

Strategy Estimation for Las Vegas GP 2023

```
% Tyres available: C3, C4, C5 - The 3 softest in the Pirelli range.  
% Race Duration: 50 laps (305.88km total distance)  
  
% Assumption of initial tyre pace delta: 0.5s between C5 and C4, and 0.5s  
% between C4 and C3. With C5 being the fastest.  
  
% Assumption of degradation per lap: Fuel corrected laptime increase  
% non-linearly as tyre wears (non-linear tyre deg model estimate)  
  
% Fuel correction assumption for 110kg of fuel to last 50 laps and 0.035s  
% laptime gain per 1kg of fuel burn.  
  
% Initial flying lap pace assumed due to lack of race historical data.
```

Calculating Fuel Correction Factor

```
fuelQuantity = 110; %kg  
totalLapNumber = 50; %laps  
lapNumber = 1:50;  
timePerKg = 0.035; %seconds  
  
fuelConsumption = fuelQuantity/totalLapNumber; %kg/lap  
  
fuelCorrectionFactor = fuelConsumption .* timePerKg; %seconds/lap  
  
fuelLapCorrections = fuelCorrectionFactor .* (lapNumber-1);
```

Defining Tyre Wear Factors

```
c5Wear = linspace(0.09,0.5,50);  
c4Wear = linspace(0.08,0.17,50);  
c3Wear = linspace(0.077,0.1,50);  
  
tyreAge = 1:50; %laps
```

Calculating Tyre Degradation Laptime Impact

```
c5InitialLaptime = 95; %seconds  
c4InitialLaptime = 95.7; %seconds  
c3InitialLaptime = 96.4; %seconds  
  
c5TyreDegLaptime = c5InitialLaptime + c5Wear .* (tyreAge-1);  
c4TyreDegLaptime = c4InitialLaptime + c4Wear .* (tyreAge-1);  
c3TyreDegLaptime = c3InitialLaptime + c3Wear .* (tyreAge-1);
```

Calculating Tyre and Fuel Effected Laptimes for Full Distance Tyre Model

```
c5Laptime = c5InitialLaptime + (c5Wear .* (tyreAge-1)) - fuelLapCorrections(lapNumber);
c4Laptime = c4InitialLaptime + (c4Wear .* (tyreAge-1)) - fuelLapCorrections(lapNumber);
c3Laptime = c3InitialLaptime + (c3Wear .* (tyreAge-1)) - fuelLapCorrections(lapNumber);
```

To determine fuel corrected laptimes for individual stints, the following formula is appropriate:

```
% Fuel_Corrected_Stint_Formula = TyreDegLaptime(tyreAge(1:end_of_stint)) - fuelLapCorrections(lapNumber);
```

