Started on	Sunday, 17 August 2025, 12:12 PM
State	Finished
Completed on	Monday, 18 August 2025, 8:00 AM
Time taken	19 hours 47 mins
Grade	**13.00** out of 25.00 (**52**%)

Information

You are required to conduct a reliability analysis for a F1 race car. The components included in the analysis are:

- Front Suspension (FS)
- Front Right Brake (FRB)
- Front Left Brake (FLB)
- Back Suspension (BS)
- Back Right Brake (BRB)
- Back Left Brake (BLB)
- Gearbox (GB)
- Engine (EN)

According to the design specification a car is able to continue racing with only one front and one rear brake. The front brakes are connected to the front suspension and the back brakes to the back suspension. The car cannot further race if any of the suspensions, gearbox or engine experience failure.

Question 1

Correct

Mark 6.00 out of 6.00

Based on preliminary failure data analysis it has been determined that the failure behaviour of the race car components can be modelled as follows (in kilometers):

Front Suspension (FS)

$f_{FS}(\alpha_0;\alpha_1) = f_{FS}(-10.0096; 0.001399\ )$

Front Right Brake (FRB)

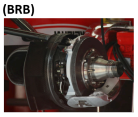
Front Left Brake (FLB)

$f_{FRB}(\beta;\eta) = f_{FLB}(\beta;\eta) = f(2.22; 1152)$

Back Suspension (BS)

$f_{BS}(\lambda,\delta) = f_{BS}(2.28E-07; 2.05686)$

Back Right Brake (BRB)



Back Left Brake (BLB)

$f_{BRB}(\beta;\eta) = f_{BLB}(\beta;\eta) = f(3.4; 630)$

Gearbox (GB)

$f_{GB}(\beta;\eta) = f_{GB}(2.14; 2795)$

Engine (EN)

$f_{EN}(\beta;\eta) = f_{EN}(3.82; 1458)$

Match the corresponding reliabilities for a 305 km race to the respective components. Assume all components are newly installed before the start of the race.

Gearbox (GB)	0.99131 ✔
Rear Brakes (BRB, BLB)	0.91861 ✔
Back Suspension (BS)	0.97106 ✔
Engine (EN)	0.99747 ✔
Front Brakes (FRB, FLB)	0.94902 ✔
Front Suspension (FS)	0.98304 ✔

Your answer is correct.

The correct answer is: Gearbox (GB) → 0.99131, Rear Brakes (BRB, BLB) → 0.91861, Back Suspension (BS) → 0.97106, Engine (EN) → 0.99747, Front Brakes (FRB, FLB) → 0.94902, Front Suspension (FS) → 0.98304

Question 2

Correct

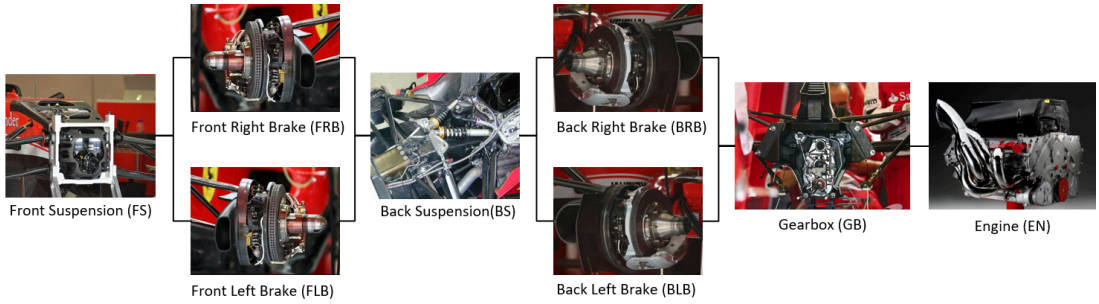
Mark 7.00 out of 7.00

What is the car system's reliability over a 305 km race? Round your calculations and final answer to 5 decimal places.

Select one:

- a. 0.98719
- b. 0.93521 ✔
- c. 0.97676
- d. 0.71736
- e. 0.98857
- f. 0.92926

Your answer is correct.



$R_S = R_{FS} \cdot 1-(1-R_{FRB})(1-R_{FLB}) \cdot R_{BS} \cdot 1-(1-R_{BRB})(1-R_{BLB}) \cdot R_{GB} \cdot R_{EN} = 0.93521$

The correct answer is: 0.93521

Question 3

Incorrect

Mark 0.00 out of 7.00

Assuming that all the components are brand new, for how many kilometers would the race car be able to race before it will breaks down for the first time? Assume infinity as 6000km. (Hint: Update your model to allow for x = 6000km) [Answer format: kilometres round to the nearest kilometre, e.g. 450]

Answer: 593 ✖

The next expected failure for both the rear brakes are 565.98km, which is the shortest driving distance compared to the next expected failures for the other components. Although the two rear brakes are connected in parallel, both have similar failure distributions are are therefore likely to failure short after each other when the 565.98km mark has been reached.

For this question your existing Excel model's x-range needs to be increased, since x=450 will result in a cut-off PDF. Update your model so that infinity is 6000. Also remember to update your lookup formulas, since your existing model's range will only go up to 450. If you get #N/A it means you are looking up a value of 6000 in a range that only goes up to 450.

The correct answer is: 565

Question 4

Incorrect

Mark 0.00 out of 5.00

Mechanics require 2 hours to repair a front suspension failure, while it takes 4 hours to repair a back suspension failure. What is the steady-state availability of the combination of the front and back suspensions for the F1 car over a 305km race (assuming that both suspensions are brand new at the start of the race)?

Select one:

- a. 0.999473
- b. 0.999615
- c. 0.999503
- d. 0.999948 ✖
- e. 0.999888

Your answer is incorrect.

$MTBF_{FS}=a_1*(305-0)/EXP(a_0+a_1*305)-EXP(a_0+a_1*0)$

$ROCOF_{FS}=1/MTBF_{FS}$

$mu_{FS}=1/2$

$A_{FS}=mu_{FS}/ROCOF_{FS}+mu_{FS}$

$MTBF_{BS}=305-0/lambda*(305^delta-0^delta)$

$ROCOF_{BS}=1/MTBF_{BS}$

$mu_{BS}=1/4$

$A_{BS}=mu_{BS}/ROCOF_{BS}+mu_{BS}$

$A_{FS,BS}=A_{FS}*A_{BS}$

The correct answer is: 0.999503

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