```
# for reps in range(runs):
    # 開始計時 & 初始化參數
    # 規劃第一個 Dispatch 的時間
    # 建立 F 個 Bus Entity，然後放入 Depot (FIFOQueue)
    # while True:
    #     NextEvent = getNextEvent(Calendar)
    #     Clock = NextEvent.EventTime
    #     if NextEvent.EventType == "Dispatch":
    #         Dispatch()
    #     elif NextEvent.EventType == "Return":
    #         Return()
    #     elif NextEvent.EventType == "Refueled":
    #         Refueled()
    #     elif NextEvent.EventType == "EndSimulation":
    #         break
```

```
# def Dispatch():
    # if Depot 內的 Bus 數為 0:
        # 新增一個計時器，並將計時器放入 Delay 隊列 (FIFOQueue)
    # else:
        # Delay Time 紀錄為 0
        # 將 Bus 從 Depot (FIFOQueue) 移動到 Running (FIFOQueue)
        # 規劃 Return 的時間
        # 已出發班次 + 1
        # if 已出發班次 == 應出發班次 (N):
            # "EndSimulation"
    # 規劃下一個 Dispatch 的時間
```

```
# Depot, Running, Refuel, Delay = FIFOQueue()
# FuelDispenser = Resource()
# DelayTime, DispatchedNum = DTStat()
```

```
# def Return():
    # 將 Bus 從 Running (FIFOQueue) 移動到 Refuel (FIFOQueue)
    # if Fuel Dispenser 空閒:
        # Fuel Dispenser 標記為忙碌
        # 規劃 Refueled 的時間
```

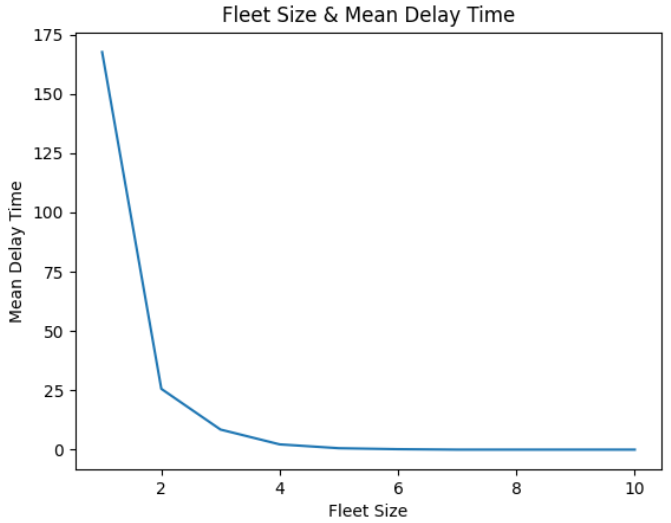
```
# def Refueled():
    # 將 Bus 移出 Refuel (FIFOQueue)

    # if Delay 隊列 (FIFOQueue) > 0:
        # 移出計時器，並記錄 Delay Time
        # 將 Bus 移入 Running (FIFOQueue)
        # 規劃 Return 的時間
        # 已出發班次 + 1
        # if 已出發班次 == 應出發班次 (N):
            # "EndSimulation"
    # else:
        # 將 Bus 移入 Dispatch (FIFOQueue)

    # if Refuel (FIFOQueue) > 0:
        # 規劃下一台車 Refueled 的時間
    # else:
        # Fuel Dispenser 標記為空閒
```

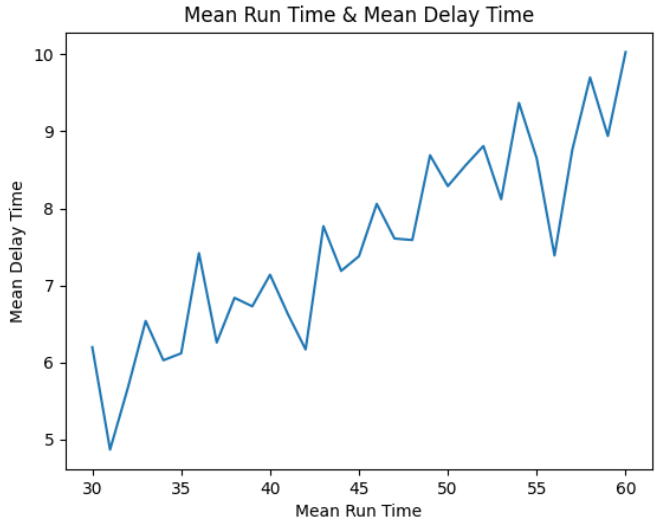
1. Plot the curve of average delay vs bus fleet size (F).
2. Plot the curve of average delay vs running time mean (R).
3. Plot the curve of average delay vs running time variance (V).
4. Plot the curve of average delay vs refueling (G).

