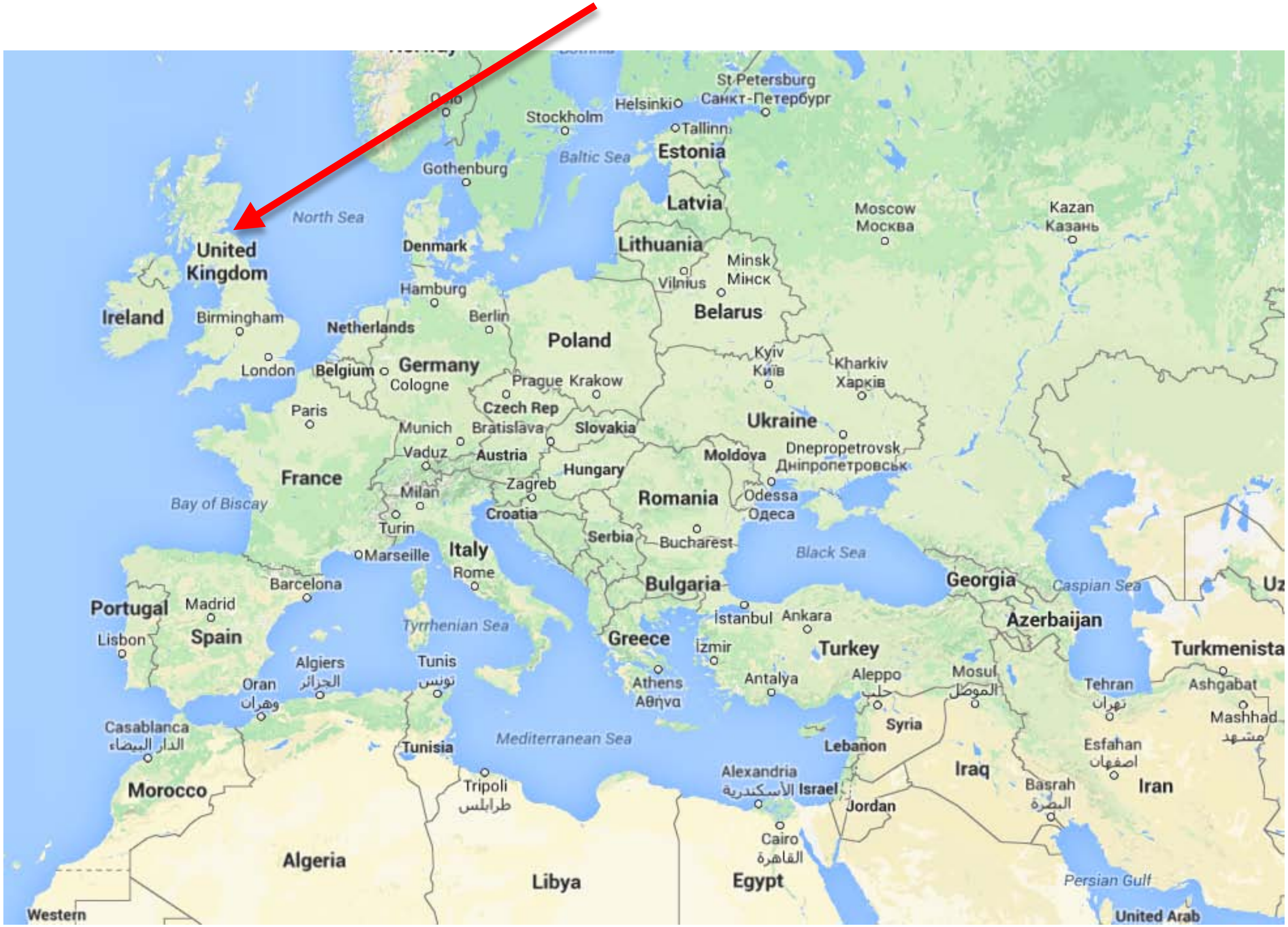
T³ Leuven, October 2016 – CAS in Statistics

Nevil Hopley

T³ National Trainer, Scotland & UK.
Head of Mathematics Department

www.calculatorsoftware.co.uk/nspire

My Home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Iran
Cairo
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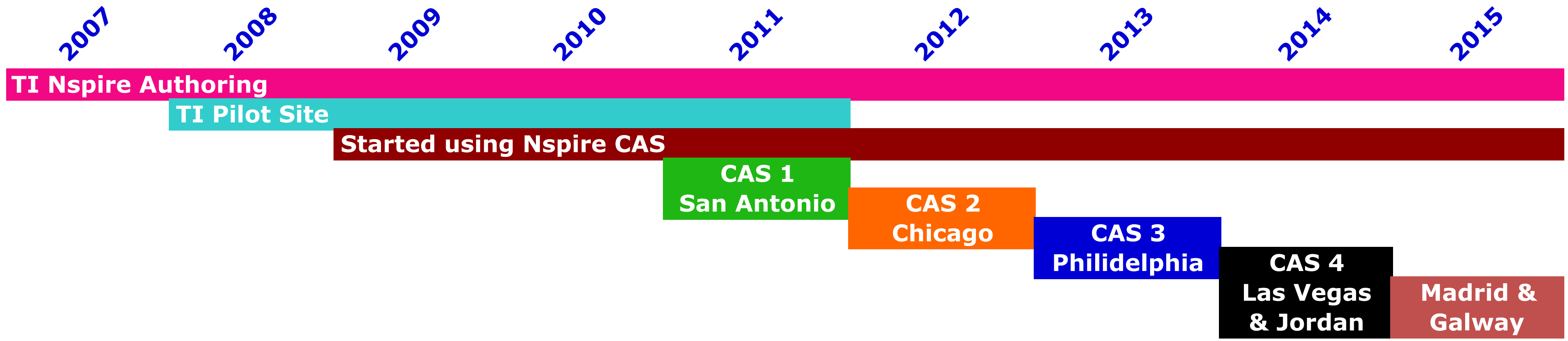
Algeria
Libya
Egypt
Persian Gulf
Western
United Arab

