

STAT 165/265: Forecasting

Discussion 9: Independence Assumptions

4/4/2025

You will work through this sheet in class on Friday, 4/4 in groups of 2-3. We will explore independence assumptions and how forecasts change when independence assumptions are removed.

Please submit the Discussion sheet for participation points on Gradescope under the "Discussion 9" assignment. Submit what you have at the end of the hour – it's ok if you didn't finish every question thoroughly!

For students who have contacted us about absences this Friday, please spend an hour on this sheet and submit to the same Gradescope assignment.

Part I. Earthquakes

For this problem, we will consider earthquakes only of at least 6.0 magnitude for the region of California or the surrounding area (defined as the region of 31.0 to 43.0 degrees North and -126.0 to -114.0 degrees West).

Suppose the historical monthly base rate of an earthquake occurring in this region was **56/936 $\approx$ 5.98%** from the years 1933 (inclusive) through 2010 (inclusive).

1.1. Assuming independence of earthquakes across months, calculate the probability of at least one earthquake occurring in this region over a year.

1.2 Removing the independence assumption, what do *you* think is the probability of at least one earthquake occurring in this region over a year. In other words, how many years from 1933 to 2010 do *you* think had at least one earthquake? How does this relate to the answer from 1.1?

Part II. Voting Patterns

For this problem, we will consider the proportion of U.S. states voting for the Republican Party in U.S. presidential elections since 1856.

Historically, the probability that a randomly chosen state votes for the Republican Party is **$\approx 54.73\%$** .

2.1. Assuming independence, calculate the probability that at least 40/50 states vote for the Republican Party in a given election. Hint: Use a Gaussian approximation.

2.2. Removing the independence assumption, what do *you* think is the probability of at least 80% of states voting for the Republican party in a given U.S. presidential election? In other words, how many elections from 1856 to 2020 do *you* think had at least 80% of states voting for the Republican Party? How does this relate to the answer from 2.1?

Part III. Disease Outbreaks

For this problem, we will consider "Disease outbreaks in the United States," according to [Wikipedia](#).

Suppose the historical annual base rate of *recorded* disease outbreaks in the U.S. was **50/286, or 17.48%** from the years 1738 (inclusive) through 2023 (inclusive).

3.1. Assuming independence of disease outbreaks across years, calculate the probability of at least one disease outbreak being recorded for this region over a decade.

3.2 Removing the independence assumption, what do *you* think is the probability of at least one disease outbreak being recorded for this region over a decade. In other words, how many decades from 1738 to 2024 do *you* think had at least one recorded disease outbreak? How does this relate to the answer from 3.1?

Part IV. Future Forecast Discussion

Discuss in groups of 2-3 about a forecast on this week's homework. Feel free to pick any of the forecasts, although we suggest you start with the following:

How many BART service alerts will there be between April 5th, 2025 (inclusive) and April 13th, 2025 (exclusive)?

Resolution Criteria:

- Resolves on April 14th at noon according to the number of posts [here](#) with a date/timestamp from April 5, 6, 7, 8, 9, 10, 11 or 12, in the year 2025.
- Any posts that are deleted by the time of resolution do not count.
- If the X account for @SFBARTalert is renamed, then the link used for resolution will change accordingly.

The next page includes some background info that could be helpful. In the space below, jot down notes about the different considerations you are weighing for this forecast, what other information you would like to look up later, etc.

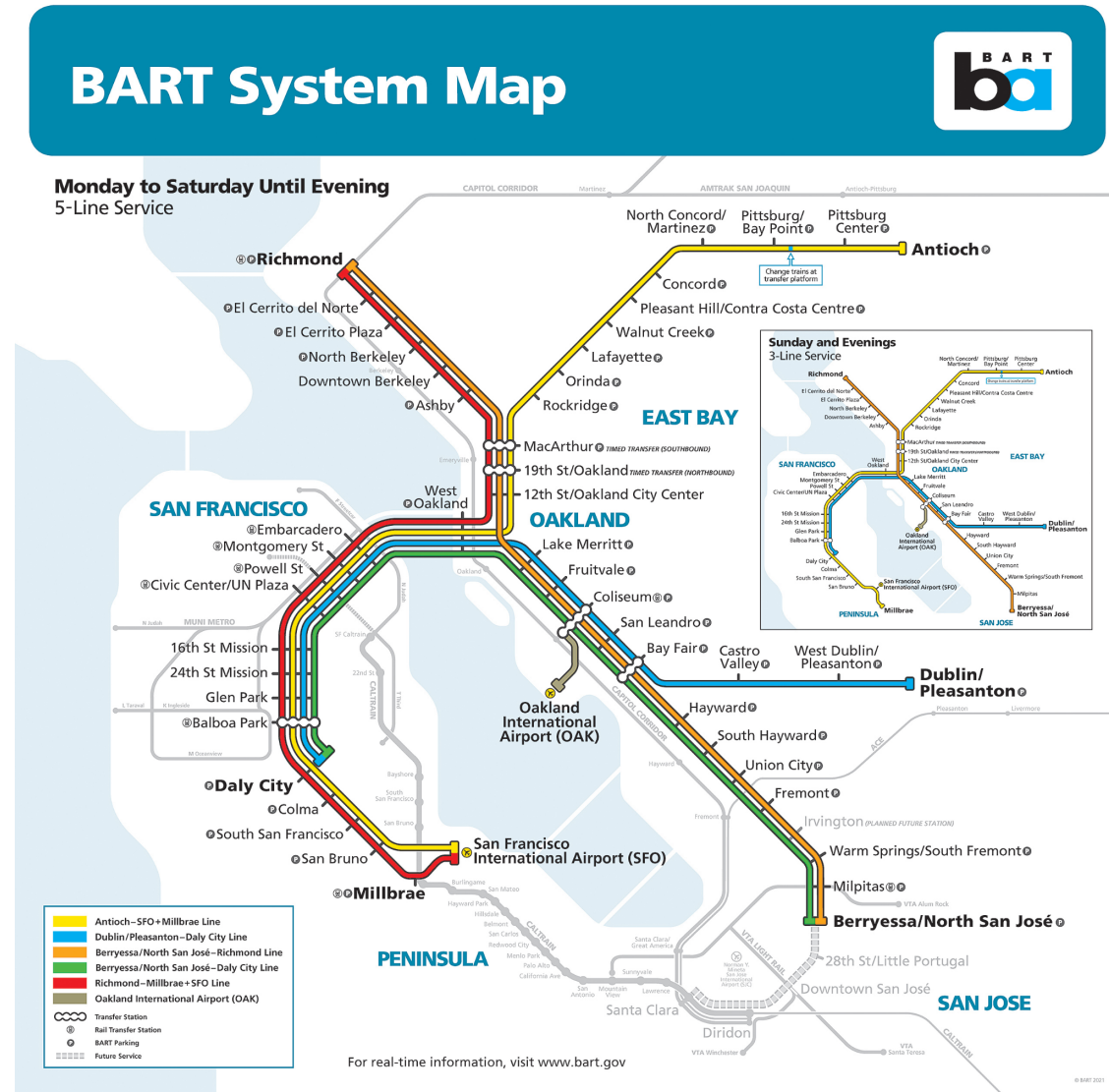
March Weather Forecast for San Francisco, CA as of April 2. (source: [accuweather.com](https://www.accuweather.com))

