Exam 1

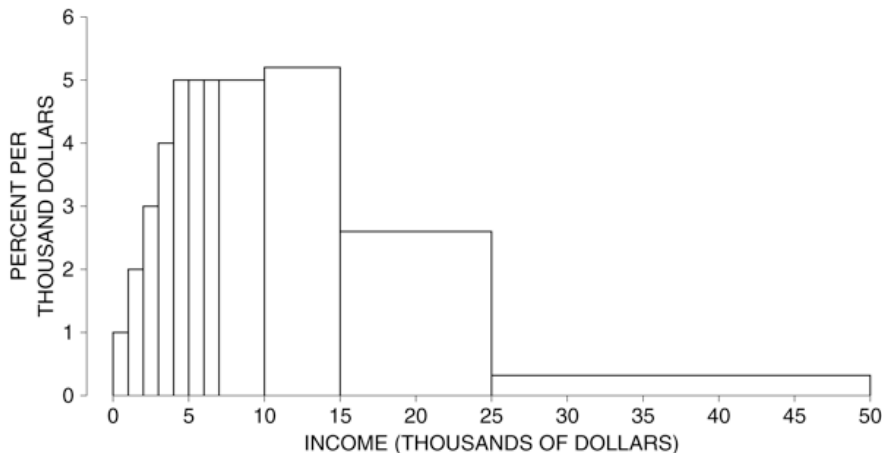## SOLUTIONS

1. The histogram below charts household income in the U.S. in 1973 on the *density scale*. Use this histogram to answer the following questions. Show your work/explain your answers.

(a) (3 pts) The percentage of households with incomes in the range \$7,000 to \$15,000 is about 31%, 41% or 51%. Which is it? Show your work.

Answer: $41 = 3 \times 5 + 5 \times 5.2$.

(b) (2 pts) Approximately what percentage of households had incomes of more than \$20,000?

Answer: 20-25 about $2.5 \times 5 = 12.5$, 25-50 about $0.25 \times 25 = 6.25$, combined, about 18.75%

2. A large study investigated the effects of diet on general health in a large sample of households. For men and women in each age group, those who had a diet rich in fruits and vegetables were on average somewhat healthier than those who ate little fruits and vegetables, but the those who who ate little fruits and vegetables were on average much healthier than those who recently switched from such a diet to one that was high in fruit and vegetables.

(a) (2 pts) Was this a controlled experiment or an observational study? Explain.

Observational study because people choose their own diets. (The diets are not assigned by the investigators).

(b) (1 pts) Why did the investigators study men and women in different age groups separately?

To control for the confounding effect of age and gender on health.

(c) (2 pts) *True* or *False*: based on this study, it appears that it is healthier to to eat a lot of fruit and vegetables, but if you currently don't eat a lot of fruit and vegetables, then it is healthier not to start doing so.

Explain your choice.

False. As in the homework problem on smoking and health, the health of the people who switched diets, just before they switched is a confounding variable. It is likely they switch because their health was declining.

3. A biometric survey of 100 college students found that their average weight was $\overline{w} = 140$ lbs, with a standard deviation of $SD_w = 27$ lbs; their average height was $\overline{h} = 60$ inches with a standard deviation of $SD_h = 2.4$ inches.

(a) (2 pts) Find the average height and weight of the students in feet and ounces, respectively. (1 lb $= 16$ ounces and 1 foot $= 12$ inches.)

Average height in feet: $\overline{h}_f = \dfrac{60}{12} = 5$ *feet.*

Average weight in ounces: $\overline{w}_o = 140 \cdot 16 = 2240$ *ounces.*

(b) (2 pts) Find the standard deviations for height and weight in feet and ounces, respectively.

SD for height in feet: $SD_h = \dfrac{2.4}{12} = 0.2$ *feet.*

SD for weight in ounces: $SD_w = 27 \cdot 16 = 432$ *ounces.*

(c) (1 pt) Later, the investigators realized that they had made a data entry error for one of the students and listed his weight as 20.0 lbs instead of 200 lbs. What is the *correct* average weight (in lbs) of the students in this study? Show your work.

Original sum of weights: $140 \cdot 100 = 14000$.

Correct sum of weights: $14000 - 20 + 200 = 14180$.

Correct average of weights: $14180/100 = 141.8$.

