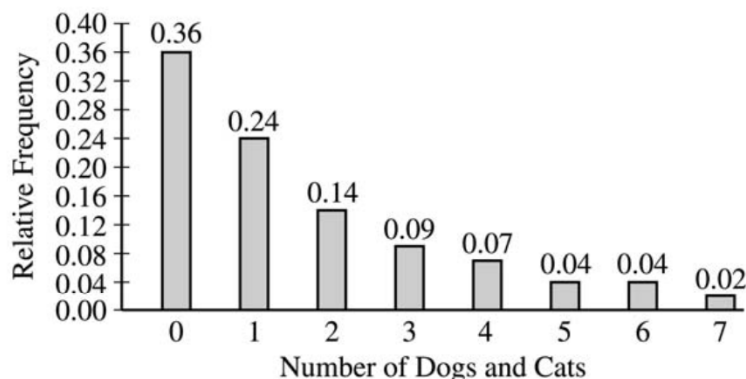


AP STATISTICS

Free Response Practice (HW #38)

This problem set contains 4 free response problems. Please work all solutions out on SEPARATE PAPER.

2. The graph below displays the relative frequency distribution for X , the total number of dogs and cats owned per household, for the households in a large suburban area. For instance, 14 percent of the households own 2 of these pets.



- (a) According to a local law, each household in this area is prohibited from owning more than 3 of these pets. If a household in this area is selected at random, what is the probability that the selected household will be in violation of this law? Show your work.
- (b) If 10 households in this area are selected at random, what is the probability that exactly 2 of them will be in violation of this law? Show your work.
- (c) The mean and standard deviation of X are 1.65 and 1.851, respectively. Suppose 150 households in this area are to be selected at random and $\bar{X}$, the mean number of dogs and cats per household, is to be computed. Describe the sampling distribution of $\bar{X}$, including its shape, center, and spread.
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3. The depth from the surface of Earth to a refracting layer beneath the surface can be estimated using methods developed by seismologists. One method is based on the time required for vibrations to travel from a distant explosion to a receiving point. The depth measurement (M) is the sum of the true depth (D) and the random measurement error (E). That is, $M = D + E$. The measurement error (E) is assumed to be normally distributed with mean 0 feet and standard deviation 1.5 feet.
- (a) If the true depth at a certain point is 2 feet, what is the probability that the depth measurement will be negative?
- (b) Suppose three independent depth measurements are taken at the point where the true depth is 2 feet. What is the probability that at least one of these measurements will be negative?
- (c) What is the probability that the mean of the three independent depth measurements taken at the point where the true depth is 2 feet will be negative?
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3. In search of a mosquito repellent that is safer than the ones that are currently on the market, scientists have developed a new compound that is rated as less toxic than the current compound, thus making a repellent that contains this new compound safer for human use. Scientists also believe that a repellent containing the new compound will be more effective than the ones that contain the current compound. To test the effectiveness of the new compound versus that of the current compound, scientists have randomly selected 100 people from a state.

Up to 100 bins, with an equal number of mosquitoes in each bin, are available for use in the study. After a compound is applied to a participant's forearm, the participant will insert his or her forearm into a bin for 1 minute, and the number of mosquito bites on the arm at the end of that time will be determined.

- (a) Suppose this study is to be conducted using a completely randomized design. Describe a randomization process and identify an inference procedure for the study.
 - (b) Suppose this study is to be conducted using a matched-pairs design. Describe a randomization process and identify an inference procedure for the study.
 - (c) Which of the designs, the one in part (a) or the one in part (b), is better for testing the effectiveness of the new compound versus that of the current compound? Justify your answer.
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6. Regulations require that product labels on containers of food that are available for sale to the public accurately state the amount of food in those containers. Specifically, if milk containers are labeled to have 128 fluid ounces and the mean number of fluid ounces of milk in the containers is at least 128, the milk processor is considered to be in compliance with the regulations. The filling machines can be set to the labeled amount. Variability in the filling process causes the actual contents of milk containers to be normally distributed. A random sample of 12 containers of milk was drawn from the milk processing line in a plant, and the amount of milk in each container was recorded.