My CAS Timeline



CAS Talks at TI International & European Conferences

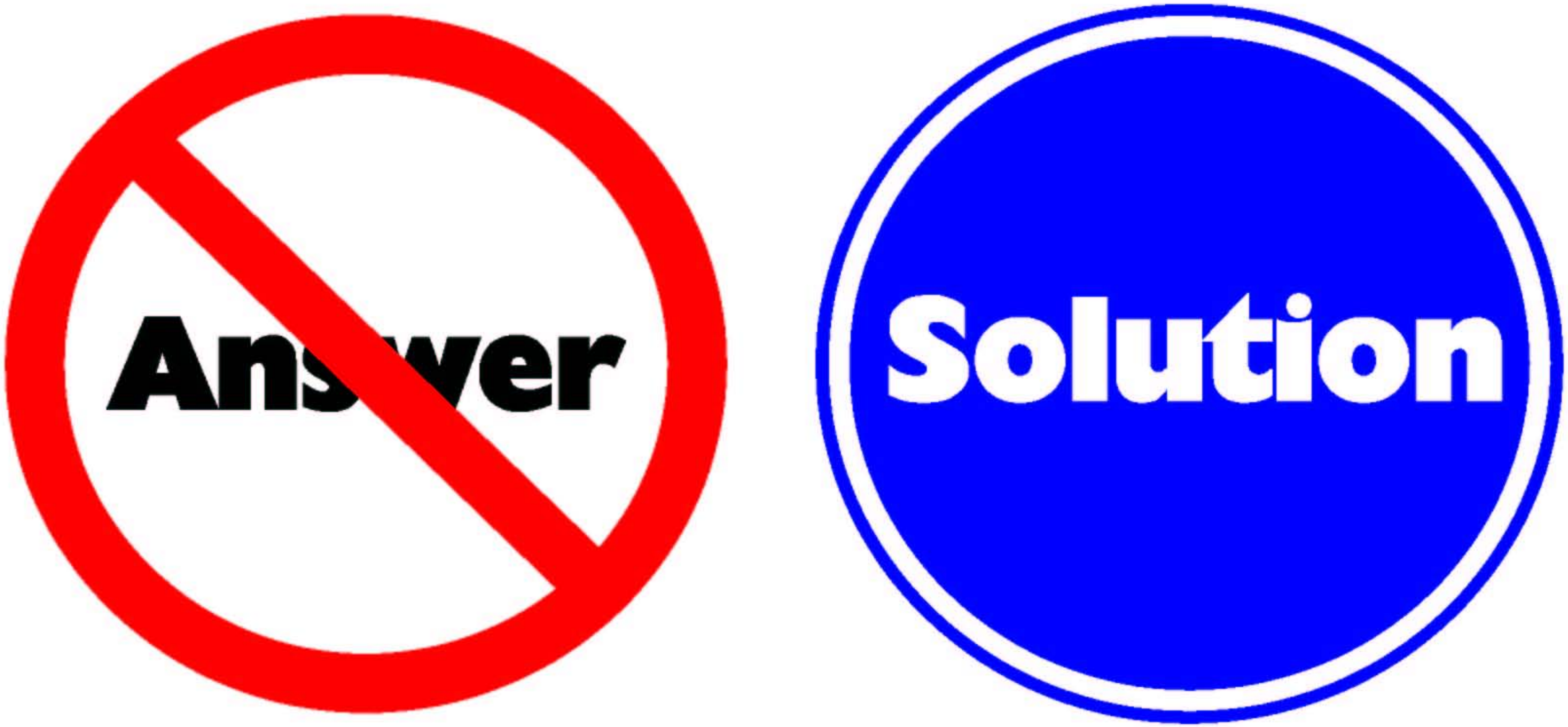
2011 My first 18 months of CAS usage

2012 Trigonometry and Rearranging Equations

2013 Linear Equations and Units

2014 Extending CAS with functions and programs

2015 CAS in Statistics (T^3 Europe, Madrid and USACAS^9, Cleveland, Ohio)


Answer
Solution

Credits

Chris Harrow, Ohio, USA
John Hanna, Honolulu, USA
Pat Mara, Pueblo, USA

www.statlect.com/distri.htm

answers.yahoo.com/question/index?qid=20120403201108AAlaU1o

math.stackexchange.com/questions/117926/finding-mode-in-binomial-distribution

Chris Harrow

casmusings.wordpress.com

$$\text{expand}\left((heads+tails)^6\right)$$

$$heads^6+6\cdot heads^5\cdot tails+15\cdot heads^4\cdot tails^2+20\cdot heads^3\cdot tails^3+15\cdot heads^2\cdot tails^4+6\cdot heads\cdot tails^5+tails^6$$

