

Coding e Fondamenti di Intelligenza Artificiale

A.A. 2026/27 — Lezione 9: Grafici

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80 prodotti, 5 categorie

Categoria	Prodotti	Fatturato totale	Prezzo medio	Valutazione media
Abbigliamento	14	1.465.159 €	58,78 €	3,85
Alimentari	17	1.582.226 €	16,16 €	3,69
Casa	17	2.068.916 €	143,69 €	3,72
Elettronica	20	2.708.195 €	361,60 €	3,70
Sport	12	1.459.227 €	105,77 €	3,66
Totale	80	9.283.723 €		

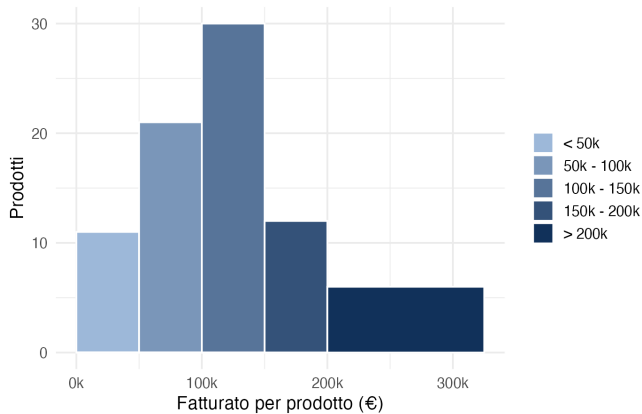
business_intelligence.csv

codice	categoria	prezzo	unità	fatturato	valutazione	reso %
PROD0001	Casa	32,16	2007	64.544,89	3,0	7,6
PROD0002	Alimentari	9,99	8241	82.311,37	3,6	4,9
PROD0003	Casa	42,13	1938	81.645,44	2,8	10,9
PROD0004	Sport	67,09	1413	94.794,81	3,6	8,9
PROD0005	Sport	49,78	1805	89.859,10	3,8	8,4
PROD0006	Elettronica	38,90	1753	68.192,84	3,0	10,4
...						

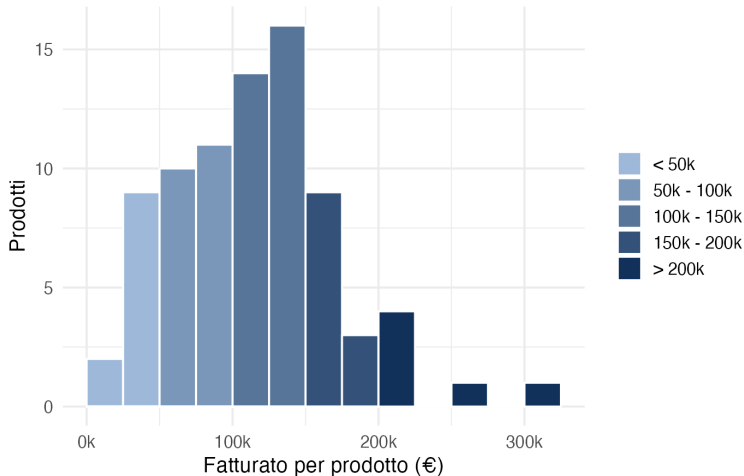
Fatturato	n	%
< 50k	11	13,8
50k - 100k	21	26,2
100k - 150k	30	37,5
150k - 200k	12	15,0
> 200k	6	7,5

