



## “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 25 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

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.

### **Scoring:**

- (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.

**E P I**

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?

**E P I**

(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.)

**E P I**

An analyst wants to use simulation to investigate the sampling distribution of the minimum. The 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 minimum (sorted from smallest to largest) are shown on the next 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.

**E P I**

**Total: \_\_/4**

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