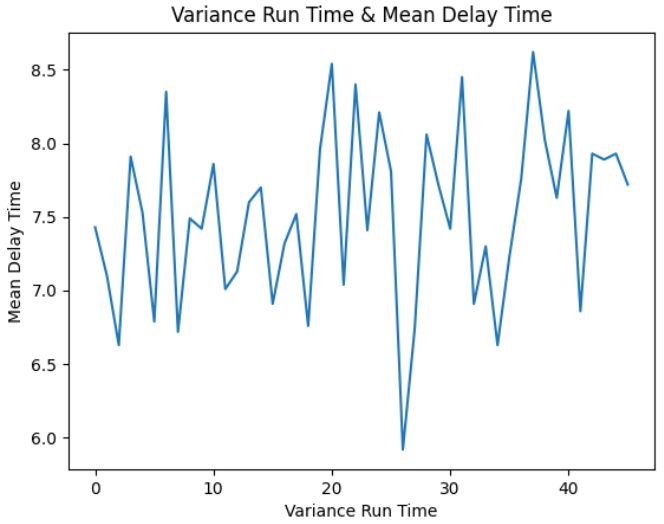
調整依據：

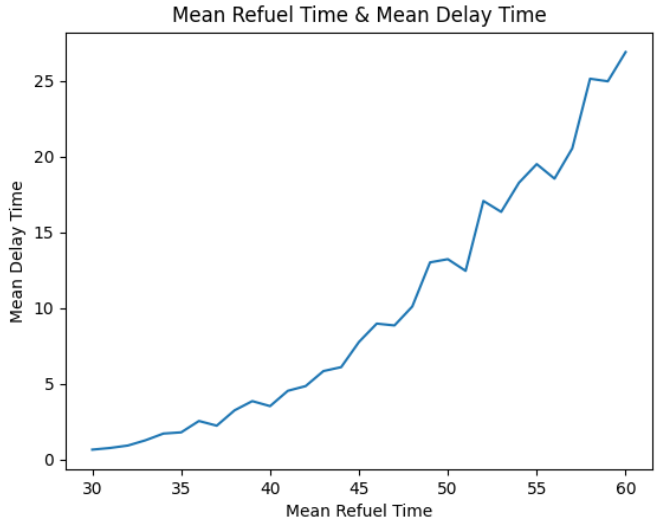
```
##########parameters###########
StartClock = 0.0
DispatchTotal = 12      # N
Headway = 60            # H
FleetSize = 3           # F
MeanRunTime = 45        # R
VarianceRunTime = 5     # V
MeanRefuel = 45         # G
################################
```

