

```

import pandas as pd
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import Ridge
from sklearn.preprocessing import StandardScaler
from statsmodels.tsa.statespace.sarimax import SARIMAX
from statsmodels.tsa.stattools import adfuller, pacf, acf
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
import matplotlib.pyplot as plt
import numpy as np
from sklearn.metrics import mean_absolute_error, mean_squared_error

#This part is to load the dataset with the timestamp or date column
def load_data(file_path):
    try:
        data = pd.read_csv(file_path, sep=';',
        parse_dates={'datetime': ['Date', 'Time']},
        infer_datetime_format=True,
                                low_memory=False, na_values=['nan', '?'],
        index_col='datetime')
        #Here the relevant columns are selected
        data = data[['Global_active_power']]
        #Here the column is renamed for clarity
        data.rename(columns={'Global_active_power': 'consumption'},
        inplace=True)
        #Here the rows are dropped with missing values
        data.dropna(inplace=True)
        return data
    except Exception as e:
        print(f"Error loading data: {e}")
        return None

#Here the basic information about the dataset is displayed
def display_basic_info(data):
    print("Basic Information of the Dataset:")
    print("-----")
    print("Number of rows and columns:", data.shape)
    print("\nFirst 5 rows of the dataset:")
    print(data.head())
    print("\nSummary statistics of the dataset:")
    print(data.describe())
    print("\nMissing values per column:")
    print(data.isnull().sum())
    print("-----\n")

#This part is to check for stationarity using Augmented Dickey Fuller
test
def check_stationarity(timeseries):
    result = adfuller(timeseries, autolag='AIC')
    print('ADF Statistic: %f' % result[0])
    print('p-value: %f' % result[1])

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print('Critical Values:')
for key, value in result[4].items():
    print('\t%s: %.3f' % (key, value))

#This part is to plot the electricity consumption data
def plot_data(data):
    plt.figure(figsize=(10, 6))
    plt.plot(data.index, data['consumption'], label='Daily
Consumption')
    plt.xlabel('Date')
    plt.ylabel('Electricity Consumption')
    plt.title('Daily Electricity Consumption Data')
    plt.legend()
    plt.grid(True)
    plt.show()

#This part is to Plot the ACF and PACF of the scaled data
def plot_acf_pacf(scaled_consumption):
    fig, (ax1, ax2) = plt.subplots(2, 1, figsize=(10, 12))

    plot_acf(scaled_consumption, lags=20, alpha=0.05, ax=ax1)
    ax1.set_xlabel('Lag')
    ax1.set_ylabel('Autocorrelation')
    ax1.set_title('ACF of Scaled Electricity Consumption')

    plot_pacf(scaled_consumption, lags=15, alpha=0.05, ax=ax2)
    ax2.set_xlabel('Lag')
    ax2.set_ylabel('Partial Autocorrelation')
    ax2.set_title('PACF of Scaled Electricity Consumption')

    plt.tight_layout()
    plt.show()

#Here the model is trained using the Ridge Regression model with Grid
Search
def train_ridge_regression(train_data, alpha_values):
    ridge_params = {"alpha": alpha_values}
    ridge_grid_search = GridSearchCV(Ridge(), ridge_params, cv=5,
scoring="neg_mean_squared_error")
    ridge_grid_search.fit(train_data.drop(columns=["consumption"]),
train_data["consumption"])
    return ridge_grid_search

#Here the model is evaluated
def evaluate_model(test_data, forecast, model_name):
    test_data = test_data.copy()
    test_data['forecast'] = forecast

    residuals = test_data['consumption'] - test_data['forecast']
    mae = mean_absolute_error(test_data['consumption'],

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test_data['forecast'])
mse = mean_squared_error(test_data['consumption'],
test_data['forecast'])
rmse = np.sqrt(mse)
print(f"{model_name} Metrics:")
print(f"MAE: {mae}, MSE: {mse}, RMSE: {rmse}")

plt.figure(figsize=(10, 6))
plt.plot(test_data.index, test_data['consumption'], label='Actual
Consumption', color='blue')
plt.plot(test_data.index, test_data['forecast'], label=f'Predicted
Consumption ({model_name})', color='red')
plt.xlabel('Date')
plt.ylabel('Consumption')
plt.title(f'Actual vs. Predicted Electricity Consumption
({model_name})')
plt.legend()
plt.grid(True)
plt.show()

plt.figure(figsize=(10, 6))
plt.plot(test_data.index, residuals, label=f'{model_name}
Residuals', color='blue')
plt.axhline(y=0, color='red', linestyle='--')
plt.xlabel('Date')
plt.ylabel('Residuals')
plt.title(f'Residuals of {model_name} Model')
plt.legend()
plt.grid(True)
plt.show()

#This is the main function
def main():
    file_path = "household_power_consumption.txt"
    data = load_data(file_path)
    if data is None:
        return

#This part is to resample to daily consumption
    daily_consumption = data.resample('D').sum()
    display_basic_info(daily_consumption)

#This part is to ensure the dataset is sorted chronologically
    daily_consumption.sort_index(inplace=True)

#Here feature scaling is applied to the consumption data
    scaler = StandardScaler()
    daily_consumption['scaled_consumption'] =
scaler.fit_transform(daily_consumption[['consumption']])

```

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#This part is to check for stationarity using ADF test
print("Stationarity Check:")
check_stationarity(daily_consumption['scaled_consumption'])

#Here the data is plotted
plot_data(daily_consumption)

#Here the ACF and PACF are plotted
plot_acf_pacf(daily_consumption['scaled_consumption'])

#This part calculates and prints the PACF and ACF values
pacf_values = pacf(daily_consumption['scaled_consumption'])
acf_values = acf(daily_consumption['scaled_consumption'])
print("Partial Autocorrelation Function (PACF) of Scaled Consumption:")
print(pacf_values)
print("Autocorrelation Function (ACF) of Scaled Consumption:")
print(acf_values)

#This part splits the data into training and testing sets based on days
train_size = int(len(daily_consumption) * 0.8)
train_data, test_data = daily_consumption.iloc[:train_size],
daily_consumption.iloc[train_size:]

#This part adds previous day consumption as a feature for Ridge Regression
train_data['prev_consumption'] =
train_data['consumption'].shift(1).fillna(0)
test_data['prev_consumption'] =
test_data['consumption'].shift(1).fillna(0)

#This part trains and evaluates the Ridge Regression model
alpha_values = [0.1, 0.5, 1.0] # Adjust the range as needed
ridge_grid_search = train_ridge_regression(train_data,
alpha_values)

print("Best parameters for Ridge Regression:",
ridge_grid_search.best_params_)
ridge_model = ridge_grid_search.best_estimator_

#Here the grid search results are saved to CSV
results_df = pd.DataFrame(ridge_grid_search.cv_results_)
columns_of_interest = ['param_alpha', 'mean_test_score',
'std_test_score', 'rank_test_score']
filtered_results = results_df[columns_of_interest]
filtered_results.to_csv('ridge_grid_search_results.csv',
index=False)
print("The results of the grid search have been saved to
'ridge_grid_search_results.csv'.")

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#This parts makes predictions for future electricity consumption using
Ridge Regression
    ridge_forecast =
ridge_model.predict(test_data.drop(columns=['consumption']))
    evaluate_model(test_data, ridge_forecast, "Ridge Regression")

#Here the SARIMA model parameters are defined
    order = (1, 0, 1)
    seasonal_order = (1, 1, 1, 12)

    sarima_model = SARIMAX(train_data['scaled_consumption'],
order=order, seasonal_order=seasonal_order)
    sarima_model_result = sarima_model.fit()
    print(sarima_model_result.summary())

    forecast = sarima_model_result.forecast(steps=len(test_data))
    forecast = scaler.inverse_transform(forecast.values.reshape(-1,
1)).flatten()
    evaluate_model(test_data, forecast, "SARIMA")

    rolling_predictions = test_data.copy()
    for i, (index, _) in enumerate(test_data.iterrows()):
        train_data = daily_consumption.iloc[:train_size + i]
        sarima_model = SARIMAX(train_data['scaled_consumption'],
order=order, seasonal_order=seasonal_order)
        sarima_model_result = sarima_model.fit()
        pred = sarima_model_result.forecast()
        pred = scaler.inverse_transform(pred.values.reshape(-1,
1)).flatten() # Reshape the predicted values
        rolling_predictions.at[index, 'forecast'] = pred[0]

    rolling_residuals = test_data['consumption'] -
rolling_predictions['forecast']
    sarima_mae = mean_absolute_error(test_data['consumption'],
rolling_predictions['forecast'])
    sarima_mse = mean_squared_error(test_data['consumption'],
rolling_predictions['forecast'])
    sarima_rmse = np.sqrt(sarima_mse)
    print("SARIMA Metrics (Rolling Origin Forecast):")
    print(f"MAE: {sarima_mae}, MSE: {sarima_mse}, RMSE:
{sarima_rmse}")

    plt.figure(figsize=(10, 6))
    plt.plot(train_data.index, train_data['consumption'],
label='Historical Consumption')
    plt.plot(test_data.index, test_data['consumption'], label='Actual
Consumption')
    plt.plot(test_data.index, rolling_predictions['forecast'],
label='Predicted Consumption (SARIMA)', color='red')

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plt.xlabel('Date')
plt.ylabel('Consumption')
plt.title('Actual vs. Predicted Electricity Consumption (SARIMA:
Rolling Origin Forecast)')
plt.legend()
plt.grid(True)
plt.show()

plt.figure(figsize=(10, 6))
plt.plot(test_data.index, rolling_residuals, label='Rolling
Forecast Residuals', color='purple')
plt.axhline(y=0, color='red', linestyle='--')
plt.xlabel('Date')
plt.ylabel('Residuals')
plt.title('Residuals of Rolling Forecast Model (SARIMA)')
plt.legend()
plt.grid(True)
plt.show()

forecast_horizon = 7
last_date = daily_consumption.index[-1]
extended_index = pd.date_range(start=last_date +
pd.Timedelta(days=1), periods=forecast_horizon, freq='D')

extended_data = pd.DataFrame(index=extended_index)

rolling_predictions_extended = extended_data.copy()
sarima_model_extended =
SARIMAX(daily_consumption['scaled_consumption'], order=order,
seasonal_order=seasonal_order)
sarima_model_result_extended = sarima_model_extended.fit()
forecast_extended =
sarima_model_result_extended.forecast(steps=forecast_horizon)
forecast_extended =
scaler.inverse_transform(forecast_extended.values.reshape(-1,
1)).flatten()
rolling_predictions_extended['forecast'] = forecast_extended

plt.figure(figsize=(10, 6))
plt.plot(daily_consumption.index,
daily_consumption['consumption'], label='Historical Consumption')
plt.plot(rolling_predictions_extended.index,
rolling_predictions_extended['forecast'], label='Forecasted
Consumption', color='red')
plt.xlabel('Date')
plt.ylabel('Consumption')
plt.title('Forecasted Electricity Consumption for Next Weeks
(SARIMA)')
plt.legend()
plt.grid(True)

```

```
plt.show()
```

```
if __name__ == "__main__":  
    main()
```

Basic Information of the Dataset:

-----

Number of rows and columns: (1442, 1)

First 5 rows of the dataset:

	consumption
datetime	
2006-12-16	1209.176
2006-12-17	3390.460
2006-12-18	2203.826
2006-12-19	1666.194
2006-12-20	2225.748

Summary statistics of the dataset:

	consumption
count	1442.000000
mean	1551.334856
std	617.297117
min	0.000000
25%	1161.198500
50%	1534.778000
75%	1889.859500
max	4773.386000

Missing values per column:

consumption 0

dtype: int64

-----

Stationarity Check:

ADF Statistic: -3.849777

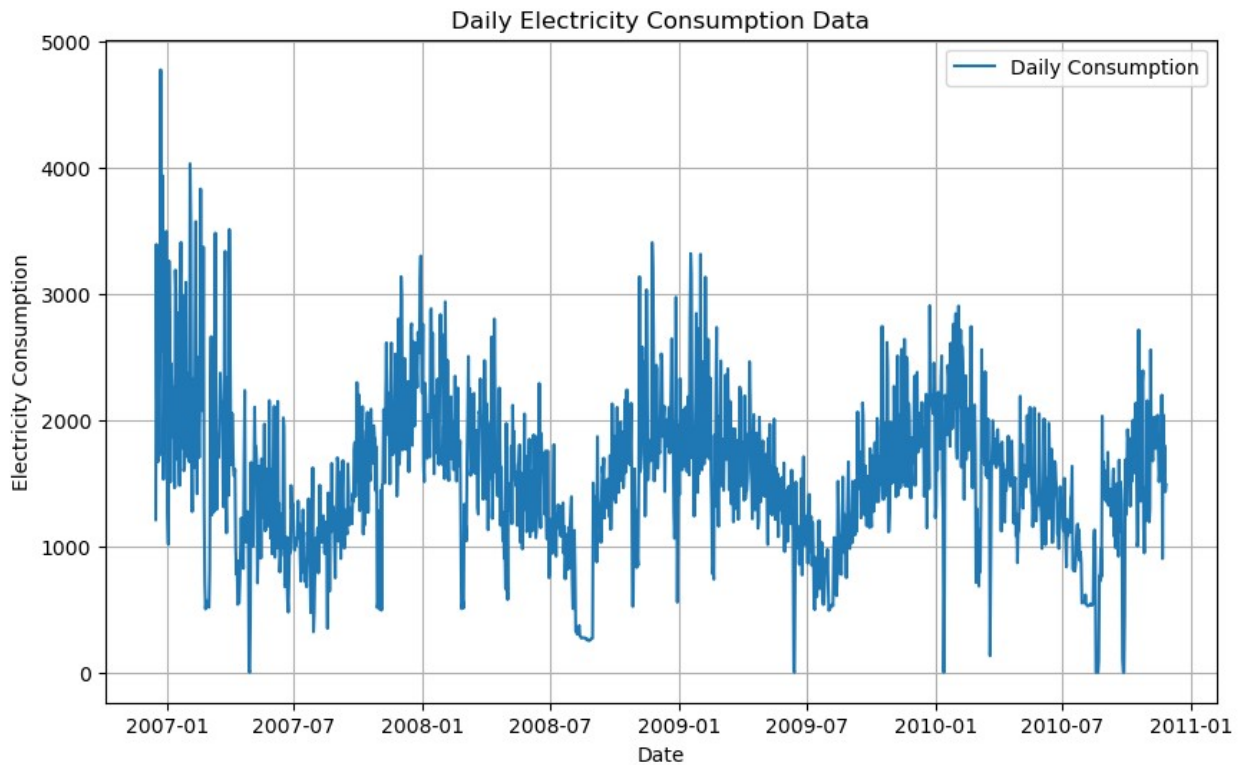
p-value: 0.002437

Critical Values:

1%: -3.435

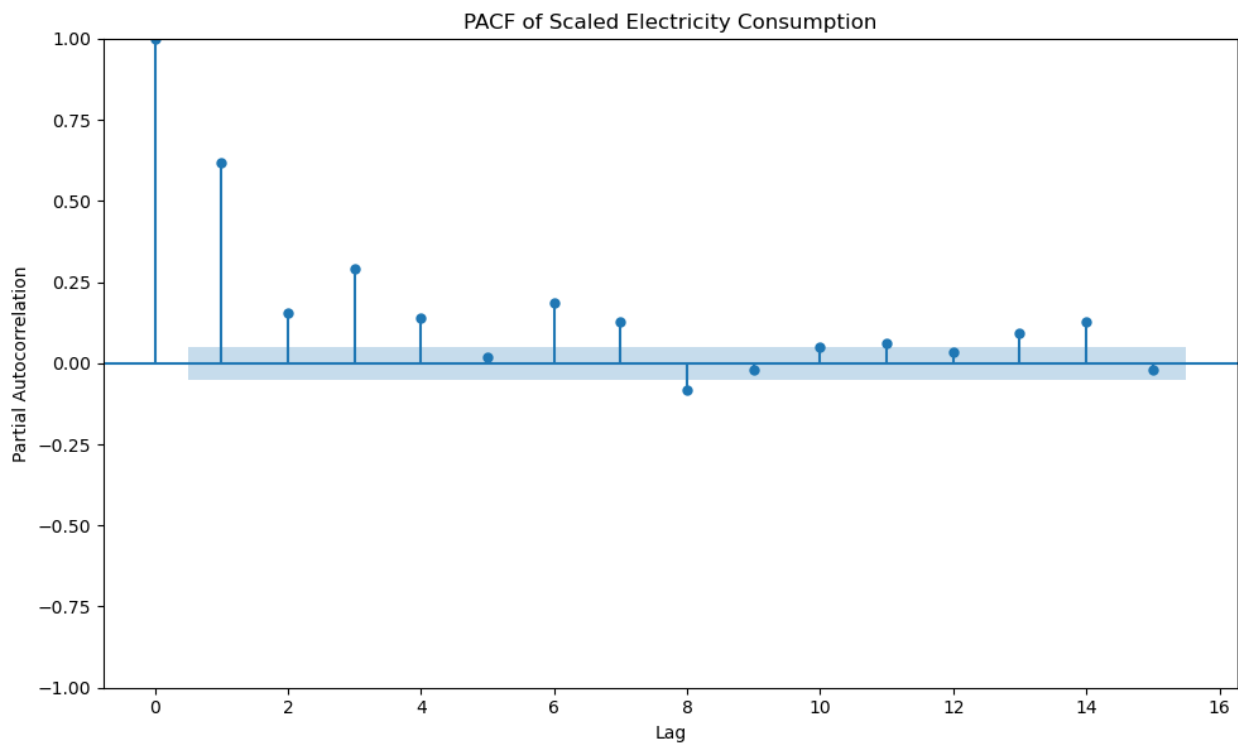
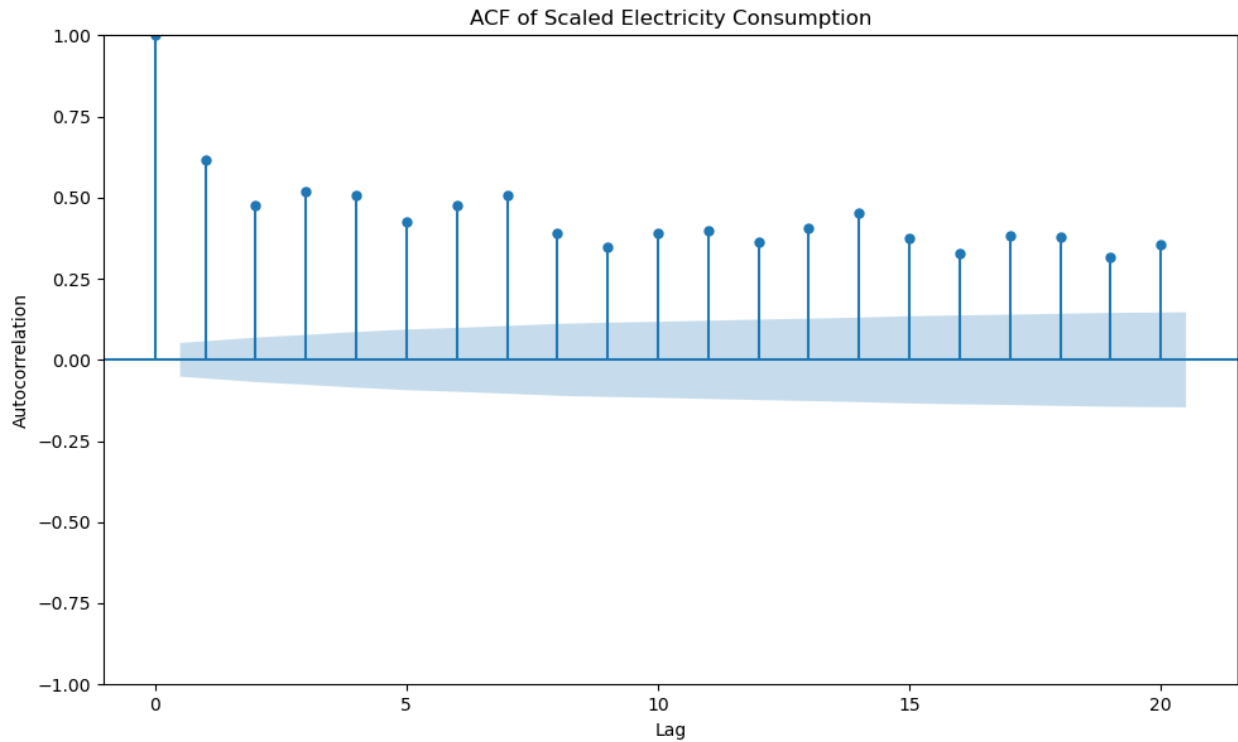
5%: -2.864

10%: -2.568



```
/Users/kimo/opt/anaconda3/lib/python3.9/site-packages/statsmodels/
graphics/tsaplots.py:348: FutureWarning: The default method 'yw' can
produce PACF values outside of the [-1,1] interval. After 0.13, the
default will change to unadjusted Yule-Walker ('ywm'). You can use this
method now by setting method='ywm'.
warnings.warn(
```





```
/var/folders/zt/9hk_2q414wv4f702386s4y7m0000gn/T/  
ipykernel_17690/702833524.py:158: SettingWithCopyWarning:  
A value is trying to be set on a copy of a slice from a DataFrame.  
Try using .loc[row_indexer,col_indexer] = value instead
```

See the caveats in the documentation:  
[https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)

```
train_data['prev_consumption'] =  
train_data['consumption'].shift(1).fillna(0)  
/var/folders/zt/9hk_2q4l4wv4f702386s4y7m0000gn/T/ipykernel_17690/70283  
3524.py:159: SettingWithCopyWarning:  
A value is trying to be set on a copy of a slice from a DataFrame.  
Try using .loc[row_indexer,col_indexer] = value instead
```

See the caveats in the documentation:  
[https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)

```
test_data['prev_consumption'] =  
test_data['consumption'].shift(1).fillna(0)
```

Partial Autocorrelation Function (PACF) of Scaled Consumption:

```
[ 1.          0.61793911  0.15534714  0.29186576  0.14086229  
0.01862999  
 0.1873312   0.12732613 -0.08077168 -0.01859002  0.05131676  
0.06250931  
 0.03591714  0.09407636  0.12718176 -0.02023178 -0.03022681  
0.05046043  
 0.00631056 -0.04220638  0.04819756  0.11959681 -0.05168831 -  
0.0592459  
-0.00327779  0.0092128  -0.05012305  0.02328676  0.06535517  0.014518  
-0.01252371 -0.01327005]
```

Autocorrelation Function (ACF) of Scaled Consumption:

```
[1.          0.61751058  0.47721398  0.52039832  0.50665926  0.42564109  
 0.47549614  0.50574125  0.39140836  0.34730034  0.39216001  0.39648856  
 0.36327903  0.40509495  0.45125592  0.37477707  0.32977284  0.38278343  
 0.37711794  0.3160496  0.35490219  0.42160336  0.32848925  0.26842992  
 0.3132775  0.31733461  0.25220832  0.29097849  0.34560096  0.28688119  
 0.24485247  0.27795785]
```

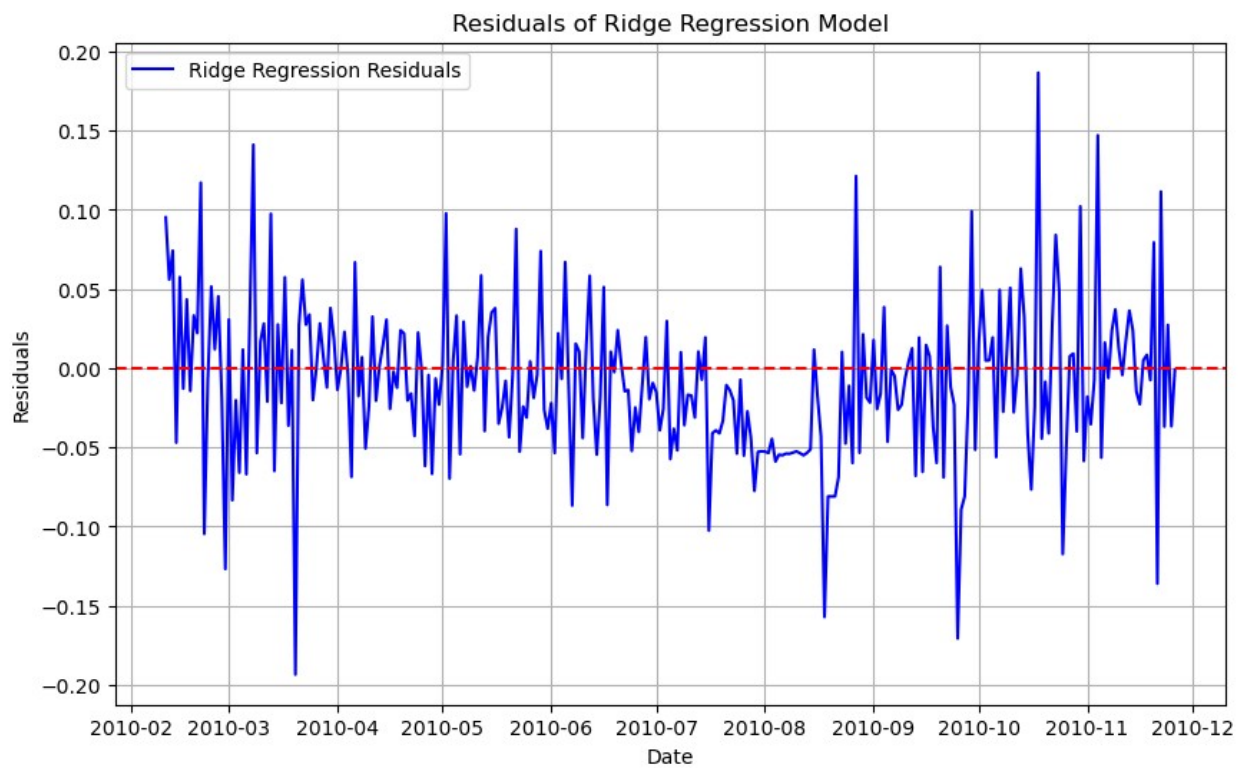
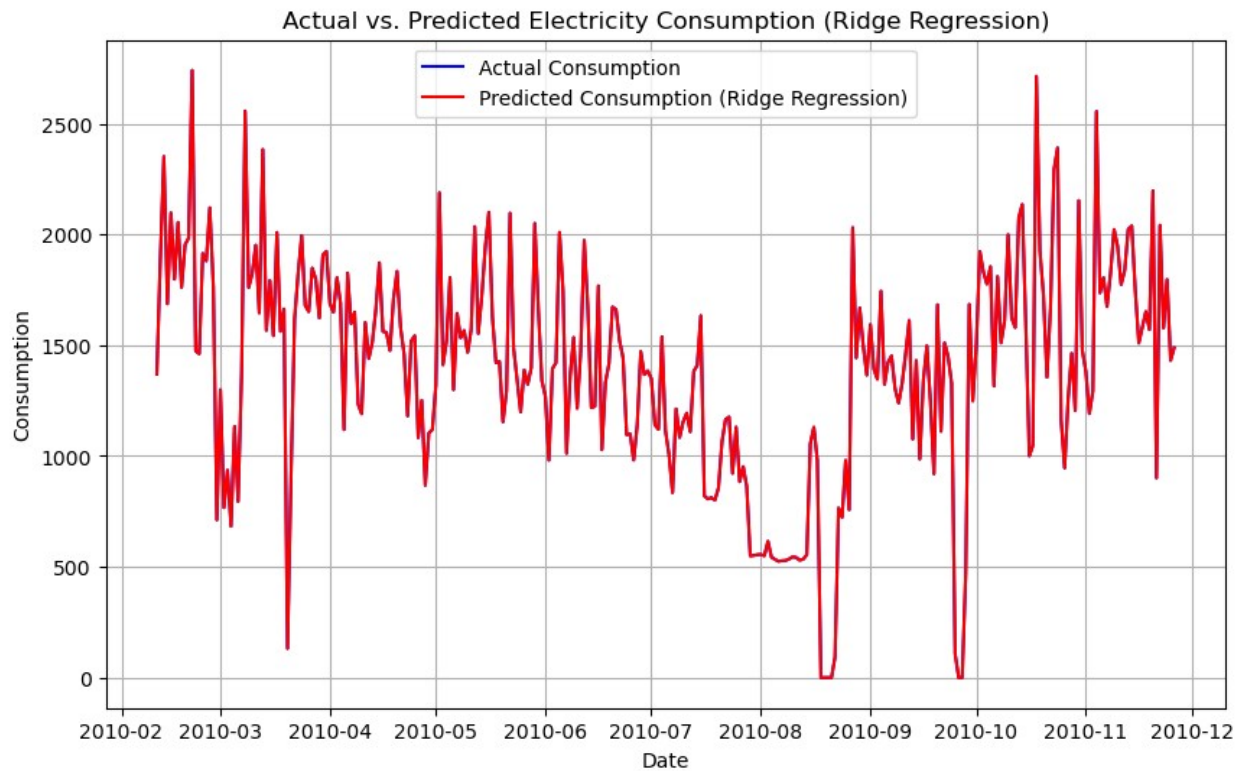
Best parameters for Ridge Regression: {'alpha': 0.1}

The results of the grid search have been saved to

'ridge\_grid\_search\_results.csv'.

Ridge Regression Metrics:

MAE: 0.03854011261285025, MSE: 0.002563362584187156, RMSE:  
0.05062966111072793



This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32331D+00 |proj g|= 2.94119D-01

At iterate 5 f= 1.25168D+00 |proj g|= 6.21898D-02

At iterate 10 f= 1.18795D+00 |proj g|= 5.80883D-02

At iterate 15 f= 1.16885D+00 |proj g|= 1.38361D-02

At iterate 20 f= 1.16834D+00 |proj g|= 8.11581D-05

At iterate 25 f= 1.16834D+00 |proj g|= 2.13454D-04

At iterate 30 f= 1.16834D+00 |proj g|= 1.21397D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	1.297D-06	1.168D+00
F =	1.1683373603359903						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

SARIMAX Results

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Dep. Variable: scaled\_consumption No. Observations: 1153

Model: SARIMAX(1, 0, 1)x(1, 1, 1, 12) Log Likelihood -1347.093

Date: Sun, 14 Jul 2024 AIC

2704.186

Time: 21:20:23 BIC

2729.384

Sample:

12-16-2006

HQIC

2713.702

- 02-10-2010

Covariance Type:

opg

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	coef	std err	z	P> z	[0.025
--	------	---------	---	------	--------

0.975]

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ar.L1	0.9759	0.009	106.410	0.000	0.958
-------	--------	-------	---------	-------	-------

0.994

ma.L1	-0.7522	0.019	-40.650	0.000	-0.788
-------	---------	-------	---------	-------	--------

-0.716

ar.S.L12	-0.0948	0.028	-3.439	0.001	-0.149
----------	---------	-------	--------	-------	--------

-0.041

ma.S.L12	-0.9802	0.017	-57.167	0.000	-1.014
----------	---------	-------	---------	-------	--------

-0.947

sigma2	0.5998	0.021	29.223	0.000	0.560
--------	--------	-------	--------	-------	-------

0.640

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Ljung-Box (L1) (Q): 20.19 Jarque-Bera (JB):

122.87

Prob(Q): 0.00 Prob(JB):

0.00

Heteroskedasticity (H): 0.50 Skew:

0.25

Prob(H) (two-sided): 0.00 Kurtosis:

4.53

=====

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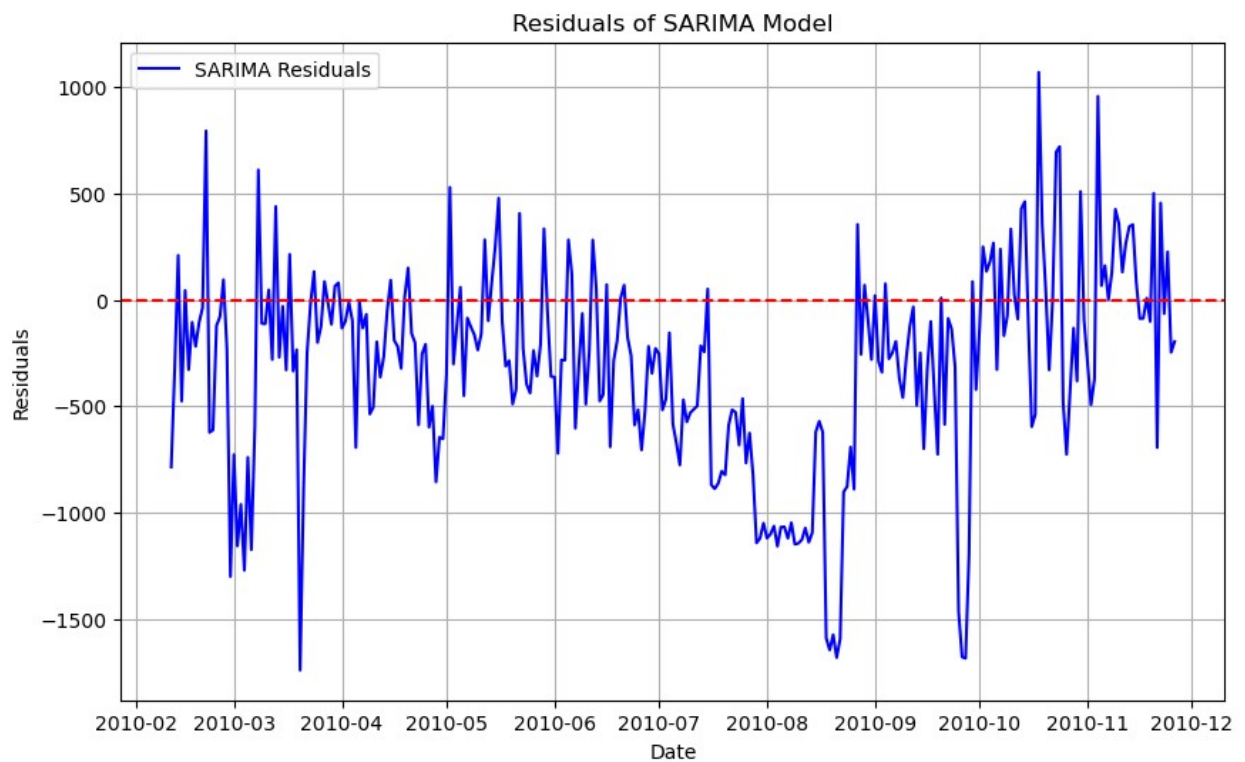
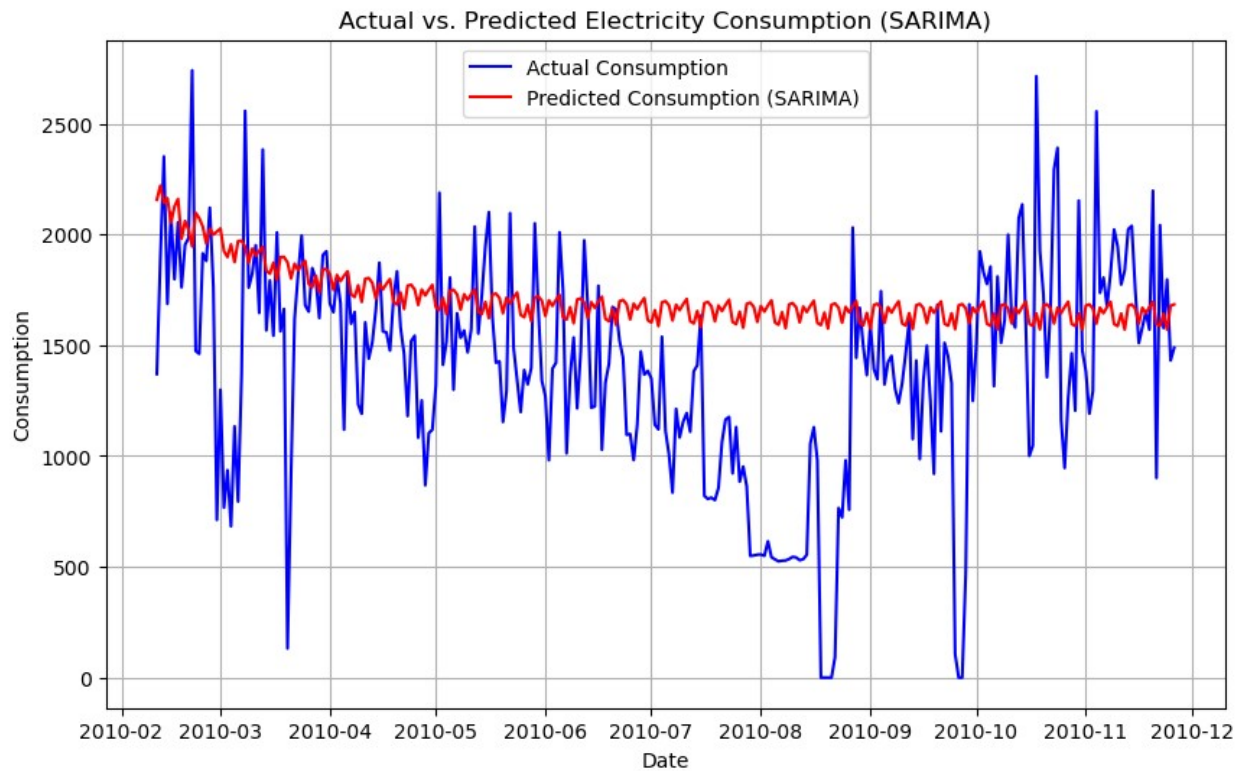
Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

SARIMA Metrics:

MAE: 438.60808116457366, MSE: 335851.22434331535, RMSE:

579.526724442726



This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32331D+00 |proj g|= 2.94119D-01

At iterate 5 f= 1.25168D+00 |proj g|= 6.21898D-02

At iterate 10 f= 1.18795D+00 |proj g|= 5.80883D-02

At iterate 15 f= 1.16885D+00 |proj g|= 1.38361D-02

At iterate 20 f= 1.16834D+00 |proj g|= 8.11581D-05

At iterate 25 f= 1.16834D+00 |proj g|= 2.13454D-04

At iterate 30 f= 1.16834D+00 |proj g|= 1.21397D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	1.297D-06	1.168D+00
F =	1.1683373603359903						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

## RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32414D+00 |proj g|= 2.94680D-01

At iterate 5 f= 1.25153D+00 |proj g|= 6.10061D-02

This problem is unconstrained.

At iterate 10 f= 1.18726D+00 |proj g|= 5.70453D-02

At iterate 15 f= 1.16940D+00 |proj g|= 7.04644D-03

At iterate 20 f= 1.16906D+00 |proj g|= 2.70125D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	29	1	0	0	2.847D-06	1.169D+00
F = 1.1690634541472482							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32408D+00 |proj g|= 2.94648D-01

At iterate 5 f= 1.25114D+00 |proj g|= 6.07392D-02

At iterate 10 f= 1.18725D+00 |proj g|= 5.79154D-02

At iterate 15 f= 1.16908D+00 |proj g|= 1.13610D-02

At iterate 20 f= 1.16867D+00 |proj g|= 6.31857D-05

\* \* \*



Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	29	1	0	0	1.883D-05	1.169D+00
F =	1.1686693331185789						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32390D+00 |proj g|= 2.94357D-01

At iterate 5 f= 1.25124D+00 |proj g|= 6.11363D-02

At iterate 10 f= 1.18752D+00 |proj g|= 5.75947D-02

At iterate 15 f= 1.16886D+00 |proj g|= 8.10448D-03

At iterate 20 f= 1.16856D+00 |proj g|= 1.87413D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
---	-----	-----	-------	------	------	-------	---

```
5      22      26      1      0      0      1.849D-05      1.169D+00
F =    1.1685612784766892
```

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32400D+00 |proj g|= 2.94151D-01

At iterate 5 f= 1.25147D+00 |proj g|= 6.13339D-02

At iterate 10 f= 1.18751D+00 |proj g|= 5.79440D-02

At iterate 15 f= 1.16869D+00 |proj g|= 6.23216D-03

At iterate 20 f= 1.16839D+00 |proj g|= 1.80942D-04

At iterate 25 f= 1.16838D+00 |proj g|= 6.70144D-04

At iterate 30 f= 1.16838D+00 |proj g|= 5.81581D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

```
N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
5      30      34      1      0      0      5.816D-06      1.168D+00
F =    1.1683819653261189
```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32370D+00 |proj g|= 2.94396D-01

At iterate 5 f= 1.25127D+00 |proj g|= 6.18857D-02

At iterate 10 f= 1.18637D+00 |proj g|= 5.59968D-02

At iterate 15 f= 1.16866D+00 |proj g|= 4.34696D-02

At iterate 20 f= 1.16805D+00 |proj g|= 1.03009D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	27	1	0	0	1.724D-05	1.168D+00
F = 1.1680496659456370							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32332D+00 |proj g|= 2.94647D-01

At iterate 5 f= 1.25103D+00 |proj g|= 6.20792D-02

At iterate 10 f= 1.18543D+00 |proj g|= 5.51553D-02

At iterate 15 f= 1.16817D+00 |proj g|= 3.67399D-02

At iterate 20 f= 1.16769D+00 |proj g|= 2.16995D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	1.659D-05	1.168D+00
F = 1.1676861362902462							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32299D+00 |proj g|= 2.94589D-01

At iterate 5 f= 1.25079D+00 |proj g|= 6.24652D-02

At iterate 10 f= 1.18485D+00 |proj g|= 5.46022D-02

At iterate 15 f= 1.16750D+00 |proj g|= 1.37238D-02

At iterate 20 f= 1.16726D+00 |proj g|= 1.47476D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	25	1	0	0	1.475D-05	1.167D+00
F = 1.1672601775033513							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32267D+00 |proj g|= 2.96163D-01

At iterate 5 f= 1.25035D+00 |proj g|= 6.28262D-02

At iterate 10 f= 1.18750D+00 |proj g|= 4.50784D-02

At iterate 15 f= 1.16720D+00 |proj g|= 2.69631D-02

At iterate 20 f= 1.16685D+00 |proj g|= 1.16556D-04

At iterate 25 f= 1.16684D+00 |proj g|= 1.64120D-03

At iterate 30 f= 1.16683D+00 |proj g|= 9.40292D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	1.047D-05	1.167D+00
F = 1.1668327531399634							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32255D+00 |proj g|= 2.96431D-01

At iterate 5 f= 1.25007D+00 |proj g|= 6.32804D-02

This problem is unconstrained.

At iterate 10 f= 1.18406D+00 |proj g|= 5.39837D-02

At iterate 15 f= 1.16701D+00 |proj g|= 4.45012D-02

At iterate 20 f= 1.16640D+00 |proj g|= 1.26985D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	1.096D-05	1.166D+00

F = 1.1664047866792620

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32256D+00    |proj g|=  2.97086D-01
At iterate    5    f=  1.24974D+00    |proj g|=  6.26997D-02
At iterate   10    f=  1.18455D+00    |proj g|=  5.63069D-02
At iterate   15    f=  1.16631D+00    |proj g|=  5.99379D-03
At iterate   20    f=  1.16599D+00    |proj g|=  1.95173D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	28	1	0	0	9.999D-06	1.166D+00

F = 1.1659940520787362

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32277D+00    |proj g|=  2.96647D-01
At iterate    5    f=  1.25086D+00    |proj g|=  6.37049D-02
At iterate   10    f=  1.18538D+00    |proj g|=  5.47340D-02
At iterate   15    f=  1.16744D+00    |proj g|=  5.00176D-03
At iterate   20    f=  1.16714D+00    |proj g|=  1.20461D-04

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	27	1	0	0	1.342D-05	1.167D+00
F =	1.1671402954664167						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32339D+00 |proj g|= 2.95621D-01

At iterate 5 f= 1.25192D+00 |proj g|= 6.37790D-02

At iterate 10 f= 1.18544D+00 |proj g|= 5.35847D-02

At iterate 15 f= 1.16793D+00 |proj g|= 3.51345D-03

At iterate 20 f= 1.16766D+00 |proj g|= 3.90897D-05

At iterate 25 f= 1.16766D+00 |proj g|= 3.39073D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*



N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	34	1	0	0	1.214D-05	1.168D+00
F = 1.1676555710794696							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32311D+00 |proj g|= 2.95660D-01

At iterate 5 f= 1.25156D+00 |proj g|= 6.35422D-02

This problem is unconstrained.

At iterate 10 f= 1.18641D+00 |proj g|= 5.52621D-02

At iterate 15 f= 1.16829D+00 |proj g|= 1.29709D-02

At iterate 20 f= 1.16789D+00 |proj g|= 8.86863D-05

At iterate 25 f= 1.16789D+00 |proj g|= 2.47827D-04

At iterate 30 f= 1.16789D+00 |proj g|= 1.58191D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	3.820D-06	1.168D+00
F = 1.1678901457210897							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32270D+00 |proj g|= 2.95773D-01

At iterate 5 f= 1.25121D+00 |proj g|= 6.36275D-02

At iterate 10 f= 1.18646D+00 |proj g|= 5.52337D-02

At iterate 15 f= 1.16788D+00 |proj g|= 1.26739D-02

At iterate 20 f= 1.16747D+00 |proj g|= 7.21052D-05

At iterate 25 f= 1.16747D+00 |proj g|= 5.86295D-04

At iterate 30 f= 1.16746D+00 |proj g|= 2.04973D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	38	1	0	0	2.050D-05	1.167D+00
F =	1.1674643454009079						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32243D+00    |proj g|=  2.95926D-01
At iterate    5    f=  1.25085D+00    |proj g|=  6.38241D-02
At iterate   10    f=  1.18600D+00    |proj g|=  5.50305D-02
At iterate   15    f=  1.16747D+00    |proj g|=  1.23480D-02
At iterate   20    f=  1.16706D+00    |proj g|=  8.70605D-05
At iterate   25    f=  1.16706D+00    |proj g|=  3.98951D-04
At iterate   30    f=  1.16706D+00    |proj g|=  2.42346D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	6.119D-06	1.167D+00

F = 1.1670605086492980

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32214D+00    |proj g|=  2.96368D-01
At iterate    5    f=  1.25053D+00    |proj g|=  6.40635D-02
At iterate   10    f=  1.18585D+00    |proj g|=  5.48827D-02
At iterate   15    f=  1.16714D+00    |proj g|=  1.23107D-02

```

At iterate 20 f= 1.16672D+00 |proj g|= 8.16868D-05

At iterate 25 f= 1.16672D+00 |proj g|= 4.42729D-04

At iterate 30 f= 1.16672D+00 |proj g|= 5.30741D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	37	1	0	0	5.307D-05	1.167D+00
F = 1.1667157400316108							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32211D+00 |proj g|= 2.96310D-01

At iterate 5 f= 1.25049D+00 |proj g|= 6.38123D-02

At iterate 10 f= 1.18547D+00 |proj g|= 5.52407D-02

At iterate 15 f= 1.16676D+00 |proj g|= 1.35758D-02

At iterate 20 f= 1.16632D+00 |proj g|= 6.41062D-05

At iterate 25 f= 1.16632D+00 |proj g|= 7.64178D-04

At iterate 30 f= 1.16631D+00 |proj g|= 1.04194D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	1.042D-05	1.166D+00
F =	1.1663148340612839						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32376D+00 |proj g|= 2.93641D-01

At iterate 5 f= 1.25193D+00 |proj g|= 6.30217D-02

At iterate 10 f= 1.18705D+00 |proj g|= 5.56751D-02

At iterate 15 f= 1.16900D+00 |proj g|= 1.47402D-02

At iterate 20 f= 1.16856D+00 |proj g|= 3.28906D-05

At iterate 25 f= 1.16856D+00 |proj g|= 9.85588D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	38	1	0	0	1.473D-05	1.169D+00

F = 1.1685568593678541

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32332D+00 |proj g|= 2.94141D-01

At iterate 5 f= 1.25146D+00 |proj g|= 6.31831D-02

At iterate 10 f= 1.18697D+00 |proj g|= 5.61571D-02

At iterate 15 f= 1.16880D+00 |proj g|= 1.52799D-02

At iterate 20 f= 1.16834D+00 |proj g|= 6.04514D-05

At iterate 25 f= 1.16834D+00 |proj g|= 2.67346D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	37	1	0	0	3.489D-05	1.168D+00

F = 1.1683413253037647

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32376D+00      |proj g|=  2.94069D-01
  This problem is unconstrained.

At iterate    5      f=  1.25132D+00      |proj g|=  6.06605D-02
At iterate   10      f=  1.18639D+00      |proj g|=  5.87613D-02
At iterate   15      f=  1.16940D+00      |proj g|=  1.72388D-02
At iterate   20      f=  1.16884D+00      |proj g|=  9.81508D-05
At iterate   25      f=  1.16884D+00      |proj g|=  1.43072D-04
At iterate   30      f=  1.16884D+00      |proj g|=  3.08304D-05

  * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

  * * *

  N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
  5       31       35    1     0     0    3.899D-06  1.169D+00
F =  1.1688403680025263

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
  This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

  * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32332D+00      |proj g|=  2.95218D-01

```

```

At iterate    5    f=  1.25096D+00    |proj g|=  6.12000D-02
At iterate   10    f=  1.18636D+00    |proj g|=  5.94334D-02
At iterate   15    f=  1.16928D+00    |proj g|=  1.49665D-02
At iterate   20    f=  1.16864D+00    |proj g|=  1.09963D-04
At iterate   25    f=  1.16864D+00    |proj g|=  9.46905D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	34	1	0	0	4.819D-06	1.169D+00

F = 1.1686383462576329

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.32587D+00    |proj g|=  2.91700D-01

```

```

This problem is unconstrained.

```

```

At iterate    5    f=  1.25183D+00    |proj g|=  5.87129D-02
At iterate   10    f=  1.17865D+00    |proj g|=  4.63566D-02
At iterate   15    f=  1.16909D+00    |proj g|=  1.84647D-02
At iterate   20    f=  1.16886D+00    |proj g|=  1.11557D-05

```

\* \* \*



Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	4.505D-06	1.169D+00

F = 1.1688648969362239

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32558D+00 |proj g|= 2.94294D-01

At iterate 5 f= 1.25123D+00 |proj g|= 5.91607D-02

At iterate 10 f= 1.18304D+00 |proj g|= 5.19463D-02

At iterate 15 f= 1.16883D+00 |proj g|= 7.51678D-03

At iterate 20 f= 1.16846D+00 |proj g|= 3.32270D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.999D-05	1.168D+00

F = 1.1684627473238605

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32574D+00 |proj g|= 2.93486D-01

At iterate 5 f= 1.25148D+00 |proj g|= 6.04459D-02

This problem is unconstrained.

At iterate 10 f= 1.17751D+00 |proj g|= 4.96108D-02

At iterate 15 f= 1.16850D+00 |proj g|= 8.67225D-03

At iterate 20 f= 1.16845D+00 |proj g|= 1.69754D-04

At iterate 25 f= 1.16843D+00 |proj g|= 2.41164D-03

At iterate 30 f= 1.16843D+00 |proj g|= 2.53824D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	34	1	0	0	4.895D-06	1.168D+00
F =	1.1684315377886552						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32535D+00 |proj g|= 2.93548D-01

At iterate 5 f= 1.25112D+00 |proj g|= 6.07149D-02

At iterate 10 f= 1.17691D+00 |proj g|= 5.80581D-02

At iterate 15 f= 1.16815D+00 |proj g|= 5.07324D-03

At iterate 20 f= 1.16812D+00 |proj g|= 5.47345D-04

At iterate 25 f= 1.16810D+00 |proj g|= 3.16077D-04

At iterate 30 f= 1.16810D+00 |proj g|= 2.13369D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	2.134D-05	1.168D+00
F = 1.1680953378499233							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32549D+00 |proj g|= 2.93118D-01

At iterate 5 f= 1.25182D+00 |proj g|= 6.09942D-02

This problem is unconstrained.

At iterate 10 f= 1.18600D+00 |proj g|= 5.49573D-02

At iterate 15 f= 1.17161D+00 |proj g|= 8.34751D-03

At iterate 20 f= 1.17120D+00 |proj g|= 3.96813D-05

At iterate 25 f= 1.17120D+00 |proj g|= 7.40823D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	33	1	0	0	1.116D-05	1.171D+00
F = 1.1711952372167598							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32539D+00 |proj g|= 2.92849D-01

At iterate 5 f= 1.25206D+00 |proj g|= 6.15070D-02

At iterate 10 f= 1.18476D+00 |proj g|= 5.17473D-02

At iterate 15 f= 1.17122D+00 |proj g|= 7.36600D-03

At iterate 20 f= 1.17095D+00 |proj g|= 4.97347D-05

At iterate 25 f= 1.17095D+00 |proj g|= 6.10052D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	33	1	0	0	1.831D-05	1.171D+00
F =	1.1709467871190862						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32500D+00 |proj g|= 2.92933D-01

At iterate 5 f= 1.25173D+00 |proj g|= 6.17957D-02

This problem is unconstrained.

At iterate 10 f= 1.18458D+00 |proj g|= 5.36335D-02

At iterate 15 f= 1.17092D+00 |proj g|= 6.30776D-03

At iterate 20 f= 1.17064D+00 |proj g|= 6.15592D-05

At iterate 25 f= 1.17064D+00 |proj g|= 1.21458D-04

At iterate 30 f= 1.17064D+00 |proj g|= 7.45914D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	7.459D-06	1.171D+00
F = 1.1706367171271583							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32470D+00 |proj g|= 2.92936D-01

This problem is unconstrained.

At iterate 5 f= 1.25133D+00 |proj g|= 6.22854D-02

At iterate 10 f= 1.18262D+00 |proj g|= 4.56562D-02

At iterate 15 f= 1.17081D+00 |proj g|= 1.64687D-02

At iterate 20 f= 1.17039D+00 |proj g|= 5.08371D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	28	1	0	0	2.145D-05	1.170D+00
F = 1.1703863017158780							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32447D+00      |proj g|=  2.93693D-01
At iterate    5      f=  1.25107D+00      |proj g|=  6.27520D-02
  This problem is unconstrained.

At iterate   10      f=  1.18097D+00      |proj g|=  5.82872D-02
At iterate   15      f=  1.17044D+00      |proj g|=  8.11625D-03
At iterate   20      f=  1.17001D+00      |proj g|=  3.21251D-04
At iterate   25      f=  1.17001D+00      |proj g|=  3.73878D-04
At iterate   30      f=  1.17000D+00      |proj g|=  4.50111D-06

      * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F      = final function value

      * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       30       36     1     0     0      4.501D-06  1.170D+00
F =  1.1700046031142868

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

      * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32456D+00      |proj g|=  2.93813D-01
At iterate    5      f=  1.25112D+00      |proj g|=  6.22209D-02
  This problem is unconstrained.