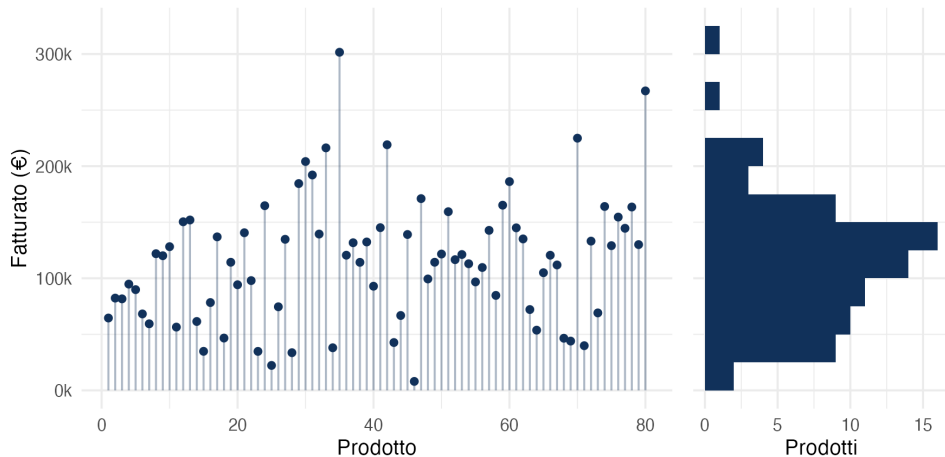
$$f_i = \frac{n_i}{N} \quad \% = 100 \cdot f_i$$

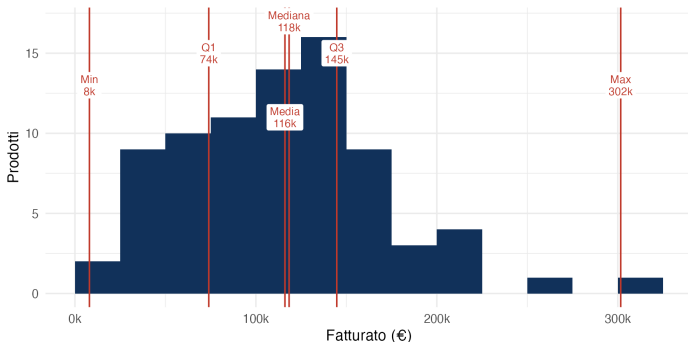
N = 80 prodotti



Barre più fini: 25k invece di 50k, gli stessi colori delle fasce







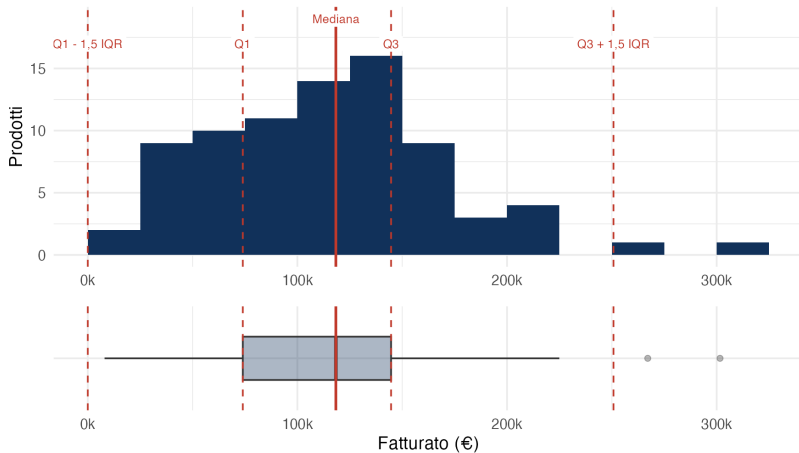
Min	1st Qu.	Median	Mean	3rd Qu.	Max
8.004	73.949	118.351	116.047	144.688	301.599

$$\bar{X} = \frac{1}{N} \sum_{i=1}^N x_i$$

Q_p = valore in posizione $1 + (N - 1)p$ nei dati ordinati

$N = 80$: $Q_{0,25}$ in posizione 20,75 mediana $Q_{0,5}$ in posizione 40,5 $Q_{0,75}$ in posizione 60,25 Min = $x_{(1)}$

