.0
4	211.0	211.0
5	219.0	216.0
6	215.0	222.0
7	211.0	NaN
8	211.0	197.0
9	225.0	213.0
10	207.0	203.0
11	216.0	203.0
12	219.0	223.0
13	203.0	186.0
14	221.0	231.0
15	202.0	220.0
16	224.0	223.0
17	205.0	215.0
18	220.0	222.0
19	223.0	208.2
20	230.0	226.0
21	221.0	228.0
22	216.0	209.0

23	211.0	211.0
24	214.0	219.0
25	213.0	209.0
26	210.0	205.0
27	216.0	228.0
28	217.0	239.0
29	226.0	219.0
30	219.0	199.0
31	208.0	221.0
32	227.0	221.0
33	203.0	201.0
34	225.0	213.0
35	223.0	214.0
36	195.0	204.0
37	215.0	NaN
38	214.0	208.0
39	227.0	225.0
40	225.0	225.0
41	221.0	209.0
42	225.0	223.0
43	222.0	227.0
44	227.0	226.0
45	223.0	201.0
46	208.0	201.0

activity	SUBIR Y BAJAR ESCALERAS	TAPIZ RODANTE	TROTAR
0	NaN	NaN	NaN
1	218.0	3481.0	242.0
2	218.0	3153.0	276.0
3	245.0	3398.0	271.0
4	241.0	2387.0	281.0
5	239.0	3040.0	312.0
6	233.0	2130.0	282.0
7	NaN	NaN	NaN
8	203.0	3268.0	281.0
9	236.0	3414.0	285.0
10	229.0	3301.0	312.0
11	218.0	3407.0	261.0
12	250.0	3184.0	231.0
13	229.0	3148.0	307.0
14	242.0	3251.0	269.0
15	206.0	2959.0	293.0
16	275.0	2974.0	246.0
17	223.0	2676.0	261.0
18	222.0	2795.0	316.0
19	235.0	2367.0	228.0
20	237.0	3151.0	276.0

21	NaN	NaN	293.0
22	224.0	3403.0	304.0
23	240.0	3258.0	274.0
24	214.0	3164.0	273.0
25	211.0	3085.0	288.0
26	241.0	3364.0	305.0
27	242.0	3400.0	321.0
28	221.0	2593.0	302.0
29	229.0	3415.0	293.0
30	230.0	2476.0	279.0
31	234.0	2816.0	265.0
32	219.0	3411.0	302.0
33	208.0	3135.0	257.0
34	221.0	3241.0	293.0
35	240.0	3284.0	260.0
36	238.0	3514.0	249.0
37	NaN	NaN	NaN
38	236.0	3242.0	273.0
39	248.0	2558.0	223.0
40	206.0	2312.0	297.0
41	230.0	3173.0	287.0
42	202.0	3175.0	309.0
43	245.0	3318.0	302.0
44	244.0	3210.0	303.0
45	232.0	3326.0	307.0
46	218.0	3156.0	210.0

```
[41]: df_ground_truth_steps_all_participants['PARTICIPANTE'] =
↳ df_ground_truth_steps_all_participants['PARTICIPANTE'].astype(str)
df_model_cog_walking_events_wide['PARTICIPANTE'] =
↳ df_model_cog_walking_events_wide['PARTICIPANTE'].astype(str)

df_model_cog_walking_events_wide['PARTICIPANTE'] =
↳ df_model_cog_walking_events_wide['PARTICIPANTE'].astype(str).str.
↳ removeprefix("PMP")

print(df_ground_truth_steps_all_participants['PARTICIPANTE'].unique())
print(df_model_cog_walking_events_wide['PARTICIPANTE'].unique())

df = df_ground_truth_steps_all_participants.
↳ merge(df_model_cog_walking_events_wide, on='PARTICIPANTE', suffixes=('_gt',
↳ '_pred'), how='inner')

df
```

```
['1002' '1003' '1006' '1011' '1013' '1014' '1017' '1018' '1019' '1020'
'1021' '1022' '1023' '1024' '1025' '1026' '1027' '1028' '1029' '1030']
```

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'1031' '1032' '1033' '1034' '1035' '1036' '1037' '1038' '1039' '1040'
'1041' '1042' '1043' '1044' '1045' '1046' '1047' '1048' '1049' '1050'
'1051' '1052' '1053' '1054' '1055' '1056' '1057' '1058' '1059' '1060'
'1061' '1062' '1063' '1064' '1065' '1066' '1067' '1068' '1069' '1070'
'1071' '1072' '1073' '1074' '1075' '1076' '1077' '1078' '1079' '1080'
'1081' '1082' '1083' '1084' '1085' '1086' '1087' '1088' '1089' '1090'
'1091' '1092' '1093' '1094' '1095' '1097']
['1003' '1006' '1011' '1019' '1020' '1022' '1025' '1026' '1027' '1032'
'1036' '1038' '1039' '1042' '1043' '1045' '1047' '1048' '1049' '1050'
'1051' '1052' '1053' '1055' '1057' '1058' '1060' '1061' '1063' '1064'
'1066' '1067' '1068' '1069' '1070' '1072' '1073' '1074' '1076' '1081'
'1085' '1086' '1088' '1090' '1091' '1093' '1095']

```