```

```

At iterate   10    f=  1.18135D+00    |proj g|=  4.93497D-02
At iterate   15    f=  1.17048D+00    |proj g|=  6.81734D-03
At iterate   20    f=  1.17032D+00    |proj g|=  1.04425D-04
At iterate   25    f=  1.17031D+00    |proj g|=  1.46400D-03
At iterate   30    f=  1.17031D+00    |proj g|=  2.41172D-06

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	2.412D-06	1.170D+00

F = 1.1703068819257270

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32407D+00    |proj g|=  2.94619D-01
At iterate    5    f=  1.25087D+00    |proj g|=  6.34153D-02
At iterate   10    f=  1.18289D+00    |proj g|=  5.05623D-02
At iterate   15    f=  1.17069D+00    |proj g|=  1.48329D-02
At iterate   20    f=  1.17001D+00    |proj g|=  4.87434D-05
At iterate   25    f=  1.17000D+00    |proj g|=  5.78550D-04

```



\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	36	1	0	0	2.732D-06	1.170D+00
F =	1.1700039572500205						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32378D+00 |proj g|= 2.95391D-01

At iterate 5 f= 1.25042D+00 |proj g|= 6.37707D-02

At iterate 10 f= 1.18314D+00 |proj g|= 5.58803D-02

At iterate 15 f= 1.17015D+00 |proj g|= 1.95354D-02

At iterate 20 f= 1.16958D+00 |proj g|= 1.82272D-04

At iterate 25 f= 1.16958D+00 |proj g|= 2.44922D-04

At iterate 30 f= 1.16958D+00 |proj g|= 1.51152D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	5.177D-06	1.170D+00
F =	1.1695834284439803						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32340D+00 |proj g|= 2.96149D-01

At iterate 5 f= 1.25057D+00 |proj g|= 6.57620D-02

This problem is unconstrained.

At iterate 10 f= 1.18341D+00 |proj g|= 6.88105D-02

At iterate 15 f= 1.16979D+00 |proj g|= 1.10484D-02

At iterate 20 f= 1.16931D+00 |proj g|= 2.78031D-05

At iterate 25 f= 1.16931D+00 |proj g|= 3.15597D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	33	1	0	0	1.774D-06	1.169D+00
F =	1.1693094981935130						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32301D+00 |proj g|= 2.96993D-01

At iterate 5 f= 1.25015D+00 |proj g|= 6.57724D-02

At iterate 10 f= 1.18421D+00 |proj g|= 4.91050D-02

At iterate 15 f= 1.16948D+00 |proj g|= 1.14896D-02

At iterate 20 f= 1.16910D+00 |proj g|= 1.27494D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	27	1	0	0	1.716D-05	1.169D+00
F =	1.1690967779831656						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32264D+00 |proj g|= 2.97578D-01

```

At iterate    5    f=  1.24968D+00    |proj g|=  6.53503D-02
At iterate   10    f=  1.18407D+00    |proj g|=  7.96448D-02
At iterate   15    f=  1.16927D+00    |proj g|=  9.11624D-03
At iterate   20    f=  1.16883D+00    |proj g|=  1.06649D-04
At iterate   25    f=  1.16883D+00    |proj g|=  5.61449D-04
At iterate   30    f=  1.16883D+00    |proj g|=  2.13678D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    31    36    1    0    0    1.236D-06  1.169D+00
F =  1.1688266480714986

```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32230D+00    |proj g|=  2.97601D-01
At iterate    5    f=  1.24925D+00    |proj g|=  6.53744D-02
At iterate   10    f=  1.18329D+00    |proj g|=  6.93031D-02
At iterate   15    f=  1.16879D+00    |proj g|=  9.27065D-03
At iterate   20    f=  1.16841D+00    |proj g|=  5.23406D-05

```

At iterate 25 f= 1.16841D+00 |proj g|= 3.29380D-04

At iterate 30 f= 1.16841D+00 |proj g|= 1.05013D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	6.595D-06	1.168D+00
F = 1.1684116324980589							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32703D+00 |proj g|= 2.96693D-01

At iterate 5 f= 1.25480D+00 |proj g|= 6.50450D-02

At iterate 10 f= 1.18165D+00 |proj g|= 5.26919D-02

At iterate 15 f= 1.17221D+00 |proj g|= 3.51370D-03

At iterate 20 f= 1.17213D+00 |proj g|= 2.54853D-04

At iterate 25 f= 1.17211D+00 |proj g|= 4.43750D-04

At iterate 30 f= 1.17211D+00 |proj g|= 5.53426D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	5.534D-06	1.172D+00

F = 1.1721075832828429

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32681D+00 |proj g|= 2.96452D-01

At iterate 5 f= 1.25428D+00 |proj g|= 6.46564D-02

At iterate 10 f= 1.17997D+00 |proj g|= 3.05546D-02

At iterate 15 f= 1.17201D+00 |proj g|= 6.59586D-03

At iterate 20 f= 1.17193D+00 |proj g|= 7.38887D-04

At iterate 25 f= 1.17192D+00 |proj g|= 3.05910D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	26	31	1	0	0	6.698D-05	1.172D+00

F = 1.1719198561294366

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32636D+00 |proj g|= 2.96754D-01

At iterate 5 f= 1.25372D+00 |proj g|= 6.48387D-02

At iterate 10 f= 1.18008D+00 |proj g|= 3.82655D-02

At iterate 15 f= 1.17185D+00 |proj g|= 6.53291D-03

At iterate 20 f= 1.17174D+00 |proj g|= 9.22911D-05

At iterate 25 f= 1.17173D+00 |proj g|= 1.27570D-03

At iterate 30 f= 1.17173D+00 |proj g|= 4.80584D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	4.806D-06	1.172D+00
F =	1.1717276457340546						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32589D+00      |proj g|=  2.97024D-01
At iterate    5      f=  1.25342D+00      |proj g|=  6.52699D-02
  This problem is unconstrained.

At iterate   10      f=  1.18291D+00      |proj g|=  6.58855D-02
At iterate   15      f=  1.17195D+00      |proj g|=  1.87358D-02
At iterate   20      f=  1.17176D+00      |proj g|=  1.88148D-04
At iterate   25      f=  1.17175D+00      |proj g|=  6.87003D-04

  * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

  * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       29       33      1      0      0      9.026D-06  1.172D+00
F =  1.1717513166212372

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
  This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

  * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.32561D+00      |proj g|=  2.97142D-01
At iterate    5      f=  1.25343D+00      |proj g|=  6.52390D-02

```



```

At iterate   10    f=  1.18182D+00    |proj g|=  4.86728D-02
At iterate   15    f=  1.17203D+00    |proj g|=  5.94621D-03
At iterate   20    f=  1.17185D+00    |proj g|=  1.44992D-04
At iterate   25    f=  1.17184D+00    |proj g|=  2.01054D-03
At iterate   30    f=  1.17183D+00    |proj g|=  2.05519D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    33    41    1    0    0    1.391D-06  1.172D+00
F =  1.1718338095340148

```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =          5      M =          10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32550D+00    |proj g|=  2.97775D-01
At iterate    5    f=  1.25334D+00    |proj g|=  6.58043D-02
At iterate   10    f=  1.18322D+00    |proj g|=  6.12685D-02
At iterate   15    f=  1.17157D+00    |proj g|=  8.55042D-03
At iterate   20    f=  1.17145D+00    |proj g|=  5.12908D-04
At iterate   25    f=  1.17143D+00    |proj g|=  1.27492D-03

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	33	1	0	0	3.854D-05	1.171D+00
F =	1.1714289162552334						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32526D+00 |proj g|= 2.97854D-01

At iterate 5 f= 1.25299D+00 |proj g|= 6.51437D-02

This problem is unconstrained.

At iterate 10 f= 1.18034D+00 |proj g|= 3.39914D-02

At iterate 15 f= 1.17111D+00 |proj g|= 6.74913D-03

At iterate 20 f= 1.17104D+00 |proj g|= 1.17973D-04

At iterate 25 f= 1.17103D+00 |proj g|= 1.65211D-03

At iterate 30 f= 1.17103D+00 |proj g|= 5.24865D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	5.249D-06	1.171D+00
F =	1.1710270535594209						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32486D+00 |proj g|= 2.97964D-01

At iterate 5 f= 1.25273D+00 |proj g|= 6.54108D-02

This problem is unconstrained.

At iterate 10 f= 1.18216D+00 |proj g|= 5.63870D-02

At iterate 15 f= 1.17096D+00 |proj g|= 2.26793D-02

At iterate 20 f= 1.17078D+00 |proj g|= 6.28205D-04

At iterate 25 f= 1.17077D+00 |proj g|= 1.28923D-03

At iterate 30 f= 1.17077D+00 |proj g|= 1.44180D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	2.403D-06	1.171D+00
F =	1.1707650330897941						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32446D+00 |proj g|= 2.98175D-01

At iterate 5 f= 1.25228D+00 |proj g|= 6.43747D-02

At iterate 10 f= 1.18238D+00 |proj g|= 4.77847D-02

At iterate 15 f= 1.17093D+00 |proj g|= 1.35823D-02

At iterate 20 f= 1.17037D+00 |proj g|= 7.26818D-05

At iterate 25 f= 1.17037D+00 |proj g|= 4.67277D-04

At iterate 30 f= 1.17036D+00 |proj g|= 1.14298D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	37	1	0	0	1.143D-05	1.170D+00
F =	1.1703640838635583						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.32406D+00      |proj g|= 2.98628D-01

At iterate    5      f= 1.25219D+00      |proj g|= 6.53954D-02

This problem is unconstrained.

At iterate    10      f= 1.18501D+00      |proj g|= 4.99358D-02

At iterate    15      f= 1.17034D+00      |proj g|= 7.26796D-03

At iterate    20      f= 1.16995D+00      |proj g|= 4.63127D-04

At iterate    25      f= 1.16995D+00      |proj g|= 5.35377D-04

At iterate    30      f= 1.16994D+00      |proj g|= 5.65026D-05

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	39	1	0	0	1.361D-05	1.170D+00
F =	1.1699437413859302						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =                    5      M =                    10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.32428D+00      |proj g|= 2.97989D-01

At iterate    5      f= 1.25190D+00      |proj g|= 6.46970D-02

This problem is unconstrained.

```

At iterate   10    f=  1.18091D+00    |proj g|=  5.92004D-02
At iterate   15    f=  1.16973D+00    |proj g|=  7.19085D-03
At iterate   20    f=  1.16959D+00    |proj g|=  2.75149D-04
At iterate   25    f=  1.16958D+00    |proj g|=  6.84164D-04
At iterate   30    f=  1.16958D+00    |proj g|=  1.80240D-06

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	1.802D-06	1.170D+00

F = 1.1695759423688370

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate   0    f=  1.32387D+00    |proj g|=  2.98122D-01
At iterate   5    f=  1.25158D+00    |proj g|=  6.49679D-02
At iterate  10    f=  1.18129D+00    |proj g|=  4.78293D-02
At iterate  15    f=  1.16946D+00    |proj g|=  2.15038D-02
At iterate  20    f=  1.16921D+00    |proj g|=  1.35580D-04
At iterate  25    f=  1.16920D+00    |proj g|=  4.37526D-04

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	32	1	0	0	9.403D-07	1.169D+00
F =	1.1691993802104261						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32401D+00 |proj g|= 3.00664D-01

At iterate 5 f= 1.26352D+00 |proj g|= 1.13909D-01

At iterate 10 f= 1.20243D+00 |proj g|= 2.29574D-01

At iterate 15 f= 1.16999D+00 |proj g|= 1.70868D-02

At iterate 20 f= 1.16889D+00 |proj g|= 2.69778D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	24	29	1	0	0	1.237D-05	1.169D+00
F = 1.1688943347207246							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32362D+00 |proj g|= 3.00815D-01

At iterate 5 f= 1.25071D+00 |proj g|= 6.53530D-02

At iterate 10 f= 1.18016D+00 |proj g|= 5.80436D-02

At iterate 15 f= 1.16875D+00 |proj g|= 3.16094D-02

At iterate 20 f= 1.16851D+00 |proj g|= 5.88577D-04

At iterate 25 f= 1.16850D+00 |proj g|= 1.82455D-03

At iterate 30 f= 1.16849D+00 |proj g|= 6.62995D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	3.213D-06	1.168D+00
F = 1.1684906875614214							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.



# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32320D+00 |proj g|= 3.00994D-01

At iterate 5 f= 1.25033D+00 |proj g|= 6.55812D-02

At iterate 10 f= 1.18027D+00 |proj g|= 4.99883D-02

At iterate 15 f= 1.16833D+00 |proj g|= 2.39790D-02

At iterate 20 f= 1.16809D+00 |proj g|= 2.78348D-04

At iterate 25 f= 1.16809D+00 |proj g|= 2.56160D-03

At iterate 30 f= 1.16808D+00 |proj g|= 2.66665D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	7.823D-06	1.168D+00
F =	1.1680815251068544						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32284D+00    |proj g|=  3.01048D-01
At iterate    5    f=  1.25015D+00    |proj g|=  6.59383D-02
At iterate   10    f=  1.18106D+00    |proj g|=  4.80587D-02
At iterate   15    f=  1.16840D+00    |proj g|=  1.89195D-02
At iterate   20    f=  1.16767D+00    |proj g|=  2.03839D-04
At iterate   25    f=  1.16767D+00    |proj g|=  7.18804D-04
At iterate   30    f=  1.16766D+00    |proj g|=  8.45932D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    31    36    1     0     0    8.611D-06  1.168D+00
F =  1.1676638646133137

```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5    M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.32256D+00    |proj g|=  3.01895D-01
At iterate    5    f=  1.25019D+00    |proj g|=  6.61704D-02
At iterate   10    f=  1.18315D+00    |proj g|=  4.78229D-02
At iterate   15    f=  1.16800D+00    |proj g|=  1.12682D-02

```

At iterate 20 f= 1.16783D+00 |proj g|= 4.70483D-04

At iterate 25 f= 1.16783D+00 |proj g|= 7.56505D-04

At iterate 30 f= 1.16783D+00 |proj g|= 2.36167D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	2.362D-06	1.168D+00
F = 1.1678285424840831							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32230D+00 |proj g|= 3.02020D-01

At iterate 5 f= 1.24987D+00 |proj g|= 6.61790D-02

This problem is unconstrained.

At iterate 10 f= 1.18312D+00 |proj g|= 6.85019D-02

At iterate 15 f= 1.16796D+00 |proj g|= 9.43221D-03

At iterate 20 f= 1.16749D+00 |proj g|= 7.18038D-05

At iterate 25 f= 1.16748D+00 |proj g|= 6.05336D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	32	1	0	0	4.836D-06	1.167D+00
F = 1.1674782095552698							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32194D+00 |proj g|= 3.02162D-01

At iterate 5 f= 1.26154D+00 |proj g|= 1.12686D-01

At iterate 10 f= 1.20038D+00 |proj g|= 2.26771D-01

At iterate 15 f= 1.16806D+00 |proj g|= 1.44311D-02

At iterate 20 f= 1.16707D+00 |proj g|= 7.37477D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	24	28	1	0	0	1.978D-05	1.167D+00
F = 1.1670654263223657							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32152D+00 |proj g|= 3.02334D-01

At iterate 5 f= 1.24912D+00 |proj g|= 6.64620D-02

At iterate 10 f= 1.18073D+00 |proj g|= 5.14939D-02

At iterate 15 f= 1.16701D+00 |proj g|= 6.92286D-03

At iterate 20 f= 1.16667D+00 |proj g|= 7.98396D-05

At iterate 25 f= 1.16667D+00 |proj g|= 1.71948D-04

At iterate 30 f= 1.16667D+00 |proj g|= 5.45411D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	37	1	0	0	9.797D-06	1.167D+00
F =	1.1666675046063910						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32132D+00 |proj g|= 3.02460D-01

At iterate 5 f= 1.24915D+00 |proj g|= 6.61207D-02

At iterate 10 f= 1.18079D+00 |proj g|= 5.13930D-02

At iterate 15 f= 1.16703D+00 |proj g|= 4.62532D-03

At iterate 20 f= 1.16653D+00 |proj g|= 4.71017D-05

At iterate 25 f= 1.16652D+00 |proj g|= 2.12669D-04

At iterate 30 f= 1.16652D+00 |proj g|= 8.35074D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	37	1	0	0	8.351D-06	1.167D+00
F =	1.1665220015458784						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32141D+00 |proj g|= 3.01730D-01

At iterate 5 f= 1.24894D+00 |proj g|= 6.60805D-02

```

At iterate   10      f=  1.18042D+00      |proj g|=  5.17425D-02
At iterate   15      f=  1.16646D+00      |proj g|=  4.23283D-03
At iterate   20      f=  1.16629D+00      |proj g|=  1.63380D-04
At iterate   25      f=  1.16629D+00      |proj g|=  5.87936D-04
At iterate   30      f=  1.16629D+00      |proj g|=  1.40189D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	2.201D-05	1.166D+00

F = 1.1662870583060514

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0      f=  1.32101D+00      |proj g|=  3.01947D-01
At iterate    5      f=  1.24874D+00      |proj g|=  6.67746D-02
At iterate   10      f=  1.17999D+00      |proj g|=  5.07674D-02
At iterate   15      f=  1.16636D+00      |proj g|=  7.25605D-03
At iterate   20      f=  1.16590D+00      |proj g|=  3.36205D-05
At iterate   25      f=  1.16590D+00      |proj g|=  6.91719D-04

```

At iterate 30 f= 1.16590D+00 |proj g|= 2.61138D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	2.611D-06	1.166D+00
F = 1.1658990283509487							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32074D+00 |proj g|= 3.02117D-01

At iterate 5 f= 1.24846D+00 |proj g|= 6.69600D-02

At iterate 10 f= 1.17948D+00 |proj g|= 5.07128D-02

At iterate 15 f= 1.16594D+00 |proj g|= 1.91470D-02

At iterate 20 f= 1.16550D+00 |proj g|= 4.44695D-05

At iterate 25 f= 1.16550D+00 |proj g|= 1.52119D-04

At iterate 30 f= 1.16549D+00 |proj g|= 5.15193D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped



Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	7.958D-06	1.165D+00
F = 1.1654943384172851							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.32042D+00 |proj g|= 3.02094D-01

At iterate 5 f= 1.24797D+00 |proj g|= 6.56692D-02

At iterate 10 f= 1.17924D+00 |proj g|= 5.18798D-02

At iterate 15 f= 1.16528D+00 |proj g|= 6.63033D-03

At iterate 20 f= 1.16508D+00 |proj g|= 4.06550D-05

At iterate 25 f= 1.16508D+00 |proj g|= 6.20727D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	33	1	0	0	4.748D-06	1.165D+00
F = 1.1650788186087750							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31996D+00 |proj g|= 3.02310D-01

At iterate 5 f= 1.24766D+00 |proj g|= 6.59774D-02

At iterate 10 f= 1.17896D+00 |proj g|= 5.14716D-02

At iterate 15 f= 1.16526D+00 |proj g|= 4.50498D-03

At iterate 20 f= 1.16474D+00 |proj g|= 9.48609D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	25	1	0	0	9.746D-05	1.165D+00
F =	1.1647396520740272						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.31956D+00    |proj g|=  3.02441D-01
At iterate    5    f=  1.24729D+00    |proj g|=  6.61437D-02
At iterate   10    f=  1.17879D+00    |proj g|=  5.14644D-02
At iterate   15    f=  1.16474D+00    |proj g|=  1.25697D-02
At iterate   20    f=  1.16448D+00    |proj g|=  1.85906D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	27	1	0	0	2.583D-05	1.164D+00

F = 1.1644821633650784

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.31929D+00    |proj g|=  3.02340D-01
At iterate    5    f=  1.24715D+00    |proj g|=  6.62114D-02

```

This problem is unconstrained.

```

At iterate   10    f=  1.17865D+00    |proj g|=  5.17295D-02
At iterate   15    f=  1.16423D+00    |proj g|=  9.60192D-03
At iterate   20    f=  1.16408D+00    |proj g|=  1.10408D-04
At iterate   25    f=  1.16408D+00    |proj g|=  9.48744D-04

```

At iterate 30 f= 1.16408D+00 |proj g|= 1.90936D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	1.662D-05	1.164D+00
F = 1.1640771128021987							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31898D+00 |proj g|= 3.02670D-01

At iterate 5 f= 1.24680D+00 |proj g|= 6.64494D-02

This problem is unconstrained.

At iterate 10 f= 1.17859D+00 |proj g|= 5.21544D-02

At iterate 15 f= 1.16387D+00 |proj g|= 5.90292D-03

At iterate 20 f= 1.16369D+00 |proj g|= 7.10872D-05

At iterate 25 f= 1.16368D+00 |proj g|= 9.05143D-04

At iterate 30 f= 1.16368D+00 |proj g|= 3.20288D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	3.535D-06	1.164D+00
F = 1.1636825461189240							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31881D+00 |proj g|= 3.02774D-01

This problem is unconstrained.

At iterate 5 f= 1.24663D+00 |proj g|= 6.68835D-02

At iterate 10 f= 1.17830D+00 |proj g|= 5.24746D-02

At iterate 15 f= 1.16350D+00 |proj g|= 6.20785D-03

At iterate 20 f= 1.16332D+00 |proj g|= 9.18550D-05

At iterate 25 f= 1.16332D+00 |proj g|= 3.98848D-04

At iterate 30 f= 1.16332D+00 |proj g|= 1.69469D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	1.695D-06	1.163D+00

F = 1.1633157676983754

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31852D+00 |proj g|= 3.02838D-01

At iterate 5 f= 1.24645D+00 |proj g|= 6.71518D-02

At iterate 10 f= 1.17869D+00 |proj g|= 5.32348D-02

At iterate 15 f= 1.16321D+00 |proj g|= 9.18180D-03

At iterate 20 f= 1.16300D+00 |proj g|= 4.58003D-05

At iterate 25 f= 1.16299D+00 |proj g|= 9.01355D-04

At iterate 30 f= 1.16299D+00 |proj g|= 5.00222D-07

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	5.002D-07	1.163D+00
F =	1.1629918470603133						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.31814D+00      |proj g|=  3.02932D-01
At iterate    5      f=  1.24610D+00      |proj g|=  6.72902D-02
  This problem is unconstrained.

At iterate   10      f=  1.17878D+00      |proj g|=  5.32646D-02
At iterate   15      f=  1.16298D+00      |proj g|=  1.06201D-02
At iterate   20      f=  1.16274D+00      |proj g|=  1.99345D-04
At iterate   25      f=  1.16274D+00      |proj g|=  1.39540D-03
At iterate   30      f=  1.16273D+00      |proj g|=  2.58026D-05

  * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

  * * *

  N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
  5      31      35    1      0      0      7.140D-06  1.163D+00
F =  1.1627335280612852

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

  * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.31779D+00      |proj g|=  3.03108D-01
At iterate    5      f=  1.24574D+00      |proj g|=  6.73103D-02
  This problem is unconstrained.

```

```

At iterate   10    f=  1.17928D+00    |proj g|=  5.30464D-02
At iterate   15    f=  1.16263D+00    |proj g|=  1.14514D-02
At iterate   20    f=  1.16235D+00    |proj g|=  6.11091D-05
At iterate   25    f=  1.16234D+00    |proj g|=  1.89898D-03
At iterate   30    f=  1.16234D+00    |proj g|=  1.27934D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	9.486D-06	1.162D+00