John Hanna

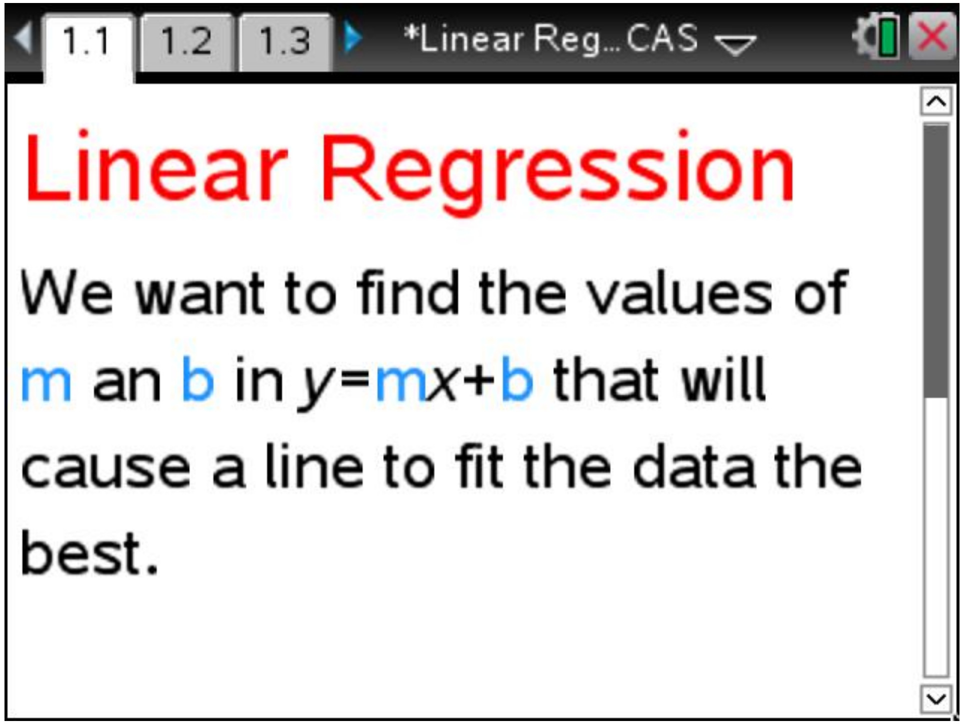
"LinReg Exposed!"

A talk from 2014 TI International Conference

Pat Mara

Linear Regression CAS.tns
(Nspire Google Group, 19 Nov 2014)

Linear Regression CAS - Pat Mara.tns



Today

Formulae for Standard Deviation

Discrete Uniform Distribution

Geometric Distribution

Laws of Expectation and Variance

Binomial Distribution

Poisson Distribution

Probability Generating Functions


UNDER CONSTRUCTION

Formulae for Standard Deviation

$$s^2 = \frac{\sum_{i=1}^{n} (x_i - \overline{x})^2}{n-1} \qquad or \qquad s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \frac{(\sum x_i)^2}{n}}{n-1}$$

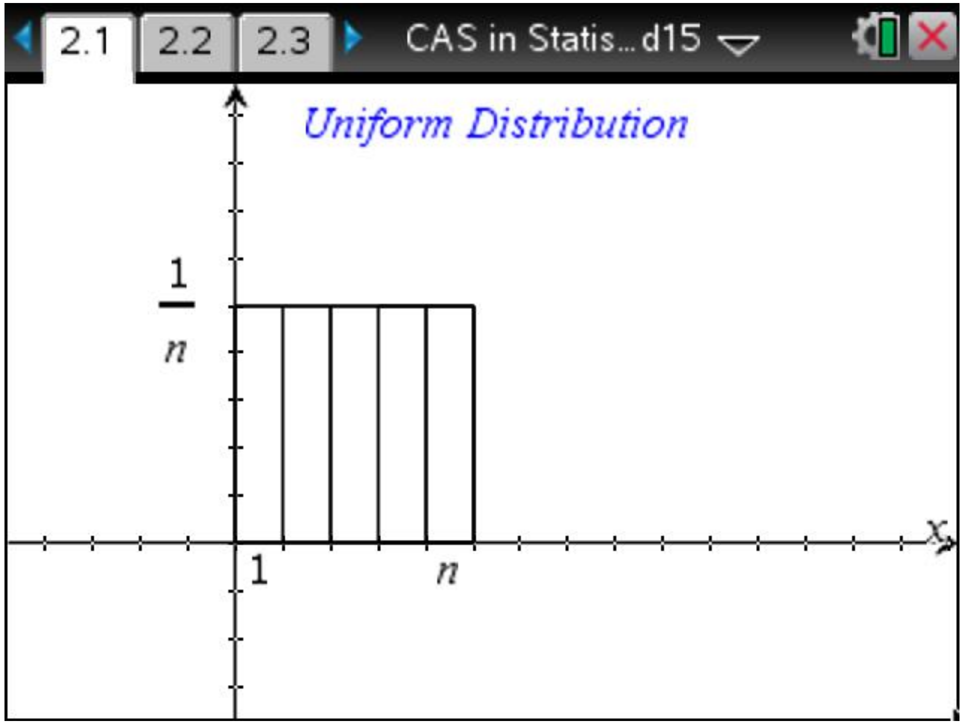
$$\sigma^2 = \frac{\sum_{i=1}^{n} (x_i - \overline{x})^2}{n} \qquad or \qquad \sigma^2 = \frac{\sum_{i=1}^{n} x_i^2 - \frac{(\sum x_i)^2}{n}}{n}$$