```

[41]: PARTICIPANTE DE PIE DOBLANDO TOALLAS_gt DE PIE MOVIENDO LIBROS_gt \
0          1003          20.0          NaN
1          1006          27.0          38.0
2          1011          19.0          16.0
3          1019          44.0          10.0
4          1020          51.0          18.0
5          1022          36.0          42.0
6          1025          39.0           4.0
7          1026          29.0          10.0
8          1027          17.0           9.0
9          1032          50.0          16.0
10         1036          28.0          72.0
11         1038          22.0          18.0
12         1039          27.0           6.0
13         1042          32.0          19.0
14         1043          27.0          32.0
15         1045          33.0          27.0
16         1047          29.0          25.0
17         1048          20.0          52.0
18         1049          58.0          58.0
19         1050          57.0          13.0
20         1051          21.0           5.0
21         1052           6.0           3.0
22         1053          26.0           5.0
23         1055          41.0          11.0
24         1057          46.0           0.0
25         1058          43.0          76.0
26         1060          49.0          10.0
27         1061          42.0          56.0
28         1063          18.0          34.0
29         1064          38.0          26.0
30         1066          17.0          16.0
31         1067          38.0          34.0
32         1068          38.0          34.0

```

33	1069	29.0	29.0
34	1070	45.0	6.0
35	1072	29.0	38.0
36	1073	31.0	14.0
37	1074	7.0	7.0
38	1076	36.0	25.0
39	1081	38.0	44.0
40	1085	35.0	22.0
41	1086	26.0	4.0
42	1088	36.0	30.0
43	1090	26.0	0.0
44	1091	55.0	80.0
45	1093	42.0	38.0
46	1095	17.0	48.0

	DE PIE BARRIENDO_gt	CAMINAR USUAL SPEED_gt	CAMINAR CON MÓVIL O LIBRO_gt \
0	55.0	220.0	220.0
1	83.0	234.0	209.0
2	91.0	180.0	190.0
3	85.0	213.0	227.0
4	108.0	225.0	210.0
5	68.0	207.0	210.0
6	85.0	190.0	196.0
7	74.0	190.0	185.0
8	36.0	190.0	176.0
9	112.0	256.0	235.0
10	97.0	223.0	216.0
11	74.0	216.0	205.0
12	88.0	210.0	260.0
13	60.0	220.0	220.0
14	93.0	208.0	200.0
15	73.0	190.0	180.0
16	85.0	270.0	240.0
17	81.0	192.0	196.0
18	102.0	234.0	245.0
19	65.0	250.0	250.0
20	25.0	180.0	190.0
21	33.0	190.0	10.0
22	51.0	230.0	214.0
23	80.0	193.0	186.0
24	69.0	186.0	170.0
25	121.0	224.0	220.0
26	89.0	NaN	250.0
27	104.0	234.0	234.0
28	69.0	224.0	217.0
29	77.0	224.0	200.0
30	115.0	260.0	250.0

31	118.0	247.0	210.0
32	102.0	223.0	209.0
33	95.0	212.0	206.0
34	81.0	220.0	190.0
35	74.0	244.0	232.0
36	94.0	254.0	260.0
37	34.0	212.0	210.0
38	74.0	200.0	190.0
39	134.0	NaN	NaN
40	104.0	202.0	200.0
41	72.0	170.0	200.0
42	89.0	220.0	200.0
43	62.0	252.0	247.0
44	116.0	235.0	200.0
45	98.0	213.0	208.0
46	60.0	200.0	200.0

	CAMINAR CON LA COMPRA_gt	CAMINAR ZIGZAG_gt	TROTAR_gt \
0	227.0	217.0	290.0
1	224.0	220.0	336.0
2	188.0	200.0	254.0
3	224.0	234.0	280.0
4	240.0	235.0	300.0
5	207.0	210.0	308.0
6	200.0	205.0	278.0
7	190.0	200.0	315.0
8	190.0	187.0	264.0
9	259.0	256.0	280.0
10	240.0	260.0	320.0
11	214.0	220.0	297.0
12	240.0	240.0	336.0
13	230.0	230.0	307.0
14	208.0	220.0	285.0
15	200.0	200.0	290.0
16	245.0	246.0	315.0
17	210.0	216.0	280.0
18	240.0	230.0	307.0
19	260.0	240.0	337.0
20	200.0	210.0	252.0
21	180.0	190.0	300.0
22	220.0	230.0	300.0
23	210.0	212.0	250.0
24	180.0	190.0	300.0
25	190.0	240.0	290.0
26	240.0	250.0	327.0
27	240.0	210.0	320.0
28	222.0	235.0	278.0

29	230.0	236.0	313.0
30	245.0	276.0	110.0
31	250.0	222.0	330.0
32	210.0	210.0	316.0
33	190.0	230.0	270.0
34	246.0	214.0	300.0
35	250.0	256.0	314.0
36	270.0	254.0	327.0
37	210.0	214.0	320.0
38	200.0	196.0	263.0
39	80.0	234.0	340.0
40	240.0	214.0	297.0
41	227.0	207.0	278.0
42	217.0	222.0	316.0
43	227.0	250.0	318.0
44	220.0	216.0	300.0
45	210.0	210.0	310.0
46	200.0	204.0	230.0

	SUBIR Y BAJAR ESCALERAS_gt	CINTA E1	CINTA E2	CINTA E3	CINTA E4	\
0	206.0	309.0	376.0	430.0	474.0	
1	280.0	338.0	407.0	446.0	485.0	
2	180.0	306.0	344.0	403.0	447.0	
3	258.0	280.0	331.0	400.0	444.0	
4	264.0	426.0	469.0	472.0	498.0	
5	238.0	284.0	333.0	373.0	417.0	
6	226.0	338.0	389.0	424.0	461.0	
7	197.0	295.0	365.0	415.0	462.0	
8	210.0	310.0	373.0	416.0	457.0	
9	242.0	305.0	402.0	454.0	487.0	
10	206.0	308.0	371.0	435.0	480.0	
11	220.0	287.0	360.0	421.0	465.0	
12	314.0	323.0	310.0	394.0	441.0	
13	319.0	280.0	333.0	375.0	415.0	
14	220.0	272.0	330.0	388.0	432.0	
15	190.0	457.0	498.0	578.0	585.0	
16	272.0	323.0	401.0	450.0	485.0	
17	217.0	305.0	355.0	391.0	428.0	
18	219.0	363.0	399.0	438.0	471.0	
19	260.0	420.0	448.0	452.0	486.0	
20	232.0	274.0	320.0	395.0	421.0	
21	227.0	276.0	320.0	373.0	410.0	
22	248.0	285.0	197.0	NaN	NaN	
23	230.0	283.0	339.0	386.0	426.0	
24	206.0	288.0	335.0	383.0	416.0	
25	213.0	330.0	359.0	406.0	449.0	
26	270.0	362.0	402.0	445.0	478.0	

27	247.0	333.0	390.0	448.0	478.0
28	200.0	310.0	364.0	415.0	456.0
29	222.0	346.0	402.0	456.0	488.0
30	362.0	359.0	435.0	464.0	496.0
31	229.0	420.0	443.0	474.0	496.0
32	220.0	294.0	365.0	421.0	460.0
33	220.0	307.0	350.0	400.0	448.0
34	222.0	332.0	380.0	410.0	443.0
35	250.0	336.0	389.0	438.0	492.0
36	238.0	380.0	437.0	474.0	506.0
37	240.0	288.0	348.0	405.0	449.0
38	326.0	316.0	366.0	406.0	434.0
39	307.0	336.0	332.0	390.0	438.0
40	207.0	406.0	411.0	431.0	472.0
41	224.0	272.0	313.0	374.0	421.0