F = 1.1623398981459880

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.31743D+00    |proj g|=  3.03203D-01
At iterate    5    f=  1.24546D+00    |proj g|=  6.75277D-02
At iterate   10    f=  1.17932D+00    |proj g|=  5.26565D-02
At iterate   15    f=  1.16226D+00    |proj g|=  1.02658D-02
At iterate   20    f=  1.16198D+00    |proj g|=  2.21405D-04
At iterate   25    f=  1.16198D+00    |proj g|=  9.49446D-04

```



At iterate 30 f= 1.16197D+00 |proj g|= 5.94621D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	1.732D-05	1.162D+00

F = 1.1619746772151831

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31726D+00 |proj g|= 3.03204D-01

At iterate 5 f= 1.24527D+00 |proj g|= 6.71462D-02

At iterate 10 f= 1.17956D+00 |proj g|= 5.24873D-02

At iterate 15 f= 1.16222D+00 |proj g|= 1.06930D-02

At iterate 20 f= 1.16193D+00 |proj g|= 2.39178D-04

At iterate 25 f= 1.16193D+00 |proj g|= 1.12725D-03

At iterate 30 f= 1.16192D+00 |proj g|= 2.90029D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	6.485D-06	1.162D+00
F = 1.1619158844638906							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31687D+00 |proj g|= 3.03422D-01

At iterate 5 f= 1.24490D+00 |proj g|= 6.72971D-02

This problem is unconstrained.

At iterate 10 f= 1.17990D+00 |proj g|= 5.20731D-02

At iterate 15 f= 1.16183D+00 |proj g|= 9.98335D-03

At iterate 20 f= 1.16151D+00 |proj g|= 2.73413D-04

At iterate 25 f= 1.16151D+00 |proj g|= 1.09853D-03

At iterate 30 f= 1.16151D+00 |proj g|= 1.82765D-03

At iterate 35 f= 1.16151D+00 |proj g|= 3.15686D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	36	41	1	0	0	8.080D-07	1.162D+00
F = 1.1615051186427103							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31651D+00 |proj g|= 3.03466D-01

At iterate 5 f= 1.24453D+00 |proj g|= 6.74635D-02

At iterate 10 f= 1.18014D+00 |proj g|= 5.16292D-02

At iterate 15 f= 1.16144D+00 |proj g|= 9.56137D-03

At iterate 20 f= 1.16110D+00 |proj g|= 2.41827D-04

At iterate 25 f= 1.16110D+00 |proj g|= 9.15374D-04

At iterate 30 f= 1.16110D+00 |proj g|= 1.99346D-03

At iterate 35 f= 1.16109D+00 |proj g|= 8.52229D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	36	41	1	0	0	6.623D-06	1.161D+00
F = 1.1610944394510385							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31650D+00 |proj g|= 3.03331D-01

At iterate 5 f= 1.24463D+00 |proj g|= 6.73596D-02

At iterate 10 f= 1.18090D+00 |proj g|= 5.08805D-02

At iterate 15 f= 1.16132D+00 |proj g|= 1.09686D-02

At iterate 20 f= 1.16095D+00 |proj g|= 1.97277D-04

At iterate 25 f= 1.16095D+00 |proj g|= 1.11998D-03

At iterate 30 f= 1.16094D+00 |proj g|= 9.48431D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	7.481D-06	1.161D+00
F =	1.1609423893394100						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31628D+00 |proj g|= 3.03348D-01

At iterate 5 f= 1.24439D+00 |proj g|= 6.74256D-02

This problem is unconstrained.

At iterate 10 f= 1.18095D+00 |proj g|= 5.07433D-02

At iterate 15 f= 1.16100D+00 |proj g|= 1.20597D-02

At iterate 20 f= 1.16061D+00 |proj g|= 2.54666D-04

At iterate 25 f= 1.16061D+00 |proj g|= 1.44604D-03

At iterate 30 f= 1.16059D+00 |proj g|= 8.35782D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	3.908D-05	1.161D+00
F =	1.1605947462504584						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31641D+00 |proj g|= 3.02978D-01

At iterate 5 f= 1.24467D+00 |proj g|= 6.76079D-02

At iterate 10 f= 1.17995D+00 |proj g|= 5.22161D-02

At iterate 15 f= 1.16109D+00 |proj g|= 1.28169D-02

At iterate 20 f= 1.16072D+00 |proj g|= 1.71824D-04

At iterate 25 f= 1.16072D+00 |proj g|= 1.18738D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	33	1	0	0	8.354D-06	1.161D+00
F = 1.1606964904352746							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31603D+00 |proj g|= 3.03204D-01

At iterate 5 f= 1.24426D+00 |proj g|= 6.76768D-02

At iterate 10 f= 1.18011D+00 |proj g|= 5.20078D-02

At iterate 15 f= 1.16074D+00 |proj g|= 1.26203D-02

At iterate 20 f= 1.16037D+00 |proj g|= 2.77342D-04

At iterate 25 f= 1.16036D+00 |proj g|= 1.35132D-03

At iterate 30 f= 1.16034D+00 |proj g|= 1.55467D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	1.233D-05	1.160D+00

F = 1.1603419449984071

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31601D+00 |proj g|= 3.02744D-01

At iterate 5 f= 1.24418D+00 |proj g|= 6.81102D-02

At iterate 10 f= 1.17727D+00 |proj g|= 5.40442D-02

At iterate 15 f= 1.16061D+00 |proj g|= 3.05162D-02

At iterate 20 f= 1.16003D+00 |proj g|= 1.19586D-03

At iterate 25 f= 1.16003D+00 |proj g|= 1.16926D-03

At iterate 30 f= 1.16001D+00 |proj g|= 5.12659D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	5.295D-06	1.160D+00
F = 1.1600048680430630							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31560D+00 |proj g|= 3.03063D-01

At iterate 5 f= 1.24380D+00 |proj g|= 6.82457D-02

This problem is unconstrained.

At iterate 10 f= 1.17775D+00 |proj g|= 5.37845D-02

At iterate 15 f= 1.16018D+00 |proj g|= 2.34520D-02

At iterate 20 f= 1.15968D+00 |proj g|= 6.20812D-04

At iterate 25 f= 1.15968D+00 |proj g|= 4.77686D-04

At iterate 30 f= 1.15966D+00 |proj g|= 3.46803D-04

At iterate 35 f= 1.15966D+00 |proj g|= 4.74782D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	41	1	0	0	4.748D-06	1.160D+00
F = 1.1596565918156831							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL



# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31550D+00 |proj g|= 3.02906D-01

This problem is unconstrained.

At iterate 5 f= 1.24406D+00 |proj g|= 6.80330D-02

At iterate 10 f= 1.18061D+00 |proj g|= 5.20997D-02

At iterate 15 f= 1.16144D+00 |proj g|= 8.84974D-03

At iterate 20 f= 1.16109D+00 |proj g|= 2.46355D-04

At iterate 25 f= 1.16106D+00 |proj g|= 3.97210D-03

At iterate 30 f= 1.16106D+00 |proj g|= 3.90233D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	3.902D-05	1.161D+00

F = 1.1610562278120080

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31518D+00 |proj g|= 3.03077D-01

This problem is unconstrained.

At iterate 5 f= 1.24400D+00 |proj g|= 6.77556D-02

At iterate 10 f= 1.18238D+00 |proj g|= 5.10511D-02

At iterate 15 f= 1.16114D+00 |proj g|= 1.41712D-02

At iterate 20 f= 1.16068D+00 |proj g|= 1.62505D-04

At iterate 25 f= 1.16067D+00 |proj g|= 8.35049D-04

At iterate 30 f= 1.16065D+00 |proj g|= 1.88408D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	2.239D-06	1.161D+00
F =	1.1606545814348110						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31479D+00 |proj g|= 3.03235D-01

At iterate 5 f= 1.24360D+00 |proj g|= 6.77555D-02

At iterate 10 f= 1.18234D+00 |proj g|= 5.10856D-02

```

At iterate   15      f=  1.16076D+00      |proj g|=  1.49428D-02
At iterate   20      f=  1.16029D+00      |proj g|=  1.39434D-04
At iterate   25      f=  1.16027D+00      |proj g|=  2.47051D-03
At iterate   30      f=  1.16026D+00      |proj g|=  2.26743D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	8.826D-06	1.160D+00

F = 1.1602571714407603

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate   0      f=  1.31453D+00      |proj g|=  3.03567D-01
At iterate   5      f=  1.24339D+00      |proj g|=  6.78605D-02
At iterate  10      f=  1.18230D+00      |proj g|=  5.08620D-02
At iterate  15      f=  1.16047D+00      |proj g|=  1.58244D-02
At iterate  20      f=  1.15999D+00      |proj g|=  1.07072D-04
At iterate  25      f=  1.15998D+00      |proj g|=  1.83762D-03
At iterate  30      f=  1.15996D+00      |proj g|=  1.27670D-04

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	2.042D-05	1.160D+00
F =	1.1599630554975287						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31428D+00 |proj g|= 3.03706D-01

At iterate 5 f= 1.24342D+00 |proj g|= 6.79639D-02

At iterate 10 f= 1.18223D+00 |proj g|= 5.16290D-02

At iterate 15 f= 1.16019D+00 |proj g|= 1.43891D-02

At iterate 20 f= 1.15974D+00 |proj g|= 1.05822D-04

At iterate 25 f= 1.15973D+00 |proj g|= 1.87143D-03

At iterate 30 f= 1.15972D+00 |proj g|= 7.58625D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	6.189D-05	1.160D+00
F = 1.1597221250802383							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31400D+00 |proj g|= 3.03734D-01

At iterate 5 f= 1.24314D+00 |proj g|= 6.83455D-02

At iterate 10 f= 1.18124D+00 |proj g|= 5.30604D-02

At iterate 15 f= 1.15976D+00 |proj g|= 1.15602D-02

At iterate 20 f= 1.15936D+00 |proj g|= 1.63535D-04

At iterate 25 f= 1.15936D+00 |proj g|= 9.44598D-04

At iterate 30 f= 1.15934D+00 |proj g|= 1.01632D-03

At iterate 35 f= 1.15934D+00 |proj g|= 5.21089D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	36	40	1	0	0	2.485D-05	1.159D+00

F = 1.1593436548872977

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31366D+00 |proj g|= 3.03943D-01

At iterate 5 f= 1.24281D+00 |proj g|= 6.85337D-02

At iterate 10 f= 1.18057D+00 |proj g|= 5.33074D-02

At iterate 15 f= 1.15934D+00 |proj g|= 1.05089D-02

At iterate 20 f= 1.15895D+00 |proj g|= 1.59256D-04

At iterate 25 f= 1.15894D+00 |proj g|= 1.00844D-03

At iterate 30 f= 1.15894D+00 |proj g|= 6.31755D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	6.318D-06	1.159D+00
F =	1.1589361800047082						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31326D+00 |proj g|= 3.04119D-01

At iterate 5 f= 1.24249D+00 |proj g|= 6.86082D-02

At iterate 10 f= 1.18006D+00 |proj g|= 5.39640D-02

At iterate 15 f= 1.15891D+00 |proj g|= 8.21014D-03

At iterate 20 f= 1.15854D+00 |proj g|= 1.35946D-04

At iterate 25 f= 1.15854D+00 |proj g|= 7.26958D-04

At iterate 30 f= 1.15853D+00 |proj g|= 1.39867D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	33	1	0	0	1.399D-05	1.159D+00
F = 1.1585306563038489							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31286D+00 |proj g|= 3.04722D-01

```

At iterate    5    f=  1.24209D+00    |proj g|=  6.85975D-02
At iterate   10    f=  1.17935D+00    |proj g|=  5.54206D-02
At iterate   15    f=  1.15851D+00    |proj g|=  6.59483D-03
At iterate   20    f=  1.15817D+00    |proj g|=  8.16097D-05
At iterate   25    f=  1.15817D+00    |proj g|=  1.13959D-03
At iterate   30    f=  1.15815D+00    |proj g|=  9.63871D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    33    37    1     0     0   1.784D-05  1.158D+00
F =  1.1581514280218843

```

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.31252D+00    |proj g|=  3.04883D-01
At iterate    5    f=  1.24173D+00    |proj g|=  6.86809D-02
At iterate   10    f=  1.17877D+00    |proj g|=  5.62156D-02
At iterate   15    f=  1.15810D+00    |proj g|=  6.95619D-03
At iterate   20    f=  1.15776D+00    |proj g|=  8.24738D-05

```



At iterate 25 f= 1.15776D+00 |proj g|= 1.73216D-03

At iterate 30 f= 1.15775D+00 |proj g|= 3.89557D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	5.728D-06	1.158D+00
F = 1.1577458362139543							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31248D+00 |proj g|= 3.05392D-01

This problem is unconstrained.

At iterate 5 f= 1.24132D+00 |proj g|= 6.83097D-02

At iterate 10 f= 1.17891D+00 |proj g|= 5.63954D-02

At iterate 15 f= 1.15804D+00 |proj g|= 8.51254D-03

At iterate 20 f= 1.15767D+00 |proj g|= 1.66572D-04

At iterate 25 f= 1.15767D+00 |proj g|= 1.42973D-03

At iterate 30 f= 1.15765D+00 |proj g|= 1.52387D-04

At iterate 35 f= 1.15765D+00 |proj g|= 2.99752D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	37	41	1	0	0	2.869D-06	1.158D+00
F =	1.1576511572053330						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31213D+00 |proj g|= 3.05437D-01

At iterate 5 f= 1.24102D+00 |proj g|= 6.83390D-02

At iterate 10 f= 1.17829D+00 |proj g|= 5.69415D-02

At iterate 15 f= 1.15763D+00 |proj g|= 8.34670D-03

At iterate 20 f= 1.15727D+00 |proj g|= 1.08281D-04

At iterate 25 f= 1.15727D+00 |proj g|= 1.56612D-03

At iterate 30 f= 1.15725D+00 |proj g|= 8.99701D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	35	1	0	0	7.710D-06	1.157D+00
F = 1.1572466114735889							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31186D+00 |proj g|= 3.05531D-01

At iterate 5 f= 1.24075D+00 |proj g|= 6.85634D-02

At iterate 10 f= 1.17793D+00 |proj g|= 5.62304D-02

At iterate 15 f= 1.15729D+00 |proj g|= 7.47438D-03

At iterate 20 f= 1.15694D+00 |proj g|= 1.01974D-04

At iterate 25 f= 1.15694D+00 |proj g|= 1.35966D-03

At iterate 30 f= 1.15692D+00 |proj g|= 8.86553D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	39	1	0	0	4.752D-06	1.157D+00
F = 1.1569171009020118							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31188D+00 |proj g|= 3.05657D-01

This problem is unconstrained.

At iterate 5 f= 1.24064D+00 |proj g|= 6.88345D-02

At iterate 10 f= 1.17739D+00 |proj g|= 5.76829D-02

At iterate 15 f= 1.15704D+00 |proj g|= 8.36316D-03

At iterate 20 f= 1.15669D+00 |proj g|= 1.02325D-04

At iterate 25 f= 1.15669D+00 |proj g|= 1.45323D-03

At iterate 30 f= 1.15668D+00 |proj g|= 4.65795D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	36	1	0	0	1.862D-05	1.157D+00

F = 1.1566750415779961

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.31181D+00      |proj g|= 3.05274D-01

At iterate    5      f= 1.24039D+00      |proj g|= 6.90290D-02

At iterate    10     f= 1.17760D+00      |proj g|= 5.61276D-02

At iterate    15     f= 1.15698D+00      |proj g|= 8.35624D-03

At iterate    20     f= 1.15663D+00      |proj g|= 1.47075D-04

At iterate    25     f= 1.15662D+00      |proj g|= 1.37149D-03

At iterate    30     f= 1.15661D+00      |proj g|= 6.00074D-05

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	37	1	0	0	5.564D-06	1.157D+00
F =	1.1566064253669759						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5            M =            10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.31149D+00      |proj g|= 3.05368D-01

At iterate    5      f= 1.24011D+00      |proj g|= 6.91296D-02

At iterate    10     f= 1.17723D+00      |proj g|= 5.67259D-02

```

At iterate   15      f=  1.15663D+00      |proj g|=  8.21040D-03
At iterate   20      f=  1.15628D+00      |proj g|=  9.43106D-05
At iterate   25      f=  1.15628D+00      |proj g|=  1.37325D-03
At iterate   30      f=  1.15626D+00      |proj g|=  1.30610D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	2.073D-05	1.156D+00

F = 1.1562619129756739

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate   0      f=  1.31115D+00      |proj g|=  3.05516D-01
At iterate   5      f=  1.23974D+00      |proj g|=  6.91530D-02
At iterate  10      f=  1.17669D+00      |proj g|=  5.84912D-02
At iterate  15      f=  1.15651D+00      |proj g|=  9.70962D-03
At iterate  20      f=  1.15615D+00      |proj g|=  6.98482D-05
At iterate  25      f=  1.15615D+00      |proj g|=  1.14635D-03
At iterate  30      f=  1.15614D+00      |proj g|=  5.42696D-04

```

At iterate 35 f= 1.15614D+00 |proj g|= 1.09537D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	37	42	1	0	0	1.054D-05	1.156D+00
F = 1.1561430785762883							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31077D+00 |proj g|= 3.05742D-01

This problem is unconstrained.

At iterate 5 f= 1.23937D+00 |proj g|= 6.91984D-02

At iterate 10 f= 1.17590D+00 |proj g|= 6.04225D-02

At iterate 15 f= 1.15621D+00 |proj g|= 1.01294D-02

At iterate 20 f= 1.15587D+00 |proj g|= 6.88277D-05

At iterate 25 f= 1.15587D+00 |proj g|= 1.29473D-03

At iterate 30 f= 1.15586D+00 |proj g|= 4.17249D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	35	1	0	0	3.110D-05	1.156D+00
F = 1.1558555209644574							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31048D+00 |proj g|= 3.05790D-01

At iterate 5 f= 1.23912D+00 |proj g|= 6.92221D-02

This problem is unconstrained.

At iterate 10 f= 1.17555D+00 |proj g|= 6.13135D-02

At iterate 15 f= 1.15610D+00 |proj g|= 9.60850D-03

At iterate 20 f= 1.15577D+00 |proj g|= 6.86873D-05

At iterate 25 f= 1.15577D+00 |proj g|= 1.37138D-03

At iterate 30 f= 1.15576D+00 |proj g|= 2.86420D-04

At iterate 35 f= 1.15576D+00 |proj g|= 1.06966D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*



N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	38	1	0	0	1.070D-05	1.156D+00
F = 1.1557596038325793							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31016D+00 |proj g|= 3.05831D-01

This problem is unconstrained.

At iterate 5 f= 1.23880D+00 |proj g|= 6.92879D-02

At iterate 10 f= 1.17504D+00 |proj g|= 6.25175D-02

At iterate 15 f= 1.15579D+00 |proj g|= 7.02668D-03

At iterate 20 f= 1.15549D+00 |proj g|= 8.28987D-05

At iterate 25 f= 1.15548D+00 |proj g|= 2.87350D-03

At iterate 30 f= 1.15547D+00 |proj g|= 4.88957D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	4.817D-05	1.155D+00
F = 1.1554701256531326							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31076D+00 |proj g|= 3.04702D-01

At iterate 5 f= 1.23919D+00 |proj g|= 6.91466D-02

At iterate 10 f= 1.17697D+00 |proj g|= 5.72448D-02

At iterate 15 f= 1.15614D+00 |proj g|= 8.81190D-03

At iterate 20 f= 1.15578D+00 |proj g|= 8.79897D-05

At iterate 25 f= 1.15578D+00 |proj g|= 5.70594D-04

At iterate 30 f= 1.15578D+00 |proj g|= 4.39119D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	34	1	0	0	7.696D-06	1.156D+00
F =	1.1557805039567521						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31036D+00 |proj g|= 3.05029D-01

At iterate 5 f= 1.23898D+00 |proj g|= 6.92136D-02

This problem is unconstrained.

At iterate 10 f= 1.17566D+00 |proj g|= 6.06678D-02

At iterate 15 f= 1.15576D+00 |proj g|= 1.09519D-02

At iterate 20 f= 1.15541D+00 |proj g|= 3.63640D-05

At iterate 25 f= 1.15541D+00 |proj g|= 7.13097D-04

At iterate 30 f= 1.15540D+00 |proj g|= 4.34679D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	35	1	0	0	8.003D-06	1.155D+00
F = 1.1554044633072011							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.31014D+00 |proj g|= 3.05232D-01

At iterate 5 f= 1.23881D+00 |proj g|= 6.91862D-02

At iterate 10 f= 1.17625D+00 |proj g|= 5.81589D-02

At iterate 15 f= 1.15545D+00 |proj g|= 5.84031D-03

At iterate 20 f= 1.15513D+00 |proj g|= 7.53999D-05

At iterate 25 f= 1.15513D+00 |proj g|= 2.18279D-04

At iterate 30 f= 1.15513D+00 |proj g|= 2.12399D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	2.124D-05	1.155D+00
F = 1.1551304795610196							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30987D+00 |proj g|= 3.05149D-01

At iterate 5 f= 1.23844D+00 |proj g|= 6.93956D-02

At iterate 10 f= 1.17587D+00 |proj g|= 5.79090D-02

At iterate 15 f= 1.15517D+00 |proj g|= 6.40394D-03

At iterate 20 f= 1.15485D+00 |proj g|= 4.92087D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.830D-05	1.155D+00
F = 1.1548549624551001							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30961D+00 |proj g|= 3.05193D-01

At iterate 5 f= 1.23817D+00 |proj g|= 6.94525D-02

At iterate 10 f= 1.17498D+00 |proj g|= 5.99310D-02

At iterate 15 f= 1.15480D+00 |proj g|= 1.04354D-02

At iterate 20 f= 1.15445D+00 |proj g|= 1.89574D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.647D-05	1.154D+00
F = 1.1544549906106889							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30924D+00 |proj g|= 3.05716D-01

At iterate 5 f= 1.23777D+00 |proj g|= 6.95182D-02

At iterate 10 f= 1.17431D+00 |proj g|= 6.13034D-02

At iterate 15 f= 1.15442D+00 |proj g|= 1.17207D-02

At iterate 20 f= 1.15407D+00 |proj g|= 1.89649D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.930D-05	1.154D+00
F =	1.1540673266382322						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30891D+00 |proj g|= 3.06153D-01

This problem is unconstrained.

```
At iterate    5    f=  1.23738D+00    |proj g|=  6.94876D-02
At iterate   10    f=  1.17372D+00    |proj g|=  6.16833D-02
At iterate   15    f=  1.15403D+00    |proj g|=  1.20589D-02
At iterate   20    f=  1.15367D+00    |proj g|=  1.87258D-05
```

```
* * *
```

```
Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value
```

```
* * *
```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.866D-05	1.154D+00
F = 1.1536713691879055							

```
CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
```

```
This problem is unconstrained.
```

```
RUNNING THE L-BFGS-B CODE
```

```
* * *
```

```
Machine precision = 2.220D-16
N = 5 M = 10
```

```
At X0 0 variables are exactly at the bounds
```

```
At iterate    0    f=  1.30901D+00    |proj g|=  3.05797D-01
At iterate    5    f=  1.23757D+00    |proj g|=  6.95885D-02
At iterate   10    f=  1.17385D+00    |proj g|=  6.14774D-02
At iterate   15    f=  1.15423D+00    |proj g|=  1.25623D-02
At iterate   20    f=  1.15387D+00    |proj g|=  3.10205D-05
```

```
* * *
```

```
Tit   = total number of iterations
```

Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.019D-05	1.154D+00
F = 1.1538710680271846							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30864D+00 |proj g|= 3.05877D-01

At iterate 5 f= 1.23723D+00 |proj g|= 6.96044D-02

At iterate 10 f= 1.17312D+00 |proj g|= 6.33305D-02

At iterate 15 f= 1.15381D+00 |proj g|= 1.16946D-02

At iterate 20 f= 1.15347D+00 |proj g|= 2.32682D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.459D-05	1.153D+00
F = 1.1534737034952729							



CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30837D+00 |proj g|= 3.05786D-01

At iterate 5 f= 1.23697D+00 |proj g|= 6.95370D-02

This problem is unconstrained.

At iterate 10 f= 1.17286D+00 |proj g|= 6.48175D-02

At iterate 15 f= 1.15356D+00 |proj g|= 1.16100D-02

At iterate 20 f= 1.15322D+00 |proj g|= 2.90187D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.179D-05	1.153D+00
F =	1.1532246285407370						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30798D+00 |proj g|= 3.05963D-01

This problem is unconstrained.

```
At iterate    5    f=  1.23661D+00    |proj g|=  6.96101D-02
At iterate   10    f=  1.17201D+00    |proj g|=  6.76871D-02
At iterate   15    f=  1.15336D+00    |proj g|=  1.15711D-02
At iterate   20    f=  1.15294D+00    |proj g|=  1.21093D-04
```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	9.972D-06	1.153D+00
F = 1.1529389315884808							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```
At iterate    0    f=  1.30778D+00    |proj g|=  3.05931D-01
At iterate    5    f=  1.23669D+00    |proj g|=  6.96134D-02
At iterate   10    f=  1.17173D+00    |proj g|=  6.97182D-02
At iterate   15    f=  1.15333D+00    |proj g|=  1.23131D-02
At iterate   20    f=  1.15309D+00    |proj g|=  4.07005D-05
At iterate   25    f=  1.15309D+00    |proj g|=  5.52165D-04
```

At iterate 30 f= 1.15309D+00 |proj g|= 1.53995D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	7.487D-06	1.153D+00
F = 1.1530886119745607							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30743D+00 |proj g|= 3.06441D-01

At iterate 5 f= 1.23634D+00 |proj g|= 6.98552D-02

At iterate 10 f= 1.17125D+00 |proj g|= 6.91927D-02

At iterate 15 f= 1.15302D+00 |proj g|= 2.17240D-02

At iterate 20 f= 1.15270D+00 |proj g|= 6.82482D-04

At iterate 25 f= 1.15270D+00 |proj g|= 1.13867D-04

At iterate 30 f= 1.15270D+00 |proj g|= 1.62566D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	35	1	0	0	2.792D-05	1.153D+00
F = 1.1526999150073807							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30712D+00 |proj g|= 3.06450D-01

At iterate 5 f= 1.23598D+00 |proj g|= 6.99701D-02

At iterate 10 f= 1.17085D+00 |proj g|= 6.96760D-02

At iterate 15 f= 1.15253D+00 |proj g|= 9.46840D-03

At iterate 20 f= 1.15231D+00 |proj g|= 2.92923D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	3.559D-05	1.152D+00
F = 1.1523053209266909							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30710D+00 |proj g|= 3.06320D-01

At iterate 5 f= 1.23591D+00 |proj g|= 7.04245D-02

At iterate 10 f= 1.17080D+00 |proj g|= 6.82376D-02

At iterate 15 f= 1.15276D+00 |proj g|= 2.53595D-02

At iterate 20 f= 1.15241D+00 |proj g|= 9.02804D-04

At iterate 25 f= 1.15240D+00 |proj g|= 1.62841D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	34	1	0	0	4.057D-06	1.152D+00
F =	1.1524004533591712						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.30674D+00    |proj g|=  3.06528D-01
At iterate    5    f=  1.23554D+00    |proj g|=  7.04339D-02
At iterate   10    f=  1.17042D+00    |proj g|=  6.83904D-02
At iterate   15    f=  1.15236D+00    |proj g|=  8.09310D-03
At iterate   20    f=  1.15212D+00    |proj g|=  5.83500D-05
At iterate   25    f=  1.15212D+00    |proj g|=  9.61047D-04
At iterate   30    f=  1.15211D+00    |proj g|=  1.44955D-05

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

```

* * *

```

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    31    34    1    0    0    2.483D-06  1.152D+00
F =  1.1521138191215987

```

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

```

```

* * *

```

```

Machine precision = 2.220D-16
N =                5    M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.30731D+00    |proj g|=  3.05104D-01
At iterate    5    f=  1.23630D+00    |proj g|=  7.07198D-02

```

```

  This problem is unconstrained.

```

```

At iterate   10    f=  1.17108D+00    |proj g|=  6.88966D-02
At iterate   15    f=  1.15305D+00    |proj g|=  2.11350D-02

```

At iterate 20 f= 1.15228D+00 |proj g|= 1.39874D-04

At iterate 25 f= 1.15227D+00 |proj g|= 1.92596D-04

At iterate 30 f= 1.15227D+00 |proj g|= 6.34039D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	37	1	0	0	4.922D-06	1.152D+00
F = 1.1522683827000861							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30690D+00 |proj g|= 3.05360D-01

At iterate 5 f= 1.23597D+00 |proj g|= 7.07288D-02

This problem is unconstrained.

At iterate 10 f= 1.17047D+00 |proj g|= 7.00435D-02

At iterate 15 f= 1.15213D+00 |proj g|= 3.79009D-03

At iterate 20 f= 1.15189D+00 |proj g|= 4.26724D-05

At iterate 25 f= 1.15189D+00 |proj g|= 1.01502D-03

At iterate 30 f= 1.15189D+00 |proj g|= 1.18622D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	37	1	0	0	2.635D-05	1.152D+00

F = 1.1518874709182862

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30654D+00 |proj g|= 3.05433D-01

At iterate 5 f= 1.23560D+00 |proj g|= 7.08101D-02

At iterate 10 f= 1.17007D+00 |proj g|= 6.99352D-02

At iterate 15 f= 1.15177D+00 |proj g|= 4.64974D-03

At iterate 20 f= 1.15153D+00 |proj g|= 4.39915D-05

At iterate 25 f= 1.15152D+00 |proj g|= 1.45716D-03

At iterate 30 f= 1.15152D+00 |proj g|= 2.15018D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value



\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	42	1	0	0	1.182D-05	1.152D+00
F = 1.1515209027608304							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30657D+00 |proj g|= 3.05873D-01

At iterate 5 f= 1.23549D+00 |proj g|= 7.07954D-02

This problem is unconstrained.

At iterate 10 f= 1.16990D+00 |proj g|= 7.03145D-02

At iterate 15 f= 1.15149D+00 |proj g|= 5.00973D-03

At iterate 20 f= 1.15123D+00 |proj g|= 4.75108D-05

At iterate 25 f= 1.15123D+00 |proj g|= 9.11140D-04

At iterate 30 f= 1.15122D+00 |proj g|= 1.49923D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	9.322D-06	1.151D+00
F = 1.1512241282461557							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30620D+00 |proj g|= 3.05992D-01

At iterate 5 f= 1.23519D+00 |proj g|= 7.08723D-02

At iterate 10 f= 1.16943D+00 |proj g|= 6.85915D-02

At iterate 15 f= 1.15111D+00 |proj g|= 6.92194D-03

At iterate 20 f= 1.15083D+00 |proj g|= 4.46049D-05

At iterate 25 f= 1.15083D+00 |proj g|= 1.76773D-03

At iterate 30 f= 1.15083D+00 |proj g|= 3.78996D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	1.289D-05	1.151D+00
F =	1.1508295885484090						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30623D+00 |proj g|= 3.05731D-01

This problem is unconstrained.

