AE 481 Team 01: Assignment 1

September 4, 2025

1 Enrichment Questions

1.1 W_e/W_o average

The average empty weight to MTOW ratio is approximately 0.503.

1.2 W_e/W_o variance

The variance for the empty weight to MTOW ratio is approximately 0.005.

1.3 Features We Don't Understand

1. Inlet design
2. Supersonic airfoil design
3. Folding wing structures
4. Carrier arrestment mechanisms and structures

2 Explanation of references

2.1 F/A-18E

Data on the F/A-18E was sourced from the NATOPS flight manual [1] and the flight performance manual [2]. The NATOPS documents provided information on aircraft dimensions, areas, as well as takeoff and landing speeds. Specifications from the Boeing website [3] were used for aircraft MTOW and empty weight, and top speed. All other data was sourced from a specifications manual from Boeing [4]. This document also includes data on carrier wind over deck requirements for catapulting and arrestment.

2.2 F-35C

Specifications for the F-35C comes from the Lockheed Martin website [5], and from an Fast Facts document from the Lockheed Martin F-35 Communications Team [6]. Certain data points were not available, including cruise Mach number, max SLS Mach number, takeoff speed, and carrier approach speed. Some data was available on the F-35 Wikipedia page, but could not be traced to an external reference. External fuel capacity is omitted since external fuel stores are not currently operational for the F-35C. The folded F-35C wingspan comes from a Virginia Tech presentation [7].

2.3 MiG-29K

The OE Data Integration Network [8] provides the majority of the gathered data relevant to the MiG-29K. This is deemed to be a trustworthy source as the data is published by the US Army. Supplemental information, particularly regarding external fuel capacity, is gathered from a website published by Greg Goebel [9], who is known for his writings on fighter jet aircraft.

2.4 Rafale M

The French Defense Ministry [10] provides most of the relevant aircraft specification data. This is deemed to be a trustworthy source. The other sources are used as cross-reference and provide the ranges for some of the aircraft specification data. The manufacturer specifications are credible sources since they are directly from the manufacturer, providing information on dimensions, weights, surface ceiling, and max thrust [11], [12]. The Directory of International Aircraft [13] provides similar numbers for weights and gives a wide range of combat radii of the Rafale C comparable to U.S. military data [14]. The U.S. Military Source [14] is also a credible source.

2.5 J-15

The US military [15] source provides all of the gathered data relevant to the J-15 except for combat radius. This is a trustworthy source as this data is gathered and published by the US military. Although there is no highly trustworthy source for combat radius data, sources [16] and [17] give similar numbers with one stating that a chief designer revealed the information. After searching through other sources, there are none that give opposing data.

2.6 Jet Engines

For each of the selected engines, sea level static thrust data was taken from the engine manufacturers' data sheets. The engines selected were the F135-PW-100 [18] [19], the F414-GE-400 [20], the F119-PW-100, the F110-GE-132 [21], the F110-GE-129 [22], and the F100-PW-229 [23]. TSFC data was sourced from [24] and [25], for dry and wet TSFC respectively. The TSFC of the F135 engine is not readily available, but data was estimated by Samet Arsan using Python [26].

F/A-18E/F References

[1] *NATOPS FLIGHT MANUAL NAVY MODEL F/A-18E/F 165533 AND UP AIRCRAFT*. A1-F18EA-NFM-000. Department of the Navy. 2008.

[2] *NATOPS Flight Manual Performance Data: Navy Model F/A-18E/F 165533 and Up Aircraft*. A1-F18EA-NFM-200. Department of the Navy. 2006.

[3] Boeing. *F/A-18 SUPER HORNET*. URL: https://www.boeing.com/defense/fa-18-super-hornet#overview (visited on 09/03/2025).

[4] *Standard Aircraft Characteristics F/A-18E Super Hornet*. NAVAIR00-110AF18-6. Boeing. 2001.

F-35C References

[5] Lockheed Martin. *F-35C CV Variant*. 2011. URL: https://web.archive.org/web/20110317173004/http://www.lockheedmartin.com/products/f35/f-35c-cv-variant.html (visited on 09/03/2025).

[6] Lockheed Martin. *F-35 Lightning II Program Status and Fast Facts*. 2012. URL: https://web.archive.org/web/20130524200620/http://f-35.ca/wp-content/uploads/2012/03/F-35-Fast-Facts-March-13-2012.pdf (visited on 09/03/2025).

