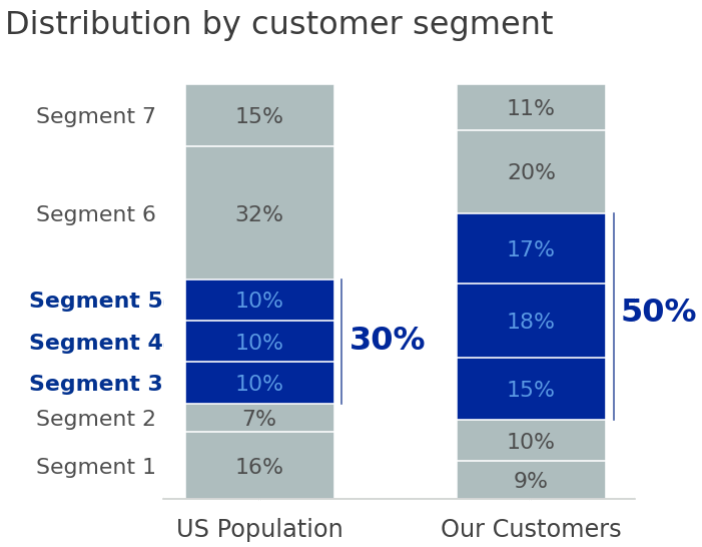
In [391]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib as mpl
import bisect
from matplotlib import colors
from matplotlib.colorbar import ColorbarBase
%config InlineBackend.figure_format = 'retina'
```

Question 1

In [268]:
```
data = dict(
    segment=['Segment 1','Segment 2','Segment 3','Segment 4','Segment 5','S
    us=[16,7,10,10,10,32,15],
    our=[9,10,15,18,17,20,11])

customer = pd.DataFrame(data)
customer = customer[['us','our']].T
customer.columns = data['segment']
```

In [269]:
```
fig, ax = plt.subplots(1,1, figsize=(5,4))

for i, columns in enumerate(reversed(customer.columns)):
    bar_color = ('#00279B' if i in [2,3,4] else '#AEBDBE')
    bar_height = customer.loc[:, :columns].sum(axis=1)
    label_height = bar_height - customer.loc[:, columns] / 2 - 1.8
    label_color = ('#5B9AE5' if i in [2,3,4] else '#4E4E4E')
    label_weight = ('bold' if i in [2,3,4] else 'regular')
    axis_color = ('#033290' if i in [2,3,4] else '#4E4E4E')

    # draw segments
    ax.bar(customer.index, bar_height
          ,color=bar_color, edgecolor='white', linewidth=0.8
          ,width=0.55)

    # label segments
    for i, height in enumerate(label_height):
        ax.text(i, height, str(customer.loc[:, columns][i]) + '%' ,
                ha='center', color=label_color,
                fontdict=dict(fontsize=11
               ,weight='light'))
    # label axis
    ax.text(-0.6, label_height[0], columns,
        ha='center', color=axis_color,
        fontdict=dict(fontsize=11
        ,weight=label_weight))

ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['left'].set_visible(False)
ax.spines['bottom'].set_color('#CDD0CE')
ax.get_yaxis().set_visible(False)
ax.tick_params(length=6, color='white')

ax.set_xticks([0,1])
ax.set_xticklabels(['US Population','Our Customers']
                   ,fontsize=12
                  ,color='#414141', fontweight='medium')

# draw annotations

ax.plot([0.55/2*1.1,0.55/2 *1.1], [23,53], c='#415BA3', lw=.8)
ax.plot([0.55/2*1.1+1,0.55/2 *1.1+1], [19,69], c='#415BA3', lw=.8)
ax.text(0.55/2*1.2, 36, '30%', ha='left',
        color='#00279B', fontsize=16, fontweight='bold')
ax.text(0.55/2*1.2+1, 43, '50%', ha='left',
        color='#00279B', fontsize=16, fontweight='bold')

# add title
ax.set_title('Distribution by customer segment' +' '*8
             ,loc='right' ,pad=15
            ,fontsize=16 ,color='#3C3C3C', fontweight='roman')

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



Question 2

In [4]:
```
df_life = pd.read_csv("life-expectancy-at-birth-total-years.csv")

df_life.head()
```

Out[4]:

