

Terminal

The objective of this activity is to interpret the meaning of derivatives and integrals in the context of the tasks performed by an airline crew.

Have you ever been to an airport and flown on an airplane? If so, you have probably seen a lot of planes landing and taking off. Have you ever watched all the activity that takes place once the plane reaches the terminal? A lot more than just unloading and loading passengers goes on during the time between landing and take off!



Fill 'er up!

Jet fuel is pumped into a plane at a rate modeled by $F(t) = 1000e^{-(t-5)^2/60}$ liters per minute for $0 \leq t \leq 15$, where t is measured in minutes.

1. How many liters of fuel are pumped into the plane during the first 5 minutes?
2. Determine $F'(9)$. Using correct units, explain the meaning of $F'(9)$ in the context of the problem.
3. How long does it take to pump 10,000 liters of fuel?

H₂O on the Go!

Potable water is used in the sinks and toilets of the bathroom and sometimes for making tea and coffee. A water truck pumps potable water into a plane's water tanks at a rate modeled by $P(t) = -0.125t^3 + 1.25t^2$ liters per minute for $0 \leq t \leq 10$, where t is measured in minutes. At the same time, waste water is removed from the plane at a rate modeled by $W(t)$ liters per minute, where W is differentiable and decreasing on $0 \leq t \leq 10$. Selected values of $W(t)$ are shown in the table below. At $t = 0$, there are 250 liters of combined water (potable and waste) on the plane.

t (minutes)	0	2	4	7	10
$W(t)$	27	23	17	9	5

1. Estimate $W'(3)$. Show the work that leads to your answer. Indicate units of measure.

2. Use a left Riemann sum with the four subintervals indicated by the table to estimate the total amount of waste water removed from the plane during the 10 minutes. Is this an overestimate or an underestimate of the total amount of water removed? Give a reason for your answer.
3. Estimate the total amount of combined water (potable and waste) in the plane after 10 minutes.

Cargo, Cargo, Cargo!

Airlines require you to check your larger bags. Checked bags are stored in the bottom of the plane. When a plane arrives at its terminal, the luggage for passengers arriving has to be removed and the luggage for passengers departing has to be stored. The number of bags on the plane during this process can be modeled by $B(t) = 50 \cos\left(\frac{1}{4}t\right) + 75$ bags, for $0 \leq t \leq 20$, where t is measured in minutes.

1. At what time t , $0 \leq t \leq 20$, is the number of bags on the plane at a minimum? Justify your answer.
2. Find the average rate of change for $B(t)$ over the interval 0 to 20. Indicate units of measure.