



Sustainable Coffee: A Statistical View

Authors

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Type of activity

This activity offers an applied introduction to managing and performing descriptive analysis of databases through the calculation of frequency tables, descriptive statistics, and graphical representations. The aim is to help students become familiar with identifying types of variables, handling them correctly, and choosing the right way to represent and interpret their characteristics.

Target educational level

This activity is aimed at first-year university students in STEM degrees, especially in Science, Engineering, Social Sciences, or Health Sciences degrees.

Initial information

The Annex I provides a database with information collected by the Coffee Quality Institute (CQI), a non-profit organization working to improve the quality and value of coffee worldwide.

The database includes 12 variables:

- **Sample_Number:** Numerical identifier for each sample.
- **Country_of_Origin:** The country where the sample comes from.
- **Grain_Color:** The color of the coffee bean.
- **Harvest_Year:** Year of harvest.
- **Altitude_m:** Altitude where the coffee was grown (in meters).
- **Bag_Weight_kg:** Weight of the coffee bag in kilograms.
- **Aroma, Flavor, Aftertaste, Acidity, Body, Balance:** Sensory evaluations on a numerical scale.



Source

Piegel, M. and Stephens, L. (2009): "Estadística (4ª edición)". Ed. Mc Graw Hill. México.

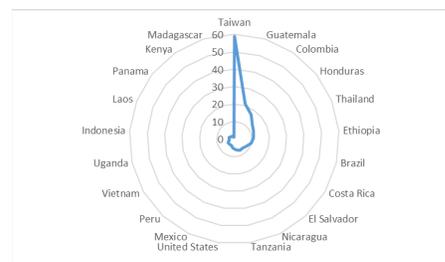
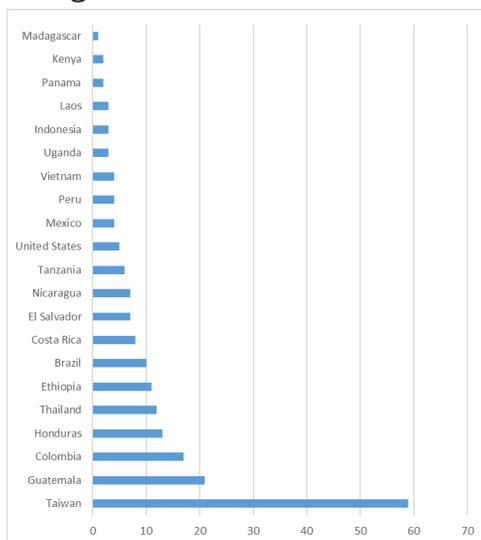
Martín, Q. and Ardanuy, R. (1993): "Estadística para ingenieros". Ed. Hespérides. Salamanca

Problem statement

1. Which types of charts are suitable for representing the Country of Origin variable? Which country has the highest frequency in the database?
2. What is the average, maximum, and minimum altitude where the coffee beans were grown?
3. What is the percentage of samples with a bean color of "green" and "brownish"?
4. How is the Bag_Weight_kg variable distributed? Is it symmetric or asymmetric? Are there any outliers?
5. Which of these two variables is more homogeneous: Aroma or Flavor? Calculate the Coefficient of Variation (CV) for both to support your answer.

Solution

1. The most suitable charts for representing the Country of Origin variable (a qualitative nominal variable) are Bar chart (vertical or horizontal), Heat map (by geographic origin) and Radial chart (when there are many categories).





A pie chart is not recommended since there are 21 different countries. The country with the highest frequency in the sample is Taiwan, followed by Guatemala and Colombia.

Frequency table	f_i
Taiwan	59
Guatemala	21
Colombia	17
Honduras	13
Thailand	12
Ethiopia	11
Brazil	10
Costa Rica	8
El Salvador	7
Nicaragua	7
Tanzania	6
United States	5
Mexico	4
Peru	4
Vietnam	4
Uganda	3
Indonesia	3
Laos	3
Panama	2
Kenya	2
Madagascar	1

- The average altitude where the coffee was grown is 1298.27 meters, with a maximum of 5400 meters and a minimum of 139 meters.