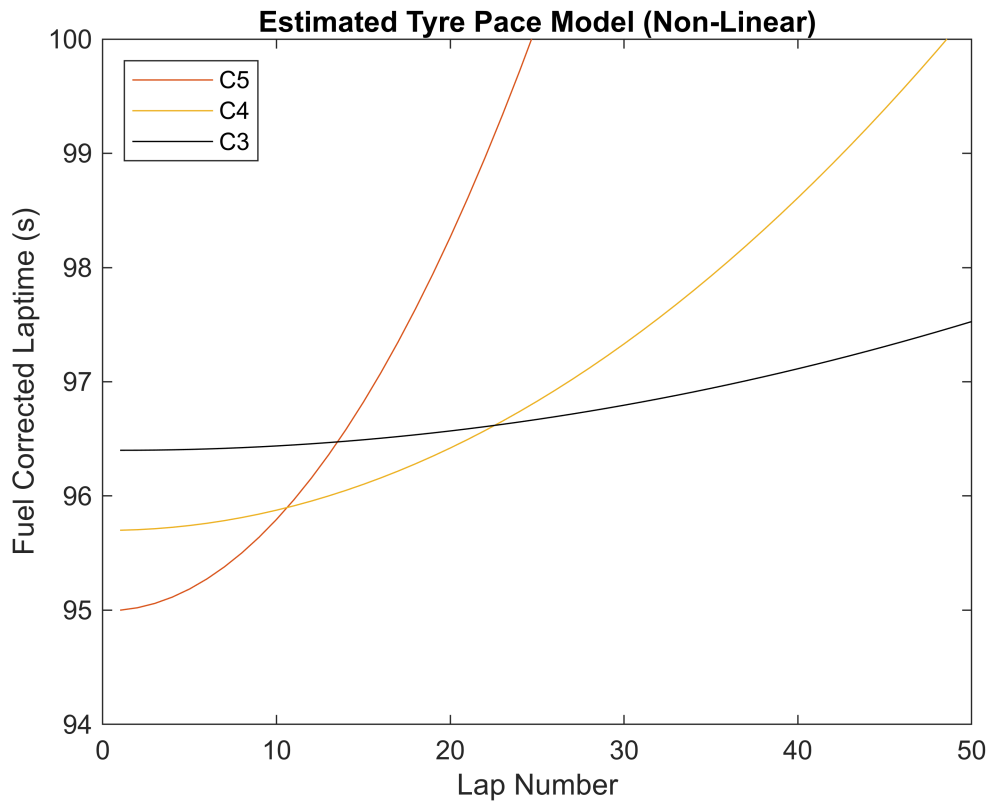
Defining Average Pit Time Loss

```
pitTime = 20; %seconds
```

Plot Laptimes for Tyre Compounds Over Full Distance.

This will be our estimated tyre model, from which we can devise strategy configurations and plot their corresponding race times.

```
plot(lapNumber,c5Laptime,"Color","#D95319")
hold on
plot(lapNumber,c4Laptime,"Color","#EDB120")
plot(lapNumber,c3Laptime,"Color","#000000")
ylim([94 100])
xlabel("Lap Number")
ylabel("Fuel Corrected Laptime (s)")
title("Estimated Tyre Pace Model (Non-Linear)")
legend(["C5" "C4" "C3"],"Location","northwest")
hold off
```

