

example-patient

December 30, 2018

1 Plot example data for a single patient

From Alistair E.W. Johnson, et al, [MIMIC-III, a freely accessible critical care database](#), *Scientific Data*, 2016-05-24 online.

Slightly modified from `example-patient.ipynb` from [MIT-LCP/mimic-iii-paper GitHub page](#) in notebooks folder.

```
In [1]: import datetime
        start_time = datetime.datetime.now()
        print (start_time)
```

2018-12-30 00:26:54.937864

```
In [2]: # Import libraries
        import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import psycpg2
        %matplotlib inline
```

```
In [3]: # Config
        sqluser = 'postgres'
        dbname = 'mimic'
        schema_name = 'mimiciii'
```

```
In [4]: # Connect to MIMIC
        con = psycpg2.connect(dbname=dbname, user=sqluser)
        cur = con.cursor()
        cur.execute('SET search_path to ' + schema_name)
```

```
In [5]: # Select a single ICU stay
        icustay_id = 293325
```

```
In [6]: # Load admissions
        query = """
        SELECT ad.subject_id
               , ad.hadm_id
```

```

    , ad.admission_type
    , ad.diagnosis
    , ic.icustay_id
    , ic.first_careunit
    , ic.last_careunit
    , ic.intime as icu_intime
    , ad.hospital_expire_flag
    , pa.expire_flag
FROM admissions ad
INNER JOIN icustays ic
ON ad.subject_id = ic.subject_id
INNER JOIN patients pa
ON ad.subject_id = pa.subject_id
WHERE ic.icustay_id = "" + str(icustay_id) + ""
ORDER BY ic.intime
""

```

```
admissions = pd.read_sql_query(query, con)
```

```
In [7]: # First few rows of admissions
admissions.head()
```

```
Out[7]:
```

	subject_id	hadm_id	admission_type	diagnosis	icustay_id	\
0	62534	181366	EMERGENCY	NEUTROPENIC FEVER	293325	

	first_careunit	last_careunit	icu_intime	hospital_expire_flag	\
0	MICU	MICU	2120-10-29 10:32:50		1

	expire_flag
0	1

```
In [8]: # Load chartevents
query = ""
SELECT ce.icustay_id
    , ce.charttime
    , ce.charttime - ie.intime AS icutime
    , di.label
    , ce.value
    , ce.valuenum
    , ce.valueuom
FROM chartevents ce
INNER join d_items di
ON ce.itemid = di.itemid
INNER join icustays ie
ON ce.icustay_id = ie.icustay_id
WHERE ce.icustay_id = "" + str(icustay_id) + ""
AND error != 1
ORDER BY ce.charttime

```

```

"""

charts = pd.read_sql_query(query, con)

In [9]: # First few rows of charts
charts.head()

Out[9]:
```

	icustay_id	charttime	icutime	label \
0	293325	2120-10-29 10:30:00 -1 days +23:57:10		Inspired O2 Fraction
1	293325	2120-10-29 10:30:00 -1 days +23:57:10		O2 Flow
2	293325	2120-10-29 10:30:00 -1 days +23:57:10		O2 Delivery Device(s)
3	293325	2120-10-29 10:32:00 -1 days +23:59:10		Religion
4	293325	2120-10-29 10:32:00 -1 days +23:59:10		Patient Location

	value	valuenum	valueuom
0	70	70.0	None
1	10	10.0	L/min
2	Aerosol-cool	NaN	None
3	Protestant	7.0	None
4	4I	NaN	None

```

In [10]: # Load outputevents
query = """
SELECT oe.icustay_id
      , oe.charttime
      , oe.charttime - ie.intime AS icutime
      , di.label
      , oe.value
      , oe.valueuom
FROM outputevents oe
INNER JOIN icustays ie
  ON oe.icustay_id = ie.icustay_id
INNER JOIN d_items di
  ON oe.itemid = di.itemid
WHERE oe.icustay_id = """ + str(icustay_id) + """
ORDER BY oe.charttime
"""

outputs = pd.read_sql_query(query, con)