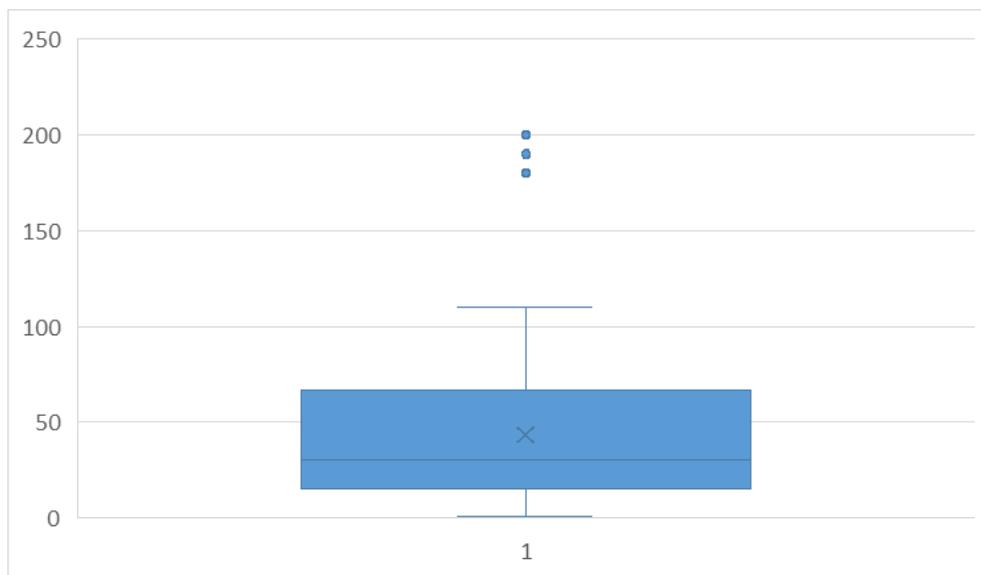
Mean	=AVERAGE(E2:E205)	1298,27451
Maximum value	=MAX(E2:E205)	5400
Minimum value	=MIN(E2:E205)	139



3. 49.01% of the samples had a “green” bean color and 4.46% had a “brownish” tone.

frequency table	fi	%
green	99	49,01
greenish	35	17,33
bluish-green	21	10,40
blue-green	11	5,45
yellow-green	10	4,95
brownish	9	4,46
yellow green	5	2,48
pale yellow	5	2,48
yellowish	4	1,98
yello-green	1	0,50
browish-green	1	0,50
yellow- green	1	0,50
	202	100

4. The Bag_Weight_kg variable has a positive skewness, meaning the distribution is skewed to the right, with 3 positive outliers detected.





5. The Coefficient of Variation (CV) for the Aroma variable is 0.38, and for Flavor it is 0.43. Therefore, the Aroma variable is more homogeneous as it shows less relative dispersion compared to its mean.

Aroma		
Standard deviation	=STDEV.S(G2:G205)	254,21
Mean	=AVERAGE(G2:G205)	662,49
CV	=254,21/662,49	0,38

Flavor		
Standard deviation	=STDEV.S (H2:H205)	275,17
Mean	=AVERAGE(H2:H205)	640,23
CV	=275,17/640,23	0,43

