AEEM 3042 Aircraft Performance & Design Aircraft Design - Airliner Research

Today there are two major aircraft manufacturers challenging for their share of the expanding market for new aircraft for the world's airline companies, as well as two smaller aircraft manufacturers hoping to carve out their own market share. The demand for new fuel-efficient airliners is escalating and Boeing, Airbus, Bombardier, and Embraer are embroiled in this high-stakes competition.

These are the first three parts of a multi-part homework assignment:
- This first part is for the aircraft designer to gather historical information on previous aircraft.
- The second part is to use the historical information to plot trendlines for certain aircraft performance parameters that may help define the boundaries of the design space for the aircraft designer.
- The third part is to take characteristic measurements from the airliner's three-view drawing and calculate important aircraft design features.

You have received an e-mail with a table that contains airliner configuration data for one or two series of aircraft that have been designed to a set of requirements, built in large quantities, sold to airline companies, and flown passengers to their destinations all over the world. **The aircraft highlighted in yellow is the aircraft that you will use for HW #18 through HW #25.** Please let your instructor know of any updated information that you may have discovered during your research.

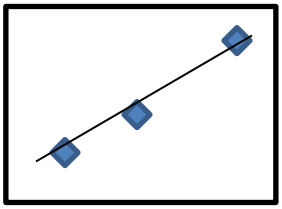
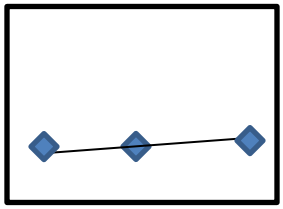
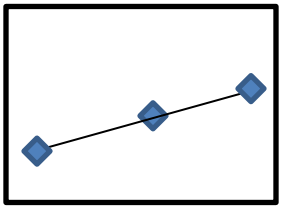
Homework #16 - Prepare a very short synopsis paper: This synopsis should be just a few pages long and should include the following for each aircraft series:

a. Manufacturer
b. Photograph
c. First flight date
d. Approximate # of aircraft built to date
e. Approximate # of backlogged/ordered aircraft
f. Approximate cost
g. Competitive aircraft
h. Military variants, if any
i. Other interesting facts or tidbits
j. References

Homework #17 - Use the data provided to construct the following plots in Microsoft Excel:

1. Maximum Range (y-axis) vs Maximum Takeoff Gross Weight (x-axis)
2. Typical payload (y-axis) vs Maximum Takeoff Gross Weight (x-axis)
3. Seat Miles (y-axis) vs Maximum Takeoff Gross Weight (x-axis)

For each plot add a trendline that linearly fits the data for each series of aircraft presented.
Discuss the possible causes for any negative trendline slopes that may appear.

Tips for successfully completing these assignments:
- Wikipedia is a fantastic resource for historical airliner information
- A series of aircraft includes all of its variants
  (example: the 727 series of aircraft includes the 727-100, 727-200, and 727-200 Adv)
- Payload should be calculated as 170 pounds per person in a seat plus 30 pounds for their luggage
- Typical payload is the number of seats in the highest number of classes available
  (example: use 3-class number of seats if available, otherwise use 2-class number of seats)
- Seat Miles = (# of seats) x (maximum range)
- If you have more than one series of aircraft, each series should have its own symbol on the plots
  (example: the A330 series is depicted by a triangle and the A380 series is depicted by a rectangle)

Homework #18 - Use the airliner three-view drawing to measure and calculate the parameters in this table:

WING CHARACTERISTICS		**Units**	**Format**	**Given Value**	**Measured Value**	**Calculated Value**
Leading Edge Sweep Angle	Λ_{LE}	deg	X.Y	**X**		**X**
Trailing Edge Sweep Angle	Λ_{TE}	deg	X.Y	**X**		**X**
Quarter-Chord Sweep Angle	$\Lambda_{c/4}$	deg	X.Y	**X**	**X**	
Tip Chord	c_t	ft	X.Y	**X**		**X**
Root Chord	c_r	ft	X.Y	**X**		**X**
Average Chord	c	ft	X.Y	**X**	**X**	
Wing Span	b	ft	X.Y		**X**	**X**
Taper Ratio	λ	--	X.YY	**X**	**X**	
Wing Area	S	ft^2	X.Y		**X**	
Aspect Ratio	AR	--	X.YY		**X**	
MAC length	MAC	ft	X.Y	**X**		
MAC location	y_{MAC}	ft	X.Y	**X**		
Dihedral Angle	Γ	deg	X.Y	**X**		**X**
AIRCRAFT CHARACTERISTICS		**Units**		**Given Value**	**Measured Value**	**Calculated Value**
Aircraft Height	$H_{a/c}$	ft	X.Y		**X**	**X**
Aircraft Length	$L_{a/c}$	ft	X.Y		**X**	**X**
Fuselage Length	L_{fuse}	ft	X.Y	**X**		**X**
Fuselage Diameter	D_{fuse}	ft	X.Y	**X**		**X**
Tail Bump Angle	θ	deg	X.Y	**X**		**X**
AIRCRAFT LOCATIONS {(0,0,0) = (nose tip,CL,ground)}				**FS**	**± BL**	**WL**
Wing	FS_w; WL_w	ft	X.Y		**0**	
Nose Gear	FS_{NG}	ft	X.Y		**0**	**0**
Main Gear	FS_{MG}; BL_{MG}	ft	X.Y			**0**

Tips for successfully completing this assignment:
- Use the graphical techniques from Block 1 to measure the required parameters on the three-view drawing
- Assume that both halves of your aircraft's wing are mirrored trapezoids
- You can use the WING Excel spreadsheet to check your measurements and calculations

<u>HOMEWORK CHECKLIST</u>

Submit your electronic files on Canvas by 11:59 p.m. on the due date. Submit each homework assignment separately and Include the following:

- HW #16: Aircraft synopsis paper (Microsoft Word or PDF document)

- HW #17: 3 graphs (Microsoft Excel file); each graph on its own tab

- HW #18: Filled-out table on its own tab (Microsoft Excel file); a scanned copy or picture of your airliner three-view drawing with your graphical solutions; your final iteration of the WING spreadsheet (if used)