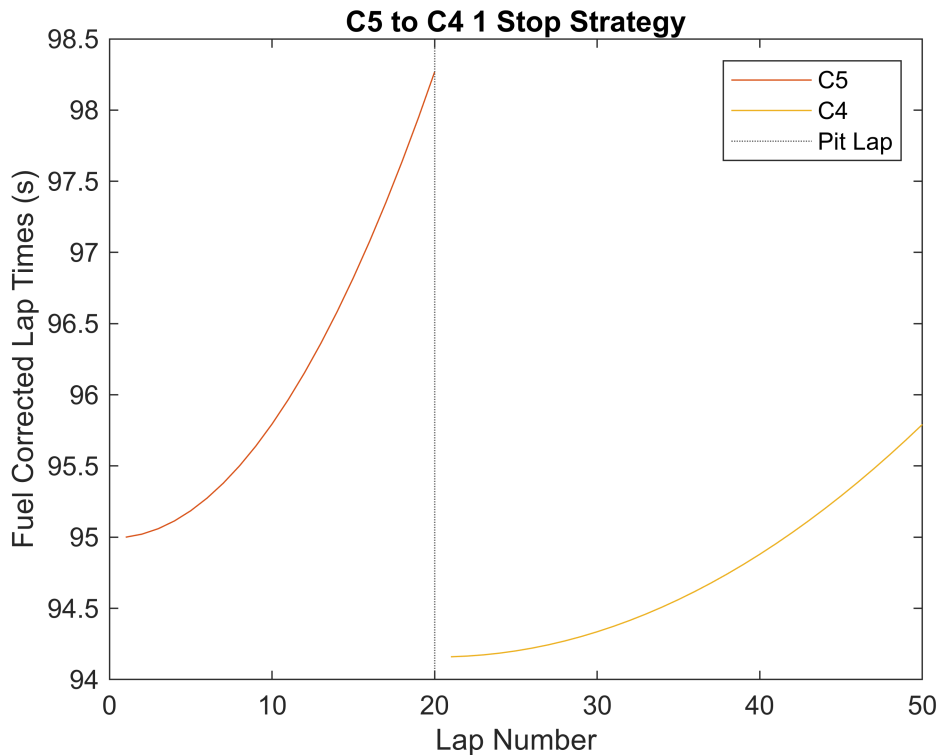


Consider a single stop strategy. C5 to C4 (Soft to Medium).

```
% Add slider to observe variable pitlap effects
pitLap = 20;

% Calculating fuel corrected stints
c5Fuel_Corrected_Stint = c5Laptime(tyreAge(1:pitLap));
c4Fuel_Corrected_Stint = c4TyreDegLaptime(tyreAge(1:(50-pitLap))) - fuelLapCorrections(lapNumber(1:(50-pitLap)));

% Plotting lap times
plot(lapNumber(1:pitLap), c5Fuel_Corrected_Stint,"Color","#D95319")
hold on
plot(lapNumber(pitLap+1:50), c4Fuel_Corrected_Stint,"Color","#EDB120")
xline(pitLap,":")
xlabel("Lap Number")
ylabel("Fuel Corrected Lap Times (s)")
title("C5 to C4 1 Stop Strategy")
legend(["C5" "C4" "Pit Lap"],"Location","northeast")
hold off
```



```
% Sum fuel corrected stint times with the pit stop time to determine
% overall race time.
```

```
totalRaceTimeC5C4_sec = seconds(sum(c5Fuel_Corrected_Stint) + sum(c4Fuel_Corrected_Stint) + pitLapTime)
```

```
totalRaceTimeC5C4_sec = duration
4785 sec
```

```
totalRaceTimeC5C4_min = minutes(minutes(totalRaceTimeC5C4_sec))
```

```
totalRaceTimeC5C4_min = duration
79.749 min
```

Consider a single stop strategy, C5 to C3 (Soft to Hard).

```
% Add slider to observe variable pitlap effects
```

```
pitLap = 18;
```

```
% Calculating fuel corrected stints
```

```
c5Fuel_Corrected_Stint = c5Laptime(tyreAge(1:pitLap));
```

```
c3Fuel_Corrected_Stint = c3TyreDegLaptime(tyreAge(1:(50-pitLap))) - fuelLapCorrections(lapNumber)
```

```
% Plotting lap times
```

```
plot(lapNumber(1:pitLap), c5Fuel_Corrected_Stint,"Color","#D95319")
```