At iterate 5 f= 1.23525D+00 |proj g|= 7.08672D-02

At iterate 10 f= 1.16960D+00 |proj g|= 7.04013D-02

At iterate 15 f= 1.15116D+00 |proj g|= 5.23742D-03

At iterate 20 f= 1.15090D+00 |proj g|= 5.57812D-05

At iterate 25 f= 1.15090D+00 |proj g|= 1.23750D-03

At iterate 30 f= 1.15089D+00 |proj g|= 1.30057D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	4.198D-06	1.151D+00
F =	1.1508932200450093						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30592D+00 |proj g|= 3.05739D-01

This problem is unconstrained.

At iterate 5 f= 1.23487D+00 |proj g|= 7.09848D-02

At iterate 10 f= 1.16922D+00 |proj g|= 7.00685D-02

```

At iterate   15      f=  1.15080D+00      |proj g|=  4.72515D-03
At iterate   20      f=  1.15054D+00      |proj g|=  5.72474D-05
At iterate   25      f=  1.15054D+00      |proj g|=  7.81621D-04
At iterate   30      f=  1.15054D+00      |proj g|=  5.20340D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	2.309D-05	1.151D+00

F = 1.1505355080030504

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate   0      f=  1.30550D+00      |proj g|=  3.06000D-01
At iterate   5      f=  1.23466D+00      |proj g|=  7.08228D-02
At iterate  10      f=  1.16910D+00      |proj g|=  6.22303D-02
At iterate  15      f=  1.15077D+00      |proj g|=  3.19065D-03
At iterate  20      f=  1.15050D+00      |proj g|=  2.72992D-04
At iterate  25      f=  1.15050D+00      |proj g|=  1.71310D-03
At iterate  30      f=  1.15049D+00      |proj g|=  1.23587D-04

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	2.213D-06	1.150D+00
F =	1.1504874390372450						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30528D+00 |proj g|= 3.05862D-01

At iterate 5 f= 1.23441D+00 |proj g|= 7.05419D-02

This problem is unconstrained.

At iterate 10 f= 1.16892D+00 |proj g|= 5.98270D-02

At iterate 15 f= 1.15072D+00 |proj g|= 1.84977D-02

At iterate 20 f= 1.15025D+00 |proj g|= 2.39016D-04

At iterate 25 f= 1.15025D+00 |proj g|= 9.20929D-04

At iterate 30 f= 1.15023D+00 |proj g|= 1.50672D-03

At iterate 35 f= 1.15023D+00 |proj g|= 2.38872D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	36	42	1	0	0	4.827D-05	1.150D+00
F = 1.1502317206168742							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30520D+00 |proj g|= 3.05680D-01

This problem is unconstrained.

At iterate 5 f= 1.23436D+00 |proj g|= 7.03894D-02

At iterate 10 f= 1.16884D+00 |proj g|= 5.72691D-02

At iterate 15 f= 1.15068D+00 |proj g|= 1.99668D-02

At iterate 20 f= 1.15005D+00 |proj g|= 9.10611D-05

At iterate 25 f= 1.15004D+00 |proj g|= 2.33672D-03

At iterate 30 f= 1.15002D+00 |proj g|= 4.81249D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	39	1	0	0	6.122D-06	1.150D+00

F = 1.1500243660231118

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30578D+00 |proj g|= 3.05896D-01

At iterate 5 f= 1.23491D+00 |proj g|= 7.00649D-02

This problem is unconstrained.

At iterate 10 f= 1.16911D+00 |proj g|= 6.38473D-02

At iterate 15 f= 1.15080D+00 |proj g|= 2.24780D-02

At iterate 20 f= 1.15013D+00 |proj g|= 1.11778D-04

At iterate 25 f= 1.15012D+00 |proj g|= 8.44522D-04

At iterate 30 f= 1.15010D+00 |proj g|= 1.55812D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	2.464D-05	1.150D+00
F =	1.1501045397752179						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.30541D+00      |proj g|=  3.05986D-01
This problem is unconstrained.

At iterate    5      f=  1.23459D+00      |proj g|=  7.01117D-02
At iterate   10      f=  1.16871D+00      |proj g|=  6.43338D-02
At iterate   15      f=  1.15038D+00      |proj g|=  5.95017D-02
At iterate   20      f=  1.14974D+00      |proj g|=  9.82300D-05
At iterate   25      f=  1.14973D+00      |proj g|=  8.64621D-04
At iterate   30      f=  1.14971D+00      |proj g|=  5.05911D-05

      * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

      * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       34       40     1     0     0      1.727D-05  1.150D+00
F =  1.1497099421214361

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

      * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.30512D+00      |proj g|=  3.06093D-01
At iterate    5      f=  1.23436D+00      |proj g|=  7.04759D-02
This problem is unconstrained.

```



```

At iterate   10    f=  1.16843D+00    |proj g|=  6.99755D-02
At iterate   15    f=  1.14963D+00    |proj g|=  7.12630D-03
At iterate   20    f=  1.14934D+00    |proj g|=  8.95936D-05
At iterate   25    f=  1.14933D+00    |proj g|=  1.64358D-03
At iterate   30    f=  1.14932D+00    |proj g|=  1.15297D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	39	1	0	0	9.284D-05	1.149D+00

F = 1.1493155664981367

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.30480D+00    |proj g|=  3.06111D-01
At iterate    5    f=  1.23406D+00    |proj g|=  7.05804D-02
At iterate   10    f=  1.16809D+00    |proj g|=  7.00201D-02
At iterate   15    f=  1.14935D+00    |proj g|=  6.81350D-03
At iterate   20    f=  1.14907D+00    |proj g|=  8.31990D-05
At iterate   25    f=  1.14907D+00    |proj g|=  1.81526D-03

```

At iterate 30 f= 1.14905D+00 |proj g|= 2.44312D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	7.089D-06	1.149D+00
F = 1.1490510280708055							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30434D+00 |proj g|= 3.06389D-01

At iterate 5 f= 1.23371D+00 |proj g|= 7.06050D-02

At iterate 10 f= 1.16768D+00 |proj g|= 6.80470D-02

At iterate 15 f= 1.14914D+00 |proj g|= 1.35140D-02

At iterate 20 f= 1.14877D+00 |proj g|= 7.95525D-05

At iterate 25 f= 1.14876D+00 |proj g|= 5.33185D-04

At iterate 30 f= 1.14875D+00 |proj g|= 9.55813D-07

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	34	1	0	0	9.558D-07	1.149D+00
F = 1.1487533223118831							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30401D+00 |proj g|= 3.06557D-01

This problem is unconstrained.

At iterate 5 f= 1.23335D+00 |proj g|= 7.06097D-02

At iterate 10 f= 1.16729D+00 |proj g|= 6.62499D-02

At iterate 15 f= 1.14898D+00 |proj g|= 9.64363D-03

At iterate 20 f= 1.14839D+00 |proj g|= 8.21569D-05

At iterate 25 f= 1.14837D+00 |proj g|= 1.51516D-03

At iterate 30 f= 1.14837D+00 |proj g|= 3.81362D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	3.814D-05	1.148D+00

F = 1.1483662556201282

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30363D+00 |proj g|= 3.06689D-01

At iterate 5 f= 1.23299D+00 |proj g|= 7.06588D-02

At iterate 10 f= 1.16685D+00 |proj g|= 6.34722D-02

At iterate 15 f= 1.14873D+00 |proj g|= 2.00607D-02

At iterate 20 f= 1.14801D+00 |proj g|= 1.11869D-04

At iterate 25 f= 1.14801D+00 |proj g|= 7.07102D-04

At iterate 30 f= 1.14800D+00 |proj g|= 1.67016D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	7.304D-06	1.148D+00
F =	1.1479954909506966						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30370D+00 |proj g|= 3.06912D-01

At iterate 5 f= 1.23293D+00 |proj g|= 7.07703D-02

At iterate 10 f= 1.16682D+00 |proj g|= 6.74684D-02

At iterate 15 f= 1.14831D+00 |proj g|= 1.63564D-02

At iterate 20 f= 1.14788D+00 |proj g|= 7.38896D-05

At iterate 25 f= 1.14787D+00 |proj g|= 2.26240D-03

At iterate 30 f= 1.14786D+00 |proj g|= 7.58964D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	33	1	0	0	7.590D-06	1.148D+00
F = 1.1478595814755121							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30332D+00 |proj g|= 3.07139D-01

```

At iterate    5    f=  1.23256D+00    |proj g|=  7.07503D-02
At iterate   10    f=  1.16648D+00    |proj g|=  6.64784D-02
At iterate   15    f=  1.14817D+00    |proj g|=  9.73077D-03
At iterate   20    f=  1.14759D+00    |proj g|=  7.26587D-05
At iterate   25    f=  1.14758D+00    |proj g|=  2.09343D-04
At iterate   30    f=  1.14758D+00    |proj g|=  2.19894D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	2.199D-05	1.148D+00

F = 1.1475781039317394

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.30287D+00    |proj g|=  3.07430D-01
At iterate    5    f=  1.23227D+00    |proj g|=  7.06500D-02

```

This problem is unconstrained.

```

At iterate   10    f=  1.16626D+00    |proj g|=  6.02153D-02
At iterate   15    f=  1.14790D+00    |proj g|=  1.26128D-02
At iterate   20    f=  1.14752D+00    |proj g|=  8.13440D-05

```

At iterate 25 f= 1.14750D+00 |proj g|= 1.28841D-03

At iterate 30 f= 1.14750D+00 |proj g|= 9.36072D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	1.749D-05	1.147D+00
F = 1.1474976469259788							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30259D+00 |proj g|= 3.07364D-01

This problem is unconstrained.

At iterate 5 f= 1.23197D+00 |proj g|= 7.08135D-02

At iterate 10 f= 1.16594D+00 |proj g|= 5.87820D-02

At iterate 15 f= 1.14764D+00 |proj g|= 1.45278D-02

At iterate 20 f= 1.14717D+00 |proj g|= 1.08247D-04

At iterate 25 f= 1.14717D+00 |proj g|= 1.63082D-03

At iterate 30 f= 1.14715D+00 |proj g|= 4.32526D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	39	1	0	0	1.959D-05	1.147D+00
F = 1.1471481223984155							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30219D+00 |proj g|= 3.07662D-01

At iterate 5 f= 1.23162D+00 |proj g|= 7.08000D-02

At iterate 10 f= 1.16567D+00 |proj g|= 5.36120D-02

At iterate 15 f= 1.14754D+00 |proj g|= 1.95492D-02

At iterate 20 f= 1.14688D+00 |proj g|= 1.44579D-04

At iterate 25 f= 1.14687D+00 |proj g|= 9.41344D-04

At iterate 30 f= 1.14686D+00 |proj g|= 6.04351D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*



N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	37	1	0	0	6.501D-06	1.147D+00
F = 1.1468597900069133							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30194D+00 |proj g|= 3.07805D-01

At iterate 5 f= 1.23133D+00 |proj g|= 7.09500D-02

At iterate 10 f= 1.16533D+00 |proj g|= 5.90690D-02

At iterate 15 f= 1.14698D+00 |proj g|= 1.64622D-02

At iterate 20 f= 1.14650D+00 |proj g|= 9.34174D-05

At iterate 25 f= 1.14649D+00 |proj g|= 2.09706D-03

At iterate 30 f= 1.14647D+00 |proj g|= 1.52492D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	1.708D-05	1.146D+00
F = 1.1464747208075343							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30156D+00 |proj g|= 3.07951D-01

At iterate 5 f= 1.23096D+00 |proj g|= 7.09621D-02

This problem is unconstrained.

At iterate 10 f= 1.16497D+00 |proj g|= 5.42448D-02

At iterate 15 f= 1.14681D+00 |proj g|= 1.78300D-02

At iterate 20 f= 1.14613D+00 |proj g|= 1.06899D-04

At iterate 25 f= 1.14611D+00 |proj g|= 7.97657D-04

At iterate 30 f= 1.14611D+00 |proj g|= 2.19017D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	39	1	0	0	8.527D-06	1.146D+00
F =	1.1461055397259010						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.30116D+00    |proj g|=  3.08104D-01
At iterate    5    f=  1.23062D+00    |proj g|=  7.07991D-02
At iterate   10    f=  1.16464D+00    |proj g|=  5.11521D-02
At iterate   15    f=  1.14613D+00    |proj g|=  1.29959D-02
At iterate   20    f=  1.14573D+00    |proj g|=  4.62746D-04
At iterate   25    f=  1.14573D+00    |proj g|=  7.61943D-04
At iterate   30    f=  1.14572D+00    |proj g|=  2.02671D-03
At iterate   35    f=  1.14572D+00    |proj g|=  1.84148D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	40	1	0	0	1.841D-05	1.146D+00
F = 1.1457171024439414							

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.30100D+00    |proj g|=  3.08190D-01

```

```

  This problem is unconstrained.

```

```

At iterate    5    f=  1.23040D+00    |proj g|=  7.08085D-02

```

```

At iterate   10    f=  1.16440D+00    |proj g|=  4.96782D-02

```

```

At iterate   15      f=  1.14580D+00      |proj g|=  1.43816D-02
At iterate   20      f=  1.14540D+00      |proj g|=  3.08014D-04
At iterate   25      f=  1.14540D+00      |proj g|=  9.94088D-04
At iterate   30      f=  1.14539D+00      |proj g|=  2.50160D-03
At iterate   35      f=  1.14539D+00      |proj g|=  7.11797D-06

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	39	1	0	0	7.118D-06	1.145D+00

F = 1.1453853988889933

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0      f=  1.30062D+00      |proj g|=  3.08501D-01
At iterate    5      f=  1.23017D+00      |proj g|=  7.07465D-02

```

This problem is unconstrained.

```

At iterate   10      f=  1.16407D+00      |proj g|=  4.92159D-02
At iterate   15      f=  1.14545D+00      |proj g|=  1.72895D-02
At iterate   20      f=  1.14505D+00      |proj g|=  1.62076D-04
At iterate   25      f=  1.14504D+00      |proj g|=  2.57300D-03

```

At iterate 30 f= 1.14503D+00 |proj g|= 7.94871D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	4.833D-06	1.145D+00
F = 1.1450316703479384							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30029D+00 |proj g|= 3.08538D-01

At iterate 5 f= 1.22987D+00 |proj g|= 7.06428D-02

At iterate 10 f= 1.16382D+00 |proj g|= 4.73889D-02

At iterate 15 f= 1.14548D+00 |proj g|= 1.58957D-02

At iterate 20 f= 1.14475D+00 |proj g|= 3.43001D-04

At iterate 25 f= 1.14474D+00 |proj g|= 6.67030D-04

At iterate 30 f= 1.14473D+00 |proj g|= 4.58555D-05

Warning: more than 10 function and gradient  
evaluations in the last line search. Termination  
may possibly be caused by a bad search direction.

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	55	1	0	0	1.300D-05	1.145D+00

F = 1.1447311259297996

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.30013D+00 |proj g|= 3.08512D-01

At iterate 5 f= 1.22971D+00 |proj g|= 7.06336D-02

This problem is unconstrained.

At iterate 10 f= 1.16355D+00 |proj g|= 4.69959D-02

At iterate 15 f= 1.14526D+00 |proj g|= 1.14816D-02

At iterate 20 f= 1.14449D+00 |proj g|= 1.75139D-04

At iterate 25 f= 1.14449D+00 |proj g|= 5.07355D-04

At iterate 30 f= 1.14448D+00 |proj g|= 5.27166D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	40	1	0	0	7.061D-06	1.144D+00
F =	1.1444783071328148						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29987D+00 |proj g|= 3.08399D-01

At iterate 5 f= 1.22951D+00 |proj g|= 7.06631D-02

This problem is unconstrained.

At iterate 10 f= 1.16339D+00 |proj g|= 4.34019D-02

At iterate 15 f= 1.14517D+00 |proj g|= 5.65795D-03

At iterate 20 f= 1.14431D+00 |proj g|= 8.23735D-05

At iterate 25 f= 1.14430D+00 |proj g|= 6.83980D-04

At iterate 30 f= 1.14430D+00 |proj g|= 8.65847D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	8.658D-06	1.144D+00
F =	1.1443005390092276						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29965D+00 |proj g|= 3.08342D-01

At iterate 5 f= 1.22926D+00 |proj g|= 7.07305D-02

At iterate 10 f= 1.16290D+00 |proj g|= 4.24813D-02

At iterate 15 f= 1.14497D+00 |proj g|= 1.28751D-02

At iterate 20 f= 1.14417D+00 |proj g|= 1.11572D-04

At iterate 25 f= 1.14417D+00 |proj g|= 3.60210D-04

At iterate 30 f= 1.14416D+00 |proj g|= 7.34517D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	2.847D-05	1.144D+00
F =	1.1441630131772804						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10



At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29933D+00      |proj g|= 3.08510D-01

At iterate    5      f= 1.22896D+00      |proj g|= 7.07354D-02

At iterate    10     f= 1.16228D+00      |proj g|= 4.25639D-02

At iterate    15     f= 1.14452D+00      |proj g|= 1.56412D-02

At iterate    20     f= 1.14378D+00      |proj g|= 1.90394D-04

At iterate    25     f= 1.14378D+00      |proj g|= 3.53149D-04

At iterate    30     f= 1.14377D+00      |proj g|= 7.91765D-04

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	1.998D-05	1.144D+00
F =	1.1437745433490629						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5            M =            10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29906D+00      |proj g|= 3.08470D-01

At iterate    5      f= 1.22877D+00      |proj g|= 7.08980D-02

At iterate    10     f= 1.16203D+00      |proj g|= 4.24585D-02

```

At iterate   15      f=  1.14419D+00      |proj g|=  1.43682D-02
At iterate   20      f=  1.14341D+00      |proj g|=  2.91332D-04
At iterate   25      f=  1.14341D+00      |proj g|=  2.97526D-04
At iterate   30      f=  1.14341D+00      |proj g|=  1.32735D-03
At iterate   35      f=  1.14341D+00      |proj g|=  3.44809D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
   5      37      43     1     0     0    6.568D-06  1.143D+00
F =  1.1434066274957371

```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0      f=  1.29874D+00      |proj g|=  3.08568D-01
At iterate    5      f=  1.22849D+00      |proj g|=  7.07913D-02
At iterate   10      f=  1.16170D+00      |proj g|=  4.24765D-02
At iterate   15      f=  1.14382D+00      |proj g|=  1.27894D-02
At iterate   20      f=  1.14303D+00      |proj g|=  1.19181D-04
At iterate   25      f=  1.14302D+00      |proj g|=  2.21289D-04

```

At iterate 30 f= 1.14302D+00 |proj g|= 5.26500D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	39	1	0	0	2.369D-05	1.143D+00
F = 1.1430187627541621							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29836D+00 |proj g|= 3.08710D-01

At iterate 5 f= 1.22815D+00 |proj g|= 7.07032D-02

This problem is unconstrained.

At iterate 10 f= 1.16118D+00 |proj g|= 4.26292D-02

At iterate 15 f= 1.14343D+00 |proj g|= 1.27300D-02

At iterate 20 f= 1.14264D+00 |proj g|= 1.04211D-04

At iterate 25 f= 1.14264D+00 |proj g|= 2.95825D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	37	1	0	0	7.992D-06	1.143D+00
F =	1.1426356967688220						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29806D+00 |proj g|= 3.08797D-01

At iterate 5 f= 1.22783D+00 |proj g|= 7.07098D-02

At iterate 10 f= 1.16086D+00 |proj g|= 4.25581D-02

At iterate 15 f= 1.14305D+00 |proj g|= 1.25904D-02

At iterate 20 f= 1.14225D+00 |proj g|= 9.01259D-05

At iterate 25 f= 1.14225D+00 |proj g|= 2.16973D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	36	1	0	0	6.622D-06	1.142D+00
F =	1.1422486579957283						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29773D+00 |proj g|= 3.08836D-01

At iterate 5 f= 1.22748D+00 |proj g|= 7.07818D-02

At iterate 10 f= 1.16033D+00 |proj g|= 4.27737D-02

At iterate 15 f= 1.14275D+00 |proj g|= 1.08085D-02

At iterate 20 f= 1.14196D+00 |proj g|= 1.07984D-04

At iterate 25 f= 1.14196D+00 |proj g|= 5.40216D-04

At iterate 30 f= 1.14196D+00 |proj g|= 5.08563D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	5.581D-06	1.142D+00
F =	1.1419569798343758						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29739D+00      |proj g|= 3.08961D-01

At iterate    5      f= 1.22712D+00      |proj g|= 7.08228D-02

At iterate    10     f= 1.16025D+00      |proj g|= 4.23487D-02

At iterate    15     f= 1.14242D+00      |proj g|= 1.20389D-02

At iterate    20     f= 1.14162D+00      |proj g|= 1.01454D-04

At iterate    25     f= 1.14162D+00      |proj g|= 3.68199D-04

At iterate    30     f= 1.14161D+00      |proj g|= 1.23648D-04

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	7.704D-06	1.142D+00
F =	1.1416148903574506						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5      M =            10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29706D+00      |proj g|= 3.09250D-01

At iterate    5      f= 1.22675D+00      |proj g|= 7.07703D-02

At iterate    10     f= 1.16003D+00      |proj g|= 4.21740D-02

```

At iterate   15      f=  1.14225D+00      |proj g|=  1.16524D-02
At iterate   20      f=  1.14146D+00      |proj g|=  7.70176D-05
At iterate   25      f=  1.14146D+00      |proj g|=  6.38291D-04
At iterate   30      f=  1.14146D+00      |proj g|=  2.69996D-05

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

```

* * *

```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	1.391D-05	1.141D+00

F = 1.1414563213725100

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

```

* * *

```

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0      f=  1.29751D+00      |proj g|=  3.08848D-01
At iterate    5      f=  1.22737D+00      |proj g|=  7.08285D-02

```

```

This problem is unconstrained.

```

```

At iterate   10      f=  1.16061D+00      |proj g|=  4.22179D-02
At iterate   15      f=  1.14252D+00      |proj g|=  8.61497D-03
At iterate   20      f=  1.14166D+00      |proj g|=  4.89274D-05
At iterate   25      f=  1.14166D+00      |proj g|=  1.62280D-04
At iterate   30      f=  1.14165D+00      |proj g|=  1.34422D-04

```

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	6.212D-06	1.142D+00
F =	1.1416547460452731						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29730D+00 |proj g|= 3.08655D-01

At iterate 5 f= 1.22711D+00 |proj g|= 7.10180D-02

At iterate 10 f= 1.15945D+00 |proj g|= 4.30101D-02

At iterate 15 f= 1.14203D+00 |proj g|= 2.63104D-02

At iterate 20 f= 1.14172D+00 |proj g|= 2.97030D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*



N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	2.974D-05	1.142D+00

F = 1.1417164190906435

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29701D+00 |proj g|= 3.08672D-01

At iterate 5 f= 1.22686D+00 |proj g|= 7.13114D-02

At iterate 10 f= 1.15933D+00 |proj g|= 4.25111D-02

At iterate 15 f= 1.14214D+00 |proj g|= 1.88260D-02

At iterate 20 f= 1.14159D+00 |proj g|= 3.57733D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	1.736D-05	1.142D+00

F = 1.1415903353568431

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.29668D+00      |proj g|=  3.08697D-01
At iterate    5      f=  1.22656D+00      |proj g|=  7.13747D-02
At iterate   10      f=  1.15901D+00      |proj g|=  4.23598D-02
At iterate   15      f=  1.14183D+00      |proj g|=  1.98267D-02
At iterate   20      f=  1.14133D+00      |proj g|=  3.39008D-04

      * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

      * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       22       26     1     0     0    1.397D-05  1.141D+00
F =  1.1413273221876925

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

      * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.29636D+00      |proj g|=  3.08934D-01
At iterate    5      f=  1.22622D+00      |proj g|=  7.12998D-02
At iterate   10      f=  1.15848D+00      |proj g|=  4.23596D-02
At iterate   15      f=  1.14123D+00      |proj g|=  3.40485D-03

```

At iterate 20 f= 1.14101D+00 |proj g|= 4.43910D-04

At iterate 25 f= 1.14101D+00 |proj g|= 5.94484D-04

At iterate 30 f= 1.14101D+00 |proj g|= 1.63820D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	1.638D-06	1.141D+00
F = 1.1410073237840201							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29599D+00 |proj g|= 3.09055D-01

At iterate 5 f= 1.22587D+00 |proj g|= 7.12759D-02

At iterate 10 f= 1.15803D+00 |proj g|= 4.21782D-02

At iterate 15 f= 1.14088D+00 |proj g|= 5.42779D-03

At iterate 20 f= 1.14063D+00 |proj g|= 3.36540D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	2.185D-05	1.141D+00
F = 1.1406275597750883							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29570D+00 |proj g|= 3.09020D-01

At iterate 5 f= 1.22556D+00 |proj g|= 7.14280D-02

At iterate 10 f= 1.15769D+00 |proj g|= 4.20221D-02

At iterate 15 f= 1.14048D+00 |proj g|= 3.26275D-03

At iterate 20 f= 1.14027D+00 |proj g|= 3.88740D-04

At iterate 25 f= 1.14026D+00 |proj g|= 3.21715D-04

At iterate 30 f= 1.14026D+00 |proj g|= 1.20249D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	4.131D-06	1.140D+00

F = 1.1402631853474252

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29530D+00 |proj g|= 3.09191D-01

At iterate 5 f= 1.22521D+00 |proj g|= 7.13069D-02

This problem is unconstrained.

At iterate 10 f= 1.15721D+00 |proj g|= 5.05532D-02

At iterate 15 f= 1.14022D+00 |proj g|= 3.65762D-02

At iterate 20 f= 1.13988D+00 |proj g|= 1.80505D-04

At iterate 25 f= 1.13988D+00 |proj g|= 9.50049D-04

At iterate 30 f= 1.13988D+00 |proj g|= 7.88387D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	37	1	0	0	7.884D-06	1.140D+00
F =	1.1398801614904321						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.29510D+00      |proj g|=  3.09022D-01
At iterate    5      f=  1.22504D+00      |proj g|=  7.15142D-02
  This problem is unconstrained.

At iterate   10      f=  1.15708D+00      |proj g|=  4.21128D-02
At iterate   15      f=  1.13976D+00      |proj g|=  9.47993D-03
At iterate   20      f=  1.13953D+00      |proj g|=  2.29468D-05

  * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

  * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       21       24     1     0     0      2.258D-05  1.140D+00
F =  1.1395322289077907

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

  * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.29471D+00      |proj g|=  3.09219D-01
At iterate    5      f=  1.22467D+00      |proj g|=  7.14134D-02
  This problem is unconstrained.

At iterate   10      f=  1.15664D+00      |proj g|=  4.21951D-02

```

```
At iterate 15    f= 1.13939D+00    |proj g|= 3.14192D-03
At iterate 20    f= 1.13916D+00    |proj g|= 4.09530D-04
At iterate 25    f= 1.13916D+00    |proj g|= 2.64734D-04
At iterate 30    f= 1.13916D+00    |proj g|= 2.21046D-04
```

```
* * *
```

```
Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value
```

```
* * *
```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	1.142D-05	1.139D+00

F = 1.1391626114886382

```
CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE
```

```
* * *
```

```
Machine precision = 2.220D-16
N = 5 M = 10
```

```
At X0 0 variables are exactly at the bounds
```

```
At iterate 0    f= 1.29453D+00    |proj g|= 3.09312D-01
At iterate 5    f= 1.22453D+00    |proj g|= 7.15352D-02
```

```
This problem is unconstrained.
```

```
At iterate 10    f= 1.15662D+00    |proj g|= 4.24350D-02
At iterate 15    f= 1.13927D+00    |proj g|= 3.58082D-02
At iterate 20    f= 1.13885D+00    |proj g|= 5.54915D-05
```

```
* * *
```

```
Tit   = total number of iterations
Tnf   = total number of function evaluations
```

Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	25	1	0	0	3.366D-05	1.139D+00
F = 1.1388546293435751							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29427D+00 |proj g|= 3.09636D-01

At iterate 5 f= 1.22425D+00 |proj g|= 7.14097D-02

This problem is unconstrained.