	Entity	Code	Year	Life expectancy at birth, total (years)
0	Afghanistan	AFG	1960	32.292
1	Afghanistan	AFG	1961	32.742
2	Afghanistan	AFG	1962	33.185
3	Afghanistan	AFG	1963	33.624
4	Afghanistan	AFG	1964	34.060

In [10]:
```
# Rename Life Expectancy column for easier reading

df_life = df_life.rename(columns={"Life expectancy at birth, total (years)"

df_life
```

Out[10]:

	Entity	Code	Year	Life Expectancy
0	Afghanistan	AFG	1960	32.292
1	Afghanistan	AFG	1961	32.742
2	Afghanistan	AFG	1962	33.185
3	Afghanistan	AFG	1963	33.624
4	Afghanistan	AFG	1964	34.060
...	...	...	...	...
13742	Zimbabwe	ZWE	2012	56.516
13743	Zimbabwe	ZWE	2013	58.053
13744	Zimbabwe	ZWE	2014	59.360
13745	Zimbabwe	ZWE	2015	60.398
13746	Zimbabwe	ZWE	2016	61.163

13747 rows × 4 columns

In [26]:
```
df_life.loc[df_life['Entity'].isin(['Egypt','Belarus', 'Finland', 'Timor'])
```

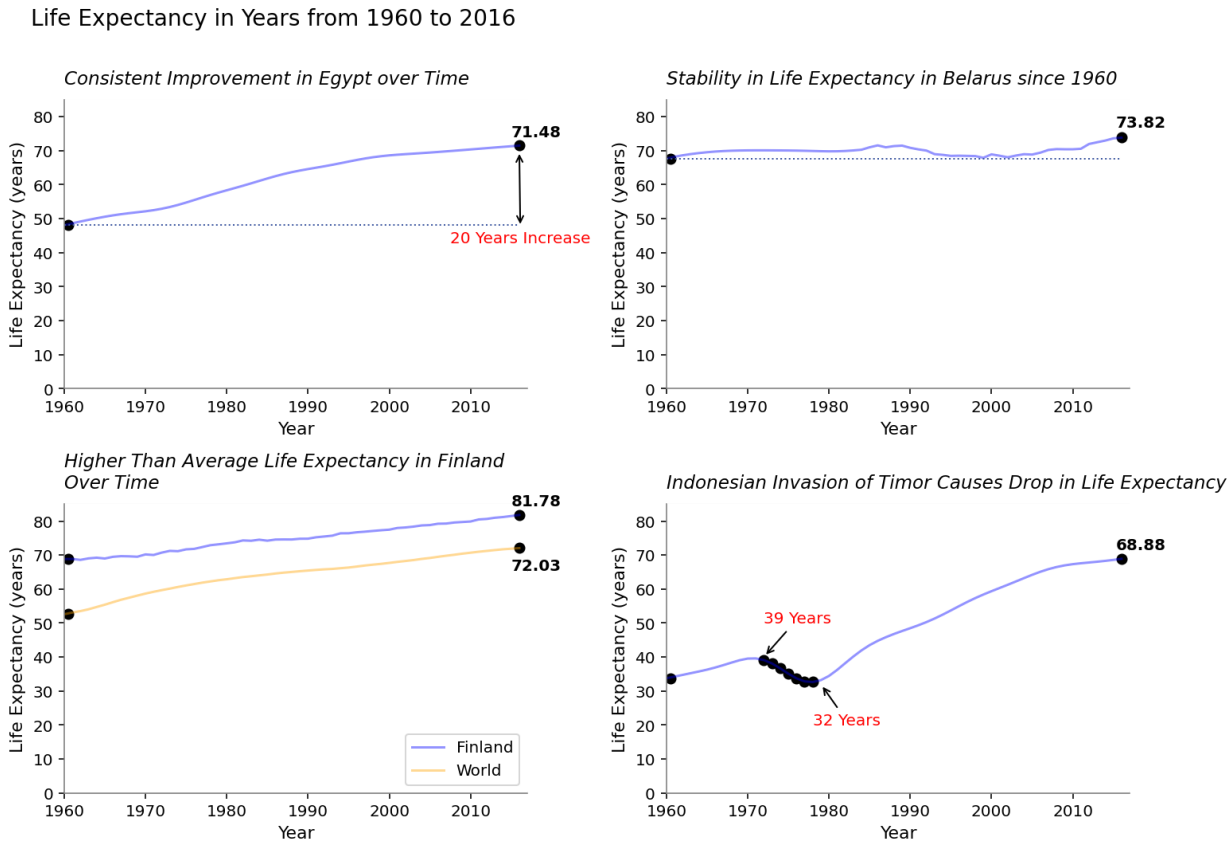
Out[26]:

	Entity	Code	Year	Life Expectancy
912	Belarus	BLR	1960	67.708098
913	Belarus	BLR	1961	68.212659
914	Belarus	BLR	1962	68.635829
915	Belarus	BLR	1963	68.992073
916	Belarus	BLR	1964	69.289927
...	...	...	...	...
12488	Timor	TLS	2012	67.805000
12489	Timor	TLS	2013	68.033000
12490	Timor	TLS	2014	68.285000
12491	Timor	TLS	2015	68.569000
12492	Timor	TLS	2016	68.881000

228 rows × 4 columns

In [272]:
```
# Putting 4 graphs of 4 countries together

lg = '#808080'
def axis_plot(ax):
    ax.set_ylim(0, 85)
    ax.set_xlim(1960, 2017)
    ax.spines["top"].set_visible(False)
    ax.spines["right"].set_visible(False)
    ax.spines["bottom"].set_color(lg)
    ax.spines["left"].set_color(lg)

    ax.set_ylabel("Life Expectancy (years)", fontsize=11)
    ax.set_xlabel("Year", fontsize=11)
    return ax

fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(nrows=2, ncols=2, figsize=(12,
                                             gridspec_kw={'hspace': 0.4, 'ws


# Egypt
df_life[df_life['Entity'] == 'Egypt'].plot(x='Year', y='Life Expectancy', c
                                           ax=axis_plot(ax1), legend=False)
years_egypt = [1960.5, 2016]
values_egypt = [48.056, 71.484]
ax1.scatter(years_egypt, values_egypt, color="black")
ax1.set_title("Consistent Improvement in Egypt over Time", style='italic',
ax1.text(0.45,0.84,'71.48',transform=fig.transFigure, fontsize=10, fontweig
ax1.plot([1960,2016], [48.05,48.05], ':', c='#415BA3', lw=1)
ax1.annotate("20 Years Increase", xy=(2016, 70), xytext=(2007.5, 43), color


# Belarus
df_life[df_life['Entity'] == 'Belarus'].plot(x='Year', y='Life Expectancy',
                                             ax=axis_plot(ax2), legend=Fals
years_bel = [1960.5, 2016]
values_bel = [67.708, 73.826]
ax2.scatter(years_bel, values_bel, color="black")
ax2.set_title("Stability in Life Expectancy in Belarus since 1960",
              style='italic', fontsize=11.5, loc='left', pad=10)
ax2.text(0.89,0.85,'73.82',transform=fig.transFigure, fontsize=10, fontweig
ax2.plot([1960,2016], [67.7,67.7], ':', c='#415BA3', lw=1)



# Finland
df_life[df_life['Entity'] == 'Finland'].plot(x='Year', y='Life Expectancy',
                                             label='Finland',ax=axis_plot(a
df_life[df_life['Entity'] == 'World'].plot(x='Year', y='Life Expectancy', l
                                           label='World',ax=axis_plot(ax3
years_fin = [1960.5, 2016]
values_fin = [68.819, 81.78]
years_world= [1960.5, 2016]
values_world = [52.57, 72.03]
ax3.scatter(years_fin, values_fin, color="black")
ax3.scatter(years_world, values_world, color="black")
ax3.set_title("Higher Than Average Life Expectancy in Finland\nOver Time",
```

```
                style='italic', fontsize=11.5,loc='left', pad=10)
ax3.text(0.45,0.4375,'81.78',transform=fig.transFigure, fontsize=10, fontwe
ax3.text(0.45,0.3675,'72.03',transform=fig.transFigure, fontsize=10, fontwe
ax3.legend(loc='lower right')


# Timor
df_life[df_life['Entity'] == 'Timor'].plot(x='Year', y='Life Expectancy', c
                                           ax=axis_plot(ax4), legend=False)
years_timor = [1960.5, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 2016]
values_timor = [33.729, 39.085, 38.077, 36.659, 35.092, 33.714, 32.826, 32.

ax4.scatter(years_timor, values_timor, color='black')
ax4.set_title("Indonesian Invasion of Timor Causes Drop in Life Expectancy"
              fontsize=11.5, loc = 'left', pad=10)
ax4.text(0.89,0.39,'68.88',transform=fig.transFigure, fontsize=10, fontweig
ax4.annotate("39 Years", xy=(1972, 40), xytext=(1972, 50), color='red',
             arrowprops=dict(arrowstyle="->"))
ax4.annotate("32 Years", xy=(1979, 32), xytext=(1978, 20), color='red',
             arrowprops=dict(arrowstyle="->"))


plt.suptitle("Life Expectancy in Years from 1960 to 2016          ", horizon
plt.show()
```