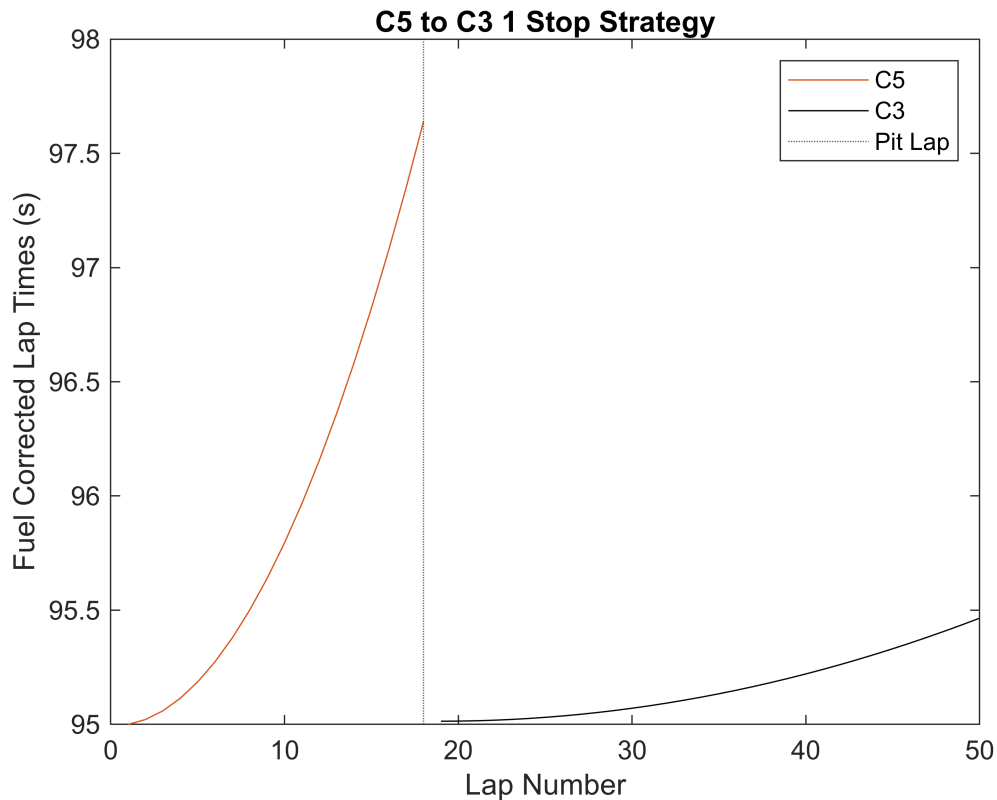
```
hold on
```

```
plot(lapNumber(pitLap+1:50), c3Fuel_Corrected_Stint,"Color","#000000")
```

```
xline(pitLap,":")
```

```
xlabel("Lap Number")
```

```
ylabel("Fuel Corrected Lap Times (s)")
title("C5 to C3 1 Stop Strategy")
legend(["C5" "C3" "Pit Lap"], "Location", "northeast")
hold off
```



```
% Sum fuel corrected stint times with the pit stop time to determine
% overall race time.
totalRaceTimeC5C3_sec = seconds(sum(c5Fuel_Corrected_Stint) + sum(c3Fuel_Corrected_Stint) + pitLapTime);

totalRaceTimeC5C3_sec = duration
    4792.3 sec
```

```
totalRaceTimeC5C3_min = minutes(minutes(totalRaceTimeC5C3_sec))
```

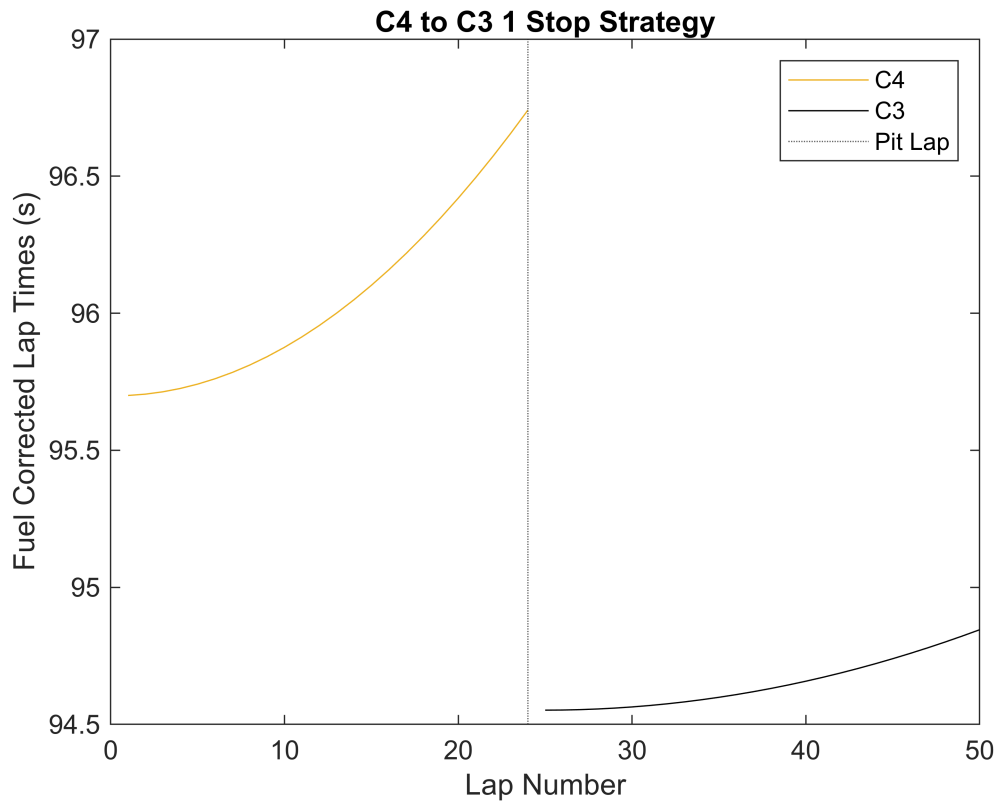
```
totalRaceTimeC5C3_min = duration
    79.871 min
```

