Acme Airlines Scheduling App

Acme Airlines

Acme Airlines provides on-demand air cargo and freight services using a handful of aircraft types to only a handful of cities across the globe. Given the on-demand nature of their services, their business is largely related to moving on-demand cargo for both trans-continental and trans-oceanic journeys. This means that Acme maintains just a handful of aircraft, types, and operating bases.

Aircraft types

Boeing 767-300F - required crew: 2
Boeing 747-400F - required crew: 2

Operating Bases

John F. Kennedy International Airport (KJFK)
Los Angeles International Airport (KLAX)
Ted Stevens Anchorage International Airport (PANC)
Heathrow Airport (EGLL)
Narita International Airport (RJAA)

Scheduling

This application is largely related to airframe and flight crew scheduling. As an Air Cargo Airline, the minimum required crew are the pilots required to operate the aircraft type assigned to the flight. It is also common that a loadmaster is usually present on any given flight.

Crew Ranks

Pilot careers progress according to seniority, experience, and type ratings. All pilots progress through the following ranks:

B767-300F Fleet

B767-300F Relief First Officer
B767-300F First Officer
B767-300F Senior First Officer
B767-300F Junior Captain
B767-300F Captain
B767-300F Senior Captain

B747-400F Fleet

B747-400F Relief First Officer
B747-400F First Officer
B747-400F Senior First Officer
B747-400F Junior Captain
B747-400F Captain
B747-400F Senior Captain

City Pairs

The following are the types allowed for given flights and city pairs:

EGLL
Flight 01 - EGLL-KJFK - B767-300F or B747-400F
Flight 02 - EGLL-KLAX - B747-400F
Flight 03 - EGLL-PANC - B747-400F
Flight 04 - EGLL-RJAA - B747-400F

KJKF
Flight 05 - KJFK-EGLL - B767-300F or B747-400F
Flight 06 - KJFK-KLAX - B767-300F
Flight 07 - KJFK-PANC - B767-300F or B747-400F
Flight 08 - KJFK-RJAA - B747-400F

KLAX
Flight 09 - KLAX-EGLL - B747-400F
Flight 10 - KLAX-KJFK - B767-300F
Flight 11 - KLAX-RJAA - B747-400F
Flight 12 - KLAX-PANC - B767-300F or B747-400F

PANC
Flight 14 - PANC-EGLL - B747-400F
Flight 15 - PANC-KJFK - B767-300F or B747-400F
Flight 16 - PANC-KLAX - B767-300F or B747-400F
Flight 17 - PANC-RJAA - B747-400F

RJAA
Flight 18 - RJAA-KJFK - B747-400F
Flight 19 - RJAA-KLAX - B747-400F
Flight 20 - RJAA-PANC - B747-400F

Crew Restrictions

The following rules and constraints apply to the scheduling problem that the system must address.

Type restrictions

All pilots are type-rated and, according to this type rating, are assigned to a given fleet.

Crew Complement

The standard crew complement is a Captain and a First Officer. When required, crew complements are extended so as to be compliant with US regulations governing duty time.

Qualifications

All Captains are expected to provide services and duties as pilot in command of a flight. All first officers will provide services and duties as second in command of a flight.

Crew Hours Restrictions

Most scheduling constraints have to do with pilot experience, rank, and US regulations regarding duty and rest restrictions.

Crew Experience Restrictions

Crew scheduling must observe several implementation rules related to time on type and time in rank. These are internal company limitations and not those imposed by US regulations.

Restrictions Related to Total Hours

- All pilots must have at least 1500 hours of total flying time, with a minimum of 500 of those hours in turbine-engined aircraft.
- All pilots must hold an Airline Transport Pilot certificate issued by the FAA.
- All pilots must hold an FAA/CAA/JAA-issued type rating for the aircraft for which they are to be scheduled.

Restrictions Related to Time in Rank

- A First Officer in his/her first 100 flight hours in rank must be scheduled with a Senior Captain.
- A Captain in his/her first 100 flight hours in rank must be scheduled with a Senior First Officer OR Senior Captain

Restrictions Related to Time on Type

- A First Officer in his/her first 75 flight hours on type must be scheduled with a Senior Captain.
- A Captain in his/her first 75 flight hours on type must be scheduled with a Senior First Officer OR Senior Captain