CAS in Statistics.tns pages 1.1 & 1.2

Discrete Uniform Distribution ~ U[1,n]

$$E(X) = \frac{\frac{1}{2}n(n+1)}{n}$$
$$= \frac{1}{2}(n+1)$$

$$Var(X) = \frac{\frac{1}{12}n(n-1)(n+1)}{n}$$
$$= \frac{1}{12}(n^2-1)$$



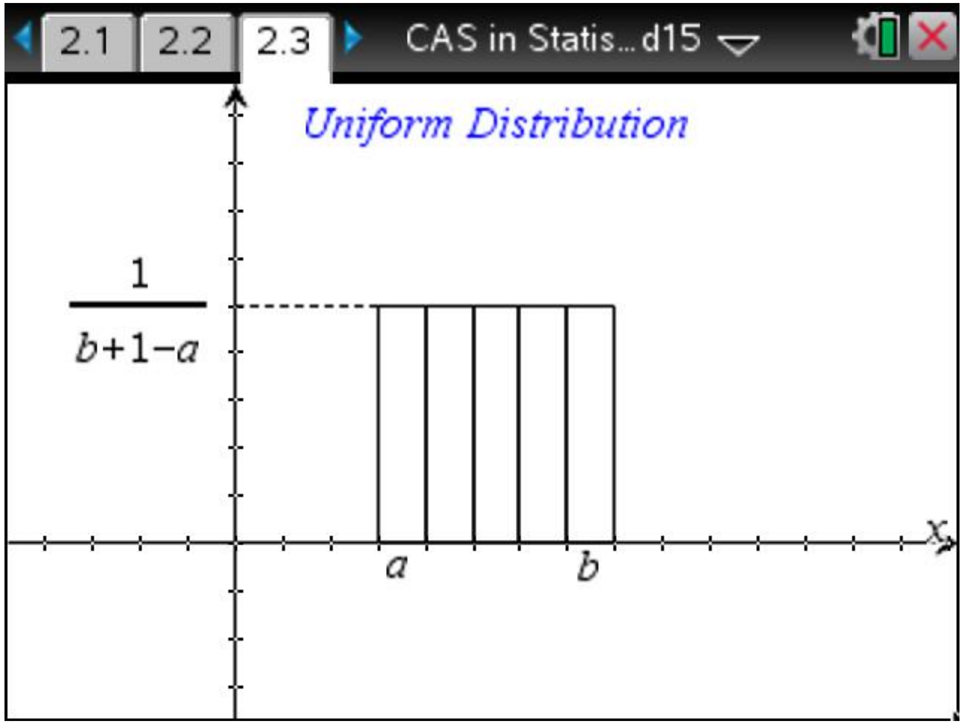
pages 2.1 & 2.2

Discrete Uniform Distribution ~ U[a,b]

$$X \sim U[a,b]$$

$$E(X) = \frac{1}{2}(a+b)$$

$$Var(X) = \frac{1}{12}[(b-a+1)^2 - 1]$$



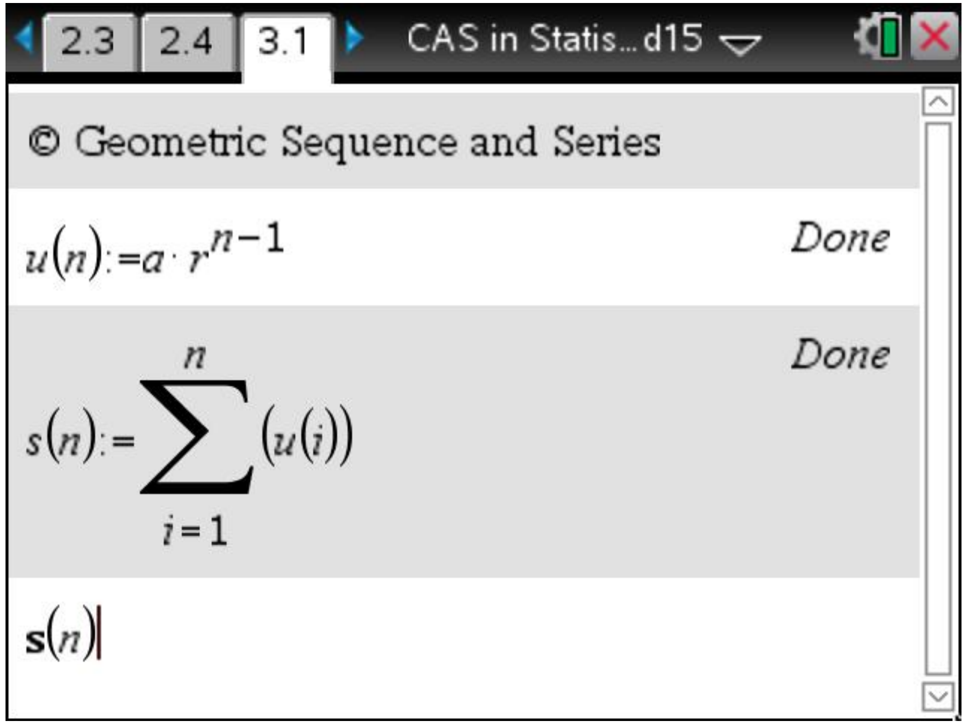
pages 2.3 & 2.4

Geometric Sequences & Series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1-r^n)}{1-r}$$