42	208.0	264.0	323.0	382.0	422.0
43	245.0	299.0	355.0	425.0	465.0
44	245.0	309.0	379.0	423.0	444.0
45	238.0	297.0	360.0	417.0	455.0
46	231.0	323.0	352.0	403.0	447.0

	CINTA E5	CINTA E6	CINTA E7	VUELTA A LA CALMA	TAPIZ RODANTE_gt \
0	510.0	616.0	632.0	38.0	3347
1	610.0	648.0	200.0	NaN	3134
2	488.0	530.0	613.0	90.0	3131
3	489.0	533.0	640.0	127.0	3117
4	522.0	NaN	NaN	220.0	2387
5	455.0	486.0	543.0	61.0	2891
6	506.0	110.0	NaN	140.0	2228
7	502.0	577.0	636.0	85.0	3252
8	488.0	528.0	646.0	93.0	3218
9	515.0	611.0	652.0	48.0	3426
10	526.0	638.0	655.0	156.0	3413
11	514.0	649.0	667.0	134.0	3363
12	470.0	295.0	NaN	NaN	2233
13	458.0	504.0	630.0	188.0	2995
14	467.0	508.0	640.0	127.0	3037
15	608.0	317.0	NaN	NaN	3043
16	523.0	646.0	663.0	155.0	3491
17	466.0	620.0	NaN	60.0	2565
18	510.0	645.0	NaN	124.0	2826
19	550.0	NaN	NaN	77.0	2356
20	450.0	480.0	568.0	166.0	2908
21	453.0	350.0	NaN	NaN	2182
22	NaN	NaN	NaN	NaN	482
23	475.0	504.0	217.0	NaN	2630
24	453.0	546.0	573.0	70.0	2994

25	492.0	614.0	667.0	111.0	3317
26	507.0	549.0	623.0	200.0	3366
27	518.0	633.0	651.0	215.0	3451
28	502.0	172.0	NaN	NaN	2219
29	525.0	640.0	636.0	43.0	3493
30	528.0	657.0	667.0	110.0	3606
31	532.0	700.0	NaN	236.0	3065
32	496.0	624.0	635.0	80.0	3295
33	480.0	530.0	660.0	157.0	3175
34	477.0	523.0	638.0	78.0	3203
35	536.0	650.0	678.0	78.0	3519
36	534.0	568.0	640.0	90.0	3539
37	488.0	553.0	623.0	32.0	3154
38	466.0	566.0	602.0	76.0	3156
39	475.0	516.0	NaN	61.0	2487
40	593.0	NaN	NaN	55.0	2313
41	470.0	506.0	554.0	55.0	2910
42	447.0	483.0	584.0	42.0	2905
43	498.0	537.0	665.0	88.0	3244
44	475.0	506.0	631.0	80.0	3167
45	490.0	608.0	649.0	74.0	3276
46	482.0	522.0	573.0	80.0	3102

	CAMINAR CON LA COMPRA_pred	CAMINAR CON MÓVIL O LIBRO_pred \
0	NaN	NaN
1	224.0	211.0
2	207.0	201.0
3	228.0	226.0
4	223.0	211.0
5	206.0	196.0
6	213.0	207.0
7	NaN	NaN
8	204.0	197.0
9	230.0	227.0
10	225.0	211.0
11	211.0	206.0
12	249.0	240.0
13	234.0	227.0
14	220.0	214.0
15	205.0	198.0
16	244.0	238.0
17	208.0	203.0
18	237.0	235.0
19	249.0	252.0
20	210.0	200.0
21	194.0	182.0
22	217.0	209.0

23	219.0	209.0
24	180.0	176.0
25	225.0	222.0
26	241.0	237.0
27	233.0	230.0
28	234.0	223.0
29	236.0	218.0
30	240.0	244.0
31	232.0	230.0
32	203.0	202.0
33	207.0	211.0
34	211.0	209.0
35	243.0	232.0
36	247.0	248.0
37	NaN	NaN
38	201.0	197.0
39	239.0	226.0
40	218.0	213.0
41	212.0	207.0
42	213.0	211.0
43	237.0	239.0
44	220.0	214.0
45	207.0	202.0
46	206.0	203.0

	CAMINAR USUAL SPEED_pred	CAMINAR ZIGZAG_pred	DE PIE BARRIENDO_pred \
0	NaN	NaN	NaN
1	227.0	216.0	175.0
2	204.0	208.0	201.0
3	229.0	236.0	196.0
4	230.0	230.0	210.0
5	206.0	201.0	225.0
6	207.0	205.0	212.0
7	NaN	NaN	NaN
8	205.0	192.0	199.0
9	245.0	244.0	204.0
10	216.0	223.0	196.0
11	209.0	217.0	193.0
12	246.0	240.0	209.0
13	228.0	230.0	171.0
14	217.0	215.0	215.0
15	201.0	195.0	204.0
16	253.0	252.0	208.0
17	202.0	211.0	208.0
18	227.0	231.0	217.0
19	251.0	244.0	203.0
20	200.0	214.0	211.0

21	199.0	193.0	189.0
22	220.0	217.0	209.0
23	210.0	216.0	217.0
24	183.0	193.0	188.0
25	224.0	240.0	184.0
26	239.0	243.0	178.0
27	241.0	212.0	199.0
28	227.0	228.0	202.0
29	228.0	238.0	215.0
30	243.0	247.0	209.0
31	236.0	229.0	228.0
32	216.0	206.0	197.0
33	217.0	221.0	209.0
34	212.0	208.0	212.0
35	238.0	247.0	200.0
36	251.0	249.0	202.0
37	NaN	NaN	NaN
38	204.0	198.0	195.0
39	233.0	233.0	211.0
40	216.0	214.0	197.0
41	200.0	205.0	217.0
42	218.0	217.0	215.0
43	246.0	240.0	207.0
44	220.0	210.0	215.0
45	208.0	204.0	179.0
46	199.0	207.0	208.0

	DE PIE DOBLANDO TOALLAS_pred	DE PIE MOVIENDO LIBROS_pred \
0	212.0	NaN
1	194.0	197.0
2	199.0	222.0
3	215.0	206.0
4	211.0	211.0
5	219.0	216.0
6	215.0	222.0
7	211.0	NaN
8	211.0	197.0
9	225.0	213.0
10	207.0	203.0
11	216.0	203.0
12	219.0	223.0
13	203.0	186.0
14	221.0	231.0
15	202.0	220.0
16	224.0	223.0
17	205.0	215.0
18	220.0	222.0

19	223.0	208.2
20	230.0	226.0
21	221.0	228.0
22	216.0	209.0
23	211.0	211.0
24	214.0	219.0
25	213.0	209.0
26	210.0	205.0
27	216.0	228.0
28	217.0	239.0
29	226.0	219.0
30	219.0	199.0
31	208.0	221.0
32	227.0	221.0
33	203.0	201.0
34	225.0	213.0
35	223.0	214.0
36	195.0	204.0
37	215.0	NaN
38	214.0	208.0
39	227.0	225.0
40	225.0	225.0
41	221.0	209.0
42	225.0	223.0
43	222.0	227.0
44	227.0	226.0
45	223.0	201.0
46	208.0	201.0

	SUBIR Y BAJAR ESCALERAS_pred	TAPIZ RODANTE_pred	TROTAR_pred
0	NaN	NaN	NaN
1	218.0	3481.0	242.0
2	218.0	3153.0	276.0
3	245.0	3398.0	271.0
4	241.0	2387.0	281.0
5	239.0	3040.0	312.0
6	233.0	2130.0	282.0
7	NaN	NaN	NaN
8	203.0	3268.0	281.0
9	236.0	3414.0	285.0
10	229.0	3301.0	312.0
11	218.0	3407.0	261.0
12	250.0	3184.0	231.0
13	229.0	3148.0	307.0
14	242.0	3251.0	269.0
15	206.0	2959.0	293.0
16	275.0	2974.0	246.0

17	223.0	2676.0	261.0
18	222.0	2795.0	316.0
19	235.0	2367.0	228.0
20	237.0	3151.0	276.0
21	NaN	NaN	293.0
22	224.0	3403.0	304.0
23	240.0	3258.0	274.0
24	214.0	3164.0	273.0
25	211.0	3085.0	288.0
26	241.0	3364.0	305.0
27	242.0	3400.0	321.0
28	221.0	2593.0	302.0
29	229.0	3415.0	293.0
30	230.0	2476.0	279.0
31	234.0	2816.0	265.0
32	219.0	3411.0	302.0
33	208.0	3135.0	257.0
34	221.0	3241.0	293.0
35	240.0	3284.0	260.0
36	238.0	3514.0	249.0
37	NaN	NaN	NaN
38	236.0	3242.0	273.0
39	248.0	2558.0	223.0
40	206.0	2312.0	297.0
41	230.0	3173.0	287.0
42	202.0	3175.0	309.0
43	245.0	3318.0	302.0
44	244.0	3210.0	303.0
45	232.0	3326.0	307.0
46	218.0	3156.0	210.0

[42]: *# Reordenamos un poco el dataframe para facilitar la interpretación*