- (a) The sample mean and standard deviation of this sample of 12 containers of milk were 127.2 ounces and 2.1 ounces, respectively. Is there sufficient evidence to conclude that the packaging plant is not in compliance with the regulations? Provide statistical justification for your answer.

Inspectors decide to study a particular filling machine within this plant further. For this machine, the amount of milk in the containers has a mean of 128.0 fluid ounces and a standard deviation of 2.0 fluid ounces.

- (b) What is the probability that a randomly selected container filled by this machine contains at least 125 fluid ounces?
- (c) An inspector will randomly select 12 containers filled by this machine and record the amount of milk in each. What is the probability that the minimum (smallest amount of milk) recorded in the 12 containers will be at least 125 fluid ounces? (Note: In order for the minimum to be at least 125 fluid ounces, each of the 12 containers must contain at least 125 fluid ounces.)

An analyst wants to use simulation to investigate the sampling distribution of the minimum. This analyst randomly generates 150 samples, each consisting of 12 observations, from a normal distribution with mean 128 and standard deviation 2 and finds the minimum for each sample. The 150 minimums (sorted from smallest to largest) are shown on the next page.

[table of simulated results is on the following page!!!]

- (d) Use the simulation results to estimate the probability that was requested in part (c) and compare this estimate with the theoretical value you calculated.

[This table of data goes with part (d) of # 6, on the previous page]

Sample	Minimum	Sample	Minimum	Sample	Minimum
1	121.45	51	124.28	101	125.25
2	122.51	52	124.29	102	125.31
3	122.53	53	124.30	103	125.36
4	122.72	54	124.31	104	125.38
5	122.75	55	124.34	105	125.40
6	122.89	56	124.36	106	125.42
7	122.93	57	124.37	107	125.48
8	122.99	58	124.37	108	125.49
9	123.04	59	124.39	109	125.50
10	123.08	60	124.39	110	125.52
11	123.09	61	124.41	111	125.54
12	123.10	62	124.44	112	125.56
13	123.31	63	124.53	113	125.61
14	123.34	64	124.53	114	125.67
15	123.39	65	124.54	115	125.72
16	123.40	66	124.55	116	125.76
17	123.41	67	124.55	117	125.77
18	123.41	68	124.55	118	125.78
19	123.46	69	124.55	119	125.79
20	123.49	70	124.58	120	125.84
21	123.51	71	124.67	121	125.87
22	123.57	72	124.69	122	125.87
23	123.58	73	124.73	123	125.90
24	123.59	74	124.77	124	125.90
25	123.60	75	124.78	125	125.93
26	123.66	76	124.78	126	125.93
27	123.67	77	124.80	127	125.93
28	123.72	78	124.80	128	125.94
29	123.75	79	124.81	129	125.98
30	123.77	80	124.85	130	126.00
31	123.78	81	124.91	131	126.03
32	123.84	82	124.92	132	126.05
33	123.91	83	124.92	133	126.05
34	123.93	84	124.96	134	126.06
35	123.95	85	125.00	135	126.09
36	123.95	86	125.01	136	126.15
37	123.98	87	125.02	137	126.15
38	123.99	88	125.02	138	126.16
39	124.05	89	125.03	139	126.19
40	124.05	90	125.04	140	126.19
41	124.06	91	125.05	141	126.25
42	124.12	92	125.07	142	126.26
43	124.14	93	125.08	143	126.33
44	124.15	94	125.09	144	126.35
45	124.16	95	125.14	145	126.45
46	124.19	96	125.18	146	126.50
47	124.23	97	125.21	147	126.57
48	124.27	98	125.21	148	126.62
49	124.28	99	125.22	149	126.64
50	124.28	100	125.25	150	126.95