

Assumed Mean Method to find Standard Deviation (σ) for Grouped Data and Calculation of 90% Interval.

This section presents sample calculations for TESS data. We grouped exoplanets based on their host star's visual magnitude. This method was used to calculate standard deviation (σ) and 90 % interval for visual magnitude.

- x_i = Mid value of the i^{th} class.
- f_i = frequency of the i^{th} class.
- A = Assumed Mean (The value of A can be taken as any one of the observations $x_1, x_2, \dots, x_n$ or any other suitable value.)
- c = Class Length
- $d_i = \frac{x_i - A}{c}$ = Deviation of x_i from Assumed Mean.
- $n = \sum f_i$ = Total number of observations.

Group (Range of V Mag)	x_i	Frequency (f_i) (No. of Exoplanets)	d_i ($A = 10.5, c = 1$)	$f_i d_i$	$f_i d_i^2$
0 - 1	0.5	0	-10	0	0
1 - 2	1.5	0	-9	0	0
2 - 3	2.5	0	-8	0	0
3 - 4	3.5	0	-7	0	0
4 - 5	4.5	0	-6	0	0
5 - 6	5.5	1	-5	-5	25
6 - 7	6.5	5	-4	-20	80
7 - 8	7.5	5	-3	-15	45
8 - 9	8.5	18	-2	-36	72
9 - 10	9.5	35	-1	-35	35
10 - 11	10.5	40	0	0	0
11 - 12	11.5	40	1	40	40
12 - 13	12.5	26	2	52	104
13 - 14	13.5	15	3	45	135
14 - 15	14.5	6	4	24	96
15 - 16	15.5	6	5	30	150
16 - 17	16.5	3	6	18	108
17 - 18	17.5	2	7	14	98
		$n = \sum f_i = 202$	$\sum d_i = -19$	$\sum f_i d_i = 112$	$\sum f_i d_i^2 = 988$

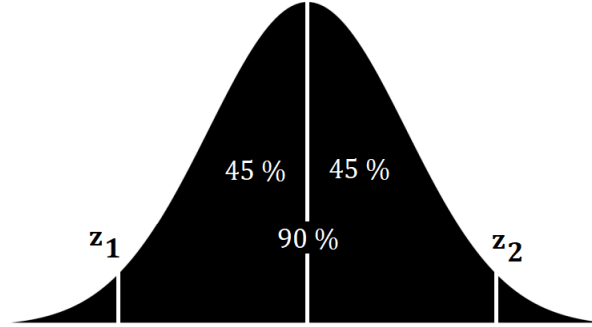
- Mean,

$$\begin{aligned}
 \mu = \bar{x} &= A + \frac{\sum f_i d_i}{n} \cdot c \\
 &= 10.5 + \frac{112}{202} \cdot 1 \\
 \mu = \bar{x} &= 11.05446
 \end{aligned} \tag{6}$$

- Standard Deviation (σ)

$$\begin{aligned}
\sigma &= \sqrt{\frac{\sum f_i d_i^2}{n} - \left(\frac{\sum f_i d_i}{n}\right)^2} \cdot c \\
&= \sqrt{\frac{988}{202} - \left(\frac{112}{202}\right)^2} \cdot 1 \\
\sigma &= 2.14095
\end{aligned} \tag{7}$$

- 90 % Interval



For 45 % Interval of each side we have find out the z_1 & z_2 from the Table of Standard Normal Curve.

$$\begin{aligned}
z_1 &= -1.645 \\
z_2 &= 1.645
\end{aligned}$$

We can find value x_1 & x_2 from the formulae below,

$$z_1 = \frac{x_1 - \mu}{\sigma} \quad z_2 = \frac{x_2 - \mu}{\sigma}$$

$$x_1 = (z_1 \cdot \sigma) + \mu \quad x_2 = (z_2 \cdot \sigma) + \mu$$

$$x_1 = (-1.645 \cdot 2.14095) + 11.05446 \quad x_2 = (1.645 \cdot 2.14095) + 11.05446$$

$$x_1 = 7.532592 \quad x_2 = 14.57632$$

So, x_1 and x_2 are the values that covers 90 % interval. In terms of exoplanetary data this is the range of Stellar Visual Magnitude in which 90 % of exoplanets lie.

