LIVING WITH UNCERTAINTY: INVESTING AND VALUATION IN THE FACE OF THE UNKONWN

Aswath Damodaran http://www.damodaran.com

Uncertainty is a feature, not a bug.. And our responses to uncertainty...







Aswath Damodaran

Unhealthy (but human) responses

- Paralysis & Denial
- 2. Mental short cuts (rules of thumb)
 - Herding

3.

- 4. Outsourcing
- 5. Divine Intervention

Not all risk is created equal...

Estimation versus Economic uncertainty

- Estimation uncertainty reflects the possibility that you could have the "wrong model" or estimated inputs incorrectly within this model.
- Economic uncertainty comes the fact that markets and economies can change over time and that even the best models will fail to capture these unexpected changes.

Micro uncertainty versus Macro uncertainty

- Micro uncertainty refers to uncertainty about the potential market for a firm's products, the competition it will face and the quality of its management team.
- Macro uncertainty reflects the reality that your firm's fortunes can be affected by changes in the macro economic environment.

Discrete versus continuous uncertainty

- Discrete risk: Risks that lie dormant for periods but show up at points in time. (Examples: A drug working its way through the FDA pipeline may fail at some stage of the approval process or a company in Venezuela may be nationalized)
- Continuous risk: Risks changes in interest rates or economic growth occur continuously and affect value as they happen.

Uncertainty: A Reality Check

1. Uncertainty is part of business, with changing contours..

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The Corporate Life Cycle: The Evolution of Uncertainty										
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Lightbulb (Ic	The P		The	The Se	The N	f		Earnir		
The								— → Tir		
cycle stage	Start-up	Young Growth	High G	rowth	Mature Growth	Mature Stable	Decline			
Amount of Incertainty	High — Uncertainty is	greatest at e	ither end of	Low -	cle, and least for	r mature compa	→ Hig anies.	gh		
mation verus Economic Incertainty	verus Mostly economic More estimation With young companies, most of the uncertainty is real, and neither data nor sophisticated models will reduce exposure to it. With young companies, most of the uncertainty is real, and neither data nor sophisticated models will reduce exposure to it. With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young companies, most of the uncertainty is real, and neither data nor sophisticated models With young company is the uncertainty is real, and neither data nor sophisticated models With young company is the uncertainty is real, and neither data nor young company is the uncertainty is real, and									
icro versus Macro Incertainty	Mostly micro (company-specific) Mostly macro With young companies, uncertainty is centered on their business models and management. With older companies, uncertainty comes more from macro sources (economy, interest rates etc.)									
crete versus Continuous Incertainty	older companies, uncertainty comes more from macro sources (economy, interest rates etc.) High discrete risk (failure) → Mostly continuous risk → High discrete risk (failure) Two thirds of start ups don't make it to young growth, and declining companies, with debt loads, face risk of distress and failure.									
	Amount of Incertainty Tration verus Economic Incertainty Ticro versus Macro Incertainty Continuous Incertainty	The Construction of the formation verus Economic Uncertainty Construction of Uncertainty Start-up Continuous Uncertainty Start	The Corporate L Image: Start-up Image: Start-up Image: Start-up Start-up Young Growth Amount of Incertainty Image: Start-up Mostly economic With young companies, modeling Macro Incertainty Incertainty	The Corporate Life Cycle: tue tue tue tue (reading of the second secon	The Corporate Life Cycle: The Evo Image: Start-up Young High Growth Cycle stage Start-up Young Growth High Growth Amount of Incertainty High Low Low Colspan="2">Companies, most of the uncertainty is greatest at either end of the life cy Incertainty Mostly economic Mostly economic With young companies, most of the uncertainty is will reduce exposure to it. Incertainty Mostly micro (company-specific) Mostly companies, uncertainty is centered of older companies, uncertainty comes more from reduce older companies, uncertainty comes more from reduced to thirds of start ups don't make it to young group loads, face risk of distress and failure.	The Corporate Life Cycle: The Evolution of Uncomparison of Uncertainty time time <thtim< th=""> tim tim< tim</thtim<>	The Corporate Life Cycle: The Evolution of Uncertainty Image: Start-up Image: Start-up Young Growth Mature Colspan="2" Mostly economic With young companies, most of the uncertainty is real, and neither data nor sop will reduce exposure to it. With young companies, uncertainty is centered on their business models and mu older companies, uncertainty is centered on their business models and mu older companies, uncertainty comes more from macro sources (economy, interes Torninuous risk models and macro sources (economy, interes Torninuous risk failure) Mostly continuous risk models	The Corporate Life Cycle: The Evolution of Uncertainty Image: Start-up Stable Image: Start-up Stable Young Growth High Growth Mature Growth Mature Stable Decline Stable Amount of Incertainty High Growth Mature Growth Mature Stable Decline Stable Mostly economic Incertainty Young Growth High Growth Mature Growth Mature Stable Decline Stable Mostly economic Incertainty Mostly economic Incertainty Nore estima Mostly economic Incertainty is greatest at either end of the life cycle, and least for mature companies. Mostly economic Incertainty Mostly economic Incertainty is centered on their business models and management. V older companies, uncertainty is centered on their business models and management. V older companies, uncertainty comes more from macro sources (economy, interest rates etc.) Mostly discrete risk (failure) Mostly continuous risk High discrete risk (failure) High discrete risk (failure) Mostly continuous risk High discrete risk (failure) Mostly continuous risk High discrete risk (failure)		