Question 3

In [286]:
```
df_brazil = pd.read_csv("brazil_excess_deaths.csv")[['country','region','mo

df_brazil.head(5)
```

Out[286]:

	country	region	month	excess_deaths_pct_change
0	Brazil	Recife	1	0.308805
1	Brazil	Recife	2	0.303300
2	Brazil	Recife	3	0.295630
3	Brazil	Recife	4	0.845450
4	Brazil	Recife	5	1.945131

In [289]:
```
region_order = np.array(['São Paulo','Rio de Janeiro', 'Manaus', 'Recife',
df_brazil.region = pd.Categorical(df_brazil.region, region_order)
df_brazil = df_brazil.sort_values('region')
```

In [369]:
```
# define color assignment function
def color_assignment(value):
    i = bisect.bisect([0, 0.25, 0.5, 1, 2], value)
    color = {0: '#E8F0F4',
             1: '#FFEDD4',
             2: '#FFC57E',
             3: '#FF804C',
             4: '#E93C28',
             5: '#B10000'}

    return color[i]

# add column mapping excess pct change to hex color
df_brazil['color_hex'] = df_brazil['excess_deaths_pct_change'].apply(color_
df_brazil[df_brazil.month ==7]
```

Out[369]:

	country	region	month	excess_deaths_pct_change	color_hex
34	Brazil	São Paulo	7	0.369215	#FFC57E
27	Brazil	Rio de Janeiro	7	-0.023321	#E8F0F4
13	Brazil	Manaus	7	0.063158	#FFEDD4
6	Brazil	Recife	7	0.523522	#FF804C
20	Brazil	Fortaleza	7	0.499261	#FFC57E

In [503]:
```
fig,ax = plt.subplots(1,1, figsize=(8,4))

regions = df_brazil.region.unique()
num_regions = len(regions)
ones = np.ones(num_regions)

for month in range(7,0, -1):

    ax.barh(regions, month * ones
            ,height=0.6
            ,color=df_brazil[df_brazil.month == month]['color_hex'],
            align='center',
            edgecolor='white')


# hide spines
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['left'].set_visible(False)
ax.spines['bottom'].set_color('#CDD0CE')
ax.tick_params(length=4, color='#CDD0CE')

# configure y-axis alignment
ax.set_yticks(np.linspace(0,4,5))
ax.set_yticklabels(regions, ha='left')
ax.get_yaxis().set_tick_params(pad=100)
ax.yaxis.set_tick_params(length=0)

# configure x-axis alignment
ax.set_xticks(np.linspace(0.2, 6.2, 7))
ax.set_xticklabels(['January', 'February', 'March', 'April', 'May', 'June',
                    ,fontsize=8
                   ,ha='center')

ax.set_title("Weekly death rates in Brazil" + " "*32, horizontalalignment='


# Adding color bar
colors = ['#E8F0F4','#FFEDD4', '#FFC57E','#FF804C','#E93C28','#B10000']
bounds = [1,2,3,4,5,6,7]
boundaries = [0, '0', '+25', '+50', '+100', '+200']

ax_c = fig.add_axes([0.585, 0.95, 0.325, 0.03])
cmap = mpl.colors.ListedColormap(colors)

cb2 = ColorbarBase(ax_c, cmap=cmap,
                   boundaries=bounds,
                   ticks=bounds,
                   label=boundaries,
                   orientation='horizontal')
cb2.set_label('Deviation from expected deaths, %' + ' '*11, fontsize=8,font
cb2.set_ticklabels(boundaries)
cb2.ax.tick_params(labelsize = 8, length = 17, direction = 'inout')
cb2.outline.set_visible(False)

for label in cb2.ax.xaxis.get_ticklabels()[:1]:
```

```
    label.set_visible(False)



plt.show()
```