Annex I

ID	Country_of_Origin	Grain_Color	Harvest_Year	Altitude_m	Bag_Weight_kg	Aroma	Flavor	Aftertaste	Acidity	Body	Balance
0	Colombia	green	2021	1700	35	858	85	842	858	825	842
1	Taiwan	blue-green	2021	1200	80	85	85	792	80	792	825
2	Laos	yellowish	2021	1300	25	833	842	808	817	792	817
3	Costa Rica	green	2022	1900	22	808	817	817	825	817	808
4	Colombia	yellow-green	2022	1850	24	833	833	808	825	792	792
5	Guatemala	green	2022	1668	30	833	833	825	783	783	817
6	Taiwan	green	2021	1250	27	833	817	808	80	783	825
7	Taiwan	yellow green	2021	1200	90	825	825	817	80	792	808
8	Taiwan	greenish	2021	1250	30	808	808	825	808	792	400
9	Tanzania	greenish	2021	1400	60	808	817	808	817	800	400
10	Ethiopia	greenish	2021	1800	30	808	825	80	808	792	792
11	Guatemala	brownish	2021	2000	15	808	80	80	775	825	817
12	Taiwan	green	2021	1250	60	808	80	808	808	800	400
13	Ethiopia	yellow- green	2021	1900	60	767	817	80	833	800	400
14	Colombia	green	2021	1850	35	808	80	808	792	800	400
15	Taiwan	green	2021	1100	60	817	808	80	792	800	792
16	Ethiopia	green	2022	1900	5	817	808	792	817	775	792
17	Taiwan	yellow-green	2022	1300	2	80	817	80	792	792	792
18	Taiwan	brownish	2021	1200	1	808	817	775	792	783	400
19	Tanzania	greenish	2021	1570	30	817	80	792	792	817	775
20	Guatemala	yellowish	2021	1900	30	80	792	808	792	775	400
21	Taiwan	green	2022	850	20	808	80	792	792	800	783
22	Thailand	browish-green	2021	1500	1	767	80	783	80	500	400
23	Colombia	brownish	2022	1350	5	808	80	783	817	775	783
24	Taiwan	bluish-green	2021	1250	50	783	80	792	80	800	792
25	Brazil	green	2022	1250	60	783	808	783	792	800	783
26	Taiwan	green	2021	1300	100	792	792	80	792	783	792
27	Taiwan	green	2021	1200	90	817	808	792	80	758	783
28	Taiwan	blue-green	2021	1060	85	80	80	80	792	775	792
29	United States	green	2021	600	15	80	792	80	783	767	400
30	Taiwan	bluish-green	2022	150	48	80	80	783	783	775	792
31	Taiwan	green	2022	150	50	792	80	783	792	783	783
32	Taiwan	green	2022	668	5	808	817	767	783	767	792
33	Ethiopia	green	2021	1950	60	767	783	783	80	800	500
34	Ethiopia	yellow green	2021	2150	60	80	808	80	80	767	775
35	Ethiopia	greenish	2021	1700	192	792	775	783	817	800	775
36	Taiwan	bluish-green	2021	1200	100	80	792	783	792	783	783