And they show up in business drivers



Zomato

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Jul-22

The Story

Zomato will benefit as the Indian food delivery market grows, driven by overall economic growth and more digital access, and it will be one of a few (two or three) players who will dominate the market; there will be a near term COVID bouncecback effect. While Amazon Food remains the wild card, economies of scales will allow the company to generate high operating margins, and the company will continue to reinvest (acquisitions and technology) as it grows. The risk of failure is low, given the company's post-IPO cash balance and access to capital and its operating risk reflects its exposure to Indian country risk.

			ine	eAssumptions		
	Base year	Next year	Years 2-5	Years 6-10	After year 10	Link to story
						Indian food market rebounds in 2021 and
Indian Food Delivery	₹500,000	₹700,000	30.00%	15.72%	₹4,149,008	grows to about \$25 billion in year 10
						Zomato is one of two or three lead players
Market Share	42.60%	40.08%		> 30.00%	30.00%	in Indian food delivery market
Revenues as % of GOV	16.95%	16.76%			15.68%	
			Total Market * Mar	rket Share* Revenue as		COVID rebound in 2021 + Growth in food
Revenues (a)	₹36,110.00	₹47,016	%	ofGOV	₹195,182	delivery market in India long term
Operating margin (b)	-42.04%	-10.0%	-10.00% —	→ 35.00%	35.00%	Margins improve as growth wanes
Tax rate	25.00%		25.00%	→ 25.00%	25.00%	Indian corporate tax rate over time
						Acquisitions & technology investments
Reinvestment (c)		5.00	2.50	3.00	39.83%	needed to sustain growth
						Newworking benefits allow for high ROIC.
Return on capital	-15.65%	Marginal ROIC =	15	7.92%	12.00%	near and long term.
Cost of capital (d)		3	13 56%	11.00%	11 00%	Cost of capital reflects Indian country risk
			Th	ne Cash Flows	11.0070	
	Total Market	Market Share	Revenues	EBIT (1-t)	Reinvestment	FCFF
1	₹700,000	40.08%	₹47,015.53	-₹4,701.55	₹2,181.11	-₹6,882.66
2	₹910,000	37.56%	₹56,676.52	₹708.46	₹3,864.39	-₹3,155.94
3	₹1,183,000	35.04%	₹68,080.36	₹4,508.67	₹4,561.54	-₹ 52.87
4	₹1,537,900	32.52%	₹81,427.35	₹7,633.81	₹5,338.80	₹2,295.02
5	₹1,999,270	30.00%	₹96,884.17	₹13,170.19	₹5,152.27	₹8,017.92
6	₹2,498,208	30.00%	₹120,198.26	₹14,190.43	₹7,771.36	₹6,419.07
7	₹2,995,651	30.00%	₹143,199.35	₹27,247.87	₹7,667.03	₹19,580.84
8	₹3,441,044	30.00%	₹163,525.91	₹42,925.55	₹6,775.52	₹ 36,150.03
9	₹3,779,093	30.00%	₹178,637.54	₹46,892.35	₹5,037.21	₹41,855.14
10	₹3,959,733	30.00%	₹186,277.57	₹48,897.86	₹2,546.68	₹46,351.19
Terminal year	₹4,149,008	30.00%	₹195,181.64	₹51,235.18	₹20,408.68	₹ 30,826.50
				The Value		
Terminal value			₹495,602.90			
PV(Terminal value)			₹148,784.62			
PV (CF over next 10 years	s)		₹49,535.26			
Value of operating assets	5 =		₹198,319.87			
Adjustment for distress			₹9,915.99	Probability of failure	•	10.00%
- Debt & Minority Intere	ests		₹769.00			
+ Cash & Other Non-ope	rating assets		₹99,606.00	Includes cash proceed	ls from IPO of	₹0
Value of equity			₹287,240.88			
- Value of equity option	S		₹14,850.97			
Number of shares			7,653.20			
Value per share			₹35.59		Stock was offered a	at = ₹41.65

