**Y13 A level Mathematics**

**Unit 38: Pure Mathematics & Statistics 2 weeks**

## Teaching objectives

**a** To revise and solidify students’ current qualitative understanding of correlation (Seen in ‘AS’).

**b** To introduce students to the idea of Pearson’s product-moment correlation coefficient. Ensuring that theyinterpret the PMCC as a measure of how close data points lie to a straight line. (Calculating the PMCC is not required)

**c** To revise the idea of a hypothesis test using the binomial distribution (Seen in ‘AS’).

**d** Students will need to perform a basic hypothesis test for the correlation coefficient using a given p-value or critical value. The test statistic is the PMCC, and a table is provided. <https://www.youtube.com/watch?v=LneJkM8waiw>.

**e** Students will need to revise the properties of the normal distribution, they should be comfortable finding probabilities and modelling etc. (Seen in ‘AS’)

**f** Students should recognise that $\overbar{X} $can be treated as a random variable. The distribution of $\overbar{X} $is called the sampling distribution of the mean), where $\overbar{X}=\frac{\sum\_{i=1}^{n}X\_{i}}{n}$. In addition, students should know that if $X\_{i}\~N\left(μ,σ^{2}\right)$we have that $\overbar{X}\~N\left(μ,\frac{σ^{2}}{n}\right)$.

*(Proof non-examinable although simple so could be shown. In addition, this is an example of the Central Limit Theorem at work so it may be worth discussing this)*

**g** Students will use the sample mean as a test statistic to perform a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance.

**Resources for advance preparation:**

**NB The new integral website is yet to include its statistics section for A2 , watch this space!**

**AS RECAP IF NEEDED:**

* Correlation Recap: <http://www.tylervigen.com/spurious-correlations>
* Binomial distribution hypothesis test recap activities:

 <http://www.s253053503.websitehome.co.uk/msv/msv-12.html>

<http://mei.org.uk/files/sow/17-statistical-hypothesis-testing-using-the-binomial-distribution-res.pdf>

* Normal distribution recap activity: <http://www.s253053503.websitehome.co.uk/msv/msv-18.html>

**Correlation**

* ‘Correlation game’ (which can be found at <http://integralmaths.org/sow-resources.php>) is a simple game where players are invited to guess the correlation in a given scatter diagram. Good for building an understanding of the visual representation of different values of correlation.
* PMCC Activity: <http://www.s253053503.websitehome.co.uk/msv/msv-17.html>
* Examples: <https://www.tes.com/teaching-resource/pmcc-hypothesis-test-6149206>
* <https://www.stem.org.uk/resources/elibrary/resource/31756/psychology-correlation-study>
* Too good to not include: <https://www.stem.org.uk/resources/elibrary/resource/31753/geography-hydraulic-radius>

**Sample Distribution**

* ‘Sampling distributions’ (which can be found at <http://www.mei.org.uk/integrating-technology>) is designed for demonstrating to students how a distribution of sample means can be generated from any population. Click the link, click the Begin button, then experiment with the buttons and drop down menus.
* Sample mean gap filler: <http://www.s253053503.websitehome.co.uk/msv/msv-14.html>

**Hypothesis Testing using the Normal Distribution**

* Normal distribution hypothesis testing Geogebra: <https://www.geogebra.org/m/H2AALBOa>
* <https://integralmaths.org/pluginfile.php/12753/mod_resource/content/0/ocrs2h2q.pdf>

**N.B. I would advise interspersing these lessons with some fluency exercise, to build understanding.**

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|  | **Starter** | **Main teaching**Including key questions, key teaching points, models and resources | **Notes**Including Support and Extension |
| **1** | Show one of the graphs from: <http://www.tylervigen.com/spurious-correlations> To discuss correlation vs causation.  | * Introduce the idea of the PMCC ‘ρ’ as being a measure of how close data points lie to a straight line.
* Display at <http://integralmaths.org/sow-resources.php>, and use this to build intuition of the value of the correlation coefficient.
* Students can then complete this matching task: <https://www.tes.com/teaching-resource/correlation-and-regression-6147553>
* EXTENSION: <http://www.s253053503.websitehome.co.uk/msv/msv-17.html> either using the casio classwizz or the formula.
 | Calculation of ρ is not required, though it may be helpful for students to look through the formula. I also love this image showing various cases to discuss: |
|  | **Starter** | **Main teaching**Including key questions, key teaching points, models and resources | **Notes**Including Support and Extension |
| **2+ 3** | Display the image in the notes section above, blank out the number and ask the students to guess the PMCC.  | Work through this excellent task: <https://www.stem.org.uk/resources/elibrary/resource/31756/psychology-correlation-study> That introduces hypothesis testing with the PMCC, not r is used r as the symbol for the PMCC when you have a sample. If you enjoyed this there is a similar, extension task here:<https://www.stem.org.uk/resources/elibrary/resource/31753/geography-hydraulic-radius> | Examples how to test the PMCC can be found here <https://www.tes.com/teaching-resource/pmcc-hypothesis-test-6149206> |
| **4a** | Ask students to sketch three different normal distributions on the same graph. With given means and standard deviations.  | Normal distribution recap activity:<http://www.s253053503.websitehome.co.uk/msv/msv-18.html> EXTENSION: Show that the inflexion points of the normal distribution are exactly 1 standard deviation away from the mean.  | **(OPTIONAL)** |
| **4b** | Alternatively, use ‘A y2 A level lesson using a LDS’ |
| **5** | Question: Why does taking a larger sample give us a better impression of the population?  | Introduce the idea of the sample distribution $\overbar{X}$ and use <http://www.mei.org.uk/integrating-technology> to explore this distribution. Explain that if $X\_{i}\~N\left(μ,σ^{2}\right)$we have that $\overbar{X}\~N\left(μ,\frac{σ^{2}}{n}\right)$. (Note link the formula to the starter). Then have a go at <http://www.s253053503.websitehome.co.uk/msv/msv-14.html>, the sample mean gap filler.  | *Proof non-**examinable although simple so could be shown. In addition, this is an example of the Central Limit Theorem at work so it may be worth* *discussing this)* |
|  | **Starter** | **Main teaching**Including key questions, key teaching points, models and resources | **Notes**Including Support and Extension |
| **6** | Ask…how can we tell if a coin is bias? | Either <http://www.s253053503.websitehome.co.uk/msv/msv-12.html> Or: <http://mei.org.uk/files/sow/17-statistical-hypothesis-testing-using-the-binomial-distribution-res.pdf> To revise hypothesis testing with the binomial distribution.  | **(OPTIONAL)** |
| **7+8** |  | Use this Geogebra applet: <https://www.geogebra.org/m/H2AALBOa> to discuss how we can test a hypothesis on the mean of a Normal distribution. Covering one tail and two tailed tests. Then start to work though this activity:* <https://integralmaths.org/pluginfile.php/12753/mod_resource/content/0/ocrs2h2q.pdf>
 | *There are a surprising lack of resources in this area, hopefully when the new integral site is updated we will have more!* |