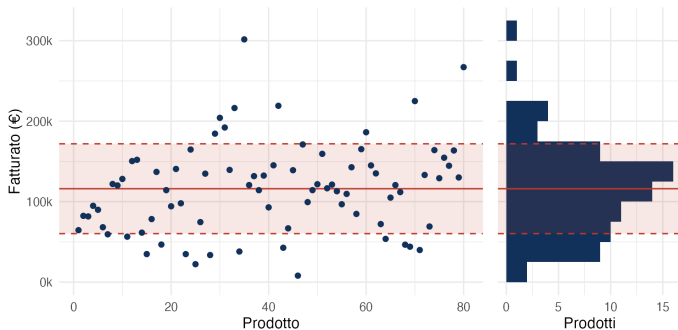
Max = $x_{(N)}$



$$\text{IQR} = Q_3 - Q_1 = 70.739$$

$$Q_1 - 1,5 \cdot \text{IQR} = -32.159$$

$$Q_3 + 1,5 \cdot \text{IQR} = 250.796$$

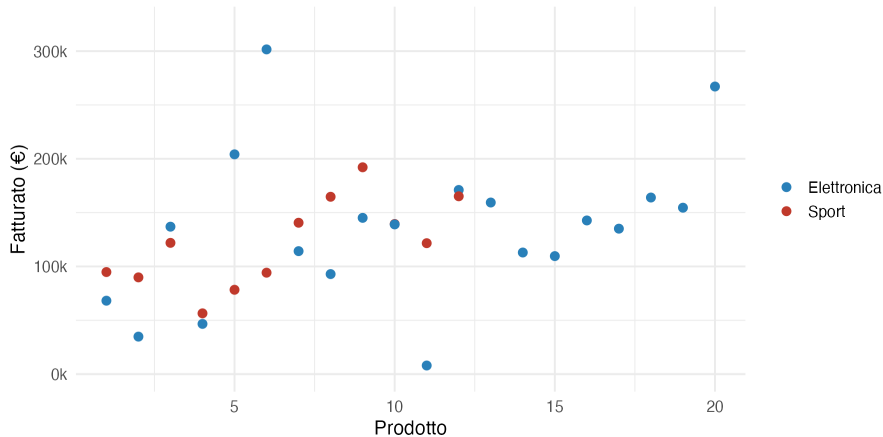


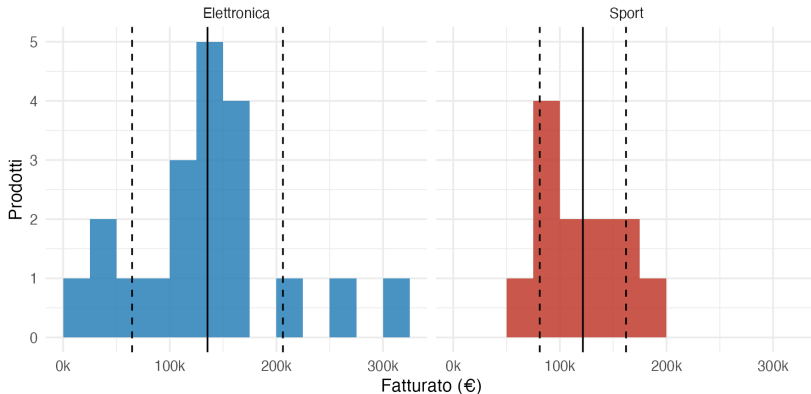
Statistica: Variabilità

Media 116.047 €

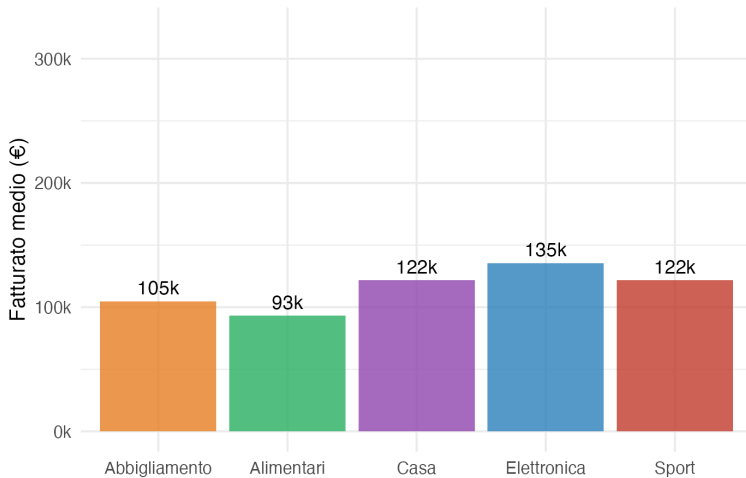
Dev. Std. 55.817 €

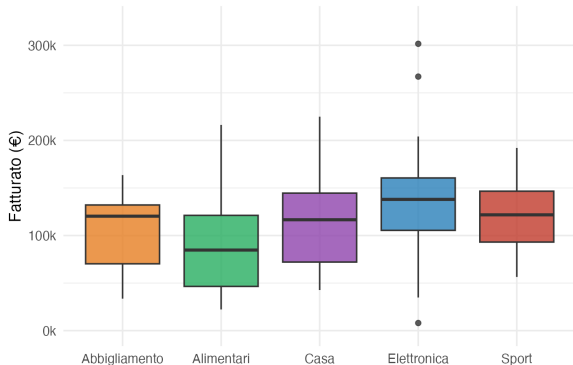
