Econ 57
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Midterm (75 minutes)

No calculators allowed. Just set up your answers, for example, P = 49/52. BE SURE TO EXPLAIN YOUR REASONING. If you want extra time, you can buy time at a price of 1 point a minute; for example, if your test is handed in 10 minutes after the scheduled finish time, 10 points will be subtracted from the test score.

1. Critically evaluate:

   The American Mustache Institute (AMI) is planning a "Million Mustache March" on the nation's capital. Their rallying cry: Pass the "Stimulus to Allow Critical Hair Expenses," or STACHE Act, which would "provide a $250 annual tax deduction for expenditures on mustache grooming supplies." According to AMI research, mustached Americans earn 4.3 percent more money than "clean-shaven Americans" on average per year. Therefore incentivising mustache growth would boost the economy.

   "Given the clear link between the growing and maintenance of mustaches and income, it appears clear that mustache maintenance costs qualify for and should be considered as a deductible expense related to the production of income under Internal Revenue Code Section 212," wrote Dr. John Yeutter, a tax policy professor at Northeastern State University, in a 2010 white paper supporting the legislation.

2. Below are the price/earnings ratios for 29 of the 30 stocks in the Dow Jones Average. (Bank of America is ignored because it earned only a penny a share and its P/E is a preposterous 816.) Use the data for the other 29 stocks to draw a box plot, identifying any outliers (and explaining how you identified them as outliers).

	P/E		P/E		P/E
3M Co	14.6	ExxonMobil	10.2	Merck	18.8
Alcoa Inc	18.6	General Electric	15.4	Microsoft	11.7
American Express	13.0	Hewlett Packard	8.8	Pfizer	19.3
AT&T	46.9	Home Depot	19.2	Procter & Gamble	19.6
Bank of America		Intel	11.2	Coca-Cola	18.7
Boeing Co	14.0	IBM	15.2	Travelers	17.2
Caterpillar	15.2	JNJ	18.6	United Technologies	15.4
Chevron	8.1	JPMorgan Chase	9.1	Verizon	45.6
Cisco	15.3	Kraft Foods	19.2	Wal-Mart	13.0
E. I. du Pont	14.0	McDonald's	18.9	Walt Disney	16.0

3. Professor McTorture reasons that if you haven't had a driving accident, your insurance company should raise your rates—not lower them—because you are due for an accident. When he had an accident, he wrote a letter to his insurance company arguing that everyone has accidents and they should lower his rates now that he has gotten an accident out of the way. Explain why you either agree or disagree with his reasoning.

4. Mendel postulated that the self-fertilization of hybrid yellow-seeded sweet peas would yield offspring with a 0.75 probability of being yellow-seeded and a 0.25 probability of being green-seeded. In 1865, he reported that 8,023 such experiments yielded 6,021/8,023 = 0.7505 yellow-seeded plants and 2,002/8,023 = 0.2495 green-seeded plants. If these were honest independent trials with each offspring having a 0.75 probability of being yellow-seeded, what is the *exact* probability that the number of yellow-seeded plants would be in the range 6,013 to 6,021 (fewer than five plants from the expected value, 6,017.25)?

5. A nation is considering two tax systems: (a) a 20% tax on every household's income; or (b) a $10,000 tax, regardless of income. The two tax systems would raise the same amount of revenue. For which system is the
   a. average of household after-tax income higher?
   b. standard deviation of household after-tax income higher?

6. The Australian Bureau of Meteorology uses the monthly air-pressure difference between Tahiti and Darwin, Australia, to calculate the Southern Oscillation Index: $SOI = 10(X - \mu)/\sigma$, where X is the air-pressure difference in the current month, μ is the average value of X for this month, and σ is the standard deviation of X for this month. Negative values of the SOI indicate an El Niño episode, which is usually accompanied by less than usual rainfall over eastern and northern Australia; positive values of the SOI indicate a La Niña episode, which is usually accompanied by more than usual rainfall. Suppose that X is normally distributed with a mean of μ and a standard deviation of σ. Explain why you believe that the probability of an SOI reading as low as –22.8, which occurred in 1994, is closer to 1.1×10^{-15}, 0.011, or 0.110.

7. There are 12 astrological signs corresponding to birth days, for example, Aquarius is January 20 - February 18 and Pisces is February 19 - March 20. Assuming birth dates are equally likely to be in each of the 12 signs, what is the probability that, in a group of 4 people, there will be at least 2 people with the same sign?

8. Here are some values of the Morgan Stanley EAFE stock index

	EAFE	Return (%)
May 2003	2024.1	
June 2003	2073.0	2.42
July 2003	2123.2	2.42
August 2003	2174.5	2.42

Suppose that the probability distribution for the first digit left of the decimal point in the return is as follows:

value	probability
0	0.4
1	0.3
2	0.2
3	0.1

and that, to the right of the decimal point, all 2-digit numbers are equally likely. What is the probability that three randomly selected months would have the same return to 2 decimal places?

9. In a routine examination, a doctor finds a lump in a female patient's breast. In 1 out of 100 cases, such lumps turn out to be malignant. If the lump is malignant, there is a 0.80 probability that a mammogram X-ray will give a positive reading; if the lump is benign, there is a 0.90 probability that the mammogram will give a negative reading. Knowing that mammograms are imperfect, the doctor orders two independent X-rays. One comes back positive and the other negative! What is probability that the lump is malignant?

10. A study looked at all U.S. stock mutual funds in 1990 and found that over the preceding 20 years, their average return was slightly better than the overall stock market. What statistical bias may undermine this conclusion?