4. The average height of the adult population of Whoville is 33 inches, with a standard deviation of 2 inches. Assuming that the histogram for heights follows the normal curve, answer the following questions. Show your work.

(a) (3 pts) Approximately what percentage of the adult population of Whoville are between 30 and 36 inches tall?

Whos who are between 30 and 36 inches tall, are between $\dfrac{30 - 33}{2} = -1.5$ *standard deviations below average and* $\dfrac{36 - 33}{2} = 1.5$ *standard deviations above average.*

This means that the percentage of such Whos is equal to the area under the normal curve between -1.5 and 1.5, which is 86.64%, from the table.

(b) (2 pts) Approximately what percentage of the adult population of Whoville taller than 34 inches?

Whos who are over 34 inches tall are more than $\dfrac{34 - 33}{2} = 0.5$ *standard deviations above average.*

This means that the percentage of such Whos is equal to the area to the right of 0.5 under the normal curve, which is

$$50\% - \frac{1}{2}T(0.5) = 50\% - \frac{38.29\%}{2} \approx 30.86\%.$$
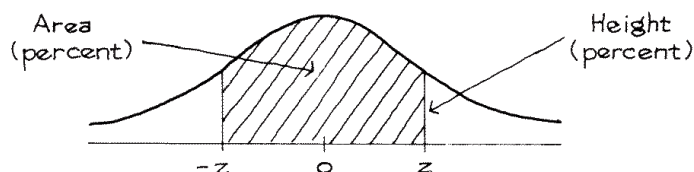
A NORMAL TABLE

z	Height	Area	z	Height	Area	z	Height	Area
0.00	39.89	0	1.50	12.95	86.64	3.00	0.443	99.730
0.05	39.84	3.99	1.55	12.00	87.89	3.05	0.381	99.771
0.10	39.69	7.97	1.60	11.09	89.04	3.10	0.327	99.806
0.15	39.45	11.92	1.65	10.23	90.11	3.15	0.279	99.837
0.20	39.10	15.85	1.70	9.40	91.09	3.20	0.238	99.863
0.25	38.67	19.74	1.75	8.63	91.99	3.25	0.203	99.885
0.30	38.14	23.58	1.80	7.90	92.81	3.30	0.172	99.903
0.35	37.52	27.37	1.85	7.21	93.57	3.35	0.146	99.919
0.40	36.83	31.08	1.90	6.56	94.26	3.40	0.123	99.933
0.45	36.05	34.73	1.95	5.96	94.88	3.45	0.104	99.944
0.50	35.21	38.29	2.00	5.40	95.45	3.50	0.087	99.953
0.55	34.29	41.77	2.05	4.88	95.96	3.55	0.073	99.961
0.60	33.32	45.15	2.10	4.40	96.43	3.60	0.061	99.968
0.65	32.30	48.43	2.15	3.96	96.84	3.65	0.051	99.974
0.70	31.23	51.61	2.20	3.55	97.22	3.70	0.042	99.978
0.75	30.11	54.67	2.25	3.17	97.56	3.75	0.035	99.982
0.80	28.97	57.63	2.30	2.83	97.86	3.80	0.029	99.986
0.85	27.80	60.47	2.35	2.52	98.12	3.85	0.024	99.988
0.90	26.61	63.19	2.40	2.24	98.36	3.90	0.020	99.990
0.95	25.41	65.79	2.45	1.98	98.57	3.95	0.016	99.992
1.00	24.20	68.27	2.50	1.75	98.76	4.00	0.013	99.9937
1.05	22.99	70.63	2.55	1.54	98.92	4.05	0.011	99.9949
1.10	21.79	72.87	2.60	1.36	99.07	4.10	0.009	99.9959
1.15	20.59	74.99	2.65	1.19	99.20	4.15	0.007	99.9967
1.20	19.42	76.99	2.70	1.04	99.31	4.20	0.006	99.9973
1.25	18.26	78.87	2.75	0.91	99.40	4.25	0.005	99.9979
1.30	17.14	80.64	2.80	0.79	99.49	4.30	0.004	99.9983
1.35	16.04	82.30	2.85	9.69	99.56	4.35	0.003	99.9986
1.40	14.97	83.85	2.90	0.60	99.63	4.40	0.002	99.9989
1.45	13.94	85.29	2.95	0.51	99.68	4.45	0.002	99.9991