```
# Listar columnas gt y pred
cols_gt = [c for c in df.columns if c.endswith("_gt")]
cols_pred = [c for c in df.columns if c.endswith("_pred")]

# Emparejarlas por actividad
pairs = []
for col in cols_gt:
    base = col.replace("_gt", "")
    pred_col = base + "_pred"
    if pred_col in df.columns:
        pairs.append((col, pred_col))

# Crear nuevo orden
new_cols = ["PARTICIPANTE"]
```

```

for gt_col, pred_col in pairs:
    new_cols.extend([gt_col, pred_col])

# añadir columnas que no entraron en los pares
extras = [c for c in df.columns if c not in new_cols]
new_cols.extend(extras)

# Reordenar dataframe
df = df[new_cols]

df

```

```

[42]: PARTICIPANTE DE PIE DOBLANDO TOALLAS_gt DE PIE DOBLANDO TOALLAS_pred \
0          1003          20.0          212.0
1          1006          27.0          194.0
2          1011          19.0          199.0
3          1019          44.0          215.0
4          1020          51.0          211.0
5          1022          36.0          219.0
6          1025          39.0          215.0
7          1026          29.0          211.0
8          1027          17.0          211.0
9          1032          50.0          225.0
10         1036          28.0          207.0
11         1038          22.0          216.0
12         1039          27.0          219.0
13         1042          32.0          203.0
14         1043          27.0          221.0
15         1045          33.0          202.0
16         1047          29.0          224.0
17         1048          20.0          205.0
18         1049          58.0          220.0
19         1050          57.0          223.0
20         1051          21.0          230.0
21         1052           6.0          221.0
22         1053          26.0          216.0
23         1055          41.0          211.0
24         1057          46.0          214.0
25         1058          43.0          213.0
26         1060          49.0          210.0
27         1061          42.0          216.0
28         1063          18.0          217.0
29         1064          38.0          226.0
30         1066          17.0          219.0
31         1067          38.0          208.0
32         1068          38.0          227.0
33         1069          29.0          203.0

```

34	1070	45.0	225.0
35	1072	29.0	223.0
36	1073	31.0	195.0
37	1074	7.0	215.0
38	1076	36.0	214.0
39	1081	38.0	227.0
40	1085	35.0	225.0
41	1086	26.0	221.0
42	1088	36.0	225.0
43	1090	26.0	222.0
44	1091	55.0	227.0
45	1093	42.0	223.0
46	1095	17.0	208.0

	DE PIE MOVIENDO LIBROS_gt	DE PIE MOVIENDO LIBROS_pred \
0	NaN	NaN
1	38.0	197.0
2	16.0	222.0
3	10.0	206.0
4	18.0	211.0
5	42.0	216.0
6	4.0	222.0
7	10.0	NaN
8	9.0	197.0
9	16.0	213.0
10	72.0	203.0
11	18.0	203.0
12	6.0	223.0
13	19.0	186.0
14	32.0	231.0
15	27.0	220.0
16	25.0	223.0
17	52.0	215.0
18	58.0	222.0
19	13.0	208.2
20	5.0	226.0
21	3.0	228.0
22	5.0	209.0
23	11.0	211.0
24	0.0	219.0
25	76.0	209.0
26	10.0	205.0
27	56.0	228.0
28	34.0	239.0
29	26.0	219.0
30	16.0	199.0
31	34.0	221.0

32	34.0	221.0
33	29.0	201.0
34	6.0	213.0
35	38.0	214.0
36	14.0	204.0
37	7.0	NaN
38	25.0	208.0
39	44.0	225.0
40	22.0	225.0
41	4.0	209.0
42	30.0	223.0
43	0.0	227.0
44	80.0	226.0
45	38.0	201.0
46	48.0	201.0

	DE PIE BARRIENDO_gt	DE PIE BARRIENDO_pred	CAMINAR USUAL SPEED_gt \
0	55.0	NaN	220.0
1	83.0	175.0	234.0
2	91.0	201.0	180.0
3	85.0	196.0	213.0
4	108.0	210.0	225.0
5	68.0	225.0	207.0
6	85.0	212.0	190.0
7	74.0	NaN	190.0
8	36.0	199.0	190.0
9	112.0	204.0	256.0
10	97.0	196.0	223.0
11	74.0	193.0	216.0
12	88.0	209.0	210.0
13	60.0	171.0	220.0
14	93.0	215.0	208.0
15	73.0	204.0	190.0
16	85.0	208.0	270.0
17	81.0	208.0	192.0
18	102.0	217.0	234.0
19	65.0	203.0	250.0
20	25.0	211.0	180.0
21	33.0	189.0	190.0
22	51.0	209.0	230.0
23	80.0	217.0	193.0
24	69.0	188.0	186.0
25	121.0	184.0	224.0
26	89.0	178.0	NaN
27	104.0	199.0	234.0
28	69.0	202.0	224.0
29	77.0	215.0	224.0

30	115.0	209.0	260.0
31	118.0	228.0	247.0
32	102.0	197.0	223.0
33	95.0	209.0	212.0
34	81.0	212.0	220.0
35	74.0	200.0	244.0
36	94.0	202.0	254.0
37	34.0	NaN	212.0
38	74.0	195.0	200.0
39	134.0	211.0	NaN
40	104.0	197.0	202.0
41	72.0	217.0	170.0
42	89.0	215.0	220.0
43	62.0	207.0	252.0
44	116.0	215.0	235.0
45	98.0	179.0	213.0
46	60.0	208.0	200.0

	CAMINAR USUAL SPEED_pred	CAMINAR CON MÓVIL O LIBRO_gt \
0	NaN	220.0
1	227.0	209.0
2	204.0	190.0
3	229.0	227.0
4	230.0	210.0
5	206.0	210.0
6	207.0	196.0
7	NaN	185.0
8	205.0	176.0
9	245.0	235.0
10	216.0	216.0
11	209.0	205.0
12	246.0	260.0
13	228.0	220.0
14	217.0	200.0
15	201.0	180.0
16	253.0	240.0
17	202.0	196.0
18	227.0	245.0
19	251.0	250.0
20	200.0	190.0
21	199.0	10.0
22	220.0	214.0
23	210.0	186.0
24	183.0	170.0
25	224.0	220.0
26	239.0	250.0
27	241.0	234.0

28	227.0	217.0
29	228.0	200.0
30	243.0	250.0
31	236.0	210.0
32	216.0	209.0
33	217.0	206.0
34	212.0	190.0
35	238.0	232.0
36	251.0	260.0
37	NaN	210.0
38	204.0	190.0
39	233.0	NaN
40	216.0	200.0
41	200.0	200.0
42	218.0	200.0
43	246.0	247.0
44	220.0	200.0
45	208.0	208.0
46	199.0	200.0

	CAMINAR CON MÓVIL O LIBRO_pred	CAMINAR CON LA COMPRA_gt \
0	NaN	227.0
1	211.0	224.0
2	201.0	188.0
3	226.0	224.0
4	211.0	240.0
5	196.0	207.0
6	207.0	200.0
7	NaN	190.0
8	197.0	190.0
9	227.0	259.0
10	211.0	240.0
11	206.0	214.0
12	240.0	240.0
13	227.0	230.0
14	214.0	208.0
15	198.0	200.0
16	238.0	245.0
17	203.0	210.0
18	235.0	240.0
19	252.0	260.0
20	200.0	200.0
21	182.0	180.0
22	209.0	220.0
23	209.0	210.0
24	176.0	180.0
25	222.0	190.0

26	237.0	240.0
27	230.0	240.0
28	223.0	222.0
29	218.0	230.0
30	244.0	245.0
31	230.0	250.0
32	202.0	210.0
33	211.0	190.0
34	209.0	246.0
35	232.0	250.0
36	248.0	270.0
37	NaN	210.0
38	197.0	200.0
39	226.0	80.0
40	213.0	240.0
41	207.0	227.0
42	211.0	217.0
43	239.0	227.0
44	214.0	220.0
45	202.0	210.0
46	203.0	200.0