37	Taiwan	green	2022	650	5	825	808	783	775	767	775
38	Kenya	greenish	2021	1600	60	817	775	783	758	792	500
39	Taiwan	bluish-green	2017	850	1	775	792	775	80	783	792
40	Taiwan	brownish	2022	300	10	80	792	783	792	775	775
41	Taiwan	greenish	2021	1000	2	80	808	767	775	792	783
42	Taiwan	pale yellow	2021	800	50	80	792	767	80	775	783
43	Uganda	green	2021	1905	60	80	792	775	775	775	792
44	Taiwan	green	2021	150	50	792	80	792	80	758	775
45	Taiwan	yellow green	2021	800	50	817	808	783	767	767	775
46	Guatemala	green	2023	1600	30	767	808	767	80	792	783
47	Guatemala	green	2023	4700	30	767	80	775	792	800	783
48	Guatemala	green	2022	1600	69	783	792	775	80	775	775
50	Taiwan	brownish	2022	230	4	80	80	775	775	767	775
51	Indonesia	bluish-green	2022	1200	60	783	792	775	783	783	783
52	Peru	greenish	2022	1750	5	80	80	783	783	758	783
53	Tanzania	greenish	2023	1654	30	792	775	775	792	783	783
54	Taiwan	greenish	2021	1300	25	783	783	767	767	783	450
55	Taiwan	green	2021	1400	30	767	792	792	783	775	783
56	Brazil	green	2022	1100	36	783	792	775	792	767	783
57	Panama	bluish-green	2022	1200	30	783	783	775	792	783	775
58	Taiwan	blue-green	2021	1200	2	792	808	767	792	767	775
59	Guatemala	green	2022	1600	30	767	80	767	783	792	767
60	Guatemala	yellow-green	2021	4895	30	783	80	767	783	775	775
61	Costa Rica	green	2022	1850	69	758	783	75	767	783	767
62	Taiwan	greenish	2021	200	16	783	783	775	775	775	775
63	Taiwan	green	2022	700	5	817	783	767	783	767	767
64	Nicaragua	green	2021	1350	45	792	775	767	767	783	775
65	Taiwan	green	2021	1250	80	808	783	767	767	767	775
66	Taiwan	green	2021	1450	104	783	80	767	775	767	775
67	Vietnam	brownish	2021	650	5	80	783	775	767	758	783
68	Costa Rica	green	2022	1900	22	775	783	767	783	775	775
69	Taiwan	bluish-green	2021	520	180	775	792	783	775	775	775
70	Honduras	green	2022	1368	69	783	792	775	775	775	775
71	Ethiopia	green	2021	1943	30	792	783	775	792	758	767
72	Taiwan	green	2021	400	20	808	792	775	783	500	758
73	Taiwan	bluish-green	2021	850	100	783	80	75	775	775	775
74	Guatemala	green	2022	1300	30	767	783	775	775	783	775
75	United States	yellow-green	2022	1300	10	792	783	775	792	500	767
76	Ethiopia	yellow green	2021	2361	60	783	775	758	792	800	475
77	El Salvador	brownish	2021	1500	30	783	783	783	783	767	767
78	Colombia	green	2021	2100	70	775	775	775	775	783	767
79	Indonesia	blue-green	2022	1250	60	767	767	783	783	767	775

80	Guatemala	green	2022	1600	30	758	792	767	775	783	775
81	Madagascar	blue-green	2022	1500	60	792	792	758	775	758	767
82	Honduras	green	2022	1368	30	775	775	758	783	775	775
83	Guatemala	green	2021	1600	69	758	792	758	783	775	767
84	Taiwan	greenish	2021	150	110	783	792	783	758	758	767
85	Taiwan	yello-green	2021	800	80	792	775	767	775	775	580
86	Guatemala	green	2022	1500	30	767	783	767	783	775	767
87	Guatemala	green	2022	1500	30	767	792	767	775	767	758
88	Honduras	green	2021	1800	30	775	775	775	767	775	767
89	Tanzania	greenish	2022	1600	60	758	767	775	775	775	775
90	Ethiopia	green	2021	1800	60	80	775	75	767	767	767
91	Tanzania	greenish	2022	1400	60	775	758	758	792	767	775
92	Colombia	green	2022	1400	70	767	783	758	792	767	767
93	Costa Rica	green	2022	1850	35	767	792	758	775	767	758
94	Guatemala	greenish	2021	1900	15	783	783	758	767	767	758
95	Guatemala	green	2022	1600	30	758	783	758	775	767	775
96	Thailand	yellowish	2022	1300	30	775	767	758	775	775	767
97	Colombia	green	2022	1411	70	767	775	767	775	767	767
98	Guatemala	green	2021	1400	30	758	783	767	767	767	767
99	Guatemala	greenish	2021	4895	30	758	792	75	767	775	767
100	Ethiopia	green	2021	2000	60	783	767	75	792	500	767
101	Colombia	green	2022	1700	70	792	775	742	758	792	767
102	United States	green	2022	400	15	767	792	758	758	758	775
103	Colombia	greenish	2022	1800	35	767	792	767	758	767	767
104	Mexico	green	2022	1200	30	767	767	758	767	783	758
106	Taiwan	bluish-green	2022	1250	2	767	767	775	775	500	767
108	Taiwan	greenish	2021	200	13	758	775	767	783	500	767
109	Honduras	pale yellow	2021	1470	15	767	767	758	775	767	767
110	Taiwan	green	2021	250	10	758	767	75	775	775	767
111	Taiwan	green	2021	250	10	758	775	758	775	758	767
112	Guatemala	green	2021	1600	69	758	783	758	767	758	758
113	Honduras	green	2021	1400	69	775	767	758	758	758	767
114	Colombia	bluish-green	2022	1700	30	775	775	75	758	783	475
115	Thailand	green	2022	1370	1	742	783	758	767	767	775
116	Ethiopia	greenish	2021	1700	192	742	742	742	80	792	767
117	Thailand	green	2022	1450	2	767	767	75	767	758	767
118	Uganda	green	2021	1600	60	775	775	75	75	758	758
119	Taiwan	blue-green	2021	1100	40	775	792	767	792	775	783
120	Uganda	green	2021	1905	60	775	767	758	75	767	500
121	Taiwan	greenish	2021	200	8	758	767	75	775	615	758
122	Guatemala	green	2021	1280	60	75	775	758	775	767	758
123	Taiwan	green	2021	300	80	758	767	758	775	742	758

