02_analisis_consumo

December 5, 2025

0.0.1 02 - Análisis de consumo (consumo_filtrado)

Notebook exploratorio sobre el dataset filtrado (`consumo_filtrado.csv`): consumo de MP, scrap y capacidad por referencia/máquina.

Imports y opciones

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

pd.set_option("display.max_columns", 120)
pd.set_option("display.width", 160)
plt.style.use("seaborn-v0_8")
```

Carga del dataset filtrado

[2]:
```
PATH = "../../data/proccessed/consumo_filtrado.csv"

df = pd.read_csv(PATH, dtype=str)

# Parseo de fechas
for c in ["ts_ini","ts_fin","fecha","fecha_recepcion_ts"]:
    if c in df.columns:
        df[c] = pd.to_datetime(df[c], errors="coerce")

# Conversión numérica
num_cols = [
    "piezas_ok","piezas_scrap","qty_plan","qty_estimado","qty_in_almacen_dia",
    "horas_teoricas","reduccion_tco","horas_ajustadas","horas_enfermedad",
    "horas_accidente","horas_permiso","horas_netas","qty_recibida",
    "peso_bruto","uds","throughput_uph","scrap_rate","duracion_min",
    "downtime_min","consumo_materia_kg","lead_time_al_almacen_dias","peso_neto_kg",
    "flag_sin_peso","flag_con_peso"
]
for c in num_cols:
    if c in df.columns:
        df[c] = pd.to_numeric(df[c], errors="coerce")
```

```
# Normaliza referencias
if "ref_id_str" in df.columns:
    df["ref_id_str"] = (df["ref_id_str"].astype(str)
                            .str.replace(r"\.0$", "", regex=True)
                            .str.zfill(6))

print("Filas, columnas:", df.shape)
df.head(3)
```

```
Filas, columnas: (30948, 40)
```

[2]:

```
  work_order_id    op_id machine_id machine_name   planta  op_text ref_id_str
familia  peso_neto_kg material_lot_id ref_materia_str  \
0       24/0767  TALLADO         49  Talladora49  Abadiño  TALLADO     000305
CORONA DE ARRANQUE           5.0             NaN             NaN
1       24/0767  TALLADO         49  Talladora49  Abadiño  TALLADO     000305
CORONA DE ARRANQUE           5.0             NaN             NaN
2       24/0767  TALLADO         49  Talladora49  Abadiño  TALLADO     000305
CORONA DE ARRANQUE           5.0             NaN             NaN

               ts_ini              ts_fin      fecha  duracion_min       evento
tipo_incidencia  piezas_ok  piezas_scrap  qty_plan  qty_estimado  \
0 2025-01-28 00:50:00 2025-01-28 01:39:00 2025-01-28          49.0  Preparación
NaN          0             0       0.0         592.0
1 2025-01-28 05:17:00 2025-01-28 05:49:00 2025-01-28          32.0   Incidencia
AUSENCIA          0             0       0.0         592.0
2 2025-01-28 01:39:00 2025-01-28 06:29:00 2025-01-28         290.0   Producción
NaN        105             3       0.0         592.0

   qty_in_almacen_dia  año_mes  horas_teoricas  reduccion_tco  horas_ajustadas
horas_enfermedad  horas_accidente  horas_permiso  horas_netas  qty_recibida  \
0                 NaN  2025-01         12350.0          788.0          11562.0
752.0              0.0          390.0      10420.0           NaN
1                 NaN  2025-01         12350.0          788.0          11562.0
752.0              0.0          390.0      10420.0           NaN
2                 NaN  2025-01         12350.0          788.0          11562.0
752.0              0.0          390.0      10420.0           NaN

   peso_bruto  uds fecha_recepcion_ts  throughput_uph  scrap_rate  downtime_min
consumo_materia_kg  flag_sin_peso  flag_con_peso
0         NaN  NaN                NaT        0.000000         NaN           0.0
0.0              0              1
1         NaN  NaN                NaT        0.000000         NaN          32.0
0.0              0              1
2         NaN  NaN                NaT       21.724138    0.027778           0.0
525.0            0              1
```

Resumen y nulos

[3]:
```
# Nulos por columna (top 10)
nulls = df.isna().sum().sort_values(ascending=False)
total = len(df)
nulls_df = (
    pd.DataFrame({"nulos": nulls, "total_filas": total})
      .assign(pct=lambda d: (d["nulos"]/d["total_filas"]) * 100)
      .sort_values("nulos", ascending=False)
)
nulls_df.head(10)
```

[3]:

	nulos	total_filas	pct
scrap_rate	20302	30948	65.600362
qty_in_almacen_dia	17494	30948	56.527078
tipo_incidencia	11945	30948	38.597001
ref_materia_str	6216	30948	20.085304
material_lot_id	6216	30948	20.085304
qty_recibida	6216	30948	20.085304
uds	6216	30948	20.085304
peso_bruto	6216	30948	20.085304
fecha_recepcion_ts	6216	30948	20.085304
throughput_uph	499	30948	1.612382

Agregados por referencia

[4]:
```
ref_agg = (
    df.groupby("ref_id_str", dropna=False)
      .agg(
          piezas_ok_totales=("piezas_ok","sum"),
          piezas_scrap_totales=("piezas_scrap","sum"),
          consumo_materia_kg_total=("consumo_materia_kg","sum"),
          peso_neto_kg_media=("peso_neto_kg","mean"),
          scrap_rate_medio=("scrap_rate","mean"),
          throughput_uph_medio=("throughput_uph","mean"),
      )
      .reset_index()
)