[7] Sean Tzeng Soumit Banerjee Michael LaPierre. *Joint Strike Fighter F-35C*. 2025. URL: https://archive.aoe.vt.edu/mason/Mason_f/JSFS05.pdf (visited on 09/03/2025).

Mig-29K References

[8] *MiG-29K (Fulcrum-D) Russian Multirole Fighter Aircraft*. 2024. URL: https://odin.tradoc.army.mil/WEG/Asset/MiG-29K_%28Fulcrum-D%29_Russian_Multirole_Fighter_Aircraft (visited on 09/03/2025).

[9] Greg Goebel. *Mikoyan Mig29K*. 2023. URL: https://www.airvectors.net/avmig29.html (visited on 09/03/2025).

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[10] Ministère Des Armées. *Rafale Marine*. URL: https://www.defense.gouv.fr/marine/aeronefs/rafale-marine (visited on 09/03/2025).

[11] Dassault Aviation. *Specifications and Performance Data*. 2025. URL: https://www.dassault-aviation.com/en/defense/rafale/specifications-and-performance-data/ (visited on 09/03/2025).

[12] Dassault Aviation. *Rafale The Omnirole Fighter*. 2015. URL: https://www.dassault-aviation.com/wp-content/blogs.dir/1/files/2015/02/Rafale-file_UK.pdf (visited on 09/03/2025).

[13] Gerald Frawley and Jim Thorn. *The International Directory of Military Aircraft 1996/97*. Aerospace Publications Pty Ltd, 1996.

[14] *Rafale French Multirole Fighter Aircraft*. 2024. URL: https://odin.tradoc.army.mil/Search/All/Rafale%20M (visited on 09/03/2025).

J-15 References

[15] *J-15 (Flanker-X2) Chinese Carrier-Based Air Superiority Fighter*. 2024. URL: https://odin.tradoc.army.mil/Search/All/J-15 (visited on 09/03/2025).

[16] Weapons Lecture Hall. *The Liaoning and Shandong are a good match for China's first generation carrier-based aircraft, the J-15, nicknamed the Flying Shark*. 2020. URL: https://baijiahao.baidu.com/s?id=1671014559581220823 (visited on 09/03/2025).

[17] China.org.cn. *J-15 fighter able to attack over 1,000 km*. 2013. URL: http://www.china.org.cn/china/2013-03/02/content_28109971.htm (visited on 09/03/2025).

Jet Engine References

[18] Pratt and Whitney. *PRATT and WHITNEY F135 ENGINE FAST FACTS*. 2025. URL: https://prd-sc102-cdn.rtx.com/-/media/pw/newsroom/collateral/documents/military-engines/f135-fast-facts.pdf (visited on 09/03/2025).

[19] Pratt and Whitney. *F135 Specs Charts*. 2012. URL: https://web.archive.org/web/20150924005241/http://www.f135engine.com/docs/B-2-4_F135_SpecsChart.pdf (visited on 09/03/2025).

[20] GE Aviation. *F414 turbofan engines*. URL: https://www.geaerospace.com/sites/default/files/2022-01/F414-Datasheet.pdf (visited on 09/03/2025).

[21] GE Aviation. *F110-GE-132 turbofan engines*. URL: https://www.geaerospace.com/sites/default/files/datasheet-F110-GE-132.pdf (visited on 09/03/2025).

[22] GE Aviation. *F110-GE-129 turbofan engines*. URL: https://www.geaerospace.com/sites/default/files/datasheet-F110-GE-129.pdf (visited on 09/03/2025).

[23] RTX. *F100-PW-229*. URL: https://prd-sc102-cdn.rtx.com/-/media/pw/newsroom/collateral/documents/military-engines/f100-pw-229-product-card.pdf (visited on 09/03/2025).

[24] Angelos T. Kottas, Michail N. Bozoudis, and Michael A. Madas. "Turbofan aero-engine efficiency evaluation: An integrated approach using VSBM two-stage network DEA". In: *Omega* 92 (2020), p. 102167. DOI: 10.1016/j.omega.2019.102167.

[25] Nathan Meier. *Military Turbojet/Turbofan Specifications*. 2005. URL: https://web.archive.org/web/20210211221008/http://jet-engine.net/miltfspec.html.

[26] Samet Arslan. *Estimating the Specific Fuel Consumption (SFC) Values of the Pratt and Whitney F119-PW-100 Engine using Python*. 2024. URL: https://medium.com/@smtrsln8/estimating-the-specific-fuel-consumption-sfc-values-of-the-pratt-whitney-f119-pw-100-engine-b052c354d487 (visited on 09/03/2025).