			Un	ileve	er					Sep-
					Aging	j Wu	Inderkind			
Amazon continues on	its tra	nsformation from	online retailer to dis	rupti	on platform, w	illlir	ng to enter any bus	ines	s that it perceives as inef	iciently run, and changing it. Along the
way, it will invest larg	e amo	unts of capital and	d wait for long period	s to a	attain profitabi	lity.				
					The	Assu	mptions			
		Base year	Next year		Years 2-5		Years 6-10		After year 10	Link to story
Revenues (a)	€	52,444.00	2.0%		2.00%		2.00%		2.00%	Limited growth prospects
										Margins stay at levels reached in most
Operating margin (b)		18 38%	18 4%		18 38%		18 00%		18 00%	recent five years
Tax rate		25.00%	10.170		25.00%		25.00%		25.00%	Global/US marginal tax rate over time
Reinvestment (c.)		23.0070	1.80		1.80		1.80		16.67%	Maintained at global industry average
Return on capital		14,39%	Marginal ROIC =		20	369	%		12.00%	Stronge brands
neturn on cupitur		11.0070	marginaritore						12.0070	
Cost of conital (d)					0.07%		0.07%		0.070/	cost of capital based on current financin
Cost of capital (d)					8.97%	-	8.97%		8.97%	and geographic mix.
	1	Revenues	On consting Manain			Casi	n Flows	1	Deinwestment	5055
1	6	F2 402 88	19.29%	£	EBI1	£	EBIT (1-1)	£	Reinvestment	FUFF
2	ŧ	55,492.88	18.38%	ŧ	9,829.74	÷ c	7,372.31	ŧ	581.71	€ 0,790.0
2	÷ c	54,562.74	18.30%	£	9,985.33	E E	7,488.99	£	593.34	€ 0,895.0
5	E E	55,055.99	10.20%	£	10,104.12	÷ F	7,023.09	÷ F	605.21	E 7,017.6
4 E	£	57,002,41	10.25%	£	10,540.07	÷ f	7,759.55	£	617.51	E 7,142.
5	£	57,902.41	10.19%	£	10,331.23	t f	9 020 75	£	642.25	E 7,200.
7	E F	60 241 67	18.13%	£	10,719.00	÷ F	9 192 56	÷ F	655.09	f 7,537.
<u> </u>	f	61 446 50	18.02%	€ F	11 106 55	÷ f	8,185.50	÷	668.20	f 7,528.
9	£	62 675 /3	18.03%	£	11,100.55	۰ £	8,323.31	£	681 56	£ 7,001.
10	£	63 928 94	18.04%	£	11,505.15	£	8 630 41	£	695.19	£ 7,137.
Torminal year	£	65 207 52	18.00%	£	11,307.21	f	8,050.41	£	1 467 17	f 7,555.
Terminal year	£	03,207.32	18.00%	£	11,757.55	the	8,803.02	ŧ	1,407.17	€ 7,555.0
Terminal value				£	105 317 15	nev	alue			
PV/Terminal value				£	105,517.15	<u> </u>				
PV (CE over next 10 ver	arel			£	46,020.23	<u> </u>				
Value of operating asso	ats –			£	91 25/ 37	<u> </u>				
Adjustment for distres	s s		-	£	-	├──			Probability of failure =	0.00%
- Debt & Minority Inte	rests			€	36,686.00	\vdash			- resubling of landre -	
+ Cash & Other Non-or	perati	ng assets	-	€	7.613.00	\vdash				
Value of equity	e a a a a			€	62.181.37					
- Value of equity option	ns				\$0.00					
Number of shares					2 569 20					
Value ner share				£	2,303.20	<u> </u>			Stock was trading at -	E AG
				- T	27.20	4			JUDER Was LIQUINE at -	40.7