	CAMINAR CON LA COMPRA_pred	CAMINAR ZIGZAG_gt	CAMINAR ZIGZAG_pred \
0	NaN	217.0	NaN
1	224.0	220.0	216.0
2	207.0	200.0	208.0
3	228.0	234.0	236.0
4	223.0	235.0	230.0
5	206.0	210.0	201.0
6	213.0	205.0	205.0
7	NaN	200.0	NaN
8	204.0	187.0	192.0
9	230.0	256.0	244.0
10	225.0	260.0	223.0
11	211.0	220.0	217.0
12	249.0	240.0	240.0
13	234.0	230.0	230.0
14	220.0	220.0	215.0
15	205.0	200.0	195.0
16	244.0	246.0	252.0
17	208.0	216.0	211.0
18	237.0	230.0	231.0
19	249.0	240.0	244.0
20	210.0	210.0	214.0
21	194.0	190.0	193.0
22	217.0	230.0	217.0
23	219.0	212.0	216.0

24	180.0	190.0	193.0
25	225.0	240.0	240.0
26	241.0	250.0	243.0
27	233.0	210.0	212.0
28	234.0	235.0	228.0
29	236.0	236.0	238.0
30	240.0	276.0	247.0
31	232.0	222.0	229.0
32	203.0	210.0	206.0
33	207.0	230.0	221.0
34	211.0	214.0	208.0
35	243.0	256.0	247.0
36	247.0	254.0	249.0
37	NaN	214.0	NaN
38	201.0	196.0	198.0
39	239.0	234.0	233.0
40	218.0	214.0	214.0
41	212.0	207.0	205.0
42	213.0	222.0	217.0
43	237.0	250.0	240.0
44	220.0	216.0	210.0
45	207.0	210.0	204.0
46	206.0	204.0	207.0

	TROTAR_gt	TROTAR_pred	SUBIR Y BAJAR ESCALERAS_gt \
0	290.0	NaN	206.0
1	336.0	242.0	280.0
2	254.0	276.0	180.0
3	280.0	271.0	258.0
4	300.0	281.0	264.0
5	308.0	312.0	238.0
6	278.0	282.0	226.0
7	315.0	NaN	197.0
8	264.0	281.0	210.0
9	280.0	285.0	242.0
10	320.0	312.0	206.0
11	297.0	261.0	220.0
12	336.0	231.0	314.0
13	307.0	307.0	319.0
14	285.0	269.0	220.0
15	290.0	293.0	190.0
16	315.0	246.0	272.0
17	280.0	261.0	217.0
18	307.0	316.0	219.0
19	337.0	228.0	260.0
20	252.0	276.0	232.0
21	300.0	293.0	227.0

22	300.0	304.0	248.0
23	250.0	274.0	230.0
24	300.0	273.0	206.0
25	290.0	288.0	213.0
26	327.0	305.0	270.0
27	320.0	321.0	247.0
28	278.0	302.0	200.0
29	313.0	293.0	222.0
30	110.0	279.0	362.0
31	330.0	265.0	229.0
32	316.0	302.0	220.0
33	270.0	257.0	220.0
34	300.0	293.0	222.0
35	314.0	260.0	250.0
36	327.0	249.0	238.0
37	320.0	NaN	240.0
38	263.0	273.0	326.0
39	340.0	223.0	307.0
40	297.0	297.0	207.0
41	278.0	287.0	224.0
42	316.0	309.0	208.0
43	318.0	302.0	245.0
44	300.0	303.0	245.0
45	310.0	307.0	238.0
46	230.0	210.0	231.0

	SUBIR Y BAJAR ESCALERAS_pred	TAPIZ RODANTE_gt	TAPIZ RODANTE_pred \
0	NaN	3347	NaN
1	218.0	3134	3481.0
2	218.0	3131	3153.0
3	245.0	3117	3398.0
4	241.0	2387	2387.0
5	239.0	2891	3040.0
6	233.0	2228	2130.0
7	NaN	3252	NaN
8	203.0	3218	3268.0
9	236.0	3426	3414.0
10	229.0	3413	3301.0
11	218.0	3363	3407.0
12	250.0	2233	3184.0
13	229.0	2995	3148.0
14	242.0	3037	3251.0
15	206.0	3043	2959.0
16	275.0	3491	2974.0
17	223.0	2565	2676.0
18	222.0	2826	2795.0
19	235.0	2356	2367.0

20	237.0	2908	3151.0
21	NaN	2182	NaN
22	224.0	482	3403.0
23	240.0	2630	3258.0
24	214.0	2994	3164.0
25	211.0	3317	3085.0
26	241.0	3366	3364.0
27	242.0	3451	3400.0
28	221.0	2219	2593.0
29	229.0	3493	3415.0
30	230.0	3606	2476.0
31	234.0	3065	2816.0
32	219.0	3295	3411.0
33	208.0	3175	3135.0
34	221.0	3203	3241.0
35	240.0	3519	3284.0
36	238.0	3539	3514.0
37	NaN	3154	NaN
38	236.0	3156	3242.0
39	248.0	2487	2558.0
40	206.0	2313	2312.0
41	230.0	2910	3173.0
42	202.0	2905	3175.0
43	245.0	3244	3318.0
44	244.0	3167	3210.0
45	232.0	3276	3326.0
46	218.0	3102	3156.0

	CINTA E1	CINTA E2	CINTA E3	CINTA E4	CINTA E5	CINTA E6	CINTA E7	\
0	309.0	376.0	430.0	474.0	510.0	616.0	632.0	
1	338.0	407.0	446.0	485.0	610.0	648.0	200.0	
2	306.0	344.0	403.0	447.0	488.0	530.0	613.0	
3	280.0	331.0	400.0	444.0	489.0	533.0	640.0	
4	426.0	469.0	472.0	498.0	522.0	NaN	NaN	
5	284.0	333.0	373.0	417.0	455.0	486.0	543.0	
6	338.0	389.0	424.0	461.0	506.0	110.0	NaN	
7	295.0	365.0	415.0	462.0	502.0	577.0	636.0	
8	310.0	373.0	416.0	457.0	488.0	528.0	646.0	
9	305.0	402.0	454.0	487.0	515.0	611.0	652.0	
10	308.0	371.0	435.0	480.0	526.0	638.0	655.0	
11	287.0	360.0	421.0	465.0	514.0	649.0	667.0	
12	323.0	310.0	394.0	441.0	470.0	295.0	NaN	
13	280.0	333.0	375.0	415.0	458.0	504.0	630.0	
14	272.0	330.0	388.0	432.0	467.0	508.0	640.0	
15	457.0	498.0	578.0	585.0	608.0	317.0	NaN	
16	323.0	401.0	450.0	485.0	523.0	646.0	663.0	
17	305.0	355.0	391.0	428.0	466.0	620.0	NaN	

18	363.0	399.0	438.0	471.0	510.0	645.0	NaN
19	420.0	448.0	452.0	486.0	550.0	NaN	NaN
20	274.0	320.0	395.0	421.0	450.0	480.0	568.0
21	276.0	320.0	373.0	410.0	453.0	350.0	NaN
22	285.0	197.0	NaN	NaN	NaN	NaN	NaN
23	283.0	339.0	386.0	426.0	475.0	504.0	217.0
24	288.0	335.0	383.0	416.0	453.0	546.0	573.0
25	330.0	359.0	406.0	449.0	492.0	614.0	667.0
26	362.0	402.0	445.0	478.0	507.0	549.0	623.0
27	333.0	390.0	448.0	478.0	518.0	633.0	651.0
28	310.0	364.0	415.0	456.0	502.0	172.0	NaN
29	346.0	402.0	456.0	488.0	525.0	640.0	636.0
30	359.0	435.0	464.0	496.0	528.0	657.0	667.0
31	420.0	443.0	474.0	496.0	532.0	700.0	NaN
32	294.0	365.0	421.0	460.0	496.0	624.0	635.0
33	307.0	350.0	400.0	448.0	480.0	530.0	660.0
34	332.0	380.0	410.0	443.0	477.0	523.0	638.0
35	336.0	389.0	438.0	492.0	536.0	650.0	678.0
36	380.0	437.0	474.0	506.0	534.0	568.0	640.0
37	288.0	348.0	405.0	449.0	488.0	553.0	623.0
38	316.0	366.0	406.0	434.0	466.0	566.0	602.0
39	336.0	332.0	390.0	438.0	475.0	516.0	NaN
40	406.0	411.0	431.0	472.0	593.0	NaN	NaN
41	272.0	313.0	374.0	421.0	470.0	506.0	554.0
42	264.0	323.0	382.0	422.0	447.0	483.0	584.0
43	299.0	355.0	425.0	465.0	498.0	537.0	665.0
44	309.0	379.0	423.0	444.0	475.0	506.0	631.0
45	297.0	360.0	417.0	455.0	490.0	608.0	649.0
46	323.0	352.0	403.0	447.0	482.0	522.0	573.0

VUELTA A LA CALMA

0	38.0
1	NaN
2	90.0
3	127.0
4	220.0
5	61.0
6	140.0
7	85.0
8	93.0
9	48.0
10	156.0
11	134.0
12	NaN
13	188.0
14	127.0
15	NaN

16	155.0
17	60.0
18	124.0
19	77.0
20	166.0
21	NaN
22	NaN
23	NaN
24	70.0
25	111.0
26	200.0
27	215.0
28	NaN
29	43.0
30	110.0
31	236.0
32	80.0
33	157.0
34	78.0
35	78.0
36	90.0
37	32.0
38	76.0
39	61.0
40	55.0
41	55.0
42	42.0
43	88.0
44	80.0
45	74.0
46	80.0

1.0.2 Vamos a explorar la analítica visual de los resultados