Consider a single stop strategy. C4 to C3 (Medium to Hard).

```
% Add slider to observe variable pitlap effects
pitLap = 24;

% Calculating fuel corrected stints
c4Fuel_Corrected_Stint = c4Laptime(tyreAge(1:pitLap));
c3Fuel_Corrected_Stint = c3TyreDegLaptime(tyreAge(1:(50-pitLap))) - fuelLapCorrections(lapNumber, tyreAge(1:(50-pitLap)));
```

```
% Plotting lap times
plot(lapNumber(1:pitLap), c4Fuel_Corrected_Stint,"Color","#EDB120")
hold on
plot(lapNumber(pitLap+1:50), c3Fuel_Corrected_Stint,"Color","#000000")
xline(pitLap,":")
xlabel("Lap Number")
ylabel("Fuel Corrected Lap Times (s)")
title("C4 to C3 1 Stop Strategy")
legend(["C4" "C3" "Pit Lap"],"Location","northeast")
hold off
```



```
% Sum fuel corrected stint times with the pit stop time to determine
% overall race time.
totalRaceTimeC4C3_sec = seconds(sum(c4Fuel_Corrected_Stint) + sum(c3Fuel_Corrected_Stint) + pitLap)

totalRaceTimeC4C3_sec = duration
4786.5 sec
```

```
totalRaceTimeC4C3_min = minutes(minutes(totalRaceTimeC4C3_sec)) %minutes
```

```
totalRaceTimeC4C3_min = duration
79.775 min
```

Consider a 2 stop strategy. C5, C5, C4 (Soft, Soft, Medium).

```
% Add sliders to observe variable pitlap effects
```