At iterate 10 f= 1.15628D+00 |proj g|= 4.26915D-02

At iterate 15 f= 1.13883D+00 |proj g|= 3.02652D-02

At iterate 20 f= 1.13848D+00 |proj g|= 3.79074D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	2.683D-05	1.138D+00
F = 1.1384783484564565							



CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29407D+00 |proj g|= 3.09458D-01

At iterate 5 f= 1.22406D+00 |proj g|= 7.17470D-02

At iterate 10 f= 1.15686D+00 |proj g|= 4.18959D-02

At iterate 15 f= 1.13880D+00 |proj g|= 3.14135D-02

At iterate 20 f= 1.13823D+00 |proj g|= 1.94555D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.906D-05	1.138D+00

F = 1.1382314250687182

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.29389D+00    |proj g|=  3.09429D-01
At iterate    5    f=  1.22402D+00    |proj g|=  7.17578D-02
At iterate   10    f=  1.15614D+00    |proj g|=  4.19700D-02
At iterate   15    f=  1.13885D+00    |proj g|=  2.08707D-02
At iterate   20    f=  1.13836D+00    |proj g|=  3.24252D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	7.854D-06	1.138D+00

F = 1.1383611671051166

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.29368D+00    |proj g|=  3.09262D-01
At iterate    5    f=  1.22385D+00    |proj g|=  7.19366D-02
At iterate   10    f=  1.15596D+00    |proj g|=  4.17352D-02
At iterate   15    f=  1.13880D+00    |proj g|=  4.25326D-02
At iterate   20    f=  1.13828D+00    |proj g|=  5.52282D-05

```

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	25	1	0	0	1.404D-05	1.138D+00

F = 1.1382796154921253

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
 N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29340D+00 |proj g|= 3.09274D-01

At iterate 5 f= 1.22359D+00 |proj g|= 7.20238D-02

This problem is unconstrained.

At iterate 10 f= 1.15562D+00 |proj g|= 4.15714D-02

At iterate 15 f= 1.13835D+00 |proj g|= 2.79363D-02

At iterate 20 f= 1.13802D+00 |proj g|= 5.57201D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	2.043D-05	1.138D+00

F = 1.1380191852067549

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29317D+00 |proj g|= 3.09218D-01

At iterate 5 f= 1.22340D+00 |proj g|= 7.19877D-02

At iterate 10 f= 1.15540D+00 |proj g|= 4.17045D-02

At iterate 15 f= 1.13806D+00 |proj g|= 2.13887D-02

At iterate 20 f= 1.13778D+00 |proj g|= 6.03911D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	25	1	0	0	1.613D-05	1.138D+00
F =	1.1377767525326288						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29297D+00      |proj g|= 3.09301D-01

At iterate    5      f= 1.22329D+00      |proj g|= 7.19017D-02

At iterate    10     f= 1.15512D+00      |proj g|= 4.17607D-02

At iterate    15     f= 1.13771D+00      |proj g|= 7.46873D-03

At iterate    20     f= 1.13748D+00      |proj g|= 3.05636D-06

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F       = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	3.056D-06	1.137D+00
F =	1.1374785466975628						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =                    5      M =                    10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.29289D+00      |proj g|= 3.09102D-01

At iterate    5      f= 1.22319D+00      |proj g|= 7.23244D-02

This problem is unconstrained.

At iterate    10     f= 1.15517D+00      |proj g|= 4.16682D-02

At iterate    15     f= 1.13791D+00      |proj g|= 8.87801D-03

At iterate    20     f= 1.13713D+00      |proj g|= 5.45720D-05

At iterate 25 f= 1.13713D+00 |proj g|= 1.96202D-04

At iterate 30 f= 1.13713D+00 |proj g|= 3.18013D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	5.170D-06	1.137D+00
F = 1.1371265079315105							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29268D+00 |proj g|= 3.09328D-01

At iterate 5 f= 1.22307D+00 |proj g|= 7.20878D-02

At iterate 10 f= 1.15504D+00 |proj g|= 4.20111D-02

At iterate 15 f= 1.13765D+00 |proj g|= 9.77427D-03

At iterate 20 f= 1.13686D+00 |proj g|= 3.06250D-05

At iterate 25 f= 1.13686D+00 |proj g|= 2.14521D-04

At iterate 30 f= 1.13686D+00 |proj g|= 1.58709D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	36	1	0	0	1.587D-05	1.137D+00
F = 1.1368554161599567							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29246D+00 |proj g|= 3.09241D-01

At iterate 5 f= 1.22289D+00 |proj g|= 7.23334D-02

At iterate 10 f= 1.15495D+00 |proj g|= 4.19850D-02

At iterate 15 f= 1.13690D+00 |proj g|= 1.63260D-02

At iterate 20 f= 1.13651D+00 |proj g|= 2.93984D-04

At iterate 25 f= 1.13650D+00 |proj g|= 1.03964D-03

At iterate 30 f= 1.13650D+00 |proj g|= 1.41357D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	1.141D-05	1.137D+00
F = 1.1365028093164404							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29250D+00 |proj g|= 3.09048D-01

At iterate 5 f= 1.22288D+00 |proj g|= 7.25222D-02

At iterate 10 f= 1.15438D+00 |proj g|= 4.21781D-02

At iterate 15 f= 1.13696D+00 |proj g|= 9.17702D-03

At iterate 20 f= 1.13616D+00 |proj g|= 3.47449D-05

At iterate 25 f= 1.13616D+00 |proj g|= 1.42372D-04

At iterate 30 f= 1.13615D+00 |proj g|= 2.58264D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	37	1	0	0	2.891D-06	1.136D+00
F = 1.1361542757301788							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*



Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29236D+00 |proj g|= 3.08779D-01

This problem is unconstrained.

At iterate 5 f= 1.22278D+00 |proj g|= 7.28453D-02

At iterate 10 f= 1.15396D+00 |proj g|= 4.19354D-02

At iterate 15 f= 1.13660D+00 |proj g|= 9.72920D-03

At iterate 20 f= 1.13582D+00 |proj g|= 6.33561D-05

At iterate 25 f= 1.13582D+00 |proj g|= 1.06926D-04

At iterate 30 f= 1.13582D+00 |proj g|= 2.00108D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	39	1	0	0	5.632D-06	1.136D+00
F =	1.1358198523123892						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.29236D+00    |proj g|=  3.08412D-01
At iterate    5    f=  1.22282D+00    |proj g|=  7.31414D-02
At iterate   10    f=  1.15369D+00    |proj g|=  4.21037D-02
At iterate   15    f=  1.13628D+00    |proj g|=  8.07507D-03
At iterate   20    f=  1.13547D+00    |proj g|=  3.36829D-05
At iterate   25    f=  1.13547D+00    |proj g|=  1.40848D-04
At iterate   30    f=  1.13547D+00    |proj g|=  3.17761D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    31    36    1     0     0   3.998D-06  1.135D+00
F =  1.1354657039025864

```

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.29208D+00    |proj g|=  3.08429D-01

```

```

  This problem is unconstrained.

```

```

At iterate    5    f=  1.22260D+00    |proj g|=  7.31384D-02
At iterate   10    f=  1.15330D+00    |proj g|=  4.19724D-02
At iterate   15    f=  1.13589D+00    |proj g|=  1.22871D-02

```

At iterate 20 f= 1.13514D+00 |proj g|= 8.59430D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	27	1	0	0	4.882D-05	1.135D+00
F = 1.1351389482595056							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29178D+00 |proj g|= 3.08421D-01

This problem is unconstrained.

At iterate 5 f= 1.22233D+00 |proj g|= 7.32189D-02

At iterate 10 f= 1.15321D+00 |proj g|= 4.22184D-02

At iterate 15 f= 1.13559D+00 |proj g|= 4.47561D-02

At iterate 20 f= 1.13481D+00 |proj g|= 5.05498D-05

At iterate 25 f= 1.13481D+00 |proj g|= 4.61737D-04

At iterate 30 f= 1.13480D+00 |proj g|= 1.24739D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	5.906D-06	1.135D+00
F = 1.1348022827955619							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29143D+00 |proj g|= 3.08497D-01

At iterate 5 f= 1.22208D+00 |proj g|= 7.30596D-02

At iterate 10 f= 1.15296D+00 |proj g|= 4.23741D-02

At iterate 15 f= 1.13507D+00 |proj g|= 3.46460D-02

At iterate 20 f= 1.13446D+00 |proj g|= 5.01424D-05

At iterate 25 f= 1.13446D+00 |proj g|= 5.07055D-04

At iterate 30 f= 1.13446D+00 |proj g|= 5.61601D-04

At iterate 35 f= 1.13446D+00 |proj g|= 1.38286D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	42	1	0	0	1.383D-05	1.134D+00
F = 1.1344567329184441							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29108D+00 |proj g|= 3.08580D-01

This problem is unconstrained.

At iterate 5 f= 1.22179D+00 |proj g|= 7.29747D-02

At iterate 10 f= 1.15267D+00 |proj g|= 4.25697D-02

At iterate 15 f= 1.13458D+00 |proj g|= 2.52302D-02

At iterate 20 f= 1.13409D+00 |proj g|= 4.77176D-05

At iterate 25 f= 1.13409D+00 |proj g|= 5.21218D-04

At iterate 30 f= 1.13409D+00 |proj g|= 5.36555D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	34	1	0	0	5.366D-06	1.134D+00
F = 1.1340877321306126							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29078D+00 |proj g|= 3.08566D-01

At iterate 5 f= 1.22154D+00 |proj g|= 7.29907D-02

At iterate 10 f= 1.15235D+00 |proj g|= 4.24675D-02

At iterate 15 f= 1.13449D+00 |proj g|= 4.17998D-02

At iterate 20 f= 1.13375D+00 |proj g|= 5.03768D-05

At iterate 25 f= 1.13375D+00 |proj g|= 3.37791D-04

At iterate 30 f= 1.13374D+00 |proj g|= 5.74159D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	1.433D-06	1.134D+00
F =	1.1337447450372764						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

## RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29049D+00 |proj g|= 3.08546D-01

At iterate 5 f= 1.22134D+00 |proj g|= 7.28863D-02

This problem is unconstrained.

At iterate 10 f= 1.15207D+00 |proj g|= 4.24986D-02

At iterate 15 f= 1.13416D+00 |proj g|= 1.71137D-02

At iterate 20 f= 1.13339D+00 |proj g|= 2.41636D-04

At iterate 25 f= 1.13339D+00 |proj g|= 2.33631D-04

At iterate 30 f= 1.13339D+00 |proj g|= 1.59661D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	39	1	0	0	8.216D-06	1.133D+00
F = 1.1333872613637475							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29018D+00 |proj g|= 3.08828D-01

At iterate 5 f= 1.22097D+00 |proj g|= 7.27383D-02

At iterate 10 f= 1.15182D+00 |proj g|= 4.24016D-02

At iterate 15 f= 1.13403D+00 |proj g|= 1.62368D-02

At iterate 20 f= 1.13327D+00 |proj g|= 1.03103D-04

At iterate 25 f= 1.13327D+00 |proj g|= 2.07503D-04

At iterate 30 f= 1.13327D+00 |proj g|= 1.12890D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	9.479D-06	1.133D+00
F = 1.1332719024953060							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28983D+00 |proj g|= 3.09171D-01

This problem is unconstrained.

At iterate 5 f= 1.22057D+00 |proj g|= 7.25791D-02

At iterate 10 f= 1.15171D+00 |proj g|= 4.29951D-02

At iterate 15 f= 1.13338D+00 |proj g|= 9.43143D-03

At iterate 20 f= 1.13303D+00 |proj g|= 2.70976D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches



Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	9.838D-06	1.133D+00
F = 1.1330330047465520							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28945D+00 |proj g|= 3.09469D-01

This problem is unconstrained.

At iterate 5 f= 1.22017D+00 |proj g|= 7.23115D-02

At iterate 10 f= 1.15132D+00 |proj g|= 4.30823D-02

At iterate 15 f= 1.13324D+00 |proj g|= 3.02240D-02

At iterate 20 f= 1.13270D+00 |proj g|= 5.13616D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	5.136D-06	1.133D+00
F = 1.1326995468441565							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29025D+00 |proj g|= 3.07810D-01

This problem is unconstrained.

At iterate 5 f= 1.22176D+00 |proj g|= 7.24574D-02

At iterate 10 f= 1.15306D+00 |proj g|= 4.25145D-02

At iterate 15 f= 1.13455D+00 |proj g|= 1.82564D-02

At iterate 20 f= 1.13374D+00 |proj g|= 4.39381D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	26	1	0	0	1.292D-05	1.134D+00

F = 1.1337373564560673

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29021D+00 |proj g|= 3.07401D-01

```

At iterate    5    f=  1.22186D+00    |proj g|=  7.26621D-02
At iterate   10    f=  1.15233D+00    |proj g|=  5.04733D-02
At iterate   15    f=  1.13461D+00    |proj g|=  7.22132D-03
At iterate   20    f=  1.13426D+00    |proj g|=  9.79147D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	22	27	1	0	0	1.802D-05	1.134D+00

F = 1.1342584248849441

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.29041D+00    |proj g|=  3.06691D-01
At iterate    5    f=  1.22217D+00    |proj g|=  7.36909D-02
At iterate   10    f=  1.15341D+00    |proj g|=  4.18121D-02
At iterate   15    f=  1.13482D+00    |proj g|=  3.85246D-03
At iterate   20    f=  1.13441D+00    |proj g|=  3.70212D-04

```

\* \* \*

```

Tit   = total number of iterations

```

Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	27	1	0	0	8.482D-06	1.134D+00
F = 1.1344106430570249							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
 N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.29027D+00 |proj g|= 3.06656D-01

At iterate 5 f= 1.22219D+00 |proj g|= 7.35384D-02

This problem is unconstrained.

At iterate 10 f= 1.15335D+00 |proj g|= 4.15756D-02

At iterate 15 f= 1.13487D+00 |proj g|= 4.11375D-03

At iterate 20 f= 1.13446D+00 |proj g|= 7.24212D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	23	28	1	0	0	2.382D-06	1.134D+00
F = 1.1344611937547382							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28999D+00 |proj g|= 3.06781D-01

At iterate 5 f= 1.22196D+00 |proj g|= 7.35197D-02

At iterate 10 f= 1.15316D+00 |proj g|= 4.26467D-02

At iterate 15 f= 1.13470D+00 |proj g|= 4.39235D-03

At iterate 20 f= 1.13425D+00 |proj g|= 2.36543D-04

At iterate 25 f= 1.13425D+00 |proj g|= 2.07796D-04

At iterate 30 f= 1.13425D+00 |proj g|= 3.66201D-04

At iterate 35 f= 1.13425D+00 |proj g|= 5.70943D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	39	1	0	0	5.709D-06	1.134D+00
F =	1.1342466235861384						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28974D+00 |proj g|= 3.06786D-01

At iterate 5 f= 1.22171D+00 |proj g|= 7.34818D-02

At iterate 10 f= 1.15297D+00 |proj g|= 4.19174D-02

At iterate 15 f= 1.13461D+00 |proj g|= 4.18207D-03

At iterate 20 f= 1.13419D+00 |proj g|= 2.81462D-04

At iterate 25 f= 1.13418D+00 |proj g|= 1.84110D-04

At iterate 30 f= 1.13418D+00 |proj g|= 1.40444D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	41	1	0	0	1.591D-04	1.134D+00
F =	1.1341842883382023						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28938D+00 |proj g|= 3.06908D-01

```

At iterate    5    f=  1.22136D+00    |proj g|=  7.33390D-02
At iterate   10    f=  1.15272D+00    |proj g|=  4.23122D-02
At iterate   15    f=  1.13440D+00    |proj g|=  4.22852D-03
At iterate   20    f=  1.13398D+00    |proj g|=  2.82410D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	24	29	1	0	0	4.718D-06	1.134D+00

F = 1.1339814034758253

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28905D+00    |proj g|=  3.07230D-01
At iterate    5    f=  1.22098D+00    |proj g|=  7.31199D-02
At iterate   10    f=  1.15238D+00    |proj g|=  4.25452D-02
At iterate   15    f=  1.13429D+00    |proj g|=  4.12642D-03
At iterate   20    f=  1.13390D+00    |proj g|=  2.59647D-04

```

\* \* \*

```

Tit   = total number of iterations

```

Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	24	29	1	0	0	1.800D-05	1.134D+00

F = 1.1338950008197366

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
 N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28867D+00 |proj g|= 3.07375D-01

This problem is unconstrained.

At iterate 5 f= 1.22067D+00 |proj g|= 7.28101D-02

At iterate 10 f= 1.15198D+00 |proj g|= 4.20983D-02

At iterate 15 f= 1.13388D+00 |proj g|= 4.26532D-03

At iterate 20 f= 1.13353D+00 |proj g|= 1.28558D-04

At iterate 25 f= 1.13353D+00 |proj g|= 8.52297D-05

At iterate 30 f= 1.13353D+00 |proj g|= 2.15676D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*



N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	5.896D-05	1.134D+00
F = 1.1335292051008408							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28979D+00 |proj g|= 3.06012D-01

At iterate 5 f= 1.22181D+00 |proj g|= 7.38644D-02

This problem is unconstrained.

At iterate 10 f= 1.15296D+00 |proj g|= 3.81797D-02

At iterate 15 f= 1.13639D+00 |proj g|= 1.37033D-02

At iterate 20 f= 1.13617D+00 |proj g|= 1.43708D-04

At iterate 25 f= 1.13617D+00 |proj g|= 1.04647D-03

At iterate 30 f= 1.13616D+00 |proj g|= 9.51286D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	9.063D-06	1.136D+00
F = 1.1361586614690600							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28945D+00 |proj g|= 3.06089D-01

At iterate 5 f= 1.22150D+00 |proj g|= 7.36809D-02

This problem is unconstrained.

At iterate 10 f= 1.15239D+00 |proj g|= 9.90603D-02

At iterate 15 f= 1.13621D+00 |proj g|= 1.01733D-02

At iterate 20 f= 1.13599D+00 |proj g|= 1.69819D-04

At iterate 25 f= 1.13598D+00 |proj g|= 2.05213D-03

At iterate 30 f= 1.13597D+00 |proj g|= 1.64010D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	1.990D-05	1.136D+00

F = 1.1359716514749461

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28972D+00 |proj g|= 3.05797D-01

At iterate 5 f= 1.22140D+00 |proj g|= 7.47057D-02

This problem is unconstrained.

At iterate 10 f= 1.15185D+00 |proj g|= 8.42637D-02

At iterate 15 f= 1.13633D+00 |proj g|= 1.17595D-02

At iterate 20 f= 1.13617D+00 |proj g|= 1.21238D-04

At iterate 25 f= 1.13614D+00 |proj g|= 8.11874D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	33	1	0	0	7.697D-06	1.136D+00
F = 1.1361364489662702							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28978D+00 |proj g|= 3.07505D-01

At iterate 5 f= 1.22099D+00 |proj g|= 7.40578D-02

At iterate 10 f= 1.15170D+00 |proj g|= 5.27155D-02

At iterate 15 f= 1.13612D+00 |proj g|= 1.80502D-02

At iterate 20 f= 1.13584D+00 |proj g|= 1.26166D-04

At iterate 25 f= 1.13583D+00 |proj g|= 3.07231D-03

At iterate 30 f= 1.13580D+00 |proj g|= 5.58242D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	38	1	0	0	2.345D-06	1.136D+00
F = 1.1357992646357007							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28964D+00 |proj g|= 3.08469D-01

At iterate 5 f= 1.22042D+00 |proj g|= 7.39460D-02

At iterate 10 f= 1.15153D+00 |proj g|= 4.05637D-02

At iterate 15 f= 1.13564D+00 |proj g|= 1.34714D-02

At iterate 20 f= 1.13548D+00 |proj g|= 2.85977D-04

At iterate 25 f= 1.13545D+00 |proj g|= 3.17848D-03

At iterate 30 f= 1.13543D+00 |proj g|= 1.08745D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	2.298D-06	1.135D+00

F = 1.1354287034357922

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28965D+00 |proj g|= 3.10485D-01

At iterate 5 f= 1.21984D+00 |proj g|= 7.32171D-02

At iterate 10 f= 1.15075D+00 |proj g|= 5.58525D-02

At iterate 15 f= 1.13542D+00 |proj g|= 5.69246D-03

At iterate 20 f= 1.13517D+00 |proj g|= 1.24497D-04

At iterate 25 f= 1.13516D+00 |proj g|= 2.34244D-03

At iterate 30 f= 1.13513D+00 |proj g|= 6.95577D-04

At iterate 35 f= 1.13513D+00 |proj g|= 2.70540D-04

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	37	40	1	0	0	2.282D-05	1.135D+00
F =	1.1351318957046448						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28951D+00 |proj g|= 3.11630D-01

At iterate 5 f= 1.21921D+00 |proj g|= 7.31664D-02

This problem is unconstrained.

At iterate 10 f= 1.15029D+00 |proj g|= 6.94677D-02

At iterate 15 f= 1.13524D+00 |proj g|= 9.27469D-03

At iterate 20 f= 1.13481D+00 |proj g|= 1.14977D-04

At iterate 25 f= 1.13480D+00 |proj g|= 1.36544D-03

At iterate 30 f= 1.13478D+00 |proj g|= 1.24779D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	41	1	0	0	6.395D-06	1.135D+00
F =	1.1347765289424154						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28956D+00 |proj g|= 3.12317D-01

This problem is unconstrained.

At iterate 5 f= 1.21870D+00 |proj g|= 7.35778D-02

At iterate 10 f= 1.15009D+00 |proj g|= 8.30162D-02

At iterate 15 f= 1.13473D+00 |proj g|= 8.78705D-03

At iterate 20 f= 1.13446D+00 |proj g|= 9.96937D-05

At iterate 25 f= 1.13445D+00 |proj g|= 1.31892D-03

At iterate 30 f= 1.13443D+00 |proj g|= 6.58886D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	37	1	0	0	6.683D-05	1.134D+00
F = 1.1344296348804916							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

# RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28998D+00 |proj g|= 3.11648D-01

At iterate 5 f= 1.21875D+00 |proj g|= 7.47052D-02

This problem is unconstrained.

At iterate 10 f= 1.15010D+00 |proj g|= 8.49165D-02

At iterate 15 f= 1.13461D+00 |proj g|= 1.01213D-02

At iterate 20 f= 1.13431D+00 |proj g|= 1.06710D-04

At iterate 25 f= 1.13431D+00 |proj g|= 2.03224D-03

At iterate 30 f= 1.13428D+00 |proj g|= 3.77911D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	37	1	0	0	8.829D-06	1.134D+00
F =	1.1342838680506964						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28976D+00 |proj g|= 3.11721D-01

This problem is unconstrained.

At iterate 5 f= 1.21832D+00 |proj g|= 7.49095D-02

At iterate 10 f= 1.15061D+00 |proj g|= 8.49573D-02



```

At iterate   15      f=  1.13435D+00      |proj g|=  1.36725D-02
At iterate   20      f=  1.13396D+00      |proj g|=  1.03971D-04
At iterate   25      f=  1.13395D+00      |proj g|=  1.85524D-03
At iterate   30      f=  1.13393D+00      |proj g|=  1.06707D-03
At iterate   35      f=  1.13393D+00      |proj g|=  1.83645D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	42	1	0	0	1.836D-05	1.134D+00

F = 1.1339269266122762

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate   0      f=  1.28979D+00      |proj g|=  3.11248D-01
At iterate   5      f=  1.21808D+00      |proj g|=  7.56825D-02
At iterate  10      f=  1.15008D+00      |proj g|=  8.26352D-02
At iterate  15      f=  1.13396D+00      |proj g|=  1.32993D-02
At iterate  20      f=  1.13358D+00      |proj g|=  1.01210D-04
At iterate  25      f=  1.13358D+00      |proj g|=  2.08230D-03

```

At iterate 30 f= 1.13356D+00 |proj g|= 1.56713D-03

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	4.013D-06	1.134D+00
F = 1.1335556466308900							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28972D+00 |proj g|= 3.11337D-01

At iterate 5 f= 1.21780D+00 |proj g|= 7.59406D-02

At iterate 10 f= 1.14976D+00 |proj g|= 8.06120D-02

At iterate 15 f= 1.13358D+00 |proj g|= 1.30313D-02

At iterate 20 f= 1.13321D+00 |proj g|= 9.92614D-05

At iterate 25 f= 1.13321D+00 |proj g|= 1.83923D-03

At iterate 30 f= 1.13319D+00 |proj g|= 1.74440D-03

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	40	1	0	0	1.266D-05	1.133D+00
F = 1.1331845410400694							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28977D+00 |proj g|= 3.11880D-01

At iterate 5 f= 1.21762D+00 |proj g|= 7.59160D-02

This problem is unconstrained.

At iterate 10 f= 1.14933D+00 |proj g|= 8.07786D-02

At iterate 15 f= 1.13323D+00 |proj g|= 1.31791D-02

At iterate 20 f= 1.13285D+00 |proj g|= 9.85787D-05

At iterate 25 f= 1.13285D+00 |proj g|= 1.91718D-03

At iterate 30 f= 1.13283D+00 |proj g|= 1.07145D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	1.356D-05	1.133D+00

F = 1.1328264883383901

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28943D+00 |proj g|= 3.11989D-01

This problem is unconstrained.

At iterate 5 f= 1.21725D+00 |proj g|= 7.59979D-02

At iterate 10 f= 1.14915D+00 |proj g|= 8.08924D-02

At iterate 15 f= 1.13295D+00 |proj g|= 1.32748D-02

At iterate 20 f= 1.13257D+00 |proj g|= 9.46427D-05

At iterate 25 f= 1.13257D+00 |proj g|= 3.00957D-03

At iterate 30 f= 1.13255D+00 |proj g|= 1.47450D-03

At iterate 35 f= 1.13255D+00 |proj g|= 4.65450D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	41	1	0	0	4.654D-05	1.133D+00

F = 1.1325489824754222

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

## RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28908D+00 |proj g|= 3.12291D-01

At iterate 5 f= 1.21689D+00 |proj g|= 7.60555D-02

At iterate 10 f= 1.14885D+00 |proj g|= 8.20147D-02

At iterate 15 f= 1.13258D+00 |proj g|= 1.32939D-02

At iterate 20 f= 1.13221D+00 |proj g|= 9.51103D-05

At iterate 25 f= 1.13220D+00 |proj g|= 1.99501D-03

At iterate 30 f= 1.13218D+00 |proj g|= 1.00908D-03

At iterate 35 f= 1.13218D+00 |proj g|= 1.31865D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	41	1	0	0	1.319D-05	1.132D+00
F =	1.1321815669932958						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

## RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.28914D+00      |proj g|= 3.11602D-01

At iterate    5      f= 1.21681D+00      |proj g|= 7.64543D-02

At iterate    10     f= 1.14764D+00      |proj g|= 8.24789D-02

At iterate    15     f= 1.13222D+00      |proj g|= 1.24936D-02

At iterate    20     f= 1.13187D+00      |proj g|= 8.84426D-05

At iterate    25     f= 1.13187D+00      |proj g|= 1.95511D-03

At iterate    30     f= 1.13185D+00      |proj g|= 8.42638D-04

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F       = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	37	1	0	0	1.592D-05	1.132D+00
F = 1.1318480902794883							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5      M =            10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.28914D+00      |proj g|= 3.11072D-01

At iterate    5      f= 1.21684D+00      |proj g|= 7.69646D-02

At iterate    10     f= 1.14692D+00      |proj g|= 8.01783D-02