```
[43]: import matplotlib.pyplot as plt
import seaborn as sns

# Detectamos actividades automáticamente
actividades = sorted({col.replace("_gt", "") for col in df.columns if col.
    ↪endswith("_gt")})

# Configuración de la figura
n = len(actividades)
cols = 3
rows = (n + cols - 1) // cols

plt.figure(figsize=(15, rows * 4))
```

```

for i, actividad in enumerate(actividades, 1):
    col_gt = actividad + "_gt"
    col_pred = actividad + "_pred"

    plt.subplot(rows, cols, i)
    sns.scatterplot(x=df[col_gt], y=df[col_pred], alpha=0.7)

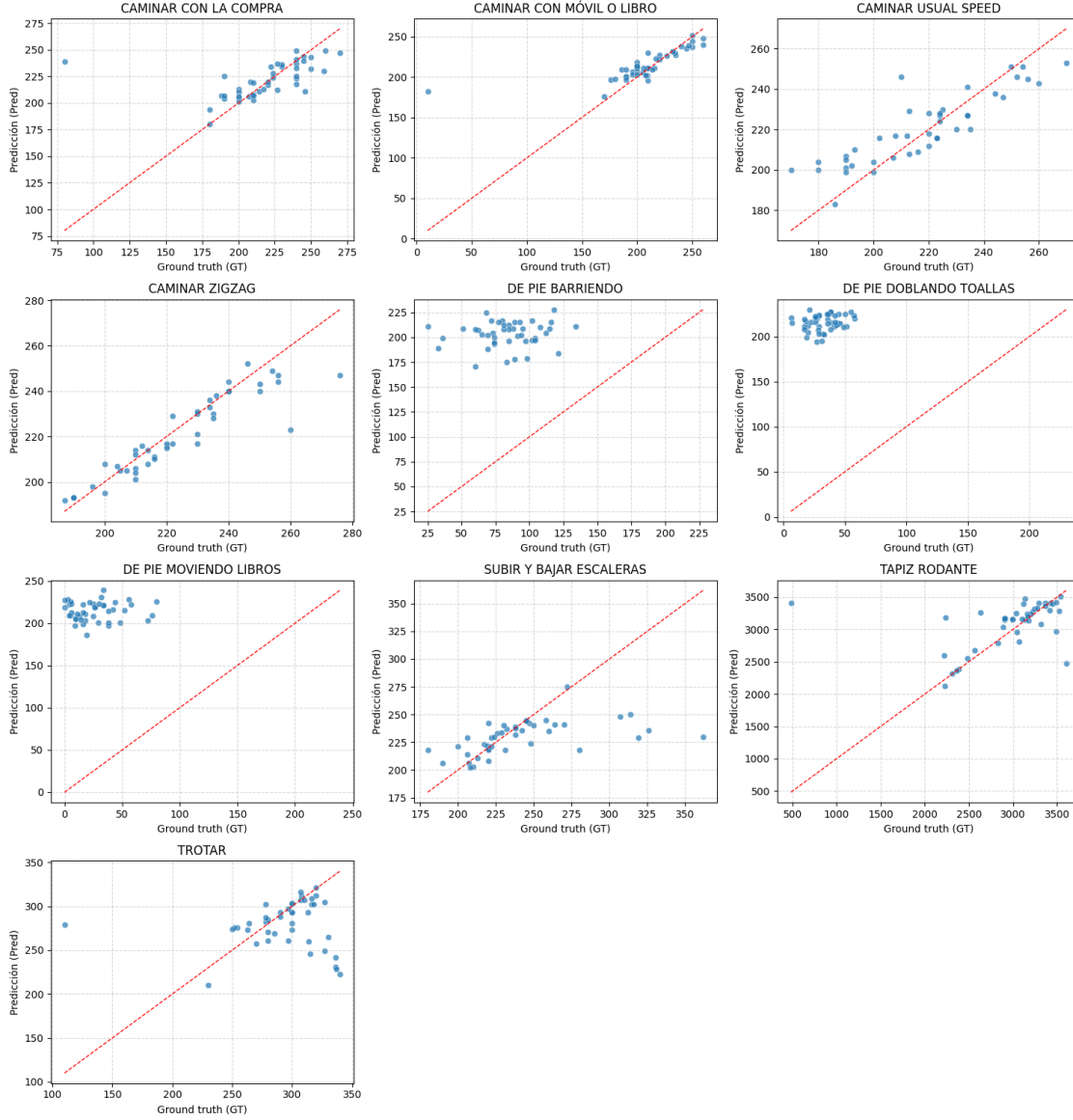
    # línea ideal (y=x)
    min_val = min(df[col_gt].min(), df[col_pred].min())
    max_val = max(df[col_gt].max(), df[col_pred].max())
    plt.plot([min_val, max_val], [min_val, max_val], 'r--', linewidth=1)

    plt.title(actividad)
    plt.xlabel("Ground truth (GT)")
    plt.ylabel("Predicción (Pred)")
    plt.grid(True, linestyle="--", alpha=0.5)

plt.suptitle("Comparación GT vs Pred por Actividad. Algoritmo_
↳MODEL_COG_WALKING_EVENTS", fontsize=18, y=1.02)
plt.tight_layout()
plt.show()

```

Comparación GT vs Pred por Actividad. Algoritmo MODEL_COG_WALKING_EVENTS



En los scatterplots se observa que el algoritmo MODEL_COG_WALKING_EVENTS es capaz de estimar el número de pasos con un error tolerable para las siguientes actividades: (1) caminar con la compra, (2) caminar con móvil o libro, (3) caminar usual speed, (4) caminar zigzag, (5) subir y bajar escaleras, (6) tapiz rodante y (7) trotar.

Sin embargo, aparece una cierta **tendencia a la sobreestimación** de pasos en las actividades del tipo “de pie + tarea”: (i) de pie barriendo, (ii) de pie doblando toallas y (iii) de pie moviendo libros.

1.0.3 Histograma de errores