$$S = \sqrt{\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N - 1}}$$



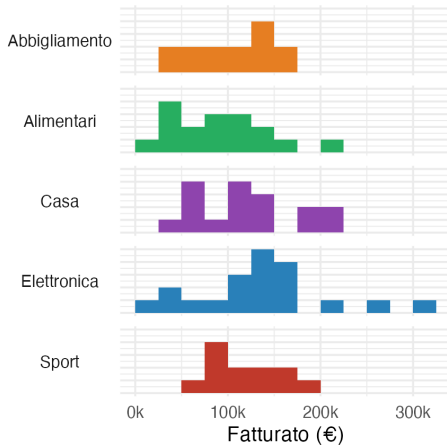
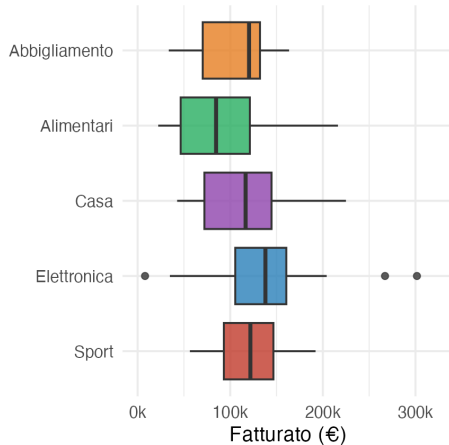


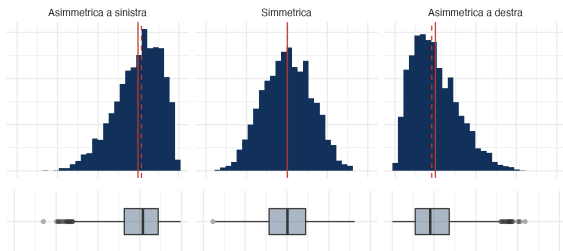
	Media	Dev. Std.
Elettronica	135.410 €	70.730 €
Sport	121.602 €	40.457 €





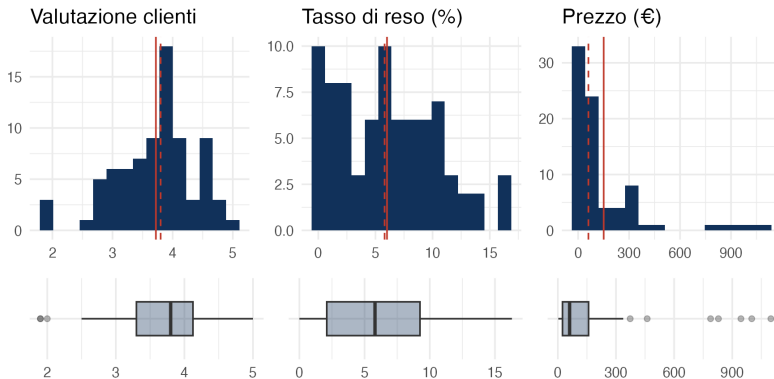
Categoria	Media	Dev. Std.
Abbigliamento	104.654	41.928
Alimentari	93.072	50.444
Casa	121.701	56.070
Elettronica	135.410	70.730
Sport	121.602	40.457