Weather Restrictions

- If the second-in-command pilot has fewer than 100 hours of flight time in rank, or in type, the pilot in command must be either a senior captain (preferred) or a captain with more than 100 hours in rank and in type, subject to the following conditions
    - When the current weather at the departure airport, or the forecasted weather at the arrival airport, at the projected time of arrival, meets ANY of the following conditions:
        - The prevailing visibility for the airport is at or below 3/4 mile.
        - The runway visual range for the runway to be used is at or below 4,000 feet.
        - The runway to be used has water, snow, slush, ice or similar contamination that may adversely affect aircraft performance.
        - The braking action on the runway to be used is reported to be less than “good.
        - The crosswind component for the runway to be used is in excess of 15 knots.
        - Windshear is reported in the vicinity of the airport.
    - FAA/NOAA-issued METAR and TAF reports will be used as the source of the above conditions.
    - If these conditions exist, the captain must be the pilot operating (flying the aircraft) and the first officer must be the pilot monitoring (performing supporting duties)

Hours Note

Flight hours are only those from when the aircraft departs (taxi out from parking and takeoff) and arrives (taxi landing and taxi in to parking). For schedule planning, the duration of a given flight will utilize the distance (in nautical miles) to be flown, multiplied by the aircraft type's cruise speed, and further multiplied by a scalar factor of 1.3.

Hours Example

The B767-300F has a cruise speed of 0.80 Mach (the appropriate measure of speed at higher altitudes). The great circle route between KJFK and EGLL is 2,999 nautical miles. The results in 6 hours and 32 minutes. This is 392 minutes, and with the scalar time factor of 1.3 applied, is 510 minutes (rounded up) - 8 hours and 30 minutes.

Airframe and Crew Bases

Pilots are “based” at a certain airport and would be expected to return to that airport eventually. While aircraft are also based at certain airports, this is less important for scheduling as they will be utilized from where they are at all times. The on-demand nature of Acme’s business suggests that the business is largely around supplementing lift capacity at these intrinsically hub airports for air cargo. As a result, the business runs by utilizing aircraft, where they were last parked, between the above city pairs.

Crew Movement

Pilots will be available for tasking, within duty limits, from the previous arrival airport within 48 hours of arrival. Thereafter, there is a 48-hour allocation for transportation back to that pilot’s crew base. There is a crew base at all airports served by Acme. All other federal regulations are applicable.

Crew Duty Time Restrictions

As ACME is an airline registered in the United States, the airline follows US regulations (14 CFR Part 121) regarding Flight time limitations and rest requirements.

Domestic

Flights between the following airports are considered “Domestic:”

- KJFK
- KLAX
- PANC

The following Duty and Rest restrictions apply for pilots scheduled on any “domestic” flight (14 CFR § 121.471).

- Scheduling will observe the following flight time limitations -
    - 1,000 hours in any calendar year
    - 100 hours in any calendar month
    - 30 hours in any 7 consecutive days
    - 8 hours between required rest periods.
- For domestic scheduling, a wait period of 24 hours must be observed since the last assignment.

International “Flag” Operations

Flights to, from, or between these airports are considered “International:”

- EGLL
- RJAA

The following Duty and Rest restrictions apply for pilots scheduled on any “international” or “flag” flight 14 CFR § 121.481:

- A flight with a crew of two pilots may be scheduled for eight hours or less during any 24 consecutive hours without a rest period during these eight hours.
- If a pilot is scheduled to fly more than eight hours during any 24 consecutive hours, the pilot is afforded an intervening rest period, at or before the end of eight scheduled hours of flight duty. This rest period must be at least twice the number of hours flown since the preceding rest period, but not less than eight hours. This is the reason for “relief” pilots.
    - Flight hours will be scheduled to provide adequate rest periods on the ground for each pilot who is away from base and who is a pilot on an airplane that has a crew of three or more pilots and an additional flight crewmember. It shall also provide adequate sleeping quarters on the airplane whenever a pilot is scheduled to fly more than 12 hours during any 24 consecutive hours.
    - Scheduling shall give each pilot, upon return to base from any flight or series of flights, a rest period that is at least twice the total number of hours flown since the last rest period at base. During the rest period, no duties are to be assigned (including travel for flight positioning). If the required rest period is more than seven days, that part of the rest period in excess of seven days may be given at any time before the pilot is again scheduled for flight duty on any route.
    - No pilot may fly as a “relief” flight crewmember more than -
        - 350 hours during any 90 consecutive days; or
        - 1,000 hours during any 12-calendar-month period.
- Each pilot who has flown more than eight hours during 24 consecutive hours must be given at least 18 hours of rest before being assigned to any further duty.
- No pilot may fly more than 32 hours during any seven consecutive days, and each pilot must be relieved from all duty for at least 24 consecutive hours at least once during any seven consecutive days.
- No pilot may fly as a member of a crew more than 100 hours during any one calendar month.
- No pilot may fly as a member of a crew more than 1,000 hours during any 12-calendar-month period.