```
[44]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Actividades a excluir (pie + tarea)
actividades_excluir = [
    "DE PIE DOBLANDO TOALLAS",
    "DE PIE MOVIENDO LIBROS",
    "DE PIE BARRIENDO"
]

# Detectar actividades válidas
actividades = sorted({
    col.replace("_gt", "")
    for col in df.columns
    if col.endswith("_gt") and col.replace("_gt", "") not in actividades_excluir
})

# Lista para almacenar métricas por actividad
results = []

for actividad in actividades:
    col_gt = actividad + "_gt"
    col_pred = actividad + "_pred"

    gt_vals = df[col_gt].values
    pred_vals = df[col_pred].values

    abs_errors = np.abs(pred_vals - gt_vals)
    rel_errors = np.where(gt_vals != 0, abs_errors / gt_vals * 100, np.nan)
    sq_errors = (pred_vals - gt_vals)**2

    mae = np.nanmean(abs_errors)
    rmse = np.sqrt(np.nanmean(sq_errors))
    mape = np.nanmean(rel_errors)

    results.append({
        "Actividad": actividad,
        "MAE": mae,
        "RMSE": rmse,
        "MAPE (%)": mape
    })

df_activities = pd.DataFrame(results)
```

```

# Métricas globales
global_mae = df_activities["MAE"].mean()
global_rmse = df_activities["RMSE"].mean()
global_mape = df_activities["MAPE (%)"].mean()

# Histograma MAPE
plt.figure(figsize=(12, 6))

sns.barplot(
    data=df_activities.sort_values("MAPE (%)"),
    x="Actividad",
    y="MAPE (%)",
    palette="viridis"
)

plt.xticks(rotation=90)
plt.ylabel("Error relativo por actividad (MAPE %)")
plt.xlabel("Actividad")

plt.title(
    f"Error relativo por actividad (sin pie+task) - "
    f"MAPE global={global_mape:.2f}%, MAE={global_mae:.2f}, RMSE={global_rmse:.2f}",
    fontsize=15
)

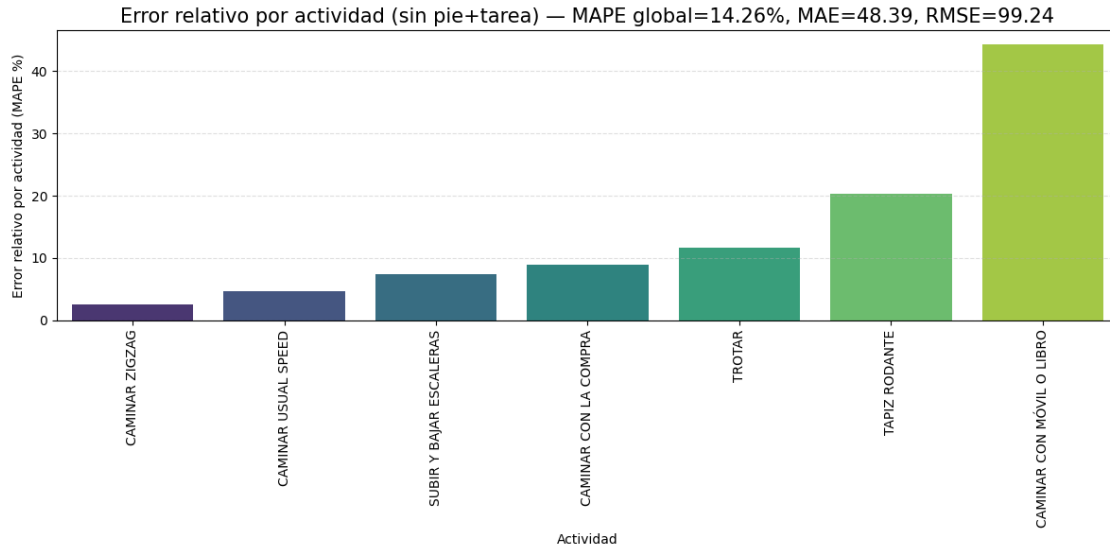
plt.grid(axis="y", linestyle="--", alpha=0.4)
plt.tight_layout()
plt.show()

```

/var/folders/fp/t8p3dx9d0jl0pw332jhykt5c0000gn/T/ipykernel_19111/1379740014.py:5
 5: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

```
sns.barplot(
```



- Error absoluto medio:

$$MAE = \frac{1}{N} \sum_{i=1}^N |y_i - \hat{y}_i|$$

- Error cuadrático medio:

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (y_i - \hat{y}_i)^2}$$

- Error absoluto medio porcentual (~ error relativo):

$$MAPE = \frac{100}{N} \sum_{i=1}^N \left| \frac{y_i - \hat{y}_i}{y_i} \right|$$

Los valores ligeramente elevados en ‘tapiz rodante’ y ‘caminar con móvil o libro’ seguramente se deben a outliers en algún participante.

1.1 ¿Tenemos valores atípicos en nuestras métricas de error porcentuales MAPE?

En las actividades ‘tapiz rodante’ y ‘caminar con móvil o libro’ hemos observado un valor de MAPE elevado, ¿es debido a la presencia de outliers para algún participante? Para comprobarlo vamos a dibujar los **histogramas de MAPE de estas dos actividades segregados en función del identificador del participante**.

```
[45]: # -----
# 1. Actividades de interés
# -----

actividad_cinta = "TAPIZ RODANTE"
```

```

actividad_movil = "CAMINAR CON MÓVIL O LIBRO" # ajusta si es otra

actividades_objetivo = [actividad_cinta, actividad_movil]

# -----
# 2. Crear dataframe con errores por participante
# -----

errores = []

for actividad in actividades_objetivo:
    col_gt = actividad + "_gt"
    col_pred = actividad + "_pred"

    for participante, row in df.groupby("PARTICIPANTE"):
        gt_vals = row[col_gt].values
        pred_vals = row[col_pred].values

        abs_error = np.abs(pred_vals - gt_vals).mean()
        mape = np.mean(np.where(gt_vals != 0,
                                abs_error / gt_vals * 100,
                                np.nan))

        errores.append({
            "PARTICIPANTE": participante,
            "Actividad": actividad,
            "Error absoluto": abs_error,
            "MAPE (%)": mape
        })

df_err = pd.DataFrame(errores)

plt.figure(figsize=(14, 6))

# --- Tapiz rodante ---
plt.subplot(1, 2, 1)
data_cinta = df_err[df_err["Actividad"] == actividad_cinta]
sns.barplot(data=data_cinta, x="PARTICIPANTE", y="MAPE (%)", palette="mako")
plt.xticks(rotation=90)
plt.title(f"Error relativo por participante - {actividad_cinta}")
plt.ylabel("MAPE (%)")
plt.grid(axis="y", linestyle="--", alpha=0.4)