Data Tables

• *Probability Distribution: Spectral Type*

Data was taken on 24th March, 2022 from NASA Exoplanet Archive

Spectral Type	Occurrence Rate (%)	No. of Exoplanets	Planetary Radii (R_E)				
			0 - 1.25	1.25 - 2	2 - 6	6 - 15	> 15
Kepler (Total number of exoplanets: 2691)							
O	0	0	0	0	0	0	0
B	0.07	2	2	0	0	0	0
A	0.19	5	0	1	2	1	1
F	25.75	693	93	231	316	44	9
G	49.24	1325	168	380	677	92	8
K	23.15	623	113	214	269	21	6
M	1.6	43	14	20	7	1	1
L	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0

K2 (Total number of exoplanets: 520)							
O	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
A	0	0	0	0	0	0	0
F	8.27	43	1	1	29	8	4
G	44.04	229	12	67	127	23	0
K	37.69	196	16	67	100	13	0
M	10	52	18	15	18	1	0
L	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0

TESS (Total number of exoplanets: 199)							
O	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
A	0.5	1	0	0	0	1	0
F	13.57	27	0	2	6	14	5
G	31.66	63	0	7	33	19	4
K	31.16	62	3	15	33	9	2
M	23.12	46	15	14	15	2	0
L	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0

Other (Total number of exoplanets: 472)							
O	0	0	0	0	0	0	0
B	0.42	2	0	0	0	0	2
A	2.12	10	0	0	0	0	10
F	34.11	161	0	0	0	66	95
G	40.04	189	1	3	6	147	32
K	18.22	86	0	4	9	65	8

Spectral Type	Occurrence Rate (%)	No. of Exoplanets	Planetary Radii (R_E)				
			0 - 1.25	1.25 - 2	2 - 6	6 - 15	> 15
M	4.45	21	8	3	3	6	1
L	0.42	2	0	0	0	1	1
T	0	0	0	0	0	0	0
Y	0.21	1	0	0	0	1	0

All Confirmed (Total number of exoplanets: 3882)

O	0	0	0	0	0	0	0
B	0.1	4	2	0	0	0	2
A	0.41	16	0	1	2	2	11
F	23.8	924	94	234	351	132	113
G	46.52	1806	181	457	843	281	44
K	24.91	967	132	300	411	108	16
M	4.17	162	55	52	43	10	2
L	0.05	2	0	0	0	1	1
T	0	0	0	0	0	0	0
Y	0.03	1	0	0	0	1	0

Hiparcos Catalogue

Total number of stars: 111222

Total number of stars hosting planets: 593

Data was taken on 30th January, 2022 from Hiparcos Catalog & NASA Exoplanet Archive

Spectral Type	Occurrence Rate (%)	No. of Stars	No. of Stars Hosting Planet/s
O	0	0	0
B	6.3	7005	2
A	15.23	16934	8
F	26.92	29946	77
G	11.89	13229	232
K	35.27	39229	254
M	4.36	4848	20
L	0.03	31	0
T	0	0	0
Y	0	0	0

• **Probability Distribution: Visual Magnitude**

Data was taken on 24th March, 2022 from NASA Exoplanet Archive

Range of V Mag	Occurrence Rate (%)	No. of Exoplanets
Kepler (Total Number of Exoplanets: 2709)		
< 0	0	0
0 - 1	0	0
1 - 2	0	0
2 - 3	0	0
3 - 4	0	0
4 - 5	0	0
5 - 6	0	0
6 - 7	0	0
7 - 8	0	0
8 - 9	0.26	7
9 - 10	0.3	8
10 - 11	0.66	18
11 - 12	3.14	85
12 - 13	7.86	213
13 - 14	18.75	508
14 - 15	27.43	743
15 - 16	33.74	914
16 - 17	7.24	196
17 - 18	0.52	14
> 18	0.11	3