$$S_\infty = \frac{a}{1-r}$$



pages 3.1 & 3.2 & 3.3

Geometric Distribution

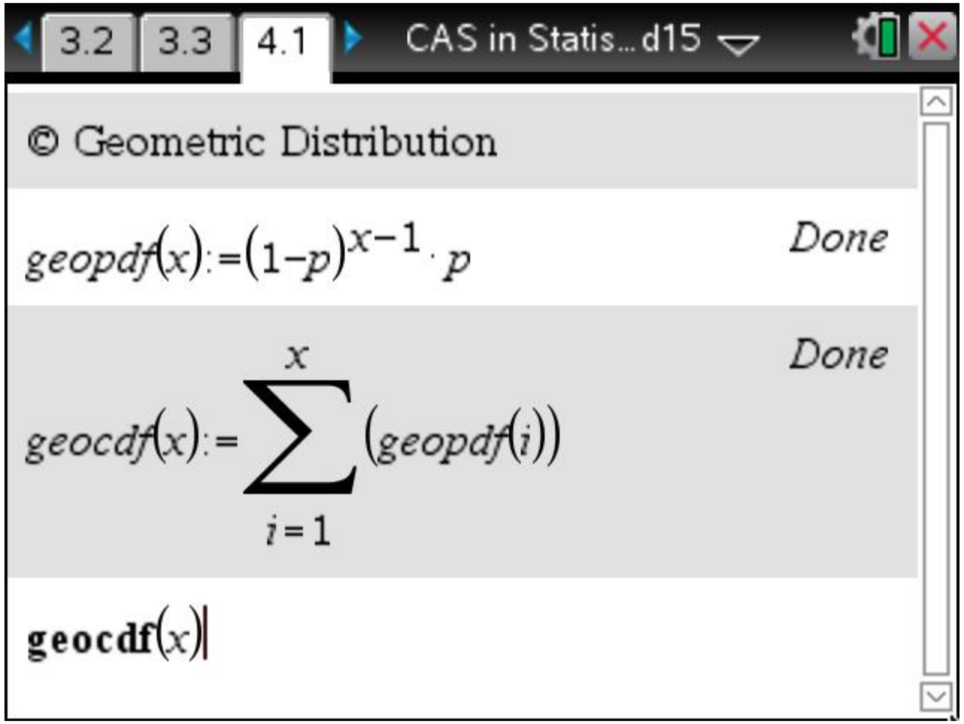
X= number of trials until the first success
P(success on each trial) = p

$$P(X = x) = q^{x-1}p$$

$$P(X \leq x) = 1 - q^{x}$$

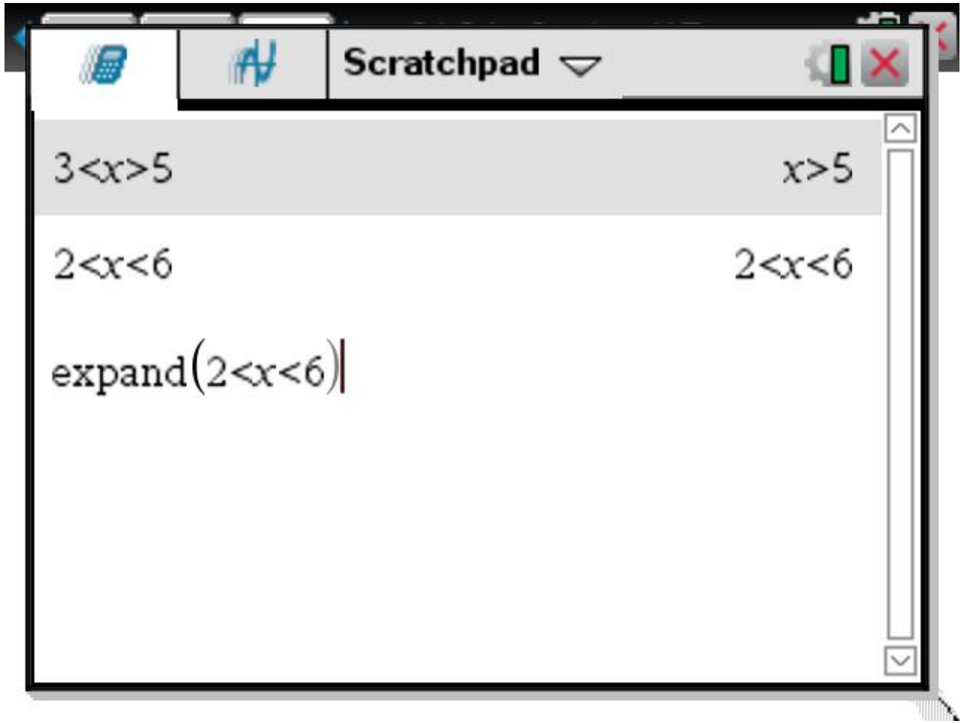
$$E(X) = \frac{1}{p}$$

$$Var(X) = \frac{q}{p}$$



pages 4.1 & 4.2 & 4.3

BONUS!