```

```

In [11]: # First few rows of outputs
outputs.head()

Out[11]:
```

	icustay_id	charttime	icutime	label	value	valueuom
0	293325	2120-10-29 10:45:00	00:12:10	Foley	50.0	mL
1	293325	2120-10-29 11:30:00	00:57:10	Foley	100.0	mL
2	293325	2120-10-29 12:00:00	01:27:10	Foley	35.0	mL
3	293325	2120-10-29 13:00:00	02:27:10	Foley	50.0	mL
4	293325	2120-10-29 14:00:00	03:27:10	Foley	40.0	mL

```
In [12]: # Load inputevents
query = """
SELECT inp.icustay_id
      , inp.starttime
      , inp.endtime
      , inp.starttime - ie.intime AS icustarttime
      , inp.endtime - ie.intime AS icuendtime
      , di.label
      , inp.amount
      , inp.amountuom
      , inp.rate
      , inp.rateuom
FROM inputevents_mv inp
INNER join icustays ie
  ON inp.icustay_id = ie.icustay_id
INNER join d_items di
  ON inp.itemid = di.itemid
WHERE inp.icustay_id = "" + str(icustay_id) + ""
AND lower(inp.statusdescription) != 'rewritten'
ORDER BY inp.starttime
"""
```

```
inputs = pd.read_sql_query(query,con)
```

```
In [13]: # First few rows of inputs
inputs.head()
```

```
Out[13]:
```

	icustay_id	starttime	endtime	icustarttime	\
0	293325	2120-10-29 11:57:00	2120-10-29 11:58:00	01:24:10	
1	293325	2120-10-29 12:00:00	2120-10-30 12:54:00	01:27:10	
2	293325	2120-10-29 15:52:00	2120-10-29 15:53:00	05:19:10	
3	293325	2120-10-29 15:52:00	2120-10-29 15:53:00	05:19:10	
4	293325	2120-10-29 16:15:00	2120-10-29 16:16:00	05:42:10	

	icuendtime	label	amount	amountuom	\
0	0 days 01:25:10	NaCl 0.9%	500.000000	ml	
1	1 days 02:21:10	NaCl 0.9%	250.000014	ml	
2	0 days 05:20:10	Dextrose 5%	100.000000	ml	
3	0 days 05:20:10	Piperacillin/Tazobactam (Zosyn)	1.000000	dose	
4	0 days 05:43:10	Dextrose 5%	100.000000	ml	

	rate	rateuom
0	NaN	None
1	10.040161	mL/hour
2	NaN	None
3	NaN	None
4	NaN	None

```
In [14]: # Load labevents
```

```

query = """
SELECT le.subject_id
      , ie.icustay_id
      , le.charttime
      , le.charttime - ie.intime AS icutime
      , di.label
      , le.value
      , le.valuenum
      , le.valueuom
FROM labevents le
INNER join icustays ie
      ON le.subject_id = ie.subject_id
      AND le.charttime >= ie.intime
      AND le.charttime <= ie.outtime
INNER JOIN d_labitems di
      ON le.itemid = di.itemid
WHERE ie.icustay_id = "" + str(icustay_id) + ""
ORDER BY le.charttime
"""

```

```

labs = pd.read_sql_query(query,con)

```

```

In [15]: # First few rows of labs
labs.head()

```

```

Out[15]:
  subject_id  icustay_id      charttime  icutime \
0         62534      293325  2120-10-29  11:42:00  01:09:10
1         62534      293325  2120-10-29  11:42:00  01:09:10
2         62534      293325  2120-10-29  11:42:00  01:09:10
3         62534      293325  2120-10-29  11:42:00  01:09:10
4         62534      293325  2120-10-29  11:42:00  01:09:10

      label value  valuenum valueuom
0      Red Blood Cells    2.64      2.64    m/uL
1  Lactate Dehydrogenase (LD)  1321    1321.00    IU/L
2      Magnesium      1.6      1.60    mg/dL
3      Basophils      0      0.00    %
4      Bands      35      35.00    %

```

```

In [16]: # Snip data to specified number of days
maxdays = 5;
charts = charts.loc[charts.icutime.dt.days<=maxdays]
outputs = outputs.loc[outputs.icutime.dt.days<=maxdays]
inputs = inputs.loc[inputs.icustarttime.dt.days<=maxdays]
labs = labs.loc[labs.icutime.dt.days<=maxdays]

```

```

In [17]: # Create column with minutes from ICU intime
charts['icutimehr'] = (charts['icutime'].dt.seconds/60/60)+(charts['icutime'].dt.days
outputs['icutimehr'] = (outputs['icutime'].dt.seconds/60/60)+(outputs['icutime'].dt.days

```

```

inputs['icustarttimehr'] = (inputs['icustarttime'].dt.seconds/60/60)+(inputs['icustarttime'].dt.days*24)
inputs['icuendtimehr'] = (inputs['icuendtime'].dt.seconds/60/60)+(inputs['icuendtime'].dt.days*24)
labs['icutimehr'] = (labs['icutime'].dt.seconds/60/60)+(labs['icutime'].dt.days*24)

```

```

In [18]: # What are the most commonly measured variables in charts?
charts['label'].value_counts().head()