K2 (Total Number of Exoplanets: 535)

< 0	0	0
0 - 1	0	0
1 - 2	0	0
2 - 3	0	0
3 - 4	0	0
4 - 5	0	0
5 - 6	0	0
6 - 7	0	0
7 - 8	0	0
8 - 9	1.87	10
9 - 10	1.5	8
10 - 11	6.36	34
11 - 12	14.58	78
12 - 13	30.65	164
13 - 14	18.32	98
14 - 15	14.02	75
15 - 16	6.36	34
16 - 17	4.49	24
17 - 18	1.87	10
> 18	0	0

TESS (Total Number of Exoplanets: 202)

< 0	0	0
0 - 1	0	0
1 - 2	0	0
2 - 3	0	0
3 - 4	0	0
4 - 5	0	0
5 - 6	0.5	1
6 - 7	2.48	5
7 - 8	2.48	5
8 - 9	9.91	18
9 - 10	17.33	35
10 - 11	19.8	40
11 - 12	19.8	40
12 - 13	12.87	26
13 - 14	7.43	15
14 - 15	2.97	6
15 - 16	2.97	6
16 - 17	1.49	3

Range of V Mag	Occurrence Rate (%)	No. of Exoplanets
17 - 18	0.99	2
> 18	0	0

Other (Total Number of Exoplanets: 1413)

< 0	0	0
0 - 1	0.07	1
1 - 2	0.14	2
2 - 3	0.14	2
3 - 4	1.42	20
4 - 5	2.55	36
5 - 6	6.37	90
6 - 7	7.15	101
7 - 8	16.77	237
8 - 9	15.22	215
9 - 10	8.35	118
10 - 11	9.13	129
11 - 12	8.42	119
12 - 13	9.7	137
13 - 14	6.09	86
14 - 15	3.26	46
15 - 16	1.98	28
16 - 17	1.34	19
17 - 18	0.78	11
> 18	1.13	16

All Confirmed (Total Number of Exoplanets: 4859)

< 0	0	0
0 - 1	0.02	1
1 - 2	0.04	2
2 - 3	0.04	2
3 - 4	0.41	20
4 - 5	0.75	36
5 - 6	1.87	91
6 - 7	2.18	106
7 - 8	4.98	242
8 - 9	5.15	250
9 - 10	3.48	169
10 - 11	4.55	221
11 - 12	6.63	322
12 - 13	11.11	540
13 - 14	14.55	707
14 - 15	18.9	870
15 - 16	20.21	982
16 - 17	4.98	242
17 - 18	0.76	37
> 18	0.39	19

• **Probability Distribution: Exoplanetary Radii**

Data was taken on 24th March, 2022 from NASA Exoplanet Archive

Range of Planetary Radii ($R_{\oplus}$)	Occurrence Rate (%)	No. of Exoplanets
Kepler (Total Number of Exoplanets: 2692)		
0 - 1.25	14.86	390
1.25 - 2	30.24	847
2 - 6	48.14	1271
6 - 15	5.68	160
> 15	1.08	24
K2 (Total Number of Exoplanets: 537)		
0 - 1.25	9.11	55
1.25 - 2	27.97	153
2 - 6	52.75	278
6 - 15	9.11	46
> 15	1.06	5
TESS (Total Number of Exoplanets: 199)		
0 - 1.25	9.33	18
1.25 - 2	20.21	37
2 - 6	43.01	88
6 - 15	22.28	45
> 15	5.18	11
Other (Total Number of Exoplanets: 481)		
0 - 1.25	1.91	8
1.25 - 2	2.13	11
2 - 6	3.83	18
6 - 15	61.06	294
> 15	31.06	150
All Confirmed (Total Number of Exoplanets: 3909)		
0 - 1.25	12.28	471
1.25 - 2	26.00	1048
2 - 6	43.01	1655
6 - 15	13.74	545
> 15	04.96	190