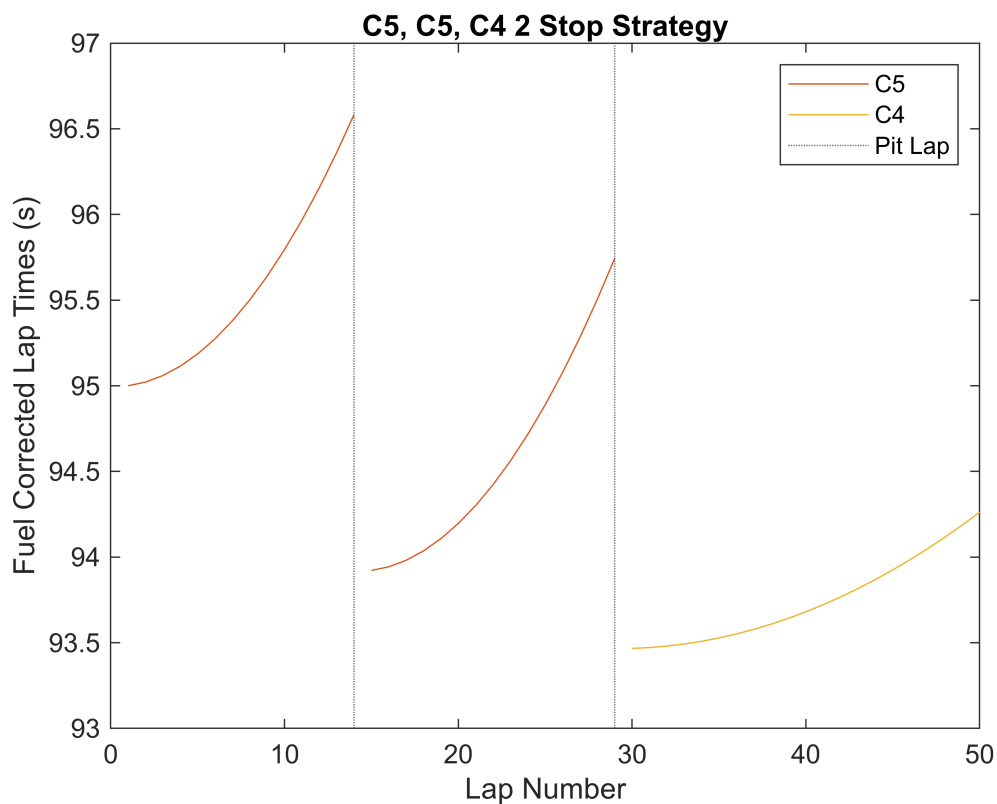
```

pitLap1 = 14;
pitLap2 = 29;

% Calculating fuel corrected stints
c5Fuel_Corrected_Stint1 = c5Laptime(tyreAge(1:pitLap1));
c5Fuel_Corrected_Stint2 = c5TyreDegLaptime(tyreAge(1:pitLap2-pitLap1)) - fuelLapCorrections(lapNumb
c4Fuel_Corrected_Stint = c4TyreDegLaptime(tyreAge(1:(50-pitLap2))) - fuelLapCorrections(lapNumb

% Plotting lap times
plot(lapNumber(1:pitLap1), c5Fuel_Corrected_Stint1,"Color","#D95319")
hold on
plot(lapNumber(pitLap1+1:pitLap2), c5Fuel_Corrected_Stint2,"Color","#D95319")
plot(lapNumber(pitLap2+1:50), c4Fuel_Corrected_Stint,"Color","#EDB120")
xline(pitLap1,":")
xline(pitLap2,":")
xlabel("Lap Number")
ylabel("Fuel Corrected Lap Times (s)")
title("C5, C5, C4 2 Stop Strategy")
legend(["C5" "" "C4" "Pit Lap" ""], "Location", "northeast")
hold off

```



```

% Sum fuel corrected stint times with the pit stop time to determine
% overall race time.
totalRaceTimeC5C5C4_sec = seconds(sum(c5Fuel_Corrected_Stint1) + sum(c5Fuel_Corrected_Stint2) -

totalRaceTimeC5C5C4_sec = duration

```

4765.4 sec

```
totalRaceTimeC5C5C4_min = minutes(minutes(totalRaceTimeC5C5C4_sec)) %minutes
```

```
totalRaceTimeC5C5C4_min = duration  
79.424 min
```

Consider a 2 stop strategy. C5, C4, C4 (Soft, Medium, Medium).

```
% Add sliders to observe variable pitlap effects
```