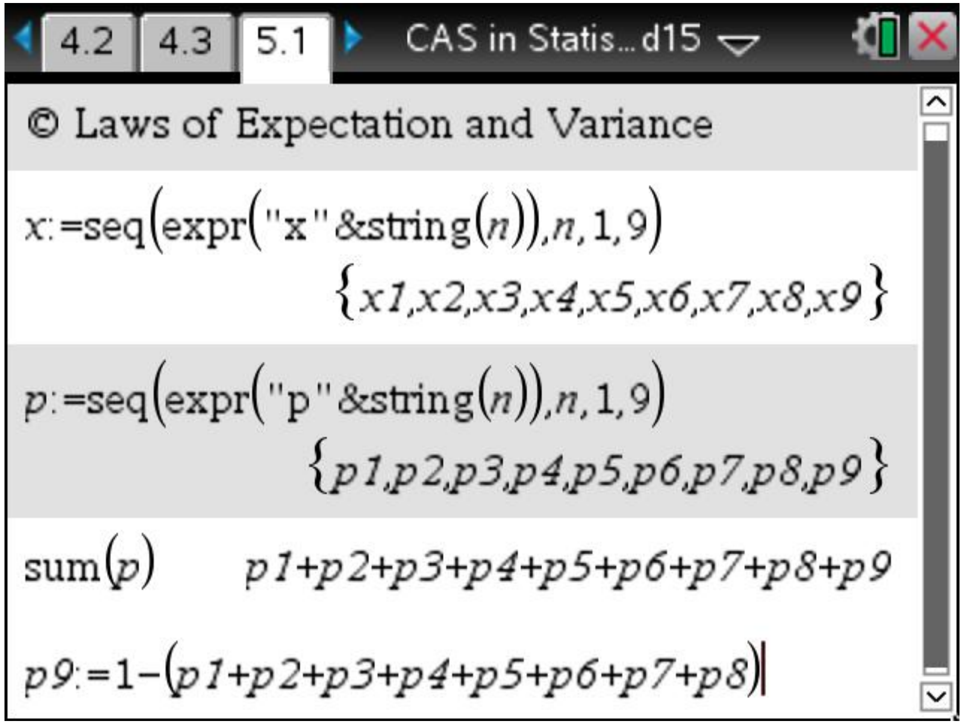


Scratchpad

Laws of Expectation and Variance

$$E(aX+b) = aE(X)+b$$

$$Var(aX+b) = a^2 Var(X)$$



pages 5.1 & 5.2

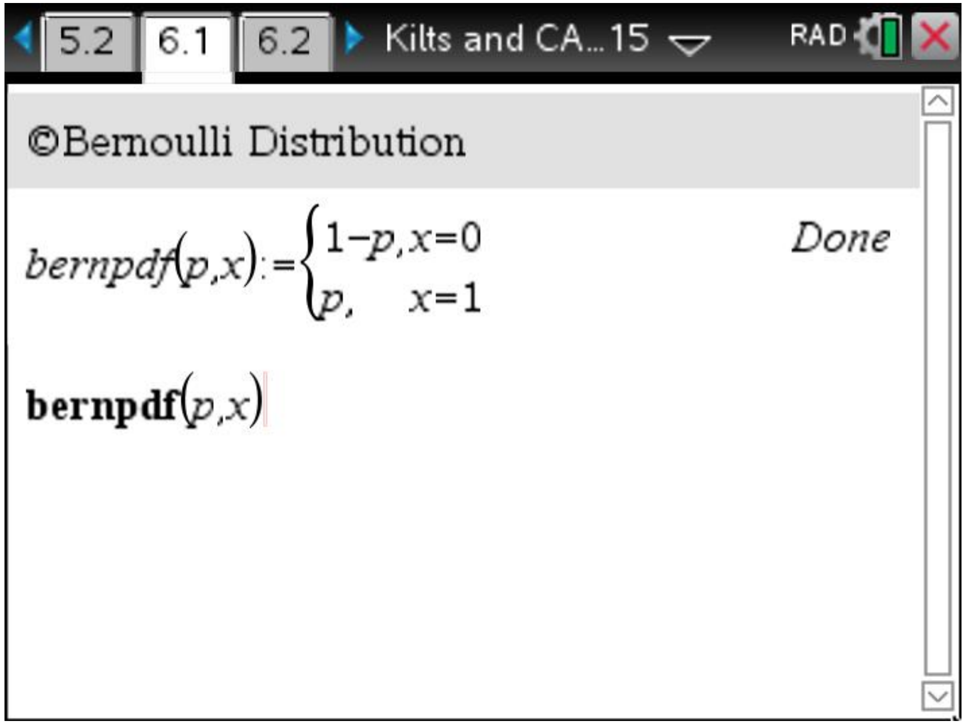
Bernoulli Distribution

X= number of successes in 1 trial
P(success on each trial) = p

$$P(X=x)=\begin{cases}1-p & if\ x=0\\ p & if\ x=1\end{cases}$$

$$E(X)=p$$