```

At iterate   15      f=  1.13192D+00      |proj g|=  1.17387D-02
At iterate   20      f=  1.13159D+00      |proj g|=  8.15256D-05
At iterate   25      f=  1.13159D+00      |proj g|=  2.65585D-03
At iterate   30      f=  1.13157D+00      |proj g|=  2.68472D-04

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

```

* * *

```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	49	1	0	0	3.724D-05	1.132D+00

F = 1.1315726952931247

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

Warning: more than 10 function and gradient evaluations in the last line search. Termination may possibly be caused by a bad search direction. This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

```

* * *

```

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate   0      f=  1.28885D+00      |proj g|=  3.11585D-01
At iterate   5      f=  1.21654D+00      |proj g|=  7.66058D-02
At iterate  10      f=  1.14730D+00      |proj g|=  8.28445D-02
At iterate  15      f=  1.13179D+00      |proj g|=  1.32155D-02
At iterate  20      f=  1.13141D+00      |proj g|=  1.08248D-04

```

At iterate 25 f= 1.13141D+00 |proj g|= 1.37546D-03

At iterate 30 f= 1.13139D+00 |proj g|= 9.04616D-04

At iterate 35 f= 1.13139D+00 |proj g|= 1.10972D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	45	1	0	0	1.110D-05	1.131D+00
F = 1.1313897526764489							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28895D+00 |proj g|= 3.10918D-01

At iterate 5 f= 1.21659D+00 |proj g|= 7.74372D-02

At iterate 10 f= 1.14576D+00 |proj g|= 7.59510D-02

At iterate 15 f= 1.13136D+00 |proj g|= 1.15144D-02

At iterate 20 f= 1.13104D+00 |proj g|= 8.29546D-05

At iterate 25 f= 1.13104D+00 |proj g|= 1.57278D-03

At iterate 30 f= 1.13102D+00 |proj g|= 1.42998D-03

At iterate 35 f= 1.13102D+00 |proj g|= 1.23703D-05



\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	39	1	0	0	1.237D-05	1.131D+00
F =	1.1310231141034319						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28858D+00 |proj g|= 3.11347D-01

At iterate 5 f= 1.21621D+00 |proj g|= 7.72486D-02

This problem is unconstrained.

At iterate 10 f= 1.14581D+00 |proj g|= 7.83343D-02

At iterate 15 f= 1.13130D+00 |proj g|= 1.21950D-02

At iterate 20 f= 1.13097D+00 |proj g|= 1.00081D-04

At iterate 25 f= 1.13097D+00 |proj g|= 2.20417D-03

At iterate 30 f= 1.13096D+00 |proj g|= 1.12755D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	4.113D-06	1.131D+00
F =	1.1309624445946826						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28828D+00 |proj g|= 3.11452D-01

At iterate 5 f= 1.21594D+00 |proj g|= 7.76387D-02

This problem is unconstrained.

At iterate 10 f= 1.14478D+00 |proj g|= 7.51868D-02

At iterate 15 f= 1.13089D+00 |proj g|= 1.09851D-02

At iterate 20 f= 1.13061D+00 |proj g|= 5.40610D-05

At iterate 25 f= 1.13061D+00 |proj g|= 9.51173D-04

At iterate 30 f= 1.13060D+00 |proj g|= 1.29627D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	8.714D-06	1.131D+00
F =	1.1306005642421797						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28819D+00 |proj g|= 3.11159D-01

This problem is unconstrained.

At iterate 5 f= 1.21593D+00 |proj g|= 7.79231D-02

At iterate 10 f= 1.14427D+00 |proj g|= 7.28111D-02

At iterate 15 f= 1.13062D+00 |proj g|= 1.08639D-02

At iterate 20 f= 1.13034D+00 |proj g|= 5.71365D-05

At iterate 25 f= 1.13034D+00 |proj g|= 9.29140D-04

At iterate 30 f= 1.13033D+00 |proj g|= 1.14398D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	4.306D-06	1.130D+00
F =	1.1303266381273751						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

```

N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.28778D+00      |proj g|=  3.11492D-01
At iterate    5      f=  1.21555D+00      |proj g|=  7.78000D-02
At iterate   10      f=  1.14390D+00      |proj g|=  7.43064D-02
At iterate   15      f=  1.13028D+00      |proj g|=  1.08551D-02
At iterate   20      f=  1.13000D+00      |proj g|=  5.77417D-05
At iterate   25      f=  1.13000D+00      |proj g|=  2.40231D-03
At iterate   30      f=  1.12999D+00      |proj g|=  2.20931D-05

      * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

      * * *

      N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
      5       31       36      1      0      0      2.850D-06  1.130D+00
F =  1.1299898206056538

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

      * * *

Machine precision = 2.220D-16
N =          5      M =          10
At X0          0 variables are exactly at the bounds
At iterate    0      f=  1.28748D+00      |proj g|=  3.11764D-01
At iterate    5      f=  1.21522D+00      |proj g|=  7.77396D-02

```

```

At iterate   10    f=  1.14390D+00    |proj g|=  7.89130D-02
At iterate   15    f=  1.13018D+00    |proj g|=  8.43271D-03
At iterate   20    f=  1.12994D+00    |proj g|=  7.80466D-05
At iterate   25    f=  1.12994D+00    |proj g|=  9.75769D-04
At iterate   30    f=  1.12992D+00    |proj g|=  1.02033D-03
At iterate   35    f=  1.12992D+00    |proj g|=  1.24529D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	39	1	0	0	1.245D-04	1.130D+00
F = 1.1299221794662695							

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.28729D+00    |proj g|=  3.11988D-01

```

```

This problem is unconstrained.

```

```

At iterate    5    f=  1.21509D+00    |proj g|=  7.75473D-02
At iterate   10    f=  1.14385D+00    |proj g|=  7.91207D-02
At iterate   15    f=  1.13009D+00    |proj g|=  9.99665D-03
At iterate   20    f=  1.12983D+00    |proj g|=  7.84202D-05

```

At iterate 25 f= 1.12982D+00 |proj g|= 1.47144D-03

At iterate 30 f= 1.12981D+00 |proj g|= 1.14374D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	39	1	0	0	8.746D-06	1.130D+00
F = 1.1298075143405504							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28695D+00 |proj g|= 3.12251D-01

This problem is unconstrained.

At iterate 5 f= 1.21481D+00 |proj g|= 7.72703D-02

At iterate 10 f= 1.14392D+00 |proj g|= 8.20903D-02

At iterate 15 f= 1.12995D+00 |proj g|= 1.12952D-02

At iterate 20 f= 1.12966D+00 |proj g|= 7.30529D-05

At iterate 25 f= 1.12966D+00 |proj g|= 1.57398D-03

At iterate 30 f= 1.12964D+00 |proj g|= 1.35088D-03

At iterate 35 f= 1.12964D+00 |proj g|= 5.21251D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	41	1	0	0	5.213D-05	1.130D+00

F = 1.1296421482595442

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28665D+00 |proj g|= 3.12373D-01

At iterate 5 f= 1.21464D+00 |proj g|= 7.72149D-02

At iterate 10 f= 1.14363D+00 |proj g|= 8.05471D-02

At iterate 15 f= 1.12971D+00 |proj g|= 1.19146D-02

At iterate 20 f= 1.12940D+00 |proj g|= 7.86311D-05

At iterate 25 f= 1.12940D+00 |proj g|= 1.70410D-03

At iterate 30 f= 1.12939D+00 |proj g|= 1.42214D-03

At iterate 35 f= 1.12939D+00 |proj g|= 7.65794D-06

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	35	39	1	0	0	7.658D-06	1.129D+00
F =	1.1293851441936889						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28640D+00 |proj g|= 3.12286D-01

At iterate 5 f= 1.21439D+00 |proj g|= 7.75361D-02

At iterate 10 f= 1.14318D+00 |proj g|= 8.29486D-02

At iterate 15 f= 1.12932D+00 |proj g|= 9.64934D-03

At iterate 20 f= 1.12907D+00 |proj g|= 7.88714D-05

At iterate 25 f= 1.12906D+00 |proj g|= 9.78650D-04

At iterate 30 f= 1.12905D+00 |proj g|= 5.65302D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	34	38	1	0	0	7.083D-06	1.129D+00
F =	1.1290480622198575						



CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28609D+00 |proj g|= 3.12398D-01

At iterate 5 f= 1.21407D+00 |proj g|= 7.76915D-02

At iterate 10 f= 1.14261D+00 |proj g|= 8.32604D-02

At iterate 15 f= 1.12888D+00 |proj g|= 5.58206D-03

At iterate 20 f= 1.12870D+00 |proj g|= 8.08924D-05

At iterate 25 f= 1.12870D+00 |proj g|= 1.03422D-03

At iterate 30 f= 1.12868D+00 |proj g|= 6.54530D-04

At iterate 35 f= 1.12868D+00 |proj g|= 1.53510D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	36	39	1	0	0	1.051D-05	1.129D+00
F =	1.1286824612097721						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28689D+00 |proj g|= 3.11357D-01

At iterate 5 f= 1.21529D+00 |proj g|= 7.66128D-02

At iterate 10 f= 1.14723D+00 |proj g|= 8.56218D-02

At iterate 15 f= 1.13138D+00 |proj g|= 1.01916D-02

At iterate 20 f= 1.13110D+00 |proj g|= 9.34427D-05

At iterate 25 f= 1.13109D+00 |proj g|= 2.86495D-03

At iterate 30 f= 1.13107D+00 |proj g|= 1.88293D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	8.453D-06	1.131D+00
F =	1.1310719976527555						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28706D+00 |proj g|= 3.12212D-01

This problem is unconstrained.

```

At iterate    5    f=  1.21518D+00    |proj g|=  7.59918D-02
At iterate   10    f=  1.14984D+00    |proj g|=  7.95307D-02
At iterate   15    f=  1.13296D+00    |proj g|=  3.88682D-03
At iterate   20    f=  1.13275D+00    |proj g|=  9.45628D-05
At iterate   25    f=  1.13274D+00    |proj g|=  1.35594D-03
At iterate   30    f=  1.13273D+00    |proj g|=  1.46462D-04

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    32    37    1     0     0   3.470D-06  1.133D+00
F =  1.1327256611308667

```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5    M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28705D+00    |proj g|=  3.12148D-01
At iterate    5    f=  1.21488D+00    |proj g|=  7.61731D-02
At iterate   10    f=  1.14988D+00    |proj g|=  7.55794D-02
At iterate   15    f=  1.13376D+00    |proj g|=  3.45776D-03
At iterate   20    f=  1.13359D+00    |proj g|=  3.26386D-05

```

At iterate 25 f= 1.13359D+00 |proj g|= 5.76042D-04

At iterate 30 f= 1.13359D+00 |proj g|= 1.85000D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	38	1	0	0	9.342D-06	1.134D+00
F = 1.1335908147206699							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28694D+00 |proj g|= 3.12490D-01

At iterate 5 f= 1.21442D+00 |proj g|= 7.59795D-02

At iterate 10 f= 1.15014D+00 |proj g|= 7.43564D-02

At iterate 15 f= 1.13343D+00 |proj g|= 3.39753D-03

At iterate 20 f= 1.13327D+00 |proj g|= 3.17284D-05

At iterate 25 f= 1.13327D+00 |proj g|= 6.62286D-04

At iterate 30 f= 1.13327D+00 |proj g|= 3.98932D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	33	1	0	0	3.989D-06	1.133D+00
F = 1.1332704202269059							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28708D+00 |proj g|= 3.11840D-01

This problem is unconstrained.

At iterate 5 f= 1.21554D+00 |proj g|= 7.54440D-02

At iterate 10 f= 1.15304D+00 |proj g|= 7.94668D-02

At iterate 15 f= 1.13532D+00 |proj g|= 1.47788D-02

At iterate 20 f= 1.13513D+00 |proj g|= 1.16770D-04

At iterate 25 f= 1.13513D+00 |proj g|= 2.45940D-03

At iterate 30 f= 1.13512D+00 |proj g|= 7.73593D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	1.698D-05	1.135D+00
F = 1.1351201458052469							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28679D+00 |proj g|= 3.11876D-01

At iterate 5 f= 1.21520D+00 |proj g|= 7.54075D-02

At iterate 10 f= 1.15280D+00 |proj g|= 7.91397D-02

At iterate 15 f= 1.13511D+00 |proj g|= 1.51120D-02

At iterate 20 f= 1.13493D+00 |proj g|= 9.55537D-05

At iterate 25 f= 1.13492D+00 |proj g|= 2.60466D-03

At iterate 30 f= 1.13492D+00 |proj g|= 1.60795D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	1.734D-05	1.135D+00
F = 1.1349175242599534							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28668D+00 |proj g|= 3.12074D-01

This problem is unconstrained.

At iterate 5 f= 1.21506D+00 |proj g|= 7.58365D-02

At iterate 10 f= 1.15103D+00 |proj g|= 7.46918D-02

At iterate 15 f= 1.13505D+00 |proj g|= 6.22610D-03

At iterate 20 f= 1.13491D+00 |proj g|= 4.76735D-05

At iterate 25 f= 1.13491D+00 |proj g|= 7.47702D-04

At iterate 30 f= 1.13491D+00 |proj g|= 3.46317D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	34	1	0	0	3.463D-05	1.135D+00
F =	1.1349088444622757						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28635D+00 |proj g|= 3.12150D-01

This problem is unconstrained.

```

At iterate    5    f=  1.21483D+00    |proj g|=  7.56193D-02
At iterate   10    f=  1.15140D+00    |proj g|=  7.46643D-02
At iterate   15    f=  1.13562D+00    |proj g|=  7.35450D-03
At iterate   20    f=  1.13550D+00    |proj g|=  5.94484D-05
At iterate   25    f=  1.13550D+00    |proj g|=  1.33577D-03
At iterate   30    f=  1.13549D+00    |proj g|=  2.48127D-04

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

```

* * *

```

```

  N    Tit    Tnf  Tnint  Skip  Nact    Projg    F
   5    33    38    1    0    0    4.106D-06  1.135D+00
F =  1.1354938452880763

```

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL

```

```

This problem is unconstrained.

```

```

RUNNING THE L-BFGS-B CODE

```

```

* * *

```

```

Machine precision = 2.220D-16
N =                5    M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.28623D+00    |proj g|=  3.12544D-01
At iterate    5    f=  1.21460D+00    |proj g|=  7.57675D-02
At iterate   10    f=  1.15037D+00    |proj g|=  7.22100D-02
At iterate   15    f=  1.13548D+00    |proj g|=  3.85549D-03
At iterate   20    f=  1.13538D+00    |proj g|=  7.27011D-05

```



At iterate 25 f= 1.13537D+00 |proj g|= 1.11783D-03

At iterate 30 f= 1.13537D+00 |proj g|= 9.27252D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	38	1	0	0	1.825D-05	1.135D+00
F = 1.1353676314419723							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28595D+00 |proj g|= 3.12510D-01

At iterate 5 f= 1.21432D+00 |proj g|= 7.58167D-02

This problem is unconstrained.

At iterate 10 f= 1.15016D+00 |proj g|= 7.21544D-02

At iterate 15 f= 1.13533D+00 |proj g|= 4.26446D-03

At iterate 20 f= 1.13522D+00 |proj g|= 8.89385D-05

At iterate 25 f= 1.13522D+00 |proj g|= 1.92560D-03

At iterate 30 f= 1.13521D+00 |proj g|= 2.42279D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	6.948D-06	1.135D+00
F = 1.1352102390343561							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28584D+00 |proj g|= 3.12373D-01

At iterate 5 f= 1.21424D+00 |proj g|= 7.61927D-02

At iterate 10 f= 1.14930D+00 |proj g|= 7.03342D-02

At iterate 15 f= 1.13513D+00 |proj g|= 2.74585D-03

At iterate 20 f= 1.13504D+00 |proj g|= 9.34968D-05

At iterate 25 f= 1.13504D+00 |proj g|= 2.42673D-03

At iterate 30 f= 1.13503D+00 |proj g|= 4.14522D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	36	1	0	0	3.541D-05	1.135D+00
F = 1.1350273617865134							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28549D+00 |proj g|= 3.12502D-01

At iterate 5 f= 1.21393D+00 |proj g|= 7.59374D-02

At iterate 10 f= 1.14940D+00 |proj g|= 7.08774D-02

At iterate 15 f= 1.13494D+00 |proj g|= 3.84995D-03

At iterate 20 f= 1.13485D+00 |proj g|= 9.24297D-05

At iterate 25 f= 1.13484D+00 |proj g|= 5.38068D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	35	1	0	0	6.974D-06	1.135D+00
F = 1.1348313382308308							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28669D+00 |proj g|= 3.14051D-01

At iterate 5 f= 1.21441D+00 |proj g|= 7.61994D-02

At iterate 10 f= 1.14699D+00 |proj g|= 6.04985D-02

At iterate 15 f= 1.13467D+00 |proj g|= 5.48158D-03

At iterate 20 f= 1.13456D+00 |proj g|= 8.85630D-05

At iterate 25 f= 1.13455D+00 |proj g|= 1.65415D-03

At iterate 30 f= 1.13454D+00 |proj g|= 5.17143D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	34	1	0	0	1.797D-05	1.135D+00
F = 1.1345435480781514							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28650D+00 |proj g|= 3.14903D-01

At iterate 5 f= 1.21398D+00 |proj g|= 7.61440D-02

This problem is unconstrained.

```

At iterate   10    f=  1.14626D+00    |proj g|=  6.01857D-02
At iterate   15    f=  1.13440D+00    |proj g|=  7.59470D-03
At iterate   20    f=  1.13426D+00    |proj g|=  8.73005D-05
At iterate   25    f=  1.13425D+00    |proj g|=  2.23416D-03
At iterate   30    f=  1.13425D+00    |proj g|=  3.07945D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	5.137D-06	1.134D+00

F = 1.1342467143738364

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28673D+00    |proj g|=  3.16196D-01
At iterate    5    f=  1.21349D+00    |proj g|=  7.64392D-02
At iterate   10    f=  1.14535D+00    |proj g|=  5.36963D-02
At iterate   15    f=  1.13400D+00    |proj g|=  9.49477D-03
At iterate   20    f=  1.13390D+00    |proj g|=  2.34325D-04
At iterate   25    f=  1.13389D+00    |proj g|=  8.61826D-04

```

At iterate 30 f= 1.13389D+00 |proj g|= 2.80603D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	9.689D-06	1.134D+00
F =	1.1338856383787799						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28670D+00 |proj g|= 3.17389D-01

At iterate 5 f= 1.21315D+00 |proj g|= 7.60787D-02

At iterate 10 f= 1.14526D+00 |proj g|= 5.33711D-02

At iterate 15 f= 1.13396D+00 |proj g|= 2.19524D-02

At iterate 20 f= 1.13379D+00 |proj g|= 4.09322D-04

At iterate 25 f= 1.13377D+00 |proj g|= 8.04756D-04

At iterate 30 f= 1.13377D+00 |proj g|= 1.10331D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	1.103D-05	1.134D+00
F = 1.1337718161571435							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28682D+00 |proj g|= 3.16825D-01

At iterate 5 f= 1.21304D+00 |proj g|= 7.66071D-02

At iterate 10 f= 1.14519D+00 |proj g|= 5.50324D-02

At iterate 15 f= 1.13357D+00 |proj g|= 1.67854D-02

At iterate 20 f= 1.13343D+00 |proj g|= 4.78351D-04

At iterate 25 f= 1.13342D+00 |proj g|= 1.11586D-03

At iterate 30 f= 1.13341D+00 |proj g|= 8.18405D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	8.184D-06	1.133D+00

F = 1.1334146877146818

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28660D+00 |proj g|= 3.17093D-01

At iterate 5 f= 1.21268D+00 |proj g|= 7.66190D-02

At iterate 10 f= 1.14478D+00 |proj g|= 5.37089D-02

At iterate 15 f= 1.13327D+00 |proj g|= 2.42749D-02

At iterate 20 f= 1.13308D+00 |proj g|= 4.52025D-04

At iterate 25 f= 1.13307D+00 |proj g|= 3.36384D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	27	30	1	0	0	8.162D-06	1.133D+00
F =	1.1330654682121137						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10



At X0            0 variables are exactly at the bounds

At iterate    0     f= 1.28704D+00     |proj g|= 3.15901D-01

At iterate    5     f= 1.21330D+00     |proj g|= 7.72288D-02

This problem is unconstrained.

At iterate    10     f= 1.14458D+00     |proj g|= 5.27588D-02

At iterate    15     f= 1.13327D+00     |proj g|= 2.54679D-02

At iterate    20     f= 1.13308D+00     |proj g|= 4.20704D-04

At iterate    25     f= 1.13307D+00     |proj g|= 8.80375D-05

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg  = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	27	30	1	0	0	3.607D-05	1.133D+00
F = 1.1330692712484725							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5     M =            10

At X0            0 variables are exactly at the bounds

At iterate    0     f= 1.28676D+00     |proj g|= 3.15880D-01

At iterate    5     f= 1.21299D+00     |proj g|= 7.72571D-02

At iterate    10     f= 1.14454D+00     |proj g|= 5.35676D-02

At iterate 15 f= 1.13316D+00 |proj g|= 2.62525D-02

At iterate 20 f= 1.13296D+00 |proj g|= 2.96260D-04

At iterate 25 f= 1.13295D+00 |proj g|= 5.80898D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	28	32	1	0	0	2.636D-05	1.133D+00
F = 1.1329513318134394							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28647D+00 |proj g|= 3.15942D-01

This problem is unconstrained.

At iterate 5 f= 1.21267D+00 |proj g|= 7.74381D-02

At iterate 10 f= 1.14418D+00 |proj g|= 5.31713D-02

At iterate 15 f= 1.13292D+00 |proj g|= 2.41715D-02

At iterate 20 f= 1.13273D+00 |proj g|= 2.17526D-04

At iterate 25 f= 1.13273D+00 |proj g|= 8.01800D-04

At iterate 30 f= 1.13273D+00 |proj g|= 5.21995D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	5.220D-05	1.133D+00
F =	1.1327271048911147						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28666D+00 |proj g|= 3.15630D-01

This problem is unconstrained.

At iterate 5 f= 1.21271D+00 |proj g|= 7.76494D-02

At iterate 10 f= 1.14481D+00 |proj g|= 5.57904D-02

At iterate 15 f= 1.13335D+00 |proj g|= 1.99726D-02

At iterate 20 f= 1.13320D+00 |proj g|= 1.20748D-04

At iterate 25 f= 1.13319D+00 |proj g|= 1.24675D-03

At iterate 30 f= 1.13319D+00 |proj g|= 3.64306D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	36	1	0	0	4.180D-06	1.133D+00
F = 1.1331926253137021							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28647D+00 |proj g|= 3.15849D-01

At iterate 5 f= 1.21232D+00 |proj g|= 7.76784D-02

At iterate 10 f= 1.14494D+00 |proj g|= 5.69032D-02

At iterate 15 f= 1.13337D+00 |proj g|= 2.23117D-02

At iterate 20 f= 1.13320D+00 |proj g|= 1.25955D-04

At iterate 25 f= 1.13319D+00 |proj g|= 1.54692D-03

At iterate 30 f= 1.13319D+00 |proj g|= 3.21159D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	1.304D-05	1.133D+00
F = 1.1331933679698130							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28863D+00 |proj g|= 3.14710D-01

This problem is unconstrained.

At iterate 5 f= 1.21616D+00 |proj g|= 7.57287D-02

At iterate 10 f= 1.14751D+00 |proj g|= 5.81093D-02

At iterate 15 f= 1.13566D+00 |proj g|= 8.37256D-03

At iterate 20 f= 1.13556D+00 |proj g|= 1.52948D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	25	1	0	0	1.055D-05	1.136D+00
F = 1.1355552913580493							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28876D+00 |proj g|= 3.14222D-01

```

At iterate    5    f=  1.21591D+00    |proj g|=  7.62564D-02
At iterate   10    f=  1.14792D+00    |proj g|=  6.06188D-02
At iterate   15    f=  1.13540D+00    |proj g|=  6.04878D-03
At iterate   20    f=  1.13529D+00    |proj g|=  1.03474D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.035D-05	1.135D+00

F = 1.1352903241562582

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28861D+00    |proj g|=  3.14107D-01
At iterate    5    f=  1.21563D+00    |proj g|=  7.66048D-02
At iterate   10    f=  1.14649D+00    |proj g|=  5.14021D-02
At iterate   15    f=  1.13506D+00    |proj g|=  1.26735D-02
At iterate   20    f=  1.13494D+00    |proj g|=  3.63496D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations

```

Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	3.635D-05	1.135D+00
F = 1.1349409187452877							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28833D+00 |proj g|= 3.14243D-01

At iterate 5 f= 1.21535D+00 |proj g|= 7.67085D-02

At iterate 10 f= 1.14602D+00 |proj g|= 4.94028D-02

At iterate 15 f= 1.13495D+00 |proj g|= 1.15488D-02

At iterate 20 f= 1.13484D+00 |proj g|= 8.17655D-05

At iterate 25 f= 1.13484D+00 |proj g|= 6.91719D-04

At iterate 30 f= 1.13484D+00 |proj g|= 1.39247D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	7.026D-06	1.135D+00
F = 1.1348358104837246							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28802D+00 |proj g|= 3.14336D-01

At iterate 5 f= 1.21512D+00 |proj g|= 7.66786D-02

At iterate 10 f= 1.14539D+00 |proj g|= 4.70529D-02

At iterate 15 f= 1.13462D+00 |proj g|= 1.79945D-02

At iterate 20 f= 1.13448D+00 |proj g|= 7.43680D-05

At iterate 25 f= 1.13448D+00 |proj g|= 5.04822D-04

At iterate 30 f= 1.13448D+00 |proj g|= 2.23374D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	5.915D-06	1.134D+00
F = 1.1344785427787156							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*



Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28806D+00 |proj g|= 3.14509D-01

At iterate 5 f= 1.21556D+00 |proj g|= 7.61752D-02

This problem is unconstrained.

At iterate 10 f= 1.14559D+00 |proj g|= 4.38253D-02

At iterate 15 f= 1.13502D+00 |proj g|= 2.17374D-02

At iterate 20 f= 1.13487D+00 |proj g|= 1.88445D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.884D-05	1.135D+00
F =	1.1348732709283134						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28836D+00 |proj g|= 3.13720D-01

This problem is unconstrained.