124	Colombia	greenish	2021	1100	1	767	767	742	775	625	775
125	Costa Rica	green	2023	1850	69	758	775	742	767	600	775
126	Taiwan	blue-green	2021	750	100	775	783	758	758	758	500
127	Thailand	yellow-green	2022	1400	1	792	792	775	733	758	500
128	Tanzania	greenish	2023	1550	60	792	767	742	75	767	758
129	Brazil	green	2023	950	60	758	75	75	783	767	500
130	Taiwan	green	2021	1150	190	775	775	758	767	742	575
131	Colombia	brownish	2022	1390	12	767	767	758	767	758	758
132	Honduras	bluish-green	2021	1600	15	767	775	767	758	555	758
133	Honduras	green	2021	1400	69	775	758	758	758	605	758
134	Taiwan	greenish	2021	250	16	775	775	75	775	800	742
135	Taiwan	blue-green	2021	340	100	767	767	75	758	758	400
136	Laos	brownish	2022	1250	60	767	775	733	767	758	400
137	Honduras	green	2021	1368	69	767	767	75	758	758	400
138	Honduras	green	2023	1450	69	775	758	758	758	758	400
139	Colombia	bluish-green	2023	1650	30	80	767	742	758	758	742
140	Taiwan	blue-green	2021	275	12	75	767	758	758	815	400
141	Mexico	green	2021	1350	69	775	75	742	767	758	400
142	Colombia	greenish	2021	1350	12	758	75	75	767	758	400
143	Taiwan	yellow-green	2022	1200	1	767	75	742	775	742	758
144	Honduras	green	2023	1280	69	767	758	75	75	758	575
145	Thailand	yellow-green	2022	1390	1	717	792	758	75	758	767
146	Vietnam	green	2021	900	60	758	742	758	75	767	775
147	Nicaragua	green	2023	1200	69	733	758	725	733	775	817
148	Costa Rica	pale yellow	2021	1450	30	733	75	725	792	775	758
149	Colombia	green	2022	1700	70	758	767	758	75	733	475
150	Thailand	greenish	2022	1380	1	733	758	758	75	767	767
151	Thailand	yellow green	2022	1200	50	75	758	75	742	780	758
152	Honduras	green	2023	1450	69	767	758	733	75	758	450
153	Taiwan	green	2021	165	4	767	767	742	742	742	450
154	Taiwan	blue-green	2021	465	32	767	758	742	742	900	450
155	Nicaragua	green	2021	1350	45	75	758	742	758	500	758
156	El Salvador	green	2023	1200	30	767	733	717	767	783	500
157	Panama	green	2021	1200	30	775	767	717	767	742	742
158	Brazil	bluish-green	2023	1100	30	75	758	75	75	767	742
159	United States	blue-green	2022	640	15	733	758	75	75	915	758
160	Mexico	pale yellow	2021	1340	15	767	742	75	75	767	742
161	Honduras	green	2021	1368	30	758	758	733	75	758	742
162	Taiwan	green	2021	139	200	742	742	758	742	758	400
163	Nicaragua	bluish-green	2021	1200	69	758	758	742	742	750	400
164	Vietnam	bluish-green	2021	1040	15	75	75	733	75	515	742
165	El Salvador	green	2023	1200	30	75	75	742	742	742	767

