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In [6]: # 导入操作系统库
import os
# 更改工作目录
os.chdir(r"D:\softwares\applied statistics\pythoncodelearning\chap1\sourcecode")
# 导入基础计算库
import numpy as np
# 导入绘图库
import matplotlib.pyplot as plt
# 导入Lasso模型
from sklearn.linear_model import MultiTaskLasso, Lasso
# 导入绘图库中的字体管理包
from matplotlib import font_manager
# 实现中文字符正常显示
font = font_manager.FontProperties(fname=r"C:\Windows\Fonts\SimKai.ttf")
# 使用seaborn风格绘图
plt.style.use("seaborn-v0_8")
# 设置样本量, 维度, 回归模型中y的维度 (响应变量的多元回归)
n_samples, n_features, n_tasks = 100, 30, 40
# 显著变量的个数
n_relevant_features = 5
# 初始化真实系数, 是一个矩阵
coef = np.zeros((n_tasks, n_features))
# 时刻
times = np.linspace(0, 2 * np.pi, n_tasks)
# 设置随机数种子
np.random.seed(10)
# 生成真实系数
for k in range(n_relevant_features):
    coef[:, k] = np.sin(
        (1.0 + np.random.randn(1)) * times + 3 * np.random.randn(1)
    )
# 生成X
X = np.random.randn(n_samples, n_features)
# 生成Y
Y = np.dot(X, coef.T) + np.random.randn(n_samples, n_tasks)
print("查看多元响应变量Y的情况: ", Y[:5, :2], sep="\n")
# 建立Lasso模型, 分别对Y的每一个分量做, 提取系数
coef_lasso_ = np.array(
    [
        Lasso(alpha=0.5).fit(X, y).coef_ for y in Y.T
    ]
)
# 建立MultiLasso模型, 提取系数
coef_multi_task_lasso_ = MultiTaskLasso(alpha=1.0).fit(X, Y).coef_
# 开始绘图
fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(8, 5))
# 用于展示稀疏二维数组的图形
axs[0].spy(coef_lasso_)
axs[0].set_xlabel("Feature")
axs[0].set_ylabel("Time (or Task)")
axs[0].text(10, 5, "Lasso")
axs[1].spy(coef_multi_task_lasso_)
axs[1].set_xlabel("Feature")
axs[1].set_ylabel("Time (or Task)")
axs[1].text(10, 5, "MultiTaskLasso")
fig.suptitle("Coefficient non-zero location")
plt.show()
fig.savefig("../codeimage/code15.pdf")

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# 绘制第一个特征前的系数
feature_to_plot = 0
# 开始绘图
fig1, ax = plt.subplots(figsize=(6,6), tight_layout=True)
# 绘制coef的线图
ax.plot(
    coef[:, feature_to_plot],
    color="seagreen",
    linewidth=2,
    label="Ground truth"
)
# 绘制coef_lasso的线图
ax.plot(
    coef_lasso[:, feature_to_plot],
    color="cornflowerblue",
    linewidth=2,
    label="Lasso"
)
# 绘制coef_task_lasso的线图
ax.plot(
    coef_multi_task_lasso[:, feature_to_plot],
    color="gold",
    linewidth=2,
    label="MultiTaskLasso",
)
# 显示图例
ax.legend(loc="best")
# 设置纵轴范围
ax.set_ylim([-1.1, 1.1])
plt.show()
fig1.savefig("../codeimage/code16.pdf")
```

查看多元响应变量Y的情况:

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[[1.89931525 1.64556889]
 [2.08468805 2.38111156]
 [1.41645186 0.98673872]
 [0.18540611 1.80601826]
 [0.69800933 0.40984124]]
```