```

```

Out[18]: O2 saturation pulseoxymetry    62
Respiratory Rate                        62
Heart Rate                             61
Heart Rhythm                           57
Ectopy Type 1                           56
Name: label, dtype: int64

```

```

In [19]: # What are the most commonly measured variables in charts?
outputs['label'].value_counts().head()

```

```

Out[19]: Foley    29
Name: label, dtype: int64

```

```

In [20]: # What are the most commonly measured variables in charts?
inputs['label'].value_counts().head()

```

```

Out[20]: Morphine Sulfate    19
Dextrose 5%                 13
NaCl 0.9%                   7
PO Intake                    6
Piperacillin/Tazobactam (Zosyn) 4
Name: label, dtype: int64

```

```

In [21]: # What are the most commonly measured variables in charts?
labs.mean()

```

```

Out[21]: subject_id    62534
icustay_id             293325
icutime    0 days 13:15:47.440000
valuenum    57.8909
icutimehr    13.2632
dtype: object

```

```

In [22]: # Get average values

```

```

hr_mean = charts.valuenum[charts.label=='Heart Rate'].mean()
bp_mean = charts.icutimehr[charts.label=='Non Invasive Blood Pressure mean'].mean()
temp_mean = ((charts.valuenum[charts.label=='Temperature Fahrenheit']-32)/1.8).mean()

# Print averages
print("Mean HR is: {0:.2f}".format(hr_mean))
print("Mean BP is: {0:.2f}".format(bp_mean))
print("Mean temp, C is: {0:.2f}".format(temp_mean))

```

Mean HR is: 98.89
Mean BP is: 22.62
Mean temp, C is: 36.33

```
In [23]: # Plot sample data over first 24 hours from admission to ICU
        # Credit: Randal Olson for styling (http://www.randalolson.com/2014/06/28/)

        # Prepare the size of the figure
        fig = plt.figure(figsize=(22, 20))
        plt.rcParams.update({'font.size': 22})

        # "Tableau 20" colors as RGB.
        tableau20 = [(31, 119, 180), (174, 199, 232), (255, 127, 14), (255, 187, 120),
                     (44, 160, 44), (152, 223, 138), (214, 39, 40), (255, 152, 150),
                     (148, 103, 189), (197, 176, 213), (140, 86, 75), (196, 156, 148),
                     (227, 119, 194), (247, 182, 210), (127, 127, 127), (199, 199, 199),
                     (188, 189, 34), (219, 219, 141), (23, 190, 207), (158, 218, 229)]

        # Scale the RGB values to the [0, 1] range, which is the format matplotlib accepts.
        for i in range(len(tableau20)):
            r, g, b = tableau20[i]
            tableau20[i] = (r / 255., g / 255., b / 255.)

        # Remove the plot frame lines.
        ax = plt.subplot(111)
        ax.spines["top"].set_visible(False)
        ax.spines["bottom"].set_visible(True)
        ax.spines["right"].set_visible(False)
        ax.spines["left"].set_visible(True)

        # Ensure that the axis ticks only show up on the bottom and left of the plot.
        ax.get_xaxis().tick_bottom()
        ax.get_yaxis().tick_left()
        ax.axis([0,60,0,225])

        # Plot vital signs
        plt.plot(charts.icutimehr[charts.label=='Heart Rate'],
                 charts.valuenum[charts.label=='Heart Rate'],
                 color=tableau20[6], lw=2.5,
                 marker='o', markersize=6, label='Heart rate')

        plt.plot(charts.icutimehr[charts.label=='O2 saturation pulseoxymetry'],
                 charts.valuenum[charts.label=='O2 saturation pulseoxymetry'],
                 color=tableau20[1], lw=2.5,
                 marker='o', markersize=6, label='O2 saturation')

        plt.plot(charts.icutimehr[charts.label=='Non Invasive Blood Pressure mean'],
```

```

        charts.valuenum[charts.label=='Non Invasive Blood Pressure mean'],
        color=tableau20[4], lw=2.5,
        marker='o', markersize=6, label='NIBP, mean')

plt.plot(charts.icutimehr[charts.label=='Respiratory Rate'],
        charts.valuenum[charts.label=='Respiratory Rate'],
        color=tableau20[2], lw=2.5,
        marker='o', markersize=6, label='Respiratory rate')

# for i, txt in enumerate(charts.value[charts.label=='Temperature Fahrenheit'].values):
#     plt.annotate(txt, (charts.icutimehr[charts.label=='Temperature Fahrenheit'].
#         values[i], 140), fontsize=15)

# Plot input/output events
plt.plot(inputs.icustarttimehr[inputs.amountuom=='mL'],
        inputs.amount[inputs.amountuom=='mL'].cumsum()/100,
        color=tableau20[9], lw=2.5,
        marker='o', markersize=6, label='Intake volume, dL')

plt.plot(outputs.icutimehr,
        outputs.value.cumsum()/100,
        color=tableau20[10], lw=2.5,
        marker='o', markersize=6, label='Output volume, dL')

# Plot intravenous meds
plt.text(-10, 150, 'NaCl 0.9%', fontsize=17)
for i, row in inputs.loc[(inputs["label"] == 'NaCl 0.9%') & (inputs["rate"] > 0)].iterrows():
    plt.plot([row['icustarttimehr'], row['icuendtimehr']], [150]*2,
            color=tableau20[16], lw=4, marker='o', markersize=6)
    plt.text(row['icustarttimehr'], 150,
            str(round(row['rate'], 1)) + ' ' + str(row['rateuom']),
            fontsize=15)

plt.text(-10, 145, 'Amiodarone', fontsize=17)
for i, row in inputs.loc[(inputs["label"] == 'Amiodarone 600/500') & (inputs["rate"] > 0)].iterrows():
    plt.plot([row['icustarttimehr'], row['icuendtimehr']], [145]*2,
            color=tableau20[16], lw=4, marker='o', markersize=6)
    plt.text(row['icustarttimehr'], 145,
            str(round(row['rate'], 1)) + ' ' + str(row['rateuom']),
            fontsize=15)

plt.text(-10, 140, 'Dextrose 5%', fontsize=17)
for i, row in inputs.loc[(inputs["label"] == 'Dextrose 5%')
    & (inputs["rate"] > 0) & (inputs["rate"] < 500)].iterrows():
    plt.plot([row['icustarttimehr'], row['icuendtimehr']], [140]*2,
            color=tableau20[16], lw=4, marker='o', markersize=6)
    plt.text(row['icustarttimehr'], 140,
            str(round(row['rate'], 1)) + ' ' + str(row['rateuom']),