$$Var(X)=pq$$



pages 6.1 & 6.2 & 6.3

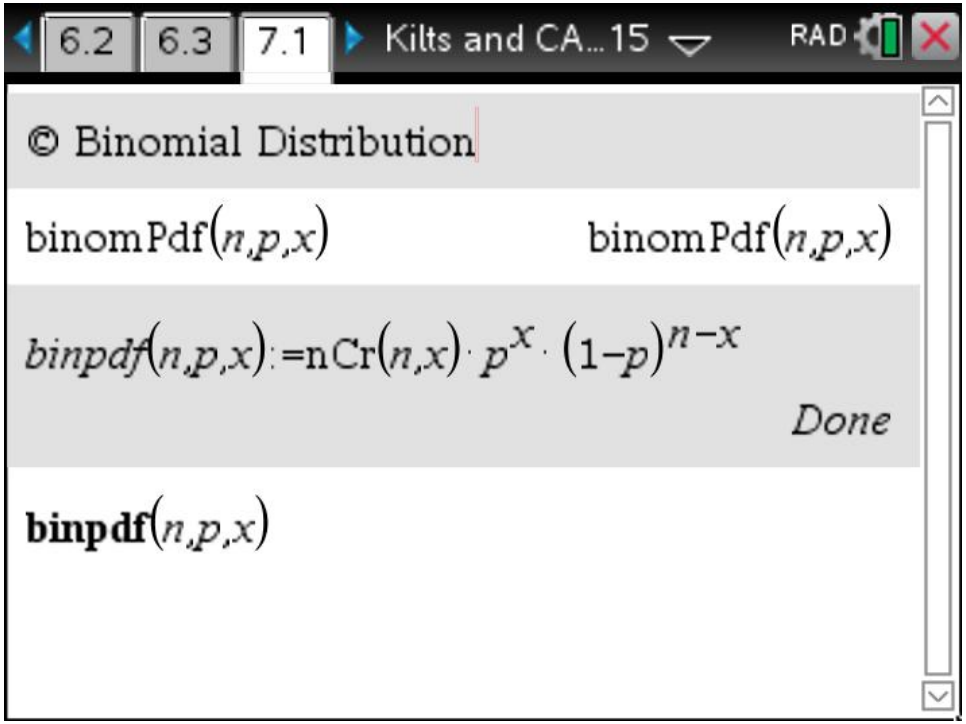
Binomial Distribution

X= number of successes in n trial
P(success on each trial) = p

$$P(X = x) = {}^{n}C_{r} p^{x} (1 - p)^{x}$$

$$E(X) = np$$

$$Var(X) = npq$$



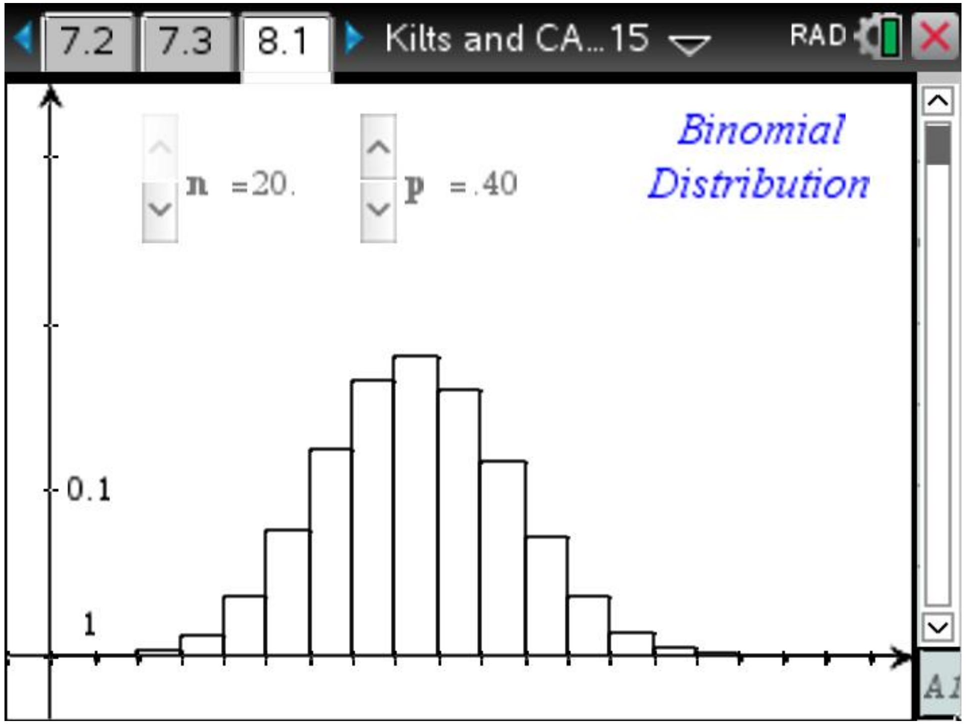
pages 7.1 & 7.2 & 7.3

Mode of Binomial Distribution

Mode is reached when:

$$P(X = x+1) \leqslant P(X = x)$$

$$\frac{P(X = x+1)}{P(X = x)} \leqslant 1$$



pages 8.1 & 9.1

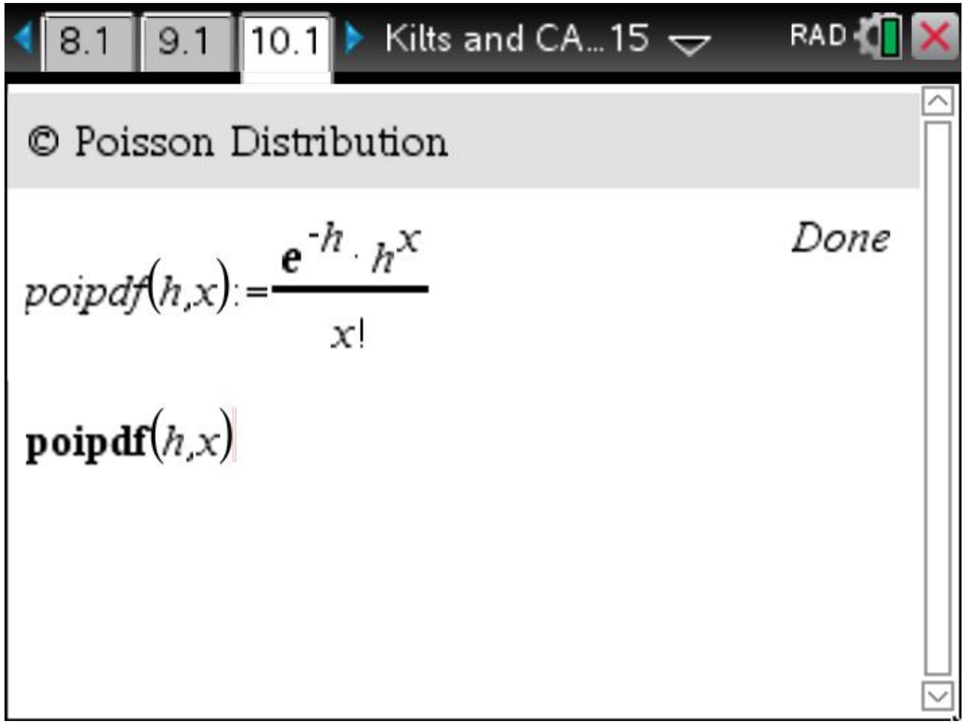
Poisson Distribution

X= number of events in a fixed interval
mean rate of events = λ

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

$$E(X) = \lambda$$

$$Var(X) = \lambda$$



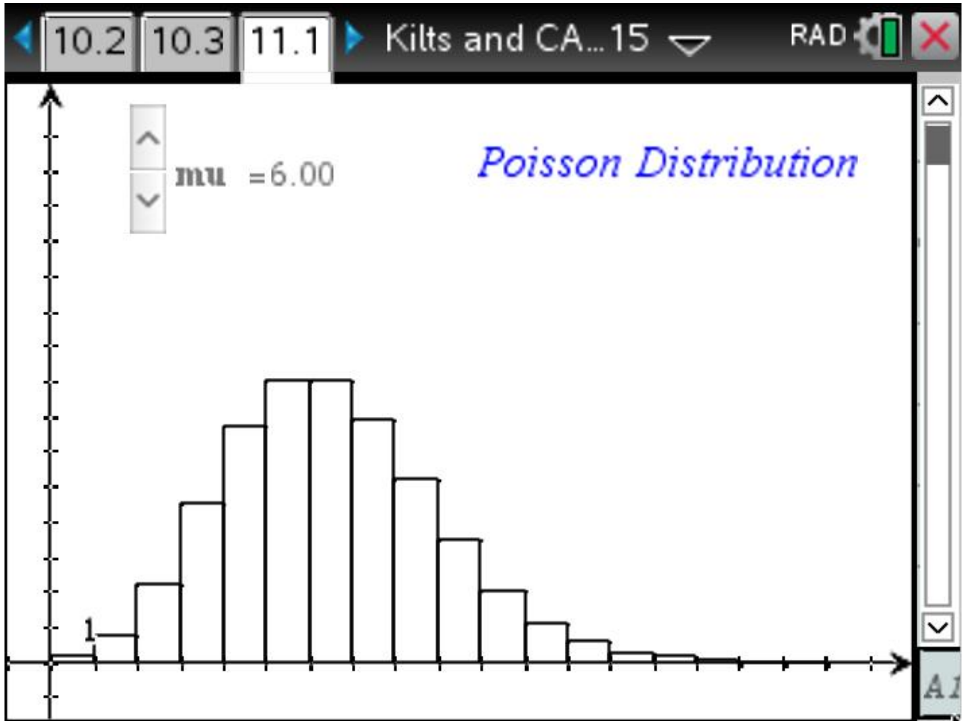
pages 10.1 & 10.2 & 10.3

Mode of Poisson Distribution

Mode is reached when:

$$P(X = x+1) \leqslant P(X = x)$$

$$\frac{P(X = x+1)}{P(X = x)} \leqslant 1$$



pages 11.1 & 12.1

Probability Generating Functions

$$G_X(t) = P(X=0)\,t^0 + P(X=1)\,t^1 + P(X=2)\,t^2 + \ldots.$$

$$G_X(t) = \sum_{x=0}^{n} P(X=x)\,t^x$$

A polynomial in t whose coefficients are the probabilities of the powers

pages 13.1 to 17.2

E(X) and Var(X) for both B(n,p) and Poi(λ)
Unbiased & Consistent Estimators
Chi-Squared Distributions

Want Copies of Everything?

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Thank you for coming to my talk.

Nevil Hopley

T^3 National Trainer, Scotland & UK.

Head of Mathematics Department

CAS user on Handhelds and TI-Nspire iPad App
TI-Basic and Lua Programmer

Mountain Unicycler