ref_agg["yield_kg_ok"] = ref_agg["piezas_ok_totales"] *␣
 ↪ref_agg["peso_neto_kg_media"]
ref_agg["kg_scrap_estimados"] = ref_agg["consumo_materia_kg_total"] -␣
 ↪ref_agg["yield_kg_ok"]
ref_agg["ratio_mp_por_1000_ok"] = np.where(
    (ref_agg["piezas_ok_totales"]>0) & (ref_agg["consumo_materia_kg_total"]>0),
    ref_agg["consumo_materia_kg_total"] / (ref_agg["piezas_ok_totales"] / 1000),
    np.nan
)
```

```
ref_agg["peso_positivo"] = ref_agg["peso_neto_kg_media"] > 0

ref_agg.sort_values("consumo_materia_kg_total", ascending=False).head(10)
```

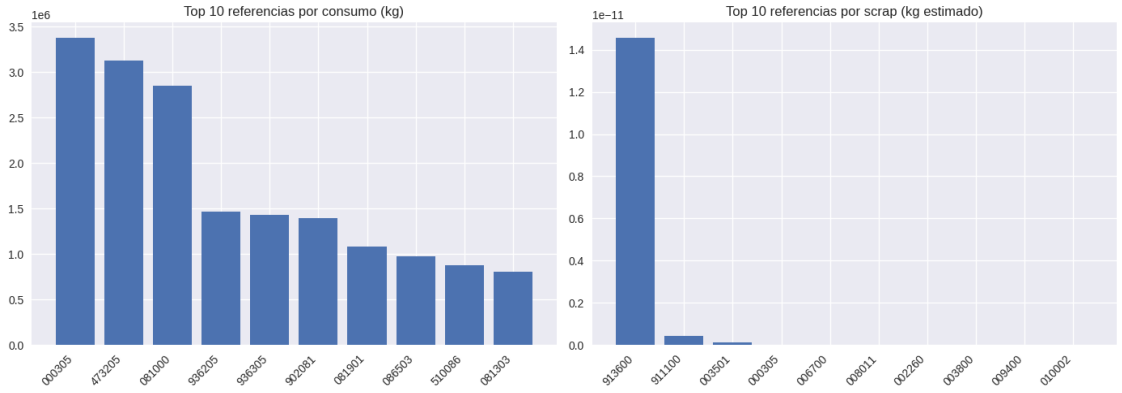
[4]:

ref_id_str	piezas_ok_totales	piezas_scrap_totales	consumo_materia_kg_total	peso_neto_kg_media	scrap_rate_medio	throughput_uph_medio	yield_kg_ok	kg_scrap_estimados	ratio_mp_por_1000_ok	peso_positivo
0	000305	674852	547	3374260.00	5.00	0.041888	198.002387	3374260.00	0.000000e+00	5000.0	True
32	473205	608250	535	3126405.00	5.14	0.047713	770.718554	3126405.00	0.000000e+00	5140.0	True
13	081000	1794108	1236	2852631.72	1.59	0.008730	923.204754	2852631.72	0.000000e+00	1590.0	True
46	936205	523009	671	1464425.20	2.80	0.047718	650.685140	1464425.20	0.000000e+00	2800.0	True
47	936305	483990	484	1432610.40	2.96	0.041304	180.207614	1432610.40	0.000000e+00	2960.0	True
40	902081	1381366	1779	1395179.66	1.01	0.025736	163.080171	1395179.66	0.000000e+00	1010.0	True
20	081901	1214710	1003	1081091.90	0.89	0.015484	295.898823	1081091.90	-2.328306e-10	890.0	True
22	086503	1191777	633	977257.14	0.82	0.018439	279.711128	977257.14	-1.164153e-10	820.0	True
33	510086	325931	357	880013.70	2.70	0.058031	419.190875	880013.70	0.000000e+00	2700.0	True
16	081303	1235060	1314	802789.00	0.65	0.022599	434.333183	802789.00	0.000000e+00	650.0	True

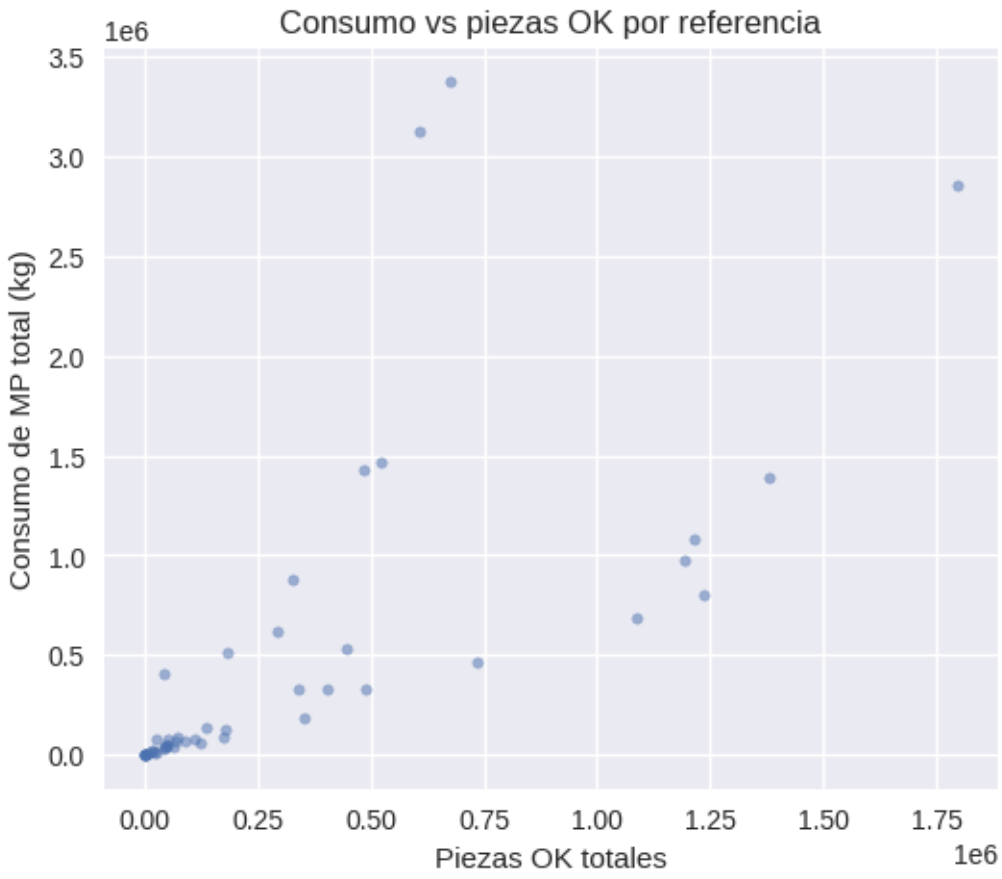
[5]:
```
# Top referencias por consumo y scrap
fig, axes = plt.subplots(1, 2, figsize=(14, 5))