```



```

        fontsize=15)

plt.text(-10,165,'Morphine Sulfate',fontsize=17)
plt.plot(inputs.icustarttimehr[inputs.label=='Morphine Sulfate'],
         [165]*len(inputs[inputs.label=='Morphine Sulfate']),
         color=tableau20[16], lw=0, marker='o', markersize=6)

plt.text(-10,160,'Vancomycin (1 dose)',fontsize=17)
plt.plot(inputs.icustarttimehr[inputs.label=='Vancomycin'],
         [160]*len(inputs[inputs.label=='Vancomycin']),
         color=tableau20[16], lw=0, marker='o', markersize=6)

plt.text(-10,155,'Piperacillin (1 dose)',fontsize=17)
plt.plot(inputs.icustarttimehr[inputs.label=='Piperacillin/Tazobactam (Zosyn)'],
         [155]*len(inputs[inputs.label=='Piperacillin/Tazobactam (Zosyn)']),
         color=tableau20[16], lw=0, marker='o', markersize=6)

# Plot labs
plt.text(-10,175,'Neutrophil, %',fontsize=17)
for i, txt in enumerate(labs.value[labs.label=='NEUTROPHILS'].values):
    plt.annotate(txt, (labs.icutimehr[labs.label=='NEUTROPHILS'].
                      values[i],175),fontsize=17)

plt.text(-10,180,'White blood cell, K/uL',fontsize=17)
for i, txt in enumerate(labs.value[labs.label=='WHITE BLOOD CELLS'].values):
    plt.annotate(txt, (labs.icutimehr[labs.label=='WHITE BLOOD CELLS'].
                      values[i],180),fontsize=17)

plt.text(-10,185,'Creatinine, mg/dL',fontsize=17)
for i, txt in enumerate(labs.value[labs.label=='CREATININE'].values):
    plt.annotate(txt, (labs.icutimehr[labs.label=='CREATININE'].
                      values[i],185),fontsize=17)

plt.text(-10,190,'Platelet, K/uL',fontsize=17)
for i, txt in enumerate(labs.value[labs.label=='PLATELET COUNT'].values):
    plt.annotate(txt, (labs.icutimehr[labs.label=='PLATELET COUNT'].
                      values[i],190),fontsize=17)

# Plot Glasgow Coma Scale
plt.text(-10,200,'GCS: Eye',fontsize=17)
for i, txt in enumerate(charts.value[charts.label=='GCS - Eye Opening'].values):
    if np.mod(i,2)==0 and i < 65:
        plt.annotate(txt, (charts.icutimehr[charts.label=='GCS - Eye Opening'].
                          values[i],200),fontsize=17)

plt.text(-10,205,'GCS: Motor',fontsize=17)
for i, txt in enumerate(charts.value[charts.label=='GCS - Motor Response'].values):

