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Subject: Statistical Methods

Tutorial: Tutorial 3

Q1. The no of items drawn from each strata is proportional to the size of the strata. The population is divided into 7 groups. Their respective sizes having being 0.8, 10, 12, 20, 18, 20, & 22 % of the population and a sample of 7000 is drawn. Obtain the desired sample for each strata

$$\rightarrow 7000 \times 8\% \Rightarrow 70 \times 8 = 560$$

$$7000 \times 10\% \Rightarrow 70 \times 10 = 700$$

$$7000 \times 12\% \Rightarrow 70 \times 12 = 840$$

$$7000 \times 20\% \Rightarrow 70 \times 20 = 1400$$

$$7000 \times 18\% \Rightarrow 70 \times 18 = 1260$$

$$7000 \times 20\% \Rightarrow 70 \times 20 = 1400$$

$$7000 \times 22\% \Rightarrow 70 \times 22 = 1540$$

Q2. You are given the following data in a town.

Income (Rs)	Carpenters	Plumbers	Electrician
Less than 50,000	1100	1250	1900
50,000 - 100,000	2050	2320	2200
100,000 - 150,000	1200	1470	1700
More than 150,000	970	890	1150

How many would be selected from each category if

i) we follow stratified proportionate sampling method and take 8% of the universe equivalent of the sample size

ii) If the size of the sample is 12% of the universe but the carpenters, plumbers and electricians are to be in ratio of 2:4:6 and weightage of the income range is to be in ratio of 5:4:2:1

i)

Income	Carpenters	Plumbers	Electrician	Total
less than 50,000	88	100	152	340
50,000 - 100,000	164	185.6	176	525.6
100,000 - 150,000	96	117.6	136	349.6
More than 150,000	77.6	71.2	92	240.8
Total	425.6	474.4	556	1456

∴ 1456 persons are selected in the sample

ii) 12% of the universe :

Carpenters	Plumbers	Electrician	Total
132	150	228	510
246	278.4	264	788.4
144	176.4	204	524.4
116.4	106.8	138	361.2
<u>638.4</u>	<u>711.6</u>	<u>834</u>	<u>2184</u>

But ratio is 2:4:6

$$\frac{2}{12} (2184) = 364 \text{ carpenters}$$

$$\frac{4}{12} (2184) = 728 \text{ plumbers}$$

And : ratio of income range is 5:4:2:1

Carpenter

$$364 \left(\frac{5}{12} \right)$$

Plumbers

$$728 \left(\frac{5}{12} \right)$$

Electrician

$$1092 \left(\frac{5}{12} \right)$$

$$364 \left(\frac{4}{12} \right)$$

$$728 \left(\frac{4}{12} \right)$$

$$1092 \left(\frac{4}{12} \right)$$

$$364 \left(\frac{2}{12} \right)$$

$$728 \left(\frac{2}{12} \right)$$

$$1092 \left(\frac{2}{12} \right)$$

$$364 \left(\frac{1}{12} \right)$$

$$728 \left(\frac{1}{12} \right)$$

$$1092 \left(\frac{1}{12} \right)$$

Income	Carpenters	Plumbers	Electricians
less than 50000	151.66	303.3	455
50000 - 100000	121.33	242.66	364
100000 - 150000	60.66	121.33	182
More than 150000	30.33	60.66	91
Total	363.98	727.98	1092

Total

$$909.99$$

$$727.99$$

$$363.99$$

$$181.99$$

$$2183.96$$

\therefore 2183.96 persons are selected in the sample

Find the estimates of the population mean and variance of the data

Class Interval	0-10	10-20	20-30	30-40	40-50
frequency	14	23	21	21	15

Class Interval	x_i	f_i	$x_i f_i$	$ x_i - \bar{x} $	$f_i x_i - \bar{x} $
0-10	5	14	70	20	280
10-20	15	23	345	10	230
20-30	25	21	675	0	0
30-40	35	21	735	10	210
40-50	45	15	675	20	300
		<u>100</u>	<u>2500</u>		<u>1020</u>

$$\begin{aligned}
 & f_i - x^2 \\
 & 350 \\
 & 5175 \\
 & 16875 \\
 & 25725 \\
 & 30375 \\
 & \hline
 & 78500
 \end{aligned}$$

$$\text{mean} = \frac{\sum x_i f_i}{\sum f_i} = \frac{2500}{100} = 25$$

$$\text{variance} = \frac{1}{n} \left(\sum_{i=1}^N x_i^2 f_i - x^2 n \right)$$

$$\text{variance} = \frac{1}{n} \left(\sum_{i=1}^N x^2 f_i - x^2 n \right)$$

$$= \frac{78500}{100} - 625$$

$$= 785 - 625$$

$$= 160$$

Estimation of population mean = 25

Estimator of population variance = 100

Q4. I. Using the random sampling number table select the sample without replacement for the following

1) 10 samples for a population 40

2) 7 samples for a population 30

II. Find the probability of drawing a sample without replacement in Part I for both the ~~samples~~ examples

I) From the random sampling number table

1) 40, 18, 26, 2, 37, 5, 27, 16, 36, 10

2) 18, 26, 2, 5, 27, 16, 10

II) The probability of drawing a sample without replacement $= \frac{1}{N C_n}$

1) $N=40$, $n=10$

$$\therefore P = \frac{1}{40 C_{10}}$$

2) $N=30$, $n=7$

$$\therefore P = \frac{1}{30 C_7}$$

Q5. Find the mean of the data

x_i	10	11	12	13	14
f_i	3	12	18	12	3

$N=500$, $s^2 = 2.25$. Also find the Var (sample mean) for sampling without replacement

x_i	f_i	$x_i f_i$
10	3	30
11	12	132
12	18	216
13	12	156
14	3	42
	<u>48</u>	<u>576</u>

$$\text{mean} = \frac{\sum x_i f_i}{\sum f_i} = \frac{576}{48} = 12$$

$$\begin{aligned}\text{Var}(\bar{y}) &= \frac{N-n}{Nn} s^2 \\ &= 2.25 \left(\frac{500-48}{500 \times 48} \right)\end{aligned}$$

$$= \frac{4.52 (2.25)}{500 \times 48}$$

$$\text{Var}(\bar{y}) = 0.042375$$