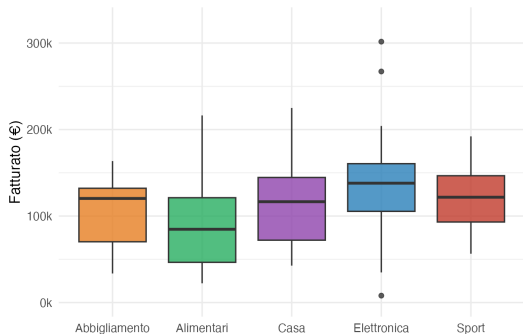


$$SK = \frac{N}{(N-1)(N-2)} \sum_{i=1}^N \left(\frac{x_i - \bar{x}}{s} \right)^3$$

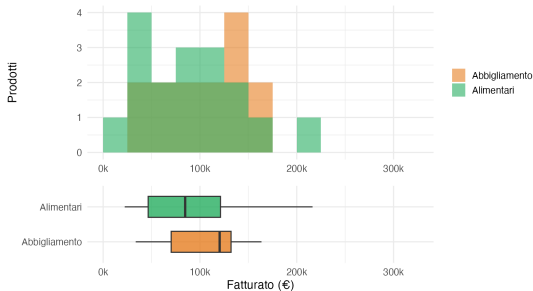
$SK < 0$ asimmetrica a sinistra
 $SK = 0$ simmetrica
 $SK > 0$ asimmetrica a destra



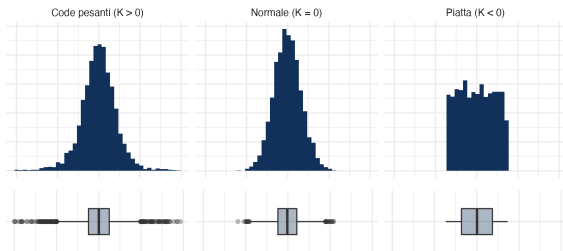
	Media	Mediana	Skewness
Valutazione clienti	3,72	3,80	-0,61
Tasso di reso	6,01	5,80	0,37
Prezzo	150,52	60,69	2,68



Categoria	Media	Dev. Std.	Skewness
Abbigliamento	104.654	41.928	-0,59
Alimentari	93.072	50.444	0,77
Casa	121.701	56.070	0,49
Elettronica	135.410	70.730	0,51
Sport	121.602	40.457	0,16



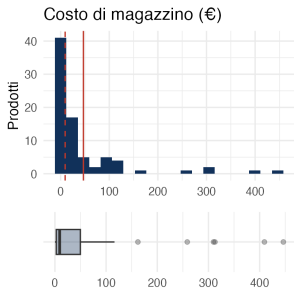
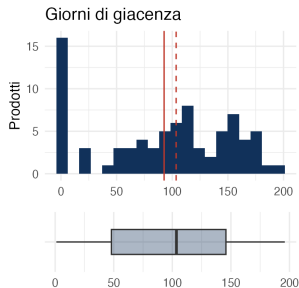
	Media	Dev. Std.	Skewness
Abbigliamento	104.654	41.928	-0,59
Alimentari	93.072	50.444	0,77



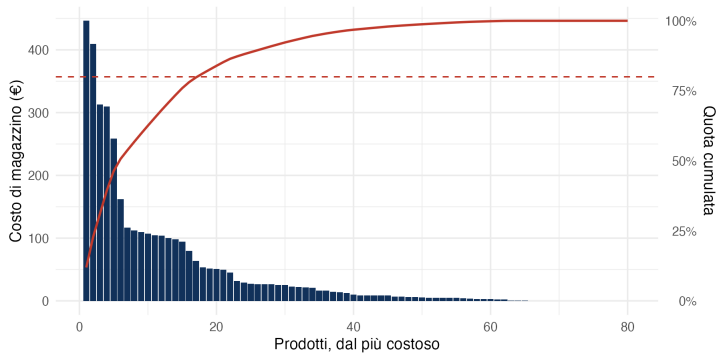
$$K = \frac{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^4}{\left(\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2 \right)^2} - 3$$

$K > 0$	valori estremi più frequenti di quanto dica la dev. std.: picchi di domanda, ritardi, costi concentrati
$K = 0$	media e dev. std. descrivono bene i dati
$K < 0$	nessun valore tipico: dati sparsi o divisi in due gruppi

Dove tagliare il costo di magazzino?

