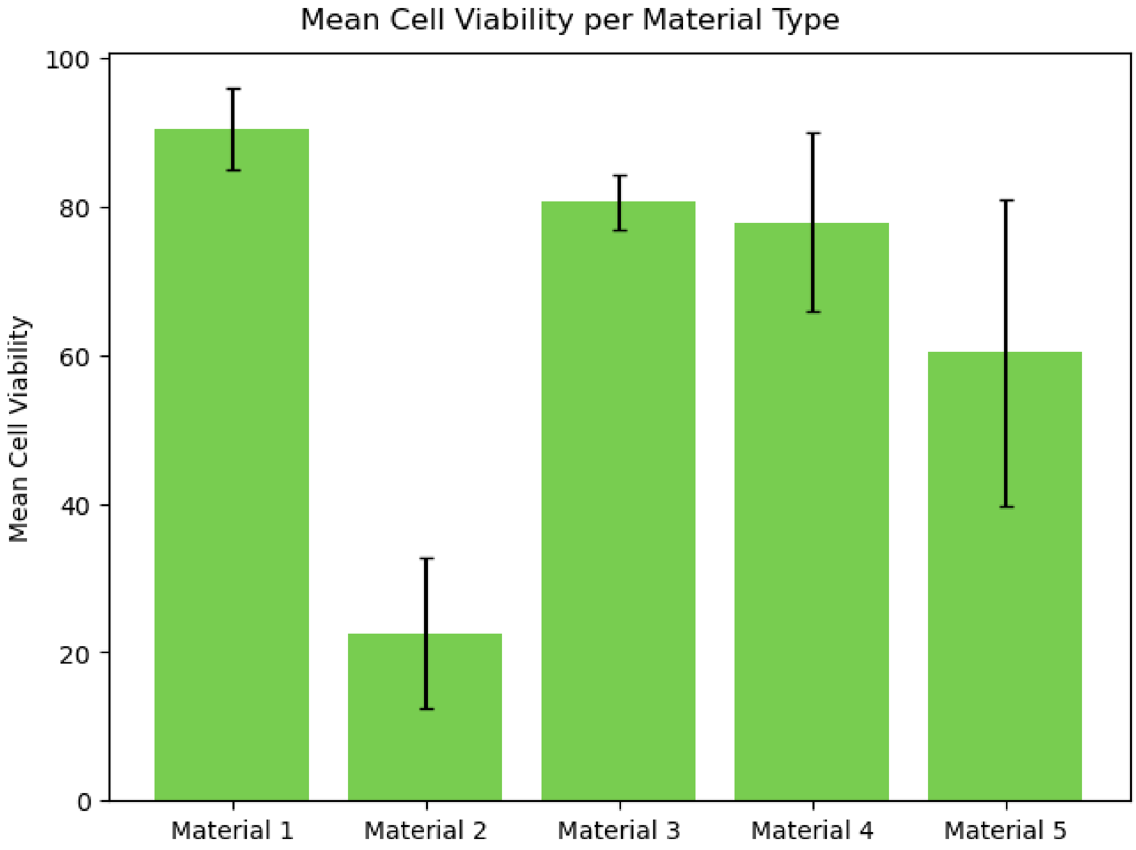
In [13]:
```
import pandas as pd
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
import scipy.stats as stats
from IPython.display import display, Latex
```

In [2]:
```
df = pd.read_excel("extra_data_example.xlsx", sheet_name=0)

COLORS = mpl.colormaps["viridis"](np.linspace(0.8,0.2,5))

df.head()
```

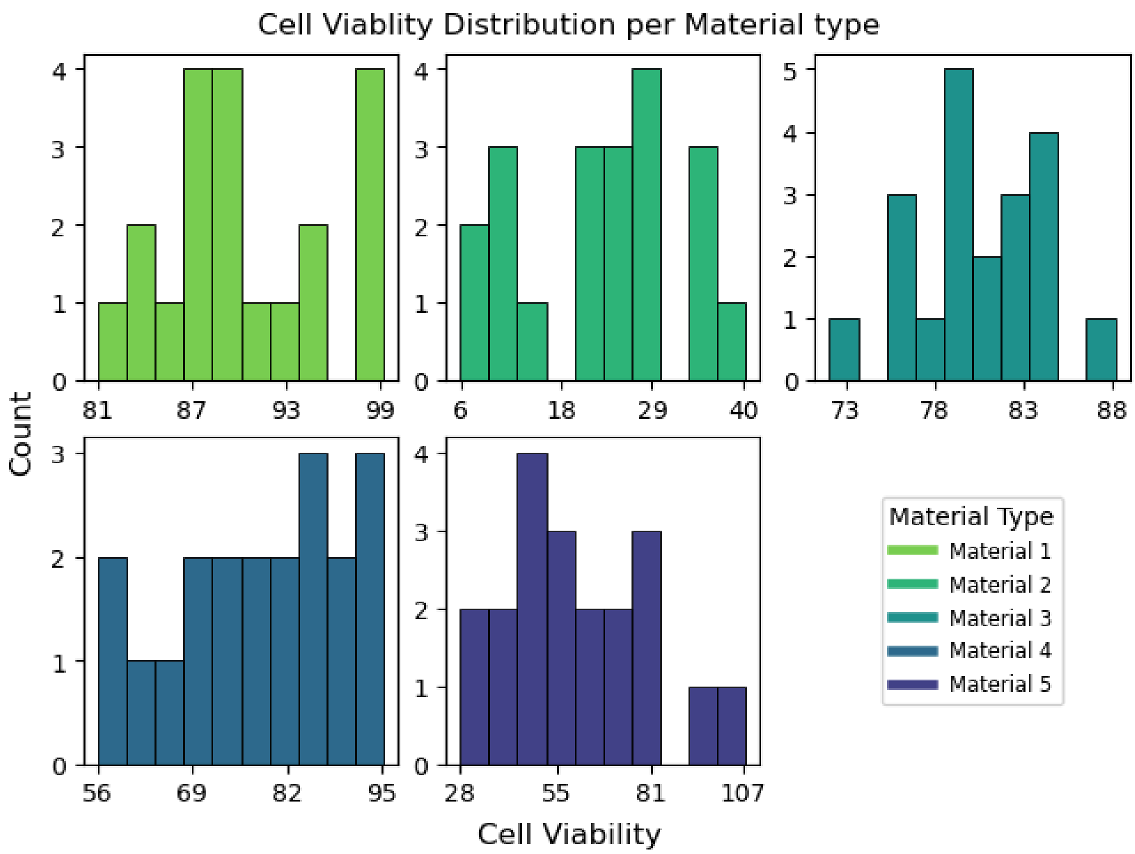
Out[2]:

	Material 1 Cell Viability	Material 2 Cell Viability	Material 3 Cell Viability	Material 4 Cell Viability	Material 5 Cell Viability
0	89.636019	36.337570	82.138034	77.959568	96.495528
1	83.022464	9.832694	76.750271	60.890488	50.656390
2	88.389779	33.625268	80.024641	84.399342	81.065215
3	95.473542	25.500794	83.302190	93.427135	63.233430
4	95.084492	6.899070	79.977589	78.029090	50.931293

In [3]:
```
fig = plt.figure(layout='constrained')

plt.bar([f"Material {i}" for i in range(1,6)], df.mean(), yerr=df.std(), co
lor=COLORS[0], capsize=3)
plt.ylabel("Mean Cell Viability")
plt.suptitle("Mean Cell Viability per Material Type")

plt.show()
```



In [62]:
```
fig, axs = plt.subplots(2, 3, constrained_layout=True)
for i in range(5):
    ax = axs[i//3, i%3]
    ax.set_xticks([*map(int, np.linspace(min(df.iloc[:,i])+1, max(df.iloc
[:,i]), 4))])
    df.iloc[:,i].hist(color=COLORS[i], edgecolor="black", linewidth=0.6, gr
id=False, ax=ax)

axs[-1,-1].legend(handles=[mpl.lines.Line2D([0], [0], color=COLORS[i], lw=
4) for i in range(5)],
                  labels=[f"Material {i+1}" for i in range(5)],
                  title="Material Type", loc='center', fontsize='small')

axs[-1,-1].axis('off')
plt.suptitle("Cell Viablity Distribution per Material type")
fig.supxlabel("Cell Viability")
fig.supylabel("Count")
plt.show()
```



In [5]:
```
for i in range(5):
    print(f"Material {i+1}:", stats.shapiro(df.iloc[:,i]))
```

```
Material 1: ShapiroResult(statistic=0.9450613047923301, pvalue=0.298262355
82609695)
Material 2: ShapiroResult(statistic=0.9464559687917486, pvalue=0.316473355
9444973)
Material 3: ShapiroResult(statistic=0.9737578703192492, pvalue=0.831377358
6100368)
Material 4: ShapiroResult(statistic=0.9525846495518314, pvalue=0.408034515
1758666)
Material 5: ShapiroResult(statistic=0.9668363915694076, pvalue=0.687175775
623706)
```

⇒ data is normally distributed

In [6]:
```
stats.f_oneway(*[df.iloc[:, i] for i in range(5)])
```

Out[6]:
```
F_onewayResult(statistic=99.65745910469758, pvalue=3.984222520241905e-33)
```

⇒ there is significant difference between some of the materials

In [39]:
```
#Post-hoc test - Bonferroni Correction
ca = 0.05/(len(df.columns) * (len(df.columns) - 1) / 2)
print('Corrected alpha: ', ca)

for i in range(len(df.columns)):
    for j in range(len(df.columns)):
        if i >= j: continue
        ttest = stats.ttest_ind(df.iloc[:, i], df.iloc[:, j])
        display(Latex(f'${"+-"[int(ttest.pvalue < ca)]}H_0$ Mat. {i+1} and {j+1}: {ttest}'))
```

```
Corrected alpha:  0.005
```

$-H_0$ Mat. 1 and 2: TtestResult(statistic=26.209820598493412, pvalue=6.169727574794117e-26, df=38.0)

$-H_0$ Mat. 1 and 3: TtestResult(statistic=6.636166622718816, pvalue=7.671528313775e-08, df=38.0)

$-H_0$ Mat. 1 and 4: TtestResult(statistic=4.224998184525236, pvalue=0.000144045710969204, df=38.0)

$-H_0$ Mat. 1 and 5: TtestResult(statistic=6.309809401743938, pvalue=2.1413757389298813e-07, df=38.0)

$-H_0$ Mat. 2 and 3: TtestResult(statistic=-23.972973296740903, pvalue=1.5153456046637023e-24, df=38.0)

$-H_0$ Mat. 2 and 4: TtestResult(statistic=-15.669300532940584, pvalue=3.592266699206426e-18, df=38.0)

$-H_0$ Mat. 2 and 5: TtestResult(statistic=-7.325053286751433, pvalue=8.971510150792276e-09, df=38.0)

$+H_0$ Mat. 3 and 4: TtestResult(statistic=0.9523016229748836, pvalue=0.3469624698766267, df=38.0)

$-H_0$ Mat. 3 and 5: TtestResult(statistic=4.328926164109077, pvalue=0.00010518670460901616, df=38.0)

$-H_0$ Mat. 4 and 5: TtestResult(statistic=3.2935192260949697, pvalue=0.0021461133452807717, df=38.0)

⇒ All materials have significant differences except 3 vs. 4