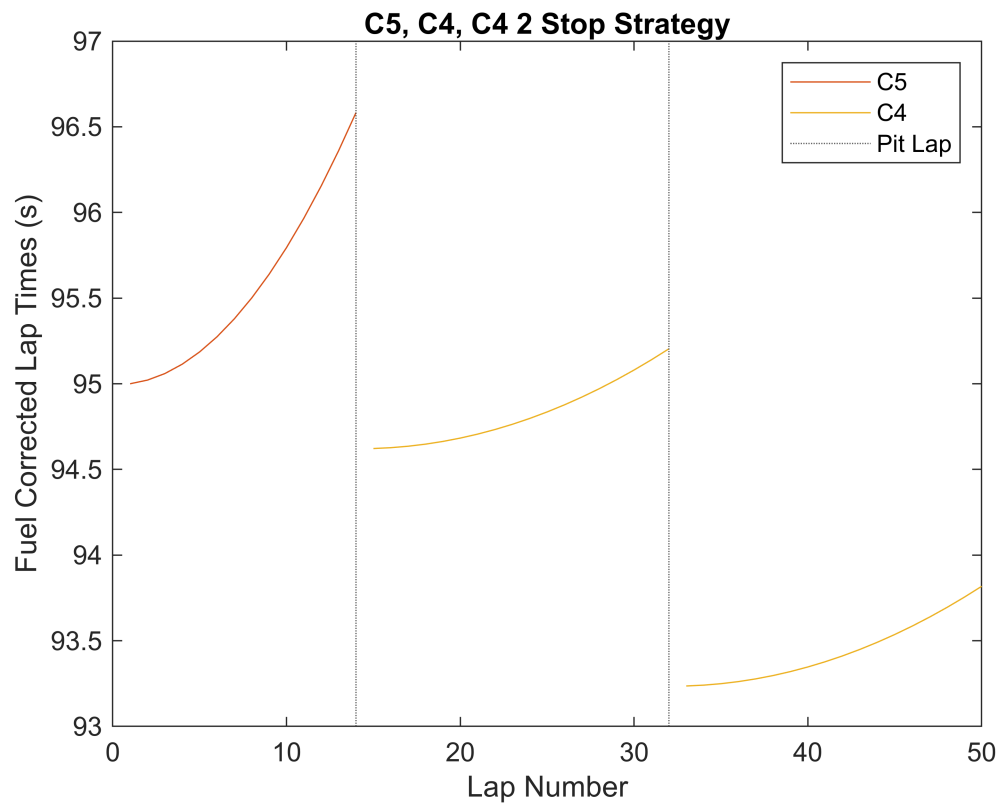
```
pitLap1 = 14;  
pitLap2 = 32;
```

```
% Calculating fuel corrected stints
```

```
c5Fuel_Corrected_Stint = c5Laptime(tyreAge(1:pitLap1));  
c4Fuel_Corrected_Stint1 = c4TyreDegLaptime(tyreAge(1:pitLap2-pitLap1)) - fuelLapCorrections(lapNumber(1:pitLap2-pitLap1));  
c4Fuel_Corrected_Stint2 = c4TyreDegLaptime(tyreAge(1:(50-pitLap2))) - fuelLapCorrections(lapNumber(1:(50-pitLap2)));
```

```
% Plotting lap times
```

```
plot(lapNumber(1:pitLap1), c5Fuel_Corrected_Stint, "Color", "#D95319")  
hold on  
plot(lapNumber(pitLap1+1:pitLap2), c4Fuel_Corrected_Stint1, "Color", "#EDB120")  
plot(lapNumber(pitLap2+1:50), c4Fuel_Corrected_Stint2, "Color", "#EDB120")  
xline(pitLap1, ":")  
xline(pitLap2, ":")  
xlabel("Lap Number")  
ylabel("Fuel Corrected Lap Times (s)")  
title("C5, C4, C4 2 Stop Strategy")  
legend(["C5" "C4" "" "Pit Lap" ""], "Location", "northeast")  
hold off
```

```
% Sum fuel corrected stint times with the pit stop time to determine
% overall race time.
```

```
totalRaceTimeC5C4C4_sec = seconds(sum(c5Fuel_Corrected_Stint) + sum(c4Fuel_Corrected_Stint1) +
```

```
totalRaceTimeC5C4C4_sec = duration
4767 sec
```

```
totalRaceTimeC5C4C4_min = minutes(minutes(totalRaceTimeC5C4C4_sec)) %minutes
```

```
totalRaceTimeC5C4C4_min = duration
79.449 min
```