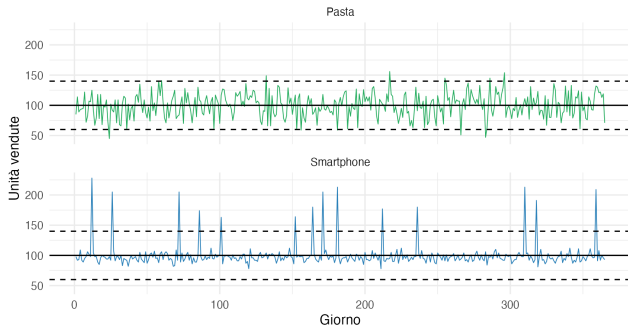


	Media	Mediana	Dev. Std.	Skewness	Curtosi
Costo di magazzino	46,84	9,30	87,95	3,01	8,79
Giorni di giacenza	92,67	103,50	60,56	-0,27	-1,16



$$\text{Quota cumulata}_k = \frac{\sum_{i=1}^k c_{(i)}}{\sum_{i=1}^N c_i} \quad c_{(1)} \geq c_{(2)} \geq \dots \text{costi ordinati dal più grande}$$

10 prodotti su 80 fanno il **63%** del costo di magazzino; 18 prodotti fanno l'**80%**.

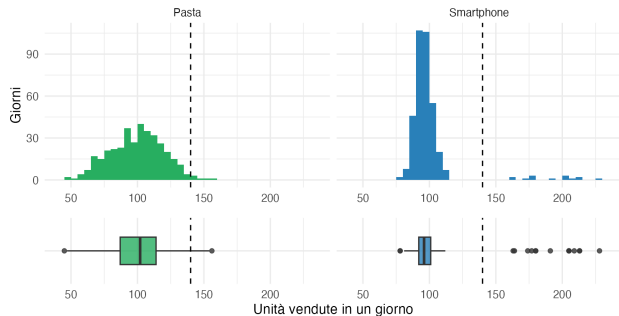


Quante scorte tenere?

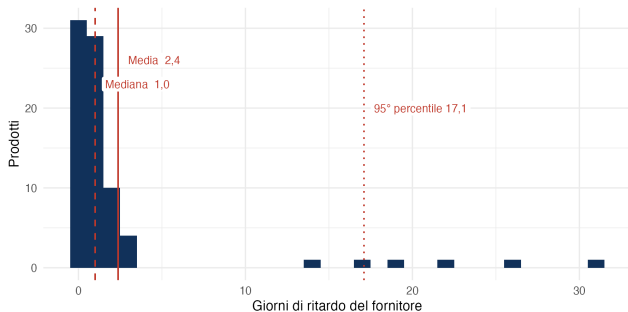
	Media	Dev. Std.
Pasta	100	20
Smartphone	100	20

Linee: $\bar{x}$ e $\bar{x} \pm 2s$

$$\bar{x} + 2s = 100 + 2 \cdot 20 = 140$$



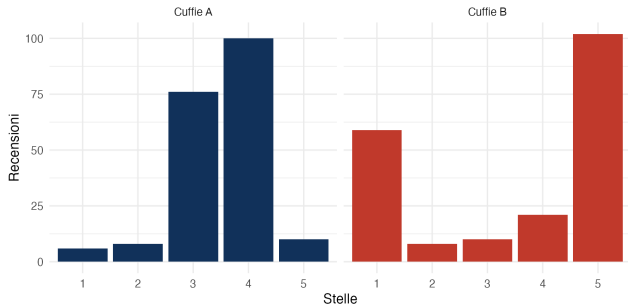
	Media	Dev. Std.	Skewness	Curtosi	Giorni oltre $\bar{x} + 2s$	Massimo
Pasta	100	20	-0,08	-0,29	6	156
Smartphone	100	20	4,40	20,30	14	228



Che tempi di consegna promettere al cliente?