```

```

if np.mod(i,2)==0 and i < 65:
    plt.annotate(txt, (charts.icutimehr[charts.label=='GCS - Motor Response'].
        values[i],205),fontsize=17)

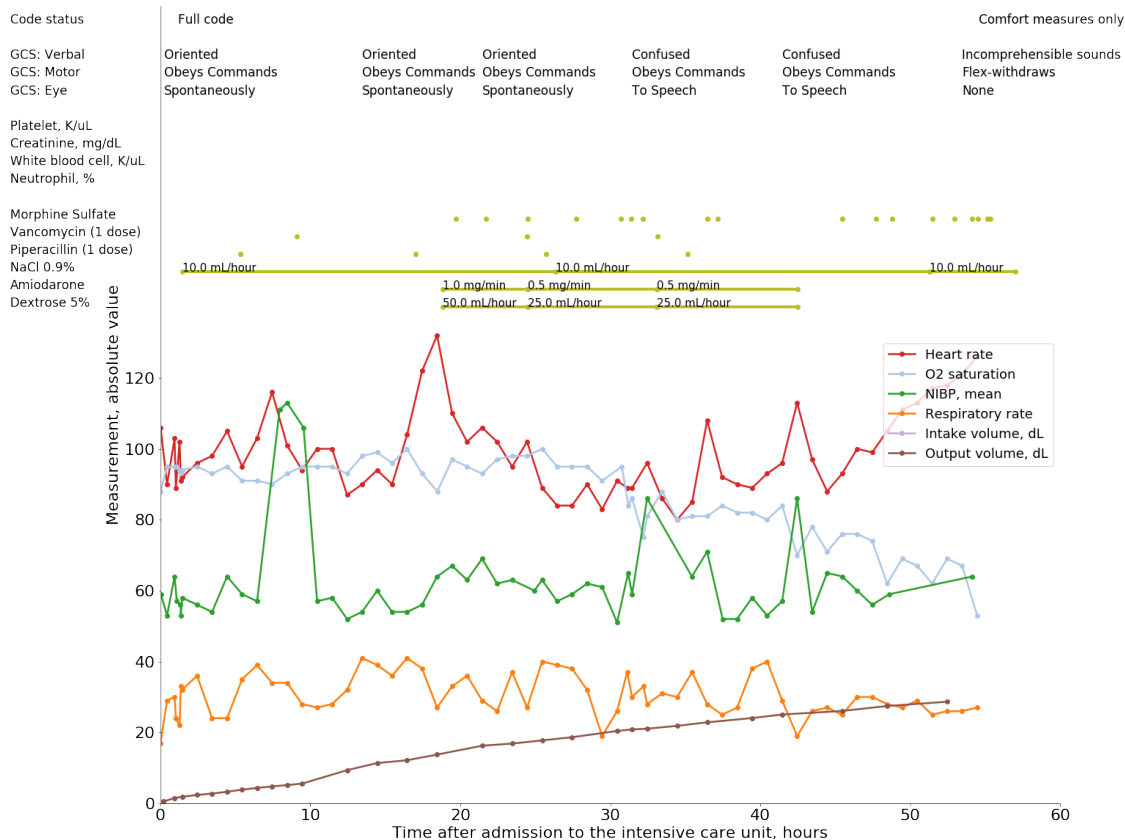
plt.text(-10,210,'GCS: Verbal',fontsize=17)
for i, txt in enumerate(charts.value[charts.label=='GCS - Verbal Response'].values):
    if np.mod(i,2)==0 and i < 65:
        plt.annotate(txt, (charts.icutimehr[charts.label=='GCS - Verbal Response'].
            values[i],210),fontsize=17)

# Plot code status
plt.text(-10,220,'Code status',fontsize=17)
for i, txt in enumerate(charts.value[charts.label=='Code Status'].values):
    plt.annotate(txt, (charts.icutimehr[charts.label=='Code Status'].
        values[i],220),fontsize=17)

plt.legend(loc=5,fontsize=18)
plt.xlabel('Time after admission to the intensive care unit, hours', fontsize=22)
plt.ylabel('Measurement, absolute value', fontsize=22)
plt.yticks(np.arange(0, 140, 20))

# Save the figure
fig.savefig('examplepatient.pdf', bbox_inches='tight')

```



```
In [24]: stop_time = datetime.datetime.now()
         print (stop_time)
         print ((stop_time - start_time), "elapsed time")
```

```
2018-12-30 00:32:01.587290
0:05:06.649426 elapsed time
```