Probability of Weekly Aircraft Sales

Posted on March 25, 2019

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Introduction

The aircraft-sales problem provides fifty weeks of historical observations and asks for the probability of selling zero, one, two, or three aircraft during a week. The data show forty weeks with no sale, eight weeks with one sale, one week with two sales, and one week with three sales. Because these probabilities are calculated directly from observed frequencies, the appropriate method is empirical, or relative-frequency, probability rather than subjective probability. Subjective probability would rely mainly on informed judgment when repeated data are limited or future conditions differ substantially from the past. Here, the historical sample supplies a transparent numerical basis: each estimated probability equals the number of weeks with a particular outcome divided by fifty. The resulting model is useful for describing the observed sales process and for simple planning calculations, but it should not be treated as a timeless law. Aircraft demand can change with economic conditions, financing, fuel prices, model availability, large contracts, staffing, regulation, and customer purchasing cycles.

Constructing the Empirical Probability Distribution

Let the random variable X represent the number of aircraft sold in one week. The frequency check is $40 + 8 + 1 + 1 = 50$, confirming that every observation is included. The empirical probability of zero sales is $P(X = 0) = 40/50 = 0.80$. The probability of exactly one sale is $P(X = 1) = 8/50 = 0.16$. Two aircraft were sold in one week, so $P(X = 2) = 1/50 = 0.02$, and three aircraft were also sold in one week, giving $P(X = 3) = 1/50 = 0.02$. The distribution is valid because every probability lies between zero and one and the values sum to 1.00. The relatively large probability of zero sales shows that weekly revenue is likely to be uneven, while the estimates for two and three aircraft are much less stable because each is based on only one observed week (Ross, 2019; Triola, 2018).

The probability of at least one aircraft sale is obtained by adding the probabilities of one, two, and three sales or by taking the complement of zero sales. Therefore, $P(X \geq 1) = 0.16 + 0.02 + 0.02 = 0.20$, which is identical to $1 - 0.80 = 0.20$. A sale occurred in 20 percent of the observed weeks. The expected number of weekly sales is calculated as $E(X) = (0 \times 0.80) + (1 \times 0.16) + (2 \times 0.02) + (3 \times 0.02) = 0.26$ aircraft per week. The same result follows from the thirteen aircraft sold across fifty weeks: $13/50 = 0.26$. An expectation of 0.26 does not predict a fraction of an aircraft next week; it represents the long-run average implied by the empirical distribution if future conditions resemble the

historical period.

Variation and Planning Implications

The mean alone does not show how uneven weekly sales are. The second moment is $E(X^2) = (0^2 \times 0.80) + (1^2 \times 0.16) + (2^2 \times 0.02) + (3^2 \times 0.02) = 0.42$. The variance is therefore $Var(X) = 0.42 - 0.26^2 = 0.3524$, and the standard deviation is approximately $\sqrt{0.3524} = 0.594$ aircraft. The standard deviation exceeds the mean because most weeks contain no sale while a few contain multiple sales. If the weekly process remained approximately stable, expected sales over ten weeks would be $10 \times 0.26 = 2.6$ aircraft, and over fifty future weeks the expected total would be thirteen. These are planning averages rather than exact forecasts. Sales of expensive products such as aircraft may be clustered around fleet purchases, financing decisions, delivery schedules, or long negotiations, so managers should use pipeline information and customer-specific knowledge alongside historical frequencies rather than evaluating performance only from one week's result.

Why Empirical Probability Fits Better Than Classical or Subjective Probability

Classical probability is most appropriate when outcomes are equally likely by design or symmetry, as with an ideal fair coin or die. Weekly aircraft outcomes of zero, one, two, and three sales are clearly not equally likely, so classical probability is not the primary method. Subjective probability is a reasoned degree of belief based on expertise, market information, customer conversations, and judgment. It could supplement the historical estimate if the business environment has changed or if a new model lacks sufficient sales history, but it is not the source of the 0.80, 0.16, 0.02, and 0.02 figures. Those values are empirical because they come directly from the fifty observations. Correct terminology matters because it tells a reader how the number can be evaluated. The empirical estimates can be reproduced from records, while a subjective estimate must be assessed through the quality, calibration, and evidence supporting the expert judgment. Fifty weeks offer useful evidence, but rare-outcome probabilities based on one observation remain highly uncertain.

GPS, Conditional Probability, and Model Limitations

Adding GPS equipment to aircraft does not automatically change the probability method. If the business question remains how many aircraft are sold per week, historical relative frequency is still the relevant calculation. GPS becomes a probability variable only when records distinguish whether sold aircraft include a particular GPS package or when location data are relevant to another operational question. With suitable data, a manager could estimate a conditional probability such as P(GPS | aircraft sold), calculated as the number of sold aircraft equipped with GPS divided by total aircraft sold, or a joint probability involving both weekly sales and GPS status. Post-sale location

tracking raises separate questions of customer agreement, privacy, cybersecurity, ownership, and aviation regulation and should not be introduced merely because the technology exists. The larger limitation of the current model is stationarity: it assumes future weeks resemble the fifty observed weeks. Seasonality, economic cycles, sales campaigns, salesperson capacity, customer concentration, and large fleet contracts may violate that assumption and justify a more detailed time-series or pipeline model.

Conclusion

The fifty-week aircraft dataset produces an empirical probability distribution of 0.80 for zero sales, 0.16 for one sale, 0.02 for two sales, and 0.02 for three sales. These probabilities sum to one, the probability of at least one weekly sale is 0.20, and expected sales are 0.26 aircraft per week. The variance is 0.3524 and the corresponding standard deviation is approximately 0.594 aircraft, reflecting the concentration of observations at zero and the small number of multi-sale weeks. The correct probability approach is relative frequency because the values come directly from historical observations. Classical probability does not fit because the outcomes are not equally likely, while subjective judgment would be relevant only as a supplement when data are scarce or business conditions have shifted. GPS installation does not alter this method unless GPS status becomes part of the research question. The model is therefore useful as a descriptive and planning tool when its small sample, rare outcomes, possible dependence between weeks, and changing market conditions are stated clearly.

References

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