Media	2,4 giorni
Mediana	1 giorno
95° percentile	17,1 giorni
Skewness	3,60
Curtosi	11,82

$P_{95} = Q_{0,95}$: posizione
 $1 + (N - 1) \cdot 0,95 = 76,05$ nei dati
ordinati

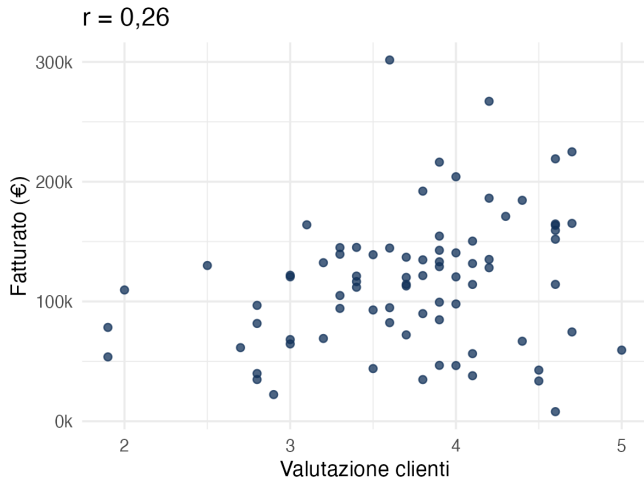


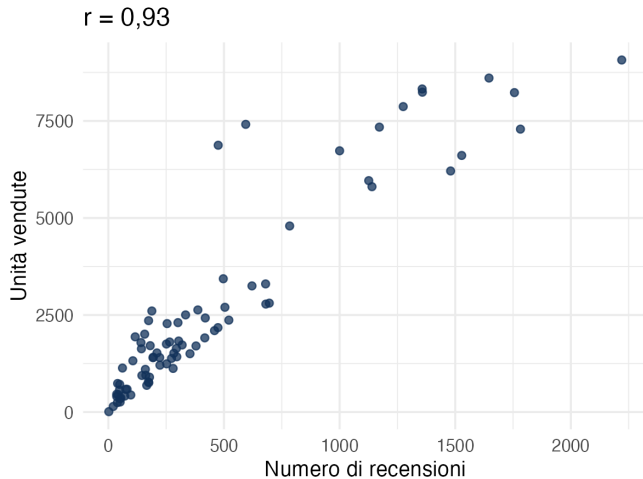
Il prodotto piace?

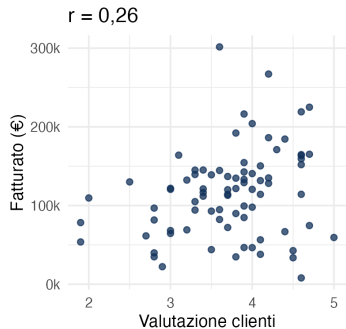
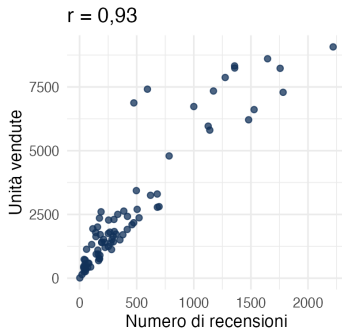
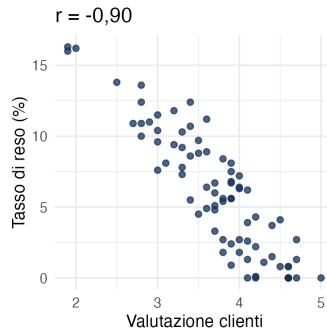
	Cuffie A	Cuffie B
Media	3,50	3,50
Dev. Std.	0,78	1,77
Curtosi	1,52	-1,54
1 stella	3%	29,5%