ref_top_consumo = ref_agg.sort_values("consumo_materia_kg_total",␣
 ↪ascending=False).head(10)
axes[0].bar(ref_top_consumo["ref_id_str"],␣
 ↪ref_top_consumo["consumo_materia_kg_total"])
axes[0].set_title("Top 10 referencias por consumo (kg)")
```

```
axes[0].set_xticklabels(ref_top_consumo["ref_id_str"], rotation=45, ha='right')

ref_top_scrap = ref_agg.sort_values("kg_scrap_estimados", ascending=False).
 ↪head(10)
axes[1].bar(ref_top_scrap["ref_id_str"], ref_top_scrap["kg_scrap_estimados"])
axes[1].set_title("Top 10 referencias por scrap (kg estimado)")
axes[1].set_xticklabels(ref_top_scrap["ref_id_str"], rotation=45, ha='right')

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

```
/tmp/ipykernel_39226/3842757625.py:7: UserWarning: set_ticklabels() should only
be used with a fixed number of ticks, i.e. after set_ticks() or using a
FixedLocator.
  axes[0].set_xticklabels(ref_top_consumo["ref_id_str"], rotation=45,
ha='right')
/tmp/ipykernel_39226/3842757625.py:12: UserWarning: set_ticklabels() should only
be used with a fixed number of ticks, i.e. after set_ticks() or using a
FixedLocator.
  axes[1].set_xticklabels(ref_top_scrap["ref_id_str"], rotation=45, ha='right')
```



[6]:
```
# Dispersión piezas OK vs consumo
plt.figure(figsize=(6,5))
plt.scatter(ref_agg["piezas_ok_totales"], ref_agg["consumo_materia_kg_total"],␣
 ↪alpha=0.5, s=15)
plt.xlabel("Piezas OK totales")
plt.ylabel("Consumo de MP total (kg)")
plt.title("Consumo vs piezas OK por referencia")
plt.show()
```