	Sep-22						
Bed Bath and Beyond is in	n a downward spiral,	but we see a glimmer	of hope, where the o	company shuts stores	that require the most capital	and get the least foot traffic over the next	
decade, shrinking already-shrunk revenues further, but seeing its operating margins improve to the US brick-and-mortar sector average margin, over the next five years. Along the w							
the divestritures and shu	t downs will relase ca	sh that can be returne	ed and used to pay d	own debt. By the end	of the forecast period, BB&B	finds a niche market, albeit wiht a smaller	
footprint, growing at the	same rate as the eco	nomy and earning no	excess returns				
The Assumptions							
	Base year	Next year	Years 2-5	Years 6-10	After year 10	Link to story	
Revenues (a)	\$7,868.00	-10.0%	-5.00%	→ 3.00%	3.00%	Disruption platform in multiple businesses	
						Margins improve, aided by cloud business	
Operating margin (b)	-1.00%	-1.0%	-1.00%	→ 5.54%	5.54%	& continued economies of scale.	
Tax rate	25.00%		25.00%	→ 25.00%	25.00%	Global/US marginal tax rate over time	
Reinvestment (c)		2.00	2.00	2.00	30.00%	Maintined at Amazon's current level	
Return on capital	-2.80%	Marginal ROIC =	-57	.31%	10.00%	Stronge competitive edges	
Cost of capital (d)			8.79%	→ 7.50%	7.50%	Cost of capital close to median company	
			The	Cash Flows			
	Revenues	Operating Margin	EBIT	EBIT (1-t)	Reinvestment	FCFF	
1	\$7,081.20	-1.00%	-\$70.81	-\$70.81	\$0.00	-\$70.81	
2	\$6,727.14	1.62%	\$108.72	\$108.72	-\$177.03	\$285.75	
3	\$6,390.78	2.92%	\$186.89	\$186.89	-\$168.18	\$355.06	
4	\$6,071.24	4.23%	\$256.96	\$256.96	-\$159.77	\$416.73	
5	\$5,767.68	5.54%	\$319.56	\$244.23	-\$151.78	\$396.01	
6	\$5,571.58	5.54%	\$308.69	\$231.52	-\$98.05	\$329.57	
7	\$5,471.29	5.54%	\$303.14	\$227.35	-\$50.14	\$277.50	
8	\$5,460.35	5.54%	\$302.53	\$226.90	-\$5.47	\$232.37	
9	\$5,536.79	5.54%	\$306.77	\$230.07	\$38.22	\$191.85	
10	\$5,702.90	5.54%	\$315.97	\$236.98	\$83.05	\$153.92	
Terminal year	\$5,873.99	5.54%	\$325.45	\$244.09	\$73.23	\$170.86	
		·	T.	he Value			
Terminal value			\$3,796.89				
PV(Terminal value)			\$1,695.10				
PV (CF over next 10 years	:)		\$1,644.97				
Value of operating assets	=		\$3,340.07				
Adjustment for distress			\$396.47		Probability of failure =	23.74%	
- Debt & Minority Intere	sts		\$3,085.00				
+ Cash & Other Non-oper	rating assets		\$440.00				
Value of equity	_		\$298.60				
- Value of equity options			\$0.00				
Number of shares			92.50				
Value per share			\$3.23		Stock was trading at =	\$8.79	

2. Face up to uncertainty...

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- The healthiest responses to uncertainty require you to face up to the uncertainty, clarifying how uncertain you feel about your inputs and why and then addressing how that uncertainty affects your decision making.
- In probabilistic approaches, we deal with uncertainty more explicitly by
 - Asking what if questions about key inputs and looking at the impact on value (Sensitivity Analysis)
 - Looking at the cash flows/value under different scenarios for the future (Scenario Analysis)
 - Using probability distributions for key inputs, rather than expected values, and computing value as a distribution as well (Simulations)

a. Sensitivity Analysis and What-if Questions...

- The NPV, IRR and accounting returns for an investment will change as we change the values that we use for different variables.
- One way of analyzing uncertainty is to check to see how sensitive the decision measure (NPV, IRR..) is to changes in key assumptions. While this has become easier and easier to do over time, there are caveats that we would offer.
- <u>Caveat 1</u>: When analyzing the effects of changing a variable, we often hold all else constant. In the real world, variables move together.
- <u>Caveat 2</u>: The objective in sensitivity analysis is that we make better decisions, not churn out more tables and numbers.
 - Corollary 1: Less is more. Not everything is worth varying...
 - Corollary 2: A picture is worth a thousand numbers (and tables).