166	El Salvador	bluish-green	2021	1200	69	733	767	725	767	783	742
167	Taiwan	green	2021	140	5	767	758	742	75	733	742
168	Peru	greenish	2023	1600	69	767	75	733	758	733	742
169	United States	green	2022	1200	30	775	742	733	75	733	500
170	Kenya	green	2022	1500	5	75	75	742	75	725	500
171	Honduras	green	2021	1368	69	767	75	725	75	515	733
172	Taiwan	bluish-green	2021	600	3	75	767	733	75	725	733
173	Taiwan	greenish	2021	460	60	733	742	742	75	742	400
174	Taiwan	green	2021	500	20	75	758	742	742	725	742
175	Thailand	green	2022	1000	1	717	75	742	742	758	500
176	Costa Rica	green	2018	1500	30	742	742	742	733	758	733
177	Guatemala	blue-green	2021	1350	69	742	742	742	733	655	742
178	Indonesia	bluish-green	2022	1350	60	767	733	725	767	742	725
179	Peru	greenish	2022	1600	69	75	75	733	75	733	733
180	Guatemala	greenish	2022	1400	30	733	742	733	742	758	742
181	Taiwan	green	2021	300	6	725	742	742	75	742	742
182	Vietnam	green	2022	5400	1	75	75	725	742	742	742
183	Brazil	pale yellow	2022	1000	5	75	75	742	733	733	733
184	Brazil	yellow-green	2021	900	59	742	75	758	733	733	725
185	Colombia	yellow-green	2021	1574	70	733	75	733	742	742	742
186	Mexico	green	2021	1200	69	758	742	725	725	875	733
187	Costa Rica	green	2023	1200	69	733	742	725	742	742	733
188	Taiwan	yellow-green	2021	300	100	742	75	733	733	733	733
189	Taiwan	green	2021	435	8	733	75	742	733	733	725
190	Thailand	green	2022	1300	1	733	742	725	733	900	742
191	Thailand	yellowish	2021	1400	15	742	725	733	742	733	733
192	Thailand	green	2022	600	1	725	725	742	725	742	742
193	Colombia	greenish	2021	1550	30	742	725	725	742	717	733
194	Brazil	greenish	2022	1200	60	742	742	725	725	717	725
195	El Salvador	bluish-green	2023	1400	2	742	733	733	75	708	400
196	Nicaragua	greenish	2021	1100	69	725	725	717	733	708	725
197	Nicaragua	green	2022	1000	69	742	717	70	708	742	717
198	Colombia	greenish	2022	1600	10	725	725	717	733	770	717
199	Peru	greenish	2022	1600	69	75	725	717	717	717	708
200	El Salvador	bluish-green	2023	1300	2	708	725	708	742	742	708
201	Brazil	greenish	2021	1200	60	725	717	717	708	717	717
202	Brazil	green	2022	950	60	717	717	692	717	742	717
203	Nicaragua	green	2023	1200	30	733	708	675	717	742	717
204	Laos	green	2021	1300	60	725	717	708	70	708	708
205	El Salvador	bluish-green	2023	1200	2	65	675	675	717	708	500
206	Brazil	green	2021	850	60	725	708	667	683	683	667