Por máquina y referencia

[7]:
```
ref_machine = (
    df.groupby(["ref_id_str","machine_id","machine_name"], dropna=False)
      .agg(
          throughput_uph_medio=("throughput_uph","mean"),
          scrap_rate_medio=("scrap_rate","mean"),
          duracion_min_media=("duracion_min","mean"),
          piezas_ok_por_evento=("piezas_ok","mean"),
      )
      .reset_index()
)

if "lead_time_al_almacen_dias" in df.columns:
    lead = (
        df.groupby(["ref_id_str","machine_id","machine_name"], dropna=False)
          .agg(lead_time_dias_medio=("lead_time_al_almacen_dias","mean"))
          .reset_index()
    )
```

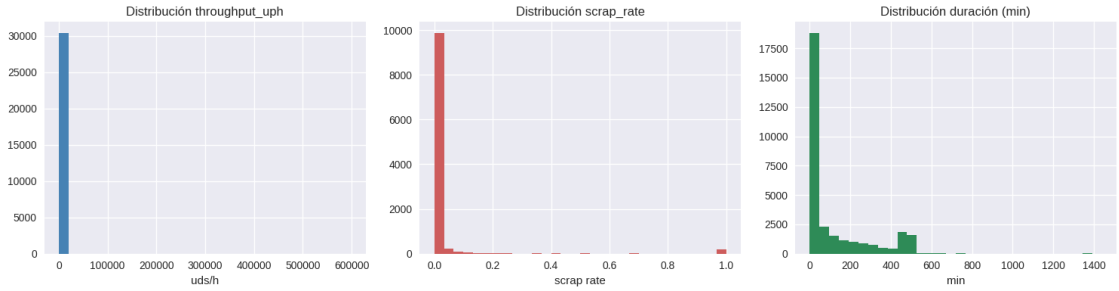
```
    ref_machine = ref_machine.merge(lead,␣
 ↪on=["ref_id_str","machine_id","machine_name"], how="left")

ref_machine.sort_values("throughput_uph_medio", ascending=False).head(10)
```

[7]:

ref_id_str	machine_id	machine_name	throughput_uph_medio	scrap_rate_medio	duracion_min_media	piezas_ok_por_evento
345	563404	505	SOLDADORA	109840.909091	0.250000	14.500000	993.375000
420	911100	27	Prensa27	58144.827586	0.000000	15.000000	1223.333333
153	081505	542	Soldadora Ideal DD0101	31372.454573	0.000043	108.000000	3021.800000
301	473205	118	Horno	14820.657644	0.000000	200.125000	2985.075000
380	902081	118	Horno	14542.853020	0.000000	135.000000	3757.833333
431	913600	542	Soldadora Ideal DD0101	13521.595818	0.000341	83.545455	2023.090909
145	081303	517	Granalladora Sthick	11556.779775	0.000000	210.256410	3785.076923
454	936205	110	Granalladora	11304.443824	0.000373	73.884615	2759.461538
441	936105	118	Horno	11041.193086	0.000000	185.416667	2886.666667
314	510086	118	Horno	9964.534041	0.000000	191.250000	3510.000000

Distribuciones básicas

[8]:
```
fig, axes = plt.subplots(1, 3, figsize=(15, 4))

axes[0].hist(df["throughput_uph"].dropna(), bins=30, color='steelblue')
axes[0].set_title("Distribución throughput_uph")
axes[0].set_xlabel("uds/h")

axes[1].hist(df["scrap_rate"].dropna(), bins=30, color='indianred')
axes[1].set_title("Distribución scrap_rate")
axes[1].set_xlabel("scrap rate")

axes[2].hist(df["duracion_min"].dropna(), bins=30, color='seagreen')
axes[2].set_title("Distribución duración (min)")
axes[2].set_xlabel("min")

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



Export de resumen por referencia

[9]:
```
# Guardar resumen por referencia para uso rápido
OUTPUT_REF = "../../data/proccessed/consumo_ref_summary.csv"
ref_agg.to_csv(OUTPUT_REF, index=False)
print("Guardado:", OUTPUT_REF)
ref_agg.head(3)
```

```
Guardado: ../../data/proccessed/consumo_ref_summary.csv
```

[9]:

	ref_id_str	piezas_ok_totales	piezas_scrap_totales	consumo_materia_kg_total	yield_kg_ok	\
0	000305	674852	547	3374260.000		
5.000	0.041888	198.002387	3374260.000			
1	002260	86	0	84.538		
0.983	0.000000	452.910448	84.538			
2	003501	868	31	824.600		
0.950	0.050880	9.436678	824.600			

	kg_scrap_estimados	ratio_mp_por_1000_ok	peso_positivo
0	0.000000e+00	5000.0	True
1	0.000000e+00	983.0	True
2	1.136868e-13	950.0	True