# --- Caminar con móvil ---
plt.subplot(1, 2, 2)
data_movil = df_err[df_err["Actividad"] == actividad_movil]

```

```
sns.barplot(data=data_movil, x="PARTICIPANTE", y="MAPE (%)", palette="viridis")
plt.xticks(rotation=90)
plt.title(f"Error relativo por participante - {actividad_movil}")
plt.ylabel("MAPE (%)")
plt.grid(axis="y", linestyle="--", alpha=0.4)

plt.tight_layout()
plt.show()
```

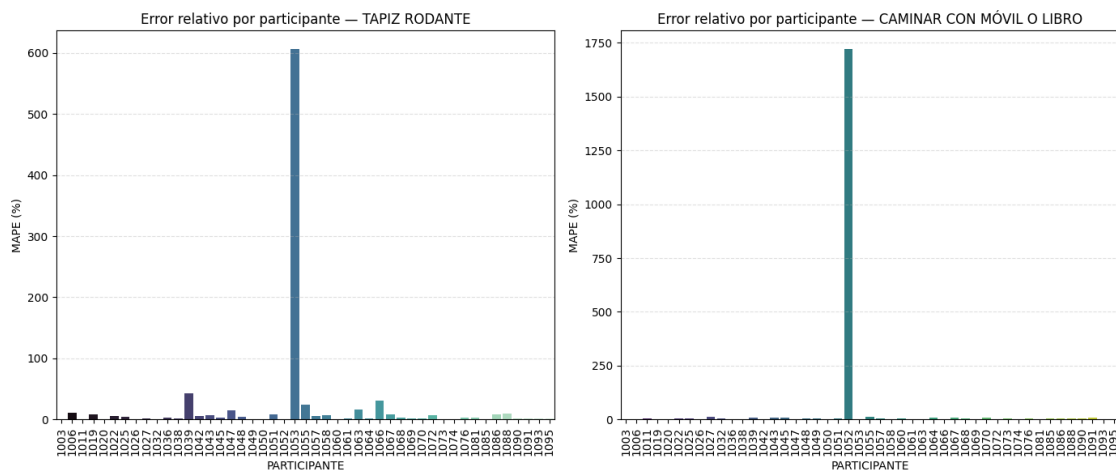
/var/folders/fp/t8p3dx9d0jl0pw332jhykt5c0000gn/T/ipykernel_19111/3377864723.py:4
4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

```
sns.barplot(data=data_cinta, x="PARTICIPANTE", y="MAPE (%)", palette="mako")
/var/folders/fp/t8p3dx9d0jl0pw332jhykt5c0000gn/T/ipykernel_19111/3377864723.py:5  
3: FutureWarning:
```

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

```
sns.barplot(data=data_movil, x="PARTICIPANTE", y="MAPE (%)",
palette="viridis")
```



En efecto, **existen valores atípicos para la distribución de MAPE:**

- En la actividad ‘tapiz rodante’ hay un *outlier* muy pronunciado en el participante PMP1053, siendo también no despreciables los existentes en PMP1039, PMP1055 y PMP1066.
- La actividad ‘caminar con móvil o libro’ manifiesta un claro *outlier* para el número de pasos

en el participante PMP1052. El valor de ground-truth registrado es 10 pasos, el cual puede deberse a dificultades en la cuenta manual de pasos por oclusiones en la cámara. La tendencia observada es que el número de pasos registrados como ground-truth para la actividad ‘caminar con móvil o libro’ está en torno a 200 para todos los participantes.

Con el objetivo de evitar que las métricas globales de error estén sesgadas por posibles *outliers*, puede ser interesante aplicar un filtro de mediana previo. Otra alternativa podría ser **representar las distribuciones de MAPE a través de diagramas de cajas y bigotes**. Vamos a explorar esta vía:

```
[52]: # Detectar actividades automáticamente a partir de las columnas *_gt
actividades = sorted({col.replace("_gt", "") for col in df.columns if col.
    ↪endswith("_gt")})

registros = []

for actividad in actividades:
    col_gt = actividad + "_gt"
    col_pred = actividad + "_pred"

    for idx, row in df.iterrows():
        gt = row[col_gt]
        pred = row[col_pred]

        # Cálculo del MAPE por fila
        if gt != 0:
            mape = abs(pred - gt) / gt * 100
        else:
            mape = np.nan # evitar división por cero

        registros.append({
            "PARTICIPANTE": row["PARTICIPANTE"],
            "Actividad": actividad,
            "MAPE (%)": mape
        })

df_mape = pd.DataFrame(registros)

actividades_pie = [
    "DE PIE DOBLANDO TOALLAS",
    "DE PIE MOVIENDO LIBROS",
    "DE PIE BARRIENDO"
]

df_mape_filtrado = df_mape[~df_mape["Actividad"].isin(actividades_pie)]
```

```

import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(14, 6))

sns.boxplot(
    data=df_mape_filtrado,
    x="Actividad",
    y="MAPE (%)",
    showfliers=False,
    notch = True,
    palette="viridis"
)

plt.xticks(rotation=90)
plt.ylabel("MAPE (%)")
plt.xlabel("Actividad")
plt.title("Distribución del error relativo (MAPE%) por actividad (sin_
↳ actividades 'de pie + tarea').\n" \
"Algoritmo MODEL_COG_WALKING_EVENTS")
plt.grid(axis="y", linestyle="--", alpha=0.4)

plt.tight_layout()
plt.show()

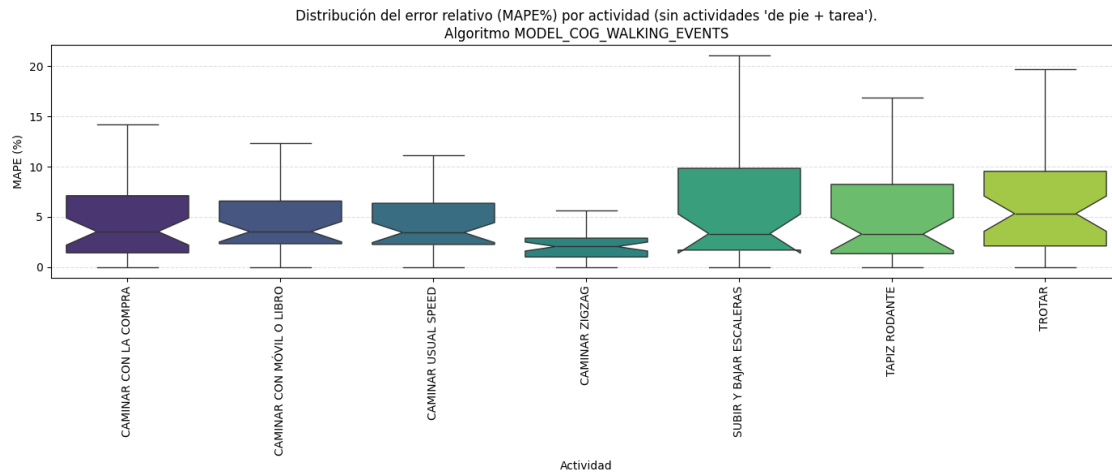
```

/var/folders/fp/t8p3dx9d0jl0pw332jhykt5c0000gn/T/ipykernel_19111/2218868827.py:4

4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

```
sns.boxplot(
```



Observamos que el valor mediano de MAPE para las diversas actividades se encuentra en torno al 5%. ¡O.K.!