$$\% 1 \text{ stella} = 100 \cdot \frac{n_1}{N} \quad N = 200$$

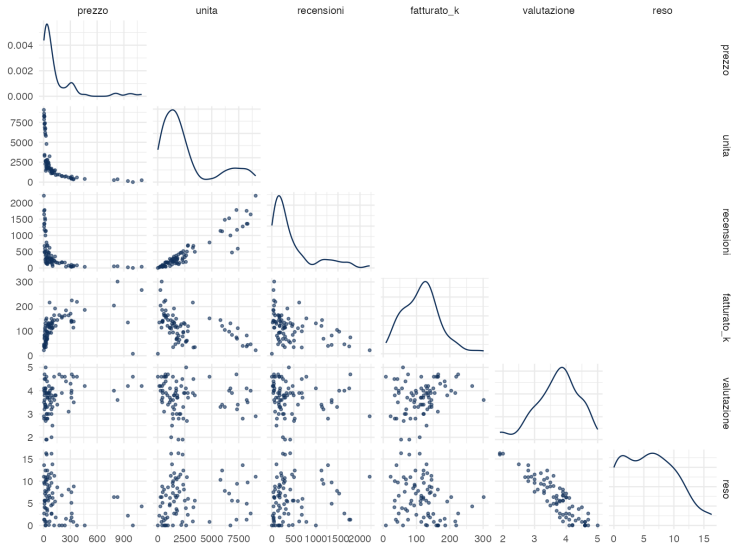
recensioni







Analisi Catalogo Prodotti - Bivariata



Analisi Univariata

Varianza

$$\text{Var}(X) = s^2 = \frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N - 1}$$

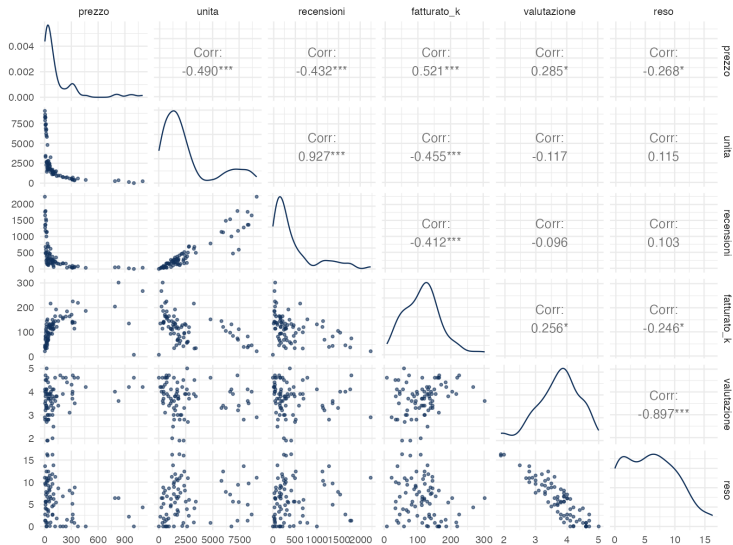
Analisi Bivariata

Covarianza

$$\text{Cov}(X, Y) = \frac{\sum_{i=1}^N (x_i - \bar{x})(y_i - \bar{y})}{N - 1}$$

Correlazione

$$\text{Corr}(X, Y) = \frac{\text{Cov}(X, Y)}{\sqrt{\text{Var}(X) \text{Var}(Y)}}$$



	prezzo	unità	recensioni	fatturato	valutazione	reso
prezzo	1,00	-0,49	-0,43	0,52	0,28	-0,27
unità	-0,49	1,00	0,93	-0,46	-0,12	0,11
recensioni	-0,43	0,93	1,00	-0,41	-0,10	0,10
fatturato	0,52	-0,46	-0,41	1,00	0,26	-0,25
valutazione	0,28	-0,12	-0,10	0,26	1,00	-0,90
reso	-0,27	0,11	0,10	-0,25	-0,90	1,00