What-if Analyses: Limits and Extensions

- <u>One equation, one unknown</u>: Since the intrinsic value is one equation, the most you can solve for is one unknown.
 - You can pick your "key variable" (growth, discount rates, margin, CAP) and solve for that variable.
 - Implicitly, you are holding all else constant, which makes sense only if your input variables are uncorrelated with each other.
- <u>Considering correlations</u>: In the real world, inputs don't move independently.
 - If your what-if is around business models, increasing one variable can come at the expense of another.
 - If your what-if is around macro shocks/changes, the shock can affect variables in the same direction.

b. Scenario Analysis

- Scenario analysis is best employed when the outcomes of a project are a function of the macro economic environment and/or competitive responses.
- As an example, assume that Boeing is considering the introduction of a new large capacity airplane, capable of carrying 650 passengers, called the Super Jumbo, to replace the Boeing 747. The cash flows will depend upon two major "uncontrollable" factors:
 - The growth in the long-haul, international market, relative to the domestic market. Arguably, a strong Asian economy will play a significant role in fueling this growth, since a large proportion of it will have to come from an increase in flights from Europe and North America to Asia.
 - The likelihood that Airbus, Boeing's primary competitor, will come out with a larger version of its largest capacity airplane, the A-300, over the period of the analysis.

Valuing easyJet: Brexit's Consequences

	No Deal Brexit	Bad Deal Brexit	Soft or No Brexit
Restructuring cost (up front)	£500 million	£300 million	\$0
Revenue growth	3.00%	5.00%	5.00%
Operating Margin	6.00%	7.00%	8.00%
Sales to Capital Ratio	1.73	1.73	1.73

	No Deal Brexit	Delayed & Messy Brexit	Soft or No Brexit	
Probability	25%	50%	25%	
Value Per Share	£12.02	£15.70	£19.38	

Expected Value per share = $.25 (\pounds 12.02) + .50 (\pounds 15.70) + .25 (\pounds 19.38) = \pounds 15.70$

A Story-based Scenario Analysis: Zomato IPO in 2021

Story	TAM (in ₹ millions)	Market Share	Revenue Slice	Target Margin	Cost of Capital	Value/share	
Delivery Juggernaut	₹ 5,000,000.00	40%	25%	45%	9.50%	₹ 150.02]]
Delivery Star	₹ 5,000,000.00	40%	22%	35%	9.50%	₹ 93.00	
Delivery Leader + Competition	₹ 5,000,000.00	40%	15%	35%	10.99%	₹ 61.55] ā
Restaurant Delivery Juggernaut + High Growth India	₹ 3,000,000.00	40%	25%	45%	9.50%	₹ 94.31	
Restaurant Delivery Star + High Growth India	₹ 3,000,000.00	40%	22%	35%	9.50%	₹ 59.02]_
Restaurant Delivery + Competition + High Growth India	₹ 3,000,000.00	40%	20%	25%	10.99%	₹ 35.52] <u>ē</u>
Base Case, Positive	₹ 2,000,000.00	40%	25%	45%	10.25%	₹ 56.66	ap
Base Case	₹ 2,000,000.00	40%	22%	35%	10.25%	₹ 39.48	٦
Base Case, Negative	₹ 2,000,000.00	40%	20%	25%	10.25%	₹ 26.16	
Restaurant Delivery Juggernaut + Low Growth India	₹ 1,125,000.00	40%	25%	45%	9.50%	₹ 36.48]_
Restaurant Delivery Star + Low Growth India	₹ 1,125,000.00	40%	22%	35%	9.50%	₹ 24.02	aus
Restaurant Delivery + Competition + low Growth India	₹ 1,125,000.00	40%	20%	25%	10.99%	₹ 16.58	

c. Simulations

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Percentiles:	Forecast values
0%	\$6.55
1 0%	\$23.90
20%	\$27.73
3 0%	\$30.89
40%	\$33.88
50%	\$36.99
60%	\$40.28
70%	\$44.22
80%	\$49.24
90%	\$57.49
100%	\$197.11



3. Macro changes can move your intrinsic value



An Example: Inflation and Value



Rule 1: Be macro consistent

Discount rate and Cash flow assumptions

- The riskfree rate that you used to estimate your discount rate already incorporates assumptions about inflation and real growth. The cash flows that you use should reflect the same expectations.
- If you mismatch inflation or real growth assumptions, you will mis value companies.
 - If you build in higher expectations of inflation and real growth into your cash flows than you have incorporated into your discount rate, you will over value companies.
 - If you build in lower expectations of inflation and real growth into your cash flows than you have incorporated into your discount rate, you will under value companies.
- Bottom line: It is more important that you be consistent in your inflation/ growth assumptions than that you are right.