At iterate 5 f= 1.21591D+00 |proj g|= 7.66613D-02

At iterate 10 f= 1.14542D+00 |proj g|= 4.04078D-02

At iterate 15 f= 1.13512D+00 |proj g|= 2.35143D-02

At iterate 20 f= 1.13502D+00 |proj g|= 2.44565D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	2.744D-05	1.135D+00
F = 1.1350159596997262							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28876D+00 |proj g|= 3.14137D-01

At iterate 5 f= 1.21639D+00 |proj g|= 7.59108D-02

At iterate 10 f= 1.14640D+00 |proj g|= 4.41151D-02

At iterate 15 f= 1.13584D+00 |proj g|= 9.05240D-03

At iterate 20 f= 1.13563D+00 |proj g|= 1.86642D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	26	1	0	0	3.482D-06	1.136D+00
F = 1.1356316587193553							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28924D+00 |proj g|= 3.13376D-01

At iterate 5 f= 1.21672D+00 |proj g|= 7.62474D-02

This problem is unconstrained.

At iterate 10 f= 1.14768D+00 |proj g|= 5.19451D-02

At iterate 15 f= 1.13652D+00 |proj g|= 6.49654D-03

At iterate 20 f= 1.13642D+00 |proj g|= 1.62776D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.628D-05	1.136D+00
F = 1.1364186384650024							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28888D+00 |proj g|= 3.13511D-01

At iterate 5 f= 1.21647D+00 |proj g|= 7.59896D-02

This problem is unconstrained.

At iterate 10 f= 1.14752D+00 |proj g|= 5.21520D-02

At iterate 15 f= 1.13638D+00 |proj g|= 6.56325D-03

At iterate 20 f= 1.13628D+00 |proj g|= 1.16851D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.169D-05	1.136D+00
F = 1.1362758391637906							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28869D+00 |proj g|= 3.13564D-01

```
At iterate    5    f=  1.21627D+00    |proj g|=  7.61157D-02
At iterate   10    f=  1.14716D+00    |proj g|=  5.28444D-02
At iterate   15    f=  1.13603D+00    |proj g|=  5.83674D-03
At iterate   20    f=  1.13592D+00    |proj g|=  1.41023D-05
```

```
* * *
```

```
Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value
```

```
* * *
```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.410D-05	1.136D+00

F = 1.1359186214400494

```
CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE
```

```
* * *
```

```
Machine precision = 2.220D-16
N =                5      M =                10
```

```
At X0          0 variables are exactly at the bounds
```

```
At iterate    0    f=  1.28842D+00    |proj g|=  3.13523D-01
```

```
This problem is unconstrained.
```

```
At iterate    5    f=  1.21598D+00    |proj g|=  7.61193D-02
At iterate   10    f=  1.14694D+00    |proj g|=  5.36584D-02
At iterate   15    f=  1.13579D+00    |proj g|=  5.54358D-03
At iterate   20    f=  1.13568D+00    |proj g|=  2.17216D-05
```

```
* * *
```

```
Tit   = total number of iterations
Tnf   = total number of function evaluations
```

Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	2.172D-05	1.136D+00
F = 1.1356776646062430							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
 RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28861D+00 |proj g|= 3.12980D-01

At iterate 5 f= 1.21655D+00 |proj g|= 7.64298D-02

This problem is unconstrained.

At iterate 10 f= 1.14771D+00 |proj g|= 5.85771D-02

At iterate 15 f= 1.13664D+00 |proj g|= 7.33277D-03

At iterate 20 f= 1.13652D+00 |proj g|= 3.70356D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	7.180D-06	1.137D+00
F = 1.1365158732413059							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28826D+00 |proj g|= 3.13173D-01

At iterate 5 f= 1.21619D+00 |proj g|= 7.61383D-02

At iterate 10 f= 1.14736D+00 |proj g|= 5.86514D-02

At iterate 15 f= 1.13630D+00 |proj g|= 7.50828D-03

At iterate 20 f= 1.13616D+00 |proj g|= 5.50134D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	4.503D-06	1.136D+00

F = 1.1361647466357521

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28790D+00 |proj g|= 3.13398D-01

At iterate 5 f= 1.21586D+00 |proj g|= 7.62314D-02

This problem is unconstrained.

At iterate 10 f= 1.14683D+00 |proj g|= 5.67092D-02

At iterate 15 f= 1.13599D+00 |proj g|= 7.16671D-03

At iterate 20 f= 1.13586D+00 |proj g|= 4.95160D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	7.556D-06	1.136D+00
F = 1.1358645090648845							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28755D+00 |proj g|= 3.13513D-01

This problem is unconstrained.

At iterate 5 f= 1.21553D+00 |proj g|= 7.60792D-02

At iterate 10 f= 1.14660D+00 |proj g|= 5.69412D-02

At iterate 15 f= 1.13581D+00 |proj g|= 7.00323D-03

At iterate 20 f= 1.13569D+00 |proj g|= 6.33271D-05

At iterate 25 f= 1.13569D+00 |proj g|= 9.53585D-04



At iterate 30 f= 1.13569D+00 |proj g|= 1.68681D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	35	1	0	0	8.954D-06	1.136D+00
F = 1.1356852204229351							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28730D+00 |proj g|= 3.13618D-01

This problem is unconstrained.

At iterate 5 f= 1.21521D+00 |proj g|= 7.60051D-02

At iterate 10 f= 1.14645D+00 |proj g|= 5.82570D-02

At iterate 15 f= 1.13550D+00 |proj g|= 7.16126D-03

At iterate 20 f= 1.13537D+00 |proj g|= 6.13743D-05

At iterate 25 f= 1.13537D+00 |proj g|= 1.11617D-03

At iterate 30 f= 1.13537D+00 |proj g|= 2.96187D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	1.878D-05	1.135D+00
F = 1.1353700556918911							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28767D+00 |proj g|= 3.12538D-01

At iterate 5 f= 1.21648D+00 |proj g|= 7.51527D-02

At iterate 10 f= 1.14872D+00 |proj g|= 6.42883D-02

At iterate 15 f= 1.13763D+00 |proj g|= 8.20413D-03

At iterate 20 f= 1.13750D+00 |proj g|= 4.61308D-05

At iterate 25 f= 1.13750D+00 |proj g|= 1.89829D-03

At iterate 30 f= 1.13750D+00 |proj g|= 1.69538D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
---	-----	-----	-------	------	------	-------	---

```
5      30      35      1      0      0      1.695D-06      1.137D+00
F =    1.1374962846324492
```

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28756D+00 |proj g|= 3.13093D-01

This problem is unconstrained.

At iterate 5 f= 1.21614D+00 |proj g|= 7.49748D-02

At iterate 10 f= 1.14851D+00 |proj g|= 6.35644D-02

At iterate 15 f= 1.13727D+00 |proj g|= 7.59155D-03

At iterate 20 f= 1.13715D+00 |proj g|= 4.48639D-05

At iterate 25 f= 1.13715D+00 |proj g|= 1.22004D-03

At iterate 30 f= 1.13715D+00 |proj g|= 4.14468D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

```
N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
5      31      35      1      0      0      1.531D-05      1.137D+00
F =    1.1371455881140013
```

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28753D+00 |proj g|= 3.13796D-01

At iterate 5 f= 1.21591D+00 |proj g|= 7.49796D-02

At iterate 10 f= 1.14787D+00 |proj g|= 5.70718D-02

At iterate 15 f= 1.13690D+00 |proj g|= 6.44685D-03

At iterate 20 f= 1.13680D+00 |proj g|= 3.99825D-05

At iterate 25 f= 1.13680D+00 |proj g|= 1.04753D-03

At iterate 30 f= 1.13679D+00 |proj g|= 6.23299D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	34	1	0	0	6.233D-06	1.137D+00
F =	1.1367937313828955						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28723D+00 |proj g|= 3.14016D-01

At iterate 5 f= 1.21563D+00 |proj g|= 7.50306D-02

This problem is unconstrained.

At iterate 10 f= 1.14737D+00 |proj g|= 5.69084D-02

At iterate 15 f= 1.13660D+00 |proj g|= 7.11065D-03

At iterate 20 f= 1.13649D+00 |proj g|= 5.04598D-05

At iterate 25 f= 1.13648D+00 |proj g|= 8.74043D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	34	1	0	0	6.237D-07	1.136D+00
F = 1.1364839504461997							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28700D+00 |proj g|= 3.14105D-01

This problem is unconstrained.

At iterate 5 f= 1.21545D+00 |proj g|= 7.49617D-02

At iterate 10 f= 1.14698D+00 |proj g|= 5.48872D-02

At iterate 15 f= 1.13624D+00 |proj g|= 5.81858D-03

At iterate 20 f= 1.13613D+00 |proj g|= 3.49639D-05

At iterate 25 f= 1.13613D+00 |proj g|= 6.16146D-04

At iterate 30 f= 1.13613D+00 |proj g|= 1.31559D-04

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	32	37	1	0	0	2.492D-05	1.136D+00
F = 1.1361323674340646							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28683D+00 |proj g|= 3.14155D-01

This problem is unconstrained.

At iterate 5 f= 1.21536D+00 |proj g|= 7.45846D-02

At iterate 10 f= 1.14698D+00 |proj g|= 5.61763D-02

At iterate 15 f= 1.13609D+00 |proj g|= 6.33957D-03

At iterate 20 f= 1.13598D+00 |proj g|= 3.65948D-05

At iterate 25 f= 1.13598D+00 |proj g|= 3.30640D-05

At iterate 30 f= 1.13598D+00 |proj g|= 8.66832D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	33	42	1	0	0	1.005D-05	1.136D+00
F = 1.1359800180878843							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28663D+00 |proj g|= 3.14487D-01

At iterate 5 f= 1.21509D+00 |proj g|= 7.44303D-02

At iterate 10 f= 1.14665D+00 |proj g|= 5.40906D-02

At iterate 15 f= 1.13578D+00 |proj g|= 5.50749D-03

At iterate 20 f= 1.13568D+00 |proj g|= 2.21711D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	2.217D-05	1.136D+00
F = 1.1356760553056586							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28653D+00 |proj g|= 3.14612D-01

This problem is unconstrained.

At iterate 5 f= 1.21491D+00 |proj g|= 7.38495D-02

At iterate 10 f= 1.14645D+00 |proj g|= 5.46989D-02

At iterate 15 f= 1.13543D+00 |proj g|= 5.46818D-03

At iterate 20 f= 1.13532D+00 |proj g|= 2.86149D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	2.861D-05	1.135D+00
F = 1.1353228045978667							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28636D+00 |proj g|= 3.14874D-01



```

At iterate    5    f=  1.21484D+00    |proj g|=  7.36478D-02
At iterate   10    f=  1.14589D+00    |proj g|=  5.01719D-02
At iterate   15    f=  1.13508D+00    |proj g|=  1.08324D-02
At iterate   20    f=  1.13498D+00    |proj g|=  1.12364D-05

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

```

* * *

```

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.222D-05	1.135D+00

F = 1.1349784830552057

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

```

* * *

```

```

Machine precision = 2.220D-16
N =                5      M =                10

```

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28647D+00    |proj g|=  3.14361D-01
At iterate    5    f=  1.21503D+00    |proj g|=  7.37187D-02
At iterate   10    f=  1.14592D+00    |proj g|=  5.33322D-02
At iterate   15    f=  1.13479D+00    |proj g|=  8.16805D-03
At iterate   20    f=  1.13470D+00    |proj g|=  1.27096D-05

```

```

* * *

```

```

Tit   = total number of iterations
Tnf   = total number of function evaluations

```

Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	25	1	0	0	9.781D-06	1.135D+00
F = 1.1346995647455507							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28669D+00 |proj g|= 3.13981D-01

At iterate 5 f= 1.21511D+00 |proj g|= 7.41178D-02

At iterate 10 f= 1.14563D+00 |proj g|= 5.18325D-02

At iterate 15 f= 1.13456D+00 |proj g|= 2.03509D-02

At iterate 20 f= 1.13441D+00 |proj g|= 1.14009D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	20	23	1	0	0	1.140D-05	1.134D+00
F = 1.1344118306934277							

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28632D+00 |proj g|= 3.14204D-01

At iterate 5 f= 1.21474D+00 |proj g|= 7.39925D-02

At iterate 10 f= 1.14539D+00 |proj g|= 5.31041D-02

At iterate 15 f= 1.13421D+00 |proj g|= 1.16148D-02

At iterate 20 f= 1.13410D+00 |proj g|= 5.55729D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	9.965D-06	1.134D+00

F = 1.1341023552512071

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

```

At iterate    0    f=  1.28671D+00    |proj g|=  3.14572D-01
At iterate    5    f=  1.21486D+00    |proj g|=  7.40425D-02
At iterate   10    f=  1.14523D+00    |proj g|=  5.20772D-02
At iterate   15    f=  1.13404D+00    |proj g|=  2.78311D-02
At iterate   20    f=  1.13384D+00    |proj g|=  1.34833D-05

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.167D-05	1.134D+00

F = 1.1338411211668953

```

CONVERGENCE: REL_REDUCTION_OF_F_<=_FACTR*EPSMCH
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0    f=  1.28640D+00    |proj g|=  3.14746D-01

```

```

This problem is unconstrained.

```

```

At iterate    5    f=  1.21454D+00    |proj g|=  7.38774D-02
At iterate   10    f=  1.14502D+00    |proj g|=  5.22630D-02
At iterate   15    f=  1.13374D+00    |proj g|=  2.68405D-02
At iterate   20    f=  1.13355D+00    |proj g|=  2.02274D-05

```

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	1.945D-05	1.134D+00

F = 1.1335496597747907

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28608D+00 |proj g|= 3.14877D-01

At iterate 5 f= 1.21426D+00 |proj g|= 7.36547D-02

At iterate 10 f= 1.14486D+00 |proj g|= 5.43446D-02

At iterate 15 f= 1.13333D+00 |proj g|= 1.53145D-02

At iterate 20 f= 1.13320D+00 |proj g|= 3.28297D-05

\* \* \*

Tit = total number of iterations  
 Tnf = total number of function evaluations  
 Tnint = total number of segments explored during Cauchy searches  
 Skip = number of BFGS updates skipped  
 Nact = number of active bounds at final generalized Cauchy point  
 Projg = norm of the final projected gradient  
 F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	21	24	1	0	0	5.926D-05	1.133D+00

F = 1.1332000567381098

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28572D+00 |proj g|= 3.15023D-01

This problem is unconstrained.

At iterate 5 f= 1.21393D+00 |proj g|= 7.34931D-02

At iterate 10 f= 1.14459D+00 |proj g|= 5.47619D-02

At iterate 15 f= 1.13301D+00 |proj g|= 1.32205D-02

At iterate 20 f= 1.13289D+00 |proj g|= 3.26478D-05

At iterate 25 f= 1.13289D+00 |proj g|= 8.91041D-04

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	33	1	0	0	8.228D-06	1.133D+00
F =	1.1328938824634991						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.28578D+00      |proj g|= 3.14558D-01

This problem is unconstrained.

At iterate    5      f= 1.21436D+00      |proj g|= 7.33050D-02

At iterate    10     f= 1.14470D+00      |proj g|= 5.37036D-02

At iterate    15     f= 1.13310D+00      |proj g|= 2.16149D-02

At iterate    20     f= 1.13294D+00      |proj g|= 7.81419D-05

At iterate    25     f= 1.13294D+00      |proj g|= 1.24133D-03

At iterate    30     f= 1.13294D+00      |proj g|= 8.39759D-06

\* \* \*

Tit    = total number of iterations

Tnf    = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip   = number of BFGS updates skipped

Nact   = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F      = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	8.398D-06	1.133D+00
F =	1.1329399240972922						

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N =            5      M =            10

At X0            0 variables are exactly at the bounds

At iterate    0      f= 1.28639D+00      |proj g|= 3.15068D-01

At iterate    5      f= 1.21520D+00      |proj g|= 7.26382D-02

```

At iterate   10      f=  1.14517D+00      |proj g|=  4.90412D-02
At iterate   15      f=  1.13385D+00      |proj g|=  1.09696D-02
At iterate   20      f=  1.13366D+00      |proj g|=  5.04857D-05
At iterate   25      f=  1.13366D+00      |proj g|=  7.08300D-04
At iterate   30      f=  1.13366D+00      |proj g|=  9.63147D-06

```

\* \* \*

```

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

```

\* \* \*

```

  N      Tit      Tnf  Tnint  Skip  Nact      Projg      F
   5      30      36     1     0     0     9.631D-06  1.134D+00
F =  1.1336592177039613

```

```

CONVERGENCE: NORM_OF_PROJECTED_GRADIENT_<=_PGTOL
RUNNING THE L-BFGS-B CODE

```

\* \* \*

```

Machine precision = 2.220D-16
N =                5      M =                10

```

```

At X0          0 variables are exactly at the bounds

```

```

At iterate    0      f=  1.28667D+00      |proj g|=  3.14434D-01

```

```

  This problem is unconstrained.

```

```

At iterate    5      f=  1.21604D+00      |proj g|=  7.24315D-02
At iterate   10      f=  1.14486D+00      |proj g|=  4.00751D-02
At iterate   15      f=  1.13395D+00      |proj g|=  7.95766D-03
At iterate   20      f=  1.13378D+00      |proj g|=  5.11935D-05
At iterate   25      f=  1.13378D+00      |proj g|=  6.99901D-04

```



At iterate 30 f= 1.13378D+00 |proj g|= 1.46872D-05

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped  
Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	31	39	1	0	0	1.397D-05	1.134D+00
F =	1.1337796842397876						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH  
RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16  
N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28701D+00 |proj g|= 3.13404D-01

This problem is unconstrained.

At iterate 5 f= 1.21597D+00 |proj g|= 7.42589D-02

At iterate 10 f= 1.14415D+00 |proj g|= 3.74540D-02

At iterate 15 f= 1.13363D+00 |proj g|= 8.24016D-03

At iterate 20 f= 1.13346D+00 |proj g|= 2.14864D-04

At iterate 25 f= 1.13345D+00 |proj g|= 8.61338D-04

At iterate 30 f= 1.13345D+00 |proj g|= 4.28579D-06

\* \* \*

Tit = total number of iterations  
Tnf = total number of function evaluations  
Tnint = total number of segments explored during Cauchy searches  
Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point  
Projg = norm of the final projected gradient  
F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	4.286D-06	1.133D+00
F = 1.1334512655932110							

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28681D+00 |proj g|= 3.13247D-01

At iterate 5 f= 1.21587D+00 |proj g|= 7.44902D-02

At iterate 10 f= 1.14365D+00 |proj g|= 3.78070D-02

At iterate 15 f= 1.13334D+00 |proj g|= 8.21662D-03

At iterate 20 f= 1.13317D+00 |proj g|= 1.67997D-04

At iterate 25 f= 1.13317D+00 |proj g|= 8.65984D-04

At iterate 30 f= 1.13317D+00 |proj g|= 6.89795D-06

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	35	1	0	0	6.898D-06	1.133D+00

F = 1.1331662696705627

CONVERGENCE: NORM\_OF\_PROJECTED\_GRADIENT\_<=\_PGTOL

This problem is unconstrained.

RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28658D+00 |proj g|= 3.13648D-01

At iterate 5 f= 1.21546D+00 |proj g|= 7.45003D-02

At iterate 10 f= 1.14329D+00 |proj g|= 3.80136D-02

At iterate 15 f= 1.13306D+00 |proj g|= 8.00470D-03

At iterate 20 f= 1.13291D+00 |proj g|= 7.41896D-05

At iterate 25 f= 1.13291D+00 |proj g|= 4.95157D-04

At iterate 30 f= 1.13290D+00 |proj g|= 1.77917D-05

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

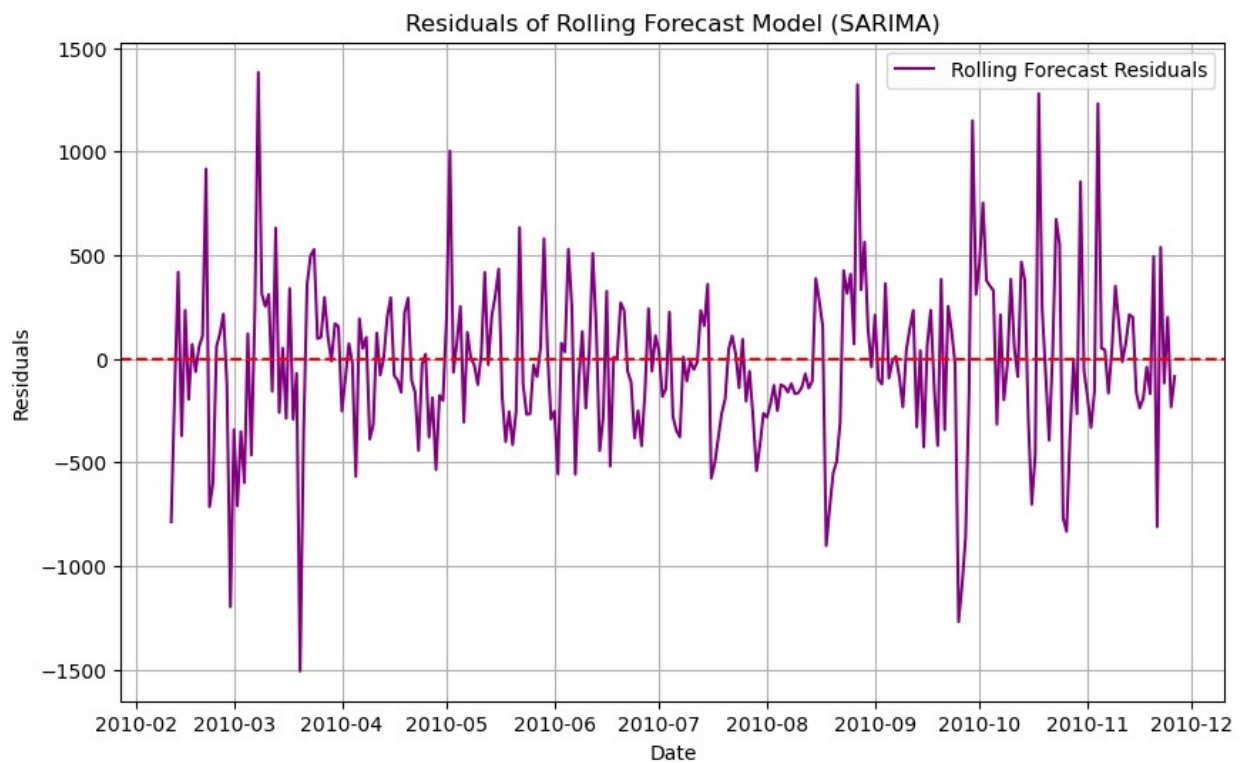
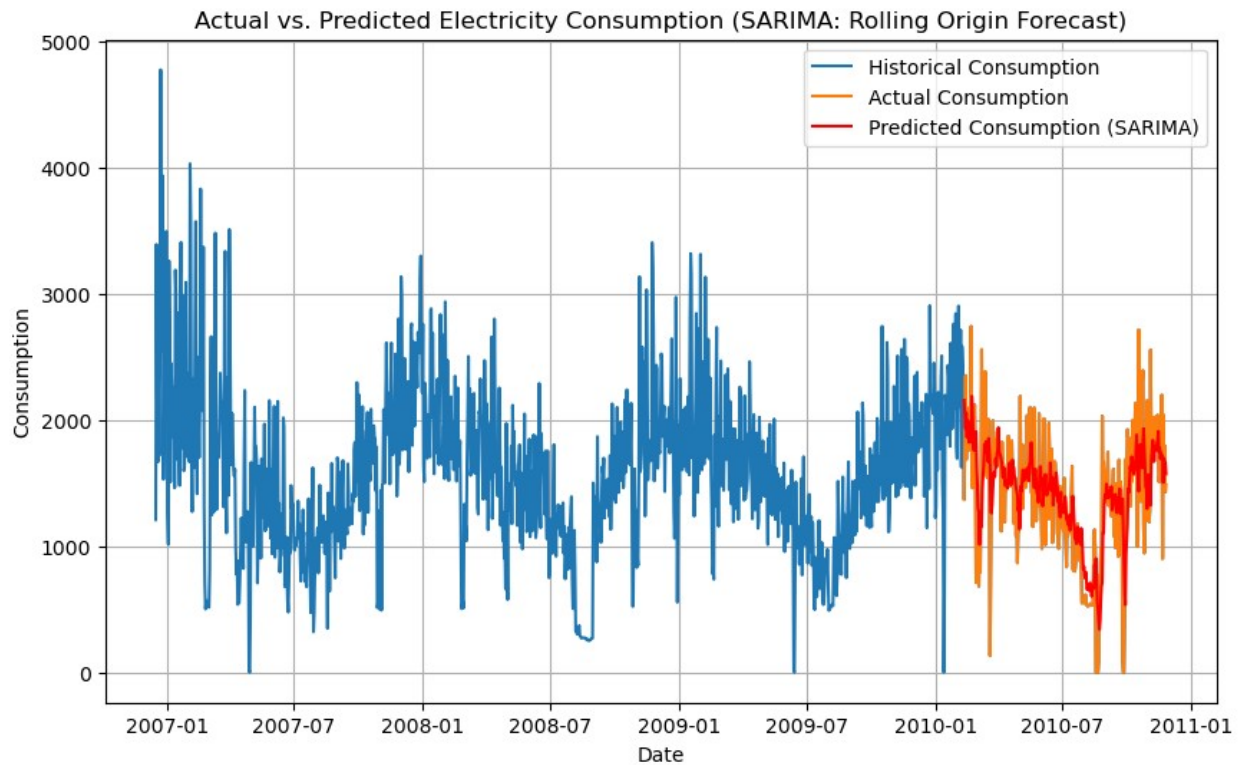
\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	30	39	1	0	0	1.779D-05	1.133D+00
F =	1.1329039776846224						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

SARIMA Metrics (Rolling Origin Forecast):

MAE: 285.956337189875, MSE: 152667.62940613672, RMSE:  
390.7270523090726



RUNNING THE L-BFGS-B CODE

\* \* \*

Machine precision = 2.220D-16

N = 5 M = 10

At X0 0 variables are exactly at the bounds

At iterate 0 f= 1.28624D+00 |proj g|= 3.13902D-01

This problem is unconstrained.

At iterate 5 f= 1.21514D+00 |proj g|= 7.44001D-02

At iterate 10 f= 1.14291D+00 |proj g|= 3.80976D-02

At iterate 15 f= 1.13271D+00 |proj g|= 7.67568D-03

At iterate 20 f= 1.13257D+00 |proj g|= 6.10319D-05

At iterate 25 f= 1.13257D+00 |proj g|= 1.55988D-03

\* \* \*

Tit = total number of iterations

Tnf = total number of function evaluations

Tnint = total number of segments explored during Cauchy searches

Skip = number of BFGS updates skipped

Nact = number of active bounds at final generalized Cauchy point

Projg = norm of the final projected gradient

F = final function value

\* \* \*

N	Tit	Tnf	Tnint	Skip	Nact	Projg	F
5	29	36	1	0	0	2.112D-05	1.133D+00
F =	1.1325654198127071						

CONVERGENCE: REL\_REDUCTION\_OF\_F\_<=\_FACTR\*EPSMCH