S	M	T	W	T	F	S
30	31	1	2	3	4	5
						
64° 49°	61° 51°	56° 49°	58° 44°	62° 45°	64° 51°	66° 51°
6	7	8	9	10	11	12
						
63° 53°	62° 53°	64° 52°	69° 52°	68° 56°	65° 52°	62° 52°
13	14	15	16	17	18	19
						
63° 51°	64° 52°	63° 50°	62° 51°	59° 47°	58° 47°	58° 46°
20	21	22	23	24	25	26
						
59° 47°	58° 48°	58° 46°	59° 46°	63° 49°	66° 50°	66° 49°
27	28	29	30	1	2	3
						
65° 50°	60° 50°	64° 50°	66° 50°	66° 50°	67° 50°	61° 50°

March Weather Forecast for Oakland, CA as of April 2. (source: [accuweather.com](https://www.accuweather.com))

S	M	T	W	T	F	S
30	31	1	2	3	4	5
						
64° 49°	59° 52°	56° 51°	60° 42°	65° 44°	71° 48°	72° 49°
6	7	8	9	10	11	12
						
68° 54°	67° 50°	70° 52°	75° 55°	74° 54°	71° 52°	68° 51°
13	14	15	16	17	18	19
						
70° 51°	69° 52°	67° 50°	66° 51°	62° 47°	62° 47°	62° 48°
20	21	22	23	24	25	26
						
62° 48°	61° 49°	61° 47°	63° 47°	66° 50°	70° 51°	70° 50°
27	28	29	30	1	2	3
						
69° ---	64° ---	68° ---	70° ---	71° ---	71° ---	65° ---

BART Map (from bart.gov)



Recent post history from @SFBARTalert's X profile.

	BART Alert  @SFBARTalert	17h
BART is recovering from an earlier problem. There is a 10-minute delay on the Berryessa Line in the Berryessa and Richmond directions due to an earlier major medical emergency.		
  1   1		
	BART Alert  @SFBARTalert	19h
BART service has stopped between Hayward and Union City stations on the Berryessa Line in the Berryessa and Richmond/Daly City directions due to person on the track. Bus service is available via A/C transit bus #60 and #99		
  1   2		
	BART Alert  @SFBARTalert	19h
BART service has stopped between Hayward and South Hayward stations on the Berryessa Line in the Berryessa and Richmond/Daly City directions due to person on the track. Bus service is available via A/C transit bus #60 and #99		
 2  4   2		
	BART Alert  @SFBARTalert	19h
BART service has stopped between Hayward and South Hayward on the Berryessa Line in the Berryessa and Richmond directions due to person on the track.		
  1   1		
	BART Alert  @SFBARTalert	23h
BART is recovering from an earlier problem. There is a 10-minute delay on the San Francisco Line in the East Bay direction due to an earlier equipment problem on a train in the Transbay Tube		
 1    1		
	BART Alert  @SFBARTalert	Apr 2
BART is recovering from an earlier problem. There is a 20-minute delay on the San Francisco Line in the SFO, Millbrae and Daly City directions due to an equipment problem on a train between Embarcadero and West Oakland.		
 2  1  1  6		
	BART Alert  @SFBARTalert	Apr 2
BART is recovering from an earlier problem. There is a major delay on the San Francisco Line in the East Bay direction due to an equipment problem on a train between Embarcadero and West Oakland.		
    1		
	BART Alert  @SFBARTalert	Apr 2
There is a major delay on the San Francisco Line in the East Bay direction due to an equipment problem on a train between Embarcadero and West Oakland.		
    5		
	BART Alert  @SFBARTalert	Apr 2
There is a 20-minute delay on the San Francisco Line in the SFO, Millbrae and Daly City directions due to an equipment problem on a train between Embarcadero and West Oakland.		
  1   1		
	BART Alert  @SFBARTalert	Apr 1
There is a 20-minute delay on the San Francisco Line in the SFO, Millbrae, Daly City and East Bay directions due to an equipment problem on a train between Embarcadero and West Oakland.		
 1  2  1  5		