Inflation Consistency in Valuation

- In a scenario where inflation is volatile and you are trying to estimate its level and effects on the value of a company, trying to get it right is an impossible task. You should however always maintain internal consistency in your valuation.
- Put simply, if you expect inflation to be low (high), your discount rate and expected growth rate should both incorporate that low (high) inflation.



Rule 2: Keep your focus Don't let the macro drown the micro

- When you are asked to value a company, you should keep your focus on what drives that value. If you bring in your specific macro views into the valuation, the value that you obtain for a company will be a joint result of what you think about the company and your macro views.
- Bottom line: If you have macro views, provide them separately. You should be as macro-neutral as you can be, in your company valuations.
- Follow up: If you find macro risk dominating your thoughts, deal with it frontally.

Rule 3: Adopt the Karmic Pose

- For existential risks (climate change, nuclear war), the best strategy is to build into your business-level expectations that which you can, and that you then let go of the rest of your concerns.
 - If the existential risk does play out, none of your investment choices will matter any way. In apocalyptic movies and books, notice that no one is talking about interest rates or stock prices.
 - If it does not play out, all your worrying would have done is cost you your sleep and health, with no tangible payoffs.



Aswath Damodaran

Forecasting in the face of uncertainty. A

test:

In which of these two cities would you find it easier to forecast the weather?

Weather changeability for Honolulu, Hawaii

Temperature	Last Month	Last Year	Precipitation	Last Month	Last Year
Average change in high temperature day-to-day	1.7°	1.2°	Chance of dry day after a precip day	67%	81%
Average change in low temperature day-to-day	1.5°	2.0°	Chance of precip day after a dry day	7%	13%

Weather changeability for Epping, North Dakota

Temperature	Last Month	Last Year	Precipitation	Last Month	Last Year
Average change in high temperature day-to-day	8.5°	7.7°	Chance of dry day after a precip day	50%	65%
Average change in low temperature day-to-day	7.1°	8.6°	Chance of precip day after a dry day	38%	20%

But the payoff is greatest where there is the most uncertainty...

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Weather changeability for Honolulu, Hawaii

Temperature	Last Month	Last Year	P	recipitation	Last Month	La Ye
Average change in high temperature day-to-day	1.7°	1.2°	C	hance of dry day after a recip day	67%	8
Average change in low temperature day-to-day	1.5°	2.0°	Cat	hance of precip day fter a dry day	7%	1

Further changeability analysis >

Weather forecast accuracy for Honolulu, Hawaii

ast Month		Last Year	
MeteoGroup	88.44%	MeteoGroup	88.50%
Persistence	81.80 %	CustomWeather	85.87%
CustomWeather	78.23 %	AccuWeather	81.82%
The Weather Channel	73.12%	The Weather Channel	81.56%
AccuWeather	69.89%	Persistence	80.44%
Weather Underground	62.10%	Weather Underground	67.07%
National Weather Service	48.39%	National Weather Service	59.90%
Foreca	44.35%	Foreca	57.52%
WeatherBug	32.26%	WeatherBug	37.09%



Weather changeability for Epping, North Dakota

Temperature	Last Month	Last Year	Precipitation	Last Month	Last Year
Average change in high temperature day-to-day	8.5°	7.7°	Chance of dry day after a precip day	50%	65%
Average change in low temperature day-to-day	7.1°	8.6°	Chance of precip day after a dry day	38%	20%

Further changeability analysis »

Weather forecast accuracy for Epping, North Dakota

Last Month	Las	
MeteoGroup	62.50%	Me
Foreca	61.61%	Th
The Weather Channel	61.31%	Ac
AccuWeather	60.42%	We
Weather Underground	56.85%	For
WeatherBug	56.17%	Cu
National Weather Service	54.76%	Na
CustomWeather	54.46%	We
Persistence	38.01%	Per

Last Year				
MeteoGroup	66.97 %			
The Weather Channel	66.73%			
AccuWeather	64.86 %			
WeatherBug	64.80%			
Foreca	62.75%			
CustomWeather	62.70%			
National Weather Service	62.64%			
Weather Underground	61.38%			
Persistence	44.09%			



Aswath Damodaran