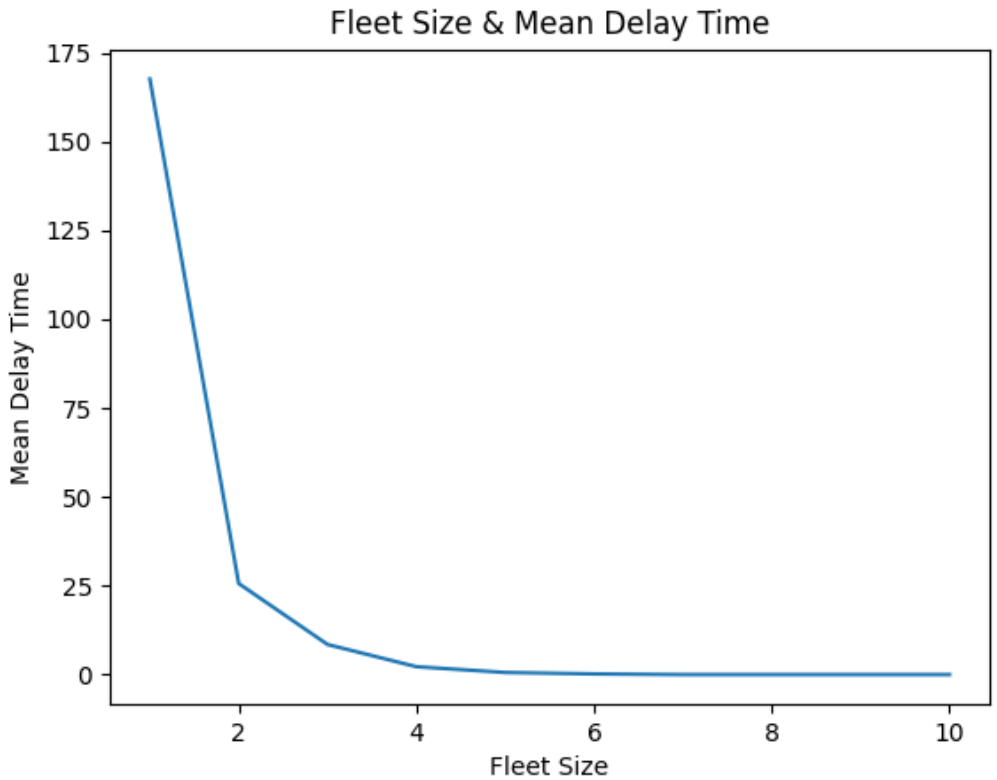
Y軸的值皆為模擬1000次後取平均



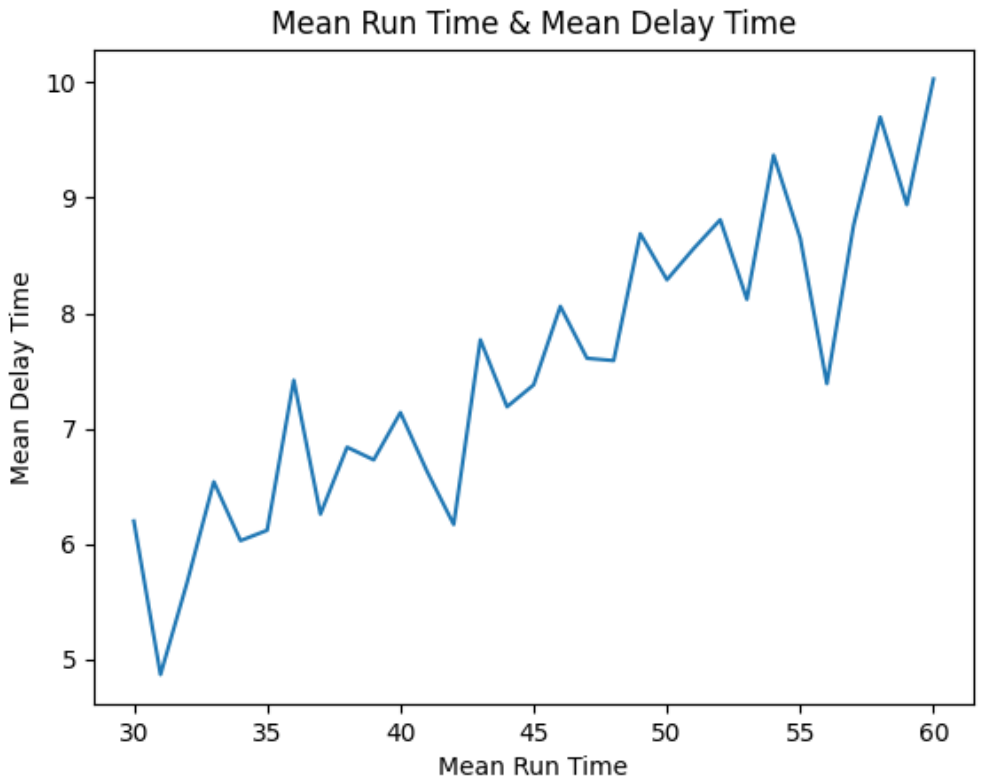




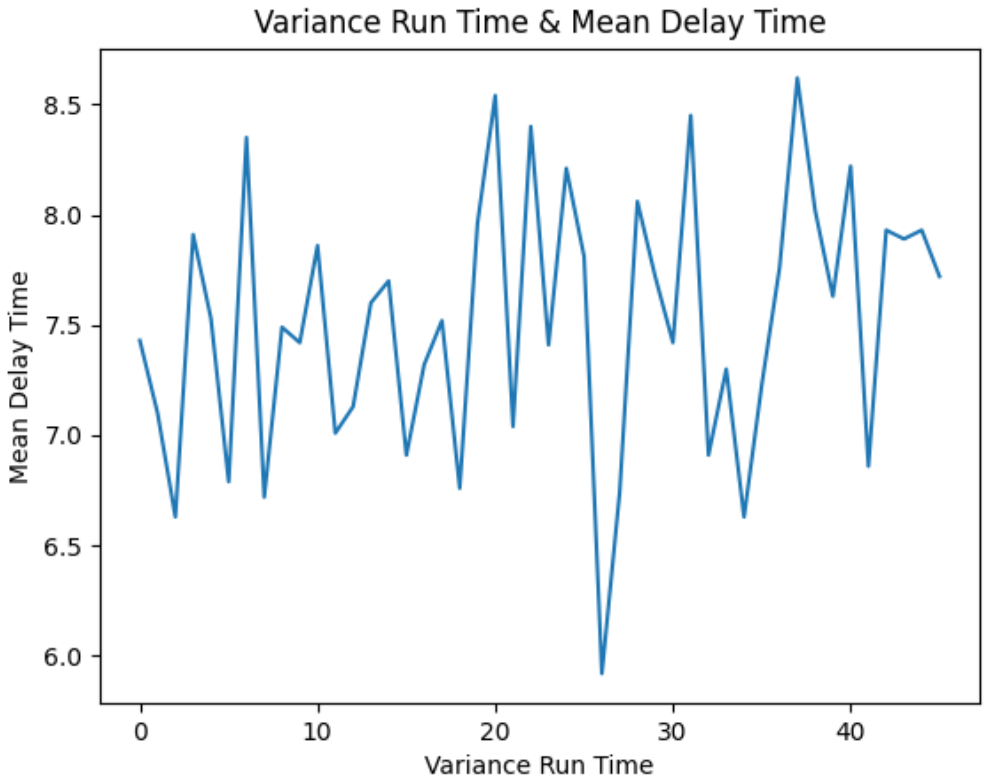




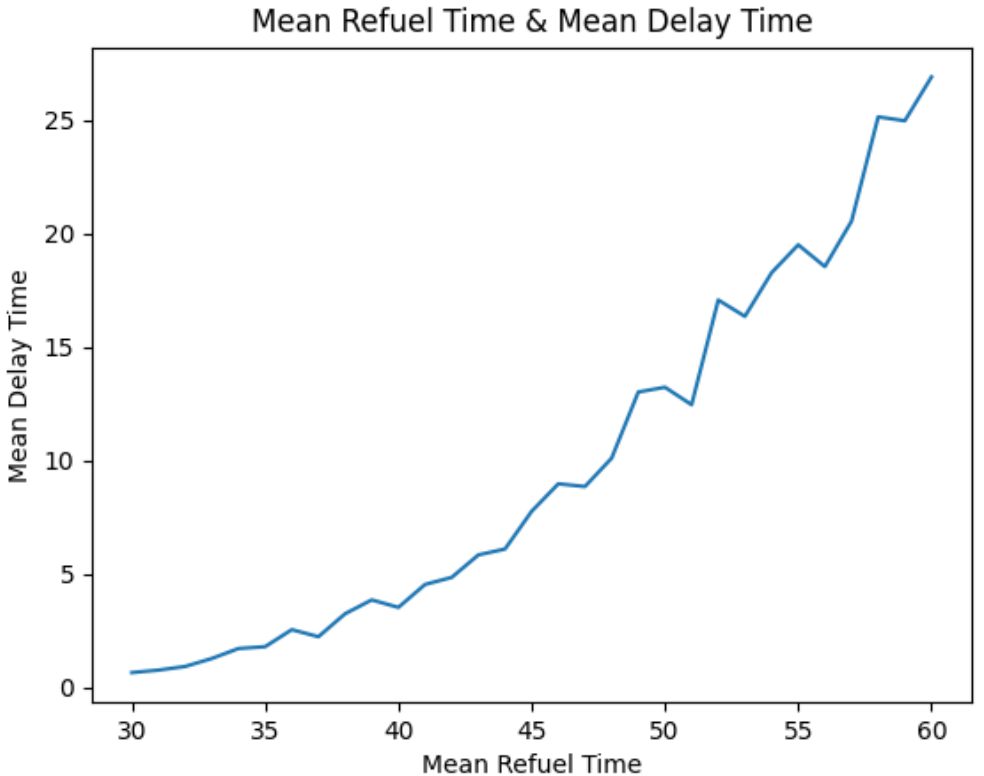
影響最大，但車隊數超過一定的值後即不再影響



影響較小，但仍呈現正相關性



沒有特別明顯的影響



影響力次之，且呈現明顯的正相關性

5. Pick a set of parameters (H, N, R, V, F, G) and estimate the average delay and its 95% upper confidence bound.

```
Z = 1.96
delayMean = round(np.mean(delay_record),2)
delayStd  = round(np.std(delay_record, ddof = 1),2)
```

```
##########parameters###########
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 45       # R
VarianceRunTime = 5    # V
MeanRefuel = 45        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 7.39
Std  of estimate delay time: 18.92
95% confidence interval: [6.22, 8.56]
```

```
##########parameters###########
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 5          # F
MeanRunTime = 45       # R
VarianceRunTime = 5    # V
MeanRefuel = 45        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 0.57
Std  of estimate delay time: 4.31
95% confidence interval: [0.3, 0.84]
```

6. Find the minimum fleet size such that the **average total delay** is less than N time units (equivalently, **average average delay** is less than 1). (Think about Problem 5 when you answer the question.)

Q：延滯時間是否會隨著H、R、G改變而成正比改變

A：看起來會，推測是因為延滯時間跟（R+G-H）有著較大的關係

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 20           # H
FleetSize = 3          # F
MeanRunTime = 15       # R
VarianceRunTime = 5    # V
MeanRefuel = 15        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 2.45
Std  of estimate delay time: 6.57
95% confidence interval: [2.04, 2.86]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 40           # H
FleetSize = 3          # F
MeanRunTime = 30       # R
VarianceRunTime = 5    # V
MeanRefuel = 30        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 4.94
Std  of estimate delay time: 12.62
95% confidence interval: [4.16, 5.72]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 45       # R
VarianceRunTime = 5    # V
MeanRefuel = 45        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 7.39
Std  of estimate delay time: 18.92
95% confidence interval: [6.22, 8.56]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 80           # H
FleetSize = 3          # F
MeanRunTime = 60       # R
VarianceRunTime = 5    # V
MeanRefuel = 60        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 9.85
Std  of estimate delay time: 25.05
95% confidence interval: [8.3, 11.4]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 180          # H
FleetSize = 3          # F
MeanRunTime = 135      # R
VarianceRunTime = 5    # V
MeanRefuel = 135       # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 22.35
Std  of estimate delay time: 57.1
95% confidence interval: [18.81, 25.89]
```

Q：那能直接用（R+G-H）
去推估延滯時間嗎

A：看來是不行。而在固定H的情況下，似乎也看不到特別的規律 QQ

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 35       # R
VarianceRunTime = 5    # V
MeanRefuel = 35        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 1.3
Std  of estimate delay time: 6.24
95% confidence interval: [0.91, 1.69]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 40       # R
VarianceRunTime = 5    # V
MeanRefuel = 40        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 3.34
Std  of estimate delay time: 10.78
95% confidence interval: [2.67, 4.01]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 45       # R
VarianceRunTime = 5    # V
MeanRefuel = 45        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 7.39
Std  of estimate delay time: 18.92
95% confidence interval: [6.22, 8.56]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 50       # R
VarianceRunTime = 5    # V
MeanRefuel = 50        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 13.7
Std  of estimate delay time: 28.69
95% confidence interval: [11.92, 15.48]
```

```
##########parameters############
StartClock = 0.0
DispatchTotal = 12     # N
Headway = 60           # H
FleetSize = 3          # F
MeanRunTime = 55       # R
VarianceRunTime = 5    # V
MeanRefuel = 55        # G
################################
```

```
Runs: 1000
Mean of estimate delay time: 23.16
Std  of estimate delay time: 40.44
95% confidence interval: [20.65, 25.67]
```